Permit Fact Sheet

General Information

Permit Number:	WI-0021903-10-0	
Permittee Name:	CITY OF BRODHEAD	
Address:	P O Box 168 1111 West 2nd Avenue	
City/State/Zip:	Brodhead WI 53520	
Discharge Location:	100 feet north of entrance to WWTF, approximately ½ mile from the Sugar River (SE ¼ of NE ¼ of Section 26, T2N, R9E Lat: 42.61921º N / Lon: 89.38693º W)	
Receiving Water:	Sugar River – Millrace (Lower Sugar River Watershed, SP11 – Sugar-Pecatonica River Basin) in Green County	
StreamFlow ($Q_{7,10}$):	25 cfs	
Stream Classification:	Warm Water Sport Fish (WWSF)	
Discharge Type:	Existing, Continuous	
Design Flow(s)	Daily Maximum	0.743 MGD
	Annual Average	0.597 MGD
Significant Industrial Loading?	None	
Operator at Proper Grade?	Yes – Basic Advanced with required subclasses A1 – Suspended Growth Processes, B – Solids Separation, C – Biological Solids/Sludges, P – Total Phosphorus, D – Disinfection, L – Laboratory, SS – Sanitary Sewage Collection System.	
Approved Pretreatment Program?	N/A	

Facility Description

The City of Brodhead Wastewater Treatment Facility serves a population of approximately 3,500 people with no significant industries or anticipated growth. The city operates a treatment facility upgraded in 1998 consisting of preliminary treatment (grit and screenings removal), a septage receiving station, biological phosphorus removal, activated sludge (oxidation ditch extended aeration), final clarification and seasonal ultraviolet disinfection. The plant currently treats 320,000 gallons of wastewater per day on an annual average (design flow is 0.597 MGD) and achieves a high level of treatment. Sludge from the treatment process is aerobically digested and stored prior to being land spread seasonally on approved sites. Treated effluent is discharged to the Sugar River.

Substantial Compliance Determination

Enforcement During Last Permit: A notice of noncompliance was issued January 18, 2024 for an incomplete permit application on April 3, 2023.

After a desk top review of all discharge monitoring reports, CMARs, land application reports, compliance schedule items, and a site visit on 3/22/2023, this facility has been found to be in substantial compliance with their current permit.

Sample Point Designation		
Sample Point Number	**Discharge Flow, Units, and Averaging Period**	**Sample Point Location, WasteType/sample Contents and Treatment Description (as applicable)**
701	0.28 MGD (2022 - 2023)	Influent: 24-Hr flow proportional sampler located at the headworks in the UV disinfection room, structure 20 after grit chamber and screening. Flow meter located in the influent channel after grit chamber.
001	0.25 MGD (2022 - 2023)	Effluent: 24-Hr flow proportional sampler located in the UV Building Room #20 prior to the UV channel and discharge to the Sugar River (millrace). Flow meter located in the main discharge pipe in basement of Building #20, prior to UV channel.
002	75 US dry Ton (per application)	Aerobically digested, Liquid, Class B. Representative sludge samples shall be collected from the sludge storage tank.

1 Influent – Monitoring Requirements

Sample Point Number: 701- INFLUENT

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		MGD	Daily	Continuous	
BOD5, Total		mg/L	3/Week	24-Hr Flow Prop Comp	
Suspended Solids, Total		mg/L	3/Week	24-Hr Flow Prop Comp	

Changes from Previous Permit:

No changes required.

Explanation of Limits and Monitoring Requirements

BOD_5 and Total Suspended Solids – Tracking of BOD_5 and Total Suspended Solids are required for percent removal requirements found in s. NR 210.05, Wis. Adm. Code.

2 Surface Water - Monitoring and Limitations

Sample Point Number: 001- EFFLUENT

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		MGD	Daily	Continuous	
BOD5, Total	Weekly Avg	45 mg/L	3/Week	24-Hr Flow Prop Comp	
BOD5, 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 (NH3-N) Total	Daily Max	20 mg/L	3/Week	24-Hr Flow Prop Comp	Monitoring year-round. Limits effective October through April
Nitrogen, Ammonia (NH3-N) Total	Weekly Avg	20 mg/L	3/Week	24-Hr Flow Prop Comp	Monitoring year-round. Limits effective October through April
Nitrogen, Ammonia (NH3-N) Total	Monthly Avg	18 mg/L	3/Week	24-Hr Flow Prop Comp	Monitoring year-round. Limits effective October through March
Nitrogen, Ammonia (NH3-N) Total	Monthly Avg	10 mg/L	3/Week	24-Hr Flow Prop Comp	Monitoring year-round. Limits effective April
E. coli	Geometric Mean - Monthly	126 #/100 ml	Weekly	Grab	May through September
E. coli	% Exceedance	10 Percent	Monthly	Calculated	May through September. See the E. coli Percent Limit section. Enter the result in the DMR on the last day of the month.
pH Field	Daily Max	9.0 su	Daily	Grab	
pH Field	Daily Min	6.0 su	Daily	Grab	
Chloride		mg/L	Monthly	24-Hr Flow Prop Comp	Monitoring only in 2028
Phosphorus, Total	Monthly Avg	1.0 mg/L	3/Week	24-Hr Flow Prop Comp	Limit effective throughout the permit term, as it represents a minimum control level. See Water Quality Trading (WQT)

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
					sections for more information.
Phosphorus, Total		lbs/day	3/Week	Calculated	Report daily mass discharged using Equation 1a. in the Water Quality Trading (WQT) section.
WQT Credits Used (TP)		lbs/month	Monthly	Calculated	Report WQT TP Credits used per month using Equation 2c. in the Water Quality Trading (WQT) section. Available TP Credits are specified in Table 2 and in the approved Water Quality Trading Plan.
WQT Computed Compliance (TP)	6-Month Avg	0.1 mg/L	Monthly	Calculated	Value entered on the last day of the month. Value entered at the end of the six-month period (June 30 and December 31).
WQT Computed Compliance (TP)	Monthly Avg	0.3 mg/L	Monthly	Calculated	Report the WQT TP Computed Compliance value using Equation 3a. in the Water Quality Trading (WQT) section. Value entered on the last day of the month.
WQT Computed Compliance (TP)	6-Month Avg	0.5 lbs/day	Monthly	Calculated	Report the WQT TP Computed Compliance value using Equation 3b. in the Water Quality Trading (WQT) section. Value entered at the end of the six-month period (June 30 and December 31).
WQT Credits Used (TP)	Annual Total	389.0 lbs/year	Annual	Calculated	2024 Limit. The sum of total monthly credits used may not exceed Table 2 values listed.
WQT Credits Used (TP)	Annual Total	416.5 lbs/year	Annual	Calculated	2025 Limit. The sum of total monthly credits used may not exceed Table 2

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
					values listed.
WQT Credits Used (TP)	Annual Total	415.3 lbs/year	Annual	Calculated	2026 Limit. The sum of total monthly credits used may not exceed Table 2 values listed.
WQT Credits Used (TP)	Annual Total	413.6 lbs/year	Annual	Calculated	2027 Limit. The sum of total monthly credits used may not exceed Table 2 values listed.
WQT Credits Used (TP)	Annual Total	414.7 lbs/year	Annual	Calculated	2028 Limit. The sum of total monthly credits used may not exceed Table 2 values listed.
WQT Credits Used (TP)	Annual Total	406.4 lbs/year	Annual	Calculated	2029 Limit. The sum of total monthly credits used may not exceed Table 2 values listed.
Nitrogen, Total Kjeldahl		mg/L	See Listed Qtr(s)	24-Hr Flow Prop Comp	Annual in rotating quarters. See Nitrogen Series Monitoring section.
Nitrogen, Nitrite + Nitrate Total		mg/L	See Listed Qtr(s)	24-Hr Flow Prop Comp	Annual in rotating quarters. See Nitrogen Series Monitoring section.
Nitrogen, Total		mg/L	See Listed Qtr(s)	Calculated	Annual in rotating quarters. See Nitrogen Series Monitoring section. Total Nitrogen shall be calculated as the sum of reported values for Total Kjeldahl Nitrogen and Total Nitrite + Nitrate Nitrogen.
PFOS		ng/L	1 / 2 Months	Grab	Monitoring only. See PFOS/PFOA Minimization Plan Determination of Need schedule.
PFOA		ng/L	1 / 2 Months	Grab	Monitoring only. See PFOS/PFOA Minimization Plan Determination of Need schedule.

Changes from Previous Permit

Updates have been highlighted in table above.

- Fecal coliform monitoring and limits have been replaced with Escherichia coli (E. coli) monitoring and limits. E. coli monitoring is required at the permit effective date. E. coli limits of 126 #/100 ml as a monthly geometric mean may not be exceeded and 410 #/100 ml as a daily maximum may not be exceeded more than 10 percent of the time in any calendar month apply.

- Water Quality Trading section updated and TP concentration limit updated to reflect the minimum control value effective in conjunction with the water quality trading for phosphorus compliance.

- Nitrogen series monitoring added.

- PFOS and PFOA monitoring once every two months is included in the permit in accordance with s. NR 106.98(2)(c), Wis. Adm. Code.
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Explanation of Limits and Monitoring Requirements

Refer to the WQBEL memo for the detailed calculations, prepared by Sarah Luck dated 11/24/2023 used for this reissuance.

BOD5, TSS, Fecal Coliform and pH - No changes are recommended in the categorical permit limitations for BOD5, TSS, or pH. Because the reference flow rates and receiving water characteristics have not changed, limitations for these water quality characteristics do not need to be re-evaluated at this time. However, on May 1, 2020 revisions to the bacteria surface water criteria became effective. Therefore, this permit has been updated to remove fecal coliform requirements and include E-*coli* monitoring and limits. Where the receiving water is classified as Warm Water Sport Fish in s. NR 102.04(3)(a), Wis. Adm. Code, the surface water criterion and categorical limits for BOD5, TSS, and pH are those limits enumerated in s. NR 102.04(4), in s. NR 102.04(4), Wis. Adm. Code.

E. Coli- Revisions to bacteria surface water quality criteria to protect recreational uses and accompanying E. coli WPDES permit implementation procedures became effective May 1, 2020. The new rule requires that WPDES permits for facilities with required disinfection include monitoring for E. coli while facilities are disinfecting during the recreation period, and establish effluent limitations for E. coli established in s. NR 210.06 (2), Wis. Adm Code. The administrative code rule changes included the following actions: revised the bacteria water quality criteria from fecal coliform to E. coli to protect recreation in ch. NR 102, Wis. Adm. Code; removed fecal coliform criteria for certain individual waters from ch. NR 104, Wis. Adm. Code; revised permit requirements for publicly and privately owned sewage treatment works in ch. NR 210, Wis. Adm. Code; and, updated approved analytical methods for bacteria in ch. NR 219, Wis. Adm. Code.
E. coli monitoring is required at the permit effective date. E. coli limits of 126 #/100 ml as a monthly geometric mean that may not be exceeded and 410 #/100 are included in the permit effective upon reissuance.

Ammonia- Current acute and chronic ammonia toxicity criteria for the protection of aquatic life are included in Tables 2C and 4B of ch. NR 105, Wis. Adm. Code. Subchapter IV of ch. NR 106 establishes the procedure for calculating water quality based effluent limitations (WQBELs) for ammonia. Monitoring year updated.
ml as a daily maximum that may not be exceeded more than 10 percent of the time in any calendar month will apply.

Total Phosphorus- Phosphorus requirements are detailed in NR 102 Water Quality Standards and NR 217 Effluent Standards and Limitations for Phosphorus. Chapter NR 217 of the Wis. Adm. Code addresses point source dischargers of phosphorus to surface waters. Currently in NR 217 Wis. Adm. Code there are two methods used to determine if a phosphorus limit is needed: a technology based effluent limit (TBEL) and a water quality based effluent limit (WQBEL).

This permit authorizes the use of trading as a tool to demonstrate compliance with the final phosphorus WQBELs. This permit includes terms and conditions related to the Water Quality Trading Plan (WQT-2024-0013) or approved amendments thereof. The total ‘WQT TP Credits’ available are designated in the approved WQT Plan. The permittee is implementing the management practices of streambank stabilization. The WQT Plan proposes the generation of phosphorus credits for the next five years listed in the chart below.

Total Phosphorus Credits Available per WQT-2024-0013

Year	Available Credits (lbs/yr) - Total
2024	389.0
2025	416.5
2026	415.3
2027	413.6
2028	414.7
2029	406.4

The minimum control value of 0.5 mg/L was calculated using recent effluent data and was not based on the amount of approved trading credits; therefore, compliance with the minimum control value may not guarantee compliance with the approved annual water quality trading credits. Brodhead is responsible for ensuring any discharge over the phosphorus WQBELs complies with the approved amount of water quality trading credits generated. Additional WQT sections in the permit provide information on compliance determinations, annual reporting and re-opening of the permit.

Total Nitrogen Monitoring (NO2+NO3, TKN and Total N)- The Department has included effluent monitoring for Total Nitrogen in the permit through the authority under §§ 283.55(1)(e), Wis. Stats., which allows the department to require the permittee to submit information necessary to identify the type and quantity of any pollutants discharged from the point source, and through s. NR 200.065(1)(h), Wis. Adm. Code, which allows for this monitoring to be collected during the permit term. More information on the justification to include total nitrogen monitoring in wastewater permits can be found in the "Guidance for Total Nitrogen Monitoring in Wastewater Permits" dated October 1, 2019. Annual tests are scheduled in rotating quarters.

PFOS and PFOA – NR 106 Subchapter VIII – Permit Requirements for PFOS and PFOA Dischargers became effective on August 1, 2022. At the first reissuance of a WPDES permit after August 1, 2022, the new rule requires WPDES permits for municipal dischargers with an average flow rate less than 1 MGD, to be evaluated on a case-by-case basis to determine if monitoring is required pursuant to s. NR 106.98(2)(c), Wis. Adm. Code. The department evaluated the need for PFOS and PFOA monitoring taking into consideration the presence of potential PFOS or PFOA industrial wastes, remediation sites and other potential sources of PFOS or PFOA. Based on information available at the time the proposed permit was drafted, it was identified that the POTW has an indirect discharger(s) that may be a potential source of PFOS/PFOA.

Therefore, monitoring once every two months is included. A sample frequency of 1/2 months means one sample is taken during any two-month period. Examples of 1/2 month sample would be every other month (Jan, March, May, etc.) or back-to-back months with a break in between (February & March, May & June, Aug & Sept, etc.). DMR Short Forms will be generated for the following time periods: January-February, March-April, May-June, July-August, September-October, and November-December. At a minimum one sample result will be present on each form.

The initial determination of the need for sampling shall be conducted for up to two years in order to determine if the permitted discharge has the reasonable potential to cause or contribute to an exceedance of the PFOS or PFOA standards under s. NR 102.04(8)(d)1, Wis. Adm. Code.

Monitoring Frequencies- The Monitoring Frequencies for Individual Wastewater Permits guidance (April 12, 2021) recommends that standard monitoring frequencies be included in individual wastewater permits based on the size and type of the facility, in order to characterize effluent quality and variability, to detect events of noncompliance, and to ensure fairness and consistency in permits issued across the state. Guidance and requirements in administrative code were considered when determining the appropriate monitoring frequencies for pollutants that have final effluent limits in effect during this permit term. No changes to sampling frequency were warranted.

Expression of Limits- In accordance with the federal regulation 40 CFR 122.45(d) and s. NR 205.065, Wis. Adm. Code. limits in this permit are to be expressed as weekly average and monthly average limits whenever practicable.

3 Land Application - Monitoring and Limitations

Municipal Sludge Description						
Sample Point	**Sludge Class (A or B)**	**Sludge Type (Liquid or Cake)**	**Pathogen Reduction Method**	**Vector Attraction Method**	**Reuse Option**	**Amount Reused/Disposed (Dry Tons/Year)**
002	B	Liquid	Fecal Coliform	Injection	Land Application	75 – according to permit application
Does sludge management demonstrate compliance? **Yes**						
Is additional sludge storage required? **No**						
Is Radium-226 present in the water supply at a level greater than 2 pCi/liter? **Yes** If yes, special monitoring and recycling conditions will be included in the permit to track any potential problems in landapplying sludge from this facility						
Is a priority pollutant scan required? **No** Priority pollutant scans are required once every 10 years at facilities with design flows between 5 MGD and 40 MGD, and once every 5 years if design flow is greater than 40 MGD.						

Sample Point Number: 002- SLUDGE

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
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	

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
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 (NH4-N) Total		Percent	Annual	Composite	
Phosphorus, Total		Percent	Annual	Composite	
Phosphorus, Water Extractable		% of Tot P	Annual	Composite	
Potassium, Total Recoverable		Percent	Annual	Composite	
Radium 226 Dry Wt		pCi/g	Annual	Composite	
PCB Total Dry Wt	Ceiling	50 mg/kg	Once	Composite	Once in 2025
PCB Total Dry Wt	High Quality	10 mg/kg	Once	Composite	Once in 2025
PFOA + PFOS		ug/kg	Annual	Calculated	Report the sum of PFOS and PFAS. See PFAS Permit Sections for more information.
PFAS Dry Wt			Annual	Grab	Perfluoroalkyl and Polyfluoroalkyl Substances based on updated DNR PFAS List. See PFAS Permit Sections for more

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
					information.

Changes from Previous Permit:

PCB sampling year updated. Annual PFAS monitoring is included in the permit pursuant s. NR 204.06(2)(b)9, Wis. Adm. Code.

Explanation of Limits and Monitoring Requirements

Enter Explanation (Requirements for land application of municipal sludge are determined in accordance with ch. NR 204, Wis. Adm. Code. Ceiling and high-quality limits for metals in sludge are specified in s. NR 204.07(5), Wis. Adm. Code. Requirements for pathogens are specified in s. NR 204.07(6) and in s. NR 204.07 (7), Wis. Adm. Code for vector attraction requirements. Limitations for PCBs are addressed in s. NR 204.07(3)(k), Wis. Adm. Code. Radium requirements are addressed in s. NR 204.07(3)(n), Wis. Adm. Code.

PFAS- The presence and fate of PFAS in municipal and industrial sludges is an emerging public health concern. EPA is currently developing a risk assessment to determine future land application rates and expects to release this risk assessment by the end of 2024. In the interim, the department has developed the "Interim Strategy for Land Application of Biosolids and Industrial Sludges Containing PFAS".

Collecting sludge data on PFAS concentrations from a wide range of wastewater treatment facilities will help protect public health from exposure to elevated levels of PFAS and determine the department's implementation of EPA's recommendations. To quantitate this risk, PFAS sampling has been included in the proposed WPDES permit pursuant to ss. NR 214.18(5)(b) and NR 204.06(2)(b)9, Wis. Adm. Code.

4 Schedules

4.1 Annual Water Quality Trading (WQT) Report

Required Action	Due Date
Annual WQT Report: Submit an annual WQT report that shall cover the first year of the permit term. The WQT shall include the total number of pollutant credits used, the source of the pollution reduction credits, a summary of annual inspections performed, and identification of noncompliance or failure to implement any terms or conditions of the approved water quality trading plan.	01/31/2025
Annual WQT Report #2: Submit an annual WQT report that shall cover the previous year.	01/31/2026
Annual WQT Report #3: Submit an annual WQT report that shall cover the previous year.	01/31/2027
Annual WQT Report #4: Submit an annual WQT report that shall cover the previous year.	01/31/2028
Annual WQT Report #5: Submit the 5th annual WQT report. If the permittee wishes to continue to comply with phosphorus limits through WQT in subsequent permit terms, the permittee shall submit a revised WQT plan including a demonstration of credit need, compliance record of the existing WQT, and any additional practices needed to maintain compliance over time.	01/31/2029
Annual WQT Report Required After Permit Expiration: In the event that this permit is not reissued by the expiration date, the permittee shall continue to submit annual WQT reports by January 31 each year covering the total number of pollutant credits used, the source of the pollution reduction credits, a summary of annual inspection reports performed, and identification on	

noncompliance or failure to implement any terms or conditions of the approved water quality trading plan for the previous calendar year.	

Explanation of Schedules

Annual Water Quality Trading (WQT) Reports - Reports are required that include the following information:

- Verification that site inspections occurred;
- Brief summary of site inspection findings;
- Identification of noncompliance or failure to implement any terms or conditions of the permit or trading plan that have not been reported in discharge monitoring reports;
- Any applicable notices of termination or management practice registration; and
- A summary of credits used each month over the calendar year.

4.2 Land Application Management Plan

A management plan is required for the land application system.

Required Action	Due Date
Land Application Management Plan Submittal: Submit a management plan to optimize the land application system performance and demonstrate compliance with ch. NR 204, Wis. Adm. Code, by the Due Date. This management plan shall 1) specify information on pretreatment processes (if any); 2) identify land application sites; 3) describe site limitations; 4) address vegetative cover management and removal; 5) specify availability of storage; 6) describe the type of transporting and spreading vehicle(s); 7) specify monitoring procedures; 8) track site loading; 9) address contingency plans for adverse weather and odor/nuisance abatement; and 10) include any other pertinent information. Once approved, all landspreading activities shall be conducted in accordance with the plan. Any changes to the plan must be approved by the Department prior to implementing the changes.	01/31/2025

Explanation of Schedules

This schedule requires a Land Application Management Plan be submitted to ensure sludge management practices comply with ch. NR 204, Wis. Adm. Code, pursuant to s. NR 204.11, Wis. Adm. Code. The management plan shall also include all department issued approval maps and Land Application Approval Forms (3400-122) for all approved sites, to comply with s. NR 204, Wis. Adm. Code. Sites that no longer match approval conditions in the department issued approval maps and Land Application Approval Forms (3400-122) in the management plan must be reviewed and potentially reauthorized to comply with ch. NR 204, Wis. Adm. Code.

Special Reporting Requirements

None

Other Comments:

None

Attachments:

Water Quality Based Effluent Limits dated November 24, 2023

Water Quality Trading Plan dated May 2024

Water Quality Trading Conditional Approval dated June 3, 2024

Expiration Date:

06/30/2029

Justification Of Any Waivers From Permit Application Requirements

No waivers were requested in the permit application.

Prepared By: Jennifer Jerich, Wastewater Specialist

Date:4/4/2024
Revision date post fact check: 6/5/2024
Revision date post public notice & hearing:

CORRESPONDENCE/MEMORANDUM

State of Wisconsin

DATE: November 24, 2023

TO: Jennifer Jerich – SCR/Horicon

FROM: Sarah Luck – SCR/Fitchburg

SUBJECT: Water Quality-Based Effluent Limitations for the Brodhead Wastewater Treatment Facility
WPDES Permit No. WI-0021903-10-0

This is in response to your request for an evaluation of the need for water quality-based effluent limitations (WQBELs) using chapters NR 102, 104, 105, 106, 207, 210, 212, and 217 of the Wisconsin Administrative Code (where applicable), for the discharge from the Brodhead Wastewater Treatment Facility in Green County. This municipal wastewater treatment facility (WWTF) discharges to the Sugar River-Millrace, located in the Lower Sugar River Watershed (SP11) in the Sugar-Pecatonica River Basin. The evaluation of the permit recommendations is discussed in more detail in the attached report.

Based on our review, the following recommendations are made on a chemical-specific basis at Outfall 001:

Parameter	Daily Maximum	Daily Minimum	Weekly Average	Monthly Average	Six-Month Average	Footnotes
Flow Rate						1
BOD_5			45 mg/L	30 mg/L		2
TSS			45 mg/L	30 mg/L		2
pH	9.0 s.u.	6.0 s.u.				2
Ammonia Nitrogen April October – March	 20 mg/L 20 mg/L		 **20 mg/L** **20 mg/L**	 10 mg/L **18 mg/L**		2,3
Bacteria *E. coli*				 126 #/100 mL geometric mean		4
Chloride						5
Phosphorus WQT MCL Final				 0.5 mg/L 0.3 mg/L	 0.1 mg/L 0.5 lbs/day	6
TKN, Nitrate+Nitrite, and Total Nitrogen						7

Footnotes:

1. Monitoring only.
2. No changes from the current permit.
3. Additional limits to comply with the expression of limits requirements in ss. NR 106.07 and NR 205.065(7), Wis. Adm. Code, are included in bold.
4. Bacteria limits apply during the disinfection season of May through September. Additional final limit: No more than 10 percent of *E. coli* bacteria samples collected in any calendar month may exceed 410 count/100 mL. No compliance schedule is necessary.
5. Monitoring during the fourth year of the permit term at a frequency to ensure that 11 samples are available at the next permit issuance.

6. Phosphorus limits are in effect. A minimum control level (MCL) is required if water quality trading (WQT) is pursued. This value is 0.5 mg/L as a monthly average and should not be exceeded during the permit term.Final phosphorus limits became effective November 1, 2019.
7. As recommended in the Department's October 1, 2019 Guidance for Total Nitrogen Monitoring in Wastewater Permits, annual total nitrogen monitoring is recommended for all minor municipal permittees. Total Nitrogen is the sum of nitrate (NO_3), nitrite (NO_2), and total kjeldahl nitrogen (TKN) (all expressed as N).

No WET testing is required because information related to the discharge indicates low risk for toxicity.

Please consult the attached report for details regarding the above recommendations. If there are any questions or comments, please contact Sarah Luck (Sarah.Luck@wisconsin.gov) or Diane Figiel (Diane.Figiel@wisconsin.gov).

Attachments (3) – Narrative, Site Map, and Ammonia Nitrogen Calculations

PREPARED BY: Sarah Luck Date: November 24, 2023

Sarah Luck
Water Resources Engineer

E-cc: Kenzie Ostien, Wastewater Engineer – SCR/Fitchburg
Tom Bauman, Regional Wastewater Supervisor – SCR/Fitchburg
Diane Figiel, Water Resources Engineer – WY/3

Attachment #1

Water Quality-Based Effluent Limitations for
Brodhead Wastewater Treatment Facility

WPDES Permit No. WI-0021903-10-0

PART 1 – BACKGROUND INFORMATION

Facility Description
The Brodhead Wastewater Treatment Facility consists of mechanical screening, grit removal, biological phosphorus selector tanks, oxidation ditches, final clarification, and ultraviolet disinfection. There is also has a chemical (aluminum sulfate) feed system for chemical phosphorus removal. Final effluent is discharged to the Sugar River-Millrace of the Lower Sugar River Watershed of the Sugar-Pecatonica River Basin in Green County. Waste sludge produced by the wastewater treatment process is stabilized by aerobic digestion and is stored in an on-site sludge storage tank. Sludge is annually removed from the sludge storage tank and is land applied to agricultural fields by a licensed contractor.

Attachment #2 is a map of the area showing the approximate location of Outfall 001.

Existing Permit Limitations
The current permit, which expired on September 30, 2023, includes the following effluent limitations and monitoring requirements.

Parameter	Daily Maximum	Daily Minimum	Weekly Average	Monthly Average	Six-Month Average	Footnotes
Flow Rate						1
BOD_5			45 mg/L	30 mg/L		2
TSS			45 mg/L	30 mg/L		2
pH	9.0 s.u.	6.0 s.u.				2
Ammonia Nitrogen April October – March	 20 mg/L 20 mg/L		 **20 mg/L** **20 mg/L**	 10 mg/L **18 mg/L**		3
Fecal Coliform May – September			**656#/100 mL geometric mean**	400#/100 mL geometric mean		3
Chloride						1
Phosphorus Interim Final				 0.5 mg/L 0.3 mg/L	 0.1 mg/L 0.5 lbs/day	4

Footnotes:

1. Monitoring only.
2. These limitations are not being evaluated as part of this review. Because the water quality criteria (WQC), reference effluent flow rates, and receiving water characteristics have not changed, limitations for these water quality characteristics do not need to be re-evaluated at this time.
3. Additional limits to comply with the expression of limits requirements in ss. NR 106.07 and NR 205.065(7), Wis. Adm. Code, are included in bold.

4. The interim limit was for water quality trading. Final phosphorus limits became effective November 1, 2019.

Receiving Water Information

- Name: Sugar River-Millrace (also referred to as the Sugar River East Channel)
- Waterbody Identification Code (WBIC): 878400
- Classification used in accordance with chs. NR 102 and 104, Wis. Adm. Code: Warm Water Sport Fish (WWSF) community, non-public water supply.
- Low flows used in accordance with chs. NR 106 and 217, Wis. Adm. Code: 25 cfs (cubic feet per second). This flow represents the weir limited flow through the Sugar River Millrace which is approximately 25% of the 7-Q_{10}. For reference, the 7-Q_{10} and 7-Q_2 of the Sugar River are 97 cfs and 144 cfs respectively.
  The 7-Q_{10}, 7-Q_2, and 1-Q_{10} flows will be considered 25 cfs because the flow is structure limited rather than precipitation limited.
- Hardness = 303 mg/L as $CaCO_3$. This value represents the geometric mean of 52 results from the Sugar River between 1998 and 2015.
  % of low flow used to calculate limits in accordance with s. NR 106.06(4)(c)5., Wis. Adm. Code: The 7-Q_{10}, 7-Q_2, and 1-Q_{10} flows will be considered 25 cfs because the flow is structure limited rather than precipitation limited.
- Source of background concentration data: Metals data from the Sugar River at Brodhead (SWIMS Station 233001) is used for this evaluation. The numerical values are shown in the tables below. If no data is available, the background concentration is assumed to be negligible and a value of zero is used in the computations. Background data for calculating effluent limitations for ammonia nitrogen and phosphorus are described later.
- Multiple dischargers: Albany Wastewater Treatment Facility discharges to the Sugar River approximately eight miles upstream of Outfall 001. However, since Albany is not in the immediate vicinity and since the mixing zones do not overlap, this does not impact this evaluation.
- Impaired water status: The Sugar River-Millrace is 303(d) listed as impaired for total phosphorus at the point of discharge (as of 4/1/2016).

Effluent Information

- Flow rate:
  Design annual average = 0.597 MGD (Million Gallons per Day)
  For reference, the actual average flow from November 2018 through September 2023 was 0.294 MGD.
- Hardness = 265 mg/L as $CaCO_3$. This value represents the geometric mean of data (n=4) from January and February 2023 reported on the permit application.
- Acute dilution factor used in accordance with s. NR 106.06(3)(c), Wis. Adm. Code: Not applicable – this facility does not have an approved Zone of Initial Dilution (ZID).
- Water source: Domestic wastewater with water supply from wells.
- Additives: Aluminum sulfate (phosphorus removal)
- Effluent characterization: This facility is categorized as a minor municipality, so the permit application required effluent sample analyses for a limited number of common pollutants, as specified in s. NR 200.065, Table 1, Wis. Adm. Code, primarily metal substances plus ammonia, chloride, hardness, and phosphorus.
- Effluent data for substances for which a single sample was analyzed is shown in the tables in Part 2 below, in the column titled “MEAN EFFL. CONC.”. Otherwise, substances with multiple effluent

data are shown in the tables below or in their respective parts in this evaluation.

Copper Effluent Data

Sample Date	Copper (μg/L)	Sample Date	Copper (μg/L)	Sample Date	Copper (μg/L)
1/31/2023	12	2/16/2023	8	3/2/2023	8
2/6/2023	14	2/20/2023	14	3/6/2023	13
2/9/2023	7	2/23/2023	8	3/9/2023	8
2/13/2023	8	2/27/2023	14		
1-day P_{99} = 19 μg/L					
4-day P_{99} = 14 μg/L					

Chloride Effluent Data

Sample Date	Chloride (mg/L)	Sample Date	Chloride (mg/L)	Sample Date	Chloride (mg/L)
1/27/2022	254	5/17/2022	207	9/6/2022	229
2/22/2022	279	6/14/2022	224	10/12/2022	203
3/22/2022	242	7/12/2022	196	11/9/2022	167
4/14/2022	228	8/9/2022	192	12/7/2022	246
1-day P_{99} = 304 mg/L					
4-day P_{99} = 261 mg/L					

The following table presents the average concentrations and loadings at Outfall 001 from November 2018 through September 2023 for all parameters with limits in the current permit to meet the requirements of s. NR 201.03(6), Wis. Adm. Code:

Parameter Averages with Limits

	Average Measurement	Average Mass Discharged
BOD_5	5 mg/L	
TSS	3 mg/L*	
pH field	7.4 s.u.	
Phosphorus	0.29 mg/L	0.59 lbs/day
Ammonia Nitrogen	0.05 mg/L*	

*Results below the level of detection (LOD) were included as zeroes in calculation of average.

PART 2 – WATER QUALITY-BASED EFFLUENT LIMITATIONS FOR TOXIC SUBSTANCES – EXCEPT AMMONIA NITROGEN

Permit limits for toxic substances are required whenever any of the following occur:

1. The maximum effluent concentration exceeds the calculated limit (s. NR 106.05(3), Wis. Adm. Code)
2. If 11 or more detected results are available in the effluent, the upper 99th percentile (or P_{99}) value exceeds the comparable calculated limit (s. NR 106.05(4), Wis. Adm. Code)
3. If fewer than 11 detected results are available, the mean effluent concentration exceeds 1/5 of the calculated limit (s. NR 106.05(6), Wis. Adm. Code)

Acute Limits based on 1-Q_{10}

Daily maximum effluent limitations for toxic substances are based on the acute toxicity criteria (ATC), listed in ch. NR 105, Wis. Adm. Code. Previously daily maximum limits for toxic substances were calculated as two times the ATC. However, changes to ch. NR 106, Wis. Code, (September 1, 2016) require the Department to calculate acute limitations using the same mass balance equation as used for other limits along with the 1-Q_{10} receiving water low flow to determine if more restrictive effluent limitations are needed to protect the receiving stream from discharges which may cause or contribute to an exceedance of the acute water quality standards. The mass balance equation is provided below.

$$\text{Limitation} = \frac{(WQC)\,(Qs + (1-f)\,Qe) - (Qs - f\,Qe)\,(Cs)}{Qe}$$

Where:

WQC =Acute toxicity criterion or secondary acute value according to ch. NR 105, Wis. Adm. Code.

Qs = average minimum 1-day flow which occurs once in 10 years (1-day Q_{10}) if the 1-day Q_{10} flow data is not available = 80% of the average minimum 7-day flow which occurs once in 10 years (7-day Q_{10}).

Qe = Effluent flow (in units of volume per unit time) as specified in s. NR 106.06(4)(d), Wis. Adm. Code.

f = Fraction of the effluent flow that is withdrawn from the receiving water, and

Cs = Background concentration of the substance (in units of mass per unit volume) as specified in s. NR 106.06(4)(e), Wis. Adm. Code.

If the receiving water is effluent dominated under low stream flow conditions, the 1-Q_{10} method of limit calculation produces the most stringent daily maximum limitations and should be used while making reasonable potential determinations. This is not the case for Brodhead Wastewater Treatment Facility, and the limits are set based on two times the acute toxicity criteria.

The following tables list the calculated WQBELs for this discharge along with the results of effluent sampling. All concentrations are expressed in terms of micrograms per Liter (µg/L), except for hardness and chloride (mg/L).

Daily Maximum Limits based on Acute Toxicity Criteria (ATC)

RECEIVING WATER FLOW = 25 cfs,

SUBSTANCE	REF. HARD. mg/L	ATC	MAX. EFFL. LIMIT*	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.	1-day P_{99}	1-day MAX. CONC.
Arsenic		340	679.6	135.9	<1.0		
Cadmium	265	31.6	63.1	12.6	<2		
Chromium	265	4010	8020.1	1604	<3		
Copper	265	39.0	77.9			19	14
Lead	265	275	549.1	109.8	1		
Nickel	265	1071	2142.7	429	<8		
Zinc	265	283	565.2	113.0	53		
Chloride (mg/L)		757	1514.0			261	279

* The 2 × ATC method of limit calculation yields a more restrictive limit than consideration of ambient concentrations and 1-Q_{10} flow rates per the changes to s. NR 106.07(3), Wis. Adm. Code, effective 09/01/2016.

Attachment #1

Weekly Average Limits based on Chronic Toxicity Criteria (CTC)

RECEIVING WATER FLOW = 25 cfs

SUBSTANCE	REF. HARD.* mg/L	CTC	MEAN BACK-GRD.	WEEKLY AVE. LIMIT	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.	4-day P_{99}
Arsenic		152.2	2	4217	843.5	<1.0	
Cadmium	175	3.82	0.14	103.31	20.7	<2	
Chromium	301	325.75	2	9076	1815.1	<3	
Copper	303	26.73	4	641.9			14
Lead	303	81.74		2294.0	458.8	1	
Nickel	268	120.18		3373	674.6	<8	
Zinc	303	317.37		8907	1781.4	53	
Chloride (mg/L)		395		11085			261

* The indicated hardness may differ from the receiving water hardness because the receiving water hardness exceeded the maximum range in ch. NR 105, Wis. Adm. Code, over which the chronic criteria are applicable. In that case, the maximum of the range is used to calculate the criterion.

Monthly Average Limits based on Wildlife Criteria (WC)

The effluent characterization did not include any effluent sampling results for substances for which Wildlife Criteria exist.

Monthly Average Limits based on Human Threshold Criteria (HTC)

RECEIVING WATER FLOW = 25 cfs

SUBSTANCE	HTC	MEAN BACK-GRD.	MO'LY AVE. LIMIT	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.
Cadmium	370	0.14	10380	2076.0	<2
Chromium (+3)	3818000	2	107150153	21430031	<3
Lead	140		3929	785.8	1
Nickel	43000		1206773	241355	<8

Monthly Average Limits based on Human Cancer Criteria (HCC)

RECEIVING WATER FLOW = 25 cfs

SUBSTANCE	HCC	MEAN BACK-GRD.	MO'LY AVE. LIMIT	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.
Arsenic	13.3	2	319.1	63.83	<1.0

In addition to evaluating the need for limits for each individual substance for which HCC exist, s. NR 106.06(8), Wis. Adm. Code, requires the evaluation of the cumulative cancer risk. Because no effluent limits are needed based on HCC, determination of the cumulative cancer risk is not needed per s. NR 106.06(8), Wis. Adm. Code.

Conclusions and Recommendations

Based on a comparison of the effluent data and calculated effluent limitations, **no effluent limitations are required.**

Chloride – Considering available effluent data from the current permit term (January 2022 through December 2022), the 1-day P_{99} chloride concentration is 304 mg/L, and the 4-day P_{99} of effluent data is 261 mg/L. These effluent concentrations are below the calculated WQBELs for chloride; therefore, **no effluent limits are needed. Chloride monitoring during the fourth year of the permit term is recommended to ensure that 11 sample results are available at the next permit issuance** to meet the data requirements of s. NR 106.85, Wis. Adm. Code.

Mercury – The permit application did not require monitoring for mercury because the Brodhead Wastewater Treatment Facility is categorized as a minor facility as defined in s. NR 200.02(8), Wis. Adm. Code. In accordance with s. NR 106.145(3)(a)3, Wis. Adm. Code, a minor municipal discharger shall monitor, and report results of influent and effluent mercury monitoring once every three months if, "there are two or more exceedances in the last five years of the high-quality sludge mercury concentration of 17 mg/kg specified in s. NR 204.07(5), Wis. Adm. Code." A review of the past five years of sludge characteristics data reveals that all the sample results are within expected analytical ranges and well below the 17 mg/kg level. The average concentration in the sludge from March 2019 through March 2022 (n=4 with one non-detect) was 0.10 mg/kg, with a maximum reported concentration of 0.20 mg/kg. Therefore, **no mercury monitoring is recommended at Outfall 001.**

PFOS and PFOA – The need for PFOS and PFOA monitoring is evaluated in accordance with s. NR 106.98(2), Wis. Adm. Code. Based on the type of discharge, the effluent flow rate, and lack of indirect dischargers, **PFOS and PFOA monitoring is not recommended.** The Department may re-evaluate the need for sampling at the next permit reissuance if new information becomes available that suggests PFOS or PFOA may be present in the discharge.

PART 3 – WATER QUALITY-BASED EFFLUENT LIMITATIONS FOR AMMONIA NITROGEN

The State of Wisconsin promulgated revised water quality standards for ammonia nitrogen in ch. NR 105, Wis. Adm. Code, effective March 1, 2004 which includes criteria based on both acute and chronic toxicity to aquatic life. The current permit has daily maximum, weekly average, and monthly average limits. These limits are re-evaluated at this time due to the following changes:

- Subchapter IV of ch. NR 106, Wis. Adm. Code allows limits based on available dilution instead of limits set to twice the acute criteria.
- The maximum expected effluent pH has changed.

Daily Maximum Limits based on Acute Toxicity Criteria (ATC)

Daily maximum limitations are based on acute toxicity criteria in ch. NR 105, Wis. Adm. Code, which are a function of the effluent pH and the receiving water classification. The acute toxicity criterion (ATC) for ammonia is calculated using the following equation:

$$\text{ATC in mg/L} = [A \div (1 + 10^{(7.204 - pH)})] + [B \div (1 + 10^{(pH - 7.204)})]$$

Where:

A = 0.411 and B = 58.4 for a Warm Water Sport fishery, and
pH (s.u.) = that characteristic of the effluent.

The effluent pH data was examined as part of this evaluation. A total of 1795 sample results were reported from November 2018 through September 2023. The maximum reported value was 8.0 s.u. (Standard pH Units). The effluent pH was 7.7 s.u. or less 99% of the time. The 1-day P_{99}, calculated in accordance with s. NR 106.05(5), Wis. Adm. Code, is 7.7 s.u. The mean plus the standard deviation multiplied by a factor of 2.33, an estimate of the upper ninety ninth percentile for a normally distributed dataset, is 7.7 s.u. Therefore, a value of 7.7 s.u. is believed to represent the maximum reasonably expected pH, and therefore most appropriate for determining daily maximum limitations for ammonia nitrogen. Substituting a value of 7.7 s.u. into the equation above yields an ATC = 14.4 mg/L.

Daily Maximum Ammonia Nitrogen Effluent Limitations Calculation Method
In accordance with s. NR 106.32(2), Wis. Adm. Code, daily maximum ammonia limitations are calculated using the 1-Q_{10} receiving water low flow if it is determined that the previous method of acute ammonia limit calculation (2×ATC) is not sufficiently protective of the fish and aquatic life. The more restrictive calculated limits shall apply.

The calculated daily maximum ammonia nitrogen effluent limits using the mass balance approach with the 1-Q_{10} (estimated as 80 % of 7-Q_{10}) and the 2×ATC approach are shown below.

Daily Maximum Ammonia Nitrogen Determination

	Ammonia Nitrogen Limit mg/L
2×ATC	29
1-Q_{10}	326

The 2×ATC method yields the most stringent limits for Brodhead Wastewater Treatment Facility.

This limit is greater than the current daily maximum limit of 20 mg/L. If Brodhead Wastewater Treatment Facility would like to request an increase to the existing permit limits, an assessment of their effluent data consistent with the requirements of ss. NR 207.04(1)(a) and (c), Wis. Adm. Code, must be provided. This evaluation is on a parameter-by-parameter basis and includes consideration of operations, maintenance, and temporary upsets. Without a demonstration of need for a higher limit in accordance with s. NR 207.04, Wis. Adm. Code, the current limits must be continued in the reissued permit. The Department would be unable to increase the limit due to the lack of need as shown via the antidegradation rule (ch. NR 207, Wis. Adm. Code) because the highest reported concentration was 3.5 mg/L during the previous permit term. No changes are recommended in any of the permit limits for ammonia.

Presented below is a table of daily maximum limitations corresponding to various effluent pH values. Use of this table is not necessarily recommended in the permit, but it is presented herein for informational purposes.

Daily Maximum Ammonia Nitrogen Limits – WWSF

Effluent pH s.u.	Limit mg/L	Effluent pH s.u.	Limit mg/L	Effluent pH s.u.	Limit mg/L
6.0 ≤ pH ≤ 6.1	108	7.0 < pH ≤ 7.1	66	8.0 < pH ≤ 8.1	14
6.1 < pH ≤ 6.2	106	7.1 < pH ≤ 7.2	59	8.1 < pH ≤ 8.2	11
6.2 < pH ≤ 6.3	104	7.2 < pH ≤ 7.3	52	8.2 < pH ≤ 8.3	9.4
6.3 < pH ≤ 6.4	101	7.3 < pH ≤ 7.4	46	8.3 < pH ≤ 8.4	7.8
6.4 < pH ≤ 6.5	98	7.4 < pH ≤ 7.5	40	8.4 < pH ≤ 8.5	6.4
6.5 < pH ≤ 6.6	94	7.5 < pH ≤ 7.6	34	8.5 < pH ≤ 8.6	5.3
6.6 < pH ≤ 6.7	89	7.6 < pH ≤ 7.7	29	8.6 < pH ≤ 8.7	4.4

Attachment #1

Effluent pH s.u.	Limit mg/L	Effluent pH s.u.	Limit mg/L	Effluent pH s.u.	Limit mg/L
6.7 < pH ≤ 6.8	84	7.7 < pH ≤ 7.8	24	8.7 < pH ≤ 8.8	3.7
6.8 < pH ≤ 6.9	78	7.8 < pH ≤ 7.9	20	8.8 < pH ≤ 8.9	3.1
6.9 < pH ≤ 7.0	72	7.9 < pH ≤ 8.0	17	8.9 < pH ≤ 9.0	2.6

Weekly and Monthly Average Limits based on Chronic Toxicity Criteria (CTC)
The weekly and monthly average ammonia nitrogen limits calculation from the previous memo do not change because there have been no changes in the effluent and receiving water flow rates. The calculations from the previous WQBEL memo are shown in Attachment #3.

Effluent Data
The following table evaluates the statistics based upon ammonia data reported from November 2018 through September 2023, with those results being compared to the calculated limits to determine the need to include ammonia limits in the Brodhead Wastewater Treatment Facility permit for the respective month ranges. That need is determined by calculating 99th upper percentile (or P_{99}) values for ammonia during each of the month ranges and comparing the daily maximum values to the daily maximum limit.

Ammonia Nitrogen Effluent Data

	Ammonia Nitrogen mg/L
1-day P_{99}	1.0
4-day P_{99}	0.5
30-day P_{99}	0.22
Mean*	0.05
Std	0.54
Sample size	443 (381 ND)
Range	<0.1 - 3.5

*"<" means that the pollutant was not detected at the indicated level of detection. The mean concentration was calculated using zero in place of the non-detected (ND) result.

Based on this comparison, there is no reasonable potential for the discharge to exceed any of the calculated ammonia nitrogen limits. However, **where there are existing ammonia nitrogen limits in the permit, the limits must be retained** regardless of reasonable potential, consistent with s. NR 106.33(1)(b), Wis. Adm. Code:

> (b) If a permittee is subject to an ammonia limitation in an existing permit, the limitation shall be included in any reissued permit. Ammonia limitations shall be included in the permit if the permitted facility will be providing treatment for ammonia discharges.

Conclusions and Recommendations
In summary, after rounding to two significant figures, **the ammonia nitrogen limitations in the table on the next page are recommended.** No mass limitations are recommended in accordance with s. NR 106.32(5), Wis. Adm Code.

Final Ammonia Nitrogen Limits

	Daily Maximum mg/L	Weekly Average mg/L	Monthly Average mg/L
April	20	**20**	10
May – September	-	-	-
October – March	20	**20**	**18**

Additional limits to meet the requirements in s. NR 106.07, Wis. Adm Code, are denoted in bold text above.

PART 4 – WATER QUALITY-BASED EFFLUENT LIMITATIONS FOR BACTERIA

On May 1, 2020, revisions to chs. NR 102 and NR 210, Wis. Adm. Codes, became effective which replace fecal coliform limits with new *Escherichia coli* (*E. coli*) limits for protection of recreational uses. Section NR 210.06(2)(a)1, Wis. Adm. Code, includes two limits which must be included in permits for facilities which are required to disinfect:

1. The geometric mean of *E. coli* bacteria in effluent samples collected in any calendar month may not exceed 126 counts/100 mL.
2. No more than 10 percent of *E. coli* bacteria samples collected in any calendar month may exceed 410 counts/100 mL.

E. coli monitoring is recommended at the same frequency that fecal coliform monitoring is required in the current permit. Since Brodhead's permit requires weekly monitoring, the 410 counts/100 mL limit will effectively function as a daily maximum limit unless the facility performs additional monitoring. Any additional monitoring beyond what is required by the permit must also be reported on the DMR as required in the standard requirements section of the permit.

These limits are required during May through September. No changes are recommended to the current recreational period and the required disinfection season.

Effluent Data
Brodhead Wastewater Treatment Facility has monitored effluent *E. coli* from July 2022 through September 2023 and a total of 16 results are available (15 samples were below the level of detection). A geometric mean of 126 counts/100 mL was not exceeded. The maximum reported value was 31 counts/100 mL. Based on this effluent data **it appears that the facility can meet new *E. coli* limits and a compliance schedule is not needed in the reissued permit.**

PART 5 – PHOSPHORUS

Technology-Based Effluent Limit
Subchapter II of Chapter NR 217, Wis. Adm. Code, requires municipal wastewater treatment facilities that discharge greater than 150 pounds of Total Phosphorus per month to comply with a monthly average limit of 1.0 mg/L, or an approved alternative concentration limit.

Since Brodhead Wastewater Treatment Facility does not currently have an existing technology-based limit, the need for this limit in the reissued permit is evaluated. The data demonstrates that the annual monthly average phosphorus loading is less than 150 lbs/month, which is the threshold for municipalities in accordance with s. NR 217.04(1)(a)1, Wis. Adm. Code, and therefore **no technology-based limit is required.**

Annual Average Mass Total Phosphorus Loading

Month	Average Phosphorus Concentration (mg/L)	Total Effluent Flow (Million Gallons)	Calculated Mass (lbs/month)
October 2022	0.269	7.79	17
November 2022	0.299	7.57	19
December 2022	0.168	7.66	11
January 2023	0.143	8.39	10
February 2023	0.127	8.17	8.6
March 2023	0.168	10.15	14
April 2023	0.187	9.65	15
May 2023	0.247	9.04	19
June 2023	0.334	8.70	24
July 2023	0.341	7.38	21
August 2023	0.406	6.93	23
September 2023	0.336	6.11	17
Average			**17**

Total P (lbs/month) = Monthly average (mg/L) × total flow (MG/month) × 8.34 (lbs/gallon)
Where total flow is the sum of the actual (not design) flow (in MGD) for that month

In addition, the need for a WQBEL for phosphorus must be considered.

Water Quality-Based Effluent Limits (WQBEL)
Revisions to administrative rules regulating phosphorus took effect on December 1, 2010. These rule revisions include additions to s. NR 102.06, Wis. Adm. Code, which establish phosphorus standards for surface waters. Subchapter III of NR 217, Wis. Adm. Code, establishes procedures for determining WQBELs for phosphorus, based on the applicable standards in ch. NR 102, Wis. Adm. Code.

Section NR 102.06(3)(a), Wis. Adm. Code, specifically names river segments for which a phosphorus criterion of 0.1 mg/L applies. The 0.1 mg/L criterion applies for the Sugar River from the outlet of Albany Lake to the state line, excluding Decatur Lake. Since the Sugar River-Millrace is not explicitly excluded, the 0.1 mg/L applies to the discharge location.

The conservation of mass equation is described in s. NR 217.13(2)(a), Wis. Adm. Code, for phosphorus WQBELs and includes variables of water quality criterion (WQC), receiving water flow rate (Qs), effluent flow rate (Qe), and upstream phosphorus concentrations (Cs) provided below.

$$\text{Limitation} = [(WQC)(Qs+(1-f)\,Qe) - (Qs-f\,Qe)\,(Cs)]/Qe$$

Where:

WQC = 0.1 mg/L for the Sugar River-Millrace
Qs = 100% of the 7-Q_2 of 25 cfs
Cs = background concentration of phosphorus in the receiving water pursuant to s. NR 217.13(2)(d), Wis. Adm. Code

Qe = effluent flow rate = 0.597 MGD = 0.924 cfs
f = the fraction of effluent withdrawn from the receiving water = 0

Section NR 217.13(2)(d), Wis. Adm. Code, specifies that the background phosphorus concentration used in the limit calculation formula shall be calculated as a median using the procedures specified in s. NR 102.07(1)(b) to (c), Wis. Code. All representative data from the most recent 5 years shall be used, but data from the most recent 10 years may be used if representative of current conditions.

A previous evaluation resulted in a WQBEL of 0.1 mg/L using a background concentration of 0.135 mg/L using data from 2013-2015 at the Sugar River-Millrace Station (Station #10039969) stored in the Surface Water Integrated Monitoring System (SWIMS) database. Section NR 217.13(2)(d), Wis. Adm. Code, states that the determination of upstream concentrations shall be evaluated at each permit reissuance. No additional data were available for consideration in estimating the background phosphorus concentration.

Substituting a background concentration above criteria into the limit calculation equation above would result in a calculated limit that is less than the applicable criterion of 0.1 mg/L. However, s. NR 217.13(7), Wis. Adm. Code, specifies that “if the WQBEL calculated pursuant to the procedures in this section is less than the phosphorus criterion specified in s. NR 102.06, Wis. Adm. Code, for the water body, the effluent limit shall be set equal to the criterion.”

The impaired water listing of the Sugar River-Millrace at the discharge location also indicates that effluent phosphorus limits equal to the water quality criterion are needed to prevent the discharge from contributing to further impairment of the receiving water. *The Guidance for Implementing Wisconsin’s Phosphorus Water Quality Standards for Point Source Discharges* (2020) suggests setting effluent limits equal to the criterion in the absence of an EPA approved total maximum daily load for discharges of phosphorus to phosphorus-impaired waters.

Effluent Data

The following table summarizes effluent total phosphorus monitoring data from November 2018 through September 2023.

Total Phosphorus Effluent Data

	mg/L	lbs/day
1-day P_{99}	1.02	2.24
4-day P_{99}	0.60	1.29
30-day P_{99}	0.39	0.81
Mean	0.29	0.59
Std	0.20	0.44
Sample size	769	626
Range	0.081 - 1.554	0 - 2.95

Reasonable Potential Determination

The discharge has reasonable potential to cause or contribute to an exceedance of the water quality criterion because the 30-day P_{99} of reported effluent total phosphorus data is greater than the calculated WQBEL**.** Therefore, **a WQBEL is required.**

Limit Expression
According to s. NR 217.14(2), Wis. Adm. Code, because the calculated WQBEL is less than or equal to 0.3 mg/L, the effluent limit of 0.1 mg/L may be expressed as a six-month average. If a concentration limitation expressed as a six-month average is included in the permit, **a monthly average concentration limitation of 0.3 mg/L,** equal to three times the WQBEL calculated under s. NR 217.13, Wis. Adm. Code **shall also be included in the permit.** The six-month average should be averaged during the months of May – October and November – April.

Mass Limits
A mass limit is also required, pursuant to s. NR 217.14(1)(a), Wis. Adm. Code, because the discharge is to a surface water that is to a phosphorus-impaired water. **This final mass limit shall be 0.1 mg/L × 8.34 × 0.597 MGD = 0.5 lbs/day expressed as a six-month average.**

WQT Minimum Control Level
A water quality trading (WQT) plan has been submitted as an alternative compliance option to offset any total phosphorus discharged from Outfall 001 that exceed the WQBELs. The phosphorus WQBELs may be expressed as computed compliance limits, but a Minimum Control Level (MCL) must be set as a limit and not be exceeded at the outfall location. **The existing WQT interim limit of 0.5 mg/L is recommended to continue as the MCL.**

PART 6 – WATER QUALITY-BASED EFFLUENT LIMITATIONS FOR THERMAL

Surface water quality standards for temperature took effect on October 1, 2010. These regulations are detailed in chs. NR 102 (Subchapter II – Water Quality Standards for Temperature) and NR 106 (Subchapter V – Effluent Limitations for Temperature) of the Wisconsin Administrative Code. Daily maximum and weekly average temperature criteria are available for the 12 different months of the year depending on the receiving water classification.

In accordance with s. NR 106.53(2)(b), Wis. Adm. Code, the highest daily maximum flow rate for a calendar month is used to determine the acute (daily maximum) effluent limitation. In accordance with s. NR 106.53(2)(c), Wis. Adm. Code, the highest 7-day rolling average flow rate for a calendar month is used to determine the sub-lethal (weekly average) effluent limitation. These values were based off actual flow reported from November 2018 through September 2023.

Brodhead Wastewater Treatment Facility last monitored effluent temperature from January 2011- October 2012 (shown in the table on the next page). Since there have been no changes to the treatment process, this data is still considered to be representative.

Attachment #1

Monthly Temperature Effluent Data & Limits

Month	Representative Highest Monthly Effluent Temperature		Calculated Effluent Limit	
	Weekly Maximum (°F)	Daily Maximum (°F)	Weekly Average Effluent Limitation (°F)	Daily Maximum Effluent Limitation (°F)
JAN	67	73	-	120
FEB	69	73	-	120
MAR	73	76	-	120
APR	79	81	-	120
MAY	74	81	-	120
JUN	79	83	-	120
JUL	81	89	-	120
AUG	91	92	-	120
SEP	89	90	-	120
OCT	77	80	-	120
NOV	70	75	-	120
DEC	70	73	-	120

At temperatures above approximately 103°F, conventional biological treatment systems do not function properly and experience upsets. There is no indication that this has ever occurred in this treatment system. Therefore, there is no reasonable potential for the discharge to exceed this limit. **No monitoring or effluent limits are recommended for temperature.**

PART 7 – WHOLE EFFLUENT TOXICITY (WET)

WET testing is used to measure, predict, and control the discharge of toxic materials that may be harmful to aquatic life. In WET tests, organisms are exposed to a series of effluent concentrations for a given time and effects are recorded. Decisions below related to the selection of representative data and the need for WET limits were made according to ss. NR 106.08 and 106.09, Wis. Adm. Code. WET monitoring frequency and toxicity reduction evaluation (TRE) recommendations were made using the best professional judgment of staff familiar with the discharge after consideration of the guidance in the *Whole Effluent Toxicity (WET) Program Guidance Document* (2022).

- Acute tests predict the concentration that causes lethality of aquatic organisms during a 48 to 96-hour exposure. To assure that a discharge is not acutely toxic to organisms in the receiving water, WET tests must produce a statistically valid LC_{50} (Lethal Concentration to 50% of the test organisms) greater than 100% effluent, according to s. NR 106.09(2)(b), Wis. Adm Code.

- Chronic tests predict the concentration that interferes with the growth or reproduction of test organisms during a seven-day exposure. To assure that a discharge is not chronically toxic to organisms in the receiving water, WET tests must produce a statistically valid IC_{25} (Inhibition Concentration) greater than the instream waste concentration (IWC), according to s. NR 106.09(3)(b), Wis. Adm Code. The IWC is an estimate of the proportion of effluent to total volume of water (receiving water + effluent).

The IWC of **4%**, shown in the WET Checklist summary below, was calculated according to the following equation, as specified in s. NR 106.03(6), Wis. Adm Code:

$$IWC\ (as\ \%) = Q_e \div \{(1 - f)\ Q_e + Q_s\} \times 100$$

Where:

Q_e = annual average flow = 0.597 MGD = 0.924 cfs
f = fraction of the Q_e withdrawn from the receiving water = 0
Q_s = 25 cfs

- Shown below is a tabulation of all available WET data for Outfall 001. Efforts are made to ensure that decisions about WET monitoring and limits are made based on representative data, as specified in s. NR 106.08(3), Wis. Adm Code. Data which is not believed to be representative of the discharge was not included in reasonable potential calculations. The table below differentiates between tests used and not used when making WET determinations.

  Tests conducted prior to 2005 are not presented in the table below due to significant changes that were made to WET test methods in 2004. These changes were assumed to be fully implemented by certified labs by no later than June 2005. Data collected before July 1, 2005 does not show repeated toxicity that was never resolved and is not the only data that are available (except for chronic).

WET Data History

Date Test Initiated	Acute Results LC_{50} %			
	C. dubia	Fathead minnow	Pass or Fail?	Used in RP?
02/14/2007	>100	100	Pass	Yes
05/21/2008	>100	100	Pass	Yes

- According to s. NR 106.08, Wis. Adm. Code, WET reasonable potential is determined by multiplying the highest toxicity value that has been measured in the effluent by a safety factor, to predict the likelihood (95% probability) of toxicity occurring in the effluent above the applicable WET limit. The safety factor used in the equation changes based on the number of toxicity detects in the dataset. The fewer detects present, the higher the safety factor, because there is more uncertainty surrounding the predicted value. **WET limits must be given, according to s. NR 106.08(6), Wis. Adm. Code, whenever the applicable Reasonable Potential equation results in a value greater than 1.0.**

  According to s. NR 106.08(6)(d), Wis. Adm. Code, TUa and TUc effluent values are equal to zero whenever toxicity is not detected (i.e., when the LC_{50}, IC_{25} or $IC_{50} \geq 100\%$).

  Acute Reasonable Potential = 0 < 1.0, reasonable potential is not shown, and a limit is not required.

The WET checklist was developed to help DNR staff make recommendations regarding WET limits, monitoring, and other related permit conditions. The checklist indicates whether acute and chronic WET limits are needed, based on requirements specified in s. NR 106.08, Wis. Adm. Code. The checklist steps the user through a series of questions, assesses points based on the potential for effluent toxicity, and suggests monitoring frequencies based on points accumulated during the checklist analysis. As toxicity potential increases, more points accumulate, and more monitoring is recommended to ensure that toxicity is not occurring. A summary of the WET checklist analysis completed for this permittee is shown in the table below. Staff recommendations based on best professional judgment are provided below the summary table. For guidance related to reasonable potential and the WET checklist, see Chapter 1.3 of the WET Guidance Document: https://dnr.wisconsin.gov/topic/Wastewater/WET.html.

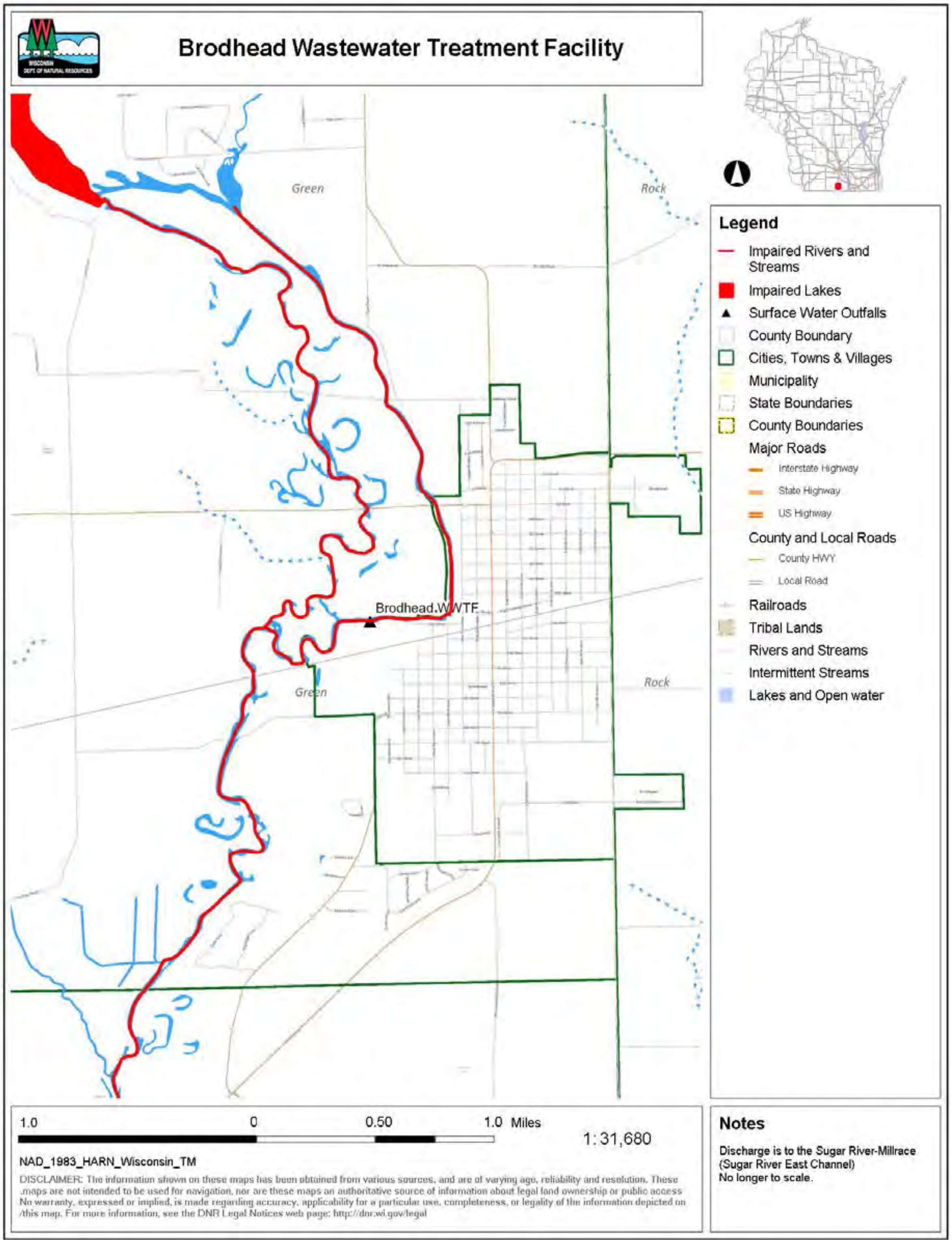
WET Checklist Summary

	Acute	Chronic
AMZ/IWC	Not Applicable. **0 Points**	IWC = 4% **0 Points**
Historical Data	No data collected since 2008. **5 Points**	No data collected since 2000. **5 Points**
Effluent Variability	Little variability, few violations, no upsets, and consistent WWTF operations. **0 Points**	Same as Acute. **0 Points**
Receiving Water Classification	WWSF **5 Points**	Same as Acute. **5 Points**
Chemical-Specific Data	No reasonable potential for limits based on ATC. Ammonia nitrogen limit carried over from the current permit. Chloride, copper, lead, and zinc detected. Additional Compounds of Concern: None. **3 Points**	No reasonable potential for limits based on CTC. Ammonia nitrogen limits carried over from the current permit. Chloride, copper, lead, and zinc detected. Additional Compounds of Concern: None. **3 Points**
Additives	No biocides and one water quality conditioner (alum) added. Permittee has proper P chemical SOP in place. **1 Point**	All additives used more than once per 4 days. **1 Point**
Discharge Category	No industrial contributors. **0 Points**	Same as Acute. **0 Points**
Wastewater Treatment	Secondary or better. **0 Points**	Same as Acute. **0 Points**
Downstream Impacts	No impacts known. **0 Points**	Same as Acute. **0 Points**
Total Checklist Points:	**14 Points**	**14 Points**
Recommended Monitoring Frequency (from Checklist):	None.	None.
Limit Required?	No	No
TRE Recommended? (from Checklist)	No	No

No WET testing is required because information related to the discharge indicates the potential for effluent toxicity is believed to be low.

Attachment #2

Site Map



Attachment #3

Ammonia Nitrogen Calculations from the WQBEL Memo Dated October 11, 2017

The rules provide a mechanism for less stringent weekly average and monthly average effluent limitations when early life stages (ELS) of critical organisms are absent from the receiving water. This applies only when the water temperature is less than 14.5 ºC, during the winter and spring months. Burbot, an early spawning species, are not believed to be present in the Sugar River, based on conversations with local fisheries biologists. So “ELS Absent” criteria apply from October through March, and “ELS Present” criteria will apply from April through September.

Since minimal ambient data is available, the “default” basin assumed values are used for Temperature, pH and background ammonia concentrations, shown in the table below, with the resulting criteria and effluent limitations.

		Spring April-May	Summer June-Sept	Winter Oct-Mar
Background Information	7-Q_{10} (cfs)	25	25	25
	7-Q_2 (cfs)	25	25	25
	Ammonia (mg/L)	0.07	0.06	0.12
	Temperature (°C)	6	19	4
	pH (s.u.)	8.27	8.3	8.23
	% of Flow used	25	100	25
	Reference Weekly Flow (cfs)	6.25	25	6.25
	Reference Monthly Flow (cfs)	5.3125	21.25	5.3125
Criteria mg/L	4-day Chronic			
	Early Life Stages Present	4.00	2.93	
	Early Life Stages Absent			6.94
	30-day Chronic			
	Early Life Stages Present	1.60	1.17	
	Early Life Stages Absent			2.77
Effluent Limitations mg/L	Weekly Average			
	Early Life Stages Present	30.61	80.50	
	Early Life Stages Absent			53.06
	Monthly Average			
	Early Life Stages Present	10.41	26.72	
	Early Life Stages Absent			18.04

State of Wisconsin
DEPARTMENT OF NATURAL RESOURCES
3911 Fish Hatchery Road
Fitchburg, WI 53711

Tony Evers, Governor

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June 3, 2024

Kristen Covert
1111 W 2nd Ave
Broadhead, WI 53520

Subject: Brodhead Wastewater Treatment Facility - WPDES Permit WI-0021903
Water Quality Trading Plan – CONDITIONAL APPROVAL

Dear Ms. Covert:

The Department recently received a water quality trading plan (WQT Plan) for ongoing compliance with phosphorus effluent limits at the Brodhead Wastewater Treatment Facility. The plan was received in February of 2024 and an updated version was received in May 2024. Based on WDNR review, the final WQT Plan (dated May 2024) is in general conformance with the WDNR Water Quality Trading Guidance and Section 283.84 of the Wisconsin Statutes. The WQT plan proposes a combination of streambank restoration, barnyard improvements, and field practices. Credits started being generated in 2019, with the first permit term WQT approval (WQT-2018-0007). The streambank projects were completed in 2019, barnyard improvements in 2020, and field practices in 2021. Credits generated from approved practices result in available credit quantities shown in Table 1. These credits will be incorporated into the reissued WPDES permit and will be used to demonstrate compliance with final phosphorus effluent limits.

Table 1: Total Phosphorus Credits Available per WQT-2024-0013

Year	Available Credits (lbs/yr) – Total
2023	379.8
2024	389.0
2025	416.5
2026	415.3
2027	413.6
2028	414.7
2029*	406.4

*The 5-year averaging period for credit generation will be 2023 through 2027.

The Department conditionally approves the WQT Plan as a basis for water quality trading during the next WPDES permit term. The Department has assigned the WQT plan a tracking number of WQT-2024-0013 and will be referenced as such in the draft WPDES permit. The final WQT plan will be included as part of the public notice package for permit reissuance. The draft WPDES permit will include a requirement for an annual trading report and effluent monitoring for total phosphorus.

If you have any questions or comments, please contact me at 608-419-4155 or at betsyjo.howe@wisconsin.gov

Thank You,

BetsyJo Howe

BetsyJo Howe
Wastewater Specialist
Wisconsin Department of Natural Resources

e-CC:

Thomas Simpson, Mayor
Richard Vogel, Facility Operator
MacKenzie Phillips, MSA Professional Services
Matt Claucherty, WDNR
Kenzie Ostien, WDNR

Water Quality Trading Plan, Revision #1

City of Brodhead
Green County, Wisconsin
Updated May 2024

City of Brodhead
Green County
Wisconsin
09336055

Prepared by:

MSA Professional Services, Inc.
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Project No. 09336055

Water Quality Trading Plan, Revision #1
City of Brodhead

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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)
LBFD	=	Left Bank Facing Downstream
NMP	=	Nutrient Management Plan
PI	=	Phosphorus Index [lb/acre/year]
RBFD	=	Right Bank Facing Downstream
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

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, 2018, 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. **Figure 1** at the end of this summary shows a map of the WQT Action Area and the Sugar River Millrace. The proposed WQBELs could not be achieved with the existing biological and chemical treatment processes utilized by the City. Through the consideration of several alternatives as detailed in the Water Quality Trading (WQT) Plan approved by the WDNR on August 2, 2018, the City of Brodhead opted to implement WQT to comply with the proposed WQBELs for phosphorus. With the reissuance of the City's WPDES permit in 2023, a revised WQT plan is necessary for submittal to address the updated credit calculations and methods for achieving WQBEL 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 considered prior to the implementation of Water Quality Trading 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 decided to implement to comply with the proposed WQBELs for phosphorus. Further details regarding implementation of Water Quality Trading are described in the City of Brodhead's *Water Quality Trading Plan* (MSA, 2018). The City is continuing to utilize WQT into the next 5-year permit term as it has proven to be effective in reducing phosphorus loadings and financially favorable.

Based on the credits generated in Permit Term #1 and further analysis in this report, it has been determined that the City of Brodhead needs to generate 234 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 recent effluent data has confirmed from previous a previous pilot study 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** at the end of this chapter. For the implementation of projects proposed in the original WQT plan, the action area was 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.

Existing and Proposed Plan:

During this previous permit term, the City and MSA have identified and completed management projects with three private landowners in the Searles Creek subwatershed who were 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 were actively eroding prior to Best Management Practices (BMP) implementation. Phosphorus credits were 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. Prior to the completed project, the farm lacked sufficient long term manure storage which made proper nutrient management of the farm's crop fields challenging. The farm also had several outdoor barnyards which lacked clean water diversions and runoff collection and treatment infrastructure. Phosphorus credits were generated with Landowner C by:

- Installing a new waste storage facility with a minimum 180 days of storage.
- 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 number of credits which were generated by working with each landowner during the City's first permit term of Water Quality Trading are shown in **Table 1**. As per the City's WPDES permit, management practices identified in the original WQT Plan were to be installed by September 30, 2019. Due to the weather delays, the installation of BMPs for Landowners A, B, and C were not substantially completed until the summer of 2020. Since projects were only partially completed for Landowners A and B at the end of 2019, the number of credits generated in 2019 as shown in **Table 1** included two months of credit generation. With the implementation of nutrient management practices by Landowner C in addition to the streambank and farmstead improvements for Landowners A, B, and C, a total of 382.6 pounds of credit per year were generated by the end of 2022 (Permit Term #1). This greatly exceeded the City's long-term goal identified in the 2018 WQT Plan of 238 pounds of credit per year needed to comply with Water Quality Trading.

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

Landowner ID	Phosphorus Credits Generated (lb/yr)			
	2019[1]	2020	2021	2022
Landowner A - Streambank Improvements	129.8	129.8	137.5	137.5
Landowner B - Streambank Improvements	83.3	90.1	97.3	97.3
Landowner C - Farmstead Improvements	0.0	31.4	79.9	58.8
Landowner C - Crop Field Improvements	0.0	0.0	57.0	89.0
Total	**213.1**	**251.3**	**371.7**	**382.6**

[1]Phosphorus credits were generated in November and December in the year 2019 after completion of portions of the projects.

Table 2 summarizes the comparison between credits used by the City's WWTF and credits generated by the WQT projects completed from the end of 2019 through 2022. An average surplus of 201.6 pounds of credit per year was generated by the end of 2022.

Table 2: Comparison of phosphorus credits used vs. generated in Permit Term #1 of WQT

Year	Credits Used (lb/yr)	Credits Generated (lb/yr)	Credit Surplus (lb/yr)
2019[1]	57.7	213.1	155.4
2020	100.4	251.3	150.9
2021	135.3	371.7	236.4
2022	118.8	382.6	263.8
Avg.	**103.1**	**304.7**	**201.6**

[1]Phosphorus credits shown in 2019 include November and December only, as credit generation began at this time.

With the same projects that generated credits during the first permit term of WQT, the number of credits which are expected to be generated for the projects during the City's second permit term of Water Quality Trading are shown in **Table 3**. Overall, the implemented projects are anticipated to far exceed the revised credit generation goal of 234 lb/year into WQT Permit Term #2.

Table 3: Total number of proposed phosphorus credits generated in Permit Term #2 of WQT

Landowner ID	Phosphorus Credits Generated (lb/yr)				
	2023 [1]	2024	2025	2026	2027
Landowner A - Streambank Improvements	137.5	137.2	137.2	137.2	137.2
Landowner B - Streambank Improvements	97.3	98.3	98.3	98.3	98.3
Landowner C - Farmstead Improvements	61.3	78.8	78.8	78.8	78.8
Landowner C - Crop Field Improvements	83.7	74.7	102.2	101.0	99.3
Total	**379.8**	**389.0**	**416.5**	**415.3**	**413.6**

[1]*Actual phosphorus credits generated.*

Estimated Costs:

The estimated costs for the City to implement this WQT Plan in Permit Term #2 are summarized in **Table 4**. As shown, the total capital cost for the plan is anticipated to be $0, as the three projects that were implemented in Permit Term #1 have been previously funded. The total annual operation and maintenance (O&M) cost is estimated to be $51,000, which was determined by applying an inflation rate to bring the estimated annual costs from the 2018 WQT Plan into present day costs (2024). This results in a total 15-year present worth of approximately $626,000. The 15-year present worth costs assume that annual O&M is sufficient to extend the design life of all trades up to 20 years, given that practices have now been installed for 5 years. The City intends to fully fund the annual costs for these projects with the implementation of an annual BMP repair fund.

Table 4: Estimated costs of implementing the Water Quality Trading Plan in Permit Term #2

Landowner ID	Capital Costs	Annual O&M Costs	15-year Present Worth
Landowner A	$ 0	$ 16,000	$ 197,000
Landowner B	$ 0	$ 12,000	$ 147,000
Landowner C	$ 0	$ 23,000	$ 282,000
Total	**$ 0**	**$ 51,000**	**$ 626,000**

Project Schedule:

The anticipated implementation schedule for this Water Quality Trading Plan is summarized in **Table 5**. For maintenance planning purposes, the City of Brodhead should budget expenses for the next five years as shown in the cash flow summary presented in **Table 6**.

Table 5: Anticipated project implementation schedule

Proposed Action	Approximate Date
Expiration of Brodhead's Current WDPES Permit	September 30, 2023
Submit Revised Water Quality Trading Plan to DNR	February 16, 2024
Anticipated DNR Approval of Revised Water Quality Trading Plan	May 2024

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

Table 6: Cash flow summary for the second WPDES permit term of Water Quality Trading

Year	Capital Costs	Annual O&M Costs
2023	$0	$51,000
2024	$0	$52,530
2025	$0	$54,110
2026	$0	$55,730
2027	$0	$57,400

[1] An inflation rate (3%) was applied to each year to account for potential future inflation.

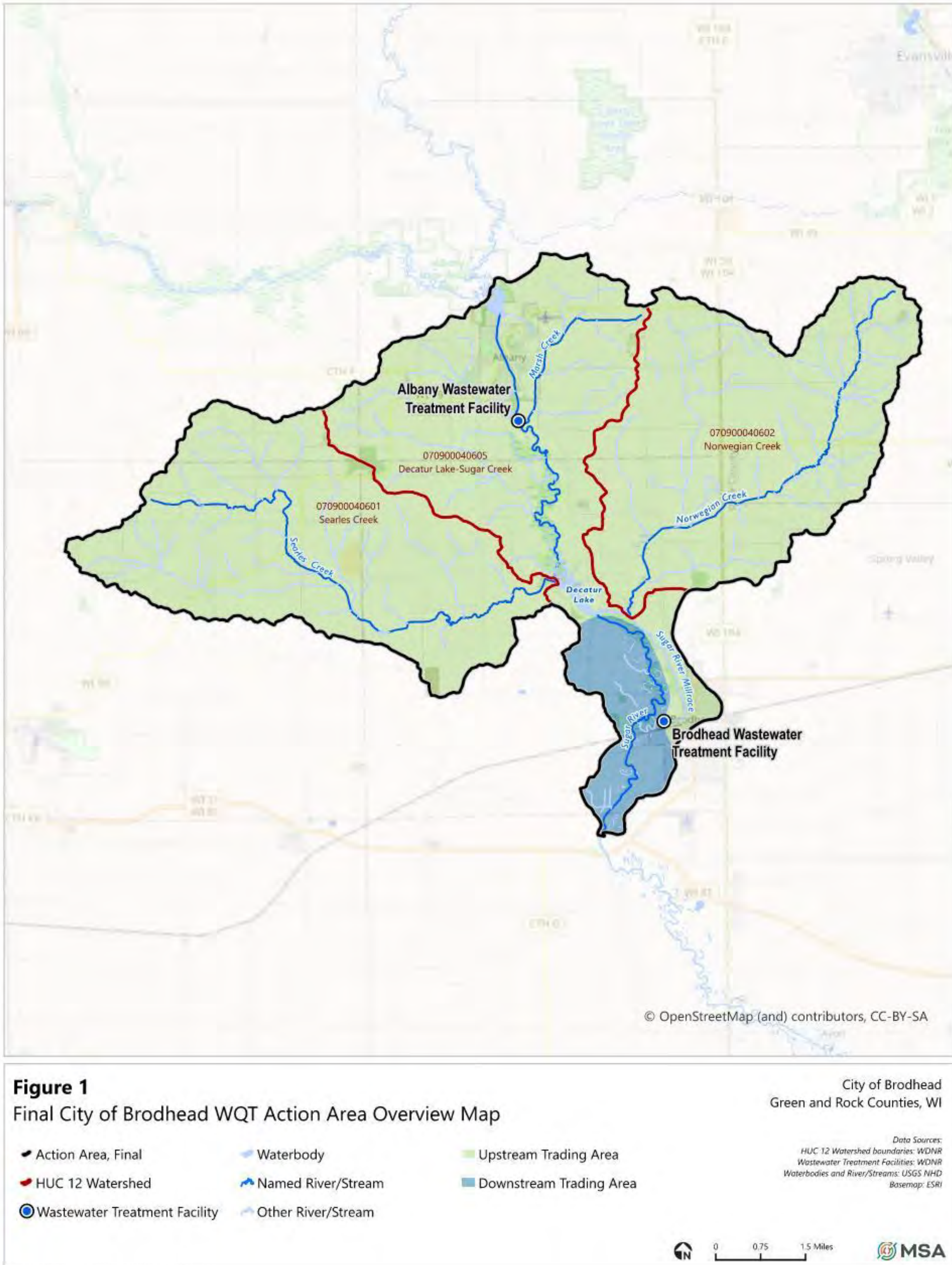

Figure 1: Final City of Brodhead WQT Action Area Overview Map

CHAPTER 1 – INTRODUCTION

1.1 BACKGROUND

The City of Brodhead (population 3,249) 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, 2018, 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 could not be achieved with the existing biological and chemical treatment processes utilized by the City. Based on the findings presented in the City of Brodhead's Preliminary Compliance Alternatives Plan (2015), it was determined that the most cost-effective means of complying the proposed phosphorus limits is to pursue Water Quality Trading (WQT). Therefore, the City of Brodhead submitted a WQT plan that was approved by WDNR on August 2, 2018. Through the duration of the City's current WPDES permit term, BMP projects have been implemented to achieve WQBEL compliance.

Further discussion on the purpose of WQT and details regarding implementation are included in the City of Brodhead's *Water Quality Trading Plan* (MSA, 2018).

Figure 1-1: Brodhead Wastewater Treatment Facility location map

1.2 PURPOSE AND SCOPE

The purpose of this WQT Plan revision is to summarize the outcome of BMP implementation during the previous permit term, to analyze the estimated credit generation of existing WQT projects into WQT Permit Term #2, and to identify additional locations within the Sugar River Basin where BMPs can be implemented by the City to further offset the environmental impacts of phosphorus discharged by the Brodhead Wastewater Treatment Facility. The objectives of this revised WQT Plan are:

- to review the City of Brodhead's WPDES permit requirements for phosphorus and rationale for continuing to apply WQT for phosphorus compliance
- to determine the minimum phosphorus load reductions needed for the City of Brodhead to comply with WQT in the coming permit term
- to identify additional eligible locations where credits can be generated for the City of Brodhead and to quantify phosphorus load reductions and implementation costs
- to identify partners who will continue to be involved with the implementation of the City of Brodhead's WQT Plan and to revise the roles and responsibilities of each partner
- to revisit processes the City of Brodhead will continue to implement to inspect installed BMPs and repair failing BMPs
- to establish a schedule for the City of Brodhead to continue compliance with WPDES permit requirements in WQT Permit Term #2

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.

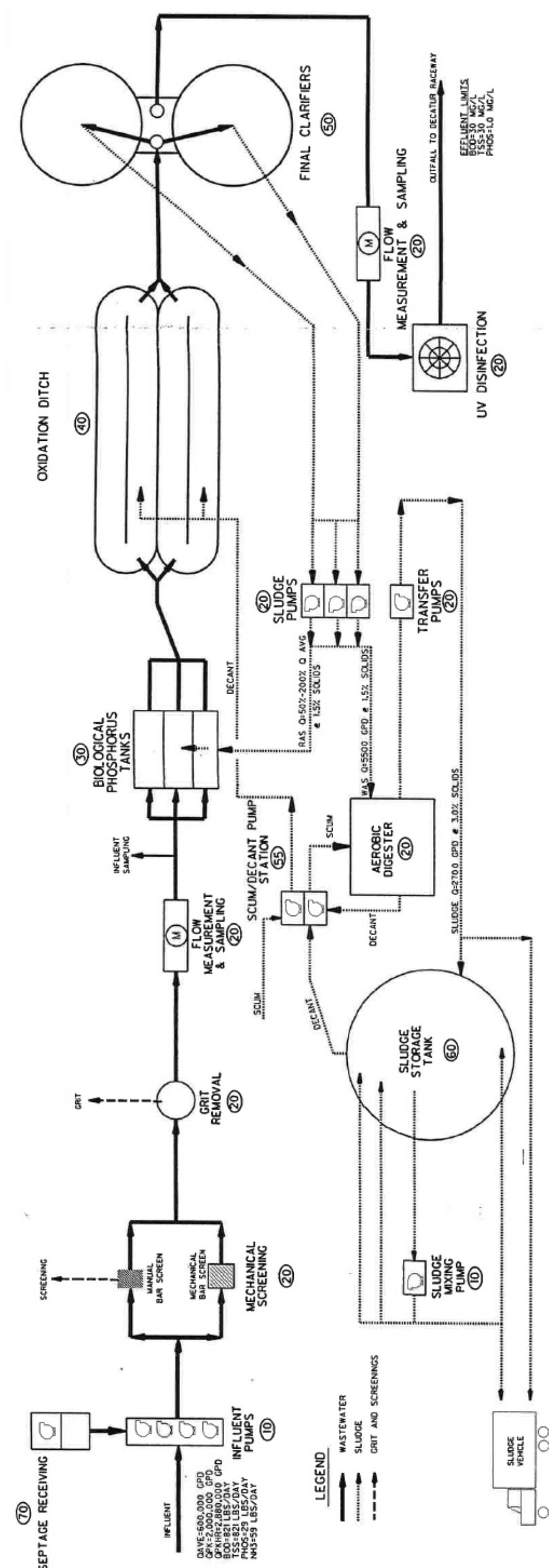

Figure 1-2: Brodhead Wastewater Treatment Facility flow schematic

1.4 WPDES PERMIT REQUIREMENTS

The current WPDES permit for the City of Brodhead Wastewater Treatment Facility was reissued on November 1, 2018. The current permit expired on September 30, 2023. 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 1.0 mg/L applied until October 31, 2019. After that date, the final water quality-based effluent limits (WQBELs) became effective. These final limits include the very stringent WQBEL of 0.3 mg/L for the monthly average, 0.1 mg/L for the 6-month average, and 0.5 lbs/day for the 6-month average. As stated in Section 2.2.1.1 of the City's WPDES permit, the permittee may use WQT to demonstrate compliance with WQBELs for total phosphorus for these final WQBEL limits. In order to comply with WQT, the City was required to complete the installation of management practices to become effective by September 30, 2019. Credit generation by partially completed BMPs began at the end of 2019, and installation of all BMPs was completed in summer 2020.

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.	1.0 mg/L	Final limits became effective November 1, 2019 but interim limit will remain as it represents the minimum control level
Final WQBEL	Monthly Avg.	0.3 mg/L	Effective November 1, 2019
Final WQBEL	6-Month Avg.	0.1 mg/L	Effective November 1, 2019
Final WQBEL	6-Month Avg.	0.5 lb/day	Effective November 1, 2019
Water Quality Trading	-	-	Effective September 30, 2019

1.5 SELECTION OF WATER QUALITY TRADING

In 2015, the City of Brodhead completed a *Preliminary Compliance Alternatives Plan* (MSA) 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 and as discussed in the City of Brodhead's *Water Quality Trading Plan* (MSA, 2018), 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. 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. Due to these anticipated cost savings, the City of Brodhead had elected to implement WQT to comply with WDPES permit requirements for phosphorus and submitted a *Notice of Intent (NOI) to Conduct Water Quality Trading* to the Wisconsin Department of Natural Resources (DNR) in September 2016.

As summarized in the City's 2018 WQT Plan, the City's *Preliminary Compliance Alternatives Plan* included a cost comparison of a WWTF tertiary phosphorus removal upgrade versus Water Quality Trading. The WWTF upgrade project that had an estimated capital cost of $4,200,000 in 2015 would now amount to approximately $5,500,000 due to market inflation in the last several years.

Due to the cost savings incurred compared to upgrading the existing WWTF after the first permit term of WQT implementation, the City submitted a renewal of the NOI in September 2022 to continue implementing WQT. Copies of the initial and renewal *Notice of Intent to Conduct Water Quality Trading* documents are included in **Appendix B** of this report.

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 continue complying with WQT.

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 2019 through 2022. As shown, the average influent and effluent flows during the four-year timeframe were 0.367 MGD and 0.293 MGD, respectively. Average effluent phosphorus concentrations and mass loads were 0.29 mg/L and 0.74 lb/day, respectively.

Table 2-1: Brodhead WWTF annual wastewater and phosphorus loads (2019-2022)

Year	Avg. Inf. Flow (MGD)	Avg. Eff. Flow (MGD)	Avg. Eff. TP Conc. (mg/L)	Avg. Eff. TP Load (lb/day)
2019	0.465	0.401	0.40	1.34
2020	0.375	0.310	0.21	0.53
2021	0.260	0.223	0.31	0.56
2022	0.366	0.237	0.25	0.52
Avg.	**0.367**	**0.293**	**0.29**	**0.74**

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 and prior to the approval of Water Quality Trading in November 2017. Optimization has included influent phosphorus source control as well as biological and chemical treatment optimization. As depicted in Figure 2-1: Brodhead WWTF average annual effluent total phosphorus loads (2009-2022), effluent phosphorus loads have been reduced by approximately 75% from 2009 through 2022. This trend supports the conclusion that the City has continued to be successful in optimizing the WWTF's phosphorus removal processes. Based on the recent historical effluent data that confirms results of a pilot study completed by the City in 2016, the City can reasonably meet an effluent phosphorus concentration of 0.3 mg/L.

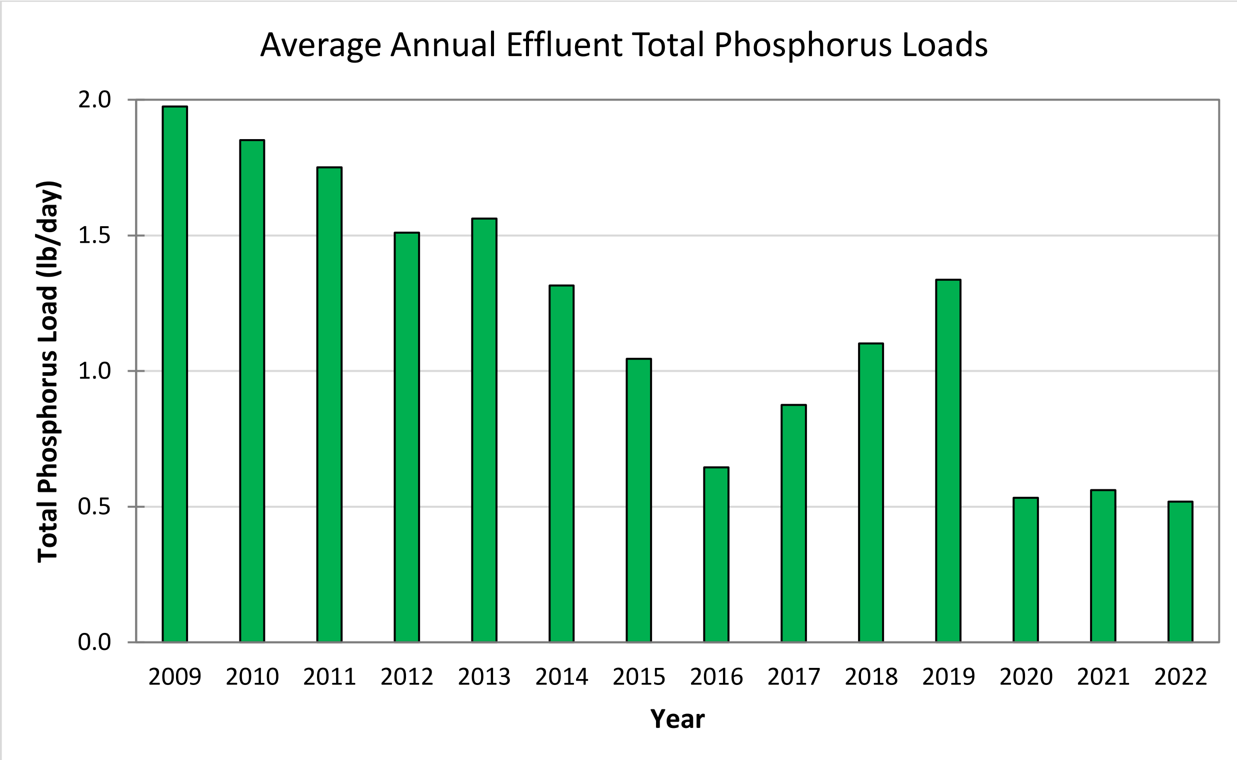

Figure 2-1: Brodhead WWTF average annual effluent total phosphorus loads (2009-2022)

Table 2-2 summarizes the difference in credits generated and credits used during the Village's first permit term of WQT. Overall, the Village generated an average surplus of 201.6 lbs/yr of credit compared to the credits used by the WWTF.

Table 2-2: Comparison of phosphorus credits used vs. generated in Permit Term #1 of WQT

Year	Credits Used (lb/yr)	Credits Generated (lb/yr)	Credits Surplus (lb/yr)
2019[1]	57.7	213.1	155.4
2020	100.4	251.3	150.9
2021	135.3	371.7	236.4
2022	118.8	382.6	263.8
Avg.	**103.1**	**304.7**	**201.6**

[1]Phosphorus credits shown in 2019 include November and December only, as credit generation began at this time.

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. As shown in **Table 2-3**, 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. The population projections utilized in the previous WQT plan match those of the 2013 DOA projections.

The revised population projections consider the new 2020 U.S. Census data collected since the previous WQT plan was developed, as well as the 2013 DOA projections since updated data has yet to be released.

The projected population increase depicted by the DOA from 2010 to 2040 is 262 people (8%), which the maximum population of 3,555 people occurring in 2030. To update the projections, this same percent increase was applied to the 2020 Census population of 3,272 over the same 30-year period to assume linear growth over this time (see Figure 2-2). Therefore, the maximum projected population in 2050 is calculated to be 3,532 people.

Table 2-3: City of Brodhead population projections

Year	Historical Population (U.S. Census)	2013 DOA Projections	Previous WQT Plan Projections	Revised WQT Plan Projections
1970	2,515	-	-	-
1980	3,153	-	-	-
1990	3,165	-	-	-
2000	3,180	-	-	-
2010	3,293	3,293	3,293	-
2015	-	3,325	3,325	-
2020	3,272	3,430	3,430	3,272
2025	-	3,505	3,505	3,315
2030	-	3,555	3,555	3,359
2035	-	3,545	3,545	3,402
2040	-	3,485	3,485	3,446
2045	-	-	-	3,489
2050	-	-	-	3,532

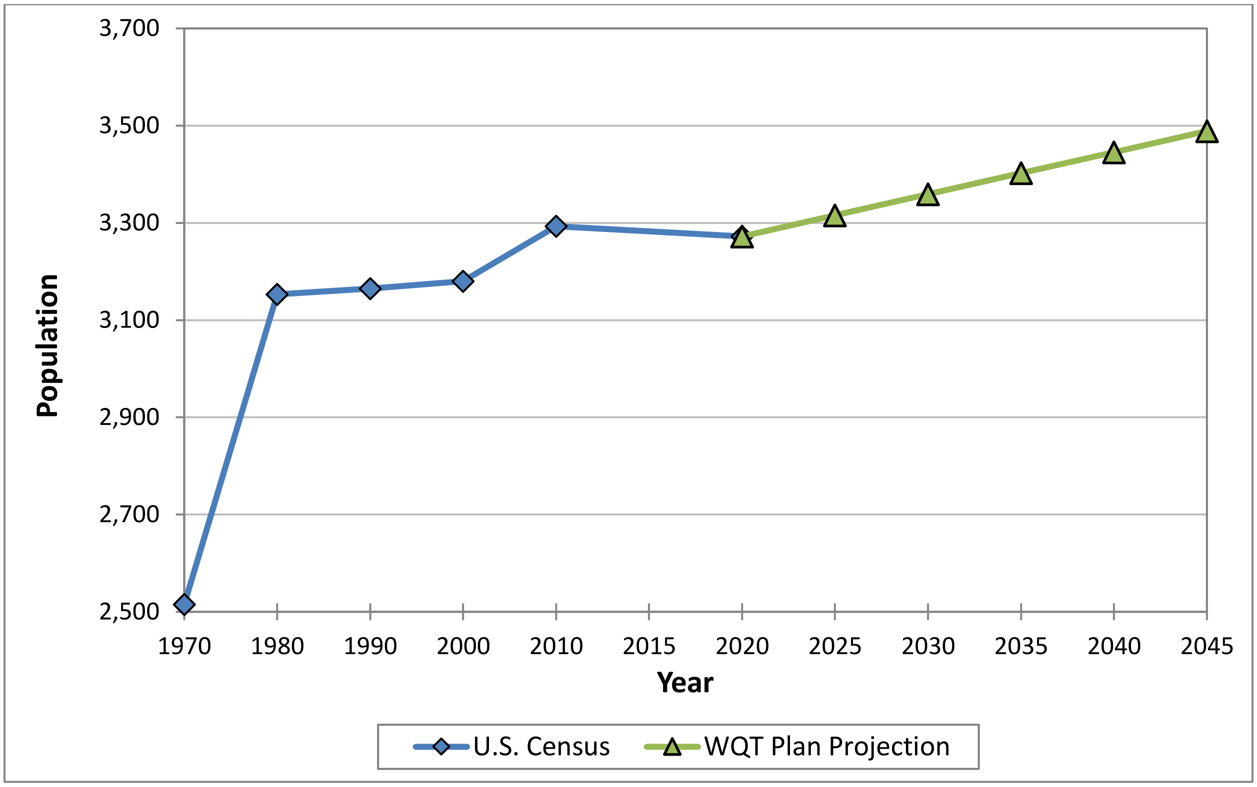

Figure 2-2: City of Brodhead 20-year population projections

2.4 Design Flow Projections

Average annual influent flows for the Brodhead WWTF were estimated for the start of WQT Permit Term #2 in the year 2023 and for maximum design conditions at the end of WQT Permit Term #4 in the year 2042. Design flows were estimated based upon historical influent flow data, population projections, and future development plans. As shown in **Table 2-4** and **Table 2-5**, the projected average annual design flows were estimated using the historical average domestic (residential and commercial) per capita wastewater baseflow of 55 gpcd and the projected population. Population estimates for the year 2023 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 2-4 Brodhead WWTF average annual design flow calculation for start of WQT compliance for Permit Term #2 (2023)

2023 Design Population		3,298
Per Capita Domestic Baseflow (gpcd)	x	55
Domestic Baseflow (gpd)		181,400
Industrial & Public Authority (gpd)	+	12,000
Future Baseflow (without I/I or future industrial growth)		193,400
Average Annual I/I (gpd)	+	86,000
Average Daily Flow (gpd)		279,400
10% Unplanned Industrial Growth (gpd)	+	18,100
Average Annual Design Flow (gpd)		**297,500**

Table 2-5 Brodhead WWTF average annual design flow calculations at design conditions (2042)

2042 Design Population		3,463
Per Capita Domestic Baseflow (gpcd)	x	55
Domestic Baseflow (gpd)		190,500
Industrial & Public Authority (gpd)	+	12,000
Future Baseflow (without I/I or future industrial growth)		202,500
Average Annual I/I (gpd)	+	86,000
Average Daily Flow (gpd)		288,500
10% Unplanned Industrial Growth (gpd)	+	19,100
Average Annual Design Flow (gpd)		**307,600**

As shown **Table 2-4** and **Table 2-5**, the projected average annual design flow for 2023 is approximately 0.298 MGD (298,000 gpd) and for 2042 is approximately 0.308 MGD (308,000 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 for Permit Term #2 and at peak design conditions in 2042.

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 from 2019 through 2022 in Table 2-1, the peak annual effluent flow of 0.401 MGD occurred in 2019. Comparing this with the historical average annual influent flow of 0.366 MGD, a peaking factor of 1.10 can be calculated using **Equation 2-1**. However, these years were noted as being drier than historical years, therefore resulting in a smaller peak flow to average flow ratio and a less conservative safety factor. The City's 2018 WQT Plan utilized a safety factor of 1.25, which is more conservative. Therefore, 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

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

2.5 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 2023 and at maximum design conditions in 2042 were estimated. As shown, it is estimated that 226 lbs credit/year is needed at the start of WQT Permit Term #2 (2023) and 234 lbs credit/year is needed at maximum design conditions (2042). With the implementation of projects in the previous permit term, the City has been exceeding these credit goals since 2020, with 251.3 lbs credit/year being generated in 2020 and a maximum of 382.6 lbs credit/year in 2022.

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:	$\mathrm{TP}_{\mathrm{min}}$	=	minimum phosphorus credits required $\left[\frac{\mathrm{lb}}{\mathrm{year}}\right]$
	$\mathrm{Q}_{\mathrm{avg.}}$	=	projected average annual influent design flow [MGD]
	$\mathrm{C}_{\mathrm{target}}$	=	target effluent phosphorus concentration $\left[\frac{\mathrm{mg}}{\mathrm{L}}\right]$
	$\mathrm{C}_{\mathrm{WQBEL}}$	=	water quality based effluent limit for phosphorus $\left[\frac{\mathrm{mg}}{\mathrm{L}}\right]$
	SF	=	safety factor

Minimum Phosphorus Credits Required at Start of Permit Term #2 WQT Compliance (2023):

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

$$= 0.298\ \mathrm{MGD} \times \left(0.3\,\frac{\mathrm{mg}}{\mathrm{L}} - 0.1\,\frac{\mathrm{mg}}{\mathrm{L}}\right) \times 8.34 \times 365\,\frac{\mathrm{days}}{\mathrm{year}} \times 1.25$$

$$= 226\ \frac{\mathrm{lb}}{\mathrm{year}}$$

Minimum Phosphorus Credits Required at Design Conditions (2042):

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

$$= 0.308\ \text{MGD} \times \left(0.3\frac{\text{mg}}{\text{L}} - 0.1\frac{\text{mg}}{\text{L}}\right) \times 8.34 \times 365\frac{\text{days}}{\text{year}} \times 1.25$$

$$= 234\ \frac{\text{lb}}{\text{year}}$$

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 2-6**. 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 2-6 Projected annual amount of phosphorus credits needed by the City of Brodhead (2023 - 2042)

Permit Term	Year	Projected Population	Projected Flow (MGD)	Phosphorus Credits Needed[1] (lb/year)
#2	2023	3,298	0.298	226
	2024	3,307	0.298	227
	2025	3,315	0.299	227
	2026	3,324	0.299	228
	2027	3,333	0.300	228
#3	2028	3,341	0.300	228
	2029	3,350	0.301	229
	2030	3,359	0.301	229
	2031	3,367	0.302	230
	2032	3,376	0.302	230
#4	2033	3,385	0.303	230
	2034	3,393	0.303	231
	2035	3,402	0.304	231
	2036	3,411	0.304	232
	2037	3,420	0.305	232
#5	2038	3,428	0.306	232
	2039	3,437	0.306	233
	2040	3,446	0.307	233
	2041	3,454	0.307	234
	2042	3,463	0.308	234

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

CHAPTER 3 – WATERSHED INVENTORY

3.1 ESTABLISHMENT OF THE FINAL WATER QUALITY TRADING ACTION AREA

In the original WQT plan, the City and MSA determined that the final action area of the WQT Plan would include the Searles Creek (HUC 070900040403) and the Decatur Lake & Sugar Creek (HUC 070900040605) subwatersheds. Projects were completed in both subwatersheds during the initial permit term. 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 3-1**. 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:

3.1.1 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.

3.1.2 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.

3.1.3 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.

3.1.4 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 **Figures 3-2a, 3-2b** and **Figures 3-3a, 3-3b**. These figures were created to help identify areas of the action area which might be prone to runoff and erosion. **Figures 3-2a** and **3-2b** are topographic maps of the subwatersheds within the action area which depict the steep ridgelines that define and separate the Searles Creek and Decatur Lake & Sugar Creek subwatersheds. Land use for the subwatersheds included in the action area is depicted in **Figures 3-3a** and **3-3b**. As shown, the primary land use in all three subwatersheds is agriculture (e.g. cultivated crops and hay/pasture), especially in the less steep areas of the action area. The maps also depict 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.

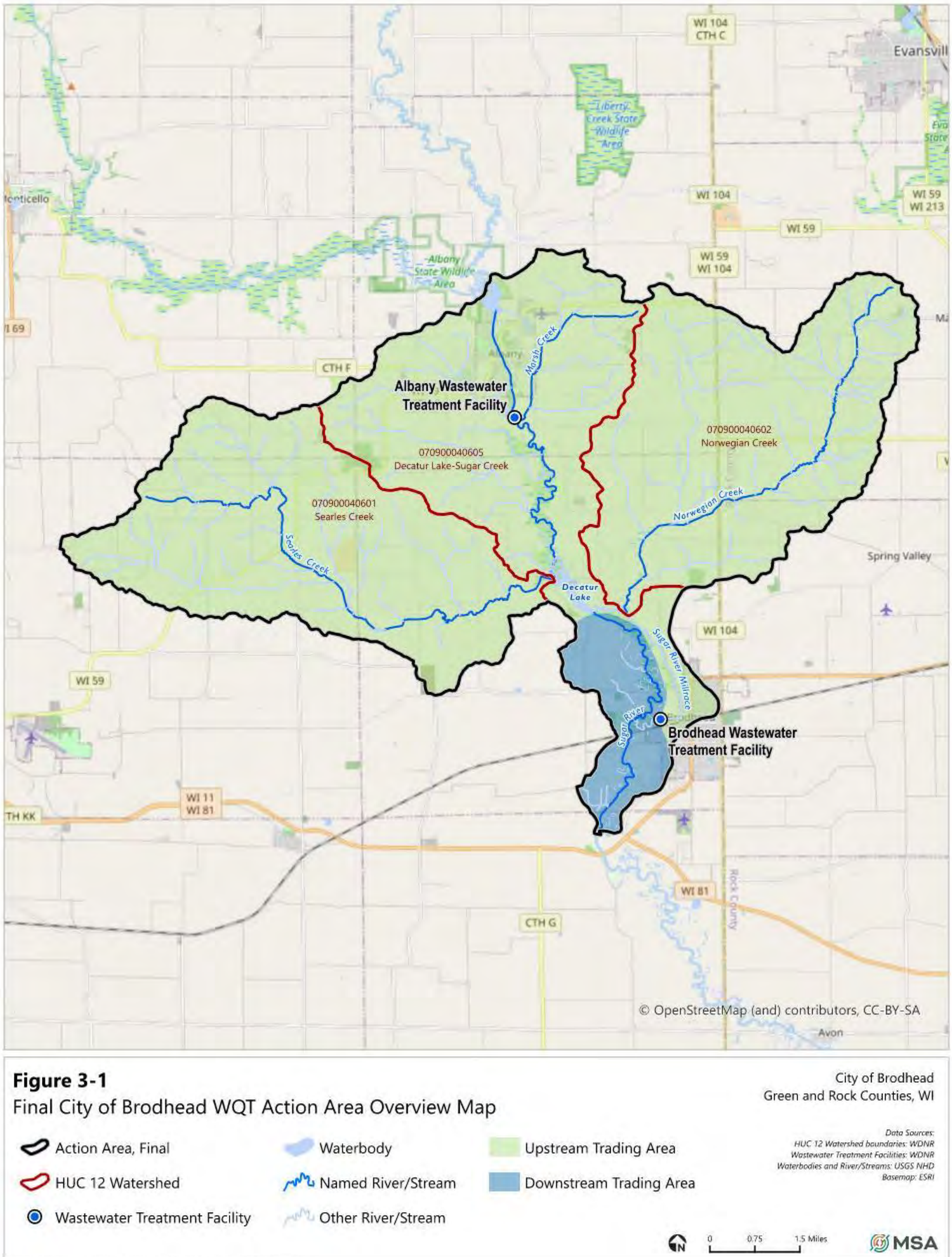

Figure 3-1: Final City of Brodhead WQT Action Area Overview Map

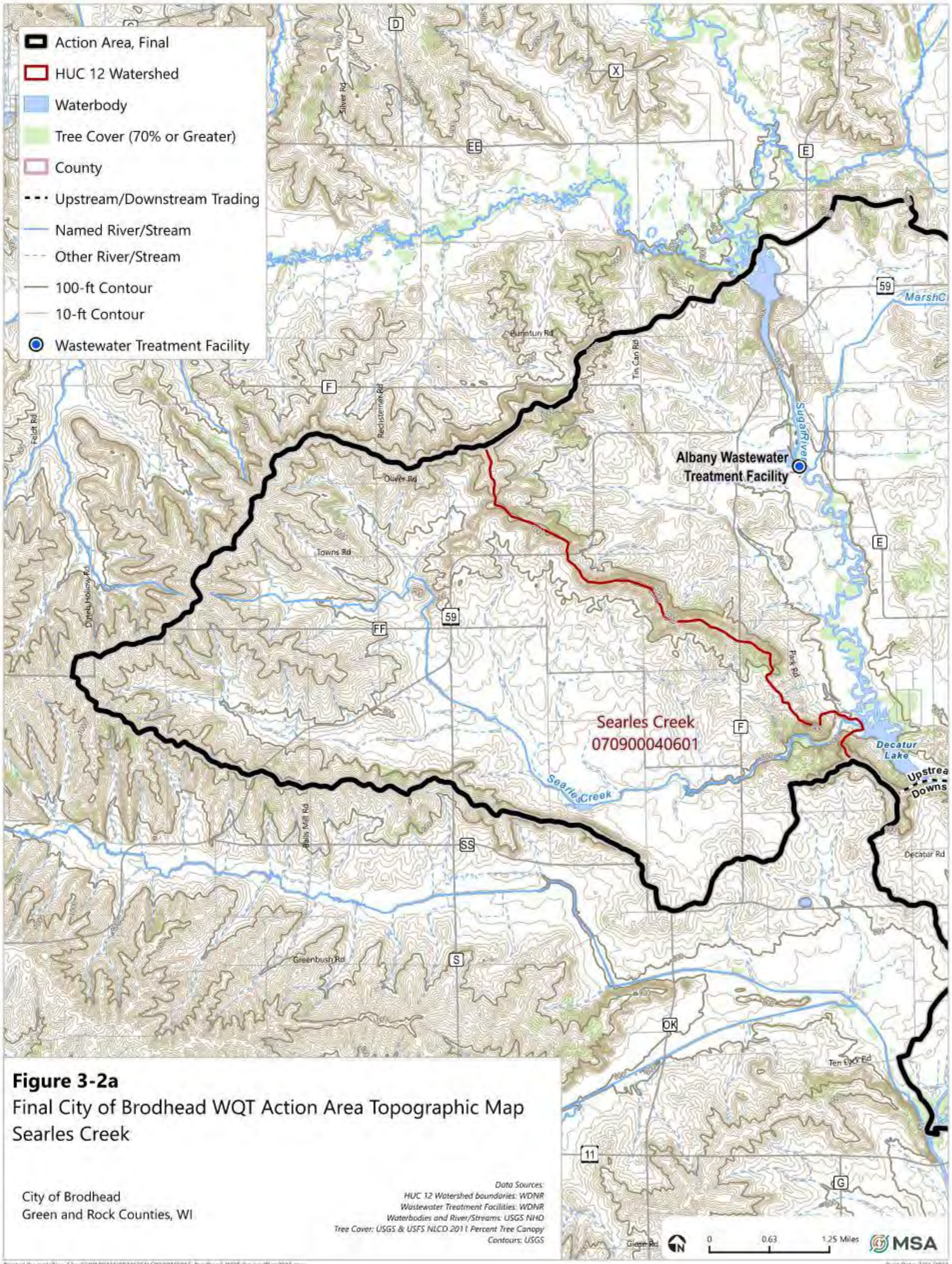

Figure 3-2a: Final City of Brodhead WQT action area topographic map – Searles Creek

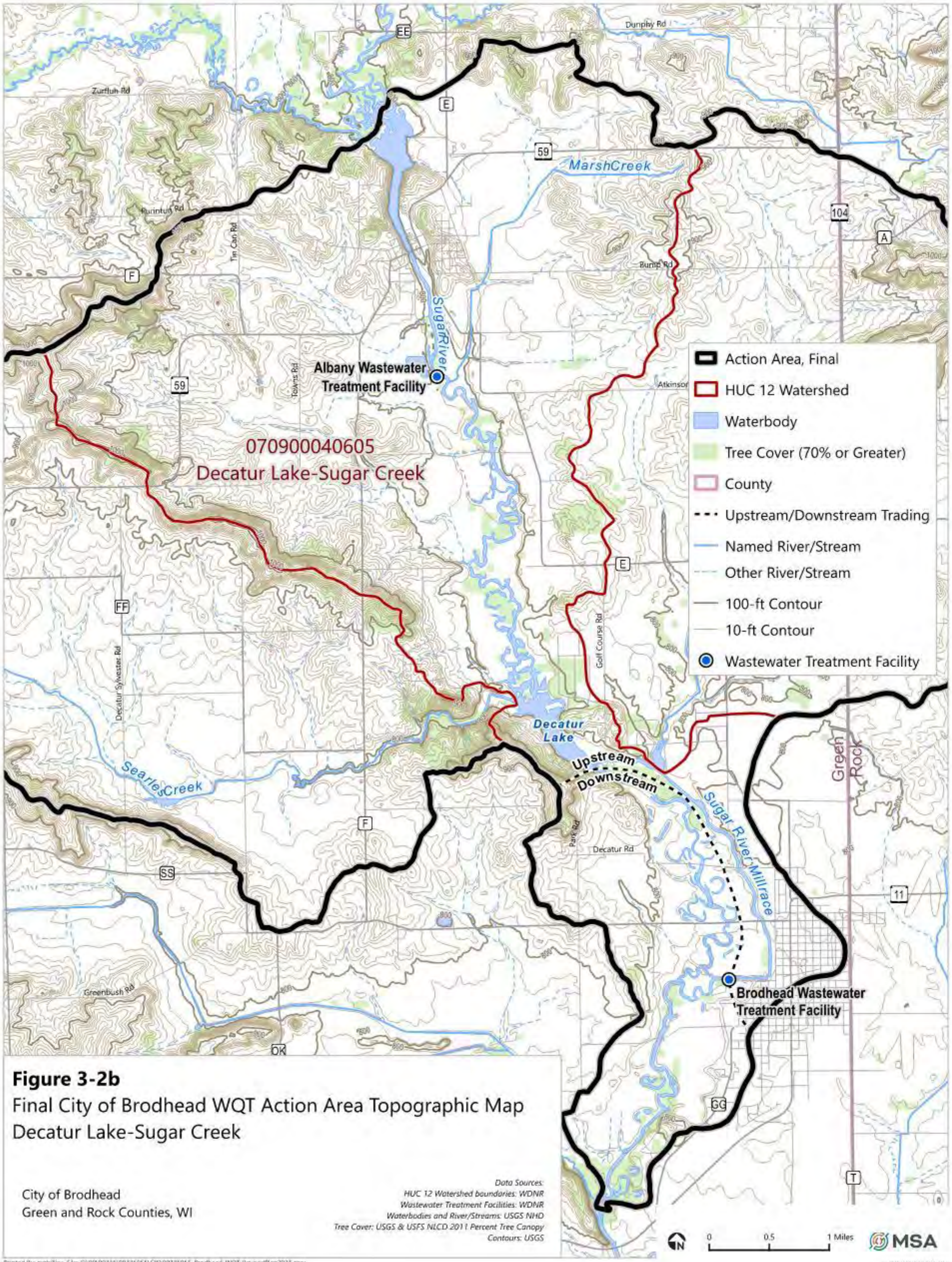

Figure 3-2b: Final City of Brodhead WQT action area topographic map – Decatur Lake-Sugar Creek

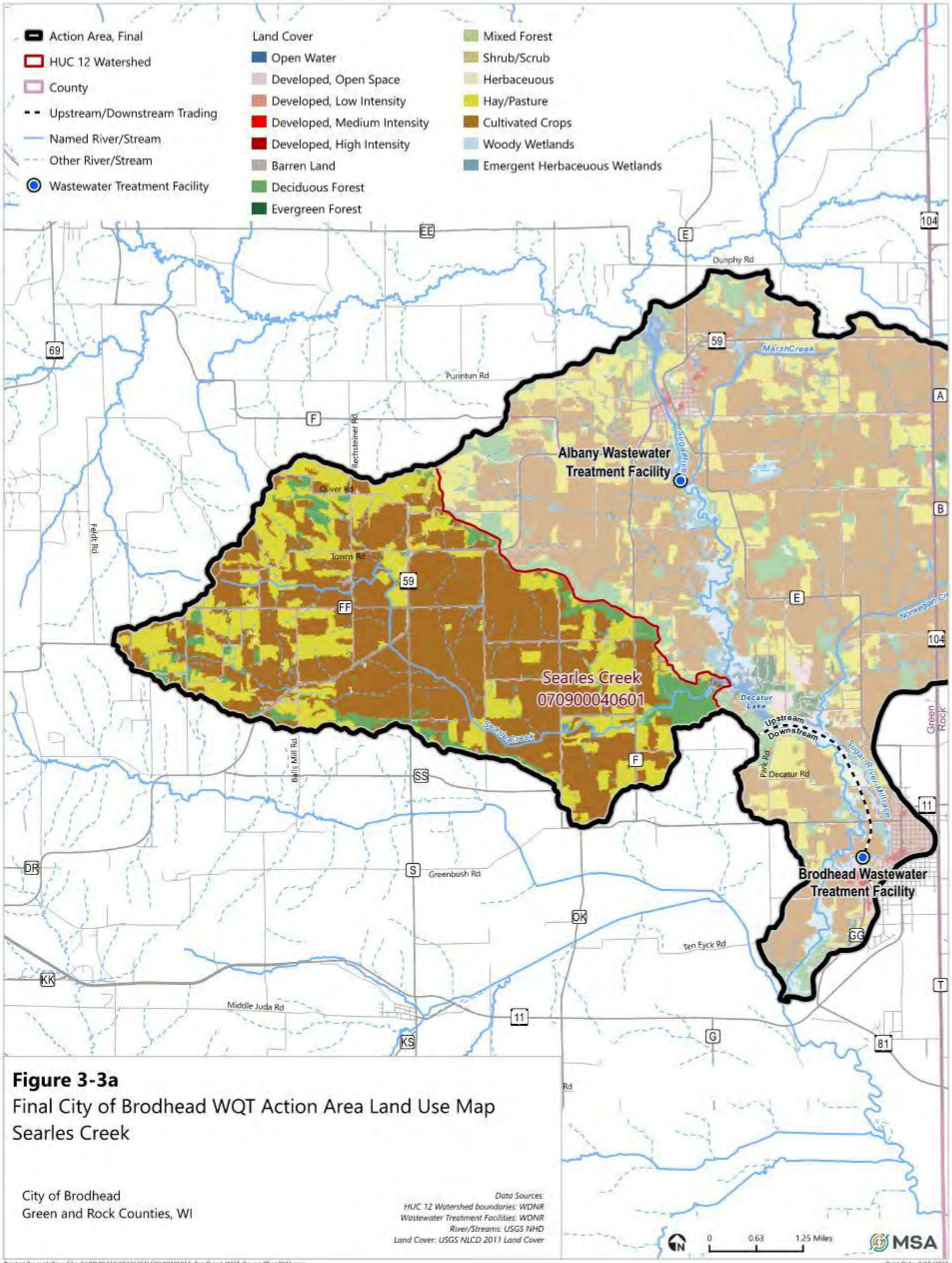

Figure 3-3a: Final City of Brodhead WQT action area land use map – Searles Creek

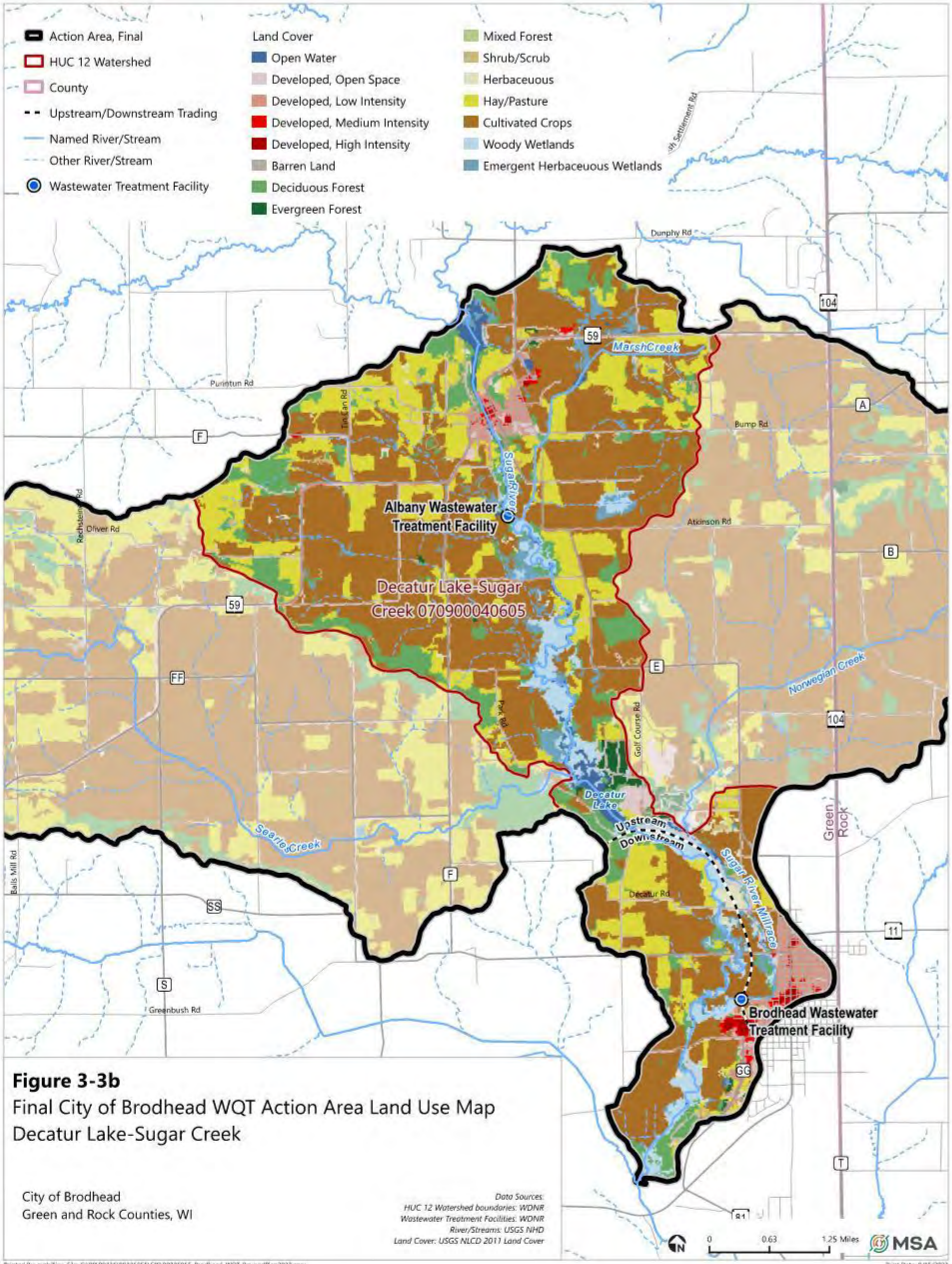

Figure 3-3b: Final City of Brodhead WQT action area land use map – Decatur Lake-Sugar Creek

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 and have been involved 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 continue to 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 continue successfully implementing the WQT Plan. Therefore, it is important to define which groups will be responsible for providing technical assistance, funding, and regulatory oversite for future projects. **Table 4-1** below summarizes the roles and responsibilities of all partners who are anticipated to continue participating 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 is the lead partner in the Water Quality Trading project. All major project-related decisions are made and reviewed by the City. The City provides a significant portion of financial assistance for the project related to technical assistance, BMP implementation, and BMP operational costs. The City works 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 provides technical assistance to the City of Brodhead. Technical assistance includes 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 efforts and is an integral partner in the implementation of the WQT Plan. Green County LWCD provides 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 are reviewed by Green County LWCD. The Green County LWCD is 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.

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 provides regulatory oversight for the WQT Plan. DNR coordinates 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 from the Green County LWCD and Lower Sugar River Watershed Association as provided in the original Brodhead WQT Plan can be found in **Appendix C**.

4.2 TRADE RATIO CALCULATIONS

The effectiveness of all phosphorus trades is 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

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

A detailed description of each factor in **Equation 4-2** can be found in DNR's *Guidance for Implementing Water Quality Trading in WPDES Permits* (2020). 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. Thus, for the purposes of this WQT Plan, **Equation 4-2** can be simplified to only include the delivery factor and uncertainty 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 (refer to **Figure 3-1**), 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 can be calculated by comparing the delivery fraction for the specific SPARROW catchment for the credit generator and the credit user (see **Equation 4-5**).

Equation 4-5

$$\text{SPARROW Delivery Fraction} = 1 - \left(\frac{\text{Credit User Del. Fraction} - \text{Generator Del. Fraction}}{\text{Credit User Del. Fraction}}\right)$$

Figures 4-1a, 4-1b, and 4-1c display the SPARROW model catchment delivery fraction values and compare them to the location of the existing HUC 12 boundaries within the WQT Action Area. The existing and potential project locations are also included in the figures to determine the individual credit generator delivery fractions. As shown, the delivery fraction for the credit user (Brodhead WWTF) is 0.97. Using **Equation 4-4** and **4-5** the delivery factor for each project location in the WQT Action Area were calculated. **Table 4-2** summarizes the delivery factors for all previous and potential trade locations in the Brodhead WQT action area (refer to **Figure 3-1**).

The SPARROW delivery fraction results for the eastern portion of Landowner A and all of the Landowner B contributing areas upstream of the WWTF in the Searles Creek subwatershed are both 1.00. Using Equation 4-4, this results in a calculated delivery factor of 0.00. The western portion of Landowner A has a SPARROW delivery fraction result of 0.94, resulting in a delivery factor of 0.07. The SPARROW delivery fraction result for the Landowner C contributing areas upstream of Decatur Lake in the Decatur Lake & Sugar Creek subwatershed is 0.94, resulting in a delivery factor of 0.07.

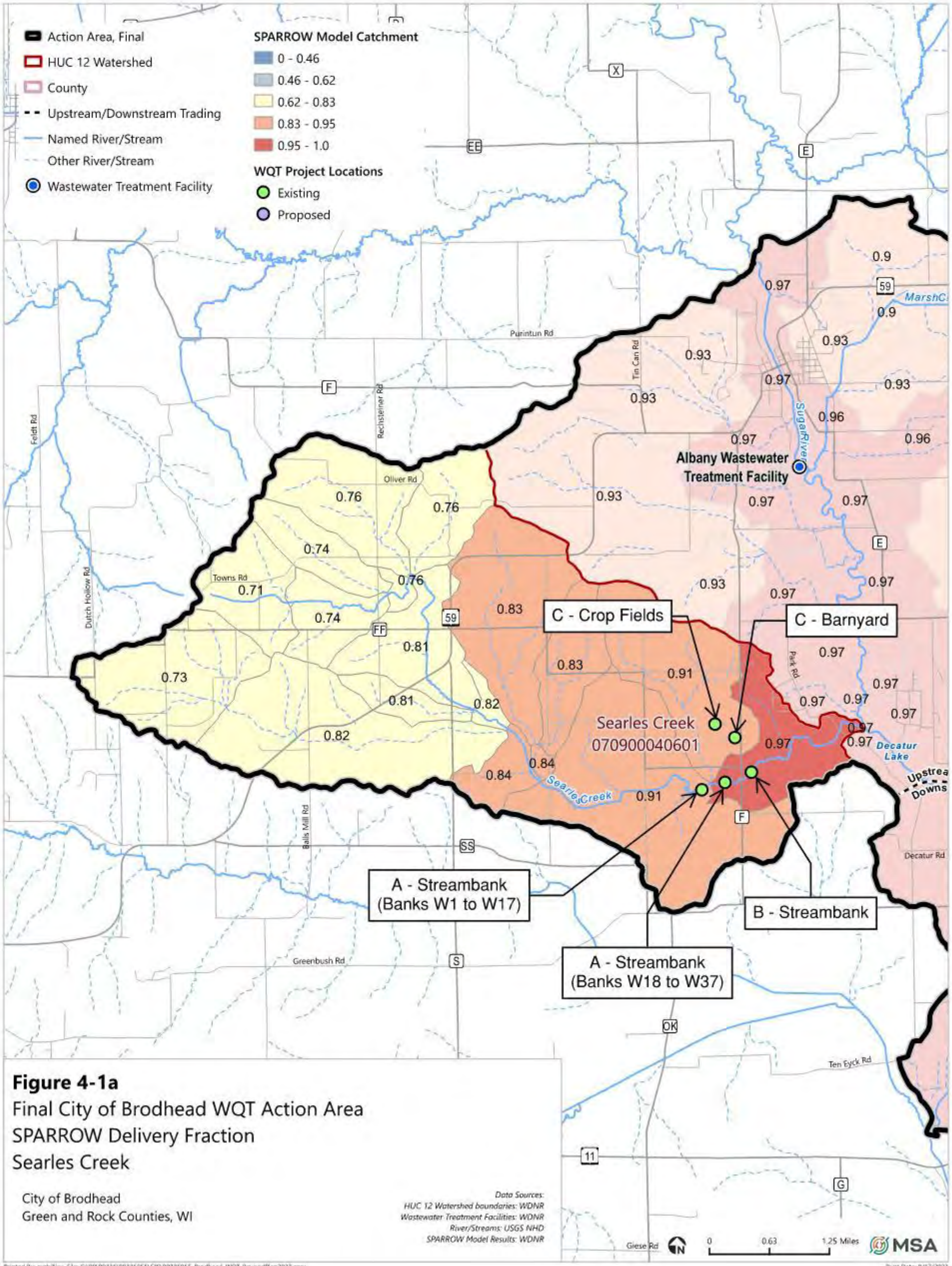

Figure 4-1a: SPARROW Delivery Fraction Values for Searles Creek Subwatershed

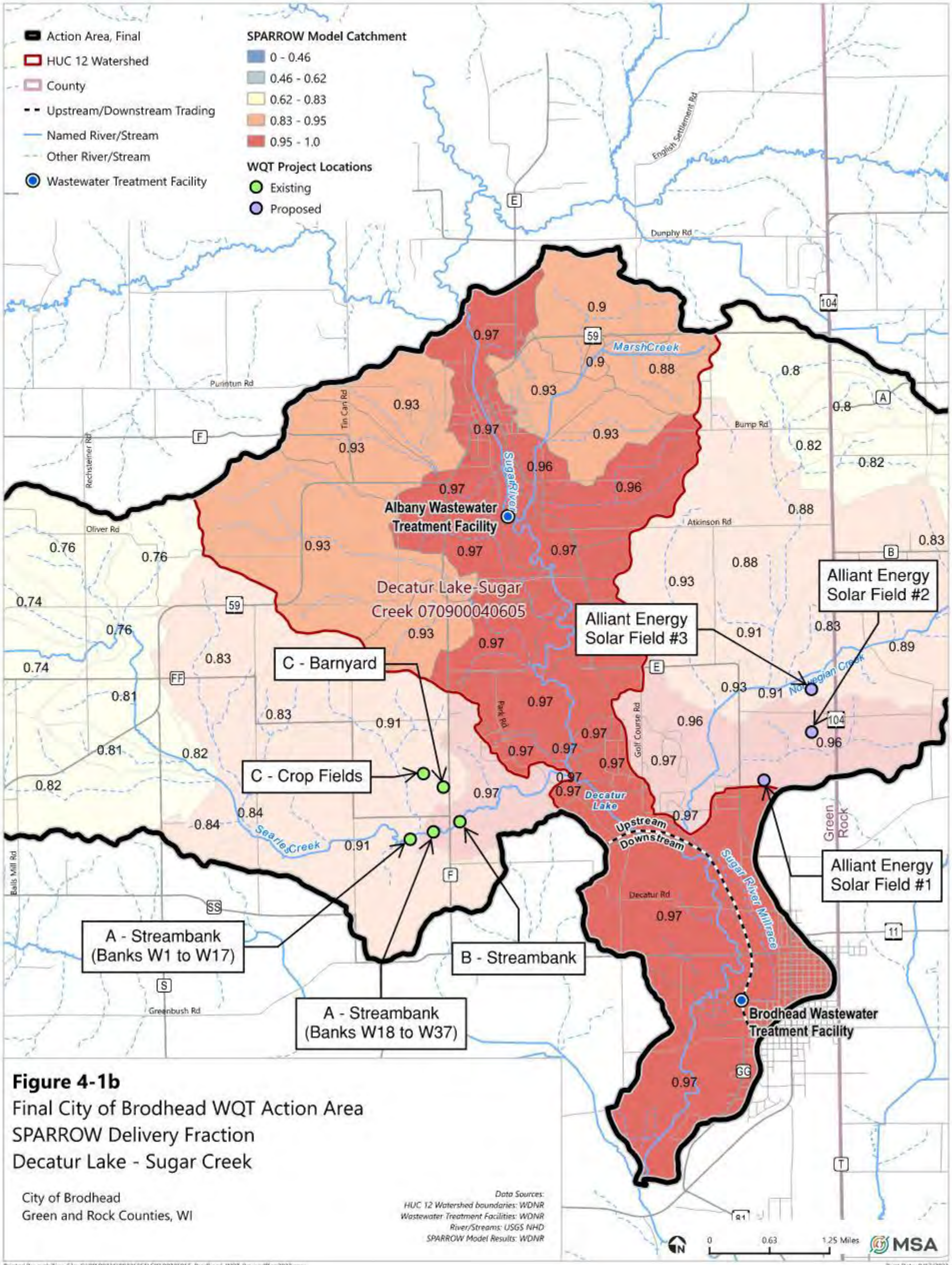

Figure 4-1b: SPARROW Delivery Fraction Values for Decatur Lake-Sugar Creek Subwatershed

Table 4-2 Delivery factors for previous and potential project locations in Brodhead WQT action area

Landowner	HUC 12	Location of Trade	SPARROW Delivery Fraction	Delivery Factor
Landowner A (from Treatment ID W1 – W17)	Searles Creek	Upstream of WWTF	0.94	0.07
Landowner A (from Treatment ID W18 – W37)	Searles Creek	Upstream of WWTF	1.00	0.00
Landowner B	Searles Creek	Upstream of WWTF	1.00	0.00
Landowner C (Farmstead)	Searles Creek	Upstream of Decatur Lake	0.94	0.07
Landowner C (Crop Field Improvements – Fields 3 through 61-62)	Searles Creek	Upstream of Decatur Lake	0.94	0.07

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 H of DNR’s *Guidance for Implementing Water Quality Trading in WPDES Permits* (2020). 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
Whole Field Management	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	4.0
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).

4.3 CREDIT THRESHOLDS

As per DNR's *Guidance for Implementing Water Quality Trading in WPDES Permits* (2020), 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. Furthermore, maintaining the completed projects at the Landowner A, B, and C properties will result in continued credit generation into Permit Term #2 of WQT.

4.4 EXISTING PROJECTS

As stated in Section 4.2, the City plans to continue generating credits from the completed projects at the properties of Landowner A, Landowner B, and Landowner C. This section briefly describes each project site, management practices which have been implemented by each landowner, and the number of credits which are estimated to be generated continuing into Permit Term #2. 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 were designed and have been maintained according to NRCS standards and design plans for all proposed practices were 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 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. Prior to completion of the BMP implementation project, streambanks along the site were 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 was 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 signified that streambank erosion was a major environmental resource concern for the site. The restoration of these areas of concern was completed in 2020.

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 with the locations of constructed BMPs is shown in **Figure 4-2**.

Completed BMPs:

BMPs which were 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
    - Escape Logs (Basking Logs)

Design Life:

10 to 20 years (with proper maintenance)

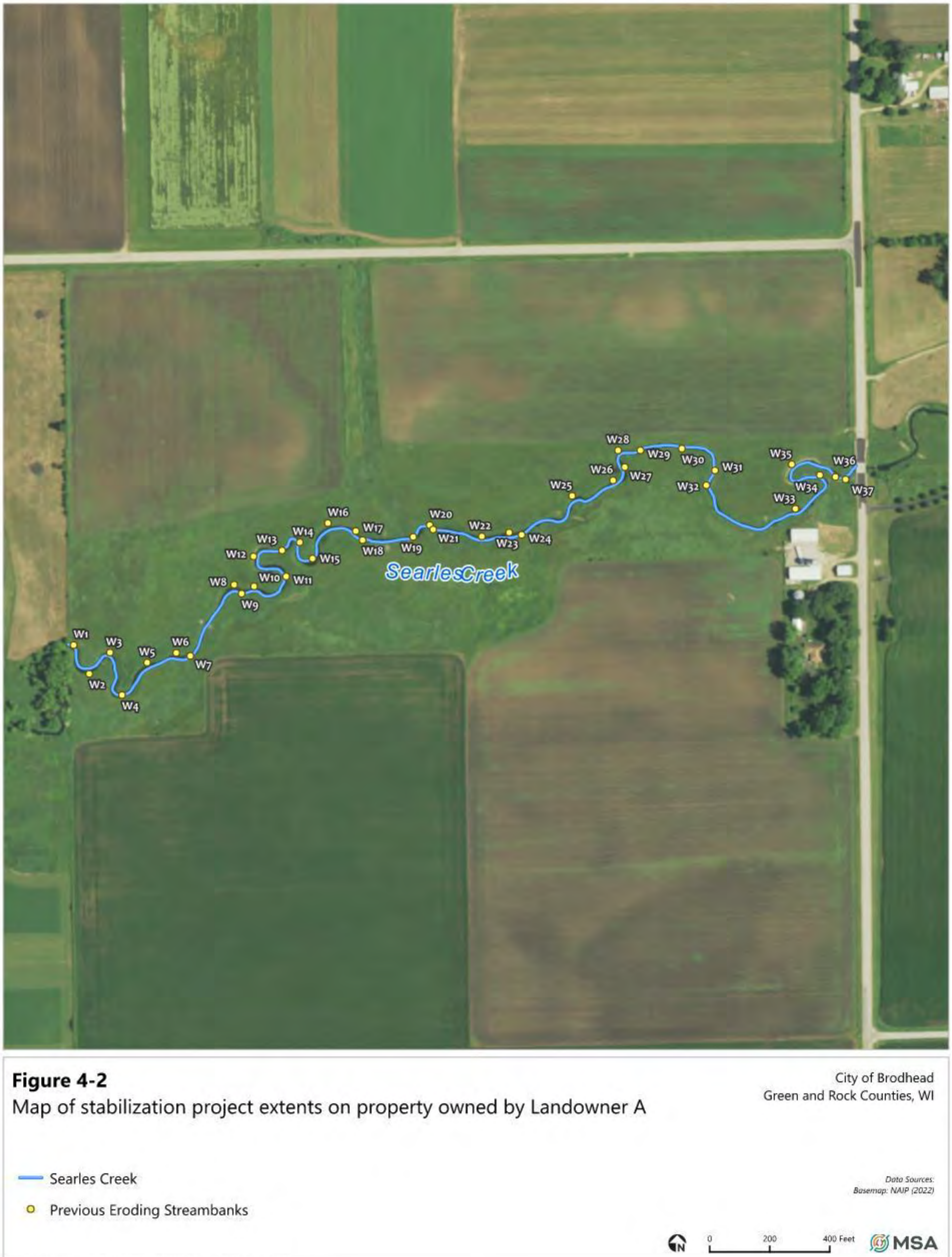

Figure 4-2: Map of constructed BMPs on property owned by Landowner A

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 Required:

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

Operation & Maintenance Plan:

Items included in the Operation and Maintenance Plan under the Water Quality Trade Agreement between Landowner A and the City of Brodhead are listed below. Implementation of the Operation and Maintenance Plan for Landowner A has been shared by the landowner and the City, 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.

2. Repair or replace any damaged or missing revetments.

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

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

5. Repair any vandalism.

6. Repair any vehicle or horse/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 due to normal use or severe floods.

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 (fenced) area of the streambank. Three to four inches of plant residue will remain at all times during the grazing season. Horses or 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. If any major changes are planned regarding the type of vegetation to be grown in the buffer area of the stream, the City and Landowner A will cooperate in good faith to maintain the intent and conditions of the Agreement.

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

5. Fences shall be maintained to prevent unauthorized human, horse, or livestock access to the stream.

6. Cash crops and row crops will not be allowed to be planted in or harvested from the buffer area.

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 in 2020. **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 generated for the site. Phosphorus credit calculations have been revised to reflect updated trade ratios and to represent the banks where BMPs were installed during construction. 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:

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

$\text{Delivery Factor (from Treatment ID W1 through W17)} = 0.07$

$\text{Delivery Factor (from Treatment ID W18 through W37)} = 0.00$ (See **Table 4-2** for Landowner A)

$\text{Uncertainty Factor} = 3.00$ (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)

$$\text{Trade Ratio (for Bank ID W1 through W17)} = 0.07 + 3.00 = 3.07$$

$$\text{Trade Ratio (for Bank ID W18 through W37)} = 0.00 + 3.00 = 3.00$$

Credit Calculations:

From Treatment ID W1 through W17:

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

$$= \frac{227.7\ \frac{\text{lb}}{\text{yr}}}{3.07}$$

$$= 74.2\ \frac{\text{lb}}{\text{yr}}$$

From Treatment ID W18 through W37:

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

$$= \frac{188.9\ \frac{\text{lb}}{\text{yr}}}{3.00}$$

$$= 63.0\ \frac{\text{lb}}{\text{yr}}$$

$$\text{Total Phosphorus Credits} = W1\ through\ W17\ Credits\ + W18\ through\ W37\ Credits$$

$$= 74.2\ \frac{lb}{yr} + 63.0\ \frac{lb}{yr}$$

$$= 137.2\ \frac{lb}{yr}$$

Maintenance and Repairs:

Through annual inspections completed by MSA in Permit Term #1, maintenance and repair items have been noted for the City to evaluate completing in the future. These items on the Landowner A site are as follows:

- One bank between streambanks W33 and W34 (RBFD) which was not an originally repaired bank treatment site has been identified as eroding in recent years (see **Figures 4-3 and 4-4**).

- Two logs (one near W16 and one between W21 and W22) are in the stream channel and are recommended for removal to prevent flow capacity issues (see **Figures 4-5 and 4-6**).

- The gate and fence posts on the west side of the property are beginning to lean and are preventing proper closure of the gate. It is recommended that the posts are repaired and H-braces are installed on all wooden posts to add support (see **Figures 4-7 and 4-8**).

The City will continue to monitor the status of these areas annually and provide an update in the annual inspection reports. The areas do not yet appear to have reached the point of needing immediate repair.

Figure 4-3: Photograph of eroding streambank between banks W33 and W34 (RBFD) taken on May 26, 2023

Figure 4-4: Photograph of eroding streambank between banks W33 and W34 (RBFD) taken on November 20, 2023

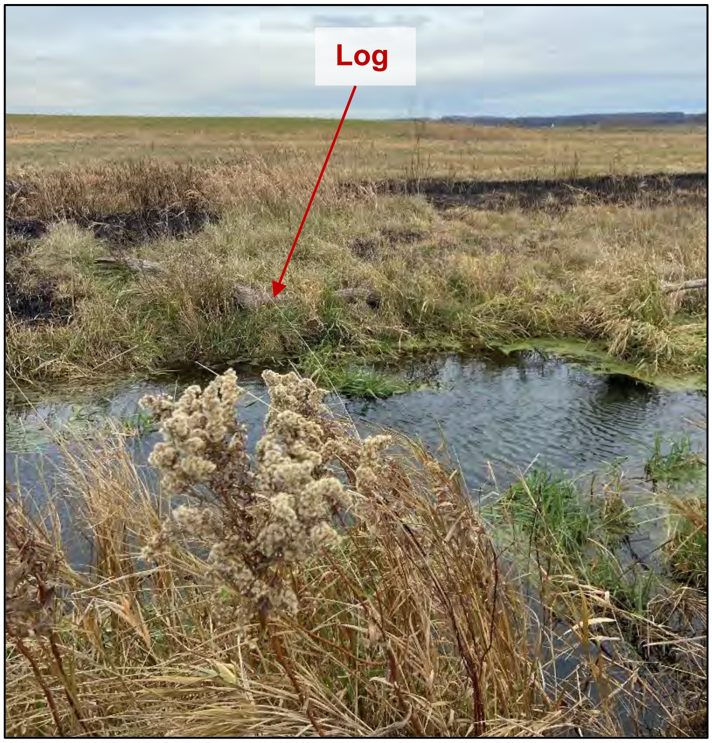

Figure 4-5: Photograph of log in stream near bank W16 taken on November 20, 2023

Figure 4-6: Photograph of log in stream between banks W21 and W22 taken on November 20, 2023

Figure 4-7: Photograph of leaning gate posts on west side of property taken on November 20, 2023

Figure 4-8: Photograph of leaning fence posts on west side of property taken on November 20, 2023

Costs:

The estimated costs for the City to maintain the Landowner A project are shown in **Table 4-4**. There are no capital costs to the previous implementation of the project in Permit Term #1. Annual operation and maintenance costs include annual repair funds to facilitate the maintenance and repair of BMPs in the future.

Table 4-4: City's estimated Costs for Landowner A into WQT Permit Term #2

Capital Costs	Annual O&M Costs	15-year Present Worth
$0	$16,000	$197,000

Landowner B

History of Project Site:

The 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. Prior to completion of the BMP implementation project, streambanks along the site were actively eroding due to unstable banks. A few areas of localized erosion from horse crossings were present. Many large trees had fallen in the stream and caused additional erosion. Bare eroding banks, slumps and slips, vegetative overhang, exposed tree roots, and exposed fence posts were all present on the site, indicating that erosion was a major environmental resource concern. The restoration of these areas of concern was completed in 2020.

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 with the locations of constructed BMPs is shown in **Figure 4-9**.

Completed BMPs:

BMPs which were 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)
    - Escape Logs (Basking Logs)
    - Backwater Wetlands

Design Life:

10 to 20 years (with proper maintenance)

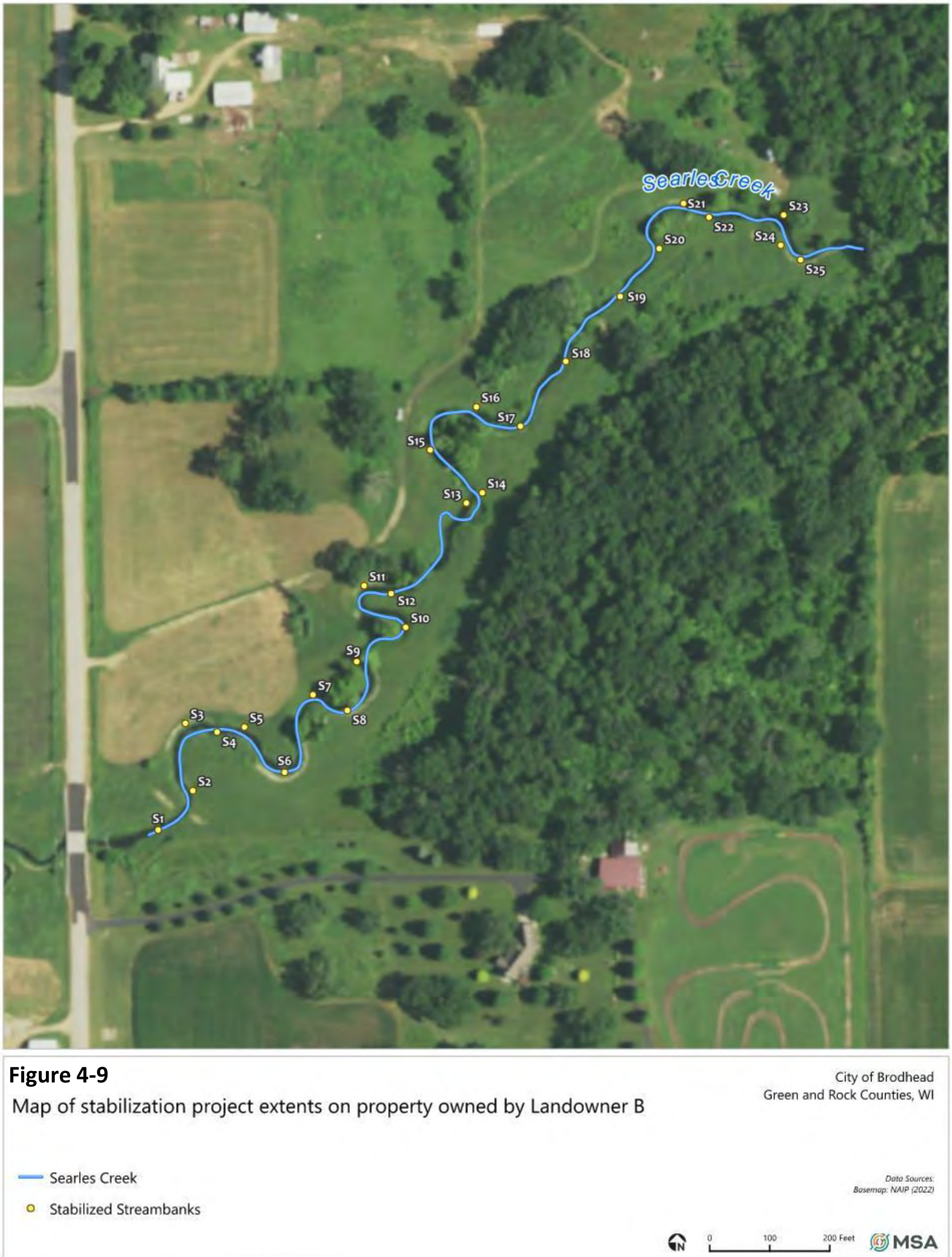

Figure 4-9: Map of constructed BMPs on property owned by Landowner B

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 Required:

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

Operation & Maintenance Plan:

Items included in the Operation and Maintenance Plan under the Water Quality Trade Agreement between Landowner B and the City of Brodhead are listed below. Implementation of the Operation and Maintenance Plan for Landowner B has been shared by the landowner and the City, 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.

2. Repair or replace any damaged or missing revetments.

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

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

5. 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 horse/livestock and vehicle usage to periods that minimize damage.

4. Periodically replace horse/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 (fenced) area of the streambank. Three to four inches of plant residue will remain at all times during the grazing season. Horses or livestock will not be placed into paddocks within the buffer area 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.

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 in 2020. **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 generated for the site. Phosphorus credit calculations have been revised to reflect updated trade ratios and to include the banks where BMPs were installed during construction. Detailed modeling procedures are provided in **Appendix D**.

Equation 4-5:

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

Where:

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

Trade Ratios Calculations:

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

$\text{Delivery Factor} = 0.00$ (see **Table 4-2** for Landowner B)

$\text{Uncertainty Factor} = 3.00$ (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)

$$\text{Trade Ratio} = 0.00 + 3.00 = 3.00$$

Credit Calculations:

From Treatment ID S1 through S26:

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

$$= \frac{294.9\ \frac{\text{lb}}{\text{yr}}}{3.00}$$

$$= 98.3\ \frac{\text{lb}}{\text{yr}}$$

Maintenance and Repairs:

Through annual inspections completed by MSA in Permit Term #1, maintenance and repair items have been noted for the City to evaluate completing in the future. These items on the Landowner B site are as follows:

- One bank between streambanks S8 and S9 (LBFD) which was not an originally repaired bank treatment site has been identified as eroding in recent years (see **Figure 4-10**).
- One bank between streambanks S10 and S11 (LBFD) which was not an originally repaired bank treatment site has been identified as eroding in recent years (see **Figure 4-11**).
- One bank between streambanks S14 and S15 (LBFD) near the walking bridge which was not an originally repaired bank treatment site has been identified as eroding in recent years (see **Figure 4-12**).
- One bank between streambanks S15 and S16 (RBFD) which was not an originally repaired bank treatment site has been identified as eroding in recent years (see **Figure 4-13**).

- One bank between streambanks S19 and S20 (RBFD) which was not an originally repaired bank treatment site has been identified as eroding in recent years (see **Figure 4-14**).

- One bank between streambank S22 and crossing C8 (RBFD) which was not an originally repaired bank treatment site has been identified as eroding in recent years (see **Figure 4-15**).

- Three logs/fallen trees (near S14, S15, and S18) are in the stream channel and are recommended for removal to prevent flow capacity issues (see **Figures 4-16 through 4-18**).

The City will continue to monitor the status of these areas annually and provide an update in the annual inspection reports. The areas do not yet appear to have reached the point of needing immediate repair.

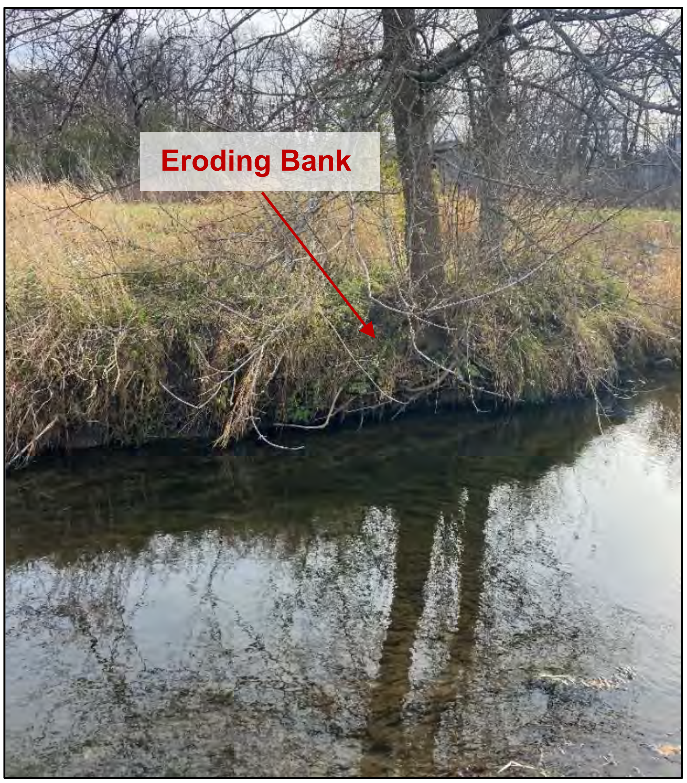

Figure 4-10: Photograph of eroding streambank between banks S8 and S9 (LBFD) taken on November 20, 2023

Figure 4-11: Photograph of eroding streambank between banks S10 and S11 (LBFD) taken on November 20, 2023

Figure 4-12: Photograph of eroding streambank between banks S14 and S15 (LBFD) taken on November 20, 2023

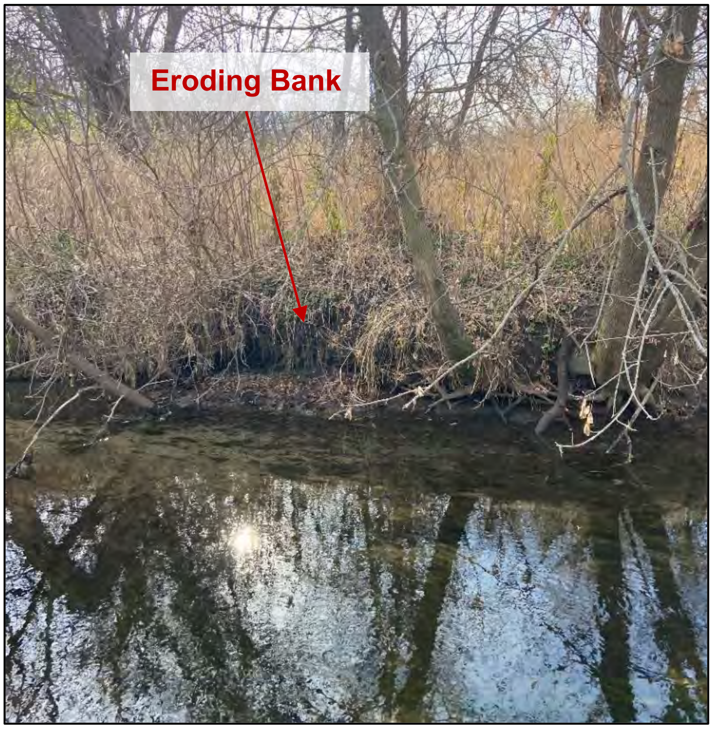

Figure 4-13: Photograph of eroding streambank between banks S15 and S16 (RBFD) taken on November 20, 2023

Figure 4-14: Photograph of eroding streambank between banks S19 and S20 (RBFD) taken on November 20, 2023

Figure 4-15: Photograph of eroding streambank between bank S22 and crossing C8 (RBFD) taken on November 20, 2023

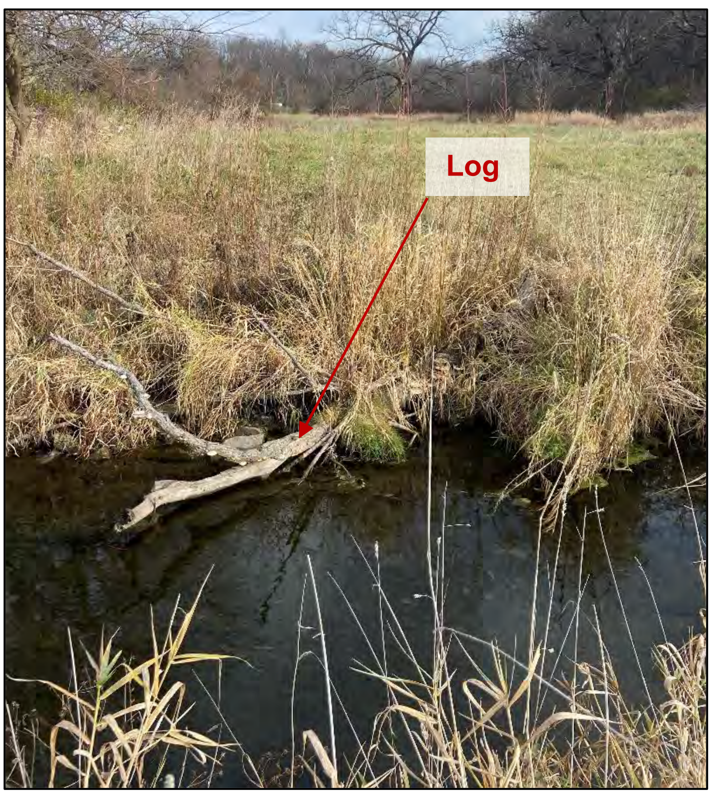

Figure 4-16: Photograph of log in stream near bank S14 taken on November 20, 2023

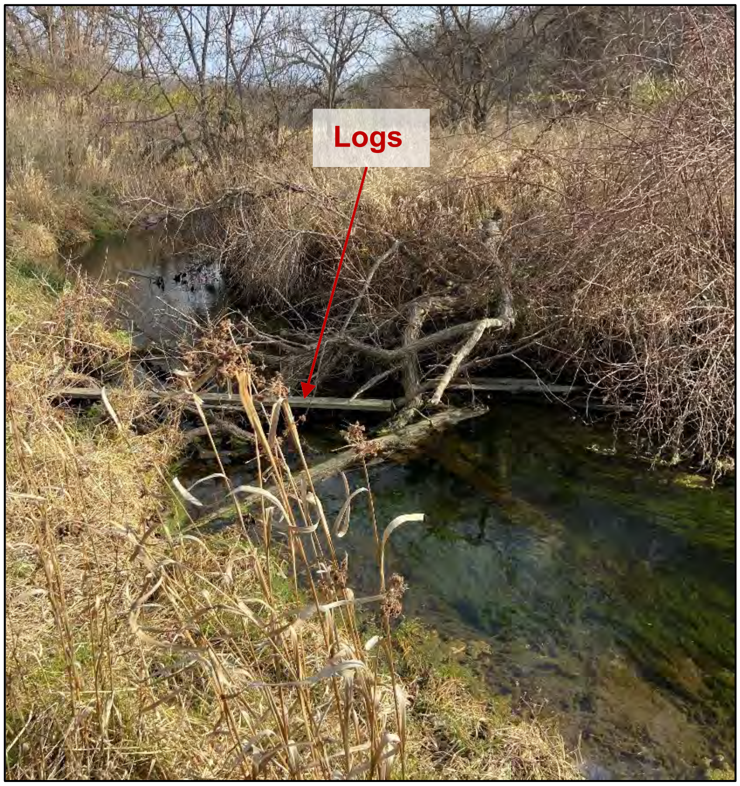

Figure 4-17: Photograph of logs in stream near bank S15 taken on November 20, 2023

Figure 4-18: Photograph of fallen tree in stream near bank S18 taken on November 20, 2023

Costs:

The estimated costs for the City to maintain the Landowner B project are shown in **Table 4-5**. There are no capital costs to the previous implementation of the project in Permit Term #1. Annual operation and maintenance costs include annual repair funds to facilitate the maintenance and repair of BMPs in the future.

Table 4-5: City's estimated Costs for Landowner B into WQT Permit Term #2

Capital Costs	Annual O&M Costs	15-year Present Worth
$0	$12,000	$147,000

Landowner C

History of Project Site:

The site includes the animal production area of a small dairy operation and crop fields owned and operated by the landowner. Prior to the completion of the BMP construction project, the animal production area of the farm included four (4) outdoor barnyards, each with environmental resource concerns. The existing barnyards lacked roof gutters to divert clean water and appropriate infrastructure to collect or treat the runoff and manure which had been previously discharged offsite. Runoff from the animal production area had left the farmstead as erosive concentrated flow. Nutrient management was another major concern for this site. Prior to the BMP construction project, the farm had recently expanded, but the farm lacked long-term waste storage. The lack of long-term storage 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 installation of a new 180-day waste storage facility, installation of roof gutters and roof cover to capture and transfer manure and runoff, abandonment of one outdoor lot, and partial abandonment of another outdoor lot were completed in 2020 as part of the construction project to remediate these issues.

The landowner owns approximately 70 acres of cropland, as well as rents and operates additional acreage. Some manure stored in the new waste storage facility is applied to the fields owned by Landowner C.

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. Maps of the farmstead and barnyards are shown before and after construction of the project are shown in **Figure 4-19** and **Figure 4-20**, respectively.

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 crop fields that Landowner C owns that are included in Landowner's nutrient management plan (NMP). A map of these crop fields is shown in **Figure 4-21**. The nutrient management practices for the fields were registered with DNR as generating credits starting in 2021. Landowner C does rent other cropland not included in **Table 4-6**; however, these fields are not listed because they are not all currently included under the Landowner's NMP. Through the agreement between Landowner C and the City of Brodhead, the process of including all rental fields under a nutrient management plan is ongoing. Most of the rental fields that the landowner has explicit control of cropping practices are not located within eligible watersheds for the WQT plan. Because of the location of rented fields, phosphorus credits are currently only being generated on the fields which Landowner C owns. Landowner C continues to implement and update their nutrient management plan that was originally developed in 2018.

Figure 4-19: Map of barnyards operated by Landowner C before construction

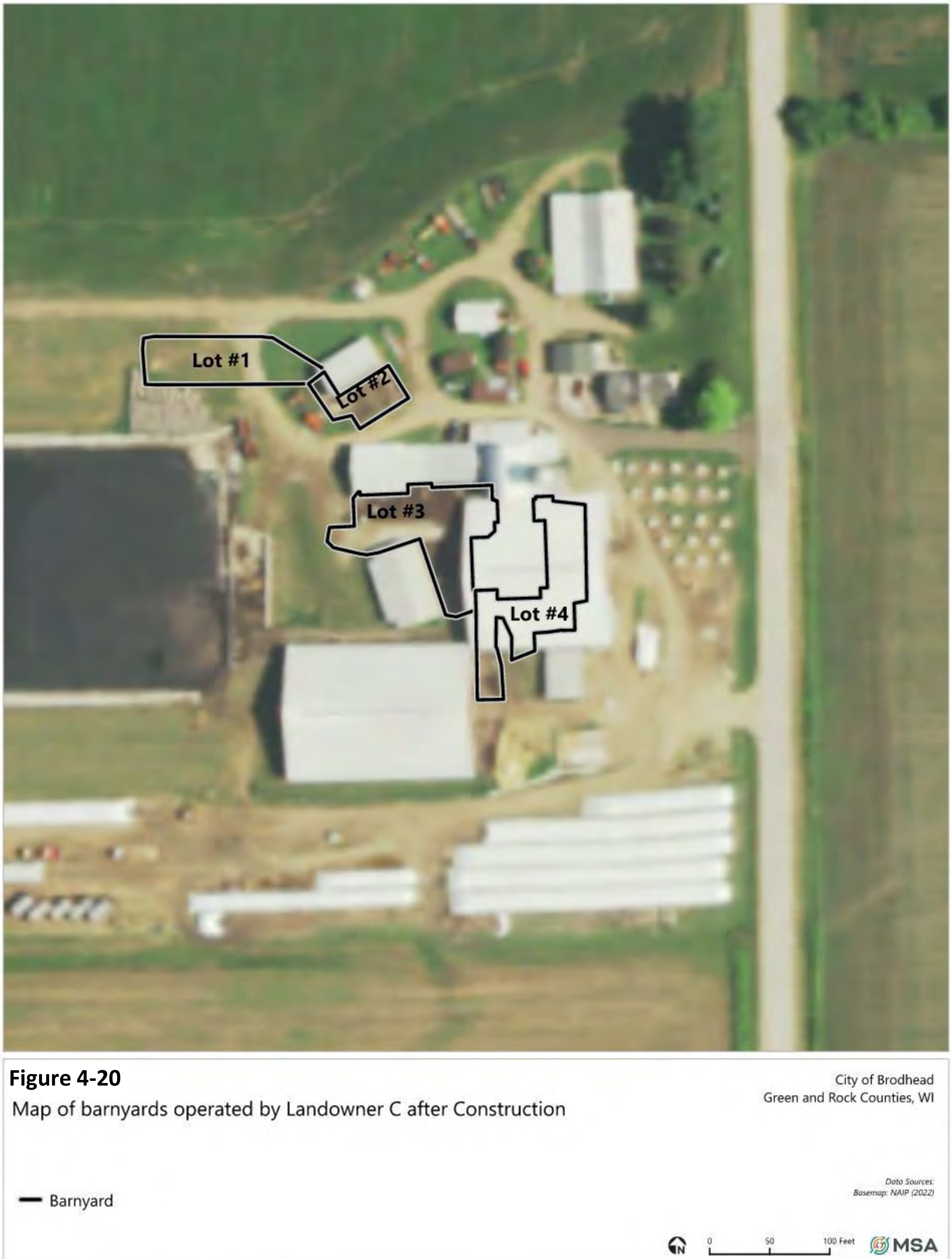

Figure 4-20: Map of barnyards operated by Landowner C after 2020 construction

Table 4-6: List of all crop fields Landowner C owns

Field ID	Acreage	HUC 12 Watershed	Management
3	14.45	Searles Creek	Owned
5	5.15	Searles Creek	Owned
7.8	7.05	Searles Creek	Owned
30	2.75	Searles Creek	Owned
31	2.31	Searles Creek	Owned
32.33	5.83	Searles Creek	Owned
36	3.42	Searles Creek	Owned
38	5.84	Searles Creek	Owned
40	6.29	Searles Creek	Owned
41	5.57	Searles Creek	Owned
43	2.79	Searles Creek	Owned
45	3.08	Searles Creek	Owned
47	3.34	Searles Creek	Owned
61-62	1.91	Searles Creek	Owned
Total	**69.78**		

Figure 4-21: Map of crop fields 3 through 61-62 owned by Landowner C

Completed BMPs:

BMPs which have been 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.

BMP 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 Required:

The project required 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 was 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 was also required.

Operation & Maintenance Plan:

Items included in the Operation and Maintenance Plan under the Water Quality Trade Agreement between Landowner C and the City of Brodhead are listed below. Implementation of the Operation and Maintenance Plan for Landowner C has been shared by the landowner and the City, 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 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.

BMP Modeling Procedures:

Barnyard Improvements
Baseline and proposed barnyard conditions were modeled using the DNR's BARNY model in the previous WQT plan. A detailed description of the modeling procedures and input and output data completed at that time can be found in the City's 2018 WQT Plan, as well as **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. The implemented barnyard improvements include abandonment, revegetation, and placing of a conservation easement in Lot #1; installation of clean water diversions (roofs and/or roof gutters) for Lot #3 and Lot #4; and installation of waste reception tanks and waste transfer piping for Lot #2, Lot #3, and Lot #4 to transfer manure and runoff to a newly constructed waste storage facility. To meet the conditions of "zero discharge" all roof runoff structures were 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 were 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, is not being collected after the installation of BMPs. Therefore, Lots #1, #2, and #3 are meeting the conditions of "zero discharge" after completion of the project and only a small portion of Lot #4 is going untreated.

Generated credits for each barnyard due to BMP installation during WQT Permit Term #1 are summarized in **Table 4-7**. As shown, a total of 170.3 lb/yr of phosphorus credits were generated by implementing the barnyard management practices.

Table 4-8 summarizes the pre- and post-BMP phosphorus outputs modeled in BARNY from the City's 2018 WQT Plan. With the installation of these barnyard practices during the previous permit term, the phosphorus reduction values remain representative of conditions for WQT Permit Term #2. It is important to note that phosphorus reductions shown in **Table 4-8** 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 it was anticipated that additional phosphorus loss was expected to be prevented (beyond what is stated in **Table 4-8**) 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 that was expected to be removed via runoff collection has not been accounted for in phosphorus credit calculations to provide more conservative estimates of available credits.

Table 4-7: Phosphorus credits generated from barnyard improvements during WQT Permit Term #1

Barnyard ID	P Credits (lb/yr)					Total P Credits (lb/yr)	Constructed BMPs
	2018	2019	2020	2021	2022		
Lot #1	-	-	7.5	19.1	19.1	45.7	Lot abandonment, critical area planting, and conservation easement
Lot #2	-	-	0.3	0.7	0.7	1.7	Reduce lot size, install waste reception tank, and install waste transfer piping
Lot #3	-	-	12.2	31.0	9.8	53.0	Reduce lot size, install roof runoff structures, install waste reception tank, and install waste transfer piping
Lot #4	-	-	11.5	29.2	29.2	69.9	Install roof cover (122’ x 116’), install roof runoff structures, install waste reception tank, and install waste transfer piping
Total	**-**	**-**	**31.5**	**80.0**	**58.8**	**170.3**	**-**

Table 4-8: 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)	Constructed 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**	**-**

Nutrient Management Plan

Phosphorus reductions from improved crop land management practices implemented during WQT Permit Term #1 were estimated using the "P Trade Report" in SnapPlus. Credit calculations based on phosphorus reductions in WQT Permit Term #1 are summarized in **Table 4-9**. The landowner plans to continue implementing a combination of no-till and cover crops to reduce phosphorus losses from crop fields. **Table 4-10** summarizes estimated annual phosphorus loss reductions from the crop fields in the nutrient management plan for an 8-year crop rotation from 2021 to 2028. SnapPlus modeling procedures are described in greater detail in **Appendix F**. Additional years were not simulated since eight years is already well beyond typical soil sampling requirements for nutrient management planning. Thus, the reductions in **Table 4-10** 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 4-10** suggests, continued nutrient management and supporting practices will annually reduce phosphorus losses from all the fields in the nutrient management plan by an average of approximately 276 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 4-9: Phosphorus credits generated by implementing improved cropping practices during WQT Permit Term #1

Field ID	Trade Ratio	Phosphorus Credits (lb/yr)					
		2018	2019	2020	2021	2022	Avg.
3	3.03	-	-	-	29.3	31.9	**30.6**
5	3.03	-	-	-	10.4	18.6	**14.5**
7.8	3.03	-	-	-	-3.1	10.4	**3.7**
30	3.03	-	-	-	1.8	0.9	**1.5**
31	3.03	-	-	-	2.1	1.9	**2.0**
32.33	3.03	-	-	-	-0.1	-1.4	**0.8**
36	3.03	-	-	-	3.5	1.3	**2.4**
38	3.03	-	-	-	2.9	14.1	**8.5**
40	3.03	-	-	-	4.4	3.7	**4.1**
41	3.03	-	-	-	-1.5	4.0	**1.3**
43	3.03	-	-	-	-0.7	-1.1	**-0.9**
45	3.03	-	-	-	8.4	5.0	**4.5**
47	3.03	-	-	-	-0.1	-0.8	**-0.5**
61-62	3.03	-	-	-	-0.2	0.3	**0.1**
KO	-	-	-	-	-	-	**-**
SL2	-	-	-	-	-	-	**-**
SL3	-	-	-	-	-	-	**-**
SL	-	-	-	-	-	-	**-**
T1	-	-	-	-	-	-	**-**
T2	-	-	-	-	-	-	**-**
T3	-	-	-	-	-	-	**-**
T4	-	-	-	-	-	-	**-**
Total		**-**	**-**	**-**	**57.0**	**89.0**	**73.0**

Table 4-10: Phosphorus reductions estimated using the SnapPlus "P Trade Report"

Field ID	Acres	Scenario	PTP (lbs/year)							
			2021	2022	2023	2024	2025	2026	2027	2028
3	14.4	Baseline	130.4	131.0	131.5	129.8	129.8	129.8	129.8	129.8
		NMP & Supporting Practices	41.7	34.2	44.8	51.8	26.8	25.6	28.4	27.1
		Phosphorus Reduction	**88.6**	**96.8**	**86.8**	**78.0**	**103.0**	**104.3**	**101.4**	**102.8**
5	5.1	Baseline	71.3	71.5	71.8	70.9	70.9	70.9	70.9	70.9
		NMP & Supporting Practices	7.8	3.8	1.7	2.8	1.6	1.4	1.6	1.3
		Phosphorus Reduction	**63.4**	**67.8**	**70.1**	**68.1**	**69.3**	**69.5**	**69.4**	**69.6**
7.8	7	Baseline	49.7	50.0	50.2	49.5	49.5	49.5	49.5	49.5
		NMP & Supporting Practices	59.0	18.3	8.4	17.5	8.4	4.8	6.6	7.6
		Phosphorus Reduction	**-9.3**	**31.6**	**41.7**	**32.1**	**41.2**	**44.7**	**42.9**	**41.9**
30	2.7	Baseline	7.1	9.2	10.1	6.2	6.2	6.2	6.2	6.2
		NMP & Supporting Practices	1.7	6.4	5.5	10.7	2.0	2.7	2.0	1.6
		Phosphorus Reduction	**5.4**	**2.8**	**4.6**	**-4.5**	**4.1**	**3.4**	**4.1**	**4.6**
31	2.3	Baseline	7.2	7.9	6.1	4.7	4.7	4.7	4.7	4.7
		NMP & Supporting Practices	0.7	2.0	2.3	6.8	2.5	1.8	1.3	0.9
		Phosphorus Reduction	**6.5**	**5.9**	**3.8**	**-2.1**	**2.2**	**2.9**	**3.4**	**3.8**
32.33	5.8	Baseline	9.7	4.7	16.2	24.1	24.1	24.1	24.1	24.1
		NMP & Supporting Practices	10.1	8.8	12.0	17.5	10.8	10.7	11.9	14.1
		Phosphorus Reduction	**-0.4**	**-4.1**	**4.3**	**6.6**	**13.4**	**13.5**	**12.2**	**10.1**
36	3.4	Baseline	16.3	14.7	5.6	15.9	15.9	15.9	15.9	15.9
		NMP & Supporting Practices	5.6	10.7	11.3	7.8	4.7	5.5	7.5	8.8
		Phosphorus Reduction	**10.7**	**4.0**	**-5.8**	**8.1**	**11.2**	**10.4**	**8.4**	**7.0**
38	5.8	Baseline	26.4	50.5	48.4	28.3	28.3	28.3	28.3	28.3
		NMP & Supporting Practices	17.5	8.0	17.8	25.3	9.0	11.1	7.1	10.7
		Phosphorus Reduction	**8.9**	**42.6**	**30.7**	**3.1**	**19.3**	**17.2**	**21.2**	**17.7**
40	6.3	Baseline	21.2	20.9	9.3	18.6	18.6	18.6	18.6	18.6
		NMP & Supporting Practices	7.9	9.6	9.9	5.3	3.4	9.8	15.1	6.3
		Phosphorus Reduction	**13.3**	**11.3**	**-0.6**	**13.3**	**15.3**	**8.8**	**3.6**	**12.3**
41	5.6	Baseline	26.7	21.5	14.1	16.9	16.9	16.9	16.9	16.9
		NMP & Supporting Practices	31.3	9.3	7.3	14.4	5.0	5.9	4.2	5.7
		Phosphorus Reduction	**-4.6**	**12.2**	**6.8**	**2.6**	**11.9**	**11.1**	**12.8**	**11.3**
43	2.8	Baseline	4.2	2.5	5.1	7.4	7.4	7.4	7.4	7.4
		NMP & Supporting Practices	6.5	5.9	4.3	2.5	2.1	2.6	2.0	2.8
		Phosphorus Reduction	**-2.3**	**-3.4**	**0.8**	**4.9**	**5.3**	**4.8**	**5.3**	**4.6**
45	3.1	Baseline	31.4	25.9	13.5	18.5	18.5	18.5	18.5	18.5
		NMP & Supporting Practices	5.9	5.8	7.1	4.4	8.6	7.8	5.6	4.3
		Phosphorus Reduction	**25.6**	**20.1**	**6.4**	**14.1**	**9.9**	**10.7**	**12.9**	**14.2**
47	3.3	Baseline	5.9	3.6	7.1	10.1	10.1	10.1	10.1	10.1
		NMP & Supporting Practices	6.4	5.9	5.1	4.9	4.1	2.3	4.5	2.9
		Phosphorus Reduction	**-0.4**	**-2.3**	**2.0**	**5.2**	**6.0**	**7.8**	**5.6**	**7.2**
61-62	1.9	Baseline	2.9	4.1	4.8	3.0	3.0	3.0	3.0	3.0
		NMP & Supporting Practices	3.6	3.3	4.0	3.1	1.5	1.9	1.4	2.0
		Phosphorus Reduction	**-0.7**	**0.8**	**0.8**	**-0.1**	**1.5**	**1.1**	**1.6**	**1.0**
Total	69.5	Baseline	410.3	418.0	393.7	404.1	404.1	404.1	404.1	404.1
		NMP & Supporting Practices	205.6	131.9	141.4	174.7	90.3	94.0	99.2	96.0
		Phosphorus Reduction	**204.7**	**286.0**	**252.3**	**229.4**	**313.8**	**310.0**	**304.8**	**308.1**
		Avg. Reduction	**276.1**							

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**)

$\text{Uncertainty Factor} = 1.00$ (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:

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

$\text{Delivery Factor} = 0.07$ (see **Table 4-2**)

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

$\text{Trade Ratio} = 0.07 + 2.00 = 2.07$

Calculation for Nutrient Management and Supporting Practices without Grassed Waterways:

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

$\text{Delivery Factor} = 0.07$ (see **Table 4-2**)

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

$\text{Trade Ratio} = 0.07 + 3.00 = 3.07$ (To be effective starting 2024)

Credit Calculations:

Credit estimates for barnyard improvements are presented in **Table 4-11**. Credits were re-calculated with **Equation 4-1** using the phosphorus reduction estimates from **Table 4-8** and the revised trade ratios for each lot. As shown, a total of 78.8 lb/yr of phosphorus credits is estimated to be generated by continuing to maintain the implemented BMPs that reduce phosphorus runoff from the barnyards operated by Landowner C.

Table 4-11: Phosphorus credits simulated for barnyards using BARNY during WQT Permit Term #2

Barnyard ID	P Reduction BARNY (lb/yr)	Trade Ratio	P Credits (lb/yr)	Constructed BMPs
Lot #1	22.9	1.20	19.1	Lot abandonment, critical area planting, and conservation easement
Lot #2	1.4	2.07	0.7	Reduce lot size, install waste reception tank, and install waste transfer piping
Lot #3	62.9	2.07	30.4	Reduce lot size, install roof runoff structures, install waste reception tank, and install waste transfer piping
Lot #4	59.2	2.07	28.6	Install roof cover (122’ x 116’), install roof runoff structures, install waste reception tank, and install waste transfer piping
Total	**146.4**	**-**	**78.8**	**-**

Credit estimates for crop land improvements are presented in **Table 4-12**. As previously stated, phosphorus credits are only planned to be generated on the crop fields owned by Landowner C since the majority of landowner’s rented fields are located in ineligible watersheds. As shown, continuing to implement improved nutrient management and supporting practices into WQT Permit Term #2 could potentially generate an average of 92.1 lb/yr of phosphorus credit. It is important to note the amount of credit varies annually depending on the actual cropping practices implemented by Landowner C during each crop year.

Table 4-12: Phosphorus credits generated by implementing improved cropping practices

Field ID	Acres	Scenario	PTP (lbs/year)									
			Permit Term #1				Permit Term #2					
			2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
3	14.4	Phosphorus Reduction	-30.8	-21.8	88.6	96.8	86.8	78.0	103.0	104.3	101.4	102.8
		Trade Ratio	3.03	3.03	3.03	3.03	3.03	3.07	3.07	3.07	3.07	3.07
		Final Credit	**-10.2**	**-7.2**	**29.3**	**31.9**	**28.6**	**25.4**	**33.6**	**34.0**	**33.0**	**33.5**
5	5.1	Phosphorus Reduction	58.6	61.6	63.4	67.8	70.1	68.1	69.3	69.5	69.4	69.6
		Trade Ratio	3.03	3.03	3.03	3.03	3.03	3.07	3.07	3.07	3.07	3.07
		Final Credit	**19.3**	**20.3**	**20.9**	**22.4**	**23.1**	**22.2**	**22.6**	**22.6**	**22.6**	**22.7**
7.8	7	Phosphorus Reduction	-15.3	-10.2	-9.3	31.6	41.7	32.1	41.2	44.7	42.9	41.9
		Trade Ratio	3.03	3.03	3.03	3.03	3.03	3.07	3.07	3.07	3.07	3.07
		Final Credit	**-5.0**	**-3.4**	**-3.1**	**10.4**	**13.8**	**10.4**	**13.4**	**14.6**	**14.0**	**13.7**
30	2.7	Phosphorus Reduction	-0.1	-1.1	5.4	2.8	4.6	-4.5	4.1	3.4	4.1	4.6
		Trade Ratio	3.03	3.03	3.03	3.03	3.03	3.07	3.07	3.07	3.07	3.07
		Final Credit	**0.0**	**-0.4**	**1.8**	**0.9**	**1.5**	**-1.5**	**1.4**	**1.1**	**1.3**	**1.5**
31	2.3	Phosphorus Reduction	-0.1	4.1	6.5	5.9	3.8	-2.1	2.2	2.9	3.4	3.8
		Trade Ratio	3.03	3.03	3.03	3.03	3.03	3.07	3.07	3.07	3.07	3.07
		Final Credit	**0.0**	**1.4**	**2.1**	**1.9**	**1.3**	**-0.7**	**0.7**	**0.9**	**1.1**	**1.2**
32.33	5.8	Phosphorus Reduction	-21.5	2.6	-0.4	-4.1	4.3	6.6	13.4	13.5	12.2	10.1
		Trade Ratio	3.03	3.03	3.03	3.03	3.03	3.07	3.07	3.07	3.07	3.07
		Final Credit	**-7.1**	**0.9**	**-0.1**	**-1.4**	**1.4**	**2.2**	**4.4**	**4.4**	**4.0**	**3.3**
36	3.4	Phosphorus Reduction	29.1	19.8	10.7	4.0	-5.8	8.1	11.2	10.4	8.4	7.0
		Trade Ratio	3.03	3.03	3.03	3.03	3.03	3.07	3.07	3.07	3.07	3.07
		Final Credit	**9.6**	**6.5**	**3.5**	**1.3**	**-1.9**	**2.6**	**3.7**	**3.4**	**2.7**	**2.3**
38	5.8	Phosphorus Reduction	3.6	2.6	8.9	42.6	30.7	3.1	19.3	17.2	21.2	17.7
		Trade Ratio	3.03	3.03	3.03	3.03	3.03	3.07	3.07	3.07	3.07	3.07
		Final Credit	**1.2**	**0.8**	**2.9**	**14.0**	**10.1**	**1.0**	**6.3**	**5.6**	**6.9**	**5.8**
40	6.3	Phosphorus Reduction	27.1	19.4	13.3	11.3	-0.6	13.3	15.3	8.8	3.6	12.3
		Trade Ratio	3.03	3.03	3.03	3.03	3.03	3.07	3.07	3.07	3.07	3.07
		Final Credit	**9.0**	**6.4**	**4.4**	**3.7**	**-0.2**	**4.3**	**5.0**	**2.9**	**1.2**	**4.0**
41	5.6	Phosphorus Reduction	-6.3	5.6	-4.6	12.2	6.8	2.6	11.9	11.1	12.8	11.3
		Trade Ratio	3.03	3.03	3.03	3.03	3.03	3.07	3.07	3.07	3.07	3.07
		Final Credit	**-2.1**	**1.9**	**-1.5**	**4.0**	**2.2**	**0.8**	**3.9**	**3.6**	**4.2**	**3.7**
43	2.8	Phosphorus Reduction	-3.8	-0.7	-2.3	-3.4	0.8	4.9	5.3	4.8	5.3	4.6
		Trade Ratio	3.03	3.03	3.03	3.03	3.03	3.07	3.07	3.07	3.07	3.07
		Final Credit	**-1.2**	**-0.2**	**-0.7**	**-1.1**	**0.3**	**1.6**	**1.7**	**1.5**	**1.7**	**1.5**
45	3.1	Phosphorus Reduction	15.4	23.7	25.6	20.1	6.4	14.1	9.9	10.7	12.9	14.2
		Trade Ratio	3.03	3.03	3.03	3.03	3.03	3.07	3.07	3.07	3.07	3.07
		Final Credit	**5.1**	**7.8**	**8.4**	**6.6**	**2.1**	**4.6**	**3.2**	**3.5**	**4.2**	**4.6**
47	3.3	Phosphorus Reduction	-1.4	2.1	-0.4	-2.3	2.0	5.2	6.0	7.8	5.6	7.2
		Trade Ratio	3.03	3.03	3.03	3.03	3.03	3.07	3.07	3.07	3.07	3.07
		Final Credit	**-0.5**	**0.7**	**-0.1**	**-0.7**	**0.7**	**1.7**	**2.0**	**2.5**	**1.8**	**2.4**
61-62	1.9	Phosphorus Reduction	-0.7	-3.3	-0.7	0.8	0.8	-0.1	1.5	1.1	1.6	1.0
		Trade Ratio	3.03	3.03	3.03	3.03	3.03	3.07	3.07	3.07	3.07	3.07
		Final Credit	**-0.2**	**-1.1**	**-0.2**	**0.3**	**0.3**	**0.0**	**0.5**	**0.3**	**0.5**	**0.3**
Total	69.5	Phosphorus Reduction	53.9	104.4	204.7	286.0	252.3	229.4	313.8	310.0	304.8	308.1
		Trade Ratio	3.03	3.03	3.03	3.03	3.03	3.07	3.07	3.07	3.07	3.07
		Final Credit	**17.8**	**34.5**	**67.5**	**94.4**	**83.3**	**74.7**	**102.2**	**101.0**	**99.3**	**100.4**
		Avg. Credit	**53.9**				**92.1**					**100.4**

Costs:

The estimated costs for the City to implement the improvements for Landowner C, as well as the estimated costs for repairing BMPs in the coming WQT permit term, are shown in **Table 4-13**. 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 4-13: City's estimated Costs for Landowner C into WQT Permit Term #2

Capital Costs	Annual O&M Costs	15-year Present Worth
$0	$23,000	$282,000

4.5 ADDITIONAL PROPOSED PROJECTS

Due to the comparison described in Chapter 2 between estimated credits required for 2042 design conditions and credits currently being generated from implemented projects, the City is not in need of additional credits for WQT Permit Term #2 and is therefore not pursuing any additional projects for credit generation. Population projections, WWTF flows, and credit generation from existing projects will continue to be reevaluated in future permit terms to determine if the City would benefit from having additional credits available to them.

4.6 TOTAL PROJECTED CREDITS

The total amount of phosphorus credits which were generated for the City of Brodhead by working with each landowner during Permit Term #1 of WQT are summarized in **Table 4-14**. The WQT management practice registration forms that were submitted to DNR to document these credits during Permit Term #1 can be found in **Appendix G**.

Table 4-14: Total amount of phosphorus credits generated in Permit Term #1 of WQT

Landowner ID	Phosphorus Credits Generated (lb/yr)			
	2019[1]	2020	2021	2022
Landowner A - Streambank Improvements	129.8	129.8	137.5	137.5
Landowner B - Streambank Improvements	83.3	90.1	97.3	97.3
Landowner C - Farmstead Improvements	0.0	31.4	79.9	58.8
Landowner C - Crop Field Improvements	0.0	0.0	57.0	89.0
Total	**213.1**	**251.3**	**371.7**	**382.6**

[1]*Phosphorus credits were generated in November and December in the year 2019 after completion of portions of the projects.*

The total amount of phosphorus credits which are expected to be generated for the City during Permit Term #2 of WQT are summarized in **Table 4-15**. The streambank protection and habitat improvement projects for Landowners A and B and the farmstead improvements and crop field conservation practices for Landowner C continue to generate credits after their completion in 2020 and 2021.

Table 4-15: Anticipated total amount of phosphorus credits generated in Permit Term #2 of WQT

Landowner ID	Phosphorus Credits Generated (lb/yr)				
	2023 [1]	2024	2025	2026	2027
Landowner A - Streambank Improvements	137.5	137.2	137.2	137.2	137.2
Landowner B - Streambank Improvements	97.3	98.3	98.3	98.3	98.3
Landowner C - Farmstead Improvements	61.3	78.8	78.8	78.8	78.8
Landowner C - Crop Field Improvements	83.7	74.7	102.2	101.0	99.3
Total	**379.8**	**389.0**	**416.5**	**415.3**	**413.6**

[1]*Actual phosphorus credits generated.*

As shown in **Table 4-15**, approximately 389 lb/yr of credit is estimated to be generated in the year 2024 and up to a maximum of approximately 416 lb/yr of credit in the year 2025. These values greatly exceed the expected minimum value needed for compliance with WQT (234 lb/year long-term). Therefore, WQT continues 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 4-16 lists the number of credits needed for the City to comply with long term WQT goals at various average effluent total phosphorus concentrations (using **Equation 2-2** from Chapter 2). Based on the results in **Table 4-15** and **Table 4-16**, it may be reasonable for the City to maintain compliance with WQT into the future if an effluent total phosphorus concentration of 0.4 mg/L is targeted.

Table 4-16: Phosphorus credits needed to comply with WQT based on effluent phosphorus concentration in WQT Permit Term #2

Avg. Effluent TP Concentration (mg/L)	Minimum Phosphorus Credits Needed[1] (lb/yr)	Maximum Estimated Credits to be Generated (lb/yr)
0.3	234	416
0.4	352	416
0.5	469	416
0.6	586	416

[1]Assumes annual design influent flow of 0.308 MGD and a safety factor of 1.25.

CHAPTER 5 – IMPLEMENTATION AND MONITORING REQUIREMENTS

5.1 LEGAL AGREEMENTS

The City of Brodhead currently has 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 are recorded with the Green County Register of Deeds and will be transferred to new landowners in the event of ownership transition. Agreements identify management practices to 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 also identify processes for repairing failing management practices. Operation and Maintenance Plans are included in each legal agreement. The parties responsible for the implementation of the various components of the Operation and Maintenance Plan are project specific and depend on the preference of the given landowner. In general, implementation of the Operation and Maintenance Plans is 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 continue to 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 continue to 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 are dependent on the practices which are implemented. Current 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 continue to provide the findings of annual inspections to the Green County LWCD and the DNR for concurrence with findings. See **Appendix H** for copies of the annual inspection reports written by MSA and provided to regulatory agencies during WQT Permit Term #1. This allows the Green County LWCD to track landowner compliance with NR 151 agricultural performance standards and manure management prohibitions and other applicable regulations and allows 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 continue to 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 are the responsibility of the Green County LWCD. All proposed practices were reviewed by the Green County LWCD prior to implementation and the findings of annual inspections will continue to be submitted to the Green County LWCD for concurrence with findings. This enables the Green County LWCD to identify initial landowner compliance with NR 151 requirements and other regulations and promotes 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 provides 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 promotes the possibility of identifying potential damage before a BMP fails, and the Annual Inspection Reports for WQT Permit Term #1 that summarize these items can be found in **Appendix H**. As described earlier, the potential issues that have been previously identified on the Landowner A and Landowner B projects are not severe enough to require immediate repair and because the issues are on banks not originally repaired, no loss of credits is warranted. The City has established and will continue to contribute to 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 provides 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 conditions. 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

CHAPTER 6 – PROJECT IMPLEMENTATION SCHEDULE

6.1 IMPLEMENTATION SCHEDULE

The anticipated implementation schedule for this Water Quality Trading Plan into Permit Term #2 is summarized in **Table 6-1**.

Table 6-1 Anticipated project implementation schedule

Proposed Action	Approximate Date
Expiration of Brodhead's Current WDPES Permit	September 30, 2023
Submit Revised Water Quality Trading Plan to DNR	February 16, 2024
Anticipated DNR Approval of Revised Water Quality Trading Plan	May 2024

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.

6.2 CASH FLOW SUMMARY FOR WQT PERMIT TERM #2

For maintenance planning purposes, the City of Brodhead should budget expenses for the next five years as shown in the cash flow summary presented in **Table 6-2**. This cash flow summary includes anticipated capital costs and annual O&M costs.

Table 6-2 Cash flow summary for WQT Permit Term #2

Year	Capital Costs	Annual O&M Costs
2023	$0	$51,000
2024	$0	$52,530
2025	$0	$54,110
2026	$0	$55,730
2027	$0	$57,400

[1] An inflation rate (3%) was applied to each year to account for potential future inflation.

The completed DNR Water Quality Trading Checklist for this revised trading plan can be found in **Appendix I**.

APPENDIX A

WPDES Permit

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
SE ¼ of NE ¼ of Section 26, T2N, R9E
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

PERMIT TERM: EFFECTIVE DATE – November 1, 2018 **EXPIRATION DATE – September 30, 2023**

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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 after the grit chamber in 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	Daily	Continuous	
BOD_5, Total		mg/L	3/Week	24-Hr Flow Prop 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 before the UV channel except Fecal samples which are collected after, 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	Daily	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 April 30
Nitrogen, Ammonia (NH_3-N) Total	Weekly Avg	20 mg/L	3/Week	24-Hr Flow Prop Comp	Oct 1 through April 30
Nitrogen, Ammonia (NH_3-N) Total	Monthly Avg	18 mg/L	3/Week	24-Hr Flow Prop Comp	Oct 1 through March 31
Nitrogen, Ammonia (NH_3-N) Total	Monthly Avg	10 mg/L	3/Week	24-Hr Flow Prop Comp	April 1 through April 30
Fecal Coliform	Geometric Mean - Monthly	400 #/100 ml	Weekly	Grab	May 1 through Sep 30
Fecal Coliform	Geometric Mean - Wkly	656 #/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	
Chloride		mg/L	Monthly	24-Hr Flow Prop Comp	Jan 1, 2022 - Dec 31, 2022 - Monitor Only

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Phosphorus, Total	Monthly Avg	1.0 mg/L	3/Week	24-Hr Flow Prop Comp	This is an interim limit. Final limits become effective November 1, 2019 but this limit will remain as it represents the minimum control level. Report mg/L of phosphorus discharged. See "Water Quality Trading (WQT)" subsections for more information.
Phosphorus, Total		lbs/day	3/Week	Calculated	Report lbs/day of phosphorus discharged. See Standard Requirements subsection 5.4.2 for the equation to use.
WQT TP Credits		lbs/day	3/Week	Calculated	Report WQT TP Credits Used. See subsections below for instructions on water quality trading.
WQT TP Computed Compliance	Monthly Avg	0.3 mg/L	3/Week	Calculated	Limit is effective Nov 1, 2019. Report the WQT TP Computed Compliance value. See subsections below for instructions on water quality trading.
WQT TP Computed Compliance	6-Month Avg	0.1 mg/L	3/Week	Calculated	Limit is effective Nov 1, 2019. Report the WQT TP Computed Compliance value. See subsections below for instructions on water quality trading. Compliance with the 6-month average limit is evaluated at the end of each six-month period on Jun. 30 & Dec. 31.
WQT TP Computed Compliance	6-Month Avg	0.5 lbs/day	3/Week	Calculated	Limit is effective Nov 1, 2019. Report the WQT TP Computed Compliance value. See subsections below for instructions on water quality trading. Compliance with the 6-month average limit is evaluated at the end of each six-month period on Jun. 30 & Dec. 31.

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
WQT TP Credits		lbs/month	Monthly	Calculated	See 'Reporting Monthly Total TP Credits' in subsection 2.2.1.4 below. Available TP credits for the calendar year are specified in the approved Water Quality Trading Plan.

2.2.1.1 Phosphorus Water Quality Trading (WQT)

The permittee may use water quality trading to demonstrate compliance with WQBELs for total phosphorus (TP) of 0.3 mg/L monthly average and 0.1 mg/L 6-month average and 0.5 lbs/day 6-month average. Pollutant reduction credits for total phosphorus are available as specified in Water Quality Trading Plan **WQT-2018-0007** or approved amendments thereof.

Table 2. Available Phosphorus Credits per WQT-2018-0007

Year	Available TP Credits (lbs/yr)
2019	79.5
2020	389.6
2021	390.5
2022	394.3
2023*	387.8

*In the event that this permit is not reissued prior to the expiration date, 387 lbs/yr of credits will be available in subsequent year(s).

Only those pollutant reduction credits established by a water quality trading plan approved by the Department may be used by the permittee to demonstrate compliance with the WQBELs identified in this subsection. If the permittee wishes to use pollutant reduction credits not identified in an approved water quality trading plan, the permittee must amend the plan or develop a new plan and obtain Department approval of the amended or new plan prior to use of the new pollutant reduction credits. Prior to Department approval, the amended or new water quality trading plan will be subject to notice and opportunity for public comment. Any change in the number of available credits requires a permit modification.

In the event pollutant reduction credits as defined in the approved water quality trading plan are no longer generated, the permittee shall comply with the WQBELs for TP contained in this subsection.

2.2.1.2 Demonstrating Compliance with TP WQBELs Using Water Quality Trading

Use the following methods to demonstrate compliance with the TP WQBELs contained in the Water Quality Trading subsection above.

WQT TP CREDITS

Use the following method to calculate the credits to be used expressed as a mass in lbs/day:

• Select and report as “WQT TP Credits” the TP pollutant reduction credits (in lbs/day) that will be used for each day that discharge is monitored for TP.

• Recommendation: When the TP discharge for a given day is greater than 0.1 mg/L or 0.5 lbs or both, report the greater of the two following values as the "WQT TP Credits" for that day:

○ WQT TP Credits (in lbs/day) = TP discharged (in lbs/day) – 0.5 lbs/day; or

○ WQT TP Credits (in lbs/day) = TP discharged (in lbs/day) – [the day's flow in MGD × 0.1 mg/L × 8.34]

Note: When the TP discharge is less than 0.1 mg/L and 0.5 lbs/day for a given day, report 0 (zero) as the "WQT TP Credits" for that day.

Use the following method to calculate the credits to be used expressed as a mass in lbs/month:

• On a monthly basis, average the reported daily TP credits used for the month, then multiply the average by the number of days of discharge during the month and report the product as "WQT TP Credits" (in lbs/month) for the last day of the month on the DMR.

WQT TP Credits (in lbs/month) = Average of daily WQT TP Credits (in lbs/day) × Number of days of discharge/month

Note: The total number of TP credits selected for the twelve months of a calendar year shall not exceed that specified in the Water Quality Trading Plan approved by the Department.

WQT TP COMPUTED COMPLIANCE

Use the following method to demonstrate compliance with TP WQBELs expressed as a concentration in mg/L:

• Convert the TP credits selected for the day to an equivalent concentration using the following formula:

TP credits (in mg/L) = [TP credits in lbs/day] ÷ [the day's flow in MGD × 8.34]

- Subtract the TP credits (in mg/L) for the day from the day's TP discharge (in mg/L) and report the difference as "WQT TP Computed Compliance" in mg/L.

Use the following method to demonstrate compliance with TP WQBELs expressed as a mass in lbs/day:

• Subtract the TP credits in lbs/day for the day from the day's TP discharge in lbs/day and report the difference as "WQT TP Computed Compliance" in lbs/day.

2.2.1.3 Additional Water Quality Trading Requirements

When using water quality trading to demonstrate compliance with WQBELs for TP, the permittee shall comply with the following:

• Failure to implement any of the terms or conditions of the approved water quality trading plan is a violation of this permit.

• Each month the permittee shall certify that the nonpoint source management practices installed to generate pollutant reduction credits are operated and maintained in a manner consistent with that specified in the approved water quality trading plan. Such a certification may be made by including the following statement as a comment on the monthly discharge monitoring report:

> I certify that management practices identified in the approved water quality trading plan as the source of pollutant reduction credits are installed, established and properly maintained.

• At least once a year the permittee or the permittee's agent shall inspect each nonpoint source management practice that generates pollutant reduction credits to confirm the implementation of the management practice and their appropriate operation and adequate maintenance.

• The permittee shall notify WDNR by telephone within 24 hours or next business day of becoming aware that pollutant reduction credits used or intended for use by the permittee are not being implemented or generated as defined in the approved trading plan. A written notification shall be submitted to the Department within 5 days regarding the status of the permittee's pollutant reduction credits.

• The permittee shall provide WDNR written notice within 7 days of the trade agreement upon which the approved water quality trading plan is based being amended, modified, or revoked. This notification shall include the details of any amendment or modification in addition to the justification for the changes.

• The permittee shall not use pollutant reduction credits for the demonstration of compliance when pollutant reduction credits are not being generated.

2.2.1.4 Annual Water Quality Trading Report

When using water quality trading to demonstrate compliance with WQBELs, the permittee shall report by January 31st each year the following information:

• The number of pollutant reduction credits (lbs/month) used each month of the previous year to demonstrate compliance;

• The source of each month's pollutant reduction credits by identifying the approved water quality trading plan that details the source;

• A summary of the annual inspection of each nonpoint source management practice that generated any of the pollutant reduction credits used during the previous year; and

• Identification of noncompliance or failure to implement any terms or conditions of this permit with respect to water quality trading that have not been reported in discharge monitoring reports.

2.2.1.5 Water Quality Trading Reopener Clause

Under any of the following conditions as provided by s. 283.53(2), Wis. Stats. and Wis. Adm. Code NR 203.135 and 203.136, the Department may modify or revoke and reissue this permit to modify or eliminate permit terms and conditions related to water quality trading:

• The permittee fails to implement the water quality trading plan as approved;

• The permittee fails to comply with permit terms and conditions related to water quality trading;

• New information becomes available that would change the number of credits available for the water quality trade or would change the Department's determinations that water quality trading is an acceptable option.

2.2.1.6 Alternative Approaches to Phosphorus WQBEL Compliance

The permittee may implement an upgrade to its wastewater treatment facility in combination with Water Quality Trading to achieve compliance, provided that the permit is modified, revoked and reissued, or reissued to incorporate any such alternative approach.

2.2.1.7 Submittal of Permit Application for Next Reissuance and Pollutant Trading Plan

The permittee shall submit the permit application for the next reissuance at least 6 months prior to expiration of this permit.

The permittee has submitted a Water Quality Trading Plan that was approved by WDNR on November 6, 2017. If the permittee intends to pursue pollutant trading to achieve compliance in a manner that differs from that allowed in this permit, the permittee shall submit a new application for water quality trading with the application for the next reissuance. If system upgrades will be used in combination with pollutant trading the permittee shall submit plans for any system upgrade.

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	
PCB Total Dry Wt	Ceiling	50 mg/kg	Once	Composite	Jan 1, 2019 - Dec 31, 2019
PCB Total Dry Wt	High Quality	10 mg/kg	Once	Composite	Jan 1, 2019 - Dec 31, 2019

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 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.

3.2.1.2 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.

3.2.1.3 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.

3.2.1.4 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).

3.2.1.5 Sludge Analysis for PCBs

The permittee shall analyze the sludge for Total PCBs one time during **2019**. The results shall be reported as "PCB Total Dry Wt". 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 Table EM in s. NR 219.04, Wis. Adm. Code and the conditions specified in Standard Requirements of this permit. PCB results shall be submitted by January 31, following the specified year of analysis.

3.2.1.6 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 Trading (WQT) Management Plan

Required Action	Due Date
Submit Progress Report on Management Practices Installation: Submit a progress report on the installation of management practices as identified in the Water Quality Management Plan WQT-2018-0007 as approved by the Department.	12/31/2018
Complete Installation of Management Practices: Complete the installation of management practices as identified in the Water Quality Management Plan WQT-2018-0007 as approved by the Department.	09/30/2019
Management Practices: The Management Practices as identified in the Water Quality Trading Plan shall become effective and the permittee shall submit a completed Management Practice Registration Form 3400-207 for each site.	09/30/2019
Comply with Total Phosphorus Limits: Comply with the TP limits as specified in Table 2.2.1.	11/01/2019

4.2 Annual Water Quality Trading (WQT) Report

Required Action	Due Date
Annual WQT Report: Submit an annual WQT report that shall cover the first year of the permit term. The WQT shall include the total number of pollutant credits used, the source of the pollution reduction credits, a summary of annual inspections performed, and identification of noncompliance or failure to implement any terms or conditions of the approved water quality trading plan.	01/31/2020
Annual WQT Report #2: Submit an annual WQT report that shall cover the previous year.	01/31/2021
Annual WQT Report #3: Submit an annual WQT report that shall cover the previous year.	01/31/2022
Annual WQT Report #4: Submit the 5th annual WQT report. If the permittee wishes to continue to comply with phosphorus limits through WQT in subsequent permit terms, the permittee shall submit a revised WQT plan including a demonstration of credit need, compliance record of the existing WQT, and any additional practices needed to maintain compliance over time.	01/31/2023
Annual WQT Report Required After Permit Expiration: In the event that this permit is not reissued by the expiration date, the permittee shall continue to submit annual WQT reports by January 31 each year covering the total number of pollutant credits used, the source of the pollution reduction credits, a summary of annual inspection reports performed, and identification on noncompliance or failure to implement any terms or conditions of the approved water quality trading plan for the previous calendar year.	

5 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).

5.1 Reporting and Monitoring Requirements

5.1.1 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). The eDMR shall be certified electronically by a responsible executive or municipal officer, manager, partner or proprietor as specified in s. 283.37(3), Wis. Stats., or a duly authorized representative of the officer, manager, partner or proprietor that has been delegated signature authority pursuant to s. NR 205.07(1)(g)2, Wis. Adm. Code. The 'eReport Certify' page certifies that the electronic report form is true, accurate and complete.

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.

5.1.2 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.

5.1.3 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.

5.1.4 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.

5.1.5 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 and certified 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.

The CMAR shall be certified electronically by a responsible executive or municipal officer, manager, partner or proprietor as specified in s. 283.37(3), Wis. Stats., or a duly authorized representative of the officer, manager, partner or proprietor that has been delegated signature authority pursuant to s. NR 205.07(1)(g)2, Wis. Adm. Code. The certification verifies that the electronic report is true, accurate and complete.

5.1.6 Records Retention

The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings or electronic data records 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.

5.1.7 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.

5.1.8 Reporting Requirements – Alterations or Additions

The permittee shall give notice to the Department as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is only required when:

- The alteration or addition to the permitted facility may meet one of the criteria for determining whether a facility is a new source.
- The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification requirement applies to pollutants which are not subject to effluent limitations in the existing permit.
- The alteration or addition results in a significant change in the permittee's sludge use or disposal practices, and such alteration, addition, or change may justify the application of permit conditions that are different from or absent in the existing permit, including notification of additional use of disposal sites not reported during the permit application process nor reported pursuant to an approved land application plan. Additional sites may not be used for the land application of sludge until department approval is received.

5.2 System Operating Requirements

5.2.1 Noncompliance Reporting

Sanitary sewer overflows and sewage treatment facility overflows shall be reported according to the 'Sanitary Sewer Overflows and Sewage Treatment Facility Overflows' section of this permit.

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 a 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.

A scheduled bypass approved by the Department under the 'Scheduled Bypass' section of this permit shall not be subject to the reporting required under this section.

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.**

5.2.2 Flow Meters

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

5.2.3 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 500-555, Wis. Adm. Code.

5.2.4 Sludge Management

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

5.2.5 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.

5.2.6 Bypass

This condition applies only to bypassing at a sewage treatment facility that is not a scheduled bypass, approved blending as a specific condition of this permit, a sewage treatment facility overflow or a controlled diversion as provided in the sections titled ‘Scheduled Bypass’, ‘Blending’ (if approved), ‘SSO’s and Sewage Treatment Facility Overflows’ and ‘Controlled Diversions’ of this permit. Any other bypass at the sewage treatment facility is prohibited and the Department may take enforcement action against a permittee for such occurrences under s. 283.89, Wis. Stats. The Department may approve a bypass if the permittee demonstrates all the following conditions apply:

- 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 or adequate back-up equipment, retention of untreated wastes, reduction of inflow and infiltration, 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 preventative maintenance. When evaluating feasibility of alternatives, the department may consider factors such as technical achievability, costs and affordability of implementation and risks to public health, the environment and, where the permittee is a municipality, the welfare of the community served; and
- The bypass was reported in accordance with the Noncompliance Reporting section of this permit.

5.2.7 Scheduled Bypass

Whenever the permittee anticipates the need to bypass for purposes of efficient operations and maintenance and the permittee may not meet the conditions for controlled diversions in the ‘Controlled Diversions’ section of this permit, the permittee shall obtain prior written approval from the Department for the scheduled bypass. A permittee's written request for Department approval of a scheduled bypass shall demonstrate that the conditions for bypassing specified in the above section titled 'Bypass' are met and include the proposed date and reason for the bypass, estimated volume and duration of the bypass, alternatives to bypassing and measures to mitigate environmental harm caused by the bypass. The department may require the permittee to provide public notification for a scheduled bypass if it is determined there is significant public interest in the proposed action and may recommend mitigation measures to minimize the impact of such bypass.

5.2.8 Controlled Diversions

Controlled diversions are allowed only when necessary for essential maintenance to assure efficient operation. Sewage treatment facilities that have multiple treatment units to treat variable or seasonal loading conditions may shut down redundant treatment units when necessary for efficient operation. The following requirements shall be met during controlled diversions:

- Effluent from the sewage treatment facility shall meet the effluent limitations established in the permit. Wastewater that is diverted around a treatment unit or treatment process during a controlled diversion shall be recombined with wastewater that is not diverted prior to the effluent sampling location and prior to effluent discharge;
- A controlled diversion does not include blending as defined in s. NR 210.03(2e), Wis. Adm. Code, and as may only be approved under s. NR 210.12. A controlled diversion may not occur during periods of excessive flow or other abnormal wastewater characteristics;
- A controlled diversion may not result in a wastewater treatment facility overflow; and
- All instances of controlled diversions shall be documented in sewage treatment facility records and such records shall be available to the department on request.

5.2.9 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. 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.

5.2.10 Operator Certification

The wastewater treatment facility shall be under the direct supervision of a state certified operator. In accordance with s. NR 114.53, Wis. Adm. Code, every WPDES permitted treatment plant shall have a designated operator-in-charge holding a current and valid certificate. The designated operator-in-charge shall be certified at the level and in all subclasses of the treatment plant, except laboratory. Treatment plant owners shall notify the department of any changes in the operator-in-charge within 30 days. Note that s. NR 114.52(22), Wis. Adm. Code, lists types of facilities that are excluded from operator certification requirements (i.e. private sewage systems, pretreatment facilities discharging to public sewers, industrial wastewater treatment that consists solely of land disposal, agricultural digesters and concentrated aquatic production facilities with no biological treatment).

5.3 Sewage Collection Systems

5.3.1 Sanitary Sewage Overflows and Sewage Treatment Facility Overflows

5.3.1.1 Overflows Prohibited

Any overflow or discharge of wastewater from the sewage collection system or at the sewage treatment facility, other than from permitted outfalls, is prohibited. The permittee shall provide information on whether any of the following conditions existed when an overflow occurred:

- The sanitary sewer overflow or sewage treatment facility overflow was unavoidable to prevent loss of life, personal injury or severe property damage;
- There were no feasible alternatives to the sanitary sewer overflow or sewage treatment facility overflow such as the use of auxiliary treatment facilities or adequate back-up equipment, retention of untreated wastes, reduction of inflow and infiltration, or preventative maintenance activities;
- The sanitary sewer overflow or the sewage treatment facility overflow was caused by unusual or severe weather related conditions such as large or successive precipitation events, snowmelt, saturated soil conditions, or severe weather occurring in the area served by the sewage collection system or sewage treatment facility; and
- The sanitary sewer overflow or the sewage treatment facility overflow was unintentional, temporary, and caused by an accident or other factors beyond the reasonable control of the permittee.

5.3.1.2 Permittee Response to Overflows

Whenever a sanitary sewer overflow or sewage treatment facility overflow occurs, the permittee shall take all feasible steps to control or limit the volume of untreated or partially treated wastewater discharged, and terminate the discharge as soon as practicable. Remedial actions, including those in NR 210.21 (3), Wis. Adm. Code, shall be implemented consistent with an emergency response plan developed under the CMOM program.

5.3.1.3 Permittee Reporting

Permittees shall report all sanitary sewer overflows and sewage treatment overflows as follows:

- The permittee shall notify the department by telephone, fax or email as soon as practicable, but no later than 24 hours from the time the permittee becomes aware of the overflow;
- The permittee shall, no later than five days from the time the permittee becomes aware of the overflow, provide to the department the information identified in this paragraph using department form number 3400-184. If an overflow lasts for more than five days, an initial report shall be submitted within 5 days as required in this paragraph and an updated report submitted following cessation of the overflow. At a minimum, the following information shall be included in the report:

  ◦The date and location of the overflow;
  ◦The surface water to which the discharge occurred, if any;
  ◦The duration of the overflow and an estimate of the volume of the overflow;
  ◦A description of the sewer system or treatment facility component from which the discharge occurred such as manhole, lift station, constructed overflow pipe, or crack or other opening in a pipe;
  ◦The estimated date and time when the overflow began and stopped or will be stopped;
  ◦The cause or suspected cause of the overflow including, if appropriate, precipitation, runoff conditions, areas of flooding, soil moisture and other relevant information;
  ◦Steps taken or planned to reduce, eliminate and prevent reoccurrence of the overflow and a schedule of major milestones for those steps;
  ◦A description of the actual or potential for human exposure and contact with the wastewater from the overflow;
  ◦Steps taken or planned to mitigate the impacts of the overflow and a schedule of major milestones for those steps;
  ◦To the extent known at the time of reporting, the number and location of building backups caused by excessive flow or other hydraulic constraints in the sewage collection system that occurred

concurrently with the sanitary sewer overflow and that were within the same area of the sewage collection system as the sanitary sewer overflow; and
◦The reason the overflow occurred or explanation of other contributing circumstances that resulted in the overflow event. This includes any information available including whether the overflow was unavoidable to prevent loss of life, personal injury, or severe property damage and whether there were feasible alternatives to the overflow.

NOTE: A copy of form 3400-184 for reporting sanitary sewer overflows and sewage treatment facility overflows may be obtained from the department or accessed on the department's web site at http://dnr.wi.gov/topic/wastewater/SSOreport.html. As indicated on the form, additional information may be submitted to supplement the information required by the form.

- The permittee shall identify each specific location and each day on which a sanitary sewer overflow or sewage treatment facility overflow occurs as a discrete sanitary sewer overflow or sewage treatment facility overflow occurrence. An occurrence may be more than one day if the circumstances causing the sanitary sewer overflow or sewage treatment facility overflow results in a discharge duration of greater than 24 hours. If there is a stop and restart of the overflow at the same location within 24 hours and the overflow is caused by the same circumstance, it may be reported as one occurrence. Sanitary sewer overflow occurrences at a specific location that are separated by more than 24 hours shall be reported as separate occurrences; and
- A permittee that is required to submit wastewater discharge monitoring reports under NR 205.07 (1) (r) shall also report all sanitary sewer overflows and sewage treatment facility overflows on that report.

5.3.1.4 Public Notification

The permittee shall notify the public of any sanitary sewer and sewage treatment facility overflows consistent with its emergency response plan required under the CMOM (Capacity, Management, Operation and Maintenance) section of this permit and s. NR 210.23 (4) (f), Wis. Adm. Code. Such public notification shall occur promptly following any overflow event using the most effective and efficient communications available in the community. At minimum, a daily newspaper of general circulation in the county(s) and municipality whose waters may be affected by the overflow shall be notified by written or electronic communication.

5.3.2 Capacity, Management, Operation and Maintenance (CMOM) Program

- The permittee shall have written documentation of the Capacity, Management, Operation and Maintenance (CMOM) program components in accordance with s. NR 210.23(4), Wis. Adm. Code. Such documentation shall be available for Department review upon request. The Department may request that the permittee provide this documentation or prepare a summary of the permittee's CMOM program at the time of application for reissuance of the WPDES permit.
- The permittee shall implement a CMOM program in accordance with s. NR 210.23, Wis. Adm. Code.
- The permittee shall at least annually conduct a self-audit of activities conducted under the permittee's CMOM program to ensure CMOM components are being implemented as necessary to meet the general standards of s. NR 210.23(3), Wis. Adm. Code.

5.3.3 Sewer Cleaning Debris and Materials

All debris and material removed from cleaning sanitary sewers shall be managed to prevent nuisances, run-off, ground infiltration or prohibited discharges.

- Debris and solid waste shall be dewatered, dried and then disposed of at a licensed solid waste facility.
- Liquid waste from the cleaning and dewatering operations shall be collected and disposed of at a permitted wastewater treatment facility.

- Combination waste including liquid waste along with debris and solid waste may be disposed of at a licensed solid waste facility or wastewater treatment facility willing to accept the waste.

5.4 Surface Water Requirements

5.4.1 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.

5.4.2 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.

12-Month Rolling Sum of Total Monthly Discharge: = the sum of the most recent 12 consecutive months of Total Monthly Discharges.

5.4.3 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.

5.4.4 Visible Foam or Floating Solids

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

5.4.5 Surface Water Uses and Criteria

In accordance with NR 102.04, Wis. Adm. Code, surface water uses and criteria are established to govern water management decisions. Practices attributable to municipal, industrial, commercial, domestic, agricultural, land development or other activities shall be controlled so that all surface waters including the mixing zone meet the following conditions at all times and under all flow and water level conditions:

a) Substances that will cause objectionable deposits on the shore or in the bed of a body of water, shall not be present in such amounts as to interfere with public rights in waters of the state.

b) Floating or submerged debris, oil, scum or other material shall not be present in such amounts as to interfere with public rights in waters of the state.

c) Materials producing color, odor, taste or unsightliness shall not be present in such amounts as to interfere with public rights in waters of the state.

d) Substances in concentrations or in combinations which are toxic or harmful to humans shall not be present in amounts found to be of public health significance, nor shall substances be present in amounts which are acutely harmful to animal, plant or aquatic life.

5.4.6 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.

5.4.7 Fecal Coliforms

The weekly and monthly limit(s) for fecal coliforms shall be expressed as a geometric mean.

5.4.8 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.

5.5 Land Application Requirements

5.5.1 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.

5.5.2 General Sludge Management Information

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

5.5.3 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.

5.5.4 Land Application Characteristic Report

Each report shall consist of a Characteristic Form 3400-49 and Lab Report. The Characteristic Report Form 3400-49 shall be submitted electronically by January 31 following each year of analysis.

Following submittal of the electronic Characteristic Report Form 3400-49, this form shall be certified electronically via the 'eReport Certify' page by a responsible executive or municipal officer, manager, partner or proprietor as specified in s. 283.37(3), Wis. Stats., or a duly authorized representative of the officer, manager, partner or proprietor that has been delegated signature authority pursuant to s. NR 205.07(1)(g)2, Wis. Adm. Code. The 'eReport Certify' page certifies that the electronic report is true, accurate and complete. The Lab Report must be sent directly to the facility's DNR sludge representative or basin engineer unless approval for not submitting the lab reports has been given.

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.

5.5.5 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

5.5.6 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

5.5.7 Annual Land Application Report

Land Application Report Form 3400-55 shall be submitted electronically by January 31, each year whether or not non-exceptional quality sludge is land applied. Non-exceptional quality sludge is defined in s. NR 204.07(4), Wis. Adm. Code. Following submittal of the electronic Annual Land Application Report Form 3400-55, this form shall be certified electronically via the 'eReport Certify' page by a responsible executive or municipal officer, manager, partner or proprietor as specified in s. 283.37(3), Wis. Stats., or a duly authorized representative of the officer, manager, partner or proprietor that has been delegated signature authority pursuant to s. NR 205.07(1)(g)2, Wis. Adm. Code. The 'eReport Certify' page certifies that the electronic report form is true, accurate and complete.

5.5.8 Other Methods of Disposal or Distribution Report

The permittee shall submit electronically the Other Methods of Disposal or Distribution Report Form 3400-52 by January 31, each year whether or not sludge is hauled, landfilled, incinerated, or exceptional quality sludge is distributed or land applied. Following submittal of the electronic Report Form 3400-52, this form shall be certified electronically via the 'eReport Certify' page by a responsible executive or municipal officer, manager, partner or proprietor as specified in s. 283.37(3), Wis. Stats., or a duly authorized representative of the officer, manager, partner or proprietor that has been delegated signature authority pursuant to s. NR 205.07(1)(g)2, Wis. Adm. Code. The 'eReport Certify' page certifies that the electronic report form is true, accurate and complete.

5.5.9 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.

5.5.10 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.

5.5.11 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.

5.5.12 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.
$(5.78 + 6.62 + 6.20 + 5.95 + 5.60 + 6.00 + 5.71) \div 7 = 5.98$
The antilog of 5.98 = 9.5×10^5

5.5.13 Class B Sludge: Aerobic Digestion

Agitate the sludge with air or oxygen to maintain an aerobic condition for a mean cell residence time and temperature between 40 days at 20° C and 60 days at 15° C.

5.5.14 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)

5.5.15 Class B Sludge - Vector Control: Injection

No significant amount of the sewage sludge shall be present on the land surface within one hour after the sludge is injected.

5.5.16 Land Application of Sludge Which Contains Elevated Levels of Radium-226

When contributory water supplies exceed 2 pci per liter of Radium 226, monitoring for Radium 226 in sludge is required. Sludge containing Radium 226 shall be land applied in accordance with the requirements in s. NR 204.07(3)(n), Wis. Adm. Code.

6 Summary of Reports Due

FOR INFORMATIONAL PURPOSES ONLY

Description	Date	Page
Water Quality Trading (WQT) Management Plan -Submit Progress Report on Management Practices Installation	December 31, 2018	12
Water Quality Trading (WQT) Management Plan -Complete Installation of Management Practices	September 30, 2019	12
Water Quality Trading (WQT) Management Plan -Management Practices	September 30, 2019	12
Water Quality Trading (WQT) Management Plan -Comply with Total Phosphorus Limits	November 1, 2019	12
Annual Water Quality Trading (WQT) Report -Annual WQT Report	January 31, 2020	12
Annual Water Quality Trading (WQT) Report -Annual WQT Report #2	January 31, 2021	12
Annual Water Quality Trading (WQT) Report -Annual WQT Report #3	January 31, 2022	12
Annual Water Quality Trading (WQT) Report -Annual WQT Report #4	January 31, 2023	12
Annual Water Quality Trading (WQT) Report -Annual WQT Report Required After Permit Expiration	See Permit	12
Compliance Maintenance Annual Reports (CMAR)	by June 30, each year	14
General Sludge Management Form 3400-48	prior to any significant sludge management changes	22
Characteristic Form 3400-49 and Lab Report	by January 31 following each year of analysis	22
Land Application Report Form 3400-55	by January 31, each year whether or not non-exceptional quality sludge is land applied	23
Other Methods of Disposal or Distribution Report Form 3400-52	by January 31, each year whether or not sludge is hauled, landfilled, incinerated, or exceptional quality sludge is distributed or land applied	23
Wastewater Discharge Monitoring Report	no later than the date indicated on the form	13

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

APPENDIX B

Notices of Intent to Conduct Water Quality Trading

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)
- ☐ 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: 070900040601-602-302-404-503-703
- ◯ 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

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: City of Brodhead
Permit Number: WI- 0021903
Facility Site Number:

Facility Address: 1700 11th Street
City: Brodhead
State: WI
ZIP Code: 53520

Project Contact Name (if applicable): Andrew Skog, PE (MSA)
Address: 1702 Pankratz St.
City: Madison
State: WI
ZIP Code: 53704

Project Name: City of Brodhead - Water Quality Trading Revision #1

Receiving Water Name: Sugar River Millrace
Parameter(s) being traded: Total Phosphorus
HUC 12(s): 07900040601, -40602, -40605

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)
- ☐ Permitted MS4
- ☐ Permitted CAFO
- ☐ Urban nonpoint source discharge
- ☒ Agricultural nonpoint source discharge
- ☒ Other - Specify: Solar Utility

Are any of the credit generators in a different HUC 12 than the applicant?
- ◉ Yes; HUC 12: 07900040601, 70900040602
- ○ 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:

The City of Brodhead will be updating their Water Quality Trading Plan per WPDES compliance schedule requirements. The new plan will include existing trading partners Landowner A, Landowner B, and Landowner C, identified in the City's 2018 WQT Plan. The updated plan will also consider a potential trading partnership with a proposed solar field located upstream of the City in the Norwegian Creek HUC 12 (070900040602). The solar field is being installed by Alliant Energy. Start of construction is planned in fall 2022. Credits are intended to be generated by converting agricultural row crops to perennial vegetation (native prairie). It is understood that areas where solar panels are installed credits will only be available from the conversion of sod to native prairie.

Method for quantifying credits generated:
- ☐ Monitoring
- ☒ Modeling, Names: Snap-Plus
- ☐ Other:

Projected date credits will be available: 10/01/2023

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
Andrew Skroc	09/09/2022

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 A Vogel	09/21/2022

APPENDIX C

Letters of Support

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

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.

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

APPENDIX D

STREAMBANK EROSION MODELING OVERVIEW

1.1 BACKGROUND

The City of Brodhead is generating phosphorus credits after the completion of approximately 1.2 miles of streambank stabilization and habitat improvements along Searles Creek. The two landowners where this work was completed are 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. In 2020, repairs for a total of 37 and 25 eroding streambanks were completed on the properties owned by Landowner A and Landowner B, respectively. As summarized in the City's 2018 WQT Plan, original 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 preliminary amount of potential phosphorus credits which could be generated by stabilizing eroding streambanks. Revised credit calculations for the streambank projects are included as a part of this WQT Trading Plan to reflect the actual bank repairs implemented as well as updates to trade ratios.

Equation 1:

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

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 $\left[\frac{\text{lb}}{\text{ft}^3}\right]$
	$\mathrm{C_{TP}}$	=	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.

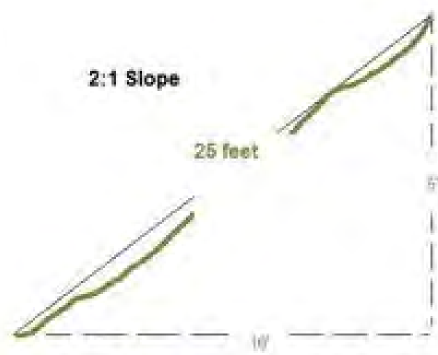

Figure 1: Example measurement of bank slope height. In this example, the bank slope height is 25 ft or the length of the hypotenuse (Source: NRCS Erosion Calculator).

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 collected 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.

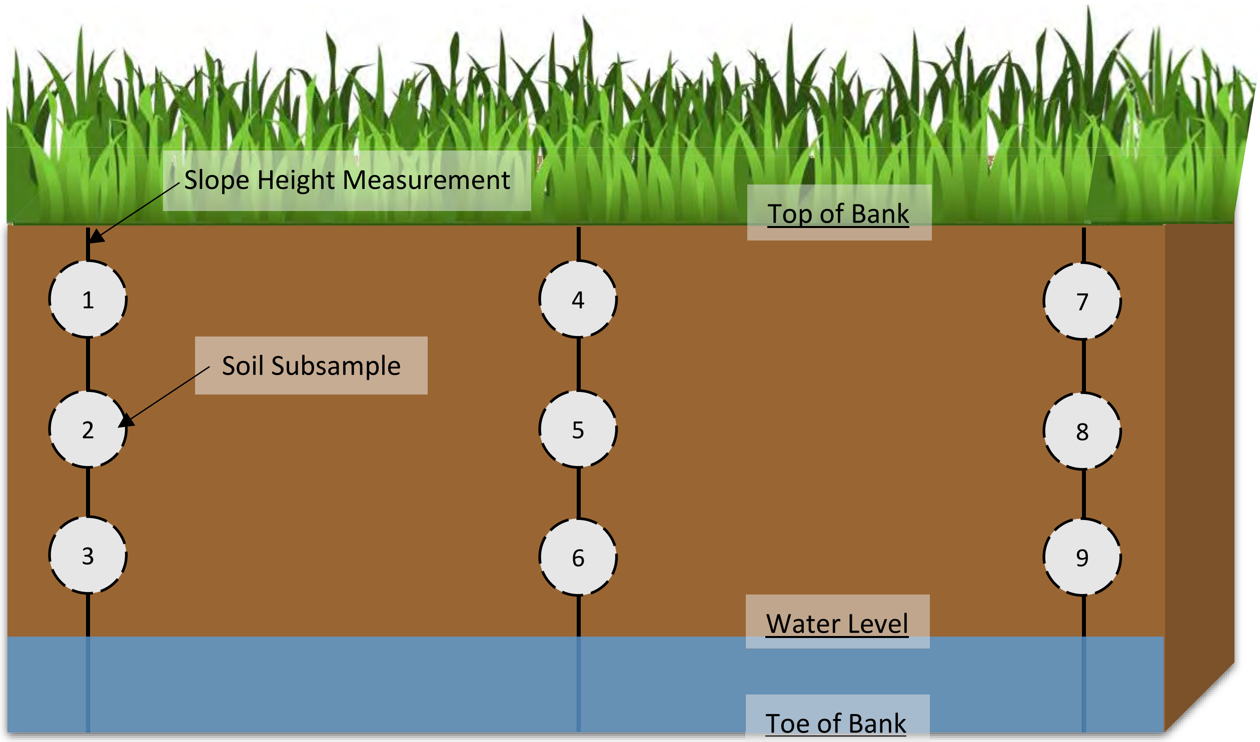

Figure 2: Diagram of soil sampling locations for a typical eroding bank

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, and 37 were repaired during construction. Photographs of each streambank prior to construction are shown in **Figures 4** through **40.** Post-construction photos of the banks can be found in the WQT Annual Reports in **Appendix J.** 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 re-estimated by dividing the estimated phosphorus loss for each bank by a trade ratio of 3.07 for banks W1 – W17 and 3.00 for banks W18 – W37 (accounting for an uncertainty factor of 3.0 for streambank stabilization and habitat restoration and delivery factors of 0.07 and 0.00 for banks W1 – W17 and W18 – W37, respectively, due to updated SPARROW delivery fraction regions within the Searles Creek Watershed). A total of 416.6 lb/yr of phosphorus loss was calculated using **Equation 1**. Accounting for the updated trade ratios, a total of 137.2 lb/yr of phosphorus credits is anticipated to be generated for the stabilized banks on the Landowner A site into WQT Permit Term #2.

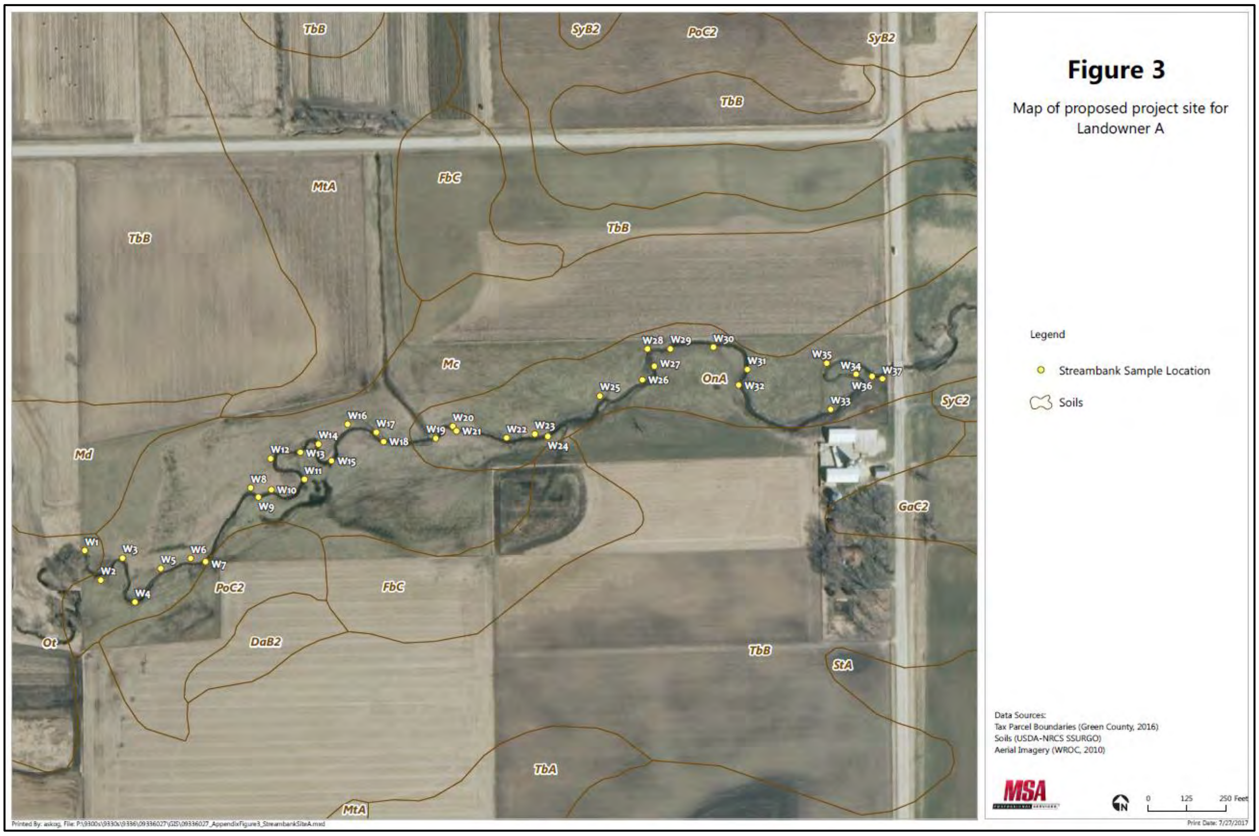

Figure 3: Map of originally proposed project site for Landowner A

Table 3: Revised phosphorus credit calculations for Landowner A

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)	Estimated Soil Loss (lb/yr)	Estimated Soil Loss (tons/yr)	Soil Total Phosphorus (%)	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	12,507	6.3	0.04	357	4.5	3.07	1.5
W2	RBFD	138	4.2	6.1	5.3	5.2	Very Severe	0.50	Marshan Silt Loam	95	34,122	17.1	0.06	598	20.4	3.07	6.6
W3	LBFD	147	6.1	8.5	6.8	7.1	Moderate/Severe	0.25	Marshan Silt Loam	95	24,930	12.5	0.04	445	11.1	3.07	3.6
W4	RBFD	141	9.2	9.9	9.0	9.4	Very Severe	0.50	Marshan Silt Loam	95	62,799	31.4	0.04	371	23.3	3.07	7.6
W5	LBFD	74	5.6	7.0	7.1	6.6	Moderate	0.13	Marshan Silt Loam	95	6,008	3.0	0.06	590	3.5	3.07	1.2
W6	LBFD	23	6.1	6.5	6.6	6.4	Moderate/Severe	0.25	Marshan Silt Loam	95	3,500	1.7	0.05	535	1.9	3.07	0.6
W7	RBFD	90	7.1	8.7	7.7	7.8	Severe	0.40	Marshan Silt Loam	95	26,818	13.4	0.05	484	13.0	3.07	4.2
W8	LBFD	66	7.8	9.2	7.6	8.2	Very Severe	0.50	Marshan Silt Loam	95	25,734	12.9	0.05	539	13.9	3.07	4.5
W9	RBFD	32	6.2	6.5	5.3	6.0	Moderate	0.13	Marshan Silt Loam	95	2,374	1.2	0.05	453	1.1	3.07	0.4
W10	LBFD	46	8.7	5.3	5.2	6.4	Moderate/Severe	0.25	Marshan Silt Loam	95	6,999	3.5	0.06	637	4.5	3.07	1.5
W11	RBFD	206	7.9	7.4	7.8	7.7	Very Severe	0.50	Marshan Silt Loam	95	75,424	37.7	0.07	733	55.3	3.07	18.0
W12	LBFD	154	6.7	8.9	7.9	7.8	Very Severe	0.50	Marshan Silt Loam	95	57,361	28.7	< 0.03	300	17.2	3.07	5.6
W13	RBFD	71	7.6	5.2	9.0	7.3	Very Severe	0.50	Marshan Silt Loam	95	24,533	12.3	0.05	506	12.4	3.07	4.0
W14	LBFD	68	6.3	8.8	6.8	7.3	Very Severe	0.50	Marshan Silt Loam	95	23,604	11.8	0.05	477	11.3	3.07	3.7
W15	RBFD	154	6.4	7.4	6.5	6.8	Very Severe	0.50	Marshan Silt Loam	95	49,550	24.8	0.06	563	27.9	3.07	9.1
W16	LBFD	83	7.0	5.4	8.2	6.9	Moderate/Severe	0.25	Marshan Silt Loam	95	13,550	6.8	0.03	320	4.3	3.07	1.4
W17	LBFD	13	9.2	6.3	5.5	7.0	Very Severe	0.50	Marshan Silt Loam	95	4,327	2.2	0.05	525	2.3	3.07	0.7
W18	RBFD	47	6.4	7.2	4.3	6.0	Moderate/Severe	0.25	Marshan Silt Loam	95	6,667	3.3	0.16	1,569	10.5	3.00	3.5
W19	RBFD	57	6.0	7.7	8.9	7.5	Very Severe	0.50	Orion Silt Loam	87	18,679	9.3	0.12	1,218	22.8	3.00	7.6
W20	LBFD	21	8.7	7.6	6.2	7.5	Moderate/Severe	0.25	Orion Silt Loam	87	3,426	1.7	0.14	1,405	4.8	3.00	1.6
W21	RBFD	54	9.4	6.5	5.5	7.1	Moderate	0.13	Orion Silt Loam	87	4,357	2.2	0.06	557	2.4	3.00	0.8
W22	LBFD	43	6.0	7.0	4.2	5.7	Moderate/Severe	0.25	Orion Silt Loam	87	5,362	2.7	0.04	435	2.3	3.00	0.8
W23	LBFD	50	5.9	7.5	7.4	6.9	Moderate/Severe	0.25	Orion Silt Loam	87	7,540	3.8	0.05	487	3.7	3.00	1.2
W24	RBFD	85	7.8	8.9	7.3	8.0	Moderate/Severe	0.25	Orion Silt Loam	87	14,790	7.4	0.03	337	5.0	3.00	1.7
W25	LBFD	73	8.4	6.0	6.8	7.1	Very Severe	0.50	Orion Silt Loam	87	22,440	11.2	0.07	652	14.6	3.00	4.9
W26	LBFD	47	4.6	5.2	4.5	4.8	Very Severe	0.50	Orion Silt Loam	87	9,745	4.9	0.05	488	4.8	3.00	1.6
W27	RBFD	61	10.5	7.3	5.9	7.9	Severe	0.40	Orion Silt Loam	87	16,770	8.4	0.04	360	6.0	3.00	2.0
W28	LBFD	98	8.1	8.1	9.6	8.6	Very Severe	0.50	Orion Silt Loam	87	36,662	18.3	0.06	627	23.0	3.00	7.7
W29	RBFD	46	5.4	5.1	7.1	5.9	Moderate/Severe	0.25	Orion Silt Loam	87	5,870	2.9	0.06	605	3.6	3.00	1.2
W30	RBFD	29	4.8	4.2	5.2	4.7	Moderate	0.13	Orion Silt Loam	87	1,552	0.8	0.07	680	1.1	3.00	0.4
W31	LBFD	169	8.2	7.7	8.7	8.2	Severe	0.40	Orion Silt Loam	87	48,226	24.1	0.03	266	12.8	3.00	4.3
W32	RBFD	46	4.2	5.4	5.4	5.0	Severe	0.40	Orion Silt Loam	87	8,004	4.0	0.03	331	2.7	3.00	0.9
W33	LBFD	45	4.0	3.6	6.1	4.6	Very Severe	0.50	Orion Silt Loam	87	8,939	4.5	0.04	443	4.0	3.00	1.3
W34	RBFD	141	6.6	3.6	4.4	4.9	Very Severe	0.50	Orion Silt Loam	87	29,850	14.9	0.04	393	11.7	3.00	3.9
W35	LBFD	187	8.4	12.0	7.3	9.2	Very Severe	0.50	Orion Silt Loam	87	75,109	37.6	0.06	618	46.4	3.00	15.5
W36	LBFD	44	5.3	4.8	5.5	5.2	Moderate/Severe	0.25	Orion Silt Loam	87	4,976	2.5	0.05	499	2.5	3.00	0.8
W37	RBFD	30	6.2	6.8	6.4	6.5	Very Severe	0.50	Orion Silt Loam	87	8,439	4.2	0.05	520	4.4	3.00	1.5
Total	**-**	**2,965**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**791,543**	**395.8**	**-**	**-**	**416.6**	**-**	**137.2**

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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

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, and 25 were repaired during construction. Photographs of each streambank are shown in **Figures 42** through **67.** Post-construction photos of the banks can be found in the WQT Annual Reports in **Appendix J**. 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 re-estimated by dividing the estimated phosphorus loss for each bank by a trade ratio of 3.00 (accounting for an uncertainty factor of 3.0 for streambank stabilization and habitat restoration and a deliver factor or 0.00 due to updated SPARROW delivery fraction regions within the Searles Creek Watershed). A total of 294.9 lb/yr of phosphorus loss was estimated using **Equation 1**. Accounting for the updated trade ratio, a total of 98.3 lb/yr of phosphorus credits is anticipated to be generated for the stabilized banks on the Landowner B site into WQT Permit Term #2.

Figure 41: Map of originally proposed project site for Landowner B

Table 4: Phosphorus credit calculations for Landowner B

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)	Estimated Soil Loss (lb/yr)	Estimated Soil Loss (tons/yr)	Soil Total Phosphorus (%)	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	9,257	4.6	0.04	376	3.5	3.00	1.2
S2	RBFD	63	8.8	6.8	9.2	8.3	Very Severe	0.50	Orion Silt Loam	87	22,655	11.3	0.05	515	11.7	3.00	3.9
S3	LBFD	117	6.7	9.1	6.3	7.4	Very Severe	0.50	Orion Silt Loam	87	37,493	18.7	0.04	437	16.4	3.00	5.5
S4	RBFD	23	5.4	6.8	4.0	5.4	Severe	0.40	Orion Silt Loam	87	4,322	2.2	0.05	459	2.0	3.00	0.7
S5	LBFD	17	6.0	-	-	6.0	Severe	0.40	Orion Silt Loam	87	3,550	1.8	0.06	616	2.2	3.00	0.7
S6	RBFD	134	8.7	9.3	8.6	8.9	Very Severe	0.50	Orion Silt Loam	87	51,684	25.8	0.04	415	21.5	3.00	7.2
S7	LBFD	74	8.7	8.2	8.1	8.3	Very Severe	0.50	Orion Silt Loam	87	26,825	13.4	0.05	481	12.9	3.00	4.3
S8	RBFD	133	9.5	9.5	11.3	10.1	Very Severe	0.50	Orion Silt Loam	87	58,434	29.2	0.16	1,619	94.6	3.00	31.5
S9	LBFD	50	6.7	-	-	6.7	Moderate	0.13	Orion Silt Loam	87	3,789	1.9	0.12	1,233	4.7	3.00	1.6
S10	RBFD	46	9.0	10.6	7.6	9.1	Moderate/Severe	0.25	Orion Silt Loam	87	9,071	4.5	0.14	1,438	13.0	3.00	4.3
S11	LBFD	38	5.3	8.1	-	6.7	Moderate	0.13	Orion Silt Loam	87	2,880	1.4	0.05	457	1.3	3.00	0.4
S12	RBFD	135	8.2	6.3	7.3	7.3	Very Severe	0.50	Orion Silt Loam	87	42,674	21.3	0.04	412	17.6	3.00	5.9
S13	LBFD	31	5.9	6.9	6.3	6.4	Very Severe	0.50	Orion Silt Loam	87	8,585	4.3	0.05	492	4.2	3.00	1.4
S14	RBFD	43	8.7	10.6	8.6	9.3	Very Severe	0.50	Orion Silt Loam	87	17,396	8.7	0.05	507	8.8	3.00	2.9
S15	LBFD	34	5.5	6.1	5.1	5.6	Severe	0.40	Orion Silt Loam	87	6,586	3.3	0.03	345	2.3	3.00	0.8
S16	LBFD	32	9.8	8.6	7.0	8.5	Moderate/Severe	0.25	Orion Silt Loam	87	5,893	2.9	0.06	575	3.4	3.00	1.1
S17	RBFD	144	8.8	8.5	10.6	9.3	Very Severe	0.50	Orion Silt Loam	87	58,255	29.1	0.04	352	20.5	3.00	6.8
S18	RBFD	81	8.0	7.7	6.0	7.2	Moderate	0.13	Orion Silt Loam	87	6,627	3.3	0.05	546	3.6	3.00	1.2
S19	RBFD	58	8.0	6.7	6.8	7.2	Very Severe	0.50	Orion Silt Loam	87	18,082	9.0	0.06	555	10.0	3.00	3.3
S20	RBFD	32	9.5	8.2	10.2	9.3	Very Severe	0.50	Orion Silt Loam	87	12,946	6.5	0.04	418	5.4	3.00	1.8
S21	LBFD	91	7.9	8.6	7.0	7.8	Very Severe	0.50	Orion Silt Loam	87	31,008	15.5	0.06	553	17.1	3.00	5.7
S22	RBFD	32	8.9	7.2	6.4	7.5	Very Severe	0.50	Orion Silt Loam	87	10,440	5.2	0.04	442	4.6	3.00	1.5
S23	LBFD	30	8.4	9.0	8.4	8.6	Very Severe	0.50	Orion Silt Loam	88	11,352	5.7	0.04	386	4.4	3.00	1.5
S24	RBFD	33	2.6	2.9	4.7	3.4	Moderate	0.13	Orion Silt Loam	87	1,269	0.6	0.06	609	0.8	3.00	0.3
S25	RBFD	64	7.3	9.3	8.4	8.3	Very Severe	0.50	Orion Silt Loam	87	23,200	11.6	0.04	361	8.4	3.00	2.8
~~S26~~	~~RBFD~~	~~21~~	~~7.1~~	~~6.7~~	~~5.2~~	~~6.3~~	~~Very Severe~~	~~0.50~~	~~Orion Silt Loam~~	~~87~~	~~5,786~~	~~2.9~~	~~0.04~~	~~436~~	~~2.5~~	~~3.00~~	~~0.8~~
Total	-	**1,613**	-	-	-	-	-	-	-	-	**490,055**	**245.0**	-	-	**294.9**	-	**98.3**

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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

APPENDIX E

Barnyard Modeling Overview

APPENDIX E

BARNYARD MODELING OVERVIEW

1.1 BACKGROUND

The City of Brodhead is generating credits after the completion of installing clean water diversions and runoff collection infrastructure for the barnyards operated by Landowner C. In order to quantify the number of credits that are being generated by implementing barnyard improvements, phosphorus losses from the barnyards must be quantified based on existing conditions and based on the constructed improvements. Appendix E in the City's 2018 WQT Plan discusses more in-depth the two models which are commonly used in Wisconsin to estimate phosphorus losses from barnyards, which are the DNR's BARNY model and the USDA's APLE-Lots model. Because the BARNY model can be used to estimate phosphorus reductions caused by the implementation of typical BMP's for barnyards, BARNY was ultimately chosen to estimate phosphorus losses and credits for the barnyards operated by Landowner C. Revised credit calculations for the barnyard upgrades are included as part of this WQT Trading Plan to reflect updates to trade ratios, given the actual practices implemented match what was originally modeled for proposed post-BMP conditions in BARNY.

A total of four barnyards owned by Landowner C were modeled using BARNY. Maps of each barnyard lot pre- and post-construction are shown in **Figure 1** and **Figure 2**, respectively. Pictures of each lot prior to construction are shown in **Figure 3** through **Figure 7.** Photos of the barnyards after construction can be found in the WQT Annual Reports in **Appendix J**. Prior to construction, Lot #1 was a bare earthen exercise lot connected to Lot #2, a concrete lot used to house and feed young dairy heifers. Lot #3 was a concrete surfaced lot which houses heifers and dry cows. Lot #4 was a concrete surfaced lot which houses milking cows. Portions of Lots #2, #3, and #4 were covered by existing roofs without roof gutters.

The ultimate goal for Landowner C's barnyards was to achieve a "zero discharge" condition or near "zero discharge" condition for each of the identified lots. Improvements made to the four barnyard lots to achieve this goal that were completed in 2020 are described below:

Lot #1:

Lot #1 was completely abandoned to generate phosphorus credits for the City of Brodhead. Abandonment was completed by transferring animals from this lot to Lot #3. The abandoned lot was seeded with grass to develop a permanent vegetated cover. Livestock is not allowed to access the lot now that the abandonment is complete. The vegetated lot has been placed in a conservation easement and will continue for the life of the binding legal agreement with the City of Brodhead. Since Lot #1 was completely abandoned and converted to permanent vegetation, it is assumed that the phosphorus credits generated from Lot #1 is based on a trade ratio of 1.20:1 (Uncertainty Factor = 1.00 and Delivery Factor = 0.07, Minimum Trade Ratio = 1.20).

Lot #2:

To address concentrated runoff from Lot #2, a new waste/runoff reception tank was constructed. The new waste reception tank was installed on the southwest side of Lot #2, the side where runoff was being discharged. To facilitate the capture of runoff, the portion of the lot on the southwest side, outside the open face of the monoslope building was abandoned, reducing the size of the existing lot. Reducing the size of the lot acts as a clean water diversion since the area of the manure pack exposed to precipitation is now 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 is based on a trade ratio of 2.07:1 (Uncertainty Factory = 2.0 and Delivery Factor = 0.07).

Waste transfer piping was constructed to transfer runoff from the waste reception tank to the constructed waste storage facility with greater than 180 days of storage. Since the waste reception tank and waste transfer piping was designed to collect, store, and transport runoff from a 25-yr 24-hr design storm, it is assumed that Lot #2 is achieving the conditions of “zero discharge”. In order to conservatively estimate the total amount of phosphorus credits which are available for trading, no credit has been 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 has been 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 has been somewhat reduced by the installation of a new roof/building which was constructed primarily to cover Lot #4. A small portion of Lot #3 was also abandoned on the west side. Roof gutters were installed on all existing buildings which previously discharged roof runoff to the lot. Roof gutters were also installed on the new roof which covers 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 generates credits based on a trade ratio of 2.07:1 (Uncertainty Factor = 2.0 and Delivery Factor = 0.07).

The waste reception tank designed to capture runoff from Lot #3 was 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 were 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 has been 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 was improved by installing a new roof cover (122 ft x 116 ft) over the existing lot. The new roof cover reduced the lot size by approximately 87%. Only the southwest portion of the lot, directly east of the large freestall barn remains open after construction of the new roof cover. This portion of the lot used to transport milking cows from the freestall barn to the existing milking parlor does not have runoff collection. Therefore, this lot does not meet all the conditions of “zero discharge.”

Roof gutters were installed on the new building and the roofs of the existing buildings immediately north of Lot #4. These improvements prevent all runoff from tributary areas from contacting the remaining open potion of Lot #4. It is assumed that phosphorus reductions due to the installation of the new roof cover and roof gutters generate credits based on a trade ratio of 2.07:1 (Uncertainty Factor = 2.0 and Delivery Factor = 0.07).

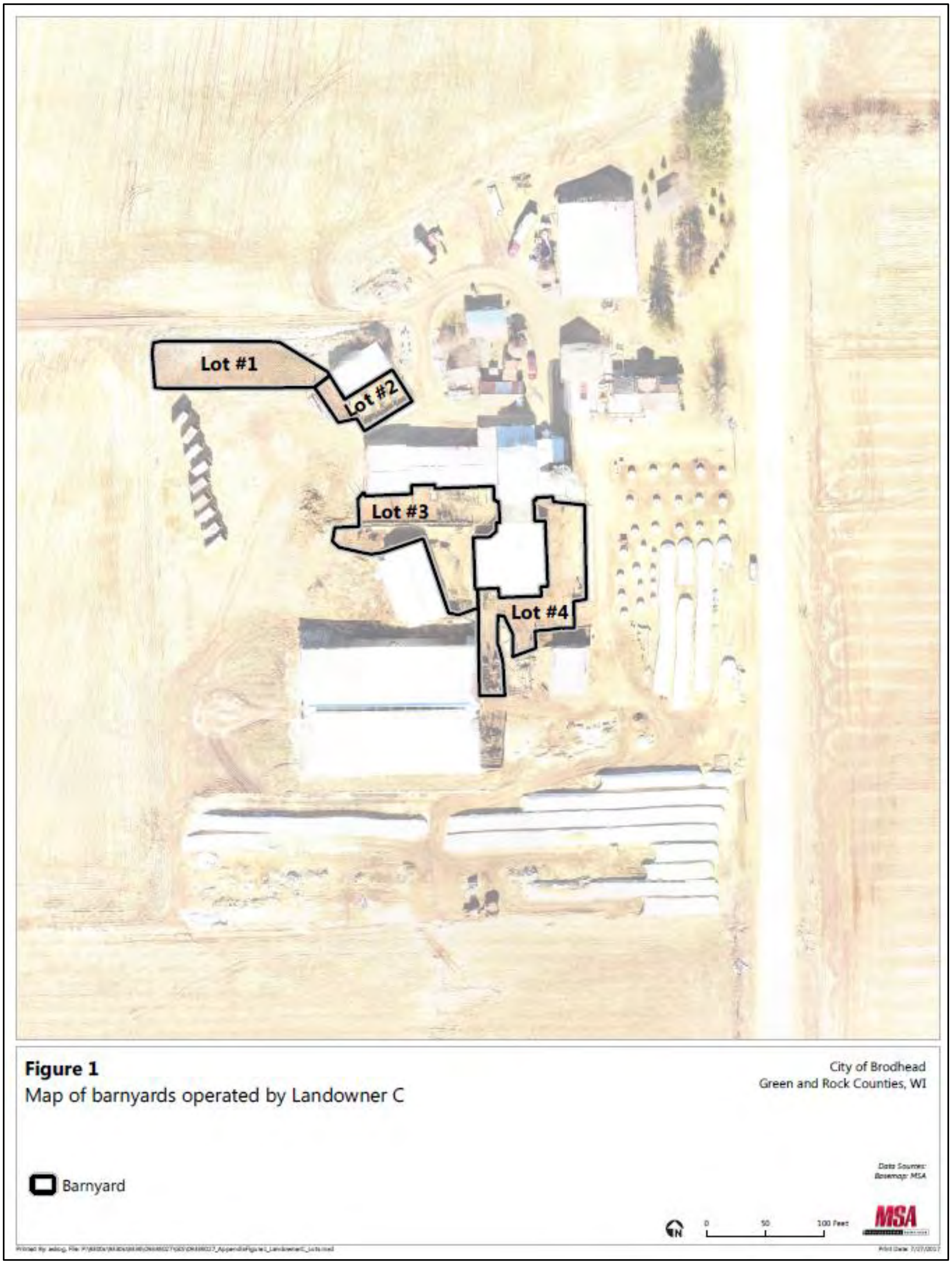


Figure 1: Map of barnyards operated by Landowner C (pre-construction)

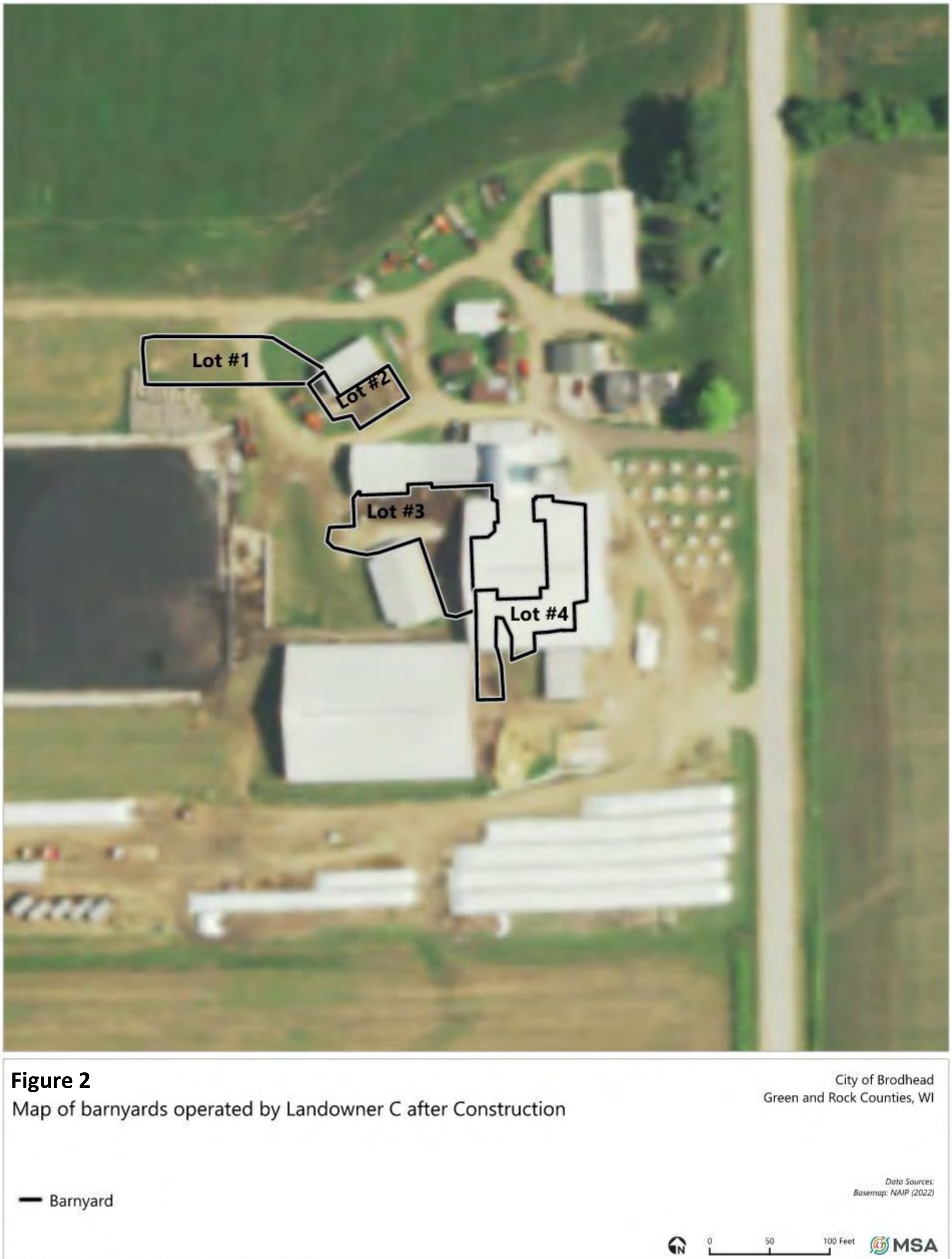


Figure 2: Map of barnyards operated by Landowner C (post-construction)

Figure 3: Photograph of Lot #1 (pre-construction)

Figure 4: Photograph of Lot #2 (pre-construction)

Figure 5: Photograph of north end of Lot #3 (pre-construction)

Figure 6: Photograph of south end of Lot #3 (pre-construction)

Figure 7: Photograph of Lot #4 (pre-construction)

1.2 METHODS

Input parameters for BARNY were estimated based on a walk over of the site and interviews with Landowner C prior to submission of the City's 2018 WQT Plan. Input parameters for BARNY are shown below. Lot areas had been 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

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 8** through **Figure 15** 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 8: 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	

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

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 9: 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

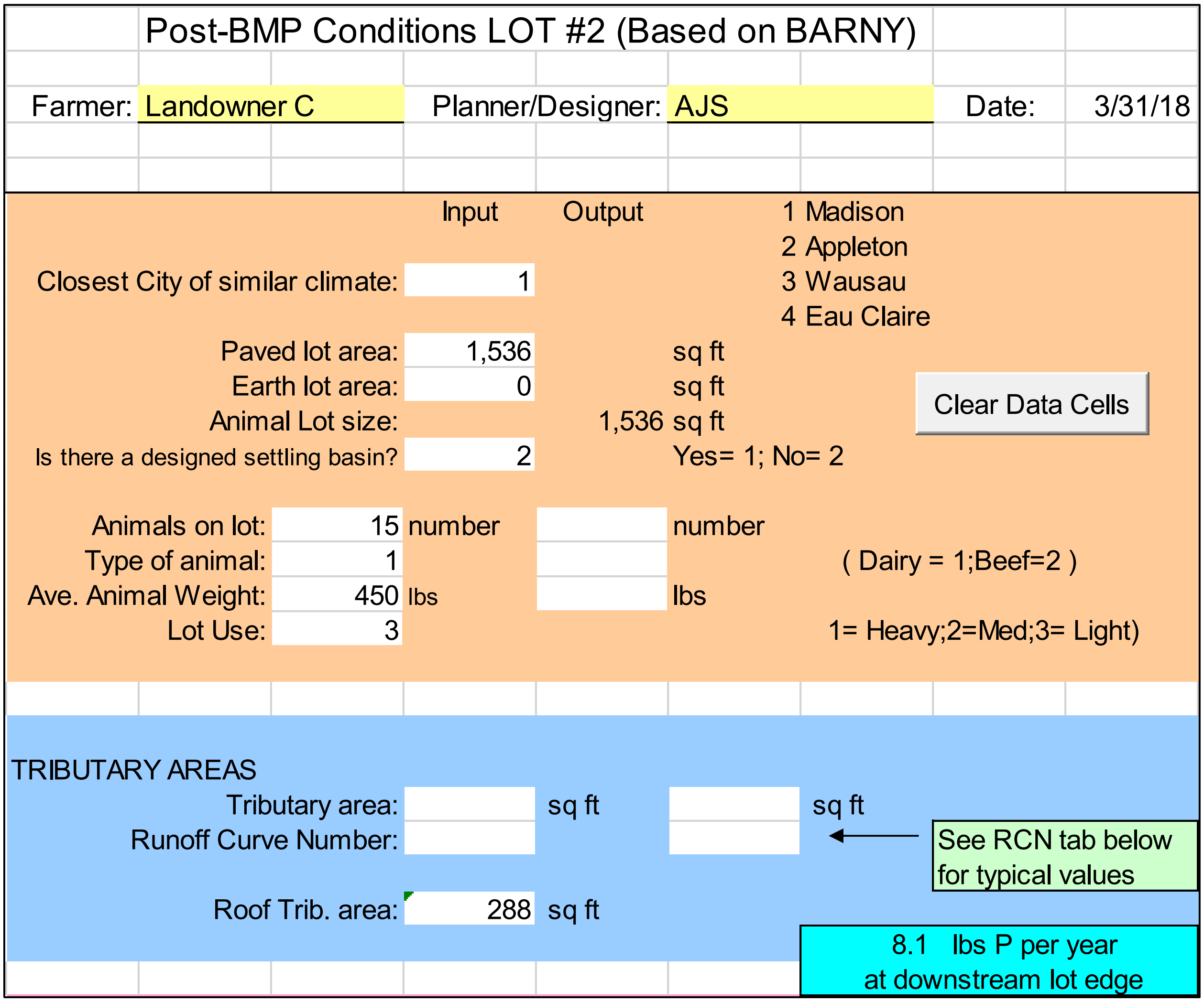
	Input		Output		
Closest City of similar climate:	1				1 Madison 2 Appleton 3 Wausau 4 Eau Claire
Paved lot area:	2,159			sq ft	
Earth lot area:	0			sq ft	Clear Data Cells
Animal Lot size:			2,159	sq ft	
Is there a designed settling basin?	2			Yes= 1; No= 2	
Animals on lot:	15	number		number	
Type of 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 10: 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	

	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

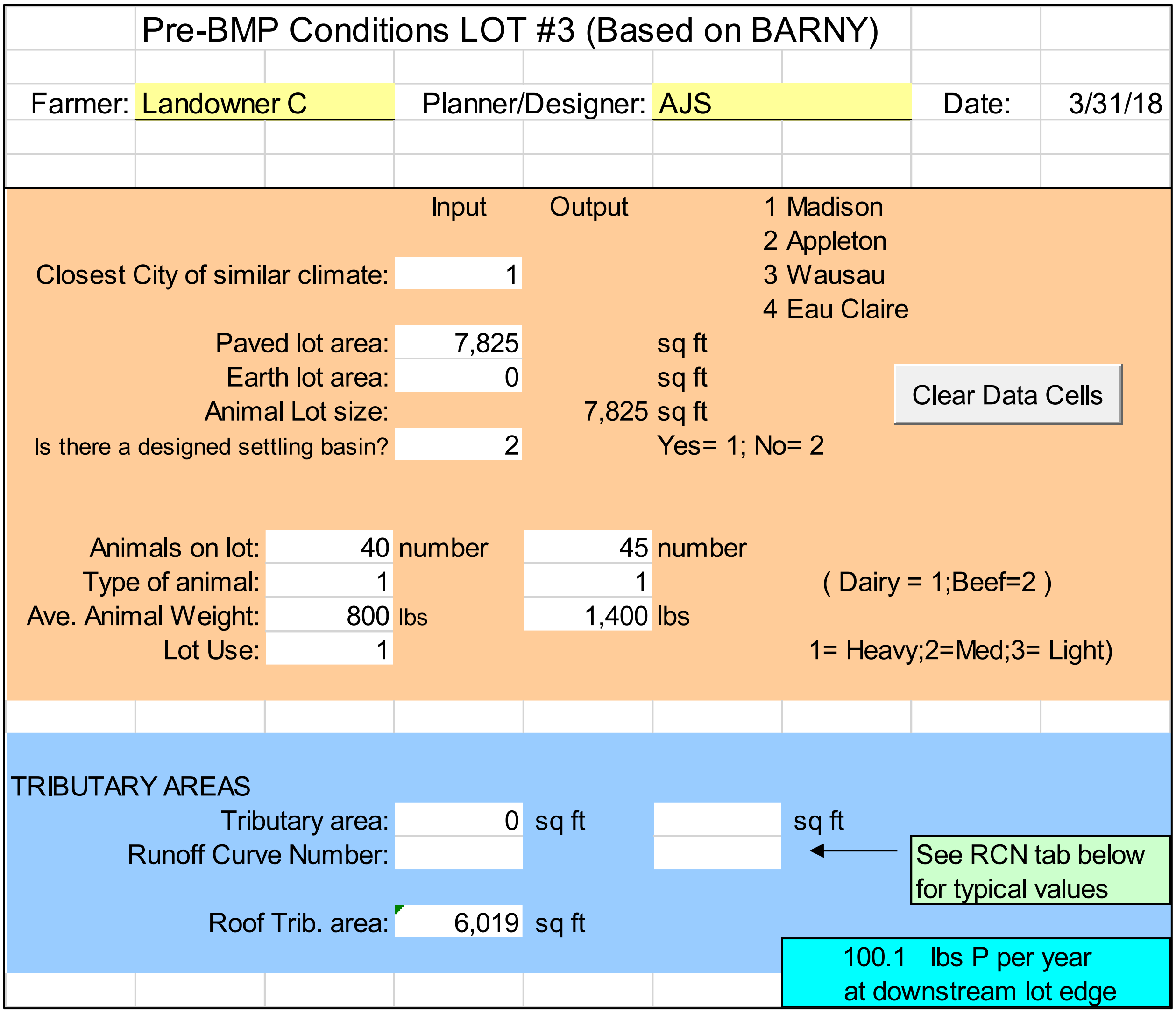
Tributary area:		sq ft		sq ft	
Runoff Curve Number:					See RCN tab below for typical values
Roof Trib. area:	288	sq ft			

8.1 lbs P per year
at downstream lot edge

Figure 11: 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	
Closest City of similar climate:	1		1 Madison 2 Appleton 3 Wausau 4 Eau Claire
Paved lot area:	7,825		sq ft
Earth lot area:	0		sq ft
Animal Lot size:		7,825	sq ft
Is there a designed settling basin?	2		Yes= 1; No= 2

Clear Data Cells

	Input		Output		
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:				
Roof Trib. area:	6,019	sq ft		

See RCN tab below for typical values

100.1 lbs P per year at downstream lot edge

Figure 12: 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	
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 13: 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	
			1 Madison
			2 Appleton
Closest City of similar climate:	1		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

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)

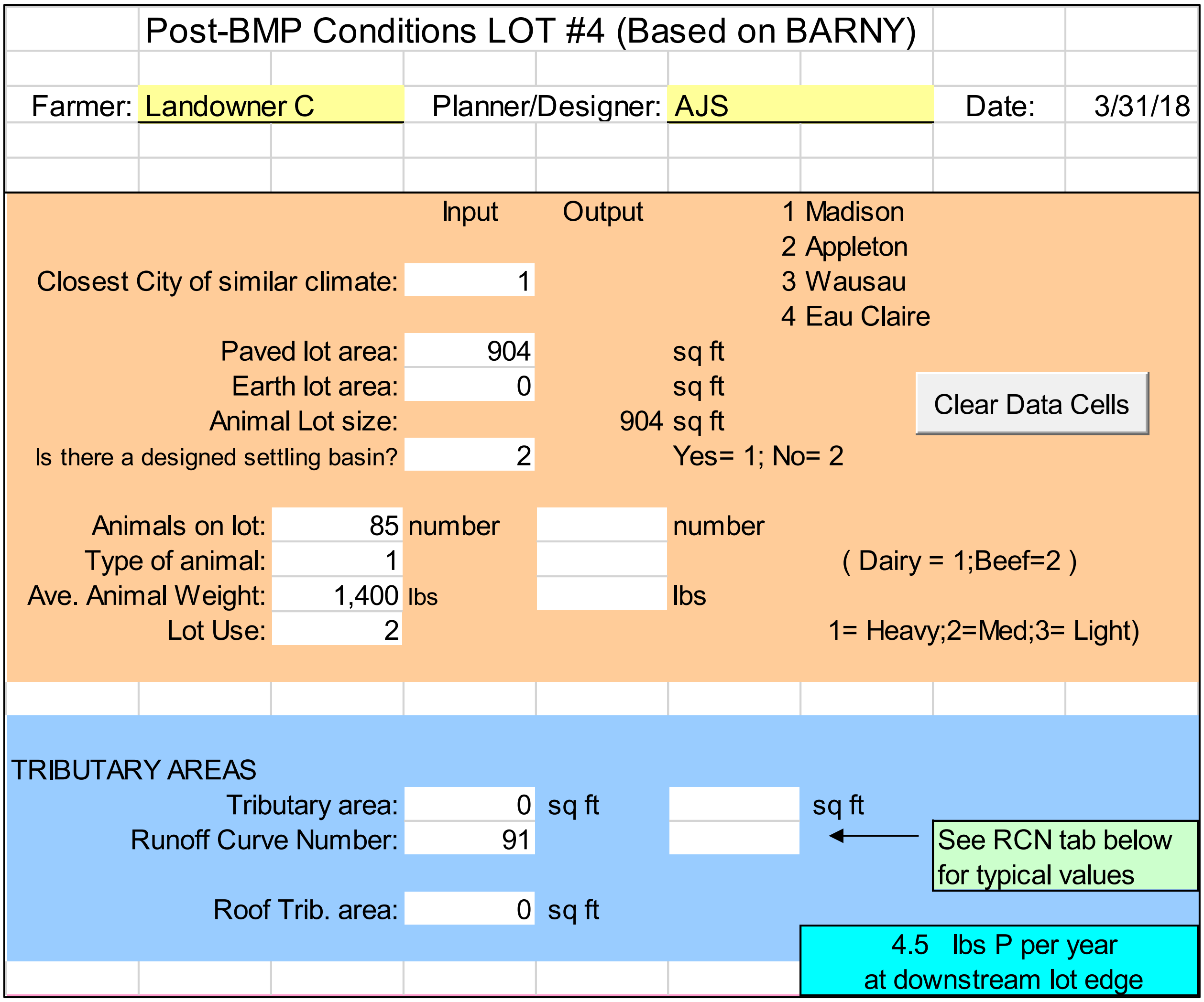
TRIBUTARY AREAS

Tributary area:	174	sq ft		sq ft
Runoff Curve Number:	91			
Roof Trib. area:	3,894	sq ft		

See RCN tab below for typical values

63.7 lbs P per year at downstream lot edge

Figure 14: 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 15: Screen capture of BARNY model for Lot #4 (Post-BMP Conditions)

1.3 RESULTS

A summary of the BARNY modeling results is shown in **Table 6**. As discussed in the City's 2018 WQT Plan, 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 78.8 lb/yr of phosphorus credit is expected to be generated as a result of implementing the proposed barnyard improvements for Landowner C into WQT Permit Term #2. 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 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 5: Summary of BARNY modeling results

Barnyard ID	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	22.9	0.0	22.9	1.20	19.1	Lot abandonment, critical area planting, and conservation easement
Lot #2	9.5	8.1	1.4	2.07	0.7	Reduce lot size, install waste reception tank, and install waste transfer piping
Lot #3	100.1	37.2	62.9	2.07	30.4	Reduce lot size, install roof runoff structures, install waste reception tank, and install waste transfer piping
Lot #4	63.7	4.5	59.2	2.07	28.6	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**	**-**	**78.8**	**-**

APPENDIX F

SnapPlus Modeling Overview

APPENDIX F

SNAPPLUS MODELING OVERVIEW

1.1 BACKGROUND

The City of Brodhead is generating 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 publicly 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 owned by Landowner C are shown in **Table 1**. As shown, the landowner owns approximately 70 acres of cropland. It is noted that the table does not include the acreage Landowner C rents, as not all rental fields are currently under a nutrient management plan. The process of including all of these rental fields under a nutrient management plan is ongoing and will continue to be pursued through the agreement between Landowner C and the City of Brodhead. Some manure stored in the new waste storage facility is applied to the fields owned by Landowner C. The farm operator has been actively using SnapPlus to track field operations since 2016 and has worked with Green County LWCD to update the farm's SnapPlus 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.

Prior to the implementation of BMPs and a nutrient management plan, Landowner C had difficulty complying with nutrient management requirements (e.g. tolerable soil loss and phosphorus index). Since development of the nutrient management plan in 2018, the landowner has been continuing to implement no-till practices and installing cover crops to reduce phosphorus losses from crop fields. Because the majority of Landowner C's rented ground is located in ineligible watersheds for trading, the City of Brodhead is only generating phosphorus credits from the fields owned by Landowner C. Landowner C continues to implement and update their nutrient management plan that was originally developed in 2018.

Maps and photos of crop fields owned by Landowner C are shown in **Figure 1** through **Figure 5**. Maps of the crop fields indicate field boundaries, topographic information, and the location of existing grassed waterways.

Table 1: List of crop fields Landowner C owns

Field ID	Acreage	HUC 12 Watershed	Management
3	14.45	Searles Creek	Owned
5	5.15	Searles Creek	Owned
7.8	7.05	Searles Creek	Owned
30	2.75	Searles Creek	Owned
31	2.31	Searles Creek	Owned
32.33	5.83	Searles Creek	Owned
36	3.42	Searles Creek	Owned
38	5.84	Searles Creek	Owned
40	6.29	Searles Creek	Owned
41	5.57	Searles Creek	Owned
43	2.79	Searles Creek	Owned
45	3.08	Searles Creek	Owned
47	3.34	Searles Creek	Owned
61-62	1.91	Searles Creek	Owned
Total	**69.78**		

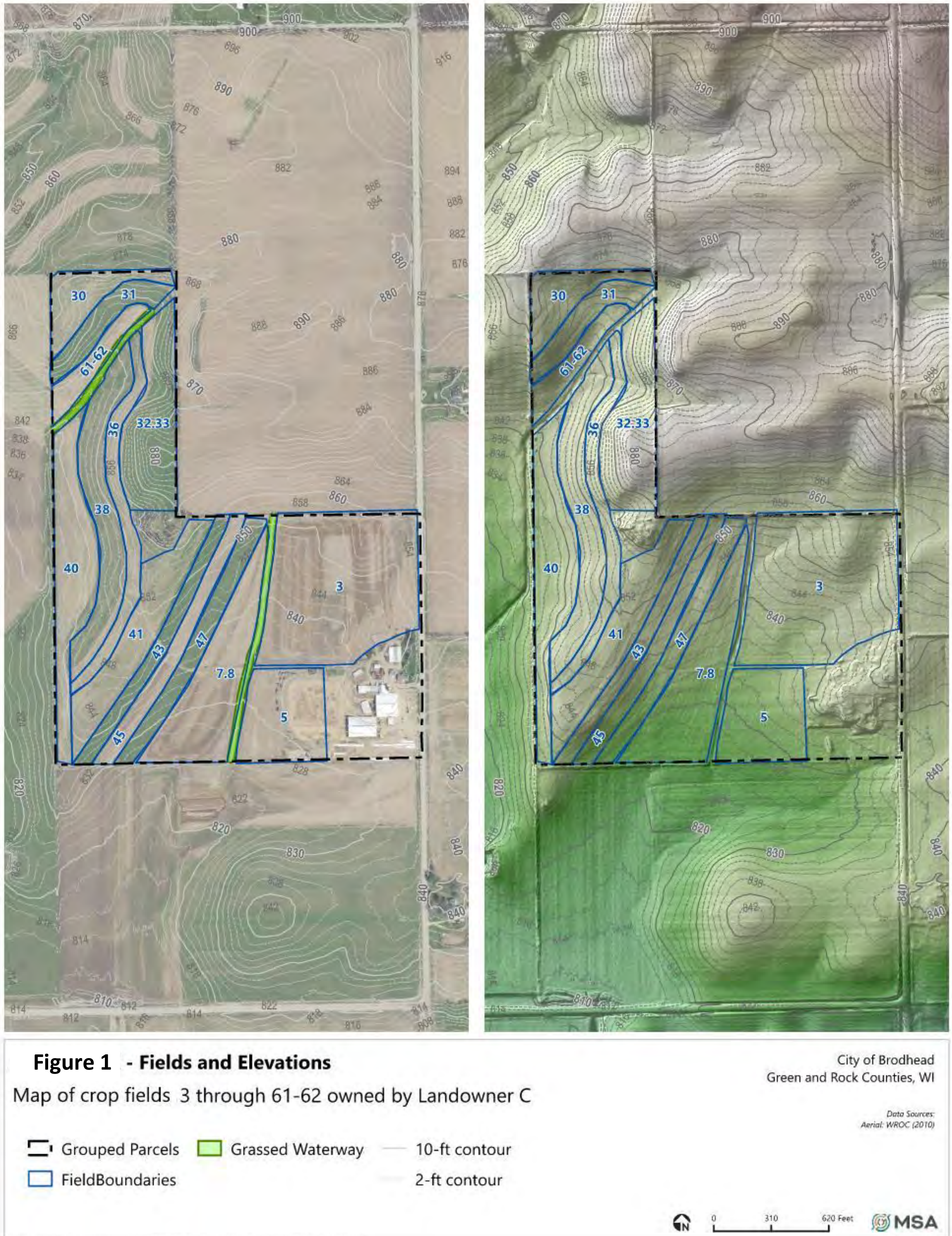


Figure 1: Map of crop fields 3 through 61-62 owned by Landowner C

Figure 2: Photo of grassed waterway between Fields 5 and 7.8 taken on November 20, 2023

Figure 3: Photo of Field 32 taken on November 20, 2023

Figure 4: Photo of Field 41 taken on November 20, 2023

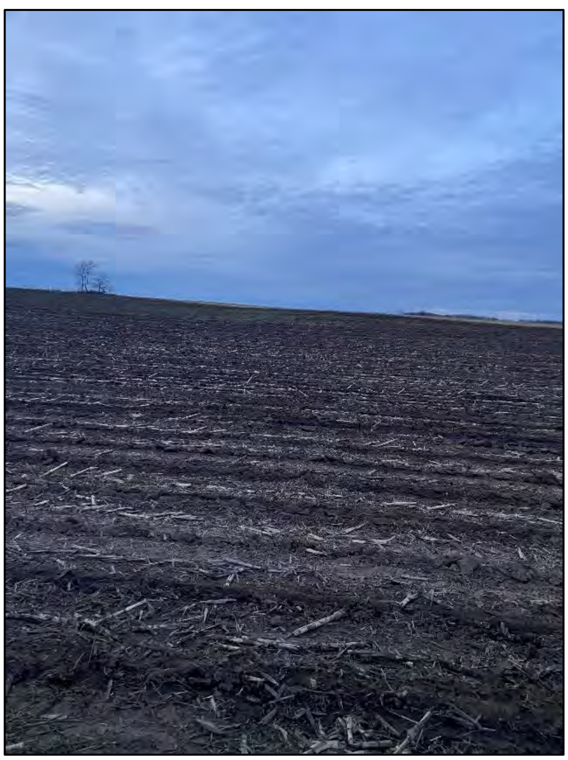


Figure 5: Photo of Field 62 taken on November 20, 2023

1.2 METHODS

In order to estimate phosphorus reductions from nutrient management and supporting practices, it is necessary to estimate phosphorus losses for baseline conditions (pre-BMP conditions) and for conditions after BMPs are implemented (post-BMP conditions). Baseline conditions for WQT Permit Term #2 utilize an 8-year rotational average of the original baseline modeled in the 2018 WQT Plan. The rotational average calculations using the original 2018 WQT baseline are shown in **Table 2**. Post-BMP conditions were updated through conversations with the landowner for planned cropping practices in the future and also assuming that no-till and cover crops would continue to be incorporated into the future cropping system. Both no-till and cover crops will allow Landowner C to continue maintaining compliance with tolerable soil and phosphorus index requirements. Pre- and post- BMP conditions were forecasted out for an 8-year crop rotation from 2021 to 2028. 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 practices and annually thereafter to more accurately calculate the number of phosphorus credits which are generated.

The rotational average values for each field were applied starting in 2024 for pre-BMP conditions, and the SnapPlus “P Trade Report” was run to update the post-BMP conditions. Phosphorus reductions were then calculated, as shown in **Table 3**. Phosphorus load reductions were estimated by subtracting the post-BMP conditions from the pre-BMP conditions. As shown, an average of approximately 276 lb/yr of phosphorus reduction will occur if Landowner C continues to incorporate no-till and cover cropping in the farm’s crop rotation through the nutrient management plan. As described earlier, the City of Brodhead only takes credit for the fields owned by Landowner C due the majority of rented fields being located in ineligible watersheds; therefore, only these owned fields were analyzed as part of the phosphorus reduction and credit calculations.

Table 2: Rotational average calculations from the original 2018 WQT Plan baseline model

Field ID	Crop Rotation (yrs)	Phosphorus Loss (lb/yr)								
		2018	2019	2020	2021	2022	2023	2024	2025	**Rot. Avg.**
3	8	122.8	128.5	129.7	130.4	131.0	131.5	132.1	132.7	**129.8**
5	8	67.3	70.4	71.0	71.3	71.5	71.8	72.0	72.2	**70.9**
7.8	8	46.6	49.0	49.5	49.7	50.0	50.2	50.4	50.6	**49.5**
30	8	3.1	2.6	4.5	7.1	9.2	10.1	7.7	5.2	**6.2**
31	8	1.7	2.4	5.4	7.2	7.9	6.1	4.1	3.1	**4.7**
32.33	8	41.5	24.4	21.2	9.7	4.7	16.2	33.1	42.3	**24.1**
36	8	20.7	31.0	25.6	16.3	14.7	5.6	2.6	10.7	**15.9**
38	8	13.7	12.3	7.6	26.4	50.5	48.4	41.5	26.3	**28.3**
40	8	22.3	31.4	26.9	21.2	20.9	9.3	5.0	12.1	**18.6**
41	8	13.3	15.5	24.2	26.7	21.5	14.1	12.9	7.3	**16.9**
43	8	11.5	8.0	7.6	4.2	2.5	5.1	9.0	11.3	**7.4**
45	8	12.6	17.5	28.5	31.4	25.9	13.5	12.3	6.3	**18.5**
47	8	15.2	11.0	10.4	5.9	3.6	7.1	12.3	15.4	**10.1**
61-62	8	1.7	1.4	2.3	2.9	4.1	4.8	3.9	2.9	**3.0**

Table 3: Phosphorus reductions estimated using the SnapPlus P Trade Report

Field ID	Acres	Scenario	PTP (lbs/year)							
			2021	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**
3	14.4	Baseline	130.4	131.0	131.5	129.8	129.8	129.8	129.8	129.8
		NMP & Supporting Practices	41.7	34.2	44.8	51.8	26.8	25.6	28.4	27.1
		Phosphorus Reduction	**88.6**	**96.8**	**86.8**	**78.0**	**103.0**	**104.3**	**101.4**	**102.8**
5	5.1	Baseline	71.3	71.5	71.8	70.9	70.9	70.9	70.9	70.9
		NMP & Supporting Practices	7.8	3.8	1.7	2.8	1.6	1.4	1.6	1.3
		Phosphorus Reduction	**63.4**	**67.8**	**70.1**	**68.1**	**69.3**	**69.5**	**69.4**	**69.6**
7.8	7	Baseline	49.7	50.0	50.2	49.5	49.5	49.5	49.5	49.5
		NMP & Supporting Practices	59.0	18.3	8.4	17.5	8.4	4.8	6.6	7.6
		Phosphorus Reduction	**-9.3**	**31.6**	**41.7**	**32.1**	**41.2**	**44.7**	**42.9**	**41.9**
30	2.7	Baseline	7.1	9.2	10.1	6.2	6.2	6.2	6.2	6.2
		NMP & Supporting Practices	1.7	6.4	5.5	10.7	2.0	2.7	2.0	1.6
		Phosphorus Reduction	**5.4**	**2.8**	**4.6**	**-4.5**	**4.1**	**3.4**	**4.1**	**4.6**
31	2.3	Baseline	7.2	7.9	6.1	4.7	4.7	4.7	4.7	4.7
		NMP & Supporting Practices	0.7	2.0	2.3	6.8	2.5	1.8	1.3	0.9
		Phosphorus Reduction	**6.5**	**5.9**	**3.8**	**-2.1**	**2.2**	**2.9**	**3.4**	**3.8**
32.33	5.8	Baseline	9.7	4.7	16.2	24.1	24.1	24.1	24.1	24.1
		NMP & Supporting Practices	10.1	8.8	12.0	17.5	10.8	10.7	11.9	14.1
		Phosphorus Reduction	**-0.4**	**-4.1**	**4.3**	**6.6**	**13.4**	**13.5**	**12.2**	**10.1**
36	3.4	Baseline	16.3	14.7	5.6	15.9	15.9	15.9	15.9	15.9
		NMP & Supporting Practices	5.6	10.7	11.3	7.8	4.7	5.5	7.5	8.8
		Phosphorus Reduction	**10.7**	**4.0**	**-5.8**	**8.1**	**11.2**	**10.4**	**8.4**	**7.0**
38	5.8	Baseline	26.4	50.5	48.4	28.3	28.3	28.3	28.3	28.3
		NMP & Supporting Practices	17.5	8.0	17.8	25.3	9.0	11.1	7.1	10.7
		Phosphorus Reduction	**8.9**	**42.6**	**30.7**	**3.1**	**19.3**	**17.2**	**21.2**	**17.7**
40	6.3	Baseline	21.2	20.9	9.3	18.6	18.6	18.6	18.6	18.6
		NMP & Supporting Practices	7.9	9.6	9.9	5.3	3.4	9.8	15.1	6.3
		Phosphorus Reduction	**13.3**	**11.3**	**-0.6**	**13.3**	**15.3**	**8.8**	**3.6**	**12.3**
41	5.6	Baseline	26.7	21.5	14.1	16.9	16.9	16.9	16.9	16.9
		NMP & Supporting Practices	31.3	9.3	7.3	14.4	5.0	5.9	4.2	5.7
		Phosphorus Reduction	**-4.6**	**12.2**	**6.8**	**2.6**	**11.9**	**11.1**	**12.8**	**11.3**
43	2.8	Baseline	4.2	2.5	5.1	7.4	7.4	7.4	7.4	7.4
		NMP & Supporting Practices	6.5	5.9	4.3	2.5	2.1	2.6	2.0	2.8
		Phosphorus Reduction	**-2.3**	**-3.4**	**0.8**	**4.9**	**5.3**	**4.8**	**5.3**	**4.6**
45	3.1	Baseline	31.4	25.9	13.5	18.5	18.5	18.5	18.5	18.5
		NMP & Supporting Practices	5.9	5.8	7.1	4.4	8.6	7.8	5.6	4.3
		Phosphorus Reduction	**25.6**	**20.1**	**6.4**	**14.1**	**9.9**	**10.7**	**12.9**	**14.2**
47	3.3	Baseline	5.9	3.6	7.1	10.1	10.1	10.1	10.1	10.1
		NMP & Supporting Practices	6.4	5.9	5.1	4.9	4.1	2.3	4.5	2.9
		Phosphorus Reduction	**-0.4**	**-2.3**	**2.0**	**5.2**	**6.0**	**7.8**	**5.6**	**7.2**
61-62	1.9	Baseline	2.9	4.1	4.8	3.0	3.0	3.0	3.0	3.0
		NMP & Supporting Practices	3.6	3.3	4.0	3.1	1.5	1.9	1.4	2.0
		Phosphorus Reduction	**-0.7**	**0.8**	**0.8**	**-0.1**	**1.5**	**1.1**	**1.6**	**1.0**
Total	69.5	Baseline	410.3	418.0	393.7	404.1	404.1	404.1	404.1	404.1
		NMP & Supporting Practices	205.6	131.9	141.4	174.7	90.3	94.0	99.2	96.0
		Phosphorus Reduction	**204.7**	**286.0**	**252.3**	**229.4**	**313.8**	**310.0**	**304.8**	**308.1**
		Avg. Reduction	**276.1**							

1.3 PHOSPHORUS CREDIT RESULTS

Phosphorus credit estimates for nutrient management improvements on crop fields owned by Landowner C are presented in **Table 4**. As summarized in **Table 4**, continued implementation of nutrient management and supporting practices by Landowner C are estimated to generate an average of 92.1 lb/yr of phosphorus credit through WQT Permit Term #2. 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 4: Phosphorus credits generated by implementing improved cropping practices

Field ID	Acres	Scenario	PTP (lbs/year)									
			Permit Term #1				Permit Term #2					
			2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
		Phosphorus Reduction	-30.8	-21.8	88.6	96.8	86.8	78.0	103.0	104.3	101.4	102.8
3	14.4	Trade Ratio	3.03	3.03	3.03	3.03	3.03	3.07	3.07	3.07	3.07	3.07
		Final Credit	**-10.2**	**-7.2**	**29.3**	**31.9**	**28.6**	**25.4**	**33.6**	**34.0**	**33.0**	**33.5**
		Phosphorus Reduction	58.6	61.6	63.4	67.8	70.1	68.1	69.3	69.5	69.4	69.6
5	5.1	Trade Ratio	3.03	3.03	3.03	3.03	3.03	3.07	3.07	3.07	3.07	3.07
		Final Credit	**19.3**	**20.3**	**20.9**	**22.4**	**23.1**	**22.2**	**22.6**	**22.6**	**22.6**	**22.7**
		Phosphorus Reduction	-15.3	-10.2	-9.3	31.6	41.7	32.1	41.2	44.7	42.9	41.9
7.8	7	Trade Ratio	3.03	3.03	3.03	3.03	3.03	3.07	3.07	3.07	3.07	3.07
		Final Credit	**-5.0**	**-3.4**	**-3.1**	**10.4**	**13.8**	**10.4**	**13.4**	**14.6**	**14.0**	**13.7**
		Phosphorus Reduction	-0.1	-1.1	5.4	2.8	4.6	-4.5	4.1	3.4	4.1	4.6
30	2.7	Trade Ratio	3.03	3.03	3.03	3.03	3.03	3.07	3.07	3.07	3.07	3.07
		Final Credit	**0.0**	**-0.4**	**1.8**	**0.9**	**1.5**	**-1.5**	**1.4**	**1.1**	**1.3**	**1.5**
		Phosphorus Reduction	-0.1	4.1	6.5	5.9	3.8	-2.1	2.2	2.9	3.4	3.8
31	2.3	Trade Ratio	3.03	3.03	3.03	3.03	3.03	3.07	3.07	3.07	3.07	3.07
		Final Credit	0.0	1.4	2.1	1.9	1.3	-0.7	0.7	0.9	1.1	1.2
		Phosphorus Reduction	-21.5	2.6	-0.4	-4.1	4.3	6.6	13.4	13.5	12.2	10.1
32.33	5.8	Trade Ratio	3.03	3.03	3.03	3.03	3.03	3.07	3.07	3.07	3.07	3.07
		Final Credit	**-7.1**	**0.9**	**-0.1**	**-1.4**	**1.4**	**2.2**	**4.4**	**4.4**	**4.0**	**3.3**
		Phosphorus Reduction	29.1	19.8	10.7	4.0	-5.8	8.1	11.2	10.4	8.4	7.0
36	3.4	Trade Ratio	3.03	3.03	3.03	3.03	3.03	3.07	3.07	3.07	3.07	3.07
		Final Credit	**9.6**	**6.5**	**3.5**	**1.3**	**-1.9**	**2.6**	**3.7**	**3.4**	**2.7**	**2.3**
		Phosphorus Reduction	3.6	2.6	8.9	42.6	30.7	3.1	19.3	17.2	21.2	17.7
38	5.8	Trade Ratio	3.03	3.03	3.03	3.03	3.03	3.07	3.07	3.07	3.07	3.07
		Final Credit	**1.2**	**0.8**	**2.9**	**14.0**	**10.1**	**1.0**	**6.3**	**5.6**	**6.9**	**5.8**
		Phosphorus Reduction	27.1	19.4	13.3	11.3	-0.6	13.3	15.3	8.8	3.6	12.3
40	6.3	Trade Ratio	3.03	3.03	3.03	3.03	3.03	3.07	3.07	3.07	3.07	3.07
		Final Credit	**9.0**	**6.4**	**4.4**	**3.7**	**-0.2**	**4.3**	**5.0**	**2.9**	**1.2**	**4.0**
		Phosphorus Reduction	-6.3	5.6	-4.6	12.2	6.8	2.6	11.9	11.1	12.8	11.3
41	5.6	Trade Ratio	3.03	3.03	3.03	3.03	3.03	3.07	3.07	3.07	3.07	3.07
		Final Credit	**-2.1**	**1.9**	**-1.5**	**4.0**	**2.2**	**0.8**	**3.9**	**3.6**	**4.2**	**3.7**
		Phosphorus Reduction	-3.8	-0.7	-2.3	-3.4	0.8	4.9	5.3	4.8	5.3	4.6
43	2.8	Trade Ratio	3.03	3.03	3.03	3.03	3.03	3.07	3.07	3.07	3.07	3.07
		Final Credit	**-1.2**	**-0.2**	**-0.7**	**-1.1**	**0.3**	**1.6**	**1.7**	**1.5**	**1.7**	**1.5**
		Phosphorus Reduction	15.4	23.7	25.6	20.1	6.4	14.1	9.9	10.7	12.9	14.2
45	3.1	Trade Ratio	3.03	3.03	3.03	3.03	3.03	3.07	3.07	3.07	3.07	3.07
		Final Credit	**5.1**	**7.8**	**8.4**	**6.6**	**2.1**	**4.6**	**3.2**	**3.5**	**4.2**	**4.6**
		Phosphorus Reduction	-1.4	2.1	-0.4	-2.3	2.0	5.2	6.0	7.8	5.6	7.2
47	3.3	Trade Ratio	3.03	3.03	3.03	3.03	3.03	3.07	3.07	3.07	3.07	3.07
		Final Credit	**-0.5**	**0.7**	**-0.1**	**-0.7**	**0.7**	**1.7**	**2.0**	**2.5**	**1.8**	**2.4**
		Phosphorus Reduction	-0.7	-3.3	-0.7	0.8	0.8	-0.1	1.5	1.1	1.6	1.0
61-62	1.9	Trade Ratio	3.03	3.03	3.03	3.03	3.03	3.07	3.07	3.07	3.07	3.07
		Final Credit	**-0.2**	**-1.1**	**-0.2**	**0.3**	**0.3**	**0.0**	**0.5**	**0.3**	**0.5**	**0.3**
		Phosphorus Reduction	53.9	104.4	204.7	286.0	252.3	229.4	313.8	310.0	304.8	308.1
Total	69.5	Trade Ratio	3.03	3.03	3.03	3.03	3.03	3.07	3.07	3.07	3.07	3.07
		Final Credit	**17.8**	**34.5**	**67.5**	**94.4**	**83.3**	**74.7**	**102.2**	**101.0**	**99.3**	**100.4**
		Avg. Credit	**53.9**				**92.1**					**100.4**

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, updated SnapPlus inputs and P-trade report outputs are provided in the following section. The P-trade report provided for the baseline condition is from the 2018 WQT Plan, since this data was utilized in calculating the rotational average for WQT Permit Term #2.

In addition, email correspondence from Green County LWCD regarding initial SnapPlus modeling efforts during the adoption of WQT is provided below. Landowner C has worked with Green County LWCD to update their NMP throughout WQT Permit Term #1 and will continue to do so into WQT Permit Term #2.

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,
[Landowner C]
I have reviewed and worked with [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.

FM6: Soil Test Report

Reported For	Riemer_Farms
Printed	2024-02-15
Plan Completion/Update Date	2022-01-03
SnapPlus Version 20.4 built on 2021-06-03	
G:\09\09336\09336055\Calculations\SnapPlus \Riemer_Farms2021_snap_actual_fromJordanRiemer_01.23.2024.snapDb	

Prepared for:
Riemer_Farms
attn:Riemer_Farms

			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	Home	14.4	SyB2	SYLVESTER	2023-03-18			3	3	7.4	3.4	78	135	1.8	16
3	Home	14.4	SyB2	SYLVESTER	2019-04-09	Rock River Lab	220600	3	3	7.2	3.9	106	287	0	21
3	Home	14.4	SyB2	SYLVESTER	2015-11-13	AgSource	768330	3	3	7.4	4.2	94	203	0	0
30	Home	2.7	SyC2	SYLVESTER	2023-03-18			1	1	7.1	3.6	43	94	2.2	19
30	Home	2.7	SyC2	SYLVESTER	2019-04-09	Rock River Lab	220600	1	1	7.2	3.9	55	164	0	18
30	Home	2.7	SyC2	SYLVESTER	2015-11-13	AgSource	768330	1	1	7.3	4.1	27	67	0	0
31	Home	2.3	SyC2	SYLVESTER	2023-03-18			1	1	7.1	3.6	43	94	2.2	19
31	Home	2.3	SyC2	SYLVESTER	2019-04-09	Rock River Lab	220600	1	1	7.1	3.5	17	81	0	16
31	Home	2.3	SyC2	SYLVESTER	2015-11-13	AgSource	768330	1	1	7.3	3.8	19	60	0	0
32.33	Home	5.8	SyC2	SYLVESTER	2023-03-18			1	2	7.1	3.6	57	125	2.1	17
32.33	Home	5.8	SyC2	SYLVESTER	2019-04-09	Rock River Lab	220600	1	2	7.0	3.1	31	104	0	15
32.33	Home	5.8	SyC2	SYLVESTER	2015-11-13	AgSource	768330	1	2	7.3	3.4	33	113	0	0
36	Home	3.4	SyC2	SYLVESTER	2023-03-18			1	2	7.2	3.3	71	146	2.1	15
36	Home	3.4	SyC2	SYLVESTER	2019-04-09	Rock River Lab	220600	1	2	7.2	3.7	34	141	0	19
36	Home	3.4	SyC2	SYLVESTER	2015-11-13	AgSource	768330	1	1	7.3	3.9	38	83	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
38	Home	5.8	SyC2	SYLVESTER	2023-03-18			1	2	7.1	3.2	57	133	2.2	16
38	Home	5.8	SyC2	SYLVESTER	2019-04-09	Rock River Lab	220600	1	2	7.2	3.5	68	165	0	18
38	Home	5.8	SyC2	SYLVESTER	2015-11-13	AgSource	768330	1	2	7.4	4.0	68	125	0	0
40	Home	6.3	TbB	TAMA	2023-03-18			1	1	7.3	2.9	25	64	2.2	17
40	Home	6.3	TbB	TAMA	2019-04-09	Rock River Lab	220600	1	1	7.1	4.0	57	132	0	19
40	Home	6.3	TbB	TAMA	2015-11-13	AgSource	768330	1	1	7.3	4.2	51	79	0	0
41	Home	5.6	SyB2	SYLVESTER	2023-03-18			1	2	7.3	3.2	49	97	2	16
41	Home	5.6	SyB2	SYLVESTER	2019-04-09	Rock River Lab	220600	1	1	7.2	3.9	96	127	0	19
41	Home	5.6	SyB2	SYLVESTER	2015-11-13	AgSource	768330	1	1	7.3	3.8	41	73	0	0
43	Home	2.8	SyB2	SYLVESTER	2023-03-18			1	1	7.4	2.7	55	142	2.8	16
43	Home	2.8	SyB2	SYLVESTER	2019-04-09	Rock River Lab	220600	1	1	6.9	3.8	122	221	0	16
43	Home	2.8	SyB2	SYLVESTER	2015-11-13	AgSource	768330	1	1	7.4	3.8	53	146	0	0
45	Home	3.1	NoC2	NORTHFIELD	2023-03-18			1	1	7.2	3.5	49	75	1.8	17
45	Home	3.1	NoC2	NORTHFIELD	2019-04-09	Rock River Lab	220600	1	1	7.2	3.7	75	158	0	18
45	Home	3.1	NoC2	NORTHFIELD	2015-11-13	AgSource	768330	1	1	7.3	4.0	41	70	0	0
47	Home	3.3	SyB2	SYLVESTER	2023-03-18			1	1	7.2	3.5	49	75	1.8	17
47	Home	3.3	SyB2	SYLVESTER	2019-04-09	Rock River Lab	220600	1	1	7.2	4.1	90	125	0	18
47	Home	3.3	SyB2	SYLVESTER	2015-11-13	AgSource	768330	1	1	7.4	4.1	78	144	0	0
5	Home	2.3	HvA	HUNTSVILLE	2023-03-18			1	1	7.3	3.7	37	45	2.2	17
5	Home	2.3	HvA	HUNTSVILLE	2019-04-09	Rock River Lab	220600	1	1	7.2	3.8	119	259	0	20
5	Home	2.3	HvA	HUNTSVILLE	2015-11-13	AgSource	768330	1	1	7.2	4.7	294	393	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
61-62	Home	1.9	TbB	TAMA	2023-03-18			**1**	**1**	6.9	3.4	43	129	2.1	16
61-62	Home	1.9	TbB	TAMA	2019-04-09	Rock River Lab	220600	**1**	**1**	7.1	3.1	20	89	0	16
61-62	Home	1.9	TbB	TAMA	2015-11-13	AgSource	768330	**1**	**1**	7.2	3.8	20	51	0	0
7.8	Home	7	TbB	TAMA	2023-03-18			**1**	**3**	7.3	3.3	37	60	2.2	16
7.8	Home	7	TbB	TAMA	2019-04-09	Rock River Lab	220600	**1**	**2**	7.2	4.1	163	296	0	21
7.8	Home	7	TbB	TAMA	2015-11-13	AgSource	768330	**1**	**2**	7.3	4.5	143	223	0	0
Baumgartner East		70.1	LlA	LAWLER	2021-04-07			**14**	**17**	5.5	2.2	53	100	3.7	13
Baumgartner Stacy		12.8	FoB2	FOX	2021-04-07			**3**	**3**	6.1	1.4	17	93	3.4	9
Baumgartner West		77.1	FsA	FOX	2021-04-07			**15**	**16**	5.2	1.4	29	110	3.8	6
Baumgartner1	Baugartner	12.3	Mc	MARSHAN	2019-04-09	Rock River Lab	220599	**2**	**4**	6.1	4.7	58	68	0	18
Baumgartner2	Baugartner	7.5	Mc	MARSHAN	2019-04-09	Rock River Lab	220599	**2**	**2**	6.9	4.3	50	71	0	20
Baumgartner3	Baugartner	7.7	Me	MAUMEE	2019-04-09	Rock River Lab	220599	**2**	**3**	6.8	3.9	113	109	0	18
Bryce 1		69.8	DsA	DOWNS	2023-03-11			**6**	**14**	6.7	4.8	73	269	0	0
Bryce 3		46	Ot	OSSIAN	2023-03-11			**9**	**9**	6.4	5.2	14	87	0	0
Bryce 4		63	Ot	OSSIAN	2023-03-11			**13**	**6**	6.7	4.1	15	106	0	0
Bryce 5		44.6	LaB	LAMARTINE	2021-11-23			**9**	**8**	6.8	5.3	15	82	0	0
Klausner1	Klausner	11.7	NoC2	NORTHFIELD	2023-03-18			**2**	**3**	7.0	2.8	13	39	1.9	13
Klausner1	Klausner	11.7	NoC2	NORTHFIELD	2019-04-29	Rock River Lab	221750	**2**	**2**	5.8	4.4	12	79	0	14
Kopp	Kopp	22.8	OcA	OCKLEY	2020-04-09	AgSource	748085	**5**	**5**	5.7	1.1	12	97	8.9	0
Kopp	Kopp	22.8	OcA	OCKLEY	2017-02-19			**5**	**1**	6.8	2.0	101	100	0	0
NC Farm River 2		30.6	Mc	MARSHAN	2023-11-21			**6**	**7**	5.5	6.5	37	79	5.7	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
NC Farm River 1		4	LIA	LAWLER	2023-11-21			**1**	**1**	6.5	4.7	32	95	6.4	0
NC Farm River 3		9.9	Mc	MARSHAN	2023-11-21			**2**	**3**	5.5	7.8	15	61	5.5	0
Popanz1	Popanz	20	DcA	DICKMAN	2023-03-18			**4**	**4**	6.1	1.2	43	83	1.4	3
Popanz1	Popanz	20	DcA	DICKMAN	2019-04-09	Rock River Lab	22094	**4**	**6**	6.5	1.4	51	88	0	5
Popanz2	Popanz	17.3	DcA	DICKMAN	2023-03-18			**3**	**3**	6.2	0.8	25	57	1.2	3
Popanz2	Popanz	17.3	DcA	DICKMAN	2019-04-09	Rock River Lab	220594	**3**	**4**	6.3	1.1	57	76	0	3
Popanz3	Popanz	5	Me	MAUMEE	2023-03-18			**1**	**2**	6.2	2.2	34	52	2.8	5
Popanz3	Popanz	5	Me	MAUMEE	2019-04-09	Rock River Lab	220594	**1**	**2**	6.5	1.8	53	56	0	6
Popanz4	Popanz	11.1	DcA	DICKMAN	2023-03-18			**2**	**2**	6.1	1.3	27	47	1.6	4
Popanz4	Popanz	11.1	DcA	DICKMAN	2019-04-09	Rock River Lab	220594	**2**	**3**	6.1	1.7	40	76	0	4
Schwartzlow1	Schwartzlow	12.4	NgC2	NEWGLARUS	2023-03-18			**2**	**2**	7.2	3.5	54	119	2.4	17
Schwartzlow1	Schwartzlow	12.4	NgC2	NEWGLARUS	2019-04-09	Rock River Lab	220597	**2**	**3**	6.9	3.3	11	89	0	17
Schwartzlow1	Schwartzlow	12.4	NgC2	NEWGLARUS	2017-02-19			**2**	**1**	6.8	2.0	101	100	0	0
Schwartzlow5	Schwartzlow	7.8	PgB2	PALSGROVE	2023-03-18			**2**	**2**	7.1	3.1	37	94	2.6	16
Schwartzlow5	Schwartzlow	7.8	PgB2	PALSGROVE	2019-04-09	Rock River Lab	220597	**2**	**2**	6.4	3.4	20	81	0	15
Schwartzlow5	Schwartzlow	7.8	PgB2	PALSGROVE	2017-02-19			**2**	**1**	6.8	2.0	101	100	0	0
Swartzlow4	Schwartzlow	13.2	NgC2	NEWGLARUS	2023-03-18			**3**	**2**	7.5	3.3	35	128	2.2	15
Swartzlow4	Schwartzlow	13.2	NgC2	NEWGLARUS	2019-04-09	Rock River Lab	220597	**3**	**3**	6.8	3.1	26	109	0	15
Swartzlow4	Schwartzlow	13.2	NgC2	NEWGLARUS	2017-02-13			**3**	**1**	6.8	2.0	101	100	0	0
Whitehead1	Whitehead	15.5	Dc	DEL REY	2020-04-09	AgSource	748085	**3**	**5**	7.0	4.7	8	85	0	18

			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
Whitehead2	Whitehead	19.9	Dc	DEL REY	2020-04-09	AgSource	748085	**4**	**6**	5.7	2.3	8	81	0	9
Whitehead3	Whitehead	4.7	ThA	THACKERY	2020-04-09	AgSource	748085	**1**	**1**	6.2	2.5	14	90	0	11
Whitehead4	Whitehead	31.9	PnB2	PECATONICA	2020-04-09	AgSource	748085	**6**	**7**	6.1	1.9	9	88	0	8
Whitehead5	Whitehead	12.2	Dc	DEL REY	2020-04-09	AgSource	748085	**2**	**3**	5.8	1.8	6	85	0	7
Wickline1	Wickline	12.3	GoA	GOTHAM	2023-03-18			**2**	**3**	6.6	1.2	57	76	1.5	5
Wickline1	Wickline	12.3	GoA	GOTHAM	2017-10-12	a&l great lakes lab	35026	**2**	**3**	6.2	1.1	60	53	0	4
Wickline2	Wickline	9.7	GoA	GOTHAM	2023-03-18			**2**	**2**	6.7	1.3	43	77	1.8	4
Wickline2	Wickline	9.7	GoA	GOTHAM	2017-10-12	A&L great lakes lab	35024	**2**	**2**	6.4	1.4	29	39	0	5

Crop Year Soil Test Needed

Field Name	Soil Test Date	2020	2021	2022	2023	2024	2025	2026	2027	2028
3	2023-03-18								X	
30	2023-03-18								X	
31	2023-03-18								X	
32.33	2023-03-18								X	
36	2023-03-18								X	
38	2023-03-18								X	
40	2023-03-18								X	
41	2023-03-18								X	
43	2023-03-18								X	
45	2023-03-18								X	
47	2023-03-18								X	
5	2023-03-18								X	
61-62	2023-03-18								X	
7.8	2023-03-18								X	

SnapPlus Soil Test Report

Field Name	Soil Test Date	2020	2021	2022	2023	2024	2025	2026	2027	2028
Baumgartner East	2021-04-07						X			
Baumgartner Stacy	2021-04-07						X			
Baumgartner West	2021-04-07						X			
Baumgartner1	2019-04-09				X					
Baumgartner2	2019-04-09				X					
Baumgartner3	2019-04-09				X					
Bryce 1	2023-03-11								X	
Bryce 3	2023-03-11								X	
Bryce 4	2023-03-11								X	
Bryce 5	2021-11-23							X		
Klausner1	2023-03-18								X	
Kopp	2020-04-09					X				
NC Farm River 2	2023-11-21									X
NC Farm River 1	2023-11-21									X
NC Farm River 3	2023-11-21									X
Popanz1	2023-03-18								X	
Popanz2	2023-03-18								X	
Popanz3	2023-03-18								X	
Popanz4	2023-03-18								X	
Schwartzlow1	2023-03-18								X	
Schwartzlow5	2023-03-18								X	
Swartzlow4	2023-03-18								X	
Whitehead1	2020-04-09					X				
Whitehead2	2020-04-09					X				
Whitehead3	2020-04-09					X				
Whitehead4	2020-04-09					X				

Field Name	Soil Test Date	2020	2021	2022	2023	2024	2025	2026	2027	2028
Whitehead5	2020-04-09					X				
Wickline1	2023-03-18								X	
Wickline2	2023-03-18								X	

NM1: Narrative and Crops Report

Starting Year	**2016**
Reported For	**Landowner C Pre-BMP (Fields 3-SL)**
Printed	**2024-02-16**
Plan Completion/Update Date:	**2017-02-10**
SnapPlus Version 20.4 built on 2021-06-03	
C:\Users\user\OneDrive - URUS\MSA\Brodhead Files\Riemer Farms \Riemer_Farms2018manure_no_storageAJS.snapDb	

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

Farm has 43 fields totalling 782.7 cropped acres.
Farm Narrative: None

Annual Farm Notes:

No Annual Farm Notes

Spreader Calibration Methods: Custom applications, Equipment calibration, Amount applied / Acres

Narrative and Crops:

Field Name	Field Acres	2016	2017	2018	2019	2020	2021	2022	2023
3	13.8	Corn grain Spring Chisel, no disk 191-210 bu/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 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

Field Name	Field Acres	2016	2017	2018	2019	2020	2021	2022	2023
31	2.3	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 (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
32.33	5.1	Oatlage w/ Alfalfa Seeding Spring Spring Chisel, no disk 2.0-3.5 ton/acre	Corn silage Spring Cultivation 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
36	4.3	Alfalfa None 4.6-5.5 ton/acre	Alfalfa 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 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
38	5.5	Corn grain Spring Chisel, no disk 191-210 bu/acre	Oats w/ Alfalfa Seeding Spring Spring Chisel, disked 61-90 bu/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
40	5.4	Alfalfa None 4.6-5.5 ton/acre	Alfalfa 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 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
41	5.3	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	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

Field Name	Field Acres	2016	2017	2018	2019	2020	2021	2022	2023
43	3.4	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	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
45	2.6	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	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
47	2.8	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	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
5	2.4	Corn grain Spring Chisel, no disk 191-210 bu/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 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
7.8	8.5	Corn grain Spring Chisel, no disk 191-210 bu/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	Field Acres	2016	2017	2018	2019	2020	2021	2022	2023
Baumgartner 1	13.2					Corn grain, baled stalks No Till 151-170/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 151-170/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 151-170/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 151-170/2.1-3 bu/acre/ton/acre
Baumgartner 2	7					Corn grain, baled stalks No Till 151-170/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 151-170/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 151-170/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 151-170/2.1-3 bu/acre/ton/acre
Baumgartner 3	8.7					Corn grain, baled stalks No Till 151-170/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 151-170/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 151-170/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 151-170/2.1-3 bu/acre/ton/acre
Baumgartner East	84.9					Soybeans 30-36 inch row Spring Cultivation 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 191-210 bu/acre	Soybeans 30-36 inch row Spring Cultivation 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre
Baumgartner Stacy	13					Soybeans 30-36 inch row Spring Cultivation 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 191-210 bu/acre	Soybeans 30-36 inch row Spring Cultivation 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre
Baumgartner West	75					Soybeans 30-36 inch row Spring Cultivation 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 191-210 bu/acre	Soybeans 30-36 inch row Spring Cultivation 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre
Bryce 1	69.9								Corn grain Spring Chisel, disked 191-210 bu/acre
Bryce 3	47.6								Sorghum-sudan forage Spring MB Plow 5-7 ton/acre

Field Name	Field Acres	2016	2017	2018	2019	2020	2021	2022	2023
Bryce 4	64.8								Corn grain Spring MB Plow 191-210 bu/acre
Bryce 5	44.3								Winter Triticale (grain) No Till 1000-5000 lb/acre
Klausner 1	11.6					Soybeans 30-36 inch row Spring Cultivation 56-65 bu/acre	Corn silage to small grain cover crop Fall Chisel, disked , cover crop disked 20.1-25 ton/acre	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn grain No Till, planted green 151-170 bu/acre
Kopp	23.8				Winter wheat (grain) to small grain cover crop No Till, cover crop no till 61-80 bu/acre	Soybeans 7-10 inch row No Till 36-45 bu/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Sorghum-sudan forage to small grain cover crop Spring Cultivation, cover crop disked 5-7 ton/acre	Corn silage No Till, planted green 20.1-25 ton/acre
NC Farm River 1	4.2						Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre
NC Farm River 2	31.8						Corn grain, baled stalks Spring Cultivation 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks Spring Cultivation 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks Spring Cultivation 111-130/2.1-3 bu/acre/ton/acre
NC Farm River 3	10.4						Corn grain, baled stalks Spring Cultivation 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks Spring Cultivation 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks Spring Cultivation 111-130/2.1-3 bu/acre/ton/acre

Field Name	Field Acres	2016	2017	2018	2019	2020	2021	2022	2023
Popanz 1	21					Alfalfa None 2.6-3.5 ton/acre	Corn grain to small grain cover crop Spring Chisel, no disk, cover crop disked 151-170 bu/acre	Soybeans 30-36 inch row No Till 46-55 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 151-170 bu/acre
Popanz 2	17.5				Alfalfa None 3.6-4.5 ton/acre	Corn grain to small grain cover crop No Till, cover crop no till 171-190 bu/acre	Soybeans 30-36 inch row No Till 56-65 bu/acre	Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop disked 171-190 bu/acre
Popanz 3	4.9					Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 151-170 bu/acre	Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 151-170 bu/acre
Popanz 4	11.4					Soybeans 7-10 inch row No Till 46-55 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 151-170 bu/acre	Soybeans 30-36 inch row No Till 46-55 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 151-170 bu/acre
Schwartzlow 1	12.7				Alfalfa (grassy, yr 3+) None 2.6-3.5 ton/acre	Corn silage No Till 20.1-25 ton/acre	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn silage No Till, planted green 15.1-20 ton/acre	Winter Triticale (forage) to Corn silage, 30 inch row No Till 2.0-3.5/20.1-25 ton/acre/ton/acre
Schwartzlow 4	13.1				Corn grain No Till 171-190 bu/acre	Winter Triticale (forage) to Sorghum-sudangrass No Till 2.0-3.5/5-7 ton/acre/ton/acre	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn silage No Till, planted green 25.1-30 ton/acre	Winter Triticale (forage) to Soybeans, 7-10 inch row No Till 2.0-3.5/56-65 ton/acre/bu/acre

Field Name	Field Acres	2016	2017	2018	2019	2020	2021	2022	2023
Schwartzlow 5	8.2				Alfalfa None 4.6-5.5 ton/acre	Corn silage No Till, planted green 20.1-25 ton/acre	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn silage No Till, planted green 20.1-25 ton/acre	Winter Triticale (forage) to Soybeans, 7-10 inch row No Till 2.0-3.5/56-65 ton/acre/bu/acre
Whitehead 1	21.2					Corn grain to small grain cover crop Spring Chisel, no disk, cover crop no till 131-150 bu/acre	Soybeans 30-36 inch row No Till 46-55 bu/acre	Corn grain to small grain cover crop No Till, cover crop disked 131-150 bu/acre	Corn grain No Till, planted green 151-170 bu/acre
Whitehead 2	20.8					Corn grain to small grain cover crop Spring Chisel, no disk, cover crop no till 131-150 bu/acre	Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre
Whitehead 3	4.9					Corn grain to small grain cover crop Spring Chisel, no disk, cover crop no till 131-150 bu/acre	Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop disked 131-150 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 36-45 bu/acre
Whitehead 4	34.7					Corn grain to small grain cover crop Spring Chisel, no disk, cover crop disked 131-150 bu/acre	Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop disked 131-150 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre
Whitehead 5	12.4					Corn grain to small grain cover crop Spring Chisel, no disk, cover crop disked 131-150 bu/acre	Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop disked 131-150 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre

Field Name	Field Acres	2016	2017	2018	2019	2020	2021	2022	2023
Wickline 1	13.9					Soybeans 7-10 inch row No Till 46-55 bu/acre	Corn silage to small grain cover crop No Till, cover crop disked 15.1-20 ton/acre	Soybeans 30-36 inch row Fall vertical tillage 46-55 bu/acre	Corn grain No Till 131-150 bu/acre
Wickline 2	9.7					Winter wheat (grain) to small grain cover crop No Till, cover crop no till 41-60 bu/acre	Corn silage to small grain cover crop Fall Chisel, disked , cover crop disked 15.1-20 ton/acre	Soybeans 30-36 inch row No Till 46-55 bu/acre	Corn grain No Till 131-150 bu/acre

Summary by Crop:

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

Crops Grouped By Category		2016	2017	2018	2019	2020	2021	2022	2023
Corn grain	Acres bu	30 6,015			13 2,347				364 65,702
Corn silage to small grain cover crop	Acres ton	14 316	39 879	34 767	33 744	33 744	89 2,007	30 677	36 812
Alfalfa	Acres ton	17 86	17 86	10 51	42 212	32 162	12 61	17 86	15 76
Alfalfa (1st cut) to Corn grain	Acres bu				2 361	5 903			
Winter wheat (grain +straw) to Late-Direct Seeded Legume Forage	Acres bu/ton			11 556		12 846	5 353	8 404	
Alfalfa (grassy, yr 3+)	Acres ton			10 51	18 91	6 30	11 56	11 56	10 51
Corn silage	Acres ton		5 113		10 226	21 474	8 180	34 597	29 654
Oatlage w/ Alfalfa Seeding Spring	Acres ton	5 14							

Crops Grouped By Category		2016	2017	2018	2019	2020	2021	2022	2023
Oats w/ Alfalfa Seeding Spring	Acres bu		6 453						
Corn grain, baled stalks	Acres bu/ton					29 4,655/74	75 12,038/191	75 12,038/191	75 12,038/191
Corn grain to small grain cover crop	Acres bu					112 20,216	210 42,105	94 13,207	55 8,828
Soybeans 30-36 inch row	Acres bu					189 11,435	112 6,776	251 15,186	
Sorghum-sudan forage	Acres ton								48 288
Winter Triticale (grain)	Acres lb								44 132,000
Sorghum-sudan forage to small grain cover crop	Acres ton						34 204	35 210	
Soybeans 7-10 inch row	Acres bu					49 1,985			
Winter wheat (grain) to small grain cover crop	Acres bu				24 1,692	10 505			
Winter Triticale (forage) to Corn silage, 30 inch row	Acres ton/ton								13 36/293
Winter Triticale (forage) to Sorghum-sudangrass	Acres ton/ton					13 36/78			
Winter Triticale (forage) to Soybeans, 7-10 inch row	Acres ton/bu								21 58/1,271

Crops Grouped By Category		2016	2017	2018	2019	2020	2021	2022	2023
Soybeans to small grain cover crop	Acres bu								73 4,417

NM1: Narrative and Crops Report

Starting Year	**2021**
Reported For	**Landowner C Pre-BMP (Fields 3-SL)**
Printed	**2024-02-16**
Plan Completion/Update Date:	**2017-02-10**
SnapPlus Version 20.4 built on 2021-06-03	
C:\Users\user\OneDrive - URUS\MSA\Brodhead Files\Riemer Farms \Riemer_Farms2018manure_no_storageAJS.snapDb	

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

Farm has 43 fields totalling 782.7 cropped acres.
Farm Narrative: None

Annual Farm Notes:

No Annual Farm Notes

Spreader Calibration Methods: Custom applications, Equipment calibration, Amount applied / Acres

Narrative and Crops:

Field Name	Field Acres	2021	2022	2023	2024	2025	2026	2027	2028
3	13.8	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
30	2.8	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	Corn silage Fall Chisel, disked 20.1-25 ton/acre	Winter wheat (grain +straw) Fall Chisel, disked 61-80 bu/acre	Alfalfa Seeding Spring Fall Chisel, disked 2.6-3.5 ton/acre

Field Name	Field Acres	2021	2022	2023	2024	2025	2026	2027	2028
31	2.3	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 silage No Till 15.1-20 ton/acre	Alfalfa Seeding Spring Fall Chisel, disked 2.6-3.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre
32.33	5.1	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) Fall Chisel, disked 61-80 bu/acre	Alfalfa Seeding Spring Fall Chisel, disked 2.6-3.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre
36	4.3	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 Fall Chisel, disked 15.1-20 ton/acre	Winter wheat (grain +straw) Fall Chisel, disked 61-80 bu/acre	Alfalfa Seeding Spring Fall Chisel, disked 2.6-3.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre
38	5.5	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) Fall Chisel, disked 61-80 bu/acre	Alfalfa Seeding Spring Fall Chisel, disked 2.6-3.5 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
40	5.4	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 Fall Chisel, disked 15.1-20 ton/acre	Winter wheat (grain +straw) Fall Chisel, disked 61-80 bu/acre	Alfalfa Seeding Spring Fall Chisel, disked 2.6-3.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre
41	5.3	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 Fall Chisel, disked 20.1-25 ton/acre	Winter wheat (grain +straw) Fall Chisel, disked 61-80 bu/acre
43	3.4	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) Fall Chisel, disked 61-80 bu/acre	Alfalfa Seeding Spring Fall Chisel, disked 1.0-2.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre

Field Name	Field Acres	2021	2022	2023	2024	2025	2026	2027	2028
45	2.6	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	Corn silage Fall Chisel, disked 20.1-25 ton/acre	Winter wheat (grain +straw) Fall Chisel, disked 61-80 bu/acre	Alfalfa Seeding Spring Fall Chisel, disked 2.6-3.5 ton/acre
47	2.8	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) Fall Chisel, disked 81-100 bu/acre	Corn silage Spring Chisel, no disk 20.1-25 ton/acre	Corn silage Spring Chisel, no disk 20.1-25 ton/acre
5	2.4	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
61-62	1.9	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 (grassy, yr 3+) None 3.6-4.5 ton/acre	Corn silage Fall Chisel, disked 20.1-25 ton/acre	Corn silage Fall Chisel, disked 20.1-25 ton/acre	Winter wheat (grain +straw) Fall Chisel, disked 81-100 bu/acre
7.8	8.5	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
Baumgartner 1	13.2	Corn grain, baled stalks No Till 151-170/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 151-170/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 151-170/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 151-170/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 151-170/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 151-170/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 151-170/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 151-170/2.1-3 bu/acre/ton/acre
Baumgartner 2	7	Corn grain, baled stalks No Till 151-170/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 151-170/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 151-170/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 151-170/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 151-170/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 151-170/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 151-170/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 151-170/2.1-3 bu/acre/ton/acre

Field Name	Field Acres	2021	2022	2023	2024	2025	2026	2027	2028
Baumgartner 3	8.7	Corn grain, baled stalks No Till 151-170/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 151-170/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 151-170/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 151-170/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 151-170/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 151-170/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 151-170/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 151-170/2.1-3 bu/acre/ton/acre
Baumgartner East	84.9	Corn grain to small grain cover crop No Till, cover crop no till 191-210 bu/acre	Soybeans 30-36 inch row Spring Cultivation 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre	Soybeans 30-36 inch row Spring Cultivation 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre	Soybeans 30-36 inch row Spring Cultivation 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre	Soybeans 30-36 inch row Spring Cultivation 56-65 bu/acre
Baumgartner Stacy	13	Corn grain to small grain cover crop No Till, cover crop no till 191-210 bu/acre	Soybeans 30-36 inch row Spring Cultivation 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre	Soybeans 30-36 inch row Spring Cultivation 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre	Soybeans 30-36 inch row Spring Cultivation 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre	Soybeans 30-36 inch row Spring Cultivation 56-65 bu/acre
Baumgartner West	75	Corn grain to small grain cover crop No Till, cover crop no till 191-210 bu/acre	Soybeans 30-36 inch row Spring Cultivation 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre	Soybeans 30-36 inch row Spring Cultivation 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre	Soybeans 30-36 inch row Spring Cultivation 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre	Soybeans 30-36 inch row Spring Cultivation 56-65 bu/acre
Bryce 1	69.9			Corn grain Spring Chisel, disked 191-210 bu/acre	Pea, field to Sorghum forage crop 1: Spring vertical till, crop 2: Vertical till 1-2/10-20	Corn grain Spring Chisel, disked 191-210 bu/acre	Soybeans 30-36 inch row Spring vertical tillage 56-65 bu/acre	Corn grain Spring Chisel, disked 191-210 bu/acre	Soybeans 30-36 inch row Spring vertical tillage 56-65 bu/acre
Bryce 3	47.6			Sorghum-sudan forage Spring MB Plow 5-7 ton/acre	Sweet Corn late plant (June10 or Later) with small grain cover crop Chisel Plow, disked, cover crop disked 6.1-8 ton/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Soybeans 30-36 inch row Spring vertical tillage 56-65 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Soybeans 30-36 inch row Spring vertical tillage 56-65 bu/acre
Bryce 4	64.8			Corn grain Spring MB Plow 191-210 bu/acre	Winter Triticale (forage) to Corn silage, 30 inch row Chisel Plow, disked 2.0-3.5/20.1-25 ton/acre/ton/acre	Corn grain Fall Chisel, disked 191-210 bu/acre	Soybeans 30-36 inch row Fall vertical tillage 56-65 bu/acre	Corn grain Fall Chisel, disked 191-210 bu/acre	Soybeans 30-36 inch row Fall vertical tillage 56-65 bu/acre

Field Name	Field Acres	2021	2022	2023	2024	2025	2026	2027	2028
Bryce 5	44.3			Winter Triticale (grain) No Till 1000-5000 lb/acre	Sweet Corn late plant (June10 or Later) with small grain cover crop Chisel Plow, disked, cover crop disked 6.1-8 ton/acre	Corn grain Fall Chisel, disked 171-190 bu/acre	Soybeans 30-36 inch row Spring vertical tillage 56-65 bu/acre	Corn grain Fall Chisel, disked 171-190 bu/acre	Soybeans 30-36 inch row Spring vertical tillage 56-65 bu/acre
Klausner 1	11.6	Corn silage to small grain cover crop Fall Chisel, disked , cover crop disked 20.1-25 ton/acre	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn grain No Till, planted green 151-170 bu/acre	Soybeans 30-36 inch row No Till 46-55 bu/acre	Soybeans 30-36 inch row Spring Cultivation 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre	Soybeans 30-36 inch row Spring Cultivation 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre
Kopp	23.8	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Sorghum-sudan forage to small grain cover crop Spring Cultivation, cover crop disked 5-7 ton/acre	Corn silage No Till, planted green 20.1-25 ton/acre	Winter wheat (grain) to small grain cover crop No Till, cover crop no till 61-80 bu/acre	Corn silage Fall Chisel, disked 20.1-25 ton/acre	Soybeans 30-36 inch row Fall Chisel, disked 56-65 bu/acre	Corn silage Fall Chisel, disked 20.1-25 ton/acre	Soybeans 30-36 inch row Fall Chisel, disked 56-65 bu/acre
NC Farm River 1	4.2	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre
NC Farm River 2	31.8	Corn grain, baled stalks Spring Cultivation 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks Spring Cultivation 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks Spring Cultivation 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks Spring Cultivation 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks Spring Cultivation 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks Spring Cultivation 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks Spring Cultivation 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks Spring Cultivation 111-130/2.1-3 bu/acre/ton/acre
NC Farm River 3	10.4	Corn grain, baled stalks Spring Cultivation 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks Spring Cultivation 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks Spring Cultivation 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks Spring Cultivation 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks Spring Cultivation 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks Spring Cultivation 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks Spring Cultivation 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks Spring Cultivation 111-130/2.1-3 bu/acre/ton/acre
Popanz 1	21	Corn grain to small grain cover crop Spring Chisel, no disk, cover crop disked 151-170 bu/acre	Soybeans 30-36 inch row No Till 46-55 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 151-170 bu/acre	Soybeans 30-36 inch row No Till 46-55 bu/acre	Corn grain Spring vertical tillage 151-170 bu/acre	Soybeans 30-36 inch row No Till 46-55 bu/acre	Corn grain Spring vertical tillage 151-170 bu/acre	Soybeans 30-36 inch row No Till 46-55 bu/acre

Field Name	Field Acres	2021	2022	2023	2024	2025	2026	2027	2028
Popanz 2	17.5	Soybeans 30-36 inch row No Till 56-65 bu/acre	Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop disked 171-190 bu/acre	Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop disked 171-190 bu/acre	Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 171-190 bu/acre	Soybeans 30-36 inch row No Till 56-65 bu/acre
Popanz 3	4.9	Corn grain to small grain cover crop No Till, cover crop no till 151-170 bu/acre	Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 151-170 bu/acre	Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre
Popanz 4	11.4	Corn grain to small grain cover crop No Till, cover crop no till 151-170 bu/acre	Soybeans 30-36 inch row No Till 46-55 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 151-170 bu/acre	Soybeans 30-36 inch row No Till 46-55 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 46-55 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 46-55 bu/acre
Schwartzlow 1	12.7	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn silage No Till, planted green 15.1-20 ton/acre	Winter Triticale (forage) to Corn silage, 30 inch row No Till 2.0-3.5/20.1-25 ton/acre/ton/acre	Corn silage No Till 20.1-25 ton/acre	Sorghum-sudan forage No Till 5-7 ton/acre	Corn silage to small grain cover crop Fall Chisel, disked , cover crop disked 20.1-25 ton/acre	Soybeans 30-36 inch row Fall Chisel, disked 46-55 bu/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 20.1-25 ton/acre
Schwartzlow 4	13.1	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn silage No Till, planted green 25.1-30 ton/acre	Winter Triticale (forage) to Soybeans, 7-10 inch row No Till 2.0-3.5/56-65 ton/acre/bu/acre	Corn silage No Till 20.1-25 ton/acre	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn silage No Till, planted green 25.1-30 ton/acre	Winter Triticale (forage) to Soybeans, 7-10 inch row No Till 2.0-3.5/46-55 ton/acre/bu/acre	Corn silage No Till, planted green 25.1-30 ton/acre
Schwartzlow 5	8.2	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn silage No Till, planted green 20.1-25 ton/acre	Winter Triticale (forage) to Soybeans, 7-10 inch row No Till 2.0-3.5/56-65 ton/acre/bu/acre	Corn silage No Till, planted green 20.1-25 ton/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre	Corn silage No Till, planted green 20.1-25 ton/acre	Winter Triticale (forage) to Soybeans, 7-10 inch row No Till 2.0-3.5/56-65 ton/acre/bu/acre	Corn silage No Till, planted green 20.1-25 ton/acre
Whitehead 1	21.2	Soybeans 30-36 inch row No Till 46-55 bu/acre	Corn grain to small grain cover crop No Till, cover crop disked 131-150 bu/acre	Corn grain No Till, planted green 151-170 bu/acre	Corn grain No Till, planted green 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 46-55 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 111-130 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 46-55 bu/acre	Corn grain No Till, planted green 151-170 bu/acre

Field Name	Field Acres	2021	2022	2023	2024	2025	2026	2027	2028
Whitehead 2	20.8	Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre	Corn grain No Till, planted green 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 46-55 bu/acre	Corn grain No Till, planted green 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 46-55 bu/acre	Corn grain No Till, planted green 151-170 bu/acre
Whitehead 3	4.9	Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop disked 131-150 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 36-45 bu/acre	Corn grain No Till, planted green 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre	Corn grain No Till, planted green 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre	Corn grain No Till, planted green 151-170 bu/acre
Whitehead 4	34.7	Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop disked 131-150 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre	Corn grain No Till, planted green 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop disked 46-55 bu/acre	Corn grain No Till, planted green 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre	Corn grain No Till, planted green 151-170 bu/acre
Whitehead 5	12.4	Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop disked 131-150 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre	Corn grain No Till, planted green 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre	Corn grain No Till, planted green 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 46-55 bu/acre	Corn grain No Till, planted green 151-170 bu/acre
Wickline 1	13.9	Corn silage to small grain cover crop No Till, cover crop disked 15.1-20 ton/acre	Soybeans 30-36 inch row Fall vertical tillage 46-55 bu/acre	Corn grain No Till 131-150 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre	Corn grain No Till, planted green 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre	Corn grain No Till, planted green 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre
Wickline 2	9.7	Corn silage to small grain cover crop Fall Chisel, disked , cover crop disked 15.1-20 ton/acre	Soybeans 30-36 inch row No Till 46-55 bu/acre	Corn grain No Till 131-150 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre	Corn grain No Till, planted green 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre	Corn grain No Till, planted green 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre

Summary by Crop:

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

Crops Grouped By Category		2021	2022	2023	2024	2025	2026	2027	2028
Corn silage to small grain cover crop	Acres ton	89 2,007	30 677	36 812	36 812	25 564	37 834	25 564	37 834

Crops Grouped By Category		2021	2022	2023	2024	2025	2026	2027	2028
Alfalfa	Acres ton	12 61	17 86	15 76	15 76	3 15	6 30	8 40	26 131
Alfalfa Seeding Spring	Acres ton					6 18	2 6	18 55	5 15
Corn silage	Acres ton	8 180	34 597	29 654	34 767	45 1,015	29 654	34 767	24 541
Winter wheat (grain +straw)	Acres bu				6 423		21 1,481	5 353	7 494
Winter wheat (grain +straw) to Late-Direct Seeded Legume Forage	Acres bu/ton	5 353	8 404						
Alfalfa (1st cut) to Corn silage	Acres ton					2 35			
Alfalfa (grassy, yr 3+)	Acres ton	11 56	11 56	10 51	10 51	10 51	5 25		
Corn grain, baled stalks	Acres bu/ton	75 12,038/191	75 12,038/191	75 12,038/191	75 12,038/191	75 12,038/191	75 12,038/191	75 12,038/191	75 12,038/191
Corn grain	Acres bu			364 65,702	94 15,087	444 80,142	84 15,162	444 80,142	106 19,133
Corn grain to small grain cover crop	Acres bu	210 42,105	94 13,207	55 8,828		34 6,137	21 2,531	34 6,137	
Soybeans 30-36 inch row	Acres bu	112 6,776	251 15,186		239 14,460	12 726	462 27,951	24 1,452	462 27,951
Pea, field to Sorghum forage	Acres				70 105/1,050				
Sorghum-sudan forage	Acres ton			48 288		13 78			

Crops Grouped By Category		2021	2022	2023	2024	2025	2026	2027	2028
Sweet Corn late plant (June10 or Later) with small grain cover crop	Acres ton				92 649				
Winter Triticale (forage) to Corn silage, 30 inch row	Acres ton/ton			13 36/293	65 179/1,466				
Winter Triticale (grain)	Acres lb			44 132,000					
Sorghum-sudan forage to small grain cover crop	Acres ton	34 204	35 210			13 78			
Winter wheat (grain) to small grain cover crop	Acres bu				24 1,692				
Soybeans to small grain cover crop	Acres bu			73 4,417	24 1,452	102 6,171	40 2,420	94 4,747	40 2,420
Winter Triticale (forage) to Soybeans, 7-10 inch row	Acres ton/bu			21 58/1,271				21 58/1,061	

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 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	
C:\SnapPlus2\MySnapPlusData \Riemer_Farms2018manure_no_storageAJS.snapDb	

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**

NM1: Narrative and Crops Report

Starting Year	**2016**
Reported For	**Riemer_Farms**
Printed	**2024-02-16**
Plan Completion/Update Date:	**2022-01-03**
SnapPlus Version 20.4 built on 2021-06-03	
C:\Users\user\OneDrive - URUS\MSA\Brodhead Files\Riemer Farms \Riemer_Farms_2023_Chuck edits 2-2024 Actual and projected thru 2028.snapDb	

Prepared for:
Riemer_Farms
attn:Riemer_Farms

Farm has 43 fields totalling 749.6 cropped acres.
Farm Narrative: None

Annual Farm Notes:

No Annual Farm Notes

Spreader Calibration Methods: Custom applications

Narrative and Crops:

Field Name	Field Acres	2016	2017	2018	2019	2020	2021	2022	2023
3	14.4	Corn grain Spring Chisel, no disk 191-210 bu/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 Spring Chisel, no disk 20.1-25 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Corn silage No Till 25.1-30 ton/acre
30	2.7	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Corn silage No Till 20.1-25 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 25.1-30 ton/acre	Sorghum-sudan forage No Till 5-7 ton/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Corn silage No Till, planted green 25.1-30 ton/acre

Field Name	Field Acres	2016	2017	2018	2019	2020	2021	2022	2023
31	2.3	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 None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Corn silage No Till, planted green 25.1-30 ton/acre
32.33	5.8	Oatlage w/ Alfalfa Seeding Spring Spring Chisel, no disk 2.0-3.5 ton/acre	Corn silage Spring Cultivation 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 None 4.6-5.5 ton/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Corn silage No Till, planted green 25.1-30 ton/acre
36	3.4	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 2.6-3.5 ton/acre	Corn silage No Till 20.1-25 ton/acre	Winter Triticale (forage) to Corn silage, 30 inch row No Till 2.0-3.5/20.1-25 ton/acre/ton/acre	Sorghum-sudan forage No Till 5-7 ton/acre	Corn silage No Till, planted green 25.1-30 ton/acre	Winter Triticale (forage) to Soybeans, 15-20 inch row No Till 2.0-3.5/56-65 ton/acre/bu/acre
38	5.8	Corn grain Spring Chisel, no disk 191-210 bu/acre	Oats w/ Alfalfa Seeding Spring Spring Chisel, disked 61-90 bu/acre	Alfalfa 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	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Winter Triticale (forage) to Soybeans, 15-20 inch row No Till 2.0-3.5/56-65 ton/acre/bu/acre
40	6.3	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 2.6-3.5 ton/acre	Corn silage No Till 20.1-25 ton/acre	Winter Triticale (forage) to Corn silage, 30 inch row No Till 2.0-3.5/20.1-25 ton/acre/ton/acre	Sorghum-sudan forage No Till 5-7 ton/acre	Corn silage No Till, planted green 25.1-30 ton/acre	Winter Triticale (forage) to Soybeans, 15-20 inch row No Till 2.0-3.5/56-65 ton/acre/bu/acre
41	5.6	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	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Corn silage Spring Cultivation 20.1-25 ton/acre	Winter Triticale (forage) to Sorghum-sudangrass No Till 2.0-3.5/5-7 ton/acre/ton/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn silage No Till, planted green 25.1-30 ton/acre

Field Name	Field Acres	2016	2017	2018	2019	2020	2021	2022	2023
43	2.8	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	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 None 4.6-5.5 ton/acre	Corn silage No Till, planted green 25.1-30 ton/acre	Winter Triticale (forage) to Soybeans, 15-20 inch row No Till 2.0-3.5/76-85 ton/acre/bu/acre
45	3.1	Alfalfa None 2.6-3.5 ton/acre	Alfalfa (grassy, yr 3+) None 2.6-3.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Corn silage No Till 20.1-25 ton/acre	Winter Triticale (forage) to Corn silage, 30 inch row No Till 2.0-3.5/20.1-25 ton/acre/ton/acre	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn silage No Till, planted green 25.1-30 ton/acre	Winter Triticale (forage) to Soybeans, 15-20 inch row No Till 2.0-3.5/76-85 ton/acre/bu/acre
47	3.3	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	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 None 4.6-5.5 ton/acre	Corn silage No Till, planted green 25.1-30 ton/acre	Winter Triticale (forage) to Soybeans, 15-20 inch row No Till 2.0-3.5/76-85 ton/acre/bu/acre
5	2.3	Corn grain Spring Chisel, no disk 191-210 bu/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 Spring Chisel, no disk 20.1-25 ton/acre	Winter Triticale (forage) to Corn silage, 30 inch row No Till 2.0-3.5/10-15 ton/acre/ton/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn silage No Till, planted green 25.1-30 ton/acre
61-62	1.9	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Hemp industrial Spring Chisel, disked 1-8	Corn silage No Till 20.1-25 ton/acre	Sorghum-sudan forage No Till 5-7 ton/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Corn silage No Till, planted green 25.1-30 ton/acre
7.8	7	Corn grain Spring Chisel, no disk 191-210 bu/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 Spring Chisel, no disk 20.1-25 ton/acre	Winter Triticale (forage) to Corn silage, 30 inch row No Till 2.0-3.5/10-15 ton/acre/ton/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn silage No Till, planted green 25.1-30 ton/acre

Field Name	Field Acres	2016	2017	2018	2019	2020	2021	2022	2023
Baumgartner East	70.1					Soybeans 30-36 inch row No Till 66-75 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 191-210 bu/acre	Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop disked 211-230 bu/acre
Baumgartner Stacy	12.8					Soybeans 30-36 inch row No Till 66-75 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 191-210 bu/acre	Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain No Till 171-190 bu/acre
Baumgartner West	77.1					Soybeans 30-36 inch row No Till 66-75 bu/acre	Corn grain No Till 191-210 bu/acre	Corn grain No Till 191-210 bu/acre	Soybeans 30-36 inch row Fall Chisel, no disk 66-75 bu/acre
Baumgartner1	12.3					Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre
Baumgartner2	7.5					Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre
Baumgartner3	7.7					Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre
Bryce 1	69.8								Corn grain Spring Chisel, disked 191-210 bu/acre
Bryce 3	46								Sorghum-sudan forage Spring MB Plow 5-7 ton/acre

Field Name	Field Acres	2016	2017	2018	2019	2020	2021	2022	2023
Bryce 4	63								Corn grain Spring MB Plow 191-210 bu/acre
Bryce 5	44.6								Winter Triticale (grain) No Till 1000-5000 lb/acre
Klausner1	11.7					Soybeans 7-10 inch row No Till 66-75 bu/acre	Corn silage to small grain cover crop No Till, cover crop no till 25.1-30 ton/acre	Sorghum-sudan forage to small grain cover crop Spring vertical tillage, cover crop no till 5-7 ton/acre	Corn grain No Till, planted green 171-190 bu/acre
Kopp	22.8	Winter wheat (grain) No Till 41-60 bu/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 grain to small grain cover crop No Till, cover crop no till 171-190 bu/acre	Soybeans 7-10 inch row No Till 36-45 bu/acre	Corn silage to small grain cover crop No Till, cover crop no till 25.1-30 ton/acre	Sorghum-sudan forage to small grain cover crop Spring vertical tillage, cover crop no till 5-7 ton/acre	Corn silage No Till, planted green 25.1-30 ton/acre
NC Farm River 2	30.6						Corn grain, baled stalks Spring Cultivation 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre
NC Farm River 1	4						Corn grain, baled stalks Spring Cultivation 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre
NC Farm River 3	9.9						Corn grain, baled stalks Spring Cultivation 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre

Field Name	Field Acres	2016	2017	2018	2019	2020	2021	2022	2023
Popanz1	20					Alfalfa None 2.6-3.5 ton/acre	Corn grain to small grain cover crop No Till, cover crop no till 71-90 bu/acre	Soybeans 30-36 inch row No Till 46-55 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 151-170 bu/acre
Popanz2	17.3				Alfalfa None 2.6-3.5 ton/acre	Corn grain to small grain cover crop No Till, cover crop no till 171-190 bu/acre	Soybeans 30-36 inch row No Till 26-35 bu/acre	Soybeans 30-36 inch row No Till 46-55 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 151-170 bu/acre
Popanz3	5					Soybeans 7-10 inch row No Till 46-55 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 151-170 bu/acre	Soybeans 30-36 inch row No Till 46-55 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 151-170 bu/acre
Popanz4	11.1					Soybeans 7-10 inch row No Till 46-55 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 151-170 bu/acre	Soybeans 30-36 inch row No Till 46-55 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 151-170 bu/acre
Schwartzlo w1	12.4	Alfalfa None 3.6-4.5 ton/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 (grassy, yr 3+) None 2.6-3.5 ton/acre	Corn silage No Till 20.1-25 ton/acre	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn silage No Till, planted green 25.1-30 ton/acre	Winter Triticale (forage) to Soybeans, 15-20 inch row No Till 2.0-3.5/96-105 ton/acre/bu/acre
Schwartzlo w4	13.2	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 2.6-3.5 ton/acre	Alfalfa (grassy, yr 3+) None 2.6-3.5 ton/acre	Corn grain No Till 171-190 bu/acre	Winter Triticale (forage) to Sorghum-sudangrass No Till 2.0-3.5/5-7 ton/acre/ton/acre	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn silage No Till, planted green 25.1-30 ton/acre	Winter Triticale (forage) to Soybeans, 15-20 inch row No Till 2.0-3.5/96-105 ton/acre/bu/acre
Schwartzlo w5	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 None 4.6-5.5 ton/acre	Corn silage No Till 20.1-25 ton/acre	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn silage No Till, planted green 25.1-30 ton/acre	Winter Triticale (forage) to Soybeans, 15-20 inch row No Till 2.0-3.5/96-105 ton/acre/bu/acre

Field Name	Field Acres	2016	2017	2018	2019	2020	2021	2022	2023
Whitehead 1	15.5					Corn grain to small grain cover crop Spring Chisel, no disk, cover crop no till 131-150 bu/acre	Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop disked 131-150 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 46-55 bu/acre
Whitehead 2	19.9					Corn grain to small grain cover crop Spring Chisel, no disk, cover crop no till 131-150 bu/acre	Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 131-150 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre
Whitehead 3	4.7					Corn grain to small grain cover crop Spring Chisel, no disk, cover crop no till 131-150 bu/acre	Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop disked 131-150 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre
Whitehead 4	31.9					Corn grain to small grain cover crop Spring Chisel, no disk, cover crop no till 131-150 bu/acre	Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop disked 131-150 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre
Whitehead 5	12.2					Corn grain to small grain cover crop Spring Chisel, no disk, cover crop no till 131-150 bu/acre	Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop disked 131-150 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre
Wickline1	12.3					Soybeans 7-10 inch row No Till 46-55 bu/acre	Corn silage to small grain cover crop No Till, cover crop disked 15.1-20 ton/acre	Soybeans 30-36 inch row No Till 46-55 bu/acre	Corn grain No Till 151-170 bu/acre

Field Name	Field Acres	2016	2017	2018	2019	2020	2021	2022	2023
Wickline2	9.7					Winter wheat (grain +straw) to annual cover crop No Till, cover crop no till 41-60 bu/acre	Corn silage to small grain cover crop No Till, cover crop disked 15.1-20 ton/acre	Soybeans 30-36 inch row No Till 46-55 bu/acre	Corn grain No Till 151-170 bu/acre

Summary by Crop:

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

Crops Grouped By Category		2016	2017	2018	2019	2020	2021	2022	2023
Corn grain	Acres bu	30 6,015			13 2,347		77 15,439	77 15,439	179 32,310
Corn silage	Acres ton		6 135		45 1,015	22 496		52 1,433	65 1,791
Corn silage to small grain cover crop	Acres ton	12 271	58 1,308	47 1,060		17 383	77 2,121	27 744	
Sorghum-sudan forage to small grain cover crop	Acres ton						51 306	55 330	
Alfalfa	Acres ton	53 268	38 192	18 91	39 197	34 172	14 71		
Sorghum-sudan forage	Acres ton						14 84		46 276
Alfalfa (grassy, yr 3+)	Acres ton		3 9	34 172	18 91				
Oatlage w/ Alfalfa Seeding Spring	Acres ton	6 17							
Winter wheat (grain +straw) to Late-Direct Seeded Legume Forage	Acres bu/ton			12 606					

Crops Grouped By Category		2016	2017	2018	2019	2020	2021	2022	2023
Winter Triticale (forage) to Soybeans, 15-20 inch row	Acres ton/bu								58 160/3,509
Alfalfa (1st cut) to Sorghum-sudangrass	Acres ton					6 36			
Oats w/ Alfalfa Seeding Spring	Acres bu		6 453	12 540					
Winter Triticale (forage) to Sorghum-sudangrass	Acres ton/ton					19 52/114			
Winter Triticale (forage) to Corn silage, 30 inch row	Acres ton/ton					22 61/275			
Hemp industrial	Acres				2 9				
Corn grain to small grain cover crop	Acres bu				23 4,152	102 18,411	119 23,860	84 11,802	123 27,122
Soybeans 30-36 inch row	Acres bu					160 11,280	102 3,111	158 9,559	77 5,429
Corn grain, baled stalks	Acres bu/ton					28 3,374/71	72 8,676/184	72 8,676/184	72 8,676/184
Winter Triticale (grain)	Acres lb								45 135,000
Soybeans 7-10 inch row	Acres bu					63 4,442			
Winter wheat (grain)	Acres bu	23 1,162							

Crops Grouped By Category		2016	2017	2018	2019	2020	2021	2022	2023
Soybeans 15-20 inch row	Acres bu		12 606						
Soybeans to small grain cover crop	Acres bu								84 4,242
Winter wheat (grain +straw) to annual cover crop	Acres bu					10 505			

NM1: Narrative and Crops Report

Starting Year	**2021**
Reported For	**Riemer_Farms**
Printed	**2024-02-16**
Plan Completion/Update Date:	**2022-01-03**
SnapPlus Version 20.4 built on 2021-06-03	
C:\Users\user\OneDrive - URUS\MSA\Brodhead Files\Riemer Farms \Riemer_Farms_2023_Chuck edits 2-2024 Actual and projected thru 2028.snapDb	

Prepared for:
Riemer_Farms
attn:Riemer_Farms

Farm has 43 fields totalling 749.6 cropped acres.
Farm Narrative: None

Annual Farm Notes:

No Annual Farm Notes

Spreader Calibration Methods: Custom applications

Narrative and Crops:

Field Name	Field Acres	2021	2022	2023	2024	2025	2026	2027	2028
3	14.4	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Corn silage No Till 25.1-30 ton/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre
30	2.7	Sorghum-sudan forage No Till 5-7 ton/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Corn silage No Till, planted green 25.1-30 ton/acre	Corn silage, aerial seeded rye cover No Till 25.1-30 ton/acre	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Winter wheat (grain) to small grain cover crop No Till, cover crop no till 61-80 bu/acre	Corn silage to small grain cover crop No Till, cover crop no till 25.1-30 ton/acre	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre

Field Name	Field Acres	2021	2022	2023	2024	2025	2026	2027	2028
31	2.3	Alfalfa None 4.6-5.5 ton/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Corn silage No Till, planted green 25.1-30 ton/acre	Corn silage, aerial seeded rye cover No Till 25.1-30 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 25.1-30 ton/acre	Oat-Pea Forage w/ Alfalfa/Grass Seeding Spring No Till 2.0-3.5 ton/acre	Alfalfa/Grass None 5.6-6.5 ton/acre	Alfalfa/Grass None 4.6-5.5 ton/acre
32.33	5.8	Alfalfa None 4.6-5.5 ton/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Corn silage No Till, planted green 25.1-30 ton/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Oatlage w/ Alfalfa Seeding Spring Spring Cultivation 2.0-3.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre
36	3.4	Sorghum-sudan forage No Till 5-7 ton/acre	Corn silage No Till, planted green 25.1-30 ton/acre	Winter Triticale (forage) to Soybeans, 15-20 inch row No Till 2.0-3.5/56-65 ton/acre/bu/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Oatlage w/ Alfalfa Seeding Spring Spring Cultivation 2.0-3.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre
38	5.8	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Winter Triticale (forage) to Soybeans, 15-20 inch row No Till 2.0-3.5/56-65 ton/acre/bu/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre
40	6.3	Sorghum-sudan forage No Till 5-7 ton/acre	Corn silage No Till, planted green 25.1-30 ton/acre	Winter Triticale (forage) to Soybeans, 15-20 inch row No Till 2.0-3.5/56-65 ton/acre/bu/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Sorghum-sudan forage No Till 5-7 ton/acre	Winter Triticale (forage) to Corn silage, 30 inch row No Till 2.0-3.5/20.1-25 ton/acre/ton/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre
41	5.6	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn silage No Till, planted green 25.1-30 ton/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre

Field Name	Field Acres	2021	2022	2023	2024	2025	2026	2027	2028
43	2.8	Alfalfa None 4.6-5.5 ton/acre	Corn silage No Till, planted green 25.1-30 ton/acre	Winter Triticale (forage) to Soybeans, 15-20 inch row No Till 2.0-3.5/76-85 ton/acre/bu/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre
45	3.1	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn silage No Till, planted green 25.1-30 ton/acre	Winter Triticale (forage) to Soybeans, 15-20 inch row No Till 2.0-3.5/76-85 ton/acre/bu/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Corn silage No Till 20.1-25 ton/acre	Winter Triticale (forage) to Soybeans, 15-20 inch row No Till 2.0-3.5/56-65 ton/acre/bu/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Corn grain No Till, planted green 151-170 bu/acre
47	3.3	Alfalfa None 4.6-5.5 ton/acre	Corn silage No Till, planted green 25.1-30 ton/acre	Winter Triticale (forage) to Soybeans, 15-20 inch row No Till 2.0-3.5/76-85 ton/acre/bu/acre	Corn silage No Till, planted green 25.1-30 ton/acre	Winter wheat (grain) No Till 61-80 bu/acre	Winter Triticale (forage) to Corn silage, 30 inch row No Till 2.0-3.5/20.1-25 ton/acre/ton/acre	Corn silage No Till, planted green 20.1-25 ton/acre	Winter wheat (grain) No Till 61-80 bu/acre
5	2.3	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn silage No Till, planted green 25.1-30 ton/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre
61-62	1.9	Sorghum-sudan forage No Till 5-7 ton/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Corn silage No Till, planted green 25.1-30 ton/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre
7.8	7	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn silage No Till, planted green 25.1-30 ton/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre	Corn silage to small grain cover crop No Till, planted green, cover crop no till 25.1-30 ton/acre

Field Name	Field Acres	2021	2022	2023	2024	2025	2026	2027	2028
Baumgartner East	70.1	Corn grain to small grain cover crop No Till, cover crop no till 191-210 bu/acre	Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop disked 211-230 bu/acre	Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop disked 211-230 bu/acre	Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop disked 211-230 bu/acre	Soybeans 30-36 inch row No Till 56-65 bu/acre
Baumgartner Stacy	12.8	Corn grain to small grain cover crop No Till, cover crop no till 191-210 bu/acre	Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain No Till 171-190 bu/acre	Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain No Till 171-190 bu/acre	Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain No Till 171-190 bu/acre	Soybeans 30-36 inch row No Till 56-65 bu/acre
Baumgartner West	77.1	Corn grain No Till 191-210 bu/acre	Corn grain No Till 191-210 bu/acre	Soybeans 30-36 inch row Fall Chisel, no disk 66-75 bu/acre	Corn grain No Till 191-210 bu/acre	Soybeans 30-36 inch row No Till 66-75 bu/acre	Corn grain No Till 191-210 bu/acre	Soybeans 30-36 inch row No Till 66-75 bu/acre	Corn grain No Till 191-210 bu/acre
Baumgartner1	12.3	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre
Baumgartner2	7.5	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre
Baumgartner3	7.7	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre
Bryce 1	69.8			Corn grain Spring Chisel, disked 191-210 bu/acre	Pea, field to Sorghum forage crop 1: Spring vertical till, crop 2: Vertical till 1-2/10-20	Corn grain Spring Chisel, disked 191-210 bu/acre	Soybeans 30-36 inch row Spring vertical tillage 56-65 bu/acre	Corn grain Spring vertical tillage 191-210 bu/acre	Soybeans 30-36 inch row Spring Cultivation 56-65 bu/acre

Field Name	Field Acres	2021	2022	2023	2024	2025	2026	2027	2028
Bryce 3	46			Sorghum-sudan forage Spring MB Plow 5-7 ton/acre	Sweet Corn late plant (June10 or Later) with small grain cover crop Chisel Plow, disked, cover crop no till 6.1-8 ton/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre	Corn grain No Till, planted green 171-190 bu/acre	Soybeans to small grain cover crop Spring vertical tillage, cover crop no till 56-65 bu/acre
Bryce 4	63			Corn grain Spring MB Plow 191-210 bu/acre	Winter Triticale (forage) to Soybeans, 15-20 inch row No Till 2.0-3.5/46-55 ton/acre/bu/acre	Corn grain No Till 171-190 bu/acre	Soybeans to small grain cover crop Spring vertical tillage, cover crop no till 56-65 bu/acre	Corn grain No Till 171-190 bu/acre	Soybeans to small grain cover crop Spring vertical tillage, cover crop no till 56-65 bu/acre
Bryce 5	44.6			Winter Triticale (grain) No Till 1000-5000 lb/acre	Sweet Corn late plant (June10 or Later) with small grain cover crop Chisel Plow, disked, cover crop no till 6.1-8 ton/acre	Corn grain No Till, planted green 171-190 bu/acre	Soybeans to small grain cover crop Spring vertical tillage, cover crop no till 56-65 bu/acre	Corn grain No Till, planted green 171-190 bu/acre	Soybeans to small grain cover crop Spring vertical tillage, cover crop no till 56-65 bu/acre
Klausner1	11.7	Corn silage to small grain cover crop No Till, cover crop no till 25.1-30 ton/acre	Sorghum-sudan forage to small grain cover crop Spring vertical tillage, cover crop no till 5-7 ton/acre	Corn grain No Till, planted green 171-190 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 46-55 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 151-170 bu/acre	Corn grain No Till, planted green 151-170 bu/acre	Corn silage No Till, planted green 20.1-25 ton/acre	Corn grain No Till 151-170 bu/acre
Kopp	22.8	Corn silage to small grain cover crop No Till, cover crop no till 25.1-30 ton/acre	Sorghum-sudan forage to small grain cover crop Spring vertical tillage, cover crop no till 5-7 ton/acre	Corn silage No Till, planted green 25.1-30 ton/acre	Winter wheat (grain) to small grain cover crop No Till, cover crop no till 61-80 bu/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn silage No Till, planted green 20.1-25 ton/acre	Winter wheat (grain) No Till 61-80 bu/acre
NC Farm River 2	30.6	Corn grain, baled stalks Spring Cultivation 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Soybeans 30-36 inch row No Till 56-65 bu/acre

Field Name	Field Acres	2021	2022	2023	2024	2025	2026	2027	2028
NC Farm River 1	4	Corn grain, baled stalks Spring Cultivation 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Soybeans 30-36 inch row No Till 56-65 bu/acre
NC Farm River 3	9.9	Corn grain, baled stalks Spring Cultivation 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Corn grain, baled stalks No Till 111-130/2.1-3 bu/acre/ton/acre	Soybeans 30-36 inch row No Till 56-65 bu/acre
Popanz1	20	Corn grain to small grain cover crop No Till, cover crop no till 71-90 bu/acre	Soybeans 30-36 inch row No Till 46-55 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 151-170 bu/acre	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn grain to small grain cover crop No Till, cover crop no till 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre
Popanz2	17.3	Soybeans 30-36 inch row No Till 26-35 bu/acre	Soybeans 30-36 inch row No Till 46-55 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 151-170 bu/acre	Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 46-55 bu/acre
Popanz3	5	Corn grain to small grain cover crop No Till, cover crop no till 151-170 bu/acre	Soybeans 30-36 inch row No Till 46-55 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 151-170 bu/acre	Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 46-55 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 131-150 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre
Popanz4	11.1	Corn grain to small grain cover crop No Till, cover crop no till 151-170 bu/acre	Soybeans 30-36 inch row No Till 46-55 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 151-170 bu/acre	Soybeans 30-36 inch row No Till 46-55 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre
Schwartzlow1	12.4	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn silage No Till, planted green 25.1-30 ton/acre	Winter Triticale (forage) to Soybeans, 15-20 inch row No Till 2.0-3.5/96-105 ton/acre/bu/acre	Corn silage No Till, planted green 20.1-25 ton/acre	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn silage No Till, planted green 20.1-25 ton/acre	Winter Triticale (forage) to Soybeans, 15-20 inch row No Till 2.0-3.5/56-65 ton/acre/bu/acre	Corn grain No Till, planted green 151-170 bu/acre

Field Name	Field Acres	2021	2022	2023	2024	2025	2026	2027	2028
Schwartzlo w4	13.2	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn silage No Till, planted green 25.1-30 ton/acre	Winter Triticale (forage) to Soybeans, 15-20 inch row No Till 2.0-3.5/96-105 ton/acre/bu/acre	Corn silage No Till, planted green 25.1-30 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 25.1-30 ton/acre	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn grain No Till, planted green 151-170 bu/acre	Winter Triticale (forage) to Corn grain No Till 2.0-3.5/151-170 ton/acre/bu/acre
Schwartzlo w5	7.8	Sorghum-sudan forage to small grain cover crop No Till, cover crop no till 5-7 ton/acre	Corn silage No Till, planted green 25.1-30 ton/acre	Winter Triticale (forage) to Soybeans, 15-20 inch row No Till 2.0-3.5/96-105 ton/acre/bu/acre	Corn silage No Till, planted green 25.1-30 ton/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre	Corn silage No Till, planted green 25.1-30 ton/acre	Soybeans 30-36 inch row No Till 56-65 bu/acre	Winter Triticale (forage) to Corn grain No Till 2.0-3.5/151-170 ton/acre/bu/acre
Whitehead 1	15.5	Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop disked 131-150 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 46-55 bu/acre	Corn grain No Till, planted green 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre	Corn grain No Till, planted green 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre	Corn grain No Till, planted green 151-170 bu/acre
Whitehead 2	19.9	Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop no till 131-150 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre	Corn grain No Till, planted green 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre	Corn grain No Till, planted green 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre	Corn grain No Till, planted green 151-170 bu/acre
Whitehead 3	4.7	Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop disked 131-150 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre	Corn grain No Till, planted green 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre	Corn grain No Till, planted green 151-170 bu/acre	Corn grain No Till, planted green 151-170 bu/acre	Corn grain No Till, planted green 151-170 bu/acre
Whitehead 4	31.9	Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop disked 131-150 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre	Corn grain No Till, planted green 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre	Corn grain No Till, planted green 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre	Corn grain No Till, planted green 151-170 bu/acre
Whitehead 5	12.2	Soybeans 30-36 inch row No Till 56-65 bu/acre	Corn grain to small grain cover crop No Till, cover crop disked 131-150 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre	Corn grain No Till, planted green 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre	Corn grain No Till, planted green 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre	Corn grain No Till, planted green 151-170 bu/acre

Field Name	Field Acres	2021	2022	2023	2024	2025	2026	2027	2028
Wickline1	12.3	Corn silage to small grain cover crop No Till, cover crop disked 15.1-20 ton/acre	Soybeans 30-36 inch row No Till 46-55 bu/acre	Corn grain No Till 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre	Corn grain No Till, planted green 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre	Corn grain No Till, planted green 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre
Wickline2	9.7	Corn silage to small grain cover crop No Till, cover crop disked 15.1-20 ton/acre	Soybeans 30-36 inch row No Till 46-55 bu/acre	Corn grain No Till 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre	Corn grain No Till, planted green 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre	Corn grain No Till, planted green 151-170 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 56-65 bu/acre

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

Crops Grouped By Category		2021	2022	2023	2024	2025	2026	2027	2028
Corn silage	Acres ton		52 1,433	65 1,791	37 1,019	3 68	20 451	38 857	
Corn silage to small grain cover crop	Acres ton	77 2,121	27 744		58 1,598	51 1,405	33 909	36 992	44 1,212
Sorghum-sudan forage to small grain cover crop	Acres ton	51 306	55 330		20 120	51 306	43 258	16 96	5 30
Corn silage, aerial seeded rye cover	Acres ton				5 138				
Sorghum-sudan forage	Acres ton	14 84		46 276		6 36			
Winter wheat (grain) to small grain cover crop	Acres bu				23 1,622		3 212		
Alfalfa	Acres ton	14 71						9 45	9 45
Alfalfa/Grass	Acres ton							2 12	2 10

Crops Grouped By Category		2021	2022	2023	2024	2025	2026	2027	2028
Oat-Pea Forage w/ Alfalfa/Grass Seeding Spring	Acres ton						2 6		
Oatlage w/ Alfalfa Seeding Spring	Acres ton						9 25		
Winter Triticale (forage) to Soybeans, 15-20 inch row	Acres ton/bu			58 160/3,509	63 173/3,182		3 8/182	12 33/726	
Winter Triticale (forage) to Corn silage, 30 inch row	Acres ton/ton						10 28/226		
Corn grain	Acres bu	77 15,439	77 15,439	179 32,310	161 32,281	258 46,569	173 34,687	276 49,818	188 30,174
Winter wheat (grain)	Acres bu					3 212			26 1,833
Corn grain to small grain cover crop	Acres bu	119 23,860	84 11,802	123 27,122		135 29,768		123 27,122	
Soybeans 30-36 inch row	Acres bu	102 3,111	158 9,559	77 5,429	116 7,018	122 8,601	153 9,257	85 5,993	197 11,919
Corn grain, baled stalks	Acres bu/ton	72 8,676/184	72 8,676/184	72 8,676/184	72 8,676/184	28 3,374/71	72 8,676/184	72 8,676/184	28 3,374/71
Pea, field to Sorghum forage	Acres				70 105/1,050				
Soybeans to small grain cover crop	Acres bu			84 4,242	34 1,717	92 5,566	229 13,855	80 4,840	229 13,855
Sweet Corn late plant (June10 or Later) with small grain cover crop	Acres ton				91 642				

Crops Grouped By Category		2021	2022	2023	2024	2025	2026	2027	2028
Winter Triticale (grain)	Acres lb			45 135,000					
Winter Triticale (forage) to Corn grain	Acres ton/bu								21 58/3,371

NM3: Field Data and 590 Assessment Plan

Reported For	Riemer_Farms
Printed	2024-02-10
Plan Completion/Update Date	2022-01-03
SnapPlus Version 20.4 built on 2021-06-03	
C:\Users\user\OneDrive - URUS\MSA\Brodhead Files\Riemer Farms \Riemer_Farms_2023_Chuck edits 2-2024 Actual and projected thru 2028.snapDb	

Prepared for:
Riemer_Farms
attn:Riemer_Farms

Field Data: 750 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	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	Home			14.4	Green	SYLVESTER SyB2	4	200	2.1 - 6	1001 - 5000	No / No	No	No	Csl-Csl +cv-SGf +cv-Csl +cv-Csl +cv-Csl +cv	NT-NTg/NTcvr - NT/NTcvr-NTg/NTcvr - NTg/NTcvr - NTg/NTcvr	2023-2028	**3**	**1.2**	**0.5**	**2**	78	-329	0
5	Home			2.3	Green	TAMA TbB	4	250	0 - 2	1001 - 5000	No / No	No	No	Csl-Csl +cv-SGf +cv-Csl +cv-Csl +cv-SGf +cv	NTg-NTg/NTcvr - NT/NTcvr-NTg/NTcvr - NTg/NTcvr -NT/NTcvr	2023-2028	**5**	**1.3**	**0.5**	**2**	37	-319	-
7.8	Home			7	Green	SYLVESTER SyB2	4	200	0 - 2	1001 - 5000	On contour / No	No	No	Csl-Csl +cv-Csl +cv-SGf +cv-Csl +cv-Csl +cv	NTg-NTg/NTcvr - NTg/NTcvr - NT/NTcvr-NTg/NTcvr - NTg/NTcvr	2023-2028	**3**	**0.9**	**0.5**	**1**	37	-284	-

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	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	Home			2.7	Green	NORTHFIELD NoD2	13	150	0 - 2	1001 - 5000	On contour / No	No	No	Csl-Csl +icv-SGf +cv-WWg +cv-Csl +cv-SGf +cv	NTg-NT-NT/NTcvr-NT/NTcvr-NT/NTcvr	2023-2028	**2**	**2**	**0.6**	**3**	43	-284	-
31	Home			2.3	Green	NORTHFIELD NoD2	13	150	0 - 2	1001 - 5000	On contour / No	No	No	Csl-Csl +icv-Csl +cv-OPfAGs-AG-AG	NTg-NT-NT/NTcvr-NT-None-None	2023-2028	**2**	**1.3**	**0.8**	**2**	43	-328	-
32.33	Home			5.8	Green	NORTHFIELD NoC2	9	200	0 - 2	1001 - 5000	On contour / No	No	No	Csl-Csl +cv-Csl +cv-OfAs-A-A	NTg-NTg/NTcvr-NTg/NTcvr-SFC-None-None	2023-2028	**2**	**1.7**	**0.5**	**2**	57	-304	0
36	Home			3.4	Green	SYLVESTER SyC2	9	200	0 - 2	1001 - 5000	On contour / No	No	No	[TTwf-Sg]-Csl+cv-SGf+cv-OfAs-A-A	NT-NTg/NTcvr-NT/NTcvr-SFC-None-None	2023-2028	**3**	**1.6**	**0.5**	**2**	71	-304	0
38	Home			5.8	Green	SYLVESTER SyC2	9	200	0 - 2	1001 - 5000	On contour / No	No	No	[TTwf-Sg]-Csl+cv-SGf+cv-Csl+cv-SGf+cv-Csl+cv	NT-NTg/NTcvr-NT/NTcvr-NTg/NTcvr-NT/NTcvr-NTg/NTcvr	2023-2028	**3**	**2.1**	**0.5**	**2**	57	-299	0
40	Home			6.3	Green	SYLVESTER SyC2	9	200	0 - 2	1001 - 5000	On contour / No	No	No	SGf-Csl-[TTwf-Sg]-Csl+cv-SGf-[TTwf-Csl30]-Csl +cv-Csl +cv	NT-NTg-NT-NTg/NTcvr-NT-NT-NTg/NTcvr-NTg/NTcvr	2021-2028	**3**	**2.6**	**0.4**	**2**	25	-488	-

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	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	Home			5.6	Green	SYLVESTER SyB2	4	200	0 - 2	1001 - 5000	On contour / No	No	No	Csl-Csl+cv-SGf+cv-Csl+cv-SGf+cv-Csl+cv	NTg-NTg/NTcvr-NT/NTcvr-NTg/NTcvr-NT/NTcvr-NTg/NTcvr	2023-2028	**3**	**0.9**	**0.6**	**1**	49	-319	-
43	Home			2.8	Green	NORTHFIELD NoC2	9	200	0 - 2	1001 - 5000	On contour / No	No	No	[TTwf-Sg]-Csl+cv-SGf+cv-Csl+cv-SGf+cv-Csl+cv	NT-NTg/NTcvr-NT/NTcvr-NTg/NTcvr-NT/NTcvr-NTg/NTcvr	2023-2028	**2**	**1.6**	**0.5**	**2**	55	-314	0
45	Home			3.1	Green	NORTHFIELD NoC2	9	200	0 - 2	1001 - 5000	On contour / No	No	No	[TTwf-Sg]-Csl+cv-Csl-[TTwf-Sg]-Csl+cv-Cg	NT-NTg/NTcvr-NT-NT-NTg/NTcvr-NTg	2023-2028	**2**	**1.2**	**0.5**	**1**	49	-269	-
47	Home			3.3	Green	NORTHFIELD NoC2	9	200	0 - 2	1001 - 5000	On contour / No	No	No	[TTwf-Sg]-Csl-Wwg-[TTwf-Csl30]-Csl-Wwg	NT-NTg-NT-NT-NTg-NT	2023-2028	**2**	**1.1**	**0.6**	**2**	49	-209	-
61-62	Home			1.9	Green	SYLVESTER SyB2	4	200	0 - 2	1001 - 5000	On contour / No	No	No	Csl-Csl+cv-SGf+cv-Csl+cv-SGf+cv-Csl+cv	NTg-NTg/NTcvr-NT/NTcvr-NTg/NTcvr-NT/NTcvr-NTg/NTcvr	2023-2028	**3**	**0.7**	**0.6**	**1**	43	-259	-
Baumgartner East				70.1	Green	FOX FoB2	4	200	0 - 2	301 - 1000	No / No	No	No	Cg+cv-Sg30-Cg+cv-Sg30-Cg+cv-Sg30	NT/Dcvr-NT-NT/Dcvr-NT-NT/Dcvr-NT	2023-2028	**3**	**1.4**	**0.7**	**1**	53	-381	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	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
Baumgartner Stacy				12.8	Green	FOX FoB2	4	200	0 - 2	1001 - 5000	No / No	No	No	Cg-Sg30-Cg-Sg30-Cg-Sg30	NT-NT-NT-NT-NT-NT	2023-2028	**3**	**0.1**	**1.1**	**1**	17	-156	-
Baumgartner West				77.1	Green	FOX FsB2	4	200	0 - 2	1001 - 5000	No / No	No	No	Sg30-Cg-Sg30-Cg-Sg30-Cg	FCND-NT-NT-NT-NT-NT	2023-2028	**3**	**0.9**	**0.9**	**1**	29	-209	-
Baumgartner 1	Baugartner			12.3	Green	MARSHAN Mc	1	250	0 - 2	301 - 1000	No / No	No	No	Cgbs-Cgbs-Cgbs-Cgbs-Cgbs-Cgbs	NT-NT-NT-NT-NT-NT	2023-2028	**3**	**0.3**	**0.6**	**1**	58	-330	0
Baumgartner 2	Baugartner			7.5	Green	MARSHAN Mc	1	250	0 - 2	0 - 300	No / No	No	No	Cgbs-Cgbs-Cgbs-Cgbs-Cgbs-Cgbs	NT-NT-NT-NT-NT-NT	2023-2028	**3**	**0.3**	**0.6**	**1**	50	-330	-
Baumgartner 3	Baugartner			7.7	Green	MAUMEE Me	1	250	0 - 2	0 - 300	No / No	No	No	Cgbs-Cgbs-Cgbs-Cgbs-Cgbs-Cgbs	NT-NT-NT-NT-NT-NT	2023-2028	**2**	**0.2**	**0.6**	**1**	113	-330	-83
Bryce 1				69.8	Green	MYRTLE MyB2	4	200	0 - 2	5001 - 10000	No / No	No	No	Cg-[PF-SGf]-Cg-Sg30-Cg-Sg30	SCD-SVT/VT-SCD-SVT-SVT-SFC	2023-2028	**5**	**3.3**	**0.4**	**4**	73	-274	0
Bryce 3				46	Green	MUSCATINE MuA	2	250	0 - 2	1001 - 5000	No / No	No	No	SGf-SCl +cv-Cg-Sg +cv-Cg-Sg +cv	SP-CP/NTcvr-SVT-NT/NTcvr-NTg-SVT/NTcvr	2023-2028	**5**	**1.3**	**0.5**	**2**	14	-190	-
Bryce 4				63	Green	STRONGHURST SuA	2	250	0 - 2	1001 - 5000	No / No	No	No	Cg-[TTwf-Sg]-Cg-Sg +cv-Cg-Sg +cv	SP-NT-NT-SVT/NTcvr-NT-SVT/NTcvr	2023-2028	**5**	**1.2**	**0.6**	**2**	15	-259	-

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	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
Bryce 5				44.6	Green	LAMARTINE LaB	4	200	0 - 2	1001 - 5000	No / No	No	No	TRg-SCl +cv-Cg-Sg +cv-Cg-Sg +cv	NT-CP/NTcvr-NTg-SVT/NTcvr-NTg-SVT/NTcvr	2023-2028	**5**	**1.9**	**0.5**	**3**	101	-165	-75
Klausner1	Klausner			11.7	Green	SOGN SoC2	9	200	2.1 - 6	1001 - 5000	No / No	No	No	Cg-Sg+cv-Cg+cv-Cg-Csl-Cg	NTg-NT/NTcvr-NT/NTcvr-NTg-NTg-NT	2023-2028	**1**	**0.5**	**0.8**	**1**	13	-286	-
Kopp	Kopp			22.8	Green	OCKLEY OeA	1	250	0 - 2	1001 - 5000	No / No	No	No	Csl-WWg +cv-Csl +cv-SGf +cv-Csl-Wwg	NTg-NT/NTcvr-NT/NTcvr-NT/NTcvr-NTg-NT	2023-2028	**4**	**0.1**	**0.9**	**0**	12	-143	-
NC Farm River 2				30.6	Green	MARSHAN Mc	1	250	0 - 2	301 - 1000	No / No	No	No	Cgbs-Cgbs-Sg30-Cgbs-Cgbs-Sg30	NT-NT-NT-NT-NT-NT	2023-2028	**3**	**0.3**	**0.6**	**2**	101	-320	-80
NC Farm River 1				4	Green	LAWLER LlA	2	250	0 - 2	301 - 1000	No / No	No	No	Cgbs-Cgbs-Sg30-Cgbs-Cgbs-Sg30	NT-NT-NT-NT-NT-NT	2023-2028	**3**	**0.3**	**0.6**	**1**	101	-320	-80
NC Farm River 3				9.9	Green	MARSHAN Mc	1	250	0 - 2	301 - 1000	No / No	No	No	Cgbs-Cgbs-Sg30-Cgbs-Cgbs-Sg30	NT-NT-NT-NT-NT-NT	2023-2028	**3**	**0.3**	**0.6**	**2**	101	-320	-80
Popanz1	Popanz			20	Rock	BILLETT BIA	1	250	0 - 2	1001 - 5000	No / No	No	No	Cg+cv-SGf+cv-Cg+cv-Sg +cv-Cg +cv-Sg+cv	NT/NTcvr-NT/NTcvr-NT/NTcvr-NT/NTcvr-NT/NTcvr-NT/NTcvr	2023-2028	**3**	**0.1**	**0.8**	**0**	43	-370	-

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	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
Popanz2	Popanz			17.3	Rock	BILLETT BlA	1	250	0 - 2	1001 - 5000	No / No	No	No	Cg+cv-Sg30-Cg+cv-Sg+cv-Cg+cv-Sg+cv	NT/NTcvr-NT-NT/NTcvr-NT/NTcvr-NT/NTcvr-NT/NTcvr	2023-2028	**3**	**0.1**	**0.7**	**0**	25	-274	-
Popanz3	Popanz			5	Rock	DICKMAN DcA	1	250	0 - 2	1001 - 5000	No / No	No	No	Cg+cv-Sg30-Cg+cv-Sg+cv-Cg+cv-Sg+cv	NT/NTcvr-NT-NT/NTcvr-NT/NTcvr-NT/NTcvr-NT/NTcvr	2023-2028	**3**	**0.1**	**0.7**	**0**	34	-210	-
Popanz4	Popanz			11.1	Rock	DICKMAN DcA	1	250	0 - 2	1001 - 5000	No / No	No	No	Cg+cv-Sg30-Cg+cv-Sg+cv-Cg+cv-Sg+cv	NT/NTcvr-NT-NT/NTcvr-NT/NTcvr-NT/NTcvr-NT/NTcvr	2023-2028	**3**	**0.1**	**0.7**	**0**	27	-182	-
Schwartzlow 1	Schwartzlow			12.4	Green	NEWGLARUS NgC2	9	150	6.1 - 12	1001 - 5000	No / No	No	No	[TTwf-Sg]-Csl-SGf+cv-Csl-[TTwf-Sg]-Cg	NT-NTg-NT/NTcvr-NTg-NT-NTg	2023-2028	**2**	**1.6**	**0.7**	**3**	54	-230	0
Schwartzlow 4	Schwartzlow			13.2	Green	NEWGLARUS NgC2	9	150	2.1 - 6	1001 - 5000	No / No	No	No	[TTwf-Sg]-Csl-Csl+cv-SGf+cv-Cg-[Wtf-Cg]	NT-NTg-NT/NTcvr-NT/NTcvr-NTg-NT	2023-2028	**2**	**1.8**	**0.8**	**3**	35	-234	-
Schwartzlow 5	Schwartzlow			7.8	Green	NEWGLARUS NgC2	9	150	2.1 - 6	1001 - 5000	No / No	No	No	[TTwf-Sg]-Csl-Sg+cv-Csl-Sg30-[Wtf-Cg]	NT-NTg-NT/NTcvr-NTg-NT-NT	2023-2028	**2**	**1.9**	**0.5**	**2**	37	-395	-
Whitehead1	Whitehead			15.5	Green	HEBRON VARIANT HeA	2	250	0 - 2	1001 - 5000	No / No	No	No	Sg+cv-Cg-Sg+cv-Cg-Sg+cv-Cg	NT/NTcvr-NTg-NT/NTcvr-NTg-NT/NTcvr-NTg	2023-2028	**5**	**0.2**	**0.7**	**0**	8	-184	-

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	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
Whitehead2	Whitehead			19.9	Green	ARLAND VARIANT ArB2	4	200	0 - 2	1001 - 5000	No / No	No	No	Sg+cv-Cg-Sg+cv-Cg-Sg+cv-Cg	NT/NTcvr-NTg-NT/NTcvr-NTg-NT/NTcvr-NTg	2023-2028	**3**	**0.4**	**0.7**	**0**	8	-102	-
Whitehead3	Whitehead			4.7	Green	THACKERY ThA	2	250	0 - 2	5001 - 10000	No / No	No	No	Sg+cv-Cg-Sg+cv-Cg-Cg-Cg	NT/NTcvr-NTg-NT/NTcvr-NTg-NTg-NTg	2023-2028	**4**	**0.2**	**0.9**	**0**	14	-113	-
Whitehead4	Whitehead			31.9	Green	PECATONICA PnB2	4	200	0 - 2	5001 - 10000	No / No	No	No	Sg+cv-Cg-Sg+cv-Cg-Sg+cv-Cg	NT/NTcvr-NTg-NT/NTcvr-NTg-NT/NTcvr-NTg	2023-2028	**5**	**0.4**	**0.7**	**0**	9	-148	-
Whitehead5	Whitehead			12.2	Green	ARLAND VARIANT ArB2	4	200	0 - 2	301 - 1000	No / No	No	No	Sg+cv-Cg-Sg+cv-Cg-Sg+cv-Cg	NT/NTcvr-NTg-NT/NTcvr-NTg-NT/NTcvr-NTg	2023-2028	**3**	**0.4**	**0.7**	**0**	6	-148	-
Wickline1	Wickline			12.3	Rock	GOTHAM GoA	1	250	0 - 2	1001 - 5000	No / No	No	No	Cg-Sg+cv-Cg-Sg+cv-Cg-Sg+cv	NT-NT/NTcvr-NTg-NT/NTcvr-NTg-NT/NTcvr	2023-2028	**5**	**0.1**	**0.7**	**0**	57	-240	0
Wickline2	Wickline			9.7	Rock	GOTHAM GoA	1	250	0 - 2	1001 - 5000	No / No	No	No	Cg-Sg+cv-Cg-Sg+cv-Cg	NT-NT/NTcvr-NTg-NT/NTcvr-NTg	2023-2027	**5**	**0.1**	**0.7**	**0**	43	-190	-

Crop Abbreviations

Abbreviation	Crop
[PF-SGf]	Pea, field to Sorghum forage

Tillage Abbreviations

Abbreviation	Tillage
CP/NTcvr	Chisel Plow, disked, cover crop no till

[TTwf-Csl30]	Winter Triticale (forage) to Corn silage, 30 inch row
[TTwf-Sg]	Winter Triticale (forage) to Soybeans, 15-20 inch row
[Wtf-Cg]	Winter Triticale (forage) to Corn grain
A	Alfalfa
AG	Alfalfa/Grass
Cg	Corn grain
Cg+cv	Corn grain to small grain cover crop
Cgbs	Corn grain, baled stalks
Csl	Corn silage
Csl+cv	Corn silage to small grain cover crop
Csl+icv	Corn silage, aerial seeded rye cover
OfAs	Oatlage w/ Alfalfa Seeding Spring
OPfAGs	Oat-Pea Forage w/ Alfalfa/Grass Seeding Spring
SCl+cv	Sweet Corn late plant (June10 or Later) with small grain cover crop
Sg+cv	Soybeans to small grain cover crop
Sg30	Soybeans 30-36 inch row
SGf	Sorghum-sudan forage
SGf+cv	Sorghum-sudan forage to small grain cover crop
TRg	Winter Triticale (grain)
Wwg	Winter wheat (grain)
WWg+cv	Winter wheat (grain) to small grain cover crop

FCND	Fall Chisel, no disk
None	None
NT	No Till
NT/Dcvr	No Till, cover crop disked
NT/NTcvr	No Till, cover crop no till
NTg	No Till, planted green
NTg/NTcvr	No Till, planted green, cover crop no till
SCD	Spring Chisel, disked
SFC	Spring Cultivation
SP	Spring MB Plow
SVT	Spring vertical tillage
SVT/NTcvr	Spring vertical tillage, cover crop no till
SVT/VT	crop 1: Spring vertical till, crop 2: Vertical till

WQ1: P Trade Report

Reported For	Riemer_Farms
Printed	2024-02-10
Plan Completion/Update Date	2022-01-03
SnapPlus Version 20.4 built on 2021-06-03	
C:\Users\user\OneDrive - URUS\MSA\Brodhead Files\Riemer Farms \Riemer_Farms_2023_Chuck edits 2-2024 Actual and projected thru 2028.snapDb	

Prepared for:
Riemer_Farms
attn:Riemer_Farms

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.

Fields without enough crop years for P Trading

		Years with crops								
Field	**Acres**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**
Baumgartner East	70	X	X	X	X	X	X	X	X	X
Baumgartner Stacy	13	X	X	X	X	X	X	X	X	X
Baumgartner West	77	X	X	X	X	X	X	X	X	X
Baumgartner1	12	X	X	X	X	X	X	X	X	X
Baumgartner2	8	X	X	X	X	X	X	X	X	X
Baumgartner3	8	X	X	X	X	X	X	X	X	X
Bryce 1	70				X	X	X	X	X	X

Bryce 3	46				X	X	X	X	X	X
Bryce 4	63				X	X	X	X	X	X
Bryce 5	45				X	X	X	X	X	X
Klausner1	12	X	X	X	X	X	X	X	X	X
NC Farm River 2	31		X	X	X	X	X	X	X	X
NC Farm River 1	4		X	X	X	X	X	X	X	X
NC Farm River 3	10		X	X	X	X	X	X	X	X
Popanz1	20	X	X	X	X	X	X	X	X	X
Popanz3	5	X	X	X	X	X	X	X	X	X
Popanz4	11	X	X	X	X	X	X	X	X	X
Whitehead1	16	X	X	X	X	X	X	X	X	X
Whitehead2	20	X	X	X	X	X	X	X	X	X
Whitehead3	5	X	X	X	X	X	X	X	X	X
Whitehead4	32	X	X	X	X	X	X	X	X	X
Whitehead5	12	X	X	X	X	X	X	X	X	X
Wickline1	12	X	X	X	X	X	X	X	X	X
Wickline2	10	X	X	X	X	X	X	X	X	X
Total	**609**									

P Trade Report				PTP								
Field Name	Soil Series	Soil Symbol	Acres	2021	2022	2023	2024	2025	2026	2027	2028	2029
3	SYLVESTER	SyB2	14	42	34	45	52	27	26	28	27	
30	SYLVESTER	SyC2	3	2	6	5	11	2	3	2	2	4
31	SYLVESTER	SyC2	2	1	2	2	7	3	2	1	1	
32.33	SYLVESTER	SyC2	6	10	9	12	18	11	11	12	14	
36	SYLVESTER	SyC2	3	6	11	11	8	5	6	7	9	
38	SYLVESTER	SyC2	6	18	8	18	25	9	11	7	11	

P Trade Report				PTP								
Field Name	Soil Series	Soil Symbol	Acres	2021	2022	2023	2024	2025	2026	2027	2028	2029
40	TAMA	TbB	6	8	10	10	5	3	10	15	6	
41	SYLVESTER	SyB2	6	31	9	7	14	5	6	4	6	
43	SYLVESTER	SyB2	3	6	6	4	3	2	3	2	3	
45	NORTHFIELD	NoC2	3	5	5	6	4	7	7	5	4	
47	SYLVESTER	SyB2	3	6	6	5	5	4	2	5	3	
5	HUNTSVILLE	HvA	2	8	4	2	3	2	1	2	1	
61-62	TAMA	TbB	2	4	3	4	3	1	2	1	2	
7.8	TAMA	TbB	7	59	18	8	17	8	5	7	8	
Kopp	OCKLEY	OcA	23	8	5	31	5	17	2	5	3	
Popanz2	DICKMAN	DcA	17	3	4	3	2	2	2	2	1	
Schwartzlow1	NEWGLARUS	NgC2	12	33	29	20	26	52	30	50	40	
Schwartzlow4	NEWGLARUS	NgC2	13	14	22	16	18	67	29	33	48	
Schwartzlow5	PALSGROVE	PgB2	8	6	5	5	6	6	7	15	9	
Total			**140**	**269**	**196**	**215**	**231**	**233**	**162**	**204**	**196**	**4**

APPENDIX G

Management Practice Registration Forms

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

Water Quality Trading Management Practice Registration

Form 3400-207 (R 1/14)

Notice: Pursuant to s. 283.84, Wis. Stats., 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			

Facility Address	City	State	ZIP Code
1700 11th Street	Brodhead	WI	53520

Project Contact Name (if applicable)	Address	City	State	ZIP Code
Andrew Skog	400 Ice Harbor Drive, Suite 110	Dubuque	IA	52001

Project Name
City of Brodhead - Water Quality Trading

Broker/Exchange Information (if applicable)

Was a broker/exchange be used to facilitate trade? ○ Yes ◉ No

Broker/Exchange Organization Name	Contact Name	
Address	**Phone Number**	**Email**

Trade Registration Information (Use a separate form for each trade agreement)

Type	Trade Agreement Number	Practices Used to Generate Credits	Anticipated Load Reduction	Trade Ratio	Method of Quantification
○ Urban NPS ○ Agricultural NPS ◉ Other	Landowner A (Final)	Streambank Stabilization & Habitat Improvements	416.6 lbs/yr	3.03	NRCS Erosion Calculator

County	Closest Receiving Water Name	Land Parcel ID(s)	Parameter(s) being traded
Green	Searles Creek	23012-0466.3,0467,0468	Total Phosphorus

The preparer certifies all of the following:

- 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 Skog	02/02/2021

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 A Vogel	02/02/2021

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Date Received		Trade Docket Number
Entered in Tracking System ☐ Yes	Date Entered	Name of Department Reviewer

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Project Contact Name (if applicable)	Address	City	State	ZIP Code
Andrew Skog	400 Ice Harbor Drive, Suite 110	Dubuque	IA	52001

Project Name
City of Brodhead - Water Quality Trading

Broker/Exchange Information (if applicable)

Was a broker/exchange be used to facilitate trade?
○ Yes
◉ No

Broker/Exchange Organization Name	Contact Name	

Address	Phone Number	Email

Trade Registration Information (Use a separate form for each trade agreement)

Type	Trade Agreement Number	Practices Used to Generate Credits	Anticipated Load Reduction	Trade Ratio	Method of Quantification
○ Urban NPS ○ Agricultural NPS ◉ Other	Landowner B (Final)	Streambank Stabilization & Habitat Improvements	294.9 lbs/yr	3.03	NRCS Erosion Calculator

County	Closest Receiving Water Name	Land Parcel ID(s)	Parameter(s) being traded
Green	Searles Creek	23012.0439.2000	Total Phosphorus

The preparer certifies all of the following:

- 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 Skog	02/02/2021

Authorized Representative Signature

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Signature of Authorized Representative	Date Signed
Richard A Vogel	02/02/2021

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Project Contact Name (if applicable)	**Address**	**City**	**State**	**ZIP Code**
Andrew Skog	400 Ice Harbor Drive, Suite 110	Dubuque	IA	52001

Project Name
City of Brodhead - Water Quality Trading

Broker/Exchange Information (if applicable)

Was a broker/exchange be used to facilitate trade? ○ Yes ◉ No

Broker/Exchange Organization Name	Contact Name	
Address	**Phone Number**	**Email**

Trade Registration Information (Use a separate form for each trade agreement)

Type	Trade Agreement Number	Practices Used to Generate Credits	Anticipated Load Reduction	Trade Ratio	Method of Quantification
○ Urban NPS ○ Agricultural NPS ◉ Other	Landowner C	Production Area Practices	146.4 lbs/yr	1.83	BARNY

County	Closest Receiving Water Name	Land Parcel ID(s)	Parameter(s) being traded
Green	Searles Creek	23012.0452.0000	Total Phosphorus

The preparer certifies all of the following:

- 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 Skog	02/02/2021

Authorized Representative Signature

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Signature of Authorized Representative	Date Signed
Richard A Vogel	02/02/2021

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Project Contact Name (if applicable)	Address	City	State	ZIP Code
Andrew Skog, P.E.	400 Ice Harbor Drive, Suite 110	Dubuque	IA	52001

Project Name
City of Brodhead - Water Quality Trading

Broker/Exchange Information (if applicable)

Was a broker/exchange be used to facilitate trade? ○ Yes ◉ No

Broker/Exchange Organization Name	Contact Name	
Address	**Phone Number**	**Email**

Trade Registration Information (Use a separate form for each trade agreement)

Type	Trade Agreement Number	Practices Used to Generate Credits	Anticipated Load Reduction	Trade Ratio	Method of Quantification
○ Urban NPS ◉ Agricultural NPS ○ Other	Landowner C	Nutrient Management & Supporting Practices	172.7 lbs (Year = 2021)	3.03	SnapPlus

County	Closest Receiving Water Name	Land Parcel ID(s)	Parameter(s) being traded
Green	Searles Creek	23012.0452.0000	Total Phosphorus

The preparer certifies all of the following:

- 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 Skog	02/04/2022

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 A Vogel	02/04/2022

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Date Received		Trade Docket Number
Entered in Tracking System ☐ Yes	Date Entered	Name of Department Reviewer

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

Facility Address	City	State	ZIP Code
1700 11th Street	Brodhead	WI	53520

Project Contact Name (if applicable)	Address	City	State	ZIP Code
Andrew Skog, P.E.	400 Ice Harbor Drive, Suite 110	Dubuque	IA	52001

Project Name
City of Brodhead - Water Quality Trading

Broker/Exchange Information (if applicable)

Was a broker/exchange be used to facilitate trade?
- ○ Yes
- ◉ No

Broker/Exchange Organization Name	Contact Name	
Address	**Phone Number**	**Email**

Trade Registration Information (Use a separate form for each trade agreement)

Type	Trade Agreement Number	Practices Used to Generate Credits	Anticipated Load Reduction	Trade Ratio	Method of Quantification
○ Urban NPS ◉ Agricultural NPS ○ Other	Landowner C	Nutrient Management & Supporting Practices	269.7 lbs Year = 2022	3.03	SnapPlus

County	Closest Receiving Water Name	Land Parcel ID(s)	Parameter(s) being traded
Green	Searles Creek	23012.0452.0000	Total Phosphorus

The preparer certifies all of the following:

- 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 Skog	04/24/2023

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 A Vogel	04/24/2023

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Date Received		Trade Docket Number
Entered in Tracking System ☐ Yes	Date Entered	Name of Department Reviewer

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Water Quality Trading Management Practice Registration

Form 3400-207 (R 1/14)

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Applicant Information

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

Facility Address	City	State	ZIP Code
1700 11th Street	Brodhead	WI	53520

Project Contact Name (if applicable)	Address	City	State	ZIP Code
MacKenzie Phillips	1702 Pankratz Street	Madison	WI	53704

Project Name
City of Brodhead - Water Quality Trading

Broker/Exchange Information (if applicable)

Was a broker/exchange be used to facilitate trade?
○ Yes
◉ No

Broker/Exchange Organization Name	Contact Name	
Address	**Phone Number**	**Email**

Trade Registration Information (Use a separate form for each trade agreement)

Type	Trade Agreement Number	Practices Used to Generate Credits	Anticipated Load Reduction	Trade Ratio	Method of Quantification
○ Urban NPS ◉ Agricultural NPS ○ Other	Landowner C	Nutrient Management & Supporting Practices	253.7 lbs Year = 2023	3.03	SnapPlus

County	Closest Receiving Water Name	Land Parcel ID(s)	Parameter(s) being traded
Green	Searles Creek	23012.0452.0000	Total Phosphorus

The preparer certifies all of the following:

- 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: MacKenzie Phillips | Date Signed: 1/24/2024

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: Richard A. Vogel | Date Signed: 1/24/2024

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Date Received		Trade Docket Number
Entered in Tracking System ☐ Yes	**Date Entered**	**Name of Department Reviewer**

APPENDIX H

WQT Annual Reports #1-5

February 6, 2020

Nathan Wells
Wisconsin Department of Natural Resources
3911 Fish Hatchery Rd.
Fitchburg, WI 53711

Re: City of Brodhead - Annual Water Quality Trading Report #1

Dear Mr. Wells:

On behalf of the City of Brodhead, MSA submits this letter to satisfy WPDES permit reporting requirements for the City's first year of Water Quality Trading (WQT) implementation. As discussed in previous updates to the Department, the City has been delayed in completing the proposed watershed improvements listed in the City's WQT Plan for the year 2019. Delayed permit approvals for streambank stabilization work, along with heavy precipitation (rain and snow) last fall, made it difficult for contractors to complete projects on time. As per the City's WPDES permit, management practices identified in the WQT Plan were to be installed by September 30, 2019. Although work for each project in the WQT Plan is currently under construction, none are fully complete at this time. Because less credits are currently being generated than originally planned, the City has been actively working to optimize phosphorus removal at the wastewater treatment facility to make up for any short term deficiencies in credit generation. Contractors also continue to make progress, despite poor weather and site conditions.

For reference, the City of Brodhead is implementing water quality improvement projects with three (3) private landowners to generate phosphorus credits for the City's wastewater treatment facility (Landowner A, B, and C). The purpose of these projects is to comply with new water quality based effluent limits (WQBELs) for total phosphorus, the most stringent being 0.1 mg/L. It is estimated that the City can comply with the new WQBELs by generating approximately 238 lbs of credit per year. The City's projects with Landowners A and B include approximately 1.25 miles of streambank stabilization and habitat improvements along Searles Creek, a tributary of the Sugar River. The project with Landowner C involves a major dairy farm upgrade and the future implementation of nutrient management improvements. In total, these projects are expected to generate approximately 390 lbs of credit per year once completed.

To document the City's progress in implementing their proposed watershed improvements, I have included several summary tables and photographs for the Department's review. Because all projects are not fully complete, I have only estimated credits for practices which were installed as of December 31, 2019. Several streambanks which have been repaired through the projects with Landowners A and B are believed to be stabilized enough to justify credit generation with the Department. Although a significant amount of construction

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has also been completed for Landowner C, the work for this project is not believed to be sufficient for credit generation at this time.

In regards to the project with Landowners A and B, bank shaping and structural toe stabilization has been completed on nearly all planned treatment sites. Approximately 55 out of 63 banks have been completed to date. Site work has begun for the remaining eight (8) streambanks: W4, S1, S2, S11, S21, S24, S25, and S26, but these banks have not been fully stabilized at this time. The specific banks that have been completed are estimated to provide a total of 213.1 lbs of credit per year (17.8 lbs/month) for the City of Brodhead, approximately 90% of the estimated total goal for these two projects based on the City's WQT Plan.

Figure 1: Photograph from December 2019 showing general overview of Site A. All soil piles have been removed from the site or evenly spread in designated areas. Bare areas have since been seeded and mulched.

Figure 2: Photograph from December 2019 of bank W28. Site was stabilized using a combination of riprap and vegetated reinforced soil (VRSS) lifts. Willow live cuttings and root wads were added to further stabilize the site and provide woody aquatic habitat.

Figure 3: Photograph from December 2019 of bank W32. This site was also stabilized using riprap, vegetated reinforced soil (VRSS) lifts, willow live cuttings, and root wads.

Figure 4: Photograph from December 2019 of banks W34, W35, and W37. All three sites were stabilized with riprap.

Table 1: List of Completed Streambank Stabilization Sites Landowner A

Streambank ID	Phosphorus Credits (lbs/year)	Phosphorus Credits (lbs/month)
W1	1.5	0.12
W2	6.7	0.56
W3	3.7	0.31
W5	1.2	0.10
W6	0.6	0.05
W7	4.3	0.36
W8	4.6	0.38
W9	0.4	0.03
W10	1.5	0.12
W11	18.3	1.52
W12	5.7	0.48
W13	4.1	0.34
W14	3.7	0.31
W15	9.2	0.77
W16	1.4	0.12
W17	0.7	0.06
W18	3.5	0.29
W19	7.5	0.63
W20	1.6	0.13
W21	0.8	0.07
W22	0.8	0.06
W23	1.2	0.10
W24	1.6	0.14
W25	4.8	0.40
W26	1.6	0.13
W27	2.0	0.17
W28	7.6	0.63
W29	1.2	0.10
W30	0.3	0.03
W31	4.2	0.35
W32	0.9	0.08
W33	1.3	0.11
W34	3.9	0.33
W35	15.3	1.28
W36	0.8	0.07
W37	1.4	0.12
Total	**129.8**	**10.82**

Figure 5: Photograph from December 2019 of bank S1, still under construction. This bank is being stabilized with riprap, vegetated reinforced soil (VRSS) lifts, and live cuttings. Top of bank yet to be fully completed.

Figure 6: Photograph from December 2019 of bank S14. This site was stabilized using riprap, vegetated reinforced soil (VRSS) lifts, willow live cuttings, and root wads. Top of bank has since been seeded and mulched.

Figure 7: Photograph from December 2019 of bank S21. This site was stabilized using riprap, vegetated reinforced soil (VRSS) lifts, willow live cuttings, and root wads.

Figure 8: Photograph from January 2020 displaying the main mobilization area located on Site B. All soil piles have now been removed from the site or evenly spread in designated areas. Contractor has attempted to seed and mulch the site despite current snow cover.

Table 2: List of Completed Streambank Stabilization Sites Landowner B

Streambank ID	Phosphorus Credits (lbs/year)	Phosphorus Credits (lbs/month)
S3	5.4	0.45
S4	0.7	0.06
S5	0.7	0.06
S6	7.1	0.59
S7	4.3	0.36
S8	31.2	2.60
S9	1.5	0.13
S10	4.3	0.36
S12	5.8	0.48
S13	1.4	0.12
S14	2.9	0.24
S15	0.8	0.06
S16	1.1	0.09
S17	6.8	0.56
S18	1.2	0.10
S19	3.3	0.28
S20	1.8	0.15
S22	1.5	0.13
S23	1.4	0.12
Total	**83.3**	**6.94**

At this time, the work that has been completed for Landowner C is still not considered sufficient to warrant credit generation. Based on the WQT plan, proposed farmstead improvements for the dairy farm operated by Landowner C include the following (see Figure 9 below for reference):

- Installation of a new 180-day waste storage facility
- Abandonment of Lot #1
- Partial abandonment Lot #2
- Installation of roof gutters and facilities to capture manure and runoff from Lot #3
- Installation of a roof cover and facilities to transfer manure from Lot #4

These improvements were estimated to result in approximately 80 lbs of credit per year. At this time, the proposed improvements are partially complete. Excavation is nearly complete for the new 180-day waste storage facility, but because of project delays, concrete placement for the waste storage will be delayed until spring 2020 to wait for suitable site conditions and to avoid having to meet requirements for cold weather concrete. Lot #1 has been abandoned according to plan, but final site restoration for the abandoned area is not yet complete. Roof gutters and waste transfer channels for Lot #3 have been installed according to plan, but final installation of a stormwater catch basin and an associated stormwater outlet still need to be completed prior to finalizing improvements for Lot #3. The new roof cover over Lot #4 has been installed. The landowner is still working to install animal headlocks, etc. inside the building to make it usable for his dairy cows. We expect all barnyard improvements will be completed in the spring of 2020.

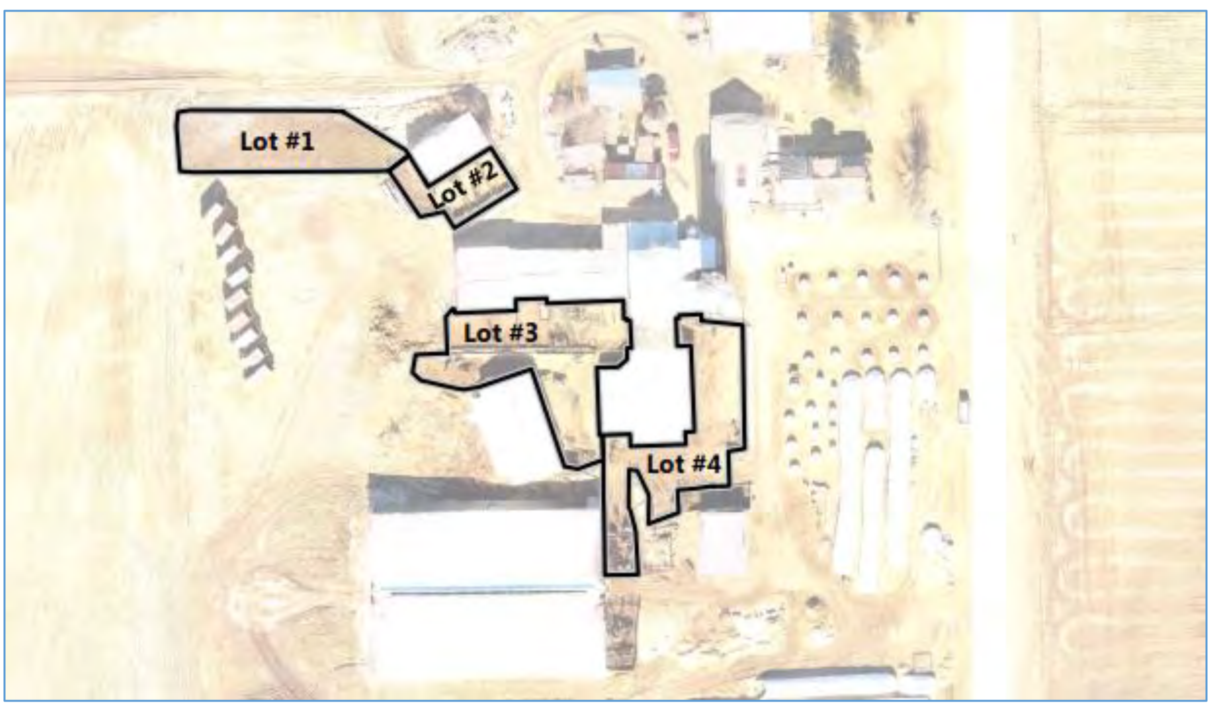

Figure 9: Map of outdoor barnyards operated by Landowner C

Figure 10: Photograph of the newly constructed building (roof cover) for Lot #4 Landowner C.

Overall, construction delays have prevented the City from achieving all the phosphorus load reduction goals that were planned for 2019, and therefore, less credits were generated in 2019 than projected based on the City's WQT plan. High flows and minor operational issues at the City's wastewater treatment facility also caused the City to need more credits than expected during the months of November and December in 2019. Per the last progress report that was provided to the Department on November 27, 2019, it was estimated that the City was generating 13.0 lbs credit per month upon the start of compliance with the new phosphorus WQBELs on November 1, 2019. As shown in **Table 3** and **Figure 11**, the City needed 37.8 lbs of credit in the month of November and 19.9 lbs of credit in December to comply with the WQBELs. This resulted in a total credit deficit of 31.7 credits during the year 2019 [(13.0 lbs - 37.8 lbs) + (13.0 lbs - 19.9 lbs) = -31.7 lbs].

Although the City has faced several issues with implementing their WQT plan 2019, many of these problems have been out of the City's control. MSA tried to expedite the permit approval process with the U.S. Army Corps of Engineers for the streambank projects with Landowners A and B but was unsuccessful. This caused the start of construction to be delayed until August. No one could have anticipated the large amount of precipitation that was received last fall, especially in September and October. Site flooding and wet site conditions significantly delayed construction for projects with Landowners A and B, and high groundwater levels necessitated a redesign of the new waste storage facility for Landowner C during construction.

Minor issues at the City's wastewater treatment facility also hindered compliance. Wastewater flows in November and December were much higher than the average projected in the WQT Plan (0.384 to 0.393 MGD vs.0.288 MGD). Wet field conditions also prevented the City from land applying sludge in a timely manner last fall. This forced wastewater operators to decant from sludge storage more frequently than usual to maintain adequate sludge storage capacity. The City also had problems with their new effluent orthophosphate analyzer which caused less alum to be added for chemical phosphorus removal than was needed to meet effluent targets. These issues collectively caused effluent phosphorus discharges to be greater than projected based on the WQT Plan (0.97 to 1.59 lbs/day vs. 0.72 lbs/day). The City and MSA are currently working to evaluate possible solutions to address these operation issues, including an evaluation of alternatives to increase sludge storage and to repair the orthophosphate analyzer.

Table 3: Summary of recent wastewater treatment facility data (Nov. 2019 – Jan. 2020)

Month	Avg. Effluent Flow (MGD)	Avg. Effluent TP Conc. (mg/L)	Avg. Effluent TP Load (lbs/day)	Credits Used (lbs/month)	Credits Generated (lbs/month)
Nov-19	0.393	0.49	1.59	37.8	13.0
Dec-19	0.384	0.30	0.97	19.9	13.0
Jan-20	0.353	0.20	0.58	9.0	17.8

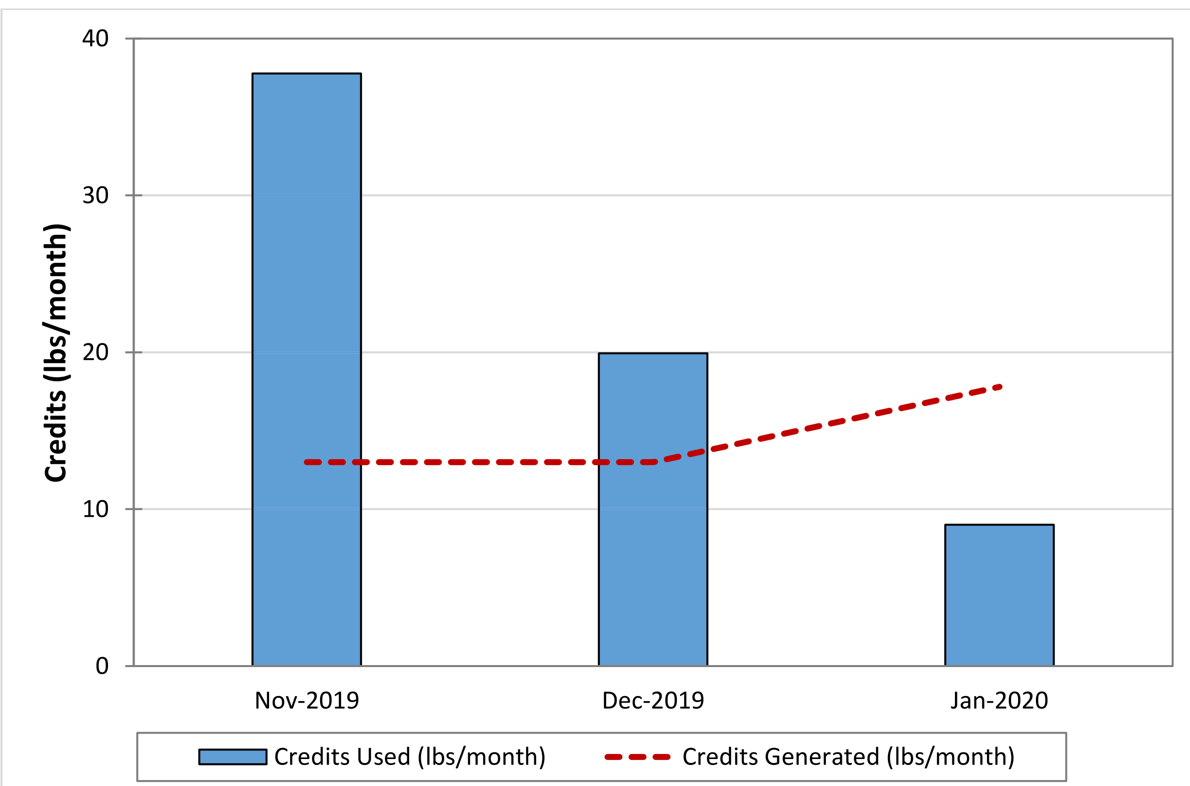

Figure 11: Credit Usage and Generation (Nov. 2019 – Jan. 2020)

Despite the City's challenges in 2019, the outlook does appear to be brighter moving into 2020. More streambanks have been repaired since the last DNR progress report in November, increasing the amount of credits available from 13.0 lbs/month to 17.8 lbs/month (213.1 lbs/year). Sludge was able to be removed from the City's sludge storage tank and wastewater operators have taken manual control over alum feed rates, resulting in improvements in effluent quality in January 2020. Based on the current data that is available, the City appears to now be in compliance with the new WQBELs. Compliance should become easier for the City as more credits become available throughout 2020. The City will continue to implement the projects identified in the WQT Plan as soon as possible and to take other necessary steps to maintain compliance with WQBELs.

Should the Department wish to discuss the City's current progress in more detail, please contact me by phone at (608) 355-8976 or by email at askog@msa-ps.com.

Sincerely,

MSA Professional Services, Inc.

Andrew Skog

Andrew Skog, P.E.
Project Engineer

Cc: Rich Vogel, City of Brodhead
Greg Gunderson, MSA

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

Water Quality Trading Management Practice Registration

Form 3400-207 (R 1/14)

Notice: Pursuant to s. 283.84, Wis. Stats., 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			

Facility Address	City	State	ZIP Code
1700 11th Street	Brodhead	WI	53520

Project Contact Name (if applicable)	Address	City	State	ZIP Code
Andrew Skog	400 Ice Harbor Drive, Suite 110	Dubuque	IA	52001

Project Name
City of Brodhead - Water Quality Trading

Broker/Exchange Information (if applicable)

Was a broker/exchange be used to facilitate trade? ○ Yes ◉ No

Broker/Exchange Organization Name	Contact Name	
Address	**Phone Number**	**Email**

Trade Registration Information (Use a separate form for each trade agreement)

Type	Trade Agreement Number	Practices Used to Generate Credits	Anticipated Load Reduction	Trade Ratio	Method of Quantification
○ Urban NPS ○ Agricultural NPS ◉ Other	Landowner A (Partial Completion)	Streambank Stabilization & Habitat Improvements	393.3 lbs/yr	3.03	NRCS Erosion Calculator

County	Closest Receiving Water Name	Land Parcel ID(s)	Parameter(s) being traded
Green	Searles Creek	230120-0466.3,0467,0468	Total Phosphorus

The preparer certifies all of the following:

- 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 Skog	2/11/2020

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 A. Vogel	2/10/2020

Leave Blank – For Department Use Only

Date Received		Trade Docket Number
Entered in Tracking System ☐ Yes	**Date Entered**	**Name of Department Reviewer**

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

Water Quality Trading Management Practice Registration

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Applicant Information

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

Facility Address	City	State	ZIP Code
1700 11th Street	Brodhead	WI	53520

Project Contact Name (if applicable)	Address	City	State	ZIP Code
Andrew Skog	400 Ice Harbor Drive, Suite 110	Dubuque	IA	52001

Project Name
City of Brodhead - Water Quality Trading

Broker/Exchange Information (if applicable)

Was a broker/exchange be used to facilitate trade? ○ Yes ◉ No

Broker/Exchange Organization Name	Contact Name	
Address	Phone Number	Email

Trade Registration Information (Use a separate form for each trade agreement)

Type	Trade Agreement Number	Practices Used to Generate Credits	Anticipated Load Reduction	Trade Ratio	Method of Quantification
○ Urban NPS ○ Agricultural NPS ◉ Other	Landowner B (Partial Completion)	Streambank Stabilization & Habitat Improvements	252.4 lbs/yr	3.03	NRCS Erosion Calculator

County	Closest Receiving Water Name	Land Parcel ID(s)	Parameter(s) being traded
Green	Searles Creek	23012 - 0436, 0439	Total Phosphorus

The preparer certifies all of the following:

- 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 Skog	2/11/2020

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 A Vogel	2/10/2020

Leave Blank – For Department Use Only

Date Received		Trade Docket Number
Entered in Tracking System ☐ Yes	Date Entered	Name of Department Reviewer

January 31, 2021

Nathan Wells
Wisconsin Department of Natural Resources
3911 Fish Hatchery Rd.
Fitchburg, WI 53711

Re: City of Brodhead - Annual Water Quality Trading Report #2

Dear Mr. Wells:

On behalf of the City of Brodhead, MSA submits this letter to satisfy WPDES permit reporting requirements for the City's second year of Water Quality Trading (WQT) implementation. For reference, the City of Brodhead is implementing water quality improvement projects with three (3) private landowners to generate phosphorus credits for the City's wastewater treatment facility (Landowner A, B, and C). The purpose of these projects is to comply with new water quality based effluent limits (WQBELs) for total phosphorus, the most stringent being 0.1 mg/L. It is estimated that the City can comply with the new WQBELs by generating approximately 238 lbs of credit per year. The City's projects with Landowners A and B include approximately 1.25 miles of streambank stabilization and habitat improvements along Searles Creek, a tributary of the Sugar River. The project with Landowner C involves a major dairy farm upgrade and the future implementation of nutrient management improvements. In total, these projects are expected to generate approximately 390 lbs of credit per year once complete.

As discussed in previous updates to the Department, implementation of the proposed watershed improvements listed in the City's WQT Plan were significantly delayed due to permitting issues and heavy precipitation in 2019. Construction was again delayed in the spring of 2020 due to the outbreak of COVID-19. As per the City's WPDES permit, management practices identified in the WQT Plan were to be installed by September 30, 2019. Because of the delays, only a portion of the projects were completed prior to the end of 2019, and substantial completion of construction activities was not fully achieved until the summer of 2020.

In order to estimate the impacts of project delays, I have provided several summary tables to document the City's implementation progress throughout 2020. I estimated the amount of credits generated in 2020 by referring to credit estimates provided in the previous year's annual report and by prorating practices installed during 2020 based the date practices were substantially complete and the number of days the various practices were actively generating credits during the year. For reference, substantial completion for the streambank stabilization projects (Landowners A and B) was achieved on July 7, 2020, and substantial completion of the dairy farm upgrade (Landowner C) was achieved by August 10, 2020.

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Landowner A – Project Summary:

A map of the 37 streambanks that were restored for Landowner A is shown in **Figure 1**. Stabilization practices (e.g., grading, riprap, soil bioengineering, and seeding & mulching) were completed for the majority of the identified streambanks prior to the end of 2019. Work that was completed in 2020 for Landowner A primarily included final installation of aquatic habitat practices (e.g., escape logs and backwater refuges), stream crossings (e.g., fords), flood gates, fencing, and final site restoration.

Of the identified streambanks, only bank W4 was not fully stabilized prior to the end of the growing season in 2020. This bank experienced a small localized failure several months after grading, seeding, and mulching was completed at the end of 2019. The failure was likely due to an unidentified, buried drain tile outlet. The bank remained extremely wet throughout the grazing season, and even though the bank was reseeded several times, vegetation did not begin to take hold until the fall of 2020. For these reasons, it was assumed that this bank did not generate credits in 2020.

Table 1 summarizes the amount of credits generated for the repair of each streambank based on the City's Water Quality Trading Plan. Per plan, the stabilization of the streambanks will generate a total of 137.5 lbs of credit per year once complete. Since credit was not taken for bank W4 this past year, only 129.8 lbs of credit is assumed for the year 2020. It is anticipated that the full credit amount of 137.5 lbs of credit will be available in 2021.

Photographs of Site A are included for the Department's reference. Before and after photographs are included, along with photographs of aquatic habitat structures installed for this project site. These photographs do not cover the entire scope of work, but summarize the major types of improvements that were completed.

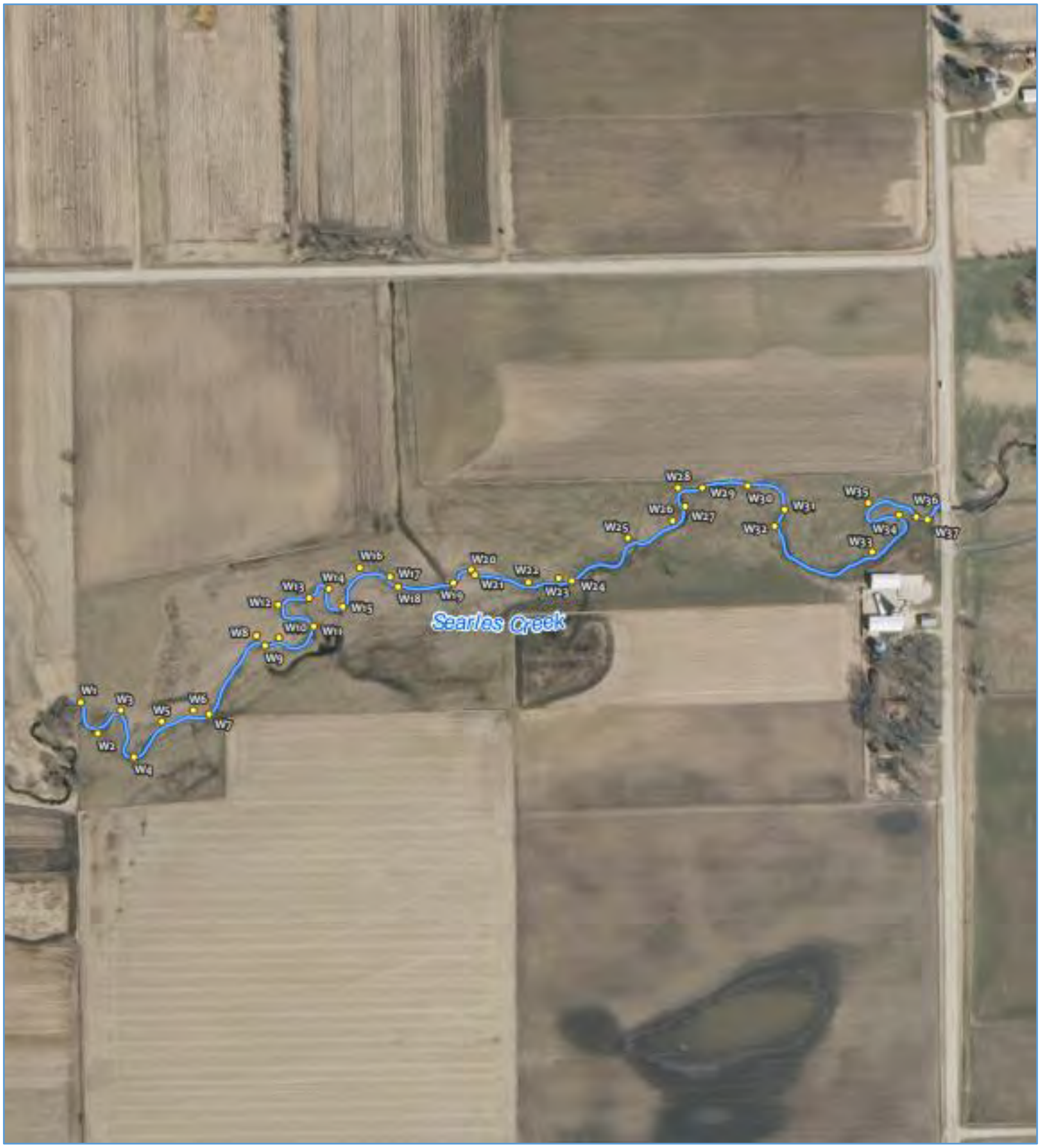

Figure 1: Map of eroding streambanks stabilized on property owned by Landowner A

Table 1: Landowner A - 2020 Credit Calculations

Streambank ID	Estimated Credits WQT Plan (lbs/year)	Completion Date	Credit Generating Period (days)	Actual Credits 2020 (lbs/year)
W1	1.5	1/1/2020	366	1.5
W2	6.7	1/1/2020	366	6.7
W3	3.7	1/1/2020	366	3.7
W4	7.7	1/1/2021	0	0.0
W5	1.2	1/1/2020	366	1.2
W6	0.6	1/1/2020	366	0.6
W7	4.3	1/1/2020	366	4.3
W8	4.6	1/1/2020	366	4.6
W9	0.4	1/1/2020	366	0.4
W10	1.5	1/1/2020	366	1.5
W11	18.3	1/1/2020	366	18.3
W12	5.7	1/1/2020	366	5.7
W13	4.1	1/1/2020	366	4.1
W14	3.7	1/1/2020	366	3.7
W15	9.2	1/1/2020	366	9.2
W16	1.4	1/1/2020	366	1.4
W17	0.7	1/1/2020	366	0.7
W18	3.5	1/1/2020	366	3.5
W19	7.5	1/1/2020	366	7.5
W20	1.6	1/1/2020	366	1.6
W21	0.8	1/1/2020	366	0.8
W22	0.8	1/1/2020	366	0.8
W23	1.2	1/1/2020	366	1.2
W24	1.6	1/1/2020	366	1.6
W25	4.8	1/1/2020	366	4.8
W26	1.6	1/1/2020	366	1.6
W27	2.0	1/1/2020	366	2.0
W28	7.6	1/1/2020	366	7.6
W29	1.2	1/1/2020	366	1.2
W30	0.3	1/1/2020	366	0.3
W31	4.2	1/1/2020	366	4.2
W32	0.9	1/1/2020	366	0.9
W33	1.3	1/1/2020	366	1.3
W34	3.9	1/1/2020	366	3.9
W35	15.3	1/1/2020	366	15.3
W36	0.8	1/1/2020	366	0.8
W37	1.4	1/1/2020	366	1.4
Total	**137.5**			**129.8**

(a) Before

(b) After

Figure 2: Before and after photographs of bank W2. Bank was repaired by grading side slopes 5:1 and seeding & mulching. New floodgate shown in foreground.

(a) Before

(b) After

Figure 3: Before and after photographs of bank W4. Bank was repaired by grading side slopes 5:1 and seeding and mulching. Seeding did not begin to take hold until fall 2020 due to flooding and excessive bank seepage. Suspected buried drain tile outlet repaired with rock riprap. No credit taken for this bank in the year 2020.

(a) Before

(b) After

Figure 4: Before and after photographs of bank W28. Bank was stabilized using riprap, vegetated reinforced soil (VRSS) lifts, willow live cuttings, and root wads.

(a) Before

(b) After

Figure 5: Before and after photographs of bank W34. Bank was repaired by installing rock riprap and seeding & mulching.

Figure 6: Photograph of backwater refuge (aquatic habitat) installed near bank W28. A total of two (2) backwater refuges were installed at Site A.

Figure 7: Photograph of an escape log (aquatic habitat) installed along bank W34. A total of six (6) escape logs and two (2) root wad log revetments were installed at Site A.

Figure 8: Photograph of a stream crossing (ford) installed near bank W25. A total of four (4) rock crossings were installed at Site A to allow safe crossing of the stream by agricultural equipment and livestock.

Landowner B – Project Summary:

A map of the twenty-six (26) streambanks that were planned to be restored for Landowner B is shown in **Figure 9**. Nineteen (19) of these banks were stabilized prior to the end of 2019. Work for the remaining banks S1, S2, S11, S21, S24, S25 was completed in 2020. It should be noted that bank S26, which was planned to be repaired per the City's WQT Plan, will not be restored as planned. During design, stabilization of bank S26 was determined to be infeasible since it continued downstream into neighboring property. Additional work that was completed in 2020 for Landowner B primarily included final installation of aquatic habitat practices, stream crossings, flood gates, fencing, and final site restoration.

Table 2 summarizes the amount of credits planned to be generated for each identified streambank based on the City's Water Quality Trading Plan. Per plan, the stabilization of the streambanks were anticipated to generate a total of 98.2 lbs of credit per year. Since six (6) of the banks were not completed until July 7, 2020, and streambank S26 is not anticipated to be repaired, only 90.1 lbs of credit was estimated to be generated for this site in 2020. It is anticipated that a total of 97.4 lbs of credit will be available in 2021.

Photographs of Site B are included below. As previously stated, these photographs only summarize the major improvements that were made to this site.

Figure 9: Map of eroding streambanks stabilized on property owned by Landowner B

Table 2: Landowner B - 2020 Credit Calculations

Streambank ID	Estimated Credits WQT Plan (lbs/year)	Completion Date	Credit Generating Period (days)	Actual Credits 2020 (lbs/year)
S1	1.1	7/7/2020	178	0.5
S2	3.9	7/7/2020	178	1.9
S3	5.4	1/1/2020	366	5.4
S4	0.7	1/1/2020	366	0.7
S5	0.7	1/1/2020	366	0.7
S6	7.1	1/1/2020	366	7.1
S7	4.3	1/1/2020	366	4.3
S8	31.2	1/1/2020	366	31.2
S9	1.5	1/1/2020	366	1.5
S10	4.3	1/1/2020	366	4.3
S11	0.4	7/7/2020	178	0.2
S12	5.8	1/1/2020	366	5.8
S13	1.4	1/1/2020	366	1.4
S14	2.9	1/1/2020	366	2.9
S15	0.8	1/1/2020	366	0.8
S16	1.1	1/1/2020	366	1.1
S17	6.8	1/1/2020	366	6.8
S18	1.2	1/1/2020	366	1.2
S19	3.3	1/1/2020	366	3.3
S20	1.8	1/1/2020	366	1.8
S21	5.7	7/7/2020	178	2.8
S22	1.5	1/1/2020	366	1.5
S23	1.4	1/1/2020	366	1.4
S24	0.3	7/7/2020	178	0.1
S25	2.8	7/7/2020	178	1.3
S26	0.0	#N/A	0	0.0
Total	**97.4**			**90.1**

(a) Before

(b) After

Figure 10: Before and after photographs of bank S1. This site was stabilized using riprap, vegetated reinforced soil (VRSS) lifts, and willow live cuttings. New floodgate shown in foreground.

(a) Before

(b) After

Figure 11: Before and after photographs of bank S20. Bank was stabilized using riprap, vegetated reinforced soil (VRSS) lifts, willow live cuttings, and root wads.

(a) Before

(b) After

Figure 12: Before and after photographs of banks S22 and S23. Banks were stabilized using grading, riprap, and seeding & mulching.

Figure 13: Photograph of backwater refuge (aquatic habitat) installed near bank S14.

Figure 14: Photograph of escape logs (aquatic habitat) installed along bank S17. A total of seven (7) escape logs and two (2) root wad log revetments were installed at Site B.

Figure 15: Photograph of native wetland vegetation reestablishing after project completion at Site B.

Figure 16: Photograph of a stream crossing (ford) installed near bank S1. A total of three (3) rock crossings were installed at Site B to allow safe crossing of the stream by agricultural equipment and livestock.

<u>Landowner C – Project Summary</u>:

Credit generation through the project with Landowner C is planned through a combination of 1) production area practices to reduce phosphorus runoff from outdoor barnyards operated by the dairy farm and 2) future improvements to nutrient management practices employed on crop fields operated by the farm. A map of the animal production area of the dairy farm operated by Landowner C is shown in **Figure 17**. Production area practices planned to be implemented per the City's Water Quality Trading Plan are summarized below:

- Installation of a new 180-day waste storage facility
- Abandonment of Lot #1
- Partial abandonment Lot #2
- Installation of roof gutters and facilities to capture manure and runoff from Lot #3
- Installation of a roof cover and facilities to transfer manure from Lot #4

As discussed in the City's previous annual report, site work for the dairy farm upgrade with Landowner C was significantly delayed from plan. Excavation that began in 2019 for the installation of a new waste storage facility had to be put on hold until 2020 due to wet weather and poor site conditions. Groundwater levels were so much higher than anticipated at the time of construction that the waste storage facility had to be redesigned after the start of construction. Although significant progress was made in 2019 to complete the project, no credits were deemed available at the start of 2020 due to the project delays. Unfortunately, construction progress was further delayed in 2020 due to continued poor site conditions and the outbreak of COVID-19 in spring 2020. Despite these delays, we are happy to report that substantial completion of the construction was finally achieved on August 10, 2020.

Because of the delays, substantially less credit was available from Landowner C in 2020 than originally planned. As summarized in **Table 3**, the barnyard improvements were anticipated to generate 79.9 lbs of phosphorus credit per year. Because the credits were only online for 144 days, only 31.4 lbs of credit was estimated to be generated in 2020; less than half of the planned target. Furthermore, because the waste storage facility was not online until late 2020, the landowner was not able to achieve compliance with the proposed nutrient management improvements planned for the 2020 crop year. This resulted in an additional loss of 74 credits for the City in 2020.

It is anticipated that the full credit amount of credit (79.9 lbs/year) will be available in 2021 for the completed barnyard improvements. The City plans to work with Landowner C to verify the number of credits that will produced by the nutrient management improvements for the 2021 crop year. It is anticipated that the City will officially register the nutrient management practices with the Department in the spring of 2021.

Photographs of the barnyard improvements made at Site C are included below for the Department's reference.

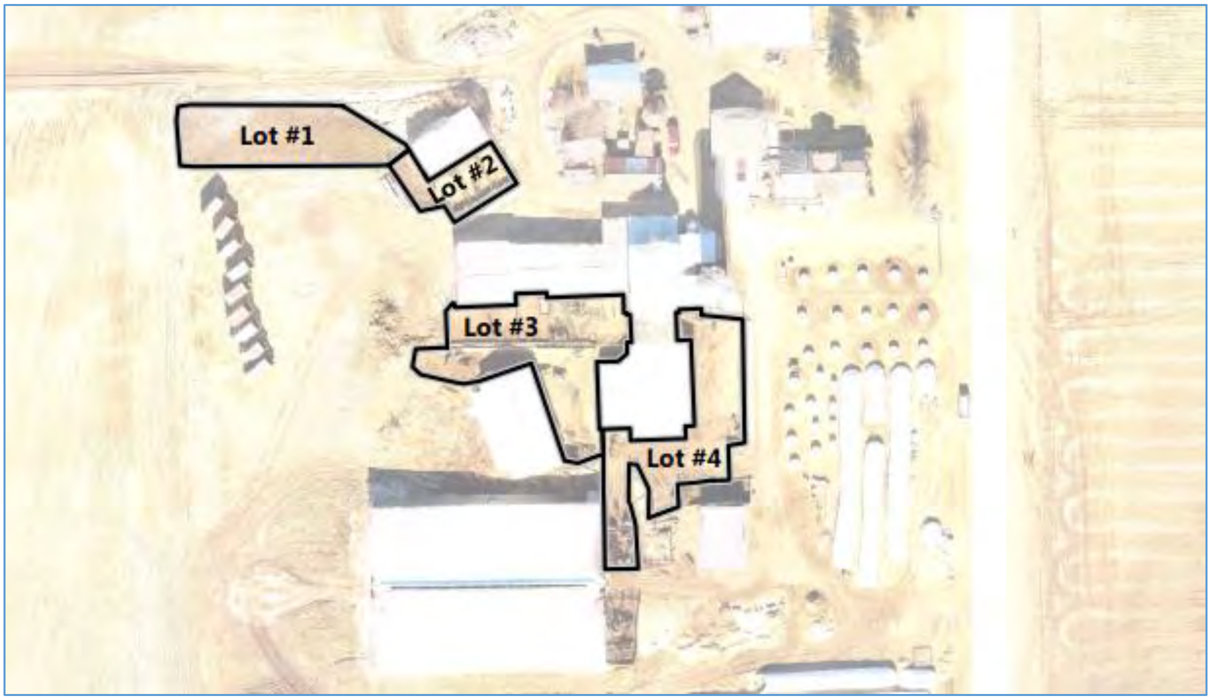

Figure 17: Map of outdoor barnyards operated by Landowner C

Table 3: Landowner C - 2020 Credit Calculations

Lot ID	Estimated Credits WQT Plan (lbs/year)	Completion Date	Credit Generating Period (days)	Actual Credits 2020 (lbs/year)
#1	19.1	8/10/2020	144	7.5
#2	0.7	8/10/2020	144	0.3
#3	31.0	8/10/2020	144	12.2
#4	29.2	8/10/2020	144	11.5
Total	**79.9**			**31.4**

(a) Before

(b) After

Figure 18: Before and after photographs of Lot #1. This earthen barnyard was completely abandoned and converted to perennial grass cover.

(a) Before

(b) After

Figure 19: Before and after photographs of Lot #2. The west end of this barnyard was abandoned and a stormwater inlet and piping was installed to route phosphorus runoff to the newly constructed waste storage facility.

(a) Before

(b) After

Figure 20: Before and after photographs of Lot #3. Roof gutters and a new stormwater inlet were installed to divert clean water from contacting manure in outdoor livestock pens.

(a) Before

(b) After

Figure 21: Additional before and after photographs of Lot #3. Roof gutters installed to divert clean water from contacting manure in outdoor livestock pens.

(a) Before

(a) After

Figure 22: Before and after photographs of Lot #4. A new building was installed over the existing outdoor lot area to prevent clean water from contacting manure in outdoor livestock pens.

Figure 23: Photograph of the new waste storage facility. The facility will provide greater than 180-days of manure storage for Landowner C. Runoff from Lots #2 and #3 will be diverted to the new storage. This manure storage is significantly larger than the Landowner's previous, which only provided 2-weeks of storage capacity. The new waste storage will allow the landowner to avoid frequent hauling of manure to crop fields in winter to frozen or snow covered ground and apply the manure at less sensitive times of the year.

<u>Wastewater Treatment Facility – Performance Summary</u>:

A brief summary of effluent flows and phosphorus discharges by the Brodhead Wastewater Treatment Facility for the year 2020 is provided in **Table 4**. As shown, the average effluent flow was 0.310 MGD and the average effluent total phosphorus concentration was 0.21 mg/L. The City has shown significant success in reducing phosphorus discharges over the past 10 years. The City has improved performance of bio-P removal and has optimized chemical phosphorus removal with the recent installation of an orthophosphorus analyzer. The proposed target effluent phosphorus concentration per the City's WQT Plan was 0.3 mg/L. The City successfully achieved this goal, and based on the City's calculations, only 100 lbs of credit was needed for the City to comply with Water Quality Trading in 2020 (see **Table 4** and **Figure 24**).

Per the calculations listed above, 251.3 lbs of credit were generated by the City in 2020.

Landowner A = 129.8 lbs
Landowner B = 90.1 lbs
Landowner C = 31.4 lbs

Total = 251.3 lbs

Therefore, the City was able to demonstrate compliance with new WQBEL's for phosphorus in 2020 (251.3 lbs of credit generated and only 100.4 lbs used). Even more credits are expected to be generated in 2021 with the additional credits proposed from the nutrient management improvements from Landowner C. Overall, the City appears to have sufficient credit generating capacity to maintain compliance through the remainder of the current WPDES permit term and beyond.

Table 4: Summary of wastewater treatment facility data (January – December 2020)

Month	Avg. Effluent Flow (MGD)	Avg. Effluent TP Conc. (mg/L)	Avg. Effluent TP Load (lbs/day)	Credits Used (lbs/month)
Jan.	0.353	0.20	0.59	9.1
Feb.	0.331	0.19	0.52	7.1
Mar.	0.364	0.17	0.52	6.8
Apr.	0.363	0.23	0.70	11.9
May.	0.362	0.24	0.71	12.7
Jun.	0.339	0.20	0.58	8.7
Jul.	0.309	0.15	0.39	3.9
Aug.	0.283	0.11	0.27	1.0
Sep.	0.274	0.21	0.47	6.9
Oct.	0.260	0.25	0.55	10.2
Nov.	0.245	0.35	0.71	15.0
Dec.	0.235	0.22	0.43	7.1
Avg.	**0.310**	**0.21**	**0.53**	**8.4**
Total	**-**	**-**	**-**	**100.4**

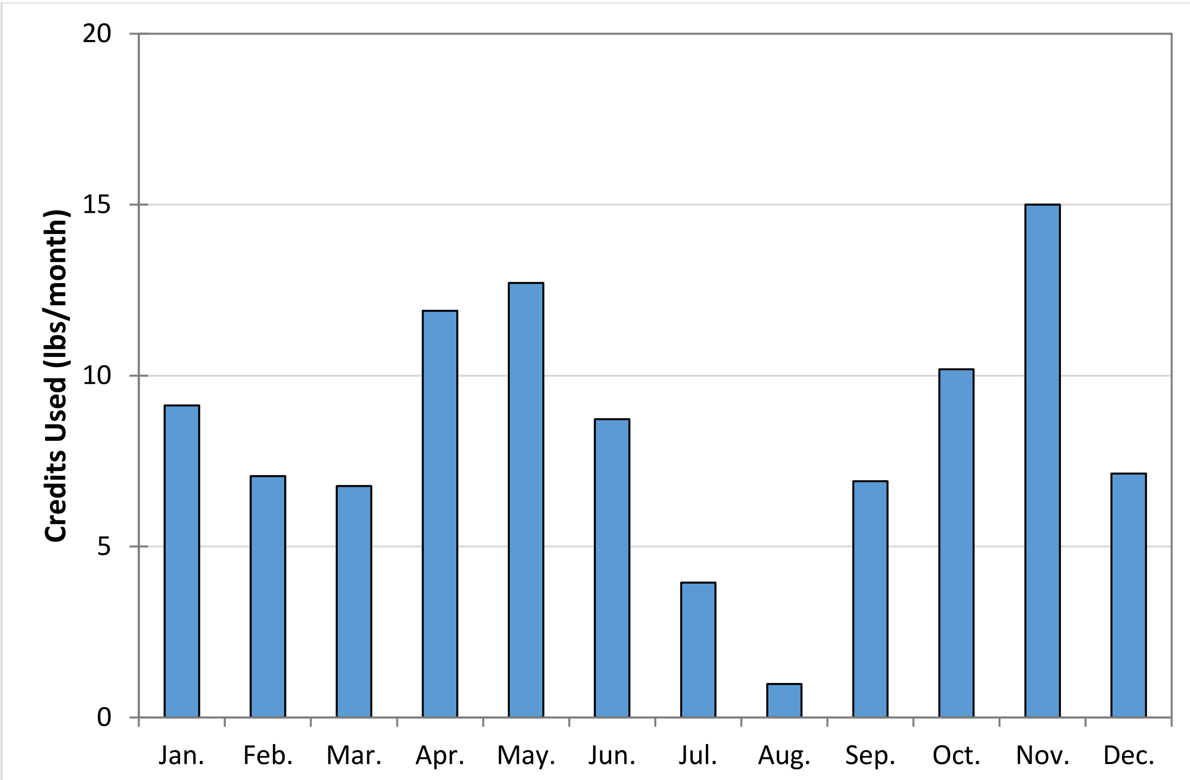

Figure 24: Graph depicting the amount of phosphorus credits used monthly by the City of Brodhead for compliance with WQBELs.

<u>Final Summary</u>:

Although the City faced several challenges with implementing their Water Quality Trading Plan in the year 2019, primarily due to issues out of the City's control, the City has remained committed to their non-point pollution reduction goals and has nearly completed all of the conservation practices originally proposed to achieve compliance. Streambank stabilization projects with Landowner A and B and barnyard improvements for Landowner C are now complete. All that remains is final verification and registration of nutrient management improvements for Landowner C in the spring of 2021. Per the calculations provided in this report, the City generated approximately 250 lbs of phosphorus credit in 2020 and only used 100 lbs of credit to comply with new WQBELs for phosphorus. This suggests that the City has been successful in optimizing phosphorus removal at the Brodhead Wastewater Treatment Facility and that the City has sufficient credit capacity to maintain compliance with the WQBELs for the near future. Compliance should become even easier for the City as more credits become available in 2021.

Should the Department wish to discuss the City's current progress in more detail, please contact me by phone at (608) 355-8976 or by email at askog@msa-ps.com. I plan to follow up the submission of this report to the Department with updated practice management registration forms for the projects with Landowners A, B, and C.

Sincerely,

MSA Professional Services, Inc.

Andrew Skog, P.E.
Project Engineer

Cc: Rich Vogel, City of Brodhead
Greg Gunderson, MSA

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www.msa-ps.com

February 15, 2022

Nathan Wells, Wastewater Engineer-Senior
Wisconsin Department of Natural Resources
3911 Fish Hatchery Rd
Fitchburg, Wisconsin 53711-5367

Re: City of Brodhead - Annual Water Quality Trading Report #3

Dear Mr. Wells,

On behalf of the City of Brodhead, MSA submits this letter to satisfy WPDES permit reporting requirements for the City's third year of Water Quality Trading (WQT) implementation. For reference, the City of Brodhead has implemented water quality improvement projects with three (3) private, rural landowners to generate phosphorus credits for the City's wastewater treatment facility (Landowner A, B, and C). The purpose of these projects is to comply with new water quality based effluent limits (WQBELs) for total phosphorus, the most stringent being 0.1 mg/L (six-month average). It is estimated that the City can comply with the phosphorus WQBELs by generating approximately 238 lbs of credit per year. The City's projects with Landowners A and B include approximately 1.25 miles of streambank stabilization and habitat improvements along Searles Creek, a tributary of the Sugar River in Green County. The project with Landowner C, also in the Searles Creek watershed, included a major dairy farm upgrade with best management practices installed to reduce the runoff potential of existing outdoor barnyards/feedlots. The project with Landowner C also includes the implementation of a nutrient management plan and supporting conservation practices (e.g., no-till and cover crops) on the crop fields owned and operated by the landowner. In total, these projects are expected to generate approximately 390 lbs of credit per year for the City.

Construction for the projects with Landowners A, B, and C were completed in the year 2020. As of 2021, the only remaining portion of the project for the City to implement was the nutrient management plan and associated conservation practices on Landowner C's crop fields. After working with Landowner C throughout the past year, we can report that the Landowner C has implemented the nutrient management plan and conservation practices as required. Therefore, in 2021 all practices that were proposed in the City's Water Quality Trading Plan (MSA, 2018) were actively generating credits.

Annual inspections of the properties generating credits were completed multiple times throughout the past year. Inspections were completed on April 1, July 1-2, and November 15, 2021. Inspections were completed as part of the regular monitoring activities. Therefore, inspections were not completed as a result of any severe flooding, complaints, etc. Overall, 2021 was a relatively dry year, and no severe precipitation events occurred in the Brodhead area.

For the Department's review, I have included brief summaries of each project in the sections below, including maps, photos, and credit calculations for the year 2021.

Landowner A – Project Summary:

A map of the 37 streambanks that were restored for Landowner A is shown in **Figure 1**. Stabilization practices (e.g., grading, riprap, soil bioengineering, and seeding & mulching) were completed in 2020. **Table 1** summarizes the amount of credits generated for the repair of each streambank based on the City's WQT Plan. Per plan, the stabilization of the streambanks generates a total of 137.5 lbs of credit annually.

Site inspections for Landowner A were completed on April 1, July 1, and November 15, 2021. See **Figures 2 – 14** for photographs of Landowner A's property from 2021. In general, all banks that were repaired in 2020 appeared to be stable and vegetation became much more established throughout the year 2021.

Nathan Wells, Wastewater Engineer-Senior
Wisconsin Department of Natural Resources
February 15, 2022

Only one area of concern was noted during the inspections: a small bank on the south side of the creek starting to erode in between the stabilization treatments of banks W33 and W34 (see **Figure 14**). Since this bank was not included in the original scope of work as part of the WQT Plan, the current intent is to continue monitoring the streambank for further signs of failure and to potentially include repair of the bank as part of the revised WQT Plan that will be due to the Department next year prior to WPDES permit reissuance.

Figure 1: Map of eroding streambanks stabilized on property owned by Landowner A

Table 1: Landowner A Streambank Stabilization - 2021 Credit Generation Summary

Streambank ID	Phosphorus Credits (lbs/year)	Phosphorus Credits (lbs/month)
W1	1.5	0.12
W2	6.7	0.56
W3	3.7	0.31
W4	7.7	0.64
W5	1.2	0.10
W6	0.6	0.05
W7	4.3	0.36
W8	4.6	0.38
W9	0.4	0.03
W10	1.5	0.12
W11	18.3	1.52
W12	5.7	0.48
W13	4.1	0.34
W14	3.7	0.31
W15	9.2	0.77
W16	1.4	0.12
W17	0.7	0.06
W18	3.5	0.29
W19	7.5	0.63
W20	1.6	0.13
W21	0.8	0.07
W22	0.8	0.06
W23	1.2	0.10
W24	1.6	0.14
W25	4.8	0.40
W26	1.6	0.13
W27	2.0	0.17
W28	7.6	0.63
W29	1.2	0.10
W30	0.3	0.03
W31	4.2	0.35
W32	0.9	0.08
W33	1.3	0.11
W34	3.9	0.33
W35	15.3	1.28
W36	0.8	0.07
W37	1.4	0.12
Total	**137.5**	**11.46**

Figure 2: Photograph of Streambank W2 on April 1, 2021

Figure 3: Photograph of Streambank W2 on July 1, 2021

Figure 4: Photograph of Streambank W2 on November 15, 2021

Figure 5: Photograph of Streambank W14 on April 1, 2021

Figure 6: Photograph of Streambank W14 on July 1, 2021

Figure 7: Photograph of Streambank W14 on November 15, 2021

Figure 8: Photograph of Streambank W28 on April 1, 2021

Figure 9: Photograph of Streambank W28 on July 1, 2021

Figure 10: Photograph of Streambank W28 on November 15, 2021

Figure 11: Photograph of Streambank W36 on April 1, 2021

Figure 12: Photograph of Streambank W36 on July 1, 2021

Figure 13: Photograph of Streambank W36 on November 15, 2021

Figure 14: Photograph of new eroding streambank between banks W33 and W34 taken on November 15, 2021

<u>Landowner B – Project Summary</u>:

A map of the twenty-six (26) streambanks that were planned to be restored for Landowner B is shown in **Figure 15**. Stabilization practices were completed in 2020 for all banks except S26, which was determined to be infeasible to repair prior to construction since it is partially located on another property. **Table 2** summarizes the amount of credits generated for each identified streambank based on the City's WQT Plan. As shown, the project with Landowner B generated 97.3 lbs of credit in 2021.

Site inspections for Landowner B were completed on April 1, July 2, and November 15, 2021. Photographs of Landowner B's property are included in **Figures 16 – 34**. Similar to Landowner A, all banks that were repaired in 2020 appeared to be stable during the inspections, and only one area of concern was noted during the inspections. On the south side of the stream between streambanks S4 and S6, a small area of erosion was noted during the November 15th inspection (see **Figure 34**). This bank was also not included in the original scope of work as part of the City's WQT Plan. The City's current plan is to continue to monitor this location and to potentially include repair of the bank as part of the revised WQT Plan that will be submitted to the Department next year.

Figure 15: Map of eroding streambanks stabilized on property owned by Landowner B

Table 2: Landowner B Streambank Stabilization - 2021 Credit Generation Summary

Streambank ID	Phosphorus Credits (lbs/year)	Phosphorus Credits (lbs/month)
S1	1.1	0.10
S2	3.9	0.32
S3	5.4	0.45
S4	0.7	0.05
S5	0.7	0.06
S6	7.1	0.59
S7	4.3	0.35
S8	31.2	2.60
S9	1.5	0.13
S10	4.3	0.36
S11	0.4	0.04
S12	5.8	0.48
S13	1.4	0.12
S14	2.9	0.24
S15	0.8	0.06
S16	1.1	0.09
S17	6.8	0.56
S18	1.2	0.10
S19	3.3	0.28
S20	1.8	0.15
S21	5.7	0.47
S22	1.5	0.13
S23	1.4	0.12
S24	0.3	0.02
S25	2.8	0.23
S26	-	-
Total	**97.3**	**8.11**

Figure 16: Photograph of Streambank S1 on April 1, 2021

Figure 17: Photograph of Streambank S1 on July 2, 2021

Figure 18: Photograph of Streambank S1 on November 15, 2021

Figure 19: Photograph of Streambank S11 on April 1, 2021

Figure 20: Photograph of Streambank S11 on July 2, 2021

Figure 21: Photograph of Streambank S11 on November 15, 2021

Figure 22: Photograph of Streambank S15 on April 1, 2021

Figure 23: Photograph of Streambank S15 on July 2, 2021

Figure 24: Photograph of Streambank S15 on November 15, 2021

Figure 25: Photograph of Streambank S19 on April 1, 2021

Figure 26: Photograph of Streambank S19 on July 2, 2021

Figure 27: Photograph of Streambank S19 on November 15, 2021

Figure 28: Photograph of Streambank S21 on April 1, 2021

Figure 29: Photograph of Streambank S21 on July 2, 2021

Figure 30: Photograph of Streambank S21 on November 15, 2021

Figure 31: Photograph of Streambank S24 on April 1, 2021

Figure 32: Photograph of Streambank S24 on July 2, 2021

Figure 33: Photograph of Streambank S24 on November 15, 2021

Figure 34: Photograph of new eroding streambank between banks S4 and S6 taken on November 15, 2021

<u>Landowner C – Project Summary</u>:

Credit generation through the project with Landowner C is via a combination of 1) production area practices to reduce phosphorus runoff from outdoor barnyards operated by the dairy farm and 2) improvements to nutrient management practices employed on crop fields owned and operated by the farm. A map of the animal production area of the dairy farm operated by Landowner C is shown in **Figure 35** and a map of the crop fields is shown in **Figure 36**.

Production area practices that have been implemented per the City's Water Quality Trading Plan include:

- Installation of a new 180-day waste storage facility
- Abandonment of barnyard Lot #1
- Partial abandonment barnyard Lot #2
- Installation of roof gutters and facilities to capture manure and runoff from barnyard Lot #3
- Installation of a roof cover over barnyard Lot #4
- Facilities to transfer manure and captured runoff from Lots #2, #3, and #4 to the new waste storage facility

Construction of the production area practices was completed in August of 2020 as described in last year's Annual Report. Based on site inspections in 2021, these practices are still in good condition and generating credits as per the City's WQT Plan. As shown in **Table 3**, the production area practices generate 79.9 lbs of credit annually.

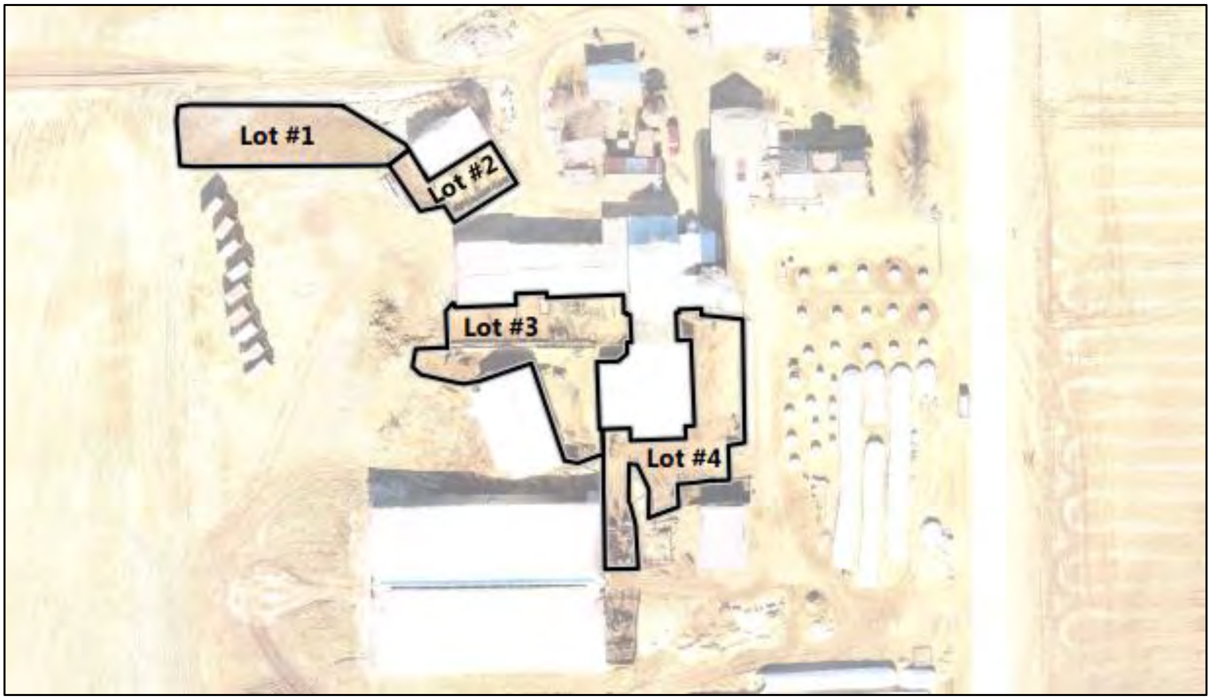

Figure 35: Map of outdoor barnyards operated by Landowner C

Table 3: Landowner C Production Area Practices - 2021 Credit Generation Summary

Lot ID	Phosphorus Credits (lbs/year)	Phosphorus Credits (lbs/month)
#1	19.1	1.59
#2	0.7	0.06
#3	31.0	2.58
#4	29.2	2.43
Total	**79.9**	**6.66**

The primary focus of 2021 for Landowner C was implementation of their proposed nutrient management plan, including no-till and cover crop conservation practices on their owned crop fields. MSA staff worked with Landowner C to document the farm's cropping practices in SnapPlus and performed site inspections of the crop fields on April 1 and November 15, 2021. Based on the site visits, Landowner C appears to be implementing the practices they promised to execute on behalf of the City.

Using the P-Trade report available in SnapPlus, MSA has compared the baseline conditions approved in the City's WQT Plan and the current model, which has been updated to account for actual cropping practices in 2021. Based on the model, 57.0 lbs of phosphorus credit was generated from Landowner C's crop fields for the 2021 crop year (see **Table 4**). For reference, this is slightly behind the City's goal of 74.9 lbs for 2021 based on the City's 2018 WQT Plan. This discrepancy is due to several factors: 1) Landowner C has implemented a slightly different crop rotation than what was included in the original WQT Plan 2) weather delays in 2019 caused the final construction of Landowner C's new waste storage facility to be delayed one year, which delayed the establishment of the no-till and cover crop practices one year, and 3) dry weather conditions in 2021 caused fall cover crops in several of Landowner C's fields not to germinate, specifically Fields 30, 36, 40, 45, and 61-62. These fields were planted to a Sorghum-Sudan grass mix in the spring of 2021. Although the Sorghum-Sudan grass successfully germinated and was harvested, the mix includes Italian ryegrass, hairy vetch, and clovers that are supposed to germinate and provide cover over winter. Based on the November 15, 2021, site visit, these plants had not germinated as expected. Landowner C's SnapPlus model was adjusted to account for this change. Looking ahead, the good news is that we are projecting the generation of 89.2 lbs of credit for the 2022 crop year, 13% better than plan (89.2 vs. 78.7 lbs), assuming that cover crops germinate on all fields as intended.

Now that we have confirmed that Landowner C has implemented the nutrient management plan as required, we feel it is appropriate to register these practices now officially with the Department. I have enclosed a copy of Management Practice Registration Form 3400-207 for Landowner C's 2021 crop land credits. Consistent with the City's WQT Plan and WPDES permit, we plan to provide an updated Management Practice Registration Form annually to the Department to account for the actual amount of credits generated each year from Landowner C's crop fields.

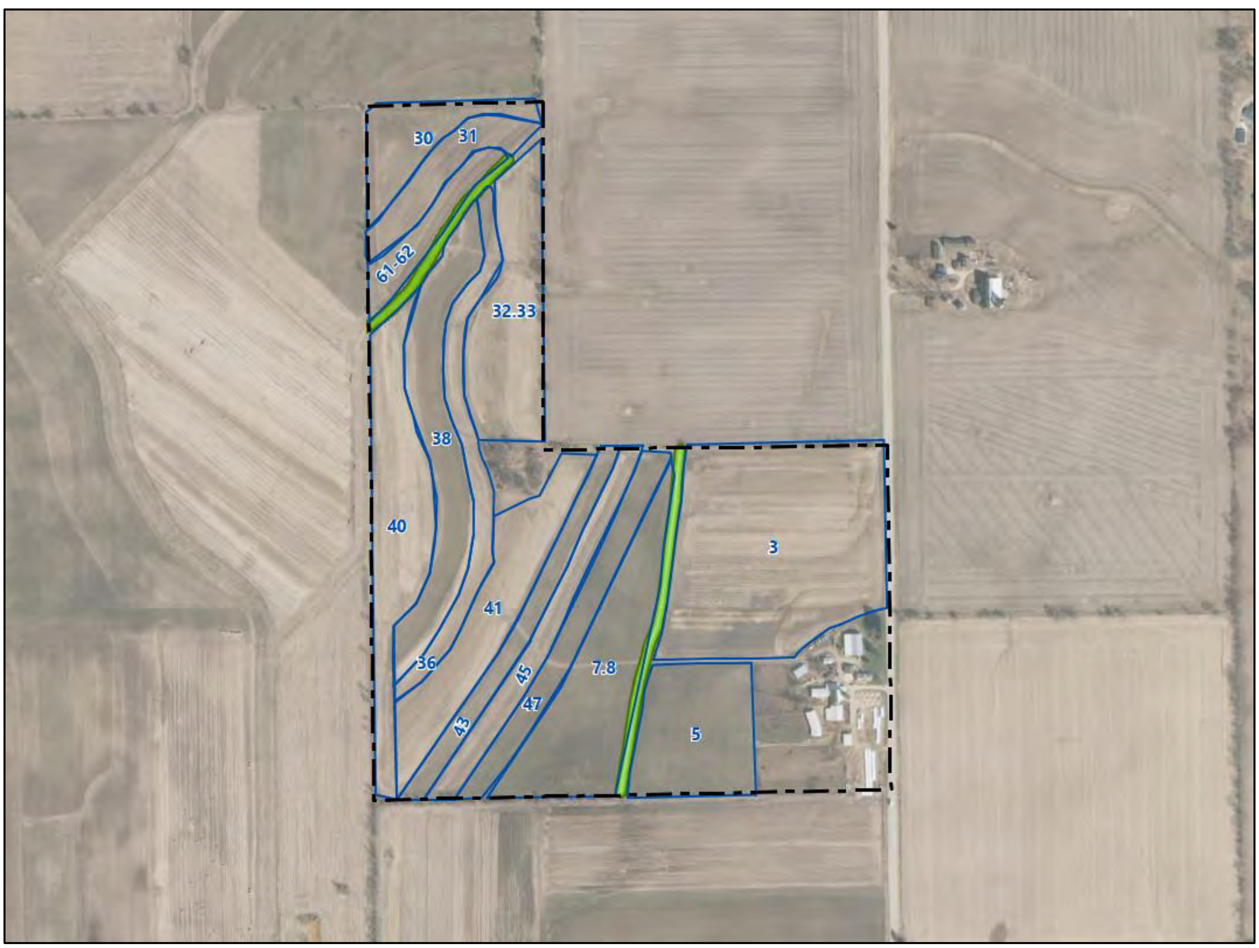

Figure 36: Map of crop fields owned and operated by Landowner C

Nathan Wells, Wastewater Engineer-Senior
Wisconsin Department of Natural Resources
February 15, 2022

Table 4: Landowner C Nutrient Management & Supporting Practices - 2021 Credit Generation Summary

Field ID	Phosphorus Credits (lbs/year)	Phosphorus Credits (lbs/month)
3	29.3	2.44
5	10.4	0.87
7.8	-3.1	-0.26
30	1.8	0.15
31	2.1	0.18
32.33	-0.1	-0.01
36	3.5	0.29
38	2.9	0.24
40	4.4	0.37
41	-1.5	-0.13
43	-0.7	-0.06
45	8.4	0.70
47	-0.1	-0.01
61-62	-0.2	-0.02
Total	**57.0**	**4.75**

Figure 37: Photograph of Field 3 on November 15, 2021 showing cover crop after Sorghum-Sudan grass mix harvest and fall manure application.

Figure 38: Photograph of Field 5 on November 15, 2021 showing Triticale cover crop after corn silage harvest.

Figure 39: Photograph of Field 7.8 on April 1, 2021 showing Triticale cover crop from previous fall planting.

Figure 40: Photograph of Field 7.8 on November 15, 2021 showing Triticale cover crop germination after corn silage harvest.

Figure 41: Photograph of Fields 30, 31, 61-62 on November 15, 2021 showing failed cover crop germination on Fields 30 and 61-62 after Sorghum-Sudan grass mix harvest and fall manure application. Field 31 planted to alfalfa.

Figure 42: Photograph of Field 32.33 on November 15, 2021 showing alfalfa after fall manure application.

Figure 43: Photograph of Field 38 (foreground) on April 1, 2021 showing crop residue after corn silage harvest with no cover crops.

Figure 44: Photograph of Field 41 on April 1, 2021 showing Triticale cover crop from previous fall planting.

Figure 45: Photograph of Field 41 on November 15, 2021 showing Triticale cover crop germination after corn silage harvest.

Wastewater Treatment Facility – Performance Summary:

A brief summary of effluent flows and phosphorus discharges by the Brodhead Wastewater Treatment Facility for the year 2021 is provided in **Table 5**. As shown, the average effluent flow was 0.223 MGD and the average effluent total phosphorus concentration was 0.31 mg/L. Per the City's WQT Plan, a minimum of 238 lbs of phosphorus credit per year would be needed assuming a target effluent concentration of 0.3 mg/L, a design flow of .313 MGD, and a safety factor of 1.25. The City essentially met the effluent target concentration and effluent flows were much lower than plan. As a result, the City only needed to use 135.3 credits in 2021. For comparison, the total amount of credits generated by the City in 2021 was 371.7 lbs, approximately 31 credits generated per month (see **Table 6**). Therefore, the City is generating significantly more credits than currently needed per the City's WQT Plan and appears to have sufficient credit generating capacity to maintain compliance through the remainder of the current WPDES permit term and beyond.

Table 5: Summary of wastewater treatment facility data (January – December 2021)

Month	Avg. Effluent Flow (MGD)	Avg. Effluent TP Conc. (mg/L)	Avg. Effluent TP Load (lbs/day)	Credits Used (lbs/month)
Jan.	0.230	0.15	0.29	3.2
Feb.	0.231	0.16	0.30	3.0
Mar.	0.255	0.11	0.24	1.0
Apr.	0.272	0.14	0.33	3.2
May.	0.254	0.14	0.29	2.4
Jun.	0.228	0.19	0.36	5.0
Jul.	0.207	0.46	0.80	19.4
Aug.	0.214	0.75	1.35	36.2
Sep.	0.206	0.92	1.59	42.5
Oct.	0.200	0.33	0.53	11.5
Nov.	0.190	0.20	0.31	6.9
Dec.	0.188	0.11	0.18	1.1
Avg.	**0.223**	**0.31**	**0.56**	**11.3**
Total	**-**	**-**	**-**	**135.3**

Table 6: Credit Generation Summary – Year 2021

Project ID	Phosphorus Credits (lbs/year)	Phosphorus Credits (lbs/month)
Landowner A - Streambank Stabilization	137.5	11.46
Landowner B - Streambank Stabilization	97.3	8.11
Landowner C - Production Area Practices	79.9	6.66
Landowner C - NMP & Supporting Practices	57.0	4.75
Total	**371.7**	**30.98**

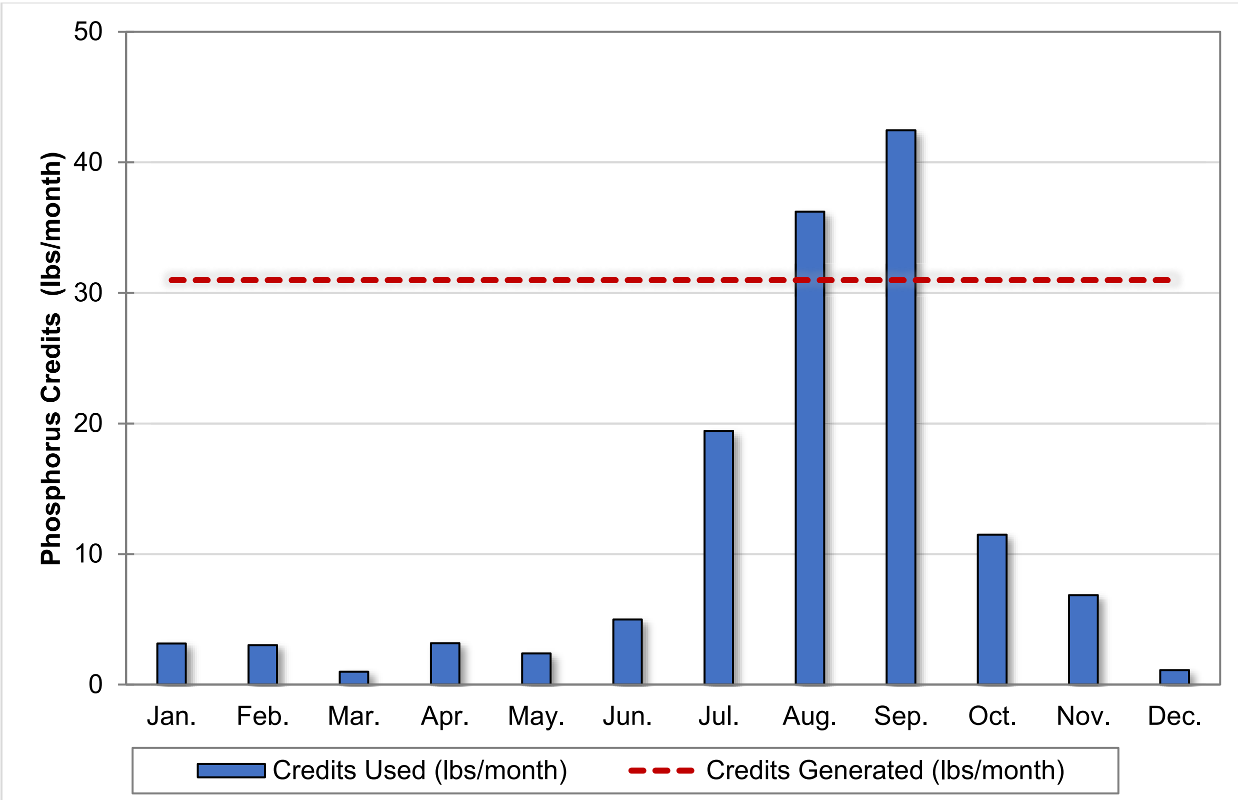

Figure 46: Graph depicting the amount of phosphorus credits used monthly by the City of Brodhead for compliance with WQBELs.

Final Summary:

Based on the findings of this report, the City has implemented all projects proposed in the City's 2018 WQT Plan. Moving forward, the City and MSA will continue to perform site inspections as required and to address issues as they arise. For 2022, the City will evaluate the necessity and means to repair the two new eroding streambanks found on the Landowner A and B project sites. Also, the City will consider evaluating other potential projects as part of the WQT Plan revision that is due to the Department next year. For now, the City appears to have sufficient credits to maintain compliance until the existing landowner agreements expire in the year 2028.

Should the Department wish to discuss the City's current progress in more detail or if you have any questions, please feel free to contact me. My contact information is listed below.

Sincerely,
MSA Professional Services, Inc.

Andrew Sky

Andrew Skog, P.E.
Senior Project Engineer - Water
askog@msa-ps.com | +1 (608) 355-8976

Enclosures: 1

cc: Rich Vogel, City of Brodhead
Tonya Gratz, Green County
Greg Gunderson, MSA

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

Water Quality Trading Management Practice Registration

Form 3400-207 (R 1/14)

Notice: Pursuant to s. 283.84, Wis. Stats., 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	

Facility Address	City	State	ZIP Code
1700 11th Street	Brodhead	WI	53520

Project Contact Name (if applicable)	Address	City	State	ZIP Code
Andrew Skog, P.E.	400 Ice Harbor Drive, Suite 110	Dubuque	IA	52001

Project Name
City of Brodhead - Water Quality Trading

Broker/Exchange Information (if applicable)

Was a broker/exchange be used to facilitate trade?
○ Yes
◉ No

Broker/Exchange Organization Name	Contact Name	
Address	**Phone Number**	**Email**

Trade Registration Information (Use a separate form for each trade agreement)

Type	Trade Agreement Number	Practices Used to Generate Credits	Anticipated Load Reduction	Trade Ratio	Method of Quantification
○ Urban NPS ◉ Agricultural NPS ○ Other	Landowner C	Nutrient Management & Supporting Practices	172.7 lbs (Year = 2021)	3.03	SnapPlus

County	Closest Receiving Water Name	Land Parcel ID(s)	Parameter(s) being traded
Green	Searles Creek	23012.0452.0000	Total Phosphorus

The preparer certifies all of the following:

- 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 Skog	02/04/2022

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 A. Vogel	02/04/2022

Leave Blank – For Department Use Only

Date Received		Trade Docket Number
Entered in Tracking System ☐ Yes	Date Entered	Name of Department Reviewer

400 Ice Harbor Drive
Suite 110
Dubuque, IA 52001

P (563) 582-3973
TF (888) 869-1214
F (563) 582-4020

www.msa-ps.com

April 24, 2023

Kenzie Ostien, Wastewater Engineer-Senior
Wisconsin Department of Natural Resources
3911 Fish Hatchery Rd
Fitchburg, Wisconsin 53711-5367

Re: City of Brodhead - Annual Water Quality Trading Report #4

Dear Ms. Ostien,

On behalf of the City of Brodhead, MSA submits this letter to satisfy WPDES permit reporting requirements for the City's fourth year of Water Quality Trading (WQT) implementation. For reference, the City of Brodhead has implemented water quality improvement projects with three (3) private, rural landowners to generate phosphorus credits for the City's wastewater treatment facility (Landowner A, B, and C). The purpose of these projects is to comply with new water quality based effluent limits (WQBELs) for total phosphorus, the most stringent being 0.1 mg/L (six-month average). It is estimated that the City can comply with the phosphorus WQBELs by generating approximately 238 lbs of credit per year. The City's projects with Landowners A and B include approximately 1.25 miles of streambank stabilization and habitat improvements along Searles Creek, a tributary of the Sugar River in Green County. The project with Landowner C, also in the Searles Creek watershed, included a major dairy farm upgrade with best management practices installed to reduce the runoff potential of existing outdoor barnyards and feedlots. The project with Landowner C also includes the implementation of a nutrient management plan and supporting conservation practices (e.g., no-till and cover crops) on the crop fields owned and operated by the landowner. In total, these projects are expected to generate approximately 390 lbs of credit per year for the City.

Construction for the projects with Landowners A, B, and C were completed in the year 2020, and the nutrient management plan for Landowner C was implemented in 2021. Therefore, all practices that were proposed in the City's WQT Plan (MSA, 2018) were actively generating credits in 2022. Annual inspections of the properties generating credits were completed multiple times throughout the past year. Inspections were completed on June 27, August 23, September 8, and December 28, 2022. For the Department's review, I have included brief summaries of each project in the sections below, including maps, photos, and credit calculations for the year 2022.

Landowner A – Project Summary:

A map of the 37 streambanks that were restored for Landowner A is shown in **Figure 1**. Stabilization practices (e.g., grading, riprap, soil bioengineering, and seeding & mulching) were completed in 2020. **Table 1** summarizes the amount of credits generated for the repair of each streambank based on the City's WQT Plan. Per plan, the stabilization of the streambanks generates a total of 137.5 lbs of credit annually.

Site inspections for Landowner A were completed on August 23 and December 28, 2022, see **Figures 2 – 12**. During the site visits, no appreciable differences were noted in the stability or condition of the streambanks when compared to previous site visits in 2021. As noted in Brodhead's Annual WQT Report #3 from 2021, there is one small streambank on the south side of the creek between treatment sites W33 and W34 that has experienced some erosion. This area appears to have self-healed slightly since the previous year, as vegetation is now protecting some of the originally eroded area (see **Figures 10-12**). Since this bank was not included in the original scope of work as part of the WQT Plan, the current intent is to continue monitoring the streambank for further signs of failure, and if conditions worsen consider repairing this streambank sometime during the next WPDES permit cycle.

Kenzie Ostien, Wastewater Engineer-Senior
Wisconsin Department of Natural Resources
April 24, 2023

Figure 1: Map of eroding streambanks stabilized on property owned by Landowner A

Table 1: Landowner A Streambank Stabilization - 2022 Credit Generation Summary

Streambank ID	Phosphorus Credits (lbs/year)	Phosphorus Credits (lbs/month)
W1	1.5	0.12
W2	6.7	0.56
W3	3.7	0.31
W4	7.7	0.64
W5	1.2	0.10
W6	0.6	0.05
W7	4.3	0.36
W8	4.6	0.38
W9	0.4	0.03
W10	1.5	0.12
W11	18.3	1.52
W12	5.7	0.48
W13	4.1	0.34
W14	3.7	0.31
W15	9.2	0.77
W16	1.4	0.12
W17	0.7	0.06
W18	3.5	0.29
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Total	**137.5**	**11.46**

Kenzie Ostien, Wastewater Engineer-Senior
Wisconsin Department of Natural Resources
April 24, 2023

Figure 2: Photograph of Streambank W2 on August 23, 2022

Figure 3: Photograph of Streambank W2 on December 28, 2022

Kenzie Ostien, Wastewater Engineer-Senior
Wisconsin Department of Natural Resources
April 24, 2023

Figure 4: Photograph of Streambank W15 on August 23, 2022

Figure 5: Photograph of Streambank W15 on December 28, 2022

Kenzie Ostien, Wastewater Engineer-Senior
Wisconsin Department of Natural Resources
April 24, 2023

Figure 6: Photograph of Streambank W27 on August 23, 2022

Figure 7: Photograph of Streambank W27 on December 28, 2022

Figure 8: Photograph of Streambank W36 on August 23, 2022

Figure 9: Photograph of Streambank W36 on December 28, 2022

Figure 10: Photograph of new eroding streambank between banks W33 and W34 taken on November 15, 2021

Figure 11: Photograph of new eroding streambank between banks W33 and W34 taken on August 23, 2022

Figure 12: Photograph of new eroding streambank between banks W33 and W34 taken on December 28, 2022

<u>Landowner B – Project Summary</u>:

A map of the twenty-six (26) streambanks that were originally planned to be restored for Landowner B per Brodhead's WQT Plan is shown in **Figure 13**. Stabilization practices were completed in 2020 for all banks except S26, which was determined to be infeasible to repair prior to construction since it is partially located on another property. **Table 2** summarizes the amount of credits generated for each identified streambank based on the City's WQT Plan. As shown, the project with Landowner B generates 97.3 lbs of credit annually.

Site inspections for Landowner B were completed on August 23 and December 28, 2022. Photographs of Landowner B's property are included in **Figures 14 – 24**. Similar to Landowner A, no appreciable differences were noted in the stability or condition of the repaired streambanks when compared to previous site visits in 2021. There is still one small streambank on the south side of the stream between treatment sites S4 and S6 that continues to be monitored for accelerated erosion (see **Figures 22 – 24)**. This bank was previously noted during inspection reports in 2021. This streambank was not included in the original scope of work for the City's WQT Plan. The City's current plan is to continue to monitor this location and consider repairing this streambank sometime during the next WPDES permit cycle, if needed.

Kenzie Ostien, Wastewater Engineer-Senior
Wisconsin Department of Natural Resources
April 24, 2023

Figure 13: Map of streambank treatment sites on property owned by Landowner B

Table 2: Landowner B Streambank Stabilization - 2022 Credit Generation Summary

Streambank ID	Phosphorus Credits (lbs/year)	Phosphorus Credits (lbs/month)
S1	1.1	0.10
S2	3.9	0.32
S3	5.4	0.45
S4	0.7	0.05
S5	0.7	0.06
S6	7.1	0.59
S7	4.3	0.35
S8	31.2	2.60
S9	1.5	0.13
S10	4.3	0.36
S11	0.4	0.04
S12	5.8	0.48
S13	1.4	0.12
S14	2.9	0.24
S15	0.8	0.06
S16	1.1	0.09
S17	6.8	0.56
S18	1.2	0.10
S19	3.3	0.28
S20	1.8	0.15
S21	5.7	0.47
S22	1.5	0.13
S23	1.4	0.12
S24	0.3	0.02
S25	2.8	0.23
S26	-	-
Total	**97.3**	**8.11**

Figure 14: Photograph of Streambank S1 on August 23, 2022

Figure 15: Photograph of Streambank S1 on December 28, 2022

Figure 16: Photograph of Streambank S10 on August 23, 2022

Figure 17: Photograph of Streambank S10 on December 28, 2022

Figure 18: Photograph of Streambank S15 on August 23, 2022

Figure 19: Photograph of Streambank S15 on December 28, 2022

Figure 20: Photograph of Streambank S21 on August 23, 2022

Figure 21: Photograph of Streambank S21 on December 28, 2022

Figure 22: Photograph of new eroding streambank between banks S4 and S6 on November 15, 2021

Figure 23: Photograph of new eroding streambank between banks S4 and S6 on August 23, 2022

Figure 24: Photograph of new eroding streambank between banks S4 and S6 on December 28, 2022

Landowner C – Project Summary:

Credit generation through the project with Landowner C is via a combination of 1) production area practices to reduce phosphorus runoff from outdoor barnyards operated by the dairy farm and 2) improvements to nutrient management practices employed on crop fields owned and operated by the farm. A map of the animal production area of the dairy farm is shown in **Figure 25** and a map of the crop fields is shown in **Figure 32**.

Production area practices that have been implemented by Landowner C per the City's WQT Plan include:

- Installation of a new 180-day waste storage facility
- Abandonment of barnyard Lot #1
- Partial abandonment of barnyard Lot #2
- Installation of roof gutters and facilities to capture manure and runoff from barnyard Lot #3
- Installation of a roof cover over barnyard Lot #4
- Facilities to transfer manure and captured runoff from Lots #2, #3, and #4 to the new waste storage facility

Collectively production area practices are intended to generate 79.9 lbs of credit per year based on the City's WQT Plan.

Nutrient management and supporting conservation practices include incorporation of no-till and cover crops on the home farm of Landowner C. Per the City's WQT Plan, 78.7 lbs of credit were anticipated to be generated in 2022.

Site inspections for Landowner C were completed on June 27, September 8, and December 28, 2022. Overall, no notable issues were discovered with Lots #1, #2, and #4 during the inspections. However, there were problems noted with the clean water diversions installed for Lot #3 during the inspection on June 27 . A small section of roof gutter was damaged by a skid steer on a barn located on the northwest side of Lot #3. Also, the landowner had allowed livestock to access a concrete area where there is a stormwater inlet that collects roof runoff and diverts it around Lot #3. At the time of the inspection, the inlet was plugged with manure and debris. The landowner did not know the exact date the damage had occurred to the roof gutter or when livestock had been allowed to access the area by the stormwater inlet.

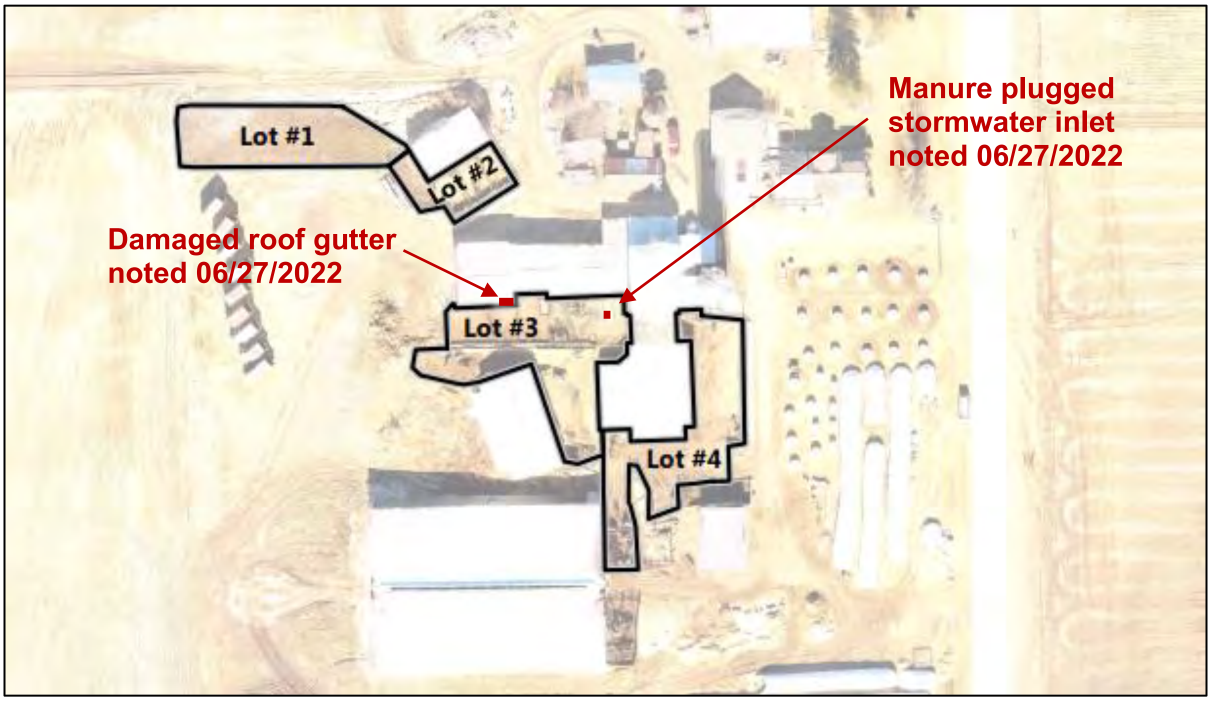

Figure 25: Map of outdoor barnyards operated by Landowner C

Based on the findings of the inspection, the City informed the DNR of the potential impact Lot #3 would have on credit generation. This notice was delivered as part of the City's Discharge Monitoring Report submitted to the Department in July 2022. Per the City's WQT Plan, Lot #3 generates 31.0 lbs of credit per year. Repairs to the damaged roof gutter and new gates and fencing to protect the stormwater inlet were completed by Landowner C prior to September 8, 2022. Given the unknown timing of the damage to the roof gutter and the mismanagement of the stormwater inlet area for Lot #3, we conservatively estimate that credits should be reduced for the City from January 1 to September 7, 2022, or 250 days. Therefore, we estimate that Lot #3 should only generate 9.8 lbs of credit for the year 2022:

$$Lot\ \#3\ Credit\ Calculation\ for\ 2022 = 31.0\ \frac{lbs\ credit}{year} \times \frac{1\ year}{365\ days} \times (365\ days - 250\ days)$$

$$Lot\ \#3\ Credit\ Calculation\ for\ 2022 = 9.8\ lbs\ credit$$

Including the new credit estimate for Lot #3, we estimate that the City generated 58.8 lbs of credit in 2022 from Landowner C's production area practices (see **Table 3**). This is 21.1 lbs lower than required per the City's WQT Plan.

Table 3: Landowner C Production Area Practices - 2022 Credit Generation Summary

Lot ID	Phosphorus Credits (lbs/year)	Phosphorus Credits (lbs/month)
#1	19.1	1.59
#2	0.7	0.06
#3	9.8	0.82
#4	29.2	2.43
Total	**58.8**	**4.90**

Figure 26: Photograph of damaged roof gutter for Lot #3 taken on June 27, 2022

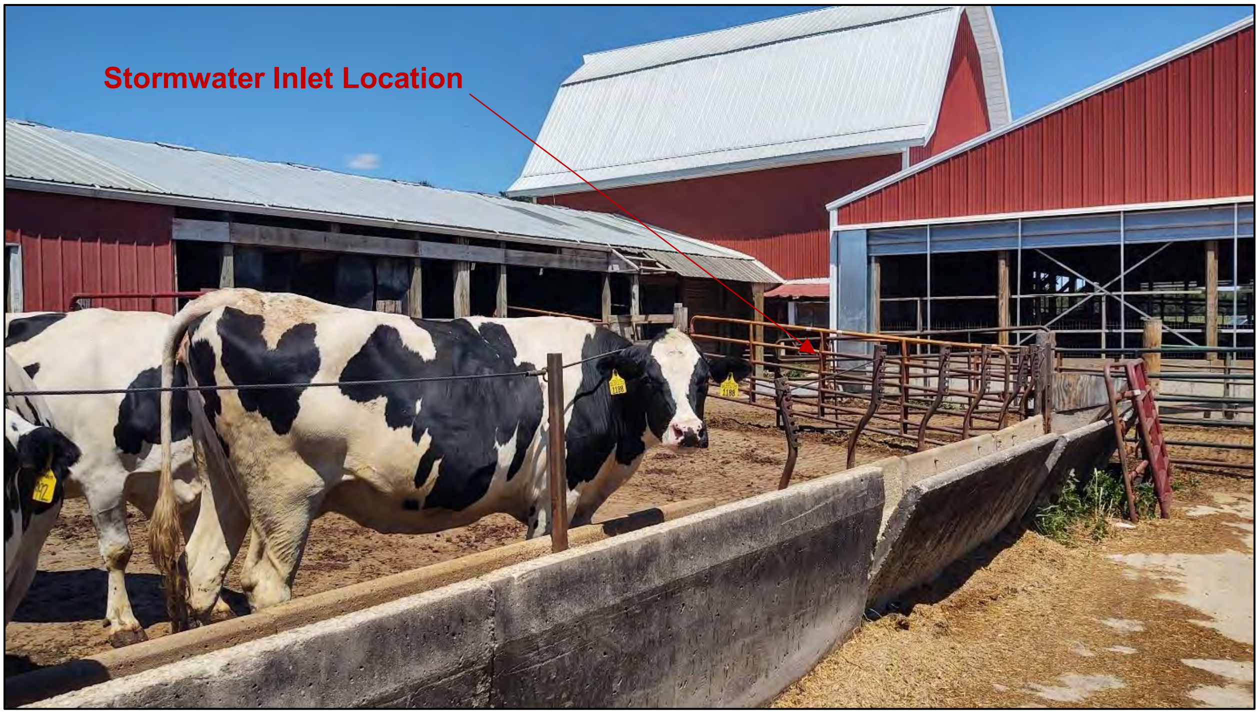

Figure 27: Photograph showing location of stormwater inlet Lot #3 taken on June 27, 2022

Figure 28: Photograph of plugged stormwater inlet Lot #3 taken on June 27, 2022

Kenzie Ostien, Wastewater Engineer-Senior
Wisconsin Department of Natural Resources
April 24, 2023

Figure 29: Photograph of repaired roof gutter for Lot #3 taken on September 8, 2022

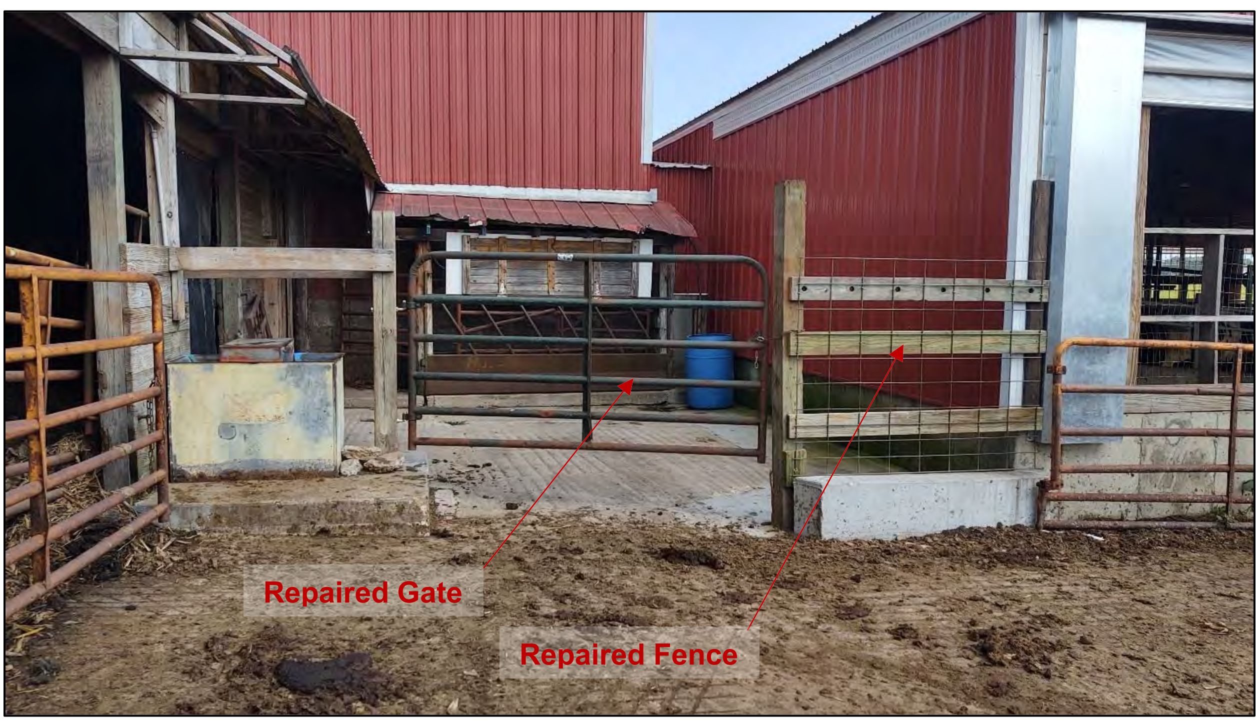

Figure 30: Photograph of repaired protective fence and gate for stormwater inlet Lot #3 taken on September 8, 2022

Figure 31: Photograph of cleaned stormwater inlet Lot #3 taken on September 8, 2022

Landowner C's nutrient management plan and supporting crop field practices were reviewed during a site visit completed on June 27, 2022. A copy of the landowner's 2022 producer's plan, including crop and tillage information, was compared to actual field conditions. Photographs of the site visit are shown in **Figures 33 – 42.** Based on the site visit, no fields were determined to be planted different than planned. We did notice that certain fields planted to Sorghum-Sudan forage were extremely overgrown with weeds. The landowner mentioned that they were unable to source necessary herbicide from the local fertilizer cooperative because of supply chain issues. The farm operator mentioned they may transition from using this forage crop in future years of the nutrient management plan due to the uncertainty of future herbicide deliveries.

Using the P-Trade report available in SnapPlus, MSA has compared the baseline conditions approved in the City's WQT Plan and Landowner C's current SnapPlus model, which has been updated to account for actual cropping practices in 2022. Based on the model, 89.0 lbs of phosphorus credit was generated from Landowner C's crop fields for the 2022 crop year (see **Table 4**). For reference, this is slightly above the City's goal of 78.7 lbs for 2022 based on the City's WQT Plan. A copy of the Management Practice Registration Form 3400-207 for Landowner C's 2022 crop land credits is enclosed with this report for the Department's record keeping purposes.

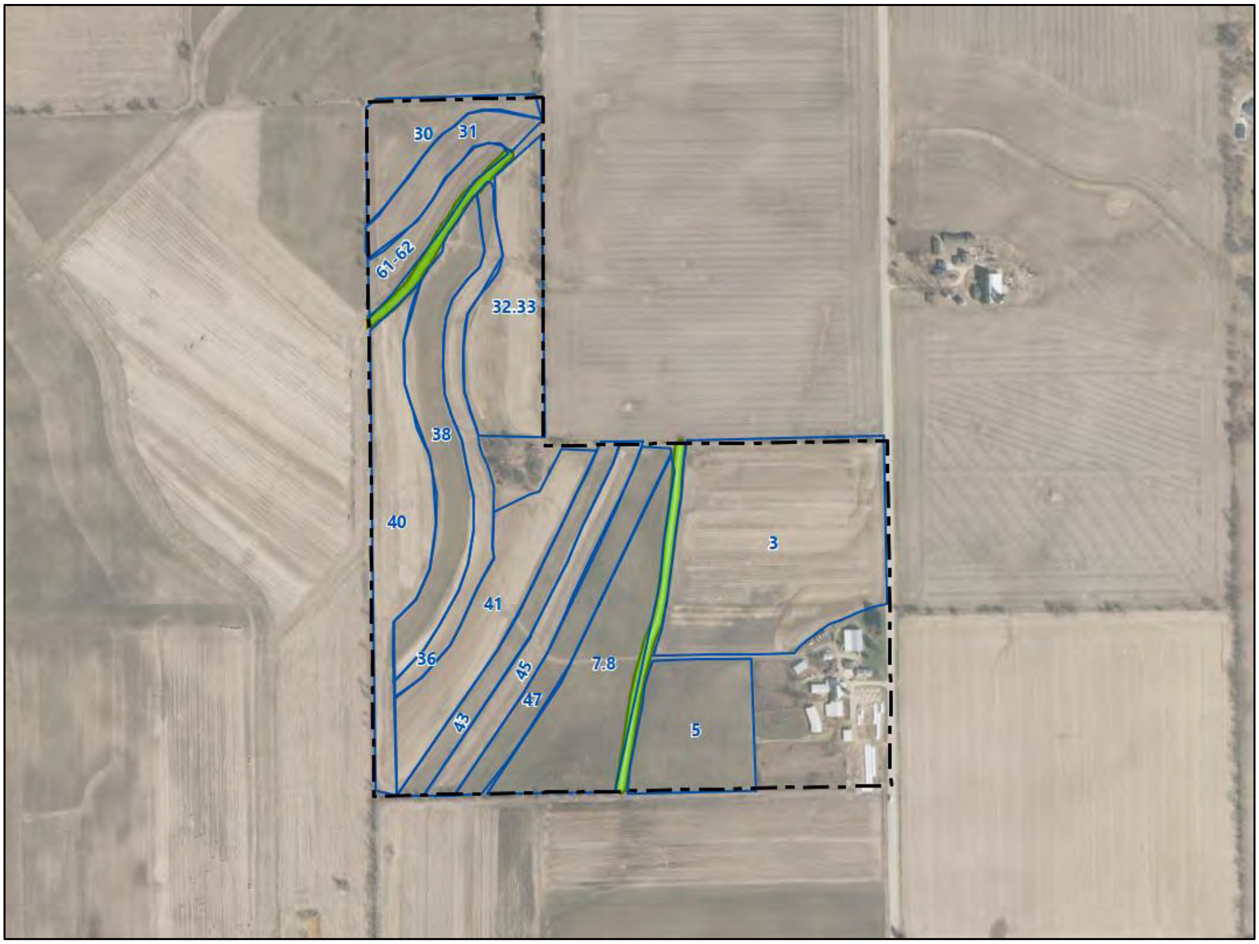

Figure 32: Map of crop fields owned and operated by Landowner C

Table 4: Landowner C Nutrient Management & Supporting Practices - 2022 Credit Generation Summary

Field ID	Phosphorus Credits (lbs/year)	Phosphorus Credits (lbs/month)
3	31.9	2.66
5	18.6	1.55
7.8	10.4	0.87
30	0.9	0.08
31	1.9	0.16
32.33	-1.4	-0.11
36	1.3	0.11
38	14.1	1.18
40	3.7	0.31
41	4.0	0.34
43	-1.1	-0.09
45	5.0	0.42
47	-0.8	-0.06
61-62	0.3	0.02
Total	**89.0**	**7.42**

Figure 33: Photograph of Field 3 on June 27, 2022 showing no-till corn silage crop

Figure 34: Photograph of Field 5 on June 27, 2022 showing no-till Sorghum-Sudan forage crop

Figure 35: Photograph of Field 7.8 on June 27, 2022 showing no-till Sorghum-Sudan forage crop

Figure 36: Photograph of Fields 43, 45, and 47 on June 27, 2022 showing no-till corn silage crop

Figure 37: Photograph of Field 41 on June 27, 2022 showing weedy no-till Sorghum-Sudan forage crop

Figure 38: Photograph of grassed waterway between Field 61-62 (no-till corn silage on right) and Field 38 (no-till Sorghum-Sudan forage crop on left) on June 27, 2022

Figure 39: Photograph of Fields 32.33 and 36 (background) on June 27, 2022 showing no-till corn silage crop

Figure 40: Photograph of Fields 30, 31, and 61-62 on June 27, 2022 showing no-till corn silage crop

Figure 41: Photograph of Fields 3 on December 28, 2022 showing fall planted triticale cover crop after corn silage harvest

Figure 42: Close up photograph of Fields 3 fall planted triticale cover crop on December 28, 2022

Wastewater Treatment Facility – Performance Summary:

A brief summary of effluent flows and phosphorus discharges by the Brodhead Wastewater Treatment Facility for the year 2022 is provided in **Table 5**. As shown, the average effluent flow was 0.237 MGD and the average effluent total phosphorus concentration was 0.25 mg/L. Per the City's WQT Plan, a minimum of 238 lbs of phosphorus credit per year would be needed assuming a target effluent concentration of 0.3 mg/L, a design flow of .313 MGD, and a safety factor of 1.25. In 2022, the City achieved treatment below the effluent target concentration and effluent flows were much lower than plan. As a result, the City only needed to use 118.8 credits in 2022. For comparison, the total amount of credits generated by the City in 2022 was 382.6 lbs (see **Table 6**). Therefore, the City is generating significantly more credits than currently needed to maintain compliance and there appears to be sufficient credit generating capacity for the remainder of the current WPDES permit term and beyond.

Table 5: Summary of wastewater treatment facility data (January – December 2022)

Month	Avg. Effluent Flow (MGD)	Avg. Effluent TP Conc. (mg/L)	Avg. Effluent TP Load (lbs/day)	Credits Used (lbs/month)
Jan.	0.198	0.12	0.19	1.1
Feb.	0.208	0.15	0.26	2.3
Mar.	0.210	0.16	0.28	3.1
Apr.	0.224	0.20	0.38	5.8
May.	0.244	0.14	0.27	2.3
Jun.	0.249	0.15	0.31	3.0
Jul.	0.254	0.23	0.48	8.9
Aug.	0.248	0.72	1.49	39.2
Sep.	0.263	0.47	1.03	23.9
Oct.	0.251	0.27	0.56	11.1
Nov.	0.252	0.30	0.63	12.7
Dec.	0.247	0.17	0.35	5.5
Avg.	**0.237**	**0.25**	**0.52**	**9.9**
Total	**-**	**-**	**-**	**118.8**

Table 6: Credit Generation Summary – Year 2022

Project ID	Phosphorus Credits (lbs/year)	Phosphorus Credits (lbs/month)
Landowner A - Streambank Stabilization	137.5	11.46
Landowner B - Streambank Stabilization	97.3	8.11
Landowner C - Production Area Practices	58.8	4.90
Landowner C - NMP & Supporting Practices	89.0	7.42
Total	**382.6**	**31.88**

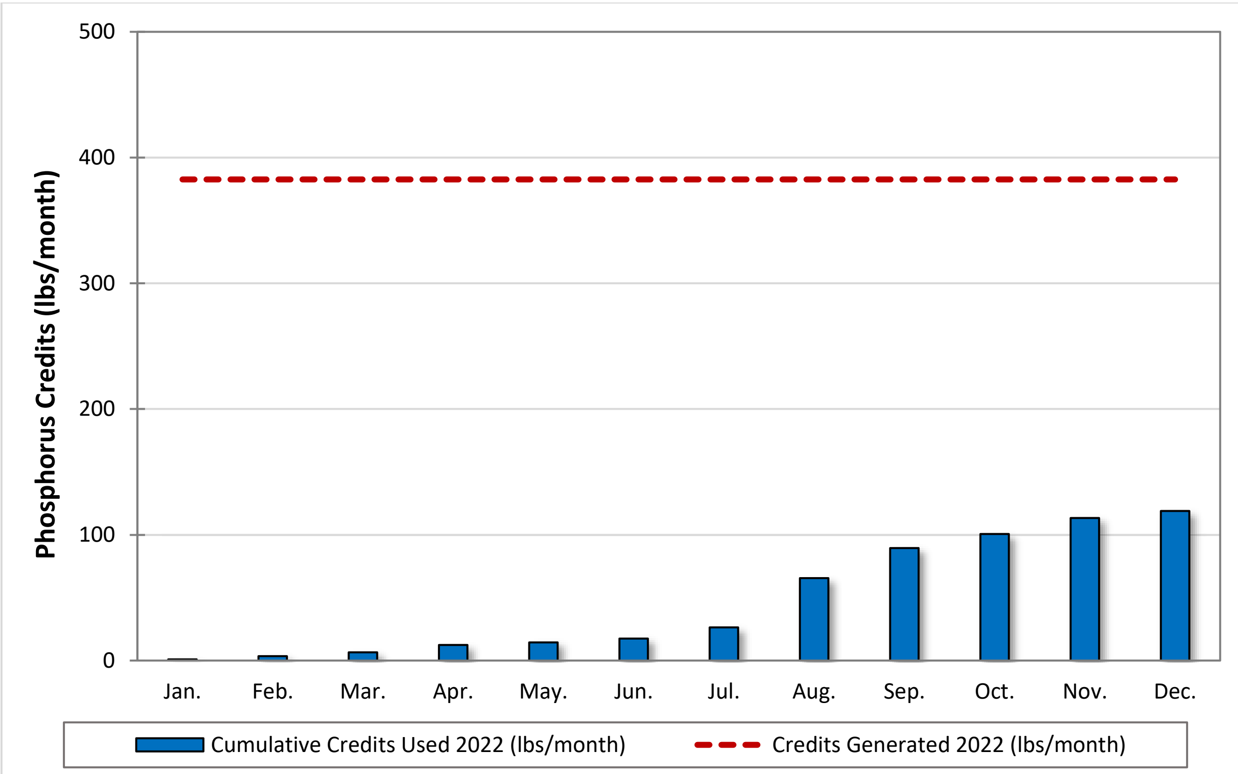

Figure 43: Graph depicting the cumulative amount of phosphorus credits used monthly by the City of Brodhead in 2022 for compliance with WQBELs.

Final Summary:

Based on the findings of this report, the City has continued to monitor and maintain credit generation for all proposed projects described in the City's 2018 WQT Plan. Moving forward, the City and MSA will continue to perform site inspections as required and to address issues as they arise. As per the requirements of the City's WPDES permit, the City and MSA intend to provide an updated WQT Plan to the Department for review so the City can continue to comply with total phosphorus WQBELs through WQT in the next WPDES permit term. MSA intends to provide the updated WQT plan to the Department no later than Friday, June 30, 2023. As per the Notice of Intent dated September 9, 2022, which was submitted to the Department as part of the City's WPDES permit application, the City intends to continue with their partnerships with Landowners A, B and C. In addition, the City is considering a potential trading partnership with Alliant Energy for a new solar field being constructed north of Brodhead, just outside of the City limits.

For more information, please feel free to contact me via email or phone number listed below. We would be happy to address any questions the Department may have regarding the City's WQT program.

Sincerely,
MSA Professional Services, Inc.

Andrew Skog

Andrew Skog, P.E.
Senior Project Engineer - Water
askog@msa-ps.com | +1 (608) 355-8976

Enclosures: 2

cc: Rich Vogel, City of Brodhead
Tonya Gratz, Green County
Greg Gunderson, MSA

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

Water Quality Trading Management Practice Registration

Form 3400-207 (R 1/14)

Notice: Pursuant to s. 283.84, Wis. Stats., 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	

Facility Address	City	State	ZIP Code
1700 11th Street	Brodhead	WI	53520

Project Contact Name (if applicable)	Address	City	State	ZIP Code
Andrew Skog, P.E.	400 Ice Harbor Drive, Suite 110	Dubuque	IA	52001

Project Name
City of Brodhead - Water Quality Trading

Broker/Exchange Information (if applicable)

Was a broker/exchange be used to facilitate trade?
- ○ Yes
- ◉ No

Broker/Exchange Organization Name	Contact Name	
Address	**Phone Number**	**Email**

Trade Registration Information (Use a separate form for each trade agreement)

Type	Trade Agreement Number	Practices Used to Generate Credits	Anticipated Load Reduction	Trade Ratio	Method of Quantification
○ Urban NPS ◉ Agricultural NPS ○ Other	Landowner C	Nutrient Management & Supporting Practices	269.7 lbs Year = 2022	3.03	SnapPlus

County	Closest Receiving Water Name	Land Parcel ID(s)	Parameter(s) being traded
Green	Searles Creek	23012.0452.0000	Total Phosphorus

The preparer certifies all of the following:

- 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 Skog	04/24/2023

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 A Vogel	04/24/2023

Leave Blank – For Department Use Only

Date Received		Trade Docket Number
Entered in Tracking System ☐ Yes	**Date Entered**	**Name of Department Reviewer**

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	

Facility Address	City	State	ZIP Code
1700 11th Street	Brodhead	WI	53520

Project Contact Name (if applicable)	Address	City	State	ZIP Code
Andrew Skog, PE (MSA)	1702 Pankratz St.	Madison	WI	53704

Project Name
City of Brodhead - Water Quality Trading Revision #1

Receiving Water Name	Parameter(s) being traded	HUC 12(s)
Sugar River Millrace	Total Phosphorus	07900040601, -40602, -40605

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)
- ☐ Permitted MS4
- ☐ Permitted CAFO
- ☐ Urban nonpoint source discharge
- ☒ Agricultural nonpoint source discharge
- ☒ Other - Specify: Solar Utility

Are any of the credit generators in a different HUC 12 than the applicant?
- ● Yes; HUC 12: 07900040601, 70900040602
- ○ 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:

The City of Brodhead will be updating their Water Quality Trading Plan per WPDES compliance schedule requirements. The new plan will include existing trading partners Landowner A, Landowner B, and Landowner C, identified in the City's 2018 WQT Plan. The updated plan will also consider a potential trading partnership with a proposed solar field located upstream of the City in the Norwegian Creek HUC 12 (070900040602). The solar field is being installed by Alliant Energy. Start of construction is planned in fall 2022. Credits are intended to be generated by converting agricultural row crops to perennial vegetation (native prairie). It is understood that areas where solar panels are installed credits will only be available from the conversion of sod to native prairie.

Method for quantifying credits generated:
- ☐ Monitoring
- ☒ Modeling, Names: Snap-Plus
- ☐ Other:

Projected date credits will be available: 10/01/2023

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
Andrew Skoss	09/09/2022

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 A Vogel	09/21/2022

1702 Pankratz Street

Madison, WI 53704

P (608) 242-7779
TF (800) 446-0679
F (608) 242-5664

www.msa-ps.com

January 31, 2024

Kenzie Ostien, Wastewater Engineer-Senior
Wisconsin Department of Natural Resources
3911 Fish Hatchery Rd
Fitchburg, Wisconsin 53711-5367

Re: City of Brodhead - Annual Water Quality Trading Report #5

Dear Ms. Ostien,

On behalf of the City of Brodhead, MSA submits this letter to satisfy WPDES permit reporting requirements for the City's fifth year of Water Quality Trading (WQT) implementation. For reference, the City of Brodhead has implemented water quality improvement projects with three (3) private, rural landowners to generate phosphorus credits for the City's wastewater treatment facility (Landowner A, B, and C). The purpose of these projects is to comply with new water quality based effluent limits (WQBELs) for total phosphorus, the most stringent being 0.1 mg/L (six-month average). It is estimated that the City can comply with the phosphorus WQBELs by generating approximately 238 lbs of credit per year. The City's projects with Landowners A and B include approximately 1.25 miles of streambank stabilization and habitat improvements along Searles Creek, a tributary of the Sugar River in Green County. The project with Landowner C, also in the Searles Creek watershed, included a major dairy farm upgrade with best management practices installed to reduce the runoff potential of existing outdoor barnyards and feedlots. The project with Landowner C also includes the implementation of a nutrient management plan and supporting conservation practices (e.g., no-till and cover crops) on the crop fields owned and operated by the landowner. In total, these projects are expected to generate approximately 390 lbs of credit per year for the City.

Construction for the projects with Landowners A, B, and C was completed in the year 2020 and the nutrient management plan for Landowner C was implemented in 2021. Therefore, all practices that were proposed in the City's WQT Plan (MSA, 2018) were actively generating credits in 2023. Annual inspections of the properties generating credits were completed multiple times throughout the past year. Inspections were completed on May 26, June 1, November 16, and November 20, 2023. For the Department's review, MSA has included brief summaries of each project in the sections below, including maps, photos, and credit calculations for the year 2023.

<u>Landowner A – Project Summary</u>:

A map of the 37 streambanks that were restored for Landowner A is shown in **Figure 1**. Stabilization practices (e.g., grading, riprap, bioengineering, and seeding & mulching) were completed in 2020. **Table 1** summarizes the amount of credits generated for the repair of each streambank based on the City's WQT Plan. Per plan, the stabilization of the streambanks generates a total of 137.5 lbs of credit annually.

Site inspections for Landowner A were completed on May 26 and November 20, 2023, see **Figures 2 – 14**. It is noted that prior to the inspection completed on November 20, 2023, controlled burning was conducted by the landowner. During the site visits, no appreciable differences were noted in the stability or condition of the streambanks when compared to previous site visits in 2022. As noted in Brodhead's Annual WQT Report #3 (2021) and #4 (2022), there is one small streambank on the south side of the creek between treatment sites W33 and W34 that has experienced some erosion. Although this bank was not included in the original scope of work as part of the WQT plan, the erosion has continued (see **Figures 10 – 12**), and the City plans to repair it. During the site visit on November 20, 2023, it was noted that the gate and fence posts on the west side of the property are beginning to lean and are preventing proper closure of the gate (see **Figures 13 – 14**). It is recommended that the posts be repaired and H-braces installed on all wooden posts to add additional support. The City's current intent is to develop a scope of work to determine the resources needed and complete the repairs when weather permits in 2024.

Figure 1: Map of eroding streambanks stabilized on property owned by Landowner A

Kenzie Ostien, Wastewater Engineer-Senior
Wisconsin Department of Natural Resources
January 31, 2024

Table 1: Landowner A Streambank Stabilization - 2023 Credit Generation Summary

Streambank ID	Phosphorus Credits (lbs/year)	Phosphorus Credits (lbs/month)
W1	1.5	0.12
W2	6.7	0.56
W3	3.7	0.31
W4	7.7	0.64
W5	1.2	0.10
W6	0.6	0.05
W7	4.3	0.36
W8	4.6	0.38
W9	0.4	0.03
W10	1.5	0.12
W11	18.3	1.52
W12	5.7	0.48
W13	4.1	0.34
W14	3.7	0.31
W15	9.2	0.77
W16	1.4	0.12
W17	0.7	0.06
W18	3.5	0.29
W19	7.5	0.63
W20	1.6	0.13
W21	0.8	0.07
W22	0.8	0.06
W23	1.2	0.10
W24	1.6	0.14
W25	4.8	0.40
W26	1.6	0.13
W27	2.0	0.17
W28	7.6	0.63
W29	1.2	0.10
W30	0.3	0.03
W31	4.2	0.35
W32	0.9	0.08
W33	1.3	0.11
W34	3.9	0.33
W35	15.3	1.28
W36	0.8	0.07
W37	1.4	0.12
Total	**137.5**	**11.46**

Figure 2: Photograph of Streambank W1 on May 26, 2023

Figure 3: Photograph of Streambank W1 on November 20, 2023

Figure 4: Photograph of Streambank W15 on May 26, 2023

Figure 5: Photograph of Streambank W15 on November 20, 2023

Figure 6: Photograph of Streambank W28 on May 26, 2023

Figure 7: Photograph of Streambank W28 on November 20, 2023

Figure 8: Photograph of Streambank W35 on May 26, 2023

Figure 9: Photograph of Streambank W35 on November 20, 2023

Figure 10: Photograph of new eroding streambank between banks W33 and W34 taken on November 15, 2021

Figure 11: Photograph of new eroding streambank between banks W33 and W34 taken on May 26, 2023.

Figure 12: Photograph of new eroding streambank between banks W33 and W34 taken on November 20, 2023.

Figure 13: Photograph of leaning gate posts on west side of property taken on November 20, 2023.

Figure 14: Photograph of leaning fence posts on west side of property taken on November 20, 2023.

Landowner B – Project Summary:

A map of the twenty-six (26) streambanks that were originally planned to be restored for Landowner B per Brodhead's WQT Plan is shown in **Figure 15**. Stabilization practices were completed in 2020 for all banks except S26, which was determined to be infeasible to repair prior to construction since it is partially located on another property. **Table 2** summarizes the amount of credits generated for each identified streambank based on the City's WQT Plan. As shown, the project with Landowner B generates 97.3 lbs of credit annually.

Site inspections for Landowner B were completed on May 26 and November 16, 2023. Photographs of Landowner B's property are included in **Figures 16 – 23**. Similar to Landowner A, no appreciable differences were noted in the stability or condition of the repaired streambanks when compared to previous site visits in 2022. There are a few streambanks not included in the original scope of work for the City's WQT plan that are experiencing erosion (see **Figures 24 – 29),** and the City intends to repair these. Additionally, there is a tree growing into the flood gate on the west side of the property, as well as driftwood logs and fallen trees throughout the stream, that are recommended for removal (see **Figures 30 – 32**). As was discussed for Landowner A, the City's current intent is to develop a scope of work to determine the resources needed and complete the repairs when weather permits in 2024.

Figure 15: Map of streambank treatment sites on property owned by Landowner B

Table 2: Landowner B Streambank Stabilization - 2023 Credit Generation Summary

Streambank ID	Phosphorus Credits (lbs/year)	Phosphorus Credits (lbs/month)
S1	1.1	0.10
S2	3.9	0.32
S3	5.4	0.45
S4	0.7	0.05
S5	0.7	0.06
S6	7.1	0.59
S7	4.3	0.35
S8	31.2	2.60
S9	1.5	0.13
S10	4.3	0.36
S11	0.4	0.04
S12	5.8	0.48
S13	1.4	0.12
S14	2.9	0.24
S15	0.8	0.06
S16	1.1	0.09
S17	6.8	0.56
S18	1.2	0.10
S19	3.3	0.28
S20	1.8	0.15
S21	5.7	0.47
S22	1.5	0.13
S23	1.4	0.12
S24	0.3	0.02
S25	2.8	0.23
S26	-	-
Total	**97.3**	**8.11**

Figure 16: Photograph of Streambank S1 on May 26, 2023

Figure 17: Photograph of Streambank S1 on November 20, 2023

Figure 18: Photograph of Streambank S3 on May 26, 2023

Figure 19: Photograph of Streambank S3 on November 20, 2023

Figure 20: Photograph of Streambank S14 on May 26, 2023

Figure 21: Photograph of Streambank S14 on November 20, 2023

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Wisconsin Department of Natural Resources
January 31, 2024

Figure 22: Photograph of Streambank S21 on May 26, 2023

Figure 23: Photograph of Streambank S21 on November 20, 2023

Figure 24: Photograph of new eroding streambank between banks S4 and S6 on November 15, 2021

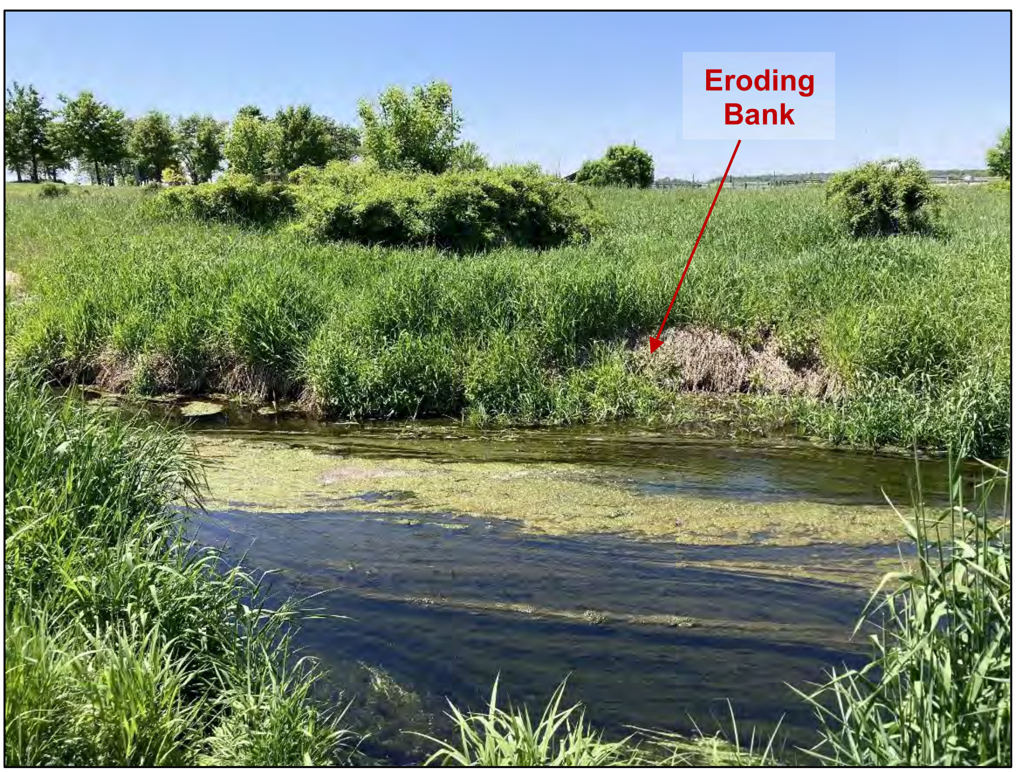

Figure 25: Photograph of new eroding streambank between banks S4 and S6 on May 26, 2023

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Wisconsin Department of Natural Resources
January 31, 2024

Figure 26: Photograph of new eroding streambank between banks S4 and S6 on November 20, 2023

Figure 27: Photograph of new eroding streambank between banks S8 and S9 on November 20, 2023

Figure 28: Photograph of new eroding streambank opposite S14 taken on November 20, 2023

Figure 29: Photograph of new eroding streambank between banks S15 and S16 taken on November 20, 2023

Figure 30: Photograph of tree growing in the west side flood gate taken on November 20, 2023

Figure 31: Photograph of logs blocking stream near S14 taken on November 20, 2023

Figure 32: Photograph of fallen tree near S18 taken on November 20, 2023

Landowner C – Project Summary:

Credit generation through the project with Landowner C is via a combination of 1) production area practices to reduce phosphorus runoff from outdoor barnyards operated by the dairy farm and 2) improvements to nutrient management practices employed on crop fields owned and operated by the farm. A map of the animal production area of the dairy farm is shown in **Figure 33** and a map of the crop fields is shown in **Figure 34**.

Production area practices that have been implemented by Landowner C per the City's WQT Plan include:

- Installation of a new 180-day waste storage facility
- Abandonment of barnyard Lot #1
- Partial abandonment of barnyard Lot #2
- Installation of roof gutters and facilities to capture runoff and manure, respectively, from barnyard Lot #3
- Installation of a roof cover over barnyard Lot #4
- Facilities to transfer manure and captured runoff from Lots #2, #3, and #4 to the new waste storage facility

Collectively, production area practices are intended to generate 79.9 lbs of credit per year based on the City's WQT Plan.

Nutrient management and supporting conservation practices include incorporation of no-till and cover crops on the home farm of Landowner C. Per the City's WQT Plan, 72.7 lbs of credit were anticipated to be generated in 2023.

Site inspections for Landowner C were completed on June 1 and November 20, 2023. On March 31, 2023, the roof installed to cover Lot #4 and corresponding gutters were damaged due to a tornado.

Figure 33: Map of outdoor barnyards operated by Landowner C

Based on the damage it was recognized that there would be an impact on credit generation for Lot #4. Per the City's WQT Plan, Lot #4 generates 29.2 lbs of credit per year. Repairs to the damaged roof and gutters were completed by Landowner C prior to the inspection completed on November 20, 2023. Given the unknown timing of repairs for Lot #4 MSA conservatively assumed that credits should be reduced for the City from March 31 to November 20, 2023, or 234 days. Therefore, we estimate that Lot #4 should only generate 10.5 lbs of credit for the year 2023:

$$Lot\ \#4\ Credit\ Calculation\ for\ 2023 = 29.2 \frac{lbs\ credit}{year} \times \frac{1\ year}{365\ days} \times (365\ days - 234\ days)$$

$$Lot\ \#4\ Credit\ Calculation\ for\ 2023 = 10.5\ lbs\ credit$$

Including the new credit estimate for Lot #4, MSA estimated the City generated 61.3 lbs of credit in 2023 from Landowner C's production area practices (see **Table 3**). This is 18.6 lbs lower than required per the City's WQT Plan.

Table 3: Landowner C Production Area Practices - 2023 Credit Generation Summary

Lot ID	Phosphorus Credits (lbs/year)	Phosphorus Credits (lbs/month)
#1	19.1	1.59
#2	0.7	0.06
#3	31.0	2.58
#4	10.5	0.88
Total	**61.3**	**5.11**

Landowner C's nutrient management plan and supporting crop field practices were reviewed during site visits completed on June 1 and November 20, 2023. A copy of the landowner's 2023 producer's plan, including crop and tillage information, was compared to actual field conditions. Photographs of the site visits are shown in **Figures 35 – 42.** Based on the site visits no fields were determined to be planted differently than planned. During the fall inspection completed on November 20, 2023 it was noted that manure was being injected into fields on the Riemer farmstead rather than surface applied per the NMP. Additionally, the landowner noted plans to apply commercial fertilizers not originally part of the NMP but will be incorporated into planning for the next WQT permit term.

Using the P-Trade report available in SnapPlus, MSA has compared the baseline conditions approved in the City's WQT Plan and Landowner C's current SnapPlus model, which has been updated to account for actual cropping practices in 2023. Based on modeling, 83.7 lbs of phosphorus credit were generated from Landowner C's crop fields for the 2023 crop year (see **Table 4**). For reference, this is slightly above the City's goal of 72.7 lbs for 2023 based on the City's WQT Plan. A copy of the Management Practice Registration Form 3400-207 for Landowner C's 2023 crop land credits is enclosed with this report for the Department's record keeping purposes.

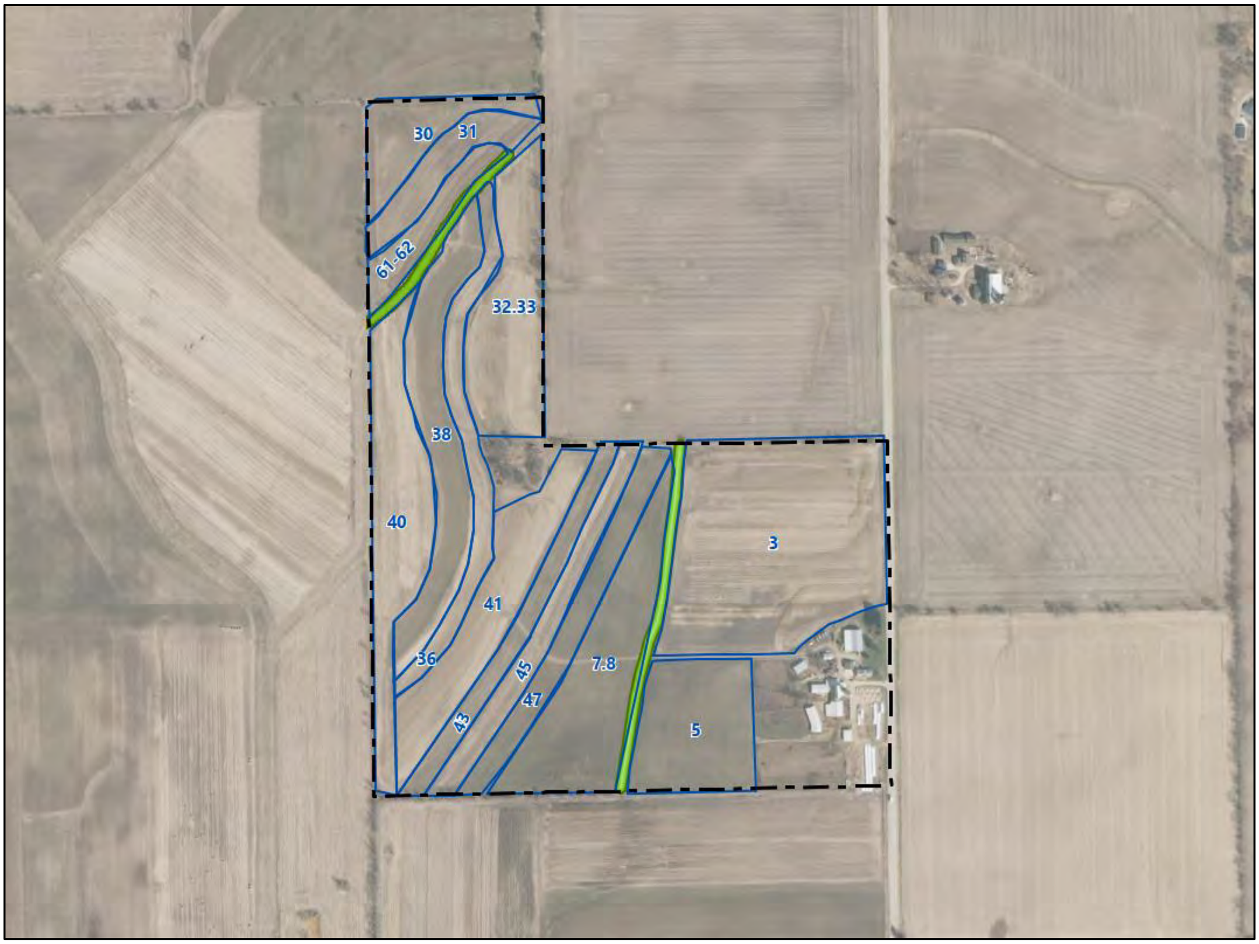

Figure 34: Map of crop fields owned and operated by Landowner C

Table 4: Landowner C Nutrient Management & Supporting Practices - 2023 Credit Generation Summary

Field ID	Phosphorus Credits (lbs/year)	Phosphorus Credits (lbs/month)
3	28.6	2.39
5	23.1	1.93
7.8	13.8	1.15
30	1.5	0.13
31	1.3	0.10
32.33	1.4	0.12
36	-1.9	-0.16
38	10.1	0.84
40	-0.2	-0.02
41	2.2	0.19
43	0.3	0.02
45	2.6	0.21
47	0.7	0.05
61-62	0.3	0.02
Total	**83.7**	**6.98**

Figure 35: Photograph of Field 5 on June 1, 2023 showing no-till corn planted green into cover crop

Figure 36: Photograph of Field 5 on November 20, 2023 showing no-till corn silage

Figure 37: Photograph of Field 7.8 on June 1, 2023 showing no-till corn

Figure 38: Photograph of Field 7.8 on November 20, 2023 showing no-till corn silage

Figure 39: Photograph of grassed waterway between Field 5 (left) and Field 7.8 (right) on June 1, 2023

Figure 40: Photograph of grassed waterway between Field 5 (left) and Field 7.8 (right) on November 20, 2023

Figure 41: Photograph of Field 41 on June 1, 2023 showing no-till corn planted green into cover crop

Figure 42: Photograph of Field 41 on November 20, 2023 showing no-till corn silage

Wastewater Treatment Facility – Performance Summary:

A brief summary of effluent flows and phosphorus discharges by the Brodhead Wastewater Treatment Facility for the year 2023 is provided in **Table 5**. As shown, the average effluent flow was 0.254 MGD and the average effluent total phosphorus concentration was 0.27 mg/L. Per the City's WQT Plan, a minimum of 238 lbs of phosphorus credit per year would be needed assuming a target effluent concentration of 0.3 mg/L, a design flow of 0.313 MGD, and a safety factor of 1.25. In 2023, the City achieved treatment below the effluent target concentration and effluent flows were much lower than plan. As a result, the City only needed to use 125.8 credits in 2023. For comparison, the total amount of credits generated by the City in 2023 was 379.8 lbs (see **Table 6**). Therefore, the City is generating significantly more credits than currently needed to maintain compliance and there appears to be sufficient credit generating capacity for the remainder of the current WPDES permit term and beyond (see **Figure 43**).

Table 5: Summary of wastewater treatment facility data (January – December 2023)

Month	Avg. Effluent Flow (MGD)	Avg. Effluent TP Conc. (mg/L)	Avg. Effluent TP Load (lbs/day)	Credits Used (lbs/month)
Jan.	0.271	0.14	0.32	3.0
Feb.	0.292	0.13	0.31	1.9
Mar.	0.327	0.20	0.54	5.6
Apr.	0.322	0.19	0.50	7.1
May.	0.291	0.25	0.60	13.4
Jun.	0.290	0.33	0.81	17.1
Jul.	0.238	0.34	0.68	15.7
Aug.	0.222	0.41	0.75	17.9
Sep.	0.204	0.34	0.57	12.5
Oct.	0.208	0.63	1.09	28.6
Nov.	0.194	0.14	0.23	2.1
Dec.	0.192	0.12	0.19	0.8
Avg.	**0.254**	**0.27**	**0.55**	**10.5**
Total	**-**	**-**	**-**	**125.8**

Table 6: Credit Generation Summary – Year 2023

Project ID	Phosphorus Credits (lbs/year)	Phosphorus Credits (lbs/month)
Landowner A - Streambank Stabilization	137.5	11.46
Landowner B - Streambank Stabilization	97.3	8.11
Landowner C - Production Area Practices	61.3	5.11
Landowner C - NMP & Supporting Practices	83.7	6.98
Total	**379.8**	**31.65**

Kenzie Ostien, Wastewater Engineer-Senior
Wisconsin Department of Natural Resources
January 31, 2024

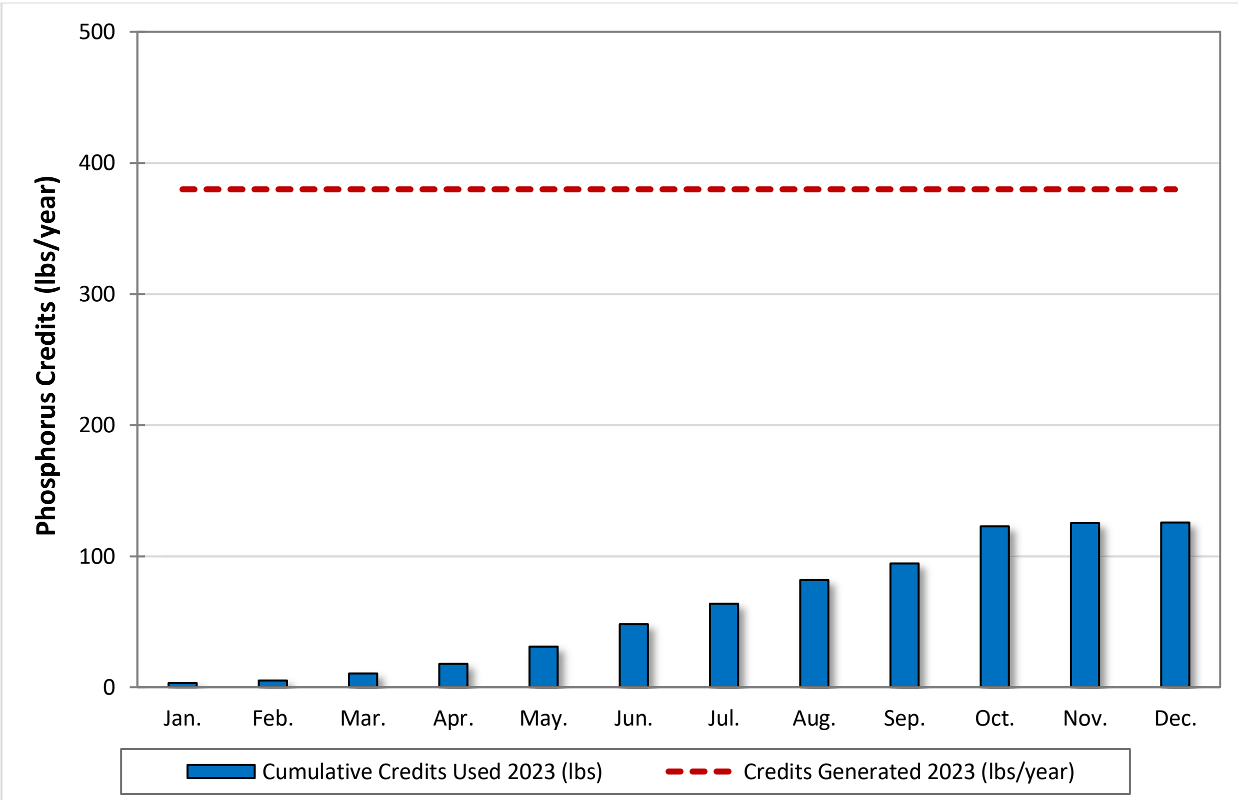

Figure 43: Graph depicting the cumulative amount of phosphorus credits used monthly by the City of Brodhead in 2023 for compliance with WQBELs.

Final Summary:

Based on the findings of this report the City has continued to monitor and maintain credit generation for all proposed projects described in the City's 2018 WQT Plan. Moving forward, the City and MSA will continue to perform site inspections as required and to address issues as they arise. As per the requirements of the City's WPDES permit, the City and MSA intend to provide an updated WQT Plan to the Department for review so the City can continue to comply with total phosphorus WQBELs through WQT in the next WPDES permit term. As per the Notice of Intent dated September 9, 2022, which was submitted to the Department as part of the City's WPDES permit application, the City intends to continue with their partnerships with Landowners A, B and C. In addition, the City is considering a potential trading partnership with Alliant Energy for a new solar field being constructed north of Brodhead, just outside of the City limits.

For more information, please feel free to contact me via email or phone number listed below. We would be happy to address any questions the Department may have regarding the City's WQT program.

Sincerely,
MSA Professional Services, Inc.

MacKenzie Phillips

MacKenzie Phillips, EIT
Engineer
mphillips@msa-ps.com | +1 (608) 421-7147

Enclosures: 2

cc: Rich Vogel, City of Brodhead
Tonya Gratz, Green County
Greg Gunderson, MSA
Jeff Felland, MSA

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State of WisconsinDepartment of Natural Resources101 South Webster Street
Madison WI 53707-7921dnr.wi.gov

Water Quality Trading Management Practice Registration

Form 3400-207 (R 1/14)

Notice: Pursuant to s. 283.84, Wis. Stats., 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	

Facility Address	City	State	ZIP Code
1700 11th Street	Brodhead	WI	53520

Project Contact Name (if applicable)	Address	City	State	ZIP Code
MacKenzie Phillips	1702 Pankratz Street	Madison	WI	53704

Project Name
City of Brodhead - Water Quality Trading

Broker/Exchange Information (if applicable)

Was a broker/exchange be used to facilitate trade?
- ○ Yes
- ⦿ No

Broker/Exchange Organization Name	Contact Name	
Address	**Phone Number**	**Email**

Trade Registration Information (Use a separate form for each trade agreement)

Type	Trade Agreement Number	Practices Used to Generate Credits	Anticipated Load Reduction	Trade Ratio	Method of Quantification
○ Urban NPS ⦿ Agricultural NPS ○ Other	Landowner C	Nutrient Management & Supporting Practices	253.7 lbs Year = 2023	3.03	SnapPlus

County	Closest Receiving Water Name	Land Parcel ID(s)	Parameter(s) being traded
Green	Searles Creek	23012.0452.0000	Total Phosphorus

The preparer certifies all of the following:

- 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
MacKenzie Phillips	1/24/2024

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 A. Vogel	1/24/2024

Leave Blank – For Department Use Only

Date Received		Trade Docket Number
Entered in Tracking System ☐ Yes	**Date Entered**	**Name of Department Reviewer**

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	

Facility Address	City	State	ZIP Code
1700 11th Street	Brodhead	WI	53520

Project Contact Name (if applicable)	Address	City	State	ZIP Code
Andrew Skog, PE (MSA)	1702 Pankratz St.	Madison	WI	53704

Project Name
City of Brodhead - Water Quality Trading Revision #1

Receiving Water Name	Parameter(s) being traded	HUC 12(s)
Sugar River Millrace	Total Phosphorus	07900040601, -40602, -40605

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)
- ☐ Permitted MS4
- ☐ Permitted CAFO
- ☐ Urban nonpoint source discharge
- ☒ Agricultural nonpoint source discharge
- ☒ Other - Specify: Solar Utility

Are any of the credit generators in a different HUC 12 than the applicant?
- ● Yes; HUC 12: 07900040601, 70900040602
- ○ 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:

The City of Brodhead will be updating their Water Quality Trading Plan per WPDES compliance schedule requirements. The new plan will include existing trading partners Landowner A, Landowner B, and Landowner C, identified in the City's 2018 WQT Plan. The updated plan will also consider a potential trading partnership with a proposed solar field located upstream of the City in the Norwegian Creek HUC 12 (070900040602). The solar field is being installed by Alliant Energy. Start of construction is planned in fall 2022. Credits are intended to be generated by converting agricultural row crops to perennial vegetation (native prairie). It is understood that areas where solar panels are installed credits will only be available from the conversion of sod to native prairie.

Method for quantifying credits generated:
- ☐ Monitoring
- ☒ Modeling, Names: Snap-Plus
- ☐ Other:

Projected date credits will be available: 10/01/2023

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
Andrew Skus	09/09/2022

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 A Vogel	09/21/2022

APPENDIX I

Water Quality Trading Checklist

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State of WisconsinDepartment of Natural Resources101 South Webster Street
Madison WI 53707-7921dnr.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 City of Brodhead	Permit Number WI- 0021903	Facility Site Number N/A		
Facility Address P.O. Box 168, 1111 West 2nd Avenue		City Brodhead	State WI	ZIP Code 53520
Project Contact Name (if applicable) MacKenzie Phillips	Address 1702 Pankratz Street	City Madison	State WI	ZIP Code 53704
Project Name City of Brodhead Water Quality Trading Plan (Revision #1)				
Receiving Water Name Sugar River Millrace	Parameter(s) being traded Total Phosphorus	HUC 12(s) 070900040601, -40605, ~~-40602~~		

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, ~~070900040602~~ ◯ 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~~	~~Conservation Easements/Field Conversion~~	~~SnapPlus~~	~~Alliant Energy Albany Solar Field Project~~	~~◯ 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	*Ch. 3*
b. Management practices used to generate credits	◉ Yes	◯ No	*Ch. 4*
c. Amount of credit being generated	◉ Yes	◯ No	*Ch. 4*
d. Description of applicable trade ratio per agreement/management practice	◉ Yes	◯ No	*Ch. 4*
e. Location where credits will be generated	◉ Yes	◯ No	*Ch. 3, 4, 5*
f. Timeline for credits and agreements	◉ Yes	◯ No	*Ch. 4 & 6*
g. Method for quantifying credits	◉ Yes	◯ No	*Ch. 4*

Does plan have a narrative that describes:			Plan Section
h. Tracking procedures	◉ Yes	○ No	Ch. 5
i. Conditions under which the management practices may be inspected	◉ Yes	○ No	Ch. 5
j. Reporting requirements should the management practice fail	◉ Yes	○ No	Ch. 5
k. Operation and maintenance plan for each management practice	◉ Yes	○ No	Ch. 4
l. Location of credit generator in proximity to receiving water and credit user	◉ Yes	○ No	Ch. 3 & 4
m. Practice registration documents, if available	◉ Yes	○ No	Appendix G
n. History of project site(s)	◉ Yes	○ No	Ch. 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
MacKenzie Phillips	2/13/2024

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 A Vogel	2/12/2024