Appendix D – Using SnapPlus to Quantify Phosphorus Trading Credits

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1.1 Purpose

The purpose of this document is to provide technical assistance for using the "P Trade" report in SnapPlus to quantify phosphorus trading credits. This document does not detail data needs for SnapPlus or how to use the SnapPlus tool. It is recommended that individuals interested in using the SnapPlus tool review the SnapPlus User Manual (http://snapplus.wisc.edu/users-manual), and attend a SnapPlus training session to gain additional information about data needs and using this tool. This document also refers to WDNR's water quality trading program available at: WDNR Water Quality Trading Webpage (http://dnr.wi.gov/topic/WasteWater/WaterQualityTrading.html).

1.2 Background on SnapPlus

SnapPlus (Soil Nutrient Application Planner) is a widely used software program to prepare WI NRCS 590 standard compliant nutrient management plans. The program helps farmers make the best use of their on-farm nutrients allowing informed and justified commercial fertilizer purchases. Two critical features of this program related to water quality are its ability to generate, by field, a phosphorus index (PI) value and capability to calculate soil erosion, based on the revised universal soil loss equation (RUSLE2). By calculating potential soil and phosphorus runoff losses on a field-by-field basis while assisting in the economic planning of manure and fertilizer applications, SnapPlus provides Wisconsin farmers with a tool for protecting soil and water quality. SnapPlus is supported by UW-Madison Department of Soil Science, DATCP, WI NRCS, UW-Extension, and WDNR, and is available for download at SnapPlus (http://snapplus.wisc.edu/).

SnapPlus was recently augmented to quantify phosphorus reductions for trading and adaptive management projects. SnapPlus, which has been calibrated using edge of field monitoring, is the preferred tool for trading and adaptive management because it can quantify the amount of phosphorus delivered from a farm field to the nearest surface water both with and without management practices installed. Management practices that can be quantified include whole field management, cover crops, conservation easements, and nutrient management and supporting practices, among other things.

1.3 Model Assumptions

When using SnapPlus to quantify phosphorus pollutant reductions resulting from changes in agricultural practices, it is important to understand there are several basic limitations of this model. Certain field elements will not be appropriate for quantification with SnapPlus. Fields that contain incompatible elements, when modeled in SnapPlus, may result in under or over-estimating phosphorus loss and may not be appropriate for a water quality trade. Please consult with WDNR staff when using SnapPlus to model pollutant reductions from agricultural practices.

A critical assumption of SnapPlus phosphorus loss calculations captured by the P Trade report is that farm fields do not have ongoing gullies or concentrated flow channel erosion. If fields modeled in SnapPlus have gullies or

concentrated flow erosional features, or aerial photos reveal these soil erosion features are ongoing, the P Trade report phosphorus loss calculation is underestimated and, accordingly, WDNR may not accept the P Trade reports for such fields.

SnapPlus also does not account for tile drains and associated phosphorus loss to surface waters from them. With that said, SnapPlus can still be used for tile drained fields; however, the uncertainty factor for a tile drained field will need to be increased to account for the additional uncertainty associated with the tile drainage. Tiled fields that generate credits for water quality trading may not receive manure, biosolids, or industrial waste. In addition, the application of manure, biosolids or industrial waste on tile drained fields may further increase the uncertainty associated with modeled pollutant reductions occurring on those fields. Uncertainty factors are discussed in greater detail below.

The modeling results conveyed within the P Trade report are intended to represent annual pounds of phosphorus delivered to surface waters. While the background calculations of SnapPlus (P Index and RUSLE2) handle soil and phosphorus transport within the field and transport to field's edge, these functions do not address connectivity from edge-of-field to perennial surface water. The P Trade report applies assumed conditions down-gradient of the field edge to determine how much sediment and phosphorus are delivered to surface water. The assumptions specify that runoff from the field edge enters a vegetated concentrated flow path (such as a grassed waterway) and then travels down the path and enters a perennial surface water. Accordingly, SnapPlus model inputs include "distance to perennial water" and "downgradient slope" which are specified by the user. These inputs are used in conjunction with a precipitation dataset applied in the model to determine channel flow volume and velocity. With the aforementioned factors quantified, infiltration and particle settling are calculated and reduce the P Trade output values, thus addressing connectivity between edge-of-field and surface waters. Sites that do not meet these assumptions (i.e. runoff enters wetlands, flat areas or depressions, or other depositional areas) may deliver less pollutant to surface waters than calculated by the P Trade report, or may not be eligible for water quality trading.

Due to the challenges with successful establishment of cover crop(s) after harvesting a corn grain crop, WQT plans should not rely upon using the cover crop practice following corn grain to generate credits. For other crops (e.g., corn silage, soybean, wheat) the cover crop practice may be used to generate credits, because a longer time window, after harvest, is available to successfully establish a cover crop.

For WQT plans that use cover crops over three or more consecutive years within a crop sequence/rotation to generate credits, it is recommended the plan assume a cover crop failure rate of 1 every 3 years to account for contingency of cover crop failure and to provide greater assurances of credit generation for both the credit user and generator.

1.4 Data Inputs

The P Trade Report is designed to aggregate data in SnapPlus to quantify the annual amount of phosphorus that is delivered to the nearest receiving water from specific farm fields under modeled management practices. Structural practices encompass physical structures or engineered solutions designed to intercept, contain, or treat erosion and manage sediment/nutrient runoff. Non-Structural practices do not involve physical structures

and focus on modifying practices and behaviors to minimize erosion and sediment/nutrient runoff via planning, education or related measures and strategies. Most practices within SnapPlus are non-structural practices. For water quality trades that rely upon non-structural practices, all fields owned and operated by the farm should be included in the farm SnapPlus database to demonstrate existing phosphorus losses are not being 'shifted' to other fields and there is an overall net reduction in phosphorus load (Note: WDNR may grant exceptions to this when site specific details indicate a low risk for shifting). If phosphorus losses are 'shifted' to other fields, the water quality trade plan needs to document, quantify, and then subtract that amount from the total calculated phosphorus reductions. For water quality trades that rely upon structural practices, only the fields with structural practices should be included in the farm SnapPlus database. Table D1 provides examples of structural and non-structural practices.

TABLE D1: EXAMPLES OF STRUCTURAL AND NON-STRUCTURAL PRACTICES

Structural Practices	Non-Structural Practices
Clean Water Diversion	Nutrient Management
Riparian Filter Strip + Field Border	Tillage + Residue Management
Grassed Waterway	Cover Crops + Crop Rotation (e.g., increase perennial crops)
Wetland Restoration	Contour Farming + Contour Strips
Sediment Control Basin Heavy Use Area Protection Streambank and Shoreline Stabilization	Manure Applications – timing, rates, amounts, methods, and manure types Prescribed Grazing Converting annual crop to continuous forage/perennial crop Conversion to Prairie

^ = Structural and Non Structural Practices: https://connect.ieca.org/blogs/jerry-b-sanders/2023/06/20/ieca-pulse-understanding-the-difference-structural

When modeling pollution reductions from practices that reduce land available for manure spreading, include all fields owned or rented by the producer in the SnapPlus database to demonstrate existing phosphorus losses are not 'shifted' to other fields ensuring an overall net reduction in phosphorus load.

Once the farm database has been created to reflect structural or non-structural practices, it is important to verify that all field information is accurately included in the "Fields" tab, particularly the predominant soil type information. The P Trade Report uses the predominant soil type (i.e., the largest soil unit within the field) to quantify the phosphorus loss in lieu of the critical soil type used for calculation of the Wisconsin P-Index. Other tabs in SnapPlus, including "Soil Tests" and "Nutrients", should be filled out the same as they would be when using SnapPlus to calculate a P-Index value.

Predominant soil type information is available from:

- Wisconsin 590 Interactive Maps (http://www.manureadvisorysystem.wi.gov/app/interactive)

- Web Soil Survey (http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm)

A minimum of two years of historical data are needed in order to generate the P Trade Report. Historic nutrient management plans and soil test values can be used to create the historic record and identify the crop sequence and management practices for all fields in the farm database. Although a two-year historic record is required for the P Trade Report, it is recommended the historic data for the crop sequence be used whenever available and should not exceed five years. If nutrient management plans are used in water quality trading, they need to be updated after each crop year to reflect real, rather than planned, management (i.e., the crop sequence). If historic nutrient management plans are not available:

- Interview the farmer, agronomist, or County LCD staff familiar with the field(s) to gather additional information and help determine what reasonable assumptions for fields included in the P Trade report
- Use USDS-NASS Cropscape Tool (https://nassgeodata.gmu.edu/CropScape/) to estimate historical crop patterns
- Use County average cropping yield information. NOTE: Using county yield data with caution; it may over or under-estimate field P losses based upon management
- Soil test all fields (routine agricultural soil test including soil test P and organic matter %) and apply the current data to the historical record. Soil testing protocol should be consistent with the 2022 Sampling Soils for Testing (A2100) publication (https://cdn.shopify.com/s/files/1/0145/8808/4272/files/A2100.pdf).
    - For WQ Trades, soil sampling depth should be consistent for all samples and be at least six inches deep. Sample locations within the field should be documented using GPS coordinates. It is important to take soil samples from the same locations in the field to exactly the same depth when comparing soil sample results from a field over time.
    - Soil samples should be taken every four years. WDNR may not accept soil samples older than four years for water quality trading purposes.

WDNR will verify SnapPlus inputs for consistency with WQT plans and agreements, as well as available baseline data (i.e., crop sequence). The most efficient way to share SnapPlus inputs with WDNR is by including the SnapPlus database files used to generate P Trade reports when submitting WQT materials.
WDNR will review SnapPlus model inputs for feasibility and compatibility with the proposed trade site conditions. WDNR may request conservative modeling inputs be used to avoid underestimating pollutant loads resulting from uncertainties with vegetation establishment. Examples include overly-aggressive vegetation establishment timeframes or cover crops in all years of a cropping sequence.

1.5 Carrying Model Inputs Through to Implementation

The pollutant load quantification and quantity of credits generated from a given field depend heavily upon modeling inputs used for the planned conditions scenario. Parameters such as cropping type, nutrient applications, type of tillage, etc. must all be specified to populate a SnapPlus model for the period of credit generation. These inputs should be reflected in the water quality trading plan and water quality trade agreement. For example, if the SnapPlus model specifies a conservation tillage will be used throughout the term of the water quality trade, the water quality trading plan should explicitly state that conservation tillage will be used. Furthermore, the water quality trade agreement with the landowner will also need to specify that

conservation tillage be used to ensure this expectation is made clear up front. If the landowner were to utilize a heavier tillage while the SnapPlus quantification specified conservation tillage, actual pollutant loads would likely be higher than modeled, and the water quality trading credits may not be valid.

SnapPlus utilizes live canopy cover metrics within the RUSLE2 sediment loss equations to model the effects of different vegetation on soil mobilization. When vegetative practices (prairie restoration, forage production, etc.) are used to generate credits, the water quality trading plan should specify a live canopy coverage metric to be verified during annual inspections. These metrics will serve as the vegetation establishment and density goals for the water quality trading effort. Maintaining the live canopy coverage assumptions of the SnapPlus model demonstrates that installed vegetative practices are performing adequately and credit quantities are not invalid due to lack of vegetation density.

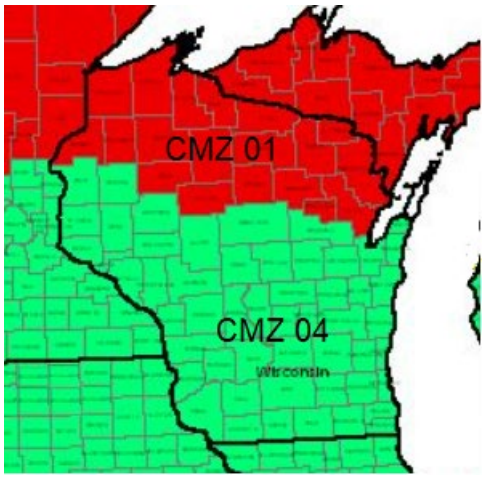

FIGURE D1: WISCONSIN CROP MANAGEMENT ZONES

Table D2 below lists weekly live canopy cover values for various vegetative practices. The values are specific to crop management zone (CMZ) 01 or 04. Refer to Figure D1 to identify the appropriate CMZ based on the location of the field being modeled. The generally accepted metric for water quality trading purposes is that sites modeled as “grasslands, not harvested” should maintain a minimum of 85 - 90% live canopy cover during the growing season. Sites modeled as “grass hay” for forage production practices should maintain a minimum of 70 - 80% live canopy cover during the growing season.

TABLE D2: SNAPPLUS LIVE CANOPY COVER ASSUMPTIONS FOR PERENNIAL VEGETATION

Week Start Date	CMZ 04 Grasslands, not harvested (%)	CMZ 04 Grass hay (%)	CMZ 01 Grasslands, not harvested (%)	CMZ 01 Grass hay (%)
6-May	81	12	66	86
13-May	89	22	72	90
20-May	92	36	81	93
27-May	95	50	89	88
3-Jun	95	64	92	54
10-Jun	95	78	95	71
17-Jun	95	86	95	83
24-Jun	95	93	95	90

Week Start Date	CMZ 04 Grasslands, not harvested (%)	CMZ 04 Grass hay (%)	CMZ 01 Grasslands, not harvested (%)	CMZ 01 Grass hay (%)
1-Jul	94	95	95	95
8-Jul	91	95	95	95
15-Jul	89	52	94	57
22-Jul	87	68	91	66
29-Jul	85	82	89	80
5-Aug	85	89	87	88
12-Aug	85	95	85	94
19-Aug	88	95	85	95
26-Aug	90	88	85	95
2-Sep	92	54	88	52
9-Sep	95	71	90	68
16-Sep	95	84	92	83
23-Sep	95	93	95	92
30-Sep	93	97	95	98
7-Oct	91	88	95	89
14-Oct	87	79	93	80
21-Oct	83	69	91	71
28-Oct	79	60	87	61
AVERAGE	90	73	89	81

1.6 Running the P Trade Report

Once the crop sequence/historic record have been entered into the SnapPlus database, run the P Trade report, absent the new practices that will be installed to reduce phosphorus. This report provides field specific annual phosphorus losses from the farm and will serve as the "baseline" for future comparisons. Table D3 is an example "baseline" P Trade Report generated from SnapPlus.

TABLE D3: BASELINE P TRADE REPORT (CURRENT CROPLAND PRACTICES 2014-2020)

Farm	Field	Acres	PTP 2014	PTP 2015	PTP 2016	PTP 2017	PTP 2018	PTP 2019	PTP 2020
Farm A	80 1	21.0	50	18	18	14	35	175	170
Farm A	80 2	10.0	13	12	7	33	58	59	19
Farm A	80 3	12.0	10	7	5	36	59	66	19
Farm A	80 4	20.0	23	131	89	31	22	18	14
Farm A	80 6	12.0	13	9	7	45	99	78	23
Farm A	HOME 1	22.0	158	41	20	19	14	34	168
Farm A	HOME 2	12.0	19	68	67	25	16	13	10
Farm A	HOME 3	10.0	49	6	26	35	8	6	4
Farm A	HOME 4	9.0	9	43	147	161	44	17	16
Farm A	HOME 5	7.0	20	66	75	23	13	13	10

Farm	Field	Acres	PTP 2014	PTP 2015	PTP 2016	PTP 2017	PTP 2018	PTP 2019	PTP 2020
Farm A	MART 1	2.0	9	3	3	3	2	3	11
Farm A	MART 2	23.0	15	18	14	22	44	80	20
Farm A	MART 3	4.0	1	1	1	1	1	1	1
Farm A	PASTURE East	3.0	45	46	46	47	47	48	48
Farm A	PASTURE West	13.0	16	14	16	21	21	21	21
Farm A	TILLIES 1	13.0	215	51	16	15	10	39	183
Farm A	TILLIES 2	11.0	5	18	66	94	21	10	9
Farm A	TILLIES 3	10.0	81	16	13	14	5	14	76
Farm A	TILLIES 4	16.0	16	15	17	36	114	141	33
Farm A	TILLIES 5	11.0	17	86	92	18	11	8	5
Farm A	TILLIES 6	10.0	5	3	13	48	82	16	7
Total		**251**	**788**	**671**	**757**	**741**	**726**	**859**	**867**

PTP = Potentially Tradeable Phosphorus

Next, make a copy of the database, rename it to indicate it will include management changes, and open the copied database in SnapPlus. Modify the cropping inputs for each field to reflect management practices that will be installed or used as part of the water quality trade for the trade contract years. Run the P Trade report again to create a "reduction" report. Table D4 is an example "reduction" P Trade Report generated from SnapPlus. P reduction practices are planned for installation beginning in year 2016.

TABLE D4: REDUCTION P TRADE REPORT (P REDUCTION PRACTICES INSTALLED 2016-2020)

Farm	Field	Acres	PTP 2014	PTP 2015	PTP 2016	PTP 2017	PTP 2018	PTP 2019	PTP 2020
Farm A	80 1	21.0	50	18	18	14	24	154	145
Farm A	80 2	10.0	13	12	7	31	71	57	19
Farm A	80 3	12.0	10	7	5	33	87	64	20
Farm A	80 4	20.0	23	131	89	31	22	18	14
Farm A	80 6	12.0	13	9	7	42	106	76	23
Farm A	HOME 1	22.0	158	41	20	19	14	24	148
Farm A	HOME 2	12.0	19	68	61	24	12	12	10
Farm A	HOME 3	10.0	49	6	25	34	4	4	3
Farm A	HOME 4	9.0	9	43	129	139	42	17	16
Farm A	HOME 5	7.0	20	66	69	23	13	13	10
Farm A	MART 1	2.0	3	2	2	2	2	2	5
Farm A	MART 2	23.0	13	14	12	16	27	54	14
Farm A	MART 3	4.0	1	1	1	1	1	1	1

Farm	Field	Acres	PTP 2014	PTP 2015	PTP 2016	PTP 2017	PTP 2018	PTP 2019	PTP 2020
Farm A	PASTURE East	3.0	45	46	26	23	23	23	23
Farm A	PASTURE West	13.0	16	17	21	21	21	22	22
Farm A	TILLIES 1	13.0	215	51	16	15	10	24	151
Farm A	TILLIES 2	11.0	5	18	60	82	20	10	9
Farm A	TILLIES 3	10.0	81	16	13	14	5	9	65
Farm A	TILLIES 4	16.0	16	15	17	26	90	122	31
Farm A	TILLIES 5	11.0	17	86	84	18	11	8	5
Farm A	TILLIES 6	10.0	5	3	9	40	71	15	7
Total		**251**	**780**	**669**	**691**	**649**	**679**	**729**	**741**

PTP = Potentially Tradeable Phosphorus

In order to determine the total phosphorus reduction for each year, subtract the total phosphorus load calculated in the "reduction" report from the total phosphorus load calculated in the "baseline" report for each field.

The P Trade Report function is found under the "Reports" menu of the SnapPlus user interface. For additional convenience, SnapPlus allows users to create reports using Adobe pdf, MS Excel spreadsheet or other applications. Using MS Excel to create P Trade Reports can help make a field specific comparison between baseline and reduction loads to calculate the resulting P savings. Table D5 provides a comparison example using SnapPlus MS Excel spreadsheet:

TABLE D5: COMPARISON OF BASELINE AND REDUCTION REPORTS (P REDUCTION PRACTICES INSTALLED 2016-2020)

Farm	Field	Acres		PTP 2014	PTP 2015	PTP 2016	PTP 2017	PTP 2018	PTP 2019	PTP 2020
Farm A	80 1	21.0	Baseline	50	18	18	14	35	175	170
Farm A	80 1	21.0	Reduction	50	18	18	14	24	154	145
Farm A	**80 1**	**21.0**	**Savings**	**0**	**0**	**0**	**0**	**11**	**21**	**25**
Farm A	80 2	21.0	Baseline	13	12	7	33	58	59	19
Farm A	80 2	21.0	Reduction	13	12	7	31	71	57	19
Farm A	**80 2**	**21.0**	**Savings**	**0**	**0**	**0**	**0**	**-23**	**2**	**0**
Farm A	80 3	12.0	Baseline	10	7	5	36	59	66	19
Farm A	80 3	12.0	Reduction	10	7	5	33	87	64	20
Farm A	**80 3**	**12.0**	**Savings**	**0**	**0**	**0**	**3**	**-28**	**2**	**-1**
Farm A	TILLIES 1	13.0	Baseline	215	51	16	15	10	39	183
Farm A	TILLIES 1	13.0	Reduction	215	51	16	15	10	24	151
Farm A	**TILLIES 1**	**13.0**	**Savings**	**0**	**0**	**0**	**0**	**0**	**15**	**32**
Farm A	TILLIES 2	11.0	Baseline	5	18	66	94	21	10	9
Farm A	TILLIES 2	11.0	Reduction	5	18	60	82	20	10	9
Farm A	**TILLIES 2**	**11.0**	**Savings**	**0**	**0**	**6**	**12**	**1**	**0**	**0**

Farm	Field	Acres		PTP 2014	PTP 2015	PTP 2016	PTP 2017	PTP 2018	PTP 2019	PTP 2020
Farm A	TILLIES 3	10.0	Baseline	81	16	13	14	5	14	76
Farm A	TILLIES 3	10.0	Reduction	81	16	13	14	5	9	65
Farm A	**TILLIES 3**	**10.0**	**Savings**	**0**	**0**	**0**	**0**	**0**	**5**	**10**
Farm A	TILLIES 4	16.0	Baseline	16	15	17	36	114	141	33
Farm A	TILLIES 4	16.0	Reduction	16	15	17	26	90	122	31
Farm A	**TILLIES 4**	**16.0**	**Savings**	**0**	**0**	**0**	**10**	**24**	**19**	**2**
Farm A	TILLIES 5	11.0	Baseline	17	86	92	18	11	8	5
Farm A	TILLIES 5	11.0	Reduction	17	86	84	18	11	8	5
Farm A	**TILLIES 5**	**11.0**	**Savings**	**0**	**0**	**8**	**0**	**0**	**0**	**0**
Farm A	TILLIES 6	10.0	Baseline	5	3	13	48	82	16	7
Farm A	TILLIES 6	10.0	Reduction	5	3	9	40	71	15	7
Farm A	**TILLIES 6**	**10.0**	**Savings**	**0**	**0**	**4**	**8**	**11**	**1**	**0**

Reminder: A water quality trading plan should be submitted to WDNR before installation of practices. Alternatively, the management practice registration form may also be used.

Converting PTP to Credit

Apply trade ratios to the calculated total P reduction to convert pounds per year into phosphorus credits. As described in the Guidance for Implementing Water Quality Trading in WPDES Permits, trade ratios are designed to account for the uncertainties associated with water quality trading.

Delivery	• Accounts for the distance between the credit generator and the credit user, and the impact that this distance can have on fate and transport of the pollutant.
Downstream	• Adjusts for local water quality impacts if the credit user is upstream of the credit generator.
Equivalency[1]	• Accounts for situations where trading partners discharge different forms of the traded pollutant. Example: Total Nitrogen vs. Nitrate-Nitrogen
Uncertainty	• Accounts for modeling inaccuracies used to quantify load reductions, ease of verification of the practice, and the reliability of the practice to reduce loads.

FIGURE D2: TYPES OF UNCERTAINTY ASSOCIATED WITH TRADING AND CREDIT GENERATION

1 - Equivalency is not applicable for phosphorus or TSS trades at this time.
Each component of the trade ratio can be determined if you:

A. Know the practices that are generating the phosphorus reductions (i.e. the ones you added in the "reduction" report), and
B. Know the location of the farm, or credit generator, in relation to the credit user. See Guidance for Implementing Water Quality Trading in WPDES Permits for a description of downstream and delivery factors.

Know the Practices

The key component of the trade ratio that directly relates to the phosphorus-reducing practices themselves is the uncertainty factor. See Appendix H - Management Practices and Associated Information of the Guidance for Implementing Water Quality Trading in WPDES Permits for specific values. The following categories convey the amount of uncertainty associated with various agricultural and other pollutant reduction practices:

Very High-certainty Practices: Multiple systems of agricultural best management practices have been shown to perform better at reducing nutrient and sediment losses from agricultural fields under a wide variety of climactic conditions. A system of agricultural practices that address both the source and delivery component of nonpoint source pollution help to better reduce or prevent nutrient-laden runoff during extreme weather events, snowmelt, and other runoff generating conditions.

High-certainty Practices: One or more practices that generally function well to limit either the source and/or delivery component of nonpoint source pollution but may be susceptible to localized failure during extreme weather, are assigned an uncertainty factor of 2. There may be more flexibility for types of practices under different scenarios within this category.

Moderate-certainty Practices: Single practices that address only one aspect of nonpoint source pollution (source or delivery) are assigned an uncertainty factor of 3. These practices may be more attainable for certain producers or may be implemented at lower cost across larger areas. SnapPlus results have greater variability associated with a single practice under average annual rainfall and climatic conditions. For example, a field with heavy tillage, nutrient applications, and steep slopes may be greatly benefitted by establishment of a vegetative buffer around the riparian down-slope field margins. Under most conditions, the buffer may intercept sediment and nutrients in runoff. However, without addressing the source of the runoff, the buffer may become saturated or overwhelmed to reduce runoff during repeated high rainfall or during extreme weather events. Risks include concentrated flow, gully formation, vegetation damage, and excessive sedimentation. For a higher-certainty pollutant reduction, practices that address soil loss on the field, such a conservation tillage and farming on the contour, could be established.

Example Calculation using one practice:

Assume that the credit generator is a 240-acre farm and plans to generate phosphorus credits for 2014 by installing edge of field filter strips on five fields. Edge of field filter strips has an uncertainty factor of 2:1. The total phosphorus reduction calculated using SnapPlus P Trade report for the five fields is 114 lbs. in 2014. Therefore, the final phosphorus credit for 2014 is:

Final Credit= 114 lbs. ÷ 2 = 57 lbs. of TP credit in 2014

Example Calculation using multiple practices:

Some trades may utilize a variety of phosphorus-reducing practices to generate phosphorus credits. In these instances, a variety of uncertainty factors may apply. Applying a trade ratio to each field is recommended to calculate field-specific credits.

$$\text{Field Weighted Trade Ratio} = \frac{\sum(\text{Practice specific trade ratio} * \#\text{of acres/practice})}{\sum(\text{acres with trading practices})}$$

For example, let's assume that the same 240-acre farm generates credits by:

- Installing of edge of field filter strip serving a 20-acre field and the filter strip is 0.25 acres in size;
- Planting cover crops on a 15-acre field;
- Implementing conservation tillage (no till) practice within the same 20 and 15-acre fields.

Because the nonpoint source fields are upstream and within the same watershed as the point source, and trading for phosphorus, the trade ratio is equal to the uncertainty factor for the specific practices. According to Appendix H of the Guidance for Implementing Water Quality Trading in WPDES Permits, (http://dnr.wi.gov/topic/WasteWater/WaterQualityTrading.html) the uncertainty factor for filter strips, cover crops and conservation tillage is 2:1, provided the fields are under an approved Nutrient Management Plan. Applying a field specific trade ratio for each field results in the following:

20-acre field with conservation tillage and filter strip (0.25 acres) = 2:1 Trade Ratio

15-acre field with conservation tillage and cover crops = 2:1 Trade Ratio

Final credits are calculated by applying the field weighted trade ratio to the field specific total phosphorus reduction created from the SnapPlus P Trade Report.

Note: Contact your local AM/WQT regional coordinator if you would like to pursue an alternative method for deriving a trade ratio in a multiple practice scenario.

Reminder: The minimum trade ratio for point source to nonpoint source trades in 1.2:1.

Using a Rotational Average Pollutant Reduction

Nutrient management efforts for agricultural fields are often captured over a crop sequence or rotation framework. Yield goals, crop types, tillage practices, and nutrient applications are planned over a crop sequence or rotation, and changes that occur based on a water quality trade will very likely impact the entire future cropping sequence or rotation. When establishing baseline (pre-trade) conditions for agricultural fields in SnapPlus, multiple years of historic records will reflect a pattern commensurate with the cropping sequence (for example: corn-alfalfa seeding--alfalfa-alfalfa-corn-soybean). When a historical baseline has been established and modeled through the water quality trading plan duration, it may be appropriate to average the annual phosphorus and sediment loss values across the duration of the sequence or rotation. Furthermore, when a

SnapPlus model shows new or additional cropping practices as part of a water quality trading effort, the future projected phosphorus losses from SnapPlus may also be averaged. The resulting baseline and future averages may then be compared to arrive at a single average pollutant reduction value. Averaging SnapPlus results should not extend beyond a five-year permit term. Water quality trading plans and agreements must ensure all practices modeled are implemented to be consistent with averaged values and the baseline (pre trade) years reflect the crop sequence. In other words, a SnapPlus model may not include practices in an average that are not supported by a water quality trading plan or agreement. Table D6 shows SnapPlus P Trade report annual results and then the average applied to a five-year corn-soybean rotation converted to perennial vegetation beginning in 2020.

When selecting an averaging period to represent baseline (pre-trade) conditions, the period should evenly weight all cropping types in the rotation or sequence. For example, in the five-year corn-soy rotation, the average should include the same number of corn years as soy years. Because pollutant losses from corn are typically greater than soy, including more corn years would inflate the baseline (pre-trade) pollutant load.

TABLE D6: EXAMPLE ROTATIONAL AVERAGE 2020-2024

Value Type	Field	Acres	PTP 2018	PTP 2019	PTP 2020	PTP 2021	PTP 2022	PTP 2023	PTP 2024	PTP 2025
Baseline Crop	32A	39.8	Corn	Soy	Corn	Soy	Corn	Soy	Corn	Soy
Baseline PTP	32A	39.8	160	120	160	120	160	120	160	120
Trade Crop	32A	39.8	Corn	Soy	Prairie	Prairie	Prairie	Prairie	Prairie	Prairie
Trade PTP	32A	39.8	160	120	20	20	20	20	20	20
P Reduction	32A	39.8	n/a	n/a	140	100	140	100	140	100
Rotational Avg P Reduction	32A	39.8	n/a	n/a	120	120	120	120	120	
Trade Ratio					1.2:1	1.2:1	1.2:1	1.2:1	1.2:1	
Credits					100	100	100	100	100	

PTP = Potentially Tradeable Phosphorus

Rotational Average PTP reduction for the five-year permit term (2020-2024) = 120 lbs./P
[140+100+140+100 = 480/ 4 = 120 lbs/P/yr = evenly weighted average]

Using the P Trade Report within Approved TMDL Watersheds

Using the P Trade Report within approved TMDL watersheds requires an additional step (from the process described above) to determine final water quality trading credits. This step requires identifying the credit

threshold for a TMDL watershed, applying the threshold to SnapPlus P Trade report results and then using applicable trade ratios.

According to WDNR's Guidance for Implementing Water Quality Trading in WPDES Permits, a credit threshold refers to the amount of pollutant reduction that needs to be achieved before credits are generated. In watersheds with an approved TMDL, the credit threshold is set equal to the TMDL load allocation. Approved TMDL load allocations are determined by calculating how much reduction below baseline load conditions is needed so an impaired waterbody can meet water quality standards. If a credit user works with a nonpoint source credit generator to comply with a TMDL load allocation, "interim" credit is generated, meaning the point source will receive credit for these reductions for up to ten years. The interim credit value is based upon the difference between pre-trade conditions and the load allocation. "Long Term" credit is given for reductions that reduce pollutant loading to levels below the load allocation in approved TMDL areas. In lieu of achieving the load allocation, trades in certain TMDL watersheds may employ an interim floor value that represents a systems-based target for preventing nutrient losses to surface water. While the interim floor defines a minimum control level that must be achieved before credits are generated, it does not distinguish between interim and long-term credits. For more information, see Section 3.3, page 23, of the Guidance for Implementing Water Quality Trading in WPDES Permit.

When using the P Trade Report within approved TMDL watersheds, implement the following:

STEP 1 - Run P Trade Baseline and Reduction reports to determine farm total and field specific P reductions as shown in tables D7 and D8 below.

TABLE D7: TOTAL P REDUCTIONS FOR ALL FARM FIELDS (P REDUCTION PRACTICES INSTALLED 2016-2020)

Farm		Acres	PTP 2014	PTP 2015	PTP 2016	PTP 2017	PTP 2018	PTP 2019	PTP 2020
Farm A	**Baseline**	**251**	**788**	**671**	**757**	**741**	**726**	**859**	**867**
	Reduction	**251**	**780**	**669**	**691**	**649**	**679**	**729**	**741**
	Savings	**251**	**8**	**2**	**66**	**92**	**47**	**130**	**126**

PTP = Potentially Tradeable Phosphorus

TABLE D8: FIELD SPECIFIC P SAVINGS

Farm	Field	Acres		PTP 2016	PTP 2017	PTP 2018	PTP 2019	PTP 2020
Farm A	1	21.0	Baseline	18	14	35	40	48
Farm A	1	21.0	Reduction	18	14	24	34	39
Farm A	**1**	**21.0**	**Savings**	**0**	**0**	**11**	**6**	**8**
Farm A	2	20.0	Baseline	7	33	38	57	47
Farm A	2	20.0	Reduction	7	31	32	34	31
Farm A	**2**	**20.0**	**Savings**	**0**	**2**	**6**	**21**	**16**
Farm A	TILL 1	13.0	Baseline	16	15	28	37	42
Farm A	TILL 1	13.0	Reduction	16	15	12	18	20

Farm	Field	Acres		PTP 2016	PTP 2017	PTP 2018	PTP 2019	PTP 2020
Farm A	**TILL 1**	**13.0**	**Savings**	**0**	**0**	**14**	**19**	**22**
Farm A	TILL 2	21.0	Baseline	66	94	21	22	29
Farm A	TILL 2	21.0	Reduction	39	46	11	10	15
Farm A	**TILL 2**	**21.0**	**Savings**	**10**	**12**	**10**	**12**	**14**

PTP = Potentially Tradeable Phosphorus

STEP 2 - For each field with P savings, complete the following as shown in Table D8:

a. Obtain TMDL Credit Threshold* (lbs/ac/yr) from WDNR for the field location(s) and insert into the P Trade Report for comparison

b. Convert Baseline and Reduction annual P loss to lbs/ac/yr ratio by dividing annual P loss by field total acres

c. Subtract Reduction (lbs/ac/yr) from either Baseline or TMDL credit threshold values; if Baseline (lbs/ac) for field is greater than TMDL credit threshold (lbs/ac), use the TMDL Credit Threshold – see columns with underlined text below in Table D9

d. Multiply difference values (lbs/ac/yr) by acres on field to get P savings for year (lbs)

e. Convert P savings into Final Credits using appropriate trade ratio(s)

* = The TMDL credit threshold may vary by field location within a watershed. Please consult with WDNR to determine TMDL credit threshold for fields in approved TMDL watersheds.

TABLE D9: COMPARE FIELD BASELINE AND REDUCTION PTP (LBS/AC/YR) TO TMDL CREDIT THRESHOLD (LBS/AC/YR)

Farm	Field	Acres		PTP 2016	PTP 2017	PTP 2018	PTP 2019	PTP 2020
Farm A	1	21.0	Baseline	18	14	35	40	48
Farm A	1	21.0	Reduction	18	14	24	34	39
Farm A	**1**	**21.0**	**Savings**	**0**	**0**	**11**	**6**	**9**
Step 2.a	TMDL credit Threshold	lbs/ac		2.0	2.0	2.0	2.0	2.0
Step 2.b	Baseline	lbs/ac		0.9	0.7	1.7	1.9	2.3
Step 2.b	Reduction	lbs/ac		0.9	0.7	1.1	1.6	1.9
Step 2.c	Difference	lbs/ac		0	0	0.6	0.3	0.1
Step 2.d	Difference x field acres	lbs		0	0	11.8	6.3	2.1
Step 2.e			Trade Ratio	2:1	2:1	2:1	2:1	2:1
			Final Credit	**0**	**0**	**5.9**	**3.1**	**1.1**

Farm	Field	Acres		PTP 2016	PTP 2017	PTP 2018	PTP 2019	PTP 2020
Farm A	2	20.0	Baseline	7	33	38	57	47
Farm A	2	20.0	Baseline	7	33	38	57	47
Farm A	2	20.0	Reduction	7	31	32	34	31
Farm A	**2**	**20.0**	**Savings**	**0**	**2**	**6**	**21**	**16**
Step 2.a	TMDL credit Threshold	lbs/ac		2.0	2.0	2.0	2.0	2.0
Step 2.b	Baseline	lbs/ac		0.4	1.7	1.9	2.9	2.3
Step 2.b	Reduction	lbs/ac		0.4	1.6	1.6	1.7	1.6
Step 2.c	Difference	lbs/ac		0	0.1	0.3	0.3	0.4
Step 2.d	Difference x field acres	lbs		0	2	6	6	8
Step 2.e			Trade Ratio	2:1	2:1	2:1	2:1	2:1
			Final Credit	**0**	**1**	**3**	**3**	**4**
Farm A	TILL 1	13.0	Baseline	16	15	28	37	42
Farm A	TILL 1	13.0	Reduction	16	15	12	18	20
Farm A	**TILL 1**	**13.0**	**Savings**	**0**	**0**	**14**	**19**	**22**
Step 2.a	TMDL credit Threshold	lbs/ac		2.0	2.0	2.0	2.0	2.0
Step 2.b	Baseline	lbs/ac		1.2	1.2	2.2	2.8	3.2
Step 2.b	Reduction	lbs/ac		1.2	1.2	0.9	1.4	1.5
Step 2.c	Difference	lbs/ac		0	0	1.1	0.6	0.5
Step 2.d	Difference x field acres	lbs		0	0	14.3	7.8	6.5
Step 2.e			Trade Ratio	2:1	2:1	2:1	2:1	2:1
			Final Credit	**0**	**1**	**7.1**	**3.9**	**3.3**
Farm A	TILL 2	21.0	Baseline	66	94	21	22	29
Farm A	TILL 2	21.0	Reduction	39	46	11	10	15
Farm A	**TILL 2**	**21.0**	**Savings**	**10**	**12**	**10**	**12**	**14**
Step 2.a	TMDL credit Threshold	lbs/ac		2.0	2.0	2.0	2.0	2.0
Step 2.b	Baseline	lbs/ac		3.1	4.5	1.0	1.0	1.4
Step 2.b	Reduction	lbs/ac		1.9	2.2	0.5	0.5	0.7
Step 2.c	Difference	lbs/ac		0.1	-0.2	0.5	0.6	0.7
Step 2.d	Difference x field acres	lbs		2.1	0	10.5	7.8	14.7
Step 2.e			Trade Ratio	2:1	2:1	2:1	2:1	2:1
			Final Credit	**1**	**0**	**5.3**	**3.9**	**7.4**

PTP = Potentially Tradeable Phosphorus

Narrative Example

Using the P Trade report, a farm has two fields with a baseline P loss of 4 lb/ac/yr under current management practices. The farm's fields are all located within a TMDL approved watershed and the TMDL load allocation/credit threshold for agriculture in the watershed is 2 lb/ac/yr.

In order to generate credits, the farm implements additional conservation practices on the two fields to reduce their annual P loss from a 4 to 1 lb/acre/year. Because the TMDL load allocation is 2 lb/ac/yr for the field's location, there is 1 lb/ac/yr available for trading as long-term credit. Because the practices reduce annual P loss below the TMDL load allocation, the 3 lb/ac/yr reduction is also available for trading, but only for the first ten years and as an interim credit. P credits are determined by applying applicable trade ratios on a field-specific basis to the corresponding P reductions calculated using the P Trade report.