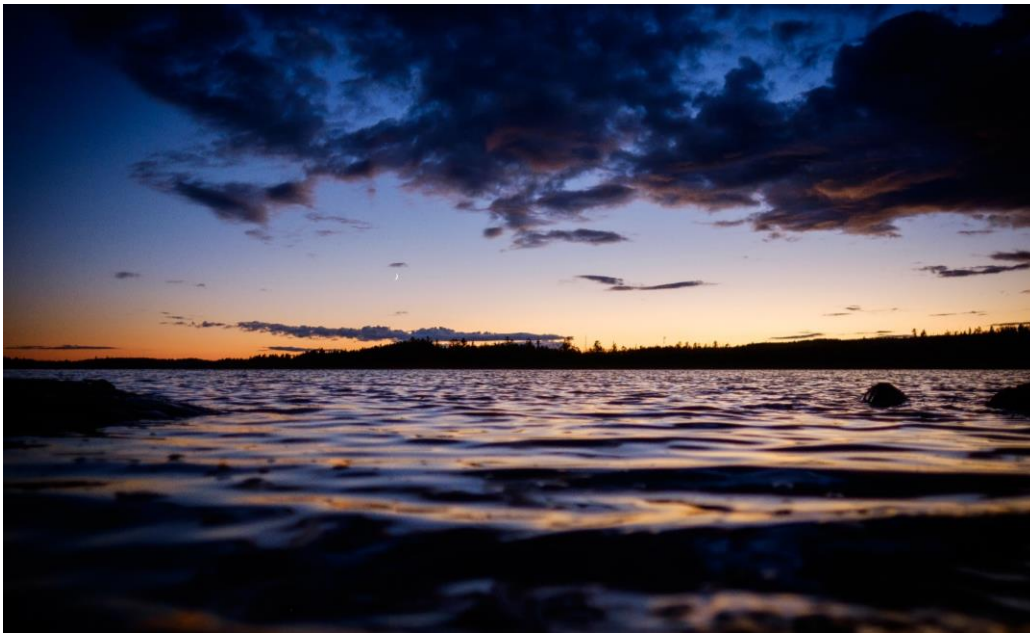
Farmers for Sustainable Food

PENINSULA PRIDE FARMS



Peninsula Pride Farms Sustainability Project Year One Progress Report

February 2023

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1 EXECUTIVE SUMMARY

Farmers for Sustainable Food and Peninsula Pride Farms (PPF), a farmer-led watershed conservation group, worked together in 2020 to create a baseline set of information for seven core sustainability metrics from a widely accepted industry leader in the space, Field to Market: The Alliance for Sustainable Agriculture™. Additionally, PPF was interested in how their farmer members were impacting local water resources and worked with FSF and Houston Engineering, Inc., to identify how current and future in-field best management practices are influencing changes to local water resources.

Founded in 2016, Peninsula Pride Farms is a group of farmers and businesses focused on improving the environment and ensuring sustainable farming into the future. Part of this commitment led PPF to start an active innovation project within Field to Market's Continuous Improvement Accelerator program. Quantifying and measuring environmental metrics that are nationally recognized aligns with PPF's mission statement: "As farmers and caretakers of the environment, we are committed to protecting, nurturing and sustaining our precious soil, water and air. To foster environmental stewardship, we will promote practices with measurable outcomes that secure and enrich the future of our shared community."

Farmer Participation:

- ***11 farms that manage over 27,500 acres are evaluating on-farm sustainability metrics***
- ***Combined dairy cattle headcount of over 41,000***
- ***Commitment to continue for 2 more years***

This report summarizes one year of data collection and analysis (2020 crop year) involving 11 PPF farmers from Door and Kewaunee counties in Wisconsin. These 11 farmers worked to obtain environmental information regarding their farming footprint on greenhouse gas emissions, water quality, soil erosion and energy efficiencies.

Tools used in the project to evaluate on-farm crop enterprise sustainability and local water quality included:

- On-farm sustainability – Field to Market's Fieldprint Platform™
- Local water resources – Prioritize, Target, and Measure Application (PTMApp), Minnesota Board of Water and Soil Resources. This is a forthcoming deliverable in the spring of 2023.

The project recently committed to complete two additional years of data entry and analysis (2021 and 2022 crop years), which will enable project participants to see how their fields are performing over a three-year period across seven of the eight environmental metrics measured by the Fieldprint Platform, shown below.

Biodiversity	Energy Use	Greenhouse Gas	Land Use Efficiency	Soil Carbon	Soil Conservation	Water Quality

Key Project Purposes

1. Assess if current farming practices in conservation-conscious areas are having a positive impact on sustainability and water quality compared to the Fieldprint Platform's national and state benchmarks.
2. Increase the use of sustainability measurement platforms by farmers to inform land and water management decisions, leading to increased adoption of conservation measures.

KEY FINDINGS

Conservation Practices

On average, there are more than two conservation practices on each enrolled field

Water Quality

73% of fields have mitigated excessive loss of nitrogen to subsurface water

Soil Erosion

0.5 tons/acre compared to 3.5 tons/acres state benchmark* for corn grain

Energy Use

169,551 btu/ton for corn silage, 46% lower/better than national indicator

Greenhouse Gas Emissions

89 lbs CO2e/ton

Seven percent higher/worse than the corn silage state benchmark*

*Field to Market's state benchmark for Wisconsin

2 METHODOLOGY

A brief explanation of four metrics (energy use, soil erosion, greenhouse gas emissions, and water quality) is described below using information from Field to Market's Sustainability Metric Documentation. A detailed description of all eight of Field to Market's metrics can be found on their website, fieldtomarket.org.

ENERGY USE METRIC

The energy use metric calculates the energy that is consumed during the production of a single crop in a single year. The calculations include activities from pre-planting to point of sale, which uses models based on user inputs to estimate the efficiency of energy per unit (bushel or ton) of production. The energy metric takes into consideration:

OPERATIONAL ENERGY from all field operations (tillage, harvest, etc.),

APPLICATION ENERGY from commercial fertilizers, herbicides, and other crop protectants (including energy to mine and manufacture said products),

MANURE LOADING ENERGY required for handling and spreading manure,

SEED ENERGY that is used during production of seeds,

IRRIGATION ENERGY when applicable**,**

POST-HARVEST TREATMENT ENERGY such as crop drying, but not including transport of final product, and finally,

TRANSPORTATION ENERGY which is used to estimate energy used to haul the harvest to first point of sale.

GREENHOUSE GAS METRIC

ENERGY USE GREENHOUSE GAS EQUIVALENT EMISSIONS

Estimates the greenhouse gas equivalent emissions from energy use consumption.

EMISSIONS FROM SOIL

Estimates the N2O emissions from soils using information on field location (climate and soil properties), organic matter in field, use of organic and inorganic nitrogen fertilizer, application timing and source of fertilizer.

EMISSIONS FROM RESIDUE BURNING

If residue is burned on fields, that management practice is considered when determining greenhouse gas emissions.

SOIL CONSERVATION METRIC

The soil conservation metric uses the USDA-NRCS Water Erosion Prediction Project and Wind Erosion Prediction System erosion models for water and wind erosion, respectively. These two models use publicly available data (climate, soil characteristics) and user-inputted data (wind barriers, management information, rotational data) to estimate soil loss.

WATER QUALITY METRIC

The water quality metric uses the NRCS Stewardship Tool for Environmental Performance (STEP) to estimate water quality on field. The metric provides information on nutrient loss pathway mitigation for both surface and subsurface nitrogen and phosphorus. The STEP model pulls on other models and survey results from the National Resources Inventory to estimate losses based on field specific data (soil and topography characteristics and climate conditions).

2.1 PROJECT-BASED RESULT METHODOLOGY

All data within the report was obtained from Field to Market's downloadable data (comprehensive data output file), the 2020 National Indicators Report (Field to Market, n.d.), and Field to Market's national and state benchmarks.

National indicators, retrieved from the National Indicators Report, and state and national benchmarks are

reference points meant to provide context for Fieldprint results. These indicators and benchmarks were calculated based on USDA Survey and Census data for prior years and thus represent a historical point of reference but do not provide a starting point for measuring continuous improvement. Project benchmarks in this report were reported for the 2020 growing season and are calculated with actual farmer data.

In instances where a project benchmark is broken down and discussed more granularly (Section 5), the comprehensive data output file was used to obtain the breakouts. For instance, the water quality metric is broken out by water quality pathways to provide a deeper insight into water quality mitigation occurring as well as opportunities for improvement. For all mitigation scores associated with the water quality score, there was no weighting by field size. The mitigated or not mitigated scores were simply tallied annually and divided by the total number of fields to determine the percent of fields that mitigate or do not mitigate certain criteria. Data is screened to ensure complete data is present before analysis is completed. Project Benchmarks were created for alfalfa, corn silage and corn grain. Project Benchmarks were weighted by field size or by production (bu/tons) where appropriate.

Total best management practices (BMP) implemented within the project can be located within the comprehensive data output file. Best management practices are self-reported and are only as accurate as the data entered into the platform. For this report, all BMPs for 2020 were summed to determine the total number of active BMPs during the 2020 growing season. To get the average active BMPs per field in 2020, the total BMP count (which includes all BMPs from the 'water conservation practices' column and the total number of fields actively using cover crops in the growing year) was divided by the total number of fields within the project during the growing season.

The Prioritize, Target and Measure Application (PTMApp) is a publicly available Geographic Information Systems (GIS) tool that was used to provide targeting for restoration actions on agricultural lands. PTMApp helps to target actions on the landscape that directly address the goals set forth by Peninsula Pride Farms. The program identifies potential load reductions of sediment, total phosphorus and total nitrogen for BMPs on the landscape. As part of the process, source maps of sediment, total phosphorus and total nitrogen are developed using the RUSLE equation, land use characteristics and literature values (BWSR, 2016).

3 ON-FARM CROP ENTERPRISE SUSTAINABILITY

Using Field to Market's Fieldprint Platform™ (FPP), seven of the eight possible on-farm sustainability metrics were measured for each project farm. The irrigation metric was not applicable to this project. The metrics use actual farm data collected from each farm for each year analyzed. Data can be presented at the field level, farm level and project level. Comparison metrics between anonymized project participants and state and national benchmarks and indicators can be used to gauge how well each farmer is doing within the group. FPP is designed to provide insights into 1) eight sustainability metrics, seven of which were utilized for this project, 2) how on-farm operations and management affect scores, 3) ability to compare individual scores against project, state and national benchmark scores, as well as national indicators and 4) evaluate and identify ways to improve scores. FPP, as an on-farm sustainability tool, can be used to quantify and measure farm and a sustainability project's pursuit of continuous improvement over time (Field to Market, n.d.).

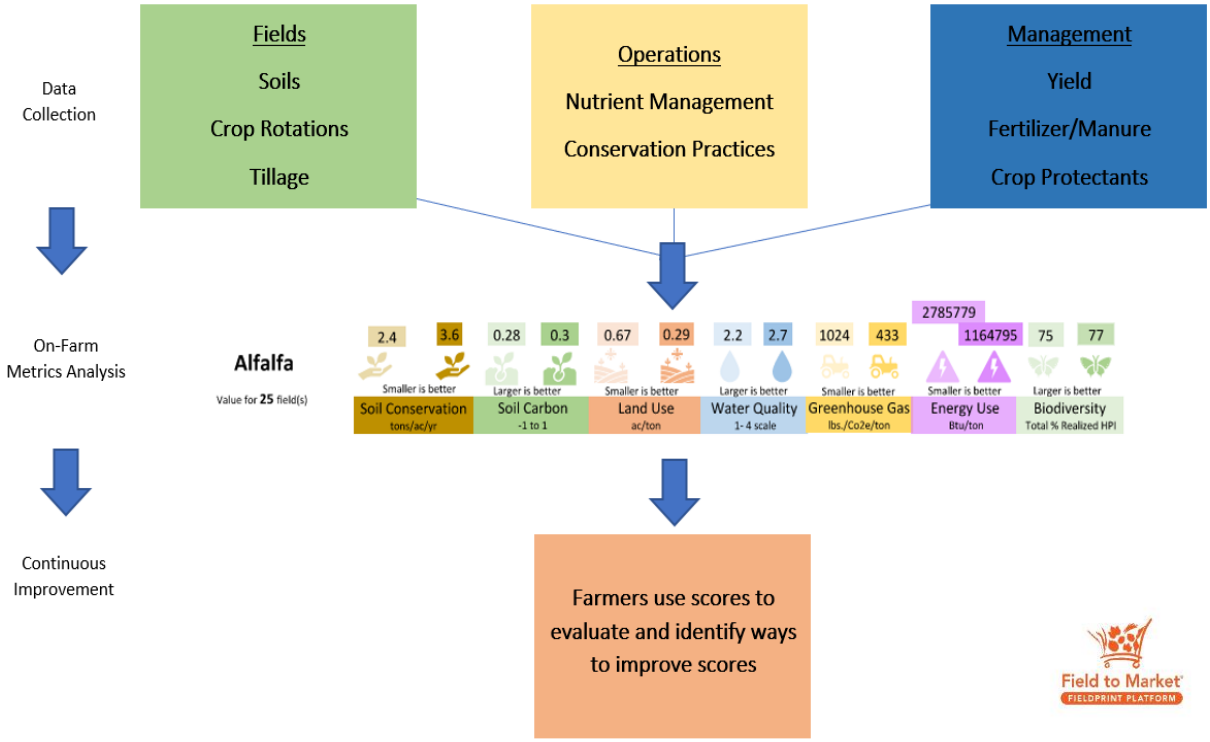


Figure 1: On-farm sustainability continuous improvement model. Data in figure is a visual representation only and does not represent any project specific scores.

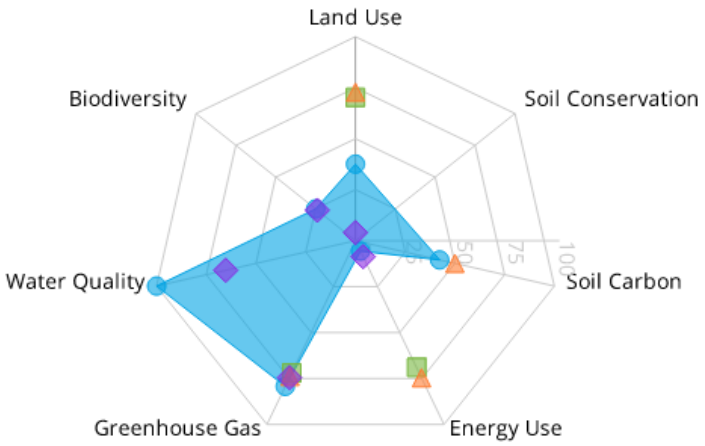
4 FIRST YEAR PROJECT RESULTS (2020 GROWING SEASON)

Field & Farm Level – Each farm receives a detailed Fieldprint Platform report for each field entered into the platform (Figure 2). The number of fields vary based on the crops grown and acres planted. Individual field data is treated under a strict confidentiality agreement and is only shared with farmer permission or when it is aggregated and anonymized. An example report for corn silage is shown in Figure 2. Each report shows how individual scores compare against project, state and national benchmarks, which gives the farmer insight into their farming operation and areas where they may want to investigate to make improvements.

Project benchmarks are a useful way to show a farmer how their individual scores compare to those of others enrolled in the project as well as at the state and national levels (Figure 3). They can also be useful for a farmer-led watershed conservation group to set goals and strive for improvement over time. At the project level, results are aggregated and anonymized, with only the individual farmer knowing who

Fieldprint Result

Fieldprint results are shown on the spidergram as relative indices on a scale of 1-100 that represent your metric scores. The indices are calculated so that smaller values indicate less resource use or environmental impact from your field. This illustration can be used to identify where the greatest opportunities for improvement are for your field, and over time can be used to evaluate progress and trade-offs between different sustainability metrics for your field.



Metric	Your Result	Project Benchmark	State Benchmark	National Benchmark
Land Use (acre / ton)	0.049	0.0382	0.0582	0.0592
Soil Conservation (ton / acre / year)	3.1	3	N/A	N/A
Soil Carbon	0.15	N/A	N/A	0
Energy Use (btu / ton)	109,204	119,343	242,976	268,076
Greenhouse Gas (lbs-CO_2e / ton)	96.9	87.9	83.2	86.8
Water Quality	0	1.39	N/A	N/A
Biodiversity	75%	76%	N/A	N/A

The Water Quality score here indicates how many of the four loss pathways have been mitigated. For more detail on each metric score please refer to the individual metric output. Benchmarks represent an average based on USDA statistical data for the period 2008-2012 and provide context for how your scores relate to this known point. Benchmarks should not be interpreted as a specific level of sustainability, or a performance target. State and National benchmarks that are not shown in the table or on the spidergram are not available for the applicable metric. Project benchmarks represent the average performance across fields enrolled in the Lafayette Ag Stewardship Alliance Project.

Figure 2: UW-Platteville Pioneer Farm 2021 corn silage Fieldprint Platform footprint results

they are. The graphic below illustrates the PPF greenhouse gas emission project benchmark for corn silage.

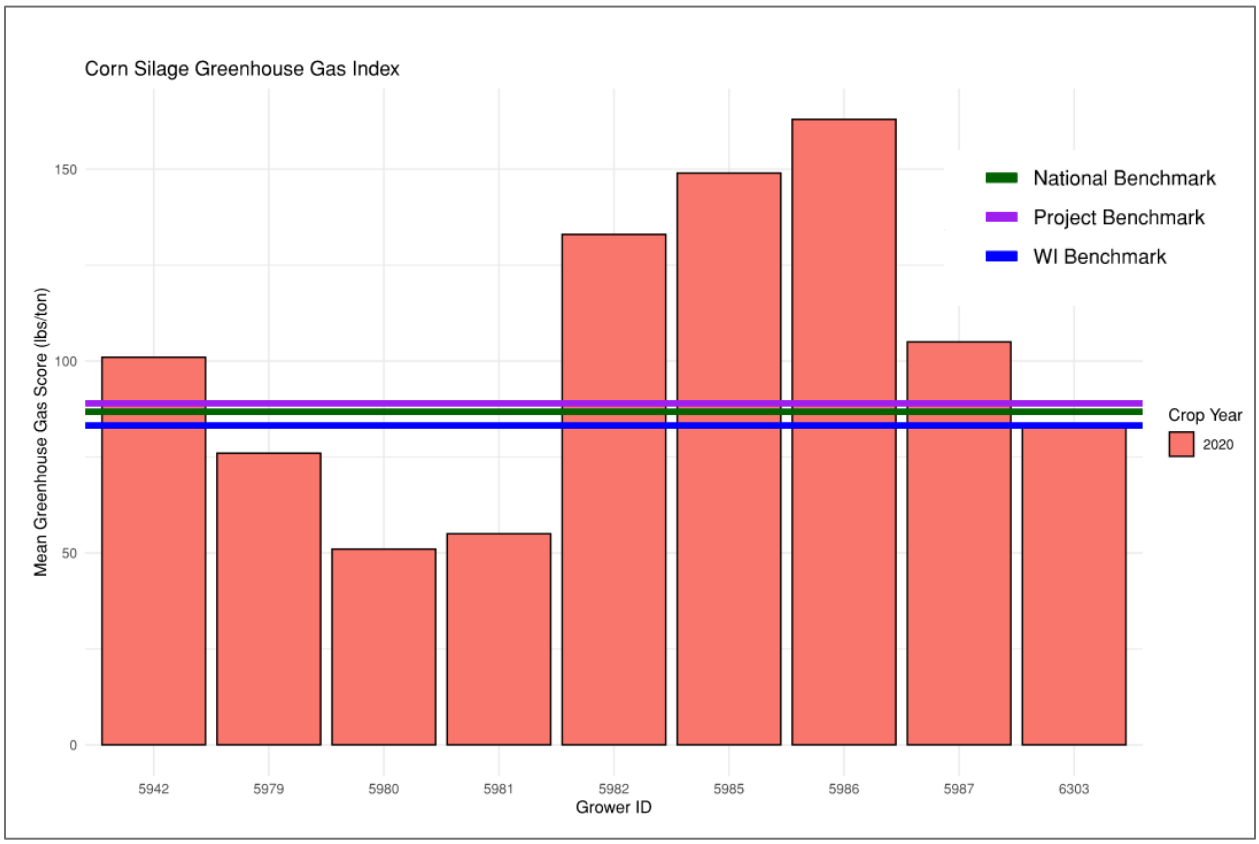


Figure 3: Comparison of greenhouse gas scores for corn silage by project participants grower ID.

Table 1: PPF Fieldprint Platform project sustainability metrics for the growing season of 2020. Data from Fieldprint Platform comprehensive data output file.

Table 1 contains the PPF project benchmarks for corn grain, corn silage and alfalfa based on 11 farms for the first year of the project.	Corn Grain	Corn Silage	Alfalfa
Soil Conservation*	..... ton/ac/yr		
	0.47	1.25	1.46
Energy Use**	... btu/bu ...	..... btu/ton	
	27,710	169,551	1,581,247
Greenhouse Gas**	lbs. CO_2e/bu	lbs. CO_2e/ton	
	14.0	89.2	704.8
Water Quality*	..... unitless		
	1.27	2.59	2.87
Biodiversity*	..... %		
	69.5	78.7	75.9
Land Use**	....ac/bu....	.....ac/ton.....	
	0.007	0.0518	0.530

*Weighted average by field sizes

**Weighted average by yields

State benchmarks and national indicators – The project partners and interested farmers can compare metrics to national indicators and state benchmarks to better understand how the project performs against national and state averages. Field to Market has published updated national indicator metrics for 2020 (FTM, 2021). State benchmarks are averages from data between 2008-2012. The comparisons are listed in Table 2.

Table 2: State Benchmarks and National Indicators vs project benchmarks by crop type

		Corn Grain	Corn Silage	Alfalfa
Soil Conservation	..... tons/ac/yr			
	Project	**0.47**	**1.25**	**1.46**
	State Benchmark	**3.5**	**N/A**	**N/A**
	National indicator	4.7	4.7	NA
Energy Use		..... btu/bu	..... btu/ton	
	Project	**27,710**	**169,551**	**1,581,247**
	State Benchmark	**25,291**	**242,976**	**N/A**
	National indicator	37,791	312,716	NA

Greenhouse Gas		lbs. CO_2e/bu	lbs. CO_2e/ton	
	Project	**14.0**	**89.2**	**704.8**
	State Benchmark	**9.3**	**83.2**	**N/A**
	National indicator	10.7	122.2	N/A
Land Use		…ac/bu…	……..ac/ton……	
	Project	**0.0066**	**0.0518**	**0.530**
	State Benchmark	**0.0069**	**0.0582**	**N/A**
	National indicator	0.0058	0.0493	N/A

Table 2 shows that the PPF group is, on average, performing better against the state benchmarks and national indicators in soil conservation. The group is performing better than the state benchmark and national indicator for energy use in corn silage. For corn grain, the project participants are consuming 10% more energy per bushel of corn grain compared to the state benchmark but performing 27% better compared to the national indicator. The group is producing higher greenhouse gasses when compared against the state benchmark and national indicator for corn grain.

In instances where there is an 'N/A' present, state benchmarks and/or national indicators have not been fully developed or not appropriate due to variation in soils and climate across the major growing areas for the crop.

5 WATER QUALITY

Water quality is the priority resource concern in the region and project area due to areas of high nitrate in groundwater and proximity to Lake Michigan. Excess sediment, phosphorus and nitrogen can result in impairment to fish and wildlife habitat and drinking water. FPP uses USDA's Stewardship Tool for Environmental Performance to assess how likely a field is to lose nutrients to waterways and subsurface water. Based on soil properties and local climate characteristics, STEP assigns a Field Sensitivity Score to each field that represents the potential for nutrient losses, either by runoff beyond the edge of the field (surface loss) or leaching below the rootzone (subsurface loss), for each of four loss pathways: surface P (Phosphorus), subsurface P, surface N (Nitrogen), and subsurface N. STEP then assigns mitigation points for management practices that impact nutrient loss (a Risk Mitigation Score (RMS)).

The final metric score for each nutrient loss pathway is a ratio of how effective management practices are at mitigating nutrient loss (RMS) to how sensitive the field is to nutrient loss based (Field Sensitivity Score (FSS)). If the ratio is 1 or higher, the basic level of risk mitigation for excessive nutrient loss has been met. If the ratio is below 1, excessive nutrient loss is likely, and producers should discuss potential mitigation practices with their advisors.

A score of 1 or above means a farmer has mitigated excessive nutrient loss to the environment for a pathway

Water Quality Score

unit of measure: Scored between 0 and 4.

numeric score in crop year 2020: 2.56 unitless

The water quality metric is comprised of four pathway mitigation processes: surface phosphorus pathway, subsurface phosphorus pathway, surface nitrogen pathway and subsurface nitrogen pathway. A larger value is preferred as it shows that more pathways were mitigated (i.e., fewer nutrients were able to leave the field from the surface and/or subsurface). This score is representative of all crops grown.

Figure 4: Water quality score and explanation. PPF 2020 crop year water quality score

The aggregated score for the PPF project in 2020 is 2.56 out of 4 (weighted by field size), suggesting that on average, each of the 11 farmers is mitigating between two and three pathways. A breakdown of each nutrient loss mitigation pathway is provided in Table 3. The graph shows the percentage of fields within the project that are mitigating each pathway. As an example, for the aggregated score, 50 percent equates to a score of 2/4 for the project, or mitigation of two pathways.

Table 3: Water quality loss pathway explanation.

	Loss Pathway	
	Phosphorus	**Nitrogen**
Surface Pathway Mitigation	**85% of the fields mitigated surface phosphorus in 2020.**	**92% of the fields mitigated surface nitrogen in 2020.**
Subsurface Pathway Mitigation	**14% of the fields mitigated subsurface phosphorus in 2020.**	**73% of the fields mitigated subsurface nitrogen in 2020.**

Table 3 outlines the different phosphorus and nitrogen loss pathways that are calculated with the FPP and the results from the project for the 2020 crop year.

Figure 5 outlines the different pathways that are mitigated within the PPF project for year one. This figure is a visual interpretation of Table 3 and shows what percentage of the project fields were able to mitigate the four pathways.

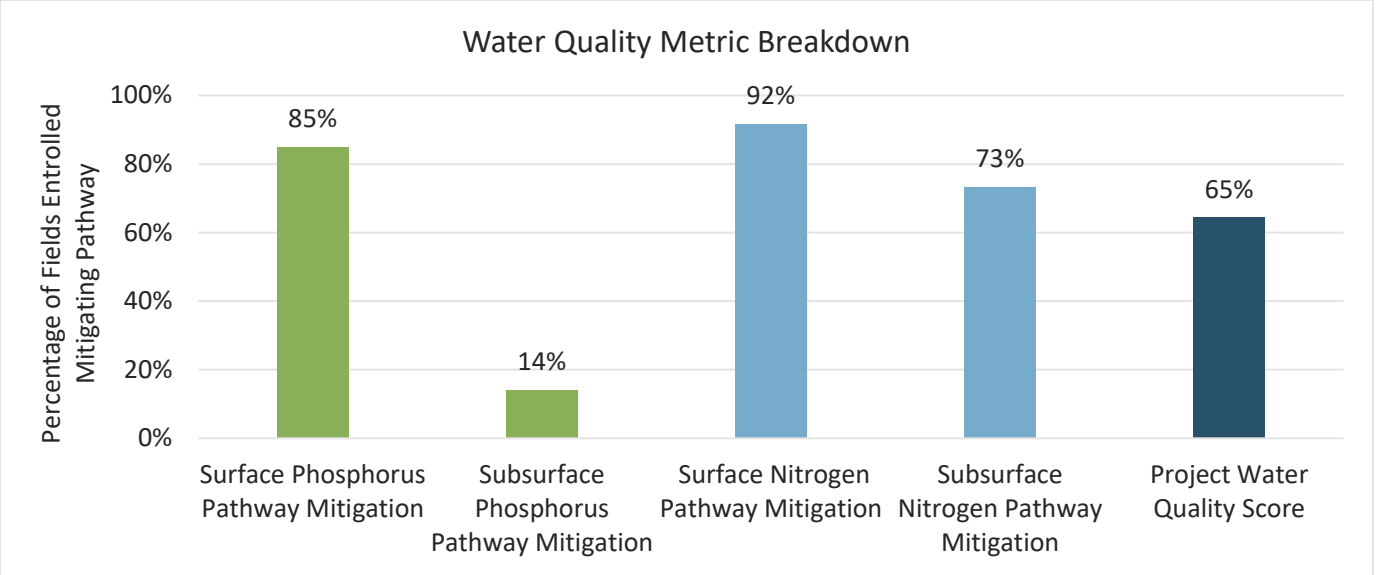


Figure 5: Water quality metric breakdown for the 2020 crop year. Pathway mitigation percentages show the percentage of fields in the project that mitigated a pathway. The project water quality score percentages show the water quality score on a scale of 0 to 4. A 50% reading of the cumulative water quality metric suggests that a score of 2 of 4 was obtained.

ADOPTION OF CONSERVATION PRACTICES

The use of conservation practices greatly influences farm field water runoff and the soil and nutrients that it carries. Conservation practices are designed to reduce water runoff and loss of sediment, phosphorus, and nitrogen by reducing water and wind erosion and precision application of crop fertilizers, including manure. Common conservation practices used by farmers in Peninsula Pride Farms are:

- No-till or reduced tillage
- Cover crops, including planting green
- Grassed waterways
- Farming on the contour
- Harvestable buffers
- Low disturbance injection of manure
- Comprehensive nutrient management
- Drainage water management

On average, there are more than two conservation practices on each of the participating fields. These fields represent over 5,650 acres across 11 farms.

Farms using the Fieldprint Platform self-report conservation practices that are implemented on each field within the platform. Across the 11 farms, there was a range between 0 and 7 conservation practices on a given field, with an average of 2.7 BMPs per field. The top four practices used within the PPF project are reduced tillage (107), cover crop (97), No-Till (57), and Grassed Waterways (44).

6 LOCAL WATER RESOURCES

As part of PPF's vision for clean, safe water and a thriving agricultural community together on the Door-Kewaunee Peninsula, the Board of Directors, as part of this project, desires to learn more about the impact of farming on local water resources, either positively or negatively. This project selected to use the PTMApp tool to establish 1) an understanding of where loss of sediment, phosphorus, and nitrogen to surface water are occurring in the project area, 2) developing a nitrogen risk infiltration assessment, 3) estimating the impact of conservation practices reported on fields enrolled in the Fieldprint Platform to see what the impact of adopted conservations are, 4) assess where and if enrolled fields are mitigating for excessive loss of nitrogen to subsurface water, and 4) develop targeted implementation scenarios to demonstrate impact and help refine PPF cost-share and outreach programs.

As of the end of 2022, the project has completed the initial source assessments for estimated losses of sediment, phosphorus and nitrogen to surface water and completion of the nitrogen infiltration risk assessment. For this report, we focus on the nitrogen risk assessment. The aspects of the local water resources assessment pertaining to sediment, phosphorus, and nitrogen loss to surface water will be finalized and reported to PPF in April 2023.

Nitrogen Infiltration Risk Assessment

A nitrogen infiltration risk assessment was completed for the watershed area encompassing the Peninsula Pride group's farming area. This analysis was completed using three publicly available datasets and combining them to create a heatmap of the most likely places within the peninsula that could have a direct connection or expeditious connection to groundwater. Using PTMApp, the peninsula was broken up into roughly 40-acre catchments based on hydroconditioned digital elevation models. Using the three layers, depth to bedrock (USGS), known sinkhole, karst features and bedrock outcrops (personal communication with county staff at both Door and Kewaunee counties), and the nutrient restriction rule 151 data layer (WIDNR), a data layer was created. With equal weighting among the data layers outlined above, a heatmap grouped into 40-acre catchments was created to show the potential risk (low, moderate, moderately high and high). If a catchment had any of the three data layers, it went up one risk category. If a catchment had none of the three data layers, it received a low-risk potential.

Using this completed heat map (Figure 6), the fields used within the Peninsula Pride group's Fieldprint Platform project were overlain with the nitrogen infiltration risk data. Of the 116 fields that are within the risk map area, 51% had at least moderate risk of groundwater infiltration, 29% had moderately high risk of groundwater infiltration and 20% had high risk of groundwater infiltration.

The Fieldprint Platform suggests that 73% of the fields within the platform currently mitigate groundwater nitrogen losses and 93% mitigate surface water nitrogen losses (see Section 5, Water Quality).

73% of FPP fields studied have mitigated excessive loss of nitrogen to subsurface water from adoption of conservation practices

A comprehensive local water resources discussion will be presented in the year two report of this document. The local water resource component of the project will look at the water quality impact on local rivers and lakes from implemented conservation practices (CP) and best management practices (BMPs). The PTMApp tool was used to evaluate the effectiveness of local conservation projects for reducing sediment, nitrogen and phosphorus delivered to local rivers and lakes. This information can help create better dialogue around agriculture and water quality issues as well as

target outreach, technical assistance and financial assistance to those farms and fields where adoption of CPs and BMPs will produce cost-effective land treatment.

In a separate project, the Lafayette AgStewardship Alliance also completed a local water resources project using the PTMApp tool. The year one report provides an extensive review of how PTMApp was used and will be used within the PPF project.. That report can be accessed at Farmers For Sustainable Foods' website.

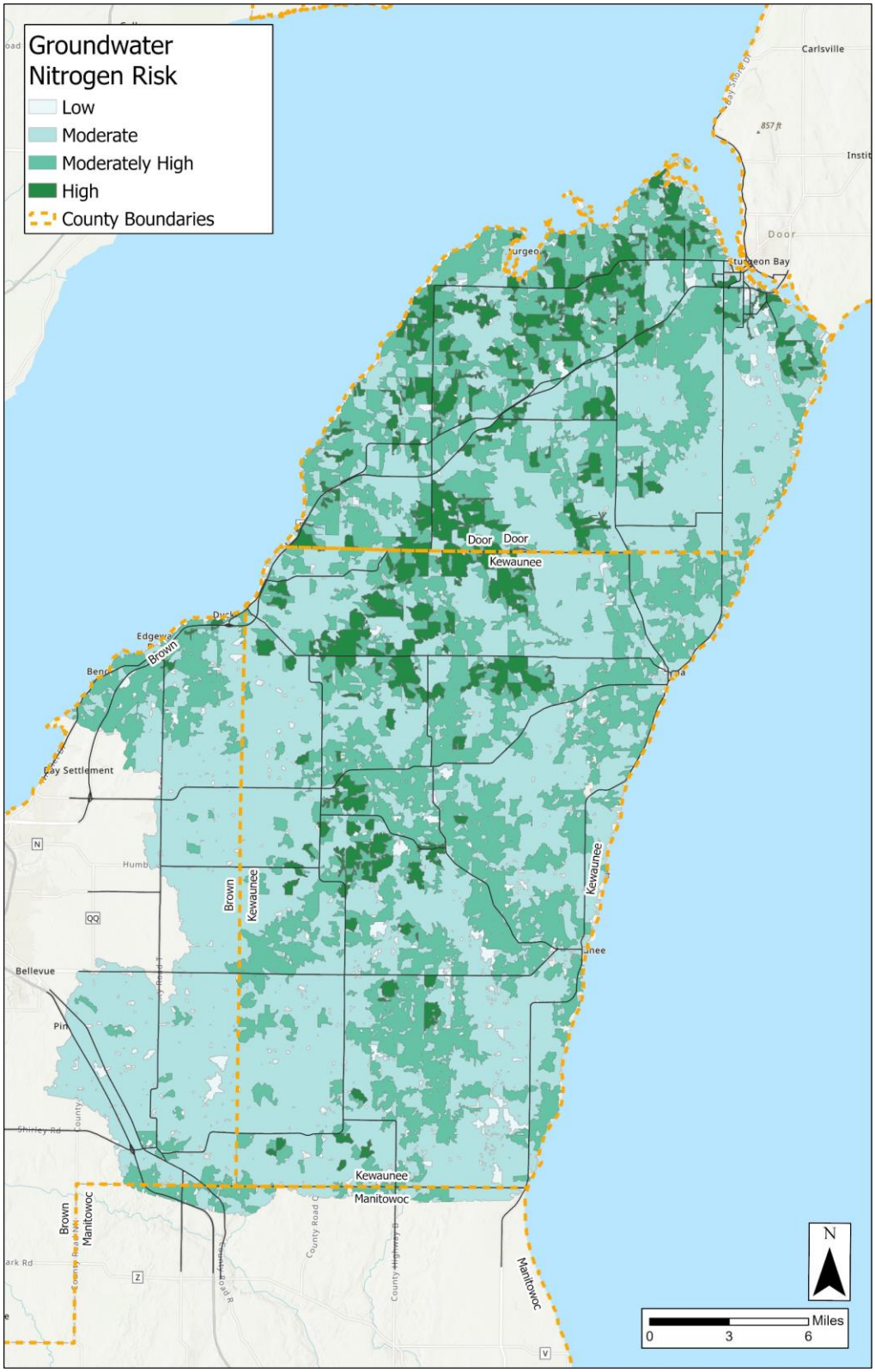


Figure 6: Groundwater nitrogen infiltration risk map

7 NEXT STEPS

At the time of publication, the Peninsula Pride group is finalizing two additional years of crop data (2021 and 2022) which will help identify any potential trends or changes that are impacting scores. The data collection will provide a total of three years of data.

The first year of this project was made possible by:

- Agropur
- Compeer Financial Fund for Rural America
- Dairy Farmers of Wisconsin
- Farmers for Sustainable Food
- GreenStone Farm Credit Services
- Houston Engineering, Inc.
- Nicolet National Bank
- Peninsula Pride Farms

8 CITATIONS

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