March 1, 2016

WI DNR
Attn: MaryAnne Lowndes
PO Box 7921
Madison, WI 53707-7921

Subject: Request for approval of the South Fish Creek Animal Waste Storage and Management Ordinance

Dear Ms. Lowndes,

Pursuant to s. 92.15 (3) Wis. Stats. and NR 151.096 Wis. Adm. Code Bayfield County is requesting approval of the Bayfield County South Fish Creek Watershed Animal Waste Storage and Management Ordinance, determined by Bayfield County to be necessary to meet surface and groundwater standards in the South Fish Creek (SFC) watershed of Bayfield County and to protect the health of citizens in Ashland and Bayfield Counties.

Per NR 151.096 (2)(a)(3), we are providing the entire South Fish Creek ordinance for review and are providing "supporting documentation explaining why the specific regulatory provisions that exceed the performance standards, prohibitions, conservation practices or technical standards are needed to achieve water quality standards, and why compliance cannot be achieved with a less restrictive standard."

Sincerely,

Mark Abeles-Alison	Dennis Pocernich
Administrator	Chairman
Bayfield County	Bayfield County Board of Supervisors

Table of Contents

South Fish Creek Watershed Animal Waste Storage and Management Ordinance

BAYFIELD COUNTY ORDINANCE No. 2016-_____

FINDINGS:

The Bayfield County Board of Supervisors makes the following findings:

1. The predominant farmed soils in Bayfield County are clay-loams originating from glacial till. With high bulk density and slow infiltration, runoff during the spring snowmelt and after heavy rains is common.

2. To farm the clay soils of Bayfield County, agricultural producers maintain extensive surface drainage networks to rapidly remove excess water.

3. Drainage practices that increase runoff rates from agricultural lands lead to higher peak flows in streams, resulting in increased streambank erosion and consequent loading of particulate phosphorus and sediment into downstream surface waters.

4. As such, the primary threat from agriculture to surface water in Bayfield County is from surface run-off carrying sediment, nutrients, and manure.

5. Phosphorus loading in surface waters and consequent algal blooms constitute a threat to human health due to toxins produced by the algae.

6. Microbiological pathogens from manure in runoff and surface waters constitute a threat to human health.

7. Most erosion, sedimentation, and nutrient loss from agricultural lands occur during spring snowmelt and during large storm events.

8. Historical precipitation data and future climate modeling indicate the Chequamegon Bay region is and will continue to receive more precipitation in larger storm events.

9. Increasing manure and fertilizer applications within a watershed is likely to increase nutrient loading into surface waters within that watershed.

10. The required manure storage capacity for Concentrated Animal Feeding Operations under NR 243 Wis. Adm. Code, given the climate and soils of Bayfield County, is likely inadequate to ensure no winter manure applications.

11. The short growing season for grain crops such as corn, soybeans, and sunflowers, and the likelihood of saturated or frozen ground conditions after harvest increases the likelihood that manure cannot be applied after harvest, and consequently, livestock operations covered by NR 243 relying on application of manure in the fall after harvest of grain crops are likely to utilize emergency spreading allowances for winter applications of manure.

12. Manitowoc County in Wisconsin, with soils similar to those found in Bayfield County, has implemented additional limits on mechanical application of manure in order to achieve water quality standards in surface waters.

13. The phosphorus levels in South Fish Creek in northeast Bayfield County have exceeded the maximum thresholds permitted under NR 102.06 Wis. Adm. Code in 2014 and 2015. (Lehr, 2015)

14. The phosphorus levels in nearshore areas of Chequamegon Bay have exceeded the maximum thresholds permitted under NR 102.06 Wis. Adm. Code in 2014 and 2015. (Lehr, 2015)

15. The Wisconsin Department of Natural Resources, Bureau of Drinking Water and Groundwater, "Source Water Assessment For Ashland Water Utility, Ashland, Wisconsin, March 27, 2003" has determined:

    a. The City of Ashland, Wisconsin, located on the south shore of Lake Superior's Chequamegon Bay, relies solely on source water from the bay to provide drinking water to its residents. (p.2)

    b. The area providing Ashland's source water includes the watersheds of Bono Creek, Boyd Creek, Whittlesey Creek, and the north and south branches of Fish Creek, located in Bayfield County. These streams drain an area of relatively flat, impermeable red clay soils, resulting in heavy sedimentation. (p.5)

    c. The source area contains a mixture of agricultural activities identified by the Department as having negative impacts on the south branch of Fish Creek (South Fish Creek). (p.6)

    d. The shallow nature of Chequamegon Bay has multiple negative impacts on source water quality, including warmer summer and autumn temperatures, more easily suspended lake bottom sediments and less dilution of contaminants entering the bay. (p.7)

    e. The normal counterclockwise circulation pattern in the bay negatively impacts source water by drawing the discharge of the Fish Creek and Bay City Creek east along the shoreline towards the drinking water intake. (p.8)

    f. Ashland's municipal water supply has one surface water intake located in southeastern Chequamegon Bay. The calculated sensitivity of the intake—defined as the likelihood that source water will be impacted by contaminants due to the intrinsic physical attributes of the source water area—is very high. (p.9)

    g. Concentrated animal feeding operations (over 1000 animal units) have the potential to contribute pollutants such as inorganic, synthetic organic, microbial contaminants as well as hormones and antibiotics to the source water. (p.10)

h. Ashland's source water quality is significantly impacted by local factors and highly susceptible to contamination. (p.14)

i. Manure management is a recommended means of dealing with negative impacts on Ashland's source water. (p.15)

Based on the foregoing findings, the Board further finds that the following regulations pertaining to the operations of Concentrated Animal Feeding Operations within the South Fish Creek watershed are necessary to achieve water quality standards under section 281.15 of the Wisconsin Statutes and to protect public health and safety.

NOW, THEREFORE, the Bayfield County Board of Supervisors does hereby ordain as follows:

Chapter 7 of Title 5 [Public Safety] is hereby created to read as follows:

Chapter 7 South Fish Creek Watershed Animal Waste Storage and Management Ordinance

Sec 5-7-1 Authority. This chapter is adopted under authority granted under Section 59.02, 59.03, 59.70, 92.15, and 92.16 of the Wisconsin State Statutes.

Sec. 5-7-2 Applicability. All Concentrated Animal Feeding Operations, as defined in Sec. 5-6-3(b) of the Bayfield County Code of Ordinances, located or utilizing owned or rented land within the South Fish Creek watershed in Bayfield County for the housing of livestock, production of crops, spreading of manure, or any other agricultural activity shall comply with the regulations in this chapter.

Sec. 5-7-3 Interpretation. In their interpretation and application, the provisions of this chapter shall be held to be minimum requirements and shall be liberally construed in favor of Bayfield County, and shall not be deemed a limitation or repeal of any other power granted by the Wisconsin State Statutes.

Sec. 5-7-4 Severability Clause. If any provision or portion of this chapter is ruled invalid by a court, the remainder of the chapter shall not for that reason be rendered ineffective.

Sec. 5-7-5 Effective Date. This chapter shall become effective upon its adoption and publication by the Bayfield County Board of Supervisors and approval by the Wisconsin Department of Natural Resources under s. 92.15 of the Wisconsin Statutes and NR 151.096 of the Wisconsin Administrative Code.

Sec. 5-7-6 Definitions. Definitions herein are to conform to the provisions set forth in the Wisconsin Administrative Code and Bayfield County Code.

(a) Compliance Order. A document or notification from the Land Conservation Committee, or their designee, outlining the nature of the violation(s) of the provisions of this chapter and corrective measures.

(b) Conduit to a navigable water. A natural or man-made area or structure that discharges to a navigable water via channelized flow. This includes open tile line intake structures, open vent pipes, sinkholes, agricultural well heads, drainage ditches that discharge to navigable waters and grassed waterways that drain directly to a navigable water.

(c) Intermittent stream. A watercourse with a bed and bank where water does not flow continuously and that is identified as an intermittent stream on a United States Geological Survey 1:24,000 quadrangle map.

(d) Manure. Excreta from livestock, poultry, or other animals. Manure includes the following when intermingled with excreta in normal farming operations: debris including bedding, water, soil, hair, and feathers: processing derivatives including separated sand, separated manure solids, precipitated manure sludges, supernatants, digested liquids, composted biosolids, and process water; and runoff collected from barnyards, animal lots, and feed storage areas.

(e) Manure storage facility. An impoundment made by constructing an embankment or excavating a pit or dugout or by fabricating a structure to contain manure and other animal or agricultural wastes that has a volume of 500 cubic feet or more and a depth of 2 feet or more.

(f) Nutrient Management Plan. A plan that outlines the management and crediting of nutrients from all nutrient sources including soil reserves, commercial fertilizer, manure, organic byproducts, legume crops, and crop residues. All nutrient sources shall be accounted for and properly utilized. This plan must meet the current NRCS 590 standard, and NR 243 where applicable, and applies to all fields where plant nutrient sources and soil amendments are applied during the course of a rotation. Management includes the rate, method, and timing of the application of all sources of nutrients to minimize the amount of nutrients entering surface water and groundwater. The plan includes manure nutrient testing and routine soil testing and is developed according to USD0A –NRCS Technical Standard 590.

(g) Operator. A person responsible for the oversight or management of equipment, facilities or livestock at a livestock operation, or is responsible for land management in the production of crops.

(h) Perennial stream. A channel where water flows continuously and that is identified as a perennial stream on a United States Geological Survey 1:24,000 quadrangle map.

(i) One hundred (100)-year, twenty-four (24)-hour rainfall event. A rainfall event measured in terms of the depth of rainfall occurring within a twenty-four(24)-hour period and having an expected recurrent interval of once in one hundred (100) years.

Sec. 5-7-7 Manure storage capacity. Animal manure storage facilities shall be properly designed to provide a minimum of 540 days of manure storage. In addition, liquid manure storage and

containment facilities shall also have markers near the bottom of the facility indicating the levels at which the facility provides 180 and 270 days of storage, respectively. Such capacity shall include storage at all times for direct precipitation and runoff from a 100 yr, 24 hr storm event.

Liquid storage facilities shall be emptied so that the 270-day level indicator is visible on at least one day between July 15 and September 1. In addition, the storage facility shall be emptied so that the 180-level indicator is visible on at least one day between October 15 and November 30. The operator shall record the days on which the 270-day and 180-day level indicators were visible and send a photo of the indicator to the Bayfield County Land Conservation Department. In the event the facility is not emptied to show the 270-day level indicator for any reason AND the facility is not emptied to show the 180-day level indicator by November 30 of the same calendar year for any reason, the operator shall transfer the manure to another manure storage facility or waste treatment plant in such quantity as to empty the facility to show the 180-day level indicator by December 10 of that calendar year.

If the facility was emptied to show the 270-day level indicator in the required time period, but was not emptied to show the 180-day level indicator during the required time period for any reason, the operator shall submit a written plan to the Land Conservation Department for approval by December 5 showing how the storage facility shall be emptied to show the 180-day level indicator by December 15 of that calendar year. Such a plan may include land-spreading the manure subject to any applicable local, state, or federal restrictions and upon approval by the Land Conservation Department. Approval of any proposed land-spreading by the Department shall depend on the ground conditions of the fields proposed for spreading, the method and rate of spreading, the forecasted weather during that time, and the Land Conservation Department's determination of the risk of runoff from such land-spreading. Land-spreading shall not be an option unless the operator can demonstrate that weather conditions or other factors beyond the operator's control prevented the spreading that otherwise would have resulted in emptying the pit to the required level by the required time.

Sec. 5-7-8 Spreading windows. The annually updated nutrient management plan required under NR 243.14 Wis. Adm. Code shall include for each cropping year at least three distinct manure spreading windows in which at least 1/3 of the total manure produced and stored annually by the animal feeding operation is capable of being mechanically applied according to the spreading rates allowed by the nutrient management plan. Spreading windows include, but are not limited to: prior to planting in the spring, after each harvest of hay or perennial forage in the summer and fall, after harvest of small grains in the summer and fall, after harvest of corn or soybeans in the fall, or at any other time when the ground is not frozen or snow-covered and the application is allowable under the NR 243.14 Wis. Adm. Code.

Sec. 5-7-9 Phosphorus. For fields within the South Fish Creek watershed, the operator may not increase soil test phosphorus levels over a 4-year crop rotation unless the operator can demonstrate that deliverability of phosphorus to the impaired waterbody will not increase as a result of increases in soil test phosphorus in the field. The operator may not raise soil test phosphorus levels

over a 4-year crop rotation above the optimum level for the highest phosphorus demanding crop in the rotation for a field with soil test phosphorus levels below optimum levels. In addition, for fields within the South Fish Creek watershed, the Phosphorus Index shall not be higher than 2 for any single cropping year in the rotation. The application of this provision shall be suspended if and when it is satisfactorily demonstrated to the County Board that the phosphorus levels in the South Fish Creek watershed have not exceeded the maximum permitted levels of phosphorus under NR 102.06 for at least two consecutive years immediately preceding such determination, but any such suspension shall terminate upon a subsequent satisfactory demonstration to the County Board that such levels have again been in excess of the maximum permitted levels for at least two consecutive years.

Sec 5-7-10 Further limits on mechanical application of manure. Mechanical application of manure is only permitted to meet crop needs and is subject to the following limitations:

(a) Manure or process wastewater may not be applied by any means when precipitation capable of producing runoff is forecast by the National Weather Service within 48 hours of the time of planned application. In addition, manure or process wastewater may not be applied by any means on days with a high or medium risk of runoff as indicated in the Runoff Risk Advisory Forecast by the Wisconsin Manure Management Advisory System.

(b) No manure at any time of the year may be mechanically applied to any channel or concentrated flow area that flows to an intermittent stream, lake, perennial stream, pond, or sinkhole. This includes all conduits to intermittent stream or navigable waters.

(c) No manure at any time of the year may be mechanically applied to land within 100 feet of an active or inactive well unless that well has been abandoned per USDA-NRCS Technical Standard 351. Manure that is mechanically applied to land that is more than 100, but less than 300 feet, and is upslope of an active or inactive well and that drains to a well must be incorporated into the soil within 48 hours of application.

(d) No manure at any time of the year may be mechanically applied to land that is within 300 feet of and that drains to a drainage tile surface inlet, intermittent stream, or perennial stream, unless the manure is incorporated into the soil within 48 hours of application.

(e) No manure at any time of the year may be mechanically applied to land that is within 1,000 feet of a lake or pond and that drains to the lake or pond unless it is incorporated into the soil within 48 hours of application.

(f) Spreading restrictions listed in this article shall be in addition to any other rules or provisions regulating the mechanical application of animal manure including, but not limited to, WPDES permits issued under NR 243 or Operations Permits issued by Bayfield County. In the case of conflict, the most stringent provisions shall apply.

Sec. 5-7-11 Inspection Authority. Bayfield County, or its designee, is authorized to enter upon any lands affected by this chapter to inspect the land or manure storage facility to determine compliance with this chapter.

Sec. 5-7-12 Penalties and Enforcement.

(a) Any violation of this chapter shall be punishable by a forfeiture of not less than $100 or more than $5000 per day for each violation of this chapter, plus the costs of prosecution, including the County's reasonable attorney fees and costs. Each day of violation shall constitute a separate offense.

(b) In addition, the County Board, or its designee, may issue a notice of violation and order that specifies required remedial action, which may include a stop operations and work order, or the Board may impose or seek any other available enforcement remedy, including injunctive relief.

South Fish Creek Watershed Animal Waste Storage and Management Ordinance - Justification

Request Summary

Pursuant to s. 92.15 (3) Wis. Stats. and NR 151.096 Wis. Adm. Code Bayfield County is requesting approval of the Bayfield County South Fish Creek Watershed Animal Waste Storage and Management Ordinance, determined by Bayfield County to be necessary to meet surface and groundwater standards in the South Fish Creek (SFC) and Lake Superior watershed of Bayfield County and to protect the health of citizens in Ashland and Bayfield Counties. The ordinance includes provisions applying to concentrated animal feeding operations including: increased manure storage capacity, enhanced management of storage capacity, limitations on unincorporated surface applications of manure to Surface Water Quality Management Areas (SWQMA), and limitations on field edge phosphorus losses. It also provides for expanded buffers around wells to reduce the risk of contaminated runoff reaching well casings and endangering groundwater quality.

As outlined in this document, the Bayfield County South Fish Creek Watershed Animal Waste Storage and Management Ordinance is necessary to meet water quality standards in the watershed and to protect the health of the citizens of Bayfield County and surrounding communities. Though some of the ordinance's provisions may not require DNR approval, the County is requesting approval of all of its provisions to reduce legal uncertainty and because the ordinance provides that it will become effective upon DNR approval.

Background

<u>Environmental, Social, and Economic Importance of Water Quality in the Chequamegon Bay</u>

South Fish Creek ("SFC") is a primary tributary to the Chequamegon Bay of Lake Superior. Water quality monitoring by the WI DNR and Northland College in SFC in 2014 and 2015 found phosphorus levels above the 75 ug/L standard, making it impaired for phosphorus. South Fish Creek has been listed on the 2016 draft 303d impaired waters list being submitted to the EPA.

> "Contamination of the Chequamegon Bay zoonotic pathogens or with excessive phosphorus and consequent algae blooms would be an environmental, public health, and

The elevated phosphorus levels of SFC are of particular concern because of potential downstream impacts to the Chequamegon Bay. The Bay is the sole source of drinking water for the City of Ashland. It supports one of the most important small mouth bass fisheries in the Great Lakes and is home to the Whittlesey Creek National Wildlife Refuge, the South Shore Lake Superior Fish and Wildlife Area, and three towns that rely extensively on the Bay for economic opportunities and recreation. Currents from the Bay extend to waters of Lake Superior supporting the largest self-sustaining lake trout and white fish populations in Lake Superior and adjoining the Apostle Islands National Lakeshore, the Reservations of the Bad River and Red Cliff Bands of Lake Superior Chippewa, and the City of Bayfield, a preeminent ecotourism destination. In addition, the Bay and adjacent waters of Lake

Superior are under consideration as a National Marine Sanctuary. Contamination of the Chequamegon Bay with zoonotic pathogens or with excessive phosphorus and consequent algae blooms would be an environmental, public health, and economic disaster.

Chequamegon Bay and its surrounding watersheds contain approximately one quarter of the coastal wetlands[1] and one fifth of the nearshore waters[2] throughout the U.S. coast of Lake Superior. Many of its coastal tributaries are identified as Outstanding Resource Waters (ORWs) by the Wisconsin Department of Natural Resources (WDNR). These diverse ecosystems support a wide range of sensitive fish and wildlife species, including coaster brook trout, piping plover, two of the only self-sustaining lake sturgeon[3] and walleye populations[4] and the largest intact wild rice bed (Kakagon/Bad River Sloughs) throughout the Lake Superior basin. The ecological significance of the Chequamegon Bay area is highlighted and recognized as a high priority in local, regional, national and international resource management plans. Similarly, because of their importance to the local economies and cultural identity, the protection and restoration of the natural resources of the Chequamegon Bay area is highlighted as a key need in the long-range community comprehensive plans throughout the region (e.g., the cities of Ashland, Washburn and Bayfield and counties of Ashland, Bayfield and Iron).

The Chequamegon Bay is a shallow body of water relatively isolated from Lake Superior. The shallow and isolated water results in warmer summer and autumn water temperatures, more easily suspended sediments, and less dilution of contaminants compared to the rest of Lake Superior. The counter-clockwise circulation of water in the Bay carries discharge from SFC toward Maslowksi Beach along the southern edge of the Bay and then toward the drinking water intake for the City of Ashland. The flow continues along Long Island at the north end of the Bay and eventually moves into the Apostle Islands National Lakeshore. ***Thus, land use activities within the SFC watershed affect the entire Bay.***

Water quality and the health of the Chequamegon Bay is of particular importance to the Red Cliff and Bad River tribal communities as natural resources are a central part of their culture. As stated in the Great Lakes Regional Collaboration document: "Many tribal members use natural resources

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[1] Maynard, Laurie and Wilcox, Douglas. 1997. Coastal wetlands. Background paper: State of the Lakes Ecosystem Conference 1996. U.S. Environmental Protection Agency Publication No. EPA 905-R-97-015b.; Minc, Leah D. and Albert, Dennis A. 2006. Great Lakes Coastal Wetlands: Abiotic and Floristic Characterization. A Summary of Reports Prepared for Michigan Natural Features Inventory. <http://www.epa.gov/greatlakes/ecopage/wetlands/glc/; accessed NOV 2009>

[2] Edsall, Thomas A. and Charlton, Murray N. 1997. Nearshore waters of the Great Lakes. Background paper: State of the Lakes Ecosystem Conference 1996. U.S. Environmental Protection Agency Publication No. EPA 905-R-97-015a.

[3] Auer, Nancy A. (Ed.). 2003. A lake sturgeon rehabilitation plan for Lake Superior. Great Lakes Fisheries Commission Misc. Publ. 2003-02. Ann Arbor, MI.

[4] Hoff, Michael H. (Ed.). 2002. A rehabilitation plan for walleye populations and habitats in Lake Superior. Great Lakes Fisheries Commission Misc. Publication 2003-01. Ann Arbor, MI.

for medicines and in religious ceremonies. Their faith in the healing and spiritual power of those resources depends upon the purity of the resources used. It is not only the physical health of the individual that may be at risk if the resource is contaminated, but also the person's faith in their medicines and religion. What might be viewed as a small, minor or short-term environmental consequence by another community could easily be viewed as a major, significant or long-term consequence by a tribal community."[5]

Current Threats to Area Surface Water Quality

In its 2003 "Source Water Assessment for Ashland Water Utility"[6], the Wisconsin Department of Natural Resources rated the sensitivity or likelihood that Ashland's drinking water supply could be impacted by contaminants due to the attributes of the source water area as "very high". One reason for this rating was the high runoff potential from agricultural land-use within the SFC watershed.

The SFC watershed is primarily lacustrine clay soils formed at the bottom of glacial Lake Duluth and 39% of the watershed is in agricultural production[7]. Above mile 2 of SFC, 65% of the watershed is in agricultural production. Spring snowmelt and stormwater runoff are identified as the primary threats to water quality in the Fish Creek watershed due largely to in-stream erosion and downstream sedimentation.[8] "Pasture, croplands and urban lands occur almost entirely on the largely impervious clayey soils of the watershed. The most dramatic historic land use changes in the watershed (removal of forest cover) have occurred on soils with the least ability to slow the flow of runoff water to drainage ways."[8]

Monitoring and restoration efforts within the Fish Creek watershed by federal, state, county and non-governmental organizations have focused largely on in-stream erosion and sedimentation caused by peak flow runoff from the clay soils. As such, the focus has largely been on the volume and rate of runoff from agricultural lands rather than what's in the runoff. However, recent water quality monitoring is changing our understanding of SFC and focusing attention on manure and nutrients in the runoff. Water quality monitoring in 2014-2015 found phosphorus levels above water quality standards in SFC and in near shore areas of the Bay.[9] Elevated E. coli levels at Maslowski Beach have led to beach closures and listing of the beach on the 2016 draft 303d impaired waters list for the first time, likely due to runoff carried by SFC.

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[5] Great Lakes Regional Collaboration – Tribal Nations Issues and Perspectives. Version 1.0. April 26, 2005.

[6] Wisconsin Department of Natural Resources, Bureau of Drinking Water and Groundwater, "Source Water Assessment For Ashland Water Utility, Ashland, Wisconsin, March 27, 2003

[7] USDA CropScape, 2014

[8] Bro, K.M, and T. W. Fratt, 2011. Fish Creek Watershed Restoration and Management Plan. Ashland County Land and Water Conservation Department.

[9] Lehr, R. 2015. Scoping comments submitted by Dr. Randy Lehr to the WI DNR regarding the Environmental Impact Statement for the Badgerwood swine operation proposed for the South Fish Creek watershed.

Although water quality monitoring within SFC is relatively recent, the Bayfield County Land Conservation Department has been working for more than a decade to help farm producers in the watershed install stream crossings, barnyard filters, and other conservation practices to reduce nutrient loading in SFC. The elevated phosphorus levels are not surprising given the known agricultural runoff problems within the watershed. In fact, the SPARROW model maintained by the USGS indicates the nutrient loading in South Fish Creek is due to manure runoff. The very same peak-flow runoff causing in-stream erosion and sedimentation also carries nutrients and manure from agricultural lands with negative downstream impacts. If agriculture intensifies and volume of spread manure within the watershed increases, the potential risks to water quality will also increase.

UW-Extension and the Bayfield County Land Conservation Department are helping write and update nutrient management plans for farm producers in Ashland and Bayfield Counties through the South Shore Nutrient Management Farmer Education Program. Soil test data from more than 12,000 acres representing more than 600 individual fields within the agricultural areas of the two counties show that phosphorus levels average less than 20 ppm, which is low for most crops.[10] With relatively flat fields, clay soils, and perennial forages, the Phosphorus Index ("PI") values for the fields average less than 2, which is well in compliance with existing regulations.[11]

As illustrated in Photo 1, although the field slopes for agricultural lands in the South Fish Creek are generally 2% or less, there are extensive surface drainage networks enhanced and maintained by the operators. Such networks are necessary to drain excess water to make already challenging soils dry enough to work in the spring and harvest in the fall. From a regulatory standpoint and certainly from a monitoring and enforcement standpoint it can be difficult to determine what is an "intermittent drainage", what is a "direct conduit to a navigable water", what is a "concentrated flow area", what is an "ephemeral gully", and what is simply a sloped part of the field. Such determinations are important as they determine whether SWQMA buffers or other spreading restrictions apply. From an operational standpoint, it can be a significant challenge to avoid spreading manure to the drainage networks and even more difficult to keep such networks in perennial vegetation. As field equipment gets larger and less maneuverable, the challenge gets even more significant.

Photo 1. Extensive surface drainage networks common to fields in the South Fish Creek watershed.

[10] Fischbach, J. 2015. "Nutrient Management and Water Quality". Manure Management Workshop, Ashland High School, March 25, 2015.

[11] Fischbach, J. 2014. Nutrient Management in the Lake Superior Watershed of WI". Large-Scale Livestock Operations in Northern Wisconsin Workshop, Northern Great Lakes Visitor Center, December 4, 2014.

How these drainage networks are managed determines in large part the soil and nutrient loss from the fields, but the current modeling of RUSTLE 2 or the PI only account for sheet and rill erosion and don't account for the variation in how the concentrated flow areas are managed. Failure to account for these drainages results in much lower estimates of soil and nutrient loss and if ephemeral gullies or concentrated flow areas rutted during harvest are repaired with tillage every year the underestimation is even greater.[12] Thus, although soil phosphorus levels are low and phosphorus index values are less than 2 for much of the agricultural land within the SFC watershed, the actual risks posed by runoff are much larger and are likely at least partly responsible for elevated phosphorus levels in SFC.

Future Threats to Area Surface Water Quality

Table 1 shows the land use within the SFC watershed as of 2014. Thirty-nine percent (39%) of the watershed is in agricultural production. Of that, 87% in perennial forages, mainly alfalfa and grass hay. Dairy cow numbers are estimated at 670 head which equates to 15.7 cropland acres per cow.[13] This level of agriculture is relatively low intensity in comparison with regions of Wisconsin with similar clay soils. In Door, Brown, and Kewaunee Counties, for example, there are approximately 3.7 harvested cropland acres per milk cow.[14] With SFC already impaired due to phosphorus, there is legitimate concern that increased agricultural activity within the watershed will only make the existing problems worse. As evidenced in Eastern Wisconsin, it is not apparent that existing regulations are adequate to protect surface water from the density and intensity of agriculture currently practiced in that region and there is every reason to believe that were such agriculture and livestock density practiced in our region the same problems would result.

	Acres	%
Forest	15138	56%
Perennial Forages	9155	34%
Annual Crops	1383	5%
Urban/Developed	1227	5%
Wetland/Water	32	0%
Total	26934	100%

Table 1. 2014 land use in the South Fish Creek watershed. Source: USDA CropScape.

The Chequamegon Bay area of Wisconsin has been and is predicted to continue receiving more precipitation and in more intense storm events.[15] With most soil and nutrient loss due to runoff events from spring snowmelt and rain events, these trends are concerning, particularly given the clay soils and extensive surface drainage networks in the watershed. The Wisconsin Climate Working Group Report predicts the Chequamegon Bay area of Wisconsin, in particular, is expected

[12] Gordon, L.M, S.J. Bennet, C.V. Alonso, and R.L. Bingner. 2008. Modeling long-term soil losses on agricultural fields due to ephemeral gully erosion.

[13] Lactating and dry cow numbers based on estimates by UW-Extension and the Bayfield County Land Conservation Department

[14] 2012 USDA Census of Agriculture

[15] Lehr, Randy. 2015. Fish Creek Water Quality Monitoring and Assessment. Presentation to the Bayfield County Large-Scale Livestock Study Committee. November 12, 2015.

to see more intense storm events.[16] As illustrated in maps within the report, the Chequamegon Bay is at the epicenter of predicted increases in total and intensity of precipitation.

Table 2 shows the number of 10-day snowmelt alerts issued by the Wisconsin Manure Management Advisory System for three Wisconsin watersheds between 2012 and 2015. The SFC watershed unit (WI14C) tends to have as many or fewer snowmelt events as watersheds further South primarily due to colder average temperatures - winter stays winter. However, as the climate warms, northern Wisconsin is expected to experience more freeze-thaw cycles during the winter leading to more snowmelt events. As such, risk reduction strategies to prevent runoff will become even more important into the future.

	MCFW3 Dane	WI09C Brown	WI14C Bayfield
2012	43	56	9
2013	79	72	23
2014	72	85	85
2015	34	29	40

Table 2. Number of 10-day snowmelt alerts issued for three WI watersheds between 2012-2015.

With no permitted point-source phosphorus discharges in the SFC watershed, improving and maintaining water quality in SFC will require a diverse set of tools to reduce non-point discharges including development and implementation of nutrient management plans, reducing stormwater and nutrient discharge from livestock facilities to surface waters, reducing peak flow events and consequent streambank erosion, repairing failing and non-conforming septic systems, retaining and filtering field-edge runoff, and protecting concentrated flow areas. In addition, a greater degree of risk reduction associated with manure storage and spreading for new and expanding livestock operations will be necessary to reduce high-risk spreading associated with limited storage capacity. Also, a more effective means to minimize cumulative impacts of non-point nutrient loading from mass balance increases will be needed.

Limitations of Existing State Livestock Performance Standards, Prohibitions, Conservation Practices and Technical Standards

Recognizing the risks posed by animal agriculture to surface and ground water quality, the legislature has promulgated regulations to minimize those risks. Such regulations essentially mandate risk reduction practices. The challenge of applying uniform risk reduction practices across Wisconsin is that risk is relative and what is sufficient in one region may not be in another. Furthermore, existing regulations are "designed to balance the economic viability of farm operations with protecting natural resources and other community interests".[17] This "balance" inherent in the existing statewide regulations may not be the right balance for all parts of Wisconsin given the unique social, environmental, and economic characteristics of a given locality. Degradation of water quality in the Chequamegon Bay carries an enormous social, environmental,

[16] Wisconsin Initiative on Climate Change Impacts Climate Working Group Report: Climate Change in Wisconsin, December 2010, pg 44

[17] Wisconsin Statutes 93.90 (2) (b) (6)

public health, and economic cost, meaning the magnitude and extent of the risk reduction strategies to prevent degradation must be commensurate with the costs of degradation.

Given the economic, social, cultural, and environmental importance of the Chequamegon Bay and its susceptibility to contamination for non-point surface runoff, the following rules contained in the Wisconsin Administrative Code NR 243 are insufficient to meet water quality standards in SFC.

Manure Storage Capacity and Management of Storage Capacity

Concentrated animal feeding operations storing liquid manure are currently required to have a minimum of 180 days of storage capacity per NR 243.15 (3) (i)(j)(k). The 180 days of storage are intended to enable compliance with NR 243.17 (3) (b) which requires emptying a liquid manure storage facility to a 180-day level at some point between October 1 and November 30 of each year. This draw down to 180-days is intended to enable storage of manure through the high-risk runoff period of February 1 through March 31 and the spring saturated-soil season immediately after spring break-up.

Recognizing that "unusual weather conditions" or "equipment failure" may limit the emptying of a manure storage facility to the 180-day level prior to the onset of saturated, frozen, or snow-covered soils in the fall, allowances are made via NR 243.14 (7) (d) for emergency spreading on areas otherwise prohibited from spreading due to frozen ground or snow-covered conditions.

To appropriately mitigate the risks of winter spreading of liquid manure through storage capacity and management, as NR 243 intends, the storage capacity must match the snow-covered and frozen-ground season and the management of the storage capacity must reflect the soil and crop management limitations specific to a region. The following scenarios illustrate why the existing regulations are not adequate for the South Fish Creek Watershed in Bayfield County:

Under the current regulations it would be permissible to empty a storage facility to the 180-day level on October 1. This would result in a full storage facility on March 31. It is not uncommon for snow cover and frozen ground conditions to persist well into April. In addition, seasonal weight limits placed on County and Town roads may further limit spring manure spreading. In many years, the road bans aren't lifted until the last week of May.[18] ***Relying on a short winter and dry spring to minimize the risks of winter-spreading is not realistic risk management for South Fish Creek or the Chequamegon Bay.***

Given the short growing season in Bayfield County, the production of corn and other long-season conventional grain crops results in grain harvests in late-October and November. With minimal growing degree days in the late-fall, soil evaporation and drying is slow and a single heavy rain on the clay soils in the late-fall is sufficient to create saturated soil conditions for the rest of the season. This often results in delay of corn grain harvest until frozen ground conditions or significant rutting of the fields. In either case, manure applications would not be allowed after the

[18] Ashland and Bayfield County record of seasonal weight limit postings.

harvest due to the saturated soil conditions. ***Relying on a dry fall to minimize the risks of winter-spreading is not realistic risk management for South Fish Creek or the Chequamegon Bay.***

As has been experienced in Wisconsin on numerous occasions, conditions that limit the ability of a livestock facility to spread manure in the fall will likely limit all the neighboring facilities as well. As a result, emergency winter-spreading may occur on a widespread basis throughout a watershed. As such, the magnitude of the risk created by only requiring 180 days of storage and allowing emergency winter spreading must be considered at a watershed scale rather than an individual farm scale. This is particularly true as the effect of agriculture on downstream water quality is due largely to the cumulative non-point nutrient loading within a watershed. As such, risk reduction practices must be concordant with the magnitude of the risk and the larger and more dense livestock operations become, the greater degree of risk reduction is required. Matching risk reduction practices to risk magnitude is a fundamental premise in Wisconsin's approach to regulating livestock operations as manifest in both the ATCP 51 and NR 243 applicability thresholds.

Managing Phosphorus in Impaired Watersheds

> "Matching risk reduction practices to risk magnitude is a fundamental premise in Wisconsin's approach to regulating livestock operations as manifest in both the ATCP 51 and NR 243 applicability thresholds."

The Phosphorus Index calculation is a relatively new tool meant to model field edge phosphorus losses based on soil and field properties, tillage practices, nutrient applications, and crop production. It is a superior tool for managing non-point phosphorus losses compared to soil test phosphorus alone as it accounts for transport potential of phosphorus within and from a field. For this reason, it has become the predominant method for phosphorus management in nutrient management plans in Wisconsin.

It would therefore make sense to use the PI to reduce phosphorus delivery in impaired watersheds. However, under Wisconsin Administrative Code NR 243.14 (5) (a), a CAFO operator has the option to utilize soil test phosphorus as a means to manage phosphorus in impaired watersheds. As long as soil test phosphorus levels don't increase above the optimum level for the highest phosphorus demanding crop in the rotation, there is no accounting for or limitation on the transport of phosphorus from the fields. In such a scenario a farm on sloping fields could convert perennial forages to corn, raise the soil test phosphorus levels to the optimum level for corn, and be in compliance with the regulations as long as soil erosion was less than 5 tons/acre, regardless of the increase in phosphorus losses as predicted by the PI.

Wisconsin Administrative Code NR 243.14 (5) (a) (2) outlines phosphorus restrictions on fields draining to impaired waters when using the PI. Use of the Index is a better option compared to soil test phosphorus alone, but the current use of the Index in NR 243 isn't adequate to manage phosphorus loading to impaired waterways. Specifically, NR 243 does not require reductions in PI values until soil test levels exceed 100 ppm and only then requires the average annual PI over a 4 year rotation to be less than 6. This is surprising given that per acre phosphorus exports identified as part of total maximum daily load (TMDL) studies for impaired watersheds are typically

calculated between 0.16 and 0.33 lbs/ac/yr. Why NR 243 would allow a field edge loss of up to 6 lbs/ac/yr is unknown, but may be simply a matter of NR 243 last being updated in 2006 when the PI tool was new. More likely, the PI threshold levels of 6 and 12 are set to accommodate predominant agricultural practices rather than to protect surface water quality.

Setting a threshold of 100 ppm for when the PI is used to limit phosphorus losses in an impaired watershed fails to account for increases in mass balance nutrient levels and cumulative non-point nutrient loading due to new and expanding livestock operations in a watershed. For example, under current regulations, a grass-based dairy operation could be replaced by a grain-based hog operation with an increase in the average annual PI from 1 to 6. This would result in an increase of 5 lbs/acre/yr field edge phosphorus loss, completely at odds with efforts to reduce phosphorus loading in an impaired watershed. Even at a relatively low Sediment Delivery Ratio of 20%, an increase in field edge losses from 1 to 6 lbs/ac/yr would result in phosphorus deliveries at least 3 times higher than would otherwise be included in a TMDL. With clay soils and runoff events occurring with frozen ground conditions or after significant precipitation events, areas in the SFC watershed likely have much higher Sediment Delivery Ratios than 20%. Further compounding the problem is that the phosphorus index does not account for nutrient losses from concentrated flows.

Application of Manure within Surface Water Quality Management Areas

Restrictions on manure and process wastewater applications within SWQMAs during the growing season are not adequate to meet surface water quality standards in the South Fish Creek watershed of Bayfield County due to the clay soils and extensive surface drainage networks. Specifically, NR 243.14 (4) (a) allows for unincorporated surface application of manure at a rate of up to 5,000 gallons per acre on clay soils within 25' of a navigable water or conduit to a navigable water. In Bayfield County, this would allow surface applications of manure to alfalfa fields immediately after harvest, corn fields immediately after harvest, and small grain fields immediately after harvest. In dry years, clay soils are likely to develop significant vertical and horizontal cracking, which are exposed following harvest. Even with 30% residue after harvest, the cracking will effectively bypass the surface residue and significantly hasten downslope movement of liquid manure.

In wet years, vehicle traffic from harvest operations closes soil pores and smooths the field surface, resulting in prime conditions for surface runoff. NR 243.14 (2) (13) prohibits surface application of manure when precipitation capable of producing runoff is forecast within 24 hours of the time of planned application. As such, an operator may spread manure on Monday morning even if heavy rain is forecast for Tuesday afternoon. With extremely narrow spreading and operational windows in Northern Wisconsin due to the wet clay soils and short growing season such last-minute spreading is common. Thus, a 25' foot buffer is not adequate to mitigate the risk of runoff from surface applied manure within SWQMAs.

There is growing evidence that manure and fertilizer application to no-till fields results in phosphorus stratification at the soil surface resulting in greater phosphorus transport and losses

compared to tillage systems. The stipulation in NR 243.14 (4) (a) (2) (a) that uses no-till as a mitigation against runoff may actually result in more phosphorus loading, not less.

> "In our determination, livestock operations with more than 1000 animal units land-spreading liquid manure on clay soils in far Northern Wisconsin within an already impaired watershed that feeds to the Chequamegon Bay of Lake Superior should have storage capacity to miss two successive fall spreading windows."

As Photo 1 illustrates, fields in the South Fish Creek watershed have extensive surface drainage networks and it can be difficult to determine what is a "direct conduit to navigable waters", what is a tributary to a direct conduit to navigable waters, and whether such tributaries are concentrated flow areas and, therefore, prohibited from receiving direct applications of manure. This differentiation is key as it relates to SWQMAs and unincorporated surface application of manure during the growing season. Application of manure to tributaries of direct conduits to navigable waters and the slopes that drain to them can result in runoff that bypasses the 21', 25', 35' or 100' no-spread buffers.

Application of Manure Near Drinking Water Wells

The 590 Technical Standard prohibits mechanical application of manure within 50 feet of a potable drinking water well. It also prohibits application of manure within 200 feet upslope of direct conduits to groundwater such as a well unless the manure is incorporated within 72 hours. ***These prohibitions are not likely adequate to protect groundwater in the South Fish Creek watershed of Bayfield County.***

The predominant soil type in the South Fish Creek watershed is clay loam, providing a significant protective barrier of groundwater in the region. However, the clay also results in rapid and extensive runoff during spring snowmelt and after rain events. Existing and abandoned wells pose the primary threat to groundwater in the clay regions as contaminated runoff can move down the side of the well casings. Given that risk contamination is a product of time and distance, the larger the setbacks the more effective they are.

Forecasting rain events 72 hours in advance comes with a degree of uncertainty anywhere in Wisconsin. Adding the localized effects of Lake Superior on weather only adds more uncertainty to the 72 hour forecast. As such, waiting 72 hours prior to incorporation is an unacceptable risk in the South Fish Creek watershed where only a small volume of precipitation can lead to runoff on clay soils.

Additional Regulations Necessary to Achieve Water Quality Standards

Manure Storage Capacity and Management of Storage Capacity

Section 5-7-7 of the Bayfield County South Fish Creek Watershed Animal Waste Storage and Management Ordinance (portions *italicized* below) includes a series of risk reduction practices necessary to meet water quality standards in the South Fish Creek and Chequamegon Bay. The practices significantly increase the likelihood that a livestock facility will have the capacity to store

manure through the winter season and thereby significantly reduce the risk of run-off from frozen, snow-covered, or saturated fields.

The issue of storage capacity is largely a matter of risk tolerance. Is capacity to store manure through one missed window adequate risk reduction or should there be capacity to miss two spreading windows? In our determination, livestock operations with more than 1000 animal units land-spreading liquid manure on clay soils in far Northern Wisconsin within an already impaired watershed that feeds to the Chequamegon Bay of Lake Superior should have storage capacity to miss two successive fall spreading windows. In addition, the operation should have a cropping plan with multiple spreading chances during the growing season

Animal manure storage facilities shall be properly designed to provide a minimum of 540 days of manure storage. **(Section 5-7-7)**

The requirement to have 540 days of storage is intended to enable a livestock facility operator involved in predominant forms of agriculture to store manure through a series of missed spreading windows. For example, a producer growing predominantly corn grain is able to fully empty the manure storage facility as of May 1. The cropping and nutrient management plan calls for spreading manure again in the fall after the crops are harvested, which in Bayfield County is typically late October or November. Due to wet conditions and saturated soils or a decision to delay harvest until the ground has frozen, the operator is unable to spread manure, but as of Dec 1, due to the required storage capacity, the facility has 330 days of manure storage capacity and is able to store the manure to the next spreading chance in April. As of April 1 there would be 210 days of storage capacity. The nutrient management plan for this example operation is based on continuous corn, but due to a late-spring and soil moisture conditions, different crops are grown and not as much manure is applied during the spring or summer season as intended. As such, the harvest season (October 1) arrives with 150 days of manure storage capacity, which provides the operator with some flexibility to adapt to another wet fall, were it to occur, including storing the manure through the winter.

Liquid storage facilities shall be emptied so that the 270-day level indicator is visible on at least one day between July 15 and September 1. In addition, the storage facility shall be emptied so that the 180-level indicator is visible on at least one day between October 15 and November 30. The operator shall record the days on which the 270-day and 180-day level indicators were visible and send a photo of the indicator to the Bayfield County Land Conservation Department. **(Section 5-7-7)**

Having 540 days of storage capacity provides additional risk reduction, but the key is to have storage capacity going into each and every winter sufficient to reach the spring spreading window. To accomplish this, producers will have to develop cropping and nutrient management plans that allow for spreading throughout the growing season to minimize the chances that a storage facility will be full going into the winter. If a producer were able to draw down the facility to the 270-day indicator on July 15 but was unable to spread in the fall due to wet conditions, there would be 150 days of storage capacity as of November 15.

If the facility was emptied to show the 270-day level indicator in the required time period, but was not emptied to show the 180-day level indicator during the required time period for any reason, the operator shall submit a written plan to the Land Conservation Department for approval by December 5 showing how the storage facility shall be emptied to show the 180-day level indicator by December 15 of that calendar year. Such a plan may include land-spreading the manure subject to any applicable local, state, or federal restrictions and upon approval by the Land Conservation Department. **(Section 5-7-7)**

In such a scenario where a facility only has 150 days of storage capacity as of November 15, the producer would be required to develop a plan to draw-down the storage facility to 180 days by December 15. This would require finding someplace to dispose of two month's worth of manure. Land spreading would be an option as long as the 270-day indicator requirement had been met and field conditions were allowable of land-spreading.

In the event the facility is not emptied to show the 270-day level indicator for any reason AND the facility is not emptied to show the 180-day level indicator by November 30 of the same calendar year for any reason, the operator shall transfer the manure to another manure storage facility or waste treatment plant in such quantity as to empty the facility to show the 180-day level indicator by December 10 of that calendar year. **(Section 5-7-7)**

If summer and fall spreading is not done in a given year, it is possible a storage facility would be full going into the winter, resulting in up to 6 months of manure being spread during the winter months. This is an unacceptable risk. Not spreading during the summer months would most likely be due to voluntary cropping decisions by the operator and taking a chance that the post-harvest fall spreading window would be available. Taking such a chance would result in the consequence of not being able to land-spread the manure to empty the pit to 180-days capacity by December 10. The 540 days of storage capacity would, however, allow the operator, at least in some years, to forgo the summer spreading window and store the manure instead.

Figure 1 shows manure storage and spreading under three different regulatory scenarios as affected by missed spreading windows. Figure 1a shows the current requirement of 180 days of storage. On a farm producing primarily corn and relying heavily on pre-plant spring applications or post-harvest fall applications, a single missed window would likely result in emergency winter spreading. Figure 1b shows storage capacity with a 540-day storage facility. On a farm with a corn-soy rotation where manure spreading volumes are limited in the soybean year, the producer would have sufficient capacity to miss two successive fall spreading windows with little to no emergency winter spreading. Figure 1c shows how a required summer draw-down would help ensure that with a 540-day facility an operator would not need emergency spreading allowances even if missing two successive fall spreading windows.

The annually updated nutrient management plan required under NR 243.14 Wis. Adm. Code shall include for each cropping year at least three distinct manure spreading windows in which at least 1/3 of the total manure produced and stored annually by the animal feeding operation is capable of

being mechanically applied according to the spreading rates allowed by the nutrient management plan. Spreading windows include, but are not limited to: prior to planting in the spring, after each harvest of hay or perennial forage in the summer and fall, after harvest of small grains in the summer and fall, after harvest of corn or soybeans in the fall, or at any other time when the ground is not frozen or snow-covered and the application is allowable under the NR 243.14 Wis. Adm. Code. **(Section 5-7-8)**

The requirement to have 540 days of manure storage capacity combined with required 270-day and 180-day drawdowns will help mitigate against full manure facilities going into the winter months and consequent emergency spreading. In order to meet the drawdown requirements and minimize the risk that an operator will rely on a single spreading window, risk management must also be built into the cropping plan such that spreading manure at multiple times per year is a possibility and, thus, an operation will be able to comply with the 270-day and 180-day drawdown requirements.

Managing Phosphorus in Impaired Watersheds

In addition, for fields within the South Fish Creek watershed, the Phosphorus Index shall not be higher than 2 for any single cropping year in the rotation. The application of this provision shall be suspended if and when it is satisfactorily demonstrated to the County Board that the phosphorus levels in the South Fish Creek watershed have not exceeded the maximum permitted levels of phosphorus under NR 102.06 for at least two consecutive years immediately preceding such determination, but any such suspension shall terminate upon a subsequent satisfactory demonstration to the County Board that such levels have again been in excess of the maximum permitted levels for at least two consecutive years. **(Section 5-7-9)**

Field edge phosphorus losses and loading of surface waters to South Fish Creek is a major concern to the residents of Ashland and Bayfield County primarily due to the threat posed to water quality in the Chequamegon Bay. Agriculture in the South Fish Creek watershed is in a major transition stage with continued loss of dairy farms expected over the coming decade. With consequently low cash rent and land prices the potential for new livestock facilities to locate in the area is high and the possibility of greatly expanded livestock numbers in the watershed is real. In such a scenario, a mass balance increase in watershed phosphorus is likely to occur and if the predominant crops in the watershed shift from perennial forages to annual row crops the average phosphorus losses will increase, as well. All of which is allowable under NR 243 as a Phosphorus Index of 6 is allowable even for fields that drain to an impaired waterbody even for fields with soil test phosphorus levels that exceed 100 ppm.

The Phosphorus Index tool is well suited to managing field edge phosphorus losses, but is not adequately used under the existing rules in NR 243. Section 5-7-9 of the SFC ordinance limits the Phosphorus Index for any given year for any field within the SFC watershed to 2. According to research by UW-Discovery Farms, field edge phosphorus losses across a range of farms and farm

practices averages 2.0 lbs/ac.[19] As such, a Phosphorus Index of 2 is achievable even for producers growing mainstream commodities with generally accepted production practices.

Figure 2 illustrates the annual Phosphorus Index calculation for a cropping system on typical soils and fields within the South Fish Creek watershed with a number of phosphorus loss risk factors including elevated soil phosphorus levels (32 ppm), heavy manure application (5,000 gallons/ac swine manure), aggressive tillage (chisel plow and disk), and corn. Even in this scenario, due primarily to the flat fields, the Phosphorus Index limitation of 2 or less will be achievable. That said, there may be restrictions on crop production or tillage practices on fields with steeper slopes. Likewise, the Phosphorus Index limitation may restrict how and when manure is applied, such as would be the case in 2018 in Figure 2 where manure is surface applied in the spring.

As has been discussed elsewhere in this document, the Phosphorus Index has its limitations in accurately predicting phosphorus losses in the South Fish Creek watershed due to the extent of the surface drainage networks and potential for runoff via concentrated flow. As such, the Phosphorus Index limitation alone is not enough to prevent non-point phosphorus losses.

Application of Manure within Surface Water Quality Management Areas

No manure at any time of the year may be mechanically applied to land that is within 300 feet of and that drains to a drainage tile surface inlet, intermittent stream, or perennial stream, unless the manure is incorporated into the soil within 48 hours of application.
(Section 5-7-10 (d))

No manure at any time of the year may be mechanically applied to land that is within 1,000 feet of a lake or pond and that drains to the lake or pond unless it is incorporated into the soil within 48 hours of application. **(Section 5-7-10 (e)**

Current regulations in NR 243 allow unincorporated surface application of manure within SWQMAs to field conditions that are likely to result in runoff in the event of a rain event occurring 25 or more hours after the application. Incorporating the manure at least 48 hours prior to a forecasted rain event will reduce the chances of the manure running off. It is important to note that not all lands within a 300' or 1000' buffer drain to the waterbody. This incorporation requirement only applies to land that is within the buffer and drains to the buffered waterbody.

Application of Manure Near Drinking Water Wells

No manure at any time of the year may be mechanically applied to land within 100 feet of an active or inactive well unless that well has been abandoned per USDA-NRCS Technical Standard 351. Manure that is mechanically applied to land that is more than 100, but less than 300 feet, and is upslope of an active or inactive well and that drains to a well must be incorporated into the soil within 48 hours of application. **(Section 5-7-10 (c))**

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[19] Cooley, Eric. 2015. UW Discovery Farms: Understanding Nutrient and Sediment Loss from Agricultural Landscapes. Presentation to the Bayfield County Large-Scale Livestock Study Committee, May 28, 2015.

Increasing the no-spread setback from 50' to 100' adds a greater degree of protection from contaminated surface runoff reaching well casings. Extending the incorporation buffer to 300' and requiring incorporation within 48 hours further reduces the risk of surface-applied manure from contaminating area groundwater resources. These very same buffers and practices were approved by the DNR in December of 2006 as necessary to meet water quality standards in Manitowoc County. Groundwater quality in the South Fish Creek watershed is generally high with no sign of E. coli contamination and little to no nitrates. However, agricultural land-use is currently low-density compared to elsewhere in Wisconsin and maintaining more vigorous well-buffers as agricultural intensity increases will help maintain the excellent water quality.

Evaluation of Less Restrictive Measures to Avoid Manure Application to Frozen, Snow-Covered, or Saturated Soil Conditions

Land-spreading liquid manure to frozen, snow-covered, or saturated soil conditions poses an unacceptable risk to water quality in Bayfield County. Installing and maintaining storage capacity imposes a significant economic cost on the operator of a new or expanding livestock facility. As such, Bayfield County has considered less restrictive measures to prevent application of liquid manure to high risk soil conditions and has determined that 540 days of storage capacity combined with required drawdowns and spreading windows to ensure there is storage capacity going into the winter months is the least restrictive means available.

180 days storage capacity with no required spreading windows

As has been discussed, current regulations requiring 180 days of storage for operations with more than 1000 animal units do not provide any risk mitigation for a missed spreading window in the fall.

180 days storage capacity with required spreading windows

Requiring an operation to develop and implement a cropping plan that provides at least three spreading windows would help ensure that an operation is not relying exclusively on a fall spreading window to empty the facility to 180-days of capacity. However, with only 180-days of storage capacity the operation would still not have enough capacity to store through the winter if the fall spreading window were missed. For example, if the pit were emptied by September 1 by applying to hay fields, the facility would still have 3 months of manure in the pit as of November 30, with only 90-days storage capacity going into the winter if the fall spreading window was missed.

270 days storage capacity with required spreading windows

If an operation were required to have and utilize a summer spreading window and the facility had 270 days of storage capacity, it would be more likely the operation would have 180-days of storage capacity going into the winter even if missing a fall spreading window. For example, if the facility were emptied as of September 1 and a fall spreading window were missed the facility would have 90 days of manure in storage as of November 30 with 180-days of storage capacity, allowing the operation to store manure through May the following spring. However, assuming the storage facility were emptied as of June 1, there would be 90 days of manure that would have to be spread

by September 1 to ensure sufficient storage capacity going into winter if the fall spreading window were missed. Spreading 1/4 of an operation's total annual manure production in July, August, and September would require significant acreage of fallow ground, hay, or other crops and may pose an unacceptably high burden of land ownership or leased land on the operator. Likewise, it would require that the pit were fully emptied by September 1. If that year's cropping and nutrient management plan called for less manure in the spring (such as a small grains, soybeans, or alfalfa establishment year), it's possible the facility would have significantly more manure to apply by September 1. Furthermore, if the fall spreading window were missed in the year prior, the operation would have 210 days of manure as of April 1 and would thus need to apply 360 days worth of manure between April 1 and September 1 to make sure there was adequate storage capacity going into the next year's winter were the fall season to be missed. With a wet spring or crops that required less manure such a scenario would pose a risk of emergency winter spreading, a risk Bayfield County is not willing to take.

360 days storage capacity with required spreading windows

Having 360 days of storage capacity would help mitigate the risks of emergency winter spreading, but as with 270 days of storage, multiple missed windows could still result in emergency winter spreading. For example, if the facility were emptied by June 1 and no manure was applied during the summer, the facility would have 120 days of manure in storage ready for spreading as of October 1. If the fall spreading window were missed, the facility would have 180 days of manure in the facility and 180 days of storage capacity as of December 1. To have 180 days of storage capacity going into the next winter, the operation would have to apply 520 days of manure (the stored manure between December 1 and March 31 plus the manure generated between April 1 and December 1) between April 1 and December 1. If the fall spreading window were again missed, that would require 520 days of manure being spread at planting and prior to the late-fall harvest. It is highly unlikely an operator will assume the second fall spreading will be missed and commit to a cropping plan that can accommodate 520 days worth of manure at planting and/or during the summer-chance window. Requiring that such manure applications be made would place a costly land ownership or lease payment burden on the operation or could require the operation to grow undesirable crops simply as a means to land-spread the manure.

In the above scenario, requiring an operator to apply manure during the first summer would reduce the amount of manure in storage going into the winter after a missed fall spreading window and, thus, could mean the 360 days of manure storage capacity would be sufficient. However, we feel it is unreasonable to require an operation to draw-down their manure storage capacity to 270-days every summer. Rather, as the ordinance reads, the operator would have the option to forgo the 270-day drawdown, but if the 180-day drawdown is also missed that year the operator would not have the option to land-spread on frozen, snow-covered, or saturated soil conditions.

540 days of storage capacity with required spreading windows

Having an additional 180 days of storage capacity would allow an operation to miss two consecutive fall spreading windows without being required to spread 520 days worth of manure during the spring or summer following the first missed fall window as outlined in the scenario above. In other words, the additional storage capacity would not require the operator to assume two consecutive fall-spreading windows would be missed and make the costly investment in land ownership or lease payments or growing undesirable crops. The operator could plan on having the fall spreading window available, but if missed there would be sufficient capacity to store the manure through the winter.

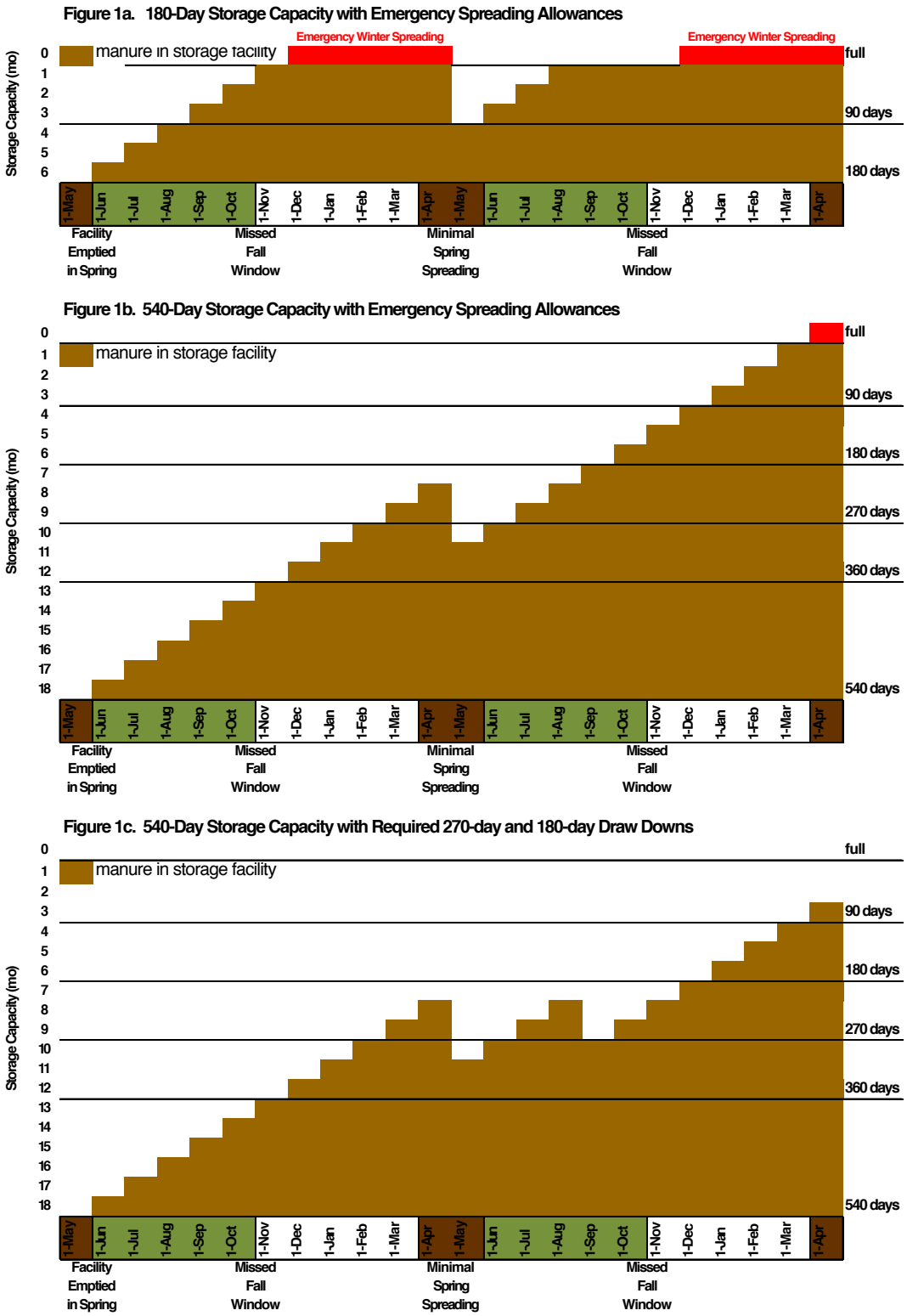

Figure 1a – Corn followed by soybeans/small grains with missed fall spreading windows.
Figure 1b – Corn followed by soybeans with missed fall spreading windows.

Figure 1c – Corn followed by soybeans with some year 2 summer spreading and missed fall spreading windows.

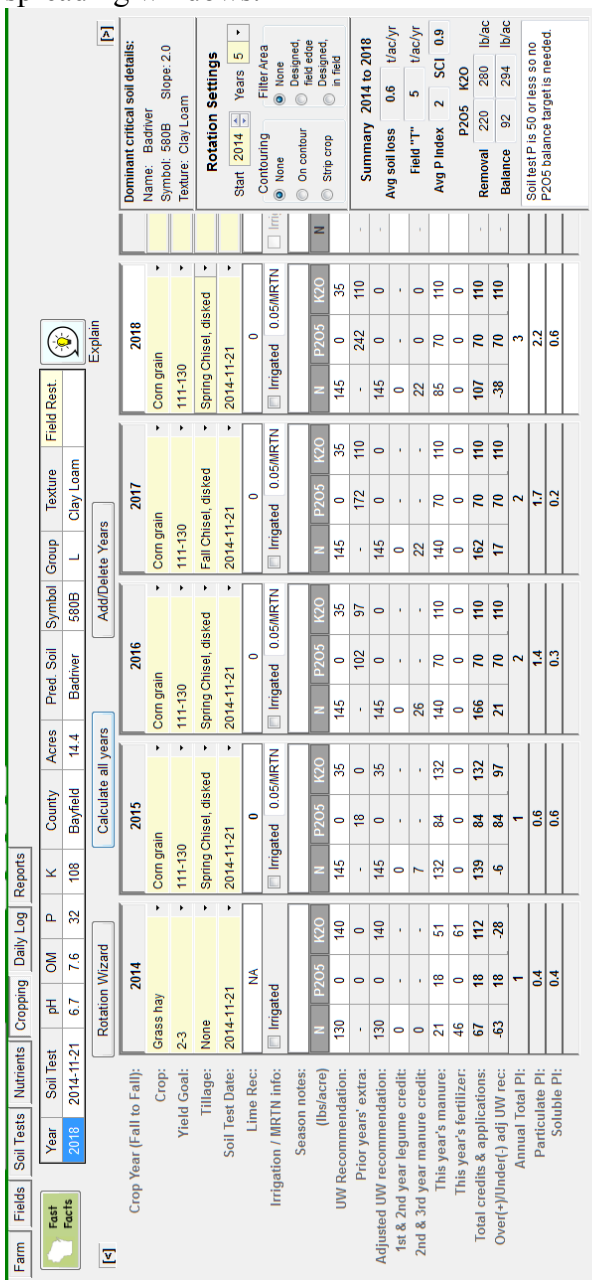

Figure 2. SNAP-PLUS simulation of a corn field within the South Fish Creek Watershed