APPENDIX A:
Land and Water Resource Inventory

PLAN APPENDIX A – LAND AND WATER RESOURCE INVENTORY (LWRI)

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This Land and Water Resource Inventory (LWRI) is intended to catalog and briefly summarize the data available for the Pomme de Terre Watershed. The objective of the LWRI is to describe the characteristics of the Watershed and provide the context for the issues, goals and actions identified in the One Watershed, One Plan – Pomme de Terre Watershed (1W1P). The name, location, and publisher or agency of any relevant datasets is included within each section of the LWRI. Datasets can be accessed through the URL links provided in the Datasets Referenced section or through inquiring at the agency websites or offices. In many cases, hyperlinks to the reports being referenced are provided in the body of the text.

A.1 WATERSHED OVERVIEW

The Pomme de Terre River Watershed is located in west central Minnesota, south of Fergus Falls and west of Willmar. The watershed stretches approximately 80 miles and flows from north to south. Six counties are located within the watershed. Those counties, and the proportion of each county making up the watershed, include Swift (12.8%), Big Stone (3.2%), Stevens (39.5%), Grant (17.9%), Douglas (3.6%), and Otter Tail (23.0%). The watershed includes portions of 10 Cities (**Error! Reference source not found.**) and 48 Townships (Table A- 2).

Table A- 1. Cities in the Pomme de Terre River Watershed

Member Community	County	% Area within Pomme de Terre Watershed	MS4 Community [Yes/No]
Alberta City	Stevens	100%	No
Appleton City	Swift	71%	No
Ashby City	Grant	100%	No
Barrett City	Grant	100%	No
Chokio City	Stevens	100%	No
Dalton City	Otter Tail	100%	No
Donnelly City	Stevens	59%	No
Fergus Falls City	Otter Tail	<1%	No
Morris City	Stevens	100%	Yes
Underwood City	Otter Tail	18%	No

Table A- 2. Townships in the Pomme de Terre River Watershed

Member Community	County	Percent Area within Pomme de Terre River Watershed
Aastad Township	Otter Tail	5%
Akron Township	Big Stone	6%
Appleton Township	Swift	42%
Artichoke Township	Big Stone	66%
Baker Township	Stevens	81%
Buse Township	Otter Tail	6%

Member Community	County	Percent Area within Pomme de Terre River Watershed
Clitherall Township	Otter Tail	15%
Dane Prairie Township	Otter Tail	67%
Darnen Township	Stevens	100%
Donnelly Township	Stevens	2%
Eagle Lake Township	Otter Tail	95%
Edison Township	Swift	6%
Elk Lake Township	Grant	56%
Erdahl Township	Grant	85%
Evansville Township	Douglas	4%
Everglade Township	Stevens	2%
Everts Township	Otter Tail	8%
Fairfield Township	Swift	92%
Framnas Township	Stevens	52%
Hegbert Township	Swift	94%
Hodges Township	Stevens	46%
Horton Township	Stevens	100%
Land Township	Grant	58%
Leaf Mountain Township	Otter Tail	50%
Lien Township	Grant	51%
Lund Township	Douglas	81%
Malta Township	Big Stone	1%
Millerville Township	Douglas	3%
Moonshine Township	Big Stone	2%
Moore Township	Stevens	18%
Morris Township	Stevens	100%
Moyer Township	Swift	31%
Pelican Lake Township	Grant	100%
Pepperton Township	Stevens	61%
Pomme de Terre Township	Grant	42%
Rendsville Township	Stevens	54%
Roseville Township	Grant	27%
Sanford Township	Grant	27%

Member Community	County	Percent Area within Pomme de Terre River Watershed
Scott Township	Stevens	100%
Shible Township	Swift	21%
St. Olaf Township	Otter Tail	100%
Stevens Township	Stevens	89%
Sverdrup Township	Otter Tail	32%
Swan Lake Township	Stevens	54%
Synnes Township	Stevens	100%
Tara Township	Swift	21%
Tordenskjold Township	Otter Tail	95%
Tumuli Township	Otter Tail	92%

A.2 TOPOGRAPHY

High-resolution (3-meter) LiDAR data was downloaded from the MnTOPO viewer application. For display purposes, the digital elevation model (DEM) was added to ArcGIS 10.3 and symbolized to accentuate the watershed's highest and lowest elevations. The Pomme de Terre River watershed starts its journey within the Alexandria Glacial Moraine at a peak elevation of just over 1,700 feet above sea level. The northern third of the watershed contains wooded hills, grassy meadows, wetlands, and lakes with undulating peaks and valleys and slopes ranging from 6-45%. Below the headwaters, the Pomme de Terre enters the Northern Glaciated Plains Ecoregion via a narrow valley that characterizes the skinny, middle portion of the watershed, which contains gently sloping to moderately steeply sloped hills (6-12%).

Areas south of Pomme de Terre Lake have generally less topographic relief in comparison with the northern portions of the watershed. Drainage on the southeastern side of the river in this ecoregion is off the Big Stone Moraine, characterized by landscapes that are gently sloping, to moderately steep (6-12%). Waters falling on the western side of the basin drain the Fergus Falls Till Plain, an outwash plain of nearly level to moderately sloping (0-6%) lands with poorly drained soils associated with the Red River Valley. The portion of the watershed that is south of the ridgeline that divides the Muddy Creek and Dry Wood Creek is very also very flat, with slopes less than 5%. The Pomme de Terre River gradient drops an average of 3.5 feet per mile resulting in an elevation of 940 feet above sea level at the mouth of the Pomme de Terre River; a drop of 760 feet from the watersheds peak elevation (Figure A- 1).

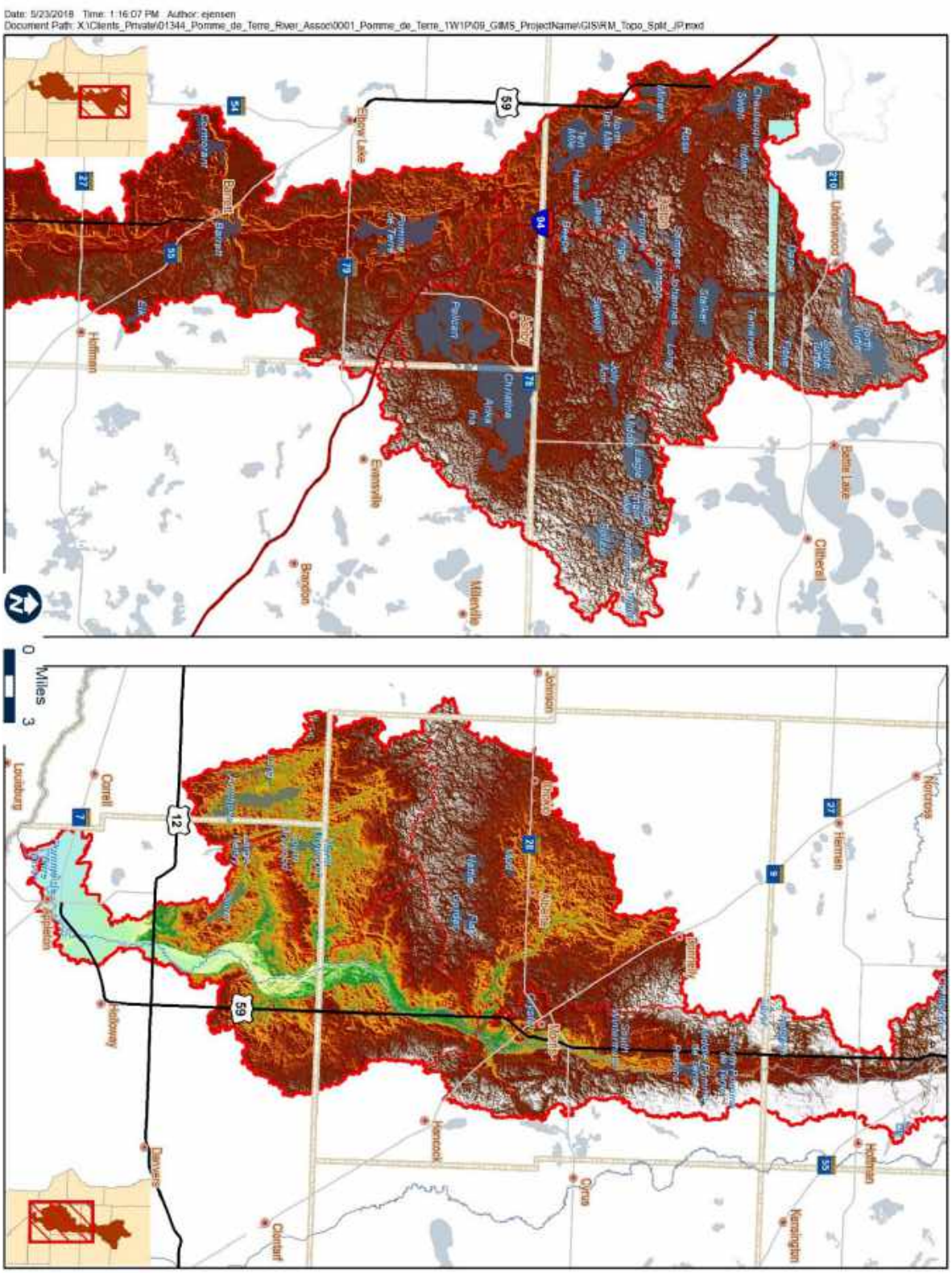


Figure A- 1. Topography of the Pomme de Terre River Watershed (LIDAR Derived Elevations)

A.3 SOILS

Soil texture and Hydrologic Soil Group varies throughout the Pomme de Terre River Watershed as shown in Figure A- 2**.** These characteristics of the soil are important in understanding the health of the watershed and can influence how natural processes like the wind and the rain shape the landscape.

Soil erosion is natural, but it can have negative impacts on the health of the watershed. In determining soil susceptibility to erosion, the MNDNR determined that landscapes in Minnesota with the steepest agricultural lands have the highest potential for erosion[1]. Within the Pomme de Terre, erosion susceptibility is relatively high in the northern part of the watershed and relatively low in the southern part of the watershed.

A.3.1 Soil Texture

Glacial sediments (outwash and till) cover the entire Pomme de Terre River Watershed. In general, soils immediately bordering the Pomme de Terre River corridor are more coarsely textured, glacial outwash soils with high groundwater infiltration rates. Similarly, in the headwaters area, sandy, coarsely textured, glacial outwash soils dominate, allowing for high groundwater inflow rates that recharge the headwater lakes, ultimately contributing to the excellent water quality of the watershed's headwater lakes. The sandy, coarsely textured soils in the headwaters area are not ideal for farming; therefore, the headwaters portion contains a higher percentage of forests and shrub land relative to the rest of the watershed.

As the Pomme de Terre moves south from the headwaters towards the middle and southern portions of the watershed, dominant soil types transition from coarsely textured glacial outwash to glacial till, largely comprised of finely-textured clay loams. These finely textured soil series have lower infiltration rates and consequently contribute more runoff per unit area in comparison with headwater soils. The ability of these clay loam soil series to retain water makes these soils ideal for growing crops. The southern half of the watershed has two distinct sections for defining soil; soils east of the Pomme de Terre River are generally coarsely textured, well-drained silty and loamy soils while soils to the west of the Pomme de Terre River are composed of poorly drained clayey and loamy soils.

A.3.2 Hydrologic Soil Groups

Northern Region

The dominant soil series in Ottertail County includes Hydrologic Soil Group (HSG) "C" soils, which often contain one or more layers that impede the downward movement of water, resulting in slow infiltration rates and moderately high runoff rates. In Grant and Douglas County, the dominant soil series transitions to HSG "B/D". HSG "B/D" soils typically are well drained, but may have a confining layer within the first 60 inches of the soil profile that produces a high water table. The prevalence of subsurface tile drainage within the currently cropped portions of the Pomme de Terre watershed allows "B/D" soils to act more like "B" soils.

Southern Region

Dominant soil series in Stevens/ Swift County include HSG "B/D" and "C" soils with the exception of areas immediately adjacent to the Pomme de Terre River which is dominated by HSG "A" and "B" soils.

A.3.3 Crop Productivity

Crop productivity index (CPI) ratings from the Natural Resources Conservation Service provide a relative ranking of soils based on their potential for intensive crop production. An index can be used to rate the potential yield of one soil against that of another over a period of time. Ratings range from zero to 100%. The higher numbers indicate higher production potential. These rankings are shown in Figure A- 3. In the northern region of the watershed, CPI values, on average, are lower than in the southern region. The sections with a higher CPI correlate with the HSG "A", "A/D", and "B" soils, while sections with lower CPI correlate with HSG "C", "C/D", and "D" soils. Overall, the northern region is less productive for crops and has more variability than the southern region.

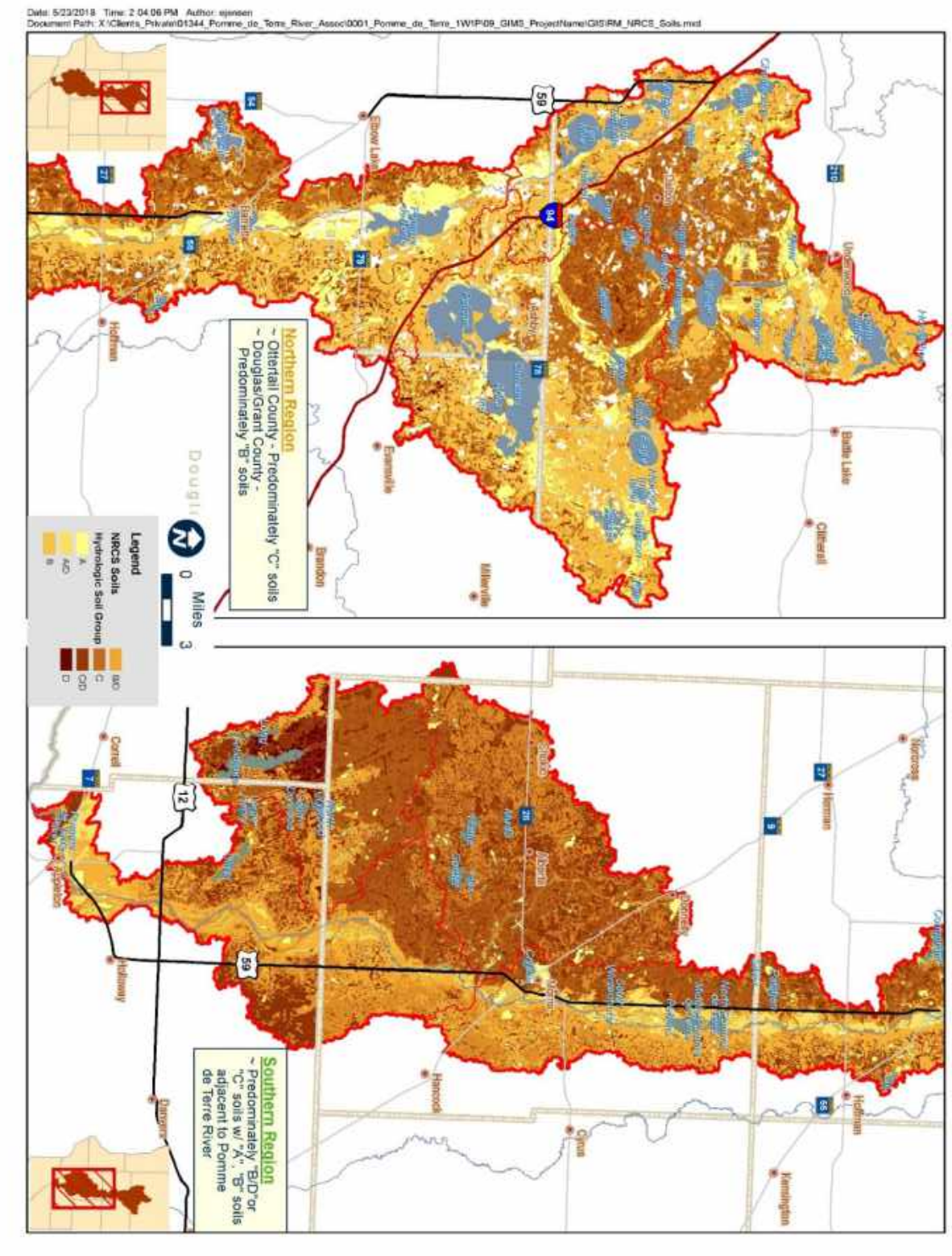


Figure A- 2. Soils of the Pomme de Terre River Watershed

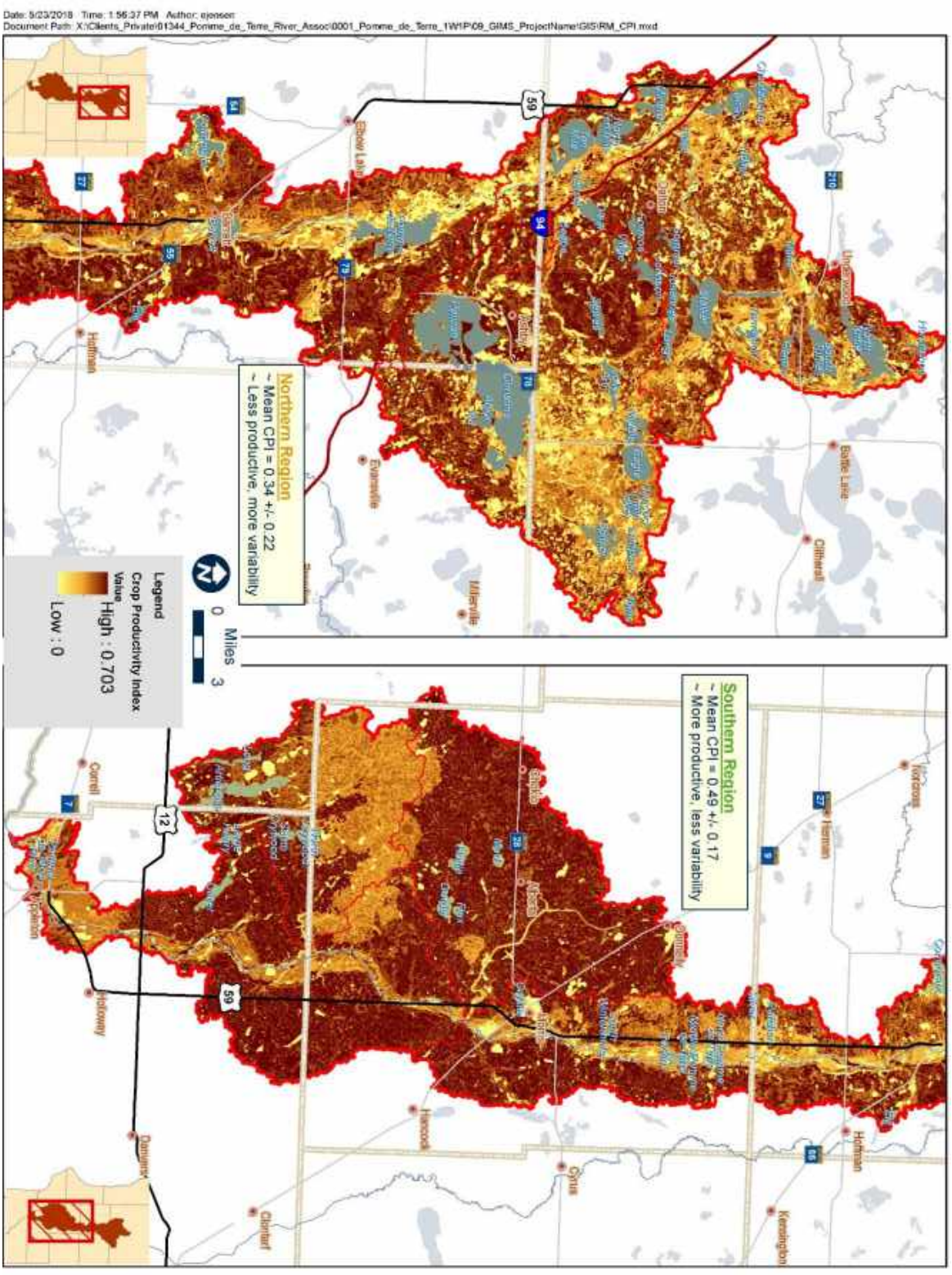


Figure A- 3. Crop Productivity Index

A.4 GEOLOGIC SETTING

The Pomme de Terre River generally serves as a dividing point for the underlying geology of the watershed, from the Red River Lobe to the Des Moines Lobe and shown in Figure A- 4.

Northern Region

The Des Moines Lobe covers the northeastern 2/3 of the Pomme de Terre Watershed. The fine-loamy till of the Des Moines Lobe is characterized by more than 18% clay, typically less than 50% sand, and a high content of shale. As the Des Moines Lobe retreated, it left behind extensive outwash plains and small to large ice-block basins that now contain lakes or marshes (Ottertail County, 2018).The Red River Lobe covers the northwestern 1/3 of the Pomme de Terre Watershed. Silt and clay-rich lacustrine deposits associated with Lake Agassiz and floodplain alluvium deposited throughout the Red River valley characterize the fine-grained sediments of the Red River Lobe.

Southern Region

The Red River Lobe covers the majority of the southern half of the Pomme de Terre watershed with the exception of the southeastern 1/3, which is comprised largely of the Des Moines Lobe interspersed with fluvial deposits associated with the Pomme de Terre River valley.

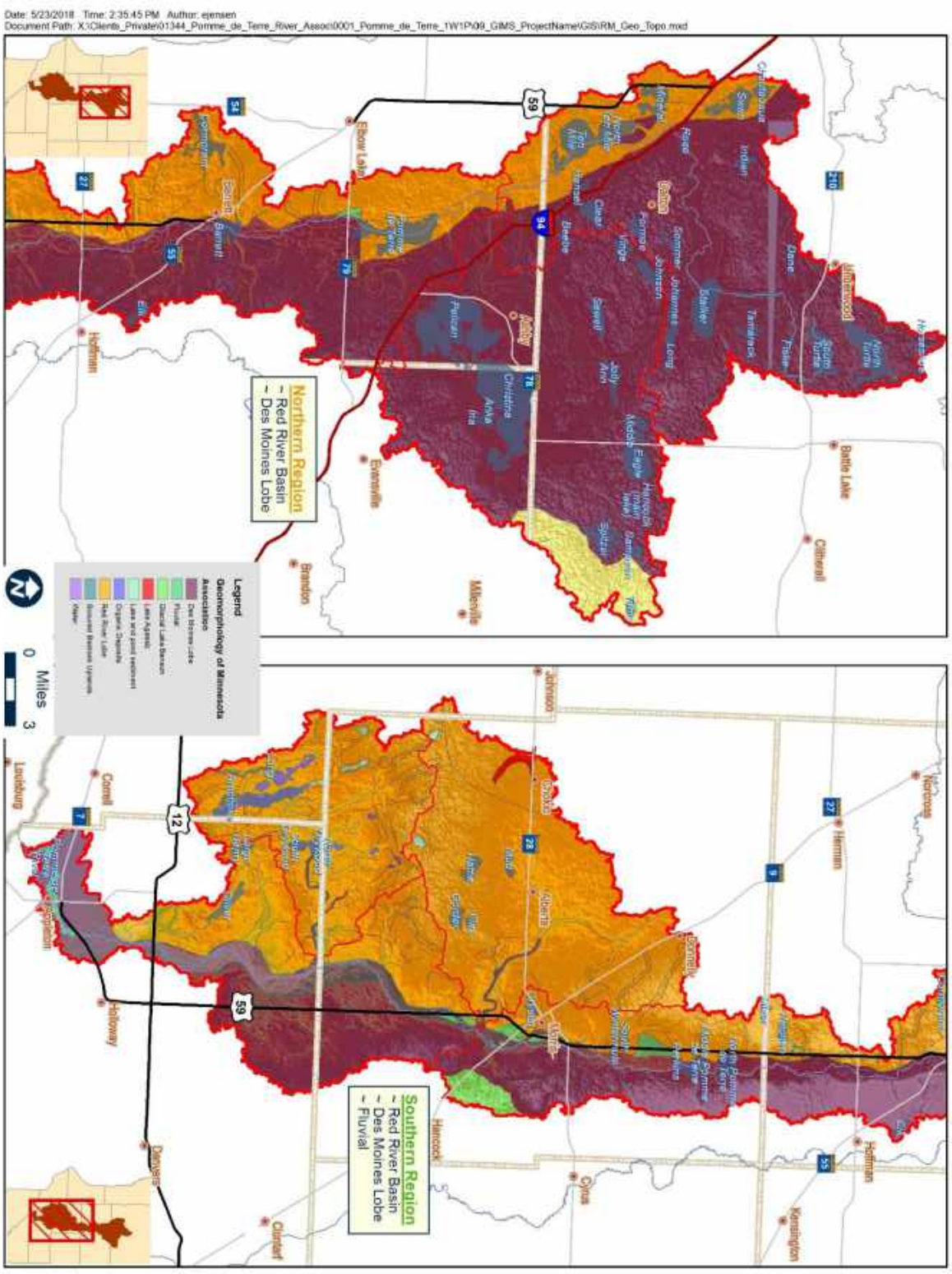


Figure A- 4. General Geomorphology of the Pomme de Terre River Watershed

A.5 CLIMATE AND PRECIPITATION

It is important to understand and prepare the Pomme de Terre Watershed for future climatic variabilities as it may require more frequent shifting of watershed management practices. In the last thirty-five years, the Pomme de Terre Watershed has experienced higher trends in both precipitation and temperature. Most notable is the increase in extreme temperatures and precipitation events.

A.5.1 Climate

In west-central Minnesota, the average temperature increase per decade was 0.14˚F from 1895-1969, which changed to an increase of 0.53˚F per decade from 1970-2016. The Pomme de Terre Watershed is no exception. As seen in Figure A- 5, the Pomme de Terre Watershed appears to be following the same increasing trend.

While some of these trends appear small, these relatively small changes to the status quo can disrupt the long established processes of a delicately balanced ecosystem. One small disruption has the potential to set off an unpredictable chain reaction that may or may not result in serious impacts to the ecosystem.

A.5.2 Precipitation

In the Pomme de Terre Watershed, average total accumulation of precipitation is highest in the summer months, with June being the greatest at approximately 3.95 inches. During the winter months, average total accumulation is lowest, with the least accumulation in February at approximately 0.64 inches. The greatest increase in precipitation is from May to June when total accumulation increases by 1.10 inches. The greatest decrease in precipitation is from October to November, when total accumulation decreases by 1.36 inches. Average annual precipitation in the watershed is 29.95 inches (Table A- 4).

According to precipitation data from the State Climatology Office, average annual precipitation has increased by 10% from the 20th Century, at 23.8 inches, to the late 1990s-2010s, at 26.3 inches (Figure A- 7). In those recent years, the Pomme de Terre Watershed has experienced multiple extreme storm events. Flooding is a frequent occurrence in the Pomme de Terre Watershed. There have been multiple precipitation events where certain reported areas accumulated over 6 inches of precipitation in 24 hours; the most notable events are the flash floods that occurred in 1991, 1993, and 2005. Flooding in the relatively rural Pomme de Terre Watershed often leads to damaged crops and impassable roadways.

It is reasonable to assume that extreme precipitation events will continue to occur in the future. If plants, wetlands, and soils are in a natural and functioning state, they have the ability to absorb and hold great amounts of water; both reducing and delaying runoff water before it enters surrounding creeks and rivers. This in turn reduces the severity of flooding would allow nearby communities more time to prepare for unavoidable flooding events.

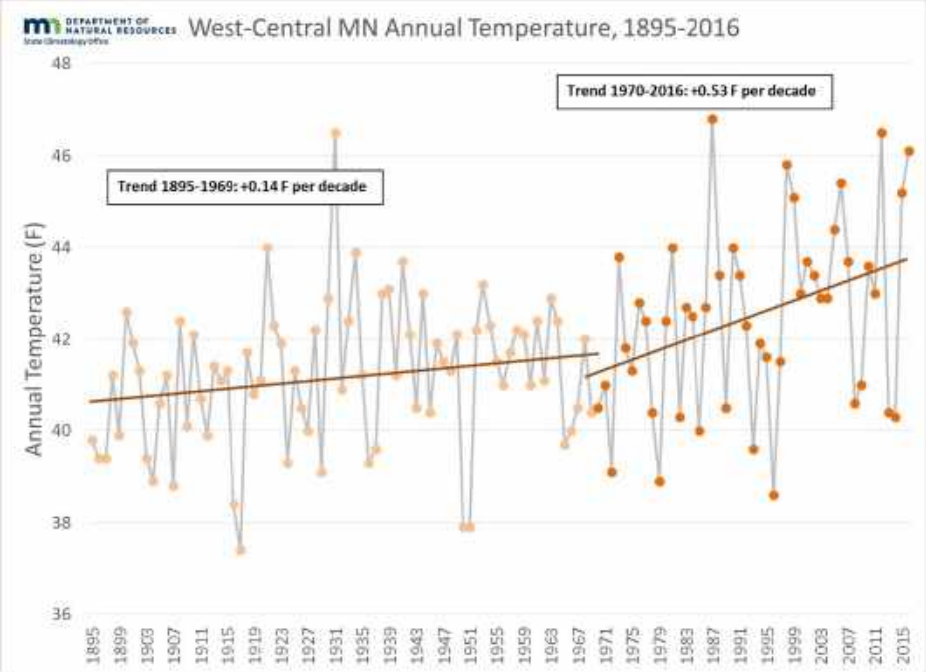


Figure A- 5. West Central MN Annual Temperature, 1895-2016

Table A- 3. Average Annual Temperature and Temperature Trends in the Pomme de Terre Watershed

Measurement Parameter	Plan Area Average
Average Normal Annual Temperature (˚F) (1980 – 2010)	42.7 ˚F
Temperature Trend (1895 – 2017)	+0.2 ˚F/decade
Temperature Trend (1980 – 2017)	+0.4 ˚F/decade

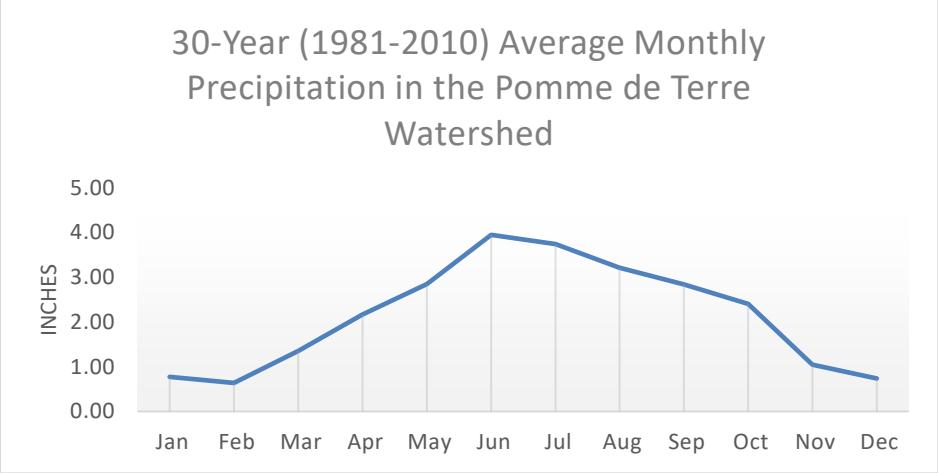


Figure A- 6. 30-year averages (1981-2010) for subbasin-averaged monthly precipitation totals in the Pomme de Terre Watershed (Minnesota State Climatology Office)

Table A- 4. Average Annual Precipitation and Precipitation Trends in the Pomme de Terre Watershed

Measurement Parameter	Plan Area Average
Average Normal Annual Precipitation (in) (1981 – 2010)	25.95 (in.)
Precipitation Trend (1895 – 2017)	+ 0.26 in/decade
Precipitation Trend (1980 – 2016)	+ 0.87 in/decade

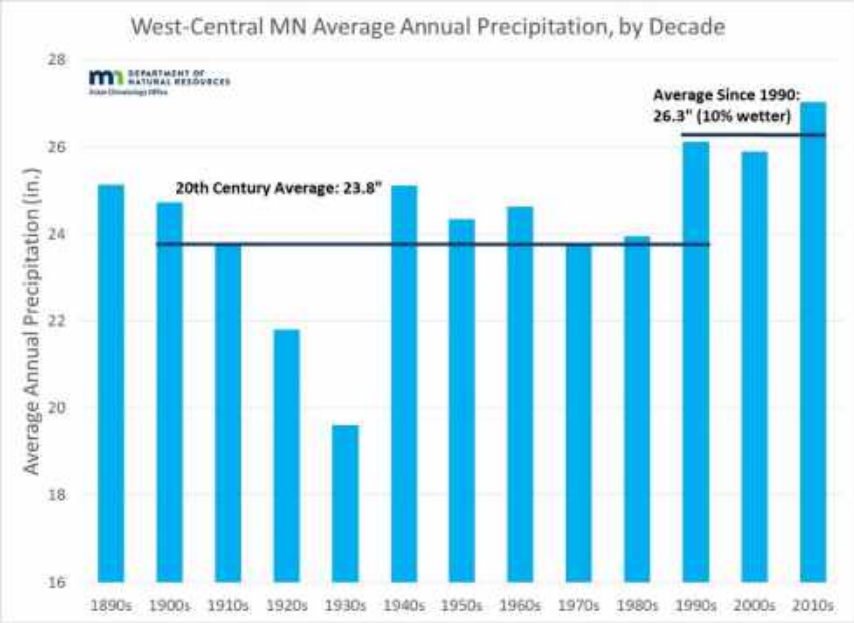


Figure A- 7. West-Central MN Average Annual Precipitation by Decade

A.5.3 Climate Trend Expectations

Temperature trend:
As shown above, the short-term temperature trend in the Pomme de Terre Watershed shows a positive 0.4˚F increase per decade. This is double the rate of the long-term trend which is a positive increase of 0.2˚F per decade.

Impacts of increasing temperatures in the Pomme de Terre Watershed include a longer growing season (increased water needs for agriculture), changes to soil frost depth and duration (implications for manure spreading), warmer waters (increases instances of low DO and hypoxia, increased frequency of algal blooms, thermal resistance to vertical mixing, stresses cold water fisheries) and increases in terrestrial invasive species since warmer temperatures allow them to survive more easily, multiply and expand their ranges.

Seasonal temperature trends:
Summer (June – August) temperature trends in the Pomme de Terre Watershed, measuring back to 1895, shown an average temperature increase by a rate of 0.1˚F per decade. Fall (September – November) temperature trends in the Pomme de Terre Watershed, measuring back to 1895, show an average increase in temperature of 0.2˚F per decade. Winter (December – February) temperature trends in the Pomme de Terre Watershed **is by far the fastest changing**. On average, the winter season in the Pomme de Terre Watershed is increasing in temperature at a rate of 0.4˚F per decade. This increase greatly outpaces the other three season's temperature rate increases and will result in shorter winters, with less snow, more ice, frequent rain events, and more rapid spring snowmelt. Spring (March – May) temperature trends shown an average temperature increase of 0.2˚F per decade.

Average ice out dates:
The average ice out dates measured in the Pomme de Terre Watershed generally falls between April 1 and April 7. As winter temperatures continue to increase, it is expected that the average yearly ice out date will take place earlier and earlier as time goes on. Impacts of earlier ice out dates include less ice coverage on surface waters (results in greater evaporation of surface waters and lower water levels, concentrating pollutant loads).

Dew points:
The Pomme de Terre Watershed has an average annual Dew Point of 32˚F. As summer temperatures and evaporation rates trend higher in the Pomme de Terre Watershed, it is expected that higher dew point averages and extremes will be observed. Impacts of higher dew point averages and extremes include increased need for energy production (e.g. air conditioning), higher demands on community water supplies and human and agricultural animal safety concerns such as heatstroke, heat exhaustion, decreases in performance (e.g. drop in food consumption, reduction in productivity) and increased mortality rates.

Seasonality in MN precipitation trends (comparing back to 1895):
Summer (June – August) precipitation trends in the Pomme de Terre Watershed shown an average rate increase in precipitation by 0.06 inches per decade. Fall (September – November) precipitation trends in the Pomme de Terre Watershed show an average increase in precipitation of 0.13 inches per decade. Winter (December – February) in the Pomme de

Terre Watershed is increasing in precipitation by 0.01 inches per decade. Spring (March – May) precipitation trends show a precipitation increase of 0.05 inches per decade.

Impacts of changes in precipitation patterns and more extreme events include increased risk of flooding, increased variability of stream flows, increased velocity of water during high flow periods, soil loss, decreased groundwater recharge (rain from extreme events falls too quickly to be absorbed in the ground) and taxes existing infrastructure. Increased flooding also results in increased loads of sediment and nutrients in the watershed.

Evaporation Trends:

As average and extreme temperatures continue to increase, evaporation rates are also expected to increase. Impacts of changes in evaporation include increased water loss from the surfaces of waterbodies, water loss from the soil profile which is challenging for shallow rooted plants and other organisms that reside in the first few inches of soil and increases the need for irrigation. The conversion of crop types from small grains and hay to corn and soybean has caused an offset in timing of peak runoff periods with peak plant water use (Figure A- 8) resulting vulnerable leaching periods in the soil.

Wind Trends:

The Pomme de Terre Watershed in general sees moderate to high wind speeds with averaging wind speeds of 10.1 miles per hour. Wind is largely dependent on the variation in air temperatures; since the poles are warming faster than the equator, there is a smaller global temperature differential, reducing the speed of wind. Global wind speeds have decreased by 5 to 15% over the last three decades, and are expected to decrease another 15% in the coming century[2]. Impacts of changes in wind speed include potential changes to lake thermal and mixing dynamics.

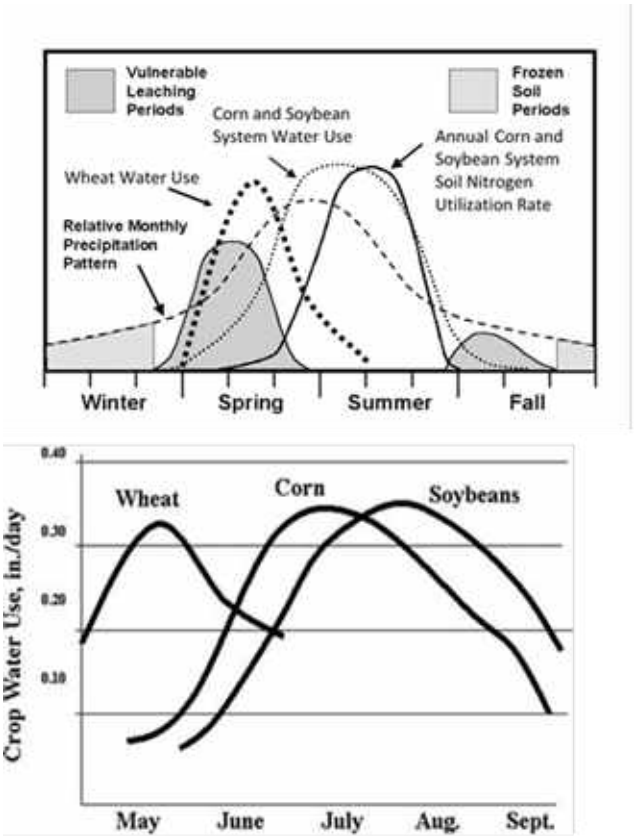


Figure A- 8. Plant Water Use versus Precipitation Seasonal Trends

A.6 WATERSHED HYDROLOGY

The Pomme de Terre River Watershed (a 'subbasin' or HUC-8 watershed in the USGS hydrologic hierarchy) drains approximately 874.9 square miles through one primary channel, the Pomme de Terre River. At its headwaters, the watershed is dominated by Lakes and Hardwood Forests. As the Pomme de Terre River flows south, the landscape transitions into a wider and flatter flood plain with fewer trees along its banks. Further information can be found on the Pomme de Terre River watershed page on the MPCA website:

https://www.pca.state.mn.us/water/watersheds/pomme-de-terre-river

The watershed is divided into six HUC-10 minor watersheds:

- **Upper Pomme de Terre Watershed:** This 85,668-acre watershed drains the lake-rich headwaters through the Pomme de Terre River.
- **Pelican Creek Watershed:** This 84,853-acre watershed has a high density of lakes some of which are very large and relatively shallow.
- **Middle Pomme de Terre Watershed:** This 138,251-acre watershed is the largest of the HUC-10 watersheds. It is a very long, narrow watershed containing several small lakes and many reaches of the Pomme de Terre River.
- **Muddy Creek Watershed:** This 92,150-acre watershed contains Muddy Creek and Hattie Lake. Land use is almost exclusively cropland.
- **Drywood Creek Watershed:** This 61,984-acres watershed is the smallest of the HUC-10 Watersheds. The watershed is home to Artichoke Lake, which was used by the EPA as an ecoregion reference lake in the 1980s.
- **Lower Pomme de Terre Watershed:** This 97,493-acre watershed includes the long reach of the Pomme de Terre River that outlets into the Lac Qui Parle River.

For some components of this document, the watershed has been divided into a northern and southern region for ease in displaying geographically information and to reflect the distinct characteristics of the northern and southern portions of the watershed. The Pomme de Terre River Watershed, its HUC-10 minor watersheds and the two mapping regions are shown in Figure A- 9.

GIS data for the hydrographic position index (HPI) is available through MNDNR[3], and provides a visual of the hydrology and geomorphology in the sub-watershed to determine the locations of drainage boundaries and water conveyance landforms within the watershed[4]. Runoff information is available via the Agricultural Runoff Model (ARM), which is incorporated into Pomme de Terre Watershed's HSPF model.

Within the Pomme de Terre Watershed, approximately 195 miles of streams have been altered, 205 miles no longer have a definable channel, and 34 were impounded (Figure A- 10).

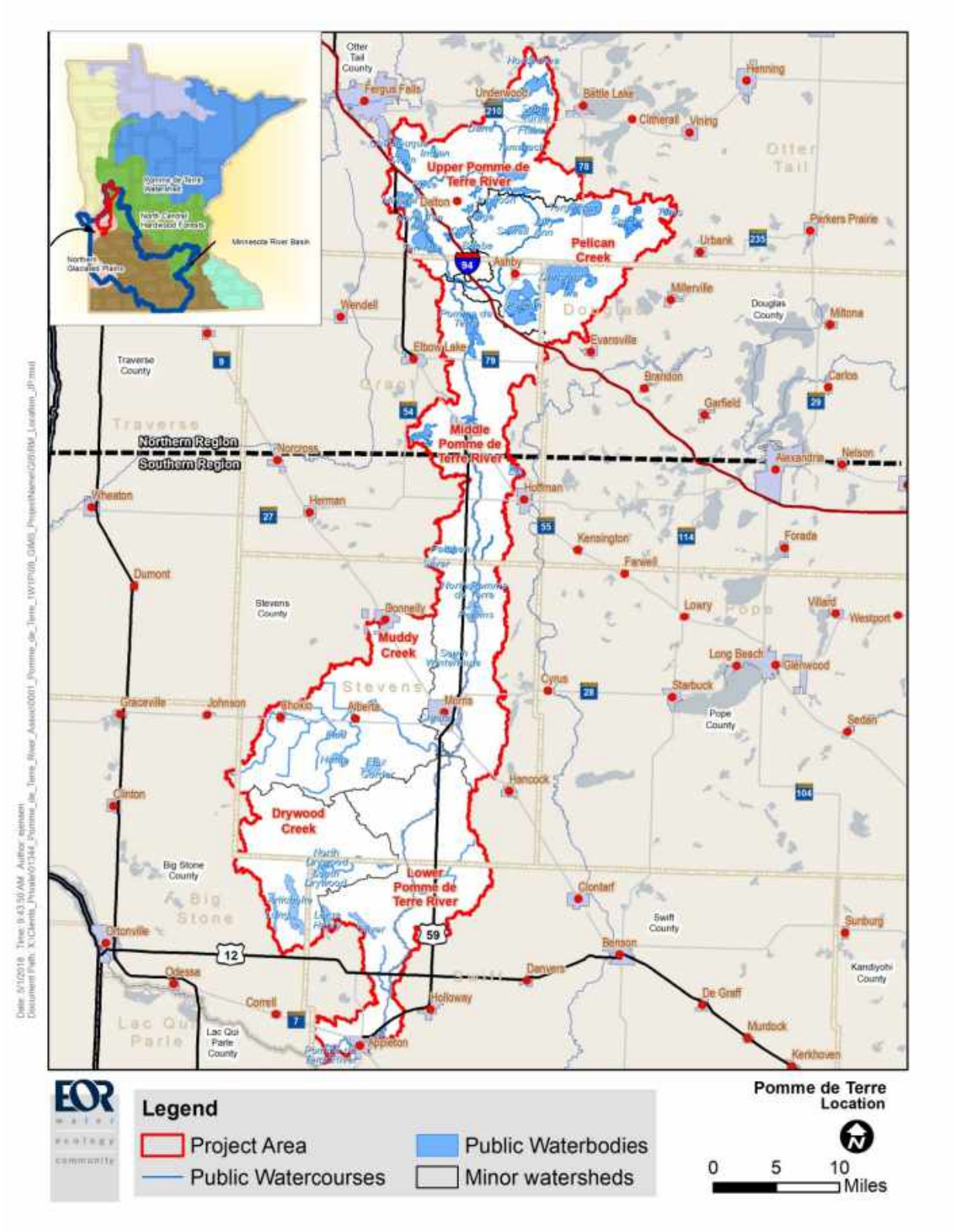


Figure A- 9. Pomme de Terre Watershed Overview

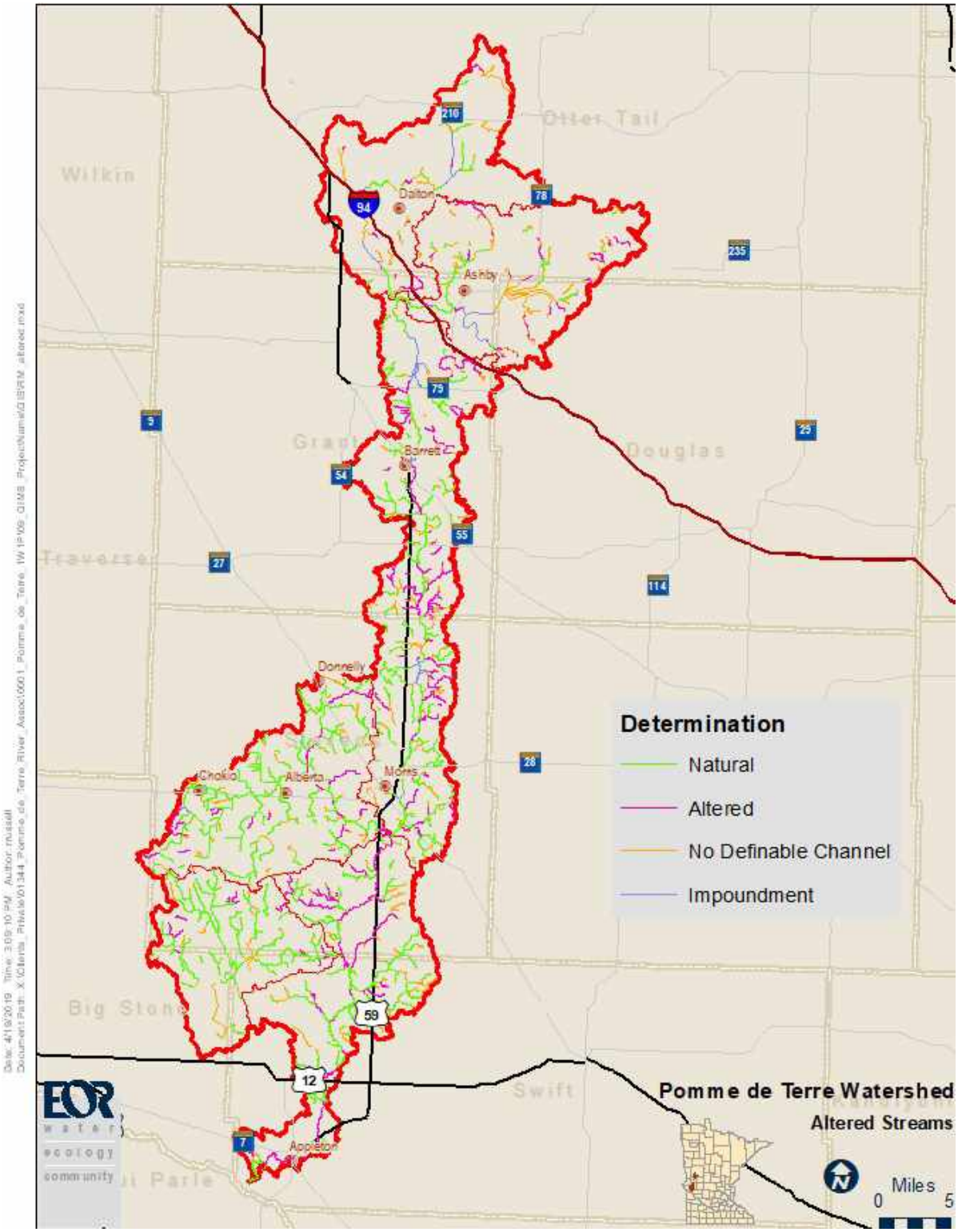


Figure A- 10. Altered Watercourses in the Pomme de Terre Watershed

A.6.1 Flooding

Flooding within the Pomme de Terre River Watershed occurs on Lake Christina, Artichoke Lake, and a reach of Dry Wood Creek above Highway 12. None of the communities within the watershed experience large-scale flooding. The pink areas shown in Figure A- 11 (Zone A) represent areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage determined using approximate methodologies. Base flood elevations (BFE) have not been determined for Zone A. Zone AE has the same definition as Zone A except that Zone AE is determined using detailed methods and BFE are known. More information on flooding can be found at the Federal Emergency Management Agency website[5].

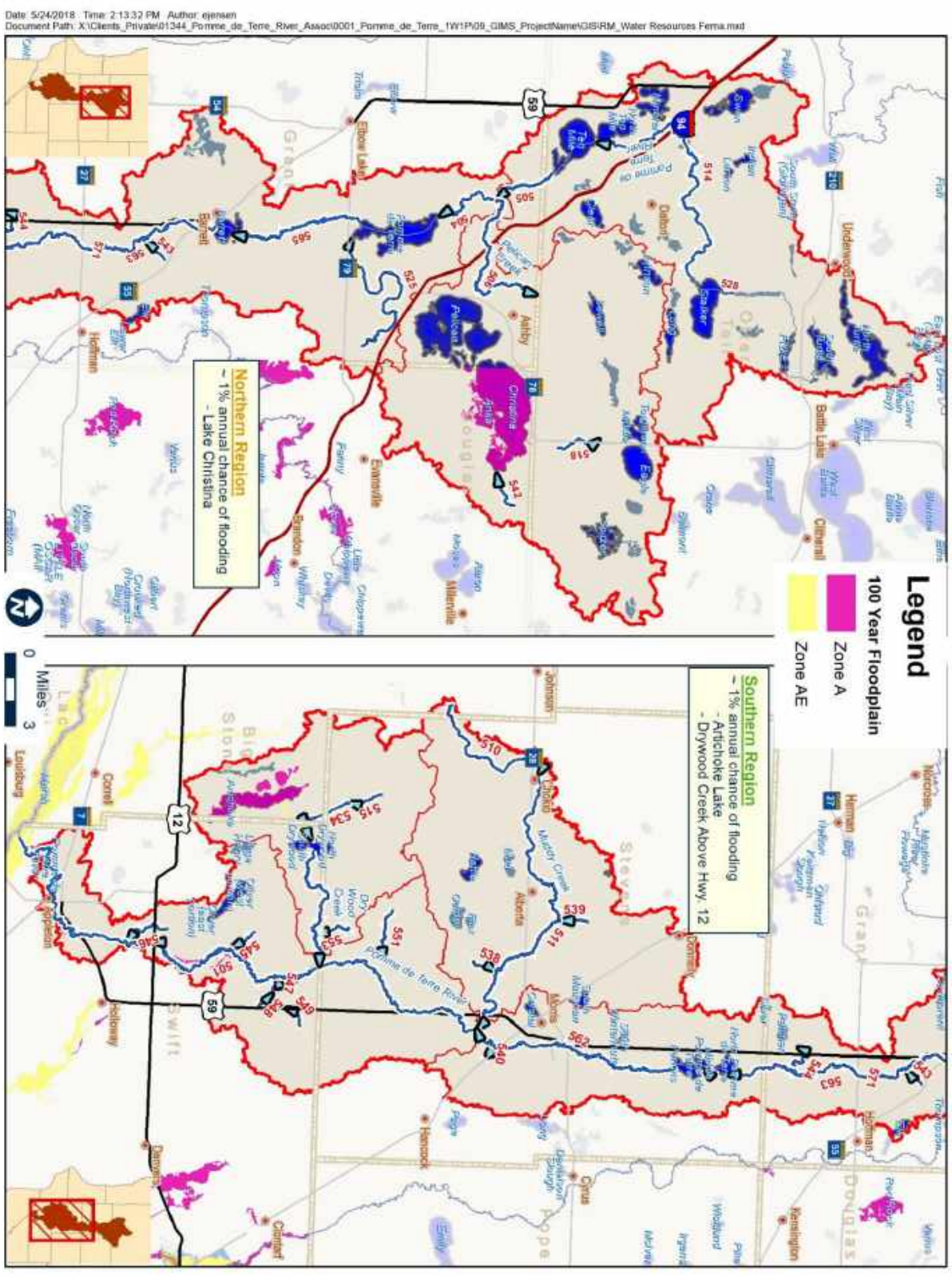


Figure A- 11. FEMA Floodplain Mapping in the Pomme de Terre River Watershed

A.7 SURFACE WATER RESOURCES

The land use and general water quality transition through the watershed. The northern headwater region of the watershed is rich with lakes, wetlands, forests, and grasslands. Moving south down the watershed, the land use transitions to predominately row crops in the central and southern regions of the watershed. The water quality is generally good in the north and degrades in the south of the watershed.

Detailed monitoring and assessment information is included in the following reports on the MPCA Website:

- Pomme de Terre River Watershed Monitoring and Assessment Report https://www.pca.state.mn.us/sites/default/files/wq-ws3-07020002b.pdf
- Assessment Report of Selected Lakes Within the Pomme de Terre River Watershed https://www.pca.state.mn.us/sites/default/files/wq-ws3-07020002.pdf
- Pomme de Terre River Watershed Biotic Stressor Identification: *A study of local stressors limiting the biotic communities in the Pomme de Terre River Watershed.* https://www.pca.state.mn.us/sites/default/files/wq-iw7-36n.pdf

A.7.1 Streams and Lakes

Beyond the Pomme de Terre River, the watershed has few large streams and creeks, limited to the Pomme de Terre tributaries: Pelican Creek in the Northern Region, and Muddy Creek and Dry Wood Creek in the Southern Region. The remaining streams are small, unnamed resources. There are 68 stream reaches in the watershed, and 40 of these were assessed for aquatic recreation and aquatic life use impairments in 2018. Chemistry and biological data for streams is aggregated by the MPCA from a number of data collection organizations and is available on their website. Data can be selected by geography and station type and can be viewed on a map[6]. See Table A- 5 for streams impaired for aquatic recreation and aquatic life uses on the 2018 Impaired Waters List.

The Pomme de Terre River stretches 125 miles from Stalker Lake down to the Minnesota River, where it is the northernmost tributary. It travels through meadows, forests, marshland, and some agricultural areas. The largest lakes on the river are Ten Mile Lake, Pomme de Terre Lake, Barrett Lake, and Perkins Lake.

Other major lakes within the Pomme de Terre River Watershed include Pelican Lake, Lake Christina, Hattie Lake and Artichoke Lake. Out of the total 87 lakes in the watershed, 36 were assessed for aquatic recreation (nutrient/eutrophication biological indicators) and aquatic life in 2016. Chemistry data for lakes can be collected at the MPCA website and other lake characteristics can be viewed on MNDNR's Lake Finder application[7]. See Table A- 5 for lakes impaired for aquatic recreation and aquatic life uses on the 2018 Impaired Waters List.

According to the Pomme de Terre Watershed Clean Water Accountability Progress Report[8] phosphorous and bacteria are the main causes of impairments to aquatic recreation in the lakes and streams. Altered hydrology, poor habitat, and high levels of nitrogen and sediment are the principal stressors for aquatic life impairments. According to the Pomme de Terre River Watershed Monitoring and Assessment Summary, nutrient concentrations and turbidity levels are steadily increasing along the main section of the Pomme de Terre River,

with the highest concentrations located in the most downstream section. According to the Pomme de Terre River Watershed Report[9], the primary pollutant sources and stressor sources, as identified in the Watershed Approach work including the *Stressor ID* report and the *Lakes Assessment* report, are summarized in Table A- 6. These sources represent the likely primary sources as identified in the Watershed Approach work and do not necessarily represent a comprehensive list of pollutant and stressor sources.

Table A- 5. Lake and stream aquatic life and aquatic recreation use impairments in the Pomme de Terre River Watershed (2018 Impaired Waters List)

Lake or reach ID	Waterbody Name	Description	Affected Designated Use	Pollutant/Stressor
07020002-501	Pomme de Terre River	Muddy (Mud) Cr to Minnesota R (Marsh Lk)	Aquatic recreation	*Fecal Coliform*
			Aquatic life	Dissolved oxygen, Benthic macroinvertebrate and Fish bioassessments, Turbidity
07020002-506	Pelican Creek	T130 R41W S4, north line to Pomme de Terre R	Aquatic recreation	*E. coli*
			Aquatic life	Benthic macroinvertebrate and Fish bioassessments, TSS
07020002-511	Muddy Creek	T124 R44W S3, west line to Pomme de Terre R	Aquatic recreation	*E. coli*
07020002-515	County Ditch 22	Unnamed ditch to Unnamed cr	Aquatic life	Fish bioassessments
07020002-534	Unnamed creek	Unnamed cr to Unnamed cr	Aquatic life	Fish and Macroinvertebrate bioassessments
07020002-540	Unnamed creek	Unnamed cr to Pomme de Terre R	Aquatic life	Fish and Macroinvertebrate bioassessments
07020002-547	Unnamed creek	Unnamed cr to Pomme de Terre R	Aquatic life	Fish and Macroinvertebrate bioassessments
07020002-549	Judicial Ditch 2	Judicial Ditch 63 to Unnamed cr	Aquatic life	Fish and Macroinvertebrate bioassessments
07020002-551	Unnamed creek	Unnamed cr to Unnamed cr	Aquatic life	Fish and Macroinvertebrate bioassessments
07020002-556	Dry Wood Creek	Dry Wood Lk to Pomme de Terre R	Aquatic recreation	*E. coli*
			Aquatic life	Benthic macroinvertebrate and Fish bioassessments, Dissolved oxygen, Turbidity
07020002-562	Pomme de Terre River	Perkins Lk to Muddy (Mud) Cr	Aquatic life	Fish bioassessments
07020002-563	Pomme de Terre River	Barrett Lk to to North Pomme de Terre Lk	Aquatic life	Fish bioassessments
07020002-566	Unnamed creek	Unnamed cr to Artichoke Cr	Aquatic life	River eutrophication
07020002-576	Unnamed creek	Unnamed cr to -95.964 45.545	Aquatic life	Fish bioassessments
26-0095-00	Barrett	AT BARRETT	Aquatic recreation	Nutrients (eutrophication biological indicators)

Lake or reach ID	Waterbody Name	Description	Affected Designated Use	Pollutant/Stressor
21-0375-00	Christina		Aquatic recreation	Nutrients (eutrophication biological indicators)
76-0149-00	South Drywood	Near Correll	Aquatic recreation	Nutrients (eutrophication biological indicators)
76-0169-00	North Drywood	AT BARRETT	Aquatic recreation	Nutrients (eutrophication biological indicators)
75-0200-00	Hattie	5 MI S OF ALBERTA	Aquatic recreation	Nutrients (eutrophication biological indicators)
76-0146-01	Oliver (east portion)	10.5 MI N OF APPLETON	Aquatic life	Fish bioassessments
76-0146-02	Oliver (west portion)	10 MI N OF APPLETON	Aquatic life	Fish bioassessments
75-0075-00	Perkins		Aquatic recreation	Nutrients (eutrophication biological indicators)
56-0379-00	North Turtle	UNDERWOOD	Aquatic recreation	Nutrients (eutrophication biological indicators)
56-0377-00	South Turtle	3 MI E OF UNDERWOOD	Aquatic life	Fish bioassessments

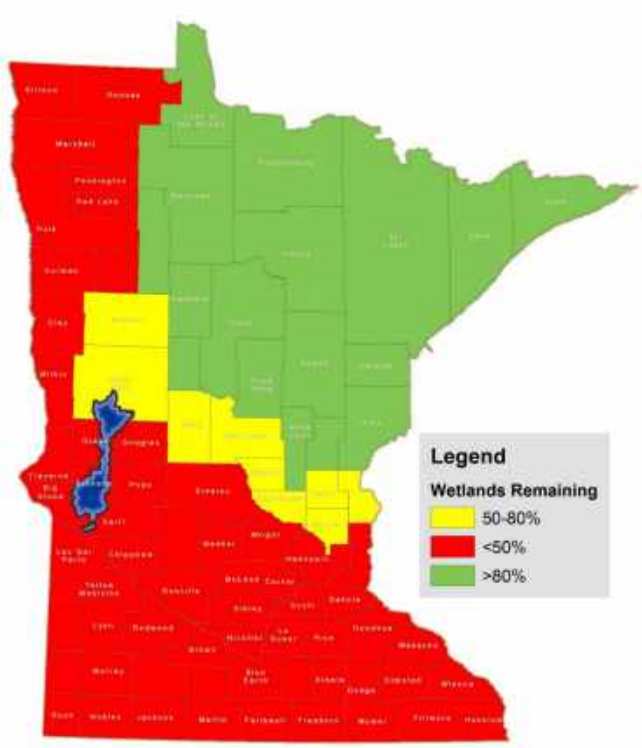
Table A- 6. Primary sources of pollutants and stressors of impaired water bodies in the Pomme de Terre River Watershed.(Pomme de Terre River WRAPS, MPCA)

Impaired Waterbody		Primary Sources of Pollutants/Stressors											
HUC-10 Subwatershed	**Water Body**	Fertilizer & manure run-off	Livestock overgrazing in riparian	Failing septic systems	Wildlife	Poor riparian vegetation cover	Upland soil erosion	Bank erosion/excessive peak flows	Low base flow	Channelization	Dams	Upstream influences	Internal sources
Upper PdT River	North Turtle Lake	●											
Pelican Creek	Christina Lake	●			●								●
Middle Pomme de Terre River	PdT River, 563	●				●		●	●	●	●		
	Perkins Lake	●					●					●	
	PdT River, 562					●		●	●	●	●		
Muddy Creek	Hattie Lake	●					●						●
Dry Wood Creek	Dry Wood Creek, 556	●	●	●		●	●	●	●	●	●	●	
Lower Pomme de Terre River	Unnamed Creek, 551	●					●		●	●		●	
	PdT River, 501	●		●		●	●	●		●	●	●	

A.7.2 Wetlands

The majority of the Pomme de Terre watershed is located in counties that have experienced more than a 50% loss in pre-settlement wetland acreage with the exception of the headwaters portion of the watershed in which 50-80% of the pre-settlement wetland acreage remains. The historic landscape of the Pomme de Terre watershed had many more seasonal and perennial wetlands, especially in the southern two-thirds of the watershed. Wetlands throughout the watershed have been drained using ditches and tile lines to accommodate agriculture, communities and roads.

Figure A- 12 compares the extent of current wetland acreage with restorable wetland acreage based on a Restorable Wetlands GIS layer created by Ducks Unlimited in 2000. NWI wetlands with a "d" modifier (partially drained/ ditched) were also added to Figure A- 12 to provide a comprehensive estimate of potentially restorable wetlands. The Northern Region of the watershed currently contains an estimated 21,739 acres of wetland, 5,419 of which are partially drained or ditched. The estimated restorable wetland acreage for the Northern Region was 5,481 acres, equivalent to approximately 25% of the existing wetland acreage. The Southern Region of the watershed currently contains an estimated 20,559 acres of wetland, 6,565 of which are partially drained or ditched. The estimated restorable wetland acreage for the Southern Region was 37,193 acres, equivalent to approximately 180% of the existing wetland acreage. Two wetlands within the watershed were assessed for impairments in 2016.



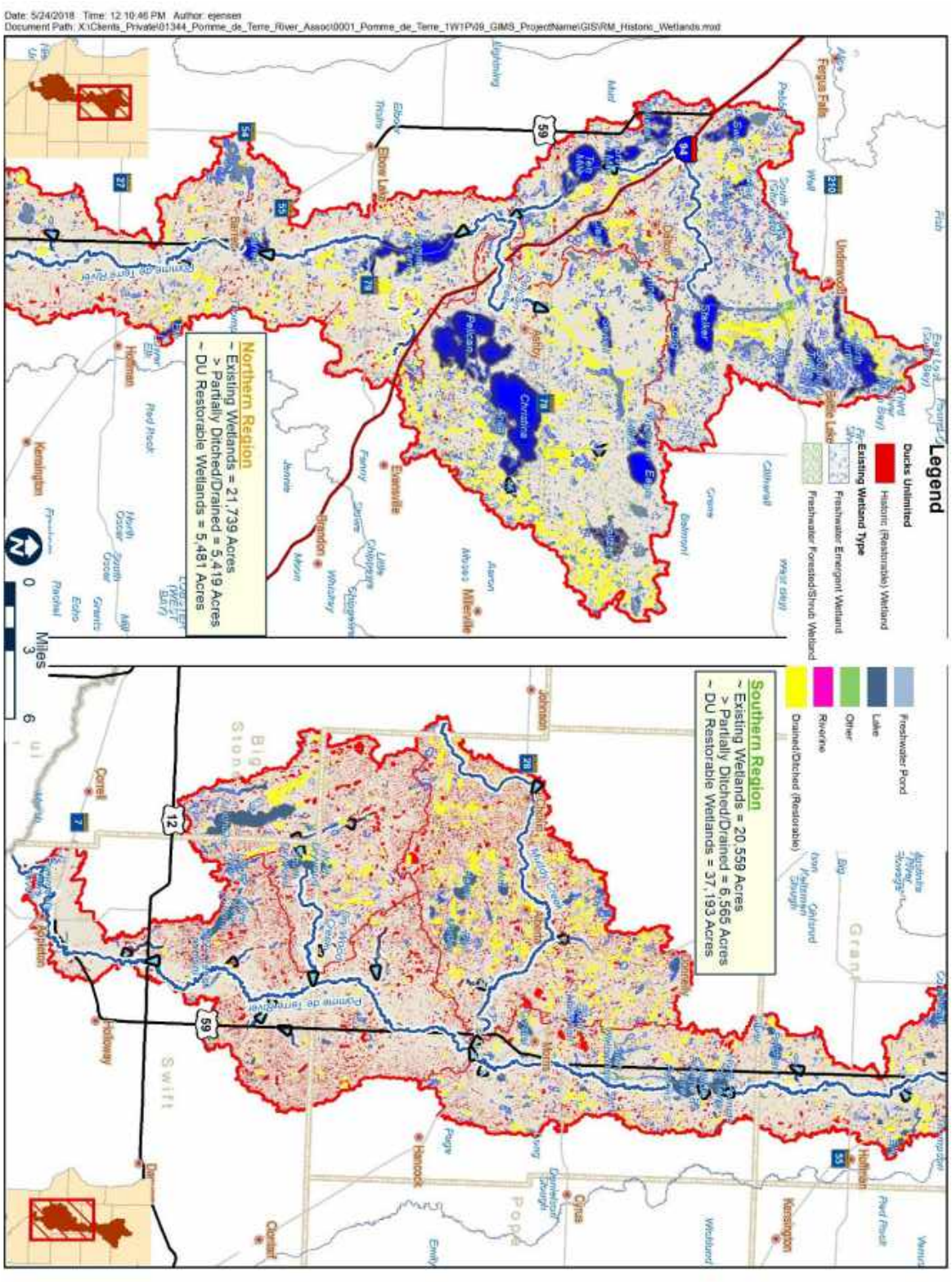


Figure A- 12. Existing and Historic Wetland Resources in the Pomme de Terre River Watershed

A.7.3 Public Waters

Within the Pomme de Terre Watershed, there are about 2,034 recorded public basins with 670 of those over 10 acres. The northern region has approximately three times the acres of lakes and ponds, while the southern region has about three times the miles of streams. This is shown in Figure A- 13, with data from the MNDNR Public Waters Inventory (PWI) [10].

A.7.4 Public Drainage System

Extensive drainage systems occur in both the urban and agricultural areas of the Pomme de Terre River watershed. While drainage systems were installed to remove excess water and lower the water table for agricultural production and/or development, there may be unintended consequences to the hydrologic system including changes in substrates, peak flow, water quantity, water quality and groundwater recharge[11].

The public drainage systems within the watershed are managed by drainage authorities on behalf of the landowners receiving benefit from the drainage system.

Table A- 7 identifies public drainage authorities for each county within the Pomme de Terre River Watershed. These drainage systems, typically open ditches or in some cases underground tiles, were established to enhance agricultural production on lands frequently too wet to produce crops. The cost for original establishment of the public drainage system and subsequent improvements is borne by the benefitted properties within the area tributary to the ditch. The drainage authority acts on behalf of all the benefitted property owners to assess fees for the level of drainage benefit each landowner receives. Chapter 103E of the Minnesota Statutes known as the Minnesota Drainage Law or Drainage Code provides the regulatory framework for managing the public drainage systems.

Benefitted property owners also frequently connect private drainage systems including both open ditches and subsurface tile lines to public ditches. These lawfully connected private drainage systems are paid for and managed by the individual landowner. Subsurface perforated tile lines are very common throughout the arable lands within the watershed. Open public drainage systems are shown in Figure A- 14.

Table A- 7. Public Drainage Authorities of the Pomme de Terre River Watershed

County	Public Drainage System(s)	Who is Drainage Authority?	Record Availability	Additional Comments
Big Stone	Yes	Big Stone County / County Board	Hardcopy Plans & Reports at Highway Department Contact Hwy Dept at 320-839-2594.	No specific ditch related concerns
Douglas	Yes, but none in PdT	Douglas County	Contact Tom Anderson 320-762-2961	No public drainage systems in PdT
Grant	Yes	Grant County Highway Department	Hardcopy Plans & Reports at Highway Department Some information may be digitized.	No specific ditch related concerns

County	Public Drainage System(s)	Who is Drainage Authority?	Record Availability	Additional Comments
Otter Tail	Yes	Otter Tail County	Hard Copy original maps. new is in electronic maps. Maintenance and repair reports are electronic and hard copy. Physically visit the Otter Tail County Drainage authority to obtain information from servers. Contact Kevin Fellbaum with Otter Tail County, 218-998-8492.	Ditch maintenance needed
Stevens	Yes	Stevens County	Yearly status reports, digital and hardcopy maps, surveys, maintenance reports. Ditch map is on Stevens County website www.stevens.mn.co Bill Kleindl 320-208-6558	No specific ditch related concerns
Swift	Yes	Swift County Parks, Drainage & Wetlands	Not currently available to public. Hard copies and a GIS shapefile available through Swift County PDW. Contact Mike Johnson Mike.johnson@co.swift.mn.us 320-843-5341	No specific ditch related concerns

A.7.5 Dams

Surface water drainage within the Pomme de Terre Watershed has been significantly manipulated to post European settlement. There are more than 10 impoundments along the main stem of the Pomme de Terre River with many additional impoundments within the tributary areas. These impoundments serve multiple purposes that benefit economic development and wildlife habitat. The dams also alter river hydrology and create biotic barriers along the river; for that reason the MPCA identified dams as stressors to biotic life within the Pomme de Terre Watershed. The USDA as well as local agencies including MnDNR and MPCA have data on the dams in the Pomme de Terre. To restore biotic passage through the river system there is interest in removing dams no longer serving a purpose. One recent example of this is the dam removed on Drywood Creek, a tributary to the Pomme de Terre River.

A.7.6 Other Waters Resolution

The following is the Other Waters Resolution adopted by Grant SWCD. All other SWCDs in the watershed have identical or very similar Other Waters Resolutions.

Grant Soil and Water Conservation District
Resolution No. 2017-01
To Adopt Summary of Watercourses
for inclusion in Local Water Management Plan

Whereas; Minnesota statues 103F.48 requires SWCDs in consultation with local water management authorities, to develop, adopt, and submit to each local water management authority within its boundary a summary of watercourses for inclusion in the local water management plan.

Whereas; The Board of Water and Soil Resources has adopted the Local Water Resources Riparian Protection ("Other Watercourses") Policy August 25, 2016 which identifies steps SWCDs are required to take in developing said inventory.

Whereas; Grant SWCD has met with local water management authorities within its jurisdiction on February 28th 2017.

Whereas; Grant SWCD and the water management authorities within its jurisdiction discussed watershed data, water quality data and land use information as a criteria in development of this list.

Whereas; Grant SWCD has assessed the water quality benefits that buffers and alternative practices could provide and determined that current State and Federal programs have eligibility criteria for watercourses where water quality would benefit from the installation of a buffer or filter strip.

Whereas; The Grant SWCD determined that the rational for inclusion of "other watercourses" is to be inclusive of all watercourses where water quality would benefit from the voluntary installation of a buffer or filter strip.

Whereas; Producing a map of all the watercourses meeting the eligibility criteria would be time consuming and may not be inclusive of all watercourses where water quality would benefit from the voluntary installation of a buffer or filter strip.

Therefore be it resolved that; The summary of watercourses or "other waters" for Grant County shall be descriptive in format instead of in map format.

Be it further resolved that; The description of watercourses to be included in the summary of watercourses or "other waters" **shall be**; all watercourses deemed eligible for the adjacent land to be voluntarily enrolled into a buffer or filter strip practice under the current eligibility criteria for state and federal programs. Excluding those watercourses depicted on the DNR buffer protection map.

A list of watercourses included in this descriptive inventory are: perennial streams, seasonal streams depicted on USGS topographic maps, seasonal streams depicted on soil survey maps, other watercourses identified by onsite visits, and drainage ditches that are perennial or seasonal streams.

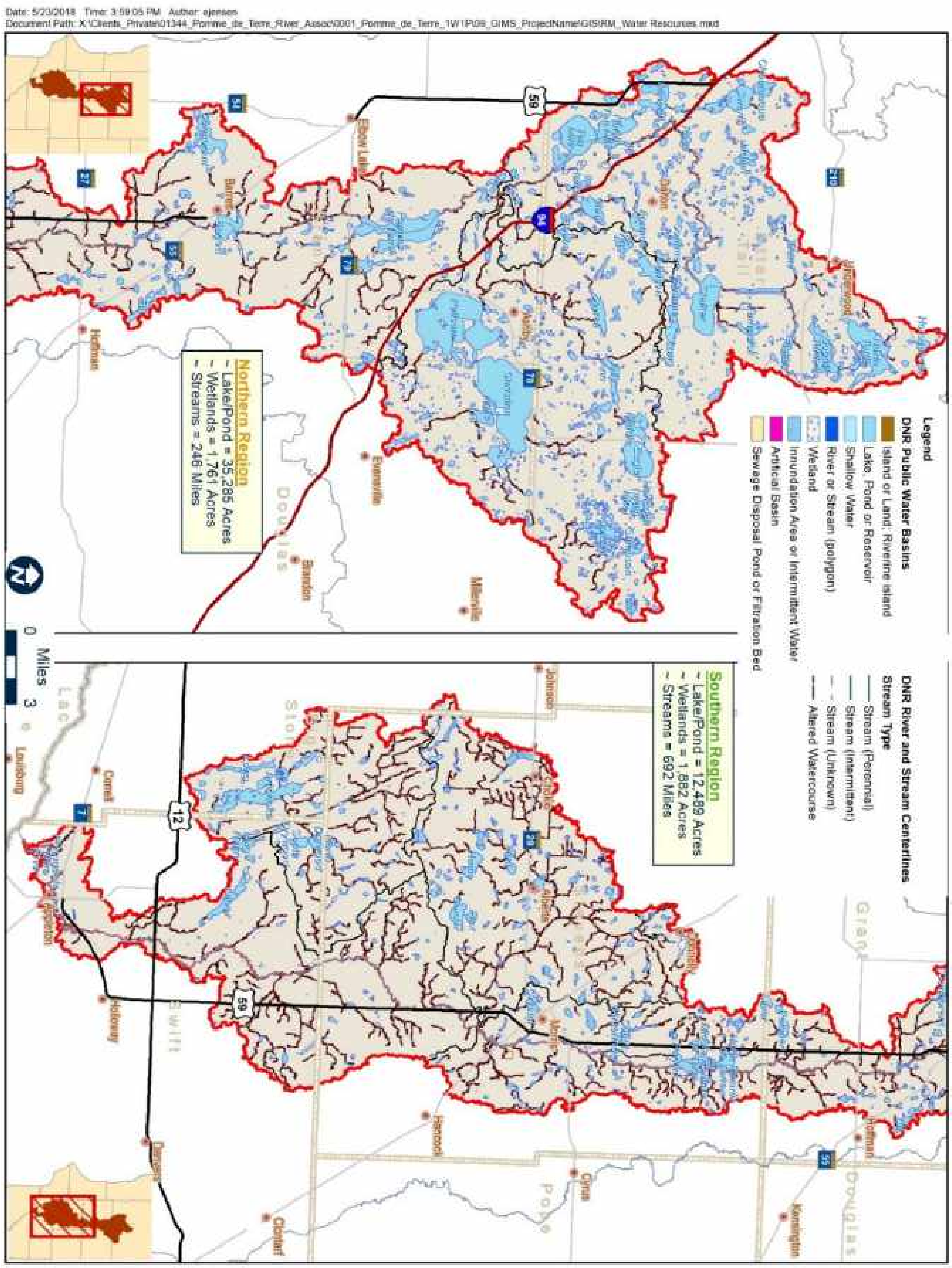


Figure A- 13. DNR Public Waters Basins and DNR River and Stream Centerlines

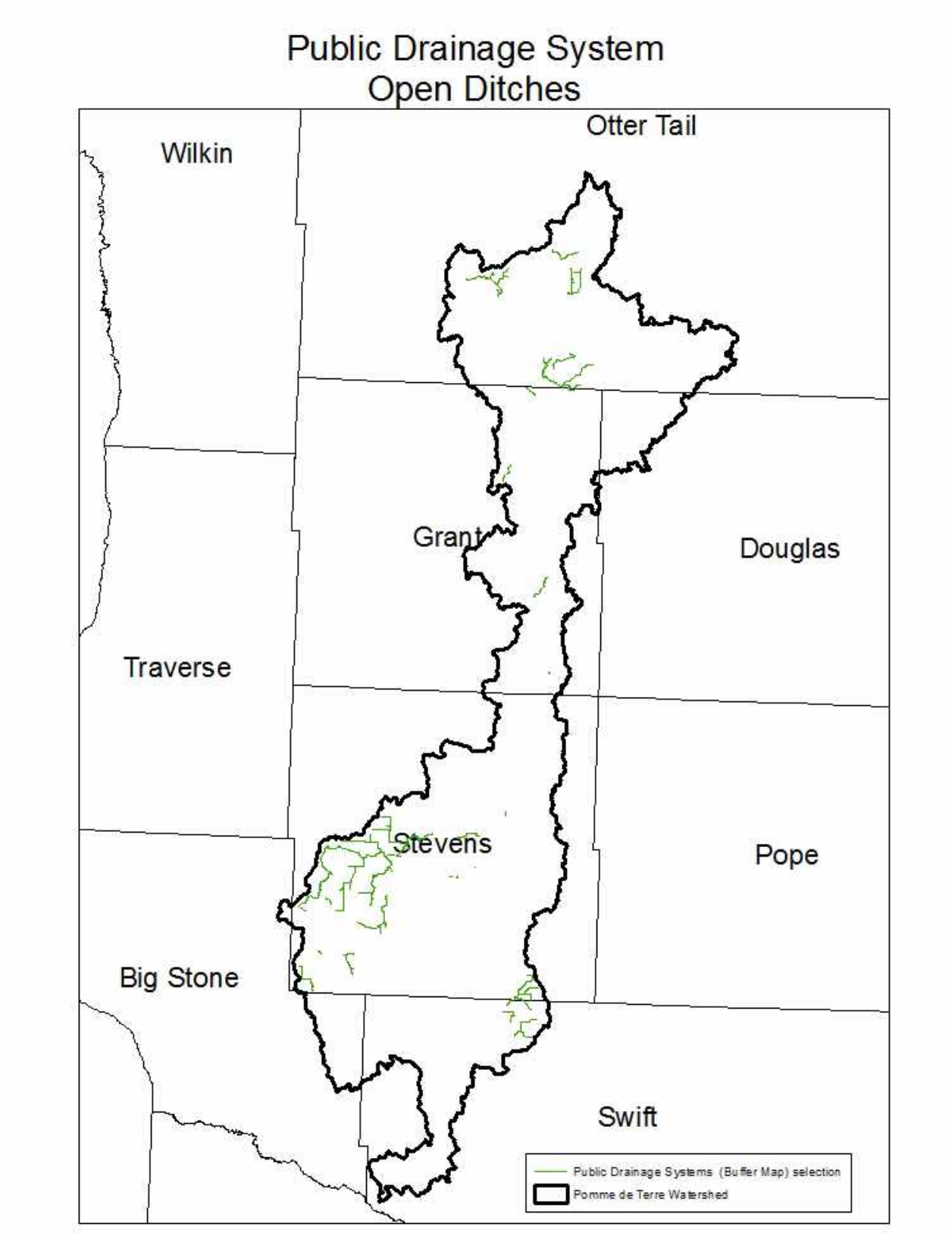


Figure A- 14. Open Public Drainage Systems in the Pomme de Terre Watershed

A.8 GROUNDWATER RESOURCE DATA

Within overlying till deposits, good quality ground water is available everywhere in the watershed. High yield aquifers are largely confined to ice-contact sand and gravel till deposits within the Alexandria Moraine and the outwash plain of the river. According to a 1966 report by United States Geological Survey, these same aquifers also have the potential to be easily contaminated. The Cretaceous and Precambrian rocks beneath the drift are poor aquifers and few wells are completed in them. The north half of the watershed is separated from the south half by a groundwater divide. Water flows through the north half from northeast to southwest. Calculated underflow from the south half of the watershed is a negligible quantity. Depth to the water table and groundwater vulnerable to pollution is shown in Figure A- 15.

Contaminants of concern for all drinking water can be human sourced or naturally occurring. Of greatest concern is arsenic, which affects large regions due to the geologic sensitivity of the watershed. Nitrates are also a concern and could become a greater issue if land use is not managed properly. Nitrate monitoring results overlaid with pollution sensitivity of wells and arsenic monitoring results are shown in Figure A- 17 and Figure A- 18.

MDNR has prepared three Regional Hydrologic Assessments (RHAs) that cover the Pomme de Terre watershed. From north to south, the RHAs are Otter Tail, Traverse-Grant, and Upper Minnesota River Basin. Each RHA has maps and data on:

- Surficial geology
- Quaternary stratigraphy
- Surficial hydrogeology
- Groundwater pollution sensitivity
- Other studies of local interest

A.8.1 Public Water Supply

There are nine public water suppliers located in the following communities: Appleton, Ashby, Barrett, Chokio, Dalton, Donnelly, Elbow Lake, Morris, and Underwood. A number of these wells are located in high to moderate vulnerability settings including Appleton, Barrett and Morris. The City of Alberta has high levels of naturally occurring arsenic in their water supply while the Cities of Appleton, Barrett and Morris have low levels of nitrates in the groundwater. The City of Chokio is in need of upgrading their current water treatment system.

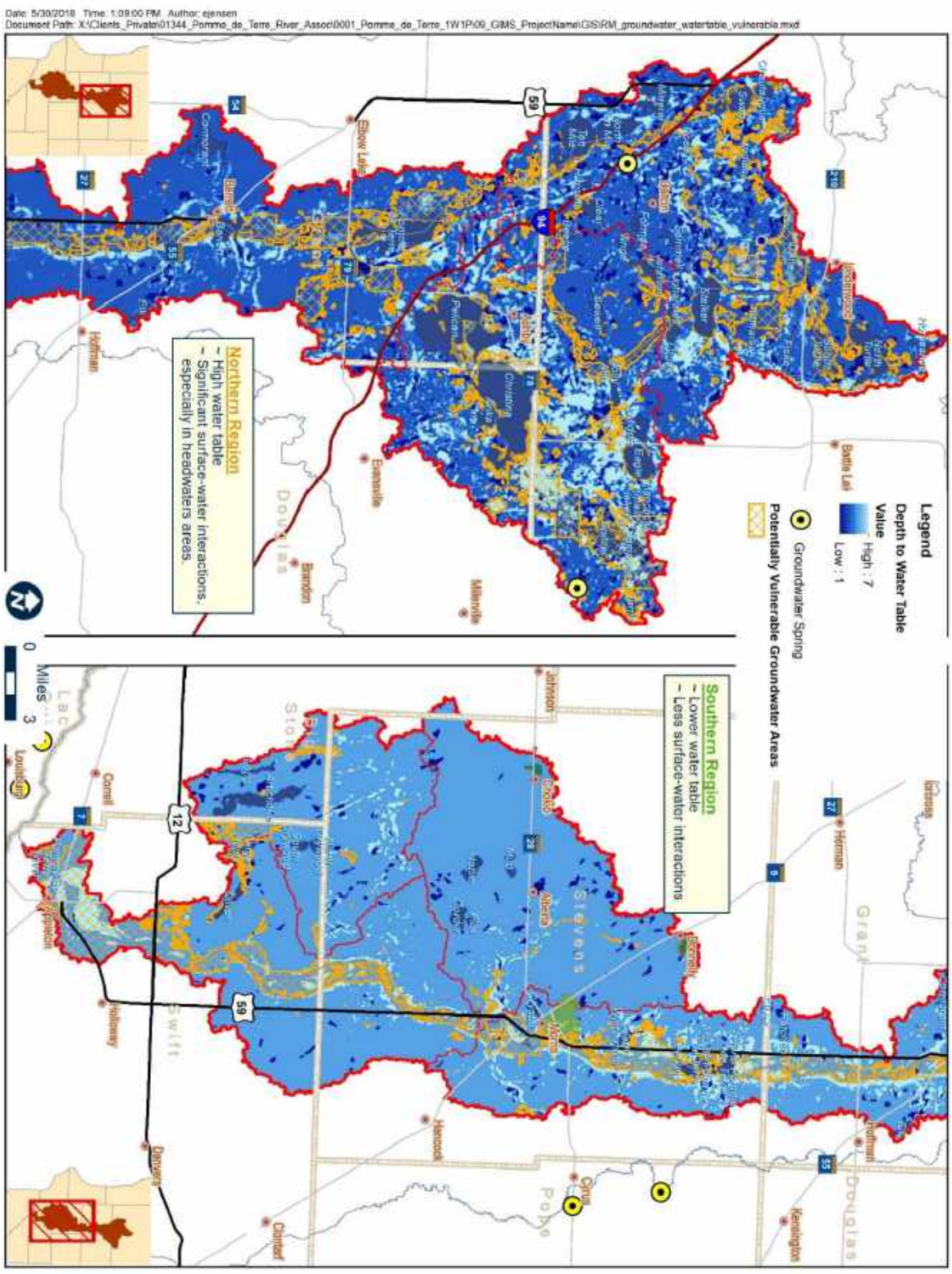


Figure A- 15. Depth to Water Table and Vulnerable Groundwater Areas in the Pomme de Terre River Watershed

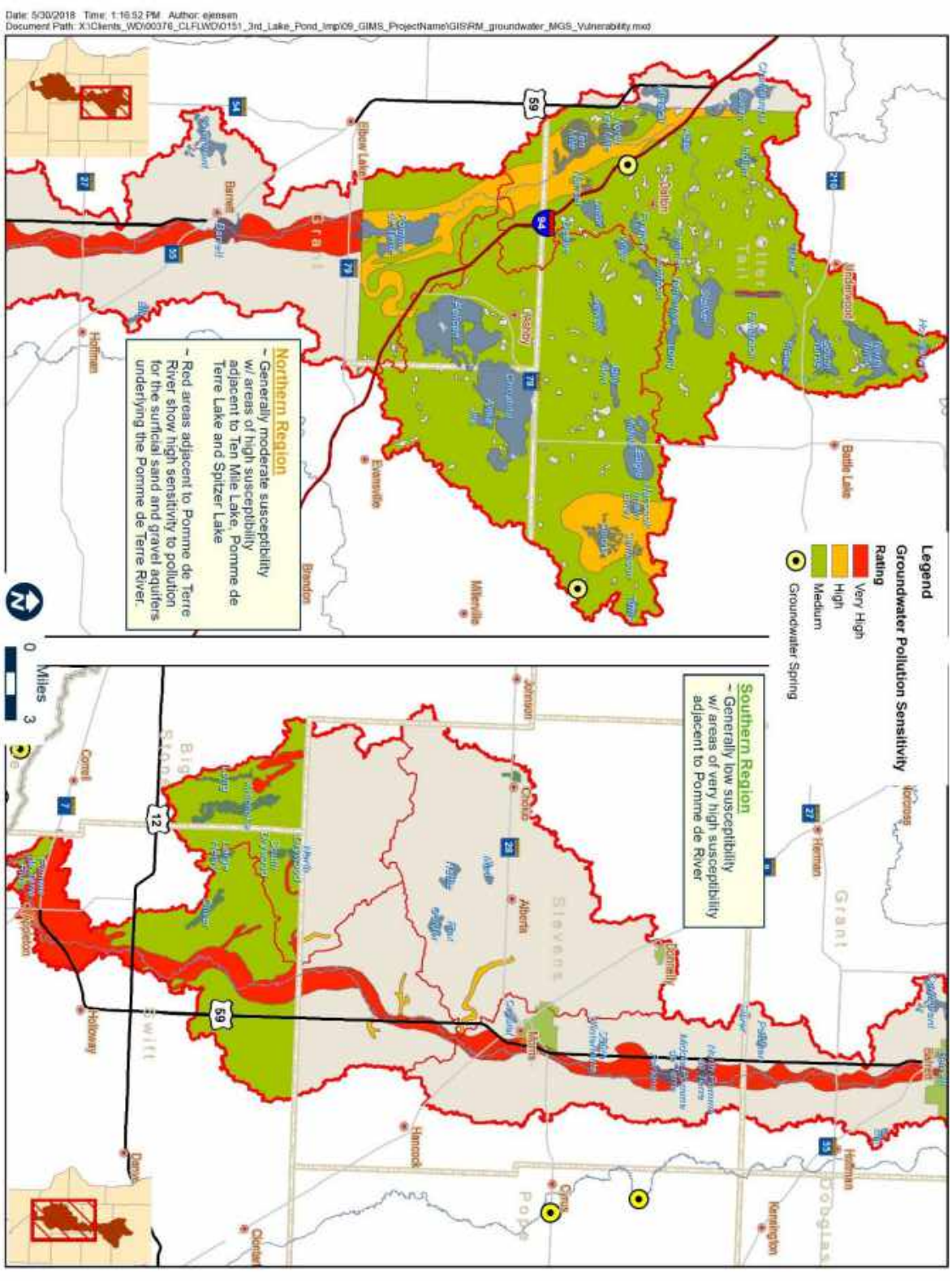


Figure A- 16. Groundwater Pollution Sensitivity. Source: Minnesota Geologic County Atlas Regional Hydrogeologic Assessment Watershed Health

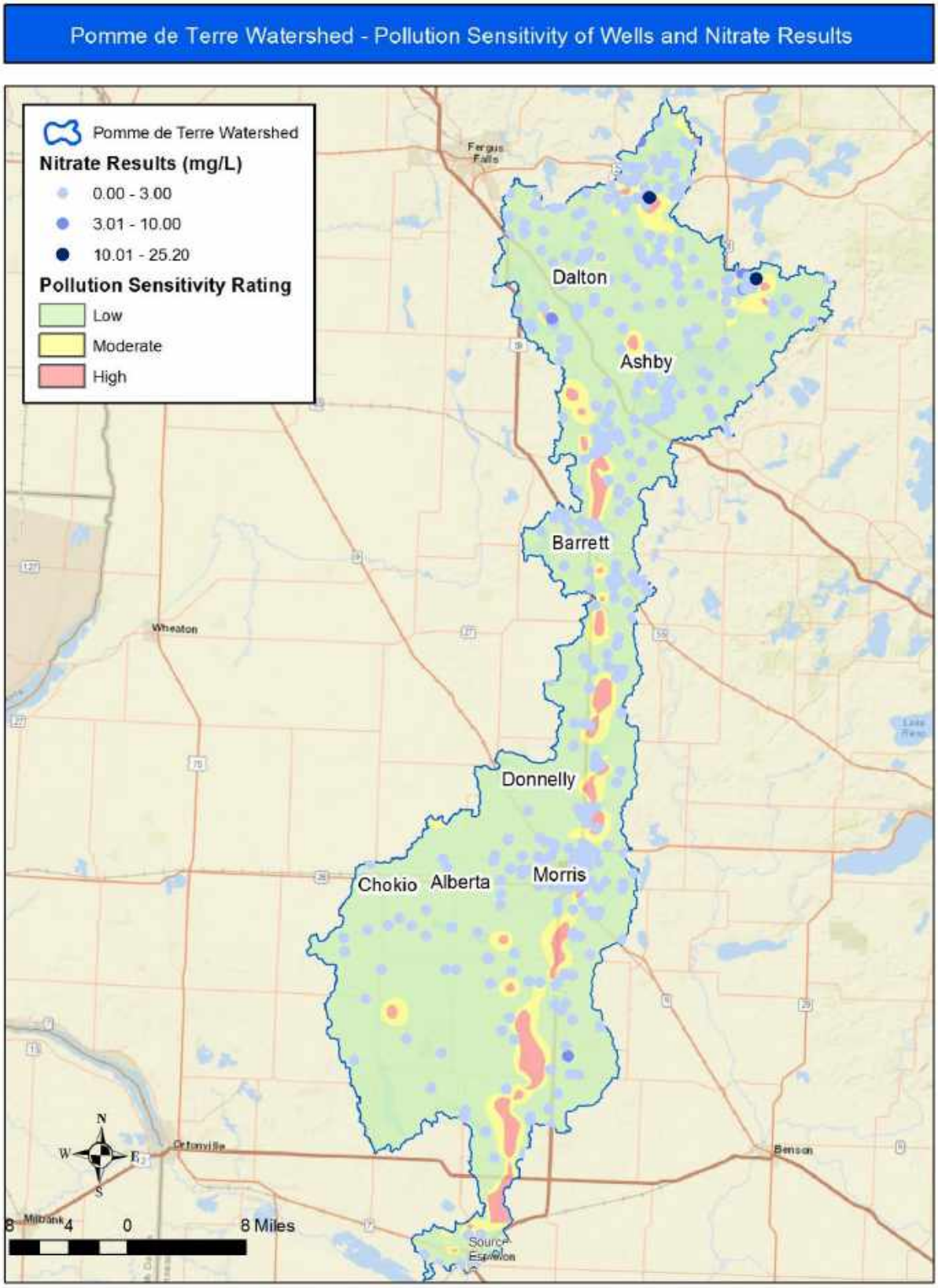


Figure A- 17. Nitrate Results and Pollution Sensitivity of Wells in the Pomme de Terre Watershed

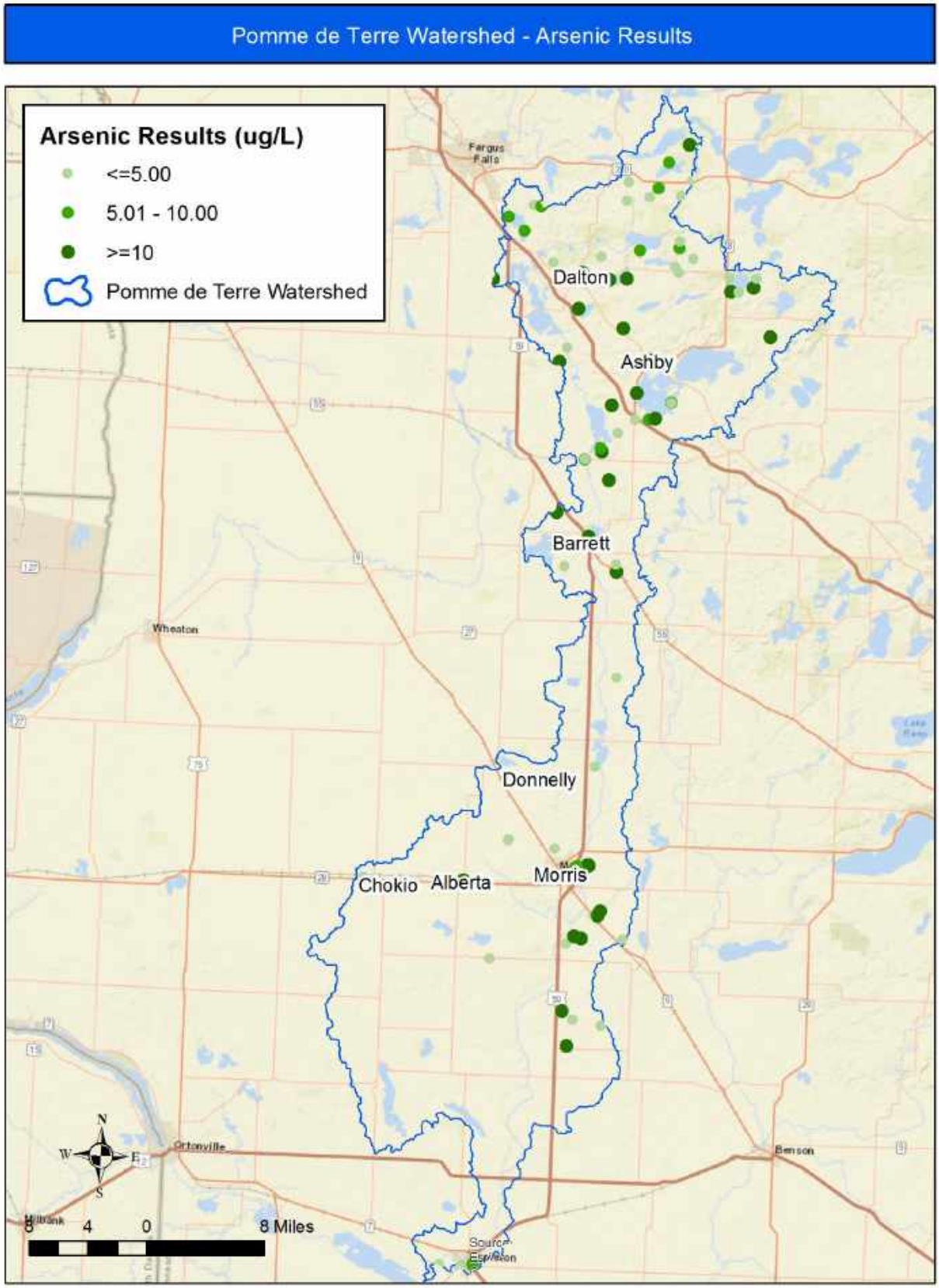


Figure A- 18. Arsenic monitoring results in the Pomme de Terre Watershed.

There are 54 noncommunity public water suppliers in the Pomme de Terre watershed. These suppliers provide drinking water to people at their places of work, gather or play (schools, offices, campgrounds, churches, etc.). These wells face the same groundwater quality issues that public water supplies face. Samples from noncommunity public water supply systems are most often collected either by the Minnesota Department of Health (MDH) or the local health department.

All nontransient public water supply systems are required to collect lead and copper samples. Some systems may be required to collect additional samples if they are treating the water to remove a regulated contaminant and/or have a population over 1000. In these cases, MDH will supply the system with the necessary bottles and precise guidelines for taking the samples. Facilities such as schools, offices, factories, and childcare are tested for the following contaminants:

- arsenic
- bacteria (total coliform)
- copper
- lead
- nitrates
- nitrites
- volatile organic chemicals (VOCs)
- soluble organic chemicals (SOCs)
- inorganic chemicals (IOCs)

In Figure A- 19, Drinking Water Supply Management Areas (DWSMA) for the watershed are ranked based on vulnerability[12]. These areas are managed by the entity identified in a wellhead protection plan[11].

- There are six DWSMAs that have low vulnerability including the communities of Ashby, Chokio, Dalton, Donnelly, Elbow Lake, Underwood, and a portion of the Morris DWSMA.
- The Appleton DWSMA contains 486 acres in the watershed and is moderate and high vulnerability. The wells have high chloride/bromide ratios, which indicate a connection to surface water. The city also treats for arsenic, which is naturally occurring.
- The Barrett DWSMA is 442 acres, and is one of the most vulnerable but most protected DWSMA. Many acres of conservation easements have been secured by the Grant County SWCD for this community's wellhead protection area and for the area around Barrett Lake.
- The Morris DWSMA is 2,814 acres, and has the greatest number of and shallowest (most average 58-82 feet) public water supply (PWS) wells. This community provides drinking water to the city of Alberta.

A.8.2 Private Water Supply

Many residents of Pomme de Terre watershed rely on a private well for the water they drink. Because there is no public entity is responsible for water testing or management of a private well after drilling is completed, these well owners have the sole responsibility for the health

and safety of their drinking water. There are 1,344 known private wells in the watershed, shown in Figure A- 20.

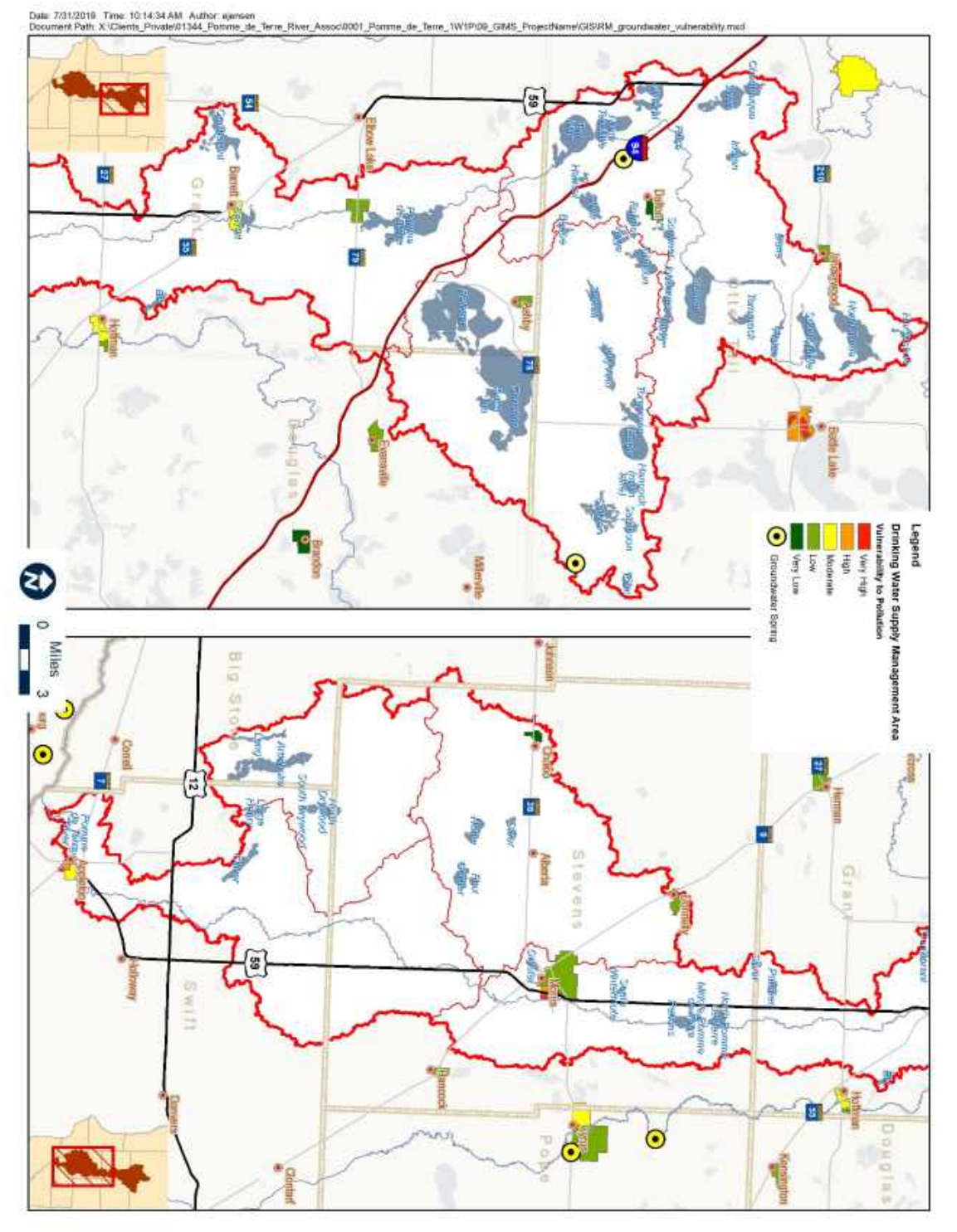


Figure A- 19. Vulnerability of Drinking Water Supply Management Areas in the Pomme de Terre Watershed

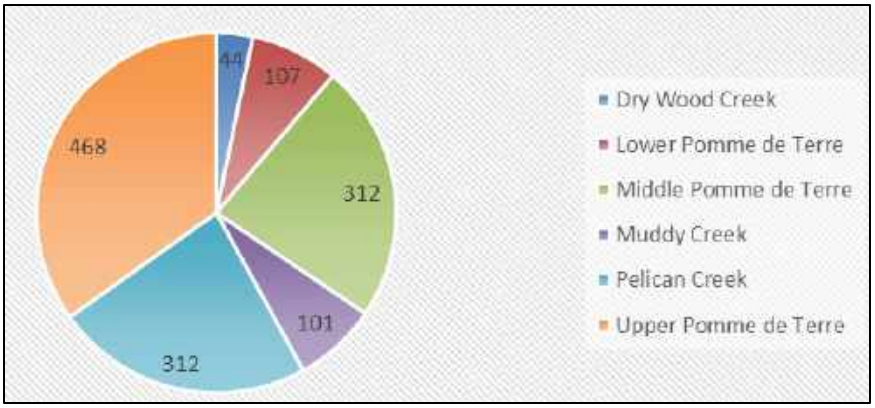


Figure A- 20. Private wells in the Pomme de Terre Watershed by subwatershed

Bedrock geology information is available from statewide maps[13]. Additional information on groundwater quantity and quality is available from county SWCD management plans. Information about wells, well construction, and groundwater quality can be assembled from the Minnesota Well Index[14]. Wellhead Protection Plans for public water supplies have information on local aquifers and groundwater flow patterns. Information on drinking water quality can be found via the MDH[15]. The MPCA has information on closed landfill facilities[16] and data can be accessed through MNDNR[17]. Pollution sensitivity of the uppermost aquifers are shown in Figure A- 21[18].

A.9 WATERSHED HEALTH

The Watershed Health Assessment Framework (WHAF), a tool developed by the MN DNR, provides an organized approach for exploring the complexity of natural and human communities as they continuously exchange material, energy, organisms and information. The WHAF can reveal patterns of ecological health from multiple viewpoints, and encourage information sharing and collaboration; fostering innovative ideas that help the health and resilience of our natural and human communities. The WHAF is an approach that uses a 5-component framework to consistently evaluate watersheds from different perspectives.

- Biology: "The study of life, encompassing the plants and animal species present in the stream, riparian lands and contributing watershed."
- Connectivity: "The maintenance of pathways that move organisms, energy, and matter throughout the watershed."
- Geomorphology: "The study of landscape features; from their origins and evolutions to the processes that continue to shape them."
- Hydrology: "The inter-relationships and interactions between water and its environment in the hydrologic cycle."
- Water Quality: "The chemical, biological, and physical characteristics of water; the current condition and future susceptibility of surface water and groundwater to degradation."

An interactive tool allowing users to access information about the Pomme de Terre River Watershed and view watershed health indices is available at the following website:

https://www.dnr.state.mn.us/whaf/index.html

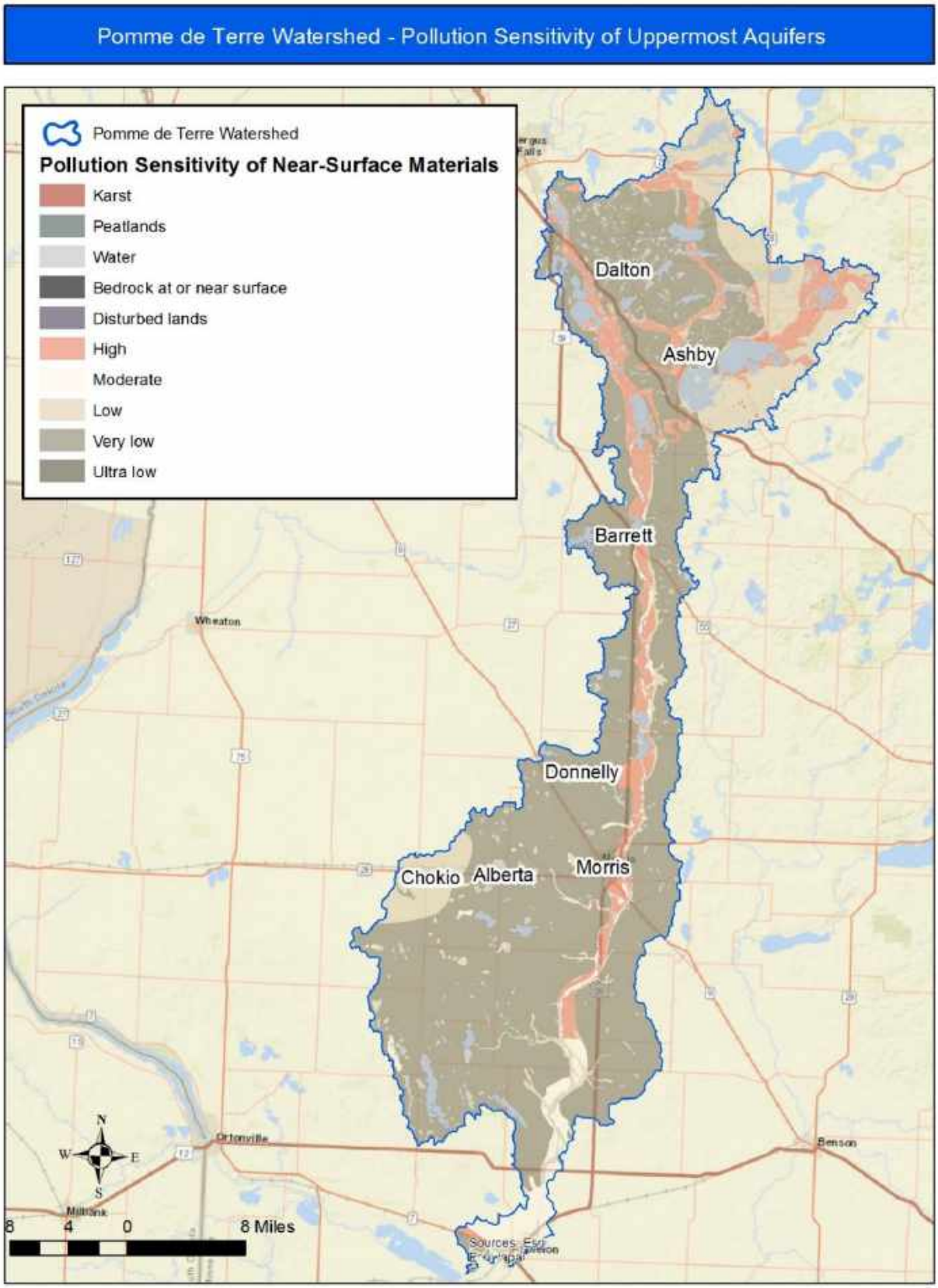


Figure A- 21. Pollution Sensitivity of the Uppermost Aquifers in the Pomme de Terre Watershed

A.10 GROUNDWATER AND SURFACE WATER APPROPRIATIONS

Permits for appropriations of surface water and ground water are provided by the MNDNR for all users withdrawing more than 10,000 gallons of water per day or 1 million gallons per year. Active water use permit information can be accessed online through the DNR Site-Specific Water Use Database (SWUDS)[19].

According to this information, as of 2017, active permits in the Pomme de Terre Watershed totaled 329, with permits for agricultural irrigation being the greatest (Figure A- 22). The water use from these permitted entities is measured in millions of gallons, and the greatest amount of water in the 10-year period from 2008-2017 was used in the years 2012 and 2015 (Figure A- 23). This, in a large part, is attributed to the increase in water level maintenance during those years. Water level maintenance uses surface water, which explains the increase in surface water use during those years (Figure A- 24). Average annual water use during the 10-year period was approximately 5,407 millions of gallons, with the greatest use from agricultural irrigation.

A.11 PERMITTED WASTEWATER DISCHARGES

NPDES permitted discharges located in the watershed are available at the MPCA website. Discharge monitoring reports are available to download for the Pomme de Terre Watershed and can also be viewed in the Wastewater Data Browser[20]. Data can be organized by facility, watershed, station type, among additional attributes. Environmental hazards located in the watershed can be accessed from the MPCA What's in My Neighborhood Database[21], which is a more general data source than the Data Desk Request method. Data on feedlots can be obtained from the MN Geospatial Commons [22], but will likely not be applicable to the project area. These datasets related to pollutant sources and permitted discharges have been synthesized and summarized in the 2013 WRAPS report for the Pomme de Terre River Watershed: https://www.pca.state.mn.us/sites/default/files/wq-ws4-01.pdf. According to the Pomme de Terre River Watershed TMDL, counties within the Pomme de Terre watershed estimate compliance with sub-surface sewage treatment systems (SSTS) to be between 25%-75%[23].

The City of Morris is a municipal separate storm sewer system (MS4) community and is required to have an MS4 General Stormwater Permit for any stormwater and to develop, implement, and enforce a stormwater pollution prevention plan (SWPPP). They applied for a permit in 2016, which they have now received[24]. An MS4 is a system of conveyances that is owned and operated by a public entity, collects stormwater, is not combined with a sewer, and is not a part of a public treatment system. MS4s are subject to regulation for reasons outlined in the Clean Water Act and Minnesota Rule 7090[25].

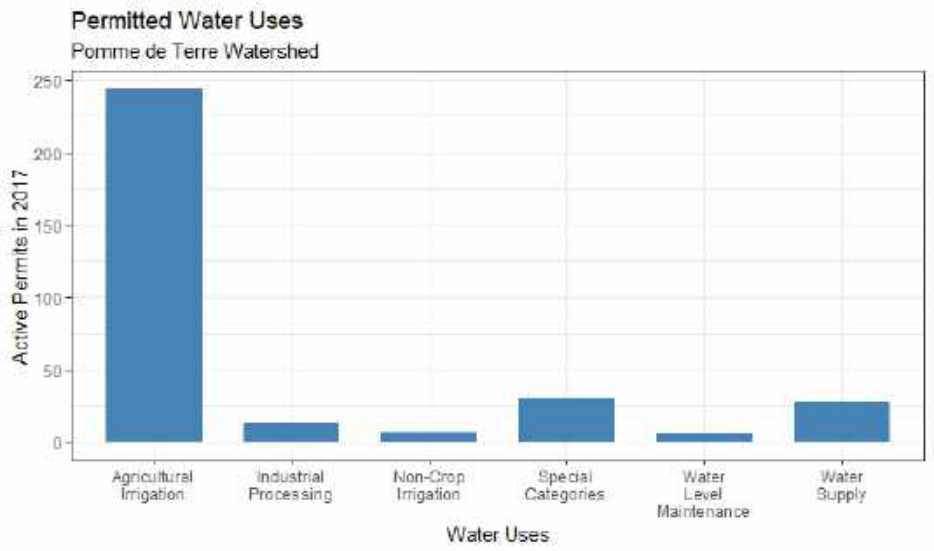


Figure A- 22. Active permits as of 2017 by water use type in the Pomme de Terre Watershed

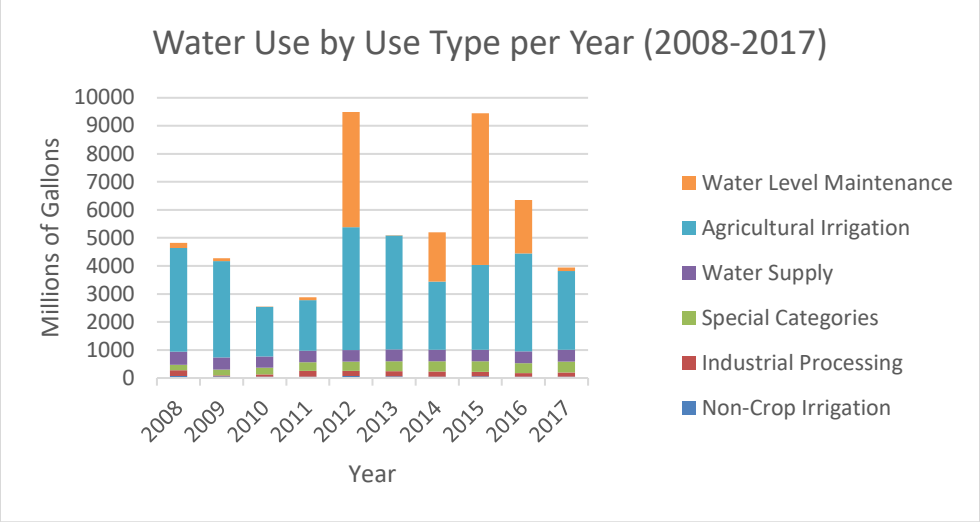


Figure A- 23. Annual water use by use type from 2008-2017 in the Pomme de Terre Watershed

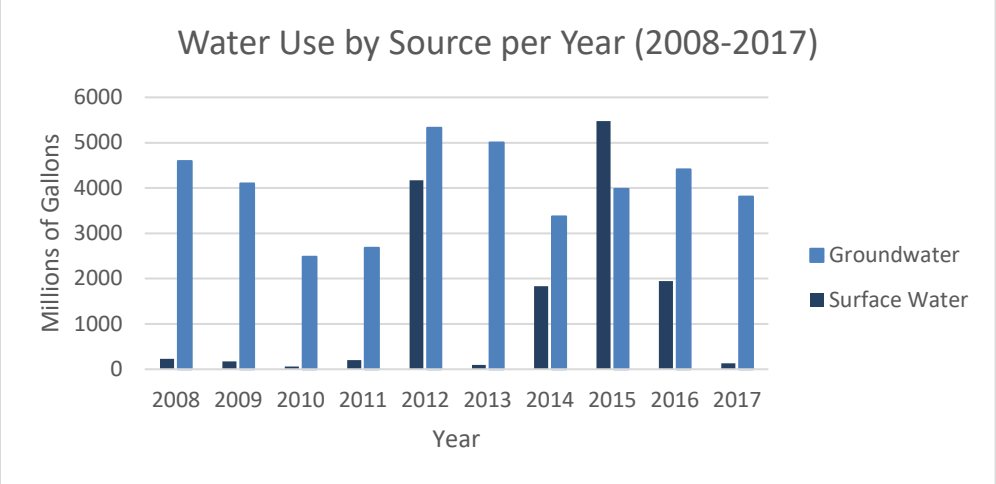


Figure A- 24. Water use by source type from 2008-2017 in the Pomme de Terre Watershed

A.12 WATER BASED RECREATION AREAS AND LAND OWNERSHIP

The Pomme de Terre watershed is home to many water features including lakes, rivers, and wetlands that provide opportunities for recreation, hunting, and fishing. In addition, according to the Protected Areas Database of the United States, over 68,000 acres of public lands and easements[26] are located within the watershed and provide further opportunity for recreation and sportsmanship. Over 340 miles of streams and rivers and over 55,000 acres of lakes and wetlands are designated by the MN DNR as Public Waters including five Aquatic Management Areas (AMAs). AMAs provide angler and management access, protect critical shore land habitat and provide areas for education and research. AMAs in the Pomme de Terre River Watershed include: East Lost Lake, Tamarack, Eagle Lake, Melby Lake, and north Turtle Lake. The Watershed is also home to one MN DNR designated State Water Trail (i.e., 30 mile reach of Pomme de Terre River to confluence with Minnesota River)[27]. However, no State- or Federally-designated wild, scenic and recreation rivers are located within the Pomme de Terre watershed. Public waters are accessible via 37 access sites administered by DNR, USFWS, and various cities within the watershed[28]. Two public fishing piers, located at Artichoke and Barret lakes, and one public shore fishing site, located at Appleton Mill Pond, also provide public access to aquatic resources and provide designated places to fish[29].

Other natural areas for recreational enjoyment include: a section of the Northern Tallgrass Prairie National Wildlife Refuge, Evansville, Crystal Lake, and Ashby State game Refuges, Clear Lake and Harstad Slough State Waterfowl Refuges, Egret Island Scenic and Natural Area (SNA), 42 publically accessible Wildlife Management Areas, state forest areas, 103 Waterfowl Production Areas, over four-thousand acres of conservation easement, and local parks associated with lakes and rivers. These areas provide space and opportunity for fishing, hiking, cross-country skiing, biking, snowmobiling, birdwatching, geocaching, morel hunting, and viewing of rare and endemic plants, canoeing, swimming, and bird watching all across the Pomme de Terre Watershed. Additionally, Inspiration Peak State Wayside Park is located along the northeast border of the watershed and provides magnificent vistas, rising over 1,700 feet above lakes and woodland, to one of the highest points in the state. No Regional parks are located within the Watershed.

There are many aquatic resources and natural areas in the watershed conducive to recreation activities including seven lakes (i.e., South Turtle, Swan, Stalker, Long, Clear, Ten Mile, and Eagle lakes) the MPCA has identified as fully supporting aquatic recreation; all of which are located in the norther third of the watershed. However, it is also important to note that based on the MPCA 2016 impaired waters list, 12 stream reaches, 17 lakes, and two wetlands are identified as impaired for aquatic life, aquatic recreation, and/or aquatic consumption and no assessed streams were identified as fully supporting aquatic recreation[30].

Additional information on water based recreation areas is available through the MN Geospatial Commons including state aquatic management areas[31], state administered lands[32], wildlife management areas[33], state parks[34], MN Water Trails, Wild and Scenic Rivers[35], and public water access sites. Land ownership and generalized land ownership data is also available for all the Watershed's counties.

A.13 FISH AND WILDLIFE HABITAT

Data for fish and wildlife habitat is available primarily from the MNDNR interactive maps. Specifically, GIS data is available for Wildlife Management Areas[33], Wildlife Refuge Inventory, Designated Wildlife Lakes[36], Trout streams and lakes[37]. Data for rare and endangered species[38] as well as Natural Heritage Inventory Data can be obtained from MNDNR.

A.13.1 Fish and Aquatic Habitat

The Pomme de Terre Watershed is home to 217 lakes and numerous wetlands, many of which, including Lake Christina, Lost Lake, Eagle Lake, Tamarack Lake, Melby Lake, Pomme de Terre Lake, Artichoke Lake, North Turtle Lake, Swan Lake, Ten Mile Lake, and Stalker Lakes, provide habitat for fish and aquatic life. Although the drainage network within the watershed is not highly developed, several larger tributaries and the Pomme de Terre River provide suitable habitat for fish. Pelican Creek, Muddy Creek, and Dry Wood Creek are permanent tributaries to the Pomme de Terre River, whereas remaining tributaries in the watershed are mostly intermittent streams with small drainages that often do not have flowing water throughout the summer months.

As mentioned in the previous section, the Pomme de Terre contains five MN DNR Aquatic Management Areas; Lost Lake (ID# 56037800), Eagle Lake (ID# 56025300), Tamarack lake (ID# 56043300), Melby Lake (ID# 26007700), and North Turtle Lake (ID# 56037900) (MN DNR 2017). No fish data is available for Tamarack or Melby lakes. However, the remaining three lakes are known to support populations of black bullhead, black crappie, bluegill, brown bullhead, green sunfish, hybrid sunfish, lake sturgeon, largemouth bass, northern pike, pumpkinseed, rock bass, tullibee (cisco), walleye, yellow bullhead, yellow perch, bowfin (dogfish), common carp, greater redhorse, shorthead redhorse, white sucker, banded killifish, bluntnose minnow, fathead minnow, Johnny darter, logperch, and golden shiner. Streams within the watershed are known to support many of the aforemention fish species and additionally support largescale stoneroller, silver redhorse, banded darter, bowfin, mimic shiner, rock bass, central stoneroller, tadpole madtom, golden redhorse, common shiner, creek chub, bluntnose minnow, black cappie,stonecat, hornyhead chub, spotfin shiner, blackside darter, spottail shiner, channel catfish, emerald shiner, sand shiner, freshwater drum, whaite bass, and orage spotted sunfish (MN DNR 2017). One stream reach has been identified as a designated trout stream (Unnamed Stream M-055-179-074) located in the far north-central portion of the watershed [37].

A.13.2 Wildlife Habitat

The Minnesota Department of Natural Resources and U.S. Forest Service Ecological Classification System (ECS) identify contiguous areas of increasingly uniform physiological and ecological features based on the National Ecological Unit Hierarchy design criteria. The ECS in Minnesota is described by the MN DNR as a three-tier hierarchy including Provinces, Sections, and Sub-sections. Subsections are the most resolute level of classification, covering smaller and more congruent ecological areas with similar geologic processes, vegetation, local climate, topography, and soils[39].

The majority of the Pomme de Terre Watershed is located within the Prairie Parkland (PP) Province and the northeast end of the watershed is located in the Eastern Broadleaf Forest (EBF) Province. The portion of the watershed within the EBF Province is further identified within the Minnesota and Northeast Iowa Morainal Section and Hardwood Hills (HH) Subsection[39]. The far northwest corner of the watershed falls within the Red River Valley Section and Red River Prairie (RRP) Subsection. The remainder of the watershed covers area identified as the North Central Glaciated Plains Section and the Minnesota River Prairie (MRP) Subsection.

The three subsections found within the Pomme de Terre Watershed differ slightly in topography, soils, geology, climate, hydrology, and historic vegetation. The HH Subsection was historically vegetated by mixed hardwood forest and tallgrass prairie and the MRP and RRP subsections were historically vegetated predominately by tallgrass prairie and wet prairie with hardwood and floodplain forests found along stream and river corridors[39]. All three subsections within the watershed are characterized by thick loamy glacial till and as a result, are highly suitable for row crop agriculture. Although land use within the watershed is currently dominated by agriculture, public and conservation lands offer habitat space within the highly fragmented landscape[40].

A unit of the Northern Tallgrass Prairie National Wildlife Refuge is also located within the watershed; west of the Pomme de Terre River near the southern border of Stevens County. The refuge is home to tallgrass prairie, Dakota skipper, grasshopper sparrows, and greater prairie chickens[41]. The watershed is also home to Egret Island Scientific and natural Area (SNA). This SNA is a low wooded island located in the center of Pelican Lake, which has the largest concentration of nesting colonial waterbirds in Minnesota. Protected bay and marshes within the island provide excellent nesting habitat for black-crowned night herons, great egrets, cattle egrets, snowy egrets, great blue herons, western grebes, tricolored herons, little blue herons, and least bitterns [42]. Two other lakes within the Pomme de Terre are identified as important to wildlife and waterfowl. Lake Anka and Lake Christina are both MN DNR Designated Wildlife Lakes and Lake Christina is additionally designated as a Migratory Waterfowl Feeding and Resting Area[36]. Furthermore, the watershed contains 18 Lakes of Biological Significance, which range in rating from moderate to outstanding[43]. These lakes are primarily located in Northern half of the watershed.

The watershed contains 42 WMAs including La Qui Parle WMA, which includes Marsh Lake within the Minnesota River Valley[44]. This WMA protects prairie pothole wetlands and native prairie tracts and is home to the largest American white pelican colony in North America[45]. The Lac Qui Parle- Big Stone Important Bird Area overlaps the southern portion of the Pomme de Terre Watershed. This IBA encompasses a wide area along the Minnesota River and over 200 bird species are recorded annually. The watershed also encompasses over 4,000 acres of state funded conservation easements (Table A- 8) and approximately 24,713 acres of land enrolled in the Conservation Reserve Program (CRP)[46].

Table A- 8. State funded Conservation Easements within the watershed (MN DNR Zonation materials)[46]

Easement Type	Contracts	Acres
CREP I	69	184.5
PWP	4	103.4
RIM	64	2,018.5
RIM-WRP	18	1,732.7
Total	**155**	**4,039.1**

A.14 UNIQUE FEATURES AND SCENIC AREAS

Data for unique features and scenic areas include SNAs, Natural Area Registry, Wild and Scenic Rivers, MBS Sites of Biodiversity Significance, all of which is available through the MN Geospatial Commons[22]. Natural Heritage Inventory data was requested as part of the zonation process. The watershed contains many important unique and rare resources, which occur throughout the northern and southern portions of the watershed.

A.14.1 Federally-listed Plant and Animal Species

According to the US Fish and Wildlife Service (USFWS) IPaC report for the Pomme de Terre Watershed, three federally-listed species have potential to be found within the Pomme de Terre Watershed including the gray wolf (*Canis Lupus*), northern long-eared bat (*Myotis sepentrionalis*), and the Dakota skipper (*Hesperia dacotae*). IPaC did not identify any a designated critical habitat for these three species within the Pomme de Terre watershed. In addition, IPac identified 26 USFWS Birds of Conservation Concern that are likely to be found within the Pome de Terre Watershed at various times of the year [47].

Table A- 9. Federally listed species found in the Pomme de Terre Watershed [47]

Species Common Name *(Scientific Name)*	Status	Habitat
Gray Wolf (*Canis lupus*)	Threatened	Habitat is variable including temperate forest, mountains, tundra, and grasslands.
Northern long-eared bat *(Myotis septentrionalis)*	Threatened	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. Roosts and forages in upland forests during spring and summer. Townships containing northern long-eared bat roost trees and hibernacula - links to Minnesota DNR PDF
Dakota Skipper (*Hesperia dacotae*)	Threatened	Moist bluestem prairie with wood lily (*Lilium philadelphicum*), harebell (*Campanula rotundifolia*) and smooth camas (*Zygadenus elegans*) and dry-mesic upland prairie found on ridges and hillsides with bluestem grasses, needlegrasses, and purple coneflower (*Echinacea angustifolia*).

(USFWS, 2017)

A.14.2 State-listed Plant and Animal Species

According to data provided by the MN DNR[38], the Pomme de Terre Watershed contains records of 47 rare species including five state-endangered, seven state-threatened, and 32 state species of concern, and three species identified as not listed but are included in the NHIS database.

Table A- 10. State-listed species found in the Pomme de Terre Watershed

Group	Common Name (State Status)		
Mammals	Northern Grasshopper Mouse (SPC)	Prairie Vole (SPC)	
Birds	American Bittern (NL)*	American White Pelican (SPC)*	Bald Eagle (NL)*
	Burrowing Owl (END)	Forster's Tern (SPC)*	Henslow's Sparrow (END)
	Hooded Warbler (SPC)	Lark Sparrow (SPC)	Loggerhead Shrike (END)
	Marbled Godwit (SPC)*	Purple Martin (SPC)*	Red-shouldered Hawk (SPC)
	Trumpeter Swan (SPC)*	Upland Sandpiper (NL)	
Amphibian/ Reptiles	Blanding's Turtle (THR)*	Great Plains Toad (SPC)*	Mudpuppy (SPC)*
Fish	Least Darter (SPC)*	Pugnose Shiner (THR)*	
Mollusks	Black Sandshell (SPC)*	Creek Heelsplitter (SPC)*	Elktoe (THR)*
	Fluted-shell (THR)*	Mucket (THR)*	Round Pigtoe (SPC)*
Jumping Spider	Habronattus viridipes (SPC)	Paradamoetas fontana (SPC)*	
Butterflies/ Moths	Dakota Skipper (END, Fed-THR)	Leonard's/Pawnee Skipper (SPC)	Poweshiek Skipperling (END)
	Regal Fritillary (SPC)		
Caddisflies	Limnephilus secludens (END)*		
Vascular Plants	American Ginseng (SPC)	Few-flowered Spikerush (SPC)*	Hair-like Beak Rush (THR)*
	Hill's Thistle (SPC)	Olive-colored Southern Naiad (SPC)*	Prairie Mimosa (SPC)*
	Prairie Moonwort (SPC)	Red Three-awn (SPC)	Sea Naiad (SPC)*
	Short-pointed Umbrella-sedge (THR)*	Small White Lady's-slipper (SPC)*	Spiral Ditchgrass (SPC)*
	Sterile Sedge (THR)*		

[1] Common name with current state status in parentheses, unless noted; an asterisk (*) indicates that these species are dependent on aquatic resources or features.
[2] State Status: END = Endangered, THR = Threatened, SPC = Special Concern, NL = Not Listed but in our NHIS database, Federal Status (Fed) C = Candidate for Federal listing. THR = Threatened

Nine of the listed plant species are dependent on high water quality, minimal disturbance, and have direct relationships to groundwater and are therefore sensitive to disturbances

such as erosion, drainage, invasive species, and lake bounce. All observations of the listed mussels are located along the Pomme de Terre River. Most mussels rely on rivers with high water clarity without impediments to fish migration (e.g. dams). Channelization, sediment pollution, and other physical alterations to stream habitat can effect fish movement and quality substrate availability for mussels.

In addition to the individual listed species identified in Table A- 10, there are also a number of colonial waterbird nesting areas within the watershed. This includes colonies of great blue heron, double-crested cormorant, and multiple species of grebe. Lake Christina has been a noted nesting location for western grebe, Forster's tern, American white pelican, red-necked grebe, and black-crowned night heron among others.

A.14.3 Ecologically Sensitive, Unique, and Important Areas

The Pomme de Terre Watershed is home to several sensitive/unique water resources including five calcareous fens in the northeast portion of the watershed (Eagle Lake 22 SW, Eagle Lake 28, Eagle Lake 27 NW, Eagle Lake 22 SE, and Eagle Lake 27 NE) and two wild rice areas in north end of watershed (Tamarack Lake (56043300) and Unnamed Lake (56108300)). No Highly Sensitive Lake Shore areas are identified within the Watershed.

The watershed also contains mapped areas of sensitive plant communities and ecological important areas. A project by South Dakota State University identified and mapped areas of Potentially Undisturbed Lands (PUDL) within several counties in south and western Minnesota. The research identifies areas with the highest probability of being native sod and maps approximately 8,931-acres of PUDL in the Pome de Terre Watershed portions of Swift and Big Stone Counties[48]. In addition to PUDL, 7 MN DNR Native Prairie banks are located within the watershed, several right-of-way prairies, and several areas of MN DNR Prairie Core Areas, Identified in the MN DNR Prairie Conservation Plan, also intersect the north and south ends of the watershed[49]. According to the MN DNR Native Plant Communities (NPC) data, the watershed contains 22 different native community types; covering approximately 7,830 acres. Most mapped NPCs are located in northeast very southern edge of the watershed (Table A- 11). Most of the mapped native plant communities are within tracts of land identified by the Minnesota County Biological Survey as Areas of Biodiversity Significance (MCBS). MCBS areas depict unique areas with varying levels of native biodiversity that may contain native plant communities, rare plants/animals, and/or animal aggregations. Biodiversity significance ranks are based on the number of rare species identified, overall quality of the native plant community, size of the site, and context within the landscape (i.e., connection or isolation to/from other high quality ecological corridors) [50]. One site within the watershed is identified as Outstanding and 21 sites are identified as High; most of with are found within the northern portion of the watershed. The watershed also contains 371 Moderate and Below MCBS sites. The following table is a breakdown of these areas based on Biodiversity Significance Rating (Table A- 12). No Regionally Significant Ecological Areas or Corridors are identified within the watershed, as this data is not available for the counties encompassed in the watershed.

Table A- 11. MN DNR NPC types and acreage found within the Pomme de Terre Watershed

Native Plant Community	Acres	State (S)/Global (G) Conservation Ranks
FDs37b - Pin Oak - Bur Oak Woodland	1,170.5	S3
FWMM_CX - Fen/Wet Meadow/Marsh Complex	79.2	CMX
MHc37b - Sugar Maple - Basswood - (Aspen) Forest	450.5	S4
MHs38 - Southern Mesic Oak-Basswood Forest	176.7	-
MHs38b - Basswood - Bur Oak - (Green Ash) Forest	1,909.8	S3
MRn83a - Cattail - Sedge Marsh (Northern)	9.1	S2
MRn83b - Cattail Marsh (Northern)	18.9	S2
MRp83a - Cattail - Sedge Marsh (Prairie)	71.0	S1
OPn92a - Graminoid Rich Fen (Basin)	18.2	S4
OPn92b - Graminoid - Sphagnum Rich Fen (Basin)	1.9	S4
OPp93a - Calcareous Fen (Northwestern)	38.7	S2/G2
UPn12d - Dry Hill Prairie (Northern)	15.7	S1/G2
UPs13b - Dry Sand - Gravel Prairie (Southern)	963.9	S2
UPs13d - Dry Hill Prairie (Southern)	938.3	S2/G1
UPs23a - Mesic Prairie (Southern)	1,688.2	S2/G2
WFs55a - Lowland Aspen Forest	11.9	S4
WMn82a - Willow - Dogwood Shrub Swamp	17.4	S5
WMn82b - Sedge Meadow	51.2	S4/S5
WMp73a - Prairie Meadow/Carr	17.8	S3/G2G3
WMs83a - Seepage Meadow/Carr	91.2	S3
WMs83a1 - Seepage Meadow/Carr, Tussock Sedge Subtype	6.5	S3
WPs54b - Wet Prairie (Southern)	84.0	S2/G2G3
Total Acres	**7830.5**	

Conservation rank of a community association plant or NPC is based on a one to five scale: 1 = critically imperiled 2 = imperiled 3 = vulnerable to extirpation or extinction 4 = apparently secure 5 = demonstrably widespread, abundant, and secure. (MN DNR Native Plant Communities Data, 2017)

Table A- 12. MCBS Area by rating within the Pomme de Terre Watershed[51]

Rating	Acres
Below	5,676.3
High	2,204.4
Moderate	11,244.1
Outstanding	58.9
Grand Total	**19,183.6**

A.15 LAND USE AND LAND COVER

The Pomme de Terre Watershed has experienced significant shifts in land use, demands on the land, and the expansions of human developments. According to the map of presettlement vegetation in the Pomme de Terre Watershed (Marschner Map of Original Vegetation) the northern section of the watershed was predominantly a combination of prairie, oak openings and barrens, big woods interspersed with aspen-oak woodlands, and lakes. The central and southern sections were predominantly a combination of prairie, wet prairie, river bottom forest, and lakes [52]. Prior to the European settlement in the 1800's, native peoples grew crops, set fires, and affected the lands in other ways. After the Europeans began to settle to area, demands on the landscape drastically changed and this shift accelerated rather rapidly resulting in the modern conditions seen today. Human settlement within the watershed influenced a change in how the land was utilized. Other human influences on land use include the suppression of fires, which has resulted in changes in fire-dependent plant communities.

Land use within the watershed is largely agricultural, with crop and pasture lands accounting for approximately 81% of the overall Watershed Area. Cropland is used predominantly for growing corn and soybeans as well as hay, pasture, and small grains (Figure A- 25). The Rapid Watershed Assessment Report of the Pomme de Terre summarized that the main resource concerns on the cropland are wind and water erosion and flooding resulting in cropland runoff. Associated with the cropland runoff are increased sediment and pollutant loadings to surface water. Additional resource concerns include surface and groundwater quality, Agricultural waste management, and declining wildlife habitat.

Urban development pressure is low in most areas, with occasional farms, timberland, and lakeshore being parceled out for recreation, lake or country homes and expanding suburban populations. Table A- 13 describes the types of land use and the ownership types of the Pomme de Terre River Watershed. Table A- 14 shows the type, number and acreage of the public lands within the watershed dedicated to conservation.

Land cover data can be obtained from the National Land Cover Database (NLCD) Land Cover data available at MN Geospatial Commons [40]. Roadways are also included in land cover and can be obtained from MNDOT. The AgroEcoregions of Minnesota data from the MDA is also available at MN Geospatial Commons [53] .

Table A- 13. Land Use by Ownership Type (NRCS Rapid Watershed Assessment: Pomme de Terre River Watershed)

Landcover/use	Public		Private		Tribal		Total Acres	Percent
	Acres	Percent	Acres	Percent	Acres	Percent		
Forest	1,888.1	0.34	32,565.75	5.82	0.0	0.00	34453.85	6.15%
Grain Crops	2,093.2	0.37	16,857.76	3.01	0.0	0.00	18950.93	3.38%
Grass, etc	8,123.3	1.45	70,160.80	12.53	0.0	0.00	78284.10	13.98%
Orchards	0.0	0.00	0.00	0.00	0.0	0.00	0.00	0.00%
Row Crops	7,113.4	1.27	332,408.83	59.36	0.0	0.00	339522.20	60.63%
Shrub, etc	12.3	0.00	538.97	0.10	0.0	0.00	551.31	0.10%

Landcover/use	Public		Private		Tribal		Total Acres	Percent
	Acres	Percent	Acres	Percent	Acres	Percent		
Wetlands	8,492.6	1.52	33,391.74	5.96	0.0	0.00	41884.29	7.48%
Residential/ Commercial	97.1	0.02	3,813.71	0.68	0.0	0.00	3910.81	0.70%
Open Water	1977.18	--	40,442.41	--	0.0	0.00	42419.59	7.58%
Totals	**29797.11**	**5.32%**	**530,180**	**94.68%**	**0.0**	**0.00%**	**559977.08**	**100%**

Table A- 14. Public Lands in the Pomme de Terre Watershed (USDA)

Public Land Type	Count	Acres
Waterfowl Production Area (USFWS)	314	21,428.4
Wildlife Management Area (MNDNR)	40	4,482.5
Lac Qui Parle WMA (MNDNR)	1	24327.7
Scientific and Natural Area (MNDNR)	1	34.4
Total	**356**	**50,273.0**

Table A- 15. Land use breakdown by Region.

Land use	North Region		South Region	
	Acres	Percent	Acres	Percent
Open Water	35,617	15.9%	13,834	4.1%
Developed	11,869	5.3%	19,444	5.8%
Barren	78	0.0%	388	0.1%
Forest	25,287	11.3%	3,973	1.2%
Shrub/Scrub	910	0.4%	16	0.0%
Grassland	20,206	9.0%	5,243	1.6%
Pasture/Hay	26,903	12.0%	9,912	3.0%
Cropland	94,279	42.1%	257,572	76.7%
Wetland	8,814	3.9%	25,369	7.6%
Total	**223,963**	**100%**	**335,750**	**100%**

Future development and land use information for communities in the watershed are available in the City of Appleton's Comprehensive Plan[54(p26)], City of Fergus Falls' Capital Improvement Plan (2019-2023)[55], and Stevens County's Comprehensive Plan[56(pp33–36)].

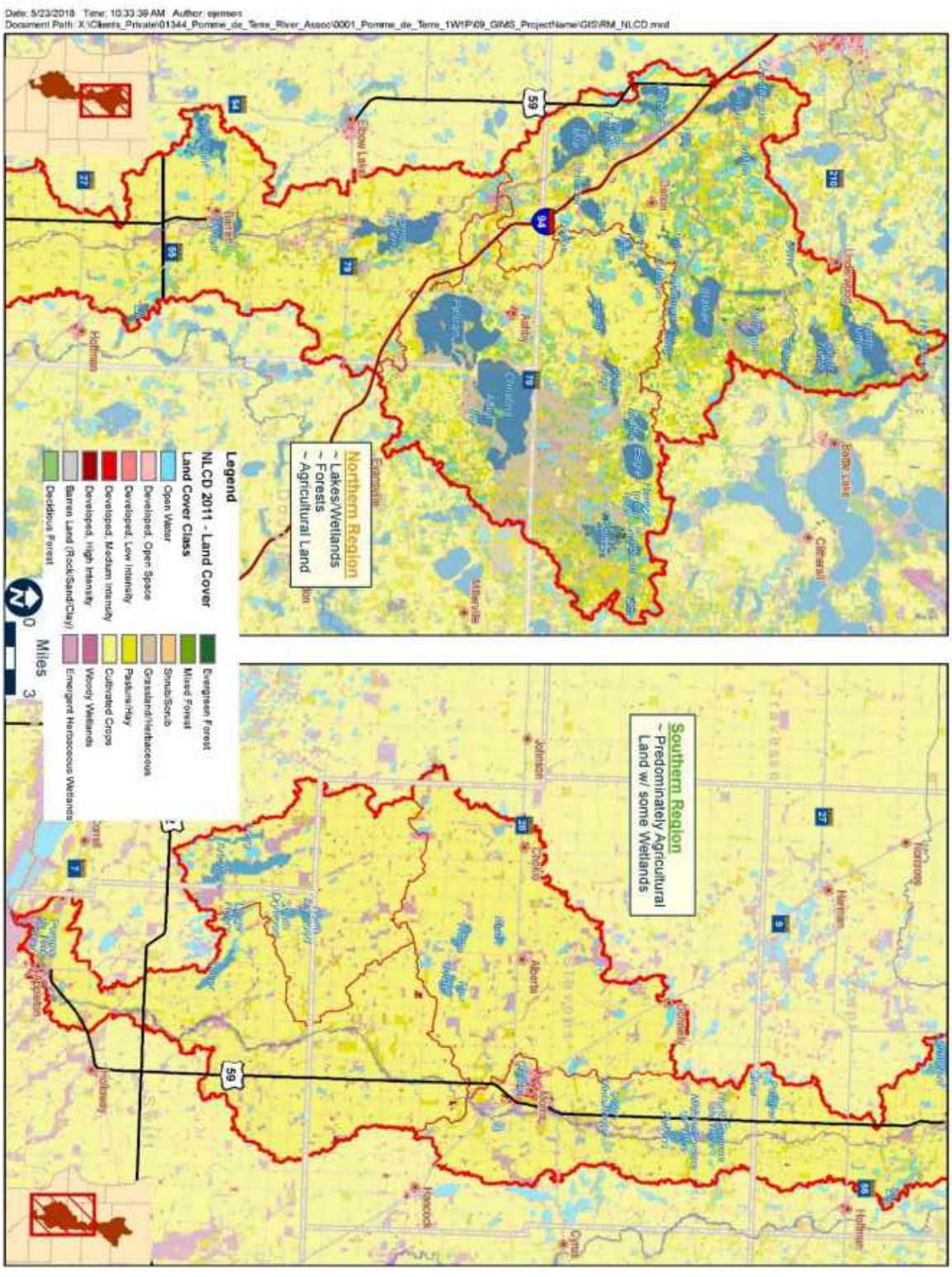


Figure A- 25. Land Cover of the Pomme de Terre River Watershed

A.16 SOCIOECONOMIC CONTEXT

The name 'Pomme de Terre' translates from French to apple of the earth, usually referencing potatoes. However, this particular name represents the "potato-like" prairie turnip (*Pediomelum esculentum* (Pursh) Rydb.) that French explorers observed being commonly eaten by the Sioux. The Pomme de Terre River and its tributaries flow through six counties on its way to Marsh Lake in the Minnesota River: Otter Tail, Grant, Douglas, Big Stone, Swift, and Stevens. Stevens County comprises the largest area of the watershed. Roughly 15,000 people live in the Pomme de Terre watershed. The two largest cities are Morris (pop. 5,295) and Appleton (pop. 1,350), but the watershed is mostly rural, with developed areas making up only five percent of the land use.

The following sections describe the socioeconomic context of the Pomme de Terre River Wateshed. When possible, the information is specific to the watershed but due to the scale of available data-sets, some of information provided pertains to the six counties that make up the Pomme de Terre Watershed. In this case, the information is referenced as being for the "six surrounding counties".

The population of the six surrounding counties—Big Stone, Douglas, Grant, Otter Tail, Stevens, and Swift is significantly larger than that of the population within the Pomme de Terre portion of each county. There are significant differences in the urban and rural populations for each of the six counties. In Stevens County, more than 50% of the population lives in an area defined by the U.S. Census Bureau as "urban." Douglas and Swift counties also have large proportions of the total population living in urban areas, 47% and 33% respectively. In comparison, 100% of the populations of Big Stone and Grant counties live in "rural" areas. Table A- 16 shows the total population and the urban/rural comparison and Table A- 17 provides a breakdown of the total population by age for each of the six counties.

Table A- 16. Total population and percentages living in urban or rural areas, by county.

	Big Stone	Douglas	Grant	Otter Tail	Stevens	Swift
Total	5,050	37,456	5,956	58,085	9,693	9,419
Urban	0%	47%	0%	26%	53%	33%
Rural	100%	53%	100%	74%	47%	67%

Table A- 17. Total population by age group, by county.

	Big Stone	Douglas	Grant	Otter Tail	Stevens	Swift
Total	5,050	37,456	5,956	58,085	9,693	9,419
Under 18 yrs	1,042	7,982	1,360	12,591	2,037	2,150
18 to 24 yrs	342	2,666	366	4,175	1,979	667
25 to 44 yrs	928	8,415	1,280	11,228	1,988	2,036
45 to 64 yrs	1,436	10,020	1,557	16,602	2,038	2,554
65 yrs and over	1,302	8,373	1,393	13,489	1,651	2,012
85 yrs and over	257	1,246	253	2,010	355	381

The population density within the Pomme de Terre River Watershed averages about 17 people per square mile. The population decreased by 1,533 from 2000 to 2010. Figure A- 26 and Figure A- 27 illustrate population density and population change in the watershed [57].

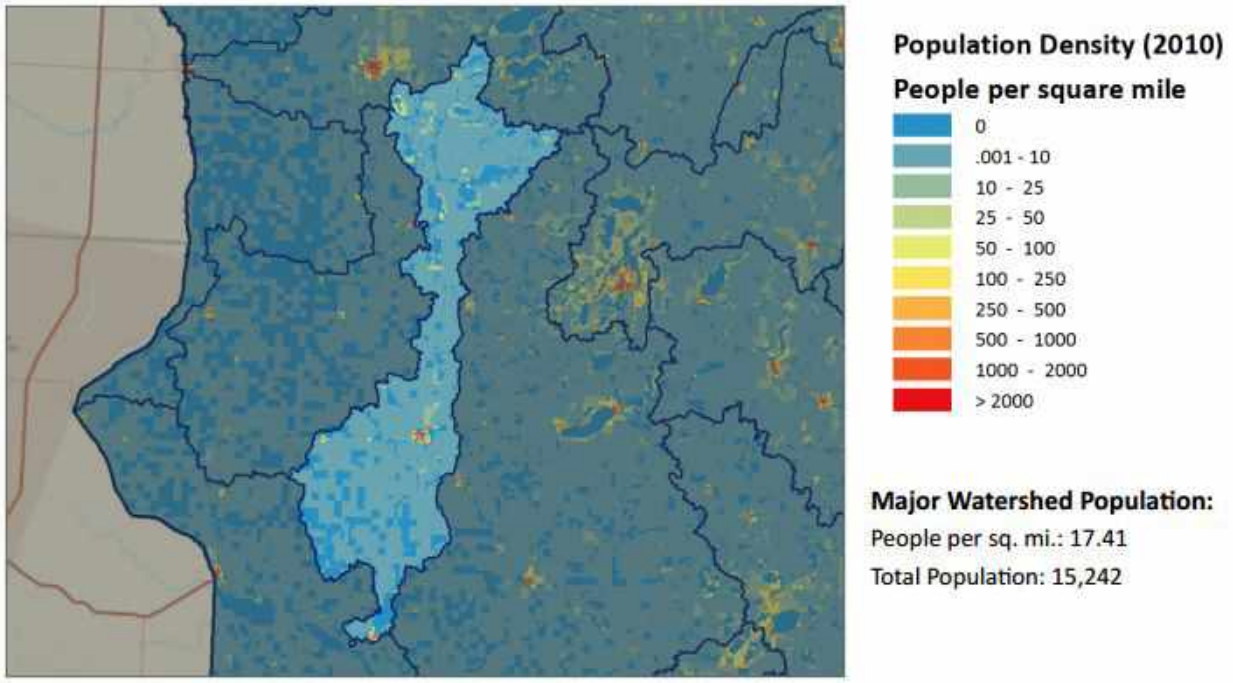


Figure A- 26. Population density in the Pomme de Terre River Watershed (2010)

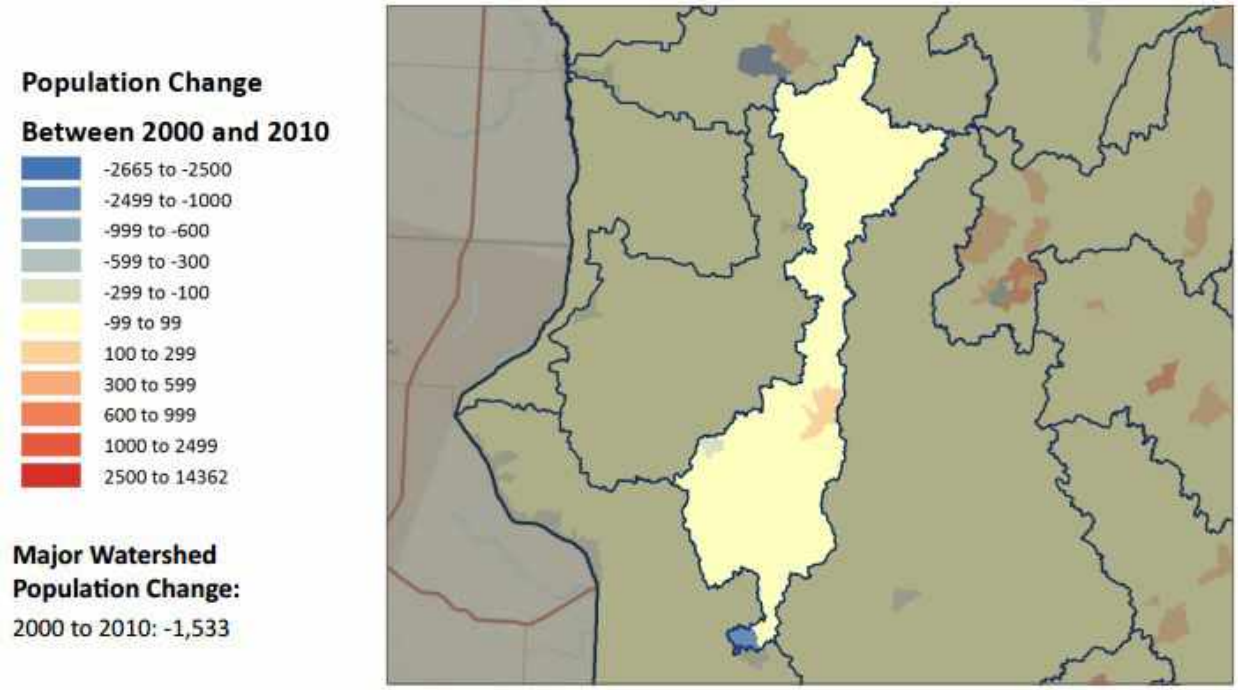


Figure A- 27. Population change in the Pomme de Terre River Watershed (2000-2010)

The economic base of the Pomme de Terre River Watershed is primarily agricultural, with 74 percent of the land used for cropland and pasture [58]. There are 966 farms in the watershed. Approximately 48 percent of the operations are less than 180 acres in size, nearly 37 percent are 180 to 1000 acres in size, and the remaining farms are larger than 1000 acres. 65 percent of the producers are full time operators and do not rely on off-farm income [59].

- Number of Farms 966
- Number of Operators 966
- Number of Full Time Operators 635
- Number of Part Time Operators 331
- Total Crop/Pastureland Acres 338,500

However, the six counties that surround the watershed have a huge variety of employers. The largest employers in all six counties are in the educational, health care and social assistance industries. Employment in agricultural and related industries is relatively small, ranging from only 2.8% to 12.9%. Other major industries include retail trade, construction, and manufacturing. Table A- 18 contains more information on the employment by industry in the six counties.

Median annual household income in the six Counties surrounding the watershed is $34,947, roughly 75% of the national average. Approximately 10% of the residents are below the national poverty level. The median value of homes is $67,733.

Table A- 18. Employment by industry, by county for population 16 years and older.

		Big Stone	Douglas	Grant	Otter Tail	Stevens	Swift
	Employed population 16 yrs and up	**2,406**	**18,975**	**2,943**	**27,662**	**5,058**	**4,865**
INDUSTRY	**Agriculture, forestry, fishing and hunting, and mining**	12.9%	2.8%	10.8%	5.4%	10.8%	10.7%
	Construction	9.5%	7.0%	8.8%	8.2%	6.0%	6.3%
	Manufacturing	8.1%	14.8%	9.6%	13.9%	11.4%	15.6%
	Wholesale trade	3.1%	3.3%	2.8%	2.8%	1.1%	4.4%
	Retail trade	14.3%	15.3%	12.0%	10.6%	11.0%	10.8%
	Transportation and warehousing, and utilities	5.1%	4.0%	4.8%	5.9%	2.3%	5.0%
	Information	1.0%	1.3%	1.0%	1.8%	2.8%	2.4%
	Finance and insurance, and real estate and rental and leasing	2.7%	6.1%	4.7%	4.5%	2.1%	3.4%
	Professional, scientific, and management, and administrative and waste management services	3.2%	6.0%	5.4%	6.3%	5.0%	5.2%
	Educational services, and health care and social assistance	27.9%	23.1%	24.9%	25.1%	30.3%	22.8%

	Big Stone	Douglas	Grant	Otter Tail	Stevens	Swift
Employed population 16 yrs and up	**2,406**	**18,975**	**2,943**	**27,662**	**5,058**	**4,865**
Arts, entertainment, and recreation, and accommodation and food services	3.7%	9.3%	5.1%	6.1%	9.3%	4.3%
Other services, except public administration	4.2%	4.6%	6.7%	5.4%	4.4%	4.9%
Public administration	4.3%	2.4%	3.4%	3.9%	3.6%	4.2%

Table A- 19. Median Household Income (in 2015 inflation-adjusted dollars) by county

	Big Stone	Douglas	Grant	Otter Tail	Stevens	Swift
Less than $10,000	6.9%	6.2%	4.9%	6.8%	10.4%	7.0%
$10,000 to $14,999	8.2%	4.4%	5.8%	5.7%	4.7%	5.6%
$15,000 to $24,999	11.4%	10.4%	10.6%	10.5%	9.6%	11.9%
$25,000 to $34,999	10.1%	8.9%	13.0%	9.9%	10.7%	10.9%
$35,000 to $49,999	15.4%	15.6%	15.5%	15.0%	12.1%	15.3%
$50,000 to $74,999	21.1%	21.4%	20.6%	21.2%	18.8%	19.9%
$75,000 to $99,999	12.4%	13.4%	14.1%	13.5%	13.6%	13.0%
$100,000 to $149,999	9.6%	12.9%	10.1%	11.5%	13.4%	12.3%
$150,000 to $199,999	2.3%	3.4%	2.4%	3.2%	2.5%	2.2%
$200,000 or more	2.7%	3.3%	2.9%	2.8%	4.1%	1.9%
Median household income	$47,794	$54,531	$50,174	$52,365	$52,302	$49,035
Mean household income	$60,692	$69,973	$64,181	$65,406	$66,134	$60,251

A.17 GAP ANALYSIS

The MPCA suggests further research to identify if additional dams are inhibiting fish movement by limiting connectivity. In addition, MCPA suggests further research on the sources of nutrient pollution and how the hydrologic regime has been altered over time.

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APPENDIX B: Documents Reviewed and Public Engagement Process

PLAN APPENDIX B – DOCUMENTS REVIEWED AND PUBLIC ENGAGEMENT PROCESS

This appendix includes the following information used to identify the priority concerns and issues addressed in the Pomme de Terre River Comprehensive Watershed Management Plan:

1. List of reports, plans, and studies reviewed as part of the Comprehensive Watershed Management Plan development process (Table B-1)
2. Record of the various meetings conducted during the plan development process (Table B-2)
   a. Summary of public engagement meetings
   b. Summary of CAC meetings
   c. Summary of Joint Powers Board Meetings
   d. Summary of Planning Committee Meeting
3. Plan Review Agency Notification Letters
   a. Board of Water and Soil Resources (BWSR)
   b. Minnesota Department of Agriculture (MDA)
   c. Minnesota Department of Health (MDH)
   d. Minnesota Department of Natural Resources (MNDNR)
   e. Minnesota Pollution Control Agency (MPCA)

Table B- 1. List of Documents Reviewed during Planning Process

Jurisdiction	Source	Document Name	Date	Document Type
City	Appleton	City of Appleton Wellhead Protection Plan (part 2)	2007	Water Management Plans
City	Ashby	City of Ashby Wellhead Protection Plan Amendment	2012	Water Management Plans
City	Barrett	City of Barrett Wellhead Protection Plan	2009	Water Management Plans
City	Chokio	City of Chokio Wellhead Protection Plan Amendment	2013	Water Management Plans
City	Dalton	City of Dalton Wellhead Protection Plan	2013	Water Management Plans
City	Donnelly	City of Donnelly Wellhead Protection Plan	2016	Water Management Plans
City	Morris	City of Morris Wellhead Protection Plan (part 2)	2007	Water Management Plans
City	Underwood	City of Underwood Wellhead Protection Plan	2016	Water Management Plans
County	Big Stone	2014-2023 Big Stone County Local Water Management Plan	2013	Water Management Plans
County	Douglas	2009-2019 Douglas County Comprehensive Local Water Management Plan	2009	Water Management Plans
County	Grant	2010-2015 Grant County Local Water Management Plan Amendment	2010	Water Management Plans
County	Otter Tail	2009-2019 Otter Tail County Local Water Management Plan	2009	Water Management Plans
County	Stevens	Stevens County Comprehensive Plan	2017	Water Management Plans

Jurisdiction	Source	Document Name	Date	Document Type
County	Stevens	2010-2015 Stevens County Local Water Management Plan Amendment	2010	Water Management Plans
County	Swift	2014-2023 Swift County Local Water Management Plan	2014	Water Management Plans
MDA	MDA	Commercial Nitrogen and Manure Applications on Minnesota's 2012 Corn Crop Compared to the U of M Nitrogen Guidelines.	2012	Guidelines
MNDNR	MN EQB	Beyond the Status Quo: 2015 EQB Water Policy Report	2015	Water Quality, TMDLs, and WRAPS Studies
MNDNR	MNDNR	Evaluating Animal Agriculture Impacts on Water Quality: Data Gaps in a West Central Minnesota Case Study	2015	Water Quality, TMDLs, and WRAPS Studies
MNDNR	MNDNR	Freshwater Society Inspiring Action for Nonpoint Source Pollution Control	2017	Water Quality, TMDLs, and WRAPS Studies
MNDNR	U of M	Minnesota Water Sustainability Framework	2011	Water Quality, TMDLs, and WRAPS Studies
MNDNR	Freshwater Society	Inspiring Action for Nonpoing Source Pollution Control	2017	Water Quality, TMDLs, and WRAPS Studies
MNDNR	MNDNR	Hydraulic Impacts of Quarries and Gravel Pits	2005	Water Quality, TMDLs, and WRAPS Studies
MNDNR	MNDNR	Final Report to the State Wildlife Grant Program Lake Christina Reclamation: Ecosystem Consequences of Biomanipulation	2006	Water Quality, TMDLs, and WRAPS Studies
MNDNR	MNDNR	Pollution Sensitivity of Near Surface Materials (includes a map in the Minnesota Hydrogeology Atlas subfolder)	2016	Water Quality, TMDLs, and WRAPS Studies
MNDNR	MNDNR	Watershed Context Report: Pomme de Terre River	2017	Water Quality, TMDLs, and WRAPS Studies
MNDNR	MNDNR	Minnesota Prairie Conservation Plan	2011	Statewide Conservation Plan
MPCA	MPCA	Watershed Context Report	2017	Water Quality, TMDLs, and WRAPS Studies
MPCA	MPCA	Pomme de Terre River Watershed Clean Water Accountability Progress Report	2016	Water Quality, TMDLs, and WRAPS Studies
MPCA	MPCA	Pomme de Terre River Fecal Coliform TMDL Implementation Plan	2008	Water Quality, TMDLs, and WRAPS Studies
MPCA	MPCA	Pomme de Terre River Turbidity TMDL Implementation Plan	2011	Water Quality, TMDLs, and WRAPS Studies
MPCA	MPCA	Pomme de Terre River Watershed TMDL	2015	Water Quality, TMDLs, and WRAPS Studies
MPCA	MPCA	Pomme de Terre River Watershed Biotic Stressor Identification	2012	Water Quality, TMDLs, and WRAPS Studies
MPCA	MPCA	Assessment Report of Selected Lakes within the Pomme de Terre River Watershed	2010	Water Quality, TMDLs, and WRAPS Studies
MPCA	MPCA	Pomme de Terre River Watershed Monitoring and Assessment Report	2011	Known Pollutant Modeling and Assessment Efforts
MPCA	MPCA	Pomme de Terre River Watershed Report (WRAPS)	2013	Water Quality, TMDLs, and WRAPS Studies
MPCA	MPCA	The Minnesota Nutrient Reduction Strategy	2014	Water Quality, TMDLs, and WRAPS Studies

Jurisdiction	Source	Document Name	Date	Document Type
MPCA	MPCA	Regional Fecal Coliform Source Inventory	2007	Known Pollutant Modeling and Assessment Efforts
PdTRA	PdTRA	Pomme de Terre River Major Watershed Restoration and Protection Strategies and Implementation Plan	2013	Water Quality, TMDLs, and WRAPS Studies
PdTRA	PdTRA	Incorporation of the PTMApp Model Report	2016	Model/Project
PdTRA	PdTRA	Pomme de Terre WRAPS Implementation Plan Clean Water Assistance Grant projects: 2017	2017	Model/Project
PdTRA	PdTRA	2011 Pomme de Terre Clean Water Fund Grant Final Project Summary	2011	Model/Project
PdTRA	PdTRA	2012 Pomme de Terre Clean Water Fund Grant Final Project Summary	2012	Model/Project
PdTRA	PdTRA	2014 Pomme de Terre Clean Water Fund Grant Final Project Summary	2013	Model/Project
PdTRA	PdTRA	Pomme de Terre Watershed Targeted BMP Implementation Project	2017	Model/Project
PdTRA	PdTRA	2015 Pomme de Terre WRAPS Implementation Plan	2015	Model/Project
Nonprofit	Freshwater Society	Freshwater Society, 2016. "Protecting groundwater-sourced drinking water"	2016	Publication

Table B- 2. Summary of Public Engagement Meetings

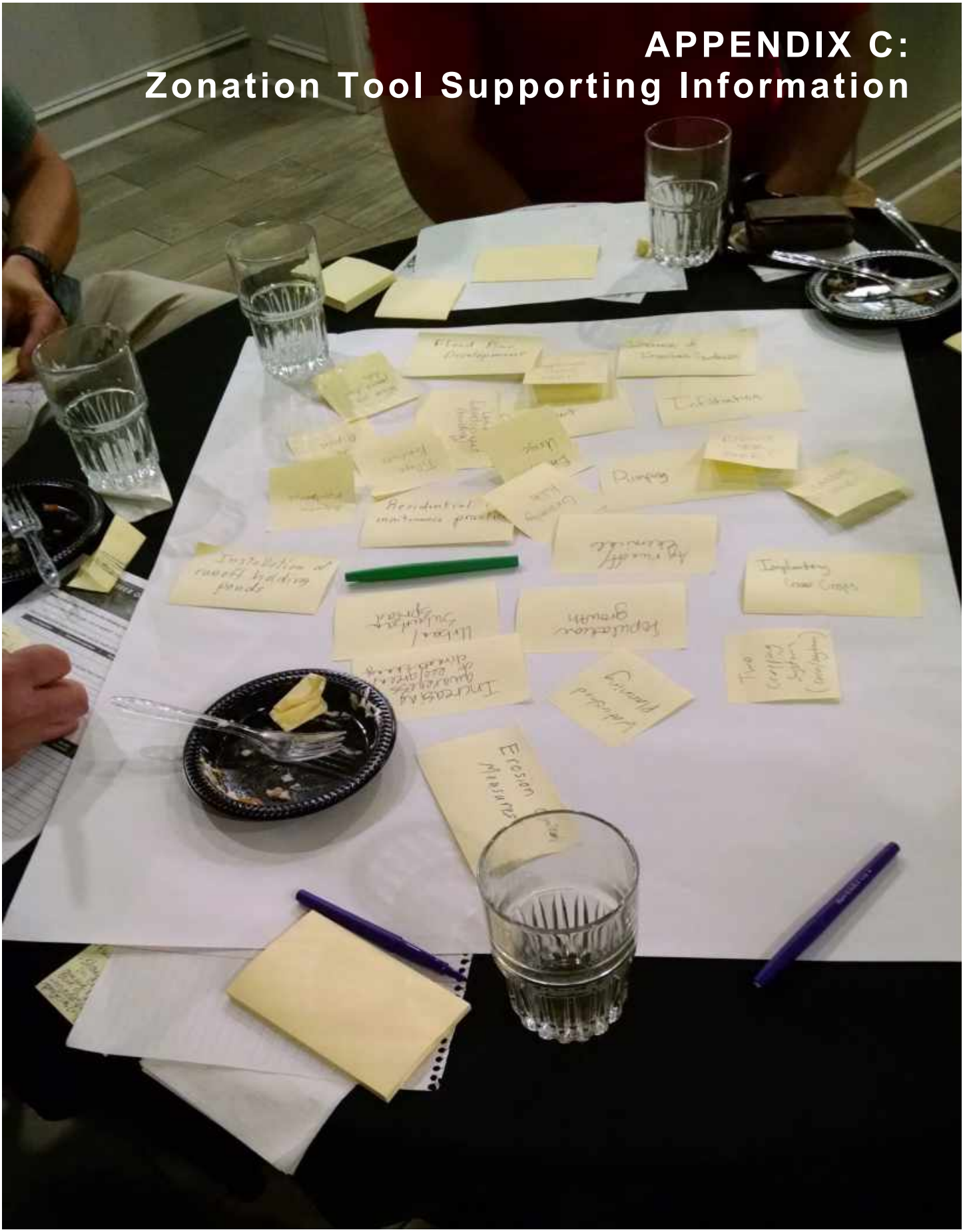
Meeting	Date	Location	Meeting Objectives
Planning Committee Meeting	July 12, 2017	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Project kick-off. Review work plan and data collection. Stakeholder Engagement Plan.
Planning Committee Meeting	August 2, 2017	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Opportunity to learn about the Planning Area, One Watershed One Plans, and provide input on priority concerns.
Watershed Bus Tour	September 13, 2017	Watershed-wide	Introduction to the watershed and the plan development process.
Planning Committee Meeting	October 4, 2017	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Intro to issues identification process and comprehensive watershed priority scheme. Zonation discussion (Paul Radomski – MNDNR). Planning for public kick-off meeting.
Joint Powers Board Meeting	October 13, 2017	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Update from PdTRA Coordinator on plan progress.
Public Information/Kick-Off Meetings	October 23, 2017	Dalton Community Center, Dalton, MN	Watershed stations. Overview of 1W1P. World Café Exercise and identification of issues and concerns.
	October 26, 2017	Old No. 1, Morris, MN	
Joint Powers Board Meeting	November 6, 2017	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Work plan progress and update on Public Information/Kick-Off Meetings.
CAC Meetings	November 6, 2017	Dalton Community Center, Dalton, MN	Intro to plan development process. Define CAC role in plan development process. World Café Exercise and identification of issues and concerns.
	November 6, 2017	AgCounty Farm Credit Service, Morris, MN	
Planning Committee Meeting	November 8, 2017	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Review draft Issues Identification Matrix and Land and Water Resources Inventory. Next steps for Zonation process.
Planning Committee Meeting	February 7, 2018	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Review comprehensive watershed priority scheme and identification of priority issues/concerns and priority areas.
Planning Committee Meeting	March 7, 2018	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Finalize priority management areas. Finalize issue prioritization and issue statements.
CAC Meetings	March 7, 2018	Stevens County SWCD Office, Morris, MN	Review comprehensive watershed priority scheme and identification of priority issues/concerns and priority areas.
	March 8, 2018	Dalton Community Center, Dalton, MN	
Planning Committee Meeting	April 4, 2018	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Review Priority Areas map. Review Resource Concerns draft issue statements and goals (Streams/Lakes/Rivers, Wetlands, Groundwater, and Habitat).
Planning Committee Meeting	June 6, 2018	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Review issue statement, goal and implementation activity structure. Revisit issue statements. Review goals.
Joint Powers Board Meeting	June 8, 2018	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Work plan progress. Review identification and prioritization of resources and issues and development of priority areas map.
Joint Powers Board Meeting	July 13, 2018	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Update from PdTRA Coordinator on plan progress and check-in with Joint Powers Board.

Meeting	Date	Location	Meeting Objectives
Planning Committee Meeting	July 23, 2018	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Review and discuss draft goals. Discuss how PTMApp will be using in the CWMP development process.
Planning Committee Meeting	August 1, 2018	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Finalize issue statements. Review and discuss draft goals.
Joint Powers Board Meeting	August 10, 2018	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Update from PdTRA Coordinator on plan progress, issue statements, goals, and priority areas documents.
Planning Committee Meeting	September 13, 2018	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Introduction to programs and funding.
Planning Committee Meeting	October 3, 2018	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Setting Altered Hydrology Goals (Henry Van Offelen – MPCA). Review and discuss draft goals (In-Stream Habitat, Education and Outreach, Altered Hydrology). Assign working groups for measurable goals/implementation plan subcommittees.
Planning Committee Meeting	November 7, 2018	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Federal Partner Program presentations. Summaries from Groundwater, Water Quality, and Altered Hydrology subcommittee meetings. Introduction to Targeted implementation Plan Structure.
Planning Committee Meeting	December 5, 2018	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Summaries from Shoreland, In-Stream Habitat, and Education and Outreach Subcommittee Meetings. Review draft Targeted Implementation Schedule.
Joint Powers Board Meeting	December 14, 2018	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Update from PdTRA Coordinator Implementation Plan and framework.
Joint Powers Board Meeting	March 8, 2019	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Update from PdTRA Coordinator on work plan progress. Revisited priority issues and reviewed drafted goals.
Planning Committee Meeting	March 13, 2019	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Reviewed Targeted Implementation Schedule.
Planning Committee Meeting	April 3, 2019	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Reviewed final sections of plan including Accounting of Local Funds, Implementation Programs and Administration & Coordination. Discussed expectations for internal review process.
Joint Powers Board Meeting	April 12, 2019	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Update from PdTRA Coordinator on Targeted Implementation Schedule.
Planning Committee Meeting	May 1, 2019	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Internal review of draft Comprehensive Watershed Management plan.
Joint Powers Board Meeting	May 10, 2019	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Update from PdTRA Coordinator on plan progress and internal review of draft plan.
Planning Committee Meeting	June 17, 2019	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Reviewed list of informal review comments and responses; updated timeline of the next steps.
Planning Committee Meeting	July 3, 2019	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Informal review follow-up.

Meeting	Date	Location	Meeting Objectives
Joint Powers Board Meeting	July 12, 2019	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Update from PdTRA Coordinator on plan progress, remaining funding, remaining work to be done, and timeline.
Planning Committee Meeting	August 7, 2019	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Informal review follow-up.
Joint Powers Board Meeting	August 9, 2019	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Update from PdTRA Coordinator to submit request to BWSR for 1W1P grant extension.
BWSR Board Annual Tour	August 28, 2019	Morris, MN and watershed-wide	BWSR Board tour of Pomme de Terre Watershed.
Planning Committee Meeting	September 4, 2019	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Informal review follow-up; updated and revised timeline of the next steps.
Joint Powers Board Meeting	September 20, 2019	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Update from PdTRA Coordinator on responses to plan comments.
Joint Powers Board Meeting	October 18, 2019	AgCountry Farm Credit Services Conference Room, 103 S Atlantic Ave, Morris MN 56267	Update from TAC chairman regarding updated plan timeline and status of draft plan.
Joint Powers Board Meeting	November 8, 2019	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Update from TAC chairman on informal review status of draft plan and deadline for local comments.
Combined Joint Powers Board and Planning Committee Meeting	December 13, 2019	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Approved draft plan for 60-day formal review.
Planning Committee Meeting	January 8, 2020	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Scheduled public hearings and received input from planning partners about hearing logistics.
Planning Committee Meeting	February 5, 2020	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Discuseds where and when to post public notice of public hearings on the plan.
Joint Powers Board Meeting	February 14, 2020	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Update from PdTRA Coordinator that formal review period ended and plan is on schedule to be finalized mid-year.
Planning Committee Meeting	March 4, 2020	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Reviewed presentation for public hearings, updated plan timeline, addressed comments received during formal review period.
Public Hearing	March 4, 2020	Old No. 1 Meeting Room, 412 S Atlantic Ave, Morris MN 56267	Presented plan to members of the public and discussed their comments and concerns.
Public Hearing	March 10, 2020	Dalton Community Center, 114 Main St E, Dalton MN 56324	Presented plan to members of the public and discussed their comments and concerns.
Joint Powers Board Meeting	March 13, 2020	ARS Soils Lab Conference Room, 803 Iowa Avenue Morris MN 56267	Update from PdTRA Coordinator about successful public hearings and comment review process.
South Subcommittee Planning Meeting	March 25, 2020	Virtual meeting (covid-19)	Addressed a subsection of comments received during formal review period.
North Subcommittee Planning Meeting	March 26, 2020	Virtual meeting (covid-19)	Addressed a subsection of comments received during formal review period.
Planning Committee Meeting	April 1, 2020	Virtual meeting (covid-19)	Addressed comments received during formal review period.
Planning Committee Meeting	May 6, 2020	Virtual meeting (covid-19)	Request final comments from planning committee before submitting for approval.

Meeting	Date	Location	Meeting Objectives
Joint Powers Board Meeting	May 8, 2020	Virtual meeting (covid-19)	Update from PdTRA Coordinator on plan status in final stages. Prepare board to approve plan at June meeting.
Planning Committee Meeting	May 27, 2020	Virtual meeting (covid-19)	Addressed final comments made on the plan during final review.
Planning Committee Meeting	June 3, 2020	Virtual meeting (covid-19)	Addressed final comments made on the plan during final review; TAC moved to recommend to the JPB that they submit the plan for 90-day BWSR review.
Joint Powers Board Meeting	June 12, 2020	Virtual meeting (covid-19)	Motion made to approve the plan for submittal to BWSR for 90-day review.

APPENDIX C:
Zonation Tool Supporting Information



Appendix C – Zonation Tool Supporting Information

C.1 Introduction

As threats to Minnesota's watersheds continue to mount, it is becoming increasingly important to identify and conserve high-priority areas. Identification of these priority areas, including sources of point and non-point pollution, will be crucial for targeting actions to improve water quality. There are multiple opportunities for protection or restoration in any watershed. Identifying which practices to implement and where in the landscape to implement them can help more effectively target efforts and more efficiently utilize limited resources.

To prioritize land within the Pomme de Terre River watershed, we used a process that included the values-based model Zonation. This process began with the identification of the goals of the watershed and concluded with a review of the results. The identification of priority areas was based on the quantitative analysis (using Zonation) of a suite of data layers. Planning team members decided on what landscape features were included in the model and set the weights on those features via a pairwise questionnaire survey. The process was framed within the DNR's healthy watershed conceptual model, and included biology, hydrology, water quality, and geomorphology components. An additional component, designed to capture other "lands of concern" within the watershed was also included.

This approach recognized that attempts to solve clean water needs within the watershed are not separate from other natural resource needs; each priority area should provide multiple benefits. The model used in this process helps achieve this goal by identifying areas that provide multiple benefits while incorporating data valued by the community.

C.2 Methods

Values-based models, such as Zonation, are an efficient method for prioritizing places on the landscape for protection or restoration of water resources. These models integrate individual landscape features with context and connections, and use an objective function to identify priority resource areas. The use of an additive benefits (i.e., multiple benefits) objective function in the value model allows for the inclusion of multiple landscape features. Value models also lend themselves to collaborative efforts, by providing an opportunity for participants to decide what features are valued and the ranking of those valued features. In addition, value models and the DNR five-component healthy watershed model used to structure the content in the value model are simple concepts that are easy to explain and apply at the local government scale. Value models do not provide guidance on what practices should be implemented where, so additional analysis and/or discussion on effective and appropriate best management practices will be necessary when project planning.

The Zonation model was based on the 5 Components of the MN DNR Watershed Health Assessment Framework (http://www.dnr.state.mn.us/whaf/index.html):

- Biology
- Connectivity
- Geomorphology
- Hydrology

- Water Quality

The 5 component approach recognizes that clean water needs are not separate from other conservation needs; and each conservation activity should provide multiple benefits. The Zonation model helps achieve this 'multiple benefits' goal by identifying areas that optimize benefits by incorporating data valued by the community.

The first step of the four-step process involved determining which features should be included in the Zonation model. The analysis included 26 features (i.e., data layers), grouped within five components (Table C- 1). Each data layer was on the same grid with a resolution of 30 by 30m. We used high-resolution data to maximize local planning realism and for greater practicality in local government water resource planning and implementation.

Weights from the surveys were used to identify which features were valued more. Within the five-component healthy watershed framework, for example, water quality features could be weighted higher than biological features. The feature-specific weights used in Zonation were set using the analytic hierarchy process (AHP; Saaty and Peniwati 2007). A hierarchical survey (components → features) comprised of pairwise comparisons was used to identify the preferences of a diverse group of individuals within the watershed. Individual components of watershed management are linked to multiple other aspects of watershed management (i.e., multiple benefits). Therefore, the objective of the pairwise survey is to help participants focus on the value they place on individual components of watershed management by considering them in pairs for all unique combination of pairs. Each individual taking the survey used his or her judgment about the relative importance of all survey elements. The relative importance values included "equal," "prefer," and "strongly prefer." Individual responses were aggregated with a geometric mean, and the pairwise comparison matrix was constructed to compute the feature-specific weights consistent with the AHP. Members of the Policy Committee took a survey consisting of the broad-scale components, and Advisory Committee members provided preferences for both the broad-scale components and the fine-scale features.

The value models were developed using Zonation software (Moilanen et al. 2009). Zonation produces a nested hierarchy of spatial priorities. It begins with the full landscape and iteratively removes cells that contribute least to the objective; therefore, the removal order is the reverse order of the priority ranking. Zonation assumes that the full watershed is available for consideration. In these models, the lakes were masked out prior to analysis. This focused the prioritization on the terrestrial parcels, in accordance with the protection and restoration goals of the Pomme de Terre River watershed. Zonation's algorithms seek maximal retention of weighted normalized landscape features.

To produce a map that identified areas on the landscape that provide multiple benefits, we used the additive benefit function within Zonation. This function aggregates values by summation across features:

$$V(P) = \Sigma w_j N_j(P) z_j$$

where the value of a parcel V(P) is equal to the summation of weighted w normalized features of the parcel Nj(P) to the power of z (set to 0.25 for all features).

Additionally, Zonation allows ranking to be influenced by neighboring parcels, so that highly valued areas can be aggregated, and fragmentation of areas can be minimized. We utilized the distribution-smoothing algorithm in Zonation, which assumes that fragmentation (low connectivity) generally should be avoided for all features. Initial analyses indicated that a connectivity distance of 200m may be appropriate for local government efforts targeted at the watershed scale. We found that very small connectivity distances made no difference in prioritization, since the connectivity effect did not extend very far, and very large connectivity distances aggregated cells across unrealistically large areas. We also found that across a modest range of connectivity distances the results were minor.

Analysis of the spatial distribution of the conservation priority scores identified clusters of high priority areas; these clusters are identified as hotspots (Figure C- 3).

C.3 Zonation Data Layers

The fine-scale components from the survey are represented spatially in the Zonation model with a unique input data layer as described in Table C- 1.

Table C- 1. Descriptions for features (i.e., data layers) used in the Pomme de Terre River Zonation model

Objective	Description
Protect or Improve Waters of Concern - Groundwater	
Focus on Groundwater contamination susceptibility	The pollution sensitivity of near-surface materials from the transmission time of water through 3 feet of soil and 7 feet of surficial geology, to a depth of 10 feet from the land surface. Source: DNR; Pollution Sensitivity of Near-Surface Materials.
Focus on Drinking Water Supply Management Area (DWSMA) vulnerability & Drinking source water assessment areas (SWA)	The risk associated with potential contaminant sources within a public water supply DWSMA to contaminate its drinking water supply. This risk is based on the aquifer's inherent geologic sensitivity, the assessed vulnerability of the public water supply well(s), and the composition of the groundwater. In highly vulnerable DWSMAs, there is a strong causal relationship between land use activities on the surface and groundwater quality. Also includes source water assessment area (SWA) is the surface and subsurface area surrounding a public water supply well that completely contains the scientifically calculated time-of-travel area. Source: MDH.
Focus on Areas with high density of wells	The groundwater irrigation well installation density (installations per square mile). Source: DNR.
Protect or Improve Waters of Concern – Lakes and Rivers	
Focus on Impaired waters	Catchments (i.e., drainage basins) upstream of impaired waters within the watershed. Identified as impaired by the Minnesota Pollution Control Agency (MPCA).
Focus on Catchments with high pollution	Estimated total suspended solids, total nitrogen, and total phosphorus by catchment as determined by a hydrological model that uses water quality and water flow/level monitoring data and physical process equations. Source: HSPF model.
Focus on Catchments of lakes vulnerable to nutrient addition	The relative susceptibility of a lake to phosphorus pollution (based on lake morphology and catchment hydrology). Source: DNR and MPCA; Lakes of Phosphorus Sensitivity Significance.
Protect or Restore Shoreland	All lands located within 300 feet of a protected water stream or 1000 feet of a lake.
Reduce Erosion & Runoff	

Objective	Description
Focus on Areas with high erosive potential	Stream Power index: This is an index of the channelized flow erosive potential. Calculated from LiDAR data.
Protect Existing wetlands	Remaining wetlands as documented by the National Wetland Inventory (NWI).
Restore Drained wetlands	Drained, potentially restorable wetlands in agricultural landscapes based on an inventory and analysis.
Protect or Restore Stream riparian areas	Stream riparian areas and potential flood zones (based on location, elevation and soil type).
Protect or Restore Stream buffers	Public waters and public ditches that require permanent vegetation buffers. Source: Buffer Protection Map, DNR.
Reduce Soil erosion risk	Susceptibility of soils to erosion. This variable is from the BWSR and UMN's Environmental Benefits Index; it was calculated from a subset of the universal soil loss equation.
Focus on Areas with high water yields (runoff)	Estimated annual water yield (inches/acre or cubic feet per second (cfs)/acre) by catchment as determined by hydrological models. Source: HSPF model.
Protect or Improve Fish & Wildlife Habitat	
Protect Rare plants or animals	Locations of species currently tracked by the DNR, including Endangered, Threatened, and Special Concern plant and animal species as well as animal aggregation sites. Excluded locations with high uncertainty. Source: DNR.
Protect Sites of biodiversity significance	Areas with varying levels of native biodiversity that may contain high quality native plant communities (e.g., native prairies, fens, quality forests, meadows, swamps, etc.), rare plants, rare animals, and/or animal aggregations. Identified by Minnesota Biological Survey. Source: DNR.
Protect or Restore Lakes of biological significance	Catchments of high quality lakes. List of high quality lakes based on dedicated biological sampling. Source: DNR's Lakes of Biological Significance.
Protect or Restore Native prairie and Prairie Core Areas	Intact native prairie and areas identified in the Prairie Plan as core areas. Source: DNR.
Protect or Restore USFWS priority wetlands	Wetland complexes with the potential to impact populations of focal species (black terns, migrant shorebirds, ducks, and pheasants). Factors include integrity of the surrounding wetland complex, the juxtaposition of wetland and grassland areas, and the potential for significant water quality enhancement benefits for shallow lakes. Source: USFWS.
Protect or Restore USFWS priority grasslands	Grassland complexes with the potential to impact populations of focal species (marbled godwit, nongame birds, migrant shorebirds, ducks, and pheasants). Factors include integrity of the grassland patch, the surrounding landscape context (% grassland and terrain relief), juxtaposition of grassland and wetland, the potential for significant water quality enhancement benefits for shallow lakes, and the potential to create large grassland patches with minimal cropland retirement. Source: USFWS.
Protect or Restore Lands of Concern	
Implement BMPs on Vulnerable cultivated cropland	Land cover type is cultivated crops (areas used for the production of annual crops or actively tilled areas) with land capability class indicating serious limitations for agriculture. Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Classification from NRCS where classes 4-8 have serious limitations for agriculture. Classes 4-8 are used to identify areas for potential conservation investments.

Objective	Description
Protect Lands close to protected lands	Lands close to protected lands may be more important for conservation, as larger, contiguous areas often have more value than smaller, fragmented lands. The data are the inverse distance to existing protected lands.
Protect or Improve Urban areas and undeveloped lands adjacent to urban areas	Urban lands have opportunities for improved management of stormwater runoff. Those areas close to existing development may be more likely to be developed, and some of these lands that provide important ecosystem services may be of conservation value.
Implement BMPs on Areas with high wind erodibility	Areas with high wind erodibility indices. Source: Soil Survey Geographic Data Base (SSURGO).

C.4 Results

Policy Committee preferences were used to set the broad-scale weights within the Zonation model. Policy Committee pairwise questionnaire survey results identified the Protect Groundwater component of the value model inputs as the highest weight, followed by Reduce Erosion & Runoff. The Protect/Improve Fish & Wildlife Habitat component was assigned the lowest weight (Table C- 1 and Table C- 2). The fine-scale weights were derived from questionnaires completed by both the Policy and Advisory Committees (Table C- 3).

The Zonation model was run using the weights derived from the questionnaire. The Zonation output map ranked lands as to their importance for land management activities that would provide greater protection of ecosystem functions, especially water quality, and to their importance for application of various land best management practices.

The Zonation priority map identified several potential priority areas. Many of the lands bordering the Pomme de Terre River were ranked high. The area around Lake Christina, particularly to the northwest, was ranked high as well. High priority ranked lands were identified near the city of Barrett, as well as near Donnelly and Dalton. Lands surrounding several lakes, including Tamarack, Ten Mile, and German Lakes were also ranked high (Figure C- 2 and Figure C- 3).

Table C- 2. Broad-scale component and feature weights used in the Zonation model. Weights were obtained from a questionnaire using the analytic hierarchy process (AHP; weights sum to 100).

Component (broad-scale) Prioritization*	Weight	Weight Used in Model
Protect Groundwater	**22.1**	**22.1**
Protect/Improve Lakes & Rivers	**24.6**	**24.6**
Reduce Erosion & Runoff	**26.2**	**26.2**
Protect/Improve Fish & Wildlife Habitat	**12.1**	**12.1**
Protect/Improve Lands of Concern	**15.0**	**15.0**

*Policy Committee broad-scale preferences were used

Table C- 3. Broad-scale component and feature weights used in the Zonation model. Weights were obtained from a questionnaire using the analytic hierarchy process (AHP; weights sum to 100).

Feature (fine-scale) Prioritization	Weight	Weight Used in Model
Protect Groundwater		
Drinking water mgmt area vulnerability	44.2	15.1
Groundwater contamination susceptibility	31.2	10.7
Areas with high well density	24.6	8.4
Protect/Improve Lakes & Rivers		
Impaired waters	23.0	3.4
Catchments with high pollution	28.1	4.1
Catchments of lakes vulnerable to TP pollution	30.4	4.4
Shoreland	18.5	2.7
Reduce Erosion & Runoff		
Areas with high erosive potential	15.1	4.4
Stream riparian areas	14.0	4.0
Soil erosion risk	14.6	4.2
Existing wetlands	14.7	4.2
Drained wetlands	14.9	4.3
Stream buffers	14.1	4.1
Areas with high water yield	12.6	3.7
Protect/Improve Fish & Wildlife Habitat		
Rare features	9.4	0.8
Sites of biodiversity significance	16.3	1.4
Lakes of biological significance	18.7	1.7
Native prairie/prairie core	20.7	1.8
USFWS priority wetlands	19.0	1.7
USFWS priority grasslands	16.0	1.4
Protect/Improve Lands of Concern		
Vulnerable cultivated croplands	39.6	5.3
Lands close to public lands	16.5	2.2
Urban areas & adjacent undeveloped lands	19.9	2.7
Areas with high wind erodibility	24.0	3.2

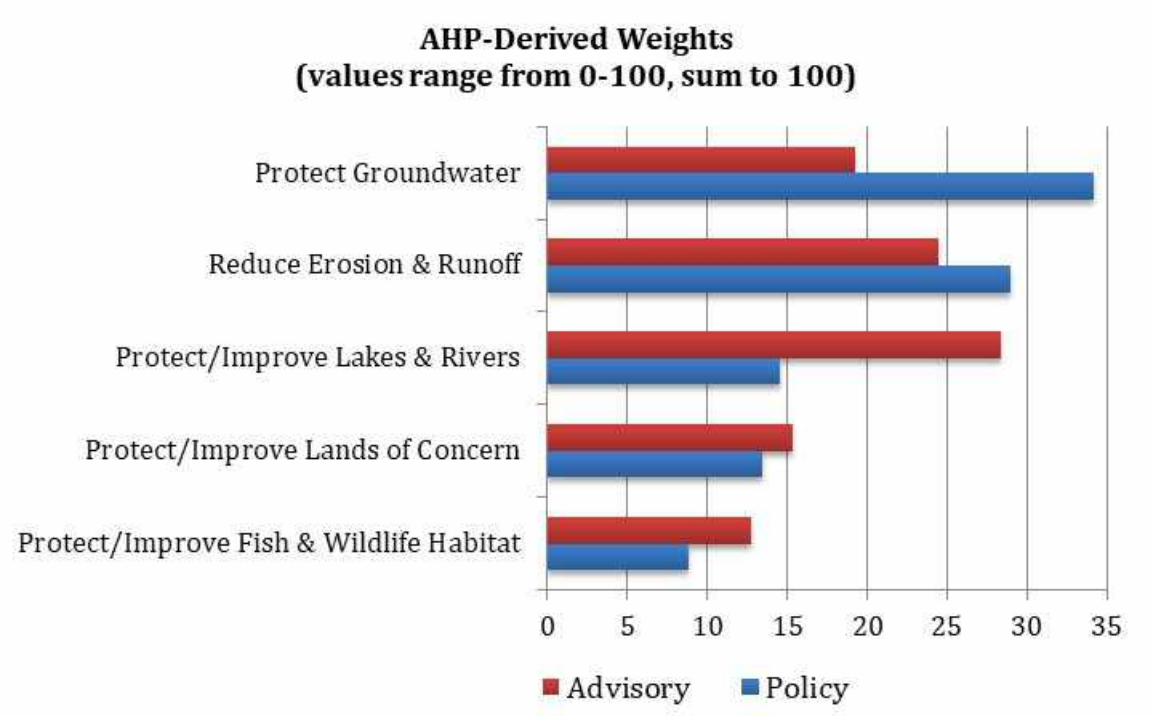


Figure C- 1. The component (broad-scale) weights obtained from a questionnaire using the analytic hierarchy process (AHP; weights sum to 100). Policy Committee weights were used to set the data weights used in the Zonation model.

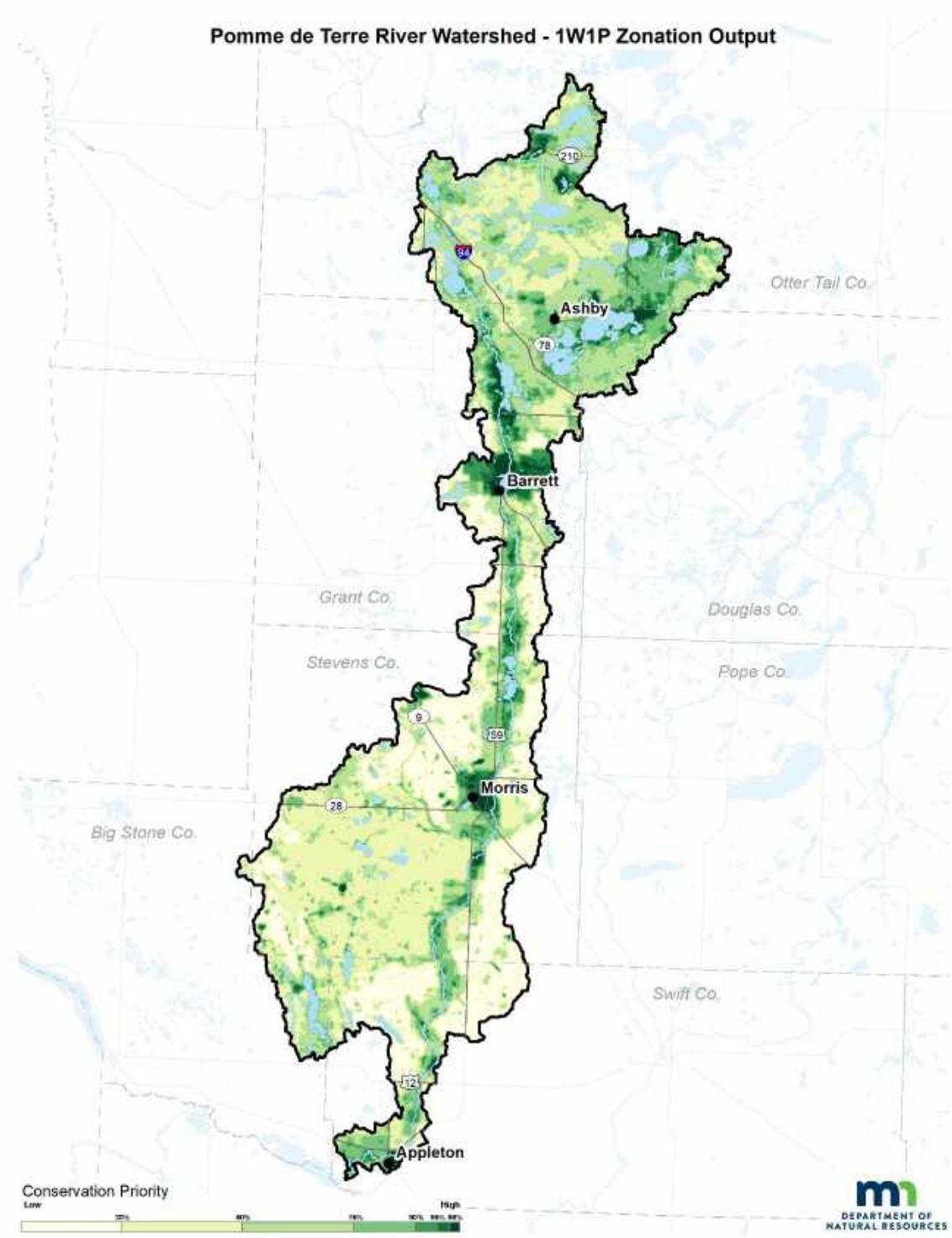


Figure C- 2. Priority map from Zonation analysis.

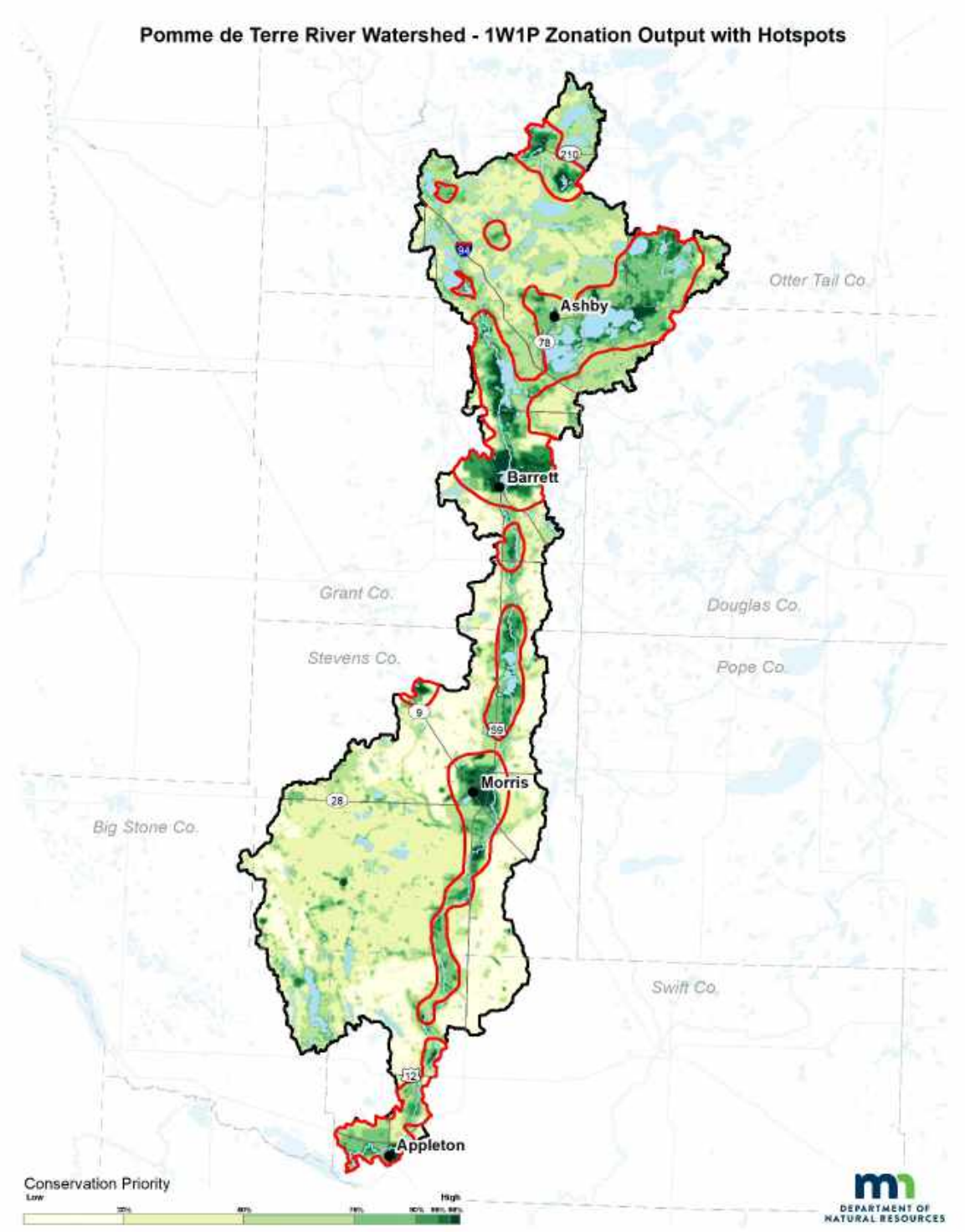
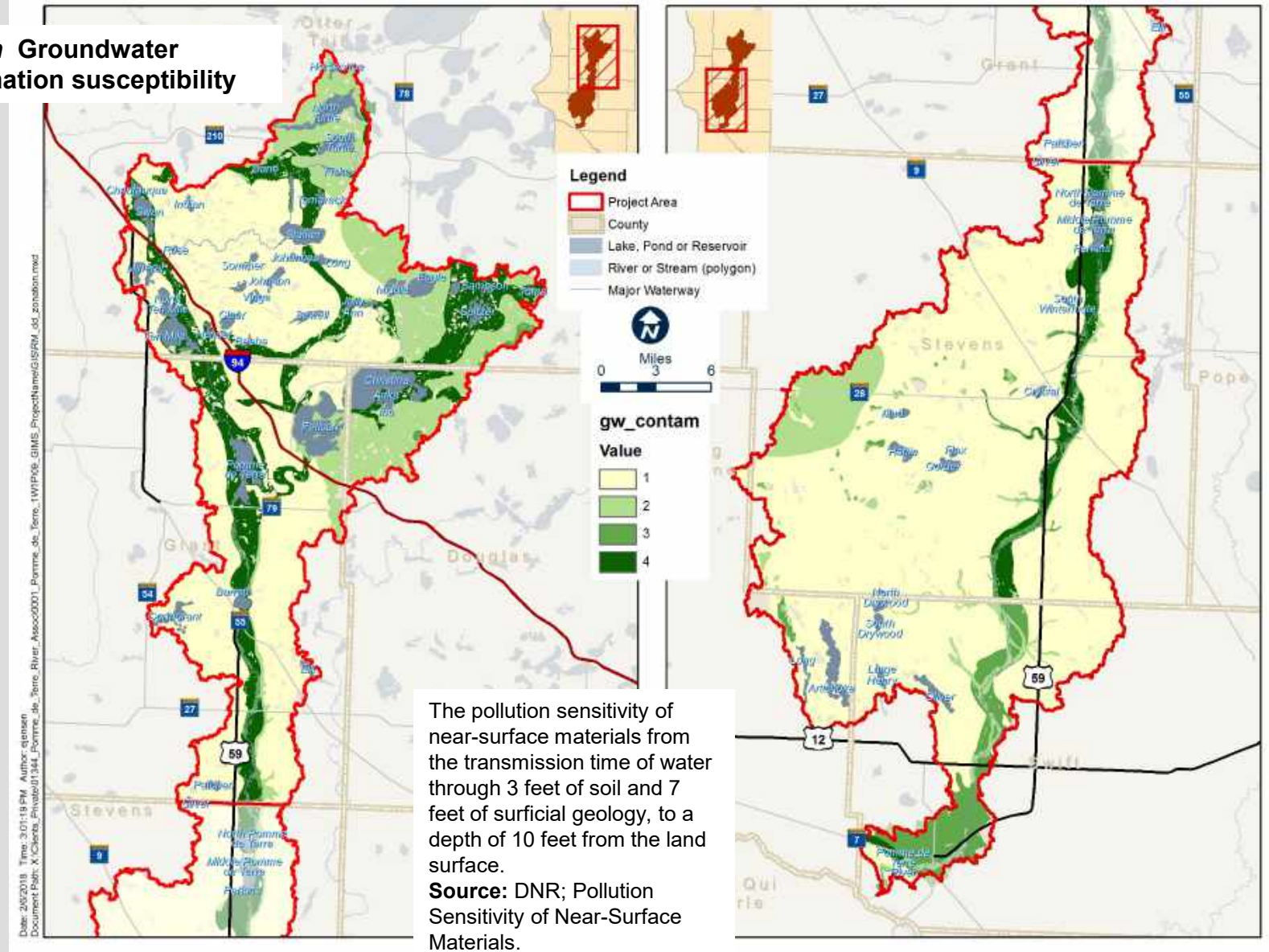


Figure C- 3. Priority map from Zonation analysis with hotspots. Hotspots derived using median conservation (WRSCR) score from Zonation output.

Protect or Improve Waters of Concern – Groundwater

Focus on **Groundwater contamination susceptibility**

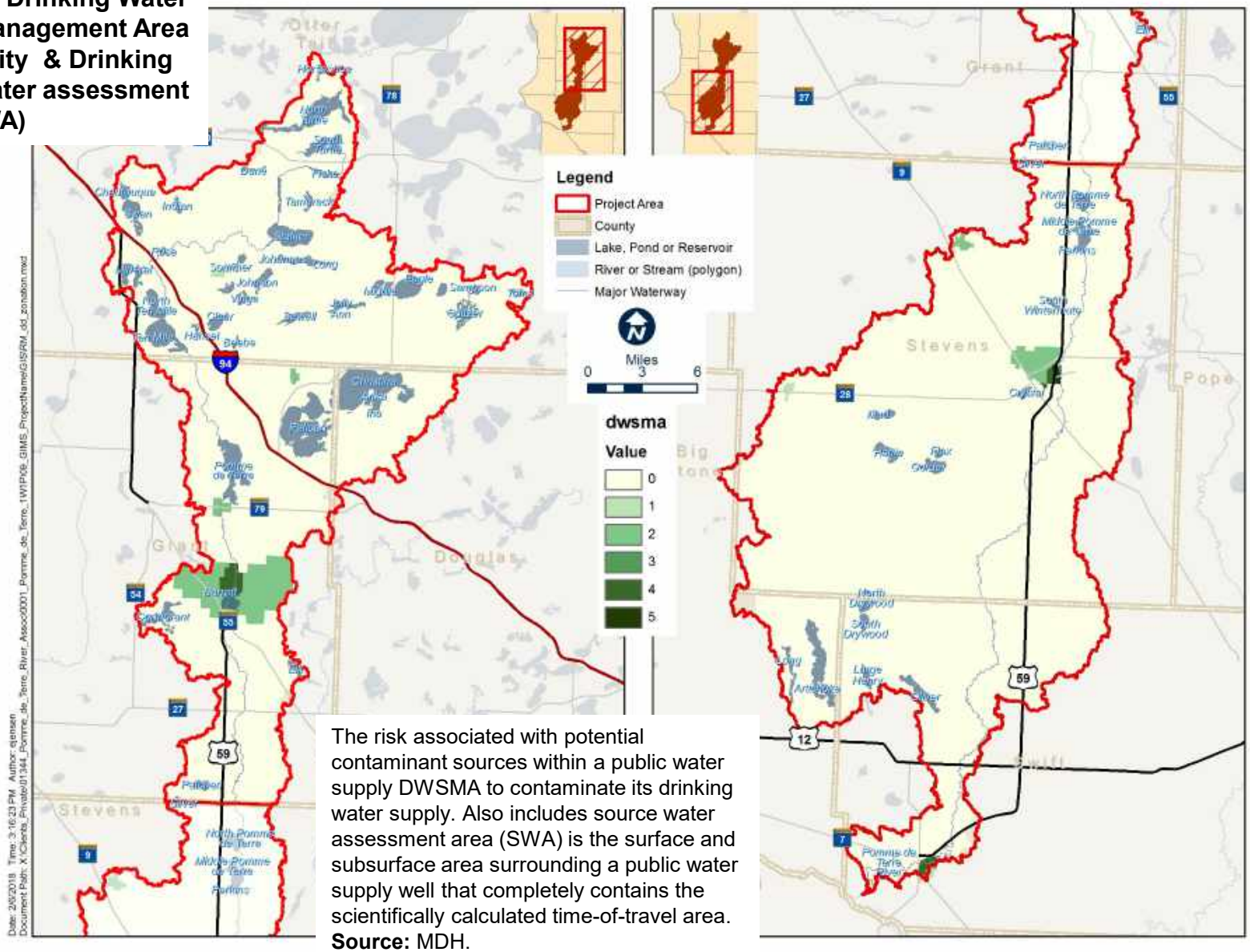


The pollution sensitivity of near-surface materials from the transmission time of water through 3 feet of soil and 7 feet of surficial geology, to a depth of 10 feet from the land surface.

Source: DNR; Pollution Sensitivity of Near-Surface Materials.

Protect or Improve Waters of Concern – Groundwater

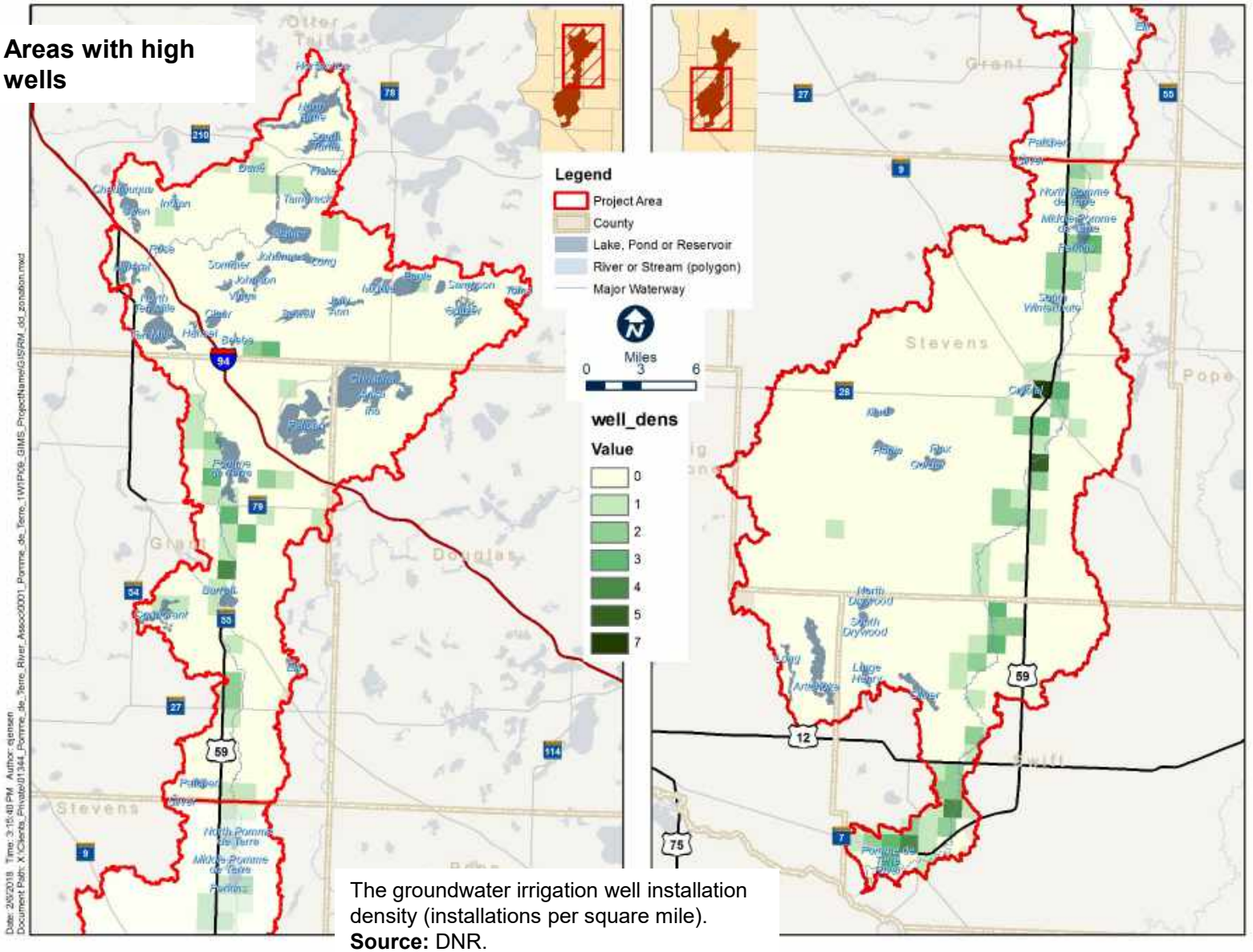
Focus on **Drinking Water Supply Management Area vulnerability & Drinking source water assessment areas (SWA)**



The risk associated with potential contaminant sources within a public water supply DWSMA to contaminate its drinking water supply. Also includes source water assessment area (SWA) is the surface and subsurface area surrounding a public water supply well that completely contains the scientifically calculated time-of-travel area. **Source:** MDH.

Protect or Improve Waters of Concern – Groundwater

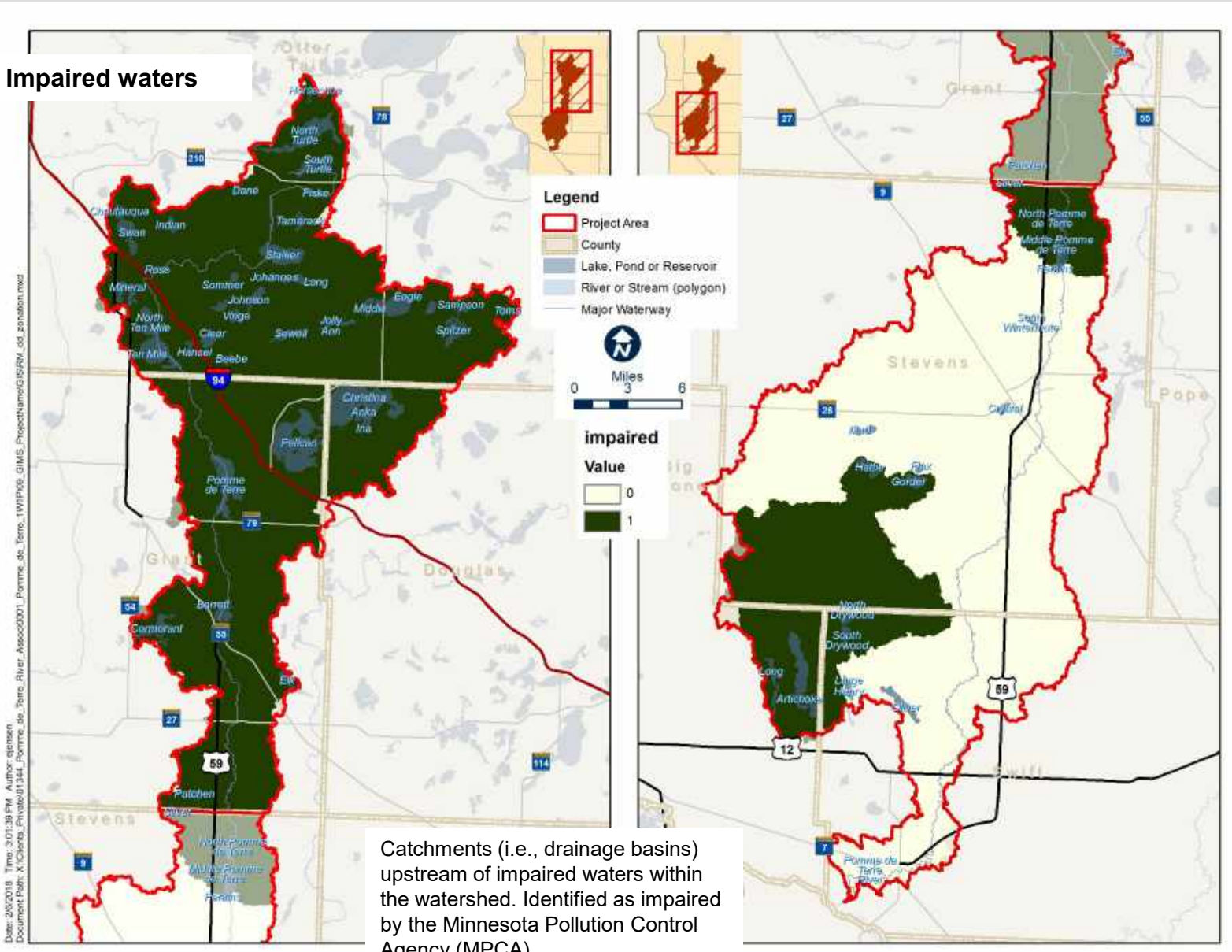
Focus on **Areas with high density of wells**



The groundwater irrigation well installation density (installations per square mile).
Source: DNR.

Protect or Improve Waters of Concern – Lakes and Rivers

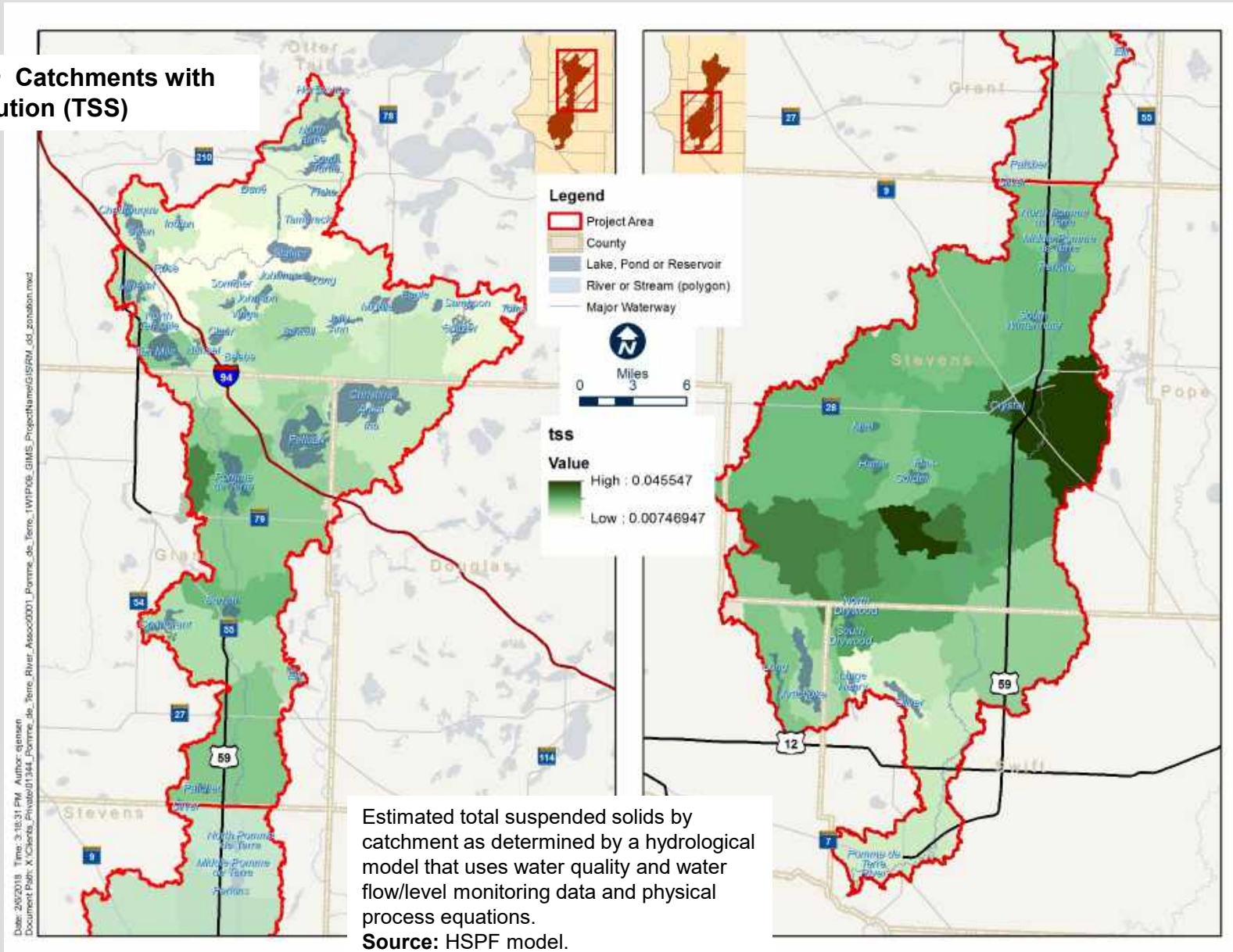
Focus on **Impaired waters**



Catchments (i.e., drainage basins) upstream of impaired waters within the watershed. Identified as impaired by the Minnesota Pollution Control Agency (MPCA).

Protect or Improve Waters of Concern – Lakes and Rivers

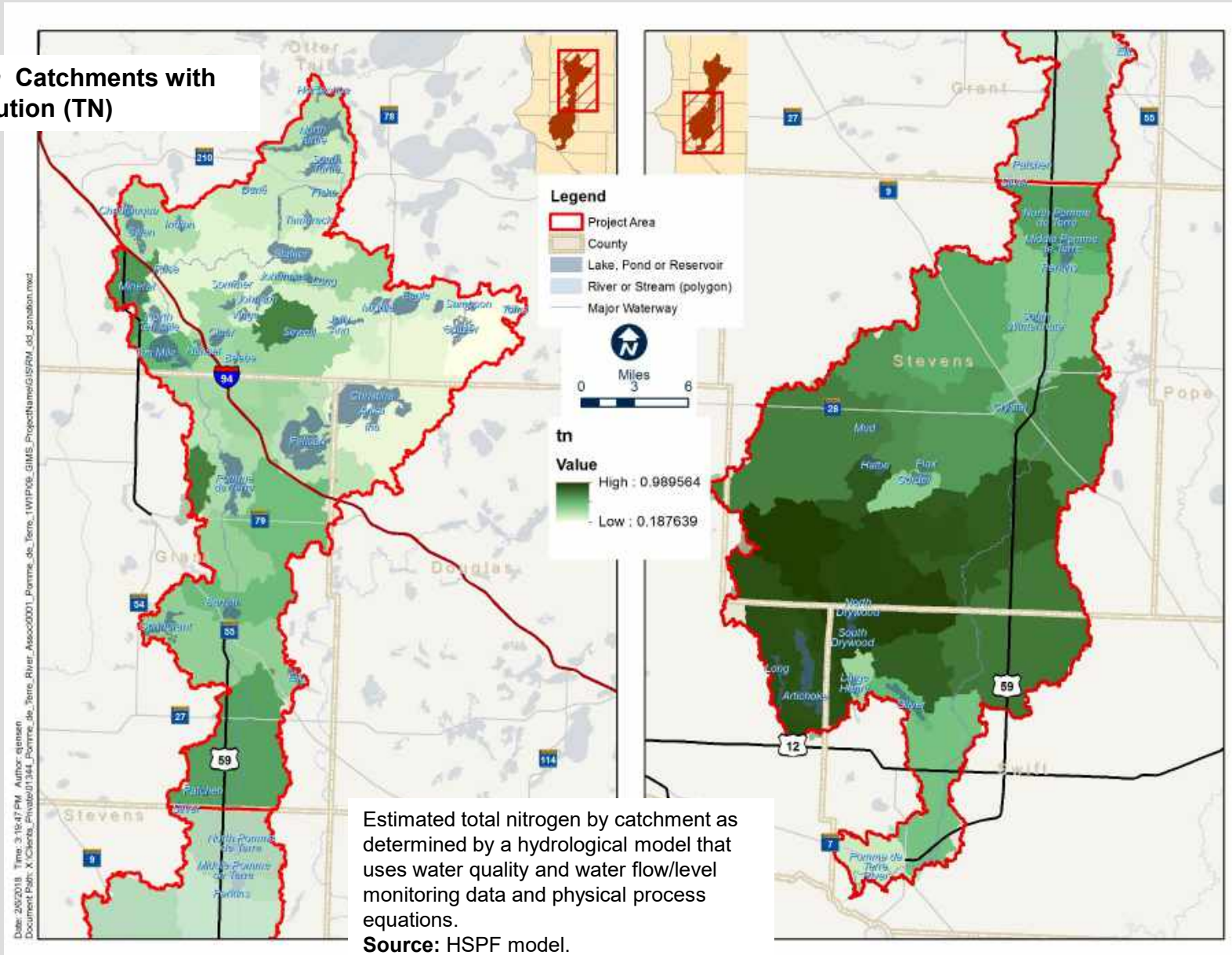
Focus on **Catchments with high pollution (TSS)**



Estimated total suspended solids by catchment as determined by a hydrological model that uses water quality and water flow/level monitoring data and physical process equations.
Source: HSPF model.

Protect or Improve Waters of Concern – Lakes and Rivers

Focus on **Catchments with high pollution (TN)**

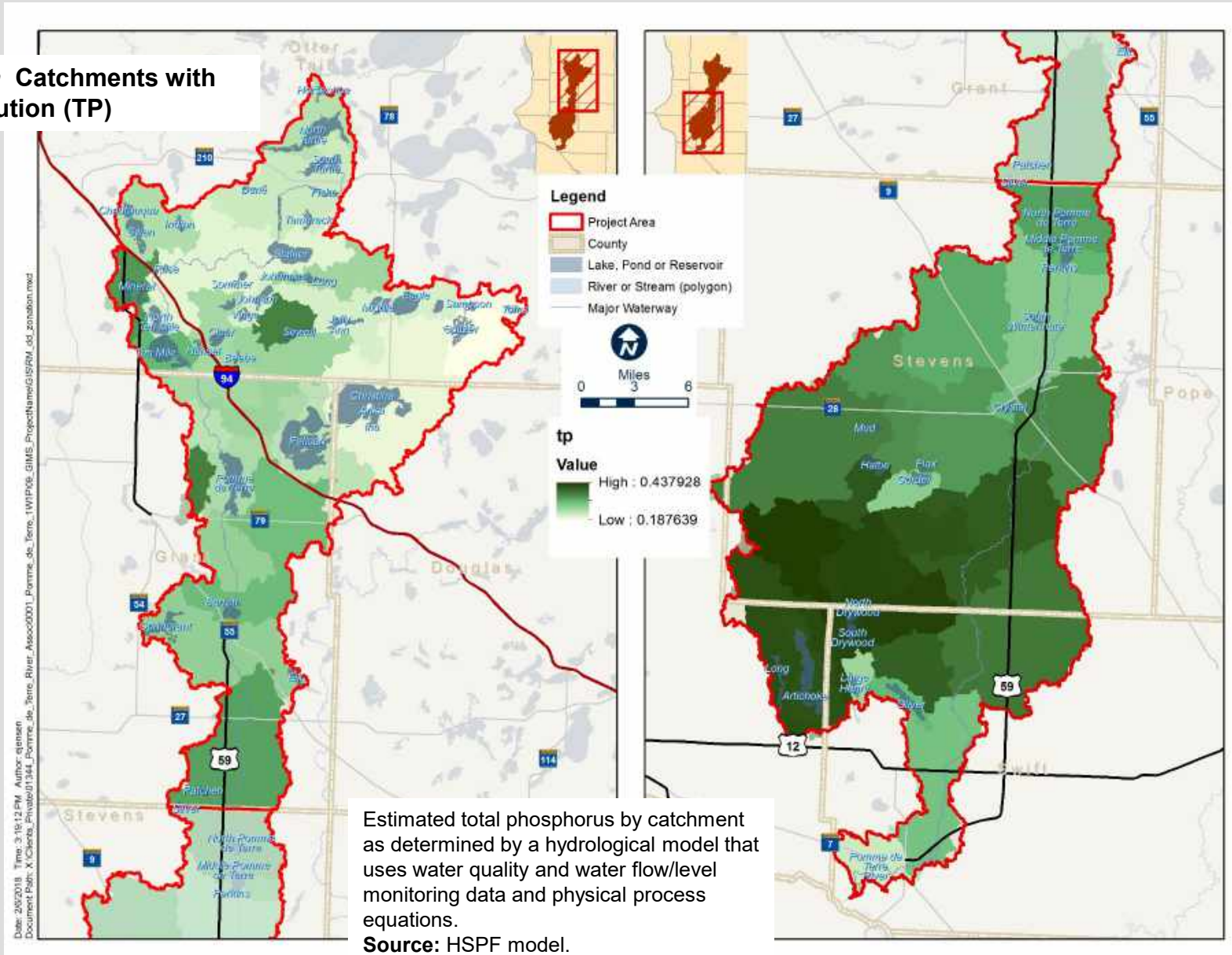


Estimated total nitrogen by catchment as determined by a hydrological model that uses water quality and water flow/level monitoring data and physical process equations.

Source: HSPF model.

Protect or Improve Waters of Concern – Lakes and Rivers

Focus on **Catchments with high pollution (TP)**

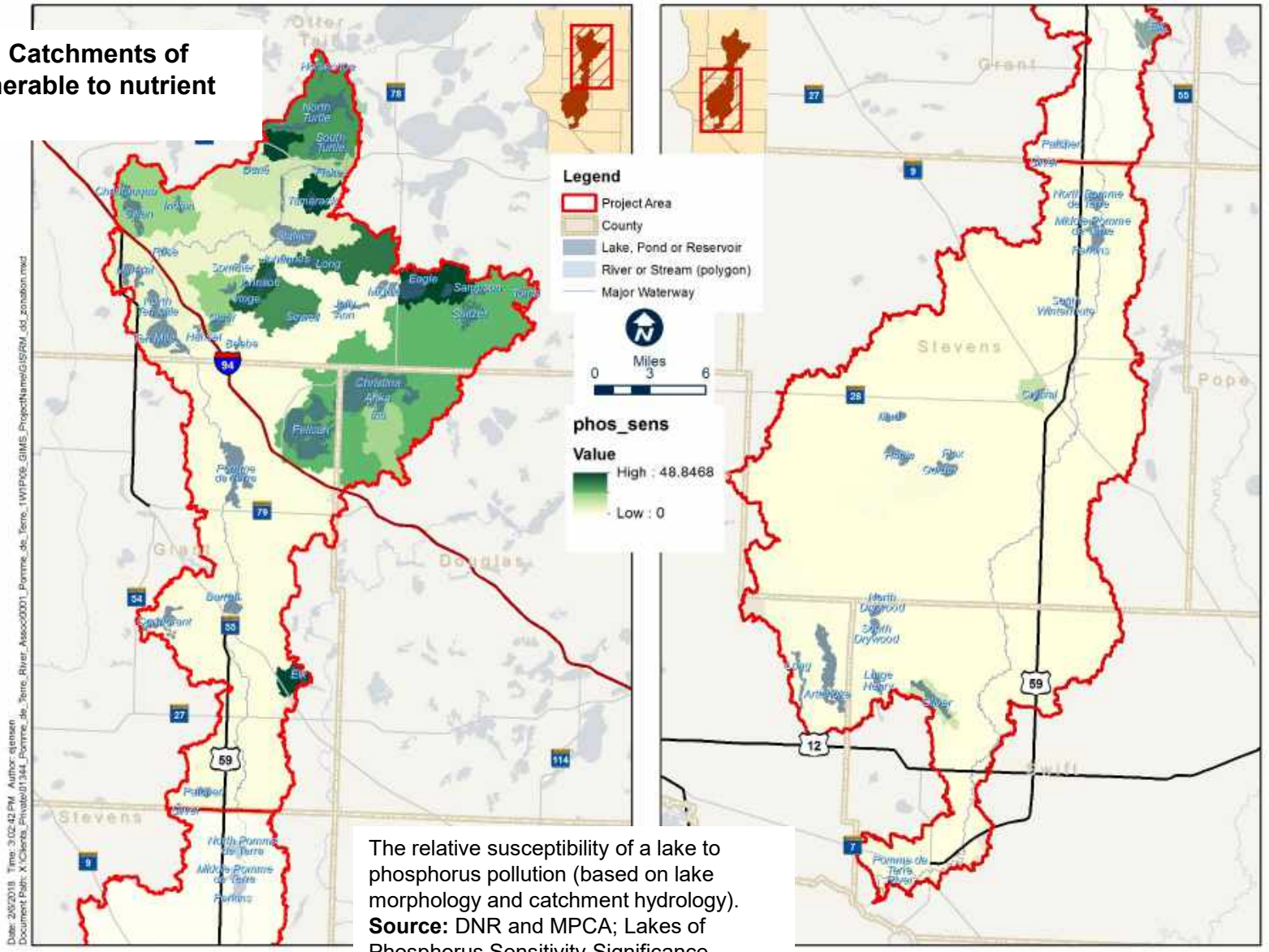


Estimated total phosphorus by catchment as determined by a hydrological model that uses water quality and water flow/level monitoring data and physical process equations.

Source: HSPF model.

Protect or Improve Waters of Concern – Lakes and Rivers

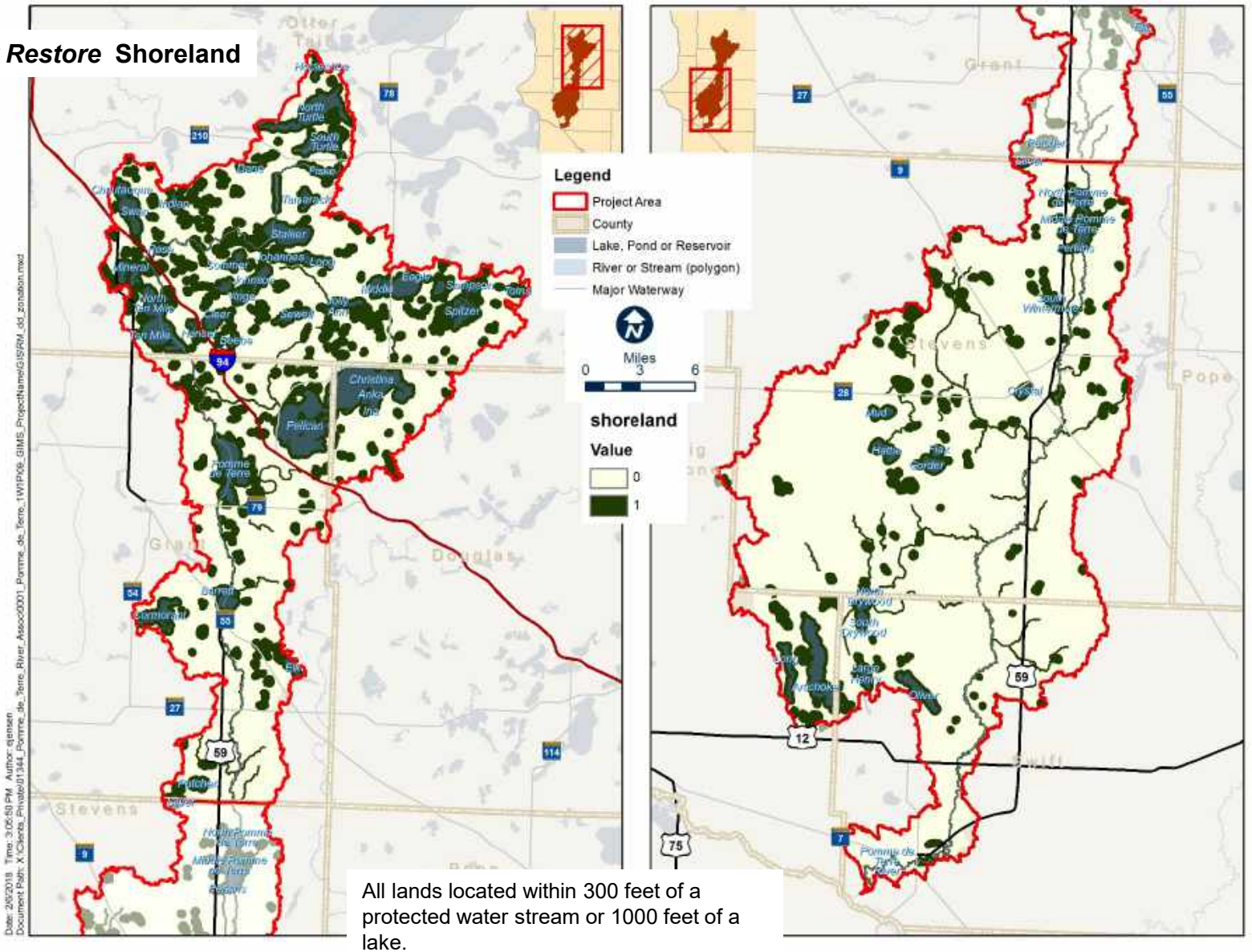
Focus on **Catchments of lakes vulnerable to nutrient addition**



The relative susceptibility of a lake to phosphorus pollution (based on lake morphology and catchment hydrology). **Source:** DNR and MPCA; Lakes of Phosphorus Sensitivity Significance.

Protect or Improve Waters of Concern – Lakes and Rivers

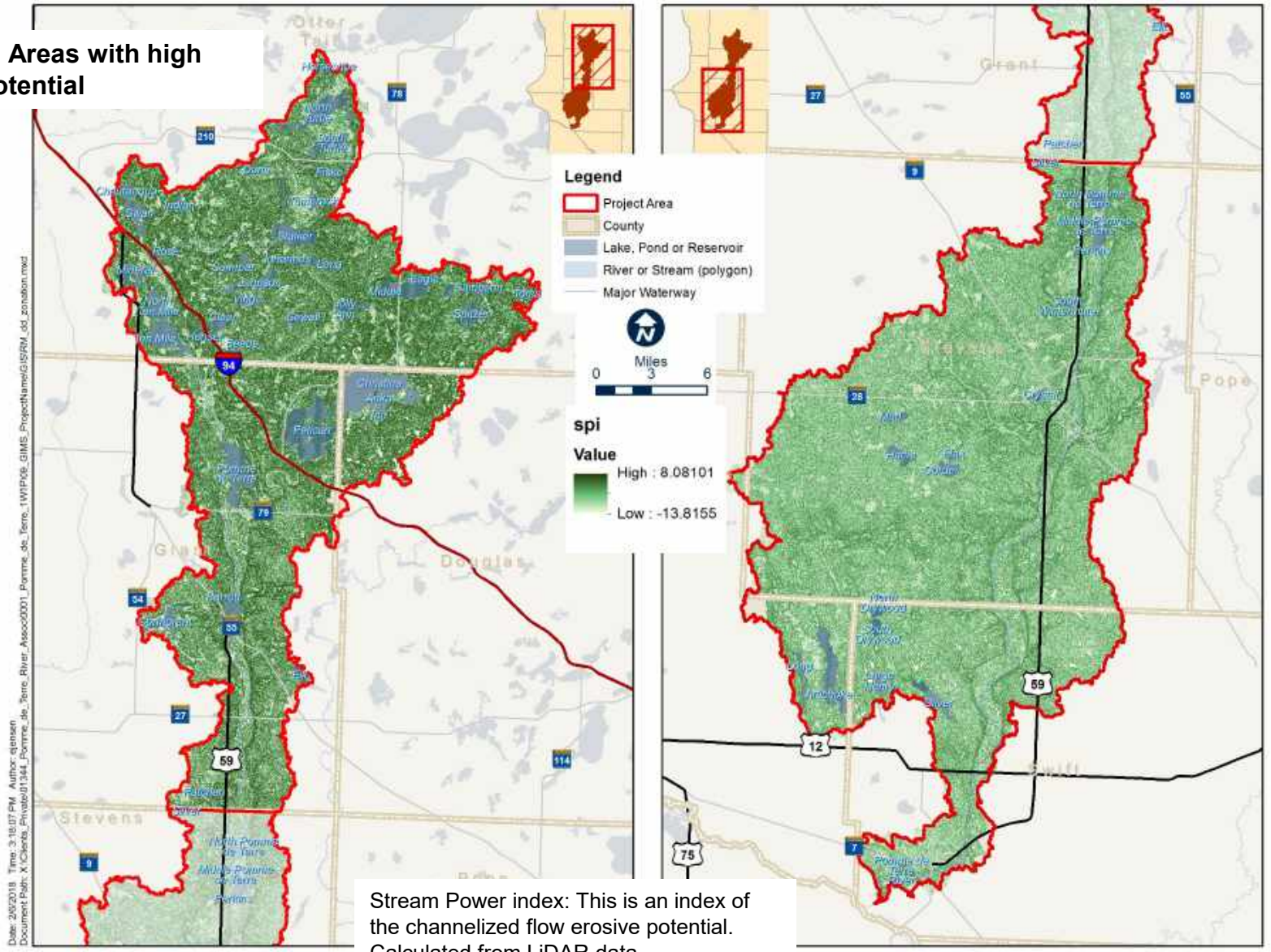
Protect or Restore **Shoreland**



All lands located within 300 feet of a protected water stream or 1000 feet of a lake.

Reduce Erosion & Runoff

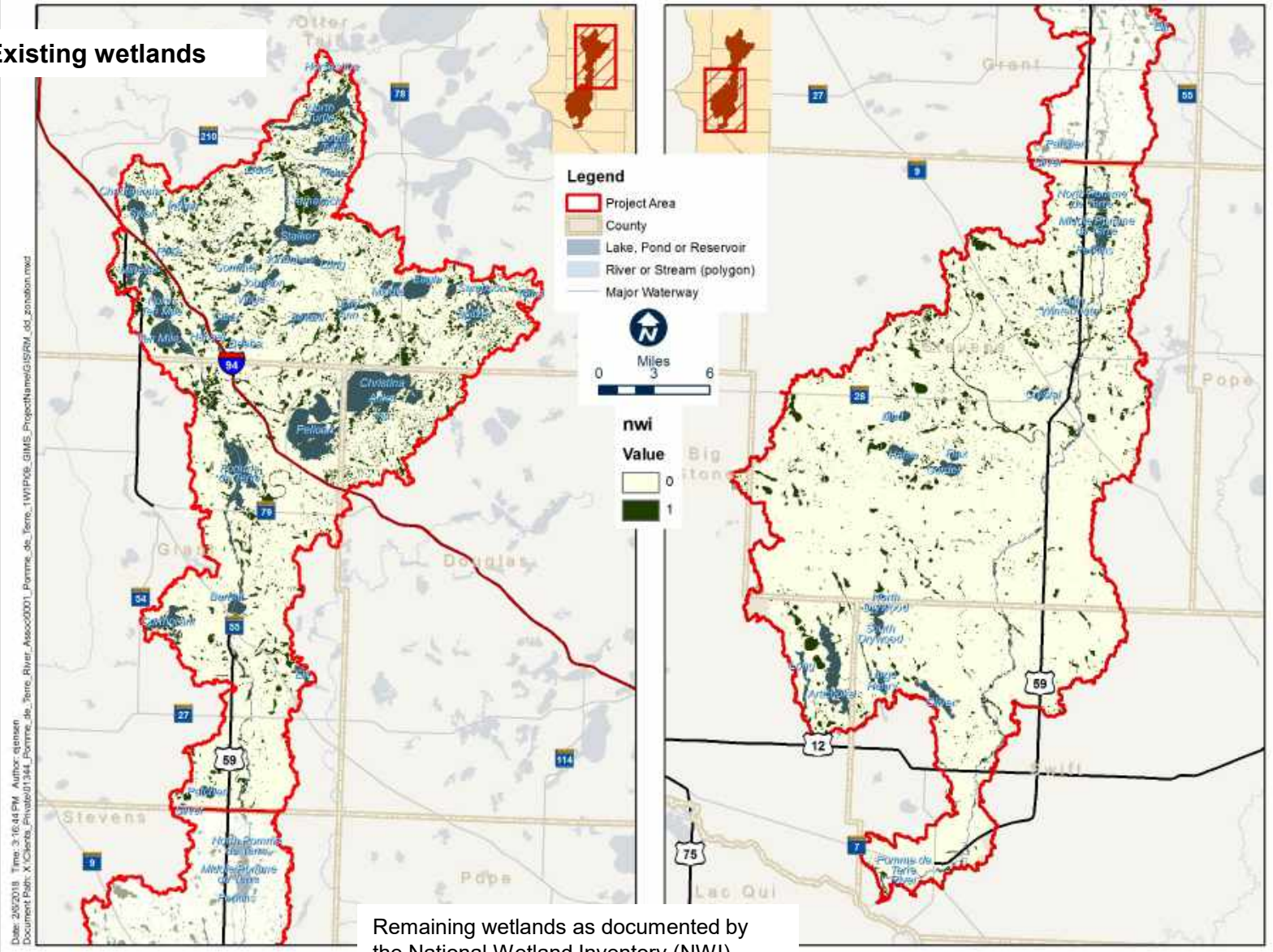
Focus on **Areas with high erosive potential**



Stream Power index: This is an index of the channelized flow erosive potential. Calculated from LiDAR data.

Reduce Erosion & Runoff

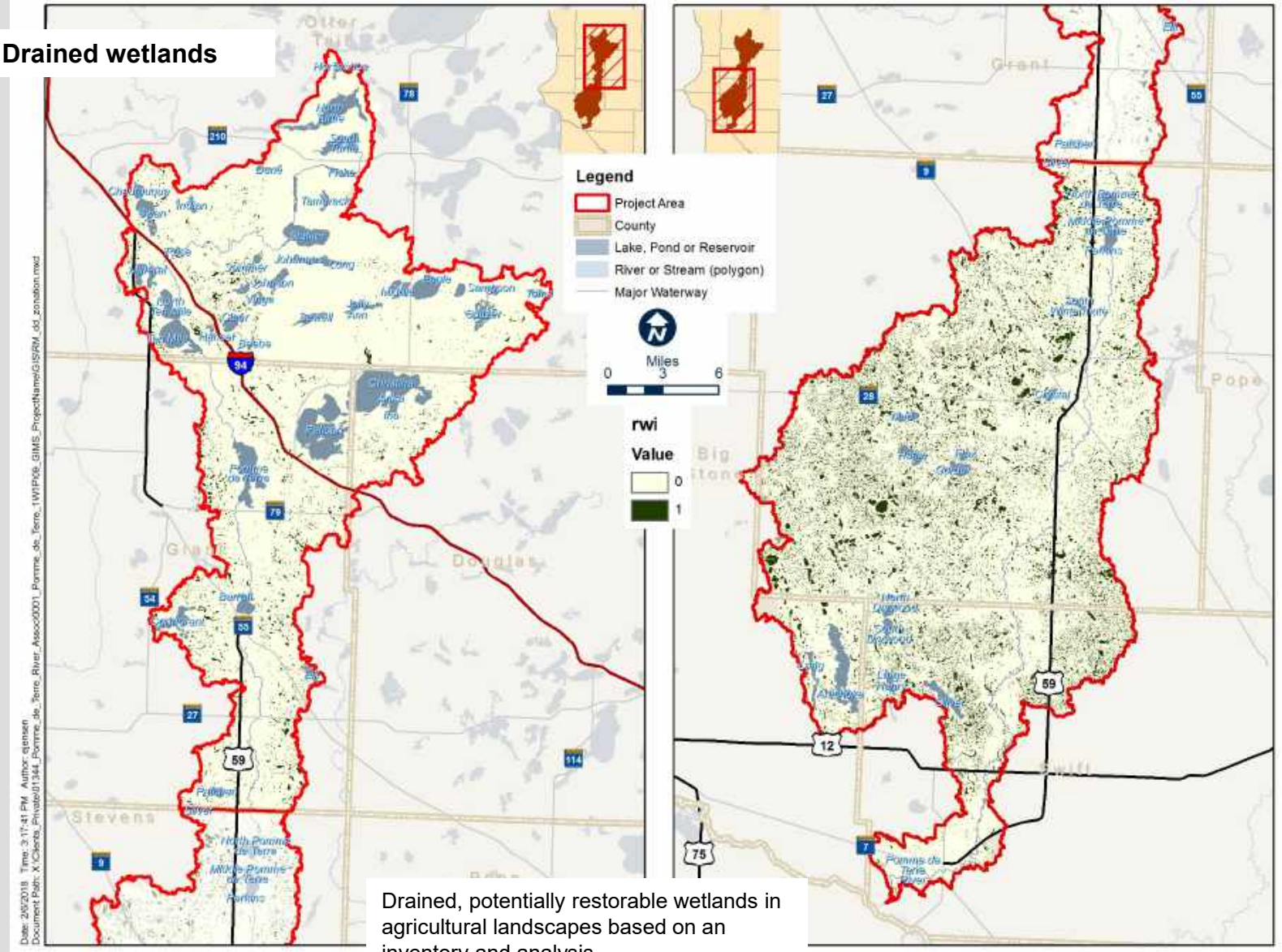
Protect **Existing wetlands**



Remaining wetlands as documented by the National Wetland Inventory (NWI).

Reduce Erosion & Runoff

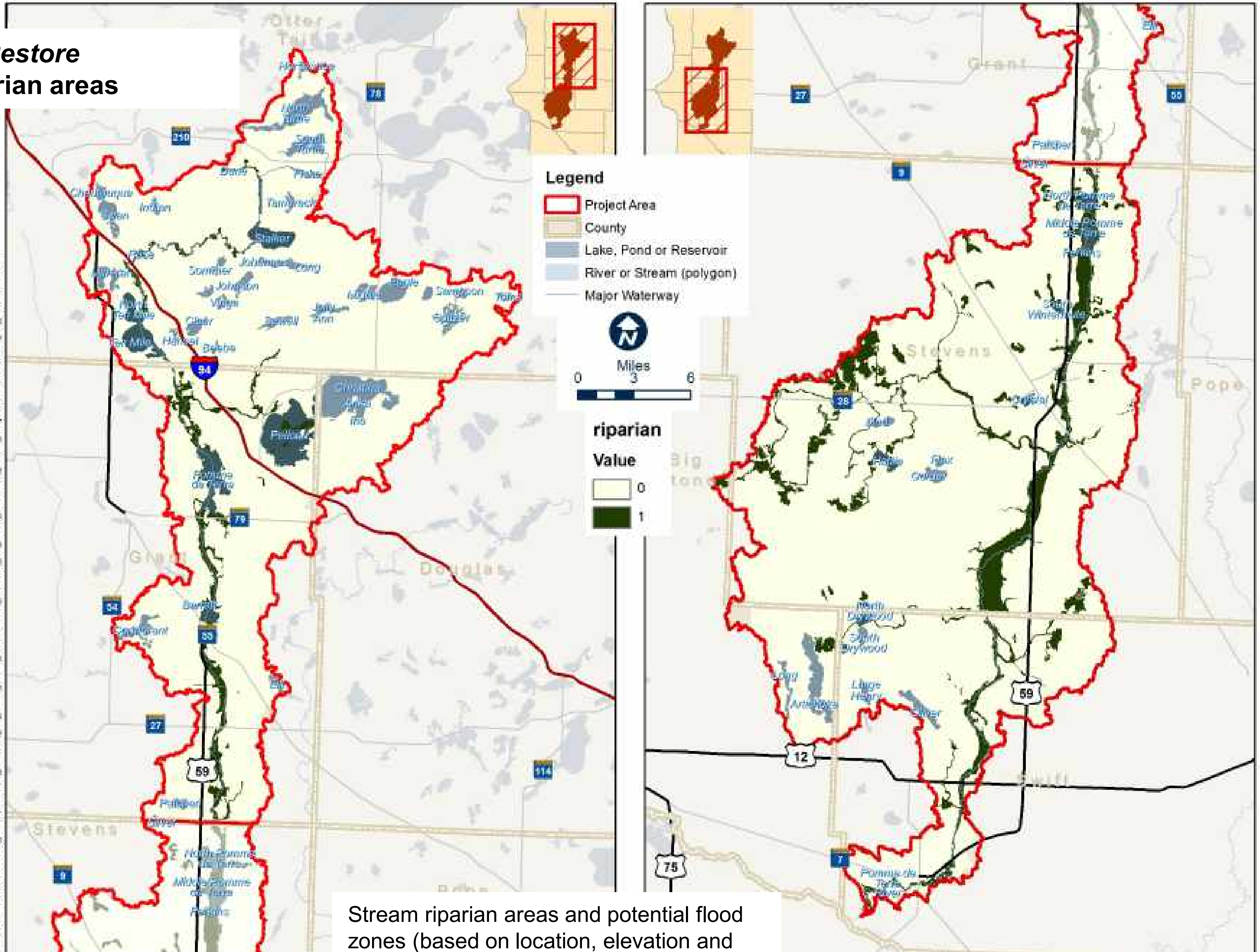
Restore **Drained wetlands**



Drained, potentially restorable wetlands in agricultural landscapes based on an inventory and analysis.

Reduce Erosion & Runoff

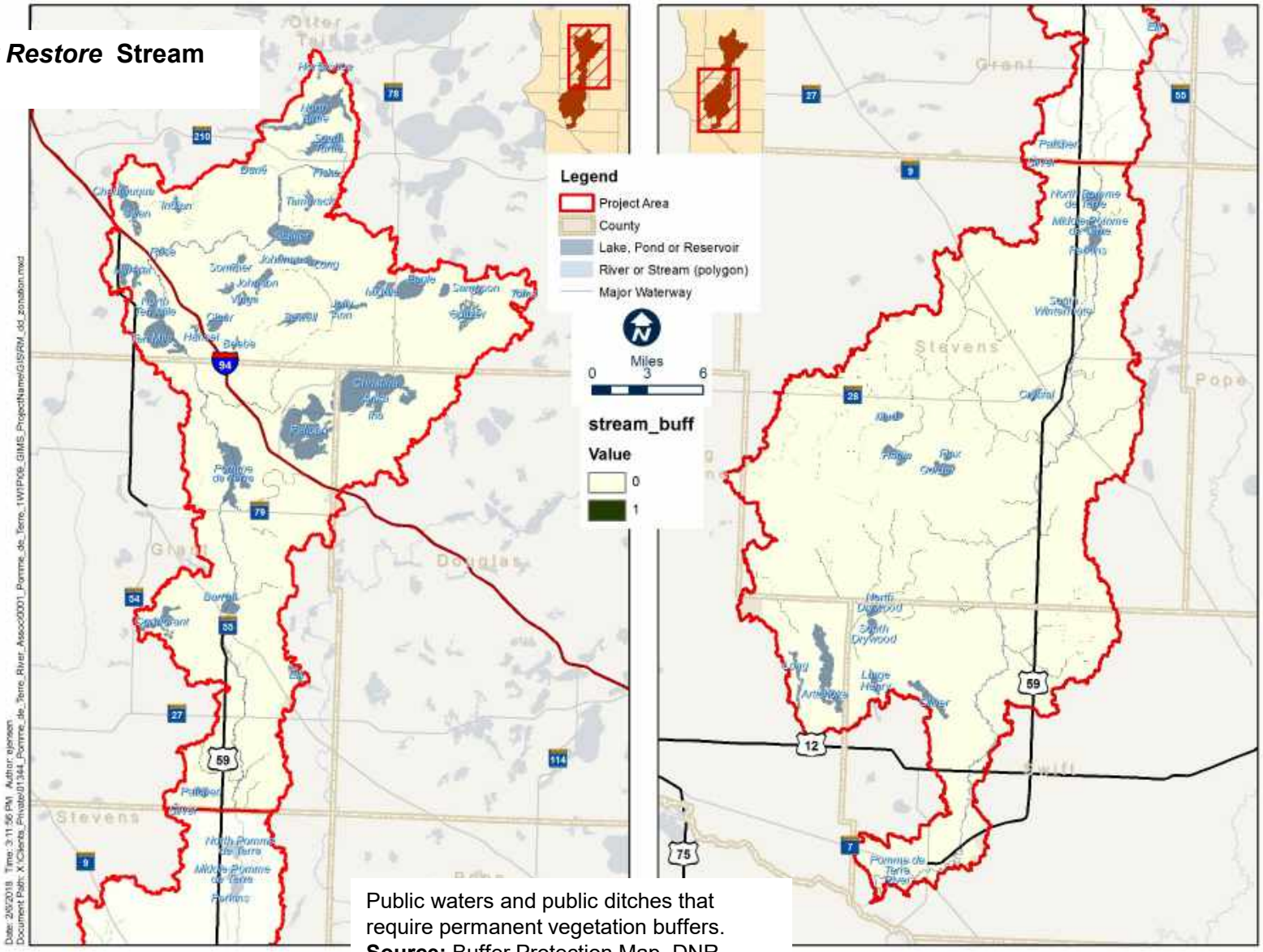
Protect or Restore
Stream riparian areas



Stream riparian areas and potential flood zones (based on location, elevation and soil type).

Reduce Erosion & Runoff

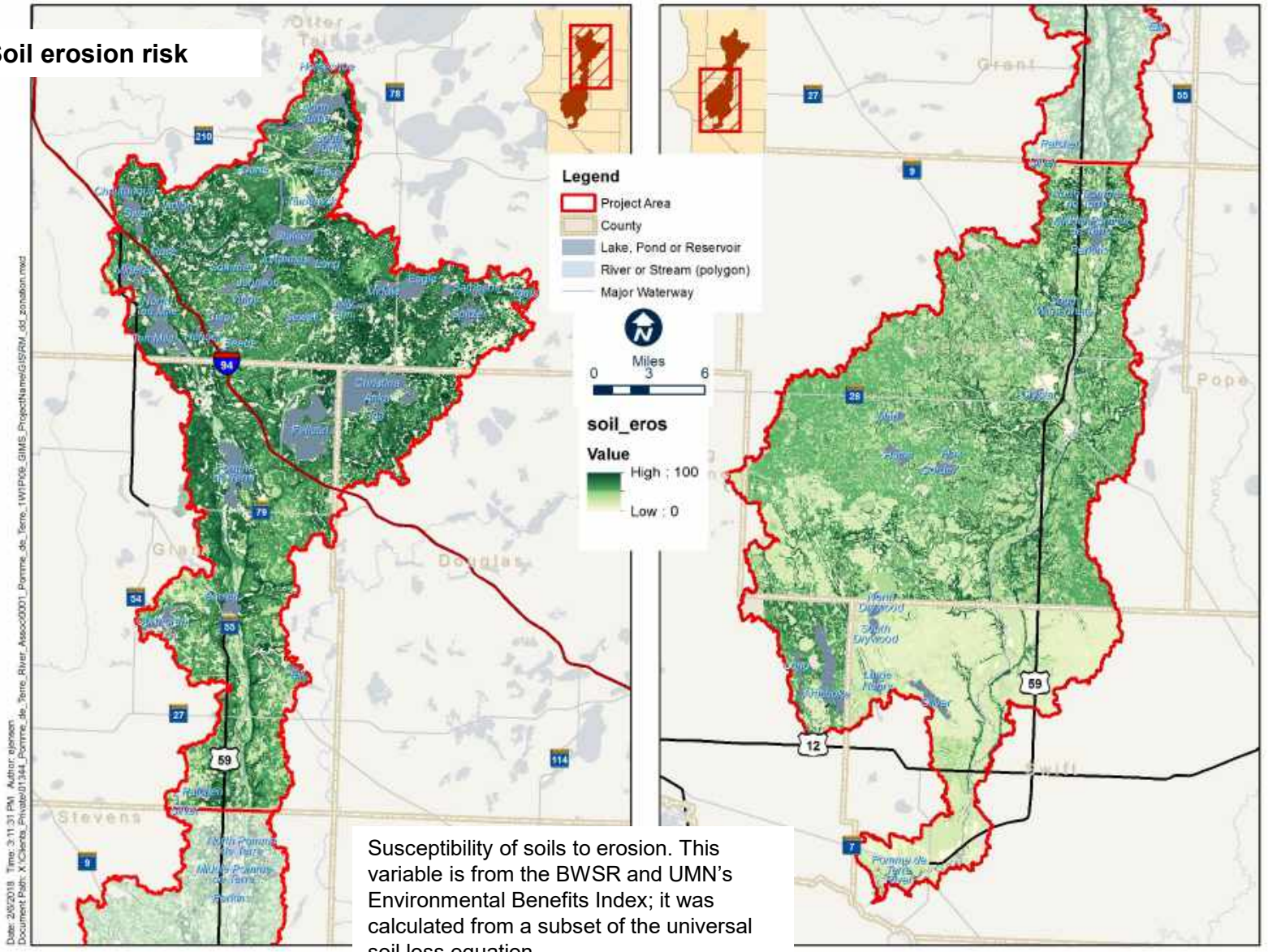
Protect or Restore **Stream buffers**



Public waters and public ditches that require permanent vegetation buffers.
Source: Buffer Protection Map, DNR.

Reduce Erosion & Runoff

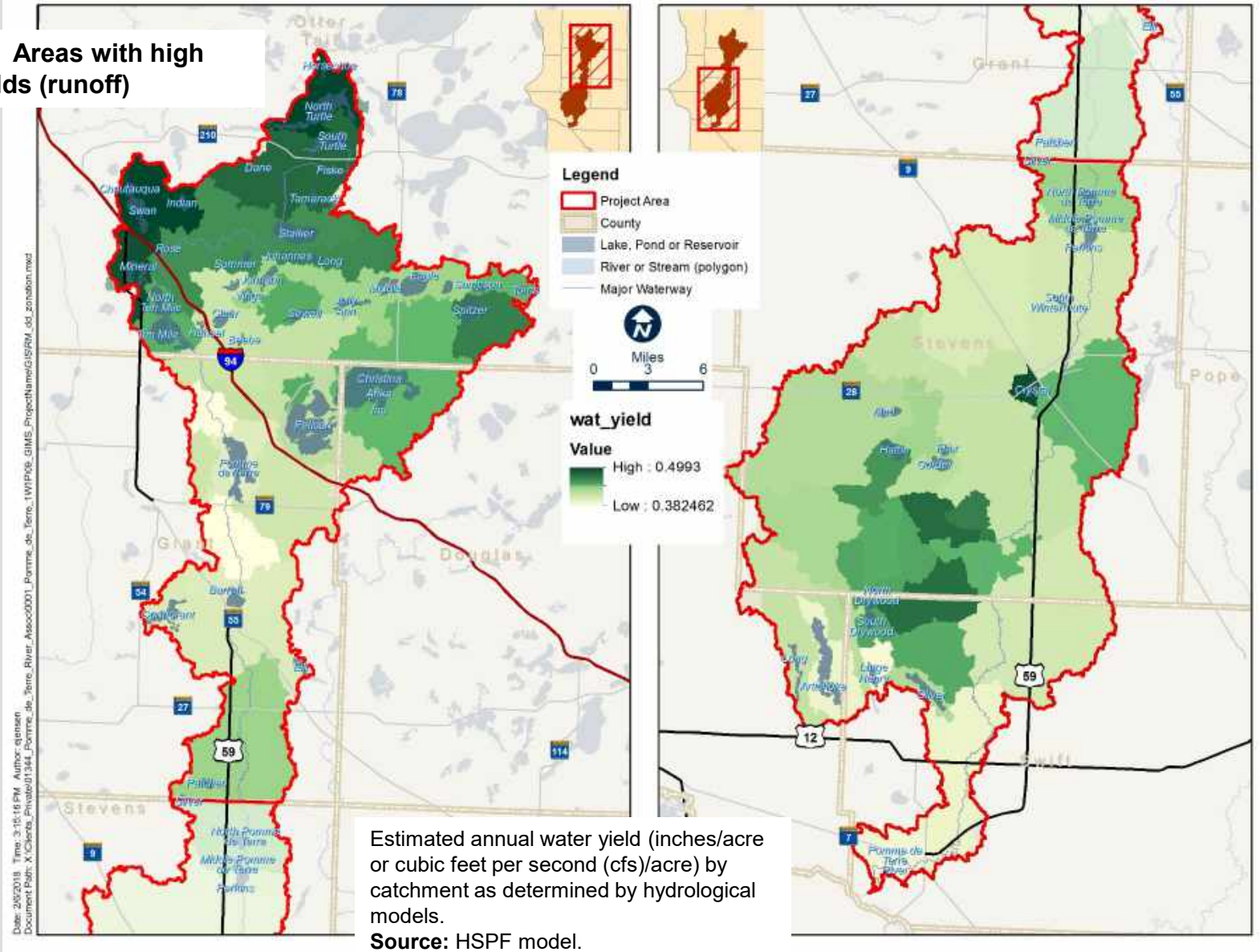
Reduce **Soil erosion risk**



Susceptibility of soils to erosion. This variable is from the BWSR and UMN's Environmental Benefits Index; it was calculated from a subset of the universal soil loss equation.

Reduce Erosion & Runoff

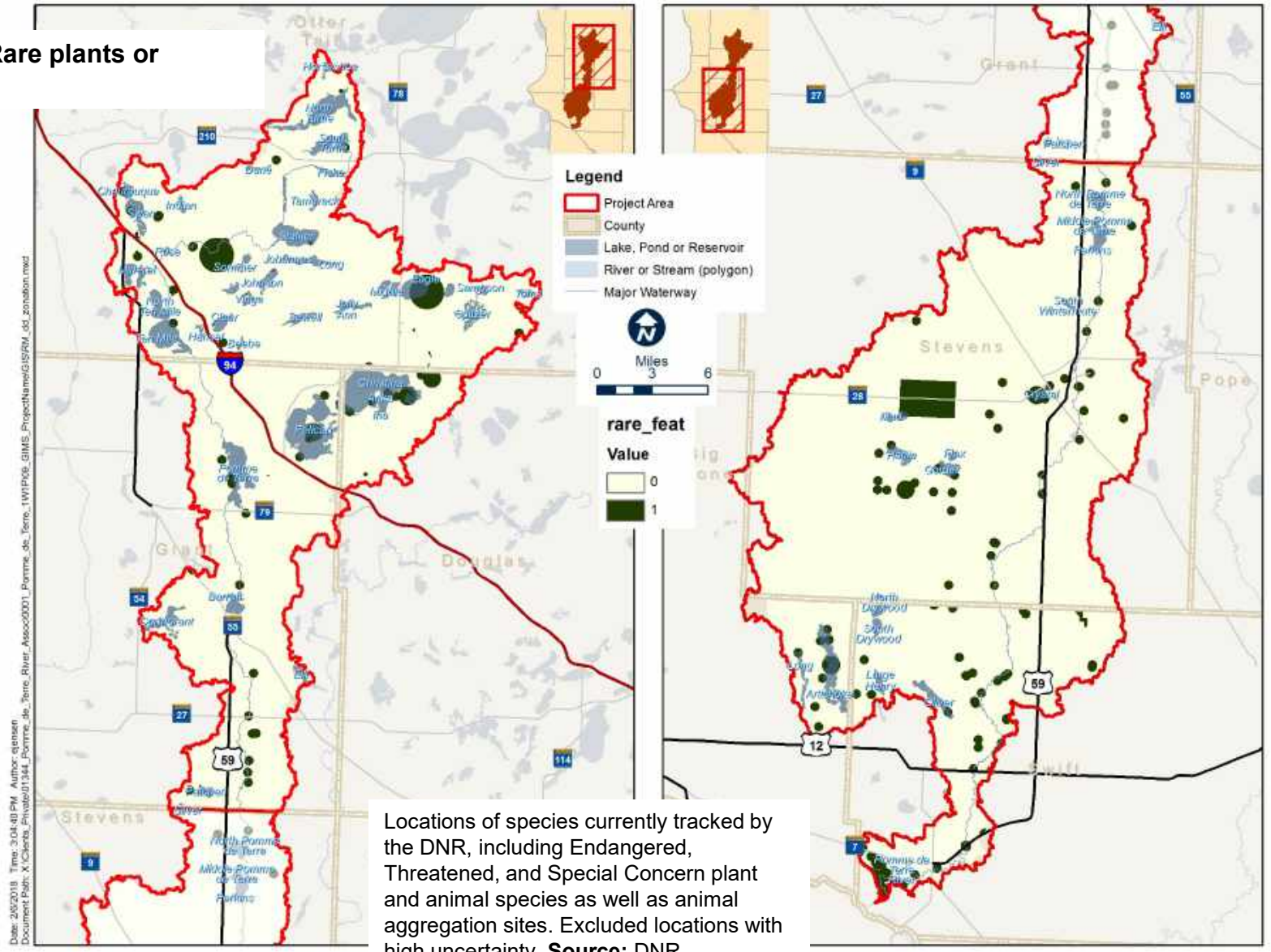
Focus on **Areas with high water yields (runoff)**



Estimated annual water yield (inches/acre or cubic feet per second (cfs)/acre) by catchment as determined by hydrological models.
Source: HSPF model.

Protect or Improve Fish & Wildlife Habitat

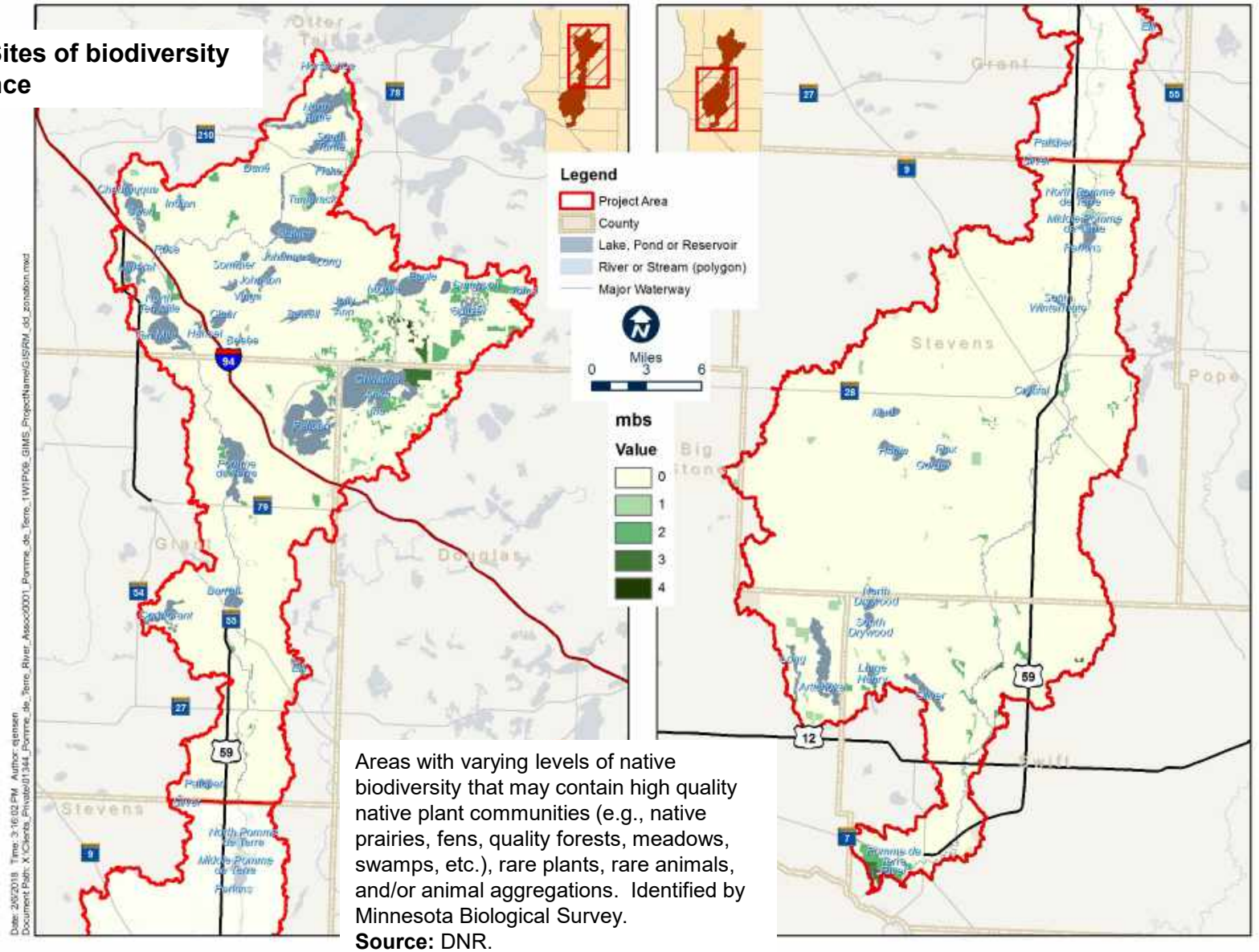
Protect **Rare plants or animals**



Locations of species currently tracked by the DNR, including Endangered, Threatened, and Special Concern plant and animal species as well as animal aggregation sites. Excluded locations with high uncertainty. **Source:** DNR.

Protect or Improve Fish & Wildlife Habitat

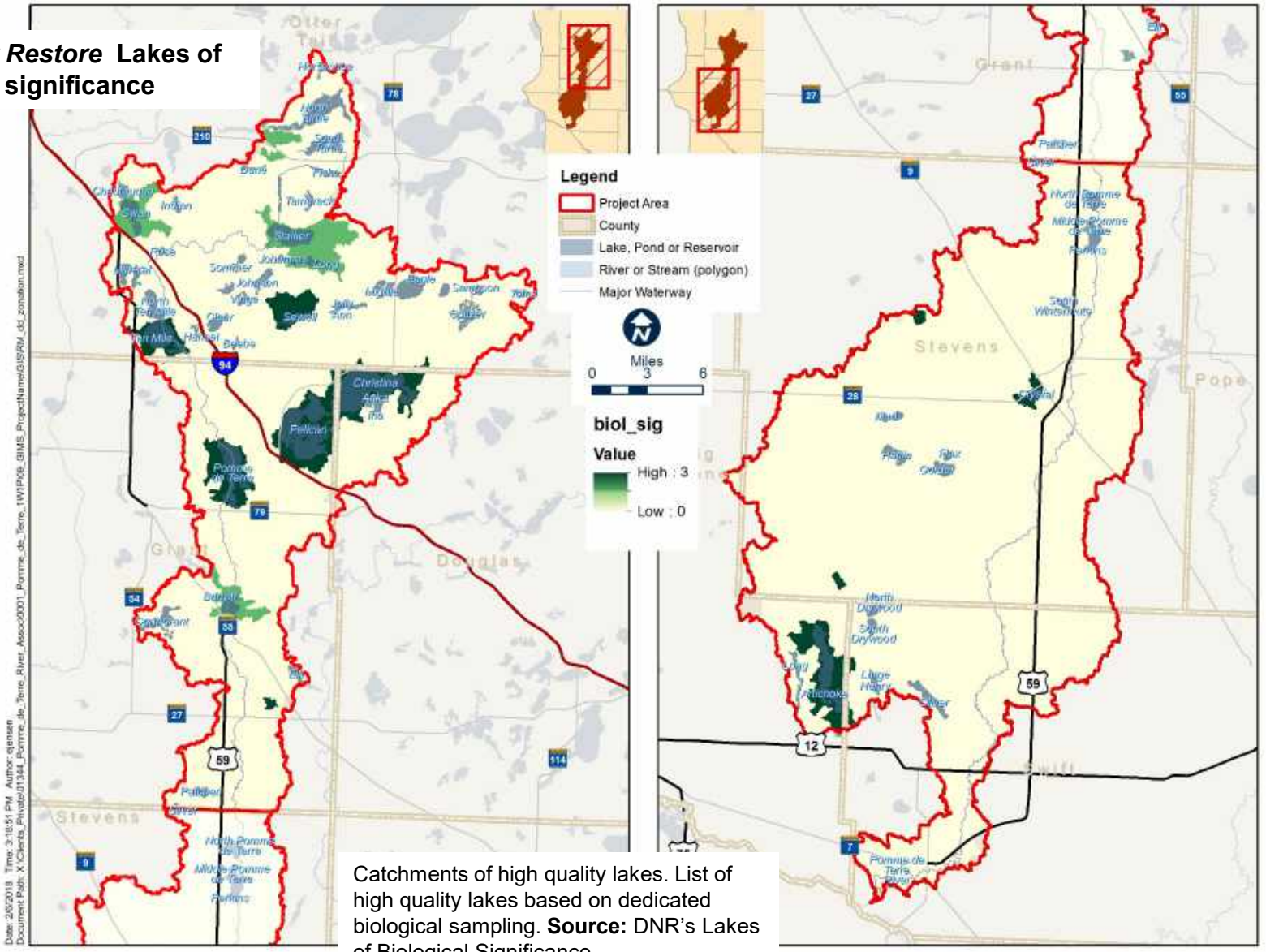
Protect **Sites of biodiversity significance**



Areas with varying levels of native biodiversity that may contain high quality native plant communities (e.g., native prairies, fens, quality forests, meadows, swamps, etc.), rare plants, rare animals, and/or animal aggregations. Identified by Minnesota Biological Survey.
Source: DNR.

Protect or Improve Fish & Wildlife Habitat

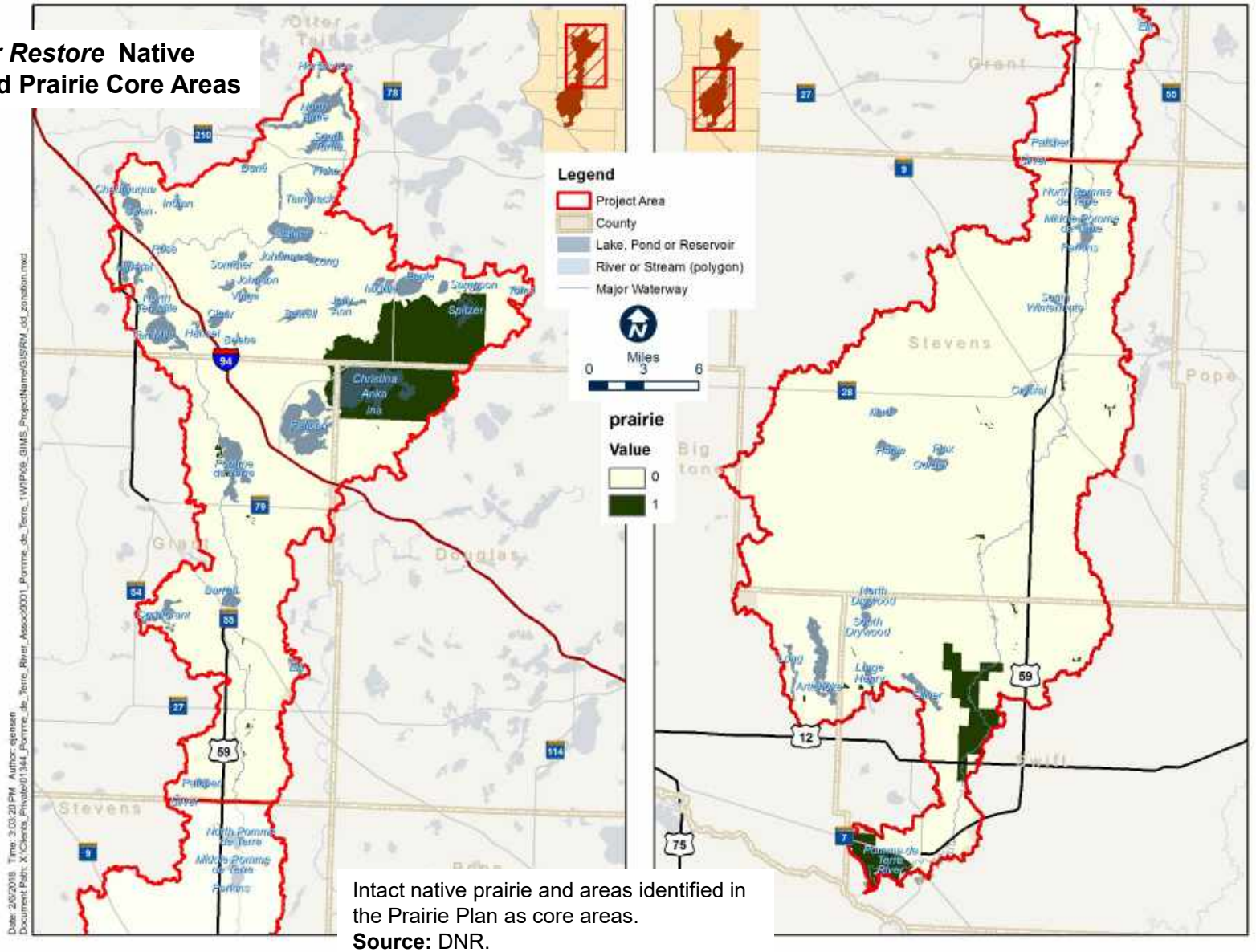
Protect or Restore **Lakes of biological significance**



Catchments of high quality lakes. List of high quality lakes based on dedicated biological sampling. **Source:** DNR's Lakes of Biological Significance.

Protect or Improve Fish & Wildlife Habitat

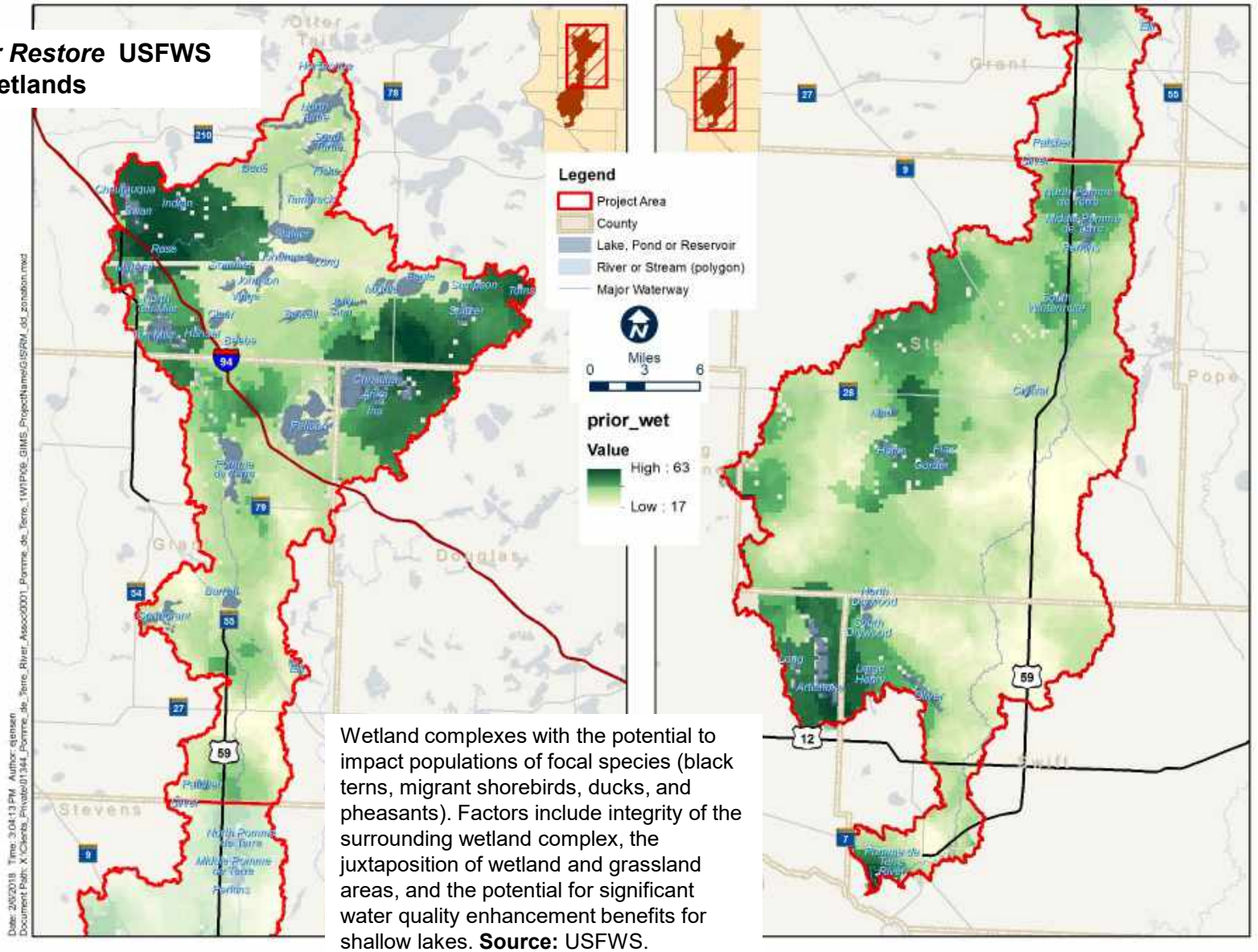
Protect or Restore **Native prairie and Prairie Core Areas**



Intact native prairie and areas identified in the Prairie Plan as core areas.
Source: DNR.

Protect or Improve Fish & Wildlife Habitat

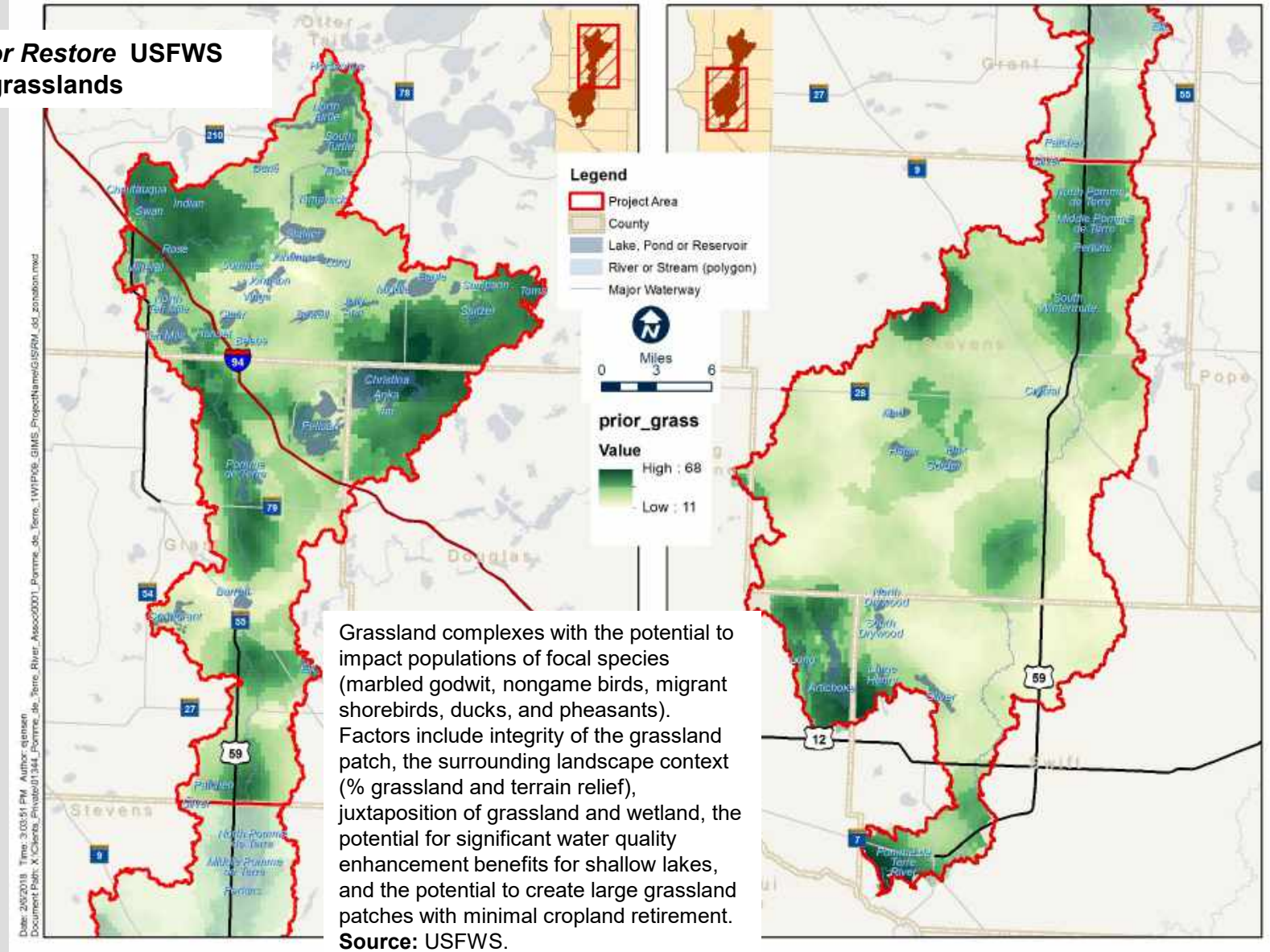
Protect or Restore **USFWS priority wetlands**



Wetland complexes with the potential to impact populations of focal species (black terns, migrant shorebirds, ducks, and pheasants). Factors include integrity of the surrounding wetland complex, the juxtaposition of wetland and grassland areas, and the potential for significant water quality enhancement benefits for shallow lakes. **Source:** USFWS.

Protect or Improve Fish & Wildlife Habitat

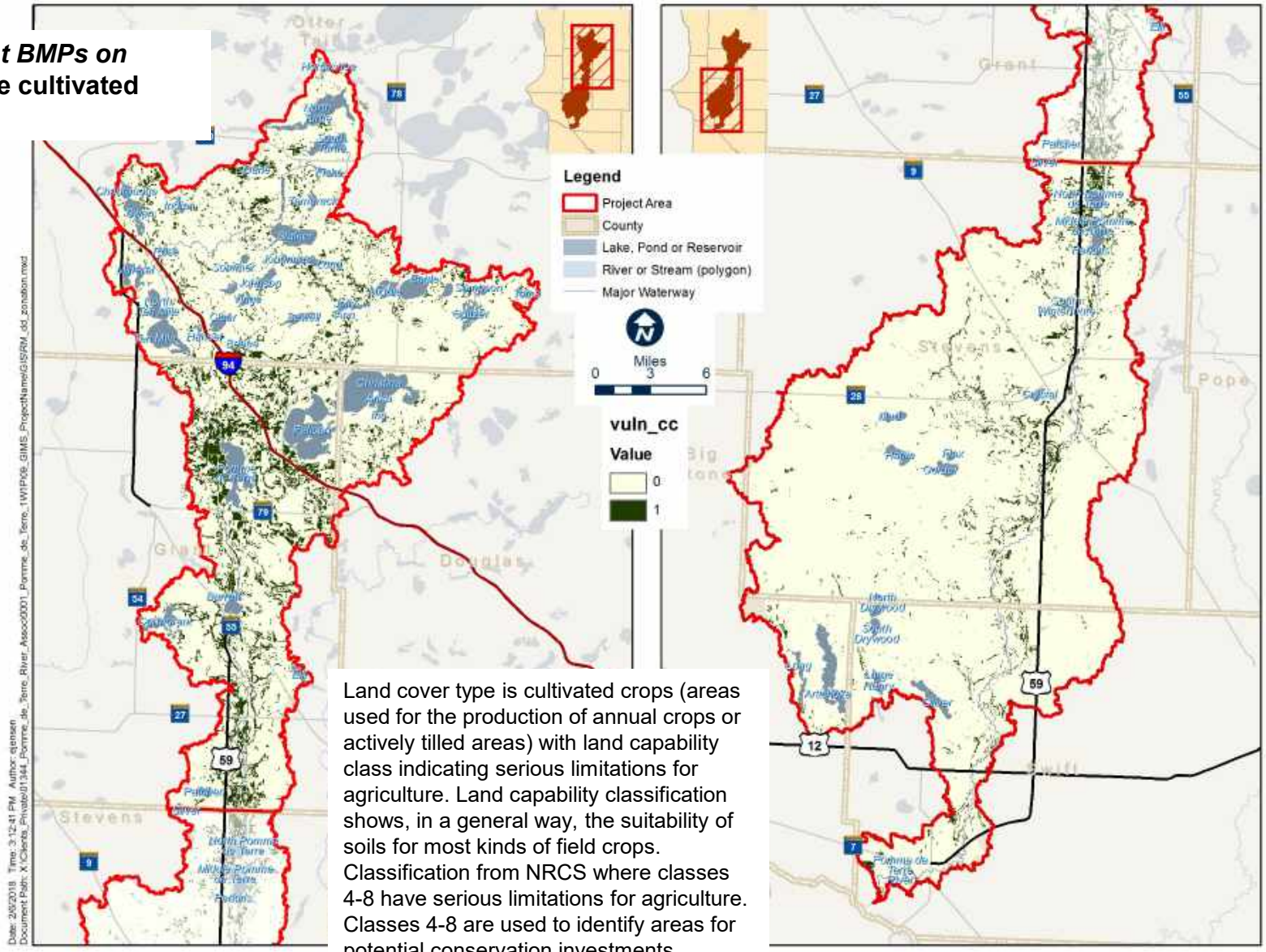
Protect or Restore **USFWS priority grasslands**



Grassland complexes with the potential to impact populations of focal species (marbled godwit, nongame birds, migrant shorebirds, ducks, and pheasants). Factors include integrity of the grassland patch, the surrounding landscape context (% grassland and terrain relief), juxtaposition of grassland and wetland, the potential for significant water quality enhancement benefits for shallow lakes, and the potential to create large grassland patches with minimal cropland retirement. **Source:** USFWS.

Protect or Restore Lands of Concern

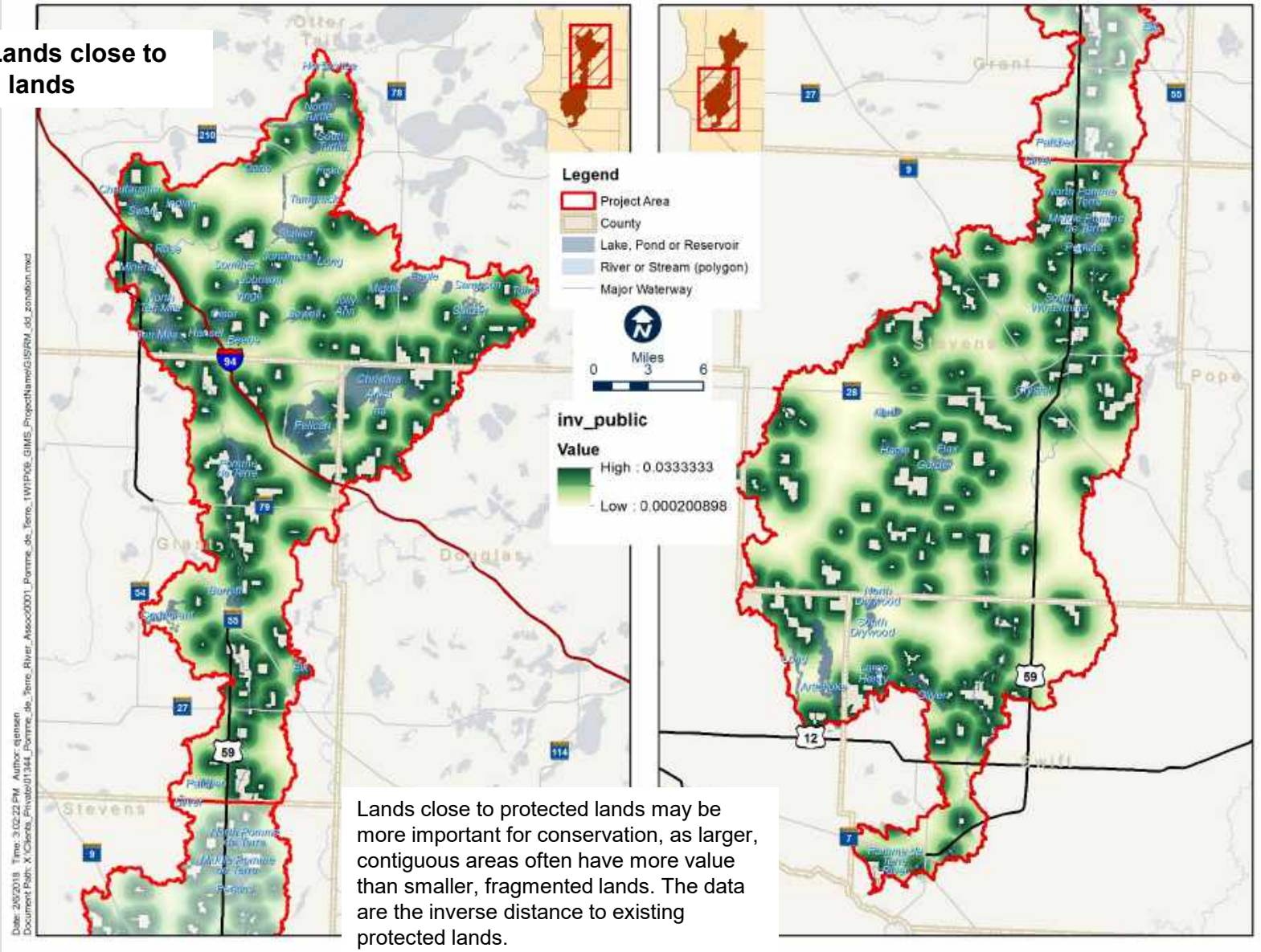
Implement BMPs on **Vulnerable cultivated cropland**



Land cover type is cultivated crops (areas used for the production of annual crops or actively tilled areas) with land capability class indicating serious limitations for agriculture. Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Classification from NRCS where classes 4-8 have serious limitations for agriculture. Classes 4-8 are used to identify areas for potential conservation investments.

Protect or Restore Lands of Concern

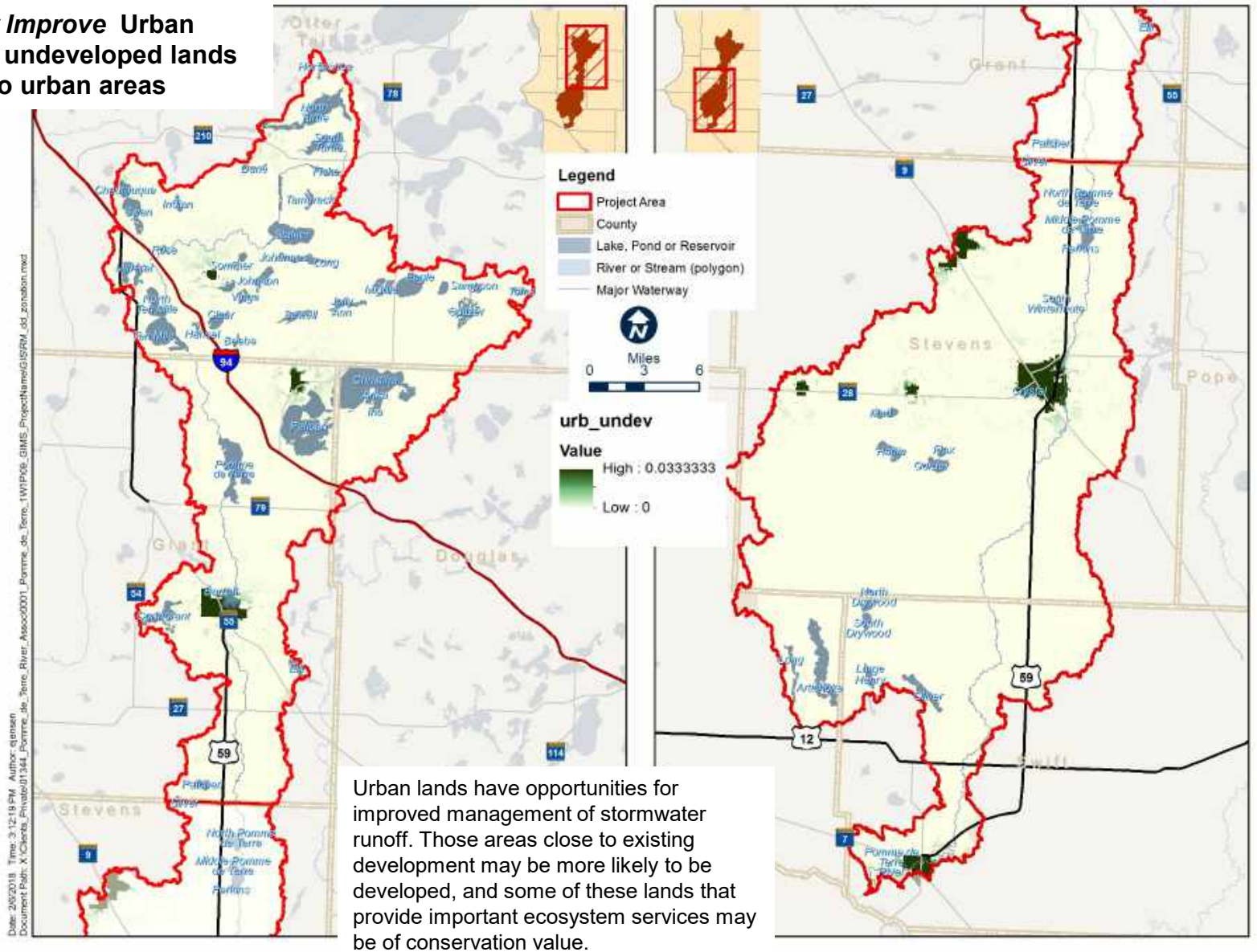
Protect **Lands close to protected lands**



Lands close to protected lands may be more important for conservation, as larger, contiguous areas often have more value than smaller, fragmented lands. The data are the inverse distance to existing protected lands.

Protect or Restore Lands of Concern

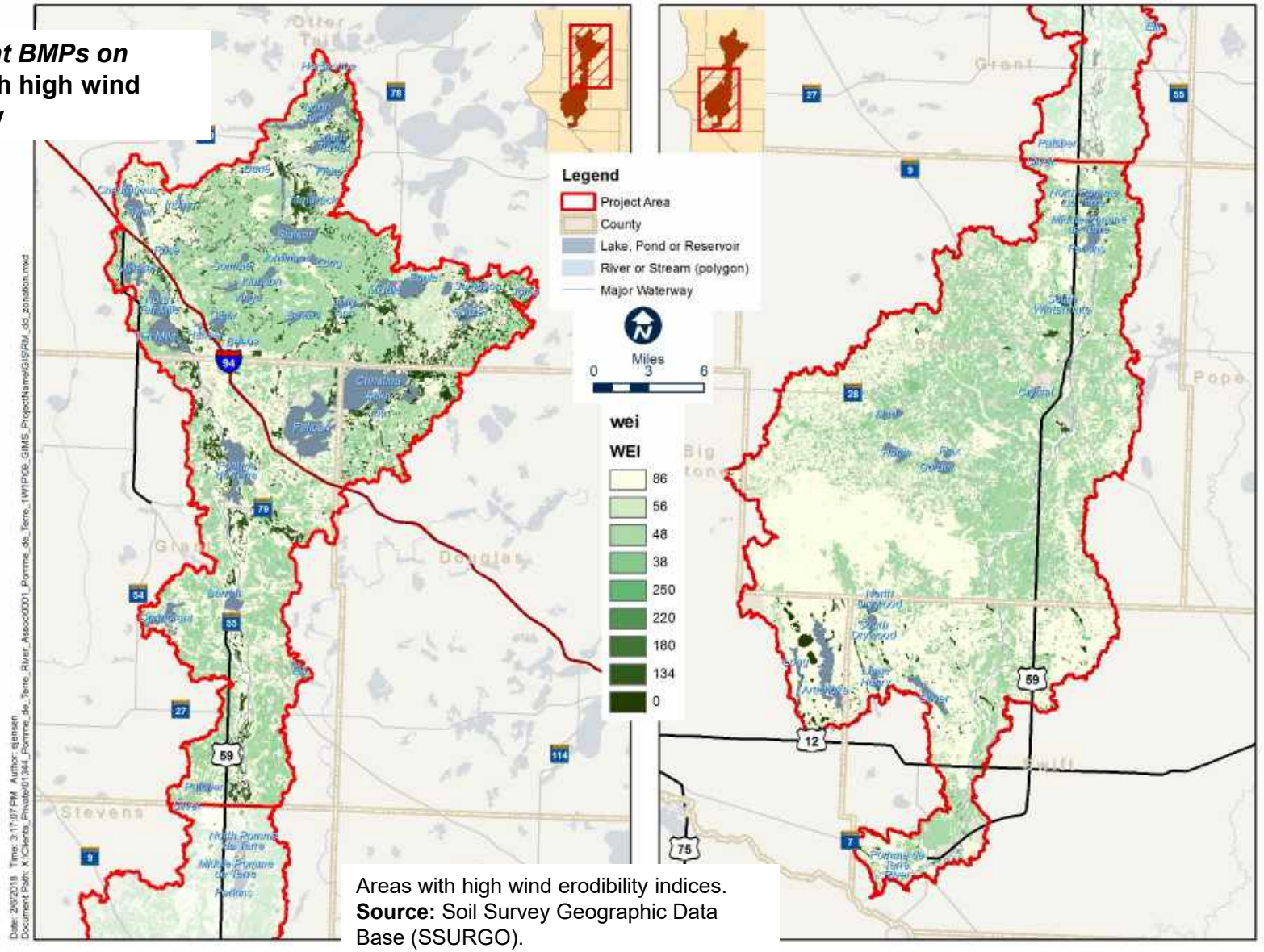
Protect or Improve **Urban areas and undeveloped lands adjacent to urban areas**



Urban lands have opportunities for improved management of stormwater runoff. Those areas close to existing development may be more likely to be developed, and some of these lands that provide important ecosystem services may be of conservation value.

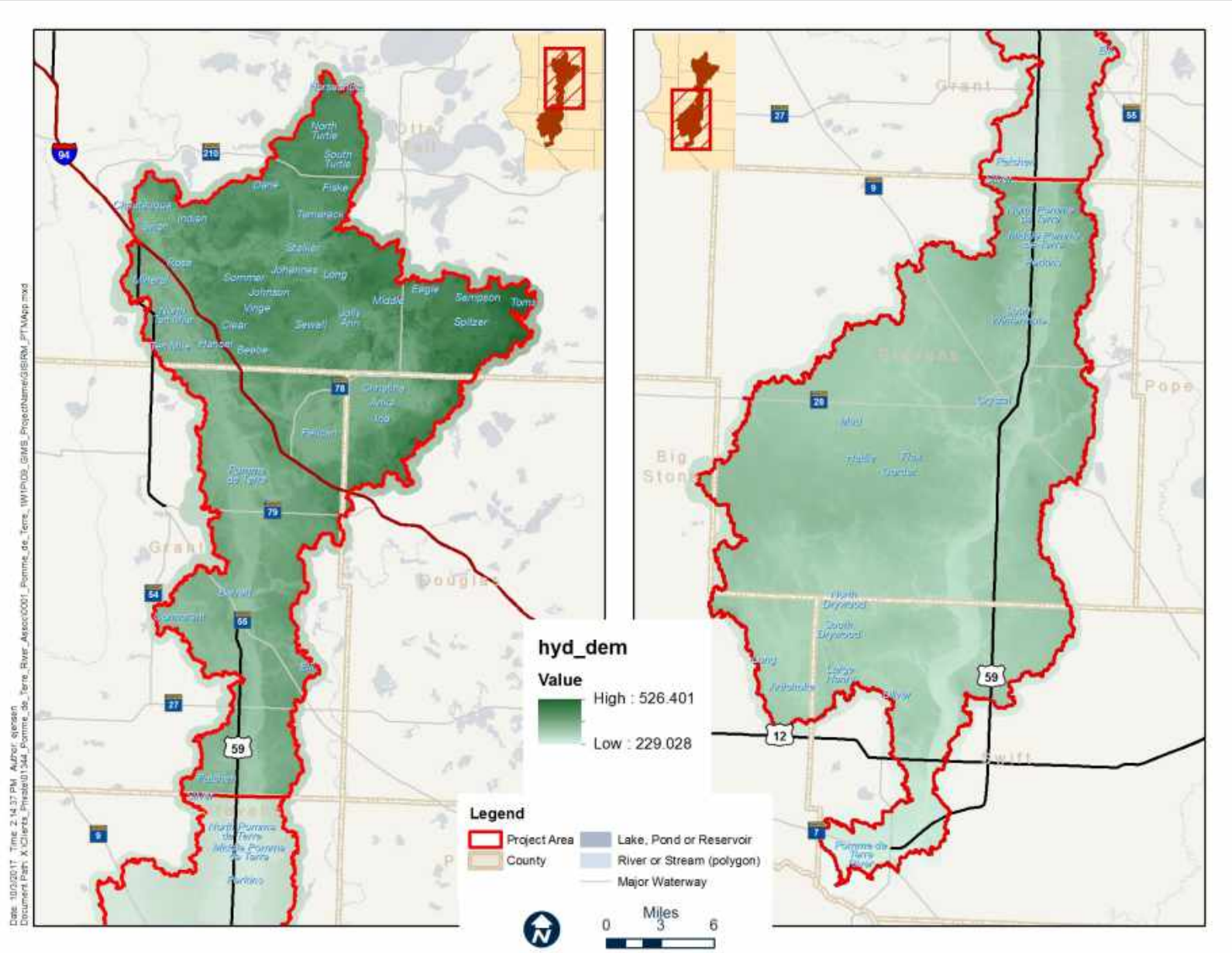
Protect or Restore Lands of Concern

Implement BMPs on
Areas with high wind erodibility

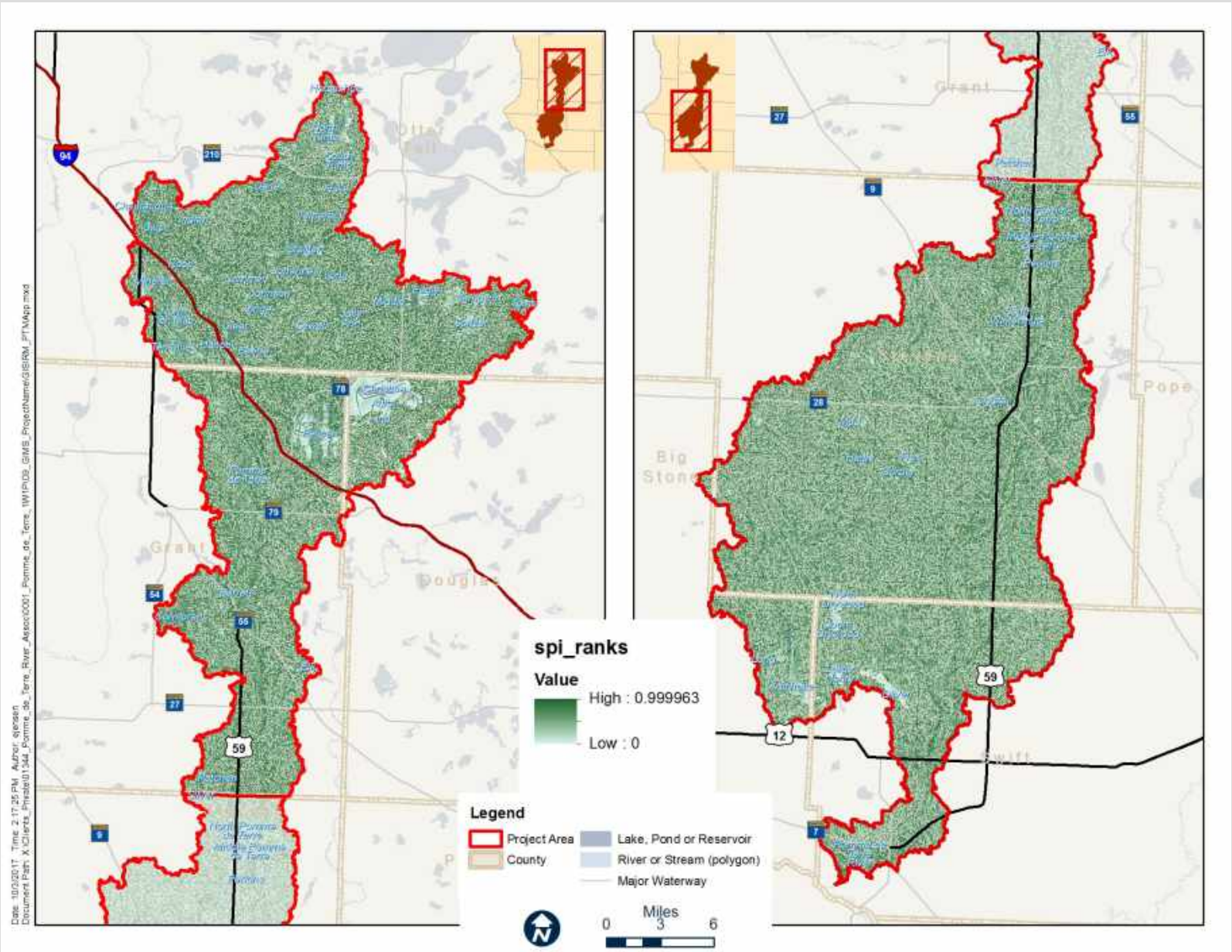


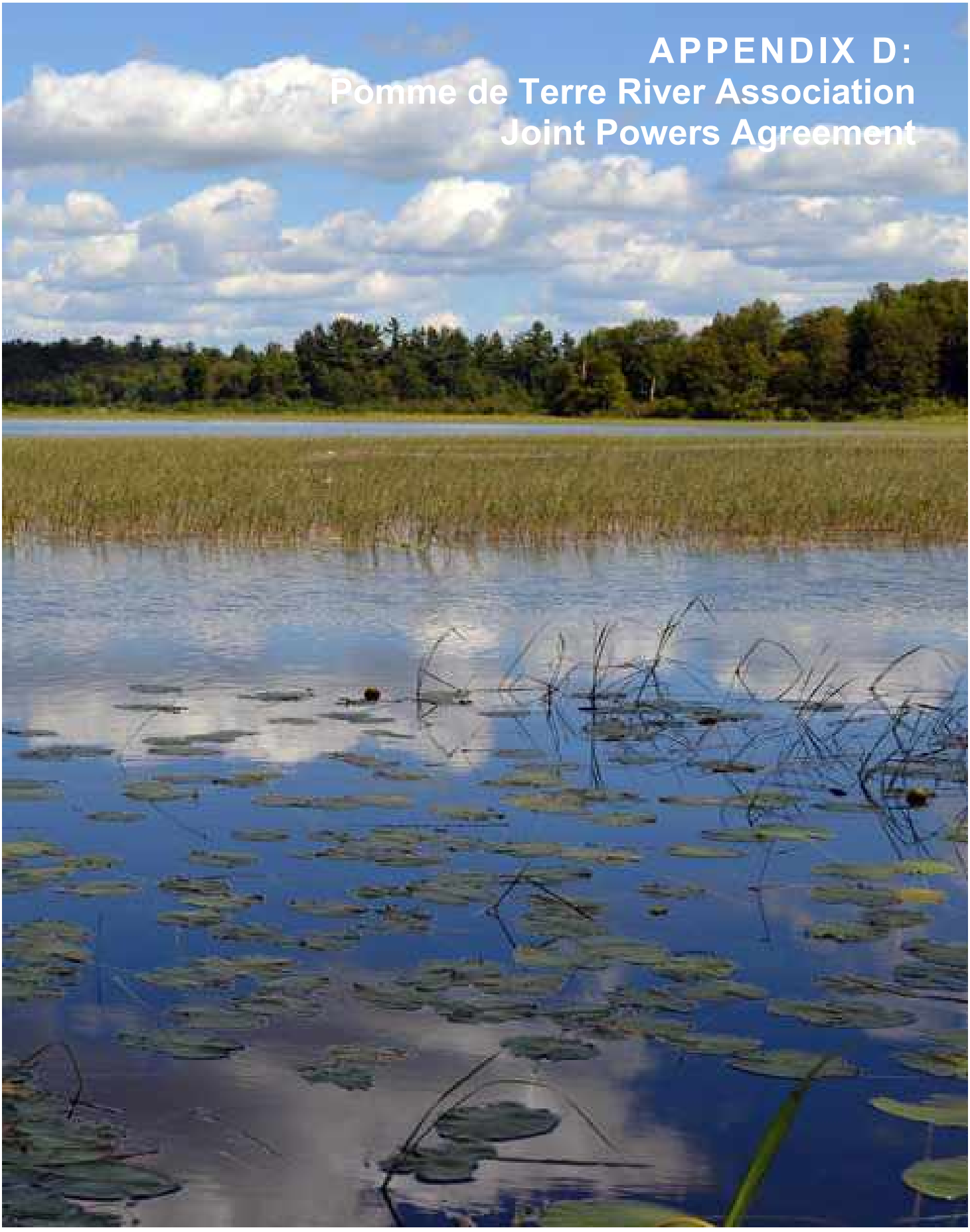
Areas with high wind erodibility indices.
Source: Soil Survey Geographic Data Base (SSURGO).

PTMApp: Hydro-conditioned DEM



PTMApp: Stream Power Index Rank





APPENDIX D:
Pomme de Terre River Association Joint Powers Agreement

Pomme de Terre River Association
Joint Powers Agreement

Article 1
Enabling Authority

THIS AMENDED AND RESTATED AGREEMENT is made by and between the political subdivision organized and existing under the Constitution and laws of the State of Minnesota, hereafter collectively referred to as "Parties", and individually as "Party" which are signatories to this "Agreement."

Minnesota Statutes, Section 471.59 provides that two or more governmental units may by Agreement jointly exercise any power common to the contracting Parties or any similar powers including those which are the same except for the territorial limits within which they may be exercised. The agreement may provide for the exercise of such powers by one or more of the participating governmental units on behalf of the other participating units. The term "governmental unit" as used in this section includes every city, county, town, school district, other political subdivision of this or any adjoin state, and any agency of the State of Minnesota of the United States, and includes any instrumentality of a governmental unit means an instrumentality having independent policy making and appropriating authority.

In consideration of the mutual promises and Agreements contained herein and subject to the provisions of Minnesota Statutes, Sections 471.59 and all other applicable statutes, rules and regulations, the following Parties:

Big Stone County, Douglas County, Grant County, Otter Tail County, Stevens County, Swift County, Big Stone SWCD, Douglas SWCD, Grant SWCD, West Otter Tail SWCD, Stevens SWCD, Swift SWCD

hereto agree as follows:

Article 2
Purpose

The purpose of this agreement is the joint exercise of powers by the undersigned governmental units to develop and implement plans with regard to protection of property from damage of flooding; controlling erosion of land; protection of property, streams and lakes from sedimentation and pollution; and maintaining and improving the quality of water in the streams, lakes and ground water: all in accordance with the intent of Section 471.59 of Minnesota Statutes.

A. Coordinate with local, state, and federal agencies to encourage landowners to voluntarily change their land use practices to improve the quality of water resources within the Pomme de Terre River watershed.

B. Provide other similar or related services and programs as determined by the

Board.
C. Establish a mechanism whereby additional and/or alternative programs and services may be developed for the benefit of the Parties and in furtherance of the objectives of the Parties.

D. Collectively develop and adopt a coordinated watershed management plan for implementation per the provisions of the plan.

Article 3
Name

The name of this joint power entity shall be Pomme de Terre River Association hereinafter sometimes referred to as PDTRA.

Article 4
Agreement to Participate

4.1 Members. The members (entities) under this agreement are those Counties and Soil and Water Conservation Districts lying within the boundaries of the watershed of the Pomme de Terre River, namely, Big Stone County, Douglas County, Grant County, Otter Tail County, Stevens County, Swift County, Big Stone SWCD, Douglas SWCD, Grant SWCD, West Otter Tail SWCD, Stevens SWCD, Swift SWCD.

4.2 Compliance. A Party agrees to abide by the terms and conditions of the Agreement; including but not limited to the Joint Powers Agreement, bylaws, policies and procedures adopted by the Board.

4.3 Financial Obligation. In addition to grant funding received, members may provide additional direct funding as they may determine from time to time. In addition to, or in lieu of financial support, the members may also contribute services, personnel, or personal property to the PDTRA in such amounts as the members may determine from time to time. Each member is not expected to make any individual contribution unless it is approved by all the Members.

Article 5
Governance

5.1 Governing Board. A governing board shall be formed to oversee the operation of the PDTRA and shall be known as the Board.

5.1.1 Membership. The Board shall be comprised of one representative of each County Board of Commissioners and each Soil and Water Conservation District included in this agreement. Each member of the Board shall be a member of each respective unit of government and shall be appointed by the respective unit of government.

5.2 Terms; Vacancies. The term of appointment shall be set by the respective unit of government. The appointing entity shall appoint a designee as soon as a vacancy occurs.

5.3 Officers of the Board. The Board shall elect a Chair, Vice Chair, and Secretary/Treasurer from its membership who shall serve two year terms.

5.3.1 Election of Officers. The JPB will elect officers at the first meeting of the year in every even-numbered year. Officers will be elected for two-year terms. A special election shall be held to replace any officer who is no longer a member of the JPB. The duties of the Officers shall be described in the By-laws of the JPB.

5.3.2 Committees. The Board shall have the authority to appoint such committees as it deems necessary to fulfill the purpose of the organization.

5.4 Meetings. The Board shall comply with the Minnesota Statutes Chapter 13D (Open Meeting Law).

5.5 Voting. A quorum for any JPB meeting shall be over 50% of the JPB membership.

5.6 By-Laws. The Board may adopt by-laws to govern its operations. Such by-laws shall be consistent with the Agreement and applicable law.

5.7 Amendments. This Agreement may be amended from time to time as deemed necessary.

5.8 Records, Accounts and Reports.

5.8.1 Records and Reports. The books and records, including minutes and the original fully executed Agreement, of the Board shall be subject to the provisions of Minn. Stat. Ch. 13. They shall be maintained at the official location of the host entity and/or fiscal agent as determined by the By-laws of the Board.

5.8.2 Receipts and Disbursements. The PDTRA will ensure strict accountability for all funds of the organization and will require reports on all receipts and disbursements made to, or on behalf of the PDTRA.

5.8.3 Audits. The Board shall have an annual third party audit of the books and accounts of the PDTRA and shall make a file report to its Members at least once each year.

Article 6
Powers of the Board

6.1 General Powers. The Board is hereby authorized to exercise such authority and powers common to the Parties as is necessary and proper to fulfill its purposes and perform its duties. Such authority shall include the specific powers enumerated in this Agreement or in the bylaws.

6.2 Specific Powers.

6.2.1 Administrative Services. The Board shall establish policies and procedures for the administration of the affairs of the Board.

Administrative services shall be provided under the direction and control of the Board. These services shall include, but are not limited to, financial, legal and general administration. The Board may enter into contract and/or agreements with one or more of its member entities as a (Host Entity/Fiscal Agent) to carry out the functions of the PDTRA.

The Board shall ensure adherence to the Minnesota Government Data Practices Act.

6.2.2 Employees. The Board may employ, train, pay, discipline, discharge and otherwise manage personnel needed to assist the PDTRA Board in carrying out its duties and responsibilities. Employees of the Board shall not be considered employees of the Parties to this Agreement for any purpose including, but not limited to, salaries, wages or other compensation or fringe benefits; worker's compensation; unemployment compensation or reemployment insurance; retirement benefits; social security; liability insurance; maintenance of personnel records and termination of employment.

6.2.3 Contracts. The Board may enter into contracts and/or agreements necessary for the exercise of its duties and responsibilities to govern the PDTRA. The board may take such action as is necessary to enforce such contracts to the extent available in equity or at law. Contracts and/or agreements let and purchases made pursuant to this Agreement shall conform to the requirements applicable to contracts and/or agreements required by law (i.e. fiscal management, personnel management).

6.2.4 The PDTRA may apply for and accept gifts, grants, or loans of money or other personal property from the United States, the State of Minnesota, or any other body, organization, political subdivision, or person, whether public or private. The board may enter into any agreement required in connection therewith, and hold, use, or dispose of any such money or other property in accordance with the terms of the gift, grant, loan or agreement relating thereto.

6.2.5 Insurance. The Board shall obtain liability, property and auto insurance and may obtain such other insurance it deems necessary to indemnify the Board and its members for actions of the Board and its members arising out of this Agreement.

6.2.6 Budget.

6.2.6 A. Budget and work plan. The PDTRA will develop an annual work

plan budget, dependent on budget reserves and/or anticipated continued Grants and Project funding. The work plan and budget may be modified as needed to meet actual grant or other funding amounts and requirements.

6.2.6 B. Budgeting and accounting services. The PDTRA may contract with one or more of its member entities (Fiscal Agent) to provide any and all budgeting and accounting services necessary or convenient for the PDTRA. Such services shall include, but not be limited to: management of all funds, including County contributions and grant monies; payment for contracted services; and relevant bookkeeping and record keeping. The contracting and purchasing requirements of the Fiscal Agent shall apply to transactions of the Board. The PDTRA, through a separate contract or joint powers agreement, shall enumerate the authorities and duties of the Fiscal Agent. The parties shall retain their authority to request reports pertaining to any and all budgeting and accounting services. All interest earned from established PDTRA funds shall be credited back to that same fund.

6.2.6 C. Employee accommodation. The PDTRA may enter into a contract and/or agreement with one or more of its member entities (Host Entity) to provide office space necessary to carry out the duties and responsibilities of administration on behalf of the PDTRA.

6.2.7 Watershed Management Plan

6.2.7 A. Submittal of the Plan. The PDTRA will recommend the plan to the Parties of this agreement. The PDTRA will be responsible for initiating a formal review process for the watershed-based plan conforming to Minnesota Statutes Chapters 103B and 103D, including public hearings. Upon completion of local review and comment, and approval of the plan for submittal by each party, the PDTRA will submit the watershed-based plan jointly to BWSR for review and approval.

6.2.7 B. Adoption of the Plan. The Parties agree to adopt and begin implementation of the plan within 120 days of receiving notice of state approval, and provide notice of state approval, and provide notice of plan adoption pursuant to Minnesota Statutes Chapters 103B and 103D.

Article 7
Indemnification and Hold Harmless

7.1 Applicability. The PDTRA shall be considered a separate and distinct public entity to which the Parties have transferred all responsibility and control for actions taken pursuant to this Agreement. PDTRA shall comply with all laws and rules that govern a public entity in the State of Minnesota and shall be entitled to the protections of Minnesota Statutes 466.

7.2 Indemnification and Hold Harmless. The PDTRA shall fully defend, indemnify and hold harmless the Parties, employees, and officials against all claims, losses, liability, suits, judgments, costs, and expenses by reason of the action or inaction of the Board and/or employees and/or the agents of the PDTRA. This Agreement to indemnify and hold harmless does not constitute a waiver by any participant of limitations on liability provided under Minnesota Statutes, Section 466.04.

To the full extent permitted by law, actions by the Parties pursuant to this Agreement are intended to be and shall be construed as a "cooperative activity' and it is the intent of the Parties that they shall be deemed a 'single governmental unit' for the purpose of liability, as set forth in Minnesota Statutes Section 471.59, Subd. 1a (a); provided further that for purposes of that statute, each Party to this Agreement expressly declines responsibility for the acts or omissions of the other Party.

The Parties of this Agreement are not liable for the acts or omissions of the other participants to this Agreement except to the extent to which they have agreed in writing to be responsible for acts or omissions of the other Parties.

Article 8
Withdrawal and Termination

8.1 Withdrawal. A Party shall have the right to withdraw from this agreement and association hereby created, in the following manner:

8.1.1 The board of the withdrawing Party shall pass a resolution declaring its intention to withdraw on December 31 and shall send a certified copy of such resolution to the Chair of the PDTRA Executive Board at least 6 months prior notice.

8.1.2 Upon receipt of the resolution of withdrawal, the Chair of the PDTRA Executive Board shall send a copy of said resolution to each Party's Board.

8.1.3 Withdrawal by a Party shall not result in the discharge of any legal or financial liability incurred by such Party before the effective date of withdrawal. All such liabilities shall continue until properly discharged or settled by the withdrawing county to the approval of the remaining member counties, which approval shall not be unreasonably withheld.

8.1.4 A withdrawing Party shall not be entitled to a refund of funds paid, or forgiveness of funds owed to the PDTRA prior to the effective date of withdrawal. A withdrawing member shall not be entitled to the return of any personal property, given, granted or loaned by it to the PDTRA unless specified by written agreement.

8.2 Effective Date and Obligations. This agreement and the PDTRA created hereby, shall continue indefinitely in full force and effect until all grant funds are exhausted or until all member Parties, or all remaining member Parties, mutually agree to terminate the agreement by joint resolution passed by the member Parties respective Boards.

8.3 Termination. This agreement shall remain in effect until rescinded or terminated by a 2/3 vote (8) or until the objectives of the plan have been fulfilled.

8.3.1 Effects of Termination. The termination of this agreement shall not act to discharge any liability incurred by the Board or by the Parties during the term of the Agreement.

8.3.1 A Financial obligations shall continue until discharged by law, the Agreement or any other agreement.

8.3.1 B Property acquired by the PDTRA and surplus funds shall be distributed and returned to the Parties by percentages pursuant to Article 4.1 of the Bylaws.

Article 9
Counterparts

This Agreement may be executed in two or more counterparts, each of which shall be deemed an original, but all of which shall constitute one and the same instrument. Counterparts shall be filed with the Chair of the PDTRA who will maintain them at the PDTRA host entity office.

In witness whereof, the undersigned governmental units, by action of their governing bodies, has caused this Agreement to be executed in accordance with the authority of Minnesota Statute 471.59.

APPROVED AS TO FORM:

_____
Governmental Unit

_____
County Attorney

_____
Board Chair

_____
Date

_____
Date

ATTEST_____
County Auditor OR Administrator

Resolution to Amend the
Joint Powers Agreement Establishing
The Pomme de Terre River Association

WHEREAS, Pomme de Terre River Association purpose currently is to develop and implement plans to improve and maintain the quality of water in the streams, lakes and ground water; and

WHEREAS, the participating Counties and Soil and Water Conservation Districts have identified organizational impediments to optimal development of a Watershed Management Plans; and

WHEREAS, the participating Counties and Soil and Water Conservation Districts have provided motions and resolutions unanimously supporting the collaborative pursuit of a Watershed Management Plan; and

WHEREAS, the Minnesota Board of Soil and Water Resources has developed policies for coordination and development of comprehensive watershed management plans, also known as One Watershed, One Plan, consistent with Minnesota Statutes, Chapter 103B.801, Comprehensive Watershed Management Planning Program; and

WHEREAS, Minnesota Statutes, Chapter 103B.301, Comprehensive Local Water Management Act, authorizes Minnesota Counties to develop and implement a local water management plan; and

WHEREAS, Minnesota Statutes, Chapter 103C.331, subdivision 11, Comprehensive Plan, authorizes Minnesota Soil and Water Conservation Districts to develop and implement a comprehensive plan.

NOW, THERFORE, BE IT RESOLVED, that the members of the Pomme de Terre River Association amend the existing Joint Powers Agreement to reflect the following:

Article 2
Purpose

The purpose of this agreement is the joint exercise of powers by the undersigned governmental units to develop and implement plans with regard to protection of property from damage of flooding; controlling erosion of land; protection of property, streams and lakes from sedimentation and pollution; and maintaining and improving the quality of water in the streams, lakes and ground water: all in accordance with the intent of Section 471.59 of Minnesota Statutes.

A. Coordinate with local, state, and federal agencies to encourage landowners to voluntarily change their land use practices to improve the quality of water resources within the Pomme de Terre River watershed.

B. Provide other similar or related services and programs as determined by the Board.

C. Establish a mechanism whereby additional and/or alternative programs and services may be developed for the benefit of the Parties and in furtherance of the objectives of the Parties.

D. Collectively develop and adopt a coordinated watershed management plan for implementation per the provisions of the plan.

Article 6
Powers of the Board

6.1 General Powers. The Board is hereby authorized to exercise such authority and powers common to the Parties as is necessary and proper to fulfill its purposes and perform its duties. Such authority shall include the specific powers enumerated in this Agreement or in the bylaws.

6.2 Specific Powers.

6.2.1 Administrative Services. The Board shall establish policies and procedures for the administration of the affairs of the Board.

Administrative services shall be provided under the direction and control of the Board. These services shall include, but are not limited to, financial, legal and general administration. The Board may enter into contract and/or agreements with one or more of its member entities as a (Host Entity/Fiscal Agent) to carry out the functions of the PDTRA.

The Board shall ensure adherence to the Minnesota Government Data Practices Act.

6.2.2 Employees. The Board may employ, train, pay, discipline, discharge and otherwise manage personnel needed to assist the PDTRA Board in carrying out its duties and responsibilities. Employees of the Board shall not be considered employees of the Parties to this Agreement for any purpose including, but not limited to, salaries, wages or other compensation or fringe benefits; worker's compensation; unemployment compensation or reemployment insurance; retirement benefits; social security; liability insurance; maintenance of personnel records and termination of employment.

6.2.3 Contracts. The Board may enter into contracts and/or agreements necessary for the exercise of its duties and responsibilities to govern the PDTRA. The board may take such action as is necessary to enforce such contracts to the extent

available in equity or at law. Contracts and/or agreements let and purchases made pursuant to this Agreement shall conform to the requirements applicable to contracts and/or agreements required by law (i.e. fiscal management, personnel management).

6.2.4 The PDTRA may apply for and accept gifts, grants, or loans of money or other personal property from the United States, the State of Minnesota, or any other body, organization, political subdivision, or person, whether public or private. The board may enter into any agreement required in connection therewith, and hold, use, or dispose of any such money or other property in accordance with the terms of the gift, grant, loan or agreement relating thereto.

6.2.5 Insurance. The Board shall obtain liability, property and auto insurance and may obtain such other insurance it deems necessary to indemnify the Board and its members for actions of the Board and its members arising out of this Agreement.

6.2.6 Budget.

6.2.6 A. Budget and work plan. The PDTRA will develop an annual work plan budget, dependent on budget reserves and/or anticipated continued Grants and Project funding. The work plan and budget may be modified as needed to meet actual grant or other funding amounts and requirements.

6.2.6 B. Budgeting and accounting services. The PDTRA may contract with one or more of its member entities (Fiscal Agent) to provide any and all budgeting and accounting services necessary or convenient for the PDTRA. Such services shall include, but not be limited to: management of all funds, including County contributions and grant monies; payment for contracted services; and relevant bookkeeping and record keeping. The contracting and purchasing requirements of the Fiscal Agent shall apply to transactions of the Board. The PDTRA, through a separate contract or joint powers agreement, shall enumerate the authorities and duties of the Fiscal Agent. The parties shall retain their authority to request reports pertaining to any and all budgeting and accounting services. All interest earned from established PDTRA funds shall be credited back to that same fund.

6.2.6 C. Employee accommodation. The PDTRA may enter into a contract and/or agreement with one or more of its member entities (Host Entity) to provide office space necessary to carry out the duties and responsibilities of administration on behalf of the PDTRA.

6.2.7 Watershed Management Plan

6.2.7 A. Submittal of the Plan. The PDTRA will recommend the plan to the Parties of this agreement. The PDTRA will be responsible for initiating a formal review process for the watershed-based plan conforming to Minnesota Statutes Chapters 103B and 103D, including public hearings. Upon completion of local review and comment, and approval of the plan for submittal by each party, the PDTRA will submit the watershed-based plan jointly to BWSR for review and approval.

6.2.7 B. Adoption of the Plan. The Parties agree to adopt and begin

implementation of the plan within 120 days of receiving notice of state approval, and provide notice of plan adoption pursuant to Minnesota Statutes Chapters 103B and 103D.

IN WITNESS WHEREOF, the parties to this agreement, by resolution, have hereunto amended the joint powers agreement establishing the Pomme de Terre River Association.

Otter Tail County	**Date**
West Otter Tail SWCD	**Date**
Grant County	**Date**
Grant SWCD	**Date**
Douglas County	**Date**
Douglas SWCD	**Date**
Stevens County	**Date**
Stevens SWCD	**Date**
Big Stone County	**Date**
Big Stone SWCD	**Date**
Swift County	**Date**
Swift SWCD	**Date**

APPENDIX E:
Executive Summary of Houston Engineering Inc. 2018 Report

Houston Engineering Inc.

Maple Grove, MN | HEI No. 7213-001
May 14, 2018; Updated June 4, 2018

TARGETED IMPLEMENTATION PLAN FOR THE POMME DE TERRE RIVER WATERSHED

to Improve Surface Water Quality

FINAL REPORT

Pomme de Terre River Association

EXECUTIVE SUMMARY

This Targeted Implementation Plan (i.e., Plan) identifies technically feasible locations for Best Management Practices and Conservation Practices (collectively referred to as Practices) on agricultural land, based on "best" (i.e., most cost effective) value. Estimates of Practice water quality benefits are also provided, as a means of proactively managing surface water quality within the Pomme de Terre River Watershed (Hydrologic Unit Code 07020002). Surface water runoff from agricultural land is the focus of the Plan, but in no way should this focus be construed as meaning agricultural land is the only source of sediment and nutrients to surface waters. Runoff from urban areas and land adjacent to lakes and stream can also contribute sediment and nutrients to surface waters. However, the tools used here are focused on agricultural lands.

The information within the Plan:

- refines and adds detail to strategies to improve water quality outlined within the Pomme de Terre Watershed Restoration and Protection Strategies (WRAPS);
- identifies the most cost-effective practices for restoring lakes and streams which are currently failing to meet water quality expectations (i.e., they are impaired) based on completed Total Maximum Daily Loads (TMDLs);
- guides the implementation needed to achieve water quality goals;
- identifies cost-effective approaches for protecting the water quality of lakes and rivers presently in "good" condition;
- identifies those area within a watershed with high contributions of sediment and nutrients as water bodies; and
- provides information products to landowners to inform and guide discussion about the water quality benefits of conservation.

The Plan can be used to guide Practice implementation decisions on both public and private lands and coordinate these efforts among local, state and federal governments; non-profit governmental organizations; individual producers and agribusiness.

The Plan divides the Pomme de Terre watershed into six planning regions for the purpose of assessing whether the water quality goals can be achieved through reductions in nutrients and sediment in surface water runoff. The planning regions are the Upper Pomme de Terre River (0702000201), Pelican Creek (0702000202), Middle Pomme de Terre River (0702000203), Muddy Creek (0702000204), Lower Pomme de Terre River (0702000206) and Drywood Creek (0702000205) subbasins (i.e., 10-digit HUCs). The goals are expressed as the annual estimated reductions in sediment and Total Phosphorus at the most downstream location (i.e., the outlet) for each planning region. The goals come from two statewide reports prepared by the Minnesota Pollution Control Agency. The sediment reduction goal consists of reducing the estimated annual amount (tons per year) at the outlet of each planning region by 25% (a milestone) and 50% (the goal) by 2020 and 2030, respectively. The Total Phosphorus goal consists of reducing the estimated annual amount (pounds per year) by 12% (from 1980-1996 condition). The water quality benefits at many lakes and rivers within the area are also estimated.

The water quality benefits of both non-structural (i.e., Management) and structural Practices are evaluated within the Plan. Non-structural practices include the use of conservation tillage, cover crops, conservation reserve program (CRP) and permanent vegetative cover. Structural practices are "constructed" and include farm ponds, grassed waterways, nutrient reduction wetlands, bio-reactors, and other common agricultural practices. Management practices tend to be more cost effective for reducing sediments and nutrient loads but can be less certain for long-term implementation because a decision to use them is typically revisited each year by the producer. Applying management practices preferentially to those fields whose sediment yield is in the upper 25% of all fields within a planning region in

most cases achieves the sediment reduction goals at an estimated 2016 annualized cost range of $52-$113 per ton. Progress toward the total phosphorus goals ranges from 3% to 33% among the planning regions at an estimated 2016 annualized cost range of $52-$113 per pound. Implementing the most cost effective structural practices also makes considerable progress toward the sediment and total phosphorus goals, but generally at a greater investment per ton of sediment or pound of phosphorus reduction. Tables 10 and 11 provide summaries of the investment by planning region, can be found within Tables 10 and 11.

The content of this Plan is intended to guide conservation investment decisions within the Pomme de Terre River watershed; i.e., the numbers and types of Practices needed relative to the anticipated fiscal investment to make progress toward achieving sediment an nutrient reduction goals. Although the Plan identifies Practice locations which are technically feasible, specific locations will be identified during implementation depending upon the willingness of landowners to implement them. The cost effectiveness information (e.g., $ / ton of sediment reduction) can be used to assess whether a specific Practice investment is reasonable. The information from this plan is made available through PTMApp – web (http://ptmapp.rrbdin.org/) for daily use to meet the needs of local water quality practitioners.

Because of a lack of information, this plan excludes the water quality benefits of practices which currently exist within the watershed. No comprehensive database of existing practices is available and is an information gap which needs closing in the near future. Some Information from recent years about constructed conservation practices is available from the Board of Water and Soil Resource e-link database. The e-link database contains 389 projects within the watershed. These Practices have no doubt lead to some water quality improvements.