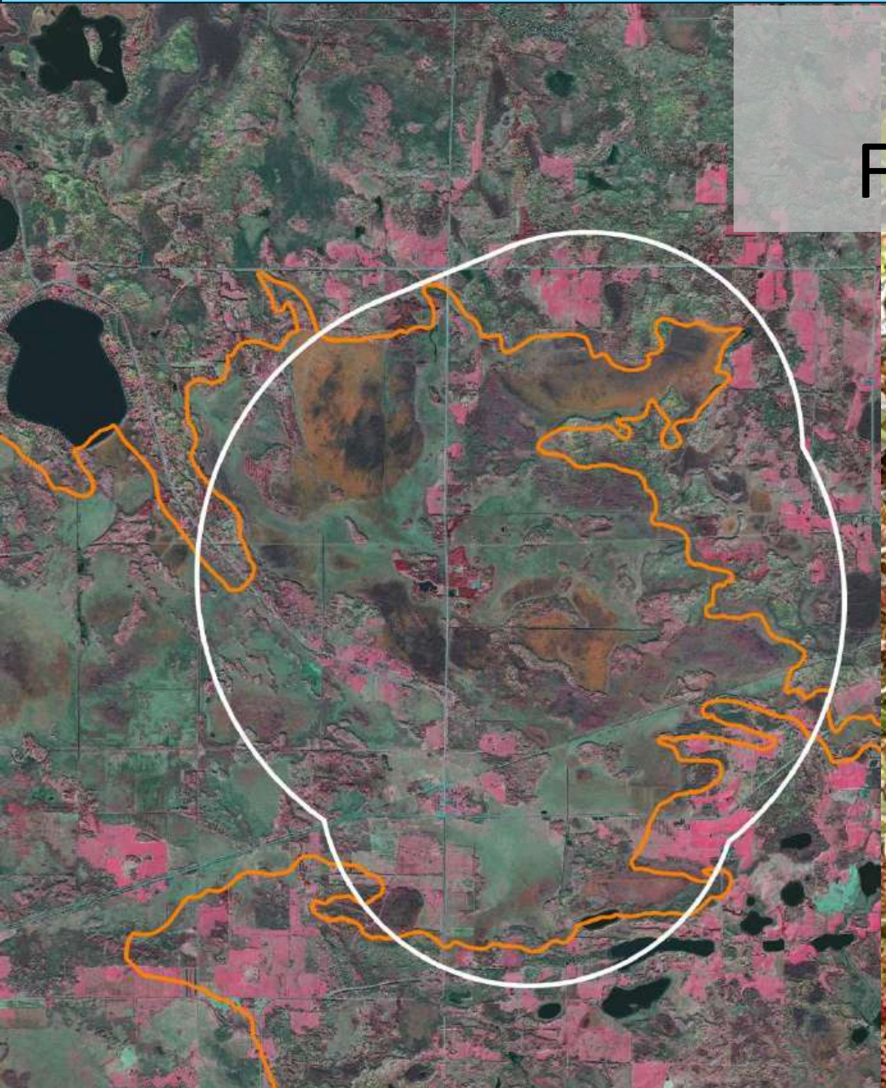
Wetland Plant Communities in the Talon Metals Project Area

Mark A. White
Forest Ecologist – Consultant



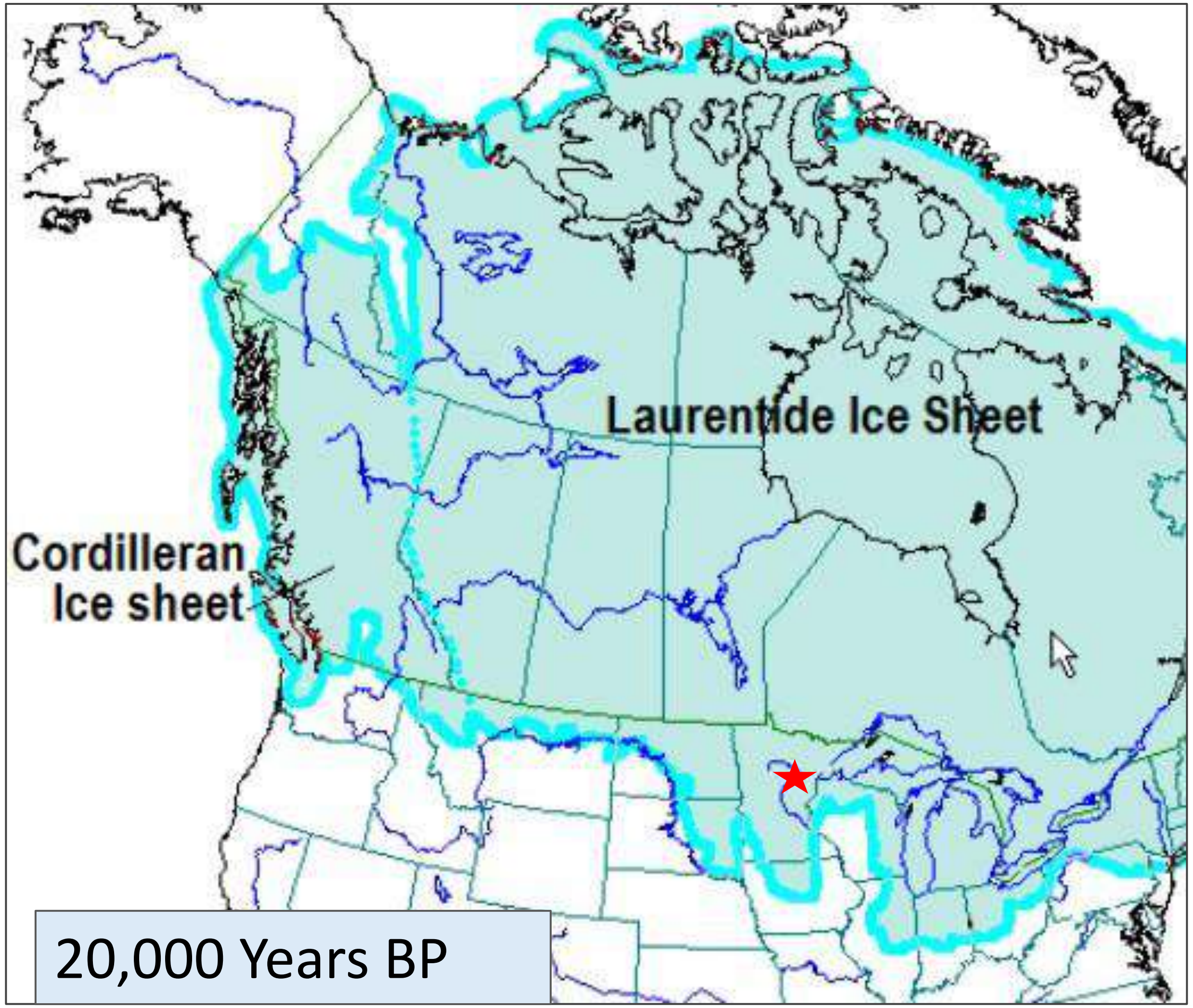
Introduction

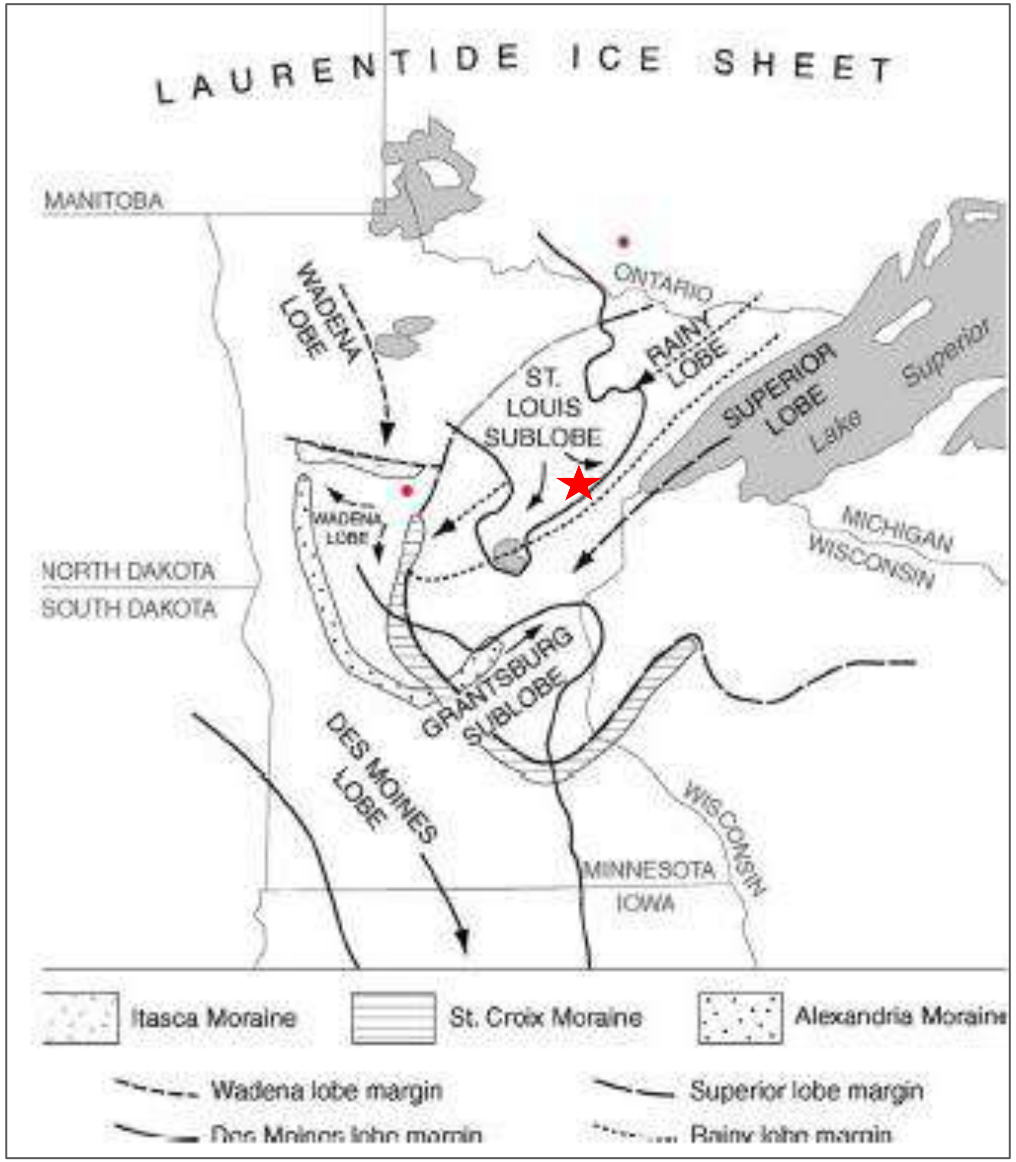
- Wetland ecosystem services
- Landscape Setting: Talon Metals Project area; Glacial Landforms, soils, topography, and watersheds
- Native Plant Communities in the Talon area: composition, structure, adaptations, hydrology, and water chemistry
- Biodiversity: wetland functions and rare species
- Underground mining: dewatering, wetland hydrology
- Climate Change Vulnerability
- Regulatory Process: Environmental Assessment Worksheet (EAW) and Environmental Impact Statement EIS

Wetland Ecosystem Services and Functions

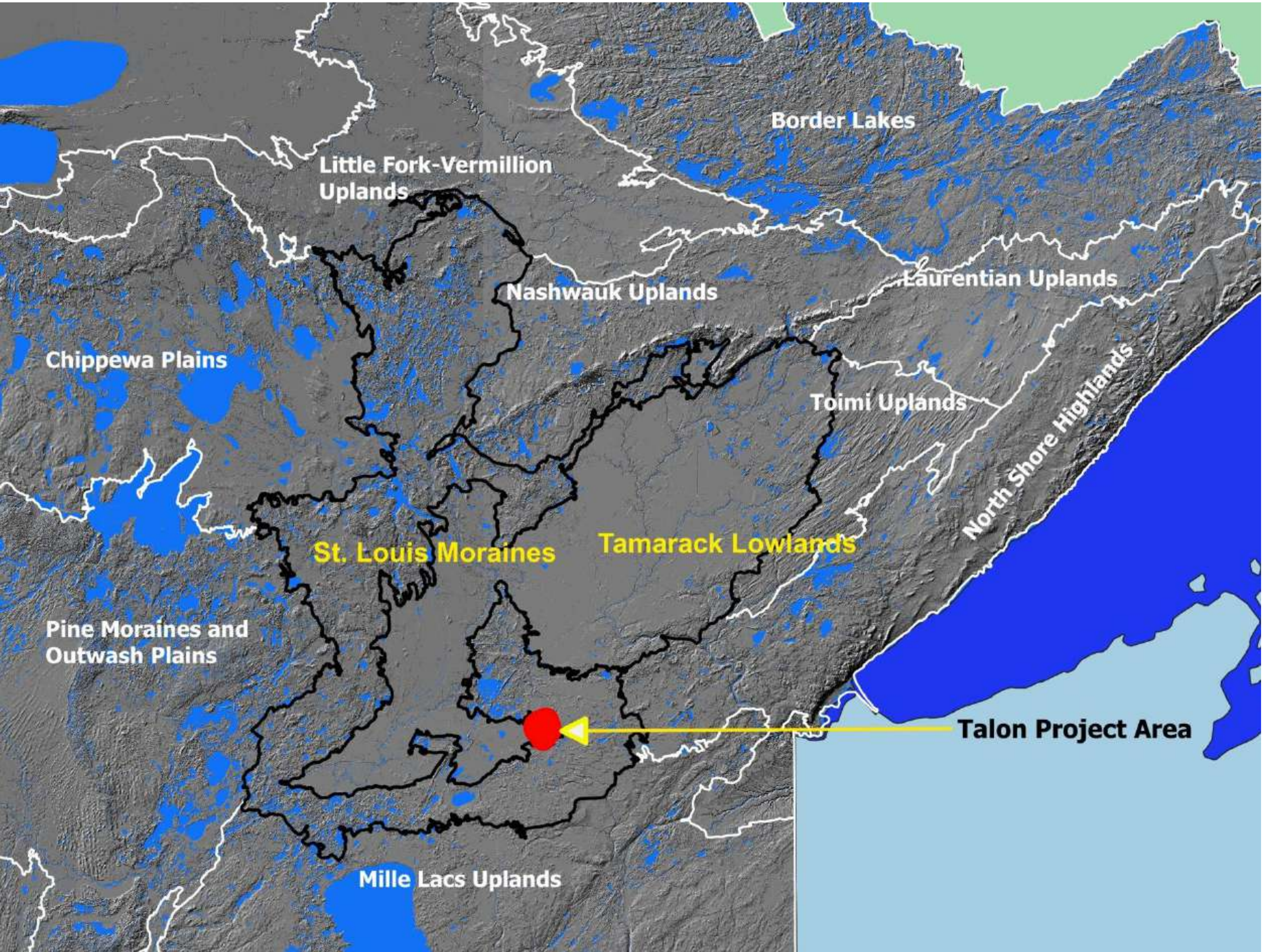
- **Carbon uptake and storage**: peatlands-high carbon density, globally 30% of soil C, 7 million acres in MN, ~28% of peatlands in coterminous USA
- **Water Quality**: sedimentation-filtration of runoff, nutrient assimilation
- **Water quantity**: storage, mitigate floods, drought, recharge groundwater
- **Biodiversity**: Unique and high levels, obligate spp., migratory spp. terrestrial, aquatic, species using upland/wetland habitats during life cycle
- **Wetland loss and degradation in Minnesota**: Pre-settlement 18.5 Million ac, 2010-10.5 million ac. Significant proportion are degraded, ag landscapes, developed areas

Landscape Setting: Glacial Landforms and Ecosystems





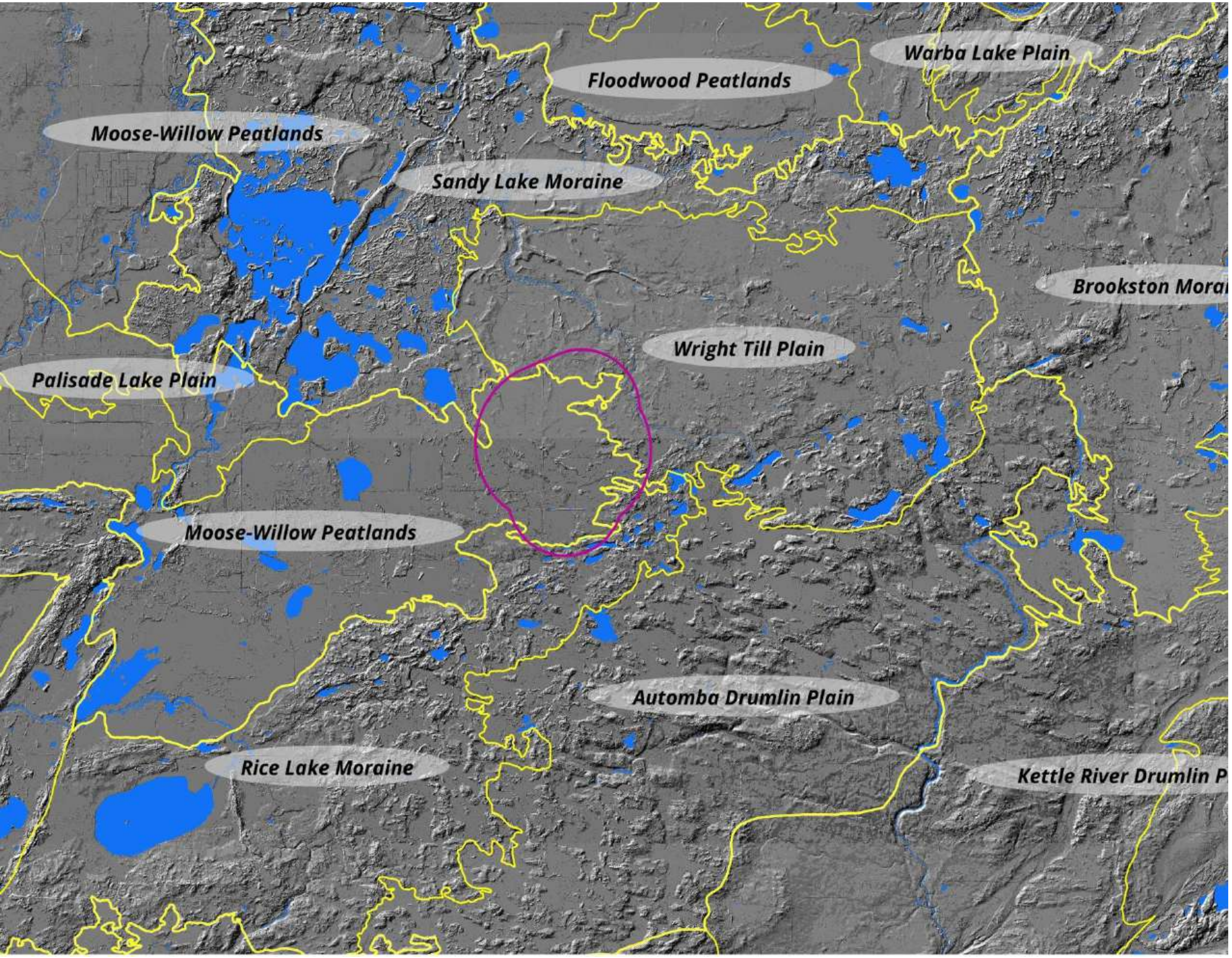
Subsections: MN Ecological Classification System



Ecological Classification-Subsection

- Defined by characteristic glacial landforms, topography, soils,and vegetation
- Talon Metals occurs primarily in the Tamarack Lowlands subsection, some overlap with St. Louis Moraines
- Tamarack Lowlands defined by Glacial Lake Upham/Aitkin
- Flat, glacial drift 100-300 ft depth, peat soils, wetland dominated

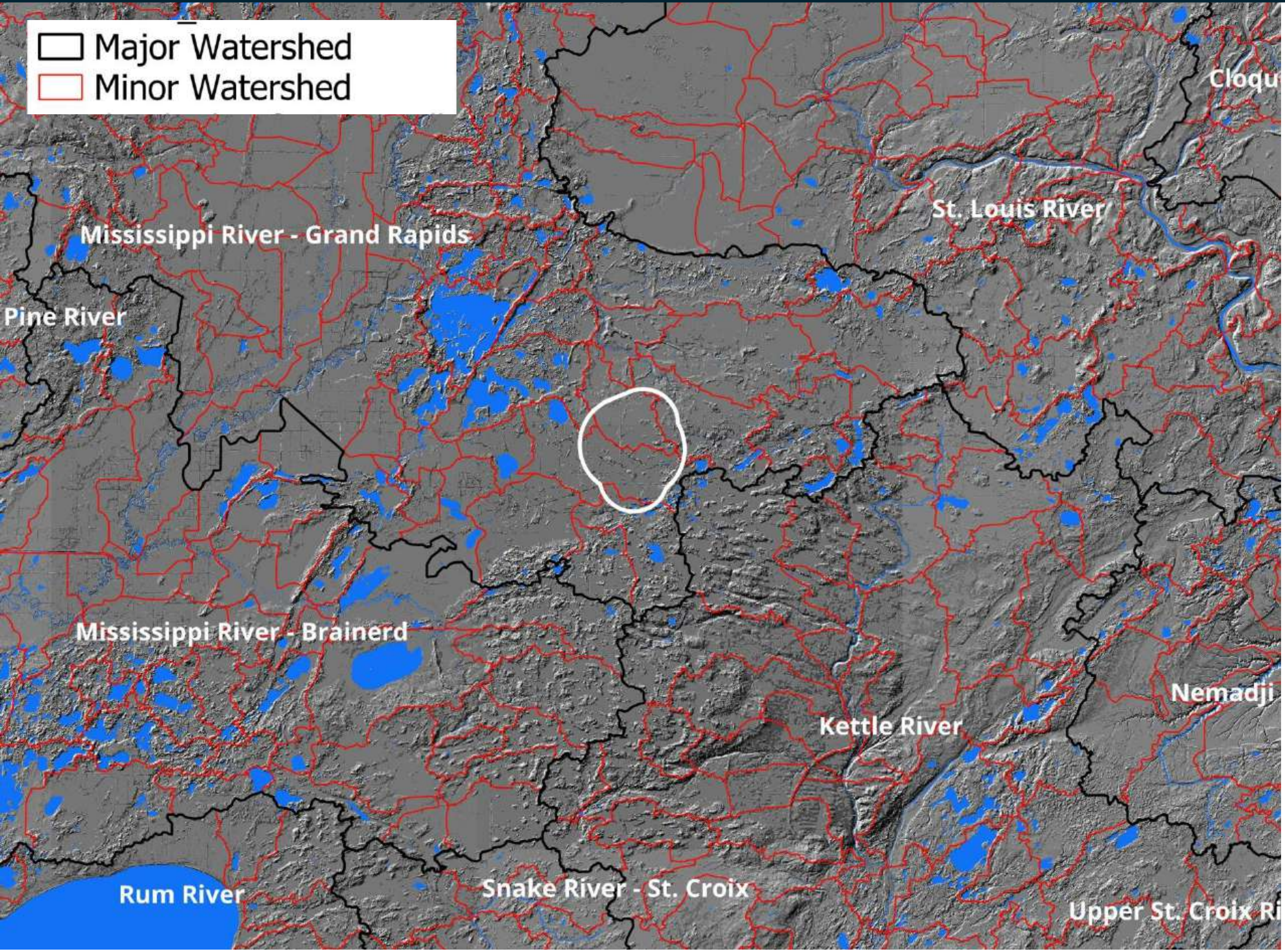
Land Type Association: MN Ecological Classification System



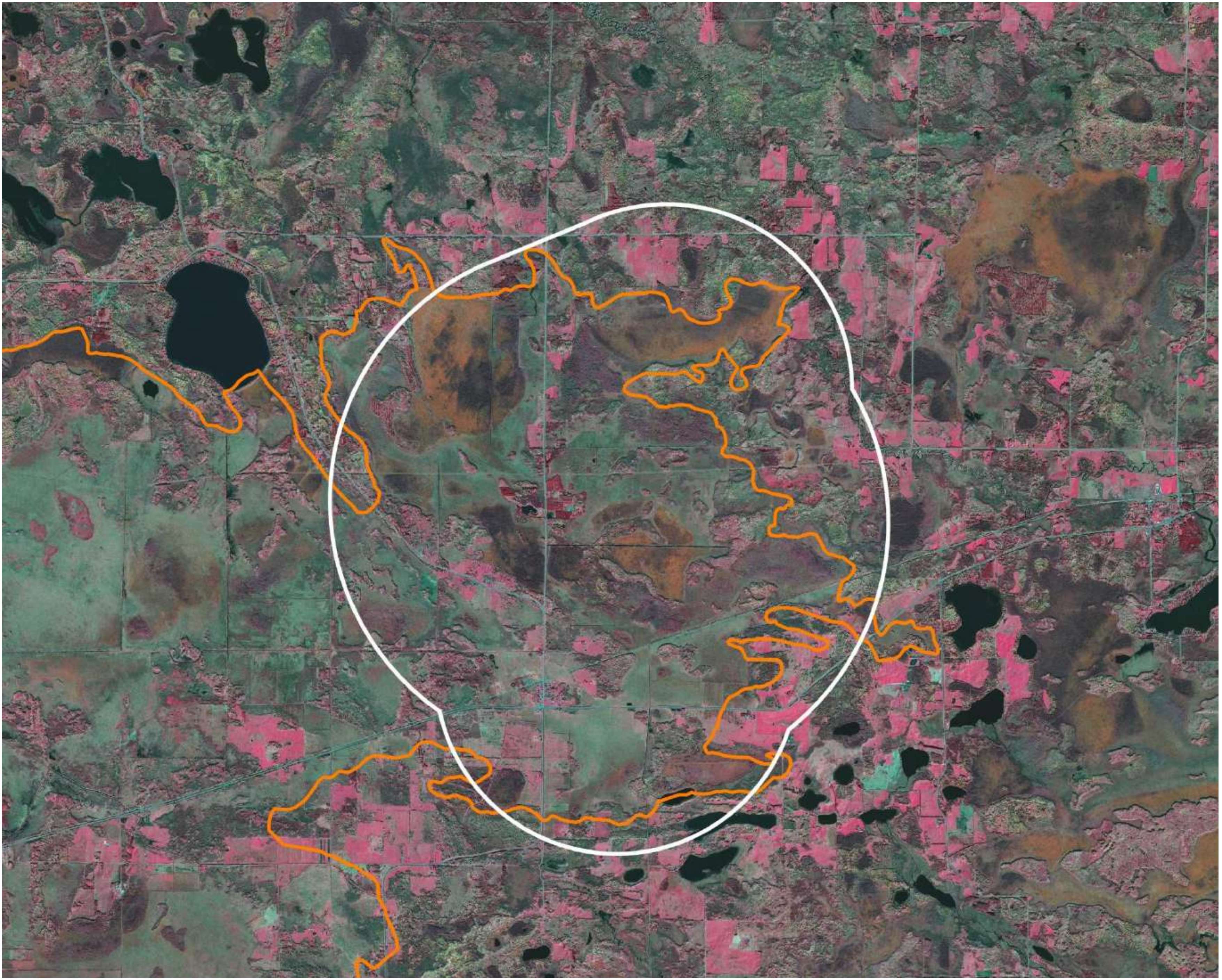
Ecological Classification-Land Type Association

- Finer level classification: Glacial landforms, topography, soils, depth to bedrock, plant communities, surface water
- Talon Metals occurs in Moose-Willow Peatlands, some overlap with Wright Till Plain and Rice Lake Moraine.
- Wetlands = 67% area; acid peatland, rich peatlands, forested peatlands, wet meadow

Major and Minor Watersheds



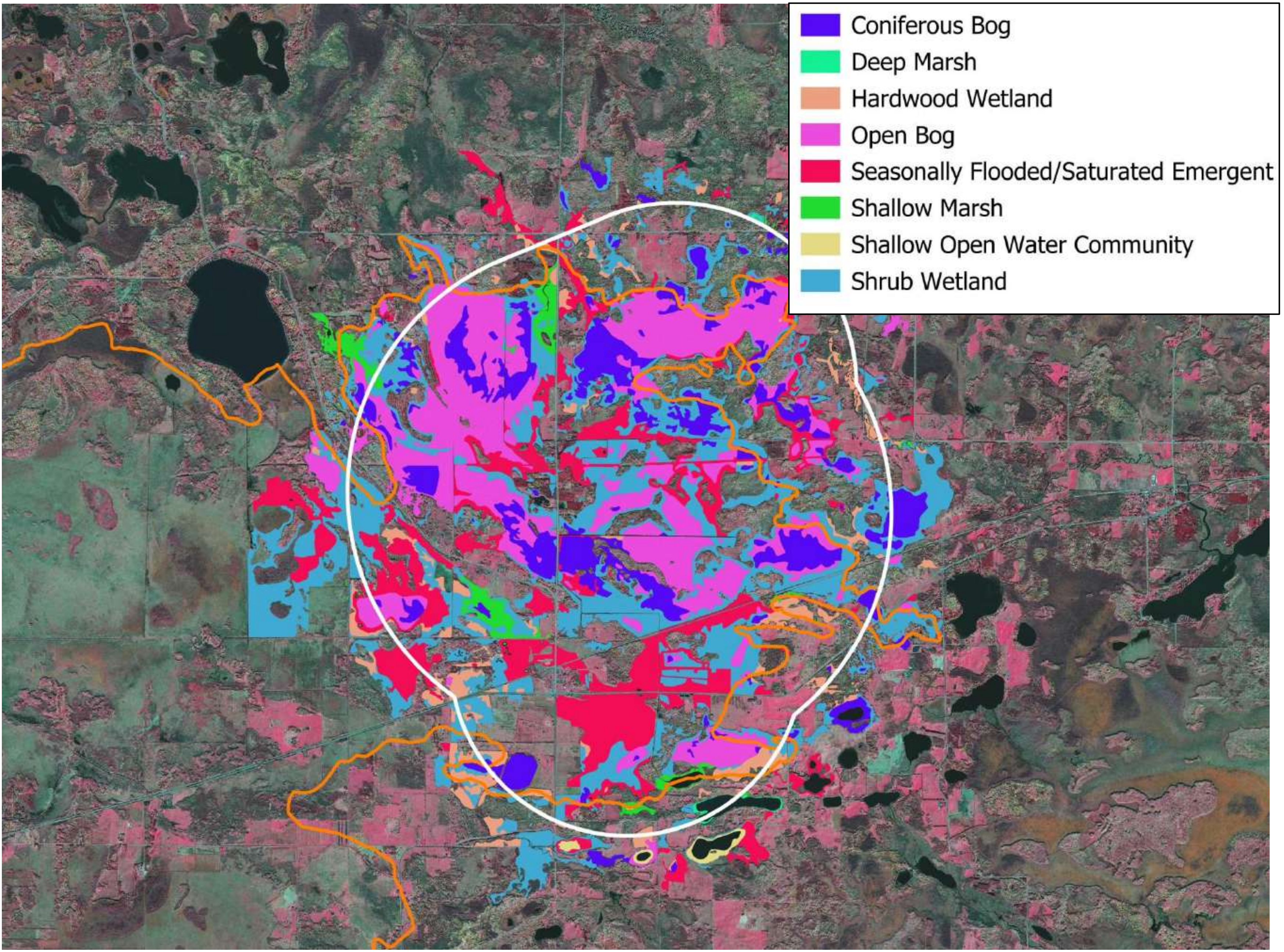
- Major Watersheds: Primarily Mississippi River drainage, Kettle River
- Intersects with several minor watershed



Wetland Plant Comunities

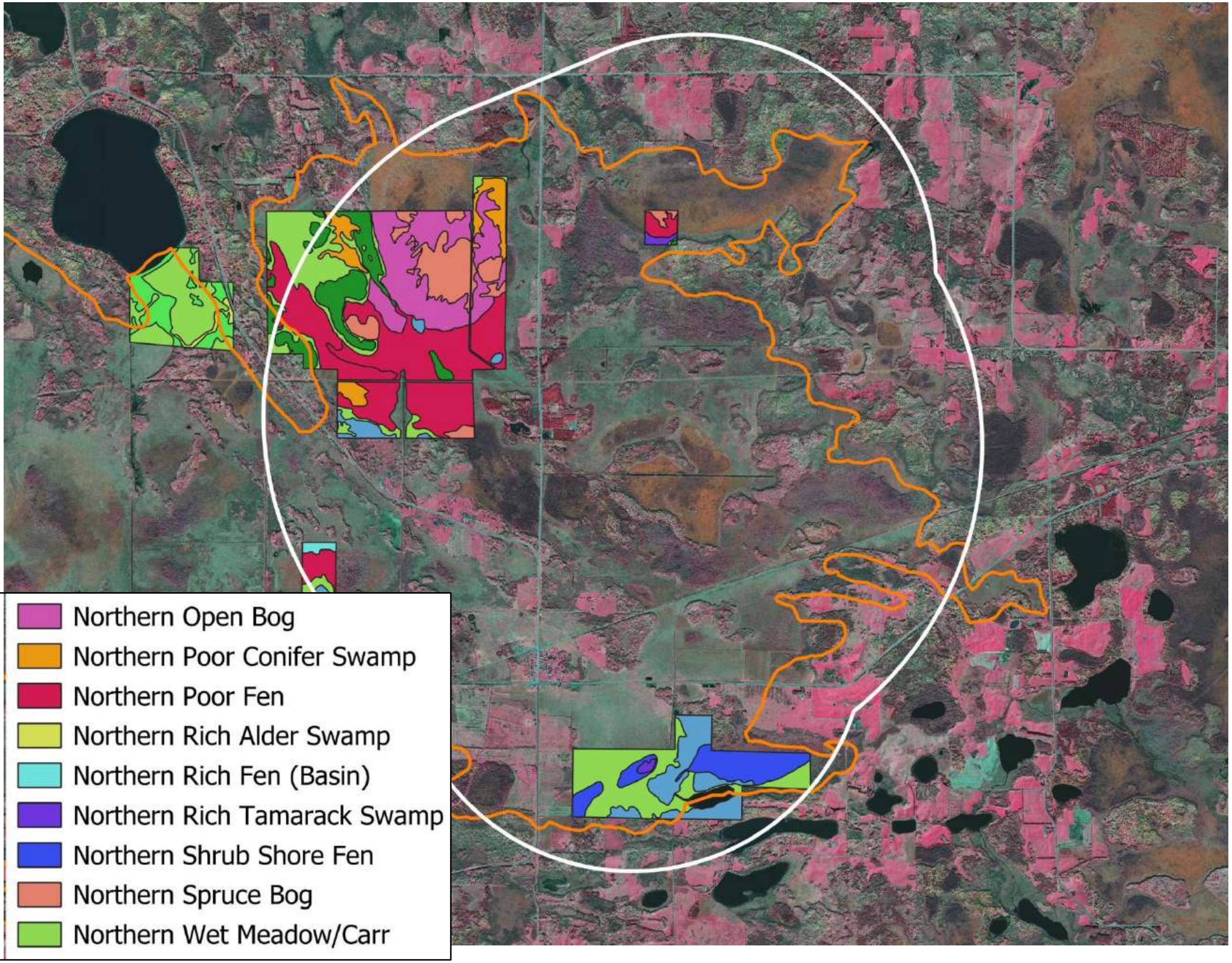
Color Infrared aerial imagery

- Red-pink = uplands, everything else is Wetland
- Wetlands are the matrix
- Acid peatlands: Orange-brown = open bog
- Dark green-black = conifer bog
- Light green = Wet Meadow
- Light pink = Rich peatlands



National Wetlands Inventory

- Complex mosaic of wetland community types
- Acid peatlands: Conifer bog and open bog, Precipitation, nutrient and mineral poor, PH < 5.5
- Hardwood wetland, emergent, and shrub wetland: groundwater dependent, mineral rich, PH 6-8



MN DNR Native Plant Communities

- More highly resolved classification
- Vegetation composition/structure relationships to soil, landform, hydrology, and water chemistry

Native Plant Communities: Hydrology and Water Chemistry

NPC Class	% Area	Water Input	PH Range
Northern Rich Alder Swamp	0.5	Groundwater, runoff, surface	~7.0
Northern Rich Tamarack Swamp	0.7	Groundwater, runoff	5.5-7.8
Northern Rich Fen (Basin)	6.9	Groundwater, runoff	>5.5
Northern Shrub Shore Fen	9.2	Groundwater, runoff	>5.5
Northern Wet Meadow/Carr	31.6	Groundwater, runoff, surface	6.0-8.0
Northern Poor Fen	30.1	Precipitation	4.2-5.5
Northern Open Bog	15.7	Precipitation	3.8-4.2
Northern Poor Conifer Swamp	4.8	Precipitation	4.2-5.5
Northern Spruce Bog	0.6	Precipitation	3.8-4.2

Plant Communities and Adaptations: Acid Peatland

Nutrient poor, low mineral content PH 3.8-5.5, Precipitation input

Conifer bog grading into forested rich peatland

Northern poor fen

Open bog with pitcher plant

Plant Communities and Adaptations: Acid Peatland

- **Plant adaptations**: tolerate low mineral levels; (calcium, magnesium) and nutrient poor conditions
- Evergreen woody plants; retain nutrients. Conifers (black spruce), shrubs (Ericaeae, Bog laurel, labrador tea, bog cranberry)
- Leathery leaf texture, alkaloids, deter herbivory
- Insectivorous plants: pitcher plant, sundews, bladderwort capture insects, nitrogen uptake

Bog laurel (*Kalmia polifolia),* Black spruce, Labrador tea (*Ledum groenlandicum)*

Pitcher plant (*Sarracenia purpurea),* Moss *(Sphagnum spp)*

Bog cranberry (*Vaccinum oxycoccos*), Moss *(Sphagnum spp)*

Plant Communities and Adaptations: Open rich peatland

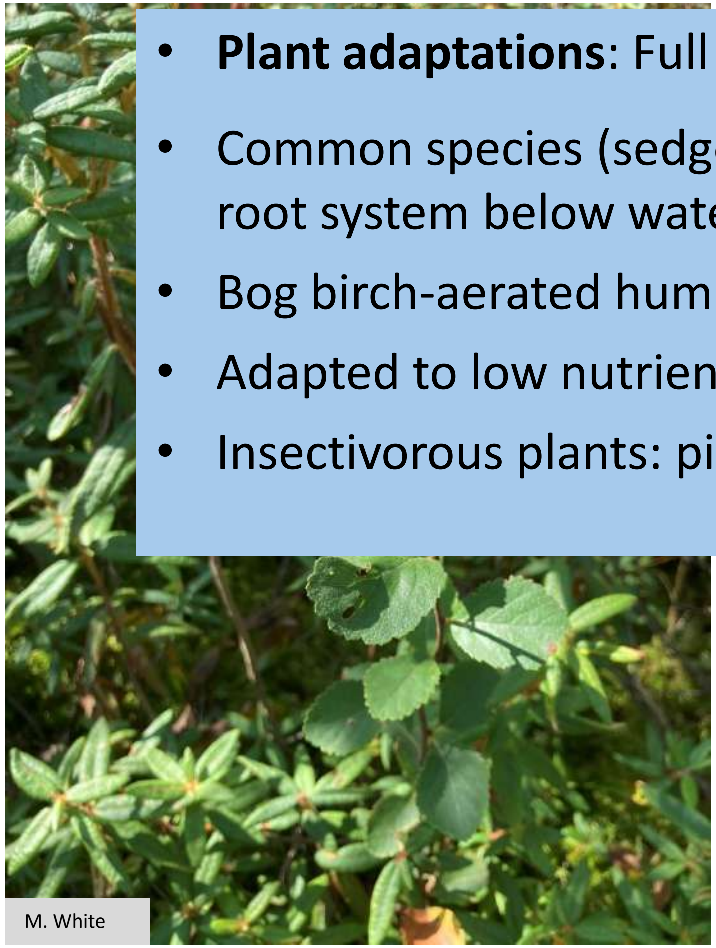
Higher mineral content, PH 6-8, groundwater input

Northern Shrub Shore Fen

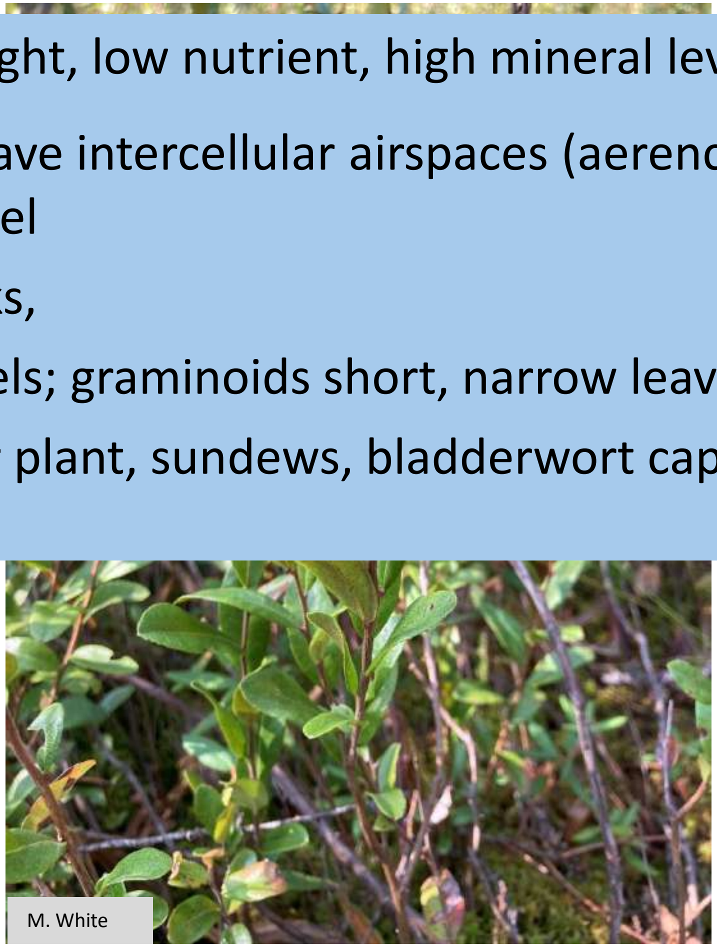
Northern Rich Fen

Plant Communities and Adaptations: Open Rich Peatland

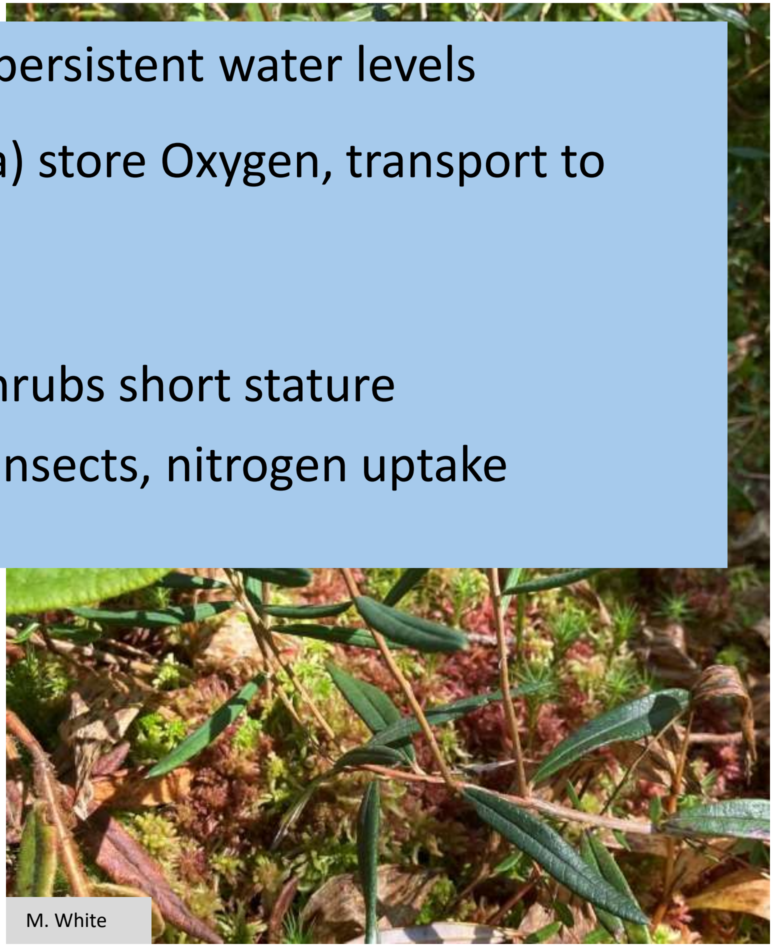
- **Plant adaptations**: Full sunlight, low nutrient, high mineral levels, persistent water levels
- Common species (sedges) have intercellular airspaces (aerenchyma) store Oxygen, transport to root system below water level
- Bog birch-aerated hummocks,
- Adapted to low nutrient levels; graminoids short, narrow leaved, shrubs short stature
- Insectivorous plants: pitcher plant, sundews, bladderwort capture insects, nitrogen uptake



Bog birch (*Betula pumila),* Labrador tea (*Ledum groenlandicum)*



Leatherleaf (*Chamaedaphne calyculata*)

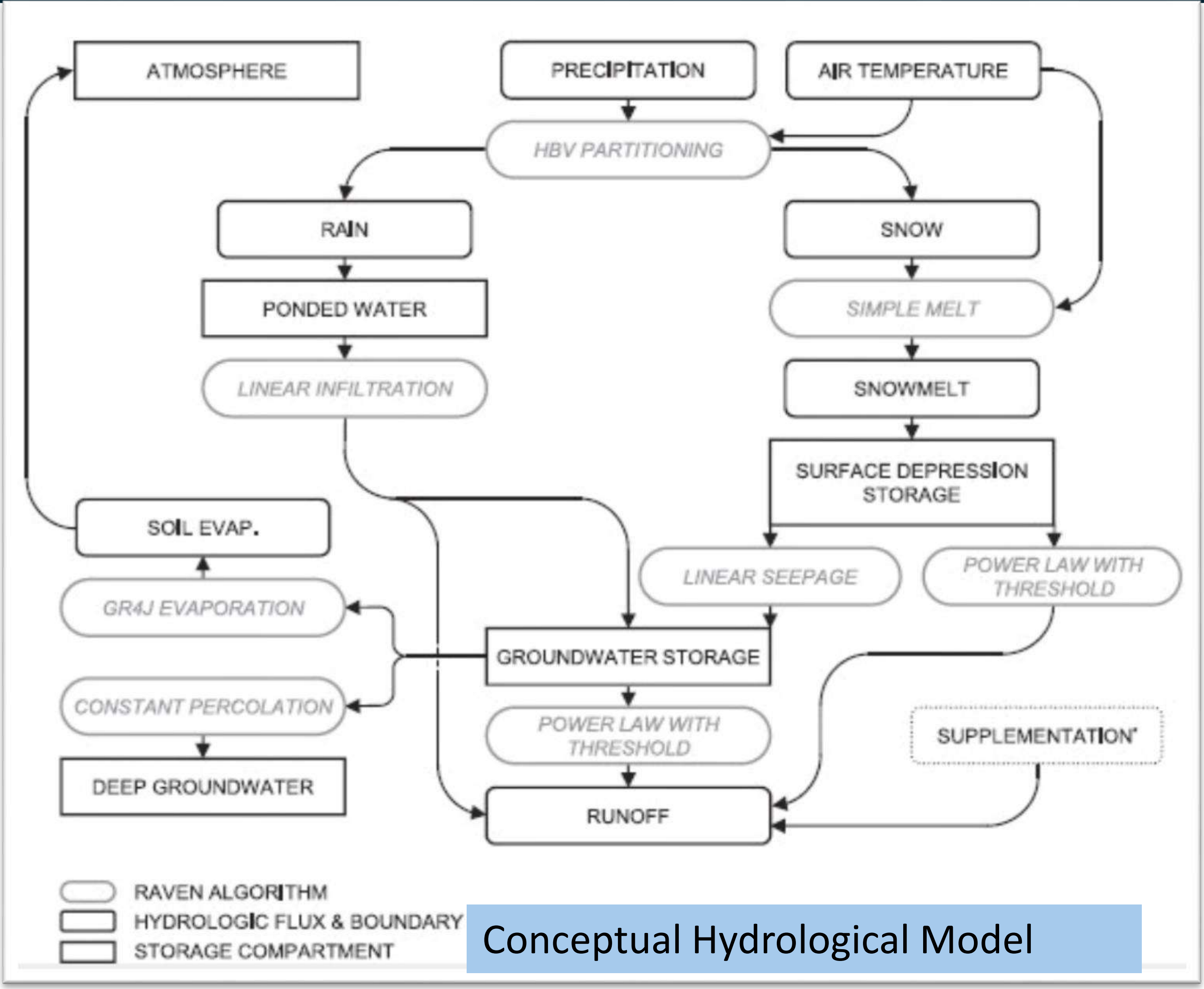


Bog rosemary *(Andromeda polifolia), Sphagnum spp.,* Labrador tea

Hydrological Impacts of Underground Mining

- Dewatering: underground mining process where water is removed from open spaces to maintain safe access for ore extraction
- Dewatering can significantly alter regional groundwater flow and storage as excavations remove aquifer materials and alter flow patterns
- Dewatering: lower groundwater storage, lower water levels, reduced stream flows.
- Lower water levels lead to shifts in plant community composition
- Habitat losses for many plant and animal species
- Drying-decomposition of peat deposits: increased Co2 emissions, loss of Co2 uptake
- Surface infrastructure: Railroad, roads, alter surface and groundwater flow

Hydrological Impacts of Underground Mining

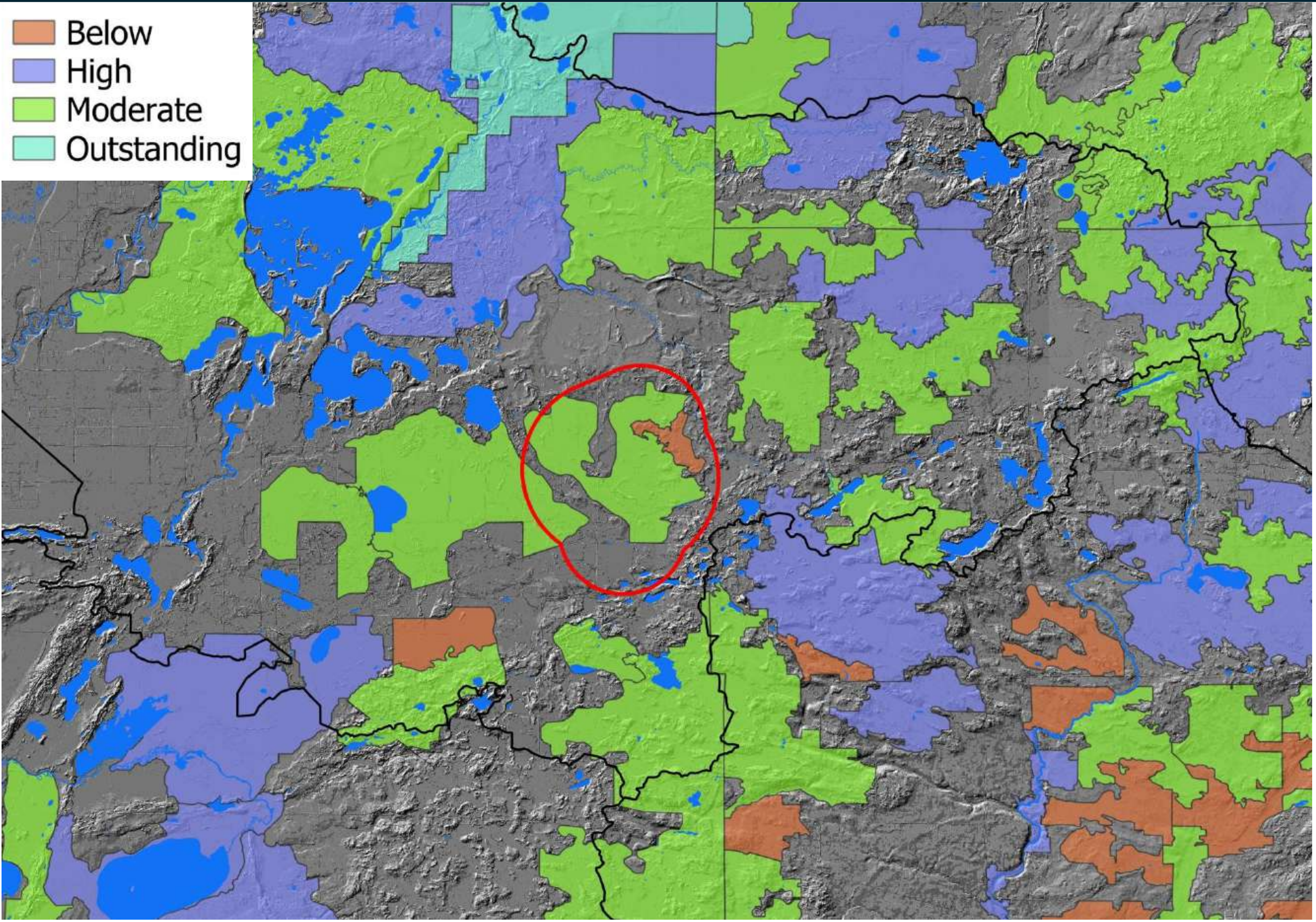


Conceptual Hydrological Model

Talon Metals Mine

- Environmental Impact Statement
- Required to show potential hydrological and related impacts from dewatering and other changes
- Requires a detailed understanding of water budget and flows throughout the project impact area
- Parameterize hydrological model to estimate changes in water levels, groundwater flow
- Needs to include wetland impacts

MNDNR Sites of Biodiversity Significance



- Presence of rare species populations
- Size and condition of native plant communities
- Landscape context: connected or near sites with similar NPCs
- Moderate: rare species, NPCs moderately disturbed
- <u>Conservation status rank</u>
  Northern Open Bog S1 – S3
  Northern Poor Fen S1 – S3

S1 Critically imperiled
S2 Imperiled
S3 Vulnerable to extirpation

Biodiversity: Rare Species in Talon Project Region

MN Natural Heritage Inventory: 31 rare species that may occur in project area

Wetland ecosystems have critical role in maintaining biodiversity

Wetlands are home endemic and obligate species

Wetlands: key habitat for migratory birds

Species needing upland and wetland habitat for life cycle (Four-toed Salamander)

Common name	Scientific name	Group	State status
Four-toed Salamander	*Hemidactylium scutatum*	amphibian	special
Boreal Owl	*Aegolius funereus*	bird	special
Nelson's Sparrow	*Ammospiza nelsoni*	bird	special
Short-eared Owl	*Asio flammeus*	bird	special
Yellow Rail	*Coturnicops noveboracensis*	bird	special
Wilson's Phalarope	*Phalaropus tricolor*	bird	threatened
Subarctic Darner	*Aeshna subarctica*	insect	special
Wood Turtle	*Glyptemys insculpta*	reptile	threatened
Montane Yellow-eyed Grass	*Xyris montana*	vascular	special
Neat Spikerush	*Eleocharis nitida*	vascular	special
Small Green Wood Orchid	*Platanthera clavellata*	vascular	special
Garber's Sedge	*Carex garberi*	vascular	threatened
Hidden-fruit Bladderwort	*Utricularia geminiscapa*	vascular	threatened
Olivaceous Spikerush	*Eleocharis*	vascular	threatened

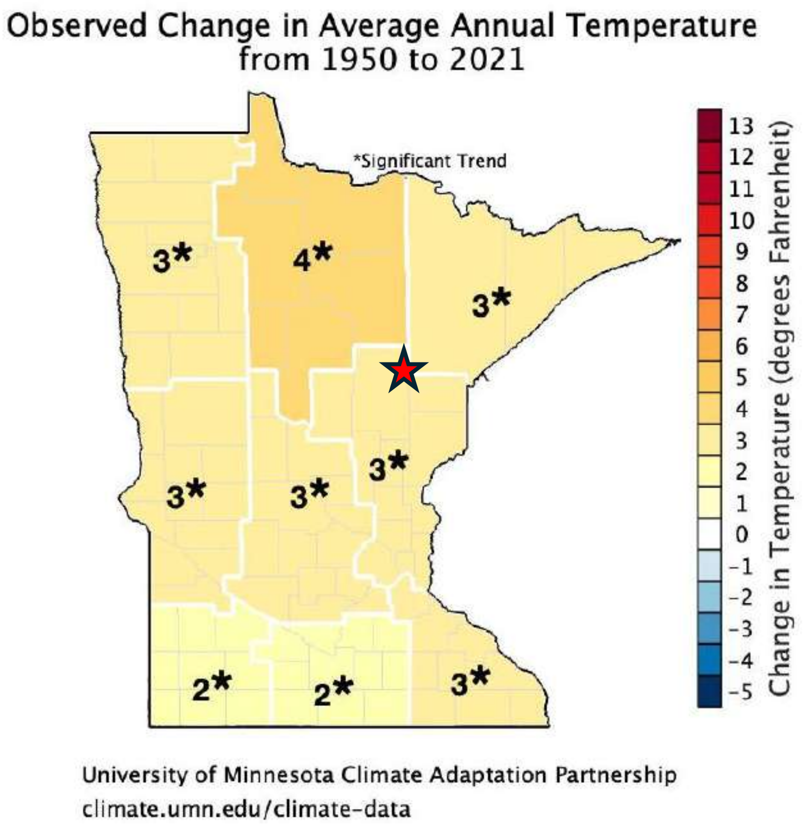
Wetlands provide water quality and quantity and are essential for aquatic species including fish and invertebrates along with amphibians (salamanders), reptiles (turtles) and many plant species.

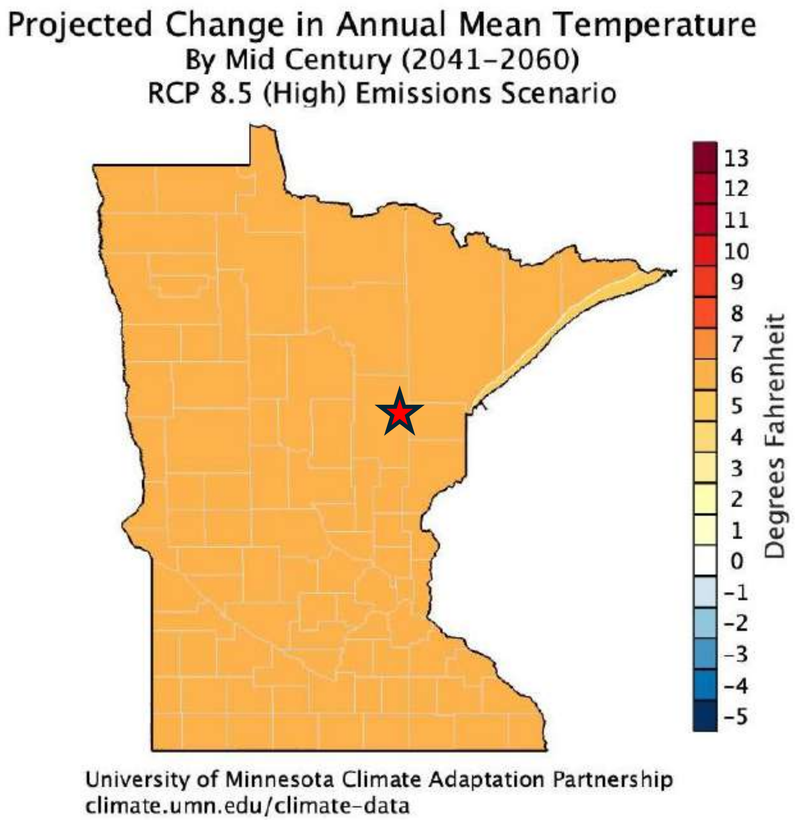
Four-toed Salamander(*Hemidactylium scutatum)* Special Concern.
Use wetlands during nesting season, lay eggs at edge of conifer swamps in Sphagnum moss hummocks

Boreal owl (*Aegolius funereus*)
Special Concern.
Roost/forage in lowland conifer, typically black spruce

Small green wood orchid (*Platanthera clavellata*)
Special Concern.
Acid peatlands, poor fens, *Sphagnum* hummocks

Climate Change: Wetland Ecosystems

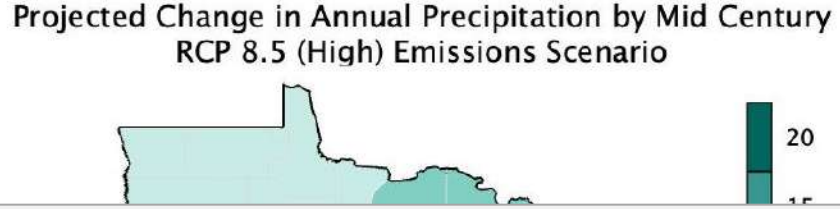




<u>Observed and Projected Temperature Change</u>

- 3° F increase in mean annual temperature
- Projected 6-7° F temperature by mid-century
- Temperature-Precipitation effects water balance
- <u>Evapotranspiration (ET)</u> = evaporation + plant transpiration

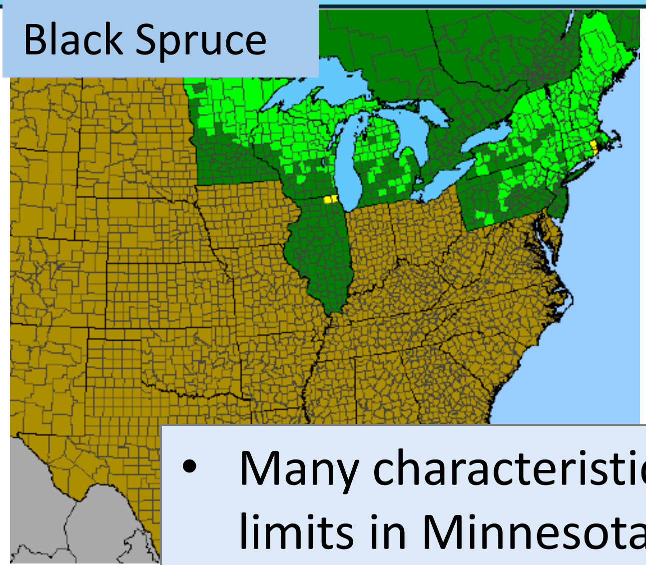
Climate Change: Wetland Ecosystems

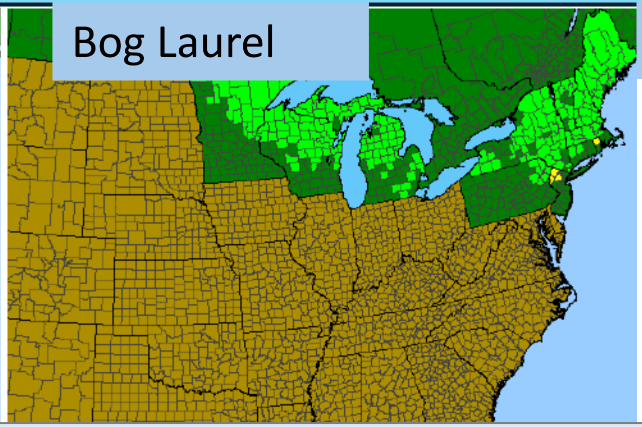


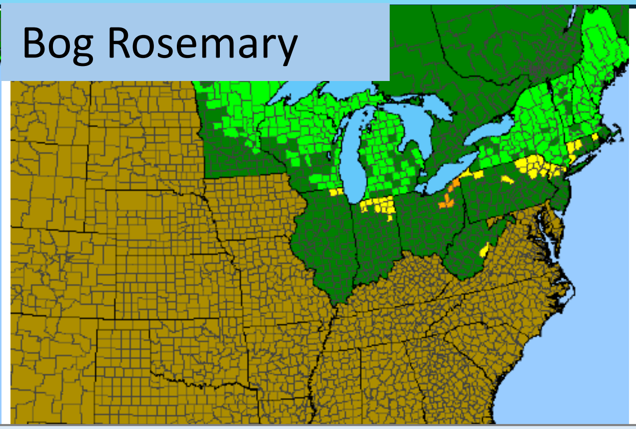
Mid-century Observed and Projected Precipitation Change

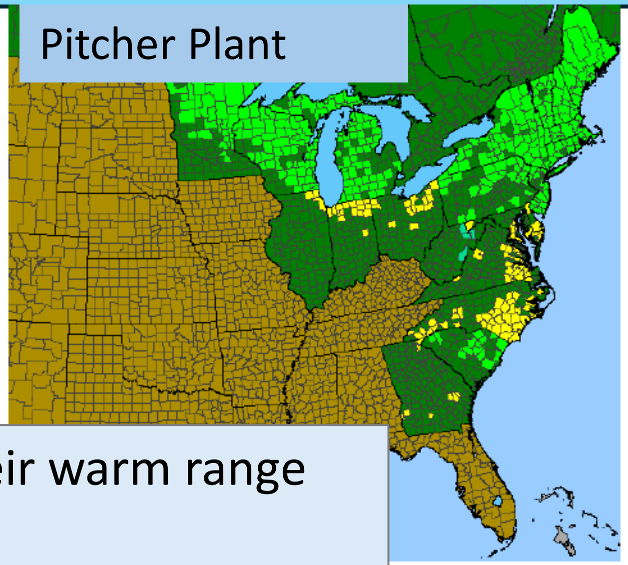
- Projected temperature increases: greater evapotranspiration (ET) lower water levels in wetlands
- Increased precipitation (P) could offset moisture loss from ET
- Some models show high probability of ET > P leading to greater frequency and duration of drought during later 21st century
- Prolonged drought can lead to lower wetland water levels impacting plant communities and their key functions: water levels, flows, C storage, biodiversity
- Climate warming may amplify impacts of mine dewatering
- Phenological mismatch: e.g. pollinators and plants life cycle shifts, flowering before pollinator emergence, migratory species and food sources out of synch.

Climate Change: Wetland Ecosystems









- Many characteristic peatland species are circumboreal; and occur close to their warm range limits in Minnesota (black spruce, bog laurel, bog rosemary, pitcher plant).
- These species can survive boreal environments due to tolerance to cold temperature, low nutrient and mineral levels.
- They can also persist further south with specific soil, hydrologic, and water quality conditions.
- <u>Maintaining hydrological integrity and water quality are especially important under climate change</u>

Mine Permitting and Review Process

- The Minnesota Department of Natural Resources (MNDNR) is the Responsible Government Unit (RGU) overseeing the environmental review and permitting process.

- The Minnesota Pollution Control Agency (MPCA) participates in review process and issues permits for air and water quality

- The Talon Metals project is in the first stage of review using the Environmental Assessment Worksheet (EAW).

- The EAW describes the total project and helps determine the probable environmental impacts and determines if an Environmental Impact Assessment (EIS) is required

- EIS provides a highly detailed project description that addresses environmental impacts. The EAW and EIS go through multiple rounds of review, comment, and response.

Mine Permitting and Review Process

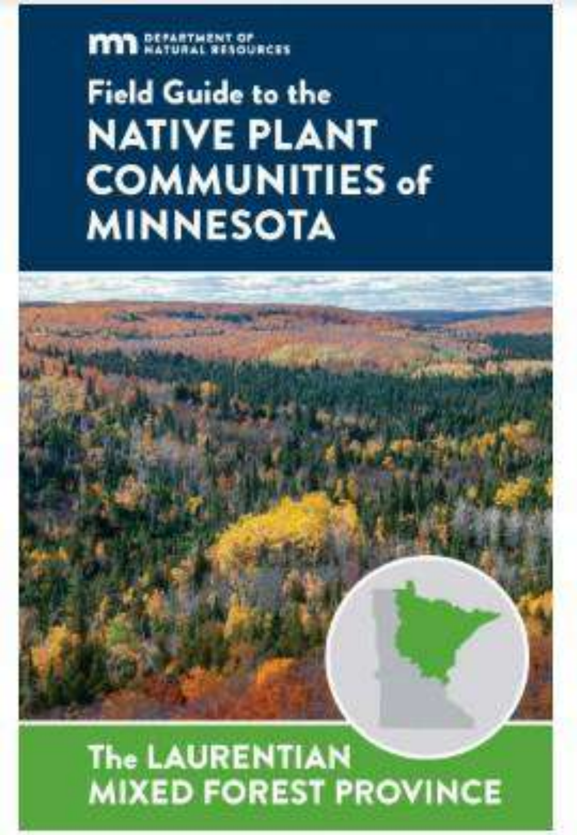
Next Public Comment Period

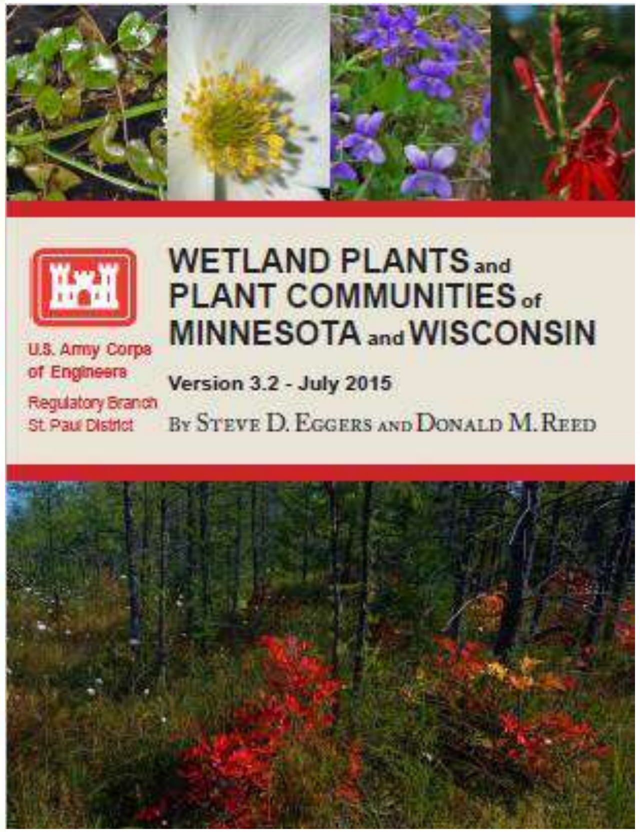
- Hydrological analysis: precipitation inputs, groundwater flows, surface-groundwater interactions, and analysis of dewatering impacts on wetland and surface water levels and downstream effects.
- This would include modeling the hydrologic system with dewatering and climate change impacts.
- Survey for state listed rare species; special concern, threatened and endangered in areas with new infrastructure as well as the surrounding wetland-upland landscape.
- Assess the potential effects of hydrological, water quality, climate changes on rare species and plant communities.

Summary

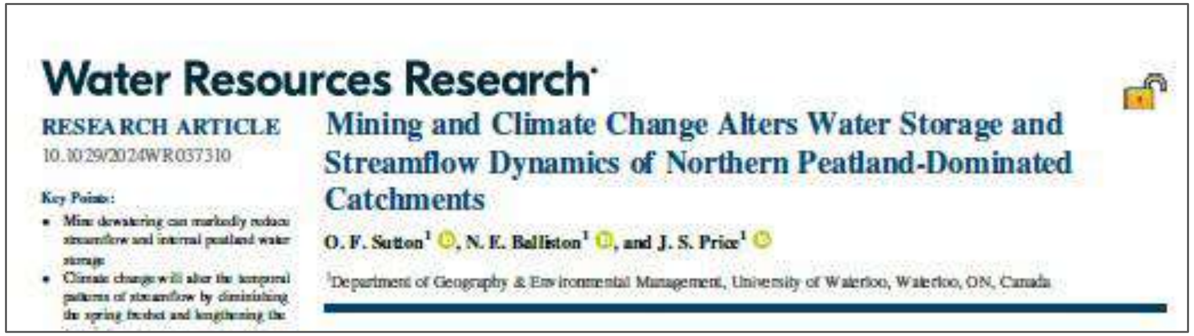
- Wetlands: Complex mosaic with variation in hydrology, PH, mineral levels, and plant communities.
- Mining operations are temporary, operational for 10 to 30 years. However, the impacts can persist for many decades and can be irreversible in some cases.
- Mining sulfide ores poses a grave threat to water quality, dewatering, development, and climate change can lead to significant impacts to hydrological function.
- Lower water levels: shifts in plant community composition and structure, drying and decomposition of peat deposits resulting in increased carbon emissions, reduced uptake, habitat losses for many plant and animal species.
- Climate heating: potential to amplify mining impacts on wetland functioning. Increased severity and frequency of drought, disrupt phenology; plants pollinators, migratory species
- Maintaining hydrological integrity and water quality are essential for people and nature in rapidly changing environment

Information Sources





Balliston, N. E. & Price, J. S (submitted March 20, 2022). Landscape scale subsidence and alterations to hydrophysical structure and function in mine-dewatered peatlands in the Hudson Bay Lowlands. Submitted to Water Resources Research



Water Resources Research

RESEARCH ARTICLE
10.1029/2024WR037310

Key Points:

- Mine dewatering can markedly reduce streamflow and internal peatland water storage
- Climate change will alter the temporal patterns of streamflow by diminishing the spring freshet and lengthening the

Mining and Climate Change Alters Water Storage and Streamflow Dynamics of Northern Peatland-Dominated Catchments

O. F. Sutton[1], N. E. Balliston[1], and J. S. Price[1]

[1]Department of Geography & Environmental Management, University of Waterloo, Waterloo, ON, Canada

NRC Research Press

REVIEW

Wetlands in the Athabasca Oil Sands Region: the nexus between wetland hydrological function and resource extraction

Olena Volik, Matthew Elmes, Richard Petrone, Eric Kessel, Adam Green, Danielle Cobbaert, and Jonathan Price

Questions?

Mark White
marco1215@msn.com