NOMINATION OF THE

St. Louis River Natural Area

TO THE DULUTH NATURAL AREAS PROGRAM

DATE: 12/30/19

Nominated by: City of Duluth Parks & Recreation Division

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Table of Contents

List of Figures

List of Tables

List of Appendices

Executive Summary

The City of Duluth, with assistance from the Minnesota Land Trust, developed this nomination for lands along the St. Louis River to be included in the Duluth Natural Area Program (DNAP) and requests submission to the Planning Commission and City Council for review under Duluth City Code, Chapter 2, Article XXIX, Sect 2-152.

The DNAP was created as a city program to protect and preserve Duluth's natural heritage by using mechanisms to identify valued environmental properties owned by the city and/or other owners interested in participating by establishing a means to protect such properties from development or exploitation. The qualifications for lands to be incorporated into the DNAP and the various avenues to protect these special places are specified in the ordinance and its complementary guidelines (City of Duluth, 2002).

The St. Louis River is a showcase feature for the City of Duluth. The river provides many recreational, health, and economic benefits to the community and its visitors. The City identified places along the river with the most intact terrestrial and aquatic habitats and the least development potential. These places align with City plans for additional community access and enjoyment initiatives. These undeveloped areas, encompassing 1,119 acres, are included in St. Louis River Natural Area (SLRNA) nomination for the (Figure 1). The nominated lands are currently owned by the City of Duluth, State of Minnesota, and private landowners (Appendix A).

The SLRNA represents a diverse and important ecosystem within the City of Duluth. As described in the DNAP Guidelines (City of Duluth, 2002), to accomplish the purpose of the DNAP, the goal is to designate the best remaining examples of viable natural areas representative of the Duluth area. The nominated lands along the St. Louis River corridor represent the best remaining examples of all five of the categories defined in the DNAP ordinance:

- Significant native plant communities area – The area supports 17 distinct native plant communities including the Lake Superior estuary marsh community that exists predominantly in the St. Louis River estuary within the state.

- Special species area – Three special plant species (pale sedge, discoid beggarticks, and soapberry) and 52 special bird species (listed in Table 5) were identified in the natural area in surveys conducted for this nomination.

- Natural water features area – the St. Louis River Estuary and four state designated trout streams, Keene, Kingsbury, Stewart, and Knowlton Creeks, are located within the natural area.

- Important bird congregation area – A plethora of bird species congregate in the natural area for nesting, foraging, and migratory habitat including shorebirds, waterbirds, waterfowl, and migratory landbirds.

- Geologic landform area – The geologic formation of Duluth is represented by landforms present in the nominated natural area, particularly the backwater areas of Rask Bay, North Bay, Radio Tower Bay, and Kingsbury Bay. These bays visually indicate the drowned river mouth that once flowed into Glacial Lake Duluth.

Introduction

The City of Duluth, with assistance from the Minnesota Land Trust, seeks to nominate certain lands to the Duluth Natural Areas Program (DNAP). This proposal would create a 1,230-acre Duluth Natural Area along the St. Louis River comprised of nine distinct project areas (Figure 1).

The DNAP was created as a city program to protect and preserve Duluth's natural heritage by using mechanisms to identify valued environmental properties owned by the city and/or other owners interested in participating by establishing a means to protect such properties from development or exploitation. The qualifications for lands to be incorporated into the DNAP and the various avenues to protect these special places are specified in the ordinance (Duluth City Code, Chapter 2, Article XXIX, Sect 2-152) and its complementary guidelines (City of Duluth, 2002).

The St. Louis River is an integral part of the City of Duluth's identity, providing a wealth of recreational, health, and economic benefits to the City's residents and visitors. Over the past several years, significant efforts have been and continue to be undertaken by local, state, and federal partners to clean up contamination and restore degraded habitat from legacy impacts to the river associated with its designation as a Great Lakes Area of Concern. In 2016, the City of Duluth launched the St. Louis River Corridor Initiative, a series of public park and trail improvement projects on the west side of Duluth from Fond du Lac to Lincoln Park with goals to support the natural environment and enrich neighborhood quality of life. The nomination of a natural area along the St. Louis River corridor supports these goals. The Western Waterfront Trail, one of the projects in the initiative, will eventually connect all but the easternmost portion of the SLRNA. Further, a number of existing and planned access points for the St. Louis River National Water Trail (designation pending) are located within the SLRNA.

In addition to its' importance to the City of Duluth, the lower St. Louis River is vitally important to the health of the region and Lake Superior. It serves as an important migration corridor for wildlife and is included in Minnesota Department of Natural Resources' (MNDNR's) Wildlife Action Network (Figure 2), which identifies priority areas for conservation in the state. Audubon has designed the estuary, from Chambers Grove downstream to Lake Superior and southeast to Wisconsin Point, as an "Important Bird Area" (IBA), because of its' significance as a migratory corridor for birds. The river's coastal wetland complex and adjacent plant communities are important to the biodiversity of the State of Minnesota; the majority of the lower river through Duluth falls within designated "sites of biological significance" as mapped by the Minnesota Biological Survey (Figure 3).

The following sections of this report provide necessary information on eligibility for nominating the SLRNA to the DNAP.

Eligibility

Eligibility of a tract for nomination under the DNAP requires both ownership and scientific criteria to be satisfied. This nomination provides documentation for the SLRNA that satisfies both types of criteria.

LAND OWNERSHIP

A tract is eligible for nomination as a natural area if it meets one of four ownership conditions, as specified by the DNAP Guidelines (City of Duluth, 2002). For the SLRNA the following ownership situations apply:

- City-owned property located within the boundaries of the City.
- Property located within the boundaries of the City which is owned by other persons or entities, whether public or private, where such owner desires to have their property enrolled in the Program and where the owner is willing to convey the necessary property interests to the City or other qualified party (e.g. state, nonprofit, etc.) to accomplish those ends.

The SLRNA comprises 1,119 acres of undeveloped land within the city of Duluth along the river corridor. A total of 256 parcels are encompassed within the natural area. Current ownership of the parcels is a mix of City, private, St. Louis County tax-forfeit, and State of Minnesota (Table 1; Figure 4 through 12). A list of the individual parcels and current ownership is provided in Appendix A.

Table 1: Land Ownership within the St. Louis River Natural Area

Ownership	Number of Parcels	Area (%)
City of Duluth	86	33
Private	26	30
St. Louis County Tax-Forfeit	142	31
State Public Property	2	5
Total	256	100

The initial boundaries of the SLRNA were selected based on the following considerations:

- Intact areas of known high quality aquatic and terrestrial habitat;
- Low development potential for neighborhoods, businesses, or industry;
- Proximity to current and planned City parks and amenities (e.g., Chambers Grove, Kingsbury Bay, Grassy Point, Munger Landing);
- Opportunities to provide protection of important undeveloped riverfront where willing private landowners exist.

Prior to finalizing the boundaries of the natural area, a development suitability analysis was completed to determine if any of the areas within the original boundaries were better suited for economic or business development. The analysis consisted of two steps: 1) desktop evaluation using the City of Duluth's Development Suitability GIS-based tool and 2) review of the results of the evaluation with City staff. City staff from Business Development, Community Planning, and Public Administration were involved in the review.

As a result of the development suitability analysis, several City-owned parcels and a private parcel were completely removed from the natural area, and the boundaries of several private parcels partially within the natural area were adjusted. Adjustments were made to remove properties that could be future infill areas for residential development, commercial development near existing infrastructure, and commercial development inland from the immediate shoreline.

Fourteen private and two other government agencies own land within the natural area. The City has contacted each of these landowners and is in the process of discussing participation in the natural area based on these contacts. The natural area boundaries may be further refined based on the results of these discussions.

SCIENTIFIC CRITERIA

The DNAP Guidelines (City of Duluth, 2002) require nominations to support one or more of the following scientific criteria:

- Significant native plant communities
- Natural water feature area
- Important bird congregation area
- Special species area
- Geological landform area

The SLRNA is being nominated under all five scientific criteria.

Significant Native Plant Communities

The SLRNA contains many assemblages of native plant species that classify as native plant communities (NPC) as defined by the Minnesota Department of Natural Resources (MDNR, 2003). A mappable NPC indicates sufficient ecological integrity of the plant community present in an area that it demonstrates characteristics of a particular natural assemblage of plants.

Native plant communities were mapped for the natural area in Summer/Fall 2018 using a combination of remote sensing and field surveys (Appendix B; Figure 13 through 21). The mapped areas differ slightly from the final natural area boundaries being nominated, as the boundaries were adjusted for various land use reasons as the project proceeded.

There are 17 distinct native plant community types within the natural area comprised of various types of hardwood forest, mixed hardwood-conifer forest, floodplain forest, forested swamps, shrub swamps, wet meadows, and marshes (Table 2). These communities are present across 85% of the natural area. Widespread past and current human disturbance has occurred throughout the corridor and although these disturbances pose challenges to the ecological integrity of the corridor, NPCs and rare plant species have persisted except in limited patches.

Non-native/disturbed cover exists on 15% of the mapped area. This includes transportation corridors (e.g., railroad, streets), invasive species, restoration areas, and old fields. These areas are included in the natural area because they are limited patches surrounded by NPCs and have the potential to reduce fragmentation; in addition, some have potential to be restored with management actions (such as invasive species control).

Table 2: Native Plant Communities in the St. Louis River Natural Area in 2018

System	Class	Subtype Description	Subtype Code	Mapped Area (%)
Sparse Vegetated Upland	Cliff/Talus	Dry Sandstone Cliff (Northern)	CTn11e	0.6
	Cliff/Talus	Wet Sandstone Cliff (Northern)	CTn42d	0.1
Forested Upland	Mesic Hardwood Forest	Aspen - Birch - Basswood Forest	MHn35a	2.3
	Mesic Hardwood Forest	Red Oak - Sugar Maple - Basswood - (Bluebead Lily) Forest	MHn35b	0.5
	Mesic Hardwood Forest	Aspen - Birch - Red Maple Forest	MHn44a	19.7
	Mesic Hardwood Forest	White Pine - White Spruce - Paper Birch Forest	MHn44b	0.8
	Mesic Hardwood Forest	Aspen - Birch - Fir Forest	MHn44d	1.5
	Mesic Hardwood Forest	Aspen - Ash Forest	MHn46a	4.5
	Mesic Hardwood Forest	Black Ash - Basswood Forest	MHn46b	0.8
	Mesic Hardwood Forest	Sugar Maple - Basswood - (Bluebead Lily) Forest	MHn47a	0.1
Forested Wetland	Floodplain Forest	Black Ash - Silver Maple Terrace Forest	FFn57a	5.3
	Wet Forest	Black Ash - Aspen - Balsam Poplar Swamp (Northeastern)	WFn55a	4.7
	Forested Rich Peatland	Alder Swamp	FPn73a	1.6
Shrub and Open Wetland	Marsh	Cattail - Sedge Marsh (Northern)	MRn83a	12.8
	Marsh	Estuary Marsh (Lake Superior)	MRu94a	16.2
	Wet Meadow/Carr	Willow - Dogwood Shrub Swamp	WMn82a	7.7
	Wet Meadow/Carr	Sedge Meadow	WMn82b	5.3

Each mapped area of NPC was assigned a condition rank according to the definitions in Table 3. Condition ranks consider both the amount of human disturbance and abundance of invasive species. Within the SLRNA, 62% of mapped NPCs are in good (B) to excellent (A) condition (Table 3). Conversely, only 3% of the mapped NPCs were below fair integrity (C/D or D).

Table 3: Condition Ranks of Native Plant Communities in the St. Louis River Natural Area

Condition Rank	Description	Mapped Area (%)
A	Excellent ecological integrity. Little disturbed by recent human activity or invasive species.	7
A/B		2
B	Good ecological integrity. Lightly disturbed or recovered from past disturbance. Can return to A-rank with protection or management.	54
B/C		1
C	Fair ecological integrity. Strong evidence of human disturbance, but retain some characteristic species.	33
C/D		2
D	Poor ecological integrity. Severely altered by human disturbance or invasive species.	1

Source: MDNR, 2009.

Significant native plant communities in the natural area include Estuary Marsh (Lake Superior), NPC code MRu94a. This coastal wetland community occurs only in estuaries and river mouths influenced by the Lake Superior seiche. The fluctuating water levels of the seiche, caused by wind-driven changes in Lake Superior elevation, can reverse the flow of the river and flush sediment and nutrients back upstream. The MRu94a community is more species-diverse than similar native marsh communities in inland settings. The St. Louis River below the Fond du Lac dam contains the largest area of this community in the state; its only other documented presence is in much smaller patches at river mouths on the north shore of Lake Superior through Lake County, Minnesota.

In Rask Bay and other project areas with large areas of wetlands influenced by the seiche of Lake Superior, there were significant areas of dead or dying woody species, likely past forested or shrub swamps that are currently classified as sedge meadows or marshes. It appears that wetland shrubs and trees have been stressed by higher Lake Superior water levels over the past several years, after experiencing historic low water levels in 2007. The lake elevation at the time of the August 2018 survey was approximately 602.69 feet, compared to a long-term average of 602.13 feet, and a low of 600.43 feet in August 2007. These communities likely fluctuate between open wetland and tree/shrub dominated communities as water levels vary. The presence of NPCs across a range of water elevations helps to preserve the ability of these communities to transition between different NPCs as water levels change.

Natural Water Feature Area

There are four eligible natural water features located within or adjacent to the SLRNA. These include the St. Louis River Estuary and four trout streams, Knowlton Creek, Stewart Creek, Kingsbury Creek, and Keene Creek.

The St. Louis River Estuary is both regionally and globally significant. The St. Louis River is the largest U.S. tributary to Lake Superior and drains over 3,600 square miles of northeastern Minnesota and northwestern Wisconsin. The lower 21 miles of the river bordering the City of Duluth is considered its' estuary, because it is part of the mixing zone with Lake Superior. This 12,000-acre freshwater estuary supports globally important coastal wetland ecosystems and is also the home to the busiest harbor and international port on the Great Lakes.

The diversity of ecosystems in the estuary, including estuarine wetland and aquatic habitats, baymouth bar complex (i.e., Minnesota and Wisconsin Points), and surrounding upland forest, are very unusual in Lake Superior, the Great Lakes Region, and the world (SLRCAC, 2002). The coastal wetlands in the St. Louis River are the largest complex on Lake Superior and provide a significant proportion of biological productivity for the entire lake and serves as the primary source for the more than 40 native fish species found in western Lake Superior, including walleye, lake sturgeon, muskellunge, and northern pike.

Numerous tributary streams drain into the St. Louis River across Duluth, including eight state designated trout streams. Four of these trout streams, Knowlton, Stewart, Kingsbury, and Keene, are located within the nominated SLRNA (Figure 22). These streams are significant natural water features, as they retain temperatures cold enough to support native brook trout populations. In recent years, MNDNR has spent significant effort restoring the Knowlton Creek watershed; restoration work is also planned for Kingsbury and Keene Creeks within the next several years.

Important Bird Congregation Area

The St. Louis River is well-known as an important migratory corridor for birds. Audubon has designed the estuary, from Chambers Grove downstream to Lake Superior and southeast to Wisconsin Point, as an “Important Bird Area” (IBA). It is described by Audubon as one of the best and most popular birding sites in all of Minnesota (Audubon, 2018). The IBA contains an exceptional diversity of bird species, with 76% of the species found in Minnesota every year regularly using the estuary (Audubon, 2018).

The DNAP Guidelines (City of Duluth, 2002) focus on areas where large concentrations of birds occur, termed Important Bird Congregation Areas. These areas are designated globally as locations that provide essential habitat for avian species during some phase of their life cycle. They may be important for species that are vulnerable, threatened, endangered, particular to a certain area, representative of a distinct region, and/or significant concentrations of birds from a diversity of guilds (e.g., waterfowl, shorebirds, migratory landbirds). The specific criteria for an Important Bird Congregation Area given in the DNAP Guidelines (City of Duluth, 2002) include numerical criteria for certain guilds of birds. Guilds are groups of species in a community that exploit the same set of resources in a similar manner, but are not necessarily closely related taxonomically.

To support the nomination of the SLRNA, bird surveys were conducted by researchers from the Natural Resources Research Institute in 2018 (Appendix C). Spring and fall migration and breeding season surveys were completed in each of the nine project areas (Figure 1). Each project area was surveyed 14 times between April and October 2018. A total of 13,953 individuals representing 169 species were documented. Overall, the surveys indicate that the diverse habitats along the St. Louis River and within the natural area provide critical stop-over habitat for a wide diversity of migrating and breeding birds. Based on the 2018 survey results, the SLRNA meets the DNAP criteria for four out of six guilds (Table 4).

Table 4: Comparison of 2018 Bird Survey Results to the DNAP Nomination Criteria

Guild	Description	Number of Individuals	Number of Species	Nomination Criteria Met
Waterfowl	A group of species that are highly adapted to living on the surface of the water and include ducks, geese, and swans.	5,184	22	✓
Shorebirds	Birds that live in wet or coastal environments; most species are commonly found wading along shorelines while foraging for food in mud or sand such as sandpipers, plovers, and yellowlegs.	126	12	✓
Waterbirds	Birds that live on or around water and have special adaptations such as webbed feet, bills and legs adapted to feed in water, and the ability to dive from the surface or the air to catch prey in water. Examples of waterbirds include pelicans, kingfishers, grebes.	995	14	✓
Raptors	Known as "birds of prey" and consist of species that primarily hunt and feed on vertebrates this group includes hawks, falcons, and eagles.	158	12	Not well assessed by survey methods
Wading Birds	Wading birds refer to birds that wade through shallow water while foraging (e.g. bitterns, herons, cranes).	44	5	
Migratory Landbirds	Refers largely to passerines or perching birds (e.g., warblers, sparrows, woodpeckers) for the purposes of these surveys.	7,373	99	✓

Twenty-three of the 169 total species observed in the 2018 survey are sensitive bird species (defined as endangered, threatened, or of special concern). These are described in the "Special Species Area" section below.

Special Species Area

The SLRNA is being nominated as a Special Species Area due to the presence of sensitive plant and sensitive bird species.

Sensitive Plant Species

Sensitive plant surveys were conducted in the SLRNA in the summer of 2018 by scientists at SEH (SEH, 2018). One state-listed endangered species, pale sedge (*Carex pallescens*), and two state-listed special concern species, discoid beggarticks (*Bidens discoidea*) and soapberry (*Shepherdia canadensis*), were found. Plant communities in the corridor may also provide suitable habitat for other rare species, including state-listed special concern narrow reedgrass (*Calamagrostis lacustris*) and state-listed endangered two leaf waterweed (*Elodea bifoliata*).

The estuary marsh (Lake Superior), MRu94a, habitat is suitable for discoid beggarticks, which was found in four of the nine project areas. The natural area contains 118 acres of this NPC. Soapberry was found in an area of upland forest, while pale sedge was found in wet meadow.

Sensitive Bird Species

Bird surveys were conducted within the SLRNA in 2018 by researchers from NRRI, as described above. A large number of species (169) were observed. Of these, 52 are species that are deemed "sensitive species" based on their designation as species of greatest conservation need (SCGN); U.S. shorebirds of conservation concern (SHCC); waterbirds of conservation concern (WACC); Partners in Flight species of continental concern (PIF), and U.S. Fish & Wildlife Service (USFWS) Region 3 and/or national birds of conservation concern (USFWS Regional or National). Birds may be listed for many reasons, including steep population declines, elevated threats, or small populations and ranges. The sensitive bird species in the SLRNA are given in Table 5.

Table 5: Sensitive Bird Species Observed During 2018 Surveys

Species	Listing
American Black Duck	SGCN
American Bittern	USFWS Regional, SGCN, WACC
American Kestrel	SGCN
American White Pelican	SGCN, WACC
Bald Eagle	USFWS National/Regional
Baird's Sandpiper	SHCC
Black-billed Cuckoo	USFWS Regional, SGCN, PIF
Belted Kingfisher	SGCN
Bobolink	SGCN, PIF
Bonaparte's Gull	WACC
Brown Thrasher	SGCN
Caspian Tern	WACC
Canada Warbler	USFWS National/Regional, PIF
Chimney Swift	SGCN
Common Loon	SGCN, WACC
Common Merganser	SGCN
Common Tern	USFWS Regional, SGCN, WACC
Dunlin	USFWS National, SHCC
Evening Grosbeak	SGCN, PIF
Forster's Tern	SGCN, WACC
Greater Yellowlegs	SGCN, SHCC
Green Heron	WACC
Golden-winged Warbler	USFWS National/Regional, SGCN, PIF
Herring Gull	WACC
Horned Grebe	USFWS Regional, SGCN, WACC
Killdeer	SHCC
Least Bittern	USFWS Regional, SGCN, WACC
Least Sandpiper	SHCC
Lesser Scaup	SGCN
Lesser Yellowlegs	USFWS National, SHCC
Northern Harrier	SGCN
Northern Pintail	SGCN
Northern Rough-winged Swallow	SGCN

Table 5: Sensitive Bird Species Observed During 2018 Surveys (Cont.)

Species	Listing
Olive Sided Flycatcher	USFWS National/Regional, SGCN, PIF
Peregrine Falcon	USFWS National/Regional, SGCN
Pectoral Sandpiper	SHCC
Philadelphia Vireo	SGCN
Pied-billed Grebe	USFWS Regional, WACC
Purple Finch	SGCN
Red-necked Grebe	SGCN, WACC
Red-shouldered Hawk	SGCN
Rusty Blackbird	USFWS National/Regional
Semipalmated Plover	SHCC
Semipalmated Sandpiper	USFWS National, SGCN, SHCC
Sedge Wren	SGCN
Sora	WACC
Solitary Sandpiper	USFWS National/Regional, SHCC
Spotted Sandpiper	SHCC
Trumpeter Swan	SGCN
Veery	SGCN
Virginia Rail	SGCN
Wilson's Snipe	SHCC

Geological Landform Area

The SLRNA has an interesting geologic history. It is located in the immediate drainage basin of a geological landform, the St. Louis River, which was significant in the formation of Lake Superior and the Great Lakes during the Post Glacial changes that followed the Great Ice Age. The geomorphology of the St. Louis River Estuary clearly depicts the natural process instrumental to the development of the present landscape of Duluth.

The St. Louis River was the largest tributary to Glacial Lake Duluth, which formed due to the retreat of the Ice Age glaciers approximately 11,500 years ago at the end of the Pleistocene era. The Great Lakes were slowly formed as the glaciers retreated and drainage outlets formed further and further east, connecting portions of the large basin that had been carved by the glaciers. The weight of the glacial mass depressed the Earth's crust, such that the elevation of the basin's outlet at Sault St. Marie was much lower than its current elevation, and the glacial deposits that had formed at the Duluth end of the lakes from the many tributaries draining into it were exposed. The St. Louis River then cut through the glacial moraine on its way to the new lower lake, whose elevation was approximately 200' lower than the current elevation of Lake Superior. Once the Earth's crust started to slowly rebound, water levels began to rise and fill in the St. Louis River valley, creating the current estuary, which is essentially a drowned river valley (Green, 1996).

Evidence of the drowned river valley is present in the form of the back waters of Rask Bay, North Bay, Radio Tower Bay, and Kingsbury Bay in the SLRNA (Figure 1). (The clay soils present throughout much of Duluth are evidence of the bed of Glacial Lake Duluth.)

Bedrock geology in the SLRNA is from the Midcontinent Rift, which is a long rift located in the center of North America that formed when the geological core of the North American continent began to split apart during the Precambrian period. From the Chambers Grove project area downstream to the North Bay project area, sedimentary sandstone and shale from the Fond du Lac formation are present. From the Radio Tower Bay project

area to the Grassy Point project area, bedrock has not been mapped in the floodplain areas. However, the layered series of Troctolite and Gabbro of the Duluth Complex is present in the more elevated areas (USGS, 2006).

The surficial geology present in the natural area is predominantly floodplain alluvium and disturbed sediment from the current interglacial Hudson period within the low-lying floodplain areas (Minnesota Geological Survey, 2009). Till deposits from the Barnum period of the Wisconsin Episode, the last glaciation period, are present in the more elevated areas (Minnesota Geological Survey, 2009).

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Figures

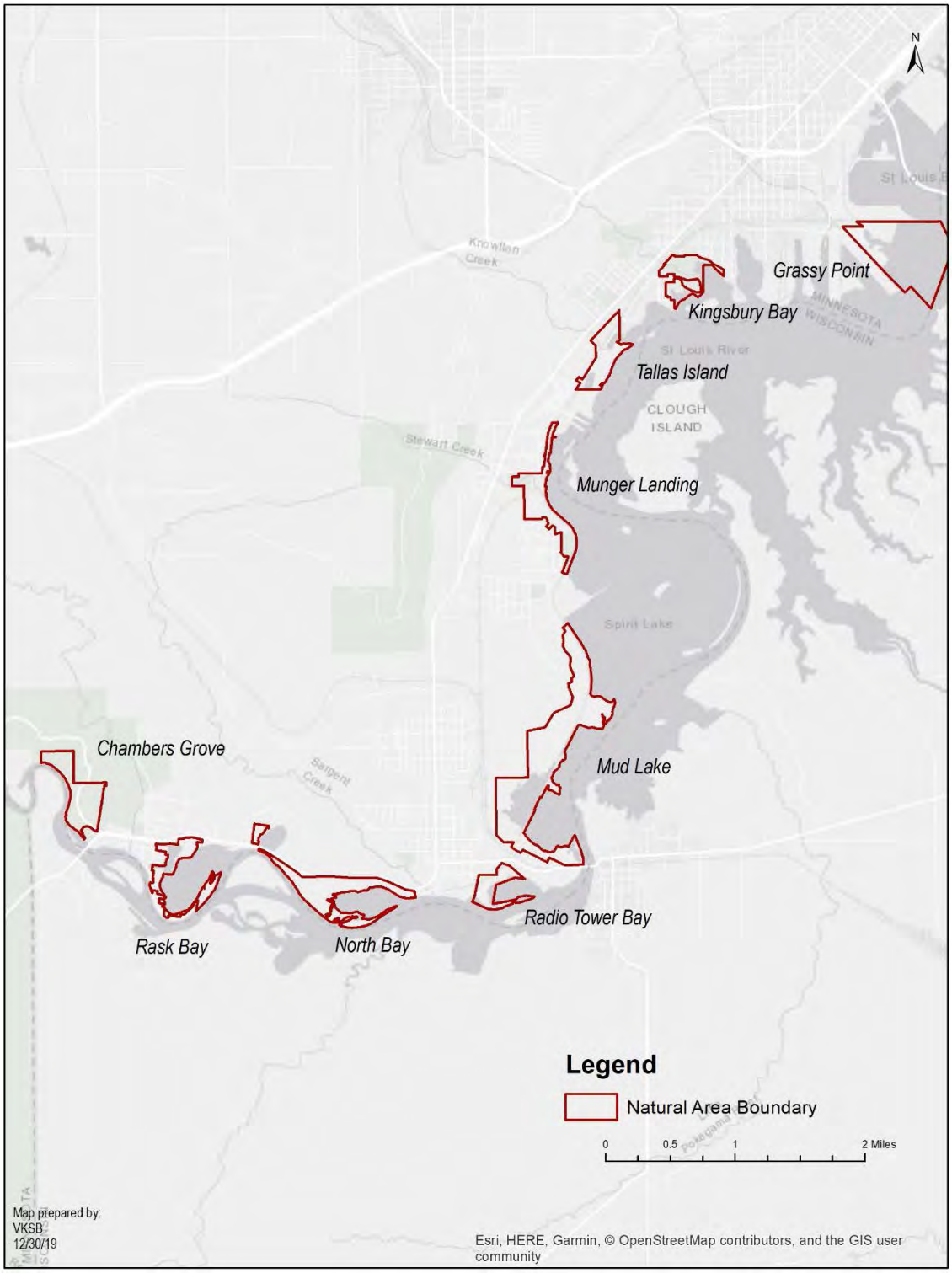

Figure 1: St. Louis River Natural Area

Inclusion in the natural area subject to landowner assent.

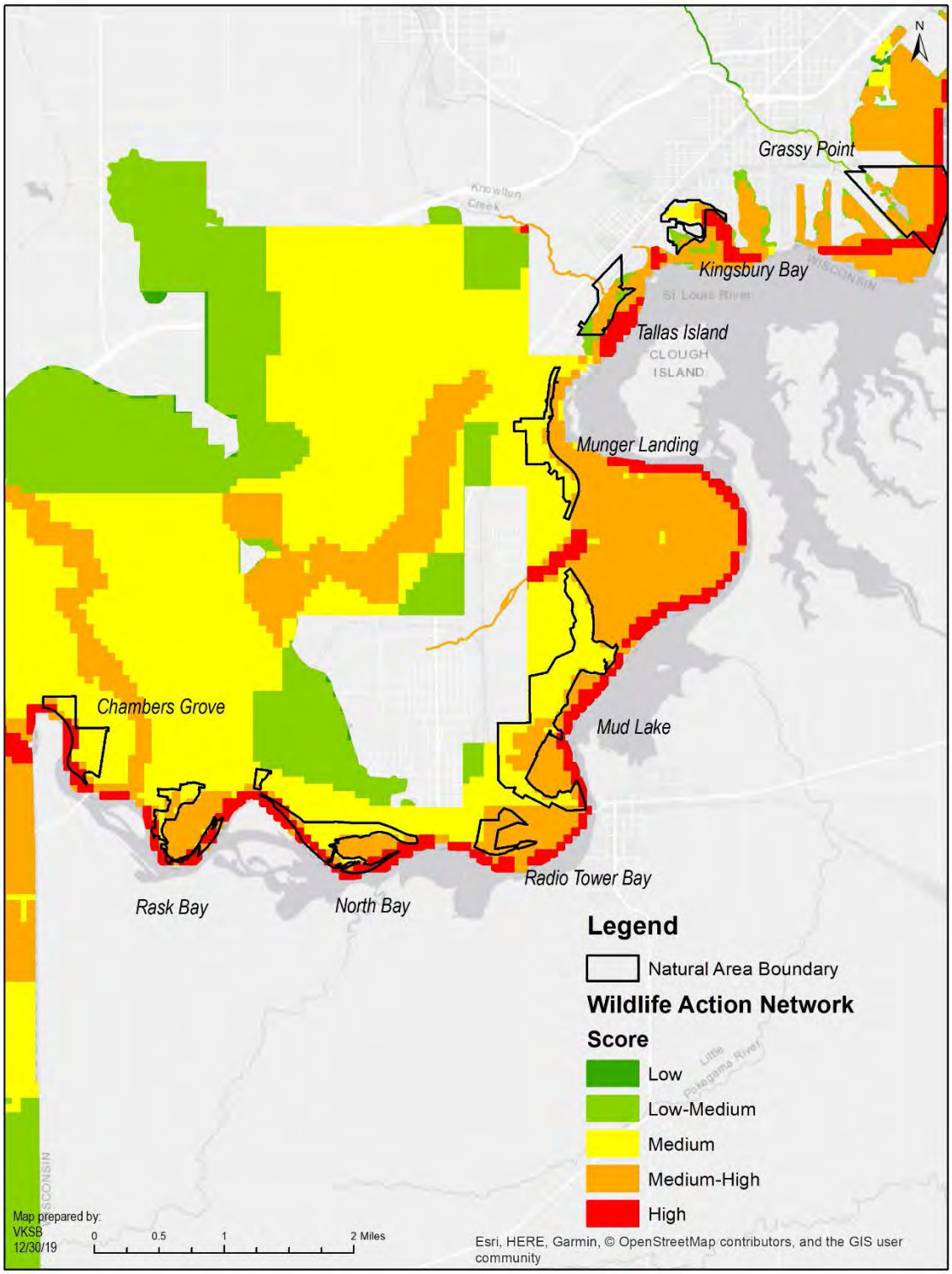

Figure 2: Wildlife Action Network Along the St. Louis River

Inclusion in the natural area subject to landowner assent.

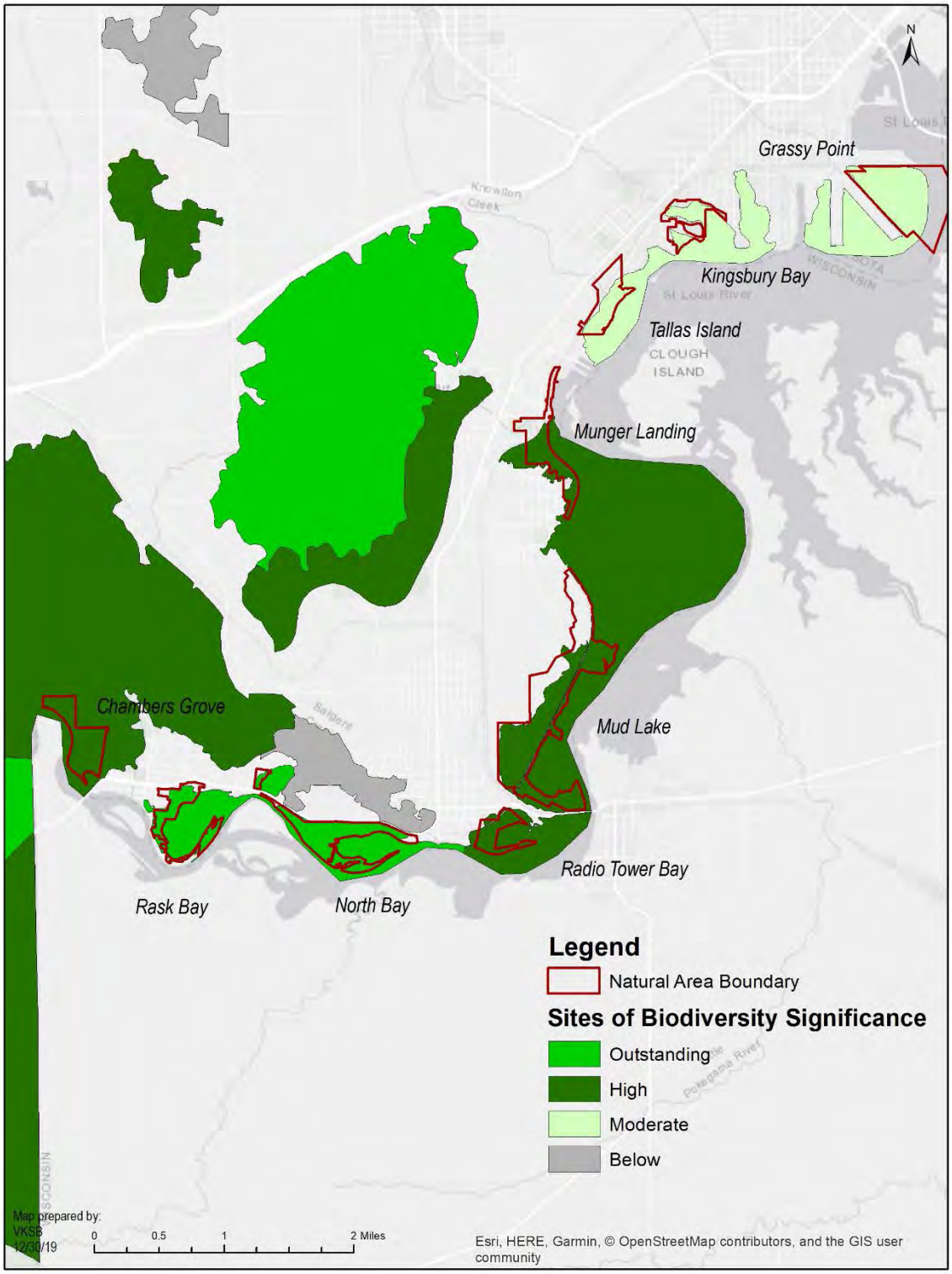

Figure 3: Sites of Biodiversity Significance Along the St. Louis River

Inclusion in the natural area subject to landowner assent.

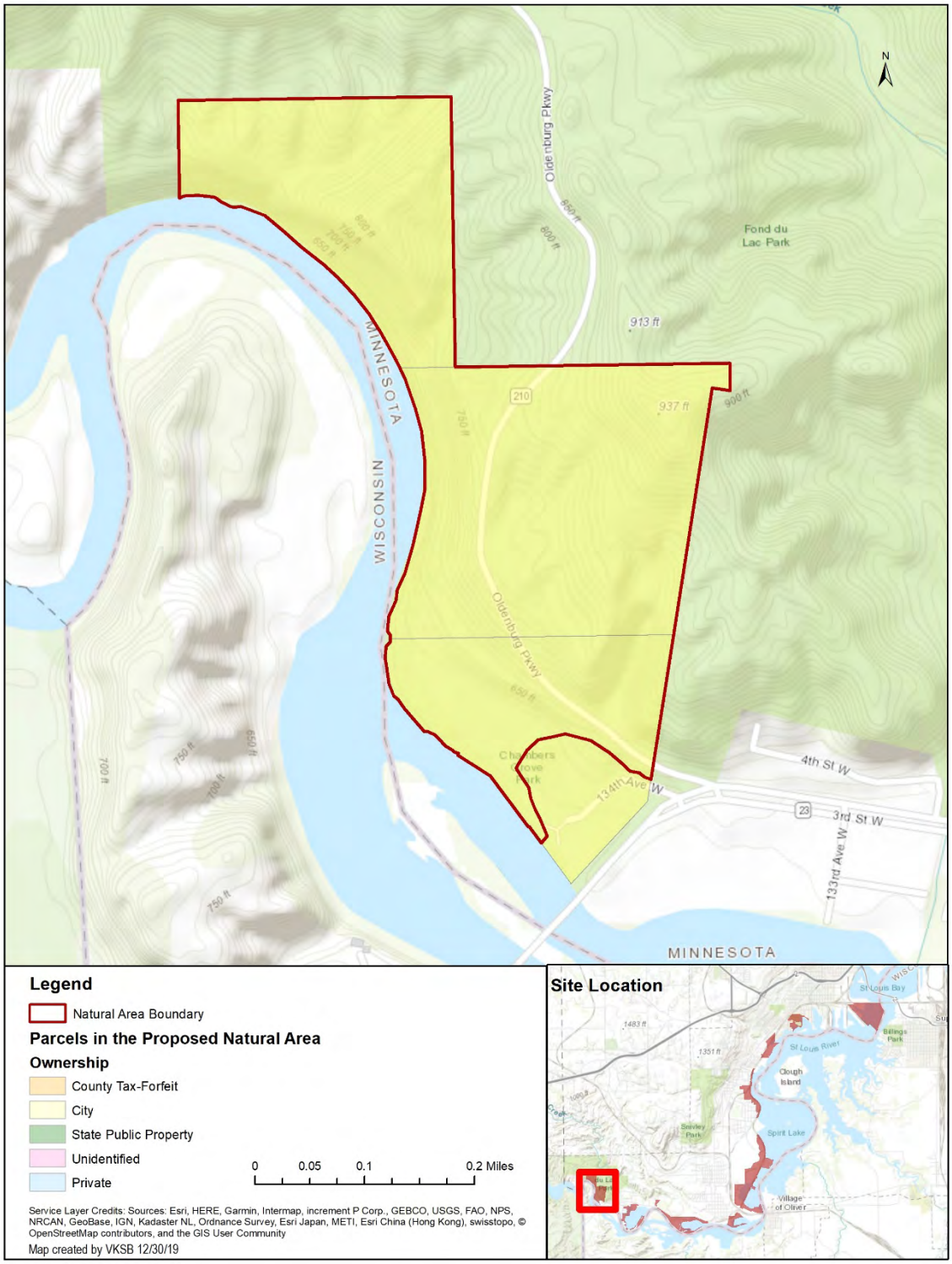

Figure 4: Property Ownership in the Chambers Grove Project Area

Figure 5: Property Ownership in the Rask Bay Project Area

Inclusion in the natural area subject to landowner assent.

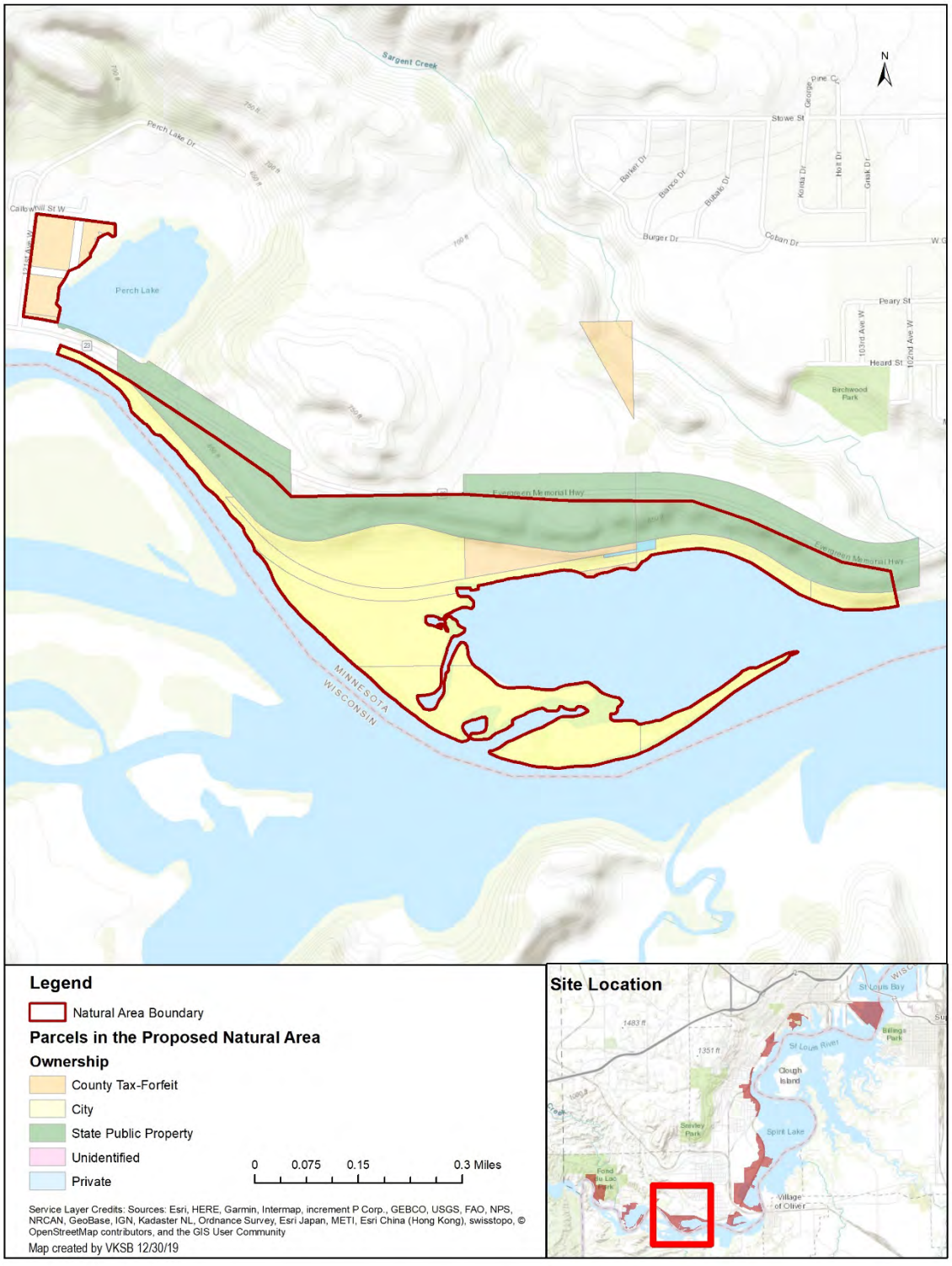

Figure 6: Property Ownership in the North Bay Project Area

Inclusion in the natural area subject to landowner assent.

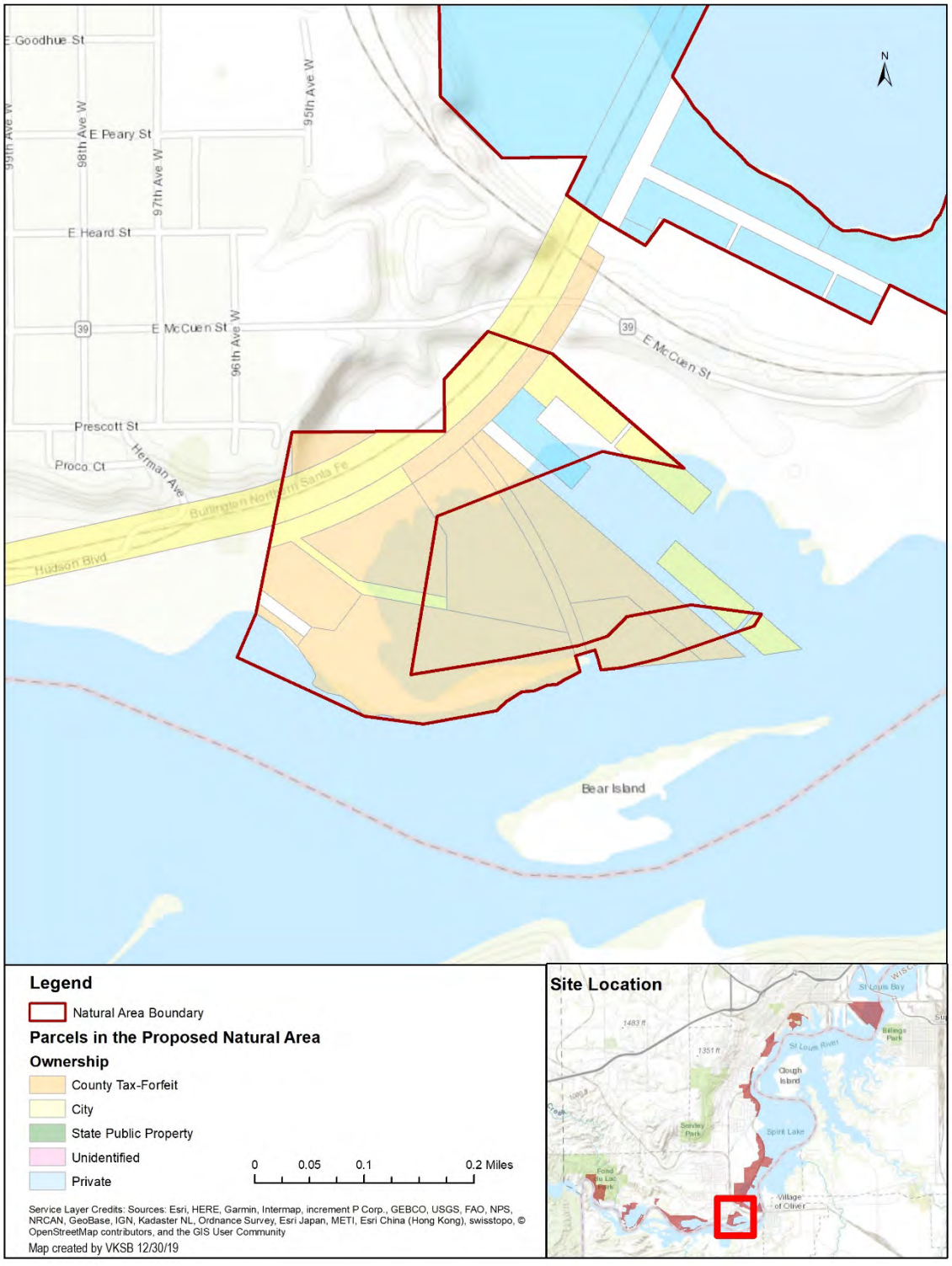

Figure 7: Property Ownership in the Radio Tower Bay Project Area

Inclusion in the natural area subject to landowner assent.

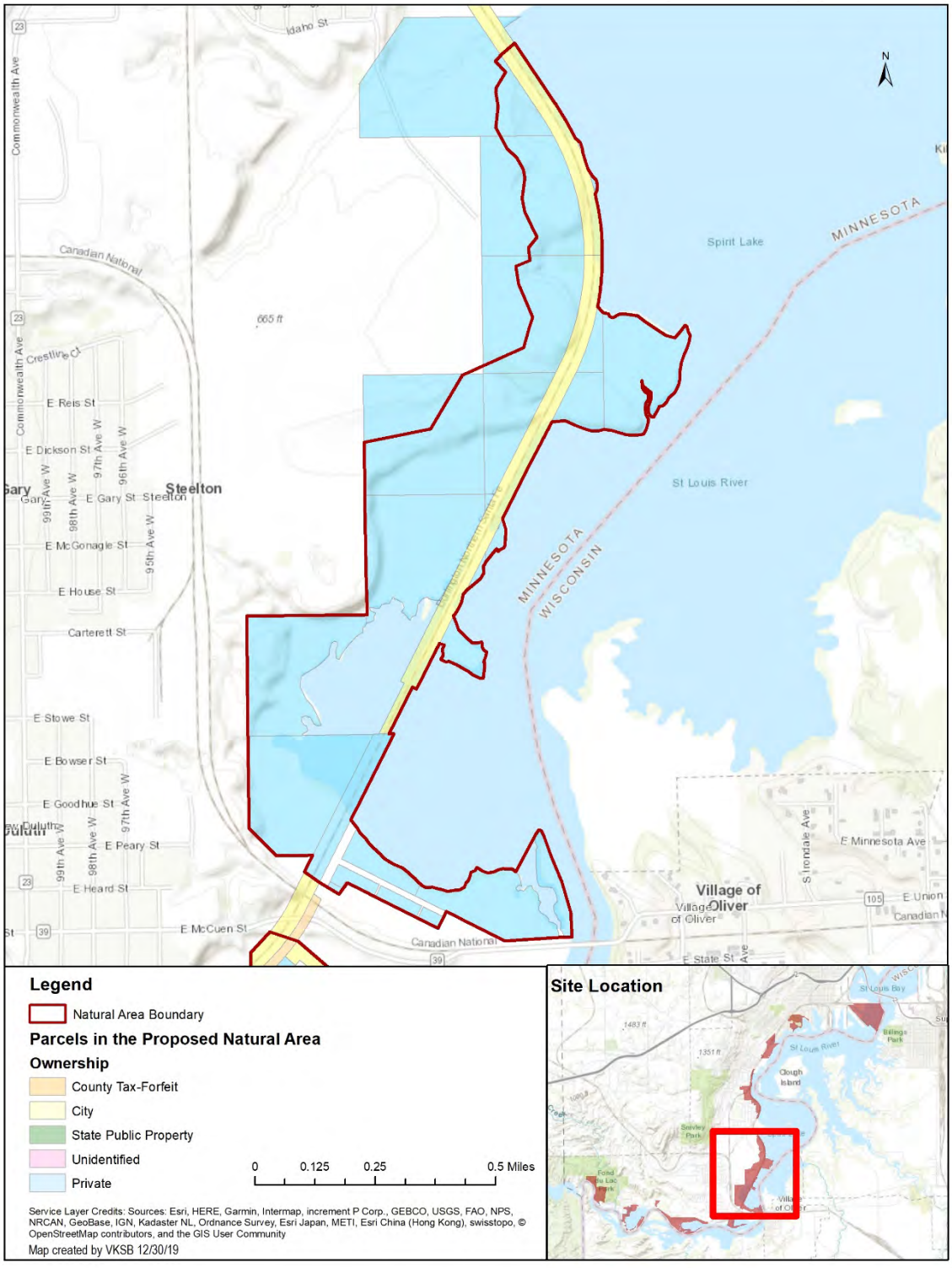

Figure 8: Property Ownership in the Mud Lake Project Area

Inclusion in the natural area subject to landowner assent.

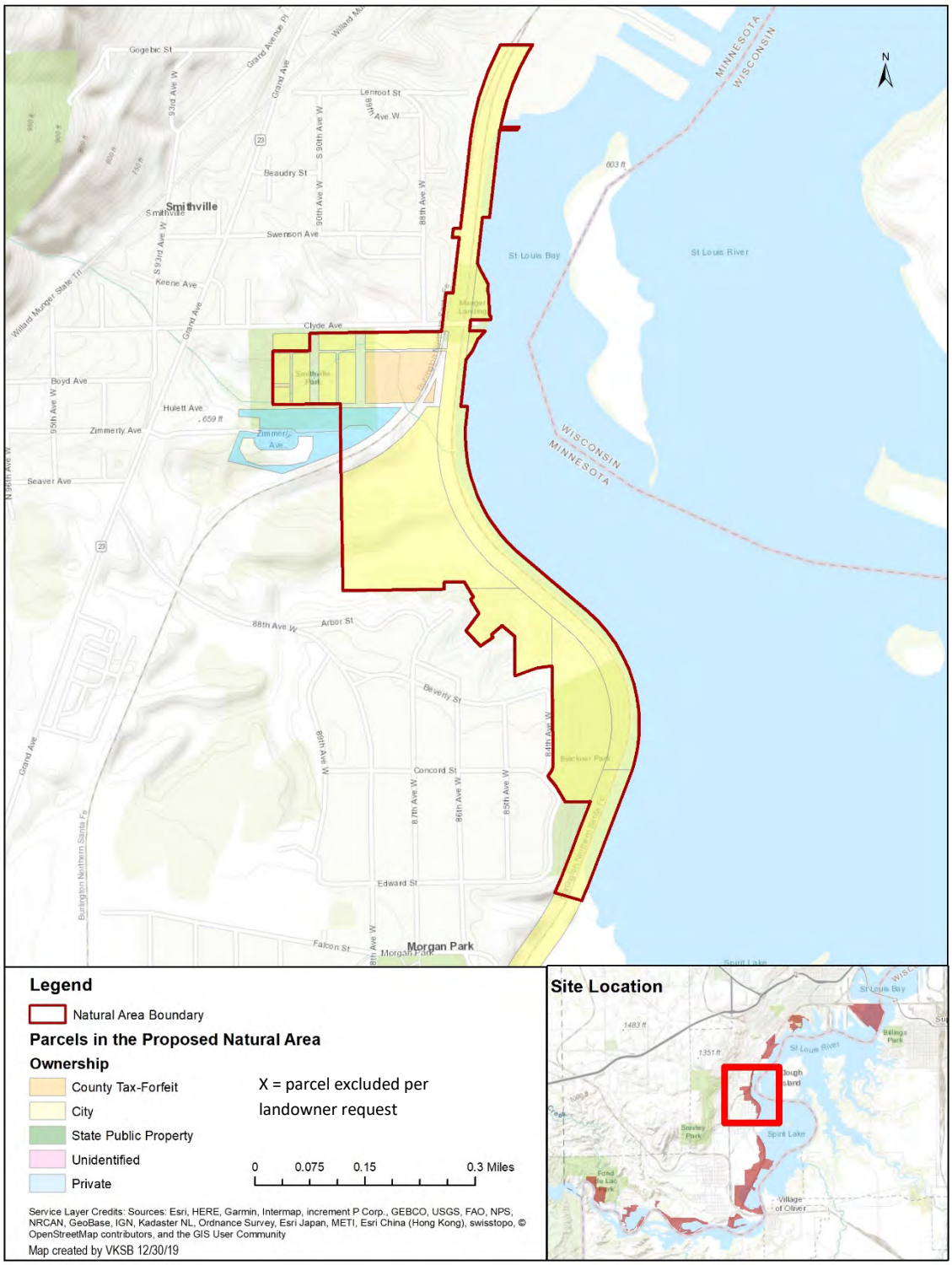

Figure 9: Property Ownership in the Munger Landing Project Area

Inclusion in the natural area subject to landowner assent.

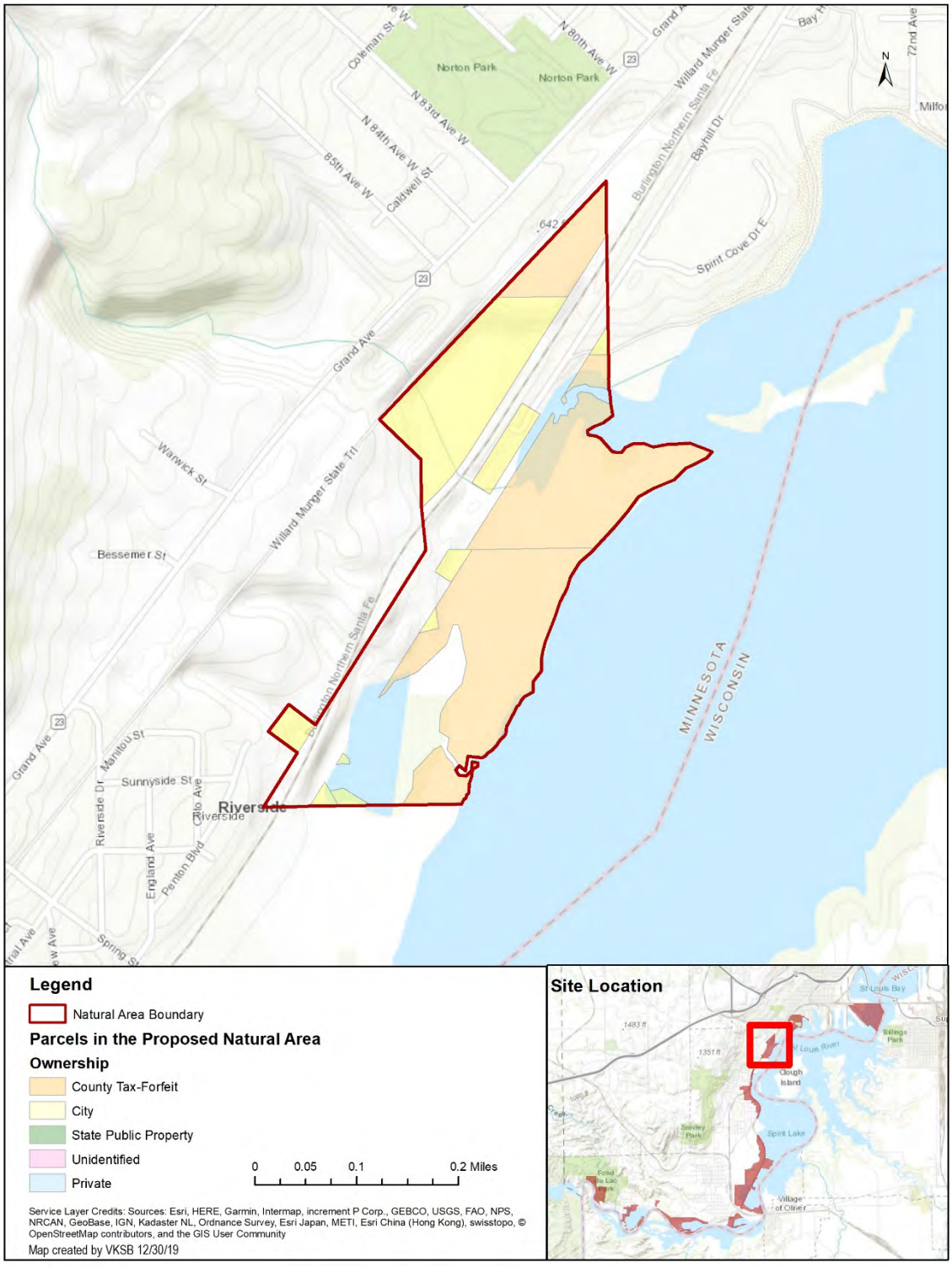

Figure 10: Property Ownership in the Tallas Island Project Area

Inclusion in the natural area subject to landowner assent.

Figure 11: Property Ownership in the Kingsbury Bay Project Area

Inclusion in the natural area subject to landowner assent.

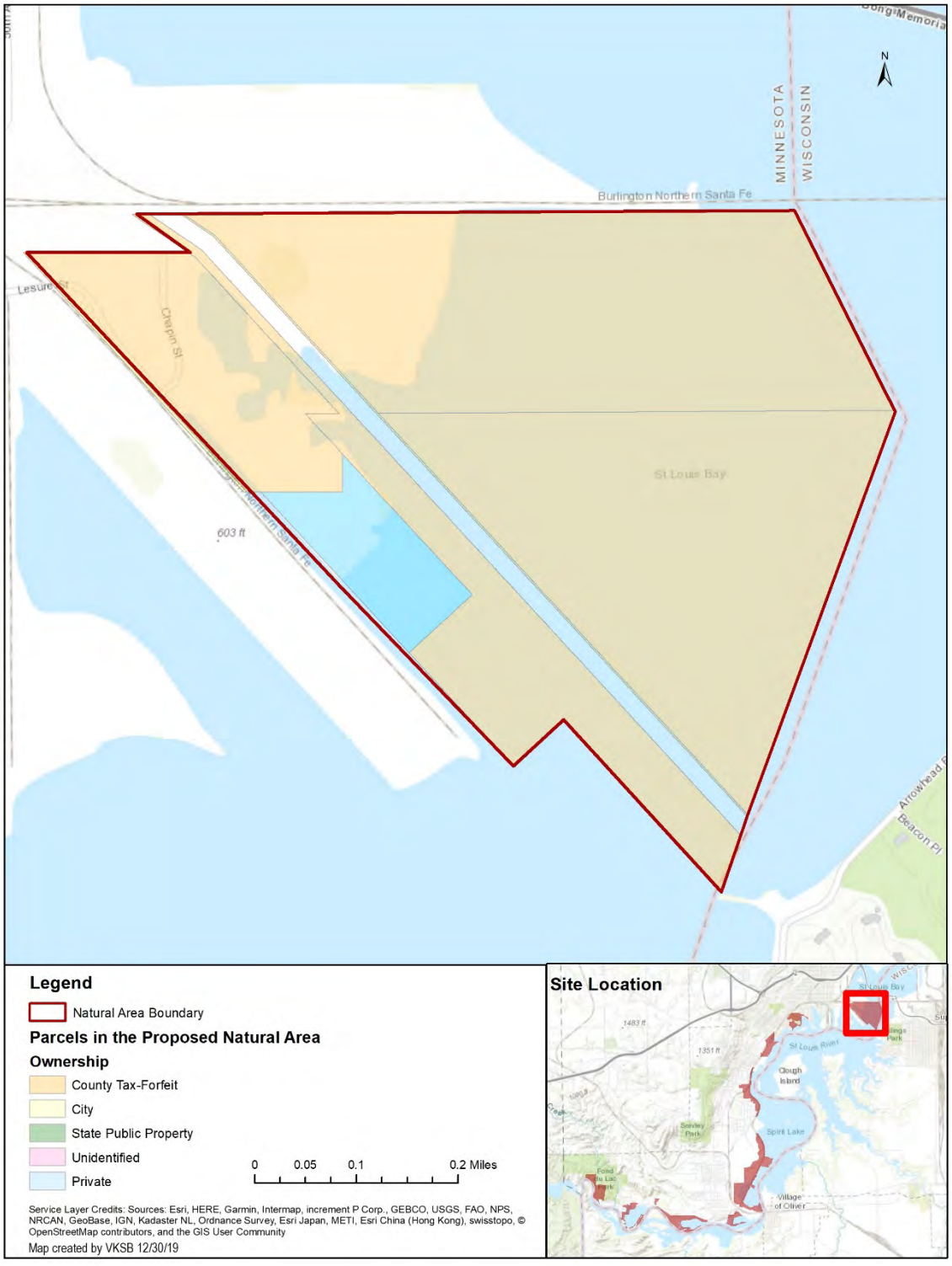

Figure 12: Property Ownership in the Grassy Point Project Area

Inclusion in the natural area subject to landowner assent.

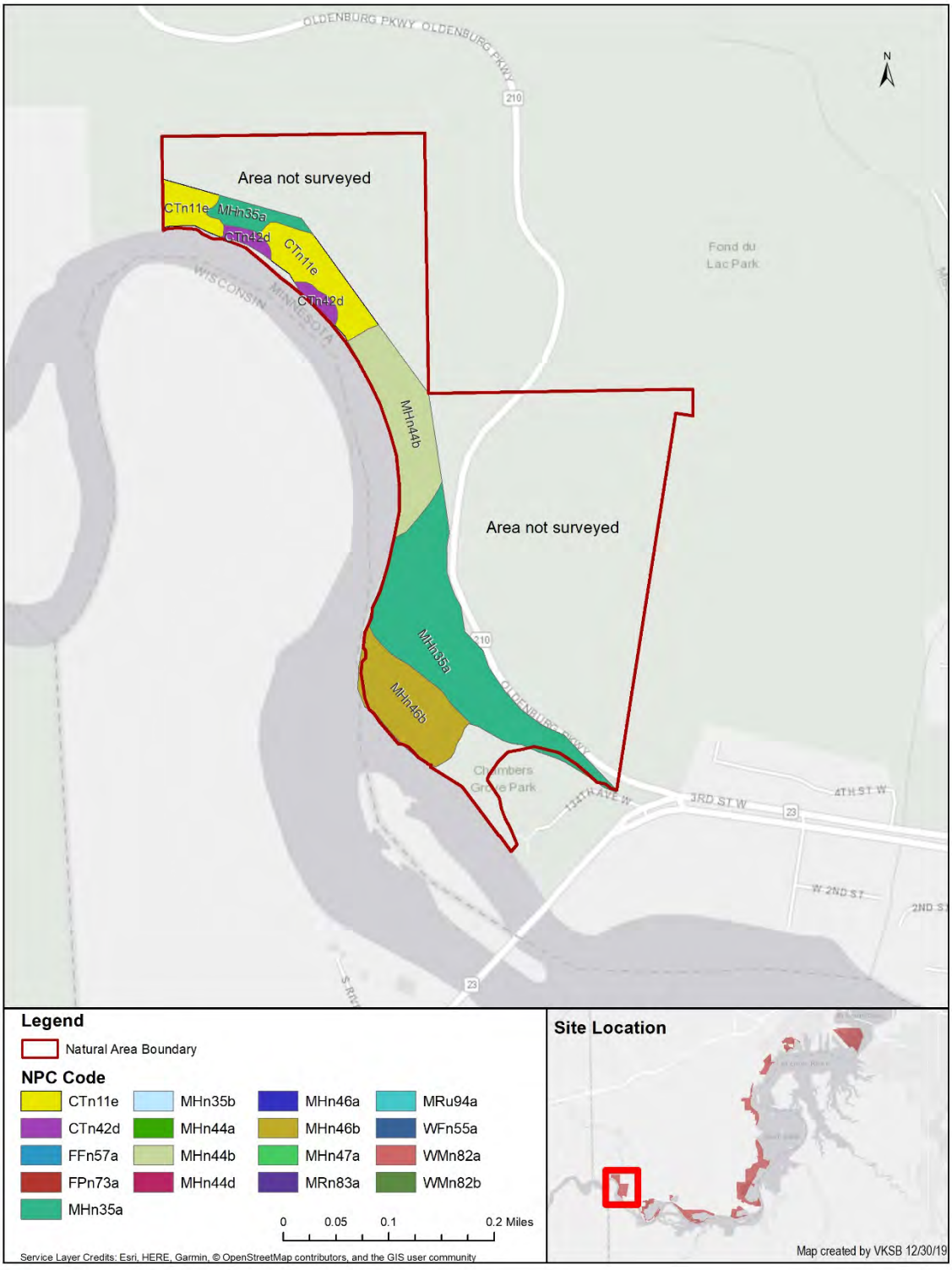

Figure 13: Native Plant Communities in the Chambers Grove Project Area

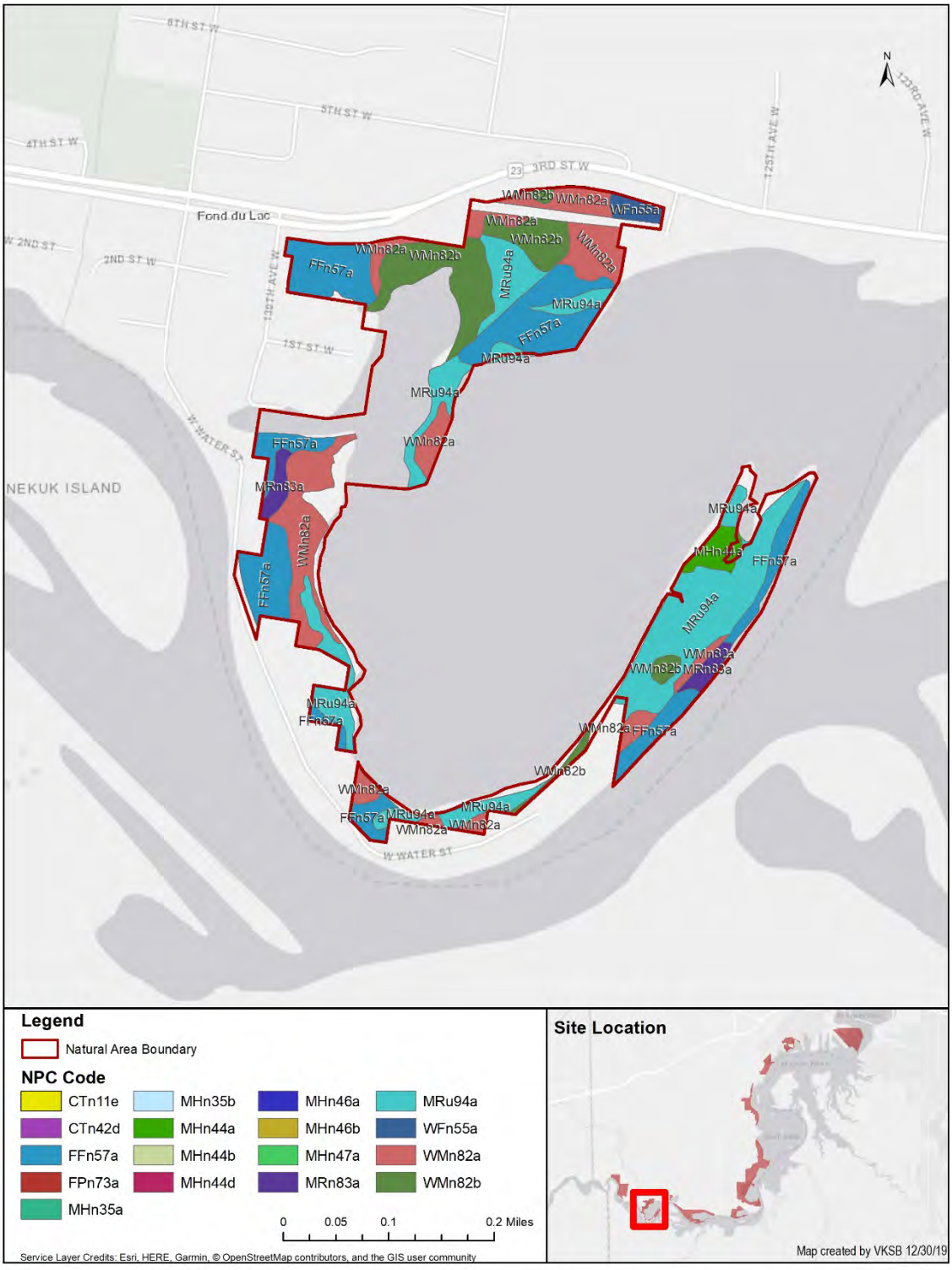

Figure 14: Native Plant Communities in the Rask Bay Project Area

Inclusion in the natural area subject to landowner assent.

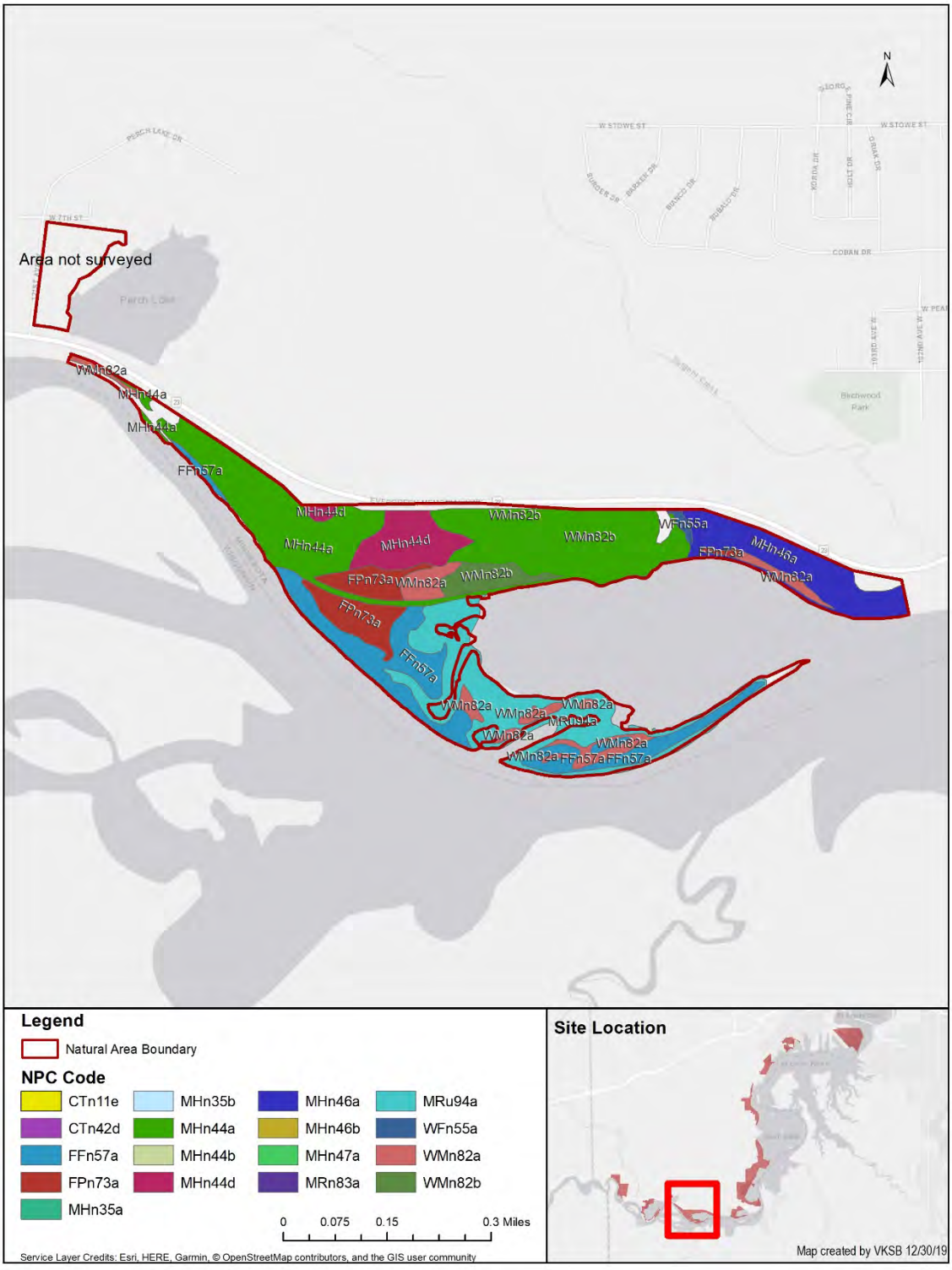

Figure 15: Native Plant Communities in the North Bay Project Area

Inclusion in the natural area subject to landowner assent.

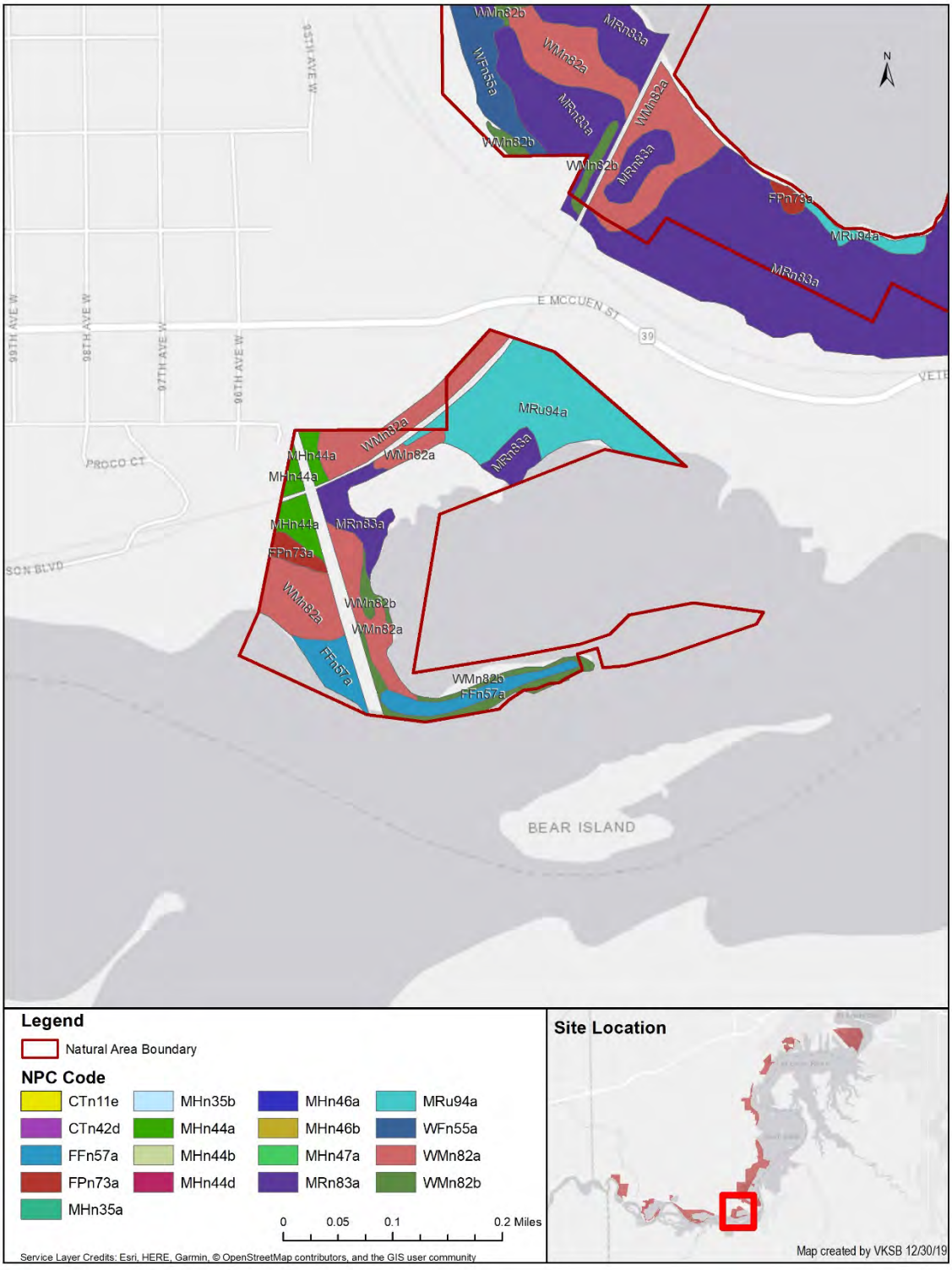

Figure 16: Native Plant Communities in the Radio Tower Bay Project Area

Inclusion in the natural area subject to landowner assent.

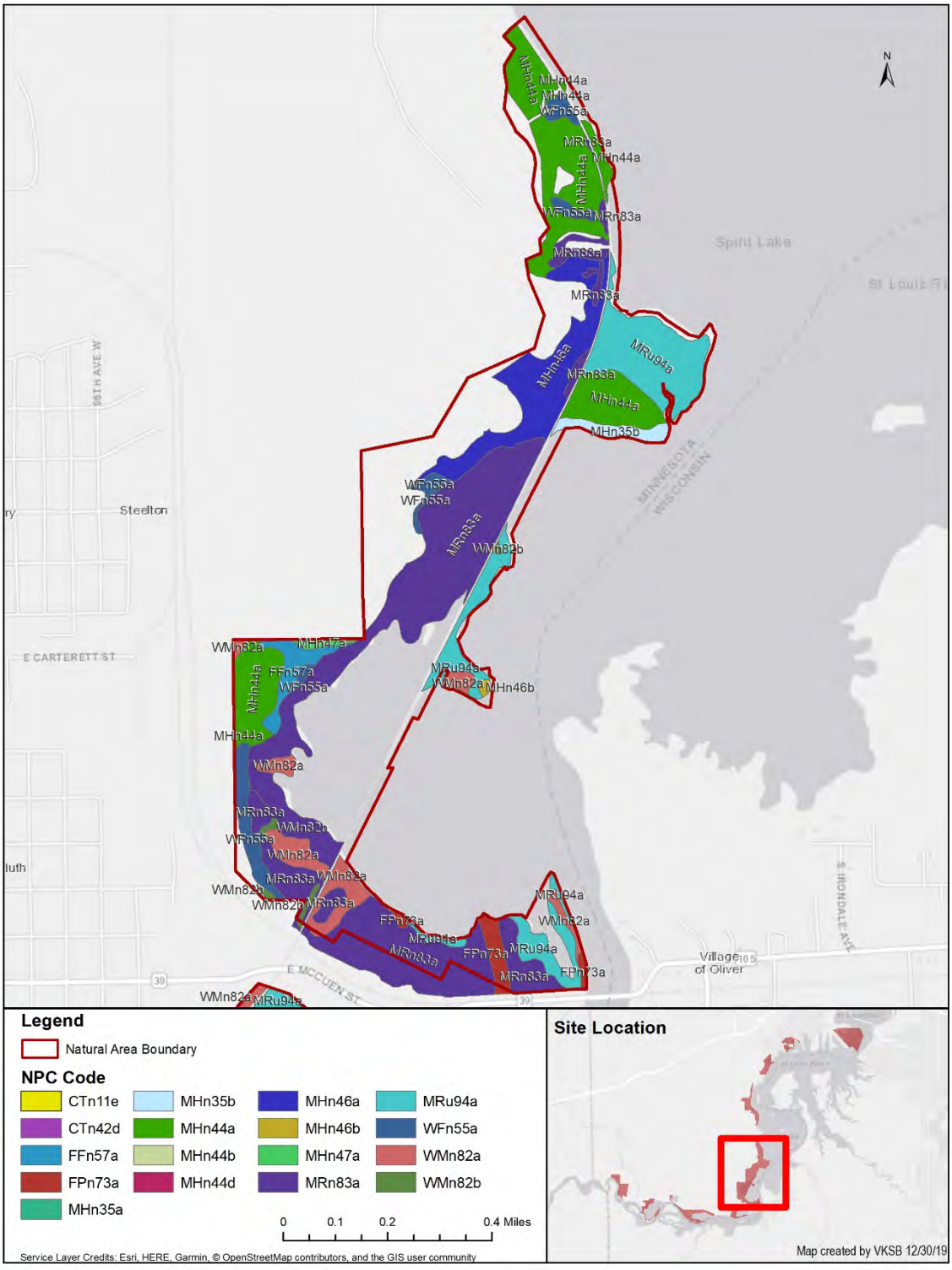

Figure 17: Native Plant Communities in the Mud Lake Project Area

Inclusion in the natural area subject to landowner assent.

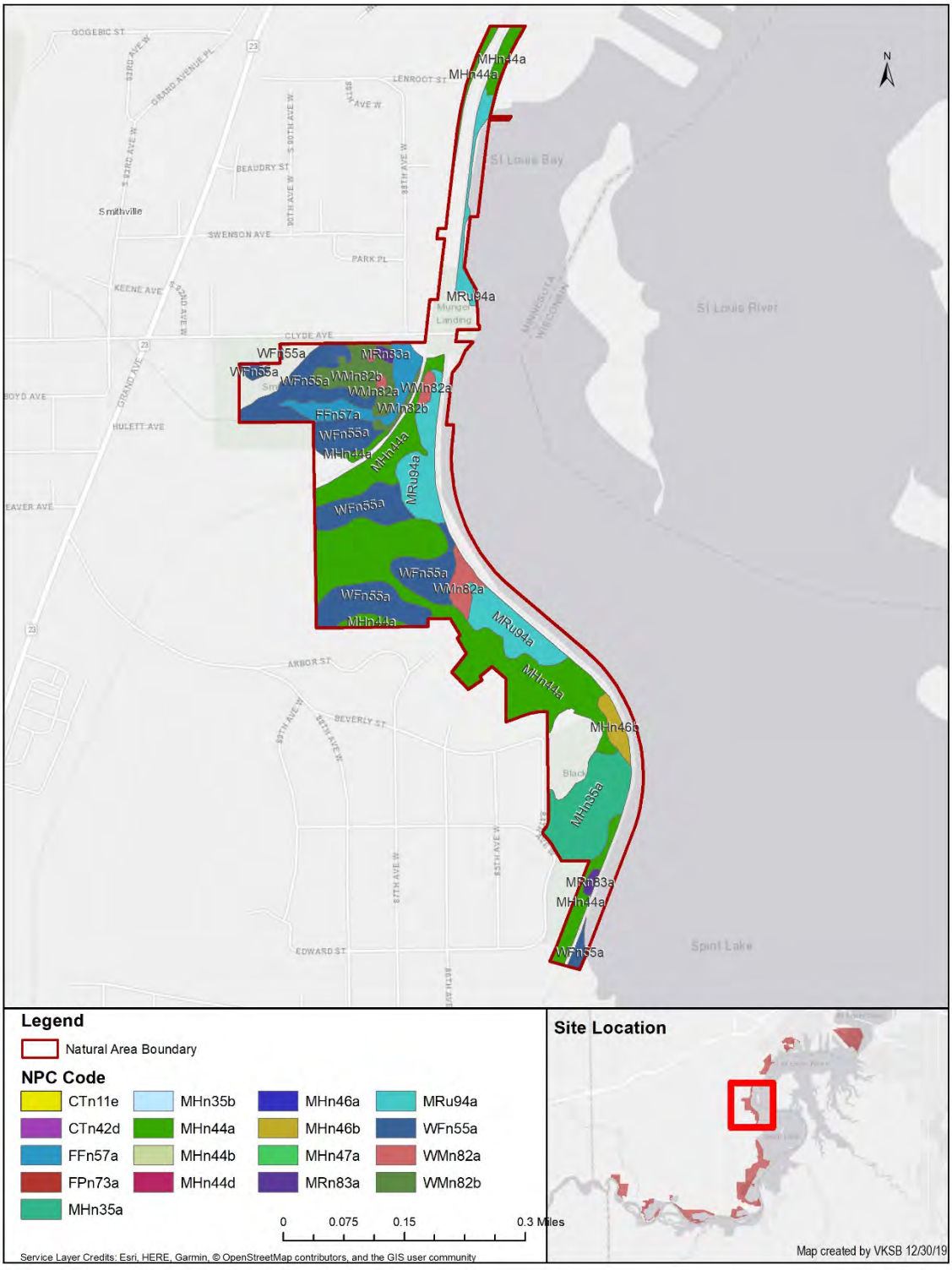

Figure 18: Native Plant Communities in the Munger Landing Project Area

Inclusion in the natural area subject to landowner assent.

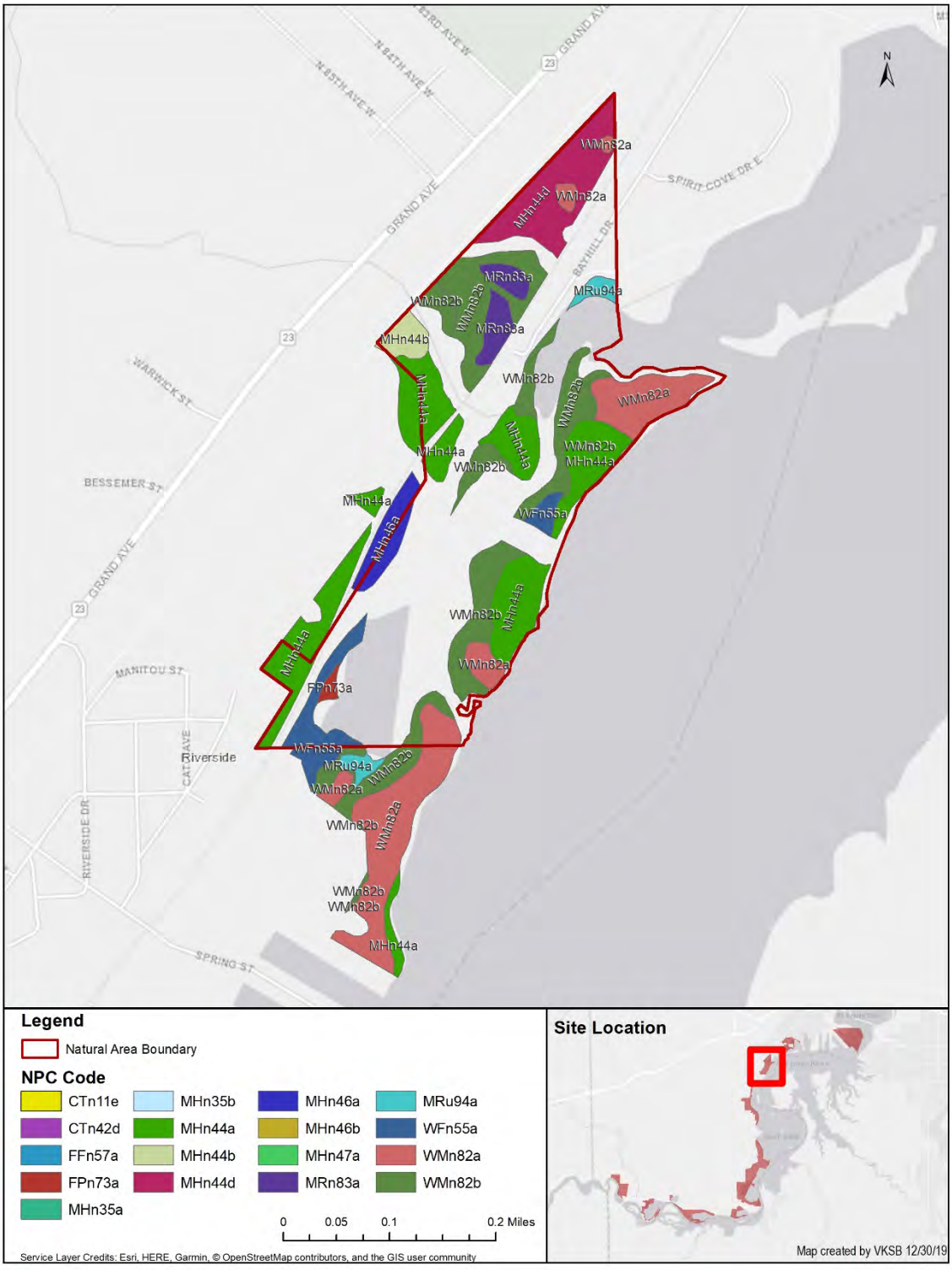

Figure 19: Native Plant Communities in the Tallas Island Area

Inclusion in the natural area subject to landowner assent.

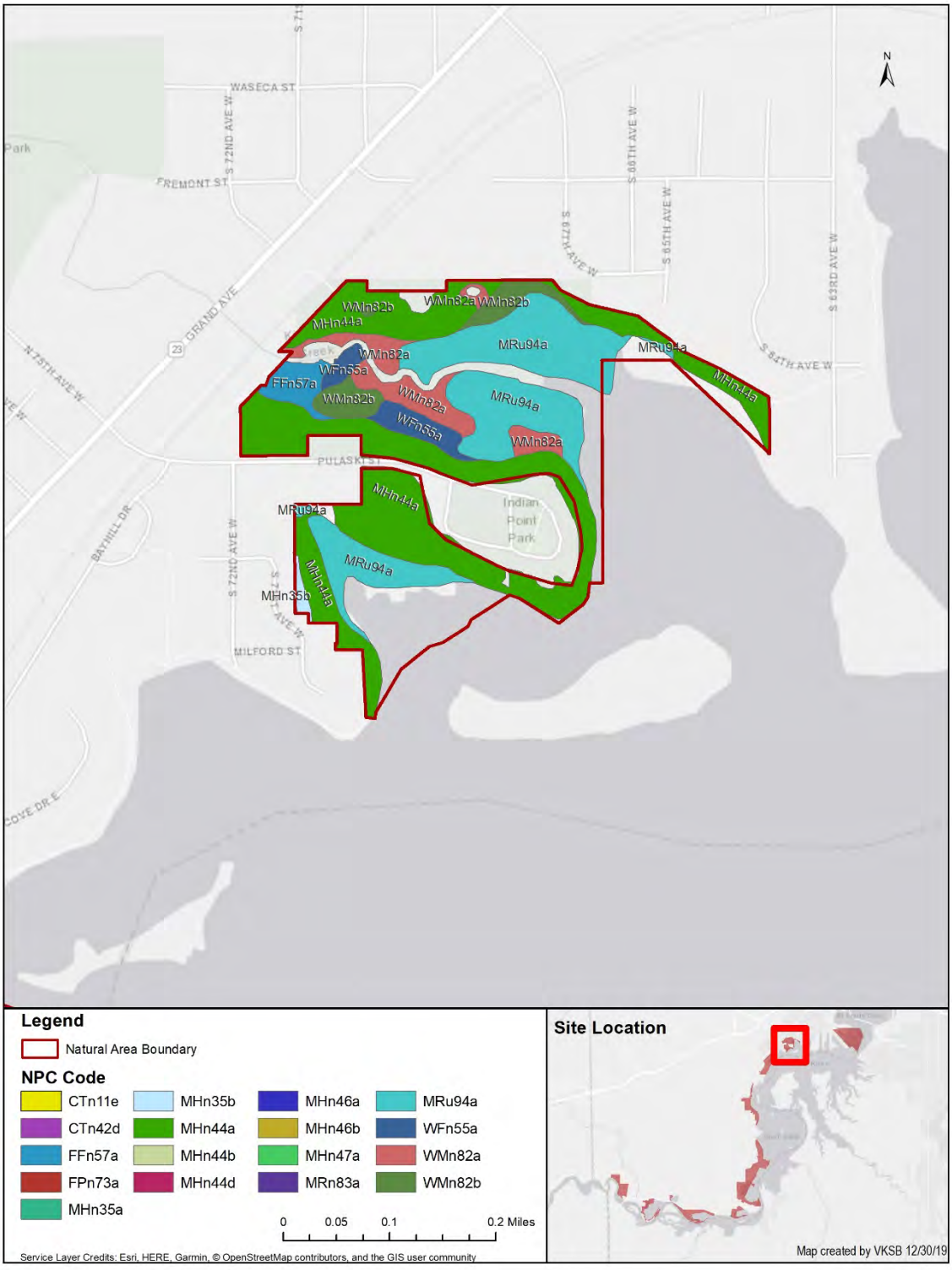

Figure 20: Native Plant Communities in the Kingsbury Bay Project Area

Inclusion in the natural area subject to landowner assent.

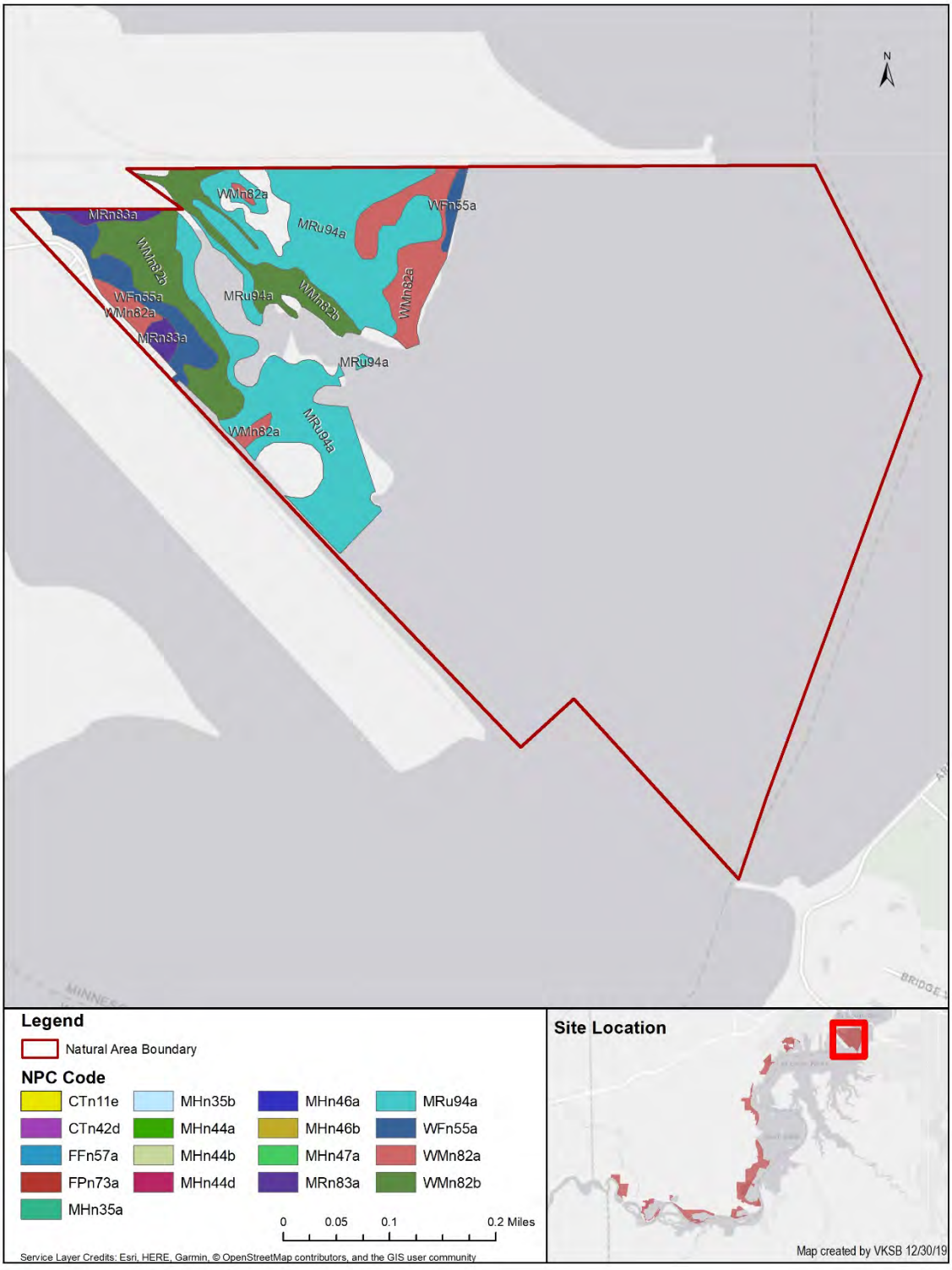

Figure 21: Native Plant Communities in the Grassy Point Project Area

Inclusion in the natural area subject to landowner assent.

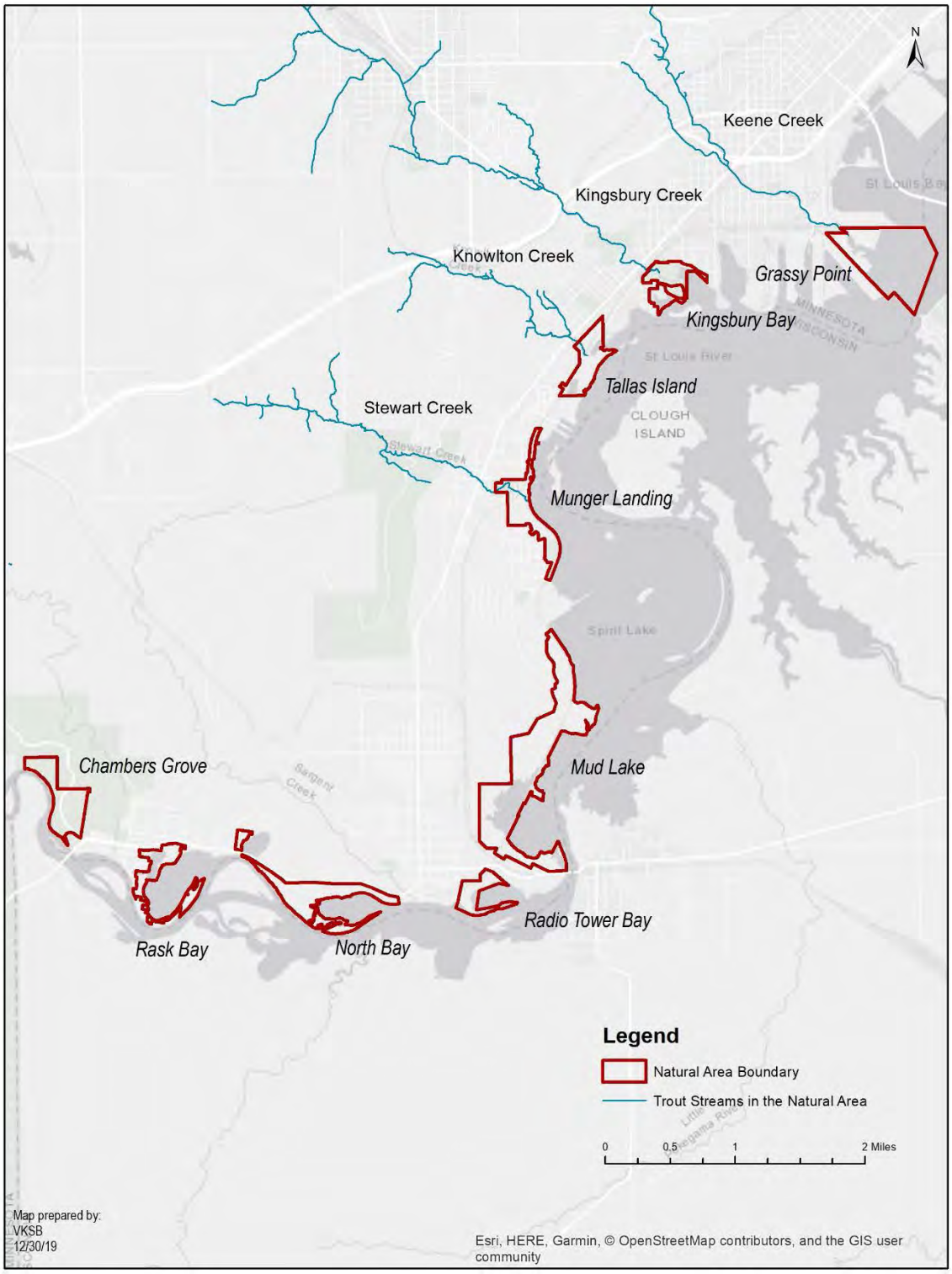

Figure 22: Natural Water Features in the St. Louis River Natural Area

Appendices

Appendix A: List of Parcels in the St. Louis River Natural Area by Ownership

Parcels in City of Duluth Ownership

Parcel IDs

010-0130-00180
010-0130-00430
010-1620-01820
010-1710-00025
010-1710-00435
010-1720-00405
010-1740-00040
010-1740-00070
010-1750-00840
010-1783-00260
010-2400-02960
010-2400-03380
010-2400-03970
010-2400-04140
010-2400-04290
010-2400-04400
010-2400-04720
010-2420-03890
010-2420-04050
010-2420-04350
010-2420-04630
010-2420-04650
010-2420-04770
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010-2420-06130
010-2420-06530
010-2420-06540
010-2420-06570
010-2420-06580
010-2420-06590
010-2420-06620
010-2420-06710
010-2420-08110
010-2420-08310
010-2420-08430
010-2420-08750
010-2420-08760
010-2420-08770
010-2420-08900
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010-2520-12670
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010-2550-02300
010-2550-03760
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010-2746-00290
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010-2746-00291
010-2746-00441
010-2746-00550
010-2746-00620
010-2746-01600
010-3160-00500
010-3160-00980
010-3160-01180
010-3160-01400
010-3160-01600
010-3300-04620
010-2746-00425
Unidentified (Blackmer Park)

Parcels in Private Ownership

Parcel IDs

010-1933-00140
010-1933-00150
010-1600-01640
010-3160-00550
010-1610-00700
010-2730-01115
010-2730-01216
010-0020-00010
010-2730-00020
010-2730-00020b
010-2730-00040
010-2730-00050
010-2730-00100
010-2730-00110
010-2730-00130
010-2730-00140
010-2730-01231
010-2746-01520
010-2746-01590
010-3160-00460
010-3160-00510
010-3160-01830
010-3160-03770
010-3160-03970
010-3160-04170
Unidentified (in Grassy Point)

Parcels in St. Louis County Tax-Forfeit Ownership

Parcel IDs

010-0130-00230
010-0130-00330
010-0130-00340
010-1590-00410
010-1590-00420
010-1590-00470
010-1590-00520
010-1590-01350
010-1590-01400
010-1590-01530
010-1600-00620
010-1600-00690
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010-1740-00360

Parcels in St. Louis County Tax-Forfeit Ownership (Continued)

Parcel IDs

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010-1740-00390	010-2730-00980	010-1680-00130
010-1740-00410	010-2746-00200	010-1690-00110
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010-1760-00010	010-2746-00291	010-1700-00110
010-1760-00070	010-2746-00541	010-1710-00100
010-1760-02180	010-3160-00360	010-1710-00530
010-1760-02340	010-3160-00370	010-1720-00100
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010-2420-04940	010-3160-00505	010-2420-04820
010-2550-02290	010-3160-00540	
010-2550-05120	010-3160-04400	

Parcels in State Public Property Ownership

Parcel IDs

010-2730-01120

010-2730-01150

Appendix B: Native Plant Community and Special Species Verification and Mapping, St. Louis River Natural Area Project

Native Plant Community and Special Species Verification and Mapping

St. Louis River Natural Area Project

Submitted to Minnesota Land Trust

MNLAN 146196 | October 31, 2018

St. Louis River Natural Area Project – Native Plant Community Summary

The proposed project areas of the St. Louis River Natural Area have many assemblages of native plant species that classify as native plant communities (NPC) as defined by the Minnesota Department of Natural Resources. Across the nine (9) project areas within the corridor, there are 17 distinct native plant community types comprised of various types of hardwood forest, mixed hardwood-conifer forest, floodplain forest, forested swamps, shrub swamps, wet meadows, and marshes. The corridor has widespread past and current human use and disturbance. Although these disturbances pose challenges to the ecological integrity of the corridor, they have not removed NPCs and rare species habitat except in limited patches.

Significant native plant communities include Estuary Marsh (Lake Superior), Minnesota NPC Code MRu94a. This community occurs only in estuaries and river mouths influenced by the Lake Superior seiche. The fluctuating water levels of the seiche, caused by wind-driven changes in Lake Superior elevation, can reverse the flow of the river and flush sediment and nutrients back upstream. The MRu94a community is more species-diverse than similar native marsh communities in inland settings. The proposed St. Louis River Natural Area below the Fond du Lac dam contains the largest area of this community in the state; its only other documented presence is in much smaller patches at river mouths on the north shore of Lake Superior through Lake County, Minnesota.

The corridor contains one (1) state-listed endangered species, pale sedge (*Carex pallescens*). In addition, the corridor contains two (2) state-listed special concern species, discoid beggarticks (*Bidens discoidea*) and soapberry (*Shepherdia canadensis*). Plant communities in the corridor may also provide suitable habitat for other rare species, including state-listed special concern narrow reedgrass (*Calamagrostis lacustris*) and state-listed endangered two leaf waterweed (*Elodea bifoliata*).

In Rask Bay and other project areas with large areas of wetlands influenced by the seiche of Lake Superior, there were significant areas of dead or dying woody species, likely past forested or shrub swamps that are currently classified as sedge meadows or marshes. These locations were generally inundated with surface water. It appears that wetland shrubs and trees are stressed by higher water levels in Lake Superior over the course of the previous years, after experiencing a historic low water level in 2007. The lake elevation at the time of the survey in August 2018 was approximately 602.69 feet, compared to a 602.13 foot long term average, and a low of 600.43 feet in August 2007. These communities may fluctuate between open wetland and tree/shrub dominated communities as water levels vary over the course of multiple years. The presence of native plant communities across a range of elevations from below to well above the current St. Louis River and Lake Superior water levels helps to preserve the ability of these communities to succeed between different NPCs as water levels change.

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SEH

Table 1 – Summary of Plant Communities

Community Grouping	Percent of Project Areas	Description
Forested Upland NPCs[1]	22%	Plant communities variously dominated by aspen, basswood, birch, white cedar, and oak
Forested Wetland NPCs	7%	Plant communities with a shallow water table variously dominated by ash, balsam poplar, and white cedar
Shrub and Open Wetland NPCs	31%	Plant communities with a shallow water table to inundation with surface water, dominated by shrub and herbaceous plants adapted to wet conditions
Aquatic Communities	29%	Aquatic communities include open water and areas dominated by submerged and floating-leaf plants
Non-native / Disturbed	11%	Non-NPC cover types such as maintained turf, non-native species, bare ground, pavement, and etc…

[1] NPCs – Native Plant Communities as defined by the Minnesota Department of Natural Resources (2003)

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Contents

St. Louis River Natural Area Project – Native Plant Community Summary
Contents

List of Tables

Contents (continued)

List of Figures

List of Appendices

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Native Plant Community and Special Species Verification and Mapping

St. Louis River Natural Area Project

Prepared for Minnesota Land Trust on behalf of the City of Duluth

1 Introduction

This project collected natural resources data in approximately 1,300 acres of properties along the Lower St. Louis River within the City of Duluth to inform potential inclusion of parcels in the Duluth Natural Areas Program (DNAP). Field scientists collected data in July and August of 2018, verifying remote sensing native plant community data, collecting plot-based vegetation data, and surveying for target state-listed rare plant species. Results indicated a number of plant communities ranging from disturbed areas to excellent quality examples of native plant community types.

Objective

The overall objective of the project is to characterize natural resources conditions within the project area. A secondary objective is to determine the condition of specific resources to inform site management and restoration goals.

In order to meet these objectives, the Minnesota Land Trust (MLT) sought classification and condition ranking of native plant communities (NPCs), as well as description of plant communities not meeting NPC classifications. Additionally, MLT sought identification of occurrences of rare and protected plant species (also referred to as species of greatest conservation need, or SGCN) within the St. Louis River project area.

2 Analysis by Project Area

Field scientists surveyed nine (9) project areas along the Lower St. Louis River (**Figure 1**). Areas dominated by native vegetation were classified by native plant community according to the *Field Guide to Native Plant Communities of Minnesota: the Laurentian Mixed Forest Province* (MNDNR 2003). The Minnesota Department of Natural Resources (MNDNR) developed the nomenclature for the plant community codes to consider the ecological system (e.g, “MH” for mesic-hardwood), floristic region (e.g., “n” for northern), relative soil moisture regime on a scale from 0-9 (0 being driest and 9 the wettest), and nutrient regime on a scale from 0-9 (0 being the poorest and 9 the richest). For example, MHn44 is a northern wet-mesic hardwood-conifer forest with a moderate moisture regime and moderate nutrient regime. A lowercase letter after the plant community code identifies a specific type of the native plant community; MHn44a is an Aspen-Birch-Red Maple Forest type within the MHn44 class.

Cover types not representing native plant communities are also present in the St. Louis River project areas, and these were also identified and mapped. Plant communities not classified as NPCs were given identifiers specific to this report: NN for nonnative plant cover (e.g., old field or turf grass), NVMM for non-vegetated manmade (e.g., roads or rail corridors), DIST for recently disturbed, INV for a discrete patch of one invasive species, and OW for open water. The code SAq was assigned to aquatic communities dominated by submerged and floating-leaf vegetation. Although these aquatic communities were dominated by native plants, the MNDNR has not assigned an NPC class to this habitat. **Figures 2-1** through **2-27** show NPCs and other cover types in the natural area. All NPCs have condition ranks ranging from excellent to poor; **Table 1** below describes the ranking system.

Table 1 – Condition Ranks for Native Plant Communities

Condition Rank	Description
A	Excellent ecological integrity. Little disturbed by recent human activity or invasive species.
B	Good ecological integrity. Lightly disturbed or recovered from past disturbance. Can return to A-rank with protection or management.
C	Fair ecological integrity. Strong evidence of human disturbance, but retain some characteristic species.
D	Poor ecological integrity. Severely altered by human disturbance or invasive species.
NA	Non-NPC cover types are not assigned a condition rank.

Source: MNDNR 2009

Figures 3-1 through **3-13** show the condition rank of each NPC. Condition ranks consider abundance of invasive species; where invasive plants are present throughout an NPC, the condition rank and detailed descriptions provide this information. Where there are discrete, concentrated patches of invasive plants, **Figures 4-1** through **4-8** identify these locations. Detailed methods for assigning NPCs and collecting vegetation data follow in **Appendix A.** The sections below contain summaries for each of the nine project areas within the larger St. Louis River Natural Area.

2.1 Chambers Grove

2.1.1 Significant Features

The Chambers Grove project area extends along the St. Louis River upstream of Trunk Highway (TH) 23 and adjacent to TH 210, on terraces, steep slopes, and cliffs above the river (**Figures 2-2** and **2-3**).

This project area contains mesic and wet-mesic forested communities as well as areas of Dry Sandstone Cliff (Northern), CTn11e, and Wet Sandstone Cliff (Northern), CTn42d, NPCs not found elsewhere in the St. Louis River natural area. See Photo 1 in **Appendix B** for a typical area of CTn11e. **Figures 2-2** and **2-3** detail the locations of NPCs within Chambers Grove, and **Table 2** below lists the NPC codes with descriptions. With the exception of eroded slopes (discussed in Section 2.1.2 below), the communities in Chambers Grove rank B and A for “good” to “excellent” condition (see **Figure 3-1**), and community composition appears typical of minimally

disturbed habitat. Chambers Grove contains suitable habitat for the boreal shrub soapberry (*Shepherdia canadensis* – state special concern).

Uses of the Chambers Grove area include established mountain biking and walking trails. Informal fire pits and "social" (unofficial) trails are also present.

The Chambers Grove project area is contained within a MNDNR-identified site of high biodiversity significance (MNDNR 2006), that covers a portion of the Mission Creek watershed and surrounding area south of I-35 and north of the St. Louis River. The biodiversity significance designation identifies the statewide significance of a natural area based on rare species, size and condition of native plant communities, and landscape context (i.e., connectivity to other native plant communities).

Table 2 – NPCs in Chambers Grove

NPC Code	Description	Condition Rank
CTn11e	Dry Sandstone Cliff (Northern)	D
CTn42d	Wet Sandstone Cliff (Northern)	A
MHn35a	Aspen-Birch-Basswood Forest	B
MHn44b	White Pine-White Spruce-Paper Birch Forest	B
MHn46b	Black Ash-Basswood Forest	A
NN	Nonnative plant community[1]	NA

[1] Not an NPC identified in the *Field Guide* (MNDNR 2003), this classification was developed for this report to refer to communities not dominated by native plant species.

2.1.2 Threats

The Chambers Grove project area has been affected by significant erosion, presumably beginning with the historic rain event of June 2012. Large areas of exposed clay are present (see Photo 2 in **Appendix B**, and areas with a condition rank of D or "poor" on **Figure 3-1**), with some early-successional and disturbance-adapted plant species such as red raspberry (*Rubus idaeus*), goldenrods (*Solidago canadensis* and *S. altissima*), and staghorn sumac (*Rhus typhina*). Erosion control measures are evident, including biorolls and erosion control netting staked into the open hillsides.

Although not widespread in the project area, common buckthorn (*Rhamnus cathartica*) was present on site. Garden lily-of-the-valley (*Convallaria majalis*) was also found in one dense patch. Locations of concentrations of invasive species are shown on **Figure 4-1**.

Social trails and fire pits are located in suitable habitat areas for soapberry, and may negatively affect the sustainability of this area for soapberry.

2.1.3 Restoration and Management Actions

In order to protect existing NPCs and rare species occurrences, erosion control activities should continue. Treatment and ongoing monitoring of common buckthorn will likely be necessary to protect the current good to excellent conditions of forested NPCs. Removal of social trails may preserve suitable habitat for soapberry.

2.2 Rask Bay

2.2.1 Significant Features

The Rask Bay project area covers aquatic, wetland, and forested areas of Rask Bay south of TH 23 in the Fond du Lac neighborhood of Duluth.

Rask Bay has large areas of Estuary Marsh (Lake Superior), MRu94a, an NPC occurring only in estuaries and embayments near river mouths along the shores of Lake Superior, where water levels are influenced by Lake Superior seiche. This community may be present in smaller patches along the north shore of Lake Superior, but is only found in sizable areas in the St. Louis River estuary below the Fond du Lac dam. The MRu94a community is suitable habitat for discoid beggarticks (*Bidens discoidea* – state special concern). Areas of deeper water with submerged and floating leaf vegetation were dominated by native species such as yellow pond-lily (*Nuphar variagata*), American white water-lily (*Nymphaea odorata*), and water marigold (*Bidens beckii*). This community is not given a native plant community classification in the *Field Guide* (MNDNR 2003), but still appears to be a good condition community with few invasive species. Rask Bay also contains sedge meadows (WMn82b), shrub swamps (WMn82a), floodplain terrace forest (FFn57a), and wet-mesic forest (MHn44a). **Figures 2-3** through **2-5** detail locations of NPCs in Rask Bay, and **Table 3** below lists the NPCs with descriptions. Most communities in Rask Bay are ranked B for “good” condition, with the exception of a few areas of marsh with dense cover of nonnative cattails (*Typha angustifolia* and/or *Typha x glauca*) (**Figure 3-2**).

In Rask Bay and other project areas with large areas of wetlands influenced by the seiche of Lake Superior, there were significant areas of dead or dying woody species (see Photo 3 in **Appendix B**). These locations were generally inundated with surface water, and anecdotally wetland shrubs and trees appear stressed by high water levels in Lake Superior over the course of the previous two (2) years, after experiencing a historic low water level in 2007. The lake elevation at the time of the survey in August 2018 was approximately 602.69 feet, compared to a 602.13 foot long term average, and a low of 600.43 feet in August 2007 (NOAA-GLERL 2018). These communities may fluctuate between open wetland and tree/shrub dominated communities as water levels vary over the course of multiple years. The presence of native plant communities across a range of elevations from below to well above the current St. Louis River and Lake Superior water levels helps to preserve the ability of habitats to succeed between different NPCs as water levels change.

Rask Bay is contained within a DNR identified site of outstanding biodiversity significance, covering both Rask and adjacent North Bays.

Table 3 – NPCs in Rask Bay

NPC Code	Description	Condition Rank
FFn57a	Black Ash-Silver Maple Terrace Forest	B, C
MHn44a	Aspen-Birch-Red Maple Forest	C
MRn83a	Cattail-Sedge Marsh (Northern)	C
MRu94a	Estuary Marsh (Lake Superior)	A, B
WMn82a	Willow-Dogwood Shrub Swamp	B, C
WMn82b	Sedge Meadow	B, C
SAq	Shallow Aquatic Community[1]	NA
NN	Nonnative plant community[2]	NA

[1] Not an NPC identified in the *Field Guide* (MNDNR 2003), but dominated by native species

[2] Not an NPC identified in the *Field Guide* (MNDNR 2003), this classification was developed for this report to refer to communities not dominated by native plant species.

2.2.2 Threats

Reed canary grass (*Phalaris arundinacea*) is present in scattered patches in the FFn57a community (typical FFn57a shown on Photo 4 in **Appendix B**). Wild rice (*Zizania palustris*) in the shallow aquatic plant communities of the bay appears to have been heavily grazed.

2.2.3 Restoration and Management Actions

Monitoring for reed canary grass and nonnative cattails, combined with herbicide treatment as needed may help maintain the integrity of the terrace forest and marsh communities. Recent research in the St. Louis River estuary by University of Wisconsin – Superior students has investigated hazing of herbivores such as Canada geese to protect wild rice. Depending on eventual results of this and other studies, herbivore hazing or exclosure fences may be considered for preserving wild rice in Rask Bay.

2.3 North Bay

2.3.1 Significant Features

The North Bay project area is located just east of Rask Bay in the Fond du Lac neighborhood, south of TH 23.

North Bay contains eight (8) distinct NPCs, as well as an aquatic community dominated by native species (see **Table 4** below). North Bay contains B rank or "good" condition examples of MRu94a (see Photo 5 in **Appendix B**), including areas of native emergent plant species with few nonnative cattails. This area also has A and B rank (excellent and good condition) examples of wet-mesic hardwood forest (MHn44a, MHn44d, and MHn46a), with canopies typical of mature forest (>95 years) and diverse ground layers (**Figures 2-6** to **2-9** and Photo 6 in **Appendix B**). In general, this project area had the highest condition ranks of the nine (9) project areas, ranking A and B for all areas assigned NPCs (**Figures 3-3** to **3-4**).

Recreational OHV/pedestrian trails cross the site on three parallel corridors: one through forested areas on the grade of old "Fond du Lac Road", one along old rail grade through wetland communities to the south (Photo 8 in **Appendix B**), and one along the outer edge of the bay through terrace forest. The old rail grade has likely changed hydrology of the low-lying areas to

the north, which are now disconnected from the influence of the St. Louis River and Lake Superior seiche.

North Bay is contained within a DNR identified site of outstanding biodiversity significance.

Table 4 – NPCs in North Bay

NPC Code	Description	Condition Rank
FFn57a	Black Ash-Silver Maple Terrace Forest	A, B
FPn73a	Alder Swamp	B
MHn44a	Aspen-Birch-Red Maple Forest	B
MHn44d	Aspen-Birch-Fir Forest	B
MHn46a	Aspen-Ash Forest	B
MRu94a	Estuary Marsh (Lake Superior)	A
WFn55a	Black Ash-Aspen-Balsam Poplar Swamp (Northern)	B
WMn82a	Willow-Dogwood Shrub Swamp	A, B
WMn82b	Sedge Meadow	B
DIST	Recently disturbed[1]	NA
NN	Nonnative plant community[1]	NA
OW	Open Water	NA
SAq	Shallow Aquatic Community[2]	NA

[1] Not an NPC identified in the *Field Guide* (MNDNR 2003), this classification was developed for this report to refer to communities not dominated by native plant species.

[2] Not an NPC identified in the *Field Guide* (MNDNR 2003), but dominated by native species

2.3.2 Threats

Threats to ecological integrity in North Bay include invasive plant species, localized areas of off-trail/unsustainable OHV use, and erosion on slopes downslope from and south of TH 23 (**Figure 2-9**). Field observation of erosion included locations where OHV trails cross wetland habitat, and rills forming from the top of slope near TH 23 in the forested communities on the north side of the project area. Similar to Rask Bay, wild rice in the shallow aquatic plant communities of the bay appears to have been heavily grazed (some grazed stems are visible on Photo 7 in **Appendix B**). Concentrations of invasive species, including purple loosestrife (*Lythrum salicaria*) on end of point, are shown on **Figure 4-2**.

2.3.3 Restoration and Management Actions

Reduce erosion by working to reduce OHV trail usage in unsuitable locations and educate the community on appropriate places for OHV use. Explore stormwater management solutions for slopes eroding near TH 23. Invasive plant species in North Bay should be monitored. If increasing in cover, management such as herbicide treatment or release of biocontrol insects (specifically for purple loosestrife) may be appropriate.

2.4 Radio Tower Bay

2.4.1 Significant Features

Radio Tower Bay is located east of North Bay, and is separated from Mud Lake to the north by TH 39.

The Radio Tower Bay project area is comprised almost entirely of aquatic, wetland, and floodplain terrace forest communities (**Figure 2-10**). The bay contains a relatively species diverse example of MRu94a (Photo 10 in **Appendix B**) that provides suitable habitat for discoid beggarticks. Most NPCs in Radio Tower Bay are in "good" condition with a B rank; a few areas rank as C or "fair" based on dense stands of nonnative cattails (**Figure 3-5** and Photo 9 in **Appendix B**). There are visible timbers and coarse woody debris at the river shoreline. A 2014-2015 restoration project removed sawmill wood waste from the bottom of the bay to restore sheltered bay bathymetry; therefore the remaining visible slab wood may not be present in ecologically significant quantities that would affect the condition ranks of the NPCs.

Like a number of other low-elevation communities in the project area, portions of Radio Tower Bay had stressed ash (*Fraxinus* species) and balsam poplar (*Populus balsamifera*) with typical marsh species such as lake sedge (*Carex lacustris*) and cattails growing in the ground layer vegetation. The trees appear to be stressed due to high water levels.

Radio Tower Bay is contained within a DNR identified site of high biodiversity significance.

Table 5 – NPCs in Radio Tower Bay

NPC Code	Description	Condition Rank
FFn57a	Black Ash-Silver Maple Terrace Forest	B
FPn73a	Alder Swamp	B
MHn44a	Aspen-Birch-Red Maple Forest	B, C
MRn83a	Cattail-Sedge Marsh (Northern)	C
MRu94a	Estuary Marsh (Lake Superior)	B
WMn82a	Willow-Dogwood Shrub Swamp	B, C
WMn82b	Sedge Meadow	B
DIST	Recently disturbed[1]	NA
NN	Nonnative plant community[1]	NA
NVMM	Nonvegetated, manmade feature (rail corridor)[1]	NA
OW	Open Water	NA

[1] Not an NPC identified in the *Field Guide* (MNDNR 2003), this classification was developed for this report to refer to communities not dominated by native plant species.

2.4.2 Threats

Nonnative cattails are present in Radio Tower Bay in a few dense stands, shown as sites of C ("fair") condition rank on **Figure 3-5** and in locations detailed on **Figure 4-3**.

2.4.3 Restoration and Management Actions

Monitor patches of nonnative cattails, and treat as needed to maintain the ecological integrity of marsh communities.

2.5 Mud Lake

2.5.1 Significant Features

The Mud Lake project area includes portions of the former U. S. Steel “Duluth Works” industrial site near the Duluth neighborhood of Morgan Park. This project area stretches from TH 39 on the south to near Idaho St. and 88th Ave. West in the north.

Mud Lake contains a mix of native plant communities and disturbed/non-native dominated habitats. Native plant communities persist in wetland and aquatic habitats immediately adjacent to the St. Louis River and in forested communities on ravines and on steep side slopes that were likely undisturbed for industrial development (**Figures 2-11** through **2-18** and Photo 11 in **Appendix B**). Areas of MRu94a in this project area provide suitable habitat for discoid beggarticks. Community condition ranks in Mud Lake are based largely on abundance of invasive species, which may itself be a function of the level of past disturbance of each community. Forested communities ranking as C or “fair” had abundant common buckthorn and showy honeysuckle (*Lonicera x bella*) in the shrub layer. The wet forest (WFn55a) community ranked A/B or “excellent/good” had a mature canopy and plant species typical of the NPC, and would rank as A except that the community is small in size, and is likely vulnerable to invasion from nearby stands of invasive plant species. Marsh communities with a C rank had dense stands of nonnative cattails. Many other areas in Mud Lake ranked as B or “good”, with plant communities typical of NPCs with more limited occurrences of invasive species (**Figures 3-6** through **3-8**).

A railroad causeway running roughly northeast to southwest bisects this bay of the St. Louis River, and may limit the influence of the Lake Superior seiche on water levels inside the causeway.

Higher-quality forested as well as all wetland/aquatic portions of the Mud Lake project area are contained within a DNR identified site of high biodiversity significance that stretches to the north and also covers portions of the Munger Landing project area.

Table 6 – NPCs in Mud Lake

NPC Code	Description	Condition Rank
FFn57a	Black Ash-Silver Maple Terrace Forest	C
FPn73a	Alder Swamp	B
MHn35b	Red Oak-Sugar Maple-Basswood-(Bluebead Lily) Forest	B
MHn44a	Aspen-Birch-Red Maple Forest	B, C
MHn46a	Aspen-Ash Forest	B
MHn47a	Sugar Maple – Basswood – (Bluebead Lily) Forest	B
MRn83a	Cattail-Sedge Marsh (Northern)	B, C
MRu94a	Estuary Marsh (Lake Superior)	B, C
WFn55a	Black Ash-Aspen-Balsam Poplar Swamp (Northern)	A/B, C
WMn82a	Willow-Dogwood Shrub Swamp	B/C
WMn82b	Sedge Meadow	B
DIST	Recently disturbed or open ground[1]	NA
NN	Nonnative plant community[1]	NA
NVMM	Nonvegetated, manmade feature (rail corridor)[1]	NA
OW	Open Water	NA

[1] Not an NPC identified in the *Field Guide* (MNDNR 2003), this classification was developed for this report to refer to communities not dominated by native plant species.

2.5.2 Threats

Threats to the ecological integrity of the Mud Lake project area include invasive plants, particularly in open fields where woody species are struggling to establish (Photo 12 in **Appendix B**). Lack of regeneration of a tree canopy could be due to lack of topsoil, compaction from past industrial use, and/or unsuitable substrate due to chemical characteristics (such as nutrient limitation). In areas already meeting NPC classifications, common buckthorn is a threat to the condition of these habitats. **Figure 4-4** identifies some localized patches of invasive plant species; where invasive plants are more broadly distributed in an NPC, these occurrences are reflected in the condition rank of the community rather than a point location.

2.5.3 Restoration and Management Actions

Tree planting could restore upland forested communities like MHn44, particularly at the boundaries of NPCs with nonnative plant communities. Investigation of soil characteristics and soil amendments, as appropriate, may encourage regeneration of native forested communities. Common buckthorn control will be important to maintaining/improving condition of Mud Lake NPCs. Herbicide treatment or hydrologic/bathymetric restoration may be useful to manage nonnative cattails.

2.6 Munger Landing

2.6.1 Significant Features

The Munger Landing project area extends north and south from the Munger Landing boat launch, and includes the mouth of Stewart Creek.

Munger Landing encompasses plant communities along the Stewart Creek floodplain (see Photo 13 in **Appendix B**), marsh and aquatic communities along the St. Louis River (Photo 14 in **Appendix B**), and upland mesic forests at higher elevations. **Figures 2-19** to **2-22** show the locations of NPCs within the Munger Landing project area, and **Table 7** below lists the NPCs with descriptions. Condition of the NPCs in Munger Landing is generally B or "good", with limited disturbance from erosion localized at trails. The marsh communities provide suitable habitat for discoid beggarticks. A few areas at the northern end of the project area rate C or "fair" based on invasive plant occurrences and remaining evidence of past development (e.g., cleared areas that have not regrown a tree canopy). **Figures 3-9** and **3-10** show condition ranks by NPC location.

Munger Landing also contains two rail corridors as well as walking and OHV trails. Similar to roads and railroad grades in other project areas, the railroad causeway may be isolating some areas of marsh from the influence of the Lake Superior seiche, and therefore having the effect of converting MRu94a to MRn83a communities.

Nonnative communities within the Munger Landing project area include both maintained turf and recreational fields in Blackmer Park, as well as old field areas just south of Clyde Avenue and parallel to an OHV/walking trail north of the Munger Landing boat launch.

The southern portion of the Munger Landing project area is contained within a DNR identified site of high biodiversity significance, which extends to the south to cover portions of the Mud Lake project area as well.

Table 7 – NPCs in Munger Landing

NPC Code	Description	Condition Rank
FFn57a	Black Ash-Silver Maple Terrace Forest	B
MHn35a	Aspen-Birch-Basswood Forest	B
MHn44a	Aspen-Birch-Red Maple Forest	B, B/C, C
MHn46b	Black Ash-Basswood Forest	B
MRn83a	Cattail-Sedge Marsh (Northern)	B
MRu94a	Estuary Marsh (Lake Superior)	A/B, B, C
WFn55a	Black Ash-Aspen-Balsam Poplar Swamp (Northern)	B, C
WMn82a	Willow-Dogwood Shrub Swamp	B
WMn82b	Sedge Meadow	B
DIST	Recently disturbed or open ground[1]	NA
INV	Invasive plant species (nonnative common reed)[1]	NA
NN	Nonnative plant community (old field, turf)[1]	NA
NVMM	Nonvegetated, manmade feature (rail corridor)[1]	NA
OW	Open Water	NA
SAq	Shallow Aquatic Community[2]	NA

[1] Not an NPC identified in the *Field Guide* (MNDNR 2003), this classification was developed for this report to refer to communities not dominated by native plant species.

[2] Not an NPC identified in the *Field Guide* (MNDNR 2003), but dominated by native species

2.6.2 Threats

Stands of nonnative common reed (*Phragmites australis*) are present at the northern edge of the project area; this species may be spreading from a larger infestation to the north (**Figure 4-6**).

2.6.3 Management and Restoration

To protect the integrity of the site NPCs, manage nonnative common reed with the goal of eradicating it from this project area. The disturbed corridor paralleling the OHV trail may be a target for restoration to MHn44a or MHn44b with tree planting (including paper birch, red maple, white pine, and/or white spruce). Old field areas near Clyde Avenue may be target for restoration to wet forest such as WFn55b or similar, by planting yellow birch, basswood, and/or red maple.

2.7 Tallus Island

2.7.1 Significant Features

The Tallus Island project area encompasses Tallus Island itself, as well as adjacent shoreline, the Knowlton Creek mouth, and a strip of upland forest parallel to the Western Waterfront Trail. Tallus Island was once connected to the shoreline by built-up sediment from the creek mouth, but is again a distinct island after a restoration and sediment removal project was constructed in 2010. The sediment removal project was part of work to restore the St. Louis River/ Interlake/Duluth Tar (SLRIDT) Superfund Site.

Plant communities in this project area include shallow aquatic communities, various wetland communities, and upland mesic forests (**Table 8** below, Photos 15 and 16 in **Appendix B**). There are disturbed and nonnative (old field) plant communities within the project area, in areas of relatively recent construction and along the Western Waterfront Trail and rail corridors. **Figures 2-22** to **2-24** show the locations of plant communities within the project area. NPCs within the Tallus Island project area rank as B or C condition (**Figures 3-10** and **3-11**), with C or "fair" condition ranks based mostly on the abundance of common buckthorn and/or nonnative cattails.

Other notable observations at Tallus Island are recent restoration in and along Knowlton Creek (see Photo 14 in **Appendix B**). Although this area is currently described as "disturbed" based on open ground and disturbance-adapted plant species, native plants and erosion control measures have been installed. The area will likely classify as an NPC in the near future. Other management/restoration efforts observed in the project area are deer exclosure fences, planted native trees with herbivore protection, and cut/treated stumps of common buckthorn.

The wetland and aquatic habitats in the Tallus Island project area, along with Tallus Island itself, are part of a DNR-identified site of moderate biodiversity significance. This site also extends north to encompass the marsh and aquatic habitats of Kingsbury Bay.

Table 8 – NPCs in Tallus Island

NPC Code	Description	Condition Rank
FPn73a	Alder Swamp	C
MHn44a	Aspen-Birch-Red Maple Forest	B
MHn44b	White Pine-White Spruce-Paper Birch Forest	B
MHn44d	Aspen-Birch-Fir Forest	B
MHn46a	Aspen-Ash Forest	B
MRn83a	Cattail-Sedge Marsh (Northern)	B, C
MRu94a	Estuary Marsh (Lake Superior)	C
WFn55a	Black Ash-Aspen-Balsam Poplar Swamp (Northern)	B
WMn82a	Willow-Dogwood Shrub Swamp	B
WMn82b	Sedge Meadow	B, C
DIST	Recently disturbed or open ground[1]	NA
INV	Invasive plant species (nonnative common reed)[1]	NA
NN	Nonnative plant community (old field, turf)[1]	NA
NVMM	Nonvegetated, manmade feature (trail, rail corridor)[1]	NA
OW	Open Water	NA
SAq	Shallow Aquatic Community[2]	NA
YF_CX	Young forest complex (dense young balsam poplar)[1]	NA

[1] Not an NPC identified in the *Field Guide* (MNDNR 2003), this classification was developed for this report to refer to communities not dominated by native plant species.
[2] Not an NPC identified in the *Field Guide* (MNDNR 2003), but dominated by native species

2.7.2 Threats

Purple loosestrife is common in recently disturbed areas on Tallus Island and in marshes on the nearby shoreline. A large stand of nonnative common reed is located at the southern edge of the Tallus Island project area, extending onto the adjacent private property. Common buckthorn has been treated in some areas near Knowlton Creek, but significant populations still exist in upland forests in the project area. Wild parsnip is present along trails and in old field areas. **Figures 4-6** and **4-7** detail localized concentrations of invasive plants.

2.7.3 Restoration and Management Actions

To maintain or improve the condition of existing NPCs, ongoing monitoring and follow-up treatment of common buckthorn will be important. In marsh and wetland areas, purple loosestrife should be monitored. If increasing in cover, management such as release of biocontrol insects may be appropriate. To ensure wetland and marsh areas continue to classify as NPCs, common reed will need to be controlled. Management should include attempts to coordinate treatment with the adjacent landowner at the area of the large reed stand. Some areas currently classified as disturbed or nonnative communities have been planted with native trees; these plantings could be expanded to the nonnative areas parallel to the Western Waterfront Trail to restore native forest to old fields.

2.8 Kingsbury Bay

2.8.1 Significant Features

The Kingsbury Bay project area is adjacent to the Kingsbury Creek mouth, and includes Indian Point Campground, a portion of the Western Waterfront Trail, and surrounding natural areas.

Plant communities in this project area include various wetland communities, floodplain terrace forest, and upland mesic forests (**Figures 2-25** and **2-26**, and listed in **Table 9** below). Kingsbury Bay has been affected by human disturbance and erosion/sedimentation from flooding, such as the large flood event of 2012. More NPCs in this project area rank as C or D ("fair" or "poor") compared to other locations in the St. Louis River project area (**Figure 3-12**); however, current and planned restoration activities may improve these rankings. Field observations included recently planted trees in floodplain (Photo 17 in **Appendix B**) and on slopes, and cut/treated common buckthorn.

The wetland and aquatic habitats in the Kingsbury Bay project area are part of a DNR-identified site of moderate biodiversity significance.

Table 9 – NPCs in Kingsbury Bay

NPC Code	Description	Condition Rank
FFn57a	Black Ash-Silver Maple Terrace Forest	B
MHn35a	Aspen-Birch-Basswood Forest	C/D
MHn44a	Aspen-Birch-Red Maple Forest	C, C/D, D
MRu94a	Estuary Marsh (Lake Superior)	C
WFn55a	Black Ash-Aspen-Balsam Poplar Swamp (Northern)	C
WMn82a	Willow-Dogwood Shrub Swamp	B, C
WMn82b	Sedge Meadow	B, C
DIST	Recently disturbed or open ground[1]	NA
INV	Invasive plant species (reed canary grass)[1]	NA
NN	Nonnative plant community (turf, old field)[1]	NA
OW	Open Water	NA

[1] Not an NPC identified in the *Field Guide* (MNDNR 2003), this classification was developed for this report to refer to communities not dominated by native plant species.

2.8.2 Threats

A community on the north side of Kingsbury Bay ranks as D condition ("poor") with a sparse ground layer that appears to be negatively affected by earthworms. Anecdotal observations from the field included a lack of humus and leaf litter, and earthworm castings on the ground surface. Some areas along Kingsbury Creek have dense stands of reed canary grass. Farther into the bay, marsh communities are dominated by nonnative cattails (see Photo 18 in **Appendix B**). **Figure 4-8** shows localized concentrations of invasive plants.

2.8.3 Restoration and Management Actions

Monitoring and maintenance of planted trees will help ensure this project area improves in condition rank. Earthworm chemical treatment may be appropriate where the infestation is

severe. Treatment of nonnative cattails will improve the condition rank of marsh and/or restore desirable aquatic communities. A planned restoration project for Kingsbury Bay will deepen areas currently dominated by cattails and may re-establish more diverse MRu94a and shallow aquatic vegetation communities.

Excluding areas maintained for Indian Point Campground facilities, nonnative plant communities in the Kingsbury Bay project area have potential for restoration to forested communities through plantings. These small, open old field and turf areas would be appropriate for restoration to MHn44a or MHn44b with tree planting (e.g., paper birch, red maple, white pine, and white spruce).

2.9 Grassy Point

2.9.1 Significant Features

The Grassy Point project area is located at the Keene Creek mouth, in a former industrial area that deposited significant wood waste in the St. Louis River.

Grassy Point contains wetland and open water communities along Keene Creek and the St. Louis River (**Figure 2-27**, and listed in **Table 10** below). The areas of highest elevation on the west side of Grassy Point contain wetland forest dominated by balsam poplar (see Photo 19 in **Appendix B**), as well as other trees [e.g., tamarack (*Larix laricina),* white cedar (*Thuja occidentalis*), and white spruce (*Picea glauca*)] that appear to have been planted approximately 15-20 years ago. Grassy Point contains suitable habitat for pale sedge (*Carex pallescens* – state endangered) and discoid beggarticks. Condition ranks for the NPCs at Grassy Point are mostly B and C, due to presence of nonnative plant species (**Figure 3-13**).

The wetland and aquatic habitats in the Grassy Point project area are part of a DNR-identified site of moderate biodiversity significance.

Table 10 – NPCs in Grassy Point

NPC Code	Description	Condition Rank
MRn83a	Cattail-Sedge Marsh (Northern)	C
MRu94a	Estuary Marsh (Lake Superior)	B, C
WFn55a	Black Ash-Aspen-Balsam Poplar Swamp (Northern)	B/C, C
WMn82a	Willow-Dogwood Shrub Swamp	A, B, C
WMn82b	Sedge Meadow	B
INV	Invasive plant species (nonnative common reed)[1]	NA
NVMM	Nonvegetated manmade (roadway, gravel)[1]	NA
OW	Open Water	NA

[1] Not an NPC identified in the *Field Guide* (MNDNR 2003), this classification was developed for this report to refer to communities not dominated by native plant species.

2.9.2 Threats

Grassy Point contains a large stand of nonnative, invasive common reed (**Figure 2-27** and **Figure 4-9**), and additional occurrences of nonnative common reed are present outside the project area nearby. Nonnative cattails are common at Grassy Point (Photo 20 in **Appendix B**). Purple loosestrife is scattered throughout the wetland communities on the site.

2.9.3 Restoration and Management Actions

Restoration to remove wood waste is planned for this area, which will improve the substrate for aquatic habitat and remove some of the nonnative cattails. Restoration activities may disturb occurrences of discoid beggarticks; however, habitat improvements through restoration may ultimately improve the area for this special concern species.

Nonnative common reed is a concern for Grassy Point. Management activities should target the existing large stand, and coordination with nearby landowners to manage additional stands of the species may be appropriate. Purple loosestrife should be monitored in this area. If it is observed to increase in cover, management such as release of biocontrol insects may be appropriate.

3 Analysis

3.1 NPC Mapping

Based on data collected, forested communities were most typical of NPCs in the Chambers Grove, Rask Bay, and North Bay project areas. In other locations, forested communities do classify as NPC types, but contained greater abundances of invasive plant species, or had more plant species with low affinity to any particular NPC. The condition of wetland communities was more consistent across the review area, with generally good quality through the corridor except in areas with high cover of nonnative cattails. Some communities were too disturbed to classify as a particular NPC, but may be restorable. Notably, old field areas dominated by nonnative grasses and forbs are likely restorable to forested NPCs typical of the corridor.

In many areas, condition rank was most affected by the presence and abundance of invasive plant species. Generally, management of invasive species has the most potential for preserving or improving NPC condition ranks. Management of the corridor as a whole may improve the likelihood of improving condition rank, as the river provides a corridor for movement of plant propagules – both desirable native plants invasive species. For example, non-native common reed is present in small patches at the northern end of the Munger Landing project area, where it has likely spread from a larger occurrence in the Tallus Island project area.

3.2 SGCN Survey

A number of areas have potential to provide habitat for SGCN encountered during the survey. Other areas may be restorable to communities that could provide additional habitat. The MRu94a community, in particular where it ranked as A or B condition, provides suitable habitat for discoid beggarticks throughout the St. Louis River project area. Planned restoration projects that will create or restore MRu94a in areas dominated by nonnative cattails will likely provide additional suitable habitat.

Similar to management of invasive plant species discussed above, management for SGCN plants is more robust when conducted along the corridor as a whole compared to individual project areas. Discoid beggarticks in particular is an annual plant with habitat in deep marshes along the corridor. Fluctuating water levels likely cause shifts in the location of suitable habitat, and protecting an individual occurrence without considering the context of how the habitat may move in the future could negatively impact the sustainability of populations of discoid beggarticks within the St. Louis River estuary.

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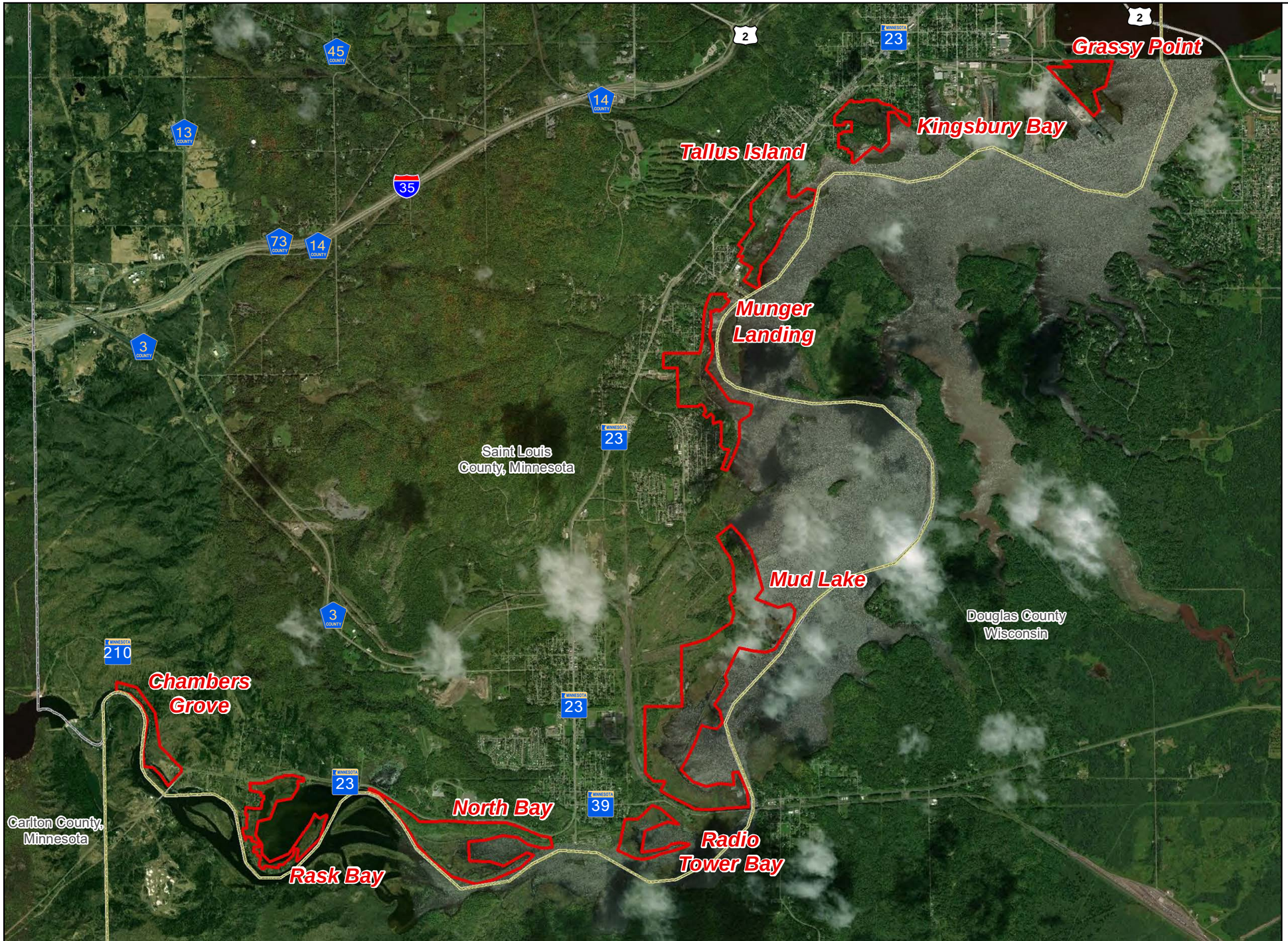
Figures



Legend

St. Louis River project areas

0 0.5 1 1.5 Miles

This map is neither a legally recorded map nor a survey map and is not intended to be used as one. This map is a compilation of records, information, and data gathered from various sources listed on this map and is to be used for reference purposes only. SEH does not warrant that the Geographic Information System (GIS) Data used to prepare this map are error free, and SEH does not represent that the GIS Data can be used for navigational, tracking, or any other purpose requiring exacting measurement of distance or direction or precision in the depiction of geographic features. The user of this map acknowledges that SEH shall not be liable for any damages which arise out of the user's access or use of data provided.

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Print Date: 10/30/2018

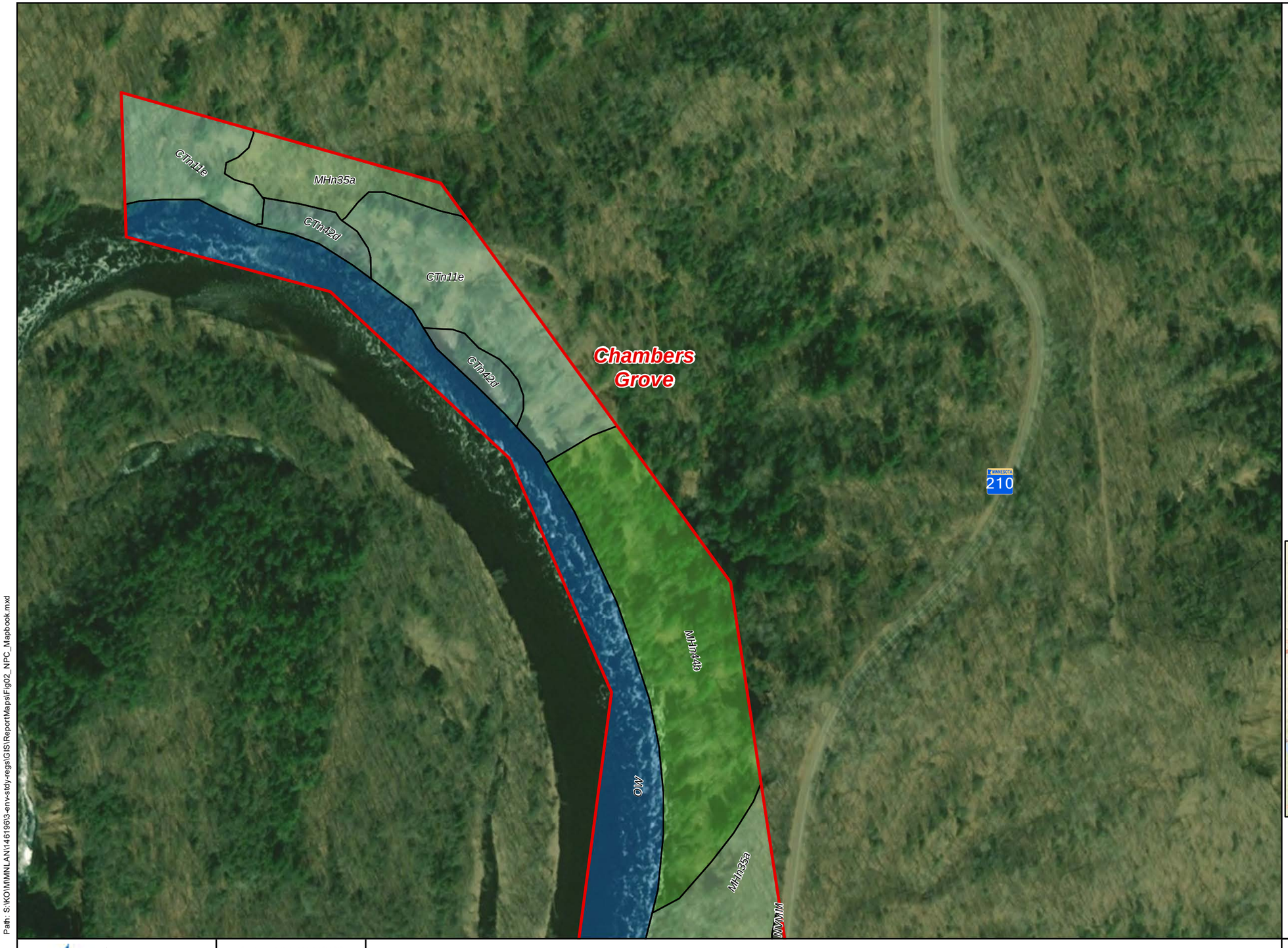
Map by: B. Tolcser
Projection: NAD83 UTM15N
Source: MNDNR, MN Land Trust, SEH
Background: DigitalGlobe 2017

ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

Project Overview Map

Figure 1

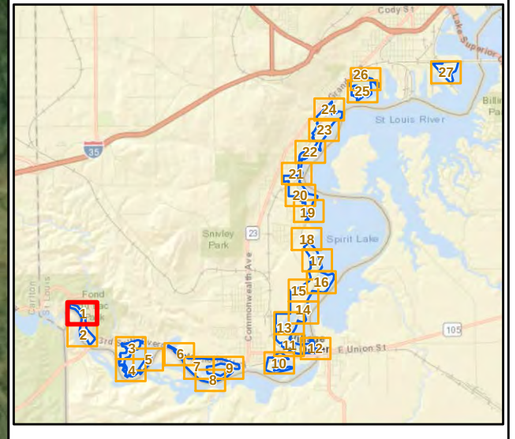


Legend

St. Louis River project areas

Native Plant Community Code

- CTn11e
- CTn42d
- MHn35a
- MHn44b
- OW
- NVMM



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Project: MNLAN 146196
Print Date: 10/31/2018

Map by: B. Tolcser
Projection: NAD83 UTM15N
Source: MNDNR, MN Land Trust, SEH
Background: FSA 2017 (CIR)

ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

Native Plant Community Map

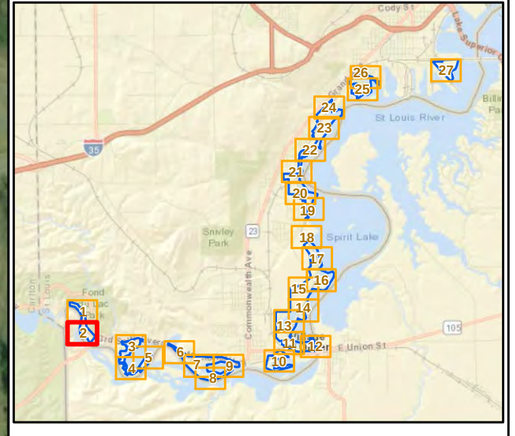
Figure 2-1

Legend

St. Louis River project areas

Native Plant Community Code

- MHn35a
- MHn44b
- MHn46b
- OW
- NVMM
- NN



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ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

Native Plant Community Map

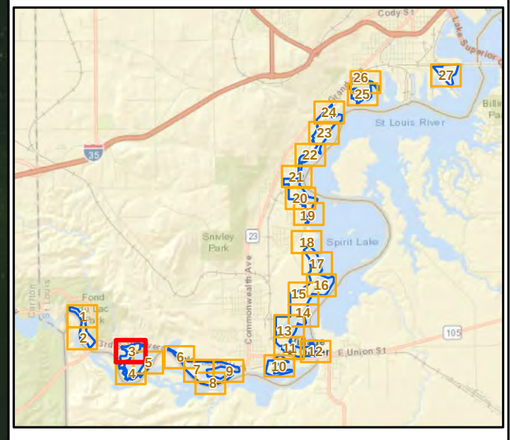
Figure 2-2

Legend

St. Louis River project areas

Native Plant Community Code

- WMn82b
- MRn83a
- MRu94a
- WMn82a
- FFn57a
- MHn44a
- WFn55a
- SAq
- DIST
- NN



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Map by: B. Tolcser
Projection: NAD83 UTM15N
Source: MNDNR, MN Land Trust, SEH
Background: FSA 2017 (CIR)

ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

Native Plant Community Map

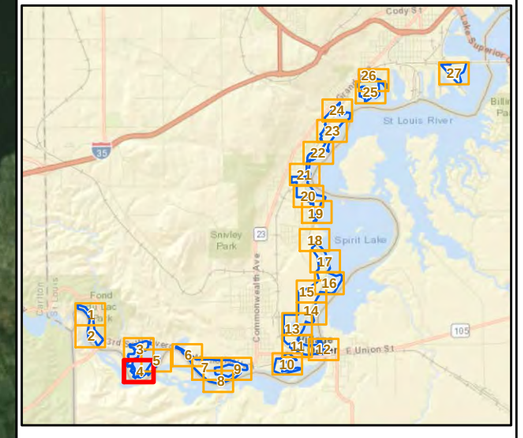
Figure 2-3

Legend

St. Louis River project areas

Native Plant Community Code

- WMn82b
- MRn83a
- MRu94a
- WMn82a
- FFn57a
- MHn44a
- SAq
- NN



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ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

Native Plant Community Map

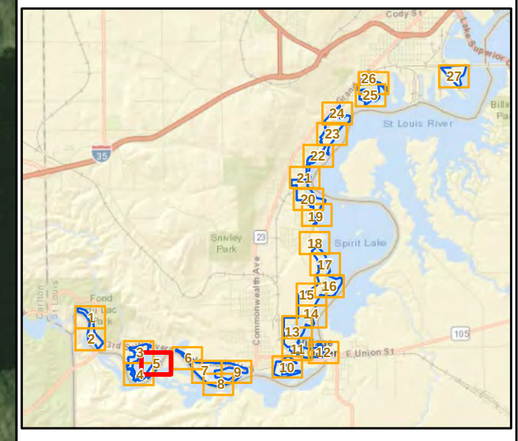
Figure 2-4

Legend

St. Louis River project areas

Native Plant Community Code

- WMn82b
- MRn83a
- MRu94a
- WMn82a
- FFn57a
- MHn44a
- SAq



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Background: FSA 2017 (CIR)

ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

Native Plant Community Map

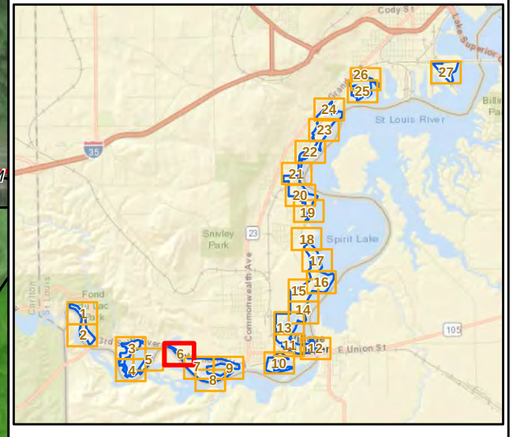
Figure 2-5

Legend

St. Louis River project areas

Native Plant Community Code

- WMn82a
- FPn73a
- FFn57a
- MHn44a
- MHn44d
- OW
- NVMM
- DIST



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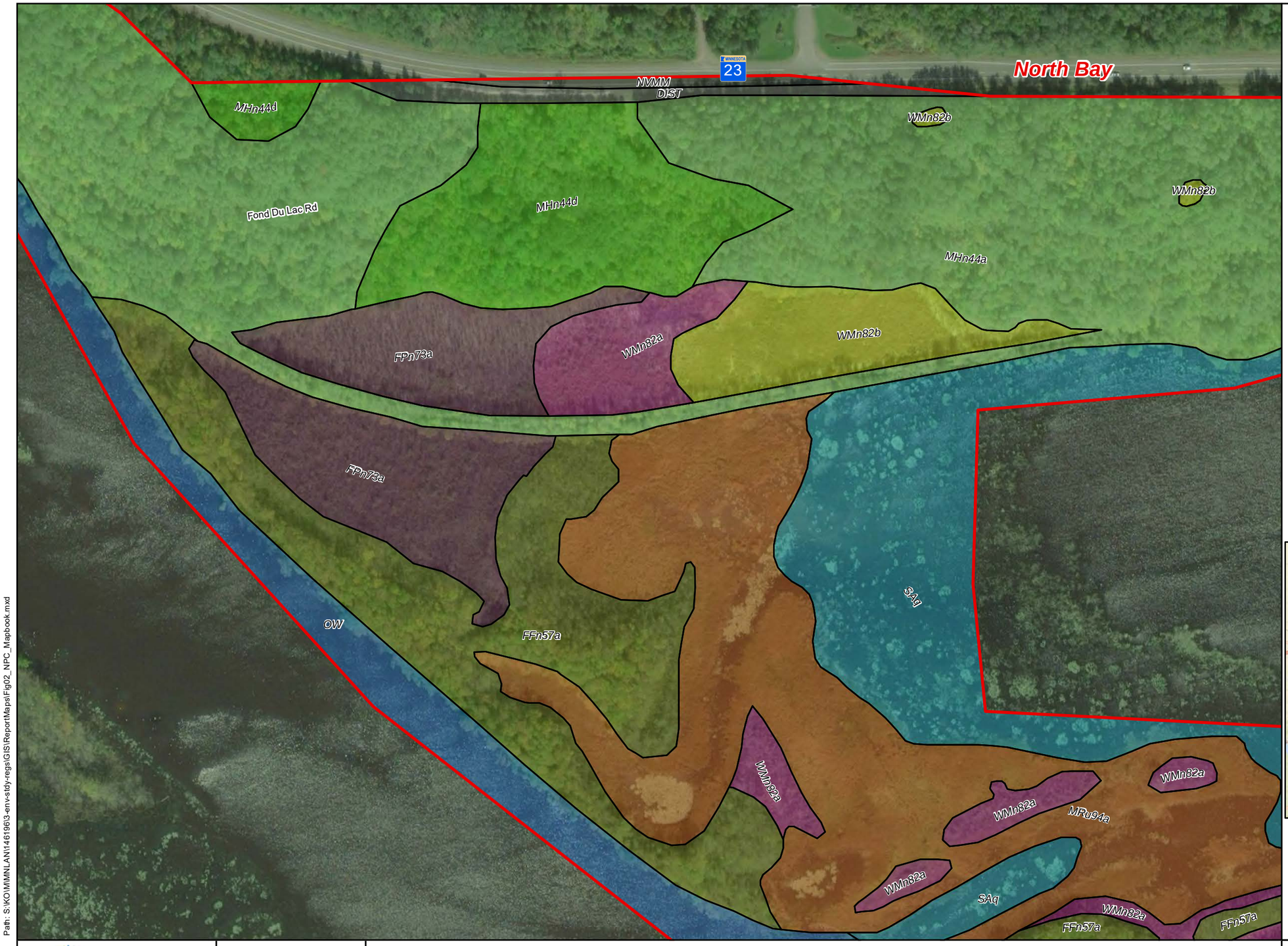
Background: FSA 2017 (CIR)

ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

Native Plant Community Map

Figure 2-6

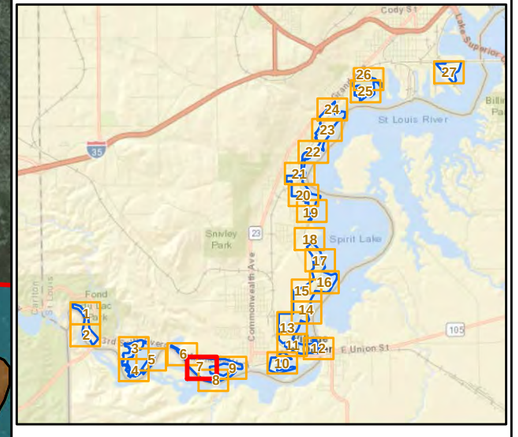


Legend

St. Louis River project areas

Native Plant Community Code

- WMn82b
- MRu94a
- WMn82a
- FPn73a
- FFn57a
- MHn44a
- MHn44d
- OW
- SAq
- NVMM
- DIST



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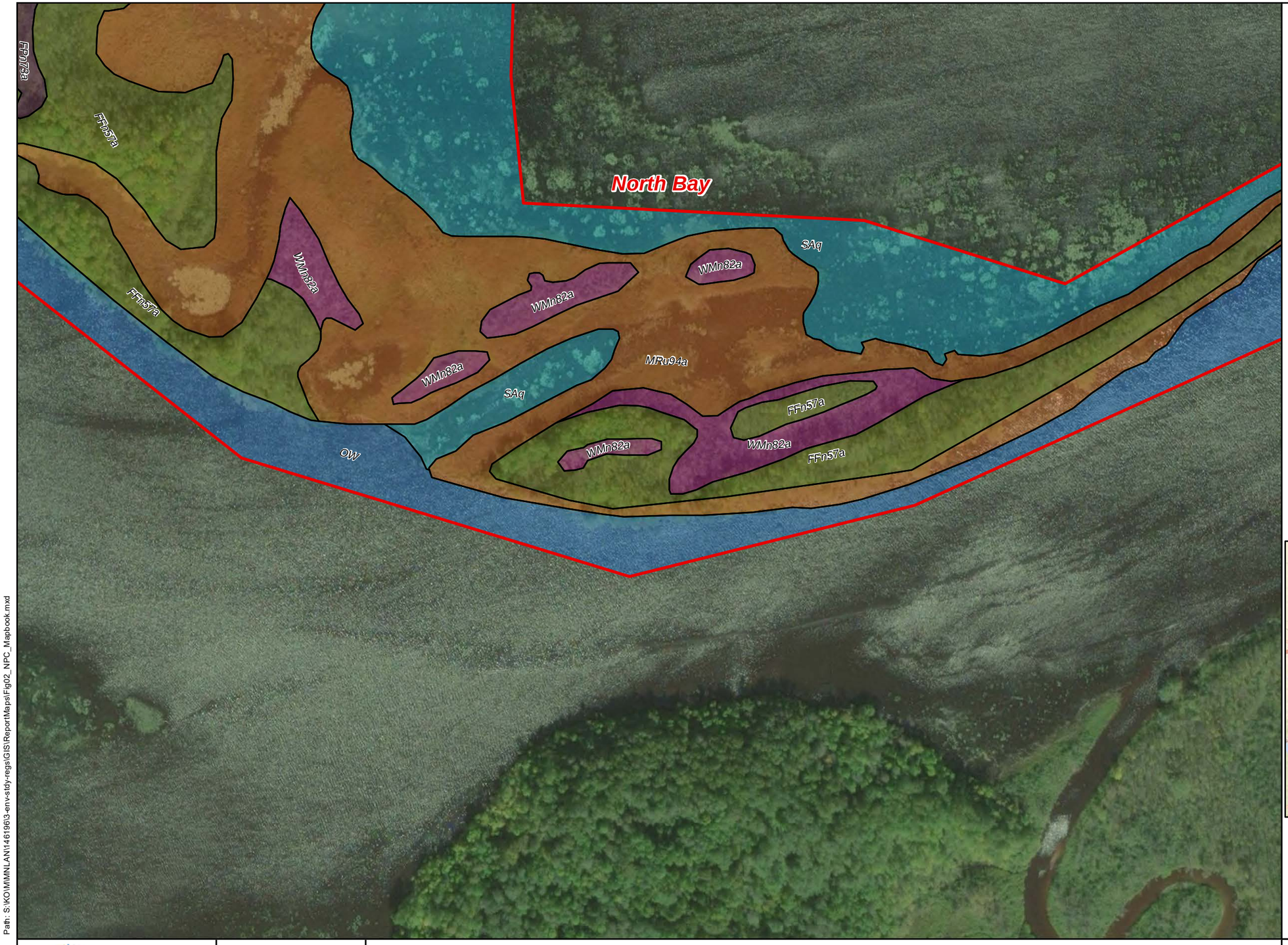
ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

Native Plant Community Map

Figure 2-7

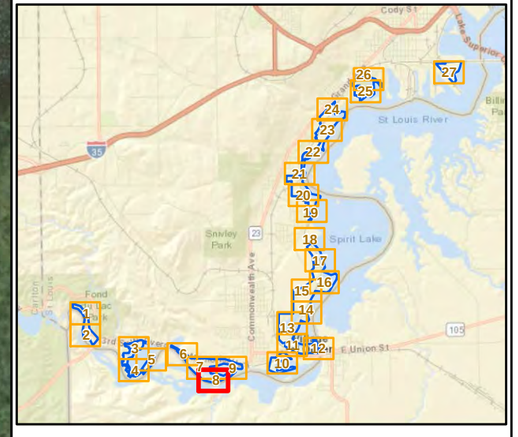


Legend

St. Louis River project areas

Native Plant Community Code

- MRu94a
- WMn82a
- FPn73a
- FFn57a
- OW
- SAq



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ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

Native Plant Community Map

Figure 2-8

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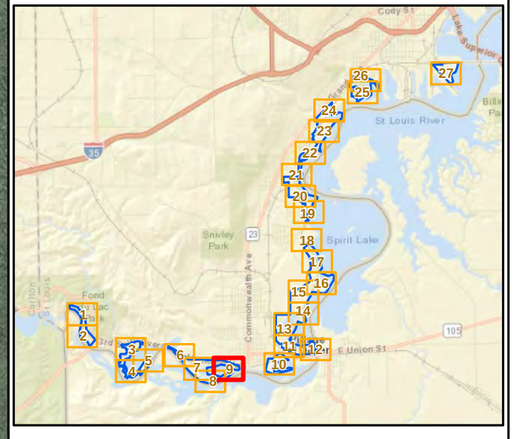
Legend

St. Louis River project areas

Native Plant Community Code

- MRu94a
- WMn82a
- FPn73a
- FFn57a
- MHn44a
- MHn46a
- WFn55a
- OW
- SAq
- INV
- DIST
- NN



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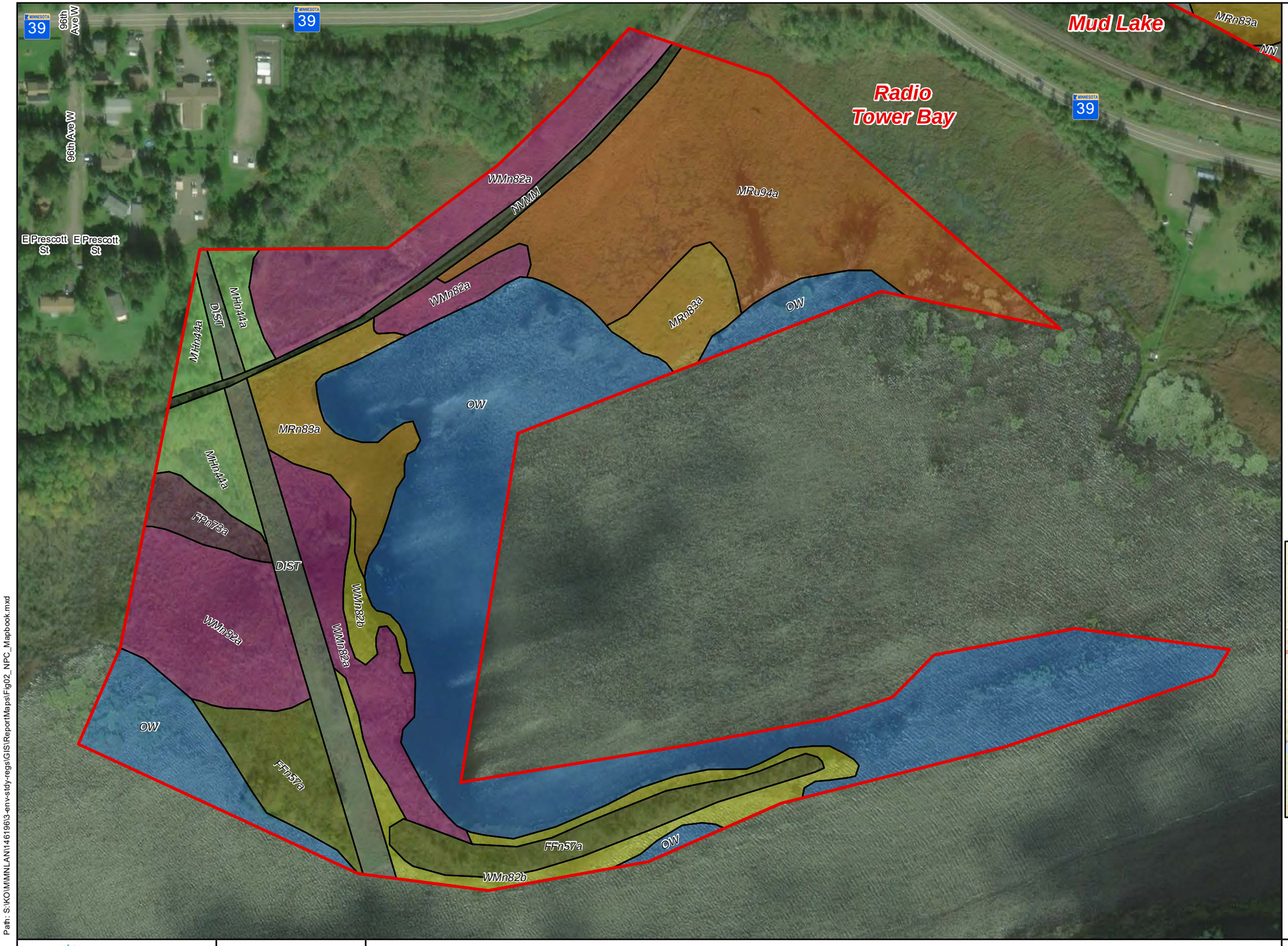
ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

Native Plant Community Map

Figure 2-9

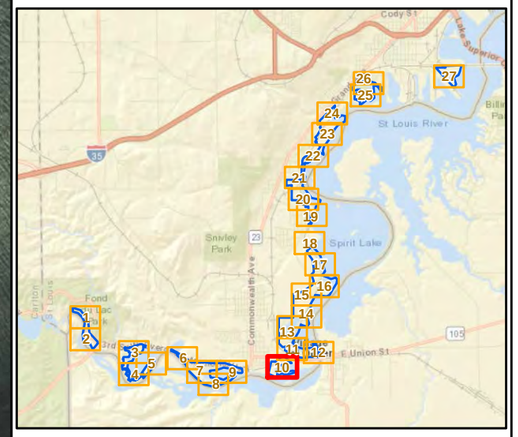


Legend

- St. Louis River project areas

Native Plant Community Code

- WMn82b
- MRn83a
- MRu94a
- WMn82a
- FPn73a
- FFn57a
- MHn44a
- OW
- NVMM
- DIST
- NN



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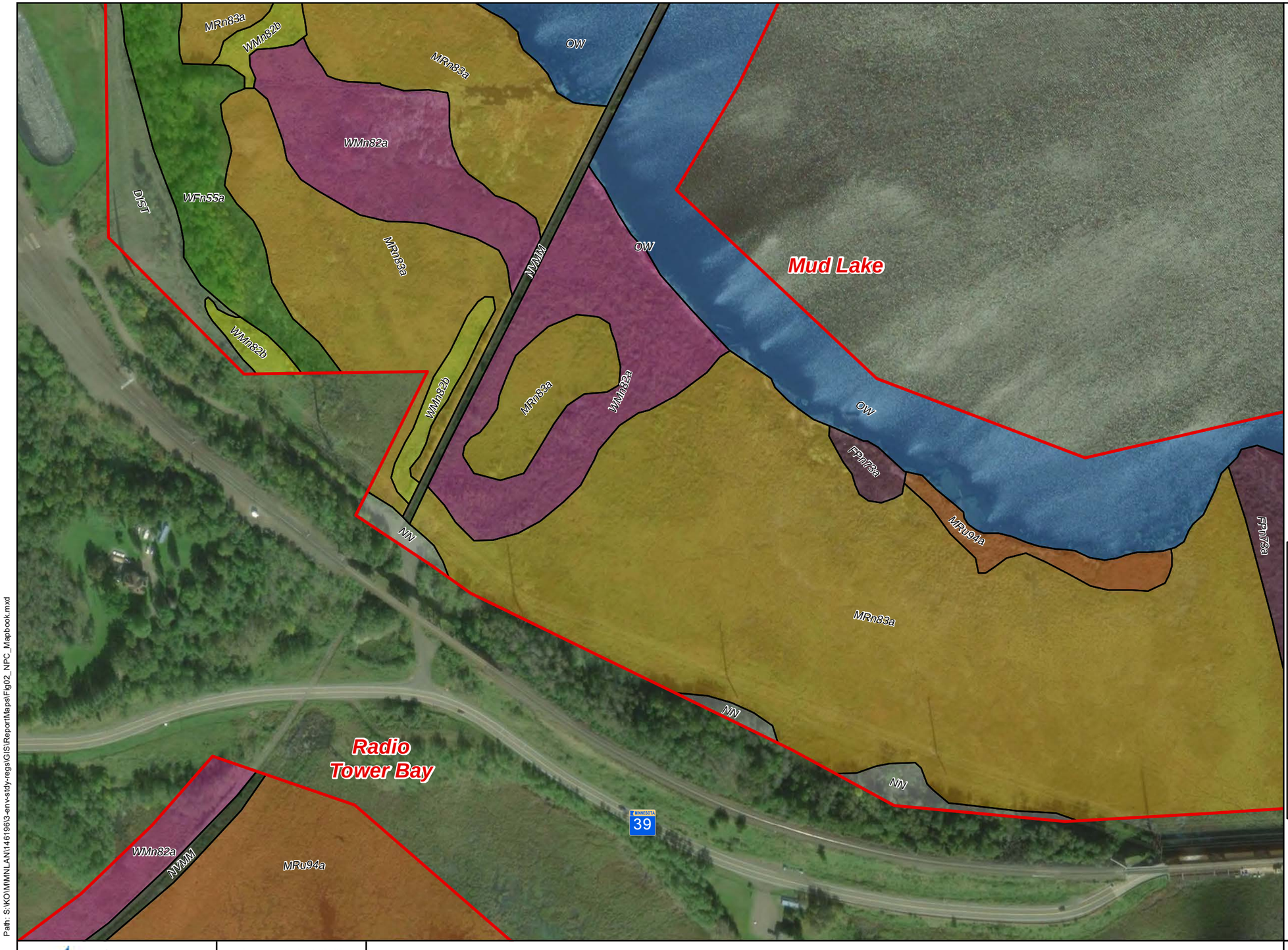
ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

Native Plant Community Map

Figure 2-10

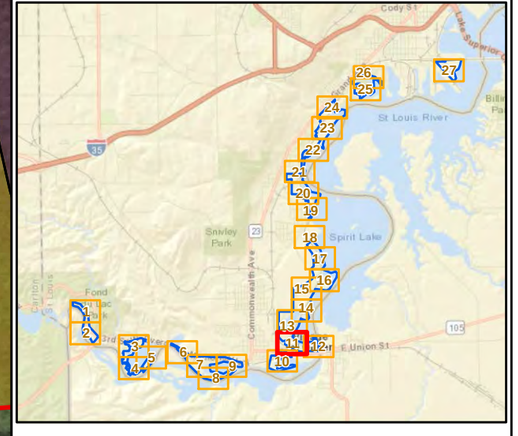


Legend

St. Louis River project areas

Native Plant Community Code

- WMn82b
- MRn83a
- MRu94a
- WMn82a
- FPn73a
- WFn55a
- OW
- NVMM
- DIST
- NN



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ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

Native Plant Community Map

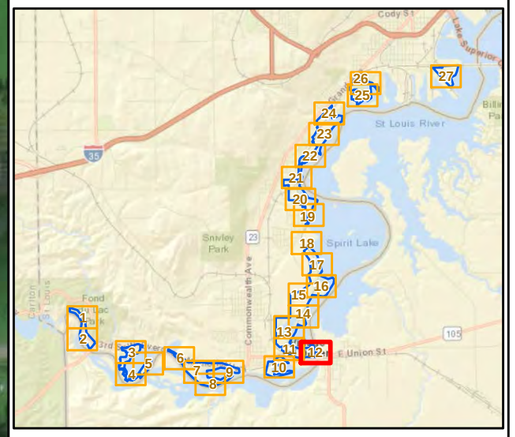
Figure 2-11

Legend

St. Louis River project areas

Native Plant Community Code

- MRn83a
- MRu94a
- WMn82a
- FPn73a
- OW



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ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

Native Plant Community Map

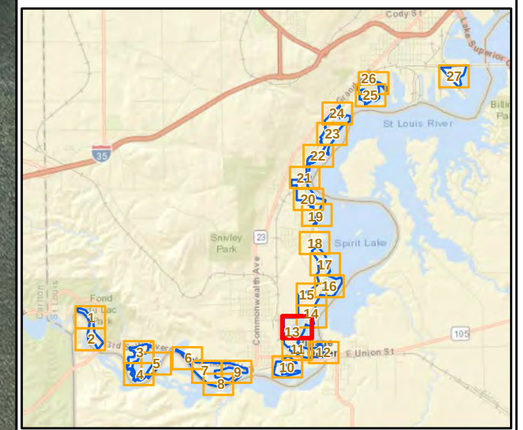
Figure 2-12

Legend

St. Louis River project areas

Native Plant Community Code

- WMn82b
- MRn83a
- MRu94a
- WMn82a
- FFn57a
- MHn44a
- MHn46b
- MHn47a
- WFn55a
- OW
- NVMM
- DIST
- NN



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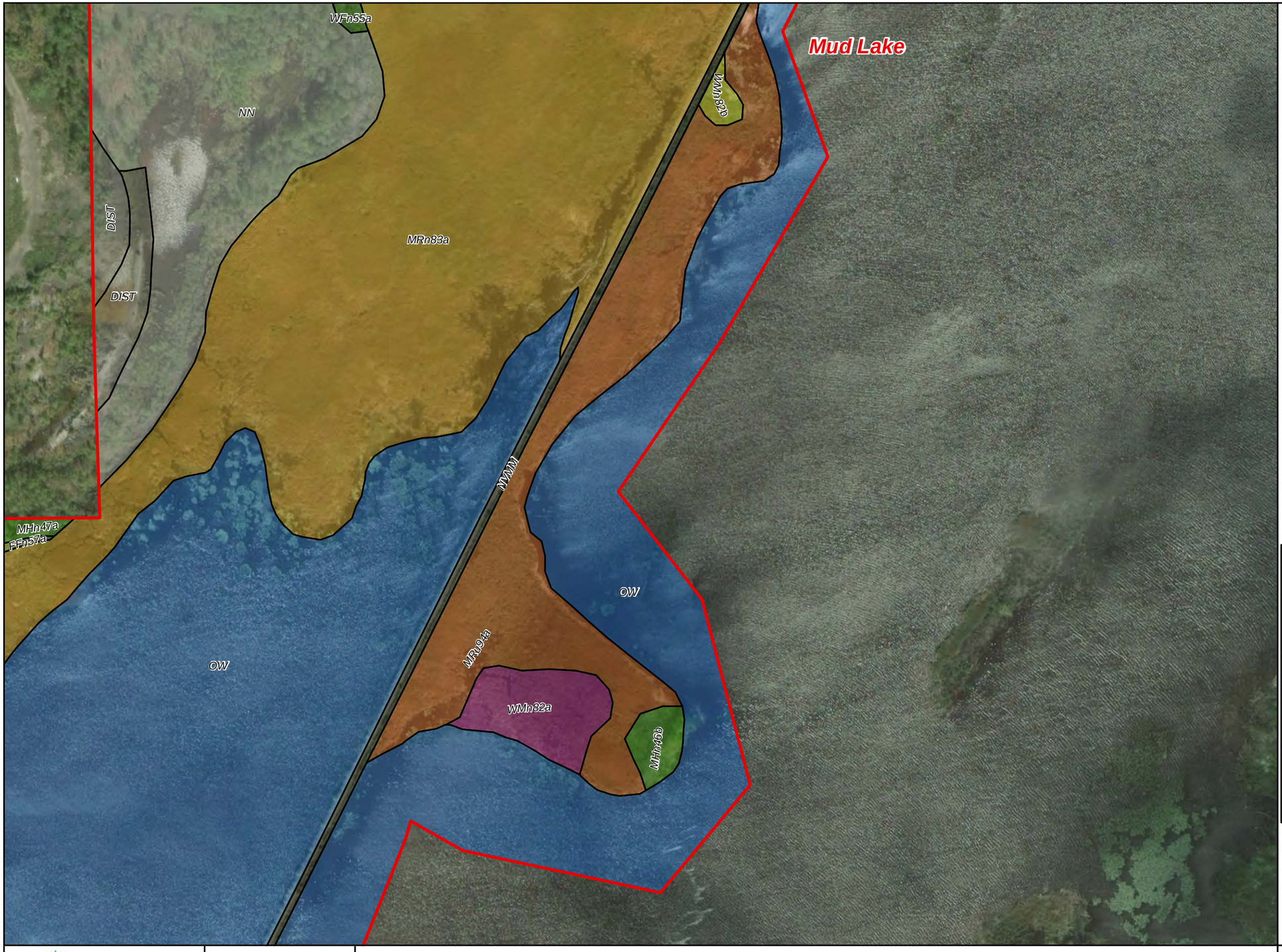
ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

Native Plant Community Map

Figure 2-13

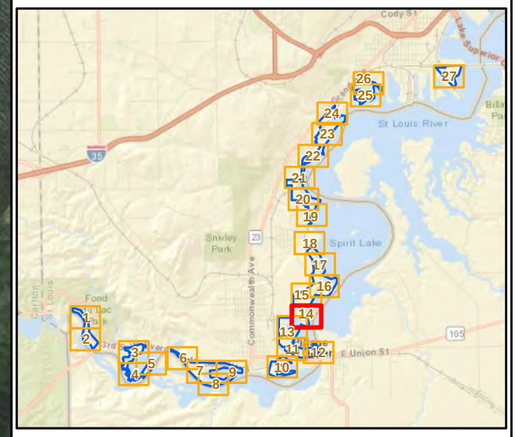


Legend

St. Louis River project areas

Native Plant Community Code

- WMn82b
- MRn83a
- MRu94a
- WMn82a
- FFn57a
- MHn46b
- MHn47a
- WFn55a
- OW
- NVMM
- DIST
- NN



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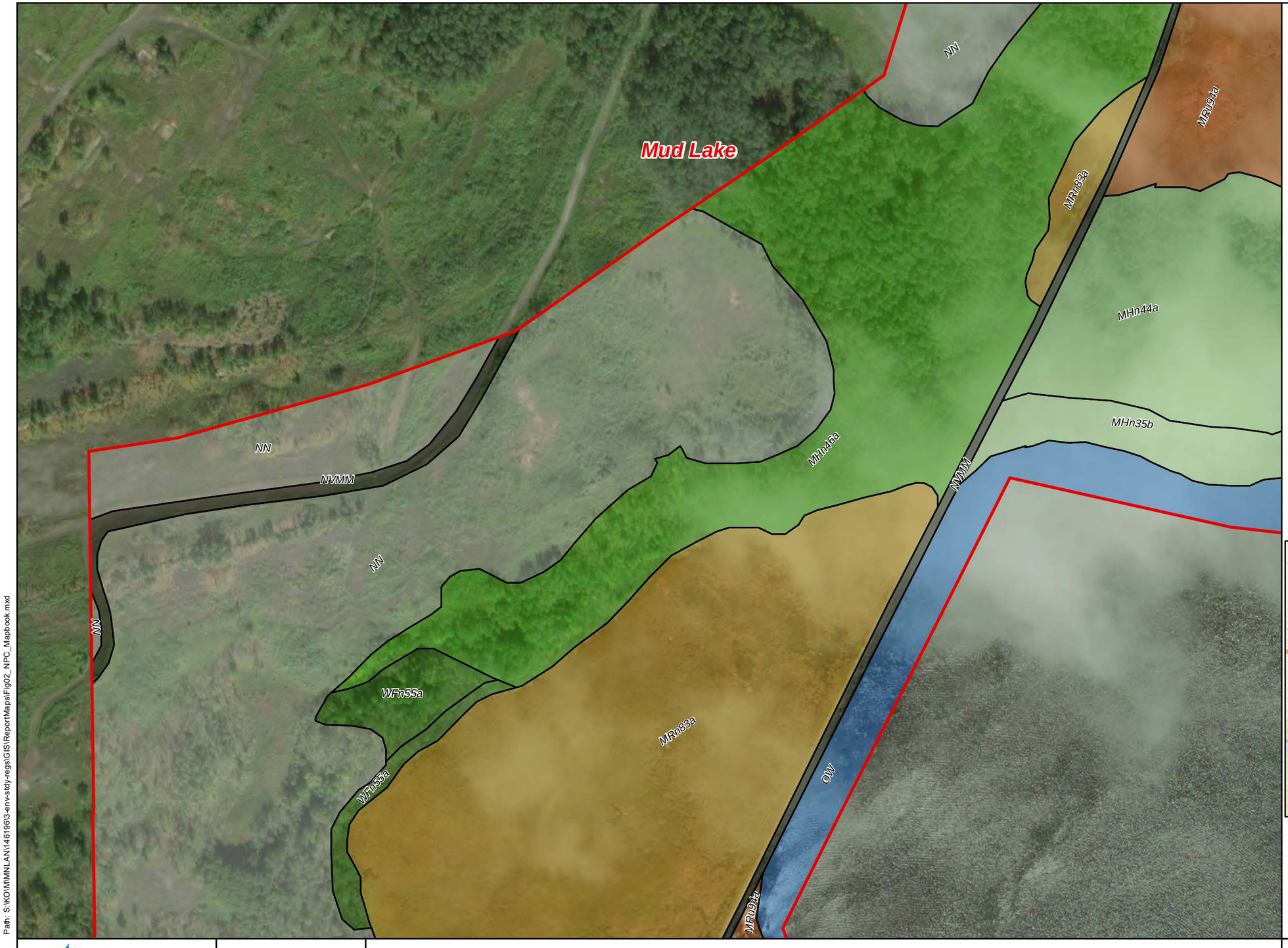
ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

Native Plant Community Map

Figure 2-14

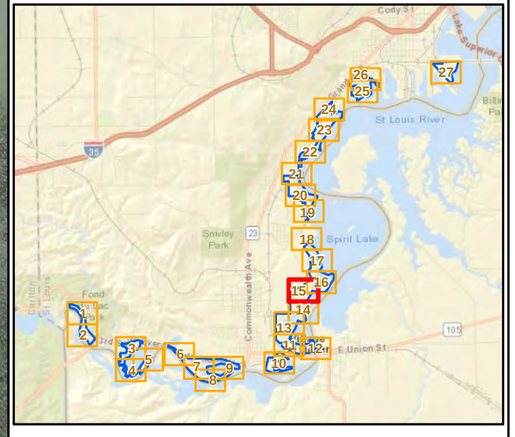


Legend

St. Louis River project areas

Native Plant Community Code

- MRn83a
- MRu94a
- MHn35b
- MHn44a
- MHn46a
- WFn55a
- OW
- NVMM
- NN



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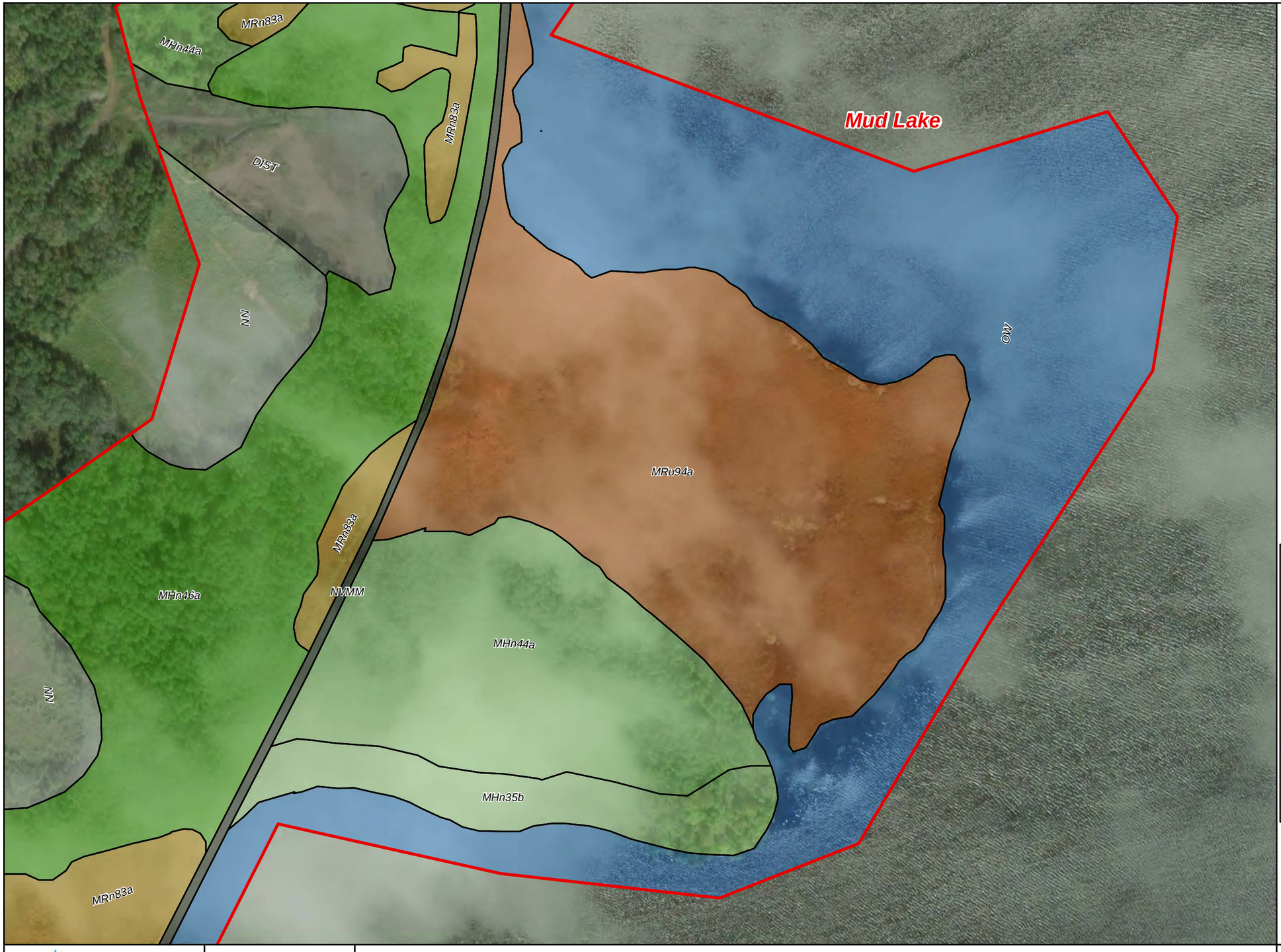
Source: MNDNR, MN Land Trust, SEH
Background: FSA 2017 (CIR)

ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

Native Plant Community Map

Figure 2-15

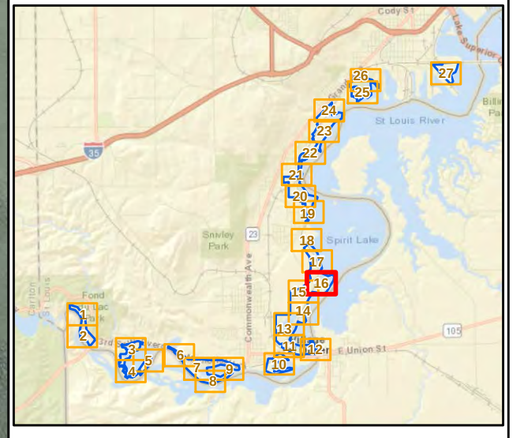


Legend

St. Louis River project areas

Native Plant Community Code

- MRn83a
- MRu94a
- MHn35b
- MHn44a
- MHn46a
- OW
- NVMM
- DIST
- NN



0 250 500 Feet

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Project: MNLAN 146196
Print Date: 10/31/2018

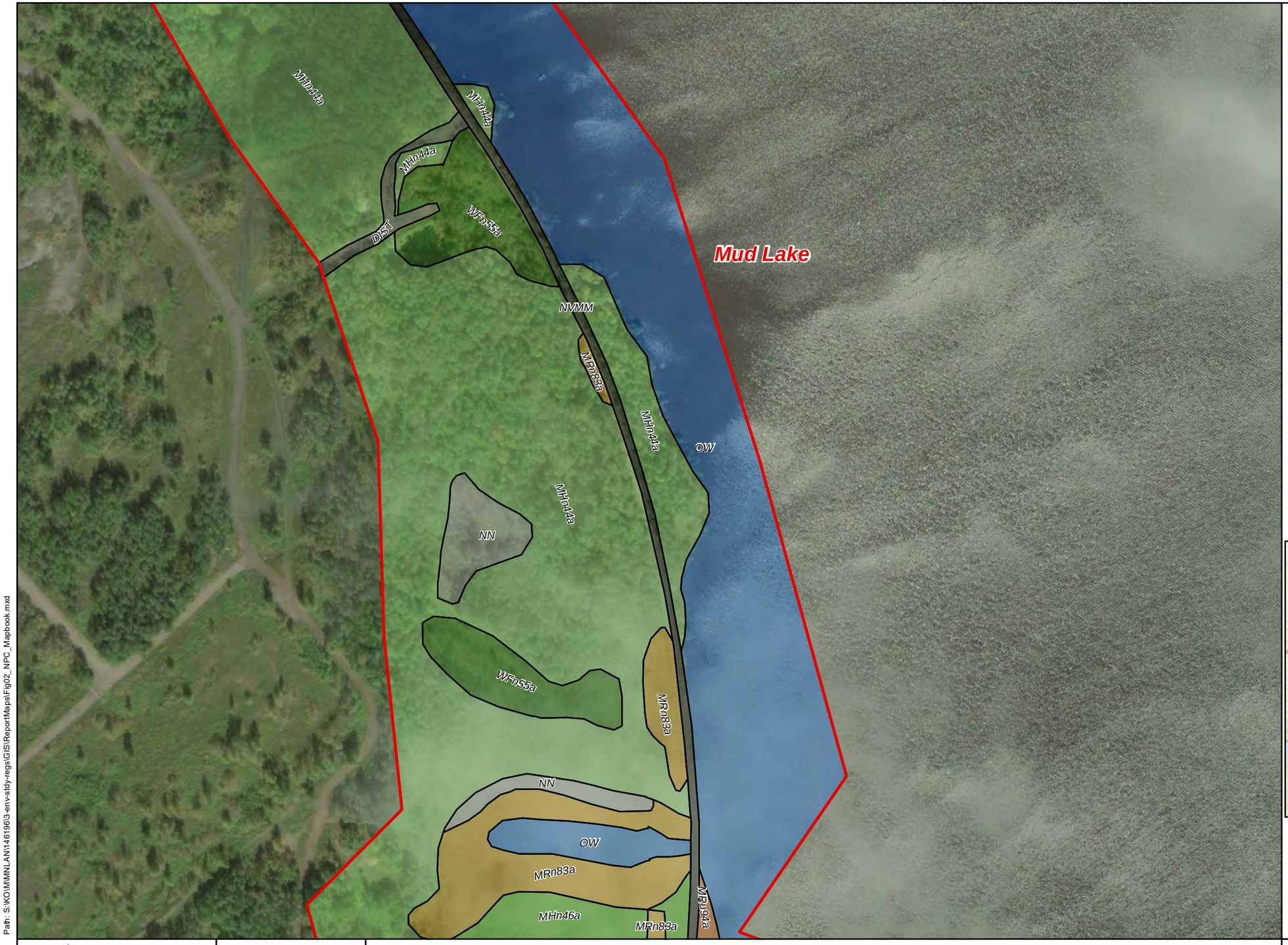
Map by: B. Tolcser
Projection: NAD83 UTM15N
Source: MNDNR, MN Land Trust, SEH
Background: FSA 2017 (CIR)

ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

Native Plant Community Map

Figure 2-16

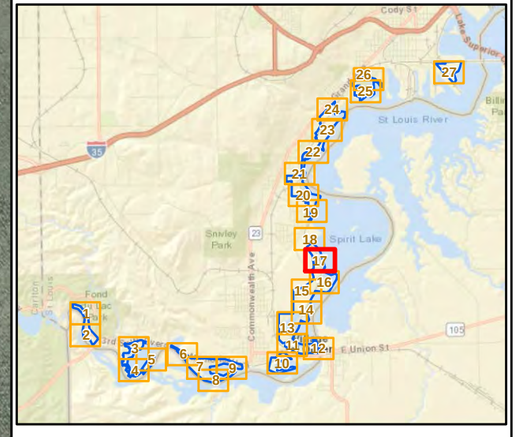


Legend

St. Louis River project areas

Native Plant Community Code

- MRn83a
- MRu94a
- MHn44a
- MHn46a
- WFn55a
- OW
- NVMM
- DIST
- NN



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ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

Native Plant Community Map

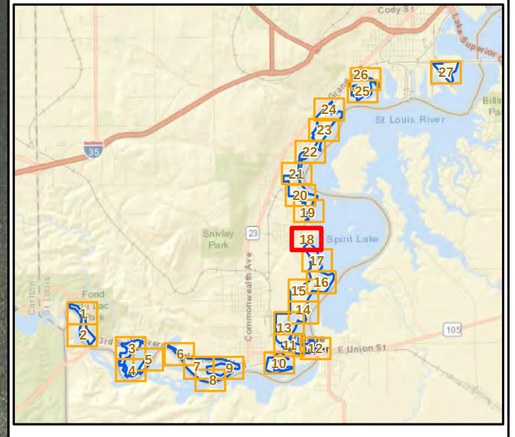
Figure 2-17

Legend

St. Louis River project areas

Native Plant Community Code

- MHn44a
- OW
- NVMM



0 250 500 Feet

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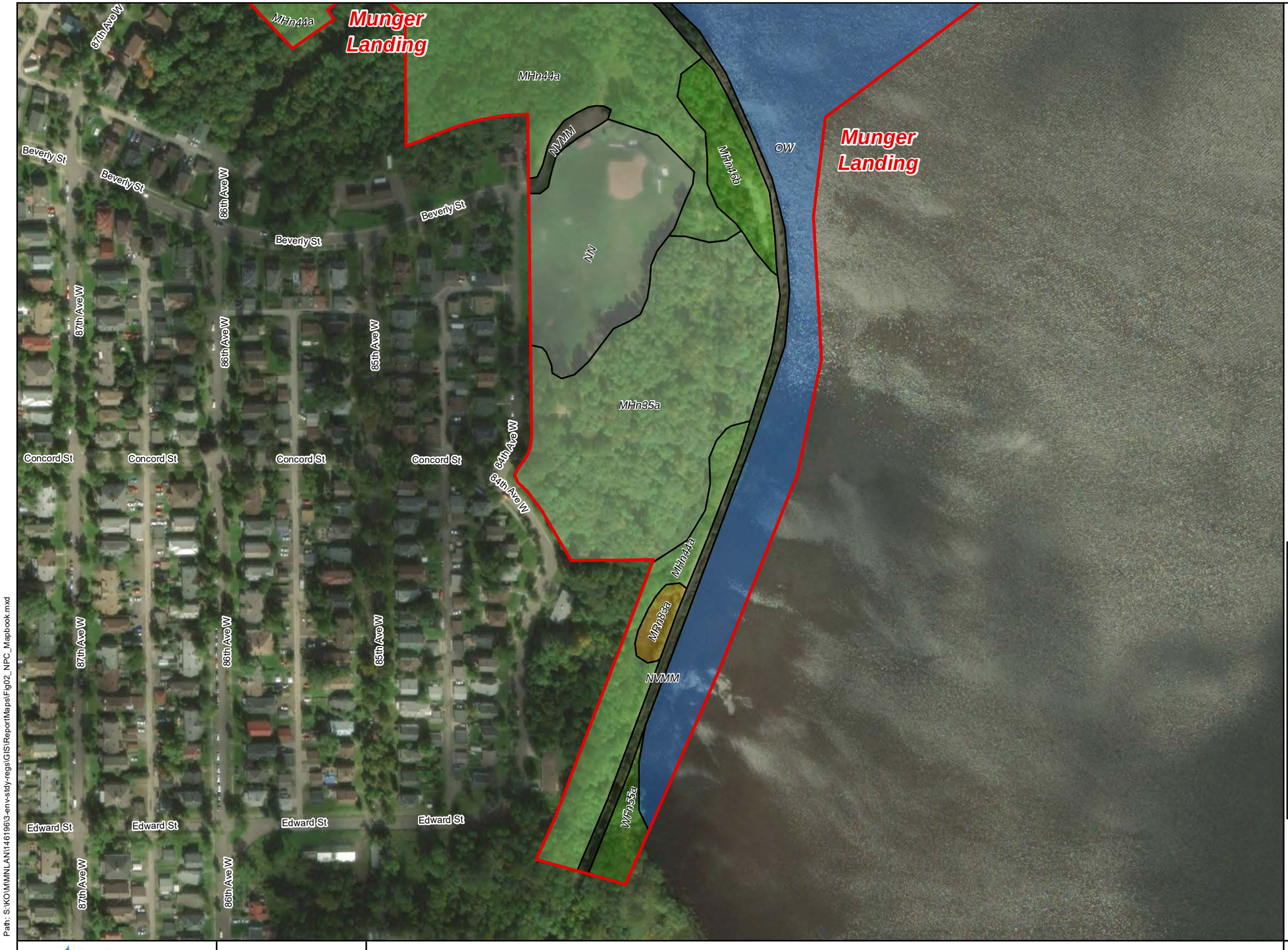
ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

Native Plant Community Map

Figure 2-18

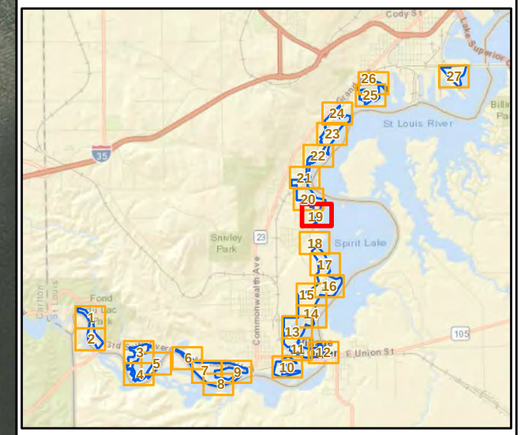


Legend

St. Louis River project areas

Native Plant Community Code

- MRn83a
- MHn35a
- MHn44a
- MHn46b
- WFn55a
- OW
- NVMM
- NN



0 250 500 Feet

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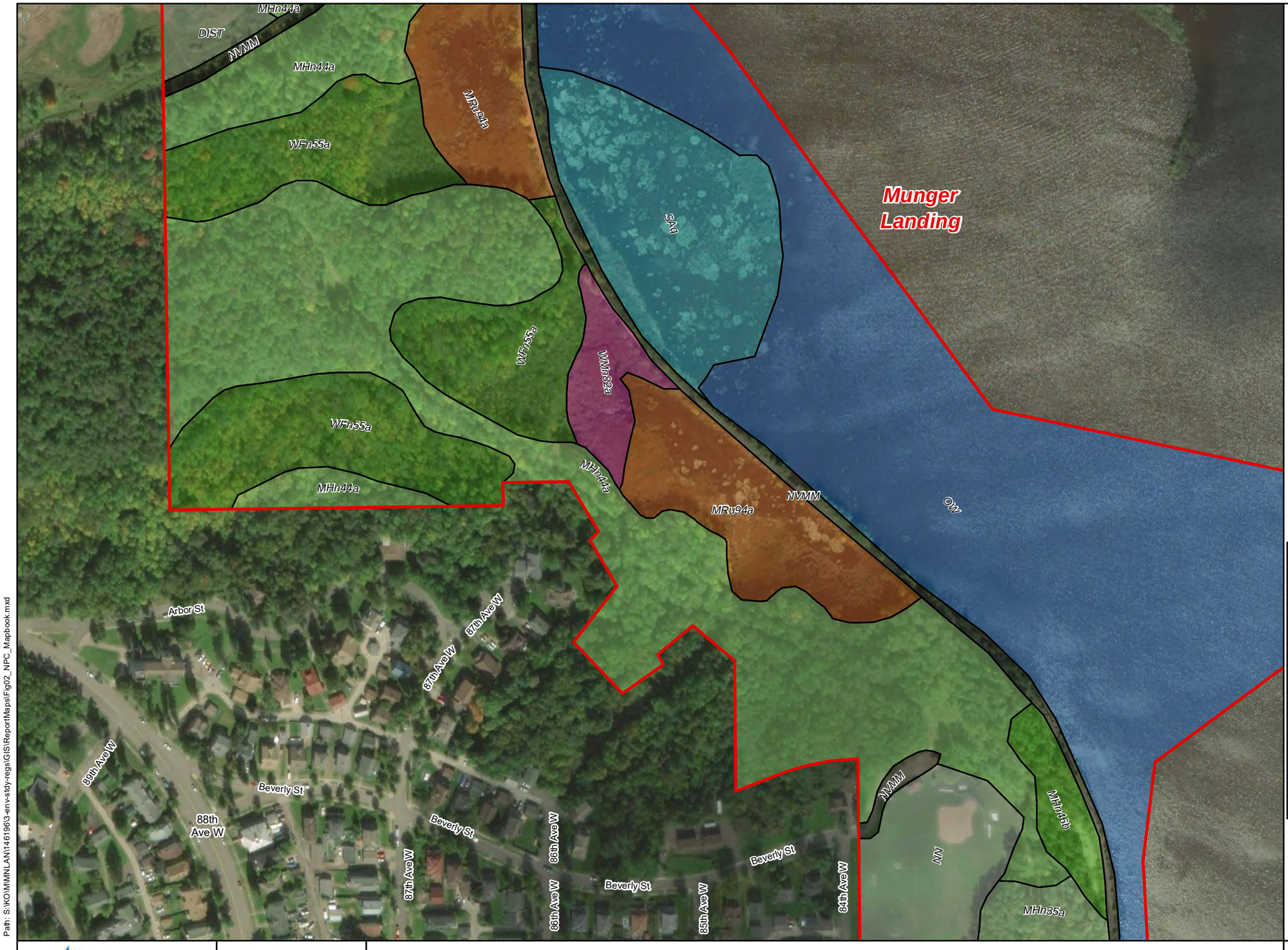
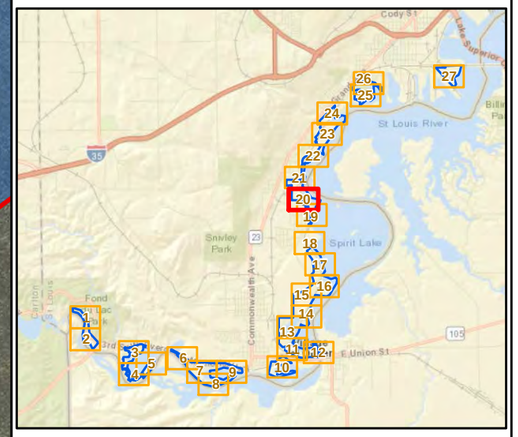
ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

Native Plant Community Map

Figure 2-19





Legend

St. Louis River project areas

Native Plant Community Code

- MRu94a
- WMn82a
- MHn35a
- MHn44a
- MHn46b
- WFn55a
- OW
- SAq
- NVMM
- DIST
- NN

0 250 500 Feet

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ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

Native Plant Community Map

Figure 2-20

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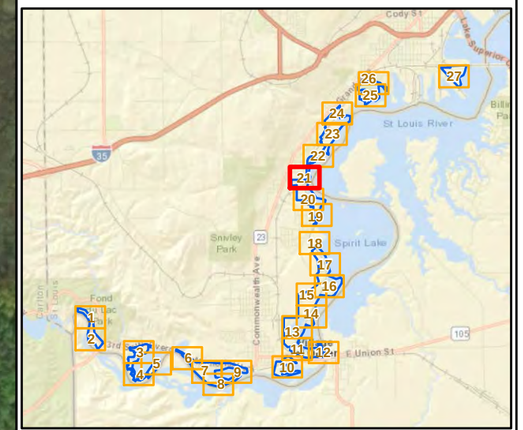
Legend

St. Louis River project areas

Native Plant Community Code

- WMn82b
- MRn83a
- MRu94a
- WMn82a
- FFn57a
- MHn44a
- WFn55a
- OW
- NVMM
- DIST
- NN



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ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

Native Plant Community Map

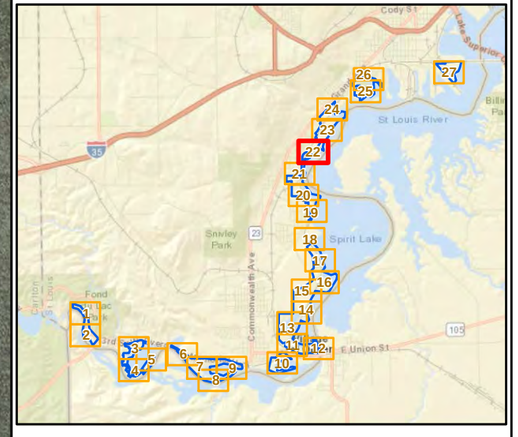
Figure 2-21

Legend

St. Louis River project areas

Native Plant Community Code

- WMn82b
- MRu94a
- WMn82a
- MHn44a
- OW
- NVMM
- INV
- DIST
- NN



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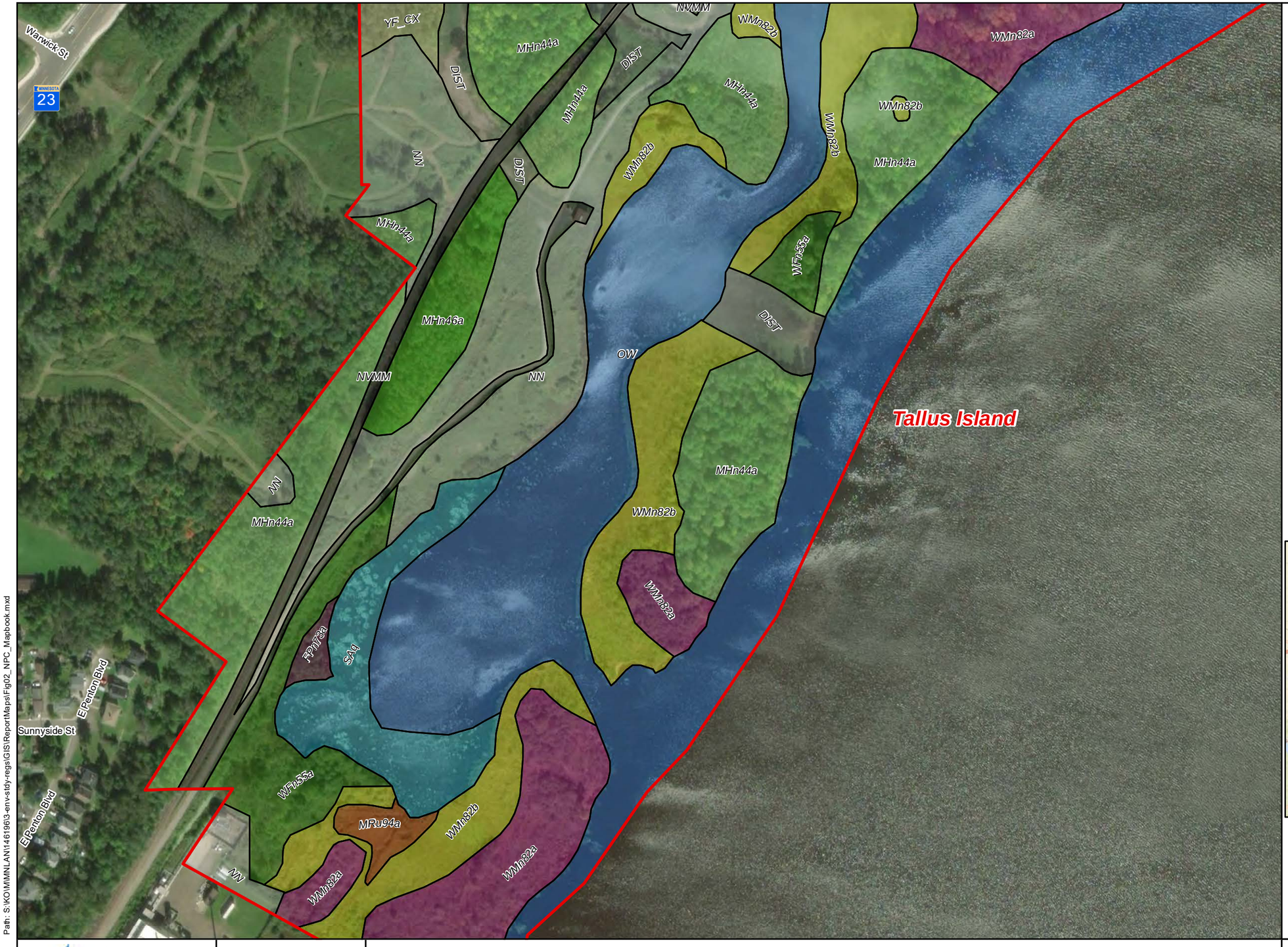
ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

Native Plant Community Map

Figure 2-22



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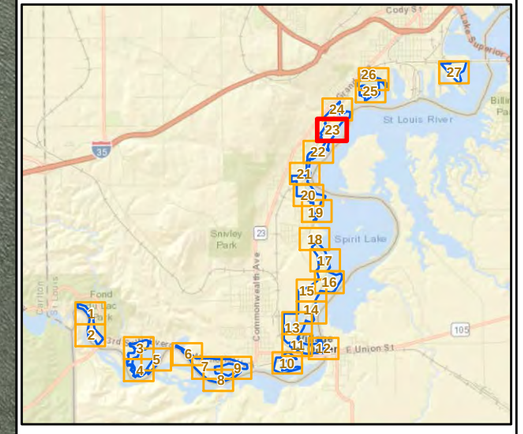
Legend

St. Louis River project areas

Native Plant Community Code

- WMn82b
- MRu94a
- WMn82a
- FPn73a
- MHn44a
- MHn46a
- WFn55a
- OW
- SAq
- NVMM
- DIST
- YF_CX
- NN



0 250 500 Feet

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ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

Native Plant Community Map

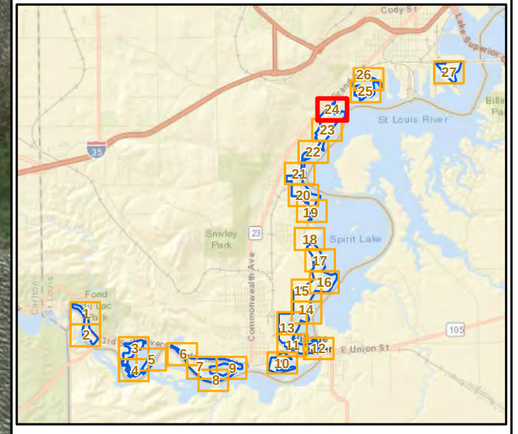
Figure 2-23

Legend

St. Louis River project areas

Native Plant Community Code

- WMn82b
- MRn83a
- MRu94a
- WMn82a
- MHn44a
- MHn44b
- MHn44d
- WFn55a
- OW
- NVMM
- INV
- DIST
- YF_CX
- NN



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ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

Native Plant Community Map

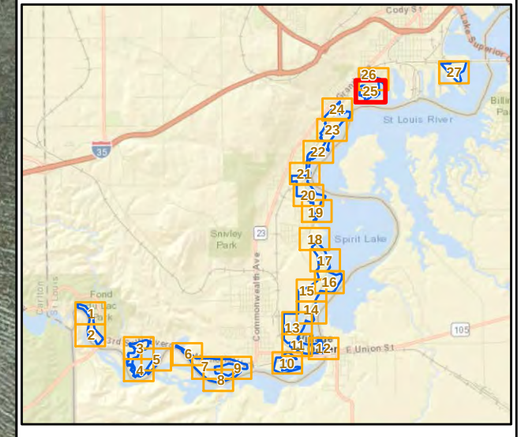
Figure 2-24

Legend

- St. Louis River project areas

Native Plant Community Code

- WMn82b
- MRu94a
- WMn82a
- FFn57a
- MHn35b
- MHn44a
- WFn55a
- OW
- INV
- NN



0 250 500 Feet

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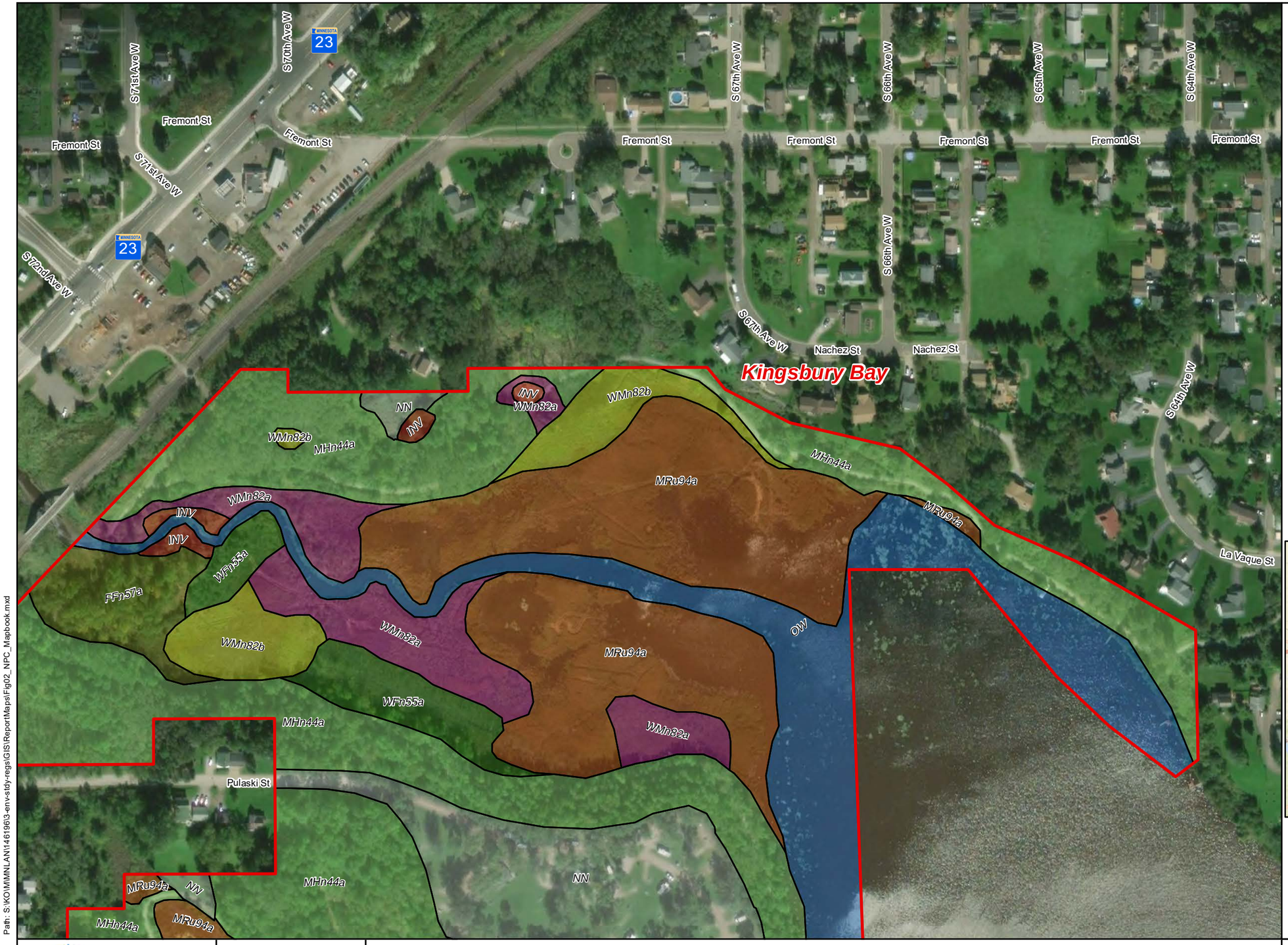
ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

Native Plant Community Map

Figure 2-25

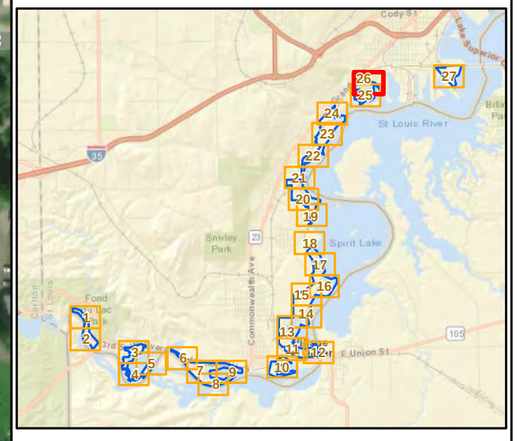


Legend

St. Louis River project areas

Native Plant Community Code

- WMn82b
- MRu94a
- WMn82a
- FFn57a
- MHn44a
- WFn55a
- OW
- INV
- NN



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Background: FSA 2017 (CIR)

ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

Native Plant Community Map

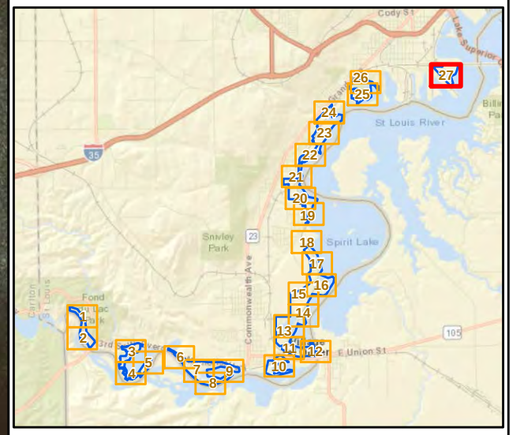
Figure 2-26

Legend

St. Louis River project areas

Native Plant Community Code

- WMn82b
- MRn83a
- MRu94a
- WMn82a
- WFn55a
- OW
- NVMM
- INV



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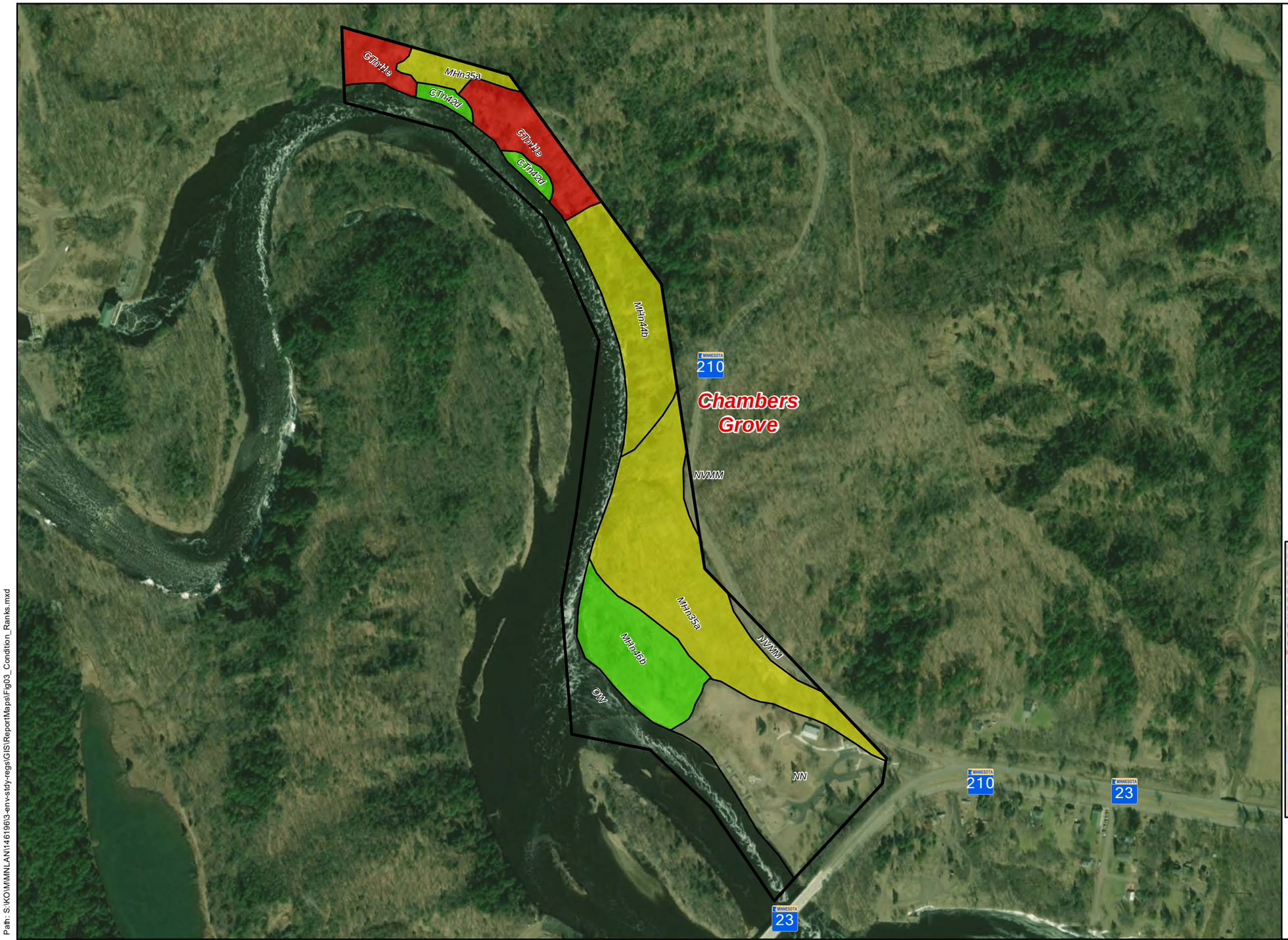
Background: FSA 2017 (CIR)

ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

Native Plant Community Map

Figure 2-27

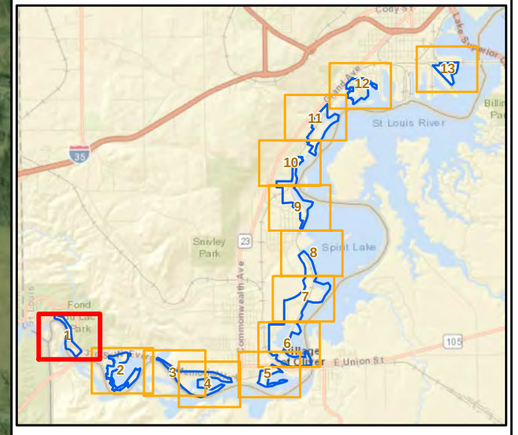


Legend

St. Louis River project areas

NPC Condition Rank

- A
- B
- D
- NA (Non-NPC)



0 500 1,000 Feet

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Projection: NAD83 UTM15N
Source: MNDNR, MN Land Trust, SEH
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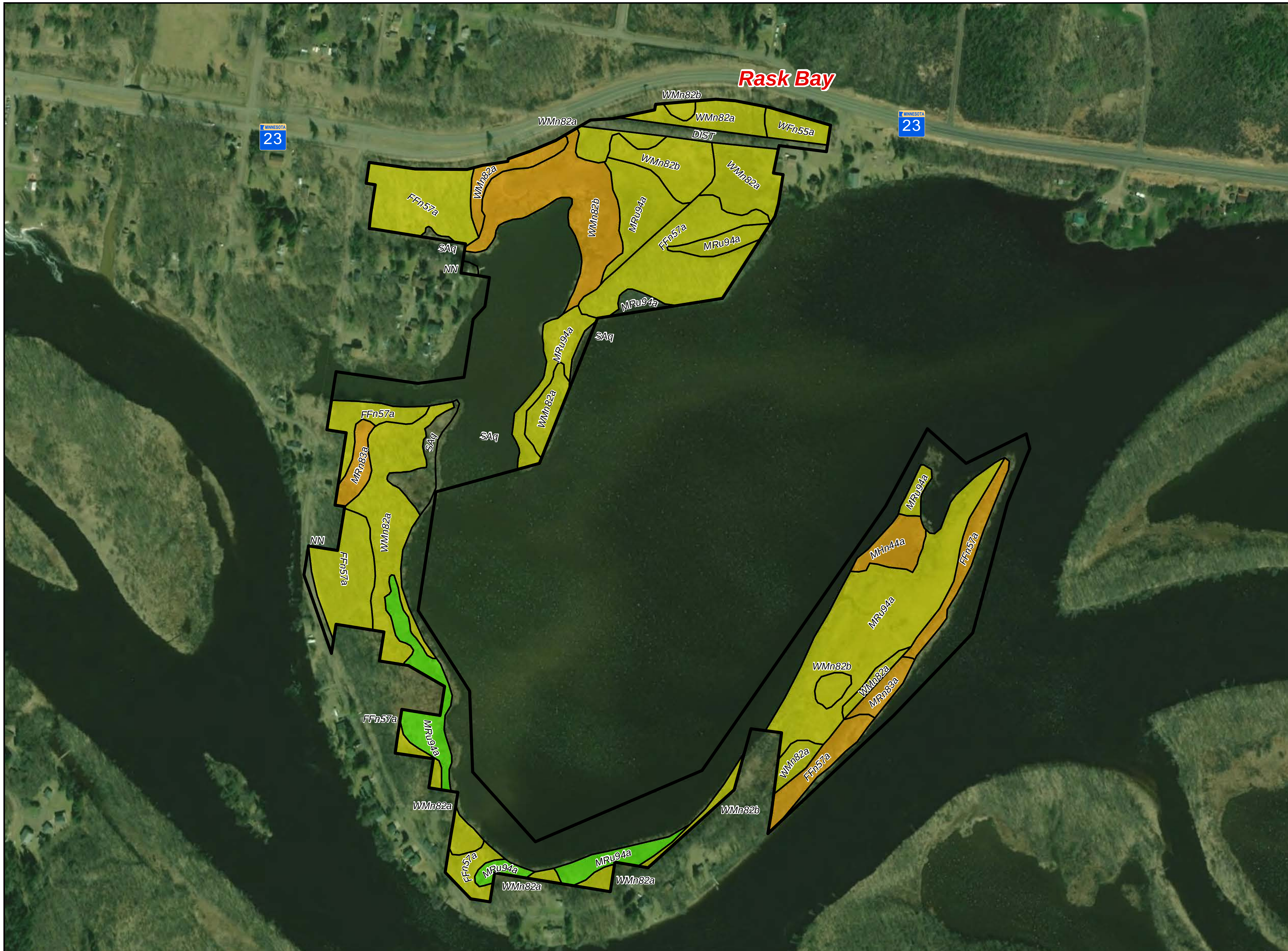
ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

NPC Condition Rankings Map

Figure 3-1

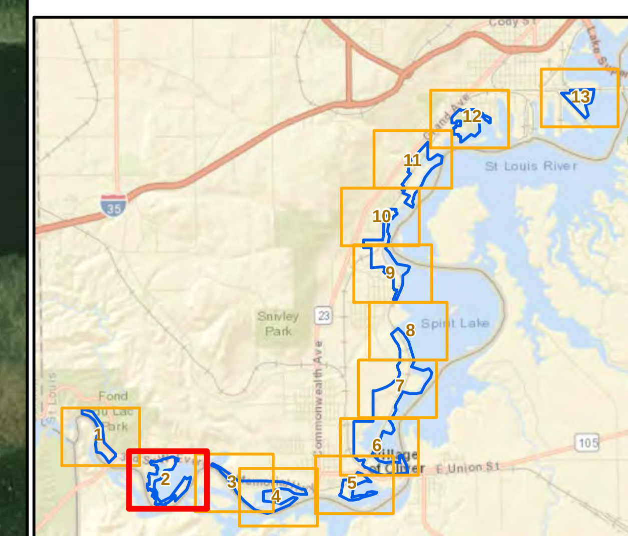


Legend

(black outline)	St. Louis River project areas

NPC Condition Rank

(green)	A
(yellow)	B
(orange)	C
(white)	NA (Non-NPC)



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Project: MNLAN 146196
Print Date: 10/30/2018

Map by: B. Tolcser
Projection: NAD83 UTM15N
Source: MNDNR, MN Land Trust, SEH
Background: FSA 2017 (CIR)

ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

NPC Condition Rankings Map

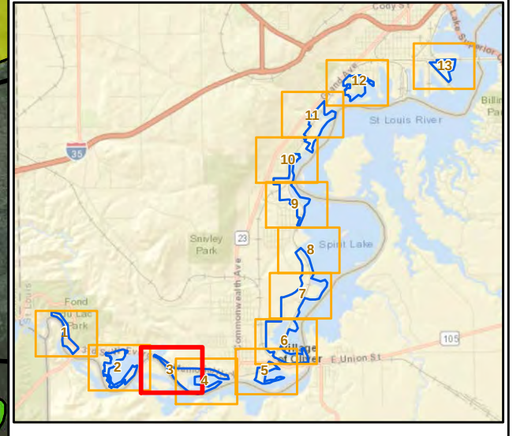
Figure 3-2

Legend

St. Louis River project areas

NPC Condition Rank

- A
- B
- NA (Non-NPC)



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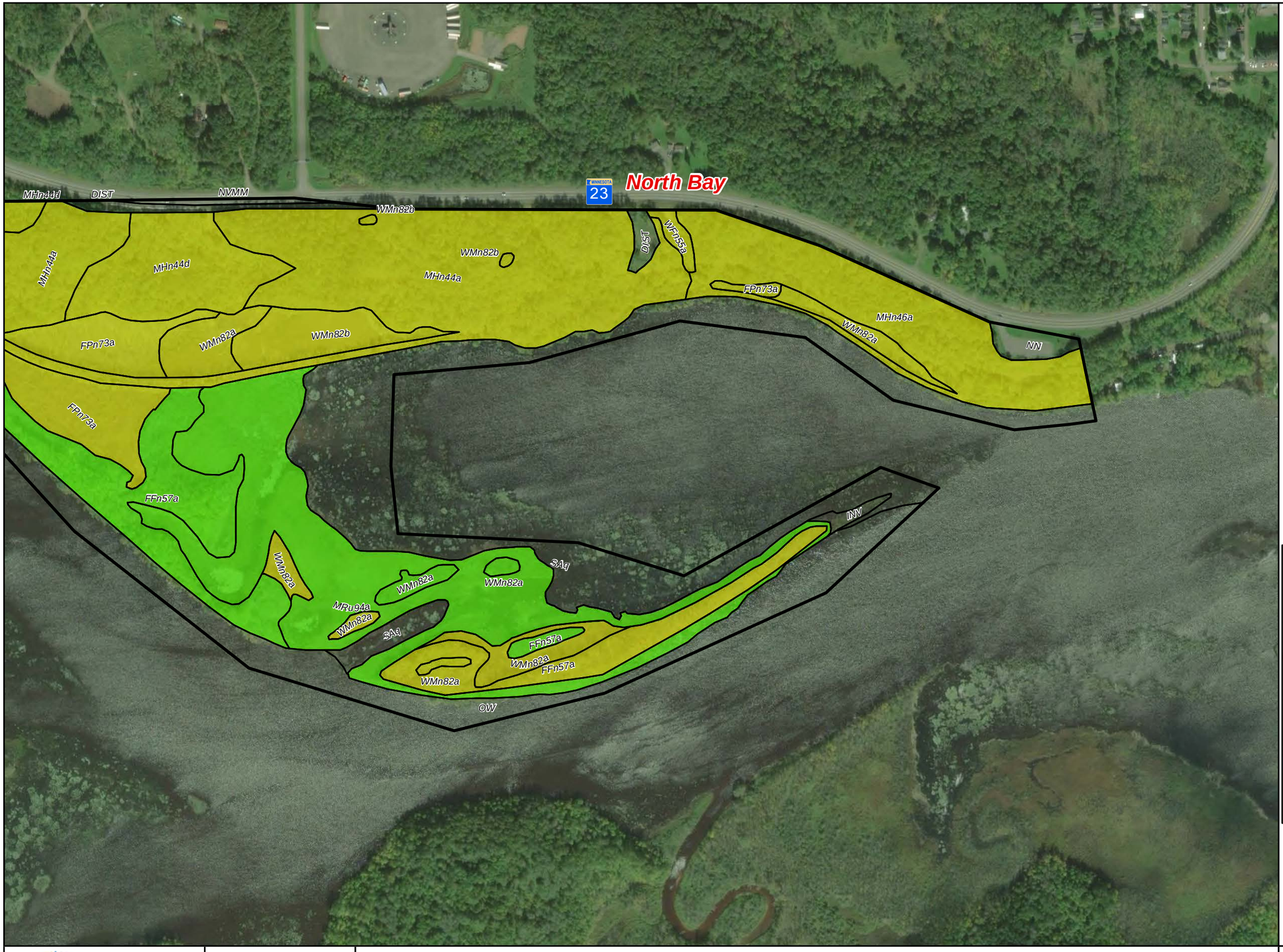
ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

NPC Condition Rankings Map

Figure 3-3

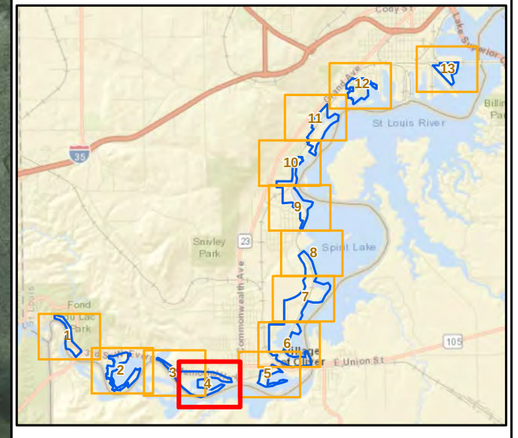


Legend

St. Louis River project areas

NPC Condition Rank

- A
- B
- NA (Non-NPC)



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ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

NPC Condition Rankings Map

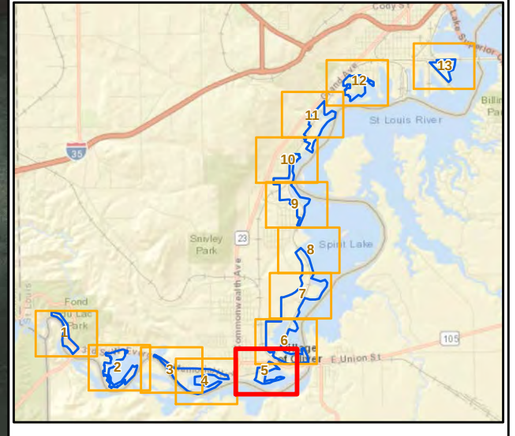
Figure 3-4

Legend

St. Louis River project areas

NPC Condition Rank

- A/B
- B
- C
- NA (Non-NPC)



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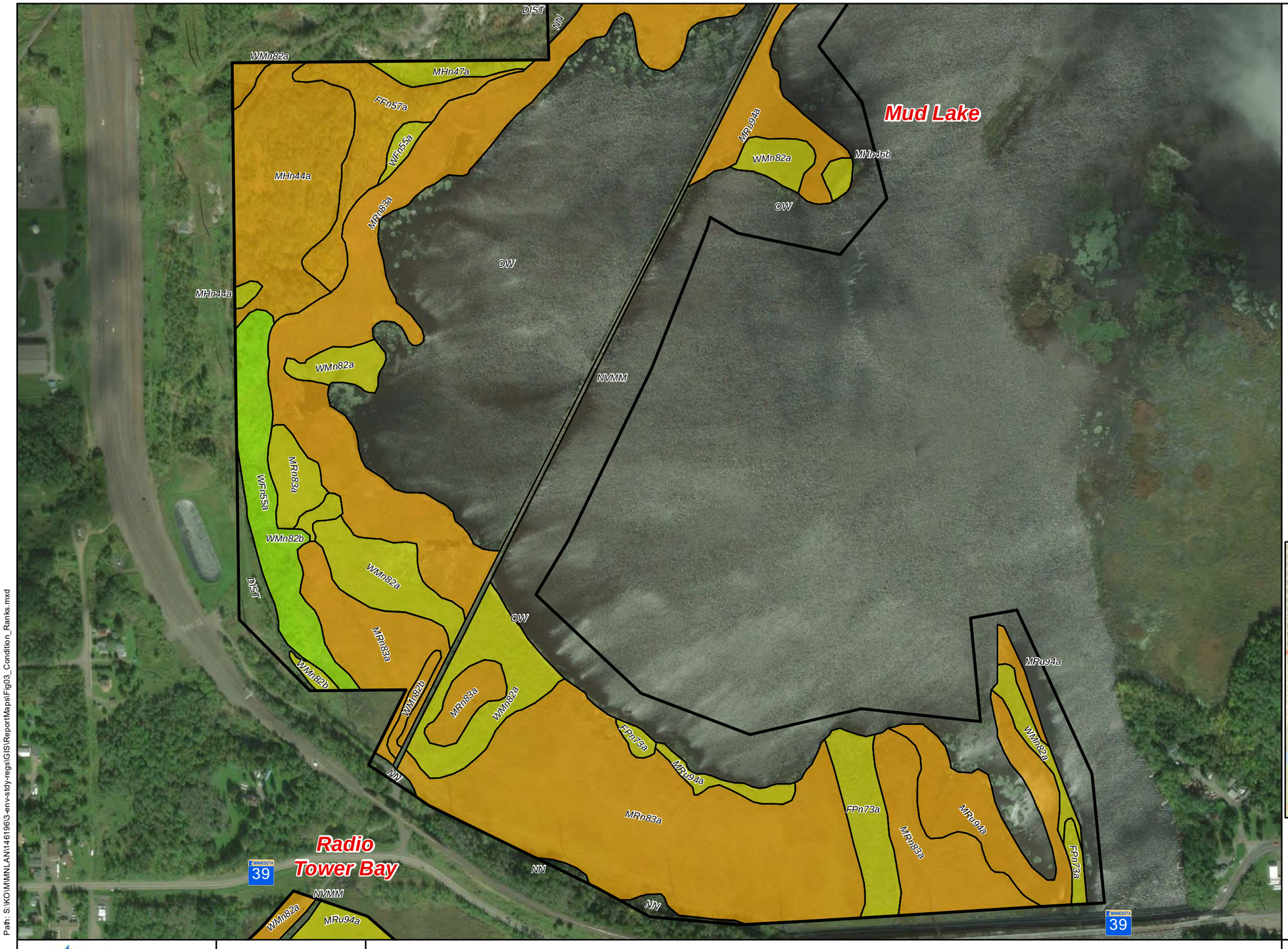
ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

NPC Condition Rankings Map

Figure 3-5

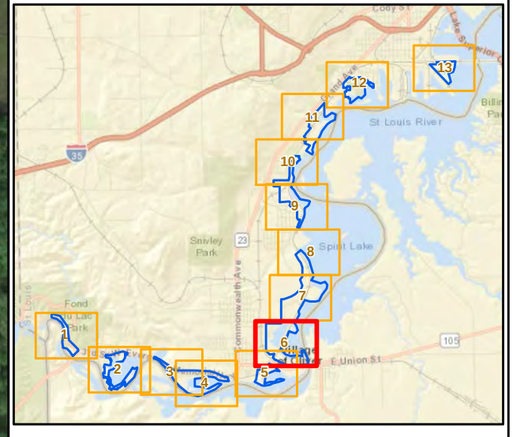


Legend

- St. Louis River project areas

NPC Condition Rank

- A/B
- B
- C
- NA (Non-NPC)



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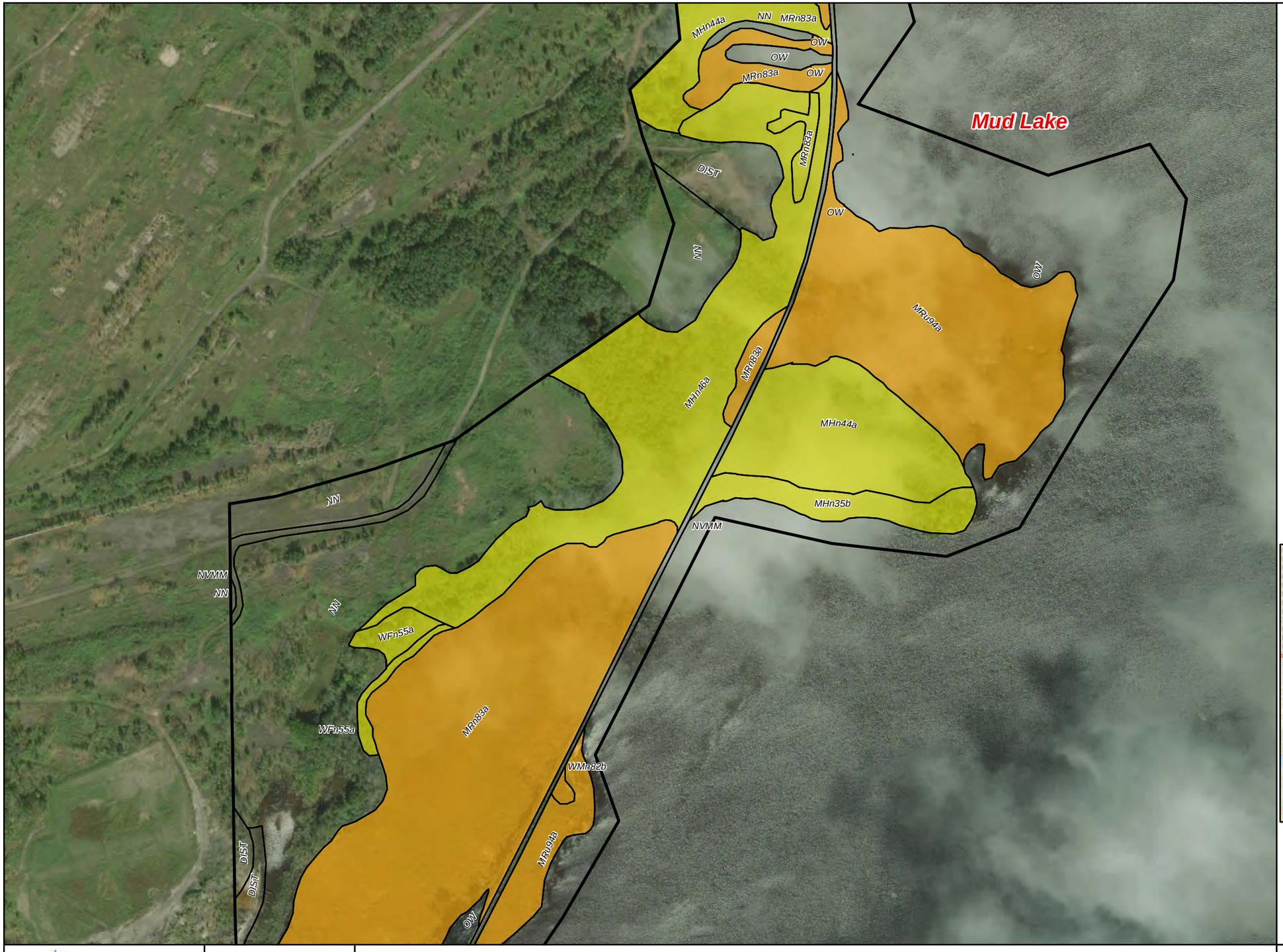
ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

NPC Condition Rankings Map

Figure 3-6

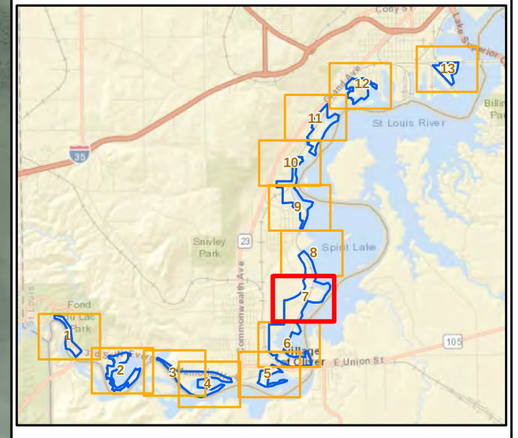


Legend

St. Louis River project areas

NPC Condition Rank

- B
- C
- NA (Non-NPC)



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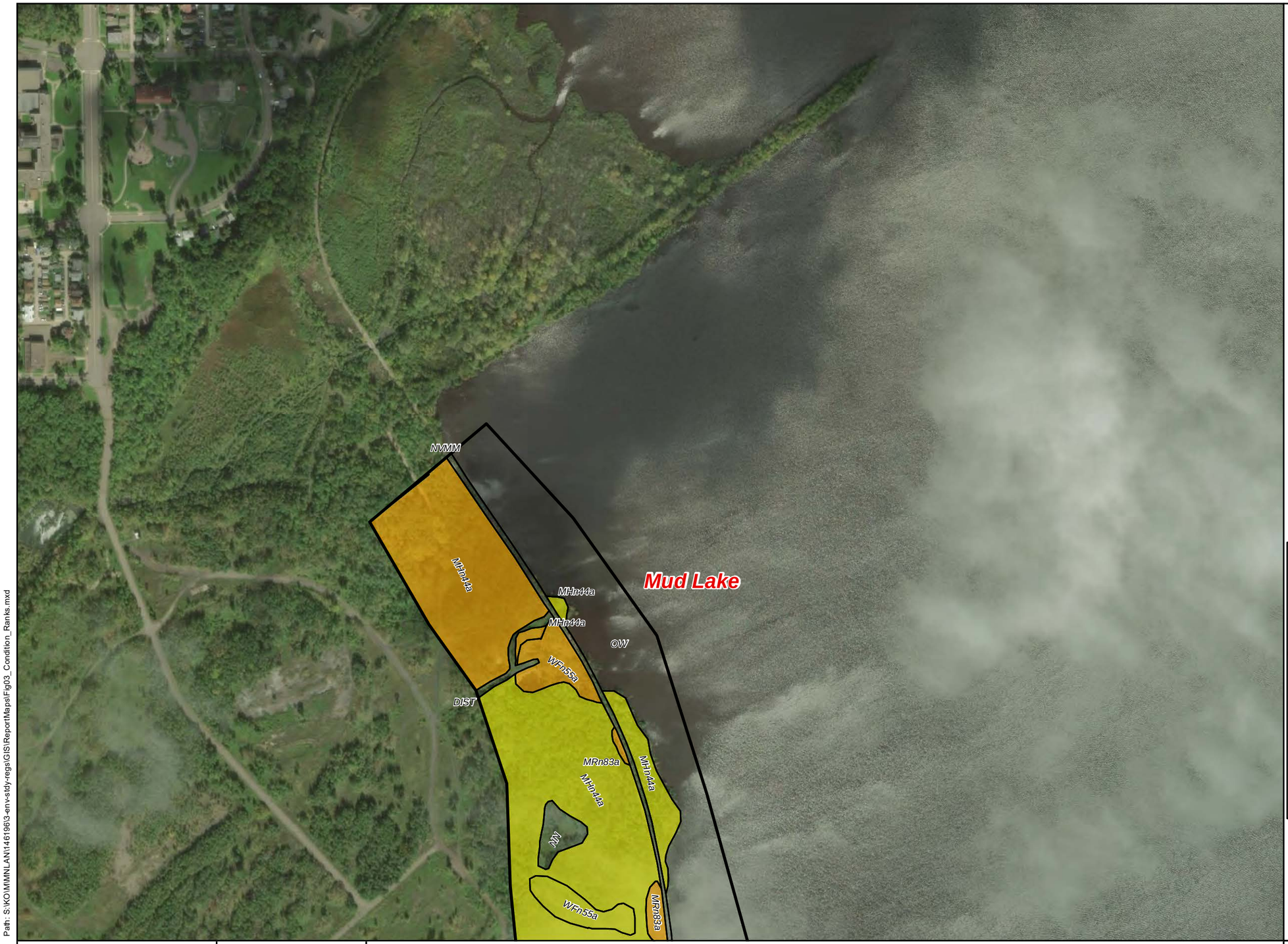
ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

NPC Condition Rankings Map

Figure 3-7



Legend

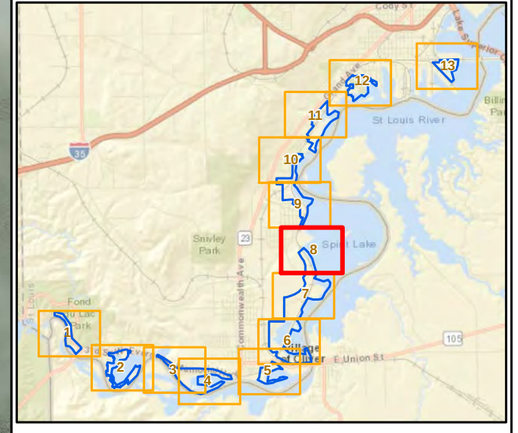
St. Louis River project areas

NPC Condition Rank

B

C

NA (Non-NPC)



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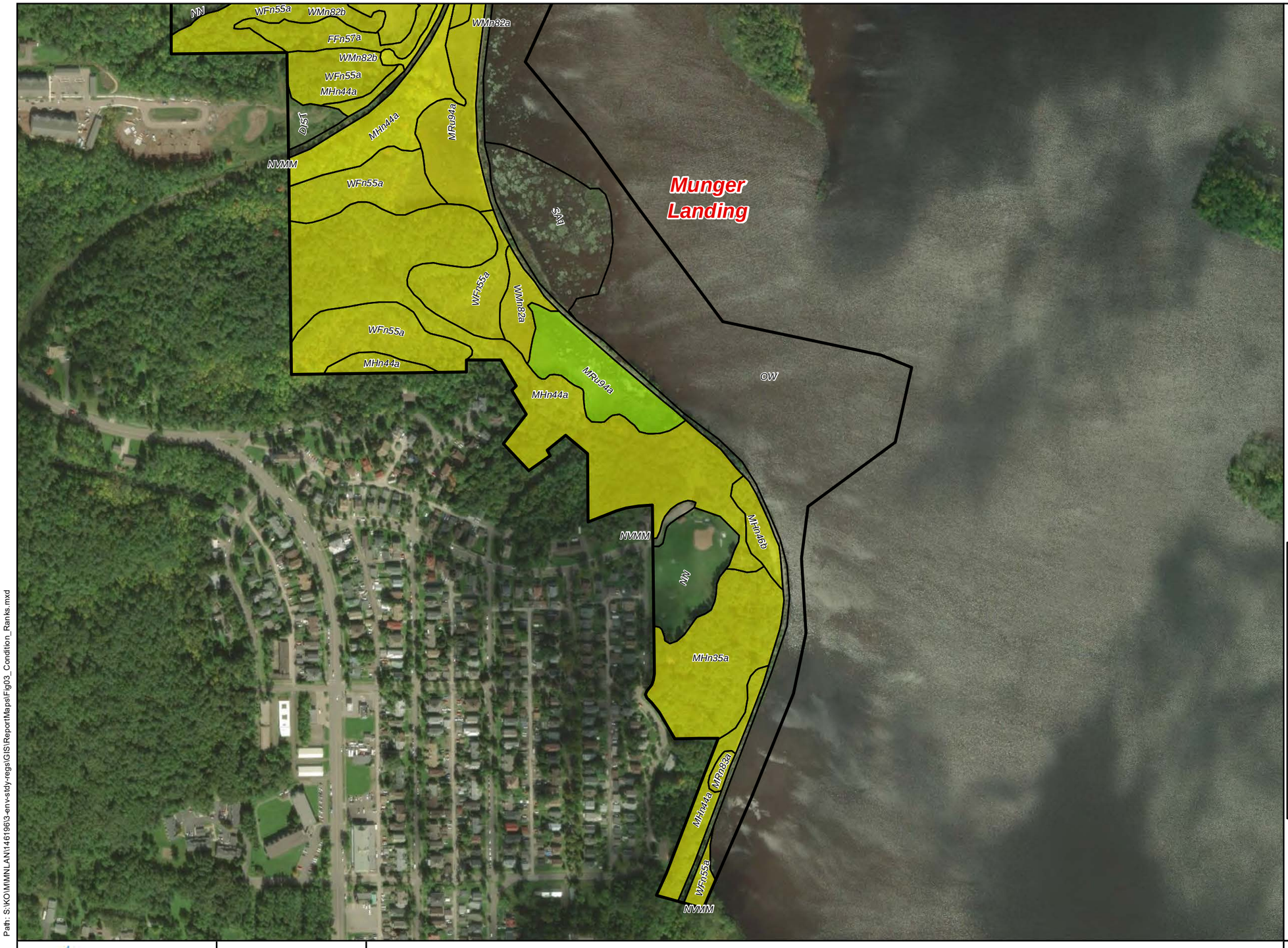
ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

NPC Condition Rankings Map

Figure 3-8

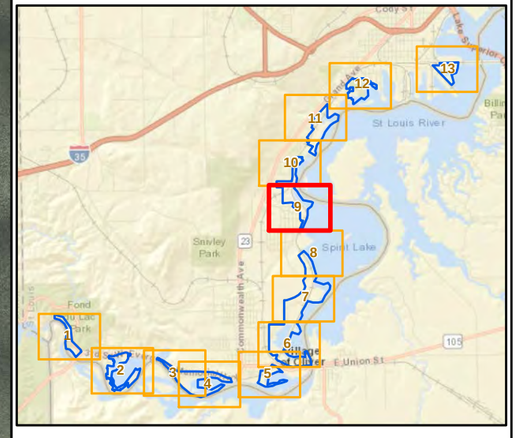


Legend

St. Louis River project areas

NPC Condition Rank

- A/B
- B
- B/C
- NA (Non-NPC)



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ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

NPC Condition Rankings Map

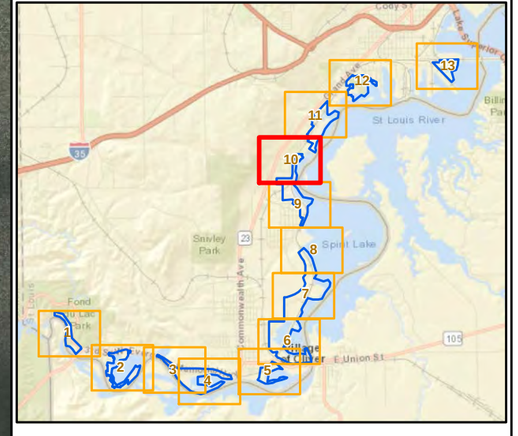
Figure 3-9

Legend

St. Louis River project areas

NPC Condition Rank

- B
- B/C
- C
- NA (Non-NPC)



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ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

NPC Condition Rankings Map

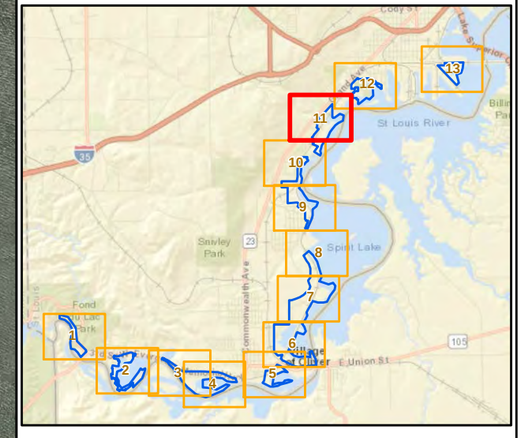
Figure 3-10

Legend

St. Louis River project areas

NPC Condition Rank

- B
- C
- NA (Non-NPC)



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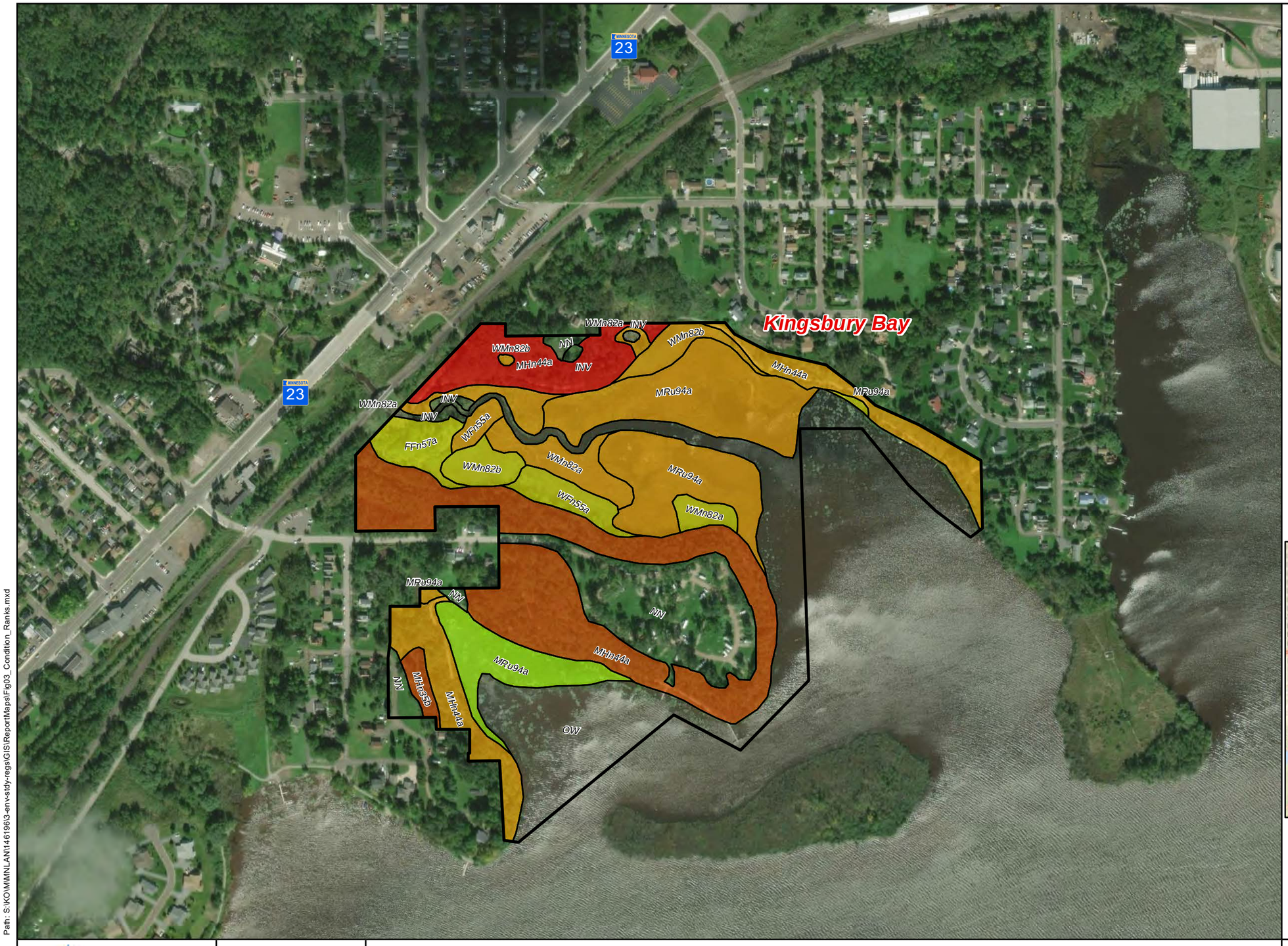
ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

NPC Condition Rankings Map

Figure 3-11

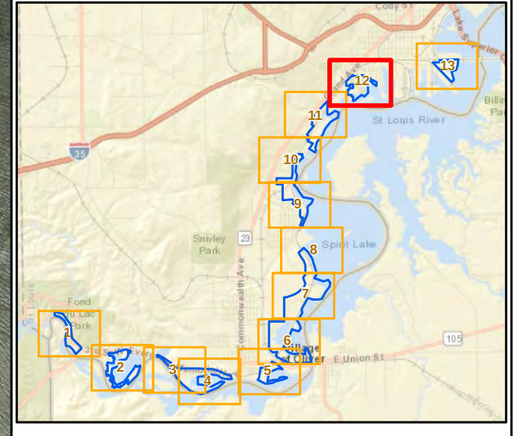


Legend

St. Louis River project areas

NPC Condition Rank

- A/B
- B
- C
- C/D
- D
- NA (Non-NPC)



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ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

NPC Condition Rankings Map

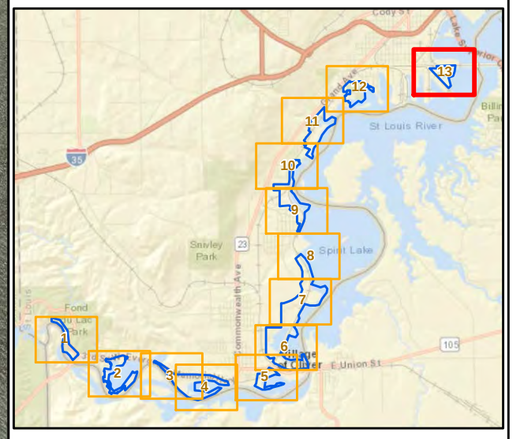
Figure 3-12

Legend

- St. Louis River project areas

NPC Condition Rank

- A
- B
- B/C
- C
- NA (Non-NPC)



0 500 1,000 Feet

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ST. LOUIS RIVER NATURAL AREA PROJECT

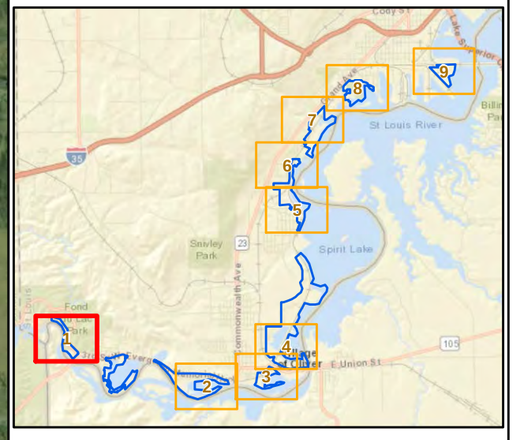
St. Louis County, Minnesota

NPC Condition Rankings Map

Figure 3-13

Legend

- St. Louis River project areas
- NPC Boundaries
- Invasive Species - Localized Observations



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ST. LOUIS RIVER NATURAL AREA PROJECT

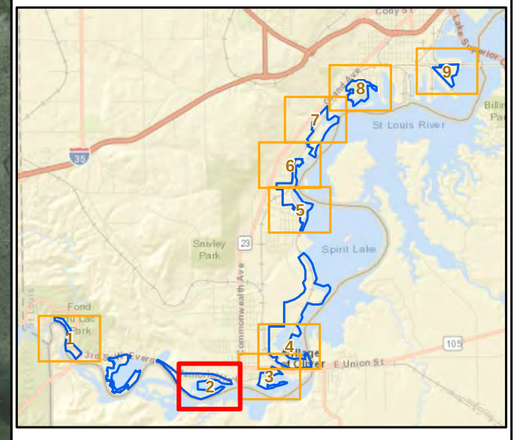
St. Louis County, Minnesota

Invasive Species Observations

Figure 4-1

Legend

- St. Louis River project areas
- NPC Boundaries
- Invasive Species - Localized Observations
- Invasive Species - Community



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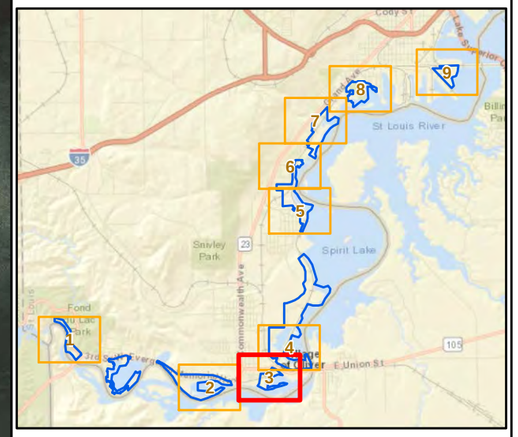
ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

Invasive Species Observations

Figure 4-2



Legend

- St. Louis River project areas
- NPC Boundaries
- Invasive Species - Localized Observations
- Invasive Species - Community

0 500 1,000 Feet

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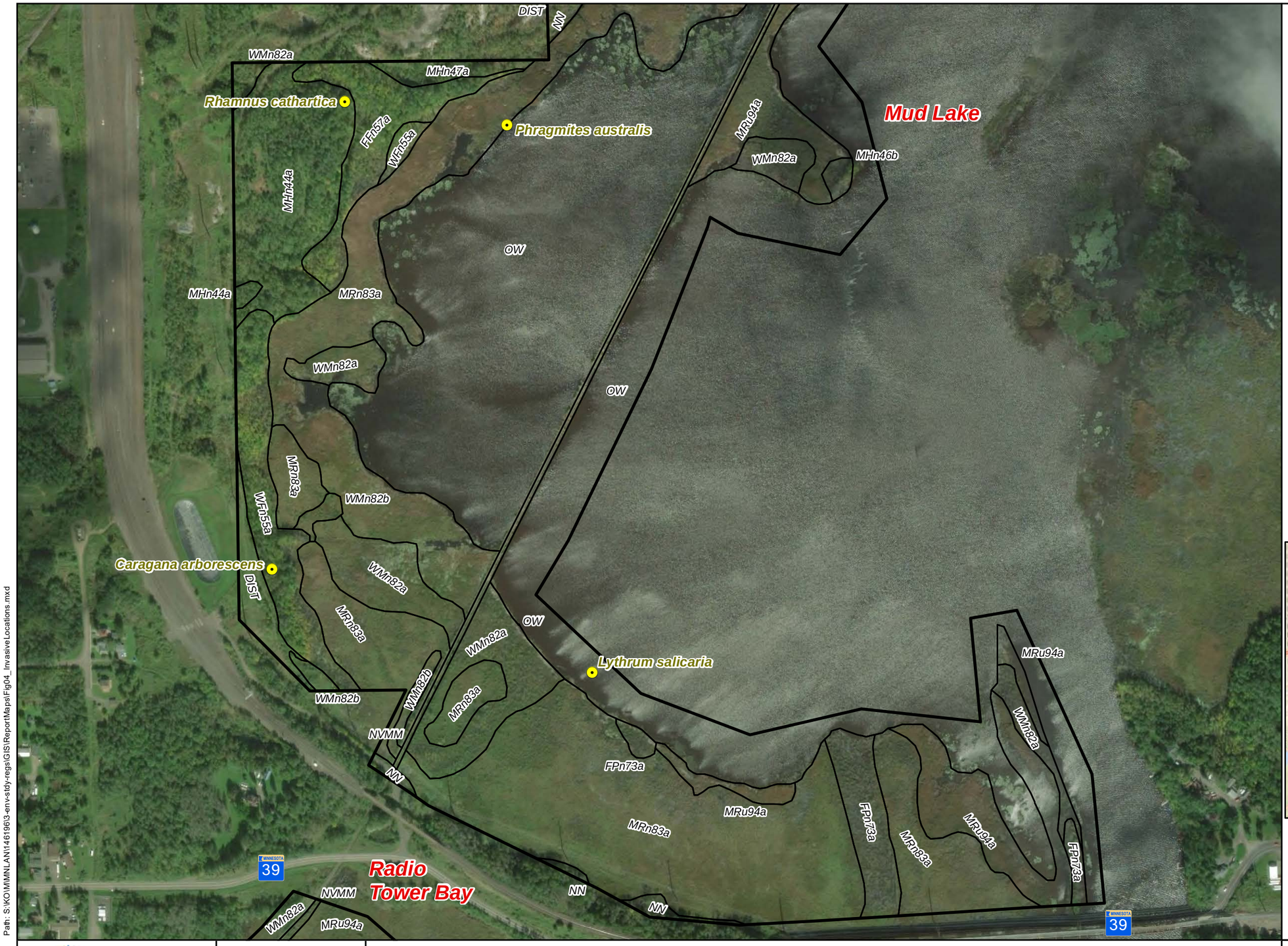
Background: FSA 2017 (CIR)

ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

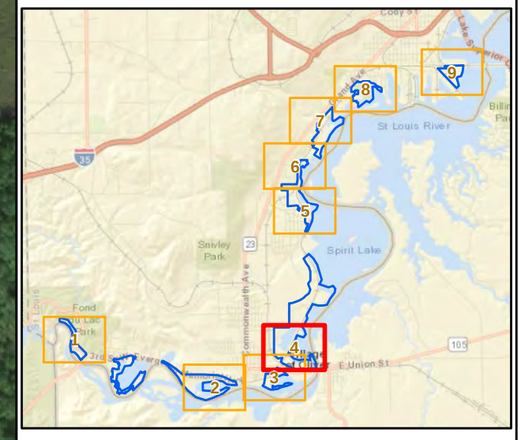
Invasive Species Observations

Figure 4-3



Legend

- St. Louis River project areas
- NPC Boundaries
- Invasive Species - Localized Observations



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Map by: B. Tolcser
Projection: NAD83 UTM15N
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Background: FSA 2017 (CIR)

ST. LOUIS RIVER NATURAL AREA PROJECT

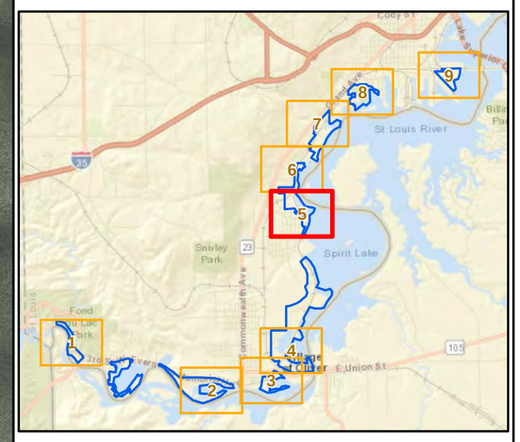
St. Louis County, Minnesota

Invasive Species Observations

Figure 4-4

Legend

- St. Louis River project areas
- NPC Boundaries
- Invasive Species - Localized Observations



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ST. LOUIS RIVER NATURAL AREA PROJECT

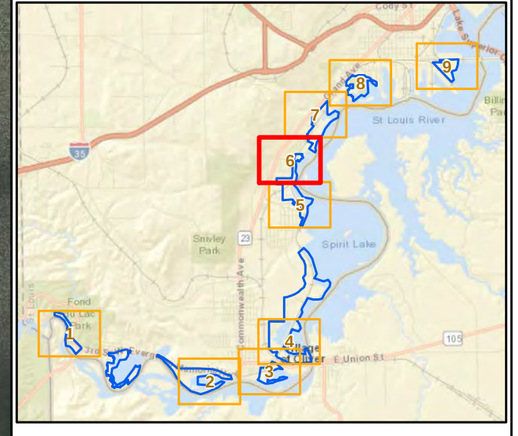
St. Louis County, Minnesota

Invasive Species Observations

Figure 4-5

Legend

- St. Louis River project areas
- NPC Boundaries
- Invasive Species - Localized Observations
- Invasive Species - Community



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ST. LOUIS RIVER NATURAL AREA PROJECT

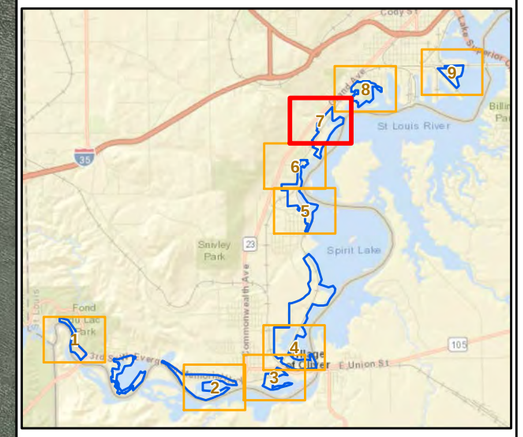
St. Louis County, Minnesota

Invasive Species Observations

Figure 4-6

Legend

- St. Louis River project areas
- NPC Boundaries
- Invasive Species - Community



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ST. LOUIS RIVER NATURAL AREA PROJECT

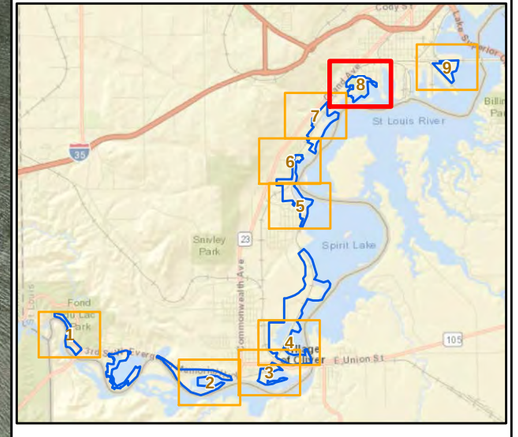
St. Louis County, Minnesota

Invasive Species Observations

Figure 4-7

Legend

- St. Louis River project areas
- NPC Boundaries
- Invasive Species - Community



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ST. LOUIS RIVER NATURAL AREA PROJECT

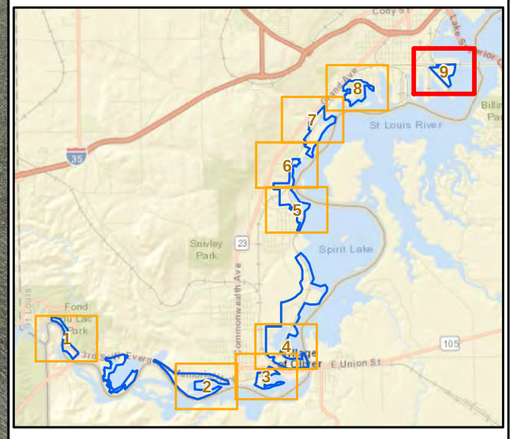
St. Louis County, Minnesota

Invasive Species Observations

Figure 4-8

Legend

- St. Louis River project areas
- NPC Boundaries
- Invasive Species - Community



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ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

Invasive Species Observations

Figure 4-9

Appendix A

Methods

Methods

NPC Mapping

Field staff used methods for mapping Native Plant Communities (NPCs) according to Minnesota's Native Plant Community Classification (Vol 2.), and to document condition rank of each NPC. Documentation of condition rank included disturbances as well as presence and abundance of invasive species.

GIS Remote Sensing

Initial mapping used GIS remote sensing techniques to generate draft NPC boundaries within the areas of interest. The approach consisted of an initial supervised classification using high resolution aerial imagery in both color and near infrared, including band ratios such as the normalized differential vegetation index (NDVI). While elevation itself has not been shown to predict plant communities, other topographic derivatives such as slope, aspect, and wetness indices were used to differentiate and discriminate land cover and plant communities. The results of the classification informed a manual "heads up" digitizing effort to map NPCs, non-native plant communities, and non-vegetated lands. The results were used to compare consistency of vegetative cover within singular NPC polygons as previously mapped by the Minnesota Biological Survey (MBS) in an effort to identify any inclusions of different, smaller NPCs. The minimum mapping unit for the draft NPC boundaries was 1.0 acre. The results of the GIS remote sensing exercise were loaded onto GPS units for field verification. Following field verification, changes in polygon boundaries or in NPC or land cover types were incorporated into the final GIS and report maps.

Field Verification of Mapped Boundaries

Natural resources scientists visited the nine (9) project areas in the field to verify mapping and document any important changes. Inclusions of different NPCs 1.0 acre or larger within a previously mapped unit were documented, as these may have been too small to be included in MBS mapping done at a larger scale. Relevé plots and smaller vegetation data collection plots were placed in the field based on best professional judgement to document typical NPCs in the project areas. Other significant features were documented as observed; these included localized concentrations of invasive plant species and areas of existing restoration and management efforts.

Plot-based Vegetation Data Collection

As described above, scientists collected data in relevé and smaller plots to support the classification of NPCs in the project areas. Scientists used objective placement of the plots, based on the GIS mapping and best professional judgement during field review. The field team used visual (vs. mechanical) estimation of cover within a plot, using a cover class scale. Plot size follows a typical DNR survey design with 20 x 20 meter plots in upland forests and woodlands and wetland forests; and 10 x 10 meter plots in shrub swamps and open wetlands. Plot locations were documented with a sub-meter accuracy GPS unit in UTM coordinates NAD83, Zone 15N. For relevé plots, the field team collected data according to the DNR relevé method handbook (MNDNR 2013a).

In some areas, scientists used streamlined plot-based field methods, modified from methods for documenting representative vegetation (wetland and upland plots) in implementing wetland delineation procedures (USACE 1987). Field scientists selected a representative observation point within a plant community using best professional judgment, based on visual characteristics of the entire community. Streamlined sample points consisted of plots in nested concentric circles, variable in size by vegetation stratum: a 10-meter radius plot for trees, 3-meter radius plot for shrubs, and 1-meter plot for herbaceous species. Similar to relevé data, cover for each species was estimated on a cover class scale and plot locations were documented with a sub-meter accuracy GPS unit in UTM coordinates NAD83, Zone 15N. Vegetation plot locations (both relevé and streamlined plots) are shown on **Figure A-1**.

Reporting

For each previously unmapped NPC, SEH scientists assigned an NPC code according to *Field Guide to the Native Plant Communities of Minnesota: the Laurentian Mixed Forest Province* (MNDNR 2003), and a condition rank (A-D) according to DNR-established ranks for NPCs (MNDNR 2009). For non-NPC plant communities, the report identifies potential restoration target communities based on the existing ecological land type, physical characteristics, and nearby NPCs.

Plant species were recorded using nomenclature according to MNTaxa, the DNR's official checklist of names for vascular plant species in Minnesota (MNDNR 2013b). The field review did not spatially map all invasive species with occurrences less than 0.10 acre in size, unless notable for other reasons, but presence and abundance of invasive species are discussed in report text and inform the condition rank of each NPC. Similarly, important features such as major disturbances (e.g., eroded slopes) have been noted, even if not specifically identified as a target mapping feature.

SGCN Survey

Field staff used focused meanders to survey for target vascular plant species. **Table A-1** below lists target species. The Minnesota Land Trust provided a list of target species based on known occurrences in the area, and SEH understood that additional rare species had potential to be present based on suitable habitat and available Natural Heritage Information System (NHIS) data.

Table A-1: Target SGCN Plants

Common Name	Taxonomic Name	Taxonomic Class	State Status
Discoid beggarticks	*Bidens discoidea*	Vascular plant	Special Concern
Narrow reedgrass	*Calamagrostis lacustris*	Vascular plant	Special Concern
Necklace spike sedge	*Carex ormostachya*	Vascular plant	Special Concern
Pale sedge	*Carex pallescens*	Vascular plant	Endangered
Beach heather	*Hudsonia tomentosa*	Vascular plant	Threatened
Small shinleaf	*Pyrola minor*	Vascular plant	Special Concern
Soapberry	*Shepherdia canadensis*	Vascular plant	Special Concern
Pale false mannagrass	*Torreyochloa pallida*	Vascular plant	Special Concern
Eastern hemlock	*Tsuga canadensis*	Vascular plant	Endangered

Survey and reporting was conducted under the direction of Principal Investigator Allyz Kramer and Field Supervisor Natalie White. Allyz Kramer is qualified by the DNR for survey of general flora and *Botrychium* spp. in the state. Natalie White is also a qualified botanist, and is pre-qualified by the DNR for survey of general flora.

Field survey took place in July-August 2018, when most target species had morphological features necessary for definitive identification (e.g., mature perigynia on *Carex* species, flowers, and/or mature fruits). SEH field scientists used a well-developed search image approach and conducted focused meanders in habitats most suitable for the target species. Selection of target habitats was informed by GIS remote sensing of Native Plant Communities (NPCs) conducted in support of NPC mapping, and field survey particularly targeted NPCs suitable for the target plant species.

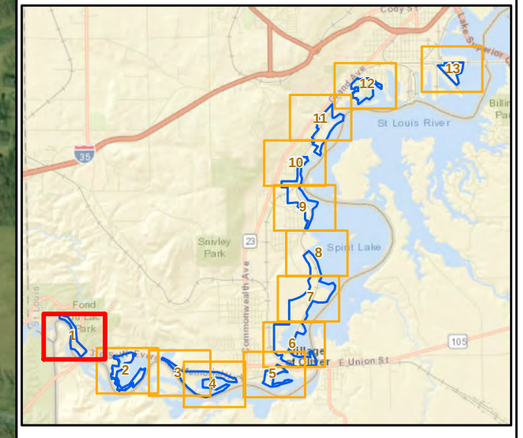
Centroid point locations of rare plant occurrences were documented with a sub-meter accuracy GPS unit in UTM coordinates NAD83, Zone 15N. For species/occurrences for which photographs are adequate for a confirmed identification, there was no plant material collection. For most target species, photographic

documentation of occurrences was sufficient for a verified identification. For pale sedge, collection was limited to the minimum necessary for a verified identification. Collection followed guidelines for vascular plant specimens found in the DNR Division of Ecological and Water Resources publication *Guidance on Documenting and Collecting Rare Plants* (2018), and was completed under Special Permit #23228 issued to Ms. Natalie White. The collected specimen was prepared by drying in a plant press with blotters, ventilators, and newspaper. The specimen was labeled using archival quality paper; the label includes species, location of collection, description of habitat, name of collector, and date of collection as described in the DNR *Guidance*.

SEH sent the prepared specimen to Welby Smith, DNR Botanist, for verification. Additional data related to the survey was provided electronically as a spreadsheet with an accompanying shapefile as described on the Natural Heritage Information System (NHIS) website. Final disposition of the specimen collected was to the University of Minnesota Bell Museum of Natural History.

Legend

- St. Louis River project areas
- NPC Boundaries
- Data Collection Points



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Projection: NAD83 UTM15N
Source: MNDNR, MN Land Trust, SEH
Background: FSA 2017 (CIR)

ST. LOUIS RIVER NATURAL AREA PROJECT

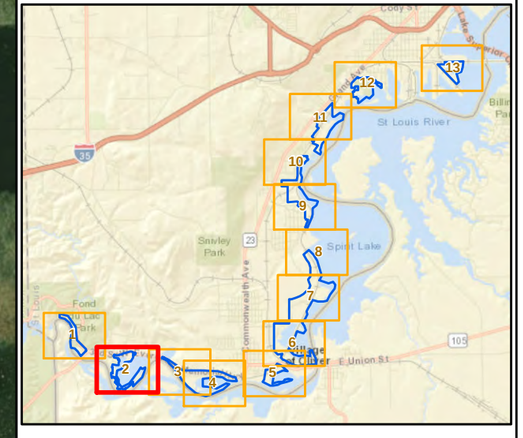
St. Louis County, Minnesota

Data Collection Locations

Figure A1-1

Legend

- St. Louis River project areas
- NPC Boundaries
- Data Collection Points



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ST. LOUIS RIVER NATURAL AREA PROJECT

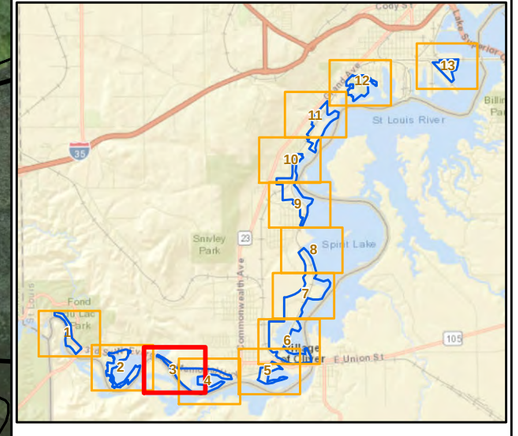
St. Louis County, Minnesota

Data Collection Locations

Figure A1-2

Legend

- St. Louis River project areas
- NPC Boundaries
- Data Collection Points



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ST. LOUIS RIVER NATURAL AREA PROJECT

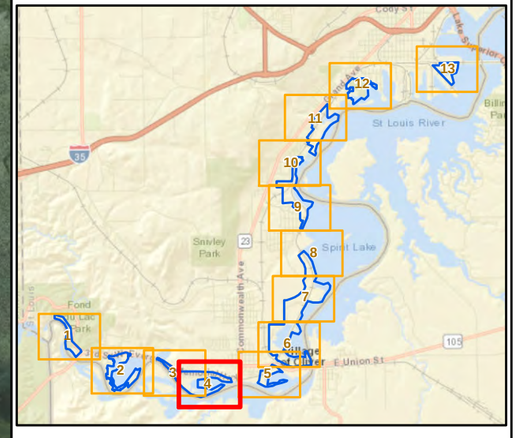
St. Louis County, Minnesota

Data Collection Locations

Figure A1-3

Legend

- St. Louis River project areas
- NPC Boundaries
- Data Collection Points



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ST. LOUIS RIVER NATURAL AREA PROJECT

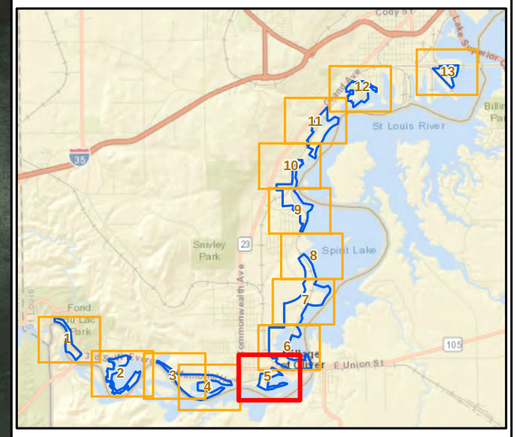
St. Louis County, Minnesota

Data Collection Locations

Figure A1-4

Legend

- St. Louis River project areas
- NPC Boundaries
- Data Collection Points



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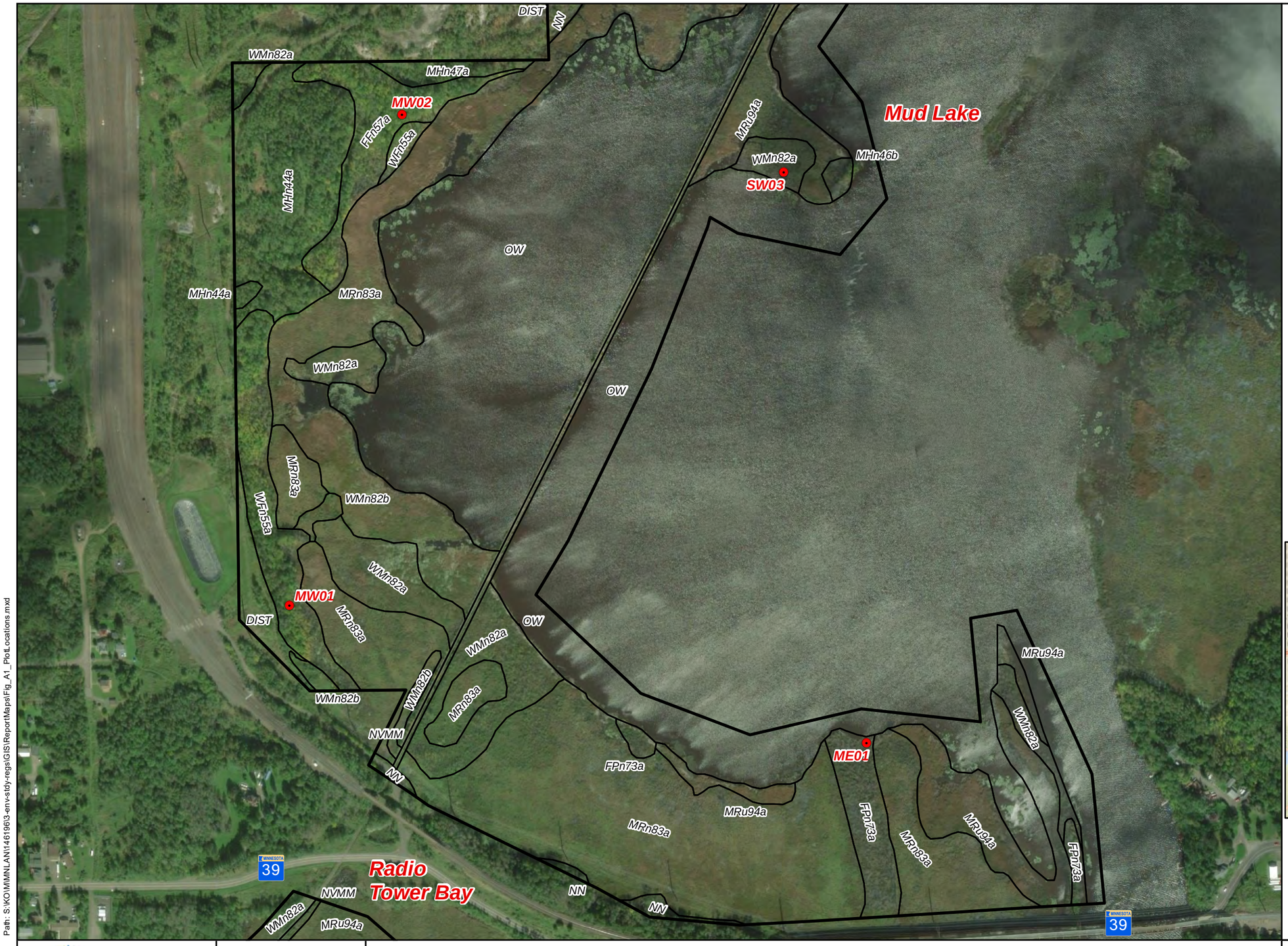
ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

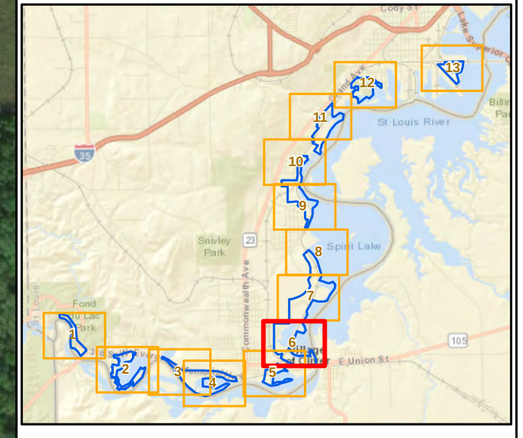
Data Collection Locations

Figure A1-5



Legend

- St. Louis River project areas
- NPC Boundaries
- Data Collection Points



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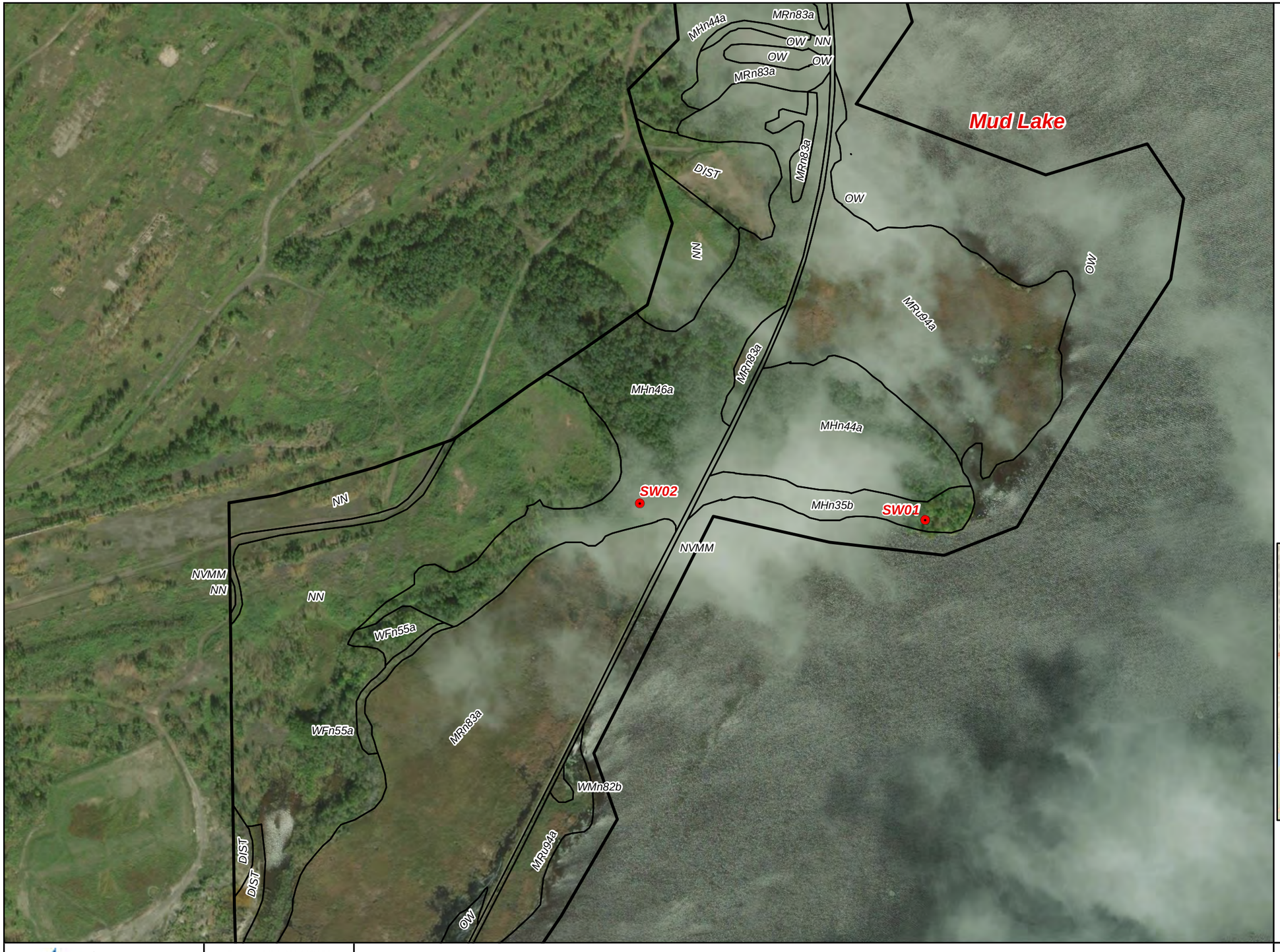
ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

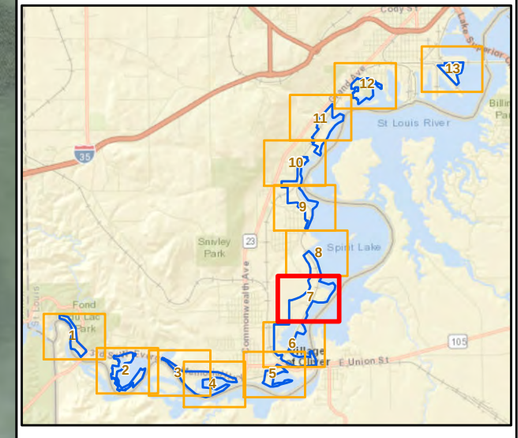
Data Collection Locations

Figure A1-6



Legend

- St. Louis River project areas
- NPC Boundaries
- Data Collection Points



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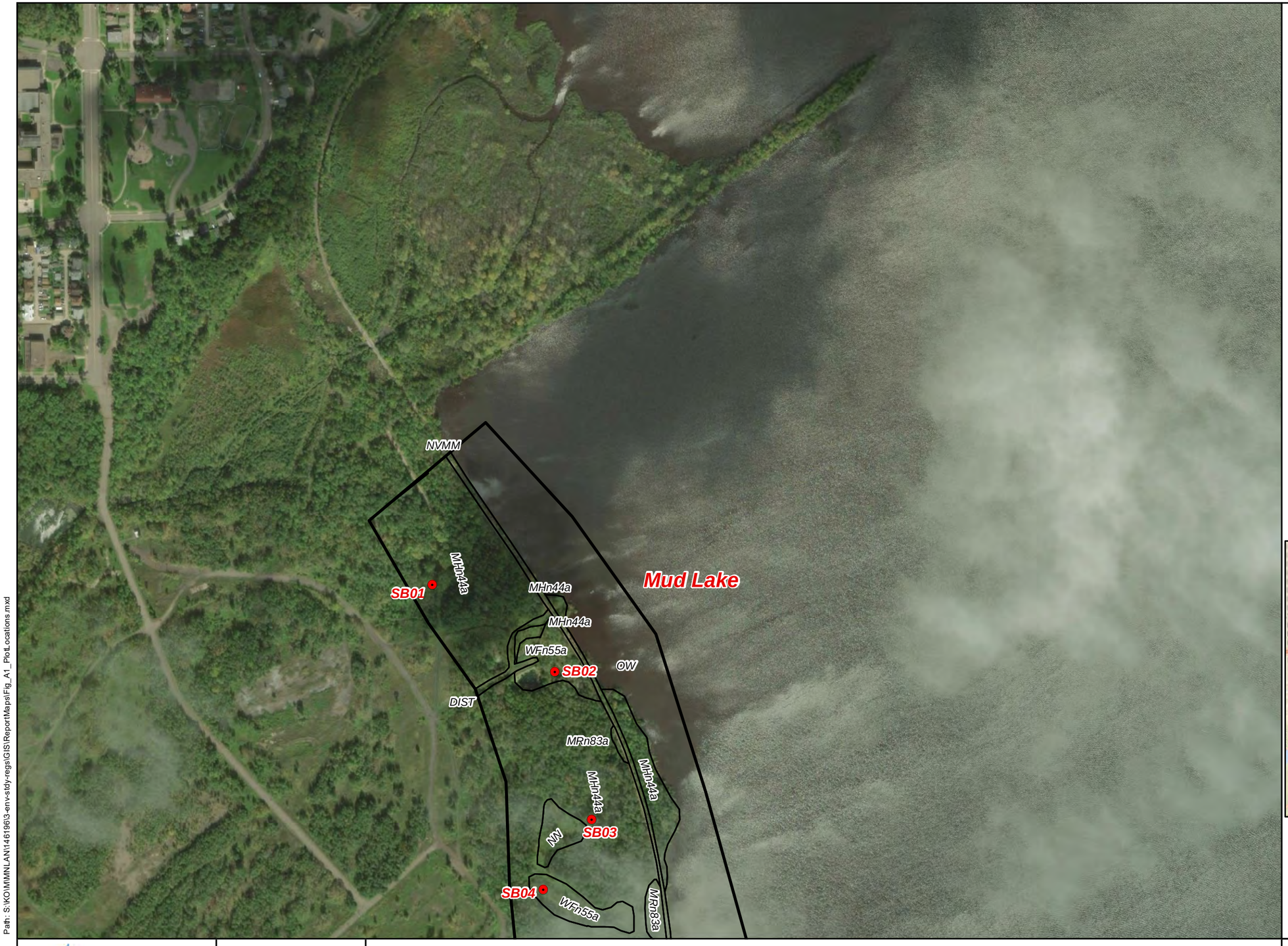
ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

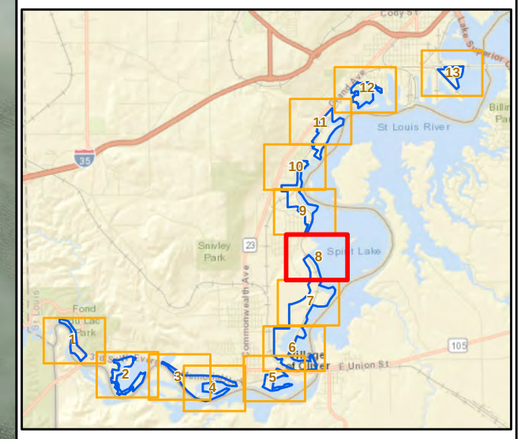
Data Collection Locations

Figure A1-7



Legend

- St. Louis River project areas
- NPC Boundaries
- Data Collection Points



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ST. LOUIS RIVER NATURAL AREA PROJECT

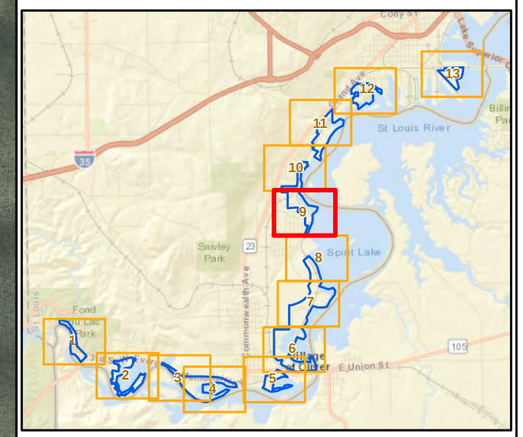
St. Louis County, Minnesota

Data Collection Locations

Figure A1-8

Legend

- St. Louis River project areas
- NPC Boundaries
- Data Collection Points



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Print Date: 10/30/2018

Map by: B. Tolcser
Projection: NAD83 UTM15N
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Background: FSA 2017 (CIR)

ST. LOUIS RIVER NATURAL AREA PROJECT

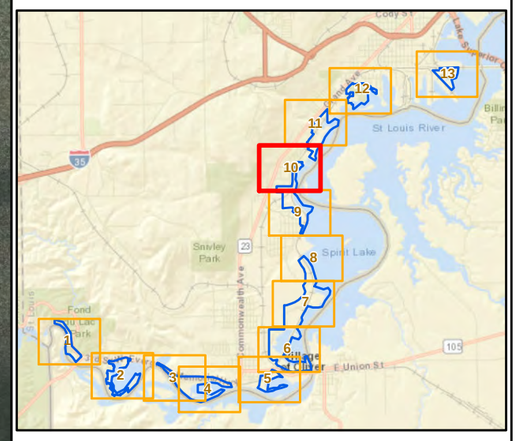
St. Louis County, Minnesota

Data Collection Locations

Figure A1-9

Legend

- St. Louis River project areas
- NPC Boundaries
- Data Collection Points



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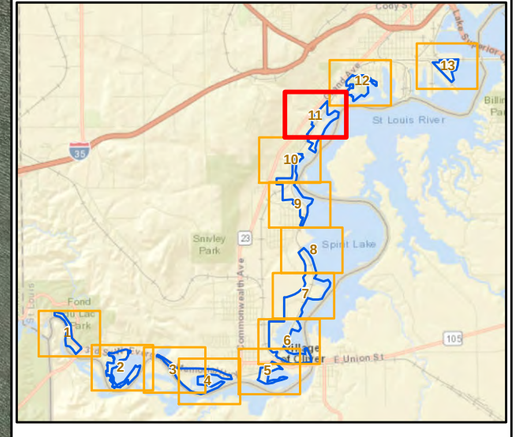
ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

Data Collection Locations

Figure A1-10



Legend

- St. Louis River project areas
- NPC Boundaries
- Data Collection Points

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ST. LOUIS RIVER NATURAL AREA PROJECT

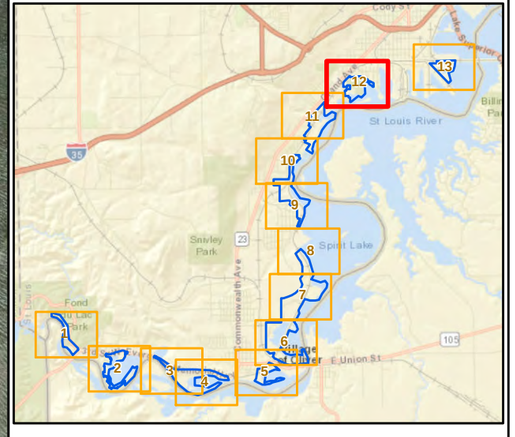
St. Louis County, Minnesota

Data Collection Locations

Figure A1-11

Legend

- St. Louis River project areas
- NPC Boundaries
- Data Collection Points



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Background: FSA 2017 (CIR)

ST. LOUIS RIVER NATURAL AREA PROJECT

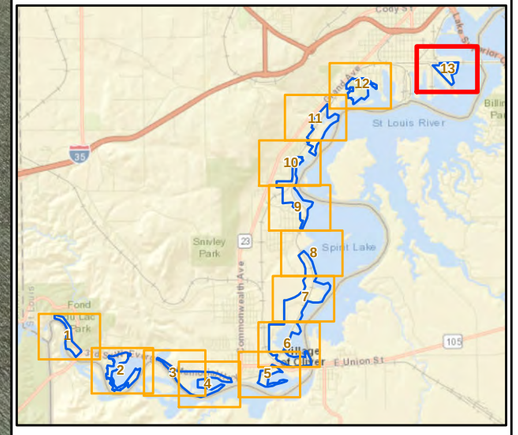
St. Louis County, Minnesota

Data Collection Locations

Figure A1-12

Legend

- St. Louis River project areas
- NPC Boundaries
- Data Collection Points



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ST. LOUIS RIVER NATURAL AREA PROJECT

St. Louis County, Minnesota

Data Collection Locations

Figure A1-13

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Appendix B

Photo Pages

Photo 1 Chambers Grove project area – Dry Sandstone Cliff (Northern), CTn11e.

Photo 2 Chambers Grove project area – eroded hillslope.

Photo 3 Rask Bay project area – example of stressed trees, presumably due to high water. Aquatic vegetation community in foreground.

Photo 4 Rask Bay project area – Black Ash-Silver Maple Terrace Forest, FFn57a.

Photo 5 North Bay project area – Estuary Marsh (Lake Superior), MRu94a. Softstem bulrush dominant, few cattails in this area.

Photo 6 North Bay project area – example of wet-mesic forest present in upland areas of North Bay. Basswood and quaking aspen dominate the canopy in this photo.

Photo 7 North Bay project area – Aquatic vegetation community, some grazed stems of wild rice visible.

Photo 8 North Bay project area – OHV/pedestrian trail, in dry area with no obvious erosion.

Photo 9 Radio Tower Bay project area – Cattail-Sedge Marsh, MRn83a, dominated by hybrid cattail.

Photo 10 Radio Tower Bay project area – Estuary Marsh (Lake Superior), MRu94a, a relatively species diverse marsh community.

Photo 11 Mud Lake project area – Red Oak-Sugar Maple-Basswood-(Bluebead Lily) Forest, MHn35b, on south facing slope above the St. Louis River.

Photo 12 Mud Lake project area – example of disturbed/non-native community in former industrial site.

Photo 13 Munger Landing project area – Black Ash-Aspen-Balsam Poplar Swamp (Northeastern), WFn55a.

Photo 14 Munger Landing project area - Estuary Marsh (Lake Superior), MRu94a, grading into aquatic vegetation community in the St. Louis River.

Photo 15 Tallus Island project area – Aspen-Birch-Red Maple Forest, MHn44a, on Tallus Island.

Photo 16 Tallus Island project area – flowering forbs in Willow-Dogwood Shrub Swamp, WMn82a.

Photo 17 Kingsbury Bay project area – Black Ash-Silver Maple Terrace Forest, FFn57a, with planted trees in cages.

Photo 18 Kingsbury Bay project area – Sedge Meadow, WMn82b, in foreground with nonnative cattail-dominated Estuary Marsh (Lake Superior), MRu94a, in background.

Photo 19 Grassy Point project area – Black Ash-Aspen-Balsam Poplar Swamp (Northeastern), WFn55a.

Photo 20 Grassy Point project area - nonnative cattail-dominated Estuary Marsh (Lake Superior), MRu94a.

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Appendix C: Avian Surveys for the St. Louis River Natural Area Project

NRRI Technical Summary Report - February 2019

Avian Surveys for the St. Louis River Natural Areas Project: Submitted to Minnesota Land Trust

Submitted by:
Alexis Liljenquist, Annie Bracey, and Alexis Grinde

Date: February 2019

Report Number: NRRI/TSR-2019/09

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

PROJECT OVERVIEW

In 2018, researchers from the Natural Resources Research Institute (NRRI) at the University of Minnesota Duluth conducted bird surveys along the St. Louis River Estuary (SLRE) in nine project areas nominated for inclusion in the Duluth Natural Areas Program (DNAP). The DNAP was created in 2002 to manage Duluth's environmentally significant areas to ensure the preservation of services and values, such as habitat diversity and water quality (Duluth Natural Areas Program Guidelines 2002). To assess the importance of the SLRE to birds, we conducted surveys throughout spring migration, the breeding season, and fall migration. In total, we documented 13,953 individuals of 169 species. We summarized bird use of the nine project areas based on abundance and diversity by guild classification within each season. All nine project areas in the nominated tract (i.e. SLRE) meet the conditions for 'Important Bird Congregation Area' based on nomination criteria outlined by DNAP. The western tip of Lake Superior is a well-known corridor for migrating birds, which funnel along the shore, using forests, wetlands, and shoreline habitat, to rest and refuel during both north and southbound migration. This study highlights the importance of the SLRE for breeding birds and as stopover habitat for a wide diversity of migratory birds, including 50 species of conservation concern.

INTRODUCTION

Wetlands are one of the most productive ecosystems in North America; they provide an abundance of habitat and food for diverse ecological communities. More than one third of threatened and endangered species in the United States live only in wetlands (U.S. Environmental Protection Agency 2018). Wetlands provide a wide variety of feeding and nesting resources for breeding birds and migrating birds, which use wetlands as stopover habitat. According to Bancroft (1989), by the 1970s more than 50% of wetlands in the United States had been drained. For this reason, it is important to protect and restore remaining wetlands because of their ecological importance and the diversity of species they sustain.

Bird communities provide many services. Diverse bird communities play a vital role in maintaining both the structure and function of ecosystems by providing numerous ecological services such as seed dispersal and pest control. Furthermore, because birds assimilate environmental variables over space and time, changes in bird communities provide meaningful signals of local ecosystem health and degradation (Gnass Giese et al. 2015). Birds are commonly used as bioindicators because they can be surveyed relatively easily and provide important information about the impacts of conservation and restoration efforts (Butler et al. 2012).

The St. Louis River Estuary (SLRE) is the largest and most biologically productive wetland and aquatic complex in western Lake Superior and supports a high level of bird diversity (The Nature Conservancy 2019). The SLRE provides unique experiences like bird watching and photography for the general public. The Duluth area is renowned for these activities, and they contribute significant ecotourism dollars to region. However, the ecological integrity and habitat quality of the SLRE has been impacted by several historical and ongoing threats including habitat loss, increased sedimentation, development, invasive species, and contaminant exposure from industrial activity. These threats have caused significant impairments to the beneficial use of resources in the SLRE, which led to its designation as a Great Lakes Area of Concern (AOC) under the 1987 Great Lakes Water Quality Agreement (St. Louis River AOC RAP Update 2013). Because progress has been made to decrease the impairments on the beneficial use of the SLRE's resources, current efforts toward delisting are in progress. In an effort to permanently

protect up to 1,300 acres of coastal wetlands and shoreline along nearly 10 miles of the SLRE, the City of Duluth and Minnesota Land Trust (MLT) are working to incorporate integrated public ownership, ecological restoration, and conservation management to nominate this area of land into the Duluth Natural Areas Program (DNAP). This nomination will facilitate a coordinated, holistic, and landscape-scale approach to long-term conservation and management of the SLRE's natural resources.

The avian research team at the Natural Resources Research Institute (NRRI), University of Minnesota Duluth has led four research projects focusing on bird populations in the SLRE since the late 1970s. Each project has had a variety of research objectives, but the overarching goal of each was to document the status of bird populations in the SLRE. This long-term data set provides a historical context for the ecological importance of birds in the SLRE for the past 40 years and also provides data with which to frame restoration outcomes and management guidelines.

The DNAP has developed standards to identify local areas as "Important Bird Congregation Areas." The criteria for this designation are modified from those used to identify Important Bird Areas (IBAs), which are designated globally as locations that provide essential habitat for avian species during some phase of their life cycle. These areas are protected for a variety of reasons including providing important habitat for vulnerable, threatened or endangered species, endemic species, species representative of a biome, or for significant concentrations of birds from a diversity of guilds (e.g. waterfowl, shorebirds, migratory landbirds; Duluth Natural Areas Program Guidelines 2002).The purpose of the IBA program at all scales, from state to global, is to identify sites that provide essential habitat for one or more species of breeding or migratory birds (BirdLife International 2019). The designation of an Important Bird Congregation Area as outlined by the DNAP is modified from the category 4 IBA criteria and is defined as: "sites that are important because they hold large concentrations of birds during one or more seasons; breeding, wintering, or migratory (Duluth Natural Areas Program Guidelines 2002)." We used these criteria as the basis of our survey design and data summaries. The overall objectives of this project were to:

1. Document bird use in nine project areas in the SLRE identified by MLT during three survey periods: spring migration, breeding season, and fall migration;
2. Summarize bird use at each project area for each survey period to determine if they meet the criteria of "Important Bird Congregation Area" as outlined by DNAP;
3. Highlight the use of project areas by species of conservation concern and provide management recommendations to the extent possible; and
4. Summarize the results of four previous bird studies that have been conducted in the area by researchers at NRRI to provide historical context of bird use in the SLRE.

METHODS

Experimental design and procedures

A total of 14 surveys were conducted at each of the 23 survey points located in the nine project areas from April–October 2018 (Fig. 1). Of these 14 surveys, 6 occurred during peak spring migration (April–May), 2 during the breeding season (June), and 6 during peak autumn migration (August–October). A total of 322 surveys were conducted between April and October 2018. Sites were revisited with a minimum of 15 days between surveys during the breeding season and 7 days between surveys during migration periods. All bird observations that occurred within the boundary of each project area were documented on aerial photo field sheets and digitized in ArcMap to allow exploration of the spatial

distribution and habitat use of species observed. The number of survey points within each project area were determined by the area of the sites and site accessibility (Fig. 1).

Figure 1. Red polygons represent project area boundaries located within the SLRE, and the black points represent the survey locations associated with that project area for 2018.

Data collection

Project area polygons were provided by the MLT project officer to ensure all sampling occurred within appropriate project area boundaries. The monitoring protocol followed methods used by Bracey et al. (2016), which have proven to be effective in documenting use by individuals and species within relatively small areas. Due to differences in the seasonal distribution of species, sampling protocols varied between breeding (June) and migration (spring/autumn) surveys as detailed below.

Surveys were designed to obtain a complete count of birds present in each project area during each visit. Surveys consisted of unlimited distance counts at designated locations within each project area; all detected individuals were recorded. The spatial location of each individual was marked on a field sheet that included an aerial photo for reference. Behavior was recorded as either singing, calling, drumming (woodpecker species and Ruffed Grouse), visual observation, or flyover.

Surveys were completed from a fixed-point location within each project area for 10 minutes. For breeding surveys, we used the same fixed-point locations as the migration surveys; however, we extended the point counts to 15 minutes to allow for the incorporation of playbacks. Playbacks were a series of recorded secretive marsh bird calls that were broadcast from an MP3 player with a speaker.

This method allowed us to target species that are difficult to detect with passive methods. The broadcast calls consisted of 30 seconds of vocalization followed by 30 seconds of silence for each of six focal species in the following order: Least Bittern, Sora, Virginia Rail, a mixture of American Coot and Common Gallinule, and Pied-billed Grebe. Broadcasts occurred during the middle 5 minutes of the 15-minute survey, with silence during the first and last 5 minutes of the survey.

Surveys were conducted from 0.5 hours before sunrise to 4.5 hours after sunrise during the breeding season and from sunrise until early afternoon during spring and autumn migration, and all were completed during suitable weather conditions (e.g. minimal wind or precipitation). Detailed sampling methodology can be found in Appendix A. We used a two-person survey protocol to insure safety in the field and for additional support in identification and documentation of observations.

Previous data

Data from four previous projects led by the avian research team at NRRI conducted on bird populations in the SLRE were compared with the data collected from the 2018 Minnesota Land Trust surveys. The most recent surveys were conducted from 2010–2011 and 2013–2015 (Bracey et al. 2016). The goal of Bracey et al. (2016) was to provide a contemporary assessment of bird use of the SLRE by comparing bird use in sites planned for restoration and reference sites with reduced degradation. Bracey et al. (2016) also compared their observations to data collected with slightly different methods in the 1970s. The St. Louis River historical bird survey data from the 1970s were obtained using original data sheets from three projects (Niemi et al. 1977, Davis et al. 1978, Niemi et al. 1979).

Although we followed the survey methods Bracey et al. (2016) used in 2010–2015, the frequency with which each project area was surveyed was not consistent with 2018 protocol. Counts from the 1970s used different methods, and the number of surveys conducted were also not consistent with protocol used for this project. Due to the varied effort and inconsistent sampling between projects, previous data will not be directly compared to 2018 data. However, the major objective of all sampling regimes is to count all detectable individuals within the sample area, so observations from all projects will be used to compare the presence or absence of species that are currently, have previously, or continue to use the SLRE. We will not compare the raw data numbers between projects. Species comparisons were limited to those project areas that overlapped two or more projects. Bracey et al. (2016) did not sample three MLT project areas: Chamber's Grove, Tallas Island, and Munger Landing. Mud Lake was the only 1970s survey area that overlapped with MLT project areas.

Guilds, nomination criteria, and species of conservation concern

Species were classified into 16 guilds based on taxonomy and physiological similarities as well as individual species groups of interest. These groups are as follows: gulls and terns, waterfowl, waterbird, wading bird, raptor, shorebird, blackbird, songbird, corvid, pigeon, woodpecker, dove, rail, hummingbird, grouse, and invasive. Grouping individuals based on taxonomy and physiological similarities is useful for illustrating habitat use similarities within these groups. Each species of bird that was observed from 1977–2018 is listed along with their guild classification in Appendix B.

DNAP outlined six guilds in their nomination and benchmark criteria for the designation of Important Bird Congregation Areas. We used 16 more-detailed guild categories that are consistent with previous surveys and provide additional insight into bird community assemblies in the SLRE as stated above. Table 1 shows the guild classification crosswalk along with a brief description of the guild

groupings. According to the DNAP Guidelines, a nominated tract that consists of a limited and defined geographical area qualifies as an Important Bird Congregation Area if one or more of the general thresholds for congregatory species are met during a limited and defined time period of the year on an annually recurring basis. The general thresholds are:

- Exceptional numbers and/or diversity of migratory landbirds;
- 5,000–10,000 raptors;
- 50–500 shorebirds;
- 100–500 wading birds;
- 500–5,000 waterbirds; and
- 1,000–10,000 waterfowl.

Table 1. The 16 guilds categorized into the six guilds highlighted by the DNAP, along with their description.

Guild	DNAP Guild	Description
Blackbird	Migratory Landbird	Landbirds is a catch-all term that refers largely to passerines or perching birds (e.g. warblers, sparrows, woodpeckers) for the purposes of our surveys.
Corvid		
Dove		
Hummingbird		
Songbird		
Woodpecker		
Raptor	Raptor	Raptors are also known as “birds of prey” and consist of species that primarily hunt and feed on vertebrates (e.g. hawks, falcons, eagles).
Shorebird	Shorebird	Shorebirds are birds that live in wet or coastal environments; most species are commonly found along shorelines while foraging for food in mud or sand (e.g. sandpipers, plovers, yellowlegs).
Wading Bird	Wading Bird	Wading birds refer to birds that have long, thin legs to wade through shallow water while foraging; other general characteristics include long necks and specialized bills (e.g. bitterns, herons, cranes).
Waterbird	Waterbird	Waterbirds refer to birds that live on or around water and have special adaptations such as webbed feet, bills and legs adapted to feed in water, and the ability to dive from the surface or the air to catch prey in water (e.g. pelicans, kingfishers, grebes).
Gulls & Terns		
Rail		
Waterfowl	Waterfowl	Waterfowl are a group of species that are highly adapted to living on the surface of the water (e.g. ducks, geese, swans).
Grouse	Not Included	These guilds did not fit into the DNAP guild specifications.
Invasive		
Pigeon		

Species of conservation concern were classified based on state, federal, and national species of concern lists. Species on these lists range from low to high concern. The lists used included Species in Greatest Conservation Need (Minnesota Department of Natural Resources 2016), U.S. Shorebirds of Conservation Concern (U.S. Shorebird Conservation Plan Partnership 2016), Waterbirds of Conservation Concern (Kushlan et al. 2002, North American Waterbird Conservation Plan 2006) Partners in Flight Species of Continental Concern (Rosenberg et al. 2016), USFWS Region 3 Birds of Conservation Concern (BCC) (U.S. Fish and Wildlife Service 2008 (Table 41)), USFWS National BCC (U.S. Fish and Wildlife Service 2008 (Table 48)). A complete list of these species of conservation concern and the lists they are included in can be found in Appendix C. All species from these lists that were observed from 1977 to 2018 were included.

RESULTS AND DISCUSSION

Estuary-wide

A. Current surveys (2018)

a. The 2018 surveys were conducted at nine project areas and included 23 point locations (322 total surveys) during peak spring and fall migration and during the breeding season in 2018. All 16 guilds were observed, with a total of 13,953 individuals and 169 bird species documented (Table 2).

b. A total of 12,152 individuals of 168 species used the SLRE as stopover habitat during spring and fall migration. Of these, 2,091 individuals of 52 species were species of conservation concern. All 52 species of conservation concern that were observed in 2018 were observed at least once during the spring or fall.

c. During the breeding season, 1,801 individuals of 67 species were observed using the SLRE, most likely as breeding habitat. Of these, there were 79 individuals of 10 species of conservation concern observed.

d. Notable observations of species of conservation concern include:
   - 178 American White Pelicans;
   - 5 Baird's Sandpipers;
   - 107 Common Mergansers;
   - 10 Forster's Terns;
   - 30 Greater Yellowlegs;
   - 52 Purple Finches;
   - 216 Rusty Blackbirds; and
   - 72 Veery.

B. Recent surveys (2010–2015)

a. The recent surveys overlapped with six MLT project areas: Grassy Point, Kingsbury Bay, North Bay, Radio Tower Bay, Rask Bay, and Mud Lake (172 total surveys). There were 15 of the 16 guilds with 13,761 individuals and 136 species observed (Table 3).

b. The number of years individual project areas were surveyed varied between two and five years, and the current surveys only have one year of data. Because of these discrepancies, raw data numbers from current and recent surveys should not be compared.

c. Notable important observations of species of conservation concern that were recorded from recent surveys include:
   - 55 American Black Ducks;
   - 3 Black-billed Cuckoos;
   - 121 Canvasbacks;
   - 73 Common Terns;
   - 136 Pied-billed Grebes;
   - 16 Red-necked Grebes; and
   - 16 Sedge Wrens.

C. Historical surveys (1977–1979)

a. Historical surveys overlapped with one MLT project area, Mud Lake. All 16 guilds were observed, with a total of 18,976 individuals of 137 species. Of these, 2,936 individuals and 50 species of species of conservation concern were observed.

b. The methods and amount of effort associated with historical surveys did not match with recent and current surveys, so these data were not used to compare between projects. Notable species of conservation concern that were recorded during this time period were:
   - 10 Black-bellied Plovers;
   - 105 Black Terns;
   - 38 Dunlin;
   - 115 Evening Grosbeaks;
   - 122 Great Blue Herons;
   - 123 Killdeer;
   - 1,117 Lesser Scaup;
   - 72 Purple Martins;
   - 18 Semipalmated Plovers;
   - 215 Semipalmated Sandpipers;
   - 61 Spotted Sandpipers; and
   - 62 Yellow-headed Blackbirds.

D. Combined (1970–2018)

a. Recent (2010–2018)

i. All 16 guilds were observed, with a total of 27,714 individuals of 176 species during recent and current surveys (2018 and 2010–2015).

ii. Notable species of conservation concern that were recorded during these survey years were:
   - 119 Bald Eagles;
   - 69 Horned Grebes;
   - 33 Rough-winged Swallows;
   - 52 Sora; and
   - 161 Trumpeter Swans.

b. All (1970–2018)
   i. All 16 guilds were observed in the SLRE, with a total of 46,690 individuals of 192 species in all nine survey years conducted from 1977–2018. There were a total of 6,313 individuals and 66 species of conservation concern observed.

Project Areas

A. Chamber's Grove

a. **Current Surveys:** A total of 904 individuals, 80 species, and 11 of the 16 guilds were detected in Chamber's Grove from April–October 2018.There were 15 species of conservation concern detected (Table 2).
   i. **Spring**: During spring migration, a total of 550 individuals and 61 species were observed. Guilds with the highest number of observations were 280 waterfowl, 139 songbirds, and 87 waterbirds.
   ii. **Summer**: During the breeding season, a total of 170 individuals and 35 different species were observed. Guilds with the highest number of observations were 97 songbirds, 38 waterfowl, and 13 gulls and terns.
   iii. **Fall**: During fall migration, a total of 184 individuals and 41 different species were observed. Guilds with the highest number of observations were 112 songbirds and 32 corvids.

b. **Recent Surveys:** Surveys were not conducted at this project area from 2010–2015.

c. **Discussion:** This location had a high number of species detected during the summer (breeding) surveys. This high number of species diversity can be contributed to the large number of songbird species observed. Chamber's Grove offers the best woodland habitat adjacent to the SLRE in our study area, which likely contributed to the high songbird diversity.

B. Grassy Point

a. **Current Surveys:** A total of 811 individuals, 61 species, and 12 of the 16 guilds were documented at Grassy Point from April–October 2018. There were 15 species of conservation concern detected in 2018 (Table 2).
   i. **Spring**: A total of 362 individuals and 45 species were observed during spring migration. Guilds with the highest number of observations were 128 waterfowl, 110 blackbirds, and 53 songbirds.
   ii. **Summer**: A total of 183 individuals and 14 species were observed during the summer breeding season. Guilds with the highest number of observations were 60 songbirds, 53 waterfowl, and 47 blackbirds.
   iii. **Fall**: A total of 266 individuals and 29 species were observed during fall migration. Guilds with the highest number of observations were 98 songbirds, 51 waterfowl, and 42 waterbirds.

b. **Recent Surveys:** A total of 1,795 individuals, 84 species, and 14 of the 16 guilds were observed. Grassy Point was surveyed for four years (2010–2011, 2013–2014). There were 22 species of concern detected (Table 3).

c. **Discussion:** This project area had a low number of observed species, and this was consistent for the spring, summer, and fall sampling periods. Additionally, the number of species of

conservation concern between recent surveys declined from 22 to 15. One of the major factors impacting Grassy Point is noise pollution from nearby industrial activity. This certainly had an effect on observers' ability to detect birds, but the effect on birds themselves is unknown.

C. Kingsbury Bay

a. **Current Surveys:** A total of 1,328 individuals, 84 species, and 15 of the 16 guilds were observed in Kingsbury Bay from April–October 2018. There were 17 species of conservation concern detected (Table 2).

i. **Spring:** A total of 491 individuals and 61 species were observed during spring migration. Guilds with the highest number of observations were 163 waterfowl, 152 blackbirds, and 114 songbirds.

ii. **Summer:** A total of 155 individuals and 20 species were observed during the summer breeding season. Guilds with the highest number of observations were 14 waterfowl, 68 blackbirds, and 68 songbirds.

iii. **Fall:** A total of 682 individuals and 57 species were observed during fall migration. Guilds with the highest number of observations were 80 waterfowl, 325 blackbirds, and 215 songbirds.

b. **Recent Surveys:** A total of 1,558 individuals, 76 species, and 15 of the 16 guilds were observed. Kingsbury Bay was surveyed for one year (2015). There were 15 species of conservation concern detected (Table3).

c. **Discussion:** This site had intermediate species richness when considering spring, summer, and fall sampling periods. However, this project area contained the highest number of guilds. This site has diverse habitats including upland forest, cattail marsh, and a shallow marsh area. The diversity of habitat makes this site important for breeding marsh species such as rails and serves as stopover habitat for many species of migrating songbirds. This area is popular with birders because of the accessibility and species diversity.

D. North Bay

a. **Current Surveys:** A total of 103 species, 1,573 individuals, and 14 out of the 16 guilds were observed in North Bay from April–October 2018. There were 22 species of conservation concern detected (Table 2).

i. **Spring**: A total of 798 individuals and 80 species were observed during spring migration. Guilds with the highest number of observations were 335 waterfowl, 80 blackbirds, and 242 songbirds.

ii. **Summer**: A total of 254 individuals and 33 species were observed during the summer breeding season. Guilds with the highest number of observations were 36 waterfowl, 59 blackbirds, and 142 songbirds.

iii. **Fall**: During fall migration, a total of 521 individuals and 63 species were observed. Guilds with the highest number of observations were 196 waterfowl, 24 corvids, and 225 songbirds.

b. **Recent Surveys:** A total of 2,073 individuals, 84 species, and 13 of the 16 guilds were observed. North Bay was surveyed for three years (2013–2015). There were 21 species of conservation concern detected (Table 3).

c. **Discussion:** This project area had a high number of total, spring, and summer species. North Bay also had a high number of guilds. Species of conservation concern detected during the recent surveys and 2018 surveys were similar. This area has several unique features, including wooded marsh and shallow wetlands. These habitats are used by a wide variety of species throughout the year, including many breeding marsh birds and migrating waterfowl. Ash trees are an important component of this site; the future impacts of emerald ash borer (EAB) should be a consideration for management.

E. Radio Tower Bay

a. **Current Surveys:** A total of 64 species, 802 individuals, and 12 of the 16 guilds were observed in Radio Tower Bay from April–October 2018. A total of 14 species of conservation concern were detected (Table 2).
   i. **Spring**: A total of 379 individuals and 45 species were observed during spring migration. Guilds with the highest number of observations were 104 waterfowl, 87 blackbirds, and 142 songbirds.
   ii. **Summer**: A total of 87 individuals and 22 species were observed during the summer breeding season. Guilds with the highest number of observations were 31 blackbirds and 49 songbirds.
   iii. **Fall**: During fall migration, a total of 336 individuals and 37 different species were observed. Guilds with the highest number of observations were 32 waterfowl, 133 blackbirds, and 139 songbirds.

b. **Recent Surveys:** A total of 487 individuals, 46 species, and 10 of the 16 guilds were observed. Radio Tower Bay was surveyed for two years (2013–2014). There were 14 species of conservation concern detected (Table 3).

c. **Discussion:** This project area had a low number of species detected. This could be due to the fact that there is only one survey location. This site is also close to the road, and birds are harder to detect due to traffic noise. Number of species of conservation concern were identical to the recent data. This site is dominated by cattails; restoration that focuses on opening additional channels to increase structure and diversity of the habitat will likely increase the value of this site for many breeding marsh birds.

F. Rask Bay

a. **Current Surveys:** A total of 96 species, 1,490 individuals, and 12 of the 16 guilds were observed in Rask Bay from April–October 2018. There was a total of 20 species of conservation concern detected (Table 2).
   i. **Spring**: A total of 805 individuals and 69 species were observed during spring migration. Guilds with the highest number of observations were 514 waterfowl, 104 waterbirds, and 88 songbirds.
   ii. **Summer**: A total of 233 individuals and 29 species were observed during the summer breeding season. Guilds with the highest number of observations were 118 waterfowl, 44 blackbirds, and 62 songbirds.

iii. **Fall**: During fall migration, a total of 452 individuals and 54 different species were observed. Guilds with the highest number of observations were 171 waterfowl, 62 blackbirds, and 168 songbirds.

b. **Recent Surveys:** A total of 3,074 individuals, 59 species, and 9 of the 16 guilds were observed. Rask Bay was surveyed for three years (2013–2015). There were 16 species of conservation concern detected (Table 3).

c. **Discussion:** Rask Bay had high numbers of species diversity. Rask Bay saw an increase in species of conservation concern, compared to the recent surveys. This project area also had one of the highest observations of waterbirds during spring migration due to the 71 American White Pelicans using Rask Bay as stopover habitat. This bay is relatively protected, with little human activity, which could account for the higher species diversity and large number of pelicans.

G. Munger Landing

a. **Current Surveys:** A total 1,272 individuals, 94 species detected, and 12 of the 16 guilds were observed in Munger Landing from April–October 2018. There were 20 species of conservation concern detected (Table 2).

i. **Spring:** A total of 704 individuals and 74 species were observed during spring migration. Guilds with the highest number of observations were 329 waterfowl, 105 blackbirds, and 146 songbirds.

ii. **Summer**: A total of 137 individuals and 25 species were observed during the summer breeding season. Guilds with the highest number of observations were 22 waterfowl, 42 blackbirds, and 60 songbirds.

iii. **Fall**: During fall migration, a total of 431 individuals and 58 different species were observed. Guilds with the highest number of observations were 107 waterfowl, 47 corvids, and 186 songbirds.

b. **Recent Surveys:** Surveys were not conducted at this project area from 2010–2015.

c. **Discussion:** This project area, similar to Rask Bay, had high levels of species richness. The habitat surveyed at this site includes a combination of open water, a small marsh, and upland forest that contribute to the high observed species richness at the site. A wide diversity of songbirds was observed in the upland forests throughout the survey periods, and many species of waterfowl used the open and marsh areas during migration.

H. Mud Lake

a. **Current Surveys:** A total of 4,498 individuals, 107 species, and 11 of the 16 guilds were observed in Mud Lake from April–October 2018. There were 32 species of conservation concern detected (Table 2).

i. **Spring:** A total of 2,538 individuals and 76 species were observed during spring migration. Guilds with the highest number of observations were 1,673 waterfowl, 286 blackbirds, and 240 songbirds.

ii. **Summer:** A total of 428 individuals and 35 species were observed during the summer breeding season. Guilds with the highest number of observations were 118 waterfowl, 117 blackbirds, and 145 songbirds.

iii. **Fall:** During fall migration, a total of 1,532 individuals and 80 different species were observed. Guilds with the highest number of observations were 300 waterfowl, 779 blackbirds, and 289 songbirds.

b. **Recent Surveys:** A total of 4,774 individuals, 95 species, and 14 of the 16 guilds were observed. Mud Lake was surveyed for three years (2013–2015). There were 22 species of conservation concern detected (Table 3).

c. **Discussion:** This project area had the highest number of species detected. This area also had the second highest number of spring species and the highest summer and fall species. Interestingly, this project area contained the fewest number of guilds. Similar to Radio Tower Bay, this site is dominated by cattails. Restoration that focuses on opening additional channels to increase structure and diversity of the habitat will be beneficial for multiple species. We suggest this site as a focal site for habitat restoration of Black Tern nesting habitat.

I. Tallas Island

a. **Current Surveys:** A total of 92 species, 1,275 individuals, and 11 of the 16 guilds were observed in Tallas Island from April–October 2018. There were 23 species of conservation concern detected (Table 2).

i. **Spring:** A total of 593 individuals and 66 species were observed during spring migration including. Guilds with the highest number of observations were 203 waterfowl, 73 blackbirds, and 168 songbirds.

ii. **Summer:** A total of 154 individuals and 22 species were observed during the summer breeding season. Guilds with the highest number of observations were 16 waterfowl, 38 blackbirds, and 97 songbirds.

iii. **Fall:** During fall migration, a total of 528 individuals and 57 different species were observed. Guilds with the highest number of observations were 93 waterfowl, 128 blackbirds, and 222 songbirds.

b. **Recent Surveys:** Surveys were not conducted at this project area from 2010–2015.

c. **Discussion:** Similar to Rask Bay and Munger Landing, this project area had high levels of species richness. This project area had a low number of overall guilds. The mudflats are an important and unique feature of this site; this unique habitat was used by several species of migrating shorebirds.

Table 2. Total number of species, individuals, guilds, and species of species of conservation concern detected in each project area from 2018.

Project Area	Species	Individuals	Guilds	Species of conservation concern
Chamber's Grove	80	904	11	15
Grassy Point	61	811	12	15
Kingsbury Bay	84	1,328	15	17
North Bay	103	1,573	14	22
Radio Tower Bay	64	802	12	14
Rask Bay	96	1,490	12	20
Munger Landing	94	1,272	12	20
Mud Lake	107	4,498	11	32
Tallas Island	92	1,275	11	23
Grand Total	**169**	**13,953**	**16**	**52**

Table 3. Total number of species, individuals, guilds, and species of species of conservation concern detected in each project area from 2010–2015.

Project Area	Species	Individuals	Guilds	Species of conservation concern
Grassy Point	84	1,795	14	22
Kingsbury Bay	76	1,558	15	15
North Bay	84	2,073	12	21
Radio Tower Bay	46	487	10	14
Rask Bay	59	3,074	9	16
Mud Lake	95	4,774	14	22
Total	**136**	**13,761**	**16**	**36**

Table 4. Total number of species, individuals, guilds, and species of species of conservation concern detected in Mud Lake from 1977–1979.

Project Area	Species	Individuals	Guilds	Species of conservation concern
Mud Lake	137	18,976	16	50

Nomination Criteria

In total, 7,373 migratory landbirds, 158 raptors, 126 shorebirds, 44 wading birds, 948 waterbirds, and 5,184 waterfowl were detected from April–October 2018. The project areas that had the most observations from all guilds in 2018 were Mud Lake, Kingsbury Bay, and Tallas Island (Appendix D). All congregatory bird species have met the DNAP criteria to qualify the SLRE as an Important Bird Congregation Area except for raptors and wading birds (Table 5). Note that the methods used for this project do not reliably survey raptors.

Table 5. Total number of individual bird observations within each DNAP specified guild category. A check mark signifies that the DNAP criteria were met, and an empty cell signifies they were not met. Observations are from 2018 data only.

DNAP Guild	Observations	Criteria Met?
Migratory Landbirds	7,373	✓
Raptors	158	
Shorebirds	126	✓
Wading Birds	44	
Waterbirds	995	✓
Waterfowl	5,184	✓

Migratory Landbirds. A total of 7,373 migratory landbirds of 99 species were observed in 2018. Migratory landbirds were observed in all project areas and had the highest species diversity compared to other guilds. The project areas where migratory landbirds were most abundant, with a range of 2,471–3,500 individuals, were Mud Lake, Kingsbury Bay, and Tallas Island (Appendix E).

Raptors. A total of 158 raptors of 12 species were observed in 2018. Although this guild was observed in all project areas, it was observed in low numbers. The methods used for this project are not appropriate for adequately surveying raptors. Raptor surveys conducted by Hawk Ridge Bird Observatory give a better estimate of raptor movement in the area. For example, the West Skyline Hawk Count conducted from Enger Tower and Thompson Hill from March–May 2018 documented 32,602 raptors of 17 species, all of which used airspace and landforms that provide updraft over the SLRE. From August–November 2018, Hawk Ridge documented 45,089 raptors of 16 species migrating along the north shore of Lake Superior; undoubtedly, most of these birds also occupied airspace over the SLRE. Unlike the methods presented here, surveys utilized by hawk watches are designed specifically to quantify migrating raptors.

Shorebirds. A total of 126 shorebirds of 12 species were observed in 2018. This guild was observed in all project areas. The project areas where shorebirds were most abundant, with a range of 21–25 individuals, were Mud Lake and Tallas Island (Appendix F).

Wading Birds. A total of 44 wading birds of five species were observed in 2018. This guild was observed in all project areas, with the exception of Chamber's Grove. Wading birds accounted for the smallest number of species observations. The project areas where wading birds were most abundant,

with a range of 10–21 individuals, were Mud Lake and North Bay. There were not enough observations of wading birds to create a useful heat map.

Waterbirds. A total of 948 waterbirds of 14 species were observed in 2018. This guild was observed in all project areas. The project areas where waterbirds were most abundant, with a range of 266–360 individuals, were Mud Lake, Rask Bay, Chamber's Grove, and Grassy Point (Appendix G). The reason for the hotspots in Rask Bay and Chamber's Grove were due to the large number of American White Pelicans observed during spring migration.

Waterfowl. A total of 5,184 waterfowl of 22 species were observed in 2018. Waterfowl were observed in all project areas. The project areas where waterfowl were most abundant, with a range of 1,031–1,820 individuals, were Mud Lake, Munger Landing, and Rask Bay (Appendix H).

Guild comparisons of current, recent, and historical surveys

Interpretation of the differences between historical, recent, and current surveys requires consideration of how populations of bird species have changed over the past 40 years, independently of the changes that have occurred in the SLRE. Many waterfowl are still common and widespread in the region and across North America and, in general, waterfowl populations have increased over the past five decades (NABCI 2016). In contrast to many areas of North America that have continued to see reductions in water quality and expansion of agriculture and human populations, the SLRE has improved in water quality with the addition of WLSSD in 1978 along with agriculture being a negligible issue in the region (Bracey et al. 2016). In addition, DDT was banned in the early 1970s, and overall contaminant levels have declined in exposure for aquatic-associated species. However, new and different contaminants are entering the SLRE every year. All of these factors have an effect on population levels for each bird species, and interpretation of these interacting effects is beyond the scope of this report. Another consideration is that the number of sites and years within each survey period vary. For example, the number of years a site could have been potentially surveyed from 2010–2015 is five (no surveys were conducted in 2012), while 2018 only had a single year of data. Similarly, 2018 data summarizes nine project areas, while the recent data (2010–2015) summarizes six project areas, and the historical data (1977–1979) summarizes one project area.

General. Waterfowl, songbirds, and blackbirds were the most abundant guilds in almost all project areas in each season. Guilds that were not well observed (20 or less total observations per guild) in any project area were doves, grouse, hummingbirds, and pigeons.

Blackbirds. This guild was observed in all project areas in 2018, with a total of 2,934 observations. Blackbirds were the least abundant in Chamber's Grove with only 19 total observations, while all other project areas had over 100 observations. Blackbirds were most abundant in Mud Lake with 1,182 observations, but this could be due to the higher amount of survey points. Kingsbury Bay had the second-largest number of blackbirds with 545 observations. This guild was observed most frequently during fall migration. Blackbirds appear to use the SLRE for stopover habitat as well as for roosting. For example, large numbers of Common Grackles and Rusty Blackbirds were noted in flocks early in the morning — typical post-roost behavior. Red-winged Blackbirds commonly breed in the estuary.

Blackbird observations increased from 1,522 observations in historical surveys to 2,934 observations in 2018. Common Grackles had an increase of 63 observations in the 1970s to 1,269 observations in 2018. The Rusty Blackbird also saw an increase in observations. Yellow-headed Blackbirds were observed in the 1970s but were not observed at all in recent or present surveys. Brown-headed Cowbird observations decreased to less than half of what they were in historical data.

Corvids. This guild was observed in all project areas in 2018, with a total of 461 observations. They were the least abundant in Rask Bay, Kingsbury Bay, and Grassy Point, and the most abundant in Tallas Island and Mud Lake. Corvids were observed the most during migration seasons, particularly fall. Corvid observations increased from 167 individuals in historical surveys to 461 individuals in 2018.There were only three species of corvid observed from 1977 to 2018: American Crow, Blue Jay, and Common Raven. Observations of all of these species increased from the first project in the 1970s to 2018.

Gulls & Terns. This guild was observed in all project areas in 2018, with a total of 352 observations. They were the least abundant in Radio Tower Bay, Kingsbury Bay, and Rask Bay, with less than 20 total observations, and the most abundant in Mud Lake and Grassy Point. Gulls and Terns were observed the most during spring migration and had the same amount of observations during breeding and fall migration seasons.

Gull and tern observations decreased from 971 individuals in the historical surveys to 352 individuals in 2018. Major decreased species observations from 1977–2018 contributing to this decline are from Black Terns, Common Terns, Bonaparte's Gulls, and Herring Gulls. Black Terns historically nested in the SLRE, but currently there is no suitable nesting habitat for this species. Common Terns have moved their breeding colony to Interstate Island, a small island in the Duluth-Superior harbor that does not overlap with any of the project areas. A large population of Ring-billed Gulls and some Herring Gulls have also moved to Interstate Island to nest. Bonaparte's Gulls breed much farther north in Canada and only migrate through the SLRE. The cause for the low number of migrating Bonaparte's Gull observations is unknown.

Invasive. The only invasive species observed in the SLRE during all surveys from 1977–2018 was the European Starling. Starlings were only observed in three project areas in 2018: North Bay, Kingsbury Bay, and Grassy Point. Kingsbury Bay had the most invasive individuals with 26 observations, Grassy Point had 18, and North Bay had 7 observations. Starlings were observed the most during breeding and fall migration seasons. There were only 6 starlings observed in recent surveys, and 32 starlings were observed in Mud Lake in historical surveys. European Starlings are locally abundant in the estuary near WLSSD but otherwise are not a major issue.

Rail. Rails were only observed in five project areas in 2018, with a total of 47 observations. Mud Lake had the most observations (33), and North Bay had the second-most observations (10) in 2018. Rails were observed the most during spring migration, but observations did not change much between the three seasons. There were only two species of rails observed: Virginia Rail and Sora. These species can be difficult to detect.

Raptor. Raptors were not well documented because of the observation methods used in historical, recent, and current surveys.

Shorebird. This guild was observed in all project areas in 2018, with a total of 126 observations. Tallas Island and Mud Lake had the most observations, and all other project areas had less than ten observations. Shorebirds were primarily observed during spring and fall migration. The majority of shorebird species observed breed much farther north in the tundra, which is why most were observed during migration. There were three shorebirds observed that breed in this region: Killdeer, Spotted Sandpiper, and Wilson's Snipe. Two Spotted Sandpipers were observed during the breeding season. The total number of observations of shorebird individuals and species from 1977 to 2018 have declined from 606 observations (17 species) in historical surveys, 33 (5 species) in recent surveys, and 126 (12 species) in present surveys. There was a total of 18 species of shorebirds documented, and only one species (Baird's Sandpiper) was not observed in historical surveys. Species of shorebirds that had an increase in observations from historical to present surveys were Greater Yellowlegs, Lesser Yellowlegs, and Baird's Sandpiper. Species of shorebirds that had a decrease in observation from historical to current surveys were Dunlin, Black-bellied Plover, Killdeer, Semipalmated Sandpiper, Spotted Sandpiper, and Wilson's Phalarope. It is not known why shorebird use of the SLRE has declined in the past 40 years. Shorebird stopover sites are ephemeral by nature: most species prefer very shallow water and/or mudflats. When these conditions are present, large numbers of shorebirds can appear practically overnight during spring and fall migration, and when they disappear, shorebirds will follow suit.

Songbird. Overall, this guild was abundant in all project areas in 2018, with a total of 3,766 observations. They were the least abundant in Grassy Point and Rask Bay and the most abundant in Mud Lake and North Bay. Songbirds were observed the most during fall migration, but they were observed in high abundances during all seasons. Of the 16 guilds, the songbird guild had the most observations during the breeding season. Songbirds were more abundant in project areas with adjacent upland forests such as North Bay and Chamber's Grove.

Songbird observations remained relatively constant from historical surveys, with 3,289 individuals, to present surveys, with 3,766 individuals. There was a decrease in observations in recent surveys, with 1,750 individuals. Some of the songbirds consistently observed the most often throughout all project years were the Common Yellowthroat, Song Sparrow, Swamp Sparrow, and Tree Swallow. Yellow Warblers, Yellow-rumped Warblers, Cedar Waxwings, and American Goldfinches all had an increase in observations from 1977 to 2018.

Wading Bird. This guild was observed in notable numbers in three project areas in 2018: Mud Lake, North Bay, and Munger Landing. They were either not observed or only had one or two observations in the other project areas. Wading birds were observed the most in fall and spring migration. Only one was observed during the breeding season.

Wading bird observations decreased from 190 individuals in historical surveys to 44 individuals in 2018. This guild only contains five species (Great Blue Heron, Green Heron, American Bittern, Least Bittern, and Sandhill Crane), all of which declined in observations from 1977 to 2018 except for the Sandhill Crane, which increased.

Waterbird. This guild was observed in all project areas in 2018, with a total of 596 observations. They were the least abundant in Radio Tower Bay and Kingsbury Bay and the most abundant in Rask Bay and Mud Lake. Waterbirds were observed the most during spring migration. Only 15 individuals were observed during the breeding season.

The total number of observations of individual waterbirds from 1977 to 2018 declined from 5,356 observations in historical surveys to 596 observations in current surveys. Species of waterbirds that had an increase in observations from historical to present surveys were American White Pelicans, Double-crested Cormorant, Pied-billed Grebe, and Horned Grebe. All of these species are consistent with increasing regional trend estimates except for the Pied-billed and Horned Grebe, which have decreasing regional trend estimates (Sauer et al. 2017). The American Coot had a decrease in observations from historical to present surveys. Regional trend estimates for this species are declining (Sauer et al. 2017).

Waterfowl. This guild was observed in all project areas in 2018, with a total of 5,184 observations. They were the least abundant in Radio Tower Bay and Grassy Point and the most abundant in Mud Lake and Rask Bay. Waterfowl were observed the most during spring and fall migration.

The total number of observations of waterfowl individuals from 1977 to 2018 have declined slightly, with 6,682 observations in historical surveys, 7,328 in recent surveys, and 5,184 in current surveys. Species of waterfowl that had an increase in observations from historical to present surveys were Hooded Merganser, Common Merganser, Greater Scaup, Northern Shoveler, Trumpeter Swan, Bufflehead, and Canada Goose. Species that had a decrease in observations from historical to current surveys were Common Goldeneye, Lesser Scaup, Mallard, Ring-necked Duck, Tundra Swan, and Wood Duck. There were 428 Redheads observed in the recent surveys, and less than 20 were observed in historical and present surveys.

Woodpecker. This guild was observed in all project areas in 2018, with a total of 193 observations. They were the least abundant in Grassy Point, Rask Bay, and Radio Tower Bay and the most abundant in Mud Lake and Munger Landing. Woodpeckers were observed the most during spring and fall migration. Woodpecker observations increased from 55 individuals in historical observations to 193 individuals in 2018. Even from 2010–2015, when six project areas were surveyed, only 41 individuals were observed. All species of woodpeckers increased in observations from 1977 to 2018 including Downy, Hairy, and Pileated Woodpeckers, Northern Flickers, and Yellow-bellied Sapsuckers.

Species of Conservation Concern

There are many reasons a species may be present or absent from a given location, and although changes or differences in species composition can be quantified, they are not always easy to interpret (Philippi et al. 1998). The presence of a species at a given site or set of sites implies these locations provide a similar set of conditions that allows a species to exist and potentially persist (Borcard et al. 2011, Bracey et al. 2016). However, if a species is absent, it is difficult or impossible to discern why it is not present. There are many reasons why a species may be absent or undetected, including: 1) poor site condition, 2) lack of detection, in which the species was present but not observed, and 3) factors outside the sampled area, such as an overall declining population and a retraction of the species range (Bracey et al. 2016).

Black Tern. Black Terns are small, graceful waterbirds that breed in freshwater wetlands, backwater marshes, and shallow lakes. Black Tern populations in Minnesota have experienced a large and statistically significant decline since 1966, declining an average of 5.8% per year for a loss of nearly 96% of the state population over 53 years. For this reason, Black Terns are designated as a Species in Greatest Conservation Need by the Minnesota Department of Natural Resources, and Audubon Minnesota has designated it a Target Conservation Species. The main cause of population declines in Minnesota appears to be habitat loss. However, habitat degradation from growth of dense invasive plants such as *Phragmities*, purple loosestrife, and hybrid cattail in the breeding areas may also be significantly impacting breeding success. In the SLRE, 105 Black Terns were observed from 1977–1979 in the breeding months in Mud Lake, but none have been observed breeding in subsequent survey years. Wetland restoration and introduction of suitable nesting platforms may provide the necessary habitat requirements for Black Tern to return to the area.

Yellow-headed Blackbird. Yellow-headed Blackbirds are wetland specialists that require deep water marshes that support diverse stands of emergent vegetation interspersed with equal areas of open water. Similar to the Black Terns, there was a total of 62 Yellow-headed Blackbirds observed from 1977 to 1978 at the Mud Lake project area only, with no observations in following survey years. The Yellow-headed Blackbird is listed as a Species of Greatest Conservation Need (Minnesota Department of Natural Resources 2016).

Purple Martin. This species has been assigned a Continental Concern Score of 10/20 by Partners in Flight and is officially listed as a Special Concern species in Minnesota and designated a Species in Greatest Conservation Need by the Minnesota Department of Natural Resources (MNBBA 2019). Purple Martins have shown a significant population decline in Minnesota from 1966–2015, with an annual decline of 6.64% (Sauer et al. 2017). There were 72 Purple Martins observed in the Mud Lake project area in the 1970s and then no observations in any project areas in subsequent survey years. Historically, the majority of this species was found in riparian areas with dead snags that had woodpecker holes suitable for nesting cavities (Brown and Tarof 2013). Nesting cavities are more commonly found in mature forests that have not been recently cut, but due to logging habits and more frequent blowdowns, these forests are becoming more difficult to find. Purple Martins are also in competition for nest cavities with European Starlings and House Sparrows and are commonly forced by these species to leave nest sites. Wetlands in the SLRE could provide foraging habitat for this aerial insectivore; we suggest using Purple Martin houses along the river to provide nesting habitat to re-establish this species.

Rusty Blackbird. Rusty Blackbirds are one of the most rapidly declining songbirds in North America, yet the reasons for this trend remain unclear. One untested hypothesis is that factors such as loss of habitat during stopover may be contributing to this decline. However, stopover ecology of Rusty Blackbirds is poorly understood on the continental scale and has not been studied in Minnesota. There were 216 Rusty Blackbird observations in 2018, primarily during the fall survey period, suggesting the SLRE provides important stopover habitat for this imperiled species. Detailed studies should be conducted in the SLRE to assess habitat use during stopover.

Common Tern. This species was assigned a Continental Concern Score of 11/20 by Partners in Flight and designated a species of Low Concern by the North American Waterbird Conservation Plan. In Minnesota, the Common Tern is officially classified as a Threatened Species and is designated a Species of Greatest Conservation Need by the Minnesota Department of Natural Resources (MNBBA 2019). Common Tern breed on Interstate Island in the Duluth-Superior harbor and use the SLRE for foraging throughout the breeding season. There were 18 Common Tern observed from 1977–1979, 48 were observed from 2014–2015, and only one was observed in 2018. This species faces a multitude of habitat-related threats including issues associated with legacy contaminants, rising lake levels, intense storms during the breeding season, and encroaching vegetation on the breeding colony. Continued active management on Interstate Island along with active habitat restoration of Interstate Island and the SLRE will help increase habitat availability and food resources for Common Tern during the breeding season.

CONCLUSION

The SLRE qualifies as an Important Bird Congregation Area based on the criteria outlined by the DNAP. The SLRE provides important habitat and resources to a multitude of species. The designation of the SLRE as an Important Bird Congregation Area will ensure protection of a unique wetland complex that has had its ecological integrity compromised by a host of threats including habitat loss, development, and industrial activities. Conservation and restoration of wetlands within the SLRE is necessary to mitigate further loss or degradation of habitat within the estuary. There are several wetland specialist species that were at one time common in the area, including Black Tern and Yellow-headed Blackbirds; continuing restoration efforts to facilitate reintroduction of these species is recommended. Overall, the conservation of the SLRE's natural resources will not only promote long-term conservation of biodiversity but also improve recreational opportunities for residents and tourists.

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Appendix A. Minnesota Land Trust Support Project: St. Louis River Estuary Natural Areas Acquisition and Conservation: Migration and Breeding Bird Distribution and Abundance Standard Operating Procedures.

Survey Protocol Summary

Spring/Fall Migration:

- Each point at each site needs to be surveyed for 10 minutes. If it is not possible to count all birds within 10 minutes, stay until all birds have been counted and write survey duration on accompanying field sheet.
- All birds seen or heard should be placed on the maps in the location in which it was observed. Observation type (e.g. singing, observed, flyover) should also be recorded.
- A field sheet will be provided with each map and should be filled out completely during each visit. This will contain site level information (e.g. date, survey duration, location, observer, temperature, etc.).

Breeding Season:

- Breeding season surveys will be extended to 15-minute surveys and include use of playbacks.

Sites to be sampled	Area (acres)	No. of survey points	Number of Surveys		
			Spring	*Breeding*	*Fall*
Chamber's Grove	48	3	6	2	6
Grassy Point	49	1	6	2	6
Kingsbury Bay	75	2	6	2	6
North Bay	164	4	6	2	6
Radio Tower Bay	40	1	6	2	6
Rask Bay	72	2	6	2	6
Munger Landing	122	3	6	2	6
Mud Lake	366	5	6	2	6
Tallas Island	104	2	6	2	6

Minnesota Land Trust: Bird Survey Standard Operating Procedures

1. Samples: Bird surveys will be conducted 14 times at each survey point.
   a. Surveys will be conducted:
      i. Six times during spring migration (April–May).
      ii. Two times during the breeding season (June).
      iii. Six times during fall migration (August–October).
   b. Sites will be revisited with a minimum of:
      i. Fifteen days between surveys during the breeding season.
      ii. Seven days between surveys during migration periods.

2. Survey weather:
   a. Because the majority of observations will be visual, wind strength is less likely to affect the quality of the survey. However, it is optimal to conduct surveys when the wind strength is less than six on the wind scale (i.e. wind < 15 mph or < 20 kmh) for identifying birds aurally.
   b. Surveys should only be conducted when there is little or no precipitation.
      i. If the precipitation is heavier than a drizzle, you should discontinue the survey. Moderate to heavy rain will decrease bird vocalization and other activity levels.

c. Wind and precipitation during breeding season surveys could affect your ability to detect territorial vocalizing males; therefore, it is more important that survey conditions are optimal.
d. The decision to discontinue a survey due to weather conditions is made at the discretion of the field crew leader.
e. If survey is conducted during questionable weather conditions, be sure to provide comments on the data sheet, such as why the survey was continued.

3. Sample periods:
   a. Be sure to get accurate sunrise and sunset times for your location.
   b. All breeding season surveys are morning surveys: sampling can begin from 0.5hrs before sunrise to 4.5hrs after sunrise.
   c. Surveys during migration can begin at sunrise and continue into the afternoon.
   d. Surveyors will survey each point within a given location until all birds present have been counted (approximately 10 minutes at each point within a site).

4. Sites and sample points:
   a. Each site can contain from 1–5 bird sample points.
   b. Sample points:
      i. Points will be located near the most convenient access point.
      ii. The location of each point will be marked using a GPS unit prior to the first sampling period (March 2018). These locations will not change during the project unless a safety or accessibility issue arises during the project.
      iii. Points will be saved in the GPS unit as a waypoint as well as in an Excel database.
      iv. Once point locations have been established, proceed to the provided point location to conduct surveys.
      v. All points must be marked on the field maps, and notes such as how to access each point must be recorded.

5. Record site data:
   a. Before beginning the survey, fill out the following:
      i. Date: Format of MM/DD/YY (e.g. 06/04/18).
      ii. Point ID: Each point has an associated ID (e.g. Site 1 pt.1).
      iii. Observer: Observer first initial and last name (J. Doe).
      iv. Time (start): Record in 24-hour format (e.g. 4:30am is 0430).
      v. Temperature: Record in ° Celsius.
      vi. Wind (code): Wind scale codes (see chart below).
      vii. Sky (code): Assign and record the appropriate sky cover code (see chart below).
      viii. Noise (code): Assign and record the appropriate background noise code (see chart below).
      ix. Weather: Circle the appropriate description: dry, damp/haze/fog, drizzle, or rain.
      x. Site description/notes: Any additional information that you think will be important to record about the survey location. Observations that could affect counts (e.g. ice covering the bay, boat activity in the area) or any other information that may be of interest (e.g. other animals using the area, e.g. beaver or otter).

WIND SCALE
0 no wind
1 leaves barely move
2 leaves, small twigs move
3 leaves, twigs in constant motion
4 small branches move
5 large branches, small trees sway
6 large branches in continuous motion
7 whole trees in motion

NOISE CODES
0 No appreciable effect (owl calling)
1 Slightly affecting sampling (distant traffic, dog barking, car passing)
2 Moderately affecting sampling (distant traffic, 2–5 cars passing)
3 Seriously affecting sampling (continuous traffic nearby, 6–10 cars passing)
4 Profoundly affecting sampling (continuous traffic passing, construction noise)

SKY CODES
0 clear (<10%)
1 scattered (10–50%)
2 broken (60–90%)
3 overcast (>90%)
4 fog
5 light mist
6 water dripping off vegetation
7 rain during last 5 minutes of census
8 rain during last 7 minutes of census
9 rain during entire census

6. Conduct the survey:
    a. Each survey point will be visited for approximately 10 minutes, or until all observations have been recorded.
        i. Using a spotting scope and binoculars, make a preliminary scan of the survey location to identify all individuals present. This is important, as some species may leave the area due to your presence.
    b. We will use unlimited-distance counts to complete a thorough inventory of bird use, counting all species identified by both visual and aural surveys.
    c. All bird observations will be identified to specific locations on aerial photo field sheets; accuracy will be approximately 25 m in open water and 10 m near or on shore.
        i. Record the four-letter alpha code for each species observed at the corresponding spatial location on the aerial map provided for each point.
        ii. Each individual bird observed must be recorded, whether you are able to identify it or not. Individuals which cannot be positively identified should be recorded as unidentified (e.g. unidentified sparrow (USPA), unidentified passerine (UPBD). (See http://www.birdpop.org/alphacodes.htm for alpha codes.) The inability to identify every individual bird is expected. However, not recording individuals because you are unable to identify them is not acceptable, as this can greatly affect survey results.
    d. Record the behavior of the individual. Notation is listed below and on each data sheet. For instance, if it was singing, circle the alpha code; if it was calling, underline it. “Observed” means

you saw the bird and it wasn't doing anything else such as calling, singing, or drumming. NOTE: record the "highest" level of observation. For instance, if a bird is first observed calling and later sings, record that observation as singing. This is most important to record during the breeding season when territorial males are singing.

i. The order of observations is as follows (highest to lowest):
   a. Two males simultaneous singing;
   b. Singing/woodpecker drumming;
   c. Calling;
   d. Observed (sight only).

Observation Type	Example
Singing	NAWA
Calling	NAWA
Observed	NAWA
Drumming	$PIWO_D$
Two males singing simultaneously	NAWA NAWA

e. For surveys conducted during the breeding season (June), record the breeding evidence code by using a subscript after the alpha code. To find evidence codes, along with descriptions, see http://www.mnbba.org/pdf/BreedingEvidenceCodes_Tips.pdf. Record the "highest" level of breeding evidence. For instance, if a bird is first observed doing a distraction display and later you see it occupying a nest, record it as occupied nest. This is a definite breeding observation, whereas a distraction display is a probable breeding observation.

i. Examples:

$TRES_{ON}$ Observed an occupied nest cavity of a Tree Swallow (adult seen entering/exiting)	$MOWA_{NB}$ Observed a Mourning Warbler building a nest	$RWBL_{FY}$ Observed a Red-winged Blackbird carrying food for young

f. If a bird moves to a different location during the survey, only record the location where the bird was originally detected within the site. If a bird is initially not using the site but moves in during the survey, it should be recorded.

g. If a bird is detected at multiple points, record it on the data sheet for each of the points where it is observed. The location where the bird was first detected is where the observation should be recorded. At all other locations where the bird was observed, record the bird and use a superscript asterisk. In the site description/notes section, write that this bird is a duplicate seen at point X. When entering the data, do not enter birds that have an asterisk denoting a duplicate observation.

i. Observations of large groups of birds (single species) should be recorded with the number of individuals in front of the species code. For example, a group of 80 Double-crested Cormorants observed on the water would be recorded as:

80 DCCO

h. Aerial foragers that are foraging should be recorded. A bird that is aerial foraging is using the airspace above the territory for foraging, catching insects in the air, using the airspace for fishing (terns), etc. It is different from a flyover in that a bird flying over the territory is traveling, not foraging.

7. Breeding Season Surveys:
   a. During the two breeding season surveys, surveys will last 15 minutes and will be broken down in the following way:
      i. 0–5 minutes: passive listening (0:00 to 5:00)
      ii. 5–10 minutes: broadcast (5:00 to 10:00)
      iii. 10–15 minutes: passive listening (10:00 to 15:00)
   b. Equipment must be capable of broadcasting at an 80 dB level with minimal distortion. A decibel meter should be used at the beginning of the first survey each day to determine that speakers are projecting at 80dB at 1m distance from the speaker.
   c. Hold speaker above the level of vegetation and broadcast in the direction of the site you are surveying.
   d. Broadcast order:
      i. 30 seconds LEAST BITTERN (LEBI)
      ii. 30 seconds silence
      iii. 30 seconds SORA (SORA)
      iv. 30 seconds silence
      v. 30 seconds VIRGINIA RAIL (VIRA)
      vi. 30 seconds silence
      vii. 30 seconds COMMON MOORHEN(COMO)
      viii. 30 seconds silence
      ix. 30 seconds PIED-BILLED GREBE (PBGR)
      x. 30 seconds silence

8. Data Management:
   a. Crews will check over data sheets after each survey, checking that all fields have been filled in properly and for readability.
   b. Data sheets will be maintained at the Natural Resources Research Institute in Duluth, Minnesota. Results from the field surveys will be stored in an excel database.
   c. Recommended prep for entering data:
      i. Using a red, ultra-fine sharpie marker, number each species code/observation in sequential order on the data sheet. This method allows you to easily follow along the numbering system during actual entry into the database and helps to eliminate mistakes.

9. Safety, Materials & Equipment:
    a. Because bird surveys are being conducted during daylight hours, observers may survey alone but are required to check in with their field crew leader on a daily basis. Field crew leaders will work out a feasible daily check-in system with their crew to ensure safety in the field.
    b. This survey can be a single- or multiple-observer protocol.
    c. Surveyors will be equipped with the following:
        i. Data sheets
        ii. Standard Operating Procedures
        iii. Clipboard
        iv. Waterproof, permanent pens/markers (Rite in the Rain pen, ultra-fine-tip Sharpie marker)
        v. Thermometer, in metal or plastic case
        vi. Site/point map(s)
        vii. GPS unit, with points loaded
        viii. Extra batteries
        ix. Each crew will carry spare equipment and materials

Appendix B. List of all 192 species observed in the St. Louis River Estuary project areas (1977–2018) including the common name, scientific name, taxa code, guild classification, and number of individuals observed by project.

Common Name	Scientific Name	Taxa Code	Guild Classification	Historical (1977–1979)	Recent (2010–2015)	Current (2018)
American Black Duck	*Anas rubripes*	ABDU	Waterfowl	29	55	10
Alder Flycatcher	*Empidonax alnorum*	ALFL	Songbird	15	24	26
American Bittern	*Botaurus lentiginosus*	AMBI	Wading Bird	7	3	4
American Coot	*Fulica americana*	AMCO	Waterbird	5,214	2,088	54
American Crow	*Corvus brachyrhynchos*	AMCR	Corvid	154	95	231
American Goldfinch	*Spinus tristis*	AMGO	Songbird	88	65	243
American Golden-Plover	*Pluvialis dominica*	AMGP	Shorebird	1	0	0
American Kestrel	*Falco sparverius*	AMKE	Raptor	0	1	1
American Pipit	*Anthus rubescens*	AMPI	Songbird	7	2	9
American Redstart	*Setophaga ruticilla*	AMRE	Songbird	28	87	168
American Robin	*Turdus migratorius*	AMRO	Songbird	115	41	180
American Wigeon	*Mareca americana*	AMWI	Waterfowl	136	31	70
American Tree Sparrow	*Spizelloides arborea*	ATSP	Songbird	14	2	7
American White Pelican	*Pelecanus erythrorhynchos*	AWPE	Waterbird	0	41	178
Bald Eagle	*Haliaeetus leucocephalus*	BAEA	Raptor	32	55	64
Bank Swallow	*Riparia riparia*	BANS	Songbird	56	9	14
Baltimore Oriole	*Icterus galbula*	BAOR	Songbird	1	10	22
Barn Swallow	*Hirundo rustica*	BARS	Songbird	48	3	88
Baird's Sandpiper	*Calidris bairdii*	BASA	Shorebird	0	0	5
Black-and-white Warbler	*Mniotilta varia*	BAWW	Songbird	0	15	31
Black-billed Cuckoo	*Coccyzus erythropthalmus*	BBCU	Songbird	0	3	1
Black-bellied Plover	*Pluvialis squatarola*	BBPL	Shorebird	10	0	0
Black-capped Chickadee	*Poecile atricapillus*	BCCH	Songbird	60	52	301
Black-crowned Night-Heron	*Nycticorax nycticorax*	BCNH	Wading Bird	3	0	0
Belted Kingfisher	*Megaceryle alcyon*	BEKI	Waterbird	57	29	52
Brown-headed Cowbird	*Molothrus ater*	BHCO	Blackbird	120	52	46
Blue-headed Vireo	*Vireo solitarius*	BHVI	Songbird	0	1	2
Blackburnian Warbler	*Setophaga fusca*	BLBW	Songbird	0	1	1
Blue Jay	*Cyanocitta cristata*	BLJA	Corvid	13	34	171
Blackpoll Warbler	*Setophaga striata*	BLPW	Songbird	1	1	2
Bobolink	*Dolichonyx oryzivorus*	BOBO	Blackbird	0	0	7
Black Tern	*Chlidonias niger*	BLTE	Gulls & Terns	105	0	0
Bonaparte's Gull	*Chroicocephalus philadelphia*	BOGU	Gulls & Terns	261	22	35
Brewer's Blackbird	*Euphagus cyanocephalus*	BRBL	Blackbird	1	0	0
Brown Creeper	*Certhia americana*	BRCR	Songbird	0	1	3
Brown Thrasher	*Toxostoma rufum*	BRTH	Songbird	8	0	1

Common Name	Scientific Name	Taxa Code	Guild Classification	Historical (1977–1979)	Recent (2010–2015)	Current (2018)
Black-throated Green Warbler	*Setophaga virens*	BTNW	Songbird	0	3	3
Bufflehead	*Bucephala albeola*	BUFF	Waterfowl	50	283	208
Broad-winged Hawk	*Buteo platypterus*	BWHA	Raptor	0	0	8
Blue-winged Teal	*Spatula discors*	BWTE	Waterfowl	1,344	44	93
Canada Goose	*Branta canadensis*	CAGO	Waterfowl	96	2,980	1,940
Canvasback	*Aythya valisineria*	CANV	Waterfowl	0	121	11
Caspian Tern	*Hydroprogne caspia*	CATE	Gulls & Terns	0	0	1
Canada Warbler	*Cardellina canadensis*	CAWA	Songbird	0	1	4
Clay-colored Sparrow	*Spizella pallida*	CCSP	Songbird	0	0	9
Cedar Waxwing	*Bombycilla cedrorum*	CEDW	Songbird	37	79	218
Chipping Sparrow	*Spizella passerina*	CHSP	Songbird	0	5	14
Chimney Swift	*Chaetura pelagica*	CHSW	Songbird	0	0	2
Cliff Swallow	*Petrochelidon pyrrhonota*	CLSW	Songbird	44	9	33
Cape May Warbler	*Setophaga tigrina*	CMWA	Songbird	0	2	0
Common Goldeneye	*Bucephala clangula*	COGO	Waterfowl	680	145	155
Common Grackle	*Quiscalus quiscula*	COGR	Blackbird	63	215	1,269
Cooper's Hawk	*Accipiter cooperii*	COHA	Raptor	0	1	0
Common Loon	*Gavia immer*	COLO	Waterbird	20	3	13
Common Merganser	*Mergus merganser*	COME	Waterfowl	74	25	107
Common Nighthawk	*Chordeiles minor*	CONI	Songbird	1	1	0
Common Raven	*Corvus corax*	CORA	Corvid	0	19	59
Common Redpoll	*Acanthis flammea*	CORE	Songbird	167	0	0
Common Tern	*Sterna hirundo*	COTE	Gulls & Terns	18	73	1
Common Yellowthroat	*Geothlypis trichas*	COYE	Songbird	126	128	169
Chestnut-sided Warbler	*Setophaga pensylvanica*	CSWA	Songbird	1	3	11
Double-crested Cormorant	*Phalacrocorax auritus*	DCCO	Waterbird	3	114	141
Downy Woodpecker	*Dryobates pubescens*	DOWO	Woodpecker	13	11	24
Dunlin	*Calidris alpina*	DUNL	Shorebird	38	0	2
Eastern Bluebird	*Sialia sialis*	EABL	Songbird	0	0	4
Eastern Kingbird	*Tyrannus tyrannus*	EAKI	Songbird	7	1	6
Eastern Phoebe	*Sayornis phoebe*	EAPH	Songbird	3	4	14
Eastern Wood-Pewee	*Contopus virens*	EAWP	Songbird	0	0	5
European Starling	*Sturnus vulgaris*	EUST	Invasive	32	6	51
Evening Grosbeak	*Coccothraustes vespertinus*	EVGR	Songbird	115	0	2
Fox Sparrow	*Passerella iliaca*	FOSP	Songbird	0	0	1
Forster's Tern	*Sterna forsteri*	FOTE	Gulls & Terns	5	0	10
Gadwall	*Mareca strepera*	GADW	Waterfowl	10	4	31
Great Blue Heron	*Ardea herodias*	GBHE	Wading Bird	122	24	16
Great Crested Flycatcher	*Myiarchus crinitus*	GCFL	Songbird	2	6	5
Golden-crowned Kinglet	*Regulus satrapa*	GCKI	Songbird	0	2	7

Common Name	Scientific Name	Taxa Code	Guild Classification	Historical (1977–1979)	Recent (2010–2015)	Current (2018)
Gray-cheeked Thrush	*Catharus minimus*	GCTH	Songbird	1	0	1
Gray Catbird	*Dumetella carolinensis*	GRCA	Songbird	71	20	32
Green Heron	*Butorides virescens*	GRHE	Wading Bird	55	9	5
Greater Scaup	*Aythya marila*	GRSC	Waterfowl	0	8	46
Greater Yellowlegs	*Tringa melanoleuca*	GRYE	Shorebird	2	0	30
Green-winged Teal	*Anas crecca*	GWTE	Waterfowl	249	81	125
Golden-winged Warbler	*Vermivora chrysoptera*	GWWA	Songbird	0	0	1
Harris's Sparrow	*Zonotrichia querula*	HASP	Songbird	3	0	0
Hairy Woodpecker	*Dryobates villosus*	HAWO	Woodpecker	3	8	45
Herring Gull	*Larus argentatus*	HERG	Gulls & Terns	191	25	20
Hermit Thrush	*Catharus guttatus*	HETH	Songbird	0	0	3
House Finch	*Haemorhous mexicanus*	HOFI	Songbird	0	1	3
Horned Grebe	*Podiceps auritus*	HOGR	Waterbird	18	32	37
Horned Lark	*Eremophila alpestris*	HOLA	Songbird	0	0	1
Hooded Merganser	*Lophodytes cucullatus*	HOME	Waterfowl	51	64	110
House Wren	*Troglodytes aedon*	HOWR	Songbird	0	2	8
Indigo Bunting	*Passerina cyanea*	INBU	Songbird	1	0	0
Killdeer	*Charadrius vociferus*	KILL	Shorebird	123	5	11
Lapland Longspur	*Calcarius lapponicus*	LALO	Songbird	6	0	8
Least Bittern	*Ixobrychus exilis*	LEBI	Wading Bird	3	0	1
Least Flycatcher	*Empidonax minimus*	LEFL	Songbird	13	17	29
Least Sandpiper	*Calidris minutilla*	LESA	Shorebird	18	0	13
Lesser Scaup	*Aythya affinis*	LESC	Waterfowl	1,117	447	830
Lesser Yellowlegs	*Tringa flavipes*	LEYE	Shorebird	14	5	25
Lincoln's Sparrow	*Melospiza lincolnii*	LISP	Songbird	0	1	0
Mallard	*Anas platyrhynchos*	MALL	Waterfowl	1,253	931	514
Magnolia Warbler	*Setophaga magnolia*	MAWA	Songbird	2	1	1
Marsh Wren	*Cistothorus palustris*	MAWR	Songbird	91	18	65
Merlin	*Falco columbarius*	MERL	Raptor	0	4	10
Mourning Dove	*Zenaida macroura*	MODO	Dove	19	7	4
Mourning Warbler	*Geothlypis philadelphia*	MOWA	Songbird	4	2	8
Nashville Warbler	*Oreothlypis ruficapilla*	NAWA	Songbird	3	21	13
Northern Cardinal	*Cardinalis cardinalis*	NOCA	Songbird	0	0	6
Northern Flicker	*Colaptes auratus*	NOFL	Woodpecker	38	15	66
Northern Harrier	*Circus hudsonius*	NOHA	Raptor	8	2	5
Northern Parula	*Setophaga americana*	NOPA	Songbird	0	0	2
Northern Pintail	*Anas acuta*	NOPI	Waterfowl	17	12	11
Northern Waterthrush	*Parkesia noveboracensis*	NOWA	Songbird	1	5	30
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	NRWS	Songbird	2	18	15
Northern Shoveler	*Spatula clypeata*	NSHO	Waterfowl	13	26	67

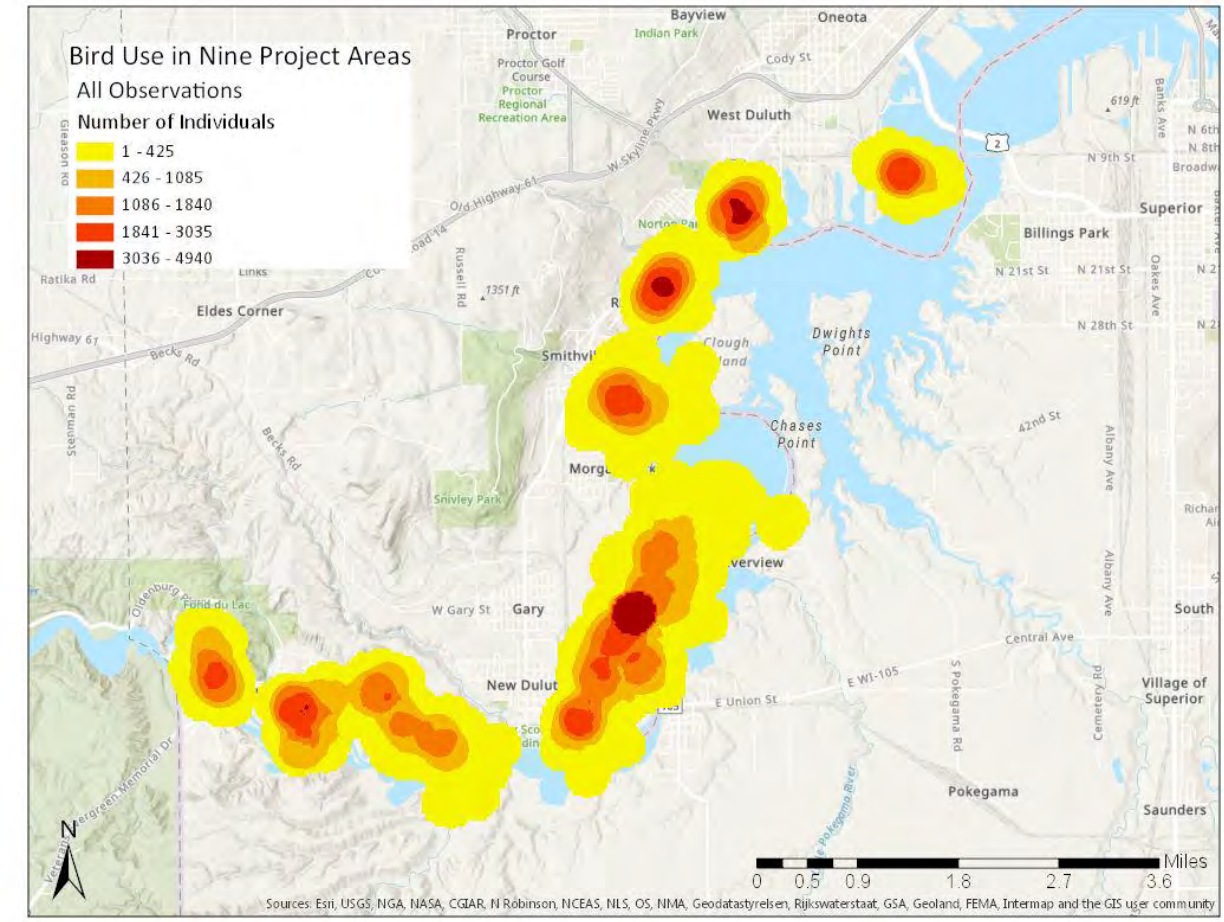
Common Name	Scientific Name	Taxa Code	Guild Classification	Historical (1977–1979)	Recent (2010–2015)	Current (2018)
Northern Shrike	*Lanius borealis*	NSHR	Songbird	1	1	1
Olive Sided Flycatcher	*Contopus cooperi*	OSFL	Songbird	0	0	1
Orange-crowned Warbler	*Oreothlypis celata*	OCWA	Songbird	1	2	0
Osprey	*Pandion haliaetus*	OSPR	Raptor	0	1	1
Ovenbird	*Seiurus aurocapilla*	OVEN	Songbird	1	14	49
Palm Warbler	*Setophaga palmarum*	PAWA	Songbird	34	7	49
Pied-billed Grebe	*Podilymbus podiceps*	PBGR	Waterbird	40	136	114
Peregrine Falcon	*Falco peregrinus*	PEFA	Raptor	0	1	1
Pectoral Sandpiper	*Calidris melanotos*	PESA	Shorebird	1	0	1
Philadelphia Vireo	*Vireo philadelphicus*	PHVI	Songbird	0	0	1
Pine Grosbeak	*Pinicola enucleator*	PIGR	Songbird	19	0	0
Pine Siskin	*Spinus pinus*	PISI	Songbird	49	28	121
Pine Warbler	*Setophaga pinus*	PIWA	Songbird	0	0	1
Pileated Woodpecker	*Dryocopus pileatus*	PIWO	Woodpecker	0	6	32
Purple Finch	*Haemorhous purpureus*	PUFI	Songbird	3	19	52
Purple Martin	*Progne subis*	PUMA	Songbird	72	0	0
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	RBGR	Songbird	14	4	7
Ring-billed Gull	*Larus delawarensis*	RBGU	Gulls & Terns	282	179	240
Red-breasted Merganser	*Mergus serrator*	RBME	Waterfowl	0	17	63
Red-breasted Nuthatch	*Sitta canadensis*	RBNU	Songbird	0	0	17
Red-bellied Woodpecker	*Melanerpes carolinus*	RBWO	Woodpecker	0	1	9
Ruby-crowned Kinglet	*Regulus calendula*	RCKI	Songbird	1	6	21
Redhead	*Aythya americana*	REDH	Waterfowl	9	428	15
Red-eyed Vireo	*Vireo olivaceus*	REVI	Songbird	8	28	138
Red-headed Woodpecker	*Melanerpes erythrocephalus*	RHWO	Woodpecker	1	0	0
Rough-legged Hawk	*Buteo lagopus*	RLHA	Raptor	5	1	1
Ring-necked Duck	*Aythya collaris*	RNDU	Waterfowl	720	525	379
Red-necked Grebe	*Podiceps grisegena*	RNGR	Waterbird	0	16	7
Rock Pigeon	*Columba livia*	ROPI	Pigeon	2	6	20
Red-shouldered Hawk	*Buteo lineatus*	RSHA	Raptor	0	0	1
Red-tailed Hawk	*Buteo jamaicensis*	RTHA	Raptor	2	0	11
Ruby-throated Hummingbird	*Archilochus colubris*	RTHU	Hummingbird	8	4	15
Rusty Blackbird	*Euphagus carolinus*	RUBL	Blackbird	13	4	216
Ruddy Duck	*Oxyura jamaicensis*	RUDU	Waterfowl	0	3	0
Ruffed Grouse	*Bonasa umbellus*	RUGR	Grouse	3	0	2
Red-winged Blackbird	*Agelaius phoeniceus*	RWBL	Blackbird	1,263	1,138	1,395
Sandhill Crane	*Antigone canadensis*	SACR	Wading Bird	0	1	18
Sanderling	*Calidris alba*	SAND	Shorebird	3	0	0
Savannah Sparrow	*Passerculus sandwichensis*	SAVS	Songbird	16	0	4

Common Name	Scientific Name	Taxa Code	Guild Classification	Historical (1977–1979)	Recent (2010–2015)	Current (2018)
Slate-colored Junco	*Junco heymalis hyemalis*	SCJU	Songbird	1	8	16
Scarlet Tanager	*Piranga olivacea*	SCTA	Songbird	0	3	1
Semipalmated Plover	*Charadrius semipalmatus*	SEPL	Shorebird	18	0	1
Semipalmated Sandpiper	*Calidris pusilla*	SESA	Shorebird	215	0	2
Sedge Wren	*Cistothorus platensis*	SEWR	Songbird	4	16	1
Snow Bunting	*Plectrophenax nivalis*	SNBU	Songbird	46	1	6
Snowy Owl	*Bubo scandiacus*	SNOW	Raptor	1	0	0
Sora	*Porzana carolina*	SORA	Rail	4	21	31
Solitary Sandpiper	*Tringa solitaria*	SOSA	Shorebird	5	0	6
Song Sparrow	*Melospiza melodia*	SOSP	Songbird	235	155	303
Spotted Sandpiper	*Actitis macularius*	SPSA	Shorebird	61	10	27
Sharp-shinned Hawk	*Accipiter striatus*	SSHA	Raptor	4	0	6
Stilt Sandpiper	*Calidris himantopus*	STSA	Shorebird	6	4	0
Swamp Sparrow	*Melospiza georgiana*	SWSP	Songbird	185	72	241
Swainson's Thrush	*Catharus ustulatus*	SWTH	Songbird	0	0	7
Tennessee Warbler	*Oreothlypis peregrina*	TEWA	Songbird	8	0	1
Tree Swallow	*Tachycineta bicolor*	TRES	Songbird	157	108	254
Trumpeter Swan	*Cygnus buccinator*	TRUS	Waterfowl	0	43	118
Tundra Swan	*Cygnus columbianus*	TUSW	Waterfowl	242	51	14
Turkey Vulture	*Cathartes aura*	TUVU	Raptor	1	17	47
Veery	*Catharus fuscescens*	VEER	Songbird	34	50	72
Virginia Rail	*Rallus limicola*	VIRA	Rail	12	15	16
Warbling Vireo	*Vireo gilvus*	WAVI	Songbird	16	14	5
White-breasted Nuthatch	*Sitta carolinensis*	WBNU	Songbird	0	3	30
White-crowned Sparrow	*Zonotrichia leucophrys*	WCSP	Songbird	2	2	5
Wilson's Phalarope	*Phalaropus tricolor*	WIPH	Shorebird	15	0	0
Wilson's Snipe	*Gallinago delicata*	WISN	Shorebird	11	3	3
Wilson's Warbler	*Cardellina pusilla*	WIWA	Songbird	0	5	3
Wood Duck	*Aix sponsa*	WODU	Waterfowl	302	27	115
White-rumped Sandpiper	*Calidris fuscicollis*	WRSA	Shorebird	2	0	0
White-throated Sparrow	*Zonotrichia albicollis*	WTSP	Songbird	55	23	36
Yellow-bellied Flycatcher	*Empidonax flaviventris*	YBFL	Songbird	0	0	1
Yellow-bellied Sapsucker	*Sphyrapicus varius*	YBSA	Woodpecker	0	0	10
Yellow Warbler	*Setophaga petechia*	YEWA	Songbird	64	163	192
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	YHBL	Blackbird	62	0	0
Yellow-rumped Warbler	*Setophaga coronata*	YRWA	Songbird	55	63	187
Yellow-throated Vireo	*Vireo flavifrons*	YTVI	Songbird	0	1	3

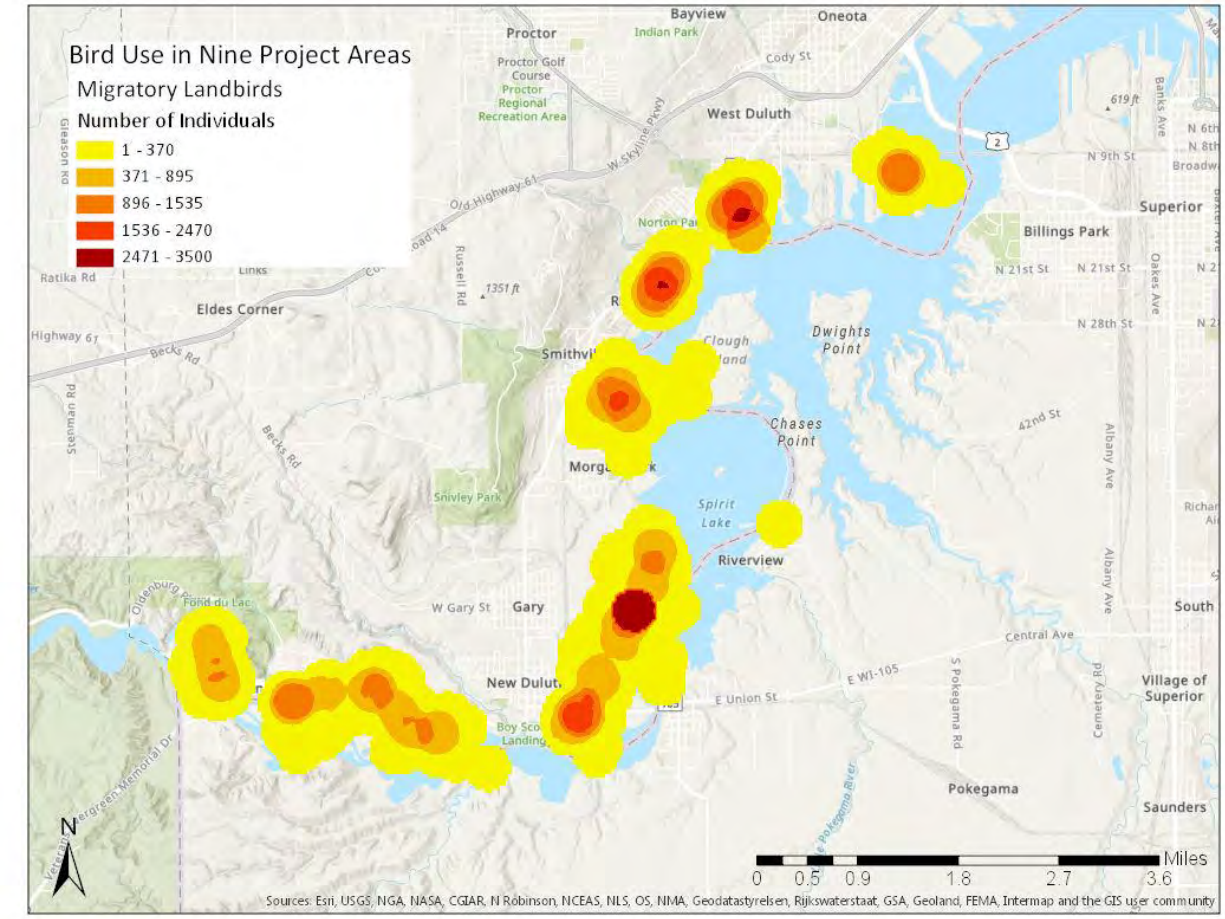
Appendix C. Common names of species identified as species of conservation concern that were observed at least once in the SLRE. Lists include Species in Greatest Conservation Need (SGCN), U.S. Shorebirds of Conservation Concern (SHCC), Waterbirds of Conservation Concern (WACC), Partners in Flight Species of Continental Concern (PIF), and USFWS Region 3 and/or National Birds of Conservation Concern (USFWS Regional or National). Species with asterisks (*) represent species observed in 2018 surveys (52 species total).

Common Name	Lists	Common Name	Lists
American Black Duck *	SGCN	Least Bittern *	USFWS Regional, SGCN, WACC
American Bittern *	USFWS Regional, SGCN, WACC	Least Sandpiper *	SHCC
American Golden-Plover	SHCC	Lesser Scaup *	SGCN
American Kestrel *	SGCN	Lesser Yellowlegs *	USFWS National, SHCC
American White Pelican *	SGCN, WACC	Northern Harrier *	SGCN
Bald Eagle *	USFWS National/Regional	Northern Pintail *	SGCN
Baird's Sandpiper *	SHCC	Northern Rough-winged Swallow *	SGCN
Black-billed Cuckoo *	USFWS Regional, SGCN, PIF	Olive Sided Flycatcher *	USFWS National/Regional, SGCN, PIF
Black-bellied Plover	SHCC	Peregrine Falcon *	USFWS National/Regional, SGCN
Black-crowned Night-Heron	SGCN, WACC	Pectoral Sandpiper *	SHCC
Belted Kingfisher *	SGCN	Philadelphia Vireo *	SGCN
Bobolink *	SGCN, PIF	Pied-billed Grebe *	USFWS Regional, WACC
Bonaparte's Gull *	WACC	Purple Finch *	SGCN
Black Tern	USFWS Regional, SGCN, WACC	Purple Martin	SGCN
Brown Thrasher *	SGCN	Red-headed Woodpecker	USFWS National/Regional, SGCN, PIF
Caspian Tern *	WACC	Red-necked Grebe *	SGCN, WACC
Canada Warbler *	USFWS National/Regional, PIF	Red-shouldered Hawk *	SGCN
Chimney Swift *	SGCN	Rusty Blackbird *	USFWS National/Regional
Cape May Warbler	SGCN, PIF	Sanderling	SHCC
Common Loon *	SGCN, WACC	Semipalmated Plover *	SHCC
Common Merganser *	SGCN	Semipalmated Sandpiper *	USFWS National, SGCN, SHCC
Common Nighthawk	SGCN	Sedge Wren *	SGCN
Common Tern *	USFWS Regional, SGCN, WACC	Snowy Owl	PIF
Dunlin *	USFWS National, SHCC	Sora *	WACC
Evening Grosbeak *	SGCN, PIF	Solitary Sandpiper *	USFWS National/Regional, SHCC
Forster's Tern *	SGCN, WACC	Spotted Sandpiper *	SHCC
Greater Yellowlegs *	SGCN, SHCC	Stilt Sandpiper	SHCC
Green Heron *	WACC	Trumpeter Swan *	SGCN
Golden-winged Warbler *	USFWS National/Regional, SGCN, PIF	Veery *	SGCN
Harris's Sparrow	USFWS National, PIF	Virginia Rail *	SGCN
Herring Gull *	WACC	Wilson's Phalarope	SGCN, SHCC
Horned Grebe *	USFWS Regional, SGCN, WACC	Wilson's Snipe *	SHCC
Killdeer *	SHCC	Yellow-headed Blackbird	SGCN

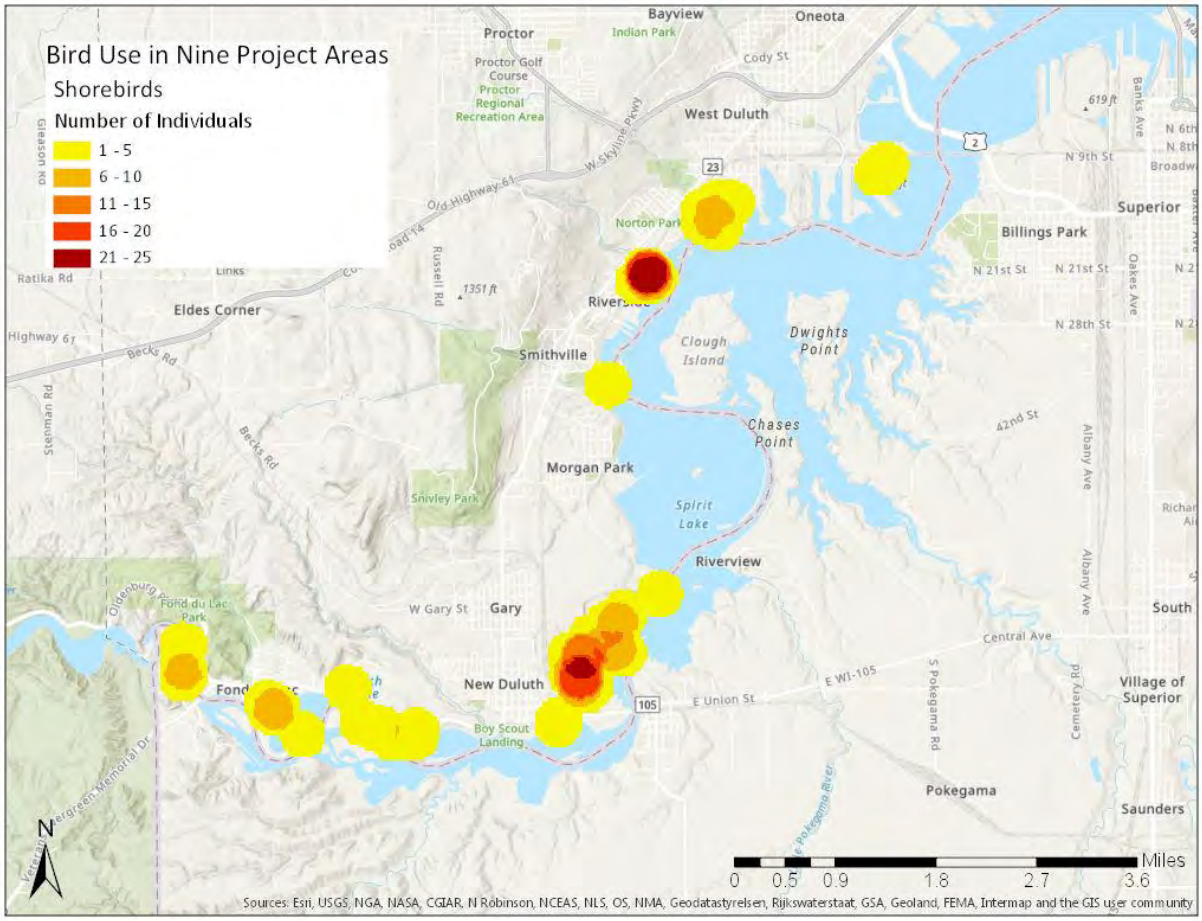
Appendix D. Heat map representing where all 16 guilds were most observed in the nine project areas from April–October 2018.



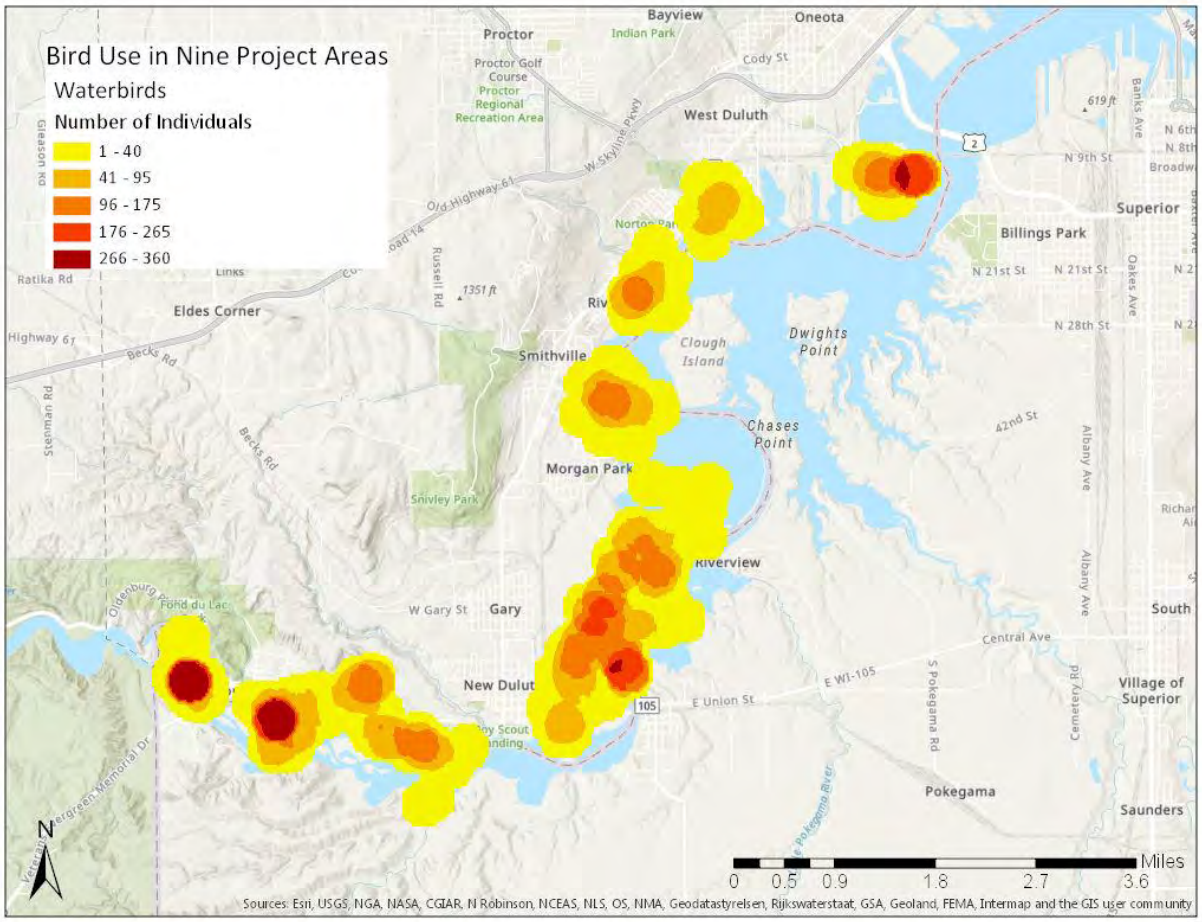
Appendix E. Heat map representing where migratory landbirds were most observed in the nine project areas from April–October 2018.



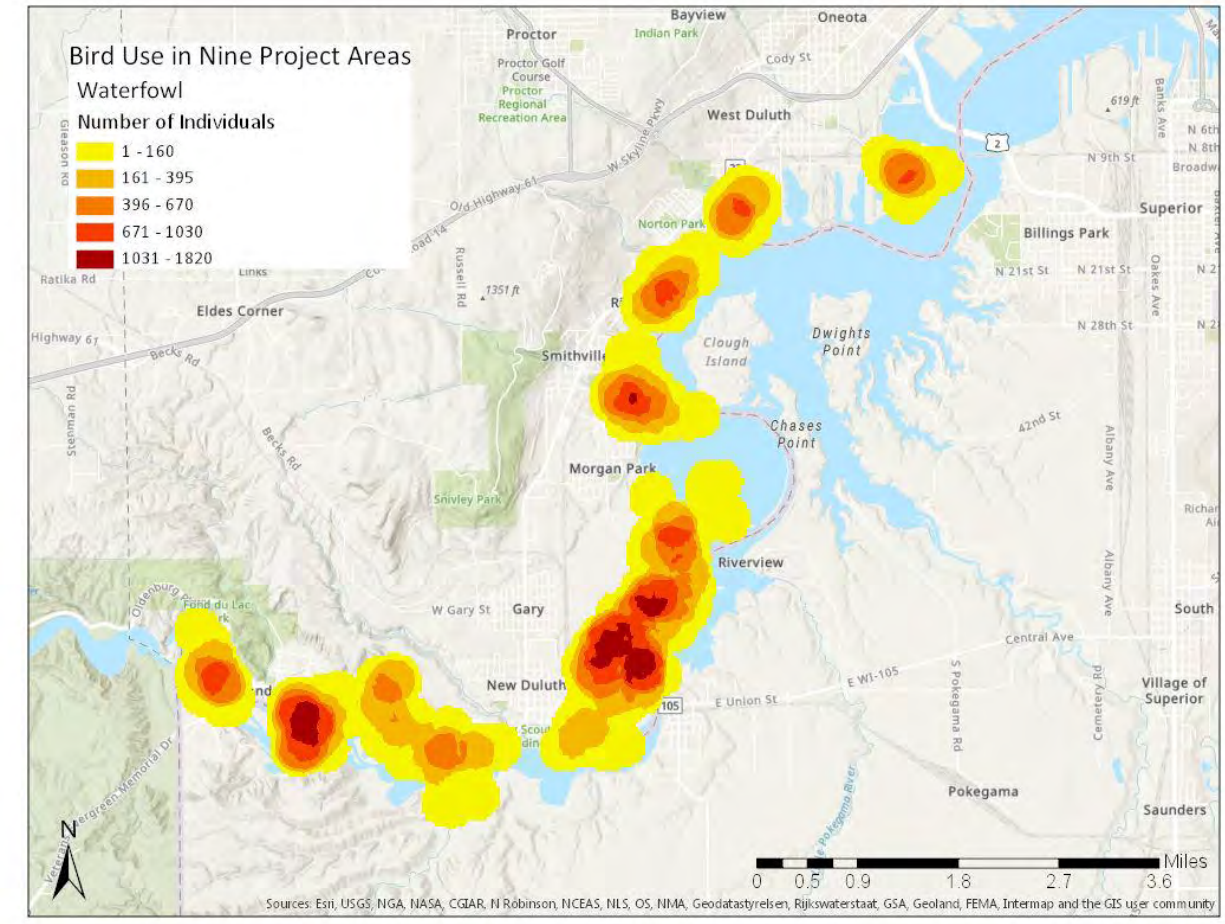
Appendix F. Heat map representing where shorebirds were most observed in the nine project areas from April–October 2018.



Appendix G. Heat map representing where waterbirds were most observed in the nine project areas from April–October 2018.



Appendix H. Heat map representing where waterfowl were most observed in the nine project areas from April–October 2018.




DULUTH NATURAL AREAS PROGRAM

MANAGEMENT PLAN FOR THE

St. Louis River Natural Area

OF THE DULUTH NATURAL AREAS PROGRAM

DATE: 12/30/19

Nominated by: City of Duluth Parks & Recreation Division

This report was produced by the Minnesota Land Trust for the City of Duluth. Funding was provided by U.S. Environmental Protection Agency Great Lakes Restoration Initiative grant number GL00E02202. Our thanks to the many organizations and individuals participated in a variety of ways as collaborators to the report.

Table of Contents

List of Figures

List of Tables

List of Appendices

List of Acronyms

AOC	Area of Concern
BMP	Best management practive
BUI	Beneficial use impairment
CISMA	Duluth Cooperative Invasive Species Management Area
COGGS	Cyclist of Gitchee Gummee Shores
DNAP	Duluth Natural Areas Program
EAB	Emerald ash borer
IBA	Important Bird Area
LA	Load allocation
MNDNR	Minnesota Department of Natural Resources
MPCA	Minnesota Pollution Control Agency
MS4	Municipal separate storm sewer system
NOAA	National Oceanic and Atmospheric Adminstration
NPC	Native plant community
OHV	Off-highway vehicle
PCB	Polychlorinated biphenyl
SLRNA	St. Louis River Natural Area
TMDL	Total maximum daily load
TSS	Total suspended solids
WLA	Wastelod allocation
WDNR	Wisconsin Department of Natural Resources

Introduction

This management plan for the St. Louis River Natural Area (SLRNA) was developed following the requirements of the Duluth Natural Area Program (DNAP) ordinance. The purpose of this plan is to provide guidance for maintaining and improving the ecological function of the natural features for which the St. Louis River Natural Area was nominated to the program, including significant native plant communities, natural water feature area, important bird congregation area, special species area, and geological landform area.

The 2019 Waabizheshikana (Marten Trail), Mini-Master Plan (final draft), the 2017 Duluth Traverse Mini Master Plan, and the 2017 St. Louis River Estuary National Water Trail Plan are additional guiding documents related to the infrastructure and uses within the St. Louis River Natural Area that this plan is intended to inform and does not supersede.

The City of Duluth will implement this plan with the assistance of its partners with interests within the natural area. Partners involved in stewardship, management, and maintenance of features within the SLRNA include the Duluth Cooperative Invasive Species Management Area (CISMA), Community Action Duluth, Cyclists of Gitchee Gumee Shores (COGGS), Friends of Western Duluth Parks and Trails, and the St. Louis River Alliance. Partners involved in the restoration and remediation of prioritized sites and actions in the St. Louis River Area of Concern (AOC) include Fond du Lac Band of Lake Superior Chippewa, Minnesota Department of Natural Resources (MNDNR), Minnesota Land Trust, Minnesota Pollution Control Agency (MPCA), Wisconsin Department of Natural Resources (WDNR), US Environmental Protection Agency, as well as other local and federal partners.

This plan presents an inventory of natural resources and human uses within the natural area, describes threats to the ecological function of these features, describes strategies for preserving the natural features, and presents an implementation plan with prioritized actions, timelines, and costs.

Natural Area Conditions

This section provides a summary of natural resources in each of the five scientific categories for which the SLRNA was nominated to the DNAP, describes human use of the natural area, and discusses the current status of land ownership for future preservation.

The SLRNA is comprised of approximately 1,119 acres located in nine project sites along the St. Louis River (Figure 1) from Chamber's Grove on the southwest (most upstream) to Grassy Point on the northeast (most downstream). Selection of the lands for inclusion in the natural area is described in the SLRNA Nomination (City of Duluth, 2019).

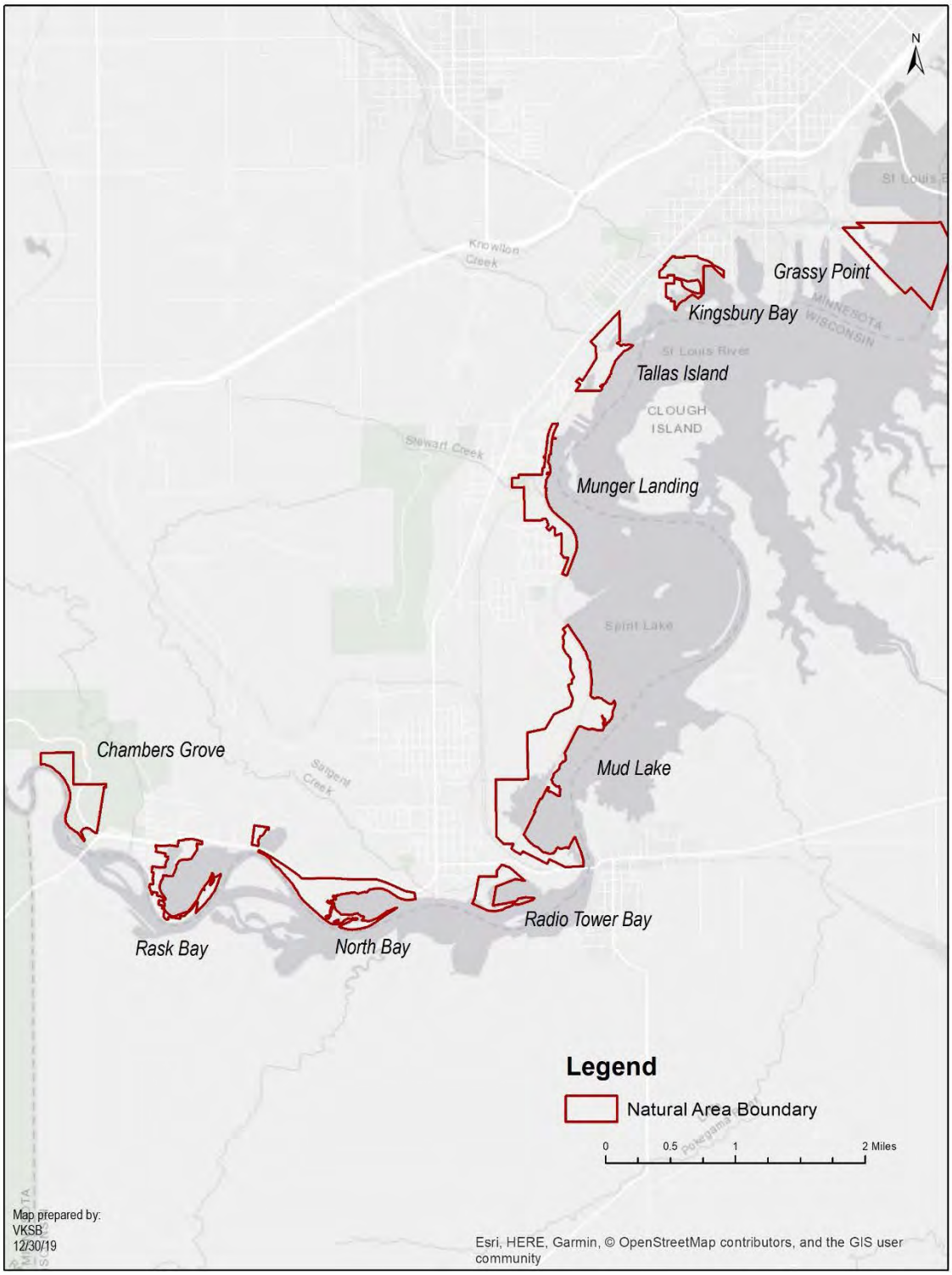


Figure 1: St. Louis River Natural Area Boundary

Note: Inclusion in the natural area is subject to landowner assent and land protection in accordance with the DNAP ordinance.

NATURAL RESOURCES INVENTORY

The significant natural resources for which the St. Louis River Natural Area was nominated include:

- Significant native plant communities (NPCs)
- Natural water features
- Important bird congregation area
- Special species area
- Geological landforms

Please refer to the SLRNA Nomination for descriptions of the ecological resources within each of these categories. The important features of these resources are summarized in Table 1.

Table 1: Summary of Important Features in the St. Louis River Natural Area

DNAP Scientific Category	Important Features
Significant native plant communities	• 17 distinct native plant community types within the natural area comprised of various types of hardwood forest, mixed hardwood-conifer forest, floodplain forest, forested swamps, shrub swamps, wet meadows, and marshes. • 120 acres of Estuary Marsh (Lake Superior) – MRU94a - This coastal wetland community is unique because it only occurs in estuaries and river mouths influenced by the Lake Superior seiche. • 63% of the NPCs have condition rank of B (good) or higher
Natural water features	• St. Louis River Estuary is the largest tributary to Lake Superior in the U.S. and supports globally important coastal wetland ecosystems • Mouths of four designated trout streams, Knowlton Creek, Stewart Creek, Kingsbury Creek, and Keene Creek, are in the SLRNA
Important bird congregation area	• Important congregation area for four bird guilds: waterfowl, shorebirds, waterbirds, and migratory landbirds • 169 species and almost 15,000 individuals surveyed in 2018
Special species area	• One state-listed endangered species, pale sedge (*Carex pallescens*) • Two state-listed special concern species, discoid beggarticks (*Bidens discoidea*) and soapberry (*Shepherdia canadensis*) • 52 sensitive bird species
Geological landforms	• Evidence of the drowned river valley draining to Glacial Lake Duluth is present in the form of backwater bays (e.g., Rask Bay, North Bay, Radio Tower Bay, Kingsbury Bay) • Bedrock geology from the Midcontinent Rift

HUMAN USES

Recreational uses are abundant within the nine project sites of the SLRNA and include hiking, biking, shore fishing, birdwatching, picnicking, and access for paddling. Recreational infrastructure within each project site is inventoried in Table 2. Note: the Tallas Island project area includes the future Spirit Landing Park's passive boat launch and infrastructure.

Table 2: Recreational Infrastructure in the Nine Project Areas of the St. Louis River Natural Area

Recreational Use Facilities	Project Area								
	Chamber's Grove	Rask Bay	North Bay	Radio Tower Bay	Mud Lake	Munger Landing	Tallas Island	Kingsbury Bay	Grassy Point
Hiking trail	X		X				X	X	(X)
Mountain Biking trail	X						X	X	
Accessible trail*	X	(X)	X	(X)	(X)	(X)	X	X	(X)
Picnic area	X					X	(X)	X**	
Shorefishing pier	X		X		(X)	X			
Trailhead with parking and restrooms	X		(X)		(X)	(X)	(X)	X	
Carry-in boat access (nonmotorized)	X		X		(X)	(X)	(X)	X	(X)
Public water access (motorized and nonmotorized)						X			

(X) = planned
* Meets Americans with Disabilities Act requirements
** nearby on City property at Indian Point Campground

The 2019 Waabizheshikana (Marten Trail) Mini-Master Plan (LHB, Inc., 2019) details the planned extension of the Waabizheshikana from its current end point at Spring Street (just south of the Tallas Island project site) upstream along the St. Louis River to Chamber's Grove. Once the plan is fully implemented it will connect all of the project sites within the SLRNA with the exception of Grassy point (Figure 2). This plan also includes

construction or improvement of existing trailheads along the trail which also serve as access points for the St. Louis River National Water Trail (designation pending). Note, all trails and amenities will not be located on Tallas Island proper, but only along the shoreline.

An accessible hiking trail and carry-in boat access are identified as desired future amenities at Grassy Point in the St. Louis River Corridor Mini-Master Plans (City of Duluth, 2016). The existing boardwalk trail at Grassy Point is in disrepair and is being removed during the extensive habitat restoration work that is happening at the site.

Other existing trails within the SLRNA include:

- Chamber's Grove - Mission Creek mountain biking trails (portions), including the Duluth Traverse; St. Louis River accessible interpretive trail; Mission Creek trails with access to the Superior Hiking Trail (Figure 3)

- North Bay –accessible Boy Scout hiking trail (Figure 4)

The St. Louis River Estuary National Water Trail (designation pending) is a bi-state trail consisting of a series of paddling routes from Fond du Lac Dam downstream to Stryker Bay on the Minnesota side. Trail routes go in and through all of the SLRNA project areas, except Grassy Point. Detailed maps can be found in the water trail master plan (Hoisington, et al. 2017). Recreational infrastructure associated with Waabizheshikana was coordinated with water trail infrastructure needs in the planning process. The National Oceanic and Atmospheric Administration's (NOAA's) St. Louis River Estuary Public Access and Cultural Guidebook provides maps of trails, public access locations, and other areas of interest, as well as descriptions of cutltural resources in the estuary.

Maps of each project area are provided in the SLRNA Nomination . Locations of the amenities associated with Waabizheshikana can be found in the Waabizheshikana (Marten Trail) Mini-Master Plan located on the city of Duluth website.

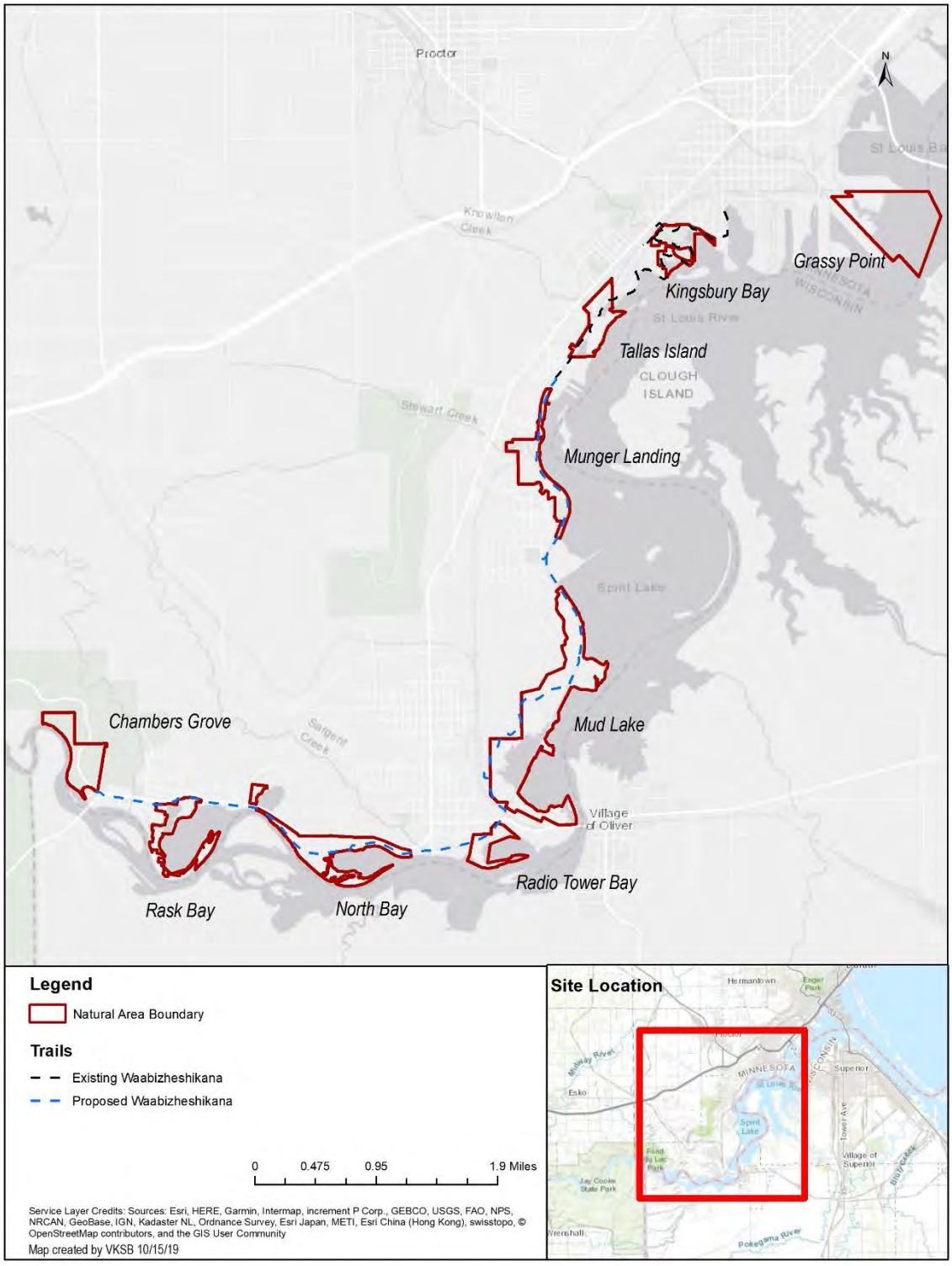


Figure 2: Waabizheshikana Project Limits

Note: Inclusion in the natural area is subject to landowner assent and land protection in accordance with the DNAP ordinance.

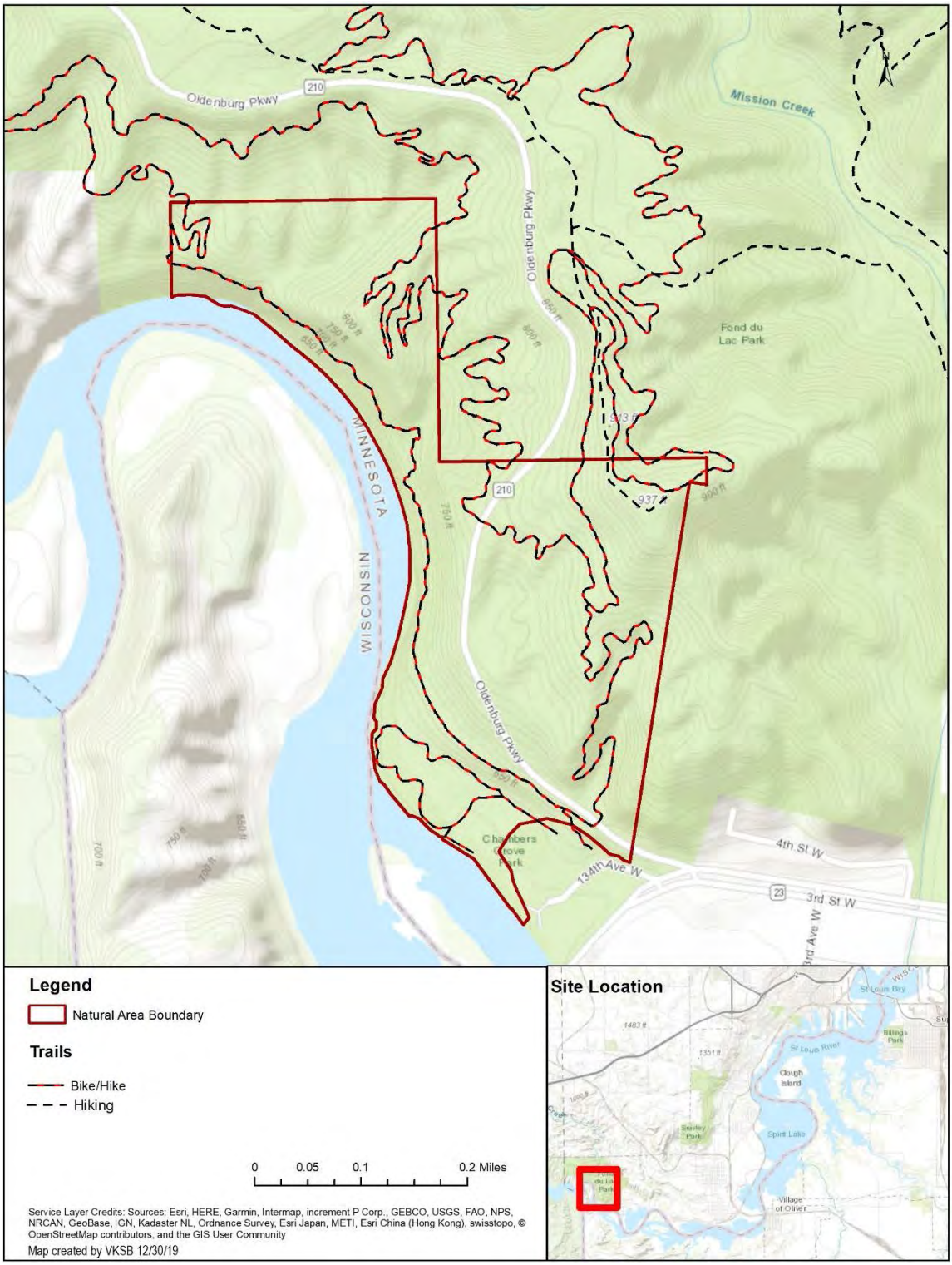


Figure 3: Trails in the Chamber's Grove Project Site

Figure 4: Trails in the North Bay Project Site

Note: Inclusion in the natural area is subject to landowner assent and land protection in accordance with the DNAP ordinance.

LAND OWNERSHIP

As described in the SLRNA Nomination and shown on Figures 4 through 12 of that document, landownership in the SLRNA is 33% City, 30% private, 32% State of Minnesota tax-forfeit, and 5% State of Minnesota. The City of Duluth is working with public and private landowners within the proposed natural area boundary to seek the conveyance of land to the DNAP through gift, sale, or other mechanism. Seven landowners have expressed interest in conveying their parcels to the City. Grant funds are being sought for parcel acquistion. The City is working closely with St. Louis County to acquire the tax forfeit parcels in the SLRNA.

The priority for acquisition of lands not currently under City ownership is as follows:

- Private parcels
- State of Minnesota tax forfeit parcels
- Larger parcels versus smaller parcels
- Higher quality habitat

Until all the parcels in the SLRNA are acquired by or conveyed to the City, the SLRNA boundaries may change slightly and should be reviewed in the next management plan update.

Threats

The threats to the ecological integrity of the special features for which the SLRNA was nominated to the DNAP are described in this section. Threats identified during the 2018 field surveys are described followed by other known threats.

THREATS IDENTIFIED DURING FIELD SURVEYS

Threats within each of the nine project areas of the SLRNA were identified during the 2018 plant and avian field surveys (Table 3). Section 2 of plant survey report (SEH, 2018) provided in Appendix B of the SLRNA Nomination provides a characterization of each project site with identified threats.

Table 3: Threats Identified in the St. Louis River Natural Area Project Areas

Threat	Chambers Grove	Rask Bay	North Bay	Radio Tower Bay	Mud Lake	Munger Landing	Tallas Island	Kingsbury Bay	Grassy Point
Invasive species	X	X	X	X	X	X	X	X	X
Erosion	X		X			X			
Unauthorized Trails	X		X			X			
Off-Highway Vehicle (OHV) Use			X			X			
Substrate issues*					X				
Earthworms								X	
Emerald Ash Borer			X						

* Includes lack of topsoil, compaction from past industrial use, and/or unsuitable substrate due to chemical characteristics (such as nutrient limitation).

Further information on the threats listed in Table 3 is as follows:

- The presence of invasive species was identified and described for each project area during the Summer 2018 plant surveys (SEH, 2018; Appendix B of SLRNA Nomination). Invasive species are discussed further below.

- Erosion is a concern at Chamber's Grove and North Bay on hillslopes affected by the 2012 flood. Erosion control work was conducted by Minnesota Department of Transportation and COGGS on hillslopes below Highway 210 within the Chamber's Grove project site. Additional work was completed in 2016/2017 that appears to have stabilized the slope. Erosion is a concern at North Bay due to runoff from Trunk Highway 23 causing rills to form in the forested communities on the top of slope below the highway in the north end of the project site. In both North Bay and Munger Landing, localized erosion occurs due to OHV use.

- Unauthorized trails and OHV use can be similarly categorized as "human uses". These uses that are not authorized within the natural area. Unauthorized trails are present in the Chamber's Grove project site that may be suitable for soapberry (*Shepherdia canadensis*), a state species of special concern. Their presence could affect habitat sustainability for this special species. OHV use on unauthorized trails is occurring in North Bay and Munger Landing and has been identified as a source

of erosion at wetland crossings in North Bay and in localized areas in Munger Landing. Human uses are further discussed below.

- Substrate issues are presumably the cause for the lack of tree canopy growing in areas described as non-native plant communities described as open fields in the Mud Lake project area. These are likely areas that were disturbed by industrial activity. These issues could include lack of topsoil, compaction from past industrial use, and/or unsuitable substrate due to chemical characteristics (such as nutrient limitation).

- Earthworms appear to be negatively affecting an Aspen-Birch-Red Maple Forest (MHn4b) community on the north side of Kingsbury Bay. This community ranks D (poor) for condition with a sparse ground layer. Anecdotal observations from the field included a lack of humus and leaf litter, and earthworm castings on the ground surface.

- Emerald ash borer (EAB) is a concern for the North Bay and Chamber's Grove project sites, as ash trees are an important component of plant communities in these areas. EAB is a beetle inadvertently imported from China that kills ash trees once it infests them. EAB is present in the Duluth area and is a significant threat to ash trees.

Invasive species

Invasive species have a variety of negative effects in an ecosystem. They can displace, weaken or kill desirable plants resulting in loss of diversity; pose human health risks; degrade wildlife habitat; interfere with recreational activities; disrupt urban and community ecosystems; and divert millions of dollars for their control (MN Invasive Species Advisory Council, 2015). Effects on human health can occur from certain invasive species, such as wild parsnip (*Pastinaca sativa)* which causes severe chemical burns on skin.

Invasive plants can quickly colonize areas with high levels of disturbance. Therefore, they are a concern wherever regular human use occurs. Compaction and erosion in high use areas such as trails provides more opportunities for invasive species to establish. Invasive species are better able to take advantage of these conditions than native species and can quickly populate disturbed sites.

Invasives may be introduced via hitchhiking of seeds on boots, tires, domestic animals, and equipment. They can also be spread by wildlife and domestic animals, and infestations can encroach from surrounding areas. Boats, trailers, and associated gear can also be a source of invasive aquatic species.

The NPC survey conducted in 2018 identified 10 invasive species that are present in infestations of 0.1 acre and greater in at least one project site in the St. Louis River Natural Area (Table 4). The species and locations of these infestations are provided in Figures 4-1 through 4-8 of the SEH (2018) report located in Appendix B of the SLRNA Nomination.

Table 4: Invasive Plant Species in the St. Louis River Natural Area in Infestations of 0.1 acre or Greater

Common Name	Latin Name	Project Sites
Canada thistle	*Cirsium arvense*	Grassy Point
Common buckthorn	*Rhamnus cathartica*	Chamber's Grove; Mud Lake; Tallas Island
False spirea	*Sobaria sorbifolia*	Tallas Island
Lily of the valley	*Convallaria majalis*	Chamber's Grove; North Bay; Munger Landing; Kingsbury Bay
Narrowleaf cattail	*Typha angustifolia*	Radio Tower Bay
Phragmites	*Phragmites australis*	Mud Lake; Munger Landing; Tallas Island; Grassy Point
Purple loosestrife	*Lythrun salicaria*	North Bay; Mud Lake
Reed canary grass	*Phalaris arundinacea*	North Bay; Kingsbury Bay
Siberian peashrub	*Caragana aborescens*	Mud Lake
Wild parsnip	*Pastinaca sativa*	Tallas Island

Human uses

Trails, both terrestrial and aquatic, provide important opportunities for people to connect with nature and improve health and well-being. However, disturbance of the natural area is inherent with human use. These disturbances can be threats to ecological function if human uses are not carefully considered and managed. A thorough review of available research in the US and aboard on the effects of recreation on the ecology of natural areas was conducted by Metro, the regional planning authority for the Portland, OR area (Henning, 2017). This section relies heavily on information summarized in this highly regarded literature review.

Trails and trail use have been found to have negative effects on soils, vegetation, water quality, plants, and wildlife (Henning, 2017). All human uses impact the ecology of a natural area in some manner. The level and type of impact is dependent both on the type of use and the frequency of use; no one user group has greater impacts in all categories. For example, hikers typically cause greater amounts of trail widening and associated impacts on vegetation; they are also likely the group most prone to creating unauthorized trails (in part because they are often the most common type of user and because they can readily move off trail on foot). Bikers can cause trail incision and have greater effects on wildlife than hikers. While it is important to understand possible effects by different user groups in order to properly plan for and manage impacts, it is also important to consider these impacts without bias towards any one set of users. Regarding impacts to trails themselves, the literature is inconclusive about which user group cause the most damage on a one-to-one basis (Henning, 2017).

Damage from trails is generally greatest during trail construction. Further impacts can and do occur over time from users. These include:

- Vegetation damage adjacent to trails
- Soil erosion and compaction
- Trail widening and incision

Effects on ecological processes by trails and trail use in a natural area can include:

- Riparian habitat and water quality – disturbed riparian vegetation; altered drainage patterns and increased runoff
- Habitat loss, fragmentation, and edge effects – altered vegetation structure and invasive species introductions along corridors; creation of zones of avoidance for wildlife
- Introduction of invasive species – trail users transport species along trail systems, with multi-use trails tending to have more invasive species than single-use trails

The use of OHVs is not authorized within City limits. Any use of OHVs on trails within the natural area exacerbates erosion, invasive species colonization, wildlife disturbance and user conflicts.

Boats, trailers, and associated gear provide a vector for transport of aquatic invasive species from one water body to another. Accessing water from non-designated access points can damage shoreline vegetation, disturb wildlife, and cause erosion.

OTHER KNOWN THREATS

Other known threats to the ecological integrity of the features for which the SLRNA was nominated to the DNAP include historic contamination and degradation of habitat in the St. Louis River AOC and water quality impairments in three trout streams and the St. Louis River. It should be noted that while these threats exist, the ecological integrity of the natural area is still intact and improving.

Historic Contamination and Degradation of Habitat

The SLRNA is located within the boundary of the St. Louis River AOC was listed by the International Joint Commission as one of 43 Great Lakes AOCs in 1987 because it was identified as an area where "…significant impairment of beneficial uses has occurred as the result of human activities at the local level" (Annex 1 of the Great Lakes Water Quality Protocol of 2012). Historical actions such as unregulated municipal and industrial waste disposal and unchecked landuse practices, including dredging and filling of aquatic habitat and damaging logging practices contributed to the complex set of issues facing the St. Louis River AOC at the time it was listed. By 1992, many of the discharges were eliminated or permitted with appropriate treatment as required by the Clean Water Act. The primary concerns for the AOC that remain are legacy contamination and historical habitat degradation. These sources of impairment led to the designation of nine of 14 possible beneficial use impairments (BUIs) as existing in the AOC.

Today, the St. Louis River AOC Remedial Action Plan (MNDNR and WDNR, 2019) describes the actions necessary to officially "delist" the AOC along with the degree of progress; the plan is updated every year. (For future updates go to the Minnesota Pollution Control Agency's website for the St. Louis River AOC). A number of actions in the Remedial Action Plan are located in the aquatic portions of the river immediately adjacent to the SLRNA (Figure 5), some of which have been completed. The green sites were selected for restoration and/or remediation and remedial decisions are being evaluated for the red sites based on historic habitat degradation and the presence of sediment contamination exceeding allowable thresholds. The required actions in the 2019 Remedial Action Plan for each of these sites are listed in Table 5. Restoration actions in or adjacent to SLRNA project sites have been completed at Chamber's Grove, Radio Tower Bay, and in the Knowlton Creek watershed. Restoration is underway at Kingsbury Bay, Grassy Point, and the wild rice restoration sites and will be started in the next year at the US Steel/Spirit Lake site (Figure 5). Planning for the

Perch Lake and Mud Lake restoration sites is underway. Remediation has been completed at the St. Louis River/Interlake/Duluth Tar Site and is expected to begin at the US Steel/Spirit Lake site in 2020. Work is underway to make remedial decisions at Mud Lake West and Munger Landing.

The MPCA and MNDNR will be implementing institutional controls and long term monitoring and maintenance plans as appropriate to each completed remediation and restoration sites.

The St. Louis River AOC remediation and restoration work is a huge investment by the community and its' implementing partners including: MPCA, WDNR, MNDNR, and Fond du Lac Band of Lake Superior Chippewa. The overarching goal for this area is to transform these remediation and restoration projects into sustainable revitalization of the surrounding community by maximizing, to the extent possible, the positive societal and environmental outcomes. NOAA recognized this goal by designating the estuary as a Habitat Focus Area. Through the SLRNA, the City is providing complimentary work to the AOC by preserving and protecting the terrestrial connection to this amazing aquatic resource. The City's goal is to continue to work with the AOC partners by managing and monitoring the upland and riparian native plant communities along the St. Louis River corridor.

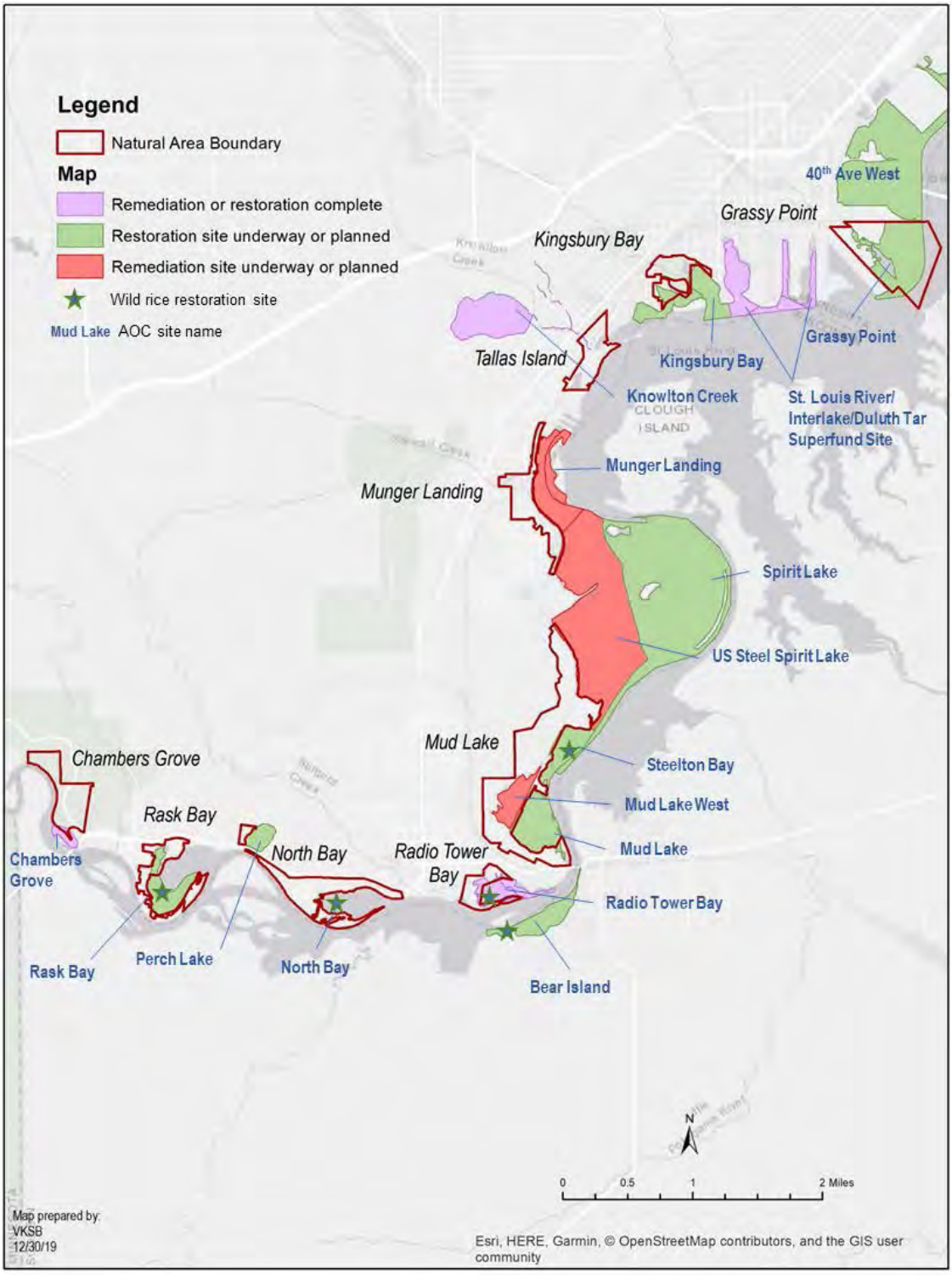


Figure 5: St. Louis River Area of Concern Sites Adjacent to the St. Louis River Natural Area

Note: Inclusion in the natural area is subject to landowner assent and land protection in accordance with the DNAP ordinance.

Table 5: St. Louis River AOC Projects Adjacent to the St. Louis River Natural Area

Note: this table is updated annually as part of the AOC's Remedial Action Plan updates which can be found on the MPCA's St. Louis River AOC website.

Project Name	AOC Action Number	Status	Project Description	Estimated Completion
Perch Lake	9.09	Pre-design	Revitalize biological connection between estuary and Perch Lake and restore optimum bathymetry	2021
Wild Rice Plan and Associated Restoration Sites	9.21	In progress	Develop a plan that identifies the high priority restoration sites and provides a process for restoring those sites. Restoration of 275 acres of wild rice.	2024
Mud Lake	9.08	Pre-design	Remediate contaminated sediments, establish more vital hydrologic connection and restore wetland habitat including wild rice; establish deep water.	2022
Mud Lake West	5.18	Remedial decision	Remediate contaminated sediments.	2020
US Steel/Spirit Lake	9.01	Design	Remediate contaminated sediments and restore emergent wetlands.	2023
Munger Landing	5.09	Pre-design	Remediate contaminated sediments.	2022
Kingsbury Bay	9.06	Construction	Restore wetland complex at the mouth of Kingsbury Creek to pre-1961 condition.	2021
Grassy Point	9.04	Construction	Remove non-native material and restore optimum bathymetry.	2020

Source: St. Louis River AOC 2019 Remedial Action Plan

Water Quality Impairments

Stewart Creek, Kingsbury Creek, Keene Creek, and the St. Louis River have been listed by MPCA as impaired in Minnesota's 2018 Impaired Waters List (MPCA, 2019). Impairments in these waterbodies are summarized in Table 6.

Table 6: Water Quality Impairments of Waterbodies in the St. Louis River Natural Area

Waterbody	Impaired Beneficial Use	Pollutant or Stressor
Stewart Creek	Aquatic recreation	E. coli
Keene Creek	Aquatic recreation	E. coli
Kingsbury Creek	Aquatic life	Aquatic macroinvertebrate bioassessment, Fishes bioassessments
St. Louis River - Fond du Lac Dam to Mission Creek and Mission Creek to Oliver Bridge	Aquatic consumption	DDT, dieldrin, mercury in fish tissue, mercury in water column, PCB in fish tissue, PCB in water column,
St. Louis River - Oliver Bridge to Pokegama River	Aquatic consumption	Mercury in fish tissue, PCB in fish tissue
St. Louis River - Pokegama River to Mouth of St. Louis Bay at Blatnik Bridge	Aquatic consumption	DDT, dieldrin, mercury in fish tissue, mercury in water column, PCB in fish tissue, PCB in water column, dioxin (including 2,3,7,8-TCDD), toxaphene

Source: Minnesota's Final 2018 Impaired Waters List

Potential sources of *E. coli* include from humans (e.g., leaking wastewater infrastructure, failing septic systems, homeless population), stormwater runoff, livestock, wildlife, and domestic pets. Storm sewer systems provide a vector for transport of pathogens deposited on the land surface into waterbodies. In addition, bacterial regrowth and naturalized *E. coli* strains in the environment can be a substantial source of *E. coli* to receiving waters, particularly in urban streams.

Total suspended solids (TSS) is the water quality parameter used as a surrogate to assess effects on aquatic macroinvertebrates and fish. Sources of TSS in the Kingsbury Creek watershed include streambank and bluff erosion, unstable gully and ravine tributaries, and overland runoff from urban areas (Tetra Tech, 2018b).

Many of the impairments in the St. Louis River are hypothesized to be the result of legacy contamination from historic industrial operations in the watershed. There were also municipal contributions and natural conditions that contributed to the perceived impairments. Dioxin is a biproduct of industrial processes, but can also be created by natural sources such as forest fires. Polychlorinated biphenyls (PCBs) are a group of manmade chemicals used historically in transformers, and electrical components, as well as paper products such as carbonless copy paper. Mercury is a ubiquitous metal pollutant in Minnesota waters due to atmospheric deposition; however, in the St. Louis River, it is also present from historic discharges. DDT, dieldrin, and toxaphene are insecticides.

Strategies

Strategies for managing native plant communities, special species, non-native or cultural plant communities, natural water features, bird habitat, invasive species, and trails within the SLRNA are described in this section.

NATIVE PLANT COMMUNITIES

The DNAP uses NPCs, defined according to MNDNR's *2005 Field Guide to Native Plant Communities of Minnesota*, to assess and manage all natural areas within the city. The classification of NPCs is a scientifically based method to assist understanding and managing an area's natural resources. A NPC is composed of plant species that were commonly associated prior to European development. Identifying a NPC today indicates a relatively high degree of naturalness, or lack of human disturbance. NPC species lists can also be used as a template for restorations or reintroductions. In addition to identifying NPCs, data can be collected to also identify growth stage and condition rank (a measure of quality).

Forest and wetland ecosystems rely on certain types of natural disturbance processes to recruit, and maintain their array of native plants and animals, recycle nutrients, and stimulate growth and reproduction. The techniques used to manage any vegetation should be based on mimicking, or using, the natural ecosystem processes that shape a particular NPC, such as fire, windthrow, or flooding.

Plant communities within the St. Louis River Natural Area will be managed to maintain or improve the condition rank of each NPC, while recognizing natural development through growth stages. Management actions should be aligned with an understanding of the timing, extent, severity, and frequency of natural dynamics of each NPC to the extent practicable.

Management recommendations follow for each of the major plant community systems in the St. Louis River Natural Area.

Mesic Hardwood Forest

Aspen – Birch – Basswood Forests (MHn35a), Red Oak – Sugar Maple – Basswood (Bluebead Lily) Forests (MHn35b), Aspen – Birch – Red Maple Forests (MHn44a), White Pine – White Spruce – Paper Birch Forest (MHN44b), Aspen – Birch – Fir Forest (MHn44d), Aspen – Ash Forests (MHn46a), Black Ash – Basswood Forests (MHn46b), and Sugar Maple – Basswood (Bluebead Lily) Forests (MHn47a)

Dry-mesic to wet-mesic forests occur on well-drained and loamy to poorly drained and clayey soils, often with high local water tables. They are generally located on level-ground over glacial lake deposits, moraines, or till plains, but occasionally over bedrock hills. These soil characteristics buffer these communities from drought; however, they only occasionally experience saturated soils after snowmelt or heavy rains. These moist, level soils create a rich humus layer that provides predictable access to water and nutrients. Accordingly, these forests are generally dominated by hardwoods such as sugar maple, basswood, paper birch, quaking aspen, black ash and northern red oak. Balsam fir is also a typical component of these forests. These forests have continuous, dense canopies that restrict the amount of light reaching the forest floor and have well-defined sub-canopy, shrub and herbaceous layers. Characteristic understory species are adapted to low-light conditions and include wild sasparilla (*Aralia nudicaulis*), canada mayflower (*Maianthemum canadense*), dwarf raspberry (*Rubus pubescens*), sweet-scented bedstraw (*Galium triflorum*), large-leaved aster (*Eurybia macrophylla*), lady fern (*Arthyrium felix-femina*), rose twisted stalk (*Streptopus roseaus*), and

pennsylvania sedge (*Carex pensylvanica*). The shrubs beaked hazelnut (*Corylus cornuta*), chokecherry (*Prunus virginiana*), and fly honeysuckle (*Lonicera canadensis*) are also common. Unique spring ephemerals are also found in these forests, and capture light and energy before full canopy closure.

The typical source of mortality in these systems is windthrow or other small-scale disturbances, with fire uncommon due to the moist soils. In general, these systems, once mature, can operate for thousands of years with little management. Catastrophic disturbances such as fire or large windthrow events occur approximately every 1000 years. Patchy windthrow or light surface fires happened more often, about every 150 years.

Management: These systems generally require low maintenance once mature. Patchy windthrow is the most common disturbance and still operates in these areas today. Allowing this type of disturbance to proceed naturally will be the main management action required in these areas, with monitoring and response to invasive species colonization following disturbance. However, these forests do have various stages of development, from young to mid-aged to mature forests, and successional progression may need to be assisted in certain areas. Aspen dominate in young stands but are replaced by later successional species such as white pine, sugar maple, basswood, white spruce and yellow birch in older stands. In densely overgrown areas, selective clearing of aspen accompanied by planting of late successional species could speed progression towards mature mesic hardwood forests. The planting of long-lived conifers, such as white pine, spruce and cedar, is especially recommended as they suffer from over browsing by deer, and protection from deer browse will be required. Finally, due to logging and other human disturbances, the amount of mature mesic hardwood forests in Minnesota has declined substantially. Therefore, maintaining as much of this community in older age classes as possible is desirable.

Additional management concerns include invasive species, erosion and trails, and forest pests and diseases. First, these communities can be prone to invasion by non-native species. Ongoing monitoring and control of invasive species, such as buckthorn, non-native honeysuckles, and garden lily of the valley (C*onvallaria majalis*) will be required. Additionally, invasive earthworms reduce the humus layer in these forests and threaten to permanently change the community composition of these systems. Reducing the spread of these invaders will help maintain the full diversity of mesic hardwood systems. When repairing and maintaining trails, care needs to be taken to avoid working these areas when soils are saturated, generally in the spring, which compacts soils and destroys plants and plant roots. Trails also need to be planned so that they drain away water and maintain a dry surface during these times. Trails can damage fragile understory plants in these areas. Forest pests and diseases can be major threats to healthy forest systems and continual attention should be paid for unusual symptoms of decline in tree species.

Floodplain Forests

Black Ash - Silver Maple Terrace Forest (FFn57a)

Flood plain forests are wet-mesic deciduous forests on silty or sandy alluvium on level sites associated with rivers. They are high enough for only occasional flooding which occurs every 5 to 20 years. Mature forests are naturally dominated by American elm, black ash, and green ash mixed with some bur oak, basswood, and white spruce. This community increasingly includes silver maple as a significant component of the canopy. This plant community is stable and normally driven by individual windthrow or rare flood disturbance. Stand replacing events happen extremely rarely, occurring every 600 years or longer.

Management: The objective for floodplain forest management is the mature growth stage. Natural windfall events will create adequate regeneration. Active forestry is not recommended for this plant community. However, response to EAB may be advised. Individual or small group selection of green and black ash with replanting of silver maple, white spruce, or basswood will keep this plant community intact. Mesic to moist soil conditions can be conducive to exotic species, such as buckthorn, invasion following natural or man made clearing and disturbance. Trail routing and building should consider river terrace soils may be saturated for long periods; appropriate methods should apply. Monitoring for invasive species and response should follow wind throw events and new trail work.

Wet Forests

Black Ash - Aspen - Balsam Poplar Swamp (Northeastern) (WFn55a)

Wet forest systems are hardwood forests on wet, mucky mineral soils in shallow basins and groundwater seepage areas and on low, level terrain near rivers, lakes, or wetlands. Standing water is typical in the spring and grading from wet to dry by late summer. Forest is stable in species composition and can consist solely of black ash or black ash mixed with other hardwood species including alder, basswood, red maple, quaking aspen, green ash, balsam poplar and, yellow birch and white cedar.

Management: The objective for wet forest communities in the SLRNA is to manage for mature growth stages with limited presence of non-native species. Timber harvest is not recommended for these plant communities. Natural windfall events will create adequate opportunities for regeneration. However, response to EAB impacts may be advised. Planting of red maple, northern white cedar, basswood, and yellow birch in gaps created by windfalls or in areas of mortality caused by EAB may keep these plant communities intact. Wet soil conditions can be conducive to invasive species, such as reed canary grass, with invasion following natural or manmade clearing and disturbance. Trail routing should be avoided in wet forest community types. Where trails are necessary, raised boardwalks should be used to avoid negative impacts to the soils and plant communities. Monitoring for invasive species and response should follow wind throw events and EAB treatments.

Shrub Swamps

Willow - Dogwood Shrub Swamp (WMn82a) and Alder Swamp (FPn73a)

Shrub swamps are open wetlands dominated by dense cover of broad-leaved graminoids and tall shrubs. These communities are typically present on mineral to sapric peat soils in basins and along streams. Tall shrubs such as willows (*Salix spp.*), red-osier dogwood (*Cornus sericea*), and speckled alder (*Alnus incana*) can be dense, along with meadowsweet (*Spiraea alba*). Paper birch, black ash, red maple, American elm, and tamarack saplings are occasionally present in the shrub layer. Trees taller than 16ft (5m) are rarely present and if so, have less than 25% cover. Peak water levels are high enough and persistent enough to prevent trees from becoming established, although there may be little or no standing water much of the growing season. The invasive species common reed grass (*Phragmites australis*) and reed canary grass (*Phalaris arundinacea*) have become increasingly abundant in this community type over the past several decades, reducing species diversity in many occurrences.

Management: Maintain NPC as is, discourage invasive species including Phragmites ssp. and purple loosestrife by limiting disturbance. An early detection and treatment plan for these species should be developed and implemented to ensure treatment of small patches of invasive plants before they spread. Shrub swamps don't exhibit age related growth stages. Die-back and community composition changes can be seen when water levels remain higher or lower for extended periods.

Wet Meadow and Marsh

Cattail - Sedge Marsh (Northern) (MRn83a) and Sedge Meadow (WMn82b)

Emergent marsh communities are typically dominated by cattails in areas where standing water is present most of the year. They can be present as floating mats along shorelines in lakes, ponds, and river backwaters or rooted in mineral soil in shallow basins. Vegetation is often composed of dense stands of cattails interspersed with pools of open water. Shallow water wetlands throughout much of the state have been invaded by dense stands of the non-native species narrow-leaved cattail (*Typha angustifolia*) and hybrid cattail (*T. x glauca*). Marshes dominated by the native species broad-leaved cattail (*T. latifolia*) are considered higher-quality and are increasingly rare in Minnesota. Substrate surface is usually covered with plant litter, especially dead cattail stalks. Marshes are transitional between shallow aquatic communities and wet meadows.

Management: The objective for these communities is to manage to enhance sedge marsh and sedge meadow characteristics. Cattail often comes to dominate these communities in stable conditions, decreasing plant diversity and lowering habitat quality for wildlife. Occasional physical disturbance by mechanical removal, prescribed burning, or water level management will benefit these communities. Trail routing should be avoided in wet meadow and marsh community types. Where trails are necessary, boardwalks should be used to avoid negative impacts to the soils and plant communities.

Estuary Marsh

Estuary Marsh (Lake Superior) (MRu94a)

These emergent marshes only occur in estuaries at river mouths along the shore of Lake Superior. Vegetation consists of a variable mixture of species, typically with a dense layer of submerged plants under and between floating-leaved and emergent aquatic plants. Cyclic wind-driven changes in lake level cause changes in local water levels resulting in water levels oscillating up and down similar to tidal effects. These oscillations can reverse the flow of these tributary rivers and function to flush sediment, move nutrients, and change water surface elevations. Water surface elevation changes, normally ranging between 1 to 10 inches, are the primary mechanism limiting dominance of these marsh communities by cattail. Water levels in coastal marshes are also influenced by river flooding from runoff following snowmelt or heavy precipitation. Estuary marsh generally has higher species diversity than cattail marsh.

Management: Estuary marsh is listed by MNDNR as a community of special conservation need with a conservation status rank of “critically imperiled”. Management objectives are to maintain or restore the open and diverse growth forms found in this community. Stabilizing water levels, reducing flow rates, and filling or hardening shoreline promotes invasion by cattail mats reducing the open water, species diversity, and aquatic habitats characteristic of estuary marsh. Land use planning that allows for migration of these communities up and down slope as water levels fluctuate can benefit the long term health of the estuary marsh.

Sparse Vegetated Upland

Dry Sandstone Cliff (Northern) (CTn11e), Wet Sandstone Cliff (Northern) (CTn42d)

Both wet and dry sandstone cliff communities are open communities on moderately acidic cliffs composed of quartz sandstone. Differences in the two communities arise from their moisture level due to their orientation (south- to west-facing, sunny cliffs or shaded northwest- to east-facing). Few records are available on the

flora of these communities. Birds-eye primrose (*Primula mistassinica*) and shrubby cinquefoil are present on one known occurrence of CTn42d in Hinckley.

Management: These communities are highly restricted in area because they occur only on vertical, or nearly vertical sandstone. The primary location for this NPC is on the exposed rock faces of the abandoned quarry west of Chambers Grove Park. The bedded sandstones along the lower St. Louis River are weak and brittle and unsuitable for climbing or trails. Only hardy plants can survive the conditions and the species tend to be slow growing and long lived. Therefore, the community tends to be stable and the best management for these communities is protecting them from human disturbances such as climbing, unauthorized trails, and other direct impacts. However, trails, or other human use in the near these communities, such as the trails through the quarry, do not now have a detrimental effect. Exotic plant invasion is unlikely because of the extremely harsh growing conditions on the rock.

SPECIAL SPECIES

To protect the three sensitive plant species, locations of the occurences are not available to the public. The City will consider the locations of these populations when planning future human use or land management actions. Unauthorized trails within Chamber's Grove are a threat to habitat for soapberry (*Shepherdia canadensis*). Efforts will be undertaken to close these trails and discourage additional unauthorized trail creation, as described in the Prioitized Actions section below. Additional recommendations may be made for these species following coordination with MNDNR ecologists.

For the 52 sensitive bird species, the strategies that support healthy NPCs and water features will serve to protect the habitat for these species.

CULTURAL OR NON-NATIVE PLANT COMMUNITIES

In general, the DNAP program encourages the establishment of NPCs to the extent possible. Cultural or non-native plant communities exist on approximately 15% of the natural area (City of Duluth, 2019). These are areas with cultural influences on the land cover and include transportation corridors (e.g., railroads, streets), invasive species, restoration areas, and old fields. These areas are included in the natural area because they are limited patches surrounded by NPCs and have the potential to reduce fragmentation; in addition, some have potential to be restored with management actions (such as invasive species control). The plant community survey provides valuable information on possible NPC targets for these areas.

The current focus of plant community restoration within the SLRNA is within Grassy Point, as described in the Prioritized Actions below.

INVASIVE SPECIES

Invasive plant species are present throughout the SLRNA and the City of Duluth. Their control is an integral part of stewardship efforts. Management must address both existing infestations, as well as the ongoing possibility of introduction of new seeds through human use and disturbance.

Control of Existing Invasive Infestations

The City will continue to work with partners to control infestations of invasive plant species within the SLRNA and to continually assess available control techniques for invasive species.

Management of New Introductions

Because of the many human uses within the project sites of the SLRNA, management of new introductions of invasive species is vital to long term control or eradication. This must include both education of all natural area users and requirements for use of best management practices (BMPs) for restoration and maintenance activities.

The City and its partners will work in partnership to address both education and control of invasive species. Future management efforts, including detection, monitoring, and treatment of invasive species will be managed according to the City's invasive species management plan. A draft plan of past and on-going work is being used until it is incorporated into a comprehensive natural resource management plan. See Prioritized Actions below for description of work anticipated in 2020-2022.

NATURAL WATER FEATURES

Strategies for managing the natural water features of the trout streams and the St. Louis River estuary are described in this section.

Trout Streams

Knowlton Creek, Stewart Creek, Kingsbury Creek, and Keene Creek are class 2A waters under Minnesota Rule 7050.0470. The rule states that the quality of these waters shall be such as to permit the propagation and maintenance of a healthy community of cold water aquatic biota, and their habitats. In addition, these waters shall be suitable for aquatic recreation of all kinds, including bathing. This class of surface waters is also protected as a source of drinking water" (Minnesota Rule 7050.0222), though none of these creeks serve as drinking water sources for the City.

Management of these trout streams and their surrounding landscapes within the SLRNA need to comply with water quality standards appropriate to the class 2A designation, as specified in Minnesota Rule 7050.0222 and to support the health of the unique cold water fisheries.

Total Maximum Daily Loads (TMDLs) are in draft form for Stewart Creek, Keene Creek, and Kingsbury Creek. As a permtted municipal separate storm sewer system (MS4), the City of Duluth will receive wasteload allocations (WLAs) for their portion of the TMDLs once the they are approved and will be responsible for implementing actions to meet these WLAs. The City will also particiate, along with multiple stakeholders, in addressing the load allocations (LA) for the non-permitted pollutant sources, such as pet waste, channel erosion, failing septic systems, and wildlife.

The overwhelming majority of the watersheds for Stewart, Kingsbury, and Keene Creek are located upstream of the SLRNA project sites in which the creek mouths are located. Therefore, the focus of management efforts will be predominantly outside of the natural area. Stream restoration projects are planned by MNDNR for Kingsbury Creek and Keene Creek in reaches of those streams just upstream of the natural area boundaries.

St. Louis River Estuary

The St. Louis River is a class 2B water under Minnesota Rule 7050.0470. The rule states that the quality these waters shall be such as to permit the propagation and maintenance of a healthy community of cool or warm water aquatic biota, and their habitats…". These waters shall be suitable for aquatic recreation of all kinds, including bathing. This class of surface water is not protected as a source of drinking water.

Management of the landscapes contributing to the St. Louis River within the SLRNA shall comply with water quality standards appropriate to the class 2B designation, as specified in Minnesota Rule 7050.0222 and to support the health of this ecosystem that is vital to the region and Lake Superior.

TMDLs for toxics have yet to be completed for the St. Louis River impairments.

The shallow sheltered bays of the St. Louis River located adjacent to the SLRNA project areas (i.e., Rask Bay, North Bay, Radio Tower Bay, Mud Lake, Kingsbury Bay, and Grassy Point) are an important habitat type within the estuary. As described above, significant remediation and restoration efforts have been undertaken or are planned for most of these bays as part of the delisting process for the St. Louis River AOC, including restoration of wild rice. The presence of the SLRNA immediately surrounding these bays provides opportunity to further support these efforts through land protection and the recreational amenities identified in Table 2. Management of the SLRNA will consider the vital connection of riparian areas of these bays with the adjacent terrestrial areas to support healthy wetland ecosystems.

BIRD HABITAT

The SLRNA is nesting and stopover habitat for at least 169 species of birds, including 52 species of concern (NRRI, 2018) and is a key reason for designating the SLRNA. Further, as described in the SLRNA Nomination (City of Duluth, 2019), Audubon has designated the estuary, from Chambers Grove downstream to Lake Superior and southeast to Wisconsin Point, as an “Important Bird Area” (IBA), because of its’ significance as a migratory corridor for birds.

The City will continue to work with partners to provide for restoration and enhancement of avian habitats within and adjacent to the SLRNA. Implementing the strategies for maintaining or improving NPCs, controlling invasive species, and management of human uses will support vibrant bird habitat in the natural area.

The University of Minnesota Natural Resources Research Institute completed further analysis of the 2018 bird survey data for the SLRNA (original survey data can be found in Appendix C of the SLRNA Nomination) along with other recent and historical survey data to identify bird-habitat associations to help guide restoration and conservation efforts. The analysis, which can be found in Appendix A, indicates the importance of emergent wetland habitats, located throughout the SLRNA, for birds in the estuary. In addition, this work identified the importance of restoration of emergent wetland habitats in the more highly developed areas situated in the lower estuary, such as Grassy Point. Results of this work will be used to inform restoration of the Grassy Point in the Grassy Point Revegtation Project described below.

TRAILS

Trails allow citizens to recreate and experience the benefits of nature within the natural area. The Waabizheshikana (Marten Trail) Mini-Master Plan (City of Duluth, 2019) describes planned extensions of the Waabizheshikana and associated facilities, incuding river access points for the St. Louis River Estuary National Water Trail (designation pending), from Tallas Island to Chamber’s Grove.

All trail construction, restoration, and realignments must follow best practices in sustainable trail design, management, and maintenance principles and must consider impacts to NPCs and natural water features. The City will work with their partners to maintain the trail system and to educate users on proper BMPs related to trail use (e.g., invasive species and erosion control).

Impact reduction must also include proper trail maintenance, prevention of unauthorized trail segments, and education of users regarding appropriate trail use and BMPs for invasive species control.

Unauthorized "social" trails and water-based landings are not allowed within the natural area. Social trails are generally created by members of the general public versus members of organized groups. The City will work with partners to eliminate unauthorized trails and educate users about the negative impacts of unauthorized trail creation. Water access features and education as part of the proposed National Water Trail will be used to help prevent unauthorized landings.

OHV use is strictly prohibited within city limits. Damage to trails from these vehicles can be severe.

Implementation

Management of natural resources in the SLRNA will rely on the approaches described in the previous section. A set of prioritized actions has been selected based on the identified threats to ecological function in the natural area. The prioritized actions with associated timelines and costs, as well as partner responsibilities for implementing this St. Louis River Natural Area Management Plan are described in this section.

PRIORITIZED MANAGEMENT ACTIONS

Four prioritized actions have been identified for the St. Louis River Natural Area. These are summarized in Table 7 and described below.

Funding will be sought from appropriate sources for these projects. Possible sources include: Great Lakes Restoration Initiative, Conservation Partners Legacy Fund, NOAA Coastal Program, and the National Fish and Wildlife Foundation Sustain Our Great Lakes program.

Table 7: Prioritized Actions for the St. Louis River Natural Area

Action	Cost	Responsible Parties	Target Completion Date
Special Plant Species Evaluation	None.	City of Duluth	2020
Invasive Species Control and Re-Planting with Native Species	$165,000	Community Action Duluth or other contractor	2025
See comment			
Address Unauthorized Trails, Landings, and OHV Use	$7,500	City of Duluth	2022
Grassy Point Revegetation Project	Funds secured.	Minnesota Land Trust, MNDNR	2022
Coordination with MPCA and MNDNR on St. Louis River AOC Projects	None.	City of Duluth staff	2025
Land Acquisition	To be determine by appraisals	City of Duluth	2025

Special Plant Species Evaluation

The City will coordinate with MNDNR ecologists to identify potential habitat protection and management needs for pale sedge (*Carex pallescens*), discoid beggarticks (*Bidens discoidea*), and soapberry (*Shepherdia canadensis*). No funds are needed for this initial task. The evaluation will be completed in 2020.

Invasive Species Control and Re-Planting with Native Species

The City is working with contractors to control invasive species along the St. Louis River corridor. Figure 6 and Figure 7 show the quality of the NPCs with locations where invasive species have been identified inside and outside the SLRNA. The purple dots are areas noted in the 2018 plant survey where infestations are greater than a tenth of an acre and the blue dots are invasive species locations identified by the public and verified by the Minnesota Department of Agriculture through a computer application called EDDMaps (Early Detection and Distribution Mapping System). A total of 382 acres have been treated since 2015 and trees and shrubs have been planted in some locations as well. Funding is being sought from the Great Lakes Restoration Initiative through the US Environmental Protection Agency as well as other potential sources to continue to control invasives and manage the existings plantings as necessary. This work is planned for 2020-2022 and is estimated to cost $165,000.

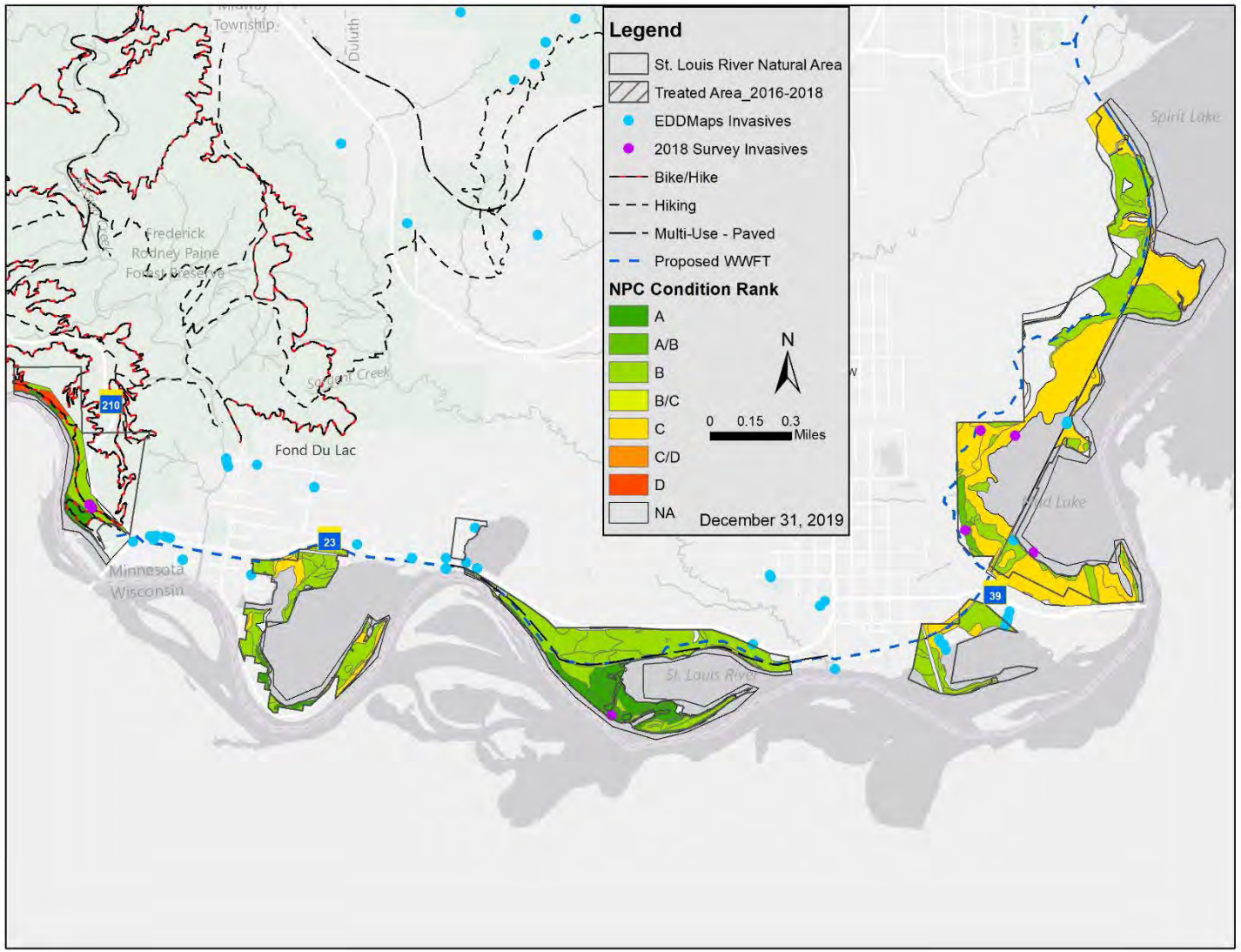


Figure 6: Priority Invasive Species Control Areas for 2020-2021 in the SLRNA

Note: Inclusion in the natural area is subject to landowner assent and land protection in accordance with the DNAP ordinance.

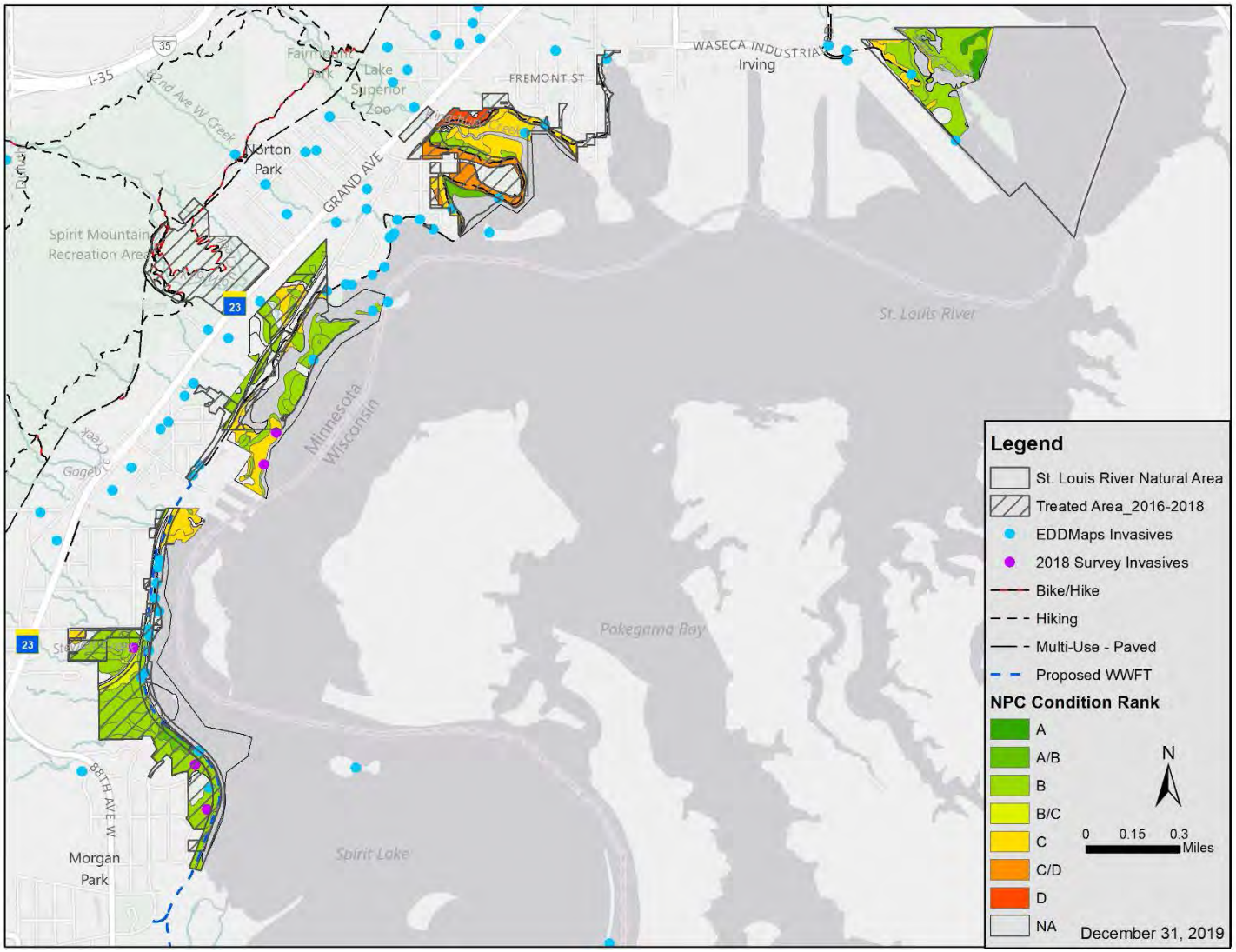


Figure 7: Priority Invasive Species Control Areas for 2020-2021 in the SLRNA

Note: Inclusion in the natural area is subject to landowner assent and land protection in accordance with the DNAP ordinance.

Address Unauthorized Trails, Landings and OHV Use

Unauthorized trails were identified as threats in Chamber's Grove, North Bay, and Munger Landing with OHV use occuring in North Bay and Munger Landing. In addition, the City is aware that unauthorized foot trails and water landings occur. The City will develop an approach for addressing unauthorized trails, landings and OHV within the natural area, with a focus on these three project sites for OHV and trails and review potential concerns along the corridor for water landings. Most likely this work will consist of an information and education campaign along with signage and barricading at select locations. Funds required for this effort are estimated at $7,500. This initial work is expected to begin in 2022 after much of the construction that is underway or planned for the near future has occurred.

Coordination with MPCA and MNDNR on St. Louis River AOC Projects

City staff have been assigned to each of the St. Louis River AOC sites for which designs and construction are not yet complete. Staff are involved in the in-water restoration planning, design, and construction for Grassy Point, Kingsbury Bay, Perch Lake, Mud Lake, US Steel/Spirit Lake, Munger Landing, and wild rice restoration to ensure communication, cooperation and terrestrial issues on City land are represented. This includes recognition of current and future human uses planned for each site, as well as the important ecological values in relation to the adjacent natural area. It is anticipated that the remediation and restoration work will follow the estimated timelines listed in Table 5. No outside funds are required for this effort.

Grassy Point Revegetation Project

This project compliments the St. Louis River AOC in-water restoration project at Grassy Point and Kingsbury Bay. The AOC project is underway and consists of the removal of accumulated sediments, wood waste, and historic wetland fill. The bathymetry will be restored to provide for a sheltered bay habitat. The Grassy Point Revegetation Project, which focuses on the terrestrial areas of Grassy Point, will follow in-water construction to maximize migratory bird habitat value of adjacent wetland and upland areas. The work includes invasive species control (e.g., Phragmites, narrow leaf cattail, buckthorn) followed by revegetation of terrestrial native plants (i.e., grasses, forbs, shrubs trees). Invasive species control in areas proximal to the project is included to reduce the potential for spread and colonization by invasive plant species in the periphery (Figure 7). Minnesota Land Trust is leading this effort with involvement from the City, MNDNR, University of Minnesota Natural Resources Research Institute, CISMA, Community Action Duluth, and US Fish and Wildlife Service. Funding has been secured. Work is anticipated to be complete in 2022.

Land Acquisition

City staff will work to secure funding for acquisition of private and State of Minnesota tax forfeit properties within the SLRNA. Costs for aquisition of these properities will be determined by property appraisals. This effort, which is contigent on landowner assent, is anticipated to be complete in 2025.

RESPONSIBILITIES

Responsibilities for implementation of this SLRNA Management Plan are described in this section.

City of Duluth

The city of Duluth is responsible for implementing the strategies and prioritized actions described in this plan. The City will work in close collaboration with partners to implement the plan.

The City will present annual progress updates on the plan to the City of Duluth Natural Resource Commission.

Trail User Groups

Implementation of this plan requires cooperation and participation of the user groups responsible for trails management and repair. In particular, partners will be asked to:

- Develop user education on appropriate trail use with the City. The issues to be addressed include, but are not limited to the following key messages:
    - Stay on the trail to minimize trail widening and trampling of native vegetation
    - Stay off trails when they are wet
    - Clean bikes, shoes, and other equipment regularly to minimize introduction of invasive species
    - Unauthorized trails are strictly forbidden
- Use sustainable trail construction techniques
- Implement BMPs for invasive species control during all maintenance and construction activities
- Train all volunteers and contractors to comply with sustainable trail construction and invasive species BMP requirements
- Trail restoration/realignment efforts must be reviewed for compliance with this plan

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Appendices

Appendix A: Let the Birds Guide You Final Report

NRRI Technical Report – December 2019

Minnesota Land Trust
Final Report - Let the Birds Guide You

Submitted by:

Alexis Grinde, Nick Walton, Annie Bracey, and Alexis Liljenquist

Date:
December 2019

Report Number:
NRRI/TR-2019/70

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

PROJECT OVERVIEW

Identifying environmental and habitat characteristics associated with specific bird communities can help guide conservation and habitat management efforts. The goal of this project was to quantify and characterize bird communities in the St. Louis River Estuary (SLRE) based on bird-habitat associations. Bird communities are commonly described with respect to their associated cover types (i.e., habitat). However, birds often respond to combinations of local cover types and larger-scale landscape features (e.g., forested wetlands in proximity to emergent wetlands), which are not adequately described by a single attribute such as dominant plant species or aquatic habitat type. Therefore, to understand bird species' ecological needs and habitat preferences, we evaluated community assemblages without initially linking the locations sampled for birds with standard habitat categories.

Bird assemblages were first identified using hierarchical cluster analysis, which revealed relationships among locations sampled within the SLRE based solely on bird species composition. This approach identified assemblages of species that tend to co-occur irrespective of traditionally defined habitat types. We used percent perfect indication (PPI) models to identify which species or groups of species were most strongly associated with specific landscape features. We also assessed habitat availability at the landscape-scale (i.e., within a 400m buffer from the shoreline) to identify specific features that are under-represented in the SLRE but likely important to a species or group of species. We also quantified species relative abundance, richness, and diversity throughout the SLRE to identify locations of high use and diversity. Once those locations were identified, we summarized local-scale habitat data define vegetation characteristics at locations with the highest and lowest species richness. Together, these analyses will provide a holistic assessment of the environmental and habitat requirements of migratory and breeding birds at multiple spatial scales. We quantitatively assessed which landscape and habitat characteristics are most likely to be beneficial for birds that use the SLRE and, ultimately, to assist in informing habitat management objectives for current and future projects in the area.

AIMS AND OBJECTIVES

Our first objective was to identify bird community assemblages using bird survey data collected by researchers at Natural Resources Research Institute (NRRI). NRRI has conducted bird surveys throughout the SLRE for a variety of projects since the 1970s. The purpose of these surveys was to document bird use throughout the SLRE, including specific locations identified as targets for current and future habitat restoration (e.g., 21st and 40th Avenues West). These bird data were the basis for our analyses. Our second objective was to quantify spatially explicit environmental variables and habitat characteristics associated with the NRRI bird surveys. Because the SLRE is an important stopover location, where birds rest and forage during migration, it was critical to quantify these associations for migrating birds in addition to breeding birds. To identify which environmental and habitat variables were associated with current bird use, we used data from a variety of regional and local sources, which are described in detail in the Methods section.

The overall aim of this study was to identify how species assemblages relate to specific landscape features and cover types. By combining NRRI's bird surveys with environmental and cover type variables, we were able to quantify current habitat availability and provide management guidelines for restoring habitat that is lacking for the bird communities described, guilds, as well as for individual species of interest. For example, we specify use by species of greatest conservation need (SGCN),

defined by the Minnesota Department of Natural Resources (MNDNR) as species whose populations are rare, declining, or vulnerable to decline and below levels desirable to ensure their long-term health and stability (MNDNR 2006). Management recommendations include restoration efforts that promote the long-term maintenance of hemi-marsh condition (ratio of open water to emergent vegetation), planting of native perennial vegetation to provide food and cover for a variety of bird species, and using islands to increase mudflat availability for migrating shorebirds. Based on our findings, additional recommendations are provided at the close of this report. Our results will inform restoration goals aimed at maximizing bird biodiversity, benefiting species of conservation concern and to guide current and future restoration efforts in the SLRE.

METHODS

Study Sites and Data Sources

A total of 107 bird survey point-count locations occurring within the SLRE were included in our analyses. These locations spanned from the Duluth-Superior harbor to up-river locations near Chambers Grove (Fig. 1). The spatial extent of these surveys provided an adequate representation of current bird use in the SLRE. Surveys occurred along a gradient of human disturbance, from highly developed (e.g., Minnesota Slip) to primarily forested (e.g., Pokegama River). There were a variety of land cover types surrounding the point-count locations, with many having a mix of emergent wetlands, forested wetlands, shrub/scrub, upland forest, and developed land.

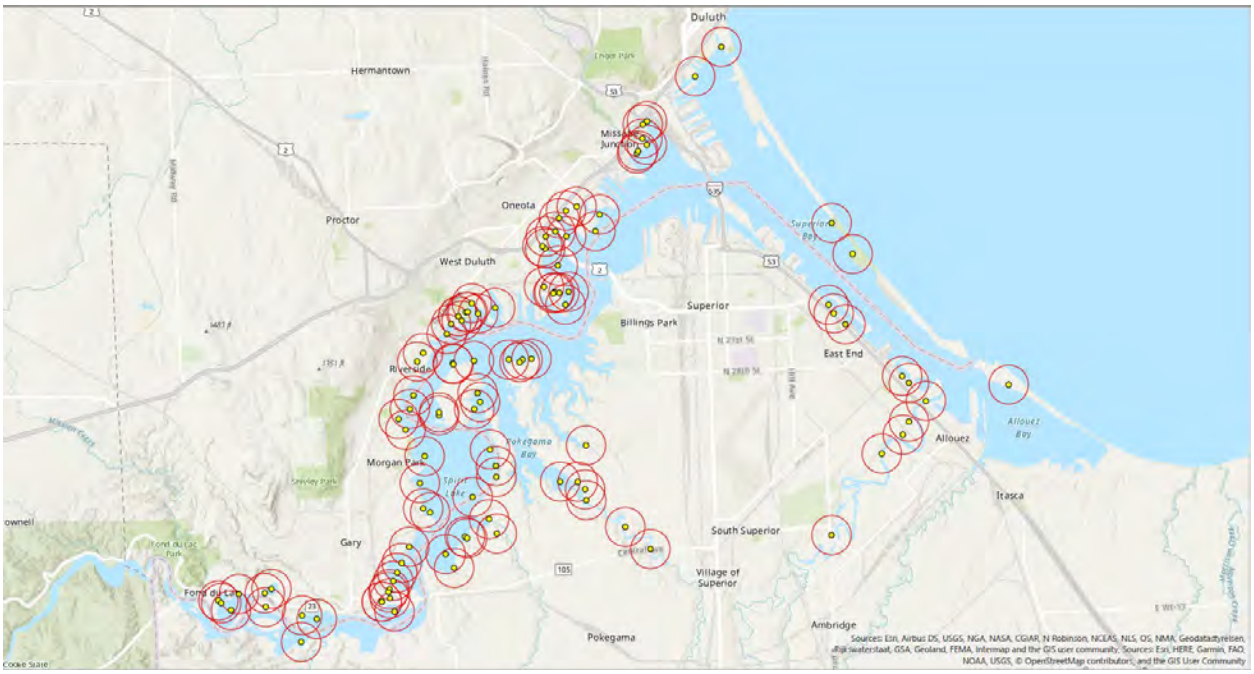

Figure 1. Map of bird point-count locations within the St. Louis River Estuary (*n* = 107). The red circle around each point-count location represents a 500m buffer from which we extracted environmental variables.

Bird Data

We included only current bird survey data collected by NRRI researchers (2011–2018). We restricted our analyses to include only these years because they are most representative of current conditions in the SLRE, and therefore will be most useful for informing current restoration and management efforts. Additionally, many of the bird surveys conducted prior to 2011 either used different sampling methodologies, did not have enough metadata to determine spatial extent or effort, or had no existing land cover or habitat data available.

We used point-count surveys to determine bird use in the SLRE. These surveys are a tally of birds detected by sight and sound at a fixed location during a specified period of time by a trained observer. Bird surveys were conducted during spring (April – early May) and fall (August – November) migration as well as during the breeding season (May 25 – July 10). We combined data collected by NRRI researchers from three sources: 1) Minnesota Pollution Control Agency St. Louis River AOC R2R Support Project: Ecological Monitoring and Assessment (Bracey et al. 2016); 2) Minnesota Land Trust Avian Surveys for the St. Louis River Natural Areas Project (Liljenquist et al. 2019); and 3) the Great Lakes Coastal Wetland Monitoring Program (CWM; https://www.greatlakeswetlands.org/Home.vbhtml). See Bracey et al. (2016) for detailed information about how bird surveys were conducted for both migration and breeding season counts.

Landscape and Local Vegetation Data

We quantified landscape- and local-scale variables from the following sources: 1) The National Oceanic and Atmospheric Administration (NOAA) C-CAP Regional Land Cover; 2) the U.S. Fish & Wildlife Service (USFWS) National Wetland Inventory; and 3) The St. Louis River Estuary Vegetation Database (Danz et al. 2017). Large-scale environmental variables (NOAA C-CAP and USFWS National Wetland Inventory) were quantified within a 200m and 500m circular buffer placed around the center of each bird survey location. We chose 200m and 500m buffers because this adequately captured the scales at which birds select resources and observations were made. The local habitat variables (Danz et al. 2017) were restricted to vegetation surveys conducted within a 200m buffer around each bird survey location, a spatial extent that appropriately described the wetland habitat within each survey location and that is also useful for restoration projects.

Patch Analyst (Rempel et al. 2012) in ArcGIS (ESRI 2019) was used to extract NOAA C-CAP land cover and USFWS National Wetland Inventory wetland classes within each 500m buffer around point-count locations. Extracted area values were converted to percent area per buffer. Land cover and wetland classes used in the analyses are listed in Appendix A. The same process was used to extract land cover occurring within the SLRE from Allouez Bay to Chamber's Grove. We chose to delineate this spatial extent of the river because it encompasses the wetland areas most likely to be chosen for restoration. Land cover and wetland classes were extracted from a 400m buffer (200m on land and 200m in the river) along the shoreline of the SLRE on both the MN and WI sides (Fig. 2).

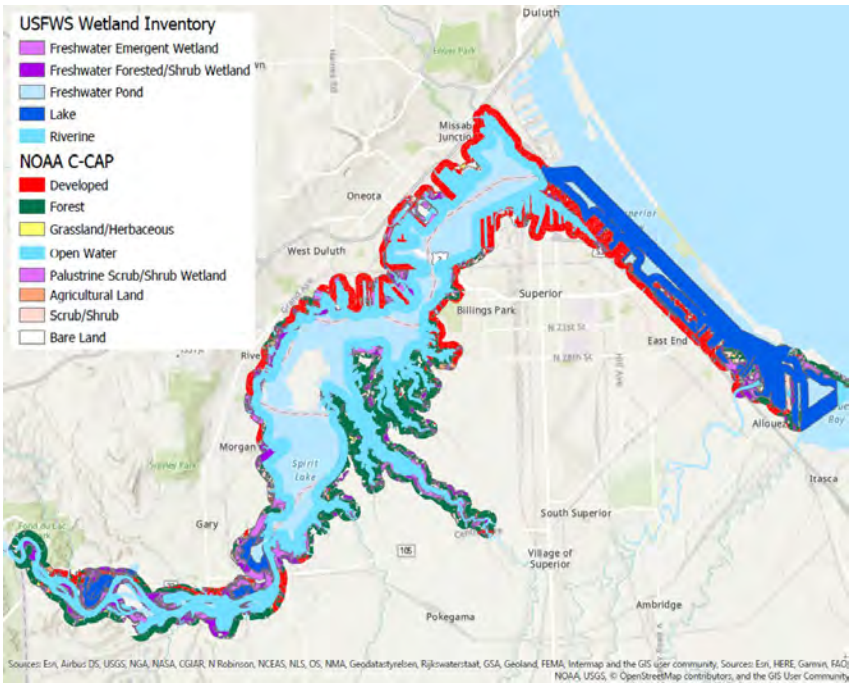

Figure 2. Map of land cover and wetland cover types from USFWS Wetland Inventory and NOAA C-CAP data. Calculations of cover types were restricted to a 400m buffer along the shoreline of the SLRE, from Allouez Bay to Chambers Grove.

We restricted local vegetation variables (Danz et al. 2017) to those that fell within a 200m buffer around each point-count location. Because of the magnitude of the 2012 flooding, we used the following rules to select local vegetation data that aligned best (temporally) with the bird data: 1) if a bird survey year was < 2012: select closest year before 2012; 2) if a bird survey year was ≥ 2012: select closest year after 2011; if no data matching were found in 2 or 3: select closest year ignoring 2012; and 4) select a sample at random if more than one is available from the selected year. Descriptions of local vegetation variables included in the summaries can be found in Appendix B.

Analytical Methods

For all analyses, unknown bird observations and flyovers were excluded. A total of 36,540 individual birds of 169 species were detected for all surveys and seasons combined. The number of bird surveys conducted and species detected varied by season (Table 1). All analyses were conducted independently by season using R version 3.6.1 (R Core Team 2019).

Table 1. The number of individual birds of known species detected during each season (spring migration, breeding season, fall migration) is provided along with the number of species detected, number of point-count surveys conducted, number of point-count locations, and years in which surveys were conducted.

Season	Number of Individuals	Number of Species	Number of Surveys Conducted	Number of Point-Count Locations	Years Surveyed
Spring Migration	8,725	134	174	40	2014 – 2015, 2018
Breeding Season	13,102	120	400	91	2011 – 2019
Fall Migration	14,713	130	312	52	2013 –2015, 2018

Guilds and community metrics

Each bird species was categorized within three different group types based on broad taxonomic groups (11), family (43), and foraging behavior (12; Appendix C). Information for categorizing species was obtained primarily from Cornell Lab of Ornithology (2019). Bird communities were summarized for each site by season using three metrics: species richness, Shannon–Wiener index of diversity, and Shannon evenness to assess bird use among sites and between seasons. We used t-tests to compare differences in environmental variables (cover types) within 200m and 500m buffers of sites with highest and lowest species richness.

To identify local-scale vegetation characteristics associated with diverse bird communities, we used linear regression models to assess the relationship between bird species richness and five vegetation metrics; vegetation species abundance (restricted to species with at least 10 detections), exotic cover, native species richness, water depth, and weighted mean C (Appendix B; refer to Danz et al. 2017 for additional details). Single vegetation metric (e.g., vegetation species abundance) models were fit, and best models were identified using both forward and backward stepwise AIC model selection (Burnham and Anderson 2003), using R package MASS (Venables and Ripley 2002).

Hierarchical cluster analysis

We calculated relative abundance (RA) for each species by aggregating individual counts at each point-count location, summing observations for each species detected and dividing by the number of surveys conducted at each site by season. We then used R package vegan (Oksanen et al. 2019) to identify site clusters. Environmental variables at the 200m and 500m scales were summarized to characterize clusters of sites. Percent Perfect Indicator analysis (see details below) was applied to clusters to identify bird species representative of associated bird communities.

PPI

We used Percent Perfect Indicator (PPI) models to determine associations between environmental variables and bird RA by season (Dufrêne and Legendre 1997). This modeling approach identifies the

proportion of a given species detected in a given land cover type (e.g., developed) or wetland type (e.g., freshwater emergent) relative to the proportion of sites in that cover type or wetland type that were occupied by the species. This value can be used as an indicator for how important a landscape characteristic is to a given species (i.e., how strongly the species is associated with given characteristic).

Within each 200m and 500m buffer around point-count locations we calculated percent dominant habitats, after excluding the riverine category, as it comprised 43% of sites and was not useful in these analyses. The C-CAP categories Forested Wetland and Emergent Wetland were also removed because their definitions overlapped with the Wetland Inventory categories of Emergent Wetland and Forested Shrub Wetland. Any land cover type or wetland type categories that were dominant in less than 1% of sites were excluded. We also limited calculations of PPI to species that were detected in at least 10 sites. In addition to species RA, we also calculated PPI values for guilds to identify general patterns in cover type associations for similar species. The *P*-value for PPI indicates whether a species or group of species is a significant indicator of a given land cover type or wetland type. Non-significant values are still informative, as they identify which cover type or wetland type is most frequently used by a given species. PPI models were fit using R package labdsv (Roberts 2019).

RESULTS AND DISCUSSION

Overall

Spring migration: A total of 8,725 individuals of 134 species were observed over three survey years (2015, 2016, and 2018) during 174 point counts (*n*= 40) in the SLRE during spring migration (Table 1). The most common species included Lesser Scaup (1,187), Red-winged Blackbird (1,061), Canada Goose (751), Ring-necked Duck (661), and Mallard (486). Annual relative abundance for each species observed during spring migration can be found in Appendix D.

Breeding season: A total of 13,102 individuals of 120 species were observed over nine survey years (2011–2019) during 400 point counts (*n*= 91) in the SLRE during the breeding season (Table 1). The most common species detected during the breeding season included Red-winged Blackbird (3,043), Canada Goose (2,050), Ring-billed Gull (1,261), Yellow Warbler (795), and Song Sparrow (646). Annual relative abundance for species observed during the breeding season can be found in Appendix E.

Fall migration: A total of 14,713 individuals of 130 species were observed over four survey years (2013, 2014, 2015, and 2018) during 312 point counts (*n*= 52) in the SLRE during fall migration (Table 1). The most common species included Canada Goose (3,996), American Coot (2,298), Mallard (2,104), Common Grackle (1,093), and European Starling (652). Annual relative abundance for each species observed during fall migration can be found in Appendix F.

Land Cover Types

To determine the availability of different land cover types within the SLRE, we calculated the percentages of each land cover type from the NOAA C-CAP and USFWS Wetlands Inventory datasets (Appendix A). Because of differences in land use between MN and WI, we calculated percentages both independently for each state and with states combined (Fig. 2; Tables 2 and 3).

Table 2. Percent area of NOAA C-CAP land cover types found within a 400m buffer along the shoreline of the St. Louis River Estuary (SLRE). Values are provided separately ("Independent") for shoreline occurring in Minnesota (MN) and Wisconsin (WI), as well as in reference to availability within the entire SLRE (confined to 400m buffer around shoreline). See Appendix A for a description of land classifications. "Independent" values were calculated by dividing the land cover area by the total wetland area in the state. "Relative to SLRE" values were calculated by dividing the land cover area by the combined 400m buffer area in the SLRE.

	Independent (%)		Relative to entire SLRE (%)		
C-Cap Land Classification	***WI***	***MN***	***WI***	***MN***	***Total***
Developed	13.7	22.0	8.8	7.9	16.7
Agricultural Land	0.2	0.3	0.1	0.1	0.3
Grassland/Herbaceous	0.3	0.4	0.2	0.2	0.4
Forest	19.7	5.2	12.7	1.9	14.5
Scrub/Shrub	3.5	3.4	2.3	1.2	3.5
Palustrine Forested Wetland	4.3	2.0	2.8	0.7	3.5
Palustrine Scrub/Shrub Wetland	4.3	9.6	2.8	3.5	6.2
Palustrine Emergent Wetland	2.7	4.6	1.8	1.7	3.4
Bare Land	0.2	1.0	0.1	0.4	0.5
Open Water	51.0	51.6	32.7	18.5	51.2
Totals	100.0	100.0	64.1	35.9	100.0

Table 3. Percentages of USFWS Wetland Inventory wetland cover type found along the shoreline of the St. Louis River Estuary (SLRE). Values are provided separately ("Independent") for shoreline occurring in Minnesota (MN) and Wisconsin (WI), as well as in reference to availability of total wetland area and availability within the entire SLRE (confined to 400m buffer around shoreline). See Appendix A for a description of land classifications. "Independent" values were calculated by dividing the land cover area by the total wetland area in the state. "Relative to SLRE" values were calculated by dividing the land cover area by the combined 400 m buffer area in the SLRE.

	Independent (%)		Relative to entire SLRE (%)		
Wetland Inventory Land Classification	***WI***	***MN***	***WI***	***MN***	***Total***
Lake	31.7	22.3	11.7	5.3	17.0
Riverine	49.5	54.9	18.3	13.0	31.3
Freshwater Emergent Wetland	9.6	13.1	3.6	3.1	6.7
Freshwater Forested/Shrub Wetland	8.7	8.3	3.2	2.0	5.2
Freshwater Pond	0.6	1.4	0.2	0.3	0.5
Total	100.0	100.0	37.0	23.7	60.7

Land cover type summary: Based on the wetlands inventory data, there are approximately 3,100 hectares of 'wetland habitat' in the SLRE, including lands classified as riverine and lakes. Approximately 1,900 hectares are located in WI and 1,200 hectares are in MN. The three most abundant land cover types in the SLRE, after excluding riverine and lake, are developed, forest, and emergent wetland, respectively. As shown in Figure 2, the majority of developed land is located in the lower SLRE, in both MN and WI, while the majority of forested land is south of Billings Park in the Superior Municipal Forest, WI.

Minnesota: The three main land cover types in MN, excluding riverine and lake, are developed (covered by varying amounts of constructed materials), forest (dominated by trees generally greater than 5 meters tall and greater than 20% of total vegetation cover), and scrub/shrub wetland (dominated by woody vegetation less than 5 meters in height and total vegetation cover > 20%). Lands classified as wetlands comprise 66% of the 400m buffer area. Relative to size, there is more scrub/shrub and emergent wetland habitat (dominated by persistent emergent vascular plants, emergent mosses or lichens and total vegetation cover > 20%) located in MN than in WI.

Wisconsin: The three main land cover types in WI, excluding riverine and lake, are developed, forest, and emergent wetland. Lands classified as wetlands comprise 58% of the 400m buffer area. Compared to MN, there is more forested land in WI along the shore of the SLRE.

Discussion: An important takeaway from this summary is that while emergent wetland is a relatively common cover type, it primarily occurs in small patches throughout the SLRE. For example, less than 15% of the survey sites had more than 30% emergent cover at the 200m scale, and only two sites had more than 30% emergent wetland cover at the 500m scale. In general, increasing the amount and quality of emergent wetland habitat in the SLRE would be beneficial for bird communities. Long-term conservation efforts should focus on protecting the existing emergent wetland habitat and identifying restoration activities that enhance the connectivity between the small patches to provide quality habitat.

Guilds and community metrics

Bird community metrics (species richness, Shannon–Wiener index of diversity and Shannon evenness) were summarized by site and season for all bird guilds and groups, the full set of figures can be found in Appendix G. The results for the overall bird community metrics (i.e., all species; Fig. 3a) show that high diversity locations differ between seasons (spring migration, breeding, and fall migration), but in general, diversity and richness are higher in up-river sites compared to those in the lower part of the estuary and are highest near the Riverside the Spirit Lake areas (Table 4). Maps focusing on SGCNs (Fig. 3b) show a similar pattern (Table 5).

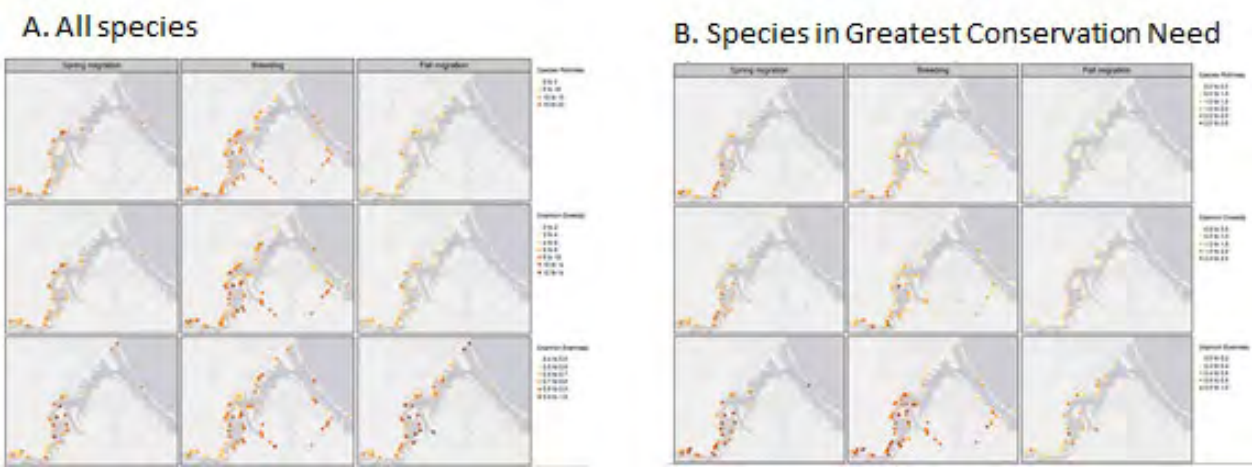

Figure 3. Maps of community metrics by season in the SLRE. A. shows the community metrics for all species observed each season, and B. shows community metrics for those designated as Species in Greatest Conservation Need by the Minnesota Department of Natural Resources.

Table 4. List of bird survey point-count locations within the St. Louis River Estuary (SLRE) where the highest and lowest mean species richness (SR) were detected during each season (spring migration, breeding, fall migration). We restricted sites to include the five highest and lowest values.

Season	Site	High SR		Site	Low SR
Spring migration	Grassy Point 2	16.33		Slip C 1	4.33
	Kingsbury Bay KB.2	15.20		Minnesota Slip 1	4.25
	Mud Lake ML.1	14.67		Clough Island 2	4.00
	Rask Bay RB.1	14.50		Spirit Lake West 3	3.00
	North Bay NB.1	13.83		Clough Island 1	2.00
Breeding	Clough Island 1	16.00		7073 4 (Kingsbury Bay)	6.50
	North Bay 1	15.80		7049 2 (21st Ave W)	6.17
	Kingsbury Bay 2	15.50		Minnesota Slip 1	5.60
	Perch Lake 1	14.67		7073 1 (Kingsbury Bay)	4.50
	Tallas Island TI.1	14.67		7074 1 (Grassy Point)	4.00
Fall migration	Kingsbury Bay KB.2	13.33		40th Avenue West 2	2.00
	Sargent Creek Floodplain SF.1	11.83		Spirit Lake West 3	1.83
	Spirit Lake SL.2	11.00		Spirit Lake East 2	1.67
	North Bay NB.1	10.67		Slip C 1	1.56
	Mud Lake ML.1	10.33		Spirit Lake East 1	1.20
	Mud Lake ML.1	10.33		Spirit Lake East 1	1.20

Table 5. List of bird survey point-count locations within the St. Louis River Estuary (SLRE) where the highest and lowest mean species richness (SR) were detected for species of greatest conservation need (SGCN), during each season (fall migration, breeding, spring migration). We restricted sites to include the five highest and lowest values. When sites had equal SR values, both were included; therefore, some seasons have more than five sites listed.

Season	Site	High SR	Site	Low SR
Spring migration	Rask Bay 2	3.00	Slip C 1	0.67
	Mud Lake ML.1	2.33	Spirit Lake East 1	0.67
	Spirit Lake SL.3	2.20	Sargent Creek Floodplain SF.2	0.60
	Mud Lake ML.2	2.00	Spirit Lake East 2	0.33
	Radio Tower Bay 1	2.00	Minnesota Slip 1	0.25
	Rask Bay RB.2	2.00		
	Spirit Lake West 1	2.00		
Breeding	7064 2 (Mud Lake)	2.50	1191 1 (Wisconsin Point Bay)	0.25
	Radio Tower Bay 1	2.33	7048 1 (40th Ave West)	0.25
	North Bay 1	2.20	Minnesota Slip 1	0.20
	Clough Island 1	2.00	1194 1 (inlet near Barker's Island)	0.17
	Kingsbury Bay 2	2.00	7049 2 (21st Ave West)	0.17
			7049 1 (21st Ave West)	0.13
Fall migration	Spirit Lake SL.2	1.17	Perch Lake 1	0.18
	Rask Bay RB.2	0.83	Grassy Point GP.1	0.17
	Spirit Lake SL.3	0.83	Kingsbury Bay 1	0.17
	40th Avenue West 3	0.80	Kingsbury Bay 2	0.17
	Little Pokegama Bay 2	0.75	Little Pokegama Bay 1	0.14

Based on linear regression models, there were no significant vegetation characteristics associated with species richness during any season, which may be a consequence of inadequate sample sizes for some metrics each season and high within group variability. However, the best model for the breeding season was nearly significant (p = 0.07) and showed that breeding bird species richness was positively correlated with native richness of plant communities. Some of the sites with the lowest species richness did not contain any vegetation (e.g., Minnesota Slip), and therefore there are no values to compare. Although we were unable to identify specific differences in local-scale vegetation metrics and species richness based on sites with highest and lowest species richness, we summarize the local-scale vegetation metrics for the sites identified in Table 4, including most abundant species of plants observed at sites where data are available, though note the small sample sizes (Appendix H). Although local-scale vegetation metrics were not significantly associated with species richness, landscape-scale environmental variables summarized for the sites with highest and lowest diversity show differences by season (Appendix I). During spring migration, species richness was significantly higher at sites with emergent wetland at the 500m scale and at sites with forested shrub wetlands, at both scales (Appendix I). During the breeding season, the amount of developed land is significantly lower in sites with highest species richness, at both spatial scales (Appendix I). During fall migration, the amount of emergent

wetland was significantly greater in sites with highest species richness (Appendix I). These results suggest that breeding birds in the SLRE are more sensitive to human development than are birds during migration, which makes sense given migrating birds are using the habitat for short-term needs associated with rest and foraging, while migrating birds tend to use sites that are more sheltered and surrounded with vegetation (Appendix I).

Discussion: The results of these analyses suggest that pursuing opportunities for wetland restoration in the highly developed areas (i.e., those in the lower SLRE, closer to Lake Superior) would likely benefit birds. An expected outcome would be an overall increase in bird richness and diversity throughout the year and an increase in breeding and stop-over habitat use by SGCNs. A coordinated long-term monitoring program that temporally and spatially tracks changes in both bird and plant communities is recommended for the SLRE. This type of monitoring program will allow us to assess and make specific recommendations regarding plant community composition that will aid habitat restoration teams in identifying, targeting, and mitigating issues associated with biodiversity loss related to habitat quality in a timely manner. At a local scale, restoration plans should focus on the vegetation characteristics that benefit both breeding and migratory bird communities. Specifically, we recommend that restoration plans promote diverse native plant communities and account for ecological processes that will promote resiliency after disturbance.

Hierarchical cluster analysis

Hierarchical cluster analysis illustrated relationships among survey points conducted in each season based on bird associations alone (i.e., ignoring the assigned habitat categories). The relationships between the bird communities and site characteristics paint a complex picture of bird community composition within the SLRE. The relative abundance of species by cluster and results of the PPI for the clusters can be found in Appendix J.

Spring migration: Spring bird communities split the sites into three groups. At the 200m scale, the first group, “Spring A,” had a relatively high proportion of emergent and shrub wetland, and high proportion of developed land at the 500m scale. Based on the results of the PPI analysis, the bird species that were characteristic of this group included Tree Swallow, Swamp Sparrow, Hooded Merganser, Blue Jay, American Robin, and Belted Kingfisher (Appendix J). The second group, “Spring B,” had a high proportion of the lake cover type at the 200m and 500m scales. Species characteristic of this cluster included Ring-necked Duck and Redhead (Appendix J). Both species are surface divers and were likely responding to the deeper areas associated with the lake cover type. The third group, “Spring C,” was a mix of cover types at both scales (Fig. 4), and the only characteristic species for this cluster was Common Tern (Appendix J).

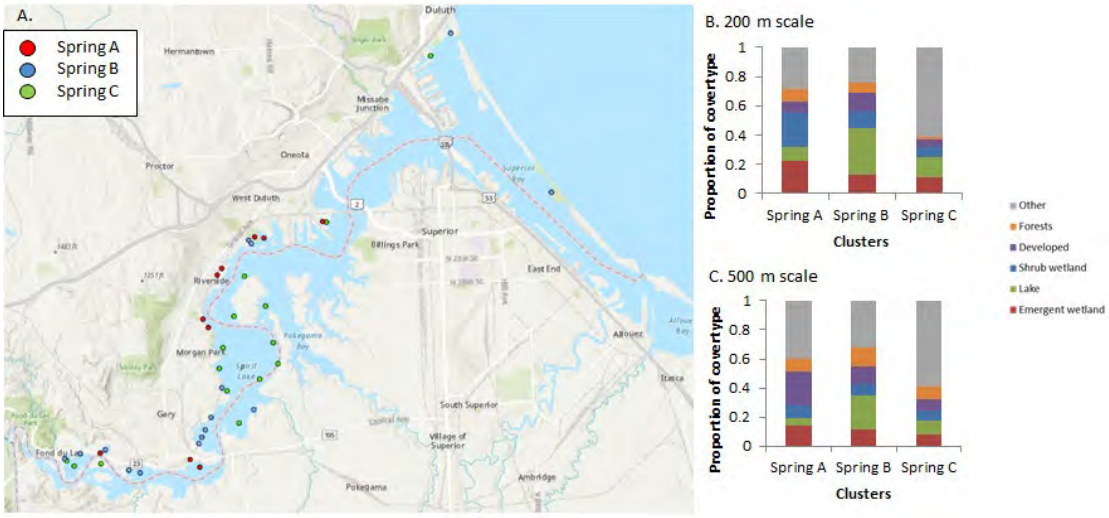

Figure 4. Site groupings based on the results of hierarchical cluster analysis for spring migration. **A.)** map of sites by cluster and summary of cover type variables of sites at the **B.)** 200m and **C.)** 500m scales.

Breeding season: The breeding season bird communities split the sites into four groups; the clusters had a similar proportion of emergent wetland, shrub wetland, and forest cover at the 200m scale (Fig. 5). Breeding group A had a relatively high proportion of developed cover, and characteristic species were those well-adapted to humans and included Ring-billed Gull, Mallard, and European Starling (Fig. 5; Appendix J). Sites in breeding group B had a mix of cover types at the 200m scale, but distinctive features were a high proportion of forests at the 500m scale. There were several characteristic species including European Starlings, Veery, Red-eyed Vireo, Ovenbird, Black-capped Chickadee, White-throated Sparrow, Chestnut-sided Warbler, Northern Flicker, and Black-throated Green Warbler (Appendix J). All characteristic species for this cluster breed in forest habitats with the exception of European Starling. Breeding groups C and D had a mix of land cover types, but sites in breeding group D had a higher proportion of lake cover (Fig. 5). There were no species that were characteristic of Breeding C, but there was high relative abundance of many wetland breeding species such as Yellow Warbler, Common Yellowthroat, Swamp Sparrow, and Marsh Wren. Importantly, this cluster had the highest relative abundance of both Virginia Rail and Sora. Breeding group D also had several wetland-associated species, including Swamp Sparrow and Marsh Wren. Red-winged Blackbird, Canada Goose, and Common Grackle were characteristic species of Breeding D. The results of breeding groups C and D show that these are the sites that are important for breeding wetland birds. The combination of “wetland” habitats including lake, emergent wetland, and scrub-shrub wetlands for these sites are, on average, at least 50% of the 200m scale (Fig. 5).

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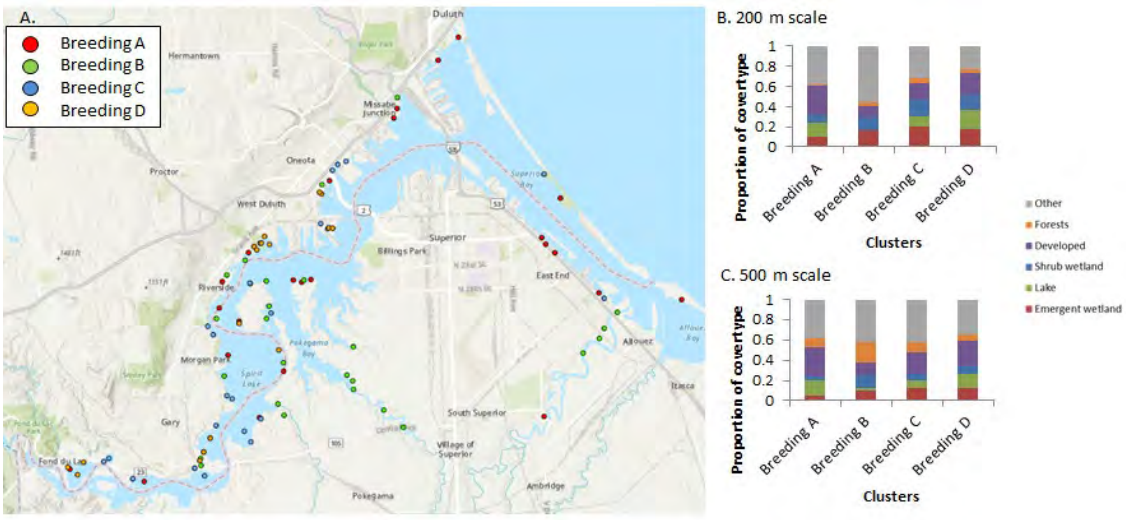

Figure 5. Site groupings based on the results of hierarchical cluster analysis for the breeding season. **A.)** map of sites by cluster and summary of cover type variables of sites at the **B.)** 200m and **C.)** 500m scales.

Fall migration: The fall migration bird communities clustered sites into three groups. Sites in fall group A had a mix of cover types at the 200m scale and a high proportion of developed and lake cover types at the 500m scale (Fig. 6). Sites in the fall group B sites had relatively little lake cover at the 200m scale and high percentage of forest at the 500m scales (Fig. 6). Sites in the fall group C cluster had a high proportion of lake and developed at the 200m scale (Fig. 6). There were no species that had significant associations for the fall migration clusters (Appendix J), although there were patterns in overall relative abundances between groups. For example, Fall A had many species that are tolerant to development such as Canada Goose, Mallard, and Common Grackle. Importantly, this group had the highest relative abundance of Rusty Blackbirds. Fall group B had a mix of waterfowl such as Canada Goose, Mallard, and American Coot, along with wetland species such as Red-Winged Blackbird, and forest species such as Black-capped Chickadees. Fall Group C had several waterfowl species with relatively high abundances such as American Coot, Ring-necked Duck, and Bufflehead (Appendix J).

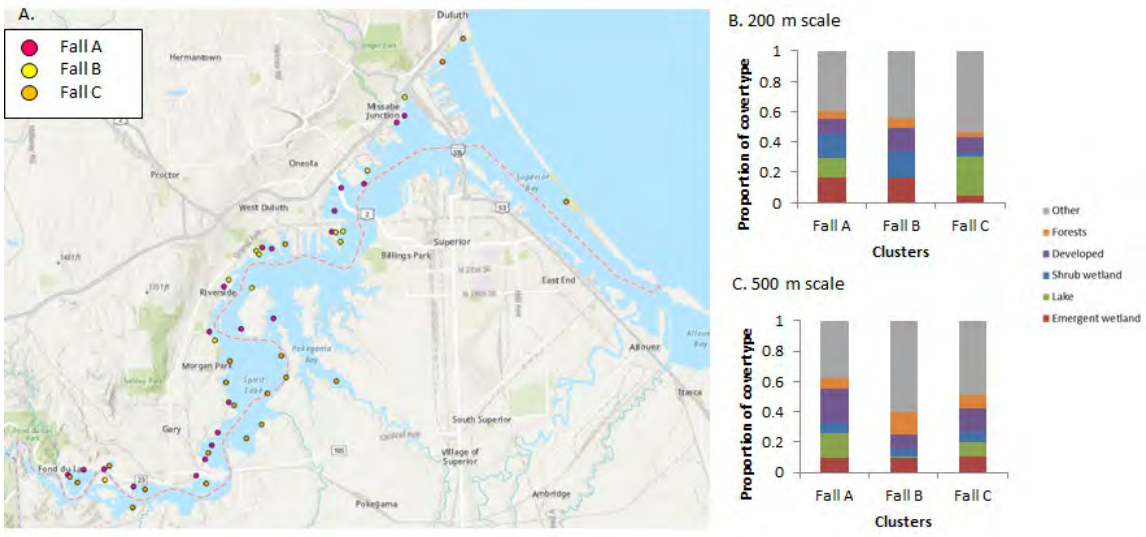

Figure 6. Site groupings based on the results of hierarchical cluster analysis for fall migration. **A.)** map of sites by cluster groupings and summary of cover type variables of clustered sites at the **B.)** 200m and **C.)** 500m scales.

Discussion: The overall results of these analyses show that birds use a combination of scrub-shrub, emergent, and lake habitats, i.e., there are no groups that have a dominant "emergent wetland," "scrub-shrub wetland," or "lake" characteristics. The goal of restoration priorities should be to provide a minimum of 50% of "wetland-associated" cover types to support breeding wetland species. This guideline will also benefit migrating birds.

PPI

Species-specific. The results of the species PPI analysis showed 25 species had significant associations with cover type variables at the 200m and 500m scales (Appendix K). Red-winged Blackbird was the only species that had a significant result during spring migration and was associated with shrub wetlands at the 200m scale. Fourteen (14) species had significant associations with cover type variables at the 200m scale, and 17 species had significant associations at the 500m scale. This result is likely due to the fact that species respond to different scales, particularly during the breeding season, and scale of importance is generally associated with territory size, foraging behavior, and nesting requirements. During fall migration, four species — American Goldfinch, Common Yellowthroat, Hairy Woodpecker, and Red-eyed Vireo — were significantly associated with forested shrub wetland at the 200m scale. These results show the importance of a variety of habitat types in the SLRE used by birds throughout the year.

There were no significant habitat associations for these wetland-obligate bird species including American Coot, Marsh Wren, Pied-billed Grebe, Sora, Swamp Sparrow, and Virginia Rail (Fig. 7). However, the results of the PPI show the relative importance of different habitat types for each species.

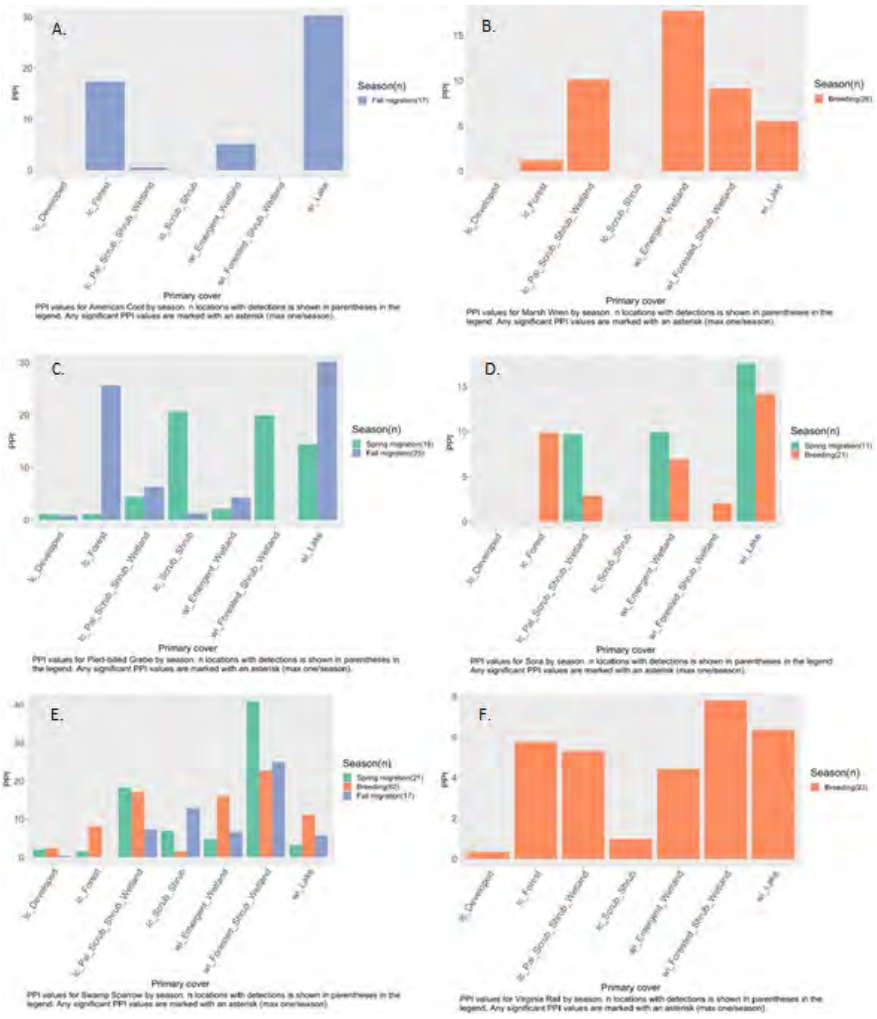

Figure 7. PPI results of cover type associations for wetland obligate bird species including **A.)** American Coot, **B.)** Marsh Wren, **C.)** Pied-billed Grebe, **D.)** Sora, **E.)** Swamp Sparrow, and **F.)** Virginia Rail.

Guilds. The results of the PPI analysis showed significant associations for 5 guilds during spring migration, 13 guilds during the breeding season, and 4 guilds during fall migration (Appendices L–N).

Forested shrub wetlands was significantly associated with several guilds. For example, groups that characterize sandpipers (probing, Scolopacidae, shorebirds) were significantly associated with forested shrub wetlands at the 200m scale during spring migration and during the breeding season. Additionally, aerial foragers, kingfishers, and swallows were associated with forested shrub wetlands at the 200m scale during the breeding season. Warblers and bark foragers were significantly associated with forest cover type during the breeding season at the 200m and 500m scales, respectively. During fall migration, forested shrub wetlands were significantly associated with finches and cormorants at the 200m scale and soaring foragers at the 500m scale. Importantly, emergent wetland at the 500m scale was significantly associated with rails during fall migration.

SUMMARY AND MANAGEMENT RECOMMENDATIONS

- The SLRE is critical to birds throughout the year. A consistent, dedicated, long-term bird monitoring program in the SLRE is essential for long-term conservation of biodiversity. We recommend a monitoring program that focuses on bird use in the SLRE throughout the year (spring migration, breeding, and fall migration). The monitoring program should also include an overlapping and coordinated fine-scale vegetation component that allows for classifying native plant communities at the bird survey sites. Annual drone imagery that facilitates monitoring the amount and locations of emergent wetland at the landscape scale would be important for documenting changes in wetland quality over time. Specifically, changes in the availability of emergent wetland habitat from a combination of shrub encroachment, water level changes, and the spread of invasive plant species needs to be monitored.
- Results of cluster and PPI analyses show the importance of having a variety of habitat types in the SLRE, which are used by birds throughout the year. Many bird species and guilds rely on "shrub- scrub" wetlands, maintaining these cover types is recommended.
- Birds that are considered "wetland obligate" species are present but not widespread in the estuary, despite the fact that there is habitat available. While wetland obligate species such as Virginia Rail are often observed in the SLRE, they are found in low densities, thus making site-specific habitat recommendations challenging.
- Our results suggest that pursuing opportunities for wetland restoration in the highly developed areas (i.e., those that are closer to Lake Superior) would likely benefit birds, and an expected outcome would be an overall increase in bird richness and diversity throughout the year and an increase in available breeding and stop-over habitat for SGCN. Based on sites with highest species richness and cluster analyses, increasing the amount and quality of emergent wetland habitat in the SLRE would be beneficial for several bird communities. The goal of restoration priorities should be to provide a minimum of 50% "wetland-associated" cover types to support breeding wetland species. This guideline will also benefit migrating birds.
- Long-term conservation efforts should focus on protecting the existing emergent wetland habitat and identifying restoration activities that enhance connectivity between the small patches that are providing quality habitat.

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LIST OF APPENDICES

Appendices are attached to this document as individual PDF files. Following are descriptions for each appendix:

Appendix A. List of landscape-scale variables included in analyses to identify bird-habitat associations. These variables were calculated within a 200m and 500m buffer around each bird survey point count location. A brief description of each classification is provided for each dataset. A link to additional metadata for each source can be found in the footnotes.

Appendix B. List of local-scale (within wetland) plant community variables included in analyses to identify bird-habitat associations. These variables were calculated within a 200m buffer around each bird survey point count location. A brief description of each classification is provided for each dataset. A link to additional metadata for each source can be found in the footnotes.

Appendix C. List of species detected during point-count surveys in the St. Louis River Estuary. The four-letter alpha code is provided for each species as well as common and scientific name, group it was included in for analysis, family group, foraging behavior, and whether it was identified as a species of greatest conservation need (SGCN) by the Minnesota Department of Natural Resources (DNR). The footnote has a link to the Minnesota DNR listed species that provides additional information about each species.

Appendix D. Relative abundance of each species detected per year during spring migration.

Appendix E. Relative abundance of each species detected by year during the breeding season.

Appendix F. Relative abundance of each species detected by year during fall migration.

Appendix G. Bird community species richness, species diversity, and species evenness maps of the St. Louis River Estuary for spring migration, breeding season, and fall migration.

Appendix H. List of local-scale vegetation metrics included in the species richness linear regression models. The sites with highest and lowest species richness (SR), provided in Table 6, are summarized here. Detailed descriptions of the vegetation metrics can be found in Appendix B and in Danz et al. (2017). The average value of each metric and range of values is provided with the sample size (n). For plot_obs, the most common species are listed, note the sample size of plot_obs is particularly low for all seasons.

Appendix I. Comparison of environmental variables within 200 and 500m buffers around bird survey locations for sites with highest and lowest species richness (see Table 6 for list of sites). Within each season (Breeding, Fall migration, Spring migration), mean percent cover and range are provided. T-test Results are provided by buffer distance and significant values ($p \leq 0.05$) and in bold.

Appendix J. Species relative abundance and results of the Percent Perfect Indicator analyses based on the results of the heirarchical cluster analysis.

Appendix K. Percent Perfect Indication (PPI) values for species relative to cover type and season (spring, breeding, and fall). Values are listed at the 200m and 500m scales. Significant values are denoted in bold with an asterisk and the number of locations with detections is included in parentheses.

Appendix L. Percent Perfect Indication (PPI) values for groups of species (behavior, family, general) relative to cover type and season (Spring, Breeding, and Fall). Values are listed at the 200m and 500m scales. Significant values are denoted in bold with an asterisk and the number of locations with detections is included in parentheses.

Appendix M. Percent Perfect Indication (PPI) values for groups of species (behavior, family, general) relative to season (spring, breeding, and fall) and cover type at the 200m scale.

Appendix N. Percent Perfect Indication (PPI) values for groups of species (behavior, family, general) relative to season (spring, breeding, and fall) and cover type at the 500m scale.


DULUTH NATURAL AREAS PROGRAM