Wild Rice Restoration Implementation Plan for the St. Louis River Estuary

St. Louis County, Minnesota and Douglas County, Wisconsin

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Cardno JFNew
Shaping the Future

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Acronyms

AOC	Area of Concern
BUI	Beneficial Use Impairement
FdLNR	Fond du Lac Band of Lake Superior Chippewa Natural Resources
GLIFWC	Great Lakes Indian Fish and Wildlife Commission
GLRI	Great Lakes Restoration Initiative
LSNERR	Lake Superior National Estuarine Research Reserve
MNDNR	Minnesota Department of Natural Resources
MLT	Minnesota Land Trust
NRRI	Natural Resources Research Institute
QAPP	Quality Assurance Project Plan
SLRAOC	St. Louis River Area of Concern
UWS-LSRI	University of Wisconsin – Superior, Lake Superior Research Institute
WIDNR	Wisconsin Department of Natural Resources

Executive Summary

Northern wild rice (*Zizania palustris*) was once abundant in the St. Louis River estuary (Schwartzkopf 1999). Prior to development, the estuary was estimated to contain approximately 3,400 acres with a water depth of four feet or less (Hollenhorst et al. 2010), most of which was likely suitable wild rice habitat. However, over approximately the past 50 to 125 years, wild rice abundance and distribution has been reduced to a few remnant stands or areas where short-term or small-scale restoration efforts have occurred. Wild rice is an important component of the St. Louis River estuary because it is valued as both a cultural and ecological resource.

In 1987 the St. Louis River estuary, along with the St. Louis River system, was designated as a Great Lakes Area of Concern (AOC) due to water resource impairments resulting from a history of pollution, unregulated land use, and degraded habitat (MPCA and WIDNR 1992). Nine Beneficial Use Impairment (BUIs) were identified as causes for the AOC designation. Efforts to delist the St. Louis River AOC (SLRAOC) are underway through partnerships between the States of Minnesota and Wisconsin and tribal partners, along with other stakeholders in the area. Developing a plan for wild rice restoration in the estuary was identified as an action item in the most recent version of the SLRAOC Remedial Action Plan (RAP; MPCA 2013). Wild rice beds are considered a component of BUI 9 – Loss of Fish and Wildlife Habitat. Restoring wild rice will support the removal of BUI 9 in the SLRAOC.

While water quality has improved in the St. Louis River estuary over the past three decades, due in part to waste treatment facilities going online such as the Western Lake Superior Sanitary District in 1978, wild rice populations have not rebounded on their own. The time is right to begin an estuary-wide effort to restore wild rice, initially to support delisting the SLRAOC, and over the long term through building a wild rice program for the estuary.

The Minnesota Department of Natural Resources (MNDNR), Minnesota Pollution Control Agency (MPCA), Wisconsin Department of Natural Resources (WIDNR), Fond du Lac Band of Lake Superior Chippewa Natural Resources (FdLNR), 1854 Treaty Authority, Great Lakes Indian Fish and Wildlife Commission (GLIFWC), and Minnesota Land Trust (MLT) identified the area from the Fond du Lac Dam downstream to Grassy Point and Allouez Bay in Wisconsin as the primarily focus for wild rice restoration efforts in the St. Louis River estuary. The defined project area includes sites that historically had wild rice and currently offer the best opportunities for successful wild rice restoration.

This plan outlines the specific implementation strategies that will be employed over the next 10 years to restore at least 275 acres of wild rice in the estuary, to provide fish and wildlife habitat and opportunities for wild rice harvest. Restoring at least 275 acres over the next 10 years represents the first step in a longer term goal of restoring wild rice to a greater abundance and distribution within the estuary. Restoration will include seeding, vegetation management, and protection against herbivory by Canada geese and common carp. Annual monitoring of restoration areas will provide information on success of the restoration efforts and help to inform future management actions and decisions. Activities associated with wild rice restoration will allow for the development of the knowledge, partnerships, and understanding required to build the long-term capacity needed to achieve this goal.

1 Wild Rice Restoration Planning

1.1 Project Scope and Background

Northern wild rice (*Zizania palustris*) was once abundant in the St. Louis River estuary (Schwartzkopf 1999). Over approximately the past 50 to 125 years, its abundance and distribution has been reduced to a few remnant stands or areas where short-term or small-scale wild rice restoration efforts have occurred. Wild rice is an important component of the St. Louis River estuary because it is valued as both a cultural and ecological resource. Efforts are underway to delist the St. Louis River estuary as an Area of Concern (SLRAOC) by 2025 (MPCA 2013). Wild rice restoration will support this effort by improving fish and wildlife habitat.

Minnesota Department of Natural Resources (MNDNR) Division of Ecological and Water Resources and Division of Fish and Wildlife, and Minnesota Pollution Control Agency (MPCA) are collaborating to develop a comprehensive implementation plan for wild rice restoration in the St. Louis River estuary. The development of an implementation plan was identified as an action item in the 2013 Remedial Action Plan (RAP; MPCA 2013). MNDNR, along with Wisconsin Department of Natural Resources (WIDNR), Fond du Lac Band of Lake Superior Chippewa Natural Resources (FdLNR), Minnesota Land Trust (MLT), 1854 Treaty Authority, Great Lakes Indian Fish and Wildlife Commission (GLIFWC), and MPCA will use the plan to guide and coordinate wild rice restoration efforts in the estuary over the next 10 years.

With the effort to delist the SLRAOC and a general trend toward improving water quality and habitat conditions in the estuary, MNDNR, WIDNR, and other project partners feel the timing is right begin a concerted, long-term effort to restore wild rice in the St. Louis River estuary. The immediate desired outcome is for wild rice restoration to support delisting the SLRAOC by 2025 through improved fish and wildlife habitat. The long-term desired outcome is to restore wild rice to a level that provides fish and wildlife benefits, affords harvest opportunities, and is self-sustaining. To achieve this, MNDNR, WIDNR, and other project partners envision using this plan over the next 10 years to start the initial phase of wild rice restoration and build a wild rice program for the estuary that can be maintained beyond the delisting of the SLRAOC.

MNDNR, WIDNR, and other project partners envision that wild rice restoration will be a collaborative effort undertaken by different agencies and organizations, each bringing a unique value to the process, working towards the overall goal of restored wild rice within the estuary. They view this plan as a working document that will be updated over time and could be used by anyone restoring wild rice in the estuary.

Defining the Project Area and Extent

The St. Louis River estuary currently encompasses approximately 12,442 acres of open water from the Fond du Lac dam downstream to the outlet to Lake Superior. It includes Superior Bay and Allouez Bay, which are influenced by the Nemadji River (SLRCAC 2002). The defined SLRAOC boundary is approximately 650,720 acres and includes portions of the watersheds of the St. Louis River, Pokegama River, Nemadji River, and several other tributaries (MPCA and WIDNR 1992). During the scoping process for the project, the Restoration Site Team defined the area of interest or project area for wild rice restoration in the estuary covered under this plan as the approximately 6,046-acre area from the Fond du Lac dam downstream to Grassy Point and includes Allouez Bay, an additional 1,302 acres. It includes waters in both states' jurisdiction (Figure 1). The exclusion of areas downstream of Grassy Point to the harbor does not prevent future wild rice restoration activities in these areas. It was the intent of the Restoration Site Team to focus their efforts on the areas within the estuary that offered the most potential for wild rice restoration or where restoration could occur as a stand-alone activity. Areas downstream of Grassy Point reflect the working harbor of the Duluth/Superior area, where wild rice restoration would be done as part of the comprehensive remediation or restoration projects.

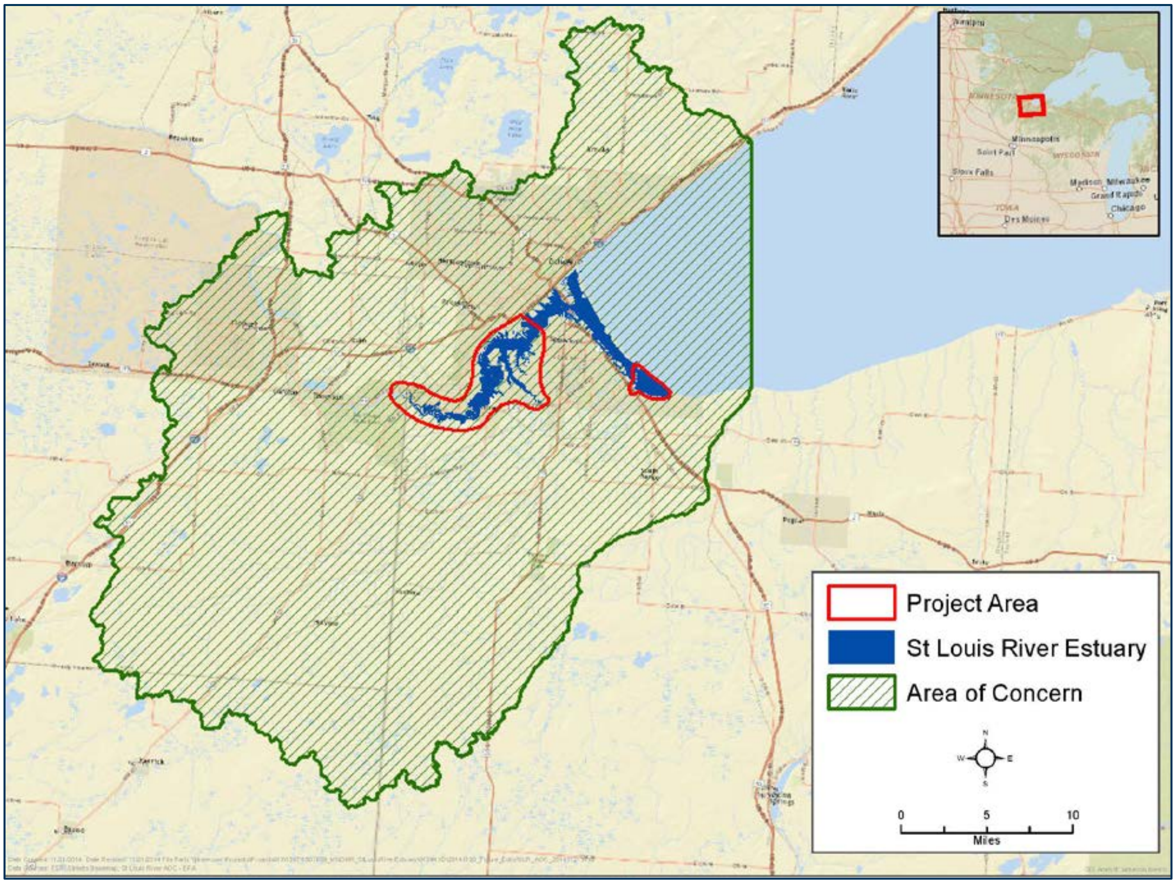


Figure 1. Defined Wild Rice Restoration Project Area under the Wild Rice Restoration Implementation Plan within the context of the St. Louis River Estuary and SLRAOC.

1.2 Importance of Wild Rice in the St. Louis River Estuary

Cultural Importance

Wild rice in the St. Louis River estuary is an important cultural resource for the Ojibwe people. In their Migration Story, the Ojibwe people were told to migrate from the east until they found land where "the food that grows on water" (Benton-Banai 1988) occurs. One of the early Fond du Lac Band of Lake Superior Chippewa seasonal gathering areas was near the mouth of Mission Creek by Rask Bay. Today, the Ojibwe community continues to revere wild rice is as a gift from the Creator (Ackley 2000). One of the most nutritious natural sources of food in the region, it has been a staple of Ojibwe (David 2013a) and other Native American tribes' diet for centuries (Valppu 2000). Today, wild rice harvest remains a very important cultural event for the Ojibwe and other tribal communities. Across Minnesota, it is estimated that more than 3,000 tribal members participate in the annual wild rice harvest (MNDNR 2008).

The tradition of harvesting wild rice in the St. Louis River estuary extended to early fur trappers and settlers utilizing wild rice for a food source. Non-tribal residents of Duluth and Superior also developed a tradition of harvesting wild rice (See John Turk's historical accounts of ricing in the St. Louis River estuary at http://www.stlouisriverestuary.org/wildrice.php?tab=1).

Ecological Importance

Wild rice is an important ecological resource within the St. Louis River estuary. It provides a food resource and breeding and rearing habitat for a variety of fish and wildlife species throughout the growing season (MNDNR 2008). It may also play an important role in water quality by preventing re-suspension of sediments (David 2013a) and nutrient cycling (Pastor and Duree Walker 2006). Wild rice has long been acknowledged as one of the most important food resources for waterfowl, because the seed maturation coincides with fall migration (Kreitinger et al. 2013). One acre of natural wild rice can produce more than 500 lbs of seed (MNDNR 2008). The seed is an important food resource for mallard, wood duck, American black duck, northern pintail, blue-winged teal, canvasback, and other waterfowl species (Rossman et al. 1982; Fannucchi 1983; Huseby 1997). In the St. Louis River estuary and in northern Minnesota and Wisconsin, Canada geese browse on the soft stems during the entire growing season (P. David, personal communication 2014). Goose herbivory on southern wild rice, *Z. aquatica,* occurs during the submerged stage through floating-leaf stage, but as southern wild rice plants continue to grow in height, grazing by geese may actually decline (Haramis and Kearns 2007). The decrease in herbivory may be due to that southern wild rice typically reaches a height of 7 to 10 feet with thick stalks (Penskar et al. 2000), which may be unpalatable or harder to graze. Northern wild rice in the estuary typically reaches a height of 2 to 8 feet, with more grass-like flowering stalks (NRCS 2004).

Shallow, sheltered bays where wild rice is found serve as important habitat for several life stages of fish species in the estuary. Northern pike lay eggs in the spring on the submergent vegetation. Wild rice stands provide nursery habitat for juvenile fish (Radomski and Goeman 2001) to take cover from predation and feed on invertebrates living on the accumulated organic matter and live plant material. Fish produced in wild rice stands help to contribute to adult populations of both game and non-game fish species in the estuary.

Both the States of Minnesota and Wisconsin have recognized the importance of wild rice in restoring and maintaining healthy wildlife populations. Minnesota's Species of Greatest Conservation Need list includes 17 bird species that utilize wild rice for one or more aspects of their lifecycle (Table 1; MNDNR 2006; MNDNR 2008). The Wisconsin All-Bird Conservation Plan recognizes wild rice as a separate priority habitat from emergent marsh because of its high wildlife value and the role that it plays in the conservation of 16 bird species (Table 1; Kreitinger et al. 2013).

Table 1. Bird species of priority conservation concern in Minnesota and Wisconsin and their utilization of wild rice habitat.

Bird Species	Wild Rice Habitat Utilization	
	Minnesota[1]	Wisconsin[2]
American Black Duck	Breeding and migration	Migration[3]
Lesser Scaup	Migration	Migration[3]
Northern Pintail	Migration	Migration
Trumpeter Swan	Breeding and migration	Foraging, breeding, and migration[3]
American Bittern	Breeding and migration	Foraging[3]
Least Bittern	Breeding and migration	
Red-necked Grebe	Breeding and migration	
Common Loon	Breeding and migration	
Sora Rail	Breeding and migration	
King Rail	Migration	
Virginia Rail	Breeding and migration	
Yellow Rail	Breeding and migration	
Black Tern	Breeding and migration	Breeding[3]
Bobolink	Foraging and migration	
Rusty Blackbird	Foraging and migration	
Sedge Wren	Foraging and migration	
Bald Eagle	Foraging and migration	
Tundra Swan		Migration
Canada Goose		Migration
Mallard		Breeding and migration
Blue-winged Teal		Breeding and migration
Canvasback		Migration[3]
Redhead		Migration
Hooded Merganser		Breeding and migration

Bird Species	Wild Rice Habitat Utilization	
	Minnesota[1]	Wisconsin[2]
Northern Harrier		Breeding and migration[3]
Common Yellowthroat		Breeding
Swamp Sparrow		Migration

[1] – MNDNR 2006
[2] – Kreitinger et al. 2013
[3] - Listed as being associated with Lake Superior Coastal Plain Ecological Landscape (WIDNR 2005).

Conservation and Restoration Planning Importance

For more than 20 years wild rice restoration has been recognized as a priority for stakeholders within the estuary (MPCA and MNDNR 1992). In the 1990s, FdLNR completed a project that attempted to identify causes of wild rice decline in the estuary and began to restore it to historical abundance at a select number of sites (Schwartzkopf 1999). Wild rice was the only plant species listed as a conservation target in the Lower St. Louis River Habitat Action Plan because it was the only plant species evaluated at the time that met any of the qualifying criteria (SLRCAC 2002). In the Habitat Action Plan, the stated goal for wild rice was to restore it to healthy populations in appropriate wetland habitats. Additionally, the presence of wild rice along with other submergent and floating-leaved vegetation is a component of conservation targets for three habitats identified in the Habitat Action Plan: upper estuary flats, sheltered bays, and Great Lakes coast wetland complex.

Currently, wild rice restoration is planned to address the loss of fish and wildlife habitat (Beneficial Use Impairment [BUI] 9) as part of the activities being undertaken by the States of Minnesota and Wisconsin to delist the St. Louis River estuary as an AOC (MPCA 2013).

1.3 Wild Rice Natural History and Habitat Requirements

Wild Rice Life Cycle

Wild rice is an annual plant that develops in the spring from seed that is dispersed into the water from the parent plant during the previous fall (Moyle 1944). In some cases, wild rice may germinate from seed that is one or more years old and has been lying dormant in the seed bank waiting for the right growing conditions. To germinate, the seed must be exposed to water 35^{o} F or colder for a period of at least three months (Oelke et al. 2000; Oelke 2007). Germination is triggered when the substrate and water temperatures reach approximately 40^{o} F, typically in April in Minnesota. A germinated seed begins to grow and develops a shallow root system followed by three submerged leaves on the main stalk (Figure 2). The plant is in the submerged leaf phase at this point. The plant enters the floating-leaf stage when one to two leaves develop and float on the surface of the water. Typically, this occurs between late May and mid-June in Minnesota, but it is dependent on water depth and weather. Emergent, aerial leaves will appear two to three weeks later. Relative to the St. Louis River estuary, during a typical year wild rice can first be observed in July in the emergent stage. Additional tillers and flowering stems can develop on one plant and are often related to water depth and plant density, with an increased number of stems in more shallow water.

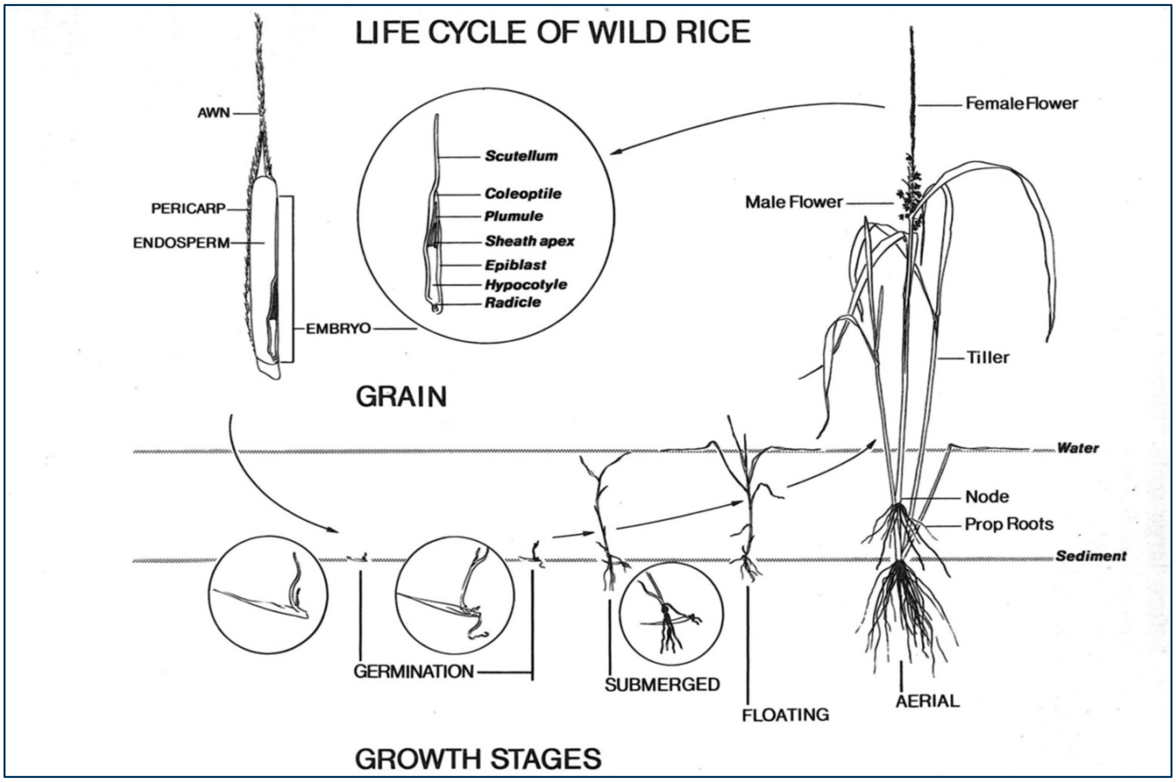


Figure 2. Life stages of wild rice (Courtesy of Peter Lee, Lakehead University; Aiken et al. 1988).

Flowering occurs in mid to late July. Both female and male flowers are located on the same panicle, but position separates them, with the female flowers located on the top of the flowering stem and the male flowers located lower on the stem. The wind typically cross pollinates the female flower. Seeds ripen over a period of days, starting at the top of the flowering stem. The main stem matures approximately one to two weeks before the secondary tillers. The extended period of seed ripening and "shattering," or dropping of mature seed, helps to increase the likelihood that some seed makes it to the next growing season. Seed drops into the water, sinks to the bottom, and rests on the sediments relatively close to the parent plant (Moyle 1944). The entire process from germination to seed drop is approximately 110 to 130 days, or approximately 2,600 growing-degree days, depending upon environmental conditions (MNDNR 2008).

Wild rice production has been shown to vary annually; however, it appears to follow a three to five-year cycle of high production years, followed by one to two unproductive years, followed by one to two years of recovery (Atkins 1986; Lee 1986; Archibold et al. 1989; Pastor and Duree Walker 2006; Walker et al. 2006). Delays in nutrient cycling of wild rice plant litter may influence nutrient availability, which impacts wild rice growth (Pastor and Duree Walker 2006).

<u>Water Depth and Flow</u>

Wild rice grows in lakes and rivers and prefers some type of water movement or flow. It can be found primarily in water depths ranging from 0.5 feet to 3 feet, with 1.5 feet potentially the optimal water depth (Moyle 1944). Wild rice may be found in deeper water; however, these stems typically do not produce seed (David 2013a). Stable or slowly decreasing water levels are preferred. During the early growing season, in particular, during the floating-leaved stage, abrupt increases in water elevation can uproot plants.

<u>Substrate</u>

Wild rice can be found growing in a variety of substrates including sandy and rocky substrates (David 2013a); however, the preferred substrate types are soft, organic sediments with plenty of available nutrients (Lee 1986; Carson 2002). In 2014, wild rice was observed at 14 locations within the estuary and all of those points could be classified as soft with an organic component (Cardno 2014b). Wild rice may be able to grow on moderately flocculated sediments that are too soft for other aquatic plants to become established (David 2013a).

Water Quality and Chemical Parameters

Wild rice prefers clear to moderately stained water. The preferred pH range is 6.0 to 8.0. Alkalinity concentrations can be greater than 40 ppm (MNDNR 2008). Wild rice prefers nutrient-rich sediments (Carson 2002).

Existing Vegetation

Wild rice is associated with other floating leaf and emergent plant species. In particular, the Restoration Site Team generally agreed that yellow water lily (*Nuphar* sp.), white water lily (*Nymphaea* sp.), potamogetons (*Potamogeton* sp.), and bur-reed (*Sparganium* sp.) can be indicator species of potential wild rice habitat because their habitat requirements overlap (Wild Rice Restoration Site Team 2014).

1.4 Wild Rice in the St. Louis River Estuary

Historical Accounts

Wild rice was historically abundant in the St. Louis River estuary. As previously discussed, it played an important role in the Migration Story of the Ojibwe people and allowed them to settle in the area more than 500 years ago (Benton-Benai 1988). The first written accounts of the abundance of wild rice in the estuary can be seen in an early account from an 1820 expedition to locate the source of the Mississippi River, where Henry Schoolcraft writes:

> "On reaching the mouth of the St. Louis River or Fond du Lac River, the Cabotian mountains present a lofty barrier towards the north. We here saw in plenty the folle avoine, or wild rice…" (Schoolcraft 1855).

In 1861, William Hearding surveyed the estuary to map possible navigational routes and assist planning for development of the estuary. His work generated detailed maps (commonly referred to as the Hearding Charts) that provide insight into water depths and the extent of wetland plant communities in the estuary prior to industrialization. Although this information does not contain specific information about the location and density of wild rice, it may be inferred, based on water depths, that much of the shallow shoreline habitat was most likely suitable for wild rice. Based on the Hearding's work, approximately 3,390 acres of the 13,381 acres he surveyed throughout the estuary had a water depth of 4 feet or less (Figure 3a). When the area of interest is limited to just upstream and downstream boundaries of the current wild rice project area, there were approximately 2,275 acres with a water depth of 4 feet or less during Hearding's time (Figure 3b and Figure 3c). Since the industrial era in the estuary, it has been estimated that nearly 7,000 acres of wetland and shallow water habitat were lost to dredging and infill for shoreline development (DeVore 1978; MPCA and WIDNR 1992).

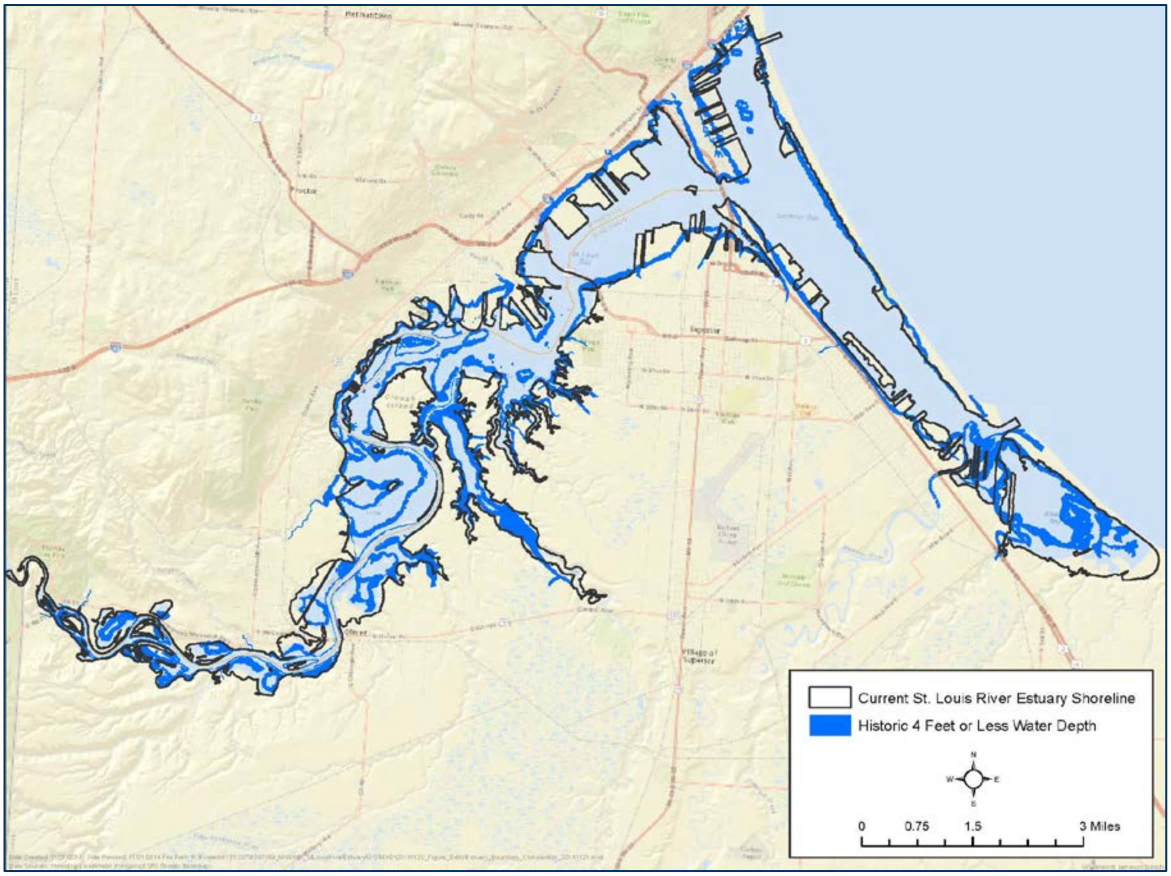


Figure 3a. Water depths of four feet or less from the 1861 Hearding Chart for the St. Louis River estuary (Hearding data courtesy of D. Peterson, MLT and T. Hollenhorst, USEPA).

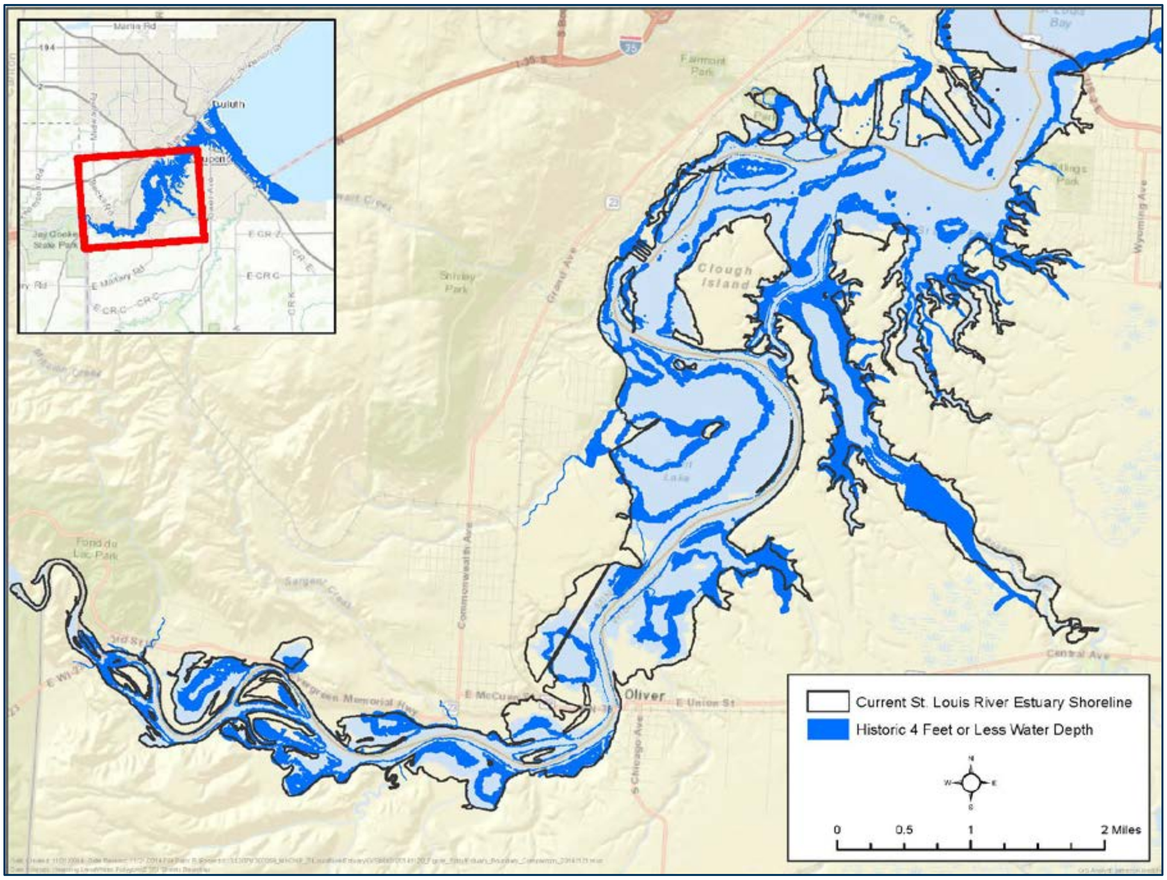


Figure 3b. Water depths of four feet or less from the 1861 Hearding Chart for Grassy Point to the Fond du Lac dam (Hearding data courtesy of D. Peterson, MLT and T. Hollenhorst, USEPA).

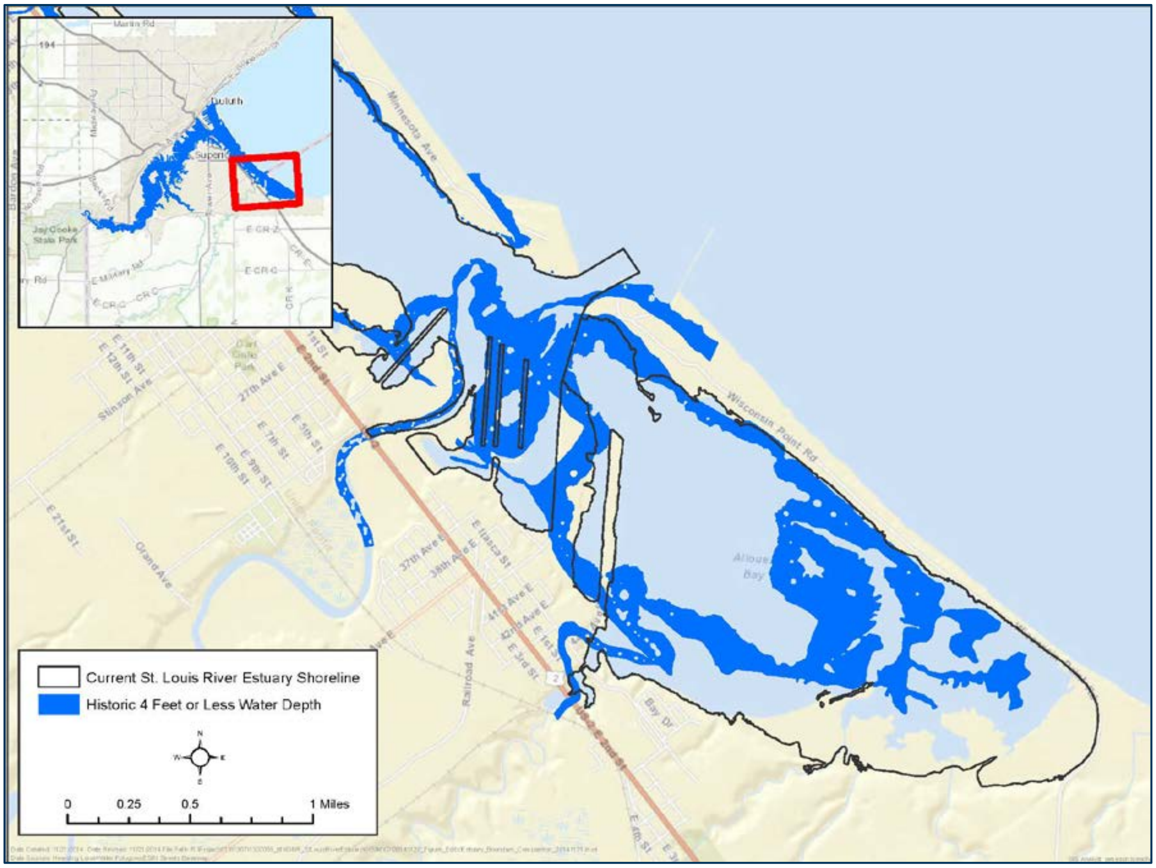


Figure 3c. Water depths of four feet or less from the 1861 Hearding Chart for Allouez Bay (Hearding data courtesy of D. Peterson, MLT and T. Hollenhorst, USEPA).

Figures 4a and 4b compare water depth in a digitized spatial dataset of the Hearding Chart against the best available bathymetry of the estuary from 2010 (Hollenhorst et al. 2013) for the wild rice project area. Current bathymetry information extends beyond Hearding's original survey boundary in many areas, especially in the upper portion of the estuary and in Allouez Bay. It is likely a combination of improved surveying and data collection ability and loss or alternation of habitat that accounts for the differences between the boundaries of the Hearding Chart and the current shoreline of the estuary. Where the two boundaries overlap, areas that were historically four feet or less during Hearding's time but are now deeper, are shaded yellow; areas that in 1861 and today still have water depths four feet or less are shaded blue.

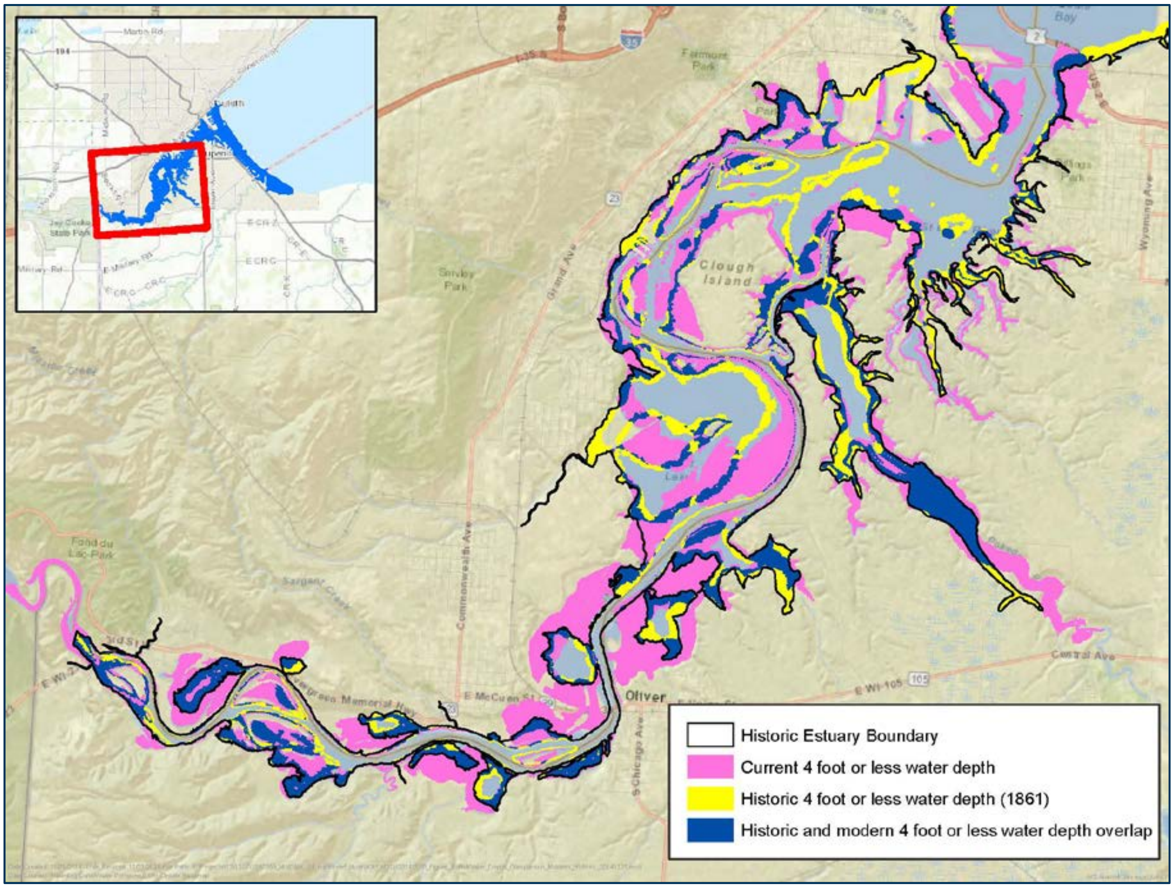


Figure 4a. Comparison of 4 feet or less depths in the project area between the 1861 Hearding data and the contemporary (2010) bathymetry, Fond du Lac Dam to Grassy Point. (Hearding data courtesy of D. Peterson, MLT and T. Hollenhorst, USEPA).

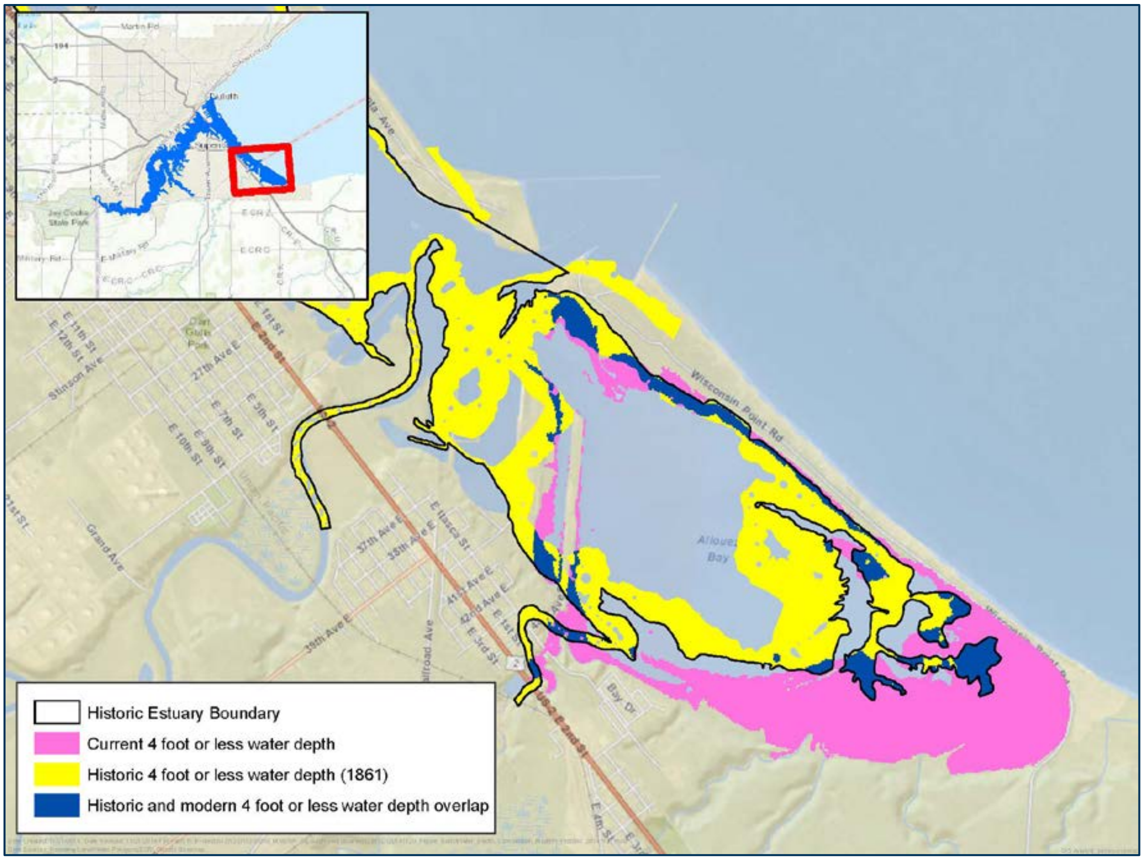


Figure 4b. Comparison of 4 feet or less depths in the project area between the 1861 Hearding data and the contemporary (2010) bathymetry, Allouez Bay. (Hearding data courtesy of D. Peterson, MLT and T. Hollenhorst, USEPA).

Prior to European settlement of the St. Louis River Estuary, the Fond du Lac Band of Lake Superior Chippewa was the primary inhabitants of the estuary. The river at that time had an average depth of five to eight feet and had abundant natural floating bogs and wild rice beds, making canoe travel the only type of viable transportation (SLRCAC 2002). After the LaPointe Treaty was signed in 1854, the river was transformed by industrialization and development, resulting in severe habitat alteration and water quality degradation (MPCA and WIDNR 1992). Industries such as mining, logging, iron making, grain trade, shipbuilding, acetylene gas production, and goods production moved into the shorelines of the estuary.

The excavation of the Soo Canal in 1855 was a turning point for shipping. It allowed for passage between the Duluth-Superior Harbor and the Great Lakes. This increase in the potential for unimpeded shipping created a need for deeper channels, and dredging of the river soon followed. Most notable are the dredges of the Duluth Harbor in 1867 and the Superior Harbor in 1871 (MPCA and WIDNR 1992). By 1902 a total of 17 miles had been dredged to create 20-foot deep shipping channels. By the 1960s shipping channels depths were increased to 27 feet, to accommodate larger shipping vessels (SLRCAC 2002).

Impacts to the St. Louis River estuary began to become a concern in the late 1920s when governmental agencies began testing pollution levels in the river. Sources of pollution were primarily from the growing adjacent industries disposing their waste and contaminants either on-shore or directly into the river. Pollution investigation studies conducted from the 1940s to 1960s documented degrading fish habitat, declining water quality standards, and growing concentrations of toxic contaminants (MPCA and WIDNR 1992). The studies recommended fish consumption advisories. Loss of habitat for fish and wildlife, increased sedimentation, competition from invasive species, exposure to contaminants, and degraded water quality have been identified as the adverse effects from the rapid industrialization and development by industry in the St. Louis River Estuary (SLRCAC 2002).

Through this industrialization period, wild rice in the estuary likely decreased due to a combination of habitat alteration and degradation. Despite the impact to the estuary, anecdotal observations between the 1930s and 1960s indicate wild rice remained abundant when compared to today's abundance in the St. Louis River estuary, with dense stands covering approximately 600 to 1,000 acres (Angell 1971; Schwarzkopf 1999). Based on accounts from longtime Fond du Lac tribal members (Schwartzkopf 1999), Superior residents (P. David, personal communication), and Gordon MacQuarrie, an outdoor writer, wild rice was abundant from Kekuk Island downstream to Mud Lake and Pokegama Bay as well as Allouez Bay (MacQuarrie 1998; Figure 5). Although Figure 5 should not be considered a comprehensive overview of where wild rice was historically found within the estuary, it does represent a snapshot of locations where wild rice was once present and abundant during the period when the estuary was still being impacted by pollution and habitat alteration.

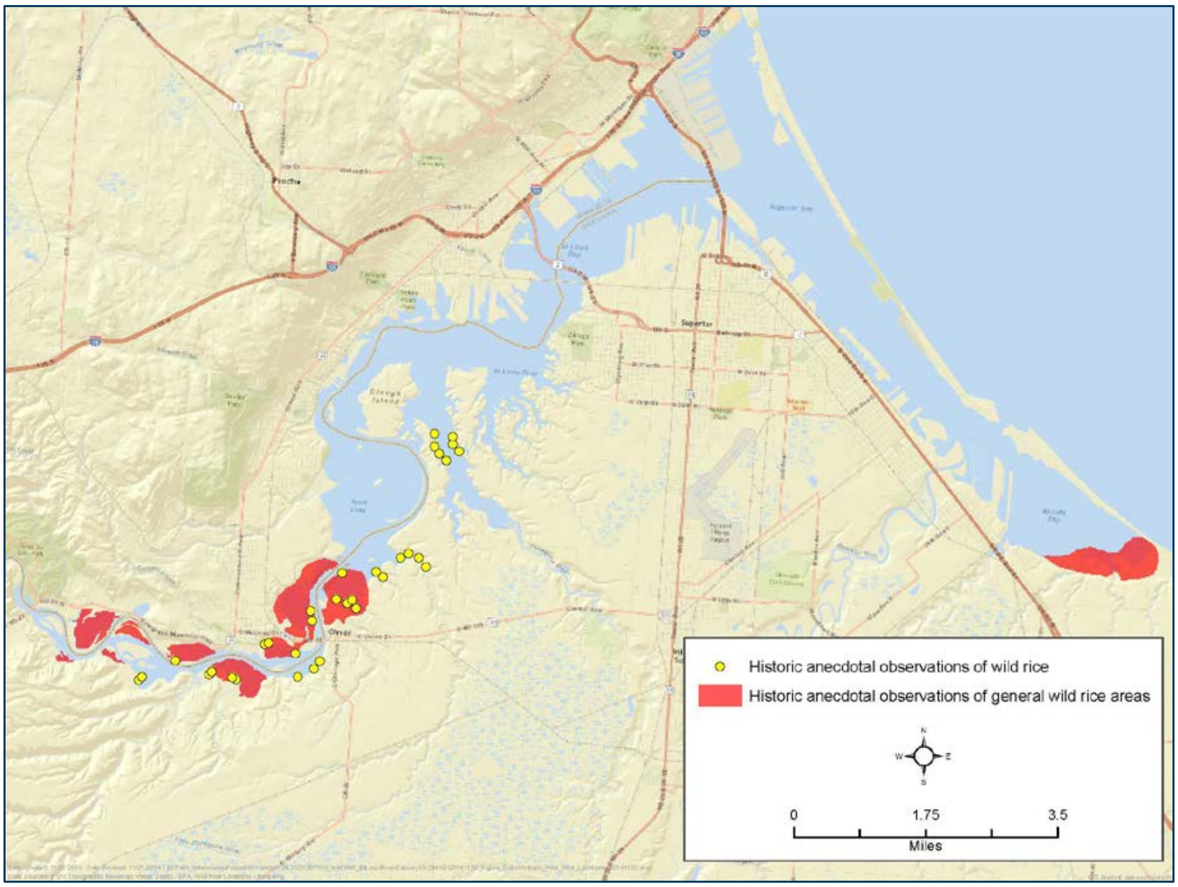


Figure 5. Approximate distribution of wild rice in the St. Louis River estuary between between1920 and 1960 based on anecdotal observations (Schwartzkopf 1995 and P. David, personal communication).

Starting in the 1960s through the 1970s, wild rice abundance decreased dramatically, to the point where there were only sparse remnant stands in backwaters and side channels of the estuary (Schwarzkopf 1999). A 1971 survey estimated the remnant stands to total approximately one acre (Angell 1971). In the 1990s, Fond du Lac Natural Resources began working on restoring wild rice and identifying potential causes for the decline. Through their investigation, they were unable to identify one single factor that may have led to the decline. Multiple factors including lasting effects of historical impacts such as sediment loading, pesticide use in the watershed, contaminants, changes to nutrient loading and cycling, and increasing herbivory may have played a contributing or compounding role to wild rice's decrease (Schwartzkopf 1999).

Previous Wild Rice Restoration in the St. Louis River Estuary

From 1993 to 1996, FdLNR initiated wild rice restoration at a few select sites in an attempt to re-establish wild rice to its historic density and distribution (Schwartzkopf 1999). The program was intended to start a 30-year effort to restore wild rice to the estuary. During this time, approximately 2,165 lbs of wild rice were seeded in Rask Bay, North Bay, Radio Tower Bay, Mud Lake, and Indian Point Bay, using seed from several Minnesota wild rice lakes and rivers. In 1996, Canadian seed was used when weather caused problems with the Minnesota seed harvest. Between 1994 and 1995, several experimental exclosure plots were set up to determine the effect of carp or geese herbivory to wild rice survival. Although quantitative results are not available, observations made during the project indicated that herbivory was a noteworthy negative impact to wild rice in the estuary.

Overall, the wild rice restoration project had mixed success during this time period. Sites with the most appropriate sediment conditions (high organic content), such as Rask Bay, performed well, and sites such as Mud Lake with less organic sediments performed poorly. After 1997 restoration efforts were scaled back to focus on areas such as Rask Bay, where sediments provided more potential for successful wild rice restoration. Programmatic funding by FdLNR to maintain the wild rice restoration effort over the proposed 30 years was not identified, and the project promptly ended. Currently, FdLNR has not completed any additional restoration activities on the estuary.

Similar to the FdLNR efforts, from 2010 to 2011 the University of Wisconsin – Superior, Lake Superior Research Institute (UWS-LSRI) completed a pilot wild rice restoration effort in Allouez Bay ((http://www.uwsuper.edu/lsri/hogisland/allouez-bay-wild-rice-restoration.cfm). Wild rice was seeded in two areas, totaling approximately 4 acres near the outlet of Bear Creek, where it was historically known to be present. A portion of the seeding area had exclosures installed to limit herbivory by carp and geese. Wild rice germinated both inside and outside of the exclosures; however, wild rice outside of the exclosures was severely grazed, while the plants inside the structures were able to develop seed heads.

Current Status

It is difficult to develop an accurate estimate of the current wild rice acreage because there is no dedicated or regularly scheduled survey work to assess wild rice in the estuary. Also, wild rice is an annual plant that can show high variability in a single growing season as well as over several years. The SLRAOC is a fairly well-studied resource with work being completed by agencies representing both the states of Wisconsin and Minnesota, FdLNR, USEPA, and several academic institutions (University of Minnesota and University of Wisconsin-Superior) along with the Lake Superior National Estuary Research and Reserve. Over the past 15 years, there have been various studies or projects that have investigated, observed, or documented wild rice in the estuary; however, no surveys have quantified the total acreage of wild rice in the estuary during any one year or over a short period of years. However, a review of available data from multiple sources and studies does provide a basis for where wild rice has been found in the estuary over approximately the past 15 years (Figure 6). Since 2007, wild rice has been found or can be found in approximately 20 areas and bays in the estuary.

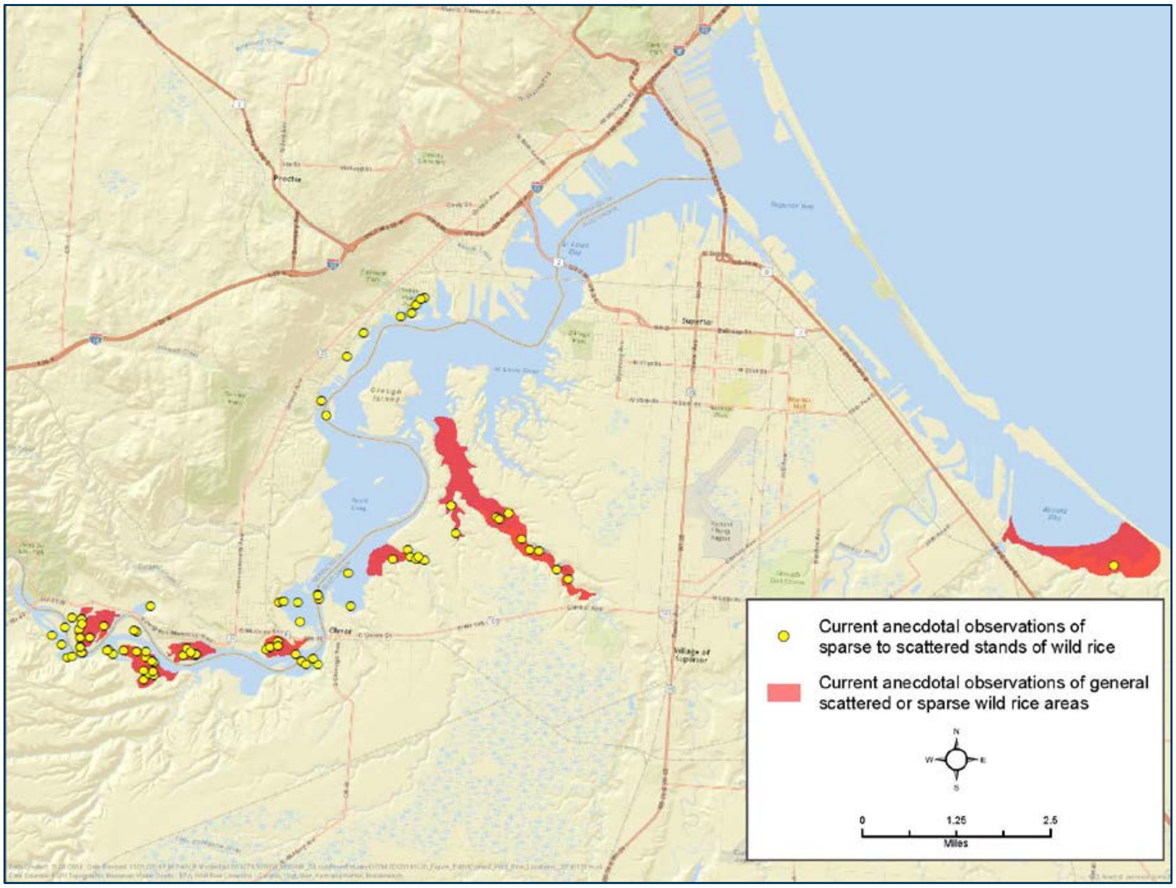


Figure 6. Anecdotal observations of current distribution of wild rice during the period of 2007 to 2014 based on multiple data sources.

At first glance, it may appear that the current distribution of wild rice is equal to or greater than the more recent historical accounts (Figures 5 and 6). Scattered or sparse remnant or restored stands are responsible for the current distribution and may overestimate the current abundance and distribution. Additionally, there is a mixture of data reported as specific locations and other observations representing a general area such as bay. Similar to Figure 5, data represented in Figure 6 should not be considered a comprehensive overview of where wild rice is currently located within the estuary. The intent of Figure 6 is to compile multiple sources of data to provide an overview of where wild rice has been observed in the estuary during a more contemporary period and provide insight into where wild rice restoration may be possible. In Section 1.9, a discussion about the wild rice restoration objective notes that there are little to no wild rice stands currently in the estuary considered equivalent to what is believed to be their historical condition. A general consensus among natural resource professionals and wild rice stakeholders in the estuary is that wild rice currently is a minor, background component of the estuary, hanging on at a fraction of its former abundance. An outcome of wild rice restoration efforts in the estuary will be to achieve an increase in the distribution and abundance of wild rice stands in the estuary.

1.5 Threats and Limitations to Wild Rice in the St. Louis River Estuary

Water Level Changes

The influence of water level and water level changes in the estuary can operate on two different temporal scales. During the growing season, water level can be important to the growth and abundance of wild rice. A wild rice stand is most vulnerable when water levels abruptly increase during the floating leaf stage of the plant in early summer (MNDNR 2008). An abrupt water level increase can uproot entire plants, limiting production for the year. Wild rice can tolerate water level changes, with ideal conditions being a gradual change of less than one foot during the growing season (Oelke et al. 2000; Oelke 2007). Data from a NOAA observation station in the Duluth Harbor indicates that from 1960 through 2014, the average change in water elevation during June and July (as measured by the difference between the highest recorded water elevation and the lowest recorded elevation during those two months) is 1.2 feet (Data obtained from http://tidesandcurrents.noaa.gov/stations.html?type=Water+Levels for Station 9099064; 1960 through 2014). In the St. Louis River estuary, the most likely cause of a water level increase that results in uprooting floating leaf-stage wild rice would be a significant storm event during the early summer period. The Fond du Lac Dam is a hydropower generating facility located at the upstream end of the wild rice project area. During normal operating conditions, water release from the dam likely has minimal potential to increase water levels beyond the water level change tolerance of wild rice. Because the dam is used to generate electricity, in most instances, water is held back to create the required head pressure to operate the facility's turbines. In most situations, when the dam is releasing excess water, it is due to a major storm event that would likely impact wild rice even if the dam were not present.

Another influence on growing season water level changes in the estuary is the seiche generated by Lake Superior. The seiche results in water level changes, due to high wind or barometric pressure "piling up" water on one end of the lake and the subsequent decrease or rebound once the wind changes (SLRCAC 1992). During a typical seiche event, water levels change by less than one foot. Areas closest to the outlet to Lake Superior are the most impacted on a regular basis by the seiche; however, strong seiche events can have an influence all the way upstream to Rask Bay (SLRCAC 1992). The seiche may not be considered a threat to wild rice restoration because it is a natural phenomenon that will continue to persist within the estuary. It may be considered a limitation because wild rice restoration may not be appropriate in areas within the estuary that are most impacted by regular and significant water level changes due to the seiche; however, it could be inferred that it is likely wild rice was not historically present in those areas prior to industrialization due to the physical limiting factor. In general, the seiche is an important process that provides water movement and the exchange of materials and nutrients into the sheltered back bays where wild rice is typically found.

Changes in Lake Superior water level throughout the year and over a period of years could have an influence on the locations and habitat for wild rice restoration. Wild rice can be found in water depths ranging from 0.5 to 5 feet, but its preferred depth range is 2 to 3 feet. Extended periods of higher or lower water elevations can both create or eliminate restoration opportunities by making water depth either ideal for wild rice or too shallow or too deep. Figure 7 displays the annual average Lake Superior water elevation during May through July, from 1960 to 2014 (Data obtained from http://tidesandcurrents.noaa.gov/stations.html?type=Water+Levels for Station 9099064; 1960 through 2014). Over the past 55 years during May to July, the average water level is 601.8 feet Mean Sea Level (msl). The highest recorded average water level during that time period was 603.0 feet msl, and the lowest recorded average was 600.4 feet msl. When water levels are above normal, the average is 0.4 feet above normal; when water levels are below normal, the average is 0.3 feet below normal. Focusing restoration on areas that have a bathymetry that provides water depths ideal for wild rice through both high and low water periods will help to minimize the impact to changing water levels.

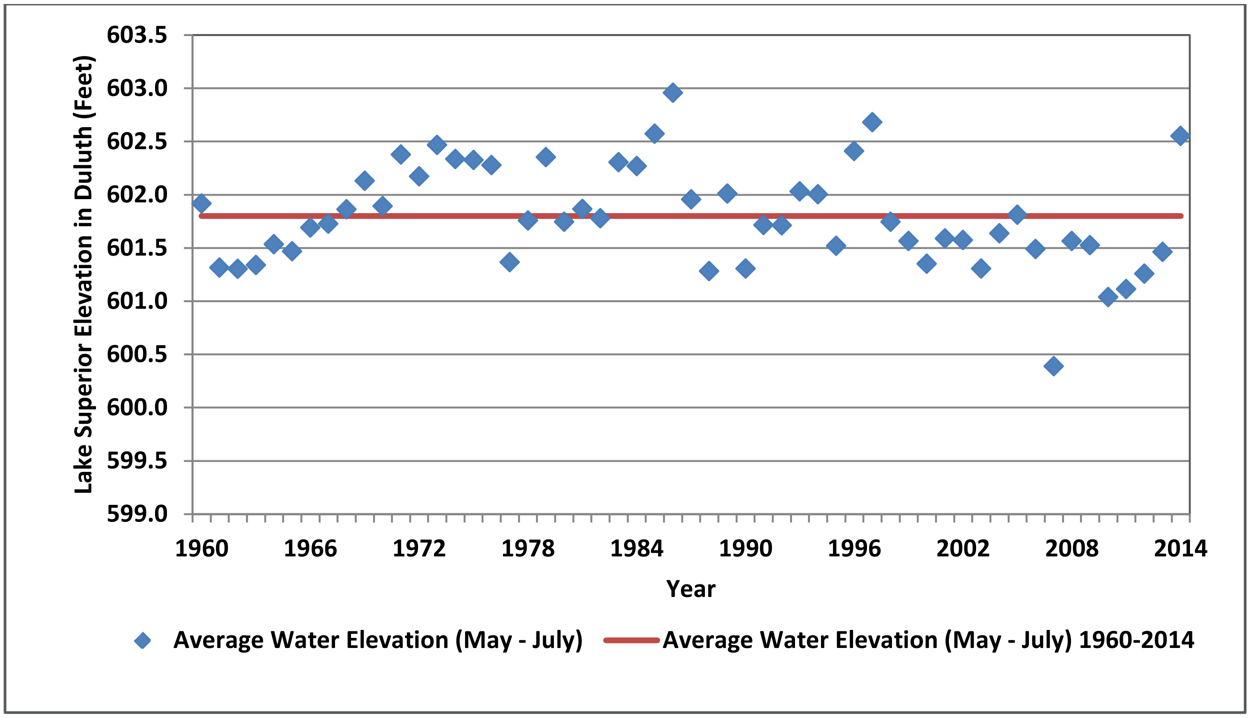


Figure 7. Average water elevation from May to July for Lake Superior from 1960 to 2014. Data recorded by NOAA Observation Station 909906.

It is difficult to discuss long-range wild rice restoration planning without mentioning the potential impacts from global climate change to Lake Superior water levels and subsequently available wild rice habitat. Data collected from the early 20th century through present day documents that seasonal and annual water level fluctuations are a natural occurrence within Lake Superior. These natural and historical fluctuations are cause by changes in the water inputs and outputs to the lake, mainly snowmelt, runoff, precipitation, and evaporation. As a result of the combined effects of global climate change on Lake Superior, lake levels are anticipated to decrease in the future (Huff 2014). Hydrology models developed to predict the impacts of global climate change have predicted a decrease in water levels of 0.5 to 2.0 feet by the year 2050 (Kahl 2013). Air temperatures are predicted to rise by 3 to 4 degrees Fahrenheit by the year 2035 in the Great Lakes Region, causing a reduction in ice cover, an increase in water temperature, and a decrease in the amount of precipitation (Huff 2014; Kahl 2013; Kling 2003). Along with these reductions in water input to the Lake, these effects would also cause higher rates of evaporation, thereby further increasing water outputs (Huff 2014; Kahl 2013). It may be difficult on an annual basis to distinguish natural variation in water levels from changes related to global climate change, but considering the potential long-term impacts may help with individual site selection and provide opportunities to improve wild rice resilience in the estuary.

Herbivory

Herbivory by common carp (Johnson and Havranek 2010) and Canada geese (Haramis and Kearns 2007) has been shown to have significant negative impacts on wild rice. Carp are abundant and widely distributed in the St. Louis River estuary. The shallow, sheltered bays of the St. Louis River estuary provide ideal foraging and spring spawning habitat for adult carp. Carp foraging through soft sediments for invertebrates and plant material can uproot plants and increase turbidity and nutrient loading.

Once nearly extinct in much of the Midwest by the 1960s, Canada geese are common throughout Minnesota and the estuary with a statewide population of more than 430,000 individuals (Smith 2013). Geese use the estuary for foraging and breeding habitat during the late spring and summer months. Feeding on wild rice occurs throughout all of the plant's life stages. Canada geese can have a dramatic, negative impact on wild rice density and abundance, as demonstrated by UWS-LSRI's pilot wild rice restoration project and FdLNR's restoration work in the 1990s (Schwartzkopf 1999).

Recreational Boating

Boat traffic can negatively impact aquatic plant communities by physical disturbance from propeller action and increased wave energy (Asplund 2000). For many recreational boaters, wild rice, with its tough stems, can be considered a nuisance (MNDNR 2008). The St. Louis River estuary is a highly used public resource because of outstanding recreational boating, fishing, and hunting opportunities. Fortunately, many of the areas targeted for wild rice restoration will be in shallow, sheltered back bays that will likely see limited recreational pressure because they are difficult to navigate. Wild rice restoration that targets areas along the main navigational channel or in larger bays with adequate water depths for recreational boating such as Rask Bay, Pokegama Bay, and the Spirit Lake area may require signage or boater education to prevent unnecessary disturbance to wild rice stands. In some instances, "slow no wake" zones may need to be considered to limit impacts to wild rice stands from recreational boating. Coordination with the US Coast Guard and/or the law enforcement division of each state's DNR may be required to implement any zone.

Water Quality

Over the past 40 years, water quality has improved in the St. Louis River estuary due to municipal waste facilities in Duluth (Western Lake Sanitary District) and Cloquet coming online and preventing significant discharges to the estuary (Schwartzkopf 1999; Hoffman 2011). Since 1973, trends indicate that dissolved oxygen concentration has increased, while total dissolved solids and total phosphorus have decreased. Recent sampling indicates that sediments within the wild rice project area (above Grassy Point) may be a source of nutrients to the river (Hoffman 2011). It is believed that wild rice can become nitrogen and phosphorus limited (Carson 2002); however, this is usually related to continuous production and slow decomposition of wild rice plants, which delays the release of nutrients available for annual growth (Peter Lee, personal communication; Pastor and Walker 2006).

Wild rice prefers clear water; however, it can tolerate moderately stained water when light penetration in shallow depths is not limiting (David 2013a). Data reviewed during plan development indicate that water clarity may not be a limiting factor for the estuary. As part of the planning process, a site selection model for wild rice restoration was developed (see section 1.6 and Cardno 2014a). Data on water clarity were reviewed and considered for inclusion in the model, but they were later removed during the final revision because the Restoration Site Team believed the data did not provide additional information in determining where to restore wild rice. Based on estuary-wide data during sampling events in 2010 and 2014, water clarity, as measured by the ratio of Secchi depth to water depth, averaged 0.81 at 462 sample points. Wild rice was found at sampling points averaging 0.92, with a range of 0.43 to 1.00 (Cardno 2014b). Because water clarity can change based on storm events, water clarity measurements during one sampling event may not represent the cumulative impact of water clarity on wild rice growth and development. Future work may consider ways to integrate a temporal component into water clarity measurements and its influence on wild rice in the estuary.

Sulfate

The State of Minnesota has an established water quality standard for sulfate of 10 mg/L for "water used for production of wild rice" (Minn. R. 7050.0224, subp. 2). Recently, MPCA completed a series of studies to understand the role of sulfate in impacting wild rice (MPCA 2014a). Currently, MPCA along with other experts are continuing to refine the data analysis and develop a technical document to support water quality standards rulemaking (MPCA 2014b). As more information becomes available on this topic, additional impacts to wild rice in the estuary should be reviewed. During wild rice restoration monitoring, collecting data on sulfate and the related chemical parameters should be completed to develop an estuary-specific understanding of the impact of sulfate levels on wild rice.

1.6 Wild Rice Restoration Implementation Planning Process

In October 2013 MNDNR initiated the planning effort for the wild rice restoration implementation plan by inviting individuals engaged in research and natural resource management in the St. Louis River estuary to a project kickoff meeting. Participants included 18 individuals from 13 entities, including state, federal, and tribal government, non-profits, private industry, and academia. They provided information about data availability for wild rice site selection in the estuary, existing wild rice stands, potential restoration areas, and limits to wild rice restoration. Following the initial kickoff meeting, the Restoration Site Team was formed from representatives from MNDNR, MPCA, WIDNR, 1854 Treaty Authority, FdLNR, GLIFWC, and MLT (Appendix A). The Restoration Site Team provided technical and management decision support as the project proceeded. The primary objectives of the Restoration Site Team were to determine the highest to lowest priority sites where wild rice restoration could be targeted in the estuary and to develop specifications and guidelines on how restoration activities should be implemented.

Wild Rice Restoration Site Selection Model

To assist with site selection for wild rice restoration, following the project kick-off meeting a geospatial model was developed based on site-level factors believed to be important for wild rice establishment and growth. The model was populated using existing available data sets obtained from stakeholders (agencies, academia, and private industry) and from field work conducted in summer 2014. From December 2013 to September 2014, the Restoration Site Team reviewed and revised the model based on available data, current information on wild rice habitat, institutional knowledge of the estuary, and restoration objectives. See Cardno (2014a) for a detailed description of the model process and the final site selection model.

The final site selection model assigned a score to areas within the project area that had water depths of four feet or less based on substrate characteristics and existing plant community. During the modeling process, other factors including wave energy, water clarity, and herbivory were considered, but eliminated due to the limited additional value each parameter provided for classifying restoration potential. Individual parameter scoring criteria were calibrated with an estuary-wide data set from 2010 and other reference data from previous reports. Qualitative scores for each parameter were standardized, and a total site score was assigned by summing the parameter scores (Cardno 2014a). Model parameter scoring was developed to align site scores towards identifying sites with high potential for wild rice restoration (minimal efforts required to restore or enhance wild rice), medium potential (conditions appropriate for wild rice, but a management action is required) or low potential sites (higher level of effort to restore wild rice) (Table 2).

Table 2. Wild rice site selection model with current water depth of four feet or less.

Wild Rice Restoration Potential	Substrate Characteristics	Plant Community Characteristics	Impact to Wild Rice Restoration
High	Soft, silt or organic-dominated.	Wild rice already present	• Cost effective • Minimal site preparation • Minimal regulatory considerations • High probability of success
Medium	Muck (peat)-dominated	Plant species that have similar habitat requirements as wild rice present and/or invasive species present such as cattails	• Cost effective • More site preparation required • Minimal regulatory considerations • May require maintenance in future to provide adequate wild rice habitat
Low	Substrate not typically associated with wild rice (hard, rocky,	No plant species that have similar habitat requirements as wild rice are present.	• Increased cost • Intense site preparation required • Regulatory considerations • Requires altering existing site conditions

Using the Wild Rice Site Selection Model in Wild Rice Restoration Implementation

The wild rice site selection model was developed using data specifically from the St. Louis River estuary to guide and prioritize restoration efforts across a relatively large, multi-jurisdictional area. At its most basic level, it is a decision-support tool to help stakeholders make an informed choice on where and how to restore wild rice. The model outputs allow an understanding of the scale and potential for wild rice restoration in the estuary under current conditions. Additionally, the model provides insight into where to consider restoring wild rice and what actions or efforts may be required for restoration at the site level. Implementation planning will also consider cost, regulatory constraints, previous restoration success, and current conditions in determining where and how to restore wild rice. Section III provides a complete breakdown of model outputs by selected priority wild rice restoration areas.

1.7 Development of a Wild Rice Restoration Goal and Objective for the St. Louis River Estuary

During the scoping stage of the planning process, the Restoration Site Team developed a wild rice restoration goal and objective for the St. Louis River estuary. Both the goal and the objective were used to guide the planning process and will provide a framework for future wild rice restoration efforts. The goal statement is used to describe the desired future condition of wild rice in the estuary using descriptive, open-ended statements (Adamcik et al. 2004). A well-written goal should clearly define and communicate the purpose of the desired condition so stakeholders such as natural resource managers, resources users, and the public clearly understand it. It does not provide information on how success toward the goal is measured.

The Restoration Site Team developed a wild rice restoration objective that attempted to satisfy <u>S</u>pecific, <u>M</u>easurable, <u>A</u>chievable, <u>R</u>esults-oriented, <u>T</u>ime-fixed (SMART) criteria (Doran 1981). A SMART objective is a concise statement that provides detail about what will be achieved, how much will be achieved, when and where it will be achieved, and who is responsible for the work to meet the conditions outlined in the goal (Adamcik et al. 2004). It provides the detail on how progress and success towards the goal is measured and directs appropriate management actions (strategies) necessary to achieve the goal.

1.8 Wild Rice Restoration Goal for the St. Louis River Estuary

The goal for wild rice restoration in the St. Louis River estuary is:

> Increase abundance and distribution of self-sustaining wild rice within the St. Louis River estuary including areas in both Minnesota and Wisconsin to increase opportunities for culturally important harvest and benefit fish and wildlife species including contributing to the removal of the Loss of Fish and Wildlife Habitat BUI within the St. Louis River Area of Concern.

<u>Rationale</u>

The desired future condition for wild rice in the St. Louis River estuary will be an increased distribution and abundance so that the cultural influence and ecological impact it has on the estuary is increased. Historically, wild rice was common within the estuary and documented during the early European explorations of the estuary (Schoolcraft 1855). Currently, wild rice has been observed at 20 locations over the past seven years (2007 to 2014) in the estuary (Figure 6). On the surface, this distribution appears to be similar to historical accounts (Figure 5). However, it is documented that current abundance and distribution of wild rice is less than what it was historically. Successful wild rice restoration will increase the abundance and distribution from the current levels.

Successful wild rice restoration will not require continuous seeding for it to persist at a site or within the estuary. By nature, wild rice densities fluctuate through time, based on annual and periodic site and growing conditions (Atkins 1986; Lee 1986; Archibold et al. 1989; Pastor and Duree Walker 2006; Walker et al. 2006), and nutrient cycling (Pastor and Duree Walker 2006). Restoring wild rice within the estuary will help to increase the overall resilience of wild rice to endure the natural population variations.

Responsibility for managing the St. Louis River estuary is shared between the States of Minnesota and Wisconsin and under treaty rights with tribes. Successful restoration will require coordination by all stakeholders involved. As demonstrated by past and current efforts to delist the SLRAOC through planning and implementation, Minnesota, Wisconsin, and tribal partners such as the Fond du Lac Band of Lake Superior Chippewa view wild rice restoration as a shared responsibility with mutual benefits.

Increasing the abundance and distribution of wild rice in the estuary will provide benefits to fish and wildlife such as providing food for waterfowl species during the migration period, cover for waterfowl brood rearing, and habitat for larval and juvenile fish. Providing or improving wild rice habitat will have a direct impact on fish and wildlife habitat and will help support the removal of the Loss of Fish and Wildlife Habitat BUI within the SLRAOC.

1.9 Wild Rice Restoration Objective for the St. Louis River Estuary

The objective for wild restoration in the St. Louis River estuary is:

> By 2025, at least 275 acres of wild rice will be restored or enhanced in approximately 15 locations where habitat conditions are suitable for wild rice, to benefit fish and wildlife resources and provide opportunities for harvest, including a minimum of one wild rice stand greater than 50 acres in size. Restored or enhanced wild rice stands will comprise the following characteristics:
>
> 1. Wild rice is present with an average density of greater than 1 stem/0.5 m^2 in 50% of the sampling points within the defined site in three of every five years and not absent in 60% or more of the sampling points for more than three straight years.
>
> 2. Stands targeted to provide harvest opportunities have an average stand density that can be identified through standard aerial photography methodology in late summer (August 7 through Sept 15) in two of every five years.

<u>Rationale</u>
As previously mentioned, there are no direct estimates on how much wild rice was present in the estuary prior to industrialization. The Hearding Chart from 1861 estimates that there were approximately 3,390 acres within the entire estuary with a water depth of four feet or less. Based on historical accounts by Schoolcraft (1855), it may be inferred that much of that acreage either contained wild rice or was likely suitable habitat for wild rice. According to Angell (1971), by the early 1970s, wild rice in the estuary had been reduced to scattered stands totaling approximately one acre. Over the past 7 years, wild rice has been found in scattered or sparse stands in at least 20 locations. Although its abundance is not even close to historical accounts, previous restoration efforts and improving water quality and habitat conditions in the estuary have increased its abundance from the early 1970s.

The SLRAOC RAP does not define a goal for wild rice restoration acres; however, restoring 275 acres of wild rice will support the delisting of BUI 9 – Loss of Fish and Wildlife Habitat for the SLRAOC. In addition to supporting the delisting, restoring at least 275 acres of wild rice in the estuary over the next 10 years represents what MNDNR, WIDNR, and other project partners believe is the first phase in a long-term process to achieve the wild rice restoration goal for the estuary and to build momentum for the development of a wild rice restoration program that will persist beyond the delisting of the SLRAOC. Schwartzkopf (1999) acknowledged that wild rice restoration in the estuary would require a long-term effort (30 years).

Restoring 275 acres that meet the criteria outlined in the objective is a balance between setting a target acreage that can realistically be achieved and one that will require resources and efforts including partnerships beyond existing levels. At the time this plan was prepared, funds were secured for the initial wild rice restoration efforts by the states of Minnesota and Wisconsin, and MLT. With funding vehicles such as the federal Great Lakes Restoration Initiative (GLRI), which is proposed to run through 2019 (USEPA 2014), and Minnesota's Clean Water, Land, and Legacy Amendment, which provides sales tax-dedicated funds through 2034 (http://www.dnr.state.mn.us/legacy/index.html), there is an opportunity to build capacity for a concerted and continuous effort to restore wild rice in the estuary first by supporting the delisting process in the SLRAOC and then through the development of a long term wild rice program.

Wild rice restoration should not stop when at least 275 acres are restored, but, it does represent a significant step toward restoring the overall restoration of wild rice in the estuary. Hearding estimated that there were approximately 2,275 acres with a water depth of four feet or less within the currently defined boundary for the wild rice restoration project (Hollenhorst et al. 2013), most of which was likely wild rice habitat. Accounts from the 1930s to the 1960s describe the estuary (primarily within the wild rice project area) as having between 600 and 1,000 acres of wild rice (Angell 1971; Schwartzkopf 1999). Based on the site selection and scoring criteria in the wild rice site selection model developed for the planning process, there are currently approximately 1,129 acres classified as high wild rice restoration potential habitat in the project area and 1,679 acres classified as medium wild rice restoration potential habitat (Table 3). While wild rice restoration will not be feasible in all these areas because there are locations where the existing plant community may be high quality or unique, this acreage total does provide a point of reference on what may be possible with a concerted effort. Additionally, wild rice restoration may occur in the future in select locations within the approximately 792 acres of low wild rice potential areas as part of larger restoration projects or focused efforts.

Table 3. Potential wild rice implementation areas within the St. Louis River estuary based on model results.

Area name	State*	Modeled acres of wild rice restoration potential (acres)			Total Acres
		High	Medium	Low	
Fond du Lac – Kekuk Island	WI	6	20	87	113
Rask Bay	MN	82	37	4	123
Perch Lake	MN	17	6	1	24
Walleye Alley Bay	WI	25	5	1	31
Landslide Bay	WI	10	5	0	15
Duck Hunter Bays	WI	85	30	6	121
North Bay	MN	20	31	11	62
Foundation Bay	WI	86	22	2	110
Radio Tower Bay	MN	24	66	2	92
Bear Paw Island	MN	0	4	1	5
Oliver Landing	WI	0	21	7	28
Mud Lake West	MN	0	45	50	95
Mud Lake East	MN	55	43	5	103
Oliver Bay – Little Pokegama Bay	WI	164	153	27	344
Spirit Lake	MN	169	231	53	453
Munger Landing	MN	26	18	28	72
Clough Island	WI	45	59	15	119
Clough Island Wetlands	WI	37	73	12	122
Tallus Island	MN	23	46	17	86
Kingsbury Bay – Indian Point Bay	MN	19	53	17	89
Stryker Bay	MN	5	42	32	79
Dwight’s Point	WI	8	78	52	138
Wisconsin Tributaries	WI	13	62	23	98
Billings Park	WI	28	49	31	108
Grassy Point	MN	23	85	3	111
Pokegama Bay	WI	99	219	28	346
Allouez Bay	WI	51	175	284	510
Total Acres		1,129	1,679	789	3,597

*Designated as the state where the majority of the acreage for the areas is located.

The ultimate number of acres targeted for wild rice restoration was not determined during this planning process. The Restoration Site Team believes the wild rice restoration implementation plan should be viewed as a working document that will be updated at some point in the future, potentially when the SLRAOC is delisted. Information and insight gained over the next 10 years will be used to update the plan and set a revised restoration acreage objective based on the success and accomplishments completed under this plan.

A recommended practice when restoring wild rice is to seed over a minimum of a three-year period to help establish the necessary seed bank to provide a long-term seed source (David 2013a). The 10-year period between initiation and delisting of the SLRAOC will allow the wild rice restoration program to establish areas, monitor success and failures, and continually improve methodology by using adaptive management. Currently, MNDNR, MLT, and WIDNR have secured funding to begin the initial phase of restoration activities over a three-year period. The initial funds are being used to seed up to 275 acres of wild rice at several locations within the estuary. Additional funds will be required to provide the resources (labor and materials) to manage the areas that are seeded so they meet the criteria outlined in the wild rice restoration objective.

Wild rice restoration in the St. Louis River estuary is going to be a cooperative effort among the states of Minnesota and Wisconsin, tribal partners, and non-profit organizations. Based on the state boundary, Minnesota has approximately 1,374 acres with a water depth of four feet or less, and Wisconsin has approximately 2,223 acres (Table 4). Both states have more than 75% of their potential wild rice acres classified as either high or medium wild rice restoration potential sites.

Table 4. Modeled wild rice restoration potential by state jurisdiction for areas with a water depth of four feet or less within the wild rice project area of the St. Louis River estuary.

State	Modeled acres of wild rice restoration potential (acres)			Total
	High	Medium	Low	
Minnesota	463	679	232	1,374
Wisconsin	666	1,000	557	2,223
Total Acres	1,129	1,679	789	3,597

To achieve at least 275 acres of wild rice in the estuary, two approaches will be pursued. One approach will be to enhance and restore wild rice at priority locations within the estuary where wild rice is already present or where the current or potential conditions provide for a high probability of success. For example, in summer and fall 2015 MNDNR, MLT, and WIDNR will initiate pilot restoration projects targeting Rask Bay, Duck Hunter Bay, North Bay, and Allouez Bay. In each of these bays, there was a historical account of wild rice being present and currently contains a remnant stand. In these areas, wild rice restoration will likely be the sole activity occurring to help support SLRAOC BUI removal objectives. Focusing on these areas will provide important experience, and information can be utilized when addressing areas that may be more difficult to restore wild rice or may be limited by other factors. In addition to the areas listed above, Pokegama Bay, Oliver Bay – Little Pokegama Bay, Walleye Alley Bay, Foundation Bay, and Landslide Bay will be priorities for wild rice restoration because they offer the potential to enhance or restore larger blocks wild rice relatively easily.

A second approach to achieve the total proposed wild rice restoration acres will be to include wild rice habitat restoration as a component of other larger restoration projects. For example, the removal of wood waste from Radio Tower Bay currently underway in fall 2014 provides an opportunity to seed wild rice in areas where the resulting substrate and water depth are favorable for establishment. Enough information is known about the water depth and substrate requirements for wild rice that these conditions could be considered and incorporated into the designs for these larger projects. Areas with existing or future restoration plans to address a legacy impact that is beyond the scope of just wild rice restoration include Perch Lake, Mud Lake, Spirit Lake, and Grassy Point. With inclusive planning and consideration, there is the potential for wild rice restoration at these sites.

With wild rice restoration success at larger priority areas such as Rask Bay and Allouez Bay, lessons learned can be applied to areas within the wild rice project area where the total impact may not be as great (such as total acreage), but establishing wild rice will help increase the overall distribution of wild rice in the estuary and build toward accomplishing the desired acreage in the objective. Additionally, restoring wild rice in these smaller areas helps increase wild rice resilience in the estuary. With pockets of wild rice distributed throughout the estuary, a plant species that naturally fluctuates in abundance becomes less susceptible to long-term change. Areas that may provide limited opportunity but have a high probability of success for wild rice restoration include Tallus Island, the back bays of the Wisconsin tributaries, and Kingsbury Bay – Indian Point Bay.

At an individual site-level, a successful wild rice restoration ideally produces a stand with a density that provides both cultural benefits through opportunities for harvest and improved fish and wildlife habitat. Defining a wild rice stand can be difficult because density can change from year to year over a three to five year period, due to natural cycles in nutrient availability (Atkins 1986; Lee 1986; Archibold et al. 1989; Pastor and Duree Walker 2006; Walker et al. 2006). A success criterion that a stand should have a density of wild rice greater than 1 stem/0.5 m^2 in three of every five years ensures the stand has a density that provides the intended fish and wildlife habitat benefits, and has the potential to be self-sustaining over a period of time. Field work conducted in summer 2014 measured density at 14 points where wild rice was observed. Densities ranged from 0.2 to 43.9 stems/0.5 m^2 with an average of 9.0 stems/0.5 m^2. These data may be somewhat deceptive because they include only those points where wild rice was found. A comprehensive monitoring program would have included more points and likely points where no wild rice was found, lowering the overall density. For comparison sake, during the 2013 growing season the 1854 Treaty Authority found an average of 19 stems/0.5 m^2, with stand densities ranging from 4 to 56 stems/0.5 m^2 in 10 wild rice lakes in northeastern Minnesota (Vogt 2014).

An average stand density of 1 stem/0.5m^2 will likely be enough for the stand to be self-sustaining through annual population cycles and to provide fish and wildlife habitat benefits; however, it may not be dense enough to provide harvest (ricing) opportunities for tribal and non-tribal members. A portion of the wild rice restoration efforts will focus on establishing at least one stand greater than 50 acres that has a density that provides quality harvest opportunities. Initial efforts will target areas such as Rask Bay or Duck Hunter Bay because of the large area (greater than 50 acres) classified as either high or medium wild rice restoration potential. Management may be more intense in areas designated to provide harvest opportunities. Existing vegetation management or the use of exclosures along with extended seeding may be required to achieve the higher stem densities. During the planning and establishment phase, partners such as FdLNR, the 1854 Treaty Authority, and GLIFWC should be consulted on potential target stem densities due to their extensive experience in monitoring stands to estimate wild rice abundance for harvest (Vogt 2014).

In addition to site-level density estimates, utilizing aerial surveys to estimate wild rice acreage and density will provide a comprehensive overview of the status of wild rice in the estuary. Currently, the 1854 Treaty Authority, FdLNR, and GLIFWC have completed these types of aerial surveys for wild rice waters in northeastern Minnesota, along with MNDNR and US Forest Service and northern Wisconsin, with much success. The aerial surveys can help to cover areas not sampled on the ground (David 2013b). Where wild rice stands are dense and are the primary emergent species, it can easily be observed from the air during August and September due to its characteristic seed head color and greenish stem color as it matures. Monitoring during the flowering period is also a good indicator of what is available for harvest and what areas are producing seed for the following year.

2 Wild Rice Restoration Implementation in the St. Louis River Estuary

2.1 Introduction

Wild rice restoration in the St. Louis River involves five steps: site preparation, seeding, operation and maintenance of exclosures (to limit herbivory, as necessary), and monitoring of restoration success. This section provides general information about guidelines for wild rice restoration in the St. Louis River estuary. Except where noted, the information is summarized from David (2013a).

The process of restoring wild rice at a given site is estimated to be a three to five year activity (David 2013a). Table 5 provides a general example of the tasks and timing associated with wild rice restoration at a site over a five-year period. Depending on the site, elements such as site preparation and exclosures may not be necessary. Additionally, where wild rice enhancement is occurring, seeding may not need to occur for three consecutive years. Proper planning and monitoring of annual results will indicate if and how the general schedule and tasks need to be modified.

Table 5. Potential schedule of wild rice restoration tasks for a project site over a 5-year period (F W S Su = Fall, Winter, Spring, Summer).

Task	Year 1				Year 2				Year 3				Year 4				Year 5			
	F	W	S	Su	F	W	S	Su	F	W	S	Su	F	W	S	Su	F	W	S	Su
Acquire permits and plan	■																			
Prepare site	■																			
Seeding	■				■				■											
Install exclosure			■				■				■				■				■	
Remove exclosure					■				■				■				■			
Maintenance			■	■			■	■			■	■			■	■			■	■
Monitoring				■				■				■				■				■

2.2 Site Preparation

One of the key steps to restoring wild rice in the St. Louis River estuary may be preparing a site for seeding. Where water depth and substrates are suitable for wild rice, the existing vegetation may need to be manipulated to provide an opportunity for wild rice to become established. Because it is an annual plant, wild rice may be even more susceptible to plant competition. Described below are two approaches to vegetation manipulation that may be required for site preparation, vegetation reduction and vegetation removal. During the planning phase for a restoration project, on-site observations should be made to determine the appropriate vegetation manipulation techniques. Section 2.6, Regulatory Requirements discusses permit requirements for each of the techniques.

<u>Vegetation Reduction</u>

In some situations, site preparation may consist of simply reducing the density of existing vegetation so wild rice can become established (Figure 8). An example of equipment used by FdLNR to reduce vegetation is an airboat equipped with a cutter head (Figure 9). Through this process, the existing vegetation is essentially mowed down or setback, potentially making more resources, such as sunlight or nutrients, available for wild rice. Typically mowing occurs in the summer months prior to seeding. Follow up treatments are sometimes necessary, depend on wild rice establishment and re-growth of existing vegetation.

Figure 8. An example of a potential wild rice restoration site where site preparation includes reducing the existing vegetation.

Figure 9. An example of equipment used by FdLNR to reduce existing vegetation prior to wild rice seeding. (Photo courtesy of FdLNR).

<u>Vegetation Removal</u>

In areas with dense vegetation, especially cattails or floating mats, vegetation removal may be required to prepare a site for wild rice seeding. FdLNR has used different pieces of equipment to effectively remove vegetation for wild rice restoration. The "cookie cutter" or "sedge mat cutter" has blades on the front that can effectively chop up vegetation. The removed vegetation is dispersed behind the boat. The aquatic plant harvester has blades that cut the vegetation and roots and collects the removed material at the back of the boat using a conveyor system (Figure 10). Removed material can then be transported to a collection area and disposed of on land. Both pieces of equipment effectively remove the existing vegetation and a significant portion of the root system so that other vegetation such as wild rice has the opportunity to grow. Vegetation removal typically occurs in the late summer or early fall prior to seeding and is effective for three to five years before it needs to be repeated. Because there is the potential for additional handling of the removed vegetation, this option is slightly more expensive; however, the longer lasting effect and the ability to address cattail stands may make up for the increased cost.

Figure 10. An example of equipment used by Fond du Lac Natural Resources to remove existing vegetation from the roots prior to wild rice seeding. (Photo courtesy of Terry Perrault, FdLNR).

Other Site Preparation Scenarios

Vegetation reduction or vegetation removal is appropriate for sites where the vegetation component is the only factor that needs to be manipulated prior to wild rice seeding, because the current water depth and substrate type are suitable for wild rice. In low potential areas, water depth and/or substrate may need to be manipulated to make the site more suitable for wild rice establishment. Water depth should be between 0.5 and 3 feet with a gradual slope across the area. This range of depth with a gradual slope may allow wild rice to respond to changing water levels across a several year period. For example, during low water periods, wild rice can have favorable habitat in the deeper areas and vice versa during a high water period. When substrate manipulation is required, the focus should be on providing at least 6 inches of a soft substrate, primarily silt and organic material, with a high nutrient content. Material for substrate manipulation could come from a terrestrial source outside of the estuary, or more likely it could result from a sediment removal (dredging) project within the estuary being completed as part of other habitat restoration projects or navigational maintenance. Adding material to a jurisdictional waterbody (Waters of the State and US) will likely trigger additional permitting requirements beyond permits for both vegetation reduction and removal activities. Preplanning and early coordination should be considered prior to implementing a wild rice restoration involving sediment manipulation. More information on the regulatory requirements can be found in Section 2.6.

2.3 Seeding

Successful seeding efforts are the result of proper seed handling, timing, and frequency. The seeding should occur annually over a three to four-year period. Multi-year seedings allow for the seed bank to establish and to cover variations in growing conditions between years. The outcome of a successful wild rice seeding and stand establishment may not be apparent until after five years from the initial seeding. Therefore, resource agencies involved in wild rice restoration should commit to working and maintaining a restored area for three to five years.

Seed Sources and Genetics

Identifying sources for wild rice seed is an important component to restoration work. Kahler et al. (2011) and Kahler (2010) found that wild rice populations in lakes and rivers at the landscape scale tend to be highly distinct from one another and that the St. Louis River estuary may have its own “genetic identity” (Kern and Kahler 2014). Early restoration efforts by FdLNR in the 1990s utilized seed from Moosehorn River, Stone Lake, and Kettle Lake in northeastern Minnesota and from Stone Lake in Canada one year when weather impacted seed availability in Minnesota (Schwartzkopf 1999). A 2013 investigation into the genetic structure and diversity of wild rice by Kern and Kahler (2014) found wild rice sampled from six locations (Rask Bay, North Bay, Little Pokegama Bay, Pokegama Bay, Lower Pokegama River, and Allouez Bay) had high genetic diversity, and the extensive seed bank may be preventing the loss of genetic diversity typically associated with small, fragmented populations. Additionally, Rask Bay, North Bay, Little Pokegama Bay and Pokegama Bay were closely related, while the Lower Pokegama River and Allouez Bay are less related to that group of four. Based on their work, FdLNR recommend that the Lower Pokegama River and Allouez Bay wild rice stands be treated as separate ecological units. This approach could be considered during future restoration planning; however, it may not be feasible from a management standpoint. There currently are no regulations that limit where wild rice can be collected beyond obtaining a valid wild rice harvesting permit. As discussed in section 2.4, just seeding wild rice in Wisconsin does not require a permit; however, a permit is required for work on the Minnesota side of the estuary.

One of the immediate obstacles for sourcing seed from the St. Louis River estuary for work in the estuary will be the existing small stand sizes with limited potential to produce the necessary volume of seed. Additionally, natural variability in wild rice stand density may make it difficult to reliably plan on availability. Initial seeding efforts will likely require sources outside of the estuary to be used, similar to efforts completed by FdLNR in the 1990s (Schwartzkopf 1999). When selecting seed sources, a stratified approach may be necessary to meet the annual seed volume needs. The stratified approach would seek to acquire as much local seed as possible, from both the estuary and local wild rice waterbodies. As annual supply dictates, additional sources radiating out from the estuary may be required to meet the seed volume demand. Seed from both lake and rivers should be acquired to provide the necessary mix of genetic characteristics that may overlap with the estuarine environment. Records on the seed source and the location of the seeding should be kept as part of a larger wild rice restoration data set to allow for an understanding of what worked and what did not.

In the future, consideration should be given to establishing seed source areas within the estuary where wild rice is currently present as a way to supplement or reduce the amount of outside seed needed for annual restoration efforts. It has been estimated that one acre of wild rice can produce 500 pounds of seed (MNDNR 2008). Setting up exclosures and harvesting within certain areas such as Rask Bay, Duck Hunter Bay, or Landslide Bay may be a way to provide local, estuary-specific seed.

Seed Handling and Preparation

Seed is collected in the fall and kept wet to prevent it from drying out or heating up. If seed will be used within a few days of being collected, it does not need to be kept wet. It can be stored in seed sacks in the bottom of a lake or river or water tanks. To prevent odors from developing when stored in tanks, water should be changed or circulated on a regular basis. If the seed will be planted in the spring, it needs to be stored so that it will be exposed to temperatures at or below 35^{o} F for three to four months so the seeds will germinate the following spring. No other preparation is required prior to seeding. Ideally, large amounts of seed (500 to 2,000 lbs) would be obtained by purchasing seed from harvesters at lakes and rivers nearby, and seed would be “planted” within 24 hours. Storage of seed is labor intensive and undesirable due to the odors associated with wet storage. When wild rice productivity from nearby waterbodies is high, storage will not be necessary.

Seeding Rates and Timing

In areas where the objective is to enhance an existing wild rice stand, the most common seed rate is 50 lbs/acre. It should be noted a natural stand of wild rice can produce an estimated 500 lbs/acre (MNDNR 2008). However, areas where wild rice already exists, such as Rask Bay or Pokegama Bay, a rate of less than 50 lbs/acre may be appropriate. Depending on funding and purpose, seeding rates could be increased to 100 lbs/acre for the first few years in areas without any existing wild rice to help establish a seed bank. In any given year, the wild rice that grows may be from seed that is one year old or more. A higher seeding rate may help increase the potential for initial establishment. Seeding rates could then be reduced after evidence of establishment has been observed. As part of an adaptive management strategy, the success of different seeding rates should be investigated. Ideally, seeding should occur immediately following seed maturation and harvest because this mimics the natural process (Tom Howes, personal communication); however, temporary storage may be required to reach the necessary seed volume to fulfill the needs for a particular seeding area. Seeding can also occur on the ice in late winter and has the advantage that seed coverage can be easily observed. The disadvantages are the amount of labor required and storage time. Spring seeding is also an option if completed immediately after ice-out. With both winter and spring seeding, successful germination during the initial year may be influenced by the seed storage techniques including temperature exposure and wetness.

Seeding Techniques

Wild rice seed can be broadcast by hand from a canoe or boat into the water or on the ice. An effort should be made to evenly distribute the seed across the project area; however, pockets without wild rice are expected and help to promote habitat diversity within a stand. When seeding areas greater than 5 acres, it may be advantageous to divide up the area and assign a certain amount of seed to that area to calibrate effort, and seeding rate required to cover the entire area. Seed sinks immediately to the bottom. Some of the broadcast seed may be consumed off the bottom by waterfowl during migration, but the total amount consumed does not appear to significantly impact the success of the seeding (Tom Howes, personal communication).

2.4 Exclosures and Herbivory

Herbivory by geese (Haramis and Kearns 2006) and carp (Johnson and Havranek 2010) has been shown to have a significant negative impact on the growth of wild rice. Exclosures are structures installed in the water typically using wire mesh or some type of matrix to fence off an area to limit or prevent herbivory by wildlife (Figure 11). Studies using exclosures to prevent or limit access to both geese and carp have shown that wild rice responds favorably when herbivory is limited (Haramis and Kearns 2006, Johnson and Havranek 2010). As previously mentioned, there is anecdotal evidence that wild rice in the estuary is being impacted in a similar way, (Schwartzkopf 1999 and UWS-LSRI project in 2010-2011). Successful wild rice restoration in the estuary will likely require the use of exclosures in some fashion to help establish and maintain wild rice and prevent herbivory.

Figure 11. Example of an exclosure used for wild rice restoration in Allouez Bay in 2010-11 (Photo courtesy of Paul Hlina).

It is not feasible financially or logistically, or from a public use perspective, to consider using exclosures around every wild rice restoration area. Different approaches to the use of exclosures may provide the most effective use of this technique. The use, duration (number of years), and size of an exclosure will ultimately be determined on a site-specific basis, determined by a combination of the desired restoration outcome for that area, regulatory restrictions, available project budget and resources, and public use.

Installing an exclosure across the mouth of shallow, sheltered bay such as Walleye Alley Bay or Landslide Bay may offer the greatest number of acres protected from or subjected to reduced carp and geese herbivory for the least amount of effort. A key element that makes this approach work is that these are shallow bays with little to no public use pressure, such as recreational boating and limited angling pressure during the growing season. Closing off a large area such as a bay at pinch points has been shown to be an effective way to establish and increase wild rice density (Johnson and Havranek 2013).

In bays and areas where installing an exclosure across the bay opening is not possible, another option may be to install multiple areas of half to one-acre exclosures. Exclosures of this size may balance the ease of installation and maintenance with a size large enough to make an impact on wild rice acreage in the estuary. The location and number of exclosures used per area should be determined during restoration planning and account for such considerations as public use, existing wild rice stands, and existing use by Canada geese and carp.

The size, location, and configuration of exclosures will also be influenced by public use and constraints from individual state regulations and regulatory support. Early coordination within WIDNR for 2015 wild rice restoration work indicates that one-acre exclosures may be the largest size allowable in Allouez Bay. Placing exclosures in locations that minimize impacts to and from recreational boaters will be a key to obtaining community support for the wild rice restoration effort. In areas commonly used by the public, leaving spaces between individual exclosures that maintain public access to shorelines or fishing locations will likely be required in any permit. Additionally, exclosures should be removed at the end of growing season and before waterfowl season to allow access for hunters and minimize the potential for conflicts.

Exclosures may be used for one or more years or for an indefinite period of time to prevent herbivory by geese and carp. UWS-LSRI's project in Allouez Bay demonstrated that once exclosures are removed, geese can have a dramatic impact on wild rice and potentially reduce a stand back to pre-seeding levels. The study was relatively short-term and one a small, pilot-project scale. Understanding if, how, where, and for how long exclosures need to be used as part of wild rice restoration in the estuary are some of the fundamental questions that need to be addressed through an adaptive management approach as wild rice restoration scales up from short-term pilot projects to long-term, estuary-wide restoration. For example, are exclosures necessary to build the seed bank up over a period of a few years so the stand can reach a "critical mass"? Can the stand be self-sustaining for a while before requiring the protection of exclosures to rebuild the seed bank?

Operation and Maintenance of Exclosures

Monitoring and maintaining exclosures will likely be the main activity occurring during the growing season. Site preparation through either vegetation reduction or removal is a pre-seeding activity that does not need to be done on an annual basis. No additional vegetation treatment such as herbicide spraying should be done in conjunction with wild rice restoration after seeding has occurred.

Exclosures should be installed in the spring immediately after ice-out. This timing provides the earliest protection to germinating or soon-to-germinate wild rice seed. UWS-LSRI had success using welded wire mesh with 2-in. x 4-in. openings to prevent adult carp and geese accessing the areas. Throughout the summer, the exclosures should be monitored to make sure they maintain their integrity and to remove accumulated debris. After wild rice drops its seed or prior to waterfowl season, exclosures should be removed for the season to allow public access to hunting areas. All exclosures, regardless of location, should be removed prior to ice-out (Schwartzkopf 1999).

2.5 Monitoring Strategies

Developing a monitoring program that is implemented on a regular basis will be important to track progress and achievements toward the wild rice restoration goal and objective. The key elements to a wild rice monitoring program include measuring the density of wild rice (number of stems/unit area) and the aerial coverage of wild rice in the estuary. Combined with additional data collection (See section 2.7), questions such the effectiveness of restoration techniques (site preparation, seeding rates, exclosures), and limitations to restoration (such as herbivory and sediment characteristics) can be systematically addressed over time.

Wild rice restoration will be completed using partnerships among state and tribal agencies, non-profits, and private industry. These partnerships should include a monitoring program. Additional partnerships (e.g., Lake Superior National Estuarine Research Reserve (LSNERR), UWS-LSRI, University of Minnesota's Natural Resources Research Institute (NRRI), and USEPA) may provide additional resources to complete components of a wild rice restoration program.

Specific monitoring protocols will be developed during restoration planning. Some funding sources such as federal money may require the development of a project-specific Quality Assurance Project Plan (QAPP). Developing a consistent, monitoring program, in both approach and occurrence, will result in a data resource that can inform future management actions. The St. Louis River partnership has developed a data system in conjunction with the SLRAOC program. Data related to this work should be incorporated in this data system to ease access and encourage similar data collection methods for future analysis.

Recommended monitoring strategies include:

- Collect information on wild rice density at any restoration areas for a period of at least five years.

- Establish permanent monitoring stations in locations where wild rice has been growing consistently over time (e.g., Rask Bay, Pokegama Bay). Although wild rice abundance is a cyclical or variable, these stations may provide insight into the annual conditions for wild rice.

- Utilize late summer/early fall aerial survey flights to identify location and extent of wild rice in the estuary. Use site-level field surveys to confirm aerial information and develop an index of wild rice abundance similar to Vogt (2013).

2.6 Regulatory Requirements

Some wild rice restoration activities will require permits from either the State of Minnesota or Wisconsin. In some cases, an additional permit from US Army Corps of Engineers (USACE) will be required. Successful restoration will require early planning to identify what permits are required and the estimated time to acquire the permits. Table 6 provides a preliminary list of permits and corresponding contact information to assist with the planning process. Additionally, a brief description of the potential regulatory permits and process for both Minnesota and Wisconsin is provided. Any projects that involve excavation or fill of waters of the U.S. will require coordination or permitting with USACE, regardless of the state involved in the work.

Table 6. Wild rice restoration activity and potential permits required to perform the work.

Activity	Minnesota	Wisconsin
Seed collection (harvesting)	MNDNR staff may collect seed for use in research or restoration projects without a permit. **MNDNR Wild Rice Harvesting License** Other individuals collecting wild rice need to obtain a wild rice license. Band members may not be required to obtain a state license; but are permitted to harvest wild rice under their individual tribal treaty authority.	**WIDNR Wild Rice License** Limited to Wisconsin residents only. Required to collect wild rice. Bands members can obtain an Off-Reservation Natural Resource Harvesting Permit from their tribal conservation department. See WIDNR website for the most current information on license requirements.

Activity	Minnesota	Wisconsin
	See MNDNR website for the most current information on license requirements.	
Seeding	**MNDNR Permit to Collect/Transport Aquatic Plants** Contact MNDNR Fisheries Grand Rapids Region 2 office for more information.	No permits required if seeding is the only activity.
Vegetation reduction and/or removal	**Permit to Control Aquatic Plants, Algae, Swimmer's Itch, and Leeches** Contact MNDNR Fisheries Grand Rapids Region 2 office for more information. Additional support and coordination from the Aquatic Plant Management Program staff and Duluth Area Fisheries Manager. Additional information on amount of material generated and potential disposal locations may be required during application process.	**Permit for Mechanical/Manual Aquatic Plant Control** Permit will required coordination and approval from WIDNR AOC Coordinator, WIDNR, Douglas County Aquatic Plant Management Coordinator, and the owner of the riparian area In Allouez Bay, riparian owner may likely be Douglas County. Along the St. Louis River and Red River Streambank Protection Area, the riparian owner is WIDNR. Check riparian ownership prior to starting a project. A separate permit application through the WIDNR is required for chemical control of aquatic plants.
Placement of fill into waters of the State or US	**MNDNR Public Waters Work Permit** Contact local MNDNR Division of Ecological and Water Resources Area Hydrologist at the Two Harbors Area office. **Clean Water Act Section 404 Permit and/or Section 10 Rivers and Harbor Act** Contact USACE St. Paul District, Hayward, WI Field Office The State of Minnesota has a joint application through MNDNR that allows for the permit application to be routed to the necessary regulatory agencies.	**WIDNR Permit for wetland or waterway fill** Contact WIDNR Douglas County Waterways Division Water Management Specialist. Depending on scale of work, project may qualify for either general permit, regional general permit through USACE, or individual permit. Early coordination recommended. **Clean Water Act Section 404 Permit and/or Section 10 Rivers and Harbor Act** Contact USACE St. Paul District, Hayward, WI Field Office
Exclosures	Permit requirements for the use of exclosures in Minnesota are unknown at this time. Authorization will likely be required from MNDNR Duluth Area	**NR Chapter 30 Permit for Miscellaneous Structures** Contact WIDNR Douglas County

Activity	Minnesota	Wisconsin
	Fisheries Manager and/or incorporated as part of the submittals for MNDNR Public Waters Work Permit.	Waterways Division Water Management Specialist.
Fish removal	**MNDNR Permit to Remove Rough Fish** Contact MNDNR Duluth Area Fisheries Manager for permit to remove rough fish such as carp from exclosures, as necessary.	**WIDNR Scientific Collector's Permit** Contact WIDNR Bureau of Wildlife Management for permit to remove rough fish such as carp from exclosures, as necessary.

Minnesota

In Minnesota waters of the estuary, wild rice restoration activities will require two permits from the MNDNR: a permit to collect or transport aquatic plants and a permit to control aquatic plants, algae, swimmer's itch, and leeches (an aquatic plant control permit). Both permits are issued through the MNDNR Fisheries Region 2 office in Grand Rapids with support from the Aquatic Plant Management Program staff and the Duluth Area Fisheries Manager. The aquatic plant control permit will potentially be triggered by activities associated with site preparation. The elements in wild rice restoration that potentially trigger the necessity of this permit are:

- Cutting or removing emergent vegetation,
- Manipulating (cutting or removing) greater than 2,500 ft^2 of submergent vegetation, OR
- Cutting or removing a bog.

Site preparation may also require a permit to transport and properly dispose of invasive plant material when vegetation removal is involved.

Harvesting wild rice seed to plant requires a license or a special permit. DNR staff is allowed to collect wild rice seed for planting or research through authority granted to the Commissioner of Natural Resources in Minnesota Statute 84.15, Sub. 2. If non-MNDNR staff will be collecting seed, they will need to purchase a wild rice harvesting license or obtain a special permit through the MNDNR Section of Wildlife.

The act of seeding wild rice is regulated under the permit to collect or transplanting aquatic plants. The purpose of the permit is to authorize and regulate the transplanting of aquatic plant material in waters of the state. This requirement helps to prevent the spread of invasive species from one waterbody to the next.

Both permit applications are relatively simple to complete. Information on the location and size of area to be treated will be required. Early coordination with MNDNR Aquatic Plant Management staff is recommended to address any concerns or non-standard issues that occur with wild rice restoration; however, final approval is issued through the Division of Fisheries.

Installing and operating exclosures for wild rice seeding is an additional activity that requires a permit because a man-made structure is placed in a water of the state.

Wisconsin

Similar to Minnesota, the State of Wisconsin and the WIDNR regulate activities that directly impact aquatic plants in the waters of the State. Unlike Minnesota, wild rice restoration activities involving just seeding with no additional site preparation or use of exclosures do not require a permit or further approval. WIDNR has separate permit applications based on the techniques used to control aquatic plants. Reducing or removing vegetation by hand or with machinery qualifies under a NR (Natural Resources) Chapter 109 Mechanical or Manual Aquatic Plant Control permit from the WIDNR. A separate permit application is required for treating vegetation with herbicides (NR Chapter 107). Any structure placed on the bed of a public waterway requires a NR Chapter 30 Miscellaneous Structures permit, also issued by the WIDNR.

Project permitting and approval will require coordination with at least three different entities: WIDNR AOC Coordinator, WIDNR Douglas County Aquatic Plant Management Coordinator, and the riparian owner where the project is occurring. This process could include WIDNR Lands Division, City of Superior, or private owners. Additionally, using exclosures as mentioned above will require coordinating with WIDNR Waterways Division. Early coordination is recommended during the planning phase to avoid project delays.

Other Regulatory Considerations

Projects that involve excavation or the placement of fill into the St. Louis River will likely involve both a permit from the respective state and a regulatory permit from USACE under either Section 10 of the River and Harbors Act or Section 404 of the Clean Water Act. In Minnesota, a MNDNR Public Waters Work Permit will be required. In Wisconsin, a permit through the WIDNR Waterways Division will be required.

It is assumed that any wild rice restoration project that triggers USACE involvement will likely be incorporated into a larger project such as sediment remediation. If a stand-alone wild rice restoration occurs involving a USACE permitting process, it will be important to consider and plan in the appropriate permit processing time. USACE permits can take up to several months to acquire, relatively longer than aquatic plant management permits. Additionally, early coordination with USACE regulatory staff is recommended because a project, depending on scope and scale, may qualify through one or more existing general permits issued within the estuary to either the states of Minnesota or Wisconsin.

2.7 Partnerships

Successful wild rice restoration in the St. Louis River estuary will be a collaborative, long-term effort among state governments tribal partners, non-profits, other governmental agencies, and local academic and research institutions. Wild rice restoration includes planning, securing funding, completing the restoration work (site preparation, seeding, maintenance), and monitoring to track project success and inform future management decisions. Completing all necessary work is beyond the current capacity of any one particular agency or organization. Partnerships will be required to effectively achieve the desired outcome of restoring wild rice in the estuary. Collectively, the existing stakeholders for wild rice restoration have the potential to contribute within their own strengths, missions, or resources to build the required capacity to accomplish wild rice restoration in the estuary. Table 7 provides a preliminary overview of the role potential partners can play in supporting wild rice restoration. Responsibilities related to wild rice restoration such as monitoring, much like other projects in the estuary, will need to be determined in the future as activities associated with delisting the SLRAOC decrease. Developing partnerships and building a wild rice program for the estuary over the next 10 years will provide the momentum necessary to continue restoration beyond the delisting period and into the future.

Table 7. Potential partnerships and roles that existing organizations can provide for wild rice restoration in the St. Louis River estuary.

Activity	Partner Organization	Roles
Pre-project planning	MNDNR SLRAOC program WIDNR SLRAOC program MLT	Obtaining project funding, developing partnerships, leading the direction of wild rice restoration in the estuary
Project planning	MNDNR SLRAOC program WIDNR SLRAOC program MLT	Project contracting and management, permitting
Project implementation	FdLNR 1854 Treaty Authority GLIFWC Private contractors	Obtaining seed, site preparation, seeding, operation and maintenance of exclosures, and general wild rice restoration

Activity	Partner Organization	Roles
	MNDNR WIDNR MLT	technical guidance
Project monitoring	LSNERR LSRI NRRI UMD UWS FdLNR 1854 Treaty Authority GLIFWC	Establishing long-term monitoring stations, collecting annual data, supporting adaptive management program, developing study design and sample methodology, data management
Project Outreach	MNDNR WIDNR LSNERR MLT St. Louis River Alliance (SLRA)	Develop educational materials, provide opportunities to engage school and community groups in small-scale projects, build community support for wild rice restoration efforts
Additional Technical Expertise	MPCA USEPA LSNERR LSRI NRRI UMD UWS	Provide support for large questions such as the impact of sulfate on wild rice in the estuary or other issues that develop during the lifetime of the plan

2.8 Adaptive Management and Additional Information Needs into the Future

Large-scale wild rice restoration in the St. Louis River estuary is in the beginning stage of what will be a long-term process. The MNDNR, WIDNR, and other partners will use the information provided in this plan, which summarizes the best available information about the estuary including opportunities, limitations, and techniques, to start this process. Through the plan development process, the Restoration Site Team has identified knowledge gaps that will require additional information to better inform future wild rice restoration in the estuary. Several of the issues will require additional resources beyond the current capacity of MNDNR, WIDNR, and MLT. The role for MNDNR and WIDNR will focus on planning, securing funding, implementing wild rice restoration, and monitoring progress toward the restoration goal and objective. Partnerships with other governmental agencies and academic institutions such as UMD, UWS, LSNERR, and NRRI, along with private industry, will help fill the resource gap and strengthen the capacity to address information needs.

Key areas identified during the planning process that require further investigation include:

- **Comprehensive, estuary-wide survey of wild rice** – As mentioned previously, a comprehensive survey of wild rice has not been completed in the estuary. The current understanding of where wild rice is present is based on a compilation of data sets that includes information about wild rice but has not been the sole focus of the data collection activity. A comprehensive survey will provide a more thorough and potentially quantitative baseline of wild rice locations and acreage in the estuary. Completing this survey across several years at the onset of the wild rice restoration and periodically into the future may provide an integrated picture on how wild rice restoration populations have improved due to both site-level restorations and improving habitat conditions and water quality in the estuary.

- **Impacts to wild rice from herbivory and the use of exclosures** – Herbivory by Canada geese and disturbance by carp has been shown to have an impact on wild rice growth and establishment (Schwartzkopf 1999, Haramis and Kearns 2007, Johnson and Havranek 2013, and

UWS-LSRI's pilot study). In general, these studies have looked at using exclosures over a relatively short period of time (one to several years) and on a relatively small scale. Using exclosures to help establish wild rice will be a major component to restoration in the estuary; however, questions still exist, including: What is period of use (number of years)? What size of area needs to be excluded to be effective at promoting overall wild rice establishment? What is the rate of herbivory by Canada geese and carp? Does herbivory impacts change based on location in the estuary? Additionally, the operation and maintenance of exclosures represents a significant cost to the overall restoration effort. It will be important to understand how, when, and where to use exclosures to be efficient with both funding and resources as restoration efforts move forward.

- **Influence of sulfate and sulfate-related factors on wild rice** – Sulfate and its related compounds can impact wild rice (MPCA 2014b). The influence of sulfate and sulfide on wild rice is determined by complex relationships that may be site-specific and depend on multiple factors. In addition to the work MPCA is doing to evaluate the state water quality standard for sulfate, collecting data on sulfate and the sulfate-related factors such as sulfide, iron content in the water column, and water flow will help to understand sulfate specifically within the estuary. Collecting the MPCA-suggested parameters at sites prior to and during restoration may provide insight that helps further refine where wild rice restoration has potential in the estuary.

Partners can play a role in developing study designs, survey and monitoring methodologies to address these and other questions, completing the necessary field work and data analysis, and communicating the results back to MNDNR, WIDNR, and other partners in the estuary. The knowledge obtained from addressing these questions will help to build a stronger wild rice program in the estuary over the next 10 years and beyond. Short-term questions (ones that can be addressed over the course of several years) may provide opportunities for graduate student projects. Longer-term questions may fall to partners such as LSNERR that can help develop and manage an "institutional knowledge" on wild rice in the estuary by providing consistency that may be beyond the scale of a typical graduate student career and that can work across state borders. Other agencies such as MPCA may provide the necessary technical knowledge to address a question.

Wild rice restoration in the estuary represents an opportunity to implement adaptive management to improve restoration methodology and approaches. Because wild rice restoration is viewed as a long-term effort, a process to continually gain and apply knowledge obtained from previous efforts will increase the probability of being successful and make the use of resources, both monetary and personnel more efficient. As defined in Williams et al (2009):

> Adaptive management [is a decision process that] promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process. Adaptive management also recognizes the importance of natural variability in contributing to ecological resilience and productivity. It is not a 'trial and error' process, but rather emphasizes learning while doing. Adaptive management does not represent an end in itself, but rather a means to more effective decisions and enhanced benefits. Its true measure is in how well it helps meet environmental, social, and economic goals, increases scientific knowledge, and reduces tensions among stakeholders.

Adaptive management can be summarized as the methodical process of making management decisions (how and where to restore wild rice) while acknowledging that there are uncertainties (impacts from Canada geese or success of establishment), documenting assumptions and hypotheses (use of exclosures), and collecting information during the restoration process. Outcomes are monitored and compared against predicted outcomes. New knowledge is incorporated into management actions and monitored or used to adjust or adapt new resource objectives.

Successful implementation of adaptive management requires three attributes: collaboration with partners, practical and informative decision framework components, and a sustained commitment to the process (Moore et al. 2011). Partnerships among the state agencies, tribal partners, non-profits, local universities, and other governmental staff will need to be utilized to address wild rice restoration in the estuary. Continued success of the partnerships will rely on each partner understanding their role, responsibility, and the ultimate product or service being provided to wild rice restoration efforts. The Restoration Site Team is building the components of successful adaptive management through development of this implementation plan and implementing monitoring program along with identifying issues that require additional investigation. Data from monitoring and investigations will provide the feedback loop necessary to update and improve restoration and management decisions. MNDNR, WIDNR, and partners involved in wild rice restoration support using adaptive management with the understanding that it is a long-term process, not an endpoint, and that it will allow for more effectively actions in the future.

2.9 Probable Cost for Wild Rice Restoration

It is difficult to develop a total probable cost for restoring at least 275 acres of wild rice over the next 10 years because each area will not be treated in the exact same way. The required activities associated with wild rice restoration will vary between sites and likely between years during restoration, based on annual site conditions (i.e. water level) and stage of restoration. For example, not every targeted acre will require site preparation or exclosures. Some areas may only require seeding and a temporary exclosure to set the area on a trajectory to meet the criteria identified in the restoration objective. In an effort to inform future wild rice restoration planning, Table 6 provides unit costs for individual tasks associated with wild rice restoration. Individual wild rice restoration projects will likely differ in cost based on the total number of acres, amount of site preparation, use of exclosures, and level of maintenance. Individuals planning wild rice restoration projects can reference Table 6 for the specific tasks that will be required for their site and scale the unit costs accordingly. Typically, the larger the project area is, the lower the unit cost will be. Conversely, smaller projects may have higher unit costs.

As discussed in the previous subsections, successful wild rice restoration in the estuary will likely require returning to a site repeatedly over a period of three to five years for re-seeding, operating and maintaining exclosures, and monitoring success and required management actions. Table 7 provides an example of probable costs associated with individual wild rice restoration activities implemented on a theoretical one-acre wild rice restoration site over a five-year period. Similar to Table 6, this information can be used to understand the level of potential cost and investment into wild rice restoration over time and reinforces the idea that successful wild rice restoration in the estuary is not a one-time event. As projects are being undertaken within the estuary, a database of project costs could be maintained by each agency and compiled into a larger data set that would better inform restoration planning in the future.

Table 8. Probable unit cost for items associated with wild rice restoration for one calendar year.

Item	Unit Cost	Comments/Notes
SITE PREPARATION		
Vegetation reduction	$1,000/acre	
Vegetation removal	$3,000/acre	Cost may be higher if additional material handling is required.
Permitting and coordination	$2,000 each	
SEEDING		
Seed	$4.00/lbs	Typical seeding rates are between 40 to 60 lbs/acre
Seeding	$200/acre	
EXCLOSURE MATERIAL		
Fence (72-in welded wire)	$1.75/foot	
Steel t-post or 4-inch wood post (8 ft)	$10/post	Posts can be spaced 8 to 24 feet on-center
Buoy	$30/buoy	
Miscellaneous (mylar ribbons, zip ties, sod staples)	$100/exclosure	General cost estimate for additional supplies beyond fence and post

		material.
INSTALLATION, REMOVAL AND MAINTENANCE OF EXCLOSURE		
Replacement supplies	$50/year	
Installation	$100/hour	4 hours/acre for installation
Removal	$100/hour	2 hours/acre for removal
Inspection and maintenance	$50/hour	Monthly trips may need to be considered during growing season.
MONITORING		
Site-level monitoring	$500/trip	
Aerial survey	$1,500/trip	
Analysis and report	$500/report	

Table 9. Generalized probable cost for completing individual items on one acre of wild rice restoration over a five-year period.

Item	Estimated Cost/Acre Over 5-Year Period
Permitting and coordination (Completed once with annual coordination and updates)	$4,000
Vegetation reduction (Completed twice)	$2,000
Vegetation removal (Completed once)	$3,000
Seeding (3-year period – Material and installation)	$1,200
Exclosure (1-acre perimeter of material, annual operation and maintenance over 5-year period)	$6,100
Monitoring and reporting (Annually over 5-year period)	$5,000

3 Wild Rice Restoration – Targeted Restoration Areas

3.1 Introduction

For current and future planning purposes, the wild rice project area was divided into 29 wild rice restoration areas based on a combination of physical characteristics, commonly accepted demarcations, and logistical feasibility (i.e. attempting to limit combining areas of shared jurisdiction between states). The Restoration Site Team designated 27 of the 29 areas a priority for future wild rice restoration efforts (Table 8). Only two areas, the area around Boy Scout Landing and Red River Bay, were removed from further consideration, primarily due to small size.

A summary of the 27 priority areas including a brief description, example photos of the area from 2014, and maps of the plant community, substrate characteristics, and model output is provided. Each area description and associated maps should help with future restoration planning and funding requests. Site-level reconnaissance will still be required to help further plan restoration activities.

Table 10. Index for wild rice restoration area descriptions in the St. Louis River estuary.

Area name	Alternate Name(s)	State*
Fond du Lac – Kekuk Island		WI
Rask Bay	Fond du Lac Bay	MN
Perch Lake		MN
Walleye Alley Bay	Horseshoe Island Bay	WI
Landslide Bay	Bryozoan Bay	WI
Duck Hunter Bays	Lunch Bay, Weasel Bay, and Sunset Bay (separate bays within larger bay)	WI
North Bay	Ek’s Bay	MN
Foundation Bay	Lyndy’s Bay	WI
Radio Tower Bay	Cedar Yard Bay	MN
Bear Paw Island	Bear Island	MN
Oliver Landing		WI
Mud Lake West		MN
Mud Lake East		MN
Oliver Bay – Little Pokegama Bay	Little Pokegama Bay (Oliver Bay)	WI
Spirit Lake		MN
Munger Landing		MN
Clough Island		WI
Clough Island Wetlands	Devil’s Elbow and Mosquito Island (separate areas within larger area)	WI
Tallus Island		MN
Kingsbury Bay – Indian Point Bay		MN
Stryker Bay		MN
Dwights Point		WI
Wisconsin Tributaries	Sawmill Bay, Kimball’s Bay, Kilner Bay, Kelly Bay, and Chipmunk Hollow	WI
Billings Park		WI
Grassy Point		MN
Pokegama Bay		WI
Allouez Bay		WI

*Designated as the state where the majority of the acreage for the areas is located.

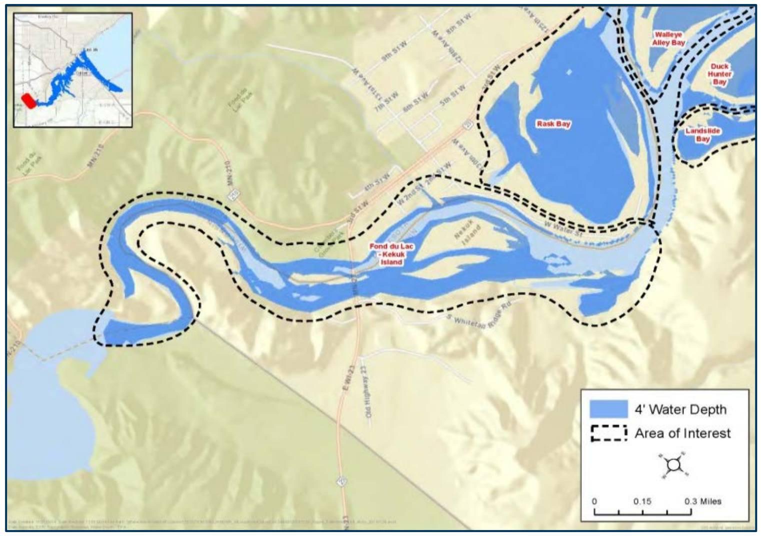
Fond du Lac Dam to Kekuk Island Area

Primary State
Wisconsin

Subareas Included
Fond du Lac Dam, Chambers Grove, Kekuk Island

Wild Rice Restoration Acreage Potential
(Based on Site Selection Model)

Site Potential	Acres
High Potential	6
Medium Potential	20
Low Potential	87
Total Acres	113



Areas Description for Wild Rice Restoration
The Fond du Lac to Kekuk Island area is directly downstream from the Fond du Lac dam to a small, sheltered bay downriver from Kekuk Island. From the Fond du Lac dam to Chambers Grove, the area is primarily riverine habitat with limited emergent and submergent aquatic plant growth. Substrates are primarily rocky with a lack of soft substrate, which then transition into firm silt and sand downstream of the Highway 23 Bridge.

Kekuk Island consists of three islands and one small backbay on the Wisconsin side of the estuary. On the upstream end of the islands, habitat is more riverine-like with firm, sandy substrate. Along the eastern half of Kekuk Island, floating and emergent vegetation is present, with scattered to small monocultures of cattail towards the downstream end. The western half of the small, sheltered backbay is primarily a sedge meadow with scattered cattail. Cattail density increases towards the eastern half and represents an area where site preparation could improve habitat conditions for the wild rice. Current anecdotal observations of wild rice have been made on the downstream end of Kekuk Island.

Wild rice restoration in this area will be considered a stand-alone activity and not incorporated into any current or future restoration plans addressing other BUIs.

Representative Photos of the Area

Photo Point 1

Photo Point 2


Photo Point 3

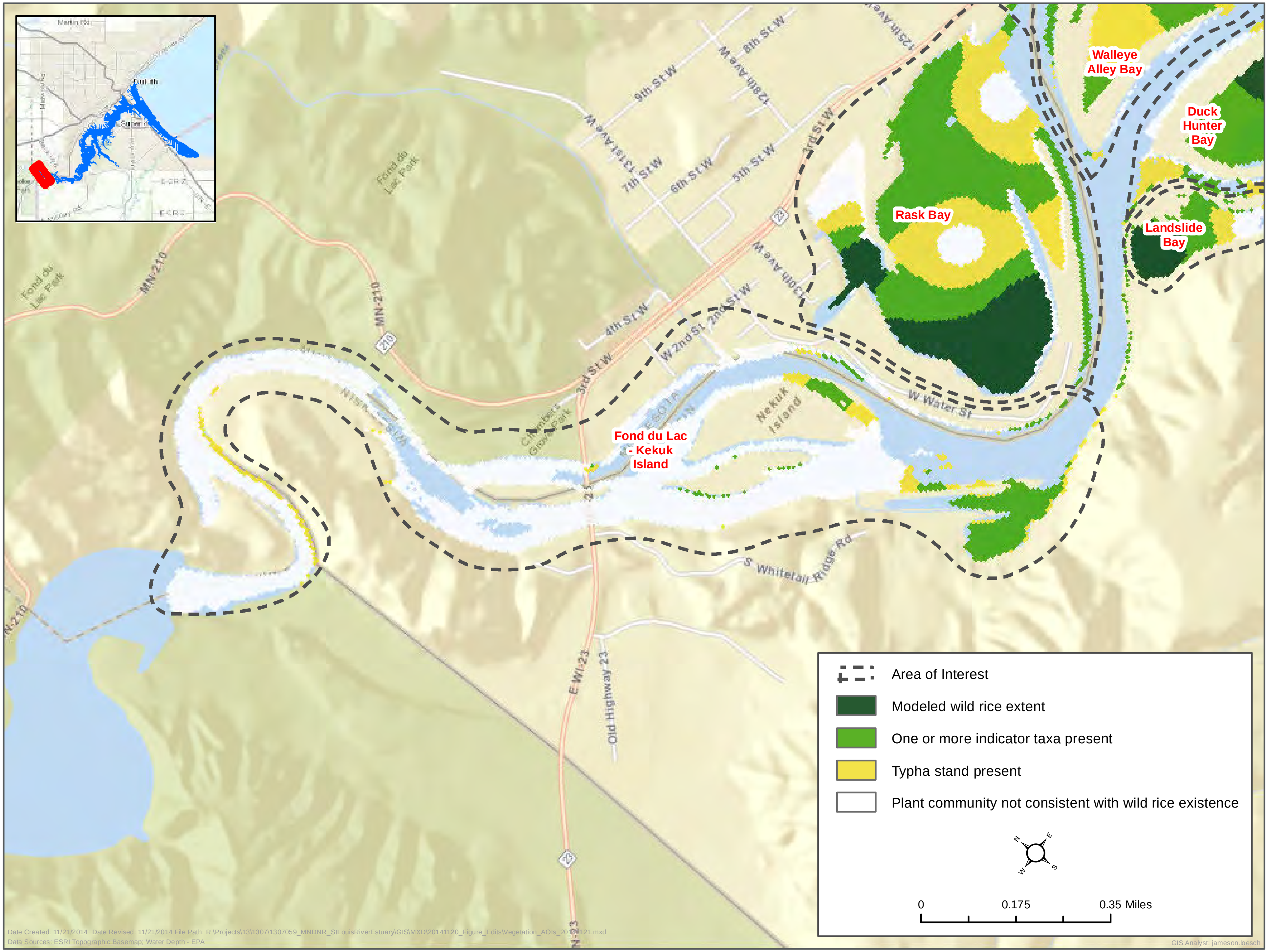

Photo Point 4

Wild Rice Restoration Opportunities and Strategies

- There are limited opportunities for wild rice restoration due to the riverine nature of this habitat.
- Use seeding and exclosures to establish wild rice in small areas of shallow backwater habitat adjacent to shoreline and along island fringes.
- Use vegetation mowing, seeding, and exclosures along the eastern portion of Kekuk Island and the southern backbay, where dense cattail stands are present to improve habitat conditions.

Wild Rice Restoration Limitations

- Habitat in the upper portion of this area is predominately riverine with limited aquatic vegetation and suitable substrate.
- Water depths may be too deep for extensive wild rice establishment.
- Recreational boat traffic may require additional signage and precautions along channel.



Walleye Alley Bay
Duck Hunter Bay
Rask Bay
Landslide Bay
Fond du Lac - Kekuk Island
Nekuk Island
Fond du Lac Park
Chambers Grove Park
W Water St
S Whitetail Ridge Rd
Old Highway 23
E WI-23
MN-210
MN-23
9th St W
8th St W
7th St W
6th St W
5th St W
4th St W
3rd St W
W 2nd St
2nd St W
131st Ave W
128th Ave W
133rd Ave W
Area of Interest
Modeled wild rice extent
One or more indicator taxa present
Typha stand present
Plant community not consistent with wild rice existence
N
E
S
W
0
0.175
0.35 Miles
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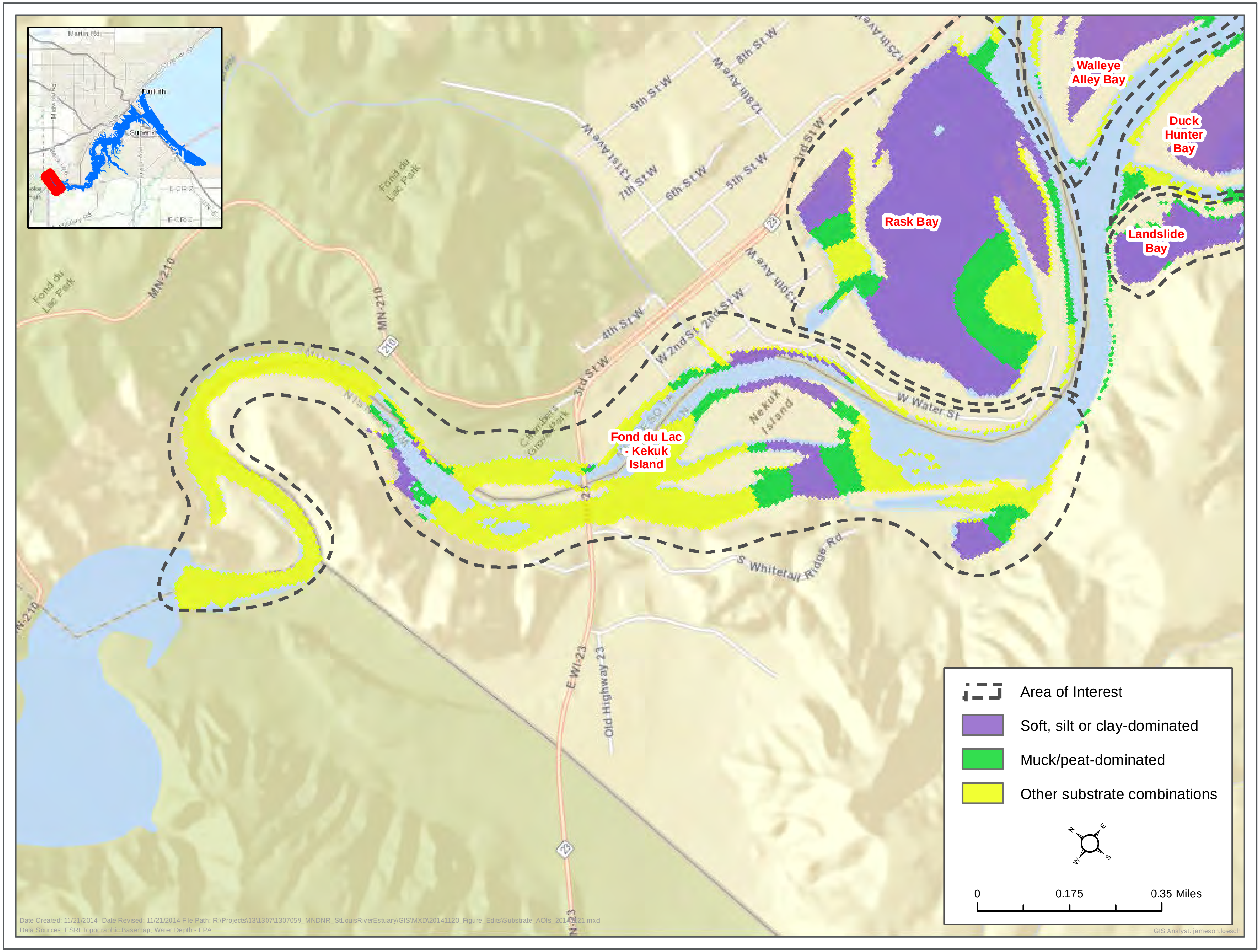
GIS Analyst: jameson.loesch


Walleye Alley Bay
Duck Hunter Bay
Rask Bay
Landslide Bay
Fond du Lac - Kekuk Island
Nekuk Island
W Water St
S Whitetail Ridge Rd
Old Highway 23
E WI-23
MN-210
Fond du Lac Park
Chambers Grove Park
3rd St W
4th St W
5th St W
6th St W
7th St W
8th St W
9th St W
W 2nd St
131st Ave W
128th Ave W
130th Ave W
Area of Interest
Soft, silt or clay-dominated
Muck/peat-dominated
Other substrate combinations
N
E
S
W
0
0.175
0.35 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Substrate_AOIs_20141121.mxd
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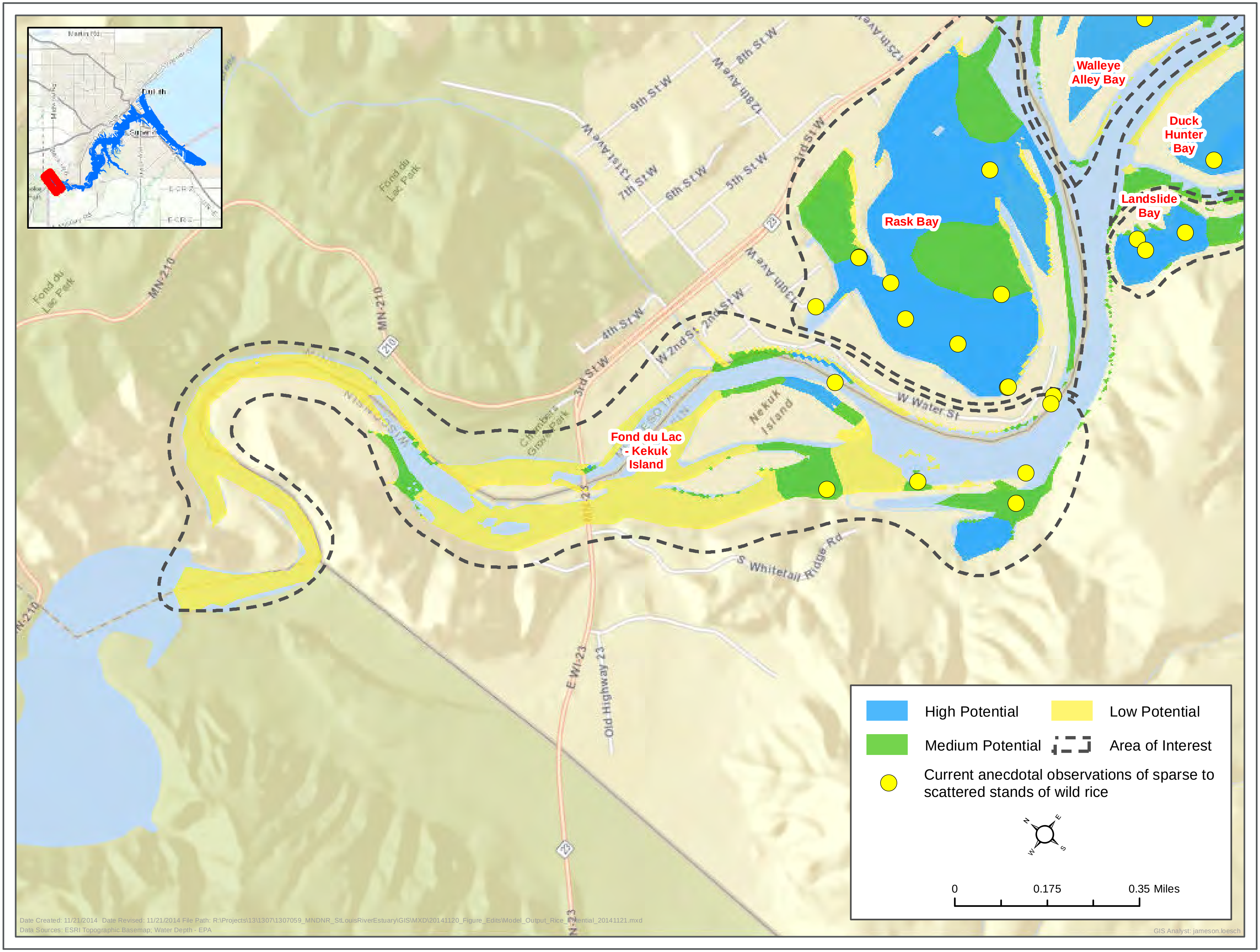
GIS Analyst: jameson.loesch


Walleye Alley Bay
Duck Hunter Bay
Landslide Bay
Rask Bay
Fond du Lac - Kekuk Island
Nekuk Island
Fond du Lac Park
Chambers Grove Park
MN-210
MN-23
E WI-23
Old Highway 23
W Water St
S Whitetail Ridge Rd
3rd St W
4th St W
5th St W
6th St W
7th St W
8th St W
9th St W
W 2nd St
131st Ave W
128th Ave W
130th Ave W
High Potential
Low Potential
Medium Potential
Area of Interest
Current anecdotal observations of sparse to scattered stands of wild rice
0
0.175
0.35 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Model_Output_Rice_Potential_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch

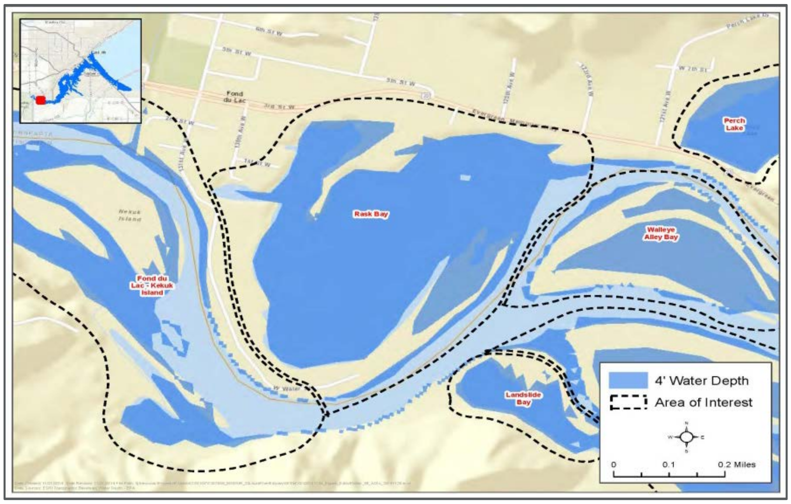
Rask Bay

<u>Primary State</u>
Minnesota

<u>Subareas Included</u>
None.

<u>Wild Rice Restoration Acreage Potential</u>
(Based on Site Selection Model)

Site Potential	Acres
High Potential	82
Medium Potential	37
Low Potential	4
Total Acres	123



<u>Area Description for Wild Rice Restoration</u>
The Rask Bay area is a shallow bay located on the Minnesota-side of the estuary. The majority of the eastern half of the bay is open water with floating and emergent vegetation. The western half of the bay consists of scattered floating and emergent vegetation, including a continuous stand of wild rice scattered among the emergent vegetation. Wild rice density decreases towards the south but is still present. The northern portion of the western half of the bay is more dominated by emergent vegetation, including an increasing density of cattails. The southeastern portion of the bay is dominated by a cattail stand with scattered other species.

Wild rice restoration in this area will be considered a stand-alone activity and not incorporated into any current or future restoration plans addressing other BUIs.

<u>Representative Photos of the Area</u>


Photo Point 1


Photo Point 2

Photo Point 3

Photo Point 4

Photo Point 5

Photo Point 6

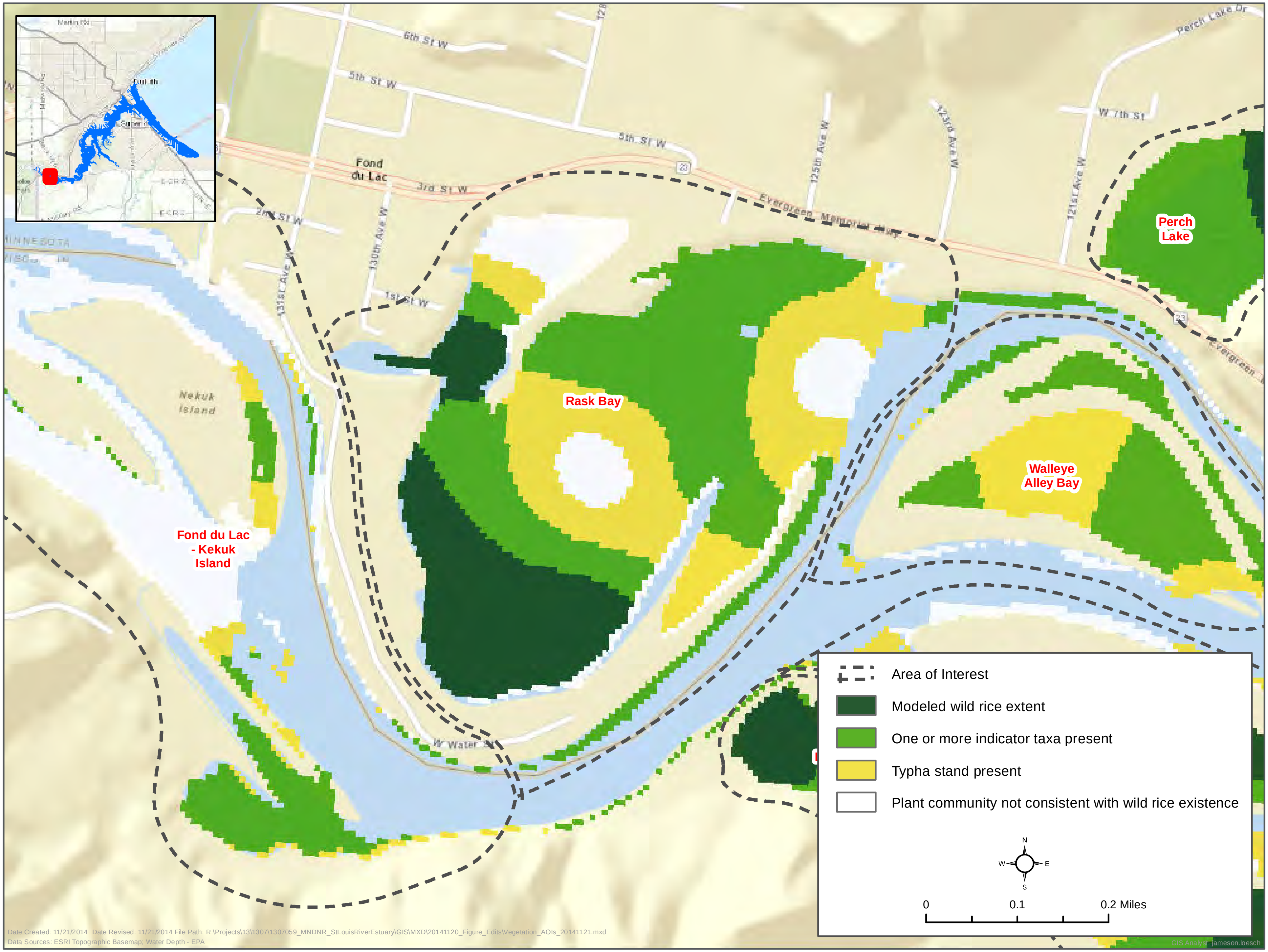
Wild Rice Restoration Opportunities and Strategies

- Use vegetation mowing and direct seeding in the western half of the bay to enhance existing stands to reduce plant competition, when necessary.
- Use vegetation removal and thinning in the northern portion of the western half of the bay and southern portion of the eastern half of the bay to establish scattered stands of wild rice where depth variation allows for consistent establishment.
- Protect the existing stands of wild rice and establish a monitoring site for wild rice in the estuary.

Wild Rice Restoration Limitations

- Water depth in the eastern half of the bay.
- Cattail removal and management techniques may limit area manipulated each year.

  .



Perch Lake
Rask Bay
Walleye Alley Bay
Fond du Lac - Kekuk Island
Nekuk Island
Fond du Lac
6th St W
5th St W
3rd St W
2nd St W
1st St W
W 7th St
W Water St
Evergreen Memorial Hwy
Perch Lake Dr
131st Ave W
130th Ave W
125th Ave W
123rd Ave W
121st Ave W
MINNESOTA
Duluth
Area of Interest
Modeled wild rice extent
One or more indicator taxa present
Typha stand present
Plant community not consistent with wild rice existence
N
S
E
W
0
0.1
0.2 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Vegetation_AOIs_20141121.mxd
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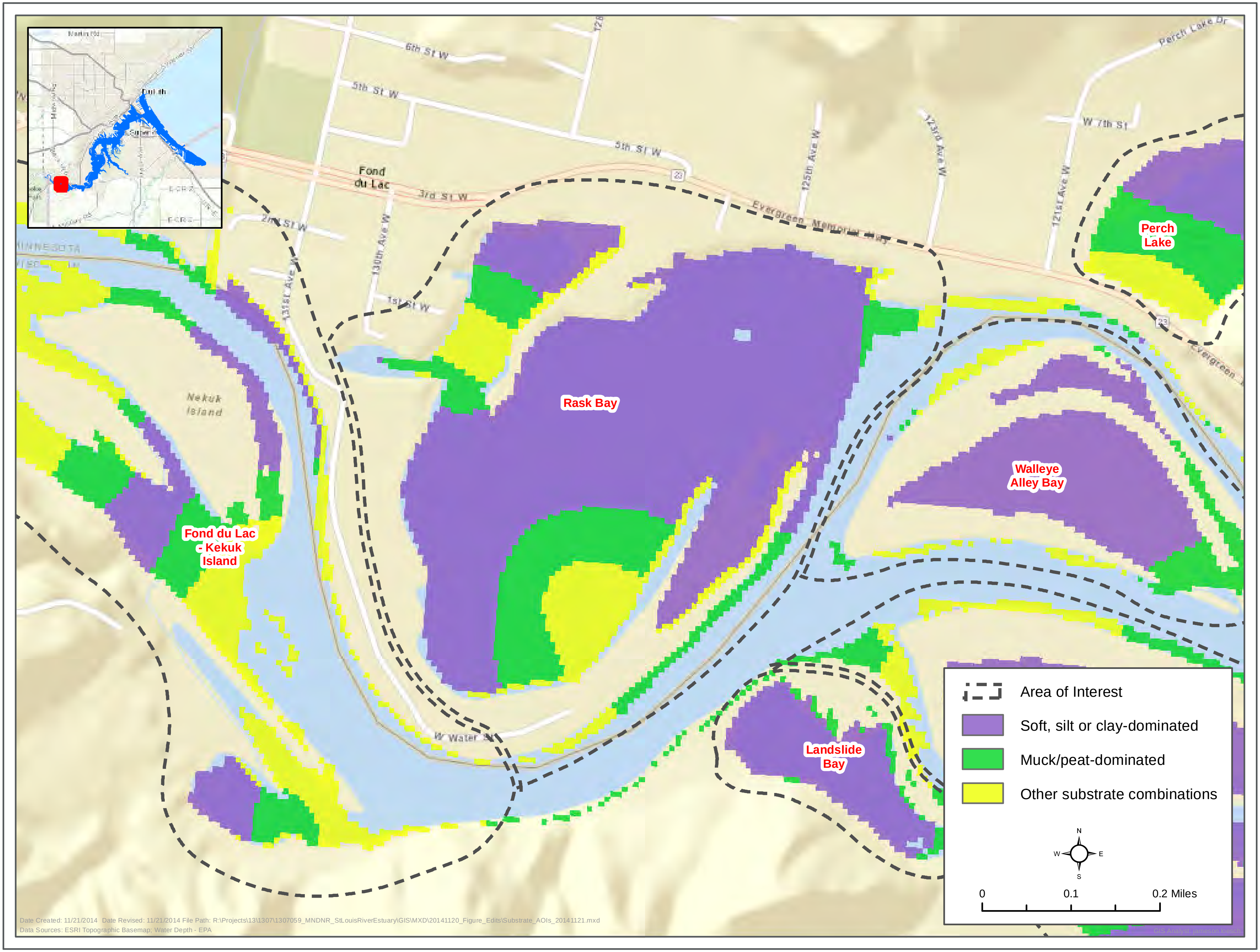
GIS Analyst: jameson.loesch



6th St W
5th St W
5th St W
Perch Lake Dr
W 7th St
125th Ave W
123rd Ave W
121st Ave W
Fond du Lac
3rd St W
2nd St W
130th Ave W
131st Ave W
1st St W
Evergreen Memorial Hwy
Evergreen
Nekuk Island
W Water St
Rask Bay
Perch Lake
Walleye Alley Bay
Fond du Lac - Kekuk Island
Landslide Bay
Duluth
Area of Interest
Soft, silt or clay-dominated
Muck/peat-dominated
Other substrate combinations
N
S
E
W
0
0.1
0.2 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Substrate_AOIs_20141121.mxd
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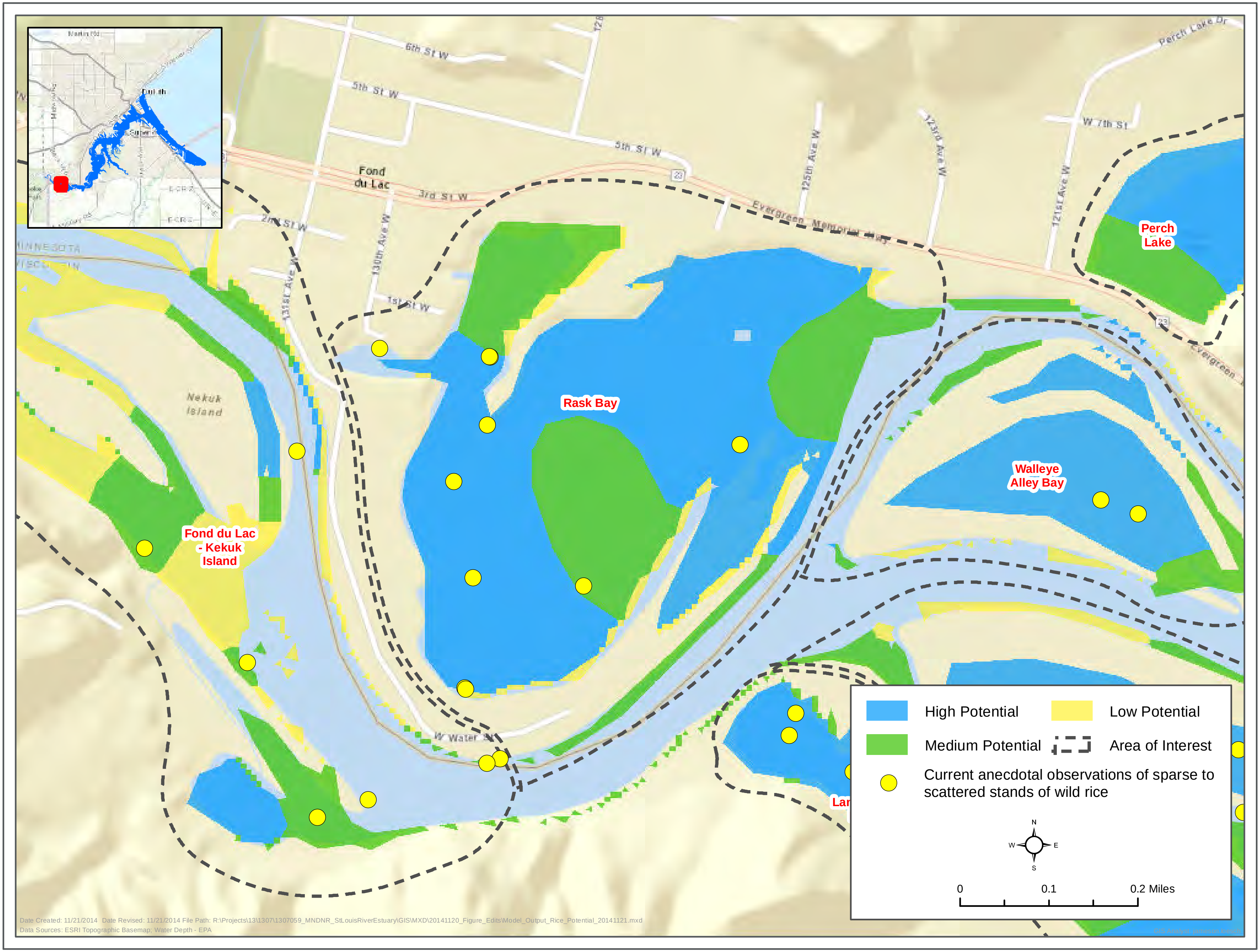


Rask Bay
Fond du Lac - Kekuk Island
Walleye Alley Bay
Perch Lake
Nekuk Island
Fond du Lac
6th St W
5th St W
3rd St W
2nd St W
1st St W
W 7th St
W Water St
Evergreen Memorial Hwy
Perch Lake Dr
131st Ave W
130th Ave W
125th Ave W
123rd Ave W
121st Ave W
MINNESOTA
WISCONSIN
Duluth
High Potential
Low Potential
Medium Potential
Area of Interest
Current anecdotal observations of sparse to scattered stands of wild rice
N
W
E
S
0
0.1
0.2 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Model_Output_Rice_Potential_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA

Perch Lake

Primary State
Minnesota

Subareas Included
None.

Wild Rice Restoration Acreage Potential
(Based on Site Selection Model)

Site Potential	Acres
High Potential	17
Medium Potential	6
Low Potential	1
Total Acres	

Area Description for Wild Rice Restoration
The Perch Lake area is a shallow lake located on the Minnesota-side of the estuary. The entire lake is covered with a combination of submergent, floating, and emergent vegetation. In 2014 a small, sparse, scattered stand of wild rice was observed. It has primarily soft, organic substrate. Perch Lake is largely hydrologically isolated from the estuary by the Highway #23 causeway.

There is a current restoration plan for Perch Lake that addresses an existing BUI. Wild rice restoration in this area would need to be integrated during the final plan development.

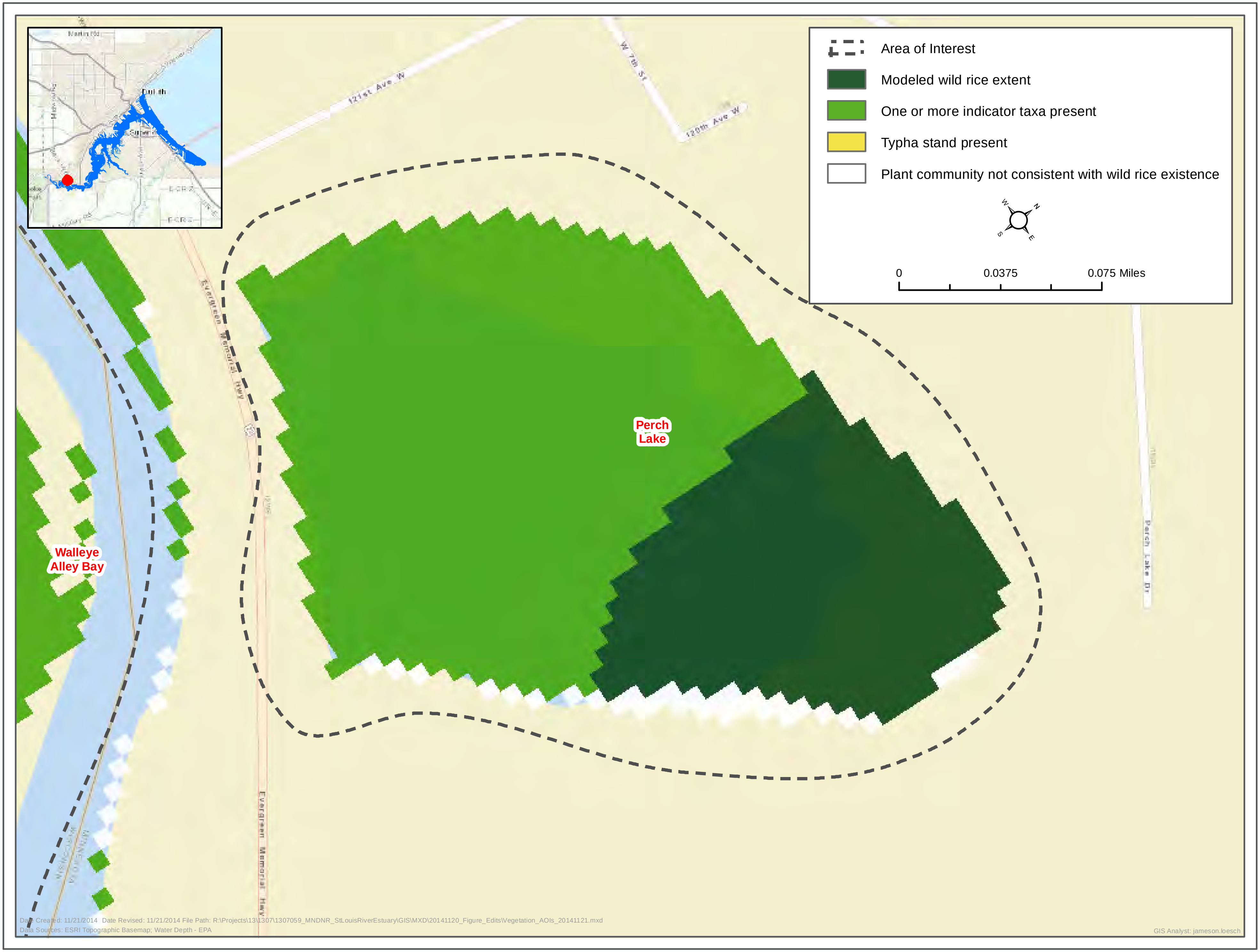
Representative Photos of the Area


Photo Point 1


Photo Point 2

Wild Rice Restoration Opportunities
- Enhance existing stands through vegetation management such as occasional vegetation reduction and seeding.
- Use vegetation mowing to manage cattail and submergent vegetation and direct seeding throughout the entire lake to improve wild rice habitat.

Wild Rice Restoration Limitations
- Equipment access.


Area of Interest
Modeled wild rice extent
One or more indicator taxa present
Typha stand present
Plant community not consistent with wild rice existence
0
0.0375
0.075 Miles
Perch Lake
Walleye Alley Bay
121st Ave W
120th Ave W
W 7th St
Evergreen Memorial Hwy
Perch Lake Dr
Duluth
Superior
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Vegetation_AOIs_20141121.mxd
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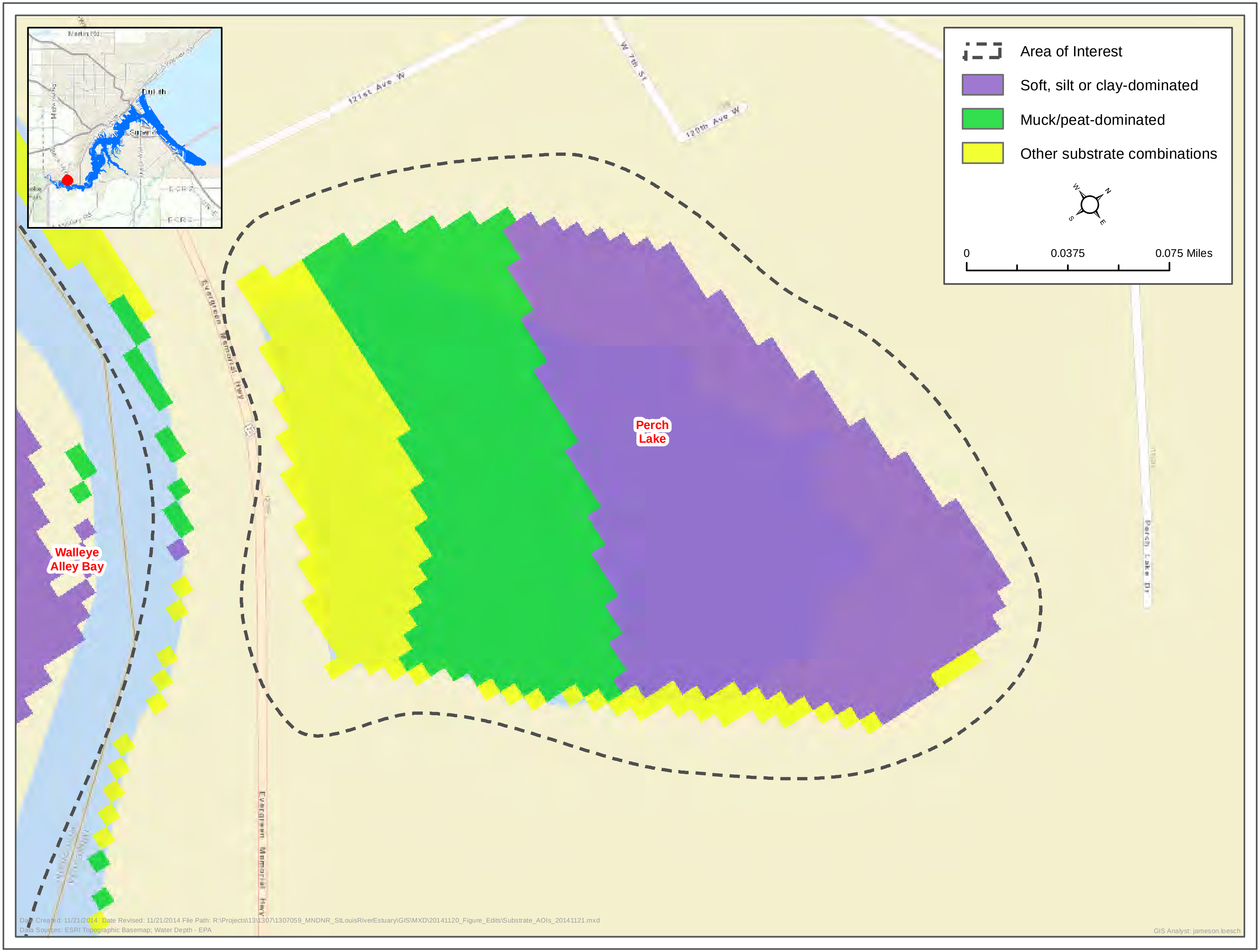
GIS Analyst: jameson.loesch



Area of Interest
Soft, silt or clay-dominated
Muck/peat-dominated
Other substrate combinations
0
0.0375
0.075 Miles
Perch Lake
Walleye Alley Bay
121st Ave W
120th Ave W
W 7th St
Evergreen Memorial Hwy
Perch Lake Dr
Duluth
Superior
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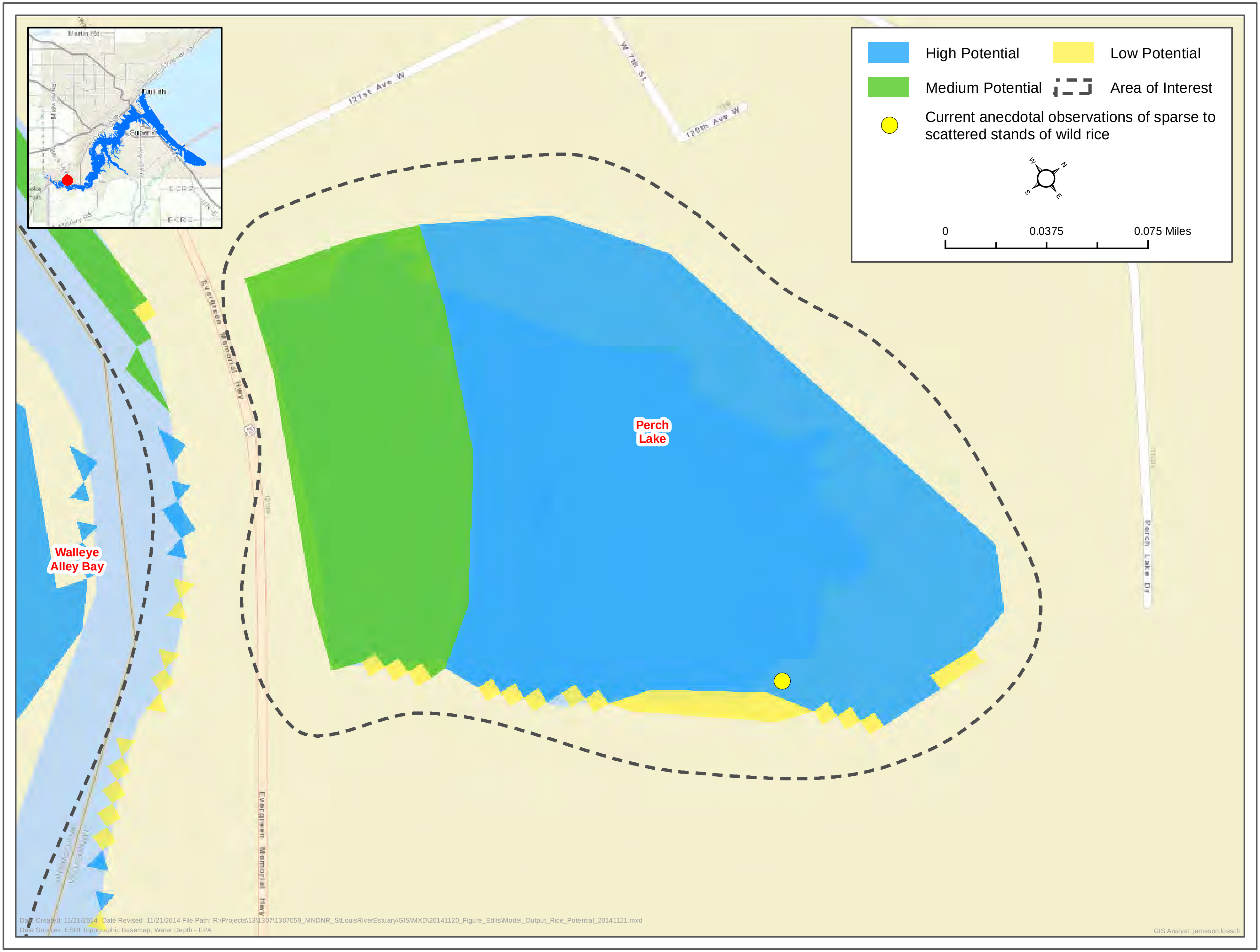
GIS Analyst: jameson.loesch



High Potential
Low Potential
Medium Potential
Area of Interest
Current anecdotal observations of sparse to scattered stands of wild rice
0
0.0375
0.075 Miles
Perch Lake
Walleye Alley Bay
121st Ave W
W 7th St
120th Ave W
Evergreen Memorial Hwy
Perch Lake Dr
Duluth
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Model_Output_Rice_Potential_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch

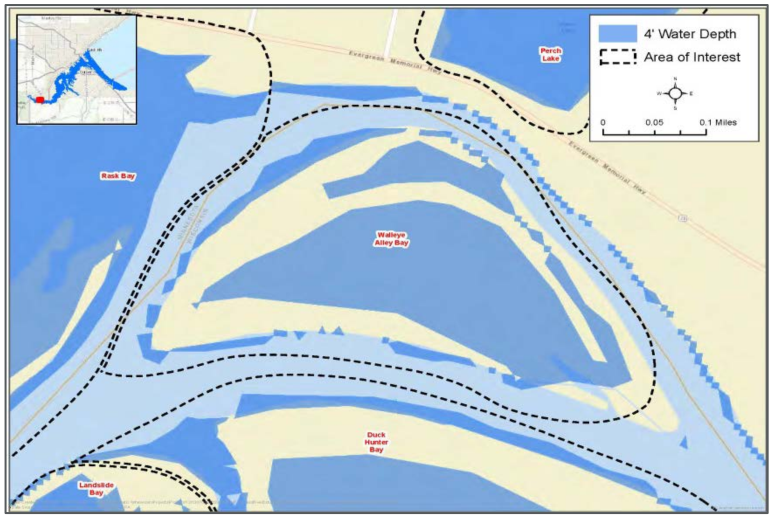
Walleye Alley Bay

<u>Primary State</u>
Wisconsin

<u>Subareas Included</u>
None.

<u>Wild Rice Restoration Acreage Potential</u>
(Based on Site Selection Model)

Site Potential	Acres
High Potential	25
Medium Potential	5
Low Potential	1
Total Acres	31



<u>Area Description for Wild Rice Restoration</u>

The Walleye Alley Bay area consists of two shallow, sheltered bays. The mouths of the bays consist of scattered patches of aquatic vegetation with patches of open water. Vegetation density increases towards the interior (more sheltered) portions of the bays with a transition from more cattail-dominated to less cattail-dominated emergent vegetation. A narrow band of vegetation is present around the perimeter of the island where water depths allow establishment. Current anecdotal wild rice observations have been made near the entrance to the bay.

Wild rice restoration in this area will be considered a stand-alone activity and not incorporated into any current or future restoration plans addressing other BUIs.

<u>Representative Photos of the Area</u>


Photo Point 1


Photo Point 2

Photo Point 3

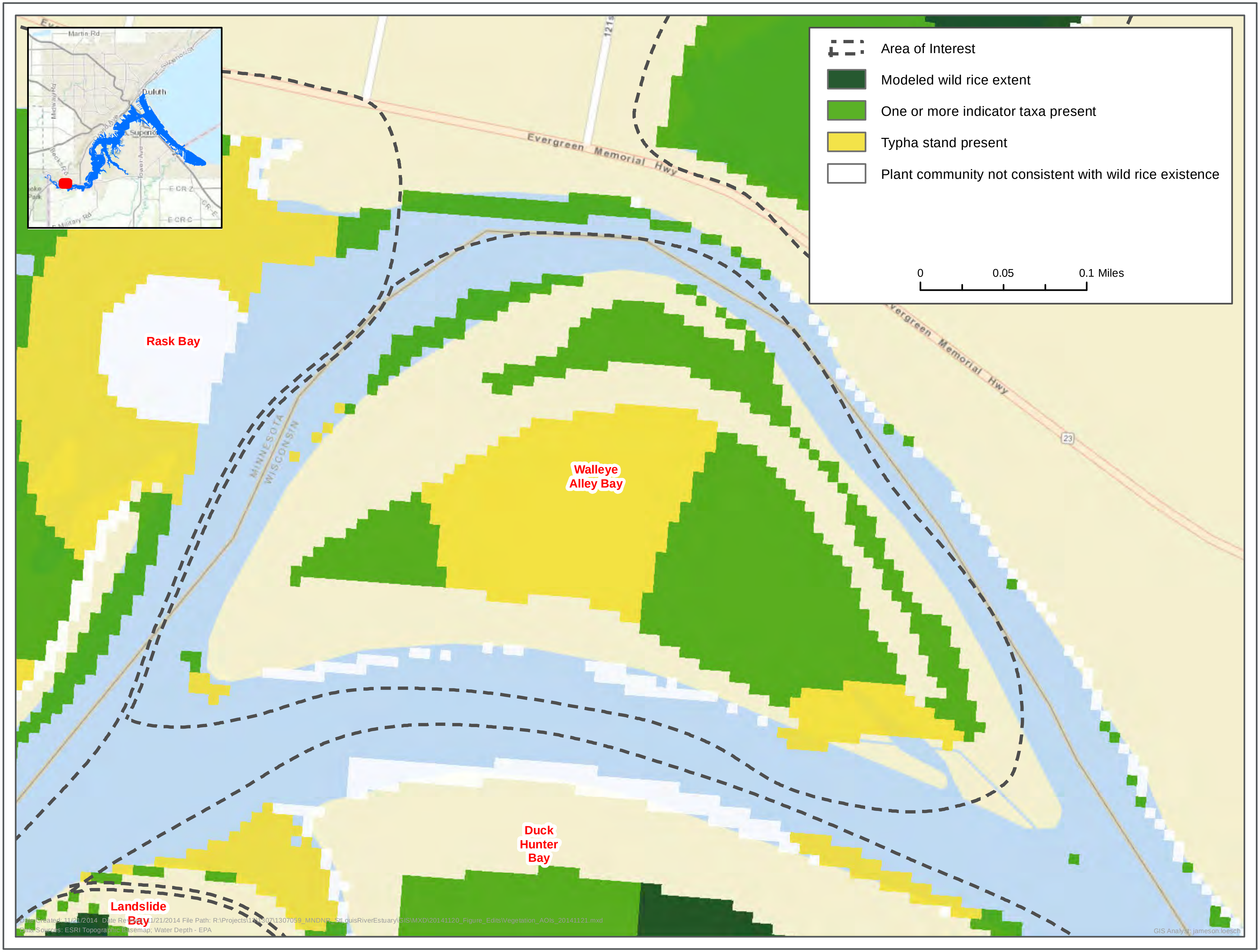
Photo Point 4

Wild Rice Restoration Opportunities and Strategies

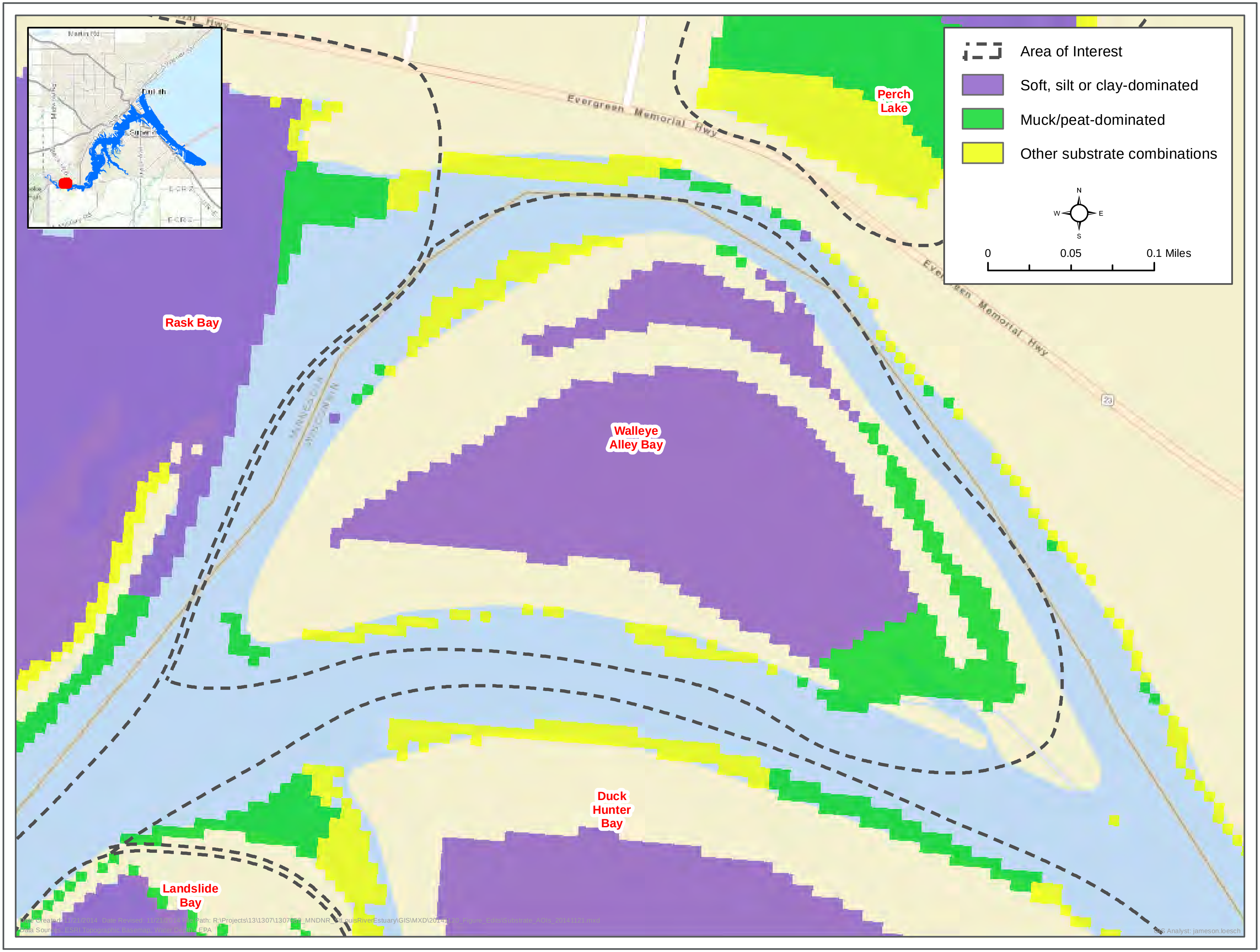
- Use vegetation mowing and seeding where floating and emergent vegetation is present to establish wild rice stands in sheltered bays, and use exclosures to limit herbivory.
- Use vegetation removal and thinning where cattail stands are present to establish wild rice stands.
- Consider using an exclosure across the mouths of the two bays to provide an increased area protected from herbivory.
- Use vegetation mowing and seeding around the outer fringe of the island to establish wild rice stands.

Wild Rice Restoration Limitations

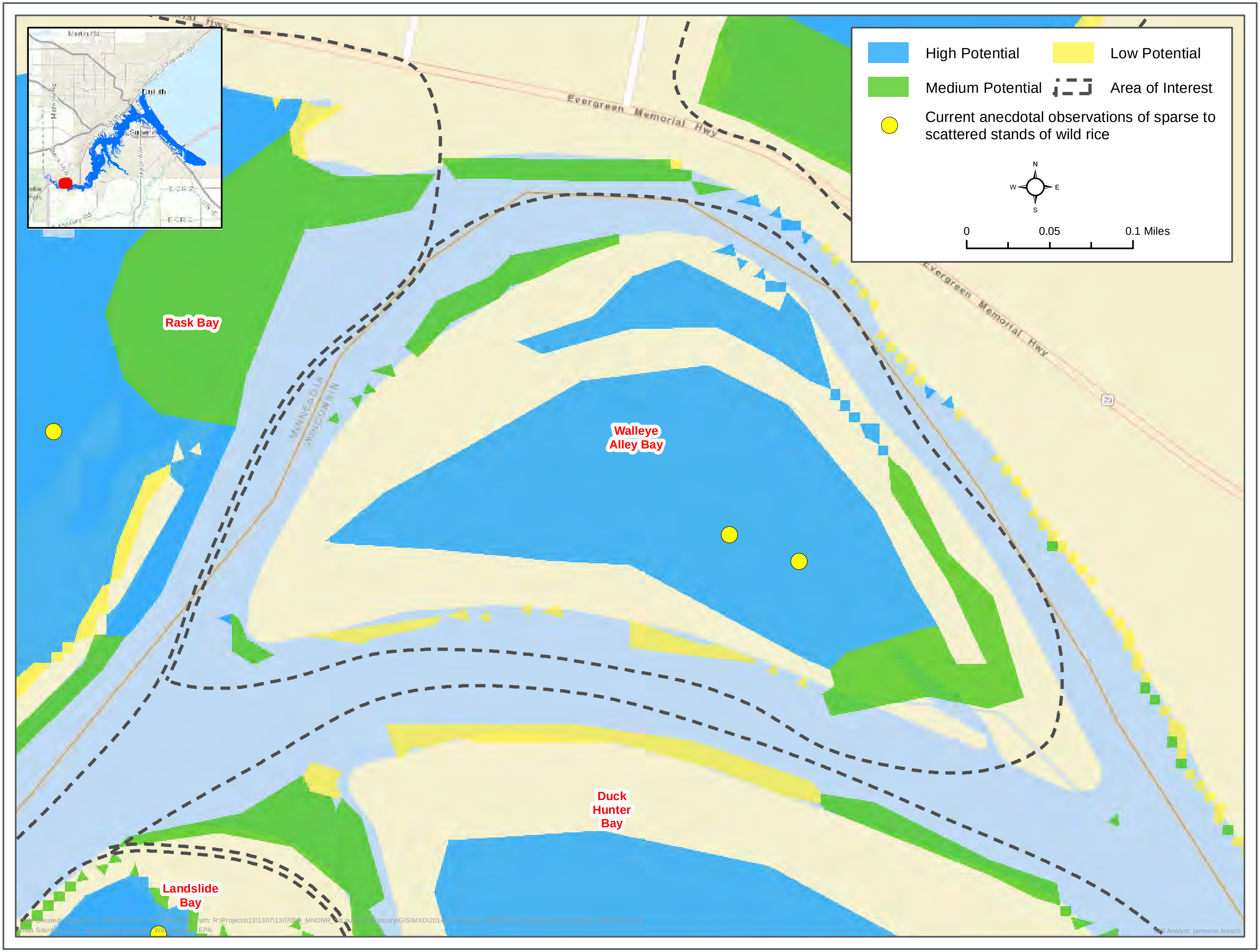
- Sedge meadow in the interior of the bays.



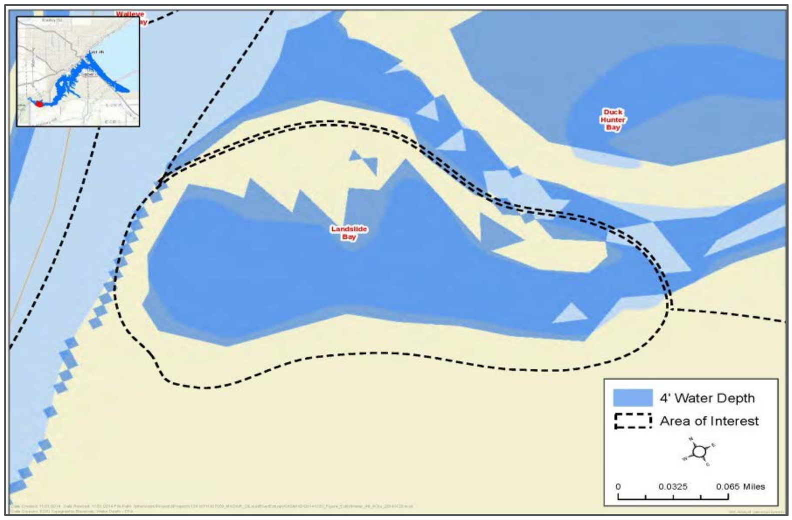
Area of Interest
Modeled wild rice extent
One or more indicator taxa present
Typha stand present
Plant community not consistent with wild rice existence
0
0.05
0.1 Miles
Rask Bay
Walleye Alley Bay
Duck Hunter Bay
Landslide Bay
Evergreen Memorial Hwy
MINNESOTA
WISCONSIN
23
Duluth
Superior
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Vegetation_AOIs_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch



Area of Interest
Soft, silt or clay-dominated
Muck/peat-dominated
Other substrate combinations
0
0.05
0.1 Miles
Perch Lake
Rask Bay
Walleye Alley Bay
Duck Hunter Bay
Landslide Bay
Evergreen Memorial Hwy
Duluth
Superior
Data Sources: ESRI Topographic Basemap; Water Depth: EPA
GIS Analyst: jameson.loesch


High Potential
Low Potential
Medium Potential
Area of Interest
Current anecdotal observations of sparse to scattered stands of wild rice
N
S
E
W
0
0.05
0.1 Miles
Rask Bay
Walleye Alley Bay
Duck Hunter Bay
Landslide Bay
Evergreen Memorial Hwy
MINNESOTA
WISCONSIN
Duluth
Superior
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307050_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Model_Output_Rice_Potential_20141121.mxd
Data Sources: ESRI Topographic Basemap, Water Depth - EPA
GIS Analyst: jameson.loesch

Landslide Bay



Primary State
Wisconsin

Subareas Included
None.

Wild Rice Restoration Acreage Potential
(Based on Site Selection Model)

Site Potential	Acres
High Potential	10
Medium Potential	5
Low Potential	0
Total Acres	15

Area Description for Wild Rice Restoration

The Landslide Bay area is a shallow, sheltered bay. The mouth of the bay lacks floating and emergent vegetation. Vegetation density increases towards the interior of the bay. A sedge meadow is present in the western (most sheltered) portion of the bay. A narrow band of vegetation is present around the perimeter of the peninsula where water depths allow establishment. Current anecdotal observations of wild rice have been made in several locations throughout the bay.

Wild rice restoration in this area will be considered a stand-alone activity and not incorporated into any current or future restoration plans addressing other BUIs.

Representative Photos of the Area


Photo Point 1


Photo Point 2

Photo Point 3

Photo Point 4

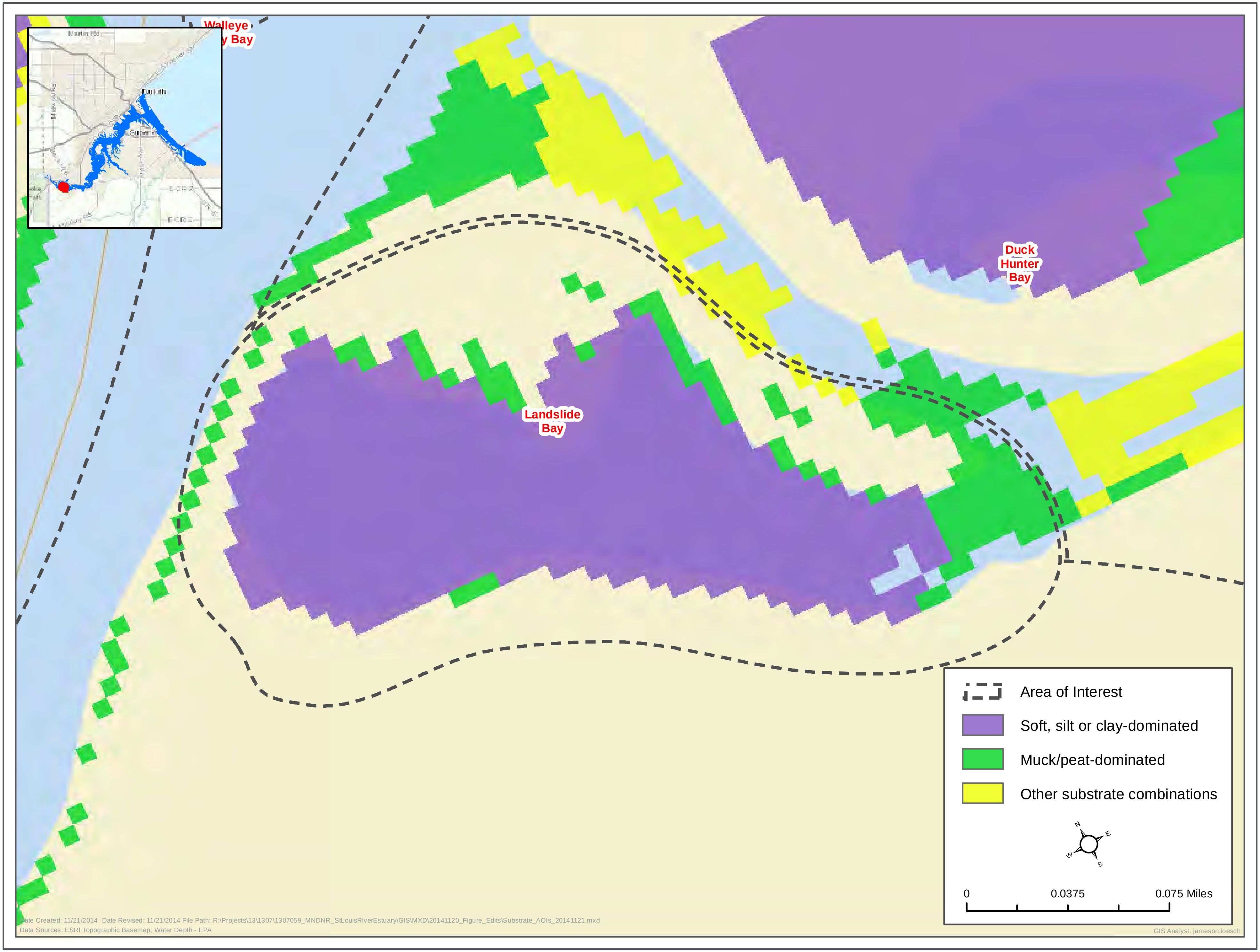
Wild Rice Restoration Strategies and Opportunities

- Establish wild rice stands in a sheltered bay and use exclosures to limit herbivory.
- Use vegetation mowing and direct seeding where floating and emergent vegetation is present to establish wild rice stands on outer fringe of the peninsula and front half of the bay.

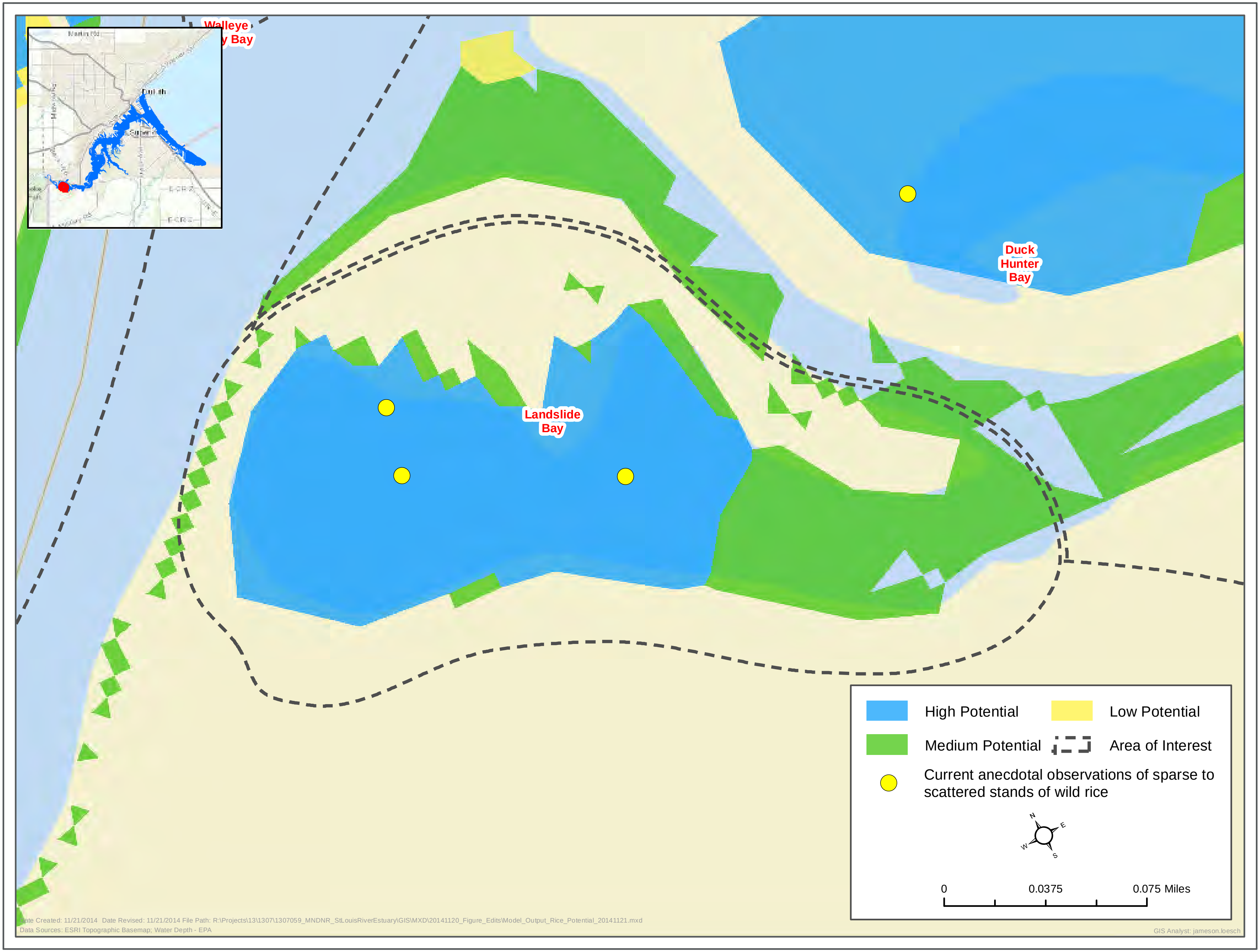
Wild Rice Restoration Limitations

- Increased water depth at the mouth of the bay.
- Sedge meadow in the interior of the bay.


Walleye
y Bay
Duluth
Landslide
Bay
Area of Interest
Modeled wild rice extent
One or more indicator taxa present
Typha stand present
Plant community not consistent with wild rice existence
N
E
S
W
0
0.0375
0.075 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Vegetation_AOIs_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch

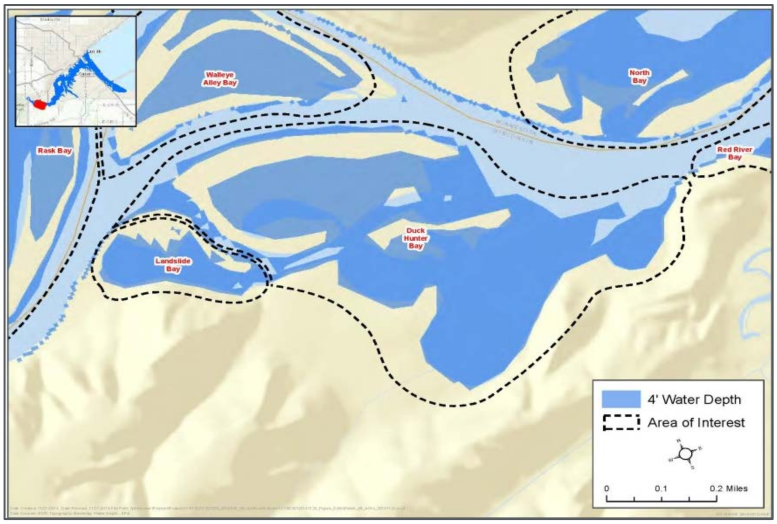


Walleye
Bay
Duluth
Superior
Landslide
Bay
Duck
Hunter
Bay
Area of Interest
Soft, silt or clay-dominated
Muck/peat-dominated
Other substrate combinations
N
E
S
W
0
0.0375
0.075 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Substrate_AOIs_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch



Walleye
y Bay
Duck
Hunter
Bay
Landslide
Bay
Duluth
High Potential
Low Potential
Medium Potential
Area of Interest
Current anecdotal observations of sparse to scattered stands of wild rice
N
E
W
S
0
0.0375
0.075 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Model_Output_Rice_Potential_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch

Duck Hunter Bay



Primary State
Wisconsin

Subareas Included
None.

Wild Rice Restoration Acreage Potential
(Based on Site Selection Model)

Site Potential	Acres
High Potential	85
Medium Potential	30
Low Potential	6
Total Acres	121

Area Description for Wild Rice Restoration
The Duck Hunter Bay area consists of two shallow, sheltered bays where wild rice has been observed. Floating and emergent vegetation is consistent through both bays. A narrow band of vegetation is present around the perimeter of the island where water depths allow establishment.

Wild rice restoration in this area will be considered a stand-alone activity and not incorporated into any current or future restoration plans addressing other BUIs.

Representative Photos of the Area


Photo Point 1


Photo Point 2


Photo Point 3


Photo Point 4


Photo Point 5

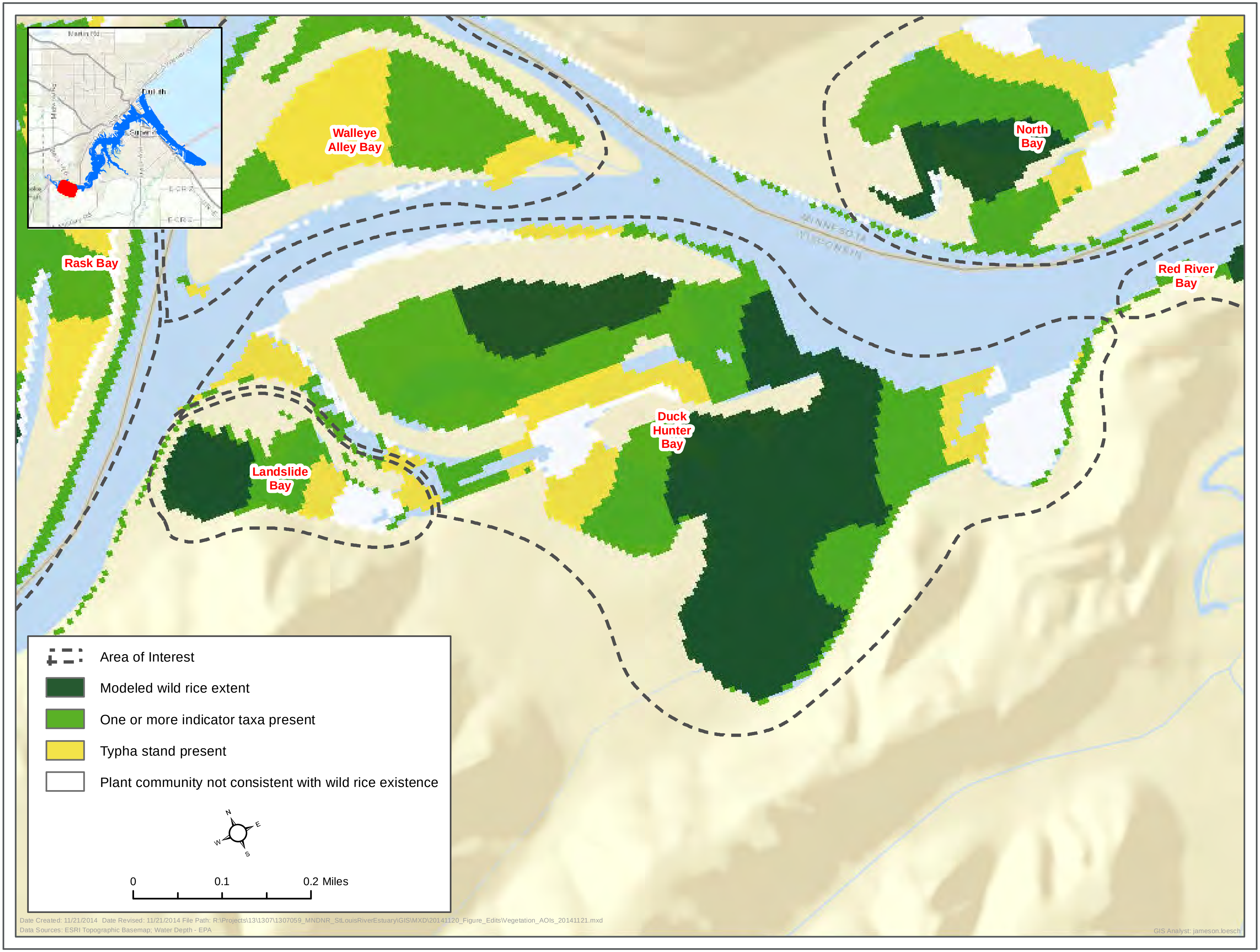

Photo Point 6

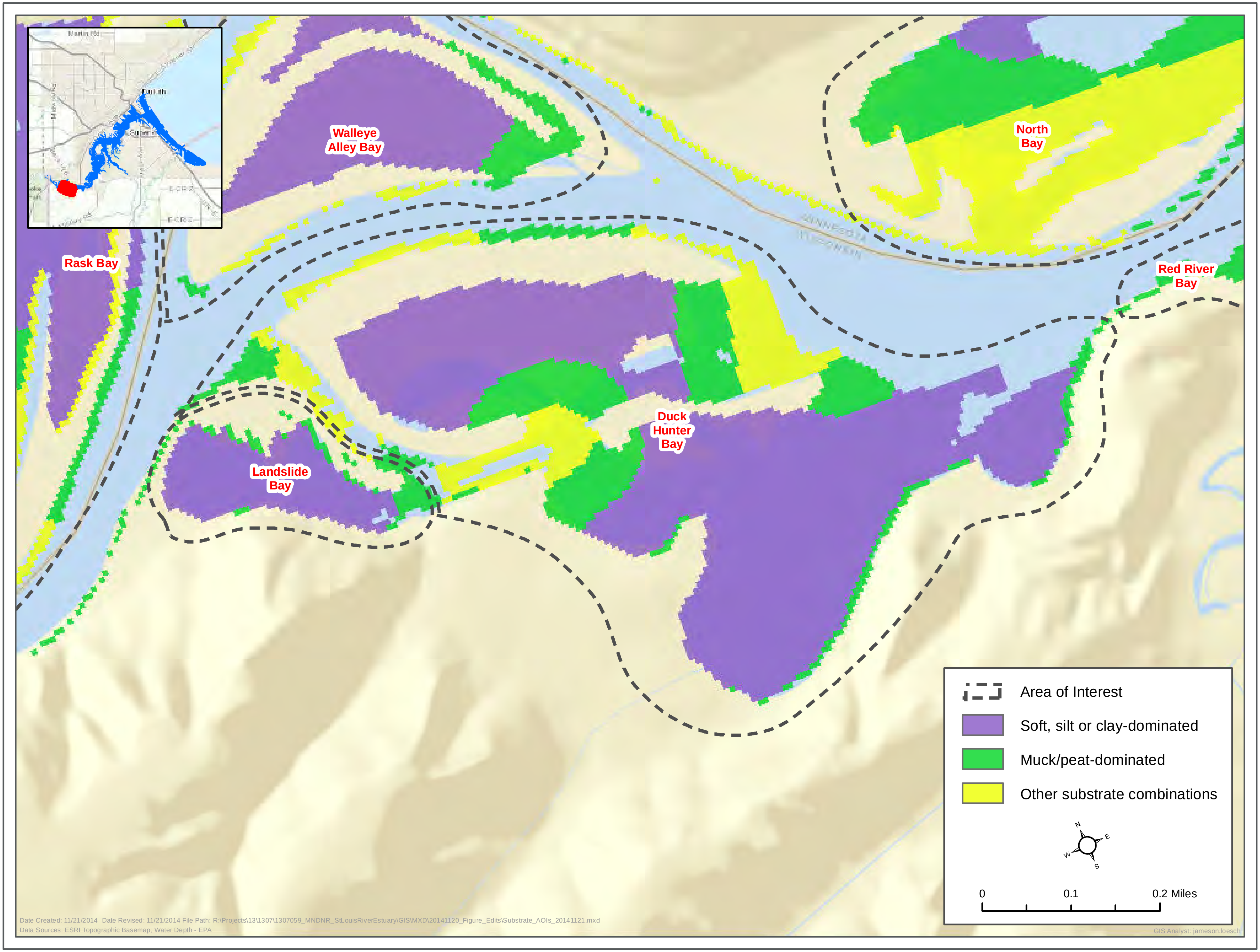
Wild Rice Restoration Opportunities and Strategies

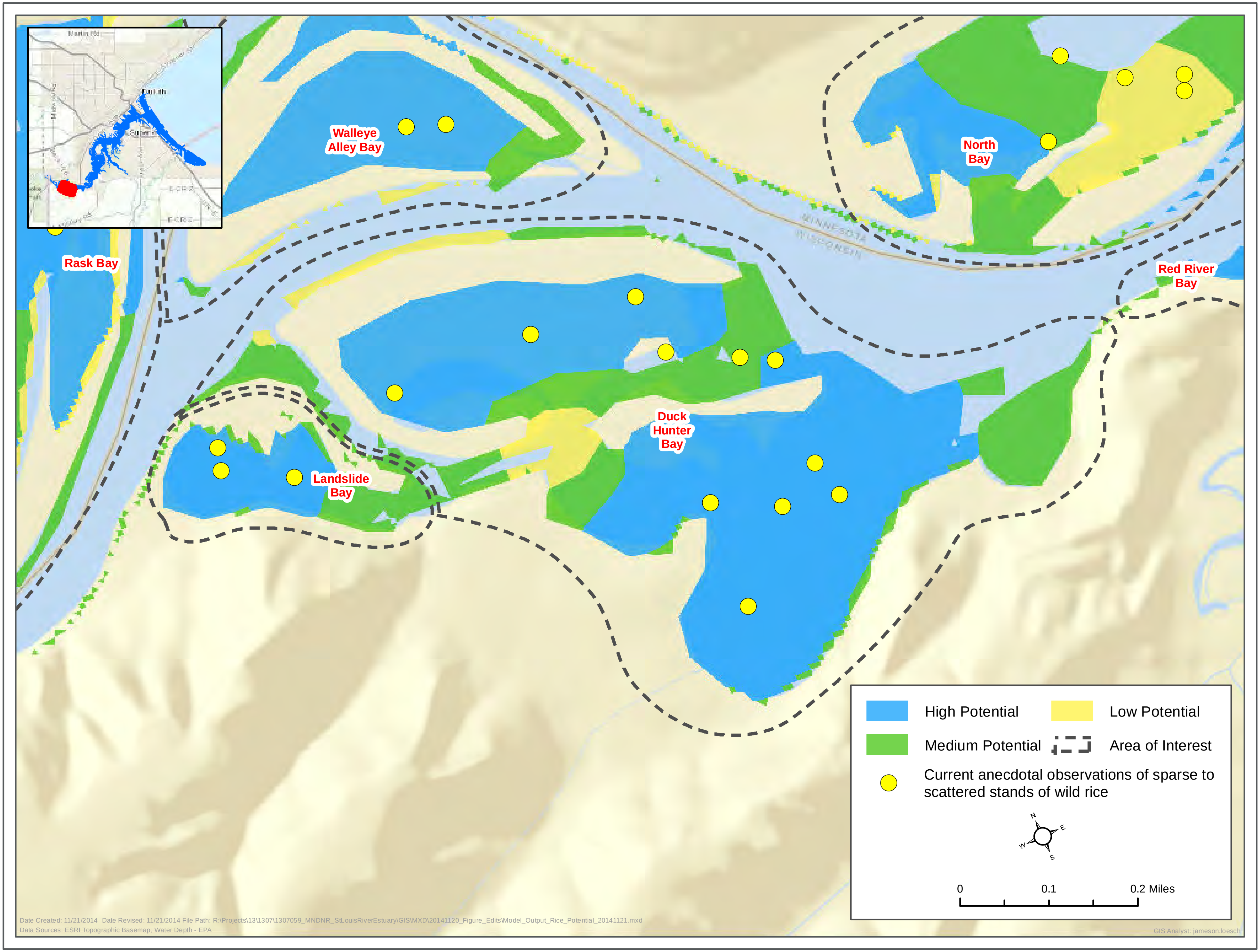
- Use vegetation mowing and seeding where floating and emergent vegetation is present to enhance wild rice stands in sheltered bays.
- Use vegetation removal and thinning where cattail stands are present to establish wild rice stands.
- Establish wild rice stands on outer fringe of island.
- Consider installing an exclosure across the mouth of the bay to provide an increased area protected from herbivory.

Wild Rice Restoration Limitations

- None.

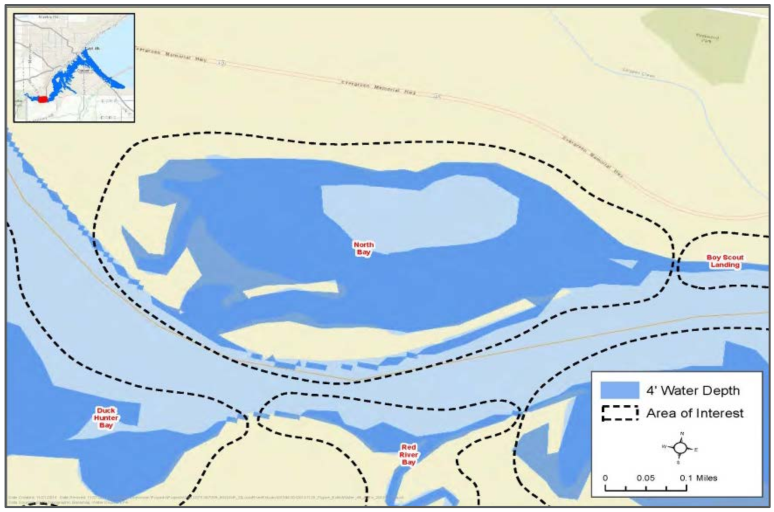

Walleye Alley Bay
North Bay
Rask Bay
Red River Bay
Duck Hunter Bay
Landslide Bay
MINNESOTA
WISCONSIN
Duluth
Area of Interest
Modeled wild rice extent
One or more indicator taxa present
Typha stand present
Plant community not consistent with wild rice existence
N
E
S
W
0
0.1
0.2 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Vegetation_AOIs_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch


Walleye Alley Bay
North Bay
Rask Bay
Red River Bay
Duck Hunter Bay
Landslide Bay
Duluth
Area of Interest
Soft, silt or clay-dominated
Muck/peat-dominated
Other substrate combinations
N
E
S
W
0
0.1
0.2 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Substrate_AOIs_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch



Walleye Alley Bay
North Bay
Rask Bay
Red River Bay
Duck Hunter Bay
Landslide Bay
MINNESOTA
WISCONSIN
Duluth
High Potential
Low Potential
Medium Potential
Area of Interest
Current anecdotal observations of sparse to scattered stands of wild rice
N
E
W
S
0
0.1
0.2 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Model_Output_Rice_Potential_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch

North Bay



Primary State
Minnesota

Subareas Included
None.

Wild Rice Restoration Acreage Potential
(Based on Site Selection Model)

Site Potential	Acres
High Potential	20
Medium Potential	31
Low Potential	11
Total Acres	62

Area Description for Wild Rice Restoration
The North Bay area is a shallow, sheltered bay. The mouth of the bay lacks floating and emergent vegetation. Vegetation density increases along the perimeter of the bay and towards the interior (western half) of the bay where cattail density increases. A narrow band of vegetation is present around the perimeter of the peninsula where water depths allow establishment. Current anecdotal observations of wild rice have been made along the cattail fringe in western half of the bay.

Wild rice restoration in this area will be considered a stand-alone activity and not incorporated into any current or future restoration plans addressing other BUIs.

Representative Photos of the Area


Photo Point 1


Photo Point 2


Photo Point 3

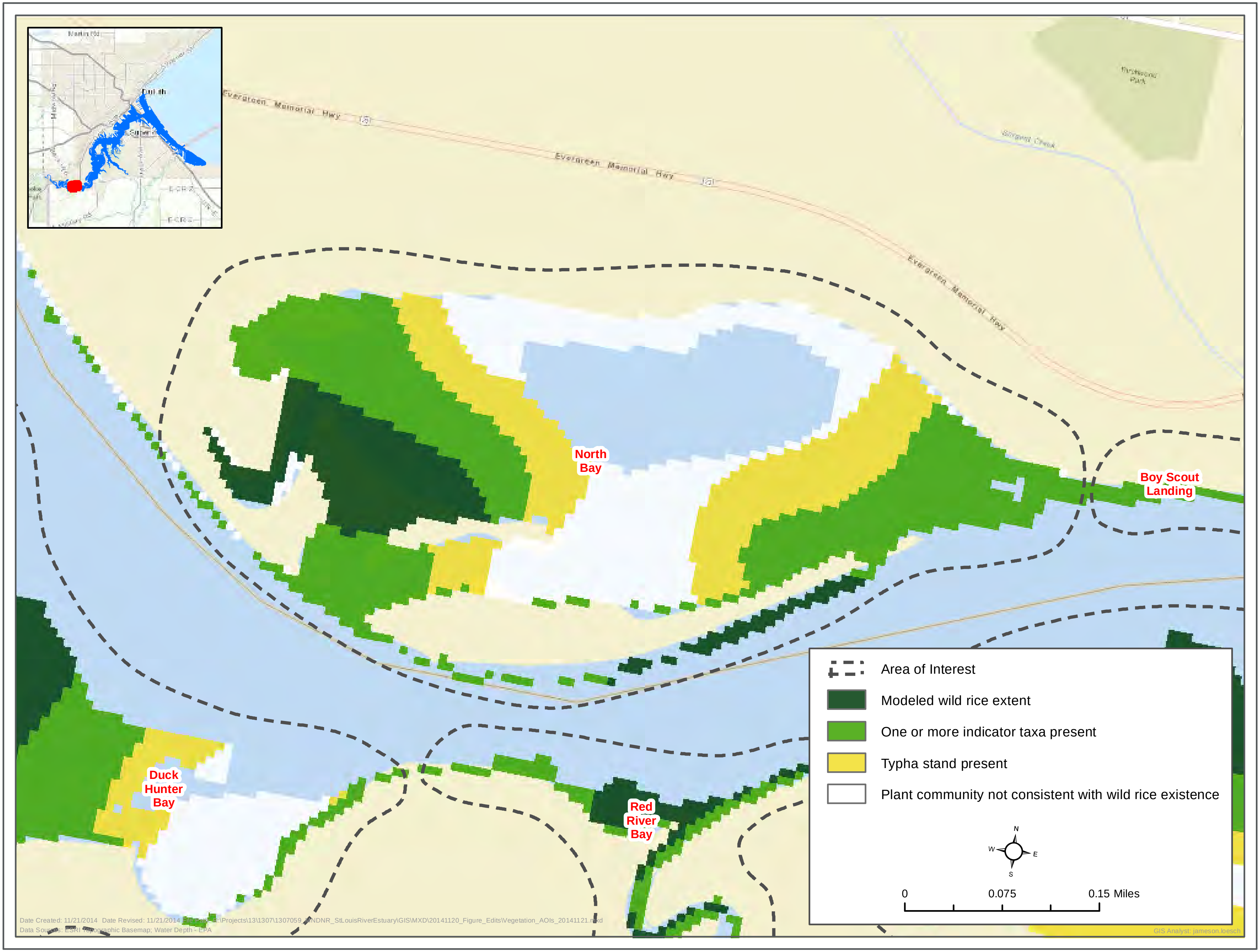

Photo Point 4

Wild Rice Restoration Opportunities

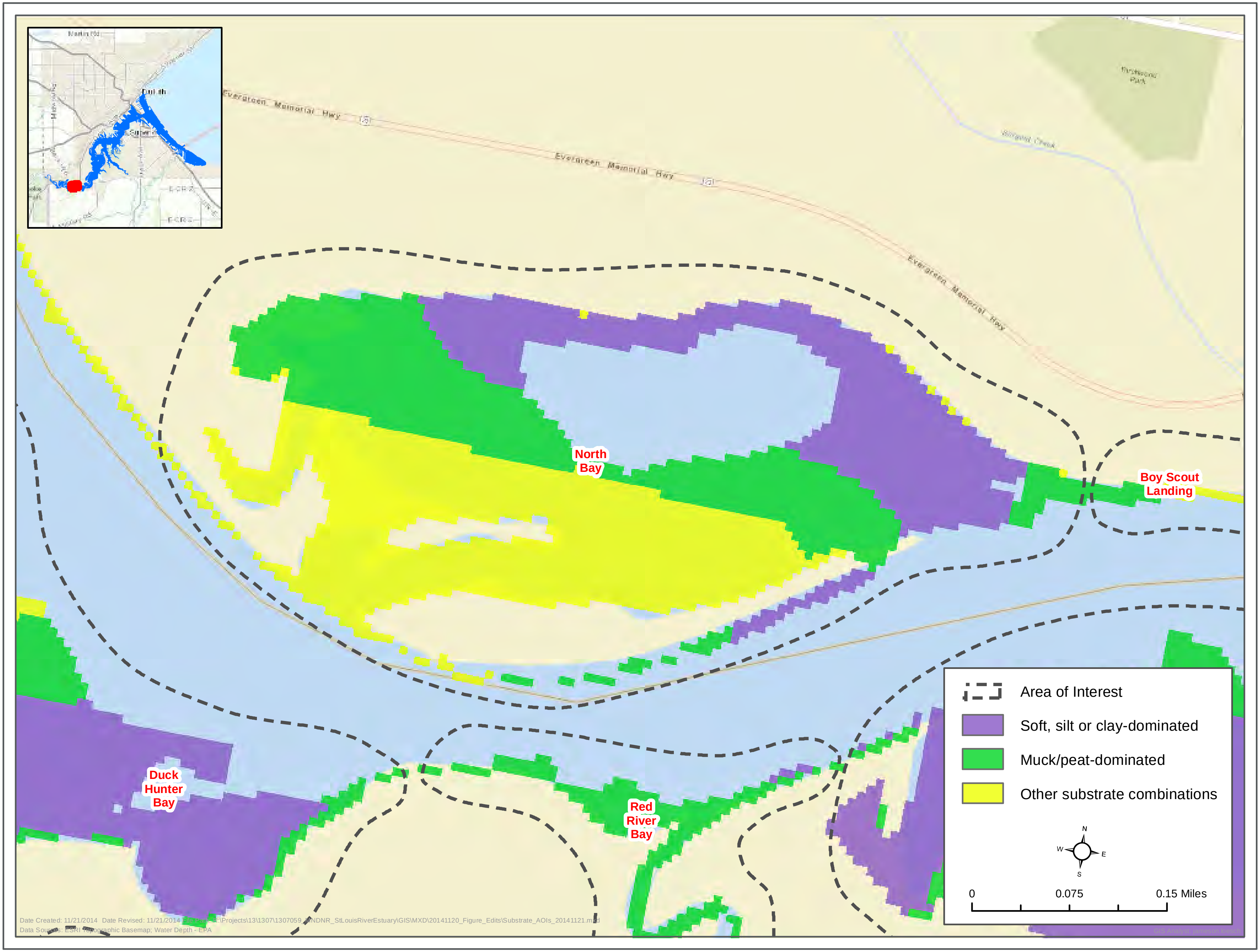
- Use vegetation mowing and direct seeding where floating and emergent vegetation is present to establish wild rice stands.
- Use vegetation removal and thinning where cattail stands are present in the western half of the bay to establish wild rice stands.
- Use seeding and exclosures to establish wild rice stands on outer fringe of the peninsula and eastern half of the bay.

Wild Rice Restoration Limitations

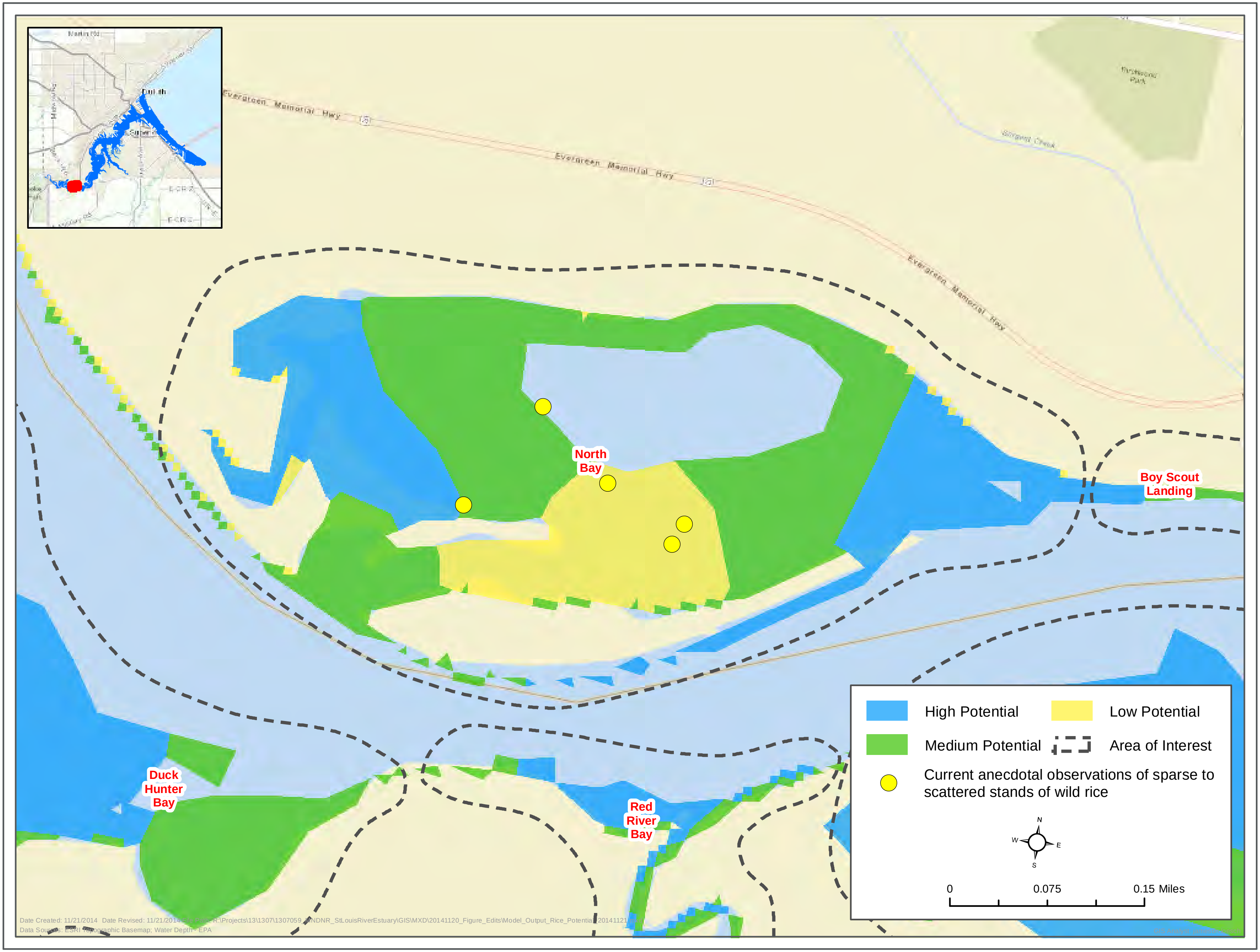
- Water depth in the interior of the bay.
- Extensive cattail stand in the western half of the bay.



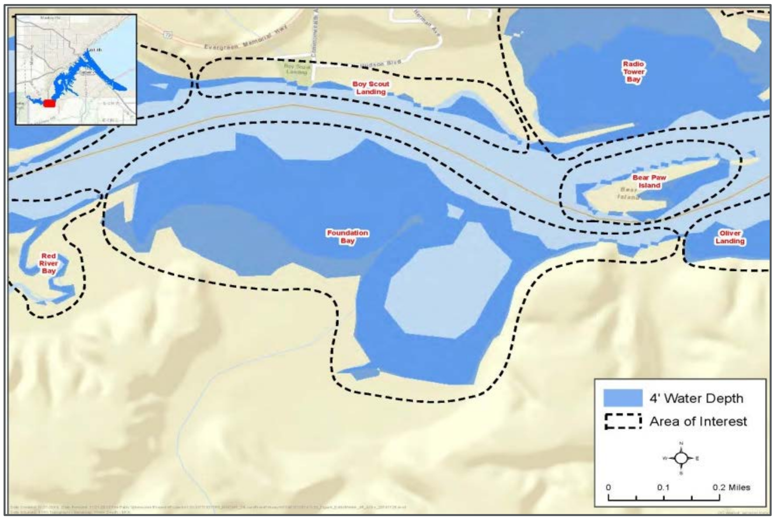
Evergreen Memorial Hwy
North Bay
Boy Scout Landing
Duck Hunter Bay
Red River Bay
Area of Interest
Modeled wild rice extent
One or more indicator taxa present
Typha stand present
Plant community not consistent with wild rice existence
N
W
E
S
0
0.075
0.15 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Vegetation_AOIs_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch



Evergreen Memorial Hwy
North Bay
Boy Scout Landing
Duck Hunter Bay
Red River Bay
Area of Interest
Soft, silt or clay-dominated
Muck/peat-dominated
Other substrate combinations
N
W
E
S
0
0.075
0.15 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Substrate_AOIs_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA


Duluth
Evergreen Memorial Hwy
Evergreen Memorial Hwy
Evergreen Memorial Hwy
North Bay
Boy Scout Landing
Duck Hunter Bay
Red River Bay
High Potential
Low Potential
Medium Potential
Area of Interest
Current anecdotal observations of sparse to scattered stands of wild rice
N
W
E
S
0
0.075
0.15 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Model_Output_Rice_Potential_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA

Foundation Bay



Primary State
Wisconsin

Subareas Included
None.

Wild Rice Restoration Acreage Potential
(Based on Site Selection Model)

Site Potential	Acres
High Potential	86
Medium Potential	22
Low Potential	2
Total Acres	110

Area Description for Wild Rice Restoration
The Foundation Bay area is a shallow bay located on the Wisconsin-side of the estuary across from Boy Scout Landing. The eastern portion of the bay is sparsely vegetated. A cattail/floating vegetation mat is present along the southern and western border. Remnants of a train trestle are located in approximately the center of the bay. A narrow band of vegetation is present around the perimeter of the peninsula where water depths allow establishment.

Wild rice restoration in this area will be considered a stand-alone activity and not incorporated into any current or future restoration plans addressing other BUIs.

Representative Photos of the Area

Photo Point 1

Photo Point 2


Photo Point 3

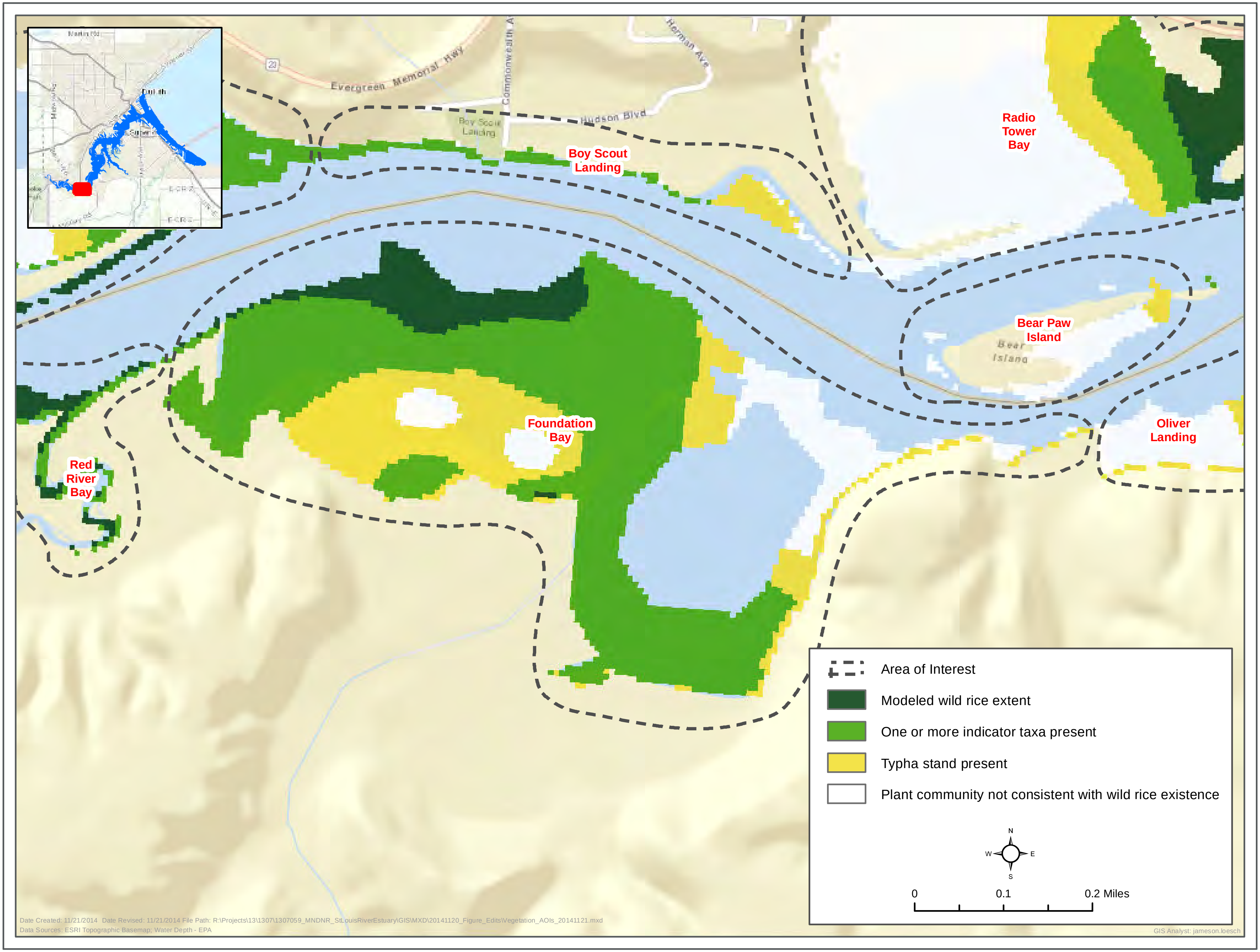

Photo Point 4

Wild Rice Restoration Opportunities and Strategies

- Use direct seeding to enhance habitat conditions for wild rice on the fringe of the shoreline.
- Use vegetation removal and thinning where the cattail stand and floating mat is present to establish wild rice.

Wild Rice Restoration Limitations

- Exposure to wind and wave energy.
- Anthropogenic substrate (wood waste).
- Extensive cattail stands and floating mat along the southern and western shoreline of the bay.



Radio Tower Bay
Boy Scout Landing
Bear Paw Island
Foundation Bay
Oliver Landing
Red River Bay
Evergreen Memorial Hwy
Commonwealth A
Hudson Blvd
Herman Ave
Bear Island
Area of Interest
Modeled wild rice extent
One or more indicator taxa present
Typha stand present
Plant community not consistent with wild rice existence
N
W
E
S
0
0.1
0.2 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Vegetation_AOIs_20141121.mxd
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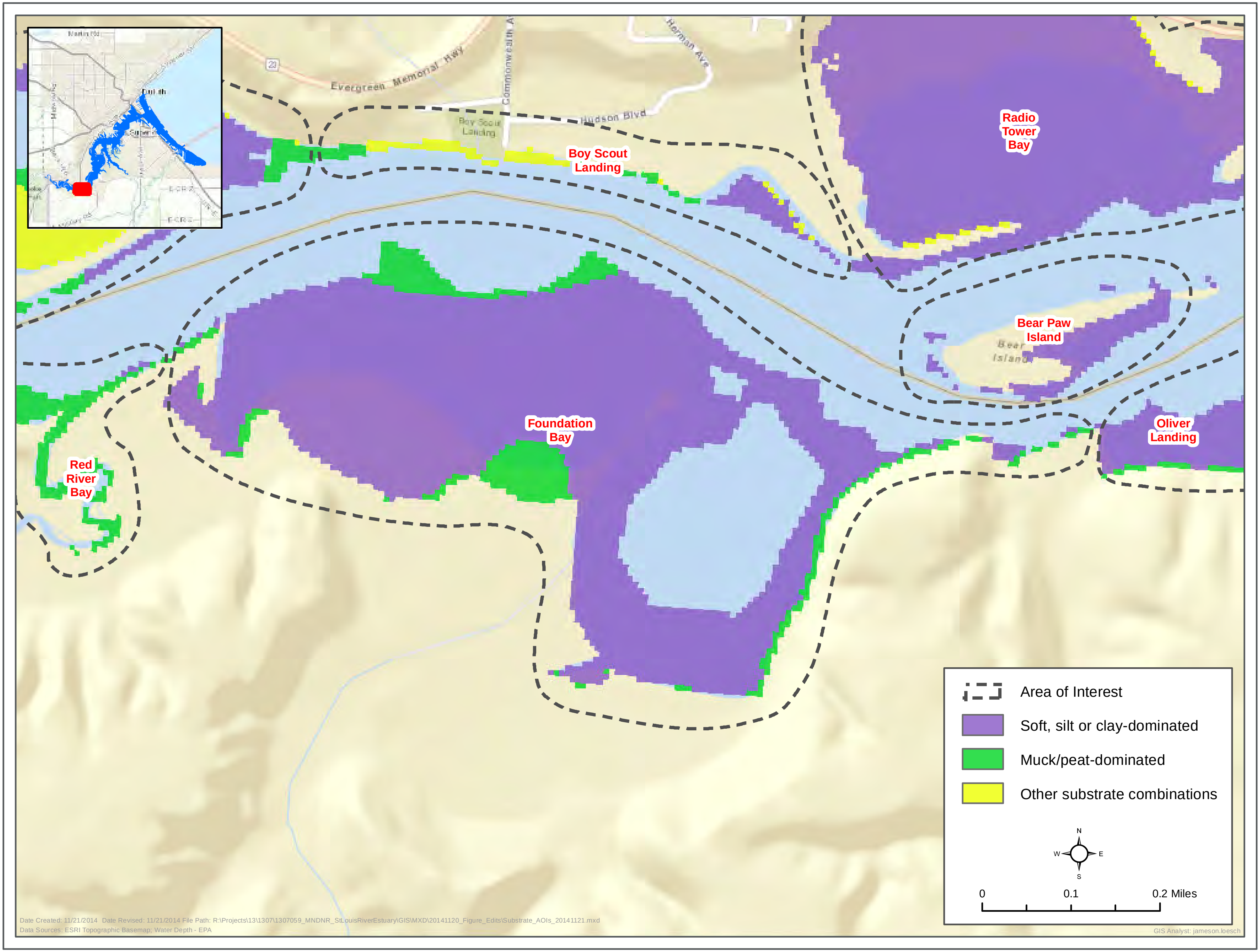
GIS Analyst: jameson.loesch



Evergreen Memorial Hwy
Commonwealth A
Herman Ave
Hudson Blvd
Boy Scout Landing
Radio Tower Bay
Boy Scout Landing
Bear Paw Island
Bear Island
Foundation Bay
Oliver Landing
Red River Bay
Duluth
Area of Interest
Soft, silt or clay-dominated
Muck/peat-dominated
Other substrate combinations
N
W
E
S
0
0.1
0.2 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Substrate_AOIs_20141121.mxd
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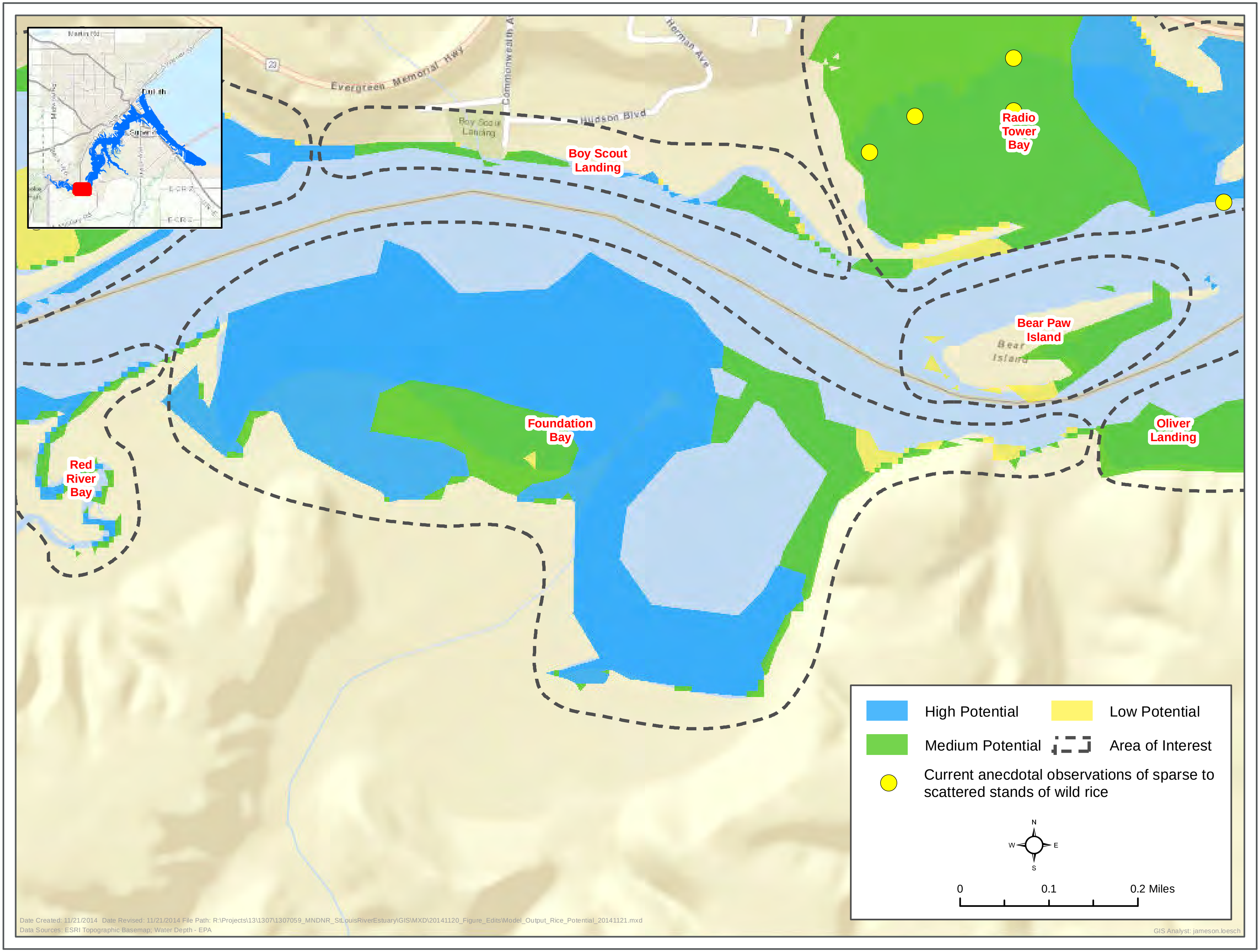
GIS Analyst: jameson.loesch


Evergreen Memorial Hwy
Commonwealth A
Herman Ave
Hudson Blvd
Boy Scout Landing
Boy Scout Landing
Radio Tower Bay
Bear Paw Island
Bear Island
Foundation Bay
Oliver Landing
Red River Bay
Duluth
High Potential
Low Potential
Medium Potential
Area of Interest
Current anecdotal observations of sparse to scattered stands of wild rice
N
W
E
S
0
0.1
0.2 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Model_Output_Rice_Potential_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch

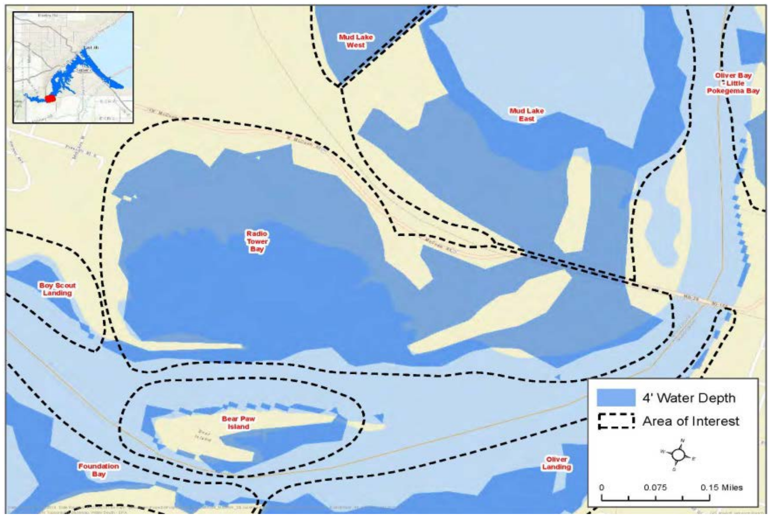
Radio Tower Bay

Primary State
Minnesota

Subareas Included
None.

Wild Rice Restoration Acreage Potential
(Based on Site Selection Model)

Site Potential	Acres
High Potential	24
Medium Potential	66
Low Potential	2
Total Acres	92



Area Description for Wild Rice Restoration
The Radio Tower Bay area is a shallow, sheltered bay downriver from Boy Scout Landing. The central portion of the bay is sparsely vegetated and covered with wood waste. The northern half of the bay is a floating bog. Wild rice has been observed at the edge of the floating bog and is likely a remnant stand from early FdLNR restoration efforts in the 1990s. The site is impacted by anthropogenic wood waste, which will be removed starting in fall 2014. The resulting depth and substrate should allow for wild rice restoration in the northern portion of the site and along the fringes of the shoreline. The Radio Tower Bay area also extends downriver of the bay to the Oliver Bridge. Water depths in this portion of the area create areas of open water, with scattered submergent vegetation to dense stands of emergent vegetation.

Once wood waste and a portion of the cattail stand is removed, wild rice restoration in this area will be considered a stand-alone activity and not incorporated into any current or future restoration plans addressing other BUIs.

Representative Photos of the Area


Photo Point 1


Photo Point 2


Photo Point 3

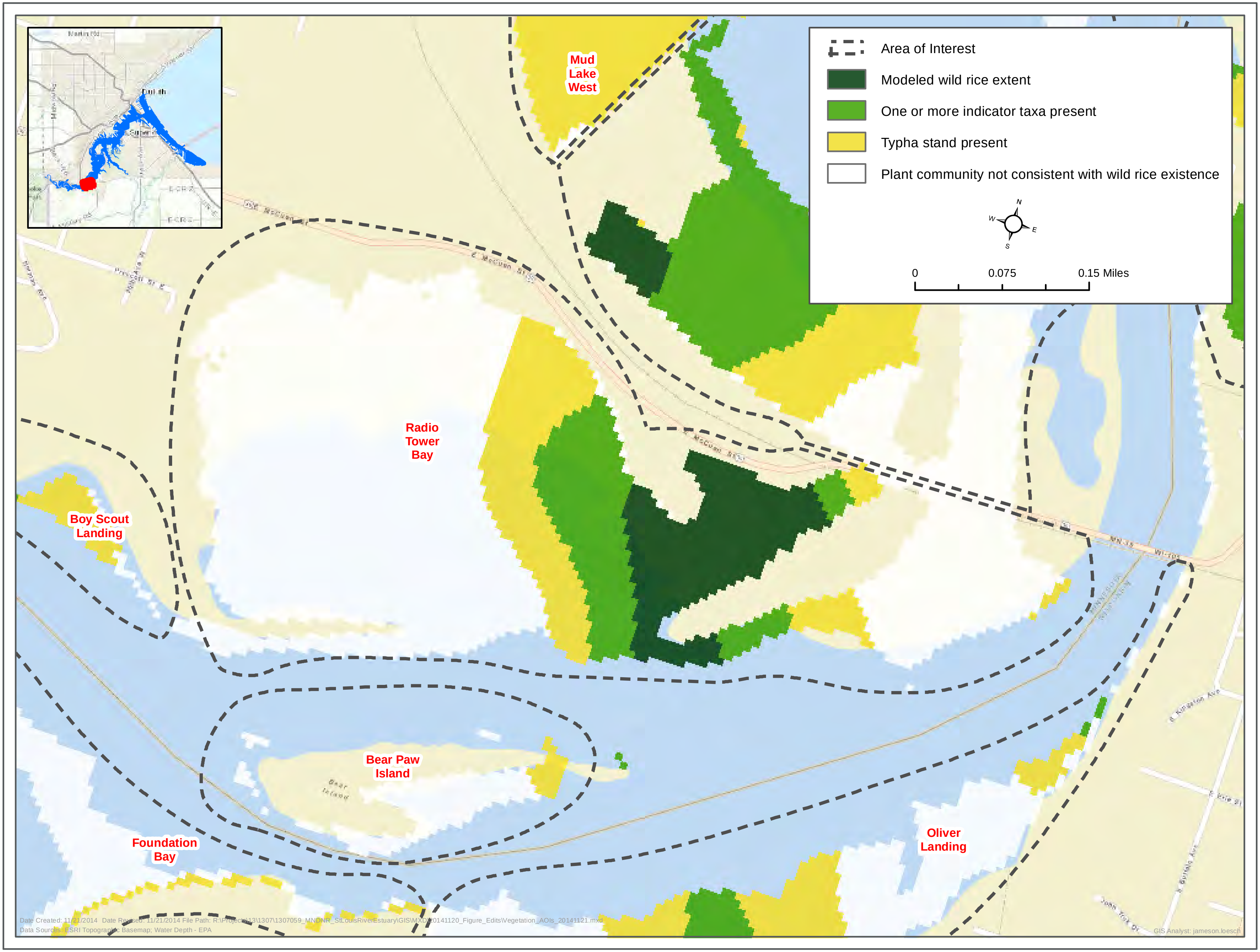

Photo Point 4

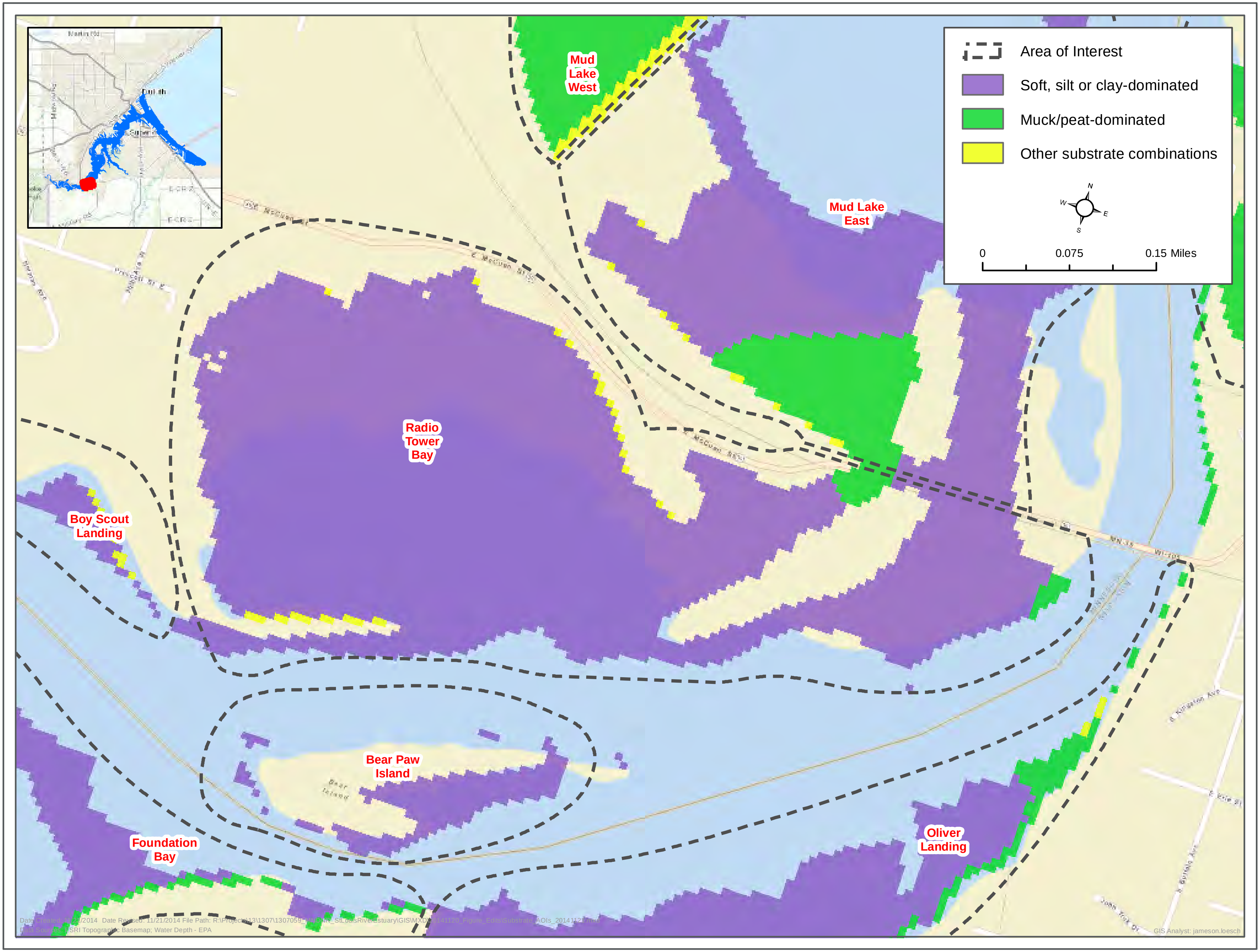
Wild Rice Restoration Opportunities and Strategies

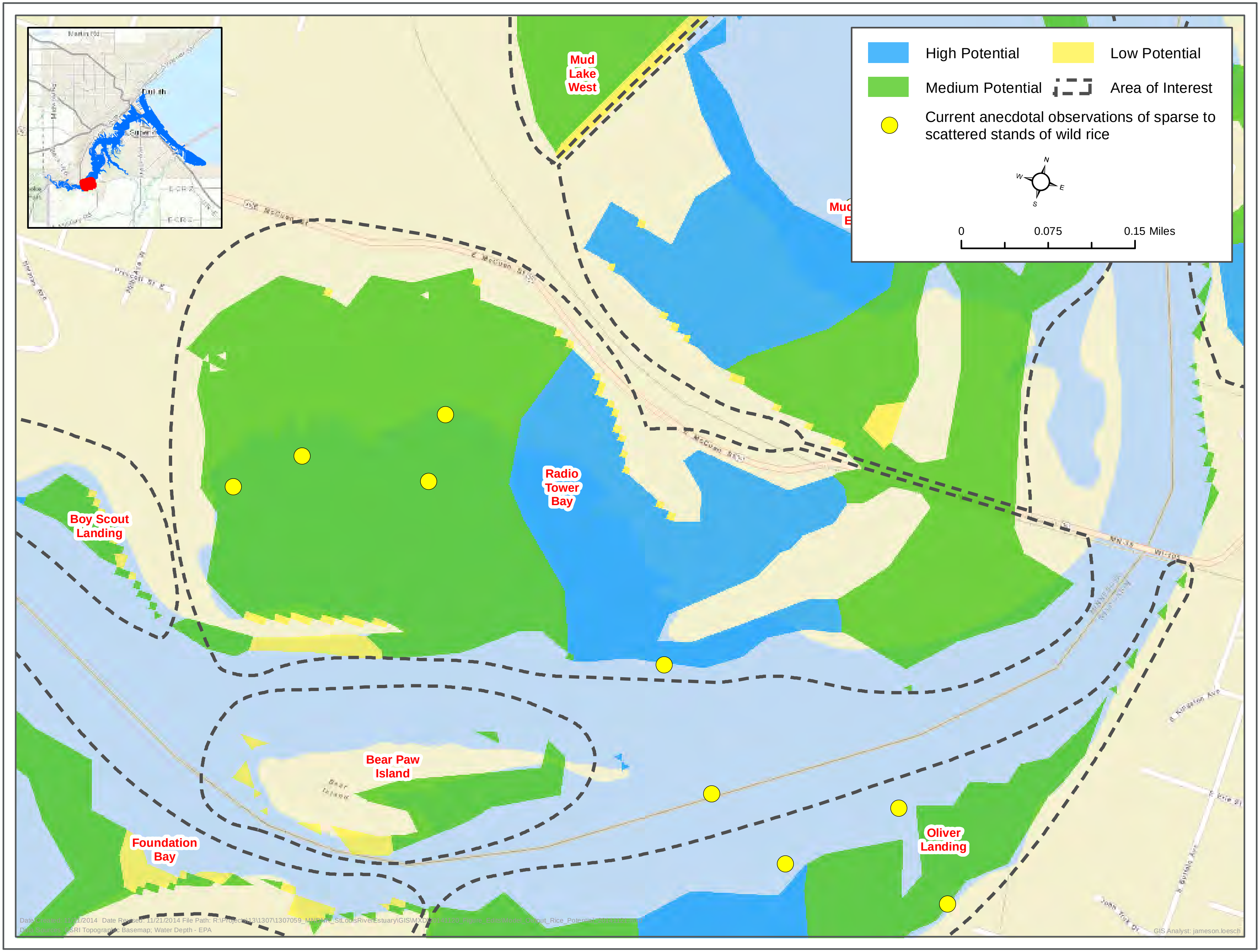
- Use seeding to enhance habitat conditions for wild rice on the fringe of the shoreline and northern portion of the bay.
- Use vegetation removal and thinning where cattail stands and floating mat is present to establish wild rice stands.

Wild Rice Restoration Limitations

- Anthropogenic substrate (wood waste).
- High quality bog plant community in the northeastern portion of the site.
- Existing infrastructure (radio tower bases and copper wire grid on surface of eastern third of site).

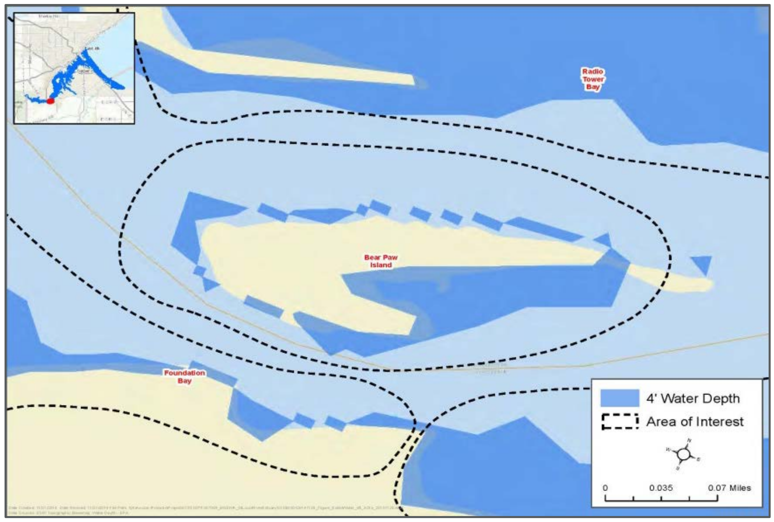

Area of Interest
Modeled wild rice extent
One or more indicator taxa present
Typha stand present
Plant community not consistent with wild rice existence
0
0.075
0.15 Miles
Mud Lake West
Radio Tower Bay
Boy Scout Landing
Bear Paw Island
Foundation Bay
Oliver Landing
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Vegetation_AOIs_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch


Area of Interest
Soft, silt or clay-dominated
Muck/peat-dominated
Other substrate combinations
N
E
S
W
0
0.075
0.15 Miles
Mud Lake West
Mud Lake East
Radio Tower Bay
Boy Scout Landing
Bear Paw Island
Foundation Bay
Oliver Landing
Duluth
Superior
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Substrate_AOIs_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch



High Potential
Low Potential
Medium Potential
Area of Interest
Current anecdotal observations of sparse to scattered stands of wild rice
N
S
E
W
0
0.075
0.15 Miles
Mud Lake West
Radio Tower Bay
Boy Scout Landing
Bear Paw Island
Foundation Bay
Oliver Landing
Date Revised: 11/21/2014
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch

Bear Paw Island



Primary State
Minnesota

Subareas Included
None.

Wild Rice Restoration Acreage Potential
(Based on Site Selection Model)

Site Potential	Acres
High Potential	0
Medium Potential	4
Low Potential	1
Total Acres	5

Area Description for Wild Rice Restoration

The Bear Paw Island area is a small island downriver from Boy Scout Landing. The island is located adjacent to the main St. Louis River channel. Water depth increases quickly away from the island limiting the amount of available or restorable habitat.

Wild rice restoration in this area will be considered a stand-alone activity and not incorporated into any current or future restoration plans addressing other BUIs.

Representative Photos of the Area

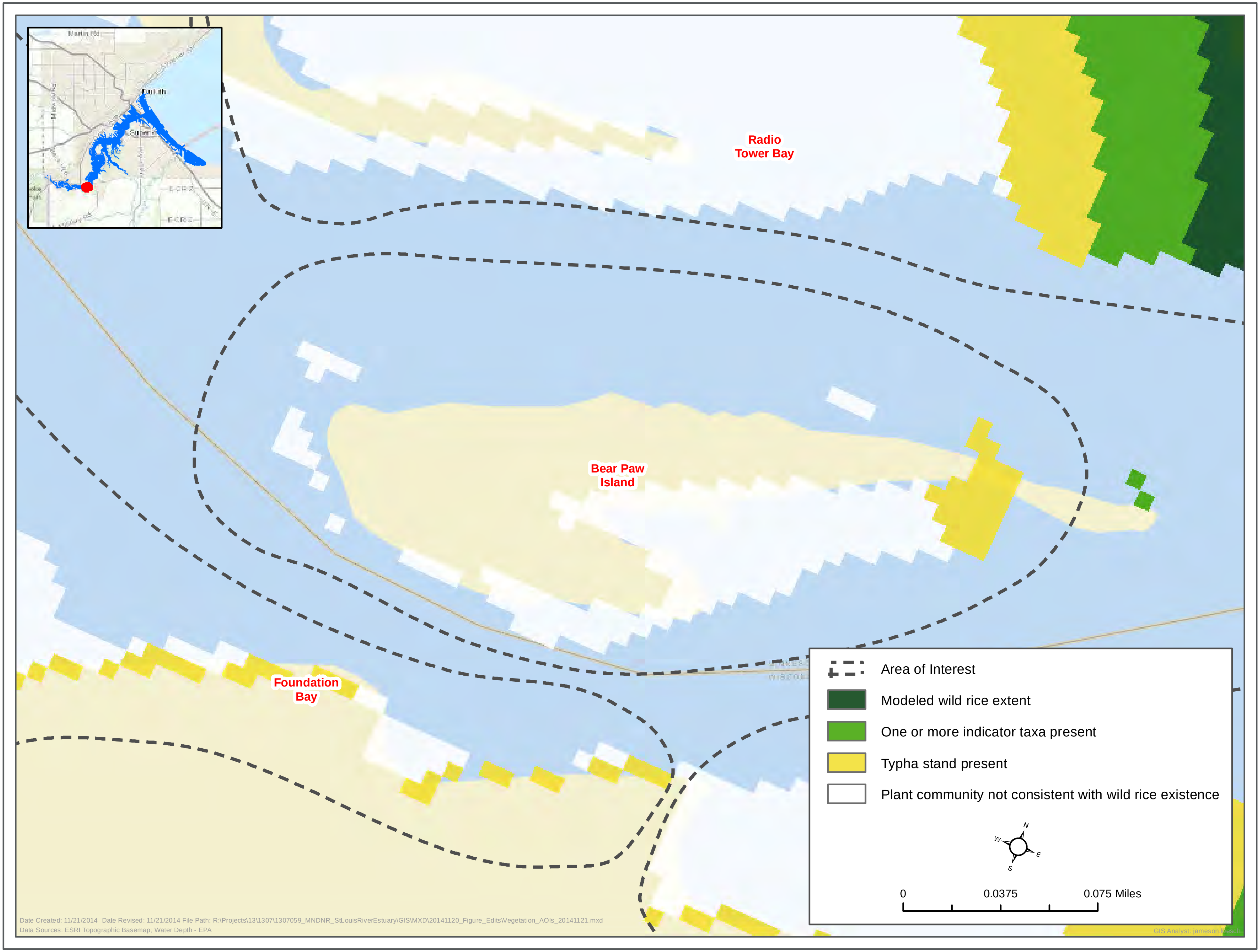
No pictures available.

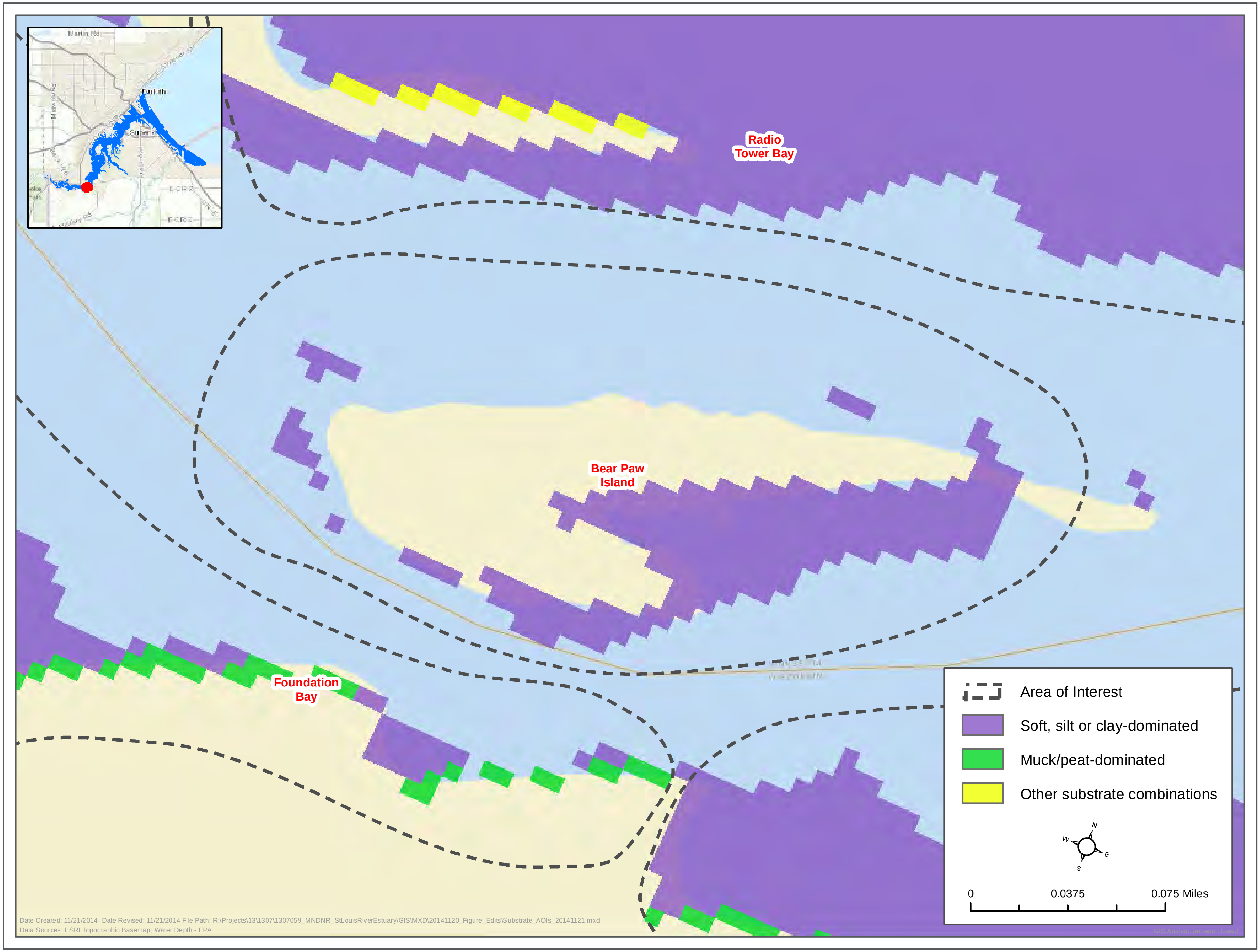
Wild Rice Restoration Opportunities

- Use vegetation removal and thinning where cattail stands are present to improve habitat conditions for wild rice on the eastern edge of the island along the shore.

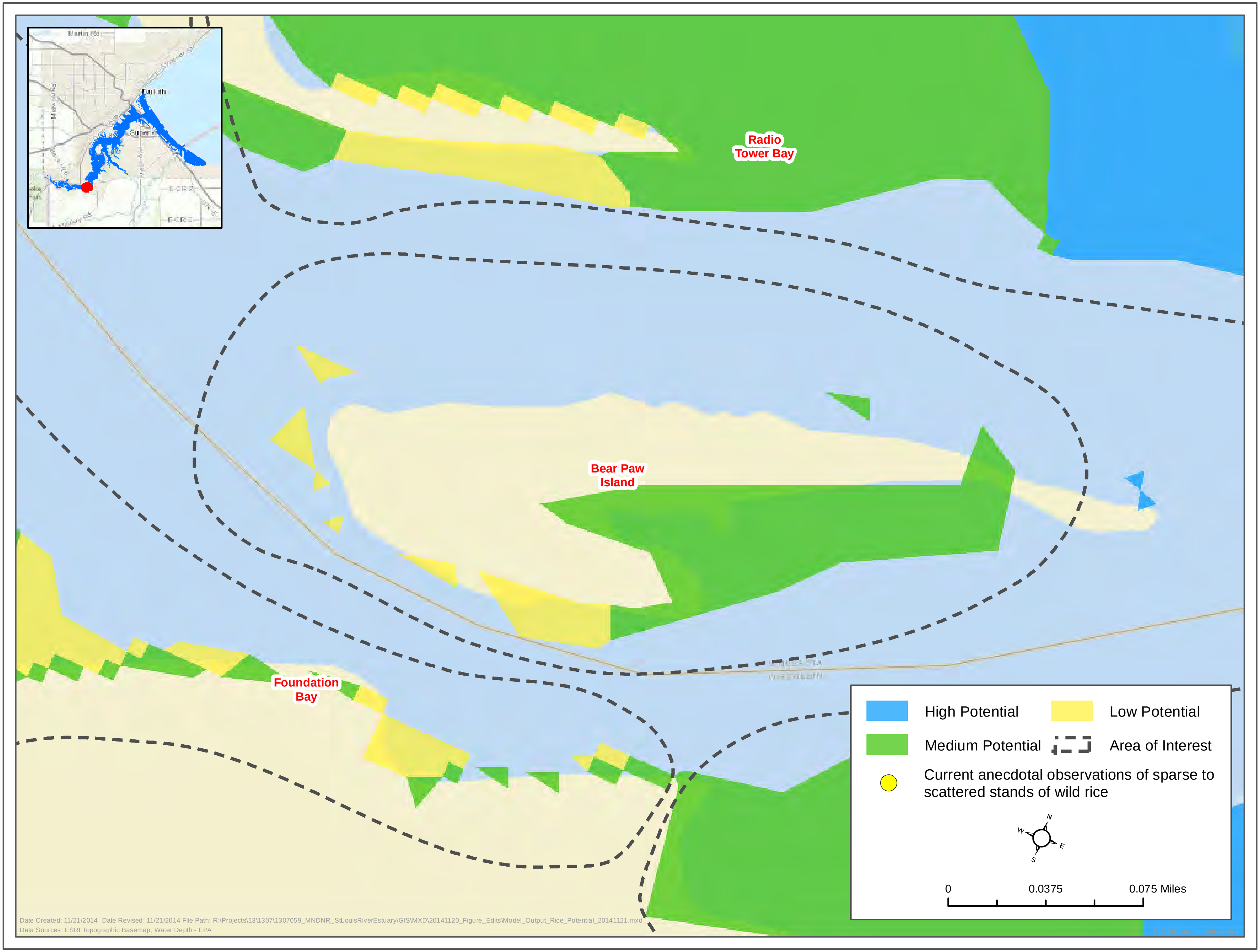
Wild Rice Restoration Limitations

- Small amount of restorable habitat.
- Located adjacent to main channel.

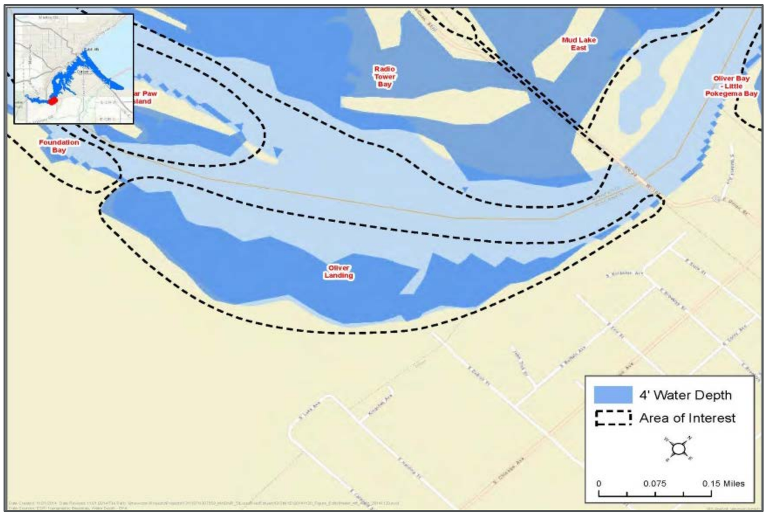

Radio
Tower Bay
Bear Paw
Island
Foundation
Bay
Duluth
Area of Interest
Modeled wild rice extent
One or more indicator taxa present
Typha stand present
Plant community not consistent with wild rice existence
N
S
E
W
0
0.0375
0.075 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Vegetation_AOIs_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch



Radio Tower Bay
Bear Paw Island
Foundation Bay
Duluth
Superior
Area of Interest
Soft, silt or clay-dominated
Muck/peat-dominated
Other substrate combinations
N
E
S
W
0
0.0375
0.075 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Substrate_AOIs_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA


Radio Tower Bay
Bear Paw Island
Foundation Bay
High Potential
Low Potential
Medium Potential
Area of Interest
Current anecdotal observations of sparse to scattered stands of wild rice
0
0.0375
0.075 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Model_Output_Rice_Potential_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA

Oliver Landing



Primary State
Wisconsin

Subareas Included
None.

Wild Rice Restoration Acreage Potential
(Based on Site Selection Model)

Site Potential	Acres
High Potential	7
Medium Potential	21
Low Potential	0
Total Acres	28

Area Description for Wild Rice Restoration

The Oliver Landing area is a shallow marsh directly upstream from the Oliver Bridge. It is a mix of open water with emergent and floating vegetation with limited patches of cattails. Aquatic vegetation abundance and presence is reduced towards the bridge where the main channel has a greater influence. Current anecdotal observations of wild rice have been made at several locations throughout this area.

Wild rice restoration in this area will be considered a stand-alone activity and not incorporated into any current or future restoration plans addressing other BUIs.

Representative Photos of the Area


Photo Point 1

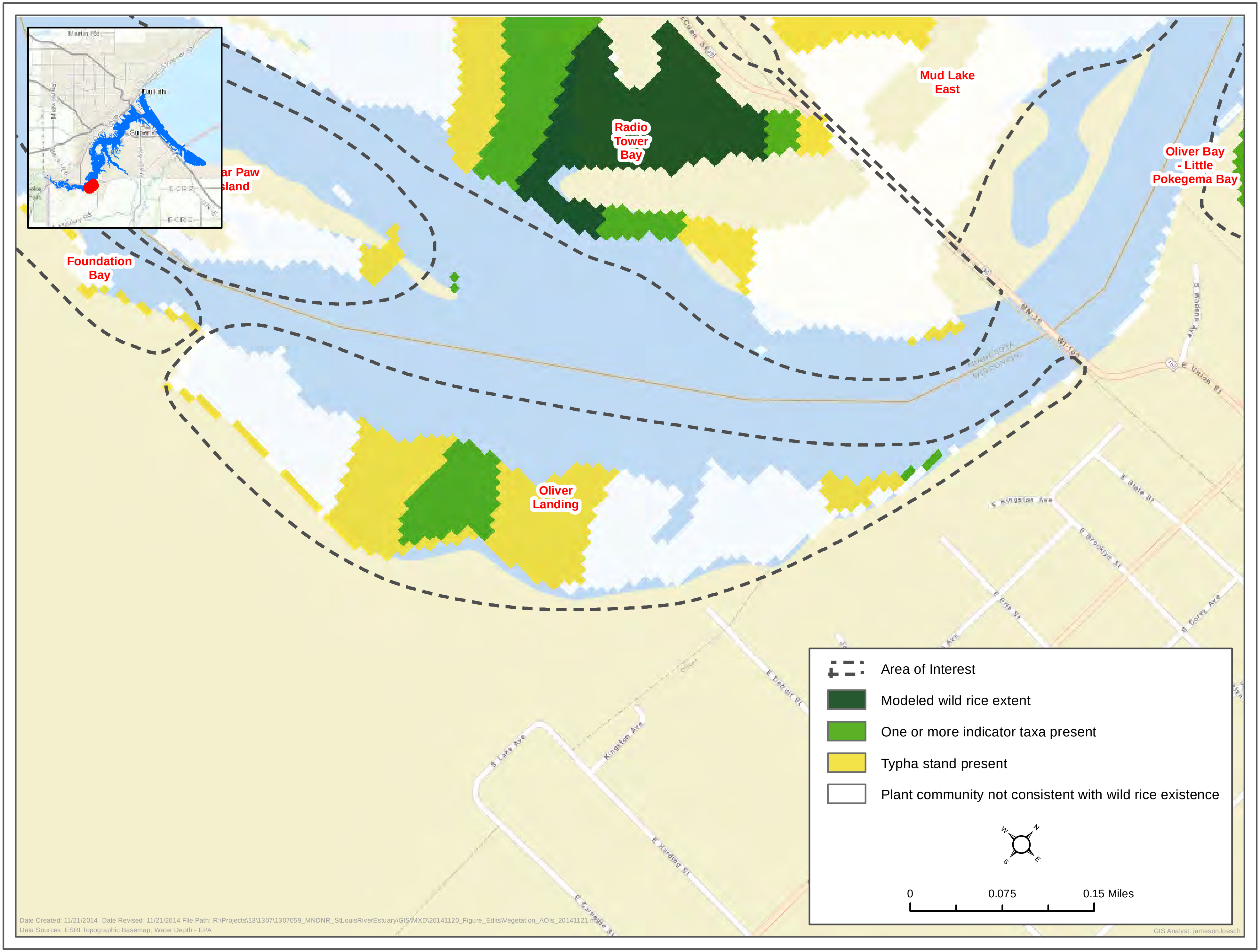

Photo Point 2

Wild Rice Restoration Opportunities and Strategies

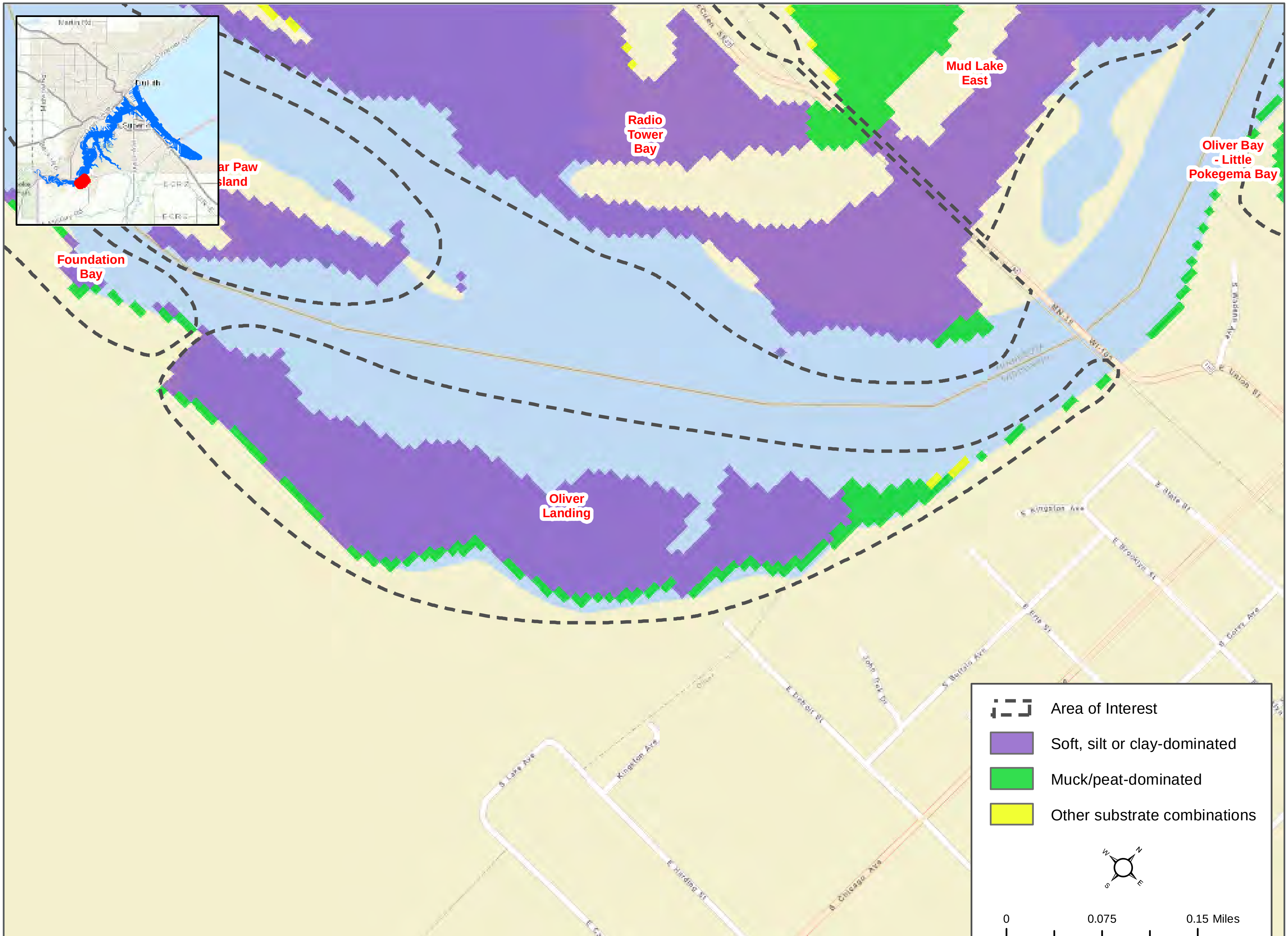
- Use vegetation mowing and seeding where floating and emergent vegetation is present to enhance habitat conditions for wild rice.

Wild Rice Restoration Limitations

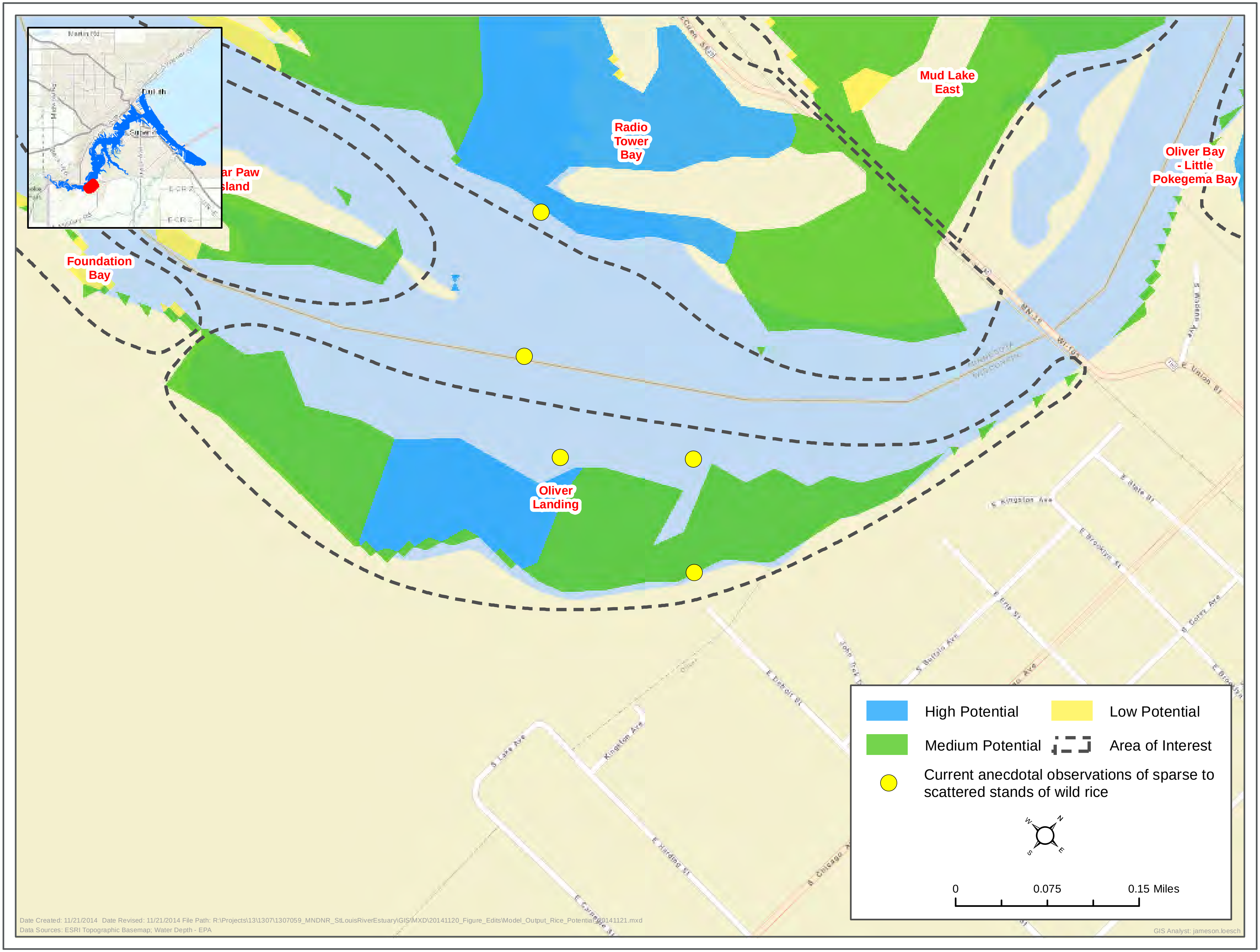
- None identified.



Mud Lake East
Radio Tower Bay
Oliver Bay - Little Pokegema Bay
ar Paw sland
Foundation Bay
Oliver Landing
Area of Interest
Modeled wild rice extent
One or more indicator taxa present
Typha stand present
Plant community not consistent with wild rice existence
0
0.075
0.15 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Vegetation_AOIs_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch

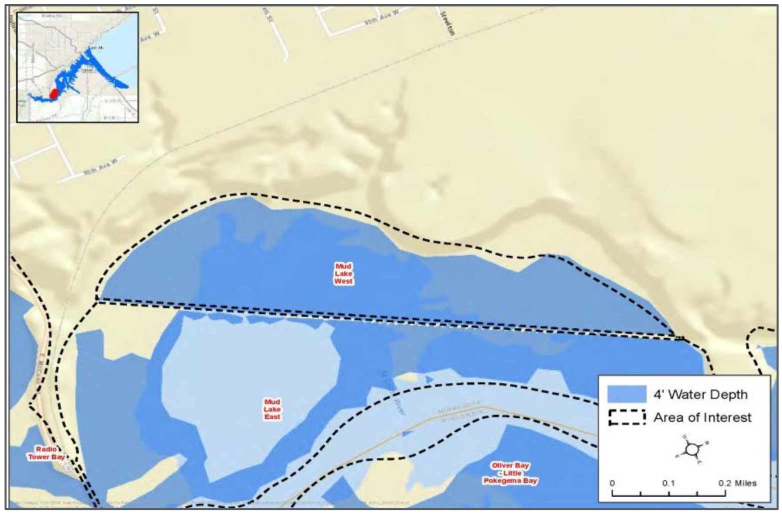


Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Substrate_AOIs_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch



Radio Tower Bay
Mud Lake East
Oliver Bay - Little Pokegema Bay
ar Paw sland
Foundation Bay
Oliver Landing
High Potential
Low Potential
Medium Potential
Area of Interest
Current anecdotal observations of sparse to scattered stands of wild rice
0
0.075
0.15 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Model_Output_Rice_Potential_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch

Mud Lake West



Primary State
Minnesota

Subareas Included
None.

Wild Rice Restoration Acreage Potential
(Based on Site Selection Model)

Site Potential	Acres
High Potential	0
Medium Potential	45
Low Potential	50
Total Acres	95

Area Description for Wild Rice Restoration

The Mud Lake West area is a deep marsh directly downstream from the Oliver Bridge. The perimeter of the area is surrounded by a floating mat of vegetation ranging from a sedge meadow with minimal cattail presence to dense cattail and purple loosestrife stands. The central portion of the area is open water with limited aquatic vegetation. Current anecdotal observations of wild rice have been made along the cattail fringe.

Mud Lake is currently undergoing a remedial investigation to determine the extent of contaminated sediments. Remedial activity is anticipated within Mud Lake West. It is hoped that wild rice restoration will be incorporated into the remediation to restoration project implemented in this location.

Representative Photos of the Area

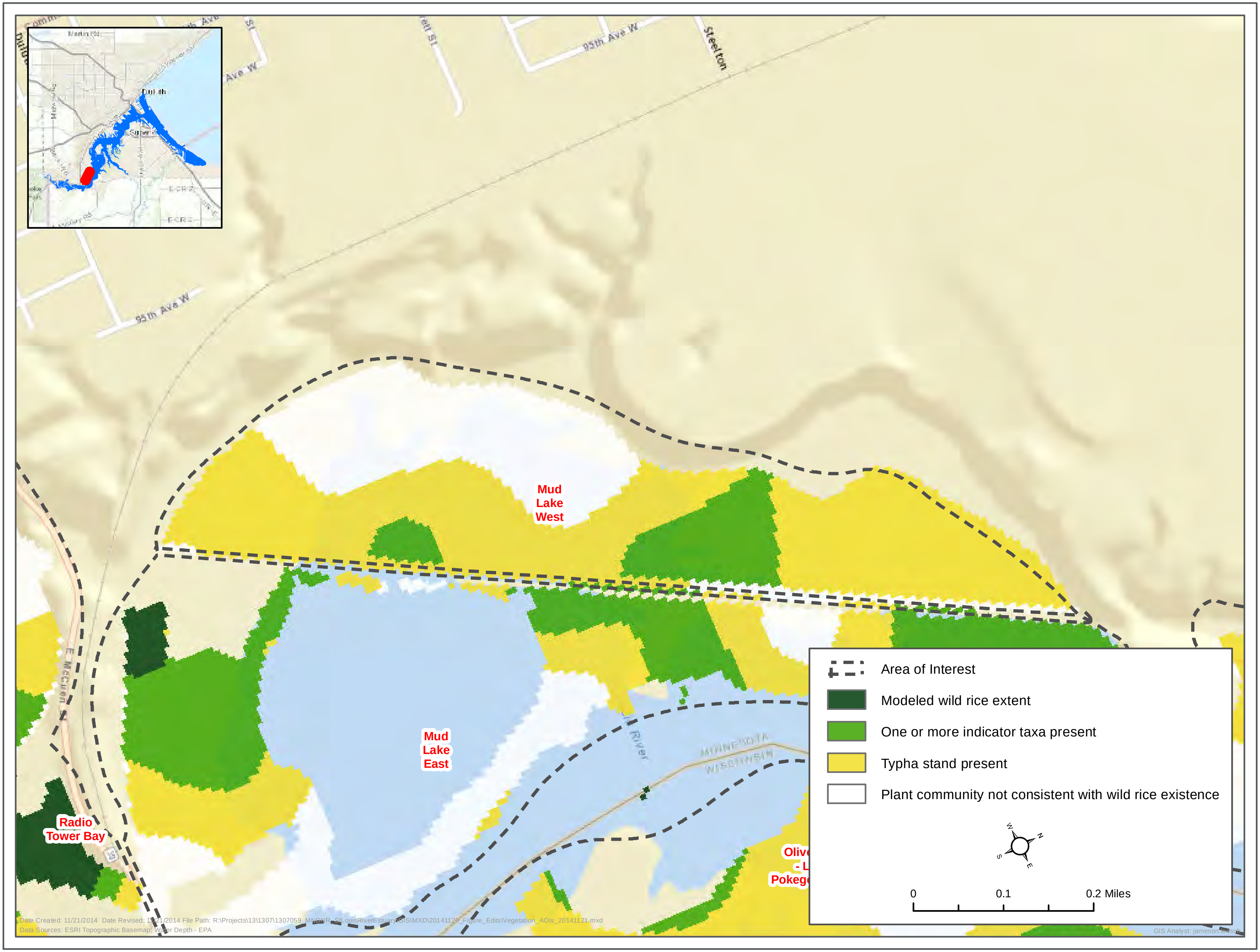
Photo Point 1

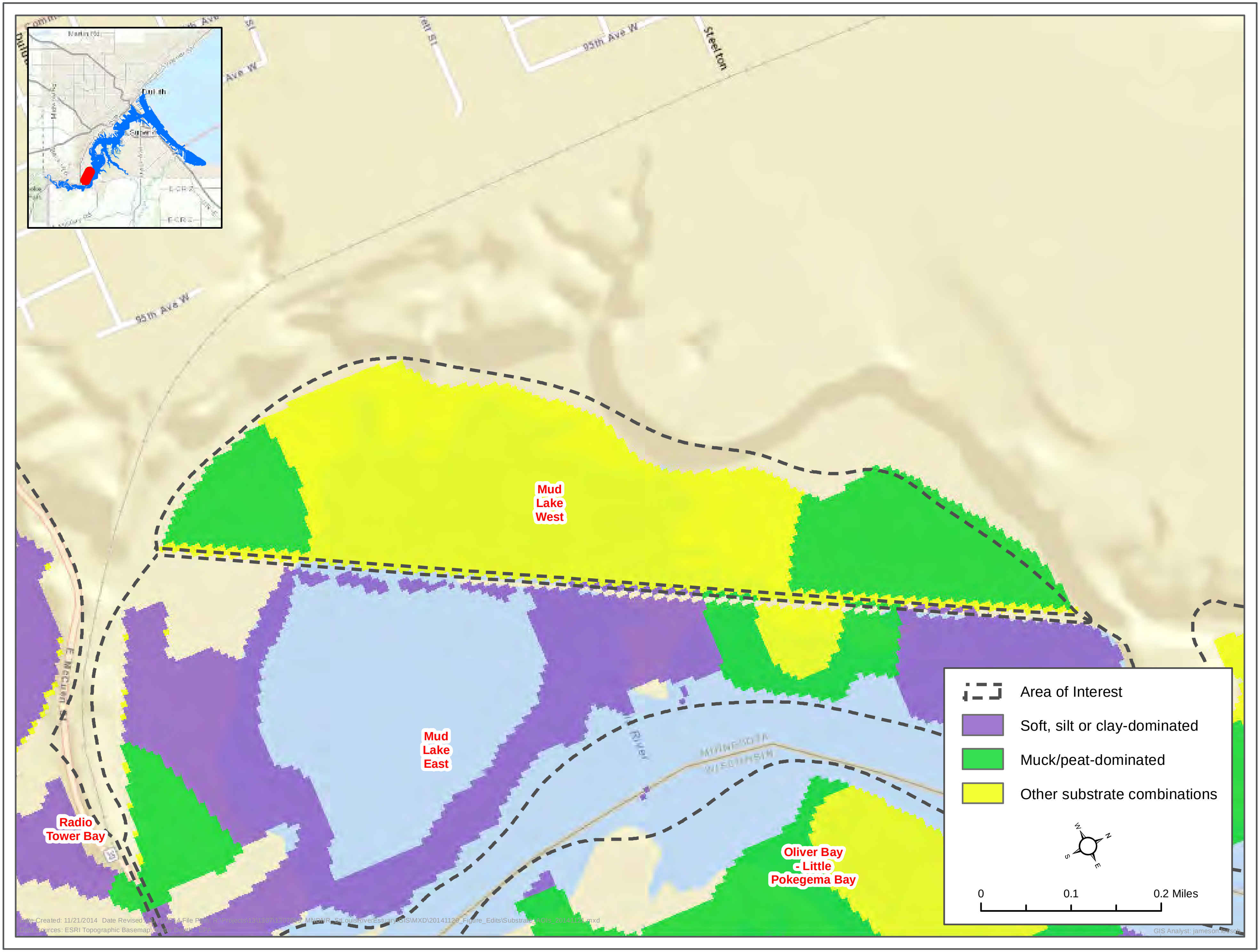
Wild Rice Restoration Opportunities

- Use vegetation removal and thinning and seeding where cattail stands and floating mat is present to enhance habitat conditions for wild rice.

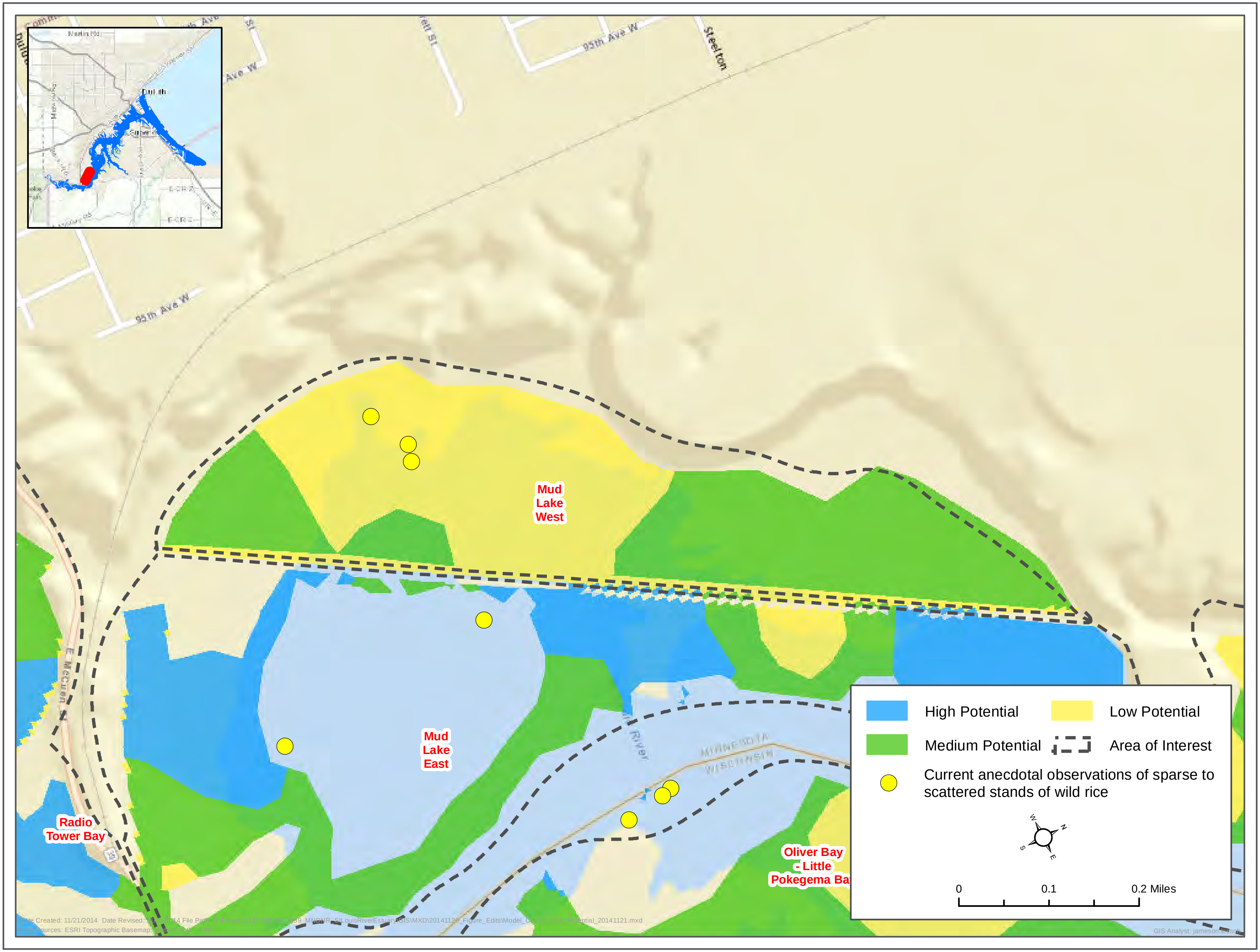
Wild Rice Restoration Limitations

- Contaminated sediments
- Equipment access across or under railroad grade.


95th Ave W
Steelton
Mud
Lake
West
Mud
Lake
East
Radio
Tower Bay
MINNESOTA
WISCONSIN
Area of Interest
Modeled wild rice extent
One or more indicator taxa present
Typha stand present
Plant community not consistent with wild rice existence
0
0.1
0.2 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Vegetation_AOIs_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA



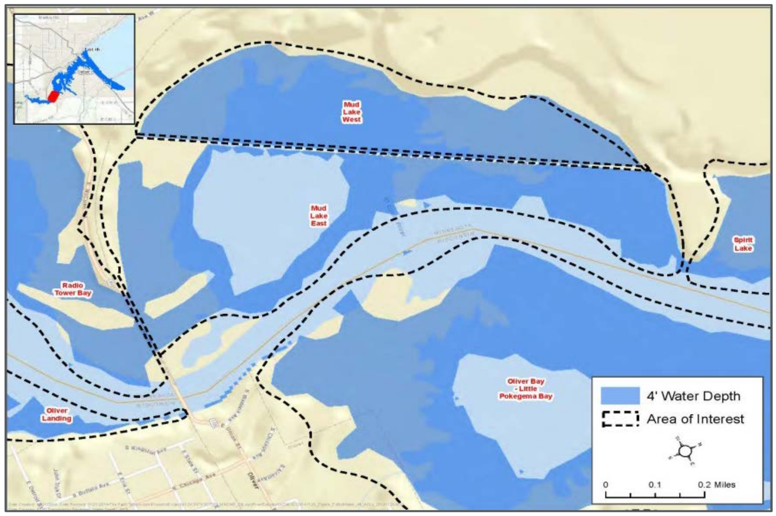
Duluth
Superior
95th Ave W
Steelton
Mud Lake West
Mud Lake East
Radio Tower Bay
Oliver Bay - Little Pokegema Bay
MINNESOTA
WISCONSIN
Area of Interest
Soft, silt or clay-dominated
Muck/peat-dominated
Other substrate combinations
0
0.1
0.2 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Substrate_AOIs_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA



Mud
Lake
West
Mud
Lake
East
Radio
Tower Bay
Oliver Bay
- Little
Pokegema Bay
95th Ave W
Steelton
E McCuen St
MINNESOTA
WISCONSIN
Duluth
Superior
High Potential
Low Potential
Medium Potential
Area of Interest
Current anecdotal observations of sparse to scattered stands of wild rice
N
0
0.1
0.2 Miles
Date Created: 11/21/2014
Data Sources: ESRI Topographic Basemap

- Invasive plant species that may require persistent control to allow wild rice establishment.

Mud Lake East



Primary State
Minnesota

Subareas Included
None.

Wild Rice Restoration Acreage Potential
(Based on Site Selection Model)

Site Potential	Acres
High Potential	55
Medium Potential	43
Low Potential	5
Total Acres	103

Area Description for Wild Rice Restoration
The Mud Lake East area is a deep marsh directly downstream from the Oliver Bridge. The western end of the area is a combination of sedge meadow and cattail-dominated stands. The central portion of the area is mixture of open water pockets and emergent and floating vegetation mats. Large logs and wood debris is intermixed among the floating mats on the central portion of the area. Current anecdotal observations of wild rice have been made along the cattail fringe.

Mud Lake is currently undergoing a remedial investigation to determine the extent of contaminated sediments. Remedial activity is not anticipated within Mud Lake East. It is hoped that wild rice restoration will be incorporated into the implementation of the remediation to restoration activities in Mud Lake.

Representative Photos of the Area


Photo Point 1


Photo Point 2

Photo Point 3

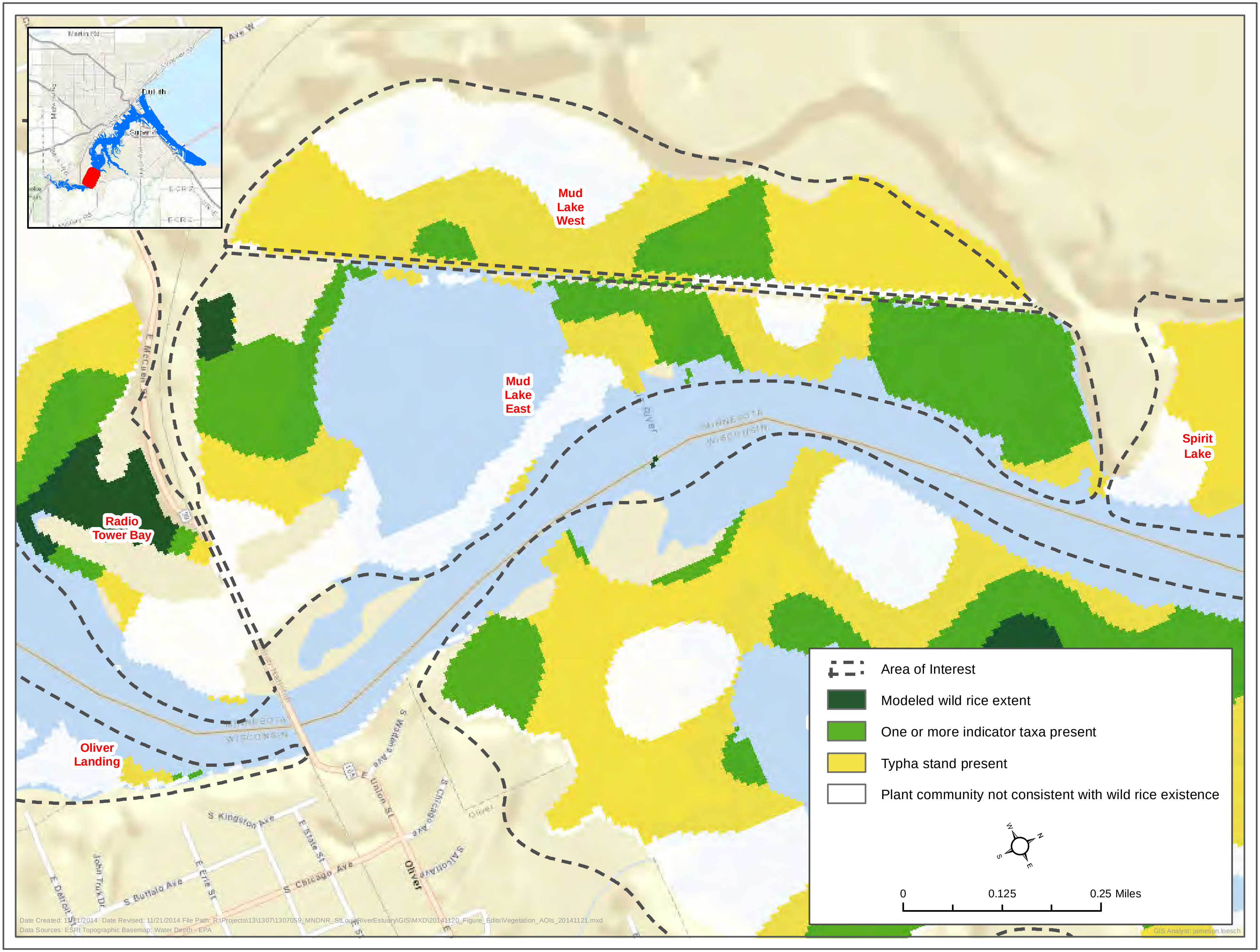
Photo Point 4

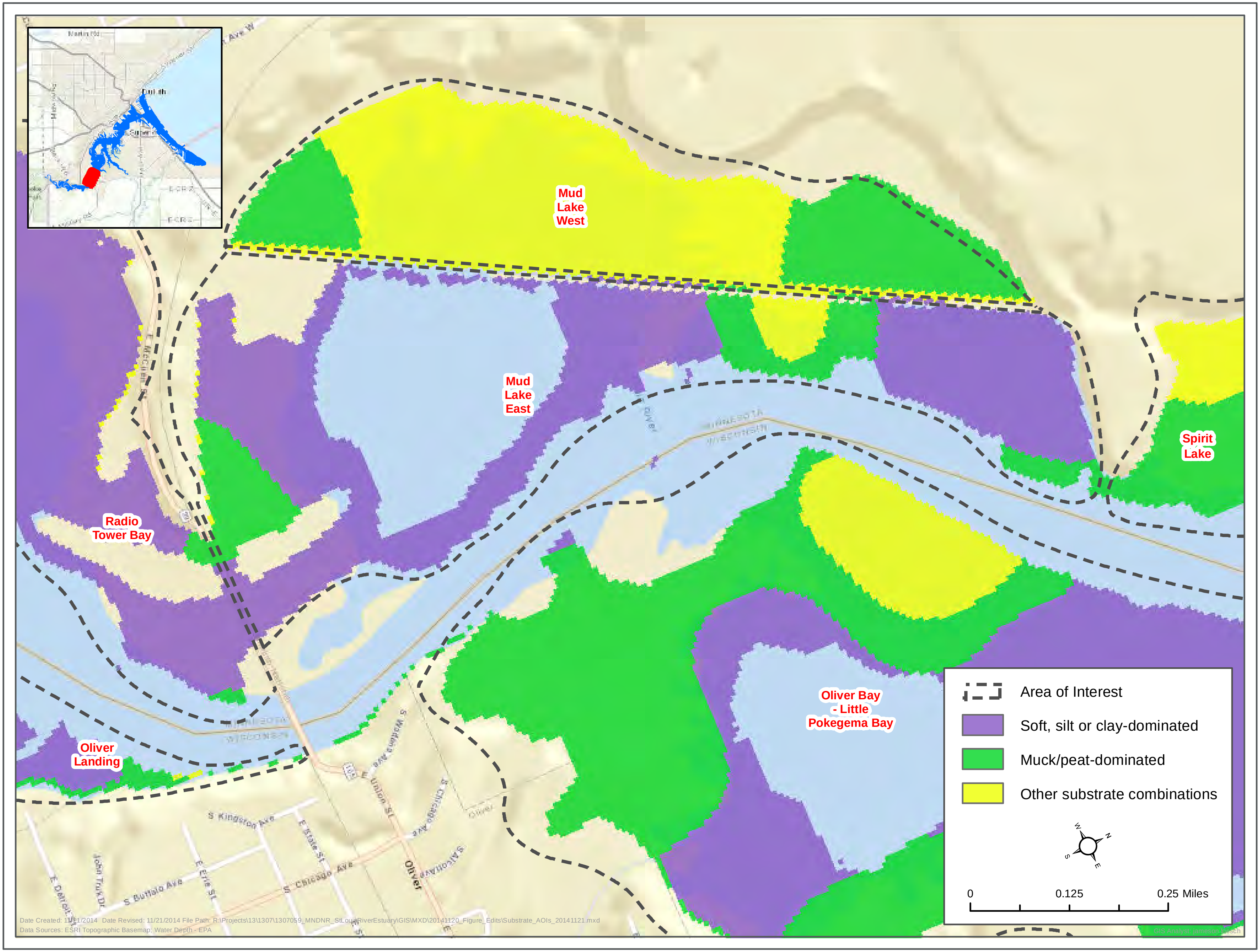
Wild Rice Restoration Opportunities and Strategies

- Use vegetation mowing and seeding where floating and emergent vegetation is present to establish wild rice stands.
- Use vegetation removal and thinning where cattail stands and floating mats are present to establish wild rice stands.

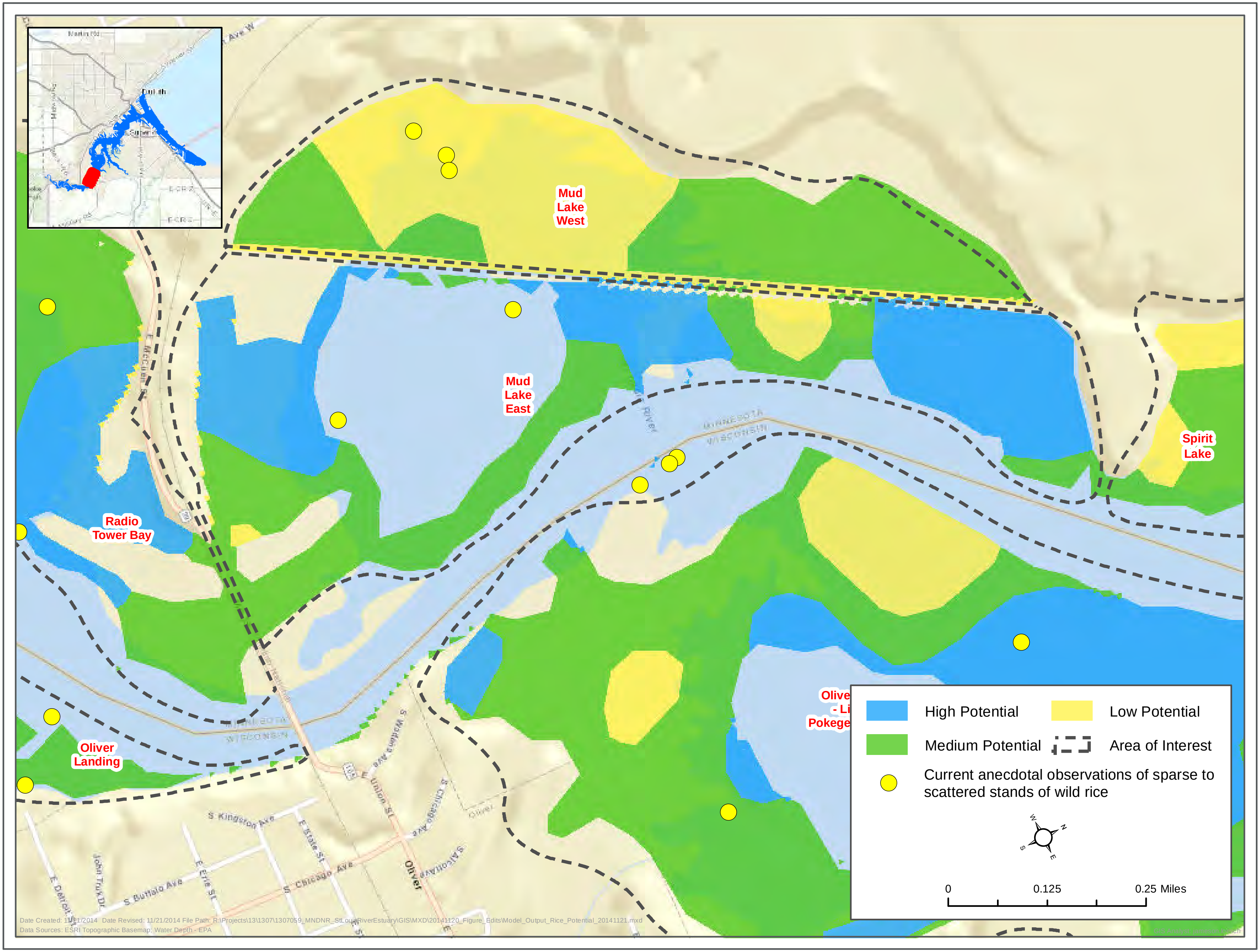
Wild Rice Restoration Limitations

- Potential contaminated sediments
- Invasive plant species that may require persistent control to allow wild rice establishment.
- Accumulated debris (logs and other woody material) incorporated into floating mats.

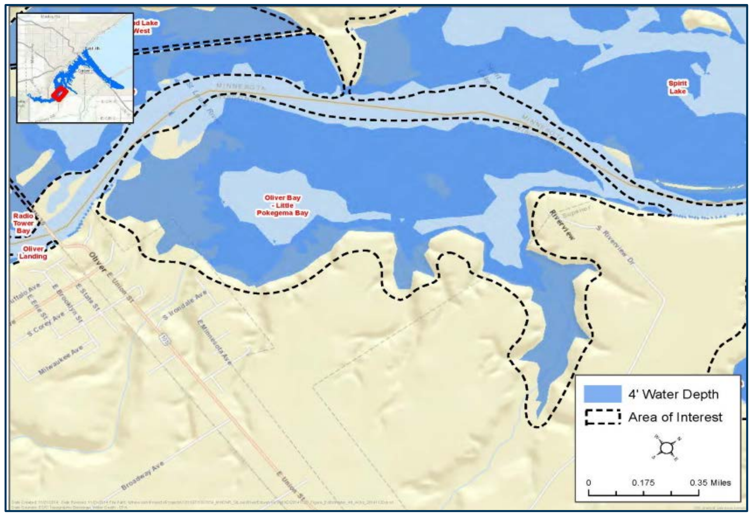

Mud
Lake
West
Mud
Lake
East
Spirit
Lake
Radio
Tower Bay
Oliver
Landing
Area of Interest
Modeled wild rice extent
One or more indicator taxa present
Typha stand present
Plant community not consistent with wild rice existence
0
0.125
0.25 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Vegetation_AOIs_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch



Mud Lake West
Mud Lake East
Radio Tower Bay
Spirit Lake
Oliver Landing
Oliver Bay - Little Pokegema Bay
Area of Interest
Soft, silt or clay-dominated
Muck/peat-dominated
Other substrate combinations
0
0.125
0.25 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Substrate_AOIs_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA


Mud Lake West
Mud Lake East
Spirit Lake
Radio Tower Bay
Oliver Landing
High Potential
Low Potential
Medium Potential
Area of Interest
Current anecdotal observations of sparse to scattered stands of wild rice
0
0.125
0.25 Miles
MINNESOTA
WISCONSIN
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Model_Output_Rice_Potential_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA

Oliver Bay – Little Pokegama Bay



Primary State
Wisconsin

Subareas Included
None.

Wild Rice Restoration Acreage Potential
(Based on Site Selection Model)

Site Potential	Acres
High Potential	164
Medium Potential	153
Low Potential	27
Total Acres	344

Areas Description for Wild Rice Restoration
The Oliver Bay – Little Pokegama Bay area is a large area downriver of the Oliver Bridge on the Wisconsin-side of the estuary and includes where the Little Pokegama River outlets into the estuary. It is a mixture of high quality sedge meadow on the southern portion of the area and cattail and floating mat around the perimeter. The central portion of the area is open water lacking floating and emergent vegetation, likely due to the greater water depths. Wild rice has been observed in the bay where the Little Pokegama River enters the estuary.

Wild rice restoration in this area will be considered a stand-alone activity and not incorporated into any current or future restoration plans addressing other BUIs.

Representative Photos of the Area


Photo Point 1


Photo Point 2


Photo Point 3


Photo Point 4


Photo Point 5


Photo Point 6


Photo Point 7

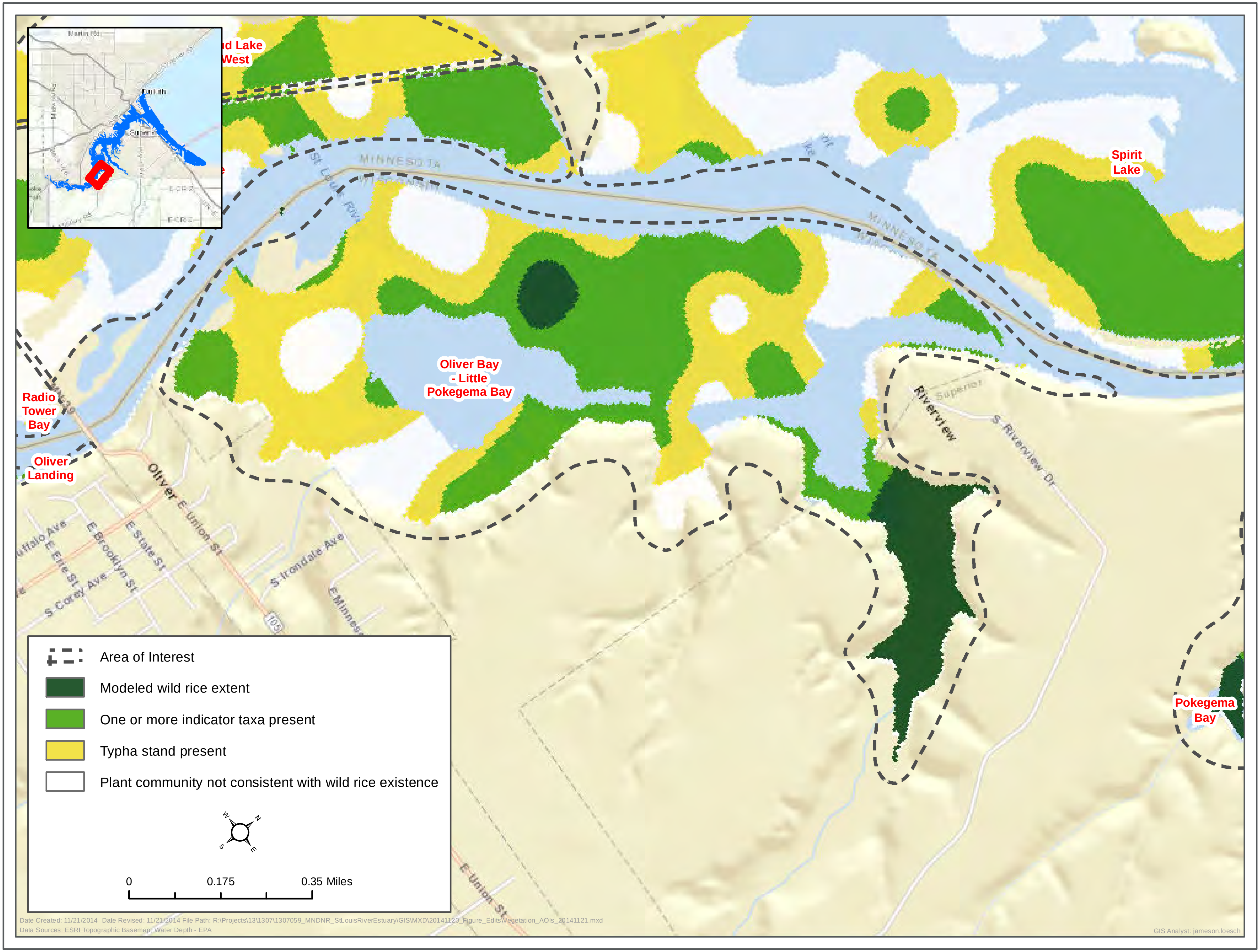

Photo Point 8

Wild Rice Restoration Opportunities and Strategies

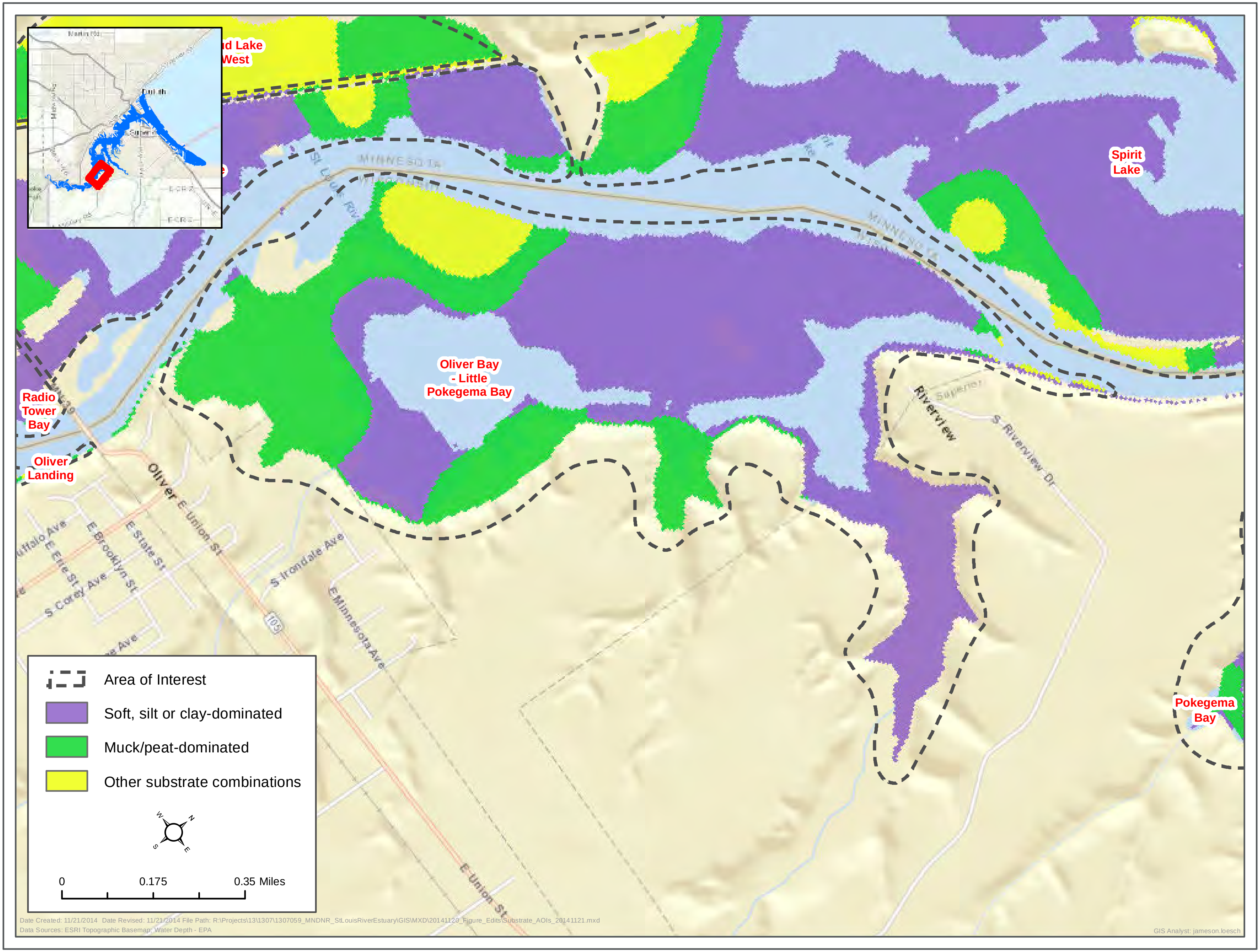
- Use vegetation mowing and seeding where floating and emergent vegetation is present to establish wild rice stands.
- Use vegetation removal and thinning where cattail stands and floating mats are present to establish wild rice stands.

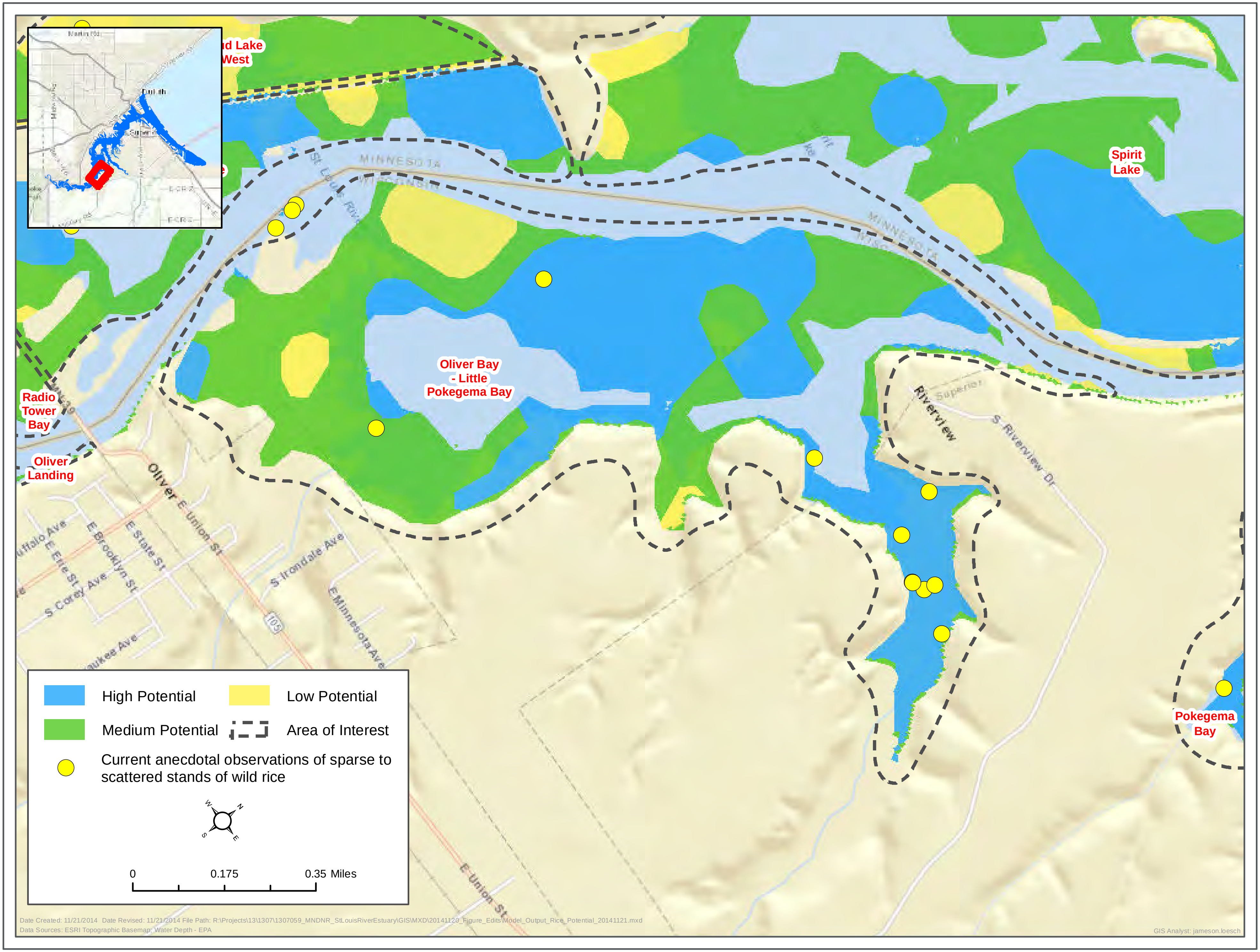
Wild Rice Restoration Limitations

- Water depth.
- Extensive cattail and floating mat with accumulated wood debris.



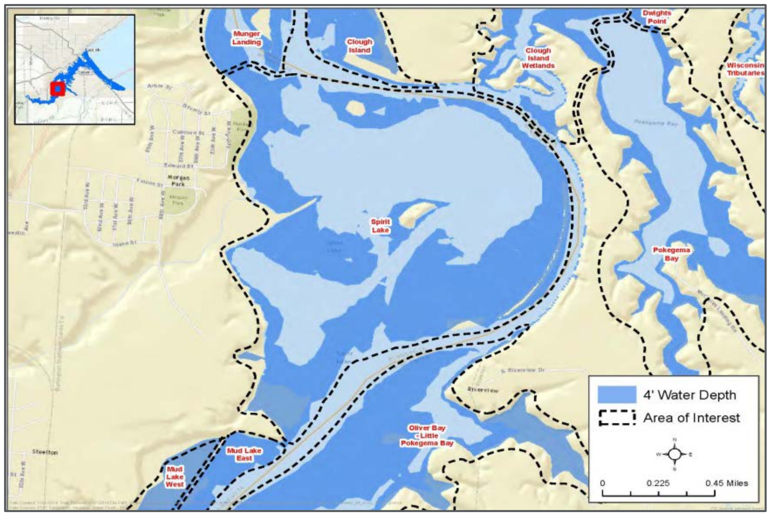
Oliver Bay - Little Pokegema Bay
Spirit Lake
Radio Tower Bay
Oliver Landing
Pokegema Bay
MINNESOTA
WISCONSIN
St Louis Riv
Riverview
S Riverview Dr
Oliver E Union St
S Irondale Ave
E Brooklyn St
E State St
E Erie St
S Corey Ave
E Union St
Area of Interest
Modeled wild rice extent
One or more indicator taxa present
Typha stand present
Plant community not consistent with wild rice existence
0
0.175
0.35 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Vegetation_AOIs_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch


Spirit Lake
Oliver Bay - Little Pokegema Bay
Radio Tower Bay
Oliver Landing
Pokegema Bay
Area of Interest
Soft, silt or clay-dominated
Muck/peat-dominated
Other substrate combinations
0
0.175
0.35 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Substrate_AOIs_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch



Spirit Lake
Oliver Bay - Little Pokegema Bay
Radio Tower Bay
Oliver Landing
Pokegema Bay
MINNESOTA
WISCONSIN
Oliver
E Union St
S Irondale Ave
E Minnesota Ave
E Brooklyn St
E State St
S Riverview Dr
Riverview
High Potential
Low Potential
Medium Potential
Area of Interest
Current anecdotal observations of sparse to scattered stands of wild rice
0
0.175
0.35 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Model_Output_Rice_Potential_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch

Spirit Lake



Primary State
Minnesota

Subareas Included
Kilchiss Meadow

Wild Rice Restoration Acreage Potential
(Based on Site Selection Model)

Site Potential	Acres
High Potential	169
Medium Potential	231
Low Potential	53
Total Acres	453

Areas Description for Wild Rice Restoration

The Spirit Lake area is a large, open water area on the Minnesota-side of the estuary and includes Spirit Island and Kilchiss Meadow. Along the western portion of the site, dense cattail stands are present. In Kilchiss Meadow, floating and emergent vegetation is present where water depths are reduced.

There is a current restoration plan for Spirit Lake that addresses an existing BUI. Wild rice restoration in this area would need to be integrated during the final plan development.

Representative Photos of the Area


Photo Point 1


Photo Point 2


Photo Point 3

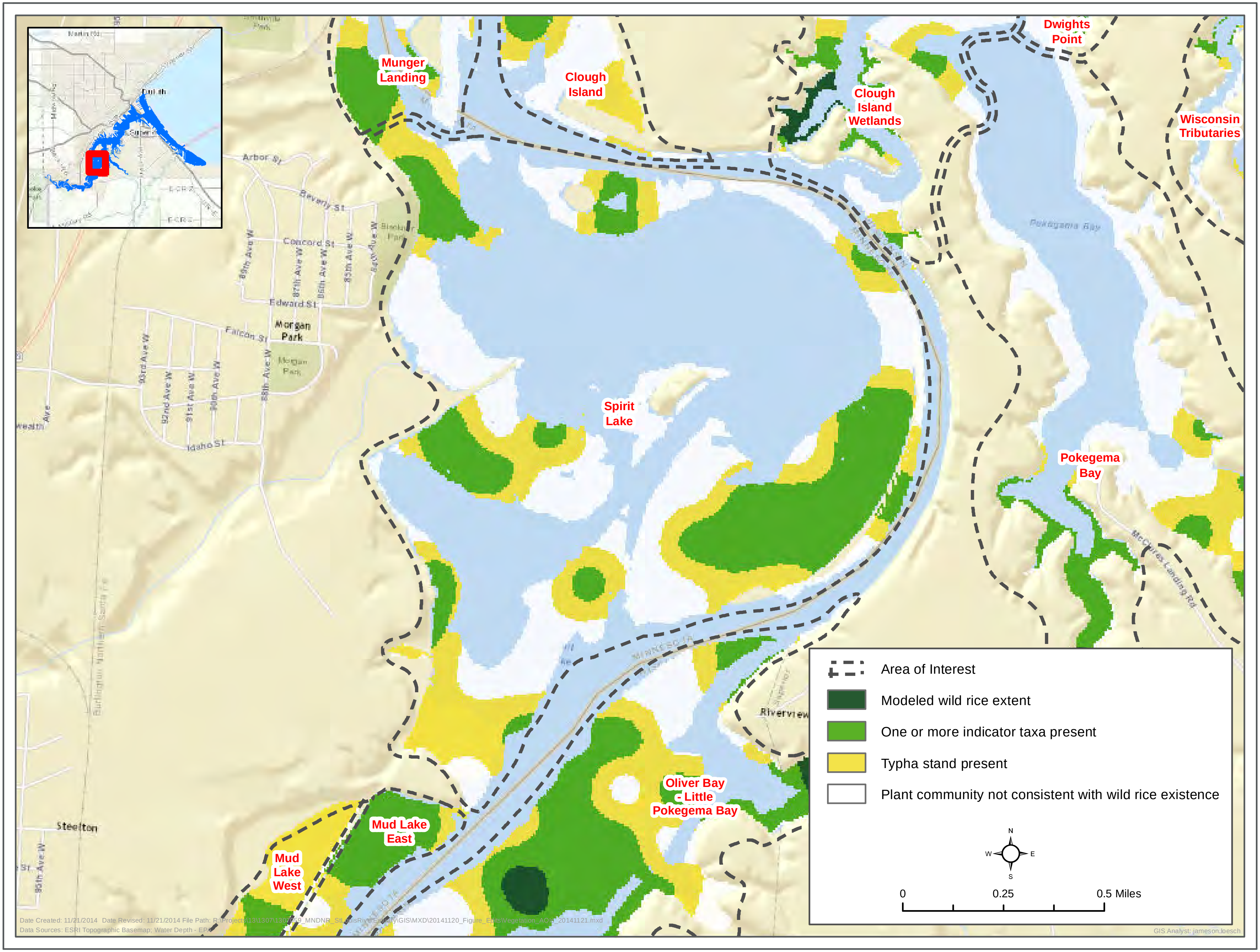

Photo Point 4

Wild Rice Restoration Opportunities and Strategies

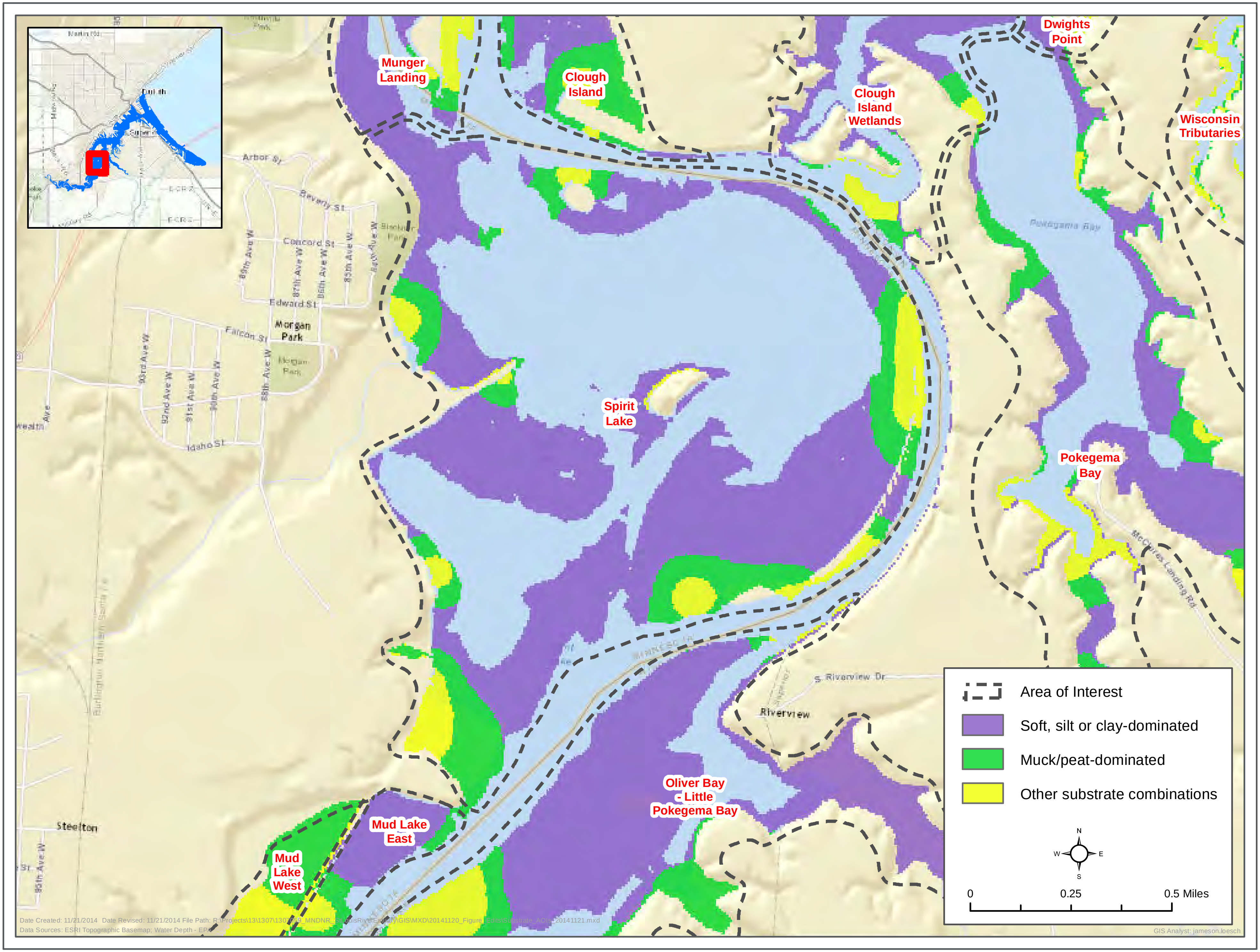
- Use vegetation mowing and seeding where floating and emergent vegetation is present in Kilchiss Meadow to establish wild rice stands.
- Use vegetation removal and thinning in the western portion of the area where cattail stands and floating mats are present to establish wild rice stands.

Wild Rice Restoration Limitations

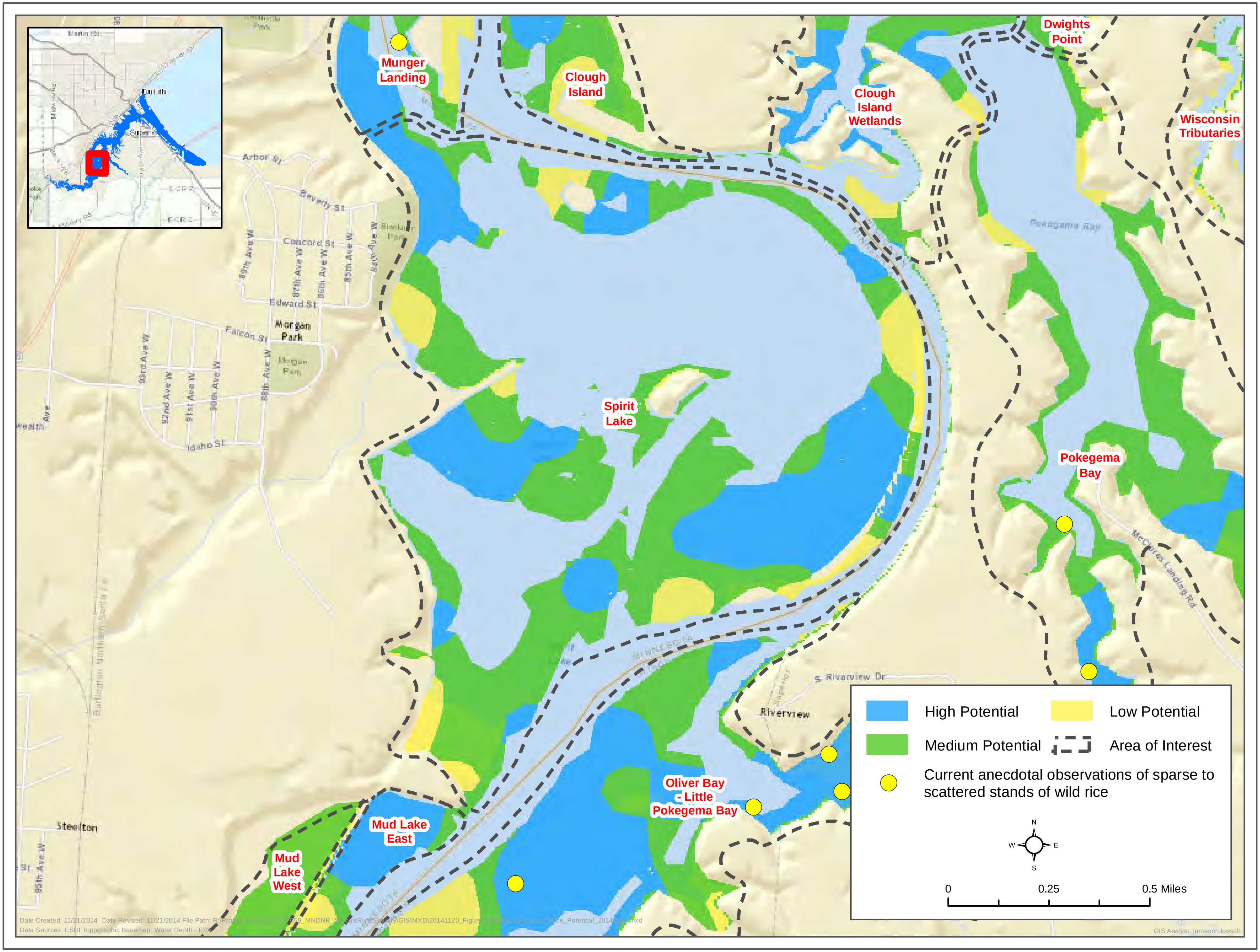
- Water depth.
- Contaminated sediment associated with the CERCLA (Superfund) site.



Munger Landing
Clough Island
Clough Island Wetlands
Dwights Point
Wisconsin Tributaries
Spirit Lake
Pokegema Bay
Oliver Bay - Little Pokegema Bay
Mud Lake East
Mud Lake West
Arbor St
Beverly St
Concord St
Edward St
Falcon St
Morgan Park
Idaho St
Steelton
Riverview
Pokegama Bay
Area of Interest
Modeled wild rice extent
One or more indicator taxa present
Typha stand present
Plant community not consistent with wild rice existence
N
W
E
S
0
0.25
0.5 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Vegetation_AOIs_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch

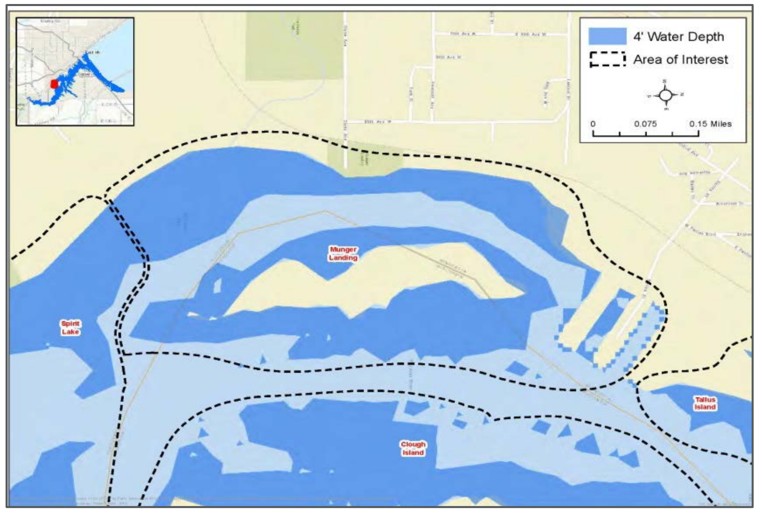


Munger Landing
Clough Island
Clough Island Wetlands
Dwights Point
Wisconsin Tributaries
Spirit Lake
Pokegema Bay
Oliver Bay - Little Pokegema Bay
Mud Lake East
Mud Lake West
Area of Interest
Soft, silt or clay-dominated
Muck/peat-dominated
Other substrate combinations
0
0.25
0.5 Miles
Morgan Park
Arbor St
Beverly St
Concord St
Edward St
Falcon St
Idaho St
Steelton
Riverview
S Riverview Dr
Pokegema Bay
McCuen Landing Rd
Duluth
Superior
Date Created: 11/21/2014 Date Revised: 11/21/2014
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch



Munger Landing
Clough Island
Clough Island Wetlands
Dwights Point
Wisconsin Tributaries
Spirit Lake
Pokegema Bay
Oliver Bay - Little Pokegema Bay
Mud Lake East
Mud Lake West
High Potential
Low Potential
Medium Potential
Area of Interest
Current anecdotal observations of sparse to scattered stands of wild rice
0
0.25
0.5 Miles
N
S
E
W
Arbor St
Beverly St
Concord St
Edward St
Falcon St
Idaho St
Morgan Park
Riverview
S Riverview Dr
Steelton
McCuen Landing Rd
Pokegama Bay
Burlington Northern Santa Fe

Munger Landing



Primary State
Minnesota

Subareas Included
None.

Wild Rice Restoration Acreage Potential
(Based on Site Selection Model)

Site Potential	Acres
High Potential	26
Medium Potential	18
Low Potential	28
Total Acres	72

Areas Description for Wild Rice Restoration
The Munger Landing area is a shallow side channel off the main St. Louis River channel with floating and emergent vegetation along the shoreline in western portion of the area. Remediation at the Superfund site upriver would impact wild rice restoration planning and efforts at Munger Landing. Current anecdotal observations of wild rice have been made in the area.

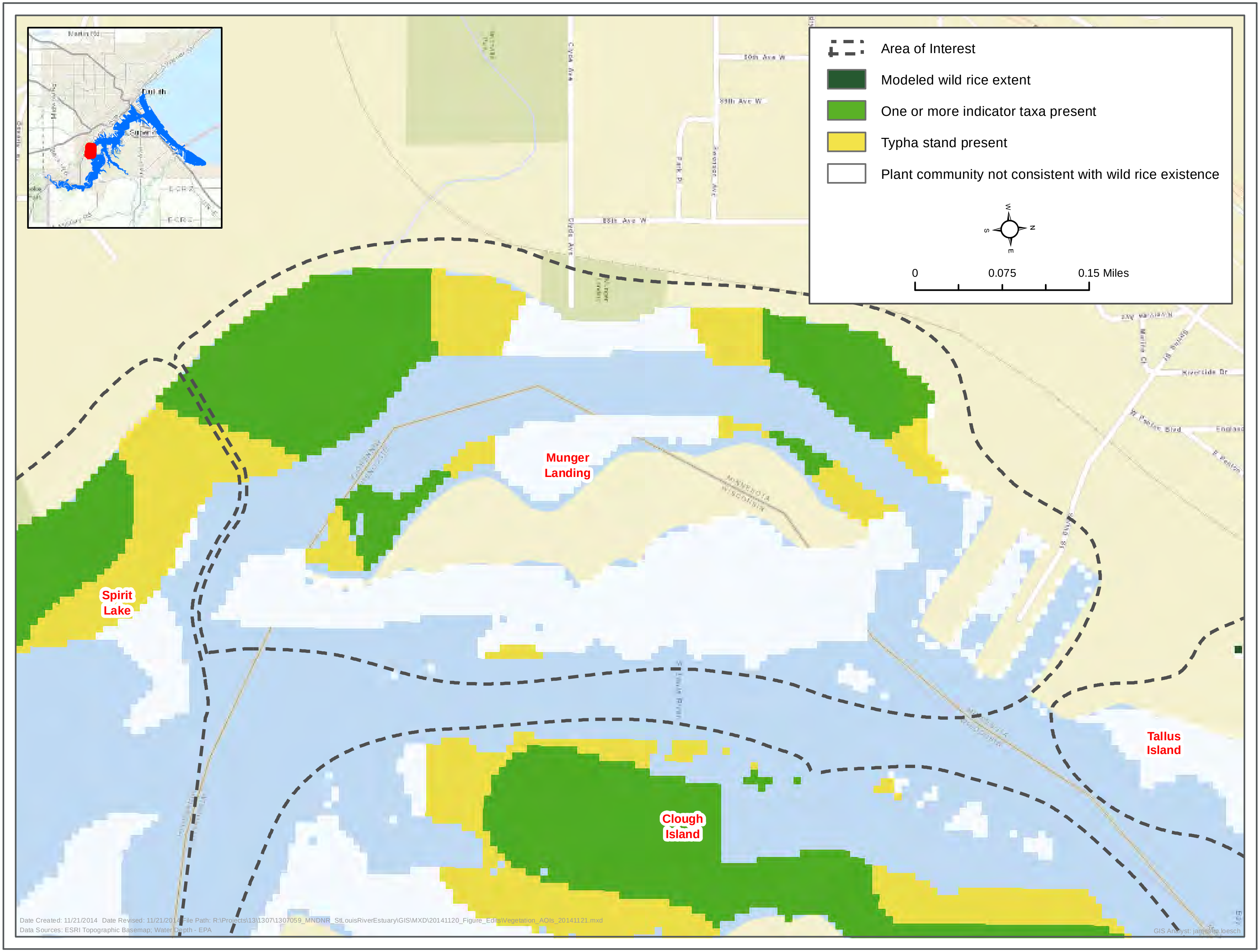
This area is currently undergoing a remedial investigation to determine the extent of contaminated sediments. Remedial activity is anticipated and it is hoped that wild rice restoration will be incorporated into any the remediation to restoration project implemented in this location.

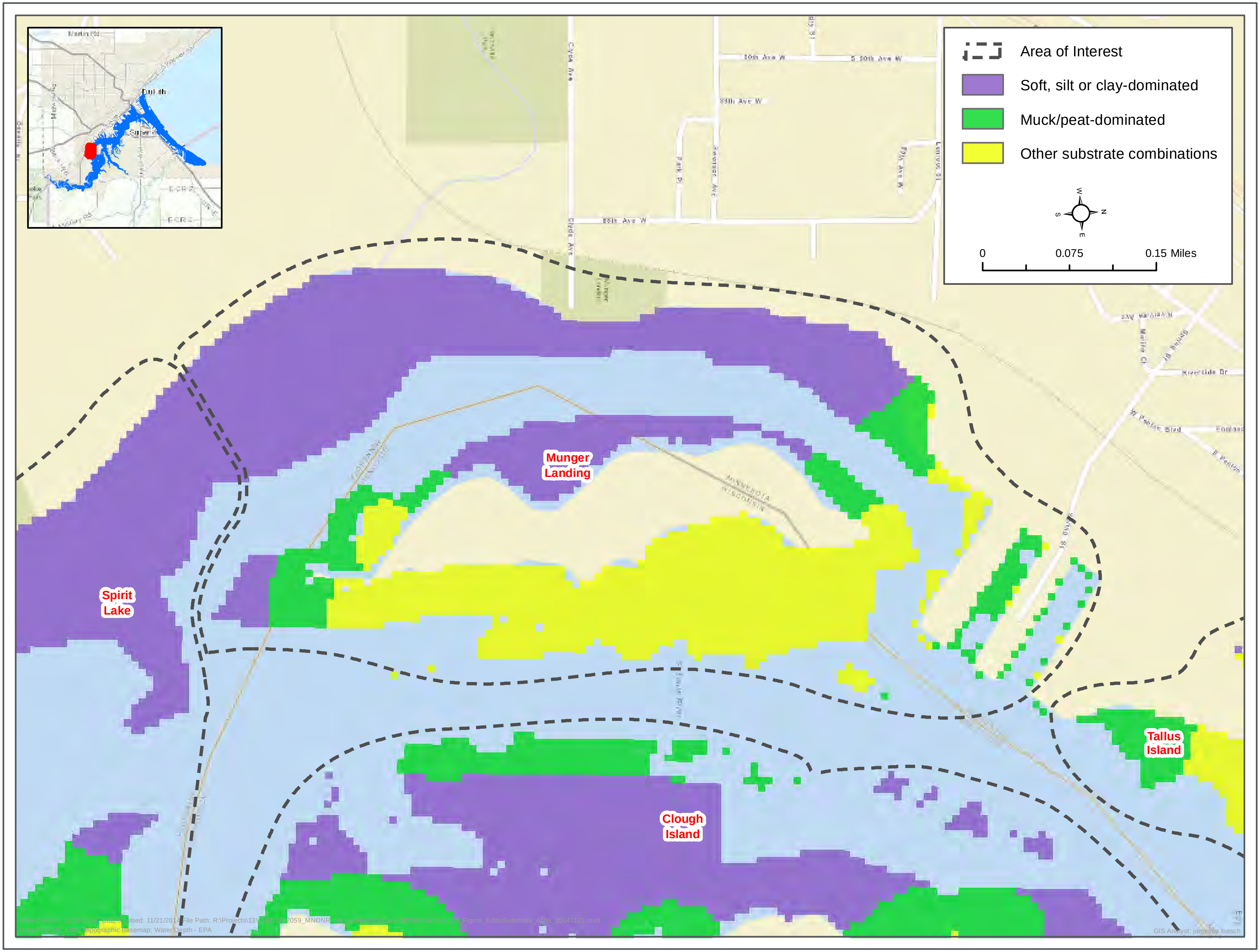
Representative Photos of the Area

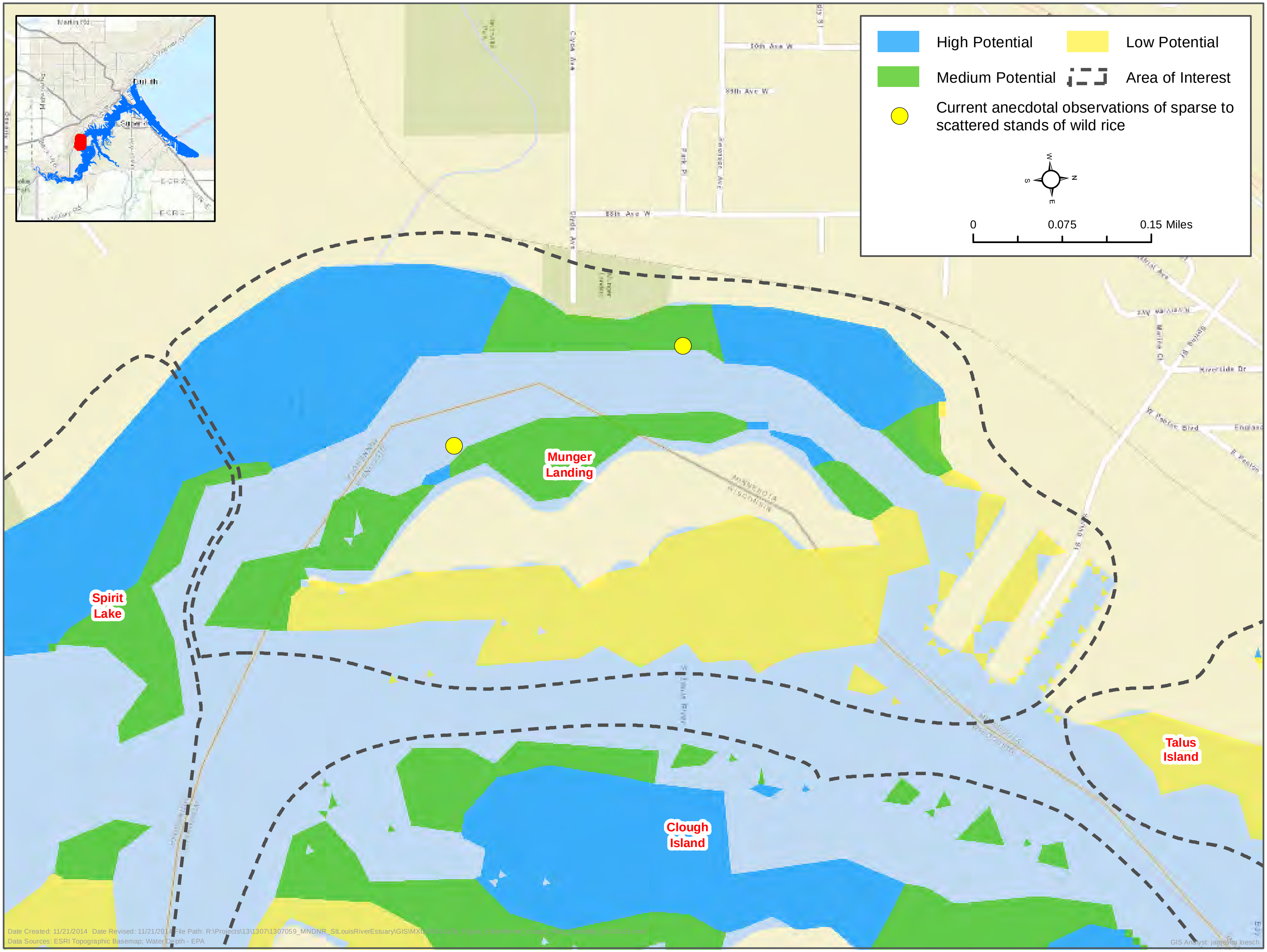
Photo Point 1

Wild Rice Restoration Opportunities and Strategies
- Use vegetation mowing and seeding where floating and emergent vegetation is to establish wild rice stands.

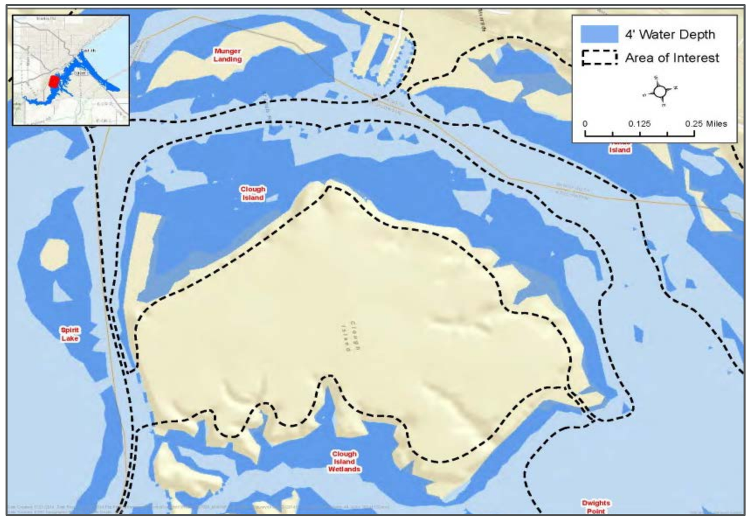
Wild Rice Restoration Limitations
- Contaminated sediments
- Proximity to Superfund site, contaminated sediments.


Area of Interest
Modeled wild rice extent
One or more indicator taxa present
Typha stand present
Plant community not consistent with wild rice existence
0
0.075
0.15 Miles
Munger Landing
Spirit Lake
Clough Island
Tallus Island
Duluth
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Vegetation_AOIs_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA


Area of Interest
Soft, silt or clay-dominated
Muck/peat-dominated
Other substrate combinations
0
0.075
0.15 Miles
Munger Landing
Spirit Lake
Clough Island
Tallus Island
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Substrate_AOIs_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch


High Potential
Low Potential
Medium Potential
Area of Interest
Current anecdotal observations of sparse to scattered stands of wild rice
0
0.075
0.15 Miles
Munger Landing
Spirit Lake
Clough Island
Talus Island
Duluth
Date Created: 11/21/2014 Date Revised: 11/21/2014
Data Sources: ESRI Topographic Basemap; Water Depth - EPA

Clough Island



Primary State
Wisconsin

Subareas Included
None.

Wild Rice Restoration Acreage Potential
(Based on Site Selection Model)

Site Potential	Acres
High Potential	45
Medium Potential	59
Low Potential	15
Total Acres	119

Areas Description for Wild Rice Restoration
The Clough Island area is the shallow and narrow band around the western half of Clough Island, adjacent to the main St. Louis River channel. Cattail stands and floating mats are present adjacent to the shore. Open water with a lack of floating and emergent vegetation is present throughout the majority of the area where water depths may be limiting plant growth.

Wild rice restoration in this area will be considered a stand-alone activity and not incorporated into any current or future restoration plans addressing other BUIs.

Representative Photos of the Area


Photo Point 1


Photo Point 2


Photo Point 3

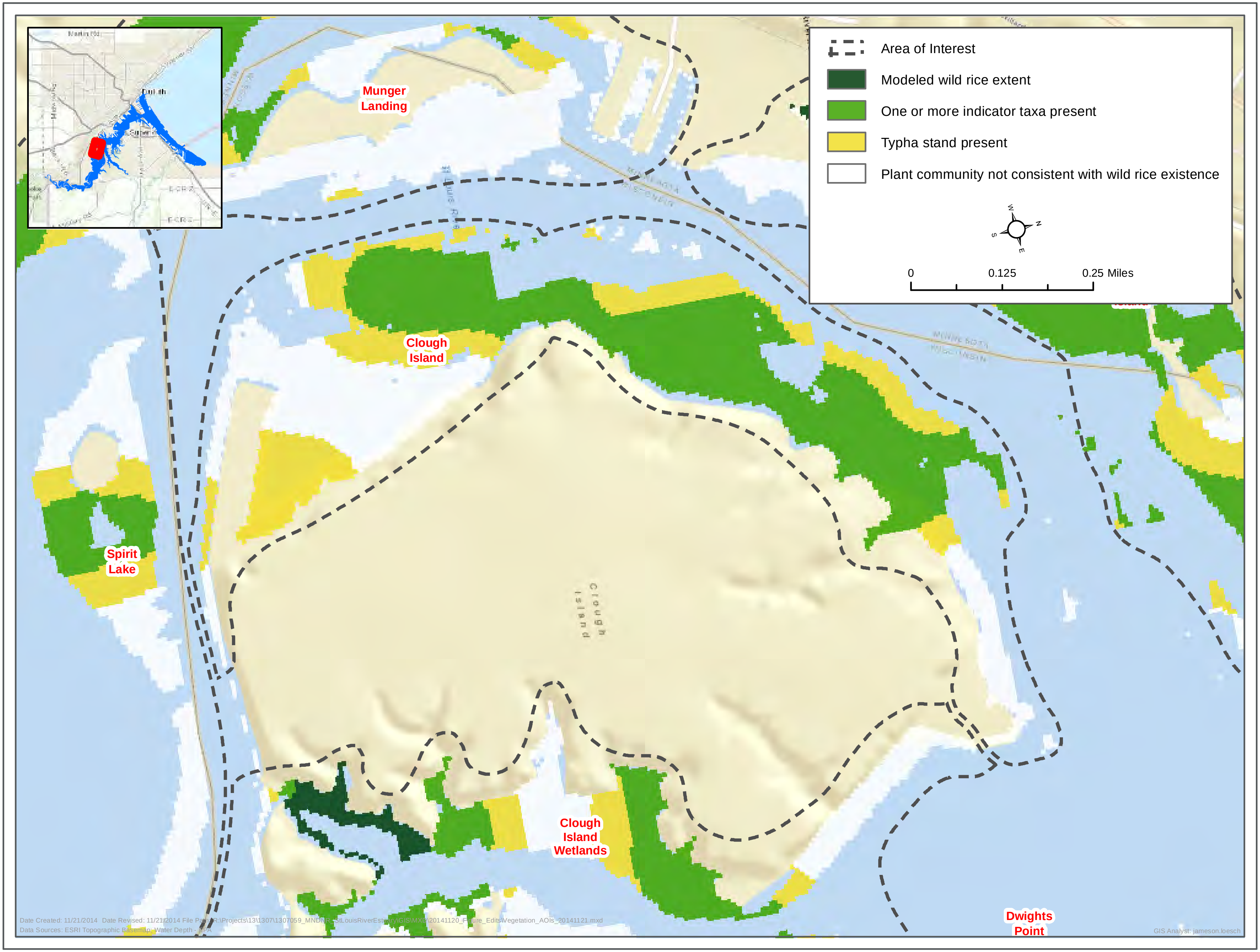

Photo Point 4

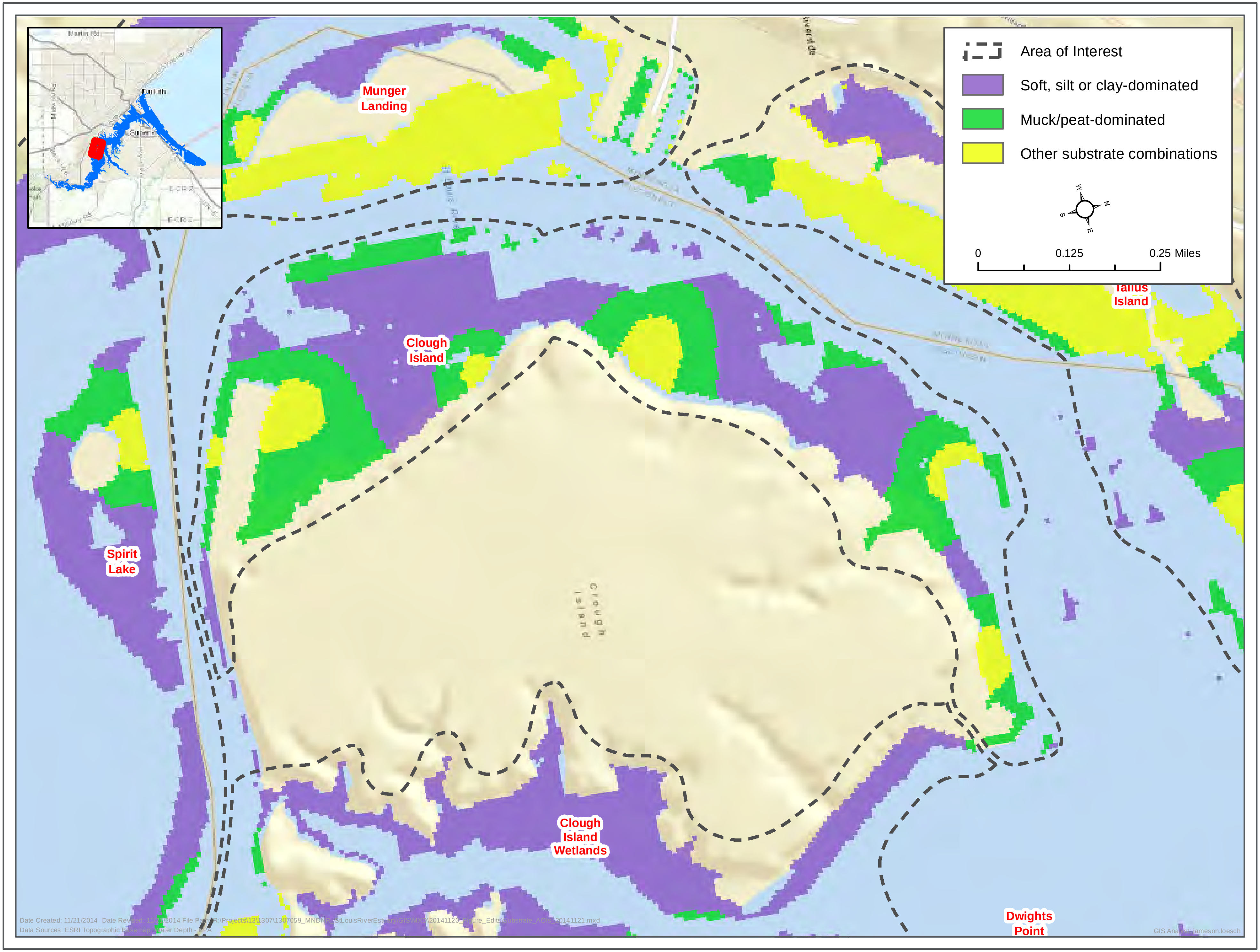
Wild Rice Restoration Opportunities and Strategies

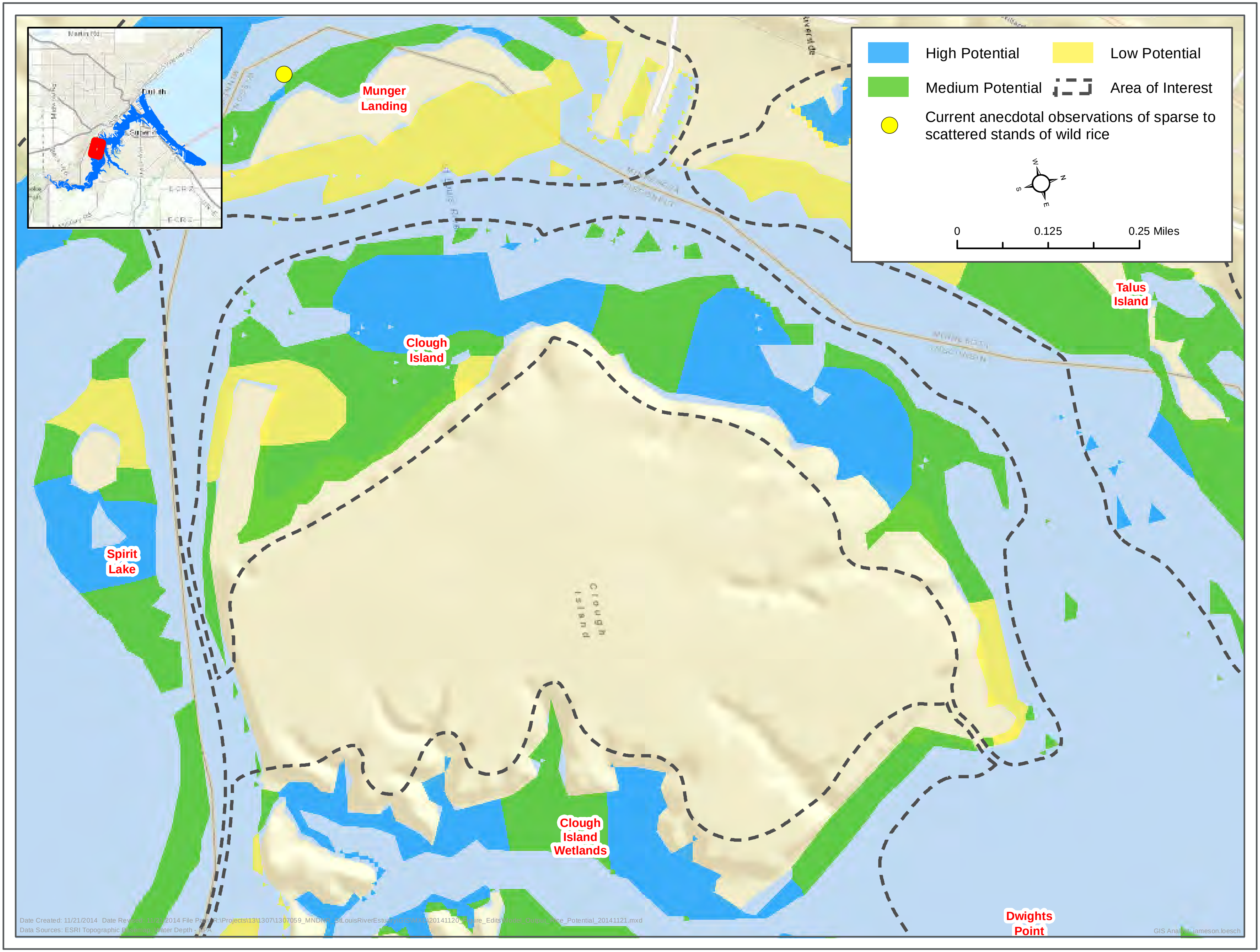
- Use vegetation removal and thinning along the shoreline where cattail stands and floating mats are present to establish wild rice stands.
- Seed and install exclosures to establish wild rice where depth allows and no existing floating or emergent vegetation is present.

Wild Rice Restoration Limitations

- Recreational boating along main river channel.
- Water depth.

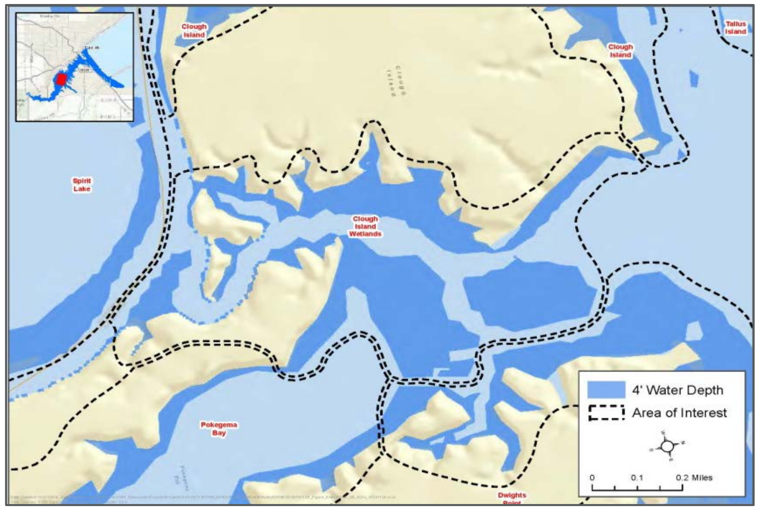

Munger Landing
Clough Island
Spirit Lake
Clough Island
Clough Island Wetlands
Dwights Point
Area of Interest
Modeled wild rice extent
One or more indicator taxa present
Typha stand present
Plant community not consistent with wild rice existence
0
0.125
0.25 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Vegetation_AOIs_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch


Area of Interest
Soft, silt or clay-dominated
Muck/peat-dominated
Other substrate combinations
0
0.125
0.25 Miles
Munger Landing
Clough Island
Spirit Lake
Tallus Island
Clough Island Wetlands
Dwights Point
Duluth
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Substrate_AOIs_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch



High Potential
Low Potential
Medium Potential
Area of Interest
Current anecdotal observations of sparse to scattered stands of wild rice
0
0.125
0.25 Miles
Munger Landing
Clough Island
Spirit Lake
Talus Island
Clough Island Wetlands
Dwights Point
Clough Island
Duluth
Date Created: 11/21/2014
Data Sources: ESRI Topographic

Clough Island Wetlands



Primary State
Wisconsin

Subareas Included
Devil's Elbow and Mosquito Island

Wild Rice Restoration Acreage Potential
(Based on Site Selection Model)

Site Potential	Acres
High Potential	37
Medium Potential	73
Low Potential	12
Total Acres	122

Areas Description for Wild Rice Restoration
The Clough Island Wetlands area is the portion of the estuary between the eastern side of Clough Island and mouth of Pokegama Bay. It is characterized by floating and emergent vegetation along with shoreline with portions of open water lacking vegetation. Cattail stands and floating mats are limited to small, scattered stands adjacent to the shoreline.

Wild rice restoration in this area will be considered a stand-alone activity and not incorporated into any current or future restoration plans addressing other BUIs.

Representative Photos of the Area


Photo Point 1


Photo Point 2

Photo Point 3

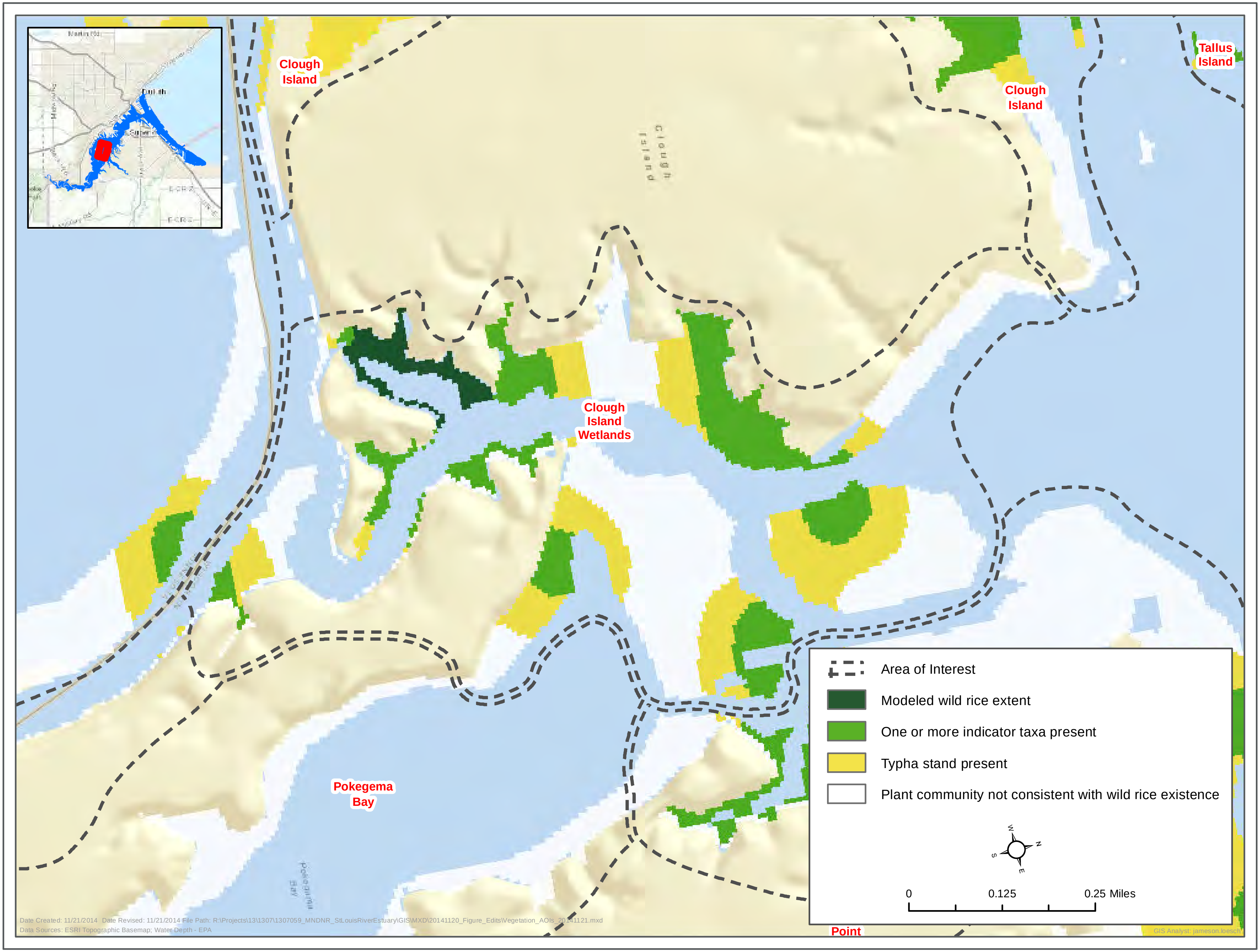
Photo Point 4

Wild Rice Restoration Opportunities and Strategies

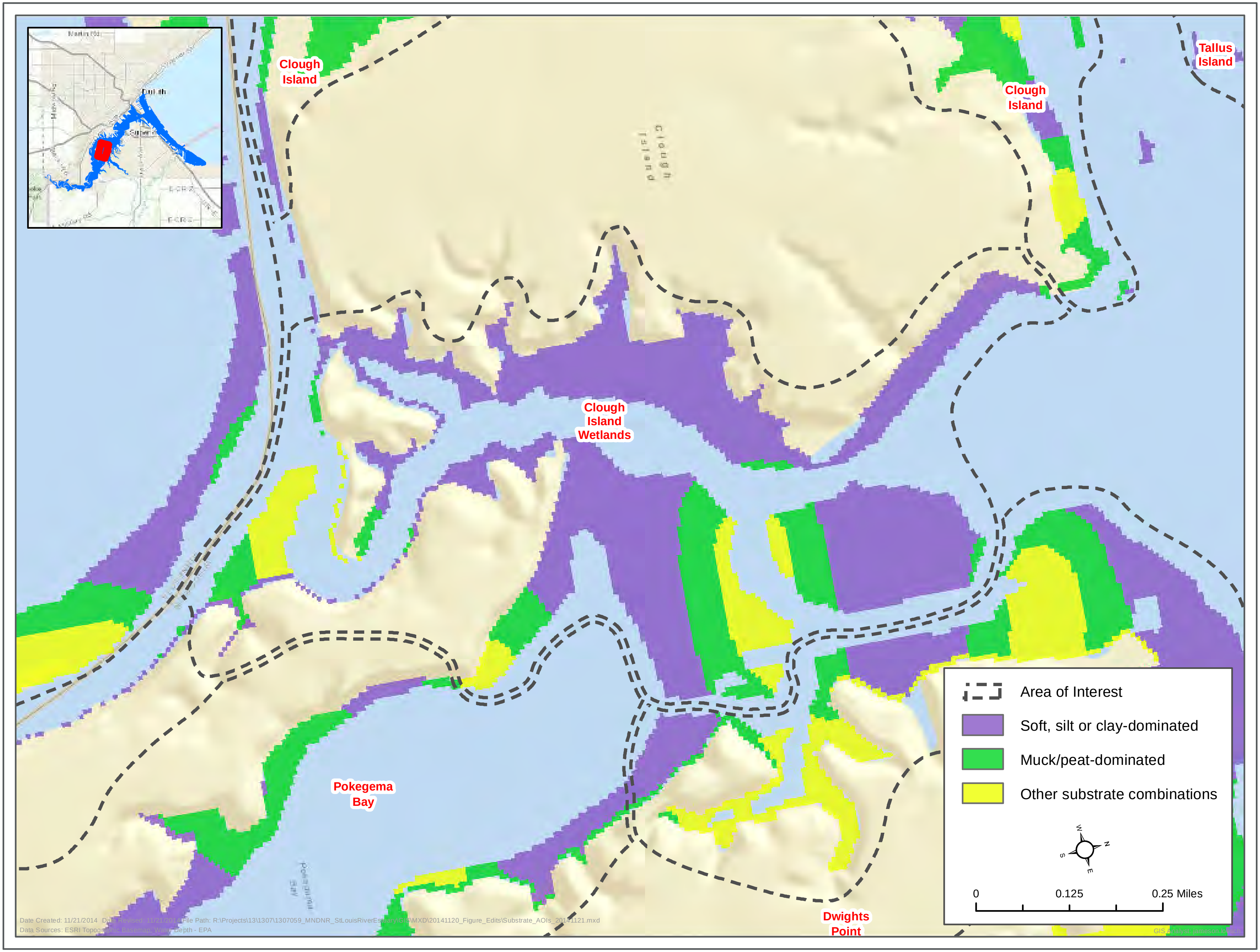
- Use vegetation mowing and seeding where floating and emergent vegetation is to establish wild rice stands.

Wild Rice Restoration Limitations

- Recreational boating.
- Water depth.



Clough Island
Clough Island
Tallus Island
Clough Island
Clough Island Wetlands
Pokegema Bay
Point
Area of Interest
Modeled wild rice extent
One or more indicator taxa present
Typha stand present
Plant community not consistent with wild rice existence
0
0.125
0.25 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Vegetation_AOIs_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch



Clough Island
Clough Island
Tallus Island
Clough Island
Clough Island Wetlands
Pokegema Bay
Dwights Point
Area of Interest
Soft, silt or clay-dominated
Muck/peat-dominated
Other substrate combinations
0
0.125
0.25 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Substrate_AOIs_20141121.mxd
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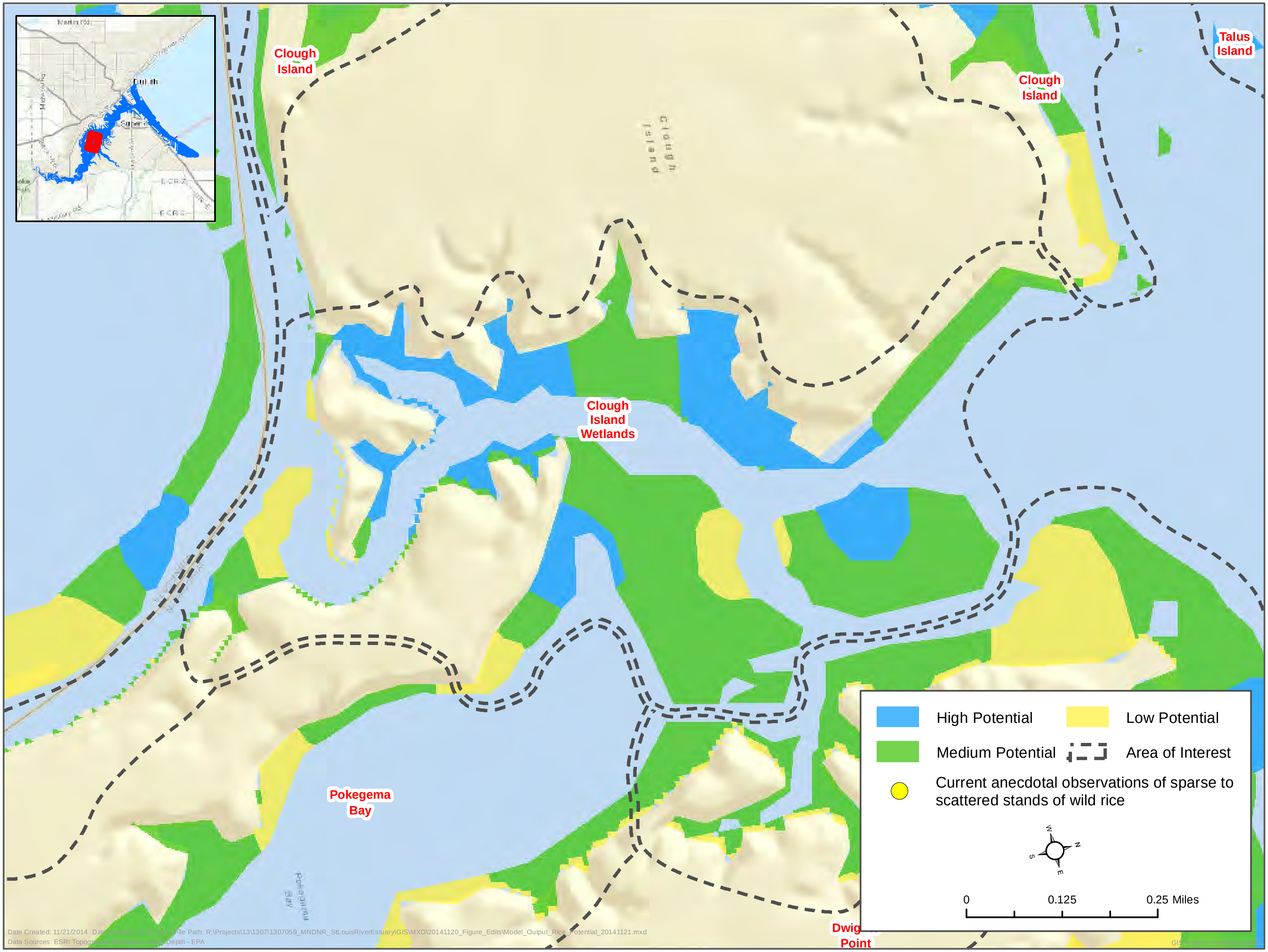

Clough Island
Clough Island
Talus Island
Clough Island
Clough Island Wetlands
Pokegema Bay
Pokegama Bay
Dwig... Point
Duluth
High Potential
Low Potential
Medium Potential
Area of Interest
Current anecdotal observations of sparse to scattered stands of wild rice
0
0.125
0.25 Miles

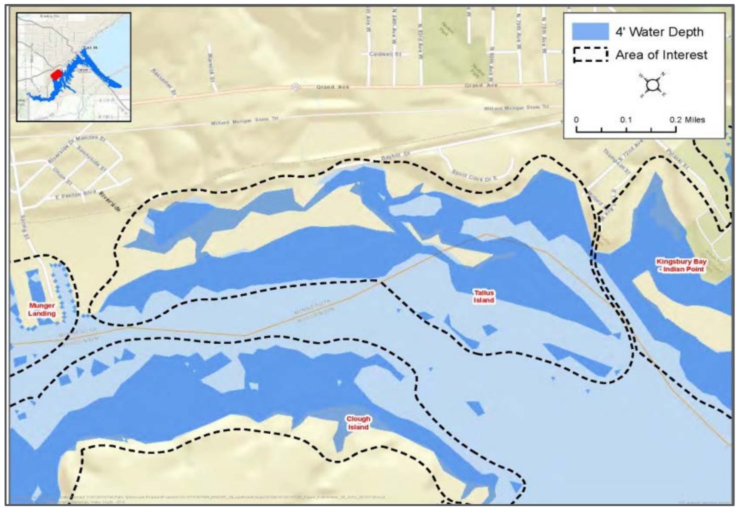
Tallus Island

Primary State
Minnesota

Subareas Included
None.

Wild Rice Restoration Acreage Potential
(Based on Site Selection Model)

Site Potential	Acres
High Potential	23
Medium Potential	46
Low Potential	28
Total Acres	86



Areas Description for Wild Rice Restoration
The Tallus Island area is shallow bay off the main St. Louis River channel. The area was the focus of a previous restoration project that involved dredging to remove accumulated sediment. Current anecdotal observations of wild rice have been made in several locations in the area.

Wild rice restoration in this area will be considered a stand-alone activity and not incorporated into any current or future restoration plans addressing other BUIs.

Representative Photos of the Area

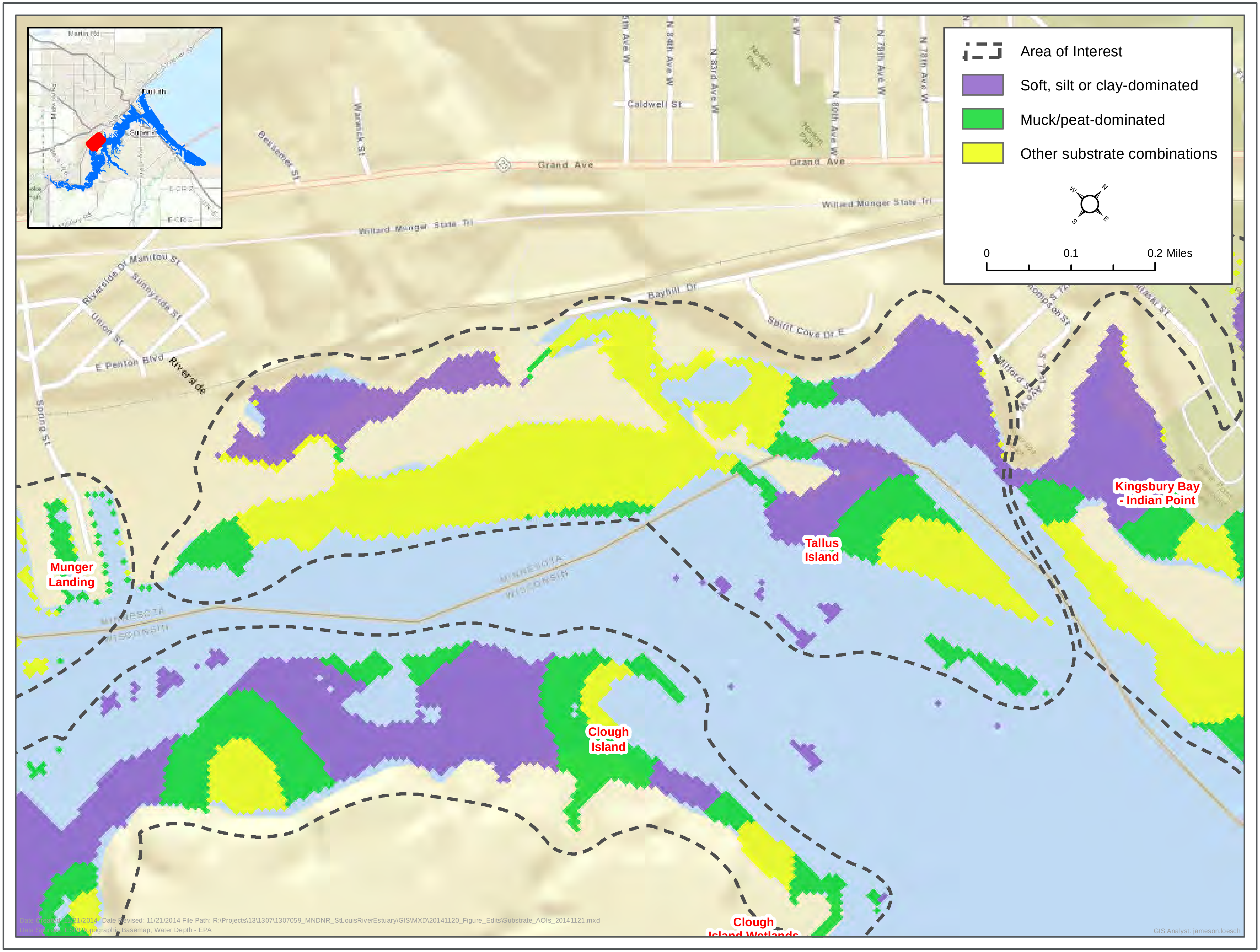

Photo Point 1


Photo Point 2

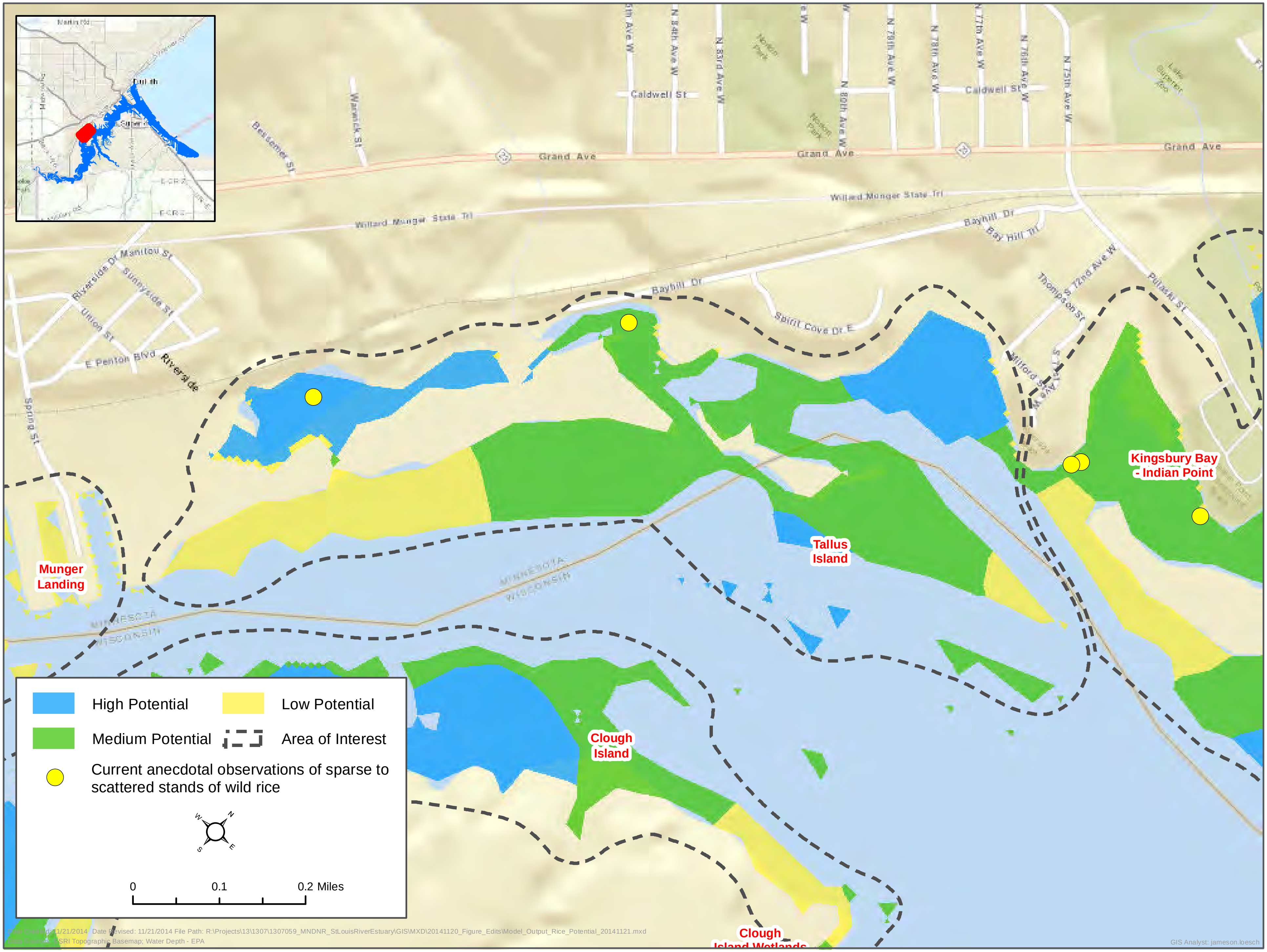
Wild Rice Restoration Opportunities and Strategies
- Seed and install exclosures to establish wild rice where depth allows and no existing floating or emergent vegetation is present.

Wild Rice Restoration Limitations
- Recreational boating.
- Water depth.

Area of Interest
Modeled wild rice extent
One or more indicator taxa present
Typha stand present
Plant community not consistent with wild rice existence
0
0.1
0.2 Miles
Duluth
Munger Landing
Clough Island
Tallus Island
Kingsbury Bay - Indian Point
Grand Ave
Willard Munger State Trl
Bayhill Dr
Coleman St
Caldwell St
N 85th Ave W
N 84th Ave W
N 83rd Ave W
N 81st Ave W
Norton Park
Warwick St
Bessemer St
Manitou St
Riverside Dr
Sunnyside St
Union St
E Penton Blvd
Riverside
Spring St
Spirit Cove Dr E
Bay Hill Trl
Thompson St
S 72nd Ave W
Milford St
Pulaski St
MINNESOTA
WISCONSIN
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Vegetation_AOIs_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch



Area of Interest
Soft, silt or clay-dominated
Muck/peat-dominated
Other substrate combinations
0
0.1
0.2 Miles
Munger Landing
Tallus Island
Kingsbury Bay - Indian Point
Clough Island
Clough Island Wetlands
Grand Ave
Willard Munger State Trl
Bayhill Dr
Spirit Cove Dr E
Caldwell St
Riverside
E Penton Blvd
MINNESOTA
WISCONSIN
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Substrate_AOIs_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch



Kingsbury Bay - Indian Point
Tallus Island
Munger Landing
Clough Island
Clough Island Wetlands
Grand Ave
Willard Munger State Trl
Bayhill Dr
Caldwell St
Spirit Cove Dr E
MINNESOTA
WISCONSIN
High Potential
Low Potential
Medium Potential
Area of Interest
Current anecdotal observations of sparse to scattered stands of wild rice
0
0.1
0.2 Miles
GIS Analyst: jameson.loesch

Kingsbury Bay – Indian Point Bay

Primary State
Minnesota

Subareas Included
None.

Wild Rice Restoration Acreage Potential
(Based on Site Selection Model)

Site Potential	Acres
High Potential	19
Medium Potential	53
Low Potential	17
Total Acres	89

Areas Description for Wild Rice Restoration
The Kingsbury Bay – Indian Point Bay area is a series of two shallow bays on the Minnesota-side of the estuary. Both bays have an extensive open water component at their mouths. Cattails and floating mats become more dominant towards the interior of each bays. Current anecdotal observations of wild rice have been made at several locations in the area.

There is a current restoration plan for Kingsbury Bay that addresses an existing BUI. Wild rice restoration in this area would need to be integrated during the final plan development.

Representative Photos of the Area


Photo Point 1

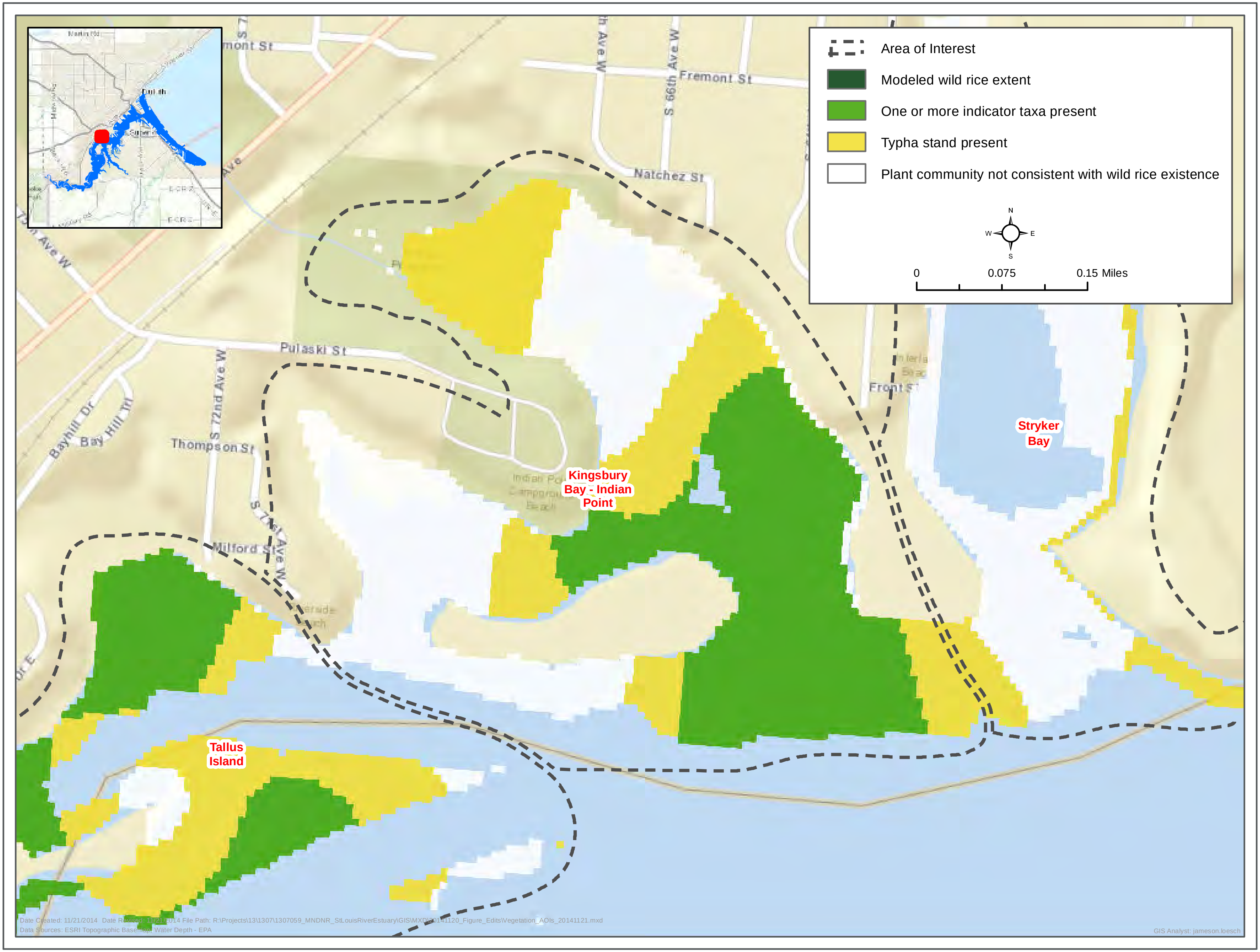

Photo Point 2

Wild Rice Restoration Opportunities and Strategies

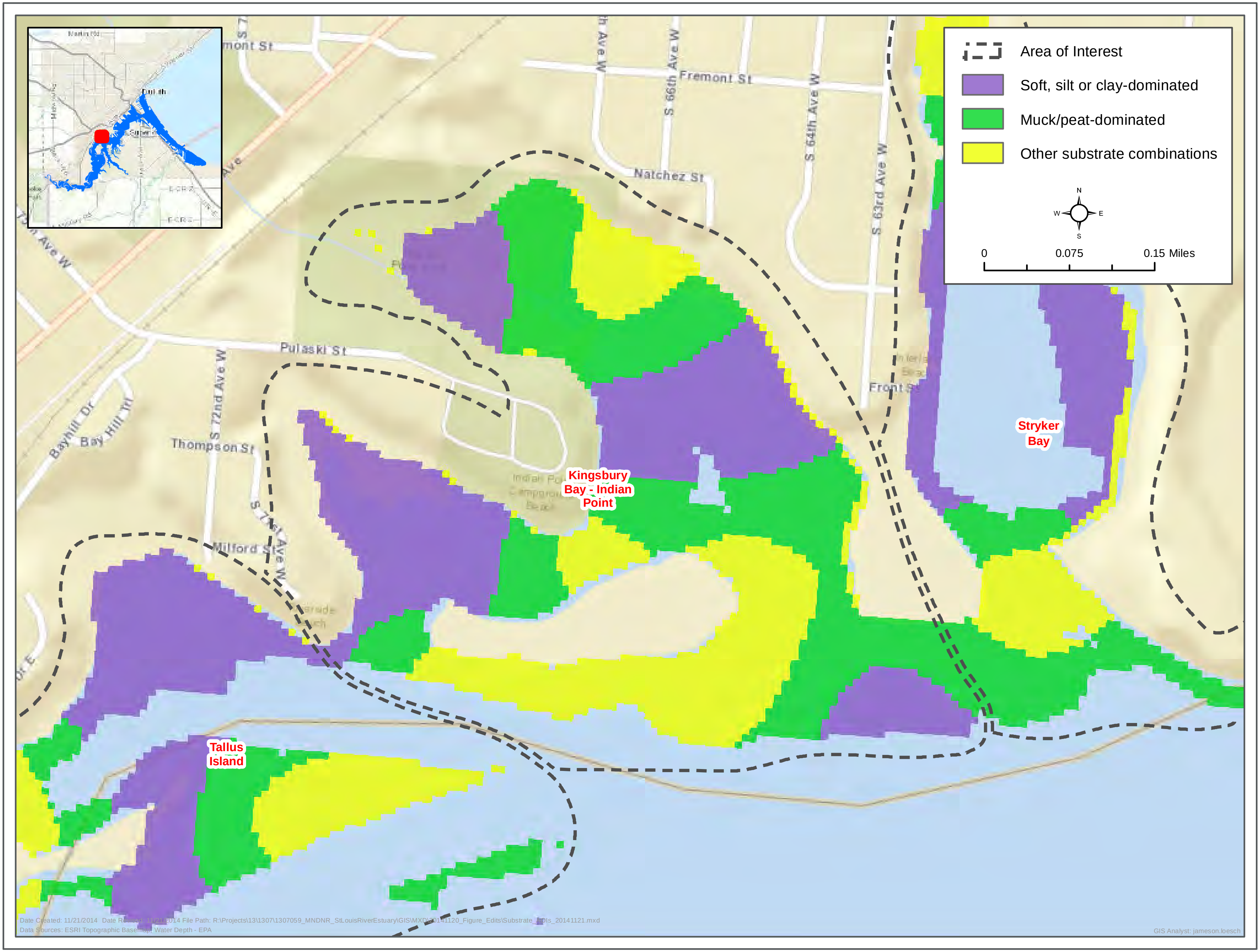
- Use vegetation removal and thinning within each bay where cattail stands and floating mats are present to establish wild rice stands.
- Seed and install exclosures to establish wild rice where depth allows and no existing floating or emergent vegetation is present.

Wild Rice Restoration Limitations

- Invasive species.
- Recreational boating.



Area of Interest
Modeled wild rice extent
One or more indicator taxa present
Typha stand present
Plant community not consistent with wild rice existence
N
W
E
S
0
0.075
0.15 Miles
Kingsbury Bay - Indian Point
Stryker Bay
Tallus Island
Fremont St
Natchez St
Pulaski St
Thompson St
Milford St
S 72nd Ave W
S 66th Ave W
Bayhill Dr
Front St
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Vegetation_AOIs_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch



Area of Interest
Soft, silt or clay-dominated
Muck/peat-dominated
Other substrate combinations
N
W
E
S
0
0.075
0.15 Miles
Stryker Bay
Kingsbury Bay - Indian Point
Tallus Island
Duluth
Fremont St
Natchez St
Pulaski St
Thompson St
Milford St
Front St
Bay Hill Trl
Bayhill Dr
S 72nd Ave W
S 71st Ave W
S 66th Ave W
S 64th Ave W
S 63rd Ave W
GIS Analyst: jameson.loesch


High Potential
Low Potential
Medium Potential
Area of Interest
Current anecdotal observations of sparse to scattered stands of wild rice
N
S
W
E
0
0.075
0.15 Miles
Kingsbury Bay - Indian Point
Stryker Bay
Talus Island
Fremont St
Natchez St
Pulaski St
Thompson St
Milford St
Front St
Bayhill Dr
Bay Hill Trl
S 72nd Ave W
S 71st Ave W
S 66th Ave W
S 64th Ave W
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Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch

Stryker Bay

Primary State
Minnesota

Subareas Included
None.

Wild Rice Restoration Acreage Potential
(Based on Site Selection Model)

Site Potential	Acres
High Potential	5
Medium Potential	42
Low Potential	32
Total Acres	79

Areas Description for Wild Rice Restoration

The Stryker Bay area consists of a bay and two slips. All three locations have been remediated and restored as part of the St. Louis River Interlake/Duluth Tar Superfund process. Stryker Bay has retained most of its physical characteristics, while the westernmost slip has been greatly reduced in depth and the eastern-most slip has been slightly reduced in depth and its outline has been altered. The back portion of Stryker Bay and the western-most slip provide the greatest opportunity for wild rice restoration.

Any further restoration in this area would have to be a standalone project.

Representative Photos of the Area


Photo Point 1


Photo Point 2

Photo Point 3

Photo Point 4

Wild Rice Restoration Opportunities and Strategies

- Use vegetation removal and thinning in the back portion of Stryker Bay and the western-most slip to establish wild rice stands.
- Seed and install exclosures to establish wild rice where depth allows and no existing floating or emergent vegetation is present.

Wild Rice Restoration Limitations

- Status as a remediated Superfund Site.
- Industrial land use adjacent to the slips.
- Natural water depth and substrate characteristics.


Area of Interest
Modeled wild rice extent
One or more indicator taxa present
Typha stand present
Plant community not consistent with wild rice existence
N
W
E
S
0
0.125
0.25 Miles
Kingsbury Bay - Indian Point
Stryker Bay
Grassy Point
Billings Park
St Louis River
MINNESOTA
WISCONSIN
Waseca St
Waseca Industrial Rd
Raleigh St
Redruth St
Fremont St
Duluth
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Vegetation_AOIs_20141121.mxd
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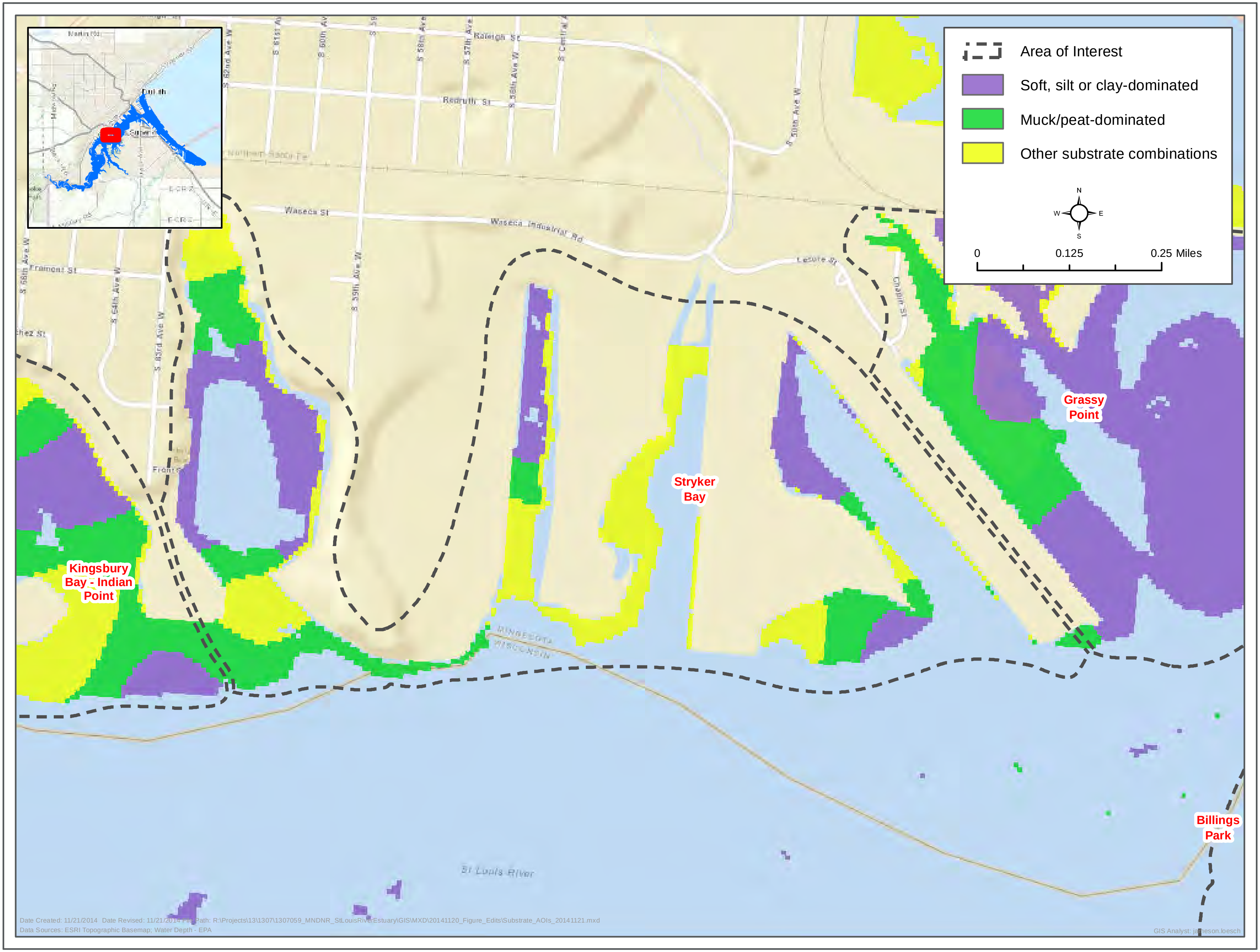


Area of Interest
Soft, silt or clay-dominated
Muck/peat-dominated
Other substrate combinations
N
W
E
S
0
0.125
0.25 Miles
Grassy Point
Stryker Bay
Kingsbury Bay - Indian Point
Billings Park
St Louis River
Duluth
Raleigh St
Redruth St
Waseca St
Waseca Industrial Rd
Fremont St
Lesure St
Minnesota
Wisconsin
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Substrate_AOIs_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch

Grassy Point
Stryker Bay
Kingsbury Bay - Indian Point
St Louis River
Waseca St
Waseca Industrial Rd
Raleigh St
Redruth St
Fremont St
Front St
Minnesota
Wisconsin
Duluth
High Potential
Low Potential
Medium Potential
Area of Interest
Current anecdotal observations of sparse to scattered stands of wild rice
N
E
S
W
0
0.125
0.25 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Model_Output_Rice_Potential_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch

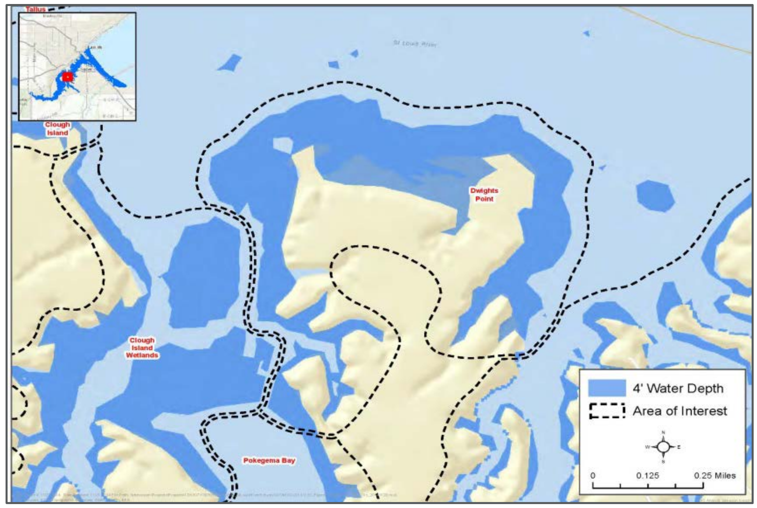
Dwight's Point

Primary State
Wisconsin

Subareas Included
None.

Wild Rice Restoration Acreage Potential
(Based on Site Selection Model)

Site Potential	Acres
High Potential	8
Medium Potential	78
Low Potential	52
Total Acres	138



Areas Description for Wild Rice Restoration
The Dwight's Point area is the portion of the estuary between the mouth of Pokegama Bay and the Wisconsin tributaries. It is characterized by patches of floating and emergent vegetation along the shoreline with portions of open water lacking vegetation. Cattail stands and floating mats are present along the northern and eastern shorelines.

Wild rice restoration in this area will be considered a stand-alone activity and not incorporated into any current or future restoration plans addressing other BUIs.

Representative Photos of the Area


Photo Point 1


Photo Point 2


Photo Point 3

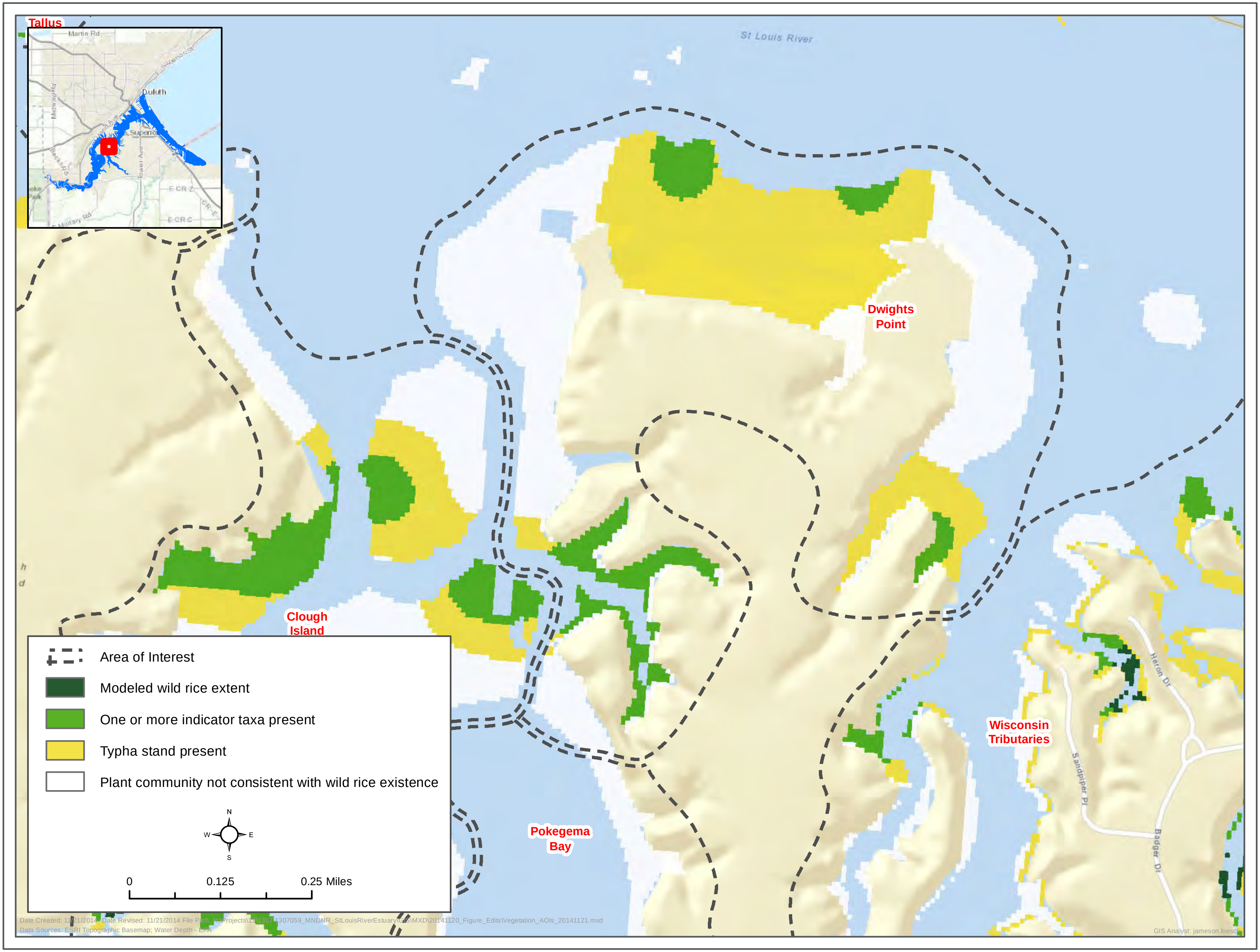

Photo Point 4

Wild Rice Restoration Opportunities and Strategies

- Use vegetation removal and thinning along the northern shoreline where cattail stands and floating mats are present to establish wild rice stands.
- Seed and install exclosures to establish wild rice where depth allows and no existing floating or emergent vegetation is present.

Wild Rice Restoration Limitations

- Water depth.
- Recreational boating.


Tallus
St Louis River
Dwights Point
Clough Island
Pokegema Bay
Wisconsin Tributaries
Area of Interest
Modeled wild rice extent
One or more indicator taxa present
Typha stand present
Plant community not consistent with wild rice existence
N
W
E
S
0
0.125
0.25 Miles
Duluth
Superior
Martin Rd
Heron Dr
Sandpiper Pl
Badger Dr
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Vegetation_AOIs_20141121.mxd
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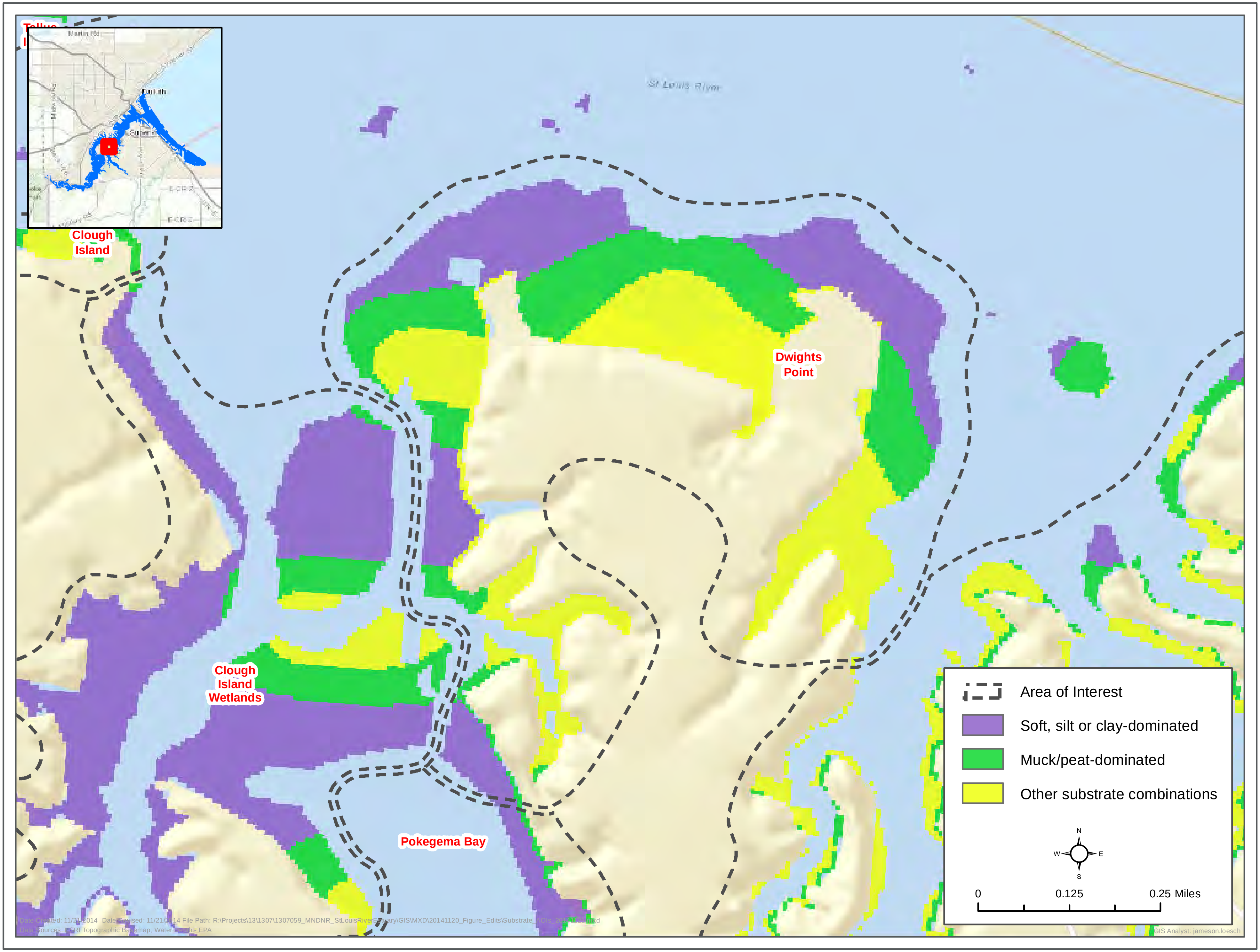
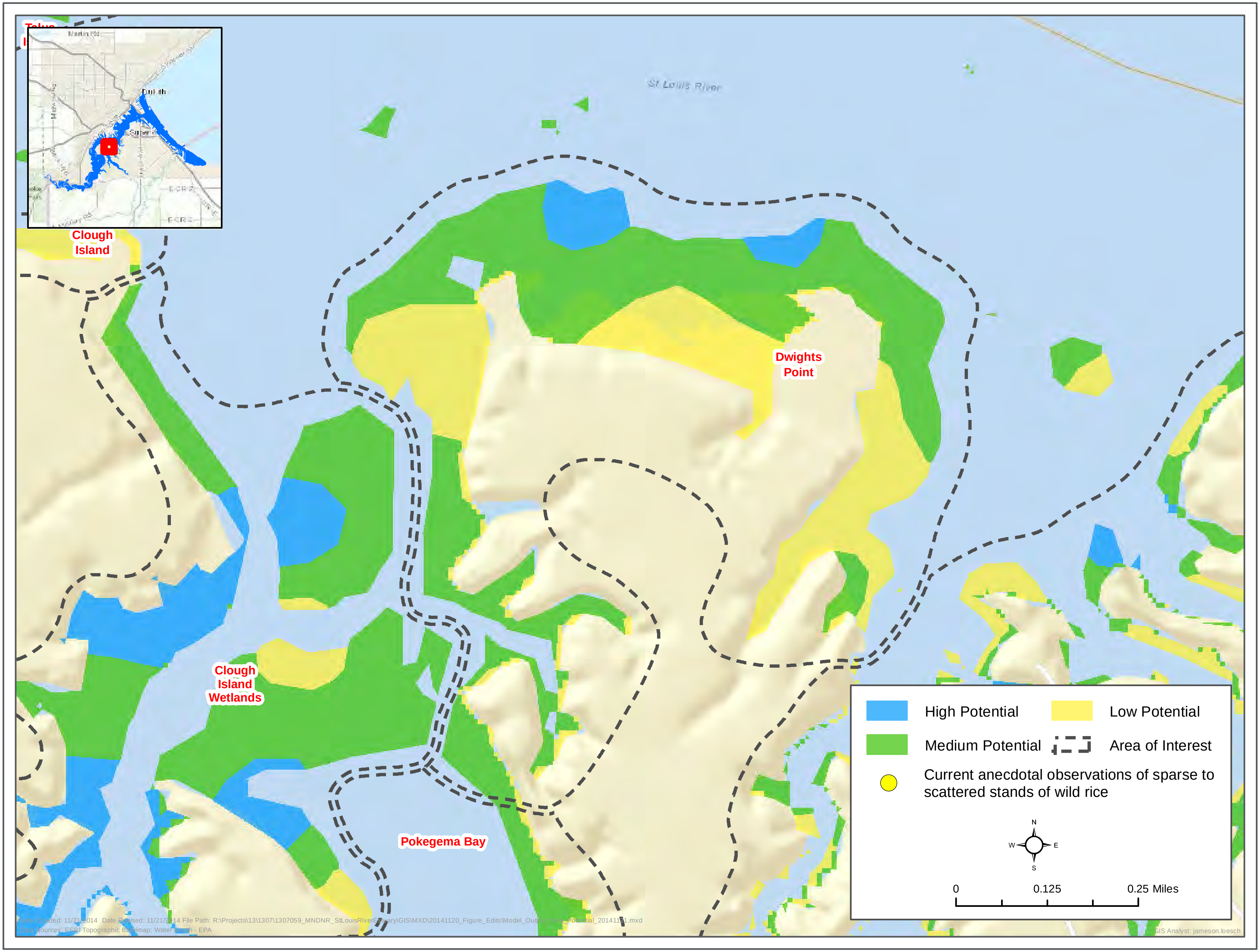
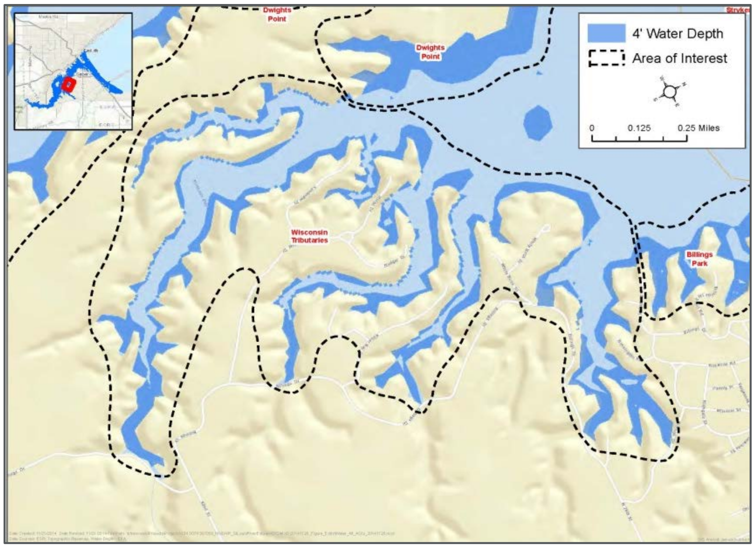
GIS Analyst: jameson.loesch


St Louis River
Clough Island
Dwights Point
Clough Island Wetlands
Pokegema Bay
Duluth
Area of Interest
Soft, silt or clay-dominated
Muck/peat-dominated
Other substrate combinations
N
W
E
S
0
0.125
0.25 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Substrate_AOIs
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch



St Louis River
Clough Island
Dwights Point
Clough Island Wetlands
Pokegema Bay
High Potential
Low Potential
Medium Potential
Area of Interest
Current anecdotal observations of sparse to scattered stands of wild rice
N
S
E
W
0
0.125
0.25 Miles
Duluth
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Model_Output_Rice_Potential_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch

Wisconsin Tributaries



Primary State
Wisconsin

Subareas Included
Kimball's Bay, Kilner Bay, Kelly Bay, and Chipmunk Bay

Wild Rice Restoration Acreage Potential
(Based on Site Selection Model)

Site Potential	Acres
High Potential	13
Medium Potential	62
Low Potential	23
Total Acres	98

Areas Description for Wild Rice Restoration
The Wisconsin Tributaries area is a series of four shallow, narrow bays where small tributaries or drainages enter the estuary. They are characterized by wooded, steep slopes surround the narrow bays. Each bay is primary composed of open water with limited floating and emergent vegetation that increases distance back into the bays. Cattail stands and floating mats are limited.

Wild rice restoration in this area will be considered a stand-alone activity and not incorporated into any current or future restoration plans addressing other BUIs.

Representative Photos of the Area


Photo Point 1


Photo Point 2


Photo Point 3


Photo Point 4

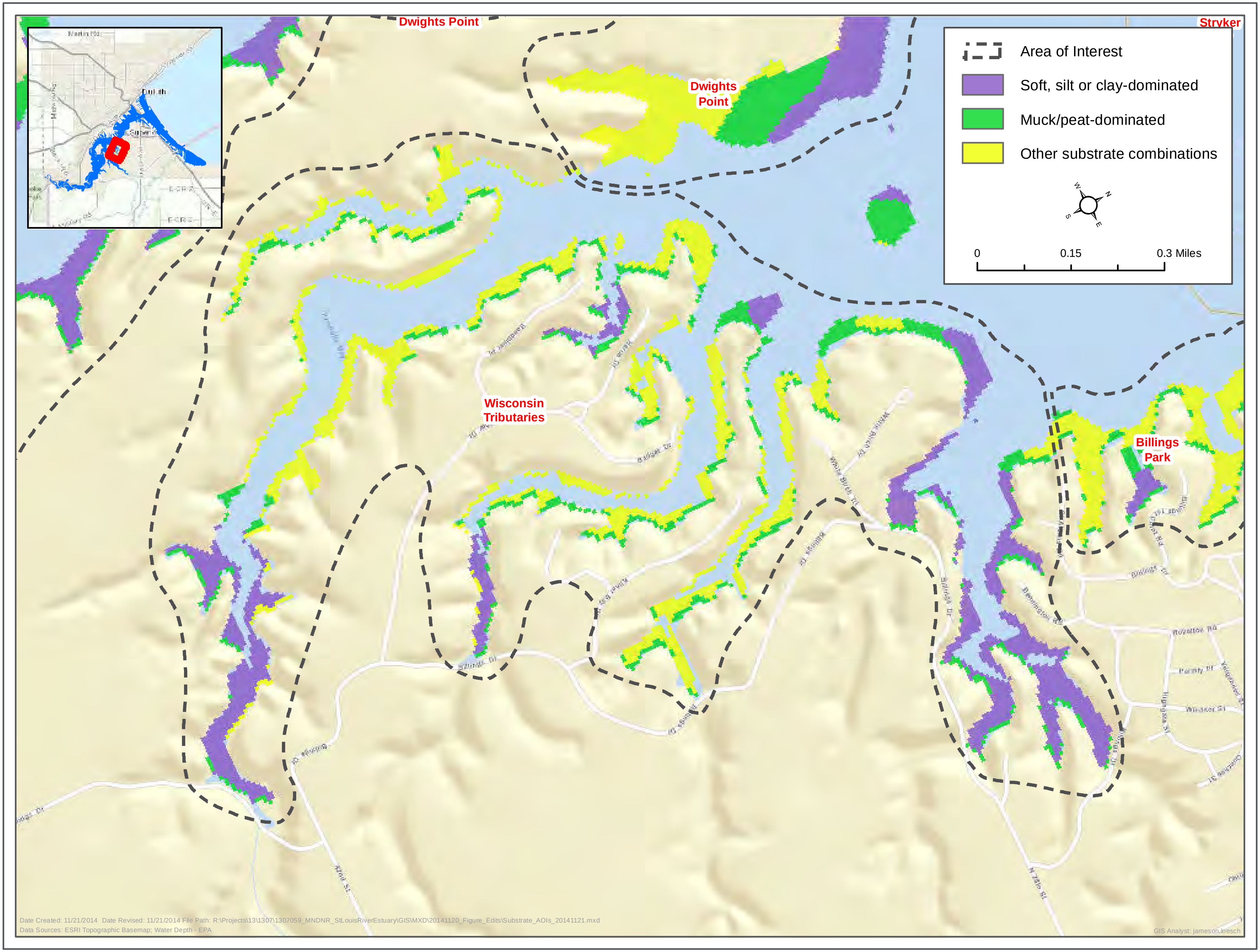
Wild Rice Restoration Opportunities and Strategies

- Use vegetation mowing and seeding where floating and emergent vegetation is to establish wild rice stands.
- Seed and install exclosures to establish wild rice where depth allows and no existing floating or emergent vegetation is present.

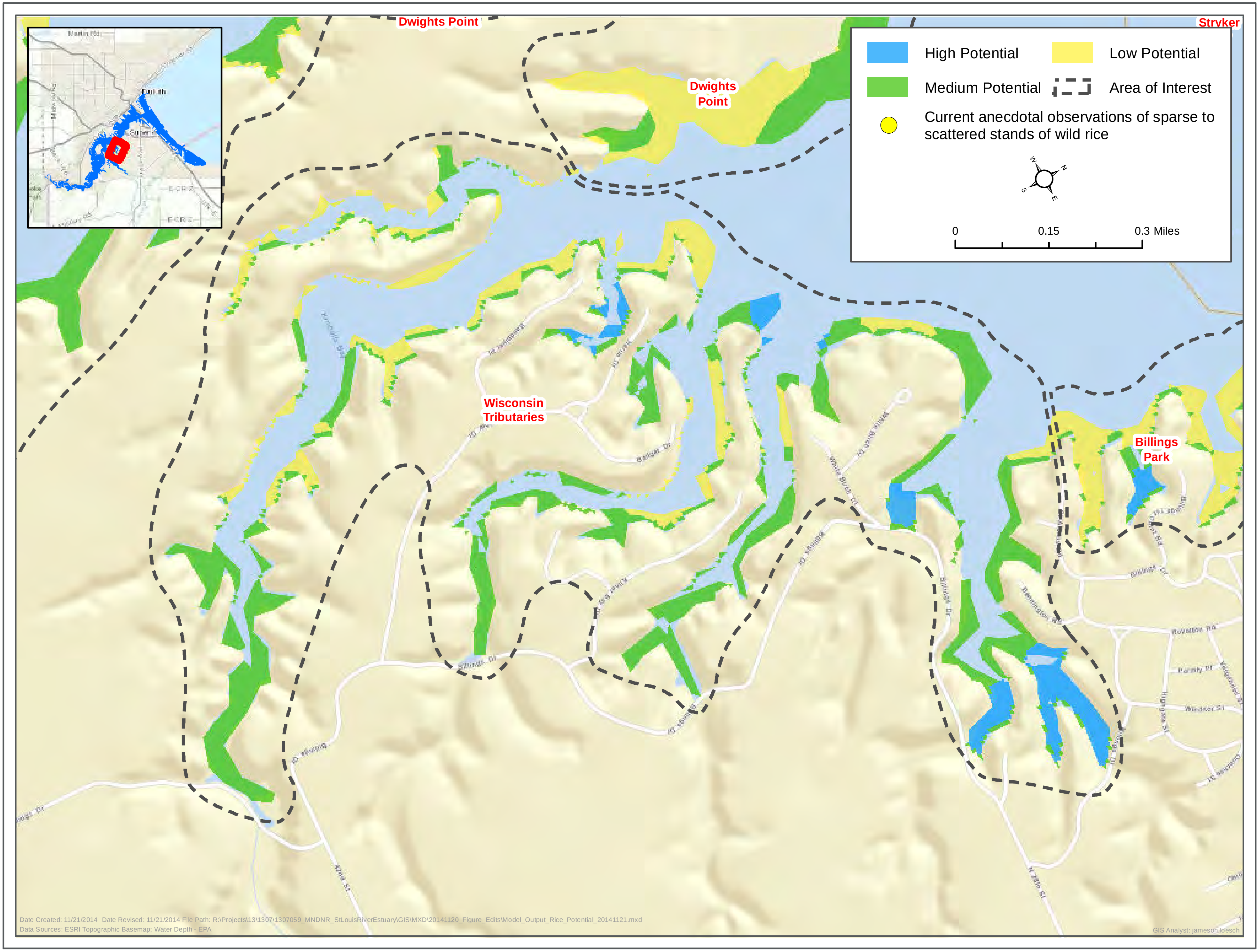
Wild Rice Restoration Limitations

- Water depth.
- Small area for restoration.

Dwights Point
Dwights Point
Wisconsin Tributaries
Billings Park
Area of Interest
Modeled wild rice extent
One or more indicator taxa present
Typha stand present
Plant community not consistent with wild rice existence
0
0.15
0.3 Miles
Duluth
Superior
Martin Rd
Kimballs Bay
Badger Dr
Heron Dr
Billings Dr
White Birch Dr
Bennington Rd
Royalton Rd
Parmly Pl
Windsor St
Highgate St
Vergennes St
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Vegetation_AOIs_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jamesonhosch



Dwights Point
Stryker
Area of Interest
Soft, silt or clay-dominated
Muck/peat-dominated
Other substrate combinations
0
0.15
0.3 Miles
Dwights Point
Wisconsin Tributaries
Billings Park
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Substrate_AOIs_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch



Dwights Point
Dwights Point
Stryker
Wisconsin Tributaries
Billings Park
High Potential
Low Potential
Medium Potential
Area of Interest
Current anecdotal observations of sparse to scattered stands of wild rice
0
0.15
0.3 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Model_Output_Rice_Potential_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch

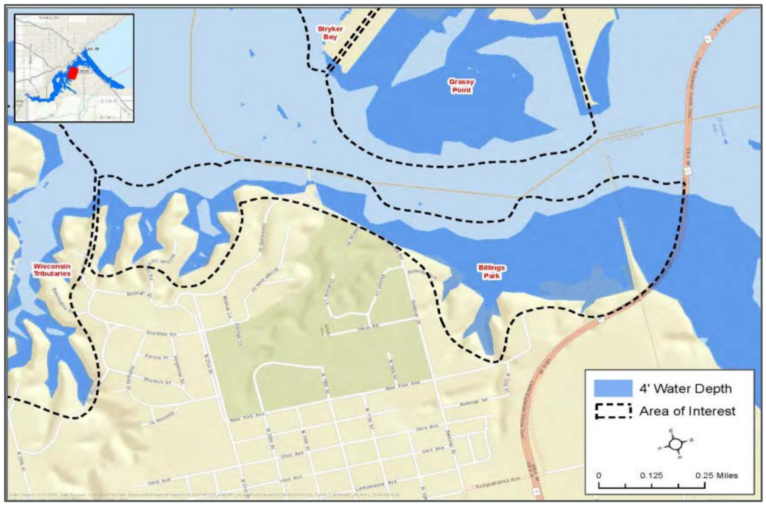
Billings Park

Primary State
Wisconsin

Subareas Included
None.

Wild Rice Restoration Acreage Potential
(Based on Site Selection Model)

Site Potential	Acres
High Potential	28
Medium Potential	49
Low Potential	31
Total Acres	108



Areas Description for Wild Rice Restoration
The Billings Park area is a series of four shallow, narrow bays where small tributaries or drainages enter the estuary and a large expansive open water area with a large floating mat adjacent to the Highway 2 Bridge.

Wild rice restoration in this area will be considered a stand-alone activity and not incorporated into any current or future restoration plans addressing other BUIs.

Representative Photos of the Area


Photo Point 1

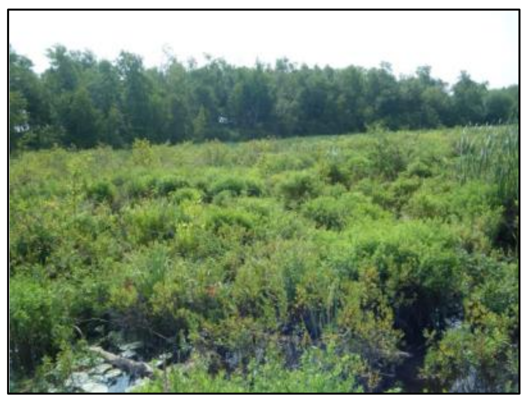
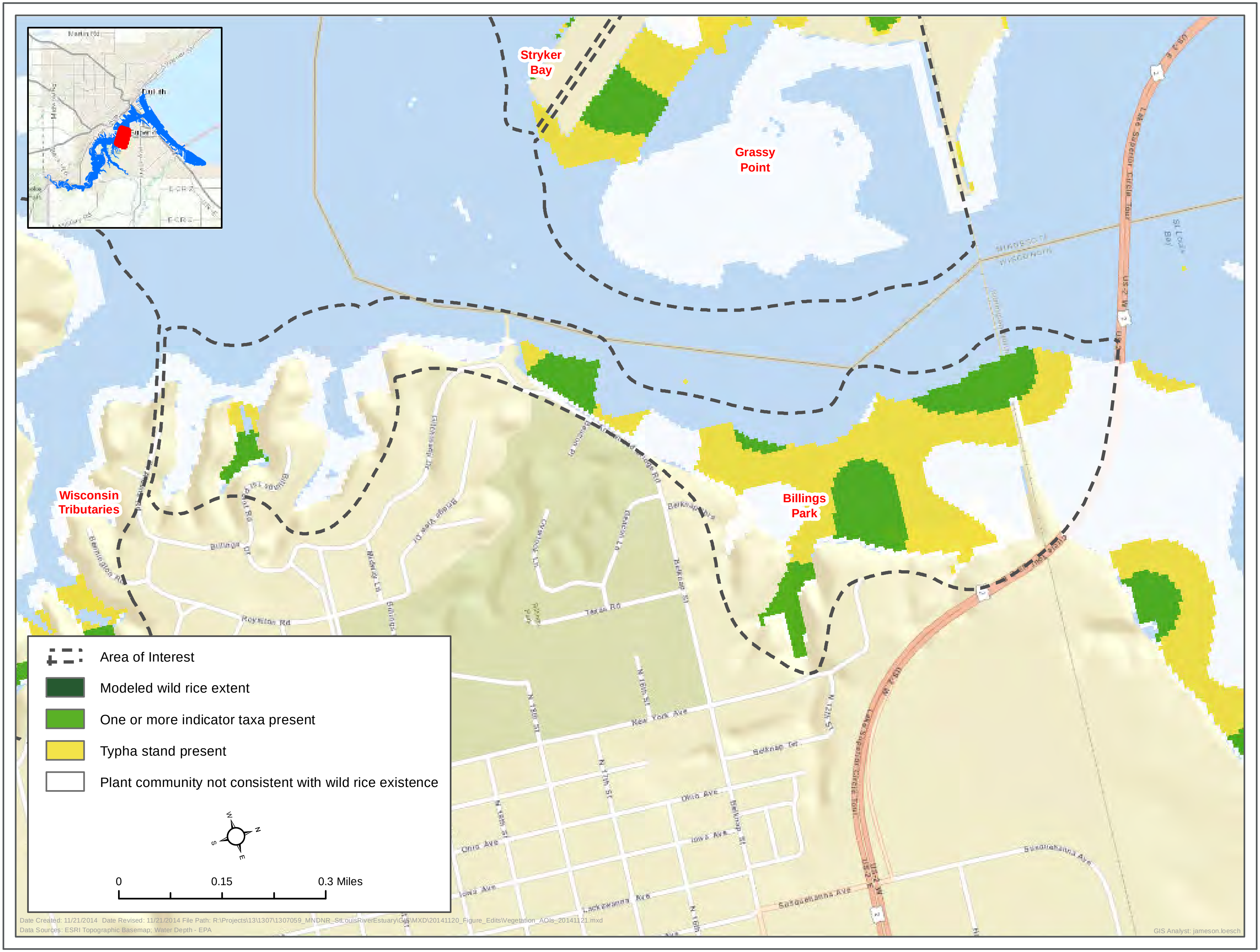


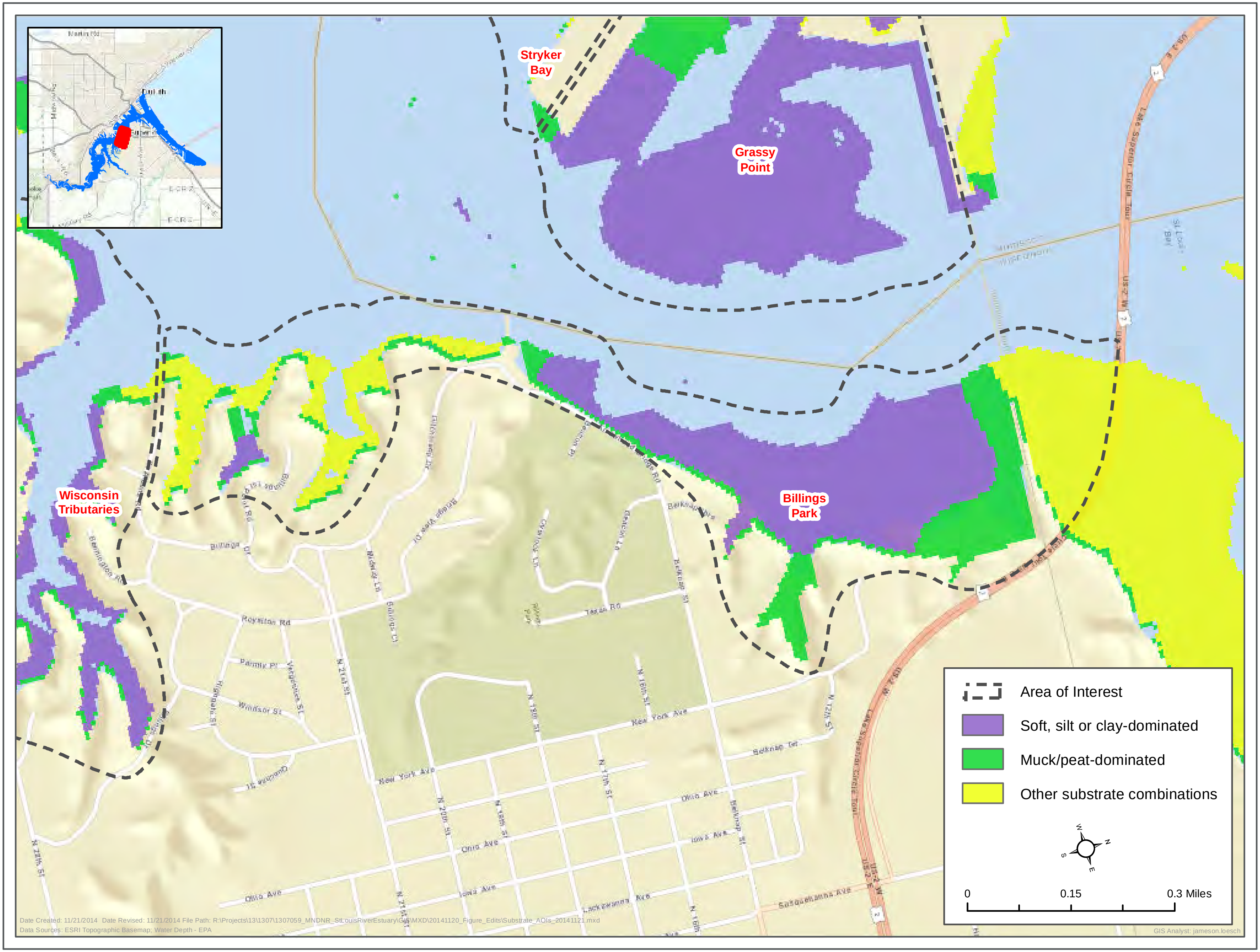
Photo Point 2

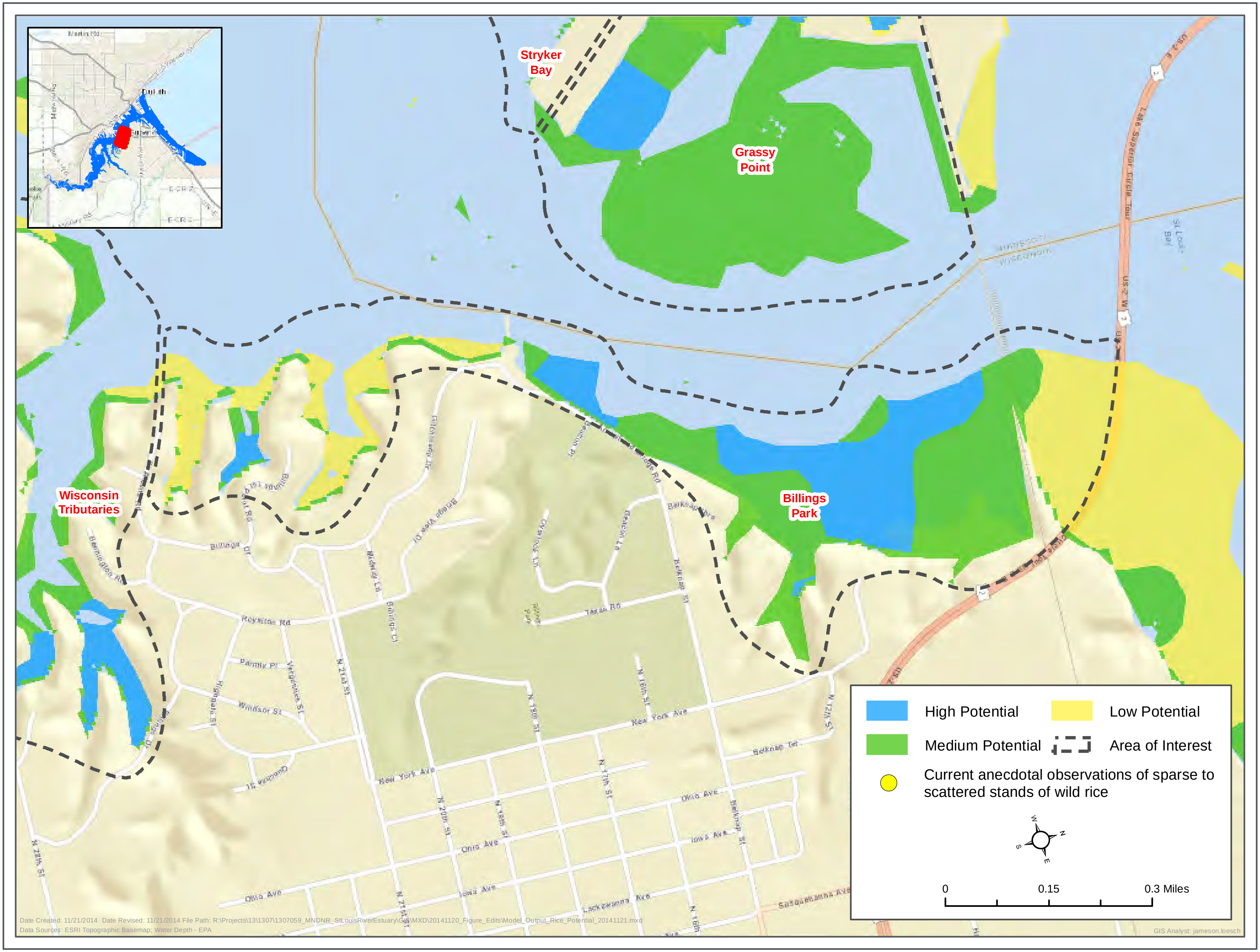
Wild Rice Restoration Opportunities and Strategies
- Use vegetation removal and thinning along the northern shoreline where cattail stands and floating mats are present to establish wild rice stands.
- Seed and install exclosures to establish wild rice where depth allows and no existing floating or emergent vegetation is present.

Wild Rice Restoration Limitations
- Water depth
- Recreational boating

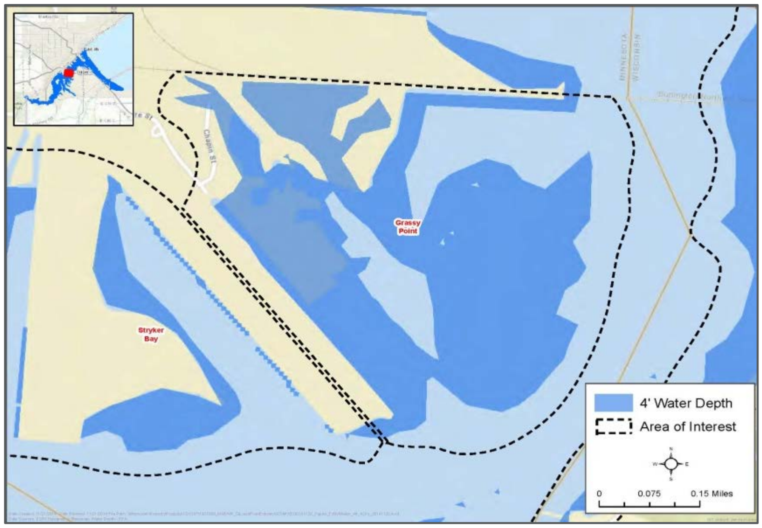


Stryker Bay
Grassy Point
Wisconsin Tributaries
Billings Park
Area of Interest
Modeled wild rice extent
One or more indicator taxa present
Typha stand present
Plant community not consistent with wild rice existence
0
0.15
0.3 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Vegetation_AOIs_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch


Stryker Bay
Grassy Point
Wisconsin Tributaries
Billings Park
Area of Interest
Soft, silt or clay-dominated
Muck/peat-dominated
Other substrate combinations
0
0.15
0.3 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Substrate_AOIs_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch


Stryker Bay
Grassy Point
Wisconsin Tributaries
Billings Park
High Potential
Low Potential
Medium Potential
Area of Interest
Current anecdotal observations of sparse to scattered stands of wild rice
0
0.15
0.3 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Model_Output_Rice_Potential_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch

Grassy Point



Primary State
Minnesota

Subareas Included
None.

Wild Rice Restoration Acreage Potential
(Based on Site Selection Model)

Site Potential	Acres
High Potential	23
Medium Potential	85
Low Potential	3
Total Acres	111

Areas Description for Wild Rice Restoration
The Grassy Point area is a mix of open water, cattail stands, sedge meadow, and floating mats. Similar to Radio Tower Bay, the area has anthropogenic wood waste from a historical milling operation on the site that has reduced water depth and covered up native sediments. Currently, a design is being completed to restore the area to a more historical condition and address contaminated sediments on-site.

There is a current restoration plan for Grassy Point that addresses an existing BUI. Wild rice restoration in this area would need to be integrated during the final plan development.

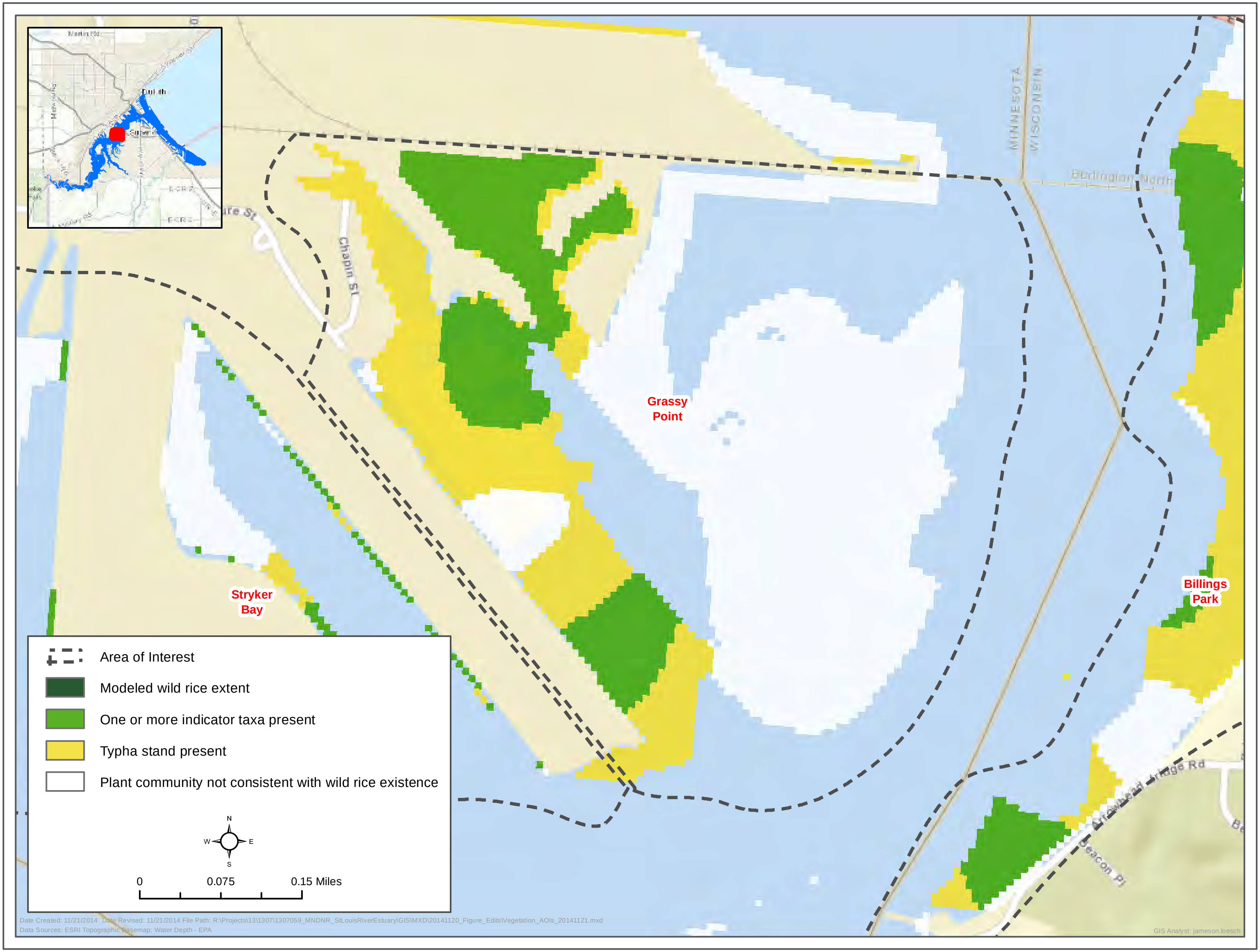
Representative Photos of the Area


Photo Point 1

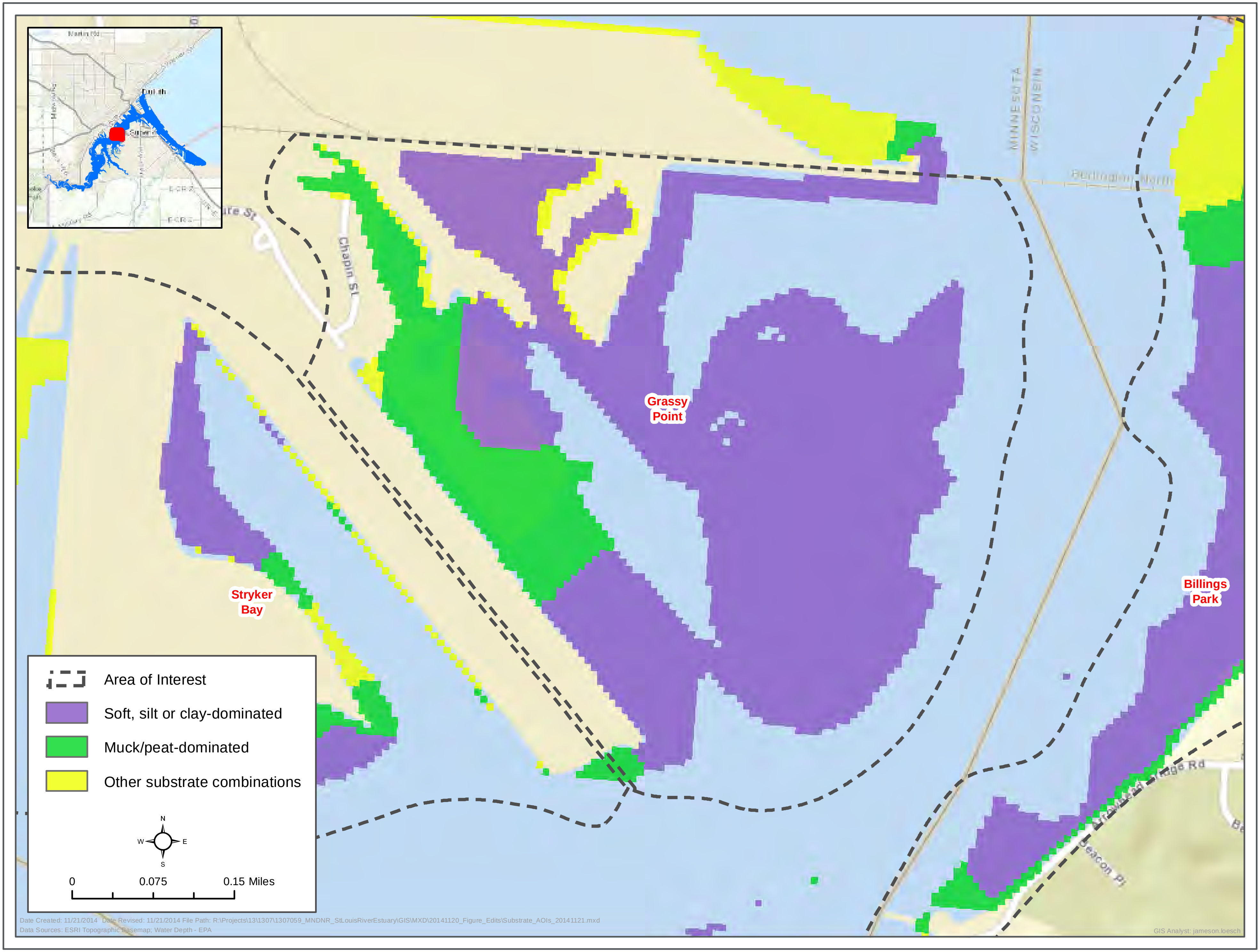

Photo Point 2

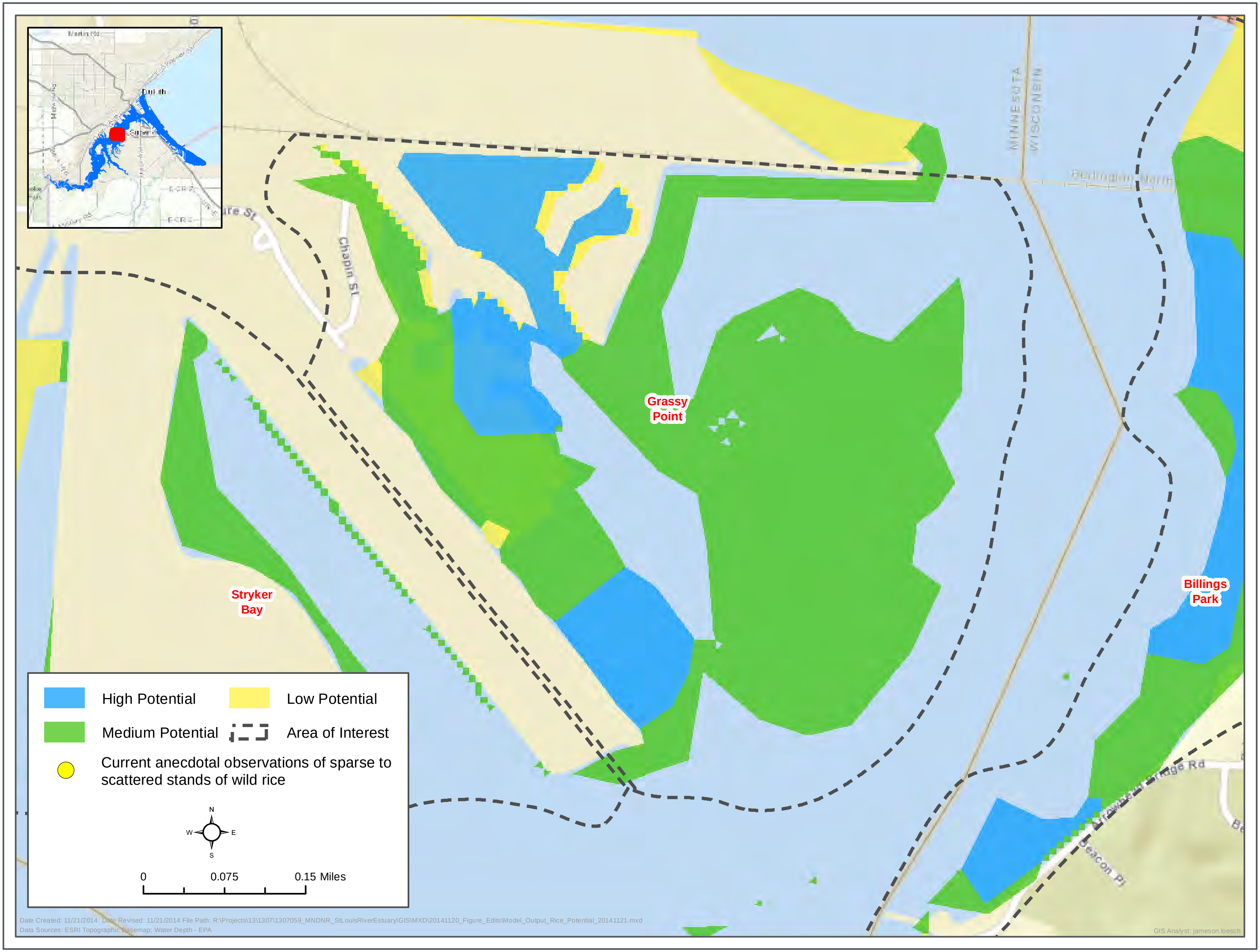
Wild Rice Restoration Opportunities and Strategies
- Use vegetation removal and thinning along the northern shoreline where cattail stands and floating mats are present to establish wild rice stands.
- Seed and install exclosures to establish wild rice where depth allows and no existing floating or emergent vegetation is present.

Wild Rice Restoration Limitations
- Anthropogenic wood waste.
- Contaminated sediments.



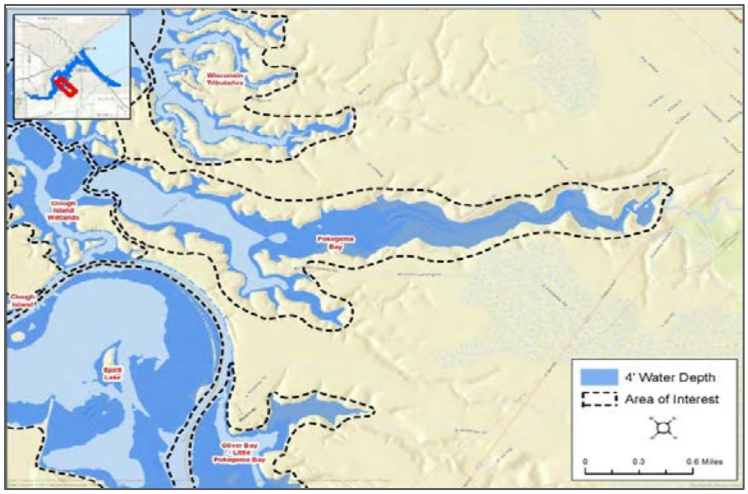
Grassy Point
Stryker Bay
Billings Park
Chapin St
MINNESOTA
WISCONSIN
Burlington North
Arrowhead Bridge Rd
Beacon Pl
Duluth
Area of Interest
Modeled wild rice extent
One or more indicator taxa present
Typha stand present
Plant community not consistent with wild rice existence
N
W
E
S
0
0.075
0.15 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Vegetation_AOIs_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch


Grassy Point
Stryker Bay
Billings Park
Chapin St
MINNESOTA
WISCONSIN
Beacon Pl
Area of Interest
Soft, silt or clay-dominated
Muck/peat-dominated
Other substrate combinations
N
W
E
S
0
0.075
0.15 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Substrate_AOIs_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch



Duluth
Superior
Chapin St
Grassy Point
Stryker Bay
Billings Park
MINNESOTA
WISCONSIN
Burlington North
Beacon Pl
High Potential
Low Potential
Medium Potential
Area of Interest
Current anecdotal observations of sparse to scattered stands of wild rice
N
W
E
S
0
0.075
0.15 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Model_Output_Rice_Potential_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch

Pokegama Bay



Primary State
Wisconsin

Subareas Included
None.

Wild Rice Restoration Acreage Potential
(Based on Site Selection Model)

Site Potential	Acres
High Potential	99
Medium Potential	219
Low Potential	28
Total Acres	346

Areas Description for Wild Rice Restoration

The Pokegama Bay area is a large bay where the Pokegama River enters the St. Louis River estuary. The mouth of the bay is wide and floating, and emergent plants are restricted to the fringes due to water depth. Moving towards its interior, the bay narrows and extensive floating and emergent vegetation beds are present. Pokegama Bay has historically been known as one of best places in the estuary to find wild rice.

Wild rice restoration in this area will be considered a stand-alone activity and not incorporated into any current or future restoration plans addressing other BUIs.

Representative Photos of the Area


Photo Point 1


Photo Point 2


Photo Point 3


Photo Point 4


Photo Point 5


Photo Point 6


Photo Point 7

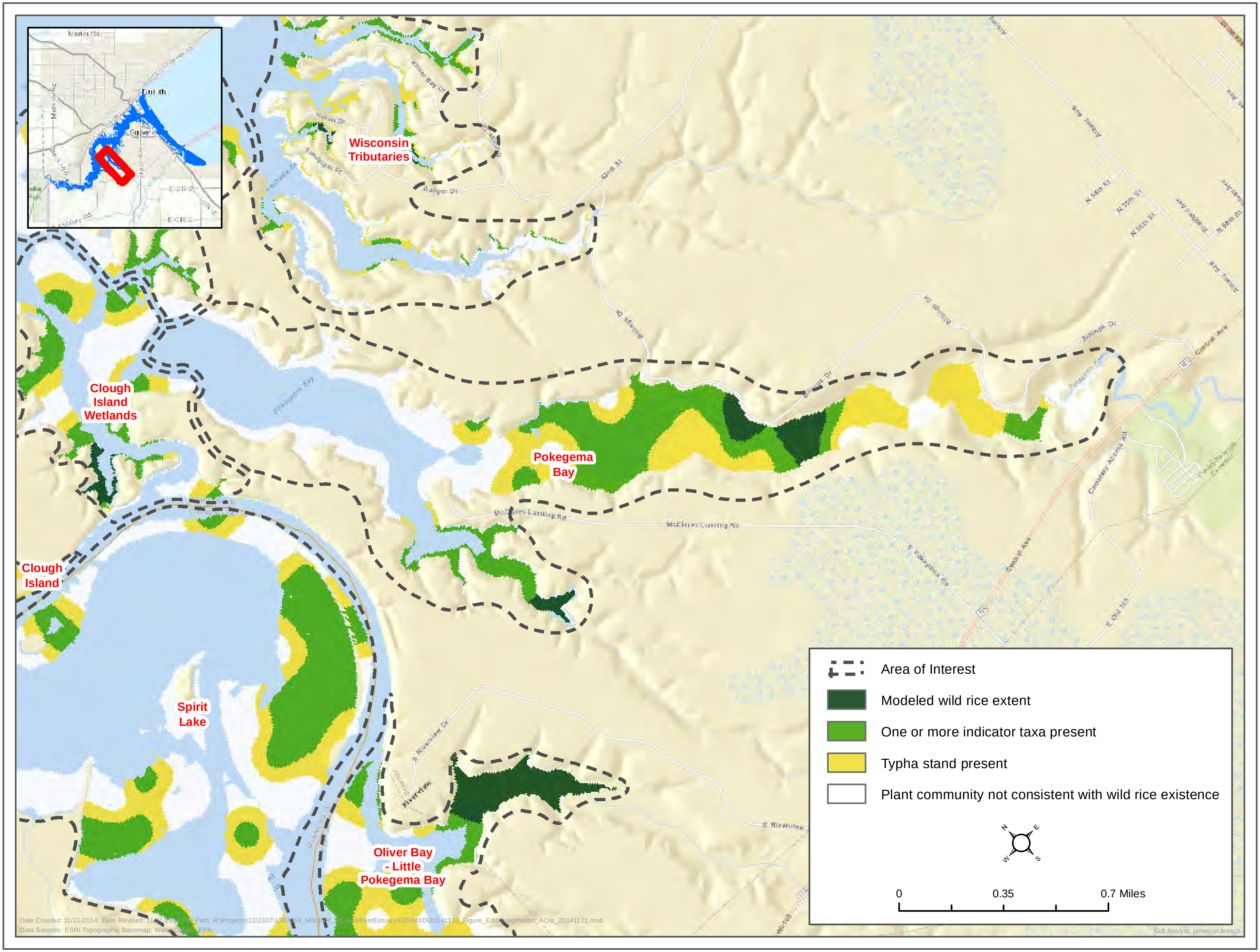

Photo Point 8

<u>Wild Rice Restoration Opportunities and Strategies</u>

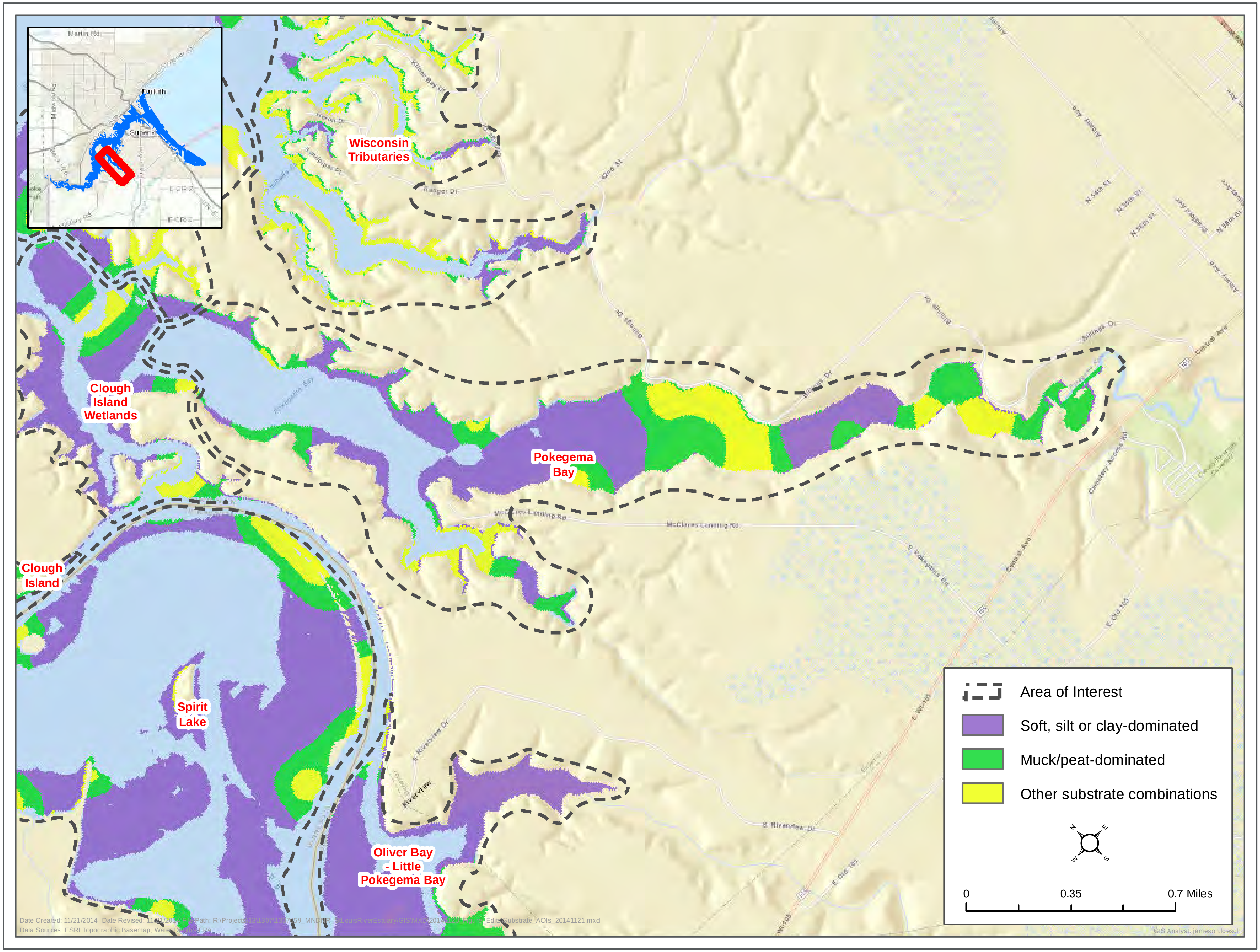
- Use vegetation mowing and seeding where floating and emergent vegetation is to establish wild rice stands.
- Use vegetation removal and thinning along the northern shoreline where cattail stands and floating mats are present to establish wild rice stands.
- Seed and install exclosures to establish wild rice where depth allows and no existing floating or emergent vegetation is present.

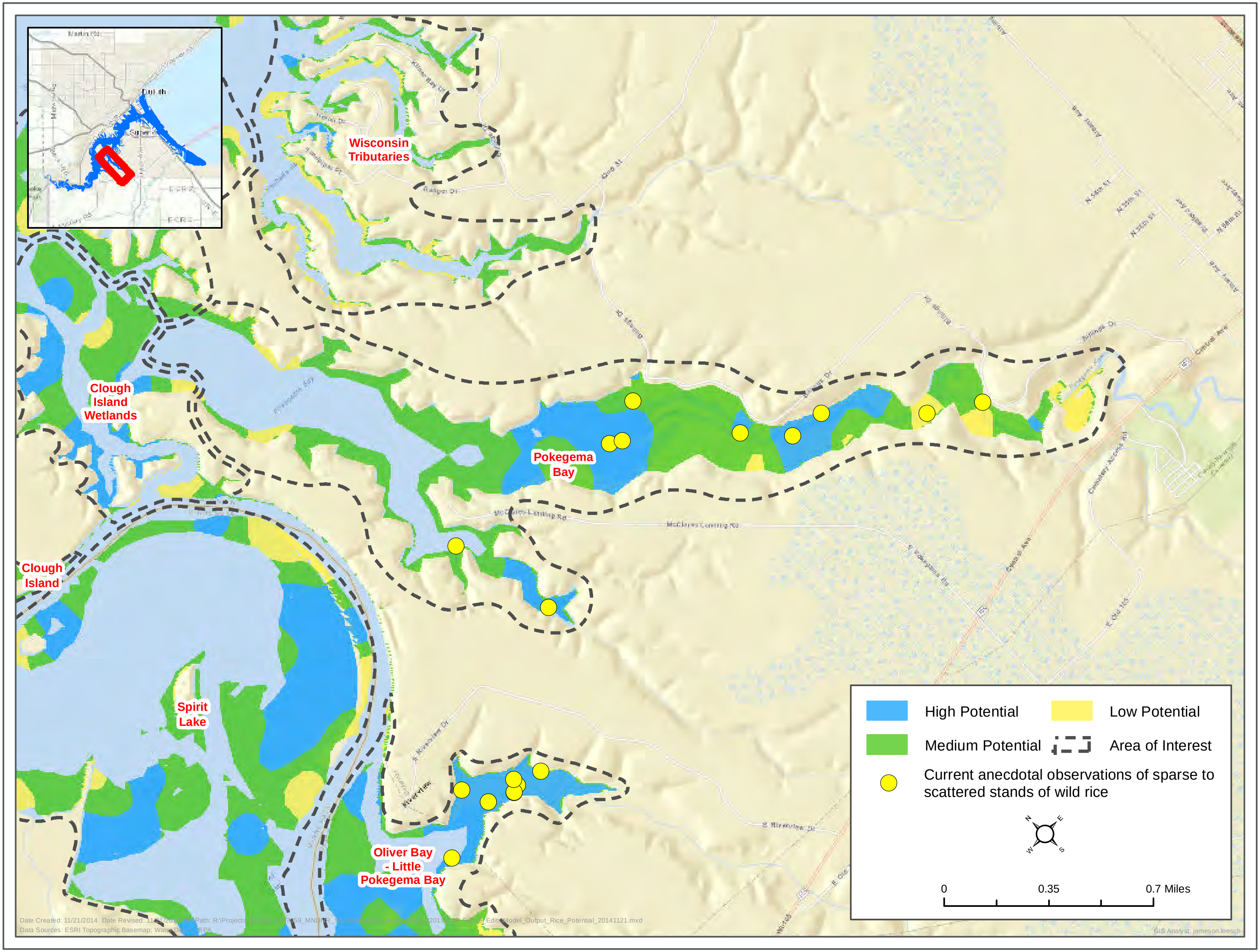
<u>Wild Rice Restoration Limitations</u>

- High quality existing native vegetation.



Wisconsin Tributaries
Clough Island Wetlands
Pokegema Bay
Clough Island
Spirit Lake
Oliver Bay - Little Pokegema Bay
Area of Interest
Modeled wild rice extent
One or more indicator taxa present
Typha stand present
Plant community not consistent with wild rice existence
0
0.35
0.7 Miles
Date Created: 11/21/2014 Date Revised: 11/21/2014 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Vegetation_AOIs_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch


Wisconsin Tributaries
Clough Island Wetlands
Pokegema Bay
Clough Island
Spirit Lake
Oliver Bay - Little Pokegema Bay
Duluth
Area of Interest
Soft, silt or clay-dominated
Muck/peat-dominated
Other substrate combinations
0
0.35
0.7 Miles
Date Created: 11/21/2014
GIS Analyst: jameson.loesch


Wisconsin Tributaries
Clough Island Wetlands
Pokegema Bay
Clough Island
Spirit Lake
Oliver Bay - Little Pokegema Bay
High Potential
Low Potential
Medium Potential
Area of Interest
Current anecdotal observations of sparse to scattered stands of wild rice
0
0.35
0.7 Miles
Data Sources: ESRI Topographic Basemap; Water Data - EPA
GIS Analyst: jameson.loesch

Allouez Bay

Primary State
Wisconsin

Subareas Included
None.

Wild Rice Restoration Acreage Potential
(Based on Site Selection Model)

Site Potential	Acres
High Potential	51
Medium Potential	175
Low Potential	284
Total Acres	509

Areas Description for Wild Rice Restoration
The Allouez Bay area is a large bay to the east of the Superior Harbor. Floating and emergent vegetation is restricted to the fringe perimeter, particularly in the southeast corner, where wild rice was historically known to be present and previous wild rice restoration projects have occurred.

Wild rice restoration in this area will be completed in conjunction with work to reduce/remove existing invasive plant species.

Representative Photos of the Area


Photo Point 1


Photo Point 2

Photo Point 3

Photo Point 4

Photo Point 5

Photo Point 6

Photo Point 7

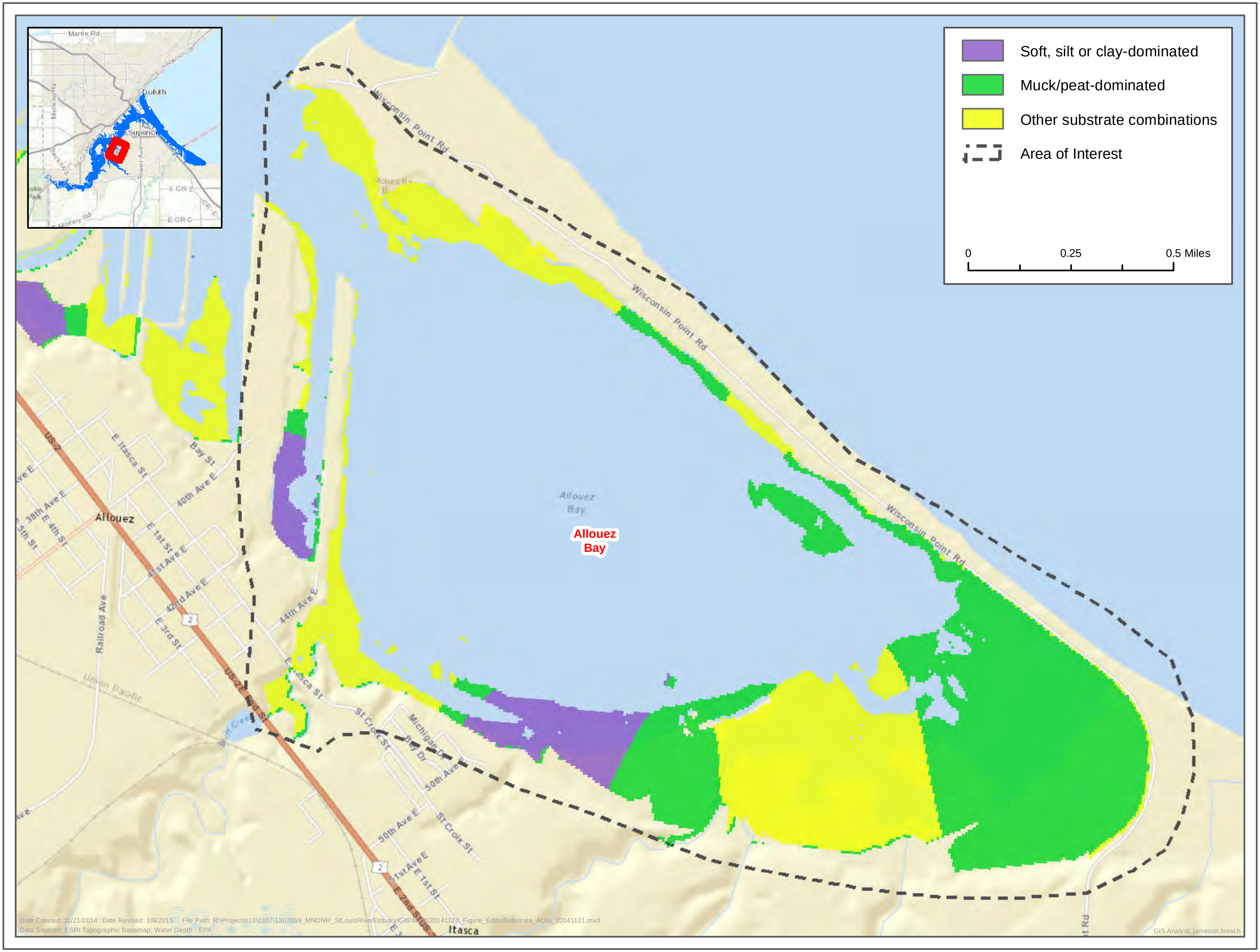
Photo Point 8

Wild Rice Restoration Opportunities and Strategies

- Seed and install exclosures to establish wild rice where depth allows and no existing floating or emergent vegetation is present.

Wild Rice Restoration Limitations

- Water depth.
- Recreational boating.



Soft, silt or clay-dominated
Muck/peat-dominated
Other substrate combinations
Area of Interest
0
0.25
0.5 Miles
Allouez Bay
Wisconsin Point Rd
Allouez
Itasca
Duluth
Superior
Date Created: 11/21/2014 Date Revised: 1/8/2015 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Substrate_AOIs_20141121.mxd
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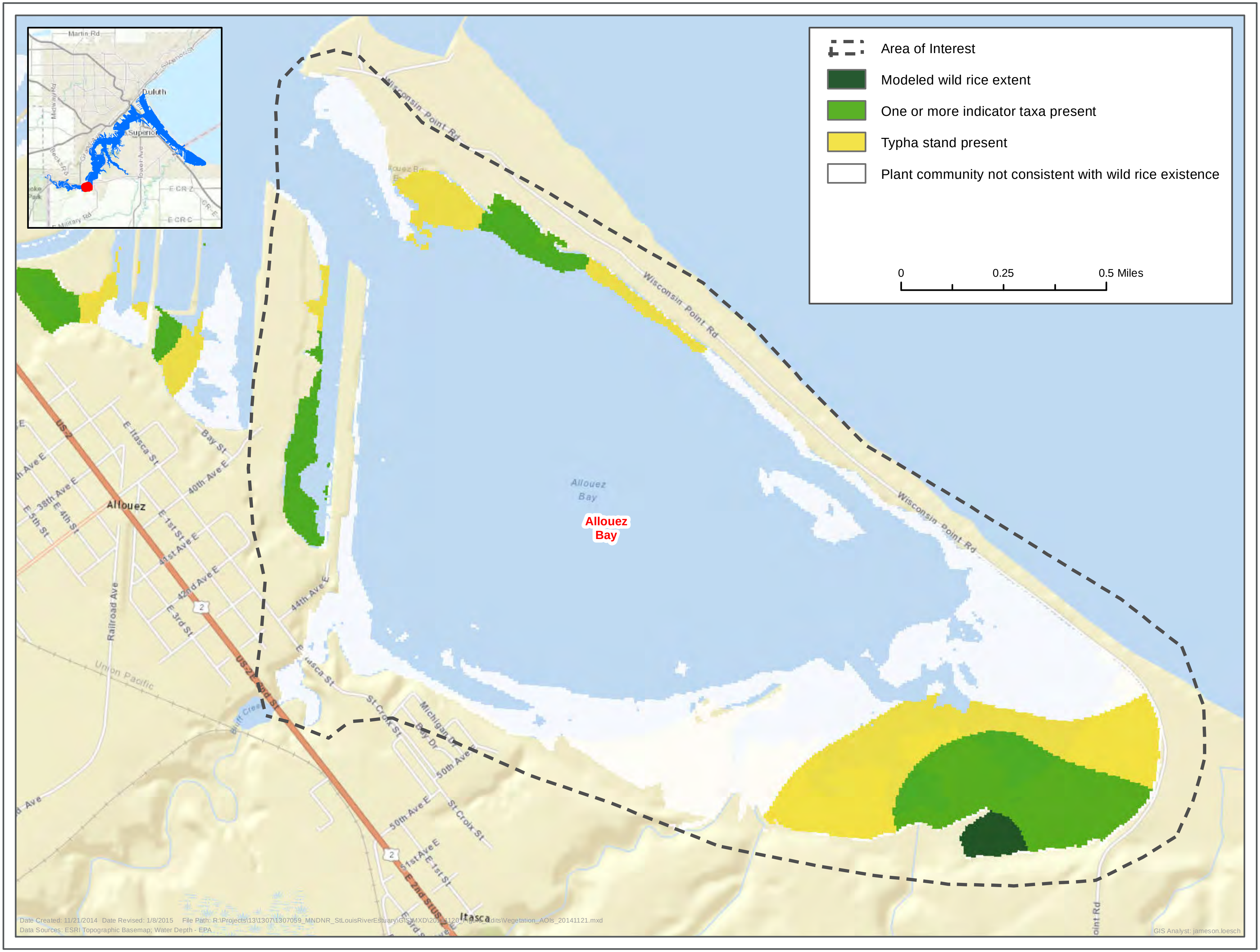
GIS Analyst: jameson.loesch



Area of Interest
Modeled wild rice extent
One or more indicator taxa present
Typha stand present
Plant community not consistent with wild rice existence
0
0.25
0.5 Miles
Allouez Bay
Wisconsin Point Rd
Allouez
Date Created: 11/21/2014 Date Revised: 1/8/2015
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch


High Potential
Low Potential
Medium Potential
Area of Interest
Current anecdotal observations of sparse to scattered stands of wild rice
0
0.25
0.5 Miles
Allouez Bay
Allouez Bay
Wisconsin Point Rd
Wisconsin Point Rd
Wisconsin Point Rd
Allouez
Itasca
E Itasca St
Bay St
40th Ave E
44th Ave E
50th Ave E
St Croix St
Michigan Dr
Railroad Ave
Union Pacific
US 2
Duluth
Superior
Date Created: 11/21/2014 Date Revised: 1/8/2015 File Path: R:\Projects\13\1307\1307059_MNDNR_StLouisRiverEstuary\GIS\MXD\20141120_Figure_Edits\Model_Output_Rice_Potential_20141121.mxd
Data Sources: ESRI Topographic Basemap; Water Depth - EPA
GIS Analyst: jameson.loesch

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Lakehead University
Peter Lee

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Paul Hlina

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Gini Breidenbach

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Minnesota Land Trust
Daryl Peterson

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Diane Desotelle
Ed Swain

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Paul Meysembourg
Carol Reschke

University of Minnesota – Duluth Civil Engineering Department
Nate Johnson

University of Wisconsin Extension
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Richard Kiesling

Wisconsin Department of Natural Resources
Matt Steiger
Molly Wick

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Wild Rice Restoration Implementation Plan
for the St. Louis River Estuary

St. Louis County, Minnesota
Douglas County, Wisconsin

APPENDIX A

RESTORATION SITE TEAM MEMBERSHIP

Wild Rice Restoration Site Team Participants

Minnesota
John Lindgren
Minnesota Department of Natural Resources
St. Louis River AOC Coordinator

Martha Minchak
Minnesota Department of Natural Resources
Habitat Restoration Project Manager

Diane Desotelle
Minnesota Pollution Control Agency
St. Louis River AOC Coordinator

Wisconsin
Matt Steiger
Wisconsin Department of Natural Resources
St. Louis River AOC Coordinator

Molly Wick
Wisconsin Department of Natural Resources
Habitat Coordinator

Tribal
Darren Vogt
1854 Treaty Authority
Environmental Director

Peter David
Great Lakes Indian Fish and Wildlife Commission
Wildlife Biologist

Thomas Howes
Fond du Lac Band of Lake Superior Chippewa
Natural Resources Manager

Non-Profit Partner
Daryl Peterson
Minnesota Land Trust
Senior Project Manager

Contractor
Mark Pranckus
Cardno JFNew
Senior Project Scientist

Paul Hlina
Leaning Pine Natives
Owner

Wild Rice Restoration Implementation Plan for the St. Louis River Estuary

St. Louis County, Minnesota
Douglas County, Wisconsin

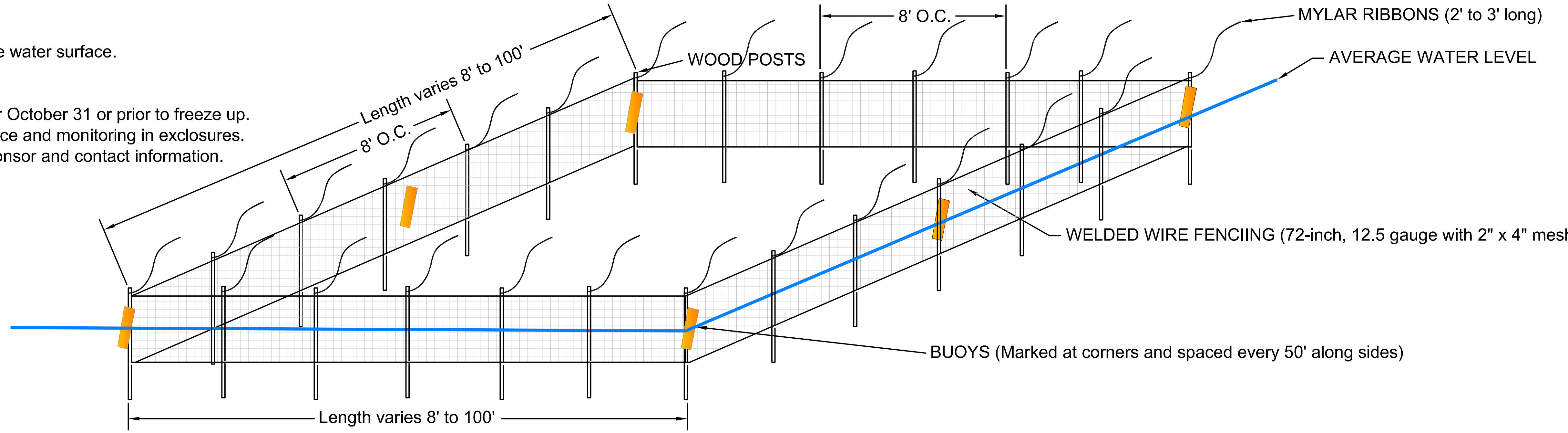
APPENDIX

B

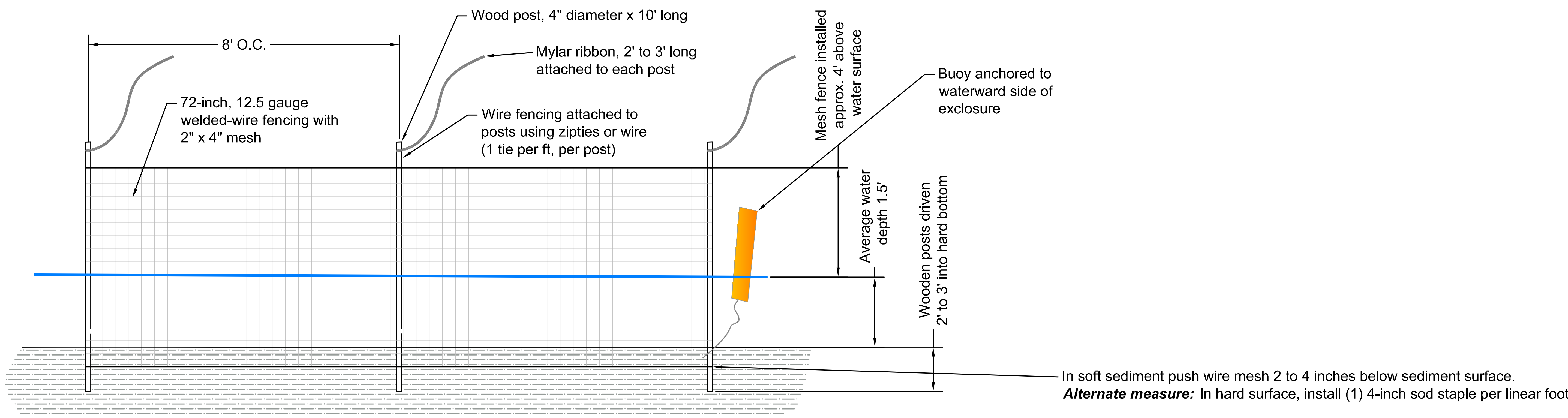
EXAMPLE TECHNICAL AND ENGINEERING SPECIFICATIONS FOR WILD RICE RESTORATION

CONSTRUCTION NOTES:

1. Mesh fence installed approximately 4 feet above water surface.
2. Buoy anchored to waterward side of exclosure.
3. Wood posts driven 2 to 3 feet into hard bottom.
4. Install exclosure following ice-cut. Remove after October 31 or prior to freeze up.
5. Provide access at marked corner for maintenance and monitoring in exclosures.
6. Buoys shall be marked with name of project sponsor and contact information.



TYPICAL EXCLOSURE



DETAIL

Project No. J 1307059

Exclosure Detail

MN Wild Rice Restoration

St. Louis River Estuary

St. Louis County, Minnesota

NOT TO SCALE

Cardno JFNew

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Data Sources:

CAD Analyst: Christine.dittmar