



# **2014 Wild Rice and Water Quality Monitoring Summary**

Prepared for  
Poly Met Mining Inc.

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# 2014 Wild Rice and Water Quality Monitoring Summary

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# 1.0 Background

Poly Met Mining Inc. (PolyMet) has retained Barr Engineering Co. (Barr) to complete baseline wild rice studies in response to the Minnesota Pollution Control Agency's (MPCA) "Wild Rice Information Request" of May 28, 2009, with regard to the PolyMet NorthMet Project (Project). This report, the *2014 Wild Rice and Water Quality Monitoring Summary* (2014 summary), presents the results of the wild rice survey and associated surface water sampling conducted in 2014—the sixth year of wild rice survey data collection.

## 1.1 Purpose

According to the MPCA, waters that contain or have the potential to contain wild rice may be regulated under Minnesota Rules, part 7050.0224, subpart 2. The purpose of this work is to collect information about the presence of wild rice in water bodies located downstream of potential discharges that could be part of the Project. The scope of the work includes:

- on-site verification of the presence and density of wild rice in water bodies located downstream of the Project
- plant collection at select wild rice stands for measurement and basic statistical analyses of plant growth including: total plant biomass, root biomass, stem biomass, seed biomass, and seed number
- chemical analysis of surface water grab samples collected in or next to wild rice stands including identification of sulfate ( $\text{SO}_4^{2-}$ ), major cations ( $\text{Mg}^{2+}$ ,  $\text{Ca}^{2+}$ ,  $\text{K}^+$ , and  $\text{Na}^+$ ), and major anions ( $\text{HCO}_3^-$  and  $\text{Cl}^-$ )
- on-site verification of aquatic vegetation (macrophytes) growing near wild rice stands

The 2014 summary provides information regarding location and density of wild rice stands, water quality within or proximate to those stands, biomass characteristics of select stands, and the presence of other macrophytes in water bodies near the Project. These water bodies were recommended for survey by the MPCA: Spring Mine Creek, Embarrass River, Hay Lake 1, Sabin Lake, Wynne Lake, Embarrass/Lower Embarrass Lake, Unnamed Lake, Cedar Island Lake, Fourth Lake, Partridge River, Wyman Creek, Second Creek, Little Rice Lake, Pike River/Hay Lake Outlet, Hay Lake 2, St. Louis River, and Pokegama Bay (study area). They have been surveyed (all or in part) since 2009. Figure 1 shows the portions of these water bodies surveyed in 2014.

## 1.2 Wild Rice Characteristics

Wild rice is the official state grain of Minnesota and the only indigenous aquatic cereal plant in North America. Wild rice is an important aquatic plant species in Minnesota with many ecosystem functions. Some of these functions include contributing to water quality and serving as a food source for waterfowl, muskrats, and beavers (Reference (1)). Wild rice is spiritually, culturally, and economically important to many Native American tribes as well as non-native Americans who harvest, process, and market wild rice (Reference (2)).

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Wild rice habitat typically includes open-water areas with direct sunlight, the presence of other macrophytes (aquatic plants that are emergent, submergent, or floating in the water body), and water depths between 1 and 4 feet (approximately 30–120 cm). Other conditions that favor wild rice growth include flowing water (water bodies with an inlet and an outlet) and a predominantly mucky substrate (Reference (1)).

Characteristics that limit the suitability of habitat for wild rice growth include shallow water depths (less than 1 foot), predominantly rocky substrates, narrow channel conditions with little or no open water because of thick vegetation (e.g., cattails, arrowheads, bur-reeds), and dense overhanging vegetation (e.g., reed canary grass). These are examples of plants that may be observed and do not represent a complete species list.

Wild rice populations oscillate over an approximate 4- to 6-year period, so wild rice may be present in a water body one year and absent the following year. Therefore, it is difficult to determine whether a water body has wild rice habitat without analyzing the results of multi-year field surveys (Reference (3) and Reference (4)). Other parameters may also play a role in whether wild rice grows in a water body from one year to the next, including water levels, parasites, browsing by ducks and muskrats, and large storm events (Reference (5), Reference (6), and Reference (7)).

Water-level fluctuations during the growing season may also influence wild rice growth. For example, if water levels fluctuate in early summer during the early stages of growth, it is possible that wild rice plants may become dislodged and die (Reference (5) and Reference (6)). Given that wild rice populations fluctuate over a multiple-year period, studies carried out over shorter time periods may not provide reliable information regarding the growth and production of wild rice.

### **1.3 Minnesota Wild Rice Sulfate Rule**

The Minnesota sulfate standard for wild rice of 10 mg/L was adopted in 1973 for Class 4A waters (used for agriculture and irrigation) based on the results of studies primarily conducted by an Minnesota Department of Natural Resources (MDNR) scientist, Dr. John B. Moyle, in the 1940s (Reference (8)). Moyle reported that a sulfate level higher than 10 mg/L is detrimental to the growth of wild rice (Reference (9), Reference (10), Reference (11), and Reference (12)). The intent of the sulfate standard (Minnesota Rules, part 7050.0224, subpart 2) is to protect “water used for production of wild rice during periods when the rice may be susceptible to damage by high sulfate levels.”

The MPCA is currently working to clarify current and future implementation of this sulfate standard. This work includes (1) examining whether the 10 mg/L sulfate standard is scientifically valid and (2) clarifying the seasonality of the sulfate standard by identifying the period during the wild rice life cycle when the plant may be affected by sulfate. In 2011, the Minnesota legislature mandated that the MPCA initiate studies to re-evaluate the sulfate standard. The MPCA sent out competitive requests for proposals (RFPs) and chose several researchers from the University of Minnesota-Duluth and the University of Minnesota-Minneapolis to conduct the research. The studies were completed and submitted to the MPCA on December 31, 2014. The MPCA has released a preliminary analysis of these studies: Wild Rice Sulfate

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Standard Study Preliminary Analysis (Reference (13)). They have stated they will release recommendations regarding the Minnesota sulfate standard for wild rice by approximately the end of March 2015.

As required by the Clean Water Act, MPCA regularly reviews, and as needed, updates Minnesota's water quality standards; this update is known as the triennial review. As part of the current review, the MPCA is working to clarify what constitutes "water used for production of wild rice." The MPCA is developing a proposed approach and getting input from interested and affected parties, including Minnesota Tribes, MDNR, and members of the Wild Rice Standards Study Advisory Committee (Advisory Committee). The Advisory Committee is composed of representatives from Minnesota Tribes, academic institutions, citizen groups, businesses, and trade organizations.

Any additional rulemaking that might be needed for revision of the wild rice sulfate standard would take place at a later time after the wild rice research studies are completed. If needed, this rulemaking would begin in spring 2015.

While the standards study and rulemaking are underway, the MPCA is implementing the current standard of 10 mg/L in water quality permits on a case-by-case basis. The following document outlines current implementation of the wild rice standard in agency permits.

## 2.0 Methods

### 2.1 Wild Rice Survey Methods

Prior to conducting field work, Barr staff reviewed aerial photographs and GIS maps of the study area water bodies to determine (1) whether water bodies in the study area had flowing streams with open water—which would potentially support wild rice populations and (2) whether water bodies could be safely accessed and surveyed.

Wherever possible, water bodies in the study area were surveyed directly by kayak. Some stream reaches that were not accessible by kayak were surveyed on foot from observation points (road crossings or other access points). Field staff were able to directly observe and collect data from the portion of the stream immediately adjacent to the observation point and make observations of stream segments within their line of sight. Both kayak surveys and line-of-sight surveys are referred to as “direct surveys.”

The survey methods are similar to those presented in the 1854 Treaty Authority, Wild Rice Monitoring and Abundance in the 1854 Ceded Territory (1998–2014) (Reference (14) and other vegetation plot data surveys designed to quantify in situ plant species (e.g., A Handbook for Collecting Vegetation Plot Data in Minnesota: The Relevé Method (Reference (15)). Field staff observe the shorelines of water bodies in the study area and note where wild rice is present. Where present, the wild rice density is qualitatively assessed using the rating scale of 1 to 5 that is presented in the 1854 Treaty Authority Wild Rice Monitoring and Abundance in the 1854 Ceded Territory (1998-2014). The rating references approximate percent coverage of wild rice in a water body or defined section of a water body. Table 2-1 relates wild rice density scale ratings to the approximate percent coverage of wild rice.

**Table 2-1 Wild Rice Density Scale**

Wild Rice Density Rating	Description
1	<10% wild rice cover
2	10–25% wild rice cover
3	25–50% wild rice cover
4	50–75% wild rice cover
5	>75% wild rice cover

As in 2013 (Reference (16), field and GIS techniques were used to record qualitative wild rice density in large stands as “areas.” This improves precision and the ability to make multi-year comparisons. Small wild rice stands (less than approximately 100 ft<sup>2</sup>) and individual plants were recorded as “points.” Graphic 2-1 defines the wild rice densities as represented in figures.

**Wild Rice Density Point**

- 1: <10% Wild Rice Coverage
- 2: 10-25% Wild Rice Coverage
- 3: 25-50% Wild Rice Coverage
- 4: 50-75% Wild Rice Coverage

**Wild Rice Areas with Density**

- 1: <10% Wild Rice Coverage
- 2: 10-25% Wild Rice Coverage
- 3: 25-50% Wild Rice Coverage
- 4: 50-75% Wild Rice Coverage
- 5: >75% Wild Rice Coverage

**Graphic 2-1 Wild Rice Density Legend**

**2.1.1 Wild Rice Stand and Stream Data**

In addition to qualitative wild rice stand density observations, field staff collected a range of qualitative and quantitative data about water bodies, vegetation, and wild rice stands in the study area. The types of data recorded for streams and wild rice stands are summarized in Table 2-2 and Table 2-3.

**Table 2-2 Stream Data**

Data Type	Rationale
Stream reach divisions	Divided the stream into sub-units
Stream reach type	Riffle, pool, narrow channel, or open water, as detailed below; informed judgment on suitability for wild rice habitat
Substrate/sediment type	Informed judgment on likelihood of wild rice presence (certain substrates are favorable for wild rice growth)
Water depth	Informed judgment on likelihood of wild rice presence (certain water depths are favorable for wild rice growth)
Flow conditions	Informed judgment on likelihood of wild rice presence (certain flow conditions—presumably a defined range of flows, not too slow or fast—are favorable for wild rice growth)
Dominant aquatic vegetation	Baseline habitat characterization that included dominant aquatic vegetation types; Barr did NOT determine whether wild rice is associated with other aquatic vegetation
Dominant aquatic vegetation vouchers	Verified field identification of aquatic vegetation
Riparian categories	Shrub-carr, wet meadow, coniferous wetland, or upland forest, as detailed below

**Table 2-3 Wild Rice Stand Data**

Data Type	Rationale
Location and approximate dimension of wild rice stand	Characterized presence and abundance of wild rice plants
Qualitative wild rice plot survey	Characterized stand density using the density scale of 1–5 (Table 2-1); provides approximation of wild rice plant abundance
Wild rice biomass samples	Fifteen plants from each grid sampling site are collected during the field survey and transported to the lab for drying and weighing; seeds from the plants were also counted in the lab.
Wild rice vouchers	Wild rice plants collected during the field survey were reviewed in the lab to verify identification of wild rice.
General observations of wild rice for animal browsing and parasites	Observations during field surveys were documented to characterize potential limitations on wild rice growth and abundance.
Surface water grab sample for sulfate	Meets MPCA requirement that surface water samples be collected and analyzed for sulfate in water bodies where wild rice is present and sulfate concentration is > 10mg/L; data supported position that current standard is unreasonably low.
Surface water sample for other analytes	May be useful for future discussions if the current MPCA research study determines that wild rice is associated with levels of these analytes
Description and photographs of access limits	Provided rationale and documentation about why certain areas were not safe to sample

### 2.1.2 Grid Sampling

Twelve select wild rice stands in study area water bodies have been the subject of detailed grid sampling each year since 2009. Locations of grid sampling sites are shown on Figure 1; these locations have been the same since the surveys' inception in 2009. At each grid sampling site, twenty 0.5 m<sup>2</sup> plots were set up. Within each plot, field staff counted all wild rice stems and measured the height of five plants above the water surface. The stem density counts for the grid sampling represented a different metric than the qualitative density observations during the direct surveys. The qualitative density observations (Table 2-1) indicate an assessment of the percentage of a water body covered by wild rice, whereas grid sampling produces actual counts of the number of stems present in a given sampling 0.5 m<sup>2</sup> area.

Wild rice biomass samples were collected at the grid sampling sites and transported to the lab for analysis. At the lab, samples were dried and weighed, and seeds were counted. Total plant, shoot, root, and seed weight (dry weight) and total seed numbers were calculated for plants collected from the Embarrass River (including the chain of lakes), the Pike River (including Little Rice Lake), the Partridge River, and the St. Louis River. Mean, median, and standard deviation of each parameter were also calculated. To assure accuracy of plant weight calculations, total plant biomass of intact plants was compared to the sum of individual roots, shoots, and seed biomass calculations.

### 2.1.3 Stream Reach Characterization

For the 2014 wild rice survey, Second Creek, the Embarrass River, the Upper and Lower Partridge River, and Spring Mine Creek were divided into stream reaches based on roads, railroads, impasses, and field survey observations. Stream reach definitions are subjective, so reaches defined for the 2013 field survey (Reference (16)) were further refined in 2014 as more information was collected. Divisions between reaches are shown on Figure 2, Figure 9, Figure 11, Figure 15, and Figure 16. Water bodies were frequently found to be heterogeneous with multiple reach types present between reach divisions. The surveyed reaches were characterized as predominantly consisting of one of the following four channel types:

- **Riffle** – Channels that included riffles, rapids, and boulder fields, primarily with rocky substrates. Water was often fast-flowing and of shallow depth (less than 12 inches). The highest river slopes were observed in these reaches. Riffles were typically relatively straight channels that were not highly meandering.<sup>1</sup>
- **Pool** – Channels that included flat, slow-moving, or stagnant water, typically located behind beaver dams, rock, woody debris, or other obstructions. The water depth typically ranged between 12 and 60 inches. The substrate was primarily mucky, and the river slope was minimal and often hard to detect in the field. Pool reaches were typically moderately meandering—more than riffles but less than open water.
- **Open water** – Channels that included relatively wide, flowing water with higher slope and flow velocity than pools, but lower than the riffle category. The open water category included runs and glides. The water depth was between 12 and 60 inches. The substrate varied from mucky to sand, gravel, and rock. Typically, pools and open water types were on a continuum of stream type and difficult to distinguish in the field. Open water reaches were typically moderately to highly meandering, more so than pools and riffles.
- **Narrow channel** – Channels through headwaters, wetlands, or constrictions that were not wide and possibly impassable by kayak. These channels might consist of a single narrow channel or numerous braided channels, often passing through dense wet meadow or alder thicket vegetation. Woody debris was common; channels could be highly meandering and less than 10 feet wide. The water depth was typically less than 12 inches. The substrate was typically mucky, but could also be sandy or rocky.

Riparian communities adjacent to the streams were categorized as shrub-carr (wetlands dominated by shrubs, particularly alder thicket), wet meadow (wetland dominated by sedges and grasses), hardwood swamp (wetland typically dominated by black ash), coniferous wetland (swamp or bog wetland dominated by black spruce and/or tamarack), or upland forest (wetland dominated by pines, aspen, and birch).

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<sup>1</sup> A meander is a river bend and meandering refers to the pattern of the river channel curving back and forth as it flows across the landscape. Highly meandering channels have extensive and tight curves and are considered very sinuous or winding. Channels that are relatively straight have little meander and are not sinuous.

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## 2.2 Macrophyte Survey Methods

As part of the 2014 wild rice surveys, staff surveyed macrophytes at locations of known or potential wild rice habitat. Macrophyte surveys included identification and qualitative abundance estimation using methods similar to the qualitative wild rice density method (Section 2.1). A subset of macrophyte observations included collection of plant specimens to verify field identification. As part of the quality control and quality assurance measures for the 2014 wild rice surveys, Barr conducted plant identification training facilitated by in-house botanists and ecologists. The objectives of the training were to (1) ensure accurate identification—with staff able to distinguish wild rice from other macrophytes commonly growing in similar northern Minnesota habitats and (2) accurately assess wild rice habitat characteristics (including the presence and abundance of other macrophytes).

## 2.3 Water Quality Monitoring Methods

In 2014, water quality monitoring was conducted using the same methods described in the *2013 Wild Rice Survey and Water Quality Monitoring Summary* (Reference (16)). These are consistent with Barr's standard operating procedures (SOP), *Collection of Surface Water Samples* (Reference (17)). Water samples were collected at or near wild rice stands located in study area water bodies at the time of the wild rice surveys. Upon collection, unfiltered samples were placed in a cooler with ice and submitted to Pace Analytical (Pace) for analysis.

Water samples were analyzed for concentrations of sulfate ( $\text{SO}_4^{2-}$ ), major cations (magnesium [ $\text{Mg}^{2+}$ ], calcium [ $\text{Ca}^{2+}$ ], potassium [ $\text{K}^+$ ], and sodium [ $\text{Na}^+$ ]) and major anions (bicarbonate [ $\text{HCO}_3^-$ ] and chloride [ $\text{Cl}^-$ ]). The major cations were analyzed using U.S. Environmental Protection Agency (USEPA) method 200.7, sulfate and chloride were analyzed using USEPA method 300.0, and bicarbonate was measured as bicarbonate alkalinity and reported as  $\text{CaCO}_3$  using SM 2320B.

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## 3.0 Results

Barr conducted the PolyMet 2014 wild rice survey between August 4 and September 12, 2014. An overview of surveyed water bodies is shown on Figure 1. Figures 3-8, 10, 12-14 and 17-19 show qualitative wild rice density results from direct and indirect surveys. Qualitative results are discussed in Section 3.1, grouped by watershed. Generally, the summary for each reach describes wild rice location and density, channel width and depth, substrate characteristics, shoreline (riparian) vegetation, and in-stream vegetation. Where one or more of these types of information is absent from a reach description, it is because the information was not recorded during the survey. Water bodies were surveyed by kayak, unless otherwise noted. Designations of right and left bank are reported as viewed looking downstream.

Quantitative wild rice density and biomass results from grid sampling are presented in Figures 20–37 and discussed in Section 3.2. Macrophyte occurrences are recorded on Large Table 1 and discussed in Section 3.3. Surface water quality results are recorded on Large Table 2 and Large Table 3, illustrated on Figure 38, and discussed in Section 3.4. Photographs of select wild rice locations within the study area are included in Appendix A. Grid sampling sheets including wild rice stem count, plant height, and macrophyte occurrences are included in Appendix B.

### 3.1 Qualitative Wild Rice Survey Results

#### 3.1.1 Embarrass River Watershed

##### 3.1.1.1 Spring Mine Creek

Spring Mine Creek was directly surveyed by kayak and on foot, beginning at its confluence with the Embarrass River (just west of County Road 620), proceeding upstream and ending south of County Road 615/Salo Road (Figure 2). A total of 1.1 miles were surveyed and two distinct reaches were identified:

- **Reach SM-1 (narrow channel):** No wild rice was observed in this narrow (0–10 feet), 1.1-mile reach. The water here was shallow (approximately 33-90 cm) and the substrate throughout was mucky. Pondweed (*Potamogeton* spp.) and bur-reed (*Sparganium* spp.) were the most common vegetation in the stream. Reed canary grass (*Phalaris arundinacea*) and Canada bluejoint (*Calamagrostis canadensis*) were observed adjacent to the stream with shrub-carr beyond.
- **Reach SM-2 (open water):** No rice was observed in this 0.1 mile reach. The width in this reach was 5–10 feet and the observed maximum depth was about 50 cm. As in SM-1 the substrate was mucky. Bur-reed was the only vegetation observed in the stream. Reed canary grass grew adjacent to the stream with shrub-carr observed beyond.

##### 3.1.1.2 Trimble Creek

A line-of-sight survey of Trimble Creek was performed from two observation points on land. The creek is a narrow channel ranging in depth from approximately 27 to 55 cm. Water was turbid and no vegetation was observed in the stream. Riparian habitat near the creek was dominated by bluejoint and shallow marsh with reed canary grass. Tussock sedge (*Carex stricta*) was also observed. Shrub-carr and mixed coniferous/hardwood forest were seen further away from the stream.

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### 3.1.1.3 Unnamed Creek

A line-of-sight survey of Trimble Creek was performed from one observation point on land. The width of the creek at this point ranged from 5–15 feet; the depth was approximately 15–30 centimeters. The substrate comprised partially exposed muck. In-stream vegetation included yellow water-lily (*Nuphar variegata*) and broad-leaf arrowhead. Riparian habitat adjacent to the stream was a mosaic of shrub-carr dominated by willow (*Salix* spp.) and shallow marsh wetland dominated by reed canary grass and cattails. Shrub-carr was also observed further away from the stream as well as mixed coniferous/hardwood forest.

### 3.1.1.4 Embarrass River

The Upper Embarrass River was directly surveyed by canoe entering the water at the bridge on Salo Road and ending upstream of Sabin Lake near River Mile 24 (Figure 2). Seventeen distinct reaches were identified in this 23.5-mile segment. From the end of Reach 17 to Sabin Lake the Embarrass River was inaccessible by canoe, so an indirect survey was performed by consulting aerial photographs. The majority of the Upper Embarrass River consists of a meandering, narrow channel marked by intermittent riffles, pools, and open water. Wild rice (density 1) was observed in Reach 2 (pool) and Reach 17 (open water).

The Lower Embarrass River comprises a chain of lakes. Of these lakes, Cedar Island Lake had the greatest number of wild rice stands with the highest stand densities (1–5). Wynne Lake had no wild rice.

- **Reach ER-1 (open water):** No wild rice was observed in this reach, which extends 2.2 miles from the survey start point near River Mile 48. The width of the river in this segment typically ranged from 10–40 feet; the maximum observed depth was approximately 100 cm. The substrate comprised gravel and cobble with muck at the edges. Bur-reed was the only in-stream vegetation seen. Riparian habitat adjacent to the stream was shrub-carr; coniferous swamp was observed beyond. An old beaver dam was found in this reach.
- **Reach ER-2 (pool):** Wild rice (density 1) was found in this 1.2-mile reach (Figure 3). Rice was observed on both banks, starting just upstream of River Mile 47. Single rice points (density 1) were also observed near River Mile 46.5 (one point upstream and one point downstream). The width of this reach ranged from approximately 40–100 feet, and the observed maximum depth was approximately 120 cm. The substrate was mucky. Narrow-leaved bur-reed (*Sparganium emersum*), floating bur-reed (*Sparganium fluctuans*), marsh cinquefoil (*Comarum palustre*), and water milfoil (*Myriophyllum* spp.) were observed in the stream. Alder thicket was found adjacent to the stream with coniferous swamp observed beyond. One water sample was collected at this location.
- **Reach ER-3 (open water):** No wild rice was found in this 10.1-mile reach containing multiple beaver dams. The width of the river here ranged from approximately 10–100 feet; the maximum observed depth was about 150 cm. The substrate comprised muck and silt. Common in-stream vegetation was giant bur-reed, floating bur-reed, yellow pond-lily (*Nuphar variegata*), floating pondweed (*Potamogeton natans*), northern manna grass (*Glyceria borealis*), and rush (*Juncus* spp.). Alder thicket and shrub-carr grew adjacent to the stream. Riparian habitat observed away from the stream comprised coniferous swamp and upland forest.

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- **Reach ER-4 (riffle):** No wild rice was found in this short reach (about 0.2 miles). The river in this area was approximately 40–50 feet wide and 115 cm deep with a substrate of mucky sand. No in-stream vegetation was observed, but alder thicket was noted growing adjacent to the stream with upland forest beyond.
  - **Reach ER-5 (open water):** No wild rice was observed in this reach, which begins near River Mile 36 and extends about 0.2 miles. This is a shallow stretch of river (approximately 60 cm) that varied in width between 20 and 30 feet. The substrate here comprised cobbles and boulders and no vegetation was seen in the stream. Alder thicket was observed adjacent to the stream with upland forest beyond.
  - **Reach ER-6 (riffle):** No rice was found in this very short reach (384 feet). The width of the river here was typically 40–50 feet; the observed maximum depth was about 120 cm. The substrate comprised sand, gravel, cobble, and boulder. No in-stream vegetation was observed; but, similar to Reach 5, alder thicket was seen growing adjacent to the stream with upland forest beyond.
  - **Reach ER-7 (open water):** No wild rice was found in this reach, which extends about 0.4 miles. The river here was narrow (typically 10–20 feet) and shallow (about 30 cm), with cobble and boulder substrate. Upland forest was observed adjacent to and away from the stream; no in-stream vegetation was noted.
  - **Reach ER-8 (riffle):** No wild rice or other in-stream vegetation was seen in this 95-foot reach. The river widens here to approximately 30–40 feet and becomes deeper (about 100 cm). Riparian habitat adjacent to and away from the stream was upland forest.
  - **Reach ER-9 (open water):** No wild rice was observed in this 1.4-mile reach, which extends slightly beyond River Mile 34. The river ranged from about 10–30 feet in width and 15–120 cm in depth. The substrate consisted of sand, gravel, silt, and cobble. In-stream vegetation consisted of floating bur-reed and giant bur-reed. Hardwood swamp was observed adjacent to the stream; riparian habitat beyond the stream was not visible.
  - **Reach ER-10 (riffle):** No wild rice was seen in this 170-foot reach, which extends to the eastern edge of Waisanen Road. The river here was narrow (about 10–20 feet) and shallow (approximately 24 cm). Giant bur-reed was observed among cobbles and boulders. Riparian habitat adjacent to and away from the stream was upland forest.
  - **Reach ER-11 (open water):** No wild rice was found in this 217-foot reach. Here, the river was 30–40 feet wide with a maximum observed depth of about 90 cm. The substrate comprised silt and sand. In-stream vegetation consisted of floating bur-reed. Upland forest was seen adjacent to and away from the stream.
  - **Reach ER-12 (pool):** No wild rice was observed in this 157-foot reach. The width of the river ranged from 20–30 feet; the maximum depth was approximately 75 cm. The substrate comprised silt, sand, and bedrock. There was no in-stream vegetation; but, upland forest was observed adjacent to the stream.
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- **Reach ER-13 (open water):** No wild rice was found in this reach, which extends 1.3 miles—passing River Miles 33 and 32. The river here was approximately 120 cm deep and ranged from 10–40 feet in width. The substrate comprised sand, cobble, and silt. While there was no in-stream vegetation in the first half of this reach, shrub-carr and upland forest were observed. Floating bur-reed was scattered throughout the second half of the reach with alder thicket adjacent to the stream.
- **Reach ER-14 (riffle):** No wild rice was seen in this 306-foot-long riffle reach, which ranged from 20–30 feet in width and had a maximum observed depth of about 60 cm. Cobble and boulder substrate were noted with a greater variety of in-stream vegetation: floating bur-reed, narrow-leaved bur-reed, yellow pond-lily, arrowhead (*Sagittaria* spp.), and broadleaf arrowhead (*Sagittaria latifolia*).
- **Reach ER-15 (open water):** No wild rice was observed in this 0.8-mile reach. The river here was approximately 40–50 feet wide and 125 cm deep, with a substrate of silt and sand. In-stream vegetation comprised floating bur-reed, giant bur-reed, and yellow pond-lily; alder thicket was observed adjacent to the stream.
- **Reach ER-16 (riffle):** No wild rice was observed in this reach, which was approximately 0.2-miles long, 20–30 feet wide, and 45 cm deep. The substrate here was sand, gravel, and cobble. Floating bur-reed was seen in the stream. Riparian habitat adjacent to the stream consisted of alder thicket.
- **Reach ER-17 (open water):** Two (density 1) wild rice points were found slightly beyond River Mile 25, 2–5 feet from the right bank (Figure 3). Along this 7.5-mile stretch the river typically ranged from 20–50 feet and had an observed maximum depth of about 150 cm. The substrate comprised sand and silt, with some mucky silt. In-stream vegetation consisted of broadleaf arrowhead, floating bur-reed, giant bur-reed, northern manna grass, yellow pond-lily, grass-leaved arrowhead (*Sparganium rigida*), and floating pondweed. Riparian habitat adjacent to the stream primarily consisted of reed canary grass with some shrub-carr. Some upland forest and coniferous swamp areas were observed away from the stream. Small beaver dams were seen at the end of the reach. A water sample was collected at this location.

#### 3.1.1.5 Hay Lake 1

Density-1 wild rice was observed in the center of Hay Lake 1 (Figure 3). Because open water was not accessible from the shoreline, a line-of-sight survey was conducted from a single location on the east side. In-lake vegetation included peat moss (*Sphagnum* spp.), large cranberry (*Vaccinium macrocarpon*), lake sedge (*Carex lacustris*), and cattails (*Typha* spp). Coniferous forest was seen adjacent to and behind the lake.

#### 3.1.1.6 Sabin Lake

One small area of density-1 wild rice was observed on the west central shoreline of Sabin Lake, slightly west of the boat launch (Figure 4). Lake depth at this location was about 40 cm. Sabin Lake was surveyed

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on two separate days: the back bay and islands at the south end of the lake were surveyed by kayak on September 4 and the main waterbody was surveyed on September 11 by motorboat—starting at the boat launch and proceeding clockwise. The substrate consisted of sand, gravel, and cobble. Rock beach was found along the shoreline of the main lake, while upland forest was observed along the shoreline and beyond the lake in the southern bays. Vegetation in the main lake area included water-lily (*Nymphaea odorata*), floating bur-reed, pickerelweed (*Pontederia cordata*), spikerush (*Eleocharis palustris*), river horsetail (*Equisetum fluviatile*), cattails, and Richardson's pondweed (*Potamogeton richardsonii*). Other vegetation seen in the southern bays included grass-leaved arrowhead, broadleaf arrowhead, narrow-leaved bur-reed, yellow pond-lily, manna grass (*Glyceria* spp.), big-leaf pondweed (*Potamogeton amplifolius*), flat-stem pondweed (*Potamogeton zosteriformis*), ribbon-leaf pondweed (*Potamogeton ephedrus*), and grass-leaved pondweed (*Potamogeton graminea*).

#### **3.1.1.7 Wynne Lake**

No wild rice was found on Wynne Lake. The back bays of the lake were surveyed by kayak on September 4. The main lake was surveyed by motorboat on September 11, starting at the boat access on the northwest corner of the lake (Figure 4) and proceeding counter-clockwise. Similar to Sabin Lake, the substrate comprised sand, gravel, and cobble and the shoreline was primarily rock beach with upland forest beyond. In-lake vegetation included spikerush, bulrush (*Scirpus* spp. or *Schoenoplectus* spp.), yellow pond-lily, white water-lily, grass-leaved arrowhead, cattails, and reed canary grass.

#### **3.1.1.8 Embarrass Lake and Lower Embarrass Lake**

A single area of density-3 wild rice was found in these lakes (Figure 5), which were surveyed directly by motorboat. The survey started at the Embarrass Lake boat launch and proceeded clockwise around Bradley Island and the small island to its north, then down to the south end of Lower Embarrass Lake. Heading back north along the west shoreline of Lower Embarrass Lake, a small area (approximately 10 x 5 feet) of wild rice (density 3) was observed at the tip of the lake's southwest bay, near a beaver lodge. The depth here was approximately 200 cm. The shoreline in this area, and along the rest of both lakes, was primarily rock beach surrounded by upland forest. In general, the substrate comprised sand, gravel, and cobble. Small areas of vegetation punctuated the rocky shorelines. Commonly seen plants included spikerush, yellow pond-lily, cattails, river horsetail, reed canary grass, white water-lily, floating pondweed, broadleaf arrowhead, grass-leaved arrowhead, narrow-leaved bur-reed, and algae.

#### **3.1.1.9 Unnamed Lake**

Wild rice stands (density 1–3) were observed along the lake's shorelines and near the island (Figure 6). The survey started in the northern bay and moved counter-clockwise. Wild rice stands, covering areas of 5–50 feet, were generally located 0–15 feet from shore. These stands were often mixed with other vegetation, including yellow pond lily, white water lily, grass-leaved arrowhead, spike rush, water celery (*Vallisneria americana*), floating pondweed, Robbins' pondweed (*Potamogeton robbinsii*), and flat-stem pondweed.

#### **3.1.1.10 Fourth Lake, the Embarrass River, and Cedar Island Lake**

These waterbodies were surveyed by kayak, starting at the southeast shoreline of Fourth Lake, heading north on the Embarrass River, entering into Cedar Island Lake. Cedar Island Lake was surveyed counter-

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clockwise. The team then returned south through the Embarrass River back to Fourth Lake to survey its western shoreline. The following observations were made for the three waterbodies:

- **Cedar Island Lake:** Wild rice (density 1–5) was observed along most of the lake’s shoreline and center island (Figure 7). The rice was generally observed 0–20 feet from shore at water depths ranging from about 60–90 cm. The highest density rice (5) was located on the west side of the south island. Diverse vegetation found among the wild rice plants included yellow water-lily, white water-lily, arrowhead, bladderwort (*Utricularia macrorhiza*), flat-stem pondweed, spikerush, bur-reed, floating pondweed, Robbins’ pondweed, waterweed (*Elodea canadensis*), northern manna grass, water shield (*Brasenia schreberi*), and water milfoil.
- **Fourth Lake:** Wild rice (density 1–3) was found intermittently near the south and east shorelines, generally 10–20 feet from shore (Figure 8). No wild rice was observed on the north or west shorelines. Wild rice plants were mixed with other vegetation including grass-leaved arrowhead, bur-reed, white water-lily, spikerush, and floating pondweed.
- **Embarrass River:** Four areas of wild rice (density 1–2) were found intermittently in the Embarrass River channel between Fourth Lake and Cedar Island Lake (Figure 8). The largest of these was a 100 x 30-foot stand in the middle of the channel. Other vegetation included grass-leaved arrowhead, bur-reed, white water-lily, spikerush, and floating pondweed.

### 3.1.2 Partridge River Watershed

#### 3.1.2.1 Partridge River

The Partridge River was directly surveyed by kayak—from its confluence with Longnose Creek to just upstream of Colby Lake (Upper Partridge, Figure 9) and from approximately 1 mile downstream of Colby Lake to its confluence with the St. Louis River (Lower Partridge, Figure 11).

For the purposes of this report the Upper Partridge River was divided into three distinct reaches, with wild rice found in one reach. The Lower Partridge River was divided into 16 reaches, with wild rice observed in 11 reaches (Figure 12 [Reaches 1–11], Figure 13 [Reaches 12–13], and Figure 14 [Reaches 14–16]).

#### 3.1.2.2 Upper Partridge River

- **Reach UP-1 (open water):** No wild rice was found in this 1.9-mile reach, starting at the confluence of the Partridge River and Longnose Creek. The width of the river was typically 40–50 feet; the observed maximum depth ranged from 90–180 cm. The substrate comprised silt, sand, and boulders. In-stream vegetation consisted of emergent bur-reed, arrowhead, pondweed, and northern manna grass. Alder thicket grew adjacent to the stream with coniferous swamp observed beyond.
- **Reach UP-2 (riffle):** No wild rice was observed in this 0.8-mile reach. The river here was about 30–40 feet wide with an observed maximum depth of about 45 cm. Bedrock, gravel, boulder, and cobble formed the substrate. Commonly seen vegetation included northern manna grass,

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emergent bur-reed, floating and emergent arrowhead, and pondweed. Riparian habitat consisted of alder thicket adjacent to the stream with upland forest beyond.

- **Reach UP-3 (open water):** Wild rice (density 1–3) was first observed near River Mile 13.0 and was scattered for a distance of about 1.5 miles (Figure 10). The width of this 7.9-mile reach ranged from 50–250 feet and the observed maximum depth ranged from 60–180 cm. Silt substrate was found throughout, in combination with boulders, cobble, sand, gravel, and some muck. The highest density wild rice (density 3) was seen in an area with silt, muck, and boulders. Vegetation observed in the stream included northern manna grass, yellow pond-lily, floating bur-reed, emergent bur-reed, floating arrowhead, emergent arrowhead, pondweed, floating pondweed, river horsetail, star duckweed (*Lemna trisulca*), and slender naiad (*Najas flexilis*). Similar to reaches UP1 and UP2, alder thicket grew adjacent to the stream. Areas of upland forest and coniferous swamp were observed further away.

### 3.1.2.3 Lower Partridge River

- **Reach LP-1 (open water):** Wild rice (density 2–4) was found on both banks of this 837-foot reach, which begins slightly upstream of River Mile 5.5. The width of the river here was about 75 feet, while the observed maximum depth ranged from approximately 40–100 cm. The substrate at the start of the reach was gravel and rock, transitioning to primarily muck with some rocky features. Common in-stream vegetation included yellow pond-lily, white water-lily, water-shield, and floating pondweed. Riparian habitat comprised shrub-carr and mixed coniferous/hardwood forest adjacent to and away from the river.
  - **Reach LP-2 (riffle):** No wild rice was found in this very short (116 feet) riffle reach. The width of this reach was 50–100 feet, the observed maximum depth was about 60 cm, and the substrate was rocky. The only forms of vegetation observed were water-shield in the stream and shrub-carr adjacent to it.
  - **Reach LP-3 (open water):** Wild rice (density 1–3) was found on the right bank of nearly the entire 0.2-mile reach. Rice was also found along the upper- and lower-third of the left bank (density 3 and density 1). The river in this area ranged from about 50–250 feet in width and from approximately 20–65 cm in depth. Substrate at the start of the reach was rocky, later becoming mucky with some rocky shoreline. Vegetation in the stream comprised bladderwort, slender naiad, white water-lily, and northern manna grass. A mix of shrub-carr and wet meadow was seen adjacent to the river with mixed coniferous/hardwood and upland forest beyond.
  - **Reach LP-4 (riffle):** No wild rice was found in this 922-foot riffle reach, which extends just past River Mile 5.0. The characteristics of this reach were similar to those in LP-2. The width of the river was between 50–100 feet, and the observed maximum depth was approximately 15 cm. Boulders formed the substrate and no vegetation was observed in the stream. Riparian habitat consisted of shrub-carr adjacent to the river with mixed coniferous/hardwood and upland forest beyond.
  - **Reach LP-5 (open water):** Low-density wild rice was found in the upper and middle sections of this 0.23-mile reach. At this location the river ranged from 100–250 feet in width and the
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observed maximum depth ranged from about 30–55 cm. The substrate was mucky with gravelly material in sections throughout. Rice was observed on the left bank at the beginning of the reach (density 2). Rice was also found on the right bank (density 1) in the middle of the reach, heavily mixed with river horsetail. Other in-stream vegetation included yellow pond-lily, water-shield, floating pondweed, bladderwort, broad-leaf arrowhead, grass-leaved arrowhead, and floating bur-reed. Coniferous forest (with some areas of shrub-carr) grew adjacent to and beyond the river.

- **Reach LP-6 (riffle):** No wild rice was observed in this 410-foot riffle reach. The width of the river here was typically 50–100 feet with an observed maximum depth of about 12 cm. The only in-stream vegetation was algae growing on the boulder substrate. The riparian habitat consisted of hardwood swamp with upland forest beyond.
  - **Reach LP-7 (open water):** Two small areas of low-density wild rice (density 1–2) were seen in this 717-foot reach which passes River Mile 4.5. In this reach the river width was typically 40–50 feet and the observed maximum depth ranged from 30–50 cm. The only in-stream vegetation was arrowhead, which was mixed with wild rice. The area adjacent to and beyond the river bank was forested; some alder thicket was also seen along the banks.
  - **Reach LP-8 (riffle):** No wild rice was found in this very short (131 feet) riffle reach. A substrate of cobbles was noted, with an observed maximum water depth of about 15 cm. The width of the river here was approximately 40–50 feet. Areas adjacent to and beyond the river bank were forested.
  - **Reach LP-9 (open water):** Wild rice (density 1–5) was found along both shorelines in this reach, which extends 0.24 miles to Highway 110. The areas of greatest density (4–5) were primarily along the right bank. The river here ranged from approximately 50–100 feet, with an observed maximum depth of about 60 cm. The substrate was predominantly muck, sand, and gravel, with some boulders on the banks and in the middle of the river. In some areas river horsetail was found intermixed with rice along the shoreline. Other commonly seen in-stream vegetation included floating pondweed, long-leaf pondweed (*Potamogeton nodosus*), waterweed, watershield, bladderwort, slender naiad, arrowhead, grass-leaved arrowhead, white water lily, yellow pond-lily, floating bur-reed, and spikerush. The riparian habitat consisted of reed canary grass adjacent to the stream with upland forest 10–20 feet beyond.
  - **Reach LP-10 (riffle):** Two wild rice points (density 3 and 4) were observed toward the end of this very short reach, which extends about 397 feet from Highway 110. The width ranged from approximately 50–100 feet and the observed maximum depth was about 30 cm. The substrate comprised muck, sand, cobbles, and boulders. Floating pondweed and grass-leaved arrowhead were commonly seen in the stream. Riparian habitat consisted of reed canary grass adjacent to the river with upland forest 10–20 feet beyond.
  - **Reach LP-11 (open water):** Wild rice areas (densities 3–5) extended along both shorelines through most of this 0.4-mile reach, with some lower-density points (1–2) observed near the end.
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The observed width and depth here were similar to LP-1 (about 50–100 feet wide and 60 cm deep). Muck, sand, cobbles, and boulders were observed as substrate. Common in-stream vegetation included grass-leaved arrowhead, water lily, sweet flag (*Acorus americanus*), yellow pond-lily, water celery, arrowhead, and bur-reed. Hardwood swamp and reed canary grass were seen adjacent to the river with upland forest 50–100 feet beyond.

- **Reach LP-12 (riffle):** Wild rice was found in the lower half of this reach, which starts past River Mile 3.5 and extends approximately 0.9 miles. The largest rice density (3) was observed near River Mile 2.9. In this section, the river is typically 40–50 feet wide, with a maximum observed depth of 60 cm. The substrate comprised sand with cobbles, boulders, and gravel. In-stream vegetation included northern manna grass, grass-leaved arrowhead, broadleaf arrowhead, bur-reed, floating bur-reed, water-lily, waterweed, spikerush, unidentified pondweed, floating pondweed, and water celery. Hardwood swamp with cedar (*Thuja occidentalis*) was observed near the river with upland forest 50–100 feet beyond.
  - **Reach LP-13 (open water):** A single wild rice point (density 2) was found near the start of this 1.8-mile reach, giving way to wild rice areas of varying density (1–5) along both sides of the river through the rest of the reach. The highest density rice (density 5) extended about 0.2 miles, starting just above River Mile 1.6. The width of the river in this reach ranged from about 50–100 feet. The observed maximum depth was about 60 cm and the substrate consisted of muck, sand, gravel, cobbles, and boulders. Floating pondweed, unidentified pondweed, water lily, waterweed, grass-leaved arrowhead, bur-reed, spikerush, water celery, and yellow pond-lily were observed in the stream. Reed canary grass grew near the water with upland forest 10–20 feet beyond.
  - **Reach LP-14 (riffle):** No wild rice was observed in this very short reach (875 feet). This reach is similar to LP-5 in width (typically 50–100 feet) but shallower (20 cm vs. 60 cm). The substrate comprised muck, sand, gravel, cobble, and some boulders. No vegetation was visible in the water. The riparian habitat consisted of reed canary grass near the water with upland forest beyond.
  - **Reach LP-15 (pool):** A very dense area of wild rice (density 5) was found along the right bank at the start of this reach (beginning above River Mile 0.6), followed by an area of lower-density rice (2). No rice was observed on the left bank. The width of this 326-foot-long reach ranged from approximately 50–100 feet; the observed maximum depth was about 30 cm. The substrate comprised muck over sand, gravel, and cobbles. Common in-stream vegetation included grass-leaved arrowhead, broadleaf arrowhead, water celery, and water lily. Reed canary grass was seen adjacent to the stream with upland forest 10–20 feet beyond.
  - **Reach LP-16 (open water):** Low-density (1) areas of wild rice were scattered primarily along the right bank of this reach, which extends more than 0.5 miles to the Partridge River's confluence with the Saint Louis River. The width of the river here was about 50–100 feet; the observed maximum depth was about 40 cm. The substrate was composed of muck, sand, gravel, cobbles, and boulders. Duckweed (*Lemna minor*), grass-leaved arrowhead, broadleaf arrowhead, water lily, unidentified pondweed, flat-stem pondweed, and water celery were identified in the stream. Reed
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canary grass and upland forest continued to be observed along the banks of the river and beyond.

#### 3.1.2.4 Wyman Creek

No wild rice was identified on Wyman Creek (Figure 15). The survey started approximately one-half mile upstream of the Dunka Road crossing and concluded at the Partridge River. Because much of the creek was inaccessible by kayak (comprising shrub wetland and beaver dams), a line-of-sight survey was conducted at points where the channel could be directly observed and photographed. The information below characterizes those observation points but is not meant to describe the creek in its entirety. There were no observation points taken between River Mile 7.0 and River Mile 3.0.

- **Observation point WC-1 (narrow channel):** At this culvert observation point Wyman Creek was approximately 30 feet wide and 36 cm deep with a rocky/gravelly substrate. In-stream vegetation included cattails, soft-stem bulrush, and river horsetail. Berms on either side of the inlet were dominated by birch (*Betula* spp.).
- **Observation point WC-2 (narrow channel):** The creek was observed at a culvert near River Mile 8.0. The width here was approximately 15 feet and no in-stream vegetation was noted. Cattail marsh was found adjacent to the stream with shrub-carr and hardwood forest beyond.
- **Observation point WC-3 (open water):** The creek was observed at a culvert slightly downstream of River Mile 7.5. The average width was about 30 feet, the observed maximum depth was approximately 70 cm, and the substrate comprised exposed muck. No in-stream vegetation was observed. Riparian habitat adjacent to the stream included shallow marsh, cattail, woolgrass (*Scirpus cyperinus*), and Canada bluejoint. Mixed hardwood and coniferous forest were seen further away from the stream.
- **Observation point WC-4 (narrow channel):** At this observation point (near River Mile 2.5) Wyman Creek was about 5 feet wide. There was no in-stream vegetation; but, shallow marsh, lake sedge, and Canada bluejoint grew adjacent to the stream. Shrub-carr was observed further away from the stream with mixed hardwood and coniferous forest behind.
- **Observation point WC-5 (narrow channel):** The creek was very narrow (3 feet) at this observation point between River Mile 2.5 and 2.0. The substrate comprised rock and boulders in water approximately 30 cm deep. There was no vegetation in the stream. The riparian habitat included shallow marsh adjacent to the stream; shrub-carr was observed further away with coniferous forest behind.
- **Observation point WC-6 (open water):** Wyman Creek was observed at a railroad bridge crossing downstream of River Mile 1.5. The creek here was about 20–50 feet wide with a mucky substrate. Yellow water-lily was observed in the creek; shallow marsh was found adjacent to the stream with mixed hardwood and coniferous forest beyond.

- **Observation point WC-7 (open water):** Wyman Creek was observed at County Road 666 and the railroad crossing (near River Mile 0.5). The width of the creek here was approximately 8 feet, and the observed maximum depth was about 30 cm. The substrate was rocky/gravelly. No vegetation was observed in the creek. Riparian habitat adjacent to the stream was dominated by shrub-carr; shrub-carr was also seen further away from the stream, in addition to mixed hardwood forest.
- **Observation point WC-8 (open water):** This observation point was taken between River Mile 0.5 and the Partridge River. The width of the creek here was approximately 30 feet and the substrate was mucky. In-stream vegetation included long-leaf pondweed, arrowhead, and yellow water-lily. Riparian habitat adjacent to the creek included shallow marsh dominated by Canada bluejoint. Shrub-carr and mixed hardwood and coniferous forest were observed further beyond the stream.

### 3.1.2.5 Second Creek

The Second Creek survey, from County Road 666 to the creek's confluence with the Partridge River, was primarily conducted through direct observation via kayak (Figure 16). In portions of the creek too shallow and rocky to traverse by kayak, observations were made while carrying the kayaks over rocks or beaver dams. A majority of Second Creek was meandering channel marked by intermittent open water and pools. Wild rice (densities 1–4) was identified in two of the 11 defined reaches.

- **Reach SC-1 (open water):** No wild rice was found in this reach, which begins at approximately River Mile 9.0 and extends 3.6 miles west, past SD001, Knox Pit, and the Area 2WX Pit. Stream widths in this reach ranged from 10–100 feet; maximum observed depth was approximately 120 cm. Substrate comprised muck, sand, gravel, cobble, and boulders. In-stream vegetation consisted of Bur-reed, water milfoil, yellow pond-lily, sago pondweed (*Stuckenia pectinata*), flat-stem pondweed, unidentified pondweed, bladderwort, muskgrass (*Chara* spp.), arrowhead, water lily, and coontail (*Ceratophyllum demersum*). Reed canary grass, purple loosestrife (*Lythrum salicaria*), cattail marsh, and alder thicket was seen adjacent to the stream bank with upland forest beyond. Beaver dams were frequently observed.
- **Reach SC-2 (narrow channel):** No wild rice was observed in this very narrow, shallow reach (about 5–10 feet wide and 20 cm deep). Direct observation was conducted by foot, starting near River Mile 5.5 and extending about 0.6 miles. As in SC-1, beaver dams were frequent. The substrate here was mucky with sand, gravel, and cobbles. In-stream vegetation was limited to arrowhead, water milfoil, and bur-reed. Riparian habitat consisted of reed canary grass adjacent to the stream bank with alder thicket beyond.
- **Reach SC-3 (open water):** No wild rice was observed. Numerous beaver dams of various sizes and conditions were seen along this 0.7-mile reach, which begins near River Mile 4.8. The width of the creek here was typically 20–40 feet, with a maximum observed depth of about 120 cm. The substrate comprised muck, sand, and boulders. Common in-stream vegetation included arrowhead, water milfoil, bur-reed, water lily, yellow pond lily, floating pondweed, sago pondweed, flat-stem pondweed, cattail, and water smartweed (*Persicaria amphibia*). Riparian

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habitat adjacent to the stream was diverse, consisting of Bulrush (*Scirpus* spp.), cattails, reed canary grass, sedges (*Carex* spp.), flat sedge (*Cyperus* spp.), and thistle (*Cirsium arvense*). Alder thicket and coniferous swamp were observed beyond the stream bank.

- **Reach SC-4 (narrow channel):** No wild rice was found in this 327-foot-long reach. A large beaver dam was found at the start of this reach, near River Mile 4.1. The width here was typically 10–20 feet and the maximum observed depth was approximately 10 cm. The substrate consisted of boulders. There was no in-stream vegetation, but cedars and alder thicket were observed growing adjacent to the stream and coniferous swamp beyond.
  - **Reach SC-5 (open water):** No wild rice was found in SC-5, which starts just above River Mile 4.0 and extends approximately 1.6 miles. The creek became wider (about 10–30 feet) and deeper (approximately 100 cm) here. The substrate consisted of boulders, with some mucky areas. Sedges, bulrush, and bur-reed were found in the stream, while the riparian habitat adjacent to and beyond consisted of cattail marsh and alder thicket.
  - **Reach SC-6 (narrow channel):** No wild rice was identified in this reach. The narrow channel begins slightly above River Mile 2.5 and extends approximately 735 feet. The width of the creek was about 40–50 feet and the observed maximum depth was about 40 cm. Substrate comprised cobbles and boulders with muck between. There was no in-stream vegetation; but, alder thicket and cedars were observed near the stream with upland forest beyond.
  - **Reach SC-7 (open water):** Wild rice (density 1 and 2) was observed on both sides of the channel at approximately the 2.2 River Mile mark (Figure 17). Along its approximately 1.5-mile length, this reach showed great variation in width (30–250 feet). The maximum observed depth was about 100 cm, and the substrate was mucky with gravel and boulders. Water lily, common pondweed, narrow-leaved pondweed, bur-reed, arrowhead, bulrush, woolgrass, and yellow pond-lily were all observed in the stream. Cattail marsh with reed canary grass grew near the stream; coniferous swamp was seen both adjacent to the stream and beyond.
  - **Reach SC-8 (narrow channel):** No wild rice was seen in this narrow (approximately 10–20 feet), shallow (20 cm) section of the creek. The beginning of the reach, which extends about 564 feet past River Mile 1, was marked by a beaver dam. Boulders comprised the substrate and no in-stream vegetation was observed. Riparian habitat consisted of cedars and hardwood swamp.
  - **Reach SC-9 (open water):** No wild rice was observed in this reach, which extends less than a half mile, just past River Mile 0.5. The width of the creek typically ranged from 40–50 feet and the observed maximum depth was about 70 cm. The substrate was mucky with sand, gravel, and boulders. In-stream vegetation was limited to bur-reed. Reed canary grass grew near the stream with coniferous swamp beyond the banks.
  - **Reach SC-10 (riffle):** No wild rice was found in this 577-foot reach—the only riffle reach on Second Creek. The width of the creek here was approximately 30–40 feet, and the observed maximum depth was about 40 cm. The substrate comprised boulders. No in-stream vegetation
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was observed; but, riparian habitat consisted of reed canary grass, black ash (*Fraxinus nigra*), and hardwood swamp.

- **Reach SC-11 (narrow channel):** Wild rice of varying densities (1-4) was found on both sides of this 1,475-foot narrow channel (Figure 12). The reach starts just above the 0.1 River Mile mark and ends close to the creek's convergence with the Partridge River. The width here typically ranged from 20–30 feet, and the maximum observed depth was about 100 cm. The substrate was composed of muck and sand. Arrowhead, water lily, bulrush, soft-stem bulrush (*Schoenoplectus tabernaemontani*), bur-reed, and spikerush were found in the stream. Reed canary grass was predominant adjacent to the stream with upland forest beyond.

### 3.1.3 Pike River Watershed

Wild rice was observed in all three water bodies surveyed in the Pike River Watershed: Little Rice Lake, Hay Lake 2, and a portion of the Pike River between the two lakes (Figure 18).

#### 3.1.3.1 Little Rice Lake

Wild rice stands of density 1 to 5 were observed throughout the lake, which was directly surveyed by kayak, starting at the intersection with the Pike River and proceeding clockwise. The depth of the lake at its intersection with the Pike River was approximately 140 cm; the lake's substrate was muck. The predominant form of in-lake vegetation is wild rice, growing about 5–50 feet from shore. Long-leaf pondweed and flat-stem pondweed were also commonly seen. Adjacent shoreline habitat consisted primarily of wet meadow or shrub-carr. Conifer and black spruce swamp were observed further away from the shore.

#### 3.1.3.2 Pike River/Hay Lake Outlet

The Pike River was surveyed from its confluence with Little Rice Lake to the Hay Lake Outlet. The Hay Lake Outlet was surveyed from its intersection with the Pike River to Hay Lake 2. Both water bodies were surveyed by kayak.

- **Pike River:** Wild rice stands ranging in density from 2 to 4 were observed from the river's confluence with Little Rice Lake slightly past River Mile 3.8. No rice was found between this point and the river's confluence with the Hay Lake Outlet (west). The width of the river in this area ranged from approximately 50–100 feet; observed maximum depths ranged from about 120–140 cm. The predominant substrate was muck. The most common forms of in-stream vegetation were flat-stem pondweed, long-leaf pondweed, floating bur-reed, yellow pond-lily, bladderwort, marsh cinquefoil, and broad-leaf arrowhead. Shrub-carr and reed canary grass were observed adjacent to the river with conifer swamp further away.
  - **Hay Lake Outlet:** No wild rice was found in the Hay Lake Outlet, which extends 0.4-miles from the Pike River to Hay Lake 2. The channel of the Hay Lake Outlet was approximately 5–10 feet wide, and its observed maximum depth was about 50 cm. The substrate was mucky. There was no in-channel vegetation; however, cattails were observed adjacent to the channel and reed canary grass grew both adjacent to the channel and beyond, up to a conifer forest.
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### 3.1.3.3 Hay Lake 2

Wild rice (density 1) was observed at the entrance to the lake from the Hay Lake Outlet and on the northwest shoreline. The lake was surveyed by kayak, starting at the outlet and proceeding clockwise. The water depth in areas surveyed ranged from approximately 30 to 57 cm. The substrate was muck. Commonly observed vegetation included water-shield, long-leaf pondweed, floating bur-reed, yellow pond-lily, bulrush, and river horsetail. Reed canary grass and bulrushes were seen on the shoreline, and shrub-carr and conifer forest beyond the lake.

## 3.1.4 St. Louis River Estuary

Wild rice stands (density 1–5) were observed. The St. Louis River (Lower and Upper Estuaries) was directly surveyed by motor boat (Figure 19). The extent of the surveyed area was from Munger Landing in Duluth to Chamber's Grove Park in Fond du Lac. The Estuary has a wide main channel (up to 3,800 feet at its widest point) with intermittent stands of wild rice, primarily growing in back bays.

### 3.1.4.1 Lower Estuary

The direct survey of the Lower Estuary started and ended at Munger Landing on the estuary's northwest side, proceeding through the open channel and back bays in a generally counter-clockwise direction. There were two wild rice points (density 1) at the start of the survey, but none along the widest portions of the channel or on the western shoreline—with the exception of a point in Radio Tower Bay. The substrate in these areas consisted primarily of silt, cobble, and sand—with logs and woody debris also observed in Radio Tower Bay. Common in-stream vegetation included water celery, bulrush, common reed (*Phragmites australis*), yellow pond-lily, arrowhead, white water-lily, Richardson's pondweed, narrow-leaf pondweed, floating pondweed, water milfoil, coontail, and floating bur-reed. Riparian habitat consisted of cattails, purple loosestrife, and bulrushes adjacent to the river with upland forest beyond.

Scattered areas of rice (density 1–2) were found primarily in the bays along the Lower Estuary's eastern shoreline. Water depth at these rice points ranged from approximately 30–200 cm; substrate was silt or silty clay. Vegetation among rice plants included arrowhead, floating pondweed, Richardson's pondweed, yellow pond-lily, white water-lily, bur-reed, floating bur-reed, coontail, water milfoil, and bladderwort. Cattails and reed canary grass were observed adjacent to the river with upland forest beyond.

### 3.1.4.2 Upper Estuary

The direct survey of the Upper Estuary started and ended at the Boy Scout Landing in New Duluth, proceeding through the main channel and bays in a generally counter-clockwise direction. Wild rice of varying density (1–5) was found in most of the Upper Estuary's back channels and bays. The highest density rice (5) was found in the corner of a northwest bay, roughly parallel to River Mile 2.5. West of this area, however, there was no rice (around Nekuk Island and to the survey's upstream extent at Chamber's Grove Park). Water depth at wild rice locations ranged from about 60 to 150 cm. Substrates included silt, silty clay, muck, silty muck, and sand. Vegetation common to the Lower Estuary was also found in the Upper Estuary. Sessilefruit arrowhead, narrow-leaved bur-reed, flat-stem pondweed, star duckweed, sago pondweed, and Canadian waterweed were also observed. Cattails were commonly seen adjacent to the river with upland forest beyond.

## 3.2 Quantitative Wild Rice Survey Results

Mean stem counts per 0.5m<sup>2</sup> as measured during grid sampling surveys in 2009–2014 are shown in Figures 20–25. Plant heights are recorded on data sheets in Appendix B. Biomass results, including plant weights and seed count from plants collected during grid sampling surveys in 2010, 2011, 2013, and 2014 are shown on Figures 26–35; mean stem densities (stems/0.5m<sup>2</sup>) by grid according to year are shown on Figures 36–37. This information was not compiled in 2012 due to very little wild rice growth.

## 3.3 Macrophyte Survey Results

Macrophyte species were documented at various locations along stream reaches. The plants observed include submergent, floating, and emergent macrophytes in the water, and in many cases, plants growing along the immediate shoreline. Large Table 1 lists the species observed and their occurrence in each surveyed water body. The most observation points were on the Lower Partridge River. Over 45 taxa of vascular plants were identified.

The most common submerged species included coontail (*Ceratophyllum demersum*), waterweed (*Elodea canadensis*), water milfoil (*Myriophyllum verticillatum*), pondweeds (*Potamogeton nodosus*, *P. richardsonii*, *P. robbinsii*, *P. zosteriformis*, and *Stuckenia pectinata*), bladderwort (*Utricularia macrorhiza*), and water celery (*Vallisneria americana*). The most frequently observed floating species include water shield (*Brasenia schreberi*), yellow pond-lily (*Nuphar variegata*), white water-lily (*Nymphaea odorata*), water smartweed (*Polygonum amphibium*), pondweeds (*Potamogeton amplifolius*, *P. epihydrus*, and *P. natans*), and floating bur-reed (*Sparganium fluctuans*). The most common emergent species were marsh cinquefoil (*Comarum palustre*), spikerush (*Eleocharis palustris*), river horsetail (*Equisetum fluviatile*), northern mannagrass (*Glyceria borealis*), arrowheads (*Sagittaria latifolia* and *S. rigida*), soft-stem bulrush (*Schoenoplectus tabernaemontani*), and narrow-leaved bur-reed (*Sparganium emersum*).

## 3.4 Water Quality Monitoring Results

A total of 35 water samples were collected from 16 different water bodies near wild rice stands during the 2014 wild rice survey. Collection locations are shown on Figure 38. Full water quality results are presented in Large Table 2 and Large Table 3. Sulfate concentrations by location are depicted on Figure 39, and concentration ranges by water body are presented in Table 3-1.

Second Creek had significantly higher sulfate concentrations than the rest of the water bodies (859 mg/L maximum), or more than twice the level in Spring Mine Creek, which had the second highest concentration. While Trimble Creek had the lowest sulfate value (0.76 mg/L), it also had the highest concentrations of calcium and potassium. Hay Lake 2 had the lowest concentrations of all parameters except sulfate and potassium. Lakes in the Embarrass River chain (Sabin Lake, Wynne Lake, Embarrass Lake, Unnamed Lake, Cedar Island Lake) had comparable concentrations of all water quality parameters, with values generally differing by only a few mg/L or less (Large Table 3).

**Table 3-1 Maximum, Minimum, and Average Sulfate Concentrations (mg/L) in 2014**

Water Body	Sulfate, as SO <sub>4</sub> (mg/L)		
	Max	Min	Avg
Cedar Island Lake	13.1	13	13.1
Embarrass Lake	16.9	14.0	15.5
Embarrass River	188	36.8	82.2
Hay Lake 2	1.3	1.3	1.3
Little Rice Lake	2.3	2.3	2.3
Lower Partridge	16.4	6.2	10.4
Partridge River	7.3	7.3	7.3
Pike River	2.7	2.3	2.5
Pokegama Bay	10.9	6	7.9
Sabin Lake	16.1	15.4	15.8
Saint Louis River	13.4	6.8	11
Second Creek	859	824	841.5
Spring Mine Creek	406	326	366
Trimble Creek	0.76	0.76	0.76
Unnamed Lake	13.8	13.8	13.8
Wynne Lake	16.8	14.4	15.6

A quality assurance and quality control (QA/QC) review was completed to assess the validity of the analytical surface water results. This review was performed in accordance with Barr's standard operating procedures (SOPs) for routine data evaluation, which are based on *The National Functional Guidelines for Inorganic Data Review* (Reference (18)). Data evaluation included a review of technical holding times, preservation, method blanks, laboratory control samples, matrix spike samples, and data package completeness. Barr-defined qualifiers, based on USEPA-defined qualifiers, were assigned for this project in the data summary tables and the associated database during the evaluation process. All reported data has been determined to be acceptable and usable as presented in the data summary tables.

Results were reported to the method detection limit (MDL) to maintain consistency with additional water quality reporting. Results between the MDL and reporting limit (RL) were qualified (j), indicating estimated concentrations.

Analyte concentration detections in laboratory blank samples were compared to project sample analyte concentrations. Any sample concentration within five times the blank sample detection concentration was qualified and should be considered a potential false positive concentration.

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## 4.0 Summary

### 4.1 Summary of Results by Watershed

#### 4.1.1 Embarrass Watershed

In general, observations of wild rice in 2014 were very similar to those made in 2013 (Reference (16)). Cedar Lake saw the greatest change, with greater density rice (1–5 in 2014, compared to 1–3 in 2013) observed at more locations along the shoreline.

- **Spring Mine Creek:** No rice was observed in Spring Mine Creek in 2014 or 2013.
- **Trimble Creek:** No rice was observed in Trimble Creek in 2014 or 2013.
- **Unnamed Creek:** No rice was observed in Unnamed Creek in 2014 or 2013.
- **Embarrass River:** Low-density wild rice (density 1) was found in approximately the same locations (near River Miles 47 and 25) in 2014 and 2013. The total area of rice was slightly larger in 2013.
- **Hay Lake 1:** Low-density wild rice (density 1) covered the extent of Hay Lake in 2013; the rice observed in 2014 was confined to the center of the lake.
- **Sabin Lake:** One small area of density-1 wild rice was observed on the west central shoreline of Sabin Lake in 2014. In 2013 no rice was found.
- **Wynne Lake:** No rice was found on Wynne Lake in 2014; a single stem was observed in 2013.
- **Embarrass Lake/Lower Embarrass Lake:** A small area (approximately 10 x 5 feet) of wild rice (density 3) was seen at the tip of the southwest bay of Lower Embarrass Lake in 2014. Density-1 rice was seen at this location in 2013, as well as a single wild rice plant on the southeast side of Lower Embarrass Lake.
- **Unnamed Lake:** Wild rice (density 1–3) was found in Unnamed Lake in roughly the same locations in 2014 and 2013. While the rice areas identified in 2013 appear to be larger in size, the amount of mid-density rice (density 3) increased in 2014.
- **Fourth Lake:** Wild rice (density 1–3) was found on the east side of Fourth Lake in both 2014 and 2013. While the rice areas identified in 2013 appear to be larger in size, the amount of mid-density rice (density 3) increased in 2014.
- **Cedar Island Lake:** Rice was found in more locations along the shoreline of Cedar Lake in 2014 and with greater density. In 2014 high-density rice was found near the lake's south island (density 5) and at three locations on the east and northwest shorelines (density 4). No high-density rice (4–5) was observed in 2013.

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### 4.1.2 Partridge Watershed

- **Upper Partridge River:** Wild rice was observed in roughly the same areas in 2014 and 2013, near River Mile 13 and River Mile 11.5. However, in 2014 there was some density-2 and density-3 rice observed; only density-1 rice was observed in 2013.
- **Lower Partridge River:** Intermittent wild rice stands, with a range of densities, was identified in approximately the same locations of the Lower Partridge River in 2014 and 2013. There were, however, a greater number of mid- to high-density stands and points (density 3–5) identified in 2014. Grid surveys also showed higher rice densities in 2014, as measured by stem counts per 0.5<sup>2</sup> meter (Table 4-1).
- **Wyman Creek:** No wild rice was found on Wyman Creek in 2014 or 2013.
- **Second Creek:** Wild rice was found in roughly the same locations on Second Creek in 2014 and 2013—near its confluence with the Partridge River and between River Mile 2.0 and 2.5. However, the density ratings of rice at many of these locations increased between 2014 and 2013.

### 4.1.3 Pike River Watershed

- **Little Rice Lake:** In 2014 wild rice stands of density 1 to 5 were observed throughout the lake, while in 2013 rice (density 1–3) was confined to shoreline areas around the lake and island. Grid surveys also showed significantly higher rice densities in 2014 as measured by stem counts per 0.5<sup>2</sup> (Table 4-1). The increases in wild rice density between 2012 and 2014 are quite notable; in 2012 only low-density (density 1) was observed.
- **Pike River/Hay Lake Outlet:** Wild rice was found in approximately the same Pike River locations in 2014 and 2013. However, higher density rice was found in 2014 (density ratings 2–3 in 2014 compared to 1–2 in 2013). No rice was found in the Hay Lake Outlet in either 2014 or 2013.
- **Hay Lake 2:** Significantly less rice was seen in 2014 than in 2013. In 2014 density-1 rice was found at the entrance to the lake from the outlet and on the northwest shoreline (similar to 2012 observations). In 2013 density-1 rice was found throughout the lake.

### 4.1.4 St. Louis River Estuary

- **Upper Estuary:** Low-density rice (density 1–2) was observed in the lower estuary, primarily scattered in the southeastern bays—where it was not observed in 2013. In 2013 some rice was seen on the shoreline of the wide main channel; this was not the case in 2014.
  - **Lower Estuary:** In 2014 wild rice was found in most of the Upper Estuary's back channels and bays. There were a greater number of rice areas than observed in 2013 and greater densities. In 2014 rice densities ranged from 1–5; in 2013 only low-density (density 1–2) was observed.
  - **Pokegama Bay:** An extensive survey of Pokegama Bay was not performed in 2014, but grid sampling was performed. This sampling revealed a significant decrease in sample-area stems per 0.5 m<sup>2</sup> (Table 4-1).
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## 4.2 Grid Sampling Results

Rice was present at all grid sampling locations in 2014 and at greater density year-over-year in eight of 12 grid locations (Table 4-1). The exceptions were one of two grid locations in Cedar Island Lake (Grid 29) and all four grids in Pokegama Bay, where the change in density was quite notable. Year-over-year sulfate levels increased in exactly half of the grid locations—three in the Lower Partridge River and three in Pokegama Bay. The increases in Pokegama Bay ranged from 2 to 57%; however, only one grid (Grid 92, 10.9 mg/L) had levels above the Minnesota sulfate standard of 10.0 mg/L. Sulfate levels in the Lower Partridge grids rose by between 28% and 34% from 2013 to 2014. All three grids, however, also showed increases in wild rice density.

**Table 4-1 2014 and 2013 Wild Rice Densities and Sulfate Concentrations at Grid Sampling Locations**

	2014		2013	
	Stems per 0.5 <sup>2</sup> m	Sulfate in mg/L	Stems per 0.5 <sup>2</sup> m	Sulfate in mg/L
Lower Embarrass Lake (Grid 22)	14.8	2.3	4	2.8
Unnamed Lake (Grid 21)	0.5	13.8	0.3	16.6
Cedar Island Lake (Grid 29)	2.1	13.1	11.0	16.1
Cedar Island Lake (Grid 30)	92.1	13	38.4	16.2
Lower Partridge River (Grid 26)	2.2	192	0.1	159
Lower Partridge River (Grid 27)	84.7	274	45.8	190
Lower Partridge River (Grid 28)	8.4	40.4	5.8	26.9
Little Rice Lake (Grid 19)	40.4	2.3	3.1	2.7
Little Rice Lake (Grid 20)	14.8	2.3	4	2.8
Pokegama Bay (Grid 90)	0.1	6.7	30.2	4.6
Pokegama Bay (Grid 91)	0.4	6	27.1	5.9
Pokegama Bay (Grid 92)	0.1	10.9	35.6	4.7

## 4.3 Summary

Overall, results of the 2009 through 2014 wild rice surveys identify trends of wild rice growth in water bodies in the study area. In certain lakes and stream reaches wild rice is consistently present, in others it is intermittently present, and in some it is consistently absent. If wild rice is absent, it is not possible to definitively determine that the water body does not provide suitable wild rice habitat. It is possible, however, to observe which areas exhibit habitat characteristics that are more or less conducive to wild rice growth. Stream reaches with rocky or boulder substrates, fast-flowing water, or dense shrub vegetation encroaching over the stream are not likely to provide favorable habitat conditions for wild rice growth. Stream reaches with mucky substrates, open water with direct sunlight, presence of other macrophytes, and water depths of 1–4 feet could provide suitable habitat for wild rice growth.

Interpreting the observed patterns of wild rice growth is also complex because of the cyclical nature of wild rice populations (cycling occurs over 4–6 years) and the potential effects of many other factors

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including variability in water level and weather. Some years, like 2012, may be “bust” years with very low wild rice growth. Wild rice populations may also shift within a water body or along a river reach. Wild rice seed present in the sediment may grow during some portion of the 4- to 6-year cycle—not appearing in the first few years but observed in subsequent years. Due to this cyclical nature of wild rice growth, we recommend that field surveys continue to be conducted yearly. By conducting surveys over the length of more than one cycle, PolyMet could build a more complete understanding of wild rice growth and of habitat in study area water bodies that potentially supports wild rice growth.

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## Large Tables



Scientific Name(2)	Common Name	Cedar Island Lake		Embarrass Lake		Embarrass River		Fourth Lake		Hay Lake (2), Pike River, Little Rice Lake		Partridge River (Lower)		Partridge River (Upper)		Sabin Lake, Wynne Lake, Embarrass Lake		Second Creek		Spring Mine Creek, Wyman Creek, Trimble Creek, Unnamed Creek		St. Louis River Estuary	
		Wild Rice Present	Wild Rice Absent	Wild Rice Present	Wild Rice Absent	Wild Rice Present	Wild Rice Absent	Wild Rice Present	Wild Rice Absent	Wild Rice Present	Wild Rice Absent	Wild Rice Present	Wild Rice Absent	Wild Rice Present	Wild Rice Absent	Wild Rice Present	Wild Rice Absent	Wild Rice Present	Wild Rice Absent	Wild Rice Present	Wild Rice Absent	Wild Rice Present	Wild Rice Absent
		n = 72	n = 1	n = 1	n = 14	n = 6	n = 31	n = 12	n = 0	n = 16	n = 7	n = 94	n = 25	n = 8	n = 6	n = 1	n = 11	n = 11	n = 39	n = 0	n = 23	n = 66	n = 18
<i>Potamogeton epihydrus</i>	Ribbon-leaf pondweed				1																		
<i>Potamogeton natans</i>	Floating pondweed	1			1		2	1				13	3	7	5				6			6	1
<i>Potamogeton nodosus</i>	Long-leaf pondweed									6		1									1	13	
<i>Potamogeton richardsonii</i>	Richardson's pondweed															1						4	3
<i>Potamogeton</i> spp. (narrow-leaf)	Unidentified pondweed species											4		2	3			1	2		1		1
<i>Potamogeton vaseyi</i>	Vasey's pondweed																						
<i>Potamogeton zosteriformis</i>	Flat-stem pondweed	1			1					6		1							3			3	
<i>Sagittaria latifolia</i>	Broadleaf arrowhead				5		1			2		11	1					4	4		2	16	
<i>Sagittaria cf. latifolia</i>	Broadleaf arrowhead																						
<i>Sagittaria rigida</i>	Sessilefruit arrowhead				4	1	1	1		1		22	1				5					24	
<i>Sagittaria</i> spp.	Unidentified arrowhead species						1					4	1	2	6						1	14	2
<i>Schoenoplectus tabernaemontani</i>	Softstem bulrush																5	3	2		1	11	2
<i>Scirpus cyperinus</i>	Woolgrass																		1				
<i>Sium suave</i>	Water parsnip																						
<i>Sparganium fluctuans</i>	Floating bur-reed				1	1	14			2		3	1	4	2		5		1			11	1
<i>Sparganium emersum</i>	Narrow-leaved bur-reed			1	4	5	19					4		4	6				1			9	
<i>Sparganium</i> spp.	Unidentified bur-reed species	1					1	1										2	6		4	8	
<i>Spirodela polyrhiza</i>	Giant duckweed																					1	
<i>Stuckenia filiformis</i>	Fine-leaved pondweed																					1	
<i>Stuckenia pectinata</i>	Sago pondweed																		4			1	
<i>Typha</i> spp.	Unidentified cattail species				1												10		1		2	2	2

Scientific Name(2)	Common Name	Cedar Island Lake		Embarrass Lake		Embarrass River		Fourth Lake		Hay Lake (2), Pike River, Little Rice Lake		Partridge River (Lower)		Partridge River (Upper)		Sabin Lake, Wynne Lake, Embarrass Lake		Second Creek		Spring Mine Creek, Wyman Creek, Trimble Creek, Unnamed Creek		St. Louis River Estuary	
		Wild Rice Present	Wild Rice Absent	Wild Rice Present	Wild Rice Absent	Wild Rice Present	Wild Rice Absent	Wild Rice Present	Wild Rice Absent	Wild Rice Present	Wild Rice Absent	Wild Rice Present	Wild Rice Absent	Wild Rice Present	Wild Rice Absent	Wild Rice Present	Wild Rice Absent	Wild Rice Present	Wild Rice Absent	Wild Rice Present	Wild Rice Absent	Wild Rice Present	Wild Rice Absent
		n = 72	n = 1	n = 1	n = 14	n = 6	n = 31	n = 12	n = 0	n = 16	n = 7	n = 94	n = 25	n = 8	n = 6	n = 1	n = 11	n = 11	n = 39	n = 0	n = 23	n = 66	n = 18
<i>Utricularia macrorhiza</i>	Common bladderwort	1			1					2		8	2						1			4	
<i>Vallisneria americana</i>	American eelgrass											6										12	4

(1) Occurrences of individual species based on number of sample points where species was observed. Sample points are defined as locations with recorded GPS coordinates. Number of sample points (n) for each waterbody are categorized by the presence or absence of wild rice.

(2) When a plant could only be identified confidently to genus, it is designated "Genus spp." When a likely genus or species identification could be made, but without complete confidence, it is indicated with "cf."

**Large Table 2 Water Quality Data Collected during the 2014 Wild Rice Survey**

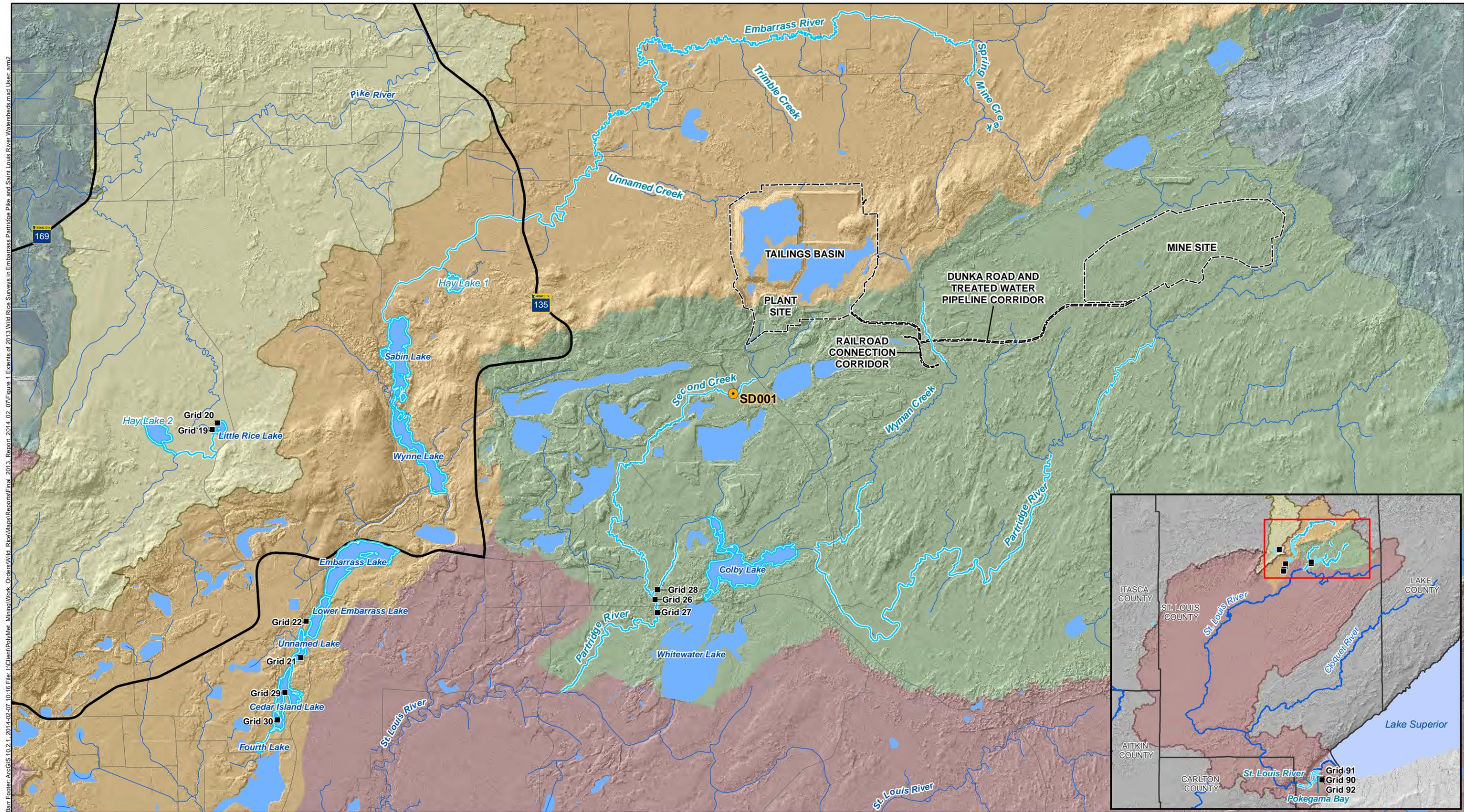
Chemical Name			Alkalinity, bicarbonate, as CaCO3 (mg/l)	Chloride (mg/l)	Sulfate, as SO4 (mg/l)	Calcium (mg/l)	Magnesium (mg/l)	Potassium (mg/l)	Sodium (mg/l)	
Location	Date	Water Body	Sample Type	NA	NA	NA	Total	Total	Total	Total
PM-CI-GWB-29-01	8/06/2014	Cedar Island Lake	N	53.8 mg/l	4.6 mg/l	13.1 mg/l	15.8 mg/l	8.9 mg/l	1.5 mg/l	5.6 mg/l
PM-CI-GWB-30-01	8/06/2014	Cedar Island Lake	N	54.3 mg/l	4.7 mg/l	13.0 mg/l	15.6 mg/l	8.8 mg/l	1.6 mg/l	5.5 mg/l
PM-EL-KMS2-01	9/11/2014	Embarrass Lake	N	62.9 mg/l	5.4 mg/l	16.9 mg/l	17.5 mg/l	9.7 mg/l	1.5 mg/l	5.8 mg/l
PM-EL-LEN-22-01	8/05/2014	Embarrass Lake	N	56.1 mg/l	4.6 mg/l	14.0 mg/l	14.8 mg/l	8.6 mg/l	1.7 mg/l	5.7 mg/l
PM-ER-JTK-01	9/11/2014	Embarrass River	N	107 mg/l	4.1 mg/l	188 mg/l	29.1 mg/l	46.6 mg/l	8.6 mg/l	16.8 mg/l
PM-ER-JTK-01	9/12/2014	Embarrass River	N	115 mg/l	4.3 mg/l	40.6 mg/l	26.2 mg/l	18.3 mg/l	2.5 mg/l	10.8 mg/l
PM-ER-JTK-02	9/11/2014	Embarrass River	N	120 mg/l	3.7 mg/l	63.4 mg/l	25.2 mg/l	24.1 mg/l	3.4 mg/l	13.8 mg/l
PM-ER-JTK-02	9/12/2014	Embarrass River	N	113 mg/l	4.2 mg/l	36.8 mg/l	26.0 mg/l	17.3 mg/l	2.5 mg/l	10.2 mg/l
PM-ES-KMS2-04	8/27/2014	Saint Louis River	N	87.2 mg/l	16.2 mg/l	6.8 mg/l	23.6 mg/l	12.0 mg/l	1.2 mg/l	7.8 mg/l
PM-ES-KMS2-05	8/27/2014	Saint Louis River	N	86.2 mg/l	9.2 mg/l	13.4 mg/l	23.3 mg/l	11.9 mg/l	1.2 mg/l	7.8 mg/l
PM-ES-KMS2-06	8/26/2014	Saint Louis River	N	88.5 mg/l	9.6 mg/l	12.8 mg/l	24.3 mg/l	12.4 mg/l	1.0 mg/l	8.1 mg/l
PM-H2-KMS2-01	8/22/2014	Hay Lake 2	N	10.2 mg/l	< 0.50 mg/l	1.3 jb mg/l	4.9 mg/l	1.6 mg/l	0.34 mg/l	1.2 mg/l
PM-LP-KMS2-26-02	8/18/2014	Lower Partridge	N	143 mg/l	6.2 mg/l	192 mg/l	30.9 mg/l	67.1 mg/l	4.0 mg/l	14.6 mg/l
PM-LP-KMS2-27-03	8/18/2014	Lower Partridge	N	170 mg/l	6.4 mg/l	274 mg/l	31.6 mg/l	82.7 mg/l	4.7 mg/l	16.4 mg/l
PM-LP-KMS2-28-01	8/18/2014	Lower Partridge	N	90.3 mg/l	5.7 mg/l	40.4 mg/l	26.7 mg/l	15.7 mg/l	1.7 mg/l	7.5 mg/l
PM-LP-TJM2-04	8/07/2014	Lower Partridge	N	58.9 mg/l	4.3 mg/l	31.5 mg/l	21.1 mg/l	10.7 mg/l	1.2 mg/l	6.2 mg/l
PM-LP-TJM2-05	8/07/2014	Lower Partridge	N	64.3 mg/l	4.6 mg/l	32.4 mg/l	22.0 mg/l	11.6 mg/l	1.3 mg/l	6.4 mg/l
PM-LR-KMS2-20-01	8/20/2014	Little Rice Lake	N	36.2 mg/l	2.8 mg/l	2.3 mg/l	11.0 mg/l	4.5 mg/l	0.40 mg/l	3.0 mg/l
PM-MN-LP-KMS2-03	8/06/2014	Lower Partridge	N	118 mg/l	5.2 mg/l	153 mg/l	24.4 mg/l	47.1 mg/l	2.9 mg/l	11.4 mg/l
PM-MN-SC-KMS2-01	8/05/2014	Second Creek	N	401 mg/l	7.0 mg/l	859 mg/l	48.1 mg/l	283 mg/l	12.9 mg/l	41.7 mg/l
PM-MN-SC-KMS2-02	8/05/2014	Second Creek	N	408 mg/l	7.0 mg/l	824 mg/l	48.8 mg/l	270 mg/l	12.5 mg/l	39.8 mg/l
PM-PB-KMS2-90-01	8/25/2014	Pokegama Bay	N	102 mg/l	15.1 mg/l	6.7 mg/l	32.1 mg/l	10.8 mg/l	3.0 mg/l	13.8 mg/l
PM-PB-KMS2-91-02	8/25/2014	Pokegama Bay	N	102 mg/l	14.8 mg/l	6.0 mg/l	29.7 mg/l	10.2 mg/l	2.3 mg/l	12.4 mg/l
PM-PB-KMS2-92-03	8/25/2014	Pokegama Bay	N	102 mg/l	9.5 mg/l	10.9 mg/l	30.7 mg/l	10.5 mg/l	2.7 mg/l	13.0 mg/l
PM-PR-KMS2-01	8/22/2014	Pike River	N	63.1 mg/l	6.8 mg/l	2.7 mg/l	17.9 mg/l	7.4 mg/l	0.30 mg/l	5.4 mg/l
PM-PR-KMS2-19-01	8/20/2014	Pike River	N	35.7 mg/l	2.8 mg/l	2.3 mg/l	10.7 mg/l	4.3 mg/l	0.37 mg/l	2.9 mg/l
PM-SL-KMS2-01	9/11/2014	Sabin Lake	N	74.1 mg/l	3.3 mg/l	16.1 mg/l	18.6 mg/l	10.6 mg/l	1.5 mg/l	5.8 mg/l
PM-SL-KMS2-02	9/11/2014	Sabin Lake	N	72.9 mg/l	3.3 mg/l	15.4 mg/l	18.4 mg/l	10.4 mg/l	1.5 mg/l	5.6 mg/l
PM-SM-BKB-01	8/04/2014	Spring Mine Creek	N	197 mg/l	1.0 mg/l	326 mg/l	42.1 mg/l	84.5 mg/l	15.4 mg/l	28.8 mg/l
PM-SM-BKB-02	8/04/2014	Spring Mine Creek	N	216 mg/l	0.50 j mg/l	406 mg/l	47.9 mg/l	99.2 mg/l	17.9 mg/l	33.9 mg/l
PM-TC-BKB-03	8/04/2014	Trimble Creek	N	369 mg/l	6.6 mg/l	0.76 jb mg/l	48.9 mg/l	44.1 mg/l	1.4 mg/l	43.4 mg/l
PM-U1-LEN-21-01	8/05/2014	Unnamed Lake	N	50.9 mg/l	4.6 mg/l	13.8 mg/l	15.2 mg/l	8.7 mg/l	1.6 mg/l	5.8 mg/l
PM-UP-GWB-01	8/07/2014	Partridge River	N	54.8 mg/l	5.3 mg/l	7.3 mg/l	13.4 mg/l	8.1 mg/l	1.0 mg/l	6.0 mg/l
PM-WL-KMS2-01	9/11/2014	Wynne Lake	N	58.6 mg/l	3.9 mg/l	16.8 mg/l	15.9 mg/l	9.5 mg/l	1.4 mg/l	5.2 mg/l
PM-WL-KMS2-02	9/11/2014	Wynne Lake	N	58.8 mg/l	3.7 mg/l	14.4 mg/l	15.6 mg/l	9.0 mg/l	1.4 mg/l	5.1 mg/l

**Large Table 3 Maximum, Minimum, and Average Bicarbonate, Chloride, and Cations Concentrations (mg/L) in 2014**

Water Body	Alkalinity, bicarbonate, as CaCO <sub>3</sub> (mg/l)			Chloride (mg/l)			Calcium (mg/l)			Magnesium (mg/l)			Potassium (mg/l)			Sodium (mg/l)		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
Cedar Island Lake	54.3	53.8	54.1	4.7	4.6	4.7	16	16	16	8.9	8.8	8.9	1.6	1.5	1.6	5.6	5.5	5.6
Embarrass Lake	62.9	56.1	59.5	5.4	4.6	5.0	18	15	16	9.7	8.6	9.2	1.7	1.5	1.6	5.8	5.7	5.8
Embarrass River	120	107	114	4.3	3.7	4.1	29	25	27	47	17	27	8.6	2.5	4.3	17	10	13
Saint Louis River	88.5	86.2	87.3	16	9.2	12	24	23	24	12	12	12	1.2	1.0	1.1	8.1	7.8	7.9
Hay Lake 2	10.2	10.2	10.2	0.50 <sup>(1)</sup>	0.50 <sup>(1)</sup>	0.50 <sup>(1)</sup>	4.9	4.9	4.9	1.6	1.6	1.6	0.34	0.34	0.34	1.2	1.2	1.2
Lower Partridge	170	58.9	107	6.4	4.3	5.4	274	32	121	32	21	26	82.7	10.7	39.2	5	1.2	3
Little Rice Lake	36.2	36.2	36.2	2.8	2.8	2.8	11	11	11	4.5	4.5	4.5	0.40	0.40	0.40	3.0	3.0	3.0
Second Creek	408	401	405	7.0	7.0	7.0	49	48	48	283	270	277	13	13	13	42	40	41
Pokegama Bay	102	102	102	15	10	13	32	30	31	11	10	11	3.0	2.3	2.7	14	12	13
Pike River	63.1	35.7	49.4	6.8	2.8	4.8	17.9	11	14	7.4	4.3	5.9	0.4	0.3	0.3	5.4	2.9	4.2
Sabin Lake	74.1	72.9	73.5	3.3	3.3	3.3	18.6	18	19	10.6	10	11	1.5	1.5	1.5	5.8	5.6	5.7
Spring Mine Creek	216	197	207	1.0	0.5	0.8	48	42	45	99	85	92	18	15	17	34	29	31
Trimble Creek	369	369	369	6.6	6.6	6.6	48.9	48.9	48.9	44.1	44.1	44.1	1.4	1.4	1.4	43.4	43.4	43.4
Unnamed Lake	50.9	50.9	50.9	4.6	4.6	4.6	15.2	15.2	15.2	8.7	8.7	8.7	1.6	1.6	1.6	5.8	5.8	5.8
Partridge River	54.8	54.8	54.8	5.3	5.3	5.3	13.4	13.4	13.4	8.1	8.1	8.1	1.0	1.0	1.0	6.0	6.0	6.0
Wynne Lake	58.8	58.6	58.7	3.9	3.7	3.8	15.9	15.6	15.8	9.5	9.0	9.3	1.4	1.4	1.4	5.2	5.1	5.2

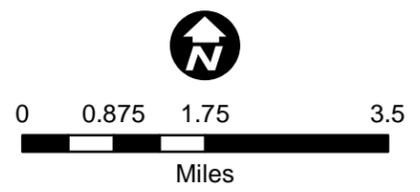
(1) The chloride result for Hay Lake 2 was below the laboratory method detection limit (MDL), therefore the maximum, minimum and average calculations were based on the MDL (< 0.50 mg/l).

## Figures

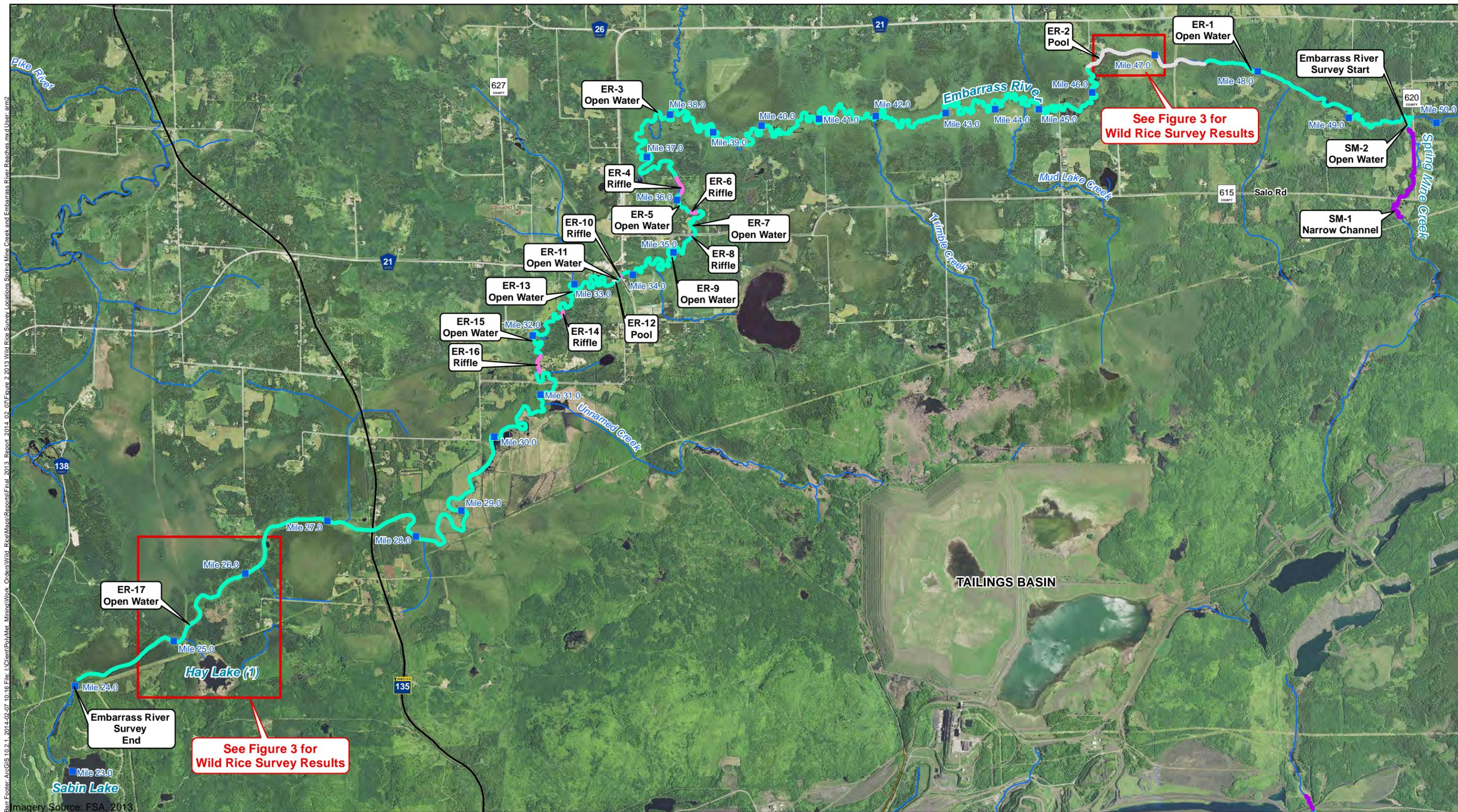


Barr Footer: ArcGIS 10.2.1 2014-02-07 10:16 File: I:\Client\PolyMet\_Mining\Work\_Orders\Wild\_Rice\Maps\Reports\Final\_2013\_Report\_2014\_02\_07\Figure\_1\_Extents\_of\_2013\_Wild\_Rice\_Surveys\_in\_Embarrass\_Partridge\_Pike\_and\_Saint\_Louis\_River\_Watersheds.mxd User: am2

- Surface Discharge Location
- Grid Sampling Locations
- Surveyed Lakes in 2014
- Surveyed Rivers in 2014
- National Hydrography Dataset
- Lakes
- NorthMet Project Areas
- Study Area Watersheds
- Embarrass River
- Partridge River
- Pike River
- St. Louis River



**Figure 1**  
**EXTENTS OF 2014 WILD RICE SURVEYS IN THE EMBARRASS RIVER, PARTRIDGE RIVER, PIKE RIVER, AND ST. LOUIS RIVER WATERSHEDS**  
 NorthMet Project  
 Poly Met Mining, Inc.  
 Hoyt Lakes, Minnesota



Barr Footer: ArcGIS 10.2.1, 2014-09-07 10:16 File: I:\Client\PolyMet\_Minimo\Work\_Orders\Wild\_Rice\Map\Reports\Final\_2013\_Report\_2014\_02\_07\Figure 2 2013 Wild Rice Survey Locations Spring Mine Creek and Embarrass River Reaches.mxd User: arm2  
 Imagery Source: FSA, 2013

- Surface Discharge Location
  - River Mile
- | Stream Reach Type |
|-------------------|
| Narrow Channel    |
| Open Water        |
| Pool              |
| Riffle            |

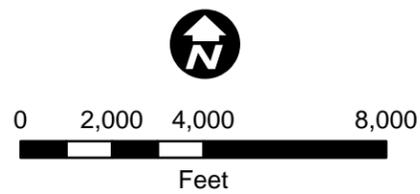
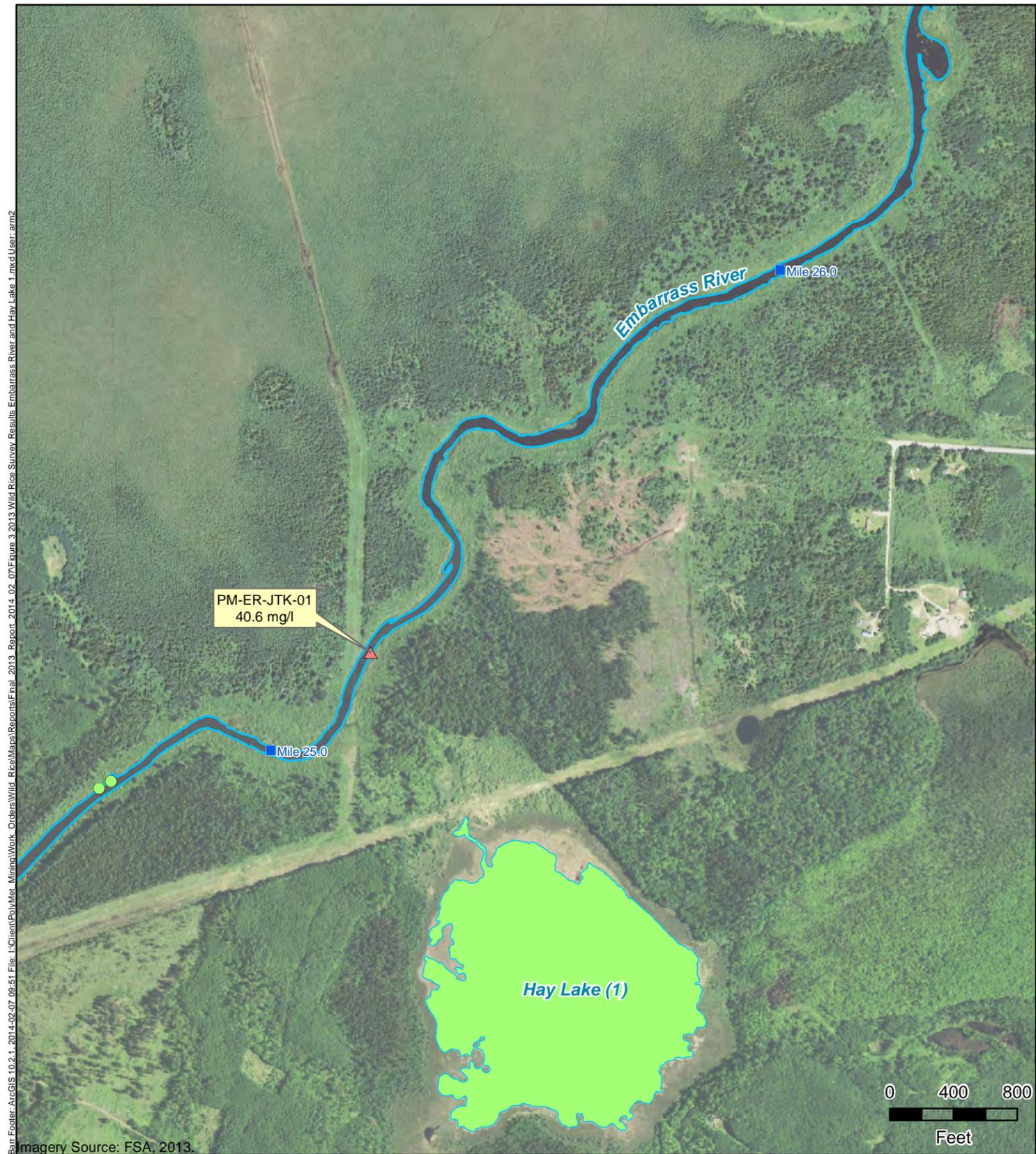


Figure 2  
 2014 WILD RICE SURVEY LOCATIONS  
 SPRING MINE CREEK, TRIMBLE CREEK,  
 UNNAMED CREEK AND EMBARRASS RIVER  
 NorthMet Project  
 Poly Met Mining, Inc.  
 Hoyt Lakes, Minnesota



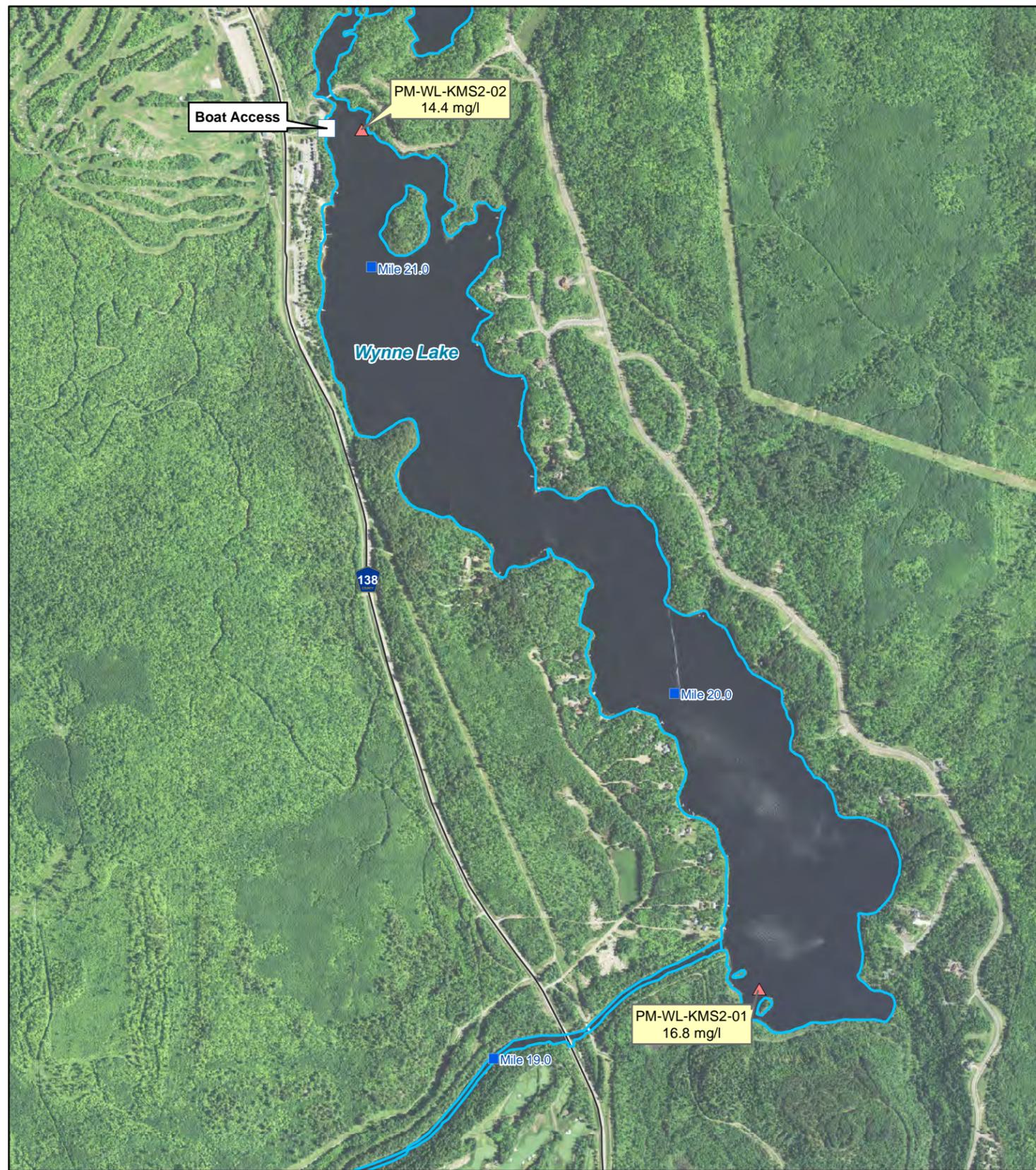
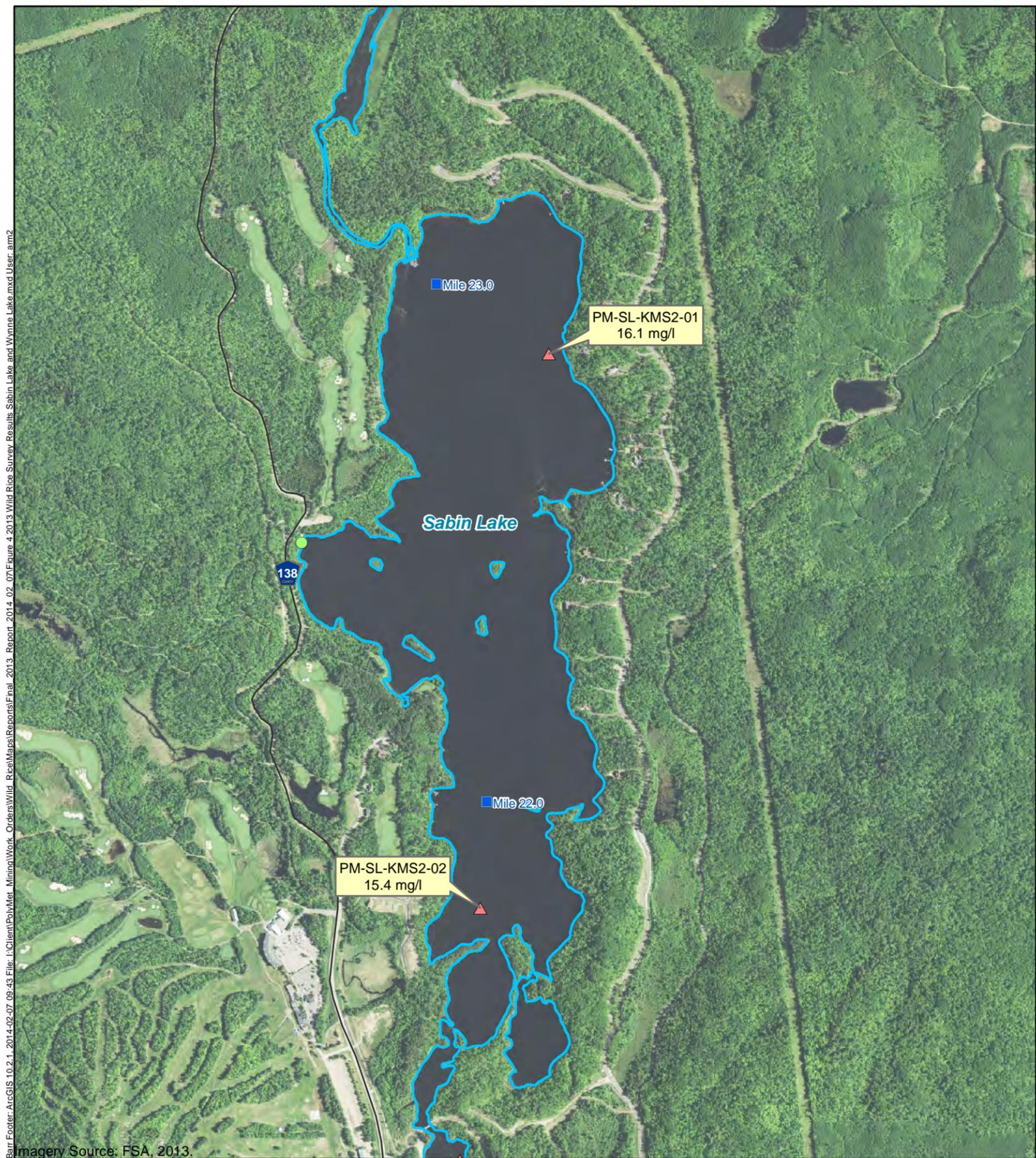
- |                                |                                |  |
|--------------------------------|--------------------------------|--|
| <b>Wild Rice Density Point</b> | <b>Wild Rice Density Area</b>  | <b>River Mile</b>  |
| ● 1: <10% Wild Rice Coverage   | ■ 1: <10% Wild Rice Coverage   | ▲ Water Sample Location with Sulfate, as SO <sub>4</sub> in mg/L |
| ● 2: 10-25% Wild Rice Coverage | ■ 2: 10-25% Wild Rice Coverage | — Shoreline  |
| ● 3: 25-50% Wild Rice Coverage | ■ 3: 25-50% Wild Rice Coverage |  |
| ● 4: 50-75% Wild Rice Coverage | ■ 4: 50-75% Wild Rice Coverage |  |
| ● 5: >75% Wild Rice Coverage   | ■ 5: >75% Wild Rice Coverage   |  |



Figure 3  
 2014 WILD RICE SURVEY  
 RESULTS EMBARRASS RIVER  
 AND HAY LAKE 1  
 NorthMet Project  
 Poly Met Mining, Inc.  
 Hoyt Lakes, Minnesota

Barr Footer: ArcGIS 10.2.1, 2014-05-07 09:51 File: I:\Client\Polymet\_Minna\Work\_Orders\Wild\_Rice\MapReports\Final\_2013\_Report\_2014\_02\_07\Figure\_3\_2013\_Wild\_Rice\_Survey\_Results\_Embarrass\_River\_and\_Hay\_Lake\_1.mxd User: arm2  
 Imagery Source: FSA, 2013.

Barr Footer: ArcGIS 10.2.1, 2014-05-07 09:43 File: I:\Client\Polymet Mining\Work Orders\Wild Rice\Maps\Reports\Final\_2013\_Report\_2014\_02\_07\Figure 4 2013 Wild Rice Survey Results Sabin Lake and Wynne Lake.mxd User: am2



**Wild Rice Density Point**

- 1: <10% Wild Rice Coverage
- 2: 10-25% Wild Rice Coverage
- 3: 25-50% Wild Rice Coverage
- 4: 50-75% Wild Rice Coverage
- 5: >75% Wild Rice Coverage

**Wild Rice Density Area**

- 1: <10% Wild Rice Coverage
- 2: 10-25% Wild Rice Coverage
- 3: 25-50% Wild Rice Coverage
- 4: 50-75% Wild Rice Coverage
- 5: >75% Wild Rice Coverage

- River Mile
- Public Boat Access
- ▲ Water Sample Location with Sulfate, as SO<sub>4</sub> in mg/L
- Shoreline

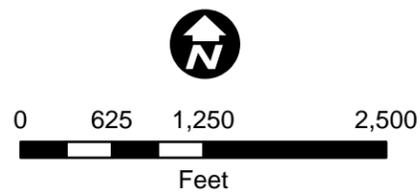


Figure 4  
**2014 WILD RICE SURVEY RESULTS**  
**SABIN LAKE AND WYNNE LAKE**  
 NorthMet Project  
 Poly Met Mining, Inc.  
 Hoyt Lakes, Minnesota

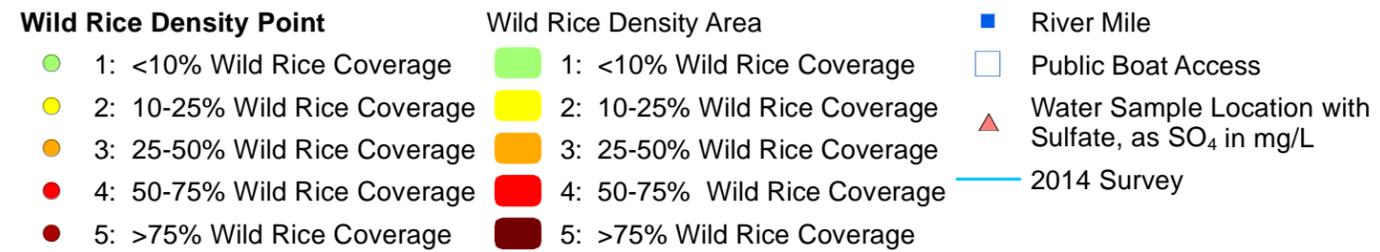
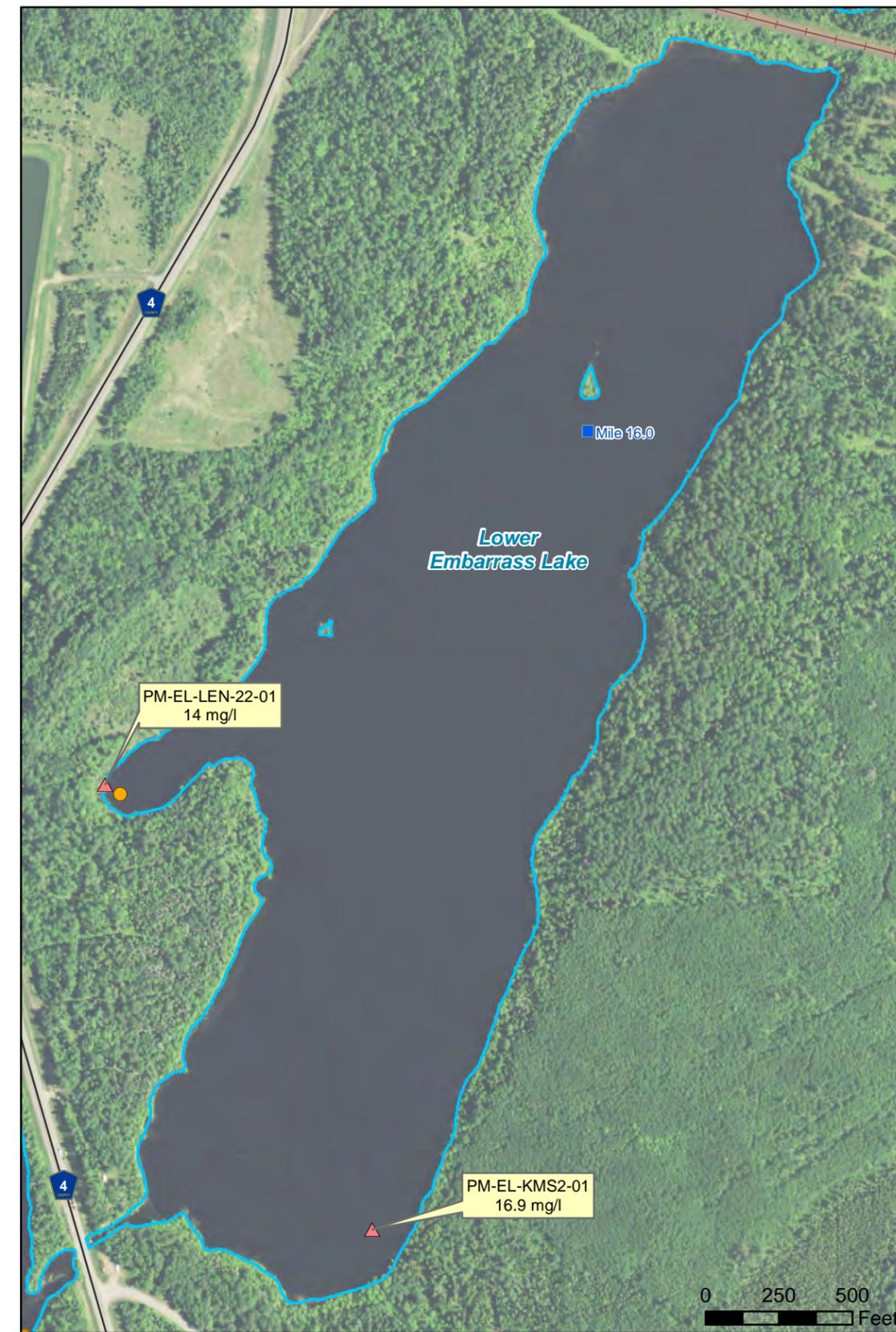
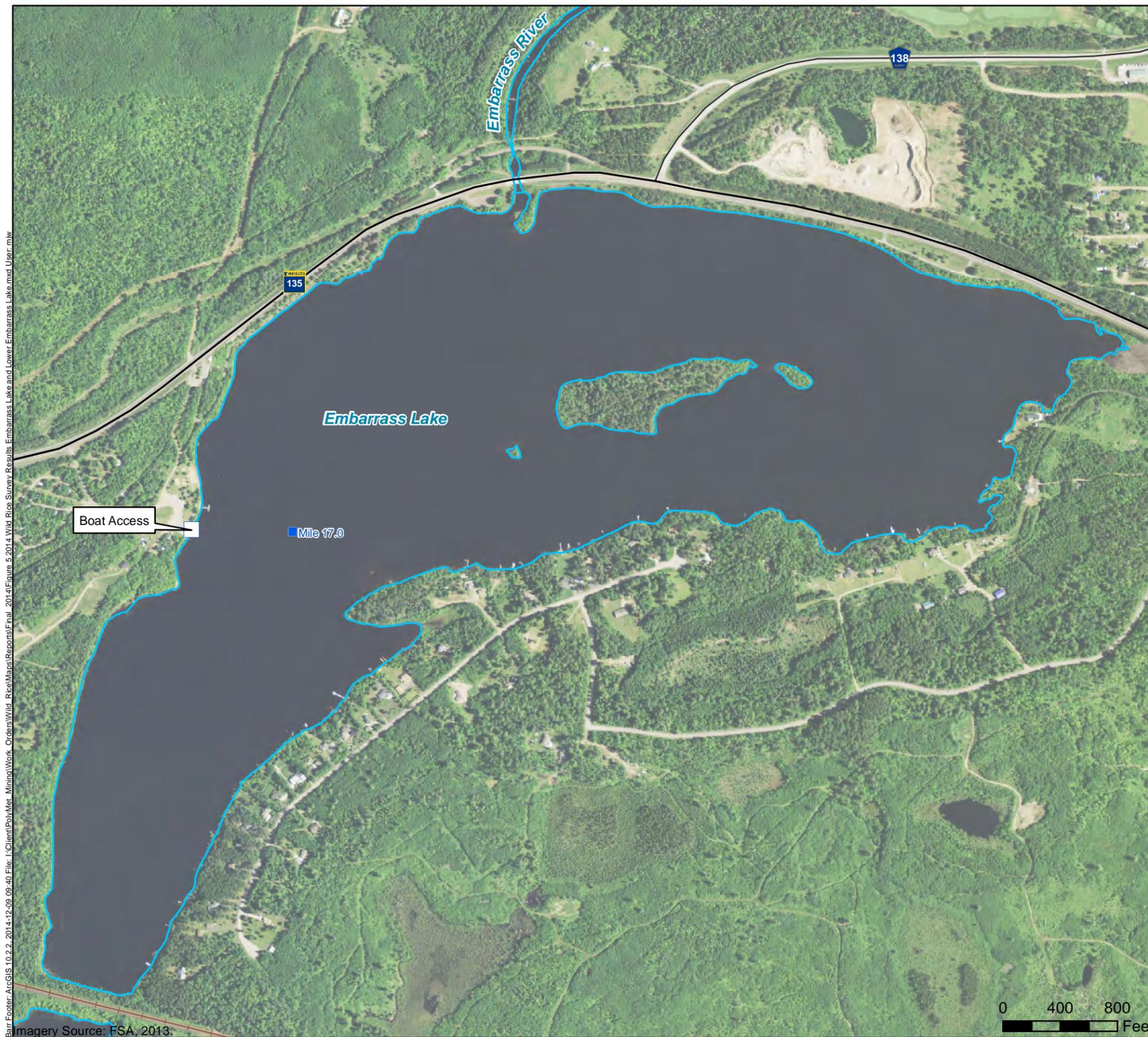
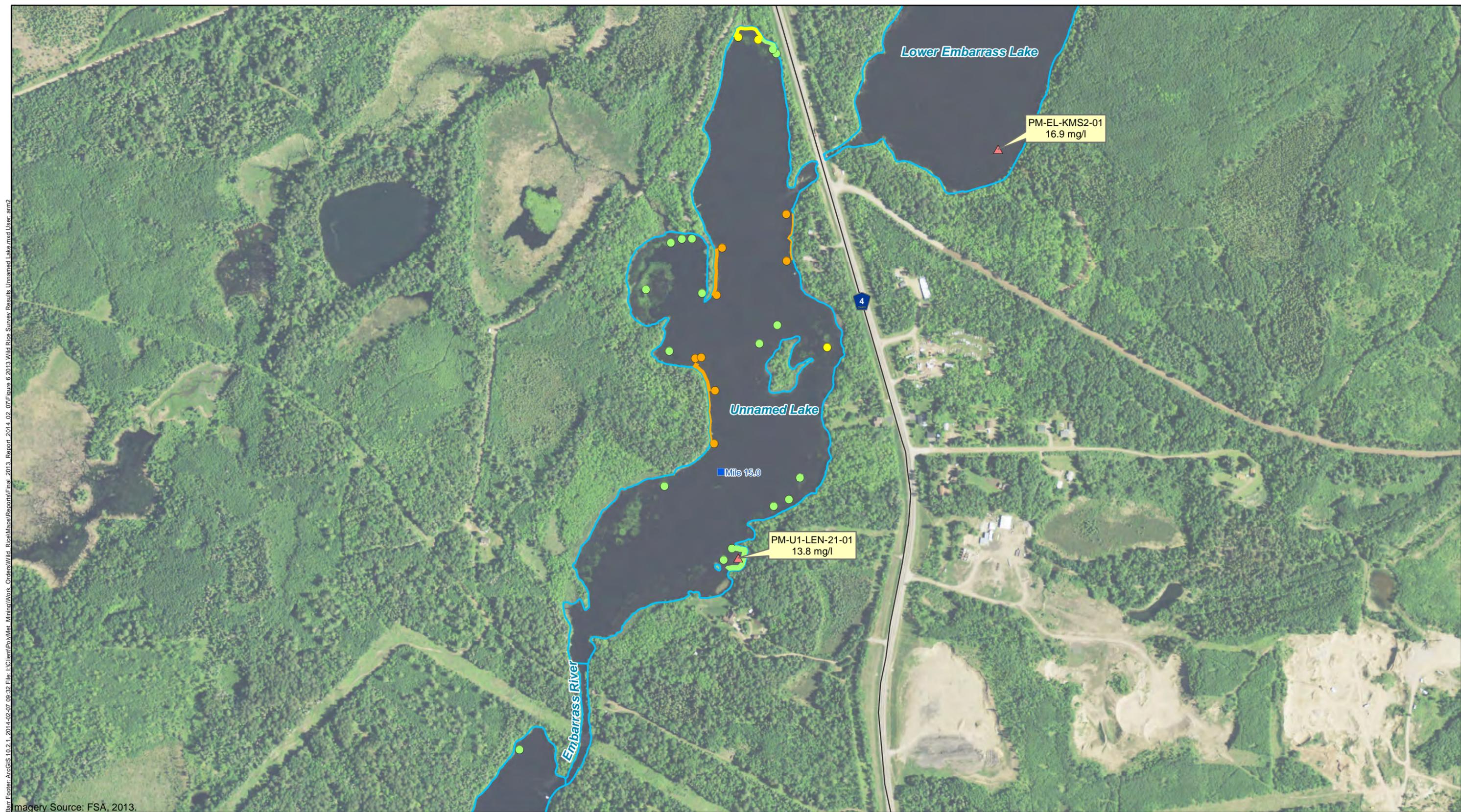


Figure 5  
 2014 WILD RICE SURVEY RESULTS  
 EMBARRASS LAKE AND  
 LOWER EMBARRASS LAKE  
 NorthMet Project  
 Poly Met Mining, Inc.  
 Hoyt Lakes, Minnesota



imagery Source: FSA, 2013.

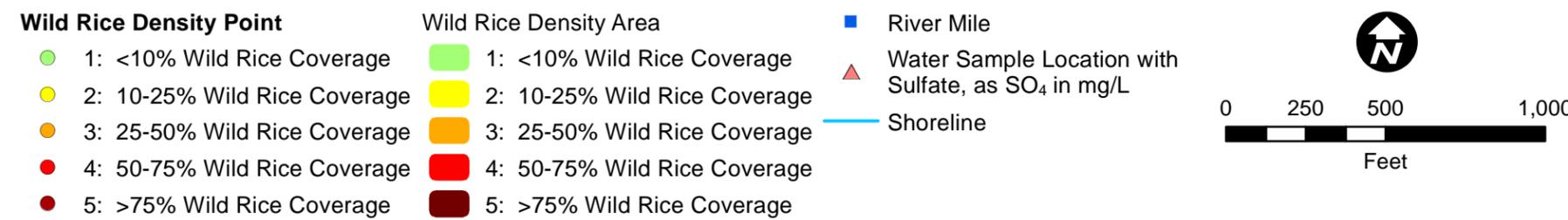
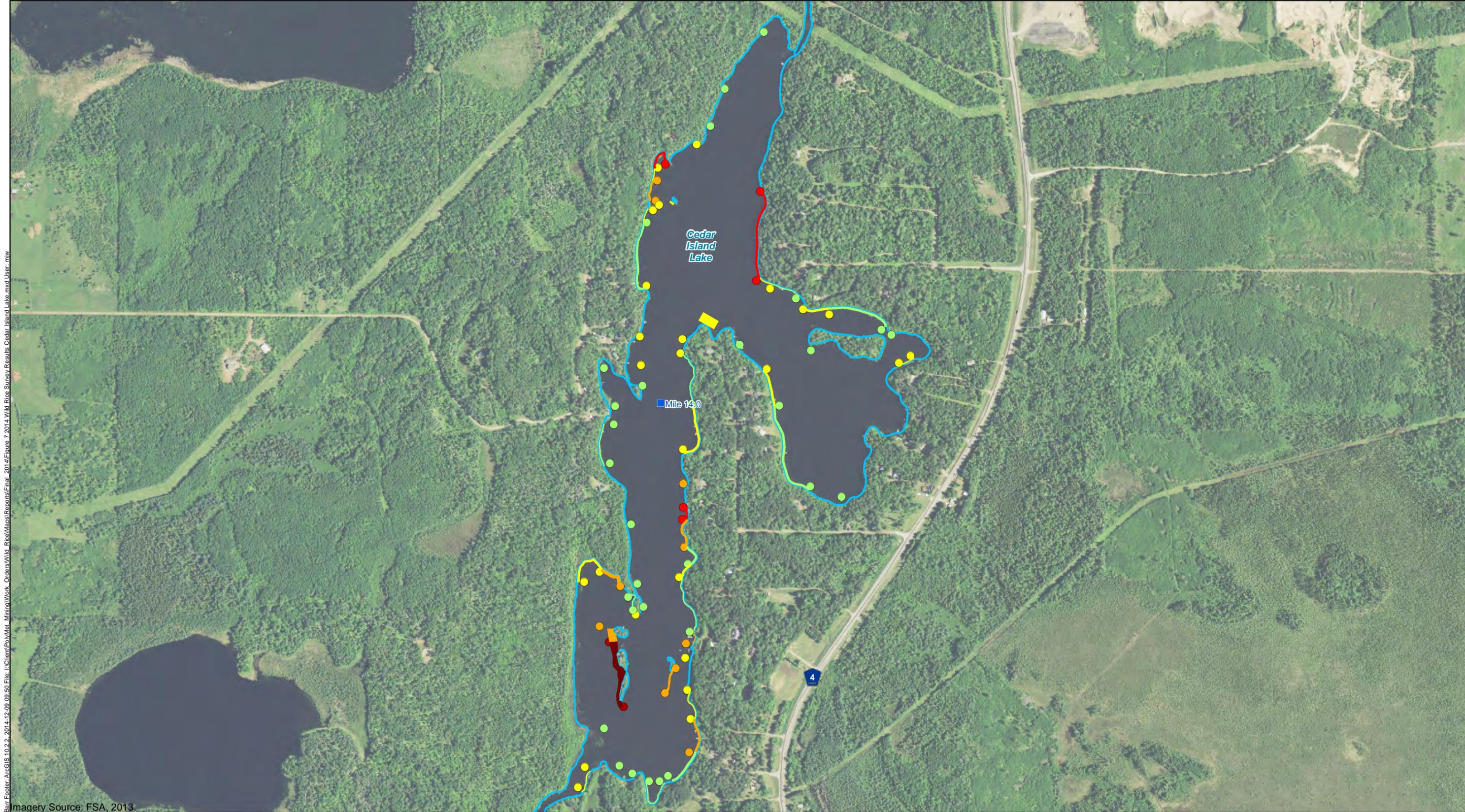


Figure 6  
 2014 WILD RICE SURVEY RESULTS  
 UNNAMED LAKE  
 NorthMet Project  
 Poly Met Mining, Inc.  
 Hoyt Lakes, Minnesota



Barr Footer: ArcGIS 10.2.2, 2014-12-09 09:50 File: I:\Client\Polymet\_Mining\Work\_Orders\Wild\_Rice\Maps\Reports\Final\_2014\Figure 7 2014 Wild Rice Survey Results Cedar Island Lake.mxd User: miw  
 Imagery Source: FSA, 2013.

**Wild Rice Density Point**

- 1: <10% Wild Rice Coverage
- 2: 10-25% Wild Rice Coverage
- 3: 25-50% Wild Rice Coverage
- 4: 50-75% Wild Rice Coverage
- 5: >75% Wild Rice Coverage

**Wild Rice Density Areas**

- 1: <10% Wild Rice Coverage
- 2: 10-25% Wild Rice Coverage
- 3: 25-50% Wild Rice Coverage
- 4: 50-75% Wild Rice Coverage
- 5: >75% Wild Rice Coverage

- River Mile
- Shoreline

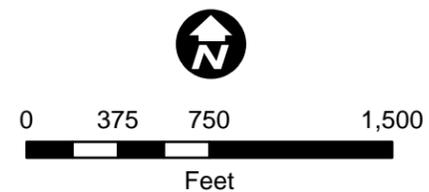
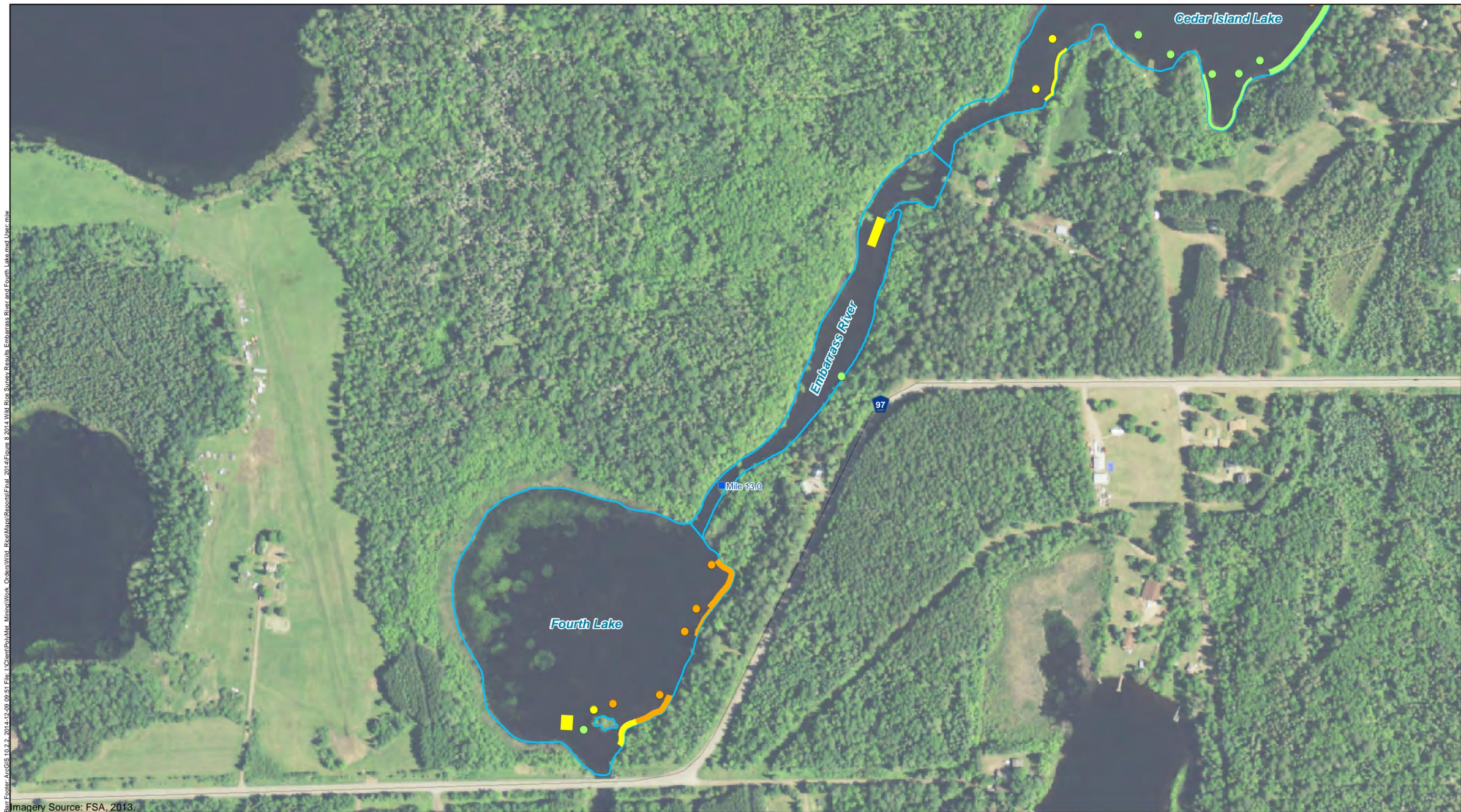


Figure 7  
 2014 WILD RICE SURVEY RESULTS  
 CEDAR ISLAND LAKE  
 NorthMet Project  
 Poly Met Mining, Inc.  
 Hoyt Lakes, Minnesota



Barr Footer: ArcGIS 10.2.2, 2014-12-09 09:51 File: I:\Client\Polymet\_Minim\Work\_Orders\Wild\_Rice\Map\Reports\Final\_2014\Figure 8 2014 Wild Rice Survey Results Embarrass River and Fourth Lake.mxd User: mtw  
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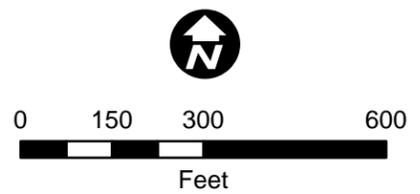
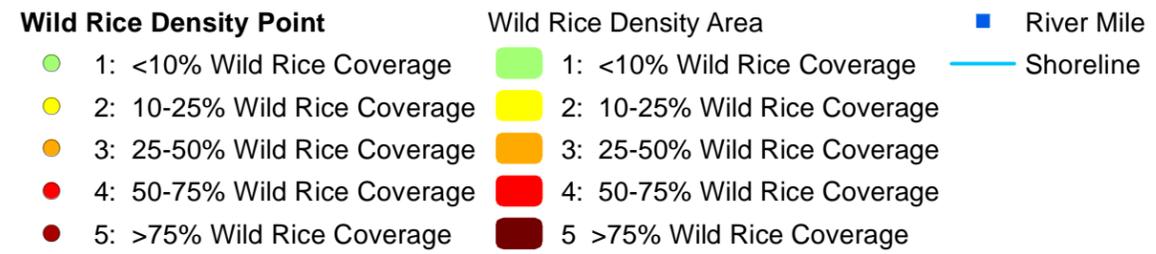
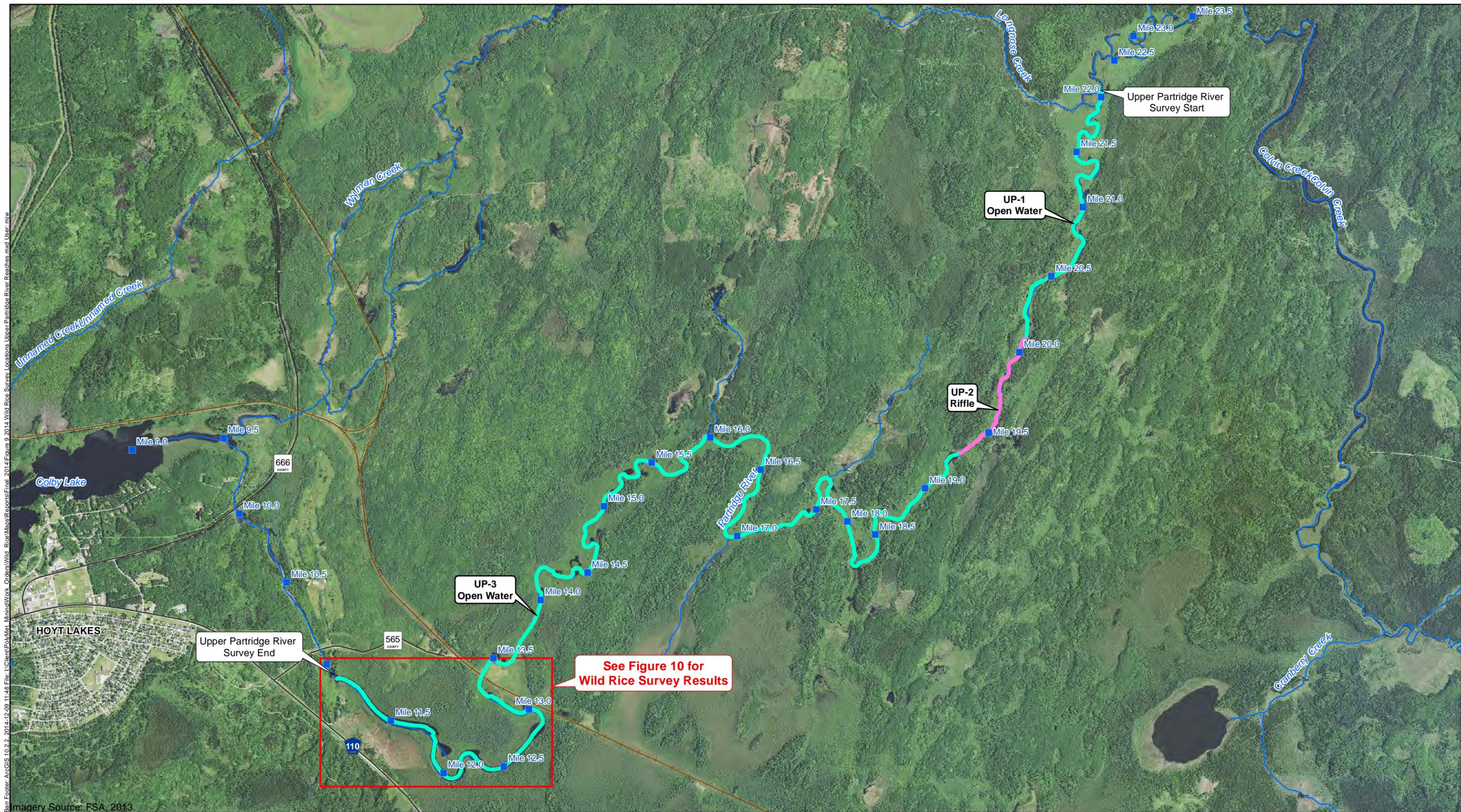


Figure 8  
 2014 WILD RICE SURVEY RESULTS  
 EMBARRASS RIVER AND FOURTH LAKE  
 NorthMet Project  
 Poly Met Mining, Inc.  
 Hoyt Lakes, Minnesota



Barr Footer: ArcGIS 10.2.2, 2014-12-09 11:48 File: I:\Client\PolyMet\_Mining\Work\_Orders\Wild\_Rice\Maps\Reports\Final\_2014\Figure 9 2014 Wild Rice Survey Locations Upper Partridge River Reaches.mxd User: mlw  
 Imagery Source: FSA, 2013.

- River Mile
- Stream Reach Type**
- Narrow Channel
- Open Water
- Pool
- Riffle

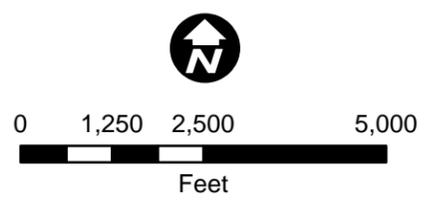


Figure 9  
 2014 WILD RICE SURVEY LOCATIONS  
 UPPER PARTRIDGE RIVER  
 NorthMet Project  
 Poly Met Mining, Inc.  
 Hoyt Lakes, Minnesota



imagery Source: FSA, 2013.

Wild Rice Density Point

- 1: <10% Wild Rice Coverage
- 2: 10-25% Wild Rice Coverage
- 3: 25-50% Wild Rice Coverage
- 4: 50-75% Wild Rice Coverage
- 5: >75% Wild Rice Coverage

Wild Rice Density Areas

- 1: <10% Wild Rice Coverage
- 2: 10-25% Wild Rice Coverage
- 3: 25-50% Wild Rice Coverage
- 4: 50-75% Wild Rice Coverage
- 5: >75% Wild Rice Coverage

■ River Mile

- ▲ Water Sample Location with Sulfate, as SO<sub>4</sub> in mg/L

— Shoreline

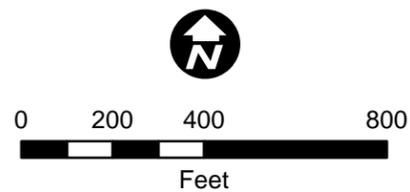
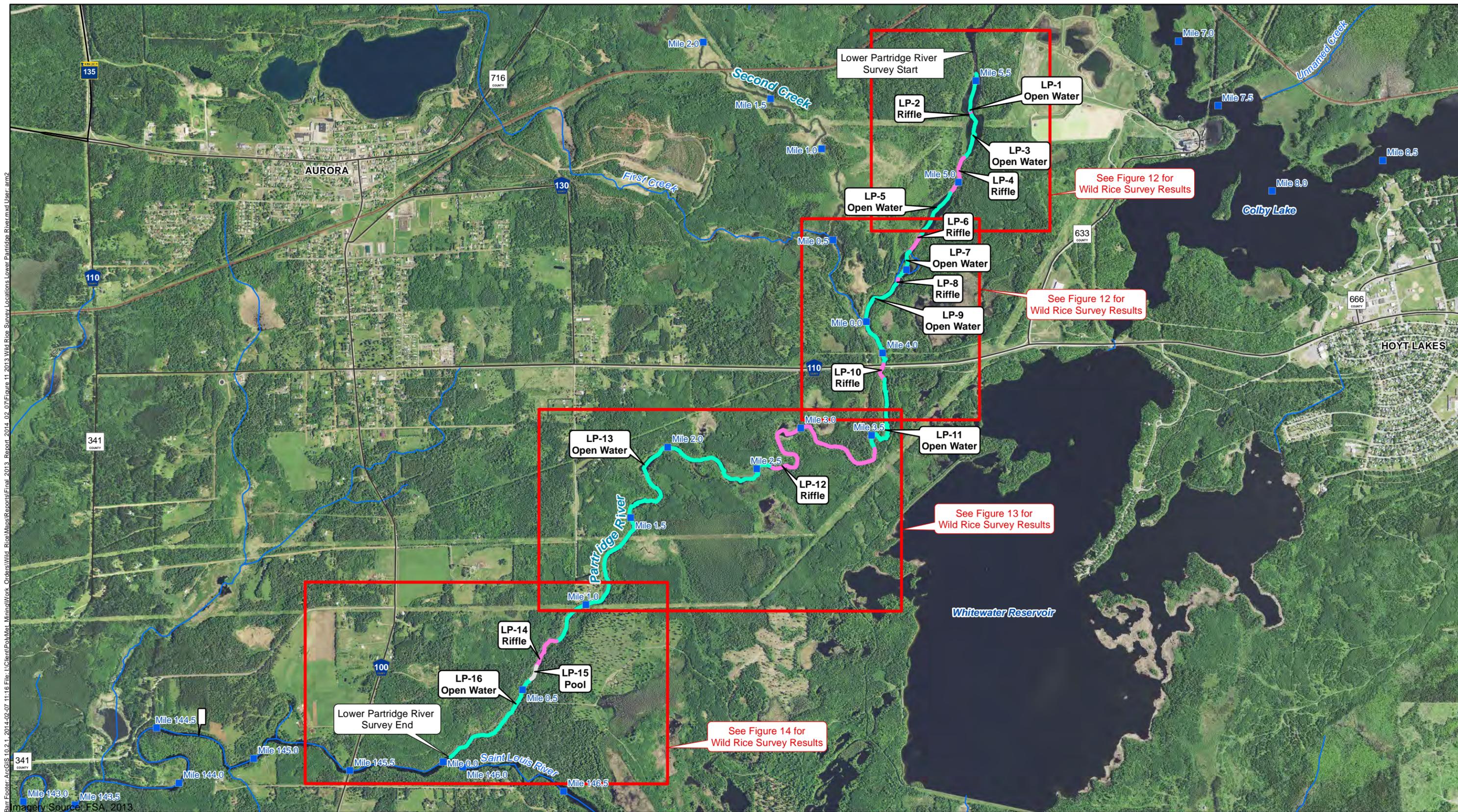


Figure 10  
 2014 WILD RICE SURVEY RESULTS  
 UPPER PARTRIDGE RIVER  
 NorthMet Project  
 Poly Met Mining, Inc.  
 Hoyt Lakes, Minnesota



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 Imagery Source: FSA, 2013.

- River Mile
- Stream Reach Type**
- ~ Narrow Channel
- ~ Open Water
- ~ Pool
- ~ Riffle

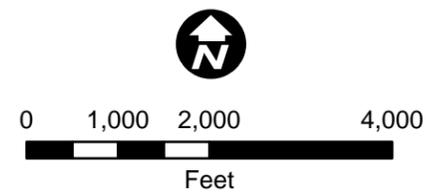
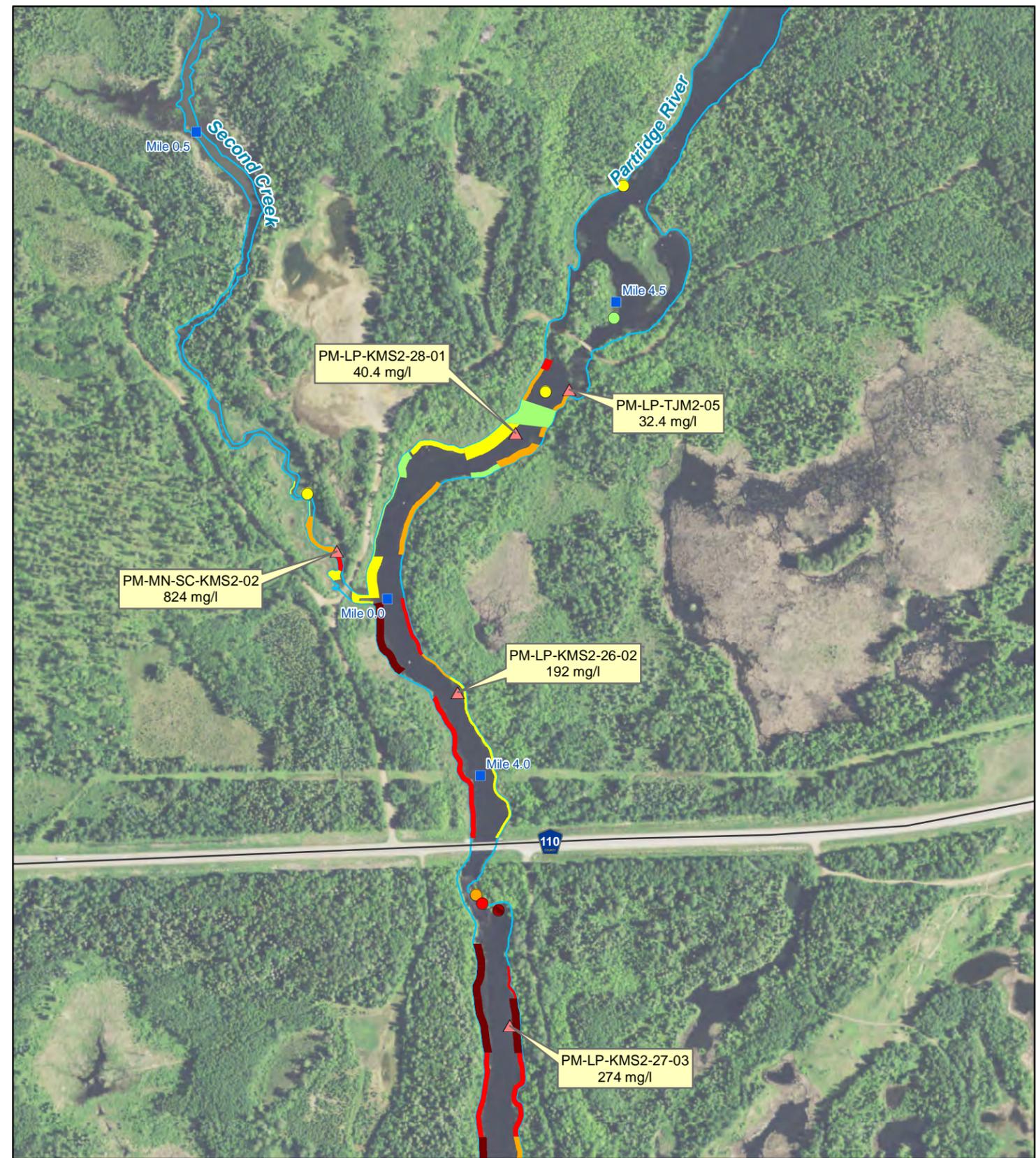
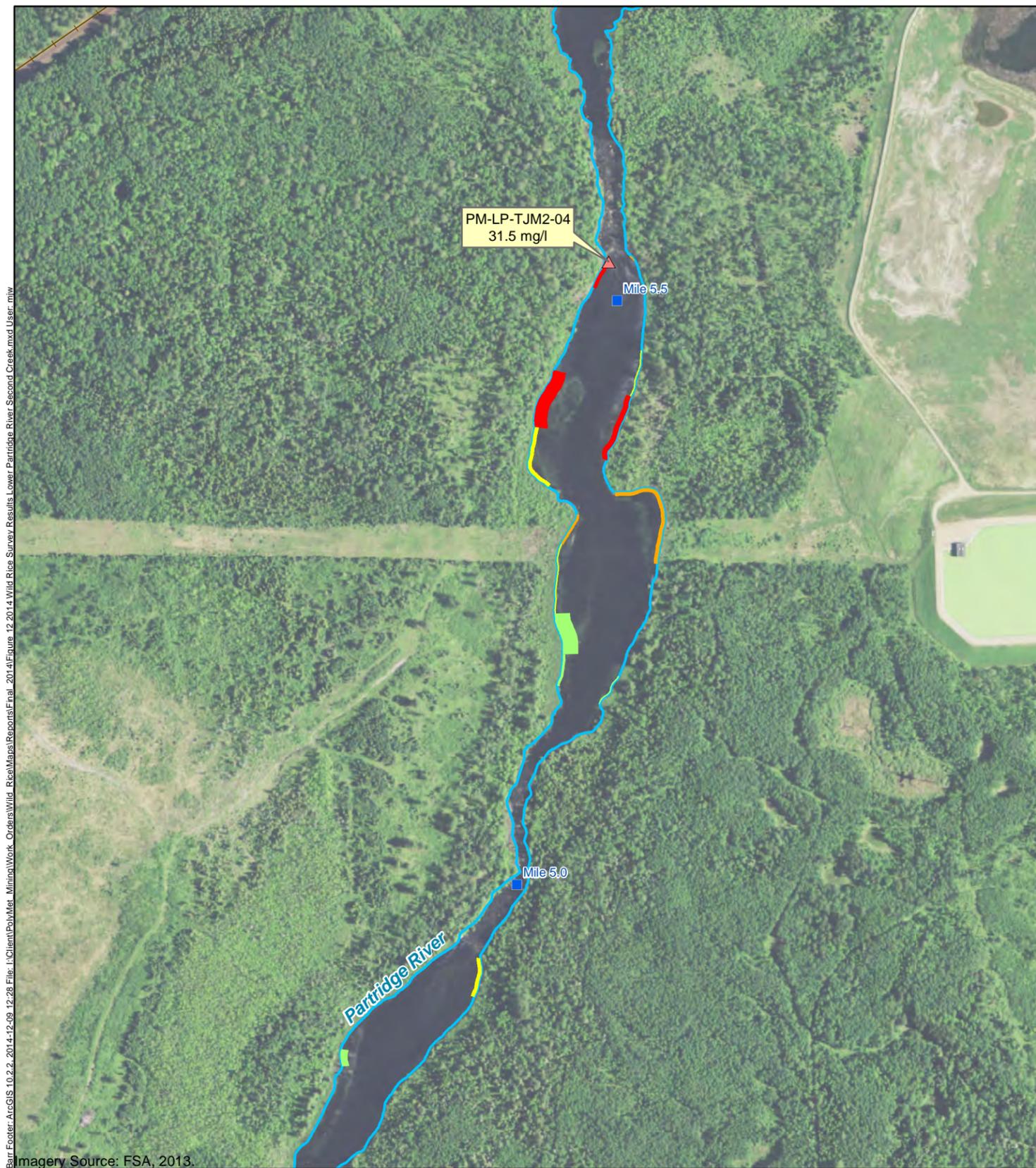


Figure 11  
 2014 WILD RICE SURVEY LOCATIONS  
 LOWER PARTRIDGE RIVER  
 NorthMet Project  
 Poly Met Mining, Inc.  
 Hoyt Lakes, Minnesota



**Wild Rice Density Point**

- 1: <10% Wild Rice Coverage
- 2: 10-25% Wild Rice Coverage
- 3: 25-50% Wild Rice Coverage
- 4: 50-75% Wild Rice Coverage
- 5: >75% Wild Rice Coverage

**Wild Rice Density Area**

- 1: <10% Wild Rice Coverage
- 2: 10-25% Wild Rice Coverage
- 3: 25-50% Wild Rice Coverage
- 4: 50-75% Wild Rice Coverage
- 5: >75% Wild Rice Coverage

- River Mile
- ▲ Water Sample Location with Sulfate, as SO<sub>4</sub> in mg/L
- Shoreline

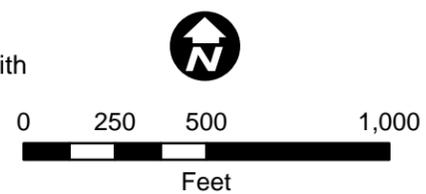
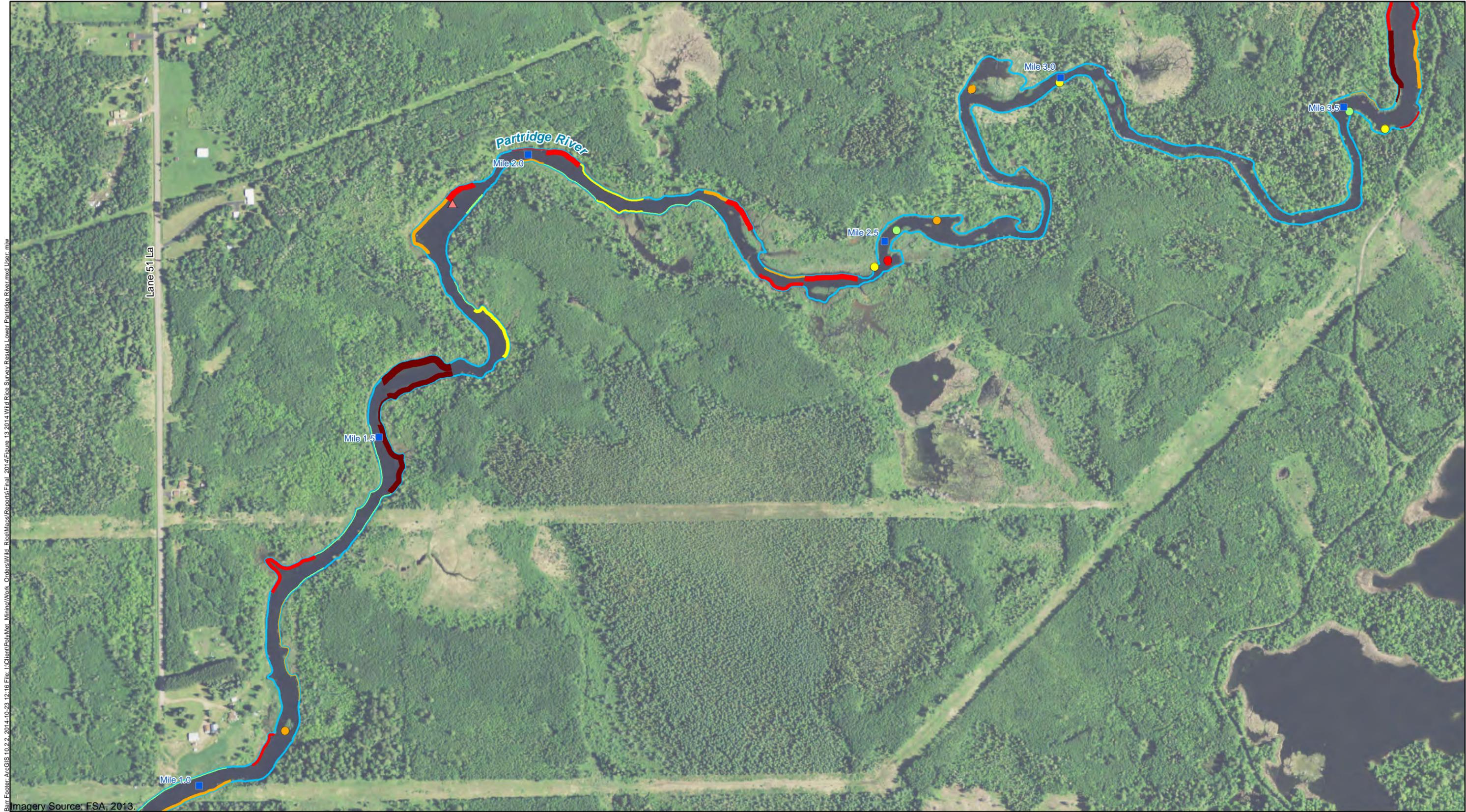


Figure 12  
 2014 WILD RICE SURVEY RESULTS  
 LOWER PARTRIDGE RIVER  
 AND SECOND CREEK  
 NorthMet Project  
 Poly Met Mining, Inc.  
 Hoyt Lakes, Minnesota

Barr Footer: ArcGIS 10.2.2, 2014-12-09 12:28 File: I:\Client\Polymet\_Minimo\Work\_Orders\Wild\_Rice\Maps\Reports\Final\_2014\Figure\_12\_2014\_Wild\_Rice\_Survey\_Results\_Lower\_Partridge\_River\_Second\_Creek.mxd User: mhw Imagery Source: FSA, 2013.



Barr Footer: ArcGIS 10.2.2, 2014-10-23 12:16 File: I:\Client\Polymet\_Mining\Work\_Orders\Wild\_Rice\Maps\Reports\Final\_2014\Figure\_13\_2014\_Wild\_Rice\_Survey\_Results\_Lower\_Partridge\_River.mxd User: mlw  
 Imagery Source: FSA, 2013.

**Wild Rice Density Point**

- 1: <10% Wild Rice Coverage
- 2: 10-25% Wild Rice Coverage
- 3: 25-50% Wild Rice Coverage
- 4: 50-75% Wild Rice Coverage
- 5: >75% Wild Rice Coverage

**Wild Rice Density Area**

- 1: <10% Wild Rice Coverage
- 2: 10-25% Wild Rice Coverage
- 3: 25-50% Wild Rice Coverage
- 4: 50-75% Wild Rice Coverage
- 5: >75% Wild Rice Coverage

- River Mile
- ▲ Water Sample Location with Sulfate, as SO<sub>4</sub> in mg/L
- Shoreline

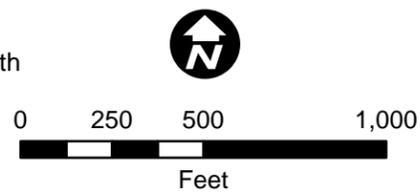
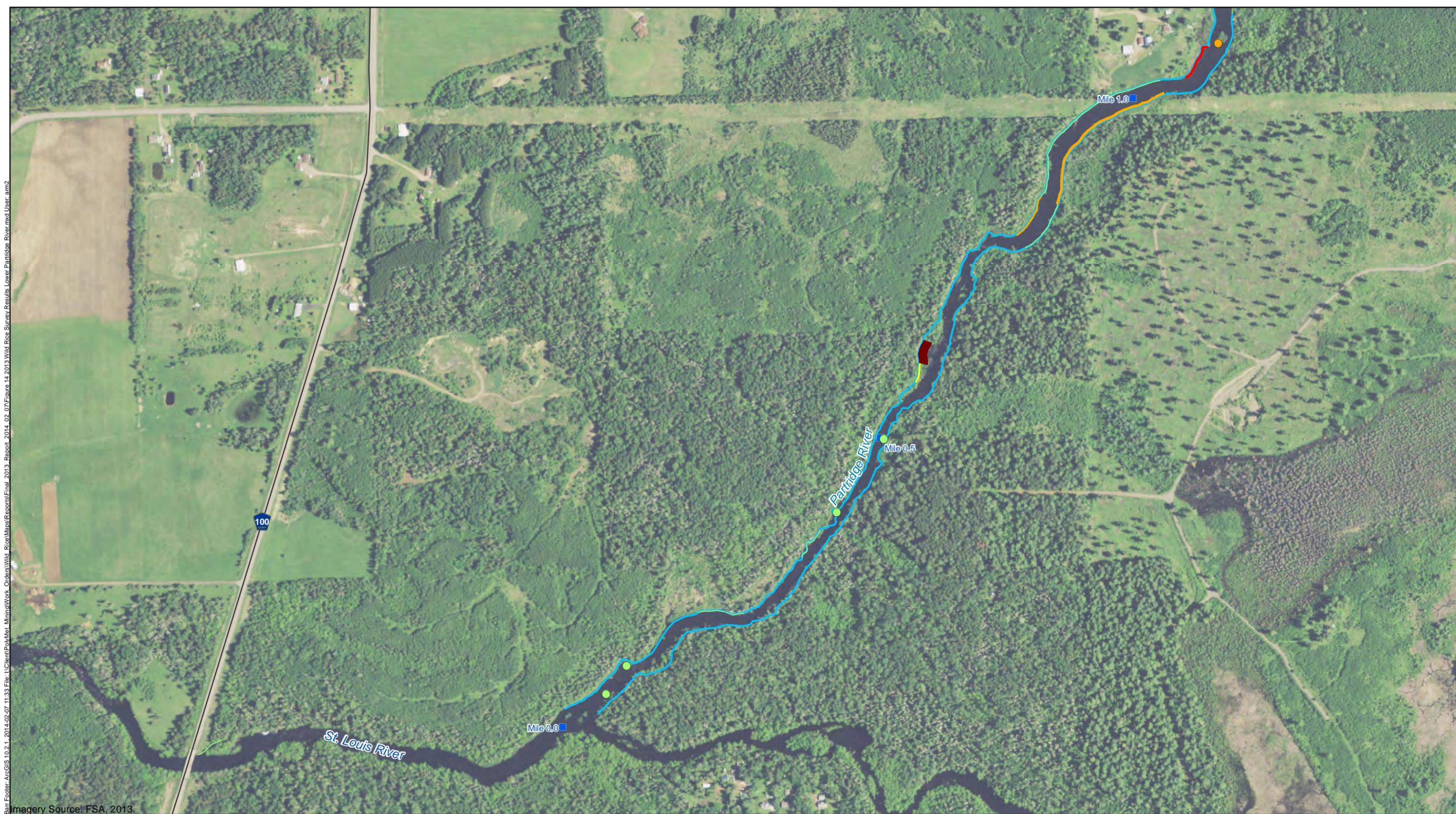


Figure 13  
 2014 WILD RICE SURVEY RESULTS  
 LOWER PARTRIDGE RIVER  
 (MILE 3.5 - 1.0)  
 NorthMet Project  
 Poly Met Mining, Inc.  
 Hoyt Lakes, Minnesota



Barr Footer: ArcGIS 10.2.1, 2014-09-07 11:33 File: I:\Client\Polymet\_Mining\Work\_Orders\Wild\_Rice\Maps\Reports\Final\_2013\_Report\_2014\_02\_07\Figure\_14\_2013\_Wild\_Rice\_Survey\_Results\_Lower\_Partridge\_River.mxd User: am2  
 Imagery Source: FSA, 2013.

Wild Rice Density Point		Wild Rice Density Area		■ River Mile
● 1: <10% Wild Rice Coverage	■ 1: <10% Wild Rice Coverage	■ 2: 10-25% Wild Rice Coverage	■ 3: 25-50% Wild Rice Coverage	— Shoreline
● 2: 10-25% Wild Rice Coverage	■ 4: 50-75% Wild Rice Coverage	■ 5: >75% Wild Rice Coverage		
● 3: 25-50% Wild Rice Coverage				
● 4: 50-75% Wild Rice Coverage				
● 5: >75% Wild Rice Coverage				

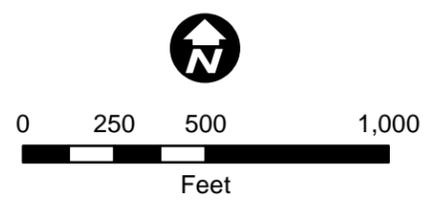
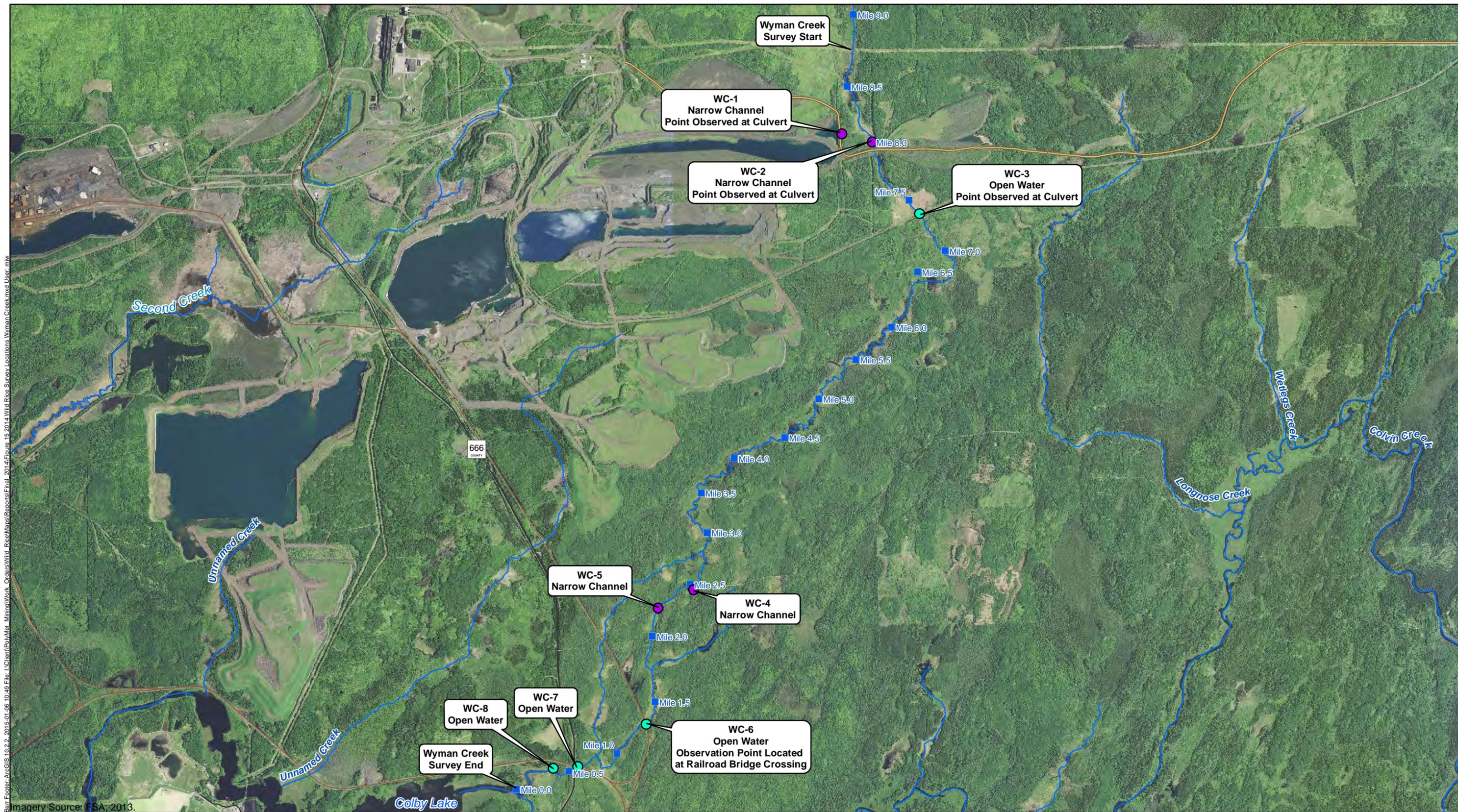


Figure 14  
 2014 WILD RICE SURVEY RESULTS  
 LOWER PARTRIDGE RIVER (MILE 1.0 - 0.0)  
 NorthMet Project  
 Poly Met Mining, Inc.  
 Hoyt Lakes, Minnesota



Barr Footer: ArcGIS 10.2.2, 2015-01-06 10:49 File: I:\Client\PolyMet\_Mining\Work\_Orders\Wild\_Rice\Maps\Reports\Final\_2014\Figure\_15\_2014\_Wild\_Rice\_Survey\_Locations\_Wyman\_Creek.mxd User: mlw  
 Imagery Source: FSA, 2013.

**Observation Points**

- Narrow Channel
- Open Water
- River Mile
- Dunka Road

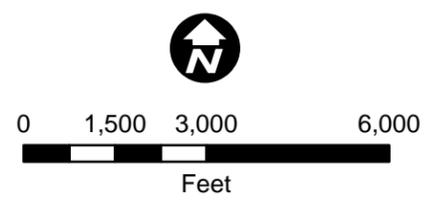
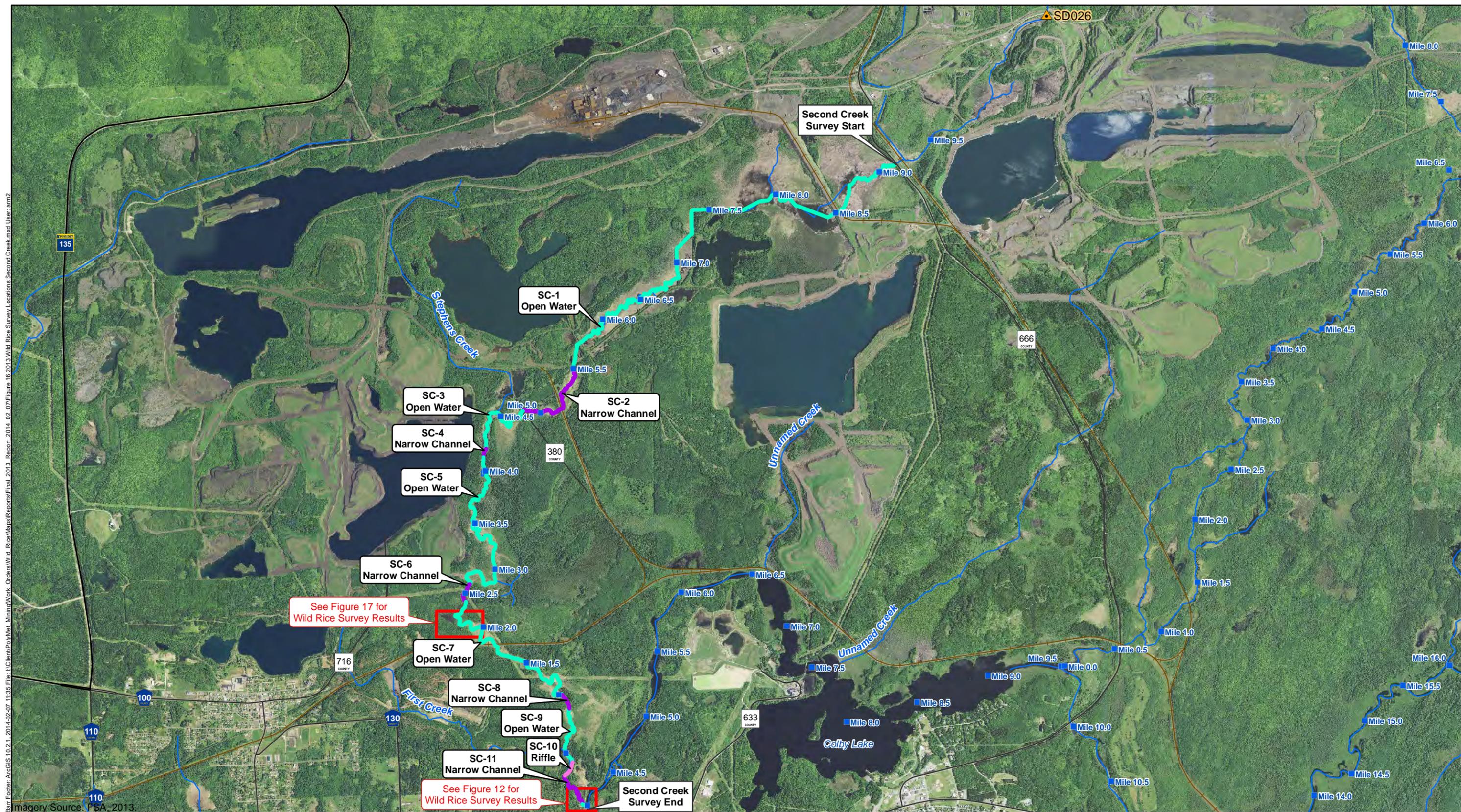


Figure 15  
 2014 WILD RICE SURVEY LOCATIONS  
 WYMAN CREEK  
 NorthMet Project  
 Poly Met Mining, Inc.  
 Hoyt Lakes, Minnesota



**Stream Reach Type**

- Narrow Channel
- Open Water
- Pool
- Riffle
- River Mile

▲ Existing Surface Discharge SD026

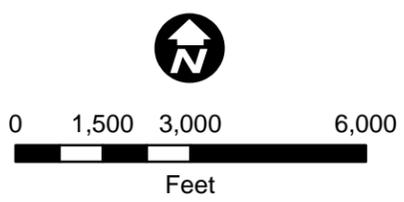


Figure 16  
 2014 WILD RICE SURVEY LOCATIONS  
 SECOND CREEK  
 NorthMet Project  
 Poly Met Mining, Inc.  
 Hoyt Lakes, Minnesota

Barr Footer: ArcGIS 10.2.1, 2014-09-07 11:35 File: I:\Client\Polymet\_Minimetal\Orders\Wild\_Rice\Maps\Reports\Final\_2013\_Report\_2014\_02\_07\Figure\_16\_2013\_Wild\_Rice\_Survey\_Locations\_Second\_Creek.mxd User: arm2  
 Imagery Source: FSA, 2013.

Barr Footer: ArcGIS 10.2.1 - 2014-09-07 11:36 File: I:\Client\Polymet\_Mining\Work\_Orders\Wild\_Rice\Maps\Reports\Final\_2013\_Report\_2014\_02\_07\Figure\_17\_2013\_Wild\_Rice\_Survey\_Results\_Second\_Creek.mxd User: am2

imagery Source: FSA, 2010.



Wild Rice Density Point

- 1: <10% Wild Rice Coverage
- 2: 10-25% Wild Rice Coverage
- 3: 25-50% Wild Rice Coverage
- 4: 50-75% Wild Rice Coverage
- 5: >75% Wild Rice Coverage

Wild Rice Density Area

- 1: <10% Wild Rice Coverage
- 2: 10-25% Wild Rice Coverage
- 3: 25-50% Wild Rice Coverage
- 4: 50-75% Wild Rice Coverage
- 5: >75% Wild Rice Coverage

River Mile

- ▲ Water Sample Location with Sulfate, as SO<sub>4</sub> in mg/L

Shoreline

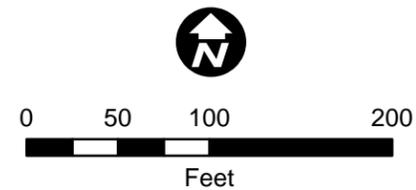


Figure 17  
 2014 WILD RICE SURVEY RESULTS  
 SECOND CREEK  
 NorthMet Project  
 Poly Met Mining, Inc.  
 Hoyt Lakes, Minnesota



Barr Footer: ArcGIS 10.2.2, 2014-12-23 15:11 File: I:\Client\Polymet\_Minim\Work\_Orders\Wild\_Rice\Maps\Reports\Final\_2014\Figure 18 2014 Wild Rice Survey Results Hay Lake Hay Lake Outlet Little Rice Lake Pike River.mxd User: mhw  
 Imagery Source: FSA, 2013

- |  |  |
|--|--|
| <b>Wild Rice Density Area</b>  | <b>Wild Rice Density Point</b>   |
| <span style="display: inline-block; width: 15px; height: 10px; background-color: #90EE90; border: 1px solid black;"></span> 1: <10% Wild Rice Coverage   | <span style="display: inline-block; width: 5px; height: 5px; background-color: #90EE90; border: 1px solid black; border-radius: 50%;"></span> 1: <10% Wild Rice Coverage   |
| <span style="display: inline-block; width: 15px; height: 10px; background-color: #FFFF00; border: 1px solid black;"></span> 2: 10-25% Wild Rice Coverage | <span style="display: inline-block; width: 5px; height: 5px; background-color: #FFFF00; border: 1px solid black; border-radius: 50%;"></span> 2: 10-25% Wild Rice Coverage |
| <span style="display: inline-block; width: 15px; height: 10px; background-color: #FFA500; border: 1px solid black;"></span> 3: 25-50% Wild Rice Coverage | <span style="display: inline-block; width: 5px; height: 5px; background-color: #FFA500; border: 1px solid black; border-radius: 50%;"></span> 3: 25-50% Wild Rice Coverage |
| <span style="display: inline-block; width: 15px; height: 10px; background-color: #FF0000; border: 1px solid black;"></span> 4: 50-75% Wild Rice Coverage | <span style="display: inline-block; width: 5px; height: 5px; background-color: #FF0000; border: 1px solid black; border-radius: 50%;"></span> 4: 50-75% Wild Rice Coverage |
| <span style="display: inline-block; width: 15px; height: 10px; background-color: #800000; border: 1px solid black;"></span> 5: >75% Wild Rice Coverage   | <span style="display: inline-block; width: 5px; height: 5px; background-color: #800000; border: 1px solid black; border-radius: 50%;"></span> 5: >75% Wild Rice Coverage   |

- River Mile
- Water Sample Location with Sulfate, as SO<sub>4</sub> in mg/L
- Shoreline
- Stream Reach Type**
- Open Water

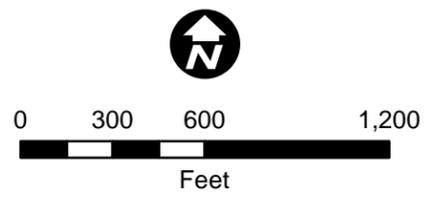


Figure 18  
 2014 WILD RICE SURVEY RESULTS  
 LITTLE RICE LAKE, THE PIKE RIVER, AND HAY LAKE 2  
 NorthMet Project  
 Poly Met Mining, Inc.  
 Hoyt Lakes, Minnesota

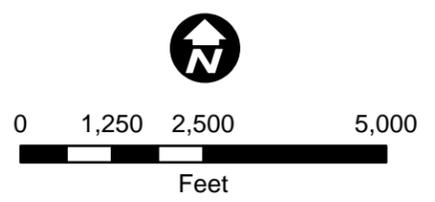
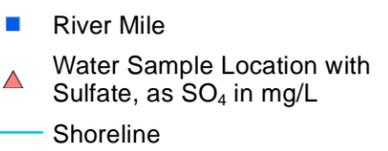
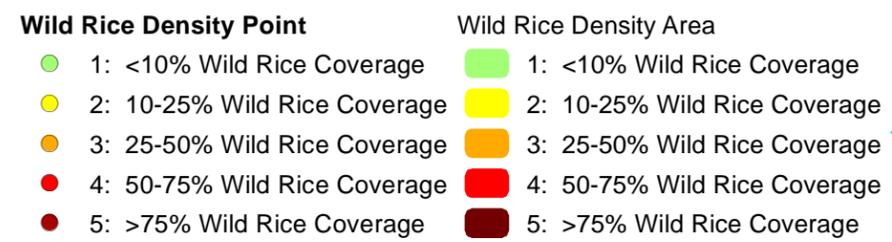
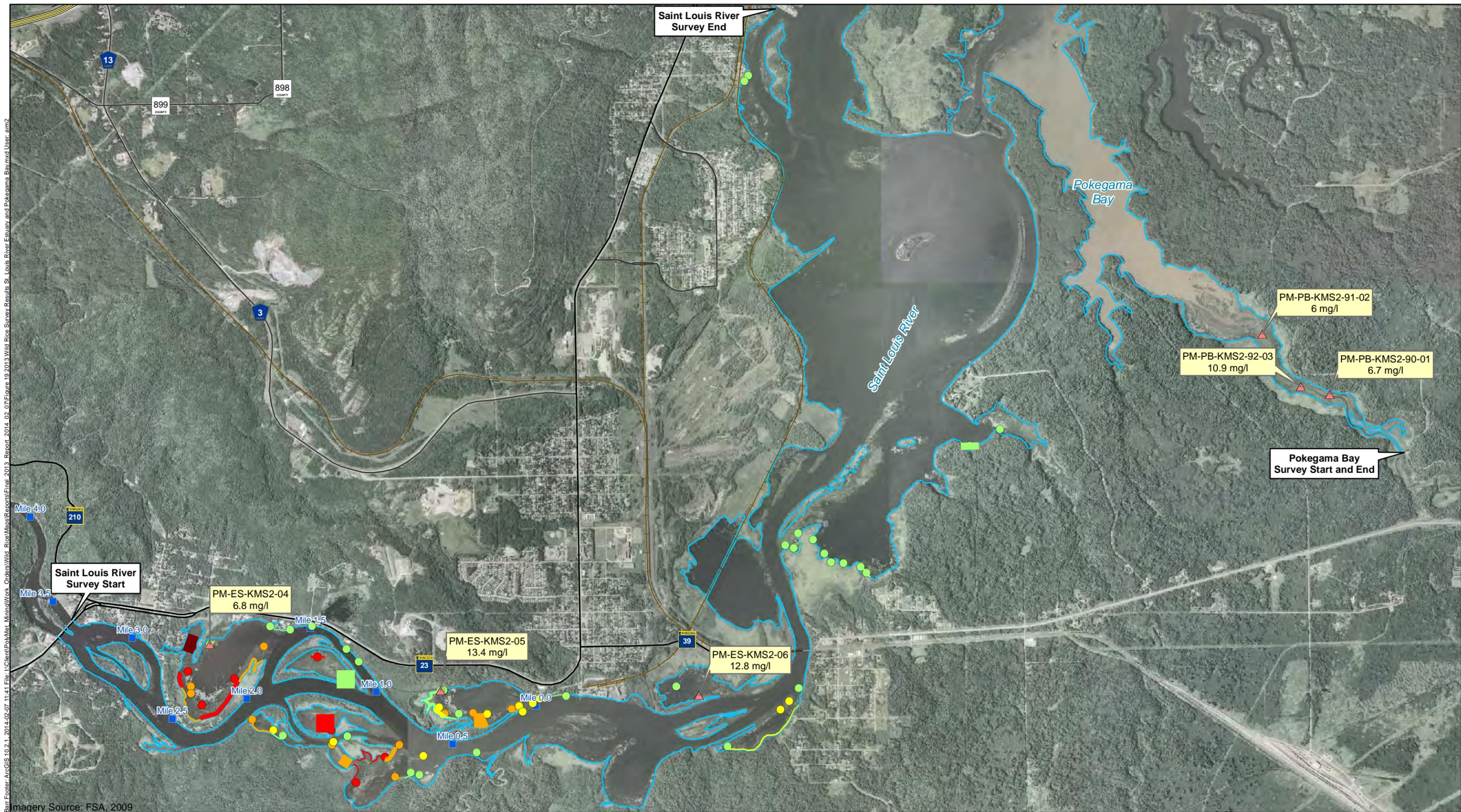
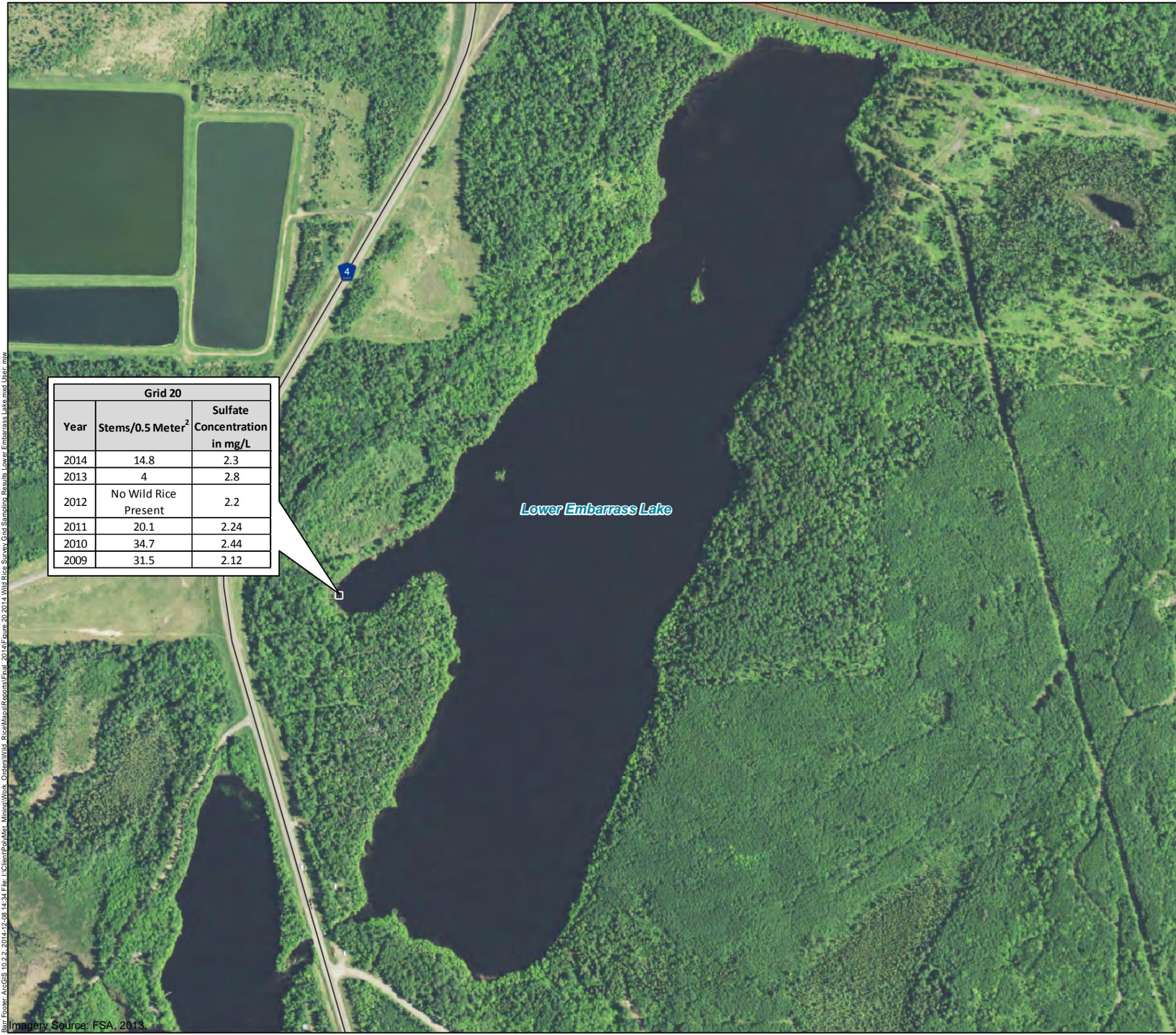


Figure 19  
 2014 WILD RICE SURVEY RESULTS  
 SAINT LOUIS RIVER AND POKEGAMA BAY  
 NorthMet Project  
 Poly Met Mining, Inc.  
 Hoyt Lakes, Minnesota

Barr Footer: ArcGIS 10.2.1, 2014-09-07 11:41 File: I:\Client\Polymet\_Minim\Work\_Orders\Wild\_Rice\Maps\Reports\Final\_2014\_Report\_2014\_02\_07\Figure\_19\_2013\_Wild\_Rice\_Survey\_Results\_Saint\_Louis\_River\_Estuary\_and\_Pokegama\_Bay.mxd User: arm2  
 Imagery Source: FSA, 2009



Grid 20		
Year	Stems/0.5 Meter <sup>2</sup>	Sulfate Concentration in mg/L
2014	14.8	2.3
2013	4	2.8
2012	No Wild Rice Present	2.2
2011	20.1	2.24
2010	34.7	2.44
2009	31.5	2.12

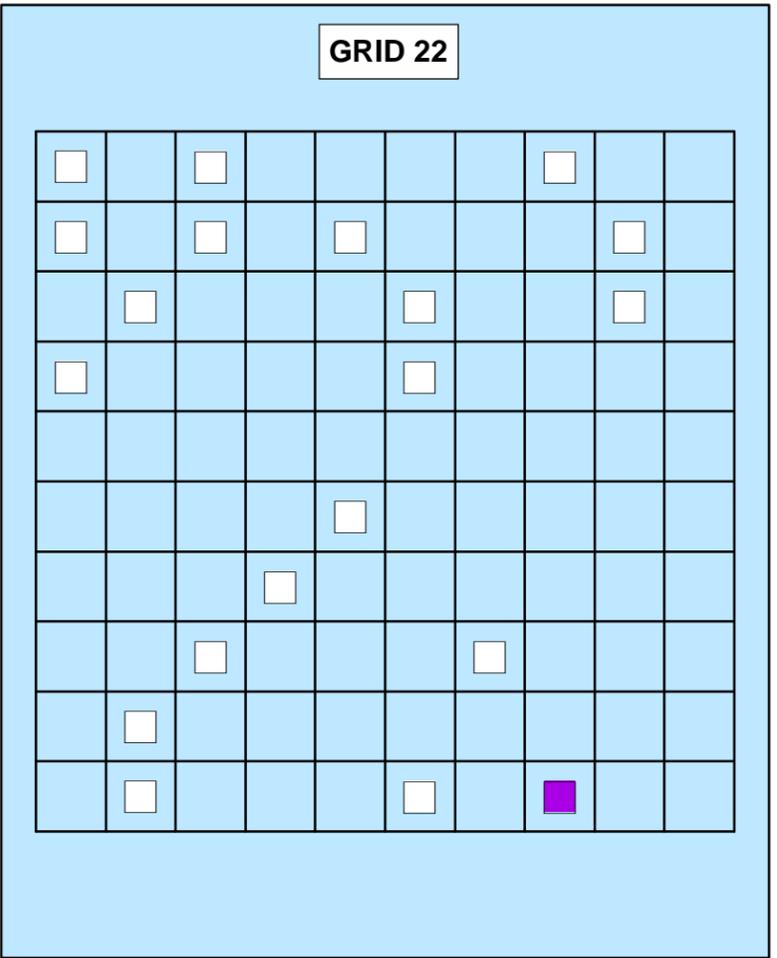
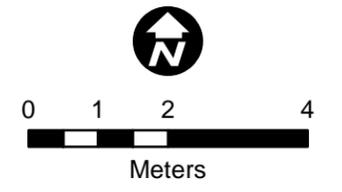


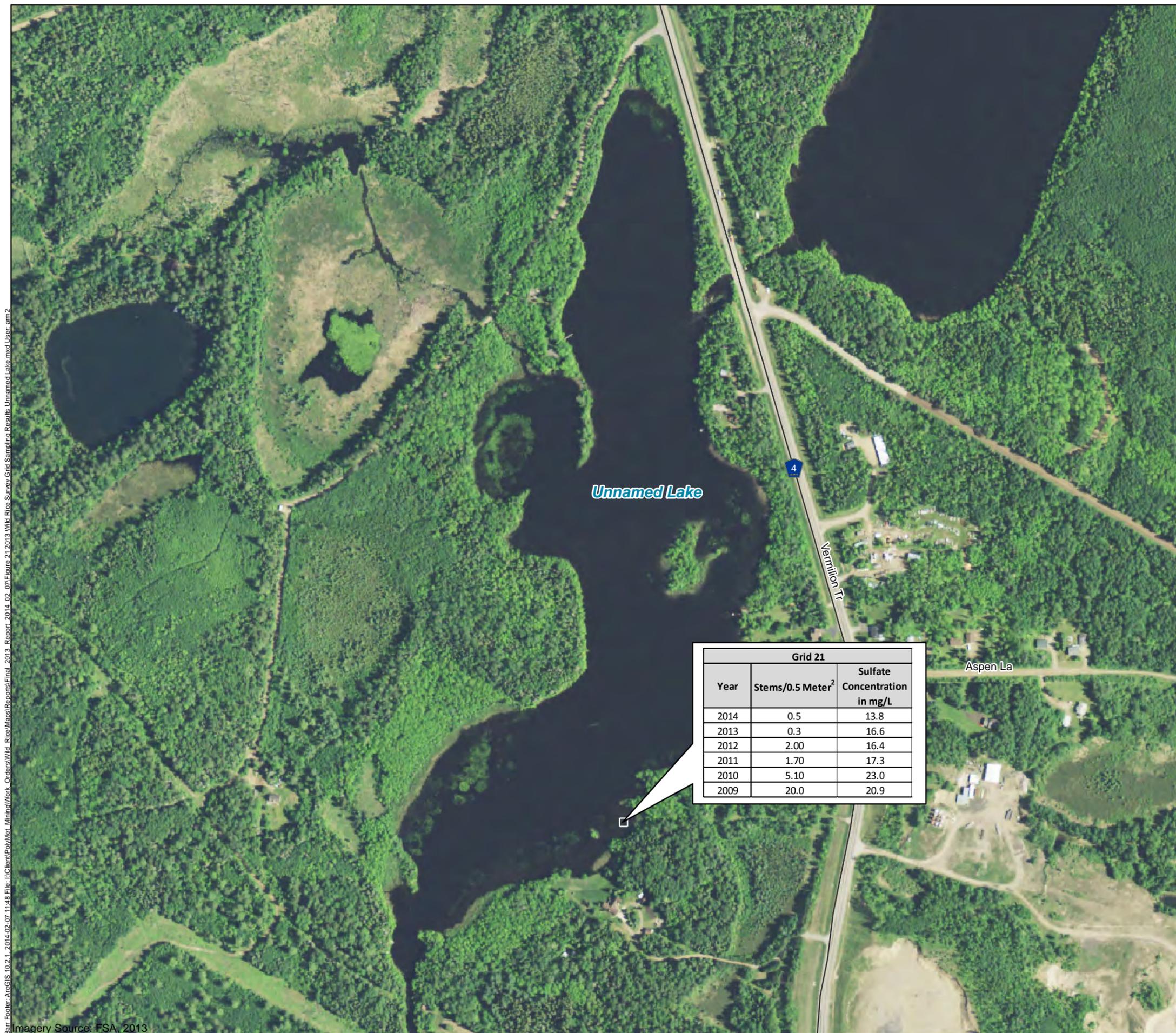
Figure 20  
 2014 WILD RICE SURVEY  
 GRID SAMPLING RESULTS  
 LOWER EMBARRASS LAKE  
 (EMBARRASS RIVER)  
 NorthMet Project  
 Poly Met Mining, Inc.  
 Hoyt Lakes, Minnesota

Stem Count/0.5m<sup>2</sup>

- 0
- 1 - 25
- 10x10 Meter Grid



Barr Footer: ArcGIS 10.2.2 - 2014-12-08 14:34 File: I:\Client\PolMet\_Mining\Work\_Orders\Wild\_Rice\Maps\Reports\Final\_2014\Figure 20 2014 Wild Rice Survey Grid Sampling Results Lower Embarrass Lake.mxd User: mhw Imagery Source: FSA, 2013.



Grid 21		
Year	Stems/0.5 Meter <sup>2</sup>	Sulfate Concentration in mg/L
2014	0.5	13.8
2013	0.3	16.6
2012	2.00	16.4
2011	1.70	17.3
2010	5.10	23.0
2009	20.0	20.9

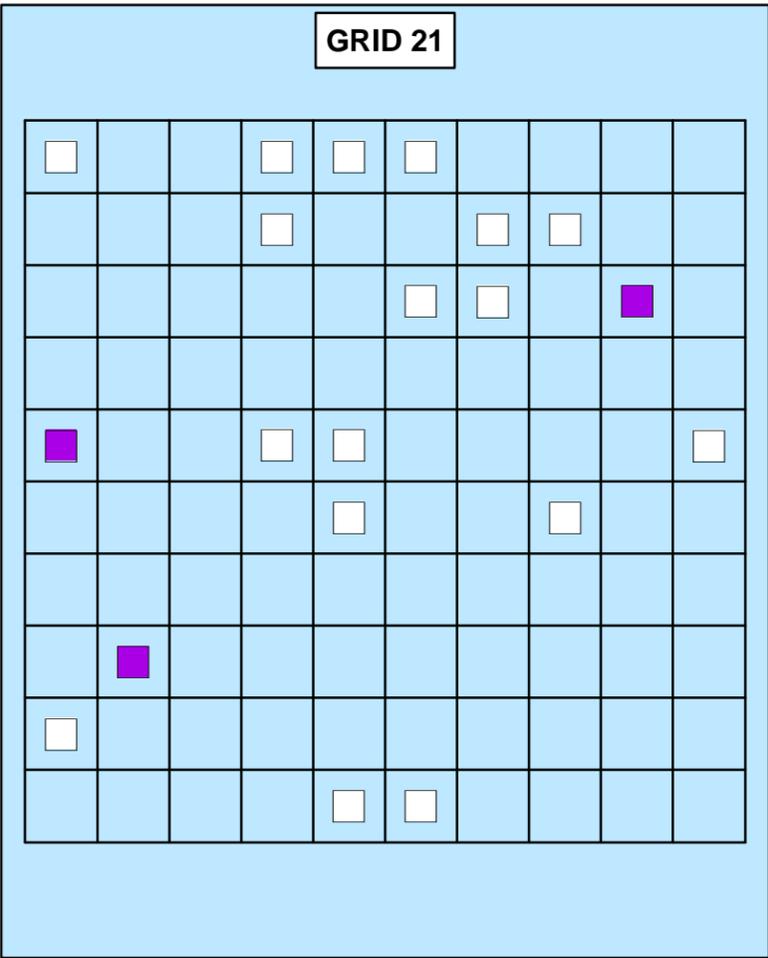


Figure 21  
 2014 WILD RICE SURVEY  
 GRID SAMPLING RESULTS  
 UNNAMED LAKE  
 (EMBARRASS RIVER)  
 NorthMet Project  
 Poly Met Mining, Inc.  
 Hoyt Lakes, Minnesota

Stem Count/0.5m<sup>2</sup>

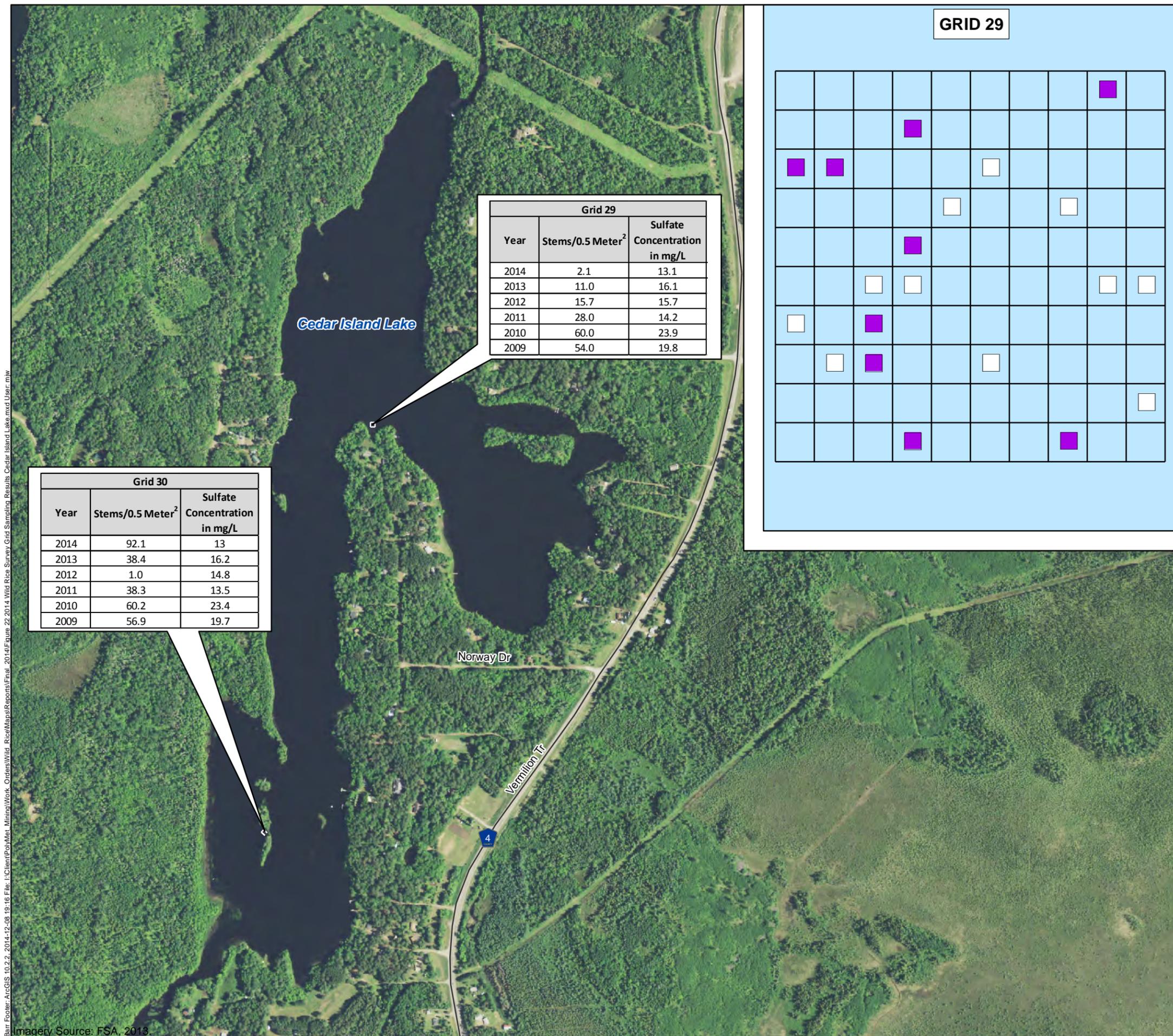
□ 0

■ 1-25

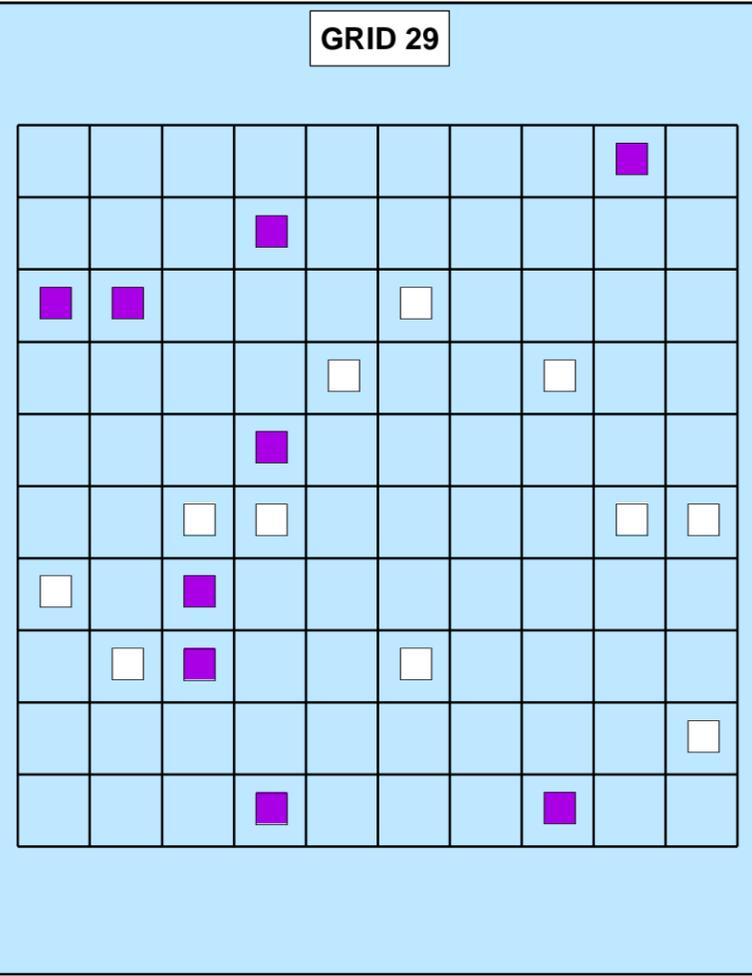
— 10x10 Meter Grid



Meters



Grid 29		
Year	Stems/0.5 Meter <sup>2</sup>	Sulfate Concentration in mg/L
2014	2.1	13.1
2013	11.0	16.1
2012	15.7	15.7
2011	28.0	14.2
2010	60.0	23.9
2009	54.0	19.8



Grid 30		
Year	Stems/0.5 Meter <sup>2</sup>	Sulfate Concentration in mg/L
2014	92.1	13
2013	38.4	16.2
2012	1.0	14.8
2011	38.3	13.5
2010	60.2	23.4
2009	56.9	19.7

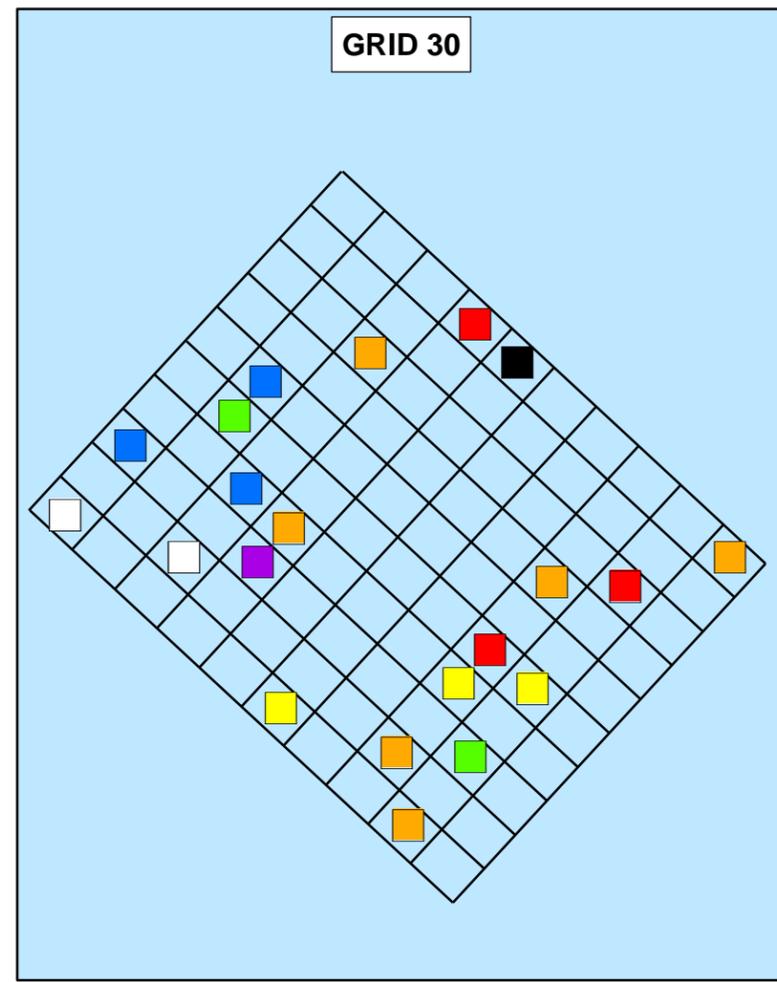
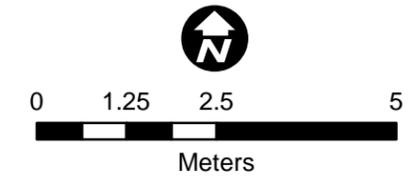
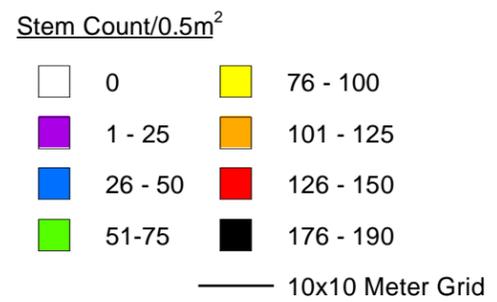
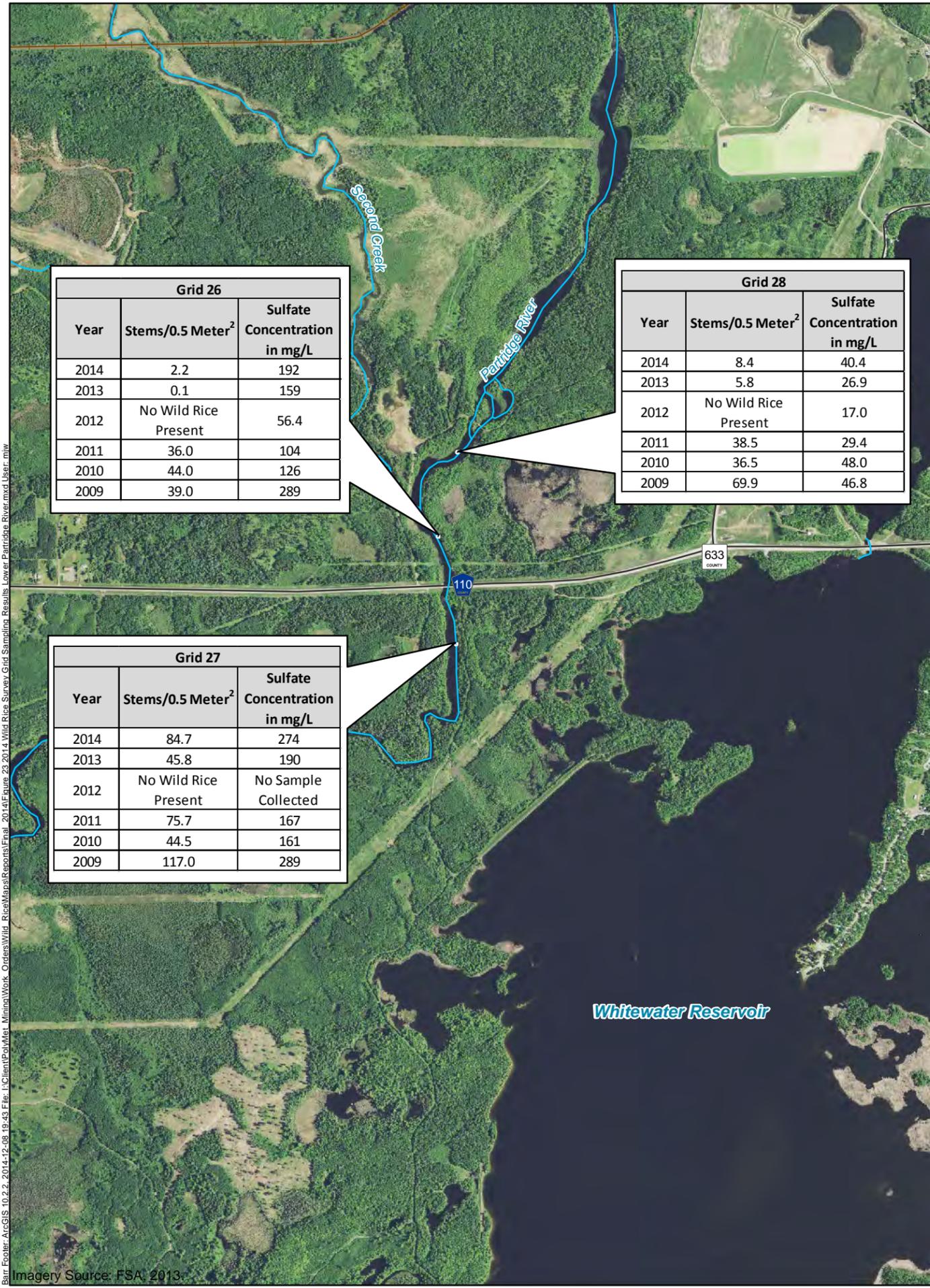


Figure 22  
 2014 WILD RICE SURVEY  
 GRID SAMPLING RESULTS  
 CEDAR ISLAND LAKE  
 (EMBARRASS RIVER)  
 NorthMet Project  
 Poly Met Mining, Inc.  
 Hoyt Lakes, Minnesota

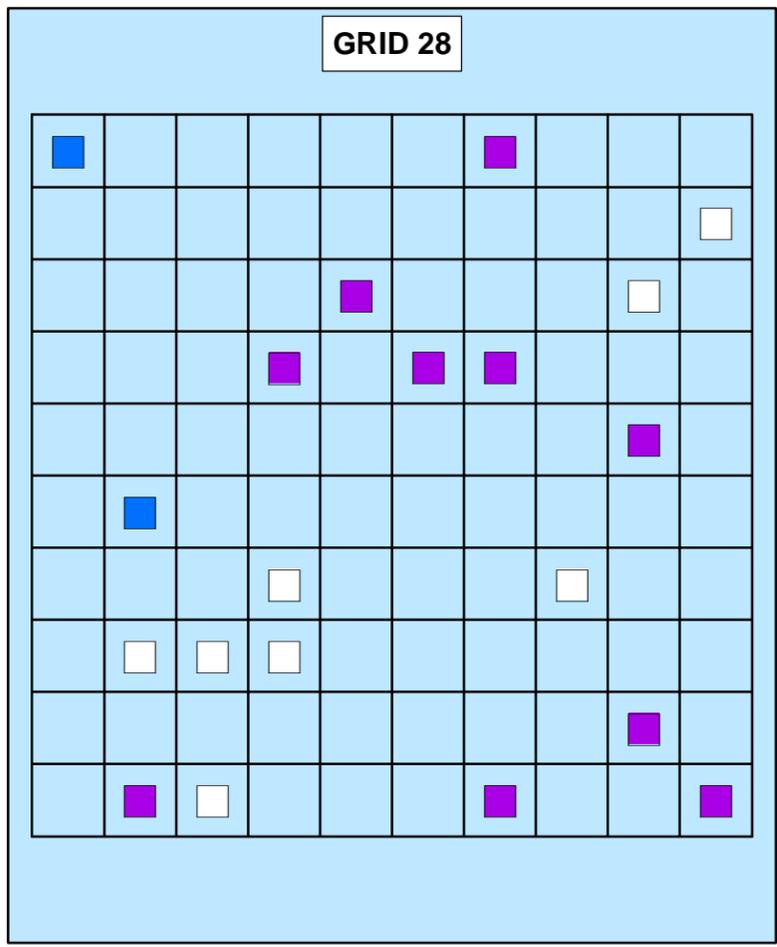
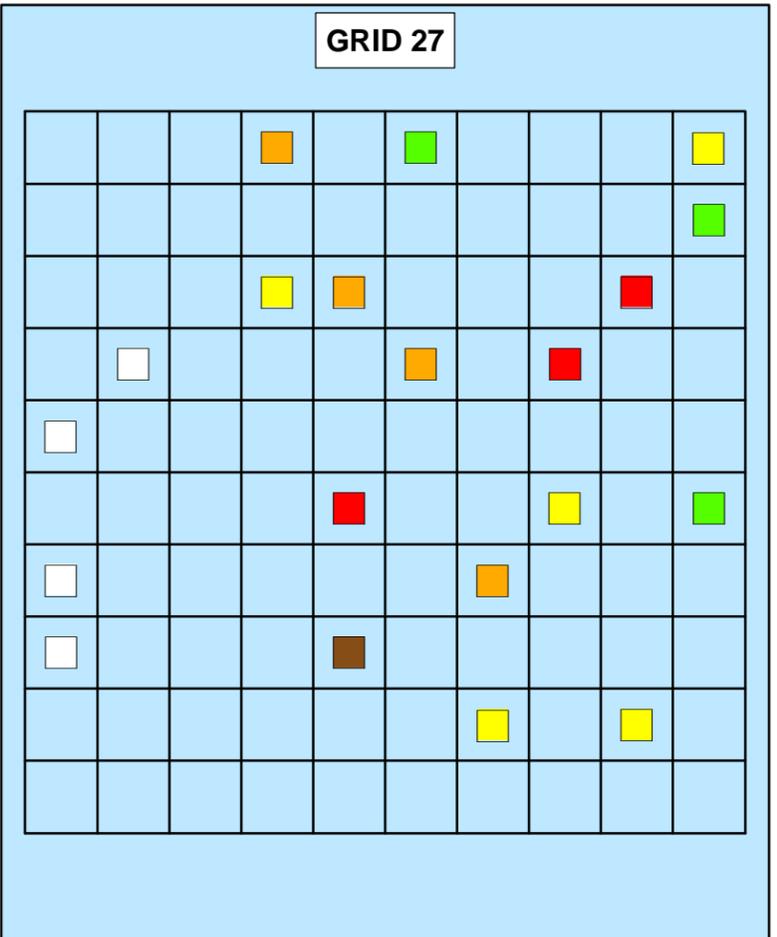
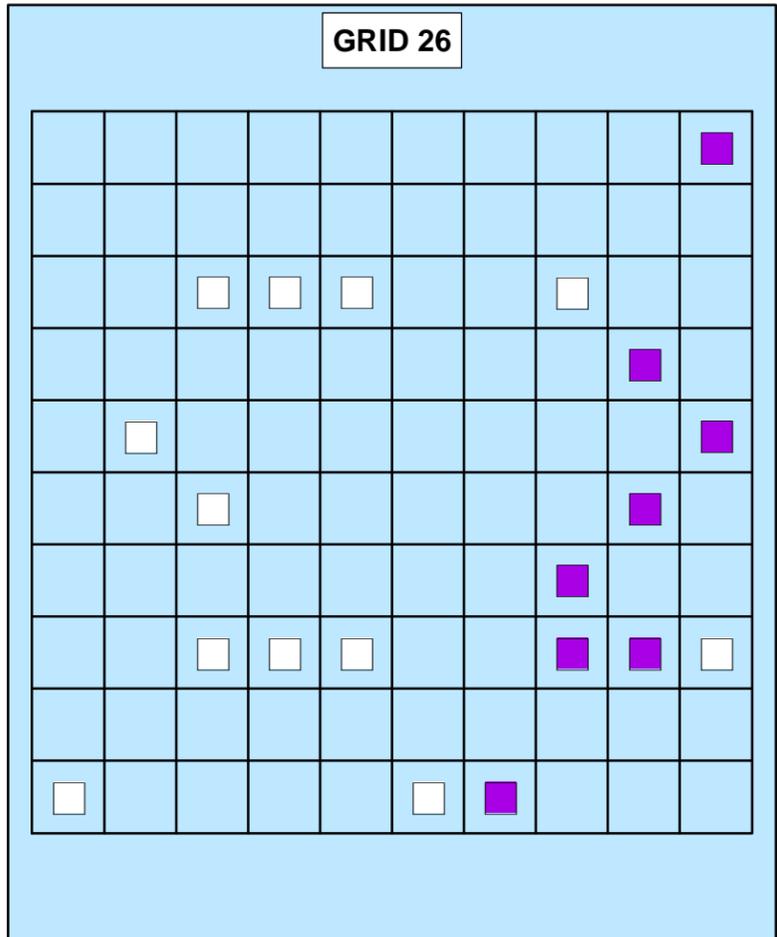




Grid 26		
Year	Stems/0.5 Meter <sup>2</sup>	Sulfate Concentration in mg/L
2014	2.2	192
2013	0.1	159
2012	No Wild Rice Present	56.4
2011	36.0	104
2010	44.0	126
2009	39.0	289

Grid 28		
Year	Stems/0.5 Meter <sup>2</sup>	Sulfate Concentration in mg/L
2014	8.4	40.4
2013	5.8	26.9
2012	No Wild Rice Present	17.0
2011	38.5	29.4
2010	36.5	48.0
2009	69.9	46.8

Grid 27		
Year	Stems/0.5 Meter <sup>2</sup>	Sulfate Concentration in mg/L
2014	84.7	274
2013	45.8	190
2012	No Wild Rice Present	No Sample Collected
2011	75.7	167
2010	44.5	161
2009	117.0	289



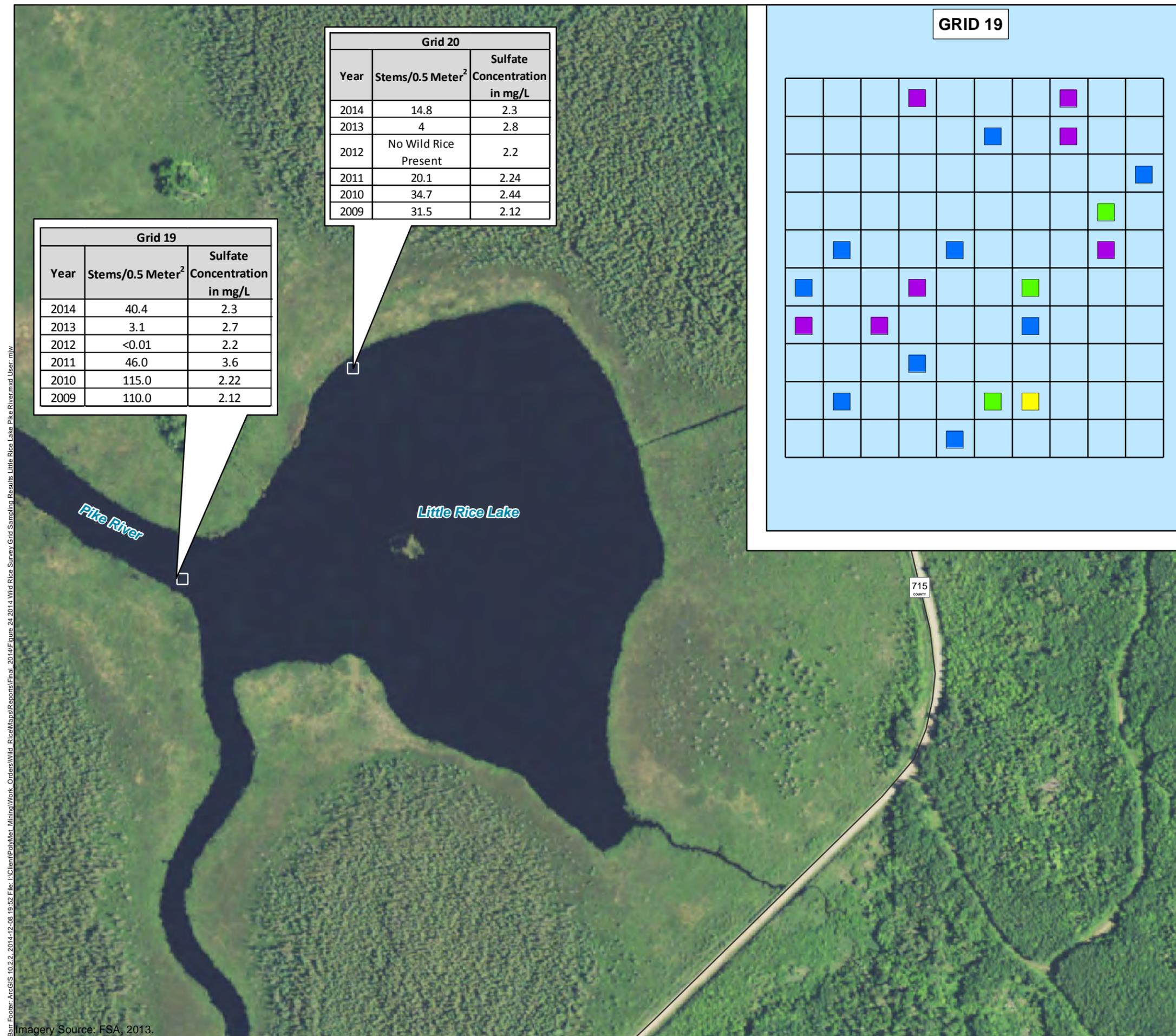
**Figure 23**  
**2014 WILD RICE SURVEY**  
**GRID SAMPLING RESULTS**  
**LOWER PARTRIDGE RIVER**  
 NorthMet Project  
 Poly Met Mining, Inc.  
 Hoyt Lakes, Minnesota

**Stem Count/0.5m<sup>2</sup>**

□ 0	■ 76 - 100
■ 1 - 25	■ 101 - 125
■ 26 - 50	■ 126 - 150
■ 51 - 75	■ 151 - 175
— 10 x 10 Meter Grid	



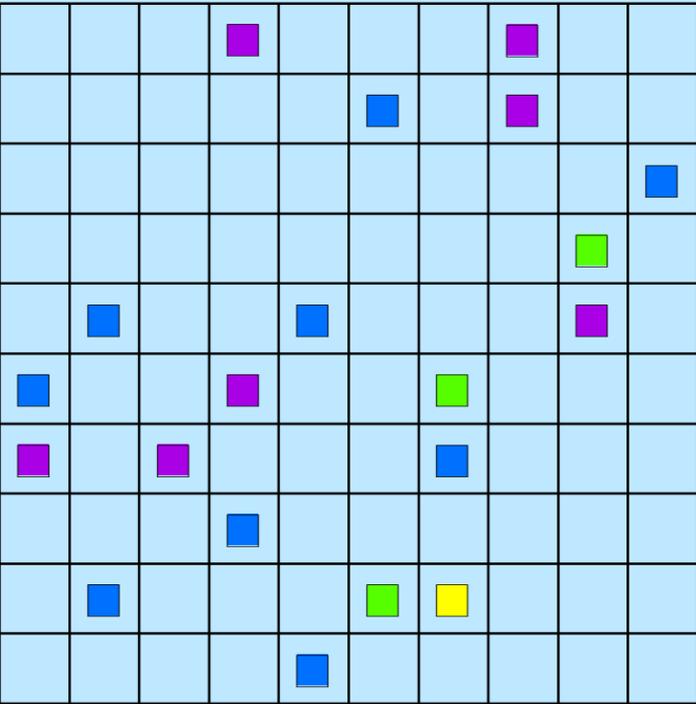
0 1 2 4  
Meters



Grid 20		
Year	Stems/0.5 Meter <sup>2</sup>	Sulfate Concentration in mg/L
2014	14.8	2.3
2013	4	2.8
2012	No Wild Rice Present	2.2
2011	20.1	2.24
2010	34.7	2.44
2009	31.5	2.12

Grid 19		
Year	Stems/0.5 Meter <sup>2</sup>	Sulfate Concentration in mg/L
2014	40.4	2.3
2013	3.1	2.7
2012	<0.01	2.2
2011	46.0	3.6
2010	115.0	2.22
2009	110.0	2.12

GRID 19



GRID 20

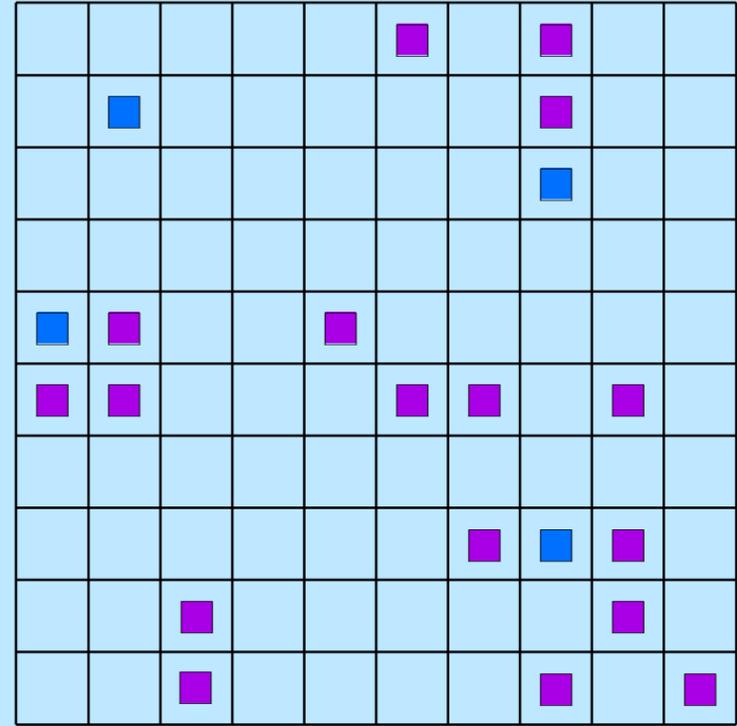
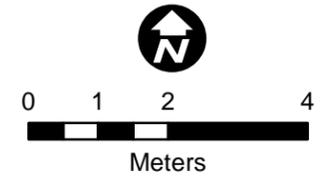
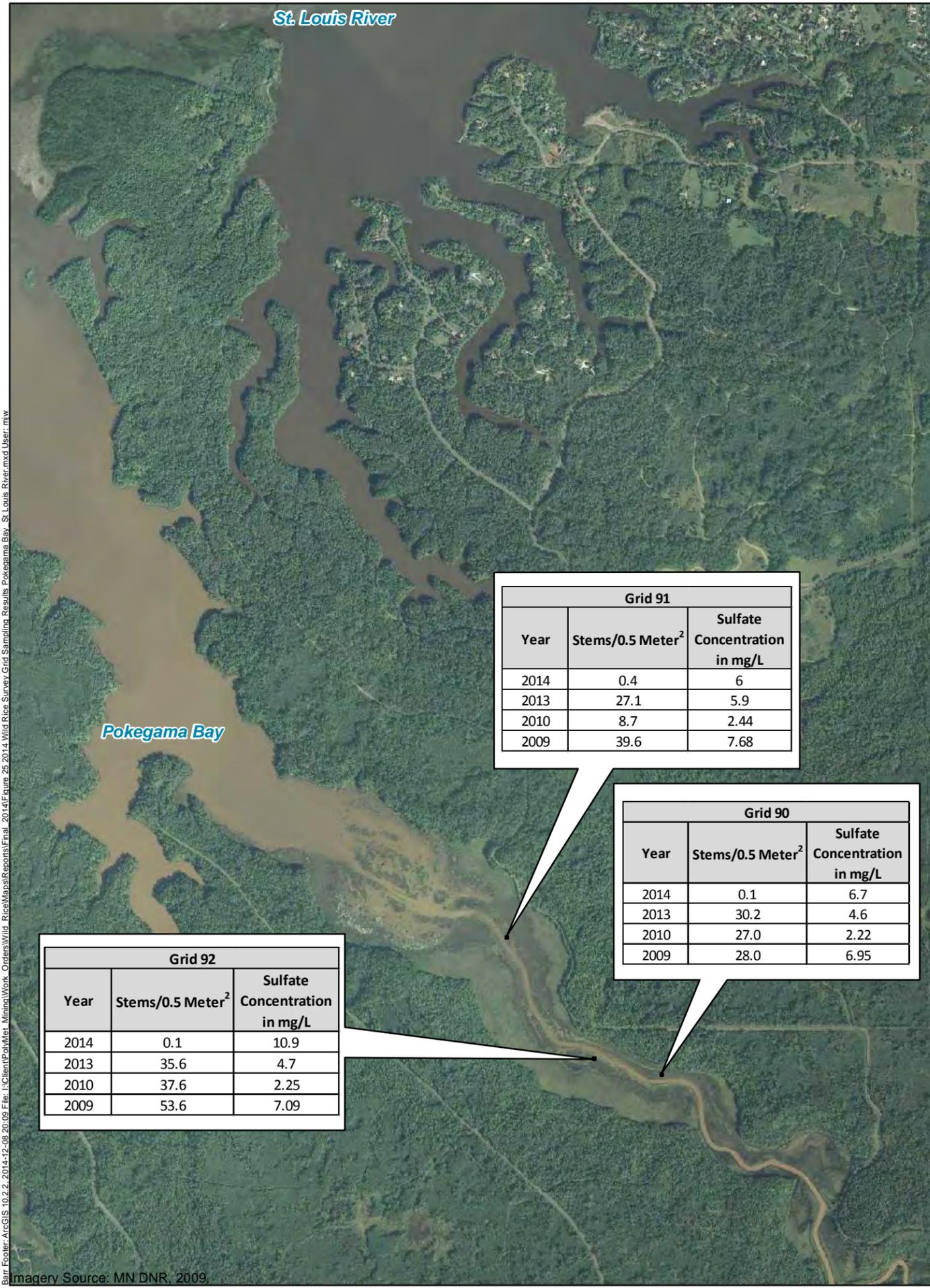


Figure 24  
 2014 WILD RICE SURVEY  
 GRID SAMPLING RESULTS  
 LITTLE RICE LAKE  
 (PIKE RIVER)  
 NorthMet Project  
 Poly Met Mining, Inc.  
 Hoyt Lakes, Minnesota

- Stem Count/0.5m<sup>2</sup>
- 0
  - 1 - 25
  - 26 - 50
  - 51-75
  - 76 - 100
  - 10x10 Meter Grid





St. Louis River

Pokegama Bay

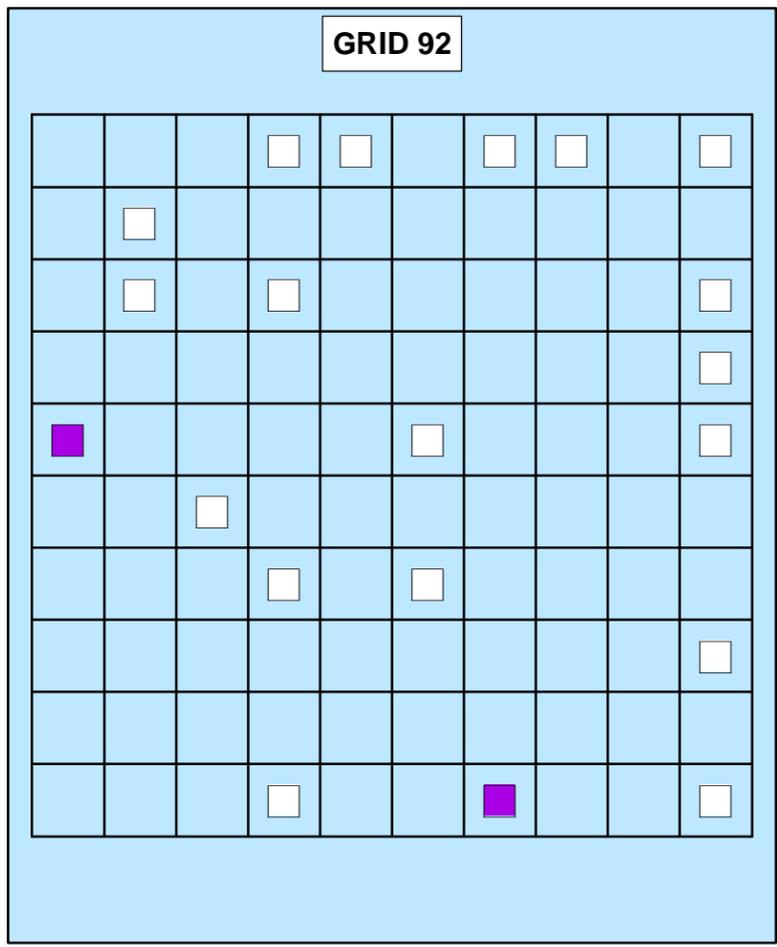
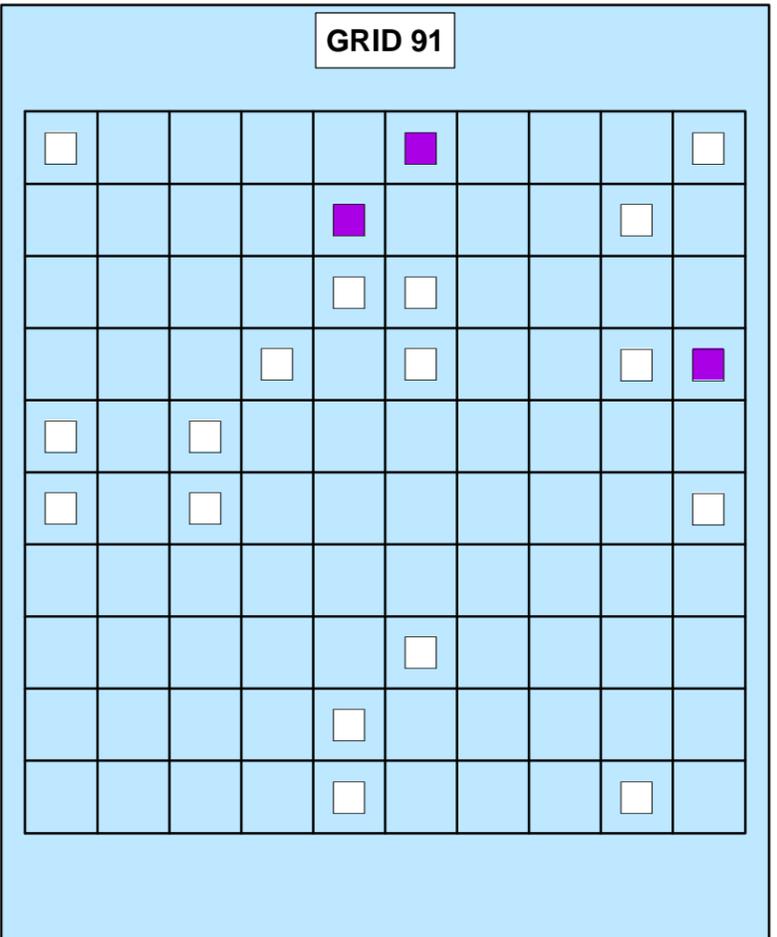
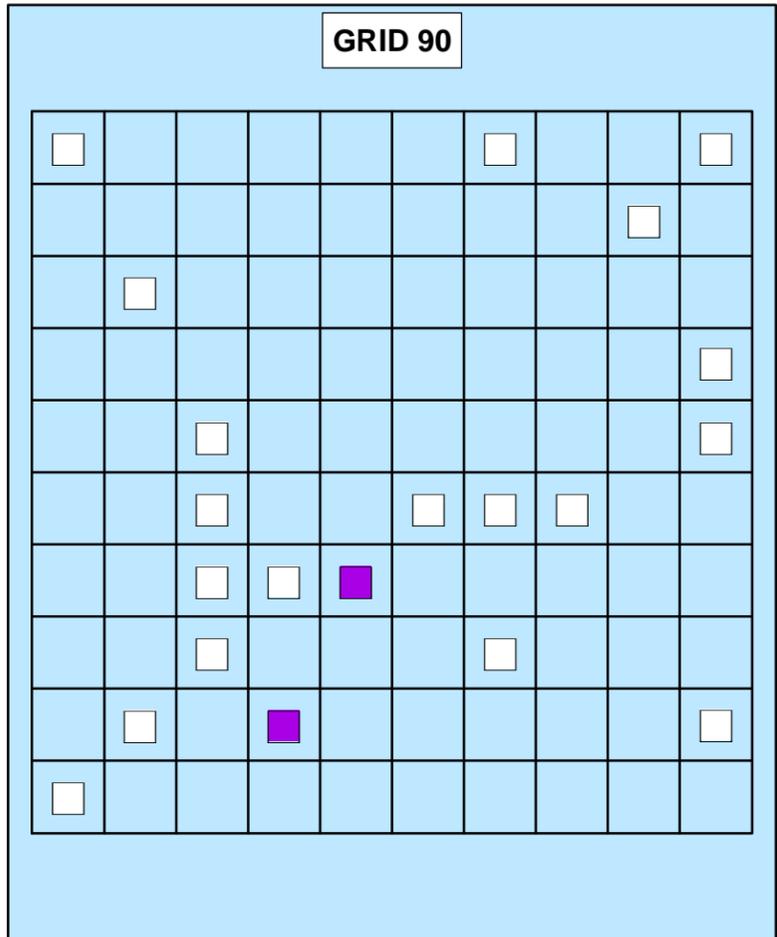
Grid 91		
Year	Stems/0.5 Meter <sup>2</sup>	Sulfate Concentration in mg/L
2014	0.4	6
2013	27.1	5.9
2010	8.7	2.44
2009	39.6	7.68

Grid 90		
Year	Stems/0.5 Meter <sup>2</sup>	Sulfate Concentration in mg/L
2014	0.1	6.7
2013	30.2	4.6
2010	27.0	2.22
2009	28.0	6.95

Grid 92		
Year	Stems/0.5 Meter <sup>2</sup>	Sulfate Concentration in mg/L
2014	0.1	10.9
2013	35.6	4.7
2010	37.6	2.25
2009	53.6	7.09

Barr Footer: ArcGIS 10.2.2 - 2014-12-08 20:09 File: I:\Client\PolMet\_Mining\Work\_Orders\Wild\_Rice\Map\Reports\Final\_2014\Figure 25 2014 Wild Rice Survey Grid Sampling Results Pokegama Bay - St. Louis River.mxd User: miv

imagery Source: MN DNR, 2009.



**Figure 25**  
**2014 WILD RICE SURVEY**  
**GRID SAMPLING RESULTS**  
**POKEGAMA BAY (ST. LOUIS RIVER)**  
 NorthMet Project  
 Poly Met Mining, Inc.  
 Hoyt Lakes, Minnesota

Stem Count/0.5m<sup>2</sup>

- 0
- 1 - 25

— 10x10 Meter Grid

0 1 2 4  
Meters

Figure 26 Mean and Standard Deviation of Total Calculated Plant Weight (g)  
in the Partridge River, Pike River, and Embarrass River, 2010-2014, and St. Louis River, 2010

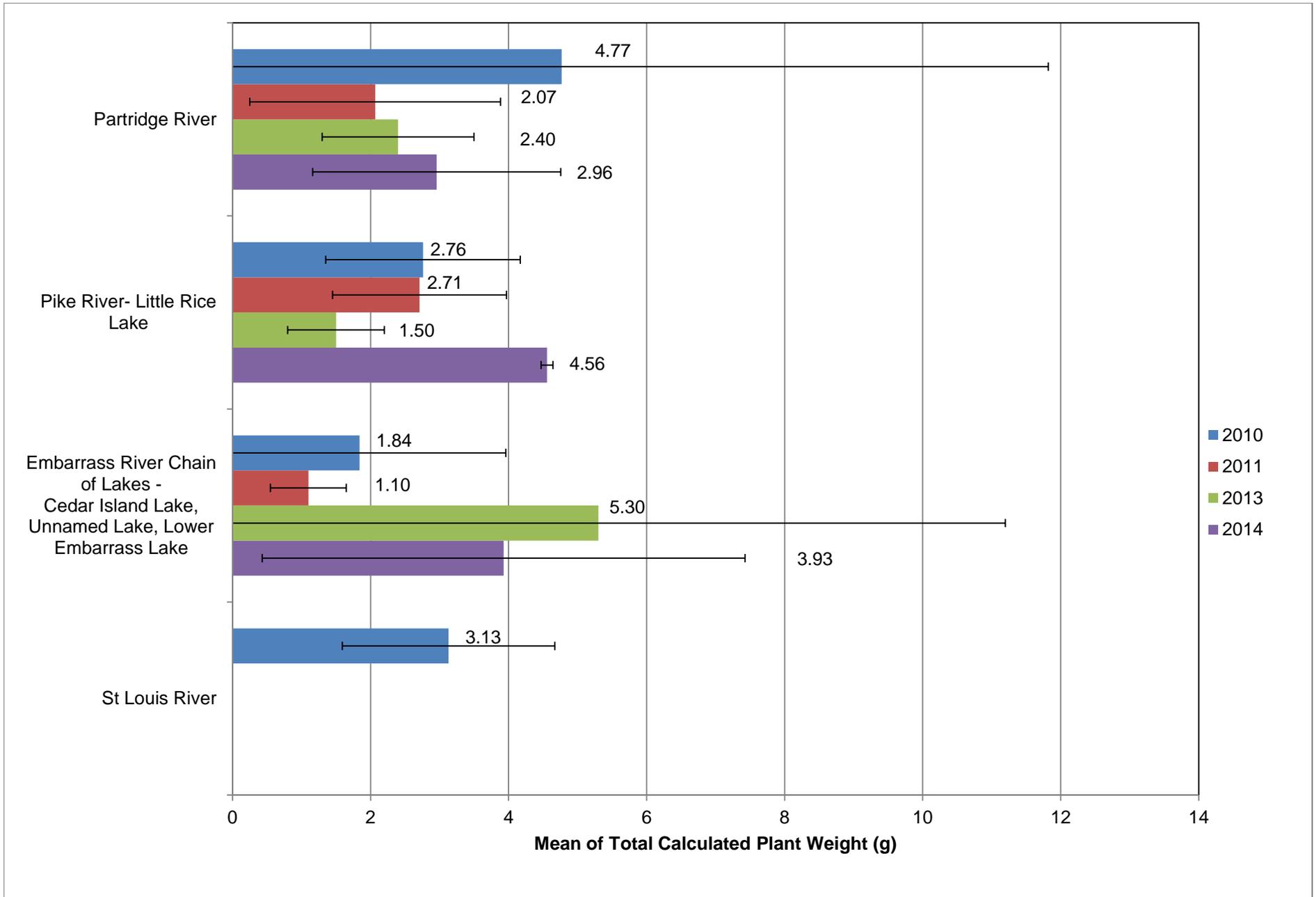


Figure 27 Mean and Standard Deviation of Root Weight (g)  
 in the Partridge River, Pike River, and Embarrass River, 2010-2014, and St. Louis River, 2010

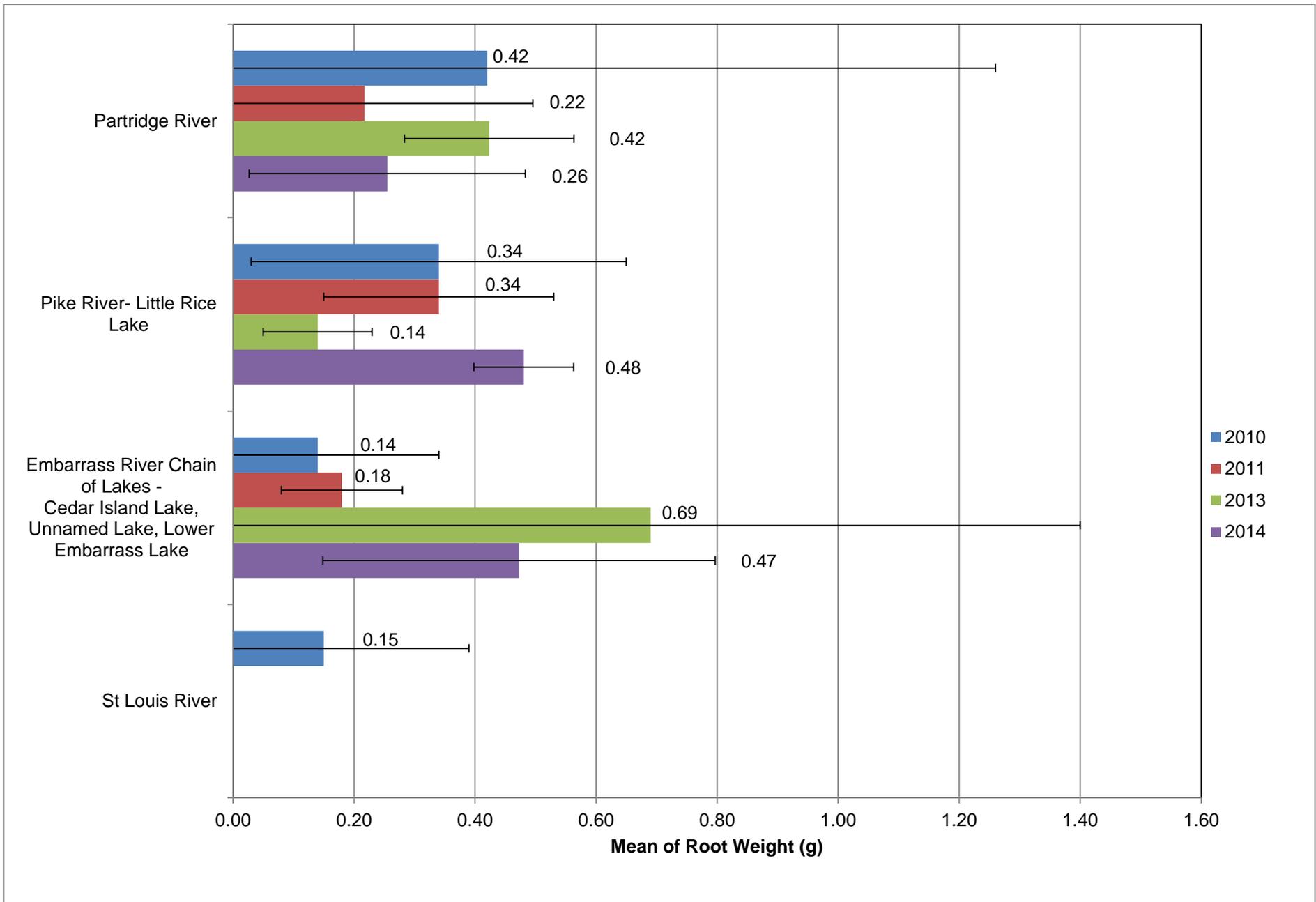


Figure 28 Mean and Standard Deviation of Shoot Weight (g)  
 in the Partridge River, Pike River, and Embarrass River, 2010-2014, and St. Louis River, 2010

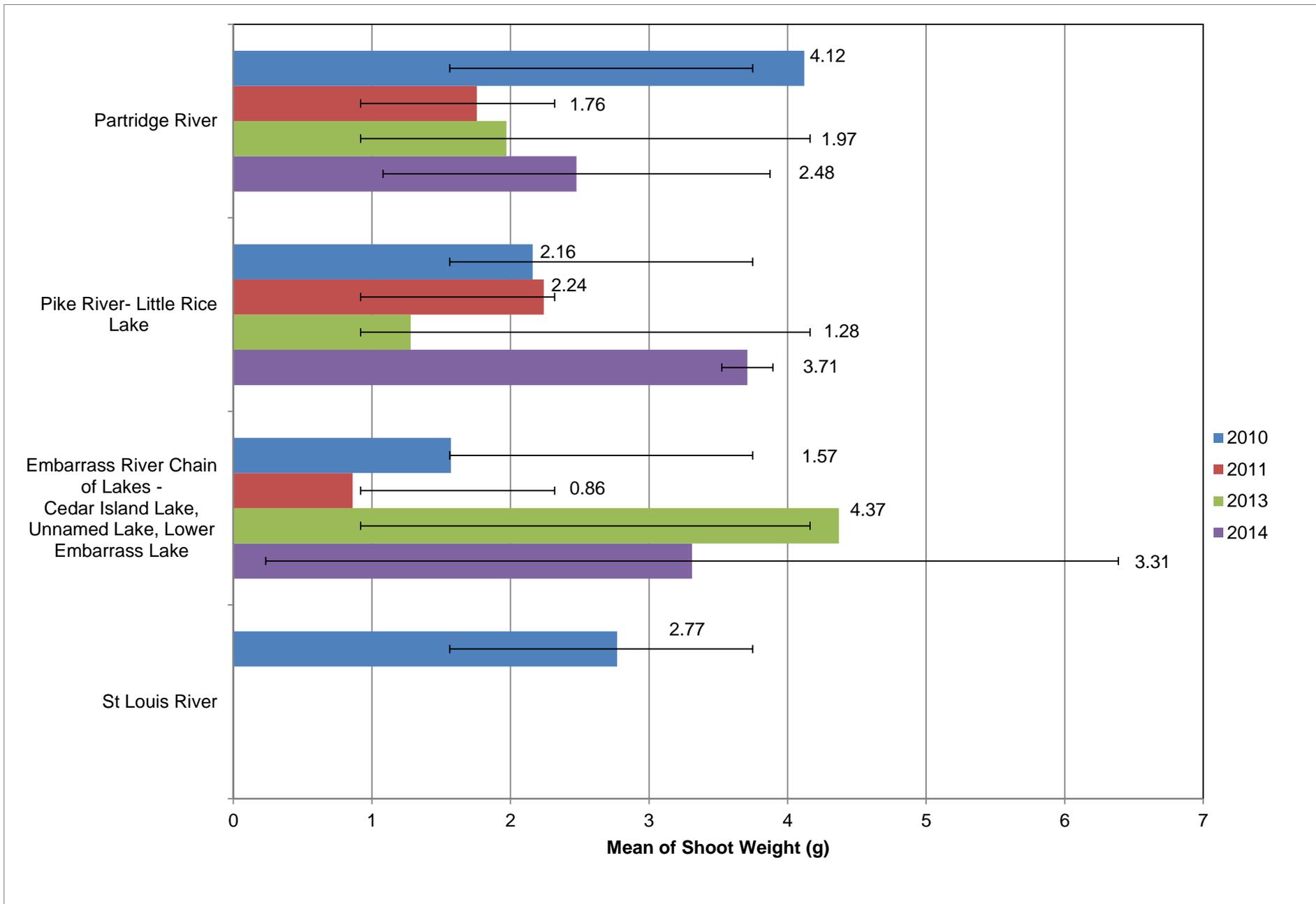


Figure 29 Mean and Standard Deviation of Calculated Seed Weight (g)  
in the Partridge River, Pike River, and Embarrass River, 2010-2014, and St. Louis River, 2010

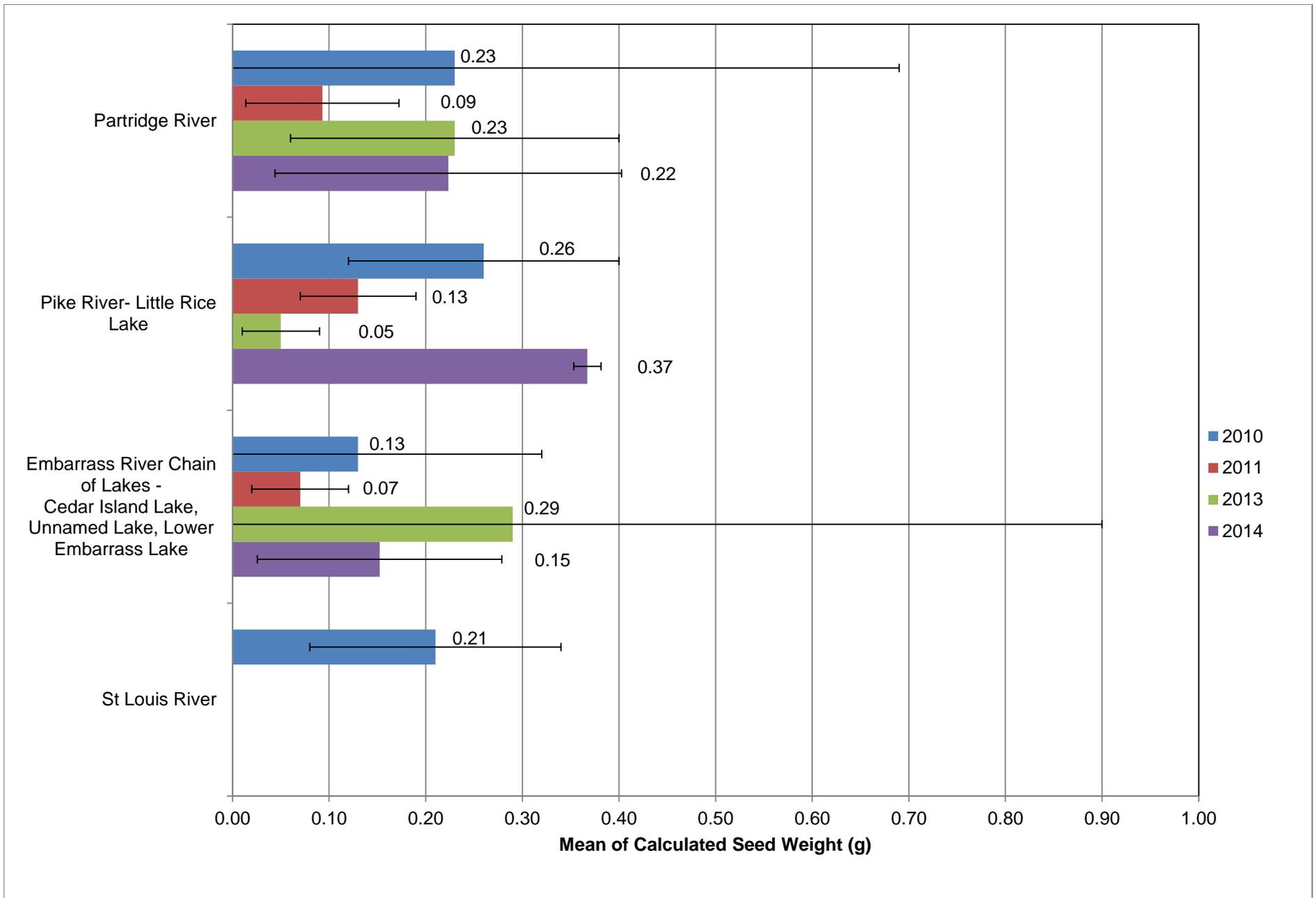


Figure 30 Mean and Standard Deviation of Calculated Seed Number in the Partridge River, Pike River, and Embarrass River, 2010-2014, and St. Louis River, 2010

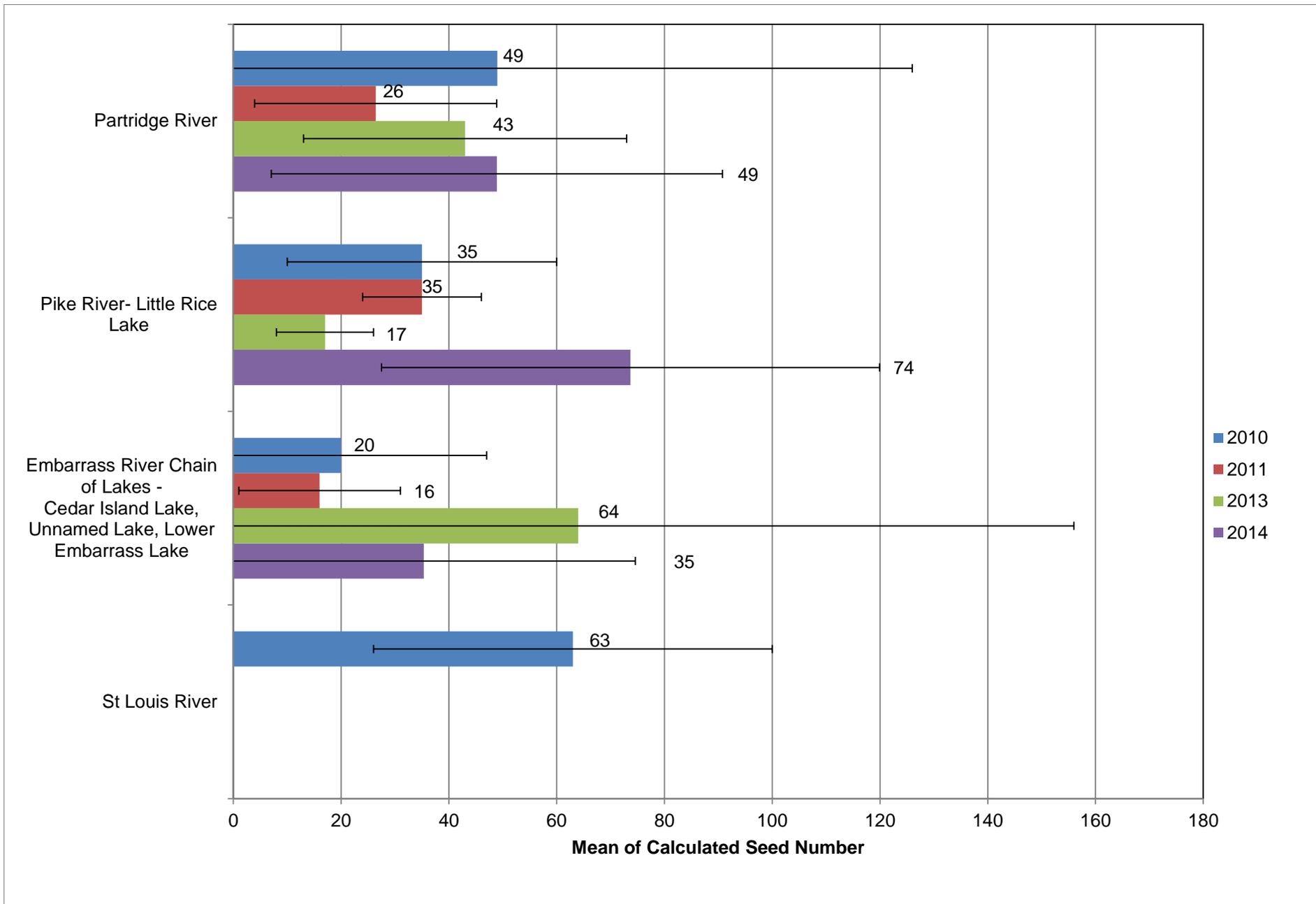


Figure 31 Median of Total Calculated Plant Weight (g)  
in the Partridge River, Pike River, and Embarrass River, 2010-2014, and St. Louis River, 2010

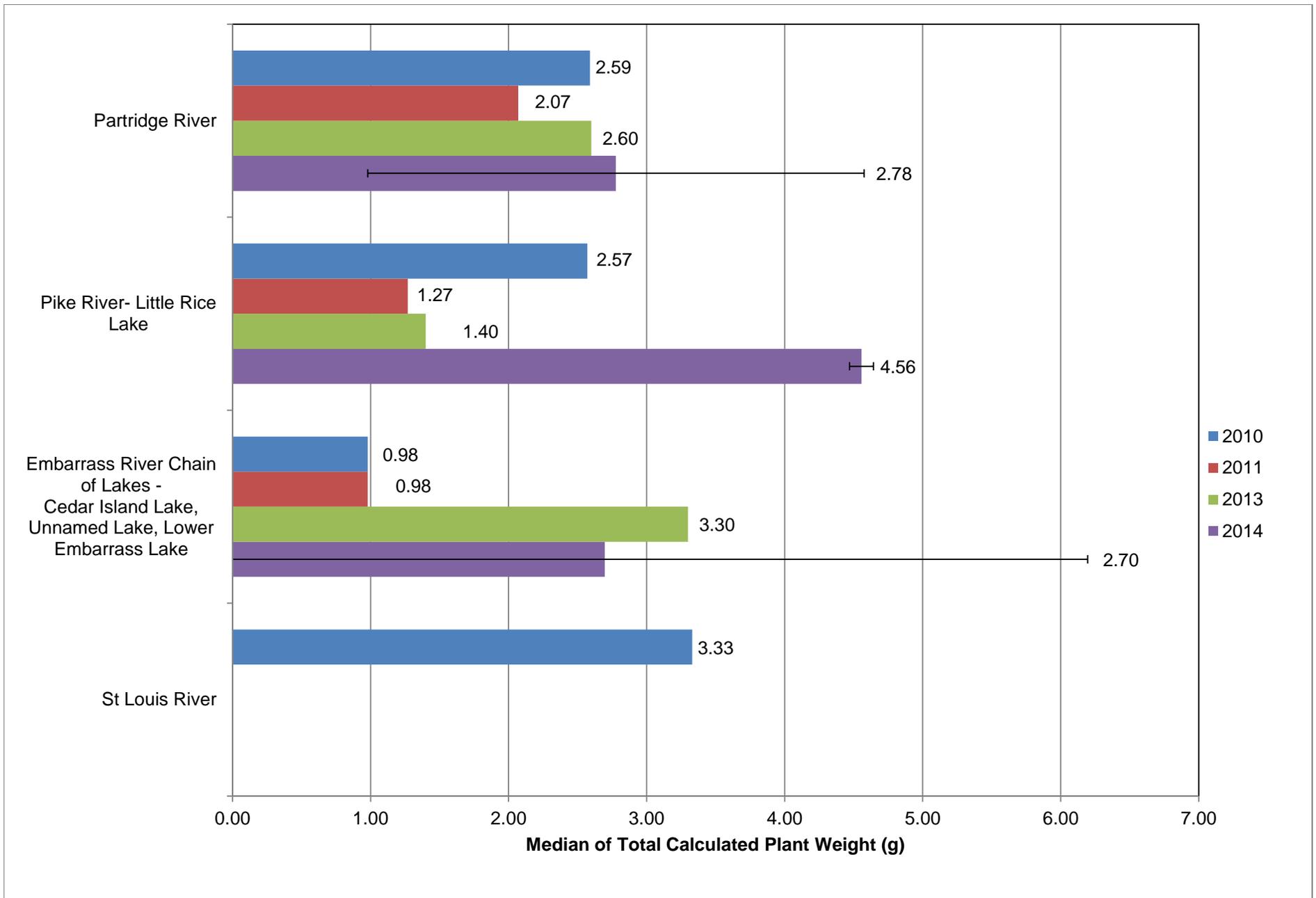


Figure 32 Median of Root Weight (g)  
in the Partridge River, Pike River, and Embarrass River, 2010-2014, and St. Louis River, 2010

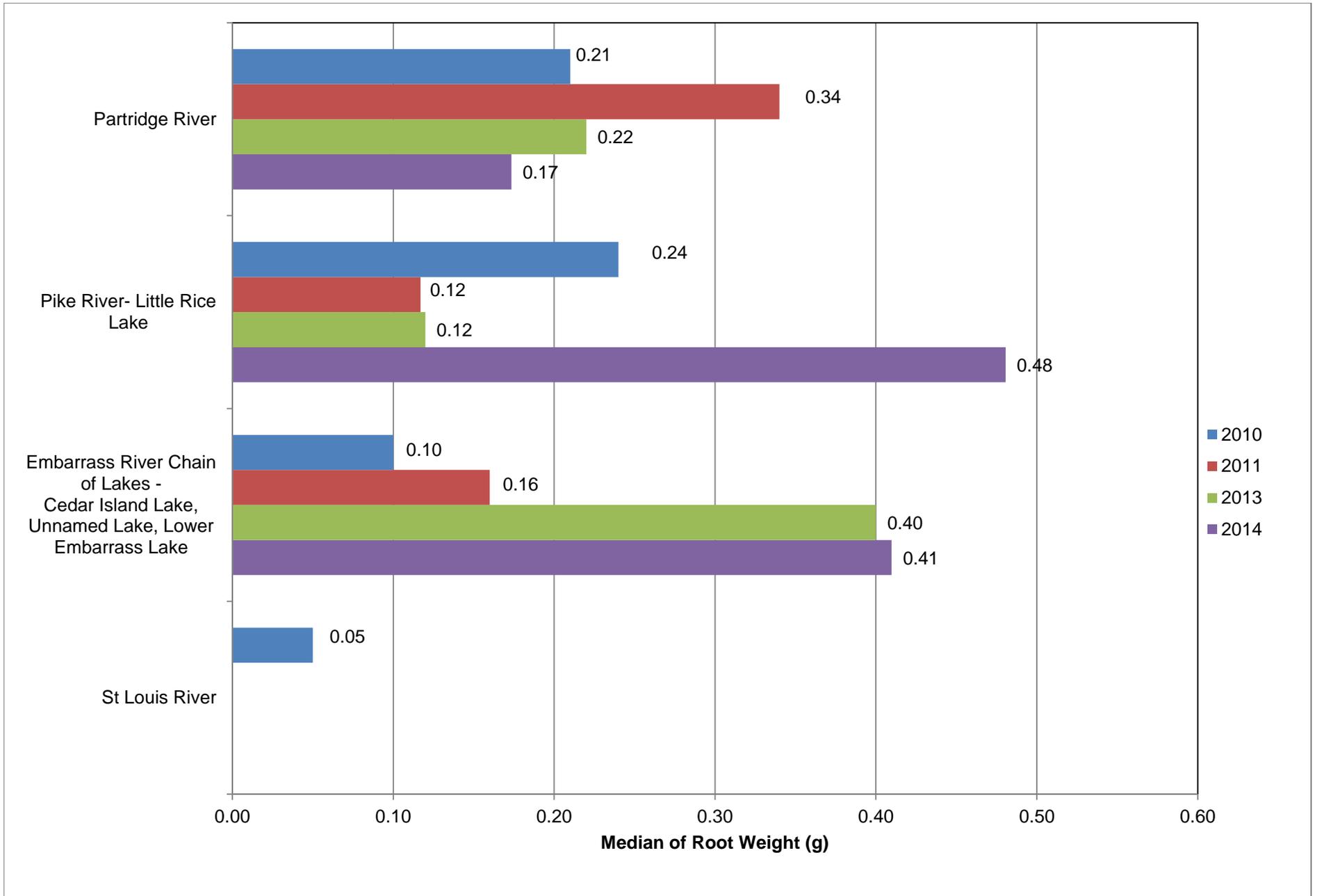


Figure 33 Median of Shoot Weight (g)  
in the Partridge River, Pike River, and Embarrass River, 2010-2014, and St. Louis River, 2010

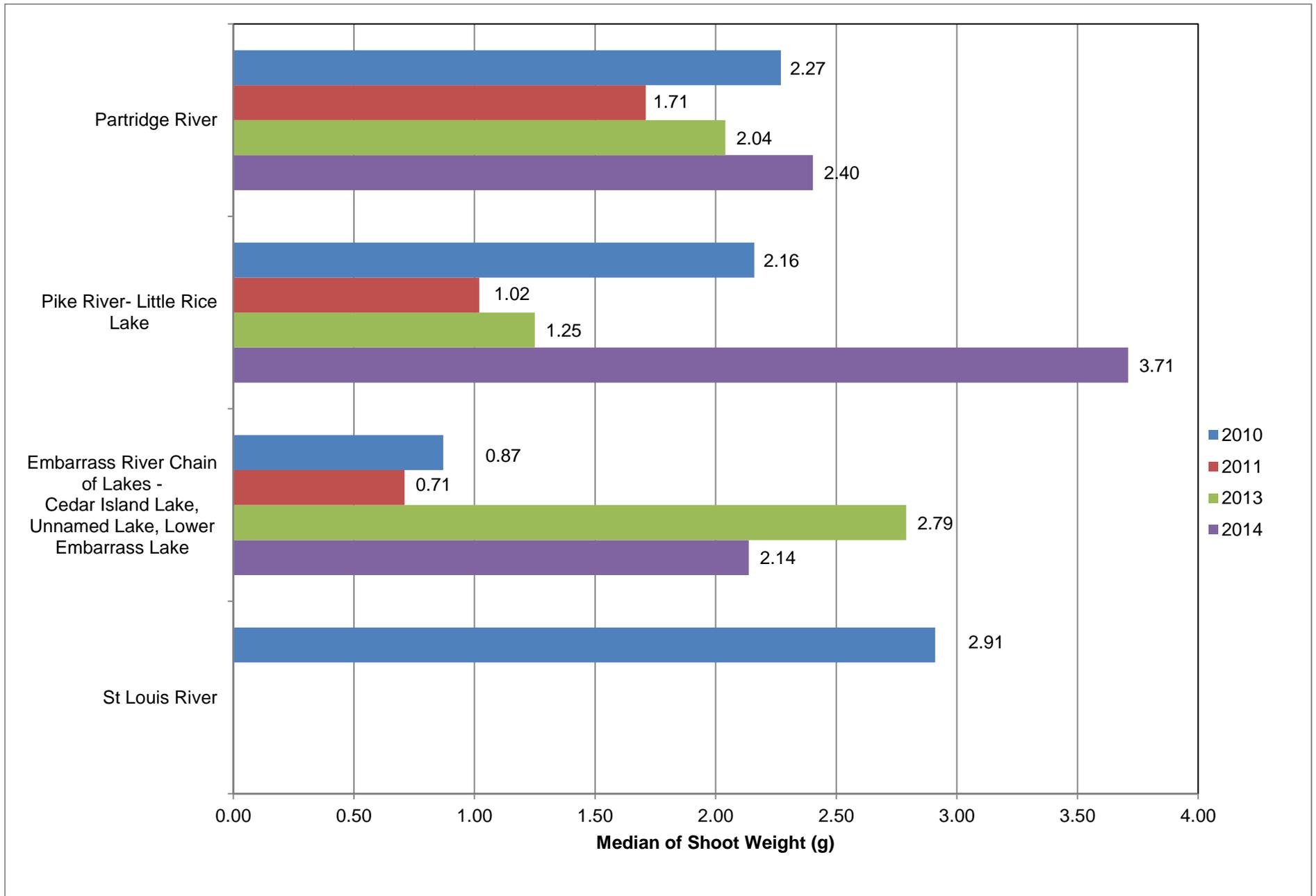


Figure 34 Median of Calculated Seed Weight (g)  
in the Partridge River, Pike River, and Embarrass River, 2010-2014, and St. Louis River, 2010

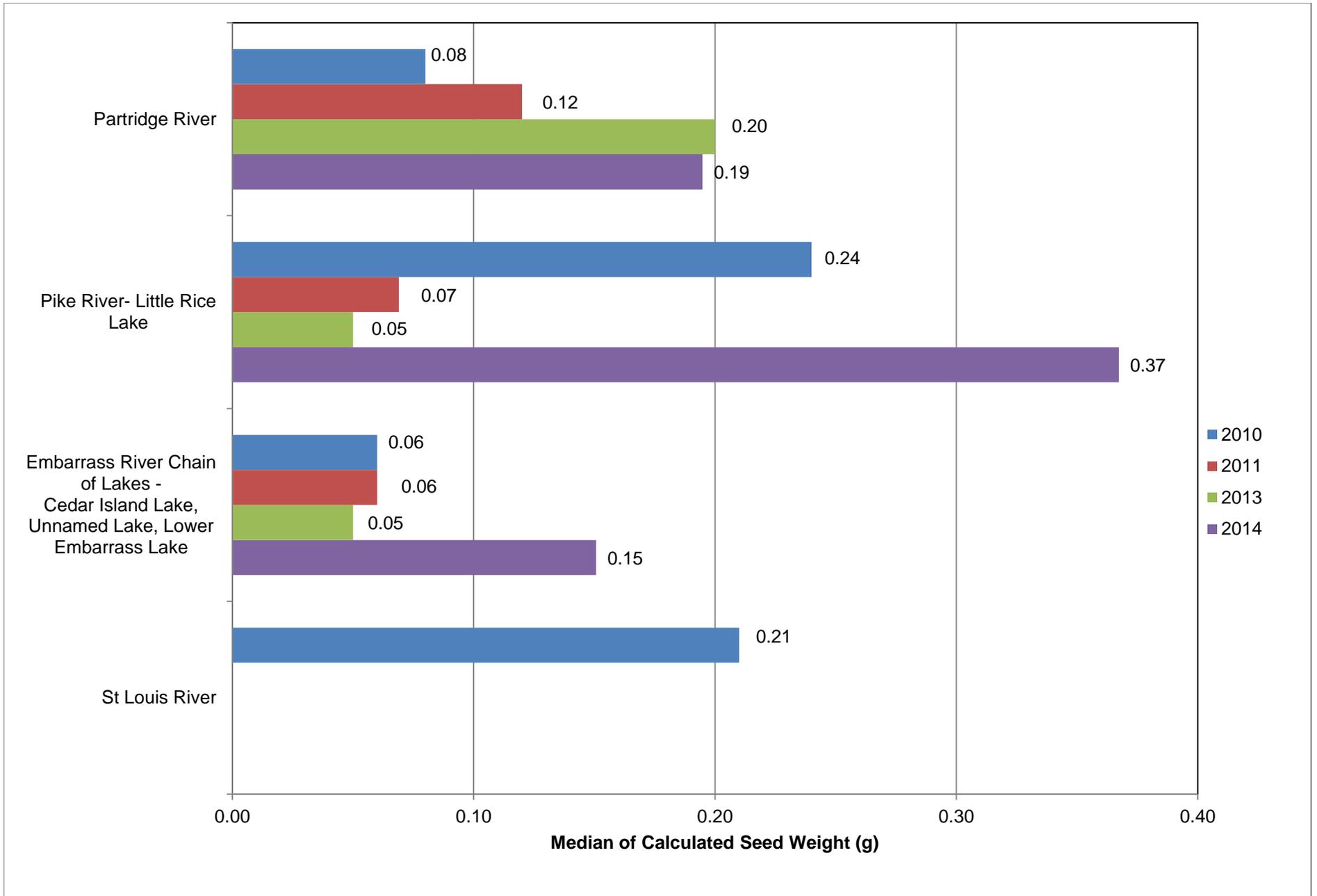


Figure 35 Median of Calculated Seed Number  
in the Partridge River, Pike River, and Embarrass River, 2010-2014, and St. Louis River, 2010

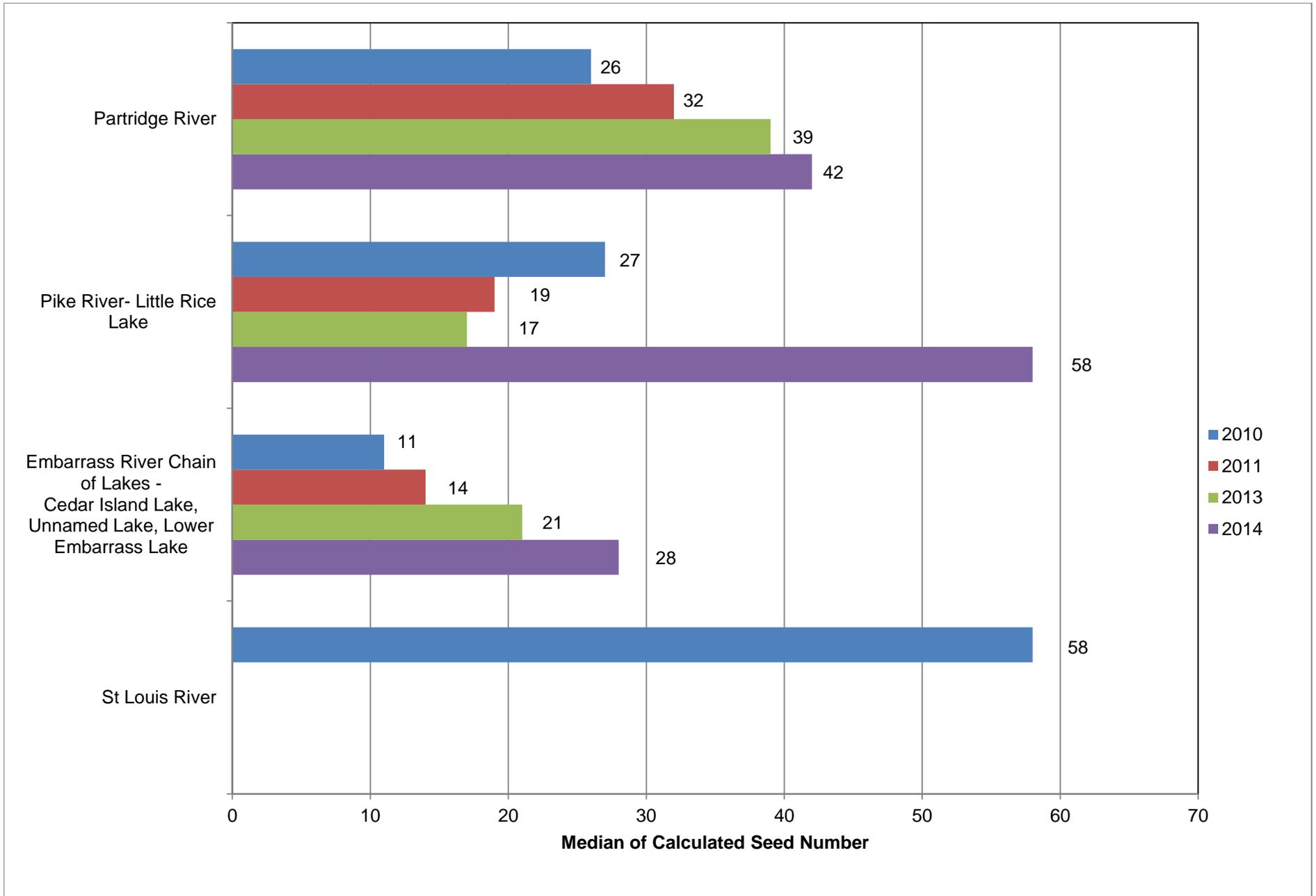


Figure 36 Mean Stem Densities (stems/0.5m<sup>2</sup>) by Grid According to Year for Lower Embarrass Lake, Unnamed Lake, and Cedar Island Lake, 2009-2014

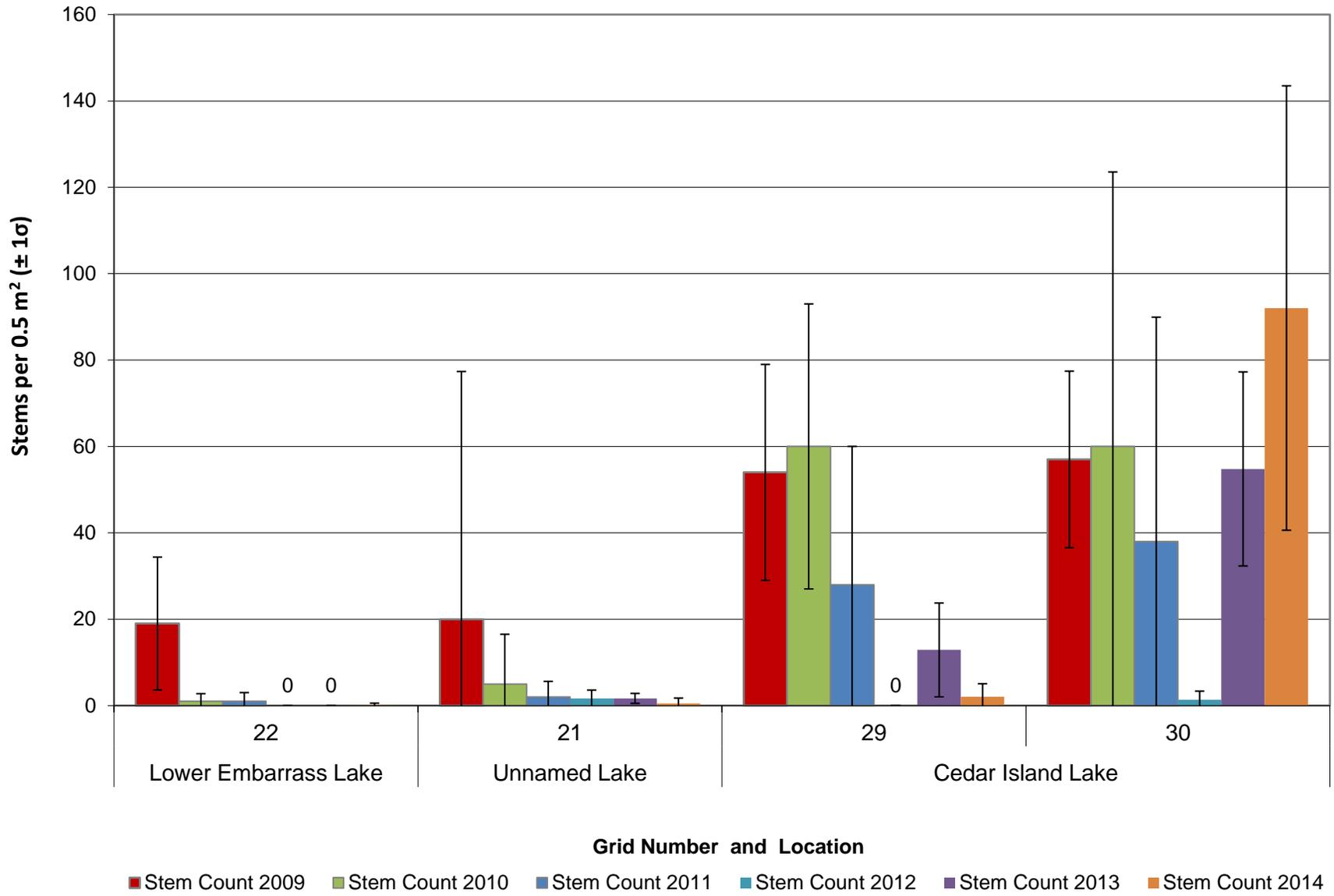
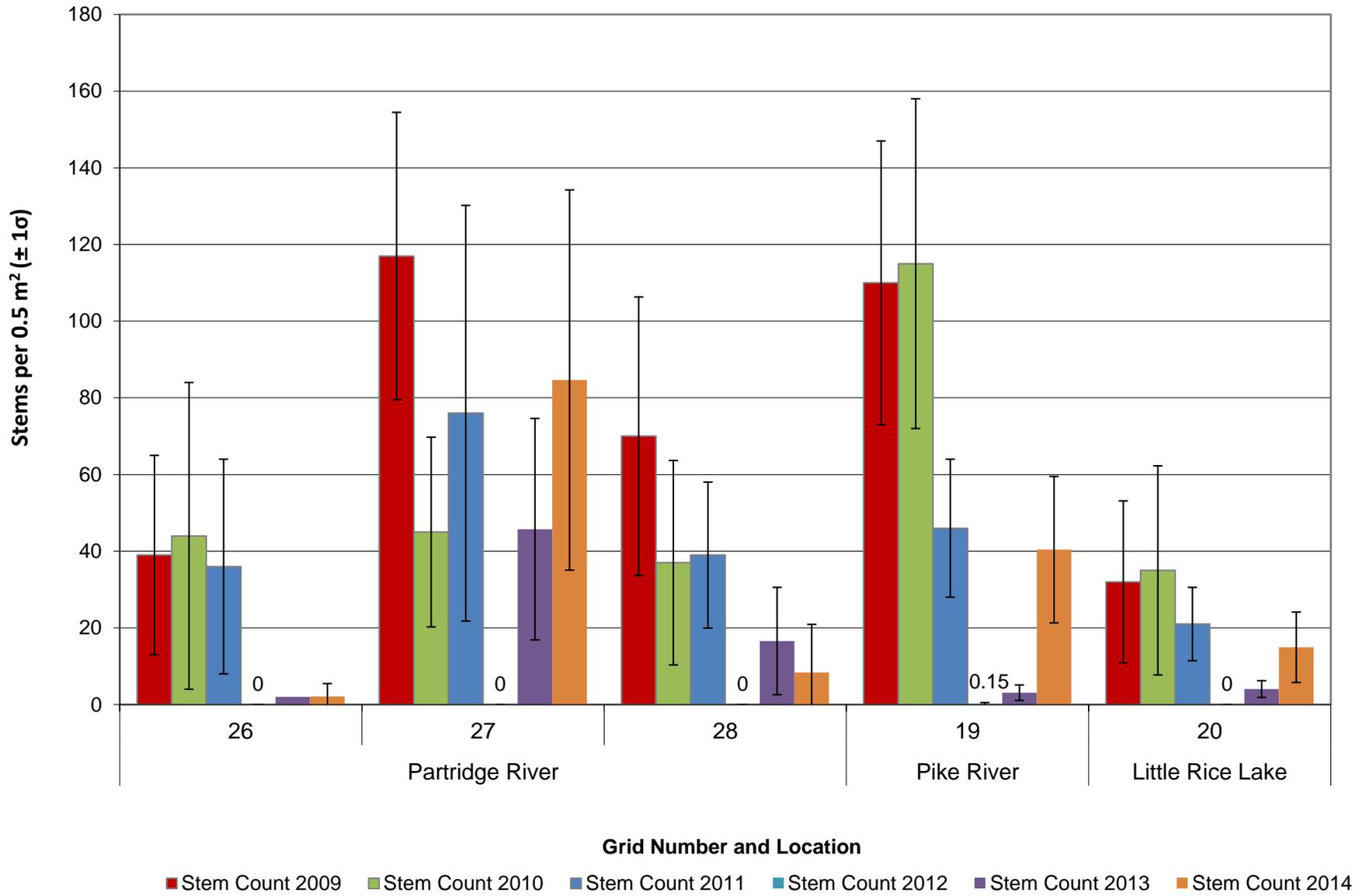


Figure 37 Mean Stem Densities (stems/0.5m<sup>2</sup>) by Grid According to Year for Partridge River, Little Rice Lake, and Pike River, 2009-2014





Barr Footer: ArcGIS 10.2.1 2014-09-07 12:26 File: I:\Client\Polymet\_Minim\Work\_Orders\Wild\_Rice\Map\Reports\Final\_2013\_Report\_2014\_02\_07\Figure\_38\_2013\_Wild\_Rice\_Survey\_Results\_Surface\_Water\_Sample\_Locations\_Measured\_at\_Wild\_Rice\_Stands.mxd User: arm2  
 Imagery Source: FSA, 2013.

▲ Water Sample Locations

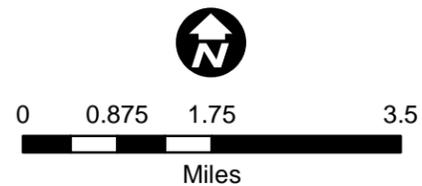


Figure 38  
 2014 WILD RICE SURVEY  
 SURFACE WATER SAMPLE LOCATIONS  
 MEASURED AT WILD RICE STANDS  
 NorthMet Project  
 Poly Met Mining, Inc.  
 Hoyt Lakes, Minnesota



## Appendices

## **Appendix A**

### **2014 Wild Rice Study Area Photographs**

Appendix A 2014 Wild Rice Study Area Photographs

Embarrass River Watershed

Spring Mine Creek



Spring Mine Creek, August 4, 2014: Beaver dam; no wild rice observed

Trimble Creek



Trimble Creek, August 4, 2014: No wild rice observed

*Unnamed Creek*



Unnamed Creek, August 7, 2014: No wild rice observed

*Embarrass River*



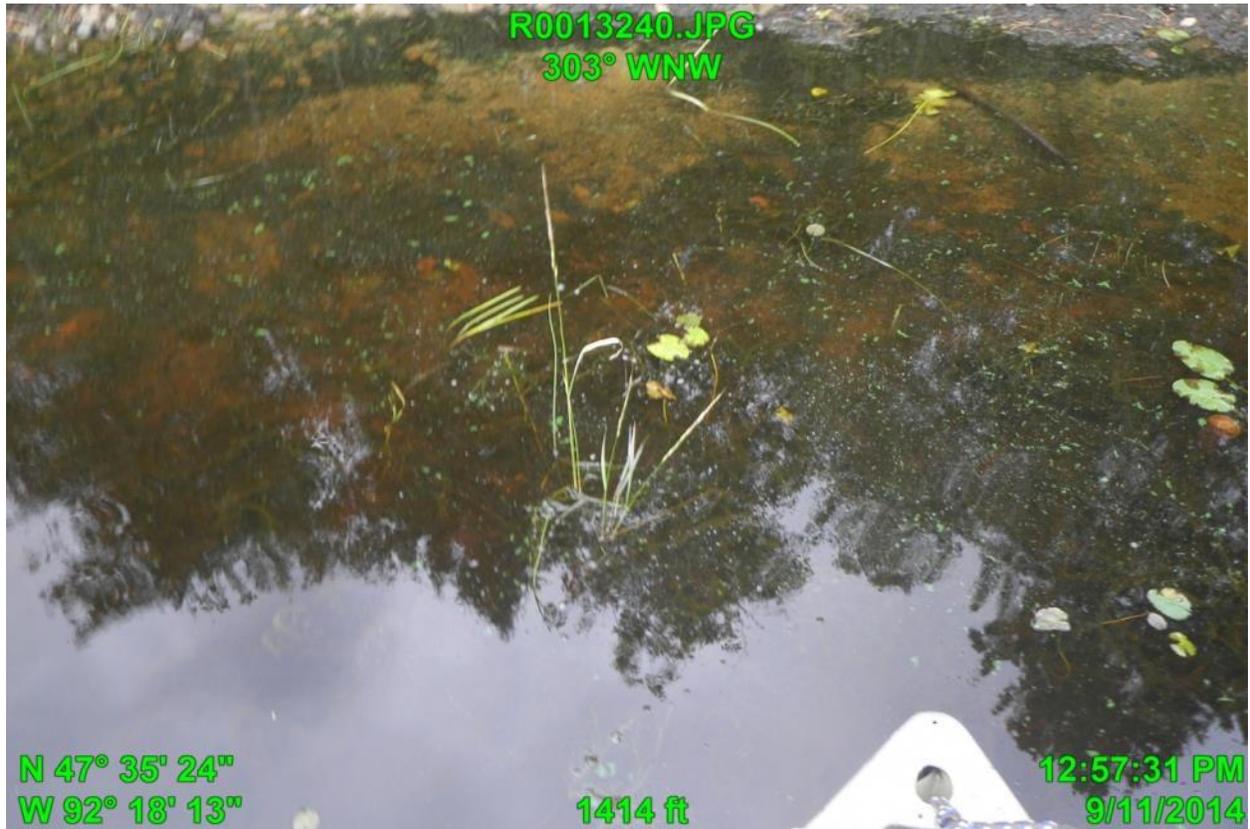
Embarrass River (Reach 17), September 12, 2014: Wild rice (density 1) observed slightly past River Mile 25 (heading downstream).

Hay Lake 1



Hay Lake 1, August 5, 2014: Wild rice (density 1) observed in the center of the lake

Sabin Lake



Sabin Lake, September 11, 2014: Wild rice (density 1) observed on the west central shoreline of the lake

Wynne Lake



Wynne Lake, September 11, 2014: No wild rice observed

Embarrass Lake



Embarrass Lake, September 11, 2014: No wild rice observed

Lower Embarrass Lake



Lower Embarrass Lake, September 11, 2014: Wild rice (density 3) on tip of southwest bay

*Unnamed Lake*



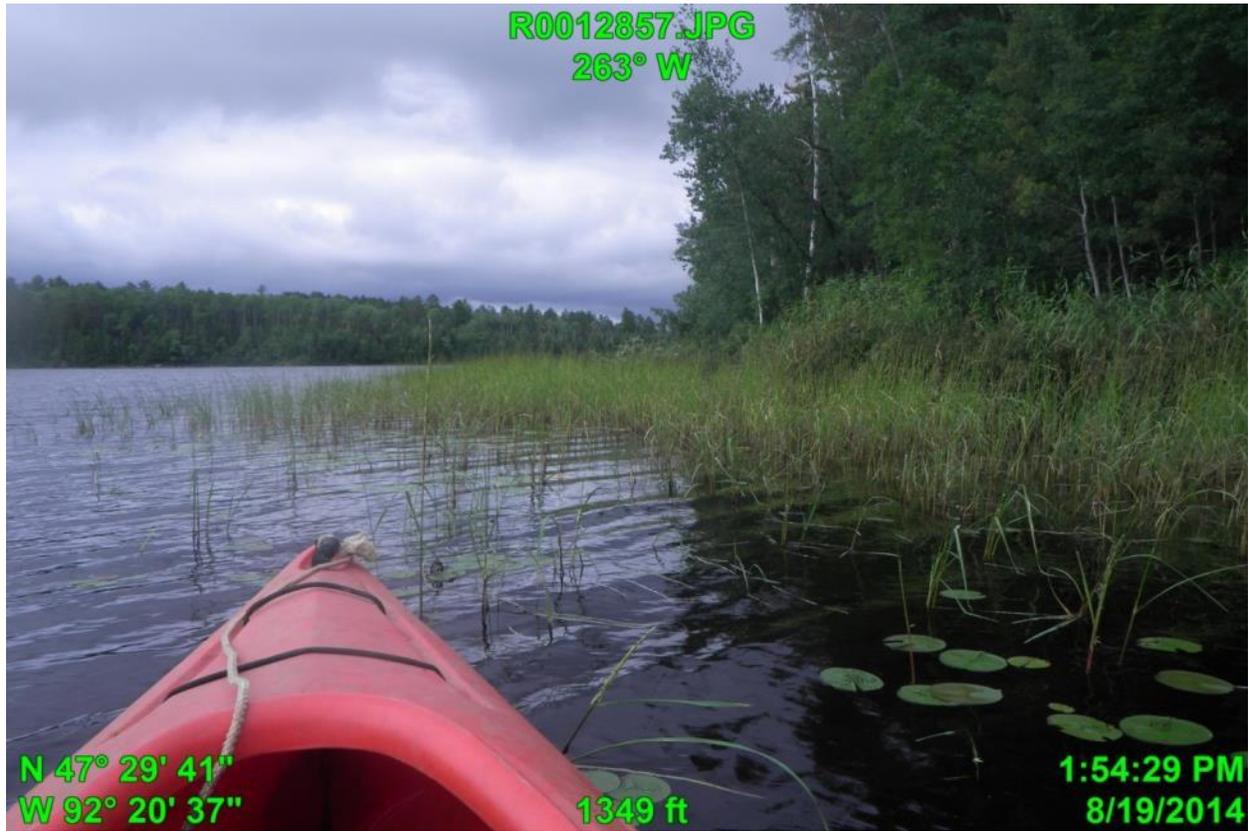
Unnamed Lake, August 18, 2014: Wild rice (density 3) on west side of the lake

Fourth Lake



Fourth Lake, August 19, 2014: Wild rice (density 3) on east side of the lake

Cedar Island Lake



Cedar Island Lake, August 19, 2014: Wild rice (density 4) on northeast side of the lake

Partridge River Watershed

Upper Partridge River



Upper Partridge River (Reach 3), August 7, 2014: Wild rice (density 2) near River Mile 13.0

*Lower Partridge River*



Lower Partridge River (Reach 1), August 7, 2014: Wild rice (density 3) between River Mile 5.5 and 5.0

Lower Partridge River



Lower Partridge (Reach 9), August 6, 2014: Wild rice (density 5) near the Partridge River's confluence with Second Creek

Wyman Creek



Wyman Creek, August 6, 2014: No rice observed

Second Creek



Second Creek (Reach 7), August 5, 2014: Wild rice (density 1 and 2) observed on both sides of the channel near River Mile 2.2

Pike River Watershed

Little Rice Lake

RIMG0025.JPG  
300° WNW



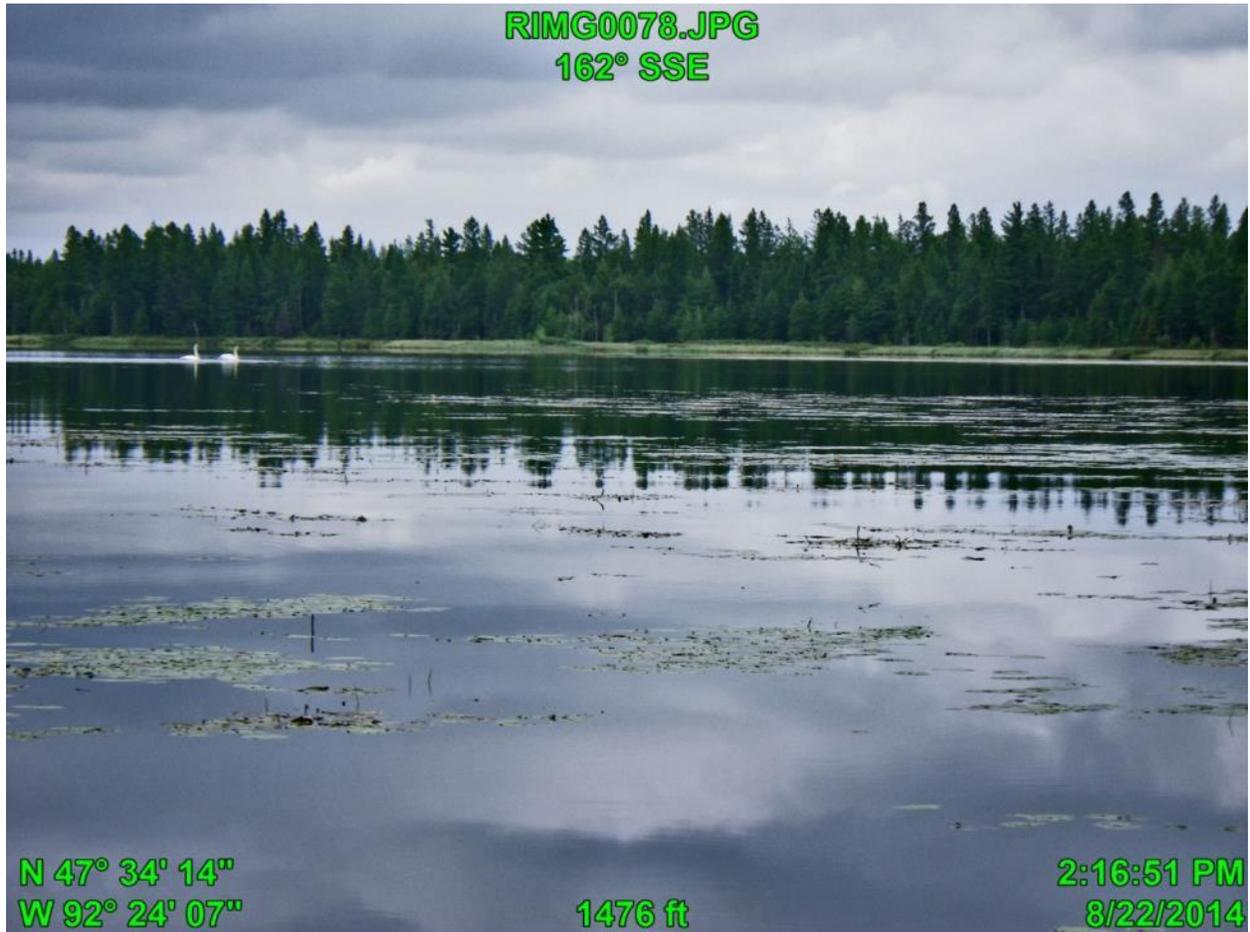
Little Rice Lake, August 22, 2014: Wild rice (density 4) in Little Rice Lake, near its confluence with the Pike River

Pike River



Pike River, August 22, 2014: Wild rice (density 3) in Pike River between Little Rice Lake and Hay Lake 2

Hay Lake 2



Hay Lake 2, August 22, 2014: Wild rice (density 1) at the northwest corner of Hay Lake 2

St. Louis River Watershed

Lower Estuary



St. Louis River (Lower Estuary), August 26, 2014: Wild rice (density 2)

*Upper Estuary*



St. Louis River (Upper Estuary), August 27, 2014: Wild rice (density 4)

## **Appendix B**

### **Grid Sampling Sheets**

**Grid 19 Pike River**

8/20/2014 water depth = 84.45 cm Transparency Reading = 85 cm

Plot# UTM Coordinates (meters)	# of 0.5m <sup>2</sup> Stems	Height (cm)	% Cover Submergent Vegetation	% Cover Floating Vegetation	% Cover Emergent Vegetation	% Cover Wild Rice	Submergent Species	Floating Species	Emergent Species	* Water Sample ID/ Wild Rice Sample ID/ Comments
Plot 4	23	62	10	0	0	15	Utricularia, Potamogeton zosteriformis	--	Zizania L.	--
5268478 N		80								
547066 E		54								
		36								
		61								
Plot 8	10	78	30	0	0	5	Potamogeton zosteriformis	--	Zizania L.	--
5268478 N		46								
547070 E		44								
		65								
		43								
Plot 16	44	69	70	0	0	40	Utricularia, Potamogeton zosteriformis	--	Zizania L.	--
5268477 N		77								
547068 E		54								
		53								
		68								
Plot 18	23	36	15	0	0	10	Potamogeton zosteriformis	--	Zizania L.	--
5268477 N		59								
547070 E		70								
		73								
		62								
Plot 30	33	43	30	0	0	15	Potamogeton zosteriformis	--	Zizania L.	PM_PR_KMS2_19_01_140820 water sample 1644
5268476 N		59								
547072 E		58								
		67								
		52								
Plot 39	62	68	10	0	0	60	Potamogeton zosteriformis	--	Zizania L.	PM_PR_KMS2_19_WR12_14082 0 extra roots
5268475 N		87								
547071 E		92								
		71								
		77								
Plot 42	46	60	15	0	0	25	Potamogeton zosteriformis	--	Zizania L.	PM_PR_KMS2_19_WR15_14082 0
5268474 N		57								
547064 E		69								
		75								
		58								
Plot 45	43	46	15	0	0	20	Potamogeton zosteriformis	--	Zizania L.	PM_PR_KMS2_19_WR14_14082 0 extra roots
5268474 N		69								
547067 E		72								
		58								
		80								
Plot 49	25	43	0	0	0	15	--	--	Zizania L.	PM_PR_KMS2_19_WR13_14082 0
5268474 N		63								
547071 E		56								
		81								
		74								
Plot 51	35	57	5	0	0	30	Potamogeton zosteriformis	--	Zizania L.	PM_PR_KMS2_19_WR11_14082 0
5268473 N		59								
547063 E		72								
		65								
		58								

**Grid 19 Pike River**

8/20/2014 water depth = 84.45 cm Transparency Reading = 85 cm

Plot# UTM Coordinates (meters)	# of 0.5m <sup>2</sup> Stems	Height (cm)	% Cover Submergent Vegetation	% Cover Floating Vegetation	% Cover Emergent Vegetation	% Cover Wild Rice	Submergent Species	Floating Species	Emergent Species	* Water Sample ID/ Wild Rice Sample ID/ Comments
Plot 54	36	66	0	0	0	15	--	--	Zizania L.	PM_PR_KMS2_19_WR08_14082 0
5268473 N		54								
547066 E		49								
		58								
		53								
Plot 57	73	89	30	0	0	50	Potamogeton zosteriformis	--	Zizania L.	PM_PR_KMS2_19_WR06_14082 0 extra roots
5268473 N		51								
547069 E		70								
		66								
		90								
Plot 61	24	59	10	0	0	10	Potamogeton zosteriformis	--	Zizania L.	PM_PR_KMS2_19_WR10_14082 0
5268472 N		93								
547063 E		48								
		64								
		62								
Plot 63	22	60	5	0	0	10	Potamogeton zosteriformis	--	Zizania L.	PM_PR_KMS2_19_WR09_14082 0
5268472 N		59								
547065 E		46								
		46								
		65								
Plot 67	34	62	15	0	0	15	Potamogeton zosteriformis	--	Zizania L.	PM_PR_KMS2_19_WR07_14082 0 extra roots
5268472 N		55								
547069 E		63								
		53								
		49								
Plot 74	44	68	0	0	0	25	--	--	Zizania L.	PM_PR_KMS2_19_WR04_14082 0
5268471 N		62								
547066 E		65								
		57								
		78								
Plot 82	47	48	0	0	0	25	--	--	Zizania L.	PM_PR_KMS2_19_WR05_14082 0 extra roots
5268470 N		78								
547064 E		79								
		62								
		64								
Plot 86	51	52	0	0	0	40	--	--	Zizania L.	PM_PR_KMS2_19_WR02_14082 0 extra roots
5268470 N		41								
547068 E		69								
		73								
		102								
Plot 87	92	47	0	0	0	60	--	--	Zizania L.	PM_PR_KMS2_19_WR01_14082 0 extra roots
5268470 N		58								
547069 E		57								
		106								
		93								
Plot 95	41	93	15	1	0	35	Potamogeton zosteriformis	Nuphar Varigata	Zizania L.	PM_PR_KMS2_19_WR03_14082 0
5268477 N		55								
547973 E		67								
		65								
		56								

**Grid 19 Pike River**

8/20/2014 water depth = 84.45 cm Transparency Reading = 85 cm

Plot# UTM Coordinates (meters)	# of 0.5m <sup>2</sup> Stems	Height (cm)	% Cover Submergent Vegetation	% Cover Floating Vegetation	% Cover Emergent Vegetation	% Cover Wild Rice	Submergent Species	Floating Species	Emergent Species	* Water Sample ID/ Wild Rice Sample ID/ Comments
Mean	40.40	63.61	13.75	0.05	0.00	26.00	--	--	--	--
Median	39	62	10	0	0	23	--	--	--	--
S.D.	19.10	14.03	16.69	0.22	0.00	16.59	--	--	--	--

**Grid 20 Little Rice Lake**

8/20/2014 water depth = 91.38 Transparency Reading = 86 cm

Plot# UTM Coordinates (meters)	# of 0.5m <sup>2</sup> Stems	Height (cm)	% Cover Submergent Vegetation	% Cover Floating Vegetation	% Cover Emergent Vegetation	% Cover Wild Rice	Submergent Species	Floating Species	Emergent Species	* Water Sample ID/ Wild Rice Sample ID/ Comments
Plot 6	25	75	10	0	0	25	Potamogeton zosteriformis	--	Zizania L.	--
5268672 N		53								
547226 E		55								
		40								
		77								
Plot 8	2	64	0	0	0	2	--	--	Zizania L.	--
5268672 N		53								
547228 E										
Plot 12	30	66	10	0	0	30	Potamogeton zosteriformis	--	Zizania L.	20_WR06_140820
5268671 N		56								
547222 E		79								
		72								
		65								
Plot 18	19	53	5	0	0	20	Potamogeton zosteriformis	--	Zizania L.	--
5268671 N		65								
547228 E		75								
		67								
		49								
Plot 28	26	108	0	0	0	25	--	--	Zizania L.	--
5268670 N		74								
547228 E		62								
		73								
		64								
Plot 41	33	61	5	0	0	30	Potamogeton zosteriformis	--	Zizania L.	20_WR03_140820
5268668 N		71								
547221 E		65								
		52								
		83								
Plot 42	18	74	10	0	0	15	Potamogeton zosteriformis	--	Zizania L.	20_WR05_140820
5268668 N		78								
547222 E		84								
		81								
		94								
Plot 45	9	73	10	0	0	10	Potamogeton zosteriformis	--	Zizania L.	--
5268668 N		52								
547225 E		83								
		56								
		69								
Plot 51	5	70	0	0	0	5	--	--	--	20_WR02_140820
5268667 N		68								
547221 E		61								
		50								
		43								
Plot 52	5	34	0	0	0	5	--	--	Zizania L.	20_WR04_140820
5268667 N		64								
547222 E		49								
		66								
		38								
Plot 56	7	74	0	0	0	5	--	--	Zizania L.	PM_LR_KMS2_20_01_140820 1440
5268667 N		37								
547226 E		67								
		69								
		47								

**Grid 20 Little Rice Lake**

8/20/2014 water depth = 91.38 Transparency Reading = 86 cm

Plot# UTM Coordinates (meters)	# of 0.5m <sup>2</sup> Stems	Height (cm)	% Cover Submergent Vegetation	% Cover Floating Vegetation	% Cover Emergent Vegetation	% Cover Wild Rice	Submergent Species	Floating Species	Emergent Species	* Water Sample ID/ Wild Rice Sample ID/ Comments
Plot 57	15	56	0	0	0	15	--	--	Zizania L.	WR15_140820
5268667 N		62								
547227 E		72								
		79								
		82								
Plot 59	15	70	0	0	0	15	--	--	Zizania L.	WR14_140820
5268667 N		67								
547229 E		80								
		105								
		69								
Plot 77	4	56	0	0	0	5	--	--	Zizania L.	WR11_140820
5268665 N		76								
547227 E		49								
		82								
Plot 78	28	59	0	0	0	0	--	--	--	WR12_140820
5268665 N		39								
547228 E		36								
		84								
		83								
Plot 79	17	64	0	0	0	10	--	--	Zizania L.	WR13_140820
5268665 N		69								
547229 E		61								
		112								
		74								
Plot 83	4	64	0	0	0	5	--	--	Zizania L.	WR07_140820
5268664 N		57								
547223 E		56								
		74								
Plot 89	14	44	0	0	0	10	--	--	Zizania L.	20_WR10_140820
5268664 N		78								
547229 E		69								
		48								
		63								
Plot 93	6	61	0	2	0	5	Nuphar Varigata	--	Zizania L.	PM_LR_KMS2_20_WR01_140820
5268663 N		85								
547223 E		39								
		47								
		53								
Plot 98	18	57	1	0	0	20	Potamogeton zosteriformis	--	Zizania L.	PM_LR_KMS2_20_WR08_140820
5268663 N		63								
547228 E		53								
		87								
		59								
Plot 100	11	55	0	0	0	10	--	--	Zizania L.	PM_LR_KMS2_20_WR09_140820
5268663 N		80								
547230 E		70								
		51								
		41								
<b>Mean</b>	14.95	65.39	2.16	0.11	0.00	12.63	--	--	--	--
<b>Median</b>	15	65	0	0	0	10	--	--	--	--
<b>S.D.</b>	9.18	15.47	3.82	0.46	0.00	8.88	--	--	--	--

Grid 21 Unnamed Lake (Embaraass Chain)										
8/5/2014 water depth = 35.35 cm Transparency Reading = 26 cm										
Plot# UTM Coordinates (meters)	# of 0.5m <sup>2</sup> Stems	Height (cm)	% Cover Submergent Vegetation	% Cover Floating Vegetation	% Cover Emergent Vegetation	% Cover Wild Rice	Submergent Species	Floating Species	Emergent Species	* Water Sample ID/ Wild Rice Sample ID/ Comments
Plot 1 5261322 E 549831 E	0	--	20	15	0	0	Potamogeton robbinsii, Najas spp.s	Potamogeton obtusifolius, Nuphar variegatum	--	--
Plot 4 5261322 N 549834 E	0	--	20	20	5	0	Najas spp.s	Vallisneria americana, Nuphar variegatum	Sagittaria graminea	--
Plot 5 5261322 N 549835 E	0	--	0	20	0	0	--	Nymphaea odorata, Nuphar variegatum	--	--
Plot 6 5261322 N 549836 E	0	--	0	15	0	0	--	Nymphaea odorata, Nuphar variegatum	--	--
Plot 14 5261321 N 549834 E	0	--	10	40	0	0	Utricularia	Nymphaea odorata, Vallisneria americana, Nuphar variegatum	--	V06: Vallisneria americana
Plot 17 5261321 N 549837 E	0	--	10	20	0	0	Utricularia, Potamogeton obtusifolius	Nymphaea odorata, Vallisneria americana, Nuphar variegatum	--	--
Plot 18 5261321 N 549838 E	0	--	50	5	3	0	Potamogeton diversifolius, Najas spp.s	Nymphaea odorata	Sagittaria graminea	--
Plot 26 5261320 N 549836 E	0	--	10	25	0	0	Utricularia, Potamogeton obtusifolius	Nuphar variegatum	--	V05: Potamogeton obtusifolius
Plot 27 5261320 N 549837 E	0	--	75	5	2	0	Najas spp.s, Potamogeton obtusifolius	Nymphaea odorata	Sagittaria graminea	--

Grid 21 Unnamed Lake (Embarass Chain)										
8/5/2014 water depth = 35.35 cm Transparency Reading = 26 cm										
Plot# UTM Coordinates (meters)	# of 0.5m <sup>2</sup> Stems	Height (cm)	% Cover Submergent Vegetation	% Cover Floating Vegetation	% Cover Emergent Vegetation	% Cover Wild Rice	Submergent Species	Floating Species	Emergent Species	* Water Sample ID/ Wild Rice Sample ID/ Comments
Plot 29 5261320 N 549839 E	3	32 51 36	10	40	4	1	Najas spp.	Nymphaea odorata, Nuphar variegatum	Sagittaria graminea, Zizania L.	WR03
Plot 41 5261318 N 549831 E	4	39 40 31 39	20	40	3	1	Potamogeton zosteriformis, Utricularia	Nymphaea odorata, Nuphar variegatum	Sagittaria graminea, Zizania L.	WR02
Plot 44 5261318 N 549834 E	0	--	10	10	0	0	Potamogeton zosteriformis	Nymphaea odorata, Nuphar variegatum	--	--
Plot 45 5261318 N 549835 E	0	--	5	15	0	0	Potamogeton zosteriformis	Nuphar variegatum	--	--
Plot 50 5261318 N 549840 E	0	--	10	20	5	0	Utricularia	Nymphaea odorata, Nuphar variegatum	Sagittaria graminea	--
Plot 55 5261317 N 549835 E	0	--	15	15	10	0	Najas spp., Myriophyllum heterophyllum Michx.	Nymphaea odorata, Nuphar variegatum	Sagittaria graminea	--
Plot 58 5261317 N 549838 E	0	--	30	20	20	0	Potamogeton zosteriformis, Utricularia	Nymphaea odorata, Nuphar variegatum	Sagittaria graminea	--
Plot 72 5261315 E 549832 E	3	40 46 58	30	15	2	2	Najas spp.	Nymphaea odorata	Zizania L.	WR01
Plot 81 5261314 N 549831 E	0	--	20	50	1	0	Myriophyllum heterophyllum Michx., Utricularia	Nymphaea odorata, Nuphar variegatum	Sagittaria graminea	V04: Myriophyllum heterophyllum Michx.
Plot 95 5261313 N 549835 E	0	--	30	5	5	0	Potamogeton diversifolius	Nymphaea odorata	Sagittaria graminea	V03: Utricularia

Grid 21 Unnamed Lake (Embaraass Chain)										
8/5/2014 water depth = 35.35 cm Transparency Reading = 26 cm										
Plot# UTM Coordinates (meters)	# of 0.5m <sup>2</sup> Stems	Height (cm)	% Cover Submergent Vegetation	% Cover Floating Vegetation	% Cover Emergent Vegetation	% Cover Wild Rice	Submergent Species	Floating Species	Emergent Species	* Water Sample ID/ Wild Rice Sample ID/ Comments
Plot 96 5261313 N 549836 E	0	--	30	30	5	0	Najas spp., Potamogeton diversifolius	Nuphar variegatum, Potamogeton diversifolius	Sagittaria graminea	V01: Najas spp. V02: Ranunculus aquatilis
<b>Mean</b>	0.50	41.20	20.25	21.25	3.25	0.20	--	--	--	--
<b>Median</b>	0	40	18	20	2	0	--	--	--	--
<b>S.D.</b>	1.24	8.36	17.73	12.76	4.77	0.52	--	--	--	--

**Grid 22 Lower Embarrass Lake**

8/5/2014 water depth = 45.10 cm Transparency Reading = 60 cm

Plot# UTM Coordinates (meters)	# of 0.5m <sup>2</sup> Stems	Height (cm)	% Cover Submergent Vegetation	% Cover Floating Vegetation	% Cover Emergent Vegetation	% Cover Wild Rice	Submergent Species	Floating Species	Emergent Species	* Water Sample ID/ Wild Rice Sample ID/ Comments
Plot 1 5262472 N 550001 E	0	--	5	10	10	--	Utricularia	Nuphar variegatum	Sagittaria graminea, Potamogeton natans L.	V03: Nuphar variegatum water sample: 01
Plot 3 5262472 N 550003 E	0	--	0	0	1	0	--	--	Sparganium fluctuans	--
Plot 8 5262472 N 550008 E	0	--	0	0	0	0	--	--	--	--
Plot 11 5262471 N 550001 E	0	--	0	20	0	0	--	Nuphar variegatum	--	--
Plot 13 5262471 N 550003 E	0	--	0	0	0	0	--	--	--	V04: Nymphaea odorata
Plot 15 5262471 N 550005 E	0	--	0	20	0	0	--	Nymphaea odorata	--	--
Plot 19 5262471 N 550009 E	0	--	0	0	0	0	--	--	--	--
Plot 22 5262470 N 550002 E	0	--	1	3	0	0	Sagittaria graminea	Nymphaea odorata	--	--
Plot 26 5262470 N 550006 E	0	--	0	0	0	0	--	--	--	--
Plot 29 5262470 N 550009 E	0	--	0	2	0	0	--	Nymphaea odorata	--	--

**Grid 22 Lower Embarrass Lake**

8/5/2014 water depth = 45.10 cm Transparency Reading = 60 cm

Plot# UTM Coordinates (meters)	# of 0.5m <sup>2</sup> Stems	Height (cm)	% Cover Submergent Vegetation	% Cover Floating Vegetation	% Cover Emergent Vegetation	% Cover Wild Rice	Submergent Species	Floating Species	Emergent Species	* Water Sample ID/ Wild Rice Sample ID/ Comments
Plot 31 5262469 N 550001 E	0	--	0	0	10	0	--	--	Sagittaria graminea	V01: Sagittaria graminea V02: Sparganium fluctuans
Plot 36 5262469 N 550006 E	0	--	0	10	0	0	--	Nymphaea odorata	--	--
Plot 55 5262467 N 550005 E	0	--	2	0	0	0	Potamogeton robbinsii	--	--	--
Plot 64 5262466 N 550004 E	0	--	0	0	0	0	--	--	--	--
Plot 73 5262465 N 550003 E	0	--	0	0	0	0	--	--	--	--
Plot 77 5262465 N 550007 E	0	--	0	40	0	0	--	Nymphaea odorata	--	--
Plot 82 5262464 N 550002 E	0	--	0	0	0	0	--	--	--	--
Plot 92 5262463 N 550002 E	0	--	5	10	15	0	Unknown	Nymphaea odorata	Sparganium fluctuans, Sagittaria graminea	--
Plot 96 5262463 N 550006 E	0	--	0	10	5	0	Sagittaria graminea	Potamogeton zosteriformis	--	--
Plot 98 5262463 N 550008 E	2	51 62	0	0	1	1	--	--	Zizania L.	--
<b>Mean</b>	0.10	56.50	0.65	6.25	2.10	0.05	--	--	--	--
<b>Median</b>	0	57	0	0	0	0	--	--	--	--
<b>S.D.</b>	0.45	7.78	1.57	10.34	4.38	0.23	--	--	--	--

**Grid 26 Partridge**

8/18/2014 water depth = 76.55 cm Transparency Reading = >120 cm

Plot# UTM Coordinates (meters)	# of 0.5m <sup>2</sup> Stems	Height (cm)	% Cover Submergent Vegetation	% Cover Floating Vegetation	% Cover Emergent Vegetation	% Cover Wild Rice	Submergent Species	Floating Species	Emergent Species	* Water Sample ID/ Wild Rice Sample ID/ Comments
Plot 10 5263128 N 560970 E	11	51 47 42 42	0	25	0	10	--	Nymphaea odorata	Zizania L.	5 plants
Plot 23 5263126 N 560963 E	0	--	0	1	0	0	--	Nymphaea odorata	--	--
Plot 24 5263126 N 560964 E	0	--	0	1	0	0	--	Nymphaea odorata	--	--
Plot 25 5263126 N 560965 E	0	--	0	0	0	0	--	--	--	--
Plot 28 5263126 N 560968 E	0	--	0	0	0	0	--	--	--	--
Plot 39 5263125 N 560969 E	4	40 41 40 24	0	0	0	0	--	--	--	--
Plot 42 5263124 N 560962 E	0	--	0	0	0	0	--	--	--	--
Plot 50 5263124 N 560970 E	3	34 40 43	0	5	0	0	--	Nymphaea odorata	--	--
Plot 53 5263123 N 560963 E	0	--	0	0	0	0	--	--	--	--
Plot 59 5263123 N 560969 E	3	32 32 27	0	1	0	0	--	Nymphaea odorata	--	14:27 water sample

**Grid 26 Partridge**

8/18/2014 water depth = 76.55 cm Transparency Reading = >120 cm

Plot# UTM Coordinates (meters)	# of 0.5m <sup>2</sup> Stems	Height (cm)	% Cover Submergent Vegetation	% Cover Floating Vegetation	% Cover Emergent Vegetation	% Cover Wild Rice	Submergent Species	Floating Species	Emergent Species	* Water Sample ID/ Wild Rice Sample ID/ Comments
Plot 68	8	40	0	0	0	5	--	--	Zizania L.	--
5263122 N		31								
560968 E		52								
		35								
		35								
Plot 73	0	--	0	0	0	0	--	--	--	--
5263121 N										
560963 E										
Plot 74	0	--	0	0	0	0	--	--	--	--
5263121 N										
560964 E										
Plot 75	0	--	0	0	0	0	--	--	--	--
5263121 N										
560965 E										
Plot 78	7	23	0	0	0	5	--	--	Zizania L.	rice samples 5 plants
5263121 N		22								
560968 E		25								
		40								
		64								
Plot 79	6	53	0	0	0	5	--	--	Zizania L.	--
5263121 N		63								
560969 E		68								
		32								
		25								
Plot 80	0	--	0	5	0	0	--	Nymphaea odorata	--	--
5263121 N										
560970 E										
Plot 91	0	--	0	0	0	0	--	--	--	--
5263119 N										
560961 E										
Plot 96	0	--	0	1	0	0	--	Nymphaea odorata	--	--
5263119 N										
560966 E										
Plot 97	1	51	0	0	0	1	--	--	Zizania L.	--
5263119 N										
560967 E										
<b>Mean</b>	2.15	39.87	0.00	1.95	0.00	1.30	--	--	--	--
<b>Median</b>	0	40	0	0	0	0	--	--	--	--
<b>S.D.</b>	3.34	12.06	0.00	5.63	0.00	2.74	--	--	--	--

**Grid 27 Partridge**

8/18/2014 water depth = 47 cm Transparency Reading = >120 cm

Plot# UTM Coordinates (meters)	# of 0.5m <sup>2</sup> Stems	Height (cm)	% Cover Submergent Vegetation	% Cover Floating Vegetation	% Cover Emergent Vegetation	% Cover Wild Rice	Submergent Species	Floating Species	Emergent Species	* Water Sample ID/ Wild Rice Sample ID/ Comments
Plot 4	119	69	0	0	1	60	--	--	Sagittaria graminea, Zizania L.	--
5262728 N		94								
561031 E		82								
		71								
		85								
Plot 6	68	86	0	0	1	50	--	--	Sagittaria graminea, Zizania L.	5 plant samples
5262728 N		72								
561033 E		86								
		81								
		48								
Plot 10	99	97	0	0	10	60	--	--	Sagittaria graminea, Zizania L.	--
5262728 N		98								
561037 E		92								
		72								
		82								
Plot 20	67	97	0	0	10	60	--	--	Sagittaria graminea, Zizania L.	--
5262727 N		105								
561037 E		84								
		101								
		78								
Plot 24	80	90	0	1	5	80	--	Nymphaea odorata	Sagittaria graminea, Zizania L.	water sample 15:47
5262726 N		75								
561031 E		93								
		80								
		90								
Plot 25	115	87	0	5	5	90	--	Nymphaea odorata	Sagittaria graminea, Zizania L.	--
5262726 N		97								
561032 E		59								
		71								
		105								
Plot 29	128	94	0	0	10	90	--	--	Sagittaria graminea, Zizania L.	--
5262726 N		110								
561036 E		107								
		103								
		95								
Plot 32	0	--	0	0	0	0	--	--	--	--
5262725 N										
561029 E										

**Grid 27 Partridge**

8/18/2014 water depth = 47 cm Transparency Reading = >120 cm

Plot# UTM Coordinates (meters)	# of 0.5m <sup>2</sup> Stems	Height (cm)	% Cover Submergent Vegetation	% Cover Floating Vegetation	% Cover Emergent Vegetation	% Cover Wild Rice	Submergent Species	Floating Species	Emergent Species	* Water Sample ID/ Wild Rice Sample ID/ Comments
Plot 36	110	108	0	0	1	70	--	--	Sagittaria graminea, Zizania L.	--
5262725 N		84								
561033 E		85								
		89								
		61								
Plot 38	133	99	0	0	10	85	--	--	Sagittaria graminea, Zizania L.	--
5262725 N		104								
561035 E		84								
		69								
		53								
Plot 41	0	--	0	0	0	0	--	--	--	--
5262724 N										
561028 E										
Plot 55	129	76	0	30	5	60	--	Nymphaea odorata	Sagittaria graminea, Zizania L.	--
5262723 N		100								
561032 E		101								
		74								
		75								
Plot 58	89	92	0	0	5	70	--	--	Sagittaria graminea, Zizania L.	--
5262723 N		71								
561035 E		81								
		94								
		101								
Plot 60	75	99	0	0	10	70	--	--	Sagittaria graminea, Zizania L.	--
5262723 N		105								
561037 E		70								
		110								
		85								
Plot 61	0	--	0	0	0	0	--	--	--	--
5262722 N										
561028 E										
Plot 67	123	83	0	0	5	75	--	--	Sagittaria graminea, Zizania L.	--
5262722 N		64								
561034 E		82								
		89								
		98								
Plot 71	0	--	0	0	0	0	--	--	--	--
5262721 N										
561028 E										

**Grid 27 Partridge**

8/18/2014 water depth = 47 cm Transparency Reading = >120 cm

Plot# UTM Coordinates (meters)	# of 0.5m <sup>2</sup> Stems	Height (cm)	% Cover Submergent Vegetation	% Cover Floating Vegetation	% Cover Emergent Vegetation	% Cover Wild Rice	Submergent Species	Floating Species	Emergent Species	* Water Sample ID/ Wild Rice Sample ID/ Comments
Plot 75	165	109	0	15	0	0	--	Nymphaea odorata, Sagittaria graminea	--	5 plants collected
5262721 N		94								
561032 E		73								
		118								
		82								
Plot 87	100	81	0	0	5	75	--	--	Sagittaria graminea, Zizania L.	5 plants collected
5262720 N		75								
561034 E		81								
		101								
		67								
Plot 89	93	83	0	0	25	65	--	--	Sagittaria graminea, eleocharis sp, Zizania L.	--
5262720 N		75								
561036 E		89								
		105								
		62								
<b>Mean</b>	84.65	86.46	0.00	2.55	5.40	53.00	--	--	--	--
<b>Median</b>	96	86	0	0	5	63	--	--	--	--
<b>S.D.</b>	49.60	14.53	0.00	7.33	6.05	33.02	--	--	--	--

**Grid 28 Partridge**

8/18/2014 water depth = 27.45 cm Transparency Reading = >120 cm

Plot# UTM Coordinates (meters)	# of 0.5m <sup>2</sup> Stems	Height (cm)	% Cover Submergent Vegetation	% Cover Floating Vegetation	% Cover Emergent Vegetation	% Cover Wild Rice	Submergent Species	Floating Species	Emergent Species	* Water Sample ID/ Wild Rice Sample ID/ Comments
Plot 1	46	74	70	0	0	50	Elodea, Potamogeton epihydrus	--	Zizania L.	--
5263440 N		55								
561032 E		69								
		55								
		90								
Plot 7	5	63	40	25	0	5	Elodea	Sagittaria graminea, Potamogeton nodosus	Zizania L.	--
5263440 N		68								
561038 E		46								
		60								
		46								
Plot 20	0	--	0	0	0	0		--	--	--
5263439 N										
561041 E										
Plot 25	23	81	85	5	0	25	Elodea	Sagittaria graminea	Zizania L.	--
5263438 N		80								
561036 E		42								
		82								
		63								
Plot 29	0	--	30	0	0	0	Elodea, Stuckenia pectinata	--	--	--
52634378 N										
561040 E										
Plot 34	3	43	95	0	0	2	Elodea, Potamogeton epihydrus	--	Zizania L.	--
5263437 N		69								
561035 E		36								
Plot 36	11	42	90	5	0	0	Elodea, Stuckenia pectinata	Sagittaria graminea	--	--
5263437 N		76								
561037 E		31								
		56								
		72								
Plot 37	6	72	70	2	1	0	Elodea, Potamogeton epihydrus, Stuckenia pectinata	Sagittaria graminea	--	--
5263437 N		50								
561038 E		55								
		47								
		48								
Plot 49	1	45	25	5	0	0	Elodea, Stuckenia pectinata	Sagittaria graminea	--	--
5263436 N										
561040 E										
Plot 52	29	82	75	0	0	10	Elodea, Potamogeton epihydrus, Potamogeton sp.	--	Zizania L.	--
5263435 N		61								
561033 E		61								
		46								
		55								

**Grid 28 Partridge**

8/18/2014 water depth = 27.45 cm Transparency Reading = >120 cm

Plot# UTM Coordinates (meters)	# of 0.5m <sup>2</sup> Stems	Height (cm)	% Cover Submergent Vegetation	% Cover Floating Vegetation	% Cover Emergent Vegetation	% Cover Wild Rice	Submergent Species	Floating Species	Emergent Species	* Water Sample ID/ Wild Rice Sample ID/ Comments
Plot 64 5263434 N 561035 E	0	--	100	0	0	0	Elodea, Stuckenia pectinata	--	--	--
Plot 68 5263434 N 561039 E	0	--	25	0	2	0	Elodea	--	Sagittaria (graminea)	--
Plot 72 5263433 N 561033 E	0	--	70	0	0	0	Elodea, Stuckenia pectinata, Sagittaria graminea, Potamogeton epihydrus	--	--	--
Plot 73 5263433 N 561034 E	0	--	70	5	0	0	Elodea, Stuckenia pectinata, Potamogeton epihydrus	--	--	--
Plot 74 5263433 N 561035 E	0	--	100	0	0	0	Elodea, Stuckenia pectinata	--	--	--
Plot 89 5263432 N 561040 E	21	52 57 76 25 68	5	0	0	0	Elodea	--	--	--
Plot 92 5263431 N 561033 E	6	68 44 65 62 48	85	0	1	4	Elodea, Potamogeton epihydrus, Potamogeton sp., Stuckenia pectinata	--	Sagittaria graminea, Zizania L.	--
Plot 93 5263431 N 561034 E	0	--	97	2	0	0	Elodea, Potamogeton epihydrus	Sparganium fluctuans	--	--
Plot 97 5263431 N 561038 E	2	46 76	85	5	0	2	Elodea, Potamogeton epihydrus	Potamogeton epihydrus	Zizania L.	PM_LP_KMS2_28_01_14 0818

**Grid 28 Partridge**

8/18/2014 water depth = 27.45 cm Transparency Reading = >120 cm

Plot# UTM Coordinates (meters)	# of 0.5m <sup>2</sup> Stems	Height (cm)	% Cover Submergent Vegetation	% Cover Floating Vegetation	% Cover Emergent Vegetation	% Cover Wild Rice	Submergent Species	Floating Species	Emergent Species	* Water Sample ID/ Wild Rice Sample ID/ Comments
Plot 100	15	76	25	5	0	5	Elodea, Potamogeton epihydrus	Potamogeton epihydrus	Zizania L.	--
5263431 N		61								
561041 E		85								
		41								
		29								
<b>Mean</b>	8.40	58.82	62.10	2.95	0.20	5.15	--	--	--	--
<b>Median</b>	3	60	70	0	0	0	--	--	--	--
<b>S.D.</b>	12.51	15.55	33.01	5.66	0.52	12.07	--	--	--	--

Grid 30 Cedar Island Lake										
8/6/2014 water depth = 85.3 cm Transparency Reading = 65 cm										
Plot# UTM Coordinates (meters)	# of 0.5m <sup>2</sup> Stems	Height (cm)	% Cover Submergent Vegetation	% Cover Floating Vegetation	% Cover Emergent Vegetation	% Cover Wild Rice	Submergent Species	Floating Species	Emergent Species	* Water Sample ID/ Wild Rice Sample ID/ Comments
Plot 4	154	80	0	20	90	90	--	Nymphaea odorata	Zizania L.	WR01-WR07
5259372 N		85								
549106 E		73								
		93								
		90								
Plot 5	177	69	3	5	90	90	Ceratophyllum demersum L.	Nymphaea odorata, Brasenia schreberi	Zizania L.	WR08-WR15
5259371 N		82								
549106 E		84								
		110								
		89								
Plot 10	122	79	5	15	90	89	Myriophyllum exallescens	Nymphaea odorata	Sagittaria graminea, Zizania L.	--
5259368 N		91								
549110 E		90								
		59								
		88								
Plot 23	102	79	20	2	35	35	Elodea, Potamogeton zosteriformis, Myriophyllum exallescens	Nymphaea odorata	Zizania L.	Water sample: 01
5259371 N		68								
549104 E		68								
		66								
		76								
Plot 29	154	82	10	1	0	90	Myriophyllum exallescens, Potamogeton robbinsi, Elodea	Nymphaea odorata	Zizania L.	--
5259367 N		85								
549108 E		70								
		96								
		99								
Plot 38	122	67	1	0	60	60	Potamogeton robbinsi	--	Zizania L.	--
5259367 N		79								
549107 E		71								
		56								
		104								
Plot 42	37	55	80	5	30	30	Potamogeton zosteriformis	Nymphaea odorata, Vallisneria americana	Zizania L.	--
5259371 N		45								
549102 E		31								
		38								
		61								
Plot 52	61	70	30	0	40	40	Ceratophyllum demersum L., Potamogeton zosteriformis, Elodea	--	Zizania L.	--
5259370 N		59								
549101 E		38								
		70								
		57								
Plot 58	174	92	4	1	90	90	Utricularia	Nymphaea odorata	Zizania L.	--
5259366 N		78								
549106 E		60								
		63								
		63								
Plot 59	90	55	1	1	50	50	Myriophyllum exallescens	Nymphaea odorata	Zizania L.	--
5259365 N		76								
549107 E		96								
		83								
		58								
Plot 63	40	49	40	5	30	30	Ceratophyllum demersum L., Potamogeton zosteriformis, Elodea	Vallisneria americana	Zizania L.	--
5259369 N		71								
549102 E		87								
		63								
		74								
Plot 64	102	63	40	0	50	50	Potamogeton zosteriformis	--	Zizania L.	--
5259368 N		75								
549102 E		51								
		61								
		56								
Plot 68	95	85	3	3	50	50	Myriophyllum exallescens	Nymphaea odorata	Zizania L.	--
5259366 N		74								
549105 E		70								
		74								
		93								

**Grid 30 Cedar Island Lake**

8/6/2014 water depth = 85.3 cm Transparency Reading = 65 cm

Plot# UTM Coordinates (meters)	# of 0.5m <sup>2</sup> Stems	Height (cm)	% Cover Submergent Vegetation	% Cover Floating Vegetation	% Cover Emergent Vegetation	% Cover Wild Rice	Submergent Species	Floating Species	Emergent Species	* Water Sample ID/ Wild Rice Sample ID/ Comments
Plot 71 5259370 N 549100 E	33	48 68 44 61 38	70	0	30	30	Ceratophyllum demersum L., Potamogeton zosteriformis, Elodea	--	Zizania L.	V01
Plot 74 5259368 N 549102 E	14	41 29 35 29 27	40	0	10	10	Potamogeton zosteriformis, Elodea, Potamogeton robbinsi	--	Zizania L.	--
Plot 79 5259364 N 549105 E	54	77 74 70 56 54	1	2	50	50	Myriophyllum exallescens, Elodea	Brasenia schreberi	Zizania L.	--
Plot 83 5259368 N 549101 E	0	--	10	0	0	0	Potamogeton zosteriformis, Elodea, Potamogeton robbinsi, Utricularia, Myriophyllum farwellii	--	--	--
Plot 88 5259364 N 549104 E	105	44 62 82 68 83	1	3	75	75	Myriophyllum exallescens	Brasenia schreberi	Zizania L.	--
Plot 96 5259365 N 549102 E	96	52 54 54 65 71	5	5	50	50	Myriophyllum exallescens	Nymphaea odorata	Zizania L.	--
Plot 99 5259365 N 549102 E	109	52 66 83 63 64	0	10	80	80	--	Brasenia schreberi	Zizania L.	dense
<b>Mean</b>	92.05	67.75	18.20	3.90	50.00	54.45	--	--	--	--
<b>Median</b>	99	68	5	2	50	50	--	--	--	--
<b>S.D.</b>	51.45	17.74	24.13	5.38	29.15	27.89	--	--	--	--

**Grid 90 Pokegoma Bay**

8/25/2014 water depth = 104.26 cm Transparency Reading = 15 cm (Very turbid after heavy rainfall)

Plot# UTM Coordinates (meters)	# of 0.5m <sup>2</sup> Stems	Height (cm)	% Cover Submergent Vegetation	% Cover Floating Vegetation	% Cover Emergent Vegetation	% Cover Wild Rice	Submergent Species	Floating Species	Emergent Species	* Water Sample ID/ Wild Rice Sample ID/ Comments
Plot 1 5169514 N 565561 E	0	--	0	0	0	0	--	--	--	--
Plot 7 5169514 N 565567 E	0	--	0	0	0	0	--	--	--	--
Plot 10 5169514 N 565570 E	0	--	0	0	0	0	--	--	--	--
Plot 19 5169513 N 565569 E	0	--	0	0	0	0	--	--	--	--
Plot 22 5169512 N 565562 E	0	--	0	0	0	0	--	--	--	--
Plot 40 5169511 N 565570 E	0	--	0	0	0	0	--	--	--	--
Plot 43 5169510 N 565563 E	0	--	0	0	0	0	--	--	--	--
Plot 50 5169510 N 565570 E	0	--	0	0	0	0	--	--	--	--
Plot 53 5169509 N 565563 E	0	--	0	0	0	0	--	--	--	--
Plot 56 5169509 N 565566 E	0	--	0	0	0	0	--	--	--	--
Plot 57 5169509 N 565567 E	0	--	0	0	0	0	--	--	--	--
Plot 58 5169509 N 565568 E	0	--	0	0	0	0	--	--	--	--
Plot 63 5169508 N 565563 E	0	--	0	0	0	0	--	--	--	PM_PB_KMS2_90_01_140825 1028
Plot 64 5169508 N 565564 E	0	--	0	0	0	0	--	--	--	--

**Grid 90 Pokegoma Bay**

8/25/2014 water depth = 104.26 cm Transparency Reading = 15 cm (Very turbid after heavy rainfall)

Plot# UTM Coordinates (meters)	# of 0.5m <sup>2</sup> Stems	Height (cm)	% Cover Submergent Vegetation	% Cover Floating Vegetation	% Cover Emergent Vegetation	% Cover Wild Rice	Submergent Species	Floating Species	Emergent Species	* Water Sample ID/ Wild Rice Sample ID/ Comments
Plot 65 5169508 N 565565 E	1	32	0	0	0	1	--	--	Zizania L.	--
Plot 73 5169507 N 565563 E	0	--	0	0	2	0	--	--	Sagittaria graminea	--
Plot 77 5169507 N 565567 E	0	--	0	0	1	0	--	--	Sagittaria graminea	--
Plot 82 5169506 N 565562 E	0	--	0	0	0	0	--	--	--	--
Plot 84 5169506 N 565564 E	1	52	0	0	1	1	--	--	Sagittaria graminea	--
Plot 91 5169505 N 565561 E	0	--	0	0	1	0	--	--	Sagittaria graminea	--
<b>Mean</b>	0.10	42.00	0.00	0.00	0.25	0.10	--	--	--	--
<b>Median</b>	0	42	0	0	0	0	--	--	--	--
<b>S.D.</b>	0.31	14.14	0.00	0.00	0.55	0.31	--	--	--	--

**Grid 91 Pokegama Bay**

8/25/2014 water depth = 98.9 cm Transparency Reading = 15 cm

Plot# UTM Coordinates (meters)	# of 0.5m <sup>2</sup> Stems	Height (cm)	% Cover Submergent Vegetation	% Cover Floating Vegetation	% Cover Emergent Vegetation	% Cover Wild Rice	Submergent Species	Floating Species	Emergent Species	* Water Sample ID/ Wild Rice Sample ID/ Comments
Plot 1 5170023 N 564985 E	0	--	0	75	1	0	--	Nymphela	Sagittaria graminea	--
Plot 6 5170023 N 564990 E	4	50 60 73 18	0	0	60	5	--	--	Schoenoplectus acutus	--
Plot 10 5170023 N 564994 E	0	--	0	5	0	0	--	Nymphela	--	--
Plot 15 5170022 N 564989 E	2	60 55	0	10	20	2	--	Nymphela	Sagittaria graminea, Zizania L.	PM_PB_KMS2_91_V01_140825 wild rice
Plot 19 5170022 N 564993 E	0	--	0	0	30	0	--	--	Sagittaria graminea	--
Plot 25 5170021 N 564989 E	0	--	0	0	3	0	--	--	Sagittaria graminea	--
Plot 26 5170021 N 564990 E	0	--	0	3	5	0	--	Nymphela	Sagittaria graminea	--
Plot 34 5170020 N 564988 E	0	--	0	0	0	0	--	--	--	PM_PB_KMS2_91_02_140825 1136
Plot 36 5170020 N 564990 E	0	--	0	0	0	0	--	--	--	--
Plot 39 5170020 N 564993 E	0	--	0	0	0	0	--	--	--	--
Plot 40 5170020 N 564994 E	1	60	0	0	0	1	--	--	Zizania L.	--
Plot 41 5170019 N 564985 E	0	--	0	0	0	0	--	--	--	--
Plot 43 5170019 N 564987 E	0	--	0	0	0	0	--	--	--	--
Plot 51 5170018 N 564985 E	0	--	0	0	0	0	--	--	--	--

**Grid 91 Pokegama Bay**

8/25/2014 water depth = 98.9 cm Transparency Reading = 15 cm

Plot# UTM Coordinates (meters)	# of 0.5m <sup>2</sup> Stems	Height (cm)	% Cover Submergent Vegetation	% Cover Floating Vegetation	% Cover Emergent Vegetation	% Cover Wild Rice	Submergent Species	Floating Species	Emergent Species	* Water Sample ID/ Wild Rice Sample ID/ Comments
Plot 53 5170018 N 564987 E	0	--	0	0	0	0	--	--	--	--
Plot 60 5170018 N 564994 E	0	--	0	5	0	0	--	Nymphela	--	--
Plot 76 5170016 N 564990 E	0	--	0	0	5	0	--	--	Sagittaria graminea	--
Plot 85 5170015 N 564989 E	0	--	0	0	0	0	--	--	--	--
Plot 95 5170014 N 564989 E	0	--	0	0	0	0	--	--	--	--
Plot 99 5170014 N 564993 E	0	--	0	0	0	0	--	--	--	--
<b>Mean</b>	0.35	53.71	0.00	4.90	6.20	0.40	--	--	--	--
<b>Median</b>	0	60	0	0	0	0	--	--	--	--
<b>S.D.</b>	0.99	17.23	0.00	16.71	14.85	1.19	--	--	--	--

**Grid 92 Pokegoma Bay**

8/25/2014 water depth = 105.11 cm Transparency Reading = 15 cm

Plot# UTM Coordinates (meters)	# of 0.5m <sup>2</sup> Stems	Height (cm)	% Cover Submergent Vegetation	% Cover Floating Vegetation	% Cover Emergent Vegetation	% Cover Wild Rice	Submergent Species	Floating Species	Emergent Species	* Water Sample ID/ Wild Rice Sample ID/ Comments
Plot 4 5169573 N 565313 E	0	--	0	0	0	0	--	--	--	--
Plot 5 5169573 N 565314 E	0	--	0	0	0	0	--	--	--	--
Plot 7 5169573 N 565316 E	0	--	0	0	0	0	--	--	--	--
Plot 8 5169573 N 565317 E	0	--	0	0	1	0	--	--	Sagittaria graminea	PM_PB_KMS2_92_03_140825_1100
Plot 10 5169573 N 565319 E	0	--	0	0	1	0	--	--	Sagittaria graminea	--
Plot 12 5169572 N 565311 E	0	--	0	0	0	0	--	--	--	--
Plot 22 5169571 N 565311 E	0	--	0	0	1	0	--	--	Sagittaria graminea	--
Plot 24 5169571 N 565313 E	0	--	0	0	0	0	--	--	--	--
Plot 30 5169571 N 565319 E	0	--	0	0	0	0	--	--	--	--
Plot 40 5169570 N 565319 E	0	--	0	0	1	0	--	--	Sagittaria graminea	--
Plot 41 5169569 N 565310 E	1	48	0	0	0	1	--	--	Zizania L.	--
Plot 46 5169569 N 565315 E	0	--	0	0	0	0	--	--	--	--
Plot 50 5169569 N 565319 E	0	--	0	0	1	0	--	--	Sagittaria graminea	--
Plot 53 5169568 N 565312 E	0	--	0	0	0	0	--	--	--	--
Plot 64 5169567 N 565313 E	0	--	0	0	0	0	--	--	--	--

**Grid 92 Pokegoma Bay**

8/25/2014 water depth = 105.11 cm Transparency Reading = 15 cm

Plot# UTM Coordinates (meters)	# of 0.5m <sup>2</sup> Stems	Height (cm)	% Cover Submergent Vegetation	% Cover Floating Vegetation	% Cover Emergent Vegetation	% Cover Wild Rice	Submergent Species	Floating Species	Emergent Species	* Water Sample ID/ Wild Rice Sample ID/ Comments
Plot 66 5169567 N 565315 E	0	--	0	0	0	0	--	--	--	--
Plot 80 5169566 N 565319 E	0	--	0	0	0	0	--	--	--	--
Plot 94 5169564 N 565313 E	0	--	0	0	1	0	--	--	Sagittaria graminea	--
Plot 97 5169564 N 565316 E	1	30	0	0	5	1	--	--	Sagittaria graminea	--
Plot 100 5169564 N 565319 E	0	--	0	0	1	0	--	--	Sagittaria graminea	--
<b>Mean</b>	0.10	39.00	0.00	0.00	0.60	0.10	--	--	--	--
<b>Median</b>	0	39	0	0	0	0	--	--	--	--
<b>S.D.</b>	0.31	12.73	0.00	0.00	1.14	0.31	--	--	--	--