

2013 Wild Rice and Water Quality Monitoring Summary

Prepared for
PolyMet Mining Inc.

January 2014



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1.0 Background

PolyMet Mining Inc. (PolyMet) has retained Barr Engineering Company (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 *2013 Wild Rice and Water Quality Monitoring Summary* (2013 summary), presents the results of the wild rice survey and associated surface water sampling conducted in 2013—the fifth 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 (SO_4^{2-}), major cations (Mg^{2+} , Ca^{2+} , K^+ , and Na^+), and major anions (HCO_3^- and Cl^-).
- On-site verification of aquatic vegetation (macrophytes) growing near wild rice stands.

The 2013 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 2013.

1.2 Wild Rice Characteristics

Wild rice is the official state grain of Minnesota and the only indigenous aquatic cereal plant in North America. In Minnesota, wild rice is an important aquatic plant species 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)).

Wild rice habitat typically includes open-water areas with direct sunlight, presence of other macrophytes (aquatic plants that are emergent, submergent, or floating in the water body), and water depths between 1 and 4 feet. 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 canarygrass). 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, but 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), 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 MnDNR 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), 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. Results from the first two years of these studies are available on the MPCA website - <http://www.pca.state.mn.us/index.php/water/water-permits-and-rules/water->

rulemaking/minnesotas-sulfate-standard-to-protect-wild-rice.html (Reference (13)). The studies were completed and submitted to the MPCA on December 31, 2013. The MPCA is analyzing the studies and has stated they will release preliminary recommendations regarding the Minnesota sulfate standard for wild rice by the end of February 2014.

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.” A few sections of study area water bodies could not be directly surveyed due to safety concerns or access limitations. For these stream segments, a desktop survey was conducted using aerial photographs. These surveys are referred to as “indirect surveys.”

The survey methods are similar to those presented in the 1854 Treaty Authority, *Wild Rice Monitoring and Abundance in the 1854 Ceded Territory (1998–2008)* 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 (14))). Field staff observe the shorelines of water bodies in the study area, noting 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 Guide*. 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.

The method of recording wild rice density was refined for the 2013 wild rice survey. Previous PolyMet wild rice surveys have recorded qualitative wild rice density only as points. The 2013 survey added field and GIS techniques to record wild rice density in larger stands as areas, providing greater precision and improving the ability to make multi-year comparisons. Small wild rice stands (less than approximately 100 ft²) and individual plants were still recorded as points for the 2013 survey.

Table 2-1 Wild Rice Density Scale

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

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. These data were collected during the direct surveys of study area water bodies and at 12 grid sampling sites.

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 m² 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. Note that the stem density counts for the grid sampling represent 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 each 0.5 m² 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, weighed, and seeds were counted. Total plant, shoot, root, and seed weight (dry weight) and total seed number 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.

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, as part of this study, 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	MPCA requirement that surface water samples be collected and analyzed for sulfate in water bodies where wild rice is present and sulfate concentration > 10mg/L; data supported our 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

For the 2013 wild rice survey, each stream has been divided into stream reaches, which were defined based on roads, railroads, impasses, and field survey observations. Stream reach definitions are subjective, so reaches defined for this year's field survey may need to be further refined in subsequent years as more information is collected. Divisions between reaches are indicated on figures with the survey results in Section 3.0. 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.¹
- **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).

¹ 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.

2.2 Macrophyte Survey Methods

As part of the 2013 wild rice surveys, staff surveyed macrophytes present 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 (Reference (14)). A subset of macrophyte observations included collection of plant specimens to verify field identification. As part of its quality control and quality assurance measures for the 2013 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 2013, water quality monitoring was conducted using the same methods described in the *2012 Wild Rice Survey and Water Quality Monitoring Summary* (Reference (15)). These are consistent with Barr's standard operating procedures (SOP), *Collection of Surface Water Samples* (Reference (16)). 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 SO_4^{2-} , major cations (Mg^{2+} , Ca^{2+} , K^+ , and Na^+) and major anions (HCO_3^- and Cl^-). The major cations were analyzed using EPA method 6010, sulfate and chloride were analyzed using EPA method 300.0, and bicarbonate was measured as bicarbonate alkalinity and reported as CaCO_3 using SM 2320B.

3.0 Results

Barr conducted the PolyMet 2013 wild rice survey between August 5 and August 30, 2013. An overview of surveyed water bodies is shown on Figure 1. Figures 2–19 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.

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

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 and proceeding upstream, ending south of County Road 615 (Salo Road) (Figure 2). Spring Mine Creek comprises a narrow, fairly straight channel with very few pools and alternating muck, gravel, and sandy substrate. No wild rice was observed. Three distinct reaches were identified in this 1-mile segment:

- **Reach 1:** No wild rice was observed. This 10-foot-wide, 0.1-mile reach consisted of shallow (6 inches), open water and was surveyed on foot. Reed canarygrass (*Phalaris arundinacea*) and willow (*Salix spp.*) were found growing adjacent to the stream in sandy substrate.
- **Reach 2:** No wild rice was observed. The average width of this 0.8-mile reach was 6 feet; depth ranged from 0.4 to 1.7 feet. The substrate was mucky at the downstream end of the reach, turning to gravel and rock further upstream. Rusty crayfish, a native species, was observed. Common in-stream vegetation included broad-leaf arrowhead (*Sagittaria cf. latifolia*) and bur-reed (*Sparganium spp.*). The dominant shoreline vegetation adjacent to the stream was reed canarygrass.
- **Reach 3:** No wild rice was observed. This 0.1-mile reach had a maximum depth of 3 feet and a mucky substrate. The width of the channel was approximately 48 feet at the start, narrowing upstream to 15 feet. Floating pondweed was the most common in-stream macrophyte. Vegetation adjacent to the stream included bluejoint (*Calamagrostis canadensis*), horsetail (*Equisetum sp.*), Oakes Robbins' spikerush (*Eleocharis robbinsii*), green bulrush (*Scirpus atrovirens*),

sedge (*Carex spp.*), and alder (*Alnus spp.*). Bluejoint, Kentucky bluegrass (*Poa pratensis*), willow, and alder were observed away from the stream—as well as two homesteads with manicured lawns to the east.

Embarrass River

The Upper Embarrass River was directly surveyed by kayak starting at CR 620 and ending upstream of Sabin Lake (Figure 2). Nine distinct reaches were identified in this 25.8-mile segment. From the end of Reach 9 to Sabin Lake the Embarrass River was inaccessible by kayak, so an indirect survey was performed from the downstream end of Reach 9 to Sabin Lake (consulting aerial photographs or observing stream conditions from the nearest accessible points on the stream). The majority of the Upper Embarrass River consists of a meandering, narrow channel marked by intermittent riffles, pools, and open water. Wild rice was identified along Reaches 2 and 8 in small bays adjacent to the main channel.

The Lower Embarrass River comprises a chain of lakes. Wild rice stands with densities of 2 to 5 were observed in the Lower Embarrass River lakes. Cedar Island Lake had the largest wild rice stands with the highest stand densities. Sabin Lake had no wild rice and Wynne Lake had one stem of wild rice.

- **Reach 1:** No wild rice was observed. This 2.1-mile reach varied between 12 and 80 feet in width, with a maximum depth of 4 feet. Mucky substrate was seen throughout. Common in-stream vegetation included water knot weed (*Polygonum amphibium*), broad-leaf arrowhead, yellow pond-lily (*Nuphar variegata*), and marsh cinquefoil (*Potentilla paulstris*). Most of this vegetation was along the shore, with open water in the channel. Riparian habitat adjacent to the stream included reed canarygrass and alder. Pine trees were seen at the downstream end of this segment, approximately 20 yards beyond shore.
- **Reach 2:** Wild rice stands of density 1 were observed. This 0.9-mile reach narrowed from 80 feet at the upstream end to 50 feet at the downstream end. Mucky substrate was seen throughout. At the upstream end of the reach, scattered wild rice stems were found in the center and on both sides of the river (approximately 10 stems per 100 feet, density 1). Wild rice became sparser toward the downstream end of the reach (a few stems every 20–25 feet, density 1). Water knot weed, floating pondweed (*Potamogeton natans*), and narrow-leaf bur-reed (*Sparganium cf. fluctuans*) were the predominant forms of in-stream vegetation. Alder and reed canarygrass were commonly found adjacent to the stream.
- **Reach 3:** No wild rice was observed. This reach varied from 20–30 feet in width and extended 10.7 miles. Once again, the substrate was mucky. For the majority of this reach, the river flowed through brush marsh wetland; several beaver dams and washed out banks were seen toward the downstream end of the reach. In-stream vegetation included broad-leaf arrowhead, water knot weed, floating-leaf bur-reed (*Sparganium cf. fluctuans*), spikerush (*Eleocharis*), yellow pond-lily, and flat-stem pondweed (*Potamogeton zosteriformis*). Reed canarygrass and alder were commonly found adjacent to the stream.

- **Reach 4:** No wild rice was observed. This 0.8-mile reach was 30 feet wide and 2 feet deep. Progressing downstream, the river shoreline changed from mucky/marsh to rocky and wooded, with some small rapids and riffles. Brush shrubs were observed adjacent to the stream but no in-stream vegetation was seen.
- **Reach 5:** No wild rice was observed. This 1.5-mile reach varied from 30 to 50 feet in width and 2 to 6 feet in depth. The substrate was, again, mucky. Yellow pond-lily was the predominant in-stream vegetation; reed canarygrass was found adjacent to the stream.
- **Reach 6:** No wild rice was observed. This 6.4-mile reach varied from 20 to 40 feet in width and about 9 inches to 4 feet in depth. Arrowhead (*Sagittaria spp.*) was the predominant in-stream vegetation, with yellow pond-lily found in bays. Reed canarygrass was observed adjacent to the stream on steep-sided banks. There were some exposed banks and beaver dams.
- **Reach 7:** A wild rice stand of density 1 was observed. This reach varied in width from 30 to 60 feet for most of its length (2.0 miles). Toward the middle of the reach, however, a small bay east of the main channel widened to about 110 feet. A few wild rice plants (density 1) were found in this bay among grassy arrowhead (*Sagittaria graminea*)—the most common form of in-stream vegetation. Reed canarygrass was seen adjacent to the stream, as well as shrub-carr. Conifer swamp was found away from the stream.
- **Reach 8:** A wild rice stand of density 1 was observed. At the upstream end of this 1.1-mile reach the river narrowed to about 30 feet. Stands of grassy arrowhead were found close to shore and reed canarygrass on the banks. Toward the downstream end of the reach a small group of wild rice plants was found on the shoreline.
- **Reach 9:** No wild rice was observed. This 0.3-mile reach was about 30 feet wide. It was characterized by shallow water and rocky substrate. Few aquatic plants were seen. Shrub-carr was found growing adjacent to the stream with upland forest behind.

Hay Lake 1

Wild rice stands of density 1 were observed. Hay Lake 1 (east of the Embarrass River) was directly observed from the shoreline at a single location; mucky conditions prohibited access to a larger portion of the lake (Figure 3). Water depth was approximately 2 feet and low-density wild rice (density 1) was observed throughout the lake. Other in-lake macrophytes were northern manna grass (*Glyceria borealis*) and bluejoint. Habitat adjacent to the lake included rice cutgrass (*Leersia oryzoides*), spikerush, and bluejoint.

Sabin Lake

No wild rice was observed. Sabin Lake was surveyed directly by kayak (Figure 4). The survey started at the boat landing on the northwest side of the lake and headed south. Depths of the surveyed areas ranged from 1.5 to 2.5 feet. The substrate was rocky. In-lake vegetation included spikerush, yellow pond-lily, floating-leaf bur-reed, northern manna grass, broad-leaf arrowhead, floating pondweed, sago pondweed (*Stuckenia pectinata*), and pickerelweed (*Pontederia cordata*). Vegetation was less abundant on the upper

half of the lake's east side. Spikerush was commonly found along the shoreline as well as some reed canarygrass.

Wynne Lake

A single stem of wild rice was observed. Wynne Lake was surveyed directly by kayak (Figure 4). The survey started at the boat landing on the northwest corner of the lake. This is the only area where wild rice (a single stem) was found. The depth of the surveyed waters ranged from 3 to 4 feet. The shoreline was primarily rocky, with steep upland slopes. On the west side of the lake very little vegetation was observed, though scattered floating-leaf bur-reed, yellow pond-lily, and grassy arrowhead were found. More vegetation was found on the south and east side of the lake where the substrate changed from rocky to a mix of sand, gravel, rock, and muck. This included spikerush, floating pondweed, northern manna grass, yellow pond-lily, and floating-leaf bur-reed.

Embarrass Lake and Lower Embarrass Lake

Several single wild rice plants and one wild rice stand of density 1 were observed. Embarrass Lake and Lower Embarrass Lake were surveyed directly by motorboat (Figure 5). The survey started at the boat landing on the west side of Embarrass Lake and moved clockwise through both lakes (i.e., the lakes were surveyed as a single water body). The north side of Embarrass Lake was a mix of rocky and sandy shoreline, with little aquatic plant life either in or adjacent to the lake. Some yellow pond-lily and spikerush were found, as well as a large stand of cattail (*Typha*) in the northeast corner of the lake. Three islands were also surveyed in the northern area of the lake; spikerush was present near these islands, but no wild rice.

The substrate on the east side of both lakes was sandy, while the shoreline was rocky and sandy with patches of spikerush, cattail, and yellow pond-lily. A single wild rice plant was found near submerged pondweeds on the southeast side of Lower Embarrass Lake.

Headed north, on the west side of Lower Embarrass Lake, a single wild rice plant was found in a bay near grassy arrowhead and yellow pond-lily. A 100- by 15-foot stand of rice (density 1) was also observed in the bay, about 10 feet from shore. A beaver hut was located approximately 150 yards north of the wild rice.

From the bay, moving north toward Embarrass Lake and the survey starting point, the substrate again became rocky. Spikerush and yellow pond-lily were found in the lake and near islands, with rock and bushes along the shoreline.

Unnamed Lake

Wild rice stands of density 1 and 3 were observed. Unnamed Lake was surveyed directly by kayak, starting in the northern bay, where about 25 stems of wild rice were found (Figure 6). The depth of the areas surveyed ranged from 1.5 to 2.3 feet. In general, this lake was dominated by low-density (density 1) wild rice and multiple macrophytes adjacent to wet meadow or shrub-carr on the shoreline. Common macrophytes included white water-lily (*Nymphaea odorata*), arrowhead, ribbon-leaf pondweed

(*Potamogeton epihydrus*), Richardson's pondweed (*Potamogeton richardsonii*), flat-stem pondweed, narrow-leaf pondweed (*Potamogeton spp.*), yellow pond-lily, nodding water nymph (*Najas*), and bur-reed. The area of low-density wild rice ranged from single points to 50- by 20-foot stands located 10 to 120 feet from the shoreline.

Rocky shoreline was observed at five locations, with only a few scattered stems of wild rice found. Dense horsetail was found at two locations, but no wild rice.

Wild rice (density 3) was found on the east side of the lake, just south of incoming flow from the Embarrass River. Richardson's pondweed and water-celery (*Vallisneria americana*) were also found at this location.

Cedar Island Lake

Wild rice stands of density 1 to 3 were observed. Cedar Island Lake was surveyed directly by kayak, starting on the southwest side of the lake and proceeding north (clockwise) (Figure 7). The depth of areas surveyed ranged from 1.7 to 2.2 feet. Ninety-seven wild rice points were observed in this lake. Many of these were areas of low-density rice (density 1) adjacent to wet meadow, shrub-carr, and shallow marsh. On the northeast side of the lake, the rice was found mixed with soft-stem bulrush (*Schoenoplectus tabernaemontani*) and sessile-fruit arrowhead (*Sagittaria rigida*), or in solitary stands 10 to 20 feet from shore. Other common macrophytes were white water-lily, yellow pond-lily, common bladderwort (*Utricularia macrorhiza*), and water-celery.

Six locations, primarily on the west side of the lake, were differentiated by rocky shoreline with no wild rice or only a few stems. Yellow pond-lily and white water-lily were commonly seen in these areas.

Wild rice (density 2–3) was found on the west side of the south island—where mucky substrate was also present. White water-lily, yellow pond-lily, coon's tail (*Ceratophyllum*), Richardson's pondweed, water-celery, water-shield (*Brasenia schreberi*), Canadian waterweed (*Elodea canadensis*), flat-stem pondweed, and common bladderwort were also found there.

In three other locations—two on the northwest side of the lake and one southeast—wild rice (density 2) was found growing in open, shallow areas with rocky bottoms and some emergent rocks. Other macrophytes identified in these locations included yellow pond-lily, white water-lily, common bladderwort, flat-stem pondweed, and coon's tail.

Please note that field staff sampling in early August and then again in late August observed some differences in wild rice densities in Cedar Island Lake. Densities in grid areas were taken on August 6; densities recorded as part of the field survey were taken on August 21. A desktop review of photos from both grid and shoreline surveys confirms that there was a decrease in plant density between the August 6 survey (density 1–5) and the August 21 survey (density 1–3).

Embarrass River and Fourth Lake

Wild rice stands of density 1 to 3 were observed. The direct survey of Fourth Lake and the portion of the Embarrass River that connects it to Cedar Island Lake were conducted by kayak (Figure 8). The survey started in the southeast corner of Fourth Lake, heading northeast. Water depth ranged from about 1 foot to 2.5 feet. Single points of wild rice were seen throughout the lake. Distinct stands of rice (density 1–3) were observed on the east shoreline with multiple other macrophytes including arrowhead, emergent bur-reed, white water-lily, common bladderwort, ribbon-leaf pondweed, longleaf pondweed, (*Potamogeton nodosus*), water-celery, yellow pond-lily, flat-stem pondweed, and coon's tail. These areas were primarily adjacent to wet meadow, shrub-carr, and shallow marsh; deciduous forest was often seen beyond the shoreline. The distance of the wild rice to the shoreline ranged from 10 to 120 feet.

3.1.2 Partridge River Watershed

Partridge River

The Partridge River was directly surveyed by kayak—from its confluence with Longnose Creek to just upstream of Colby Lake (Upper Partridge) and from approximately 1 mile downstream of Colby Lake to its confluence with the St. Louis River (Lower Partridge) (Figures 9–14). Twenty-three distinct reaches were identified and are described below. Stream reaches that were unnavigable by kayak or difficult to access by foot were indirectly surveyed by consulting aerial photographs or observing stream conditions from the nearest accessible points on the stream.

The majority of the Upper Partridge River consisted of a meandering, narrow channel marked by intermittent riffles, pools, and open water. Wild rice stands (density 1) were identified along Reach 6. The Lower Partridge River (Colby Lake to the St. Louis River) comprised a wider, less meandering channel up to Reach 14. Thereafter, the channel narrowed—marked by intermittent riffles, pools, and open water. Intermittent wild rice stands, with a range of densities, were identified along the entire length of the Lower Partridge River.

Upper Partridge River

- **Reach 1:** No wild rice was observed. This 2.0-mile reach starts near the confluence of the Partridge River with Longnose Creek. The average width was 60 to 120 feet. At the upstream end of the reach the river meandered through a wide wetland with mucky substrate; further downstream the river straightened and the substrate became cobble and boulder. Shoreline outcrops of bedrock were observed. The most common in-stream vegetation observed were floating-leaf bur-reed, spikerush, northern manna grass, pondweed, and arrowhead.
- **Reach 2:** No wild rice was observed. The width of this 0.8-mile reach ranged from 30 to 100 feet. Boulder riffles/rapids were frequently encountered, with deep pools found between stretches of rapids. Northern manna grass, arrowhead, floating-leaf bur-reed, and pondweed were the most commonly observed macrophytes. In-stream vegetation was sporadic and mostly limited to near-shoreline areas.

- **Reach 3:** No wild rice was observed. The width of this 2.4-mile reach varied widely—from 30 to 250 feet. A wide, deep pool was found at the upstream end of this reach, with other wide pools located at river bends. The water was generally deep enough for easy kayaking, though occasional short stretches of shallow rocky riffles were encountered. The substrate was variable in this section—boulders, cobble, silt, muck, and gravel. Northern manna grass was the dominant in-stream vegetation.
- **Reach 4:** No wild rice was observed. The general characteristics of this 1.7-mile reach were similar to Reach 3—though width was not as varied (50 to 100 feet). A decrease in the amount of rocky substrate was evident, along with increases of silt, sand, and muck. Northern manna grass was, again, the most commonly observed in-stream macrophyte.
- **Reach 5:** No wild rice was observed. This 2.2-mile reach varied in width from 50 to 150 feet. The substrate continued to be composed of less rock and more silt, sand, and muck. Vegetation changed significantly compared to upstream reaches, with large, dense stands of horsetail seen in several near-shore areas. In-stream vegetation included pondweed and northern manna grass.
- **Reach 6:** Wild rice stands of density 1 were observed. In this 1.9-mile stretch the river was consistently wider than 100 feet—ranging to 250 feet. The substrate was comprised silt and muck. Wild rice (density 1) was observed growing among several large, dense stands of horsetail near shore. In general, wild rice was seen in small, sparse stands. One of these stands was located in a backwater pool. In-stream vegetation included horsetail, pondweed, northern manna grass, floating-leaf bur-reed, and yellow pond-lily.

Lower Partridge River

- **Reach 7:** No wild rice was observed. The length of this reach was 500 feet and consisted of boulder rapids. The width of this segment ranged from 80 to 120 feet.
- **Reach 8:** Wild rice stands of density 1 to 4 were observed. This 0.4-mile reach was characterized by large, wide pools. Vegetation was found in the shallow areas near shore with deep, open water near the center. The width of this segment ranged from 120 to 400 feet. The substrate comprised boulders, cobble, and muck. Wild rice (density 1–4) was found on both shorelines. Other common forms of in-stream vegetation were water-shield (*Brasenia schreberi*), yellow pond-lily, white water-lily, pondweed, water-milfoil (*Myriophyllum spp.*), filamentous algae, northern manna grass, spikerush, bladderwort, and floating-leaf bur-reed.
- **Reach 9:** No wild rice was observed. This 0.2-mile reach ranged from 40 to 80 feet in width. A segment of boulder rapids, approximately 1,000 feet in length, was encountered. No in-stream vegetation was observed.
- **Reach 10:** Wild rice stands of density 2 were observed. The width of this 0.5-mile reach varied from 70 to 280 feet. A wide pool with sandy substrate was found downstream of the Reach 9 rapids, with wild rice (density 2) growing on its east bank. Moving downstream, the river gradually became more narrow and shallow and the substrate more varied (sand, cobble, and boulder).

Emergent arrowhead, water-celery, water-shield, yellow pond-lily, and white water-lily were commonly seen in the wide part of this reach; pondweed, horsetail, and northern manna grass were found in the narrow and shallow sections.

- **Reach 11:** Wild rice stands of density 1 to 4 were observed. This 0.3-mile reach ranged from 100 to 170 feet in width. The substrate comprised sand and boulders. Nearly continuous areas of wild rice (density 1–4) were found growing on both sides of the shore. While no vegetation was found in the center of the channel, some areas on the west shoreline were dominated by horsetail. White water-lily and water-shield were also observed.
- **Reach 12:** Wild rice stands of density 1 to 4 were observed. The width of the river in this 0.2-mile reach ranged from 80 to 120 feet. Open water was seen in the middle of the river, while wild rice (density 1–4) and other vegetation were found growing in shallow areas near shore. The substrate was composed of muck, sand, and cobble. Floating pondweed, emergent arrowhead, white water-lily, spikerush, and emergent bur-reed were common forms of in-stream vegetation. Riparian habitat adjacent to the river comprised tall grasses and brush.
- **Reach 13:** No wild rice was observed. In this small reach (0.1 mile), the river was between 25 and 100 feet wide. A stretch of boulder rapids was found downstream of the County Road 110 Bridge. Tall grasses and brush were seen adjacent to the river.
- **Reach 14:** A 0.4-mile-long stretch of wild rice (density 2–5) was found along both shorelines, growing in water less than 3 feet deep. Water in the middle of the channel was deeper, with no vegetation. The width of the river ranged from 100 to 160 feet. Varied substrates included sand, muck, cobble, and boulders. Tall grasses and brush were found adjacent to the river. Common in-stream vegetation included arrowhead and white water-lily.
- **Reach 15:** Wild rice stands of density 2 were observed. This 0.6-mile reach was composed of shallow rocky riffles/rapids and intermittent pools. The width was between 60 and 100 feet. Wild rice (density 2) was found near the downstream end of the reach. Substrate materials were cobble, boulders, sand, gravel, and muck. Riparian habitat adjacent to the river was composed of tall grasses and brush. Northern manna grass and emergent burr-reed were common forms of in-stream vegetation.
- **Reach 16:** Wild rice stands of density 1 were observed. This small reach (less than 0.1 mile), ranged between 60 and 80 feet in width. A bend in the river revealed a deep pool with shallow backwater connected to the river channel. Wild rice (density 1) was found in this area. Riparian habitat adjacent to the stream consisted of tall grasses and brush. Common forms of in-stream vegetation were arrowhead, burr-reed, and spikerush.
- **Reach 17:** No wild rice was observed. The width of this 0.3-mile reach was between 40 and 100 feet. Although wild rice was found on the upstream and downstream borders of this reach, no rice was found in the reach itself. Sand, gravel, and shallow riffles were common substrates. Arrowhead was noted in the stream, while tall grasses and brush grew adjacent to it.

- **Reach 18:** Wild rice stands of density 1 to 4 were observed. This 0.6-mile reach ranged from 60 to 120 feet in width. Wild rice of varying density (1–4) was found growing in shallow areas near both shorelines. In-stream vegetation consisted primarily of arrowhead, white water-lily, yellow pond-lily, and spikerush. Substrates noted were sand, muck, gravel, and silt. Tall grasses and brush were seen adjacent to the stream.
- **Reach 19:** Wild rice stands of density 1 to 4 were observed. The stream characteristics and riparian habitat of this 0.6-mile reach were almost identical to Reach 18. The exception was the river's width, which expanded to about 200 feet in some sections. Wild rice of varying density (1–4) was found on both sides of the river.
- **Reach 20:** Wild rice stands of density 1 to 2 were observed. Again, the stream characteristics and riparian habitat of this 0.6-mile reach were nearly identical to Reaches 18 and 19. The width of the river here, however, was much less varied—with a maximum of 100 feet. Other differences included some hard-bottom substrate and, in one area, mowed grass adjacent to the river. Wild rice (density 1–2) was found along both shorelines.
- **Reach 21:** No wild rice was observed. This small reach (0.2 mile), ranged from 40 to 100 feet in width and was characterized by shallow, rocky riffle. The substrate comprised cobble and boulder. Mixed coniferous and deciduous forest was found immediately adjacent to the stream. No species of in-stream vegetation dominated.
- **Reach 22:** Wild rice stands of density 2 to 5 and were observed. This small reach (0.04 mile) was about 140 feet wide. The most commonly observed in-stream vegetation was dense wild rice (density 5) found along the west shore; some lower-density rice (density 2) was immediately adjacent, extending to the end of the reach. Mixed coniferous and deciduous forest was seen adjacent to the stream.
- **Reach 23:** Wild rice stands of density 1 were observed. This reach (approximately 0.4 mile), immediately adjacent to the St. Louis River, was fairly consistent in width (60 to 80 feet). There were a few occurrences of sparse wild rice (density 1). Shallow, rocky riffles were present 800 to 1000 feet upstream of the confluence with the St. Louis River. Habitat adjacent to and away from the river was dominated by mixed coniferous and deciduous forest. Emergent arrowhead was also found. The substrate was composed of cobble, boulder, and gravel.

Wyman Creek

Wyman Creek was directly surveyed (from north to south) by kayak and on foot (Figure 15). No wild rice was identified. The survey started approximately one-half mile upstream of the Dunka Road crossing and concluded at the Partridge River. A majority of Wyman Creek comprises numerous beaver dams and intermittent, shallow, open water with few riffles.

- **Reach 1:** No wild rice was observed. This 0.6-mile reach was not navigable by kayak due to shallow water (0.5–1.0 foot), a steep rock pile berm, and thick vegetation. Instead, it was observed from the shoreline. The substrate in this section of the creek was primarily muck, with some sand

and rock. Common in-stream vegetation included cattail, slender rush (*Juncus tenuis*), algae, and floating pond weed. Habitat found adjacent to the stream included bulrush, alder, low-growing shrubs, and tussock sedge (*Carex stricta*). Birch (*Betula spp.*), aspen (*Populus tremuloides*), and spruce (*Picea spp.*) were commonly seen away from the stream.

- **Reach 2:** No wild rice was observed. The survey of this 5.5-mile reach was conducted by kayak. The average width of the segment was 25 feet, with a maximum depth of 2 feet. Many beaver dams were noted. Floating pondweed and algae were the most common forms of in-stream vegetation. Cattail and rice cutgrass were found adjacent to the stream; alder, aspen, and spruce were observed away from the stream.
- **Reach 3:** No wild rice was observed. This 2.4-mile segment of the creek was surveyed on foot due to shallow water and a rocky stream bed. The width of the creek here ranged from 5 to 25 feet and depth ranged from 0.5 to 2 feet. Both rocky and mucky substrates were found. Yellow pond-lily and bur-reed grew in the stream, though open water was also seen. Bluejoint was commonly observed both adjacent to the stream and away from it. Alder, aspen, green ash (*Fraxinus pennsylvanica*), spruce, balsam poplar (*Populus balsamifera*), and birch were found adjacent to a particularly shallow, fast-moving portion of this reach.

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 (Figures 16 and 17). Historically, the creek had many beaver dams, making surveys by kayak or on foot difficult. In 2013, in accordance with MnDNR permits and approvals, several beaver dams were mechanically removed along Second Creek. As a result it was possible to directly survey a majority of Second Creek by kayak and on foot. 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. Stream reaches that were unnavigable by kayak or difficult to access by foot were indirectly surveyed by consulting aerial photographs or observing stream conditions from the nearest accessible points on the stream. A majority of Second Creek was meandering channel marked by intermittent open water and pools. Wild rice (densities 1-3) was identified along Reaches 6, 7, and 8.

- **Reach 1:** No wild rice was observed in this shallow, narrow, 0.7-mi reach (1 foot deep and 5 feet wide). Common in-stream vegetation included sago pondweed, yellow pond-lily, duckweed (*Lemna minor*), water-milfoil, and bur-reed. Dense cattail marsh with some purple loosestrife (*Lythrum salicaria*), fowl manna grass (*Glyceria striata*), broad-leaf arrowhead, beggars-ticks (*Bidens spp.*), and reed canarygrass, were observed adjacent to the stream. Two beaver dams were seen near the reach start.
- **Reach 2:** No wild rice was observed in this 0.9-mile reach—which widened downstream to an open-water pond. This pond, approximately 500 feet wide with a maximum depth of 2 feet, provided habitat for trumpeter swans. Sago pondweed and flat-leaf bladderwort (*Utricularia intermedia*) were the dominant vegetation.

- **Reach 3:** No wild rice was observed. The average width of this 0.7-mile reach, which includes a man-made channel, was 30 feet; the maximum depth was 3 feet. The substrate was composed of rocks and muck. Common in-stream vegetation included sago pondweed, water milfoil, flat-leaf bladderwort, water-celery, and burr-reed. Riparian habitat adjacent to the stream consisted of rattlesnake manna grass (*Glyceria canadensis*), woolgrass (*Scirpus cyperinus*), bluejoint, and cattail. Birch (*Betula spp.*), black spruce (*Picea mariana*), and tamarack (*Larix laricina*) were seen in the forested area away from the stream.
- **Reach 4:** No wild rice was observed in this 2.6-mile reach. A few beaver dams were found in the first mile as the reach returned to a natural channel. The average width of the stream in this section was 10 feet; depth ranged from 1 to 3 feet. The substrate was composed of muck and sand. Many portions of this segment were too shallow and rocky to traverse by kayak. Instead, observations were made while carrying kayaks over rocks. Flooding was observed just upstream of a beaver dam and culvert under County Road 380. Riparian habitat adjacent to the stream included cattail marsh, wet meadow dominated by reed canarygrass, and alder thicket with speckled alder (*Alnus incana*) and bluejoint. Sago pondweed, burr-reed, floating pondweed, and coon's tail (*Ceratophyllum spp.*) were common forms of in-stream vegetation.
- **Reach 5:** No wild rice was observed in this 2.2-mile reach. The width of the creek here varied from 5 to 20 feet, while depths ranged from 0.5 to 3 feet. The substrate consisted of rock. Flooding, caused by beaver dams, was frequently observed. Yellow pond-lily, flat-stem pondweed, burr-reed, and narrow-leaved pondweed were the most common forms of in-stream vegetation. Cedar swamp and shallow marsh, dominated by cattail, were found adjacent to the stream.
- **Reach 6:** Sparse amounts of wild rice (density less than 1) were observed in this 2.1-mile reach which averaged 10 feet in width and 3 feet in depth. Common in-stream vegetation was burr-reed, yellow pond-lily, and narrow-leaved pondweed. Riparian habitat adjacent to the stream consisted of wet meadow dominated by bluejoint, manna grass, and reed canarygrass. Alder, cedar (*Thuja occidentalis*), and birch were observed away from the stream.
- **Reach 7:** Wild rice stands of density 1 to 3 were observed. This 0.1-mile reach was about 10 feet wide and 3 feet deep. The observed substrate was sand. Wild rice (density 1–3) was found just downstream from a rocky area. Wet meadow dominated by reed canarygrass grew adjacent to the stream. Yellow pond-lily was the most common in-stream vegetation.
- **Reach 8:** Wild rice (density 3–4) was found in the area near the confluence with the Partridge River. The width of this 0.02-mile reach was 20 feet; the depth was 4 feet. Cattail marsh and wet meadow were observed adjacent to the stream, with yellow pond-lily growing in the stream.

3.1.3 Pike River Watershed

The water bodies surveyed in the Pike River Watershed were Little Rice Lake, Hay Lake 2, and a portion of the Pike River (Figure 18). Substrates were primarily muck and water levels ranged from 1-5 feet. Wild rice (density 1–2) was observed in Hay Lake 2 and Little Rice Lake. Wild rice (density 1–2) was also identified in Reach 1 of the Pike River.

Little Rice Lake

Wild rice stands of density 1 to 3 were observed. Little Rice Lake was directly surveyed by canoe, starting at the intersection with the Pike River and heading east. The depth of the areas surveyed ranged from 1 to 3.5 feet; the lake's substrate was muck. The predominant form of in-lake vegetation is wild rice (density 1-2), growing 5 to 50 feet from shore. Blunt-leaved pondweed (*Potamogeton obtusifolius*) was also commonly seen. Adjacent shoreline habitat consisted primarily of wet meadow or shrub-carr. Conifer and black spruce swamp were often observed away from the shore.

A survey of the island in the center of the lake revealed higher density rice (density 3) approximately 40 feet from the shoreline. Adjacent shoreline habitat consisted of sub-carr.

Pike River/Hay Lake Outlet

The Pike River was directly surveyed by canoe, starting at the confluence with Little Rice Lake and travelling west.

- **Reach 1 (Pike River):** Wild rice stands of density 1 to 2 were observed. This 0.5-mile reach ranged from 40 to 100 feet in width and 2 to 5 feet in depth. The substrate was mucky. The most common form of in-stream vegetation was wild rice, found on both banks. The areas of wild rice (density 1-2) ranged from 5 to 30 feet in width. Riparian habitat adjacent to the stream consisted of wet meadow. Conifer black spruce swamp and forested upland were observed away from the stream.
- **Reach 2 (Pike River):** No wild rice was observed. This 1.0 mile reach extended downstream to the Hay Lake outlet. Here, the river was 70 to 80 feet wide and 3 to 6 feet deep. The substrate was mucky and wet meadow was observed adjacent to the stream. No in-stream macrophytes were found.
- **Reach 3 (Hay Lake Outlet):** The Hay Lake Outlet is a 0.4-mile reach from Hay Lake to the the Pike River. It was survey in the upstream direction, from the confluence of the Pike River and the Hay Lake Outlet to Hay Lake. The channel of the Hay Lake Outlet ranged from 5 to 10 feet in width; water depth was 1 to 3 feet. The wet meadow floodplain observed adjacent to the stream was dominated by lake sedge. Conifer black spruce swamp was seen away from the stream. Two wild rice plants, found near the entrance of Hay Lake, were the only form of in-stream vegetation observed.

Hay Lake 2

Wild rice stands of density 1 were observed. Hay Lake was directly surveyed by kayak, starting at the end of the Hay Lake Outlet and proceeding northeast. The water depth in areas surveyed ranged from 1.5 to 3.5 feet. The substrate was primarily mucky. Low-density wild rice (density 1) was observed on all sides of the lake. In general, the distance of the wild rice from the shoreline ranged from 5 to 100 feet. In two areas on the north side of the lake individual stems of sparsely scattered rice were found 500 feet toward the lake's center. Scattered, single stems of rice were found throughout the center of the lake. Other forms of in-lake vegetation were scouring rush, northern manna grass, water-shield (*Brasenia schreberi*),

and yellow pond-lily. Adjacent shoreline habitat was primarily wet meadow, containing lake sedge and other wet-grass species; some forested upland was also seen. Conifer black spruce and tamarack swamp and forested upland were observed away from the shoreline.

3.1.4 St. Louis River Estuary

Wild rice stands of density 1 to 5 were observed. The St. Louis River was directly surveyed by kayak (Upper Estuary) and motor boat (Lower Estuary) (Figure 19). The extent of the surveyed area was from the Fond du Lac Reservation, Minnesota to the downstream side of Pokegama Bay, Wisconsin. The Estuary has a wide main channel (several hundred feet) with intermittent stands of wild rice primarily growing in back bays ranging in size and density (densities 1-4). Pokegama Bay had a very large stand of wild rice (density 5).

Upper Estuary

Wild rice stands of density 1 were observed. The direct survey of this area, conducted by sea kayak, started and ended at Chamber's Grove Park in Fond du Lac. Low-density wild rice (density 1) was found throughout the Upper Estuary, which is characterized by wide, open channels and back bays.

The most common in-stream vegetation in the open channels was pondweed (floating, long-leaf, Richardson's, and flat-stem), arrowhead (broad-leaf and sessile-fruit), and purple loosestrife. Leafy pondweed (*Potamogeton foliosus*), Richardson's pondweed, broad-leaf arrowhead, yellow pond-lily, white water-lily, bladderwort, bulrush, bur-reed, cattail, and purple loosestrife were commonly seen in the back bays.

Lower Estuary

Wild rice stands of density 1 to 2 were observed. The direct survey of the Lower Estuary started from Spirit Lake Marina, located on the estuary's northwest side. Scattered wild rice (density 1) was seen at a number of points in this area. Clusters of low-density wild rice points (density 1-2) were also found at the south end of the Lower Estuary. Only four low-density points were found in the estuary's main channel (two along the west shore, one on the west side of a small island, and one on the east shore). The east (Wisconsin) side of the channel was characterized by steep clay cliffs adjacent to the river and little in-stream vegetation.

Common in-stream vegetation in the Lower Estuary's wide, open channels included white water-lily, yellow pond-lily, broad-leaf arrowhead, sessile-fruit arrowhead, spikerush, flat-stem pond weed, Richardson's pond weed, water-celery, bur-reed, cattail, and bulrush. Yellow pond-lily, floating-leaf bur-reed, water mil-foil, bladderwort, cattail, and flat-stem pondweed were found in the shallow areas with woody debris.

Pokegama Bay

Wild rice stands of density 1 to 5 were observed. Pokegama Bay was directly surveyed by canoe, starting on the upstream (south) end and proceeding counter-clockwise. The width of the bay ranged from 80 feet at the south end to 1000 feet at the north end. The maximum depth was close to 3 feet and the substrate

was mucky throughout the bay. Wild rice grew in varying densities (1–5) on both banks, with the highest densities seen on the upstream end in shallow, narrow bays. In-stream vegetation was varied. The most common included yellow pond-lily, floating pondweed, Richardson’s pondweed, arrowhead, and cattail.

Low-density rice (density 1) was found in a large bay on the south side of the main channel. This area is much narrower (100–200 feet). It was also characterized by open water with aquatic macrophytes on both shorelines. In addition to the macrophytes noted above, these included bladderwort, duckweed, water-milfoil, coon’s tail, white water-lily, broad-leaf arrowhead, sessile-fruit arrowhead, and flat-stem pondweed.

3.2 Quantitative Wild Rice Survey Results

Mean stem counts per 0.5m² as measured during grid sampling surveys in 2009–2013 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, and 2013 are shown on Figures 26–37. This information was not compiled in 2012 due to very little wild rice growth.

Please note that field staff sampling in early August and then again in late August observed some differences in wild rice densities in Cedar Island Lake. Densities in grid areas were taken on August 6; densities recorded as part of the field survey were taken on August 21. A desktop review of photos from both grid and shoreline surveys confirms that there was a decrease in plant density between the August 6 survey (density 1–5) and the August 21 survey (density 1–3).

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 Cedar Island Lake, the Partridge River, and the St. Louis River estuary. Over 60 taxa of vascular plants were identified.

The most common submerged species included slender naiad (*Najas flexilis*), water milfoil (*Myriophyllum spp.*), pondweeds (*Potamogeton spp.*), and common bladderwort (*Utricularia macrorhiza*). Common floating species included yellow pond-lily (*Nuphar variegata*), white water-lily (*Nymphaea odorata*), floating pondweed (*Potamogeton natans*), and floating bur-reed (*Sparganium fluctuans*). Common emergent species included spikerush (*Eleocharis spp.*, particularly *E. palustris*), northern mannagrass (*Glyceria borealis*), arrowhead (typically *Sagittaria latifolia* or *S. rigida*), narrow-leaved bur-reed (*Sparganium emersum*), and hard- and soft-stem bulrushes (*Schoenoplectus acutus* and *S. tabernaemontani*). Several species were common on shorelines and occasionally emergent near shorelines including bluejoint (*Calamagrostis canadensis*), sedges (*Carex spp.*, including *C. lacustris*, *C. stricta*, and *C. utriculata*), and woolgrass (*Scirpus cyperinus*).

3.4 Water Quality Monitoring Results

A total of 39 water samples were collected from 16 different water bodies near wild rice stands during the 2013 wild rice survey, including Cedar Island Lake, Embarrass River, Fourth Lake, Hay Lake (1), Little Rice Lake, Lower Embarrass Lake, Partridge River, Pike River, Pokegama Bay, Sabin Lake, Second Creek, Spring Mine Creek, St. Louis River Estuary, Unnamed Lake, Wyman Creek, and Wynne Lake (Figure 38). Water quality results are presented in Large Table 2 and Large Table 3. Sulfate concentrations are depicted on Figure 39, and sulfate concentration ranges by water body are presented in Table 3-1. The sample from Second Creek had the highest maximum concentrations for all parameters except potassium; Hay Lake 1 had the lowest maximum concentrations (Large Table 3). The Embarrass River chain of lakes (Sabin Lake, Wynne Lake, Embarrass Lake, Unnamed Lake, Cedar Island Lake and Fourth Lake) had comparable concentrations of all water quality parameters, with values generally differing by a few mg/L or less.

Table 3-1 Maximum, Minimum, and Average Sulfate Concentrations (mg/L) in 2013

Water Body	Sulfate, as SO ₄ (mg/L)		
	Maximum	Minimum	Average
Cedar Island Lake	16.3	16.1	16.2
Embarrass River	112.0	14.4	36.9
Fourth Lake	16.1	16.1	16.1
Hay Lake 1	1.3	1.3	1.3
Little Rice Lake	2.8	2.8	2.8
Lower Embarrass River	18.0	16.9	17.5
Partridge River	190	10.1	86.8
Pike River	2.7	2.7	2.7
Pokegama Bay	5.9	4.6	5.1
Sabin Lake	18.7	15.6	17.2
Second Creek	1040	1040	1040
Spring Mine Creek	336	297	317
St. Louis River Estuary	14.8	7.1	12.0
Unnamed Lake	17.4	16.6	17.0
Wyman Creek	17.0	1.0	6.4
Wynne Lake	16.9	16.0	16.5

In 2013, 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 SOPs for routine data evaluation, which are based on *The National Functional Guidelines for Inorganic Data Review* (Reference (17)). Data evaluation included a review of technical holding times, preservation, blanks, laboratory control samples, matrix spike samples, duplicate samples, and data package completeness. All data are acceptable as reported and qualified; they are usable as presented in the data summary tables.

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.

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.

4.0 Summary

In 2013, generally, wild rice grew in greater densities at more locations in the study area than it did in 2012. In 2013 wild rice was present at all but one grid sampling location (Grid 22, Lower Embarrass Lake); in 2012 wild rice was absent from five grid locations. In the study area, sulfate values range from near detection limits (1.3 mg/L) in Hay Lake 1 (near the Embarrass River) to as high as 1040 mg/L in Second Creek. The following is a brief summary of each watershed's wild rice stand locations and densities.

Embarrass Watershed: Results from the 2013 survey were similar to those recorded in 2012—except for Unnamed Lake, Cedar Lake, and Fourth Lake, where more dense rice stands (density 2–3) were observed in 2013 than in 2012.

Partridge Watershed: While there was little or no change on Wyman Creek, significant change was found on the Partridge River—particularly the Lower Partridge River, where in 2013, more wild rice was observed both in the direct surveys and the grid sampling than in 2012. In 2013 wild rice was found at all grids, with densities ranging from 1 to 125 stems per 0.5m²; in 2012 rice was absent from all three grid locations. In addition, in the 2013 direct survey, wild rice with qualitative density ratings of 4 or 5 was identified on four reaches of the Lower Partridge; in 2012, only one stand had a density rating of 4. Some change was also found on Second Creek. Wild rice was identified in Reaches 6 and 7, including one more location than was observed in past surveys.

Pike River Watershed: Increases in wild rice locations and/or density were noted in Little Rice Lake and Hay Lake 2. In 2013, wild rice (density 1–2) was the predominant form of in-lake vegetation in Little Rice Lake and was also observed near an island at the center of the lake (density 3). In 2012, low-density wild rice (density 1) was only observed at several isolated points along the shoreline of Little Rice Lake. At Hay Lake 2, in 2013, low-density wild rice was found along the shoreline of the entire lake; in 2012, low-density wild rice was observed just along the north and south shorelines.

St. Louis River Estuary: In 2012 the river was surveyed from its confluence with the Partridge River to the Co. Hwy. 100 crossing, where only one small stand of wild rice was observed. The 2013 survey included the Upper and Lower St. Louis River Estuaries, as well as Pokegama Bay. In 2013 wild rice (density 1–2) was found in both estuaries and in Pokegama Bay (density 1–5).

Overall, results of the 2009 through 2013 wild rice surveys identify patterns 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 to 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 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 (several years) of the 4–6 year cycle; wild rice that does not appear in the first few years may appear in subsequent years. Because of this cyclical nature of wild rice, 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 development and of potential wild rice habitat in study area water bodies.

5.0 References

1. **Minnesota Department of Natural Resources.** Natural Wild Rice in Minnesota Report. 2008.
2. **Vennum, Thomas.** Wild Rice and the Ojibwe People. 1988.
3. **Walker, R.D., Pastor, J., Dewey, B.W.** Effects of Wild Rice (*Zizania palustris* L.) Straw on Biomass and Seed Production in Northern Minnesota. *Canadian Journal of Botany*. 2006, 84, (1), pp. 1019-1024.
4. —. Litter Quantity and Nitrogen Immobilization Cause Oscillations in Productivity of Wild Rice (*Zizania palustris* L.) in Northern Minnesota. *Ecosystems*. 2010, 13, pp. 485-498.
5. **Ustipak, R., Contract Coordinator of Ducks Unlimited and MNDNR Cooperative Wild Rice Lake Management Program.** Personal Communication. September 9, 2011.
6. **U.S. Environmental Protection Agency.** Wild Rice Ecosystems Management in Minnesota. Subsistence Foods and Tribal Initiatives from the Office of Pesticide Programs. 1999.
7. **Kern, Dr. Anthony, Chair of Departments of Biology and Chemistry, Morningside College, Sioux City, IA.** Personal communication. May 8, 2010.
8. **Moyle, J.B.** Wild Rice in Minnesota. *Journal of Wildlife Management*. 1944, Vol. 8, 3, pp. 177-184.
9. **Moyle, J. and Krueger, P.** Wild Rice in Minnesota. *Informational Leaflet 5, State of Minnesota Department of Conservation, Division of Game and Fish*. 1968.
10. **Moyle, J.** The 1940 Minnesota Wild Rice Crop. *Bureau of Fisheries Research Division of Game and Fish. Investigational Report #22*. 1941.
11. —. The 1941 Minnesota Wild Rice Crop. *Bureau of Fisheries Research Division of Game and Fish. Investigational Report #40*. 1942.
12. **Minnesota Pollution Control Agency.** Unpublished Lists of Invertebrate and Fish Species. 1997; 2009.
13. **Myrbo, A., Ramstack, J. and Thompson, R.** Wild Rice Sulfate Standard Preliminary Field Survey 2011 Final Report. Prepared for the Minnesota Pollution Control Agency. August 2012.
14. **Minnesota Department of Natural Resources.** *A Handbook for Collecting Vegetation Plot Data in Minnesota: The Relevé Method*. 2007.
15. **Barr Engineering Co.** *2012 Wild Rice Survey and Water Quality Monitoring Summary*. 2013.
16. **Barr Engineering Co.** Standard Operating Procedure: Collection of Surface Water Samples, Revision 5. April 2011.

17. **U.S. Environmental Protection Agency.** USEPA Contract Laboratory Program, National Functional Guidelines for Inorganic Superfund Data Review. *United States Environmental Protection Agency*. [Online] OSWER 9240.1-51. USEPA-540-R-10-011, January 2010.
<http://epa.gov/superfund/programs/clp/download/ism/ism1nfg.pdf>.

Large Tables

Large Table 1 - Macrophyte Results⁽¹⁾

Scientific Name ⁽²⁾	Common Name	Cedar Island Lake		Embarrass Lake		Embarrass River		Fourth Lake		Hay Lake (1) Embarrass River		Hay Lake (2) Pike River		Little Rice Lake 8/14	
		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 = 86	n = 0	n = 0	n = 8	n = 8	n = 30	n = 11	n = 0	n = 1	n = 0	n = 13	n = 3	n = 20	n = 0
<i>Acorus americanus</i>	Sweetflag														
<i>Brasenia schreberi</i>	Water-shield	5													
<i>Calamagrostis canadensis</i>	Canada bluejoint									1					
<i>Carex lacustris</i>	Lake sedge						2								
<i>Carex</i> spp.	Unidentified species of sedge														
<i>Carex utriculata</i>	Yellow lake sedge						1								
<i>Ceratophyllum demersum</i>	Coon's tail	4						1							
<i>Comarum palustre</i>	Marsh cinquefoil						1								
<i>Eleocharis</i> spp.	Unidentified spikes rush species	2			8		3								
<i>Elodea canadensis</i>	Canadian waterweed	4													
<i>Equisetum fluviatile</i>	River horsetail				1		1					1			
<i>Equisetum hyemale</i>	Common scouring rush					1									
<i>Glyceria borealis</i>	Northern manna grass	1				1	2						1		
<i>Glyceria canadensis</i>	Rattlesnake manna grass									1					
<i>Lemna minor</i>	Duckweed					1									
<i>Myriophyllum</i> spp.	Unidentified water-milfoil species														
<i>Myriophyllum sibiricum</i>	Common water-milfoil	2													
<i>Najas flexilis</i>	Slender naiad	3													
<i>Nuphar variegata</i>	Yellow pond-lily	11			8		4	1							
<i>Nymphaea odorata</i>	White water-lily	13					1	1							
<i>Phalaris arundinacea</i>	Reed canary grass	1													
<i>Phragmites australis</i>	Common reed														
<i>Polygonum amphibium</i>	Water knotweed					2	6								
<i>Pontederia cordata</i>	Pickernelweed														
<i>Potamogeton amplifolius</i>	Big-leaf pondweed	1													
<i>Potamogeton crispus</i>	Curly-leaf pondweed	2													
<i>Potamogeton epihydrus</i>	Ribbon-leaf pondweed														
<i>Potamogeton natans</i>	Floating pondweed	2													
<i>Potamogeton nodosus</i>	Long-leaf pondweed	2						2							
<i>Potamogeton richardsonii</i>	Richardson's pondweed	4													
<i>Potamogeton</i> spp. (narrow-leaf)	Unidentified pondweed species														
<i>Potamogeton vaseyi</i>	Vasey's pondweed														
<i>Potamogeton zosteriformis</i>	Flat-stem pondweed	5					1	1							
<i>Sagittaria latifolia</i>	Broadleaf arrowhead	1				1	5								
<i>Sagittaria cf. latifolia</i>	Broadleaf arrowhead														
<i>Sagittaria rigida</i>	Sessilefruit arrowhead	11					3	1							
<i>Sagittaria</i> spp.	Unidentified arrowhead species	1					3	6							

Large Table 1 - Macrophyte Results⁽¹⁾

Scientific Name ⁽²⁾	Common Name	Cedar Island Lake		Embarrass Lake		Embarrass River		Fourth Lake		Hay Lake (1) Embarrass River		Hay Lake (2) Pike River		Little Rice Lake 8/14	
		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 = 86	n = 0	n = 0	n = 8	n = 8	n = 30	n = 11	n = 0	n = 1	n = 0	n = 13	n = 3	n = 20	n = 0
<i>Schoenoplectus acutus</i>	Hardstem bulrush														
<i>Schoenoplectus pungens</i>	Three square														
<i>Schoenoplectus tabernaemontani</i>	Softstem bulrush	2			2			1							
<i>Scirpus cyperinus</i>	Woolgrass							1							
<i>Scirpus fluviatilis</i>	River bulrush														
<i>Sium suave</i>	Water parsnip						1								
<i>Sparganium cf. fluctuans</i>	Floating bur-reed	2													
<i>Sparganium fluctuans</i>	Floating bur-reed						1								
<i>Sparganium emersum</i>	Narrow-leaved bur-reed						1	2							
<i>Sparganium</i> spp.	Unidentified bur-reed species	5						2							
<i>Stuckenia pectinata</i>	Sago pondweed														
<i>Typha</i> spp.	Unidentified cattail species	1			2			1							
<i>Utricularia intermedia</i>	Flat-leaved bladderwort	1													
<i>Utricularia macrorhiza</i>	Common bladderwort	11						1							
<i>Vallisneria americana</i>	American eelgrass	8						1							

⁽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 1 - Macrophyte Results⁽¹⁾

Scientific Name ⁽²⁾	Common Name	Lower Embarrass Lake		Partridge River (Lower)		Partridge River (Upper)		Pike River		Pokegama Bay		Sabin Lake		Second Creek	
		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 = 3	n = 4	n = 81	n = 3	n = 8	n = 6	n = 11	n = 0	n = 33	n = 6	n = 0	n = 13	n = 15	n = 6
<i>Acorus americanus</i>	Sweetflag			1	1										
<i>Brasenia schreberi</i>	Water-shield			9											
<i>Calamagrostis canadensis</i>	Canada bluejoint														
<i>Carex lacustris</i>	Lake sedge														
<i>Carex</i> spp.	Unidentified species of sedge												1		
<i>Carex utriculata</i>	Yellow lake sedge														
<i>Ceratophyllum demersum</i>	Coon's tail									1	1				3
<i>Comarum palustre</i>	Marsh cinquefoil														
<i>Eleocharis</i> spp.	Unidentified spikes rush species	2	4	5		1	1						11		
<i>Elodea canadensis</i>	Canadian waterweed														
<i>Equisetum fluviatile</i>	River horsetail			6		5	2								
<i>Equisetum hyemale</i>	Common scouring rush														
<i>Glyceria borealis</i>	Northern manna grass			3	1	5	5						2		
<i>Glyceria canadensis</i>	Rattlesnake manna grass														
<i>Lemna minor</i>	Duckweed									1	1				1
<i>Myriophyllum</i> spp.	Unidentified water-milfoil species			3						1					2
<i>Myriophyllum sibiricum</i>	Common water-milfoil														
<i>Najas flexilis</i>	Slender naiad									1			1		
<i>Nuphar variegata</i>	Yellow pond-lily	2	1	13		5		1		1			8	4	5
<i>Nymphaea odorata</i>	White water-lily			24						1					
<i>Phalaris arundinacea</i>	Reed canary grass	1													
<i>Phragmites australis</i>	Common reed														
<i>Polygonum amphibium</i>	Water knotweed														
<i>Pontederia cordata</i>	Pickerelweed												3		
<i>Potamogeton amplifolius</i>	Big-leaf pondweed														
<i>Potamogeton crispus</i>	Curly-leaf pondweed														
<i>Potamogeton epihydrus</i>	Ribbon-leaf pondweed						1			1					
<i>Potamogeton natans</i>	Floating pondweed			5		3	2			1			2		2
<i>Potamogeton nodosus</i>	Long-leaf pondweed														
<i>Potamogeton richardsonii</i>	Richardson's pondweed									1	1				
<i>Potamogeton</i> spp. (narrow-leaf)	Unidentified pondweed species					1				2				1	
<i>Potamogeton vaseyi</i>	Vasey's pondweed														
<i>Potamogeton zosteriformis</i>	Flat-stem pondweed									1					1
<i>Sagittaria latifolia</i>	Broadleaf arrowhead									1					
<i>Sagittaria cf. latifolia</i>	Broadleaf arrowhead														
<i>Sagittaria rigida</i>	Sessilefruit arrowhead	1		16	1	2				1					
<i>Sagittaria</i> spp.	Unidentified arrowhead species						3								

Large Table 1 - Macrophyte Results⁽¹⁾

Scientific Name ⁽²⁾	Common Name	Lower Embarrass Lake		Partridge River (Lower)		Partridge River (Upper)		Pike River		Pokegama Bay		Sabin Lake		Second Creek	
		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 = 3	n = 4	n = 81	n = 3	n = 8	n = 6	n = 11	n = 0	n = 33	n = 6	n = 0	n = 13	n = 15	n = 6
<i>Schoenoplectus acutus</i>	Hardstem bulrush	1	1												
<i>Schoenoplectus pungens</i>	Three square														
<i>Schoenoplectus tabernaemontani</i>	Softstem bulrush									1					
<i>Scirpus cyperinus</i>	Woolgrass														
<i>Scirpus fluviatilis</i>	River bulrush										1				
<i>Sium suave</i>	Water parsnip														
<i>Sparganium cf. fluctuans</i>	Floating bur-reed														
<i>Sparganium fluctuans</i>	Floating bur-reed			1		2	4						6		
<i>Sparganium emersum</i>	Narrow-leaved bur-reed														
<i>Sparganium</i> spp.	Unidentified bur-reed species			3	2						1			2	4
<i>Stuckenia pectinata</i>	Sago pondweed												1		4
<i>Typha</i> spp.	Unidentified cattail species									1	1				
<i>Utricularia intermedia</i>	Flat-leaved bladderwort														2
<i>Utricularia macrorhiza</i>	Common bladderwort			1						1					
<i>Vallisneria americana</i>	American eelgrass			1						1	1				1

⁽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 1 - Macrophyte Results⁽¹⁾

Scientific Name ⁽²⁾	Common Name	Spring Mine Creek		St. Louis River Estuary	
		Wild Rice Present	Wild Rice Absent	Wild Rice Present	Wild Rice Absent
		n = 0	n = 4	n = 62	n = 10
<i>Acorus americanus</i>	Sweetflag				
<i>Brasenia schreberi</i>	Water-shield				
<i>Calamagrostis canadensis</i>	Canada bluejoint				
<i>Carex lacustris</i>	Lake sedge				
<i>Carex</i> spp.	Unidentified species of sedge				
<i>Carex utriculata</i>	Yellow lake sedge				
<i>Ceratophyllum demersum</i>	Coon's tail			1	
<i>Comarum palustre</i>	Marsh cinquefoil				
<i>Eleocharis</i> spp.	Unidentified spikes rush species		1	1	
<i>Elodea canadensis</i>	Canadian waterweed			2	
<i>Equisetum fluviatile</i>	River horsetail				
<i>Equisetum hyemale</i>	Common scouring rush				
<i>Glyceria borealis</i>	Northern manna grass				
<i>Glyceria canadensis</i>	Rattlesnake manna grass				
<i>Lemna minor</i>	Duckweed				
<i>Myriophyllum</i> spp.	Unidentified water-milfoil species			1	
<i>Myriophyllum sibiricum</i>	Common water-milfoil			1	
<i>Najas flexilis</i>	Slender naiad			6	
<i>Nuphar variegata</i>	Yellow pond-lily			7	
<i>Nymphaea odorata</i>	White water-lily			3	
<i>Phalaris arundinacea</i>	Reed canary grass			1	
<i>Phragmites australis</i>	Common reed				1
<i>Polygonum amphibium</i>	Water knotweed				
<i>Pontederia cordata</i>	Pickerelweed				
<i>Potamogeton amplifolius</i>	Big-leaf pondweed				
<i>Potamogeton crispus</i>	Curly-leaf pondweed				
<i>Potamogeton epihydrus</i>	Ribbon-leaf pondweed				
<i>Potamogeton natans</i>	Floating pondweed		1	1	
<i>Potamogeton nodosus</i>	Long-leaf pondweed			4	
<i>Potamogeton richardsonii</i>	Richardson's pondweed			4	
<i>Potamogeton</i> spp. (narrow-leaf)	Unidentified pondweed species				
<i>Potamogeton vaseyi</i>	Vasey's pondweed			1	
<i>Potamogeton zosteriformis</i>	Flat-stem pondweed			4	
<i>Sagittaria latifolia</i>	Broadleaf arrowhead		1	8	
<i>Sagittaria cf. latifolia</i>	Broadleaf arrowhead			5	
<i>Sagittaria rigida</i>	Sessilefruit arrowhead			7	
<i>Sagittaria</i> spp.	Unidentified arrowhead species			2	

Large Table 1 - Macrophyte Results⁽¹⁾

Scientific Name ⁽²⁾	Common Name	Spring Mine Creek		St. Louis River Estuary	
		Wild Rice Present	Wild Rice Absent	Wild Rice Present	Wild Rice Absent
		n = 0	n = 4	n = 62	n = 10
<i>Schoenoplectus acutus</i>	Hardstem bulrush				
<i>Schoenoplectus pungens</i>	Three square			1	
<i>Schoenoplectus tabernaemontani</i>	Softstem bulrush			7	1
<i>Scirpus cyperinus</i>	Woolgrass				
<i>Scirpus fluviatilis</i>	River bulrush				
<i>Sium suave</i>	Water parsnip				
<i>Sparganium cf. fluctuans</i>	Floating bur-reed				
<i>Sparganium fluctuans</i>	Floating bur-reed			1	
<i>Sparganium emersum</i>	Narrow-leaved bur-reed				
<i>Sparganium</i> spp.	Unidentified bur-reed species		1	3	1
<i>Stuckenia pectinata</i>	Sago pondweed			1	
<i>Typha</i> spp.	Unidentified cattail species			2	2
<i>Utricularia intermedia</i>	Flat-leaved bladderwort				
<i>Utricularia macrorhiza</i>	Common bladderwort			5	
<i>Vallisneria americana</i>	American eelgrass				

⁽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."

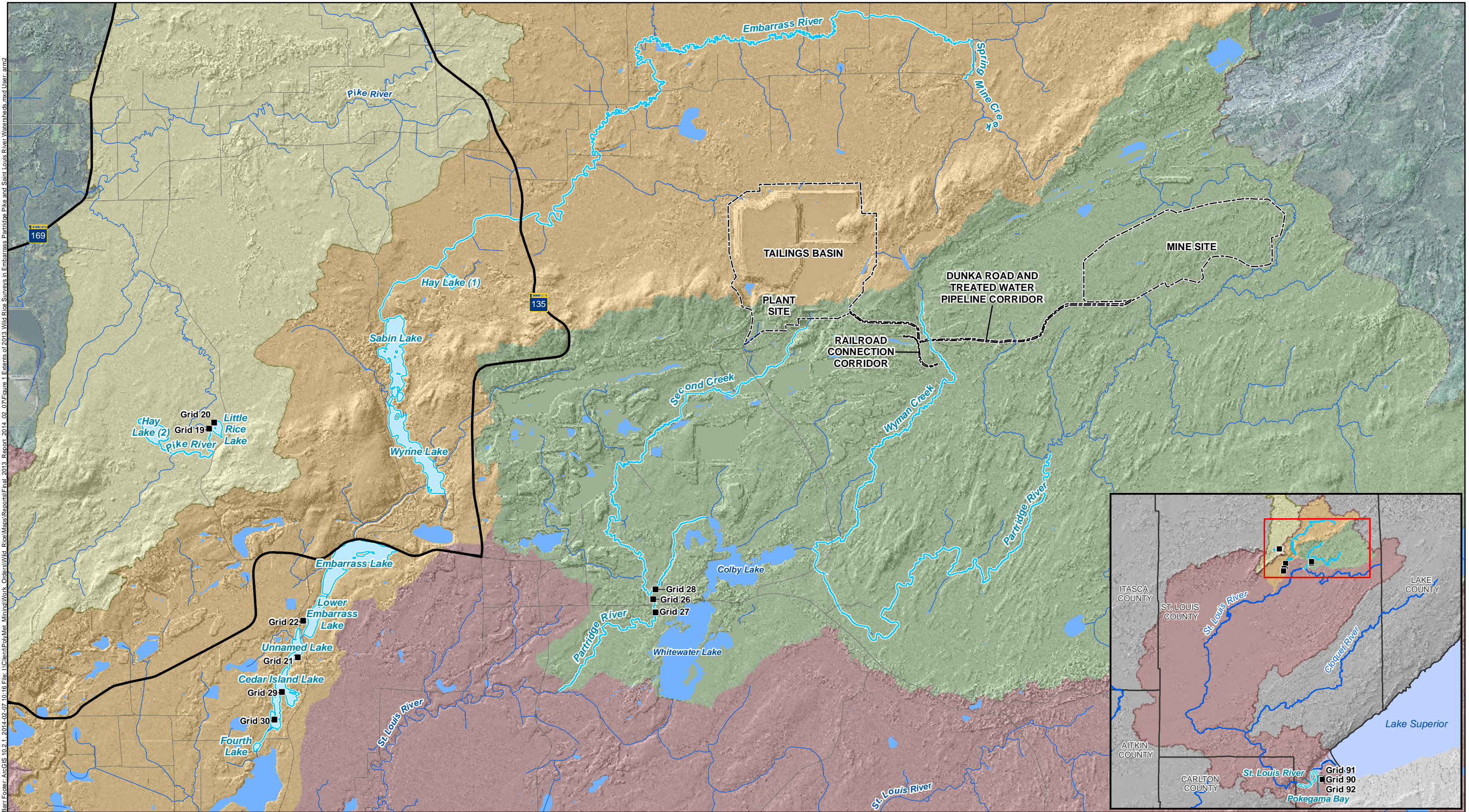
Large Table 2 Water Quality Data Collected during the 2013 Wild Rice Survey

Parameter Total or/Dissolved Unit			Alkalinity, bicarbonate, as CaCO3 NA mg/l	Chloride NA mg/l	Sulfate, as SO4 NA mg/l	Calcium Total mg/l	Magnesium Total mg/l	Potassium Total mg/l	Sodium Total mg/l
Water Body	Sample Name	Date							
Cedar Island Lake	PM-KMS2-29-21	8/6/2013	53.0	5.2	16.1	16.3	10.1	1.7	7.0
Cedar Island Lake	PM-KMS2-30-4	8/6/2013	54.2	5.2	16.2	16.6	10.0	1.7	7.0
Cedar Island Lake	PM-KSW-01	8/21/2013	55.8	5.6	16.3	15.4	9.2	1.6	6.9
Embarrass River	PM-KMS2-01	8/19/2013	83.7	2.6	20.4	20.4	13.8	1.9	7.3
Embarrass River	PM-KMS2-02	8/19/2013	83.8	2.6	20.0	21.1	13.9	1.9	7.4
Embarrass River	PM-KMS2-03	8/19/2013	97.6	3.4	17.8	23.6	14.3	1.8	8.0
Embarrass River	PM-KMS2-04	8/19/2013	96.0	3.1	14.4	25.6	12.7	1.7	6.8
Embarrass River	PM-MRB2-01	8/22/2013	119	2.4	112	25.3	35.5	6.6	13.7
Fourth Lake	PM-KSW-02	8/21/2013	58.0	5.2	16.1	16.2	9.7	1.6	6.7
Hay Lake	PM-BAW-01	8/13/2013	22.9	0.61 jb	1.3	8.0	2.7	0.17 j	1.9
Little Rice Lake	PM-KJN-20	8/15/2013	38.5	3.6	2.8	12.2	4.9	0.56	3.5
Lower Embarrass Lake	PM-KMS2-22-55	8/5/2013	55.0	5.0	16.9	16.7	10.3	1.7	7.1
Lower Embarrass Lake	PM-MRB2-01	8/23/2013	61.2	5.4	18.0	16.8	10.1	1.7	6.9
Partridge River	PM-KDM-01	8/6/2013	51.6	3.8	21.0	20.3	10.2	1.3	5.9
Partridge River	PM-KDM-02	8/7/2013	51.8	5.7	10.1	15.4	9.6	1.4	7.6
Partridge River	PM-KDM-03	8/8/2013	91.9	4.7	114	26.2	39.1	2.5	9.8
Partridge River	PM-KMS2-28	8/30/2013	84.8	5.2	26.9	22.6	10.9	1.5	6.9
Partridge River	PM-MN-KDM-03	8/8/2013	91.9	4.7	114	26.2	39.1	2.5	9.8
Partridge River	PM-MN-KMS2-26	8/30/2013	117	6.2	159	26.9	52.4	3.4	12.4
Partridge River	PM-MN-KMS2-27	8/30/2013	132	6.0	190	28.1	62.7	3.9	13.6
Pike River	PM-KJN-19	8/15/2013	44.5	4.0	2.7	13.7	5.4	0.58	3.7
Pokegama Bay	PM-KMS2-01	8/27/2013	99.5	7.1	4.6	26.8	10.2	1.0	6.9
Pokegama Bay	PM-KMS2-02	8/27/2013	84.4	5.3	5.9	23.5	9.8	0.99	5.8
Pokegama Bay	PM-KMS2-03	8/27/2013	97.2	6.8	4.7	27.0	10.4	1.1	6.9
Sabin Lake	PM-MRB2-08	8/20/2013	53.1	3.9	18.7	13.3	9.7	1.9	6.9
Sabin Lake	PM-MRB2-09	8/20/2013	72.6	3.1	15.6	18.9	11.7	1.7	6.8
Second Creek	PM-MN-GTZ-01	8/22/2013	440	8.3	1040	49.7	323	14.1	44.4
Spring Mine Creek	PM-BKB-01	8/12/2013	190	1.5 b	297	41.4	79.4	15.2	28.6
Spring Mine Creek	PM-BKB-02	8/12/2013	206	1.3 b	336	44.8	91.5	17.5	32.8
St. Louis River Estuary	PM-KMS2-04	8/28/2013	81.1	7.2	14.8	20.6	11.6	1.3	7.0
St. Louis River Estuary	PM-KMS2-05	8/28/2013	78.4	6.0	14.0	19.7	11.1	1.2	6.3
St. Louis River Estuary	PM-KMS2-06	8/29/2013	97.0	8.8	7.1	24.3	11.8	0.91	6.9
Unnamed Lake	PM-KMS2-21-01	8/5/2013	53.6	4.9	16.6	16.1	10.2	1.6	6.9
Unnamed Lake	PM-KSW-01	8/20/2013	61.5	5.5	17.4	17.2	10.3	1.8	7.2
Wyman Creek	PM-BAW-02	8/15/2013	139	0.89 jb	1.2	25.6	18.8	2.2	8.8
Wyman Creek	PM-BKB-01	8/14/2013	156	1.1 b	17.0	28.2	20.9	3.1	11.6
Wyman Creek	PM-BKB-01	8/15/2013	166	0.97 jb	0.99 j	29.2	21.2	2.6	10.7
Wynne Lake	PM-MRB2-05	8/20/2013	59.8	3.7	16.9	16.4	10.4	1.6	6.4
Wynne Lake	PM-MRB2-07	8/20/2013	72.1	3.1	16.0	18.8	12.0	1.7	6.9

Large Table 3 Maximum, Minimum, and Average Bicarbonate, Chloride, and Cations Concentrations (mg/L) in 2013

Water Body	Alkalinity, bicarbonate, as CaCO3 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	55.8	53.0	54.3	5.6	5.2	5.3	16.6	15.4	16.1	10.1	9.2	9.8	1.7	1.6	1.7	7.0	6.9	7.0
Embarrass River	119.0	83.7	96.0	3.4	2.4	2.8	25.6	20.4	23.2	35.5	12.7	18.0	6.6	1.7	2.8	13.7	6.8	8.6
Fourth Lake	58.0	58.0	58.0	5.2	5.2	5.2	16.2	16.2	16.2	9.7	9.7	9.7	1.6	1.6	1.6	6.7	6.7	6.7
Hay Lake (1)	22.9	22.9	22.9	0.6	0.6	0.6	8.0	8.0	8.0	2.7	2.7	2.7	0.2	0.2	0.2	1.9	1.9	1.9
Little Rice Lake	38.5	38.5	38.5	3.6	3.6	3.6	12.2	12.2	12.2	4.9	4.9	4.9	0.6	0.6	0.6	3.5	3.5	3.5
Lower Embarrass Lake	61.2	55.0	58.1	5.4	5.0	5.2	16.8	16.7	16.8	10.3	10.1	10.2	1.7	1.7	1.7	7.1	6.9	7.0
Partridge River	132.0	51.6	88.2	6.2	3.8	5.3	28.1	15.4	23.3	62.7	9.6	30.8	3.9	1.3	2.3	13.6	5.9	9.4
Pike River	44.5	44.5	44.5	4.0	4.0	4.0	13.7	13.7	13.7	5.4	5.4	5.4	0.6	0.6	0.6	3.7	3.7	3.7
Pokegama Bay	99.5	84.4	93.7	7.1	5.3	6.4	27.0	23.5	25.8	10.4	9.8	10.1	1.1	1.0	1.0	6.9	5.8	6.5
Sabin Lake	72.6	53.1	62.9	3.9	3.1	3.5	18.9	13.3	16.1	11.7	9.7	10.7	1.9	1.7	1.8	6.9	6.8	6.9
Second Creek	440.0	440.0	440.0	8.3	8.3	8.3	49.7	49.7	49.7	323.0	323.0	323.0	14.1	14.1	14.1	44.4	44.4	44.4
Spring Mine Creek	206.0	190.0	198.0	1.5	1.3	1.4	44.8	41.4	43.1	91.5	79.4	85.5	17.5	15.2	16.4	32.8	28.6	30.7
St. Louis River Estuary	97.0	78.4	85.5	8.8	6.0	7.3	24.3	19.7	21.5	11.8	11.1	11.5	1.3	0.9	1.1	7.0	6.3	6.7
Unnamed Lake	61.5	53.6	57.6	5.5	4.9	5.2	17.2	16.1	16.7	10.3	10.2	10.3	1.8	1.6	1.7	7.2	6.9	7.1
Wyman Creek	166.0	139.0	153.7	1.1	0.9	1.0	29.2	25.6	27.7	21.2	18.8	20.3	3.1	2.2	2.6	11.6	8.8	10.4
Wynne Lake	72.1	59.8	66.0	3.7	3.1	3.4	18.8	16.4	17.6	12.0	10.4	11.2	1.7	1.6	1.7	6.9	6.4	6.7

Figures



- Grid Sampling Locations
- ▭ NorthMet Project Areas
- Surveyed Rivers in 2013
- Surveyed Lakes in 2013
- National Hydrography Dataset
- Rivers and Streams
- Lakes
- Embarrass River
- Partridge River
- Pike River
- St. Louis River

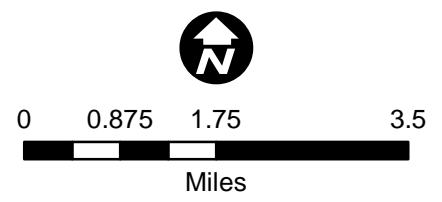
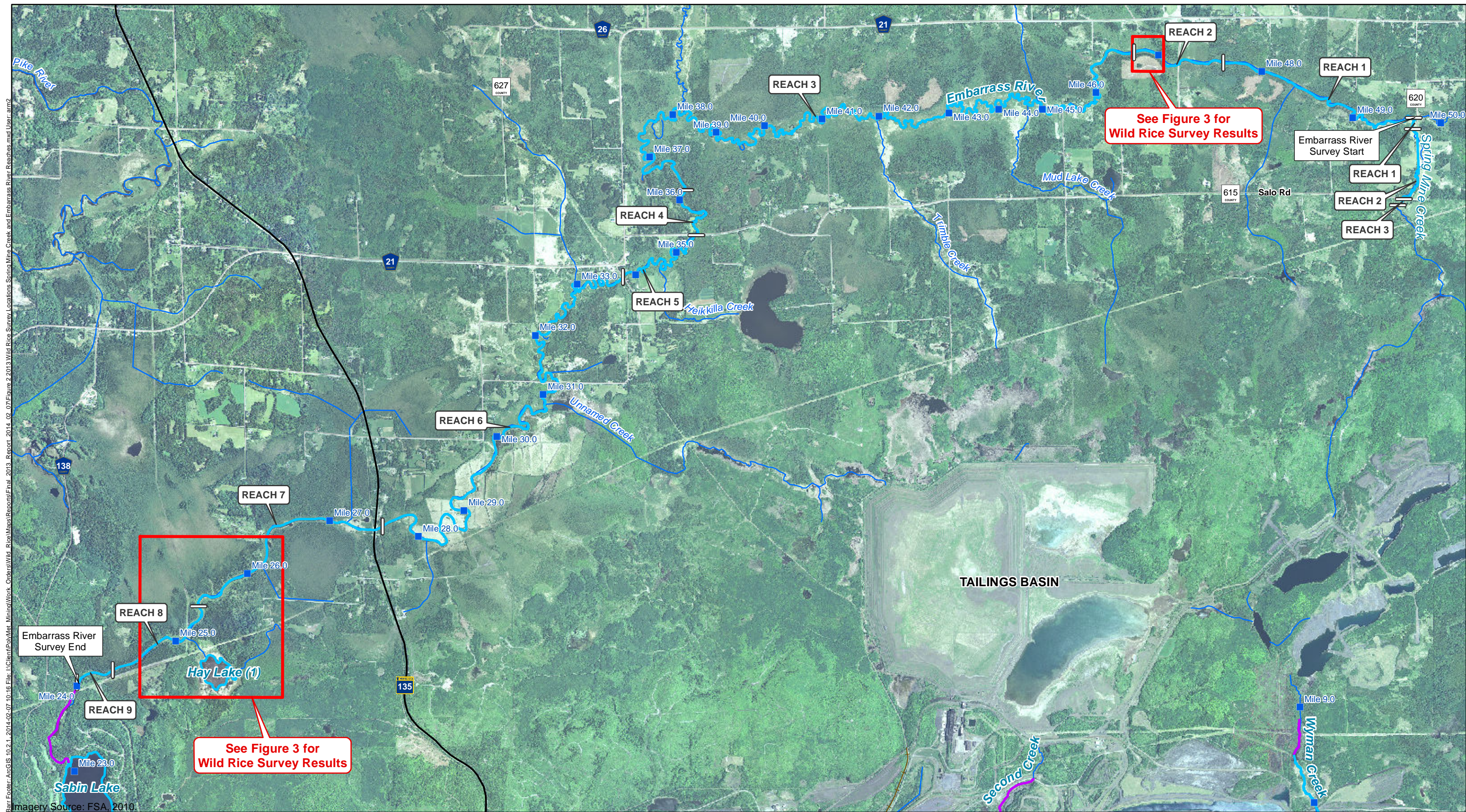


Figure 1
EXTENTS OF 2013 WILD RICE SURVEYS IN
THE EMBARRASS RIVER, PARTRIDGE RIVER,
PIKE RIVER, AND ST. LOUIS RIVER WATERSHEDS
NorthMet Project
Poly Met Mining, Inc.
Hoyt Lakes, Minnesota



- River Mile
- Reach Divisions
- 2013 Direct Survey
- 2013 Indirect Survey
- National Hydrography Dataset
- Rivers and Streams

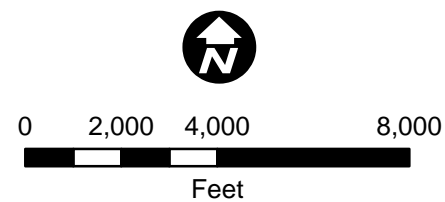


Figure 2
 2013 WILD RICE SURVEY LOCATIONS
 SPRING MINE CREEK (REACHES 1-3) AND
 EMBARRASS RIVER (REACHES 1-9)
 NorthMet Project
 Poly Met Mining, Inc.
 Hoyt Lakes, Minnesota

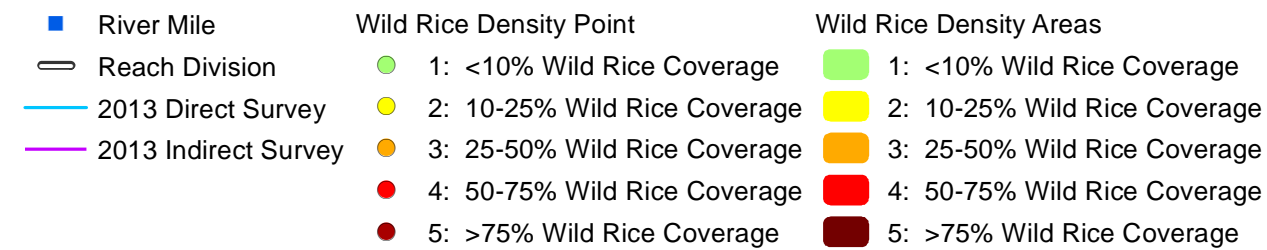
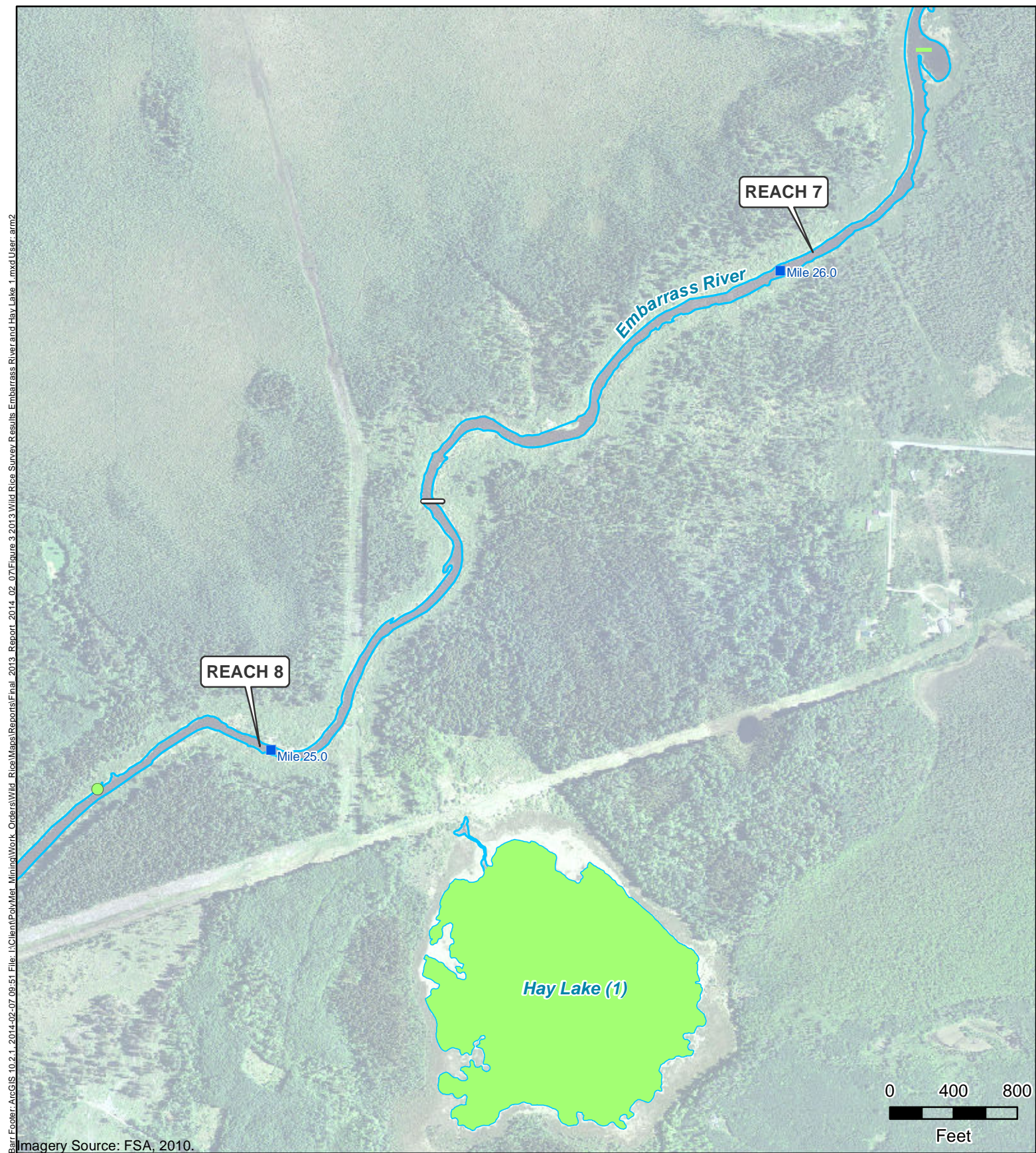


Figure 3
2013 WILD RICE SURVEY RESULTS
EMBARRASS RIVER REACHS (2,7 & 8)
AND HAY LAKE 1
NorthMet Project
Poly Met Mining, Inc.
Hoyt Lakes, Minnesota

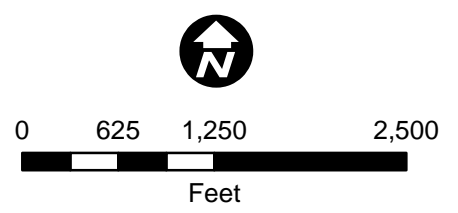
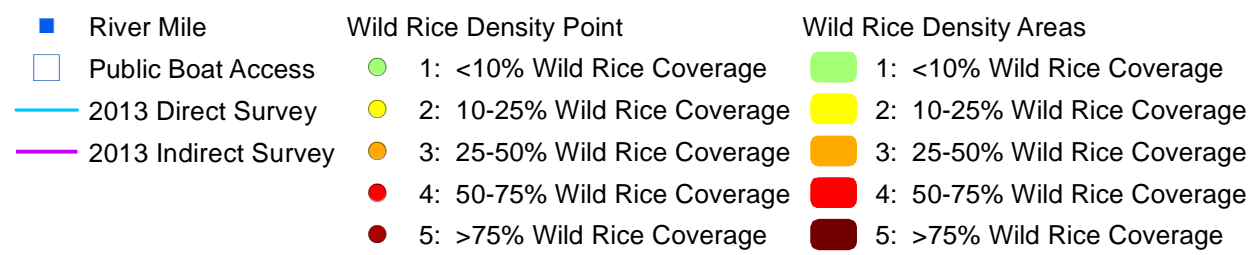
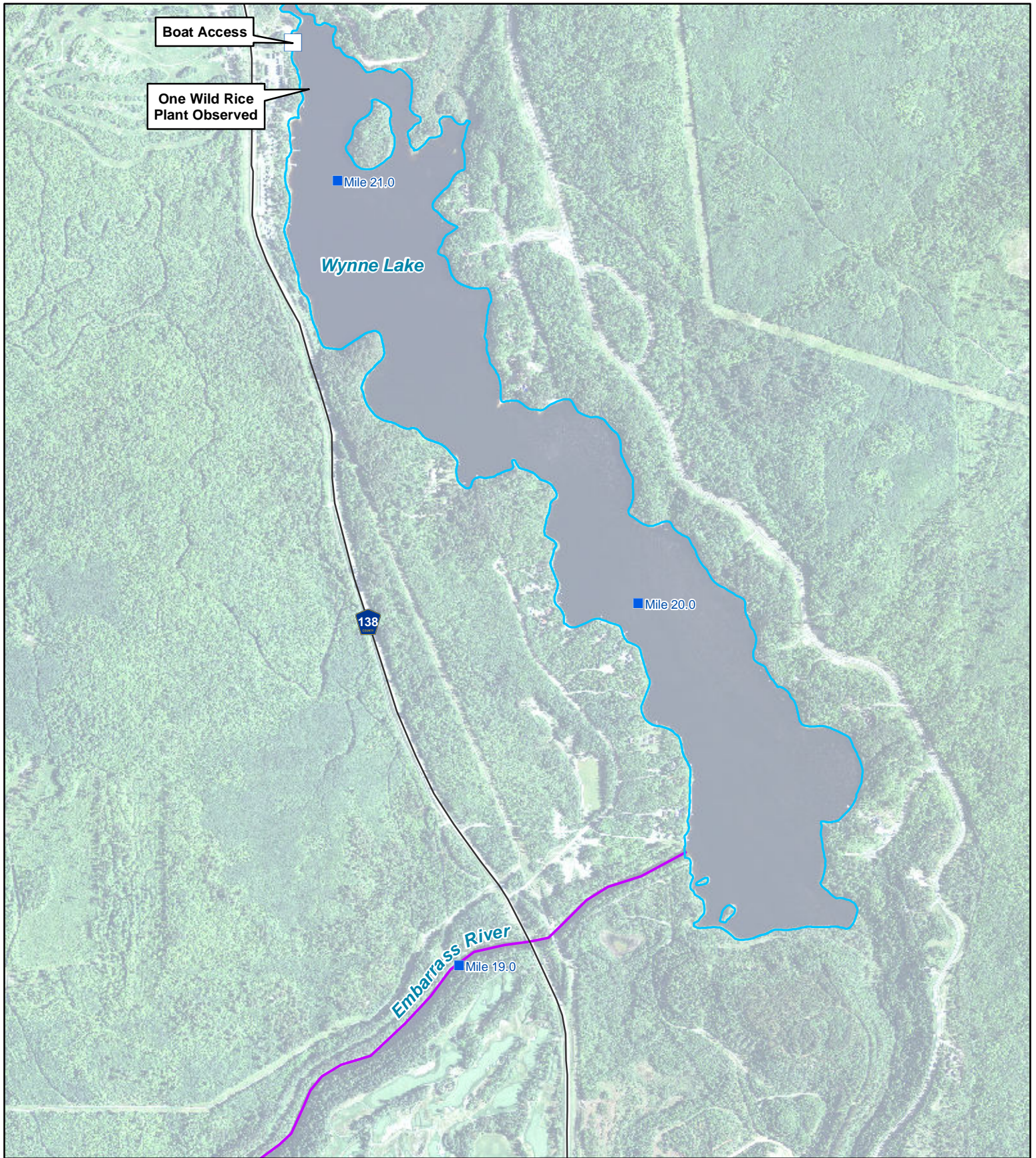
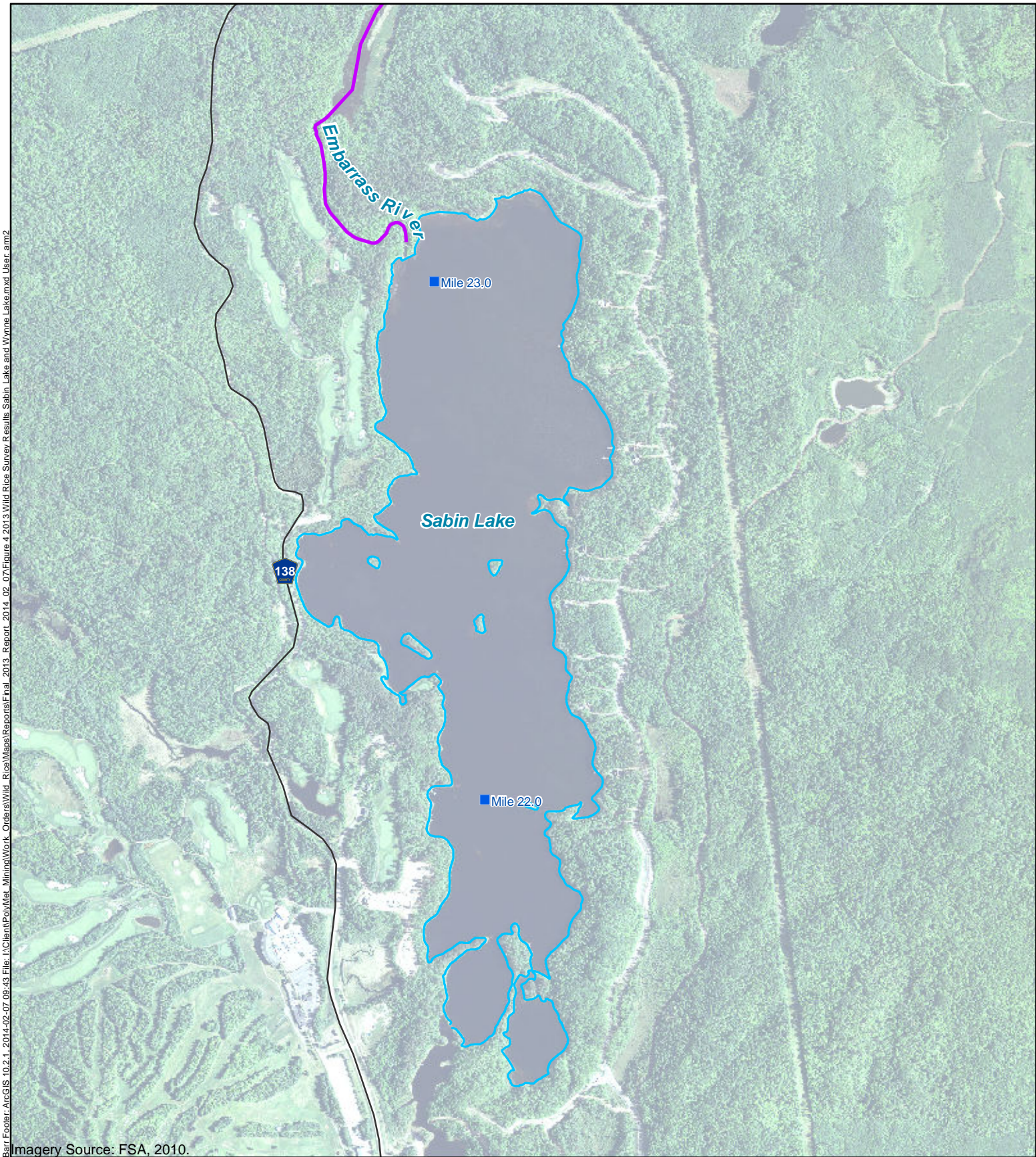


Figure 4
 2013 WILD RICE SURVEY RESULTS
 SABIN LAKE AND WYNNE LAKE
 NorthMet Project
 Poly Met Mining, Inc.
 Hoyt Lakes, Minnesota

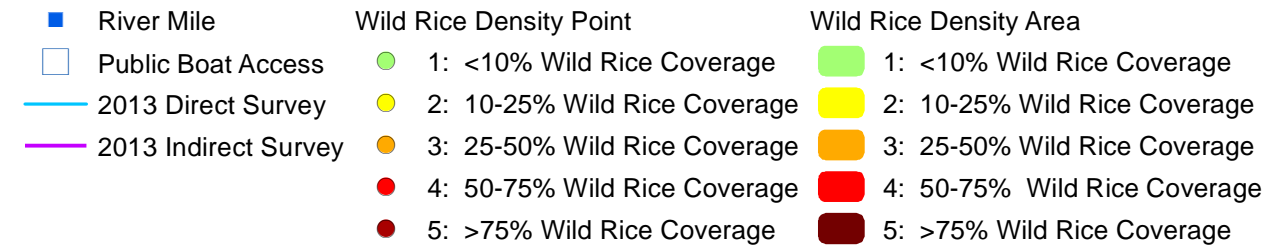
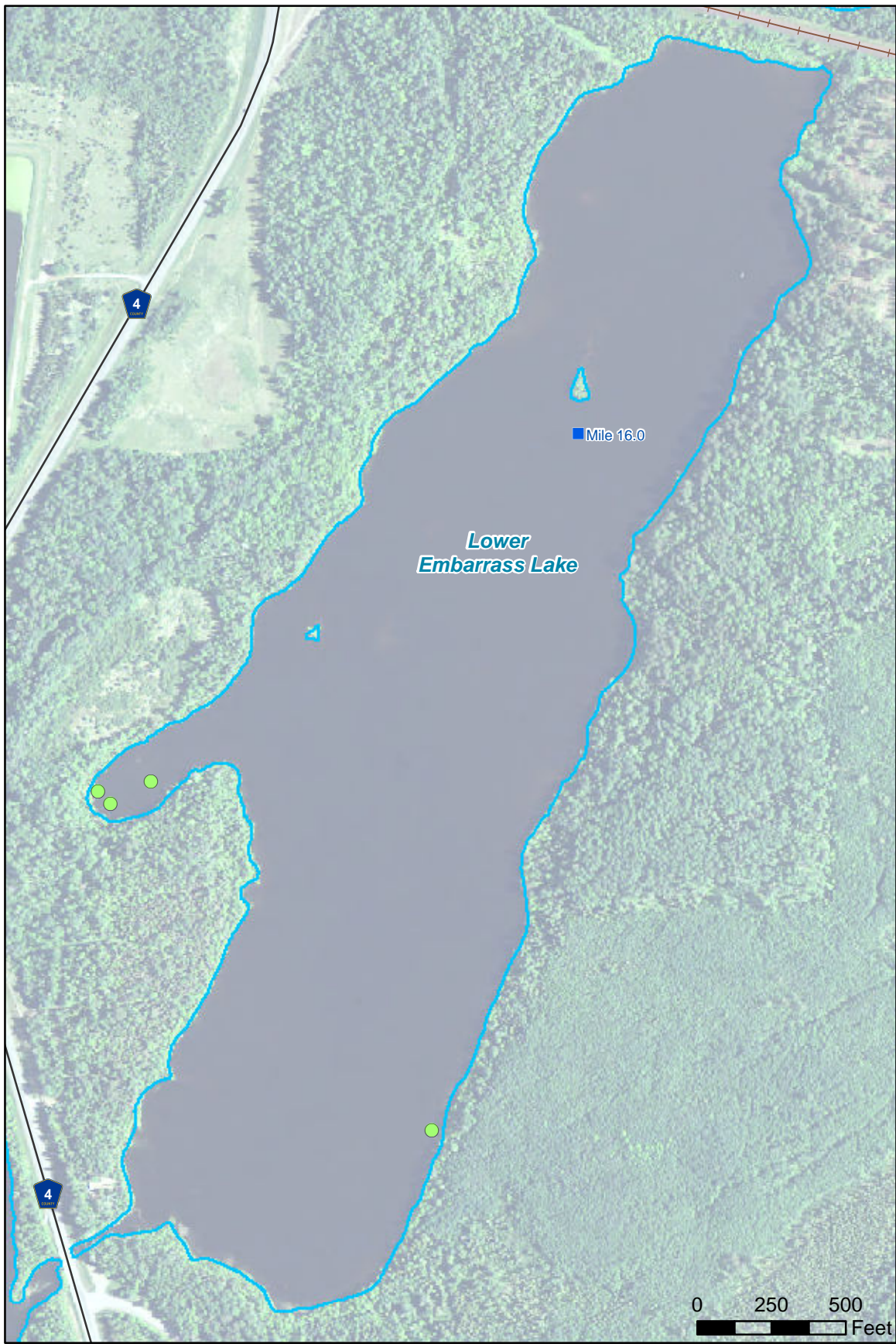
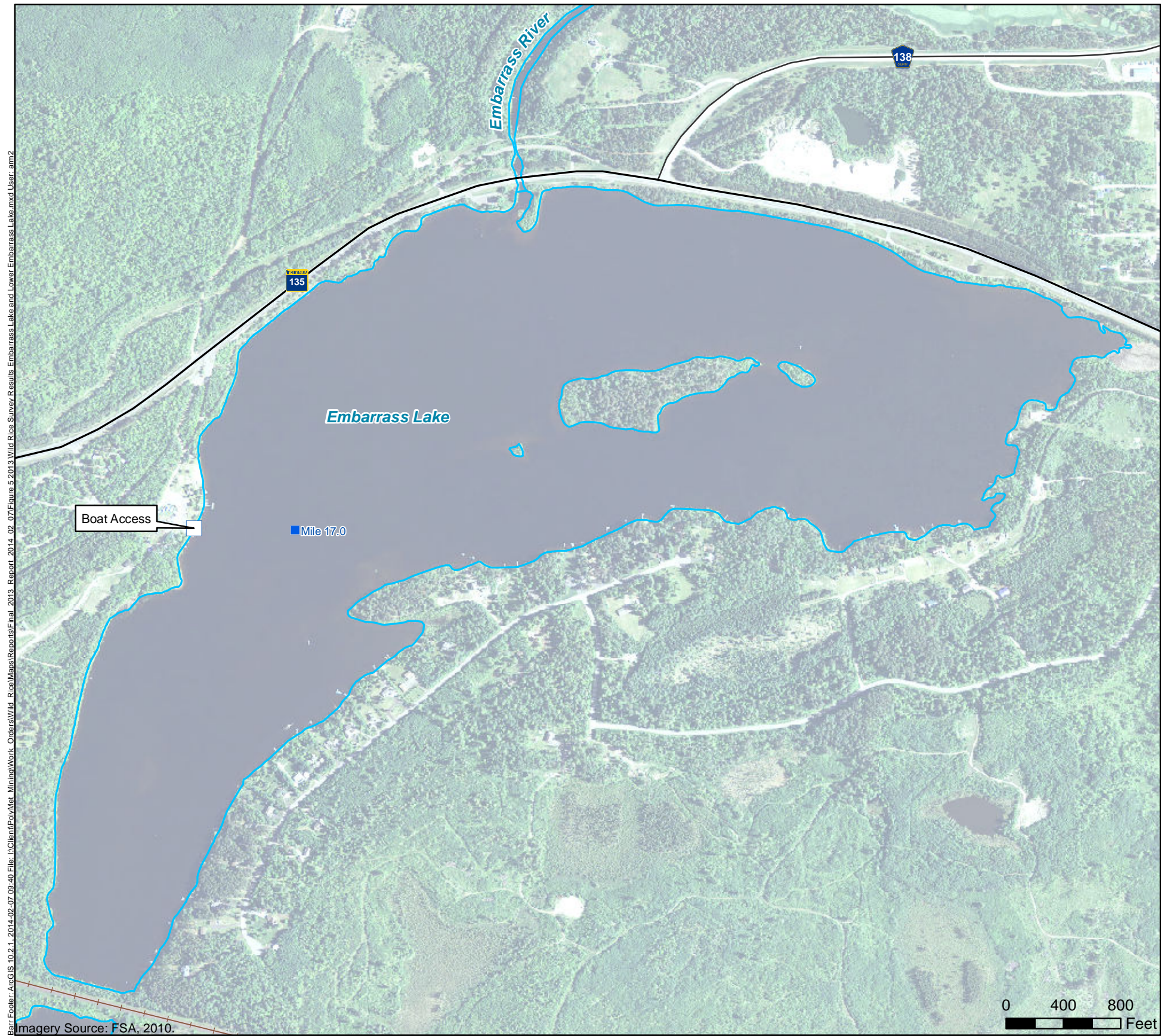
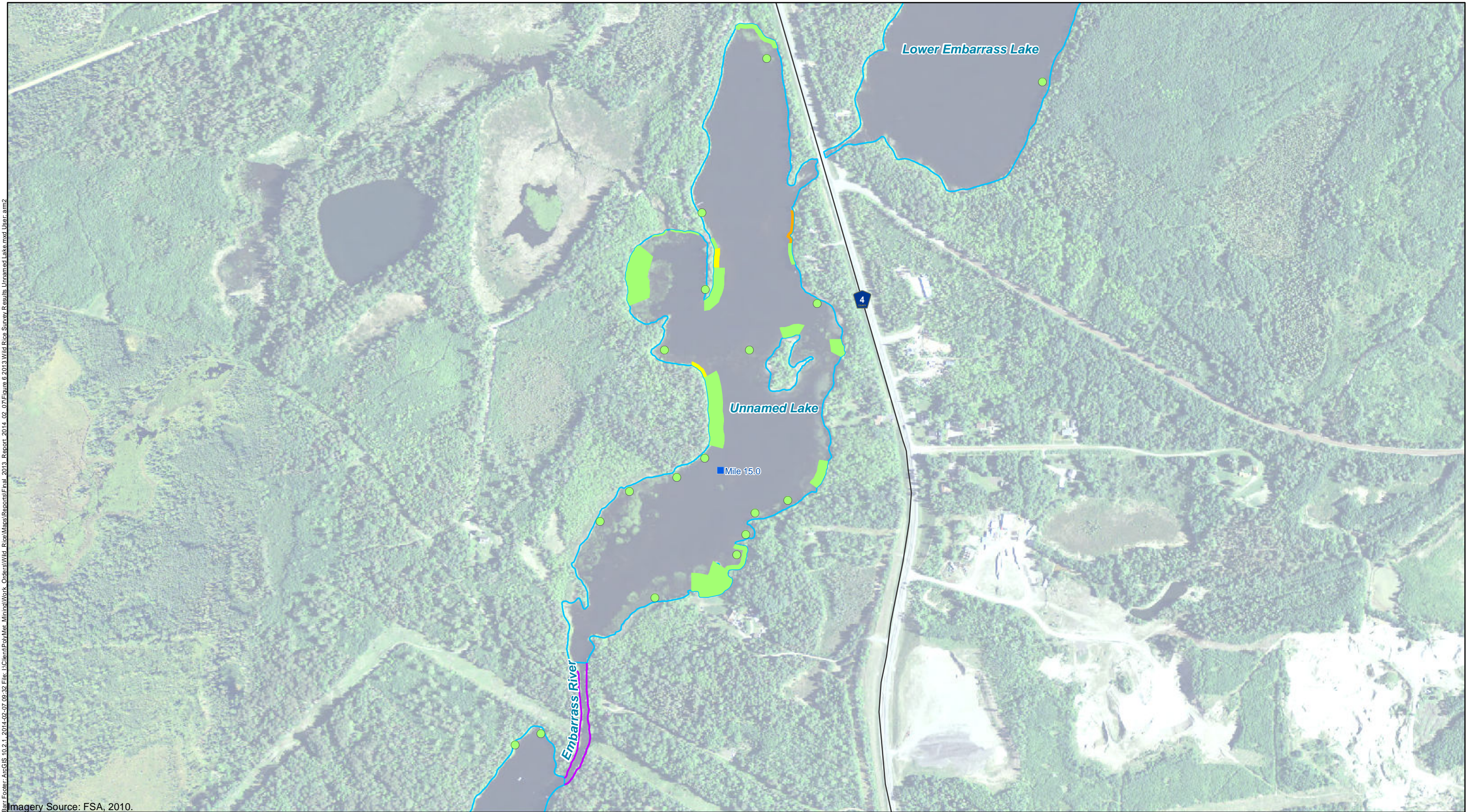


Figure 5
 2013 WILD RICE SURVEY RESULTS
 EMBARRASS LAKE AND
 LOWER EMBARRASS LAKE
 NorthMet Project
 Poly Met Mining, Inc.
 Hoyt Lakes, Minnesota



Imagery Source: FSA, 2010.

- | | | | | |
|------------------------|--------------------------------|--------------------------------|--------------------------------|--|
| ■ River Mile | Wild Rice Density Point | | Wild Rice Density Areas | |
| — 2013 Direct Survey | ● 1: <10% Wild Rice Coverage | ■ 1: <10% Wild Rice Coverage | ■ 2: 10-25% Wild Rice Coverage | |
| — 2013 Indirect Survey | ● 2: 10-25% Wild Rice Coverage | ■ 2: 10-25% Wild Rice Coverage | ■ 3: 25-50% Wild Rice Coverage | |
| | ● 3: 25-50% Wild Rice Coverage | ■ 3: 25-50% Wild Rice Coverage | ■ 4: 50-75% 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 | ■ 5: >75% Wild Rice Coverage | | |

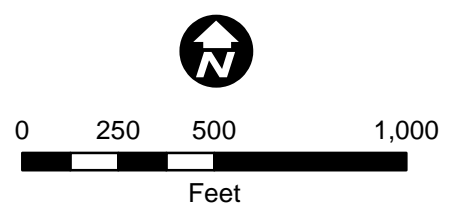
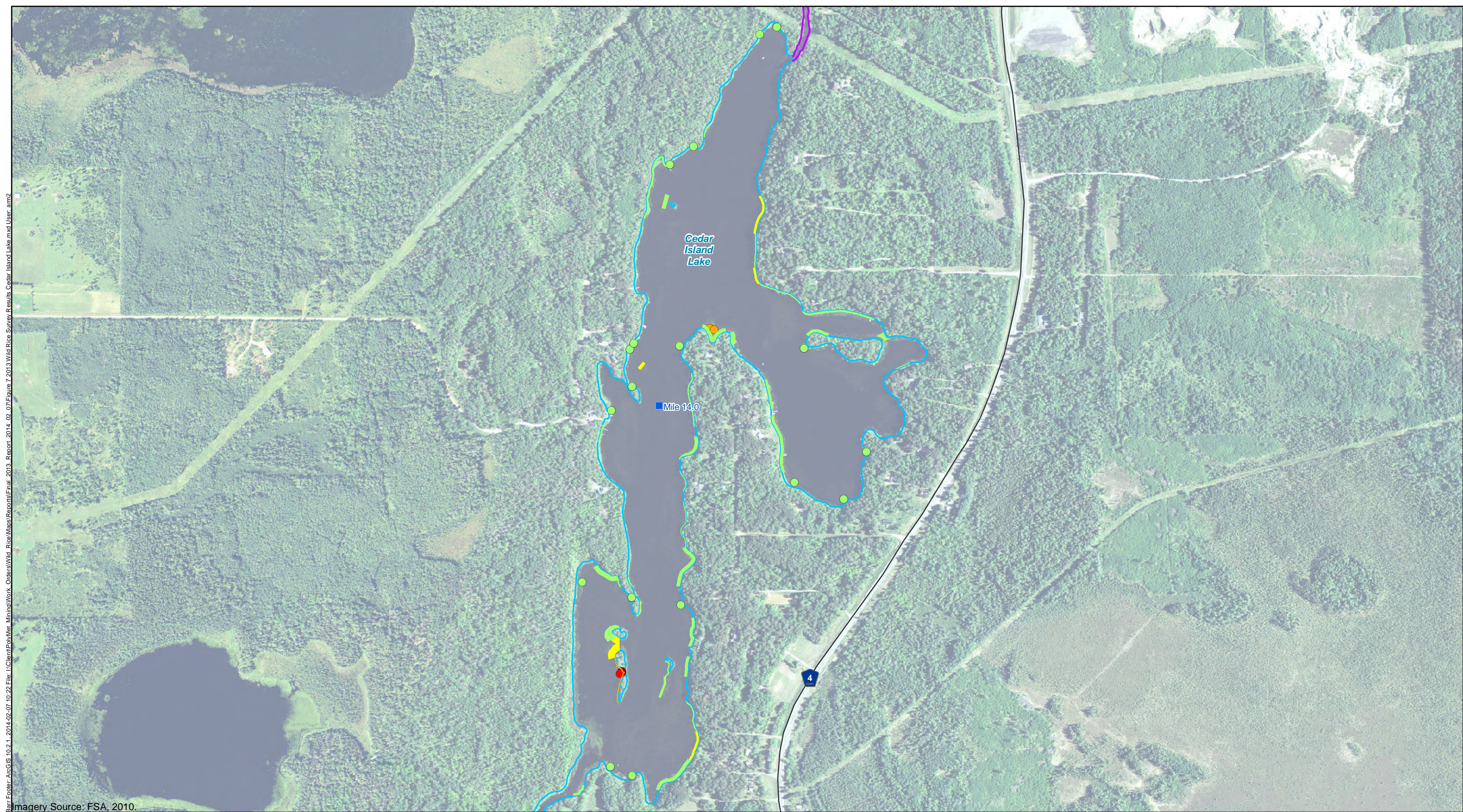


Figure 6
 2013 WILD RICE SURVEY RESULTS
 UNNAMED LAKE
 NorthMet Project
 Poly Met Mining, Inc.
 Hoyt Lakes, Minnesota



Imagery Source: FSA, 2010.

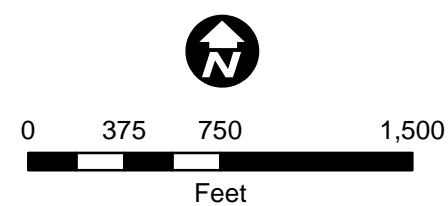
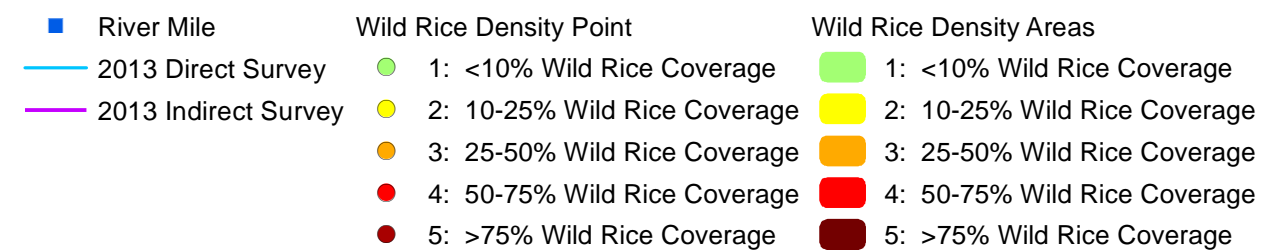
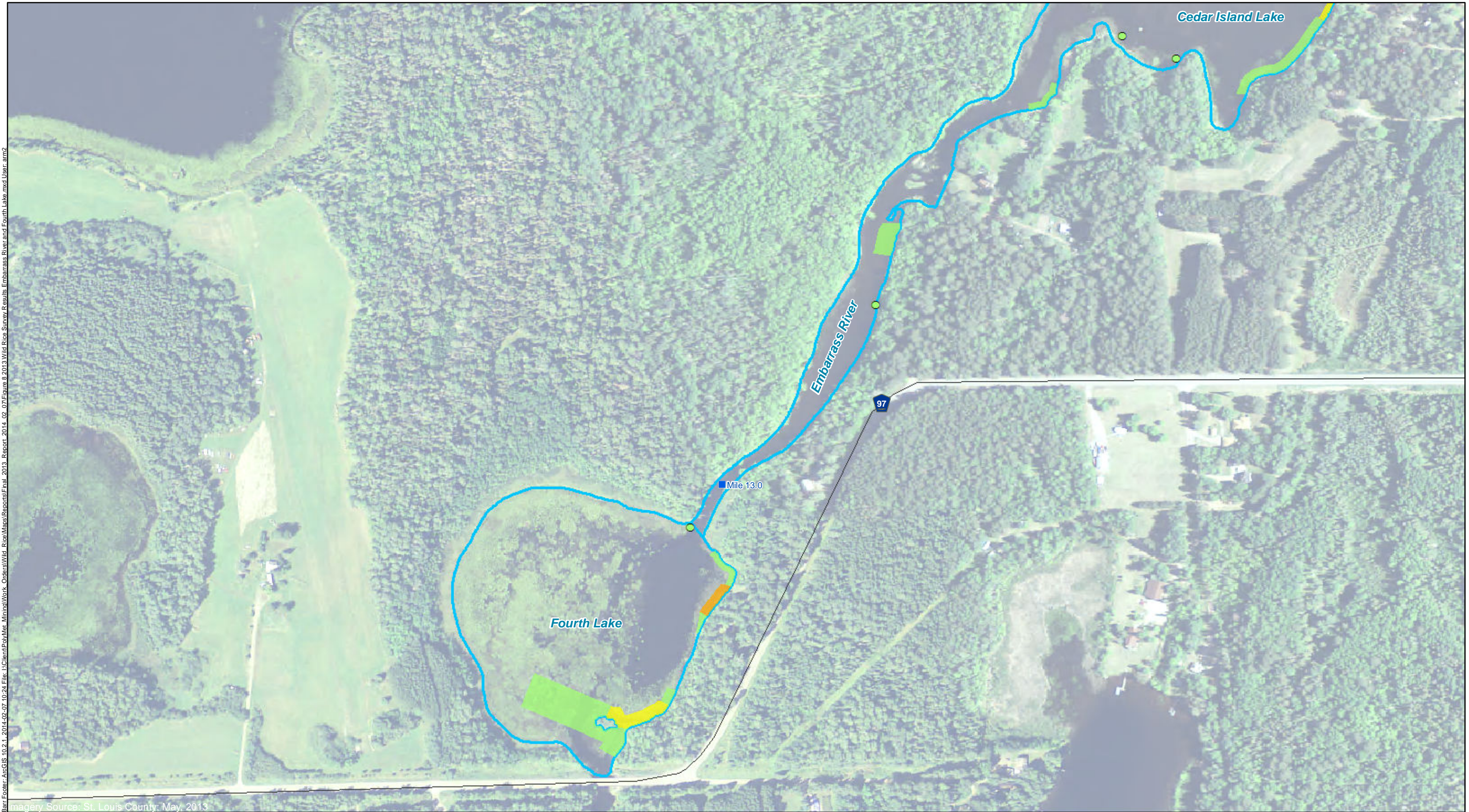


Figure 7
 2013 WILD RICE SURVEY RESULTS
 CEDAR ISLAND LAKE
 NorthMet Project
 Poly Met Mining, Inc.
 Hoyt Lakes, Minnesota



Bar Footer: ArcGIS 10.2.1, 2014-02-07 10:24 File: I:\Client\PolyMet_Mining\Work_Orders\Wild_Rice\Map\Reports\Final_2013_Report_2014_02_07\Figure 8 2013 Wild Rice Survey Results Embarrass River and Fourth Lake.mxd User: am2

imagery Source: St. Louis County, May, 2013

- | | | |
|------------------------|--------------------------------|--------------------------------|
| ■ River Mile | Wild Rice Density Point | Wild Rice Density Area |
| — 2013 Direct Survey | ● 1: <10% Wild Rice Coverage | ■ 1: <10% Wild Rice Coverage |
| — 2013 Indirect Survey | ● 2: 10-25% Wild Rice Coverage | ■ 2: 10-25% Wild Rice Coverage |
| | ● 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 |

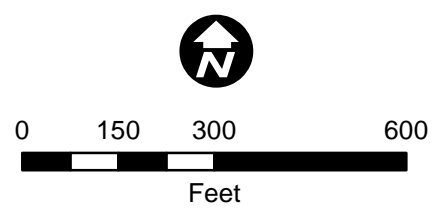
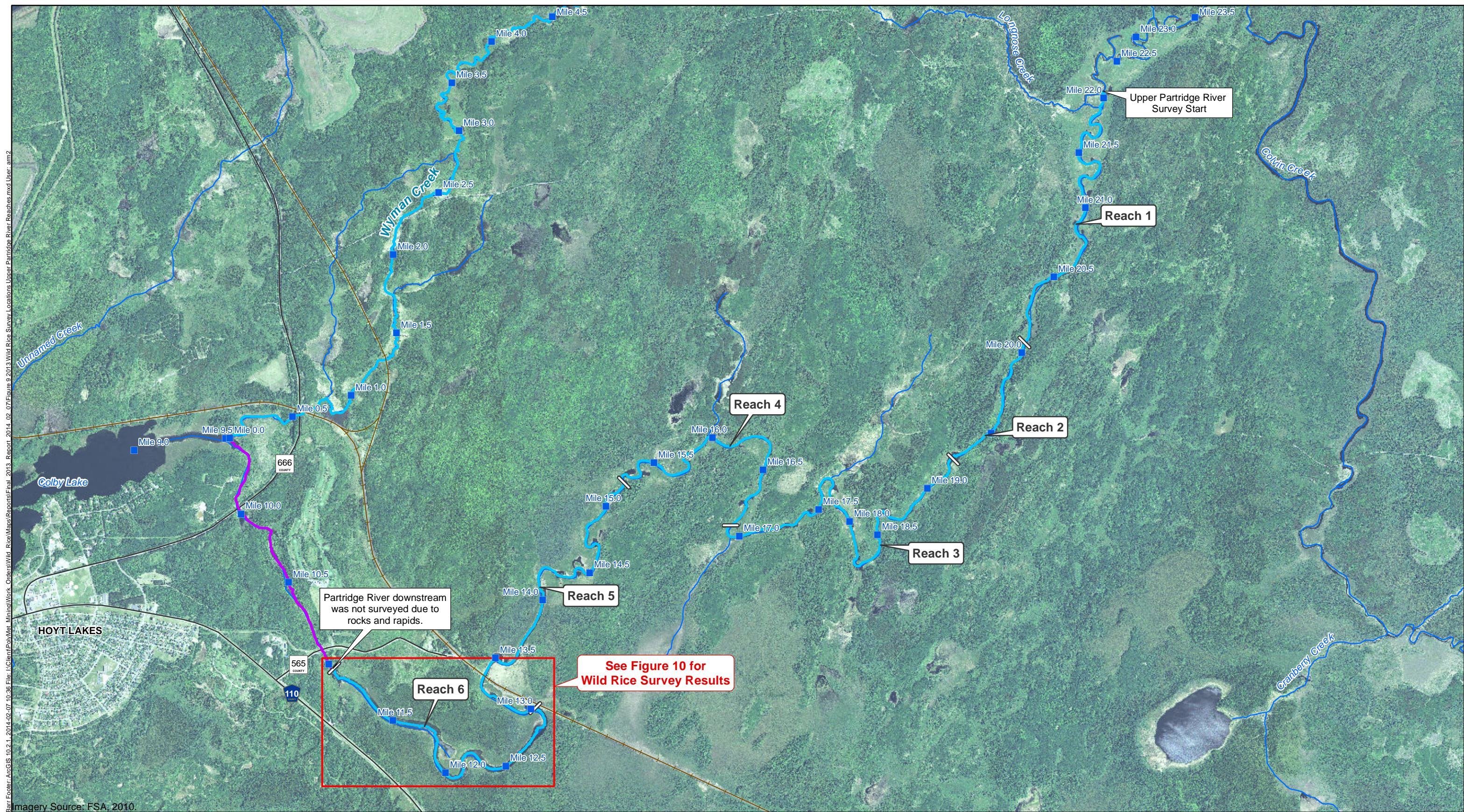


Figure 8
2013 WILD RICE SURVEY RESULTS
EMBARRASS RIVER AND FOURTH LAKE
NorthMet Project
Poly Met Mining, Inc.
Hoyt Lakes, Minnesota



Bar Footer: ArcGIS 10.2.1, 2014-02-07 10:36 File: I:\Client\PolyMet_Mining\Work_Orders\Wild_Rice\Map_Reports\Final_Rice_Maps\Reports\Final_Rice_Maps\Upper Partridge River Reaches.mxd User: am2

imagery Source: FSA, 2010.

- River Mile
- Reach Divisions
- 2013 Direct Survey
- 2013 Indirect Survey
- National Hydrography Dataset
- Rivers and Streams

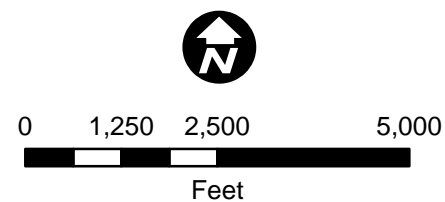


Figure 9
2013 WILD RICE SURVEY LOCATIONS
UPPER PARTRIDGE RIVER (REACHES 1-6)
NorthMet Project
Poly Met Mining, Inc.
Hoyt Lakes, Minnesota



Barr Footer: ArcGIS 10.2.1, 2014-02-07 10:37 File: I:\Client\Polymet_Mining\Work_Orders\Wild_Rice\Map\Reports\Final_2013_Report_2014_02_07\Figure 10 2013 Wild Rice Survey Results Upper Partridge River.mxd User: am2

- | | | |
|--|---|---|
| <ul style="list-style-type: none"> ■ River Mile Reach Division — 2013 Direct Survey — 2013 Indirect Survey | Wild Rice Density Point <ul style="list-style-type: none"> ● 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 <ul style="list-style-type: none"> 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 |
|--|---|---|

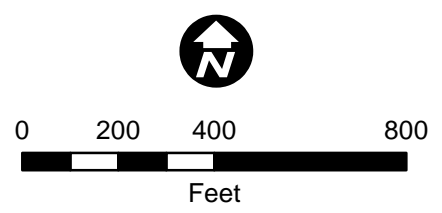


Figure 10
 2013 WILD RICE SURVEY RESULTS
 UPPER PARTRIDGE RIVER (Reach 6)
 NorthMet Project
 Poly Met Mining, Inc.
 Hoyt Lakes, Minnesota

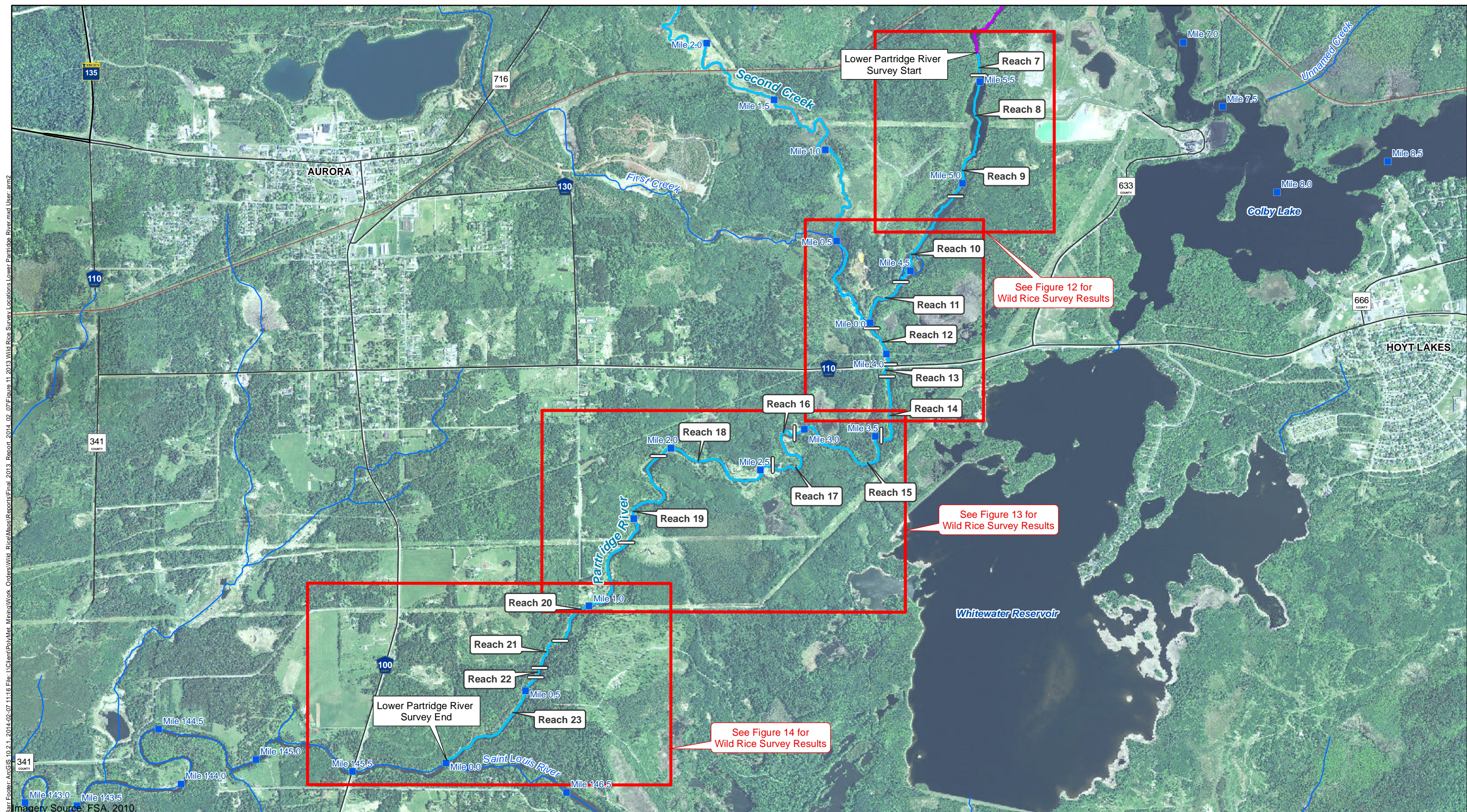


Figure 11
 2013 WILD RICE SURVEY LOCATIONS
 LOWER PARTRIDGE RIVER (REACHES 7-23)
 NorthMet Project
 Poly Met Mining, Inc.
 Hoyt Lakes, Minnesota

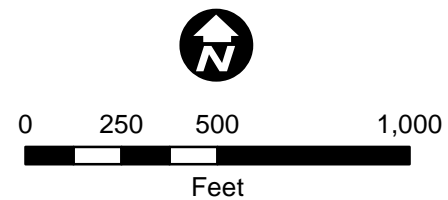
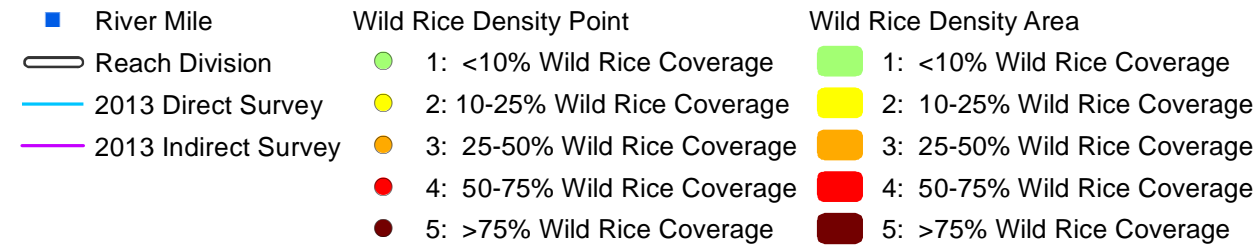
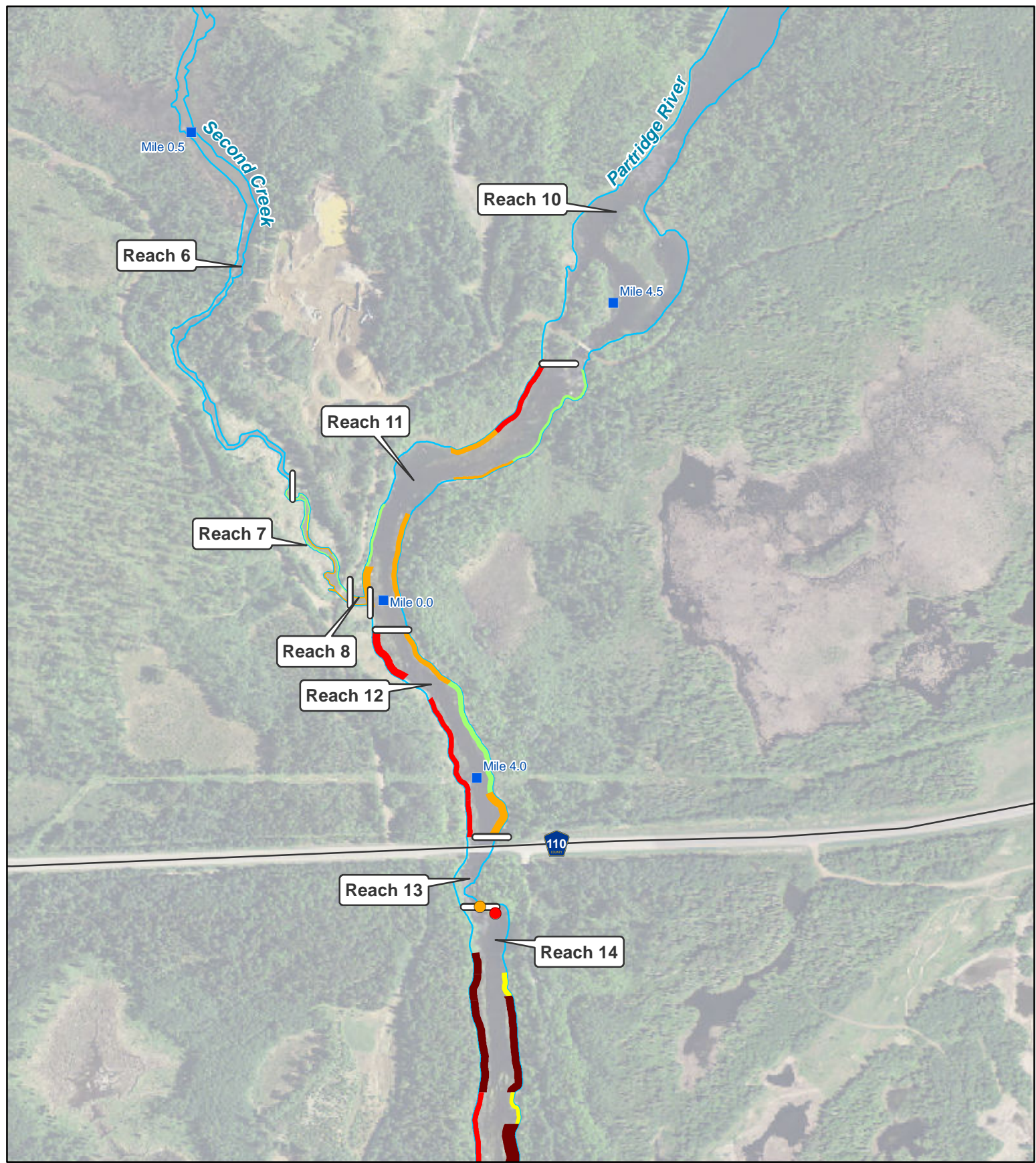
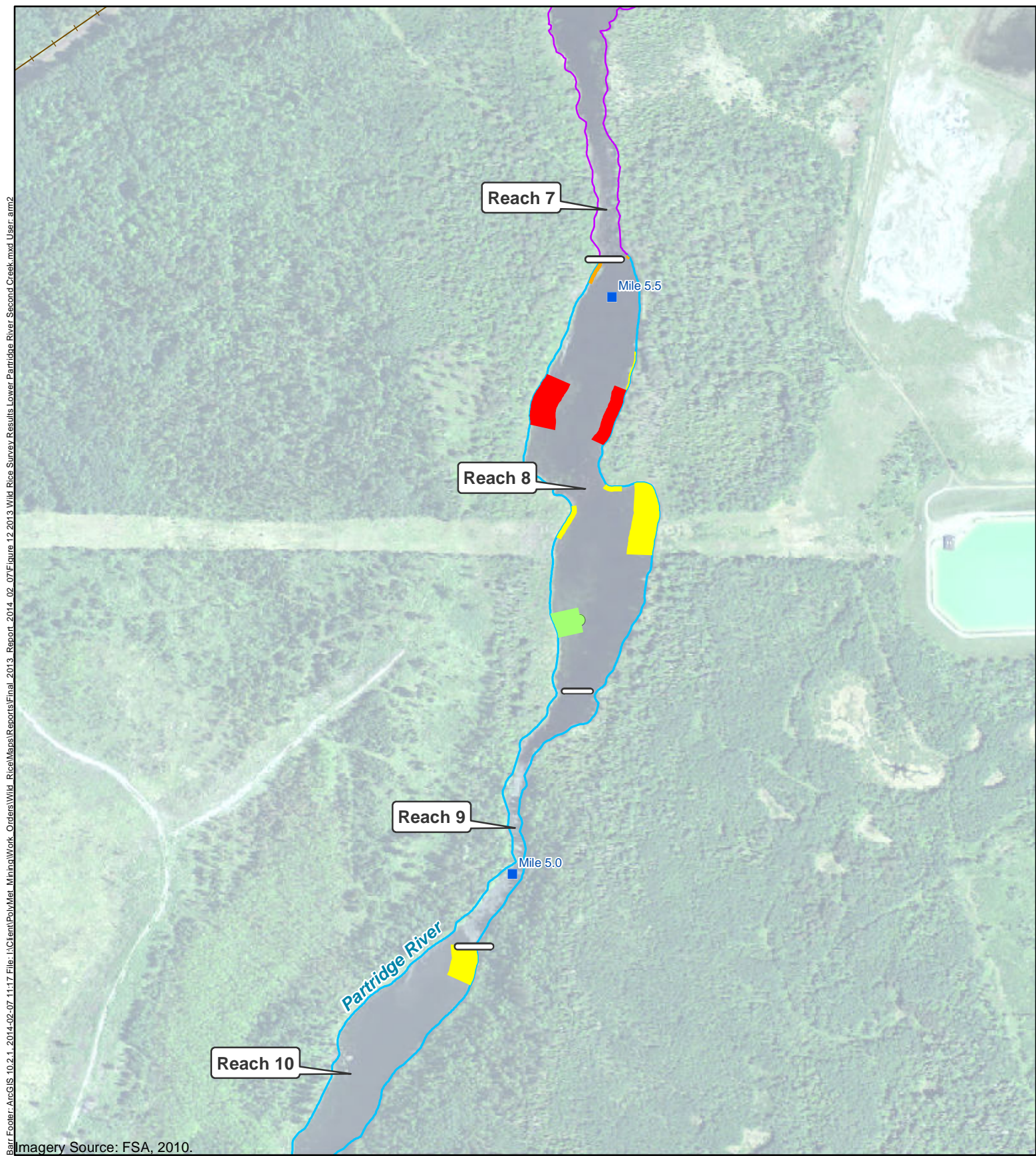
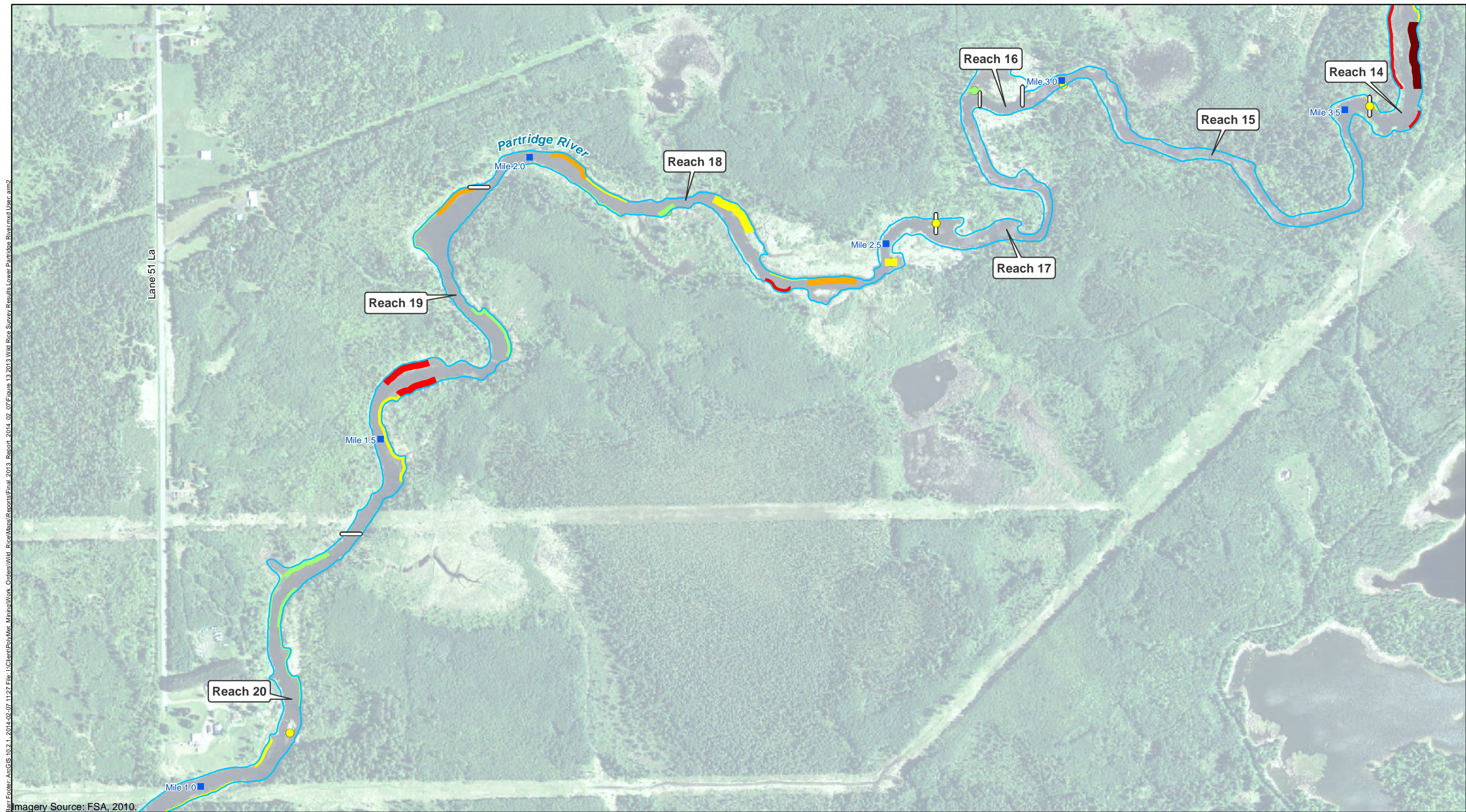


Figure 12
 2013 WILD RICE SURVEY RESULTS
 LOWER PARTRIDGE RIVER (REACHES 8-14)
 AND SECOND CREEK (REACHES 6-8)
 NorthMet Project
 Poly Met Mining, Inc.
 Hoyt Lakes, Minnesota

Bar Footer: ArcGIS 10.2.1, 2014-02-07 11:27 File: I:\Client\PolyMet_Mining\Work_Orders\Wild_Rice\Maps\Reports\Final_2013_Report_2014_02_07\Figure 13 2013 Wild Rice Survey Results Lower Partridge River.mxd User: am2



Imagery Source: FSA, 2010.

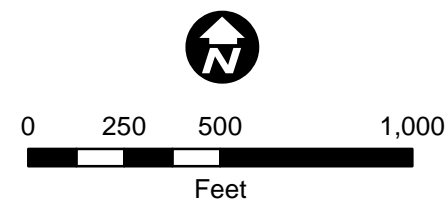
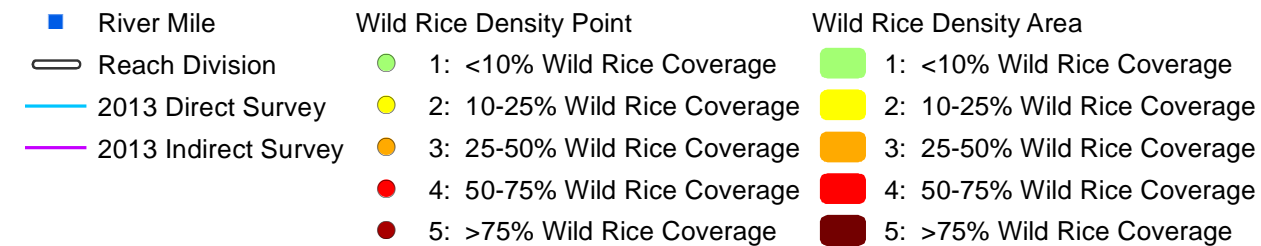
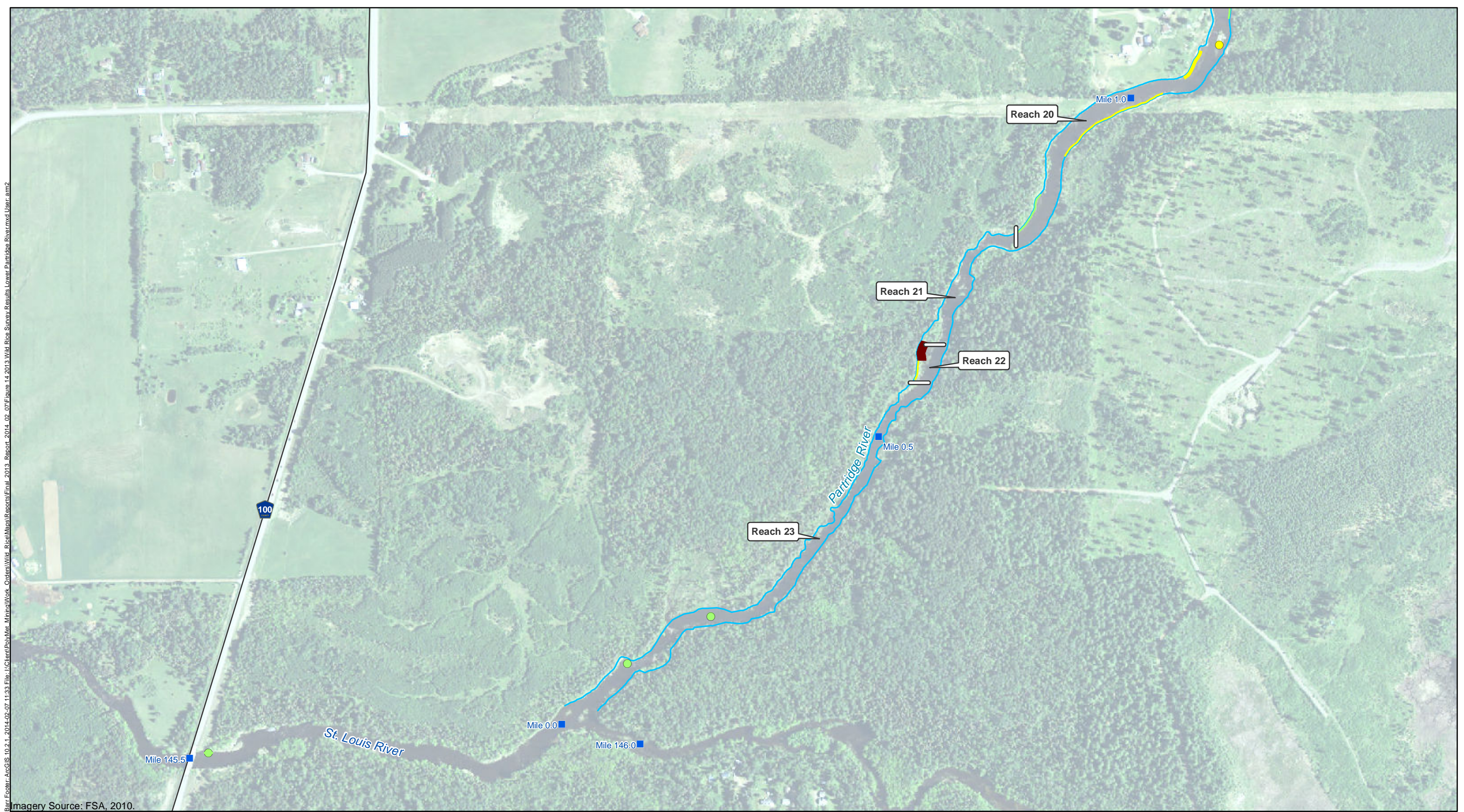


Figure 13
2013 WILD RICE SURVEY RESULTS
LOWER PARTRIDGE RIVER (REACHES 14-20)
NorthMet Project
Poly Met Mining, Inc.
Hoyt Lakes, Minnesota



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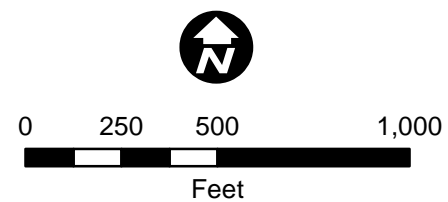
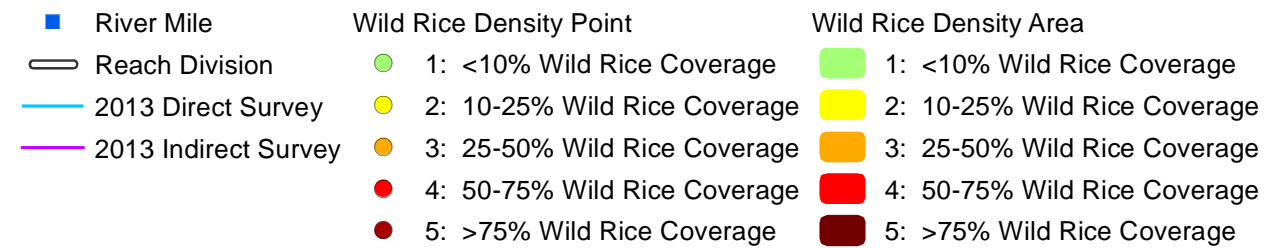
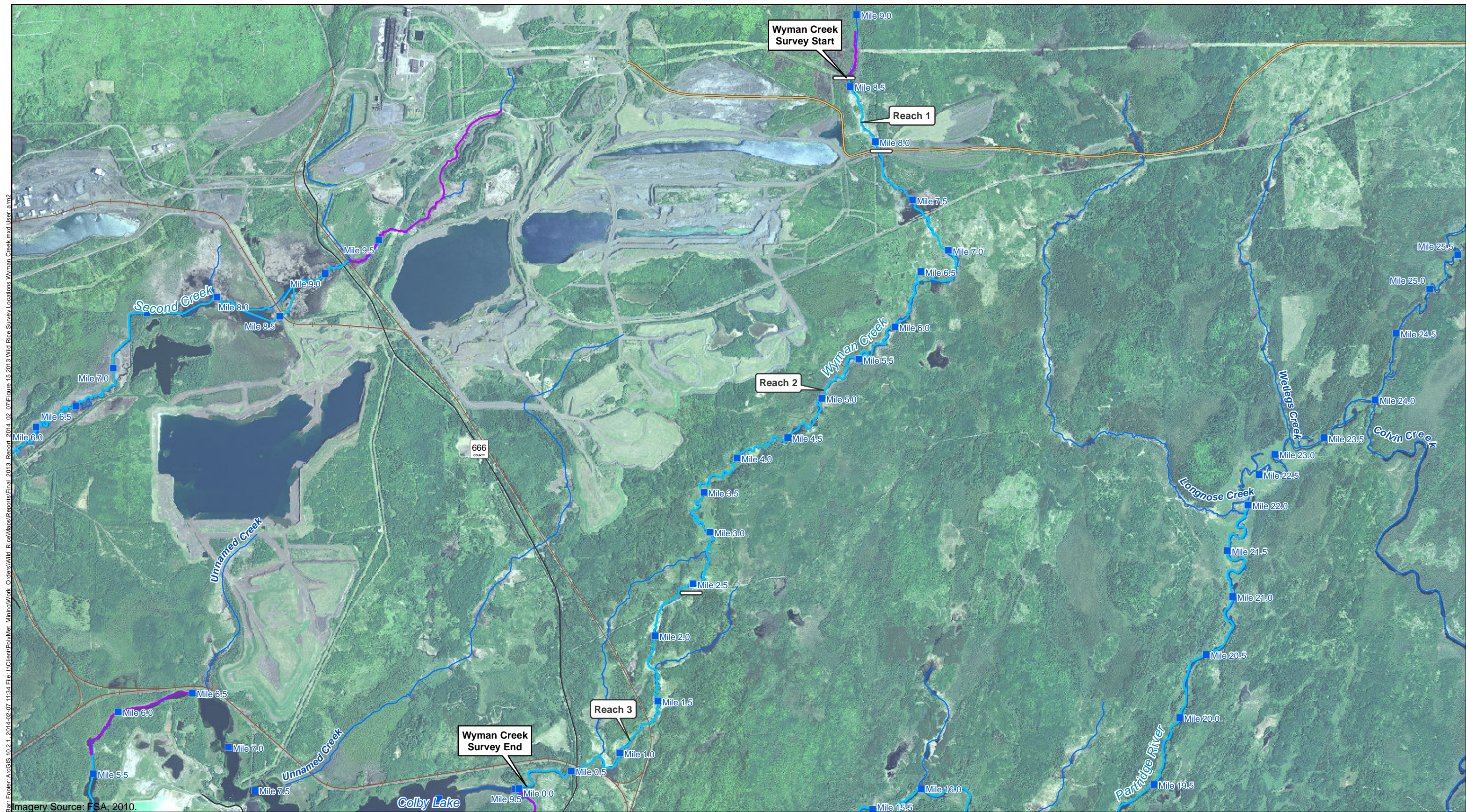


Figure 14
 2013 WILD RICE SURVEY RESULTS
 LOWER PARTRIDGE RIVER (REACHES 20-23)
 NorthMet Project
 Poly Met Mining, Inc.
 Hoyt Lakes, Minnesota



- River Mile
- Dunka Road
- Reach Divisions
- 2013 Direct Survey
- 2013 Indirect Survey
- National Hydrography Dataset
- Rivers and Streams

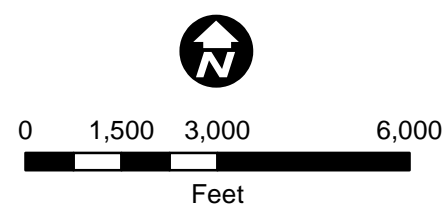
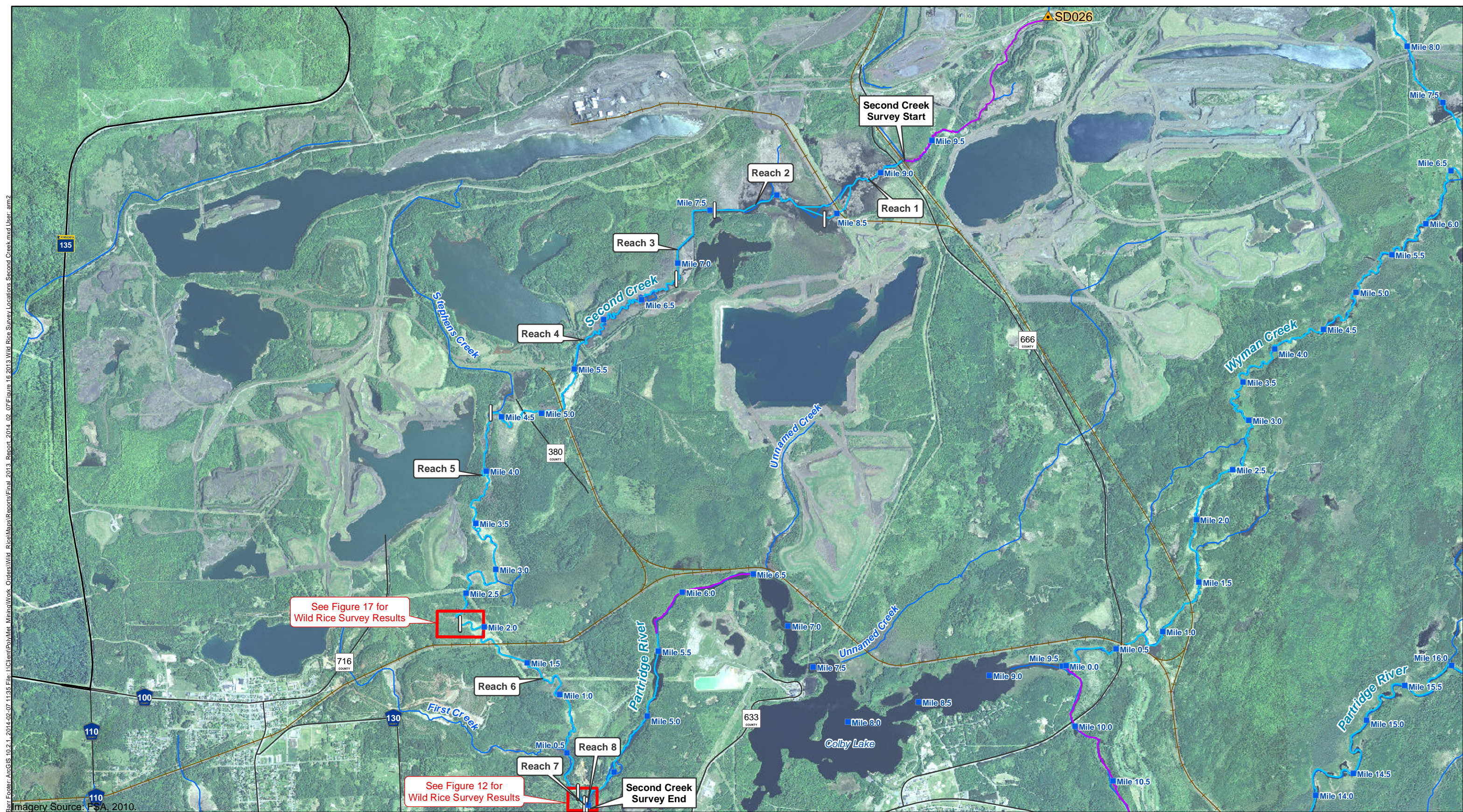


Figure 15
2013 WILD RICE SURVEY LOCATIONS
WYMAN CREEK (REACHES 1-3)
NorthMet Project
Poly Met Mining, Inc.
Hoyt Lakes, Minnesota



- ▲ Existing Surface Discharge SD026 National Hydrography Dataset
- River Mile
- Reach Division
- 2013 Direct Survey
- 2013 Indirect Survey
- Rivers and Streams

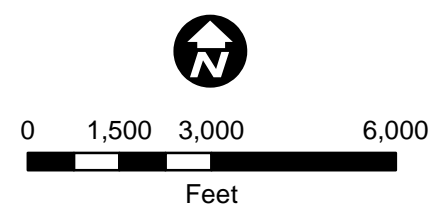
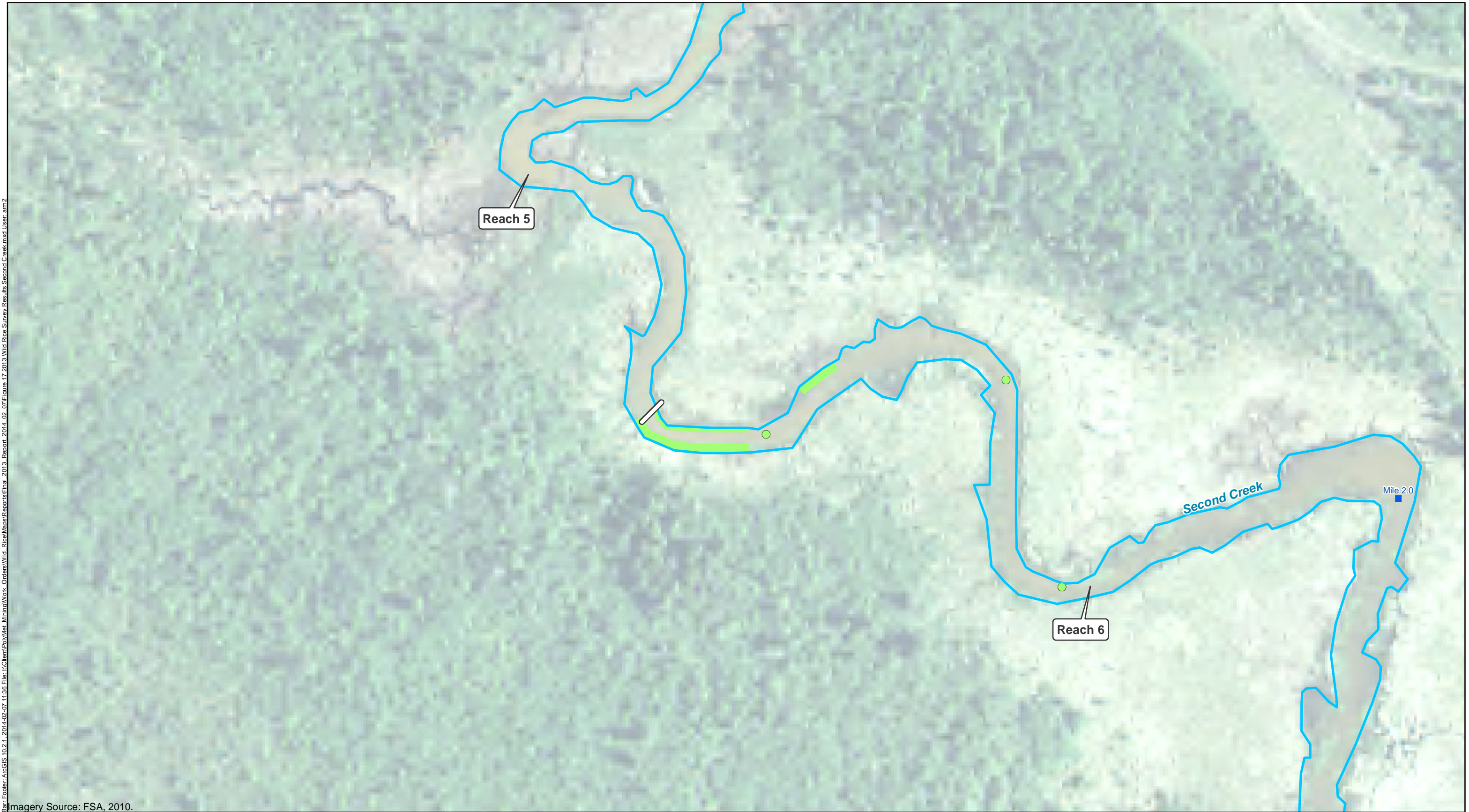


Figure 16
2013 WILD RICE SURVEY LOCATIONS
SECOND CREEK (REACHES 1-8)
NorthMet Project
Poly Met Mining, Inc.
Hoyt Lakes, Minnesota

\\bar\Footer: ArcGIS 10.2.1, 2014-02-07 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.



- | | | |
|------------------------|--------------------------------|--------------------------------|
| ■ River Mile | Wild Rice Density Point | Wild Rice Density Area |
| — Reach Division | ● 1: <10% Wild Rice Coverage | ■ 1: <10% Wild Rice Coverage |
| — 2013 Direct Survey | ● 2: 10-25% Wild Rice Coverage | ■ 2: 10-25% Wild Rice Coverage |
| — 2013 Indirect Survey | ● 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 |

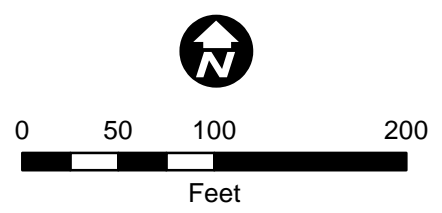
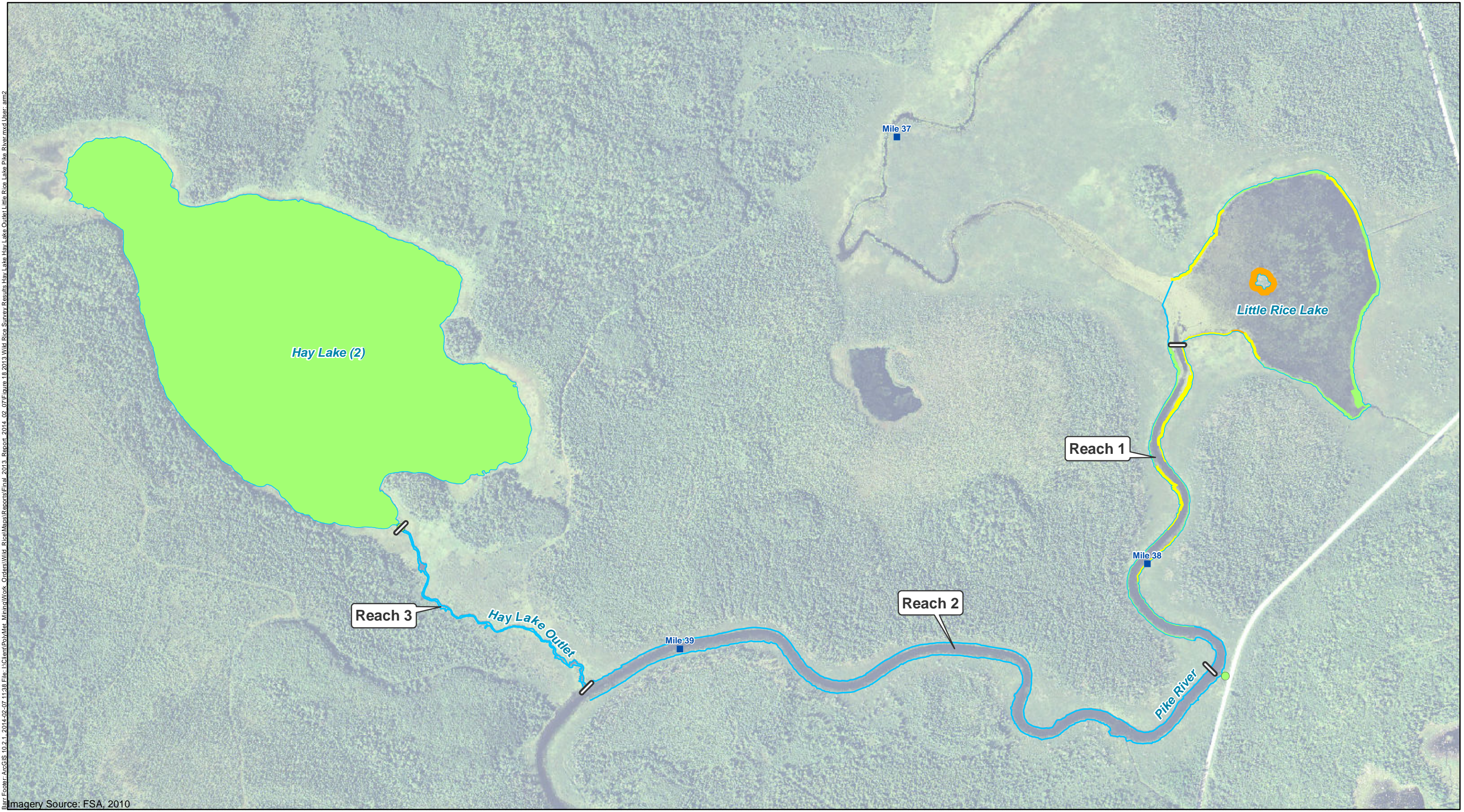


Figure 17
2013 WILD RICE SURVEY RESULTS
SECOND CREEK (Reach 6)
NorthMet Project
Poly Met Mining, Inc.
Hoyt Lakes, Minnesota

Bar Footer: ArcGIS 10.2.1, 2014-02-07 11:38 File: I:\Client\PolyMet_Mining\Work_Orders\Wild_Rice\Maps\Reports\Final_2013_Report_2014_02_07\Figure 18 2013 Wild Rice Survey Results Hay Lake Hay Lake Outlet Little Rice Lake Pike River.mxd User: am2



Imagery Source: FSA, 2010

■ River Mile	Wild Rice Density Point	Wild Rice Density Area
⎓ Reach Divisions	● 1: <10% Wild Rice Coverage	■ 1: <10% Wild Rice Coverage
— 2013 Direct Survey	● 2: 10-25% Wild Rice Coverage	■ 2: 10-25% Wild Rice Coverage
— 2013 Indirect Survey	● 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

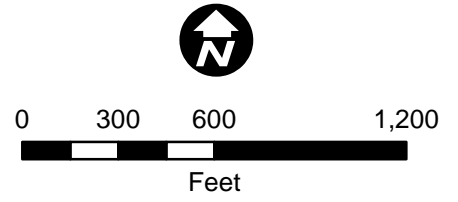


Figure 18
2013 WILD RICE SURVEY RESULTS
LITTLE RICE LAKE, THE PIKE RIVER, AND HAY LAKE 2
NorthMet Project
Poly Met Mining, Inc.
Hoyt Lakes, Minnesota

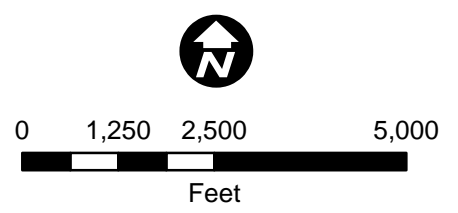
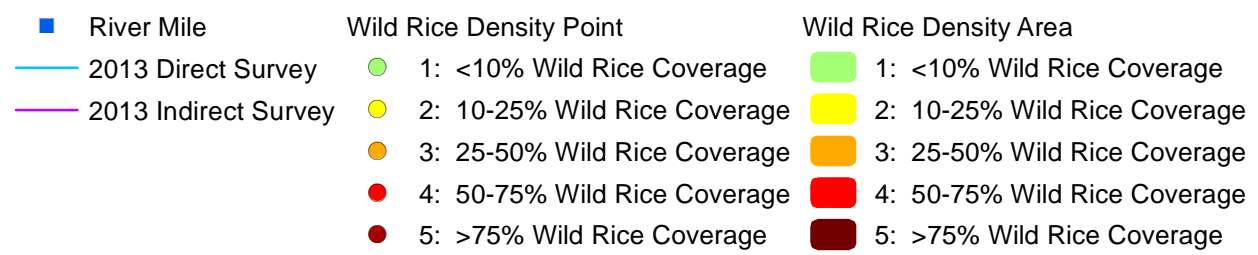
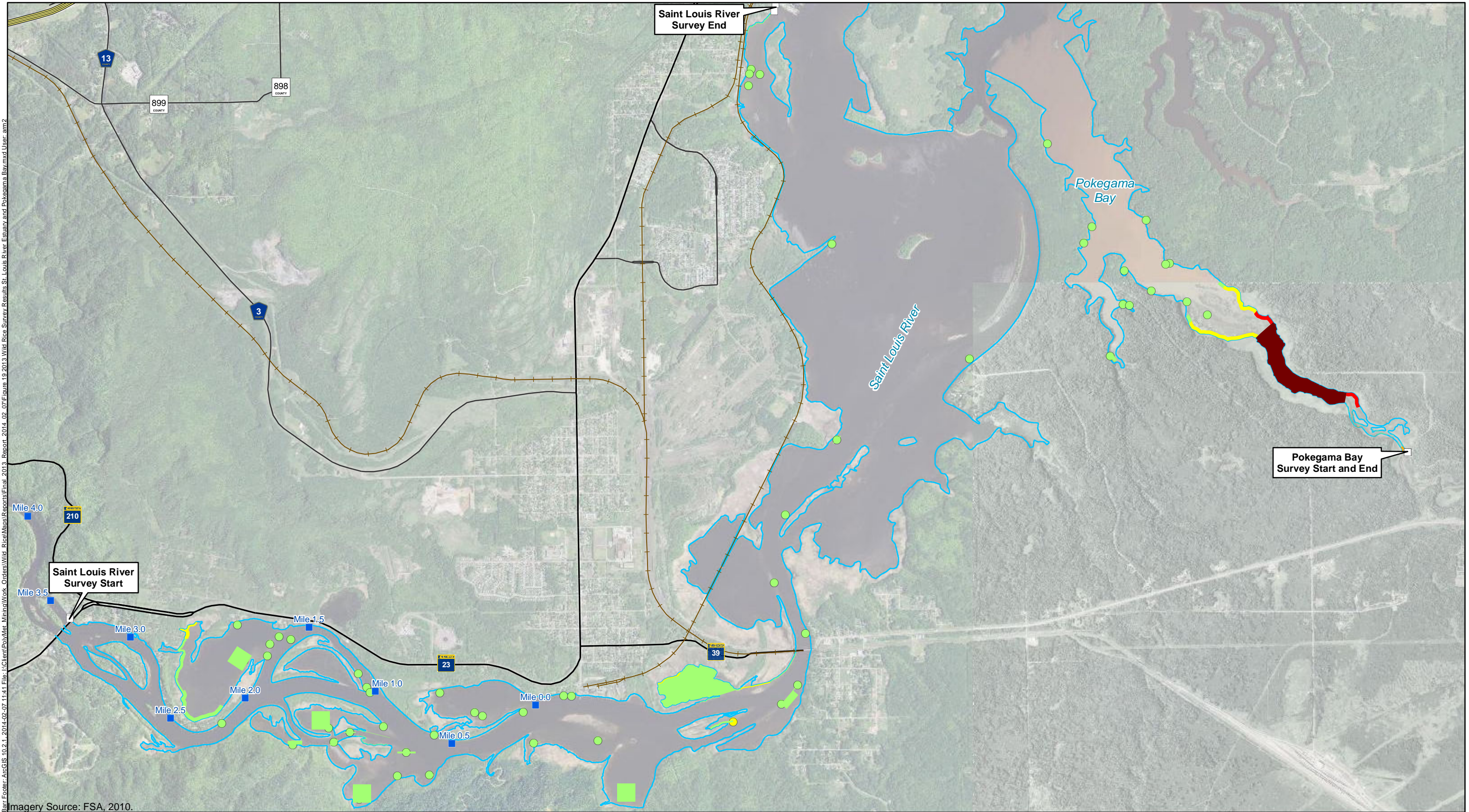
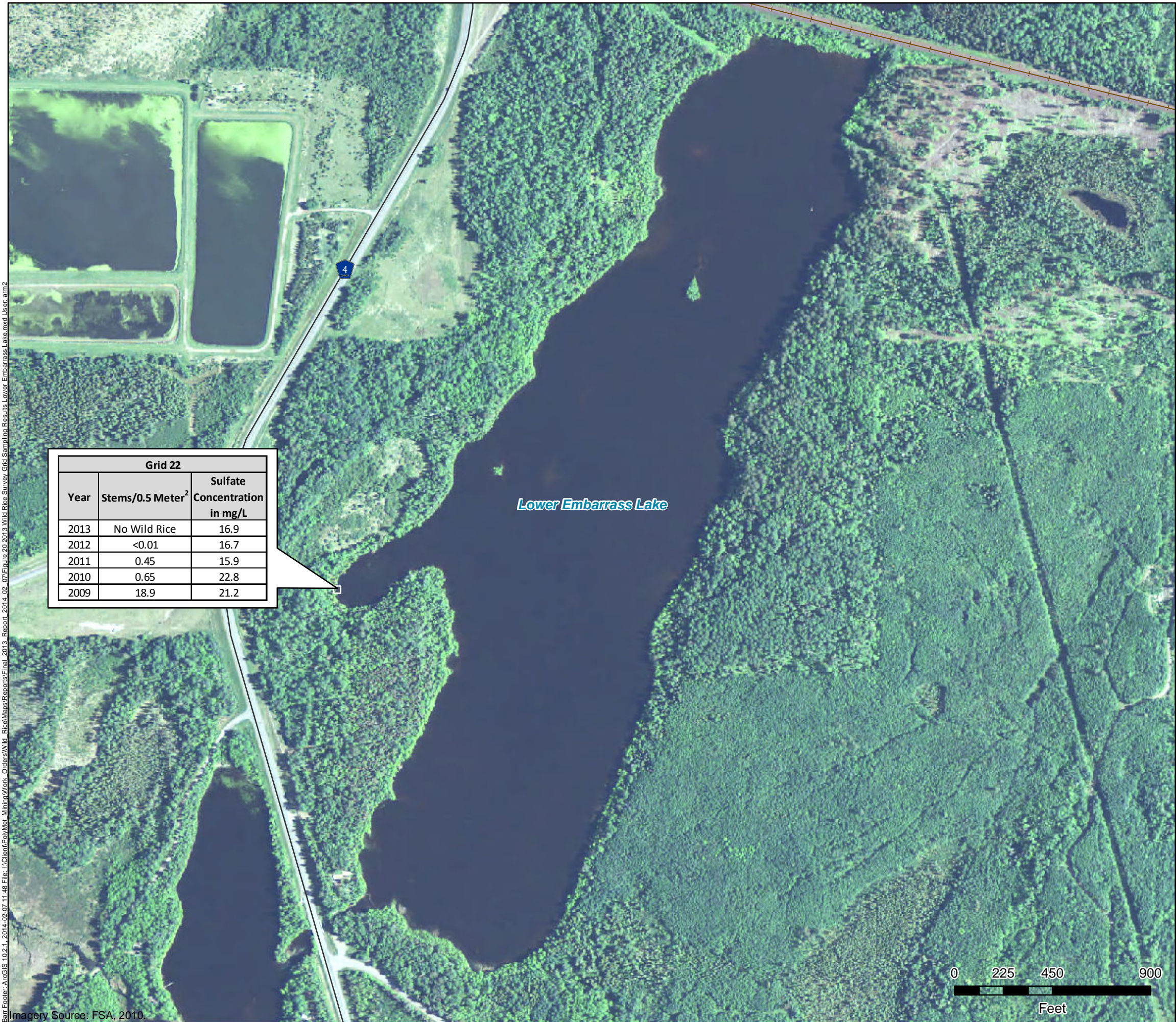


Figure 19
 2013 WILD RICE SURVEY RESULTS
 SAINT LOUIS RIVER AND POKEGAMA BAY
 NorthMet Project
 Poly Met Mining, Inc.
 Hoyt Lakes, Minnesota

Bair Footer: ArcGIS 10.2.1, 2014-02-07 11:48 File: I:\Client\PolyMet Mining\Work Orders\Wild Rice\Maps\Reports\Final_2013_Report_2014-02-07\Figure 20 2013 Wild Rice Survey Grid Sampling Results Lower Embarrass Lake.mxd User: am2



Grid 22		
Year	Stems/0.5 Meter ²	Sulfate Concentration in mg/L
2013	No Wild Rice	16.9
2012	<0.01	16.7
2011	0.45	15.9
2010	0.65	22.8
2009	18.9	21.2

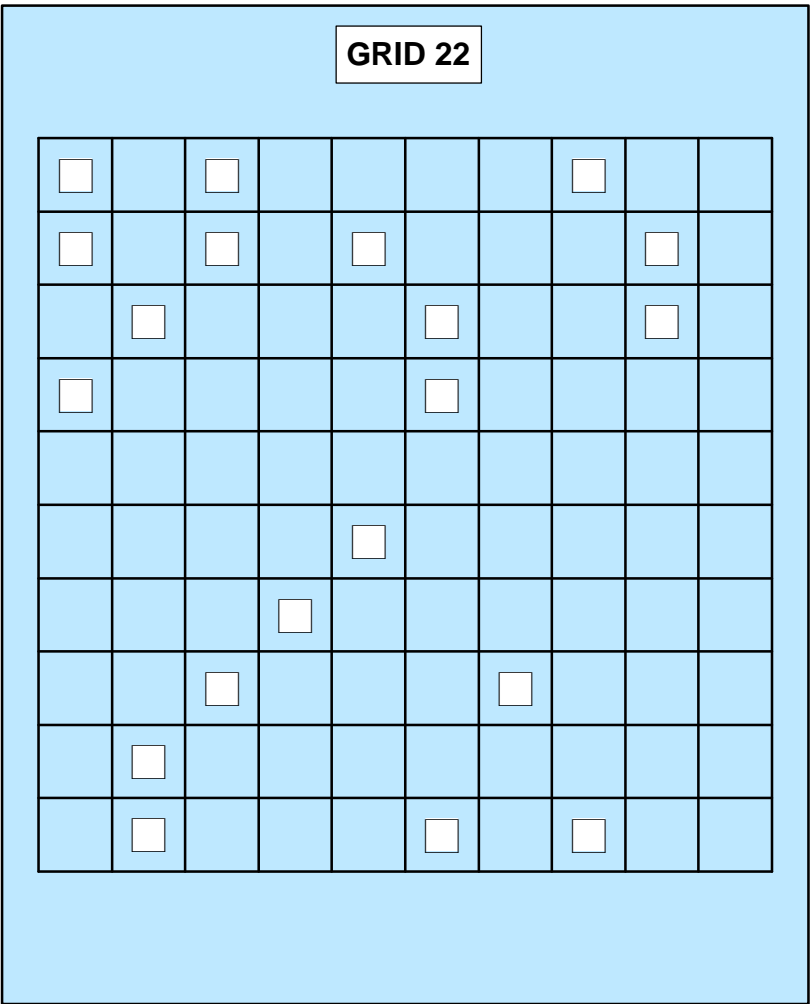

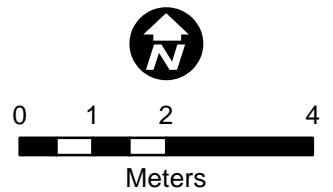


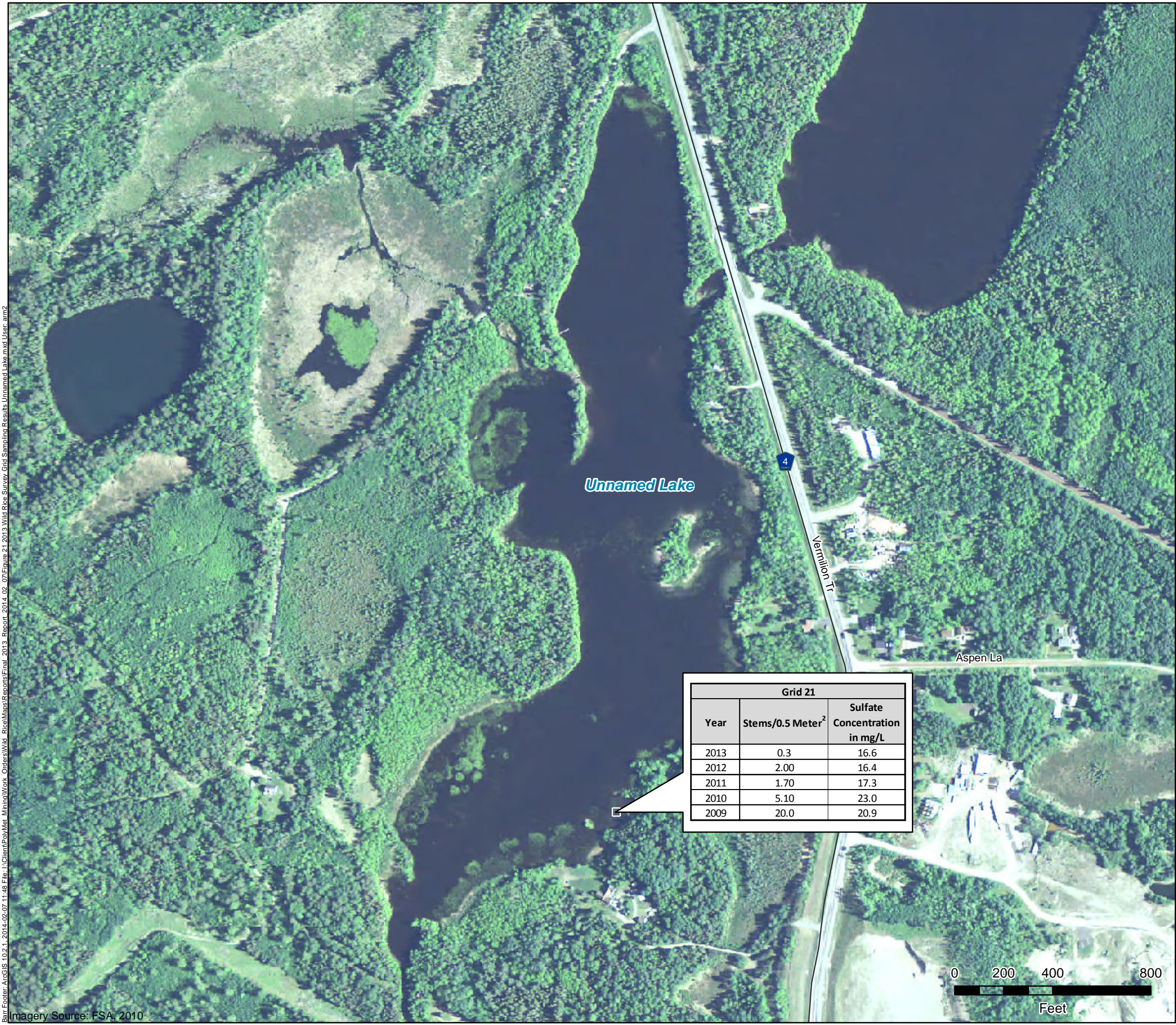
Figure 20
2013 WILD RICE SURVEY
GRID SAMPLING RESULTS
LOWER EMBARRASS LAKE
(EMBARRASS RIVER)
NorthMet Project
Poly Met Mining, Inc.
Hoyt Lakes, Minnesota

Stem Count/0.5m²

 0

—— 10x10 Meter Grid





Bair Footer: ArcGIS 10.2.1, 2014-02-07 11:48 File: I:\Client\PolyMet_Mining\Work_Orders\Wild_Rice\Maps\Reports\Final_2013_Report_2014_02_07\Figure 21 Wild Rice Survey Grid Sampling Results Unnamed Lake.mxd User: am2 Imagery Source: FSA, 2010

Grid 21		
Year	Stems/0.5 Meter ²	Sulfate Concentration in mg/L
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

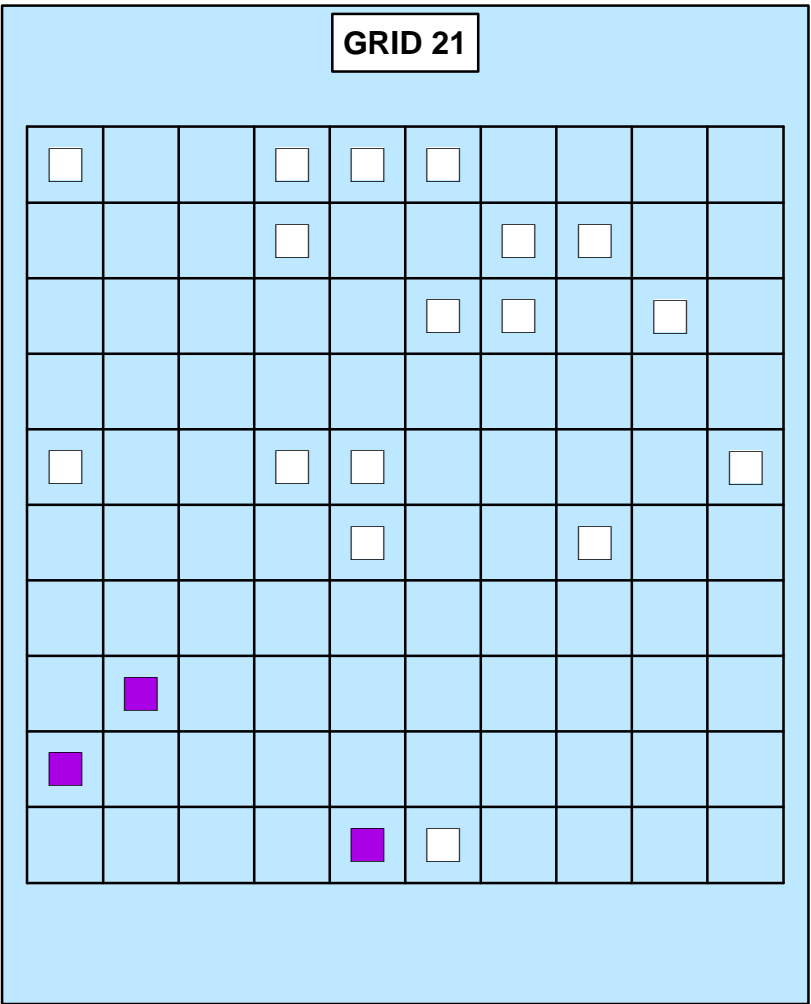
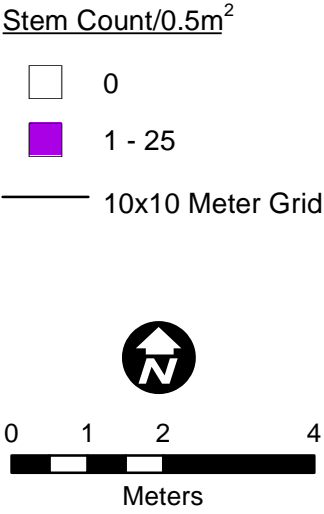
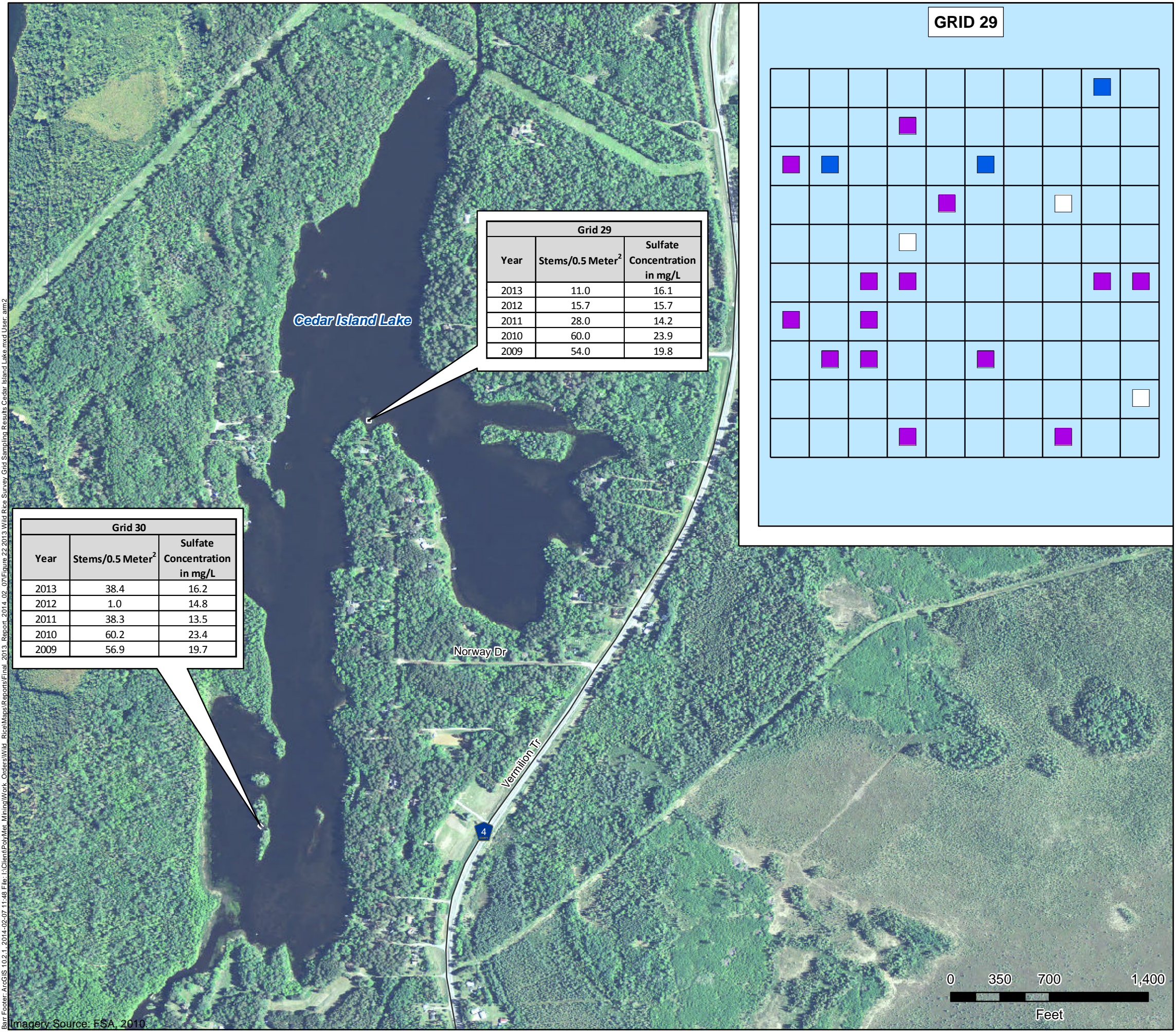


Figure 21
2013 WILD RICE SURVEY
GRID SAMPLING RESULTS
UNNAMED LAKE
(EMBARRASS RIVER)
NorthMet Project
Poly Met Mining, Inc.
Hoyt Lakes, Minnesota





Grid 29		
Year	Stems/0.5 Meter ²	Sulfate Concentration in mg/L
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 ²	Sulfate Concentration in mg/L
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

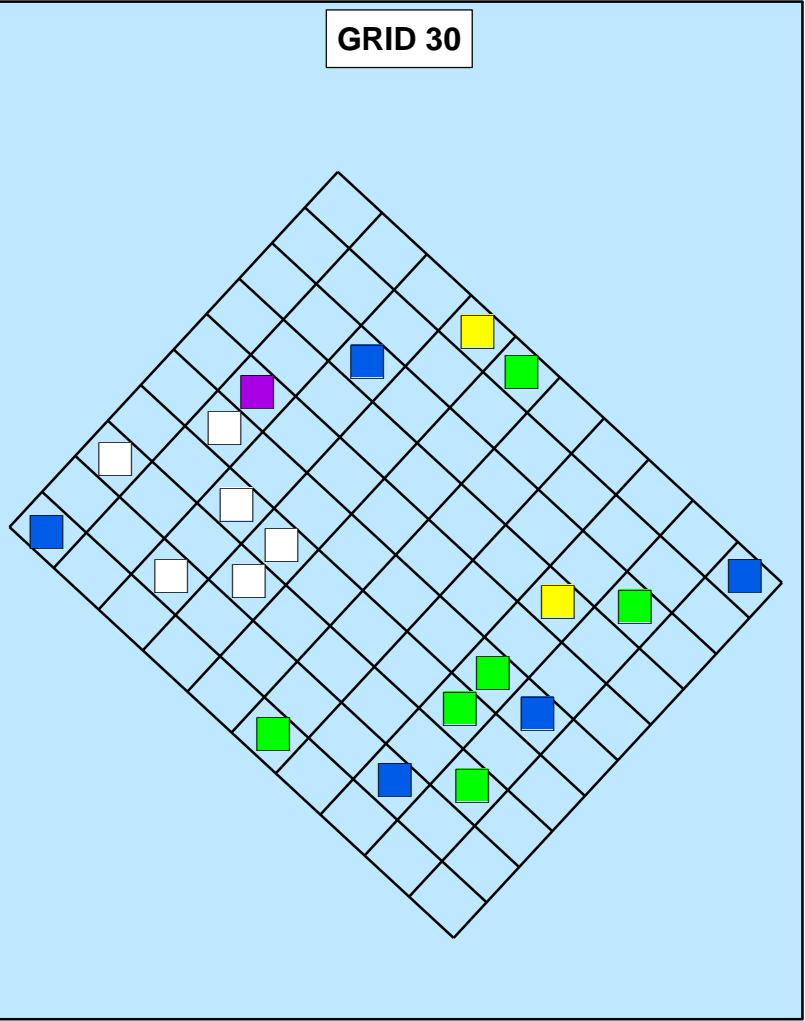
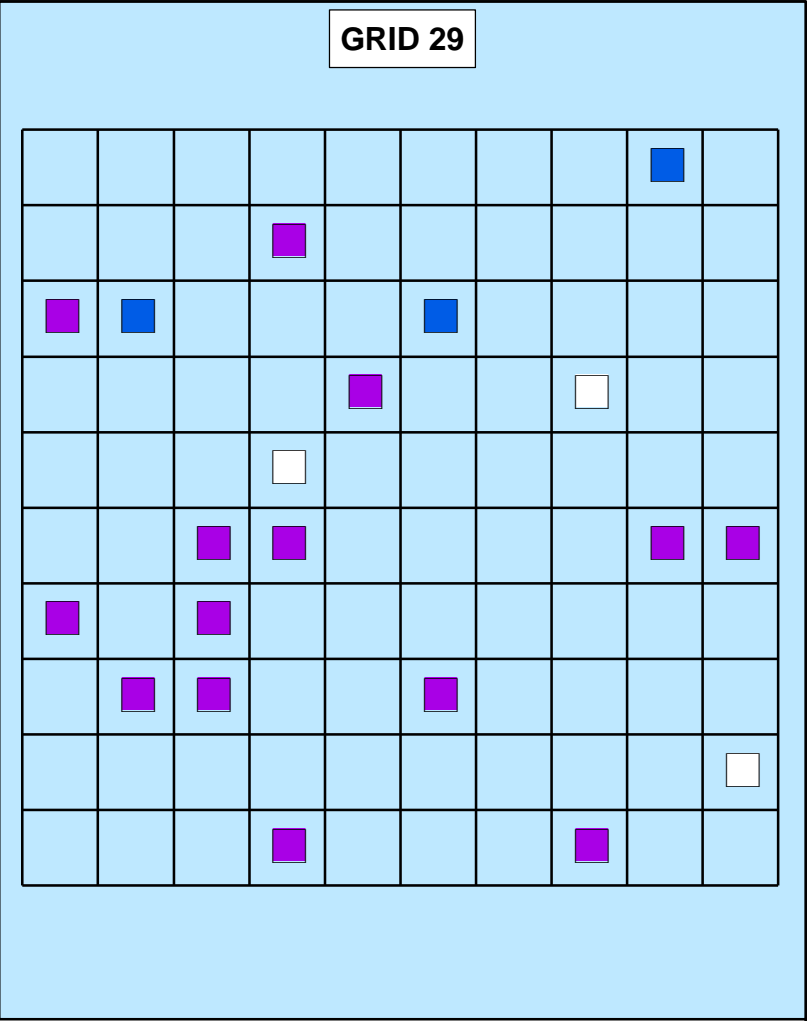
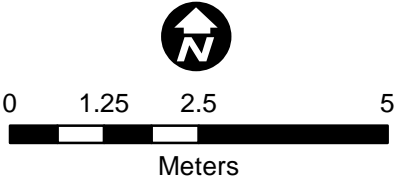
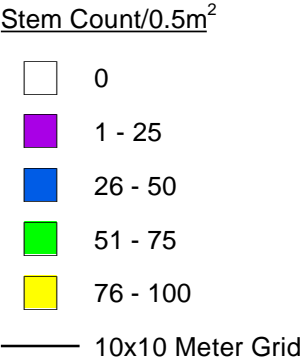
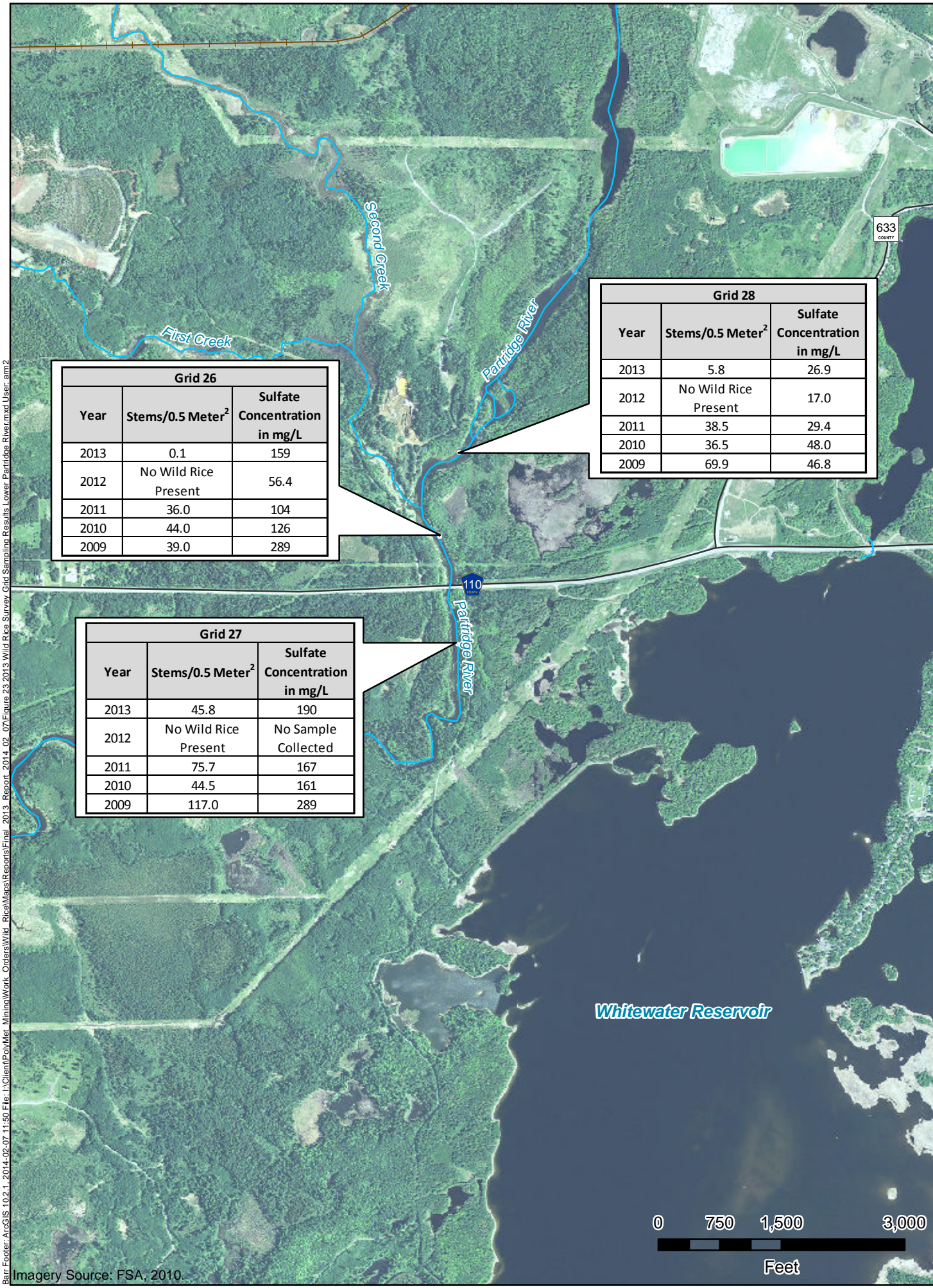


Figure 22
2013 WILD RICE SURVEY
GRID SAMPLING RESULTS
CEDAR ISLAND LAKE
(EMBARRASS RIVER)
NorthMet Project
Poly Met Mining, Inc.
Hoyt Lakes, Minnesota

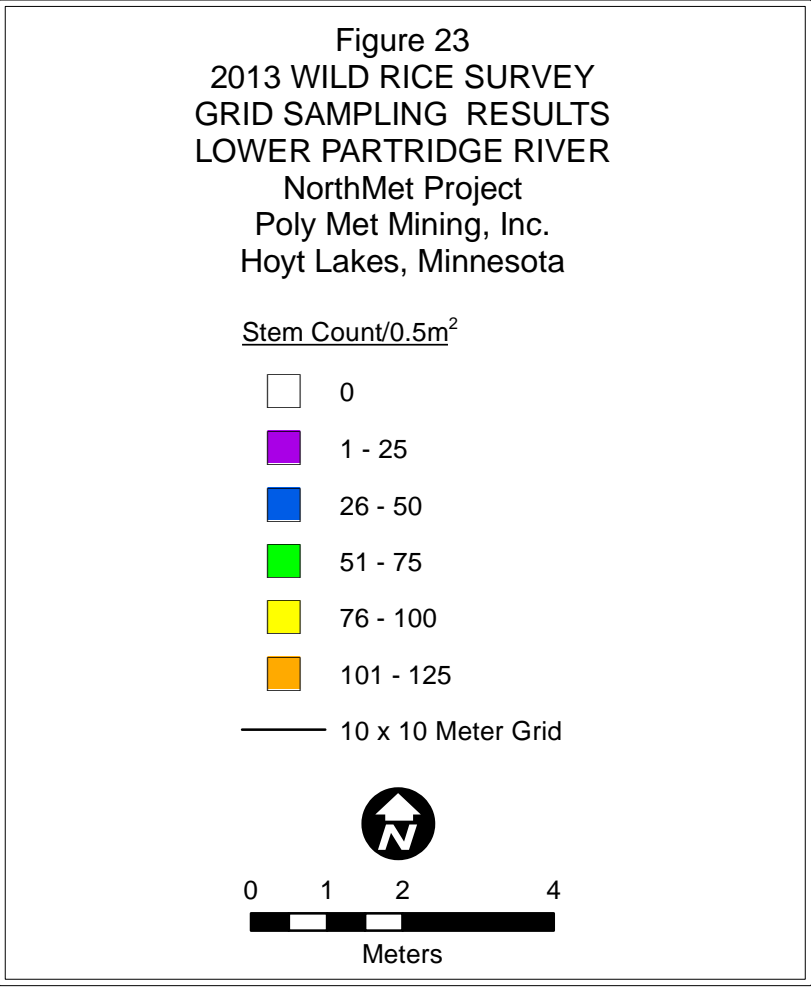
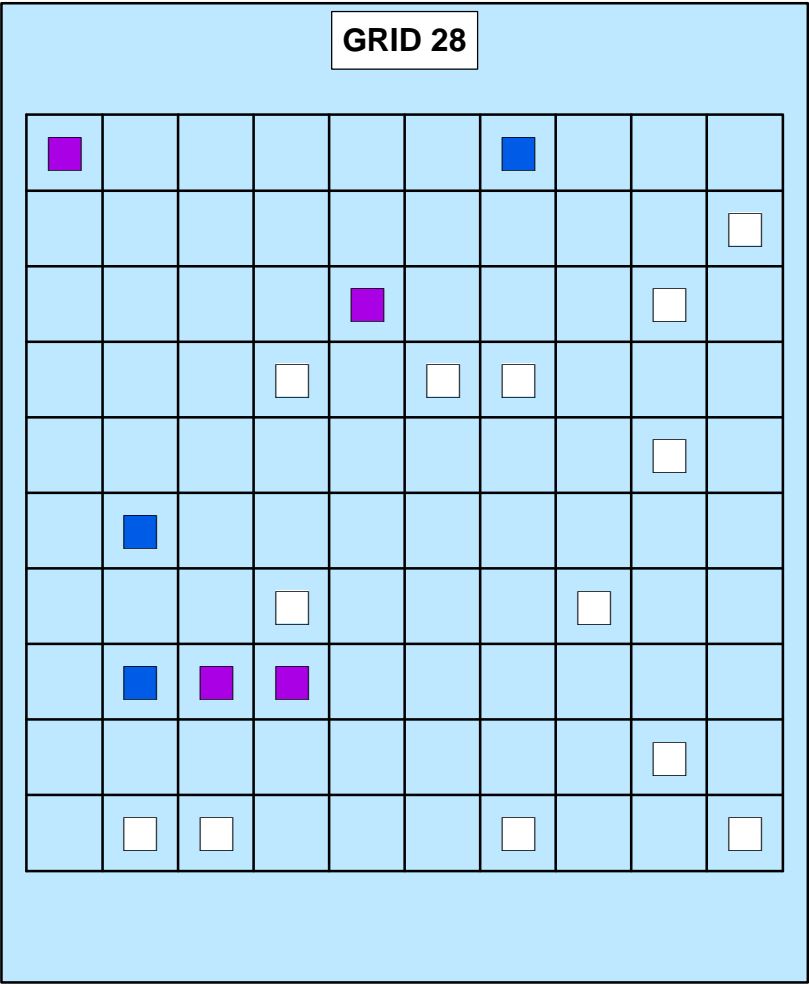
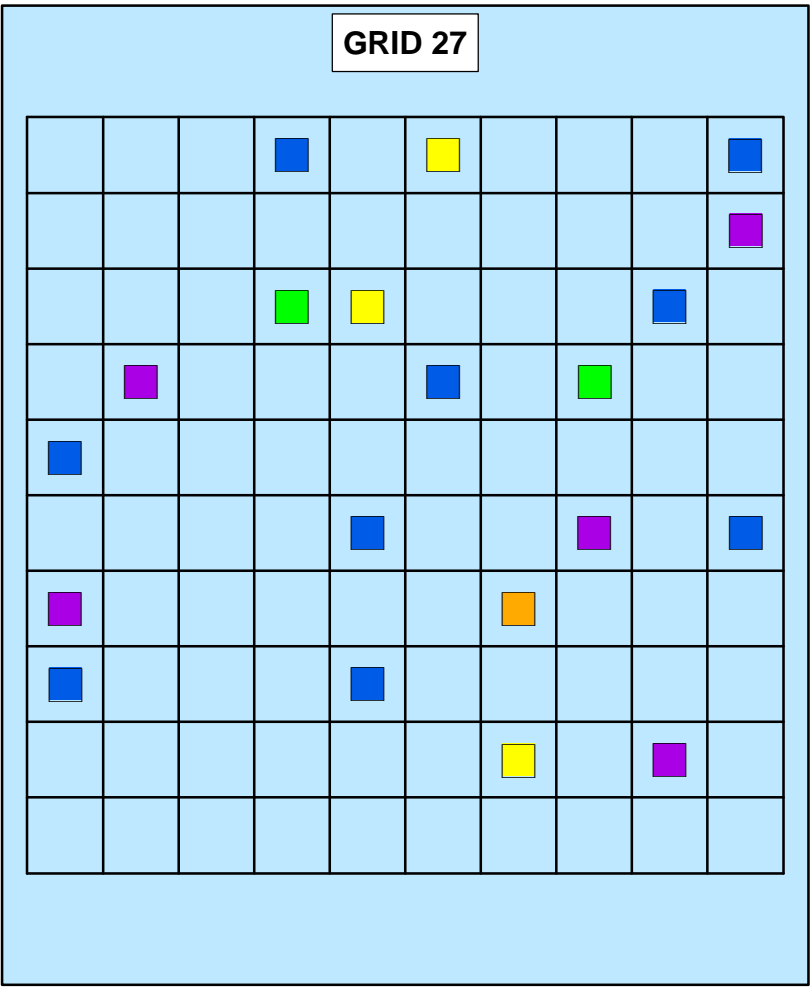
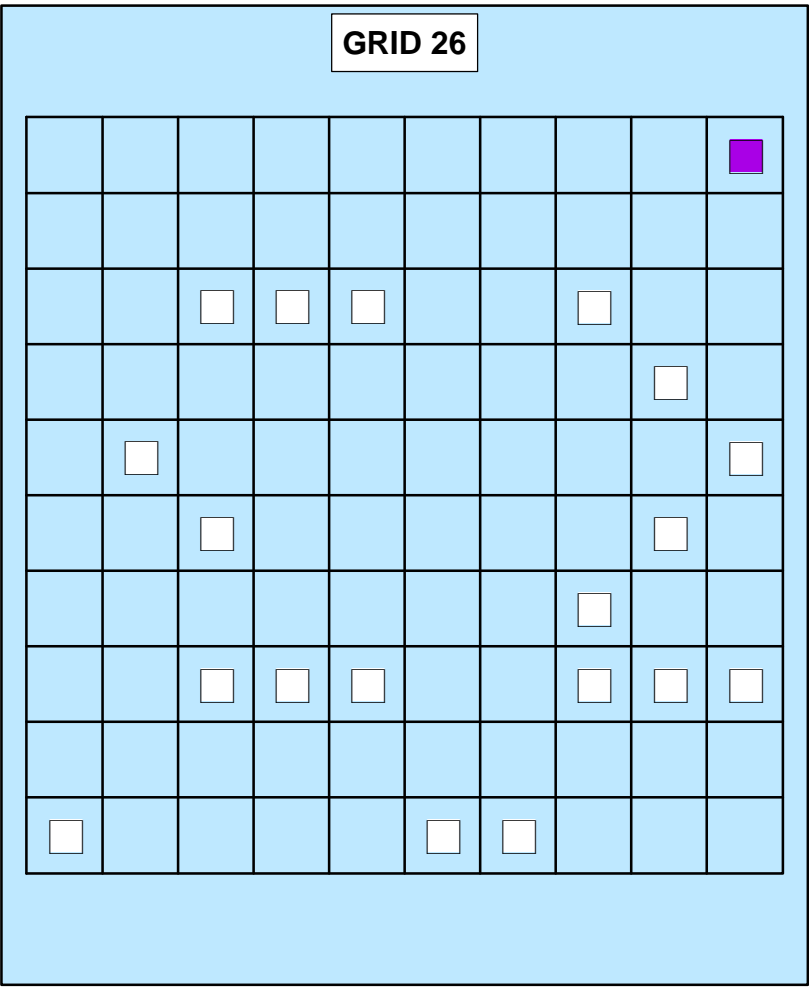




Grid 26		
Year	Stems/0.5 Meter ²	Sulfate Concentration in mg/L
2013	0.1	159
2012	No Wild Rice Present	56.4
2011	36.0	104
2010	44.0	126
2009	39.0	289

Grid 28		
Year	Stems/0.5 Meter ²	Sulfate Concentration in mg/L
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 ²	Sulfate Concentration in mg/L
2013	45.8	190
2012	No Wild Rice Present	No Sample Collected
2011	75.7	167
2010	44.5	161
2009	117.0	289



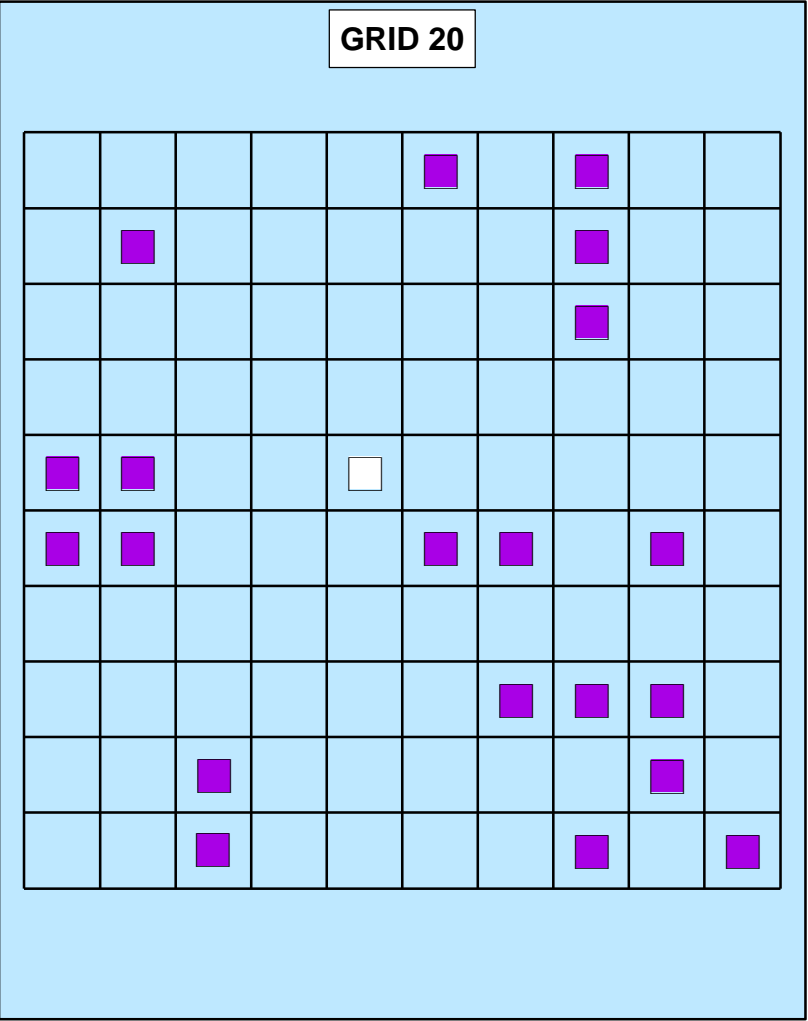
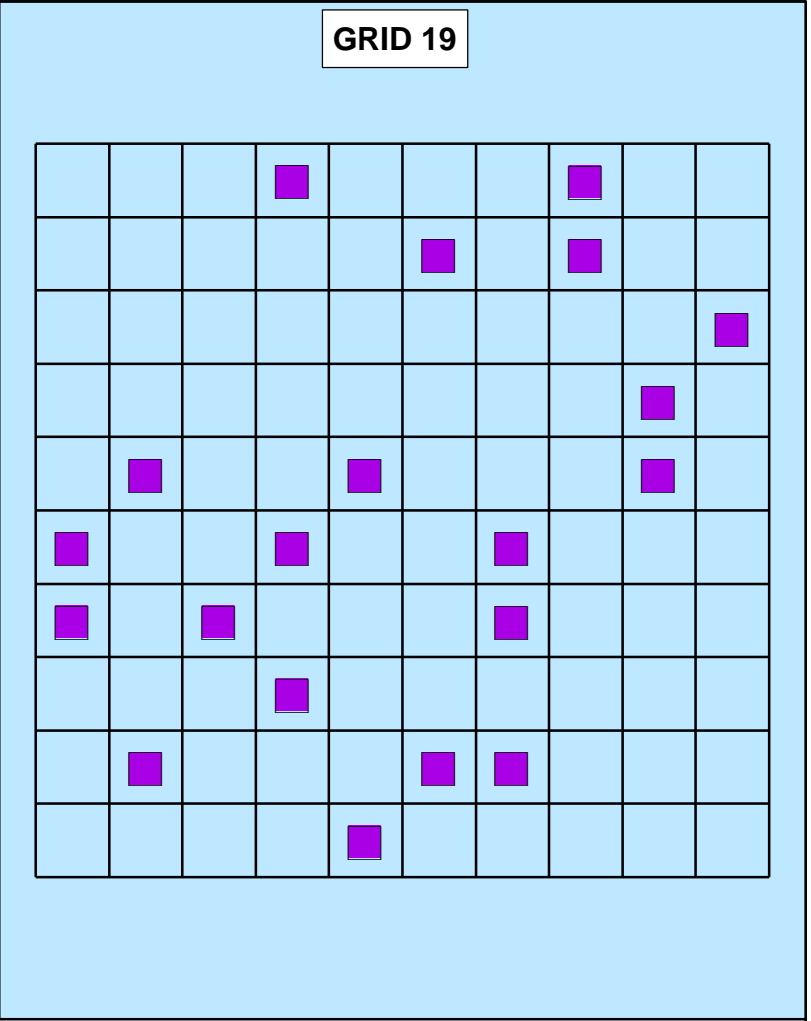
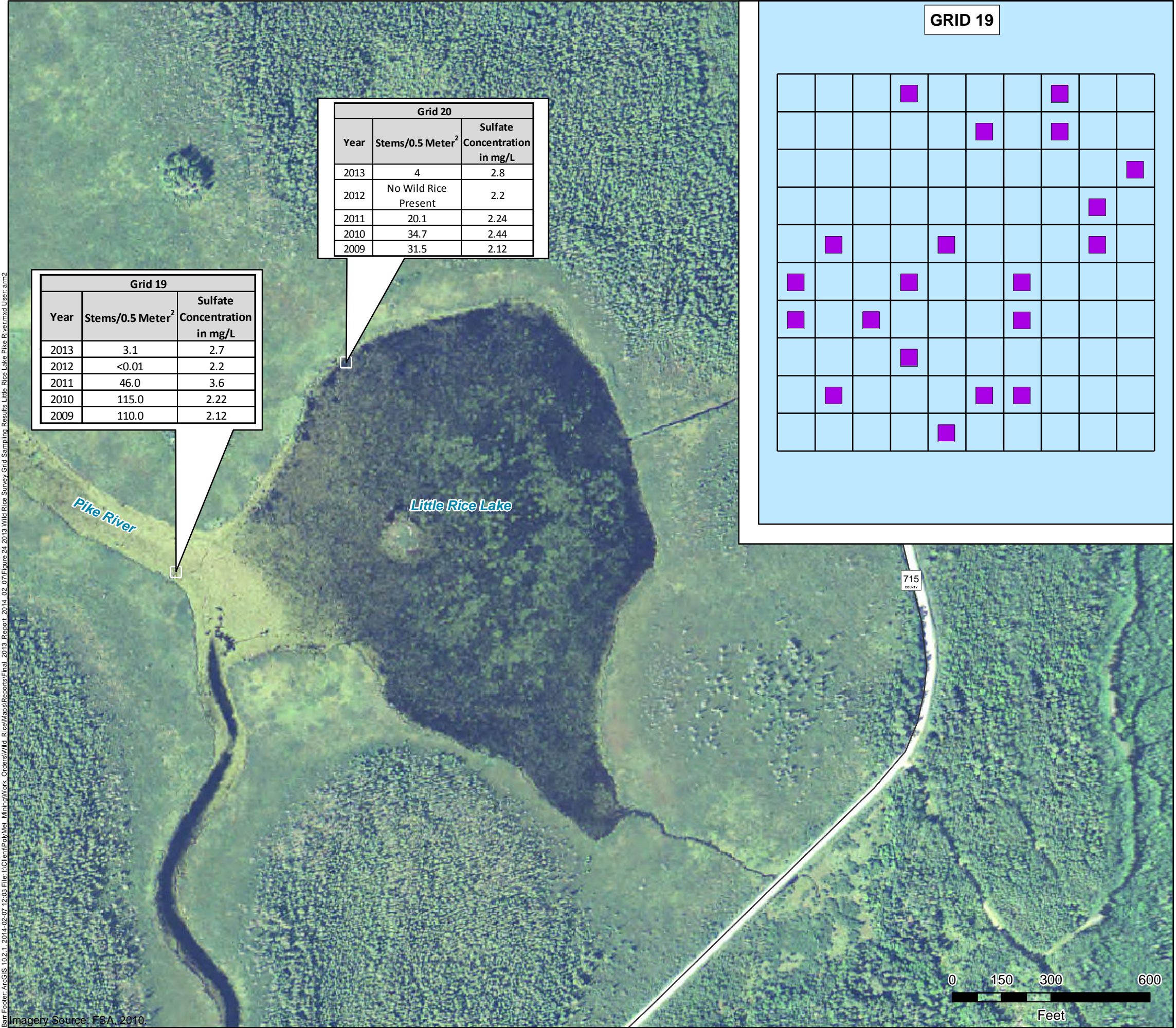


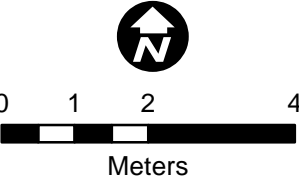
Figure 24
2013 WILD RICE SURVEY
GRID SAMPLING RESULTS
LITTLE RICE LAKE
(PIKE RIVER)
NorthMet Project
Poly Met Mining, Inc.
Hoyt Lakes, Minnesota

Stem Count/0.5m²

□ 0

■ 1 - 25

— 10x10 Meter Grid



Bar Footer: ArcGIS 10.2.1, 2014-02-07 12:11 File: I:\Client\PolyMet_Mining\Work_Orders\WILD_Rice\Maps\Reports\Final_2013_Report_2014-02-07\Figure 25 2013 Wild Rice Survey Grid Sampling Results Pokegama Bay, St. Louis River.mxd User: am2

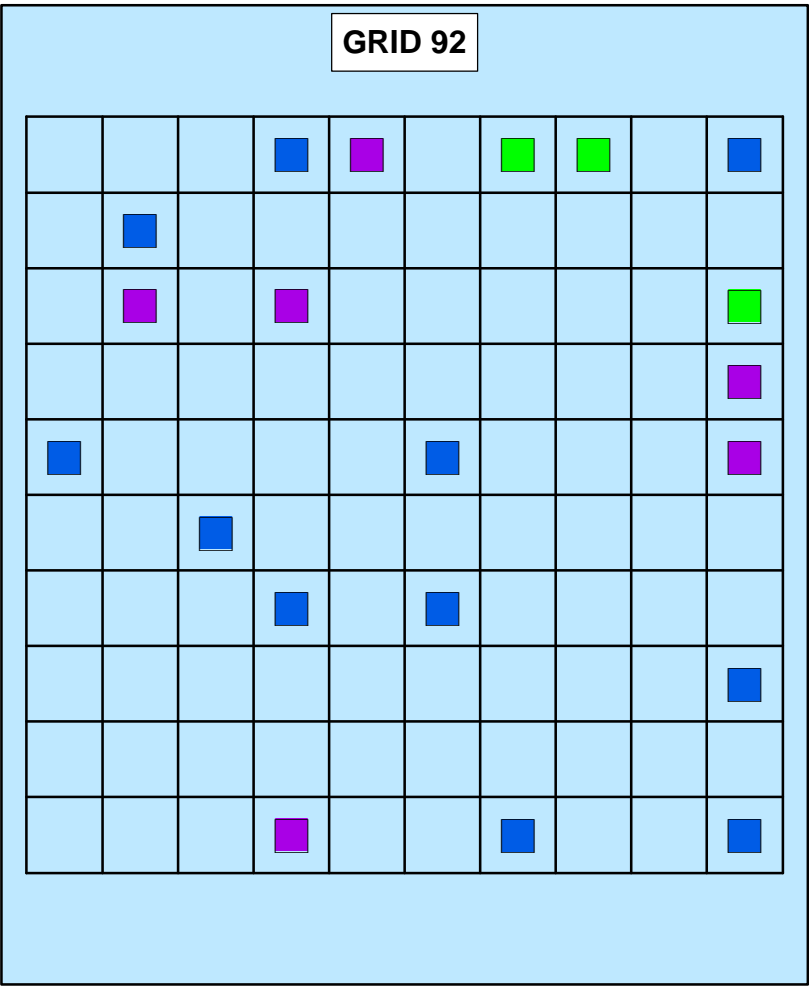
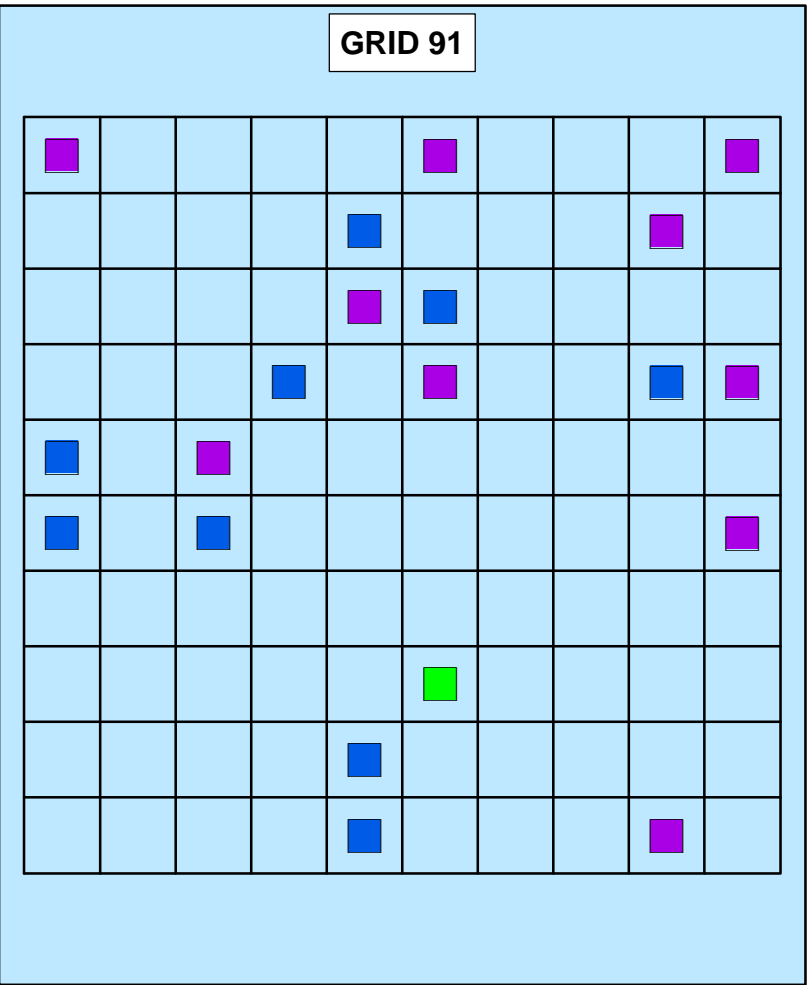
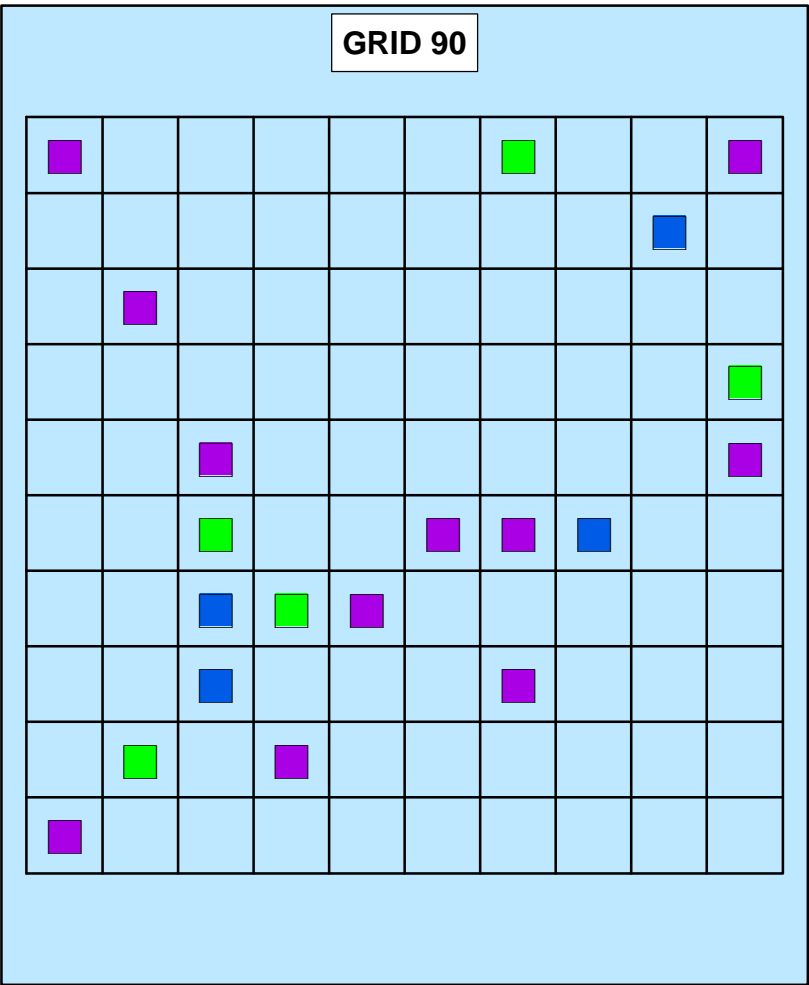
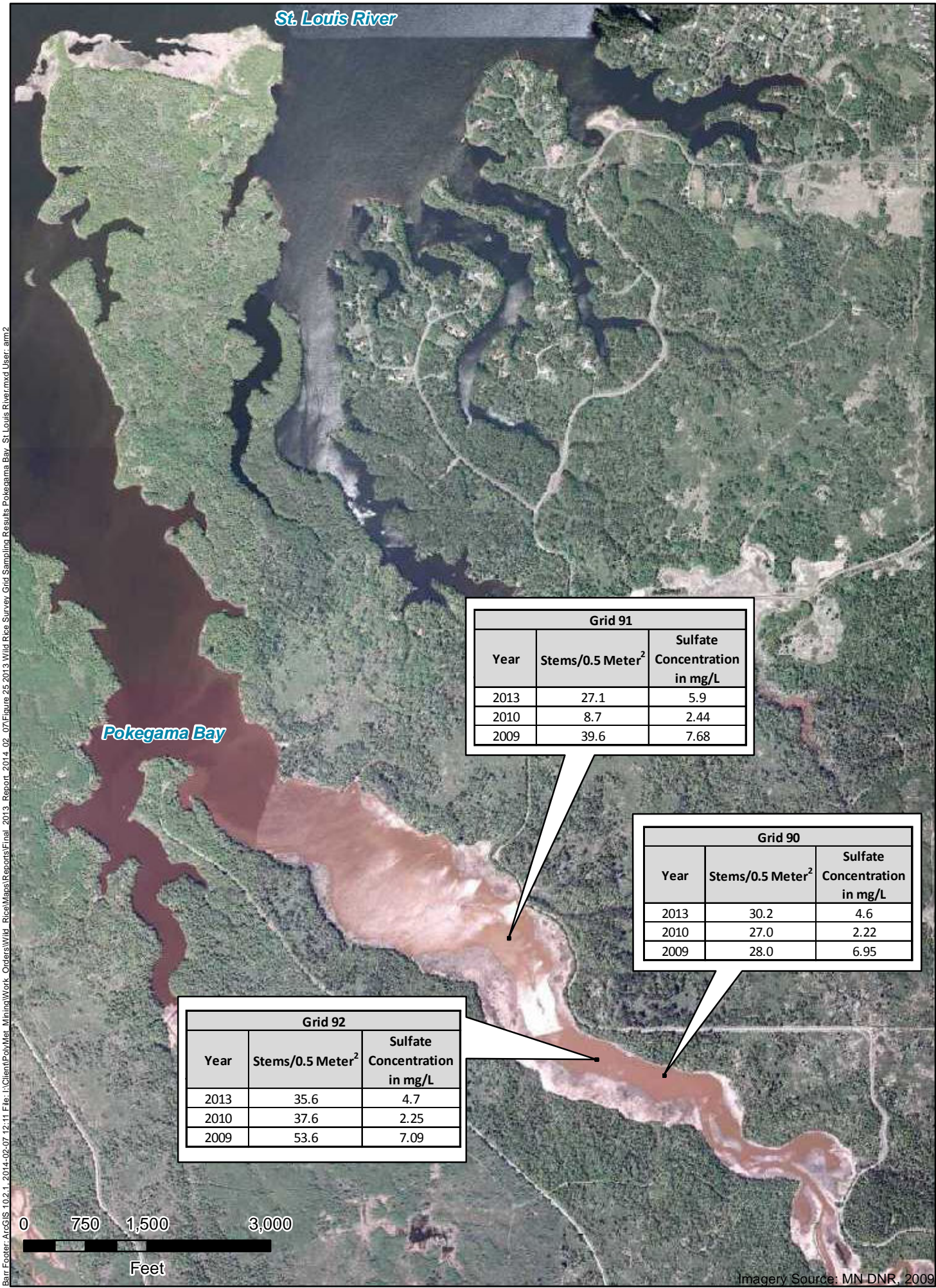


Figure 25
2013 WILD RICE SURVEY
GRID SAMPLING RESULTS
POKEGAMA BAY (ST. LOUIS RIVER)
NorthMet Project
Poly Met Mining, Inc.
Hoyt Lakes, Minnesota

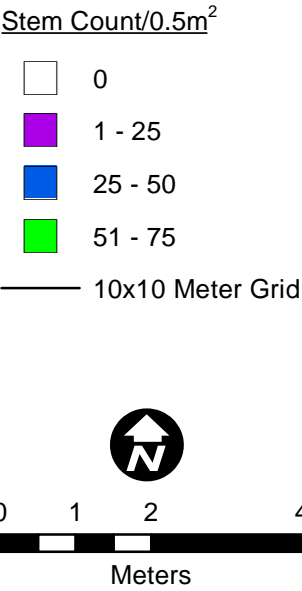


Figure 26 Mean and Standard Deviation of Total Calculated Plant Weight (g)
in the Partridge River, Pike River, and Embarrass River, 2010-2013, and St. Louis River, 2010

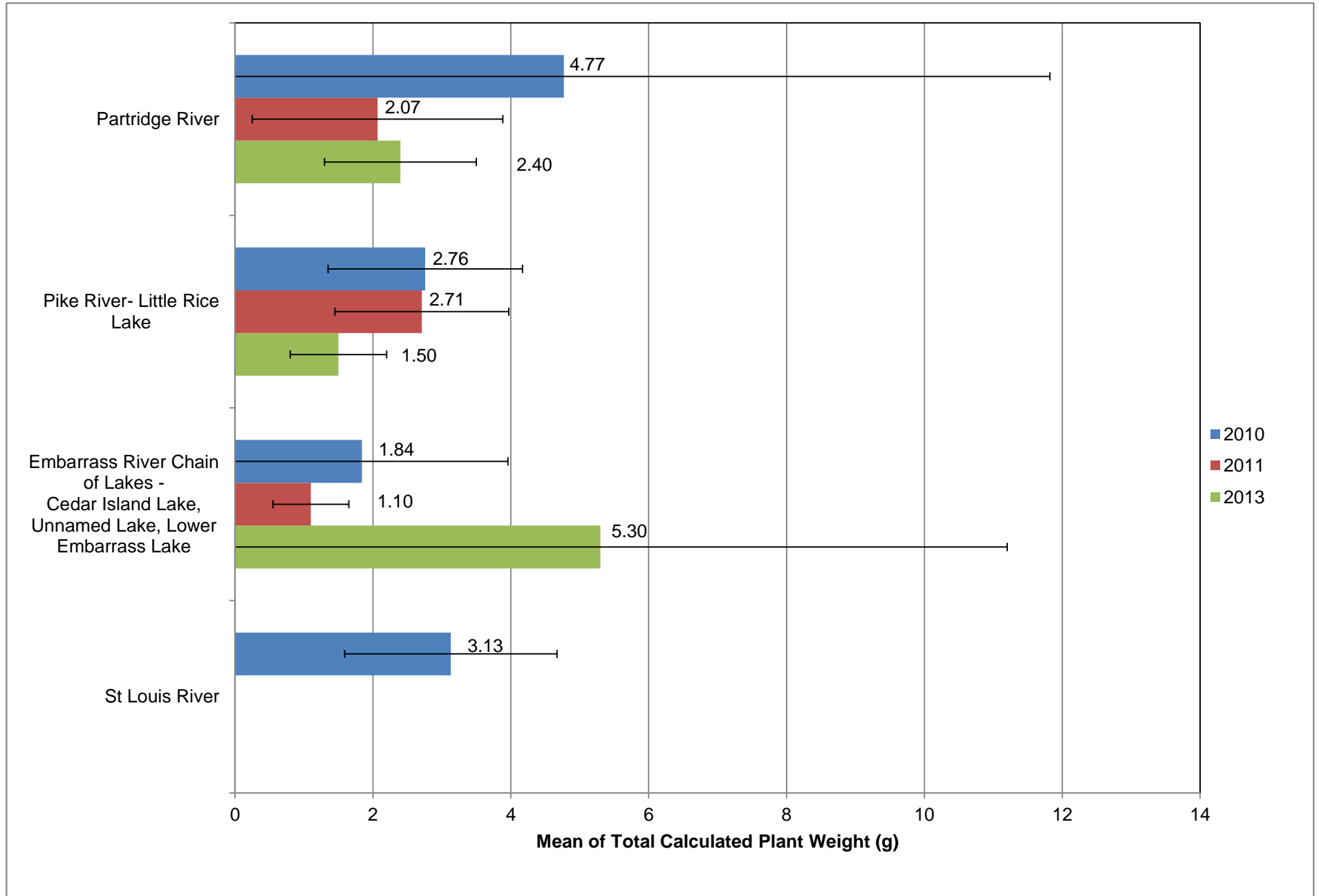


Figure 27 Mean and Standard Deviation of Root Weight (g)
in the Partridge River, Pike River, and Embarrass River, 2010-2013, and St. Louis River, 2010

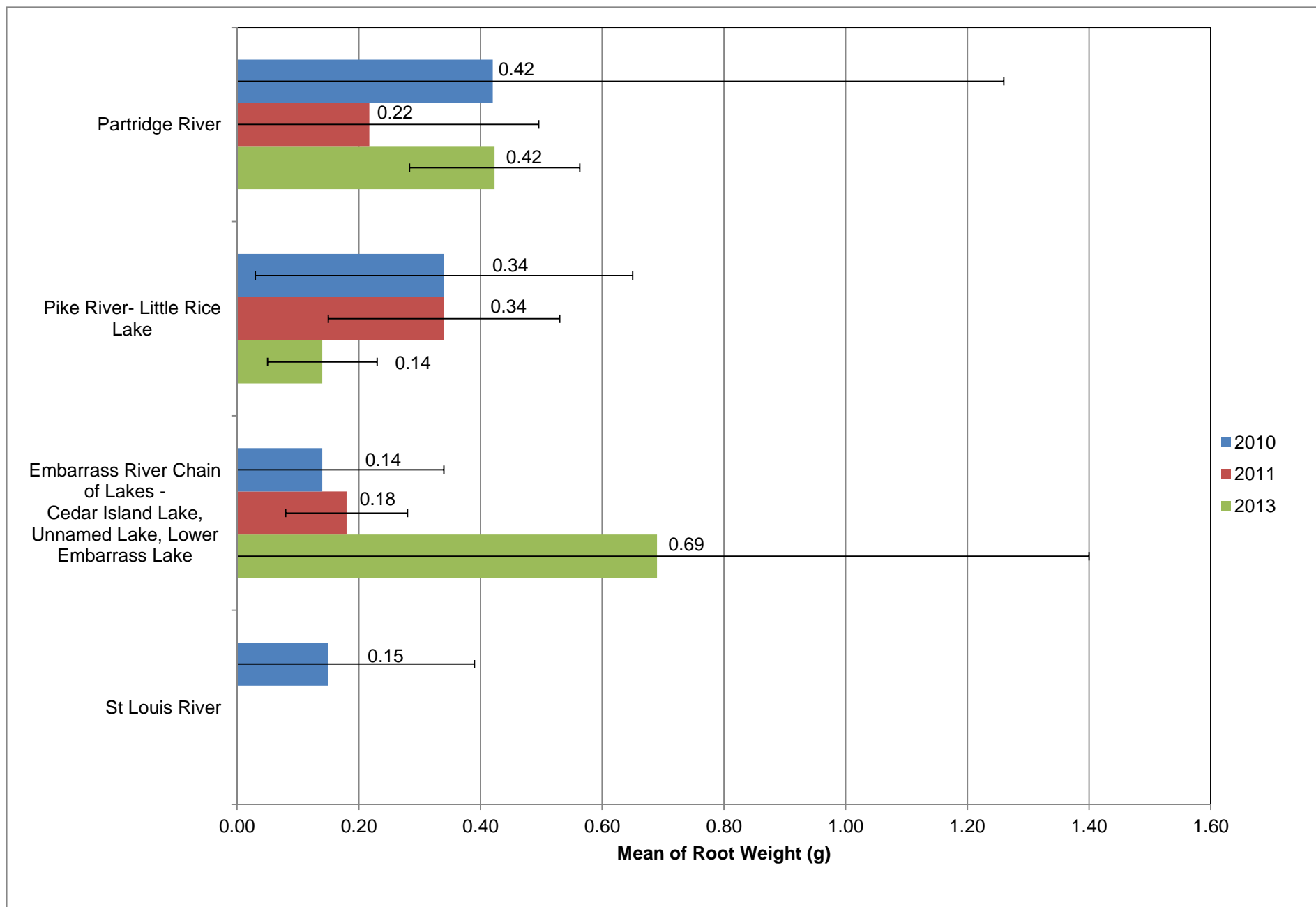


Figure 28 Mean and Standard Deviation of Shoot Weight (g)
in the Partridge River, Pike River, and Embarrass River, 2010-2013, and St. Louis River, 2010

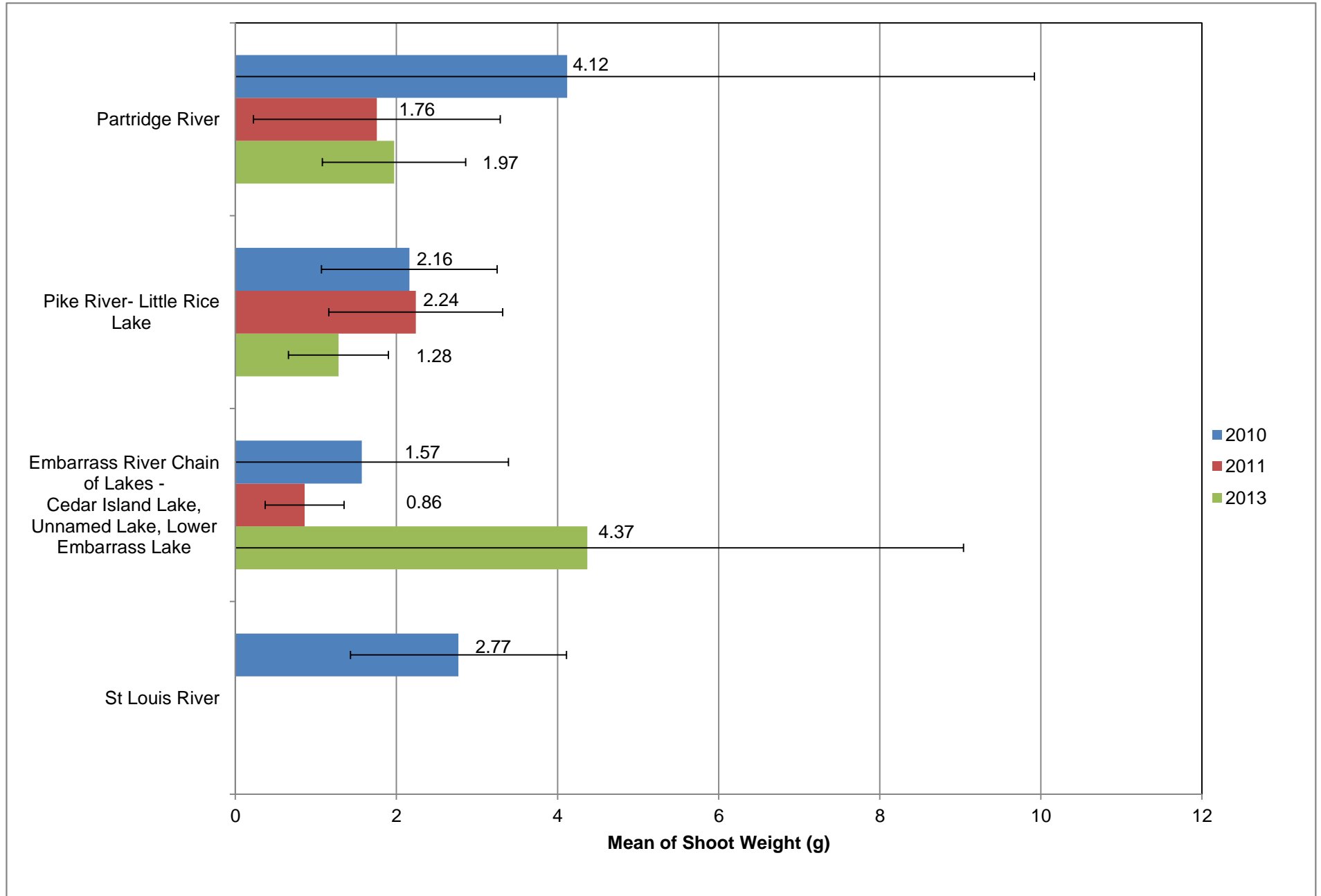


Figure 29 Mean and Standard Deviation of Calculated Seed Weight (g)
in the Partridge River, Pike River, and Embarrass River, 2010-2013, and St. Louis River, 2010

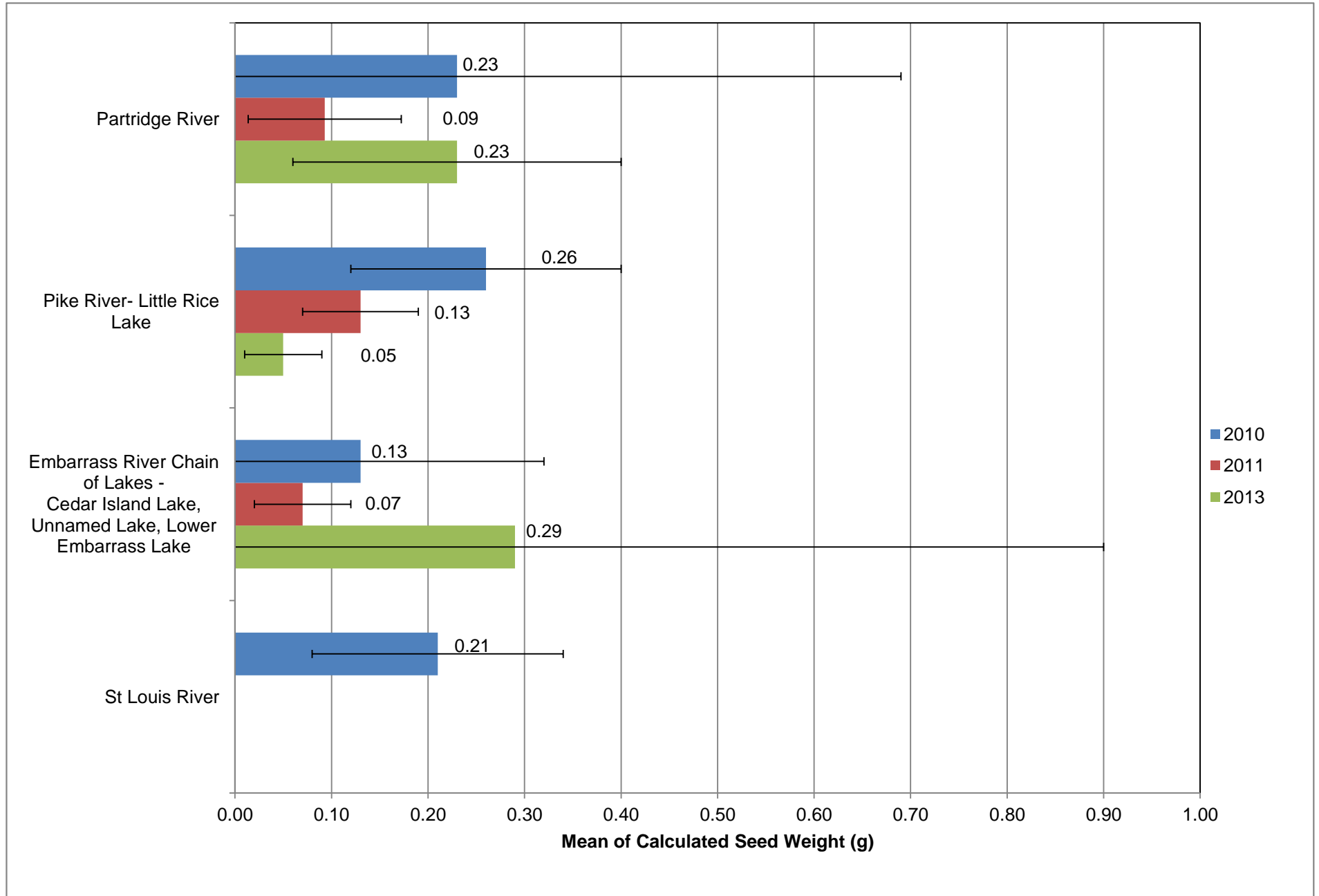


Figure 30 Mean and Standard Deviation of Calculated Seed Number
in the Partridge River, Pike River, and Embarrass River, 2010-2013, and St. Louis River, 2010

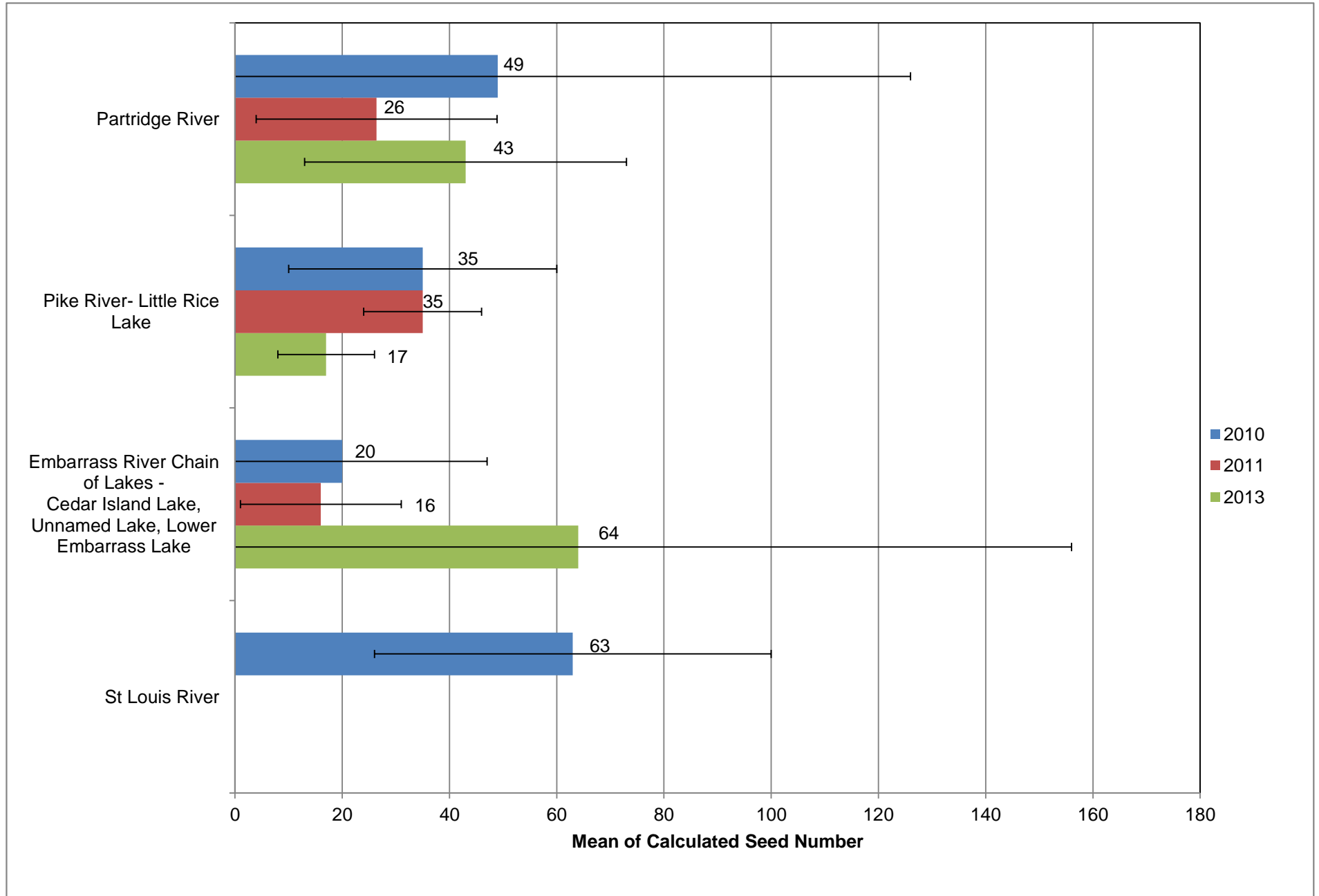


Figure 31 Median of Total Calculated Plant Weight (g)
in the Partridge River, Pike River, and Embarrass River, 2010-2013, and St. Louis River, 2010

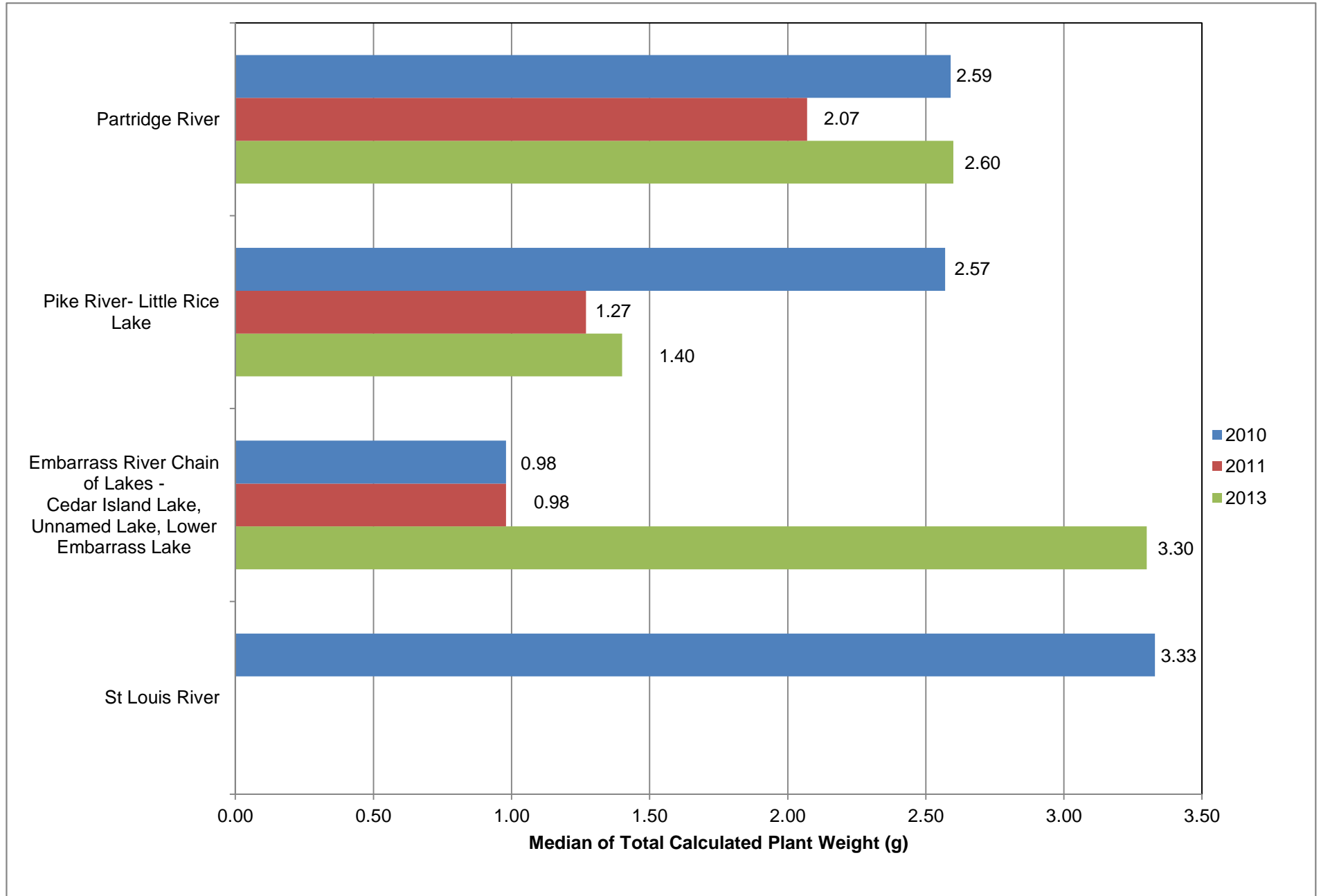


Figure 32 Median of Root Weight (g)
in the Partridge River, Pike River, and Embarrass River, 2010-2013, and St. Louis River, 2010

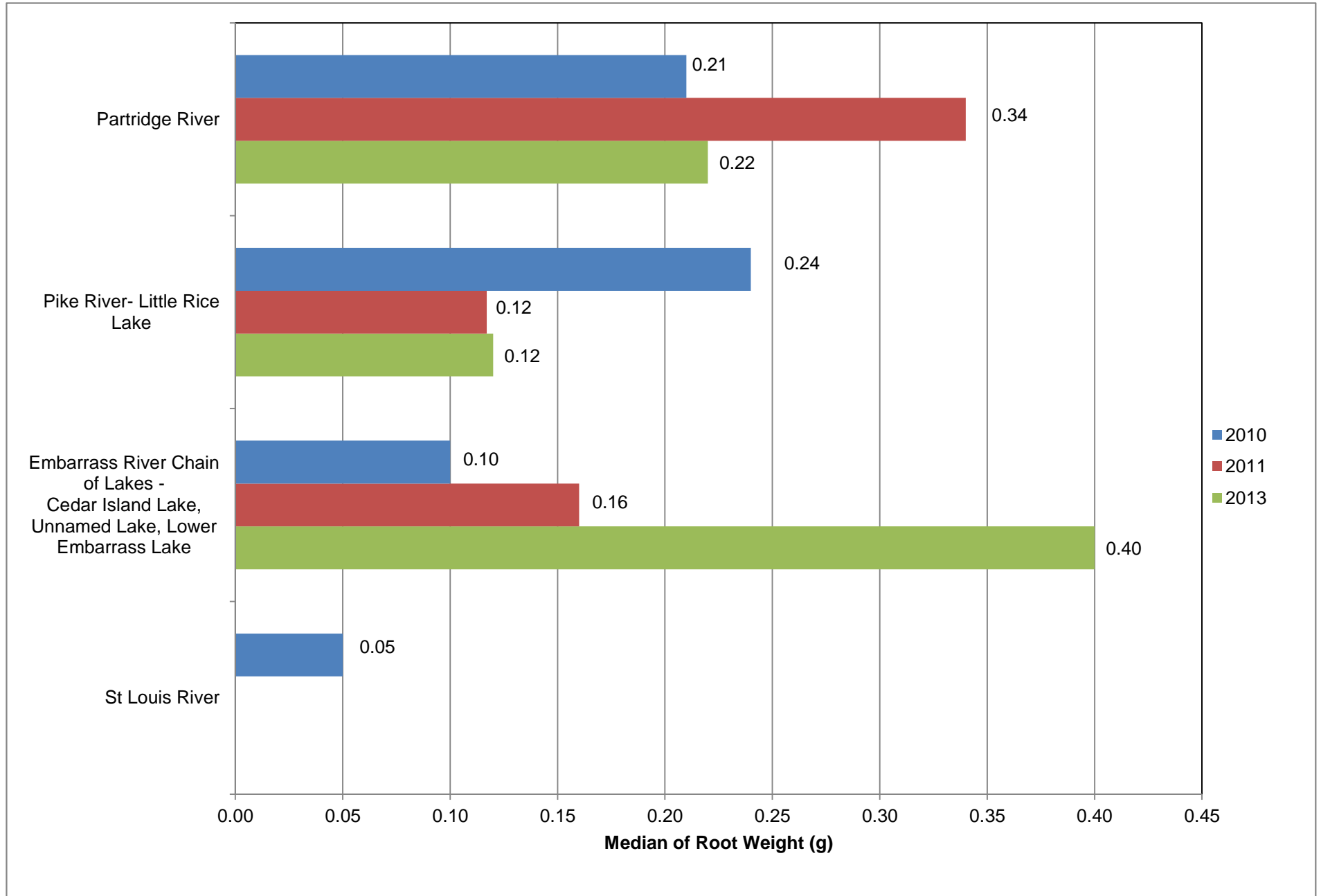


Figure 33 Median of Shoot Weight (g)
in the Partridge River, Pike River, and Embarrass River, 2010-2013, and St. Louis River, 2010

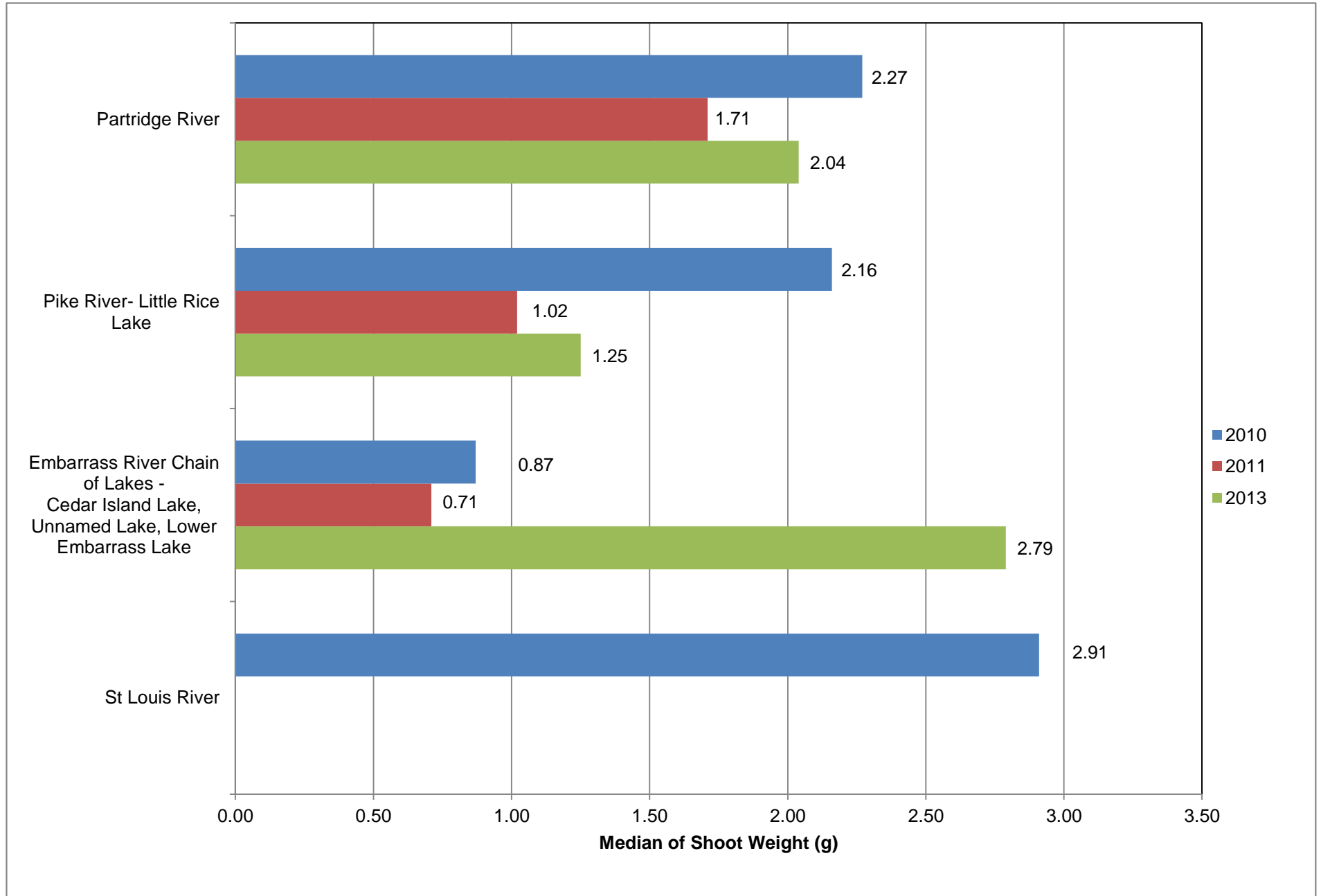


Figure 34 Median of Calculated Seed Weight (g)
in the Partridge River, Pike River, and Embarrass River, 2010-2013, and St. Louis River, 2010

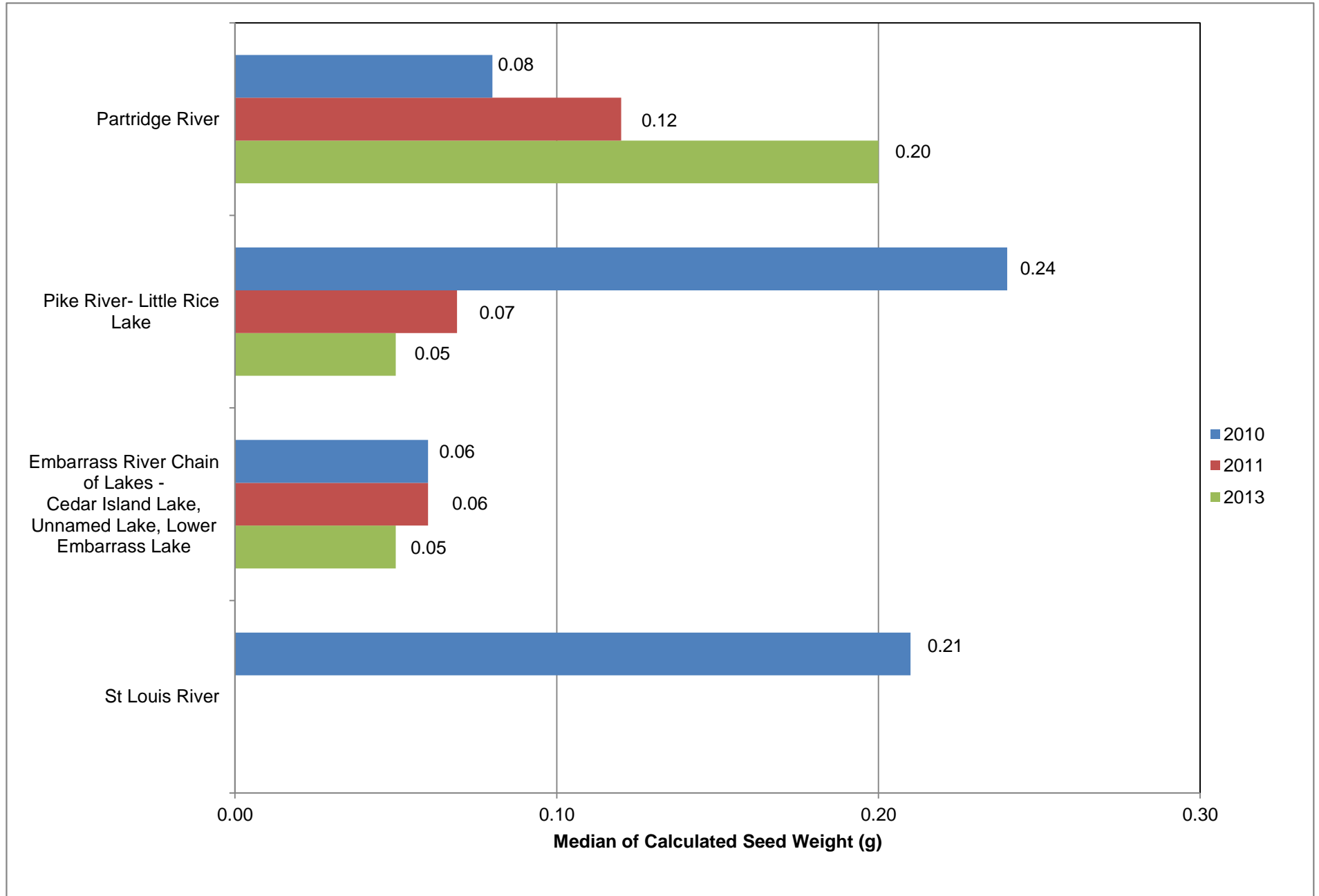


Figure 35 Median of Calculated Seed Number
in the Partridge River, Pike River, and Embarrass River, 2010-2013, and St. Louis River, 2010

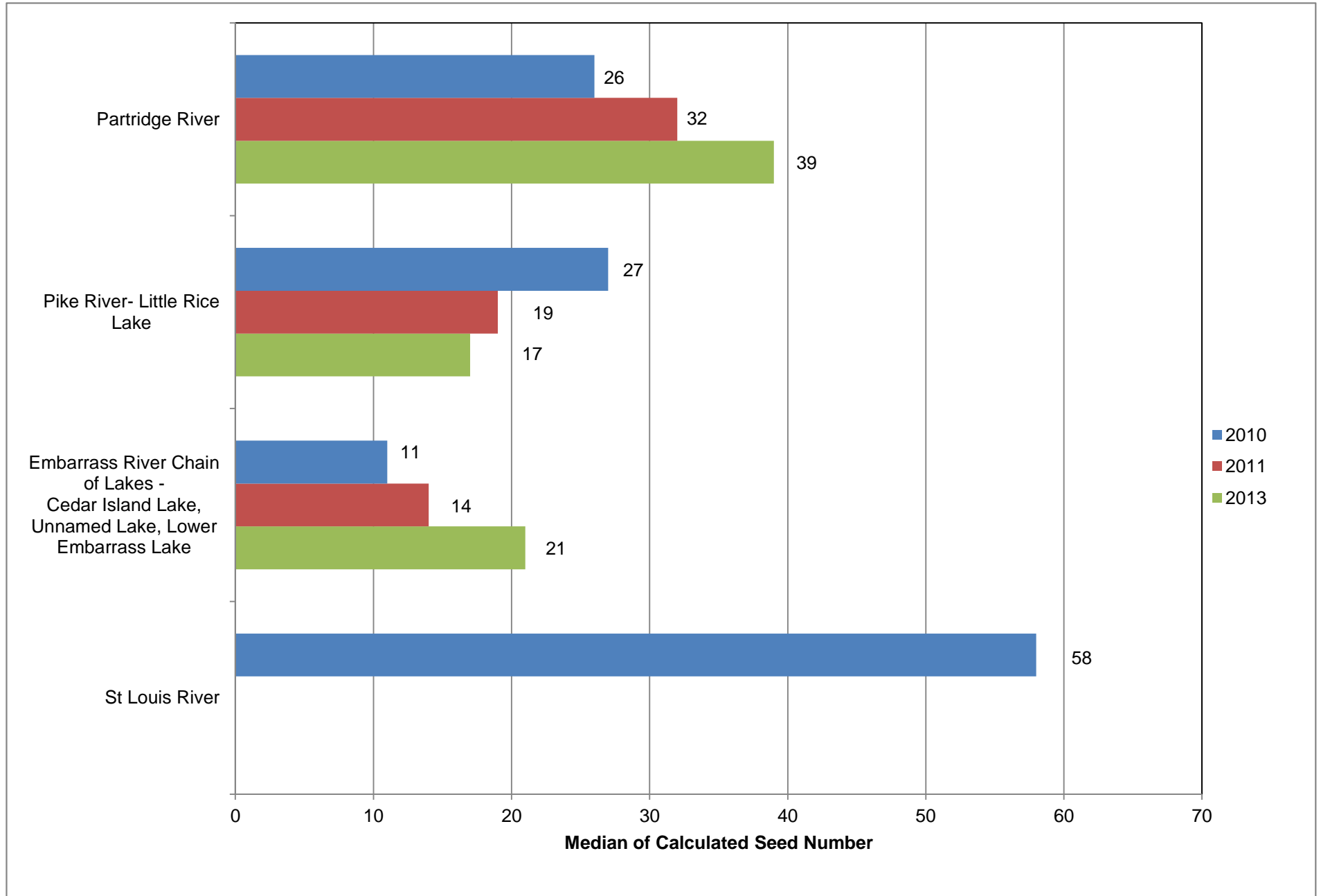


Figure 36 Mean Stem Count (stems/0.5m²) by Grid According to Year
for Lower Embarrass Lake, Unnamed Lake, and Cedar Island Lake, 2009-2013

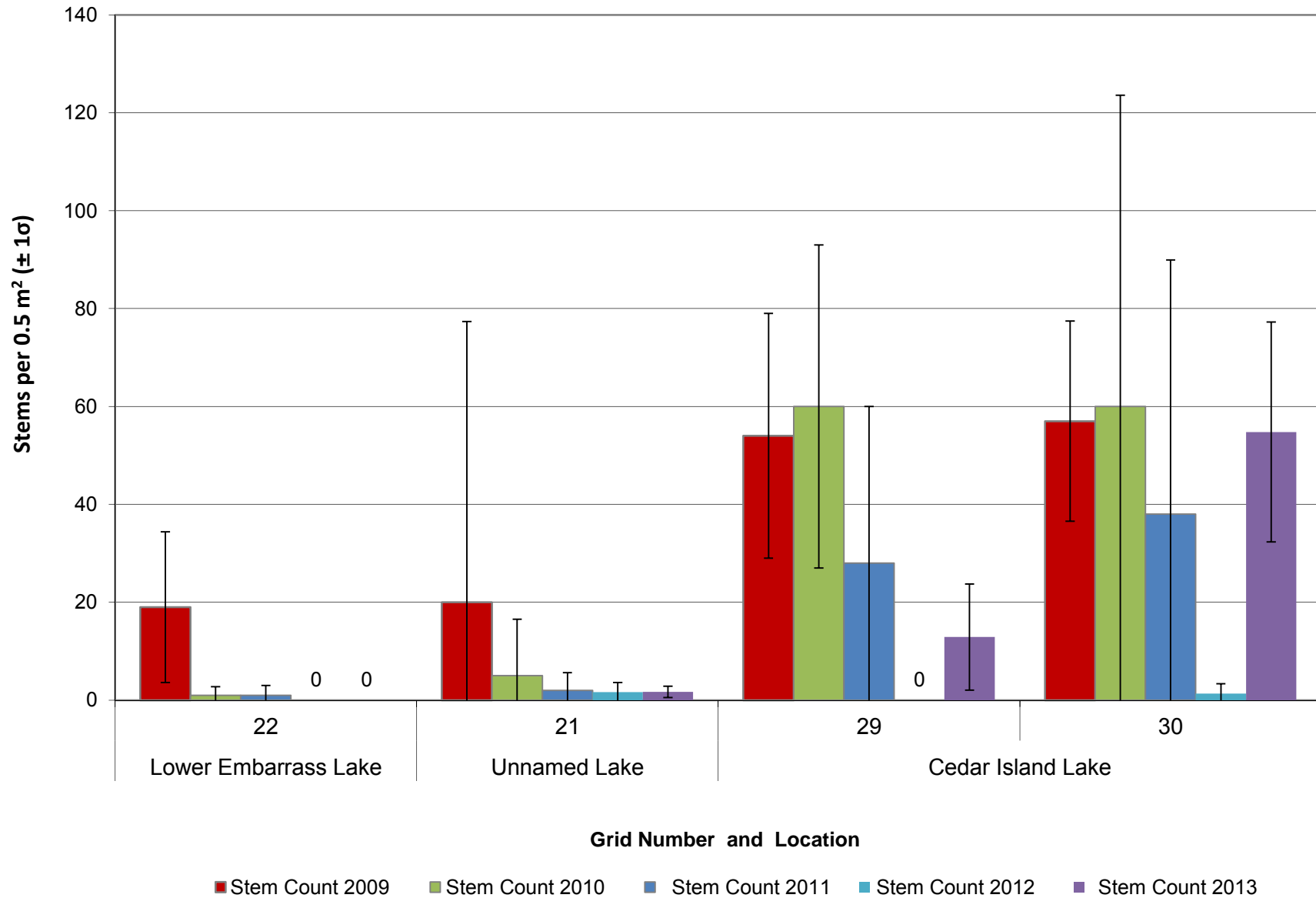
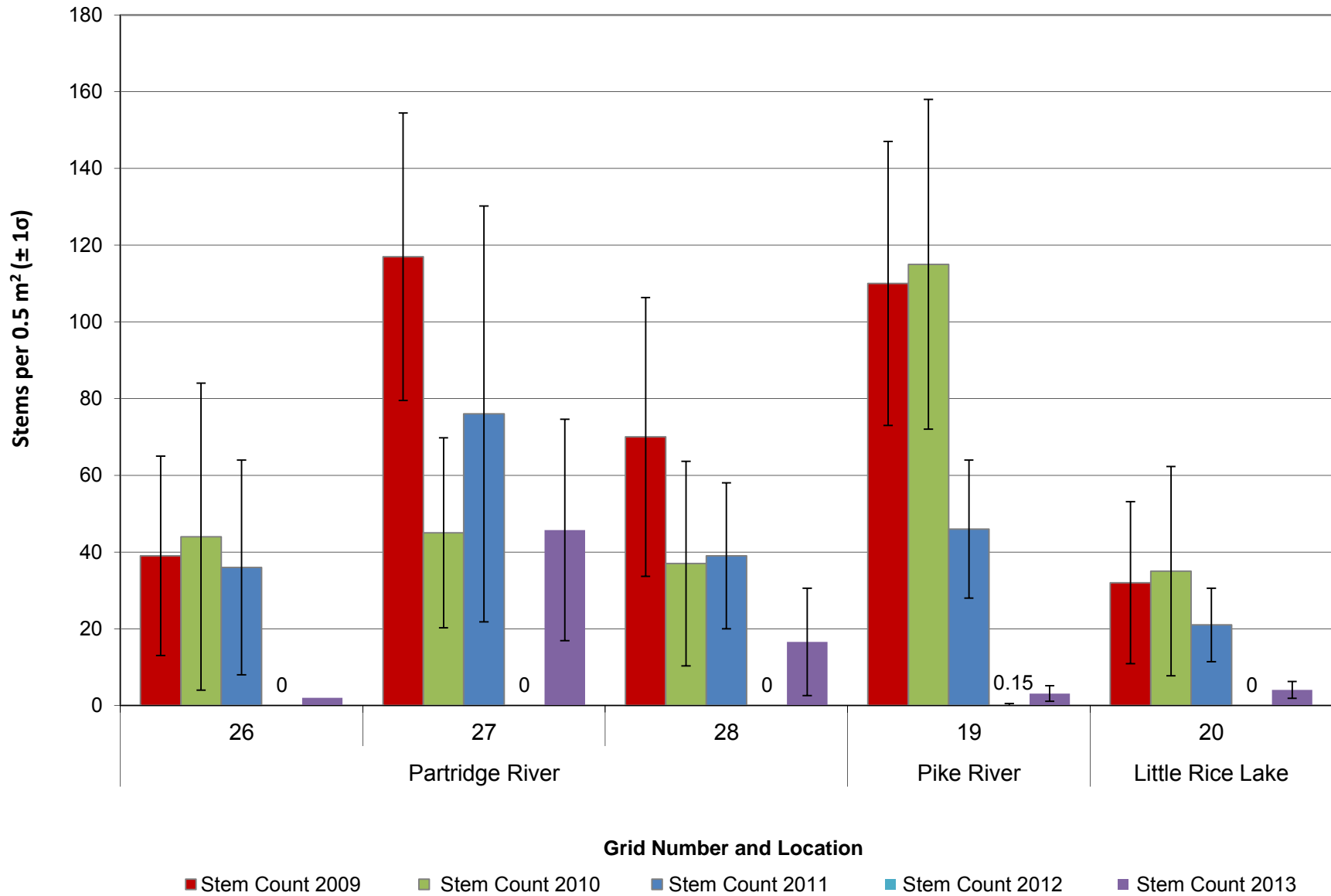


Figure 37 Mean Stem Count (stems/0.5m²) by Grid According to Year
for Partridge River, Little Rice Lake, and Pike River, 2009-2013



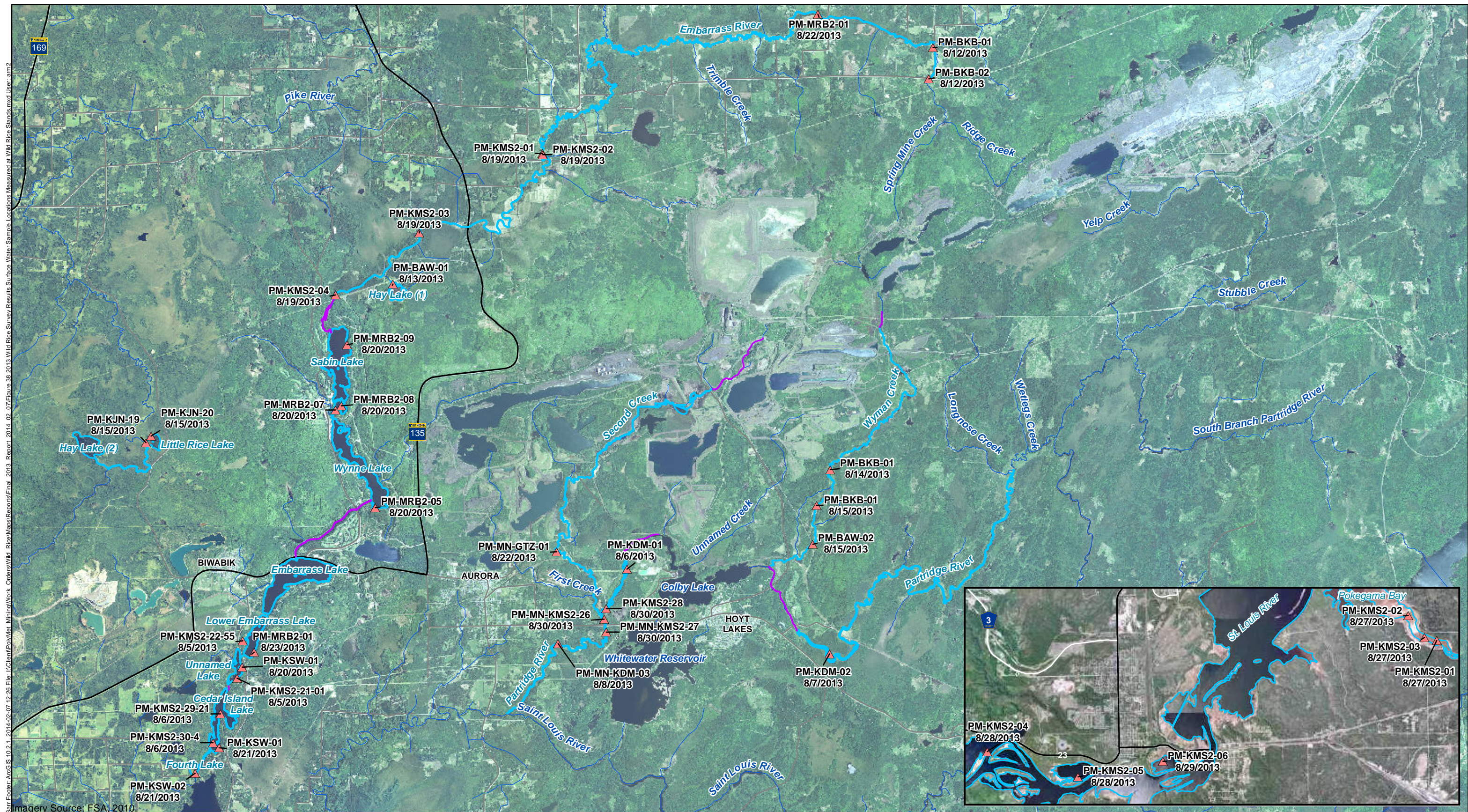
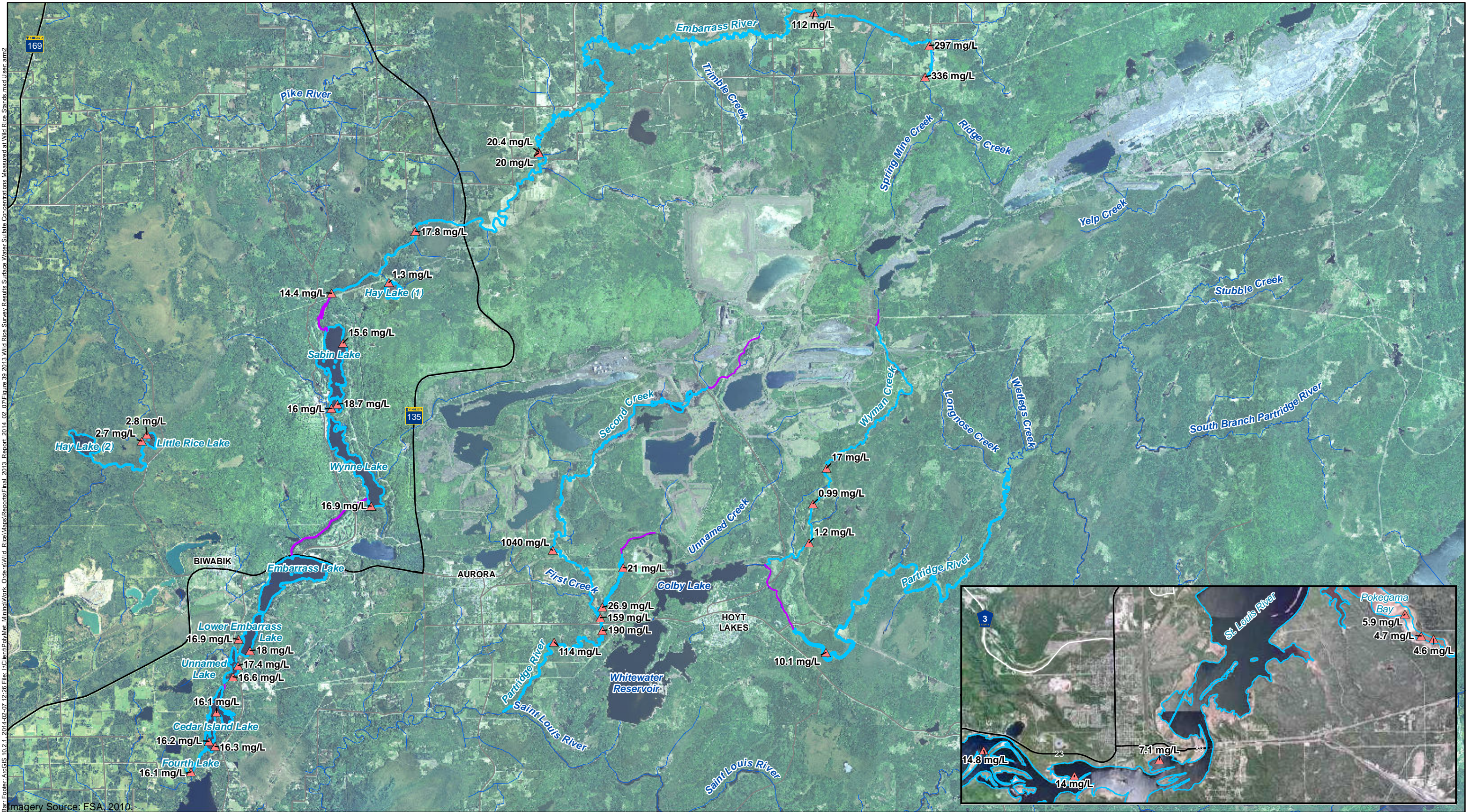


Figure 38
 2013 WILD RICE SURVEY
 SURFACE WATER SAMPLE LOCATIONS
 MEASURED AT WILD RICE STANDS
 NorthMet Project
 Poly Met Mining, Inc.
 Hoyt Lakes, Minnesota



Bar Footer: ArcGIS 10.2.1, 2014-02-07 12:26 File: I:\Client\PolyMet_Mining\Work_Orders\Wild_Rice\Maps\Reports\Final_2013_Report_2014_02_07\Figure_39_2013_Wild_Rice_Survey_Results_Surface_Water_Sulfate_Concentrations_Measured_at_Wild_Rice_Stands.mxd User: am2 Imagery Source: FSA, 2010.

Figure 39
 2013 WILD RICE SURVEY RESULTS
 SURFACE WATER SULFATE CONCENTRATIONS
 MEASURED AT WILD RICE STANDS
 NorthMet Project
 Poly Met Mining, Inc.
 Hoyt Lakes, Minnesota

Appendices

Appendix A

2013 Wild Rice Study Area Photographs



Figure A1: Spring Mine Creek, no wild rice observed — August 12, 2013



Figure A2: Embarrass River, Reach 2, sparse wild rice — August 22, 2013



Figure A3: Hay Lake near Embarrass River, sparse wild rice — August 13, 2013



Figure A4: Sabin Lake, no wild rice observed — August 20, 2013



Figure A5: Wynne Lake, no wild rice observed — August 20, 2013



Figure A6: Upper Embarrass Lake, no wild rice observed — August 23, 2013



Figure A7: Lower Embarrass Lake, sparse wild rice — August 23, 2013



Figure A8: Unnamed Lake, sparse rice — August 20, 2013



Figure A9: Cedar Island Lake, moderate wild rice — August 21, 2013



Figure A10: Fourth Lake, moderate wild rice — August 21, 2013



Figure A11: Upper Partridge River, Reach 6, sparse wild rice — August 7, 2013



Figure A12: Lower Partridge River, Reach 3, moderate wild rice along shore — August 8, 2013



Figure A13: Wyman Creek, Reach X, no wild rice observed – August 14, 2013



Figure A14: Second Creak, Reach 6, wild rice upstream of Partridge River — August 22, 2013



Figure A15: Little Rice Lake sparse wild rice — August 14, 2013



Figure A16: Pike River, Reach 1, sparse wild rice — August 14, 2013



Figure A17: Hay Lake 2, near Pike River, sparse wild rice — August 14, 2013



Figure A18: St. Louis River Upper Estuary, moderate wild rice — August 28, 2013



Figure A19: St. Louis River-Pokegama Bay, dense wild rice along shoreline — August 27, 2013



Figure A20: St. Louis River-Pokegama Bay, dense rice near south end of bay — August 27, 2013

Appendix B

Grid Sampling Sheets

Details of Wild Rice Surveys on Pike River

Grid 19 Pike River										
8/15/2013 water depth = 75.05 cm Transparency Reading = 35-49 cm										
Plot# UTM Coordinates (meters)	# of 0.5m ² 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 49	1	44	1			1	Potamogeton obtusifolius			No WR head
5268474 N										
547071 E										
Plot 39	5	55	10			1	Potamogeton obtusifolius			No WR head
5268475 N		38								
547071 E		41								
		29								
		33								
Plot 30	6	30	10			1	Potamogeton obtusifolius			WR heads; mucky bottom
5268476 N		21								
547072 E		21								
		21								
		32								
Plot 8	2	9	0			1				No floating heads
5268478 N		24								
547070 E										
Plot 18	3	32	40			1	Potamogeton obtusifolius			No floating heads
5268477 N		22								
547070 E		14								
Plot 16	1	88	5			1	Potamogeton obtusifolius			No floating heads
5268477 N										
547068 E										
Plot 4	3	30	10			1	Potamogeton obtusifolius			No floating heads
5268478 N		25								
547066 E		46								
Plot 45	2	44	80			1	Potamogeton obtusifolius			No floating heads V01= Potamogeton obtusifolius @17:16
5268474 N		38								
547067 E										
Plot 42	8	56	98	10		2	Potamogeton obtusifolius	Potamogeton natans		No floating heads V02=Utricularia vulgaris @17:25 WR1->5 @17:20
5268474 N		35								
547064 E		48								
		25								
		34								
Plot 51	4	42	50			1	Potamogeton natans			No floating heads
5268473 N		10								
547063 E		31								

Details of Wild Rice Surveys on Pike River

Grid 19 Pike River										
8/15/2013 water depth = 75.05 cm Transparency Reading = 35-49 cm										
Plot# UTM Coordinates (meters)	# of 0.5m ² 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
		39								
Plot 54	4	55	60	5		1	Potamogeton obtusifolius	Potamogeton natans		No WR head
5268473 N		60								
547066 E		32								
		28								
Plot 57	2	53	10			1	Potamogeton obtusifolius			No WR head
5268473 N		38								
547069 E										
Plot 61	1	31	95			1	Potamogeton obtusifolius			No floating heads
5268472 N										
547063 E										
Plot 63	2	24	75	1		1	Potamogeton obtusifolius	Potamogeton natans		No floating heads
5268472 N		47								
547065 E										
Plot 67	1	57	40			1	Potamogeton obtusifolius			No WR head
5268472 N										
547069 E										
Plot 74	5	64	98	10		1	Potamogeton obtusifolius	Potamogeton natans		1 WR head
5268471 N		50								
547066 E		40								
		27								
		19								
Plot 82	3	39	20			1	Potamogeton obtusifolius			1 WR head
5268470 N		34								
547064 E		33								
Plot 86	1	48	15	5		1	Potamogeton obtusifolius	Potamogeton natans		No WR head
5268470 N										
547068 E										
Plot 87	2	51	2			1	Potamogeton obtusifolius			No WR head
5268470 N		45								
547069 E										
Plot 95	6	47	40			1	Potamogeton obtusifolius			WQ @ 18:04 WR6 --> 10@ 18:00
5268477 N		40								
547973 E		51								
		44								
		47								

Details of Wild Rice Surveys on Pike River

Grid 19 Pike River										
8/15/2013 water depth = 75.05 cm Transparency Reading = 35-49 cm										
Plot# UTM Coordinates (meters)	# of 0.5m ² 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	3	38	38	6		1				
Median	3	38	30	5		1				
S.D.	2	14	35	4		0				

Details of Wild Rice Surveys on Little Rice Lake

Grid 20 Little Rice Lake										
8/15/2013 water depth = 87.25 Transparency Reading = 89 cm										
No Vegetation; Open H ₂ O										
Plot# UTM Coordinates (meters)	# of 0.5m ² 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 12	6	35	20			1	Potamogeton obtusifolius			V01 @ 14:13
5268671 N		25								
547222 E		15								
		33								
		37								
Plot 6	10	50	50			2	Potamogeton obtusifolius			WR01 -->WR05 @ 11:23
5268672 N		41								
547226 E		16								
		31								
		38								
Plot 8	5	44	20			1	Potamogeton obtusifolius			
5268672 N		31								
547228 E		34								
		43								
		25								
Plot 18	5	64	20			1	Potamogeton obtusifolius			
5268671 N		41								
547228 E		26								
		24								
Plot 28	3	24				1				
5268670 N		51								
547228 E		35								
Plot 59	5	43				1				
5268667 N		37								
547229 E		14								
		32								
		31								
Plot 79	2	28				1				
5268665 N		60								
547229 E										
Plot 89	2	43				1				
5268664 N		37								
547229 E										
Plot 100	4	36				1				
5268663 N		47								
547230 E		45								
		14								
Plot 98	1	42				1				
5268663 N										
547228 E										
Plot 77	4	47				1				
5268665 N		30								

Details of Wild Rice Surveys on Little Rice Lake

Grid 20 Little Rice Lake										
8/15/2013 water depth = 87.25 Transparency Reading = 89 cm										
No Vegetation; Open H ₂ O										
Plot# UTM Coordinates (meters)	# of 0.5m ² 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
547227 E		34								
		40								
Plot 78	3	34				1				
5268665 N		18								
547228 E		36								
Plot 57	5	32				1				WR06 -->WR10 @ 13:42
5268667 N		28								
547227 E		37								
		49								
		39								
Plot 45	0					1				
5268668 N										
547225 E										
Plot 56	3	58				1				
5268667 N		46								
547226 E		50								
Plot 51	7	74				1				WR11 --> WR15 @ 14:00; WQ #1 @14:05
5268667 N		53								
547221 E		36								
		74								
		46								
Plot 42	4	43				1				
5268668 N		39								
547222 E		47								
		39								
Plot 41	3	38				1				
5268668 N		42								
547221 E		40								
Plot 52	4	35	20			1	Potamogeton obtusifolius			
5268667 N		44								
547222 E		51								
		14								
Plot 83	3	37				1				PM-KNBB-120808-20-01
5268664 N		15								
547223 E		51								
Plot 93	6	32				1				
5268663 N		25								
547223 E		37								
		14								
		25								
Mean	4	37	26			1				
Median	4	37	20			1				
S.D.	2	13	13			0				

Details of Wild Rice Surveys on Unnamed Lake

Grid 21 Unnamed Lake (Embarrass Chain)										
8/5/2013 water depth = 50.31 cm Transparency Reading = 108 cm										
Plot# UTM Coordinates (meters)	# of 0.5m ² 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 81 5261314 N 549831 E	3	83 52 53	90	40		1	Algae	Nuphar lutea; Nymphaea odorata		Eaten WR; V03- Sagittaria rigida
Plot 72 5261315 E 549832 E	1	77	90	20		1	Algae	Nymphaea odorata		Eaten WR
Plot 41 5261318 N 549831 E	0		7				Utricularia vulgaris			V01- Potamogeton obtusifolius V02- Utricularia vulgaris
Plot 1 5261322 E 549831 E	0		5	50			Utric; Algae	Nuphar Varigata; Nymphaea odorata		Water sample 01
Plot 4 5261322 N 549834 E	0		10	80			Utricularia vulgaris ; Algae	Nuphar Varigata; Nymphaea odorata		Herbivory-WD
Plot 14 5261321 N 549834 E	0		90	50	2		Algae	Nuphar Varigata; some Nymphaea odorata	Sagittaria latifolia	
Plot 5 5261322 N 549835 E	0		70	40			Algae	Nuphar Varigata; Nymphaea odorata		
Plot 6 5261322 N 549836 E	0		90	20			Algae	Nuphar Varigata; Nymphaea odorata		Hard to see through algae
Plot 17 5261321 N 549837 E	0		10	40			Algae	Nuphar Varigata; Nymphaea odorata		
Plot 18 5261321 N 549838 E	0		10	5			Algae	Nymphaea odorata		
Plot 29 5261320 N 549839 E	0		10	10			Utricularia vulgaris; Algae; Potamogeton zosteriformis	Nymphaea odorata		

Details of Wild Rice Surveys on Unnamed Lake

Grid 21 Unnamed Lake (Embarrass Chain)										
8/5/2013 water depth = 50.31 cm Transparency Reading = 108 cm										
Plot# UTM Coordinates (meters)	# of 0.5m ² 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 27	0		30	20			Algae	Nuphar Varigata (Some Nymphaea odorata)		
5261320 N 549837 E										
Plot 26	0		50	15			Algae	Nymphaea odorata		
5261320 N 549836 E										
Plot 44	0		90	20			Algae	Nymphaea odorata (Couple of Nuphar Varigata)		
5261318 N 549834 E										
Plot 45	0		90	20			Algae	Nymphaea odorata (Couple of Nuphar Varigata)		
5261318 N 549835 E										
Plot 55	0		50	50			Algae	Nymphaea odorata (Couple of Nuphar Varigata)		
5261317 N 549835 E										
Plot 58	0		20	20			Utricularia vulgaris; Algae	Nymphaea odorata	Sagittaria spp.	
5261317 N 549838 E										
Plot 95	1	64	20	20		1	Algae	Nymphaea odorata		Less algae, V04- Potamogeton zosteriformis
5261313 N 549835 E										
Plot 96	0		40	50			Algae	Nymphaea odorata		
5261313 N 549836 E										
Plot 50	0		10	20	10		Utricularia vulgaris; Algae	Nymphaea odorata; Nuphar Varigata	Sagittaria graminea	
5261318 N 549840 E										
Mean	0	66	44	31	6	1				
Median	0	64	35	20	6	1				
S.D.	0	14	35	19	6	0				

Details of Wild Rice Surveys on Lower Embarrass Lake

Grid 22 Lower Embarrass Lake										
8/5/2013 water depth = 53.89 cm Transparency Reading = 103 cm										
Plot# UTM Coordinates (meters)	# of 0.5m ² 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 98 5262463 N 550008 E	0		1				Potamogeton cf. zosteriformis			V01-Sag.-outside grid Sagittaria graminea
Plot 96 5262463 N 550006 E	0		1				Potamogeton cf. zosteriformis			
Plot 92 5262463 N 550002 E	0				30				Sparganium eurycarpum	Tree- 20%
Plot 82 5262464 N 550002 E	0				30				Sparganium eurycarpum	Tree
Plot 73 5262465 N 550003 E	0									
Plot 64 5262466 N 550004 E	0		1				Potamogeton cf. zosteriformis			
Plot 55 5262467 N 550005 E	0		5	10			Vallisneria americana	Nymphaea odorata		Water sample pm-kms2
Plot 36 5262469 N 550006 E	0									
Plot 77 5262465 N 550007 E	0		10				Potamogeton cf. zosteriformis			V02-Sparganium eurycarpum
Plot 26 5262470 N 550006 E	0		1	1			Potamogeton zosteriformis	Nymphaea odorata		WR02
Plot 8 5262472 N 550008 E	0									
Plot 19 5262471 N 550009 E	0		10				Potamogeton zosteriformis			V03- Vallisneria americana
Plot 29 5262470 N 550009 E	0									
Plot 15	0		30				Potamogeton zosteriformis			

Details of Wild Rice Surveys on Lower Embarrass Lake

Grid 22 Lower Embarrass Lake										
8/5/2013 water depth = 53.89 cm Transparency Reading = 103 cm										
Plot# UTM Coordinates (meters)	# of 0.5m ² 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
5262471 N 550005 E										
Plot 3 5262472 N 550003 E	0		5		5		Vallisneria americana; Potamogeton zosteriformis		Sparganium eurycarpum; Sagittaria graminea	WR near by - no seed head
Plot 13 5262471 N 550003 E	0		10				Vallisneria americana; Potamogeton zosteriformis			
Plot 1 5262472 N 550001 E	0			10	10			Nuphar Varigata	Sparganium eurycarpum	
Plot 11 5262471 N 550001 E	0									Tree
Plot 22 5262470 N 550002 E	0		5		5		Potamogeton zosteriformis		Sagittaria graminea	Tree branch in plot
Plot 31 5262469 N 550001 E	0				15				Sagittaria graminea	
Mean	0		7	7	16					
Median	0		5	10	13					
S.D.	0		8	5	12					

Details of Wild Rice Surveys on Partridge River

Grid 26 Partridge										
8/30/2013 water depth = 87.74 cm Transparency Reading = 104 cm										
Plot# UTM Coordinates (meters)	# of 0.5m ² 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	2	49	5	50	5	1		Nuphar lutea ssp. Varigata	Eleocharis palustris	
5263128 N		27								
560970 E										
Plot 50	0									
5263124 N										
560970 E										
Plot 59	0									
5263123 N										
560969 E										
Plot 79	0									
5263121 N										
560969 E										
Plot 80	0									
5263121 N										
560970 E										
Plot 39	0									
5263125 N										
560969 E										
Plot 28	0			20				Nymphaea leibergii		
5263126 N										
560968 E										
Plot 25	0									
5263126 N										
560965 E										
Plot 23	0									
5263126 N										
560963 E										
Plot 24	0									
5263126 N										
560964 E										
Plot 53	0									
5263123 N										
560963 E										
Plot 42	0									
5263124 N										
560962 E										
Plot 74	0									
5263121 N										
560964 E										
Plot 75	0									
5263121 N										
560965 E										
Plot 73	0									
5263121 N										
560963 E										
Plot 78	0									
5263121 N										
560968 E										
Plot 68	0									
5263122 N										
560968 E										
Plot 96	0									WQ @ 11:53
5263119 N										
560966 E										
Plot 97	0									
5263119 N										
560967 E										
Plot 91	0									PICS: NW- 100.0769 W-100.0770

Details of Wild Rice Surveys on Partridge River

Grid 26 Partridge										
8/30/2013 water depth = 87.74 cm Transparency Reading = 104 cm										
Plot# UTM Coordinates (meters)	# of 0.5m ² 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
5263119 N										
560961 E										
Mean	0	38	5	35	5	1				
Median	0	38	5	35	5	1				
S.D.	0	16		21						

Details of Wild Rice Surveys on Partridge River

Grid 27 Partridge										
8/30/2013 water depth = 37.63 cm Transparency Reading = 81 cm										
Plot# UTM Coordinates (meters)	# of 0.5m ² 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	43	52		20		30		Nymphaea odorata		
5262728 N		46								
561031 E		48								
		68								
		37								
Plot 6	96	71			5	50			Sagittaria latifolia	WQ @ 12:59
5262728 N		66								
561033 E		67								
		59								
		66								
Plot 24	69	45			10	30			Sparganium americanum	WR01 --> WR05 @ 13:05
5262726 N		38								
561031 E		58								
		54								
		53								
Plot 25	80	53		50	10	40			Sparganium americanum	
5262726 N		62								
561032 E		83								
		60								
		61								
Plot 36	36	32			20	20			Sparganium americanum	
5262725 N		41								
561033 E		55								
		57								
		62								
Plot 55	30	33			10	10			Sparganium americanum	
5262723 N		39								
561032 E		53								
		40								
		49								
Plot 75	33	43				10				
5262721 N		42								
561032 E		37								
		33								
		50								
Plot 71	43	93		1	1	10		Nymphaea odorata	Sparganium americanum	
5262721 N		51								
561028 E		56								
		39								
		43								
Plot 61	6	37		20	1	5		Nymphaea odorata	Sparganium americanum	
5262722 N		38								
561028 E		48								

Details of Wild Rice Surveys on Partridge River

Grid 27 Partridge										
8/30/2013 water depth = 37.63 cm Transparency Reading = 81 cm										
Plot# UTM Coordinates (meters)	# of 0.5m ² 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
		40								
		31								
Plot 32	24	45		1		5		Nymphaea odorata		
5262725 N		40								
561029 E		34								
		27								
		29								
Plot 41	38	48		20	1	20		Nymphaea odorata	Sparganium americanum	
5262724 N		35								
561028 E		29								
		33								
		30								
Plot 67	103	60			15	40			Sparganium americanum	WR06 --> 10 @13:45
5262722 N		50								
561034 E		54								
		47								
		48								
Plot 87	84	62			10	40			Sparganium americanum	
5262720 N		59								
561034 E		59								
		60								
		75								
Plot 89	17	50			10	10			Sparganium americanum	
5262720 N		47								
561036 E		66								
		35								
		34								
Plot 58	9	68			20	30			Sparganium americanum	WR11 --> WR15 @14:10
5262723 N		80								
561035 E		61								
		58								
		54								
Plot 60	35	61			50	10			Sagittaria latifolia	
5262723 N		67								
561037 E		62								
		48								
		38								
Plot 38	75	63			20	25			Sagittaria latifolia	
5262725 N		71								
561035 E		64								
		63								
		61								
Plot 29	37	56			20	10			Sagittaria latifolia	
5262726 N		63								

Details of Wild Rice Surveys on Partridge River

Grid 27 Partridge										
8/30/2013 water depth = 37.63 cm Transparency Reading = 81 cm										
Plot# UTM Coordinates (meters)	# of 0.5m ² 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
561036 E		71								
		49								
		58								
Plot 20	14	67			10	5			Sagittaria latifolia	
5262727 N		41								
561037 E		47								
		55								
		64								
Plot 10	43	80			10	30			Sagittaria latifolia	
5262728 N		78								
561037 E		60								
		65								
		58								
Mean	46	53		19	13	22				
Median	38	54		20	10	20				
S.D.	29	14		18	12	14				

Details of Wild Rice Surveys on Partridge River

Grid 28 Partridge										
8/30/2013 water depth = 46 cm Transparency Reading = 116 cm										
Plot# UTM Coordinates (meters)	# of 0.5m ² 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	0									
5263434 N										
561039 E										
Plot 49	0									
5263436 N										
561040 E										
Plot 97	0									
5263431 N										
561038 E										
Plot 100	0									
5263431 N										
561041 E										
Plot 89	0									
5263432 N										
561040 E										
Plot 52	27	37				20				WR01 --> WR05; PM_KMS2_28_2930830 @10:15
5263435 N		44								
561033 E		28								
		22								
		45								
Plot 74	4	22	80			1	Eleocharis palustris			NQ @ 10:23
5263433 N		24								
561035 E		25								
		2								
Plot 73	1	15	80			1	Eleocharis palustris			
5263433 N										
561034 E										
Plot 93	0		80				Eleocharis palustris			
5263431 N										
561034 E										

Details of Wild Rice Surveys on Partridge River

Grid 28 Partridge										
8/30/2013 water depth = 46 cm Transparency Reading = 116 cm										
Plot# UTM Coordinates (meters)	# of 0.5m ² 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 92	0		80				Eleocharis palustris			
5263431 N										
561033 E										
Plot 72	28	55		5		30	Sparganium fluctuans			WR06 --> WR10 @10:37
5263433 N		41								
561033 E		38								
		40								
		40								
Plot 37	0									
5263437 N										
561038 E										
Plot 36	0									
5263437 N										
561037 E										
Plot 29	0									
52634378 N										
561040 E										
Plot 20	0									
5263439 N										
561041 E										
Plot 7	36	39	20			25	Eleocharis palustris			WR11 --> WR15
5263440 N		51								
561038 E		47								
		35								
		37								
Plot 1	4	24				1				
5263440 N		40								
561032 E		36								
		32								
Plot 34	0									
5263437 N										
561035 E										
Plot 25	16	40	30			10	Eleocharis palustris			
5263438 N		28								

Details of Wild Rice Surveys on Partridge River

Grid 28 Partridge										
8/30/2013 water depth = 46 cm Transparency Reading = 116 cm										
Plot# UTM Coordinates (meters)	# of 0.5m ² 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
561036 E		38								
		50								
		38								
Plot 64	0									
5263434 N										
561035 E										
Mean	6	35	62	5		13				
Median	0	38	80	5		10				
S.D.	11	11	29			12				

Details of Wild Rice Surveys on Cedar Island Lake

Grid 29 Cedar Island Lake										
8/6/2013 water depth = 60.6 cm Transparency Reading = 102 cm										
Mucky bottom of lake.										
Plot# UTM Coordinates (meters)	# of 0.5m ² 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 14	17	79	15	25		5	Utricularia vulgaris; Potamogeton zosteriformis	Nymphaea odorata		
5260248 N		85								
549336 E		80								
		92								
		77								
Plot 26	27	92	30	40		10	Potamogeton zosteriformis	Nymphaea odorata		
5260248 N		94								
549338 E		100								
		89								
		84								
Plot 38	0			60				Nymphaea odorata; Nuphar variegata		
5260246 N										
549340 E										
Plot 60	13	73	42	10		5	Potamogeton robbinsii; Myriophyllum sibericum	Brasenia peltata schreberi; Nymphaea odorata		
5260244 N		69								
549342 E		70								
		105								
		70								
Plot 59	15	88	25			5	Myriophyllum sibericum; Elodea canadensis; Utricularia vulgaris	Potamogeton robbinsii		WR02
5260244 N		107								
549342 E		77								
		75								
		65								
Plot 9	43	74	5			25	Utricularia vulgaris			
5260250 N		71								
549342 E		82								
		97								
		86								
Plot 35	1	86		15		1		Nymphaea odorata		
5260246 N										
549338 E										
Plot 21	9	79	2	40		5	Ceratophyllum demersum	Nymphaea odorata		herbivory, WR01 Water sample 01
5260248 N		80								
549334 E		105								
		70								
		97								
Plot 22	28	78	35			10	Utricularia vulgaris; Potamogeton zosteriformis			
5260248 N		87								
549334 E		76								

Details of Wild Rice Surveys on Cedar Island Lake

Grid 29 Cedar Island Lake										
8/6/2013 water depth = 60.6 cm Transparency Reading = 102 cm										
Mucky bottom of lake.										
Plot# UTM Coordinates (meters)	# of 0.5m ² 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
		75								
		76								
Plot 76	5	67	20			5	Potamogeton robbinsii; Utricularia vulgaris			
5260242 N		77								
549338 E		112								
		67								
		100								
Plot 98	12	81	7	85		5	Utricularia vulgaris; Potamogeton robbinsii	Brasenia schreberi; Nymphaea odorata		
5260240 N		72								
549340 E		79								
		75								
		78								
Plot 90	0		15	75			Myriophyllum sibericum	Nymphaea odorata; Brasenia schreberi		
5260242 N										
549342 E										
Plot 94	6	66	10			3	Ceratophyllum demersum; Potamogeton robbinsii			
5260240 N		80								
549336 E		63								
		66								
		88								
Plot 73	9	75	10	60		5	Utricularia vulgaris	Nuphar Varigata		
5260242 N		83								
549336 E		74								
		76								
		67								
Plot 63	8	68	2			3	Utricularia vulgaris			
5260244 N		94								
549336 E		78								
		110								
		80								
Plot 44	0			50				Nymphaea odorata; Nuphar Varigata		
5260246 N										
549336 E										
Plot 54	1	78	10	40		1	Potamogeton zosteriformis	Nuphar Varigata		
5260244 N										
549336 E										

Details of Wild Rice Surveys on Cedar Island Lake

Grid 29 Cedar Island Lake										
8/6/2013 water depth = 60.6 cm Transparency Reading = 102 cm										
Mucky bottom of lake.										
Plot# UTM Coordinates (meters)	# of 0.5m ² 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	7	62	30	40		3	Utricularia vulgaris; Ceratophyllum demersum; Potamogeton robbinsii	Nuphar Varigata		
5260244 N		79								
549336 E		73								
		70								
		91								
Plot 61	6	59	2			2	Utricularia vulgaris			
5260244 N		72								
549334 E		76								
		50								
		63								
Plot 72	12	82	5	2		5	Potamogeton robbinsii	Nuphar Varigata		
5260242 N		94								
549334 E		71								
		71								
		79								
Mean	10.95		15.5882353	42						
Median	8.5		10	40						
S.D.	11		13	25						

Details of Wild Rice Surveys on Cedar Island Lake

Grid 30 Cedar Island Lake										
8/6/2013 water depth = 59.79 cm Transparency Reading = 101 cm										
Plot# UTM Coordinates (meters)	# of 0.5m ² 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	0		30				Potamogeton obtusifolius			
Plot 63 5259369 N 549102 E	0		50				Potamogeton cf. zosteriformis			
Plot 64 5259368 N 549102 E	0		60				Potamogeton obtusifolius; Potamogeton cf. zosteriformis			
Plot 83 5259368 N 549101 E	0		25	5			Potamogeton cf. zosteriformis	Nymphaea odorata		
Plot 74 5259368 N 549102 E	0		55				Potamogeton cf. zosteriformis			
Plot 42 5259371 N 549102 E	18	120 110 105 67 72	60			50	Potamogeton obtusifolius; Ceratophyllum demersum			Some Herbivory
Plot 52 5259370 N 549101 E	0		80				Vallisneria americana; Potamogeton obtusifolius			
Plot 5 5259371 N 549106 E	70	102 106 104 143 147		30		60		Nymphaea odorata		WR06
Plot 4 5259372 N 549106 E	100	119 146 95 75 119		40		70		Nymphaea odorata		Density 5; Water sample

Details of Wild Rice Surveys on Cedar Island Lake

Grid 30 Cedar Island Lake										
8/6/2013 water depth = 59.79 cm Transparency Reading = 101 cm										
Plot# UTM Coordinates (meters)	# of 0.5m ² 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 23	30	102		65		25		Nymphaea odorata		
5259371 N		133								
549104 E		90								
		92								
		114								
Plot 96	66	136	5			50	Potamogeton cf. zosteriformis			WR07
5259365 N		115								
549102 E		130								
		134								
		140								
Plot 88	35	126		3		35		Brasenia schreberi; Nymphaea odorata		
5259364 N		109								
549104 E		133								
		133								
		134								
Plot 79	65	113	2	27		55	Utricularia vulgaris	Nuphar Varigata; Brasenia schreberi		
5259364 N		90								
549105 E		115								
		118								
		140								
Plot 68	60	87		35		65		Nuphar Varigata; Brasenia schreberi		
5259366 N		102								
549105 E		128								
		141								
		108								
Plot 58	74	117		20		50		Nuphar Varigata		
5259366 N		112								
549106 E		119								
		136								
		138								
Plot 59	43	78	0	50		25		Nuphar Varigata		
5259365 N		125								
549107 E		92								
		90								
		100								
Plot 38	76	136	15	40		55	Potamogeton cf. zosteriformis	Nymphaea odorata		
5259367 N		160								
549107 E		130								
		117								
		109								

Details of Wild Rice Surveys on Cedar Island Lake

Grid 30 Cedar Island Lake										
8/6/2013 water depth = 59.79 cm Transparency Reading = 101 cm										
Plot# UTM Coordinates (meters)	# of 0.5m ² 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	55	150	15	25		55	Utricularia vulgaris; Potamogeton cf. zosteriformis	Nuphar Varigata		
5259367 N		120								
549108 E		129								
		145								
		105								
Plot 10	45	77	25	40		30	Potamogeton cf. zosteriformis	Nymphaea odorata; Nuphar Varigata		
5259368 N		100								
549110 E		140								
		141								
		112								
Plot 90	30	112	12			15	Potamogeton cf. zosteriformis; Myriophyllum sibericum			
		130								
		100								
		133								
		148								
Mean	38	117	31	32		46				
Median	39	118	25	33		50				
S.D.	32	21	25	18		17				

Details of Wild Rice Surveys on Pokegama Bay

Grid 90 Pokegama Bay										
8/27/2013 water depth = 79.52 cm Transparency Reading = 47 cm										
Plot# UTM Coordinates (meters)	# of 0.5m ² 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	7	54				10				PM-KMS2_01_201308271119
5169514 N		91								
565561 E		58								
		70								
		42								
Plot 22	15	73				20				
5169512 N		60								
565562 E		76								
		52								
		56								
Plot 43	16	89				20				
5169510 N		44								
565563 E		67								
		75								
		71								
Plot 53	51	116				70				Collected WR01-->WR05
5169509 N		119								
565563 E		106								
		96								
		119								
Plot 63	29	121				40				Collected WR06-->WR10
5169508 N		141								
565563 E		99								
		82								
		120								
Plot 73	36	63	1			35	Ceratophyllum apiculatum (or C. demersum)			Collected WR11-->WR15
5169507 N		83								
565563 E		90								
		116								
		86								
Plot 82	62	82			1	75			Sagittaria rigida	
5169506 N		85								
565562 E		98								
		130								
		96								
Plot 91	19	105				15				
5169505 N		63								
565561 E		71								
		120								
		95								
Plot 84	11	55				10				
5169506 N		66								
565564 E		65								
		62								
		79								
Plot 64	60	89				50				
5169508 N		97								
565564 E		89								
		87								
		93								
Plot 65	13	93				10				
5169508 N		76								
565565 E		69								
		59								
		58								
Plot 56	15	67				20				
5169509 N		66								
565566 E		54								
		80								

Details of Wild Rice Surveys on Pokegama Bay

Grid 90 Pokegama Bay										
8/27/2013 water depth = 79.52 cm Transparency Reading = 47 cm										
Plot# UTM Coordinates (meters)	# of 0.5m² 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
		63								
Plot 57	8	99				5				Utricularia in the area
5169509 N		98								
565567 E		100								
		72								
		59								
Plot 58	38	105				40				
5169509 N		101								
565568 E		93								
		98								
		106								
Plot 7	62	93				60				
5169514 N		86								
565567 E		80								
		89								
		64								
Plot 10	19	94				20				
5169514 N		91								
565570 E		83								
		98								
		96								
Plot 19	49	132				70				
5169513 N		109								
565569 E		105								
		98								
		76								
Plot 40	59	101				65				
5169511 N		98								
565570 E		96								
		93								
		86								
Plot 50	18	90	3			15	Najas flexilis			Photos 6-9 NESW
5169510 N		105								
565570 E		100								
		65								
		73								
Plot 77	17	127	1			10	Najas flexilis			
5169507 N		92								
565567 E		94								
		93								
		89								
Mean	30	87	2		1	33				
Median	19	89	1		1	20				
S.D.	20	21	1			24				

Details of Wild Rice Surveys on Pokegama Bay

Grid 91 Pokegama Bay										
8/27/201 water depth = 74.45 cm Transparency Reading = 44 cm										
Plot# UTM Coordinates (meters)	# of 0.5m ² 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 95	31	90	10	20		25	Potamogeton richardsonii; Najas flexilis	Nymphaea odorata		
5170014 N		74								
564989 E		75								
		69								
		82								
Plot 85	45	76	30			40	Utricularia vulgaris ; Potamogeton richardsonii			PM_KMS2_02_2013082 7 @13:10
5170015 N		69								
564989 E		61								
		69								
		61								
Plot 76	57	88	5	5		50	Potamogeton richardsonii	Nymphaea odorata		WR01-05
5170016 N		63								
564990 E		84								
		66								
		75								
Plot 51	43	95				40				
5170018 N		82								
564985 E		76								
		77								
		75								
Plot 41	49	104	1	10		50	Najas flexilis	Nymphaea odorata		WR 06-10
5170019 N		101								
564985 E		85								
		85								
		67								
Plot 43	20	62			1	10			Sparganium americanum	Some WR stems chewed; Sparganium chewed
5170019 N		45								
564987 E		43								
		48								
		35								
Plot 53	50	83	21	2		60	Potamogeton zosteriformis; Ceratophyllum apiculatum	Nymphaea odorata		
5170018 N		71								
564987 E		74								
		75								
		83								
Plot 34	43	103		5		70		Nymphaea odorata		WR11-15
5170020 N		105								
564988 E		107								
		108								
		107								

Details of Wild Rice Surveys on Pokegama Bay

Grid 91 Pokegama Bay										
8/27/201 water depth = 74.45 cm Transparency Reading = 44 cm										
Plot# UTM Coordinates (meters)	# of 0.5m ² 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	24	82	1	50	1	15	Najas flexilis	Nymphaea odorata	Sparganium americanum	
5170020 N		78								
564990 E		64								
		34								
		75								
Plot 26	31	128	2	20	10	30	Najas flexilis	Nymphaea odorata	Sagittaria rigida	
5170021 N		112								
564990 E		97								
		100								
		104								
Plot 25	20	101	10	5	10	15	Najas flexilis	Nymphaea odorata	Schoenoplectus tabernaemontani; Sagittaria rigida	
5170021 N		95								
564989 E		78								
		73								
		88								
Plot 15	28	101		5	10	50		Nuphar Varigata	Sagittaria rigida	
5170022 N		102								
564989 E		91								
		56								
		49								
Plot 6	12	67	1		1	10	Ceratophyllum apiculatum		Sparganium americanum	Some WR chewed on
5170023 N		68								
564990 E		62								
		65								
		39								
Plot 1	13	77	1			10	Najas flexilis			Some WR chewed on
5170023 N		75								
564985 E		71								
		65								
		60								
Plot 10	1	30				1				
5170023 N										
564994 E										
Plot 19	4	31			1	2			Sparganium americanum	Chewed on stems WR
5170022 N		27								
564993 E		37								
		46								
Plot 40	1	37	6	20	10	1	Najas flexilis; Ceratophyllum apiculatum	Nymphaea odorata	Sagittaria rigida	Sagittaria rigida chewed; Potamogeton zosteriformis present
5170020 N										

Details of Wild Rice Surveys on Pokegama Bay

Grid 91 Pokegama Bay										
8/27/201 water depth = 74.45 cm Transparency Reading = 44 cm										
Plot# UTM Coordinates (meters)	# of 0.5m ² 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
564994 E										
Plot 39	38	93	5		20	50	Najas flexilis		Sagittaria rigida	Sagittaria rigida chewed
5170020 N		92								
564993 E		89								
		96								
		74								
Plot 60	12	90	5		15	5	Najas flexilis		Sagittaria rigida	
5170018 N		85								
564994 E		82								
		83								
		61								
Plot 99	20	54	5	50		10	Najas flexilis	Nymphaea odorata		
5170014 N		67								
564993 E		53								
		67								
		42								
Mean	27	75	7	17	8	27				
Median	26	75	5	10	10	20				
S.D.	17	21	8	17	7	22				