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***2009 Wild Rice and Sulfate Monitoring***

***Spring Mine Creek, Embarrass River, Partridge  
River, Pike River, and Lower St. Louis River***

***Prepared for  
PolyMet Mining Inc. – NorthMet Project***

***September 2009***



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**2009 Wild Rice and Sulfate Monitoring  
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Lower St. Louis River**

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## 1.0 Background

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The purpose of this report is to provide information in response to the Minnesota Pollution Control Agency's (MPCA) "Wild Rice Information Request" on May 28, 2009 with regard to the PolyMet Mining, Inc. (PolyMet) NorthMet Project (Project) (Appendix C).

The MPCA requested the following information:

- 1.0 A literature review to determine the location of wild rice potentially affected by waterbodies downstream from the Project. As a result of this literature review, an analysis of historic infra-red USGS photographs for the presence of wild rice in water bodies downstream from the Project was determined to be beneficial.
- 2.0 Consultation with Bands of Chippewa and the 1854 Treaty Authority.
- 3.0 A ground survey of wild rice presence and density.
- 4.0 Information on current sulfate concentrations in the bodies of water where wild rice was identified.

As part of consultation with the Bands of Chippewa (Bands), PolyMet contacted representatives from Bois Forte Band of Chippewa, Fond du Lac Band of Lake Superior Chippewa, Grand Portage Band of Lake Superior Chippewa, and the 1854 Treaty Authority. Following the literature review and prior to the ground survey, each representative was contacted by email and phone for comment regarding potential water bodies affected by the Project.

## 2.0 Wild Rice Survey

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The purpose of the Wild Rice Survey is to determine the presence of wild rice (*Zizania palustris* L, known as *Manoomin* in Ojibwe), an annual grass, on Spring Mine Creek, the Embarrass River from its headwaters to its confluence with the St. Louis River, the Partridge River from its headwaters to its confluence with the St. Louis River, the lower St. Louis River, and Hay Lake (MN ID 69579) and Little Rice Lakes near the Pike River (Study Area) (Figures 1a and 1b). Since wild rice populations oscillate over an approximate 4 to 6 year period, the following analyses and ground surveys were performed to determine past and current presence of wild rice:

1. Literature review to identify water bodies potentially affected by the Project.
2. Analysis of historic aerial photographic imagery of the Study Area.
3. On-the-ground verification of the presence and density of select wild rice stands.
4. Analysis of 2009 aerial photographic imagery to verify information obtained from the cultural data, historic aerial photography, and ground surveys.

### 2.1 Wild Rice Survey Methodology

The following section describes the methodologies used in obtaining information and data on wild rice.

#### 2.1.1 Methodology of Literature Review for Wild Rice in Downstream Receiving Waters from the Project

To determine which waterbodies downstream of the Project might potentially have wild rice, a literature review of historic and cultural information was conducted. Information examined include the 2008 DNR “Natural Wild Rice in Minnesota” Report, U.S. Department of Interior Geological Survey maps (Topo maps), and the 1854 Treaty Authority List.

#### 2.1.2 Methodology of Historic Aerial Photographic Imagery Analysis

Staff from the Geospatial Sciences and Technologies Branch USGS-BRD-Upper Midwest Environmental Sciences Center in La Crosse, WI analyzed 2004 and 2008 one-meter resolution NAIP (National Agricultural Imagery Program) natural color and color infrared aerial photographic imagery for the presence of wild rice on Spring Mine Creek, the Embarrass River, the Partridge River, the St. Louis River, and Hay Lake (MN ID 69579) and Little Rice Lake. These photos are the best publicly available aerial images from which to identify areas with the potential for the presence of wild rice. The USGS staff has over a decade of experience analyzing NAIP aerial images for the

presence of wild rice, mostly along the backwaters and bays of the Mississippi River in southeastern Minnesota and southwestern Wisconsin. The quality of the analysis is influenced by several factors, including the date of acquisition, weather conditions, light conditions, and the quality of the “wild rice photographic signature.” While the wild rice signature is considered distinct at the end of the growing season, it can be difficult to distinguish it from the signature of other emergent plants at other stages.

### **2.1.3 Methodology of Ground Verification and Density/Acreage Calculations**

Surveys to estimate wild rice density and crop acreage were carried out in August and September of 2009. Qualitative estimates of wild rice coverage were carried out by canoeing or kayaking along the perimeter of wild rice beds, recording bed locations using a Trimble® GPS Pathfinder® ProXH™ receiver, and recording approximate stand density using a density factor with a scale of one (low density) to five (high density) (similar to the method used by 1854 Treaty Authority, “Wild Rice Monitoring and Abundance in the 1854 Ceded Territory (1998- 2008)”). Quantitative estimates of wild rice coverage were determined from representative sampling grids of 10 meters x 10 meters.

Grid sampling was carried out in areas with a density factor between three and five. One grid was sampled in the Lower Embarrass Lake, one south of Unnamed Lake, and two grids on Cedar Island Lake along the Embarrass River. Two grids were sampled on Little Rice Lake near the Pike River. Three grids were sampled in the Lower Partridge River near Highway 110. Three grids were sampled in Pokegama Bay upstream from the Lower St. Louis River.

Within each grid, 20 one meter by one meter plots were randomly selected using a computer random number generator. Each randomly selected plot was sampled using a 0.5 m<sup>2</sup> sampling square made from PVC piping (0.71 m on each side). The square was placed on the water surface at each randomly selected plot and the rice stems within the 0.5 m<sup>2</sup> square were counted. Stem height above the water surface was measured for one to five plants within each 0.5 m<sup>2</sup> plot. Height was measured at the plant’s highest point (seed head or flag leaf depending on stage of plant growth). Stem count sum, mean, median, and standard deviation were calculated based on the stem count for 20 plots. The total stem count for each grid comprises 10 percent of the grid area. The total area sampled for each grid was 10 m<sup>2</sup> (20 plots x 0.5 m<sup>2</sup> each). The grid size of Grid Sample #30 was 10 meters x 7 meters with the distance between plots calculated accordingly. UTM coordinates for each plot in each grid were recorded.

#### **2.1.4 Methodology for Analysis of 2009 Aerial Photographs**

Aerial photographic images of the Study Area were acquired the first week of September 2009; rectification and analysis is currently underway, and the corresponding results will be presented at a later date. The aerial photographs are color digital imagery with a 1.9 feet/pixel resolution. The sun angle was 30 degrees but the sky conditions were somewhat hazy.

## **2.2 Wild Rice Survey Results**

The following sections present the results of the wild rice survey for the Study Area. Surveying and grid sampling were carried out between August 13 and September 8, 2009.

### **2.2.1 Results of 2009 Literature Review**

Spring Mine Creek, the Embarrass River, the Partridge River, and the Lower St. Louis River were identified as waterbodies which could potentially support wild rice downstream from the Project. Hay Lake (MN ID 69435), east of the Embarrass River, is listed in the DNR 2008 Report as historically supporting wild rice. Hay Lake (MN ID 69579) and Little Rice Lake (MN ID 69578) near the Pike River are not downstream from the Project but could potentially be control sites for monitoring wild rice presence and health. Hay Lake near the Pike River is also listed in the DNR 2008 Report. Pokegama Bay flows into the St. Louis River and could also serve as a control site (Figure 1b).

### **2.2.2 Results of Historic Aerial Photographic Imagery Analysis**

The potential presence of wild rice identified from the historic aerial photographic imagery analysis is marked with green squares (2008 photos) and yellow squares (2004 photos) (Figures 2 through 5). This method of identification did not include any estimates for bed size, overall acreage, or density. The 2003/2004 NAIP aerial imagery for the Study Area was acquired during the period of June 15-20, 2003. Additional imagery was taken on August 18, 2003 for the Lower St. Louis River and on September 18, 2004 for the Embarrass River (it includes the western portion of the river up to several miles north of Sabin Lake). The 2008 NAIP aerial imagery for Spring Mine Creek, Embarrass River (it includes the eastern portion from north of Sabin Lake to its headwaters), Partridge River and Lower St. Louis River was taken on August 17, 2008. Imagery for the Lower St. Louis River at Brookston was taken on August 18, 2008. Imagery for the Embarrass River (western portion), Hay Lake (MN ID 69435), Little Rice Lake (MN ID 69578), and Hay Lake (MN ID 69579) was taken on August 24, 2008. Additional imagery for the Lower St. Louis River was taken on August 29, 2008.

Wild rice does not typically emerge above the water level from the floating leaf stage until July in the Study Area. Therefore, only the 2008 NAIP images for the Study Area and the 2003/2004 images for the Lower St. Louis and the Embarrass River (eastern portion from north of Sabin Lake) taken in late summer are suitable for identifying wild rice. No rice was identified along the main stem of the St. Louis River from its confluence with the Partridge to Brookston. After discussion with the USGS staff who carried out the analysis, they concluded that it was unlikely wild rice grew along that portion of the St. Louis River.

### **2.2.3 Results of Ground Verification and Density/Acreage Calculations**

Wild rice was identified from ground surveys performed on Spring Mine Creek, the Embarrass River from its headwaters to its confluence with the St. Louis River, the Partridge River from its headwaters to its confluence with the St. Louis River including Colby Lake, the Lower St. Louis River from Brookston to Lake Superior, and Hay and Little Rice Lakes near the Pike River (Figure 6 through 21).

#### ***Spring Mine Creek and Embarrass River***

In general, based on qualitative assessments, the following water bodies had patches of wild rice in isolated locations comprising a few stems totaling less than 1 percent of the surveyed acreage (see photo A-9). These water bodies include the upper reach of the Embarrass River, Hay Lake (MN Lake ID 69435; east of the Embarrass River), Sabin Lake, Wynne Lake, Lower Embarrass Lake, Unnamed Lake, Cedar Island Lake, Fourth Lake, Esquagama Lake and a 0.5 mile stretch downstream from Esquagama Lake on the Embarrass River. The density factor was variable, but consistently a one or two within these stands, with the exception of some small stands in Cedar Island Lake (Figures 6 through 11 and 16 through 18). In a majority of cases where wild rice was identified on historic photographs from NAIP 2003/2004 and 2008 imagery, no rice or sparse stands of rice were identified. Other emergent vegetation was also often identified in those locations. Photographs of wild rice in the Study Area are included in Appendix A. Detailed information on density calculation results of the ground surveys is included in Appendix B. Due to difficulty related to access (no roads or access points) and navigation (rapids or the presence of large boulders prohibiting safe navigation), the upper approximately 1.5 miles (headwaters) of Spring Mine Creek were not surveyed. A road passes next to the lower portion Spring Mine Creek from which surveying was carried out; no rice was observed along Spring Mine Creek. Similarly, the Embarrass River south of Highway 95 was inaccessible and also not surveyed. No rice was observed along the Embarrass south of the outlet of Esquagama Lake, from Highway 20 to Highway 95.

### ***Partridge River***

In general, based on qualitative assessments, the following water bodies had patches of wild rice in isolated locations comprising a few stems totaling less than 1 percent of the surveyed acreage (density factor less than one) (Figure 12, see photo A-10). The first 13 miles of the Partridge River were inaccessible and therefore not surveyed (including Mud Lake (MN ID 09148)). Navigation of the Upper Partridge River, in general, was difficult, but possible from mile 13 (T59 R13 S29) to Colby Lake. Navigation was particularly difficult for the last several miles upstream of Colby Lake and very little rice was identified. No rice was identified on Colby Lake. Stands with a density factor of three to five were identified along the Lower Partridge River between Colby Lake and Highway 110 (Figures 13 and 19). Very little rice was identified after approximately 0.5 miles downstream from Highway 110. It became very difficult to navigate the last three miles of the Partridge; this section was not surveyed or sampled.

### ***Lower St. Louis River***

No rice was found along the river near Brookston, an area identified as potentially having wild rice from historic photographs (NAIP 2008). Sparse stands of wild rice were found along short stretches of the lower St. Louis River near its outlet into Lake Superior (Figure 14 and 20). A large, dense stand (approximately 30 acres) was identified in Pokegama Bay, a bay that flows into the St. Louis River. From discussion with Professor Anthony Kern, Northland College, Ashland WI who carries out research on wild rice in Pokegama Bay, wild rice is present in dense stands and covers a large acreage most years (personal communication, August 2009).

### ***Hay and Little Rice Lakes, Pike River***

Very little rice was found on Hay Lake near the Pike River (MN Lake ID 69579) with small stands totaling less than one percent of the sampled acreage. Wild rice stands with a density factor of three to five were identified in the Pike River flowing into and within Little Rice Lake (MN Lake ID 69578) (Figures 15 and 21).

## **2.2.4 Results of 2009 Aerial Photographs**

Rectification and analysis of aerial photographic imagery acquired in September 2009 is ongoing. Results will be included in a future report.

## **2.3 Wild Rice Survey Discussion**

Results from the historic aerial imagery analysis and 2009 ground surveys identified the presence of wild rice throughout the Study Area (Spring Mine Creek and the Embarrass River from its

headwaters to its confluence with the St. Louis River, the Partridge River from its headwaters to its confluence with the St. Louis River, the lower St. Louis River, and Hay and Little Rice Lakes near the Pike River). It is possible that the historic aerial imagery analysis resulted in mistaking other emergent vegetation for wild rice or in identifying the presence of stands of wild rice in 2003/2004 (only photographs taken in late summer, but not early in the season) and 2008. Several dense stands of wild rice were identified from ground surveys on Cedar Island Lake, the Lower Partridge River, Pokegama Bay near the St. Louis River, and Little Rice Lake near the Pike River. While historic photography provides evidence of some presence on those waterbodies, the locations on the photographs often did not match the locations of wild rice identified on the ground.

It is difficult to determine the health and history of wild rice in these waterbodies without a multi-year combined analysis of ground surveys and aerial photographic imagery, as wild rice populations oscillate over an approximate four to six year period. Delays in plant nutrient uptake and wild rice tissue chemistry influence wild rice growth and production from year to year (Walker et al., 2006; Walker et al., submitted for publication 2009). Other factors such as water level, parasites, herbivory and weather conditions may also play a role, but no data has been collected over multiple years and published. Given that wild rice populations fluctuate over a multiple year time period, studies carried out over a shorter time period (one year) may not provide sufficient information regarding the growth and production of wild rice.

Four areas had fairly dense stands of wild rice: Cedar Island Lake, in the Embarrass River watershed; Pokegama Bay, in the St. Louis River watershed; Little Rice Lake, in the Pike River watershed; and the Lower Partridge River. A comparison of measured wild rice densities for all grid locations is presented in Figure 23, and sulfate data collected as part of this study is presented in Section 3 below. Cedar Island Lake had densities between 54 and 57 stems / 0.5 m<sup>2</sup> with sulfate levels ranging from 19.3 mg/L to 20.3 mg/L. Pokegama Bay had densities between 28 and 54 stems / 0.5 m<sup>2</sup> with sulfate levels ranging from 7.0 mg/L to 8.8 mg/L. Little Rice Lake had densities between 31 to 110 stems / 0.5 m<sup>2</sup> and sulfate levels ranged from 1.9 mg/L to 2.3 mg/L. The Lower Partridge River downstream from Colby Lake had fairly dense stands between 39 and 117 stems / 0.5 m<sup>2</sup>. Sulfate samples were not collected at this site, but concentrations measured by Mesabi Nugget stream monitoring ranged from 46.8 mg/L to 289 mg/L (see Section 3.1). Additional monitoring data (both for sulfate concentrations and wild rice density) would be needed in order to determine the effects of sulfate on wild rice growth and production (see Walker et al., submitted for publication 2009) and the relative importance of other factors affecting wild rice density (e.g. hydrologic, weather, and ecological factors).

## **3.0 Sulfate Monitoring**

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Sulfate monitoring was carried out during the wild rice surveying in August and September of 2009. Results of measurements collected to date are presented in this report.

### **3.1 Sulfate Monitoring—2009 Data**

Results of sulfate analyses performed on water samples collected during wild rice surveys are presented in Table 1 and shown in Figures 1a, 1b, and 22. All water samples were analyzed for sulfate using an ion chromatography method (EPA 300.0). A total of 57 water samples were taken from 13 different water bodies. Observed sulfate concentrations ranged from a minimum of 1.1 mg/L (Hay Lake, off the Pike River) to a maximum of 33.3 mg/L (Embarrass River). The highest average concentration (27.3 mg/L) was observed in the Embarrass River, from which two samples were collected. Average sulfate concentrations observed throughout the Embarrass River chain of lakes decreases in the downstream direction from Embarrass Lake (21.3 mg/L) and Lower Embarrass Lake (21.3 mg/L), to Unnamed Lake (21.1 mg/L), Cedar Island Lake (19.8 mg/L), Fourth Lake (18.9 mg/L), and Esquagama Lake (17.1 mg/L). The standard deviation of concentrations for each lake within the Embarrass River chain of lakes was less than 1 mg/L (only one sample was taken in each Fourth Lake and Esquagama Lake). Sulfate concentrations in Hay Lake, located east of the Embarrass River and upstream of the chain of lakes, were lower than those observed within the chain of lakes, averaging 1.6 mg/L from three samples.

Sulfate concentrations measured in fourteen samples collected on the Upper Partridge River averaged 5.0 mg/L and ranged from 4.6 mg/L to 5.7 mg/L. Six samples collected on the St. Louis River downstream of Brookston averaged 17.7 mg/L and ranged from 8.0 mg/L to 27.4 mg/L. Sulfate concentrations in Pokegama Bay near the mouth of the St. Louis River ranged from 7.0 mg/L to 8.8 mg/L and averaged 7.6 mg/L. Additional samples collected at Hay Lake, Pike River, and Little Rice Lake yielded average sulfate concentrations of 1.1 mg/L and 2.1 mg/L, respectively, with standard deviations of 0.02 and 0.2 mg/L, respectively.

Sulfate samples were not collected during wild rice surveys on the Lower Partridge River (downstream of Colby Lake). However, water quality samples were collected by Mesabi Nugget at two surface water monitoring stations on August 19, 2009, one day before the wild rice survey was performed on this river segment. Measured sulfate levels were 46.8 mg/L just downstream of the Colby Lake outlet (MNSW14) and 289 mg/L at the Highway 110 crossing (MNSW12).

### **3.2 Sulfate Monitoring—Baseline Data**

Sulfate concentrations have been measured at five locations along the Partridge River (SW-001, SW-002, SW-003, SW-004, and SW-005) and two locations on the Embarrass River (PM-12 and PM-13) since 2004 as part of an ongoing water quality monitoring program for the PolyMet NorthMet Project (see Figures 1a and 1b, data from Barr, 2008). These data are summarized in Table 2 and Figure 22.

Measured concentrations of sulfate in the Partridge River were greatest at the most upstream monitoring location (SW-001), averaging 22.1 mg/L and ranging from 19.3 mg/L to 26.1 mg/L. Average sulfate concentrations measured between SW-001 and Colby Lake ranged between 6.3 mg/L (at SW-002) and 10.9 mg/L (at SW-003). Maximum sulfate concentrations observed downstream of SW-001 ranged from 11.8 mg/L (at SW-002) to 25.7 mg/L (at SW-003). Sulfate was not detected at SW-004 and SW-005 during at least one sampling event (detection limit of 1 mg/L).

Concentrations of sulfate measured at PM-12 in the Embarrass River averaged 4.6 mg/L and ranged from non-detection (i.e. less than 1 mg/L) to 18.2 mg/L (an outlier of 116 mg/L was excluded). At PM-13, the average sulfate concentration was 36.1 mg/L; measured sulfate concentrations ranged from 10.3 mg/L to 106.0 mg/L (an outlier of 688 mg/L was excluded).

## References

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1854 Treaty Authority (2008) Wild Rice Monitoring and Abundance in the 1854 Ceded Territory (1998 - 2008)

Barr. 2008. *RS74A Surface Water and Groundwater Quality Modeling: Mine Site*. Draft 02.

Minnesota Department of Natural Resources. 2008. *Natural Wild Rice In Minnesota: A Wild Rice Study* document submitted to the Minnesota Legislature by the Minnesota Department of Natural Resources February 15, 2008

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*Tables*

**Table 1 Sulfate and Water Depth Data at Wild Rice Stands in PolyMet NorthMet Project Study Area**

<b>Waterbody</b>	<b># Samples</b>	<b>Sulfate Concentration (mg/L)</b>			<b>Water Depth (in)</b>
		<b>Mean</b>	<b>Std. Dev.</b>	<b>Range</b>	<b>Mean</b>
Cedar Island Lake	7	19.8	0.3	19.3 - 20.3	22
Embarrass Lake	5	21.3	0.1	21.2 - 21.4	34
Embarrass River	2	27.3	--	21.2 - 33.3	12
Esquagama Lake	1	17.1	--	--	28
Fourth Lake	1	18.9	--	--	--
Hay Lake (east of Embarrass)	3	1.6	0.1	1.5 - 1.8	4
Hay Lake (off Pike River)	3	1.1	0.02	1.1 - 1.1	32
Little Rice Lake	6	2.1	0.2	1.9 - 2.3	30
Lower Embarrass Lake	2	21.3	--	21.2 - 21.4	21
Pokegama Bay	4	7.6	0.8	7.0 - 8.8	23
St. Louis River	6	17.7	7.4	8.0 - 27.4	15
Unnamed Lake	3	21.1	0.2	20.9 - 21.3	19
Upper Partridge River	14	5.0	0.3	4.6 - 5.7	12

**Table 2 Baseline Sulfate Data for Partridge and Embarrass Rivers (from Barr 2008)**

<b>Location</b>	<b>River</b>	<b>Average (mg/L)</b>	<b>Std. Dev. (mg/L)</b>	<b>Min. (mg/L)</b>	<b>Max. (mg/L)</b>
SW-001	Partridge	22.1	2.2	19.3	26.1
SW-002	Partridge	6.3	4.7	0.1	11.8
SW-003	Partridge	10.9	7.0	0.4	25.7
SW-004	Partridge	10.0	5.4	0.5 <sup>1</sup>	22.0
SW-005	Partridge	9.0	5.4	0.5 <sup>1</sup>	20.0
PM-12	Embarrass	4.6 <sup>2</sup>	4.3	0.5 <sup>1</sup>	18.2 <sup>2</sup>
PM-13	Embarrass	36.1 <sup>3</sup>	27.4	10.3	106.0 <sup>3</sup>

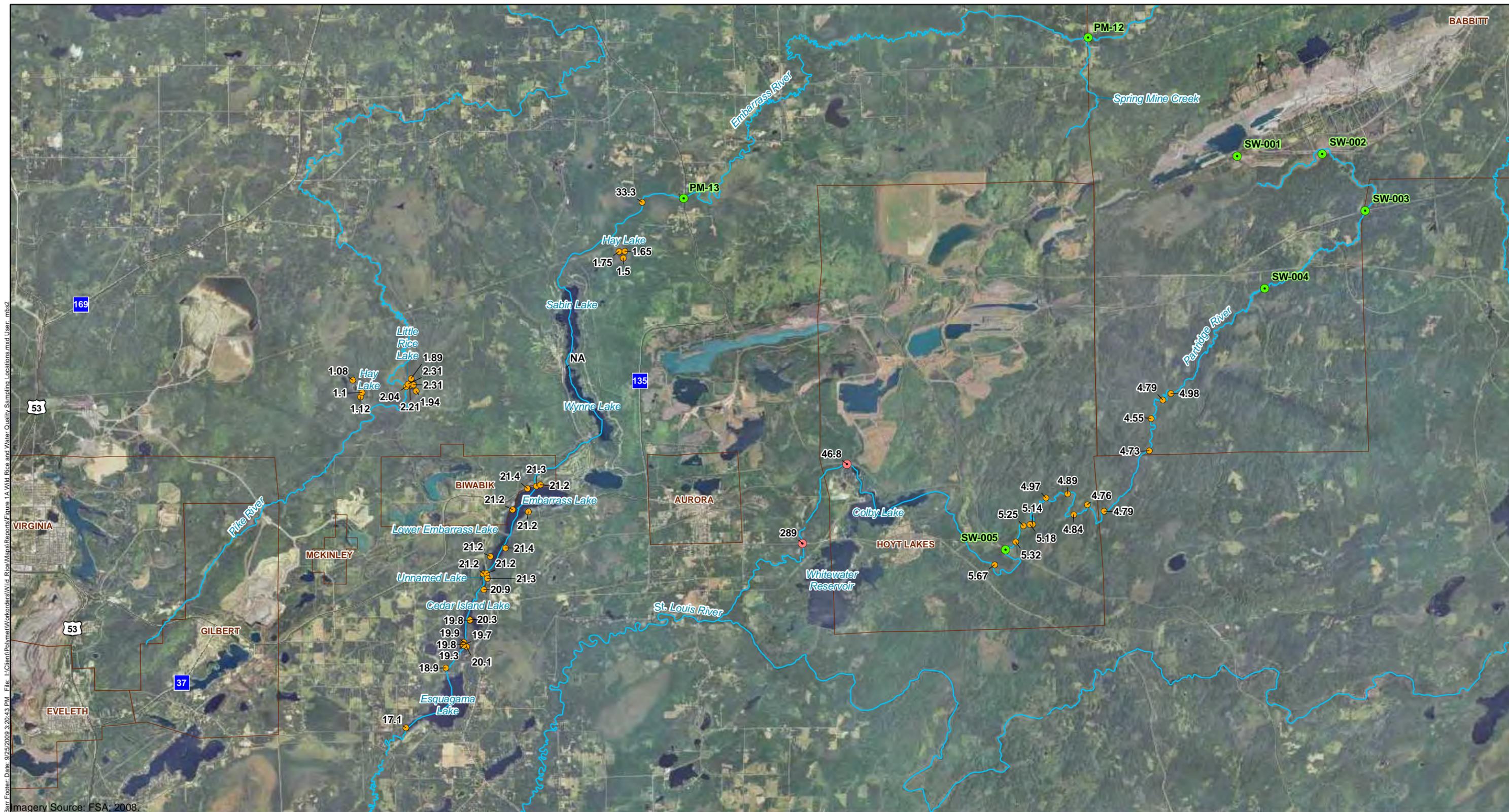
<sup>1</sup> Non-detect, value is half the detection limit

<sup>2</sup> Excludes outlier of 116 mg/L

<sup>3</sup> Excludes outlier of 688 mg/L

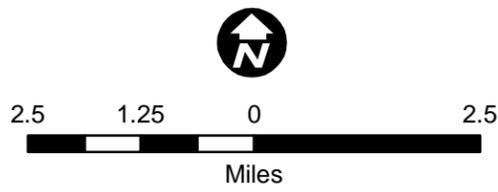
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*Figures*



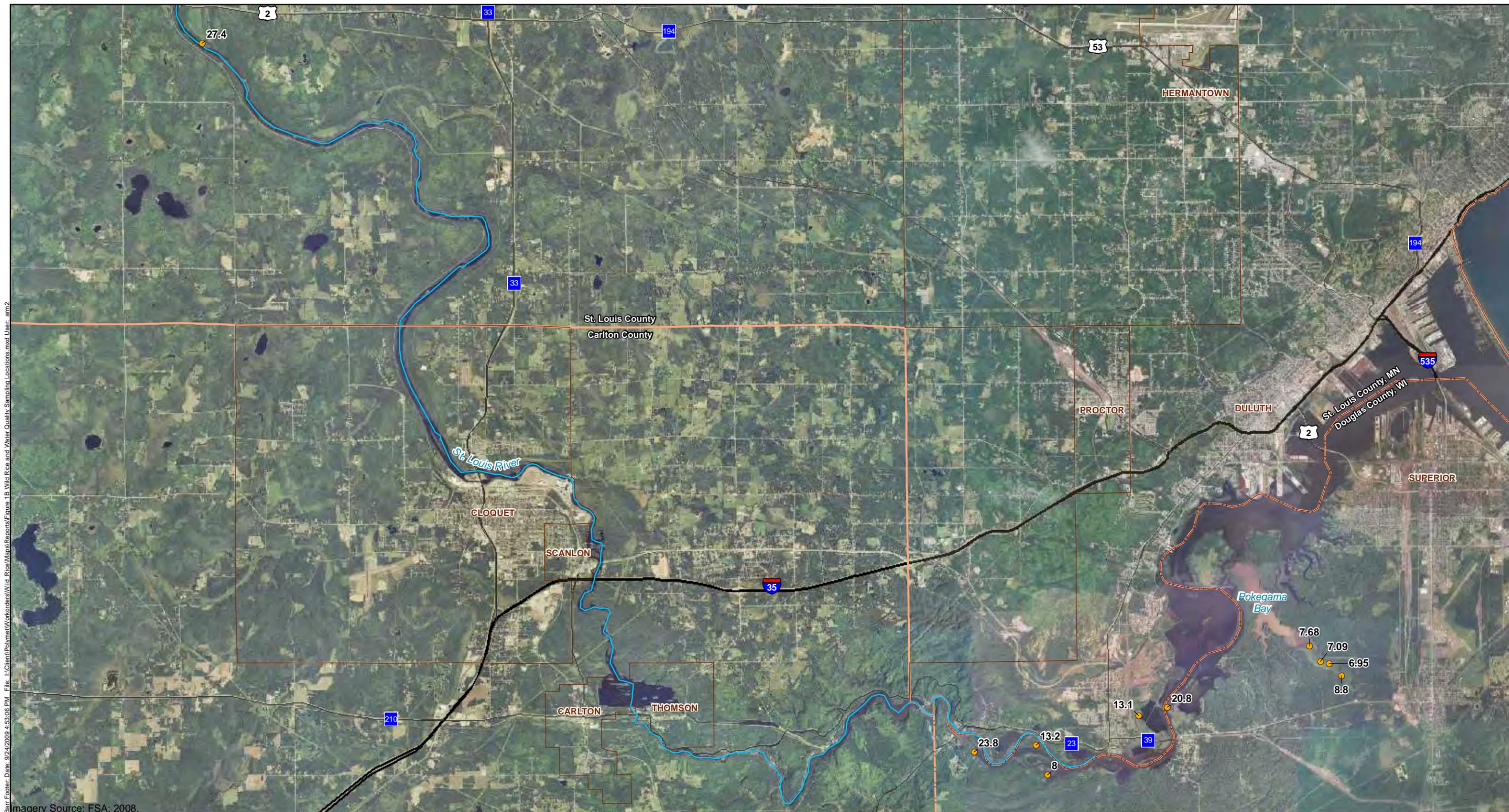
File: \\Client\Polymet\Workorders\Wild\_Rice\Map\Reports\Figure 1A Wild Rice and Water Quality Sampling Locations.mxd User: mtsz  
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 Imagery Source: FSA, 2008.

- Surface Water Monitoring Stations
- 2009 Sulfate Sampling Locations with Sulfate Listed in mg/L
- Mesabi Nugget Surface Water Monitoring Data - Aug. 19, 2009
- Rivers and Streams
- City Boundaries



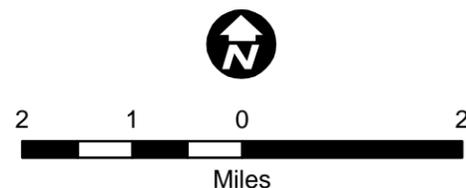
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Figure 1A  
 WILD RICE AND SULFATE  
 SAMPLING LOCATIONS  
 NorthMet Project  
 PolyMet Mining, Inc.  
 Hoyt Lakes, Minnesota



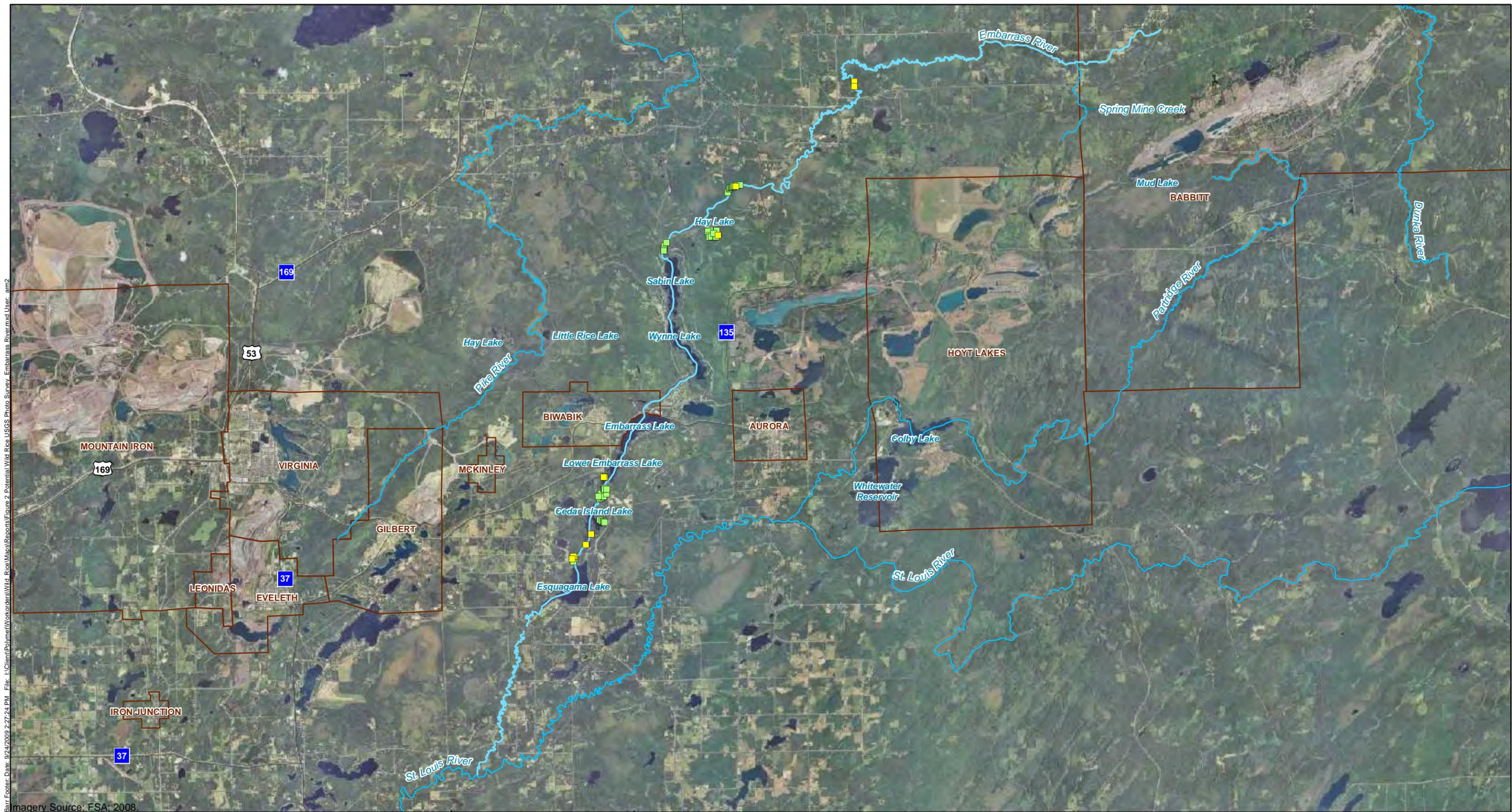
File: \\Client\Polymet\Workorders\Wild\_Rice\Maps\Reports\Figure 1B Wild Rice and Water Quality Sampling Locations.mxd User: arm2  
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 Imagery Source: FSA; 2008.

- 2009 Sulfate Sampling Locations with Sulfate Listed in mg/L
- Rivers and Streams
- City Boundaries
- County Boundary



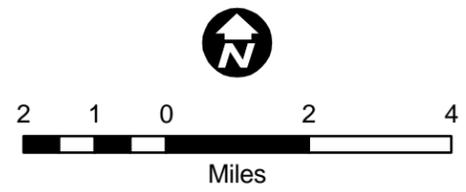
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Figure 1B  
 WILD RICE AND SULFATE  
 SAMPLING LOCATIONS  
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 PolyMet Mining, Inc.  
 Hoyt Lakes, Minnesota



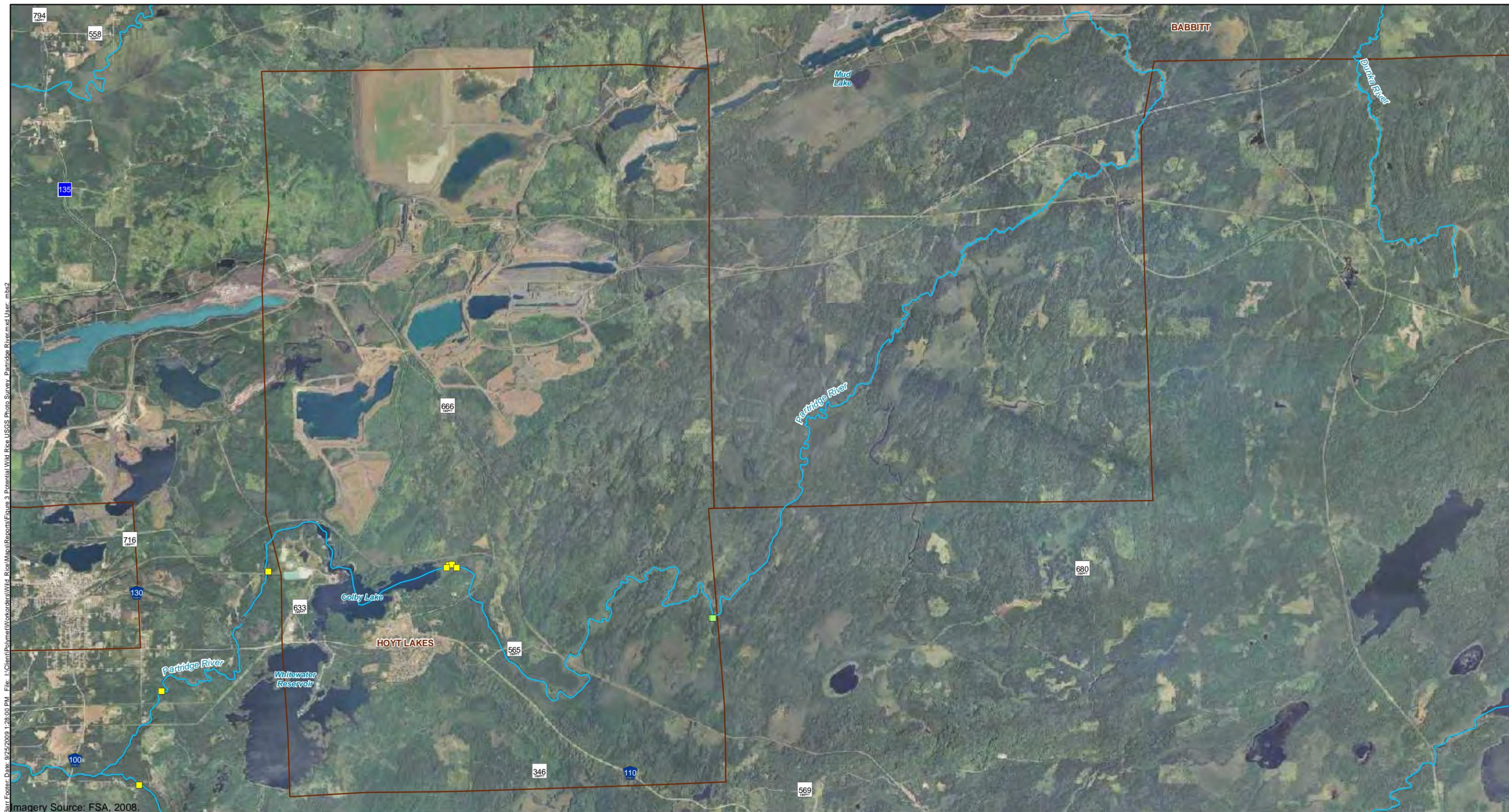
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 Imagery Source: FSA; 2008.

- Potential Wild Rice Location - 2004
- Potential Wild Rice Location - 2008
- Rivers and Streams
- City Boundaries



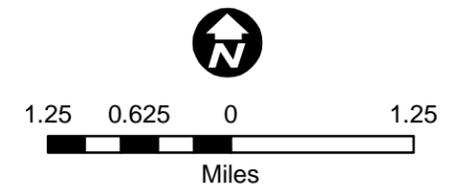
DRAFT

Figure 2  
 POTENTIAL WILD RICE USGS  
 PHOTOGRAPHIC SURVEY RESULTS FOR  
 SPRING MINE CREEK, EMBARRASS RIVER  
 AND HAY LAKE (MN ID 69435)  
 NorthMet Project  
 PolyMet Mining, Inc.  
 Hoyt Lakes, Minnesota



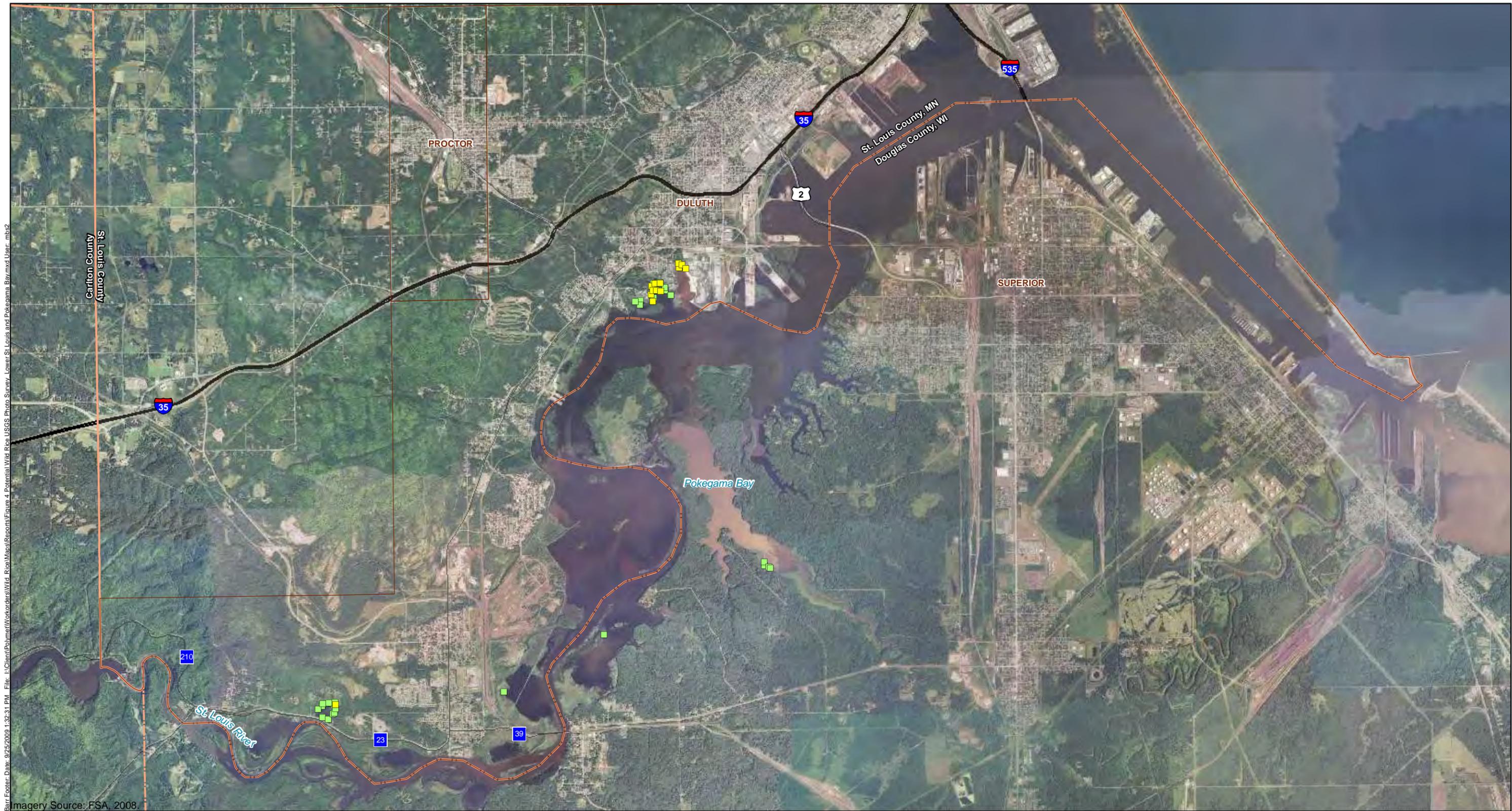
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 Imagery Source: FSA, 2008.

- Potential Wild Rice Location - 2004
- Potential Wild Rice Location - 2008
- Rivers and Streams
- City Boundaries

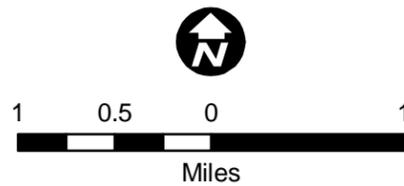


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Figure 3  
 POTENTIAL WILD RICE  
 USGS PHOTOGRAPHIC SURVEY RESULTS  
 FOR PARTRIDGE RIVER  
 NorthMet Project  
 PolyMet Mining, Inc.  
 Hoyt Lakes, Minnesota



- Potential Wild Rice Location - 2004
- Potential Wild Rice Location - 2008
- City Boundaries
- County Boundary



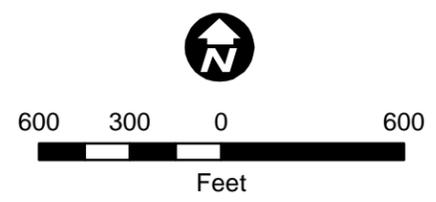
**DRAFT**

Figure 4  
 POTENTIAL WILD RICE  
 USGS PHOTOGRAPHIC SURVEY RESULTS  
 FOR POKEGAMA BAY & LOWER ST. LOUIS RIVER  
 NorthMet Project  
 PolyMet Mining, Inc.  
 Hoyt Lakes, Minnesota



File: \\Client\Polymet\Workorders\Wild\_Rice\Maps\Reports\Figure 5 Potential Wild Rice USGS Photo Survey Hay Rice Pike.mxd User: mlsz  
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 Imagery Source: FSA, 2008.

- Potential Wild Rice Location - 2004
- Potential Wild Rice Location - 2008
- Section Boundaries



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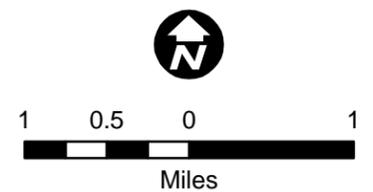
Figure 5  
 POTENTIAL WILD RICE USGS  
 PHOTOGRAPHIC SURVEY RESULTS  
 FOR HAY LAKE (MN ID 69435),  
 LITTLE RICE LAKE (MN ID 69578),  
 AND PIKE RIVER  
 NorthMet Project  
 PolyMet Mining, Inc.  
 Hoyt Lakes, Minnesota



File: \\Client\Polymet\Workorders\Wild\_Rice\Map\Reports\Figure 6 Ground Wild Rice Survey Results for Upper Embarrass River.mxd User: mbs2  
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 Imagery Source: FSA, 2008.

**Wild Rice Density**

- 1 <10% Wild Rice Coverage
- 2
- 3
- 4
- 5 >75% Wild Rice Coverage
- Rivers and Streams
- City Boundaries



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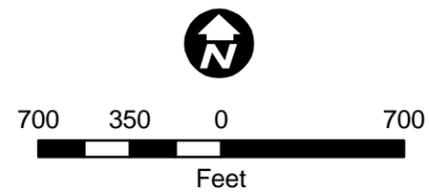
Figure 6  
 GROUND WILD RICE SURVEY RESULTS  
 FOR SPRING MINE CREEK,  
 HAY LAKE (MNID 69435) AND  
 UPPER EMBARRASS RIVER  
 Surveyed August 19-20, 2009  
 NorthMet Project  
 PolyMet Mining, Inc.  
 Hoyt Lakes, Minnesota



Bar: Footer Date: 8/25/2009 2:04:05 PM File: \\Client\Polymet\Workorders\Wild\_Rice\Map\Reports\Figure 7 Ground Wild Rice Survey Results for Embarrass Lake Embarrass River.mxd User: mbs2  
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**Wild Rice Density**

- 1 <10% Wild Rice Coverage
- 2
- 3
- 4
- 5 >75% Wild Rice Coverage
- City Boundaries



DRAFT

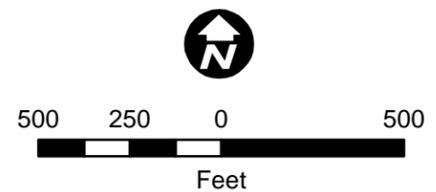
Figure 7  
 GROUND WILD RICE SURVEY  
 RESULTS FOR EMBARRASS LAKE  
 (EMBARRASS RIVER)  
 Surveyed August 20, 2009  
 NorthMet Project  
 PolyMet Mining, Inc.  
 Hoyt Lakes, Minnesota



File: \\Client\poly\met\workorders\Wild\_Rice\Map\Reports\Figure 8 Ground Wild Rice Survey Results for Lower Embarrass Lake & Embarrass River.mxd User: mbs2  
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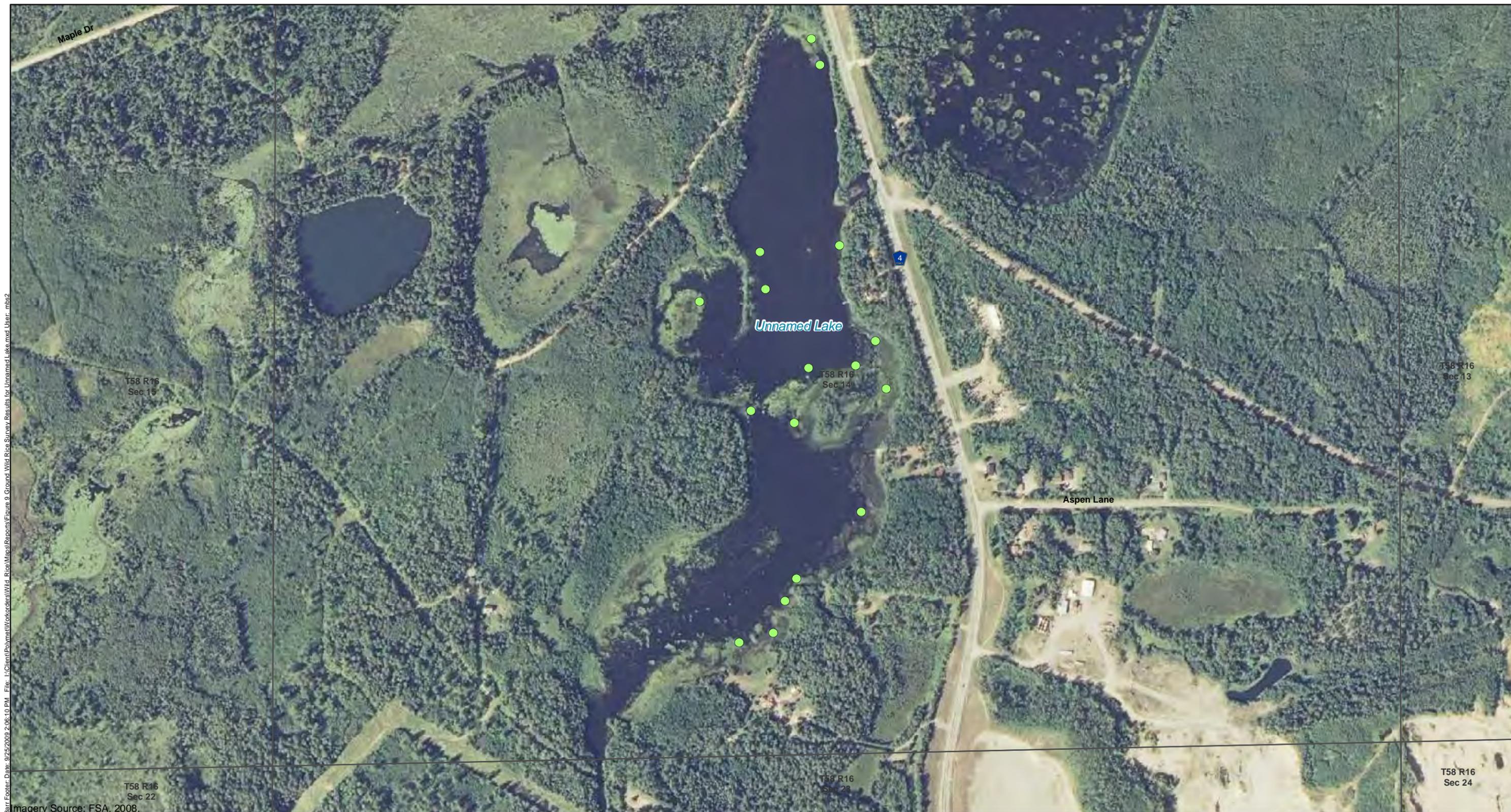
**Wild Rice Density**

- 1 <10% Wild Rice Coverage
- 2
- 3
- 4
- 5 >75% Wild Rice Coverage
- Section Boundaries



DRAFT

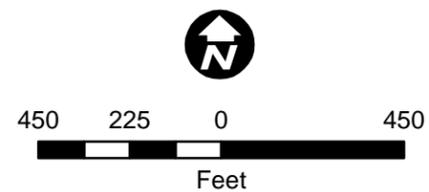
Figure 8  
 GROUND WILD RICE SURVEY RESULTS  
 FOR LOWER EMBARRASS LAKE  
 (EMBARRASS RIVER)  
 Surveyed August 13, 2009  
 NorthMet Project  
 PolyMet Mining, Inc.  
 Hoyt Lakes, Minnesota



Bar: Footer Date: 8/25/2009 2:06:10 PM File: \\Client\Polymet\Workorders\Wild\_Rice\Maps\Reports\Figure 9 Ground Wild Rice Survey Results for Unnamed Lake.mxd User: mlsz  
 Imagery Source: FSA, 2008.

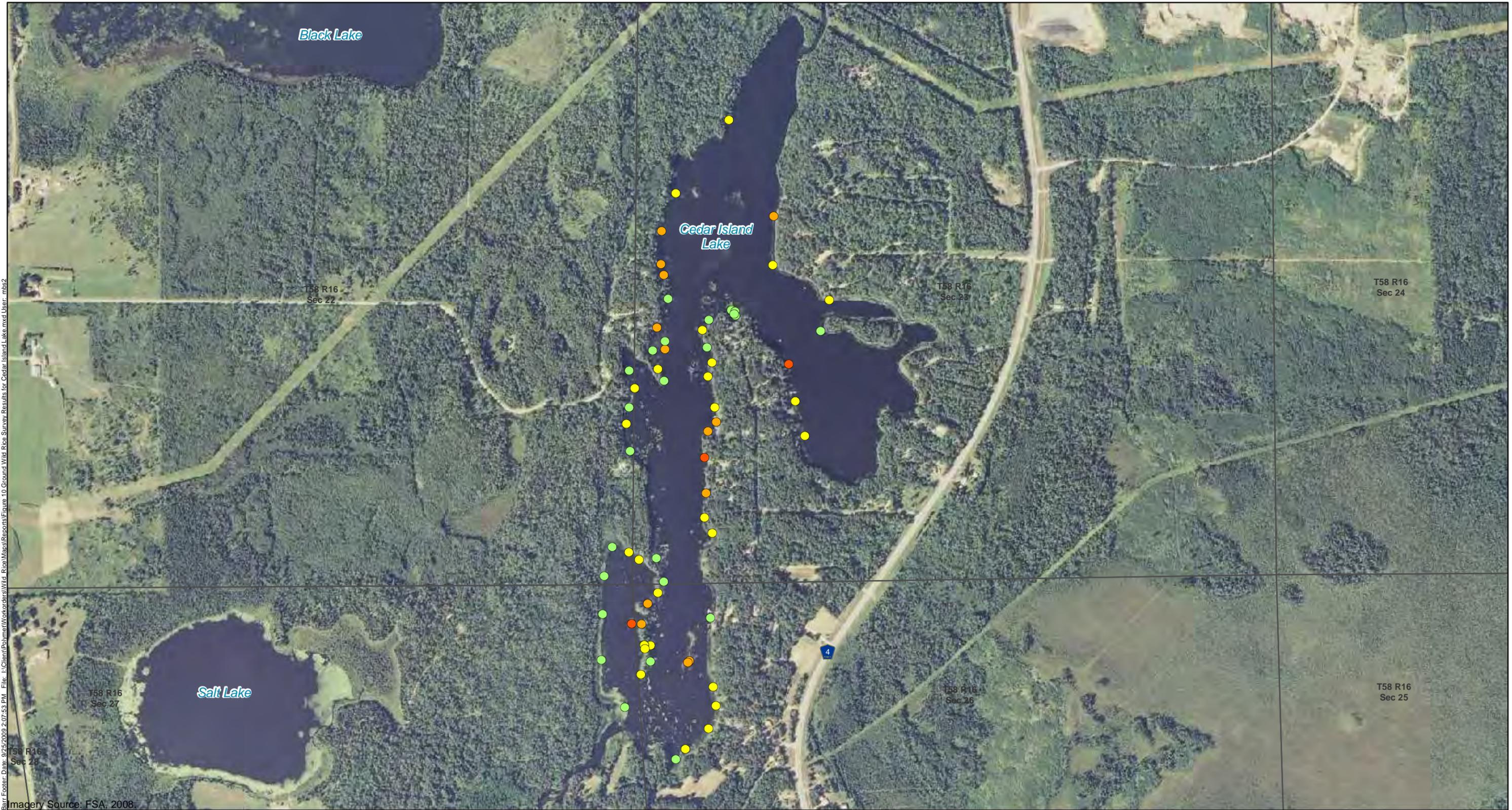
**Wild Rice Density**

- 1 <10% Wild Rice Coverage
- 2
- 3
- 4
- 5 >75% Wild Rice Coverage
- Section Boundaries



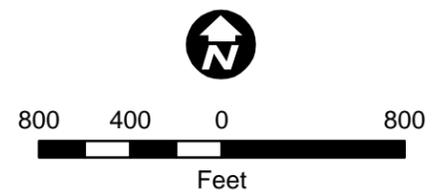
DRAFT

Figure 9  
 GROUND WILD RICE SURVEY  
 RESULTS FOR UNNAMED LAKE  
 (EMBARRASS RIVER)  
 Surveyed August 13, 2009  
 NorthMet Project  
 PolyMet Mining, Inc.  
 Hoyt Lakes, Minnesota



File: I:\Client\Polymet\Workorders\Wild\_Rice\Map\Reports\Figure 10 Ground Wild Rice Survey Results for Cedar Island Lake.mxd User: mbs2  
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 Imagery Source: FSA, 2008.

- Wild Rice Density**
- 1 <10% Wild Rice Coverage
  - 2
  - 3
  - 4
  - 5 >75% Wild Rice Coverage
  - Section Boundaries



DRAFT

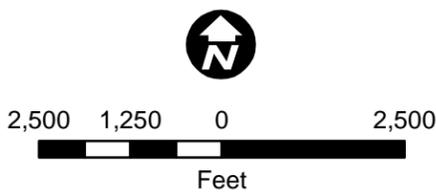
Figure 10  
 GROUND WILD RICE SURVEY RESULTS  
 FOR CEDAR ISLAND LAKE  
 (EMBARRASS RIVER)  
 Surveyed August 13, 2009  
 NorthMet Project  
 PolyMet Mining, Inc.  
 Hoyt Lakes, Minnesota





File: \\Client\Polymet\Workorders\Wild\_Rice\Maps\Reports\Figure 12 Ground Wild Rice Survey Results for Upper Partridge River.mxd User: mbs2  
 Date: 9/25/2009 2:39:50 PM  
 Imagery Source: FSA, 2008.

- Wild Rice Density**
- 1 <10% Wild Rice Coverage
  - 2
  - 3
  - 4
  - 5 >75% Wild Rice Coverage
- City Boundaries



**DRAFT**

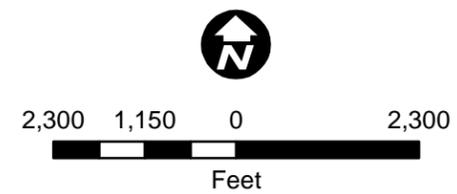
Figure 12  
 GROUND WILD RICE SURVEY RESULTS  
 FOR UPPER PARTRIDGE RIVER  
 Surveyed September 1-2, 2009  
 NorthMet Project  
 PolyMet Mining, Inc.  
 Hoyt Lakes, Minnesota



File: \\Client\Polymet\Workorders\Wild\_Rice\Map\Reports\Figure 13 Ground Wild Rice Survey Results for Colby Lake and Lower Partridge River.mxd User: mbs2  
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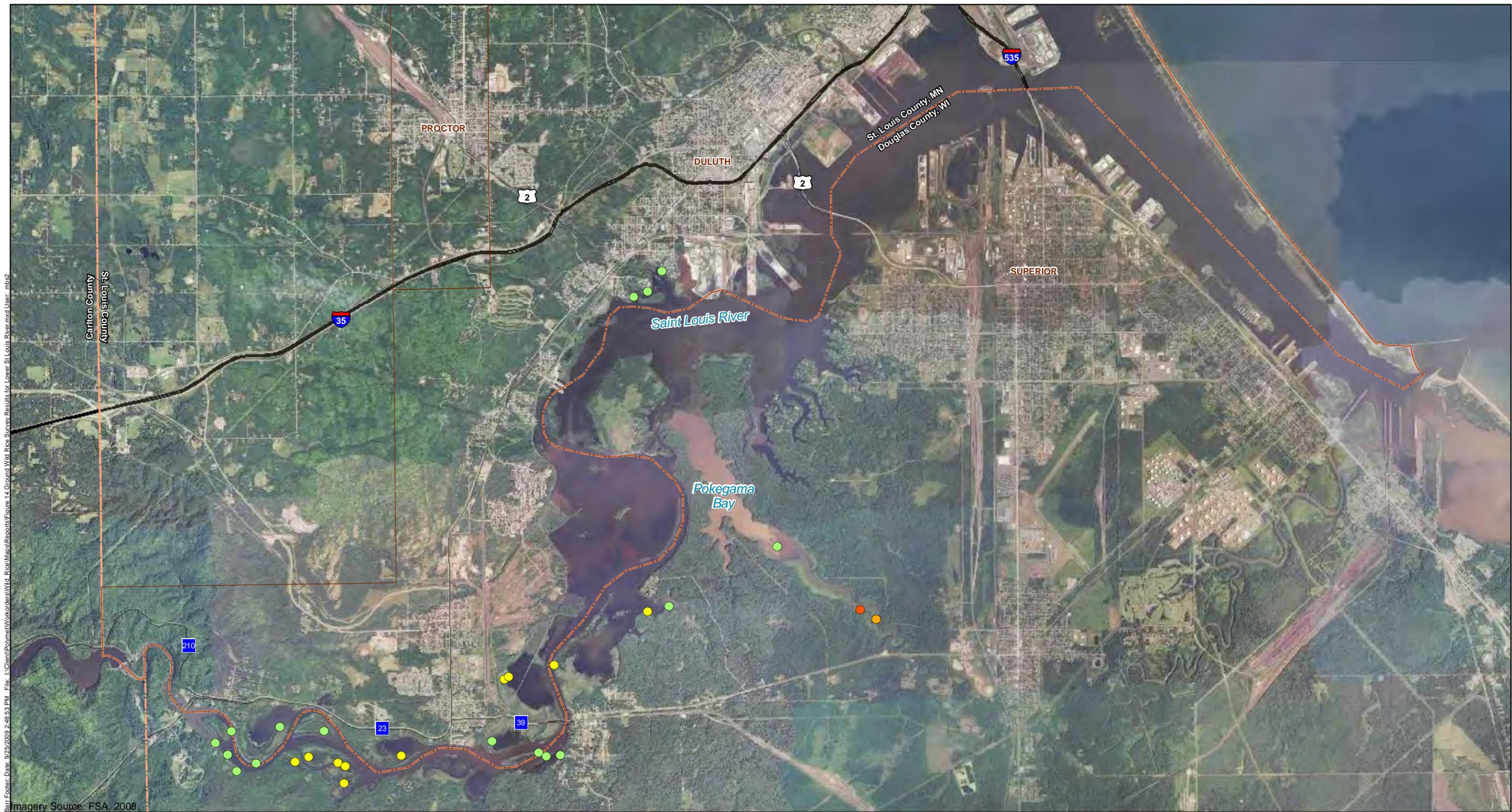
**Wild Rice Density**

- 1 <10% Wild Rice Coverage
- 2
- 3
- 4
- 5 >75% Wild Rice Coverage
- City Boundaries



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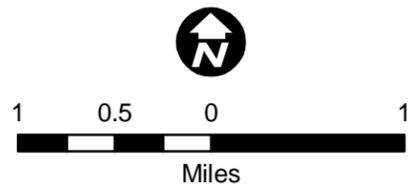
Figure 13  
 GROUND WILD RICE SURVEY RESULTS  
 FOR COLBY LAKE & LOWER PARTRIDGE RIVER  
 Surveyed August 20, 2009  
 NorthMet Project  
 PolyMet Mining, Inc.  
 Hoyt Lakes, Minnesota



File: \\Client\Polymet\Workorders\Wild\_Rice\Map\Reports\Figure 14 Ground Wild Rice Survey Results for Lower St. Louis River.mxd User: mbs2  
 Date: 8/25/2009 2:48:53 PM  
 Imagery Source: FSA, 2008.

**Wild Rice Density**

- 1 <10% Wild Rice Coverage
- 2
- 3
- 4
- 5 >75% Wild Rice Coverage
- City Boundaries
- County Boundary



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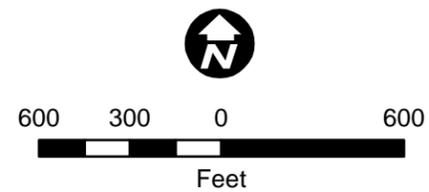
Figure 14  
 GROUND WILD RICE SURVEY RESULTS FOR  
 POKEGAMA BAY AND LOWER ST. LOUIS RIVER  
 Surveyed August 17-18, 2009  
 NorthMet Project  
 PolyMet Mining, Inc.  
 Hoyt Lakes, Minnesota



File: \\Client\Polymet\Workorders\Wild\_Rice\Map\Reports\Figure 15 Ground Wild Rice Survey Results for Hay and Rice Lakes.mxd User: mbs2  
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 Imagery Source: FSA, 2008.

**Wild Rice Density**

- 1 <10% Wild Rice Coverage
- 2
- 3
- 4
- 5 >75% Wild Rice Coverage
- Section Boundaries



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Figure 15  
 GROUND WILD RICE SURVEY RESULTS  
 FOR HAY LAKE (MN ID 69579),  
 LITTLE RICE LAKE (MN ID 69578)  
 AND PIKE RIVER  
 Surveyed August 13, 2009  
 NorthMet Project  
 PolyMet Mining, Inc.  
 Hoyt Lakes, Minnesota



Barr Footer: Date: 9/25/2009 2:58:59 PM File: I:\Client\Polymet\Workorders\Wild\_Rice\Maps\Reports\Figure\_16\_Grid\_Density\_Calculations\_Lower\_Embarrass\_Lake.mxd User: mbs2

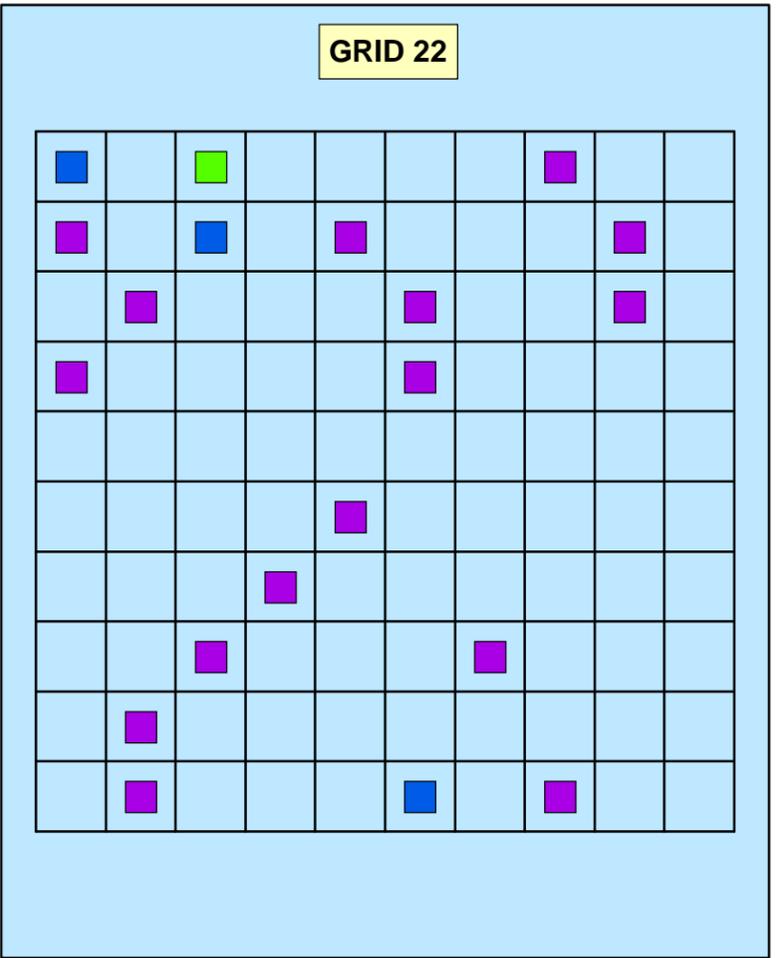


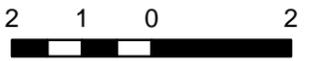
Figure 16  
**GRID DENSITY CALCULATIONS**  
**LOWER EMBARRASS LAKE**  
 (EMBARRASS RIVER)  
 NorthMet Project  
 PolyMet Mining, Inc.  
 Hoyt Lakes, Minnesota

**DRAFT**

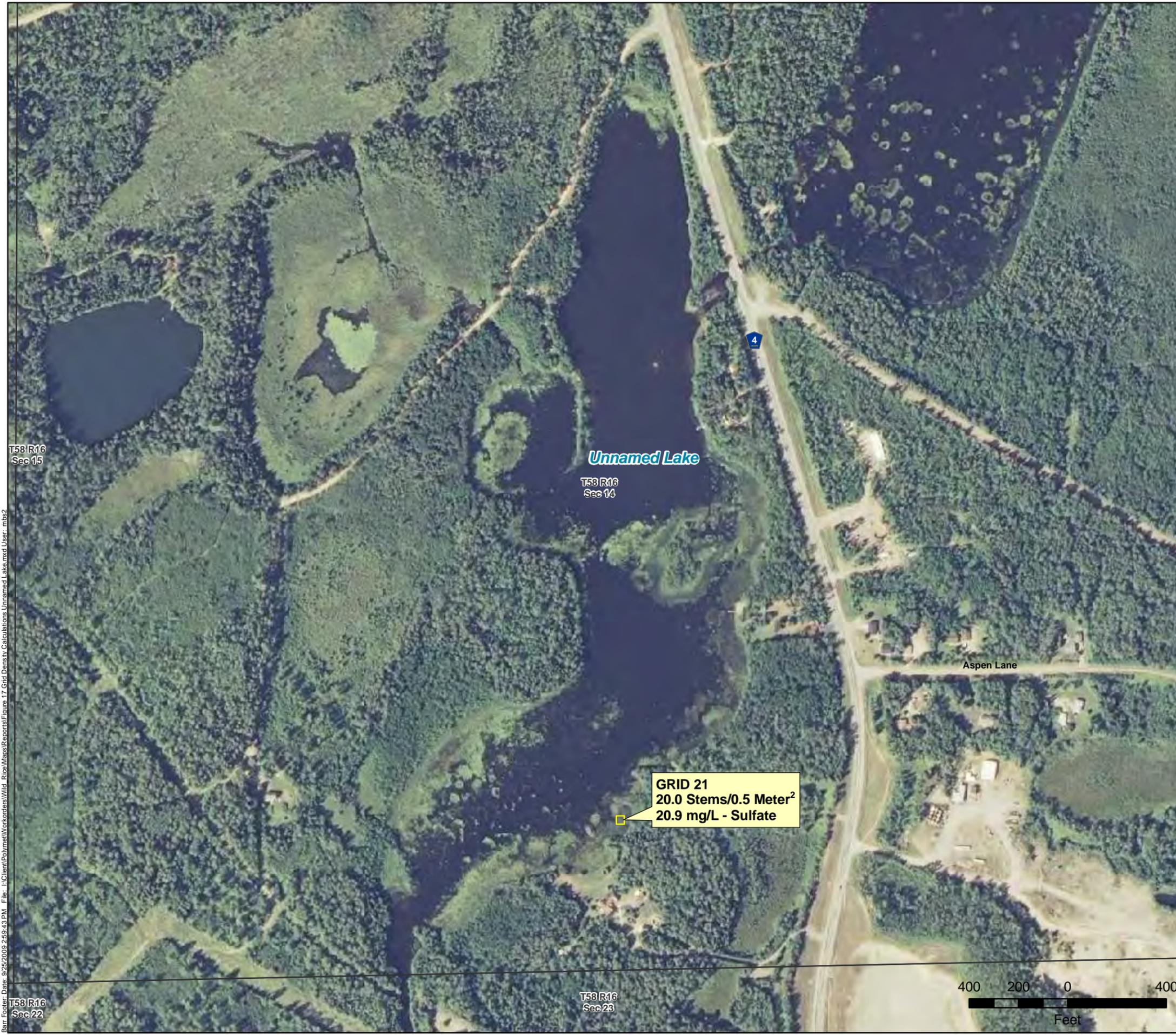
Stem Density/0.5m<sup>2</sup>

- 1 - 25
- 26 - 50
- 51 - 75

— 10x10 Meter Grid

Meters



T58 R16  
Sec 15

Unnamed Lake

T58 R16  
Sec 14

GRID 21  
20.0 Stems/0.5 Meter<sup>2</sup>  
20.9 mg/L - Sulfate

Aspen Lane

T58 R16  
Sec 22

T58 R16  
Sec 23

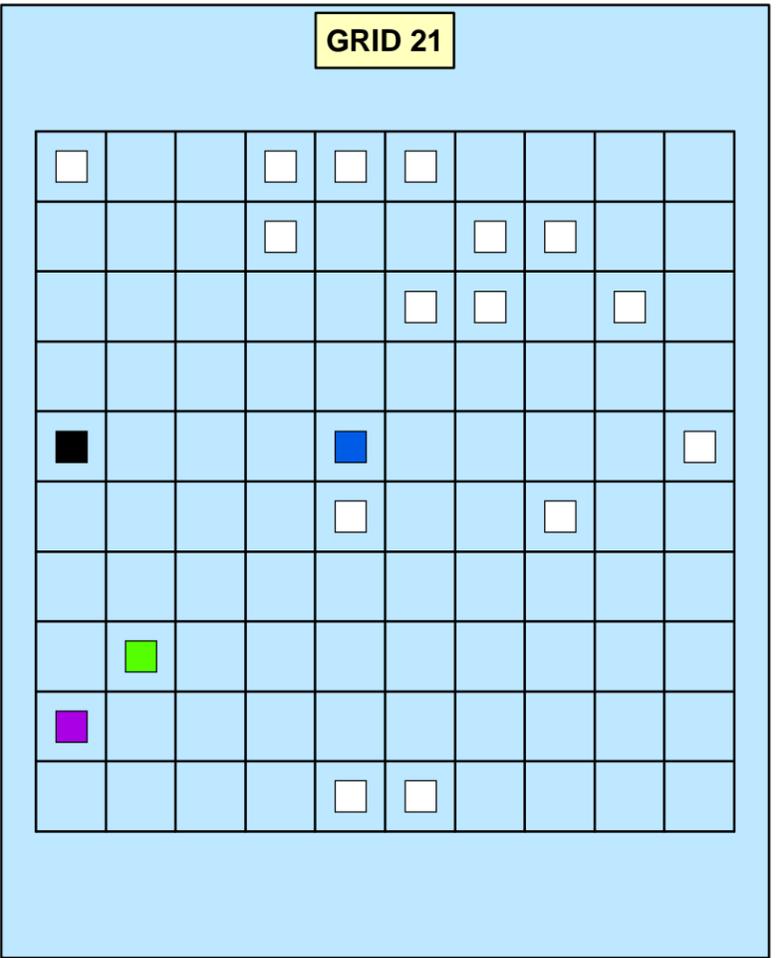
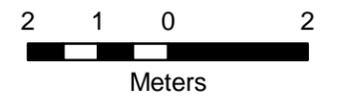


Figure 17  
GRID DENSITY CALCULATIONS  
UNNAMED LAKE (EMBARRASS RIVER)  
NorthMet Project  
PolyMet Mining, Inc.  
Hoyt Lakes, Minnesota

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

- 0
- 1 - 25
- 26 - 50
- 51 - 75
- 76 - 100
- >200

— 10x10 Meter Grid



**DRAFT**

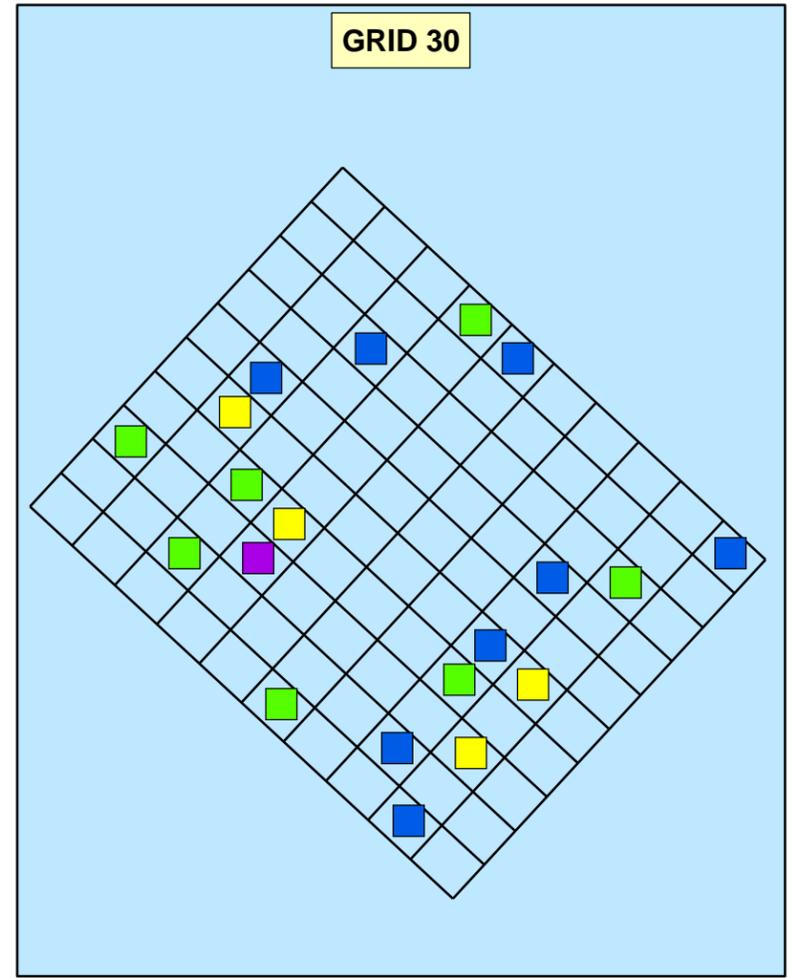
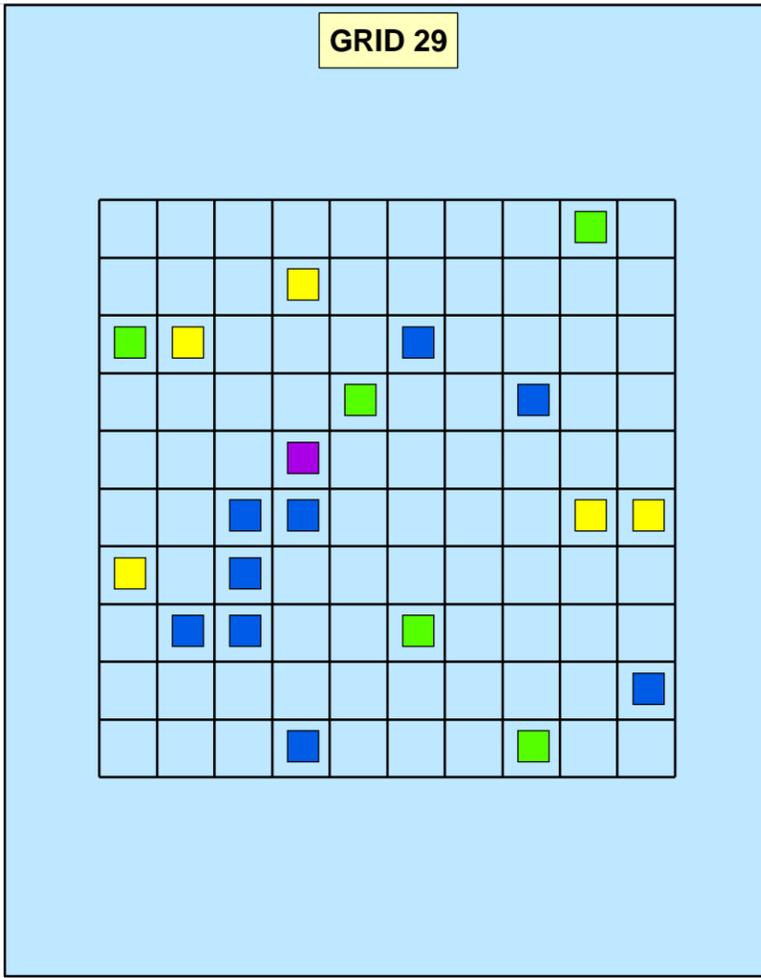
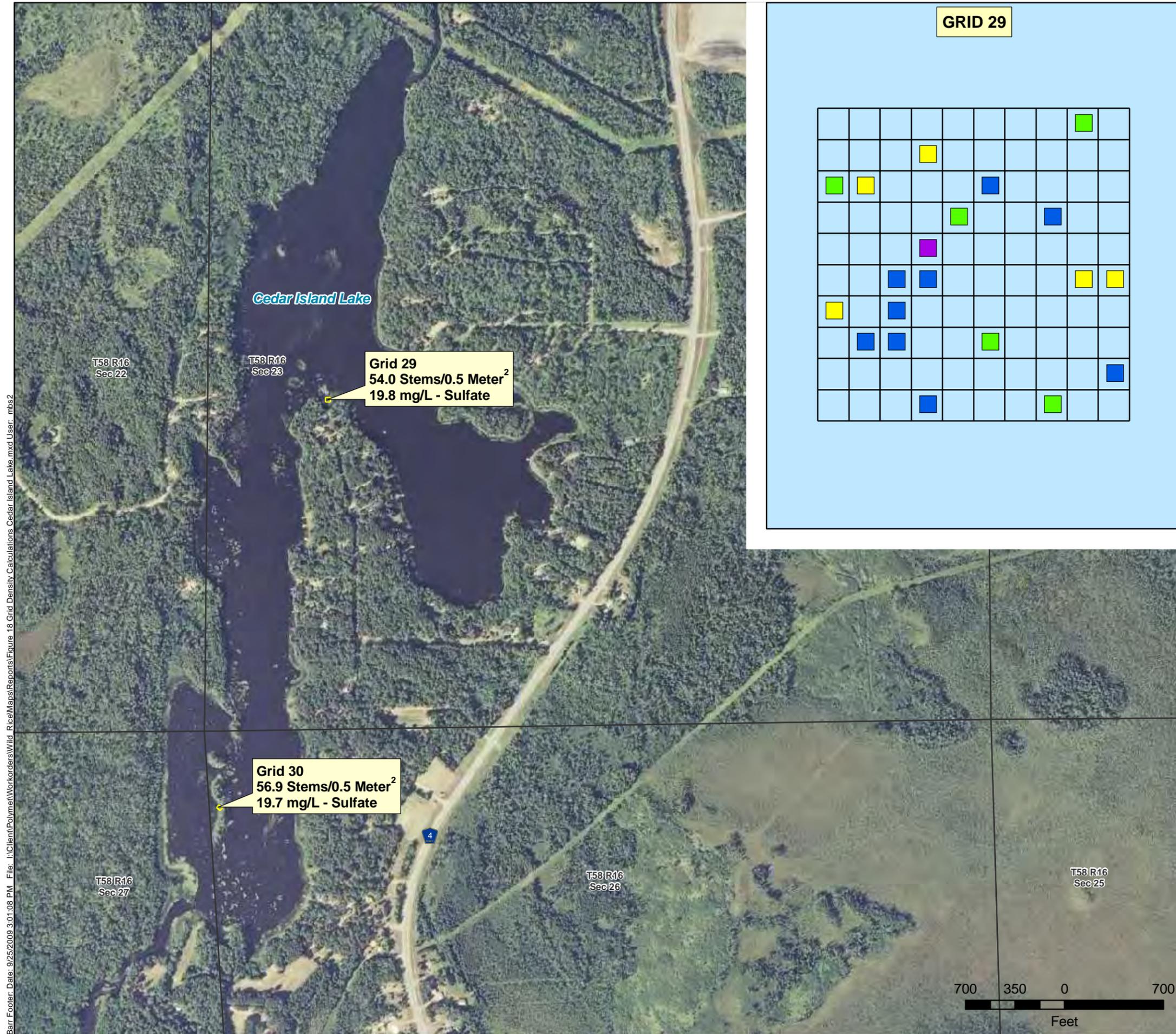


Figure 18  
 GRID DENSITY CALCULATIONS  
 CEDAR ISLAND LAKE (EMBARRASS RIVER)  
 NorthMet Project  
 PolyMet Mining, Inc.  
 Hoyt Lakes, Minnesota

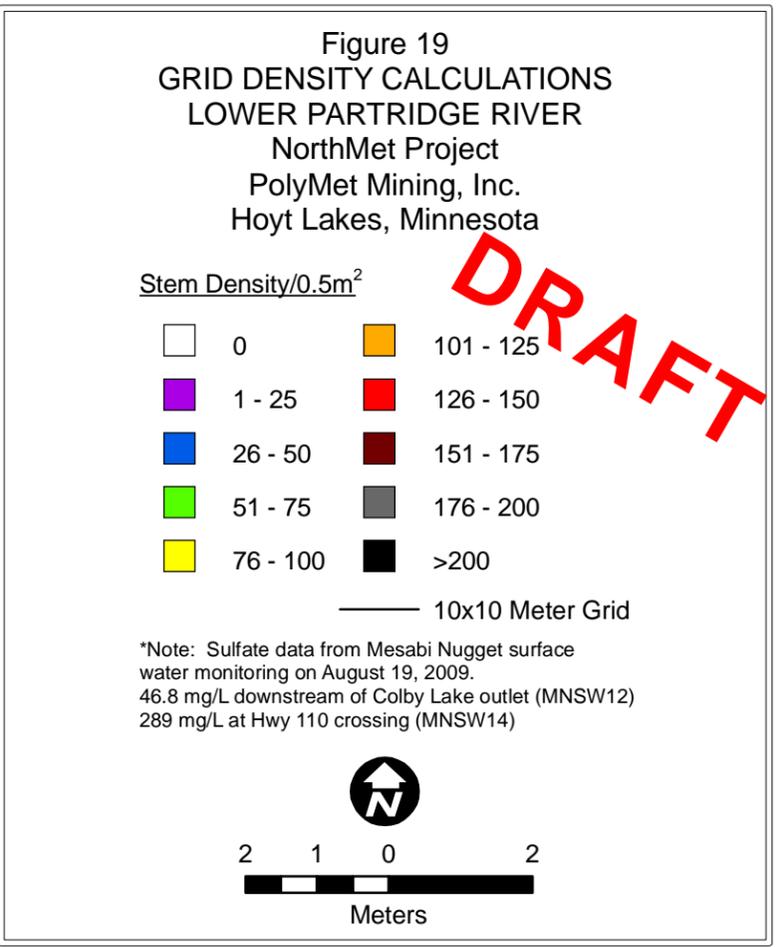
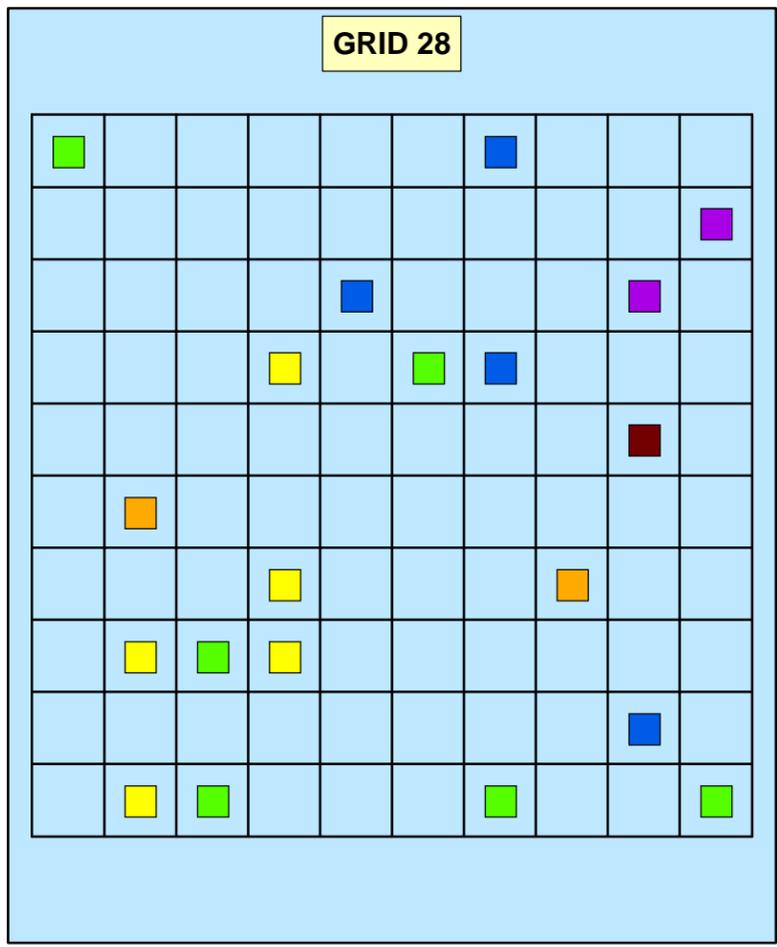
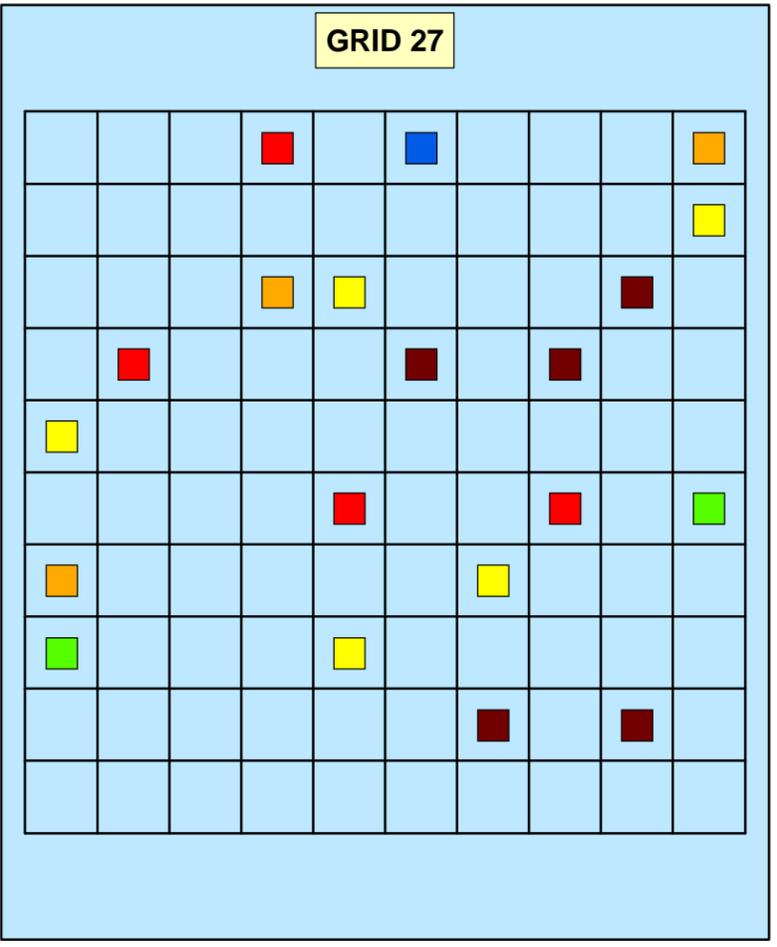
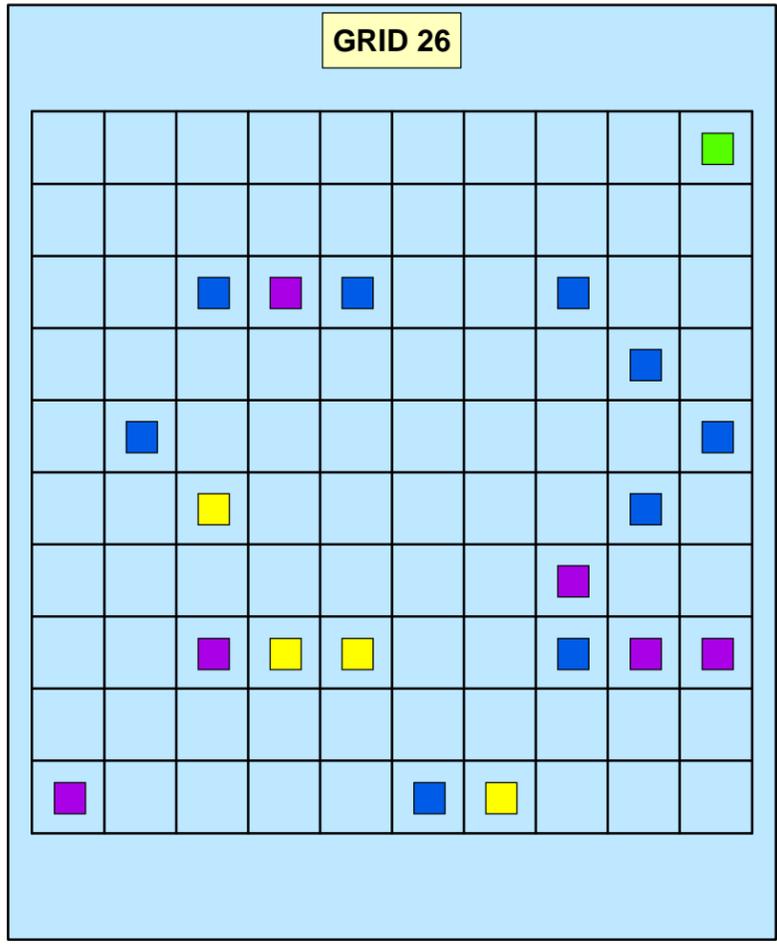
**DRAFT**

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

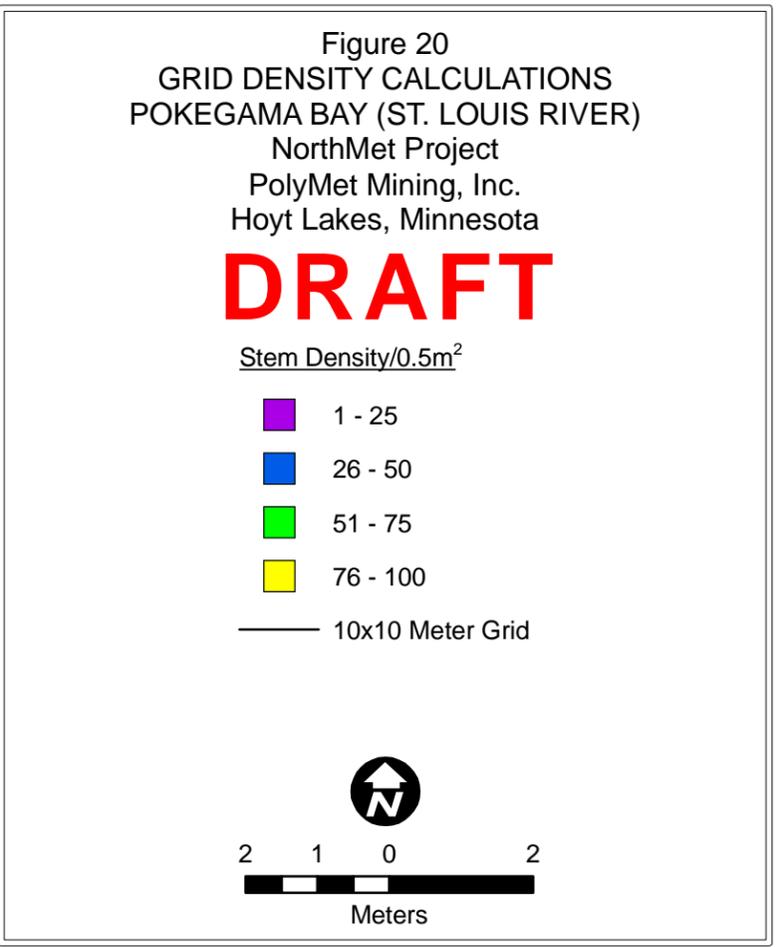
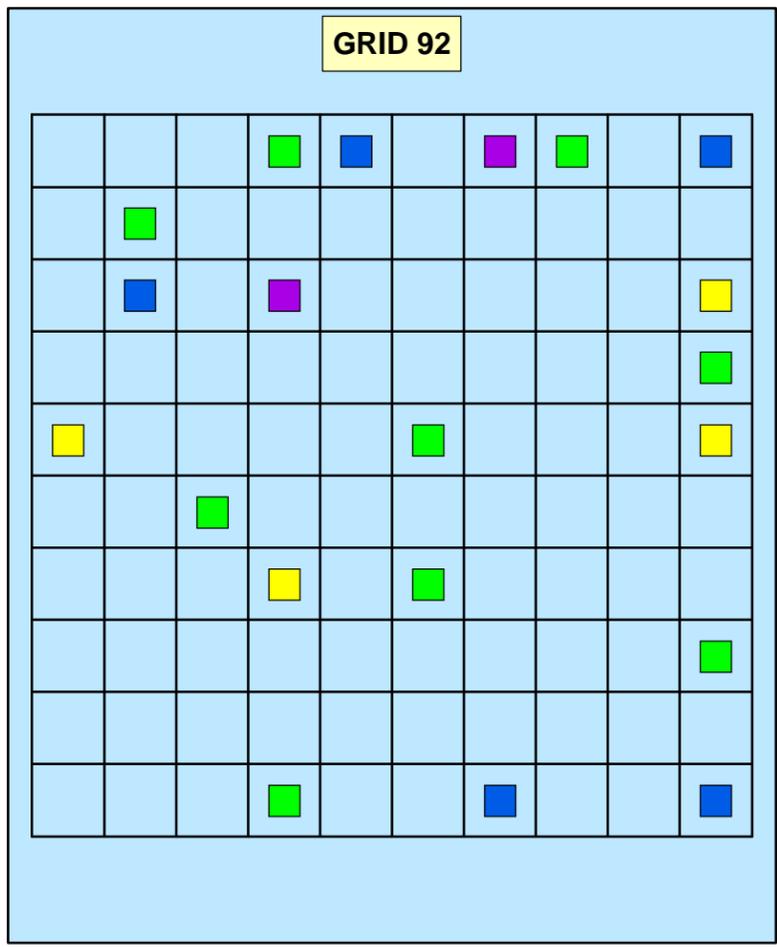
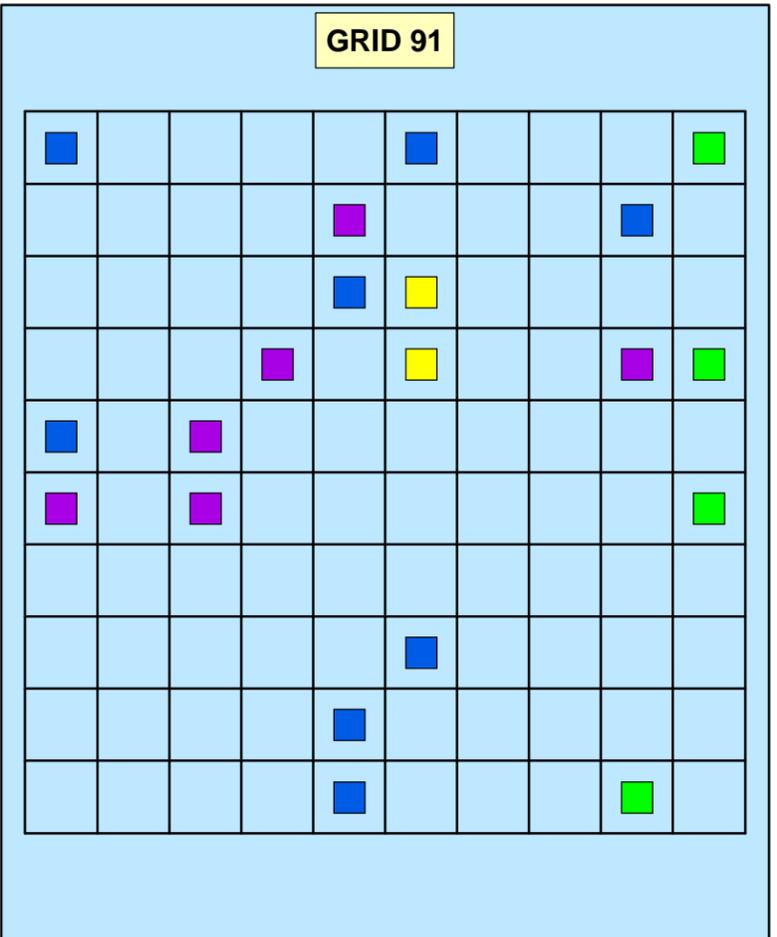
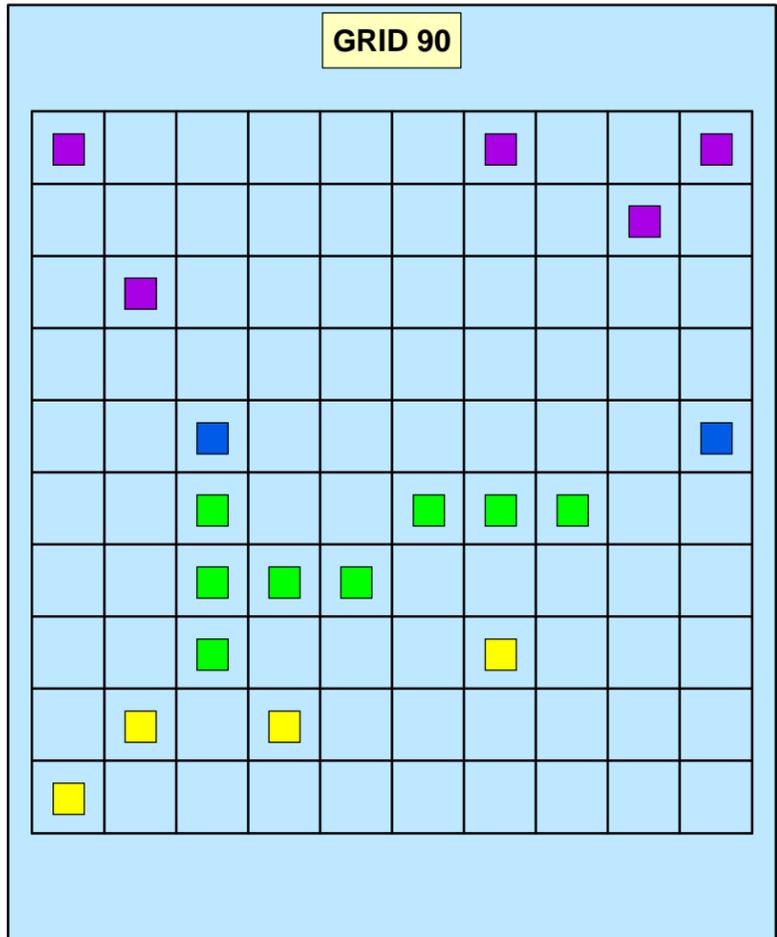
- 1 - 25
- 26 - 50
- 51 - 75
- 76 - 100
- 10x10 Meter Grid

N

2.5 1.25 0 2.5  
 Meters



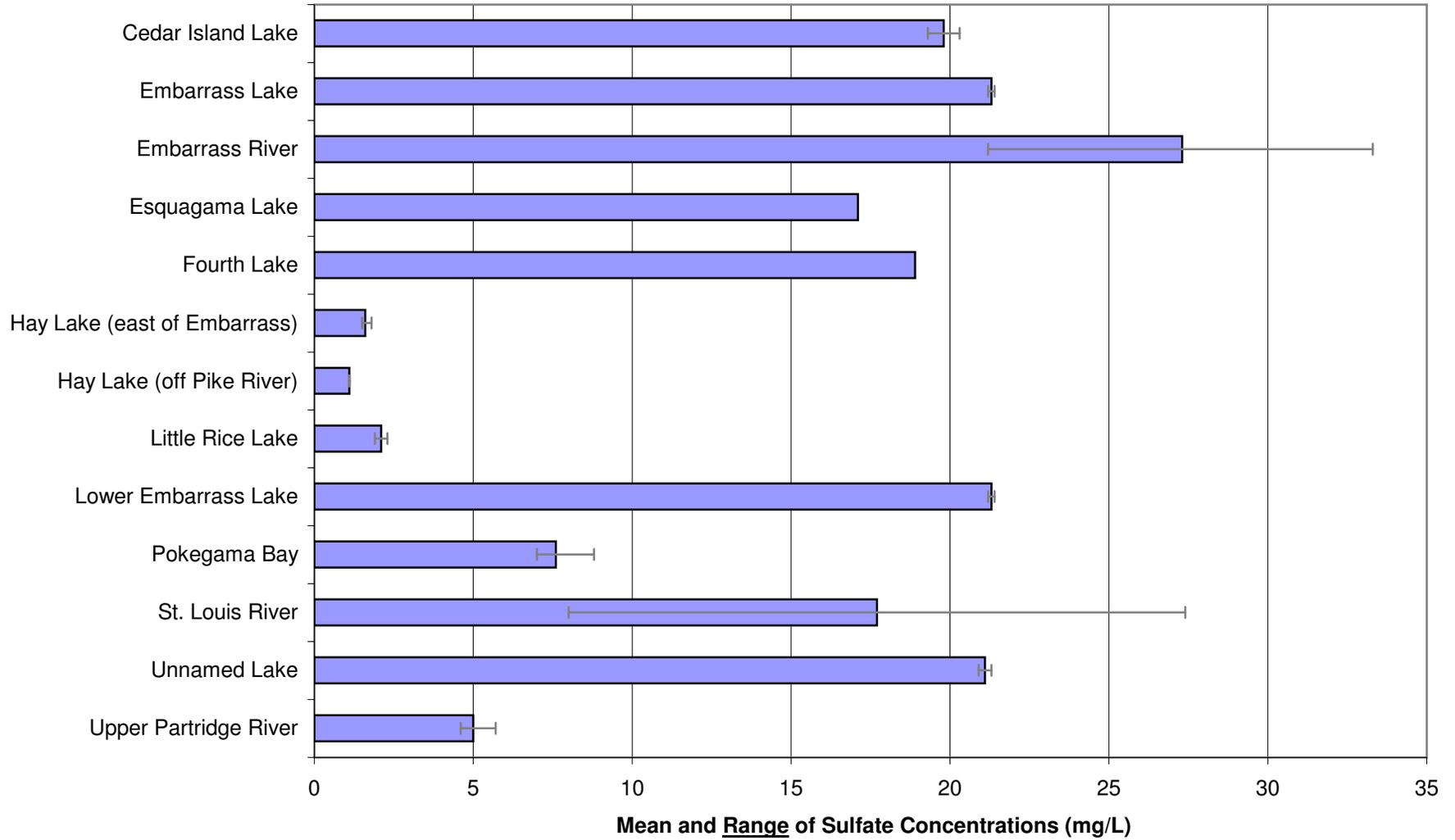
Barr Footer: Date: 9/25/2009 3:05:56 PM File: I:\Client\PolyMet\Workorders\Wild\_Rice\Maps\Reports\Figure\_19\_Grid\_Density\_Calculations\_Lower\_Partridge\_River.mxd User: mbs2



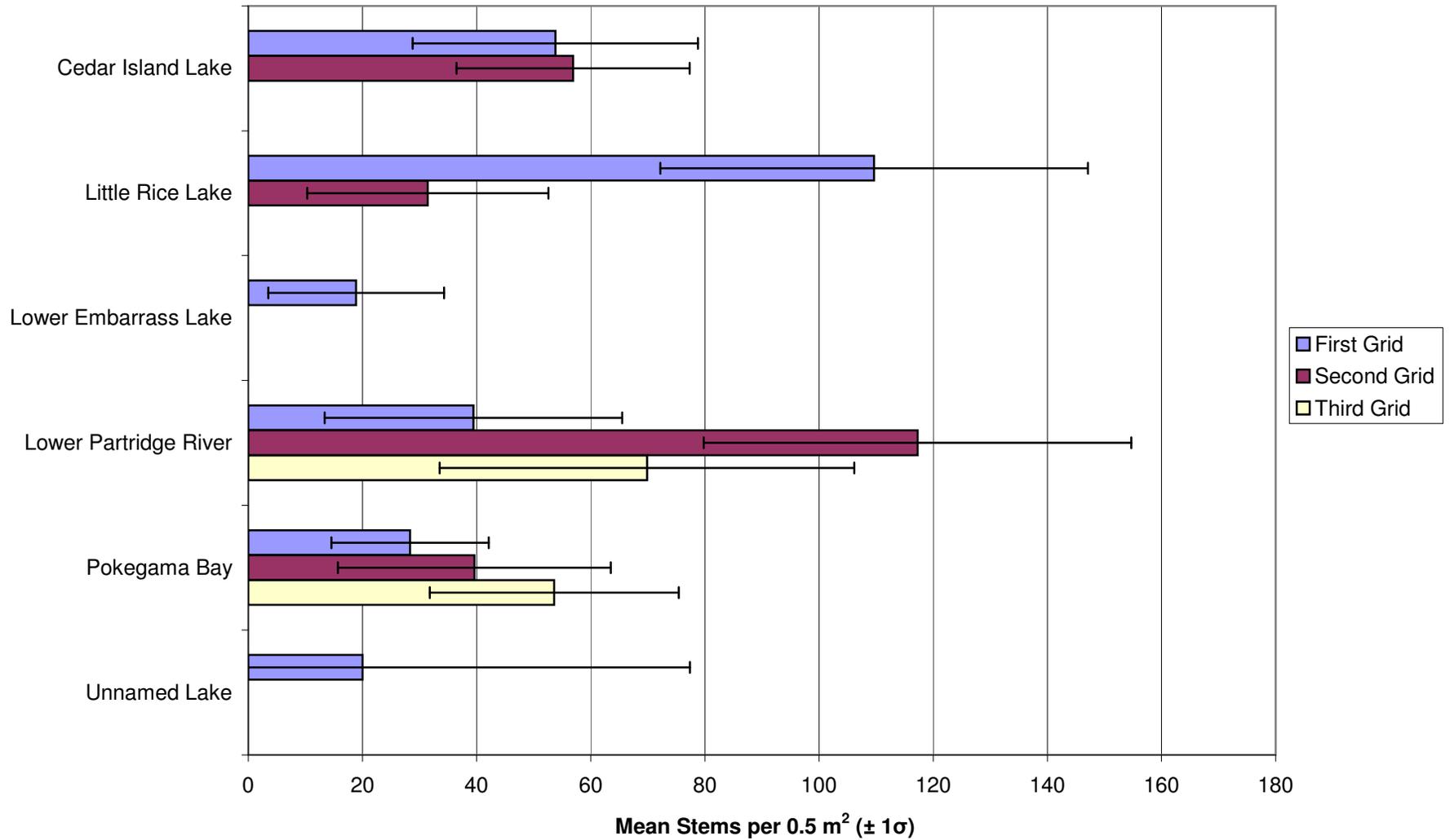
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**Figure 22**  
**Sulfate Concentrations at Wild Rice Stands in PolyMet NorthMet Project Study Area,**  
**August to September 2009**



**Figure 23**  
**Wild Rice Density at Selected Locations in PolyMet NorthMet Project Study Area,**  
**August to September 2009**



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***Appendices***

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***Appendix A***

***Photographs of Wild Rice for the Project Study Area***



**Figure A-1 Cedar Island Lake, August 13, 2009**



**Figure A-2 Cedar Island Lake, August 13, 2009**



**Figure A-3 Little Rice Lake, August 13, 2009**



**Figure A-4 Little Rice Lake, August 13, 2009**



**Figure A-5 Lower Partridge River, August 20, 2009**



**Figure A-6 Lower Partridge River, August 20, 2009**



**Figure A-7 Lower St. Louis River, August 17, 2009**



**Figure A-8 Pokegama Bay, August 17, 2009**



**Figure A-9 Upper Embarrass River, August 19, 2009**



**Figure A-10 Upper Partridge River, September 2, 2009**

***Appendix B***

***Wild Rice Grid Density Calculations for the Project Study Area***

***B-1 Cedar Island Lake (Embarrass River)***

***B-2 Unnamed Lake (Embarrass River)***

***B-3 Lower Partridge River***

***B-4 Pokegama Bay (St. Louis River)***

***B-5 Little Rice Lake (Pike River)***

***Appendix B-1***

***Cedar Island Lake (Embarrass River)***

**Appendix B-1: Cedar Island Lake (Embarrass River)**

8/25/2009

8/25/2009

Grid 29			Grid 30		
Plots	Stems	Height	Plots	Stems	Height
Plot 90	49	42	Plot 71	61	34
		60			37
		64			54
		75			62
		43			54
Plot 60	97	70	Plot 99	48	68
		63			90
		57			77
		85			53
		61			53
Plot 98	63	65	Plot 83	73	51
		92			57
		42			46
		46			71
		89			72
Plot 59	88	68	Plot 88	45	59
		57			80
		47			94
		62			76
		76			61
Plot 94	32	44	Plot 79	84	91
		66			75
		70			81
		94			72
		100			73
Plot 38	35	32	Plot 74	23	64
		44			54
		71			48
		41			45
		57			70
Plot 76	51	45	Plot 64	84	85
		39			85
		55			79
		53			86
		70			82

**Appendix B-1: Cedar Island Lake (Embarrass River)**

8/25/2009

8/25/2009

Grid 29			Grid 30		
Plots	Stems	Height	Plots	Stems	Height
Plot 9	61	54	Plot 68	60	72
		72			63
		49			66
		56			78
		57			86
Plot 73	32	64	Plot 58	41	106
		64			71
		68			74
		92			59
		43			84
Plot 14	94	85	Plot 63	55	52
		72			74
		62			49
		69			50
		89			69
Plot 72	34	51	Plot 59	93	81
		66			76
		74			89
		91			61
		52			69
Plot 22	96	49	Plot 52	91	71
		75			92
		62			71
		55			75
		74			91
Plot 79	63	65	Plot 38	38	26
		71			64
		75			83
		81			68
		50			67
Plot 80	61	81	Plot 42	38	67
		74			68
		60			69
		91			87
		71			79

**Appendix B-1: Cedar Island Lake (Embarrass River)**

8/25/2009

8/25/2009

Grid 29			Grid 30		
Plots	Stems	Height	Plots	Stems	Height
Plot 68	26	67	Plot 29	65	80
		79			91
		60			77
		62			94
		72			63
Plot 59	53	74	Plot 23	28	66
		80			86
		79			39
		60			56
		76			54
Plot 50	21	47	Plot 10	39	71
		92			46
		65			57
		68			76
		58			69
Plot 39	54	69	Plot 4	65	52
		69			63
		51			71
		62			58
		48			70
Plot 35	52	74	Plot 97	59	71
		35			80
		68			83
		72			66
		64			86
Plot 44	14	80	Plot 68	48	76
		45			78
		45			73
		61			93
		53			92

	Stems	Height		Stems	Height
<b>Total</b>	1076	6444	<b>Total</b>	1138	6983
<b>Mean</b>	54	64.44	<b>Mean</b>	56.9	69.83
<b>Median</b>	53	64.5	<b>Median</b>	57	71
<b>S.D.</b>	25	14.71	<b>S.D.</b>	20.4319	14.94

***Appendix B-2***

***Unnamed Lake (Embarrass River)***

**Appendix B-2: Unnamed Lake and Lower Embarrass Lake (Embarrass River)**

8/18/2009

8/18/2009

Grid 21				Grid 22			
Plots	Water Depth (in)	Stems	Height	Plots	Water Depth (in)	Stems	Height
Plot 1	14	0	0	Plot 1	14	29	38
5261322 N				5262472 N			
549831 E				550001 E			
Plot 41	11	240	33	Plot 11	14	24	24
5261318 N				5262471 N			
549831 E				550001 E			
Plot 72	11	89	32	Plot 22	18	20	30.5
5261315 N				5262470 N			
549832 E				550002 E			
Plot 81	9	24	28	Plot 31	15	24	34
5261314 N				5262469 N			
549831 E				550001 E			
Plot 4	11	0	0	Plot 82	14.5	11	31
5261322 N				5262464 N			
549834 E				550002 E			
Plot 5	11	0	0	Plot 92	15	10	42
5261322 N				5262463 N			
549835 E				550002 E			
Plot 14	11.5	0	0	Plot 15	21	24	21.5
5261321 N				5262471 N			
549834 E				550005 E			
Plot 45	10	27	40	Plot 55	17	21	26.5
5261318 N				5262467 N			
549835 E				550005 E			
Plot 55	10	0	0	Plot 64	16.5	11	49
5261317 N				5262466 N			
549835 E				550004 E			
Plot 95	7	0	0	Plot 73	18	4	42.5
5261313 N				5262465 N			
549835 E				550003 E			

**Appendix B-2: Unnamed Lake and Lower Embarrass Lake (Embarrass River)**

8/18/2009

8/18/2009

Grid 21				Grid 22			
Plots	Water Depth (in)	Stems	Height	Plots	Water Depth (in)	Stems	Height
Plot 6	10	0	0	Plot 3	17.5	62	26
5261322 N				5262472 N			
549836 E				550003 E			
Plot 17	13	0	0	Plot 13	20	35	25
5261321 N				5262471 N			
549837 E				550003 E			
Plot 27	10	0	0	Plot 26	30.5	17	22
5261320 N				5262470 N			
549837 E				550006 E			
Plot 26	11	0	0	Plot 36	16.5	18	22.5
5261320 N				5262469 N			
549836 E				550006 E			
Plot 96	10	0	0	Plot 77	24	1	7
5261313 N				5262465 N			
549836 E				550007 E			
Plot 18	7.5	0	0	Plot 98	28	8	21
5261321 N				5262463 N			
549838 E				550008 E			
Plot 29	9	0	0	Plot 96	19.5	45	18.5
5261320 N				5262463 N			
549839 E				550006 E			
Plot 58	7	0	0	Plot 8	30	9	13
5261317 N				5262472 N			
549838 E				550008 E			
Plot 50	9	0	0	Plot 19	30	4	17.5
5261318 N				5262471 N			
549840 E				550009 E			
				Plot 29	32	1	6
				5262470 N			
				550009 E			

**Appendix B-2: Unnamed Lake and Lower Embarrass Lake (Embarrass River)**

8/18/2009

8/18/2009

Grid 21				Grid 22			
Plots	Water Depth (in)	Stems	Height	Plots	Water Depth (in)	Stems	Height

		Stems	Height			Stems	Height
<b>Total</b>		380	133	<b>Total</b>		378	517.5
<b>Mean</b>		20	7.00	<b>Mean</b>		18.9	25.88
<b>Median</b>		0	0	<b>Median</b>		17.5	24.5
<b>S.D.</b>		57.3614	14.08	<b>S.D.</b>		15.3791	11.35

***Appendix B-3***

***Lower Partridge River***

**Appendix B-3: Lower Partridge River (Below Colby Lake)**

8/20/2009

8/20/2009

8/21/2009

Grid 26				Grid 27				Grid 28			
Plots	Water Depth (in)	Stems	Height	Plots	Water Depth (in)	Stems	Height	Plots	Water Depth (in)	Stems	Height
Plot 91	45	2	25	Plot 48	14	167	26	Plot 1	14.5	71	18
5263119 N				5262725 N			26	5263440 N			26
560961 E				561035 E			25	561032 E			24
							22				19
							20				26
Plot 42	29	30	24	Plot 39	12.5	169	29	Plot 52	13	113	24
5263124 N			17	5262726 N			22	5263435 N			22
560962 E			20	561036 E			23	561033 E			20
			25				25				26
							32				20
Plot 23	29	33	25	Plot 99	12	161	24	Plot 72	13	94	25
5263126 N			8	5262720 N			22	5263433 N			27
560963 E			26	561036 E			23	561033 E			19
			25				23				21
			24				29				17
Plot 53	29	80	28	Plot 70	14	63	22	Plot 73	12.5	72	23
5263123 N			23	5262723 N			26	5263433 N			25
560963 E			22	561037 E			24	561034 E			24
			23				24				26
			23				19				25

**Appendix B-3: Lower Partridge River (Below Colby Lake)**

8/20/2009

8/20/2009

8/21/2009

Grid 26				Grid 27				Grid 28			
Plots	Water Depth (in)	Stems	Height	Plots	Water Depth (in)	Stems	Height	Plots	Water Depth (in)	Stems	Height
Plot 73	34	21	25	Plot 30	10	97	22	Plot 74	11.5	77	24
5263121 N			16	5262727 N			21	5263433 N			24
560963 E			28	561037 E			24	561035 E			25
			30				23				19
			36				21				24
Plot 74	34	88	29	Plot 20	9	108	25	Plot 64	14	80	14
5263121 N			25	5262728 N			24	5263434 N			19
560964 E			34	561037 E			21	561035 E			21
			28				20				25
			27				18				21
Plot 75	29	78	22	Plot 51	23	99	23	Plot 93	13	56	23
5263121 N			27	5262724 N			24	5263431 N			22
560965 E			31	561028 E			24	561034 E			20
			30				24				25
			32				28				27
Plot 24	28	20	27	Plot 42	21	145	22	Plot 92	12	88	20
5263126 N			22	5262725 N			20	5263431 N			24
560964 E			15	561029 E			24	561033 E			22
			23				25				26
			24				25				33

**Appendix B-3: Lower Partridge River (Below Colby Lake)**

8/20/2009

8/20/2009

8/21/2009

Grid 26				Grid 27				Grid 28			
Plots	Water Depth (in)	Stems	Height	Plots	Water Depth (in)	Stems	Height	Plots	Water Depth (in)	Stems	Height
Plot 25	27	31	24	Plot 71	39	109	19	Plot 34	13	87	23
5263126 N			25	5262722 N			19	5263437 N			23
560965 E			16	561028 E			20	561035 E			18
			18				26				21
			20				25				28
Plot 96	31	29	16	Plot 81	37	65	24	Plot 25	13	42	31
5263119 N			23	5262721 N			19	5263438 N			24
560966 E			21	561028 E			26	561036 E			22
			24				17				19
			22				21				24
Plot 97	26	80	29	Plot 14	15	126	22	Plot 36	16	57	15
5263119 N			25	5262728 N			28	5263437 N			18
560967 E			25	561031 E			23	561037 E			18
			26				27				24
			27				29				22
Plot 78	32	33	22	Plot 34	20	114	25	Plot 37	17	34	23
5263121 N			25	5262726 N			24	5263437 N			21
560968 E			21	561031 E			24	561038 E			33
			18				30				23
			21				30				22

**Appendix B-3: Lower Partridge River (Below Colby Lake)**

8/20/2009

8/20/2009

8/21/2009

Grid 26				Grid 27				Grid 28			
Plots	Water Depth (in)	Stems	Height	Plots	Water Depth (in)	Stems	Height	Plots	Water Depth (in)	Stems	Height
Plot 79	32	18	19	Plot 35	19	100	25	Plot 7	13.5	45	20
5263121 N			13	5262726 N			28	5263440 N			19
560969 E			19	561032 E			24	561038 E			17
			24				24				22
			19				29				28
Plot 80	28	18	25	Plot 65	19	131	26	Plot 20	20	10	22
5263121 N			25	5262723 N			22	5263439 N			18
560970 E			23	561032 E			24	561041 E			25
			23				25				25
			25				23				19
Plot 68	30.5	4	24	Plot 85	19	89	21	Plot 29	16.5	10	28
5263122 N			20	5262721 N			23	5263438 N			23
560968 E				561032 E			21	561040 E			19
							24				21
							27				20
Plot 59	21.5	39	19	Plot 16	14	49	24	Plot 49	14	168	26
5263123 N			20	5262728 N			22	5263436 N			23
560969 E			31	561033 E			24	561040 E			25
			20				29				22
			22				26				28

**Appendix B-3: Lower Partridge River (Below Colby Lake)**

8/20/2009

8/20/2009

8/21/2009

Grid 26				Grid 27				Grid 28			
Plots	Water Depth (in)	Stems	Height	Plots	Water Depth (in)	Stems	Height	Plots	Water Depth (in)	Stems	Height
Plot 50	17.5	40	23	Plot 46	16	158	25	Plot 68	15	107	26
5263124 N			13	5262725 N			28	5263434 N			20
560970 E			18	561033 E			26	561039 E			21
			22				34				27
			25				23				27
Plot 39	19.5	32	19	Plot 77	14.5	81	21	Plot 89	18	45	24
5263125 N			27	5262722 N			23	5263432 N			19
560969 E			21	561034 E			26	561040 E			19
			22				22				27
			20				29				17
Plot 28	20.5	41	17	Plot 97	13.5	164	24	Plot 97	17	72	26
5263126 N			18	5262720 N			27	5263431 N			24
560968 E			20	561034 E			26	561038 E			24
			19				29				26
			26				26				22
Plot 10	10	72	32	Plot 68	14	150	25	Plot 100	20	69	22
5263128 N			28	5262723 N			24	5263431 N			35
560970 E			21	561035 E			22	561041 E			31
			27				23				29
			23				23				24

**Appendix B-3: Lower Partridge River (Below Colby Lake)**

8/20/2009

8/20/2009

8/21/2009

Grid 26				Grid 27				Grid 28			
Water Depth				Water Depth				Water Depth			
Plots	(in)	Stems	Height	Plots	(in)	Stems	Height	Plots	(in)	Stems	Height
		Stems	Height			Stems	Height			Stems	Height
<b>Total</b>		789	2129	<b>Total</b>		2345	2419	<b>Total</b>		1397	2307
<b>Mean</b>		39	23.14	<b>Mean</b>		117.25	24.19	<b>Mean</b>		69.85	23.07
<b>Median</b>		33	23	<b>Median</b>		111.5	24	<b>Median</b>		71.5	23
<b>S.D.</b>		26	4.72	<b>S.D.</b>		37.4656	3.05	<b>S.D.</b>		36.32	3.84

***Appendix B-4***

***Pokegama Bay (St. Louis River)***

**Appendix B-4: Pokegama Bay (St. Louis River)**

9/8/2009

9/8/2009

9/8/2009

Grid 90				Grid 91				Grid 92			
Plots	Water Depth (cm)	Stems	Height (cm)	Plots	Water Depth (cm)	Stems	Height	Plots	Water Depth (cm)	Stems	Height
Plot 1	57	33	142	Plot 1	62	45	168	Plot 12	60	56	138
5169514 N			128	5170023 N			145	5169572 N			139
565561 E			134	564985 E			171	565311 E			166
			112				158				138
			102				113				133
Plot 22	56	26	134	Plot 41	64	26	155	Plot 22	51	26	114
5169512 N			133	5170019 N			119	5169571 N			158
565562 E			109	564985 E			144	565311 E			119
			103				125				118
			106				107				122
Plot 91	60	31	96	Plot 51	64	12	105	Plot 41	58	86	89
5169505 N			97	5170018 N			144	5169569 N			133
565561 E			127	564985 E			139	565310 E			125
			147				109				95
			96				73				140
Plot 82	61	32	115	Plot 53	63	22	88	Plot 64	52	85	146
5169506 N			79	5170018 N			130	5169567 N			147
565562 E			98	564987 E			126	565313 E			132
			119				119				151
			82				82				108

**Appendix B-4: Pokegama Bay (St. Louis River)**

9/8/2009

9/8/2009

9/8/2009

Grid 90				Grid 91				Grid 92			
Plots	Water Depth (cm)	Stems	Height (cm)	Plots	Water Depth (cm)	Stems	Height	Plots	Water Depth (cm)	Stems	Height
Plot 84	62	23	130	Plot 43	67	14	124	Plot 53	52	61	146
5169506 N			126	5170019 N			108	5169568 N			118
565564 E			135	564987 E			123	565312 E			142
			137				111				99
			100				78				138
Plot 73	58	40	151	Plot 34	64	15	143	Plot 94	62	65	123
5169507 N			119	5170020 N			132	5169564 N			85
565563 E			34	564988 E			97	565313 E			122
			95				134				106
			121				79				102
Plot 63	63	15	112	Plot 95	57	46	147	Plot 24	65	23	131
5169508 N			119	5170014 N			108	5169571 N			120
565563 E			126	564989 E			134	565313 E			109
			113				156				110
			130				108				100
Plot 64	61	33	118	Plot 85	56	36	112	Plot 4	67	57	80
5169508 N			105	5170015 N			141	5169573 N			111
565564 E			103	564989 E			151	565313 E			100
			134				129				83
			93				127				100

**Appendix B-4: Pokegama Bay (St. Louis River)**

9/8/2009

9/8/2009

9/8/2009

Grid 90				Grid 91				Grid 92			
Plots	Water Depth (cm)	Stems	Height (cm)	Plots	Water Depth (cm)	Stems	Height	Plots	Water Depth (cm)	Stems	Height
Plot 53	62	39	115	Plot 76	57	28	151	Plot 5	55	40	103
5169509 N			151	5170016 N			136	5169573 N			130
565563 E			88	564990 E			103	565314 E			112
			92				112				121
			90				102				100
Plot 43	60	12	115	Plot 36	59	78	152	Plot 46	57	51	117
5169510 N			83	5170020 N			97	5169569 N			124
565563 E			87	564990 E			117	565315 E			146
			93				115				104
			92				142				128
Plot 22	62	15	114	Plot 25	57	45	138	Plot 66	55	53	120
5169512 N			124	5170021 N			136	5169567 N			121
565562 E			120	564989 E			124	565315 E			162
			121				131				126
			133				90				150
Plot 77	61	29	141	Plot 26	61	99	153	Plot 97	60	33	134
5169507 N			90	5170021 N			151	5169564 N			135
565567 E			111	564990 E			105	565316 E			104
			164				134				144
			153				106				131

**Appendix B-4: Pokegama Bay (St. Louis River)**

9/8/2009

9/8/2009

9/8/2009

Grid 90				Grid 91				Grid 92			
Plots	Water Depth (cm)	Stems	Height (cm)	Plots	Water Depth (cm)	Stems	Height	Plots	Water Depth (cm)	Stems	Height
Plot 56	58	43	140	Plot 6	60	28	132	Plot 8	55	58	98
5169509 N			102	5170023 N			110	5169573 N			124
565566 E			113	564990 E			100	565317 E			132
			118				89				136
			136				107				112
Plot 57	58	50	129	Plot 15	68	7	100	Plot 7	61	21	109
5169509 N			105	5170022 N			100	5169573 N			123
565567 E			91	564989 E			120	565316 E			102
			112				64				107
			113				86				114
Plot 65	62	13	140	Plot 10	59	53	139	Plot 10	62	32	88
5169508 N			117	5170023 N			122	5169573 N			108
565565 E			135	564994 E			125	565319 E			128
			79				86				125
			86				100				111
Plot 7	63	11	62	Plot 19	57	35	109	Plot 30	56	83	128
5169514 N			99	5170022 N			108	5169571 N			131
565567 E			75	564993 E			134	565319 E			137
			84				112				129
			83				112				78

**Appendix B-4: Pokegama Bay (St. Louis River)**

9/8/2009

9/8/2009

9/8/2009

Grid 90				Grid 91				Grid 92			
Plots	Water Depth (cm)	Stems	Height (cm)	Plots	Water Depth (cm)	Stems	Height	Plots	Water Depth (cm)	Stems	Height
Plot 58	58	53	106	Plot 40	56	59	137	Plot 40	53	51	125
5169509 N			104	5170020 N			107	5169570 N			149
565568 E			104	564994 E			128	565319 E			126
			128				128				165
			109				82				100
Plot 19	62	11	100	Plot 39	61	22	169	Plot 50	63	86	134
5169513 N			70	5170020 N			110	5169569 N			115
565569 E			70	564993 E			150	565319 E			144
			68				110				119
			58				112				111
Plot 10	63	13	93	Plot 60	57	54	158	Plot 80	59	75	130
5169514 N			124	5170018 N			175	5169566 N			126
565570 E			83	564994 E			117	565319 E			142
			78				140				109
			78				111				110
Plot 50	58	45	130	Plot 99	54	68	111	Plot 100	52	30	145
5169510 N			84	5170014 N			98	5169564 N			134
565570 E			82	564993 E			155	565319 E			115
			116				106				133
			109				135				121

**Appendix B-4: Pokegama Bay (St. Louis River)**

9/8/2009

9/8/2009

9/8/2009

Grid 90				Grid 91				Grid 92			
Plots	Water Depth (cm)	Stems	Height (cm)	Plots	Water Depth (cm)	Stems	Height	Plots	Water Depth (cm)	Stems	Height
<b>Total</b>		567	10850	<b>Total</b>		792	12151	<b>Total</b>		1072	12221
<b>Mean</b>		28	108.50	<b>Mean</b>		39.6	121.51	<b>Mean</b>		53.6	122.21
<b>Median</b>		30	110	<b>Median</b>		35.5	119.5	<b>Median</b>		54.5	123
<b>S.D.</b>		14	23.52	<b>S.D.</b>		23.913	23.46	<b>S.D.</b>		21.81	18.72

***Appendix B-5***

***Little Rice Lake (Pike River)***

**Appendix B-5: Little Rice Lake (Pike River)**

8/18/2009

8/18/2009

Grid 19				Grid 20			
Plots	Water Depth (in)	Stems	Height	Plots	Water Depth (in)	Stems	Height
Plot 42	23	147	39	Plot 12	31	40	39.5
5268482 N				5268671 N			
547970 E				547222 E			
Plot 51	23	125	37	Plot 42	29	57	39
5268481 N				5268668 N			
547969 E				547222 E			
Plot 61	24	168	44	Plot 41	29	78	46
5268480 N				5268668 N			
547969 E				547221 E			
Plot 82	23	109	41	Plot 51	35	53	44.5
5268478 N				5268667 N			
547970 E				547221 E			
Plot 74	25	101	39	Plot 52	29	69	36
5268479 N				5268667 N			
547972 E				547222 E			
Plot 63	24	94	38	Plot 83	31	4	29
5268480 N				5268664 N			
547971 E				547223 E			
Plot 54	26	70	31	Plot 6	30	37	28
5268481 N				5268672 N			
547972 E				547226 E			
Plot 4	23	83	35	Plot 45	31	52	31
5268486 N				5268668 N			
547972 E				547225 E			

**Appendix B-5: Little Rice Lake (Pike River)**

8/18/2009

8/18/2009

Grid 19				Grid 20			
Plots	Water Depth (in)	Stems	Height	Plots	Water Depth (in)	Stems	Height
Plot 16	26	51	33	Plot 56	31	13	36
5268485 N				5268667 N			
547974 E				547226 E			
Plot 57	24	124	47	Plot 8	31.5	17	38
5268481 N				5268672 N			
547975 E				547228 E			
Plot 67	24	124	41	Plot 18	32	20	29.5
5268480 N				5268671 N			
547975 E				547228 E			
Plot 87	29	68	42	Plot 28	30	32	39
5268478 N				5268670 N			
547975 E				547228 E			
Plot 86	24	178	35	Plot 57	32	10	34
5268478 N				5268667 N			
547974 E				547227 E			
Plot 49	24	106	33	Plot 78	33	23	41
5268482 N				5268665 N			
547977 E				547228 E			
Plot 39	26	93	38	Plot 77	31	16	37
5268483 N				5268665 N			
547977 E				547227 E			
Plot 18	24	51	30	Plot 98	32.5	20	43
5268485 N				5268663 N			
547976 E				547228 E			
Plot 8	24	104	41	Plot 100	33	22	33
5268486 N				5268663 N			
547976 E				547230 E			

**Appendix B-5: Little Rice Lake (Pike River)**

8/18/2009

8/18/2009

Grid 19				Grid 20			
Plots	Water Depth (in)	Stems	Height	Plots	Water Depth (in)	Stems	Height
Plot 30	23	99	39	Plot 89	34	16	29
5268484 N				5268664 N			
547978 E				547229 E			
Plot 45	24	179	43	Plot 79	34	41	40
5268482 N				5268665 N			
547973 E				547229 E			
Plot 95	29	119	41	Plot 59	33	9	33
5268477 N				5268667 N			
547973 E				547229 E			

	Stems	Height		Stems	Height
<b>Total</b>	2193	767	<b>Total</b>	629	725.5
<b>Mean</b>	110	38.35	<b>Mean</b>	31.45	36.28
<b>Median</b>	105	39	<b>Median</b>	22.5	36.5
<b>S.D.</b>	37	4.45	<b>S.D.</b>	21.1249	5.37

**DRAFT**

***Appendix C***

***MPCA Wild Rice Information Request***

***May 28, 2009***

## Memorandum

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**From:** Clark, Richard  
**Sent:** Thursday, May 28, 2009 6:59 AM  
**To:** Jim Scott  
**cc:** 'Stuart Arkley', 'David Blaha'  
**Subject:** MPCA Wild Rice Information Request

Jim,

The purpose of this email is to transmit to you the type of information that the MPCA is requesting from a mining project proposer/permittee of a facility that may affect waters that contain, or have the potential to contain wild rice. For the PolyMet project this information should be collected as soon as practical so that it can be available to the environmental review and permitting processes. If you have questions please feel free to contact me or Ann Foss.

Richard

651-757-2280

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1. Conduct a literature search for wild rice in the downstream receiving waters impacted by the proposed project. Some data sources that may be used to determine the potential for wild rice impacts includes Appendix A of the 2008 DNR Wild Rice Report, the most recent DNR Wild Rice Harvester Survey, and the 1854 Treaty Authority List. For waters listed in the DNR Wild Rice Report, contact Gary Drotts at 218-833-8620 and Ann Geisen at 218-833-8625 to gather all the available DNR data on those sites. Information on any active or proposed DNR management activities designed to establish, protect, or enhance the wild rice resources of these waters should be included. In addition, Darren Vogt of the 1854 Treaty Authority should be contacted at 218-722-8907 for any further data he may have related to sites listed on one of the above lists.
  2. Undertake a cooperative information gathering/exchange process with the tribes in the project area to evaluate the past, current and future wild rice status or management objectives on the sites identified above as potential wild rice waters. Informational items to be addressed include:
    - A description of the historical/cultural importance of the wild rice resources at these sites.
    - An estimate of the historic size (acres) of wild rice stands at these sites with an estimate of the year in which the observation was made.
    - Any information the tribe may have on if/how wild rice stands at each site may have changed over time.

- Any data the tribes may have concerning whether anything in particular has contributed to the change in the size of wild rice stands at these sites.
  - A description of the current use of the sites for ricing, if any.
  - Information on any active or proposed management activities designed to establish, protect, or enhance the wild rice resources of these waters.
3. Conduct a field survey to observe whether wild rice is actually present in all waters in the project area that were determined to have the potential for wild rice, either based on the literature search above or those that have characteristics which may encourage wild rice production. The field surveys should be conducted by a qualified professional and should take into account the cyclic nature of the growth of this aquatic plant.
4. Determine the current sulfate levels, as determined by known historical data or additional sampling as required, for those waters where wild rice was observed during the field survey. Sampling should be conducted at a minimum of six separate locations within discernible wild rice areas of each applicable water body or stream reach.
5. Submit any other information or data that the project proposer/permittee believes may be useful to the Agency's evaluation.