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Technical Memorandum

To: Bill Johnson, MDNR; Shirley Frank, USFS; Doug Bruner, USACE
From: Rachel Walker
Subject: Wild Rice Survey Results Summary
Date: November 5, 2013
Project: 23690862.00
c: Jennifer Saran, PolyMet

The purpose of the memorandum is to provide a summary of the wild rice surveys that were conducted for the NorthMet Project and Land Exchange in 2009, 2010, 2011, and 2012, including survey locations, wild rice presence and sulfate concentrations. The results of these surveys are presented in two sets of figures and a summary table.

The first set of figures (Figures 1 through 9) shows wild rice survey start and end points, color coded by year for each of the study area water bodies. The second set of figures (Figures 10 through 18) summarizes wild rice presence and sulfate concentrations from 2009 through 2012.

In the second set of figures (Figures 10 through 18), wild rice presence is summarized using orange points (2009 through 2011) and orange line segments (2012). Orange points do not specify the year (2009 through 2011) that wild rice was identified at that location. These figures do not provide wild rice density information. More detail regarding wild rice presence and density is available in the Wild Rice and Water Quality Monitoring Reports (reference (1)), (reference (2)), (reference (3)), and (reference (4)).

Figures 10 through 18 also show sulfate concentrations from water samples collected during wild rice surveys from 2009 through 2012. The sulfate concentrations vary by location and year. Table 1 provides a summary of sulfate data for the water bodies surveyed with discrete boundaries (lakes), where five or more water samples were analyzed for sulfate during the 2009 through 2012 period. This table also includes the number of sulfate samples, the mean sulfate concentration, and the range of sulfate concentrations. It does not summarize sulfate concentrations along river stretches or in lakes where fewer than five sulfate samples were analyzed.

Table 1 Summary of Sulfate Data

Water Body	Sulfate concentration, mg/l		Number of Samples 2009-2012
	Mean 2009-2012	Range 2009-2012	
Cedar Island Lake	18.6	13.5 - 23.9	14
Embarrass Lake	21.8	21.2 - 23.2	7
Hay Lake (near Pike River)	1.22*	<1.00 - 1.80	5
Lower Embarrass Lake	19.1	15.9 - 22.8	6
Little Rice Lake (near Pike River)	2.22	1.90 - 2.40	12
Unnamed Lake	19.8	16.3 - 23.4	8

* Calculated using non-detections at the full method detection limit

In re-examining the sulfate concentrations collected between 2009 and 2012, we discovered that in 2010 three additional samples were included in error in the Wild Rice and Water Quality Monitoring Report (reference (2)). One of these samples was collected on Unnamed Lake and two were collected on Cedar Island Lake. All three were sediment samples, not water quality samples. These samples are not included in the information presented in Table 1 or on Figures 10 through 18.

References

1. **Barr Engineering Company.** 2009 Wild Rice and Sulfate Monitoring. Prepared for Poly Met Mining, Inc. 2010.

2. —. 2010 Wild Rice and Water Quality Monitoring. Prepared for Poly Met Mining, Inc. 2011.

3. —. 2011 Wild Rice and Water Quality Monitoring. Prepared for Poly Met Mining Inc. 2012.

4. —. 2012 Wild Rive and Water Quality Monitoring. Prepared for Poly Met Mining, Inc. 2013.

Pike River
Bear Creek
Camp Eight Creek
Embarrass River
Trimble Creek
Unnamed Creek
Spring Mine Creek
Hay Lake

Mile 23
Mile 24
Mile 25
Mile 26
Mile 27
Mile 28
Mile 29
Mile 30
Mile 31
Mile 33
Mile 34
Mile 35
Mile 36
Mile 37
Mile 38
Mile 39
Mile 40
Mile 41
Mile 42
Mile 43
Mile 44
Mile 45
Mile 46
Mile 47

Embarrass River Survey Start in 2009, 2010, 2011, and 2012

Spring Mine Creek Survey Start in 2009, 2010, 2011, and 2012

Survey (at road crossing) in 2012

Survey (on foot) in 2011

Survey (on foot) End in 2010

Survey (at road crossing) in 2012

Trimble Creek Was Not Surveyed in 2009

Survey (on foot) Start in 2010

Survey (on foot) in 2011

Survey (on foot) in 2011

Unnamed Creek Was Not Surveyed in 2009

Survey (on foot) End in 2010

Survey (at railroad grade) in 2012

Hay Lake Surveyed in 2009, 2010, 2011, and 2012

364 COUNTY
303 COUNTY
364 COUNTY
615 COUNTY
656 COUNTY
21 COUNTY
363 COUNTY
362 COUNTY
558 COUNTY
558 COUNTY
362 COUNTY
796 COUNTY
318 COUNTY
615 COUNTY
620 COUNTY
358 COUNTY

Imagery Source: FSA, 2010.

▲ River Miles

Surveyed in 2009

Surveyed in 2010

Surveyed in 2011

Surveyed in 2012

0 2,000 4,000 8,000

Feet

Figure 1
WILD RICE SURVEYED WATERS:
EMBARRASS RIVER, SPRING MINE CREEK,
TRIMBLE CREEK, UNNAMED CREEK, AND HAY LAKE
NorthMet Project
Poly Met Mining, Inc.
Hoyt Lakes, Minnesota

Born Footer: ArcGIS 10.1, 2013-09-24 16:41 File: I:\Client\PolyMet Mining\Work Orders\Confidential Task 04\Maps\Reports\Wild Rice Data Summary\Embarrass River Spring Mine Creek to Hay Lake.mxd User: am2

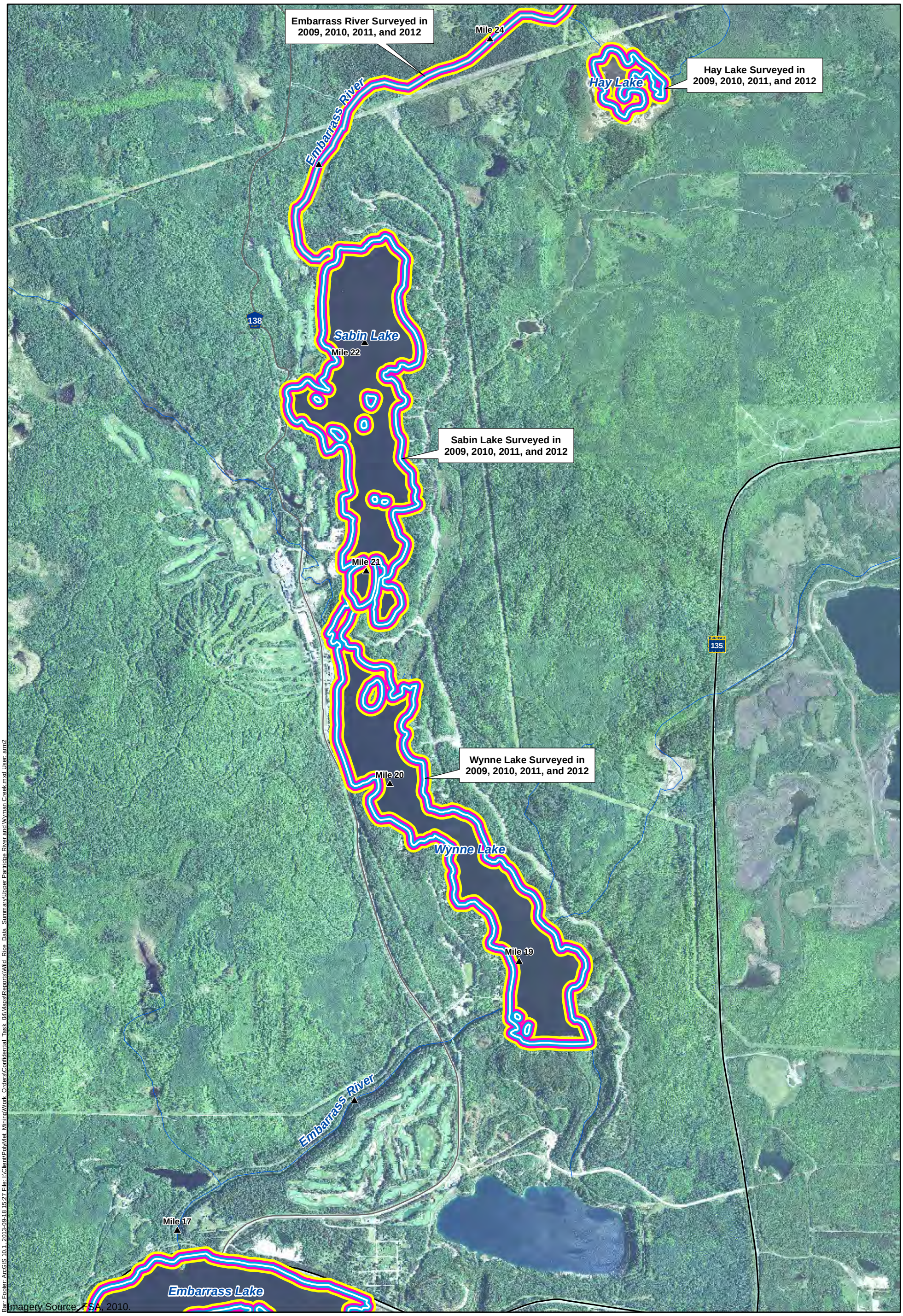
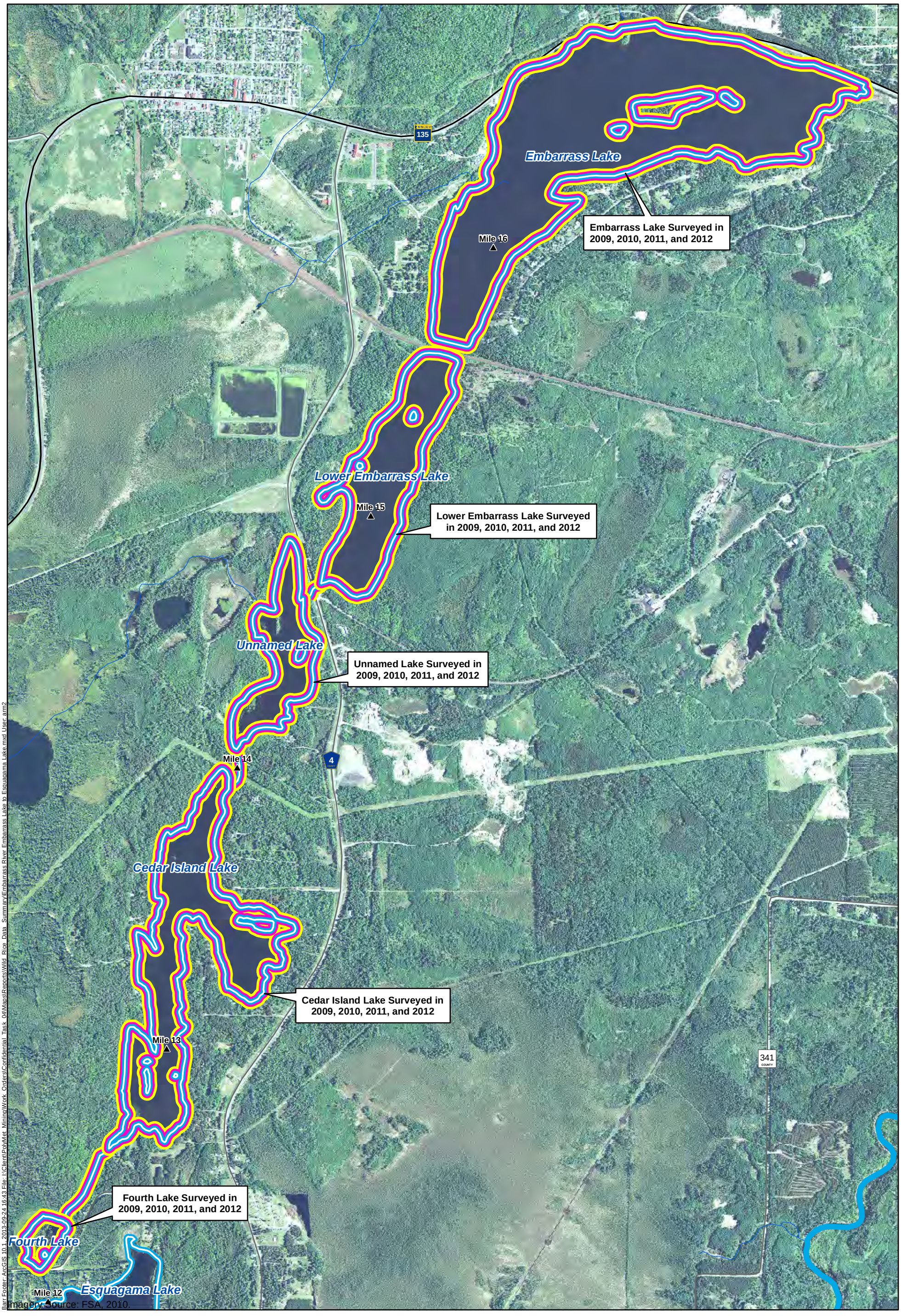


Figure 2
WILD RICE SURVEYED WATERS:
THE EMBARRASS RIVER FROM
HAY LAKE TO EMBARRASS LAKE
NorthMet Project
Poly Met Mining, Inc.
Hoyt Lakes, Minnesota



River Miles

Surveyed in 2009

Stream Segments Surveyed in 2010

Stream Segments Surveyed in 2011

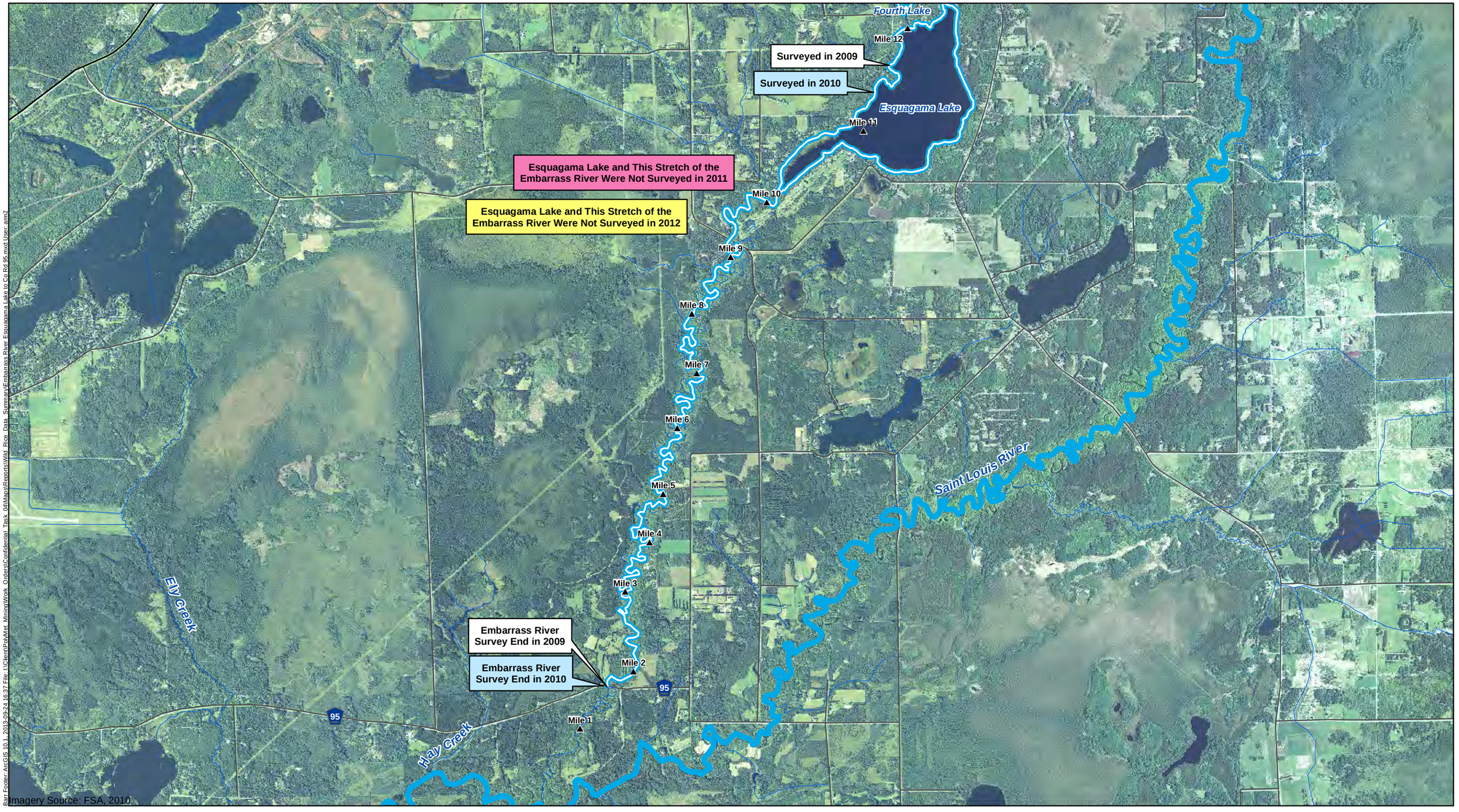
Surveyed Rivers Lakes in 2012

N

0 750 1,500 3,000

Feet

Figure 3
WILD RICE SURVEYED WATERS:
THE EMBARRASS RIVER FROM
EMBARRASS LAKE TO ESQUAGAMA LAKE
NorthMet Project
Poly Met Mining, Inc.
Hoyt Lakes, Minnesota



Barr Footer: ArcGIS 10.1, 2013-09-24 16:37 File: I:\Client\PolyMet_Mining\Work_Orders\Confidential_Trst_04\Maps\Reports\Wild_Rice_Path_Summary\Embarrass River Esquagama Lake to Co Rd 95.mxd User: amm2

River Miles

Surveyed in 2009

Surveyed in 2010

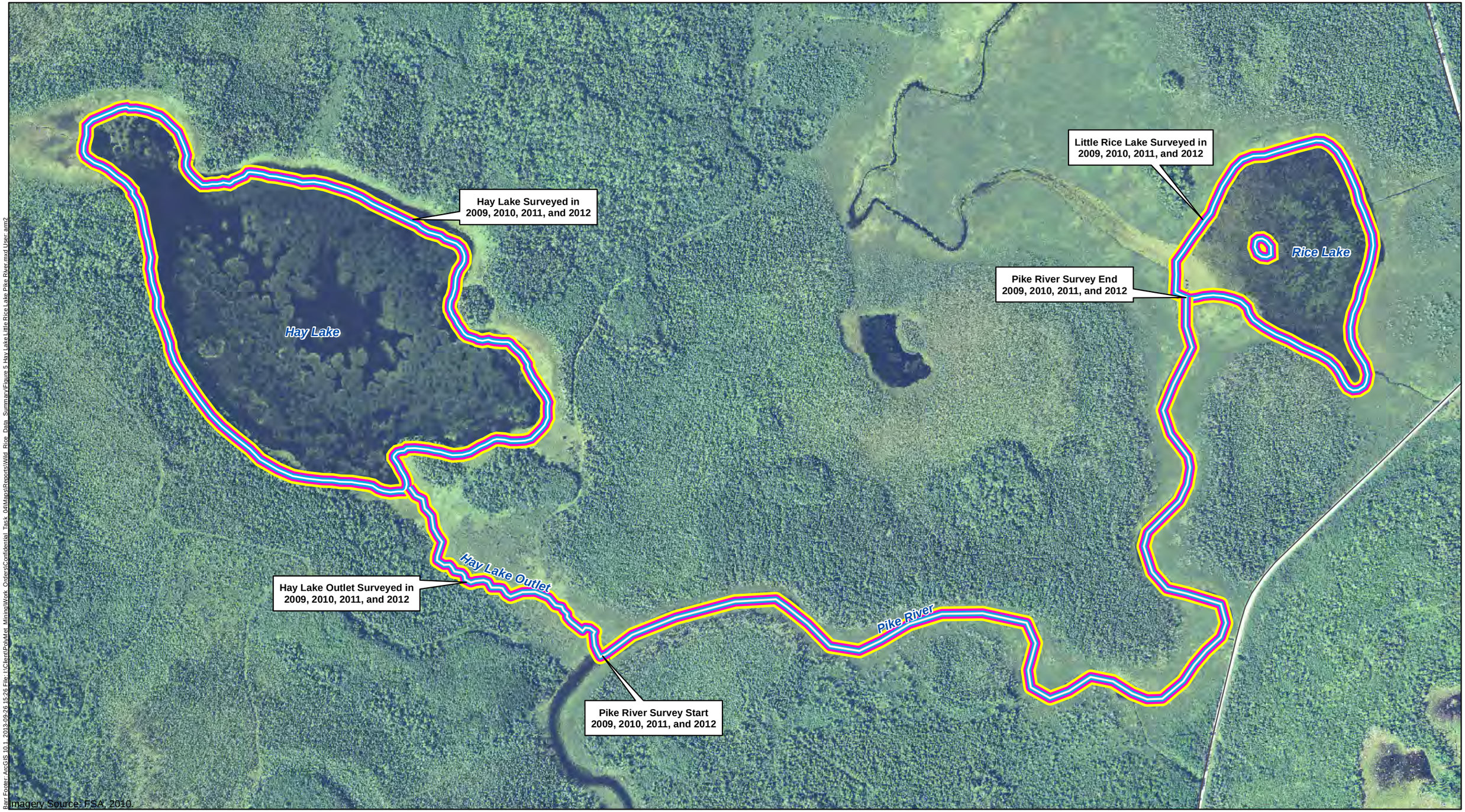
Surveyed in 2011

Surveyed in 2012

0 1,750 3,500 7,000

Feet

Figure 4
WILD RICE SURVEYED WATERS:
THE EMBARRASS RIVER FROM
ESQUAGAMA LAKE TO COUNTY RD 95
NorthMet Project
Poly Met Mining, Inc.
Hoyt Lakes, Minnesota



Barr Footer: ArcGIS 10.1, 2013-09-26 15:26 File: I:\Client\PolyMet_Mining\Work_Orders\Confidential_Task_04\Maps\Reports\Wild_Rice_Data_Summary\Figure 5 Hay Lake Little Rice Lake Pike River.mxd User: amn2

Imagery Source: FSA, 2010.

Surveyed in 2009

Surveyed in 2010

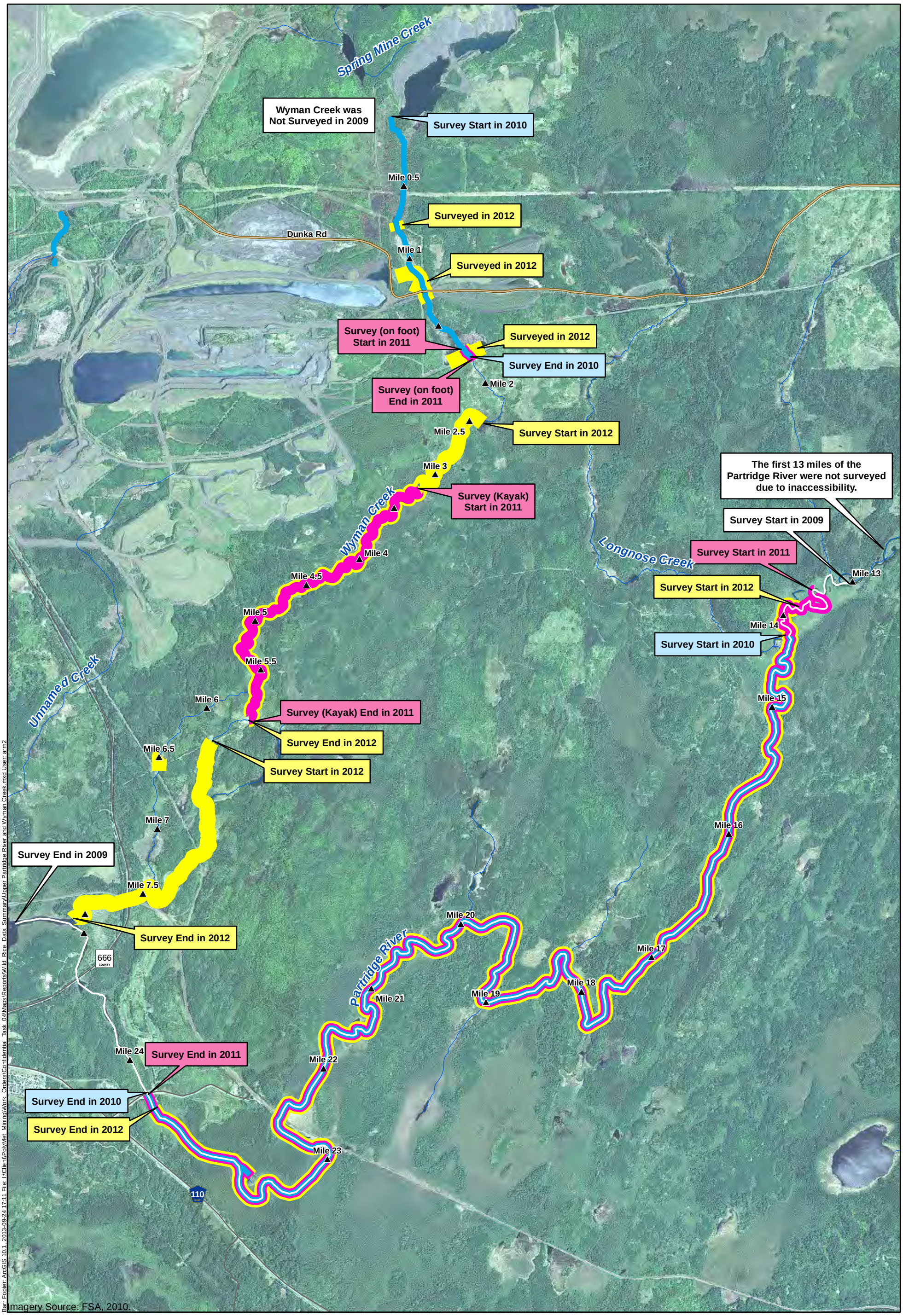
Surveyed in 2011

Surveyed in 2012

0 300 600 1,200

Feet

Figure 5
WILD RICE SURVEYED WATERS:
HAY LAKE, LITTLE RICE LAKE,
AND THE PIKE RIVER
NorthMet Project
Poly Met Mining, Inc.
Hoyt Lakes, Minnesota



▲ River Miles

Surveyed in 2009

Stream Segments Surveyed in 2010

Stream Segments Surveyed in 2011

Surveyed Rivers Lakes - 2012

N

0 1,500 3,000 6,000

Feet

Figure 6
WILD RICE SURVEYED WATERS:
THE UPPER PARTRIDGE RIVER
AND WYMAN CREEK
NorthMet Project
Poly Met Mining, Inc.
Hoyt Lakes, Minnesota

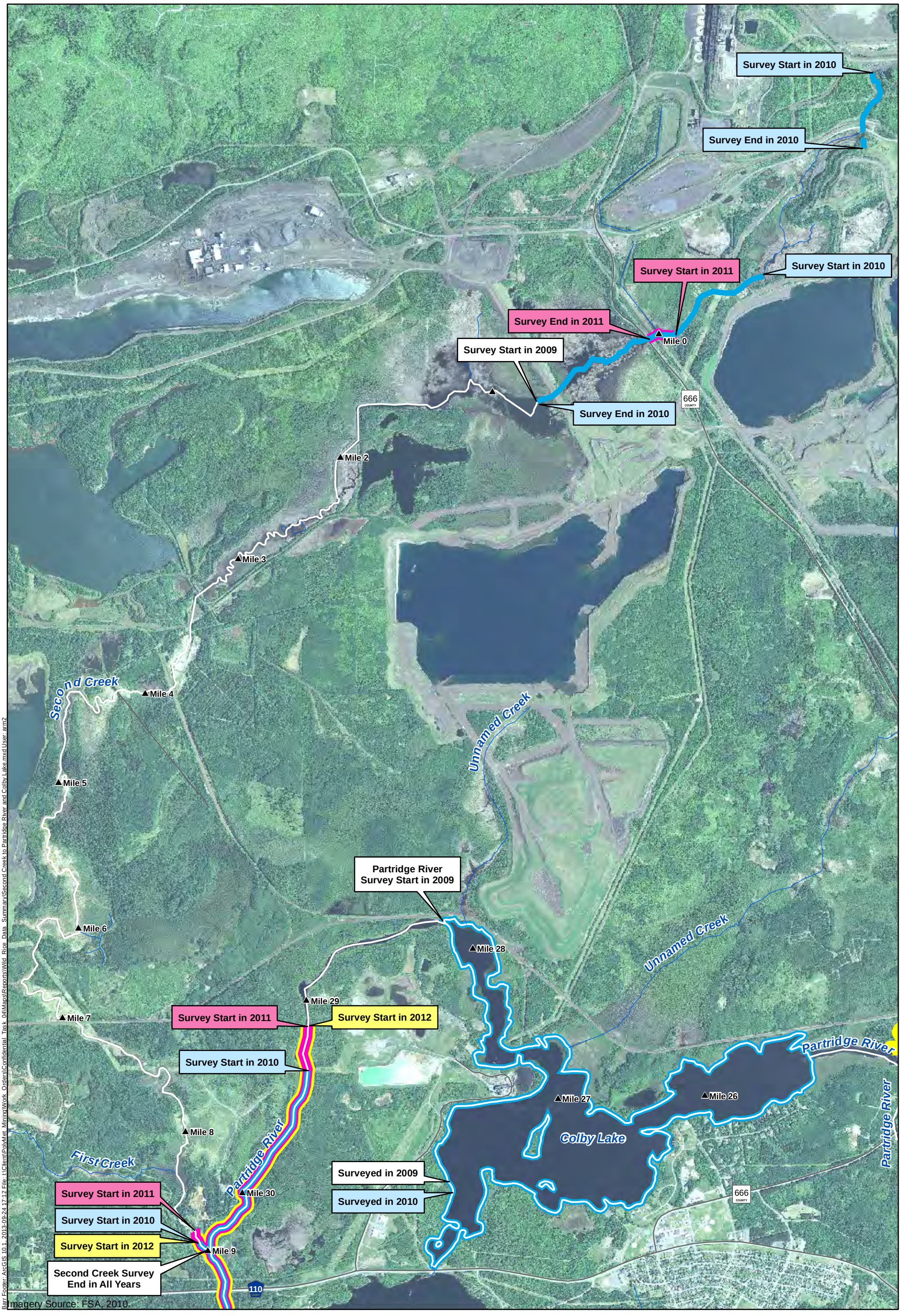


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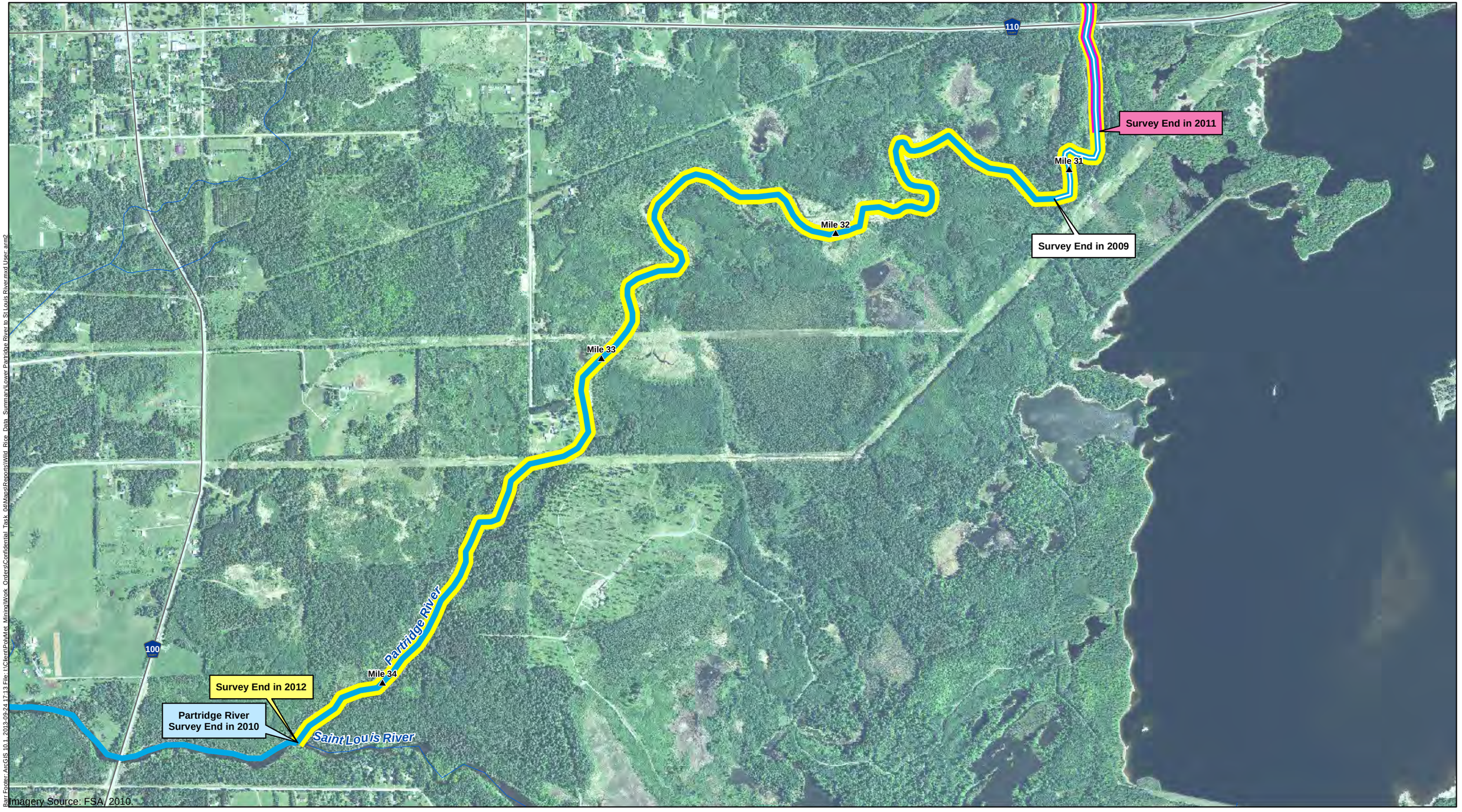
Figure 7
WILD RICE SURVEYED WATERS:
SECOND CREEK, THE LOWER
PARTRIDGE RIVER, & COLBY LAKE
NorthMet Project
Poly Met Mining, Inc.
Hoyt Lakes, Minnesota



Imagery Source: FSA, 2010.

▲ River Miles

Surveyed in 2009

Surveyed in 2010

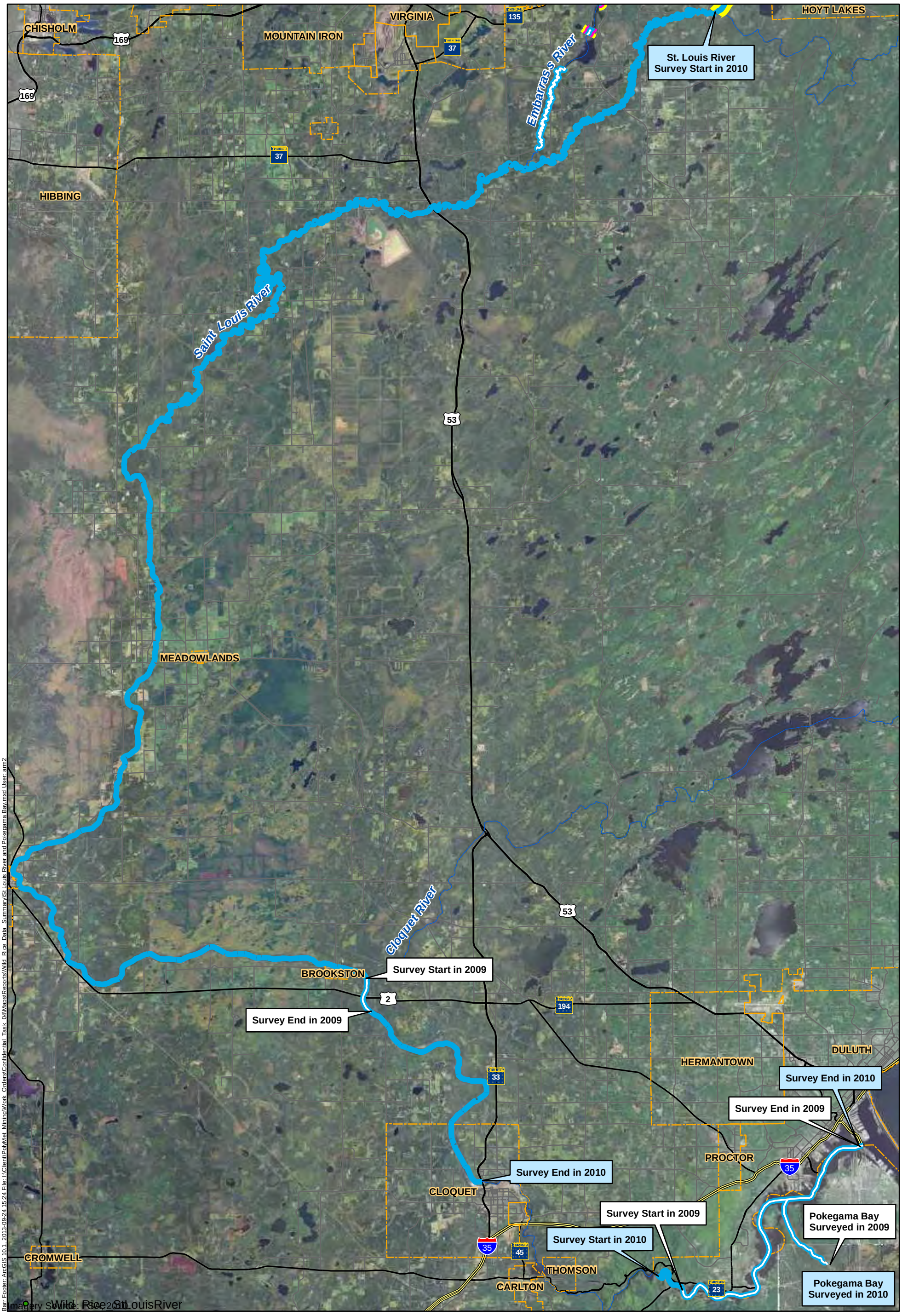
Surveyed in 2011

Surveyed in 2012

0 550 1,100 2,200

Feet

Figure 8
WILD RICE SURVEYED WATERS:
THE LOWER PARTRIDGE RIVER
AND SAINT LOUIS RIVER
NorthMet Project
Poly Met Mining, Inc.
Hoyt Lakes, Minnesota



River Miles

Surveyed in 2009

Stream Segments Surveyed in 2010

Stream Segments Surveyed in 2011

Surveyed Rivers Lakes - 2012

N

0 2 4 8

Miles

Figure 9
WILD RICE SURVEYED WATERS:
THE ST. LOUIS RIVER AND
POKEGAMA BAY
NorthMet Project
Poly Met Mining, Inc.
Hoyt Lakes, Minnesota

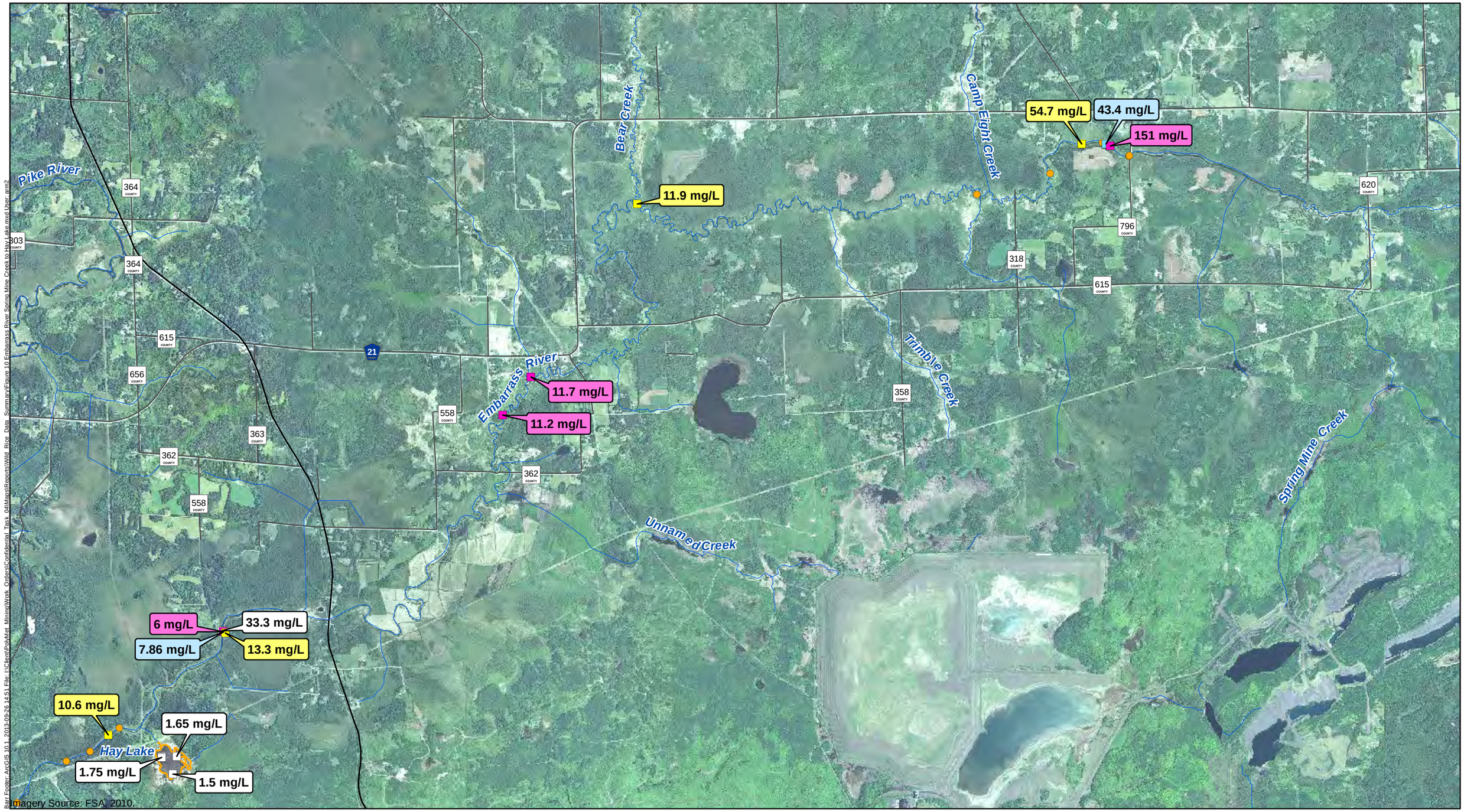


Figure 10
WATER SAMPLES AND WILD RICE OBSERVATIONS:
EMBARRASS RIVER, SPRING MINE CREEK, TRIMBLE CREEK,
UNNAMED CREEK, AND HAY LAKE
NorthMet Project
Poly Met Mining, Inc.
Hoyt Lakes, Minnesota

10.6 mg/L
1.65 mg/L
1.75 mg/L
Hay Lake
1.5 mg/L
Embarrass River
138
Sabin Lake
14.7 mg/L
16.3 mg/L
Wynne Lake
15.4 mg/L
Embarrass River
21.3 mg/L
21.2 mg/L
21.4 mg/L
23.2 mg/L
Embarrass Lake
Imagery Source: FSA, 2010.

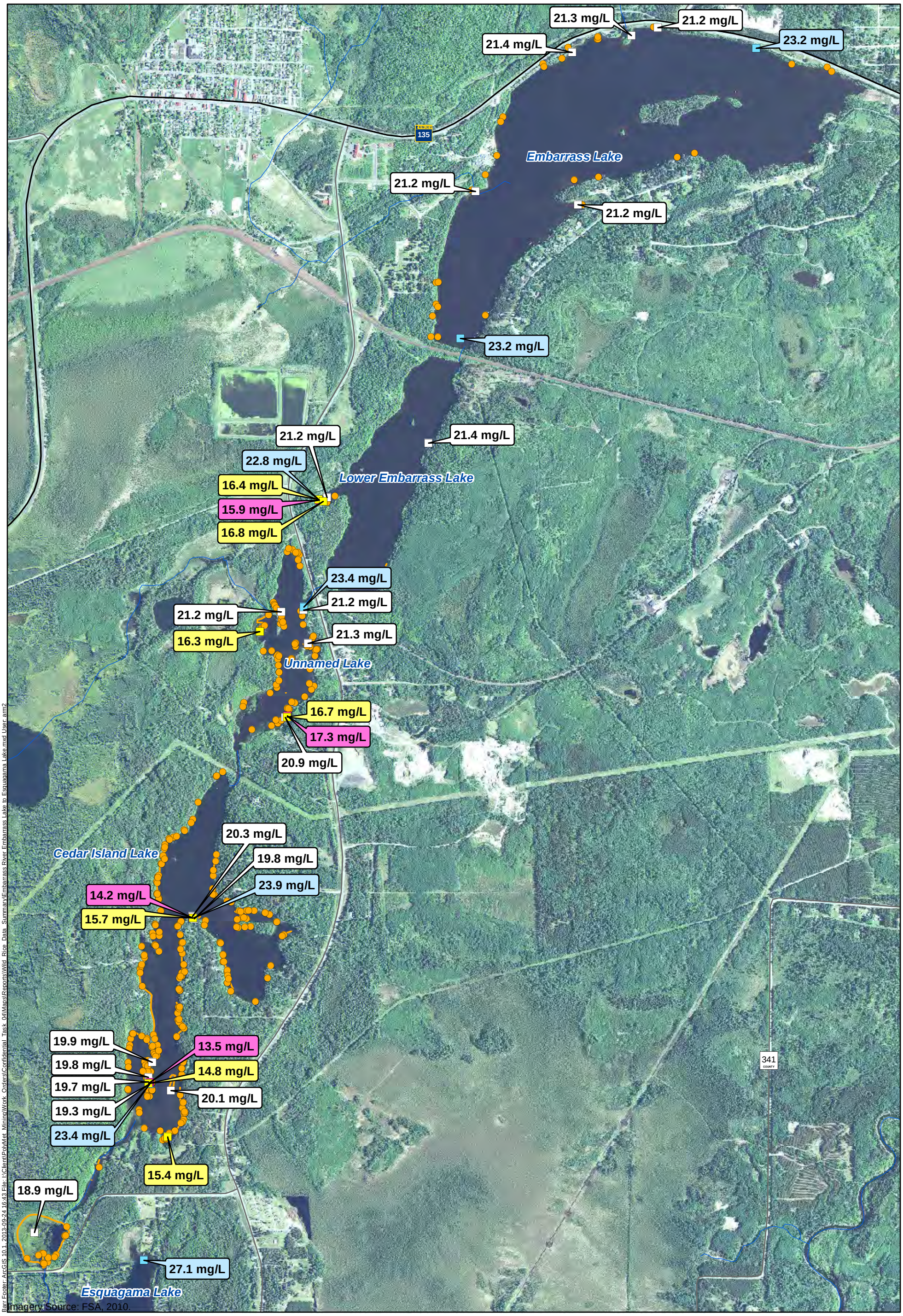
Water Samples by Year
- 2009
- 2010
- 2011
- 2012

Wild Rice Observations in 2009, 2010, or 2011
Wild Rice Observations in 2012
Rivers and Streams

0 1,000 2,000 4,000
Feet

Figure 11
WILD RICE SURVEYED WATERS:
THE EMBARRASS RIVER FROM
HAY LAKE TO EMBARRASS LAKE
NorthMet Project
Poly Met Mining, Inc.
Hoyt Lakes, Minnesota

Barr Footer: ArcGIS 10.1, 2013-09-26 14:54 File: I:\Client\PolyMet_Mining\Work_Orders\Confidential_Task_04\Maps\Reports\Wild_Rice_Data_Summary\Figure 11 Embarrass River Hay Lake to Embarrass Lake.mxd User: arm2



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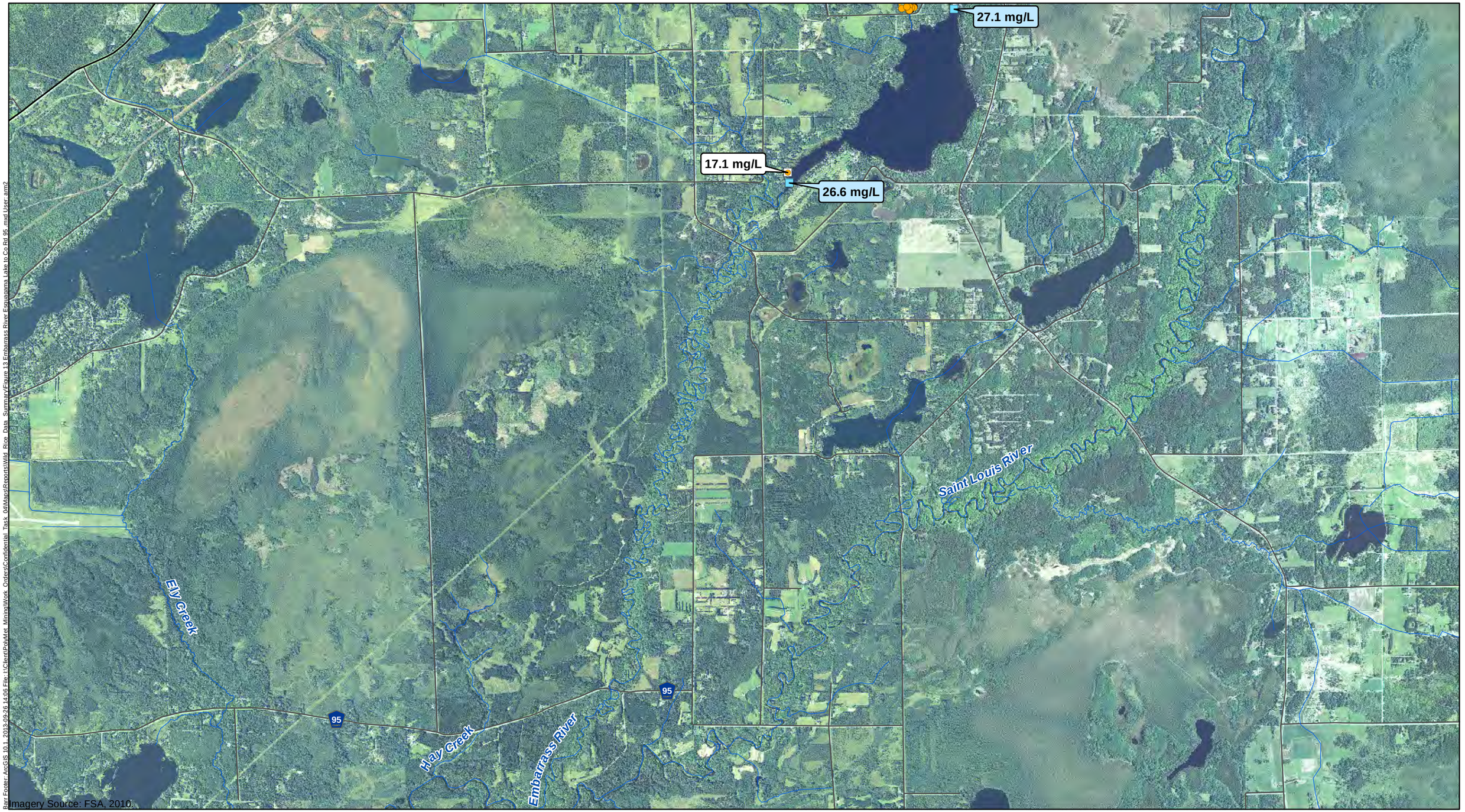
Water Samples by Year
- 2009
- 2010
- 2011
- 2012

- Wild Rice Observations in 2009, 2010, or 2011
- Wild Rice Observations in 2012
- Rivers and Streams

0 750 1,500 3,000
Feet

Figure 12
WILD RICE SURVEYED WATERS:
THE EMBARRASS RIVER FROM
EMBARRASS LAKE TO ESQUAGAMA LAKE
NorthMet Project
Poly Met Mining, Inc.
Hoyt Lakes, Minnesota



Imagery Source: FSA, 2010.

Water Samples by Year
- 2009
- 2010
- 2011
- 2012

Wild Rice Observations in 2009, 2010, or 2011

Wild Rice Observations in 2012

Rivers and Streams

N

0 1,750 3,500 7,000

Feet

Figure 13
WILD RICE SURVEYED WATERS:
THE EMBARRASS RIVER FROM
ESQUAGAMA LAKE TO COUNTY RD 95
NorthMet Project
Poly Met Mining, Inc.
Hoyt Lakes, Minnesota

Water Samples by Year
- 2009
- 2010
- 2011
- 2012

- Wild Rice Observations in 2009, 2010, or 2011
- Wild Rice Observations in 2012
- Rivers and Streams

N

0 300 600 1,200
Feet

Figure 14
WILD RICE SURVEYED WATERS:
HAY LAKE, LITTLE RICE LAKE,
AND THE PIKE RIVER
NorthMet Project
Poly Met Mining, Inc.
Hoyt Lakes, Minnesota

Dunka Rd

Wyman Creek

Unnamed Creek

Longnose Creek

Wetlegs Creek

4.79 mg/L

4.98 mg/L

4.55 mg/L

4.73 mg/L

4.89 mg/L

4.76 mg/L

4.97 mg/L

5.25 mg/L

5.14 mg/L

4.84 mg/L

4.79 mg/L

5.18 mg/L

5.32 mg/L

21.3 mg/L

5.67 mg/L

5.4 mg/L

666

110

Imagery Source: FSA, 2010.

Barr Footer: ArcGIS 10.1, 2013-09-26 10:51 File: I:\Client\PolyMet_Mining\Work_Orders\Confidential_Task_04\Maps\Reports\Wild_Rice_Data_Summary\Figure 15 Upper Partridge River and Wyman Creek.mxd User: arm2

Water Samples by Year

- 2009
- 2010
- 2011
- 2012

Wild Rice Observations in 2009, 2010, or 2011

Wild Rice Observations in 2012

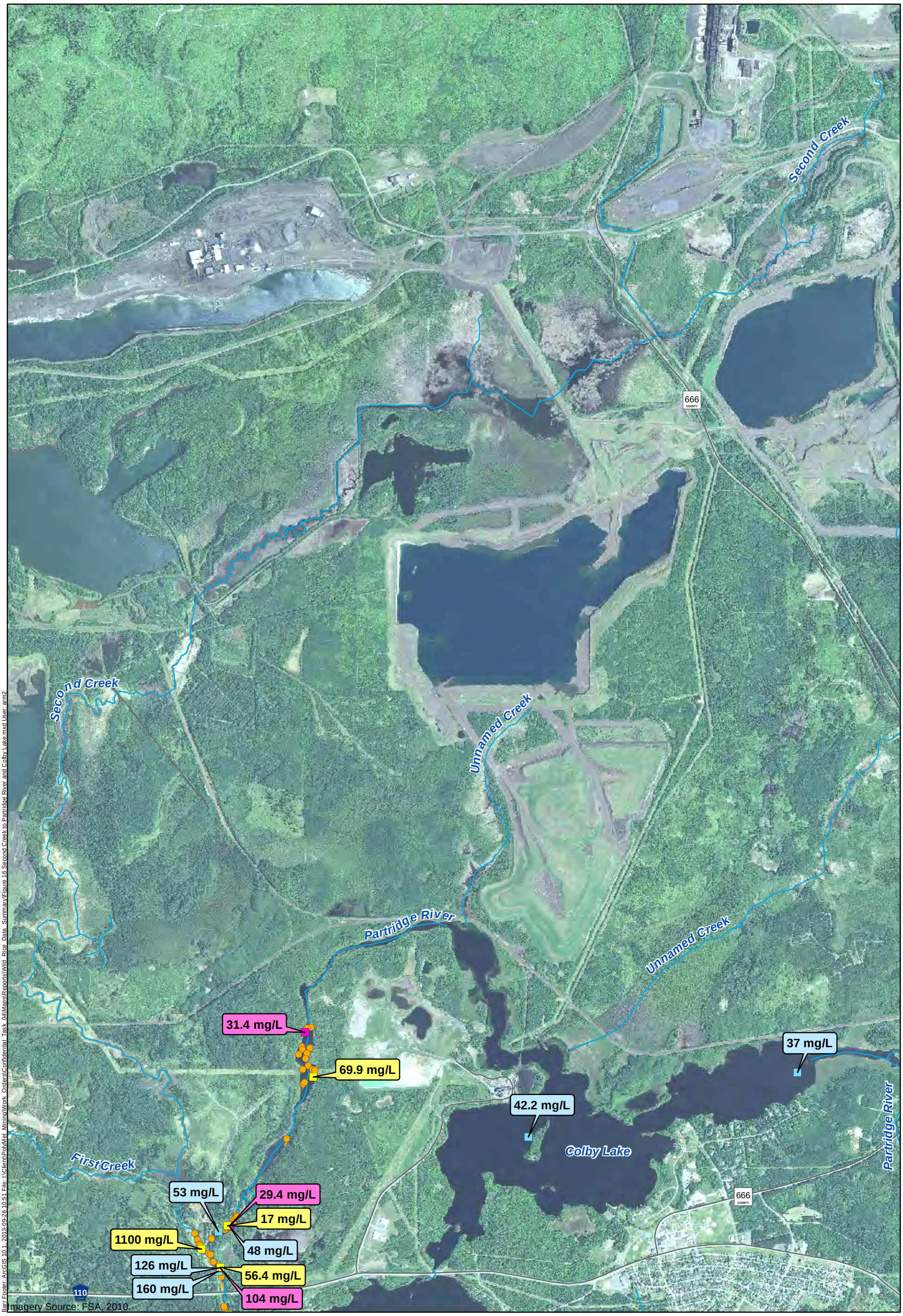
Rivers and Streams

N

0 1,500 3,000 6,000

Feet

Figure 15
WILD RICE SURVEYED WATERS:
THE UPPER PARTRIDGE RIVER
AND WYMAN CREEK
NorthMet Project
Poly Met Mining, Inc.
Hoyt Lakes, Minnesota



Water Samples by Year

- 2009
- 2010
- 2011
- 2012

Wild Rice Observations in 2009, 2010, or 2011

Wild Rice Observations in 2012

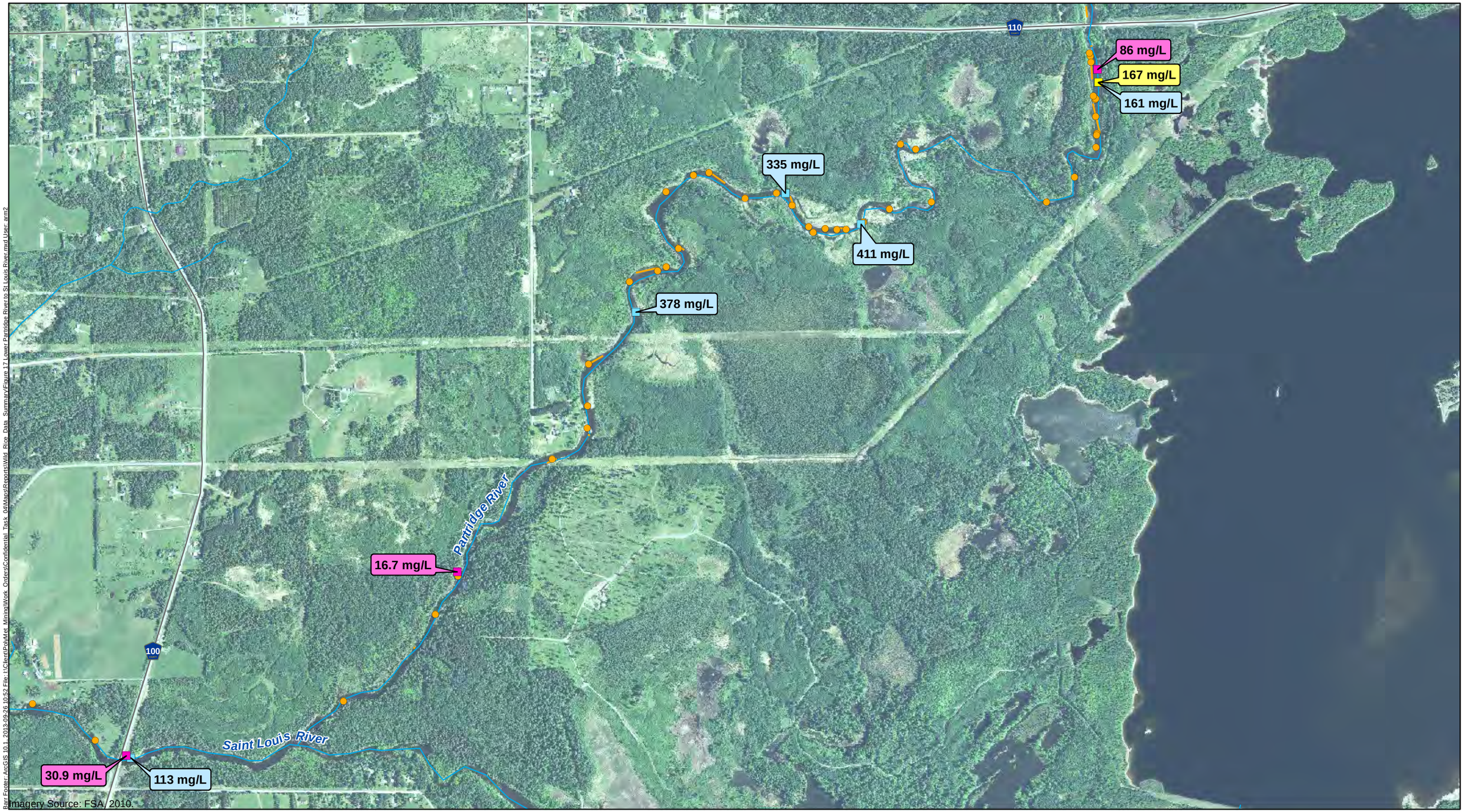
Rivers and Streams

N

0 1,000 2,000 4,000

Feet

Figure 16
WILD RICE SURVEYED WATERS:
SECOND CREEK, THE LOWER PARTRIDGE RIVER, & COLBY LAKE
NorthMet Project
Poly Met Mining, Inc.
Hoyt Lakes, Minnesota



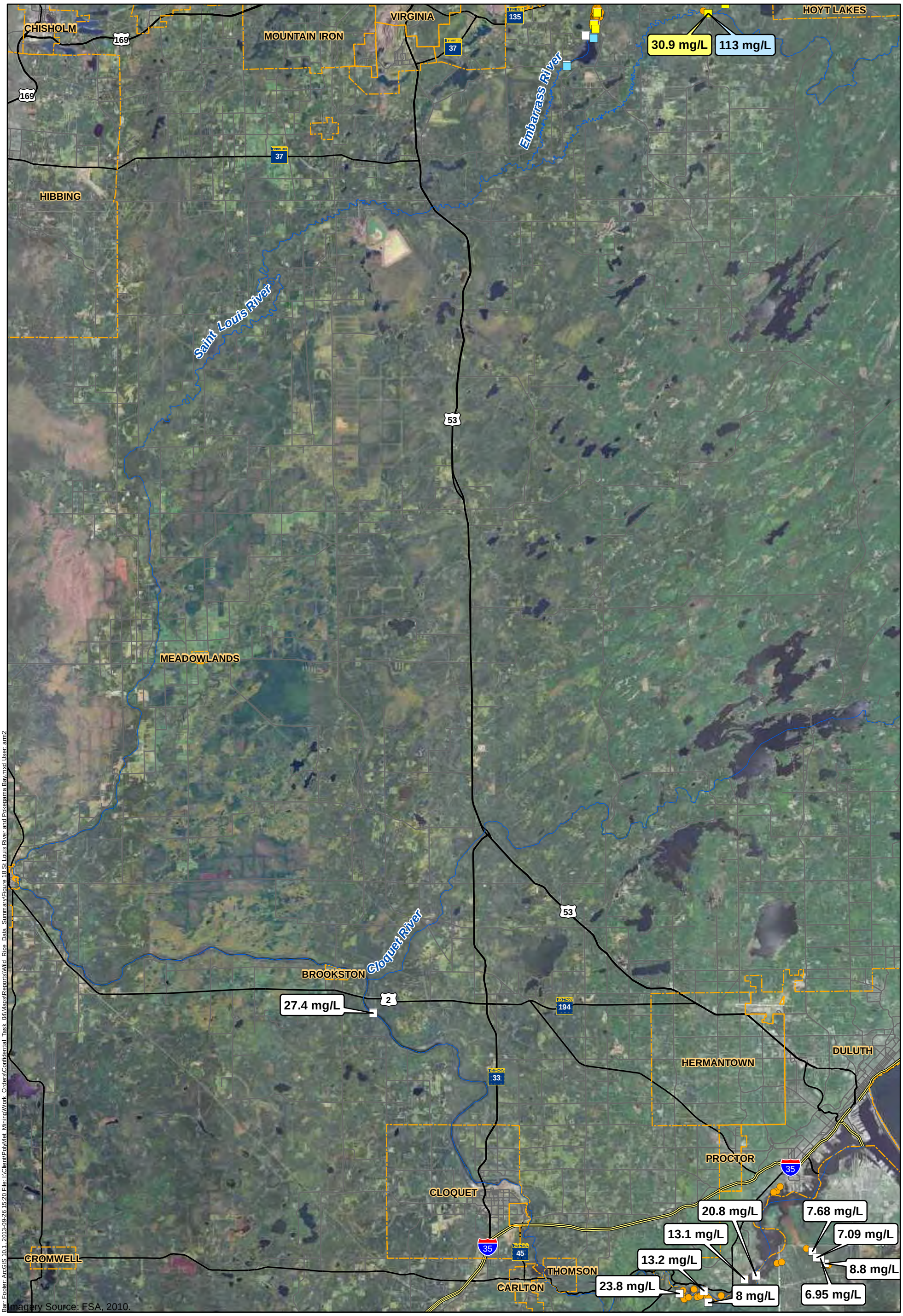
Barr Footer: ArcGIS 10.1, 2013-09-26 10:52 File: I:\Client\PolyMet_Mining\Work_Orders\Confidential_Task_04\Maps\Reports\Wild_Rice_Data_Summary\Figure 17 Lower Partridge River to St Louis River.mxd User: arm2

Water Samples by Year
- 2009
- 2010
- 2011
- 2012

- Wild Rice Observations in 2009, 2010, or 2011
- Wild Rice Observations in 2012
- Rivers and Streams

0 550 1,100 2,200
Feet

Figure 17
WILD RICE SURVEYED WATERS:
THE LOWER PARTRIDGE RIVER
AND SAINT LOUIS RIVER
NorthMet Project
Poly Met Mining, Inc.
Hoyt Lakes, Minnesota



Water Samples by Year

- 2009
- 2010
- 2011
- 2012

Wild Rice Observations in 2009, 2010, or 2011

0 2 4 8

Miles

Figure 18
WILD RICE SURVEYED WATERS:
THE ST. LOUIS RIVER AND
POKEGAMA BAY
NorthMet Project
Poly Met Mining, Inc.
Hoyt Lakes, Minnesota