Kawishiwi River Watershed Septic System Assessment

Kawishiwi River Watershed, Minnesota

Wenck File #2229-02

Prepared for:
KAWISHIWI RIVER WATERSHED

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1.0 Introduction

The Kawishiwi River Watershed is located in northeastern St. Louis County, northern Lake County, and in eastern Cook County, Minnesota (Figure 1). A number of residents within the watershed currently do not have municipal sewer or water systems; dwellings are served by Subsurface Sewage Treatment Systems (SSTS); a.k.a. septic systems, and private wells.

Wenck was retained to assess the existing condition of the SSTS within the watershed and provide an evaluation of the susceptibility of shallow groundwater and surface water from the existing SSTS in the area.

Wenck is an MPCA SSTS licensed business; License #L1282. Field visits were completed in Fall 2011 and Spring 2012. County record reviews were conducted during Fall 2011 and Winter 2012 by watershed volunteers. Assistance in file reviews as well as local knowledge of septic system compliance status and area soils was generously provided by staff from Lake and St. Louis Counties.

2.0 Unsewered Area Needs Documentation

2.1 INTRODUCTION

Using the guidance of the MPCA Clean Water Revolving Fund Unsewered Area Needs Documentation (UAND) this report summarizes the findings regarding the existing condition of the SSTS within the Kawishiwi River Watershed.

Individual parcel information for the watershed was provided by Lake and St. Louis Counties. After reviewing the parcel data, it was determined that 1,274 parcels exist within the watershed in Lake County. It is difficult to calculate the exact number of dwellings on these parcels; however, 1,096 parcels were identified in Lake County that either had a building (based on an estimated building value of greater than $0 in the Lake County parcel database) or were classified as residential in the class description. St. Louis County parcel data indicated that approximately 1,145 total parcels exist within the St. Louis County portion of the watershed, including some parcels within the City of Ely which do not use septic systems. The number of parcels estimated to have septic systems in St. Louis County was 1,095. Although a portion of the watershed extends into Cook County, a very limited number of septic systems are expected to exist in the Cook County portion of the watershed as it is mostly within the Boundary Waters Canoe Area Wilderness.

With many parcels being vacant, or attached to an adjacent parcel with a dwelling, it was estimated that 905 parcels within Lake County and 1,047 parcels within St. Louis County (1,952 parcels total) contain a seasonal residence, full time residence, business, and/or resort that generates wastewater. Our estimates of the total number of wastewater generating dwellings found in Section 2.3.1 are further refined to account for parcels added or deleted during County file reviews, field visit results, and comparison with current GIS parcel maps.

2.2 METHODS

The UAND is intended to document the wastewater needs of an unsewered area. A tabular assessment is required to identify the existing SSTS condition of all wastewater generating dwellings. Four categories (shown below from MPCA form wq-wwtp2-10, Appendix A) of existing system condition need to be identified with more than one condition possible for an individual SSTS.

A. System condition per Minn. R. chs. 7080 and 7082:

1. Imminent threat to public health or safety (Minn. R. 7080.1500, subp. 4A).
2. Failure to protect groundwater — Cesspools, seepage pits and/or systems lacking three (3) feet of vertical separation from seasonal high groundwater or bedrock (Minn. R. 7080.1500, subp. 4B). Type V systems defined in Minn. R. 7080.2400 that fail consistently.
3. Setback issues --- Properties that cannot conform to setback requirements from water supply wells or piping, buildings, property lines, or high water level of public waters (Minn. R. 7080.2150, subp. 2F).
4. Conforming system --- SSTS system is in conformance.

Privies/outhouses are a special class of SSTS that have their own set of regulations. The regulations governing privies from *Minnesota Rules Chapter 7080.2280 Privies* can generally be summarized as follows:

1. If unsealed, the privy shall have three feet of vertical separation to seasonally high groundwater or bedrock.
2. If sealed, the privy shall employ a water-tight tank.
3. The pit or vault must have sufficient capacity for the dwelling it serves, but must have at least 25 cubic feet of capacity.
4. The sides of the pit shall be curved to prevent cave-in.
5. The privy must be easily maintained and insect proof. The door and seat must be self-closing. All exterior openings, including vent openings, shall be screened.
6. Privies must be adequately vented.

Privies that do not meet these requirements are generally considered as failures to protect groundwater, although vectors such as insects having access to privy contents can pose a public health threat as well. In general, based on Wenck's experience inspecting privies across the

state, public privies (such as privies at National Forest campgrounds or latrines in the Boundary Water Canoe Area Wilderness) meet privy compliance requirements and pose minimal threat of impact to water quality. Based on Wenck's experience inspecting private privies across the state, most private privies do not meet privy compliance requirements and pose a threat to groundwater-especially those privies built within 150 feet of the shoreline.

Another concern associated with privies is graywater. Graywater means sewage that does not contain toilet wastes (bathing, laundry, culinary operations, etc.). Often, although not always, graywater at sites containing only privies is disposed of by discharging directly onto the soil surface or nearby body of water. *Minnesota Rules Chapter 7080.1500 subp. 4* states that discharge to the ground surface of any sewage, including graywater, is an imminent threat to public health and safety.

Several methods to determine the existing SSTS condition are identified by the MPCA. One method includes completing a Compliance Inspection; however a Compliance Inspection is not required to determine existing SSTS condition. The six methods to determine existing SSTS condition identified by the MPCA are shown below:

B. Methods of determining project need include:

1. Visual site inspection --- A visual site inspection to document obvious threats to public health and safety, such as residential connections to a drain tile, overflow pipes, cesspools, or other unacceptable discharge locations.
2. Soil survey data review --- A review of existing soil survey data to reasonably conclude if appropriate wastewater treatment technologies are being used on site. For example, seasonal high ground-water conditions may dictate the need for a mound system. If there are no mounds, the systems are considered failing.
3. Site investigation with soil borings --- A site investigation including enough soil borings to create a soils map of the area. Complete an evaluation of the soil conditions to determine compatibility with existing wastewater treatment systems. For example, the soils map may dictate the need for a mound system. If mounds currently do not exist, treatment systems are considered failing.
4. Review of government records --- A review of local government records of the systems. If none exist, the system is unlikely to be in compliance. Existing records should be verified for accuracy.
5. Review of plat maps --- A review of plat maps and other records to determine if any code setbacks, such as distance between SSTS and potable water wells or surface water,

cannot be met based on lot size. Systems on lots with inadequate size for setbacks should be considered noncompliant.

6. Compliance inspection per Minn. R. 7082.0700, subp. 2 --- A compliance inspection per Minn. R. 7082.0700, subp. 2 is completed.

For this investigation, Wenck was not given permission to complete a Compliance Inspection on the existing SSTS; furthermore we did not have access to individual properties to extensively identify the location of imminent threats to public health, straight pipe discharges, pit privies, and other conditions that may pose potential public health threats.

Our investigation did include using a combination of approved methods given the time and site access constraints. Wenck started by obtaining from the counties the available historic permitting information. The data included the year of SSTS installation, type of SSTS installed, and known compliance information and notes since installation. The data was collected, compiled, and entered into a master spreadsheet by volunteers, who looked through the available records for each parcel with a septic system within the watershed. County staff assisted the effort by pulling files and creating a work space for the volunteers.

After initial data gathering and parcel base map preparation we created a spreadsheet to use during parcel field visits. The number of parcels identified with SSTS after county file review within the watershed grew to 1,952. However, only 1,893 parcel numbers as identified on county SSTS records matched current GIS-based parcel maps. On occasion, parcel numbers are added or deleted by counties as land is sold or is subdivided. Some parcel numbers may have been accidentally recorded incorrectly on the original SSTS permit application. Whatever the reason, only 1,893 of the parcels could be mapped by GIS for potential site visits. Parcels were further selected for priority field visits based on the following criteria:

1. **Within 500 feet of impaired water and less than 10 acres in size**[1]

[1] The best available parcel mapping data available was utilized for this investigation. The 10 acre property size is an estimate based on this data. The 10 acre size does not imply that the property is buildable or meets any zoning standard. A baseline of properties needed to be established for the field visits so a 10 acre size was decided to be used because a property with the potential to be that size may have some limitations to having a suitable site for an SSTS. It is recognized that at this scale identifying individual property boundaries on 1,800+ properties is not practical so this methodology was employed.

a. Project Priority List (PPL) scoring (MPCA form wq-wwtp2-35, Appendix B) gives a higher score to failing SSTS that are within 500 feet of an Outstanding Resource Value Water (ORVW) or impaired waters (see questions 120 and 125 of the form).
b. The UAND form from the MPCA (Appendix A) also requires that an applicant indicate if a non-conforming septic is discharging within 500 feet of an ORVW or impaired water.
c. 1,476 properties with SSTS (78% of GIS evaluated parcels) are within 500 feet of any surface water within the Kawishiwi watershed (lake, stream, or river), whether it is impaired or not.
d. 1,041 properties (55% of 1,893 parcels where the parcel number on the permit matches an existing GIS parcel in Lake or St. Louis County) are within 500 feet of an impaired water and are less than 10 acres in size. Parcels greater than 10 acres in size are generally expected to have room to install the SSTS greater than 500 feet away from the surface water.

Dense, smaller lake shore properties exist in portions of the watershed. Smaller parcels have more difficulty meeting required setbacks or finding areas of suitable soil for a standard SSTS treatment area onsite.

Appendix C contains the field maps that were used for the study. The field sheets highlight the areas that were chosen for field investigation based on location relative to impaired waters, property size estimated to be less than 10 acres, and dwelling density adjacent to surface waters within the watershed.

Our visits were limited to right of way access and did not include extensive property investigation. Even with limited access this type of investigation is practical due to the fact that a number of lake shore properties are small, narrow, and can be viewed from the right of way. However, due to the topography, forested nature of the area, parcel geometry, and ease of access approximately 55% of the visited properties were not easily seen from the right of way. In addition, a number of properties were not visited as they could only be accessed by water or private road. Consideration for these properties was given as discussed in Section 2.3.

To further gain knowledge of the SSTS in the Watershed, Wenck interviewed the Lake County Land Use Specialist Mr. Walt VanDenHeuvel of the Lake County Planning and Zoning Department and St. Louis County Environmental Health Specialist Mr. John A Lindquist of the St. Louis County Environmental Services Department. Mr. VanDenHeuvel and Mr. Lindquist provided historical information regarding the procedural efforts of the counties and SSTS permitting. Wenck staff spent time with Mr. Lindquist and Mr. VanDenHeuvel discussing specific SSTS in the area and obtaining personal knowledge of specific areas within the watershed, parcel uses, likely septic system compliance status, and local soils. Mr. Lindquist also spent time in the field with Wenck staff viewing local soils and geology that affect septic system performance in the watershed.

2.3 FINDINGS

The purpose of the site visits was to obtain: information on the type of dwelling contained within the parcel, the likely compliance[2] status of the SSTS, and setback conformance of any compliant SSTS. In addition, a number of parcels identified for investigation were discovered to be shared as one property or vacant during field reconnaissance; reducing the total number of estimated

[2] "Likely" is used throughout this report to describe the compliance status. The findings of this investigation utilize the MPCA methodology described in Section 2.2. The methodology allows for a high confidence level assessment but does not constituent an actual compliance inspection so the "likely" modifier is being used.

properties generating wastewater that are within 500 feet of an impaired water and less than 10 acres in size in the watershed to 1,004. Based on vacant/shared parcel findings, the total number of wastewater generating parcels in the watershed was reduced to 1,909 (37 vacant or shared parcels, 1,946 parcels total in the watershed).

2.3.1 Type of Property

A determination was made on the type of property for visited parcels that were visible from the public right of way. The type of property was not able to be estimated visually for parcels not visible from the right of way; however, county records include a parcel class that can be used to estimate the type of property. Table 1 summarizes the type of property findings.

Table 1: Estimate of Property Type

Type of Property	Estimated Percent of Total
Business	0.7%
Seasonal residential	62.1%
Full time residential	33.5%
Resort/lodging or campground	1.8%
Vacant	1.9%
Other	0.2%
Total	100.0%

2.3.2 SSTS Status

Upon visiting each individual parcel a determination was made regarding the potential that the SSTS for the dwelling(s) would be likely compliant or non-compliant with Minnesota Rules Chapter 7080. For several of the properties the compliance status was already known using the gathered county information. Generally, the system was counted as compliant if the county data indicated that the system was:

- a mound, at-grade or system with pretreatment;
- a drainfield installed within the past 10 years appearing to conform to applicable rules; or
- a holding tank

If systems did not meet the above criteria they were generally considered non-compliant with Minnesota Rules Chapter 7080, unless county file review or visual evidence suggested otherwise. County-reviewed information also documented some existing non-compliant SSTS.

Properties that did not have any information on file with the counties and did not appear to have been upgraded in the recent past were counted as non-compliant. Properties that were vacant were documented with no compliance status, as no SSTS currently exists on the parcel. Dwellings that could not be easily viewed from the road had a determination of compliance status based solely on county records and known information about local soils.

Difficulty in viewing of properties from the public right of way was encountered in a variety of situations. Conditions that prevented viewing of properties included seasonal road conditions, long driveways, dense forests, changes in topography, and communities with private road access.

It is important to note that local St. Louis County rules differ from Minnesota Rules Chapter 7080 in that only one foot of vertical separation is required for compliance on an existing system that is not in shore land or a restaurant/lodging institution, as compared with the three feet of vertical separation required by Chapter 7080. Lake County rules generally agree with Chapter 7080, and require the three feet of vertical separation for likely compliance. Since this report addresses the likely compliance status of parcels in multiple counties, a determination of compliant would indicate likely compliance with Minnesota Rules Chapter 7080. Properties may exist within both counties that are considered compliant by local standards but are not considered compliant in this report (as determined by Minnesota Rules Chapter 7080).

The SSTS that were documented as non-compliant were identified as such for a failure to protect groundwater (i.e. less than three feet of vertical separation). As stated in Section 2.2 the lack of

site access did not allow us to identify imminent threats to public health. In addition, the seasonal nature of the majority of dwellings typically did not have them occupied within the previous month before our investigation. Imminent threats to public health from a seasonal dwelling typically do not show obvious signs of failure without frequent use, i.e., summer occupancy. It is likely that imminent threats to public health, as defined in Minnesota Rules Chapter 7080, do exist within the watershed, however due to the reasons indicated none were documented.

Table 2 summarizes the likely SSTS compliance status. Our likely compliance status is based on county permit information, soils data, known water elevations, and our experience. The likely compliance status data includes a specific number of SSTS as compliant or non-compliant; however during data collection we estimated 10% of the results have uncertainty in the determination without a specific onsite inspection. We estimate that approximately half of the 10% were counted as complaint and half as non-compliant. For this reason we believe the SSTS compliance status data should have a range of +/- 5%.

Table 2: Likely SSTS Status

Status	Estimated Number	Estimated Percentage Range
Failure to Protect Groundwater	1173	55-65%
Compliant Not Meeting Setbacks	9	0-5%
Compliant Holding Tank Only	34	0-5%
Compliant SSTS	693	30-40%
No System (vacant/shared lot)	37	0-5%
Total	1946	100%

In addition to likely compliance status, a determination was made as to if SSTS components for likely compliant systems meet setbacks to property lines, structures, wells, and surface waters. In many cases it was difficult with this type of investigation to identify the type of well (deep or shallow) and its location. For this reason the number of well setback violations documented is likely lower than actual. Table 2 also indicates results regarding expected setback conformance.

3.0 Ground/Surface Water Quality Impact

3.1 WATER QUALITY IMPACTS FROM SEPTIC SYSTEMS

SSTS can be an important source of biological oxygen demand (BOD), total suspended solids (TSS), phosphorus, nitrogen, and bacteria/pathogens to ground and surface water. Of specific concern for surface water are BOD, phosphorus, TSS, and bacteria/pathogens. A high BOD in surface water can lower dissolved oxygen levels and contribute to fish kills. Higher levels of phosphorus in surface water can contribute to algal blooms. A higher concentration of TSS can reduce water clarity. Higher levels of bacteria/pathogens (often measured using fecal coliform bacteria) can directly affect the health of humans and animals that come into contact with the water. Nitrogen and bacteria/pathogens are ground water concerns and can impact water quality in wells. Table 3 compares typical wastewater levels to those levels expected in typical northern Minnesota lakes in the summer.

Table 3: Water Quality Comparison

Wastewater Constituent	Domestic Wastewater Average	Typical Northern Lakes and Forests Summer Average[1]
Biological Oxygen Demand (BOD)	220 mg/L	0.8-1.7 mg/L
Total Suspended Solids (TSS)	220 mg/L	<1-2 mg/L
Fecal Coliform Bacteria	100,000 cfu/100 mL	11-20 cfu/100 mL
Total Phosphorus (TP)	8 mg/L	0.014-0.027 mg/L
Total Nitrogen (TN)	40 mg/L	10 mg/L[2]

[1]Adapted from MPCA *Comparison of typical Minnesota water quality conditions*, Environmental Outcomes Division, 2003.

[2]Maximum Contaminant Limit (MCL) in drinking water (ground or well water) as determined by the EPA.

The degree of SSTS compliance and sensitivity of the receiving environment will affect the ability of the SSTS to remove/treat wastewater constituents before they enter the surrounding environment. The septic systems in this study have been grouped into the following five categories based on system type and likely compliance status relative to Minnesota Rules Chapter 7080.

Table 4: Septic System Treatment Categories

Existing Septic System Coding
0 = Vacant (parcel with no septic system)
1 = Imminent Public Health Threat
2 = Imminent Public Health Threat with Managed Septic Tank
3 = Failing to Protect Groundwater
4 = SSTS Trench or Bed with 3 feet of separation
5 = SSTS Mound or Nitrogen reducing Type IV

Adapted from UMN OSTP (2012)

The two main wastewater constituents of concern from a watershed perspective are likely phosphorus and bacteria/pathogens. As it relates to phosphorus, SSTS vary in their treatment ability of phosphorus from sewage. Soils differ in clay mineralogy, Ca, Fe, and Al content, and pH, and therefore differ substantially in their capacity to retain phosphorus. Even after being bound in the soils, anaerobic conditions can cause microbial reduction of Fe oxides and release phosphorus into groundwater. It has been documented that septic tanks remove from approximately 20%-30% of wastewater phosphorus (Lombardo, 2006) to 48%-57% of wastewater phosphorus (CEEP, 2006). On average, SSTS are expected to remove from 23%-99% of phosphorus in septic tank effluent in the vadose zone within one meter of outflow (CEEP, 2006 from Robertson et. al., 1998). From this wide range of potential phosphorus removal in soils it is difficult to specifically quantify the phosphorus load SSTS have in the watershed without a more detailed study. However, the University of Minnesota Onsite Sewage Treatment Program (UMN OSTP) has created estimates for removal percentages of various

wastewater constituents based on the existing system coding in Table 4, as shown in Table 5 (UMN OSTP, June 2012).

Table 5: Estimated Wastewater Constituent Reduction Percentages for SSTS Based on Treatment Category

	Existing Septic System Coding Category from Table 3				
Wastewater Constituent	1=Imminent Public Health Threat (IPHT)	2=IPHT with Managed Tank	3=Failing to Protect Groundwater (<3 feet separation)	4=Non-mound SSTS with 3 feet separation	5=Mound or Nitrogen Reducing SSTS with 3 feet separation
BOD Reduction	0	50%	75%	100%	100%
TSS Reduction	0	50%	75%	100%	100%
Fecal/E-Coli Reduction	0	0	50%	100%	100%
Nitrogen Reduction	0	5%	10%	25%	50%
Phosphorous Reduction	0	5%	50%	100%	100%

Adapted from UMN OSTP (2012)

While phosphorus loading to shallow groundwater interconnected to surface water is of concern for long term phosphorous loading to surface waters; bacteria, viruses, and pathogens pose a short term exposure risk in surface water. Bacteria have been documented to travel 3-5 meters within 24 hours of a rain event with survival in groundwater less than 100 days. (GWMAP, 1999). Assuming a travel of 1 meter per day in loam soils (the most likely soil type to be encountered in the watershed) multiplied by 100 days, untreated bacteria could travel as far as 100 meters (~330 feet) to enter shallow wells or surface waters (distance traveled would be even farther in coarser texture soils or fractured bedrock). Many of the properties evaluated have septic systems located less than 330 feet from the adjacent surface water. Some research indicates viruses travel further than bacteria and generally represent a greater health risk to humans than bacteria (DeBorde et al. 1998). With peak loadings from SSTS in the watershed during busy summer weeks there is increased potential for short term exposure along beach areas.

Lake shore properties built on low elevations adjacent to surface waters exist in portions of the watershed.

3.2 ESTIMATE OF WATER QUALITY IMPACT TO WATERSHED

As detailed in Section 2.3.1 the number of seasonal and full time dwellings has been determined, along with other parcel types. To develop an estimate of flow to the SSTS, the seasonal residences were assumed to be occupied from May through October, or 50% of the year. Therefore, the average daily flow on an annual basis was assumed to be half that of full time dwellings (See Appendix D).

Table 6 summarizes loading from SSTS estimated using UMN OSTP values for wastewater constituent reductions based on the SSTS treatment category and conditions shown in Table 4. It is important to remember that these numbers are only estimates; the actual loading to the watershed may be greater or less and depends on a number of variables that are too complex to be incorporated during the course of this study. We estimate the loading numbers to be correct to plus or minus 33% (for example, estimated phosphorus loading from SSTS to entire watershed is likely between 2,293 lbs/yr and 4,552 lbs/yr).

Table 6: Estimated Annual Loading from SSTS[1]

Included Area	Estimated Number of SSTS	Estimated Pounds of BOD per Year from SSTS	Estimated Pounds of TSS per Year from SSTS	Estimated CFU of Coliform Bacteria per Year from SSTS	Estimated Pounds of Phosphorus per Year from SSTS	Estimated Pounds of Nitrogen per Year from SSTS
Entire Kawishiwi Watershed	1,909	47,601	47,601	1.96E+15	3,462	43,597
Properties less than 10 acres within 500 feet of impaired water	1,004	18,478	18,478	7.62E+14	1,344	18,526

[1]Note: BOD, TSS, Bacteria, and Phosphorus in the annual loading calculations come only from non-compliant septic systems. Nitrogen is contributed to the annual loading by both compliant and non-compliant septic systems.

3.3 SSTS DENSITY BY LAKE

The watershed can also be analyzed on a lake by lake basis to further understand the potential impact of SSTS. Table 7 shows the estimated number of SSTS by lake, as well as the lake size and the estimated number of SSTS per acre of surface area of the lake. Table 7 is useful in that it identifies lakes that are more densely populated in terms of properties within 500 feet of the shoreline per acre of lake surface. Lakes with a higher density of SSTS are likely to be more susceptible to impacts from non-compliant SSTS.

Table 7: Number and Density of SSTS by Lake

Lakes with SSTS in Kawishiwi Watershed	Estimated Number of SSTS	Lake Size in Acres[1]	Number of SSTS per Acre of Lake
Middle McDougal	30	104	0.29
Gunsten	4	19	0.21
Farm	172	1292	0.13
One Pine	42	355	0.12
Garden	73	653	0.11
White Iron	281	3238	0.09
Bear Island	171	2362	0.07
Slate	18	294	0.06
Grouse	7	119	0.06
Sand	28	486	0.06
Dumbbell	19	406	0.05
Birch	174	5628	0.03
North McDougal	8	273	0.03
Gegoka	4	145	0.03
Johnson	8	454	0.02
Muckwa	1	147	0.01
Deep	1	148	0.01
Total	1041	16123	0.06

[1]Source: MN DNR Lakefinder, 2012

3.4 SSTS IMPACT BY LAKE

In January 2011, the MPCA published "A Water Quality Assessment of Select Lakes within the Kawishiwi River Watershed." Appendix B of the report estimates a total phosphorus load for select lakes within the watershed (Bear Island, Birch, White Iron, and the Garden Lake Reservoir, which includes Farm, South Farm, and Garden). Table 8 compares the estimated annual phosphorus loading from the MPCA report with the estimated phosphorus loading to the lake system from SSTS.

Table 8: Annual Phosphorus and Bacteria Loading for Select Lakes

Lake Name	Estimated Coliform Bacteria Contributed from SSTS in cfu/yr	Estimated Phosphorus Contributed from SSTS in lbs/yr	Estimated Total Phosphorus Load in lbs/yr[1]	Estimated Percent of Total Phosphorus Load from SSTS
Bear Island	1.33E+14	235	1,232	19%
Birch	1.70E+14	300	33,376	1%
White Iron	1.71E+14	302	30,999	1%
Garden Lake Reservoir	1.61E+14	284	40,323	1%

[1]From Appendix B of "A Water Quality Assessment of Select Lakes within the Kawishiwi River Watershed," MPCA, January 2011.

From Table 8, it is clear that Bear Island is the most susceptible lake to phosphorus impacts from SSTS. The other three lake systems are less likely to be impacted by phosphorus loading from SSTS because of lower phosphorus retention percentages, higher outflows, shorter hydraulic residence times, and higher areal loads.

Table 8 also includes the estimated coliform bacteria loading from SSTS per year. The MPCA report did not estimate bacteria loading for the selected lake systems; therefore, there is no value to compare the load to. What is important to note is that the annual load of both bacteria and phosphorus from SSTS could be reduced to near zero if all SSTS were compliant and maintained/used properly.

3.5 SSTS IMPACT BY SERVICE AREA

Finally, water quality impacts from SSTS were evaluated on a "Service Area" basis. Service Areas were selected and defined by local SSTS density, soil type, geology, topography, parcel size, parcel use, and/or likely current SSTS compliance status. Based on conversations with County staff, SSTS records review, and Wenck's field reconnaissance, the following Service Areas have been identified as the areas with the most potential for impacting water quality from SSTS. Appendix E contains maps of the Service Areas.

- Dunka Bay Area, Birch Lake. The Dunka Bay area includes Boundary Street, 1st Street, and Elm Street. The area is very dense with a number of parcels that are less than 1 acre in size. According to St. Louis County staff, contamination of wells as a result of non-compliant septic systems has been reported in this area. The area is largely full-time residential and includes one resort.
- Middle McDougal Lake. The area includes Middle Road and is characterized by areas of very dense development (< 1 acre parcels), low-lying topography, and drainfield type of SSTS. Approximately 50% of properties have no SSTS records on file with Lake County, suggesting very old or non-compliant SSTS for the majority of the properties in this area. The area appears largely seasonal in nature.
- Southwest Bear Island Lake. The area on Bear Island Cabin Drive and West Bear Island Lake Road is characterized by very dense development on a number of parcels that are less than 1 acre in size. In addition, the west side of the area is characterized by challenging topography and a number of outhouses/privies. The area is largely seasonal in nature in the west and includes some full time residents in the east.
- North White Iron Lake. The area south of Kawishiwi Trail, east of Pine Road, and west of the bridge over Silver Rapids, including Hickory Road, Ironwood Road, Maple Road, Oak Road, Villa Road, Chestnut Drive, Balsam Road, White Iron Beach Road, and North Pine Road. The North White Iron Lake area is very dense and includes a number of small (<2 acres) and very small (<1 acre) properties. Some properties are inhabited year around, some are seasonal.
- Southwest White Iron Lake. The area on South White Iron Road, Burley Road, and Chippewa Shores is characterized by a high water table, rapidly permeable soils, and a number of properties that are less than two acres in size. A number of the SSTS in this area are drainfields or are over 15 years old. The area includes some full time residents and some seasonal residents.
- Finn Bay, Birch Lake. The Finn Bay Area includes Finn Bay Road, Lamppa Road, and Spring Ridge Road. The area is characterized by very dense development (<1 acre parcels), natural springs, and challenging topography. Finn Bay and Lamppa Road are seasonal residential, Spring Ridge Road is largely full-time residential.

- Sand Lake. The Sand Lake area includes Sand Point Road, Monson Road, Peterson Road, and Papieo Beach Road. Only about 25% of the SSTS in this area have records on file with Lake County, suggesting very old or non-compliant SSTS for the majority of the properties in this area. The area appears largely seasonal in nature.
- Kawishiwi Trail on Farm Lake. The area on Farm Lake east of the Farm Lake boat access and west of the channel where Farm Lake meets South Farm Lake north of Kawishiwi Trail. The area is characterized by small (<2 acre) properties and resorts; and includes a number of drainfield type SSTS that are older than 10 years. The area appears to include both seasonal and full time residents.
- Sunset Road. The area on Sunset Road on the east shore of White Iron Lake is characterized by a number of small (<2 acre) properties with challenging topography for SSTS installation, shallow bedrock, and a number of SSTS that are over 15 years old. The area appears to include both seasonal and full time residents.

4.0 Summary and Next Steps

4.1 SUMMARY OF FINDINGS

Wenck has completed an assessment of the existing Subsurface Sewage Treatment Systems (SSTS) in the Kawishiwi River Watershed. Our experiences and protocols established by the MPCA were used to determine: type of dwellings, existing SSTS likely compliance status, and setback conformance. In addition, we estimated the potential water quality impacts from SSTS and identified areas within the watershed where impacts to water quality from SSTS are the most likely to take place. Below is a summary of the findings.

- Type of Property
  - Seasonal Dwelling: 62%
  - Full-Time Dwelling: 33%
  - Resort/lodging: 2%
  - Vacant: 2%
  - Business/other: 1%

- SSTS Likely Compliance Status
  - Compliant: 35%-45%
  - Non-Compliant: 55%-65%

- Estimated Annual Phosphorus Load from SSTS to Surface Water and Shallow Groundwater
  - 3,462 pounds per year to entire watershed
  - 1,344 pounds per year within 500 feet of an impaired water

- Lakes with the Highest Density of SSTS per Acre of Lake Surface
    - Middle McDougal: 0.29 SSTS/acre
    - Gunsten: 0.21 SSTS/acre
    - Farm: 0.13 SSTS/acre
    - One Pine: 0.12 SSTS/acre
    - Garden: 0.11 SSTS/acre

- Bear Island Lake is the most susceptible to phosphorus impacts from SSTS of the four lakes evaluated by the MPCA for annual phosphorus loading (Bear Island, Birch, White Iron, and the Garden Lake System)

- Nine Service Areas on six lakes have been identified that pose the greatest threat of water quality impacts from SSTS within the watershed
    - Dunka Bay, Birch Lake
    - Middle McDougal Lake
    - Southwest Bear Island Lake
    - North White Iron Lake
    - Southwest White Iron Lake
    - Finn Bay, Birch Lake
    - Sand Lake
    - Kawishiwi Trail, Farm Lake
    - Sunset Road, White Iron Lake

4.2 NEXT STEPS

Based on the results of this study, Wenck recommends the following steps.

- For lakes that have a high density of SSTS per surface area of the lake, monitor lake water quality more closely for phosphorus and bacteria/pathogen impacts from SSTS.
    - The top five lakes to monitor include:
        - Middle McDougal

        - Gunsten
        - Farm
        - One Pine
        - Garden
- Monitor dense development areas more closely for water quality impacts to wells.
    - Dunka Bay, Birch Lake
    - North White Iron Lake
    - Southwest Bear Island Lake
    - Finn Bay, Birch Lake
    - Sand Lake
    - Middle McDougal Lake
- Apply for funding from the MPCA to complete Community Assessment Reports of the nine Service Areas identified in Section 3.5. A Community Assessment Report will include a more rigorous onsite evaluation of soils and SSTS compliance status for each property in the Service Area. The reports will also evaluate the feasibility and costs of various wastewater infrastructure solutions for properties with non-compliant SSTS.
    - Complete separate Unsewered Area Needs Documentations and Project Priority List Applications to apply for funding to do a Community Assessment Report for each of the nine identified Service Areas.
    - Complete upgrades to wastewater treatment infrastructure in each of the Service Areas based on Community Assessment Report Findings to protect water quality. Apply for grant funding to help reduce/eliminate costs to Service Area residents for wastewater treatment upgrades based on eligibility of each area for available grants.
- Educate homeowners within the watershed on septic systems.
    - Provide education on what qualifies as a compliant septic system and the potential water quality and human health impacts of non-compliant septic systems.
    - Provide education on operation and maintenance of septic systems to prevent system failure and to prolong the life of existing compliant septic systems.
- Encourage upgrades to non-compliant septic systems.

- Continue requiring point of sale septic inspections.
- Continue requiring septic inspections at time of building permit issue.
- Educate on what makes a septic system non-compliant and the effects of such a system to public health and the environment.
- Provide recognition from WICOLA or lake associations giving recognition to those who either currently have compliant septic systems or who upgrade to compliant systems.
    - Yard signs
    - Recognition on the website
    - Plaques, magnets, other for home/business
- Encourage inspection of system at time of system maintenance
    - Example: car maintenance
        - Oil change = tank pumping.
        - Inspection of tires, shocks, engine, etc. = system inspection.
    - Encourage local system maintainers to offer inspection package with tank pumping.
- Provide discounted or free septic system inspections to determine compliance status.
    - Example: Jefferson German Septic Inventory in Le Sueur County
        - Grant funded septic inspections
    - Example: Lake Sally and Melissa in Becker County
        - Volume discounted septic inspections
- Focus on upgrades area by area.
    - Provide educational events focused on residents of a specific lake or area within a lake (example: Middle McDougal Lake).
    - Encourage a grass-roots effort where residents lead the way in seeking to have effective wastewater treatment in their area. “This is *my* lake and I want to protect it.”

- Local government (county, township, etc.) can apply for funding from the MPCA to perform Community Assessment Reports on an area-by-area basis.
- Empower residents to make community-based wastewater decisions
    - Formation of Sanitary Sewer District
    - Use results of Community Assessment Report to make decision on future wastewater infrastructure
    - Apply for grants/loans for any necessary upgrades based on existing septic compliance status and income of residents

5.0 References

CEEP (Centre Européen d'Etudes sur les Polyphosphates) Special Issues: *Fate of Phosphorus in Septic Tanks*. Scope Newsletter Number 26. 2006.

DeBorde, D.C., W.W. Woessner, B. Lauerman, and P.N. Ball. *Virus Occurrence and Transport in a School Septic System and Unconfined Aquifer*. Ground Water. 1998.

Lombardo, P. *Phosphorus Geochemistry in Septic Tanks, Soil Absorption Systems, and Groundwater*. Prepared by Lombardo Associates, Inc., Newton, MA. 2006.

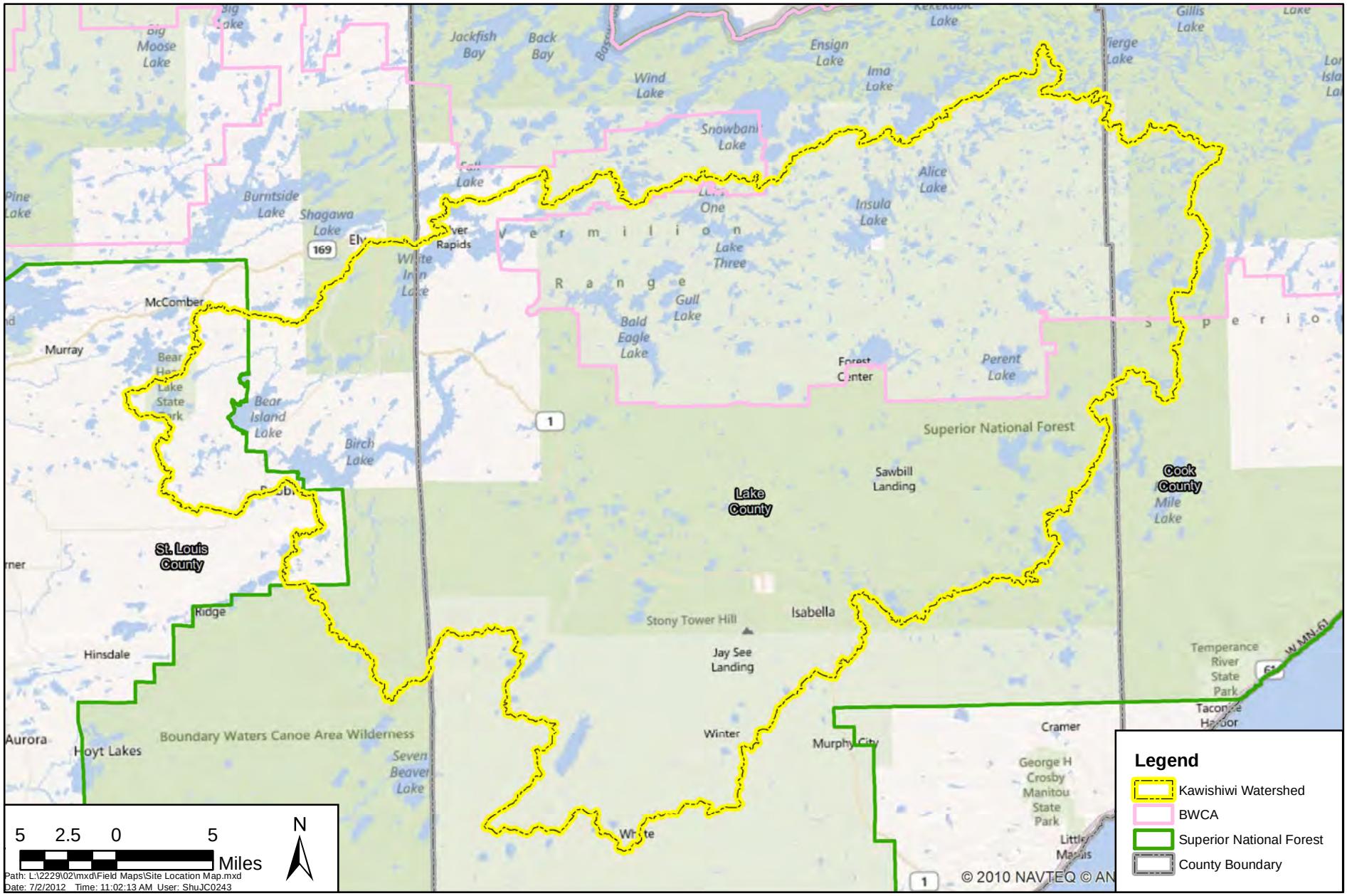
Minnesota Pollution Control Agency, *Effects of Septic Systems on Ground Water Quality – Baxter, Minnesota*, prepared by Ground Water Monitoring and Assessment Program (GWMAP), May 1999

Minnesota Pollution Control Agency, *A Water Quality Assessment of Select Lakes within the Kawishiwi River Watershed*, prepared by Water Monitoring Section, Lakes and Streams Monitoring Unit, January 2011

Robertson, W.D. *Development of steady-state phosphate concentration in septic system plumes.* Journal of Contaminant Hydrology 19:289-305. 1995.

Robertson, W.D., and J. Harman. *Phosphate plume persistence at two decommissioned septic system sites*. Ground Water 37:228-236. 1999.

Figures



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Site Location Map

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Figure 1

Appendix A

Unsewered Area Needs Documentation Form

Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul, MN 55155-4194

Unsewered Area Needs Documentation Form

Clean Water Revolving Fund Project Priority List

Doc Type: Priority Points/Admin. Checklist

Project Information

Project name:		MPCA Engineer:	
Contact name:		Contact phone number:	
Form completed by:		MN SSTS license number:	
Date:			

Instructions

The Unsewered Area Needs Documentation form is designed to document wastewater needs for project applicants requesting Clean Water Revolving Fund financial assistance for wastewater collection and treatment facilities improvements in unsewered areas of Minnesota. It is part of a process to encourage project applicants to evaluate all wastewater collection and treatment alternatives that are prudent and feasible. This form should be submitted with the applicant's request for placement on the Project Priority List per Minn. R.

The Minnesota Pollution Control Agency (MPCA) defines wastewater treatment need in unsewered areas as the inability of subsurface sewage treatment systems (SSTS) to meet the compliance criteria in Minn. R. 7080.1500 or the required setbacks from water supply infrastructure, buildings, property lines, and the high water level of nearby public waters.

The Unsewered Area Needs Documentation form must be completed by a Certified Inspector (Minn. R. 7083.0750). Preliminary site investigations in accordance with Minn. R. 7080.1710 are not required in order to complete a planning evaluation to determine needs. Compliance inspections in accordance with Minn. R. 7082.0700, subp. 2 is an acceptable method, but not required. A physical site investigation may not be necessary at SSTS locations. Reasonable documentation of each system's condition must be provided. In addition to this form, applicants must provide a scaled map identifying each SSTS site location in the project service area.

Section A (System condition per Minn. R. 7080 and 7082)

The following options are available in the drop down menu. Select the appropriate option based on the description below.

ITPHS-Imminent threat to public health or safety (Minn. R. 7080.1500, subp. 4A).

Failure to protect GW-Cesspools, seepage pits and/or systems lacking three (3) feet of vertical separation from seasonal high groundwater or bedrock (Minn. R. 7080.1500, subp. 4B). Type V systems defined in Minn. R. 7080.2400 that fail consistently.

Setback issues-Properties that cannot conform to setback requirements from water supply wells or piping, buildings, property lines, or high water level of public waters. (Minn. R. 7080.2150, subp. 2F)

Conforming system-SSTS system is in conformance.

Section B (Methods of determining project need)

The following options are available in the drop down menu. Select the **primary method** of determination based on the description below.

Visual site inspection-A visual site inspection to document obvious threats to public health and safety, such as residential connections to a drain tile, overflow pipes, cesspools, or other unacceptable discharge

Soil survey data review-A review of existing soil survey data to reasonably conclude if appropriate wastewater treatment technologies are being used on site. For example, seasonal high groundwater conditions may dictate the need for a mound system. If there are no mounds, the systems are considered

Site investigation with soil borings-A site investigation including enough soil borings to create a soils map of the area. Complete an evaluation of the soil conditions to determine compatibility with existing wastewater treatment systems. For example, the soils map may dictate the need for a mound system. If

Review of government records-A review of local government records of the systems. If none exist, the system is unlikely to be in compliance. Existing records should be verified for accuracy.

Review of plat maps-A review of plat maps and other records to determine if any code setbacks, such as distance between SSTS and potable water wells or surface water, cannot be met based on lot size. Systems on lots with inadequate size for setbacks should be considered noncompliant.

Compliance inspection per Minn. R. 7082.0700, subp. 2-A compliance inspection per Minn. R. 7082.0700, subp. 2 is completed.

Other-Please explain method in separate submittal.

Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul, MN 55155-4194

Unsewered Area Needs Documentation Form

Clean Water Revolving Fund Project Priority List

Doc Type: Priority Points/Admin. Checklist

Site Location (address, plat number, unique numbering system, or owner name)	Existing System Condition (see Section A on page 1)	Documentation of Need and Method of Determination (see Section B on page 1)	Is one or more of the non-conforming SSTS discharging within 500 feet of an impaired water or ORVW?	Residential or Non-Residential Property

	Residential Systems	Non Residential Systems	All Systems
ITPHS	0	0	0
Failure to protect GW	0	0	0
Setback issues	0	0	0
Conforming systems	0	0	0
TOTAL	0	0	0

Page Number:	
Of Total Pages:	

Appendix B

Project Priority List Application Form

Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul, MN 55155-4194

Project Priority List (PPL)

Projects in Unsewered Areas Scoring Worksheet

Minnesota Rule Chapter 7077.0118

Office use only

Project Number
Staff Engineer
Total Points
Date

Facility Information (please print)

Project name: _____

Applicant name (if different): _____

Contact name: _____ Title: _____

E-mail address: _____ Phone: _____

Instructions

This worksheet is used to score all requests for state financial assistance for wastewater improvement projects in unsewered areas. Scoring is based on the environmental criteria contained in Minnesota Rule Chapter 7077. The result of scoring is a ranked list called the Project Priority List (PPL) from which projects will be selected for funding.

Applicants must complete their sections of the worksheet and submit it with their requests for placement on the PPL. As part of completing the worksheet, the applicant must provide sufficient documentation to support the award of points. Complete application information is located on the Minnesota Pollution Control Agency (MPCA) Web site at www.pca.state.mn.us/water/wpcrf-psource.html.

Complete this form if your proposal includes new or improved wastewater facilities within an unsewered area.

NOTE: Round up calculated point value for each of the questions 105 – 115 and 125 to the next whole number (e.g., 4.1 = 5).

NOTE: Subsurface Sewage Treatment System (SSTS)

Applicant completes questions 105 – 140; MPCA completes questions 145 - 150

Points

Required submittals include:

1) State Revolving Fund Project Priority List, Part 1: Unsewered Area Needs Documentation for questions 105, 110, 115, 120 and 125. Form is located at http://www.pca.state.mn.us/publications/wq-wwtp2-10.doc.

2) Provide a scaled map showing locations of existing Subsurface Sewage Treatment System (SSTS) as supporting documentation for questions 120, 125 and 130.

[105] Existing SSTS systems discharges posing threat to public health or safety [subp. 1]

Existing SSTS systems that have the potential to immediately and adversely affect or threaten public health or safety. At a minimum, this includes ground surface or surface water discharges of untreated or partially treated wastewater and sewage backup into a dwelling or other establishment. (Minn. R. 7080.0020, subpart 19a)

105.1 How many total structures with SSTS systems are included in the project? _____

105.2 How many structures with SSTS systems are posing a threat to public safety? _____

(45) x (total number of failures calculated in 105.2) / (total number of waste discharging structures105.1) = _____

[110] Existing SSTS systems with failure to protect ground water [subp. 2]

110.1 How many structures with SSTS systems or other systems (not counted in question 105.1 above) in the proposed project area that have one or more sewage tanks which obviously leak below the designated operating level or have less than the required vertical separation (Minn. R. 7080.0060, subpart 3, item B)? _____

(15) x (total number of failures to protect ground water in 110.1) / (total number of waste discharging structures 105.1) = _____

Project Name: **Points**

[115] Existing SSTS systems with properties that cannot conform to setback requirements [subp. 3]

115.1 Remaining number of structures discharging wastewater in the proposed project area (not counted in 105.2 and 110.1), that because of property size or configuration, *do not* conform to setback requirements as they apply to one or more of the following:

Water supply wells	
Buried water lines	
Buildings	
Property lines	
Ordinary high water level of public waters	

(5) x (total number of setback failures115.1) / (total number of waste discharging structures 105.1) =

[120] Existing discharge near impaired water or outstanding resource value water (ORVW) [subp. 4]

120.1 Does one or more of the existing SSTS discharge within 500 feet of an impaired water or ORVW? ☐ Yes ☐ No

If Yes, enter 5 points

[125] Failed SSTS near impaired water or ORVW [subp. 5]

125.1 How many failed SSTS, that meet the definition of failure under numbers 105.2 or 110.1 above, have wastewater discharge areas within 500 feet of an impaired water or ORVW?

(5) x (number of failed SSTS within 500 ft. of an impaired water or ORVW in 125.1) / (total number of waste discharging structures) =

[130] Existing impact density of SSTS systems [subp.6]

Provide a scale map which contains all existing structures which generate wastewater and the "Impact Zone" identified. The Impact Zone is defined as the smallest possible circle drawn around the area that encompasses 90 percent of the structures discharging wastewater in the proposed project area.

130.1 How many acres is the impact zone (area of drawn circle) of the proposed project service area?

130.2 How many structures discharge wastewater within the impact zone of the proposed project?

130.3 **Number of structures within the impact zone/area (acres) of impact zone = impact density**

If density is less than 0.25 enter 0 points

If density is 0.25-0.5 enter 10 points

If density is 0.5-1.0 enter 20 points

If density is greater than 1.0 enter 30 points

[135] Proposed land (including sub-surface) discharge [subp. 7]

135.1 Does the proposed project call for consumptive use (nitrogen or volume) spray irrigation or land disposal systems, which are required by permit to denitrify (nitrate limit)? ☐ Yes ☐ No

If Yes, enter 20 points

[140] Proposed project implements corrective measures *(Effluent Limits Coordinator)* [subp. 8]

140.1 Will this project implement corrective measure(s) for problems identified in a diagnostic study such as Clean Water Partnership Phase 1, TMDL assessment, MPCA approved Watershed Restoration Action Strategy or equivalent study such as a County Water Plan? ☐ Yes ☐ No

If Yes, enter 5 points

Type of Study: *Attach supporting documentation and identify relevant sections.* ☐ Yes ☐ No

Project name: **Points**

[145] Project helps meet a total maximum daily load (TMDL) for receiving water *(Effluent Limits Coordinator)* [subp. 9]

145.1 Does this project contribute to the achievement of a TMDL by being designed to reduce the discharge of pollutants as required by an Agency approved TMDL implementation plan or does the project require an National Pollutant Discharge Elimination System (NPDES) Permit or a State Disposal System (SDS) Permit that will require the reduced discharge of pollutants based on a TMDL? ☐ Yes ☐ No

If Yes, enter 20 points ☐

[150] Proposed project points reduction for new/expanded discharges into specified water *(Effluent Limits Coord.)* [subp. 10]

150.1 Does the proposed project involve a new discharge to one or more of the following waters: ☐ Yes ☐ No

a) Outstanding Resource Value Waters (Minn. R. 7050.0180)

b) Impaired waters (Section 303(d)) of the Clean Water Act

c) Classification 2A, lake, or wetland that exceeds 200,000 gallons per day

If Yes, enter minus 5 points ☐

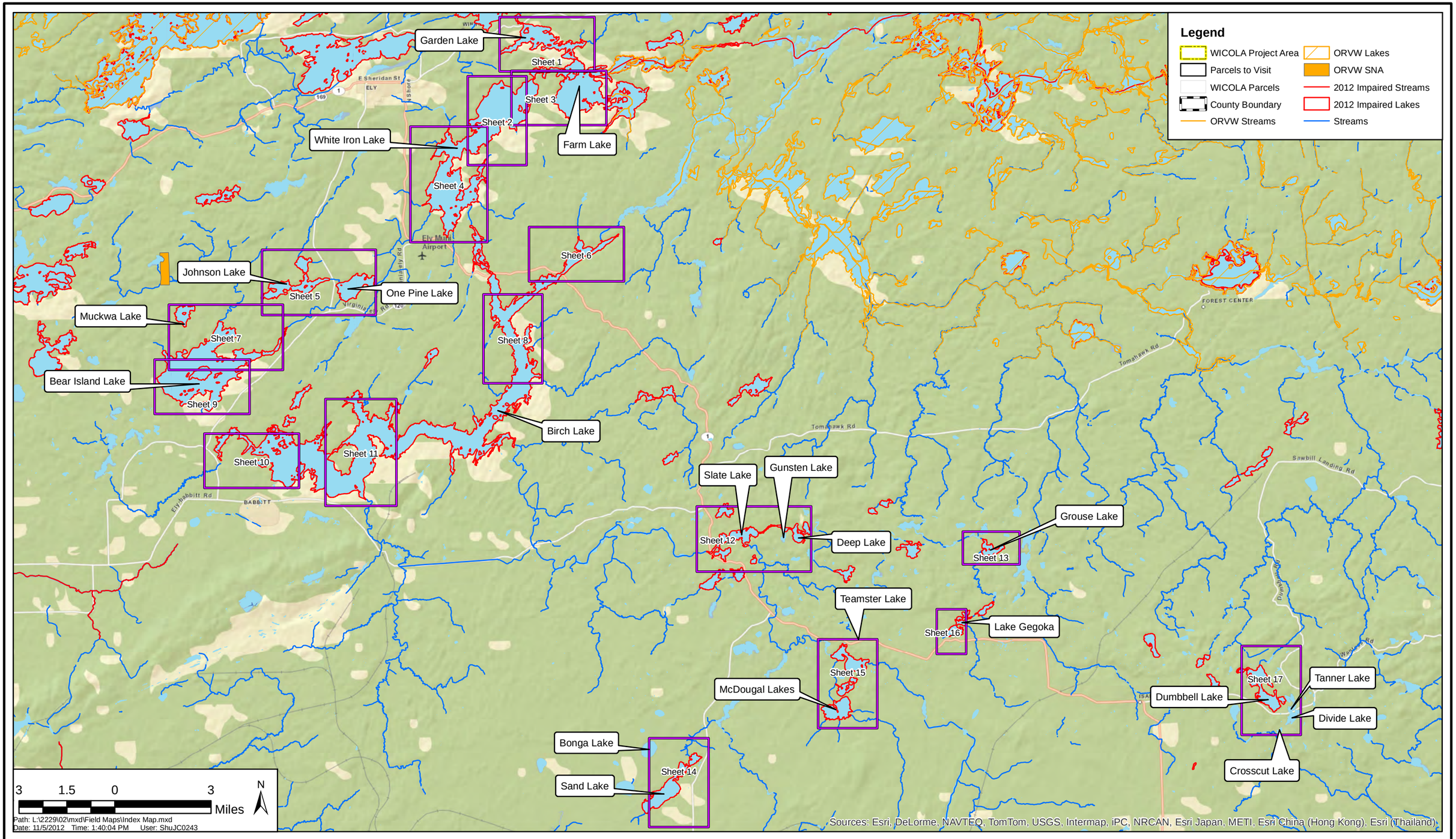
Total ☐

For more information, contact:

Bill Dunn, Clean Water Revolving Fund Coordinator at 651-757-2324, Fax 651-297-8676 or bill.dunn@state.mn.us

Appendix C

Field Maps



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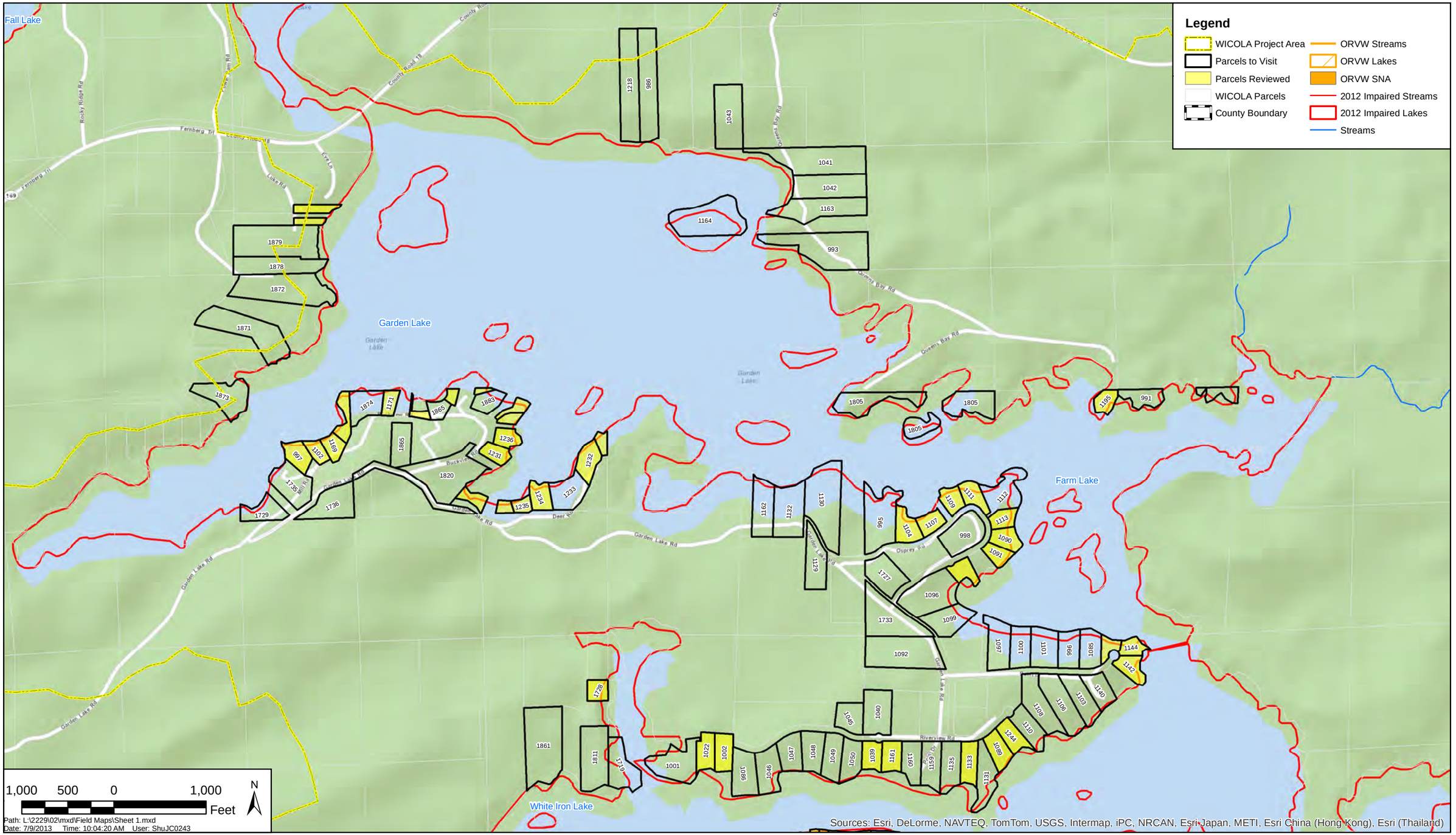

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Field Maps - Garden Lake and North Farm Lake

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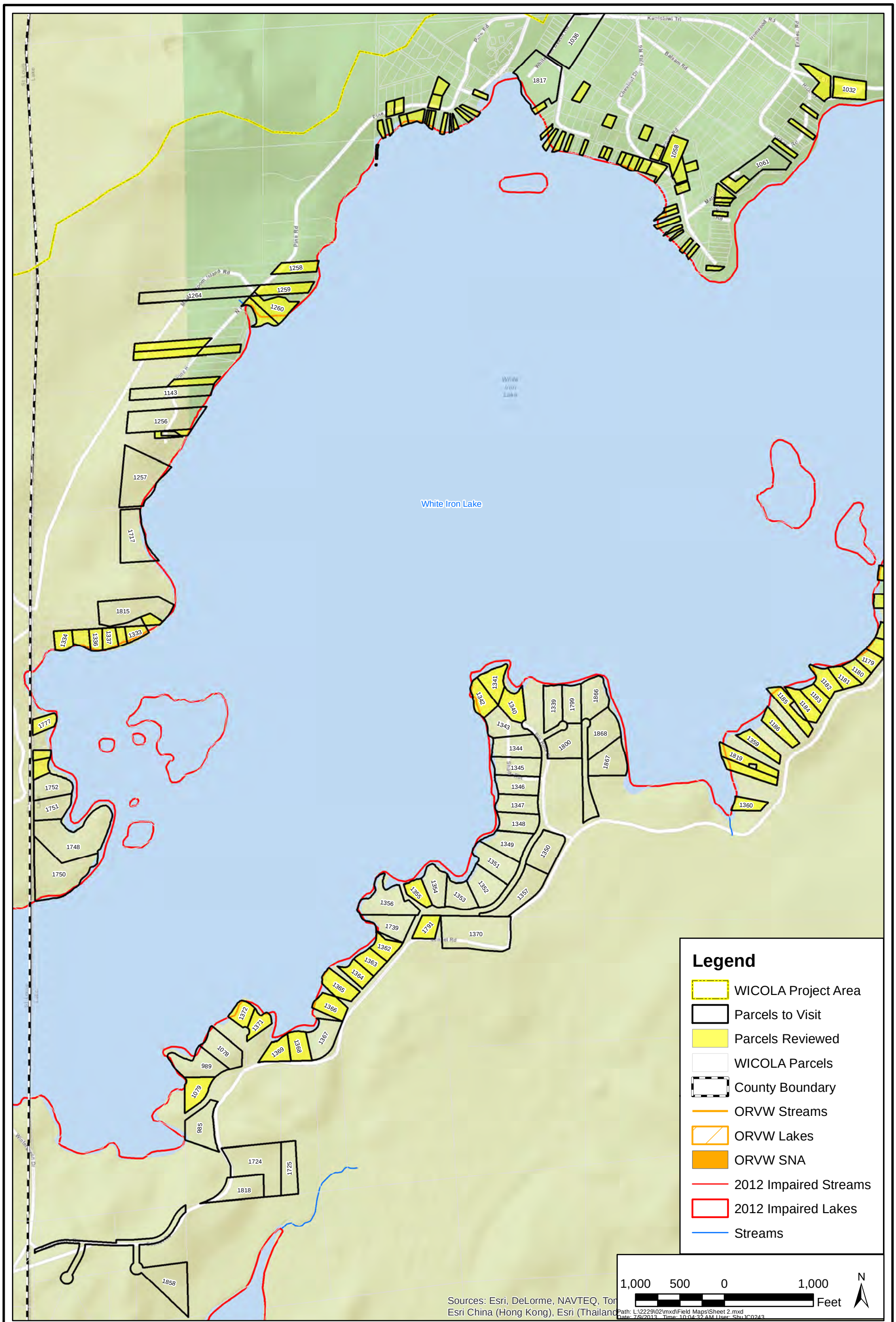

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Field Maps - Northeast White Iron Lake

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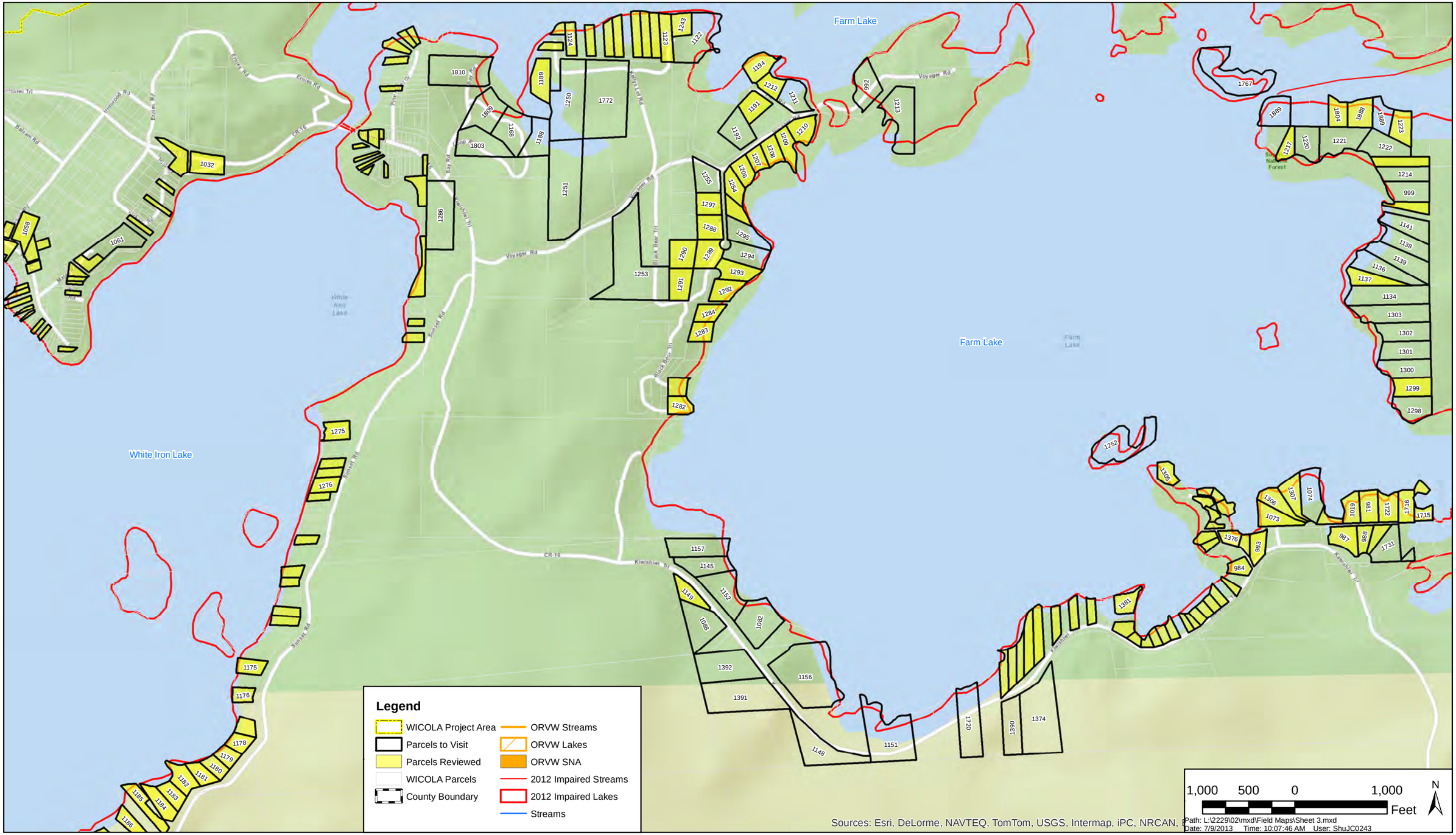

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Field Maps - Northeast White Iron Lake and Southwest Farm Lake

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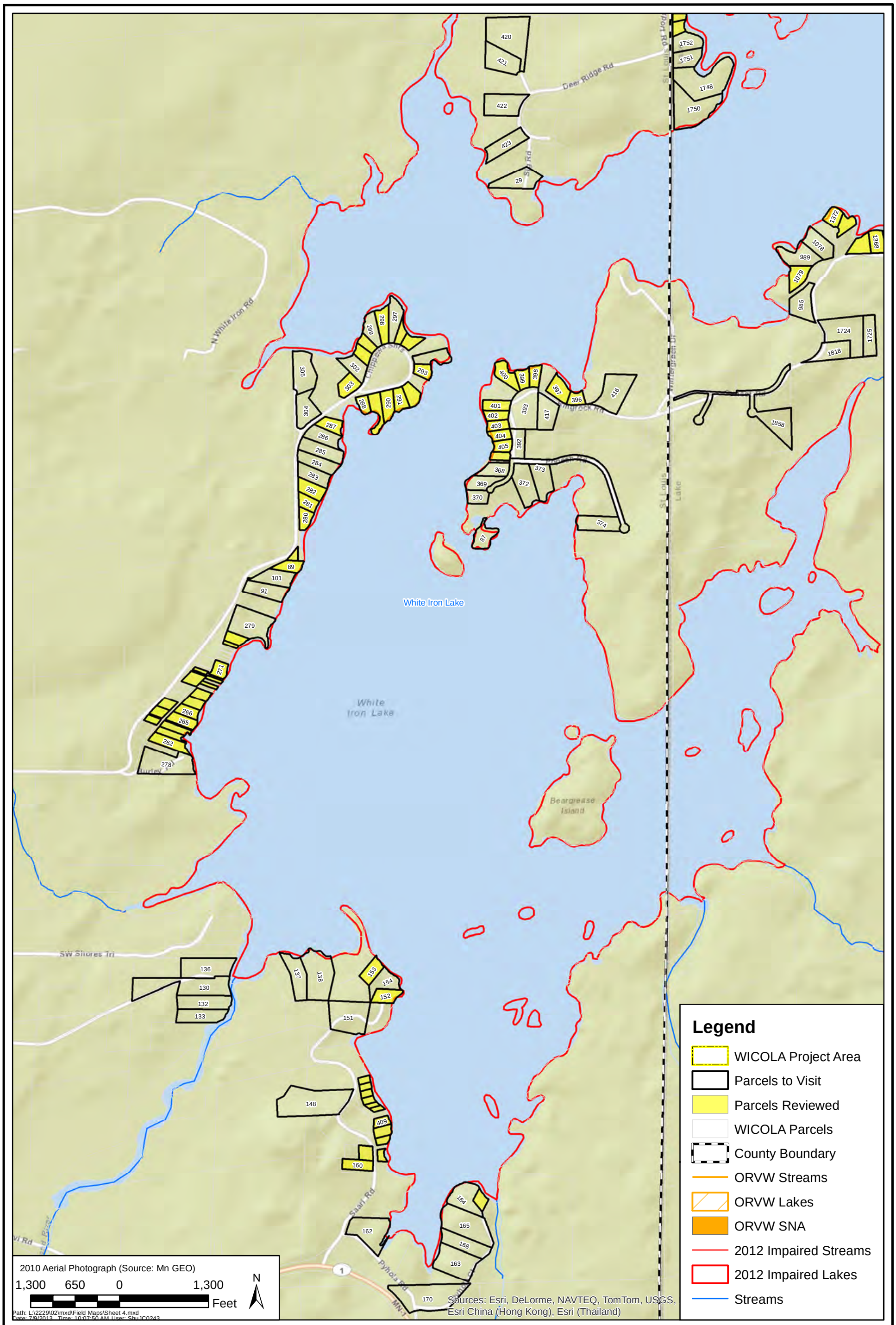

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Field Maps - White Iron Lake

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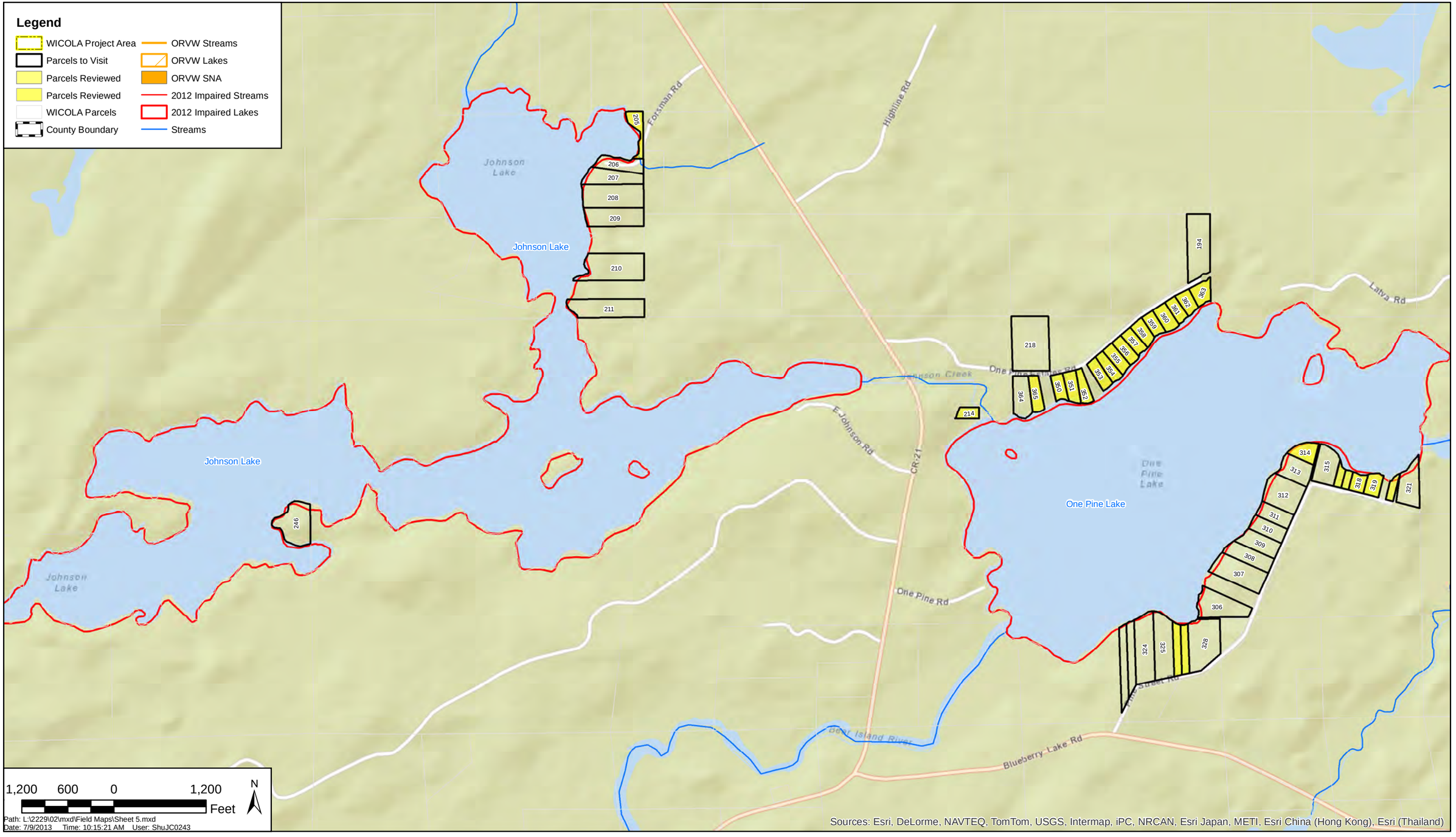

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Field Maps - Johnson Lake and One Pine Lake

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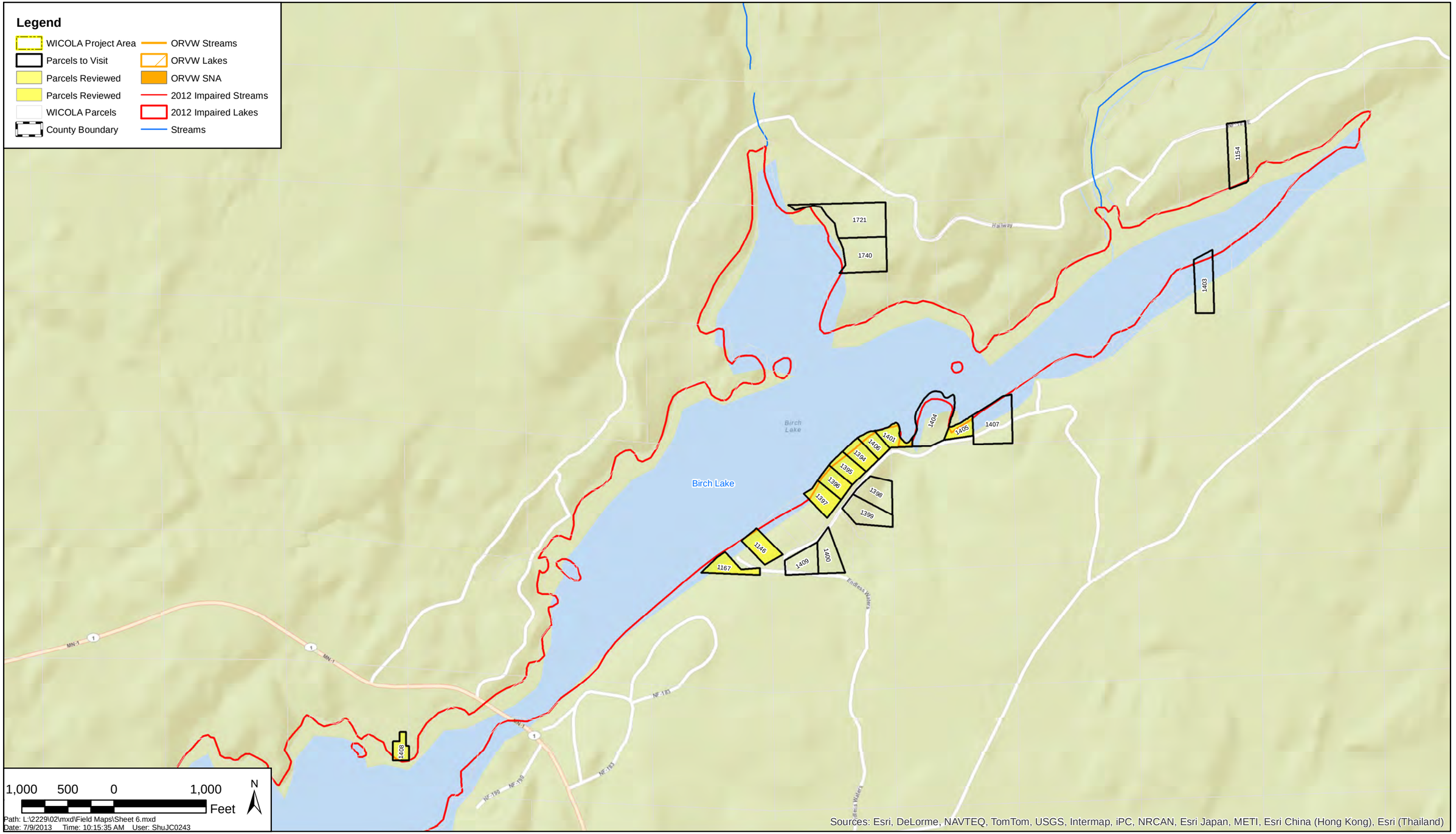

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Field Maps - Northeast Birch Lake

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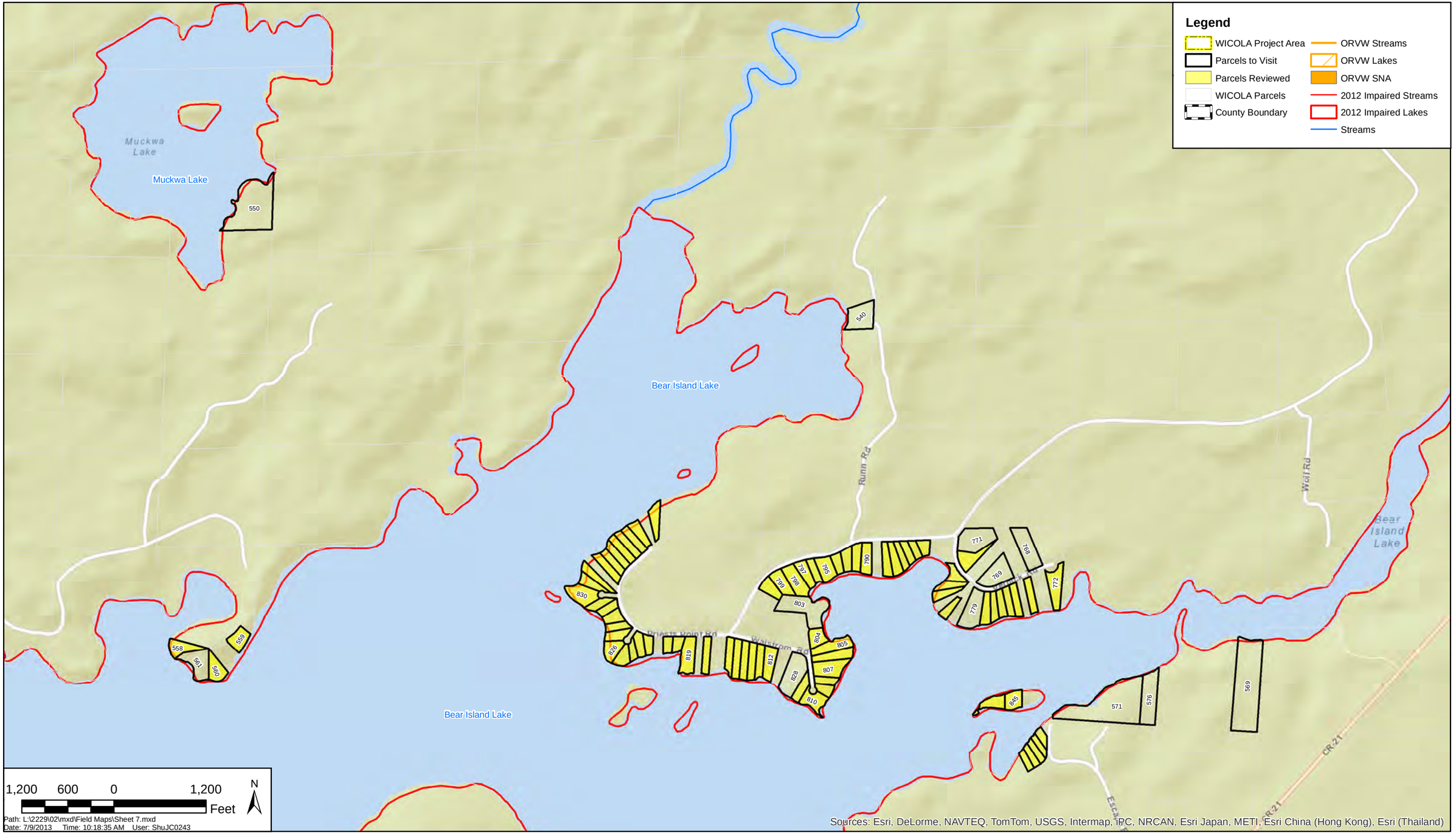

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Field Maps - North Bear Island Lake

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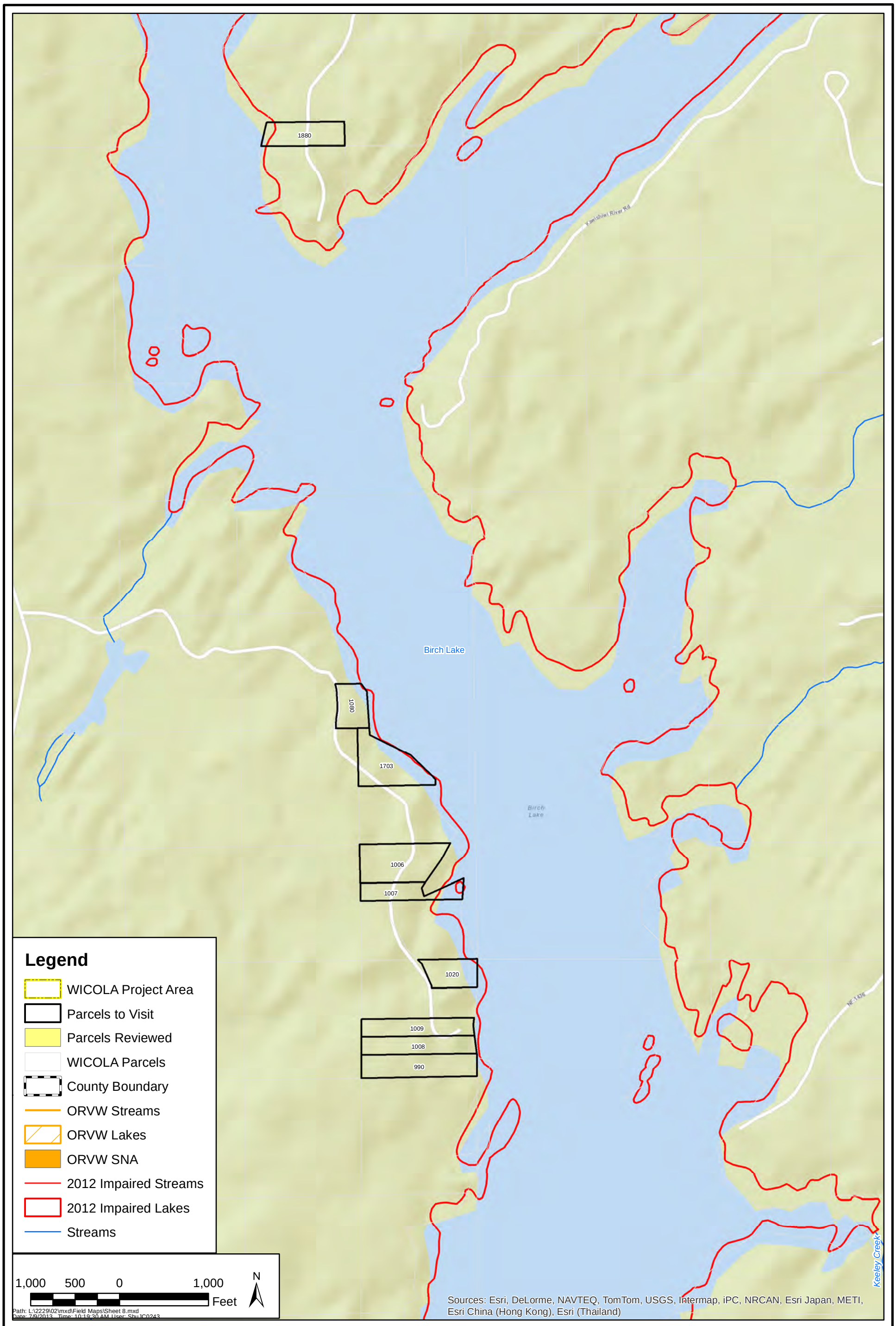

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Field Maps - East Birch Lake

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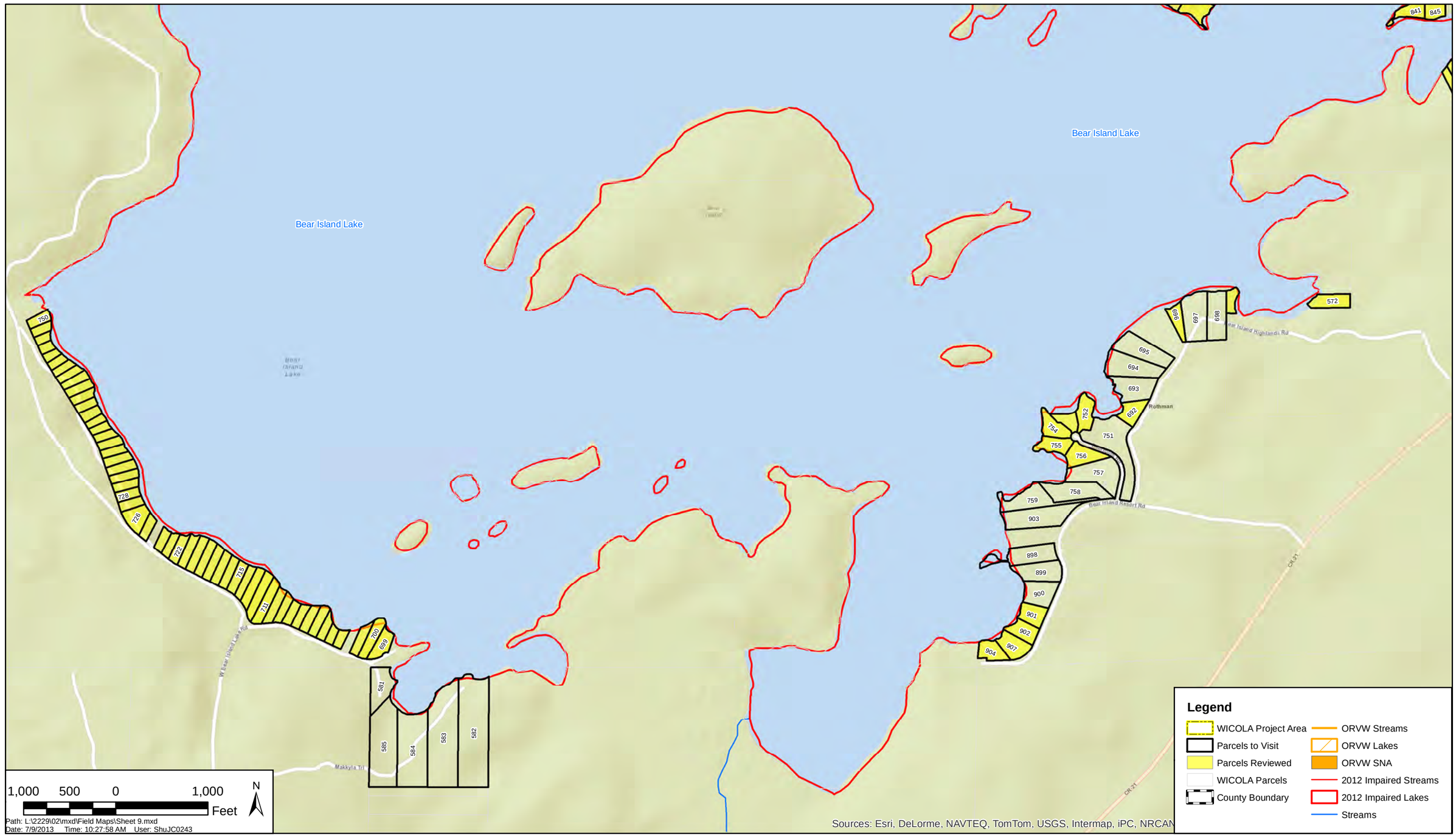

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Field Maps - South Bear Island Lake

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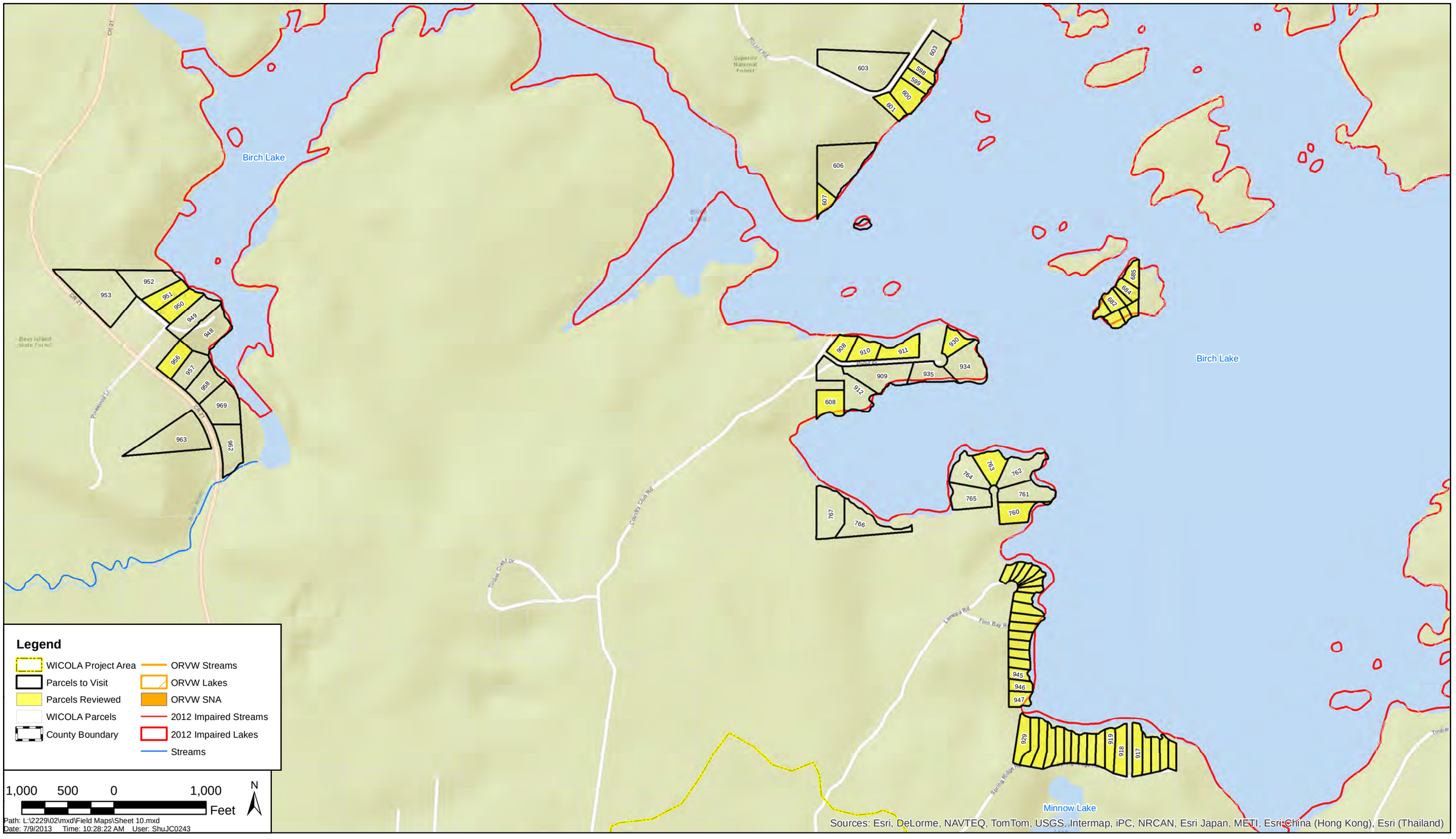

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Field Maps - West Birch Lake

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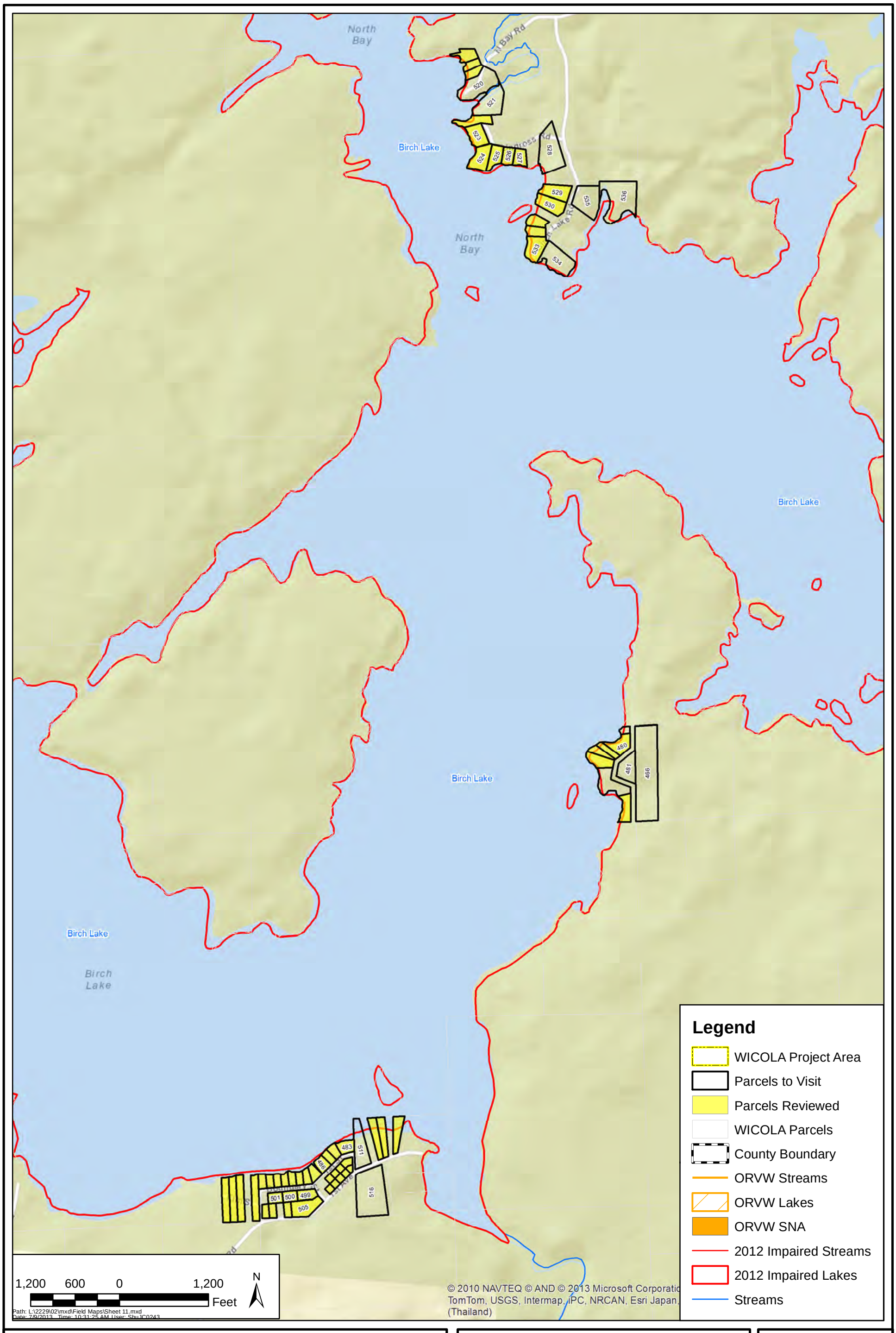

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Field Maps - West Central Birch Lake

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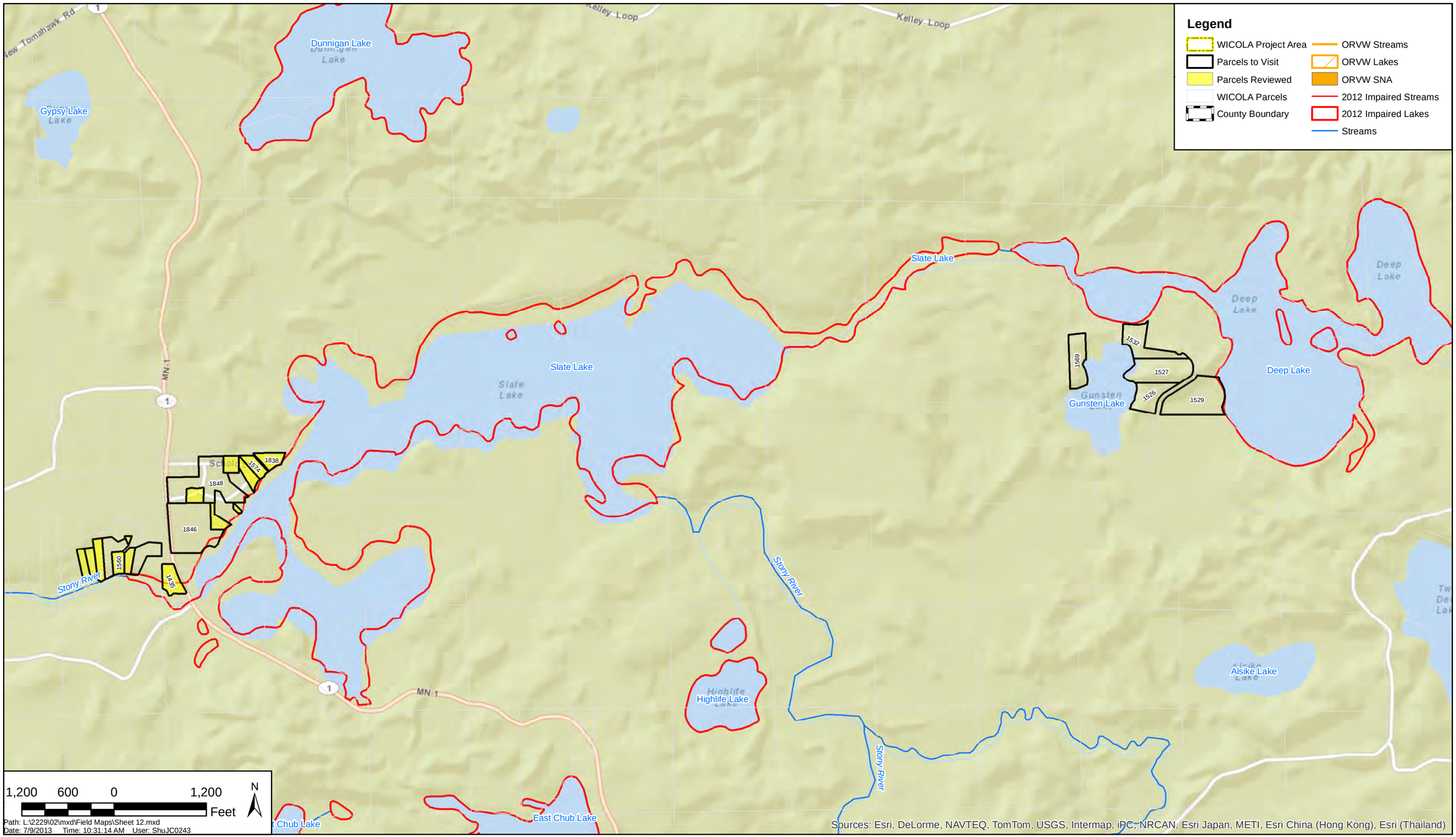

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Field Maps - Slate Lake, Deep Lake and Gunsten Lake

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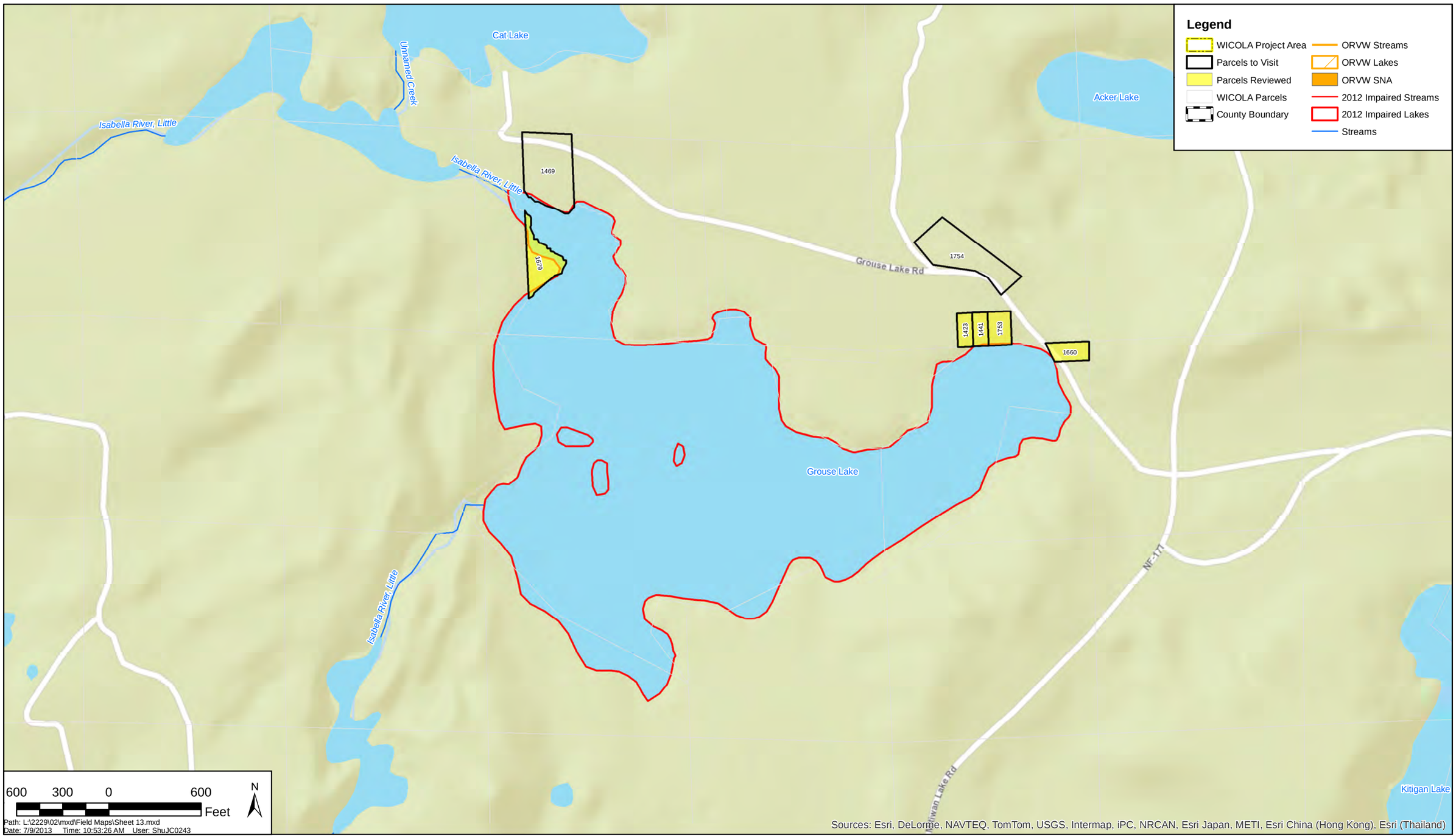

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Field Maps - Grouse Lake

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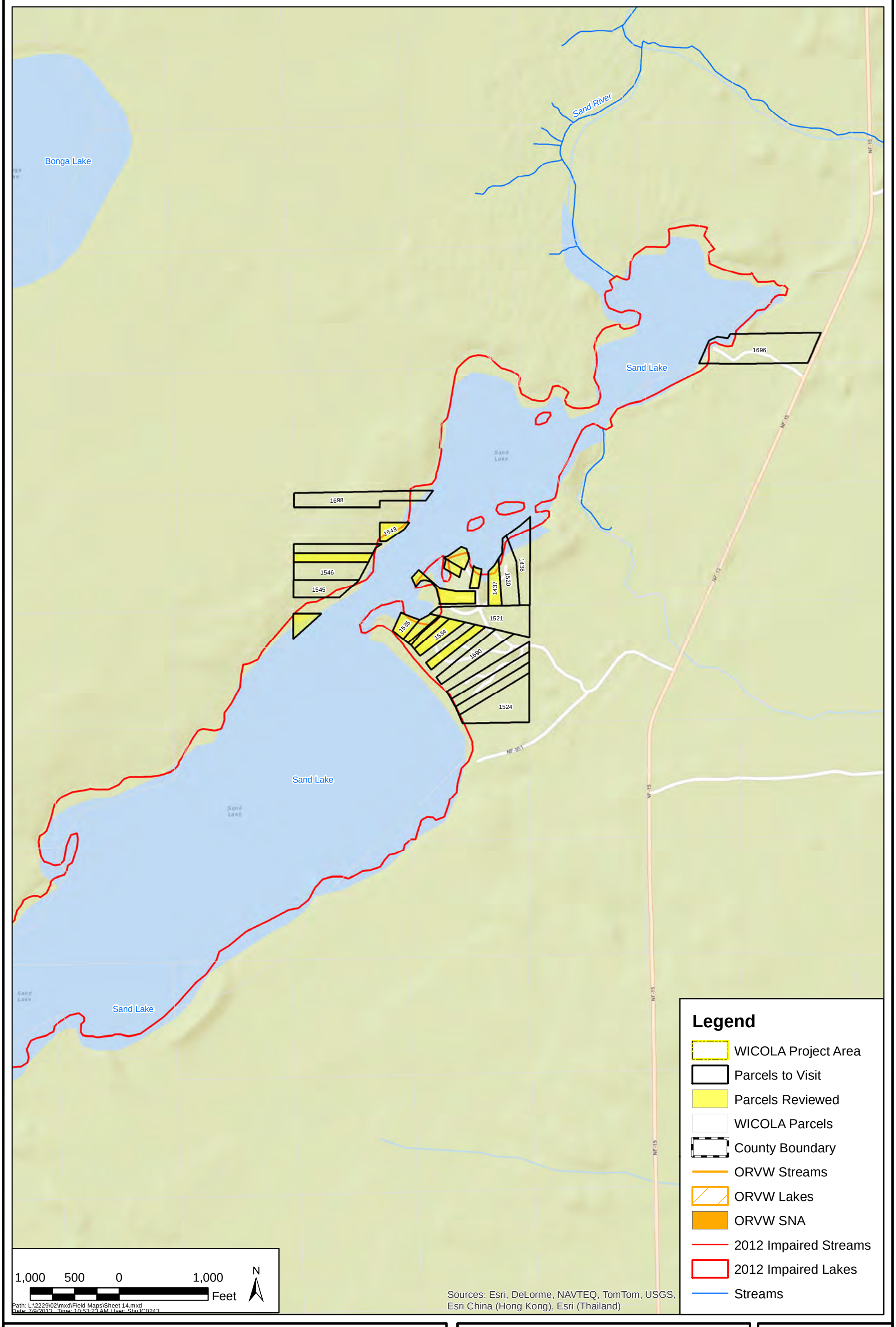

KAWISHIWI RIVER WATERSHED

Field Maps - Sand Lake

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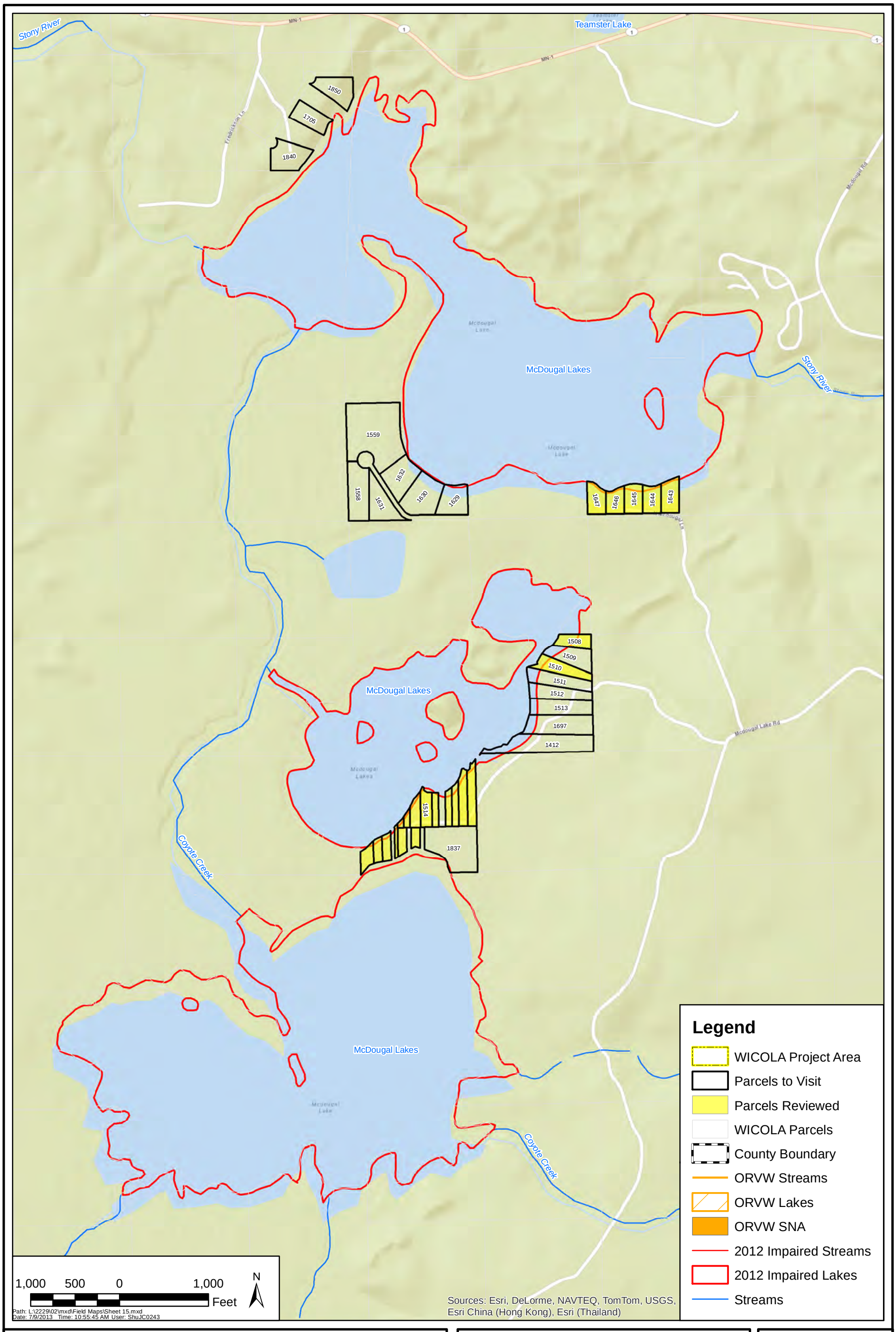

KAWISHIWI RIVER WATERSHED

Field Maps - McDougal Lakes

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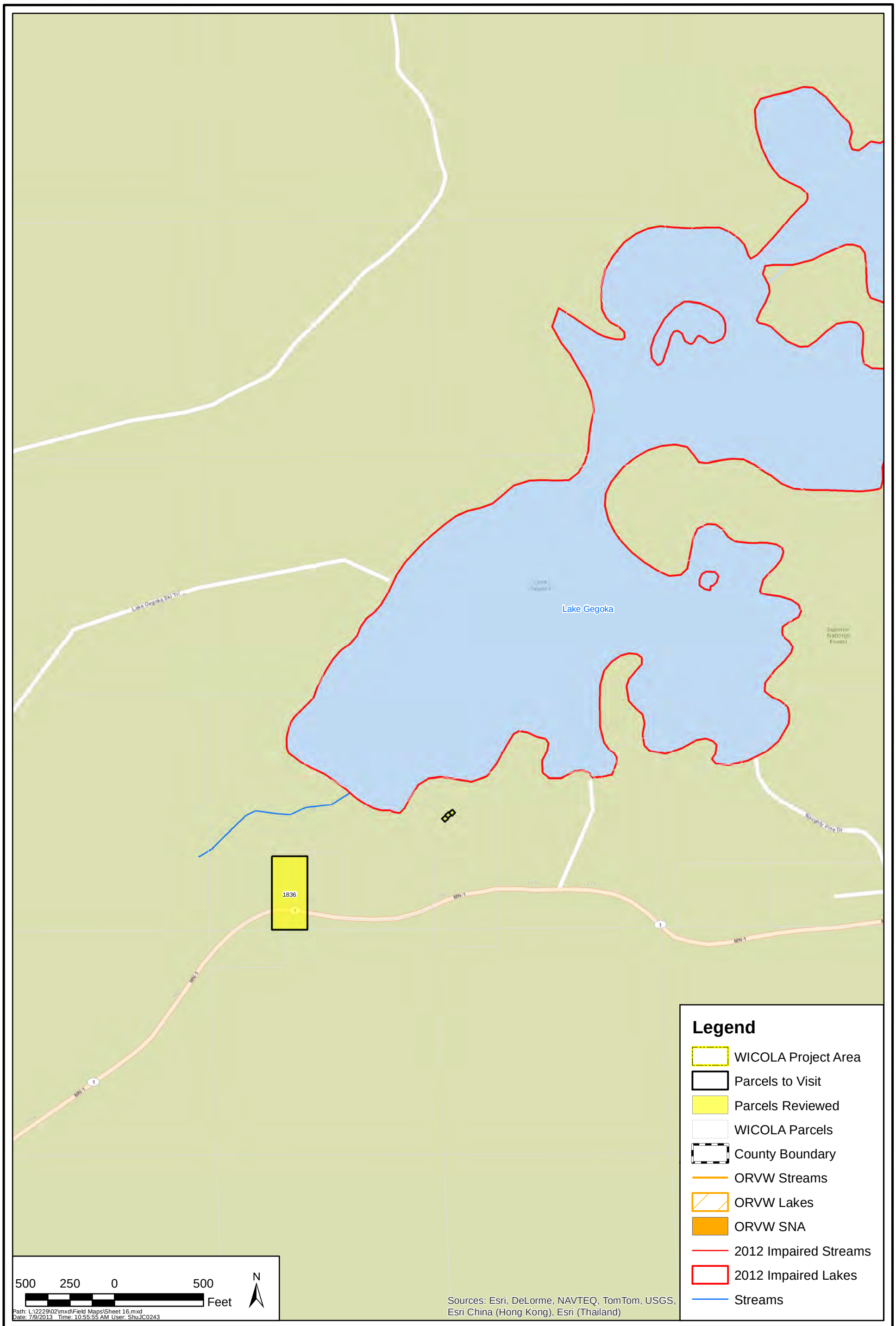
Sheet 15



KAWISHIWI RIVER WATERSHED

Field Maps - Lake Gegoka

Wenck
Engineers - Scientists
Business Professionals
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1800 Pioneer Creek Center
Maple Plain, MN 55359-0429
1-800-472-2232

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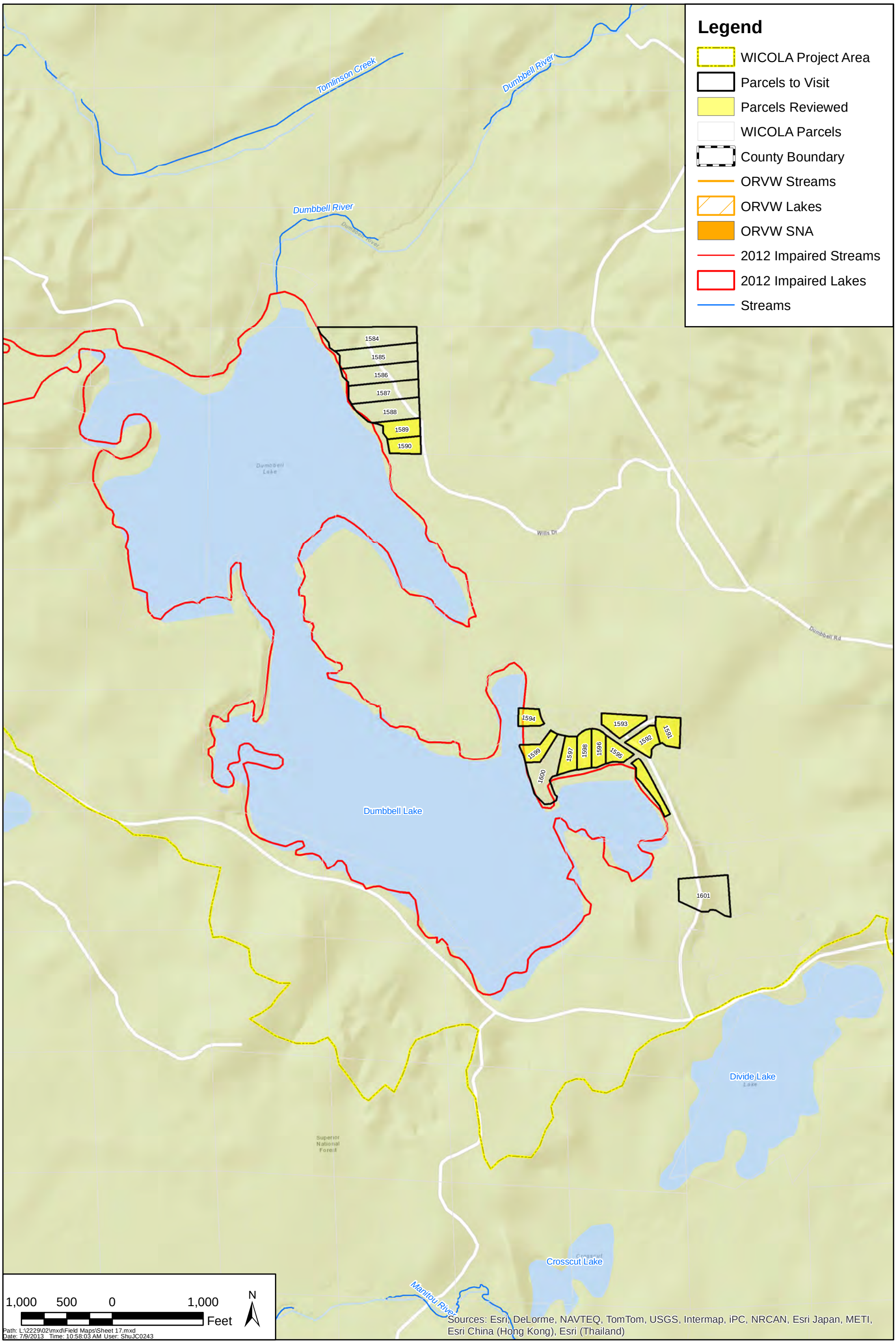
Sheet 16



KAWISHIWI RIVER WATERSHED

Field Maps - Dumbbell Lake

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Sheet 17

Appendix D

SSTS Water Quality Impact Calculations

Wenck Modified UMN Septic System Impact Estimator

SSTS on Parcels <10 acres within 500 feet of an impaired water

1. Statistics from Study

Total Systems	1,004
Type of Property	
Est. Full Time Residential	18.4%
Est. Seasonal Residential	80.0%
Est. Lodging	1.3%
Est. Other	0.3%
Compliance Status	
% Existing Cond 1 IPHT	0.0%
% Existing Cond 2 IPHT with Managed Tank	0.0%
% Existing Cond 3 Failure To Protect GW	53.5%
% Existing Cond 4 Compliant Non-mound	9.4%
% Existing Cond 5 Compliant Mound	37.2%

Existing Septic System Coding
0 = Vacant (parcel with no septic system)
1 = Imminent Public Health Threat (IPHT)
2 = IPHT with Managed Septic Tank
3 = Failing to Protect Groundwater
4 = SSTS Trench or Bed with 3 feet of separation
5 = SSTS Mound or Nitrogen reducing Type IV

New System Coding
NA = Not available
1 = SSTS Trench or Bed with 3 feet of separation
2 = SSTS Mound with 3 feet of separation

2. Enter Existing System Information

Existing Condition of Systems	Type of Property	Estimated Number of Systems	Estimated Daily Flow Per System	Pounds of BOD per Year	Pounds of TSS per Year	Bacteria per Year	Pounds of Phosphorus per Year	Pounds of Nitrogen per Year
3	Full Time Residential	99	300	4976	4976	2.05E+14	362	3257
4	Full Time Residential	17	300	0	0	0.00E+00	0	475
5	Full Time Residential	69	300	0	0	0.00E+00	0	1257
3	Lodging	7	2250	2622	2622	1.08E+14	191	1717
4	Lodging	1	2250	0	0	0.00E+00	0	250
5	Lodging	5	2250	0	0	0.00E+00	0	662
3	Seasonal Residential	429	150	10799	10799	4.45E+14	785	7069
4	Seasonal Residential	75	150	0	0	0.00E+00	0	1031
5	Seasonal Residential	298	150	0	0	0.00E+00	0	2728
3	Other	2	300	81	81	3.33E+12	6	53
4	Other	0	300	0	0	0.00E+00	0	8
5	Other	1	300	0	0	0.00E+00	0	20
	Total	1004	-	18478	18478	7.62E+14	1344	18526

3. Enter Proposed System Information

New System Code	Type of Property	Estimated Number of Systems	Estimated Daily Flow Per System	Pounds of BOD per Year	Pounds of TSS per Year	Bacteria per Year	Pounds of Phosphorus per Year	Pounds of Nitrogen per Year
2	Full Time Residential	99	300	0	0	0.00E+00	0	1809
2	Full Time Residential	17	300	0	0	0.00E+00	0	317
2	Full Time Residential	69	300	0	0	0.00E+00	0	1257
2	Lodging	7	2250	0	0	0.00E+00	0	954
2	Lodging	1	2250	0	0	0.00E+00	0	167
2	Lodging	5	2250	0	0	0.00E+00	0	662
2	Seasonal Residential	429	150	0	0	0.00E+00	0	3927
2	Seasonal Residential	75	150	0	0	0.00E+00	0	687
2	Seasonal Residential	298	150	0	0	0.00E+00	0	2728
2	Other	2	300	0	0	0.00E+00	0	29
2	Other	0	300	0	0	0.00E+00	0	5
2	Other	1	300	0	0	0.00E+00	0	20
	Total	1004	-	0	0	0.00E+00	0	12563

4. Potential Improvement with System Upgrades

Decrease in Pounds of BOD per Year	Decrease in Pounds of TSS per Year	Decrease in Bacteria per Year	Decrease in Pounds of Phosphorus per Year	Decrease in Pounds of Nitrogen per Year
18478	18478	7.62E+14	1344	5964

Wenck Modified UMN Septic System Impact Estimator

Loading to Entire Kawishiwi Watershed

1. Statistics from Study

Total Systems	1,909
Type of Property	
Est. Full Time Residential	34.1%
Est. Seasonal Residential	63.1%
Est. Lodging	1.9%
Est. Other	0.9%
Compliance Status	
% Existing Cond 1 IPHT	0.0%
% Existing Cond 2 IPHT with Managed Tank	0.0%
% Existing Cond 3 Failure To Protect GW	61.4%
% Existing Cond 4 Compliant Non-mound	11.2%
% Existing Cond 5 Compliant Mound	27.3%

Existing Septic System Coding
0 = Vacant (parcel with no septic system)
1 = Imminent Public Health Threat (IPHT)
2 = IPHT with Managed Septic Tank
3 = Failing to Protect Groundwater (<3 ft sep.)
4 = SSTS Trench or Bed with 3 feet of separation
5 = SSTS Mound or Nitrogen reducing Type IV

New System Coding
NA = Not available
1 = SSTS Trench or Bed with 3 feet of separation
2 = SSTS Mound with 3 feet of separation

2. Enter Existing System Information

Existing Condition of Systems Code	Type of Property	Estimated Number of Systems	Estimated Daily Flow Per System	Pounds of BOD per Year	Pounds of TSS per Year	Bacteria per Year (cfu)	Pounds of Phosphorus per Year	Pounds of Nitrogen per Year
3	Full Time Residential	400	300	20116	20116	8.29E+14	1463	13167
4	Full Time Residential	73	300	0	0	0.00E+00	0	2002
5	Full Time Residential	178	300	0	0	0.00E+00	0	3255
3	Lodging	22	2250	8343	8343	3.44E+14	607	5461
4	Lodging	4	2250	0	0	0.00E+00	0	830
5	Lodging	10	2250	0	0	0.00E+00	0	1350
3	Seasonal Residential	740	150	18617	18617	7.67E+14	1354	12186
4	Seasonal Residential	135	150	0	0	0.00E+00	0	1853
5	Seasonal Residential	329	150	0	0	0.00E+00	0	3013
3	Other	10	300	525	525	2.16E+13	38	344
4	Other	2	300	0	0	0.00E+00	0	52
5	Other	5	300	0	0	0.00E+00	0	85
	Total	1909	-	47601	47601	1.96E+15	3462	43597

3. Enter Proposed System Information

New System Code	Type of Property	Estimated Number of Systems	Estimated Daily Flow Per System	Pounds of BOD per Year	Pounds of TSS per Year	Bacteria per Year (cfu)	Pounds of Phosphorus per Year	Pounds of Nitrogen per Year
2	Full Time Residential	400	300	0	0	0.00E+00	0	7315
2	Full Time Residential	73	300	0	0	0.00E+00	0	1335
2	Full Time Residential	178	300	0	0	0.00E+00	0	3255
2	Lodging	22	2250	0	0	0.00E+00	0	3034
2	Lodging	4	2250	0	0	0.00E+00	0	553
2	Lodging	10	2250	0	0	0.00E+00	0	1350
2	Seasonal Residential	740	150	0	0	0.00E+00	0	6770
2	Seasonal Residential	135	150	0	0	0.00E+00	0	1235
2	Seasonal Residential	329	150	0	0	0.00E+00	0	3013
2	Other	10	300	0	0	0.00E+00	0	191
2	Other	2	300	0	0	0.00E+00	0	35
2	Other	5	300	0	0	0.00E+00	0	85
	Total	1909	-	0	0	0.00E+00	0	28170

4. Potential Improvement with System Upgrades

Decrease in Pounds of BOD per Year	Decrease in Pounds of TSS per Year	Decrease in Bacteria per Year	Decrease in Pounds of Phosphorus per Year	Decrease in Pounds of Nitrogen per Year
47601	47601	1.96E+15	3462	15427