



NUCLEAR WASTE SOCIÉTÉ DE GESTION
MANAGEMENT DES DÉCHETS
ORGANIZATION NUCLÉAIRES

Phase 1 Desktop Assessment Environment Report

TOWNSHIP OF IGNACE, ONTARIO



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PHASE 1 DESKTOP ASSESSMENT

Environment Report Township of Ignace, Ontario

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REPORT



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ENVIRONMENT REPORT - TOWNSHIP OF IGNACE, ONTARIO



1.0 INTRODUCTION

The Township of Ignace in northwestern Ontario is considering hosting a facility to manage Canada's Used Nuclear Fuel through the Nuclear Waste Management Organization's (NWMO) Adaptive Phased Management Site Selection Process (NWMO, 2010). This process is seeking to find a site for a deep geological repository that will provide safe long-term containment and isolation with an informed and willing host community. The process is presently at an early stage.

Part of the process is focussed on determining if there are environmental features that would preclude the potential for a facility to be constructed in the vicinity of Ignace. To this end, this report provides a general description of the environment in the Township of Ignace and surrounding area. It is complemented by reports prepared in parallel which characterize the geoscientific conditions and community well-being profile of the area. These reports are summarized, with other information, in an integrated Preliminary Assessment Report.

This report is not an environmental assessment. Its purpose is to provide a high level description of the current human and natural environment based on readily available sources of data. Additional detailed information for specific locations will be sought at subsequent phases of the work.

The area considered here is similar to that used for the Phase I Geoscientific Desktop Assessment for Ignace. This area is shown on Figure 1, and includes the Township of Ignace, as well as areas to the north, south, east and west of this Township.



ENVIRONMENT REPORT - TOWNSHIP OF IGNACE, ONTARIO



2.0 COMMUNITIES AND INFRASTRUCTURE

2.1 Communities

The Township of Ignace is approximately 93 km² in size¹, situated in the District of Kenora in northwestern Ontario (LIO, 2012). The settlement area is shown on Figure 1 along the north shore of Lake Agimak, approximately 250 km northwest of Thunder Bay and 110 km southeast of Dryden. Figure 2 presents satellite imagery for the area taken in 2006. Table 1 summarizes the total population and population density for the Township of Ignace and District of Kenora.

Table 1: Population Statistics for the Ignace Area

Political Boundary	Population	Population Density per km ²
Township of Ignace	1,202	16.5
District of Kenora	57,607	0.1

Source: 2011 Census of Population (Statistics Canada, 2012)

Figure 1 also shows the geographic boundaries for neighbouring townships within the Ignace area. These township boundaries represent former municipal boundaries; the Township of Ignace is the only township within the Ignace area that currently maintains a municipal government (MMAH, 2009). Land ownership within the Ignace area, including areas of Crown land², Crown Reserve³ lands, parks and reserves and private lands, is shown on Figure 3.

There are a number of Aboriginal communities and organizations in the Ignace area including Lac Seul First Nation, Seine River First Nation and Wabigoon Lake First Nation. Métis Councils in the area include Atikokan and Area Métis Council, Kenora Métis Council, Northwest Métis Council and Sunset Country Métis Council as represented by the Lake of Woods/Lac Seul, Rainy Lake/Rainy River and Treaty 3 Traditional Territory Consultation Committee and Greenstone Métis Council, Superior North Shore Métis Council and Thunder Bay Métis Council as represented by Lakehead/Michipicoten/Nipigon Traditional Territory Consultation Committee and the Métis Nation of Ontario.

Further information on Ignace and its surrounding communities is provided in the Community Well Being Profile Report.

2.2 Infrastructure

Figure 1 shows the location of the primary infrastructure corridors in the Ignace area. The main transportation routes include the Trans-Canada Highway (Highway 17) which passes through the center of the area in an east-west orientation, and through the community of Ignace. As well, Highway 599 runs northeast from its intersection with Highway 17 from the community of Ignace, and Highway 622 runs southwest from Highway 17

¹ Area calculated using Geographic Information System (GIS) municipal boundaries from the Ministry of Municipal Affairs and Housing (MMAH, 2009).

² Crown land is divided on the Figure into Crown Leased Land, Non-freehold Disposition Public and Unpatented Public Land. Crown Leased land is acquired by MNR for reasons based on ecological sustainability, including ecosystem health, the protection of natural and cultural assets, recreation, and / or the protection of people and property. Non-freehold Dispositions Public are a tenure holding, usually for a set term and a specific purpose (e.g., Lease, Licence of Occupation, Land Use Permit, Beach Management Agreement and Easement), excluding permanent disposition in the form of a patent. Unpatented Public Land is generally land that has never been granted or sold by the Crown to people or organizations for their private use and are under the mandate or management of the MNR.

³ Crown Reserves are Crown lands that have been withdrawn from dispositioning under Section 21 of the Crown Minerals Act.



from between the settlement areas of Borups Corners and Raleigh (Figure 1). A Canadian Pacific (CP) rail corridor runs approximately parallel to Highway 17 through the area also, as does a natural gas pipeline. There are two primary transmission corridors through the area, a 230 kV line which parallels the Trans-Canada Highway in the western half of the area, moving south between Elsie and Sandford Lakes south of Ignace towards Atikokan. As well, a 115 kV transmission line connects to the 230 kV line south of Raleigh, oriented northeast to the community of Pickle Lake, parallel to Highway 599. There is one airport in the area, the Ignace Municipal Airport, located to the northwest of Ignace and a float plane dock, the Ignace Waterdome, located on Agimak Lake, as shown on Figure 1. There are three operating landfills within the Ignace area and a wastewater treatment plant.

2.3 Protected Areas

2.3.1 Parks and Reserves

There are four provincial parks and eight conservation reserves in the Ignace area. Figure 4 shows the location of these protected areas. The Sandbar Lake Provincial Park is 80 km² in size; it is classed as a natural environment park. Its southern tip occupies part of the northeast corner of the Township of Ignace. The park offers day use and overnight camping (Ontario Parks, 2009a). The Turtle River-White Otter Lake Provincial Park lies south and southwest of the Township of Ignace and covers approximately 400 km² (Ontario Parks, 2009b). Turtle River – White Otter Provincial Park is a waterway park, offers no facilities and is accessible by water only. The southernmost portion of the East English River Provincial Park (approximately 170 km²) and Bonheur River Kame Provincial Park (approximately 8 km²) lie about 17 km north and 26 km east of the Township of Ignace, respectively. Bonheur River Kame Provincial Park is classed as a nature reserve. It is fly-in access only and provides no facilities for visitors (Ontario Parks, 2008).

Conservation and Forest reserves are lands set aside by the government (municipal, provincial or federal) to protect ecosystems that are representative of a natural region, protect significant elements of natural and cultural heritage, and maintain biodiversity. There are eight conservation reserves in the Ignace area. Those closest to the Township of Ignace include the Campus Lake (194 km²) and Gulliver River (27 km²) Conservation Reserves, approximately 8 km and 15 km south and southeast of the Township of Ignace, respectively. As well, the Stormy Lake, Adair, Melgund, Pyatt Lake, Upper English River and Side Lake Conservation Reserves are all located within the Ignace area (LIO, 2012).

2.3.2 Heritage Sites

The cultural heritage screening examined known archaeological and historic sites in the Ignace area, using the Ontario Archaeological Sites Database, the Ontario Heritage Trust Database and the National Historic sites Database. There are 45 known archaeological sites in the Ignace area (von Bitter, 2010). There are no National or Provincial Historic Sites in the Ignace area (Ontario Heritage Trust, 2012; Parks Canada, 2010).

Seven of the archaeological sites are located within the Township boundaries. Six of these sites are located on islands within Agimak Lake or on its shore and one site is located north of Agimak Lake close to the existing railway line. The latter is a historic Euro-Canadian storage structure probably related to the construction of the railway in the last half of the 19th century. Three of the sites on Agimak Lake are pre-contact Aboriginal sites including two Late Woodland period sites dating between 500 and 1,000 years ago and one other site is a 19th century Euro-Canadian logging camp with evidence for a historic Ojibwa component. Oral tradition indicates First Nations use on the lake during the 19th century. For the other two sites on Agimak Lake, aside from their



location, no information is contained in the database (e.g., time period or cultural affiliation is not provided). The potential for archaeological and historical sites around Agimak Lake is considered to be high given the sites already documented within and around the lake.

The other 38 archaeological sites are at the periphery of the Township of Ignace. Eighteen of these are pictographs, or rock paintings. These paintings can be found along the shores of Indian Lake, Owl Lake and Mameigwess Lake. Those paintings found along the shores of Mameigwess Lake are of particular consideration as it is likely that they were painted entirely from the water, since access to the paintings is probably only by boat (Dewdney and Kidd, 1967). Ten of the sites at the periphery of the Township are pre-contact Aboriginal campsites or habitation sites, with seven identified as either Middle or Late Woodland. Of the remaining ten known archaeological sites, one is a small Hudson's Bay Company post, one is a fishing station, two are isolated finds and the remaining six are undetermined.

Archaeological potential is established by determining the likelihood that archaeological resources may be present on a subject property. In archaeological potential modelling, a distance criterion of 300 m is generally employed for known archaeological resources; water sources; and early Euro-Canadian settlements (Government of Ontario, 2011). Local archaeologists have documented a number of sites in the Ignace area with archaeological potential (Smyk, 1990). The presence of local heritage sites would need to be further confirmed in discussion with the community and Aboriginal peoples in the area.

2.4 Land Use

Land use described in this section refers to commercial land use such as forestry, mining, trapping and agriculture, but not recreation or Aboriginal spiritual use.

Forestry is a major industry in the area and the largest single land-use. The region has more than 66% productive forest and a number of private timber companies are currently managing forestry operations. Forest Management Units (FMU) in the vicinity of Ignace are presented on Figure 5.

The Township of Ignace lies in the southwestern limit of the English River FMU (Dryden District), which extends towards the northeast of the Town and is currently managed by Resolute FP Canada Inc., although it was managed for many years by Abitibi Bowater. West of Ignace, the Wabigoon and Dryden forests, also part of the Dryden district, are managed by Weyerhaeuser Company Inc. and the Dryden Forest Management Company, respectively. Other FMUs nearby Ignace are the Crossroute, Sapawe and Black Spruce forests to the south, southeast and east.

Within heavily forested areas such as the Ignace area there is a risk of forest fires. Locations where forest fires occurred in the vicinity of the Ignace area between 1976 and 2010 affecting an area of greater than 200 ha are also shown on Figure 5.

In the Township of Ignace, there is no record of metallic mineral production in the past and no exploration potential for metallic ore has been identified within the Township boundaries. The area surrounding Ignace has seen, in the past, production of metallic resources and exploration potential for different minerals has been recognized. The area is part of the Kenora Mining District, where mining history is closely related to the exploration of gold, which was produced in the past at a number of mines. Gold potential has been identified in



the greenstone belt⁴ rocks west and north of Ignace. While there are currently no active producing mines in the Township, a number of claims for exploration activities exist. These activities have been limited to the greenstone belts and the margins of the various intrusive bodies in the Ignace area.

There are a number of small sand and gravels pits in the Ignace area, as well as the Butler Quarry (located approximately 8 km west of the Township of Ignace and north of the Trans-Canada Highway), which extracts ornamental stone. There have been four other past producing ornamental stone quarries in the area.

As noted in Section 3.3, other land uses include trapping, commercial fishing, and the harvesting of wild blueberries and wild rice.

⁴ A greenstone belt is a zone of volcanic and sedimentary rocks that have undergone metamorphic alteration. The name comes from the green hue imparted by the colour of the dominant minerals within the rocks.



3.0 DESCRIPTION OF THE ENVIRONMENT

3.1 Physiography

The Canadian Shield region generally has a low-relief, gently undulating land surface with an elevation of about 150 masl (metres above sea level) in the north and about 450 masl in the south. The Township of Ignace lies in the Severn Uplands, which comprises broadly rolling surfaces of Canadian Shield bedrock that occupies most of northwestern Ontario and which is either exposed at surface or shallowly covered with Quaternary⁵ glacial deposits. Terrains in the Severn Uplands contain numerous lakes and the terrain of the Ignace area is typical in that regard. The land surface within the Ignace area varies somewhat from the region in that there is considerable relief between the lakes in most areas and the ground surface elevation ranges from 368 masl where the Wabigoon River intersects the western boundary of the Ignace area to 554 masl in the southeast.

At the periphery of the Township of Ignace there are two major moraine ridges that represent dominant topographic features: the Hartman and Lac Seul moraines and associated glacial deposits (e.g., eskers, tills, kames and outwash). Figure 6 presents the topography of the Ignace area as a digital elevation model (DEM).

3.2 Geology

3.2.1 Bedrock Geology

The bedrock geology of the Ignace area is shown on Figure 7. Geologically, the municipal boundaries of the Township of Ignace are situated in the Wabigoon Subprovince, which is part of the western region of the Superior Province of the Canadian Shield – 3 to 2.6 billion year old rocks that form the core of the North American continent. The Township of Ignace is located on the southwestern edge of the Indian Lake batholith⁶, an irregularly shaped, granitic intrusion that covers approximately 1,366 km² and extends well beyond the boundaries of the Township of Ignace to the north and east. There are other batholiths in the Ignace area. The closest ones to the Township of Ignace are the White Otter Lake and Revell batholiths. These are Neoproterozoic⁷ intrusions that were emplaced into the older Raleigh Lake and Bending Lake greenstone belts. Other smaller-scale plutons of different compositions and ages also intrude the greenstone belt rocks at specific locations (e.g., the Paddy Lake and Islet plutons).

3.2.2 Quaternary Geology

The Quaternary geology of the Ignace area is shown on Figure 8. The Hartman and Lac Seul moraines and associated glacial deposits (e.g., eskers, tills, kames and outwash) are located at the periphery of the Township of Ignace. These glacial deposits accumulated to different thicknesses and are located to the general north and northeast of Highway 17.

3.3 Natural Environment

3.3.1 Natural Environment Overview

The natural environment of the Ignace area is, and always has been, an important resource to the local community. Since pre-colonial time, First Nations hunted moose (*Alces alces*), beaver (*Castor canadensis*) and small game in the territory which now includes the Township of Ignace. They have fished for northern pike (*Esox*

⁵ Quaternary refers to the last 2.6 million years of Earth's history.

⁶ Batholiths are made of multiple masses, or plutons, of igneous rock that have melted and intruded surrounding strata at great depths.

⁷ Neoproterozoic intrusions would have occurred between 2800 and 2500 million years ago.



Lucius), walleye (*Sander vitreus*), trout (*Salvelinus spp.*) and lake sturgeon (*Acipenser fulvescens*), and gathered an assortment of flora, in particular, northern wild-rice (*Zizania palustris*) and blueberries (*Vaccinium spp.*) (Daugherty, 1986). More recently, trapping, hunting, fishing and forestry has provided socio-economic benefit to local communities. Conifer dominated expanses not only provide valuable timber, but habitat for a variety of animals harvested for their fur, hides and food. The underlying geology supports forest growth as well as lakes, rivers and wetlands which provide life to several fish and wildlife species. The natural environment of the Ignace area contains an abundance of plant and animal communities, some of which have special status or designations. The following sections describe the protected natural areas, the terrestrial ecology and aquatic ecology and focus on rare species that may be most sensitive to impacts from alterations or changes to the landscape.

3.3.2 Natural Areas

There are no federal, provincial or municipal parks, conservation areas, nature reserves or national wildlife areas wholly contained within the Township of Ignace (yellow-bound box on Figure 9). The Turtle River-White Otter Lake Provincial Park is located just outside of the Township of Ignace and the southern corner of the Sandbar Lake Provincial Park intersects the northeast corner of the Township of Ignace. Bonheur River Kame Provincial Nature Reserve Park, East English River Provincial Park and eight conservation reserves are within the Ignace area (LIO, 2012). No Areas of Natural and Scientific Interest (ANSI) or Provincially Significant Wetlands (PSW) evaluated by the Ministry of Natural Resources (MNR) have been identified, although Turtle River Provincial Park is a Candidate Life Science ANSI. Earth or Life Science Sites, nature reserves and wilderness areas located within the Ignace area include the following, shown and numbered on Figure 9: Adair Lake Peatland/Sand Plain Complex (1), Bonheur River Kame Provincial Natural Reserve (2), Campus Creek Peatland (3), Dibble Lake Esker/Kame Complex (4), Gulliver River Peatland (5), Little Sandbar Lake Red Pine Stand (6), Sandbar Lake Provincial Park (7), Sandbar Lake Provincial Park Addition (8), Turtle River Moraine (9), Turtle River Provincial Park (10), Wabigoon River Clay Plain (11), White Otter Lake (12), White Otter Lake Jack Pine Forest (13), White Otter Lake Spruce Sedge Sphagnum (14), White Otter Lake White Birch (15) and White Otter Lake Red Pine Stand (16).

Wetlands identified in the natural resources data layers (LIO, 2012) have been depicted on Figure 10. The Ignace area contains a total of 43,473 ha of wetlands, which is 7% of the land coverage according to the LIO data. Ground investigations are likely to identify additional wetland areas that have not been identified in the LIO data. If wetlands are to be impacted by a proposed activity, they may require evaluation of significance according to the Ontario Wetland Evaluation System (OWES).

3.3.3 Terrestrial Features and Wildlife

Ignace lies in a transition zone between the boreal and the Great Lakes-St. Lawrence forest (Watkins, 2011). FMU 230, the English River Forest, extends over the Township of Ignace. The Wabigoon Forest (FMU 130) is adjacent to it to the west (MNR, 2009; LIO, 2012) (Figure 5). Two major surface soil types exist, clay and sand, and these support conifer and mixed forest types frequently with spruces (*Picea spp.*), pines (*Pinus spp.*), eastern white cedar (*Thuja occidentalis*), tamarack (*Larix laricina*), poplars (*Populus spp.*), birch (*Betula spp.*) and black ash (*Fraxinus nigra*) (Lawson, 2004). The region's forest ecosites and succession types provide habitat for various wildlife including game, furbearing mammals and fish. Where forests have been cleared for timber harvesting, an alternative land use is the establishment of blueberries. Blueberries are considered a marketable resource that can also draw tourism (Forbes et al., 2010). The portion of the Township of Ignace



north of the Trans-Canada Highway is located within an area designated by the MNR as Wildlife Management Unit 15A (WMU 15A) while lands to the south of the Highway are within WMU 12A. These areas are considered important for the trapping of furs and hunting of game. Emphasis on retaining old growth stands, particularly those of white pine (*Pinus strobus*) and red pine, (*Pinus resinosa*) and maintaining natural disturbance patterns are main objectives in managing the overall ecology (Walker and Macadam, 2010). No known migration routes or animal movement corridors have been identified based on existing publicly available information. Migration routes or animal movement corridors are typically described based on field investigations. Known areas may be requested from agencies, which would complement the results of field investigations. Management of moose populations are a particular concern to the MNR. Known feeding, wintering and calving sites are depicted on Figure 9. Concentration and nesting areas for raptors, herons and waterfowl are also considered an important management concern; known locations are also depicted on Figure 9.

3.3.4 Aquatic Features and Fish

The general terrain of the Ignace area is located within the Nelson River basin and the English River sub-basin and cradles wetlands, lakes and rivers that support a diversity of fish and wildlife. Wetlands, including fens and bogs, are often ecologically sensitive. Waterbodies are mainly cool water classified including major lakes, interspersed with smaller warm waterbodies (Figure 10). A total of 19% of the Township of Ignace and 18% of the Ignace area are mapped as water bodies (LIO, 2012). Three coolwater lakes are located around the periphery of the Township of Ignace: Agimak, Michel and Osaquan Lakes. A major cold water fishery, Indian Lake is situated to the north of the Township of Ignace (MNR, 2009), and within the Ignace area. The Ignace area is between Fisheries Management Zones 4 and 5 and fisheries in and around the township support recreational and commercial tourism use (Fish and Wildlife Service Branch, 2010). Major species include: walleye (*Sander vitreus*), northern pike (*Esox lucius*), brook trout (*Salvelinus fontinalis*), lake trout (*Salvelinus namaycush*), smallmouth bass (*Micropterus dolomieu*), perch (*Perca flavescens*) and whitefish (*Coregonus/Prosopium spp.*) (MNR, 2009; Township of Ignace, 2007). These populations, especially the lake trout and walleye, are managed to maximize their size and availability to both locals and tourists. Additional income is provided in areas with bait fishing operations and commercial fishing and the shallows of several lakes support natural wild rice crops (MNR, 2007). Fish and fish habitat are managed by the MNR and the Department of Fisheries and Oceans (DFO). There are 36 commercial fisheries licences in Fisheries Management Zone 4 (FMZ 4) (16 active, 20 inactive). Of these, 25 licences are held by Aboriginal individuals or communities and 11 by non-Aboriginal licence holders (MNR, 2010). Within the Dryden District of Fisheries Management Zone 5, there are seven licences held by Aboriginal individuals or communities and four non-Aboriginal licence holders (MNR, 2012).

General information is available publicly for each FMZ, but more detailed information must be obtained directly from these agencies for further investigations. Publicly available data for each FMZ may not be consistent for each area. Although there is consistency in the types of data collected by MNR for each area, data deemed sensitive within the FMZ may not be reported or shown on mapping. Classification of data sensitivity may vary based on the FMZ. Therefore, features such as spawning areas which appear to be disproportionately abundant across the landscape may reflect reporting constraints, rather than actual presence or absence of these features. Field verification will be required to determine the actual fish habitat and use by species across the landscape.



3.3.5 Endangered, Threatened and Special Concern Species

The Natural Heritage Information Centre (NHIC, 2012) records show an occurrence of a species that is listed as Endangered (END), Threatened (THR) or Special Concern (SC) either under the Ontario *Endangered Species Act* (ESA) (Government of Ontario, 2007) or the Federal *Species at Risk Act* (SARA) (Government of Canada, 2012) within the Ignace area: grey fox (*Urocyon cinereoargenteus*) (Table 2). The Royal Ontario Museum range maps (ROM, 2012) provide general areas where species at risk may occur, including that of listed species. The Ontario Herpetofaunal Summary Data, Atlas of the Breeding Birds of Ontario (Cadman et al., 2007), the Ontario Odonata Atlas (2005) and the Ontario Butterfly Atlas (Holmes et. al, 1991) were also queried for listed species. END, THR or SC species identified from these sources to have a range that overlaps the Ignace area are listed in Table 2.

In particular, wolverine (*Gulo gulo*) is provincially threatened and special concern nationally, and woodland caribou (*Rangifer tarandus*) is currently listed as threatened provincially and federally. Both of these species have a current range that reaches the northern portion of the Ignace area according to ROM range maps. A large component of forestry management is focused on the creation and maintenance of woodland caribou habitat. The ranges of the provincially endangered eastern cougar (*Puma concolor*) and golden eagle (*Aquila chrysaetos*) also extend to the region (ROM, 2012; Walker and Macadam, 2010; Government of Ontario, 2007; Government of Canada, 2012; Cadman et al., 2007), as does the provincially threatened northwestern Ontario population of lake sturgeon.

The records identified here represent known occurrences that have been reported in the past. However, more recent occurrences of species at risk will be on record with the MNR, upon request. In addition to species that are listed on the ESA and SARA, species of conservation concern including those that are considered regionally rare or uncommon or in significant decline would also be considered in the evaluation of wildlife of the area. Many of these species are not tracked in public databases, and therefore a complete list would be obtained as part of the data requests to agencies which would complement the results of field investigations conducted at the site.

With reference to Table 2, there were no species of plants, mosses or lichens were identified as END, THR or SC within the Ignace area.

Table 2: Potential Endangered, Threatened and Special Concern Species in the Ignace Area

Common Name	Scientific Name	ESA Status ^a	SARA Status (Schedule) ^b	Source ^c
Mammals				
Eastern cougar	<i>Puma concolor</i>	END		ROM
Grey fox	<i>Urocyon cinereoargenteus</i>	THR	THR (1)	NHIC
Wolverine	<i>Gulo gulo</i>	THR	Not at risk	ROM
Woodland caribou (Forest-dwelling boreal population)	<i>Rangifer tarandus caribou</i>	THR	THR (1)	ROM
Birds				
Common nighthawk	<i>Chordeiles minor</i>	SC	THR (1)	OBBA, ROM
Eastern whip-poor-will	<i>Antrostomus vociferus</i>	THR	THR (1)	ROM



Common Name	Scientific Name	ESA Status ^a	SARA Status (Schedule) ^b	Source ^c
Golden eagle	<i>Aquila chrysaetos</i>	END		ROM
Olive-sided flycatcher	<i>Contopus cooperi</i>	SC	THR (1)	ROM
Rusty blackbird	<i>Euphagus carolinus</i>	not at risk	SC (1)	ROM
Short-eared owl	<i>Asio flammeus</i>	SC	SC (3)	ROM
Reptiles and Amphibians				
Common snapping turtle	<i>Chelydra serpentina</i>	SC	SC (1)	Herp Atlas, ROM
Fish and other Aquatic Species				
Lake sturgeon (Northwestern Ontario Population)	<i>Acipenser fulvescens</i>	THR		ROM
Invertebrates				
Monarch butterfly	<i>Danaus plexippus</i>	SC	SC (1)	ROM, Butterfly Atlas

Notes:

blank: species not assessed; Not at risk: species assessed to be not at risk; SC: special concern species; THR: threatened species; END: endangered species; EXP: extirpated species

^a Status on the Species at Risk of Ontario list of the *Endangered Species Act* (ESA), (Government of Ontario, 2007)

^b Status listed on the federal *Species at Risk Act* (SARA) (Government of Canada, 2012)

^c Data obtained from the Natural Heritage Information Centre (NHIC) (NHIC, 2012), Royal Ontario Museum (ROM) range maps (ROM, 2012), Ontario Herpetofaunal Summary Database (Herp Atlas) (Oldham and Weller, 2000) or Atlas of the Breeding Birds of Ontario (OBBA) (Cadman et al., 2007) or the Ontario Butterfly Atlas (Holmes et. al, 1991)

3.3.6 Aboriginal Interests and Traditional Knowledge

Traditional lifestyles, culturally significant wildlife and the extent of sacred and ceremonial locations important to Aboriginal communities are important factors to be considered when identifying potential repository locations for further detailed study.

For this phase of the work, the extent to which such information has been sought is that which can be found in publicly available sources. Known archaeological sites, many of which are Aboriginal, are noted in Section 2.3.2. Trapline License Areas, which include portions of Ignace around Lake Agimak and other areas to the south of Highway 17, are shown on Figure 3. Figure 9 presents terrestrial ecology mapping for the area and Figure 10 presents aquatic resource mapping.

It is recognized that this does not fully represent the environmental interests and concerns of Aboriginal communities in the area and that further information and discussion is required before a more complete picture can be developed. Discussions with Aboriginal groups, community members and field investigations would be undertaken in later phases of the work program to further enhance the environmental understanding of specific locations.



3.4 Background Environmental Conditions

3.4.1 Air Quality

Air quality monitors in northwestern Ontario indicate that ground-level ozone and particulate matter fall within normal values compared to the national average (EC, 2011a). Table 3 provides a list of industrial facilities that reported air and water emissions through Environment Canada’s National Pollutant Release Inventory (NPRI) database (EC, 2012). The list includes sites in Atikokan, Dryden, Fort Frances and Terrace Bay, Ontario which have local air emissions. Additional sources that may affect background air quality include rail operations and the Trans-Canada Highway both of which traverse the area and use of diesel generators in the remote First Nations communities in northwestern Ontario.

Table 3: NPRI Regional Sources of Air Emissions

NPRI ID	Facility Name	City
10374	Hydro One Remote Communities Inc. - Armstrong Diesel Generating Station	Armstrong
3238	Ontario Power Generation Inc. - Atikokan Generating Station	Atikokan
10376	Hydro One Remote Communities Inc. - Bearskin Diesel Generating Station	Bearskin Lake
928	Domtar Inc. - Dryden Mill	Dryden
10381	Hydro One Remote Communities Inc. - Gull Bay Diesel Generating Station	Gull Bay
917	Resolute FP Canada Inc. - Fort Frances Division	Fort Frances
3197	Williams Operating Corporation - Williams Mine	Hemlo
10382	Hydro One Remote Communities Inc. - Hillsport Diesel Generating Station	Hillsport
10385	Hydro One Remote Communities Inc. - Lansdowne Diesel Generating Station	Lansdowne House
1400	Newmont Canada Corporation - Golden Giant Mine	Marathon
3197	Williams Operating Corporation - Williams Mine	Marathon
10405	Atlantic Power LP - Nipigon Power Plant	Nipigon
11906	Hydro One Remote Communities Inc. - Marten Falls Diesel Generating Station	Ogoki Post
2607	AV Terrace Bay Inc. - AV Terrace Bay	Terrace Bay
6771	TransCanada PipeLines Ltd. - Station 62 - Upsala	Thunder Bay
10392	Hydro One Remote Communities Inc. - Webequie Diesel Generating Station	Webequie

3.4.2 Background Radiation

The source of background radiation in the Ignace area is attributed to naturally occurring radioactive materials (NORM), specifically potassium, uranium and thorium-bearing minerals. The background radiation levels for the Ignace area are presented on Figure 11. The dose rate in the Ignace area ranges from approximately 10 to 80 nGy/h, with an average of approximately 25 nGy/h. This range of dose rates and average are consistent with regional dose rates for northwestern Ontario. NORM minerals are typically elevated in granitic geology and local dose rate highs are attributed to granitic batholiths, notably the White Otter Lake batholith. These highs are consistent with dose rate highs in other areas of northwestern Ontario.

A recent review of background concentrations of radionuclides in surface waters and soils across Canada has been supplemented by measurements of surface waters sampled at various Canadian sites (NWMO, 2011). There were several sites in Ontario, one of which was on the Canadian Shield at English River, near Ignace (the crossing at Highway 17). Results included measured concentrations of cosmogenic radionuclides such as



Iodine-129, primordial radionuclides such as uranium and man-made radionuclides. Additional detailed information is available in the geophysical interpretation report (PGW, 2013).

3.4.3 Soil Quality

There is no specific information on background soil quality in the Ignace area available, although soil concentrations would be expected to be consistent with Ontario Typical Background ranges, as noted in Table 1 of Ontario MOE Regulation 153/04 (Government of Ontario, 2004).

3.4.4 Water Quality

The Township of Ignace draws its potable water supply from Michel Lake. The 2011 annual report on water quality from the Ignace Drinking Water System operated by Northern Waterworks Inc. compared monitored water quality to the requirements of the Ontario *Safe Drinking Water Act* (O. Reg. 170/03) (Government of Ontario, 2002) and regulations therein (i.e., Ontario Drinking Water Standards, Objectives and Guidelines [ODWS] (Government of Ontario, 2006)). The report indicated that in 2011 there were no exceedances for any measured organic parameter (e.g., pesticides, herbicides, PCBs, volatile organics) or inorganic parameter (i.e., antimony, arsenic, cadmium, mercury, uranium, nitrate or nitrites) (Northern Waterworks Inc., 2012). An exceedance of lead was observed from a plumbing sample; however, this represented less than 10% of the total samples from plumbing and subsequent monitoring has met requirements. Notification of, and corrective actions for, adverse water quality incidents (e.g., exceedance of a Maximum Acceptable Concentration or where observations indicate safety of water cannot be guaranteed) are required under O. Reg. 170/03. No such incidents were recorded in 2011.

As noted, a recent review of background concentrations of radionuclides in surface waters and soils across Canada has been supplemented by measurements of surface waters sampled at various Canadian sites (NWMO, 2011) including one at English River, near Ignace. Results included elemental composition.

Surface water hydrology, groundwater and wells are further discussed in Sections 3.5 and 3.6, respectively.

3.4.5 Lake Sediment Chemistry

Lake sediments in the Ignace area have been studied fairly extensively by Jackson (2003) as part of Operation Treasure Hunt (OTH). The OTH program was a 3-year initiative by the Ontario Geologic Survey (OGS) to investigate mineral potential in Ontario. Lake sediment samples were collected at over 2,000 sites in the Ignace area. Preliminary interpretation of the geochemical patterns outlined 40 areas with some concentrations of elements elevated above the typical crustal abundance. These elements include: Au, Pt, Pd, Ni, Cu, Cr, Zn, Pb, Ag, Cd, Co, Mo, As, V, Sc, Li, Be, Cs, Nb, Ta and rare earth elements (REEs). Digital geochemical data for this survey is available as Miscellaneous Release—Data (MRD) 118 (Jackson, 2003). The anomalous geochemical patterns observed in the lake sediment chemistry, relative to typical abundances, are a result of natural mineralization.

3.4.6 Potential Sources of Pollutants

There are a number of potential sources of pollutants in the Ignace area including landfills, transportation corridors, domestic septic systems and local industries.



There are three operating landfill sites within the Ignace area (Figure 1), the Ignace Landfill, Victoria Lake Landfill and the Bowater Canadian Forest Products Landfill (Table 4). All sites are classified as small landfills. As well there are a number of other small, now closed, landfills within the area (MOE, 2010).

Table 4: Registered Landfills in the Ignace Area

Certificate of Approval (C of A) Number	Site Name	Location	Status
A600007	Victoria Lake Landfill	SW side of Victoria Lake North side of GLP Rd	Open
	Client: Ministry of Natural Resources	Twp of Ignace	
A600009	Client: Ministry of Natural Resources	Valora Station, 4 mile south of CNR Tracks	Closed
		Twp of Ignace	
A600303	Client: Abitibi-Consolidated Company - Rec Center	Lot 2 Part Lot 4, PL cubic metre 66	Closed
		Twp of Ignace	
A600501	Ignace Landfill	E of Hwy 599	Open
	Client: The Corporation of the Township of Ignace	Twp of Ignace	
A600503	Client: Bowater Canadian Forest Products Inc.	South of Shellfish Lake	Open
		Twp of Ignace	
A600508	Client: The Corporation of the Township of Ignace	South side of Hwy 599 as described in the site location maps and the Land-Use Permit	Closed
		Twp of Ignace	

Source: Ontario Landfills List (MOE, 2010)

Transportation corridors, such as Highway 17, secondary roads, logging roads and rail lines, traverse the Ignace area, and are considered to be potential sources of pollution, as a result of salt application for de-icing and mobile air emissions from internal combustion. There is also a potential for chemical releases along transportation routes as a result of spills or accidents. Additionally, the Township of Ignace contains an airport and a float plane dock which are also a potential source of pollution, due to air emissions and potential chemical spills. Local septic systems are a potential source of pollutants, mainly as a result of septic waste and possibly as a result of chemical disposal into the septic system. Industrial operations in the area may be a source of pollutants, due to the potential release of chemicals as a result of spills or improper chemical handling practices. No specific releases of the above-named pollutants into the environment were identified in this review.

3.5 Surface Water Hydrology

The Ignace area is contained within the Nelson River Drainage Area, which drains into Hudson Bay through the Nelson River. In the Ignace area there are three tertiary watersheds, the Upper English sub-basin, the Wabigoon sub-basin and the Central Rainy sub-basin. The Ignace area is abundant in lakes, which are interconnected by an intricate network of small and medium sized rivers, and by large rivers such as the Wabigoon River, Bending River and Gulliver River. Watershed boundaries and surface water drainage for the Ignace area is shown on Figure 12. The Township of Ignace and the northeastern part of the Ignace area is located within the Upper English sub-basin which generally drains to the northeast. The Wabigoon sub-basin is located in the western part of the Ignace area and is drained by the Wabigoon River to the northwest. The



Central Rainy sub-basin, located south and southwest of the Ignace area, is drained largely by the Turtle River which eventually flows into the Rainy River. Given the modestly rugged terrain, modest precipitation and relatively small size of catchment areas, no large areas of floodplain are expected to be present.

3.6 Groundwater and Wells

Information concerning groundwater in the Ignace area was obtained from the Ontario Ministry of the Environment (MOE) Water Well Record (WWR) database (MOE, 2012). The locations of known water wells are shown on Figure 12. Until recently, the Township of Ignace obtained its municipal water supply from two overburden water wells which supplied the normal demands of the municipality and a third well which provided fire flows. The municipality has recently constructed an upgraded water supply system, sourcing water from a new surface water intake structure. A number of scattered wells serving individual private residences exist mostly along the shores of Agimak Lake.

Water wells in the Ignace area obtain water from the overburden or the shallow bedrock. The MOE water well database contains 120 discrete water well records in the Ignace area (Figure 12), 85 of which provided useful information regarding aquifer, yield and other parameters noted in Table 5.

Table 5: Water Well Record Summary for the Ignace Area

Water Well Type	Number of Wells	Total Well Depth (m)	Median Well Depth (m)	Static Water Level (m below surface)	Tested Well Yield (L/min)	Depth to Top of Bedrock (m)
Overburden ¹	48	4.5 to 42	16.9	0 to 12	4.5 to 930	N/A
Bedrock	37	5.5 to 154	46.3	0 to 22.5	0 to 206	0 to 80.5

Note:

¹ Inferred for some records which were lacking stratigraphic descriptions.

3.6.1 Overburden Aquifers

There are 48 water well records in the Township of Ignace that can be confidently assigned to the overburden aquifer. These wells generally are 4 to 42 m deep and have pumping rates of 9.5 L/min to 930 L/min. These well yields reflect the purpose of the wells (i.e., mainly private residential supply) and do not necessarily reflect the maximum sustained yield that might be available from the aquifer.

The limited number of well records and their concentration along the main roadways and Agimak Lake limits the available information regarding the extent and characteristics of the overburden aquifers in the Ignace area.

3.6.2 Bedrock Aquifers

No information was found on deep bedrock groundwater conditions in the Ignace area at a typical repository depth of approximately 500 m. In the Township of Ignace there are 37 well records that can be confidently assigned to the shallow bedrock aquifer. These wells range from 6 to 154 m in depth, with most wells between 20 and 40 m deep. The anomalously deep well extending to 154 m has coordinates which place it along the shore of Sandbar Lake to the north of Ignace. The well record contains little stratigraphic information but its accuracy cannot be discounted given its location in an area known to contain thick overburden of the Lac Seul moraine. Measured pumping rates in the bedrock wells are variable and range from 0 L/min to 206 L/min, with



yields typically between 30 and 40 L/min. These well yields reflect the purpose of the wells (i.e., mainly private residential supply) and do not necessarily reflect the maximum sustained yield that might be available from the shallow bedrock aquifers. Long-term groundwater yield in fractured bedrock will depend on the number and size of fractures, their connectivity, transmissivity, storage and on the recharge properties of the fracture network in the wider aquifer.

No potable water supply wells are known to exploit aquifers at typical repository depths in the Ignace area or anywhere else in northern Ontario. Experience from other areas in the Canadian Shield has shown that active groundwater flow is generally confined to shallow fractured localized systems. In these shallow regions, flow tends to be dependent on the secondary permeability created by fractures. In deeper regions, hydraulic conductivity tends to decrease as fractures become less common and less interconnected. Increased vertical and horizontal stresses at depth tend to close or prevent fractures thereby reducing permeability and resulting in diffusion-dominated groundwater movement.

3.7 Climate and Meteorology

The Ignace area has a primarily continental climate, with cold winters and mild summers. Most precipitation falls in the form of summer showers and thunderstorms; winter snowfall amounts can be impressive, but usually contain less water. Precipitation amounts increase as one moves from northwest to southeast across Ontario; a reflection of the increasing influence of moisture transported from the Great Lakes and the Gulf of Mexico. In winter, the region can experience prolonged periods of extreme cold. Major winter storms affect most parts of northern Ontario, including the Ignace area, at least once or twice per year.

Climatological information presented in this section is based on meteorological data from Environment Canada's meteorological station located in Atikokan, Ontario approximately 70 km to the south, which has more than 30 years of continuous data and is at a similar elevation. Parameters that are measured at the Atikokan Airport station include: temperature, precipitation, wind, atmospheric pressure and relative humidity.

3.7.1 Temperature

Temperature data was obtained from Environment Canada's 1971-2000 climate normals for the Atikokan meteorological station (EC, 2011b). Figure 13 presents monthly temperatures for Atikokan, displaying daily average, maximum and minimum and extreme values over the calendar year.

3.7.2 Precipitation

Figure 14 presents monthly precipitation data obtained from Environment Canada's 1971-2000 climate normals for the Atikokan meteorological station, including total rainfall, rainfall, snowfall and all-time extreme values over the calendar year (EC, 2011b).

3.7.3 Wind

Table 6 presents the monthly wind data obtained from Environment Canada's 1971-2000 climate normals for the Atikokan meteorological station (EC, 2011b). Wind speed and direction are an average for each month over the calendar year. Annual and seasonal wind roses for Atikokan using data from 2006 to 2010 are presented on Figure 15, and show an overall trend of a west to northwest wind direction.



Table 6: Monthly Wind Normals for Atikokan, Ontario

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Speed (km/h)	14.5	13.1	13.2	13.9	13.1	14.2	13.6	13.4	14.8	17	16.1	14.1	14.2
Most Prevalent Direction	W	W	W	NW	NW	NW	W	S	W	S	W	W	W

3.8 Natural Hazards

3.8.1 Earthquakes and Seismicity

The Ignace area lies within the Canadian Shield, where large parts have remained tectonically stable for the last 2.5 billion years (Percival and Easton, 2007). The Ignace area has a low seismic hazard rating (NRCan, 2010). Since 1627, no earthquakes exceeding a magnitude m_N 6 have been known to occur within 1,000 km of the Ignace area. According to the National Earthquake Database (NEDB) for the period between 1985 and 2011 (NRCan, 2012) all recorded seismic events in the Ignace area had magnitudes m_N ranging from less than 1 to 3.2.

Ma et al. (2008) have recently pointed out the existence of small swarms of microseismic activity in the physiographic Severn Highlands of northwestern Ontario, which roughly extends west and north-northwest of Lake Nipigon. The closest such occurrence was the Dryden swarm, which occurred in 2002-2003 just north of the Town of Dryden and northwest of the Ignace area, with a total of 22 events recorded, the largest having a magnitude m_N of 3.2. These events may be related to post-glacial rebound and appear to correlate to a particularly thick and cold lithospheric root beneath the Severn Highlands.

In summary, available literature and recorded seismic events indicate that the Ignace area is located within a region of low seismicity.

3.8.2 Tornadoes and Hurricanes

As noted in Table 6, average monthly wind speeds in the Ignace area are low, ranging from 13 to 17 km/hr. The Ignace area experiences thunderstorms in the summer months and is located in an area with a low tornado frequency (<0.2 tornadoes per year / 10,000 km²), but where there is a potential for F2-F5 tornadoes (Sills et al., 2012). The Ignace area is situated is too far away from the Atlantic Ocean to be susceptible to hurricanes. The National Building Code of Canada recommends a design 1/50 maximum hourly wind pressure for the Dryden area of 0.23 kPa and for the Thunder Bay area of 0.39 kPa, which are low to typical values for Ontario (NRC, 2010).

3.8.3 Drought and Flooding

According to precipitation climate normals for the region (Figure 14), the Ignace area experiences on average between 25 and 100 mm of precipitation each month, and is therefore unlikely to experience drought conditions that would affect the viability of local water sources. The single day extreme rainfall and snowfall events on record at the Atikokan station (Figure 14) are 46 mm of rain and 96 cm of snow, respectively. In years where there is a high snowpack accumulation, the spring freshet can result in a nominal increase in water levels in local streams and rivers. As noted on Figure 12, the Ignace area lies at the headwaters of three watersheds, making the size of the upstream catchments areas relatively small. The small catchment size in combination with



modestly rugged terrain makes the overall risk of significant flooding in the Ignace area quite low. The potential risk of drought or flooding affecting the facility will also depend to some degree on the specific location selected.

3.8.4 Snow and Ice

As noted on Figure 14, the Ignace area receives on average about 240 cm of snowfall per year, primarily between the months of November and March. No single month receives an average snowfall greater than 50 cm. There are usually one or two high snowfall events per year, with accumulations of 30 cm or greater, noting that the highest single day snowfall accumulation on record is 96 cm, recorded on November 23, 1983. The National Building Code of Canada recommends a design 1/50 snow load ($S_s + S_i$) for the Dryden area of 2.7 kPa and for the Thunder Bay area of 3.3 kPa, which are typical values for northern Ontario (NRC, 2010). Local lakes and water bodies freeze over in the winter months in the Ignace area, as average daily temperatures from November to March typically range from -15 to -5°C.

3.8.5 Forest Fires and Lightning

Within heavily forested areas such as the Ignace area there is a risk of forest fires. Locations where forest fires have occurred in the vicinity of the Ignace area between 1976 and 2010 affecting an area of greater than 200 ha are shown on Figure 5. These forest fires combine to comprise approximately 3% of the total Ignace area. Forest fires can be initiated by lightning strikes or human activity, particularly if dry conditions are present in the forest understory. As previously noted, thunderstorms do occur in the Ignace area and lightning strikes are not uncommon in the summer months.

3.8.6 Landslides and Tsunamis

Moderately steep slopes in the Ignace area, where present, are generally comprised of crystalline rock with only a thin veneer of soil cover. The physical nature of these slopes, combined with typically modest precipitation and very low seismicity, results in a low landslide risk for the Ignace area. There is no risk of tsunamis in the Ignace area, owing to the very low seismicity and a lack of large water bodies.



4.0 SUMMARY

This report provides a high level description of the environment in the Township of Ignace and surrounding area.

Situated in the District of Kenora between Dryden and Thunder Bay, the Township of Ignace is approximately 100 km² in size (LIO, 2012), with a population of 1,202 (Statistics Canada, 2012). The Ignace area has a primarily continental climate, with cold winters and mild summers with most precipitation falling in the form of summer showers and thunderstorms. Although winter snowfall amounts are moderate, they do not make up the majority of annual precipitation.

There are a number of Aboriginal communities and organizations in the Ignace area including Lac Seul First Nation, Seine River First Nation and Wabigoon Lake First Nation. Métis Councils in the area include Atikokan and Area Métis Council, Kenora Métis Council, Northwest Métis Council and Sunset Country Métis Council as represented by the Lake of Woods/Lac Seul, Rainy Lake/Rainy River and Treaty 3 Traditional Territory Consultation Committee and Greenstone Métis Council, Superior North Shore Métis Council and Thunder Bay Métis Council as represented by Lakehead/Michipicoten/Nipigon Traditional Territory Consultation Committee and the Métis Nation of Ontario.

The Township of Ignace lies in the Severn Uplands, featuring the broadly rolling surfaces of Canadian Shield bedrock that occupies most of northwestern Ontario; either exposed at surface or shallowly covered with Quaternary glacial deposits. At the periphery of the Township of Ignace, the Hartman and Lac Seul moraines represent dominant topographic features. Geologically, the Township of Ignace is situated in the Wabigoon Subprovince, which is part of the western region of the Superior Province of the Canadian Shield. The Township of Ignace is located on the southwestern edge of the Indian Lake batholith, an irregularly shaped, granitic intrusion that covers approximately 1,366 km² and extends well beyond the boundaries of the township. There are also other batholiths in the Ignace area.

There is no record of past metallic mineral production or current exploration in the Township of Ignace. However the area surrounding Ignace, part of the Kenora Mining District, has seen past production of metallic resources and current exploration potential for minerals, including gold.

Infrastructure within the area includes the Trans-Canada Highway (Highway 17) heading east-west through the community of Ignace, Highway 599 heading northeast from Ignace and Highway 622 heading southwest from Highway 17 through the southwestern part of the Ignace area. As well, a rail corridor runs approximately parallel to Highway 17 through the Ignace area, as does a natural gas pipeline. There are 230 kV and 115 kV transmission line corridors running through the area, paralleling Highways 17 and 599. The area is serviced by one municipal airport. Four provincial parks: Sandbar Lake, Turtle River-White Otter Lake, East English River and Bonheur River Kame Provincial Parks and eight conservation reserves are located in the Ignace area.

Ignace lies in a transition zone between the boreal and the Great Lakes-St. Lawrence forest (Watkins, 2011). The two major surface soil types, clay and sand, support conifer and mixed forest types frequently with spruces, pines, cedar, tamarack, poplars, birch and ashes (Lawson, 2004). Forestry is a major industry in the area and the largest single land-use with more than 75% productive forest. The Township of Ignace lies in the southwestern limit of the English River Forest Management Unit (Dryden District), managed by Abitibi Bowater.

The region's forests provide habitat for wildlife including game, furbearing mammals and fish. Management of moose populations and concentration and nesting areas for raptors, herons and waterfowl are a particular



concern to the MNR. The Natural Heritage Information Centre (NHIC, 2012) identified one species observed within the Ignace area that is listed as endangered, threatened or special concern, either under the Ontario *Endangered Species Act* (Government of Ontario, 2007) or the Federal *Species at Risk Act* (Government of Canada, 2012): grey fox. Using habitat range mapping, an additional 15 endangered, threatened or special concern species were identified to have a range that overlaps the Ignace area (ROM, 2012; Oldham and Weller, 2000; Cadman et. al, 2007; Holmes et. al, 1991). In particular, wolverine (provincially threatened and special concern nationally) and woodland caribou (threatened provincially and federally) each have a current range that reaches the northern portion of the Ignace area. The ranges for provincially endangered eastern cougar and golden eagle also extend to the region, as does provincially threatened lake sturgeon (northwestern Ontario population).

The Ignace area is abundant in lakes, which are interconnected by a network of rivers, such as the Wabigoon River, Bending River and Gulliver River. Surface water generally flows to the northeast in the Upper English sub-basin and to the northwest in the Wabigoon sub-basin and the southwest in the Central Rainy sub-basin. There are three coolwater lakes located around the periphery of the Township of Ignace: Agimak, Michel and Osaquan and a major cold water fishery exists in Indian Lake, north of the Township of Ignace (MNR, 2009). The Ignace area supports recreational and commercial fishing, with species including walleye, northern pike, brook trout, lake trout, smallmouth bass, perch and whitefish (MNR, 2009; Township of Ignace, 2007).

Water wells in the Ignace area obtain water from the overburden or the shallow bedrock. The Ministry of Environment water well database contains 120 discrete water well records), 85 of which provided useful information regarding aquifer, yield and other parameters, in the Ignace area. No potable water supply wells are known to exploit aquifers at typical repository depths in the Ignace area or anywhere else in northern Ontario.

Air, soil and surface water quality within the Ignace area are expected to be within the normal range for northwestern Ontario. Sources of background radioactivity in the Ignace area are attributed to naturally occurring radioactive materials, specifically potassium, uranium and thorium-bearing minerals. The range of dose rates and average are consistent with regional dose rates for northwestern Ontario.

The Ontario Archaeological Sites Database identified 45 known archaeological sites in the Ignace area, with seven of these found within the Township of Ignace. Sites identified at the periphery of the Township of Ignace include pictographs or rock paintings, pre-contact Aboriginal sites and Euro-Canadian sites. The potential for archaeological and historical sites around Agimak Lake is considered to be high given the sites already documented within and around the lake; the presence of local heritage sites would need to be confirmed in discussion with the community and Aboriginal peoples in the area.



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Report Signature Page

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BT/DM/GWS/JLH/wlm

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ENVIRONMENT REPORT - TOWNSHIP OF IGNACE, ONTARIO

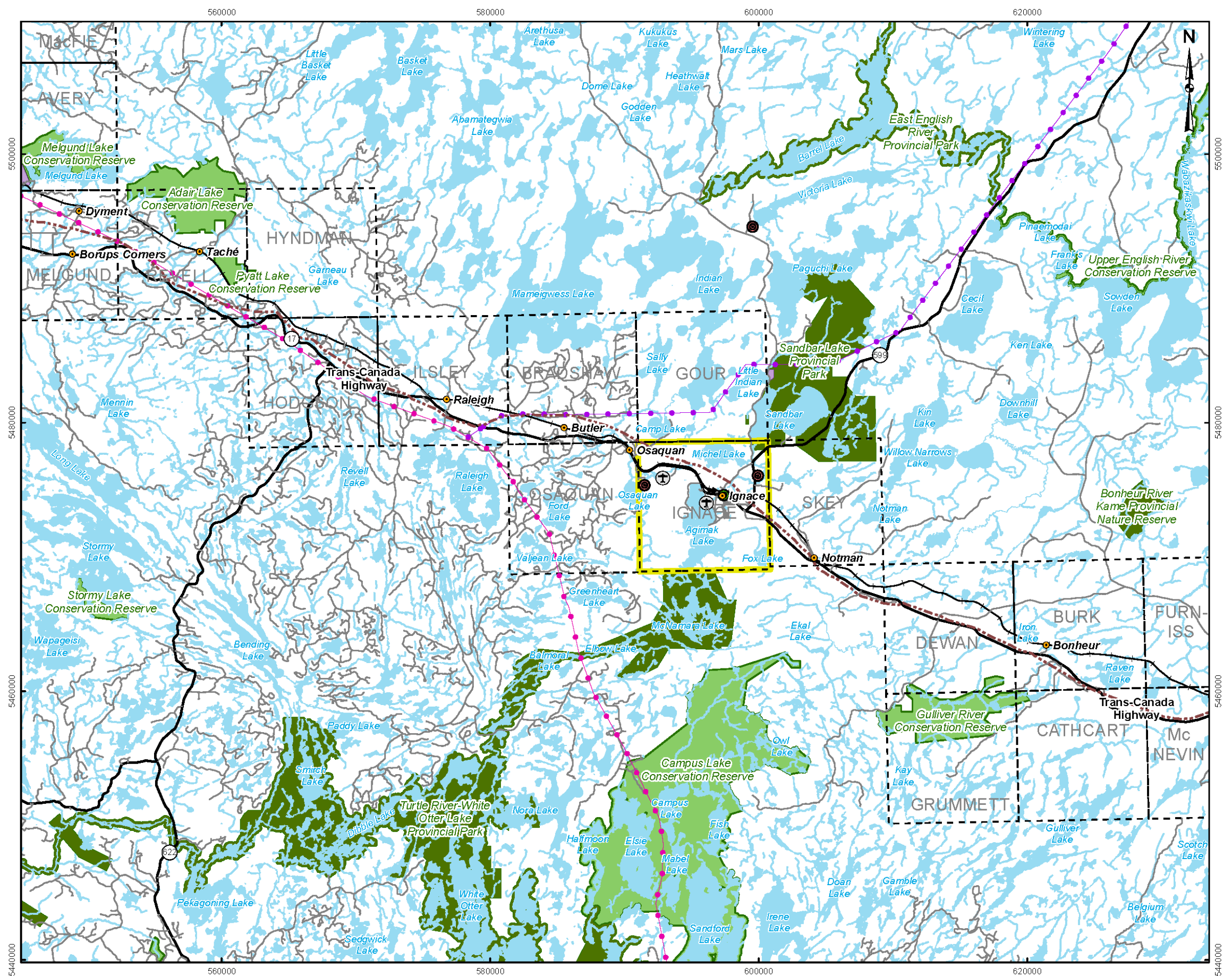


FIGURES



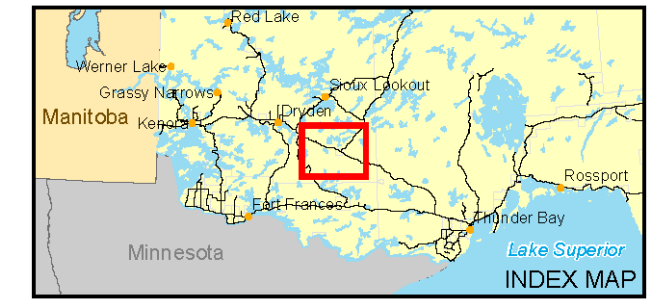
ENVIRONMENT REPORT - TOWNSHIP OF IGNACE, ONTARIO

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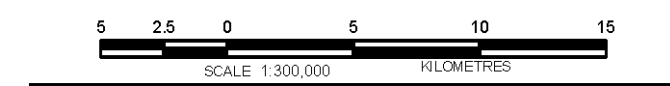
LEGEND

- Community
- ✈ Airport
- Domestic Waste Site
- Waste Water Treatment Plant
- Main Road
- Local Road
- Railway
- 230 kV Transmission Line
- 115 kV Transmission Line
- Natural Gas Pipeline
- Watercourse, Permanent
- Watercourse, Intermittent
- Water Area, Permanent
- Forest Reserve
- Conservation Reserve
- Provincial Park
- Geographic Township
- Municipal Boundary (Township of Ignace)



REFERENCE

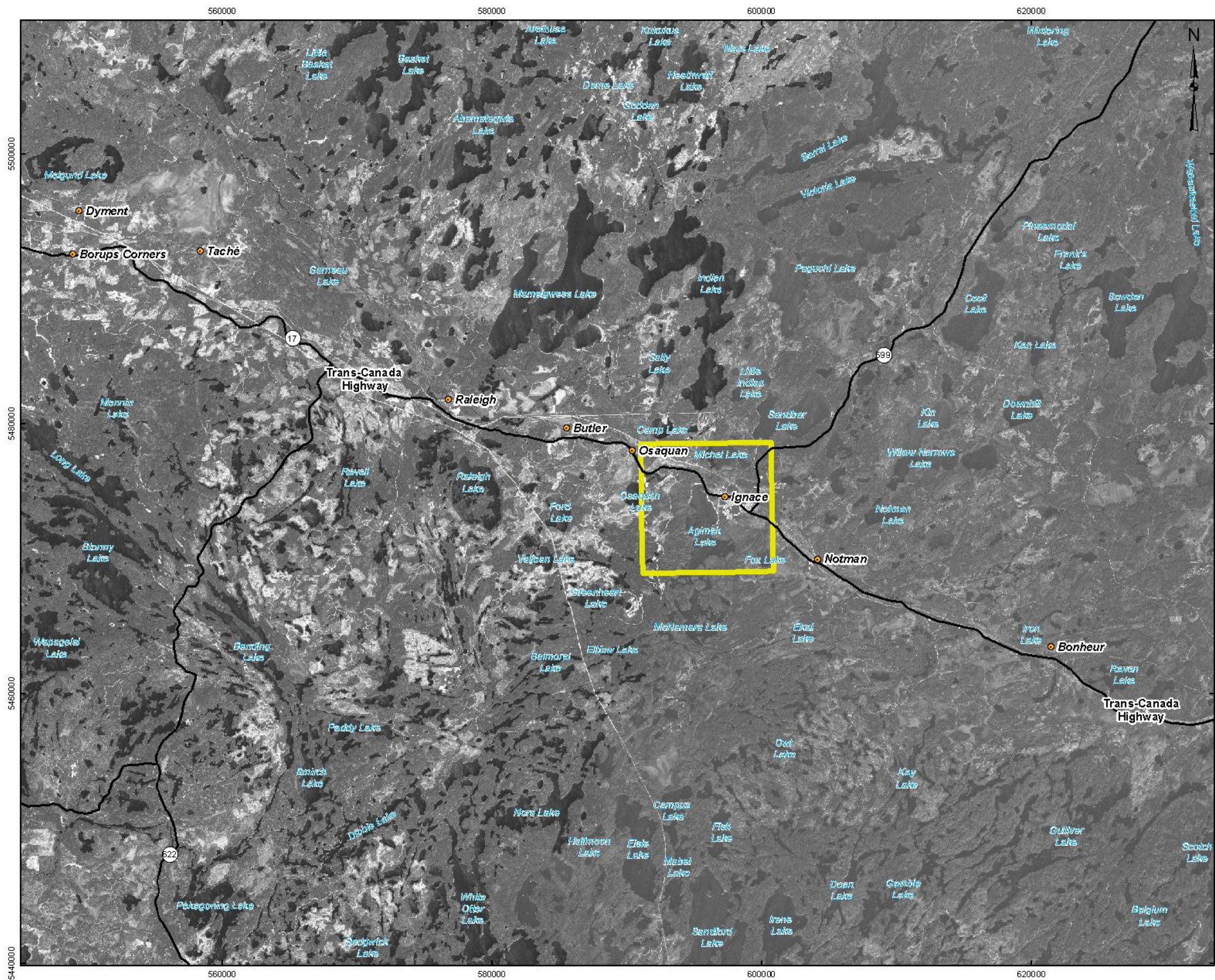
Base Data - MNR LIO, obtained 2009-2012, CANMAP v2006.4
 Produced by Golder Associates Ltd under licence from Ontario Ministry of Natural Resources, © Queens Printer 2009
 Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 18



<p>PROJECT</p> <p style="text-align: center;">Environment Report Township of Ignace, Ontario</p> <p>TITLE</p> <p style="text-align: center;">Ignace and Surrounding Lands</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%;">PROJECT NO. 12-1152-0026</td> <td style="width: 33%;">SCALE AS SHOWN</td> <td style="width: 33%;">REV. 0.0</td> </tr> <tr> <td>DESIGN PM 28 Mar. 2012</td> <td colspan="2"></td> </tr> <tr> <td>GIS PM/JB 15 Aug. 2013</td> <td colspan="2"></td> </tr> <tr> <td>CHECK JH 15 Aug. 2013</td> <td colspan="2"></td> </tr> <tr> <td>REVIEW GWS 15 Aug. 2013</td> <td colspan="2"></td> </tr> </table> <p style="text-align: right; font-weight: bold; font-size: 1.2em;">FIGURE: 1</p>	PROJECT NO. 12-1152-0026	SCALE AS SHOWN	REV. 0.0	DESIGN PM 28 Mar. 2012			GIS PM/JB 15 Aug. 2013			CHECK JH 15 Aug. 2013			REVIEW GWS 15 Aug. 2013		
PROJECT NO. 12-1152-0026	SCALE AS SHOWN	REV. 0.0														
DESIGN PM 28 Mar. 2012																
GIS PM/JB 15 Aug. 2013																
CHECK JH 15 Aug. 2013																
REVIEW GWS 15 Aug. 2013																



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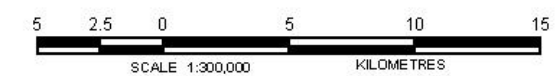
LEGEND


- Community
- Main Road
- Municipal Boundary (Township of Ignace)



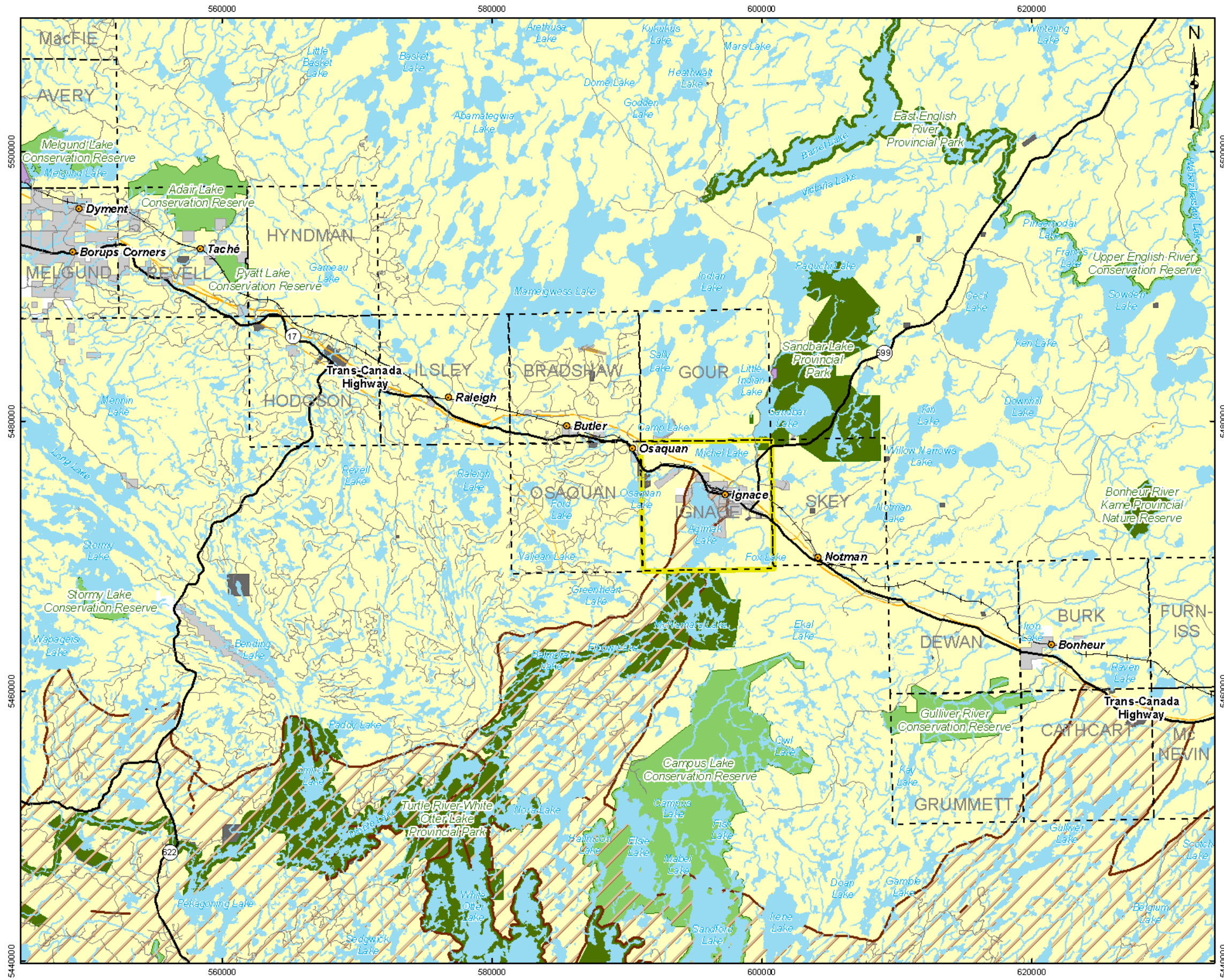
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Base Data - MNR LIO, obtained 2009-2012, CANMAP v2006.4
 Imagery: Spot 5, Obtained from Geobase (2006, 10m resolution)
 Produced by Golder Associates Ltd under licence from Ontario Ministry of Natural Resources, © Queens Printer 2009
 Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 15



PROJECT	Environment Report Township of Ignace, Ontario		
TITLE	Satellite Imagery of the Ignace Area		
 Golder Associates Mississauga, Ontario	PROJECT NO.	12-1152-0026	SCALE AS SHOWN
	DESIGN	PM 28 Mar. 2012	REV. 00
	GIS	PM/JB 15 Aug. 2013	FIGURE: 2
	CHECK	JH 15 Aug. 2013	
REVIEW	GMS 15 Aug. 2013		

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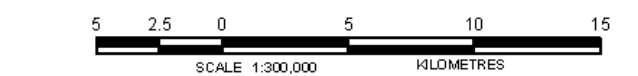



- LEGEND**
- Community
 - Main Road
 - Local Road
 - + Railway
 - Watercourse, Permanent
 - - - Watercourse, Intermittent
 - Water Area, Permanent
 - Forest Reserve
 - Conservation Reserve
 - Provincial Park
 - Private Land
 - Crown Leased Land
 - Crown Land - Non-Freehold Dispositions Public
 - Crown Land - Unpatented Public Land
 - Crown Reserves
 - Regular Registered Trapline Area License
 - Geographic Township
 - Municipal Boundary (Township of Ignace)



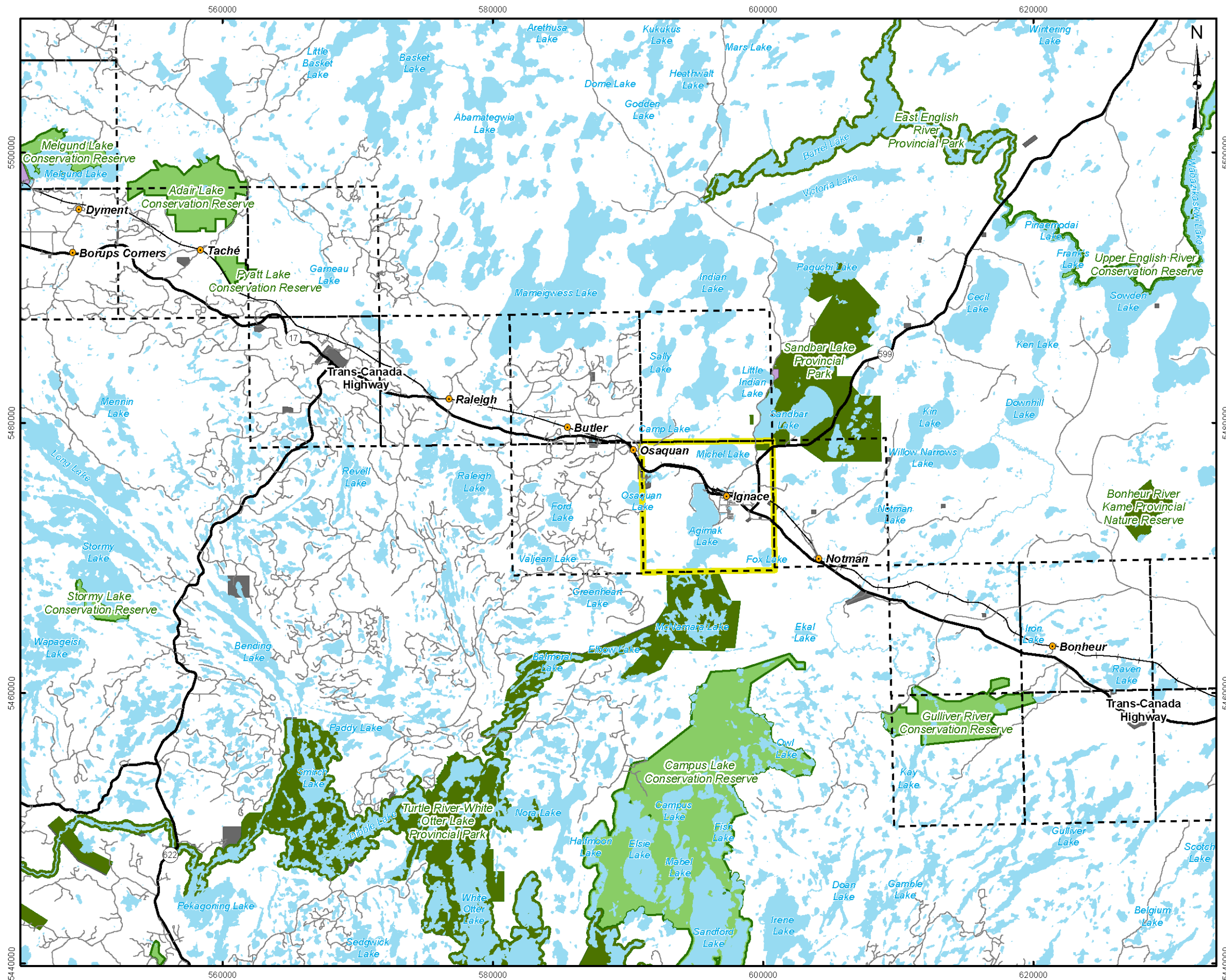
REFERENCE

Base Data - MNR LIO, obtained 2009-2012
 Produced by Golder Associates Ltd under licence from
 Ontario Ministry of Natural Resources, © Queens Printer 2009
 Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 15



PROJECT	Environment Report Township of Ignace, Ontario		
TITLE	Ignace Area Land Ownership		
 Golder Associates Mississauga, Ontario	PROJECT NO.	12-1152-0026	SCALE AS SHOWN
	DESIGN	PM 28 Mar. 2012	REV. 00
	GIS	PM/JB 15 Aug. 2013	FIGURE: 3
	CHECK	JH 15 Aug. 2013	
REVIEW	GMS 15 Aug. 2013		

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- LEGEND**
- Community
 - Main Road
 - Local Road
 - + Railway
 - Water Area, Permanent
 - Forest Reserve
 - Conservation Reserve
 - Provincial Park
 - Crown Reserves
 - - - Geographic Township
 - ▭ Municipal Boundary (Township of Ignace)



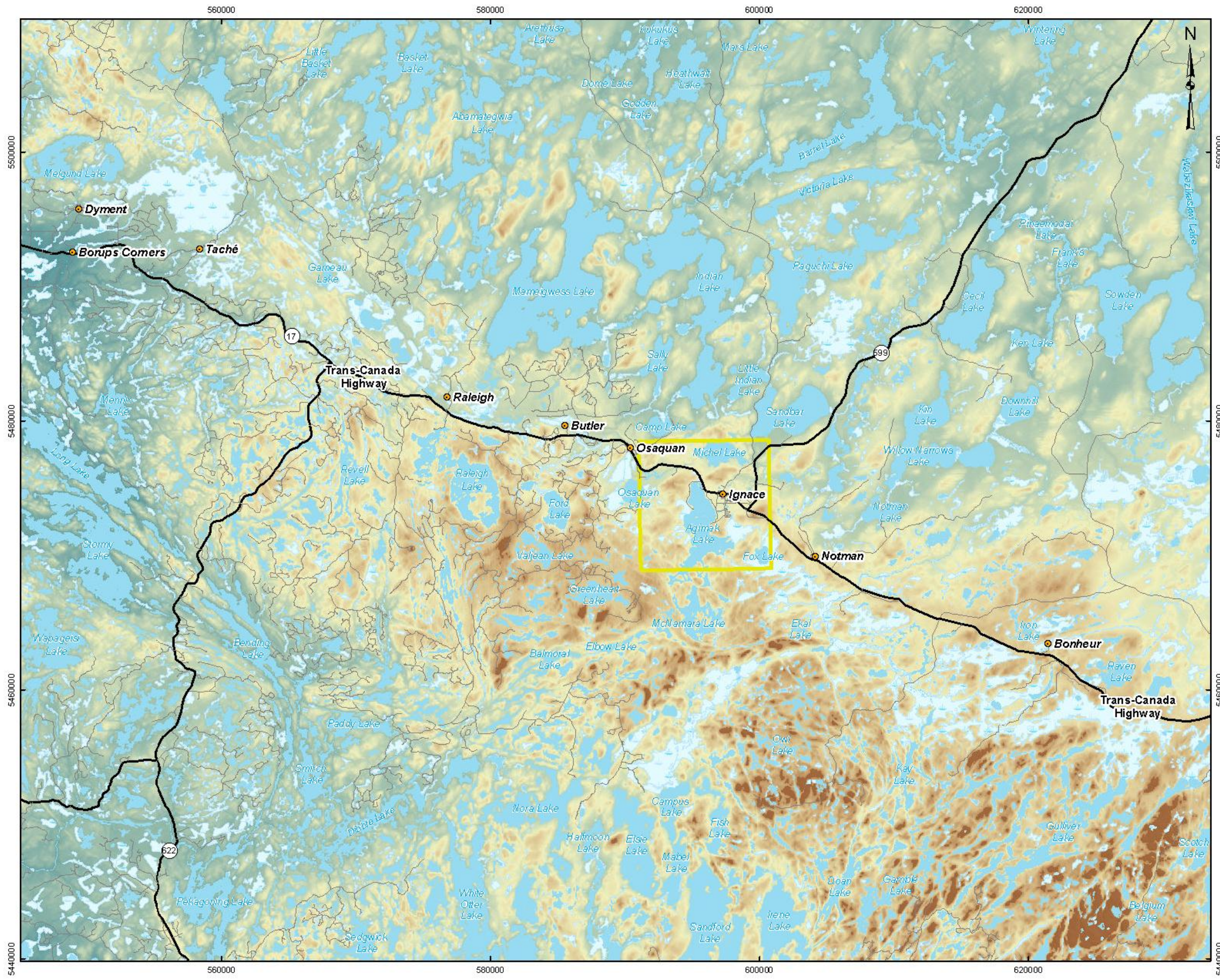
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Base Data - MNR LIO, obtained 2009-2012, CANMAP v2006.4
 Produced by Golder Associates Ltd under licence from
 Ontario Ministry of Natural Resources, © Queens Printer 2009
 Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 15



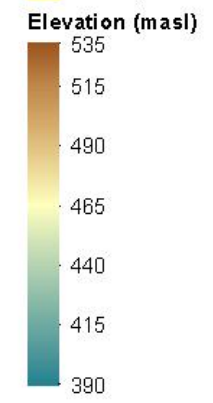
PROJECT			
Environment Report Township of Ignace, Ontario			
TITLE			
Ignace - Parks and Protected Lands			
 Golder Associates Mississauga, Ontario	PROJECT NO. 12-1152-0026	SCALE AS SHOWN	REV. 0.0
	DESIGN PRM 28 Mar. 2012		
	GIS PM/JB 15 Aug. 2013		
	CHECK JH 15 Aug. 2013		
	REVIEW GWS 15 Aug. 2013		
			FIGURE: 4

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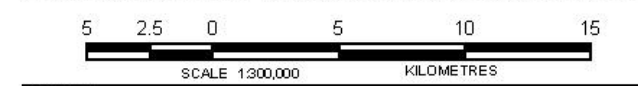
LEGEND

- Community
- Main Road
- Local Road
- Water Area, Permanent
- Wetland, Permanent
- Municipal Boundary (Township of Ignace)



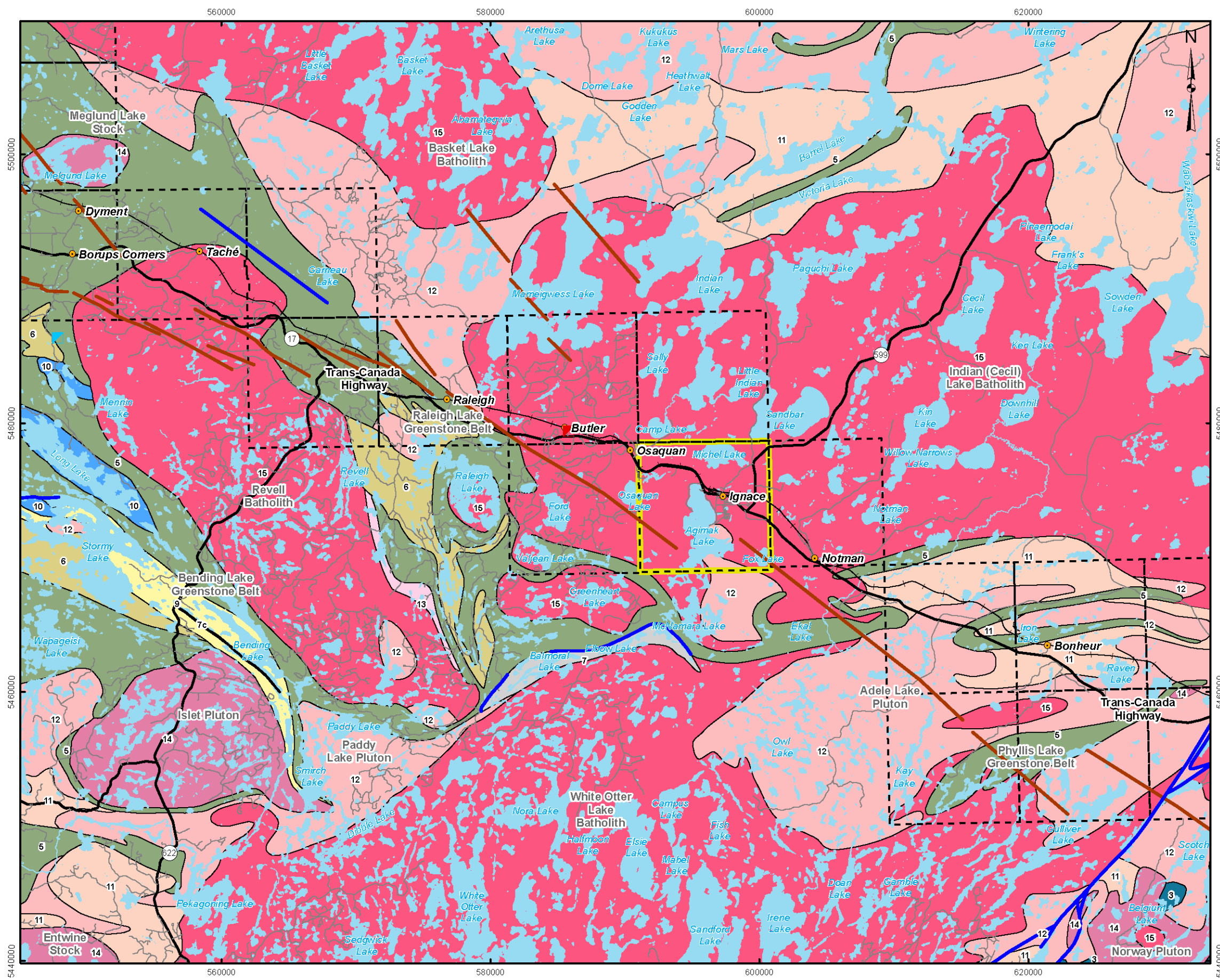
REFERENCE

Base Data - MNR LIO, obtained 2009-2012, CANMAP v2006.4
 Digital Elevation Model - CDED slope raster, Geobase.ca (1:50,000)
 Produced by Golder Associates Ltd under licence from Ontario Ministry of Natural Resources, © Queens Printer 2009
 Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 15



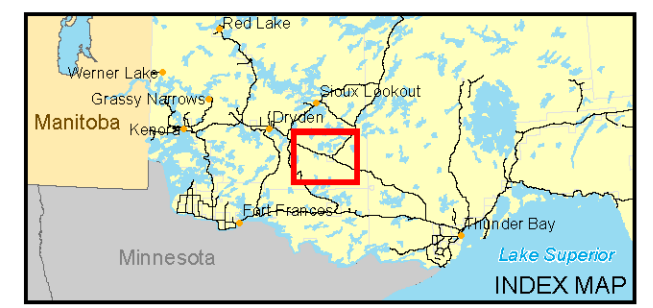
PROJECT	Environment Report Township of Ignace, Ontario		
TITLE	Digital Elevation Model (DEM) of the Ignace Area		
Golder Associates Mississauga, Ontario	PROJECT NO.	12-1152-0026	SCALE AS SHOWN
	DESIGN	PFM 28 Mar 2012	REV. 00
	GIS	PM/JB 15 Aug 2013	FIGURE: 6
	CHECK	JH 15 Aug 2013	
REVIEW	GMS 15 Aug 2013		

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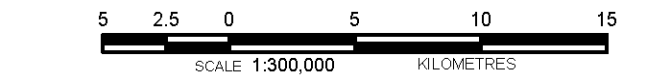
LEGEND

- Community
- Past Producing Mine with Reserves
- Past Producing Mine without Reserves
- Main Road
- Local Road
- Railway
- Water Area, Permanent
- Geologic Dike
- Geological Fault
- Geological Contact
- Iron Formation
- 15 Massive granodiorite to granite
- 14-Diorite-monzodiorite-granodiorite suite
- 13 Muscovite-bearing granitic rock
- 12 Foliated tonalite suite
- 11 Gneissic tonalite suite
- 10 Mafic and ultramafic rocks
- 9 Coarse clastic metasedimentary rocks
- 7 Metasedimentary rocks
- 7c Marble, chert, iron formation, minor metavolcanic rocks
- 6 Felsic to intermediate metavolcanic rocks
- 5 Mafic to intermediate metavolcanic rocks
- 3 Mafic metavolcanic and metasedimentary rocks
- Geographic Township
- Municipal Boundary (Township of Ignace)



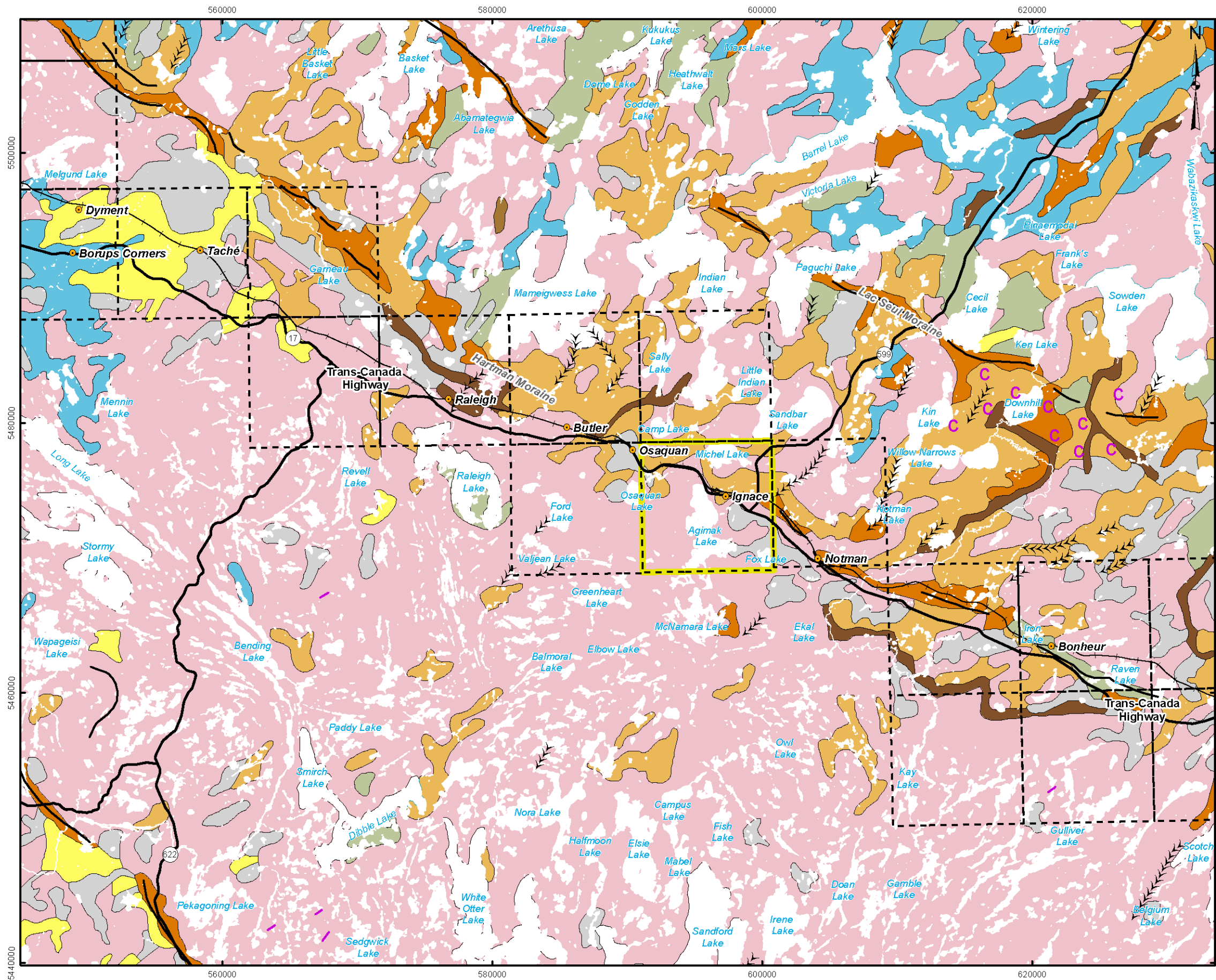
REFERENCE

Base Data - MNR LIO, obtained 2009-2012, CANMAP v2006.4
 Geology - MRD126 - Bedrock Geology of Ontario, 2011
 Produced by Golder Associates Ltd under licence from Ontario Ministry of Natural Resources, © Queens Printer 2009
 Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 15



PROJECT		Environment Report Township of Ignace, Ontario	
TITLE			
Bedrock Geology of the Ignace Area			
<p>Golder Associates Mississauga, Ontario</p>	PROJECT NO.	12-1152-0026	SCALE AS SHOWN
	DESIGN	PM 28 Mar. 2012	REV. 1.0
	GIS	PM/JB 15 Aug. 2013	FIGURE: 7
	CHECK	JH 15 Aug. 2013	
REVIEW	GWS 15 Aug. 2013		

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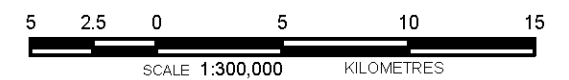
LEGEND


- Community
- Dunes
- Main Road
- Railway
- Drumlin or area of drumlins
- Trend of end moraine crest
- Esker or area of eskers; direction of flow known or assumed
- 1: Bedrock
- 18: Till
- 22: Glaciofluvial Ice
- 23: Glaciofluvial Outwash deposits
- 24: Glaciolacustrine deposits
- 25: Glaciolacustrine deposits
- 28: Fluvial deposits
- 31: Fluvial deposits
- 32: Organic deposits
- 33: Water Area
- ⊠ Geographic Township
- ▭ Municipal Boundary (Township of Ignace)

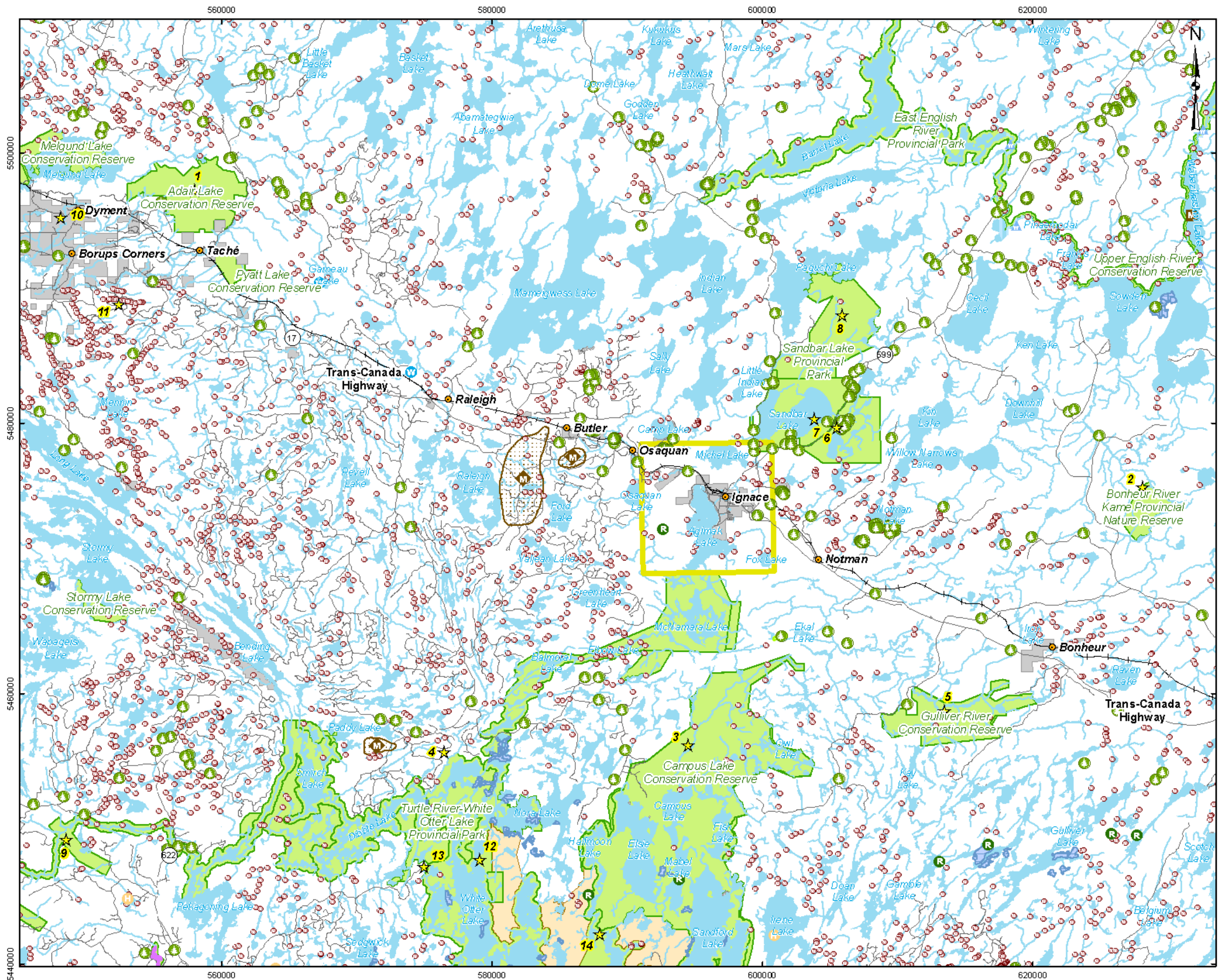


REFERENCE

Base Data - MNR LIO, obtained 2009-2012, CANMAP v2006.4
 Geology: Modified EDS014 - Surficial Geology of Ontario 1:1,000,000, 2000
 Produced by Golder Associates Ltd under licence from
 Ontario Ministry of Natural Resources, © Queens Printer 2009
 Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 15



PROJECT	Environment Report Township of Ignace, Ontario		
TITLE	Quaternary Geology of the Ignace Area		
 Golder Associates Mississauga, Ontario	PROJECT NO.	12-1152-0026	SCALE AS SHOWN
	DESIGN	PM 28 Mar. 2012	REV. 0.0
	GIS	PM/JB 15 Aug. 2013	FIGURE: 8
	CHECK	JH 15 Aug. 2013	
REVIEW	GWS 15 Aug. 2013		



LEGEND

- Community
- Road
- + Railway
- Watercourse
- Water Area, Permanent
- Provincial Park / Reserve
- Enhanced Management Area
- Private Land
- Municipal Boundary (Township of Ignace)
- ★ Earth or Life Science Site

Wildlife and Forestry

- Forest Research Area
- Moose Aquatic Feeding Area

Nesting

- Heron
- Raptor
- Waterfowl

Significant Ecological Area

- Significant Ecological Community
- Significant Woodland
- Old Growth Forest, Designated Old Growth Forest

Staging Area

- Waterfowl
- Waterfowl

Wintering Area

- Moose
- Moose

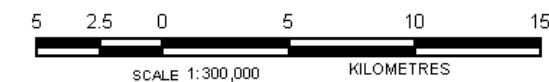
Calving/Fawning Sites


- Moose Calving Site



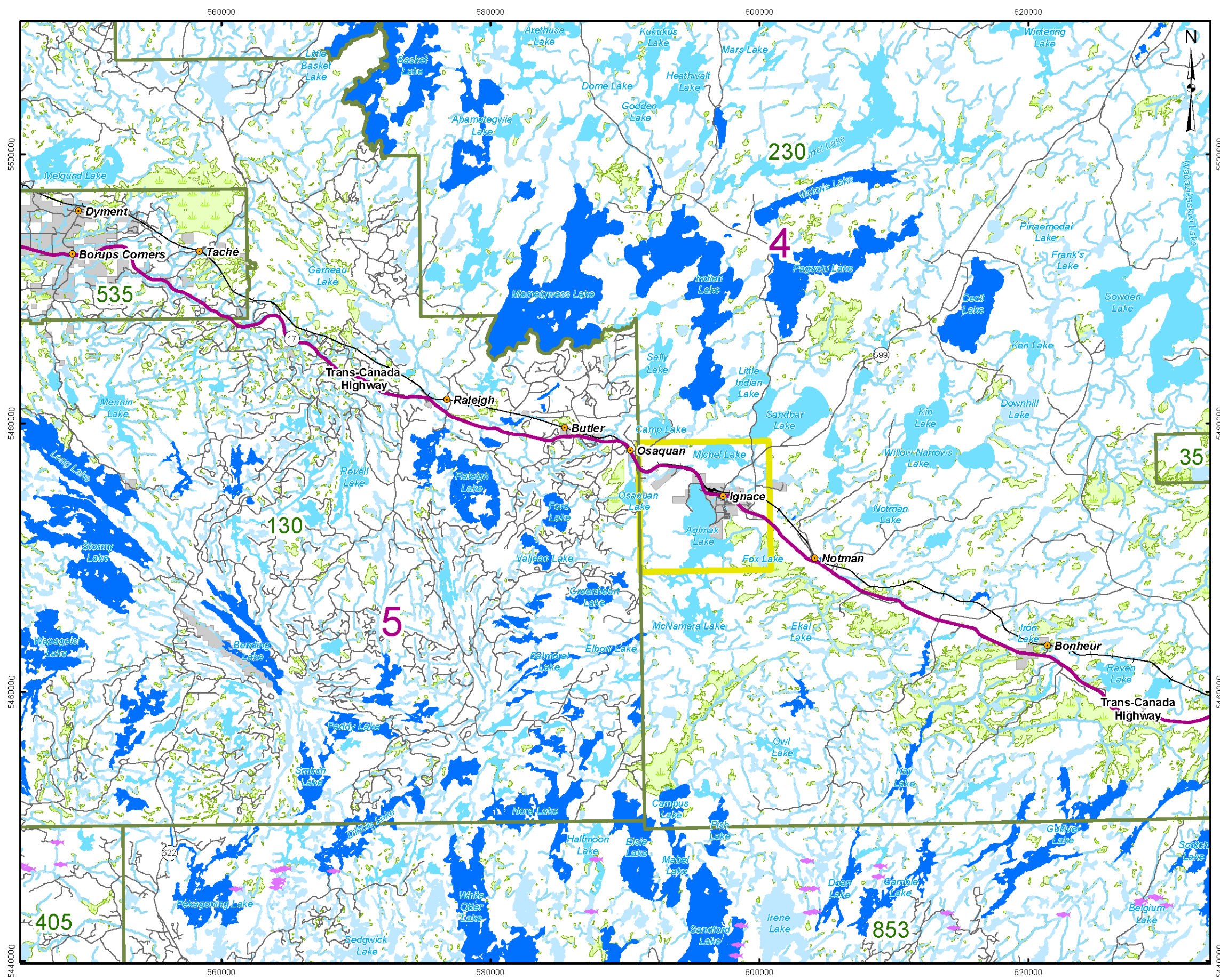
REFERENCE

Base Data - MNR LIO, obtained 2009-2012, CANMAP v2006.4
 Produced by Golder Associates Ltd under licence from
 Ontario Ministry of Natural Resources, © Queens Printer 2009
 Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 15



PROJECT	Environment Report Township of Ignace, Ontario		
TITLE	Ignace - Terrestrial Ecology		
 Golder Associates Mississauga, Ontario	PROJECT NO.	12-1152-0026	SCALE AS SHOWN
	DESIGN	PM	29 Sep. 2010
	GIS	PM/JB	15 Aug. 2013
	CHECK	JH	15 Aug. 2013
	REVIEW	GNIS	15 Aug. 2013
			FIGURE: 9

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- LEGEND**
- Community
 - Road
 - +— Railway
 - Watercourse
 - ▭ Forest Management Unit
 - ▭ Fisheries Management Zone
 - ▭ Municipal Boundary (Township of Ignace)
 - ▭ Ignace Study Area

- Fisheries and Wetlands ¹**
- ◆ Spawning Area
 - Waterbody (unspecified)
 - Cold Water Lake
 - Cool Water Lake
 - Warm Water Lake

- Natural Heritage**
- Wetland

- Forest Management Unit**
- 035 - Spruce River Forest
 - 130 - Wabigoon Forest
 - 177 - Dog River-Matawin Forest
 - 230 - English River Forest
 - 405 - Crossroute Forest
 - 535 - Dryden Forest
 - 702 - Lac Seul Forest
 - 853 - Sapawe Forest

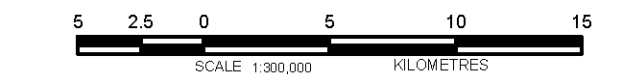
NOTE


¹ - Data shown is provided per Forest Management Unit (FMU). In FMU 535, 130, 230 and 35 fish spawning areas are not publically available.



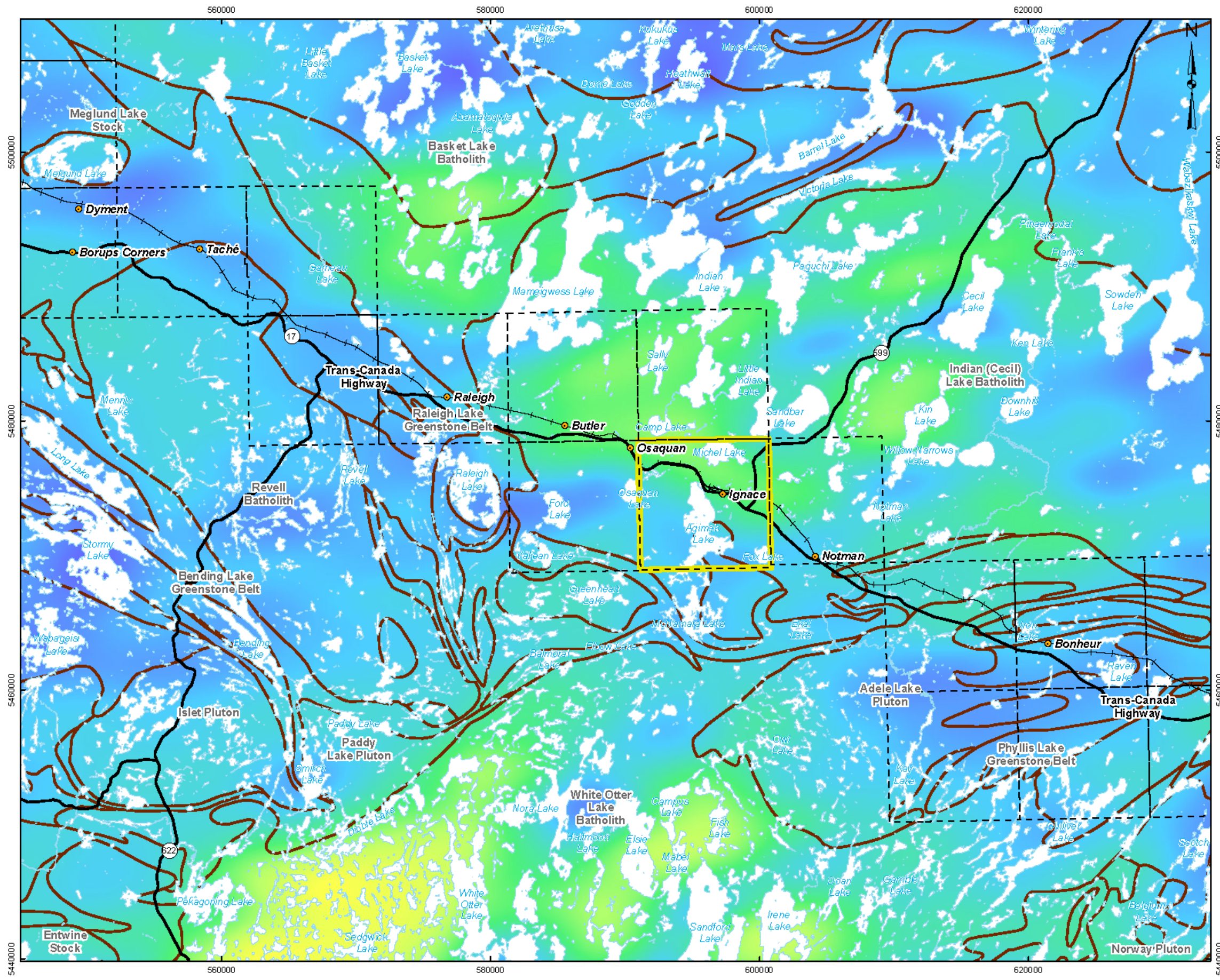
REFERENCE

Base Data - MNR LIO, obtained 2009-2012, CANMAP v2006.4
 Fisheries and Wetlands Maps - Wabigoon and English River FMU (2008 & 2009)
 Produced by Golder Associates Ltd under licence from Ontario Ministry of Natural Resources, © Queens Printer 2009
 Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 15



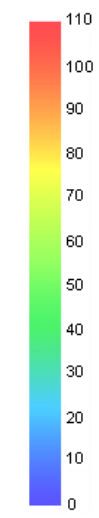
PROJECT		Environment Report Township of Ignace, Ontario	
TITLE		Ignace - Aquatic Ecology	
 Mississauga, Ontario	PROJECT NO.	12-1152-0026	SCALE AS SHOWN
	DESIGN	PRM 29 Sep. 2010	REV. 0.0
	GIS	PMWJB 15 Aug. 2013	FIGURE: 10
	CHECK	JH 15 Aug. 2013	
	REVIEW	GWS 15 Aug. 2013	

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- LEGEND**
- Community
 - Main Road
 - + Railway
 - Water Area, Permanent
 - ▭ Geological Contact
 - ▭ Geographic Township
 - ▭ Municipal Boundary (Township of Ignace)

Air Absorbed Radiation Levels (nGy/h)



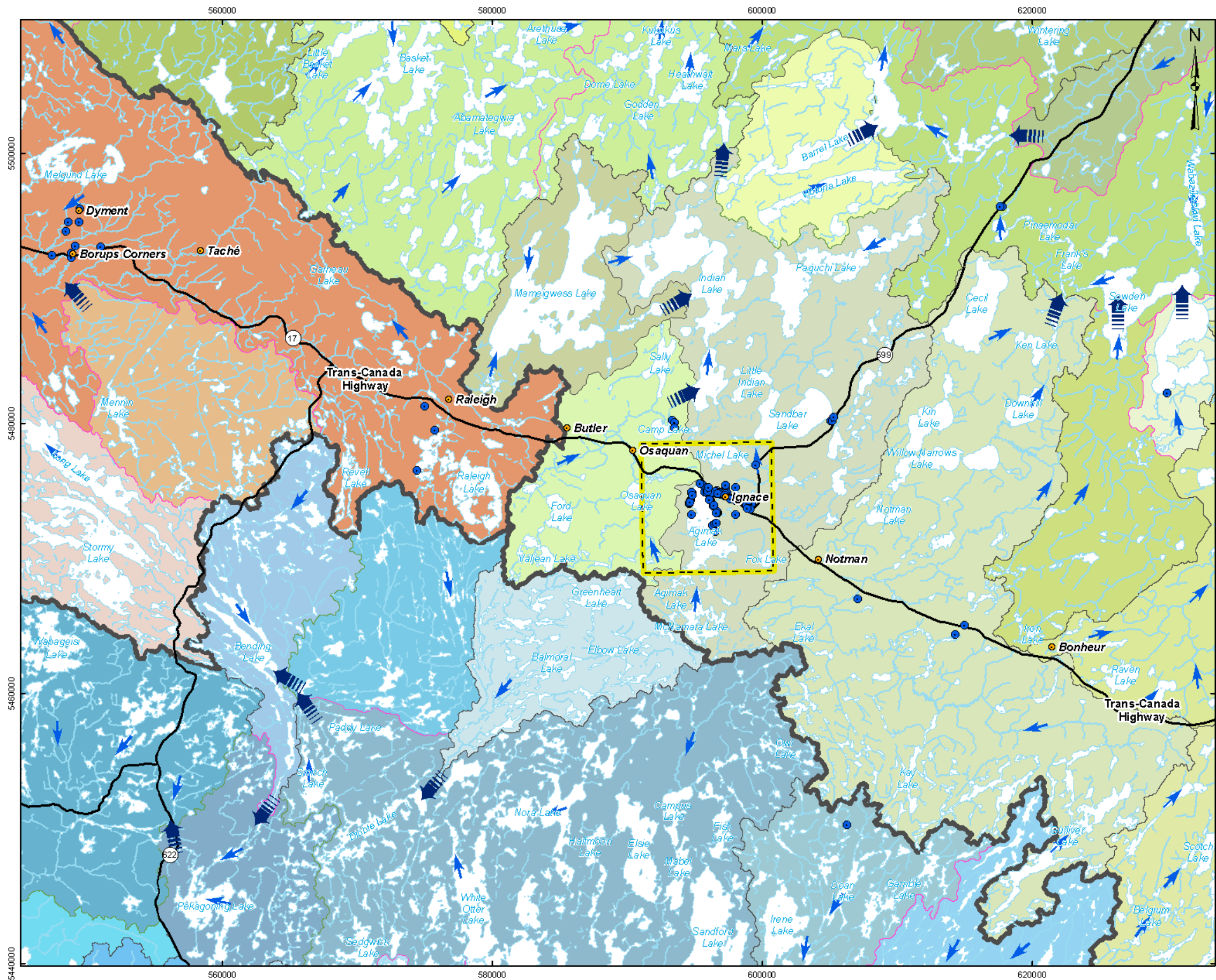
REFERENCE

Base Data - MNR LID, obtained 2009-2012, CANMAP v2006.4
 Radiometrics: GSC Canada - 250m - Natural Air Absorbed Dose Rate, 2012;
 National Gamma-Ray Spectrometry Program Data Base, Airborne Geophysics Section, GSC - Central Canada Division, Geological Survey of Canada, Earth Sciences Sector, Natural Resources Canada
 Geology: MRD126- Bedrock Geology of Ontario, 2011
 Produced by Golder Associates Ltd under licence from Ontario Ministry of Natural Resources, © Queen's Printer 2009
 Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 15

5 2.5 0 5 10 15
 SCALE 1:300,000 KILOMETRES

PROJECT		Environment Report Township of Ignace, Ontario	
TITLE		Ignace - Background Radiation Levels	
<p>Golder Associates Mississauga, Ontario</p>	PROJECT NO.	12-1152-0026	SCALE AS SHOWN
	DESIGN	PM 27 Mar 2012	REV. 1.0
	GIS	PM/JB 15 Aug 2013	FIGURE: 11
	CHECK	JH 15 Aug 2013	
	REVIEW	GMS 15 Aug 2013	

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LEGEND

- Community
- MOE Well Location
- Main Road
- Watercourse, Permanent
- - - Watercourse, Intermittent
- Water Area, Permanent
- ▭ Geographic Township
- ➔ Surface Water Flow Direction
- ▬ Watershed Outflow Point

Drainage Divide

- Delineated by MNR/JDMA
- Delineated by JDMA
- Delineated by MNR
- ▭ Municipal Boundary (Township of Ignace)



REFERENCE

Base Data - MNR LIO, obtained 2009-2012, CANMAP v2006.4
 Wells: Ministry of the Environment, 2010
 Watershed: LIO quaternary watershed (updated by JDMA)
 Produced by Golder Associates Ltd under licence from Ontario Ministry of Natural Resources, © Queens Printer 2009
 Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 15
 5 2.5 0 5 10 15

SCALE 1:200,000 KILOMETRES


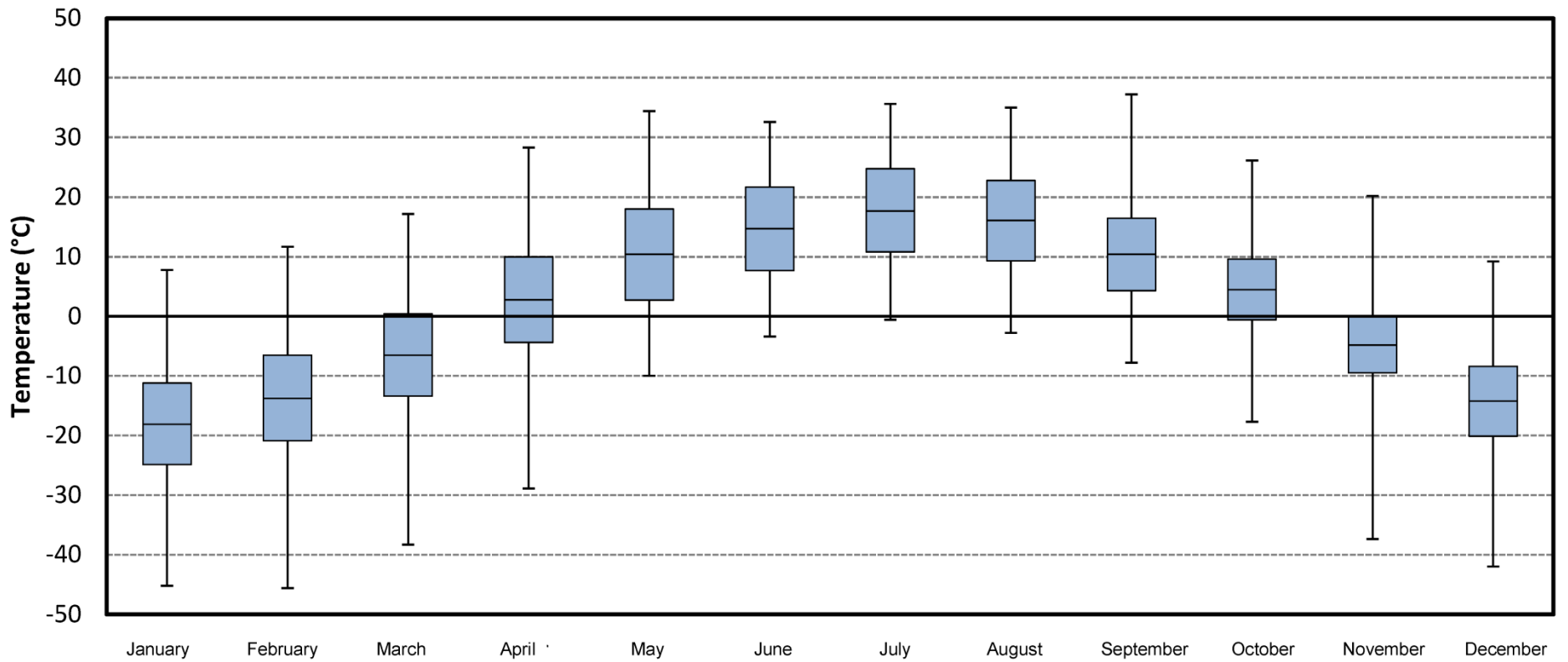
PROJECT	Environment Report Township of Ignace, Ontario		
TITLE	Ignace Surface Water Drainage and Water Wells		
 Mississauga, Ontario	PROJECT NO.	12-1152-0026	SCALE AS SHOWN
	DESIGN	PM 29 Mar. 2012	REV. 00
	GIS	PM/JB 15 Aug. 2013	
	CHECK	JH 15 Aug. 2013	
	REVIEW	GW 15 Aug. 2013	

FIGURE: 12




LEGEND

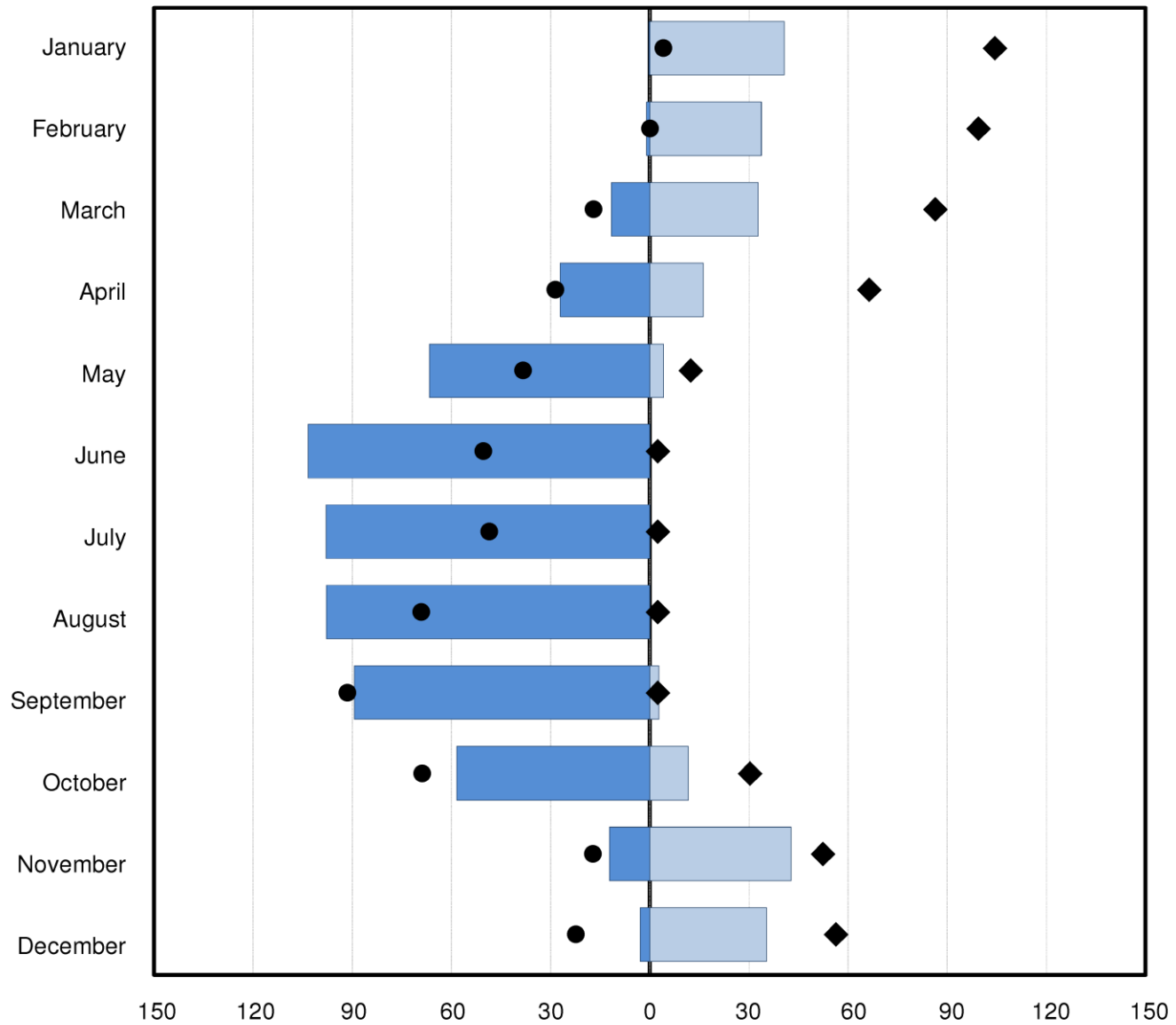
- Extreme Maximum (°C)
- Daily Maximum (°C)
- Daily Average (°C)
- Daily Minimum (°C)
- Extreme Minimum (°C)

DATA SOURCE

Environment Canada

PROJECT		Environment Report Township of Ignace, Ontario	
TITLE		Atikokan 1971-2000 Temperature Data Summary	
 Golder Associates Mississauga, Ontario	PROJECT NO.	12-1152-0026	SCALE AS SHOWN
	DESIGN	PM 28 Mar. 2011	REV. 0.0
	GIS	PJM/JB 7 Aug. 2013	FIGURE: 13
	CHECK	JH 7 Aug. 2013	
REVIEW	GWS 7 Aug. 2013		

G:\Projects\2012\12-1152-0026_NWMO_Phase1_Feasibility\GIS\MXDs\Reporting\Env_Safety_Report\Ignace\IgnaceAtikokanPrecipitationDataSummary.mxd




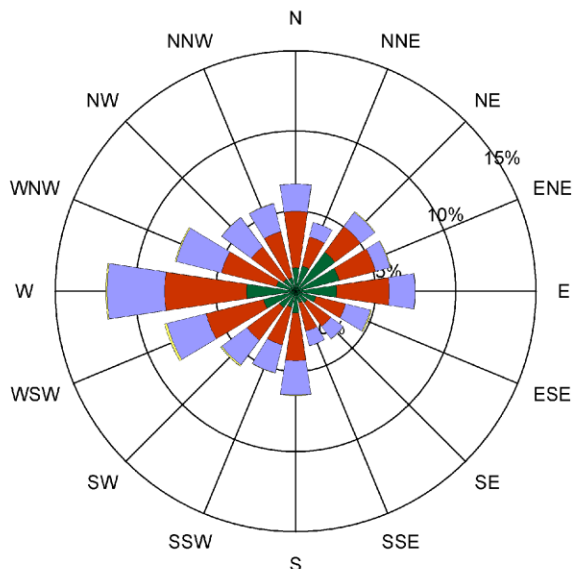
LEGEND

- Extreme Daily Rainfall (mm eq.)
- ◆ Extreme Daily snowfall (mm eq.)
- Monthly Rainfall (mm eq.)
- Monthly Snowfall (mm eq.)

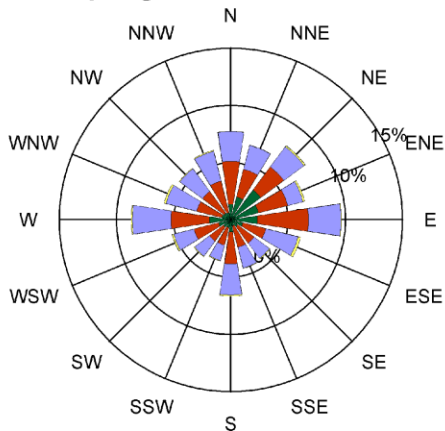
DATA SOURCE

Environment Canada

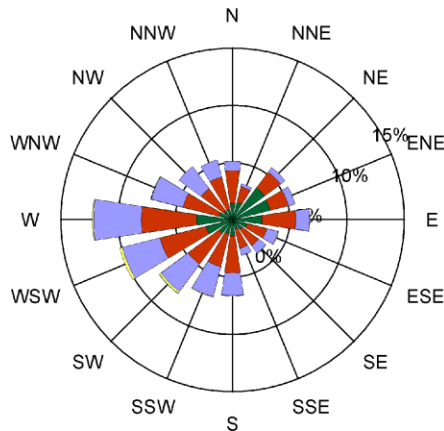
PROJECT		Environment Report Township of Ignace, Ontario	
TITLE		Atikokan 1971-2000 Precipitation Data Summary	
 Golder Associates Mississauga, Ontario	PROJECT NO.	12-1152-0026	SCALE AS SHOWN
	DESIGN	PM	29 Mar. 2012
	GIS	PM/JB	7 Aug. 2013
	CHECK	JH	7 Aug. 2013
	REVIEW	GWS	7 Aug. 2013
			FIGURE: 14



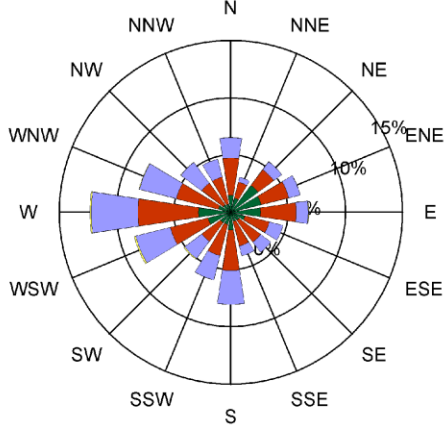
Spring



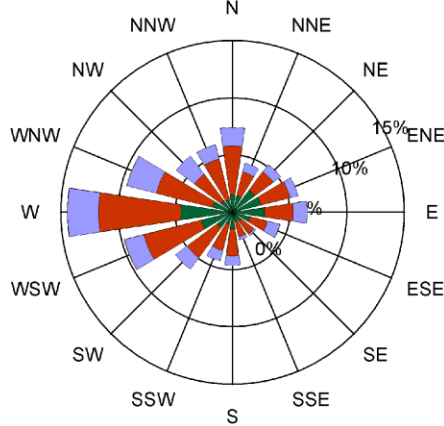
Summer



Fall



Winter




LEGEND

Wind Speed (km/hr)

- >1 - 5
- >5 - 10
- >10 - 20
- >20 - 30
- >30

DATA SOURCE

Environment Canada

PROJECT		Environment Report Township of Ignace, Ontario	
TITLE		Annual and Seasonal Wind Rose January 1, 2006 - December 31, 2010	
 Golder Associates Mississauga, Ontario	PROJECT NO. 12-1152-0026	SCALE AS SHOWN	REV. 0.0
	DESIGN PRM 1 Mar. 2011	FIGURE: 15	
	GIS PM/JB 7 Aug. 2013		
	CHECK JH 7 Aug. 2013		
REVIEW GWS 7 Aug. 2013			

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