NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

Phase 1 Desktop Assessment Environment Report

ENGLISH RIVER FIRST NATION, SASKATCHEWAN

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PHASE 1 DESKTOP ASSESSMENT

Environment Report English River First Nation, Saskatchewan

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1.0 INTRODUCTION

The English River First Nation (ERFN) in Saskatchewan 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 ERFN. To this end, this report provides a general description of the environment in the ERFN 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 Assessment for ERFN. This area is shown on Figure 1, and includes three Sub-Regions around a number of ERFN reserves and communities, and the surrounding area.

2.0 COMMUNITIES AND INFRASTRUCTURE

2.1 Communities

The ERFN reserve areas are located across central and northern Saskatchewan and cover a large territory. The nearest large centre is the City of Prince Albert, about 450 km to the south via Highway 914. For the initial screening conducted for this area, the 13 reserves within the ERFN area (AANDC, 2013) were grouped into three regions comprising distinct geologic settings. Three reserves are within the sedimentary rocks of the Athabasca Basin (Region 1), seven reserves are within the Canadian Shield (Region 2) and three reserves are within the sedimentary rocks of the Western Canada Sedimentary Basin (Region 3). The initial screening found the seven reserve areas located on the Canadian Shield are potentially suitable for hosting a deep geological repository. The ERFN reserve areas located within the sedimentary rocks of the Athabasca Basin and the Western Canada Sedimentary Basin were excluded from further consideration, as they did not meet the screening criteria.

The seven potentially suitable reserve areas within Region 2 (the Canadian Shield) were grouped into three sub-regions (Sub-Regions 2.1, 2.2 and 2.3). Note that the numbering of these regions in this report has been maintained to be consistent with the initial screening report (Golder, 2011) even though Regions 1 and 3 have been excluded from further consideration.

Sub-Region 2.1 includes one reserve area (Figure 1):

- Haultain Lake Indian Reserve (IR): This reserve area covers 2 km^2 and is located on the east shore of Haultain Lake, approximately 9 km west of Highway 914.

Sub-Region 2.2 includes the following two reserve areas (Figure 1):

- Flatstone Lake IR: This reserve area covers 2.3 km^2 and is another remote site located 37 km north of the community of Patuanak.
- Porter Lake Island IR: This reserve area covers 0.425 km^2 and is a remote site located north of the Churchill River, near the winter road route leading to Cree Lake.

Sub-Region 2.3 includes the following four reserve areas (Figure 1):

- Dipper Rapids IR: This reserve area covers 8.4 km^2 and is located 22 km east of Patuanak along the Churchill River system.
- Primeau Lake IR: This reserve area covers 17 km^2 and is located 29 km east of Patuanak along the Churchill River system.
- Knee Lake IR: This reserve area covers 5 km^2 and is located 40 km east of Patuanak along the Churchill River system.
- Elak Dase IR: This reserve area covers 14 km^2 and is located 51 km east of Patuanak along the Churchill River system.

This report describes the environment within the ERFN area, focusing on Sub-Regions 2.1, 2.2 and 2.3 in the discussion where applicable.

Figure 2 presents satellite imagery for the ERFN area taken in 2006. Table 1 summarizes the total population for the ERFN and total population and population density for Division No. 18, CDR[1].

Table 1: Population Statistics for the ERFN Area

Political Boundary	Population	Population Density per km²
English River First Nation	1,480 [a]	N/A
Division No. 18, CDR	36,557 [b]	0.1 [b]

Notes:

[a] Population for the ERFN available from Aboriginal Affairs and Northern Development Canada (AANDC, 2013) includes the registered on and off reserve population, and includes all reserves within the First Nation, not only those within the ERFN area.

[b] Population and population density within Region No. 18 from the Statistics Canada 2011 Census (Statistics Canada, 2012).

Land ownership in the ERFN area, including areas of Crown land managed by the Saskatchewan Ministry of the Environment, Crown Reserve[2] areas, recreation sites, First Nation reserves and private land, is shown on Figure 3.

There are a number of First Nations and Métis communities and organizations in the ERFN area including Birch Narrows First Nation, Buffalo River Dene First Nation, Canoe Lake First Nation, Clearwater River Dene Nation, Flying Dust First Nation, Makwa Sahgaiehcan First Nation, Ministikwan Lake First Nation (formerly known as Island Lake First Nation) and Waterhen Lake First Nation; all are signatories to Treaty 6, 8 or 10. Métis Locals in the area include Patuanak #82, Beauval #37, Canoe River #174, Cole Bay #41, Kineepik– Pinehouse #9 and Sakitawak – Île-à-la-Crosse #21; all are located within Métis Nation-Saskatchewan Northern Region III.

Further information on ERFN and its surrounding communities, including First Nations and Métis communities, is provided in the Community Profile Report for ERFN.

2.2 Infrastructure

Figure 1 shows the location of the primary infrastructure corridors in the ERFN area. The main transportation routes include Highway 918 which travels north into the Wapachewunak IR (south of Sub-Region 2.2 and west of Sub-Region 2.3) and Highway 914, which traverses in a north-south direction along the eastern side of the ERFN area. Highway 914 is located approximately 10 km east of the Haultain Lake IR (Sub-Region 2.1) and approximately 15 km from the Elak Dase IR (Sub-Region 2.3) (Figure 1). There is one airport within the ERFN area at Patuanak. No rail or transmission lines or gas pipelines were identified within the ERFN area. There is one operating landfill and a wastewater treatment plant within the ERFN area.

[1] CDR is defined as census division / division de recensement and is a geographic unit created as equivalent to a census division by Statistics Canada, in cooperation with applicable provinces, for the purpose of disseminating statistical data.

[2] Crown Reserves are Crown lands that have been withdrawn from dispositioning under Section 21 of the Crown Minerals Act. Note that in Saskatchewan, Crown Reserve lands could also include freehold lands because the person who owns the land/mineral rights may only own those rights for a particular mineral. Therefore the Crown would own the rights for the other minerals that would be found on that land.

2.3 Protected Areas

2.3.1 Parks and Reserves

There are no wildlife areas or conservation reserves within or adjacent to the ERFN area, including within Sub-Regions 2.1, 2.2 or 2.3. One park, the Gordon Lake Recreation Site, is located approximately 10 km east of the Elak Dase IR (Sub-Region 2.3) along Highway 914. Figure 4 shows the location of this area.

2.3.2 Heritage Sites

The database for previously recorded heritage resources maintained by the Saskatchewan Ministry of Tourism, Parks, Culture and Sport (TPCS, 2012) as well as the National Historic Sites Database (Parks Canada, 2012) were consulted to identify previously recorded heritage sites found within the ERFN area. Heritage resources include all of Saskatchewan's historic and pre-contact archaeological sites, architecturally significant structures and paleontological resources. Heritage resources are property of the Provincial Crown, and as such, are protected under *The Heritage Property Act* (Government of Saskatchewan, 1980).

The results of the database search indicate that 19 archaeological sites have been recorded within the ERFN area. The majority, 15 of the sites, are pre-contact artifact find and scatter sites; of the remainder, one is a pre-contact artifact/feature combination site, and one is historic recurrent feature site. Two heritage resources have insufficient information to be given a site type designation. According to the site database, the known heritage resources were recorded between 1960 and 1999; either prior to the provincial permitting system or by avocational archaeologists.

The Churchill River in the south of ERFN area was a significant waterway during both pre-contact and historic times. Archaeological evidence indicates that people were occupying the Churchill River as early as 10,000 years ago (Meyer, 1999). During the early fur trade period, explorers and traders began travelling the Churchill River beginning in the 1770s. This was soon followed by the establishment of fur trade posts by both the English and French beginning in 1775 and continuing through to the 1930's (Russell and Meyer, 1999). At least two other fur trade posts have been documented. This includes the Hudson's Bay Company Dipper and Elbow (Knee) Lake Posts established in 1905 and 1921, respectively.

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. The presence of local heritage sites would need to be further confirmed in discussion with the community, and First Nations and Métis 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 spiritual use.

Most of the ERFN area is located within the Northern Provincial Forest North (Government of Saskatchewan, 2007). The Northern Provincial Forest North has a gross area of 21,196,445 ha (hectares), which makes up 63% of provincial forest in Saskatchewan. This area is designated as non-commercial; therefore, no forestry Term Supply Licenses (TSL) have been granted for this area (Government of Saskatchewan, 2007). The southwest of the ERFN area includes the northern portion of the North West Communities TSL (Figure 5), a partnership of the communities of Beauval, Buffalo Narrows, Green Lake, Île-à-la-Crosse, La Loche, Patuanak

and Pinehouse Lake. North West Communities TSL has a gross area of approximately 770,000 ha, which makes up 6% of provincial commercial forest in Saskatchewan (Government of Saskatchewan, 2007). Commercial forest makes up 37% of total provincial forest (Government of Saskatchewan, 2007).

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

There is no record of metallic mineral production near the ERFN reserve areas, with the exception of uranium from the Athabasca Basin to the north of the ERFN area. Past exploration has occurred in the areas of Dipper and Porter Lakes, but on a reconnaissance level. Gold occurrences have been associated with mafic granulites and ultramafic metasedimentary rocks in the Porter Lake area, in the area of the Porter Lake Island IR. In this area, gold mineralization is also associated with silver and metal sulphides like copper, nickel, minor zinc and lead (Harper, 1988). Approximately 40 km to the north of the Porter Lake Island IR near Ithingo Lake, there is a mineral disposition with developed gold mineral prospects hosted within the metasedimentary rock; however, there are no occurrences within the area of Porter Lake Island IR that are currently economically proven. Iron occurrences are found within a metasedimentary banded iron formation within the western extent of the Mudjatik domain, and can be found in the area of the Porter Lake Island IR. No occurrences appear to be economically viable (Pearson, 1977; Gilboy, 1985). Molybdenum occurrences have been found on an island in May Bay of Primeau Lake near the Primeau Lake IR, occurring in the alaskite rock (Scott, 1977). An iron occurrence has also been found in alaskite to the north of the Primeau Lake IR, and a copper occurrence associated with amphibolite is located along the eastern edge of the Primeau Lake IR. Neither occurrence is currently economically relevant.

At present, there are no sand and gravel pits, or rock quarries in the ERFN area.

As noted in Section 3.3, other land uses include trapping and commercial fishing.

3.0 DESCRIPTION OF THE ENVIRONMENT

3.1 Physiography

Physiography for the ERFN area is typical for the Canadian Shield, with extensive areas of bedrock that form broad, smooth uplands and lowlands (Schreiner, 1984a). In the Canadian Shield, bedrock and thin moraine veneer (thin deposit of glacial material over bedrock) are typical. The land surface elevation within the ERFN area ranges from 631 masl (metres above sea level) in the northeast, decreasing to 385 masl towards the southeast along Sandfly Lake. Localized relief is complex due to the variations in rock type and erosion. The Flatstone Lake IR and Porter Lake Island IR are located on terrain classified as moraine veneer (Simpson, 1997), with some rock exposed at the Flatstone Lake IR area but concealed by vegetation at the Porter Lake Island IR (Schreiner, 1984b). The Haultain Lake IR area is classified as glaciofluvial hummocky terrain with sandy beaches along the east shoreline of the lake (Schreiner, 1984b). The Dipper Rapids IR area, adjacent to Dipper Lake, is on a glaciofluvial plain and the portion along White Inlet was a historical glacial meltwater channel that exhibits erosional features (Schreiner, 1984c). The Primeau Lake IR area is characterized by bedrock and hummocky moraine landscape (Schreiner, 1984c). The terrain on the Knee Lake IR and Elak Dase IR reserve areas is classified as having moraine veneer with some bedrock ridges (Schreiner, 1984c).

The southeast corner of the ERFN area includes an area of the Western Canada Sedimentary Basin, specifically, the Manville group, an undeformed, nearly flat sedimentary rock sequence that is predominantly sandstone and carbonate in composition.

Figure 6 presents the topography of the ERFN area as a digital elevation model (DEM).

3.2 Geology

3.2.1 Bedrock Geology

The bedrock geology of the ERFN area is shown on Figure 7. The ERFN reserve areas are located within or underlain by the Hearne Province of the Canadian Shield. The Hearne Province comprises the eastern portion of the Churchill Structural Province of the Precambrian Canadian Shield (SGS, 2003). The Precambrian rocks of the Hearne Province are overlain by sedimentary rocks of the Athabasca group within the Athabasca Basin and Phanerozoic sedimentary rocks within the Western Canada Sedimentary Basin. Rocks of the Canadian Shield continue southward, deepening beneath the sedimentary rocks of the Western Canada Sedimentary Basin and northward, outcropping again along the northern margin of the Athabasca Basin.

The ERFN reserve areas for all three potentially suitable sub-regions occur within the Precambrian Canadian Shield and are primarily within the Mudjatik domain, with the exception of the Elak Dase IR, which is situated within the Wollaston domain. The Haultain Lake, Flatstone Lake, Porter Lake Island and Dipper Rapids reserve areas lie on 2.65 to 2.5 billion year old felsic gneiss that was formed by metamorphism of precursor plutonic rocks and is mostly granitic in composition. The Primeau Lake reserve area lies on alaskite which is mostly granitic in composition. The Knee Lake and Elak Dase reserve areas contain both felsic gneiss and metasedimentary rocks. All Canadian Shield rocks near the ERFN reserve areas show evidence of metamorphism, regardless of domain.

3.2.2 Quaternary Geology

The Quaternary[3] geology of the ERFN area is shown on Figure 8. Regionally, the main Quaternary deposits include morainal plains, and glaciofluvial plains, with sparse occurrences of glaciolacustrine plains. Areas dominated by rock outcrop are present to the north of Primeau Lake and marshy organic areas also occur throughout low lying areas in the region. Thicknesses for the Quaternary geology in the areas of the Haultain Lake IR, Flatstone IR, Porter Lake Island IR, Dipper Rapids IR, Primeau Lake IR, Knee Lake IR and Elak Dase IR are unknown. In Sub-Region 2.1, the main Quaternary deposits are glaciofluvial and morainal with eskers mapped in and near the area (Schreiner, 1984b). Quaternary deposits in the area of Sub-Region 2.2 are morainal in nature. In Sub-Region 2.3, the Quaternary deposits near Dipper Rapids IR consist of ridged moraine and morainal plains, with minor glaciofluvial sediments, and rock outcrop along the northeast shore of Dipper Lake. The north side of the Primeau IR is adjacent to bedrock outcrop, while ridged moraine and morainal plains occur adjacent to the west, south and east sides. The Knee Lake IR is located within ridged moraine and morainal plain deposits. Rock outcrops in the area southeast of the Elak Dase IR, while glaciofluvial and morainal deposits occur to the south, west and north, respectively.

3.3 Natural Environment

3.3.1 Natural Environment Overview

The ERFN area is located in central and northern Saskatchewan and within the boreal forest. It is an important area for many First Nations and Métis communities. There is limited information about the natural environment of this area available from public data sources. Consultation with the First Nations and Métis communities in later stages of the Adaptive Phased Management process is likely to provide additional knowledge on the natural environment passed down through generations. The Northern Fur Conservation Block, which covers most of Northern Saskatchewan, is divided into 89 Fur Conservation Areas (FCAs). These are units for trapline management with a restricted number of trappers per FCA. The ERFN area is largely located in FCA N-16, with the southeast corner of the ERFN area in N-11[4] and the northwest in N-17 (Figure 3). 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 alterations or changes to the landscape.

3.3.2 Natural Areas

According to the Saskatchewan Representative Areas Network, there are no game preserves, migratory bird sanctuaries, national parks, national wildlife areas, provincial parks, special management areas or wildlife refuges identified within the ERFN area (Saskatchewan Ministry of the Environment, 2005; GeoSask, 2012). As noted in Section 2.3.1, the Gordon Lake Recreation Site is located at the south end of Gordon Lake (Figure 9). There are no other known protected areas within the ERFN area, but there are several First Nations reserve areas as described in Section 2.1. The ERFN area falls within the Northern Saskatchewan Administration District. No Official Plan was available in public databases for this area.

Mapping from GeoSask shows that the ERFN area contains 196,235 ha of wetlands, which is approximately 13% of the area (GeoSask, 2012) (Figure 9). Ground investigations and consultation with local experts and First Nations communities may identify additional wetland areas that are not part of the GeoSask data. If wetlands

[3] Quaternary refers to the last 2.6 million years of Earth's history.

[4] The full extent of FCA N-11 extends beyond the boundaries of the ERFN area to the north, as shown on Figure 3.

may be affected by a proposed activity, they may require evaluation according to the Saskatchewan Wetland Policy.

3.3.3 Terrestrial Features and Wildlife

The ERFN area falls within the Saskatchewan Wildlife Management Zones 72, 73 and 74 (Figure 9) and is located in the Churchill River Upland Eco-region of the Boreal Shield. According to mapping from GeoSask, the ERFN area contains 1,104,599 ha of woodland, which is approximately 74% of the ERFN area (GeoSask, 2012). Black spruce (*Picea mariana*) dominates the region where soils are moderately well drained, and on ridges and clay plains, while jack pine (*Pinus banksiana*) dominates dry sandy deposits (Acton et al., 1998) with a shrub layer of ericaceous shrubs and a ground cover of mosses and lichens.

Moose (*Alces alces*), black bear (*Ursus americanus*), and other mammals such as the muskrat (*Ondatra zibethicus*), beaver *(Castor canadensis)*, river otter (*Lontra canadensis)*, snowshoe hare (*Lepus americanus*) and gray wolf (*Canis lupus*) are common within the Churchill River Upland. Woodland caribou (*Rangifer tarandus*), a federally protected species, are found in moderate numbers within the ERFN area, typically in muskeg and semi-open bog habitat.

Bird diversity is considered to be moderate within the Churchill River Upland Eco-region; however, the Churchill River system contains the second highest concentration of nesting bald eagles (*Haliaeetus leucocephalus*) in North America, surpassed only by Alaska (Acton et al., 1998). There are approximately 204 bird species reported to occur in the eco-region. Some year round resident birds include: great horned owl (*Bubo virginianus*), common raven (*Corvus corax)*, spruce grouse (*Falcipennis canadensis*), ruffed grouse (*Bonasa umbellus*), black-capped chickadee (*Poecile atricapillus*), red-breasted nuthatch (*Sitta canadensis)* and great gray owl (*Strix nebulosa*) (Acton et al., 1998).

Amphibians and reptiles common in the Churchill River uplands include Canadian toad (*Bufo hemiophrys*), wood frog *(Rana sylvatica)*, and red-sided garter snake (*Thamnophis sirtalis*) (Acton et al., 1998).

3.3.4 Aquatic Features and Fish

The ERFN area encompasses numerous named and unnamed waterbodies and watercourses of varying size (Figure 9). According to mapping from GeoSask, the ERFN area contains 190,655 ha of aquatic areas, which is approximately 13% of the surface area (GeoSask, 2012). The ERFN area falls within both the central and northern zone fish management areas.

Existing fisheries information for lakes within the ERFN area was obtained from two primary information sources. The first, “Fish Species Distribution in Saskatchewan” is a document that was prepared by the Saskatchewan Government in 1991 (Liaw, 1991). This report represents a compilation of fish species information for various lakes, rivers and streams in Saskatchewan. The second information source was the “Saskfishinglakes.ca” (2011) website that summarizes much of the same information, but is supplemented with fish stocking information and more recent surveys completed by provincial agencies.

Historical fisheries information is not readily available for some larger water bodies in the ERFN area, including: Haultain Lake, English River (at Porter Lake) and Flagstone Lake. A previously operating fishing lodge on Porter Lake identified that anglers fished for northern pike (*Esox lucius)*, lake trout (*Salvelinus namaycush*), arctic grayling (*Thymallus arcticus*) and walleye (*Sander vitreus)* on Porter Lake.

Primeau Lake and Knee Lake are reported to support a commercial fishery that targets northern pike, walleye and lake whitefish (*Coregonus clupeaformis*) (SERM, 2000). Additional site specific historical fisheries information is not readily available for Dipper Rapids (located on Dipper Lake), Primeau Lake, Knee Lake and Elak Dase (east side of Knee Lake). However, each of these locations is situated on waterbodies that comprise a section of the Churchill River. Other sections of the Churchill River (e.g., Lac Île-à-la-Crosse) are known to contain northern pike, walleye, yellow perch (*Perca flavescens*), sauger (*Sander canadense*), lake trout, lake whitefish, cisco (*Coregonus artedi*), burbot (*Lota lota*), white sucker (*Catostomus commersonii*), longnose sucker (*Catostomus catostomus)*, fathead minnow (*Pimephales promelas*), logperch (*Percina caprodes*), troutperch (*Percopsis omiscomaycus*), ninespine stickleback (*Pungitius pungitius*), brook stickleback (*Culaea inconstans*), emerald shiner (*Notropis atherinoides*), spottail shiner (*Notropis hudsonius*), Iowa darter (*Etheostoma exile*), Johnny darter (*Etheostoma nigrum*) and slimy sculpin (*Cottus cognatus*) (Liaw, 1991).

3.3.5 Endangered, Threatened and Special Concern Species

The Saskatchewan Conservation Data Centre (SKCDC) maintains mapping of rare species found within the province (Figure 9). Queries were also made of the Encyclopedia of Saskatchewan (EOS, 2012). All species which are classified as endangered (END), threatened (THR) or special concern (SC) under either the provincial *Wildlife Act*, 1998 (Statutes of Saskatchewan, 1998) or the federal *Species at Risk Act* (SARA) (Government of Canada, 2012) have been listed in Table 2. These species have a home range that may extend into the ERFN area, but there may not be observations actually within the ERFN area.

Based on a search of the SKCDC database (SKCDC, 2010), no federally listed plant species are currently identified as occurring within the ERFN area, but there are several species tracked by the province. Provincially tracked plant species identified within the ERFN area include: yellow immaculate lily (*Lilium philadelphicum var. andinum f immaculata*), pale manna grass (*Torreyochloa pallida var. fernaldii*), northern groundsel (*Senecio streptanthifolius*), water lobelia (*Lobelia dortmanna*), smooth cinquefoil (*Potentilla pensylvanica var. litoralis*), large-leaved sandwort (*Moehringia macrophylla*), hairy panic-grass (*Dichanthelium acuminatum var. fasciculatum*) and michaux' sedge (*Carex michauxiana*) (SKCDC, 2010). Areas where these plants occur are indicated using green hatching on Figure 9.

Woodland caribou is a THR species that has known habitat within the ERFN area (Figure 9), although it is likely that this species may exist beyond the habitat boundary depicted where contiguous boreal forest exists.

Lake sturgeon (*Acipenser fulvescens*) is known to occur in downstream sections of the Churchill River near the Manitoba border. The lake sturgeon has been identified as Endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC, 2010). It is currently being considered for listing under the federal *Species at Risk Act* (SARA) (Government of Canada, 2012). The upstream distribution of this species, within the Churchill River system, is not known.

In addition to species that are listed on the *Wildlife Act* and SARA, species of conservation concern including those that are considered regionally rare, 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 ERFN area.

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

Common Name	Scientific Name	SKCDC Rank	Wildlife Act Status[a]	SARA Status (Schedule)[b]	Source[c]
Mammals					
Wolverine	*Gulo gulo*	S3S4		SC	SKCDC, COSEWIC
Woodland caribou	*Rangifer tarandus*	S3		THR (1)	SKCDC
Birds					
Canada warbler	*Cardellina canadensis*	S5B		THR (1)	SKBA
Common nighthawk	*Chordeiles minor*	S4S5B, S4S5M		THR (1)	SKBA, SKCDC
McCown's longspur	*Calcarius mccownii*	S3S4B		SC (1)	COSEWIC
Olive-sided flycatcher	*Contopus cooperi*	S4		THR (1)	SKBA
Peregrine falcon	*Falco peregrinus*	S1B, S4M, S2N	SC	THR (1)	SKBA
Rusty blackbird	*Euphagus carolinus*	S4B		SC (1)	SKBA
Short-eared owl	*Asio flammeus*	S3B, S2N		SC (3)	SKCDC
Whooping crane	*Grus americana*	SXB, S1M	END	END (1)	SKCDC
Reptiles and Amphibians					
Northern leopard frog	*Rana pipiens*	S3		SC (1)	SKCDC, EOS
Fish and other Aquatic Species					
Lake sturgeon	*Acipenser fulvescens*	S2B		END	COSEWIC
Invertebrates					
Monarch butterfly	*Danus plexippus*	S3B		SC	SKCDC

Notes:

S1:Extremely rare; S2: Rare; S3: Rare – uncommon; S4: Common; S5: Very common; A: accidental or casual in the province; B: breeding population in province for a migratory species; N: non-breeding population in province for a migratory species; M: transient population in province for a migratory species; H: historical occurrence without verification in last 20 years; U: status uncertain in province due to limited information; X: believed to be extinct or extirpated

blank: species not assessed; Not At Risk: species assessed to be not at risk; SC: special concern species; THR: threatened species; END: endangered species.

[a] Provincial Wild Species at Risk listed under *The Wildlife Act* (Statues of Saskatchewan,*1998).*

[b] Status listed on the federal *Species at Risk Act*; endangered (END), threatened (THR), special concern (SC) (Government of Canada, 2012).

[c] Data obtained from the Saskatchewan Conservation Data Centre (SKCDC, 2010), The Encyclopedia of Saskatchewan (EOS) (2012), Saskatchewan Bird Atlas (SKBA) (Saskatchewan Ministry of Environment, 2012) or COSEWIC Status Reports (COSEWIC, 2010).

3.3.6 First Nations and Métis Interests and Traditional Knowledge

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

This phase of the work was limited to desktop studies using publicly available sources. It is recognized that consultation with ERFN communities is required before a more complete picture can be developed.

3.4 Background Environmental Conditions

3.4.1 Air Quality

Air quality monitors across the Prairies 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) based on searches for both Division No. 18 and the postal code for the ERFN.

Additional sources that may affect background air quality include Highways 914 and 918, both of which traverse the area and the use of diesel generators in the First Nations and Métis communities.

Table 3: NPRI Regional Sources of Air Emissions

NPRI ID	Facility Name	City
23186	Richardson Pioneer Ltd. - Marshall	Marshall East
6691	TransGas Limited - Beacon Hill	Pierceland
24207	Cargill Limited - Cargill AgHorizons, Birch Hills, SK	Birch Hills
5381	Eacom Timber Corp. - Big River Sawmill	Big River
23785	TransGas Limited - St. Louis	St. Louis
6510	Vermette Wood Preservers - Vermette Wood Preservers Limited Spruce Home	Spruce Home
3348	AREVA Resources Canada Inc. - Cluff Lake Project	Division No. 18
4866	AREVA Resources Canada Inc. - McClean Lake Operations	Division No. 18
1147	CAMECO - Rabbit Lake Operation	Division No. 18
1148	CAMECO - Key Lake Operation	Division No. 18
1149	CAMECO - McArthur River	Division No. 18
19397	CAMECO - Cigar Lake Operation	Division No. 18
23273	Claude Resources Inc. - Seabee	Saskatoon
17302	NuVista Energy Ltd. - Primrose Comp Station 07-30	N/A
23618	NuVista Energy Ltd. - Primrose Comp Station 05-26	N/A

3.4.2 Background Radiation

The source of background radioactivity in the ERFN area is attributed to naturally occurring radioactive materials (NORM), specifically potassium, uranium and thorium-bearing minerals. The background radioactivity for the ERFN area is presented on Figure 10. Statistically, the majority of the dose rate in the ERFN area ranges from approximately 10 to 55 nGy/h, with an average of approximately 30 nGy/h. This range of dose rates and average are consistent with regional dose rates for northern Saskatchewan. Dose rate highs are generally related to granitic geology and areas with thin overburden cover. As shown on Figure 10, dose rate highs are

generally found in areas where bedrock is near or at surface and dose rate lows are found where there is thicker overburden or in the Western Canadian Sedimentary Basin.

Additional detailed information is available in the geophysical interpretation report (PGW, 2013).

3.4.3 Soil Quality

There is no specific available information on background soil quality in the ERFN area. It would be expected that the soil would have concentrations below guideline limits suggested by the Canadian Council of Ministers of the Environment (CCME, 1999), given that this is an area of largely undisturbed natural forest.

3.4.4 Water Quality

No information on water quality is publicly available for the reserve areas within Sub-Regions 2.1, 2.2 and 2.3. Water quality of the water supply to Patuanak, which is drawn from the Churchill River, was measured in April 2012. As reported by the Government of Saskatchewan through the SaskH_2O website, measured parameters applicable to drinking water quality were in compliance with Saskatchewan Drinking Water Quality Standards and Objectives for the Patuanak Waterworks (SaskH_2O, 2012).

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

3.4.5 Lake Sediment Chemistry

The desktop review did not identify any current information related to lake sediment chemistry for the ERFN area.

3.4.6 Potential Sources of Pollutants

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

According to SaskH_2O, a website developed by the Government of Saskatchewan to provide information and services related to water, there are no permitted or approved waste disposal grounds within the ERFN area (Government of Saskatchewan, 2012). The nearest permitted waste disposal ground is in the Northern Village of Pinehouse approximately 20 km south of the ERFN area. However, SaskH_2O (Government of Saskatchewan, 2012), does identify one landfill in Patuanak and a closed landfill in the same area (Table 4).

Table 4: Landfills in the English River First Nation Area

OPR ID	Location	Status
—	Patuanak, Churchill Region	Operating
—	Patuanak, Churchill Region	Closed

Source: Government of Saskatchewan (2012)

Transportation corridors, such as Highways 914 and 918, secondary roads and logging roads traverse the ERFN 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, Patuanak contains a local airport which is 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

Watershed boundaries and surface water drainage for the ERFN area are shown on Figure 11. All of the reserve areas in Sub-Regions 2.1, 2.2 and 2.3 are within the Churchill River Basin, which drains into Hudson Bay. The sub-basins extending into the ERFN area are drained by the Churchill, Haultain and Mudjatik rivers.

The Churchill River begins at the outlet of Churchill Lake near the community of Buffalo Narrows and flows from west to east through Saskatchewan and Manitoba. Tributaries entering the Churchill River from the north flow through exposed Canadian Shield terrain, while many tributaries entering the Churchill River from the south flow through the Boreal Plain. Haultain Lake drains into the Haultain River, which flows south and joins the Churchill River downstream of Knee Lake. The Porter Lake Island IR is located beside Porter Lake, which drains into Porter Creek and the southward-flowing Mudjatik River that in turn enters the Churchill River upstream of Dipper Lake. The Flatstone Lake IR is on the shores of Flatstone Lake, which drains into the Mudjatik River just before it enters the Churchill River. The Dipper Rapids IR is located adjacent to White Inlet on the west shores of Dipper Lake on the Churchill River. The Primeau Lake IR is on the south shores of Primeau Lake on the Churchill River. The Knee Lake IR is on the north shores of Knee Lake on the Churchill River, and the Elak Dase IR is north of the Churchill River near the Haultain River inflow. The Wapachewunak IR is located near the main segment of the Churchill River system at the north end of Lac Île-à-la-Crosse. Given moderately-sized catchment areas and low lying areas along major rivers, there is a potential risk of significant flooding in parts of the ERFN area.

3.6 Groundwater and Wells

Information concerning groundwater in the ERFN area was obtained from the Saskatchewan Watershed Authority (SWA) Water Well Record (WWR) database (SWA, 2009). The locations of known water wells are shown on Figure 11.

There is no record of groundwater use in Sub-Regions 2.1, 2.2 and 2.3. A search of the SWA WWR database (SWA, 2009) indicated that there are wells recorded in the ERFN area at two locations, clustered within the Western Canada Sedimentary Basin approximately 25 km west of the Dipper Rapids IR (Figure 11). There are four well records for one of the locations shown and two at the other location. These wells are located within the village of Patuanak, in closer proximity to the Wapachewunak IR and within the ERFN area, but outside of Sub-Region 2.3. Five are recorded as domestic or municipal withdrawal wells and one as a water test hole. All appear to have been completed in the overburden.

3.6.1 Overburden Aquifers

There is no available information on the presence, extent or other characteristics of overburden aquifers of all three sub-regions in the ERFN area. In general, the main Quaternary deposits of this region include morainal, glaciofluvial and glaciolacustrine plains, although the thickness of these deposits is unknown. The groundwater

table is expected to be shallow in low-lying areas, and it is expected that shallow unconfined groundwater flow generally parallels surface water drainage patterns.

3.6.2 Bedrock Aquifers

No information is available on deep bedrock groundwater conditions in Sub-Regions 2.1, 2.2 and 2.3. In general, crystalline bedrock formations in Saskatchewan do not readily permit groundwater flow, except as fracture flow. Experience from other areas in the Canadian Shield has shown that active groundwater flow is generally confined to shallow fractured localized systems. In Ontario, Singer and Cheng (2002) studied the groundwater movement in shallow bedrock of the Canadian Shield and reported that it is controlled by the secondary permeability created by fractures. Everitt (1999) reported that in Manitoba's Lac du Bonnet batholith[5], groundwater movement is largely controlled by a fractured zone down to about 200 m depth. It is expected that groundwater flow within Canadian Shield rocks in Saskatchewan will be similar to those found in other locations within the Canadian Shield.

The bedrock in the ERFN area is not considered to be a significant groundwater resource. There are currently no existing bedrock wells in the area, and it is unlikely to be used for such purposes in the future.

3.7 Climate and Meteorology

The ERFN area has a sub-Arctic climate, with long, cold winters (about 6 to 7 months) and cool to mild summers. The flow of air masses is dominated by mainly Arctic airstreams. The long cold winters and cool summers in the region are attributed to the long distance from a significant body of water to moderate temperatures, combined with its northerly latitude. Despite the overall cool temperature regime, there are periods in the summer season when temperatures can reach greater than 30^{o}C.

Precipitation falls mainly from eastward moving weather fronts from the Arctic and interior regions of the continent. Most precipitation falls between June through September and are associated with continental weather fronts moving from the pacific crossing the prairies bringing showery weather or scattered thunderstorms. In the spring, fall and winter, the driest time of the year, the area is dominated by Arctic low pressure areas moving southward into the region bringing very cold temperatures and very little overall precipitation.

Climatological information presented in this section is based on meteorological data from Environment Canada's meteorological station located in Cree Lake, Saskatchewan approximately 110 km northwest of the ERFN area at similar elevation, which has more than 30 years of continuous data (EC, 2011b). Parameters that are measured at the Cree Lake station include: temperature, precipitation, wind and relative humidity.

3.7.1 Temperature

Temperature data were obtained from Environment Canada's 1971-2000 climate normals for the Cree Lake meteorological station (EC, 2011b). Figure 12 represents monthly temperatures for the ERFN area, displaying daily average, maximum and minimum and extreme values over the calendar year.

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

3.7.2 Precipitation

Figure 13 presents monthly precipitation data obtained from Environment Canada's 1971-2000 climate normals for the Cree Lake meteorological station, including total rainfall, rainfall, snowfall and all-time extreme values over the calendar year (EC, 2011b).

3.7.3 Wind

Table 5 presents the monthly wind data obtained from Environment Canada's 1971-2000 climate normals for the Cree Lake meteorological station (EC, 2011b). Average wind speed and direction are average for each month over the calendar year. The dominant wind direction is from the southwest, with winds from the northwest dominant during the winter and from the northeast occasionally dominant during the spring months.

Table 5: Monthly Wind Normals for Cree Lake, Saskatchewan

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Speed (km/h)	9.6	9.8	11	11.5	11.5	11.8	11.3	11.4	12.8	12.9	10.8	9.4	11.1
Most Prevalent Direction	NW	NW	NW	E	NE	NE	SW	SW	SW	SW	SW	W	SW

3.8 Natural Hazards

3.8.1 Earthquakes and Seismicity

The ERFN 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 ERFN area has a low seismic hazard rating (NRCan, 2010). According to the National Earthquake Database (NEDB) for the period between 1985 and 2011 (NRCan, 2012) there have been no earthquakes in the ERFN area. The largest earthquake recorded in Saskatchewan, at a magnitude of 5.5, occurred in 1909 near the USA border (about 800 km from EFRN) (NRCan, 2012).

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

3.8.2 Tornadoes and Hurricanes

As noted in Table 5, average monthly wind speeds in the ERFN area are low, ranging from 9 to 13 km/hr. The ERFN 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 km^2), but where there is a potential for F0-F1 tornadoes (Sills et al., 2012). The ERFN area is situated too far away from the Atlantic and Pacific oceans to be susceptible to hurricanes. The National Building Code of Canada recommends a design 1/50 maximum hourly wind pressure for the northern Saskatchewan and Alberta area of 0.35 kPa, which are low to typical values for Saskatchewan and Alberta (NRC, 2010).

3.8.3 Drought and Flooding

According to precipitation climate normals for the region (Figure 13), the ERFN area experiences on average between 15 and 90 mm of precipitation each month, and is therefore unlikely to experience drought conditions that would affect the viability of local water sources. The ERFN area can experience dry periods in the summer months that may result in an increased forest fire risk. The single day extreme rainfall and snowfall events on

record at the Cree Lake station (Figure 13) are 72 mm of rain and 31 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 11, the ERFN area lies within a number of moderately sized watersheds which form a part of the Churchill River Basin. Given moderate sized catchment areas and low lying areas along major rivers, there is a potential risk of significant flooding in parts of the ERFN area. 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 13, the Cree Lake station receives on average about 180 cm of snowfall per year, primarily between the months of October and April. No single month receives an average snowfall greater than 32 cm. The highest single day snowfall accumulation on record is 31 cm, recorded on November 21, 1990. The National Building Code of Canada recommends a design 1/50 snow load (S_s + S_r) for the Fort McMurray area of 1.5 kPa, which is assumed to be a similar value for northern Saskatchewan (NRC, 2010). Local lakes and waterbodies freeze over in the winter months in the ERFN, as average daily temperatures from October to April typically range from -23 to -0^{0}C.

3.8.5 Forest Fires and Lightning

Within heavily forested areas such as the ERFN area there is a risk of forest fires. Locations where forest fires have occurred in the vicinity of the ERFN area between 1976 and 2010 affecting an area of greater than 200 ha are shown on Figure 5. These forest fires combine to comprise greater than 50% of the total ERFN 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 ERFN area and lightning strikes are not uncommon in the summer months.

3.8.6 Landslides and Tsunamis

Moderately steep slopes in the ERFN area, where present, are generally comprised of crystalline rock with only a thin veneer of soil cover. Due to the physical nature of these slopes, combined with typically modest precipitation and very low seismicity, there is no landslide risk for the EFRN area. There is also no risk of tsunamis in the EFRN 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 English River First Nation (ERFN) and surrounding area.

Situated in Division No. 18, the ERFN has a population of 1,480 (AANDC, 2013). The ERFN has a sub-Arctic climate, with very long and cold winters and cool to mild summers. Precipitation falls mainly in the summer months (June through September) in the form of locally driven showers and thunderstorms that are associated with low pressure systems, as well as weather fronts moving from the Pacific into western Canada and moving through the northern Prairies.

There are a number of First Nations and Métis communities and organizations in the ERFN area including Birch Narrows First Nation, Buffalo River Dene First Nation, Canoe Lake First Nation, Clearwater River Dene Nation, Flying Dust First Nation, Makwa Sahgaiehcan First Nation, Ministikwan Lake First Nation (formerly known as Island Lake First Nation) and Waterhen Lake First Nation; all are signatories to Treaty 6, 8 or 10. Métis Locals in the area include Patuanak #82, Beauval #37, Canoe River #174, Cole Bay #41, Kineepik– Pinehouse #9 and Sakitawak – Île-à-la-Crosse #21; all are located within Métis Nation-Saskatchewan Northern Region III.

The ERFN area is typical for the Canadian Shield, with extensive areas of bedrock that form broad, smooth uplands and lowlands (Schreiner, 1984a). The ERFN reserve areas for all three sub-regions occur within the Precambrian Canadian Shield and are primarily within the Mudjatik domain, with the exception of the Elak Dase IR, which is situated within the Wollaston domain. The Haultain Lake, Flatstone Lake, Porter Lake Island and Dipper Rapids reserve areas lie on 2.65 to 2.5 billion year old felsic gneiss that is mostly granitic in composition. The Primeau Lake reserve area lies on alaskite which is mostly granitic. The Knee Lake and Elak Dase reserve areas contain both felsic gneiss and metasedimentary rocks. All Canadian Shield rocks near the ERFN reserve areas show evidence of metamorphism, regardless of domain. Regionally, the main Quaternary deposits include morainal plains, and glaciofluvial plains, with sparse occurrences of glaciolacustrine plains.

There is no record of metallic mineral production near the ERFN reserve areas, with the exception of uranium from the Athabasca Basin, north of the ERFN area. Past exploration has occurred in the areas of Dipper and Porter Lakes on a reconnaissance level. Gold occurrences have been associated with mafic granulites and ultramafic metasedimentary rocks in the Porter Lake area, in the area of the Porter Lake Island IR; however, there are no occurrences within the area of Porter Lake Island IR that are currently economically proven. Iron and molybdenum occurrences have also been identified.

The main transportation routes through the ERFN area include Highway 918 which travels north into the community of Patuanuk in the Wapachewunak IR, as well as Highway 914 running in a north-south direction along the eastern side of the ERFN area. There is one airport within the ERFN area at Patuanak. No rail or transmission lines were identified within the ERFN area.

Most of the ERFN area is located within the Northern Provincial Forest North (Government of Saskatchewan, 2007). The Northern Provincial Forest North makes up 63% of provincial forest in Saskatchewan and is designated as non-commercial (Government of Saskatchewan, 2007). The southwest of the ERFN area includes the northern portion of the North West Communities TSL, which makes up 6% of provincial commercial forest in Saskatchewan (Government of Saskatchewan, 2007). Commercial forest makes up 37% of total provincial forest (Government of Saskatchewan, 2007).

The ERFN area is located in central and northern Saskatchewan's boreal forest. The ERFN area is located in the Churchill River Upland Eco-region of the Boreal Shield. There are no federally listed plant species currently identified as occurring within the ERFN area, but there are several species tracked by the province. Woodland caribou is a threatened species that has known habitat within the ERFN area, and it is likely that this species may also exist beyond the habitat boundary depicted where contiguous boreal forest exists. Lake sturgeon is known to occur in downstream sections of the Churchill River near the Manitoba border. The lake sturgeon has been identified as Endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and is currently being considered for listing under the federal *Species at Risk Act*.

All of the reserve areas in Sub-Regions 2.1, 2.2 and 2.3 are within the Churchill River Basin, which drains into Hudson Bay. The sub-basins extending into the ERFN area are drained by the Churchill, Haultain and Mudjatik rivers. Primeau Lake and Knee Lake are reported to support a commercial fishery that targets northern pike, walleye and lake whitefish (SERM, 2000). Site specific historical fisheries information is not readily available for Dipper Rapids, Primeau Lake, Knee Lake and Elak Dase; however, each of these locations is situated on waterbodies that comprise a section of the Churchill River. Other sections of the Churchill River are known to contain northern pike, walleye, yellow perch, sauger, lake trout, lake whitefish, cisco, burbot, white sucker, longnose sucker, fathead minnow, logperch, troutperch, ninespine stickleback, brook stickleback, emerald shiner, spottail shiner, Iowa darter, Johnny darter and slimy sculpin.

No information was publicly available regarding potable water supply within Sub-Regions 2.1, 2.2 or 2.3 of the ERFN area. The SWA water well database contains six water well records at two locations within the village of Patuanak, outside of Sub-Region 2.3. Five are recorded as domestic or municipal withdrawal wells and one as a water test hole. All appear to have been completed in the overburden.

Air, soil and surface water quality within the ERFN area are expected to be within the normal range for Saskatchewan. Sources of background radioactivity 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 Saskatchewan.

The Saskatchewan Ministry of Tourism, Parks, Culture and Sport as well as the National Historic Sites Database identified 19 known archaeological sites in the ERFN area. Fifteen of the sites are pre-contact artifact find and scatter sites; of the remainder, one is a pre-contact artifact/feature combination sites, one is historic recurrent feature site and one a traditional cultural location. Two heritage resources have insufficient information to be given a site type designation.

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Report Signature Page

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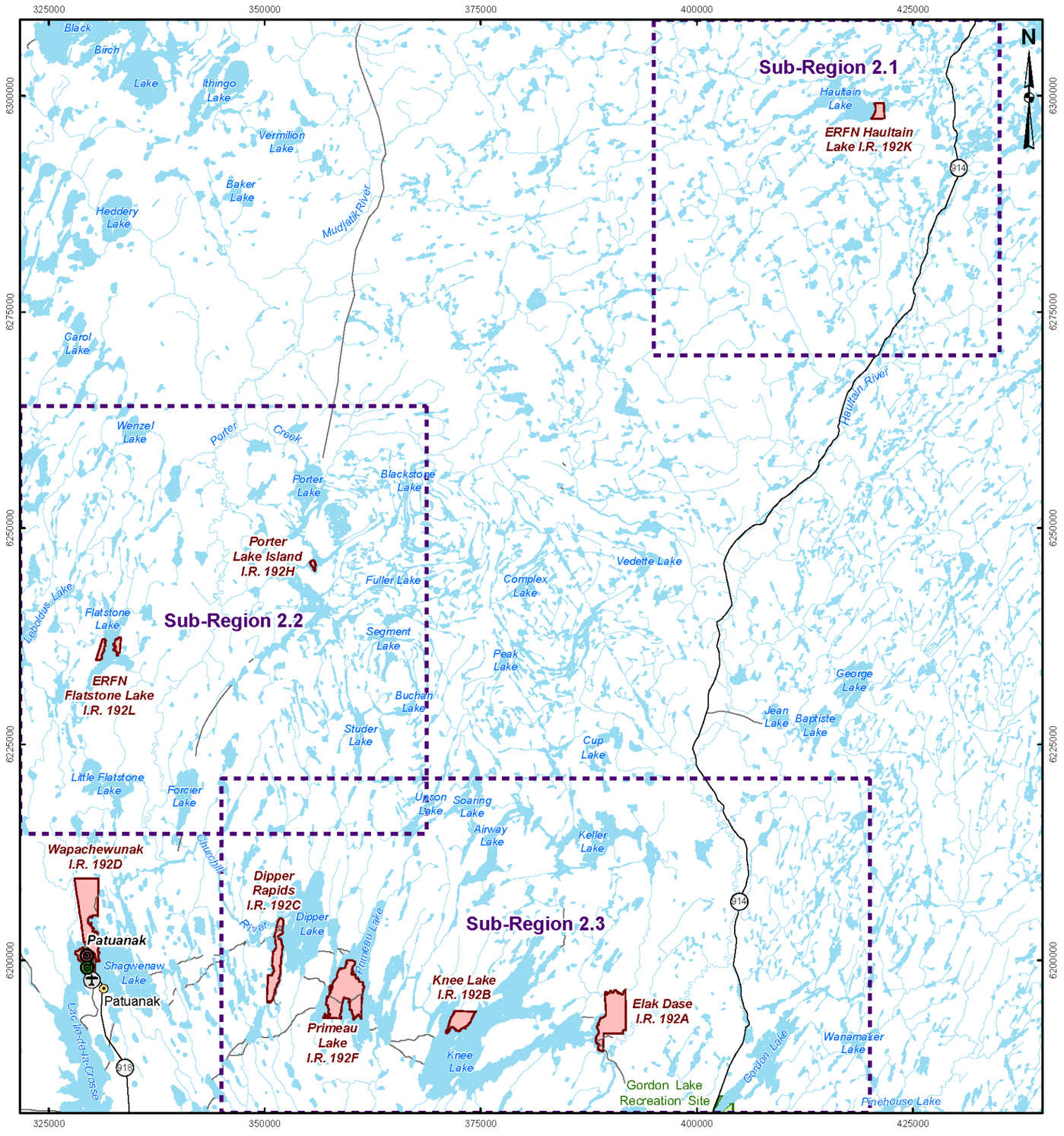
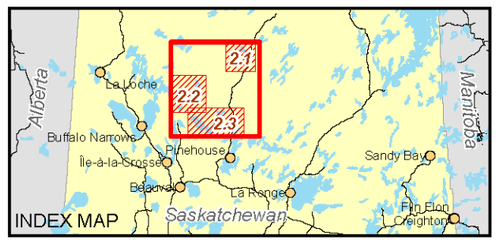


LEGEND

- Community
- Airstrip
- Domestic Waste Site
- Waste Water Treatment Plant
- Main Road
- Local Road
- Watercourse
- Waterbody
- Park and Recreation Area
- Federal Land - Indian Reserve
- English River First Nation Detailed Area



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Administrative Boundaries - Information Services Corporation of Saskatchewan,
Administrative Boundary Overlays (2012)
Projection: Universal Transverse Mercator
Datum: NAD 83 Coordinate System: UTM Zone 13N

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SCALE 1:525,000 KILOMETRES

PROJECT
Environment Report
English River First Nation, Saskatchewan

TITLE
English River First Nation and Surrounding Lands

Golder Associates
Mississauga, Ontario

PROJECT NO. 12-1152-0026		SCALE AS SHOWN	REV. 0.0
DESIGN	PM	3 May. 2012	
GIS	PMJB	13 Aug. 2013	
CHECK	JH	13 Aug. 2013	
REVIEW	GWS	13 Aug. 2013	

FIGURE: 1

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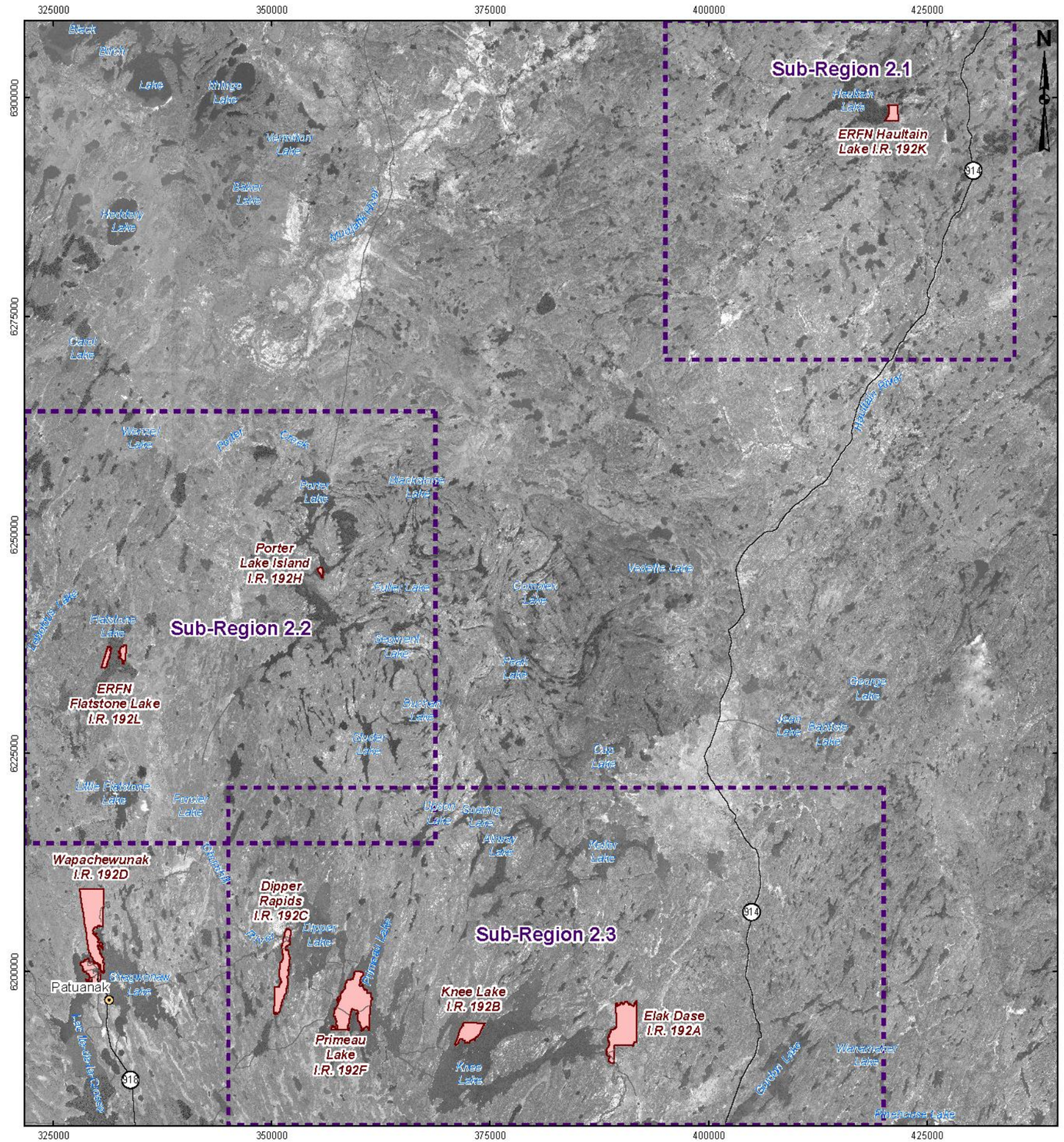
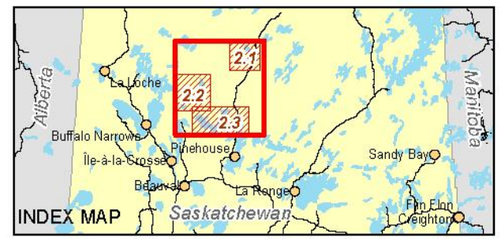


LEGEND

- Community
- Main Road
- Local Road
- Federal Land - Indian Reserve
- English River First Nation Detailed Area



REFERENCE

Basedata - CANVEC V10 Topographic Mapping of Canada (1:50000)
Administrative Boundaries - Information Services Corporation of Saskatchewan, Administrative Boundary Overlays (2012)
SPOT Imagery courtesy of GeoBase
Projection: Universal Transverse Mercator Datum: NAD 83
Coordinate System: UTM Zone 13N

10 5 0 10 20 30
SCALE 1:525,000 KILOMETRES

PROJECT
Environment Report
English River First Nation, Saskatchewan

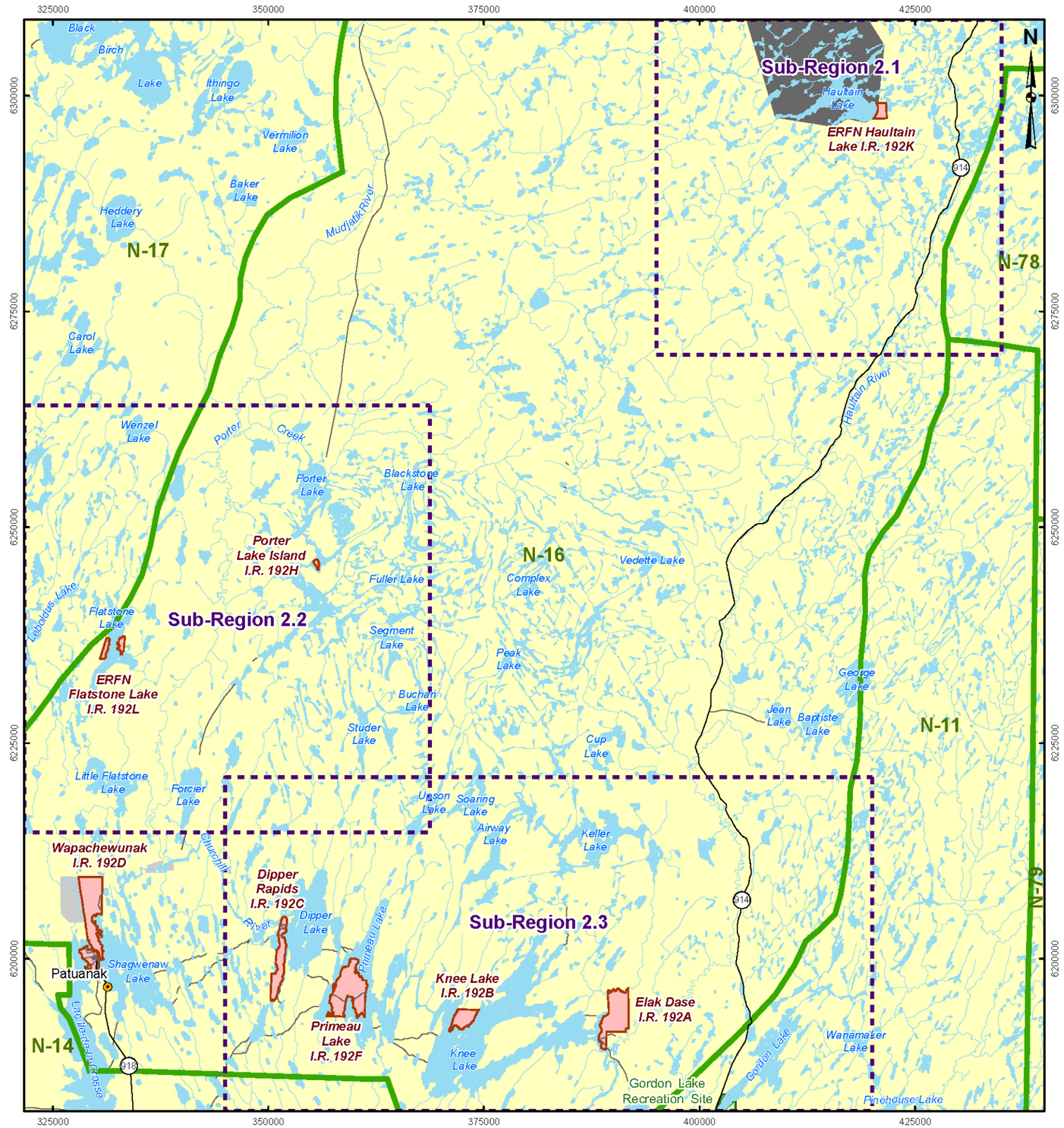
TITLE
Satellite Imagery of the English River First Nation

Golder Associates
Mississauga, Ontario

PROJECT NO. 12-1152-0026			SCALE AS SHOWN	REV. 0.0
DESIGN	PM	3 May, 2012		
GIS	PM/JB	13 Aug, 2013		
CHECK	JH	13 Aug, 2013		
REVIEW	GWS	13 Aug, 2013		

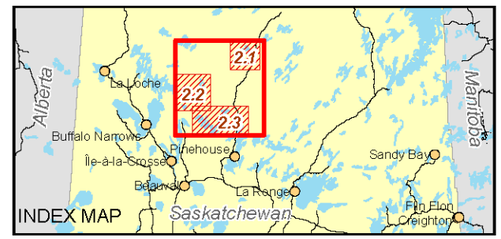
FIGURE: 2

G:\Projects\2012\12-1152-0026_NWMO_Phase1_Feasibility\GIS\MXD\Reporting\Env_Safety_Report\ERFN\ERFNSatelliteImagery.mxd



LEGEND

- Community
- Main Road
- Local Road
- Watercourse
- Waterbody
- Park and Recreation Area
- Federal Land - Indian Reserve
- Crown Land
- Private Land
- Crown Reserves
- Fur Conservation Area (N-11, N-14, N-16, N-17, N-78, N-79)
- English River First Nation Detailed Area



REFERENCE

Basedata - CANVEC V10 Topographic Mapping of Canada (1:50000)
Administrative Boundaries - Information Services Corporation of Saskatchewan, Administrative Boundary Overlays (2012)
Crown Reserves - Saskatchewan Geological Atlas
Cadastral Data - Information Services Corporation of Saskatchewan, 2008
Fur Conservation Areas - Saskatchewan Environment Administrative Map, Saskatchewan Environment, April 2002
Projection: Universal Transverse Mercator
Datum: NAD 83 Coordinate System: UTM Zone 13N

10 5 0 10 20 30
SCALE 1:525,000 KILOMETRES

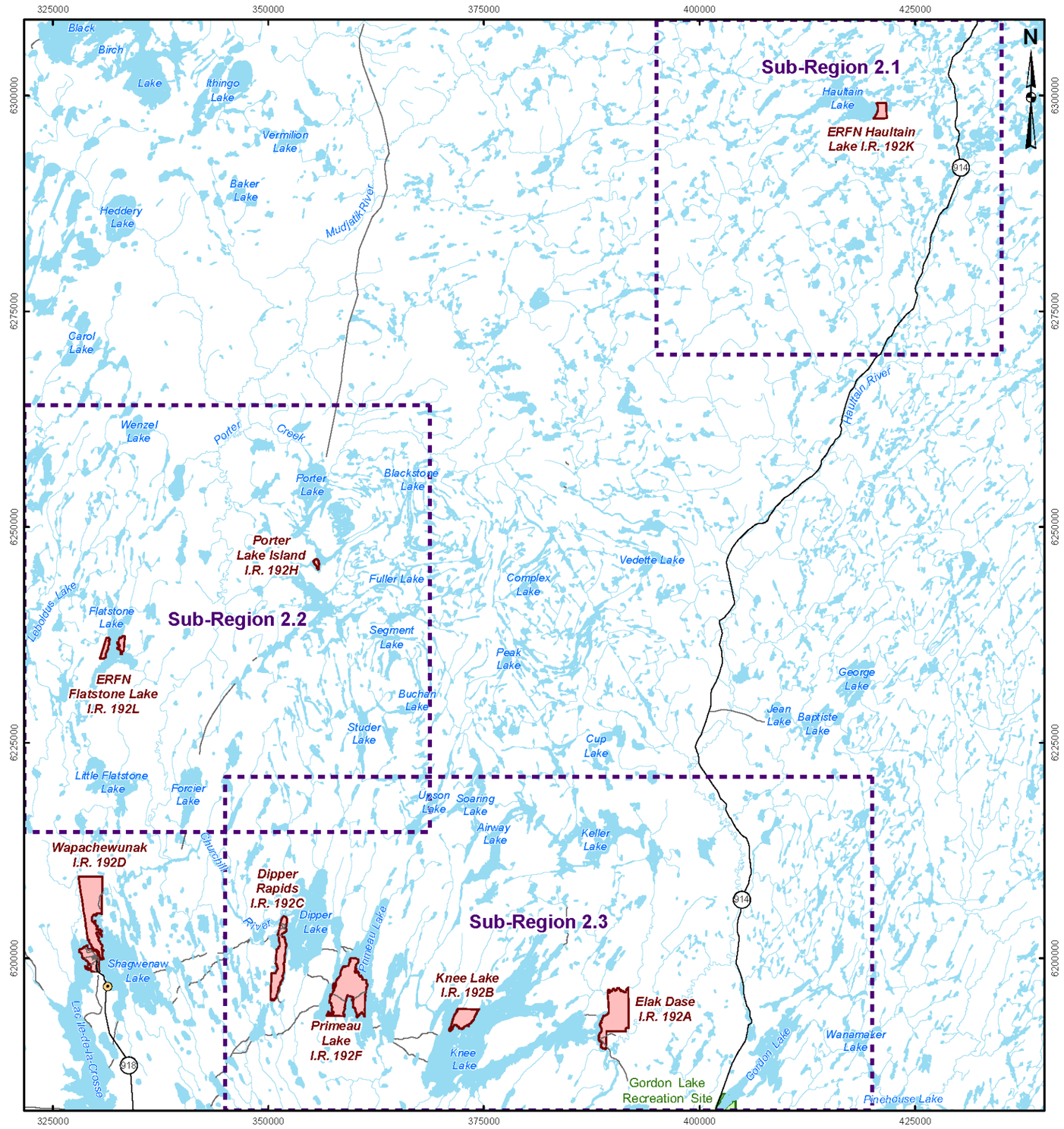
PROJECT
Environment Report
English River First Nation, Saskatchewan

TITLE
English River First Nation Land Ownership

Golder Associates
Mississauga, Ontario

PROJECT NO. 12-1152-0026			SCALE AS SHOWN		REV. 0.0
DESIGN	PM	3 May, 2012	**FIGURE: 3**		
GIS	PMJB	13 Aug, 2013			
CHECK	JH	13 Aug, 2013			
REVIEW	GWS	13 Aug, 2013			

G:\Projects\2012\12-1152-0026_NWMO_Phase1_Feasibility\GIS\MXDs\ReportingEnv_Safety_Report\ERFNERFNLandOwnership.mxd



LEGEND

- Community
- Main Road
- Local Road
- Watercourse
- Waterbody
- Federal Land - Indian Reserve
- Park and Recreation Area
- English River First Nation Detailed Area

REFERENCE

Basedata - CANVEC V10 Topographic Mapping of Canada (1:50000)
Administrative Boundaries - Information Services Corporation of Saskatchewan,
Administrative Boundary Overlays (2012)
Projection: Universal Transverse Mercator
Datum: NAD 83 Coordinate System: UTM Zone 13N

10 5 0 10 20 30
SCALE 1:525,000 KILOMETRES

PROJECT
Environment Report
English River First Nation, Saskatchewan

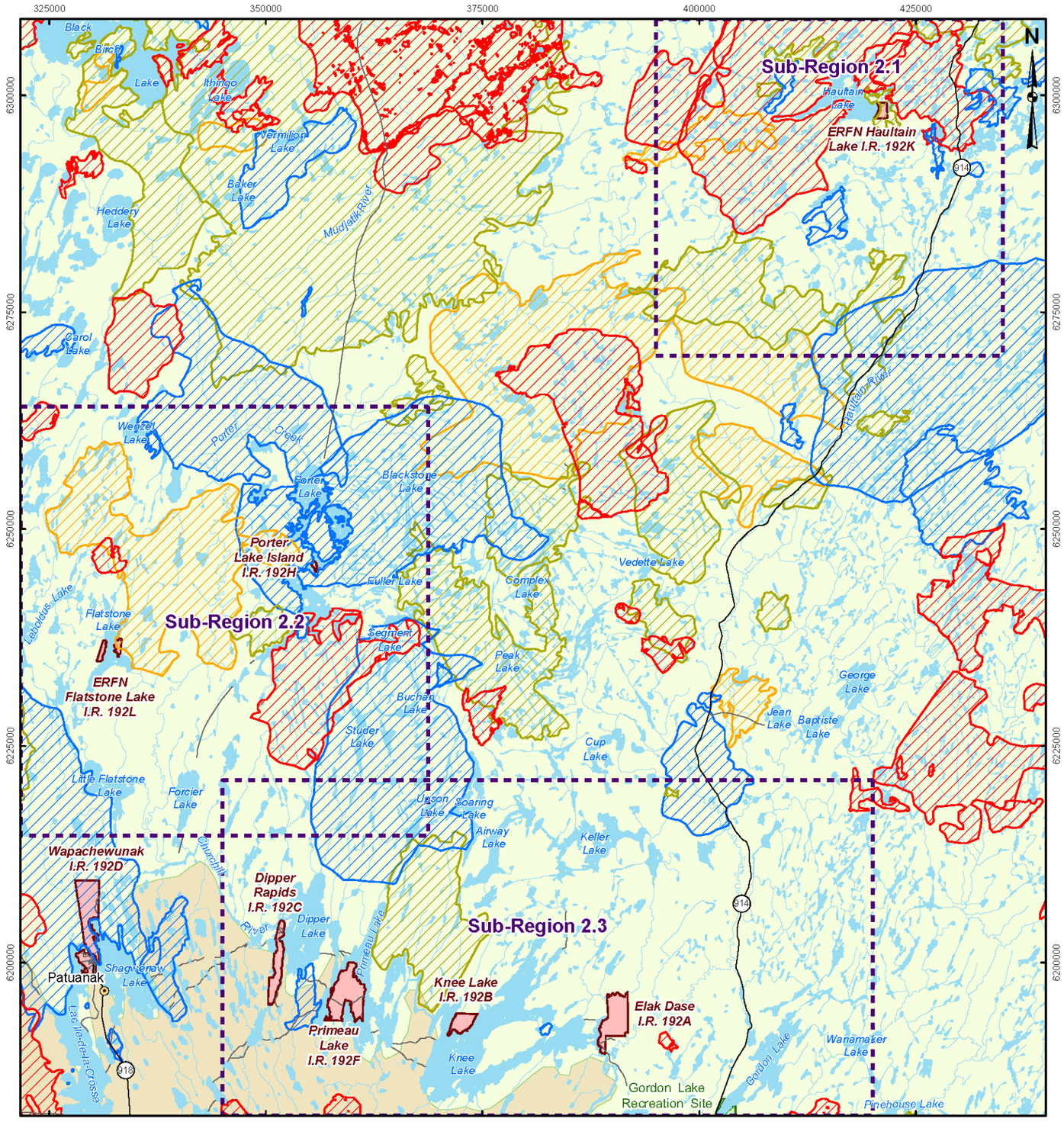
TITLE
English River First Nation - Parks and Protected Lands

Golder Associates
Mississauga, Ontario

PROJECT NO. 12-1152-0026			SCALE AS SHOWN	REV. 0.0	
DESIGN	PM	3 May. 2012			
GIS	PMJB	13 Aug. 2013			
CHECK	JH	13 Aug. 2013			
REVIEW	GWS	13 Aug. 2013			

FIGURE: 4

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



LEGEND

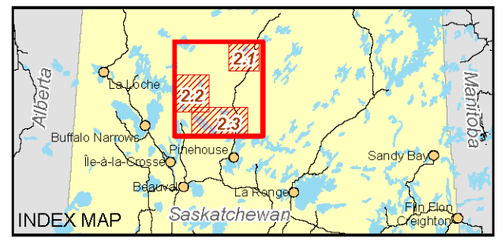
- Community
- Main Road
- Local Road
- Watercourse
- Waterbody
- Federal Land - Indian Reserve
- Park and Recreation Area
- English River First Nation Detailed Area

Forest Fire Areas (greater than 200 hectares)

- 1976 - 1980
- 1981 - 1990
- 1991 - 2000
- 2001 - 2010

Crown Forest Areas

- North West Communities TSL
- Northern Provincial Forest North



REFERENCE

Basedata - CANVEC V10 Topographic Mapping of Canada (1:50000)
Administrative Boundaries - Information Services Corporation of Saskatchewan, Administrative Boundary Overlays (2012)
Crown Forest - Saskatchewan Crown Forest Areas, Forest Service, Saskatchewan Environment, 2006
Forest Fire Areas - Canadian Forest Service. 2010. Canadian National Fire Database - Agency Fire Data. Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre, Edmonton, Alberta.
Projection: Universal Transverse Mercator
Datum: NAD 83 Coordinate System: UTM Zone 13N

10 5 0 10 20 30
SCALE 1:525,000 KILOMETRES

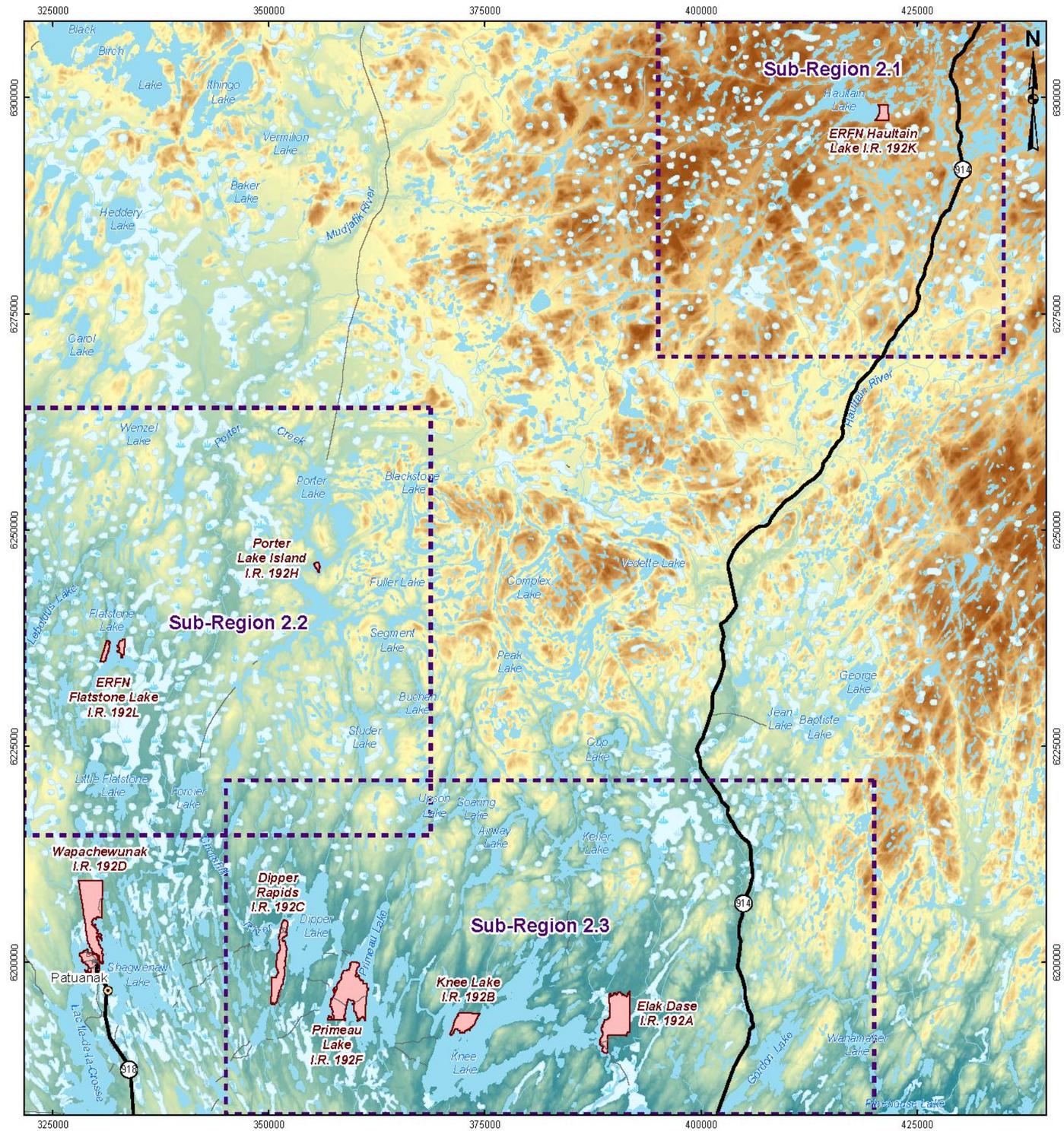
PROJECT
Environment Report
English River First Nation, Saskatchewan

TITLE
English River First Nation - Crown Forest Areas

Golder Associates
Mississauga, Ontario

PROJECT NO. 12-1152-0026			SCALE AS SHOWN	REV. 0.0
DESIGN	PM	3 May. 2012	
GIS	PMJB	13 Aug. 2013	FIGURE: 5
CHECK	JH	13 Aug. 2013	
REVIEW	GWS	13 Aug. 2013	

G:\Projects\2012\12-1152-0026_NWMO_PhaseI_Feasibility\GIS\MXDs\Reporting\Env_Safety_Report\ERFNIERFNCrownForestAreas.mxd

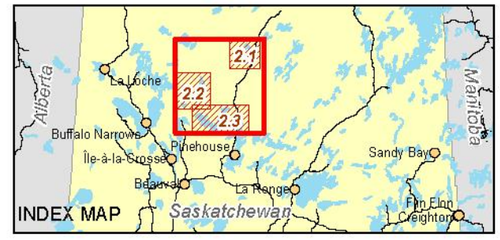


LEGEND

- Community
- Main Road
- Local Road
- Waterbody
- Wetland
- Federal Land - Indian Reserve
- English River First Nation Detailed Area

Elevation (masl)

625
575
525
475
425
375



REFERENCE

Basedata - CANVEC V10 Topographic Mapping of Canada (1:50000)
Administrative Boundaries - Information Services Corporation of Saskatchewan, Administrative Boundary Overlays (2012)
Digital Elevation Model - CDED slope raster: Geobase.ca (1:50,000)
Projection: Universal Transverse Mercator
Datum: NAD 83 Coordinate System: UTM Zone 13N

10 5 0 10 20 30
SCALE 1:525,000 KILOMETERS

PROJECT
Environment Report
English River First Nation, Saskatchewan

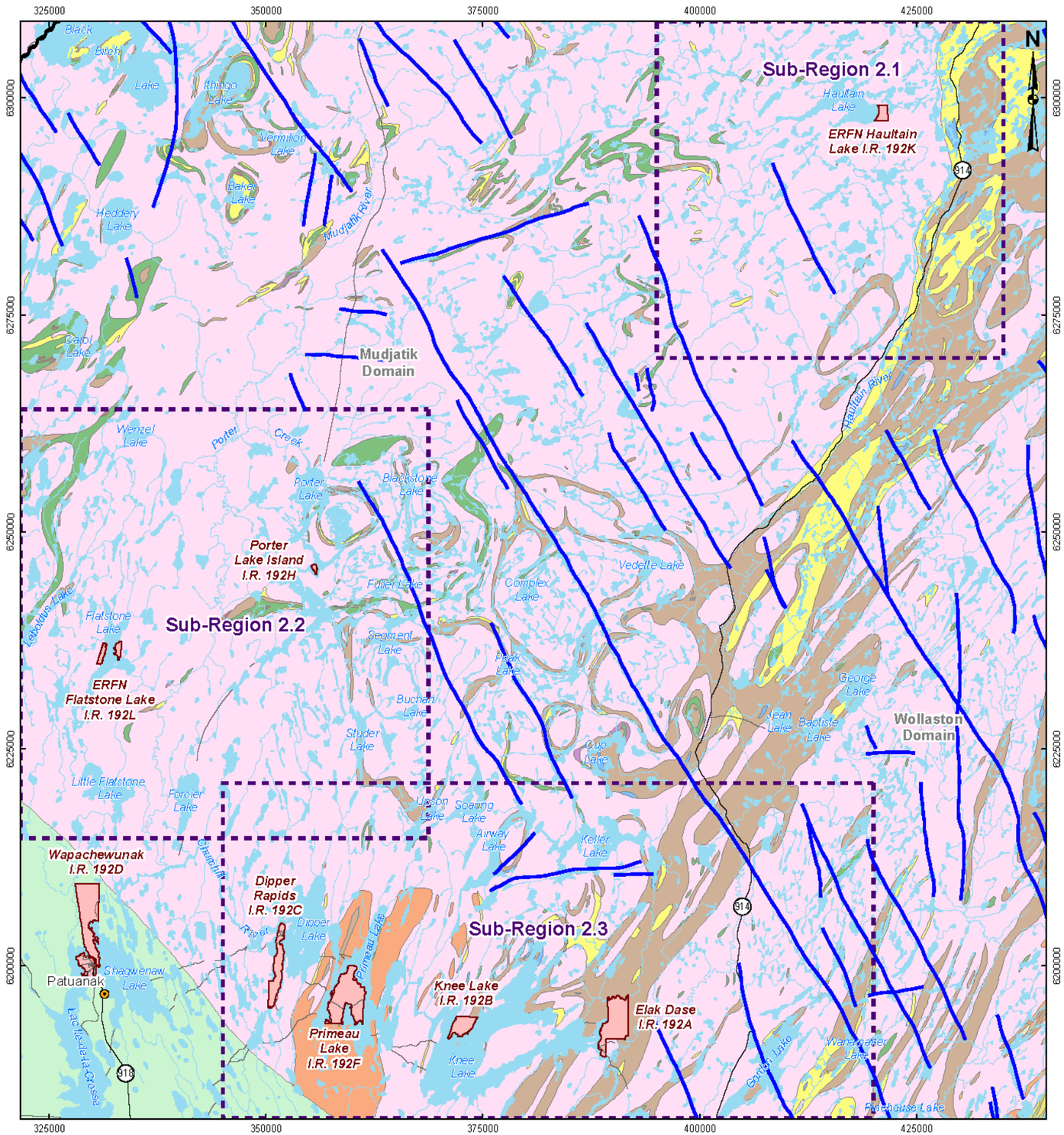
TITLE
Digital Elevation Model (DEM) of the English River First Nation

Golder Associates
Mississauga, Ontario

PROJECT NO. 12-1152-0026			SCALE AS SHOWN	REV. 0.0
DESIGN	PM	3 May. 2012	
GIS	PM/JB	13 Aug. 2013	
CHECK	JH	13 Aug. 2013	
REVIEW	GWS	13 Aug. 2013	

FIGURE: 6

G:\Projects\2012\12-1152-0026_NWMO_Phase1_FeasibilityVGIS\MXDsReporting\Env_Safety_Report\ERFN\ERFNDigitalElevationModel.mxd



LEGEND

- Community
- Main Road
- Local Road
- Watercourse
- Waterbody
- Federal Land - Indian Reserve
- English River First Nation Detailed Area
- Fault
- Shear Zone

Western Canada sedimentary basin
- Km - Manville Group

Mudjatik domain
- Mcn - Calc-silicate rock, marble
- Mfn - Felsic gneiss
- Mg - Leucogranite
- Mif - Banded iron formation
- Mm - Amphibole gneiss
- Mpsn - Pelitic, psammopelitic and psammitic gneisses
- Mm - Psammitic to meta-arkosic gneiss
- Mu - Ultramafic rock

Virgin River domain
- Vfn - Felsic gneiss

Wollaston domain
- Wcb - Massive coarse grained calc-silicate
- Wcn - Calc-silicate rock, marble
- Wfn - Felsic gneiss
- Wg - Leucogranite, granite, monzogranite, granodiorite
- Wm - Amphibolite
- Wma - Amphibolite (Archean)
- Wpsn - Pelitic, psammopelitic gneiss
- Wpx - Migmatized supracrustal rocks
- Wq - Metaquartzite
- Wr - Meta-arkose
- Wm - Psammitic to meta-arkosic gneiss
- Wvn - Biotitic mafic gneiss

REFERENCE

Basedata - CANVEC V10 Topographic Mapping of Canada (1:50000)
Administrative Boundaries - Information Services Corporation of Saskatchewan, Administrative Boundary Overlays (2012)
Bedrock Geology - Saskatchewan Geological Atlas (1:250,000)
Projection: Universal Transverse Mercator
Datum: NAD 83 Coordinate System: UTM Zone 13N

10 5 0 10 20 30
SCALE 1:525,000 KILOMETRES

PROJECT
Environment Report
English River First Nation, Saskatchewan

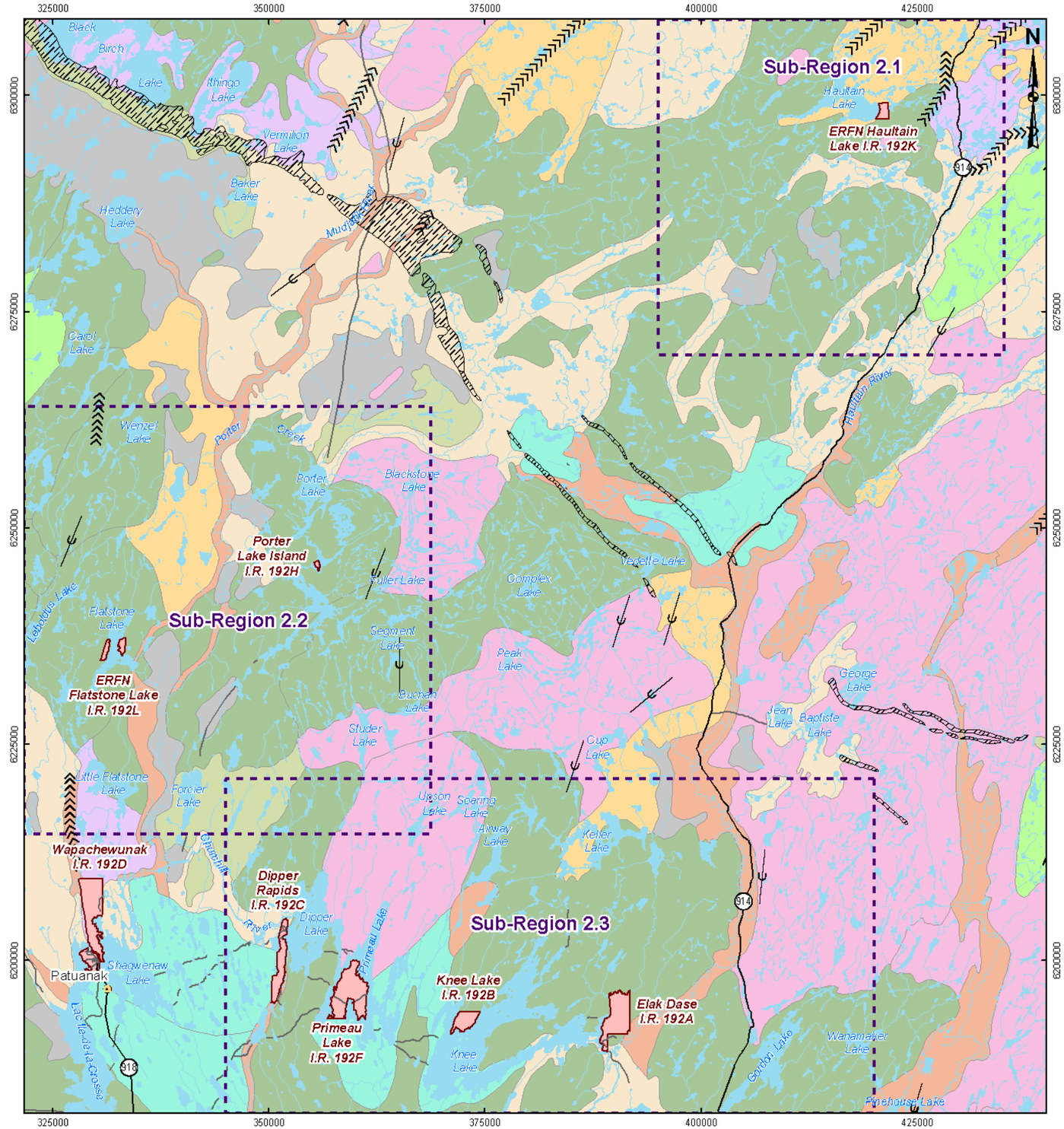
TITLE
Bedrock Geology Within the English River First Nation Areas

Golder Associates
Mississauga, Ontario

PROJECT NO. 12-1152-0026			SCALE AS SHOWN	REV. 1.0
DESIGN	PM	3 May, 2012		
GIS	PM/JB	13 Aug, 2013		
CHECK	JH	13 Aug, 2013		
REVIEW	GWS	13 Aug, 2013		

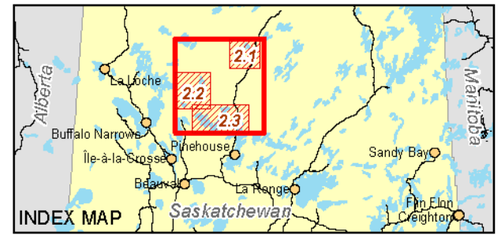
FIGURE: 7

G:\Projects\2012\12-1152-0026_NWMO_PhaseI_FeasibilityVGIS\MXDaReporting\Env_Safety_Report\ERFN\ERFNBedrockGeology.mxd



LEGEND

- Community
- Main Road
- Local Road
- Watercourse
- Waterbody
- Federal Land - Indian Reserve
- English River First Nation Detailed Area
- Moraine
- Drumlin
- Esker
- Striation
- Glaciofluvial
- Glaciofluvial Hummocky
- Glaciofluvial Outwash Plain
- Glaciolacustrine
- Morainal Plain
- Morainal Drumlinoid
- Hummocky Moraine
- Morainal Ridged
- Organic Plain
- Rock



REFERENCE

Basedata - CANVEC V10 Topographic Mapping of Canada (1:50000)
Administrative Boundaries - Information Services Corporation of Saskatchewan,
Administrative Boundary Overlays (2012)
Quaternary Geology - Saskatchewan Geological Atlas (1:250,000)
Projection: Universal Transverse Mercator
Datum: NAD 83 Coordinate System: UTM Zone 13N

10 5 0 10 20 30
SCALE 1:525,000 KILOMETRES

PROJECT
Environment Report
English River First Nation, Saskatchewan

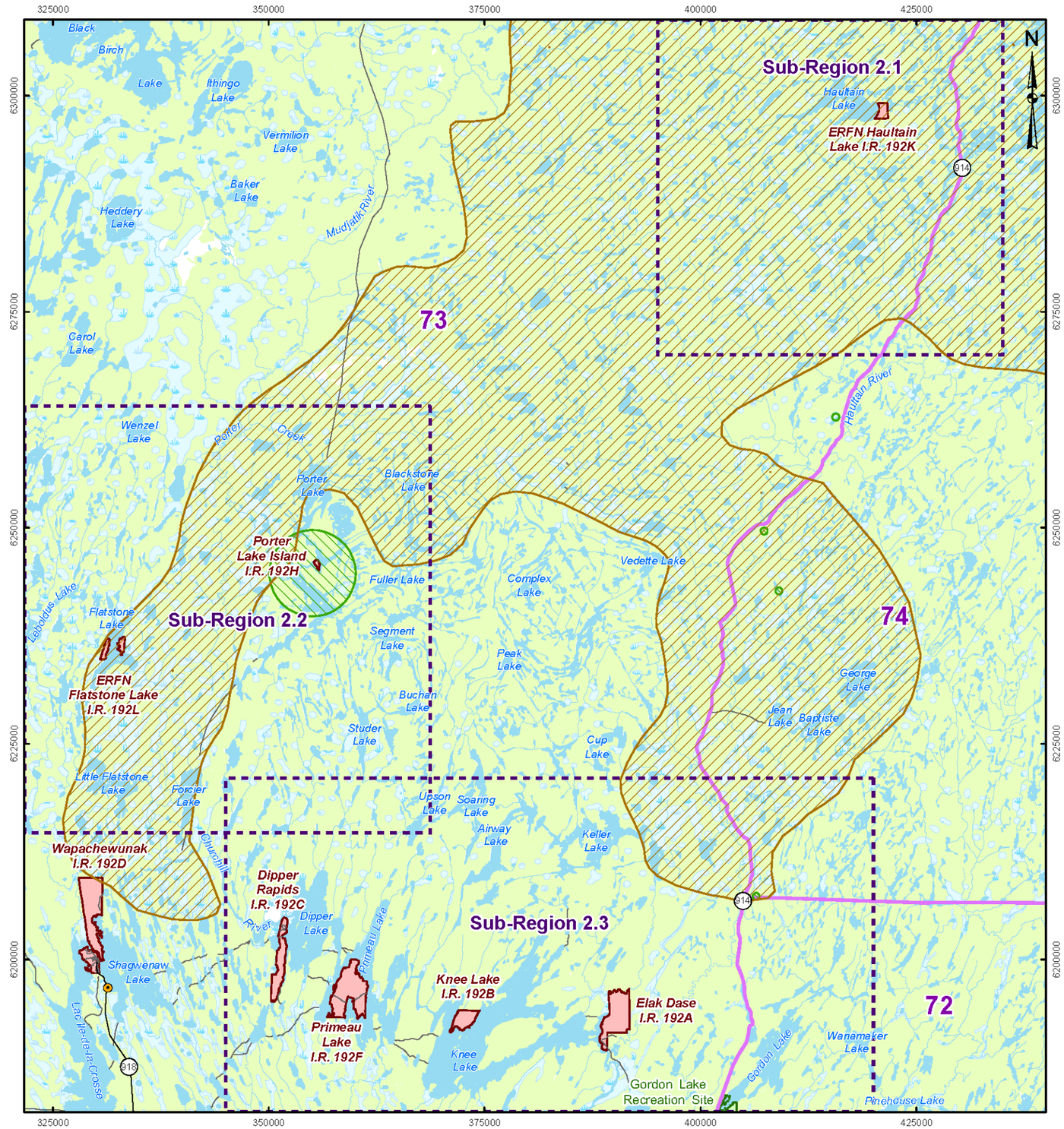
TITLE
Quaternary Geology of the English River First Nation

Golder Associates
Mississauga, Ontario

PROJECT NO. 12-1152-0026			SCALE AS SHOWN	REV. 1.0
DESIGN	PM	3 May, 2012		
GIS	PMJB	13 Aug, 2013		
CHECK	JH	13 Aug, 2013		
REVIEW	GWS	13 Aug, 2013		

FIGURE: 8

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

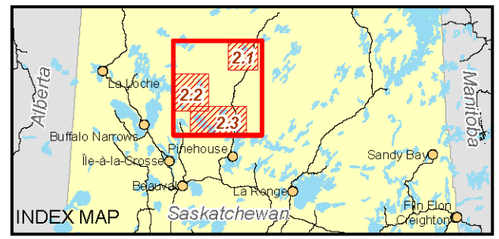


LEGEND

- Community
- Main Road
- Local Road
- Watercourse
- Waterbody
- Wetland
- Wooded Area
- Federal Land - Indian Reserve
- Park and Recreation Area
- Wildlife Management Zone (72, 73, 74)
- English River First Nation Detailed Area

Rare Species Range

- Woodland Caribou
- Plant (Various)



REFERENCE

Basedata - CANVEC V10 Topographic Mapping of Canada (1:50000)
Administrative Boundaries - Information Services Corporation of Saskatchewan, Administrative Boundary Overlays (2012)
Rare Species - CDC Wildlife Map, Fish and Wildlife Branch, Saskatchewan Ministry of Environment
Projection: Universal Transverse Mercator
Datum: NAD 83 Coordinate System: UTM Zone 13N

10 5 0 10 20 30
SCALE 1:525,000 KILOMETRES

PROJECT
Environment Report
English River First Nation, Saskatchewan

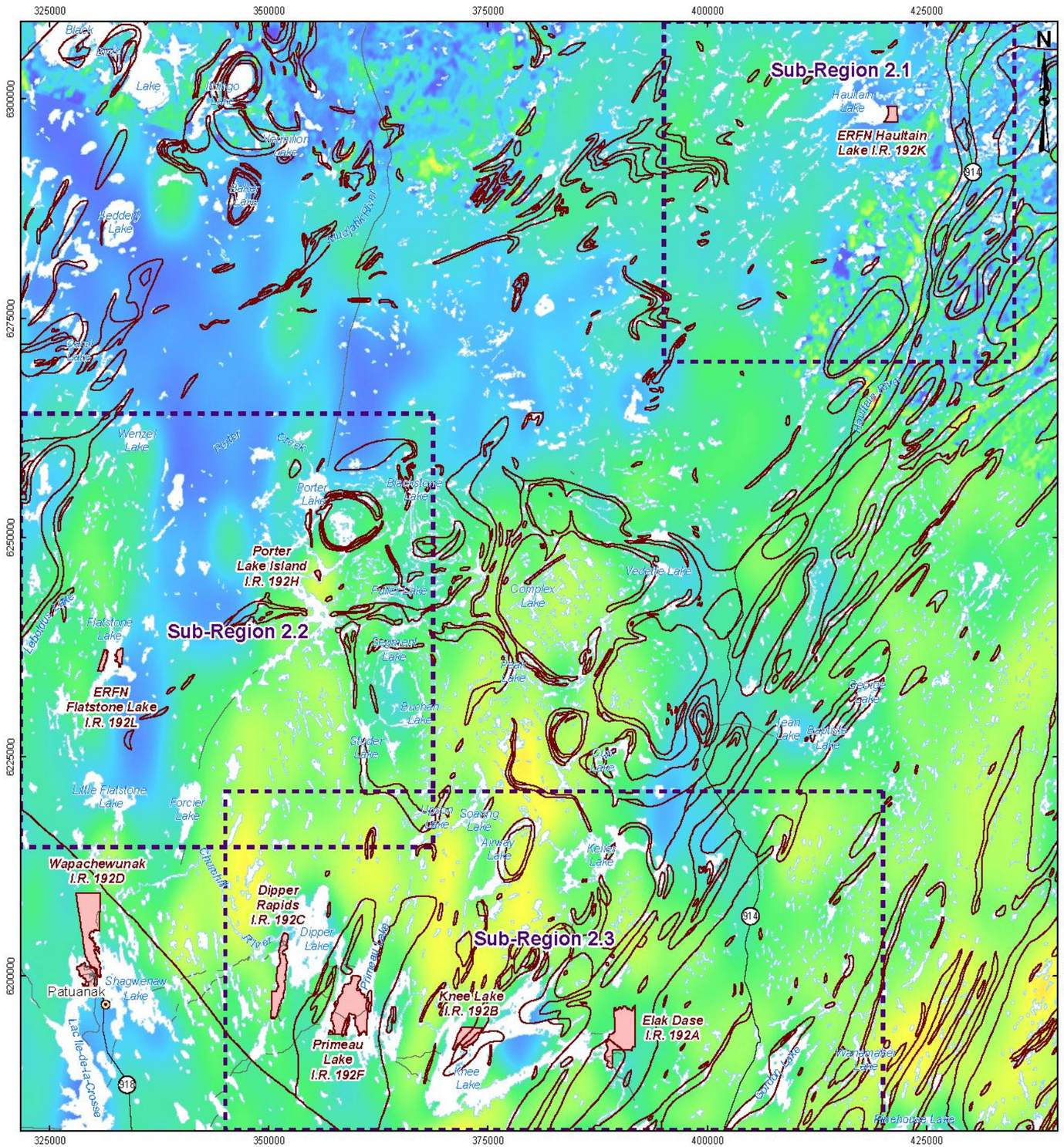
TITLE
English River First Nation - Ecology

Golder Associates
Mississauga, Ontario

PROJECT NO. 12-1152-0026			SCALE AS SHOWN	REV. 0.0
DESIGN	PM	3 May. 2012		
GIS	PMJB	13 Aug. 2013		
CHECK	JH	13 Aug. 2013		
REVIEW	GWS	13 Aug. 2013		

FIGURE: 9

G:\Projects\2012\12-1152-0026_NWMO_Phase1_FeasibilityAssess\MXDs\Reporting\Env_Safety_Report\ERFN\ERFNEcology.mxd

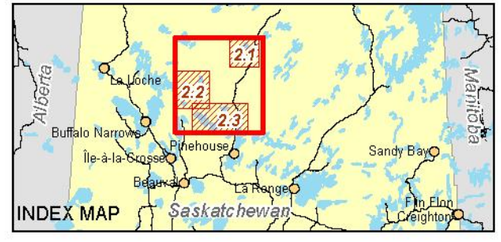


LEGEND

- Community
- Main Road
- Local Road
- Waterbody
- Geological Contact
- Federal Land - Indian Reserve
- English River First Nation Detailed Area

Air Absorbed Radiation Levels (nGy/h)

110
100
90
80
70
60
50
40
30
20
10
0



REFERENCE

Basedata - CANVEC V10 Topographic Mapping of Canada (1:50000)
Administrative Boundaries - Information Services Corporation of Saskatchewan, Administrative Boundary Overlays (2012)
Bedrock Geology - Saskatchewan Geological Atlas (1:250,000)
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
Projection: Universal Transverse Mercator
Datum: NAD 83 Coordinate System: UTM Zone 13N

10 5 0 10 20 30
SCALE 1:525,000 KILOMETRES

PROJECT
Environment Report
English River First Nation, Saskatchewan

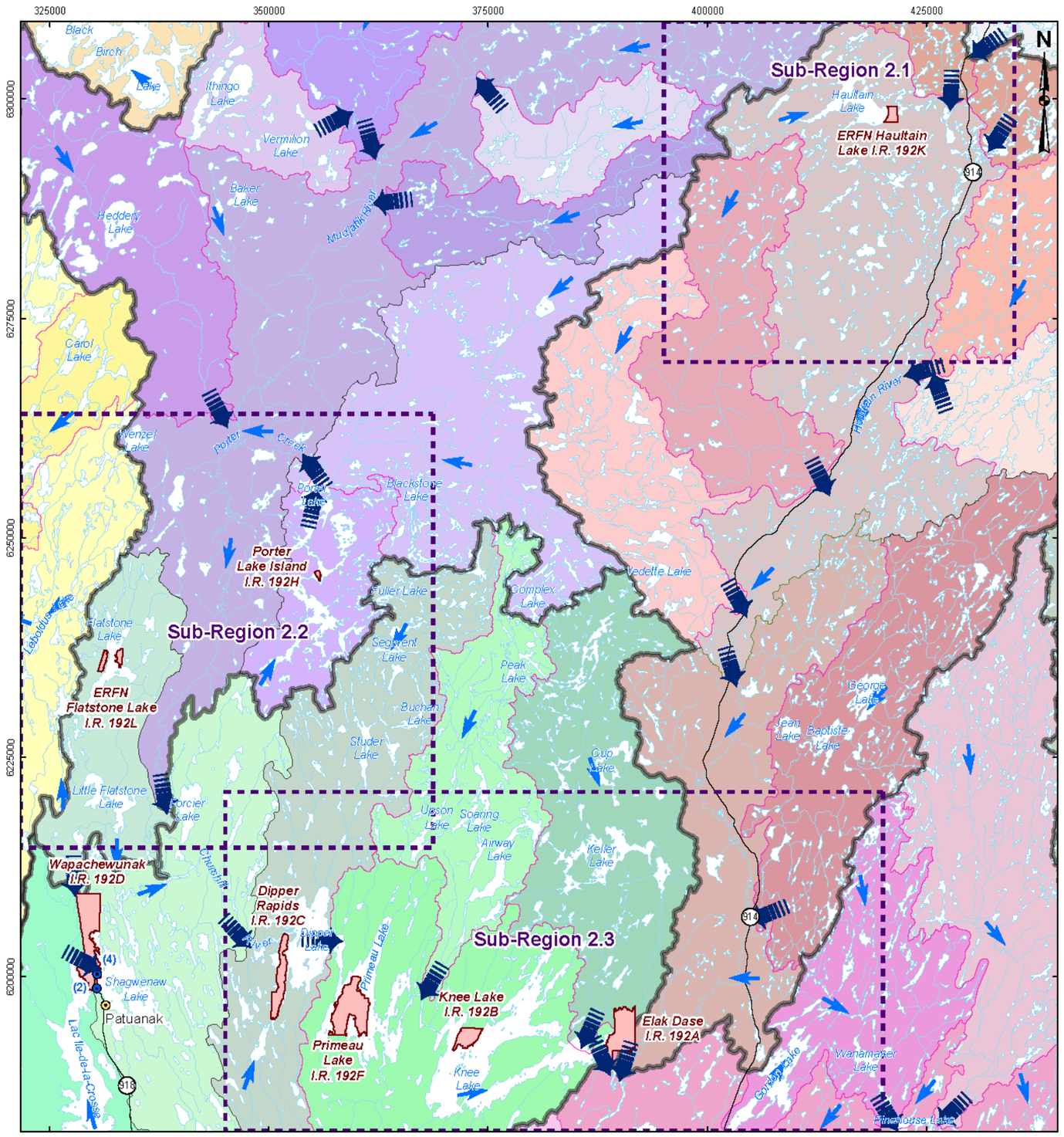
TITLE
English River First Nation - Background Radiation Levels

Golder Associates
Mississauga, Ontario

PROJECT NO. 12-1152-0026			SCALE AS SHOWN	REV. 1.0
DESIGN	PM	3 May. 2012		
GIS	PM/JB	13 Aug. 2013		
CHECK	JH	13 Aug. 2013		
REVIEW	GWS	13 Aug. 2013		

FIGURE: 10

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



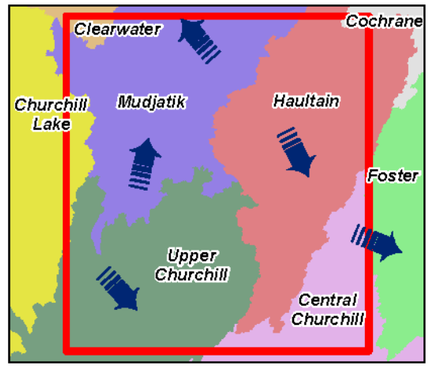
LEGEND

- Community
- Groundwater Well Location
- Main Road
- Watercourse
- Waterbody
- Federal Land - Indian Reserve
- English River First Nation Detailed Area
- Surface Water Flow Direction
- Watershed Outflow Point

Drainage Divide

- Delineated by JDMA/MNR
- Modelled
- Delineated by PFRA

TERTIARY WATERSHEDS



REFERENCE

Basedata - CANVEC V10 Topographic Mapping of Canada (1:50000)
Administrative Boundaries - Information Services Corporation of Saskatchewan, Administrative Boundary Overlays (2012)
Catchments - Terrain and Remote Sensing Study, English River First Nation, Saskatchewan (JDMA, 2012)
Wells - Saskatchewan Watershed Authority Water Well Database
Projection: Universal Transverse Mercator
Datum: NAD 83 Coordinate System: UTM Zone 13N

10 5 0 10 20 30
SCALE 1:525,000 KILOMETRES

PROJECT
Environment Report
English River First Nation, Saskatchewan

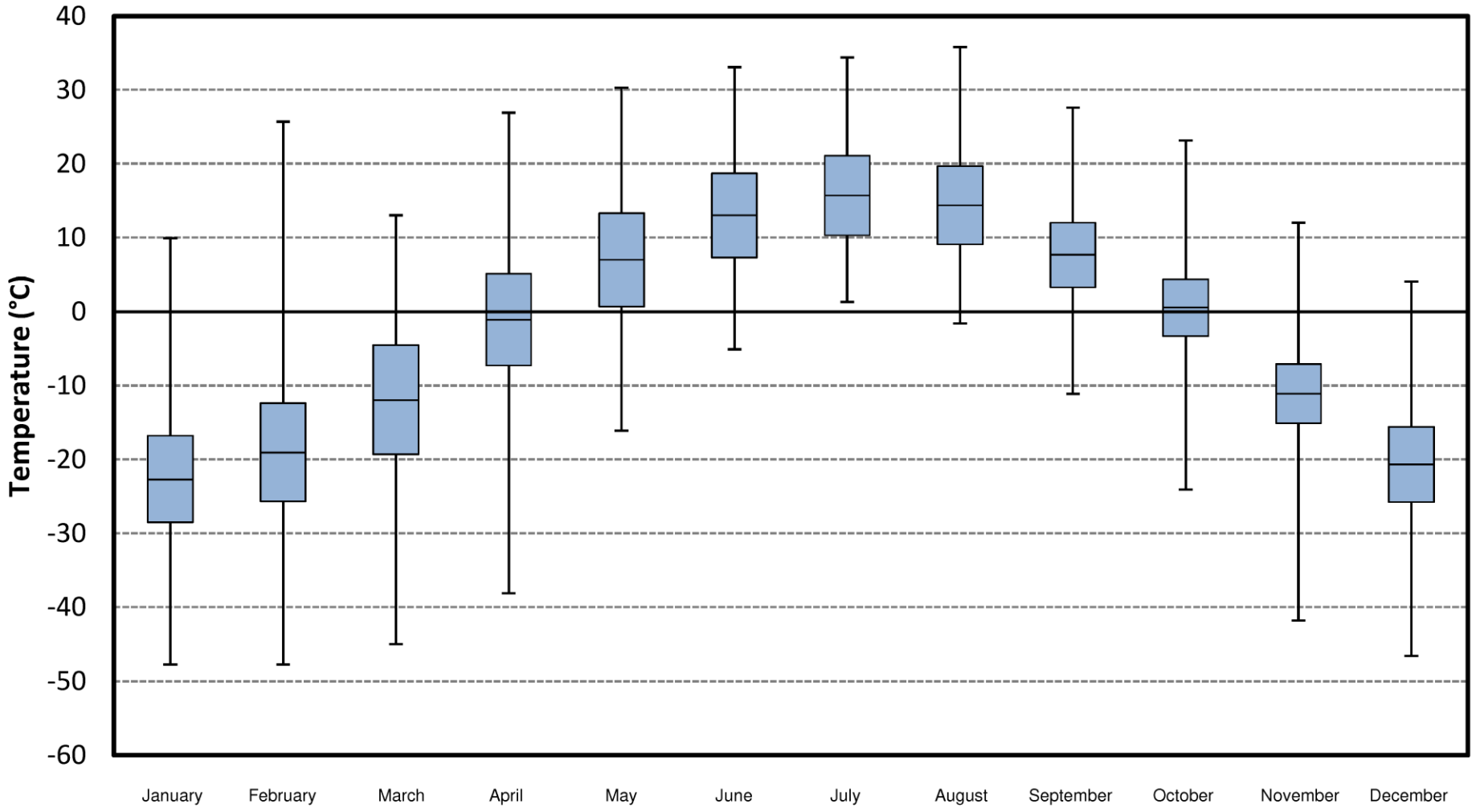
TITLE
English River First Nation Surface Water Drainage and Water Wells

Golder Associates
Mississauga, Ontario

PROJECT NO. 12-1152-0026			SCALE AS SHOWN	REV. 1.0
DESIGN	PM	3 May. 2012		
GIS	PM/JB	13 Aug. 2013		
CHECK	JH	13 Aug. 2013		
REVIEW	GWS	13 Aug. 2013		

FIGURE: 11

G:\Projects\2012\12-1152-0026_NWMO_PhaseI_FeasibilityVGIS\MXD\Reporting\Env_Safety_Report\ERFN\ERFNSurfaceWaterDrainage.mxd



LEGEND

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

DATA SOURCE

Environment Canada

PROJECT

Environment Report
English River First Nation, Saskatchewan

TITLE

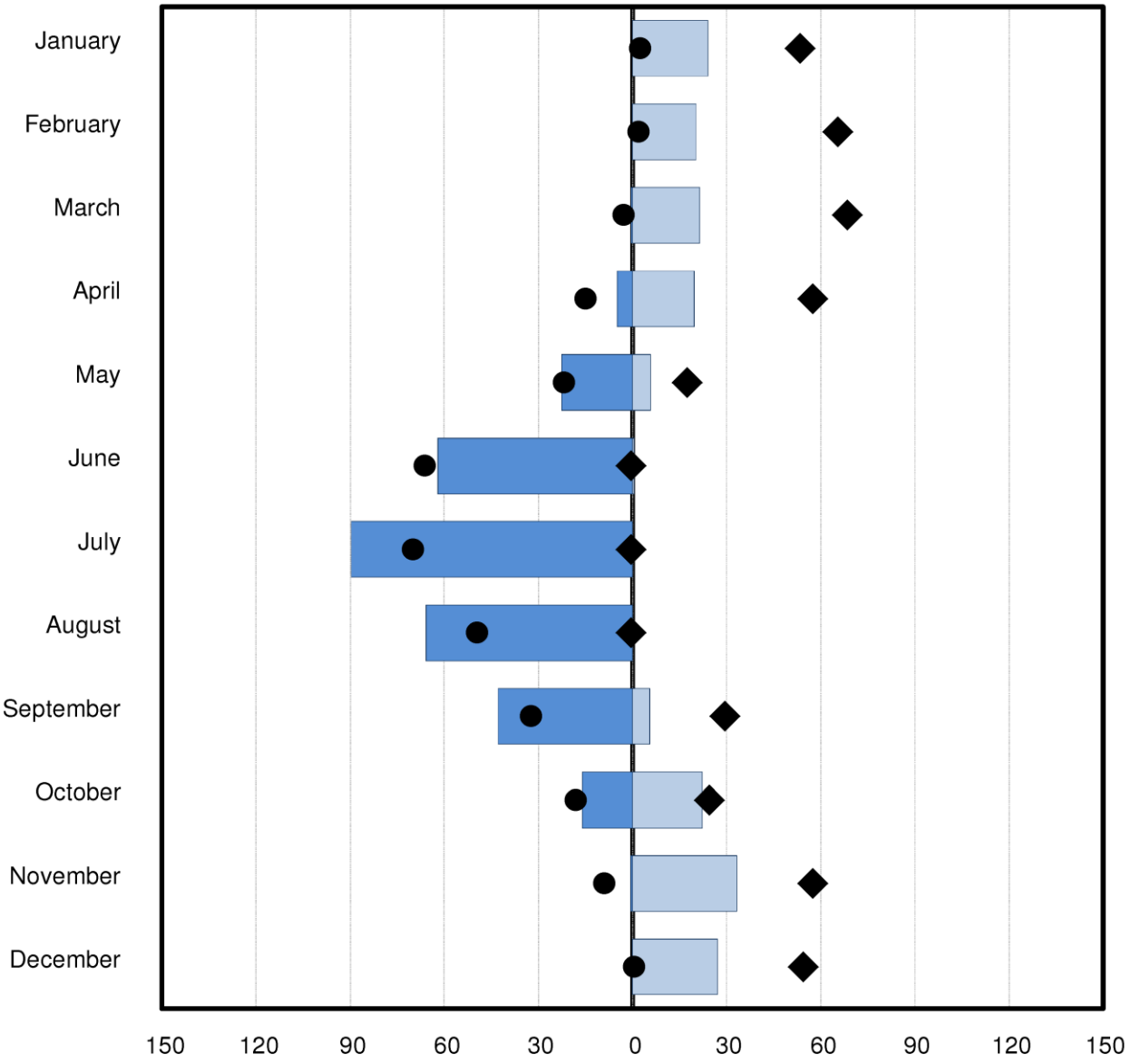
Cree Lake 1971-2000 Temperature Data Summary

Golder Associates
Mississauga, Ontario

PROJECT NO. 12-1152-0026			SCALE AS SHOWN	REV. 0.0
DESIGN	PM	7 Jun. 2012		
GIS	PM	9 Aug. 2013		
CHECK	JH	9 Aug. 2013		
REVIEW	GWS	9 Aug. 2013		

FIGURE: 12

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



LEGEND

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

DATA SOURCE

Environment Canada

PROJECT

Environment Report
English River First Nation, Saskatchewan

TITLE

Cree Lake 1971-2000 Precipitation Data Summary

Golder Associates
Mississauga, Ontario

PROJECT NO. 12-1152-0026			SCALE AS SHOWN	REV. 0.0
DESIGN	PM	7 Jun. 2012		
GIS	PM	9 Aug. 2013		
CHECK	JH	9 Aug. 2013		
REVIEW	GWS	9 Aug. 2013		

FIGURE: 13

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

As a global, employee-owned organisation with over 50 years of experience, Golder Associates is driven by our purpose to engineer earth's development while preserving earth's integrity. We deliver solutions that help our clients achieve their sustainable development goals by providing a wide range of independent consulting, design and construction services in our specialist areas of earth, environment and energy.

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South America	+ 56 2 2616 2000

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