Environment

Auriga Gold Corp.

Puffy Lake Mine: Environmental Baseline Assessment

draft for discussion

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Revision Log

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1	M. Hadfield	May 2, 2014	Draft for review.

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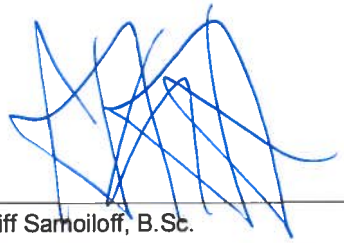

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Executive Summary

This Environmental Baseline Assessment has been prepared to support the development of five open pits at the existing Puffy Lake Mine and the pending operation of the underground mine, mill, and Ragged Tailings Impoundment Area (TIA) which would operate as licenced under *Environment Act* Licence No. 1207E.

The existing Puffy Lake Mine is located at 55^{0}01'56" north latitude and 100^{0}58'54" west longitude in north-central Manitoba, approximately 60 km northeast of Flin Flon and approximately 12 km southeast of the community of Sherridon. The former operations of Puffy Lake Mine are approved under *Environment Act* Licence No. 1207E and included a decline and underground mine, a mill for concentrating ore on-site and a TIA at nearby Ragged Lake for the deposition of tailings produced at the mill.

Auriga Gold Corp. (Auriga) is the licence holder for the Puffy Lake Mine and proposes to develop five open pits at the existing Puffy Lake Mine site that will be supported by the existing infrastructure (*e.g.,* mill, Ragged TIA). The proposed Alteration involves the sequential operation of the five open pits that will be progressively rehabilitated as mining progresses over a period of approximately three years. It is anticipated that the licensed underground works at the Puffy Lake Mine will begin to produce ore from a test stope in the third quarter of 2014.

The proposed Alteration is located within the Puffy Lake Mine site (Mining Lease ML 65), that was previously operated by Pioneer from December 1987 to March 1989. The mining activities were suspended in April 1989 and the Puffy Lake Mine site has since been under Care and Maintenance. The Proposed Alteration will be supported by existing licensed components including the main access road which connects the Puffy Lake Mine site to the Sherridon Road, the 1,000 tpd capacity mill that will operate at an initial targeted rate of 750 tpd, and the Ragged TIA. The proposed open pit mining plan involves the sequential operation of five initial open pits that will be progressively rehabilitated as mining progresses to minimize the extent and duration of potential environmental effects.

Glossary

Item	Explanation
ABA	Acid base accounting; is the balance between acid-production and acid-consumption properties of a mine waste rock.
Auriga	Auriga Gold Corp.
BIC	Benthic invertebrate community.
Bedrock	Solid rock that underlies soil, sand, clay, gravel, and loose materials on the Earth's surface.
Benthic Invertebrate	Invertebrates living on or in the sediment of a waterbody.
Berm	A sloped wall or embankment used to prevent the inflow or outflow of material into/from an area.
Bog	An area having a wet, spongy, acidic substrate composed chiefly of sphagnum moss and peat in which characteristic shrubs and herbs and sometimes trees usually grow.
Browse Species	Plant species grazed upon by ungulates and other animals.
CWQG	*Canadian Water Quality Guidelines for the protection of aquatic life.*
EC	Environmental Components (ECs) include topography, soil, air, climate, groundwater, surface water, terrestrial resources, aquatic resources and protected species.
EEM	Environmental Effects Monitoring.
EIS	Environmental Impact Statement
EPT	Orders of benthic invertebrates that are typically sensitive to environmental perturbations and include Ephemeroptera, Plecoptera and Tricoptera.
Ecodistrict	Unit of land that is characterized by relatively homogenous physical landscape and climatic conditions. As a sub-division of Ecoregions, they have a more uniform biological production potential.
Ecoregion	Large unit of land characterized by various items including distinctive climate, ecological features and terrestrial communities.
Ecozone	The largest scale biogeographic division of the earth's surface based on the historic and evolutionary distribution patterns of plants and animals.
FMU	Forestry Management Unit.
Fauna	All animal life in a particular region.
Fen	A low and frequently flooded area of land.
Flora	All plant life and vegetation in a particular region.
Groundwater	Water that exists beneath the earth's surface in underground streams and aquifers.
Growing Degree-Days	The number of days per year on which the mean daily temperature is one degree above the minimum temperature required for the vegetative growth.
ha	Area in hectares, equivalent to 10,000 square metres.
HRIA	Heritage Resources Impact Assessment.
Hydrology	The study of the distribution and movement of water.
masl	Metres Above Sea Level.
MCDC	Manitoba Conservation Data Centre.
MESA	*Manitoba Endangered Species Act.*
MMER	Federal *Metal Mining Effluent Regulations*.

Item	Explanation
Mitigation	Actions taken to reduce effects by limiting, reducing or controlling hazards and contamination sources.
Overburden	Overburden; materials overlying the pit or deposit, usually includes vegetation and soils.
Phytoplankton	Small, often microscopic organisms that are capable of photosynthesis that live in the water.
area	The area includes the area up to 2,000 m beyond the site, which could potentially be affected either directly or indirectly by project activities, for example by noise, vehicle emissions, traffic, etc.
region	The region includes the area up to 10 km beyond the area, which could potentially be affected indirectly by project activities, such as increase in regional traffic or aesthetics etc.
site	The site represents the area expected to be directly affected by project related activities. For this assessment, the site includes the area of the five proposed open pits at the existing Puffy property, the Access Road to the mine site, waste rock stockpiles and the haulage roads.
Proponent	A person or organization seeking approval to conduct a business or activity that impacts on the environment.
RCMP	Royal Canadian Mounted Police.
RQD	Rock quality designation.
RTLs	Registered trap lines.
Residual Effects	Effects that remain after mitigation has been applied.
SARA	*Species at Risk Act.*
SC	Social Components (SCs) include protected areas, resource uses, heritage resources and aesthetics.
SDI	Simpsons Diversity Index; abundance patterns and taxonomic richness by determining for each taxonomic group of benthic invertebrates at a station.
SQG-RP	Soil quality guidelines for the Protection of Environmental and Human Health – Residential and Parkland Use
Sediment	Any particulate matter that can be transported by fluid flow and which eventually is deposited as a layer of solid particles on the bed or bottom of a body of water or other liquid.
Surface Water	Water that sits or flows above the earth, including lakes, oceans, rivers, and streams.
Terrestrial	Existing on land.
TIA	Tailings Disposal Area.
tpd	Tonnes per day.
Tonne	Unit of mass equal to 1,000 kg or 2,204.6 pounds. Also referred to as “metric tons”.
Topography	The physical features of the land.
USgpm	US gallons per minute.
Ungulate	Hoofed animal such as deer.
WMA	Wildlife Management Area.
Waterfowl	Birds that swim and live near water, including ducks, geese, pelicans and swans.
Zooplankton	Small floating or weakly swimming organisms that, with phytoplankton, form the basis of an aquatic food web. Zooplankton feed on phytoplankton.

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1. Introduction and Background

The existing Puffy Lake Mine is located at 55^{0}01'56" north latitude and 100^{0}58'54" west longitude in north-central Manitoba, approximately 60 km northeast of Flin Flon and approximately 12 km southeast of the community of Sherridon (**Figure 01**) and lies wholly within Mineral Lease 065 and Crown Land Miscellaneous Lease 96093, the corresponding surface lease. Access to the Puffy Lake Mine controlled by a security gate located on a 9 km long gravel main access road that extends east from kilometre 66 on the all-season gravel road that connects Sherridon to Provincial Trunk Highway (PTH) #10 (the Access Road) as shown on **Figure 02**.

Auriga Gold Corp. (Auriga) is an emerging Canadian gold producer focused on re-starting the Puffy Mine and expanding gold resources on its Puffy and Nokomis gold deposits (collectively the "Maverick Gold Project"). The Maverick Gold Project is located in the Flin Flon Greenstone Belt, approximately 65 km northeast of Flin Flon, Manitoba. Auriga acquired the Puffy Lake Mine in October of 2010, and has advised that its intention is to re-open the mine in the third quarter of 2014, commencing with a program of underground test mining, and followed in 2015 by resumption of mill operations, production of gold for the market, and the deposit of tailings into the Ragged Tailings Impoundment Area (TIA), all in accordance with *Environment Act* Licence No. 1207E and the letter of the Director of Environmental Approvals dated May 17, 2012.

With the assistance of various consultants, Auriga has undertaken further environmental work to update information with respect to the site. Further to this effort, AECOM carried out aquatic and terrestrial investigations in September 2012, the results of which are contained in this report.

1.1 History and Future Development

The first claims on the Puffy property were staked in 1953 (A.C.A. 2012). There have been 15 mining operations within a 50 km radius of the Puffy property (**Figure 01**); however, none of these mines are currently operational (including the Puffy Lake Mine).

The Puffy Lake Mine, approved under *Environment Act* Licence No. 1207E, was developed by Pioneer Metals Corporation (Pioneer). Approval of the Puffy Lake Mine was supported by baseline terrestrial and aquatic investigations carried out in May 1987, which formed the basis for the 1987 Environmental Impact Statement (EIS) prepared by Ilam Associates Ltd. and filed at that time with Manitoba Environment (as it then was known).

Auriga acquired a 54% interest in the adjacent Nokomis property from Pioneer in October 2010, at the same time as it acquired the Puffy Lake Mine, and the remaining 46% interest in the Nokomis property was acquired from Claude Resources Inc. in November 2011. The Nokomis property is located less than 8 km northeast of the Puffy Lake Mine (**Figure 03**). Additional staked claims in this area were acquired by Auriga in April 2011. The Puffy Lake Mine, Nokomis property and the staked claims are collectively named the Maverick Properties, which cover an area of approximately 6,640 hectares (ha) (**Figure 03**).

Auriga has determined that the near surface ore included in the Puffy Lake Mine mineral resource would be accessed more economically and efficiently from the surface than from the existing underground workings. Auriga therefore proposes the development of five open pits and related infrastructure (the Proposed Alteration).

The five open pits are located adjacent to the existing development and will be developed sequentially and progressively rehabilitated as mining progresses. Mining and concurrent rehabilitation of the open pits would occur over a 3.5 to 4 year period, with peak ore production from the open pits anticipated in 2016/17. By the end of 2018, the open pits will be exhausted, with closure activities ceasing in early 2019 (for a total period of approximately 4 years).

2. Baseline Assessment

In September 2012, a supplemental aquatic and terrestrial investigation was initiated by AECOM to examine the areas potentially impacted by the development of the proposed open pits at the Puffy property. The environmental components examined during this survey included:

- Terrestrial vegetation and wildlife survey in the vicinity of the proposed open pits, main access road and on-site roads;
- Aquatic habitat assessment within and downstream of Fire Pond and along the main access road and on-site access roads;
- Sediment quality in Fire Pond;
- Fish and invertebrate (*i.e.*, phytoplankton, zooplankton, and benthic invertebrate) community in Fire Pond; and
- Bathymetry of Fire Pond.

2.1 Historical Environmental Baseline Studies

In May 1987, baseline terrestrial and aquatic investigations were originally conducted at the Puffy property. These investigations focused broadly on the aquatic and terrestrial resources that could be affected by development of the Puffy Lake Mine. The Environmental Impact Statement (EIS) filed in 1987 by Ilam Associates Ltd. described the existing environment with respect to the following components:

1. Air Quality;
2. Terrain, Soils and Vegetation;
3. Water Quality and Fisheries;
4. Wildlife; and
5. Heritage Resources.

WESA, on behalf of Auriga, conducted investigations in the area of Puffy Lake Mine, including a stage-storage curve analysis for the Ragged TIA (WESA 2012a) and an assessment of pit inflows and groundwater quality (WESA 2012b). Parks Environmental Inc. completed a biological baseline assessment, however only water quality information from samples that were collected from No Name Lake, Puffy Lake, Ragged TIA (tailings beach and outlet), and from the water in the underground mine at the portal, and the vent raise in June and September 2011 were available for this assessment. In addition, Auriga collected a water quality sample from Fire Pond in June 2012.

2.2 Physical Environment

The physiographic setting for the proposed open pits at the Puffy property is defined using the ecological land classification system. This hierarchical system of ecozones, ecoregions, and ecodistricts represents subdivisions of increasing ecological detail. The proposed open pits are located within the:

- Boreal Shield Ecozone, which contains the
- Churchill River Upland Ecoregion, which contains the
- Granville Lake Ecodistrict.

The region is located in the Boreal Shield Ecozone. As the largest ecozone in Canada, it extends from northern Saskatchewan east to Newfoundland, north and east of Lake Winnipeg and finally north of the Great Lakes and

St. Lawrence River. The proposed Project and the immediate surrounding area, which includes the areas under investigation, are located in the Granville Lake Ecodistrict in the Churchill River Upland Ecoregion (Smith *et al.* 1998). The region is wholly contained within the Churchill River Upland Ecoregion but overlaps two ecodistricts, the Granville Lake Ecodistrict and the Reed Lake Ecodistrict (**Figure 04**). For the purposes of this assessment, the characteristics of only the Granville Lake Ecodistrict, within which the site resides, are presented.

2.2.1 Topography

The Granville Lake Ecodistrict is characterized as a rolling to hummocky morainal and bedrock plain covered by extensive clayey glaciolacustrine blankets and veneers at lower elevations. Elevations range from approximately 255 masl to about 405 masl in the Granville Lake Ecodistrict. Slope lengths can vary from less than 50 m to more than 150 m. (Smith *et al.* 1998)

The Puffy property is situated on terrain typical of the Canadian Shield characterized by extensive areas of rock outcrop on higher ridges interspersed with lakes and low lying swampy areas. Elevations range from 350 masl at the mill site to 340 masl at Puffy Lake (south of the proposed open pits, underground mine, mill and Ragged TIA) (A.C.A. 2012).

2.2.2 Geology

In the vicinity of the site, the geology is made up of three distinct sequences of rock intruded by large tonalitic-granitic bodies (**Figure 05**):

1. Amisk Lake Group: fine-grained, intermediate to mafic biotite and amphibole-bearing schists and gneisses;
2. Burntwood Group: greywacke derived gneisses; and
3. Missi Group: quartzofeldspathic gneisses.

According to the NI 43-101 Preliminary Economic Assessment report prepared by A.C.A. 2012:

“Four main rock assemblages have been identified on the Puffy property:

- *A structurally lower homogeneous, light grey to white, medium to coarse grained, lineated and gneissose hornblende-biotite-tonalite (“Footwall Augen Gneiss” or “Archie Lake Pluton”) which forms a distinctive “footwall” for drilling;*
- *A central, well layered, heterogeneous, generally mafic, schist and gneiss package of the Amisk Lake Group which is the host to the predominance of the gold bearing quartz veins;*
- *Fine to coarse grained gneissose sandstone to conglomerate of the Missi Group; and*
- *A structurally upper unit of more competent gneissose biotite granite (“Hanging wall Pink Granitic Gneiss” or “Ragged Lake Pluton”).*

On a property scale, the Puffy deposit is located along the eastern flank of a southeasterly plunging anticline consisting predominantly of interleaved Amisk Group intermediate to mafic gneisses. The Missi quartzofeldpathic gneiss (“Hangingwall Pink Granitic Gneiss”) overlies the Amisk gneisses which in turn structurally overlie a medium to coarse grained augen gneiss (“Footwall Augen Gneiss”) of uncertain origin.

The known mineralization at the Puffy deposit consists of five parallel gold-bearing veins that strike N30W and dip 30 degrees northeast. The zones are designated from top to bottom, as the Sherridon, Upper, Main, Lower and Lower 2 zones. The veins are hosted primarily by mafic amphibolites that are considered to be part of the Amisk Group and by metasedimentary gneisses of the Missi Group.”

2.2.3 Soil

Associated with the acidic granitoid bedrock in the Granville Lake Ecodistrict are *"well to excessively drained, shallow, sandy, and stony veneers of water-worked glacial till on which Dystric Brunisols have developed. On clayey deposits, Eutric Brunisols and Gray Luvisols prevail. Peat-filled depressions are common and "form complexes of very poorly drained, Typic (deep) and Terric (shallow) Fibrisolic and Mesisolic Organic soils overlying loamy to clayey glaciolacustrine sediments. Widespread patches of Organic Cryolsols occur where permafrost is present in peatlands (peat plateau and veneer bogs) and in some clayey mineral soils"* within the Granville Lake Ecodistrict. (Smith *et al.* 1998)

In general, the soils within the Granville Lake Ecodistrict are described as compact clayey subsoil with poor structure, low soil temperatures, large amounts of cobbles and stones, coarse surface textures and the poor water and nutrient holding capacity of the till all greatly constrain the use of mineral soils (Smith *et al.* 1998). In the site, overburden depths, estimated (based on open pit area and overburden volumes provided by Auriga) to range from 1.5 m to 6.0 m in depth.

2.2.4 Air

2.2.4.1 Air Quality

Specific measurements of air quality in the region are not available. However, it is expected that the air quality in this area is considered very good compared with larger cities and commercial and industrial areas in Manitoba. There are no industrial operations that release to the atmosphere within the region. Industrial activity occurs in the City of Flin Flon, the Town of The Pas and the City of Thompson, all located outside the region. Remediation of the historic Sherritt-Gordon tailings in Sherridon is currently underway. The tailings have been observed to generate dust clouds during high wind events and can result in contamination of the terrestrial environment up to 500 m from the tailings pile (UMA/SENES 2004). However, a human health and ecological risk assessment determined that the tailings dust was not a significant risk to human health or the natural environment (UMA/SENES 2004). Occasional regional impediments to air quality from other sources, although uncommon, may occur in the region. This could include smoke from forest fires and wood-burning stoves, emissions from fuel storage tanks and vehicle emissions.

2.2.4.2 Noise and Vibration

The Puffy property is located approximately 12 km southeast of Sherridon, the closest community. Noise generated at the Puffy property is buffered by the surrounding terrain and forest cover. There is currently limited activity related to the care and maintenance of the former Puffy Lake Mine, and therefore little noise is generated at the Puffy property. Remediation activities at the former Sherritt-Gordon tailings area, and traffic within Sherridon and along the Sherridon Road, currently are the major sources of noise near the region. Traffic noise from the Sherridon Road was not heard at the Puffy Lake Mine site during the AECOM field visit in September 2012. The majority of the region currently has noise levels typical of undeveloped forest.

2.2.5 Climate

The region lies within a warmer, more humid subdivision of the High Boreal Ecoclimatic Region in Manitoba. In the Granville Lake Ecodistrict, summers are cool and short with an average growing season of 151 days. Winters are characterized as long and cold. (Smith et al. 1998)

Although the closest community to the Project is Sherridon, the closest weather station to the site is located near Baker's Narrows at the Flin Flon airport, approximately 60 km southwest of the Puffy property. The Flin Flon airport is located at an elevation of 304 masl and is considered climatically representative of the region.

The mean annual air temperature at the Flin Flon airport is -0.2°C. The daily mean temperature ranges from approximately 18°C in July to -21°C in January. Total annual precipitation at the Flin Flon airport is includes 339 mm of rain and 141 cm of snow. July has the highest average rainfall (approximately 77 mm), whereas November and December have the highest average snowfall (approximately 25 cm and 24 cm, respectively) (Environment Canada 2012a).

The monthly average temperature, precipitation and wind conditions measured at the Flin Flon airport are provided in **Table 2.1**.

Table 2.1: Climate Data for the Flin Flon A, Manitoba (1971-2000)

	Month													
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Year**	**Code**
Temperature (°C)														
Daily Average	-21.4	-16.7	-9.3	0.7	8.8	14.9	17.8	16.6	9.8	2.7	-8.4	-18.4	-0.2	A
Daily Maximum	-16.6	-11	-2.9	6.9	15	20.4	23.1	21.8	14.2	6.2	-5.1	-14	4.8	A
Daily Minimum	-26.2	-22.3	-15.8	-5.5	2.6	9.3	12.6	11.4	5.4	-0.8	-11.7	-22.6	-5.3	A
Monthly Average Precipitation														
Rainfall (mm)	0.1	0.3	0.9	8.6	36.9	66.6	76.5	66.6	55.3	25.6	1.4	0.4	339.2	A
Snowfall (cm)	19.6	14.6	19.1	20	3.7	0	0	0	2	13	25.4	23.9	141.3	A
Wind Conditions														
Monthly Average Wind Speed (km/h)	9.4	9.7	10	10.9	11.1	11.2	10.9	10.7	12.1	12.2	11.1	9.3	10.7	A
Most Frequent Direction	NW	NW	S	S	NE	S	NW	S	NW	NW	NW	NW	NW	A

Notes:

Latitude 54° 41' N Longitude 101° 41' W Elevation 303.90 masl

Data obtained from Environment Canada Flin Flon A meteorological station (2012a)

"A": World Meteorological Organization "3 and 5 rule" (i.e., no more than three consecutive and no more than five total missing for either temperature or precipitation) between 1971 and 2000.

2.2.6 Groundwater

Ten groundwater monitoring wells were installed in 2011 and 2012 by WESA in bedrock exploration boreholes located throughout the Puffy property. Groundwater samples were collected and submitted by WESA to an accredited laboratory for analysis of general chemistry and dissolved metals. Concentrations of arsenic, copper, iron, molybdenum, selenium, silver, and uranium exceeded the Federal *Canadian Water Quality Guidelines for the protection of aquatic life* (CWQG) and the Provincial *Manitoba Water Quality Standards, Objectives and Guidelines*. None of the concentrations exceeded the *MMER*. (WESA 2012b)

In addition, static water levels and hydraulic conductivities were estimated as part of the WESA study. Hydraulic conductivities at the ten groundwater monitoring wells ranged from 1 x 10^{-8} m/s to 1 x 10^{-4} m/s (**Table 2.2**). Using a geometric mean bulk hydraulic conductivity of 5 x 10^{-7} m/s, pit inflow estimates ranged from 1.3 L/s (20 USgpm) to 4.4 L/s (70 USgpm, **Table 2.2**). (WESA 2012c)

Table 2.2: Inflow Estimates for the Proposed Open Pits at the Puffy Property

Pit	Sidewalls of Pit Inflow, USgpm	Bottom of Pit Inflow, USgpm	Total Inflow, USgpm	ROI, m
Pit 1	37 (2.3)	31 (2.0)	70 (4.4)	300
Pit 2	21 (1.3)	13 (0.8)	30 (1.9)	200
Pit 3	26 (1.6)	20 (1.3)	50 (3.2)	200
Pit 4	39 (2.5)	33 (2.1)	70 (4.4)	300
Pit 5	16 (1.0)	8 (0.5)	20 (1.3)	200

Note: Pit inflows are estimated using a geometric mean bulk hydraulic conductivity of 5 x 10^{-7} m/s. Total inflow estimates were rounded to the nearest 10 USgpm. Radius of influence (ROI) was measured from centre of the pit. Values in brackets are in Litres per second.

Manitoba Conservation and Water Stewardship well records indicate no groundwater utilization near the site, with no registered groundwater wells in use within at least 9.6 km (6 miles) of the site (Manitoba Water Stewardship 2009)

2.3 Terrestrial Environment

The area is located in the Churchill River Upland Ecoregion which is established on shield rock with fens and bogs developed extensively across the landscape. Bedrock outcrops are common and typically support open lichen woodlands. The area is in the eastern extent of this ecoregion where sand outwash areas support Jack Pine (*Pinus banksiana*) stands. Wildfire is the predominant natural source of tree stand renewal that supports widespread Jack Pine, White Birch (*Betula papyrifera*), and Trembling Leaf Aspen (*Populus tremuloides*) growth. (Smith *et al.* 1998)

There are no available comprehensive lists of flora and fauna species available for the Churchill River Upland Ecoregion. A list of flora and fauna species occurring within the Boreal Shield Ecozone in a more southern ecoregion (Mid-Boreal Lowland Ecoregion) is provided in **Appendix C, Tables 01 and 02**.

2.3.1 Regional Vegetation Analysis

The vegetation that may be present at the site, area, and region was characterized using a regional analysis of vegetation as defined by the Forestry Branch of Manitoba Conservation. It should be noted that the site, as it was defined in **Section 1.1**, encompasses the entire site footprint and is greater than the anticipated footprint resulting from development of the proposed open pits, waste stockpiles and haulage roads. Potentially unique vegetation types within the area or region were determined using Forest Management Units (FMU). The Forestry Branch of

Manitoba Conservation creates forest inventory maps that are developed from interpretation of 1:15,840 aerial photography. Each forest inventory map covers one township (96 km^2). For purposes of indexing and assembling the data, multiple townships of data are packaged into a FMU. Within each FMU package, the individual townships are maintained as separate files along with their associated attributes. Each FMU identifies the vegetation cover class of the FMU and identifies the species composition based a hierarchical series of attributes (*i.e.,* land cover, productivity, tree type, and species composition). This cover class identifies a unique area of tree canopy that combines a series of attributes and species composition that can be interpolated into a general habitat classification. The FMU is the most detailed vegetation identification information available for the undeveloped portions of the province.

The forestry inventory maps created for this region predate the 1989 forest fire that impacted the majority of the site. Therefore, although these maps do not accurately reflect the current baseline conditions, the vegetative communities present on the forestry inventory maps are those that will likely develop over time as the forest regenerates following the 1989 forest fire. Further, it is anticipated that the vegetation regeneration will be determined by soils, topography and water availability that, for the most part, were all similarly affected by the fire. Therefore, although the FMU mapping does not capture the vegetation changes by the 1989 forest fire, it does reflect the similar conditions for vegetation growth within the broader area and region and can provide context to determine if the growth conditions for vegetation are unique to the site or if similar conditions are available in the broader area and region. A description of the vegetation observed at the site is provided in **Section 2.3.2**.

2.3.2 Terrestrial Field Surveys

During a Heritage Resource Impact Assessment (HRIA) conducted by Ilam Associates Ltd in May 1987, a brief examination of the floral and faunal communities near the Puffy Lake Mine, including the Ragged TIA, was conducted. Subsequent to the HRIA, a large forest fire came through the area of the Puffy property in 1989. More recently, the sites of the five proposed open pits were examined September 24 and 25, 2012 by AECOM to assess the current vegetation and animal communities in this area, and the potential for the presence of rare or endangered species. The AECOM field team walked each proposed open pit location in a random pattern covering distinct vegetation types present in the area (**Figure 06**). The characteristics and dominant species present were recorded for each area surveyed. In addition, a specific search was made for unique vegetative habitats that might harbour rare or endangered species within the site. Photographs were collected of each proposed pit and recorded by location on a handheld GPS unit. Representative photographs are included at the end of this report.

The site shows evidence of the 1989 forest fire. Natural regeneration is progressing at a normal rate and the area is returning to a typical post-burn forest stand. The majority of forest on the rocky uplands shows evidence of being affected by the 1989 forest fire. There are isolated stands of older forest that may have escaped burning, particularly in the area of proposed Pit 2. Fire events, and subsequent regeneration, are a natural and common feature of the boreal zones of Canada. The bog areas that are targeted for pit development show little evidence of fire due to their wet nature. Some tree growth in the bogs was burned and ground cover in the wet meadows adjacent to the bogs shows evidence of past burning. The plant species that could potentially be found in the Mid-Boreal Lowland Ecoregion are listed in **Appendix C, Table 02**.

Ground nesting birds and small mammal species such as Snowshoe Hare (*Lepus americanus*) and Meadow Vole (*Microtus pennsylvanicus*) will make use of burned areas once re-growth has progressed to the high shrub stage. This makes the area attractive to hawks and owls, as well as mammalian predators such as Coyote (*Canis latrans*) and Short-Tailed Weasel (*Mustela ermine*). Burned areas do not provide high quality nesting habitat for birds, with the exception of the boundary between the burned areas and unburned remnant areas (edge habitats). A burned area is highly disturbed and does not contain habitat critical to wildlife species. Due to the impact of the 1989 forest fire and historical development at the Puffy Lake Mine site, the terrestrial habitat is in this area is not, at present,

ideal to support diverse wildlife and would not represent an area that would be attractive for most animals that are commonly considered for trapping or hunting.

The existing clearings, trails, and roads provide edge habitat that benefits many species of nesting migratory birds, especially warblers. The extensive system of lakes and rivers in the region offers a large area potentially suitable for nesting migratory waterfowl. It should be noted however, the waterfowl do not typically make extensive use of boreal areas for nesting. Similar to the findings of the 1987 terrestrial investigation, the mammal population of the site as encountered in 2012, was quite limited, especially the ungulates, likely because of a lack of suitable habitat and food supply. Other mammals, including fur-bearers, game birds and waterfowl were also not numerous. One Lynx (*Lynx canadensis*) was observed along the Sherridon Road south of the Puffy Lake main access road during the AECOM terrestrial survey in September 2012. The wildlife species that could potentially be found in the Mid-Boreal Lowland Ecoregion are listed in **Appendix C, Table 02**.

2.3.2.1 Pit 1

The proposed Pit 1 area has a long narrow wetland and fen in the southern portion. It is relatively open with some incursion by Tamarack (*Larix laricina*) and Black Spruce (*Picea mariana*) along the eastern and southern margins of the area. The proposed pit area is adjacent to the existing underground mine portal (**Figure 02**) where a dense sedge stand to the south ending in a cattail (*Typha* sp.) marsh exists (**Photographs 01 and 02**). The northern area is dominated by *Sphagnum* sp. moss with sedge (*Cyperaceae* sp.) hummocks (**Photograph 03**). The eastern side of the area is bounded by rocky upland. The wet fen and open marsh grade into this area, becoming drier with wet meadow predominating. Tree growth increases at the margins of the proposed Pit 1 (**Photograph 04**).

Overall, the Pit 1 area appears to be a deep and very wet bounded fen contiguous with a much larger fen and marsh system to the south and east (**Photograph 05**). Vegetation is typical for this environment. There is a great deal of variation from north to south, and across the fen towards the rocky boundary. The Sphagnum mat that covers most of this area is growing out into open water marsh as is typical with restricted flow water systems in the boreal north. This floating mat supports Sedge growth and is covered with typical wetland species such as Bog Birch (*Betula pumila*) and Bog Cranberry (*Vaccinium oxycoccus*). Despite the variability of this area, no unique vegetative communities were found that would suggest the presence of rare or endangered vegetation species.

Wildlife use of fen areas is typically sparse. Moose (*Alces alces*) tracks were observed along the eastern wet meadow boundary for browse species. Moose are adapted to moving through wet areas and take advantage of shrub growth along the edges of wetlands. They will make use of open marsh areas, grazing wetland plants and escaping insects by entering the water. They also make use of these areas in winter, again primarily for browse species along the margins of the open fen. Birds use the edge habitat along fens for nesting. The open area of a fen backed by the forested margins creates a varied habitat for songbirds.

2.3.2.2 Pit 2

The Pit 2 area is bisected by the access road running east from the existing, flooded underground mine portal to the TIA. The south side of the access road is a bog continuous with that in the Pit 1 area. The north side is wet forest and heavily treed. This area is hummocky sphagnum/sedge area covered with Bog Birch and Bog Cranberry supporting a sparse growth of Tamarack and Black Spruce. It is very wet and is bounded by the higher ground that supports the on-site road.

The Pit 2 area is bounded by treed uplands to the east and west and has a treed fen through the middle of the proposed pit area. The wet area is also covered by forest growth (**Photograph 06**). This zone is highly varied with

a Sedge base bounded by grassy uplands. The tree cover is primarily Jack Pine with White Birch and some Black Spruce. A heavy alder (*Alnus* sp.) understory covers the wetter areas. Jack Pine was observed growing with Tamarack in the fen centre of the pit area. This is highly unusual since Jack Pine typically prefer sandy dry uplands. This is a highly varied environment, dominated by treed wet fen. No wildlife use of this area was directly observed.

2.3.2.3 Pit 3

The proposed location of Pit 3 is north of the proposed Pit 2 and is continuous with the wet fen area that bisects Pit 2. This area is very similar to that of the Pit 2 area in that it is a central wet fen bounded in the north and south by forested upland (**Photograph 07**). The species composition and characteristics of the central wet fen are the same as that described for Pit 2. The upland areas show evidence of burning. Forest regrowth is primarily Jack Pine with a mixture of poplar (*Populus* sp.) and Birch. Fallen tree trunks (burn deadfall) are abundant in this area (**Photograph 08**). Ground cover also shows evidence of burning and consists of mossy species and grass. Bare rock is exposed over much of the upland area. Some shrub growth is present along the fen edge. The wet fen is bounded by the burned rocky upland common throughout this area. Pit 3 shows no evidence of use by wildlife. This area does not suggest a high value for nesting birds, as they are typically found in abundance in edge habitats.

2.3.2.4 Pit 4

This area is part of a large bog complex. Like all bog development, the sphagnum mat is growing out from a bounded shoreline into a formerly open water area. The pit area encompasses the northern edge of Fire Pond and the extensive bog north of the pond. It also includes some of the adjoining rocky upland.

The bog mat in the central part of the pit area varies from floating at the edge of the open water to solid and raised further to the north (**Photograph 09**). As Fire Pond fills in, sphagnum accumulation tends to produce a raised bog that eventually dries out. The base of sphagnum is covered with hummocks of sedge and Labrador Tea (*Ledum groenlandicum*) and Bog Cranberry. The ground cover in this area is highly varied with typical bog vegetation intermixed with some Tamarack islands (**Photograph 10**).

The rocky upland is primarily Jack Pine regeneration from the 1989 forest fire. There is some poplar and birch in this area. Shrub growth along the boundary between the upland and the bog is well developed, and extends into open areas within the local forest. Ground cover is poorly developed and has not yet recovered from the 1989 burn. There are wet areas intermixed with the rocky upland and these low spots are covered in dense Alder bogs. Deadfall from the burn is abundant in the upland area (**Photograph 11**).

Several historical and/or recent drill roads and cutlines are present in parts of the Pit 4 area (**Photograph 12**). Wildlife use of this area is anticipated to be minimal. The edge of a bog where the biome changes to forest is often used by a variety of bird species for nesting or foraging. However, the majority of edge habitat in this area is not well defined and has not recovered from the past fire. Moose are endemic in the area and would pass through the bog and forest on occasion. One Black Bear track was recorded on a drill road clearing in the forested area near the bog. As with Moose, Black Bears are common in the overall region, and will make use of the general area for foraging.

2.3.2.5 Pit 5

The proposed location of Pit 5 is a small pit and is located west of the proposed Pit 4. This area is very wet, surrounded by raised Sphagnum bog that is contiguous with that running through Pit 4 (**Photograph 13**). The area of Pit 5 is bounded by the greater bog to the east and a rocky upland to the west. The sedge marsh is not open and

is covered in dense plant growth. As such, it is not suitable habitat for waterfowl species. The rocky upland forest is Jack Pine regeneration similar to that in Pit 4. Wildlife habitat potential in the area of Pit 5 is similar to that of Pit 4. This is in general an extension of the Pit 4 area with similar plant community composition.

Overall, the areas of the proposed open pits provide varying extents of edge habitats that support birds, small mammals, such as rodents, and larger mammals, such as Moose, Black Bear (*Ursus americanus*), Lynx, and Wolf. Beaver activity was observed along the main access road. There is limited available habitat for waterfowl or White-Tailed Deer (*Odocoileus virginianus*) in the site. Though the relative distribution of unburned forest will vary throughout the region, it is not anticipated that the areas within the site contain unique habitat.

2.4 Protected Species

The Manitoba Conservation Data Centre (MCDC) provides lists of species of special concern by ecoregion. The term "species of concern" includes species that are rare, distinct, or at risk or in need of further research. Species are evaluated and ranked based on their range-wide (global) status, and their province-wide (sub-national) status according to a standardized procedure used by all Conservation Centres and Natural Heritage Programs. Twenty species of fungi, plants, and vertebrate animals are listed as species of special concern in the Churchill River Upland Ecoregion (**Appendix C, Table 03**).

As confirmed through field observations conducted in September 2012, the wildlife habitats within the area of the site were considered typical for the region, with no unique or rare habitats encountered. No species listed in the MCDC ranking tables were observed in the areas included in the assessment. There is little to suggest that unique or rare habitats and plants occur in the area that does not also occur in the local region. That is, the area of the proposed open pits does not contain unusual or uncommon plant communities.

Of the twenty species listed as species of special concern by the MCDC (**Appendix C, Table 03**), there are six species that are protected species. Protected species, as defined by either Federal or Provincial legislation, are species that are endangered, threatened, or are of special interest. The provincial *Manitoba Endangered Species Act* (*MESA*) may have species that overlap with the Federal *Species at Risk Act* (*SARA*). The protected species with potential to occur in the Churchill River Upland Ecoregion are listed in **Table 2.4**.

Table 2.4: List of Protected Species within the Churchill River Upland Ecoregion

Common Name	Scientific Name	SARA Status	MESA Status
Boreal Woodland Caribou	*Rangifer tarandus caribou*	Threatened	Threatened
Flooded Jellyskin	*Leptogium rivulare*	Threatened	Not Ranked
Monarch	*Danaus plexippus*	Special Concern	Not Ranked
Northern Leopard Frog	*Lithobates pipiens*	Special Concern	Not Ranked
Shortjaw Cisco	*Coregonus zenithicus*	Threatened	Not Ranked
Yellow Rail	*Coturnicops noveboracensis*	Special Concern	Not Ranked

Source: Manitoba Conservation 2011b and Government of Canada 2011

Manitoba recognizes three varieties of caribou: Coastal, Barren-ground and Boreal Woodland. The Boreal Woodland Caribou was designated as threatened under *The Endangered Species Act* in June 2006 (Manitoba Conservation 2011b). Habitat destruction, hunting, disturbance by humans, and predation are all contributing factors to the decline of caribou. In many parts of their range, anthropogenic activities have resulted in the loss, alteration or have created discontinuity in important caribou habitat. Weather and climate change also influence recovery. The biggest challenge of recovery plans for caribou and other species is to determine how these factors interact and how to manage them to decrease their threat to populations that are at risk (Government of Canada 2011). The

Kississing-Naosap herd is composed of an estimated 150 individuals and is currently considered stable (COSEWIC 2002). According to *Manitoba's Conservation and Recovery Strategy for Boreal Woodland Caribou* (Government of Manitoba 2005), the conservation risk of the Kississing and Naosap herds are considered to be high risk and medium risk, respectively. The 1989 forest fire burned approximately 12% of their 10,060 km² range (COSEWIC 2002). In a radio telemetry study conducted on the Kississing-Naosap herd in 2002-2005, the collared Boreal Woodland Caribou (eleven individuals) typically avoided young or deciduous forest and disturbed areas, including those impacted by the 1989 forest fires. However, the snow-free season range of the Kississing-Naosap herd overlaps with the site (Lander 2007).

The range of the Monarch butterfly can extend to the 54^0 Latitude in the Prairie Provinces. However, the bulk of their occurrences are south of the 50^0 Latitude. Recorded occurrences are limited to Thompson, The Pas and Grand Rapids, however, these are generally considered vagrants (COSEWIC 2010). The ranges of the Flooded Jellyskin, Shortjaw Cisco, and Yellow Rail are not included in the region. The range of the Northern Leopard Frog is within the region, however none were observed during the terrestrial surveys conducted by AECOM in September 2012. Northern Leopard Frogs prefer flowing streams, they are not likely found in the area of the proposed open pits and stockpiles.

2.5 Aquatic Environment

2.5.1 Hydrology

2.5.1.1 Regional Hydrology

The area crosses the watershed divide between the Burntwood River sub-basin of the Nelson River watershed and the Upper Churchill River sub-basin of the Churchill River drainage system. The region overlaps with the Burntwood River sub-basin and the Grass River sub-basin of the Nelson River drainage and the Upper Churchill River sub-basin of the Churchill River drainage system (**Figure 07**).

Small to large lakes and an irregular bedrock-controlled network of secondary streams, drain generally northeastward over terrain that falls at about 1.5 m to 2.0 m per km in the Granville Lake Ecodistrict (Smith *et al.* 1998).

2.5.1.2 Local Hydrology

Approximately 63% of the area is located within the Upper Churchill River sub-basin (**Figure 07**). The remaining portion of the area is located in the Burntwood River sub-basin of the Nelson River watershed.

The area is defined by small to large headwater lakes, such as Puffy Lake and numerous ponded areas. Fire Pond is characterised by as a depression, where there is no clearly defined inflow or outflow and the contributing area and receptors are intermittent flow from wetlands surrounding part or all of this ponded area (**Figure 08**).

Locally, runoff from bedrock and upland areas collects in peat-filled lows, which slowly releases excess water to surrounding lakes and creeks. Groundwater tables are high in most wetlands and in low areas bordering the wetlands. Wetlands are localized to low lying areas between topographical highs and along drainage pathways from creeks and lakes.

The Ragged TIA has a catchment area of 2.9 km² (WESA 2012b) that encompasses all waste rock stockpiles and the mill. Ragged TIA naturally discharged towards Puffy Lake through a small creek, where a concrete weir was installed during the former operations of Puffy Lake Mine. The proposed open pits, Fire Pond and the underground

mine portal are located immediately adjacent to the Ragged TIA catchment area, where surface water flows towards Puffy Lake as diffuse overland flow (not through the Ragged TIA). Klohn Leonoff Ltd. (1988) determined the water balance of the Ragged TIA and, at the time of the assessment, the total inflows were 29,135 L/s (including tailings water, mean annual precipitation and displaced lake water) and total outflows were 13,812 L/s (including water in the tailings voids, mean annual evaporation, and mill reclaim water volumes).

To estimate the total surface runoff volumes anticipated, total contributing drainage areas were delineated for each open pit area. Based on the topography, the largest catchment area is at Pit 1 at 1.01 km^2, whereby all the other open pit areas will contribute to Pit 1. The total annual surface runoff to Pit 1 was estimated as 182,800 m^3 based on the average annual precipitation of 470.8 mm. A daily averaged flow for Pit 1 was estimated based on this runoff volume as 5.8 L/s (92 USgpm). In addition to the average annual precipitation of 470.8 mm, a maximum water year precipitation (from June to June) was determined from the entire period of record at the Flin Flon A meteorological gauge. The maximum precipitation for a water year occurred from 1984-1985 with a total precipitation of 681.3 mm. The total annual surface runoff for the water year 1984-1985 was estimated as 262,800 m^3. The maximum daily averaged flow into Pit 1, including surface runoff and maximum annual precipitation volumes, was estimated as 8.3 L/s (132 USgpm). The other four open pits have smaller catchment areas and would receive less average and maximum surface flows compared to Pit 1.

2.5.2 Lake Bathymetry

A bathymetric survey was conducted on Fire Pond during the aquatic assessment studies conducted by AECOM on September 25, 2012 (**Figure 08**). The bathymetric survey was conducted using a boat with motor and a chart plotting sonar attachment that was used to log position and depth to bottom. The chart plotter utilized a built in GPS to allow a significant number of points to be collected with both horizontal position (4.5 m average accuracy) and depth (0.1 m resolution) collected simultaneously and automatically. The sonar was set to collect a data point every second to allow collection of a high density of points. The survey was conducted by first travelling near to the shore to delineate the near shore depth and then infilling the resulting perimeter shots with a series of tracks to cover the reminder of the lake. This allowed a collection many points to aid in modelling the lake bottom surface.

At the time of the bathymetric assessment, baseline information was recorded, and the results are presented in **Table 2.5**.

Table 2.5: Summary of Bathymetric Survey in Fire Pond, September 2012

Waterbody	Maximum Depth (m)	Average Depth (m)	Area (m^2)	Volume (m^3)	Average Grade (%)
Fire Pond	2.2	1.6	19,126	30,764	2.5

Fire Pond is a relatively shallow lake, with a mean depth of 1.6 m and a maximum depth of 2.2 m (**Table 2.5**). The total surface area of Fire Pond was 19,126 m^2 and the total calculated volume was 30,764 m^3. The average grade is typical of headwater lakes, where there is little topographical relief within the pond.

2.5.3 Surface Water Quality

Surface water quality samples were used to establish the baseline water chemistry of Fire Pond and will function as a benchmark for future water quality monitoring, if required, in the lakes and other waterbodies, within the potential area of influence of the proposed open pits. One surface water sample was collected from Fire Pond in July 2012 by Auriga.

The water quality sample was analyzed for the following parameters:

- Routine parameters (*e.g.*, physical and nutrients);
- Major ions (*i.e.*, chloride, sulphate, bromide and silicate);
- Cyanides (*i.e.*, weak acid dissociable, total and free);
- Dissolved organic carbon;
- Total and dissolved metals; and
- Total and dissolved mercury.

AECOM compared the water chemistry data collected by Auriga (**Appendix C, Table 04**) to national guidelines for various water quality parameters: the *CWQG* (CCME 2011a) and the *MMER* (Government of Canada 2002).

In situ water physicochemical parameters were not recorded at the time Auriga collected the water quality sample from Fire Pond. The laboratory analytical pH value was within the *CWQG* range of 6.5 to 9.0 and the *MMER* range of 6.0 to 9.5. Based on information provided by Auriga, the concentrations of anions, nutrients and other routine parameters were similar to those measured in other waterbodies near the site (*e.g.,* Puffy Lake).

Concentrations of most metals were below the detection limit in the water quality sample from Fire Pond (*e.g.*, mercury, nickel, silver, and thallium). Concentrations of arsenic (0.0087 mg/L) and iron (0.7 mg/L) exceeded the *CWQG* of 0.005 mg/L and 0.3mg/L, respectively (**Appendix C, Table 04**). None of the concentrations exceeded *MMER*.

2.5.4 Sediment Quality

A sediment quality sample were used to establish the baseline sediment chemistry of Fire Pond and to function as a benchmark for future potential sediment quality monitoring in the lakes and other waterbodies, within the potential area of influence of the proposed open pits. One sediment quality sample was collected from Fire Pond on September 24, 2012 (**Figure 08; Appendix C, Table 05**). The surficial sediment quality sample was analyzed for particle size, total metals and total mercury.

AECOM compared the sediment chemistry results to national guidelines for various sediment quality parameters: the CCME *Interim Sediment Quality Guideline* (*ISQG*) for the protection of aquatic life and the *Probable Effects Levels* (*PEL*) (CCME, 2011b), and the CCME *Soil Quality Guidelines – Residential and Parkland Use (SQG-RP)* (CCME 2011c).

The Sediment Quality Index (SQI) is a tool developed by the CCME to summarise the results of measured concentrations of chemicals of concern from a waterbody (CCME 2001a). The SQI is a general indicator of sediment quality, where lower values indicate a higher probability of ecological effects (CCME 2001a). Factors such as the number of compounds that exceed a guideline, the number of times they exceed (frequency), and the amount by which they exceed (amplitude) are combined to give a single value. The guideline values used to compare sediment quality in Fire Pond was the *ISQG* and *PEL*. Sediment quality is ranked, based on the SQI into one of five categories:

- **Excellent (>95)**: Absence of threat or impairment; close to natural or pristine conditions; nearly all measurements are below guideline values;
- **Good (80-94)**: Only minor degree of threat or impairment; conditions rarely depart from natural conditions;
- **Fair (65-79)**: Occasionally threatened or impaired; conditions sometimes depart from natural or desirable levels;

- **Marginal (45-64)**: Frequently threatened or impaired; conditions often depart from natural or desirable levels; and
- **Poor (<44)**: Almost always threatened or impaired; conditions usually depart from natural or desirable levels.

A single surficial sediment sample was collected from Fire Pond on September 24, 2012 and the results of the analysis are presented in **Appendix C, Table 05**. The sediment sample collected was characterized as having a silt-loam texture and was predominately silt, typical of waterbodies with little to no inflow or outflow. Concentrations of arsenic (48.5 milligram per kilogram dry weight (mg/kg dw)) and cadmium (0.768 mg/kg dw) exceeded at least one applicable sediment quality guideline (**Appendix C, Table 05**).

Sediment quality was ranked as Good (based on SQI of 83 using the *ISQG*) or Marginal (based on SQI of 62 using the *PEL*). SQI values based on *PEL* were considerably higher than those based on the *ISQG*, and probably more accurately reflect the potential for ongoing impact to aquatic life. The SQI values in Fire Pond are comparable to previous AECOM aquatic investigations in the area and probably reflect naturally elevated metals concentrations.

2.5.5 Aquatic Invertebrates

As part of the environmental baseline aquatic assessment, phytoplankton, zooplankton and benthic invertebrate community data was collected from Fire Pond (**Figure 08**). The results of the phytoplankton, zooplankton and benthic invertebrate community study will be used to establish the baseline biological content of Fire Pond and will function as a benchmark for environmental monitoring, if required, in the lakes and other waterbodies within the potential area of influence of the proposed open pits.

AECOM collected samples for taxonomic identification and enumeration of phytoplankton, zooplankton, and benthic invertebrates from Fire Pond in September 2012.

2.5.5.1 Phytoplankton

AECOM retrieved one phytoplankton sample from Fire Pond on September 24, 2012 by directly filling sample bottles (provided by the analytical laboratory) at approximately 0.3 m below the water surface. The field crews preserved each sample with sufficient quantities of Lugol's solution to form a tea-coloured solution and submitted the sample to ALS Laboratory Group in Winnipeg for analysis of biomass and taxonomic identification.

The analytical laboratory identified eight classes of phytoplankton in the sample collected from Fire Pond, with Chrysophyceae (yellow-green algae) present in the highest abundance and Euglenophyceae (flagellates) as the rarest class of phytoplankton (**Table 2.6**). Fire Pond had a total phytoplankton density (1.5×10^7 n/L) and diversity comparable to previous AECOM aquatic investigations in the area. Cryptophyceae (biflagellate algae) dominate the phytoplankton community biovolume (63% of the total biovolume) while accounting for 1.3% of the total abundance.

Table 2.6: Phytoplankton Abundance in Fire Pond, September 2012

Class	Species	Abundance (x 10^4 n/L)	Total Biovolume (x 10^7 µm³/L)
Bacillariophyceae	*Gomphonema sp.*	0.10	2.09
	Nitzschia sp.	1.86	
Chlorophyceae	*Chlamydomonas sp.*	1.24	19.3
	Crucigenia sp.	22.3	
	Dictyosphaerium sp.	0.20	
	Elakatothrix sp.	17.98	
	Monoraphidium sp.	24.8	
	Pediastrum privium	6.82	
	Planktosphaeria sp.	0.10	
	Quadrigula sp.	4.0	
	Scenedesmus arcuatus	3.2	
	Scenedesmus quadricauda	1.86	
Chrysophyceae	*Bitrichia sp.*	2.48	95.1
	Dinobryon bavaricum	1.24	
	Dinobryon sp.	0.10	
	Mallomonas sp.	0.62	
	small chrysophytes	1,372.8	
Cryptophyceae	*Cryptomonas sp.*	19.84	238
Cyanophyceae	*Anabaena sp.*	0.10	0.918
	Merismopedia sp.	4.96	
	Planktolyngbya sp.	1.24	
Dinophyceae	*Gymnodinium sp.*	0.62	2.79
Euglenophyceae	*Euglena sp.*	0.10	9.60
Fragilariophyceae	*Synedra sp.*	10.54	9.52
	Tabellaria sp.	1.20	

2.5.5.2 Zooplankton

AECOM retrieved zooplankton in conjunction with phytoplankton sampling. Zooplankton samples were collected using a 0.90 m long, 63 µm mesh size conical net with a weighted cod-end and an opening diameter of 0.30 m. Field crews performed a horizontal tow, whereby the net was lowered into the water and pulled horizontally two lengths of 3 m. Upon retrieval, field crews washed captured zooplankton into the sample jar, fixed the sample with 70% ethanol, and shipped the sample to ALS Laboratory Group in Winnipeg for analysis of biomass and taxonomic identification. Sampling equipment was rinsed prior to sampling with ambient water.

The abundance of each taxon per tow was estimated by calculating the number of individuals per litre of water (n/L). The volume of water filtered was calculated by multiplying the net mouth area (0.071 m²) by the distance of the horizontal tow (6 m).

Total zooplankton abundance in Fire Pond was 83.8 n/L in September 2012 (**Table 2.7**). Species diversity and abundance in Fire Pond was comparable to previous AECOM aquatic investigations in the area. Monogononta (a class of rotiferans) was the dominant group in Fire Pond, comprising approximately 60% of the total zooplankton abundance. The sub-dominant class of zooplankton was Ciliata (ciliated protists) and Copepoda (crustaceans), accounting for 27% of the total zooplankton abundance. Branchipoda (filter-feeding freshwater shrimp) dominate the zooplankton community biovolume (53% of the total biovolume) while accounting for 2% of the total abundance.

Table 2.7: Zooplankton Abundance in Fire Pond, September 2012

Class	Species	Abundance (n/L)	Total Biovolume (x 10^8 µm³/L)
Branchiopoda	*Bosmina sp.*	1.97	226
	Holopedium sp.	0.09	
Ciliata	*Epistylis sp.*	10.7	22.3
	Vorticella sp.	9.01	
	unidentified	2.63	
Copepoda	*Cyclops sp.*	0.02	54.6
	Diaptomus sp.	0.21	
	Nauplii sp.	3.80	
	unidentified	0.28	
Insecta	*unidentified*	0.02	1.20
Lobosa	*Arcella sp.*	0.09	0.93
	Difflugia sp.	0.09	
Monogononta	*Collotheca sp.*	0.19	76.3
	Conochilus sp.	19.6	
	Gastropus sp.	0.28	
	Kellicottia bostoniensis	7.84	
	Kellicottia longispina	1.92	
	Keratella sp.	6.01	
	Monostyla sp.	0.19	
	Ploesoma sp.	0.05	
	Polyarthra sp.	13.6	
	Trichocerca sp.	0.23	
Phylum Rotifera	*unidentified*	4.93	48.4
Phylum Nematoda	*unidentified*	0.02	0.081

2.5.5.3 Benthic Invertebrates

AECOM collected benthic samples to characterize the benthic invertebrate community (BIC) on September 24, 2012 from the centre of Fire Pond. Two samples of surficial sediments were collected using a Petit Ponar (sampling area of 0.0232 m^2). Field crews submitted the first replicate for metals analysis and the second (taken from the other side of the boat to ensure the grab was from undisturbed sediments) for BIC identification and enumeration. Acceptable grab samples were retrieved to the surface and water was decanted from the sampler. Grab samples were deposited in a 500 µm sieve bucket to remove fine materials. The Petit Ponar sampler was triple-rinsed prior to

sampling with ambient water. The BIC sample was rinsed from the sieve bucket into a sample jar, preserved with 70% ethanol, and was submitted to ALS Laboratory Group in Winnipeg for benthic invertebrate taxonomic identification and enumeration.

Benthic habitat was characterized in the field using descriptions of colour, odour, substrate type (*e.g.*, fines or organics), and presence of aquatic vegetation. The BIC descriptors will be calculated and reported as recommended by Environment Canada (2002) and shown below. Individuals that were not identified at the family level will be included for calculations of BIC descriptors only if there were no other families identified in the order.

- Total invertebrate diversity is the total number of individuals of all taxonomic categories expressed per unit area (*i.e.*, numbers/m²);
- Taxon (family) richness is the total number of families collected;
- Evenness is a measure of the distribution of organisms among identified taxa. Evenness values are lower when communities are less balanced (*i.e.,* dominated by few taxa). Evenness is calculated as below:

$$E = 1 / \Sigma (p_i)^2 / S$$

Where:
E = Evenness
p_i = proportion of the i^{th} taxon at the station
S = number of taxa at the station

- Simpson's Diversity Index (SDI) expresses both abundance patterns and taxonomic richness by determining for each taxonomic group, the proportion of individuals that it contributes to the total. Higher SDI values are associated with more diverse communities. SDI is calculated as below:

$$SDI = 1 - \Sigma (pi)^2$$

Where:
SDI = Simpson's Diversity Index
p_i = proportion of the i^{th} taxon at the station

- Another descriptor used to describe the benthic invertebrate community includes the percentage of *Ephemeroptera*, *Plecoptera* and *Tricoptera* (% EPT). The EPT contain taxa considered to be the least tolerant of environmental stress or pollutants and their presence can be an indication of habitat health or quality.

Sediment in Fire Pond was highly organic with fines and a slight sulfur smell. At the site of sample collection, there were no aquatic vegetation however, *Potamogeton gramineus* and other aquatic vegetation was observed in other portions of Fire Pond. Dissolved oxygen concentration was high just above the sediment (10.5 mg/L).

In total, there were seven orders of benthic invertebrates identified in the sample collected in September 2012 from Fire Pond (**Table 2.8**). The dominant order was Diptera, accounting for 88% of the total BIC density. The sub-dominant order was *Copepoda*, accounting for 5% of the total BIC density. Although species density in Fire Pond was comparable to previous AECOM aquatic investigations in the area, species diversity was low. Family richness was seven in Fire Pond. Evenness in Fire Pond was 0.34 which suggests an unbalanced community, dominated by few taxa (*i.e.,* 93% of the density is in two orders). The SDI value in Fire Pond was 0.22 which indicates low BIC diversity. There were no EPT taxa in the sample collected from Fire Pond in September 2012.

Table 2.8: Benthic Invertebrate Density in Fire Pond, September 2012

Order	Family	Genus	Density (n/m²)
Oligochaeta	Tubificidae	unidentified (with hair setae)	86
Trombidiformes	Unionicolidae	*Unionicola sp.*	43
Cladocera	unidentified	unidentified	86
Copepoda	Calanoida	unidentified	216
Diptera	Chaoboridae	*Chaoborus sp.*	345
	Chironomidae	*Chironomini sp.*	3,750
Veneroida	Pisiidae	*Pisidium sp.*	43
		unidentified	43
Class Nematoda	unidentified	unidentified	43

Low invertebrate densities and diversity generally indicate poor habitat quality, whereas excessively high densities may indicate nutrient enrichment, toxic conditions, or physical disturbance of habitat. High diversity may indicate better and more stable environmental conditions, while low values can indicate stresses on the system. The absence of EPT taxa generally indicates poor environmental conditions, as they are sensitive to pollution (Hubbard 1978). The reduced sediment quality in Fire Pond could contribute to the low diversity and density of the benthic invertebrate community.

2.5.6 Fish Community

The fish community in Fire Pond was assessed as part of the environmental baseline aquatic assessments conducted in September 2012 by AECOM (**Figures 15 and 17**). Fishing effort methods included:

- Small gang gill nets: three (3) 10 m long by 1.8 m deep panels of 13 mm, 19 mm, and 25 mm twisted nylon stretched mesh; and
- Baited Gee minnow traps.

Fish species known to be present in the Churchill River and Nelson River watersheds are listed in **Appendix C, Table 06**. Of the species identified in **Appendix C, Table 06**, only Brook Stickleback (*Culaea inconstans*) was captured in Fire Pond. This species is typical of small, headwater lakes and are widespread throughout the province. Brook Stickleback grow rapidly, reaching sexual maturity within one year with a maximum reported age of two years (Scott & Crossman 1998). A total of 197 Brook Stickleback were captured in Fire Pond using five minnow traps and one small gang gill net (**Appendix C, Table 07**). Total length was measured for 103 individuals and ranged from 46 mm to 66 mm (55 mm ± 5.2 mm) (**Appendix C, Table 08**). Weight information was not collected due to malfunction of the weighing balance.

2.5.7 Metal Residue in Fish

Fish captured during the fish community assessment in Fire Pond conducted in September 2012 (described in **Section 2.5.6**) were retained for future analysis of mercury and metal content in whole-body samples.

2.5.8 Aquatic Habitat Assessment

Development of the proposed open pits at the Puffy property will require installation of a berm in Fire Pond and installation of haulage roads to support the proposed open pits. AECOM fisheries biologists conducted aquatic habitat assessments in the vicinity of the site (**Figures 15 and 17**) in September 2012 to describe fish habitat potentially affected by Alteration activities, in three areas:

- Along the main access road, from the Sherridon road to the existing mill facility;
- Along the on-site road leading from the existing underground mine portal to the mill facility; and
- Within the vicinity of the proposed open pits, with particular emphasis within and downstream of Fire Pond.

At potential fish bearing waterbodies or fish habitat locations, habitat characteristics such as water depth, cover types, and substrates were documented. The presence of culverts or other structures was also noted. Potential fish habitat use (*e.g.*, spawning or overwintering) was also assessed at the time of the field survey. At the time of the assessment, water levels were very low and as a result, potential fish habitats present during high water conditions could not be determined.

Unique or critical fish habitat was not observed during the aquatic habitat assessments (**Appendix C, Table 09**). Fish habitat at watercourse crossings along the main access road provided, at most, Marginal aquatic habitat value (**Table 2.6**). Marginal habitats have low productive capacity and contribute marginally to fish production (Fisheries and Oceans Canada, 1998). Several small ponded areas were identified along the Main Access Road with no apparent connectivity to other waterbodies, even with higher water levels (**Photograph 14**). Some culverts were not functional at the water levels observed at the time of survey and were either perched or embedded (**Photograph 15**). Significant Beaver (*Castor canadensis*) activity in the area creates impediments to fish passage (**Photograph 16**). Fishing effort at crossing PLM-03 was minimal and essentially ineffective due to site conditions and low water levels. No fish were captured.

Table 2.9: Summary of Aquatic Habitat Assessment Along the Main Access Road, September 2012

Crossing ID	Photograph #	KM from Sherridon Road	Fish Use				Connectivity	Aquatic Habitat Sensitivity	Aquatic Habitat Value
			Spawning	Migration	Rearing	Over-Wintering			
PLM-01	14, 16	8.4	Poor	Poor	Poor	Poor	Poor	Low	None
PLM-02	15, 17	7.9	Poor	Poor	Poor	Poor	None	Low	None
PLM-03	18,19, 20	5.5	Good	Poor	Good	Poor	Good	Low	Marginal
PLM-04	21, 22	1.7	Good	Poor	Good	Poor	Poor	Low	Marginal

Several ponded areas and culverts were observed along the main access road. The ponded areas are generally low lying areas in which water accumulates between bedrock outcrops and, culverts at these locations permit drainage across the roadway. These ponded areas do not support fish and provide no fish habitat. A summary of the aquatic habitat assessment is provided in **Table 2.6**.

There were no potential fish bearing waterbodies or fish habitat identified along the on-site roads and only two small ponded areas were observed (**Photographs 23 and 24**). Limited connectivity and shallow water that would freeze to the bottom in winter limits the habitat value of these ponded areas.

There were no potential fish bearing waterbodies or fish habitat observed in the vicinity of the proposed open pits with the exception of Fire Pond. General observations of the site indicate that there are no other waterbodies that could support fish habitat in the areas of other proposed developments (*e.g.*, waste rock stockpiles). Within Fire Pond, cover was provided by overhanging vegetation, woody debris and, to a lesser degree, submergent vegetation (**Appendix C, Table 07**). Maximum depth was 2.2 m and the substrate largely consisted of organics. A portion of the western shore was bedrock, but the majority of shoreline was composed of wetland grasses and shrubs (**Photographs 25 and 26**). Typical of headwater lakes and ponds, Brook Stickleback were captured in Fire Pond. Brook Stickleback are widely distributed and abundant throughout the province. There was no evidence of a creek or potential for fish or fish habitat downstream of Fire Pond (**Photographs 05 and 27**). The aquatic habitat value of Fire Pond is categorized as *Marginal* as it provides habitat only for small-bodied fish (*i.e.,* Brook Stickleback) and there is no connectivity to other waterbodies.

2.6 Socio-Economic Environment

2.6.1 Protected Areas

Grass River Provincial Park is located approximately 15 km southeast of the site and covers an area of 2,279 km^2. This Provincial Park is also classified as a Natural Park as its purpose is to preserve natural areas that represent the Churchill River Upland portion of the Precambrian Boreal Forest. Woodland Caribou can be found throughout the park year round, and are usually found in areas with mature forest and treed muskeg (Manitoba Conservation, 2011c).

Cormorant Provincial Forest is located approximately 69 km south of the site and is the most northern Provincial Forest in Manitoba. This provincial forest was established in 1947 and covers an area of 1,479 km^2 including Clearwater Lake Provincial Park. Provincial forests are Crown Lands managed by Manitoba Natural Resources (Manitoba Conservation, 2011d).

The Saskeram Wildlife Management Area (WMA) is located approximately 107 km south of the site and occupies an area of 958 km^2. The Tom Lamb WMA is located approximately 97 km south of the site and occupies an area of 2,083 km^2. Both of these WMAs encompass a large portion of the Saskatchewan River Delta. These areas provide breeding and staging areas for waterfowl and habitat for Moose, wolves, Black Bear, and other furbearers (Manitoba Conservation, 2011e).

2.6.2 Heritage Resources

A heritage resource impact assessment conducted by Quarternary Consultants Ltd was included in the EIS report prepared by Ilam Associates Ltd in 1987 for the original Puffy Lake Mine. The potential for heritage resources along the main access road, the mill, the underground mine portal, the Ragged TIA, two potential fresh water sources, and on-site roads was determined. Sub-surface tests were conducted in areas with potential for archaeological significance. At the time of the assessment in 1987, all evidence of human activity was attributed to mineral exploration activities. No evidence of any prehistoric utilization of the region was found.

More recently, information from the Historic Resources Branch of Manitoba Culture, Heritage and Tourism was requested for the presence of known historic or heritage resources at the proposed open pits or the surrounding area. The Historic Resources Branch confirmed that there were no known heritage resources located at the site.

In addition, the Historic Resources Branch examined Branch records for areas of potential concern in the vicinity of the site and determined that the potential to impact heritage resources was low, and, therefore, the Historic Resources Branch had no concerns with the project (**Appendix D**).

2.6.3 The Community of Sherridon / Cold Lake

The community of Sherridon originated as a service centre for the Sherritt-Gordon Mines. Many families relocated to Lynn Lake following the mine closure in 1940. The community of Cold Lake is a Métis Community on the shore of Kississing Lake adjacent to the community of Sherridon. Sherridon and Cold Lake are located approximately 155 km north of The Pas and approximately 65 km northeast of Flin Flon. Both communities are accessed by the Omnitrax rail line and a community access road that connect to PTH #10 between Cranberry Portage and Flin Flon.

The population of Sherridon in 2011 was 80 (98 in 2006), according to census figures (Statistics Canada 2012a). There are no census figures available for Cold Lake. The community is serviced directly by Manitoba Hydro transmission lines and has telephone access through Manitoba Telecom Services Inc.

The Cold Lake School, which is operated by Frontier School Division, is located in Cold Lake. Firefighting capability is based on a pumper truck and equipment from the community fire hall. Portable forestry equipment is also available for grass and brush fires. Police are dispatched from Cranberry Portage where a RCMP detachment is located and medical services are based on services of a community health worker. The nearest hospital is located in Flin Flon (NORMAN 2011).

The community water supply for Sherridon is drawn from Sherlett Lake and treatment involves sand filtration followed by chlorine disinfection. Residences in Cold Lake are served by water drawn from the embayment on Cold Lake/Kississing Lake. The Cold Lake treatment plant includes clarification, filtration, and chlorination of the water. The Sherridon portion of the community is served by a gravity-fed wastewater treatment plant, comprising a rotating biological plant, followed by a two-cell treatment lagoon. The Cold Lake portion of the community is on a pump-out system, with effluent trucked to the lagoon (Manitoba Aboriginal and Northern Affairs 2012).

The primary economic activities of Sherridon and Cold Lake and surrounding area include commercial fishing, trapping, forestry, tourism, and some wild rice harvesting in nearby lakes. Kississing Lake provides both commercial and recreational fishing opportunities (Manitoba Aboriginal and Northern Affairs 2012).

2.6.4 The City of Flin Flon

The City of Flin Flon, with an approximate population of 5,592 in 2011 (5,836 in 2006) (Statistics Canada 2012b), is the main mining community in northwestern Manitoba and northeastern Saskatchewan. Flin Flon is located just over 800 km north-northwest of Winnipeg, Manitoba, and 65 km southwest of the community of Sherridon. The community occupies portions of both Manitoba and Saskatchewan.

In addition to mining, Flin Flon has a strong tourism industry that includes hunting, fishing, camping, and boating.

2.6.5 Traffic

According to Manitoba Infrastructure and Transportation, the 1995 annual average daily traffic (AADT) flow for the Sherridon Road was 160 vehicles per day. The AADT level in 2011 on PTH #10 at Baker's Narrows was 840 vehicles per day.

2.6.6 First Nations

The Mathias Colomb Cree Nation (MCCN), located approximately 73 km north of Sherridon at the community of Pukatawagan, is the closest First Nation community to area. Pukatawagan had a population of 1,826 in 2011 (1,478 in 2006, Statistics Canada, 2012c). MCCN has a band population of 1,576 people in 2006 (Statistics Canada, 2012d). There is no permanent access road serving Pukatawagan. The community is accessible year-round by air and by rail. Depending on conditions, the community is accessible by winter road for a period of approximately three months of the year.

Other First Nations that are within a similar distance to the proposed site include:

- Opaskwayak Cree Nation at Opaskwayak (86 km);
- Nisichawayasihk Cree Nation at Nelson House (150 km);
- Mosakahiken Cree Nation at Moose Lake (150 km);
- Cross Lake First Nation at Cross Lake (195 km); and
- Norway House Cree Nation at Norway House (240 km).

Figure 09 shows the locations of these First Nations relative to the region.

2.6.7 Regional Resource Use

2.6.7.1 Lodge Owners

There are two lodges and one camp in operation in the Sherridon area; Kississing Lake Lodge, Kenanow Lodge, and Sharron's Outfitting Service, respectively. Kississing Lake Lodge is accessible by air and boat and specializes in recreational fishing. Kississing Lake Lodge has a number of outpost lakes. Kenanow Lodge and Sharron's Outfitting Service are accessible by road and specialise in fishing. None of the lodges or outpost cabins are located within the region.

2.6.7.2 Trapping

Two Registered Trap Line (RTL) blocks are located within the region. The site is within Trapline 11 in the Sherridon RTL block and currently belongs to Martin Charlette of Sherridon, Manitoba. Based on review of the original HRIA, the region overlaps with Trapline 5, Trapline 4, and Trapline 3, all within the Sherridon RTL block (Ilam Associates Ltd. 1987). Auriga will contact the Conservation office in Cranberry Portage to request contact information for the owners of these traplines.

2.6.7.3 Wild Rice Harvesting

Wild rice is harvested in nearby lakes in the Sherridon area (Manitoba Aboriginal and Northern Affairs 2012). Wild rice is harvested for commercial purposes from companies based in Cranberry Portage (Naosap Harvest 2012), Flin Flon (Far North Wild Rice 2012), and The Pas (Wild Man Ricing Wild Rice 2012). No commercial wild rice harvesting occurs within in the region.

2.6.7.4 Forestry

Tolko Industries Ltd. (Manitoba Solid Wood Division, Woodlands), located in The Pas, Manitoba has three Forest Sections in the region (Highrock, Nelson River and Saskatchewan River) where wood is harvested. The Highrock

Forest Section includes areas surrounding Flin Flon, Sherridon and the area (Tolko Industries Ltd. 2011). According to Tolko's Annual Harvest Plan, available on their website, there are contingency harvest blocks within the region, near Syme Lake (Tolko Industries Ltd. 2012; **Figure 10**).

2.6.7.5 Fishing

Kississing Lake provides both commercial and recreational fishing opportunities (Manitoba Aboriginal and Northern Affairs 2012). In the region, there are several moderate-sized lakes that could potentially support recreational fishing for local residents (*e.g.*, Dumbell Lake or Jay Lake). There is no evidence that suggests there are waterbodies within the region that currently support a commercial fishery.

2.6.7.6 Medicinal and Traditional Plant Harvesting

A variety of plant and berry species are traditionally harvested by Aboriginal people. The variety of plants and berries harvested varies based on the ecological and cultural composition of an area or community and may hold important cultural value for many Aboriginal people.

Currently there is no central source of information to describe plants that are of cultural significance to Aboriginal people near the existing Puffy Lake Mine. AECOM consulted Manitoba Hydro's Environmental Impact Statement for their Bipole III Project and conducted an internet search to determine if any of the plant species identified during the field surveys may have cultural significance to Aboriginal People in Manitoba. Large varieties of plants and berries have been, or continue to be, harvested by Aboriginal people in Manitoba, including:

- Balsam
- Bearberry
- Birch tree leaves*
- Blueberry
- Bunchberry
- Cranberry*
- Dandelion root and leaves
- Gooseberry
- Icelandmoss
- Juniper berries
- Labrador Tea*
- Mint
- Raspberry
- Red Clover
- Saskatoon berries
- Seneca Snakeroot
- Stinging Nettle
- Strawberry
- Sweet Flag
- Sweet Grass
- Tamarack*
- Water Lily
- Wormwood
- Yarrow

These species have the potential to occur in or near the region and some were directly observed during AECOM's 2012 terrestrial field visit (indicated by an asterisk in above list; **Section 2.3.2**). Several of these plant species can be found in disturbed sites, and would likely be encountered in road ditches and cleared areas within the area and region. The other species are very common boreal species and are expected to be encountered throughout the area and region. None of the identified species are considered unique to the existing Puffy Lake Mine site.

2.7 Protected and Other Aquatic Resources

For the purpose of this Environmental Baseline Assessment, aquatic resources refers to any living species present in a surface waterbody, including benthic invertebrates, macrophytes, fish, and fish habitat. The invertebrate communities (i.e., phytoplankton, zooplankton and benthic invertebrates) in Fire Pond are generally comparable to previous AECOM aquatic investigations in the area. A general discussion of these resources are discussed in general terms below.

Shortjaw Cisco is the only protected aquatic species that has potential to occur within the Churchill River Upland Ecoregion. The distribution of the Shortjaw Cisco is restricted to waterbodies outside the Nelson River watershed,

within which the site exists. The closest record of Shortjaw Cisco is in Athapapushkow Lake, over 70 km southeast from the site. As such, Shortjaw Cisco will not be affected by the proposed Alteration. No other protected aquatic species are anticipated to occur in the region.

Unique or critical fish habitat was not observed during the 2012 aquatic habitat assessment (**Section 2.5.8**). Fish habitat at watercourse crossings along the main access road or within Fire Pond provided, at most, Marginal aquatic habitat value. Marginal habitats have low productive capacity and contribute marginally to fish production (Fisheries and Oceans Canada 1998).

The potential drawdown of Fire Pond during mining of Pit 4 will prevent this waterbody from supporting any fish habitat during the mining phase. The only fish species present in Fire Pond was Brook Stickleback. The invertebrate communities in waterbodies, such as Fire Pond that occur near historically disturbed sites, are generally characterized as having a low abundance and diversity. These invertebrate communities form the foundation of the food web and hence, the fish habitat quality within a waterbody.

2.8 Protected and Other Flora Species

As described in **Section 2.4**, the Federally protected Flooded Jellyskin has the potential to occur within the Churchill River Upland Ecoregion. This lichen species was not observed in the terrestrial surveys conducted for the project. The nearest record of occurrence of the Flooded Jellyskin to the site is near Flin Flon, approximately 54 km southeast.

2.9 Protected and Other Fauna Species

2.9.1 Protected Fauna Species

As described in **Section 2.4**, the Federally protected Monarch, Boreal Woodland Caribou, Northern Leopard Frog and Yellow Rail have the potential to occur within the Churchill River Upland Ecoregion. The distribution range of the Yellow Rail and Monarch are outside of the region. The range of Northern Leopard Frog is within the region, however none were observed during the terrestrial surveys conducted by AECOM in September 2012. Northern Leopard Frogs prefer flowing streams, therefore, they are not likely to be found in the area of the proposed open pits and stockpiles.

The Kississing-Naosap Boreal Woodland Caribou herd, whose snow-free season range overlaps with the site, is composed of an estimated 150 individuals and is currently considered stable (COSEWIC 2002). According to *Manitoba's Conservation and Recovery Strategy for Boreal Woodland Caribou* (Government of Manitoba 2005), the conservation risk of the Kississing and Naosap herds are considered to be high risk and medium risk, respectively. In many parts of their range, including the site, anthropogenic activities have resulted in the loss, alteration or have created discontinuity of important caribou habitat. The proposed open pits and stockpiles are located within 500 m of previously disturbed forest, through either the former operations at Puffy Lake Mine or the 1989 forest fire. The 1989 forest fire burned approximately 12% of their 10,060 km² range (COSEWIC 2002). In a radio telemetry study conducted on the Kississing-Naosap herd in 2002-2005, the collared Boreal Woodland Caribou (eleven individuals) typically avoided young or deciduous forest and disturbed areas, including those impacted by the 1989 forest fires. There are some areas within the site that escaped the 1989 forest fires, however, these are isolated and small and, as such, will not likely be used by Boreal Woodland Caribou. It is anticipated that Boreal Woodland Caribou are likely already avoiding the site and immediate area, given the lack of suitable habitat and historical and recent presence of activity.

2.10 Socio-Economic Environment

2.10.1 Resource Use

This Mineral Lease permits use and occupation of the land surface for the purpose of prospecting, exploring for, developing, mining or production of minerals on, in or under the land. Access to the Puffy Lake Mine site is restricted by a gate on the main access road from the Sherridon Road. Auriga has indicated that they are committed to working with local trappers and interested stakeholders to ensure access to trap lines and other resource harvesting is not affected by the proposed Alteration.

2.10.2 Heritage Resources

Ground disturbance and excavation in soils as well as drilling and blasting of surface bedrock have the potential to damage heritage resources if any were present. Potential effects on heritage resources can be either reversible (in the case of additional burial or flooding) or irreversible (in the case of physical damage to site integrity).

A Heritage Resource Impact Assessment (HRIA) was originally conducted by Quaternary Consultants Ltd. and was included in the EIS report prepared by Ilam Associates Ltd 1987. As a result of the HRIA in 1987, conducted under the terms of Heritage Permit A1-87 issued by Historic Resources Branch, Quaternary Consultants Ltd. concluded that the impoverished biotic diversity and abundance in the area explained the lack of archaeological evidence in the region and that, as a result, there were no impediments to the proposed development of Puffy Lake Mine (Ilam Associates Ltd 1987). More recently, information from the Historic Resources Branch confirmed that there were still no known heritage resources located at the site and that the potential to impact heritage resources was considered low.

The proposed Alteration is contained entirely within the Puffy Lake Mine site which was assessed during the original HRIA. No evidence of pre-mining human presence in the area was found in the original HRIA.

If artefacts, historical features or skeletal remains are encountered during mining activities, work activities should stop immediately around the affected area with the find reported to the site supervisor. A qualified archaeologist may investigate and assess the find prior to the continuation of work. If skeletal remains are encountered during construction activities, the find will be immediately reported to the site supervisor and the RCMP.

3. Conclusions and Recommendations

The preceding summary of baseline conditions at the Puffy Lake Mine and surrounding area is considered a comprehensive synthesis of the current and historical information available. Due to the nature of this summary no recommendations or conclusions have been made in this assessment. Future activities at the site will occur under *Environment Act* License No. 1207E.

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Figures

Photographs

Appendix A
Tables