HUDBAY

May 10, 2013

Ms. Tracey Braun, M.Sc.
Director, Environmental Assessment & Licensing Branch
Manitoba Conservation and Water Stewardship
123 Main Street, Suite 160
Winnipeg, Manitoba
R3C 1A5

Dear Ms Braun,

We write to apply for a Class 2 *Environment Act* license for the construction and operation of the Lalor Concentrator, located in the Snow Lake mining district in Northern Manitoba. A cheque for the application fee in the amount of $5,000.00 is enclosed along with an *Environment Act* Proposal Form and Report (the "Proposal"), prepared by AECOM on behalf of Hudson Bay Mining and Smelting Co., Limited (HBMS).

The purpose of a concentrator is to process ore into a product that can be further refined for market use. It uses a combination of mechanical (crushing and grinding) and chemical processes (flotation) to extract target metals from the ore. The Lalor Concentrator will process ore taken from future Lalor Mine, producing zinc and copper/lead concentrates which will be trucked to HBMS facilities in Flin Flon, Manitoba.

The proposed concentrator building will be located within the site currently occupied by the Lalor Advanced Exploration Project and the future Lalor Mine (*Environment Act* Proposal filed in May, 2012) on which HBMS has been operating intensively since 2007. The Lalor Concentrator will be connected to the Anderson TIA, Anderson TIA Reclaim Pumphouse and Snow Lake Pumphouse by pipelines laid in or alongside rights of way that have been owned in fee simple by HBMS or occupied by HBMS for mining purposes or by the Province of Manitoba for public purposes for more than 30 years.

The Lalor Concentrator also will be supported by other HBMS existing licensed operations in the Snow Lake region. As outlined in this report, the proposed Lalor Mine has been planned, to the maximum extent possible, to avoid adverse environmental effects by taking advantage of available existing licensed support facilities and by keeping the footprint of the development as small as possible.

The Lalor AEP Closure Plan, which was approved by the Director of Mines on April 9, 2010, will be updated to account for operation of the proposed Lalor Concentrator and will be submitted to the Director of Mines for approval, along with any increase/decrease in financial assurance that may be required. In accordance with HBMS experience with mine closure, it is expected that closure activities will, in time post-closure, result in substantial return of the site to pre-project conditions.

P.O. Box 1500
1 Company Road
Flin Flon, Manitoba
Canada R8A 1N9
hudbayminerals.com

Along with the Proposal, we include in this submission a copy of each of the reports used by AECOM in completing the Proposal.

We provide 7 hard copies and 22 electronic copies of this submission. In order to facilitate public review, each set contains both the Proposal and all of the additional above-mentioned reports.

As well, we can advise that we are providing both electronic and hard copies of the submission to Mathias Colomb Cree Nation, as they have expressed an interest in receiving information about the project.

We look forward to hearing from you with your instructions concerning the assessment process and schedule to be followed.

We would be pleased to provide any other information that you may require. Thank you very much for your kind attention to this application.

Sincerely,

Stephen West, P. Eng.
Superintendent, Environmental Control

cc: Sheryl Rosenberg
Tom Goodman
Brad Lantz

Environment

Hudson Bay Mining and Smelting Co., Limited

Lalor Concentrator Environment Act Proposal

Prepared by:

AECOM
99 Commerce Drive 204 477 5381 tel
Winnipeg, MB, Canada R3P 0Y7 204 284 2040 fax
www.aecom.com

Project Number:

60263712 (402.19.2)

Date:

May, 2013

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The attached Report (the "Report") has been prepared by AECOM Canada Ltd. ("Consultant") for the benefit of the client ("Client") in accordance with the agreement between Consultant and Client, including the scope of work detailed therein (the "Agreement").

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- may be based on information provided to Consultant which has not been independently verified;
- has not been updated since the date of issuance of the Report and its accuracy is limited to the time period and circumstances in which it was collected, processed, made or issued;
- must be read as a whole and sections thereof should not be read out of such context;
- was prepared for the specific purposes described in the Report and the Agreement; and
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This Statement of Qualifications and Limitations is attached to and forms part of the Report and any use of the Report is subject to the terms hereof.

AECOM: 2012-01-06

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99 Commerce Drive
Winnipeg, MB, Canada R3P 0Y7
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204 477 5381 tel
204 284 2040 fax

May 9, 2013

Mr. Stephen West
Hudson Bay Mining and Smelting Co., Limited
PO Box 1500
#1 Company Road
Flin Flon, Manitoba
R8A 1N9

Dear Mr. West:

Project No: 60263712 (402.19.2)

Regarding: Lalor Concentrator, Environment Act Proposal

AECOM Canada Ltd. (AECOM) is pleased to submit our report regarding the above referenced project. If you have any questions, please do not hesitate to contact Cliff Samoiloff directly at 204-477-5381.

Sincerely,
AECOM Canada Ltd.

R.V. Typliski

Ron Typliski, P.Eng.
District Manager
Manitoba/Saskatchewan Environment

SK:dh

Distribution List

# of Hard Copies	PDF Required	Association / Company Name
7		Manitoba Conservation
2		Hudson Bay Mining and Smelting Co., Limited
1		Thompson Dorfman Sweatman
1		Julian N. Falconer, Falconer Charney LLP

Revision Log

Revision #	Revised By	Date	Issue / Revision Description
1	S. Sadiq	May 9, 2013	Final

AECOM Signatures

Report Prepared By:

Somia Sadiq, B. Env.Sc (Honours), EP
Environmental Planner
Environment

Report Reviewed By:

Cliff Samoiloff, B.Sc.
Manager, Health & Safety Consulting,
Environment

Executive Summary

This *Environment Act* Proposal (EAP) report contains the information described in Manitoba Conservation's Information Bulletin, "Environment Act Proposal Report Guidelines." It has been prepared and is submitted for consideration of HBMS' application for an Environment Act licence for the proposed Lalor Concentrator.

Hudson Bay Mining and Smelting Co., Limited (HBMS) proposes to construct and operate a new ore concentrator ("Lalor Concentrator") within the site currently occupied by the Lalor Advanced Exploration Project ("Lalor AEP") and the future Lalor Mine (*Environment Act* Proposal filed in May, 2012) (the "Lalor site"), on which HBMS has been operating intensively since 2007. The Lalor site is located in the Snow Lake mining district in Northern Manitoba.

The purpose of a concentrator (or mill) is to process ore into a product that can be further refined for market use. It uses a combination of mechanical (crushing and grinding) and chemical processes (flotation) to extract target metals from the ore. The Lalor Concentrator will process ore taken from Lalor Mine, producing zinc and copper/lead concentrates which will be trucked to HBMS facilities in Flin Flon, Manitoba.

The Lalor Concentrator will replace and upgrade the ore processing capacity of the existing Stall Lake Concentrator which is located about 16 km by road from the Lalor site (or 13.2 km from site to site). The new concentrator will use the same water sources and discharge to the same tailings impoundment area used today by the Stall Lake Concentrator. The only components of the proposed project, therefore, are the concentrator itself and pipelines to these existing facilities.

The Lalor Concentrator will have a design capacity of 4,500 tonnes per day (tpd). It is anticipated that it will operate 24 hours per day, 362 days per year, with scheduled downtime for maintenance as required.

The results of the effects assessment can be summarized as follows:

Topography

Construction and operation of the proposed Lalor Concentrator will have a negligible impact on topography. The Lalor site has already been cleared and leveled during construction of the Lalor AEP, and any blasting, clearing and leveling required for the Pipeline System will be minimal. The closure phase will include restoration of the topography of the site to match the surrounding area to the extent that is practical. Therefore, the changes in topography are assessed to be insignificant.

Soil

The plan for operation of the Lalor Concentrator minimizes the potential to generate ARD on-site, therefore minimizing consequent effects on soil quality. Soil erosion could potentially occur along the Pipeline System ROW during construction due to activities like clearing and grubbing, or during closure, during activities involving application of soil to all disturbed areas. However, with implementation of the measures described in the assessment, residual effect on soil is assessed to be insignificant.

Air

Dust will be generated during construction along the Pipeline System ROW due to activities such as blasting, clearing, and leveling. During operation, dust will be generated at the jaw crusher building, and general equipment and vehicular movement on site. During closure, activities such as leveling, contouring, excavating, and hauling materials will produce dust. However, implementation of measures such as using dust control agents, designing the jaw crusher building to include a wet scrubber, and imposing speed limits on HBMS-owned roadways are expected to mitigate potential adverse effects. Therefore, the effect of dust on air quality is assessed to be negligible.

With respect to exhaust emissions, although the increase in traffic along PR 392 and PR 395 is considered major in relation to the existing level of traffic on these roads, the resulting impact on air quality in the Project Region is assessed to be negligible. The propane heating system in the Concentrator will generate pollutants which may include nitrogen oxides (NOx), carbon monoxide, sulphur dioxide, particulate matter, or greenhouse gases. However, with the measures described in the assessment, such as equipping the heating system with low NOx burners, the effect on air from exhaust emissions is assessed to be insignificant.

With respect to noise, all practices performed on the Project Site will be carried out in accordance with *The Workplace Safety and Health Act* and HBMS' OHSAS 18000 certified management system, which will minimize the risk of occurrences that may affect worker health and safety. Noise levels are not expected to be high enough to cause any significant disturbance in the Project Region. Therefore, effects due to noise are assessed to be negligible.

Climate

Although effects of GHG emissions on climate change are considered irreversible, given the negligible contribution of GHG emissions from the construction, operation and closure phases of the Lalor Concentrator, the residual effect of GHG emissions on climate change is assessed to be insignificant.

Groundwater

Activities such as handling fuels and lubricants, waste and ore management can potentially affect groundwater quality. However, the measures described to avoid groundwater effects from leaks and spills are judged to be sufficient to mitigate any such risk. ARD could also potentially affect soil quality with consequent effects on groundwater quality. However, the ore management practices described in **Section 5.3.1** will appropriately mitigate any potential effects from ARD. Lastly, since groundwater is not being used as a source of process water, no impact on groundwater availability is expected to occur. Therefore, the overall residual effect on groundwater is assessed to be negligible and insignificant.

Surface Water

As the need for freshwater is accommodated within existing approved limits, any effect on surface waterbodies is expected to be negligible. Wastewater generated during the operation phase of the Lalor Concentrator will be managed using existing licensed treatment facilities, and sanitary sewage generated will be treated in an on-site sewage treatment plant until plans for a new treatment plant are in place.

Improper waste management and generation of ARD on site could potentially affect surface water quality (surface runoff and drainage). However, with implementation of measures described in this assessment, potential effects from ARD and wastes are assessed to be appropriately mitigated. Surface water quality in culverts along the Pipeline System ROW may be affected during construction from activities such as blasting, clearing, or replacing culverts. However, with implementation of sediment and erosion control measures described in the assessment, the residual effects are assessed to be negligible and insignificant.

Tailings will be generated during the operation phase and deposited into the Anderson TIA. An accidental spill along the tailings pipe could potentially affect water quality in culverts along the Pipeline System ROW. However, HBMS will implement spill control measures to minimize the risk of this occurring. Effluent from Anderson TIA is discharged into Anderson Creek. Anderson Creek flows into Anderson Bay of Wekusko Lake. Therefore, deposition of tailings in Anderson TIA could potentially affect water quality in these waterbodies. Based on the comparative analysis set out in **Section 4.3.5**, and continued sub-aqueous deposition of tailings, it was concluded that since currently there are no exceedances of MMER criteria in the Anderson TIA, it is expected that the effluent produced in the future from the Lalor Concentrator will also meet the required water quality guidelines. Assuming implementation of the measures described in **Section 5.7.5**, the residual effects on water quality in Anderson Bay of Wekusko Lake are assessed to be negligible.

Protected and Other Flora Species

Although the Lalor Concentrator will result in loss in vegetation in the Project Site, vegetation communities that will be lost are common throughout the Project Region. Further, a majority of the components will be utilizing areas that are already disturbed. During closure, the Project Site will be re-vegetated and returned to native conditions to the extent that is practical. Therefore, the loss of vegetation to the Lalor Concentrator footprint is not considered significant.

Protected and Other Fauna Species

No habitat of specific or critical value to wildlife was observed at the Project Site (such as calving or over-wintering areas), and based on site conditions and limited field observations, it is expected that there is no critical wildlife value in the Project Area. Although, the Lalor Concentrator will result in a loss of habitat due to clearing in the Project Site, the type of habitat that will be lost is common in the Project Region. There will be some noise disturbance during construction and operation, but it is anticipated that wildlife in the area are accustomed to these noise levels, given other development activity in the region. During closure, the Project Site will be restored to native conditions to the extent practical. For these reasons, the residual effect on fauna is assessed to be insignificant.

Aquatic Resources and Protected Species

Changes in sediment quality can potentially affect aquatic invertebrates with secondary effects on organisms higher in the food chain. Fish and fish habitat can be affected directly due to physical activities destroying fish habitat (physical damage of shoreline), changes in water quality, or indirectly through changes in sediment quality. There are no protected species known to occur in the Nelson River watershed, including the waterbodies surrounding the Lalor Concentrator or in Anderson Bay of Wekusko Lake into which effluent discharged from the Anderson TIA eventually flows. However, the mitigation measures described in **Section 5.7.5** for surface water are anticipated to sufficiently mitigate potential effects on aquatic resources.

Land and Resource Use

As presented in **Section 5.12.1**, residual environmental effects on aquatic and terrestrial components have been assessed to be minor to negligible in magnitude. Therefore, the consequential effects on any natural resource harvesting, trapping, and fishing (recreational, subsistence and commercial) are assessed to be insignificant. HBMS will continue to work with the local trappers to ensure that access to their trap lines is not impacted by the proposed development. With respect to snowmobile trails, HBMS will continue to work with Sno-Drifters to discuss any issues with respect to use of HBMS-owned property as recreational trails.

Heritage Resources

There are no known historic or heritage resources at the Project Site or in the immediate surrounding area. Since physical disturbances during construction will be limited to the Project Site, and no further disturbance will occur during operation or closure, no effects on heritage resources are anticipated during construction, operation or closure of the Lalor Concentrator.

Aesthetics

During construction, the Project Site will be kept tidy. The Project Site is accessed by a 3 km long access road and is surrounded by dense vegetation, minimizing the visual impact of the project in the Project Area and Project Region. During the closure phase, the Project Site will be re-vegetated and returned to native conditions to the extent that is practical. Therefore the aesthetics of the region are not expected to significantly change as a result of the proposed Lalor Concentrator.

Aboriginal Peoples

The project does not require access to, use or occupation of, or the exploration, development and production of lands and resources currently used for traditional purposes by Aboriginal peoples. All elements of the proposed Lalor Concentrator will be on land which HBMS holds under lease or in fee simple, and is occupied and used by HBMS for mining purposes.

As discussed above in **Section 8**, during the latter half of 2010, Mathias Colomb Cree Nation (MCCN) began to suggest that its traditional lands encompass a large portion of northwestern Manitoba, including the entire Snow Lake mining district, in which the Lalor projects, including the proposed Lalor Concentrator, are located. HBMS therefore entered into information sharing with MCCN and Manitoba commenced a Crown consultation process in relation to HBMS' proposed Lalor Mine. HBMS information sharing also has included Lalor Concentrator.

As well, HBMS and Manitoba funded a traditional use and knowledge study by an expert of MCCN's choice, but MCCN has instructed the expert to stop work on the report of the study. Therefore it is not known if there are any traditional uses by MCCN in the Project Region. However, any resource that currently is being used for trapping, fishing or hunting in the Project Region will be unaffected by construction or operation of the Lalor Concentrator project.

With respect to commercial trapping, although the potential effect on trapping activities is assessed to be insignificant, HBMS is committed to working with trappers in the area to ensure that access to their trap lines is not impacted by the proposed development. None of these trappers is associated with an Aboriginal community.

For all these reasons, the Lalor Concentrator is not expected to cause any environmental effects that would lead to consequential effects on Aboriginal peoples.

Conclusions Summary

In summary, the residual environmental effects will be negligible to minor in magnitude with the implementation of the design features and the standard operating and mitigation measures described in this report. The measures described to mitigate the risk of occurrence of accidents and malfunctions are deemed to be appropriate in mitigating such risks. Therefore, it is our opinion that based on the available information and documented assumptions, the overall potential adverse effects of the proposed project will be negligible to minor in magnitude, and are assessed to be not significant.

Glossary

Item	Explanation
AADT	Annual Average Daily Traffic.
AEP	Advanced Exploration Project.
Ambient	Surrounding, encircling - pertaining to any local non-point source conditions such as temperature, air quality or noise levels.
ANFO	Ammonium nitrate/fuel oil.
Aquifer	A geological formation of permeable rock, sand, or gravel that conducts groundwater and yields useable quantities of water to springs and wells.
Archaeology	The scientific study of past human cultures by analyzing the material remains.
ARD	Acid Rock Drainage
Bedrock	Solid rock that underlies soil, sand, clay, gravel, and loose materials on the Earth's surface.
Berm	A sloped wall or embankment used to prevent the inflow or outflow of material into/from an area.
Biota	Living organisms.
CCME	Canadian Council of Ministers of the Environment.
Clay	A fine-textured, sedimentary or residual deposit consisting of hydrated silicates of aluminum mixed with various impurities.
Conductivity	The ability of an aqueous solution to carry electrical current.
CSQG	*Canadian Soil Quality Guidelines.*
CWQG	*Canadian Water Quality Guidelines.*
Deposition	The geological process by which material is added to a landform or land mass.
DFO	Fisheries and Oceans Canada.
Dissolved oxygen	DO; the amount of oxygen dissolved in water.
DO	Dissolved oxygen.
EAP	*Environment Act* Proposal.
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.
EEM	Environmental Effects Monitoring.
Emergent plant	A plant rooted in shallow water with most of the stem and leaves above water.
Ephemeral	A stream that flows during, and for short periods, following a precipitation event. The stream may or may not have a well-defined channel.
Erosion	The removal of solids (sediment, soil, rock and other particles) in the natural environment. It usually occurs due to transport by wind, water, or ice; by down-slope creep of soil and other material under the force of gravity; or by living organisms, such as burrowing animals.
Erosion control techniques	Methods used to prevent or reduce the risk or erosion from disturbed sites. Methods include re-vegetation, riprap and silt fences.
Eutrophic	The trophic status of a waterbody; whereby the waterbody has relatively high primary productivity, based on total phosphorus concentrations between 35µg/L and 100µg/L (CCME, 1999).
Evaporation	The transition from a liquid state into a gaseous state.
Fauna	All animal life in a particular region.

Item	**Explanation**
FFB	Flin Flon Belt.
Flood plain	Area of land adjacent to a watercourse that is covered by water during a flood.
Flora	All plant life and vegetation in a particular region.
Fluvial	Of, pertaining to, inhabiting, or produced by the action of a river or stream.
FMU	Forest Management Units
Glacial	Relating to or derived from a glacier; "glacial deposit".
Gravel	Gravel is rock that is of a specific particle size range. Specifically, it is any loose rock that is larger than two millimeters (2 mm/0.079 in) in its smallest dimension (about 1/12 of an inch) and no more than 64 mm (2.5 in).
Groundwater	Water that exists beneath the earth's surface in underground streams and aquifers.
HBMS	Hudson Bay Mining and Smelting Co., Limited.
Hydrogeology	The study of the distribution of groundwater.
Hydrology	The study of the distribution and movement of water.
Hydrometric station	An active water level and streamflow station that collects surface water quality and sediment data.
Infiltration	Infiltration is the process by which water on the ground surface enters the soil.
Lacustrine	Sediment deposits related to a lake.
LHD	Load haul dumps.
Loam	A loose mixture of clay, sand, and silt.
masl	Metres Above Sea Level.
MESA	*Manitoba Endangered Species Act.*
Mesotrophic	The trophic status of a waterbody; whereby the waterbody has relatively moderate primary productivity, based on total phosphorus concentrations between 10µg/L and 20µg/L (CCME, 1999).
Meso-eutrophic	The trophic status of a waterbody; whereby the waterbody has moderate to high primary productivity, based on total phosphorus concentrations between 20µg/L and 35µg/L (CCME, 1999).
Mitigation	Actions taken to reduce effects by limiting, reducing or controlling hazards and contamination sources.
MMER	Federal *Metal Mining Effluent Regulations*.
Moraine	Accumulated earth and stones deposited by a glacier.
MPN	Most Probable Number
MSQG	*Manitoba Sediment Quality Guidelines.*
NAG	Non acid generating.
OHSAS	Occupational Health and Safety Assessment Series
Oligotrophic	The trophic status of a waterbody; whereby the waterbody has relatively low primary productivity, based on total phosphorus concentrations between 4µg/L and 10µg/L (CCME, 1999).
PAG	Potentially acid generating.
Permeability	The facility with which a porous mass permits passage of a fluid. Soil permeability can be determined using the ‘constant head’ method or the ‘falling head’ method.
pH	A measure of the activity of hydrogen ions (H+) in a solution and, therefore, its acidity, a number between 0 and 14, that indicates whether a solution is acidic (pH <7).

Item	Explanation
Potable Water	Water safe for human consumption.
PM	Particulate matter.
Ppb	Parts per billion.
Proponent	A person or organization seeking approval to conduct a business or activity that impacts on the environment.
RCMP	Royal Canadian Mounted Police.
Renewable Resources	A resource that is capable of being naturally restored or replenished over time.
Residual Effects	Effects that remain after mitigation has been applied.
R.M.	Rural Municipality.
RTLs	Registered trap lines.
Sand	Material containing loose, unconsolidated accumulations of sediment.
SARA	*Species at Risk Act.*
Saturated	A condition in which all voids between soil particles are temporarily or permanently filled with water.
SCAT	Self-contained aboveground tank.
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.
Sewage	Wastewater produced in showers, toilets, sinks, laundry facilities sent for treatment at an onsite Sewage Treatment Facility
Shale	A consolidated clay rock which possesses closely-spaced well defined laminates.
Silt	Material of an earthy character intermediate in grain-size between sand and clay, with greater than 50% passing through a No. 200 sieve.
Silt Fences / Silt Curtain	A temporary barrier used to intercept sediment-laden runoff from small areas.
Sinking	Refers to excavating a vertical (or near vertical) shaft from the top down.
Soil series	A grouping of soils that have similar soil profiles and are developed from a particular kind of parent material.
Spawning	The production or depositing of large quantities of eggs in water.
STP	Sewage Treatment Plant.
Subsurface	The geological zone beneath the surface of the Earth.
Surface Water	Water that sits or flows above the earth, including lakes, oceans, rivers, and streams.
TDGA	*Transportation of Dangerous Goods Act.*
TDS	Total dissolved solids.
Terrestrial	Existing on land.
TIA	Tailings Impoundment Area.
Till	Dominantly unsorted and unstratified drift, generally deposited directly by and underneath a glacier without subsequent reworking by meltwater, and consisting of a heterogeneous mixture of clay, silt, sand, gravel, stones, and boulders.
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.
Tributary	A stream or river which flows into a mainstem (or parent) river.
TSS	Total Suspended Solids.

Item	Explanation
Turbidity	A measure of water clarity.
Unemployment Rate	Number of unemployed persons expressed as a percentage of the labour force.
Ungulate	Hoofed animal such as deer.
USgpm	US gallons per minute.
VMS	Volcanic-hosted massive sulphide.
Wastewater	Water containing waste products requiring treatment.
Waterfowl	Birds that swim and live near water, including ducks, geese, pelicans and swans.
Watershed	The entire geographical area drained by a river and its tributaries; an area characterized by all runoff being conveyed to the same outlet.
WMA	Wildlife Management Area.
WMO	World Meteorological Organization.
WTP	Water Treatment Plant.

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Appendices

1. Introduction and Background

1.1 Project Overview

Hudson Bay Mining and Smelting Co., Limited (HBMS) proposes to construct and operate a new ore concentrator ("Lalor Concentrator") within the site currently occupied by the Lalor Advanced Exploration Project ("Lalor AEP") and the future Lalor Mine (*Environment Act* Proposal filed in May, 2012) (the "Lalor site"), on which HBMS has been operating intensively since 2007. The Lalor site is located in the Snow Lake mining district in Northern Manitoba.

The purpose of a concentrator (or mill) is to process ore into a product that can be further refined for market use. It uses a combination of mechanical (crushing and grinding) and chemical processes (flotation) to extract target metals from the ore. The Lalor Concentrator will process ore taken from Lalor Mine, producing zinc and copper/lead concentrates which will be trucked to HBMS facilities in Flin Flon, Manitoba.

A concentrator requires water to operate and it produces tailings as the waste by-product. The Lalor Concentrator will replace and upgrade the ore processing capacity of the existing Stall Lake Concentrator which is located about 16 km by road from the Lalor site (or 13.2 km from site to site). The new concentrator will use the same water sources and discharge to the same tailings impoundment area used today by the Stall Lake Concentrator. The only components of the proposed project, therefore, are the concentrator itself and pipelines to these existing facilities.

The Lalor Concentrator will have a design capacity of 4,500 tonnes per day (tpd). It is anticipated that it will operate 24 hours per day, 362 days per year, with scheduled downtime for maintenance as required.

Figure 1 displays the general location of the proposed project in Manitoba. **Figure 2** displays the proposed concentrator in context with the Lalor site and existing HBMS facilities in the Snow Lake region. **Figure 3** displays the municipal boundary of the Town of Snow Lake, in which the Lalor projects are located.

The *Environment Act* Proposal (EAP) report contains the information described in Manitoba Conservation's Information Bulletin, "Environment Act Proposal Report Guidelines." It has been prepared and is submitted for consideration of HBMS' application for an Environment Act licence for the proposed Lalor Concentrator.

A copy of the *Environment Act* Proposal Form is attached in **Appendix A**.

1.2 Proponent Contact Information

Table 1.1 – Proponent Contact Information

Name of Project	Lalor Concentrator
Name of Proponent	Hudson Bay Mining and Smelting Co., Limited (HBMS)
Address of Proponent	PO Box 1500, #1 Company Road, Flin Flon, Manitoba, R8A 1N9
Chief Executive Officer	**Brad Lantz** Vice-President of Hudbay Minerals Inc. for Manitoba Operations Ph: (204) 687-2331
Principal Contact Person(s) for the EAP	**Stephen West, P. Eng.** Superintendent Environment, Hudson Bay Mining and Smelting Co., Limited PO Box 1500, #1 Company Road, Flin Flon, Manitoba, R8A 1N9 Ph: (204) 687-2229 Email: steph.west@hudbayminerals.com

Name of Project	Lalor Concentrator
	Jay Cooper Assistant Superintendent Environment, Hudson Bay Mining and Smelting Co., Limited PO Box 1500, #1 Company Road, Flin Flon, Manitoba, R8A 1N9 Ph: (204) 687-2667 Email: jay.cooper@hudbayminerals.com

1.3 Company Profile

The proponent of the proposed Lalor Concentrator is HBMS, which is a wholly owned subsidiary of HudBay Minerals, Inc. HBMS operates the 777 Mine in Flin Flon, Manitoba, and is developing the Lalor Project near Snow Lake, Manitoba. The Trout Lake Mine, located in Flin Flon, closed in June 2012. HBMS has engaged in two advanced exploration projects, Lalor AEP and Reed AEP, both of which are the subject of *Environment Act* applications to convert from exploration to mining.

Copper and zinc ore from the 777 Mine is concentrated in the Flin Flon Metallurgical Complex. Zinc and copper ore produced in the Snow Lake area, such as from the Chisel North Mine (where ore production has now concluded), has been processed in the Stall Lake Concentrator.

Zinc concentrate from both Flin Flon and Snow Lake is processed to produce refined zinc in the Flin Flon Metallurgical Complex (which includes the zinc pressure leach, cellhouse and zinc casting plant). Since closure of the Flin Flon copper smelter in June of 2010, copper concentrate has been shipped out of Manitoba for further processing.

For the year 2011, HBMS directly employed 1,286 people, with an annual payroll of $188.4 million in wages and benefits, contributed $7.6 million in municipal taxes and grants in Manitoba, and paid $90.2 million in income, mining and capital taxes in Canada. HBMS also contributed $1.7 million in community investments and contributions to charities.

1.4 Project History

The Lalor deposit was discovered in the spring of 2007. The initial discovery hole intersected a zinc-rich base metal horizon. Subsequent drilling confirmed the occurrence of several base metal horizons, two of which were very extensive in size. Diamond drilling has been successful in outlining these horizons and delineating to approximately 50 m to 70 m spacing. These base metal horizons are comprised mainly of zinc, with lesser amounts of copper, silver, gold and lead, which is very similar to the mineralization encountered at the Chisel North Mine.

On April 9, 2010, HBMS was granted approval from the Manitoba Mines Branch to conduct advanced exploration for the Lalor Project. Construction of the Lalor AEP infrastructure is currently underway. Following exploration activities, HBMS expects to convert the Lalor AEP into Lalor Mine. In that regard, HBMS filed an EAP with Manitoba Conservation and Water Stewardship in May, 2012.

At the time of discovery of the Lalor deposit in 2007 and the gold and copper zones in 2008, two options were proposed for the concentration of ore from the Lalor deposit: refurbishing the existing Stall Lake Concentrator; and constructing a new concentrator within the Lalor site. The latter option was chosen based on reasons set out in **Section 1.5** below.

1.5 Project Planning Process

In its planning process, HBMS considered two options for processing ore from the Lalor deposit:

(1) **Refurbishing** the existing Stall Lake Concentrator (approximately 16 km by road from the Lalor site); or

(2) Constructing a **new concentrator** within the Lalor site.

Both options included continued use of the following licensed facilities which currently support the Stall Lake Concentrator:

- Tailings will continue to be discharged into the Anderson Tailings Impoundment Area (“Anderson TIA”), which has been permitted and operated since 1978-9 (listed as Item 1 on Schedule 2 to the Metal Mining Effluent Regulations (SOR/2002-222) (MMER)).

- The primary source of process water will continue to be recycled water drawn from the Anderson TIA via the Anderson TIA Reclaim Pumphouse.

- The balance of process water will continue to be fresh water drawn from Snow Lake via the existing Snow Lake Pumphouse.

HBMS chose the **new concentrator** option, which has these economic and environmental advantages:

- It eliminates the 16 km ore haul from the Lalor Mine to the Stall Lake Concentrator and hence reduces:
    - traffic and associated greenhouse gas and other emissions;
    - potential for accidents along Provincial Roads (PR 395 and 392); and
    - the operating cost of hauling the ore itself.

- It provides an opportunity for an increased production rate. The maximum capacity of a refurbished Stall Lake Concentrator would be 3,500 tonnes per day, whereas the new concentrator will be designed for 4,500 tonnes per day.

- It reduces the maintenance costs associated with the Stall Lake Concentrator, given the age of the facility.

- It allows for production of paste backfill, thereby reducing the amount of tailings to be sent to Anderson TIA and improving ore recovery (paste backfill is pumped back underground, filling the spaces left by removal of ore from the mine and forming platforms for further mine development).

- It provides for implementation of newest technologies, including new mill drive systems and process control system.

- It provides for a reduction in the proportion of freshwater to recycled water use: Stall Lake Concentrator uses 70% recycled and 30% freshwater, whereas the new concentrator will use 81% recycled and only 19% freshwater.

1.6 Context for the Proposed Project

The proposed Lalor Concentrator thus will be located within the site of the existing Lalor AEP/future Lalor Mine. This site has already been cleared and developed. **Photo 1** in **Appendix B** displays an aerial photo of this site, with an outline of the specific area to be occupied by the new concentrator.

Lalor Concentrator will be connected to the Anderson TIA, Anderson TIA Reclaim Pumphouse and Snow Lake Pumphouse by pipelines laid in or alongside rights of way that have been owned in fee simple by HBMS or occupied by HBMS for mining purposes or by the Province of Manitoba for public purposes for more than 30 years.

2. Project Description

2.1 Components and Activities

The proposed concentrator has two components:

1. the concentrator itself, comprised of the concentrator building, a jaw crusher, a concentrate load-out shed and a paste backfill module (the "Concentrator"). The Concentrator component is located within the existing Lalor site; and

2. a pipeline system, comprised of three pipes laid along approximately 17 km between the Lalor site and the existing facilities (the "Pipeline System").The Pipeline System will be laid in or alongside rights of way that have been owned in fee simple by HBMS or occupied by HBMS for mining purposes or by the Province of Manitoba for public purposes for more than 30 years.

The following boundaries are used in describing the Project Components and Activities:

- **Project Site** – is comprised of Lalor site, the Lalor Access Road, and the proposed ROW for the Pipeline System.
- **Project Area** – is comprised of an area 2 km beyond the Project Site, which is intended to take into account the effects of the Project (such as noise, vehicle emissions and traffic).
- **Project Region** – is comprised of an area up to 10 km beyond the Project Site, which is intended to take into account the maximum spatial extent of any potential impacts of the Project.

Figure 4 shows the Project Site, Area and Region.

2.1.1 The Concentrator Component

This section discusses the sub-components of the Concentrator component, describing them in the order in which ore will flow through the various processes. **Figure 5** displays a plan of the Lalor site, showing the location of the Concentrator component and its sub-components within the Lalor site.

2.1.1.1 Jaw Crusher Building

- Crushing is the first step in the processing of ore. A jaw crusher building (13 m x 18 m x 22 m) will be constructed to the west of the concentrator building (see site plan in **Figure 5**). Coarse ore as large as 610 mm (24 inches) will be withdrawn from the Lalor Mine headframe by an apron feeder and transferred to this jaw crusher using a conveyer belt (shown in **Figure 5**).
- The conveyer belt will be covered with a half roof to protect the ore from wind and precipitation. A wet scrubber will be installed in the jaw crusher building to minimize dust and magnets will provide tramp metal protection. Sump pumps in the annex will collect dust and clean-up for transfer to the Semi Autogenous Grinding (SAG) mill feed chute (described in **Section 2.4.1**). Water collected in these pumps will be used as process water for concentrator processes.
- Ore coming out of the jaw crusher will be 100 mm to 150 mm (4 to 6 inches), and will be conveyed to an enclosed stockpile (described below in **Section 2.1.1.2**).

2.1.1.2 Concentrator Building

The total footprint of the concentrator building will be 115,000 m^2. Roof height in the building will vary from 6 m to 21 m. Conveyer belts will carry ore from the stockpile to the concentrator building.

Figure 6 illustrates the layout of the building.

The concentrator building will be comprised of the following:

1. A 908 m^2 enclosed ore stockpile (see location of ore stockpile **Figure 5**), with a maximum storage capacity of 10,000 tonnes of ore. At any given time, it is expected that a minimum of 2,000 tonnes of ore will be stored in this stockpile before it is fed to the SAG mill. The ore stockpile will have a 1.5 m high concrete berm around it. The base of the ore stockpile will be lined with a synthetic liner to prevent penetration of leachate. The stockpile will be covered with a "cover-all" fabric, to minimize exposure to wind and precipitation. A belt scale located on the conveyer will measure the concentrator feed tonnage for accounting purposes.
2. Modular offices, laboratories, control rooms, a warehouse, a compressor room, an analyzer room and maintenance shops (shown in **Figure 6**).
3. A SAG mill feed chute, process and fresh water storage tanks, zinc rougher/scavenger flotation circuit, bulk copper/lead rougher/scavenger flotation circuit, and other miscellaneous equipment to process the ore. These are further described in **Section 2.4.**

Operation of the concentrator also will require augmentation of the facilities in the Lalor Mine change house/administration building from 300 to 440 lockers (including 40 lockers for contractors and visitors).

2.1.1.3 Concentrate Load-out Shed

Concentrate produced in the concentrator building will be transferred via a conveyer belt into a fully enclosed concentrate load-out shed, which will have separate areas for zinc and copper/lead concentrate. The load-out shed will be located immediately adjacent to the concentrator building (as shown in **Figure 6**). The shed will have a storage capacity of up to 2,500 tonnes of zinc concentrate (to accommodate an average production rate of 400 dry tonnes per day) and up to 1,000 tonnes of copper/lead (to accommodate an average production rate of 190 dry tonnes per day).

A front end loader will be used to load the filtered concentrate into trucks for transport to Flin Flon. The trucks will be loaded inside the load-out shed to minimize exposure to wind and precipitation and release of concentrate dust. Before and after loading, each truck will be weighed on a truck scale located in the load-out shed. The trucks will be equipped with retractable covers to minimize dust generation when transporting.

Approximately 12 trucks per day will be required to ship zinc concentrate, and approximately 5 trucks to ship copper/lead concentrate.

2.1.1.4 Paste Backfill Module

A paste backfill module will be located north of the concentrator building (as shown in **Figure 6**). When the Lalor Mine requires backfill, tailings will be mixed with water and cement slurry and pumped underground (described in more detail in **Section 2.4.5**).

It is expected that up to 25% of the tailings produced at the Lalor Concentrator will be converted to backfill for the mine, thereby reducing the amount of tailings going to the Anderson TIA.

2.1.1.5 Electrical Yard

An electrical yard will be located east of the concentrator building (as shown in **Figure 6**).

The electrical yard will contain two enclosed 25 kV capacitor banks, each with two steps 1,000 kVAr each for a total of 2,000 kVAr each. Each capacitor bank will have approximate dimensions of 5 m x 2 m x 3 m. Each capacitor bank holds 108 L of liquid contained in individual 9 L capacitor cans. Drip-cans will be provided to contain any spills that may occur.

2.1.2 Pipeline System Component

The purpose of the pipeline system is to bring process water into the concentrator and take tailings away. The Pipeline System will be comprised of three pipes:

- **Pipe 1**: To transport recycled water ("reclaim water") to the concentrator from the Anderson TIA via the Anderson TIA Reclaim Pumphouse (primary source of process water).
- **Pipe 2**: To transport freshwater to the concentrator from Snow Lake via the Snow Lake Pumphouse (supplemental source of process water) ("freshwater pipe").
- **Pipe 3**: To transport tailings from the concentrator to the Anderson TIA ("tailings pipe").

2.1.3 Route of the Pipeline System

This section describes the route for the Pipeline System. The following general routing criteria were used:

- Following existing linear features to allow for gradual bends.
- Avoiding and/or minimizing water crossings, to the extent possible.
- Avoiding rock outcrops to minimize the need for levelling and the use of explosives.
- Using available cleared ROW, where available, to minimize clearing requirements.

An additional consideration was that the ROW containing the Pipeline System must be wide enough to accommodate vehicle access. This is needed because the pipes will be subject to daily inspection. Some clearing (or re-clearing) may be required, as described below.

For most of its length, the route will be the same for all three pipes. The only differences occur at the points of terminus/origin of the three pipes.

Figure 2 illustrates the whole of the route. It also shows the route in relation to the Anderson TIA Reclaim Pumphouse, the Anderson TIA and the Snow Lake Pumphouse.

2.1.4 Detailed Characteristics of Pipeline Route and Clearing Requirements

Figure 7 shows the route in six portions, with illustrations of their current use.

2.1.4.1 Portion 1 (all three Pipes)

Portion 1 lies between the concentrator building and PR 395. Portion 1 is inside the ROW which already contains the Lalor Access Road and the water lines which service the Lalor AEP. Please see **Figure 7** which displays a photograph of Portion 1 as it exists today. Portion 1 is gated at the intersection of the Lalor Access Road and PR 395. Access is restricted to HBMS and HBMS authorized persons.

The additional clearing requirements for this portion are about 1,750 m^2, including approximately 400 m^2 within the Lalor site. Given its proximity to industrial operations and traffic, it is highly unlikely that migratory birds are using the area to be cleared.

2.1.4.2 Portion 2 (all three Pipes)

Portion 2 runs approximately one and a half kilometres along PR 395. Portion 2 is inside the ROW which already contains PR 395 and the waterlines which service the Lalor AEP.

Portion 2 will be linked to Portion 3 (described below) by crossing a distance of about 150 m. A Manitoba Hydro transmission line runs beside PR 395, within a cleared ROW. The link between Portions 2 and 3 transects the Manitoba Hydro ROW. Please see **Figure 7**, which illustrates this link.

The additional clearing requirements for Portion 2, including the link to Portion 3, are approximately 6,000 m^2. Given its proximity to PR 395 and exposure to industrial traffic, it is highly unlikely that migratory birds are using the area to be cleared.

2.1.4.3 Portion 3 (all three Pipes)

Portion 3 lies within the ROW for a former rail bed. This ROW is owned by HBMS pursuant to Certificate of Title No. 1701932. Currently, HBMS maintains the rail bed as an access road. It is accessible to car and truck traffic for most of its length and to off-road vehicles for its full length. **Figure 7** contains a photo of the current condition of the rail bed. Access to the rail bed is restricted to HBMS and HBMS authorized persons.

Those portions of the rail bed which have become somewhat overgrown will have to be re-cleared to accommodate the Pipes and the inspection vehicle. As well, there will have to be turnaround bays (described below) to safely accommodate vehicles travelling in opposite directions. These turnarounds also will be within the rail bed ROW owned by HBMS.

2.1.4.4 Portion 4 (Pipe 3 – Terminus of the Tailings Pipe)

Portion 4 runs from the former rail bed into the Anderson TIA. This area is already occupied by HBMS infrastructure associated with the operation of the Anderson TIA. Portion 4 lies behind gates that restrict access to HBMS and HBMS authorized persons.

2.1.4.5 Portion 5 (Pipe 1 – Origin of the Reclaim Water Pipe)

Portion 5 runs from the former rail bed to the Anderson TIA Reclaim Pumphouse. Similarly, this area is already occupied by HBMS infrastructure associated with the operation of the Anderson TIA and lies behind gates that restrict access to HBMS and HBMS authorized persons. Currently, Portion 5 is occupied by an existing water line which delivers (recycle) process water from the Anderson TIA Reclaim Pumphouse to the existing Stall Lake Concentrator.

2.1.4.6 Portion 6 (Pipe 2 – Origin of the Freshwater Pipe)

Portion 6 runs from the former rail bed to the Snow Lake Pumphouse. Currently, this portion contains the water pipe which delivers freshwater from the Snow Lake Pumphouse to the Stall Lake Concentrator. Portion 6 also lies behind gates that restrict access to HBMS and HBMS authorized persons.

The total clearing requirements for Portions 3 through 6 will be approximately 35,700 m^2. The majority of the required clearing will consist of brush overgrowth. These areas can be classified as existing edge habitat, which would have the potential for use by migratory birds. However, the additional clearing that may be required will result in a relocation of edge habitat, rather than a net increase or loss in edge habitat, and thus will have no impact on potential use by migratory birds. In addition, any such clearing will be done outside of the nesting season (April 15 to July 31).

2.1.5 Pipeline Construction and Materials

2.1.5.1 Pipe 1: Reclaim Water Pipe

The reclaim water pipe will deliver recycled water from the Anderson TIA Reclaim Pumphouse to the process water tank located inside the concentrator building (described above in **Section 2.1.1.2**). The pipeline will be composed of 305 mm (12 inch) insulated polyethylene pipe. It will transport approximately 1,299,000 m^3 of reclaim water annually. Its total length will be approximately 17 km.

The reclaim water pipe is shown in **Figure 7**.

2.1.5.2 Pipe 2: Freshwater Pipe

The freshwater pipe will deliver freshwater from the Snow Lake Pumphouse to the concentrator. The pipeline will be composed of 150 mm (6 inch) insulated polyethylene pipe. It will transport approximately 298,000 m^3 of freshwater annually. Its total length will be approximately 14.8 km.

2.1.5.3 Pipe 3: Tailings Line

The tailings line (total length of approximately 17 km) will be comprised of seven pipe segments designed to withstand different pressures encountered along various sections of the line. The first segment (approximately 0.275 km long), will be composed of 254 mm (10 inches) nominal diameter Schedule 40 steel pipe, with ceramic or basalt lining to prevent abrasion.

The next six segments will all be high density polyethylene pipe of varying wall thickness, the first two of which (approximately 7.2 km long) will have an outside diameter of 305 mm (12 inches), and the final four of which (approximately 9.9 km long) will have an outside diameter of 254 mm (10 inches).

Leak detection will be provided by monitoring flow rates using meters located near each end of the line. A rupture in the line would result in a difference between the two flow rates, which will be picked up through the concentrator process control system. In the event of an alarm, site personnel will be dispatched to visually inspect the length of the pipeline to determine if there is a problem.

The pumping system for the tailings line will be designed for the maximum possible pumping distance (approximately 17 km). Two 2-stage pumping systems (one operating and one standby) will be installed in the concentrator building, eliminating the requirement for booster pumps along the tailings line. It is anticipated that using pumping systems instead of booster pumps will significantly reduce the risk of spills.

2.1.5.4 Fill Requirements

Within Portion 3 of the route, design provides for intermittent 10 m wide points to allow for construction of the turnaround bays. These bays will occur at an average of approximately 250 m intervals. The exact location of the turnaround bays will be determined in the detailed design phase of the project, avoiding features such as bedrock outcrops, marsh/bogs, and water crossings.

Fill requirements will be met from non-acid generating (NAG) sources (limestone or quarry) available in the region. Once constructed, the pipes will be covered with a loosely placed cover material (*i.e.,* sand) along the entire route. Approximately 11,560 m^3 of cover material will be required, which will come from a local sand quarry.

2.1.5.5 Culvert Locations

In total, the route of the Pipeline System traverses 20 locations which contain existing culverts. The locations of these culverts are shown on **Figure 7** and their type, length, and diameter are displayed below on **Table 2.1**. No new culverts will be required. The culvert locations fall into two categories, as follows:

<u>Culverts in Drainage Features (17)</u>

These culverts were installed at the time the Provincialroad or railway was constructed. They were placed in drainage features, either natural or engineered, that traversed that linear feature. Their purpose was and is to prevent surface runoff from ponding along the linear feature. These culverts are merely water control features of the particular linear feature. They are not connected to any potentially fish bearing habitat.

These culverts may be replaced as required in construction of the pipeline system. Even though these culverts are not connected to any potentially fish bearing habitat, culvert replacement will be carried out in accordance with Fisheries and Oceans Canada (DFO)'s Operational Statement on Culvert Maintenance.

<u>Culverts in Streams and Off-take Ditches (3)</u>

These culverts were also installed at the time the road or railway was constructed. They were installed for the purpose of directing the flow of a stream or off-take ditch through the road or railbed so that flow could continue, unimpeded by construction of that linear feature. These three locations consist of streams or off-take ditches which are or may lead to potentially fish bearing waterbodies.

These culverts will not be altered during construction of the pipeline system. However, any activities that occur near these culverts will be carried out in accordance with applicable DFO Operational Statement(s) or other applicable standards.

Table 2.1 – Culvert Features

ID	Number	Type (1)	Diameter (m)	Length (m) (2)	Location	Comment
LR01	2	HDPE	0.9	15	Stream or Off-take Ditch	
LR02	1	HDPE	0.6	15	Drainage Feature	
RB01	1	CSP	0.77	10	Drainage Feature	
RB02	2	CSP	1.63	25	Stream or Off-take Ditch	
RB03	2	CSP	1.95	25	Stream or Off-take Ditch	
RB04	1	CSP	-	10	Drainage Feature	Buried*
RB05	1	CSP	0.8	10	Drainage Feature	
RB06	1	CSP	0.7	10	Drainage Feature	
RB07	1	CSP	0.86	10	Drainage Feature	
RB08	1	CSP	0.75	10	Drainage Feature	
RB09	1	CSP	0.56	10	Drainage Feature	
RB10	1	CSP	0.6	10	Drainage Feature	
RB11	1	CSP	0.62	10	Drainage Feature	
RB12	1	CSP	0.8	10	Drainage Feature	
RB13	1	CSP	0.6	10	Drainage Feature	
RB14	1	CSP	0.55	10	Drainage Feature	
RB15	-	-	-	10	Drainage Feature	Buried*
RB16	1	CSP	0.95	10	Drainage Feature	
RB17	1	CSP	0.7	10	Drainage Feature	
AB03	1	CSP	0.9	10	Drainage Feature	

Notes:

1. CSP - Corrugated Steel Pipe; HDPE - High Density Polyethylene

2. Length is approximate

*3. * Diameter was not measured since the feature was buried.*

2.2 Continued Use of Existing Approved Facilities

2.2.1 Sewage

The Lalor Concentrator will rely on existing and future sewage facilities built for Lalor AEP/future Lalor Mine. No separate sewage facility is planned.

2.2.2 Snow Lake Pumphouse

The existing Snow Lake Pumphouse is operated under Manitoba Water Rights Licence No. 2011-110. Under this licence, HBMS is permitted to withdraw 1150 dam^3/year of water from Snow Lake, not exceeding a withdrawal rate of 1300 L/s.

The only modification to the Snow Lake Pumphouse will take place at the pumphouse building. The existing pumps will be upgraded and a 15/0.6 kV, 0.2 MVA outdoor oil-filled transformer will be installed. The new pumps will be capable of maintaining a constant flow rate over a longer distance. The upgrade is required because the distance from Snow Lake to the Lalor Concentrator is greater than the distance from Snow Lake to the Stall Lake Concentrator.

This work will occur inside and immediately adjacent to the pumphouse building. It will not involve the water intake and it will not entail any physical activity at or below the Snow Lake high water mark.

When operation of the Lalor Concentrator replaces operation of the Stall Lake Concentrator, the amount of freshwater drawn from this pumphouse will decrease, even though the throughput of the new Lalor Concentrator will be greater than the throughput of the existing Stall Lake Concentrator.

2.2.3 Anderson TIA

The Anderson TIA has been used for sub-aqueous disposal of tailings since commissioning of the Stall Lake Concentrator in 1979. It is operated in accordance with the MMER and Manitoba CEC Order No. 766. The MMER-regulated final discharge point is a decant pipe passing through Anderson Dam into Anderson Creek. The tailings line from Lalor Concentrator will discharge into the Anderson TIA, which will continue to operate in accordance with these approvals.

2.2.3.1 Anderson TIA Reclaim Pumphouse (reclaim water source)

The current purpose of the Anderson TIA Reclaim Pumphouse is to recycle water from the Anderson TIA to the Stall Lake Concentrator. It pumps only reclaimed water drawn from the TIA. It does not relate to any freshwater source. Its purpose is to draw water from the Anderson TIA to be used as process water in the concentrator. Using water from the Anderson TIA in this manner allows for a reduction in freshwater use.

Eventually, the existing pumphouse will be decommissioned and a new pumphouse will be built at a location within 100 m of the existing location. The new Anderson TIA Reclaim Pumphouse will be equipped with larger units capable of maintaining the current maximum flow rate of 233 m^3/h (1200 USgpm). As with the Snow Lake Pumphouse, this upgrade is required because of the need to maintain a constant flow rate over a longer distance.

2.2.4 Use of Other Existing Facilities

- The existing access road from the Lalor site to PR 395 will be used for construction and operation of the proposed Lalor Concentrator.
- Lalor Concentrator will be connected to water distribution lines already on the Lalor site (for supply of water for domestic use).
- Equipment used in construction and operation of Lalor Concentrator will connect to fuel facilities constructed for the Lalor AEP/future Lalor Mine.
- The parking lot constructed for Lalor Mine also will be used by employees working at the proposed Lalor Concentrator.
- The communication tower on the Lalor Site currently provides wireless phone services and internet access. No separate communications facility will be required for Lalor Concentrator.
- An underground power line from the electrical room in the Concentrator building will tie into the electrical grid at the Lalor Mine.
- The new Chisel Electrical Substation will also supply power to the proposed Lalor Concentrator.

2.3 Production Capacity

The Lalor Concentrator will be designed to have a production capacity of 4,500 tonnes per day.

2.4 Production Processes

This section outlines the steps involved in the ore production process within the concentrator building after it has been crushed by the jaw crusher (described above in **Section 2.1.1.1**) and stockpiled (discussed in **Section 2.1.1.2**).

Figure 8 provides an illustration of these steps. Detailed process flow diagrams are provided in **Appendix C**.

2.4.1 Grinding

Crushed ore will be withdrawn from the base of the stockpile by apron feeders and belt-conveyed to the Semi Autogenous Grinding (SAG) mill feed chute. Crushed ore will be slurried with process water and ground in the SAG mill, which will operate in closed circuit with a vibrating screen. Oversize from the vibrating screen will be circulated back to the SAG mill by gravity. Undersize from the screen will go to a pump box feeding a cluster of primary cyclones. Cyclone overflow at a target particle size of 80 microns (P_{80}) will flow to the flotation circuit. Cyclone underflow will flow to a ball mill operating in closed circuit with the cyclones. A sump pump in the grinding area will collect clean-up and return it to the SAG mill screen feed pump box.

2.4.2 Bulk Copper/Lead Flotation

Flotation feed will be conditioned with reagents (including lime slurry for pH control, Methyl isobutyl carbinol (MIBC) frother, 3418A flotation collector and Carboxyl Methyl Cellulose (CMC) depressant solution) in an agitated tank and then fed by gravity to the bulk copper/lead rougher/scavenger flotation circuit consisting of six 30 m^3 tank cells in series. Scavenger concentrate will be recycled to the conditioning tank while scavenger tailings will be pumped to the zinc flotation circuit. Rougher flotation concentrate along with the flash flotation cell concentrate will be reground to a target particle size of 30 microns (P_{80}) in a regrind mill operating in closed circuit with cyclones. Additional lime slurry, 3418A and zinc sulphate solution will be added to the regrind mill to condition the feed for cleaner flotation. Reground bulk concentrate will be cleaned in a closed three-stage tank flotation circuit. The first cleaner tails will be pumped back to the conditioning tank. The third cleaner concentrate will be pumped to the copper/lead dewatering circuit. A sump pump in the area will collect clean-up and send it back to the regrind cyclones feed pump box.

2.4.3 Zinc Flotation

Zinc flotation feed will be conditioned with reagents (including lime slurry, MIBC frother, Sodium Isopropyl Xanthate (SIPX) zinc mineral flotation collector solution and copper sulphate mineral activator solution) in an agitated tank and then fed by gravity to the zinc rougher/scavenger flotation circuit consisting of six 30 m^3 tank cells in series. Scavenger concentrate will be recycled to the conditioning tank while scavenger tailings will be pumped to the flotation tailings thickening circuit. Zinc rougher concentrate will be cleaned in a closed two-stage tank cell flotation circuit. The first cleaner tails will be pumped back to the conditioning tank. The second cleaner concentrate will be pumped to the zinc dewatering circuit. A sump pump in the area will collect clean-up and send it back to the conditioning tank.

2.4.4 Concentrate Dewatering

This step of the process involves dewatering of two types of concentrate: Copper/Lead concentrate and Zinc concentrate.

2.4.4.1 Copper/Lead Concentrate

Flocculated bulk copper/lead concentrate will be pumped to a dedicated high-rate thickener. To reduce freshwater consumption, thickener overflow will be pumped to the process water storage tank for further use. Underflow, at a target density of 70% solids, will be pumped to an agitated stock tank capable of holding 12 hours of production capacity. Using a pressure filter, thickened copper/lead concentrate will be further dewatered to approximately 8% moisture, producing a filter cake. To prevent loss of fine solids and increase recycle water, filtrate will be recycled to the bulk copper/lead concentrate thickener. The filter cake will be gravity-fed to a storage bin in the concentrate load-out shed (described above in **Section 2.1.1.3**).

2.4.4.2 Zinc Concentrate

Flocculated zinc concentrate will be pumped to a dedicated high-rate thickener. Overflow will be recycled to the process water storage tank. Underflow, at a target density of 70% solids, will be pumped to an agitated stock tank capable of holding 12 hours of production capacity. Using a vacuum filter, thickened zinc concentrate will be further dewatered to approximately 8% moisture, producing a filter cake. To prevent loss of fine solids and increase recycle water, filtrate will be recycled to the zinc concentrate thickener. The filter cake will be gravity-fed to a storage bin in the concentrate load-out shed (described above in **Section 2.1.1.3**).

A sump pump located near each thickener will collect any clean-up and send it back to the appropriate thickener feedwell.

2.4.5 Paste Backfill

Flocculated flotation tailings will be pumped to a high-rate thickener located in the paste backfill module (described in **Section 2.1.1.4**). Thickener overflow will be pumped to the process water storage tank for recycle in the milling process. Underflow, at a target density of 50% solids, will be pumped to a splitter box located in the paste backfill preparation area. A sump pump located near the tailings thickener will collect any clean-up and send it back to the thickener feedwell. When paste backfill is not required in the mine, the thickened tailings will be diverted at the splitter box to the tailings pump box and pumped to the Anderson TIA via the tailings line (described in **Section 2.1.2)**.

When the mine requires paste backfill, the thickened tailings will be pumped to a cyclone in the paste plant to remove fines. The fines in the cyclone overflow will gravity-flow via the splitter box overflow to the tailings pump box. The cyclone underflow stream containing the coarse tailings material will gravity-flow to a filter feed tank with one hour storage capacity. Coarse tailings will be vacuum filtered to a target density of 88% solids and belt conveyed to a twin screw mixer. Water (referred to as “trim water”) and cement slurry will next be added to achieve a target paste slump and final backfill strength. A positive displacement pump will be used to pump the paste underground via boreholes located adjacent to the paste backfill module. A sump pump located in the paste plant area will collect any clean-up and send it to the tailings pump box, from where this clean-up will be pumped along with the tailings to Anderson TIA.

2.5 Water Requirements

The water requirements for the Lalor Concentrator are provided in the water flow diagram presented in **Figure 9**.

2.5.1 Process Water

The process water system will be designed to minimize the use of fresh water to the extent possible by using water from Anderson TIA as the primary source (reclaim water) and by reusing this water internally within the concentrator building.

A small amount of fresh water will be required in the concentrator for certain applications (such as reagent mixing, fire suppression and seal water for pumps) for which the quality of reclaim water is not adequate. This freshwater will be supplied from the Snow Lake Pumphouse located at Snow Lake (described above in **Section 2.1.4.6**).

A freshwater tank will store freshwater for use in the concentrator and for fire suppression, should it be needed. The freshwater tank is designed in such a way that there will always be sufficient water in the tank to provide water for fire suppression. Both an electric and a backup diesel fire water pump will be provided.

2.5.2 Potable Water

Potable water, sourced from the water treatment system in the Town of Snow Lake, will be hauled to the Lalor site in portable jugs.

2.5.3 Domestic Water

Domestic water for sanitary usage in the concentrator building will be pumped from the freshwater treatment system at the Lalor Mine to a water distribution system in the concentrator facility.

2.6 Air

Two plant air compressors will supply dry compressed air throughout the concentrator building and associated annexes and modules, at a pressure of 700 kPa (100 psi). Air for the tank flotation cells will be provided by a pair of low pressure blowers.

2.7 Employees

The proposed Lalor Concentrator will engage 70 people during operation, with most of the workers employed at the existing Stall Lake Concentrator transferring over to the new facility. As the Lalor site is only 8 km away from the Town of Snow Lake, it is expected that workers will take up available accommodations in the Town of Snow Lake.

2.8 Materials

The Lalor Concentrator will utilize reagents that are commonly used throughout the mining industry, including HBMS existing base metal concentrators in Flin Flon and Snow Lake. Areas where reagents are handled will be equipped with containment berms and clean-up sump pumps to minimize the risk of spills and prevent the escape of fugitive dusts into the main concentrator building or the environment.

Table 2.2 provides a summary of consumption requirements, while specific functions of these materials, addition rates, and dispositions are provided in the sections that follow.

Table 2.2 – Summary of Reagents and Additives Required for the Proposed Lalor Concentrator

Reagent Material	Quantity Required (tonnes per year)
Flocculant	15
Methyl Isobutyl Carbinol (MIBC)	82
3418A	41
Carboxy Methyl Cellulose	164
Zinc Sulphate	99
Copper Sulphate	411
Sodium Isopropyl Xanthate	58
Lime	3,285
Cement and Flyash	13,150

2.8.1 Flocculant

Flocculant is used in the bulk copper/lead concentrate, zinc concentrate and final tailings thickeners to promote the settling of solid particles and produce a clear overflow suitable for recycling via the process water system.

Flocculant will be received in 25 kg bags, mixed to a 0.2% solution with fresh water and added to each thickener feed well as required. Flocculant will report preferentially with the solids in the thickener underflow stream. Sump pumps in each flocculant preparation area will collect any clean-up and send it to the tailings pumpbox.

2.8.2 Methyl Isobutyl Carbinol (MIBC)

MIBC will be used as a frother to promote the formation of a stable froth layer on the surface of the slurry in the flotation cells. It will be used in both the bulk copper/lead and the zinc flotation circuits. Consumption of MIBC will be approximately 0.05 kg per tonne of ore milled, or 82 tonnes per year. MIBC will be received in 859 kg returnable totes and added without dilution to various locations in the circuits. MIBC will report primarily to the concentrates, with residual quantities reporting to the tailings stream.

2.8.3 3418A

3418A is a proprietary flotation reagent for the collection of copper minerals into the bulk copper/lead flotation circuit concentrate. It will be received in returnable 1,000 kg totes and added without dilution to various locations in the grinding and flotation circuits. 3418A will report preferentially to the copper/lead concentrate, with residual quantities reporting to the tailings stream. The estimated total consumption of this reagent will be 0.025 kg per tonne of ore milled, or approximately 41 tonnes per year.

2.8.4 Gangue Depressant (Carboxy Methyl Cellulose)

Depressant will be used in the bulk copper/lead flotation circuit to inhibit the flotation of unwanted gangue minerals. The estimated consumption of depressant will be approximately 0.10 kg per tonne of ore milled or 164 tonnes per year. Depressant will be received in 25 kg bags, mixed with fresh water to a 1% solution and added to the copper flotation circuit in various locations as required. Depressant will report ideally to the tailings stream, with residual quantities recycling with process water. A sump pump in the area will collect any clean-up and send it to the tailings pumpbox.

2.8.5 Zinc Sulphate

Zinc sulphate will be used in the bulk copper/lead flotation circuit to inhibit the flotation of zinc minerals. Zinc sulphate will report primarily to the zinc concentrate, with residual quantities recycling with process water. Zinc sulphate will be received in bulk 1,000 kg bags, mixed to a 25% solution with process water and added to the copper flotation circuit in various locations as required. The estimated consumption will be approximately 0.06 kg per tonne of ore milled or 99 tonnes per year. A sump pump in the area will collect any clean-up and recycle it to the mixing tank.

2.8.6 Copper Sulphate

Copper sulphate is used in the zinc flotation circuit to activate the zinc minerals which had been depressed in the bulk copper/lead flotation circuit. Estimated consumption will be approximately 0.25 kg per tonne of ore milled or 411 tonnes per year. Copper sulphate will be received in bulk 1,000 kg bags, mixed to a 15% solution with process water and added to the zinc flotation circuit conditioning tank as required. Copper sulphate will report primarily to the zinc concentrate, with residual quantities recycling with process water. A sump pump in the area will collect any clean-up and recycle it to the mix tank.

2.8.7 Sodium Isopropyl Xanthate (SIPX)

SIPX is used in the zinc flotation circuit as a collector which adheres selectively to the surface of the zinc minerals, enabling them to float and be recovered into the froth product. SIPX consumption will be approximately 0.035 kg per tonne of ore milled or 58 tonnes per year. SIPX will report primarily to the zinc concentrate, with residual quantities reporting to the tailings stream. SIPX will be received in bulk 500 kg bags, mixed to a 10% solution with fresh water and added to the zinc flotation circuit in various locations as required. A sump pump in the area will collect any clean-up and recycle it to the holding tank.

2.8.8 Lime

Pebbled quicklime (CaO) will be trucked to the concentrator in trailers and unloaded pneumatically into a 100 tonne capacity silo located outdoors beside the main concentrator building. The silo will be equipped with a dust collector to minimize particulate emissions to the environment. The quicklime will be fed from the silo into a slaking mill, utilizing process water to produce milk-of-lime slurry at 15% solid, stored temporarily in a holding tank and metered into the process at various locations as required.

Slaked lime (calcium hydroxide) slurry will be used throughout the milling circuits to control the pH in the process to the levels required for optimum flotation performance. The estimated total lime consumption will be 2.0 kg per tonne of ore milled, or approximately 3,285 tonnes per year. Most of the used lime will report to either the tailings stream or the paste backfill stream.

A sump pump in the area will collect any clean-up and recycle it to the holding tank.

2.8.9 Grinding Balls

Steel grinding balls in various sizes will be received by truck and stored in bulk bins. An overhead crane and ball transporter will be used to charge the grinding balls as required for use in the SAG mill and ball mill.

2.8.10 Cement and Flyash

Portland cement and possibly flyash will be used in the production of the cemented paste backfill for use underground. Cement and flyash will be trucked separately to the concentrator by trailer and off-loaded pneumatically into dedicated silos located outdoors beside the main concentrator building. Each 250 tonne silo will be equipped with a dust collector to minimize particulate emissions to the environment.

The estimated total cement and flyash consumption will be 30 kg per tonne of paste produced, or approximately 13,150 tonnes per year. The cement and flyash will report to the paste backfill stream. The cement and flyash will be fed from the silos into a colloidal mixer, utilizing fresh water to produce a 69% solids slurry. This slurry will be stored temporarily in a holding tank and metered into the twin screw paste mixer as required. A sump pump in the area will collect any clean-up and forward it to the paste plant sump pump.

2.8.11 Lubricants and Fuel

Diesel fuel for the emergency power generator and the backup diesel fire water pump will be stored in double-walled tanks. These will be located on pads, adjacent to the main concentrator building.

Lubricating oils will generally be received in 20 L plastic containers or 200 L barrels. These will be placed in a dedicated storage area equipped with spill containment berms and fire suppression. Used oil will be temporarily stored in a double-walled tank, then removed from the site by a licensed contractor.

2.9 Equipment Use

Table 2.3 presents the equipment use expected during construction of the proposed Lalor Concentrator.

Table 2.3 – Equipment Use during Construction of the Proposed Lalor Concentrator

Equipment	Units	Duration of Use
Forklift	1	18 months
Zoom Boom	1	18 months
30t RT Crane	2	One for 18 months, one for 3 months
50t Crane	1	2 weeks
100t Crane	1	12 months
Air Compressors	2	Two for 18 months
JLG® Manlift	1	18 months
Welders	8	18 months
Light Stands	4	18 months
Construction Crew/Supervisor Trucks	6	18 months
Front End Loader	2	One dedicated to Lalor site for 18 months, and one specifically for winter snow removal for 8 months

Equipment	Units	Duration of Use
Bobcat	2	18 months
Caterpillar dozer	2	One for 3 months, one for 2 weeks
Generator	1	3 months
Construction Heaters	8	8 months
Excavator	2	One for 3 months, one for 6 months
Dump Trucks	4	2 for 3 months, 2 for 6 months
Crushing Plant	1	2 months

2.10 Traffic

Table 2.4 presents the estimated daily traffic volumes expected during construction and operation of the proposed Lalor Concentrator.

Table 2.4 – Estimated Daily Traffic Volumes [1]

Vehicle	Construction							Operation				
	2013		2014				2015				2016	
	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Trucks – concrete	40	40	40	-	-	-	-	-	-	-	-	-
Trucks – equipment[2]	-	1	2	2	2	2	1	1	1	1	1	1
Trucks – delivery warehouse[3]	-	-	-	-	-	-	-	1	1	1	1	1
Trucks – delivery mill[4]	-	-	-	-	-	-	-	1	2	2	2	2
Trucks - concentrate	-	-	-	-	-	-	-	17	17	17	17	17
Cars – pick-ups	10	20	20	20	20	20	20	12	12	12	12	12
Bus	4	4	4	4	4	4	4	4	2	2	2	2
Total Lalor Concentrator Traffic	**54**	**65**	**66**	**26**	**26**	**26**	**25**	**36**	**35**	**35**	**35**	**35**

Notes:

[1] Numbers are based on per day, one way.

[2] Trucks-equipment: includes steel, equipment components that would be an average per day during the quarter.

[3] Trucks-delivery warehouse: includes fuel, propane, deliveries to warehouse, sewage pump-out truck.

[4] Trucks – delivery-mill: reagents, grinding media, cement (paste fill)

2.11 Land Ownership and Property Rights

All surface and sub-surface rights required for the development of the proposed project are held by the proponent as follows:

2.11.1 The Concentrator Component

The concentrator component will be constructed within the boundaries of Mineral Lease ML-334 obtained on March 29, 2012 from the Mines Branch, Government of Manitoba. This lease was converted from mineral claims which have been held since 1960. **Figure 10** displays all of the HBMS property rights that support the Lalor projects.

2.11.2 Pipeline System

The greater extent of the Pipeline System will be laid in land that is held by the proponent in fee simple. **Figure 10** displays Portion 3 of the route of the Pipeline System, which is owned by HBMS pursuant to Certificate of Title No. 1701932.

The proponent holds the rights to the remainder of the land required for the Pipeline System by means of mineral and/or surface leases shown in **Table 2.5** and **Figure 10**. These leases were converted from claims which have been held since 1960. These leases permit use and occupation of the land for the purpose of prospecting, exploring for, developing, mining or production of minerals on, in, or under the land. Certain portions of the Pipeline System lie within areas for which HBMS has Surface Leases as well as Mineral Leases.

Table 2.5 – Mineral and/or Surface Leases Associated with Lalor Concentrator

M5779	M7238	M7359	M7493
M5780	M7239	M7360	M7494
M5730	M7240	M5808	M5719
M5731	M7241	M5809	M7298
M7307	M7242	M5741	M7297
M5732	M7243	M5740	M7299
M5726	M7286	M5739	M5745
M7276	M7285	M5810	M5744
M7266	M5784	M5812	M5749
M5725	M5789	M5813	M5751
M5724	M5803	M5721	M5750
M7309	M7333	M7491	M7383
M5776	M5806	M7515	M7374

2.12 Land and Water Use

There is no water user in or near the Project Site other than the proponent. The project site crosses three RTLs owned by Martin McLaughlin, Jim Schollie and Russell Bartlett. None of these trap lines is associated with an Aboriginal community.

The project does not require access to, use or occupation of, or the exploration, development and production of lands and resources currently used for traditional purposes by Aboriginal peoples. All elements of the proposed Lalor Concentrator will be on land which HBMS holds under lease or in fee simple, and is occupied and used by HBMS for mining purposes as follows:

- The concentrator component lies within the Lalor site, which has been developed for the Lalor AEP/future Lalor Mine Project. It lies on land that has been under continuous use for mining purposes since at least 2007.

- Portion 1 of the Pipeline System, which follows the Lalor Access Road, lies on land which is controlled by gated access, and which has been under continuous use by HBMS for mining purposes since at least 2007.

- Portion 2 of the Pipeline System tracks PR 395, which is in daily use for industrial traffic. In addition, Provincial regulations prohibit hunting within 300 m of roadways.

- Portion 3 of the Pipeline System falls within the ROW for a former rail bed, which is owned by HBMS pursuant to Certificate of Title No. 1701932.This is private land to which Aboriginal peoples do not have a right of access.

- Portions 4, 5, and 6 of the Pipeline System are located on land which the proponent has used for mining purposes since the late 1970's. These portions lie behind the gates of existing HBMS projects, which excludes users other than the proponent, on land that has been taken up for mining purposes for over 30 years.

2.13 Environmental and Water Rights Licenses

In order to proceed with the construction, operation and maintenance, and eventual closure of the proposed Lalor Concentrator, HBMS will require a licence under *The Environment Act* (Manitoba), applied for herein. Further, the proposed Lalor Concentrator will be operated in conjunction with existing approvals related to the current operation of the Stall Lake Concentrator and other HBMS facilities in the Snow Lake area, which are connected to the proposed Lalor Mine as follows:

- The Anderson TIA is operated in accordance with Clean Environment Commission (CEC) Order 766.
- Operation of the Chisel Open Pit (used for waste rock and water storage), the Chisel North WTP and Chisel North Mine are in accordance with Licences No. 1919 S2 RR and 1501 RR, issued under *The Environment Act* (Manitoba).
- Water withdrawal from Snow Lake is authorized under License No. 2011-110, issued under *The Water Rights Act* (Manitoba).
- Electrical supply from Chisel Substation is authorized under Licence No. 3005, issued under *The Environment Act* (Manitoba) on May 10, 2012. Construction of the sub-station is expected to commence in spring of 2013.

As mentioned above, an EAP for the Lalor Mine was submitted to Manitoba Conservation and Water Stewardship on May 04, 2012 and is currently in the regulatory process.

Copies of these licences are included in **Appendix D**, and description of how these facilities will support the operation of the proposed Lalor Concentrator is provided in **Section 2.2**.

2.14 Crown Land General Permits and Other Rights

The Lalor Access Road from PR 395 (at the site of the Chisel North Mine) to the Lalor site was constructed in accordance with General Permit GP59093. This road will also be used to access the Lalor Concentrator.

HBMS holds a Quarry Lease (QL-1928) for a quarry which will be used as the source of roadbed material needed for construction of the pipeline system described in **Section 2.1.5.4.** The quarry is located adjacent to the Lalor Access Road, between the Chisel North Mine and Lalor site.

Construction of the Lalor AEP infrastructure is being carried out under the General Permit GP63483.

The existing General Permits are as follows in **Table 2.6**.

Table 2.6 – Lalor General Permits

Permit Number	Work
GP59093 - General Permit for Lalor Access Road	All clearing, leveling and construction
QL-1928 Quarry Lease	Extraction of material
GP63483 – General Permit for Lalor AEP site and explosives magazine	All site clearing, leveling and construction

All clearing, leveling and construction activities have been and are being carried out in accordance with these general permits and any specific work permits issued from time to time.

Copies of these general permits are included in **Appendix D**.

2.15 Waste and Waste Disposal

2.15.1 Tailings

Table 2.7 outlines the total tailings that will be produced, tailings that will be used to generate paste for Lalor Mine backfill and tailings that will be deposited at the Anderson TIA**.**

Table 2.7 – Tailings Management

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	Total
Ore Milled - Total Tonnes	**106,377**	**322,156**	**540,500**	**1,039,175**	**1,228,910**	**1,448,000**	**1,629,000**	**1,629,000**	**1,629,000**	**1,629,000**	**1,629,000**	**1,629,000**	**1,629,000**	**1,629,000**	**1,629,000**	**1,629,000**	**1,603,995**	**1,651,871**	**1,102,235**	**683,513**	**26,016,731**
Au (g/tonne)	2.268	1.864	1.864	2.176	2.453	2.384	2.666	2.468	2.440	2.332	2.236	2.509	2.543	2.651	2.837	2.740	2.823	3.220	3.321	3.234	**2.603**
Ag (g/tonne)	22.428	19.483	19.902	22.397	24.512	23.846	23.699	23.944	24.985	22.785	22.374	24.239	22.092	22.343	20.677	19.051	21.041	20.607	22.435	20.390	**22.380**
Cu (%)	0.72	0.62	0.61	0.63	0.67	0.62	0.59	0.56	0.57	0.58	0.78	0.89	1.03	0.88	0.88	0.77	0.71	0.64	0.44	0.40	**0.70**
Zn (%)	6.16	7.14	7.33	6.52	6.30	6.09	5.07	5.20	5.53	5.03	5.60	5.48	5.95	5.13	4.59	4.22	3.58	2.82	2.74	2.08	**4.98**
Pb (%)	0.14	0.14	0.13	0.17	0.22	0.21	0.18	0.22	0.25	0.20	0.20	0.25	0.21	0.18	0.20	0.19	0.21	0.19	0.23	0.23	**0.21**
Cu Conc - Total Tonnes	**3,691**	**9,293**	**15,531**	**30,934**	**39,328**	**42,652**	**45,571**	**42,742**	**44,059**	**44,730**	**61,065**	**70,501**	**82,153**	**70,069**	**70,283**	**61,149**	**55,357**	**51,756**	**22,926**	**13,110**	**876,901**
Au (g/tonne)	42.6	40.7	40.8	47.2	50.6	53.2	64.0	62.2	59.5	55.6	38.7	38.5	33.5	41.4	44.8	49.3	55.6	72.0	112.8	118.3	51.6
Ag (g/tonne)	429.8	426.7	440.8	500.0	527.3	551.2	575.4	622.4	640.9	555.1	396.5	383.9	289.6	344.9	309.2	318.1	395.8	423.8	717.3	682.4	441.2
Cu (%)	19.44	19.44	19.44	19.44	19.44	19.44	19.44	19.44	19.44	19.44	19.44	19.44	19.44	19.44	19.44	19.44	19.44	19.44	19.44	19.44	19.44
Zn (%)	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19
Pb (%)	3.53	4.19	4.13	5.27	6.33	6.62	6.06	7.71	8.69	6.83	5.02	5.33	3.86	3.80	4.31	4.77	5.67	5.48	10.36	11.10	5.64
Zn Conc - Total Tonnes	**11,938**	**42,303**	**72,970**	**124,033**	**141,444**	**160,919**	**149,291**	**153,286**	**163,787**	**148,003**	**164,988**	**160,591**	**174,721**	**149,729**	**132,825**	**121,464**	**100,174**	**79,324**	**51,887**	**23,564**	**2,327,241**
Au (g/tonne)	1.81	1.21	1.18	1.61	1.95	1.95	2.73	2.41	2.22	2.32	1.97	2.35	2.19	2.70	3.33	3.48	4.32	6.71	7.13	9.40	2.71
Ag (g/tonne)	15.8	10.6	10.7	14.8	17.9	17.7	21.2	21.1	21.2	20.0	17.4	20.5	16.1	19.2	18.9	18.1	25.5	32.0	37.7	43.8	19.7
Cu (%)	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.30	0.27	0.27	0.27	0.27	0.27	0.27
Zn (%)	52.15	52.15	52.15	52.15	52.15	52.15	52.15	52.15	52.15	52.15	52.15	52.15	52.15	52.15	52.15	52.15	52.15	52.15	52.15	52.15	52.15
Pb (%)	0.06	0.05	0.05	0.07	0.09	0.09	0.10	0.12	0.13	0.11	0.10	0.13	0.10	0.10	0.12	0.13	0.17	0.19	0.25	0.33	0.12
Tailings - Total Tonnes	**90,748**	**270,560**	**451,999**	**884,208**	**1,048,138**	**1,244,429**	**1,434,137**	**1,432,972**	**1,421,153**	**1,436,267**	**1,402,946**	**1,397,908**	**1,372,125**	**1,409,201**	**1,425,892**	**1,446,386**	**1,448,465**	**1,520,791**	**1,027,422**	**646,839**	**22,812,589**
Au (g/tonne)	0.69	0.63	0.64	0.68	0.71	0.70	0.71	0.69	0.70	0.68	0.68	0.71	0.73	0.72	0.72	0.71	0.70	0.70	0.69	0.68	0.71
Ag (g/tonne)	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75
Cu (%)	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023
Zn (%)	0.233	0.233	0.233	0.233	0.233	0.233	0.233	0.233	0.233	0.233	0.233	0.233	0.233	0.233	0.233	0.233	0.233	0.233	0.233	0.233	0.233
Pb (%)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Total Tailings - Tonnes	**90,748**	**270,560**	**451,999**	**884,208**	**1,048,138**	**1,244,429**	**1,434,137**	**1,432,972**	**1,421,153**	**1,436,267**	**1,402,946**	**1,397,908**	**1,372,125**	**1,409,201**	**1,425,892**	**1,446,386**	**1,448,465**	**1,520,791**	**1,027,422**	**646,839**	**22,812,589**
Tailings - Paste to U/G - Tonnes	**0**	**0**	**0**	**221,052**	**262,035**	**311,107**	**358,534**	**358,243**	**355,288**	**359,067**	**350,736**	**349,477**	**343,031**	**352,300**	**356,473**	**361,597**	**362,116**	**380,198**	**256,856**	**161,710**	**5,499,820**
Tailings - to TIA - Tonnes	**90,748**	**270,560**	**451,999**	**663,156**	**786,104**	**933,322**	**1,075,603**	**1,074,729**	**1,065,865**	**1,077,200**	**1,052,209**	**1,048,431**	**1,029,094**	**1,056,901**	**1,069,419**	**1,084,790**	**1,086,348**	**1,140,593**	**770,567**	**485,129**	**17,312,768**
Tailings to TIA (m3)	**116,679**	**347,863**	**581,143**	**852,628**	**1,010,706**	**1,199,983**	**1,382,921**	**1,381,796**	**1,370,398**	**1,384,971**	**1,352,841**	**1,347,981**	**1,323,122**	**1,358,871**	**1,374,969**	**1,394,730**	**1,396,736**	**1,466,479**	**990,726**	**23,739**	**22,259,276**

Notes:

Tonnages reported in years 2028 through 2031 are based on inferred mineral resources and as such do not meet NI 43-101 reporting requirements for mineral reserves.

These numbers are shown as potential production for the purpose of tailings storage planning only.

Assumes Lalor Mine start-up in Q3, 2014

As noted above, all tailings discharged as waste will be deposited in the existing licensed Anderson TIA.

2.15.2 Solid Wastes

All domestic and non-hazardous waste generated at the Lalor Concentrator will be disposed of at HBMS present and future licensed facilities. HBMS will make arrangements with a licensed hazardous waste handler with respect to any hazardous wastes produced (for example used oil, oily rags, chemical delivery containers, etc.).

2.15.3 Sewage

During the construction phase, sewage generated will be managed on-site in the Biodisk Portable Wastewater Treatment Plant ("Lalor STP"), which is approved for operation in accordance with the Onsite Wastewater Management System Regulation and the Director's Approval dated November 29, 2010. It is intended that the Lalor STP operate at a higher flow rate once such operation has been approved pursuant to section 11 of *The Environment Act*. Application for this approval has been included in the Lalor Mine EAP. It is expected that the sewage generated during the construction phase of the Lalor Concentrator will be within the operation rate requested in the Lalor Mine EAP.

In or about 2015, during the operation phase, additional sewage treatment capacity may be required. Any such new sewage treatment facility will be the subject of a further application.

2.16 Other Approvals

The Lalor Mine Closure Plan will be developed in accordance with Manitoba Mine Closure Regulation 67/99, to be submitted to the Director of Mines for approval on or before September 30, 2014.

HBMS is filing a Project Description with the Canadian Environmental Assessment Agency in accordance with section 8 of the *Canadian Environmental Assessment Act, 2012* (CEAA, 2012). A copy of the Project Description is provided in **Appendix E**. As documented herein, however, no Federal permits are required for this development and it is not anticipated that this development will result in any environmental effects as defined in section 5 of CEAA, 2012.

As shown in **Figure 7**, a small portion of the Pipeline System will cross an existing transmission line ROW owned by Manitoba Hydro. In a letter dated March 8, 2013, Manitoba Hydro approved HBMS use of their ROW for the Pipeline System. A copy of the letter is enclosed in **Appendix D**.

All physical activities in or around culverts will be carried out in accordance with applicable DFO Operational Statement(s) or other applicable standards. No DFO permits will be sought.

2.17 Project Phases and Proposed Scheduling

Table 2.8 – Project Phases and Proposed Scheduling

Project Phases and Activity	Proposed Schedule (subject to the results of Regulatory review)
CONSTRUCTION	
Bringing Materials and Equipment to Site (excavating, hauling, stockpiling, storing fuels)	June 2013
Preparing Construction Site (Clearing vegetation, blasting, installing utilities)	August, 2013 – September 2013
Constructing Concentrator Building and Associated Facilities (erecting buildings, installing equipment, grading, backfilling)	September 2013 – September 2014
Preparing Pipeline ROW (clearing vegetation, stripping topsoil, blasting, excavating)	August 2014 – September 2014
Installing Pipeline (laying pipes, grading, compacting, installing)	August 2015 – October 2015
Upgrading support infrastructure at Snow Lake	July 2015
OPERATION	
Processing Ore (crushing, stockpiling, chemical/mechanical processing, concentrate dewatering, pumping reclaim water)	October 2015 - 2027
Transporting, Storing and Handling Materials	October 2015 - 2027
Handling Process Wastes (treating sewage, recycling process water, removing sludge)	October 2015 - 2027
Maintaining Concentrator component & Pipeline	October 2015 – 2027 (as required)
CLOSURE	
Removing all buildings, foundations, storage tanks, site refuse	2027 - 2030
Scarifying Pipeline System ROW.	2027 - 2030
Testing, removing, and remediating any contaminated soils.	2027 - 2030
Re-grading and contouring	2027 - 2030
Re-vegetating disturbed areas	2027 - 2030

2.18 Concentrator Closure Plan

Following the closure and decommissioning of the Lalor Concentrator, the site will be returned to its natural state (to the extent possible). This will be accomplished through the implementation of the Lalor Concentrator Closure Plan, which will be completed and submitted for approval to the Director of Mines in accordance with Manitoba Mine Closure Regulation 67/99. The Lalor Concentrator Closure Plan, including the information required to calculate the financial assurance to be paid to Manitoba, can be prepared as soon as construction has been completed. In accordance with the Manitoba Mine Closure Regulation 67/99, the Lalor Concentrator will not be commissioned until the closure plan has been accepted.

The Lalor Concentrator Closure Plan will include the following:

- Removing all buildings and foundations.
- Removing and appropriately disposing of any miscellaneous infrastructure such as power lines, generators, transformers, pipelines pumps, water storage tanks etc.
- Removing and appropriately disposing of site refuse.
- Scarifying Pipeline System ROW.
- Removing all fuel storage tanks.
- Testing, removing and/or remediating any contaminated soils.
- Re-grading and contouring stockpile pads, concentrator haul road and parking area.

- Re-vegetating disturbed areas in order to restore landscape to the extent possible to their native appearance.

It is anticipated that the end-use of the site will be a natural space with no planned residential, commercial or industrial development at the site. Based on HBMS closure experience in the Snow Lake region the growth of grasses and mosses is apparent within the first few years following closure, whereas trees and shrubs take longer to establish.

2.19 Potential Future Developments

It is expected that, sometime after the Lalor Concentrator has been in operation, HBMS will require an expansion of the Anderson TIA, which will be subject of a future application.

3. Scope of the Assessment

To assess the potential environmental impact of the proposed Lalor Concentrator, spatial and temporal boundaries were defined as follows:

3.1 Temporal Boundaries

The temporal boundaries of the assessment are divided as follows:

- **Construction Phase** – Construction July 2013 to September 2015.
- **Operation** – October 2015 to 2027.
- **Closure Phase** – 2027 to 2030, depending on the time it takes for re-vegetation.

3.2 Spatial Boundaries

Spatial boundaries used for the assessment are described below. However, where specifically noted, the boundaries may be adjusted to suit the Environmental Component (EC) or Social Component (SC) affected.

- **Project Site** – is comprised of Lalor site, the Lalor Access Road, and the proposed ROW for the Pipeline System.
- **Project Area** – is comprised of an area 2 km beyond the Project Site, which is intended to take into account the effects of the project (such as noise, vehicle emissions and traffic).
- **Project Region** – is comprised of an area up to 10 km beyond the Project Site, which is intended to take into account the maximum spatial extent of any potential impacts of the Project.

The Project Site, Project Area and Project Region are shown in **Figure 4**. **Figure 11** provides a closer view of the Project Site and Area.

3.3 Environmental and Social Components

This environmental assessment considers changes to the environment caused by the project, as well as any consequential socio-economic implications. The ECs and SCs were selected following the guidance provided in Manitoba Conservation's Information Bulletin, "*Environment Act* Proposal Report Guidelines". SCs include components of the socio-economic environment that may be affected by a change in the environment as a result of the project.

The potential interaction between project components and ECs and SCs are identified in **Table 3.1**. Potential Interactions were identified based on the professional judgement of the assessor combined with assumed implementation of standard environmentally responsible construction techniques and operating procedures in the course of project construction, operation and closure. The potential interactions identified in **Table 3.1** are assessed in **Section 5**. Mitigation measures and residual effects are also described in **Section 5**.

Table 3.1 – Identification of EC/SC Interactions with Project

PROJECT PHASES, COMPONENTS & ACTIVITIES	ENVIRONMENTAL COMPONENTS									
	Physical					Aquatic			Terrestrial	
	Topography	Soil	Air	Climate	Groundwater	Surface Water Quality	Surface Water Quantity	Aquatic Life	Flora	Fauna
CONSTRUCTION										
Concentrator Component										
Preparing Construction Site	X	X	X	X		X		X	X	X
Bringing Materials and Equipment to Site	X		X	X		X		X	X	X
Constructing Concentrator Building and Associated Facilities	X	X	X	X		X	X	X	X	X
Disposing of Wastes			X	X					X	X
Pipeline System										
Preparing Pipeline ROW	X	X	X	X		X	X	X	X	X
Bringing Materials and Equipment to site	X		X	X					X	X
Installing Pipeline/Constructing Access Road	X	X	X	X		X		X	X	X
Upgrading support infrastructure at Snow Lake and Anderson TIA			X	X					X	X
Disposing of Wastes			X	X					X	X
OPERATION & MAINTENANCE										
Processing Ore			X	X		X	X	X	X	X
Storing and Handling Materials and Transportation			X	X		X	X	X	X	X
Handling Process Wastes & Sewage Treatment			X	X	X	X	X	X	X	X
Maintaining Concentrator Facility & Pipeline System			X	X					X	X
CLOSURE										
Demolishing Structures/Disposing Wastes			X	X					X	X
Re-cycling and Restoration	X	X	X	X					X	X

4. Environmental Setting

This section provides an overview of the physical, terrestrial and aquatic environment in the Project Region.

4.1 Environmental Baseline Studies

In 2007, baseline terrestrial and aquatic investigations were commenced in anticipation that discoveries in the region of the Lalor Mine could lead to future development. The investigations dealt broadly with aquatic and terrestrial resources that could be affected by future development, including local geology, soil, vegetation and wildlife and 12 waterbodies that were initially identified as being located within the potential area of influence of the Lalor discovery.

As planning for the Lalor projects proceeded in subsequent years, additional focused investigations were undertaken, including Cook Lake in 2008 and a small waterbody identified by AECOM as Tern Ditch Pond in 2010. In 2011 and 2012, assessments of terrestrial and aquatic resources were conducted in additional areas within and around the Lalor site.

The baseline investigations carried out in 2007, 2008, 2010, 2011 and 2012 are reported on in the *Proposed Lalor Mine Environmental Baseline Assessment* (AECOM, 2012), which was filed with the Lalor Mine EAP, and the *Proposed Lalor Concentrator Environmental Baseline Assessment* which is included as **Appendix F**. The baseline reports are the primary source for the information summarized in this section.

4.2 Physical Environment

The physiographic setting of the Project Region is defined using the ecological land classification system. This hierarchical system of ecozones, ecoregions, and ecodistricts represents subdivisions of increasing ecological detail. The proposed Lalor Concentrator is located within the:

- **Boreal Shield Ecozone**, which contains the
- **Churchill River Upland Ecoregion**, which contains the
- **Reed Lake Ecodistrict**

The Boreal Shield Ecozone, the largest ecozone in Canada, 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 Churchill River Upland Ecoregion extends from the sparsely forested regions to the north, the southern edge of the Precambrian Shield to the south, and extends westward from the Grass River to the Saskatchewan border. The Reed Lake Ecodistrict extends west from Wekusko Lake to just over the Saskatchewan border as shown in **Figure 12**.

4.2.1 Topography

The elevations in the Reed Lake Ecodistrict range from approximately 255 metres above sea level (masl) to 335 masl. Slope lengths in the ecodistrict range from approximately less than 50 m to more than 150 m in length. Rocky cliffs can rise from 35 m to 40 m above the lakes and peat-filled depressions. (Smith, *et al.*, 1998).

The Project Region is characterized by broken, hilly to rolling bedrock, which controls relief of the area. The bedrock is partially covered by unconsolidated mineral and organic materials. Areas to the east of Lalor Lake contain extensive lacustrine deposits, while the remainder contains a mixture of lacustrine sediments, till deposits and peatlands. Elevations within the region of the proposed Lalor Concentrator vary from more than 312 masl for the highest bedrock outcrops to the west to approximately 256 masl near Wekusko Lake, located to the east (Department of Energy, Mines and Resources, 1985 and 1995).

4.2.2 Geology

The Project Region is part of the Flin Flon Belt (FFB), which according to the Manitoba Geological Survey, is in the juvenile internal zone of the Trans-Hudson Orogen and consists of Paleoproterozoic volcanic, plutonic and minor sedimentary rocks. According to Manitoba's Mineral Resources Geological Survey, *"the Flin Flon greenstone belt extends hundreds of kilometres to the south-southwest beneath a thin, geophysically transparent Phanerozoic cover. To the north the FFB is tectonically overthrust by younger metasedimentary rocks of the Kisseynew domain and by nappes of metavolcanic rocks that are the same age as those in the FFB."* (Government of Manitoba, 2011).

The tectonostratigraphic architecture of the FFB is of vital economic significance. The FFB is one of the largest Proterozoic volcanic-hosted massive sulphide (VMS) districts in the world, containing 27 copper – zinc (gold) deposits. Of these deposits, more than 162 million tonnes of sulphide have already been mined (Government of Manitoba, 2011).

The Snow Lake arc assemblage that hosts the Lalor ore deposit is a 20 km wide by 6 km thick section that records the transition from primitive to mature arc. The mature arc Chisel Sequence that hosts the Lalor deposit typically contains thin and discontinuous volcanoclastic deposits and intermediate to felsic flow-dome complexes. Rock units in the hanging walls of the deposit typically include mafic and felsic volcanic and volcanoclastic units, mafic wacke, fragmental and crystal tuff units. The footwall rocks have extensive hydrothermal alteration and metamorphic recrystalization which has produced exotic aluminous mineral assemblages including; chloritic and seracitic schist; and cordierite-anthophylite gneisses (Bailes and Galley, 2007).

4.2.3 Soil

As noted above, the Reed Lake Ecodistrict extends west from Wekusko Lake to just over the Saskatchewan border. Acidic granitoid bedrock in the form of sloping uplands and lowlands can be found in this ecodistrict. Bedrock areas are subdominant and widely distributed areas of permafrost can occur in peatlands.

Dystric Brunisols are the dominant soils in the ecodistrict. These soils have developed over glacial till overlying bedrock and consist of shallow, sandy and stoney veneers. Peat-filled depressions with very poorly drained Typic and Terric Fibrisolic and Mesisolic Organic soils can be found throughout the ecodistrict. These soils are overly loamy to clayey glaciolacustrine sediments. Eutric Brunisols and Gray Luvisols can be found on sandy bars, beaches, and exposed clayey deposits (Smith, *et al.*, 1998).

4.2.4 Air

Specific measurements of air quality in the Project Region are not available. However, 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 Project Region. The closest significant industrial activity is in the City of Flin Flon and the Town of The Pas, located approximately 109 km and 135 km west of the Lalor site, respectively. Occasional regional impediments to air quality, although uncommon, may occur in the Project Region. This could include smoke from forest fires and wood-burning stoves, emissions from fuel storage tanks and vehicle emissions.

4.2.5 Noise and Vibration

A baseline noise assessment was undertaken by AECOM in July, 2011. Noise baseline data was collected at two Points of Reception (POR) within the Town of Snow Lake. The measured background levels were determined to be typical of a suburban area where the dominant sources of ambient noise and vibration are vehicular traffic. The equivalent day/night sound levels were calculated to be 53 dBA at POR 1and 49 dBA at POR 2, Average root mean square velocities ranged from 0.045 to 0.426 mm/s at POR 1 and POR 2 over a 24 hour period.

4.2.6 Climate

The closest weather station to the site is near Baker's Narrows at the Flin Flon airport, approximately 99 km west of the Project Site. The Flin Flon airport is located at an elevation of 304 masl and in our opinion is climatically representative of the Project Site. The mean annual air temperature at the Flin Flon airport is -0.2°C. The daily mean temperature ranges between 18°C in July and -21°C in January. Total annual precipitation at the Flin Flon airport is composed of 339 mm of rain and 141 cm of snow. July has the highest average rainfall (77 mm), whereas November has the highest average snowfall (25 cm) (Environment Canada, 2012a).

The average temperature, precipitation and wind conditions measured at the Flin Flon airport each month are provided in **Table 4.1**.

Table 4.1 – 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 (ºC)														
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
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 (km/h)														
Speed	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:

Data obtained from Flin Flon A meteorological station, latitude 54 ^{0} 41' N longitude 101 ^{0} 41' W Elevation 303.90 m (Environment Canada, 2012a).

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

4.2.7 Groundwater

There is no comprehensive report describing the regional groundwater flow system. However, based on conditions in similar environments, the regional shallow groundwater flow, in particular in the overburden, is likely controlled by the topography and bedrock surface in and around the Project Region. Locally, the topography of the buried bedrock surface can have a significant effect on groundwater flow direction. Recharge of shallow groundwater can be expected to occur in elevated areas. From there, shallow groundwater flow will generally follow the topography and drain to the low-lying areas where it will discharge to surface waterbodies and wetlands. Shallow groundwater tables are high in most peat lands and in low areas bordering the peat lands. Shallow groundwater levels in the area are generally at or near surface in the spring and early summer and drop as the year progresses. Locally, the topography of the buried bedrock surface can have a significant effect on groundwater flow direction. Bedrock groundwater wells, when present, are likely connected to fractures or discontinuities that are connected to the local water table and are not likely regionally interconnected.

The Manitoba Water Stewardship water well records indicate groundwater utilization within the Project Region. There are 21 registered groundwater wells in use within the Project Region (Manitoba Water Stewardship, 2011). These are located within the property development around Wekusko Lake (Taylor Bay, Berry Bay and along PR 392), the Town of Snow Lake, and Wekusko Falls Provincial Park.

Hydrogeological testing of the bedrock in the vicinity of the Lalor deposit determined the bulk hydraulic conductivity of the fractured rock to be within the upper range for unfractured metamorphic or igneous rocks and the lower range for fractured metamorphic or igneous rocks ($K_{BULK} = 8.3 \times 10^{-10}$ m/s) (Golder Associates Ltd., 2009).

4.3 Surface Water

Since 2007, AECOM has undertaken several aquatic investigations on waterbodies in the Project Area, with select locations in the Project Region (i.e., Anderson Bay and Goose Bay). Based on proximity to the Project Site, these waterbodies were considered to be in the zone of influence of the project.

Investigations included bathymetry, water and sediment quality, aquatic invertebrates, fish community and testing for metals in fish. **Table 4.2** indicates the waterbodies sampled.

Sections 4.3.1 to **4.3.10** summarize the results of sampling carried out in 2011 and 2012. Please refer to the sampling information for waterbodies investigated in 2007 to 2010 in the *Proposed Lalor Mine Environmental Baseline Assessment (*AECOM, 2012) report.

Table 4.2 – Summary of Aquatic Baseline Investigations, 2007-2012

Waterbody	Bathymetry					Water & Sediment Quality					Aquatic Invertebrates				
	2007	2008	2010	2011	2012	2007	2008	2010	2011	2012	2007	2008	2010	2011	2012
Lalor Lake	X					X		X			X		X		X
Maw Lake	X					X		X			X		X		X
Cook Lake		X				X									
Varnson Lake	X					X		X			X		X		X
Squall Lake						X									
Unnamed Lake 1 (2007)						X					X				
Unnamed Creek 1 (2007)						X									
Snow Creek						X									
Snow Lake						X			water only						
Tern Creek						X		X							
Tern Ditch						X		X	X						
Tern Lake	X					X		X			X		X		X
Tern Ditch Pond			X					X					X		X
Anderson Bay				X					X					X	
Goose Bay															
Arm Lake				X					X					X	
Gaspard Lake				X					X					X	
Ghost Lake				X					X					X	
Nutt Lake				X					X					X	
Threehouse Lake				X					X					X	
Unnamed Lake 1 (2011)				X					X					X	
Anderson Creek									X	X				X	
Ghost Creek									X					X	
Stall Creek									X					X	
Threehouse Creek									X					X	
Unnamed Creek 1 (2011)									X					X	

Waterbody	Fish Community					Metals in Fish				
	2007	2008	2010	2011	2012	2007	2008	2010	2011	2012
Lalor Lake	X					X				
Maw Lake	X					X				
Cook Lake		X								
Varnson Lake	X					X				
Squall Lake										
Unnamed Lake 1 (2007)										
Unnamed Creek 1 (2007)	X									
Snow Creek										
Snow Lake										
Tern Creek										
Tern Ditch										
Tern Lake	X					X				
Tern Ditch Pond			X					X		
Anderson Bay				X	X					X
Goose Bay				X	X					X
Arm Lake				X						
Gaspard Lake				X						
Ghost Lake				X	X					X
Nutt Lake				X						
Threehouse Lake				X						
Unnamed Lake 1 (2011)				X						
Anderson Creek				X						
Ghost Creek				X						
Stall Creek				X						
Threehouse Creek				X	X					X
Unnamed Creek 1 (2011)				X						

Notes:

*** = Unnamed Lake 1 and Unnamed Creek 1 assessed in 2007 are NOT the same as the Unnamed Lake 1 and Unnamed Creek 1 assessed in 2011.*

Grey text = Not included in current draft of Lalor Concentrator EAP.

4.3.1 Hydrology

The Reed Lake Ecodistrict lies within the glacial Lake Agassiz basin and is part of the Nelson River drainage system. The area drains generally eastward through Wekusko Lake, other medium sized lakes in the general region, and an irregular bedrock-controlled network of streams that are all part of the Grass River watershed (Smith, *et al.*, 1998). **Figure 13** illustrates Manitoba basins and watershed boundaries. **Figure 11** shows waterbodies in the Project Area.

The closest waterbody to the Lalor site is Lalor Lake. Lalor Lake is a small (0.4 km^2) headwater lake located 250 m to the west of the Lalor site (where the concentrator and associated infrastructure will be located). Lalor Lake drains northward for approximately 300 m through a creek and marsh into Maw Lake (0.16 km^2). Maw Lake then continues to drain north into Varnson Lake, and continues to flow east into Squall Lake, a relatively large and deep lake. Squall Lake then drains south via Snow Creek and eventually into Snow Lake Narrows, which makes up the west arm of Snow Lake. Snow Lake also receives water from the south via Tern Creek, Tern Ditch, and Tern Lake, a small lake (0.15 m^2). Within the Project Region, there are numerous small to large lakes, creeks, and fens.

Along the route of the proposed pipeline system (shown in **Figure 7**), there are 20 culverts, including small channels, several small ephemeral and intermittent creeks and drainage features (e.g., culverts).

As a result of varying topography created by hummocky bedrock surfaces, the drainage conditions in the region vary considerably over short distances. Terrain falls at about 0.6 m to 1.0 m per km. Regionally, runoff from bedrock and upland areas collects in peat filled lows (bogs), which slowly release excess water to surrounding lakes and creeks. Groundwater tables are high in most bogs and in low areas bordering the bogs. Similar to much of the Boreal Shield Ecozone, contiguous and isolated bogs cover between 20% and 40% of the Project Region. Bogs are widespread and stagnant in the Project Region. Prior to clearing and leveling (for the Lalor AEP), the Lalor site was a large rocky outcrop in a large stand of dense Black Spruce surrounded by wet bog. The rock outcrop has been leveled and a bog/wet area exists to the north of the existing footprint of the Lalor site, within an area that has been previously cleared of vegetation.

4.3.2 Lake Bathymetry

The assessment of lake bathymetry carried out as part of the baseline aquatic work, summarized below, will function as a baseline reference for the depth of lakes and other waterbodies within the potential area of influence of the proposed Lalor Concentrator.

In September 2007, the bathymetry of Lalor Lake, Varnson Lake, Tern Lake and Maw Lake was assessed. Cook Lake and Tern Ditch Pond was assessed in September 2008 and 2010. Anderson Bay (in Wekukso Lake), Arm Lake, Gaspard Lake, Ghost Lake, Nutt Lake, Threehouse Lake, and Unnamed Lake 1 were assessed in 2011. Results of the bathymetric assessment are presented in **Table 4.3**.

Table 4.3 – Summary of Bathymetric Surveys, 2007-2011

Waterbody	Year Assessed	Maximum Depth (m)	Average Depth (m)	Area (m^2)	Volume (m^3)
Lalor Lake	2007	2.1	1.2	413,650	477,823
Maw Lake	2007	1.4	0.7	163,675	120,918
Varnson Lake	2007	2.6	1.7	711,350	1,229,410
Tern Lake	2007	2,2	1,6	153,150	246,701
Cook Lake	2008	9.5	5.0	2,284,027	11,533,346
Tern Ditch Pond	2010	1.0	0.5	75,125	39,750
Anderson Bay	2011	5.3	2.3	1,106,100	2,583,400
Arm Lake	2011	1.3	0.8	127,800	107,100
Gaspard Lake	2011	1.6	1.1	88,000	93,700
Ghost Lake	2011	4.4	1.6	607,100	967,700
Nutt Lake	2011	1.4	0.9	63,000	59,600
Threehouse Lake	2011	2.8	1.3	1,065,400	1,401,200
Unnamed Lake 1	2011	1.2	0.8	22,800	19,200

Notes: m = metre; % = percent.

Anderson Bay (in Wekusko Lake)

Anderson Bay, located in Wekusko Lake, has numerous islands and reef structures, a steep rocky eastern shore, a gentle shallow western shore, and estuary like features at the northern end where the combined Anderson Creek and Stall Creek discharge into Wekusko Lake. Anderson Bay had an average depth of 2.3 m and a maximum depth of 5.3 m. Anderson Bay was the largest waterbody examined during the baseline assessments, with a total surface area of 1,106,100 m^2 and a total calculated volume of 2,583,400 m^3.

Arm Lake

Arm Lake is a shallow lake with a mean depth of 0.8 m and a maximum depth of 1.3 m. The total surface area of Arm Lake was 127,800 m^2 and the total calculated volume was 107,100 m^3. The average grade was similar to other lakes along the former rail bed (*e.g.,* Gaspard Lake). There were large areas of emergent and submergent vegetation along the margins of the lake. Arm Lake is accessible via Threehouse Creek.

Gaspard Lake

Gaspard Lake was one of the smallest waterbodies examined during the baseline assessments, with a total surface area of 88,000 m^2 and the total calculated volume was 93,700 m^3. A small creek, Gaspard Creek, drains toward Gaspard Lake from the former rail bed located to the south. The shoreline of Gaspard Lake was dominated by emergent vegetation, such as wild rice, and/or fen areas.

Ghost Lake

Ghost Lake had a mean depth of 1.6 m and a maximum depth of 4.4 m, making it the deepest lake along the former rail bed. The total surface area of Ghost Lake was 607,100 m^2 and the total calculated volume was 967,700 m^3. Ghost Creek drains from the northern bay in Ghost Lake, towards the former rail bed located to the north. Ghost

Lake had a relatively complex bottom topography with several deep holes, reefs and islands. The shoreline was composed of steep bedrock and some areas of fen or emergent vegetation.

Nutt Lake

The total surface area of Nutt Lake was 63,000 m^2 and the total calculated volume was 59,600 m^3. Nutt Lake had a mean depth of 0.9 m and a maximum depth of 1.4 m. Nutt Lake had a homogenous bottom topography with a shoreline that was composed of bedrock and fen or emergent vegetation.

Threehouse Lake

Threehouse Lake had a mean depth of 1.3 m and a maximum depth of 2.8 m. The total surface area of Threehouse Lake was 1,065,400 m^2 and the total calculated volume was 1,401,200 m^3. The bottom topography was relatively complex with several reef structures and islands. A small creek, Threehouse Creek, drains Threehouse Lake towards the former rail bed located to the north.

Unnamed Lake 1

Unnamed Lake 1 was the smallest lake assessed during the bathymetric survey, with a mean depth of 0.8 m and a maximum depth of 1.2 m. The total surface area of Unnamed Lake 1 was 22,800 m^2 and the total calculated volume was 19,200 m^3. Unnamed Lake 1 had a featureless bottom, essentially a low depression that has filled with sediments.

Most lakes mapped in the study (*e.g.,* Arm Lake, Gaspard Lake, Nutt Lake, and Unnamed Lake 1) show typical headwater lake bathymetry, *i.e.*, steep slopes near shore, an immediate transition to gentle slopes, and shallow depth. Ghost Lake and Threehouse Lake have a more complicated bottom with island and reef structures, but their relatively shallow average depth for their surface area is more typical of a headwater lake, despite their larger size.

4.3.3 Surface Water Quality

In the spring and fall 2011, AECOM collected water samples from 14 waterbodies located in the Project Region. An additional station in Anderson Creek was sampled in summer of 2012. Water quality samples were also collected from Anderson TIA in winter and summer 2012. The water quality values were used to establish the baseline water chemistry and will function as a baseline reference for the quality of lakes and other waterbodies within the potential area of influence of the proposed Lalor Concentrator.

In situ water quality parameters such as pH, temperature, specific conductance, turbidity, and dissolved oxygen were measured. Water quality samples were analyzed for the following parameters:

- Routine parameters (e.g., physical and nutrients).
- Major ions (i.e., chloride, sulphate, bromide and silicate).
- Total and dissolved metals.
- Total and dissolved mercury.
- Biological parameters (i.e., chlorophyll a and pheophytin a).

Water quality data was compared to the Provincial and Federal guidelines and objectives that have been generated for various water quality parameters, with the purpose of protecting aquatic life and human health (i.e., drinking water or protection of freshwater aquatic life). The guidelines applied include:

- The Canadian Council of Ministers of the Environment Phosphorus and Lake Trophic Status (CCME, 2004).
- Canadian Council of Ministers of the Environment Canadian Water Quality Guidelines for the Protection of Aquatic Life (*CWQG*) (CCME, 2011a).
- Manitoba Water Quality Standards, Objectives and Guidelines (Williamson, 2011).

The Water Quality Index (WQI) is a tool developed by the CCME to summarize the results of measured concentrations of chemicals of concern from a waterbody (CCME, 2001a; CCME, 2001b). 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 WQI is a general indicator of water quality, where lower values indicate a higher probability of ecological effects. Water quality is ranked, based on the WQI into one of five categories (in decreasing quality): *Excellent*, *Good*, *Fair*, *Marginal*, and *Poor*.

4.3.3.1 Water Quality Results

The following is a summary of the water quality data collected during the aquatic investigations undertaken between 2011 and 2012.

Anderson Bay (in Wekusko Lake)

Anderson Bay was not thermally stratified in 2011. Water temperatures ranged from 8.3^{0}C to 13.0^{0}C in the spring and from 11.4^{0}C to 14.6^{0}C in the fall. In both spring and fall, the water was well-oxygenated, with dissolved oxygen concentrations of at least 8.2 mg/L. Based on field-measured pH, Anderson Bay was slightly alkaline. Two lab-measured pH values were outside the *CWQG* range of 6.5 to 9.0. Lab-measured pH was slightly lower than the field-measured pH values, which shows some variability between lab-measured and field-measured pH and this variability should be considered when comparing values to applicable guidelines. Some variability was observed within Anderson Bay, with inshore stations showing higher levels of some parameters, including dissolved solids, chloride, and sulfate. According to the CCME classification scheme for lake trophic status, based on total phosphorus concentrations, Anderson Bay was considered *mesotrophic* in both spring and fall. Overall, there were no consistent differences in limnological parameters between spring and fall.

Baseline concentrations of several metals were below their respective method detection limits during both sampling events (*e.g.,* mercury, nickel, silver, and thallium). None of the concentrations in Anderson Bay in 2011 exceeded the *MWQSOG* values. In Anderson Bay in 2011, baseline concentrations of fluoride, aluminum, cadmium, copper, iron, selenium, zinc and pH values exceeded the *CWQG*. The majority of baseline samples had only one or two concentrations that exceeded at least one applicable water quality guideline, namely for pH, fluoride and/or aluminum. One baseline sample from Anderson Bay in spring 2011 had seven exceedances (*i.e.,* fluoride, aluminum, cadmium, copper, iron, selenium, and zinc). In spring 2011, baseline concentrations of aluminum exceeded the *CWQG* of 0.1 mg/L in all but one sample from Anderson Bay. In the fall, baseline concentrations of aluminum in only 2 of 10 samples exceeded the *CWQG* of 0.1 mg/L.

Baseline water quality in Anderson Bay ranged from *Good* to *Excellent* according to the CCME WQI values.

Arm Lake

Arm Lake is a shallow lake located north of the former rail bed. Water temperatures ranged from 10.5^{0}C to 13^{0}C in the fall and spring, respectively. Values of pH and conductivity were lower in the fall than in the spring. In both spring and fall, the water was well-oxygenated. According to the CCME classification scheme for lake trophic status based on total phosphorus concentrations, Arm Lake was considered *oligotrophic* in both spring and fall. Baseline nutrient concentrations were very low.

Several metal concentrations in Arm Lake in spring and fall were below detection limit and none exceeded the *CWQG* or *MWQSOG* values. Baseline water quality in Arm Lake was considered *Excellent* according to the WQI value.

Gaspard Lake

Gaspard Lake is a shallow lake located north of the former rail bed. Water temperatures ranged from 11^{0}C to 15^{0}C in the fall and spring, respectively. Values of pH and conductivity in Gaspard Lake were lower in the fall than in the spring. In both spring and fall, the water was well-oxygenated. According to the CCME classification scheme for lake trophic status based on total phosphorus concentrations, Gaspard Lake was considered *mesotrophic* in both spring and fall. Nutrient concentrations were very low.

Baseline concentrations of most metals and metalloids were low and below the applicable water quality guidelines with the exception of total iron. For baseline samples collected from Gaspard Lake in spring and fall 2011, total iron concentrations (1.2 mg/L and 0.5 mg/L for spring and fall, respectively) exceeded the *CWQG* of 0.3 mg/L. None of the *MWQSOG* values were exceeded. Baseline water quality in Gaspard Lake was considered *Excellent* according to the WQI value.

Ghost Lake

Water temperatures in Ghost Lake ranged from 12^{0}C to 17^{0}C in the fall and spring, respectively. Turbidity was generally slightly higher in fall as compared to spring, likely due to the higher primary productivity in fall. In both spring and fall, the water was well-oxygenated with average dissolved oxygen concentrations of 10 mg/L and 9 mg/L, respectively. According to the CCME classification scheme for lake trophic status based on total phosphorus concentrations, Ghost Lake was considered *mesotrophic* in spring and *oligotrophic* in fall. Nutrient concentrations (*e,g.,* Total Kjeldahl Nitrogen, Total Phosphorus) were lower on average than Threehouse Lake, another similar sized waterbody along the former rail bed.

Concentrations of most metals and metalloids were low and none of the *MWQSOG* or *CWQG* values were exceeded in baseline samples collected from Ghost Lake. Baseline water quality in Ghost Lake was considered *Excellent* according to the WQI value.

Nutt Lake

Water temperatures in Nutt Lake ranged from 15^{0}C to 11^{0}C in the fall and spring, respectively. Values of pH and turbidity were lower in the spring than in the fall. In both spring and fall, the water was well-oxygenated with dissolved oxygen concentrations greater than 8 mg/L. According to the CCME classification scheme for lake trophic status based on total phosphorus concentrations, Nutt Lake was considered *mesotrophic* in both spring and fall.

Baseline concentrations of most metals and metalloids were low and below the applicable water quality guidelines with the exception of total iron and ammonia. In the baseline sample collected from Nutt Lake in spring 2011, the total iron concentration was 0.4 mg/L, exceeding the *CWQG* of 0.3 mg/L. Baseline ammonia concentrations in Nutt Lake in both spring (0.064 mg/L) and fall (0.062 mg/L) exceeded the *MWQSOG* value of 0.0067 mg/L. Baseline water quality in Nutt Lake was considered *Excellent* according to the WQI value.

Snow Lake

Snow Lake was the deepest waterbody sampled in the environmental baseline aquatic assessments in the Snow Lake area in 2011 (for example, station SNL-01 had a maximum depth of 16 m). In spring, water temperature and dissolved oxygen concentrations were stable in the top 7 m in both basins of Snow Lake. Dissolved oxygen dropped steadily as depth increased until reaching bottom (at SNL-01). This pattern (*i.e.,* DO gradient but no accompanying temperature gradient) is typical of winter stratification, prior to spring turnover. In fall, there was a similar pattern at SNL-02. A combination of depth and strong winds may have prevented the development of a thermocline over the summer in Snow Lake, even with the development of an oxygen gradient.

Concentrations of most metals and metalloids were low and below the applicable water quality guidelines with the exception of total copper at one station in Snow Lake in the fall 2011. The baseline copper concentration at this station in fall (0.00217 mg/L) exceeded the *CWQG* of 0.00216 mg/L. None of the *MWQSOG* values were exceeded in Snow Lake. Baseline water quality in Snow Lake was rated as *Excellent*, according to their WQI values.

Threehouse Lake

Threehouse Lake was the largest lake assessed along the former rail bed. Water temperatures in Threehouse Lake ranged from 17^{0}C to 11^{0}C in the spring and fall, respectively. Turbidity was generally higher in fall as compared to spring, likely due to the higher primary productivity in fall. In both spring and fall, the water was well-oxygenated with dissolved oxygen concentrations greater than 9 mg/L. According to the CCME classification scheme for lake trophic status based on total phosphorus concentrations, Threehouse Lake was considered *mesotrophic* in both spring and fall.

Concentrations of most metals and metalloids were low and below the applicable water quality guidelines with the exception of total iron at all three stations in the spring. Baseline iron concentrations in the spring ranged from 0.56 mg/L to 0.65 mg/L, exceeding the *CWQG* of 0.3 mg/L. None of the *MWQSOG* values were exceeded in Threehouse Lake. Baseline water quality in Threehouse Lake was rated as *Excellent*, according to their WQI values.

Unnamed Lake 1

Unnamed Lake 1 was the smallest lake located along the former rail bed. Water temperatures in Unnamed Lake 1 ranged from 12^{0}C to 11^{0}C in the spring and fall, respectively. pH values were lower in the spring than in the fall. Turbidity was higher in fall as compared to spring, likely due to the higher primary productivity in fall. In both spring and fall, the water was well-oxygenated with dissolved oxygen concentrations greater than 8 mg/L. According to the CCME classification scheme for lake trophic status based on total phosphorus concentrations, Unnamed Lake 1 was considered *meso-eutrophic* in both spring and fall.

Concentrations of most metals and metalloids were low and below the applicable water quality guidelines. Baseline ammonia concentrations in Unnamed Lake 1 were 0.128 mg/L in both fall, exceeding the *MWQSOG* of 0.0067 mg/L. None of the *CWQG* guideline values were exceeded. Baseline water quality in Unnamed Lake 1 was rated as *Excellent*, according to the WQI value.

Anderson Creek

Anderson Creek is the receiving waterbody for overflow discharge from the Anderson TIA. Water quality samples were collected from Anderson Creek at two stations in both May and September 2011 and one station in June 2012. The 2012 sampling station in Anderson Creek was approximately 60 m downstream of PR 392, while the 2011 sampling stations were located 630 m and 1 km downstream from PR 392.

Water temperatures in Anderson Creek were highest in the summer, followed by spring then the fall. Turbidity was generally higher in fall, likely due to the higher primary productivity in fall. The water was generally well-oxygenated with dissolved oxygen concentrations greater than 5.8 mg/L. Water in Anderson Creek was well-oxygenated with the majority of dissolved oxygen concentrations greater than the *CWQG* of 6.6 mg/L with one exception, where the dissolved oxygen concentration was 5.8 mg/L in 2012. According to the CCME classification scheme for lake trophic status based on total phosphorus concentrations, Anderson Creek was considered *mesotrophic* in 2011 and *meso-eutrophic* in 2012.

Baseline concentrations of fluoride, aluminum, cadmium, copper, iron, selenium, and zinc exceeded the CWQG values. Relative concentrations of total metals (to the detection limit) show no apparent trend with increasing distance from PR 392 with the possible exception of aluminum. Relative concentrations of aluminum decrease with increasing distance from PR 392. None of the *MWQSOG* values were exceeded. Baseline water quality in Anderson Creek was rated as *Excellent* and *Good,* according to their WQI values.

Ghost Creek

Ghost Creek is an off-take channel built during the construction of the former rail bed. Ghost Creek flows northward through a culvert under the former rail bed and joins with Threehouse Creek to form Tern Creek which flows through Tern Lake to Snow Lake. Water temperatures in Ghost Creek ranged from 20^{o}C to 11^{o}C in the spring and fall, respectively. Values of pH, conductivity and turbidity were higher in the spring than in the fall. Dissolved oxygen concentrations in fall were on average lower than in spring, with some concentrations reaching levels that may adversely affect aquatic life. According to the CCME classification scheme for lake trophic status based on total phosphorus concentrations, Ghost Creek was considered *meso-eutrophic* in spring and *eutrophic* in fall. Similar to the other creeks along the former rail bed, Ghost Creek was highly productive, with high nutrient concentrations and elevated concentrations of chlorophyll *a* and phaeophytin *a*.

Concentrations of most metals and metalloids were low and below the applicable water quality guidelines with the exception of total iron in the spring and fall and total arsenic in only fall. Baseline iron concentrations in Ghost Creek were 0.5 mg/L and 1.2 mg/L, in spring and fall, respectively, exceeding the *CWQG* of 0.3 mg/L. The baseline arsenic concentration in Ghost Creek in the fall 2011 was 0.01 mg/L, exceeding the *CWQG* of 0.005 mg/L. None of the *MWQSOG* values were exceeded. Baseline water quality in Ghost Creek was rated as *Excellent*, according to the WQI value.

Stall Creek

Stall Creek is downstream of Stall Lake but Stall Lake does not discharge to Stall Creek, as a dam blocks discharge and there is no spillway. Stall Creek flows southward to join Anderson Creek before entering Anderson Bay in Wekusko Lake. With respect to physicochemical parameters, there were differences among stations in Stall Creek. Water in Stall Creek was well-oxygenated with the majority of dissolved oxygen concentrations greater than the *CWQG* of 6.6 mg/L with one (1) exception, where the dissolved oxygen concentration was 5.8 mg/L. According to the CCME classification scheme for lake trophic status based on total phosphorus concentrations, Stall Creek was considered *meso-eutrophic* in spring and *eutrophic* in fall. Similar to the other creeks in the Snow Lake area, Stall Creek was highly productive, with high nutrient concentrations and elevated concentrations of chlorophyll *a* and phaeophytin *a*.

Baseline oncentrations of many metals and metalloids were low and below the applicable water quality guidelines with the exception of fluoride (at only one of three stations), ammonia (at only one of three stations in fall), copper (at only one of three stations) and iron (at only one of three stations). The most upstream station (closest to Stall Lake) had average baseline concentrations of fluoride (0.15 mg/L) and copper (0.01 mg/L) that exceeded the *CWQG* (0.12 mg/L and 0.00216 mg/L, respectively). Baseline copper concentrations at this upstream station in Stall Creek also exceeded the *MWQSOG* of 0.009 mg/L. Iron concentrations (average of 0.97 mg/L) in the most downstream station in Stall Creek exceeded the *CWQG* of 0.3 mg/L. Baseline water quality in Stall Creek was rated as *Excellent*, according to the WQI value.

Tern Ditch

Tern Ditch flows north through a culvert under the Lalor Access Road to join Tern Creek, which flows into Snow Lake. Water temperatures were generally higher in Tern Ditch than other similar sized creeks in the Snow Lake area studied by AECOM in 2011 during the environmental baseline aquatic assessments. Values of pH and dissolved oxygen concentrations were higher in spring than in fall, while conductivity and turbidity were generally higher in fall as compared to spring. According to the CCME classification scheme for trophic status based on total phosphorus concentrations, Tern Ditch was considered *mesotrophic* in spring and *meso-eutrophic* in fall. Similar to the other creeks in the Snow Lake area, Tern Ditch was highly productive, with elevated concentrations of nutrients and chlorophyll *a*.

Baseline concentrations of most metals and metalloids were low and below the applicable water quality guidelines with the exception of aluminum and copper in only the fall 2011. In fall, the baseline concentrations of aluminum and Iron in Tern Ditch were 0.15 mg/L and 0.55 mg/L respectively, compared to the *CWQG* of 0.1 mg/L and 0.3 mg/L respectively. None of the *MWQSOG* values were exceeded. Baseline water quality in Tern Ditch was rated as *Excellent*, according to the WQI value.

Threehouse Creek

Threehouse Creek is an off-take channel constructed during construction of the former rail bed and flows northward through a culvert under the former rail bed from Threehouse Lake and joins with Ghost Creek to form Tern Creek which flows through Tern Lake to Snow Lake. Water temperatures ranged from 10^{0}C to 17^{0}C in the fall and spring, respectively. Values of pH and conductivity were higher in spring than in fall, while dissolved oxygen concentrations and turbidity were generally higher in fall as compared to spring. According to the CCME classification scheme for trophic status based on total phosphorus concentrations, Threehouse Creek was considered *meso-eutrophic* in spring and *eutrophic* in fall.

Baseline concentrations of most metals and metalloids were low and below the applicable water quality guidelines with the exception of aluminum (fall only) and iron. In fall 2011, the baseline concentration of aluminum in Threehouse Creek was 0.12 mg/L compared to the *CWQG* of 0.1 mg/L. Baseline concentrations of iron ranged from 0.3 mg/L to 0.6 mg/L compared to the *CWQG* of 0.3 mg/L. None of the *MWQSOG* values were exceeded. Baseline water quality in Threehouse Creek was rated as *Excellent*, according to the WQI value.

Unnamed Creek 1

Unnamed Creek 1 is a small creek that has been impounded by significant beaver activity as it crosses through a culvert under the former rail bed towards Anderson TIA. pH values were higher in spring than in fall. Turbidity was higher in fall as compared to spring, due to the increased productivity. According to the CCME classification scheme for trophic status based on total phosphorus concentrations, Unnamed Creek 1 was considered *eutrophic* in spring and *hyper-eutrophic* in fall. Similar to the other creeks in the Snow Lake area, Unnamed Creek 1 was highly productive, with elevated concentrations of nutrients (highest concentration of total phosphorus of all waterbodies examined), chlorophyll *a* and phaeophytin *a*.

Concentrations of most metals and metalloids were low and below the applicable water quality guidelines with the exception of fluoride (fall only), ammonia (fall only), aluminum and iron. In fall 2011, the baseline concentration of fluoride in Unnamed Creek 1 was equal to the *CWQG* of 0.12 mg/L. The baseline concentration of ammonia in fall

2011 was 0.17 mg/L which exceeded the *CWQG* of 0.007 mg/L. Baseline concentrations of aluminum (0.12 mg/L in spring and 0.14 mg/L in fall) and iron (0.7 mg/L in spring and 3.1 mg/L in fall) were higher than the *CWQG* of 0.1 mg/L and 0.3 mg/L respectively. None of the *MWQSOG* values were exceeded. Baseline water quality in Unnamed Creek 1 was rated as *Excellent*, according to the WQI value.

4.3.3.2 Surface Water Quality Summary

There was some evidence of stratification in Snow Lake in spring 2011, the deepest waterbody included in the survey. The pattern is indicative of residual winter stratification (*i.e.,* prior to spring turnover). With few exceptions (*e.g.,* deep spots or shallow warm water), water was well oxygenated. The majority of waterbodies were *mesotrophic* or *meso-eutrophic*, with higher total phosphorus concentrations in the fall as compared to spring.

Total aluminum, cadmium, copper, iron, selenium, and zinc concentrations exceeded the *CWQG* in at least one baseline sample in several of the waterbodies assessed in the Project Region in 2011 and 2012. The baseline quality of the majority of water samples in the Project Area were classified as *Good* or *Excellent* based on their WQI values. Within Anderson Bay, differences were observed between near shore and offshore sites for parameters such as dissolved solids and conductivity, however water conditions were good at all Anderson Bay sites. Some differences were observed between spring and fall samples; however, these differences are consistent with changes in aquatic productivity during the open water season.

4.3.4 Anderson TIA Water Quality

4.3.4.1 History of Anderson TIA

The Anderson TIA has been in use since 1978, when a control dam was built at the east end of Anderson Lake across Anderson Creek to provide water discharge control from the TIA. The Stall Lake Concentrator was commissioned in 1979, and apart from brief periods in 1993-94, 1998-2000, and again in 2009, has been in continuous operation. Since 1979, approximately 11 M tonnes of tailings have been deposited into the Anderson TIA. The Stall Lake Concentrator has processed ore from 10 former Hudbay-owned mines in the Snow Lake area (**Table 4.4**).

Table 4.4 – Past-Producing Hudbay-Owned Ore Sources for Stall Lake Concentrator

Mine	Dates of Operation	UTM Easting	UTM Northing
Chisel Mine	1961-87; 1989-94	428200	6076820
Stall Lake Mine	1964-94	439585	6079327
Osborne Lake Shaft	1967-84	453348	6090712
Anderson Lake Mine	1970-88	436191	6079741
Ghost Lake Mine	1971-88	430616	6076535
Spruce Point Mine	1982-92	409341	6048489
Rod Mine	1984-95	440215	6076944
Chisel Open Pit	1988-94	427900	6076850
Photo Lake Mine	1995-98	428457	6082712
Chisel North Mine	2000-12	428352	6077865

Notes: UTM Zone 14U NAD83

4.3.4.2 Existing Anderson TIA Water Quality

In 2012, water samples and *in situ* measurements were collected at sampling stations throughout Anderson TIA to characterize the water quality and compare ice-on and summer conditions. The specific conductivity was generally 5-10% lower in the summer compared to the winter sampling event. Both seasons had generally low turbidity, except immediately adjacent to the active tailings discharge pipe where winter readings were elevated (>10 NTU) and >75% higher than the summer readings. Total dissolved solids showed little seasonal variation but were generally 5-15% lower in the summer compared to the winter sampling event. The range of winter dissolved oxygen levels (0.7 mg/L to 10.4 mg/L) was larger and had more low (<4.0 mg/L) levels than during the summer (range of 3.5 mg/L to 8.3 mg/L). Field observations indicated that the west end of the TIA has peat/bog areas where heavy odours were observed due to decomposition of organic material. This suggests that the lower dissolved oxygen measurements in this area may be locally influenced by this aquatic environment.

Collected water samples were submitted for analysis of total and dissolved metals and the results were compared to MMER maximum authorized monthly mean concentration values.

Concentrations typically decreased west to east towards the final station, closest to the overflow release to Anderson Creek. There were no exceedances of MMER values in samples collected from Anderson TIA over both seasons across all stations sampled (**Table 4.5**).

Table 4.5 – Anderson TIA Concentrations of Select Metals

Metal	MMER Value	Minimum	Maximum
Arsenic	0.5	0.00328	0.00771
Copper	0.3	0.00471	0.0456
Lead	0.5	<0.00009	0.0539
Nickel	0.2	<0.0010	<0.020
Zinc	0.5	<0.020	0.262

Note: Concentrations in milligram per Litre.

4.3.5 Tailings Decant Characterization

To understand how the water quality may change in the Anderson TIA as a result of tailings from the proposed Lalor Concentrator, the existing water quality overlying tailings in the Anderson TIA was compared to the expected water quality overlying tailings that would be produced from the ore from the Lalor deposit. While the Anderson TIA has received tailings from a variety of mines over the years, for the last 11 years, tailings have mainly been from the Chisel North Mine, with ore processed at the Stall Lake Concentrator. Given the similarities between the ore from the Chisel North Mine and the proposed Lalor Mine, and the similarities in processes between the Stall Lake Concentrator and the proposed Lalor Concentrator, this comparison provides an important benchmark for evaluation. The results of the comparative analysis are provided below.

Each sample of tailings (Chisel North ore and Lalor ore) was homogenized and split into charges. Drying, crushing, grinding and riffling were completed as required. Each homogenized mixture was placed in a container and a leachant (liquid solution) was added to the sample to prepare a leachate of the homogenized tailings for extraction testing. The leachant was exposed to the tailings sample for a period of 20 weeks. Decant analysis was performed on tailings at Day 0, Day 7 and Day 14.

Extraction testing was completed to determine the mobility of inorganic compounds present in the samples under an imposed target pH of 5. The leachant used was based on the acid neutralization capacity of the sample material and consists either of glacial acetic acid added to deionised water buffered by sodium hydroxide (resulting pH 4.93 ± 0.05, Extraction Fluid #1) or an unbuffered leachant composed of glacial acetic acid to deionised water (resulting pH 2.88 ± 0.05). The selected leachant was added to the sample at a 20:1 liquid-to-solids ratio and the sample container was rotated end over end at 29 ± 2 rpm for 18 hours. The resultant slurry was filtered through a 0.7 μm glass fibre filter and analyzed for pH and total metals.

A second extraction was conducted using deionised water conducted in the same manner as the leachate test detailed above. This generated an extract at a pH imposed by the sample itself, thereby enveloping the range of pH which the samples would be expected to encounter. Upon cessation of agitation, the supernatant solution was collected and the pH recorded. The solution was processed and submitted for pH, conductivity, alkalinity, acidity, Cl, F, NO3, NO2, SO4, and trace metals.

4.3.5.1 Chisel North Tailings Decant Characterization

To predict the quality of water as a result of the deposition of tailings from processing of the Chisel North Mine ore, decant solution analyses were performed on a sample of the tailings generated at the Stall Lake Concentrator.

The Chisel North tailings had 10 of 50 analyzed parameters whose concentrations were at or below detection limit (e.g., chromium, mercury, and thallium) for at least one test period. Twelve parameters had concentrations that decreased over the test period, such as pH, aluminum, arsenic, copper, nickel and selenium. Nine parameters increased over the test periods and were namely conventional parameters such as conductivity, ions and nutrients.

There were no exceedances of MMER values with the exception of the concentration of zinc in Day 0 Chisel North tailings decant was 0.66 mg/L which exceeds the MMER maximum authorized monthly mean concentration value of 0.5 mg/L (**Table 4.6**). The MMER maximum authorized concentration in a grab sample value is 1.0 mg/L.

Table 4.6 – Chisel North Tailings Decant Concentrations of Select Metals

Metal	MMER Value	Day 0	Day 7	Day 14
Arsenic	0.5	0.067	0.030	0.024
Copper	0.3	0.102	0.069	0.054
Nickel	0.5	0.019	0.004	0.001
Lead	0.2	0.036	0.002	0.006
Zinc	0.5	0.66	0.10	0.15

Note: Concentrations in milligram per Litre.

4.3.5.2 Lalor Tailings Decant Characterization

To predict the potential quality of water resulting from the deposition of tailings generated from Lalor ore, decant solution analyses were performed on tailings prepared from a core sample of Lalor ore and processed at the Stall Lake Concentrator. Although the milling and/or concentrating process at the proposed Lalor Concentrator may differ from the Stall Lake Concentrator, the decant solution analyses compared here are considered relevant for characterizing the tailings quality from ore obtained from the Lalor Mine. Analyses were performed by SGS and results were provided to AECOM by HBMS. Data underwent QA/QC checks to ensure the data was free of transcriptional (or other) errors prior to analysis.

The decant from Lalor tailings had ten (of 35 analyzed) metals with concentrations were at or below detection limit (*e.g.,* chromium, mercury, and thallium) for at least one test period. Several metal concentrations were highest in Day 0, compared to Day 7 and Day 14, including arsenic, cadmium and cobalt. The total metal load (sum of all metal concentrations) increased over the test period in the Lalor tailings decant. Some parameters decreased over the test period, such as pH, copper, nickel and selenium. Concentrations of other metals such as aluminum, iron and zinc were highest in Day 0 and lowest in Day 7.

There were no exceedances of MMER values in the Lalor tailings decant solution (**Table 4.7**).

Table 4.7 – Lalor Tailings Decant Concentrations of Select Metals

Metal	MMER Value	Day 0	Day 7	Day 14
Arsenic	0.5	0.014	0.044	0.005
Copper	0.3	0.056	0.041	0.024
Nickel	0.5	0.09	0.009	0.001
Lead	0.2	0.04	0.003	0.009
Zinc	0.5	0.29	0.10	0.13

Note: Concentrations in milligram per Litre.

4.3.6 Sediment Quality

In the spring and fall of 2011, AECOM collected sediment samples from 13 waterbodies located in the Project Region as part of an aquatic assessment study (**Table 4.2**). An additional station in Anderson Creek was sampled in summer of 2012.

Sediment quality samples were collected in conjunction with the water quality samples and analyzed for the following parameters:

- Total metals;
- Total mercury;
- Nutrients (*i.e.*, phosphorus, nitrogen and total organic carbon);
- Moisture; and,
- Particle size.

Sediment quality data was compared to the CCME *Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health for Residential/Parkland Land Use* (*CSQG-RPL*, CCME, 2011b) and the *Manitoba Interim Sediment Quality Guidelines* (*ISQG*) and *Probable Effect Level* (*PEL*) (Williamson, 2011).

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). 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 SQI is a general indicator of sediment quality, where lower values indicate a higher probability of ecological effects and is modelled after the equations developed for the WQI (CCME, 2001a). The same ranking system, as applied to the WQI values, was used to characterize SQI values.

The following is a summary of the sediment quality data collected during the aquatic assessment study conducted in 2011 and 2012.

<u>Anderson Bay (in Wekusko Lake)</u>

Statistical analysis detected significant differences among sites in Anderson Bay for several chemical parameters and contaminants of concern. For example, moisture, total nitrogen, total and organic carbon concentrations were significantly different among stations in Anderson Bay, with the station immediately outside of Anderson Bay having significantly lower levels of these components than the other nine stations. Total phosphorus levels increased significantly in stations further from Anderson Creek and then declined to a much lower concentration at the station immediately outside of Anderson Bay.

AECOM compared concentrations of chemicals of potential concern using one-way ANOVA comparisons between stations in Anderson Bay. Concentrations of arsenic, cadmium, copper, and zinc were heterogeneous in Anderson Bay. For example, among the ten sites sampled in Anderson Bay, arsenic concentrations ranged from 4 mg/kg dry weight (dw) to 23 mg/kg dw.

In at least one sample collected from Anderson Bay, concentrations of arsenic (average of 13.6 mg/kg dw), cadmium (average of 0.6 mg/kg dw), chromium (average of 59 mg/kg dw), copper (average of 39 mg/kg dw), selenium (average of 1.3 mg/kg dw) and zinc (average of 322 mg/kg dw) exceeded the lowest applicable sediment quality guidelines of 5.9 mg/kg dw, 0.6 mg/kg dw, 37.3 mg/kg dw, 1 mg/kg dw, and 123 mg/kg dw, respectively. The *CSQG-RPL* for nickel (50 mg/kg dw) was exceeded in only one sample (54 mg/kg dw).

SQI values based on the *ISQG* and the *PEL* guideline concentrations were ranked as *Poor* to *Good* and *Fair* to *Excellent*, respectively. 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. In general, stations closer to Anderson Creek inflow had lower SQI values than those further away.

<u>Arm Lake</u>

Arm Lake sediments had high moisture (94% ± 2.8%) and were composed primarily of silt and clay. The sediments had higher total and organic carbon than other waterbodies located along the former rail bed (*e.g.,* Gaspard Lake and Unnamed Lake 1).

All samples collected from Arm Lake in 2011 had concentrations of arsenic (average of 11.5 mg/kg dw) and selenium (average of 1.2 mg/kg dw) that exceeded applicable sediment quality guidelines of 5.9 mg/kg dw and 1 mg/kg, respectively. In one sample collected from Arm Lake in 2011, concentrations of cadmium (0.7 mg/kg dw) and zinc (124 mg/kg dw) exceeded applicable sediment quality guidelines of 0.6 mg/kg dw and 123 mg/kg dw, respectively.

SQI values based on the *ISQG* and the *PEL* guideline concentrations were ranked as *Fair* and *Excellent*, respectively.

<u>Gaspard Lake</u>

Gaspard Lake sediments had high moisture (94% ± 2.3%) and were composed primarily of silt and clay. The sediments from Gaspard Lake had similar total and organic carbon compared to other waterbodies located along the former rail bed (*e.g.,* Ghost Lake and Nutt Lake).

All samples collected from Gaspard Lake in 2011 had concentrations of arsenic (average 14.8 mg/kg dw) that exceeded the most conservative sediment quality guideline of 5.9 mg/kg dw. In one of the three replicates, the concentrations of cadmium (0.83 mg/kg dw and 0.66 mg/kg dw, in spring and fall respectively) and zinc (151 mg/kg dw in spring only) exceeded applicable sediment quality guidelines of 0.6 mg/kg dw and 123 mg/kg dw, respectively. In spring, two of the three replicates had selenium concentrations that were equal to or slightly greater than the applicable sediment quality guideline (1 mg/kg dw).

Sediment quality, based on the *ISQG* and the *PEL*, was ranked as *Marginal* to *Good*.

Ghost Lake

Ghost Lake sediments had high moisture content (97% ± 0.9%) and were composed primarily of silt and clay, similar to Threehouse Lake, a similar sized waterbody located along the former rail bed. The sediments from Ghost Lake had similar total and organic carbon compared to other waterbodies located along the former rail bed (*e.g.,* Gaspard Lake and Nutt Lake).

AECOM compared concentrations of chemicals of potential concern using one-way ANOVA comparisons between stations in each waterbody. The results indicate few spatial trends in Ghost Lake. Sediments collected from Ghost Lake in 2011 had concentrations of arsenic (average of 44 mg/kg dw), cadmium (average of 1.0 mg/kg dw), chromium (average of 9.8 mg/kg dw), copper (average of 36.7 mg/kg dw), lead (average of 31 mg/kg dw), selenium (average of 1.3 mg/kg dw) and zinc (average of 345 mg/kg dw) exceeded the lowest applicable sediment quality guidelines of 5.9 mg/kg dw, 0.6 mg/kg dw, 37.3 mg/kg dw, 35.7 mg/kg dw, 35 mg/kg dw, 1 mg/kg dw, and 123 mg/kg dw, respectively. Mercury concentrations in sediments from Ghost Lake ranged from below detection limit (0.05 mg/kg dw) to 0.3 mg/kg dw, with 7 of 18 mercury concentrations exceeding the *ISQG* of 0.17 mg/kg dw. In general, Ghost Lake sediments had higher average concentration of metals (*e.g.,* arsenic, cadmium and copper), compared to other waterbodies along the former rail bed.

Sediment quality, based on the *ISQG* and the *PEL*, was ranked as *Poor* to *Fair*.

Nutt Lake

Nutt Lake sediments had high moisture content (96% ± 1.9%) and composed primarily of silt and clay, similar to other waterbodies located along the former rail bed. The sediments from Nutt Lake had similar total and organic carbon to other waterbodies located along the former rail bed (*e.g.,* Gaspard Lake and Ghost Lake). Total phosphorus concentrations in sediment were among the lowest as compared to other waterbodies along the former rail bed.

Sediments collected from Nutt Lake in 2011 had concentrations of arsenic (average of 7.2 mg/kg dw), cadmium (average of 0.8 mg/kg dw), and selenium (average of 1.3 mg/kg dw) that exceeded the lowest applicable sediment quality guidelines of 5.9 mg/kg dw, 0.6 mg/kg dw, and 1 mg/kg dw, respectively. Zinc concentrations in sediments from Nutt Lake exceeded the applicable sediment quality guideline (123 mg/kg dw) in two of six samples (129 mg/kg dw and 132 mg/kg dw).

Sediment quality, based on the *ISQG* and the *PEL*, was ranked as *Fair* and *Excellent*.

Threehouse Lake

Threehouse Lake sediments had high moisture content (98% ± 0.4%) and were composed primarily of silt and clay, with more sand content than Ghost Lake, a similar-sized lake located along the former rail bed. The sediments from Threehouse Lake had similar total and organic carbon to other waterbodies located along the former rail bed (*e.g.,* Gaspard Lake and Ghost Lake). Total phosphorus concentrations in the sediment were among the highest compared to other waterbodies located along the former rail bed.

In order to determine spatial trends within each of the major waterbodies, AECOM compared concentrations of chemicals of potential concern using one-way ANOVA comparisons between stations in each waterbody. The results indicate few spatial trends in Threehouse Lake. Sediments collected from Threehouse Lake in 2011 had concentrations of arsenic (average of 17 mg/kg dw), cadmium (average of 0.7 mg/kg dw), and selenium (average of 1.2 mg/kg dw) that exceeded the lowest applicable sediment quality guidelines of 5.9 mg/kg dw, 0.6 mg/kg dw, and 1 mg/kg dw, respectively. Zinc concentrations in sediments from Threehouse Lake exceeded the applicable sediment quality guideline (123 mg/kg dw) in 3 of 18 samples (ranging from 127 mg/kg dw to 154 mg/kg dw).

Sediment quality, based on the *ISQG* and the *PEL* was ranked as *Fair* to *Good* for sediments from Threehouse Lake.

Unnamed Lake 1

Unnamed Lake 1 sediments, similar to other waterbodies located along the former rail bed, had high moisture content (97% ± 1.9%) and composed primarily of silt and clay. Total phosphorus concentrations in sediment were among the highest compared to other waterbodies located along the former rail bed.

Sediments collected from Unnamed Lake 1 in 2011 had concentrations of arsenic (average of 7.8 mg/kg dw), cadmium (average of 0.7 mg/kg dw), copper (average of 40 mg/kg dw), and selenium (average of 1.3 mg/kg dw) that exceeded the lowest applicable sediment quality guidelines of 5.9 mg/kg dw, 0.6 mg/kg dw, 35.7 mg/kg dw, and 1 mg/kg dw, respectively. Copper concentrations in sediments from Unnamed Lake 1 were, on average, higher than in other waterbodies located along the former rail bed.

Based on the *ISQG* and the *PEL* respectively, sediment quality in Unnamed Lake 1 was ranked as *Marginal* and *Excellent*.

Anderson Creek

Anderson Creek sediments had low moisture content (43% ± 12%) and were composed primarily of clay and sand. Sediments from Anderson Creek had the lowest total and organic carbon and nutrients (*i.e.,* total nitrogen and total phosphorus) compared to other creeks in the Snow Lake area (*e.g.,* Stall Creek, Ghost Creek).

Sediments collected from Anderson Creek in 2011 had average concentrations of arsenic (7.8 mg/kg dw), chromium (76 mg/kg dw), copper (40 mg/kg dw), and zinc (385 mg/kg dw) that exceeded the lowest applicable sediment quality guidelines. In 2012, average concentrations of arsenic (18 mg/kg dw), chromium (89 mg/kg dw), copper (85 mg/kg dw), nickel (57 mg/kg dw), and zinc (734 mg/kg dw) exceeded the lowest applicable sediment quality guidelines. One of the three replicates in 2012 had concentrations of cadmium (3.7 mg/kg dw), lead (39.5 mg/kg dw), and selenium (6.7 mg/kg dw) that exceeded the lowest applicable sediment quality guideline.

In the 2012 samples, concentrations of arsenic, cadmium, chromium, copper, lead, nickel, selenium, and zinc exceeded at least one applicable sediment quality guideline. In 2011, concentrations of lead did not exceed applicable sediment quality guidelines. Relative concentrations of some metals, such as arsenic, copper and zinc, decrease with increasing distance from PR 392. In general, concentrations of chemicals of concern were highest in ANC-04, the station closest to PR 392.

Based on the *ISQG* and the *PEL* respectively, sediment quality was ranked as *Poor* and *Excellent* for sediments from Anderson Creek. The station closer to Anderson TIA had lower sediment quality as compared to the stations closer to Anderson Bay, according to their SQI values.

<u>*Ghost Creek*</u>

Ghost Creek sediments had high moisture content (91% ± 6.5%) and composed primarily of silt and sand. Sediments from Ghost Creek had the highest total and organic carbon and nutrients (*i.e.,* total nitrogen and total phosphorus) compared to other creeks located along the former rail bed.

Sediments collected from Ghost Creek in 2011 had average concentrations of arsenic (37 mg/kg dw) and zinc (426 mg/kg dw) that exceeded the lowest applicable sediment quality guidelines of 5.9 mg/kg dw and 123 mg/kg dw, respectively. Only one sample from Ghost Creek had a concentration of cadmium (0.65 mg/kg dw), and copper (36.5 mg/kg dw) exceeded the applicable sediment quality guideline of 0.6 mg/kg dw and 35.7 mg/kg dw, respectively. Concentrations of several metals were less than those in Threehouse Creek, a nearby creek located along the former rail bed.

Based on the *ISQG* and the *PEL*, respectively, sediment quality was ranked as *Marginal* and *Fair* for sediments from Ghost Creek. The sediment quality in Ghost Creek was slightly less than sediment from Threehouse Creek, a nearby creek located along the former rail bed, according to their SQI values.

<u>*Stall Creek*</u>

Stall Creek sediments had moderate moisture content (82% ± 13%) and composed primarily of silt and clay. Sediments from Stall Creek had comparable total and organic carbon and nutrients (*i.e.,* total nitrogen and total phosphorus) compared to other creeks in the Snow Lake area.

Sediments collected from the station in Stall Creek closest to Stall Lake had a greater number of exceedances in metal concentrations (35 exceedances in total) than the other two stations closer to Anderson Bay combined (16 exceedances in total). At this upstream station in Stall Creek, average concentrations of arsenic (15 mg/kg dw), cadmium (1.2 mg/kg dw), chromium (52 mg/kg dw), cobalt (122 mg/kg dw), copper (222 mg/kg dw), and zinc (1019 mg/kg dw) exceeded the lowest applicable sediment quality guidelines of 5.9 mg/kg dw, 0.6 mg/kg dw, 37.3 mg/kg dw, 50 mg/kg dw, 35.7 mg/kg dw and 123 mg/kg dw, respectively. At least one sample had concentrations of nickel and selenium that exceeded the lowest applicable sediment quality guideline. At each of the other two stations, there was at least one concentration of arsenic, cadmium, chromium, copper, selenium or nickel that exceeded the lowest applicable sediment quality guideline. At the furthest downstream station in Stall Creek, the average concentration of chromium was 54 mg/kg dw, exceeding the lowest applicable sediment quality guideline of 37.3 mg/kg dw.

Based on the *ISQG* and the *PEL*, respectively, sediment quality was ranked as *Poor* to *Excellent* for sediments from Stall Creek. The sediment quality in Stall Creek (particularly at the station immediately downstream of Stall Lake) was less than other creeks in the Snow Lake area, according to their SQI values.

Stall Creek, particularly the far-field stations (*i.e.,* STC-02 and STC-03) have metal concentrations that are more similar to other waterbodies in the area (*e.g.,* Ghost Lake, Ghost Creek and Anderson Bay). Similar to water quality, sediment quality in Stall Creek increases with increased distance from Stall Lake.

Tern Ditch

Tern Ditch sediments had high moisture content (88% ± 2.7%) and composed primarily of silt and sand. Sediments from Tern Ditch had higher total and organic carbon and similar nutrient content (*i.e.,* total nitrogen and total phosphorus) compared to other creeks in the Snow Lake area.

Half of the replicates collected from Tern Ditch in 2011 had concentrations of selenium that exceeded the lowest applicable sediment quality guideline of 1 mg/kg dw. No other exceedances were observed in terms of sediment quality in Tern Ditch in 2011.

Based on both the *ISQG* and the *PEL*, sediment quality was ranked as *Excellent* for sediments from Tern Ditch. The sediment quality in Tern Ditch was higher than other creeks in the Snow Lake area, according to their SQI values.

Threehouse Creek

Threehouse Creek sediments had moderate moisture content (84% ± 11.6%) and were composed primarily of silt and clay. Sediments from Threehouse Creek had comparable total and organic carbon and nutrients (*i.e.,* total nitrogen and total phosphorus) compared to other creeks located along the former rail bed.

In sediments collected from Threehouse Creek, average concentrations of arsenic (23 mg/kg dw) and zinc (146 mg/kg dw) exceeded the lowest applicable sediment quality guidelines of 5.9 mg/kg dw and 123 mg/kg dw, respectively. Two samples had concentrations of chromium and copper that exceeded the lowest applicable sediment quality guideline.

Based on the *ISQG* and the *PEL* respectively, sediment quality was ranked as *Marginal* to *Good* for sediments from Threehouse Creek. The sediment quality in Threehouse Creek was comparable to other creeks located along the former rail bed, according to their SQI values.

Unnamed Creek 1

Unnamed Creek 1 sediments had low moisture content (69% ± 26.6%) and were composed primarily of silt and clay. Sediments from Unnamed Creek 1 had comparable total and organic carbon and nutrients (*i.e.,* total nitrogen and total phosphorus) compared to other creeks located along the former rail bed.

In sediments collected from Unnamed Creek 1, average concentrations of arsenic (11 mg/kg dw), chromium (54 mg/kg dw), copper (37 mg/kg dw), and zinc (479 mg/kg dw) exceeded the lowest applicable sediment quality guidelines of 5.9 mg/kg dw, 37.3 mg/kg dw, 35.7 mg/kg dw and 123 mg/kg dw, respectively.

Based on the *ISQG* and the *PEL* respectively, sediment quality was ranked as *Marginal* to *Good* for sediments from Unnamed Creek 1. Based on their SQI values, the sediment quality in Unnamed Creek 1 was comparable to other creeks located along the former rail bed.

4.3.6.1 Sediment Quality Summary

Surficial sediments were collected from 13 waterbodies in Project Region and analysed for particle size distribution, major elements (*e.g.*, nitrogen, phosphorus, and carbon), and chemicals of potential concern to determine baseline characteristics of the sediments in 2011 and 2012. The data were analysed to determine spatial trends within and among waterbodies and to classify the sediments in terms of sediment quality.

The concentrations of major elements (*e.g.*, nitrogen, phosphorus, and carbon) varied significantly between waterbodies, and in some areas, varied significantly between sampling stations within each site and, in the case of total phosphorus, also varied seasonally. Total nitrogen, phosphorus, and carbon levels are within ranges considered acceptable for both natural and impacted lakes. Chemicals of potential concern show similar spatial trends, with significantly higher levels of some compounds in lakes associated with historic or current development activity. Comparisons between sampling sites within the larger waterbodies show that these elevated levels are uniformly distributed over a large area, while at other sites (*e.g.*, Anderson Bay) differences are observed between near shore and offshore sites.

Sediment quality was ranked as *Poor* to *Excellent* in the waterbodies assessed during the baseline assessments. Lower SQI values indicate poor sediment quality due to large and/or several concentrations that exceed the applicable sediment quality guideline. SQI values improved markedly when compared to *PEL* values, suggesting few ongoing adverse ecological effects to aquatic life at most sites. SQI values based on *PELs* ranged from 63 (Anderson Creek) to 100 (various). In general, sediment quality was low in Anderson Creek and Ghost Lake, and sediments with elevated metal concentration were observed in most waterbodies along the former rail bed. Based on the SQI values, Tern Ditch and Anderson Bay (in Wekusko Lake) typically had higher sediment quality.

4.3.7 Aquatic Invertebrates

As part of the environmental baseline aquatic investigations, phytoplankton, zooplankton and benthic invertebrate community data was collected. The results of the phytoplankton, zooplankton and benthic invertebrate community study have been used to establish the baseline biological content of the sampled waterbodies and will function as a benchmark for environmental monitoring in the lakes and other waterbodies within the Project Area.

As part of an aquatic assessment study conducted in 2011, AECOM collected samples for taxonomic identification and enumeration of phytoplankton, zooplankton and benthic invertebrates from 13 waterbodies located in the Project Region (**Table 4.2**). Phytoplankton and zooplankton samples were collected in both spring and fall from all lakes and Stall Creek. Benthic invertebrates were collected only in fall from all 13 waterbodies (**Table 4.8**).

Table 4.8 – Waterbodies Sampled for Aquatic Invertebrates in the Project Region, 2011

Waterbody	Spring	Fall
Anderson Bay	PP, ZP	PP, ZP, BIC
Arm Lake	PP, ZP	PP, ZP, BIC
Gaspard Lake	PP, ZP	PP, ZP, BIC
Ghost Lake	PP, ZP	PP, ZP, BIC
Nutt Lake	PP, ZP	PP, ZP, BIC
Threehouse Lake	PP, ZP	PP, ZP, BIC
Unnamed Lake 1	PP, ZP	PP, ZP, BIC
Anderson Creek	PP, ZP	BIC
Ghost Creek	PP, ZP	BIC
Stall Creek	PP, ZP	PP, ZP, BIC
Tern Ditch	PP, ZP	BIC
Threehouse Creek	PP, ZP	BIC
Unnamed Creek 1	PP, ZP	BIC

Note: PP = phytoplankton, ZP = zooplankton; BIC = benthic invertebrate community.

Detailed information on the phytoplankton, zooplankton and benthic community is provided in the AECOM report *Proposed Lalor Concentrator Environmental Baseline Assessment* (**Appendix F**).

Anderson Bay (in Wekusko Lake)

Phytoplankton: Total phytoplankton abundance in Anderson Bay was 2.0 x 10^6 n/L in spring and 7.4 x 10^6 n/L in fall. The relatively high abundance of Chrysophyceae (yellow-green algae) was similar to other lakes examined in the Project Region. In spring, the Fragilariophyceae (pennate diatoms) were sub-dominant group while in the fall, Cyanophyceae (blue-green algae) were sub-dominant. This shift in community to blue-green algae in the fall may be due to the higher levels of primary productivity at this time of year when it comprised 38% of the total phytoplankton abundance. In the spring, the phytoplankton community was more balanced than other lakes assessed in the Project Region, suggesting the phytoplankton community is healthy in Anderson Bay.

Zooplankton: Total zooplankton abundance in Anderson Bay was 8 n/L in spring and 202 n/L in fall. Spring total zooplankton abundance was lowest in Anderson Bay compared to other lakes examined in the Project Region. Species diversity in Anderson Bay was similar to other waterbodies examined in the Project Region. Monogononta (rotiferans) was the dominant group in both spring and fall in Anderson Bay, comprising approximately 70% of the total zooplankton abundance. The sub-dominant groups were Copepoda (crustaceans) and Ciliata (ciliated protists) in the spring and fall, respectively.

Benthic Invertebrates: Benthic invertebrate samples were collected in Anderson Bay at water depths between 0.5 m to 1.75 m, where sediments were organic with fines and aquatic vegetation at near-shore sites, near the inflow of Anderson Creek. Off-shore in Anderson Bay depths ranged from 1.0 m to 4.5 m and sediments were characterized as predominately clay, with sand, gravel and little aquatic vegetation. Benthic invertebrate density in Anderson Bay was on average 2,862 n/L. Densities and family richness were highest at the near-shore sites compared to the off-shore sites. Chironomidae (non-biting midges) and Harpacticoidae (a copepod family) were the most abundant benthic invertebrate families in Anderson Bay. Hyalellidae (an amphipod family) were not observed at the farthest off-shore sites but were moderately abundant at the transition stations between the near-shore and off-shore stations.

Arm Lake

Phytoplankton: Similar to Anderson Bay, total phytoplankton abundance in Arm Lake was higher in the fall (7.4 x 10^6 n/L) than in spring (2.5 x 10^6 n/L). Species diversity in Arm Lake was higher than other waterbodies examined along the former rail bed (*e.g.,* Gaspard Lake). *Bdelloidea* was identified in only the fall sample collected from Arm Lake. Yellow-green algae (Chrysophyceae) dominated the phytoplankton community in Arm Lake, composing at least 92% and 97% of the total phytoplankton abundance in the spring and fall 2011, respectively. Blue-green algae (Cyanophyceae) was the sub-dominant group in the spring and Chlorophyceae (green algae) was the sub-dominant in the fall.

Zooplankton: Total zooplankton abundance in Arm Lake was 116 n/L in spring and 91 n/L in fall. Species diversity in Arm Lake was similar to other waterbodies located along the former rail bed. Monogononta (rotiferans) was the dominant group in both spring and fall in Arm Lake, comprising approximately 90% of the total zooplankton abundance. The sub-dominant group was Copepoda in the spring and fall, comprising 7% and 9%, respectively, of the total zooplankton abundance.

Benthic Invertebrates: Benthic invertebrate samples were collected in Arm Lake at water depths of 1.0 m, where sediments were organic with fines and aquatic vegetation. Benthic invertebrate density in Arm Lake was 1,724 n/m². Benthic invertebrate density and family richness in Arm Lake were median values compared to other waterbodies located along the former rail bed. Chironomidae (non-biting midges) and Caenidae were the most abundant benthic invertebrate families in Arm Lake in 2011. Caenidae belongs to Ephemeroptera (mayflies), a disturbance-intolerant group of organisms. In general, a higher density of Ephemeroptera in a population indicates a healthy population and benthic habitat.

<u>*Gaspard Lake*</u>

Phytoplankton: Total phytoplankton abundance in Gaspard Lake was higher in the fall (6.6×10^6 n/L) than in spring (1.5×10^6 n/L). Species diversity in Gaspard Lake was the lowest compared to other waterbodies located along the former rail bed (*e.g.,* Nutt Lake or Threehouse Lake). Yellow-green algae (Chrysophyceae) dominated the phytoplankton community in Gaspard Lake, composing at least 89% of the total phytoplankton abundance. Blue-green algae (Cyanophyceae) was the sub-dominant group in the fall (5% of the total abundance) and pennate diatoms (Fragilariophyceae) sub-dominant in the spring (1% of the total abundance).

Zooplankton: Total zooplankton abundance in Gaspard Lake was 128 n/L in spring and 412 n/L in fall. The total zooplankton abundance was highest in Gaspard Lake in fall compared to other lakes located along the former rail bed. Species diversity in Gaspard Lake was similar to other waterbodies located along the former rail bed. Rotiferans (Monogononta) was the dominant group in both spring and fall in Gaspard Lake, comprising 93% and 66%, respectively of the total zooplankton abundance. The sub-dominant group was ciliated protists (Ciliata) in the spring and fall, comprising 4% and 34% respectively, of the total zooplankton abundance.

Benthic Invertebrates: Benthic invertebrate samples were collected in Gaspard Lake at water depths of 1.2 m, where sediments were organic with fines and aquatic vegetation. Benthic invertebrate density in Gaspard Lake was 129 n/m². Benthic invertebrate density and family richness in Gaspard Lake were comparable to other waterbodies located along the former rail bed (*e.g.,* Ghost Lake). Chironomidae and Caenidae were the most abundant benthic invertebrate families. Caenidae belongs to Ephemeroptera, a known disturbance-intolerant group of organisms. In general, a higher density of Ephemeroptera in a population indicates a healthier population and benthic habitat.

<u>*Ghost Lake*</u>

Phytoplankton: Total phytoplankton abundance in Ghost Lake was higher in the spring (7.9×10^6 n/L) than in fall (7.3×10^6 n/L). Compared to other lakes located along the former rail bed, Ghost Lake had the highest spring total phytoplankton abundance. Species diversity in Ghost Lake is comparable to other waterbodies located along the former rail bed (*e.g.,* Nutt Lake or Threehouse Lake). Chrysophyceae dominated the phytoplankton community in Ghost Lake, composing 63% and 95% of the total phytoplankton abundance in the spring and fall, respectively. Cyanophyceae was the sub-dominant group in the spring and fall, composing 31% and 2% of the total abundance, respectively.

Zooplankton: Total zooplankton abundance in Ghost Lake was 82 n/L in spring and 110 n/L in fall. Species diversity in Ghost Lake was similar to other waterbodies located along the former rail bed and was lower in the spring than in the fall. Monogononta was the dominant group in both spring and fall in Ghost Lake, comprising 65% and 78% respectively, of the total zooplankton abundance. Similar to Nutt Lake, the sub-dominant groups were Copepoda and Ciliata in the spring and fall, respectively.

Benthic Invertebrates: Benthic invertebrate samples were collected in Ghost Lake at water depths between 1.1 m to 1.5 m, where sediments were organic and aquatic vegetation was present. Benthic invertebrate density in Ghost Lake was on average 244 n/m². Benthic invertebrate density and family richness in Ghost Lake were comparable to other waterbodies located along the former rail bed (*e.g.,* Gaspard Lake). The three stations sampled in Ghost Lake had different benthic invertebrate communities. The first sample was dominated by Chironomidae and Caenidae, the second sample was almost exclusively composed of Unionicolidae (mites) and Pisiidae (bivalve mollusc), and the density of the third sample was evenly distributed among Hyalellidae, Chironomidae and Limnesiidae (caddisflies). The difference among stations is due to the heterogeneity of habitat, food availability, competition or non-biotic factors (*e.g.,* sediment quality).

<u>*Nutt Lake*</u>

Phytoplankton: Total phytoplankton abundance in Nutt Lake was higher in the fall (15 x 10^6 n/L) than in spring (7.0 x 10^6 n/L). Species diversity and total abundance in Nutt Lake was comparable to other waterbodies located along the former rail bed (*e.g.,* Threehouse Lake). Chrysophyceae dominated the phytoplankton community in Nutt Lake, composing 90% and 63% of the total phytoplankton abundance in the spring and fall, respectively. Similar to Ghost Lake, Cyanophyceae was the sub-dominant group in the spring and fall, comprising 4% and 31% of the total abundance, respectively.

Zooplankton: Total zooplankton abundance in Nutt Lake was 117 n/L in spring and 101 n/L in fall. Species diversity in Nutt Lake was slightly higher compared to other waterbodies located along the former rail bed and was lower in the spring than in the fall. Across all 13 waterbodies assessed, Eutardigrada (a class of waterbears) was present only in Nutt Lake. Monogononta was the dominant group in both spring and fall in Nutt Lake, comprising 87% and 52% respectively, of the total zooplankton abundance. Similar to Ghost Lake, the sub-dominant groups were Copepoda and Ciliata in the spring and fall, respectively.

Benthic Invertebrates: Benthic invertebrate samples were collected in Nutt Lake at water depth of 1.1 m, where sediments were characterized as organic. Benthic invertebrate density in Nutt Lake was 1,897 n/m². Benthic invertebrate density and family richness in Nutt Lake were similar to Arm Lake, another lake located along the former rail bed. Hyalellidae and Calamoida (a copepod family) were the most abundant benthic invertebrate families.

<u>*Threehouse Lake*</u>

Phytoplankton: Total phytoplankton abundance in Threehouse Lake was higher in the fall (18 x 10^6 n/L) than in spring (6.1 x 10^6 n/L). Species diversity and total abundance in Threehouse Lake was comparable to other waterbodies located along the former rail bed (*e.g.,* Nutt Lake). Chrysophyceae dominated the phytoplankton community in Threehouse Lake, comprising at least 91% of the total phytoplankton abundance. Similar to Gaspard Lake, Cyanophyceae was the sub-dominant group in the fall (8% of the total abundance) and Fragilariophyceae sub-dominant in the spring (2% of the total abundance).

Zooplankton: Total zooplankton abundance in Threehouse Lake was 73 n/L in spring and 226 n/L in fall. Species diversity and total abundance (in spring) in Threehouse Lake was comparable to other lakes located along the former rail bed. Monogononta was the dominant group in both spring and fall in Threehouse Lake, comprising approximately 70% of the total zooplankton abundance. The sub-dominant group was *Ciliata* in both the spring and fall.

Benthic Invertebrates: Benthic invertebrate samples were collected in Threehouse Lake at water depths between 1.0 m to 1.4 m, where sediments were characterized as organic. Benthic invertebrate density in Threehouse Lake was on average 409 n/m². Benthic invertebrate density and family richness in Threehouse Lake were similar to Ghost Lake, another lake located along the former rail bed. Chironomidae were the most abundant benthic invertebrate families at all three stations in Threehouse Lake. At one station in Threehouse Lake, Chironomidae was the only benthic invertebrate family in the sample. The sub-dominant groups were different between the remaining two stations in Threehouse Creek and included Glossiphoniidae (leeches) and Cladocera (water flea). Only one of the three stations had individuals representing Ephemeroptera, the disturbance-intolerant group.

<u>*Unnamed Lake 1*</u>

Phytoplankton: Unnamed Lake 1 had higher total phytoplankton abundance in the fall (24 x 10^6 n/L) than in spring (7.7 x 10^6 n/L). Compared to other lakes examined along the former rail bed, Unnamed Lake 1 had the highest fall total phytoplankton abundance. Unnamed Lake 1 in the fall had the highest concentration of chlorophyll *a* (7.2 mg/L) compared to other lakes along the former rail bed. Species diversity in Unnamed Lake 1 was comparable to other waterbodies located along the former rail bed (*e.g.,* Nutt Lake). Chrysophyceae and Cyanophyceae were the dominant and sub-dominant group in Unnamed Lake 1 with 84% and 97% of the total abundance in these two groups for spring and fall, respectively.

Zooplankton: Total zooplankton abundance in Unnamed Lake 1 was 158 n/L in spring and 169 n/L in fall. Species diversity in Unnamed Lake 1 was the highest compared to other lakes examined along the former rail bed. In spring, Monogononta was the dominant group in Unnamed Lake 1, comprising approximately 90% of the total zooplankton abundance. The sub-dominant group was Ciliata in the spring. In fall, the dominance shifted to Ciliata (54% of the total zooplankton abundance) and the sub-dominant group was Monogononta (41% of the total zooplankton abundance).

Benthic Invertebrates: A benthic invertebrate sample was collected in Unnamed Lake 1 at a water depth of 1.0 m, and sediments were characterized as organic with roots. Benthic invertebrate density in Unnamed Lake 1 was 3,297 n/m². Benthic invertebrate density in Unnamed Lake 1 was highest compared to other waterbodies examined along the former rail bed. Chironomidae and Hyalellidae were the most abundant benthic invertebrate families in Unnamed Lake 1.

<u>*Anderson Creek*</u>

Phytoplankton: Total phytoplankton abundance in Anderson Creek was 1.6 x 10^6 n/L and was assessed only in the spring. The species diversity in Anderson Creek was near the median value across other creeks assessed in the Project Area. The phytoplankton community composition of Anderson Creek was different than other creeks examined in the Project Region. The phytoplankton community was dominated by Fragilariophyceae (52% of the total abundance). Fragilariophyceae was less than 5% of the total phytoplankton abundance in all other waterbodies assessed during the environmental baseline aquatic assessments, with the exception of Anderson Bay in the spring in which Fragilariophyceae was 13% of the total phytoplankton abundance.

Zooplankton: Total zooplankton abundance in Anderson Creek was 74 n/L in spring and was the highest compared to nearly all creeks examined in the Project Region. Species diversity in Anderson Creek was comparable to other creeks in the Project Area. Monogononta was the dominant group in Anderson Creek, comprising approximately 95% of the total zooplankton abundance. The sub-dominant group was Copepoda.

Benthic Invertebrates: Benthic invertebrate samples were collected in Anderson Creek at water depths between 0.5 m to 0.6 m, and sediments were characterized as sandy-clay (with no vegetation) or clay-organic (with vegetation). Benthic invertebrate density in Anderson Creek was 86 n/m² at both stations. Benthic invertebrate density and family richness in Anderson Creek were among the lowest of the waterbodies examined in the Project Area. At one station in Anderson Creek (closest downstream to the Anderson TIA), benthic diversity was distributed between two groups, Cyclopoida (a copepod family) and Chironomidae. At the second station in Anderson Creek (further downstream and closer to Anderson Bay), the benthic diversity was distributed among three groups, Chironomidae, Glossiphoniidae, and Pisiidae. In general, creeks with significant flow and with erosional sediments (*e.g.,* sand) have reduced benthic habitat and as a result, lower benthic diversity and abundance.

<u>*Ghost Creek*</u>

Phytoplankton: Total phytoplankton abundance in Ghost Creek was 6.8 x 10^6 n/L in the spring, the highest abundance as compared to other creeks examined along the former rail bed (*e.g.*, Threehouse Creek). Species diversity and phytoplankton community structure in Ghost Creek was comparable to other creeks examined along the former rail bed (*e.g.,* Threehouse Creek). Chrysophyceae dominated the phytoplankton community in Ghost Creek, composing 66% of the total phytoplankton abundance. Similar to Threehouse Creek, Cyanophyceae was the sub-dominant group, comprising 22% of the total abundance.

Zooplankton: Total zooplankton abundance in Ghost Creek was 43 n/L in spring, the highest total abundance of all but one of the other creeks examined along the former rail bed. Species diversity in Ghost Creek was comparable to other creeks examined in the Project Region. Monogononta was the dominant group in Ghost Creek, comprising approximately 92% of the total zooplankton abundance. The sub-dominant group was Copepoda.

Benthic Invertebrates: The benthic invertebrate sample was collected in Ghost Creek at a water depth of 0.5 m and sediments were characterized as organic. Benthic invertebrate density in Ghost Creek was 3,060 n/m². Benthic invertebrate density and family richness in Ghost Creek were comparable to other waterbodies examined along the former rail bed. Chironomidae and Cyclopoida dominated the benthic invertebrate community in Ghost Creek.

<u>*Stall Creek*</u>

Phytoplankton: Stall Creek had lower total phytoplankton abundance in the fall (0.11 x 10^6 n/L) than in spring (2.5 x 10^6 n/L). Stall Creek had the lowest total phytoplankton abundance and species diversity as compared to all other waterbodies assessed during the environmental baseline aquatic assessments. This diversity and abundance of phytoplankton in Stall Creek is expected given the sediment and water quality information described above. Chrysophyceae dominated the phytoplankton community in Stall Creek, comprising 93% and 85% of the total phytoplankton abundance in spring and fall, respectively. Unlike other waterbodies examined in the Project Region, Bacillariophyceae was the sub-dominant group.

Zooplankton: Total zooplankton abundance in Stall Creek was 9 n/L in spring and 0.1 n/L in fall. In spring, Monogononta was the dominant group and the sub-dominant group was Copepoda. Species diversity, total abundance and community composition in Stall Creek were significantly different in the spring than in the fall, primarily because two separate sites were sampled. The fall sample was collected closer to Stall Lake and the spring sample was collected further downstream.

Benthic Invertebrates: Benthic invertebrate samples were collected in Stall Creek at water depths between 0.5 m to 0.6 m where sediments were characterized as either clay-sand in the most upstream station or organic at the two other stations, with leaves or other decaying plant matter. Benthic invertebrate density in Stall Creek ranged from 108 n/m² to 8,039 n/m², with density increasing with increased distance from Stall Lake. The overall density of benthic invertebrates in Stall Creek was 2,787 n/m². The benthic invertebrate communities in the three stations were different; the first sample, closest to Stall Lake had three families present (Chironomidae*,* Ptilidae (beetles), and Ostracoda (seed shrimp); the second sample had four groups present (Chironomidae, Ceratopogonidae (biting midges), Ephemeroptera, and Gomphidae (clubtail dragonflies); and the third sample, closest to Anderson Bay had the highest diversity and density compared to the other two samples and was dominated by Cyclopoida and Chironomidae. The difference among stations is due to the heterogeneity of habitat, food availability, competition or non-biotic factors (*e.g.,* sediment quality).

Tern Ditch

Phytoplankton: Total phytoplankton abundance in Tern Ditch was 7.7 x 10^6 n/L in the spring, higher than other creeks examined along the former rail bed (*e.g.,* Ghost Creek). In the spring, Tern Ditch had the highest chlorophyll *a* concentration (67 mg/L) compared to other creeks located along the former rail bed. Species diversity and phytoplankton community structure in Tern Ditch was comparable to other creeks examined along the former rail bed (*e.g.,* Threehouse Creek). Chrysophyceae dominated the phytoplankton community in Tern Ditch, composing 95% of the total phytoplankton abundance. Cyanophyceae was the sub-dominant group, comprising 2% of the total abundance.

Zooplankton: Total zooplankton abundance in Tern Ditch was 22 n/L in spring, lowest among the other creeks examined in the Project Area. Species diversity in Tern Ditch was comparable to other creeks examined in the Project Region. The zooplankton community in Tern Ditch had representatives from most of the classes, suggesting a healthy community. Copepoda was the dominant group in Tern Ditch, comprising approximately 73% of the total zooplankton abundance. The sub-dominant group was Monogononta.

Benthic Invertebrates: The benthic invertebrate sample was collected in Tern Ditch at a water depth of 0.5 m, and sediments were characterized as organic. Benthic invertebrate density in Tern Ditch was 21,466 n/m². Benthic invertebrate density and family richness in Tern Ditch were higher compared to all other waterbodies examined in the Project Region. Although Chironomidae and Ceratopogonidae dominated the benthic invertebrate community in Tern Ditch, high abundances of Caenidae and Ostracoda were also observed. The healthy benthic invertebrate community could be the result of better habitat quality, reduced predation and competition and other non-biotic factors (*e.g.,* sediment quality).

Threehouse Creek

Phytoplankton: Total phytoplankton abundance in Threehouse Creek was 1.1 x 10^6 n/L in the spring. Species diversity and phytoplankton community structure in Threehouse Creek was comparable to other creeks examined along the former rail bed (*e.g.,* Ghost Creek). Chrysophyceae dominated the phytoplankton community in Threehouse Creek, composing 51% of the total phytoplankton abundance. Cyanophyceae was the sub-dominant group, comprising 39% of the total abundance.

Zooplankton: Total zooplankton abundance in Threehouse Creek was 28 n/L in spring. Species diversity in Threehouse Creek was comparable to other creeks examined in the Project Region. Monogononta was the dominant group in Threehouse Creek, comprising approximately 92% of the total zooplankton abundance. The sub-dominant group was Copepoda.

Benthic Invertebrates: The benthic invertebrate sample was collected in Threehouse Creek at a water depth of 0.5 m, and sediments were characterized as organic with fine mineral soils and some woody/organic debris. Benthic invertebrate density in Threehouse Creek was 1,638 n/m². Benthic invertebrate density and family richness in Threehouse Creek were lower than other waterbodies examined along the former rail bed (*e.g.,* Ghost Creek). Chironomidae dominated the benthic invertebrate community in Threehouse Creek. Pisiidae were also represented in the sample collected from Threehouse Creek (86 n/m²).

Unnamed Creek 1

Phytoplankton: Unnamed Creek 1 had the lowest total phytoplankton abundance (0.7 x 10^6 n/L) and species diversity compared to other creeks located along the former rail bed (*e.g.,* Threehouse Creek) in the spring. The phytoplankton community structure in Unnamed Creek 1 was comparable to other creeks examined along the former rail bed (*e.g.,* Ghost Creek). Chrysophyceae dominated the phytoplankton community in Unnamed Creek 1, comprising 48% of the total phytoplankton abundance. Cyanophyceae was the sub-dominant group, comprising 42% of the total abundance.

Zooplankton: Total zooplankton abundance in Unnamed Creek 1 was 11,720 n/L in spring, highest of all 13 waterbodies assessed in the Project Region. Two groups, Ciliata and Euglenoidea, dominated the total zooplankton abundance comprising 95% and 5%, respectively of the total abundance. The sample was collected in Unnamed Creek 1, adjacent to the former rail bed and within a large beaver impoundment area.

Benthic Invertebrates: The benthic invertebrate sample was collected in Unnamed Creek 1 at a water depth of 0.25 m and sediments were characterized as organic with fine mineral soils and some organic debris. Benthic invertebrate density in Unnamed Creek 1 was 4,569 n/m². Benthic invertebrate density and family richness in Unnamed Creek 1 were higher than other waterbodies examined along the former rail bed (*e.g.,* Ghost Creek). Cladocera, a group not represented in other creeks examined along the former rail bed, and Chironomidae dominated the benthic invertebrate community in Unnamed Creek 1.

4.3.7.1 Aquatic Invertebrates Summary

Overall phytoplankton and zooplankton abundance and species diversity coincide with low WQI and SQI values. Diversity and abundance was not consistently different in samples collected from the same waterbodies in spring and fall (**Table 4.9**). Seasonal changes are related to higher primary productivity and trophic status in fall as well as competition or predation and water physicochemistry. In addition, plankton communities in lakes and creeks were different from each other, in terms of abundance and species composition.

Table 4.9 – Aquatic Invertebrate Abundance in Waterbodies Examined in the Project Region, 2011

Waterbody	Phytoplankton Total Abundance (x 10^6 n/L)		Zooplankton Total Abundance (n/L)		Benthic Invertebrate Total Density (n/m^2)
	Spring	Fall	Spring	Fall	Fall
Anderson Bay	2.0	7.4	8	202	2,862
Arm Lake	2.5	7.4	116	91	1,724
Gaspard Lake	1.5	6.6	128	412	129
Ghost Lake	7.9	7.3	82	110	244
Nutt Lake	7.0	15	117	101	1,897
Threehouse Lake	6.1	18	73	226	409
Unnamed Lake 1	7.7	24	158	169	3,297
Anderson Creek	1.6	-	74	-	86
Ghost Creek	6.8	-	43	-	3,060
Stall Creek	2.5	0.11	9	0.1	2,787
Tern Ditch	7.7	-	22	-	21,466
Threehouse Creek	1.1	-	28	-	1,638
Unnamed Creek 1	0.7	-	11,720	-	4,569

Note: Where there were multiple samples within a single waterbody, the average is presented above.

In general, the benthic invertebrate community was less diverse and abundant in sediments that were more complex (*e.g.,* sand and gravel) such as in Anderson Creek. Creeks that had less flow and more organic sediments typically had less balanced benthic invertebrate communities than those with more complex sediments or flow. The average density ranged from 86 n/m² to 21,466 n/m², for Anderson Creek and Tern Ditch, respectively (**Table 4.9**). Lakes located along the former rail bed typically had less diversity and density but higher proportion of EPT taxa (*i.e.,* Ephemeroptera, Plecoptera and Tricoptera) than Anderson Bay in Wekusko Lake. In general, EPT taxa were present in low numbers, with eleven stations that had no EPT taxa. A few waterbodies examined along the former rail bed (*i.e.,* Arm Lake and Gaspard Lake) had higher proportion of EPT taxa, suggesting that the habitat quality is high in these areas.

4.3.8 Fish and Fish Habitat in the Project Region

The fish community was assessed as part of the environmental baseline aquatic assessments conducted in 2011 and 2012. Fishing effort included Standard gang and Small gang index gill nets, backpack electrofisher and minnow traps. Fishing effort was conducted in June 2012 to capture small-bodied fish for metals analysis. Fishing effort was conducted in 15 waterbodies located in the Project Region (as provided in **Table 4.2**).

Fish species known to be present in the Nelson River watershed, where the Project Area is located, are listed in **Table 4.10**.

Table 4.10 – List of Expected Aquatic Species in the Project Region

Family Name	Common Name	Species Name	Distribution
Petromyzontidae	Silver Lamprey	*Ichthyomyzon unicuspis*	N
Acipenseridae	Lake Sturgeon	*Acipenser fulvescens*	N
Hiodontidae	Mooneye	*Hiodon tergisus*	N
Cyprinidae	Lake Chub	*Couesius plumbeus*	N
	Carp	*Cyprinus carpio*	I
	Pearl Dace***	*Margariscus margarita*	N
	Emerald Shiner***	*Notrophis atherinoides*	N
	River Shiner***	*Notropis blennius*	0
	Blacknose Shiner***	*Notropis heterolepis*	N
	Spottail Shiner***	*Notropis hudsonius*	N
	Fathead Minnow***	*Pimephales promelas*	N
	Longnose Dace	*Rhinichthys cataractae*	N
Catostomidae	Longnose Sucker***	*Catostomus catostomus*	N
	White Sucker***	*Catostomus commersoni*	N
	Shorthead Redhorse	*Moxostoma erythurum*	N
Ictaluridae	Channel Catfish	*Ictalurus punctatus*	R
Esocidae	Northern Pike***	*Esox lucius*	N
Umbridae	Central Mudminnow	*Umbra limi*	0
Osmeridae	Rainbow Smelt	*Osmerus mordax*	I
Salmonidae	Cisco***	*Coregonus artedi*	N
	Lake Whitefish***	*Coregonus clupeaformis*	N
	Rainbow Trout	*Oncorhynchus mykiss*	I
	Brook Trout	*Salvelinus fontinalis*	N
	Lake Trout	*Salvelinus namaycush*	N

Family Name	Common Name	Species Name	Distribution
Percopsidae	Trout-perch***	*Percopsis omiscomaycus*	N
Gadidae	Burbot	*Lota lota*	N
Gasterosteidae	Brook Stickleback***	*Culaea inconstans*	N
	Ninespine Stickleback	*Pungitius pungitius*	N
Cottidae	Slimy Sculpin	*Cottus cognatus*	N
Percidae	Iowa Darter***	*Etheostoma exile*	0
	Johnny Darter***	*Etheostoma nigrum*	N
	Yellow Perch***	*Perca flavescens*	N
	River Darter	*Percina shumardi*	N
	Sauger	*Sander canadensis*	N
	Walleye***	*Sander vitreus*	N
Sciaenidae	Freshwater Drum	*Aplodinotus grunniens*	N

Source: Stewart and Watkinson, 2004.

*Note: Estuarine species are excluded from this list. N = native; I = introduced; 0 = not previously captured in this watershed; *** = captured during aquatic assessments.*

<u>*Anderson Bay (in Wekusko Lake)*</u>

Overall, 941 individuals representing 15 species were captured in Anderson Bay. The most abundant species captured in Anderson Bay in 2011 was Brook Stickleback; followed by Yellow Perch and Fathead Minnow. In 2012, the most abundant species captured was Brook Stickleback, followed by Emerald Shiner and Yellow Perch.

AECOM examined seasonal differences in length, weight, and condition for fish captured in Anderson Bay in both spring and fall 2011 (*e.g.*, Lake Whitefish, Northern Pike, White Sucker, and Yellow Perch). On average, weight and condition were higher in spring than in fall; however, there was significant overlap between the two seasons. Therefore, it has been assumed seasonal differences were negligible and not included in comparisons between fish captured in Anderson Bay.

In general, fish captured in Anderson Bay were larger (longer and heavier) and had higher condition values than those captured in Goose Bay, another bay located south of Anderson Bay in Wekusko Lake. Exceptions include White Sucker fork length, River Shiner weight, and Yellow Perch fork length and condition. Larger fish observed in Anderson Bay (as compared to those in Goose Bay) could be the result of differences in habitat availability, nutrient enrichment, general fish health, inter- and intra-specific competition (related to habitat availability and fish community composition), food type and availability, and season (including spawning condition). Assuming that catch probabilities are equal between Anderson Bay and Goose Bay, differences in length-frequency distribution suggests differences in habitat quality (*i.e.*, more suitable refuge for Age 0+ fish in Anderson Bay) or less inter- or intra-specific competition (*i.e.*, more larger adults in Goose Bay).

A diversity of fish habitat types were observed in Anderson Bay. Riparian vegetation included coniferous forest, mixed forest, grasses, shrubs and wetland. Cover included boulders, overhanging vegetation, emergent and submergent vegetation and limited amount of woody debris. A complex bottom topography, including the presence of islands and small shoals, provide ample habitat for a variety of species. In addition, as part of Wekusko Lake, fish inhabiting Anderson Bay have access to the rest of the lake and vice versa.

Arm Lake

Only 14 Brook Stickleback were captured in Arm Lake. In comparison with other Brook Stickleback captured in other waterbodies in the Snow Lake area, those captured in Arm Lake were heavier on average. This could be related to greater habitat or food quality, sexual maturity or reduced competitive pressure in Arm Lake.

Arm Lake is a shallow lake with limited connectivity to larger waterbodies. The majority of cover was provided by emergent vegetation, with wetland and flooded shorelines. Organic substrate also dominated the lake. Fish habitat is provided for small bodied fish, but not for large bodied fish.

Gaspard Lake

A total of 121 Brook Stickleback were captured in Gaspard Lake, with 45 individuals captured in a small gang index gill net and the remaining in baited minnow traps. Brook Stickleback from Gaspard Lake had the highest mean length and weight (65 mm and 2.1 g, respectively) compared to other waterbodies examined in 2011.

Riparian structures included bedrock, wetland, and coniferous and mixed forests. Cover included overhanging vegetation and undercut banks. Substrate was dominated by organics or bedrock. Given the limited habitat suitability and lack of connectivity to larger waterbodies, Gaspard Lake does not provide habitat for large-bodied fish.

Ghost Lake

A total of 317 Brook Stickleback were captured in Ghost Lake in 2011 and 2012. Brook Stickleback from Ghost Lake were often heavily parasitized by black spot.

Similar to other waterbodies located along the former rail bed, Ghost Lake provides ample habitat for small bodied fish but none for large bodied fish. Grasses, shrubs and coniferous forests comprised the majority of riparian vegetation in Ghost Lake. Cover was provided by boulders and woody debris. Boulder, bedrock and organics were the dominant substrate.

Goose Bay

Goose Bay was sampled in the fall 2011 with Anderson Bay in order to provide an opportunity for comparative analysis on fish health and condition. Goose Bay is located south of Anderson Bay on Wekusko Lake. Fish collections were conducted in Goose Bay in fall 2011 and summer 2012. A total of 167 individuals representing 12 species were captured in Goose Bay. The most abundant species captured in Goose Bay in 2011 was Yellow Perch followed by White Sucker and River Shiner. In 2012, the most abundant species was Yellow Perch followed by Spottail Shiner.

White Sucker fork length, River Shiner weight, and Yellow Perch fork length and condition were greater in Goose Bay in comparison with Anderson Bay in 2011. Larger fish in Anderson Bay (as compared to those in Goose Bay) could be the result of differences in habitat availability, nutrient enrichment, general fish health, inter- and intra-specific competition (related to habitat availability and fish community composition), food type and availability, and season (including spawning condition). Assuming that catch probabilities in 2011 were equal between Anderson Bay and Goose Bay, differences in length-frequency distribution suggests differences in habitat quality (*i.e.*, more suitable refuge for Age 0+ fish in Anderson Bay) or less inter- or intra-specific competition (*i.e.*, more larger adults in Goose Bay).

As in Anderson Bay, Goose Bay provides habitat for species inhabiting Wekusko Lake. Goose Bay habitat is less complex than Anderson Bay, where the dominant shoreline types are bedrock and shrubs as riparian vegetation. Cover is provided by cobble, boulder and woody debris. Substrate is dominated by cobble or bedrock.

Nutt Lake

No fish were captured in Nutt Lake.

Riparian vegetation was largely mixed forest or wetland. Cover types included undercut banks, boulder, and overhanging vegetation. The substrate was dominated by organics. Fish habitat may be, at most, available for small bodied fish but there is nearly no connectivity to other waterbodies.

Snow Lake

Fish collections were not conducted in Snow Lake during the environmental baseline aquatic assessments in 2011. The fish community of Snow Lake is composed of Northern Pike, Walleye, White Sucker, Cisco, Lake Whitefish, Yellow Perch, Spottail Shiner and Ninespine Stickleback (Beck, 1984; Stewart-Hay, 1963). There was a commercial gill net fishery in Snow Lake from 1989-90 targeting Lake Whitefish, but operation was suspended due to the high by-catch (~41% of round weight) of Walleye and Northern Pike. There is anecdotal evidence of a failed commercial trap net fishery on Snow Lake in 1998. The Regional Fisheries Manager, Grant McVittie, said that recreational fishers do not target Snow Lake due to the proximity of better fishing locations (*i.e.,* Wekusko Lake and Trampling Lake); however, good Northern Pike and Walleye fishing are available in Snow Lake. The fish community in the northwest or southeast arms is likely not different, with the possible exception of fewer Walleye in the northwest arm due to the shallower water (Grant McVittie, personal communication).

Threehouse Lake

A total of 28 Brook Stickleback were captured in Threehouse Lake, with a small gang index gill net and baited minnow traps. Brook Stickleback from Threehouse Lake were often in good health and comparable in terms of size to Brook Stickleback captured from other waterbodies along the former rail bed.

Similar to other waterbodies located along the former rail bed, Threehouse Lake provides ample habitat for small-bodied fish, but none for large-bodied fish. Grasses, wetland and mixed forests comprised the majority of riparian vegetation in Threehouse Lake. Cover was provided by undercut banks, overhanging vegetation, submergent vegetation and woody debris. Organics were the dominant substrate.

Unnamed Lake 1

No fish were captured in Unnamed Lake 1.

Unnamed Lake 1 is a depressional low, with organic substrate and homogenous bottom topography. At most, this waterbody may provide habitat for small bodied fish. However, there is no visible connectivity to other waterbodies. Coniferous forest dominated the riparian vegetation. Cover was provided by undercut banks and overhanging vegetation.

Anderson Creek

A total of 170 individuals representing four species were captured in Anderson Creek, with a dip net, baited minnow traps and a backpack electrofisher. Brook Stickleback, Fathead Minnow, Iowa Darter and Pearl Dace were captured in Anderson Creek.

Pearl Dace, in spawning condition, were captured only at the PR 392 crossing over Anderson Creek, where overflow from Anderson TIA creates a higher velocity riffle habitat. The downstream fishing efforts were in runs which were also considered rare among the waterbodies examined during the environmental baseline aquatic assessments. A variety of cover was available, including undercut banks, pools, overhanging vegetation, emergent and submergent vegetation, and woody debris. Silt, sand, gravel, cobble, boulders were substrate types observed during fishing efforts. Ample habitat, including habitat considered limited in this area, is available in Anderson Creek. Depending on the distribution of beaver dams along Anderson Creek, fish may access Anderson Bay from Anderson Creek (or vice versa).

Ghost Creek

A total of 544 Brook Stickleback were captured in Ghost Creek, with baited minnow traps. Brook Stickleback from Ghost Creek were often in good health and comparable in terms of size to Brook Stickleback captured from other waterbodies located along the former rail bed.

Similar to other waterbodies along the former rail bed, Ghost Creek provides ample habitat for small bodied fish but none for large bodied fish. Grasses and shrubs comprised the majority of riparian vegetation in Ghost Creek. Cover was provided by boulders and overhanging vegetation. Organics were the dominant substrate.

Stall Creek

A total of 18 individuals representing two species (Brook Stickleback and Fathead Minnow) were captured in Stall Creek, with a backpack electrofisher. Brook Stickleback from Stall Creek were often parasitized by black spot.

Stall Creek provides habitat for small bodied fish, but not for large bodied fish. Wetland and mixed forest comprised the majority of riparian vegetation in Stall Creek. There were several large beaver ponds in the lower reaches of Stall Creek. Cover was provided by undercut banks and overhanging vegetation in the upstream section only and in the lower reaches of Stall Creek, submergent vegetation and woody debris provided cover. Organics were the dominant substrate.

Tern Ditch

A total of 47 Brook Stickleback were captured in Tern Ditch, with a backpack electrofisher and baited minnow traps. Brook Stickleback from Tern Ditch were often in good health and comparable in terms of size to Brook Stickleback captured from other waterbodies assessed in the Snow Lake area.

Tern Ditch provides limited habitat for small bodied fish and none for large bodied fish. Grasses and shrubs comprised the majority of riparian vegetation in Tern Ditch. Cover was provided by undercut banks, overhanging vegetation, emergent and submergent vegetation and limited amounts of woody debris. Organics were the dominant substrate.

Threehouse Creek

A total of 105 Brook Stickleback were captured in Threehouse Creek, with baited minnow traps in 2011 and 2012. Brook Stickleback from Threehouse Creek were often in good health and comparable in terms of size to Brook Stickleback captured from other waterbodies assessed in the Snow Lake area.

Threehouse Creek provides habitat for small bodied fish and none for large bodied fish. Grasses and shrubs comprised the majority of riparian vegetation in Threehouse Creek. Cover was provided by undercut banks and overhanging vegetation. Organics were the dominant substrate.

Unnamed Creek 1

No fish were captured in Unnamed Creek 1.

Unnamed Creek 1 provides very limited habitat for small bodied fish and none for large bodied fish. Fishing effort in Unnamed Creek 1 was performed in a series of beaver ponds and small pools. Coniferous and mixed forest comprised the majority of riparian vegetation in Unnamed Creek 1. Cover was provided by overhanging vegetation, and woody debris. Organics were the dominant substrate. There was no visible connectivity between Unnamed Creek 1 and other larger waterbodies in the area.

4.3.8.1 Fish and Fish Habitat Summary

Minnow traps, gill nets, and a backpack electrofisher were used to collect fish in the selected waterbodies. In total, 17 fish species were captured in 2011 and 2012. No fish were captured in Nutt Lake, Unnamed Lake 1, and Unnamed Creek 1. In general, the larger waterbodies (*i.e.*, Anderson Bay and Goose Bay) had the highest species diversity. For most other waterbodies, Brook Stickleback were the most abundant (or only) species captured, typical of headwater waterbodies. In spring, several species were captured in spawning condition (*i.e.*, Yellow Perch, White Sucker, Brook Stickleback, and Pearl Dace). Large school of Young-of-Year Brook Stickleback and spawning Pearl Dace were captured and observed in Anderson Creek, adjacent to PR 392. In general, fish were in good health and condition. External parasites (white cysts or black spot) and fin erosion were present in fish from most waterbodies.

The majority of cover in these waterbodies included vegetation (overhanging, submergent, and emergent) and cobble. All lakes provided diverse cover types and varying degrees of shoreline complexity. As several fish species were captured in spawning condition, the majority of waterbodies provided spawning and rearing habitat. Foraging habitat for large-bodied fish is predominately available in Wekusko Lake (*i.e.*, Anderson Bay and Goose Bay). Although the creeks and lakes along the proposed pipeline ROW provided a diversity of habitats, their shallow depth and limited connectivity to other waterbodies suggests that they cannot support populations of large-bodied fish.

4.3.9 Metal Residue in Fish

Fishing effort was conducted in June 2012 in Anderson Bay (Wekusko Lake), Goose Bay (Wekusko Lake), Ghost Lake and Threehouse Lake in order to capture and submit small-bodied fish for metal and moisture analysis. Metal residues of whole-body forage fish were compared to *MWSQOG* aquatic life tissue residue guidelines for human consumption (Williamson, 2011). The two applicable guidelines include arsenic (3.5 mg/kg) and lead (0.5 mg/kg).

Brook Stickleback was the only species captured in all four waterbodies. Similar to previous investigations conducted by AECOM in the Snow Lake area, Wekusko Lake (*i.e.,* Anderson Bay and Goose Bay) had higher species diversity and abundance compared to the waterbodies along the former rail bed (*i.e.,* Threehouse Creek and Ghost Lake). Emerald Shiner is the only species not captured during previous fish sampling surveys conducted by AECOM in the Snow Lake area.

Antimony, beryllium, bismuth, lithium, nickel, silver, tellurium, thallium, thorium, uranium, vanadium and zirconium were at, or below, detection limits in at least 90% of the samples tested. Lead was detected in only 11 of 40 samples, eight of which were in fish from Ghost Lake (mean concentration of 0.05 mg/kg ± 0.02 mg/kg). Similarly, nickel was detected only in in six of ten Anderson Bay fish (maximum concentration of 0.13 mg/kg). **None of the**

concentrations of arsenic or lead exceeded the *MWSQOG* aquatic life tissue residue guidelines for human consumption.

Fish from Ghost Lake had the highest median whole-body concentration of copper, iron and zinc compared to the other waterbodies sampled in 2012. Median concentrations of aluminum, copper and iron were lowest in Goose Bay, compared with the other waterbodies sampled in 2012. There was generally overlap among the waterbodies with respect to whole-body concentrations of the selected chemicals of concern

To determine the variability between sampling locations during the June 2012 survey, concentrations in whole-body fish samples were compared using one-way ANOVA for six chemicals of concern. Parameters selected for analysis included those that were identified as chemicals of concern in water and sediment quality samples collected in 2011 from the Snow Lake area and included: aluminum, arsenic, cadmium, copper, iron, and zinc. A summary of these fish tissue concentrations is provided in **Table 4.11**. Lead and nickel were originally included on this list but had a high incidence of non-detectable concentrations and were thus excluded from the subsequent analysis. The results indicate that significant differences ($p < 0.05$) exist in whole-body concentrations of arsenic, cadmium, copper, iron and zinc (*i.e.,* all but aluminum).

Table 4.11 – Summary Statistics of Merisitics and Chemicals of Concern, 2012

Waterbody	Parameter	Length (mm)	Weight (g)	Aluminum	Arsenic	Cadmium	Copper	Iron	Zinc
Anderson Bay	**Mean**	49	1.1	7.85	0.18	0.006	1.5	30.2	40.0
	Min	42	0.5	2.17	0.12	<0.004	0.7	17.3	26.9
	Max	62	1.9	17.6	0.33	0.012	2.1	53.2	55.5
Ghost Lake	**Mean**	69	2.3	4.16	0.16	0.005	1.9	41.1	65.4
	Min	63	2.0	2.04	0.12	<0.004	0.90	29.5	40.5
	Max	77	3.2	6.04	0.21	0.005	2.8	50.8	101
Goose Bay	**Mean**	69	3.9	9.26	0.17	0.005	0.91	19.5	43.8
	Min	43	0.8	0.83	0.12	<0.004	0.61	4.9	38.7
	Max	84	6.0	40.9	0.26	0.01	2.1	57.8	52.8
Threehouse Creek	**Mean**	61	2.06	3.65	0.12	--	1.1	35.3	48.0
	Min	51	1.4	1.06	0.05	<0.004	0.69	15.9	32.9
	Max	78	3.8	6.4	0.15	0.009	1.7	50.9	68.5

Notes:

Concentrations of metals are presented as milligram per kilogram wet weight. Concentrations less than the detection limit were considered equal to one-half of the detection limit for calculation of summary statistics.

Mean concentrations from Ghost Lake were higher and significantly different from at least one of the other waterbodies for copper, iron and zinc. This higher metal load coincides with the high incidence of parasitic infestation in fish from Ghost Lake. Although water quality in Ghost Lake was rated as excellent, sediment quality was rated as poor or marginal during baseline studies conducted in 2011. Benthic invertebrate diversity and density were also reduced in Ghost Lake, compared to other waterbodies along the former rail bed.

In general, the lowest mean concentrations were found in Threehouse Creek and Goose Bay. Water and sediment quality in Threehouse Creek was considered excellent and good, comparable to other waterbodies along the former rail bed. Although no baseline information was collected from Goose Bay by AECOM, environmental effects monitoring conducted by Stantec indicates that water quality is considered comparable to other bays in Wekusko Lake (*e.g.,* Berry Bay)

Fish tissue concentrations in the Snow Lake area are influenced by a variety of sources (natural and anthropogenic). Ghost Lake sediment and fish tissue have elevated metal concentrations compared to other waterbodies along the former rail bed and could be the result of historical mining and deposition of mine rock that occurred in the area, potential influence from materials used in the former railbed or naturally elevated elements. The results presented here coincide with those previously presented (Stantec, 2010), that show Anderson Bay not having the highest concentrations compared to other waterbodies in the area.

4.3.10 Aquatic Habitat Assessments

Aquatic habitat assessments were conducted in the Project Area. These investigations took place in June 2011, September 2011, October 2011, and June 2012. Site investigations included observations, measurements and taking photographs. **Figure 7** identifies the locations of these aquatic habitat assessments. Aquatic habitat value was assessed for each site.

Habitat indicators, including physical habitat variables, connectivity to fish bearing waters and water quality, as developed under DFO's *Decision Framework for the Determination and Authorization of Harmful Alteration, Disruption or Destruction of Fish Habitat* were considered in the evaluation for fish habitat as Critical, Important, Marginal or No Fish Habitats (Fisheries and Oceans Canada, 1998). Classifications are summarized in **Table 4.12.**

Table 4.12 – Classification of Aquatic Habitats Sampled in the Project Area

Site	Habitat Classification
Lalor Site	No Fish Habitat
LR01	Marginal Fish Habitat
LR02	No Fish Habitat
RB01	No Fish Habitat
RB02	Marginal Fish Habitat
RB03	Marginal Fish Habitat
RB04	No Fish Habitat
RB05	No Fish Habitat
RB06	No Fish Habitat
RB07	No Fish Habitat
RB08	No Fish Habitat
RB09	No Fish Habitat
RB10	No Fish Habitat
RB11	No Fish Habitat
RB12	No Fish Habitat
RB13	No Fish Habitat
RB14	No Fish Habitat
RB15	No Fish Habitat
RB16	No Fish Habitat
RB17	No Fish Habitat
AD02	No Fish Habitat

Site	Habitat Classification
Freshwater Pipeline	No Fish Habitat
Snow Lake Pumphouse	Important Fish Habitat

4.3.10.1 Lalor Site

A random meander examination of the Lalor Site was completed in search of aquatic habitat in June 2012. The area is generally low lying and wet, typical of the surrounding area. There does not appear to be any connectivity to surrounding water bodies and given the shallow depths which would freeze to bottom in winter and inadequate substrate and cover it is unlikely that any of these wet areas provide fish habitat or support fish. The Lalor Site is categorized as **No Fish Habitat**.

4.3.10.2 Pipeline System

In 2011 and 2012, 20 aquatic habitat assessments were conducted in the Project Area, which included locations along the Lalor Access Road, PR 395, the former rail bed, existing access roads in the location of the former Anderson Mine and the Snow Lake pumphouse.

Figure 7 displays the location of the culverts along the route of the Pipeline System which are discussed below.

Lalor Access Road (Portion 1)

LR01 is a pair of culverts installed in Tern Ditch. Tern Ditch is an engineered off-take ditch, which was installed to allow for drainage of Tern Pond towards Snow Lake. The channel was uniform, approximately 5 m wide and up to 2 m deep. Vertical banks contained the stream with little to no riparian habitat. The substrate was highly organic with the occasional undercut bank or small woody debris providing limited cover. Two 0.9 m diameter culverts were perched above the stream substrate by approximately 0.2 m on the north side of the road. Cobble covered the channel bed approximately 5 m from the base of the culverts on either side of the road before the natural, highly organic substrate began. Although the cobble provides unique habitat in the channel, it was virtually inaccessible to fish on the north side of the road due to the perched culvert and low water levels. Fishing effort conducted during the spring 2011 baseline survey captured Brook Stickleback in Tern Ditch. *LR01* provides **Marginal Habitat** as the cover and water depth may provide habitat for small-bodied species, but fish passage and utilization is limited by low water levels through a perched culvert.

LR02 is a culvert near the quarry along the Lalor Access Road. Installation of the 0.6 m diameter culvert has channelized the water from the saturated lowland surrounding the road to create a stream. The channel on the south side of the road has been excavated adjacent to the tree line and a channel has been created to connect a wetter area to the west to the culvert location. The culvert opening on the north side of the road was perched 0.4 m, with water running down gravel before reaching the natural channel. A thick white gelatinous residue of unknown origin coated the substrate along the gravel. There was little observed in-stream habitat or cover. Due to poor connectivity to fish bearing waterways, shallow water that likely freezes to the bottom in winter and impediments to fish passage *LR02* categorically provides **No Fish Habitat**.

PR 395 (Portion 2)

The proposed tailings pipeline route along either side of PR 395 from the Lalor Access Road to and including the crossover point to the rail bed was surveyed for aquatic habitat. The area was typical of the Project Area with bedrock outcrops and low lying areas. Along PR 395, small impounded low lying areas were observed which were likely created during development of the road. Tadpoles were observed in these wet areas but it is unlikely that they would support fish due to the lack of connectivity to larger water bodies and the shallow water depth which would freeze to the bottom in winter. The substrate and surrounding vegetation is dominated by terrestrial species. The area along PR 395 provides **No Fish Habitat**.

Former Rail Bed (Portion 3)

Seventeen culverts were identified along the former railbed. A portion of the former rail bed is used by trucks to access the sand pit approximately halfway to the former Anderson Mine site from PR 395. This section of the former rail bed is graded and maintained. East of the sand pit, the former rail bed is overgrown which limited access and visibility.

The land surrounding the former rail bed is typical of mature boreal forest found throughout the area. Wetlands are interspersed between bedrock outcroppings and old growth spruce stands. Prior to the development of the former rail bed, the low-lying areas would have been somewhat uniformly saturated, collecting water from the surrounding higher areas. Installation of culverts and excavation of ditches provided an area for water to collect and small shallow pools have developed.

Of the 17 culverts examined along the existing rail bed, 15 were characterized as drainage features, essentially shallow, stagnant ponds, or beaver impoundments, which formed after the installation of culverts and excavation of ditches. Because of the limited availability of cover, lack of connectivity and low water depths (sometimes even dry channels such as at *RB01* and *RB11*), these are classified as **No Fish Habitat**.

Two culvert locations (*RB02*, *RB03*) were identified as potentially fish bearing and able to provide marginal fish habitat due to their connectivity to larger waterbodies and sufficient depth to prevent freezing to the bottom (see **Figure 7**).

RB02 crosses Ghost Creek, which is an off–take ditch constructed during early railway construction (in late 1950’s). Ghost Creek originates upstream from Ghost Lake and flows approximately 700 m north to join with Threehouse Creek to form Tern Creek. Tern Creek drains northward into Tern Lake and ultimately, to Snow Lake. There are two 1.63 m diameter culverts at RB02. The channel is uniform upstream and downstream at 7 m wide and ~1 m deep. The banks are vertical and provide little riparian habitat. Upland vegetation is a mix of wetland, grasses, deciduous forest and coniferous trees. The substrate is highly organic, but moderate amounts of cover are provided by small woody debris, overhanging vegetation and instream vegetation. Fishing effort during the spring 2011 baseline survey captured Brook Stickleback. *RB02* provides **Marginal Habitat** as the limited cover and water depth may provide habitat for small-bodied species, but it is unlikely that large-bodied species utilize this waterway.

RB03 crosses Threehouse Creek, which also is an off-take ditch, constructed during early railway construction (in late 1950’s). Threehouse Creek originates upstream from Threehouse Lake and approximately 300 m north of the former rail bed, runs along Arm Lake. Approximately 400 m past Arm Lake, Threehouse Creek joins with Ghost Creek to form Tern Creek which drains into Tern Lake and ultimately, into Snow Lake. There are two 1.95 m culverts at *RB03*. Threehouse Creek is straight, 5 m wide and 2 m deep with vertical banks. Upstream of the rail bed, Threehouse Creek flows through a fen, where the banks are floating vegetation mats. A beaver dam upstream from the former rail bed blocks Threehouse Creek. Two beaver runs, which cross this beaver dam, are lower and could potentially be submerged during high water events to allow water flow. At the time of assessment, water appeared at equilibrium across the culverts. The substrate is highly organic, but moderate amounts of cover are provided by small woody debris, overhanging vegetation and in-stream vegetation. Fishing effort at this location during the spring 2011 baseline survey captured Brook Stickleback. *RB03* provides **Marginal Habitat** as the limited availability of cover and water depth may provide habitat for small-bodied species but it is unlikely that large-bodied species utilize this waterway.

Terminus of the Tailings Pipe (Portion 4)

AD03 is at a culvert along one of the internal access roads used in the operation of the Anderson TIA. The culvert is blocked causing a small ponded area on the north side. On the south side of the road, water trickles towards Anderson TIA through an ill-defined channel overgrown with deciduous trees. AECOM field teams followed the waterway 150 m north at which point they encountered a second culvert and road. This section of road appears to be the extension of the former rail bed. Water in the channel between the culverts is shallow with low flow. The culverts were perched 0.6 m and 0.4 m and there are several small waterfalls which would prevent fish passage upstream. Substrate is sand and silt with no defined channel. Water is shallow (0.02 m) with no instream vegetation and no fish cover. The waterway at AD02 provides No Fish Habitat as there is no suitable fish cover and water would freeze to bottom in winter.

Origin of the Reclaim Water Pipe (Portion 5)

There are no culverts in this portion of the route of the Pipeline System.

Origin of the Freshwater Pipe (Portion 6)

Portion 6 of the route crosses PR 395 and continues down an internal access road used in the operation of the Anderson TIA. Currently, this portion contains the water pipe which delivers freshwater from the Snow Lake Pumphouse to the Stall Lake Concentrator. There were several saturated low-lying areas along this portion of the route, but **No Fish Habitat** was observed.

Shoreline at Snow Lake below the Snow Lake Pumphouse

A qualified fisheries biologist inspected the shoreline along Snow Lake immediately in front of the pumphouse and an area within approximately 10 m on either side. The area of the pumphouse is mature coniferous forest with thick moss undergrowth. Mature trees grow up to the edge of the water exposing bedrock that slopes steeply into the lake. Cover is available as overhanging vegetation and large woody debris from falling or fallen trees. The pumphouse sits on a flattened section of shore approximately 10 m from the water’s edge. Bedrock was leveled during construction of the pumphouse to provide a flat area for the associated buildings. The shoreline in this area is comprised of riprap which provides cover for fish and drift wood that have accumulated along the shore. Approximately 5 m off-shore, the water is approximately 15 m deep. The condition of the pipe and intake structure is unknown as it was not visible from shore. According to Fisheries and Oceans Canada (1998), the shoreline in and around the pumphouse and intake structure would be classified as **Important Habitat** due to the presence of sportfish which are of recreational importance in Snow Lake.

4.3.10.3 Summary

The route of the Pipeline System lies entirely within areas that have been developed and/or are currently occupied for mining purposes. There are 20 locations which contain existing culverts along the route. Of these crossings, 17 are classified as **No Fish Habitat**, due to lack of connectivity to fish-bearing water ways and shallow water that will likely freeze to bottom in winter. Three sites are classified as **Marginal Fish Habitat** because they provide sufficient conditions to support forage fish but are unlikely to support large-bodied fish.

Habitat along the shoreline of Snow Lake in the area adjacent to the pumphouse is classified as **Important Fish Habitat**.

4.4 Terrestrial Environment

4.4.1 Flora

Vegetation in the Reed Lake Ecodistrict is typical of the northern Boreal forest region with Black Spruce (*Picea mariana*), Jack Pine (*Pinus banksiana*), Trembling Leaf Aspen (*Populus tremuloides*), and White Spruce (*Picea glauca*). The bog peat-lands have stunted Black Spruce, moss, and ericaceous shrub vegetation, while fens have sedge (*Carex sp*.), shrub, and Tamarack (*Larix laricina*) in varying mixtures. Forest composition is reflective of a forest fire history (Smith *et al*., 1998).

4.4.1.1 Terrestrial Field Surveys

AECOM's baseline terrestrial surveys carried out in September 2007, July 2010, May/June 2011, and June 2012 included a review of local geology, soil, vegetation, and wildlife located within the Project Site and targeted sections of the Project Area. The field survey consisted of a random meander survey by qualified AECOM biologists.

The Project Region is a boreal forest biome typical of the rocky outcrop and bog landscape. Rock outcrops are primarily igneous and common, forming open lichen woodlands of White Spruce and Jack Pine. Black Spruce bog has developed in the areas between rocky outcrops and created deep deposits of sphagnum moss that restrict drainage. The bog is mature with large areas of even-aged Black Spruce stands. One indication of tree stand density is the relative lack of understory shrubs. Speckled Alder (*Alder rugosa*) dominates the shrub layer in openings created by watercourses. There were no Hazel, Saskatoon, Chokecherry, or other typical understory shrubs noted during the surveys. Ground cover is moss with typical boreal ground plants such as Bunchberry (*Cornus canadensis*) and Solomon's Seal (*Polygonatum biflorum*). Soil development has occurred in pockets between rock outcrops with good drainage. Jack Pine grows in sporadic open sandy areas.

Historical disturbance in the Project Area had opened up a portion of the forest canopy prior to AECOM's first visit in 2007. Most of this activity comprised of narrow cut lines and drag roads that grow in rapidly. Re-growth in these areas consists largely of hardwoods, but these areas also offer some growth opportunity for shrubs that were largely lacking in other parts of the forest stand. Although forest re-growth is a minor component of the forest canopy, it is extensive and likely important in terms of offering linear features that present more diversity than the surrounding forest and providing openings in an otherwise dense canopy.

A list of confirmed vegetation (based on desktop review and supported by field observations in 2007, 2010, 2011 and 2012) is provided in **Table 4.13**. It should be noted that the spring 2012 survey did not reveal any species not previously observed in the work conducted in 2007, 2010 and 2011.

Table 4.13 – Vegetation Observed During Site Visits in 2007, 2010, 2011, and 2012

Awned Hair Cap Moss (Polytrichum piliferum)	Marsh Cinquefoil (Potentilla palustris)
Balsam Fir (Abies balsamea)	Mountain Cranberry (Vaccinium visit-idaea)
Bearberry (Arctostaphylos uva-ursi)	Northern Reindeer Lichen (Cladina stellaris)
Black Spruce (Picea mariana)	Paper Birch (Betula papyrifera)
Bog Cranberry (Vaccinium vitis-idaea)	Perennial Sow Thistle (Sonchus arvensis)*
Bunchberry (Cornus canadensis)	Reed Canary Grass (Phalaris arundinacea)
Canada Anemone (Anemone canadensis)	Rough Cinquefoil (Potentilla norvegica)
Canada Bluejoint (Calamagrostis canadensis)	Sedge (Carex sp.)
Canada Buffaloberry (Sheperdia canadensis)	Shore-Growing Peat Moss (Sphagnum riparium)
Canada Thistle (Cirsium arvense)*	Snowberry (Symphoricarpos albus)
Cladonia (Cladonia sp.)	Solomon's Seal (Polygonatum biflorum)
Common Reed Grass (Phragmites australis)	Speckled Alder (Alder rugosa)
Common Cattail (Typha latifolia)	Sphagnum moss (Sphagnum sp.)
Drooping Wood-Reed (Cinna latifolia)	Squarrose Peat Moss (Sphagnum squarrosum)
Dwarf Billberry (Vaccinium caespitosum)	Stiff Club Moss (Lycopodium annotinum)
Early Blue Violet (Viola adunca)	Stinging Nettle (Urtica dioica)*
Fairy Slipper Orchid (Calypso bulbosa)	Tall Cotton-Grass (Eriophorum angustifolium)
Fern (Matteuccia sp.)	Tamarack (Larix laricina)
Finger Felt Lichen (Peltigera neopolydactyla)	Trembling Leaf Aspen (Populus tremuloides)
Girgensohn's Peat Moss (Sphagnum girgensohnii)	Tufted Moss (Aulacomium palustre)
Ground Cedar (Lycopodium complanatum)	Velvet Leaf Blueberry (Vaccinium myrtilloides)
Ground Pine (Lycopodium obscurum)	Wavy Dicranum (Dicranum undulatum)
Jack Pine (Pinus banksiana)	Wax Paper Lichen (Parmelia sulcata)
Labrador Tea (Ledum groenlandicum)	White Spruce (Picea glauca)
Large Cranberry (Vaccinium macrocarpon)	Wild Mint (Mentha arvensis)
Leatherleaf (Chamaedaphne calyculata)	Wintergreen (Pyrola asarifolia)
Lily of the Valley (Maianthemum canadense)	

*Note: * Invasive species*

4.4.1.2 Lalor Site

The Lalor site is located in a typical boreal stand common throughout the Project Area. Tree growth is primarily small Black Spruce on bog, high stand density and poor species diversity due to the relatively low productivity of this environment. No unusual plant communities and no species at risk were observed during the terrestrial surveys of the Lalor site.

The perimeter of the Lalor site creates an abrupt edge to the forest environment, where the Black Spruce stand is generally very dense with some openings to the west and along local lakes and wetlands. There is typically little variety in these stands. There were numerous White Birch trunks (mostly dead stands) surrounding the Lalor site. This may indicate a general increase in wet ground conditions in the general area, possibly due to blockage of local drainage by beavers which pre-dates development at the Lalor site.

4.4.1.3 Route of the Pipeline System

Portion 1

The Lalor Access Road is located in very similar plant communities to those around the Lalor site. As with the Lalor site, the low diversity of plant communities and extremely dense Black Spruce stand offers a very restricted habitat for wildlife.

Portion 2

The terrestrial environment along PR 395, between the Lalor Access Road and the former rail bed, is similar to what characterizes the Lalor site. The road itself has a wide ROW with pads for infrastructure and drilling developed along the road. Along the east side of PR 395 is a wet, closed canopy forest stand of mixed Black spruce and Trembling Leaf Aspen interspersed with Tamarack. Ground cover alternates from wet Alder (*Alnus crispa*) bog to rocky outcrops.

Adjacent to the forest stand, along the east side of the highway, is an upland mixed forest. The size of the trees suggests a more productive forest environment than that surrounding the Lalor site. The west side of the road is an open Black Spruce upland founded on a deep moss layer. This side of the road is dry with a dense forest canopy and typical sparse boreal ground cover. Fairy Slipper Orchids (*Calypso bulbosa*) were noted throughout the forest floor on the west side of the road. This forest stand is fairly uniform from the location of the Chisel North Mine to the crossover point to the former rail bed.

Portion 3

The former rail bed to the Anderson TIA provides a linear opening in the local forest canopy with second growth Aspen and shrubs along the edge of the ROW. Although the route is heavily overgrown along the sides with secondary growth, it still shows signs of historical disturbance. The parent forest adjacent to the former rail bed is mixed wood upland with few low lying wet areas. Typical understory and shrub growth is present throughout this forest stand. The one exception to the upland nature of the rail bed route is a low wet area currently flooded by beavers.

Portion 4

The former Anderson Mine site (which has undergone closure) is adjacent to the Anderson TIA, and the route of the Pipeline System will run through it. This area is primarily open with grassy understory, some shrubby growth and re-growth of poplar and brushy species. The shoreline of Anderson TIA supports a typical shoreline Aspen stand with extensive shrubby growth along the edge of the water.

The route continues along one of the internal access roads used in the operation of the Anderson TIA. It was not assessed for floral communities but is expected to contain similar vegetation to the other areas assessed during the 2007, 2010, 2011 and 2012 terrestrial surveys.

Portions 5 and 6

Portions 5 and 6 of the route were not specifically assessed for floral communities but were noted to be generally similar to Portions 3 and 4.

Vegetation at the Snow Lake Pumphouse

The existing Snow Lake pumphouse is located on the south shore of Snow Lake in a well-cleared area, serviced by an all-weather access road. There is a rocky shoreline area adjacent to the pumphouse that is covered in a Black Spruce stand with a deep moss ground layer.

4.4.1.4 Summary

The Project Region is characterized by naturally dense boreal forest, primarily Black Spruce interspersed with Jack Pine and hardwoods, with limited understory growth. Sphagnum forms the dominant ground cover. Baseline terrestrial surveys carried out in 2007, 2010, 2011 and 2012 included a review of local geology, soil, vegetation, wildlife, flowering plants, and migratory birds in the Project Area. No rare or endangered plant species were encountered and there are no indications that this area contains unique plant habitat. In general, the Project Site is typical for this region.

4.4.1.5 Vegetation with Potential Cultural Significance

AECOM consulted Manitoba Hydro's Environmental Impact Statement (EIS) for the Bipole III Transmission Project to obtain information on plants that have been identified as having cultural value to Aboriginal people in Manitoba. The Bipole III EIS was consulted because it is the most recent source of documentation of traditional land use by Aboriginal Peoples in Northern Manitoba, covering a study area of over 136,000 km^2, and involving interviews with participants from numerous First Nation and other Aboriginal communities. In addition, HBMS and AECOM have extended an invitation to MCCN to nominate traditional knowledge experts to review this information and return to the Project Site with AECOM to provide their advice (see Notes of Meeting with MCCN held on January 11, 2012 and letter from Stephen West to Chief Arlen Dumas dated February 10, 2012 found in **Section 8**), but to date this invitation has not been accepted.

Table 4.14 provides a list of plants that were observed during the terrestrial surveys conducted for Lalor projects that have been identified in the Bipole III EIS as having cultural value to Aboriginal people.

Table 4.14 – Plants Found during the Lalor Concentrator Surveys that may have Cultural Importance

Common Name	Scientific Name
Labrador Tea	Ledum groenlandicum
Cedar (cedar vines, ground cedar)	Juniperus horizontalis / Lycopodium tristachyum
Cranberry	Vaccinium macrocarpon
Bearberry	Arctostaphylos uva-ursi
Birch Tree Leaves	Betula papyrifera
Lowbush Blueberry/Velvet-Leaved Blueberry	Vaccinium myrtilloides
Mint	Mentha arvensis
Bunchberry	Cornus canadensis
Stinging Nettle	Urtica dioica

Stinging Nettle (*Urtica dioica*) is an invasive weed, and would likely be encountered in road ditches and cleared areas within the Project Area and Project Region. Other species identified in **Table 4.14** are common boreal species and are expected to be encountered in abundance throughout the Project Area and Region. None of the identified species are considered unique to the Project Site.

4.4.2 Fauna

The Churchill River Upland Ecoregion provides habitat for Moose (*Alces alces*), Boreal Woodland Caribou (*Rangifer tarandus caribou*), Black Bear (*Ursus americanus*), Lynx (*Lynx lynx*), Timber Wolf (*Canis lupus*), Beaver (*Castor canadensis*), Muskrat (*Ondatra zibethicus*), and Snowshore Hare (*Lepus americanus*). Various bird species are also found in this ecoregion; including Sandhill Crane (*Grus canadensis*), grouse, and waterfowl (*i.e.,* ducks, geese, and pelicans) (Smith, *et al*., 1998).

When AECOM conducted field investigations in September 2007, signs of Black Bear and Moose were apparent in the area (although no animals were actually observed). Wildlife that was observed included Coyote (*Canis latranus*), Red Fox (*Vulpes fulva*), Whitetail Deer (*Odocoileus virginianus*), Timber Wolf (*Canis lupus*), River Otter (*Lutra Canadensis*), Beaver, eagles, American White Pelican (*Pelicanus erthrorhyncos*), cranes (*Grus sp.*), loons (*Gavia sp.*) and frogs. In 2010, other than waterfowl and Common Raven (*Corvus corax*), no wildlife was observed within 1 km of the Lalor site. The densely forested Black Spruce bogs do not support nesting habitat and hence very few were heard or seen during the 2011 survey. Moose tracks were observed along the former rail bed (similar to other linear features such as roads and transmission lines in this area). One Black Bear track was also seen near the beaver pond obstructing the former rail bed in 2012.

The density of the forest canopy and poor diversity of plant life under the trees makes the Project Area generally poor in terms of wildlife diversity. Upland rocky outcrops that promote hardwood growth and open areas in lichen outcrops provide some variation in wildlife habitat quality and diversity within the Project Area.

Wildlife populations have open access to a large area of natural woodland in the region that provides river and lakeshore edge habitat and many burned areas in various stages of re-growth. Such areas provide a large diversity of habitats that favours wildlife populations and adjoin the immediate areas. Wildlife species can make use of the Project Area to the extent that it benefits them, but are not restricted to it. There is no restriction on wildlife species in terms of moving to more favourable areas within the general region.

No specific critical wildlife habitat was observed on the Project Site (such as calving or over-wintering areas) and, based on site conditions and limited field observations, it is expected that there is no critical wildlife value in the Project Area. At both the site of the Concentrator component and along the route of the Pipeline System, the low diversity of plant communities and extremely dense Black Spruce stand offer a very restricted habitat for wildlife.

4.4.3 Migratory Birds

The only migratory birds that were observed during field investigations were waterfowl. No bird species that are protected under the *Migratory Birds Convention Act, 1994* were observed in the area.

The type of habitat around the Lalor site is classified as bog and floating bog, which has very low value for migratory waterfowl nesting. Open water lakes such as Lalor Lake and Chisel Lake provide some nesting habitat in shoreline areas, and brood water along the shoreline of lakes. A survey of Anderson TIA recorded four species of ducks, mergansers, loons, grebes, geese and two species of gull. Nesting and brooding of these species is largely confined to the major lakes in the Project Area. The immediate site of the Lalor site and the surrounding Black Spruce bog offer little value for waterfowl at any stage of nesting and brooding.

Water crossings along Portions 1 and 3 of the Pipeline System offer potential nesting areas for waterfowl. To be suitable waterfowl habitat, there should be brooding areas within close proximity to the potential nesting area. This combination occurs only at LR01, RB02 and RB03.

Common Goldeneye (*Bucephala clangula*) are tree nesters that make use of boreal areas. They would be the most likely species making use of the drainages in the Project Area. However, previous terrestrial surveys conducted by AECOM have not observed Common Goldeneye. This species prefers larger trees, available in mixed upland woods around the margins of the larger lakes in the Project Area. Mixed wood upland wood in this area are isolated by the large Black Spruce bogs, making them unattractive to this species since there are no nearby waterbodies offering suitable brood areas for young ducks.

Mallards (*Anas platyrhynchos*) are ubiquitous across western Canada and will nest in all available habitats. They prefer ground nesting in heavy cover but will also nest in shrubs and trees on rare occasions. Mallards prefer marshy areas on the margins of lakes and are most likely to nest in the major lakes in the Project Area. No mallards were seen in the vicinity of the Lalor site during the previous terrestrial environmental surveys. One Mallard was seen on Anderson TIA in June 2012.

Canada Geese (*Branta canadensis*) are also boreal nesters, and one was seen on Anderson TIA in June 2012. Geese do not nest in trees, preferring large accumulations of reeds and grass. They have been known to nest on beaver lodges. The dense boreal forest cover in the Project Region is not suitable goose nesting habitat. The margins of the larger lakes in the region could be potential goose nesting and brooding habitat.

Loons, mergansers and grebes are strictly over-water nesters and require large open wetlands or lake margins. The dense nature of the black spruce bog around the Lalor site does not present nesting habitat appropriate for waterfowl. The most common nesting habitat in the Project Region is the marshy edges of major lakes, and the mixed upland woods common around the margin of these lakes.

4.5 Protected Species

The Manitoba Conservation Data Centre (CDC) provides a ranking of species of conservation concern for the Churchill River Upland Ecoregion. The term “species of concern” includes species that are rare, distinct, or at risk throughout their range or in Manitoba and need 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 (**Table 4.15**).

Table 4.15 – List of Species of Special Concern in the Churchill River Upland Ecoregion

Common Name	Scientific Name	Rank
Flooded Jellyskin	Leptogium rivulare	Globally and Provincially, the species is not ranked.
Bog Adder's-mouth	Malaxis paludosa	Globally ranked demonstrably widespread, abundant, secure throughout its range, and Provincially ranked very rare.
Few-Flowered Sedge	Carex pauciflora	Globally ranked demonstrably widespread, abundant, secure throughout its range, and provincially ranked uncommon.
Few-Fruited Sedge	Carex oligosperma	Globally ranked demonstrably widespread, abundant and secure throughout its range and Provincially ranked uncommon but status is uncertain.
Fragrant Shield Fern	Dryopteris fragrans	Globally ranked demonstrably widespread, abundant, and secure throughout its range, Provincially ranked uncommon to widespread, abundant, and apparently secure.
Limestone Oak Fern	Gymnocarpium robertianum	Globally ranked demonstrably widespread, abundant, secure throughout its range, and Provincially ranked very rare.

Common Name	Scientific Name	Rank
Long-Fruited Sedge	Carex michauxiana	Globally ranked demonstrably widespread, abundant, secure throughout its range, and Provincially ranked rare.
Moor Rush	Juncus stygius ssp. americanus	Globally ranked demonstrably widespread, abundant and secure throughout its range and Provincially ranked very rare, but status is uncertain.
Northern Oak Fern	Gymnocarpium jessoense	Globally ranked demonstrably widespread, abundant, and secure throughout its range, Provincially ranked uncommon to widespread, abundant, and apparently secure.
Northern Woodsia	Woodsia alpina	Globally ranked widespread, abundant, apparently secure throughout its range, and Provincially ranked very rare.
Oregon Cliff Fern	Woodsia oregana ssp. cathcartiana	Globally ranked demonstrably widespread, abundant, secure throughout its range while its subspecies is widespread, abundant, and apparently secure throughout its range, and Provincially ranked very rare.
Pallas Buttercup	Ranunculus pallasii	Globally ranked widespread, abundant, apparently secure throughout its range, and Provincially ranked rare.
Round-Leaved Bog Orchid	Platanthera orbiculata	Globally ranked demonstrably widespread, abundant, secure throughout its range, and Provincially ranked uncommon.
Small Water-Lily	Nymphaea tetragona	Globally ranked demonstrably widespread, abundant, secure throughout its range, and Provincially ranked rare.
Smooth Woodsia	Woodsia glabella	Globally ranked demonstrably widespread, abundant, apparently secure throughout its range, and Provincially ranked rare.
Spatulate Moonwort	Botrychium spathulatum	Globally ranked uncommon throughout its range and Provincially ranked very rare.
Wahlenberg's Wood-rush	Luzula wahlenbergii	Globally ranked widespread, abundant, apparently secure throughout its range, and Provincially ranked rare.
White Beakrush	Rhynchospora alba	Globally ranked demonstrably widespread, abundant and secure throughout its range and Provincially ranked uncommon but status is uncertain.
Boreal Woodland Caribou	Rangifer tarandus caribou	Globally ranked demonstrably widespread, abundant, secure throughout its range while its subspecies is widespread, abundant, and apparently secure throughout its range, Provincially ranked widespread, abundant, and apparently secure.
Shortjaw Cisco	Coregonus zenithicus	Globally ranked uncommon throughout its range and Provincially ranked uncommon.

Source: Manitoba Conservation, 2012a

As confirmed through field observations from 2007 to 2012, the wildlife habitats within the Project Site were considered typical for the region, with no unique or rare habitats encountered. No species listed as species of special concern by the Manitoba CDC were observed in the areas examined during the biophysical surveys.

Of the 20 species listed as species of special concern by the Manitoba CDC (**Table 4.15**), six are protected species. Protected species are species that are endangered, threatened or are of special interest as defined by either Federal or Provincial legislation. In the Province of Manitoba, endangered, threatened or special interest species are protected by *The Manitoba Endangered Species Act* (*MESA*) which 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 4.16**.

Table 4.16 – 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, 2011 and Government of Canada, 2011

The Reed herd is the closest herd to the Project Region (Manitoba Conservation, 2005), whose range is located west of the Project Region. In the Federal recovery strategy plan, Environment Canada identifies 51 known ranges of Woodland Boreal Caribou in Canada (Environment Canada, 2012b). One of the ranges, Manitoba North, overlaps with the Project Region but is identified as a conservation unit, reflecting the low level of certainty regarding the boundaries of the range. Although the Project Region contains potentially suitable habitat for Boreal Woodland Caribou, there are no known herds whose range overlaps with the Project Region.

The extent of the recently discovered population of Flooded Jellyskin near Flin Flon, Manitoba is not known. This lichen was found in Peyuk Lake, 30km east of Flin Flon and 93km west-south-west from the Lalor site (COSEWIC, 2004). This is also the northern-most occurrence of this species. There is no overlap with this species' range with the Project Region.

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 Project Region falls within the limits of the species' distribution; however no monarch butterfly were spotted during the terrestrial investigations.

The range of the Northern Leopard Frog does overlap with the Project Region and none were spotted during the terrestrial investigations.

According to the COSEWIC status report, occurrences of Shortjaw Cisco in Manitoba include (distance and direction from Lalor site in parenthesis): Athapapushkow Lake (104 km WSW), Clearwater Lake (106 km SW), Reindeer Lake (288 km NW), George Lake (603 km SE), Lake Winnipeg (409 km SE), and Lake Winnipegosis (306 km S) (COSEWIC, 2003). There have been no reported occurrences in the Grass River sub-basin in the Nelson River Basin, within which the Lalor site resides.

The known distribution of the Yellow Rail in Manitoba is scattered in locations south of the Boreal Shield Ecozone and is concentrated in the Boreal Plains and Aspen Parkland portions of the Prairie Ecozone (COSEWIC, 2009). There is potential for them to occur in the Ecozone but there are no known occurrences of Yellow Rail within the Project Region.

4.6 Socio-Economic Environment

The Project Site is located inside the municipal boundaries of the Town of Snow Lake. The Snow Lake Mining District has been developed for mining purposes for over 50 years.

4.6.1 Parks and Natural Areas

There are no national or Provincial parks in the Project Site or the Project Area. The only Provincial park in the Project Region is the Wekusko Falls Provincial Park.

Wekusko Falls Provincial Park (0.88 km^2) is located approximately 15 km southeast of the Lalor site. The Park flanks the Grass River as it drops 12 m over a series of rapids and falls, known as Wekusko Falls. The Park is classified as a Recreation Park. (Manitoba Conservation, 2012b).

The Grass River Provincial Park (2,279 km^2) is located approximately 25 km southwest of the Project Site. This Provincial park is also classified as a Natural Park and its purpose is to preserve natural areas that represent the Churchill River Upland portion of the Precambrian Boreal Forest. Woodland Caribou are found year round throughout the park, and usually in areas with mature forest and treed muskeg. (Manitoba Conservation, 2012c).

The Cormorant Provincial Forest (1,479 km^2) is located approximately 80 km southwest of the Project Site. The Provincial forest was established in 1947, and is the most northern Provincial forest. The park includes Clearwater Lake Provincial Park, extensive cross country ski trails and a ski chalet used by Manitoba Forestry for education. (Manitoba Conservation, 2012d)

The Clearwater Lake Provincial Park (593 km^2) is located approximately 105 km southwest of the Project Site. The park is characterized by Clearwater Lake which comprises almost half of the park. The park is classified as a Natural Park, with a purpose to preserve areas representative of the Mid-Boreal portion of the Manitoba Lowlands Natural Region; while accommodating diversity of recreational and resource use. (Manitoba Conservation, 2012d)

The Saskeram Wildlife Management Area (WMA) is located approximately 130 km southwest of the Project Site, occupies an area of 958 km^2, and encompasses a large portion of the Saskatchewan River delta and floodplain, providing breeding and staging area for waterfowl, and habitat for moose, wolves, black bears, and furbearers. (Manitoba Conservation, 2012e)

The Tom Lamb WMA is located approximately 85 km southwest of the Project Site and occupies an area of 2,083 km^2. Area within the WMA is flat with several limestone ridges and river levees with Aspen, jack pine, and black spruce growing along the ridges and poplar, willow Manitoba maple and green ash growing along the levees. The WMA is a breeding and staging area for waterfowl and provides habitat for furbearers, moose, wolves and black bears. Bald eagles use the WMA for feeding, staging and occasionally for nesting. (Manitoba Conservation, 2012f)

Figure 14 shows the above-mentioned parks and natural areas.

4.6.2 Heritage Resources

Information from the Historic Resources Branch of Manitoba Culture, Heritage and Tourism indicates that there are no known historic or heritage resources in the Project Site or the Project Area. **Figure 15** shows the location of known sites found within the Project Region.

4.6.3 Economy

4.6.3.1 Town of Snow Lake

According to the 2011 census data from Statistics Canada, Snow Lake has a population of 723 (Statistics Canada, 2012a) with the majority of these residents employed at, or supported by, the mines located throughout the area.

Many other Snow Lake residents are employed in the industries and services that support the region's mining operations.

The Snow Lake area has had an active mining history for more than 50 years. HBMS has played an integral part in this history since the late 1950's by operating nine mines in the area including Photo Lake, Rod, Chisel Lake, Stall Lake, Osborne Lake, Spruce Point, Ghost Lake, Anderson Lake and Chisel North Mine.

In addition to mining activities, extensive forestry operations have occurred within the region and surrounding area, with wood sent to the pulp and paper mill operation in The Pas, Manitoba. Trapping and hunting are also popular activities in the region.

4.6.3.2 City of Flin Flon

According to the 2011 census data from Statistics Canada, the City of Flin Flon has an approximate population of 5,592 people (Statistics Canada, 2012b; Statistics Canada, 2012c). The City of Flin Flon is the main mining community in northwestern Manitoba and northeastern Saskatchewan. Flin Flon is located just over 800 km northwest of Winnipeg, Manitoba, and 120 km west of the Town of Snow Lake. The community occupies portions of both Manitoba and Saskatchewan.

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

4.6.4 Community Infrastructure and Services

4.6.4.1 Town of Snow Lake

The Town of Snow Lake is situated mid-way between Thompson, Flin Flon and The Pas. Year-round road access is provided to Snow Lake by PR 392. The community is serviced directly by Manitoba Hydro transmission lines and has telephone access through Manitoba Telecom Services Inc. Potable water is obtained from Snow Lake, and is treated in a water treatment plant in the Town of Snow Lake.

In 2011, HBMS announced a $2 million commitment to the Town of Snow Lake to assist in funding the municipality's new waste water treatment plant, and a $100,000 contribution towards repair of the roof of the Snow Lake Community Hall.

4.6.4.2 City of Flin Flon

Access to Flin Flon is along paved Provincial Trunk Highway 10 from The Pas and Southern Manitoba, Provincial Trunk Highway 39 from Snow Lake and Thompson, and Highway 106 from Saskatchewan. Flin Flon is serviced directly by Manitoba Hydro transmission lines and has telephone and cellular access through Manitoba Telecom Services Inc.

The City of Flin Flon operates an airport located 20 km southeast of the city near Baker's Narrows. Other services such as a hospital, a fire hall, and an RCMP station are located in Flin Flon along with a hockey arena, curling rinks, a golf course, a public swimming pool and numerous sports fields for recreational opportunities (City of Flin Flon, 2013).

Since 2010 alone, HBMS has donated approximately $781,000 to support programs in the Flin Flon area, in addition to providing in-kind services and offering use of HBMS facilities for community events.

4.6.5 Community Services

4.6.5.1 Town of Snow Lake

The Town of Snow Lake has various community services including: a health facility that is staffed by two doctors, a grocery store, two hotels/motels, two service stations, a hockey arena, a curling rink and a nine-hole golf course. There is an un-serviced gravel municipal airstrip located approximately 20 km east of the proposed Lalor Concentrator, along PR 393, which is designed to accommodate air ambulances for medical evacuations. Other services include an RCMP station, and a volunteer fire department. There are also numerous recreational opportunities include camping; hiking trails, fishing, snowmobiling and all-terrain vehicle trails (Snow Lake, 2012).

4.6.5.2 City of Flin Flon

The City of Flin Flon operates an airport located 20 km southeast of the city near Baker's Narrows. Many other facilities and services are located in Flin Flon, including the Flin Flon General Hospital, five doctors, two dentists, two grocery stores, two day cares, a fire hall and a police/RCMP station, along with recreational facilities, such as a hockey arena, curling rinks, a drive-in theatre, a golf course, a public swimming pool and numerous sports fields. There are two high schools located in Flin Flon, Hapnot Collegiate and Many Faces Education Centre. (City of Flin Flon, 2013).

4.6.6 Personal, Family, and Community Life

4.6.6.1 Town of Snow Lake

Some of the larger community events held in Snow Lake include the Winter Whoot Festival and the Sno-Drifters Radar Runs. Other events include Bingo and Texas Hold'em that are held at the Royal Canadian Legion #241 (Snow Lake, 2012).

4.6.6.2 City of Flin Flon

Various community events are held in Flin Flon during the year. Some of these include: The Friendship Center Sled Dog Races, Baker's Narrows Day, Phantom Lake Father's Day Picnic and the Trout Festival. Other smaller events include a Spring Breakout Program, Canada Health Day Event, Terry Fox Run and the Christmas Family Event (City of Flin Flon, 2013).

4.6.7 Regional Resource Use

4.6.7.1 Trappers

The Manitoba Conservation office in Snow Lake has confirmed that there are two registered trap lines (RTLs) in the area of Cook Lake and Lalor Lake. These lines include RTL 23 and RTL 14 that are owned by Martin McLaughlin and Jim Schollie, respectively. Manitoba Conservation has confirmed that the area of Anderson Creek and Wekusko Bay is registered as RTL 13. This trap line is owned by Russell Bartlett (assisted by Greg Foord). **Figure 16** shows these trapline boundaries.

4.6.7.2 Cottages or Remote Residences

The closest cottages and remote residences are the cabin subdivisions on Berry Bay, Taylor Bay, and Bartlett's Landing. Cottages on Cook Lake are seasonal, while those along Berry and Anderson Bay are all season. The five cabins along Cook Lake have only been on the lake in the last 15 years and according to the local By-laws, five cabins is the maximum allocation on the lake, as established by Manitoba Conservation. **Figure 16** shows temporary, seasonal and permanent residences in the Project Region.

4.6.7.3 Lodge Owners

There are five lodges located in the Snow Lake region. The Diamond Willow Inn & Willow House is located in the Town of Snow Lake at 200 Lakeshore Drive and is approximately 9 km east of the Concentrator Facility site. Wekusko Falls Lodge and Tawow Lodge Ltd. (Herb Lake Landing) are located approximately 18 km and 35 km southeast of the Concentrator Facility site, respectively. Burntwood Lodge is a fly in fishing lodge located on Burntwood Lake and is estimated to be approximately 60 km northwest of the Lalor Site. Grass River Lodge is located on Reed Lake and is approximately 23 km southwest of the Lalor Site with outpost cabins on Dolomite Lake (50 km southwest of the Lalor Site) and Moody Lake (40 km northwest of the proposed Lalor Site).

4.6.7.4 Snowmobilers

The Snow Lake area is home to the Snow Lake Sno-Drifters snowmobiling club. Current snowmobile trails are indicated on **Figure 16**.

4.6.7.5 Forestry

As indicated in **Section 4.6.1**, the Cormorant Provincial Forest is located approximately 80 km southwest of the proposed Lalor Concentrator facility site and covers an area of 1,479 km^2. Provincial forests are Crown lands managed by Manitoba Natural Resources on a sustainable yield basis. A license or permit allows harvesting of trees on Crown lands and indicates quantities of each type of trees that can be harvested. Harvesting companies must regenerate forest lands that they have harvested according to their Forest Management License. A forest renewal fee is paid by individuals or small companies for reforestations. (Manitoba Conservation, 2012g).

4.6.7.6 Fisheries – Recreational and Commercial

Small to medium lakes in the Project Area include Arm Lake, Gaspard Lake, Ghost Lake, Nutt Lake, Threehouse Lake and Unnamed Lake 1. It has been determined that these lakes do not provide habitat for large-bodied fish and are therefore, limited in their recreational value. Larger lakes in the Project Area include Snow Lake and Wekusko Lake. Snow Lake and Wekusko Lake supports a variety of fish species throughout the year.

Given its proximity to the Town of Snow Lake, there are recreational opportunities such as fishing, swimming, canoeing and snowmobiling in and around the Project Region. There was a commercial gill net fishery in Snow Lake from 1989-90 targeting Lake Whitefish but was discontinued due to the high by-catch (~41% of round weight) of Walleye and Northern Pike (*pers comm*. Grant McVittie). Anecdotal evidence exists of a failed commercial trap net fishery in 1998 (*pers comm*. Grant McVittie). Wekusko Lake has had a commercial fishery since 1931 with the current limits of 65,800 kg set in 1991.

4.6.8 First Nations

HBMS has operated in the Snow Lake district for over 50 years. It has been in continuous occupation of the site of the Concentrator component since 2007. The route of the proposed Pipeline system is adjacent to a highway used for industrial traffic or is on land that has been under use, occupation and control by HBMS for decades. Much of it is on land owned in fee simple by HBMS.

The project does not require access to, use or occupation of, or the exploration, development and production of lands and resources currently used for traditional purposes by Aboriginal peoples. All elements of the proposed Lalor Concentrator will be on land which HBMS holds under lease or in fee simple, and is occupied and used by HBMS for mining purposes as follows:

- The concentrator component lies within the Lalor site, which has been developed for the Lalor AEP/future Lalor Mine Project. It lies on land that has been under continuous use for mining purposes since at least 2007.
- Portion 1 of the Pipeline System, which follows the Lalor Access Road, lies on land which is controlled by gated access, and which has been under continuous use by HBMS for mining purposes since at least 2007.
- Portion 2 of the Pipeline System tracks PR 395, which is in daily use for industrial traffic. In addition, Provincial regulations prohibit hunting within 300 m of roadways.
- Portion 3 of the Pipeline System falls within the ROW for a former rail bed, which is owned by HBMS pursuant to Certificate of Title No. 1701932. This is private land to which Aboriginal peoples do not have a right of access.
- Portions 4, 5, and 6 of the Pipeline System are located on land which the proponent has used for mining purposes since the late 1970's. These portions lie behind the gates of existing HBMS projects, which excludes users other than the proponent, on land that has been taken up for mining purposes for over 30 years.

Based on Government of Manitoba and Federal sources, there is no Indian Reserve, Registered Trap Line (RTL) zone associated with First Nation/Aboriginal community use or other Aboriginal interest located within the Project Region. The First Nations in closest proximity to the Project Region are the Mathias Colomb Cree Nation (MCCN), Nisichawayasihk Cree Nation (NCN), Mosakahiken Cree Nation (MCN), Opaskwayak Cree Nation (OCN), Cross Lake First Nation and Norway House Cree Nation. **Figure 17** illustrates the locations of these First Nations relative to the Project Region.

Pukatawagan, home to MCCN, is located approximately 122 km northwest of Snow Lake, and is geographically closest to the Project Site. According to the 2011 census from Statistics Canada, Pukatawagan had a population of 1,826, reflecting an increase of 23.5% from the 2006 population (Statistics Canada, 2012d). 2006 census for Mathias Colomb reported a population of 1,576 (Statistics Canada, 2007a).

NCN is approximately 129 km northeast of the Project Site. According to the 2006 census data, NCN had a population of 2,096, up by 22.6% from 2001. Labour force participation rate was reported as 39.3%, with an employment rate of 29.3% and an unemployment rate of 26.6% (Statistics Canada, 2007b).

MCN is approximately 131 km south of the Project Site. According to the 2006 census data, the population count was reported at 698. Labour force participation was 37.6%, employment rate was 27.1% and the unemployment rate was 28.1% (Statistics Canada, 2007c).

OCN is approximately 137 km southwest of the Project Site. According to the 2006 census data, the population of OCN was 2,578, reflecting an increase of 6% from 2001. Labour force participation rate was 54.5%, employment rate was 42% and unemployment rate was 23% (Statistics Canada, 2007d).

Cross Lake First Nation is approximately 155 km southeast of the Project Site. According to the 2011 census data, the population of Cross Lake First Nation was reported to be 326, reflecting a 19.7% decline from the 2006 population (Statistics Canada, 2012e).

Norway House Cree Nation is approximately 182 km southeast of the Project Site. According to the 2011 census data, Norway House had a population of 4,758, reflecting a 16.9% increase from 2006 (Statistics Canada, 2012f).

As discussed below in **Section 8**, during the latter half of 2010, Mathias Colomb Cree Nation (MCCN) began to suggest that its traditional lands encompass a large portion of northwestern Manitoba, including the entire Snow Lake mining district, in which the Lalor projects, including the proposed Lalor Concentrator, are located. HBMS therefore entered into information sharing with MCCN and Manitoba commenced a Crown consultation process in relation to HBMS' proposed Lalor Mine. HBMS information sharing also has included Lalor Concentrator.

As well, HBMS and Manitoba funded a traditional use and knowledge study by an expert of MCCN's choice, but MCCN has instructed the expert to stop work on the report of the study. Therefore it is not known if there are any traditional uses by MCCN in the Project Region.

5. Environmental Effects Assessment and Mitigation Measures

5.1 Effects Assessment Methods

This section contains the results of the environmental assessment.

Applying professional judgment and a thorough understanding of the components of the proposed project (outlined in **Section 2** of this application); AECOM determined the potential for each component of the proposed project to interact with each environmental component (presented in **Table 3.1** above). The assessment includes any effects on social components resulting from residual adverse environmental effects.

As indicated in **Section 3**, the assessment takes into account mitigation measures that have been incorporated into the proponent's proposed plan, as well as environmental protection practices and procedures included in the proponent's standard of operation (such as compliance with ISO certified safety and environmental management systems). The assessment includes AECOM's assessment of the sufficiency of such measures and also considers and makes recommendations for any additional measures which, in our view, would be advisable. The assessment of significance of any residual effects is based on the magnitude, spatial scope, duration, frequency and reversibility of that effect.

Environmental effects that may be caused as a result of accidents and malfunctions are discussed separately in **Section 5.11**. Definitions of the terms used to guide the effects assessment are provided in **Table 5.1**.

Table 5.1 – Terms Used in Effects Assessment

<table>
<tr><th>Project Phase:</th><th colspan="5">Refers to the phase of the project as construction, operation and maintenance (“Operation”), or closure.</th></tr>
<tr><td>Potential Effect:</td><td colspan="5">Potential change that the proposed project may cause in the environment.</td></tr>
<tr><td>Magnitude of Effect:</td><td colspan="5">Refers to the estimated percentage of population or resource that may be affected by activities associated with the construction, operation and closure of the Lalor Concentrator. Where possible and practical, the population or resource base has been defined in quantitative or ordinal terms (e.g., hectares of soil types, units of habitat). Magnitude of effect has been classified as less than (<) 1%, 1% to 10%, or greater than (>) 10% of the population or resource base.

Where the magnitude of an effect was determined as virtually immeasurable and represented a non-significant change from background in the population or resource, the effect was considered negligible. An exception to this is in terms of potential human health effects where, for example health issues due to water-borne diseases amounting to 1% of the population being affected would still be considered major.</td></tr>
<tr><td>Direction of Effect:</td><td colspan="5">Refers to whether an effect on a population or a resource is considered to have a positive, adverse or neutral effect.</td></tr>
<tr><td>Duration of Effect:</td><td colspan="5">Refers to the time it takes a population or resource to recover from the effect. If quantitative information was lacking, duration was identified as short-term (<1 year), moderate term (1 to 10 years) and long term (>10 years).</td></tr>
<tr><td>Frequency</td><td colspan="5">Refers to the number of times an activity occurs over the project phase, and is identified as once, rare, intermittent, or continuous.</td></tr>
<tr><td>Scope of Effect:</td><td colspan="5">Refers to the spatial area potentially affected by the effect and categorized as Project Site, Project Area or Project Region as defined in Section 3.2. Where possible, quantitative estimates of the resource affected were provided.</td></tr>
<tr><td>Reversibility:</td><td colspan="5">Refers to the extent to which an adverse effect is reversible or irreversible over a 10-year period.</td></tr>
<tr><td>Residual Effect:</td><td colspan="5">A qualitative assessment of the residual effect remaining after implementing appropriate measures.</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td>Magnitude of Effect</td><td>Direction of Effect</td><td>Duration of Effect</td><td>Frequency</td><td>Scope of Effect</td><td>Reversibility of Effect</td></tr>
</table>

Project Phase:	**Refers to the phase of the project as construction, operation and maintenance (“Operation”), or closure.**				
Negligible (immeasurable)	Positive	Short term (< 1 year)	Once	Project Site	Reversible
Minor (<1%)	Adverse	Moderate (1 to 10 years)	Rare	Project Area	Irreversible
Moderate (1 to 10%)	Neutral	Long term (>10 years)	Intermittent	Project Region	
Major (>10%)			Continuous		

5.2 Topography

Sources of changes to site topography include activities such as clearing, blasting, levelling, trenching or stockpiling materials. Although the area of the Concentrator component (the jaw crusher building, concentrator building, load-out shed, electrical yard and the paste backfill module) has already been levelled as a part of the Lalor AEP, some additional blasting, leveling, and clearing may be required. However, these activities have already been approved under the AEP. Therefore, changes to topography during construction of the Lalor Concentrator will be minimal.

With respect to the Pipeline System component, as described in **Section 2.1.5**, small portions of the existing rail bed will require additional clearing (4.4 ha), blasting and levelling to create the Right-of-Way (ROW) for the tailings and water pipes. The closure phase will include re-vegetation and restoration of any changes to topography of the site to match the pre-construction condition of the surrounding area to the extent practical. Therefore, effects on topography from clearing are assessed to be negligible.

Along the Pipeline System ROW, blasted rock will be stockpiled and used to build turnaround bays, which will also be used to store materials (*e.g.,* pipe) during construction. The change in topography from blasting will be permanent. However, the amount of blasting required is minimal, is occurring in an area that is already disturbed and is immediately adjacent to PR 395, and therefore the impact on topography from blasting is assessed to be minor.

5.3 Soil

5.3.1 Acid Rock Drainage

Ore that comes from the Lalor Mine to be processed at the Lalor Concentrator would be potentially acid generating over time. PAG rock has the potential, when exposed to air and water, to create acid rock drainage (ARD). ARD also has the potential to release metals from the waste rock or dust from the waste rock which can increase metal concentration in soil. ARD and elevated metal concentrations can potentially cause a decline in soil quality, which can in turn affect vegetation, groundwater (seepage), or surface water (runoff).

As outlined in **Section 2.1.1**, HBMS has incorporated the following measures designed to prevent generation of ARD:

- The stockpile will be covered with a “cover-all” fabric, and be surrounded by a 1.5 m high concrete berm, which will prevent precipitation and minimize exposure to wind.
- The waste rock pad will be lined with NAG rock (crushed limestone), which will minimize any generation of ARD due to moisture already present in the ore.
- The base of the ore stockpile will be lined with a synthetic liner to prevent penetration of leachate.
- The ground around the stockpile will be graded to direct any runoff towards a sump-pump.

In addition, HBMS will continue to monitor the stockpile for any signs of potential ARD on site.

In our view, the measures identified above are sufficient to minimize the generation of ARD to the extent necessary, and therefore any consequential effects on soil quality are assessed to be negligible.

5.3.2 Materials and Waste Management

Wastes such as sewage from the sewage treatment plant, used oils, rags, drums and miscellaneous garbage can potentially affect soil quality, which can in turn affect other environmental components (vegetation, groundwater, surface water). To prevent adverse effects on soil quality from wastes, HBMS will undertake the following waste management practices:

- Wastes generated during operation will be collected in garbage bins maintained at specific locations throughout the Lalor site. The bins will be emptied on a regular basis for recycling or disposal at a licensed waste disposal facility.
- Waste oils and other hazardous materials generated (chemicals, reagents, waste oil, lubricants or petroleum products) will be removed by a licensed hazardous materials handler for appropriate disposal or recycling.

In our opinion, the measures listed above will be sufficient and therefore effects on soil quality from wastes are assessed to be negligible and insignificant.

5.3.3 Erosion

High wind and precipitation events can lead to soil erosion, which can consequentially affect other environmental components (such as air quality through dust generation, water quality in streams through sediment loading or vegetation through dust deposition). Since the site for the Concentrator has already been cleared, levelled and covered with crushed limestone as a part of the Lalor AEP, construction and operation of this component will not include activities likely to result in soil erosion.

There is potential for soil erosion to occur during construction along the route the Pipeline System (such as clearing, grubbing, replacing culverts), which could consequentially affect water quality along the route. However, any activities that occur near culverts along the route will be carried out in accordance with applicable DFO Operational Statement(s) or other applicable standards.

Closure activities will involve application of soil to all disturbed areas, and re-seeding the Project Site with species native to the area. The following measures will minimize soil erosion and any consequent effects on other environmental components:

- The site will be contoured to match the surrounding topography to the extent possible.
- Re-vegetation will occur as soon as possible following application of soil.
- Re-vegetation efforts will be monitored until vegetation has re-established with additional re-vegetation activities occurring as required.

In our opinion, the measures listed above for construction, operation and closure will be sufficient to mitigate soil erosion. Therefore, residual effects are assessed to be not significant.

5.4 Air

5.4.1 Dust

Sources of dust include activities such as blasting, clearing, levelling, crushing, movement of traffic on roads, stockpiling materials, etc. Dust occurs primarily during summer and fall, with greater likelihood for an increase in dust during dry and windy conditions.

All clearing, levelling and blasting at the Lalor site will have been completed before construction of the Concentrator. The potential for generation of dust during construction of the Concentrator component therefore is limited to vehicular use and will be minimal. Dust may be produced along the Pipeline System ROW during construction (clearing, blasting, and laying down the pipes, stockpiling, and general use of construction equipment). Blasting is only anticipated to occur within a small portion of the ROW (area south of PR 395, and only once during spring of 2014). Therefore, dust from blasting during construction is expected to be minimal.

During operation, dust will be generated in the jaw crusher building (during operation of the jaw crusher) and by vehicle and equipment movement on site and along the Lalor Access Road and the Pipeline System ROW. **Section 2.10** outlines traffic volumes expected during the operation phase. The concentrate trucks will travel along the Lalor Access Road to PR 395 to PTH 39 to PTH 10. Since PTH 39 and PTH 10 are both paved roads, dust generation from concentrate haul trucks along these roads is expected to be minimal.

During closure, activities such as levelling, contouring, excavating and hauling materials and soils to the site will generate some dust.

To reduce dust generation at the Project Site and within the Project Area, the following mitigation measures will be implemented:

- The jaw crusher building is equipped with a wet scrubber (dust collection system) as described in **Section 2.1.1.1**.
- If required, dust suppression activities such as the use of approved dust control agents, will be undertaken for the Lalor Access Road and the Pipeline System ROW.
- The Lalor site has a speed limit of 20 km/hr, which will continue to be imposed.
- The Lalor Access Road has a speed limit of 40 km/hr, which will continue to be imposed. The same speed limit (or less) will apply to the Pipeline System ROW.
- Concentrate trucks going to Flin Flon will be covered to minimize dust coming off loads.

In our opinion, the mitigation measures proposed above are sufficient to mitigate any adverse effects due to dust during the construction, production and closure phases. Residual effects on air quality are therefore assessed to be negligible.

5.4.2 Emissions

During construction, exhaust emissions will be generated during delivery of materials to the site, laying foundations, erecting buildings and other operation of vehicles. Emissions will also be generated during construction of the Pipeline System (using diesel-fuelled equipment, clearing, blasting, grubbing, laying pipes, etc.).

During closure, emissions will be generated during hauling, excavating, grading, and placing materials. Approximately five pieces of equipment (excavator, bulldozer, haul trucks, and miscellaneous equipment) are anticipated to be required for closure-related activities (some of these may be used in conjunction with closure activities at the Lalor Mine, depending on the timing of closure). Emissions from these are anticipated to be limited to the Project Site and the Project Area and mainly occur during summer months over the three years during which closure activities are being undertaken.

The following mitigation measures will be implemented:

- Vehicles and equipment will be well maintained
- Vehicle idling will be kept to a minimum

During operation, sources of exhaust emissions include: vehicle and equipment use and propane combustion (to heat the concentrator building). As indicated in **Section 2.10**, it is expected that, during construction, a maximum of 66 vehicles and, during operation, a maximum of 25 vehicles will access public roads in vicinity of the Lalor Concentrator. **Table 5.2** presents the percentage changes associated with these numbers.

Table 5.2 – Traffic Changes

	PR 395	PR 392	PTH 39	PTH 10
AADT (MIT, 2011)[1]	520	270 to 510	310 to 390	1180 to 2490
Maximum Vehicles - Construction Phase	66	66	26	26
Percentage Change	13%	13% to 24%	7% to 8%	1% to 2%
Maximum Vehicles - Operation Phase	25	25	25	25
Percentage Change	5%	5 to 9%	6% to 8%	1% to 2%

Notes:

[1] The numbers presented represent the range of AADT along the route between the Lalor Concentrator and the City of Flin Flon.

While the increase in traffic during construction along PR 395 and PR 392 is greater than 10%, this increase is temporary, and exhaust emissions as a result of this increase are negligible in relation to air quality in the Project Region. Also, any increases in traffic due to the Lalor Concentrator will be offset by traffic reductions due to ore from Lalor Mine being processed at Lalor Concentrator instead of the Stall Lake Concentrator (*i.e.,* 24 trucks). All vehicles used for the Lalor Concentrator will comply with Environment Canada's On-Road Vehicle and Engine Emission Regulations as required.

The second source of exhaust emissions is propane heaters that will be used to heat the Concentrator. The combustion process associated with these propane heaters will generate pollutants which may include nitrogen oxides (NOx), carbon monoxide, sulphur dioxide, particulate matter, or greenhouse gases. However, in order to mitigate any adverse effects on air quality (and hence ensure good air quality), the following measures will be implemented:

- The heating system has been equipped with low NOx burners
- HBMS will maintain ongoing compliance with *The Workplace Safety and Health Act*.

These measures are judged to be sufficient to mitigate any adverse air quality effects during the construction, operation and closure phases of the proposed project. Following closure, air quality is expected to return to pre-project conditions. Therefore, potential effects are considered reversible and not significant.

5.4.3 Noise and Vibration

An increase in noise levels at the Project Site and within the Project Area could potentially affect people, wildlife and infrastructure (from vibration) in the surrounding area. Potential effects of noise on wildlife are discussed in **Section 5.9.2**.

Sources of noise during construction would be typical of heavy equipment such as haulage trucks, graders and excavators. Noise and vibration will also be generated when blasting is undertaken for the Pipeline System ROW.

Other human receptors within the general vicinity of the Project Site include cottages, remote residences and lodges. The closest residences are at the Town of Snow Lake (approximately 8 km east of the site of the Concentrator). The closest cottages and remote residences are the seasonal cottages on Cook Lake (1 km), and the cabin subdivisions on Berry Bay, Taylor Bay and Bartlett's Landing (approximately 14 km southeast). These receptors are too distant to be disturbed by everyday noise at the Project Site. For these reasons, the focus of the assessment of noise-related effects is for employees working at the Project Site.

During the operation phase, sources of noise include operation of the jaw crusher, exhaust fans, vehicle movement, trucks loading/unloading (concentrate or other materials for operation), compressors, generators, pumps, and other general equipment used on site.

Measures to mitigate noise related effects for employees on the Project Site include:

- Blasting will be limited to the south side of PR 395, will occur once and in accordance with applicable regulations made under The Workplace Safety and Health Act.
- The gensets being used at the Project Site are housed in factory designed-built enclosures to minimize noise.
- The jaw crusher is being enclosed in a building, with engineered noise-controls to minimize noise levels at the Project Site.
- In accordance with Part 12 of Hearing Conservation and Noise Control Regulation, and CAN/CSA Standard-Z107.56-06, Measurement of Occupational Exposure to Noise, an initial noise exposure assessment will be undertaken prior to commissioning, and appropriate measures implemented (such as hearing protection), depending on the results of the assessment. During operation and closure, a re-assessment will be done if any alterations, renovations or repairs of the workplace are undertaken.
- HBMS will provide hearing protection as required to ensure employees working on site are protected from noise during production and closure activities.
- All closure activities will be carried out in accordance with The Workplace Safety and Health Act and HBMS' Occupational Health and Safety Standard (OHSAS) 18000 certified management system, which will avoid potential effects on health and safety.

Noise levels from vehicular movement along PR 395, PR 392, PTH 39 and PTH 10 during the construction and operation phase would be typical of levels experienced along major roadways and are hence assessed to be insignificant. Based on the vegetated nature of land between the Project Site and the surrounding area and the intermittent nature of noise from project activities, noise levels from the project are not expected to cause disturbance to human receptors off site. The mitigation measures listed above are judged to be sufficient to mitigate any potential noise-related effects on site. Therefore, residual effects from noise are assessed to be insignificant.

All blasting for the site of the Concentrator will have been completed as a part of the Lalor AEP. Blasting for the Pipeline System ROW will only occur once, and be limited to one site, south of PR 395. The nearest receptor to the site of the blasting activity around PR 395 is Town of Snow Lake (approximately 6 km northeast). The cottages on

Berry Bay and Taylor Bay are approximately 10 km southeast and the Wekusko Falls Lodge is approximately 11 km southeast. Further, blasting is a common occurrence in the region given other mining activity, and there are no known impacts on infrastructure attributed to blasting activities in the Town of Snow Lake or the City of Flin Flon. Based on these reasons, blasting is not anticipated to affect infrastructure in the Project Area or Project Region and therefore effects from blasting are assessed to be negligible and insignificant.

5.5 Climate

Sources of greenhouse gas (GHG) emissions for the proposed project are: vehicles, exhausts from diesel construction equipment (general vehicle movement on site, using equipment for grading, placing materials etc.) and combustion of propane in propane heaters.

The GHG generating consumption expected for construction and operation of the proposed Lalor Concentrator is presented in **Table 5.3**.

Table 5.3 – GHG Generating Consumption

Fuel Type	Construction (Quantity/year)	Operation (Quantity/year)
Diesel (Stationary)	0	11.7 kL
Diesel (Mobile)	758.6 kL	20.1 kL
Propane	0	58.6 kL
Limestone[1]	0	3,258 t
Electricity[2]	0	77,378 MWh

Notes:
[1] The limestone may contain a small fraction of impurities that could contribute to the GHG emissions
[2] Electricity will be obtained from Manitoba Hydro's electrical grid, which is primarily produced from hydroelectric sources.

Using the emission factors referenced from the *National Inventory Report 1990-2010* (Environment Canada 2012) and based on the fuel consumption during construction phase provided in **Table 5.3**, the CO_2 emission projection is provided in **Table 5.4**.

Table 5.4 – CO_2 Emission Projection – Construction Phase

Fuel	Quantity		CO2		CH4		N2O	
			Factor	Tonnage	Factor	Tonnage	Factor	Tonnage
Heavy Oil	0	kL	3.124	0	0.000120	0.000	0.000064	0.000
Gasoline	0	kL	2.289	0	0.000240	0.000	0.000580	0.000
Diesel (Stationary)	0.0	kL	2.663	0	0.000133	0.000	0.000400	0.000
Diesel (Mobile)	758.6	kL	2.663	2,020	0.000140	0.106	0.000082	0.062
Propane (Heating)	0.0	kL	1.510	0	0.000024	0.000	0.000108	0.000
Limestone	0	t	0.003	0	-	-	-	-
ODS (R-22)	0.000	t	1700	0	-	-	-	-
Electricity	0	MWh	0.003	0	0.0000001	0.000	0.0000001	0.000
CO2 Equivalency Factor			1	2,020	21	2	310	19
Total CO2e Emission				2,042 tonnes				
Total CO2e Emission (excluding Electricity)				2,042 tonnes				

Total CO_2 emission projection for the operation phase is provided in **Table 5.5.**

Table 5.5 – CO_2 Emission Projection – Operation Phase

Fuel Type	Quantity		CO2		CH4		N2O	
			Factor	Tonnage	Factor	Tonnage	Factor	Tonnage
Heavy Oil	0	kL	3.124	0	0.000120	0.000	0.000064	0.000
Gasoline	0	kL	2.289	0	0.000240	0.000	0.000580	0.000
Diesel (Stationary)	11.7	kL	2.663	31	0.000133	0.002	0.000400	0.005
Diesel (Mobile)	20.1	kL	2.663	54	0.000140	0.003	0.000082	0.002
Propane (Heating)	58.6	kL	1.510	88	0.000024	0.001	0.000108	0.006
Limestone	3,258	t	0.003	11	-	-	-	-
ODS[1] (R-22)	0.000	t	1700	0	-	-	-	-
Electricity	77,378	MWh	0.003	232	0.0000001	0.008	0.0000001	0.008
CO2 Equivalency Factor			1	416	21	0	310	6
Total CO2e Emission				423 tonnes				
Total CO2e Emission (excluding Electricity)				188 tonnes				

[1] Ozone depleting substance

Using the 20,300,000 tonnes of GHG emissions reported in 2011 for the Province of Manitoba (Environment Canada, 2011), an addition of 2,042 tonnes in total (or approximately 764 tonnes/year) during construction represent a negligible increase of 0.004% in GHG emissions. Further, an addition of 423 tonnes per year during operation represents a negligible increase of 0.002% in GHG emissions.

However, operation of the Lalor Concentrator is intended to replace operation of the existing Stall Lake Concentrator. CO_2e emissions from the existing Stall Concentrator in 2012 amounted to 731 tonnes CO_2e per year. As shown above in **Table 5.5**, the proposed Lalor Concentrator will result in only 423 tonnes CO_2e. This represents a 42% decrease in CO_2e tonnes with the newer facility while significantly increasing the overall tonnes of ore processed.

To further minimize GHG emissions from project activities, the following mitigation measures will be implemented:

- Idling at the Project Site will be kept to a minimum (while waiting for concentrate trucks to load for example)
- Vehicles and equipment will be maintained in good working condition

Given the negligible increase in emissions, and with implementation of the mitigation measures listed above, the overall residual effect of GHG emissions from the project is assessed to be not significant.

5.6 Groundwater

Activities such as handling fuels and lubricants, waste and ore management can potentially affect groundwater quality. Measures to avoid groundwater effects from leaks and spills are addressed in **Section 5.11.2**.

ARD could potentially affect groundwater quality (discussed above in **Section 5.3.1**). Implementation of measures outlined in **Section 2.1.1.2** to mitigate ARD from the ore stockpile will mitigate any potential effects on groundwater quality from ARD. Implementation of measures outlined in **Section 5.3** is judged to be sufficient to mitigate effects on soil quality and therefore avoid potential consequent effects on groundwater quality.

Since the proposed Lalor Concentrator will not be withdrawing groundwater for use during construction, operation or closure, no effects on groundwater quantity will occur.

In our opinion, with the measures identified, the residual effect on groundwater is assessed to be insignificant.

5.7 Surface Water

Surface water quality may be affected by ARD, waste management, erosion, and storage and handling of materials. Surface water quantity may be affected by water withdrawal.

5.7.1 Water Withdrawal

The withdrawal of water from waterbodies to supply freshwater to the Lalor Concentrator has the potential to adversely affect water levels in these waterbodies. It is estimated that during operation, up to 289,000 m^3/year of freshwater, withdrawn at a rate of 0.00953 m^3/second (151 US gpm), will be required at the Lalor Concentrator. HBMS is presently permitted under *The Water Rights Act* Licence No. 2011-110, to withdraw 1,150,000 m^3/year of water from Snow Lake at a rate not exceeding 0.038 m^3/s (602 US gpm). As the need for freshwater is accommodated within existing approved limits, any effect on surface waterbodies is expected to be negligible.

When operation of the Lalor Concentrator replaces operation of the Stall Lake Concentrator, the amount of freshwater drawn from this pumphouse will decrease, even though the throughput of the new Lalor Concentrator will be greater than the throughput of the existing Stall Lake Concentrator.

5.7.2 Ore and Waste Management

Section 2.1.1 outlines measures to prevent generation of ARD on site, thus minimizing effects on soil quality and consequential effects on surface water quality (surface runoff and drainage).

As outlined in **Section 5.3.2**, by implementing proper waste management practices, it is assessed that surface water quality will not be affected.

5.7.3 Surface water quality along the route of the Pipeline System

Water quality in crossings along the route of the Pipeline System could potentially deteriorate (through sediment loading, dust deposition, and erosion) from activities such as blasting and excavating. In total, the route of the Pipeline System traverses 20 locations which contain existing culverts. As outlined in **Section 4.3.1**, none of the crossings have permanent year-round water flow. The culverts requiring replacement are associated with crossings with intermittent flow. Therefore, any potential changes in water quality during construction would be localized.

Blasting will only occur south of PR 395. The nearest culvert to this location is approximately 500 m away, which will minimize the amount of blast residual entering the culvert. To further minimize any effects on surface water quality in these culverts during construction, all physical activities for culvert replacement will be carried out in accordance with DFO’s Operational Statement on Culvert Maintenance.

In our opinion, the measures listed above will minimize the effect of the proposed project on surface water quality within the culverts traversing the Pipeline System ROW. Therefore, the residual effects are assessed to be negligible and not significant.

5.7.4 Wastewater Management

Wastewater generated during the operation of the Lalor Concentrator will be managed using existing licensed treatment facilities. The existing facilities will continue to operate in accordance with their *Environment Act* licenses/Clean Environment Commission Orders. Environmental Effects Monitoring (EEM) conducted under the MMER for the Chisel North WTP will continue to occur throughout the operation of the Lalor Concentrator.

5.7.5 Tailings Deposition

As indicated in **Section 2.2.3**, the Anderson TIA has been in use as a tailings management facility since 1979. Tailings are evenly distributed across the northern and western shore of the TIA via a mobile floating pipe. Effluent from the TIA is discharged to Anderson Creek in accordance with the CEC Order No. 766 and the requirements of the MMER. Anderson Creek flows into Anderson Bay of Wekusko Lake.

Tailings will be generated during the operation phase and deposited into the Anderson TIA. An accidental spill along the tailings pipeline can potentially affect water quality in crossings along the Pipeline System ROW, with consequent effects on aquatic species and aquatic habitat in these crossings or downstream in waterbodies that these crossings flow into. Effluent from the Anderson TIA has the potential to affect water quality in Anderson Creek as well as downstream in Anderson Bay in Wekusko Lake, which can have secondary effects on aquatic species and aquatic habitat, and tertiary effects on traditional, recreational or commercial fishing in Wekusko Lake. Potential effects on aquatic species are addressed in **Section 5.10**, potential effects on resource use (recreational, traditional or commercial fishing) are addressed in **Section 5.12**, and effects related to accidents and spills are addressed in **Section 5.11**.

As outlined in **Section 4.3.4**, the quality of the surface water overlying tailings in the Anderson TIA was compared to the expected quality of water that will be overlying tailings produced from Lalor ore. This allowed for AECOM to understand if the water quality in the Anderson TIA would change as a result of tailings from the proposed Lalor Concentrator. Based on this comparison, it was concluded that the water quality from tailings from Lalor will have an even lower concentration of metals than tailings from the Chisel North deposit. This will further reduce the metal concentration in the effluent being discharged from Anderson TIA.

As indicated in **Table 4.5,** the current water quality in Anderson TIA does not demonstrate any exceedance of MMER criteria. Since currently there are no exceedances of MMER criteria in the Anderson TIA, it is expected that the effluent from Anderson TIA that flows into the Anderson Creek and further downstream into Anderson Bay of Wekusko Lake also will meet the required water quality guidelines.

HBMS will continue to implement the following measures to mitigate adverse effects on water quality:

- Continue weekly monitoring of the effluent discharged from Anderson TIA into Anderson Creek to ensure that it meets MMER criteria (and therefore the limits laid out under the CEC Order No. 766).
- If any exceedances occur, discharge will be shut off immediately and not resumed unless the water quality returns to acceptable limits.

Assuming implementation of the above-noted mitigation measures, in our opinion, the residual effects on water quality in Anderson Bay of Wekusko Lake are assessed to be negligible.

5.8 Protected and Other Flora Species

As described in **Section 4.5**, the Federally-protected Flooded Jellyskin (lichen species) is known to occur in the Churchill River Upland Ecoregion, and may occur in the Project Region. However, this lichen species was not observed in the terrestrial surveys that were conducted as a part of baseline investigations. Therefore, no effects on Flooded Jellyskin are anticipated as a result of the Lalor Concentrator.

5.8.1 Clearing

As noted in **Section 2.1.5**, a maximum of 4.2 ha of additional clearing will be required for the project. To determine if any of the vegetation that may be lost is considered unique or rare within the Project Site, Project Area or Project Region, the vegetation cover of the Project Site was characterized based on the information contained in the Forestry Branch of Manitoba Conservation Forest Management Units (FMU).

The FMU is the most detailed vegetation identification information available for the undeveloped portions of the province. Each FMU identifies the vegetation cover class of the FMU by identifying the species composition based on 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 used to determine a general habitat classification.

The cover classes present at the Project Site were determined by clipping the footprint of the Project Site (34.4 ha) from the FMU that covers the Project Area (7,839.4 ha) and surrounding Project Region (59,915.1 ha). The Project Site includes a total of ten different cover classes: eight vegetated cover classes, one disturbed area cover class, and one water cover class as shown in **Table 5.5.**

To determine if the vegetation was unique in the Project Site, vegetation communities that may be lost were compared to communities available in the Project Area and Project Region. The remaining undisturbed areas of these eight vegetated cover classes were calculated and the percentages of each within the Project Area and Project Region were determined. It must be noted that the Project Area and Project Region contain cover classes not found in the Project Site (with combined area over 1,562.87 ha and 14,965.47 ha respectively). The results are as follows:

Table 5.6 – Cover Classes and Areas

Cover Class	Species Composition or Subtype	Area (ha) of Cover Class			Project Site as a % of	
		Site	Area	Region	Area	Region
Trembling Aspen	with Spruce, Balsam Fir, and Tamarack Larch	0.06	267.69	1,641.01	0.02%	0.003%
White Spruce	51% or more	0.09	38.62	131.65	0.24%	0.07%
Jack Pine	71-100%	0.09	331.41	3,011.27	0.03%	0.003%
Black Spruce	71-100%	0.11	830.55	5,037.46	0.01%	0.002%
White Spruce	50% or less with Balsam Fir, Jack Pine and Black Spruce	0.13	59.17	465.37	0.22%	0.03%
Jack Pine	40-70% with Spruce	1.10	1,041.98	6,343.11	0.11%	0.02%
Treed Muskeg	with Black Spruce	0.35	1,906.71	10,459.99	0.02%	0.003%
Treed Muskeg	with Tamarack Larch	0.14	23.03	599.91	0.63%	0.02%
Disturbed		32.20	362.50	1,121.73	8.88%	2.87%
Water		0.15	1,414.89	16,138.14	0.01%	0.001%
Classes not found within Lalor Concentrator Site		-	1,562.87	14,965.47	-	-
Total		34.41	7,839.41	59,915.10	0.44%	0.06%

Of the eight different vegetated cover classes, the largest area within the footprint of the Project Site was *Jack Pine 40-70% with Spruce* (1.10 ha); the smallest cover class disturbed was *Trembling Aspen with Spruce, Balsam Fir, and Tamarack Larch* (0.06 ha). The majority (93%) of the Project Site was composed of existing disturbed areas.

The least common cover class in the Project Area was *Treed Muskeg with Tamarack Larch* (0.14 ha, representing 0.63% of the total available in the Project Area). The least common cover class in the Project Region was *White Spruce 51% of more* (0.09 ha, representing 0.06% of total area available in the Project Region).

The loss of these cover classes still leaves a significant amount of this cover class remaining within the Project Area and Project Region. Over 23 ha of *Treed Muskeg with Tamarack Larch* remains within the Project Area (599.91 ha in the Project Region) and over 131.65 ha of *White Spruce 51% or more* remains within the Project Region. Furthermore, as shown on **Figure 18**, these cover classes are common to the area surrounding the Project Area and Project Region. In addition to that, during closure, the Project Site will be returned to native conditions to the maximum extent possible. Once the infrastructure on the site has been removed and the site has been re-graded, disturbed areas will be re-vegetated with appropriate vegetation species as applicable.

Based on HBMS mine closure experience in the Snow Lake region, the growth of grasses and mosses is apparent within the first few years following closure, whereas trees and shrubs take longer to establish through natural succession and may be evident within a five to ten year period following closure. However, to ensure the success of re-vegetation efforts at the Project Site, monitoring will occur regularly with subsequent re-vegetation occurring, if required. Once re-vegetation efforts are determined to be successful, monitoring will be scaled back or suspended.

Assuming that closure activities specific to the Lalor Concentrator occur after the proposed Lalor Mine closure, it is anticipated that re-vegetation and natural succession will substantially return the Project Site to conditions that existed prior to exploration activity in the region. For these reasons, the residual effect on flora is assessed to be negligible.

5.8.2 Dust Deposition

As noted in **Section 5.4.1**, dust generated during the construction, operation and closure phases of the Lalor Concentrator can potentially affect vegetation in the area by interfering with the photosynthetic ability of the vegetation. However, assuming implementation of the mitigation measures noted in **Section 5.4.1**, effects on flora due to dust are assessed to be negligible and insignificant.

5.9 Protected and Other Fauna Species

Clearing (loss of habitat), noise (disturbance), vehicle collisions (mortality), and light pollution are potential sources of effects on fauna.

As described in **Section 4.5**, the protected fauna species within the Churchill River Upland Ecoregion (which includes the Project Region) include: Boreal Woodland Caribou, Monarch (butterfly), Northern Leopard Frog, and Yellow Rail. As further noted in **Section 4.5**, none of these protected species was observed during the terrestrial investigations conducted for the Project.

With respect to caribou, Woodland Caribou are present in the ecoregion but, based on the information provided by the Regional Wildlife Manager of Manitoba Conservation and Water Stewardship located in The Pas, Manitoba, Woodland Caribou are not found in the Snow Lake area. Although the Project Region contains potentially suitable habitat for Woodland Caribou, there are no known herds whose ranges overlap with the Project Region. Further, HBMS is continuing to participate in Manitoba Conservation's ongoing large-scale caribou study in Northern Manitoba to understand and monitor caribou movement patterns.

For the above reasons, in our opinion, the proposed Lalor Concentrator is not expected to have a significant effect on any protected or other species.

5.9.1 Loss of Habitat

Loss of vegetation through clearing can affect fauna by reducing available habitat for these species. No specific critical wildlife habitat was observed on the Project Site (such as calving or over-wintering areas) and, based on site conditions and limited field observations, it is expected that there is no critical wildlife value in the Project Area. At both the site of the Concentrator component and along the route of the Pipeline System, the low diversity of plant communities and extremely dense Black Spruce stand offer a very restricted habitat for wildlife.

With respect to migratory birds, physical activities that will be carried out during construction of the project are not expected to adversely impact migratory birds for the following reasons:

Nesting birds that may make use of the edge habitat available along the route of the Pipeline System will be able to continue to use this habitat following development of the project. Despite clearing along the Pipeline System, there will be no net loss of edge habitat. In addition, any clearing and blasting will be done outside the nesting season (April 15 to July 31).

As observed during field investigations conducted for the proposed project, water crossings along Portion 1 (at culvert location LR01), and Portion 3 (at culverts RB02 and RB03) of the Pipeline System offer potential brooding areas for waterfowl. Due to the proximity of these brooding areas to potential nesting areas (edge habitat) this is suitable waterfowl habitat. However, no brooding areas will be affected by project activities, and as described above, there will be no net loss of edge habitat so the amount of suitable waterfowl habitat will remain.

Further, at closure, the Project Site will be returned to the native conditions to the extent possible. The restoration of vegetation during closure will provide for restoration of available habitat.

5.9.2 Noise

As described in **Section 5.4.3**., noise generated during the construction, operation and closure phases of the Lalor Concentrator has the potential to deter wildlife from the area. During construction, noise will be generated to varying degrees as described above. It is anticipated that local fauna are likely already accustomed to some level of noise based on the existing activity in the area (Lalor AEP, PR 395, PR 392 and the Chisel North Mine). Further, since the habitat in the Project Site is common and no specific or critical value to wildlife was identified, if local fauna are deterred from the Project Site, it is not anticipated that this will critically affect wildlife as similar habitats are available in the Project Area and Region.

During operation, sources of noise include use of the jaw crusher and general equipment and vehicular movement (described in **Section 5.4.3**). As mentioned above, HBMS has incorporated several engineering controls to minimize noise levels at the Project Site. Therefore, noise levels post-mitigation are assessed to be low and not expected to cause any significant disturbance to wildlife in the area.

5.9.3 Vehicle Collisions

With the anticipated increase in traffic on local roads (discussed in more detail in **Section 2.10**. and **Section 5.4.2**), there is potential for increased wildlife collisions. Moose, coyotes and wolves may pass through the Project Area, including Provincial highways and the Lalor Access Road. Edge vegetation and the open nature of these roads allows for ease of migration, making the area attractive to wildlife. However, as local wildlife populations are considered low, the potential for increased wildlife collisions is also considered low. Further, HBMS experience in the local area also indicates that wildlife collisions are rare. With continued implementation of speed limits on the access road, any likelihood of collisions occurring will be reduced. Therefore, the residual effect on wildlife population from increase in traffic is assessed to be negligible and not significant.

5.9.4 Light Pollution

The Lalor Concentrator will operate 24 hours per day and 362 days a year, resulting in the need for lighting on the site at all times to allow for a safe working environment. Light pollution has the potential to adversely affect animal behaviour by interfering with their biological cycles, which may consequently affect navigational abilities.

To minimize light disturbance, HBMS has selected lighting that directs light down to the mine site only. With selection of this lighting, residual disturbance from light would be limited to the Project Site and the area immediately surrounding the site and therefore is assessed to be insignificant.

5.9.5 Conclusion

Therefore, the potential effect of the project on fauna, including migratory birds, is assessed to be negligible.

5.10 Aquatic Resources and Protected Species

Aquatic resources are living species present in a surface water body, including benthic invertebrates, macrophytes and fish, and their habitat. Aquatic resources may be affected directly or indirectly due to changes in surface water quality.

5.10.1 Aquatic Invertebrates

Changes in sediment quality can potentially affect aquatic invertebrates with secondary effects on organisms higher in the food chain. Potential changes to sediment quality can occur from surface runoff (elevated concentration of metals or other contaminants), or through air dispersion (dust from ore crushing), or any accidental leaks or spills during construction, operation or closure.

As noted in **Section 4.3.7**, the benthic invertebrate community in the Project Area represents a wide variety of diversity, density and abundance. The benthic invertebrate community was found to be less diverse and abundant in waterbodies with complex sediments (such as those found in Anderson Creek) compared to waterbodies with highly organic sediments (such as Gaspard Lake). Crossings along the former rail bed showed less density but higher proportion of EPT taxa compared to Anderson Bay of Wekusko Lake, suggesting that the habitat quality is high in these areas despite the existing rail bed.

The nearest water body to the Concentrator is Lalor Lake. Since the jaw crusher will be enclosed, the wind direction is essentially away from Lalor Lake and there is a vegetative buffer between the Lalor site and Lalor Lake, sediment quality in Lalor Lake is not expected to be affected by dust generated on site. Further, surface runoff would adversely affect sediment quality if the material used in the ROW for the Pipeline System were acid-generating. Since HBMS will only use non-acid generating (NAG) material which is low in sulphides, runoff from the Pipeline System ROW is not expected to affect sediment quality in any waterbody in the Project Region.

Further, any changes in sediment quality resulting from potential changes in surface water quality will be mitigated through implementing the measures outlined in **Section 5.7.3**. Therefore, the residual effect on aquatic invertebrates as a result of potential changes in sediment quality is assessed to be insignificant.

5.10.2 Fish and Fish Habitat

5.10.2.1 At the site of the Concentrator Component

There is no Fish or Fish Habitat at the site of the Concentrator component.

The nearest water body to the site of the Concentrator component is Lalor Lake. Risks to this waterbody consist of dust and the potential for acid rock drainage (ARD) at the ore stockpile. However, the plan for operation of the Lalor Concentrator appropriately mitigates the potential to generate ARD. Any ARD that is generated at the ore stockpile will be collected and pumped back to the concentrator to be used as process water.

Potential impact from dust is expected to be insignificant because: the jaw crusher will be enclosed, confining any dust to the building itself; the wind direction is essentially away from Lalor Lake; and there is a vegetative buffer between the Lalor site and Lalor Lake.

Further, since Lalor Lake only provides marginal habitat which does not support large-bodied fish, the impact on Fish and Fish Habitat from the Concentrator component is expected to be insignificant.

5.10.2.2 Along the Route of the Pipeline System and at the Snow Lake Pumphouse

As described above, the route of the Pipeline System traverses a total of 20 locations which contain existing culverts. Two of these locations are in Portion 1 (on Lalor Access Road). The other 18 locations are in Portion 3 of the route (in the railbed).

As described above, only three of the 20 culverts are in water crossings located in streams or off-take ditches which are or may lead to potentially fish bearing waterbodies. These three, which contain marginal fish habitat, will not be altered during construction of the project. However, any activities that occur near these culverts will be carried out in accordance with applicable DFO Operational Statement(s) or other applicable standards. As well, all rock used to widen the existing rail bed will be non-acid generating. Therefore, these measures will avoid potential impact on any fish and fish habitat.

The other 17 culverts are merely water control features installed in the particular linear feature to keep surface run-off from ponding near that feature. These 17 locations are not connected to any potentially fish bearing habitat. Several of these 17 culverts may be subject to replacement. Even though there is no connection to fish habitat, such culvert replacement will be carried out in accordance with DFO's Operational Statement on Culvert Maintenance.

As well, the leak detection system built into the design of the Tailings Pipe will mitigate the risk of any spill from occurring. Any spill that does occur will be addressed with appropriate spill containment and management procedures in accordance with the HBMS ISO 14001 Environmental Management System.

Habitat along the shoreline of Snow Lake in the area adjacent to the pumphouse is classified as **Important Fish Habitat**. However, upgrades to the Snow Lake Pumphouse will not involve any physical activities along the Snow Lake shoreline at or below the high water mark. The pipe and water intake structure will not be affected by the upgrades. Fish habitat therefore is not affected.

5.10.2.3 Downstream of the Anderson TIA

Tailings from the Lalor Concentrator will be managed in the Anderson TIA, which has been in operation since 1979 and where tailings are deposited sub-aqueously to prevent the generation of ARD. Throughout its life, discharge at the final discharge point of the Anderson TIA has been in compliance with all Provincial and Federal regulatory criteria. Discharge from the Anderson TIA enters into Anderson Creek, which then flows into Anderson Bay of Wekusko Lake. Studies of Anderson Bay have been carried out pursuant to regulatory requirements over 34 years of operation. These studies have confirmed that water quality downstream of the Anderson TIA continues to support high species diversity.

As noted in **Section 4.3.8**, in general the larger waterbodies, such as Anderson Bay and Goose Bay of Wekusko Lake, provide the highest species diversity. Aquatic investigations further suggested availability of spawning habitat in these waterbodies despite being in a region that has been disturbed. The fact that the fish population in Anderson Bay was noted to be healthy suggests that effluent from Anderson TIA has not adversely impacted fish population in Wekusko Lake. Further, as noted in **Section 5.7.5**, tailings from Lalor Mine will result in water quality with lower concentration of metals than tailings from Chisel North Mine, suggesting an overall adverse impact with an even lower magnitude than previously experienced.

The proposed project does not entail any physical activity that could affect fish habitat downstream of the Anderson TIA. As well, the phytoplankton community in Anderson Bay of Wekusko Lake is balanced, suggesting that the phytoplankton community is Anderson Bay is healthy. For zooplankton, while abundance of species is low, the species diversity is similar to other waterbodies in the Project Region, suggesting that effluent from Anderson TIA has not adversely impacted aquatic resources downstream.

The fish tissue concentrations in the waterbodies studied as a part of the baseline investigations seem to be affected by various natural and anthropogenic sources. For instance, Ghost Lake sediment and fish tissue showed elevated metal concentrations compared to other waterbodies along the route of the Pipeline System, which could be the result of historical mining or naturally elevated elements. However, concentration of metals in the Anderson Bay was comparable to other waterbodies assessed in the area and none of the concentrations of arsenic or lead exceeded the *MWSQOG* aquatic life tissue residue guidelines for human consumption.

Since any discharge from Anderson TIA will continue to be monitored and will be in compliance with MMER criteria, the potential effect of the project on fish and fish habitat downstream of the Anderson TIA, as defined in the *Fisheries Act,* is expected to be negligible.

5.10.3 Protected Species

As indicated in **Section 4.5**, the Federally-protected Shortjaw Cisco (fish species) may occur in the Churchill River Upland Ecoregion. Occurrences of Shortjaw Cisco in Manitoba are provided in **Table 5.6**.

Table 5.7 – Shortjaw Cisco Occurences (COSEWIC, 2003)

Occurrence in Manitoba	Occurrence Relative to Lalor Site
Athapapushkow Lake	104 km southwest
Clearwater Lake	106 km southwest
Reindeer Lake	288 km northwest
George Lake	603 km southeast
Lake Winnipeg	409 km southeast
Lake Winnipegosis	306 km south

None of the waterbodies noted above are in the Nelson River watershed and Shortjaw Cisco are not expected to occur in any of the waterbodies in the Project Region. Further, no Shortjaw Cisco were collected in the aquatic surveys undertaken as a part of the baseline investigations. Therefore, no effects on Shortjaw Cisco are expected to occur.

5.11 Accidents and Malfunctions

To prevent accidents and malfunctions, all phases of the project will be conducted in accordance with applicable regulatory requirements. The following sections provide additional details on precautionary measures that will be implemented by HBMS to further minimize the potential for accidents and malfunctions to occur.

5.11.1 Worker Health and Safety

Worker protection in Manitoba is regulated through standards, procedures and training required under *The Workplace Safety and Health Act*. The Lalor Concentrator will be operated in accordance with *The Workplace Safety and Health Act* and the HBMS' OHSAS 18000 certified management system, which will minimize the risk of potential effects on worker health and safety. Safety equipment and personal protective equipment will either be supplied to the employees or be located throughout the facility, where needed.

5.11.2 Spills and Leaks

Environmental effects may occur due to fuel and chemical spills from diesel fuel, lubricants, oils, hydraulic fluids and explosives (only required construction of the Pipeline System). Effects may also occur in the case of a spill from the tailings pipe from the proposed Concentrator to the Anderson TIA. An accidental release of hazardous materials and/or equipment fluids could occur from improper storage and handling procedures (including transporting materials such as reagents and explosives from one location to another). Accidental releases have the potential to affect air, surface water, groundwater, and soils, with consequential effects on vegetation, aquatic resources and possibly human health and safety. In accordance with the HBMS ISO 14001 certified Environmental Management System, activities that may result in spills or accidents will be identified, along with measures to mitigate risks of such occurrences.

The following HBMS standard procedures will be employed to prevent spills from occurring during project activities:

- Any diesel tanks used on site will be self-contained aboveground storage tank(s) (SCAT).
- Explosives required during construction of the Pipeline System will be stored in areas equipped with spill containment measures and in accordance with *The Explosives Act*.
- When servicing requires drainage or pumping of lubricating oils or other fluids from equipment, a groundsheet of suitable material and size shall be spread on the ground to catch all fluid in the event of a leak or spill. An adequate supply of suitable absorbent material and any other supplies and equipment necessary to immediately clean up spills will also be available.
- Storage and disposal of liquid wastes and filters from equipment maintenance, and any residual material from spill clean-up will be contained in an environmentally safe manner and in accordance with any existing regulations.
- Waste oils, fuels and hazardous wastes (if any) shall be handled in a safe manner. Staff will be required to transport, store and handle all such substances as recommended by the suppliers and/or manufacturers and in compliance with applicable Federal, Provincial and Municipal regulations. Manitoba Conservation shall be notified immediately if a reportable spill occurs.
- Fuels, oils or other hazardous materials will be stored only in designated areas.
- HBMS will ensure that fuel handlers are trained and qualified, and that appropriate emergency response measures are in place and readily available.
- Storage sites will be inspected periodically for compliance with requirements as applicable.
- Investigation and remediation of spills will be undertaken, if necessary.
- Remediation of soils, as required, will be undertaken as a part of closure activities.
- Appropriate personnel will be trained in how to deal with spills, including knowledge of how to properly deploy site spill kit materials.
- Service and repairs of equipment shall only be performed by trained personnel.
- Vehicles and equipment will be maintained to minimize leaks. Regular inspections of hydraulic and fuel systems on machinery will be completed on a routine basis; when detected, leaks will be repaired immediately.

In addition to the above general measures to avoid accidental spills, the following measures have been incorporated into the design of the tailings pipeline to minimize the risk of spills:

- The pipe will use a leak detection system, which will set off an alarm if a leak occurs. If a leak is found that requires repairs, the following steps will be undertaken:
- Stop the ore feed to the Concentrator
- Run water through the Concentrator circuit and the tailings pump for 2-4 hours

- Mobilize resources to undertake repairs
- The use of a single pumping system, instead of booster stations along the length of the pipe, is expected to significantly reduce the risk of spills.

With the above noted mitigation measures employed as necessary, and assuming implementation of safe work practices, the risk of spills is assessed to be appropriately mitigated.

5.11.3 Fires/Explosions

The presence of mechanical equipment, fuels and explosives on-site creates a potential for fires and explosions. Such incidents can harm on-site personnel, cause equipment damage and lead to a release of contaminants, resulting in consequent effects to other environmental components (air, surface water, groundwater, flora, fauna, aquatic resources, and aesthetics). Potential socio-economic effects may occur if a site shut-down is required in the event of a large accident (such as incidents that may require evacuation, disruption of traffic, etc.).

The Lalor Concentrator has the potential to be affected by off-site forest fires during the summer months. Effects could include loss of infrastructure, which could consequently affect access to the site, with possible economic repercussions. All infrastructures at the Lalor site will be built on a crushed rock pad. This crushed rock is anticipated to act as a fire barrier for the site.

The Project Site will be equipped with appropriate fire control measures. In addition, the following measures will be implemented:

- Explosives required during construction of the Pipeline System will be provided in “just-in-time” deliveries.
- The mine rescue team at the future Lalor Mine will be trained for fire and explosion response with HBMS call out procedures implemented. This team will be trained to respond to any fire and explosion emergencies for proposed concentrator as well.
- HBMS can coordinate with mine rescue teams in other HBMS facilities to provide backup as required.
- All flammable waste will be removed on a regular basis and greasy or oily rags or materials subject to spontaneous combustion will be deposited and stored in appropriate receptacles. These materials will be disposed of at an appropriate waste disposal facility.
- Chemical storage and use will be in compliance with regulatory requirements.
- Smoking will be restricted to designated areas.

While the proposed Lalor Concentrator will not require use of explosives during operation, explosives will be used at the Lalor Mine. Any accidents occurring at the Lalor Mine could potentially affect operations at the Lalor Concentrator and vice versa. However, all operations at the Lalor Mine will be conducted in accordance with measures outlined in **Section 5.12** of the *Lalor Mine Environment Act Proposal Report*. Further, with the measures outlined above, and assuming implementation of typical safe work practices, the risk of fires and explosions is assessed to be appropriately mitigated.

5.11.4 Transportation Accidents

An increase in traffic has the potential to increase the likelihood for transportation accidents, including vehicular and wildlife collisions. Wildlife collisions are discussed above in **Section 5.9.3**. Transportation accidents can consequently result in release of pollutants in the environment (diesel, oils, etc.), or materials that the vehicles colliding are transporting (sewage, reagents, concentrate, etc.). Such accidental releases to the environment could potentially result in secondary effects on other environmental components (groundwater contamination through seepage, decline in surface water quality through runoff) or tertiary effects on flora (decline of growth potential due to soil contamination), fauna, aquatic resources and human health. Potential socio-economic effects may occur if road shutdowns are required in the event of a large accident (traffic interruptions could disrupt business and activity if people are not able to commute to work).

The increase in traffic on PR 395 and PR 392 during construction is considered major. This increase in traffic potentially increases the risk of transportation accidents occurring. To mitigate for the increase, HBMS will implement the following measures:

- Vehicle speed limits will continue to be imposed (20 km/hr at the Lalor site and 40 km/hr along the Lalor Access Road).
- Appropriate road signage will be provided along the Lalor Access Road.
- Personnel retained to drive and operate vehicles will have a valid Manitoba Driver's License with a copy provided to HBMS personnel.

Signage and speed limits on PR 395, PR 392, PTH 39 and PTH 10 are regulated by the Province of Manitoba.

The above-noted mitigation measures are assessed to appropriately mitigate the potential risk for transportation accidents occurring during the construction and operation phases of the proposed project.

During closure activities, approximately five pieces of equipment will be required at the Project Site, which will travel to/from the site periodically, and at least four haulage trucks will access the site on a continuous basis to haul materials to/from the site. However, traffic from the operation phase will have declined substantially before the closure phase commences (reduction on amount of ore processed and/or concentrate produced). For this reason, traffic from the closure phase is not considered to represent a further increase in the traffic count on highways in the Project Area.

5.12 Socio-Economic Effects

5.12.1 Land and Resource Use

Land and resource uses that may potentially be impacted by environmental effects of the proposed development include: harvesting and trapping opportunities, fishing (recreational, subsistence and commercial), recreational use of existing trails and any other general use of the area.

As presented in this EA, residual environmental effects on aquatic and terrestrial components have been assessed to be minor to negligible in magnitude. Therefore, the consequential effects on any natural resource harvesting, trapping, including recreational or commercial fishing in the Project Region are assessed to be insignificant.

With respect to trapping, although the potential effect on trapping activities is assessed to be insignificant, HBMS is committed to working with trappers in the area to ensure that access to their trap lines is not impacted by the proposed development.

With respect to noise-related effects, implementation of engineered noise control on noise sources (such as the jaw crusher, and other general equipment to be used during construction and operation), combined with natural attenuation is anticipated to mitigate potential noise effects at the nearest cottages at Cook Lake and Wekusko Lake as well as the closest residential areas in the Town of Snow Lake. Lodges in the Project Region are even further away from noise sources than the cottages on Cook Lake and therefore no noise effects are anticipated at these lodges.

With respect to snowmobile trails, HBMS conducted a meeting with Sno-Drifters snowmobiling club on December 7, 2012, to discuss the impact of the proposed project on HBMS-owned property that is used for recreational purposes by members of the Sno-Drifters snowmobiling club. Both HBMS and the club agreed that giving sufficient notice of construction activities to the club office (so that they may inform trail users of any disruption) was important. This will allow the club to increase signage and develop alternative routes to minimize the overall impact on recreational use of the area. HBMS will continue to work with the club to discuss any ongoing issues, as required. Meeting notes are included in **Appendix G**.

5.12.2 Heritage Resources

Project activities such as clearing, blasting, or excavating can potentially affect heritage resources. However, communication with the Heritage Resources Branch has indicated that there are no known heritage resources at the Project Site and the potential to find any is low. The nearest heritage resources lie close to the edge of the Project Area and into the Project Region. Land disturbance during construction of the proposed Lalor Concentrator will be limited to the Project Site. No further disturbance beyond the Project Site will occur during the operation or closure phases. Therefore, no effects on heritage resources are anticipated to occur as a result of the proposed project.

In the unlikely event that heritage resources are identified, the following measures will be implemented:

- If artefacts, historical features of skeletal remains are encountered during closure activities, work activities will 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 continuation of work.
- If skeletal remains are encountered, the find will be immediately reported to the site supervisor and the RCMP.

5.12.3 Aesthetics

The aesthetics of the Project Area and Project Region are not anticipated to significantly change during the construction or operation phases of the proposed Lalor Concentrator. The Project Site is accessed by a 3 km long access road (Lalor Access Road) owned by HBMS, and is surrounded by dense vegetation. The following additional measures will be undertaken:

- The site will be inspected on a regular basis for loose waste and debris in order to maintain a clean site
- Waste and debris will be stored in bins and removed from the site on a regular basis.

During the closure phase, the Project Site will be re-vegetated and returned to native conditions to the extent possible as described in **Section 2.18**. To ensure success of re-vegetation efforts, the vegetation growth will be monitored and if necessary, re-vegetation efforts will be repeated until vegetation has been re-established. Therefore, the overall impact on aesthetics as a result of the Lalor Concentrator project is assessed to be reversible and insignificant.

5.12.4 Effects on Aboriginal Peoples

As noted above in **Section 2.12**, HBMS has operated in the Snow Lake district for over 50 years. It has been in continuous occupation of the site of the Concentrator component since 2007. The route of the proposed Pipeline system is adjacent to a highway used for industrial traffic or is on land that has been under use, occupation and control by HBMS for decades. Much of it is on land owned in fee simple by HBMS.

Based on Government of Manitoba and Federal sources, there is no Indian Reserve, Registered Trap Line (RTL) zone associated with First Nation/Aboriginal community use or other Aboriginal interest located within the Project Region.

The project does not require access to, use or occupation of, or the exploration, development and production of lands and resources currently used for traditional purposes by Aboriginal peoples. All elements of the proposed Lalor Concentrator will be on land which HBMS holds under lease or in fee simple, and is occupied and used by HBMS for mining purposes as follows:

- The concentrator component lies within the Lalor site, which has been developed for the Lalor AEP/future Lalor Mine Project. It lies on land that has been under continuous use for mining purposes since at least 2007.
- Portion 1 of the Pipeline System, which follows the Lalor Access Road, lies on land which is controlled by gated access, and which has been under continuous use by HBMS for mining purposes since at least 2007.
- Portion 2 of the Pipeline System tracks PR 395, which is in daily use for industrial traffic. In addition, Provincial regulations prohibit hunting within 300 m of roadways.
- Portion 3 of the Pipeline System falls within the ROW for a former rail bed, which is owned by HBMS pursuant to Certificate of Title No. 1701932. This is private land to which Aboriginal peoples do not have a right of access.
- Portions 4, 5, and 6 of the Pipeline System are located on land which the proponent has used for mining purposes since the late 1970's. These portions lie behind the gates of existing HBMS projects, which excludes users other than the proponent, on land that has been taken up for mining purposes for over 30 years.

As discussed below in **Section 8**, during the latter half of 2010, Mathias Colomb Cree Nation (MCCN) began to suggest that its traditional lands encompass a large portion of northwestern Manitoba, including the entire Snow Lake mining district, in which the Lalor projects, including the proposed Lalor Concentrator, are located. HBMS therefore entered into information sharing with MCCN and Manitoba commenced a Crown consultation process in relation to HBMS' proposed Lalor Mine. HBMS information sharing also has included Lalor Concentrator.

As well, HBMS and Manitoba funded a traditional use and knowledge study by an expert of MCCN's choice, but MCCN has instructed the expert to stop work on the report of the study. Therefore it is not known if there are any traditional uses by MCCN in the Project Region. However, any resource that currently is being used for trapping, fishing or hunting in the Project Region will be unaffected by construction or operation of the Lalor Concentrator project.

With respect to commercial trapping, although the potential effect on trapping activities is assessed to be insignificant, HBMS is committed to working with trappers in the area to ensure that access to their trap lines is not impacted by the proposed development. None of these trappers is associated with an Aboriginal community.

For all these reasons, the Lalor Concentrator is not expected to cause any environmental effects that would lead to consequential effects on Aboriginal peoples.

5.13 Summary of Environmental Assessment and Mitigation Measures

Table 5.7 summarizes potential environmental effects of the proposed Project and the design features, standard operating procedures and other mitigation measures that will be implemented.

Table 5.8 summarizes potential accidents and malfunctions and measures to reduce the risk of such occurrences.

Table 5.8 – Summary of Environmental Assessment and Mitigation Measures

Environmental and Social Component	Project Phase	Sources of Potential Effects	Summary of Measures	Residual
Topography	Construction and closure	Clearing, blasting, leveling, trenching, stockpiling materials for Pipeline System ROW	None required	Minor and insignificant
		Re-vegetation and restoration	None required	N/A
Soil	Operation	Acid Rock Drainage from ore stockpile (soil quality)	The stockpile will be covered with a “cover-all” fabric, and be surrounded by a 1.5m high concrete berm, which will prevent precipitation and minimize exposure to wind.	Negligible to Minor and Insignificant
			The waste rock pad will be lined with NAG rock (crushed limestone), which will minimize any generation of ARD due to moisture already present in the ore.	
			The base of the ore stockpile will be lined with a synthetic liner to prevent penetration of leachate.	
			The ground around the stockpile will be graded to direct any runoff towards a sump-pump.	
			HBMS will continue to monitor the stockpile for any signs of potential ARD on site.	
	Construction, operation and closure	Improper waste management from STP, used oils, rags, drums, and miscellaneous garbage (soil quality)	Wastes generated during operation will be collected in garbage bins maintained at specific locations throughout the site. The bins will be emptied on a regular basis for recycling or disposal at a licensed waste disposal facility.	Negligible and Insignificant
			Waste oils and other hazardous materials generated will be removed by a licensed hazardous materials handler for appropriate disposal or recycling.	
	Construction and closure	Erosion (soil quantity) due to clearing, grubbing, re-grading, replacing culverts	The site will be contoured to match the surrounding topography to the extent possible	Negligible and Insignificant
			Re-vegetation will occur as soon as possible following application of soil.	
			Re-vegetation efforts will be monitored until vegetation has re-established with additional re-vegetation activities occurring as required.	
Air	Construction, operation and closure	Dust (air quality) blasting, ore crushing activities, vehicular movement, leveling, grading.	Dust suppression activities such as the use of approved dust control agents, will be undertaken (if required)	Negligible and Insignificant
			The Lalor site has a speed limit of 20 km/hr, which will continue to be imposed.	
			The Lalor Access Road has a speed limit of 40 km/hr, which will continue to be imposed. The same speed limit will apply to the concentrate haul road and the pipeline ROW.	
			Concentrate trucks going to Flin Flon will be covered to minimize dust coming off loads.	
	Construction, operation and closure	Exhaust emissions (air quality) from vehicles and equipment use	Vehicles and equipment will be well-maintained	Negligible and Insignificant
			Vehicle idling will be kept to a minimum	
	Construction, operation and closure	Noise and Vibration	The gensets being used at the Project Site are housed in factory designed-built enclosures to minimize noise.	Negligible and Insignificant
			The jaw crusher is being enclosed in a building, with engineered noise-controls to minimize noise levels at the Project Site.	
			A noise exposure assessment will inform measures to be implemented (such as hearing protection). A re-assessment will be undertaken if any alterations, renovations or repairs of the workplace are undertaken.	
			HBMS will provide hearing protection as required to ensure employees working on site.	
			All closure activities will be carried out in accordance with the Workplace Safety and Health Act and HBMS' OHSAS 18000 certified management system	
Climate Change	Construction, operation and closure	GHG emissions	Idling at the Project Site will be kept to a minimum	Negligible and Insignificant
			Vehicles and equipment will be maintained in good working condition	
Groundwater	Construction, operation and closure	Ore management (groundwater quality)	Measures listed under ARD for soil quality will prevent any secondary effects on groundwater quality from ARD	Negligible to Minor and Insignificant
		Handling fuels, lubricants and waste	Measures listed under improper waste management for soil quality will prevent any secondary effects on groundwater quality	Negligible and Insignificant

Table 5.8 – Summary of Environmental Assessment and Mitigation Measures (continued)

Environmental and Social Component	Project Phase	Sources of Potential Effects	Summary of Measures	Residual
Surface Water	Operation	Water withdrawal (water quantity)	Water withdrawal is accommodated within existing approved limits. No mitigation required	N/A
		Ore management (water quality)	Measures listed under ARD for soil quality will prevent any secondary effects on surface water quality through runoff from ARD	Negligible and Insignificant
		Tailings deposition in Anderson TIA (water quality in Wekusko Lake)	Continue weekly monitoring of the effluent discharged from Anderson TIA into Anderson creek to ensure that it meets MMER values (and therefore the limits laid out under the CEC Order No. 766).	Negligible to Minor and Insignificant
			If any exceedances occur, discharge will be shut off immediately and not resumed unless the water quality returns to acceptable limits.	
	Construction, operation and closure	Improper waste management (water quality)	Measures listed under improper waste management for soil quality will prevent any secondary effects on surface water through runoff on surface water quality	Negligible and Insignificant
	Construction	Sediment loading in culverts from blasting, excavating, replacing culverts (water quality)	Sediment and erosion control measures such as silt fences will be installed	Negligible and Insignificant
			Accumulated material and debris in the culvert will be removed slowly to allow clean water to pass, to prevent downstream flooding and reduce the amount of sediment-laden water doing downstream.	
			All equipment used near the culverts will be well-maintained	
			All rock used to widen the existing rail bed will be non-acid generating.	
Protected and other Flora Species	Construction	Clearing (loss of vegetation)	All cleared area will be re-vegetated during closure.	Negligible to Minor and Insignificant
	Construction, operation and closure	Dust (vegetative growth capacity)	See measures identified for dust under Air	Negligible and Insignificant
	Closure	Re-vegetation and restoration	None required	N/A
Protected and other Fauna Species	Construction, operation and closure	Clearing (loss of habitat), noise (disturbance), vehicle collisions (mortality)	Site will be re-vegetated during closure	Negligible to Minor and Insignificant
			See measures identified for noise under Air	
			See measures for dust (speed limits) under Air to minimize risk of accidents	
Aquatic Resources and Protected Species	Construction, operation and closure	Surface runoff, dust dispersion (sediment and water quality)	See measures to protect surface water quality to mitigate secondary effects on aquatic invertebrates and fish and fish habitat	Negligible to Minor and Insignificant
Land and Resource Use	Construction, operation and closure	Residual environmental effects	HBMS will maintain ongoing discussions with trappers in the area	Negligible and Insignificant
			Sno-Drifters will be notified about construction schedule and activities so alternative trails can be developed	
			Measures identified for surface water quality will mitigate potential effects on fishing opportunities in Wekusko Lake	
Heritage Resources	Construction, operation and closure	Clearing, blasting, excavating (loss of resources). Note: Since no known resources exist, measures are provided only for potential loss of unknown resources	If artefacts, historical features of skeletal remains are encountered during closure activities, work activities will 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 continuation of work.	Negligible and Insignificant
			If skeletal remains are encountered, the find will be immediately reported to the site supervisor and the RCMP.	
Aesthetics	Construction, operation and closure	Clearing (loss of vegetation), re-vegetation (restoration), Noise (disturbance)	The site will be inspected on a regular basis for loose waste and debris in order to maintain a clean site	Negligible and Insignificant
			Waste and debris will be stored in bins and removed from the site on a regular basis.	
			Site will be re-vegetated during closure	

Table 5.9 – Summary of Potential Accidents and Malfunctions and Measures to Mitigate Risk of Occurrence

Risks Associated with Accidents and Malfunctions	Project Phase	Possible Consequences	Measures to Reduce Risk of Occurrence	Conclusion
Worker Health and Safety	Construction, operation and closure	Workplace accidents (worker safety)	The Lalor Concentrator will be operated in accordance with The Workplace Safety and Health Act and the HBMS OHSAS 18000 certified management system	Risk is assessed to be appropriately mitigated
			Safety equipment and personal protective equipment will either be supplied to the employees or be located throughout the facility, where needed.	
Spills	Construction, operation and closure	Chemical spills from diesel fuel, lubricants, oils, hydraulic fluids, transporting reagents, and explosives (air quality, water quality, groundwater quality, fauna, flora and aquatic species, human health and safety).	Diesel tanks will be a self-contained aboveground storage tank	Risk is assessed to be appropriately mitigated
			Explosives required during construction will be stored in areas equipped with spill containment measures and in accordance with The Explosives Act.	
			Appropriate groundsheet will be used when refueling.	
			Wastes and residual material from spill clean-up will be contained in an environmentally safe manner and in accordance with any existing regulations.	
			Hazardous wastes will be stored and handled in compliance with applicable Federal, Provincial and Municipal regulations.	
			Fuel handlers are trained and qualified, Appropriate emergency response measures will be in place and readily available.	
			Storage sites will be inspected periodically for compliance	
			Investigation and remediation of spills will be undertaken, if necessary.	
			Remediation of soils, as required, will be undertaken	
			Vehicles and equipment will be maintained and inspected on a routine basis	
Fires and Explosions	Construction, operation and closure	Fires (loss of infratructure, business activity, worker health and safety, loss of wildlife habitat)	Explosives required during construction of the pipeline system will be provided in "just-in-time" deliveries.	Risk is assessed to be appropriately mitigated
			Mine rescue teams will be trained for fire and explosion response with HBMS call out procedures implemented. Backup teams will be available	
			Flammable waste will be removed on a regular basis and disposed of at an approved disposal site.	
			Materials subject to spontaneous combustion will be deposited and stored and disposed appropriately	
			Chemical storage and use will be in compliance with regulatory requirements.	
			Smoking will be restricted to designated areas.	
Transportation Accidents	Construction, operation and closure	Vehicular collisions (human health and safety, traffic disruption, road closure, release of contaminants) and wildlife collisions (loss of wildlife, human health and safety, road closures)	Vehicle speed limits will be imposed (20 km/hr at the site itself and 40 km/hr along the Lalor Access Road, the pipeline ROW and the concentrate haul road	Risk is assessed to be appropriately mitigated
			Appropriate road signage will be provided along the Lalor Access Road, the pipeline ROW and the concentrate haul road	
			Personnel retained to drive vehicles will have a valid Manitoba Driver's License	
Power Failure	Operation	Equipment malfunctions (loss of power), accidents and explosions	Backup power will be available (diesel generators) to ensure safe shutdown of concentrator processes until power is restored.	Risk is assessed to be appropriately mitigated

6. Monitoring and Follow-Up

Follow-up programs verify the accuracy of the environmental assessment of a project and determine the effectiveness of measures taken to mitigate the adverse environmental effects of the project. For the proposed Lalor Concentrator Project, mitigation measures described in this report will be implemented and a formal follow-up program is not anticipated to be required at this time.

Monitoring programs involve collection and analysis of data at any given time to identify changes or trends over time. Results from monitoring programs inform effectiveness of mitigation measures that are implemented for environmental protection. In addition, monitoring programs are used to ensure compliance with environmental standards and regulations and assist in making any potential operational changes, if required. Monitoring programs proposed for the Lalor Concentrator are described in the following sections. Mitigation requirements identified for the project are summarized in **Table 5.7**.

6.1 Water Quality Monitoring

As indicated in the Lalor Mine EAP (see **Section 7** of the report), EEM studies conducted under the MMER for the Chisel North WTP and the Anderson TIA will continue through the life of both the Lalor Mine and the Lalor Concentrator. This monitoring will include examining the potential effects of effluent on fish population, fish tissue and on benthic invertebrate communities in local waterbodies potentially influenced by the Lalor Concentrator and support facilities. These monitoring activities will continue through operation and following closure until it can be demonstrated that no adverse effects are occurring.

6.2 *Environment Act* Licence Monitoring

Monitoring programs required under existing *Environment Act* licence/Clean Environment Commission Orders for support infrastructure (Chisel North WTP, Anderson TIA and Chisel Lake pumphouse), and the Lalor Mine EAP (when issued) will continue to be conducted by HBMS. HBMS will comply with any additional monitoring requirements outlined in the *Environment Act* licence for the Lalor Concentrator.

6.3 Success of Re-vegetation Efforts

Following closure activities, once the site has been cleared of existing infrastructure and re-graded, soil will be applied to disturbed areas of the Project Site. Re-vegetation will occur as soon as practical following the application of soil. To ensure the success of the re-vegetation program, a re-vegetation monitoring program will be implemented. The monitoring program will determine the success of the re-vegetation program, and determine if follow-up reseeding or replanting is required. The monitoring program will include quarterly monitoring during the growing season until the seedlings appear to be established, following which, quarterly monitoring will continue for a minimum of two years, before a successful re-vegetation program can be declared.

6.4 Boreal Woodland Caribou Monitoring

HBMS is currently participating in Manitoba Conservation and Water Stewardship's ongoing large scale caribou study in Northern Manitoba (which includes the Lalor Concentrator Project Region) to understand potential impacts to Boreal Woodland Caribou. HBMS will continue to participate in this study in cooperation with Manitoba Conservation and Water Stewardship.

6.5 Environmental Management System

HBMS has been certified to the international standard known as ISO 14001 Environmental Management Systems since 2003. The scope of registration is “Mining and metallurgical operations related to copper and zinc production in the Flin Flon/Snow Lake area, including associated ancillary facilities”. As of November 1, 2010, the Lalor Mine Project was added to HBMS’s scope of certification, and therefore the environmental management policies and procedures, as outlined in the EMS, have been implemented at the Lalor AEP and will be adapted to capture operations associated with the construction and operation of both the Lalor Mine and the proposed Lalor Concentrator.

7. Public Engagement

7.1 Overview

Public involvement is an integral part of the environmental assessment process. It provides an opportunity for interested stakeholders to gain an understanding of the proposed project and, in return, it allows the proponents to gain an understanding of public concerns. Public involvement can also provide an opportunity to actively involve stakeholders in the early stages of a project which allows for a transparent planning process.

Since 2007, HBMS has been involved in formal and informal discussions with northern communities and regional stakeholders on the Lalor Projects, including the Lalor Mine, the Lalor Concentrator, other support infrastructure, and potential expansion of the Anderson TIA. Some of these events include:

- Town Hall presentation on Lalor Mine – Snow Lake, April 13, 2011
- Meeting with Mathias Colomb Cree Nation – Flin Flon, May 9-10, 2011
- Open House for realignment of PR 392 (led by MIT) – Snow Lake, May 17, 2011
- Meeting with Opaskwayak Cree Nation – Flin Flon, June 6-7, 2011
- Meeting and Site Tour with Mathias Colomb Cree Nation – Flin Flon and Snow Lake, January 10-12, 2012
- Interview with local trapper – Snow Lake, June 6, 2011
- Interviews with Snow Lake area residents – Snow Lake, June 7, 2011
- Open House on Lalor Mine – Snow Lake, June 8, 2011
- Interview with local trapper – Snow Lake, October 25, 2011
- Meetings with local trapper – Snow Lake, May 7, 2012 and February 12, 2013
- Town Hall presentation on Lalor Concentrator – Snow Lake, June 26, 2012
- Open House on Lalor Concentrator – Snow Lake, August 8, 2012
- Meeting with Snow Lake Cabin Owners Association – Snow Lake, August 8, 2012
- Community Meeting with Mathias Colomb Cree Nation – Pukatawagan, November 23, 2012
- Meeting with Snow Lake Sno-Drifters snowmobiling cub – Snow Lake, December 7, 2012

It was determined that the Town of Snow Lake would benefit from additional participation in the public involvement process as the project will occur near the Town of Snow Lake, will directly and indirectly employ residents, provide local economic benefits and will utilize existing infrastructure in the Snow Lake area. Based on discussions that have occurred between HBMS and local First Nations, it was determined that Mathias Colomb Cree Nation also has an interest in the project.

Public engagement specific to the Lalor Concentrator project has included a Town Hall presentation, a public Open House event in the Town of Snow Lake, a formal meeting with members of Mathias Colomb Cree Nation in the community of Pukatawagan, and interviews with residents and resource users in the Town of Snow Lake. A summary of the public involvement that has been undertaken for the Lalor Concentrator Project is included in the following sections.

7.2 Proponent Lead Public Involvement

7.2.1 Town Hall Presentation in the Town of Snow Lake

On the evening of June 26, 2012, HBMS held a Town Hall presentation in the Town of Snow Lake. The Town Hall presentation was held at the Snow Lake Community Hall, and was attended by 12 people. The presentation covered the proposed Lalor Concentrator Project in detail and the development plan for the Concentrator and

Pipeline System ROW. HBMS representatives held a question and answer period following the presentation. Area residents had questions related to building size and orientation, Anderson TIA and tailings management, roads, and impact to water quality in Wekusko Lake. HBMS provided answers to questions and committed to holding a Public Open House in Snow Lake to provide additional information on the project and present the environmental studies conducted for the project. Overall, Town Hall attendees were interested in the project and were either neutral or positive towards the project.

A copy of the presentation and a detailed list of questions received during the presentation are included in **Appendix G**.

7.2.2 Public Open House in the Town of Snow Lake

On August 8, 2012, a public Open House was held in the Town of Snow Lake by HBMS and AECOM to provide an opportunity to convey information concerning the proposed Lalor Concentrator for all interested parties, including the findings of environmental baseline studies and the environmental assessment, and allow for the public to provide the project team with feedback regarding the project. To inform the public of this event, an advertisement was placed in the July 19, 2012 and August 2, 2012 edition of the *Underground Press*. A copy of each advertisement is included in **Appendix G**.

The Open House was held at the Snow Lake Community Hall and 15 attendees participated in the event. A copy of the Open House attendance sheet has been provided in **Appendix G**. The Open House consisted of a formal presentation with a question and answer period followed by informal discussions with attendees and representatives from AECOM and HBMS.

Story boards were displayed on easels around the room for attendees to examine in detail following the presentation. Comment sheets were provided to all attendees, and only one comment sheet was completed by an Open House attendee (copy attached in **Appendix G**). This individual expressed no concerns related to the Lalor Concentrator project.

A number of questions and comments were tabled at the conclusion of the presentation, with the majority focussing on management of tailings at Anderson TIA, roads and traffic, and impact to water quality in Wekusko Lake, access to trap lines and snowmobile trails, and fate of the existing concentrator. A copy of the Open House presentation and a detailed list of questions received during the Open House are included in **Appendix G**.

An article on the Open House was featured in the August 16, 2012 edition of the *Underground Press*, the Snow Lake community newspaper. A copy of the article is included in **Appendix G**.

An online article was posted in the City of Thompson's local paper website, the *Thompson Citizen*, on August 17, 2012. It provided an overview of the Open House that was held in the Town of Snow Lake. The online article also allowed readers to post any comments regarding the article, but none were posted. A copy of the article is provided in **Appendix G**.

7.2.3 Community Meeting in Pukatawagan

On November 23, 2012, HBMS held a meeting in Pukatawagan with members of MCCN to discuss the proposed Lalor Concentrator and other HBMS mining projects. The meeting was attended by Stephen West, Jay Cooper and Pam Marsden from HBMS; Clifton Samoiloff, Alison Weiss and Shawna Kjartanson from AECOM; and Dr. Ginger Gibson and Stephen DeRoy from the Firelight Group. Fifteen (15) members of MCCN were in attendance, including Chief Arlen Dumas and various Council members and elders.

For this meeting, HBMS and AECOM prepared a presentation for the Chief and Council of MCCN regarding the environmental assessment and description of the proposed Lalor Mine, Lalor Concentrator and Reed Copper Projects. The goal of the presentation was to provide the Chief and Council and community members with information regarding the environmental work conducted as well as to describe the proposed Projects. A copy of the presentation is provided in **Appendix H**.

Generally, the presentation was well received and a good discussion between the attendees from MCCN and HBMS was held. The main concerns expressed by MCCN members were:

- Mine closure and/or historical mining impacts of non-HBMS projects (such as Lynn Lake and Sherridon).
- Long-term effects of the tailings deposition.
- Scope of potential effects (duration or geographic extent).
- Involvement in the early stages of planning or environmental assessment.
- Employment, training and business opportunities for MCCN members.

Detailed minutes and an attendance sheet from this meeting are provided in **Appendix H**.

7.3 Other Local Stakeholders

7.3.1 Trappers

The Manitoba Conservation office in Snow Lake has confirmed that there are three registered trap lines (RTLs) that overlap with the Project Region (in the area of Cook Lake, Lalor Lake, the Pipeline System ROW, Anderson TIA, and Anderson Creek). These lines are RTL 23, RTL 14 and RTL 13 that are owned by Martin McLaughlin, Jim Schollie, and Russell Bartlett respectively. Manitoba Conservation records indicate that Mr. McLaughlin has been the owner of this trap line since at least 1968.

On June 6, 2011, AECOM conducted a telephone interview with Mr. McLaughlin to discuss the Lalor Project and identify his concerns with the project. Mr. McLaughlin indicated that his primary trapping area is currently located around Cook Lake, but indicated that he used to trap along the east bank of Lalor Lake. Trapping consists primarily of lynx, mink and marten.

Mr. McLaughlin indicated that he had no major concerns with the project, and realizes that any impacts that could potentially occur are expected to be temporary. He indicated that previous line cutting that occurred during exploration in the Lalor area had the most significant impact on his trap lines to date, and that his only concern with the construction and operation of the mine is the possibility of restricted access to his trap lines (due to fencing associated with the Lalor Mine). He also expressed an interest in speaking with HBMS to discuss issues associated with trap line access. Mr. McLaughlin was notified of the Open House, but indicated that he was unable to attend. HBMS is committed to working with Mr. McLaughlin to ensure access to trap lines is not impacted by the Lalor projects.

Manitoba Conservation has also confirmed that the area of Anderson Creek and Wekusko Bay is registered as RTL 13. This trap line is owned by Russell Bartlett (assisted by Greg Foord). On October 25, 2011, AECOM contacted Mr. Bartlett to discuss any concerns he may have about HBMS developments that may affect his trap line. Mr. Bartlett was on his trap line at the time and was not able to be interviewed at length. AECOM informed him that they were interested in his opinion and encouraged him to contact AECOM to discuss any concerns at his convenience. No further communication was initiated by Mr. Bartlett.

On May 7, 2012, HBMS contacted Mr. Bartlett to discuss any concerns he may have about the Lalor Concentrator project. The discussion focused on access to trap lines, trails, and roadways, which are important to Mr. Bartlett's trapping activities. HBMS indicated to Mr. Bartlett that they were committed to working with him to ensure that access to trap lines is not impacted by the Lalor Concentrator project. This included that ensuring that trails are left in good condition and access to them is not obstructed or hindered. HBMS also indicated that, once construction has been approved and scheduled, they intend to provide notice and details such Mr. Bartlett can remove traps or snares located in the Project Area to prevent accidental damage.

HBMS arranged for a follow-up meeting with Mr. Bartlett in Snow Lake on February 12, 2013. At this meeting, HBMS provided Mr. Bartlett with an update on the status of the Lalor Concentrator project and the realignment of PR 392. HBMS also provided Mr. Bartlett with an opportunity to express any concerns he had with either project. Mr. Bartlett indicated that he did not have any concerns, and expressed his appreciation for the additional information.

7.3.2 Cottages or Remote Residences

The closest cottages to the Lalor Concentrator site are five cabins located on the west shore of Cook Lake, approximately 2 km from the Project Site. In a brief interview with one of the cabin owners during the September 2007 field study, it was indicated that these cabins have only been on the lake in the last 15 years and that five cabins is the maximum allotted to Cook Lake by Manitoba Conservation. Cabin subdivisions are also on Berry Bay, Taylor Bay, and Bartlett's Landing, approximately 13 km southeast of the Lalor Concentrator site.

On August 8, 2012, HBMS and AECOM met with Michelle Bast from the Snow Lake Cabin Owners Association at the Wekusko Fall Lodge near Snow Lake to discuss any concerns the Association may have with the Lalor Concentrator project. The discussion was focussed primarily on the potential impact to water quality in Anderson Bay in Wekusko Lake, where most of the cottages are located, and Ms. Bast was interested in hearing about the results of any environmental studies conducted on Anderson Bay. HBMS discussed the ongoing EEM studies which have been taking place in Anderson Bay since 2004, and also discussed the environmental baseline assessments conducted for both the Lalor Mine and Lalor Concentrator which have been taking place since 2007. HBMS provided copies of the EEM studies and offered to provide copies of the environmental baseline assessments for review. A summary of these EEM reports has been posted on the Association's website at *http://www.slcoa.com/envmonitor.php*.

Ms. Bast was invited to attend the public Open House for the project taking place in Snow Lake that evening, but she indicated that she was unable to attend. At the conclusion of the meeting, Ms. Bast indicated that she did not have any concerns with the project, and expressed her appreciation for having an opportunity to meet.

As indicated in **Section 5.12.1**, no adverse environmental effects are expected to affect the use of cottages in the region. Potential concerns associated with noise impacts have been addressed, and are discussed in detail in **Section 5.4.3** and **Section 5.9.2**.

7.3.3 Lodge Owners

There are five lodges located in the Snow Lake region. The Diamond Willow Inn & Willow House is located in the Town of Snow Lake at 200 Lakeshore Drive and is approximately 9 km east of the Concentrator site. Wekusko Falls Lodge and Tawow Lodge Ltd. (Herb Lake Landing) are located approximately 18 km and 35 km southeast of the Concentrator site, respectively. Burntwood Lodge is a fly in fishing lodge located on Burntwood Lake and is estimated to be approximately 60 km northwest of the Lalor Site. Grass River Lodge is located on Reed Lake and is approximately 23 km southwest of the Lalor Site with outpost cabins on Dolomite Lake (50 km southwest of the Lalor Site) and Moody Lake (40 km northwest of the proposed Lalor Site).

7.3.4 Snowmobilers

The Snow Lake area is home to the Snow Lake Sno-Drifters snowmobiling club. A map of snowmobile trails as they relate to the proposed Lalor Concentrator is provided in **Figure 16**.

On December 7, 2012, HBMS met with Chris Chell and Robert Stoupe from the Snow Lake Sno-Drifters club in Snow Lake to discuss any concerns the club may have with the Lalor Concentrator project. Although Mr. Chell and Mr. Stuope were in attendance at the August 8, 2012 Open House, they indicated that this was the first official meeting with HBMS to discuss how the project may impact the club. The discussion was focussed on the Pipeline System and construction activities and how their existing snowmobile routes will be affected at the Lalor Access Road, along the rail bed (Pipeline System ROW), portions of Anderson TIA, and the dams/ spillway locations at the east end of Anderson TIA. The club had also indicated that they are very interested in staying informed on construction activities in order to allow them time to update signage or develop new routes.

The process of developing new routes or modifying existing routes was discussed. Mr. Chell and Mr. Stuope indicated that the club is responsible for the condition of the trails, which are used by locals and visitors from southern Manitoba. These visitors may not be familiar with mining activities in the area and are using the maps provided by Manitoba Conservation and Water Stewardship. For this reason they indicated that it is important to provide enough lead time for the club to update maps. Visitors using the trails do not notify the local club or typically ask about changes or hazards that may be present.

Although exiting snowmobile trails use by the Snow Lake Sno-Drifters club may need to be closed and relocated, HBMS is committed to working with the club to ensure recreational snowmobiling in the Snow Lake area is not impacted by the Lalor Concentrator project.

7.3.5 Forestry

The Cormorant Provincial Forest is located approximately 80 km southwest of the proposed Lalor Mine site and covers an area of 1,479 km^2. Provincial forests are Crown Lands managed by Manitoba Natural Resources on a sustainable yield basis. A licence or permit allows harvesting of trees on Crown Lands and also indicates the quantity of each type of trees that can be harvested. Large companies must regenerate forest lands that they have harvested according to their Forest Management License. A forest renewal fee is paid by individuals or small companies for reforestations (Manitoba Conservation, 2011a).

Tolko Industries Ltd. (Manitoba Solid Wood Division, Woodlands), located in The Pas, Manitoba has three Forest Sections in Manitoba (Highrock, Nelson River and Saskatchewan River) where wood is harvested. These Forest Sections include areas surrounding Snow Lake, Flin Flon and Grass River Provincial Park (Tolko Industries Ltd., 2011a).

As part of the planning process and as documented in their *Annual Harvest and Renewal Plan*, public consultation has been undertaken with Pukatawagan (Mathias Colomb Cree Nation) and Snow Lake as well as other surrounding communities regarding the proposed harvest plan. According to Tolko Industries Ltd.'s record of the public consultation events in Pukatawagan and Snow Lake, no concerns regarding unique vegetation areas were identified to Tolko Industries Ltd. representatives. (Tolko Industries Ltd. 2011b)

7.4 Additional Public Notification and Information Sharing

In addition to formal public engagement as described above, the Lalor Concentrator Project has been covered extensively in various forms of media since 2011, and has been presented at industry events. The following listing includes a sampling of publications and industry events that have provided information regarding the Lalor Concentrator project:

Winnipeg Free Press

- Extra $144M for Manitoba Mine, July 6, 2011
- Province Mining Bright Future, November 19, 2011
- Snow Lake's Got it's Groove Back, December 1, 2011
- HudBay Boosts Capital Spending to Develop New Mines, December 20, 2011
- New Ventures on the Horizon, December 31, 2011
- Mining Hope in Northern Manitoba, March 1, 2012
- Lalor Mine Stealing Thunder of Other Site, August 3, 2012
- Mines are Gold for Province's North, August 15, 2012
- After the Gold Rush: Snow Lake Bursting at its Seams as Mining Activity Transforms Town, November 16, 2012
- HudBay to Spend $1.24 Billion on Projects in 2013, including Manitoba Mine, January 9, 2013

The Globe and Mail

- HudBay Minerals Announces Results of Lalor Optimization Study; Commitment to New 4,500 Tonne Per Day Concentrator, July 5, 2011
- HudBay Releases Third Quarter 2012 Results, November 1, 2012

Other Publications

- HudBay to Boost Investment in Lalor Project, Reuters, July 5, 2011
- HudBay's New Plan for Lalor, Mining Markets, July 5, 2011
- HudBay Minerals Announces Results of Lalor Optimization Study; Commitment to New 4,500 Tonne Per Day Concentrator, News Blaze, July 5, 2011
- Gold-Base Metal Development: HudBay Commits to New Concentrator at Lalor Project, Canadian Mining Journal, July 6, 2011
- HudBay to Build New concentrator at Lalor, Extends Mine Life, Mining Weekly, July 6, 2011.
- HudBay Plans New Concentrator at Lalor, Metal Bulletin, July 6, 2011
- HudBay Decides on New Manitoba Concentrator, Mining Weekly, July 8, 2011
- Thoughts From The Road: HudBay's Manitoba Site Tour, Canada Research, October 3, 2012

Conferences and Industry Events

- Lalor Project Update, Mines and Minerals Convention, November 18, 2011
- Lalor Zinc-Copper-Gold Development Project, Women in Mining Presentation, Winnipeg, January 26, 2011
- Lalor Project Update, Mines and Minerals Convention, November 16, 2012

8. Engagement with MCCN

8.1 Interested Aboriginal Group(s)

Baseline environmental surveys in the general area of HBMS's Lalor projects began in 2007, when HBMS commenced intensive drilling on the Lalor site. The environmental impact assessments of HBMS's Lalor projects have taken into account all known Aboriginal lands and traditional territories. Based on Government of Manitoba sources, there are no Indian Reserves, Registered Trap Line (RTL) zones associated with First Nation use or any other Aboriginal interests located within the Project Region.

HBMS applied for approval of the Lalor AEP in March 2010. In the report submitted in support of that application, HBMS concluded that, based on HBMS long-term (more than 50 years) mining experience in the Snow Lake region, there was no First Nation or Aboriginal hunting, fishing, trapping or other traditional use that could be affected.

During the latter half of 2010, Mathias Colomb Cree Nation (MCCN) alleged that its traditional lands encompassed a large portion of northwestern Manitoba, including the entire Snow Lake mining district, in which the Lalor projects are located.

In 2011, HBMS began to share environmental information with MCCN concerning its projects. This information sharing process is described in the sections below.

The contact information for MCCN is as follows:
Chief Arlen Dumas
Mathias Colomb Cree Nation
PO Box 135
Pukatawagan, Manitoba
R0B 1G0

8.2 Summary of Discussions with MCCN

8.2.1 MCCN Meeting #1 – May 9-10, 2011

On May 9-10, 2011, HBMS met with Chief Dumas and 7 representatives of the MCCN (Sherman Lewis, Floyd North, Ken Bighetty, Hanson Dumas, Gordie Bear and Jimmy Colomb) regarding potential cooperation between HBMS and MCCN with respect to education and training, employment and business opportunities. In the course of these discussions, MCCN made the statement that Flin Flon and the Snow Lake mining district are in areas which MCCN considers to be traditional lands.

HBMS presented information about construction of the Lalor AEP; project descriptions for future HBMS projects, including the Lalor and Reed Mine Projects; and the trade-off study then underway to help HBMS decide whether to refurbish the existing Stall Lake Concentrator or build a new concentrator on the Lalor site.

MCCN were advised that the trade-off study then underway included consideration of whether a gold plant and use of cyanide will be required. MCCN expressed concerns about potential use of cyanide during ore concentrating. Since that discussion, the gold plant and use of cyanide have been eliminated from the Lalor Concentrator project description.

Notes of this meeting are provided in **Appendix H**.

8.2.2 MCCN Meeting #2 – January 10-12, 2012

Following the May 2011 meeting, HBMS contacted Chief Dumas to schedule a meeting to share environmental information about HBMS Projects. A meeting was scheduled with MCCN for September 12, 2011 but was cancelled by MCCN on September 9, 2012.

The meeting was rescheduled and held in Flin Flon on January 10-12, 2012. The three-day visit included site tours of the Lalor project, including the Lalor site and some ancillary facilities.

Chief Arlen Dumas, Elder Marcel Caribou, Councilor Jimmy Colomb and legal counsel, Larry Sloan, represented MCCN. Topics of discussion included training and employment opportunities, Lalor project description, environmental impact assessment, and First Nation experience in the region.

HBMS advised that the trade-off study had been completed and a decision made to build a new concentrator at the site of the Lalor Mine. Information was provided about how the Lalor project would link to existing previously-licensed and operating facilities. There was some discussion about the technical aspects of planning for a new concentrator. HBMS explained that the decision to build the Lalor Concentrator at the same location as the mine allows the mine to use paste backfill, which will reduce the number of trucks on the highway from 60 trucks per day to approximately 16 trucks per day.

AECOM gave a presentation explaining the environmental assessment process and presenting their conclusions about expected environmental effects. They also outlined mitigation measures that they recommended be followed in constructing, operating and ultimately closing the Lalor project.

Most of MCCN's comments and questions were posed by MCCN legal counsel and related to regulatory process in Manitoba, waste rock management for Lalor Mine and the existing operation of the Anderson TIA.

Further questions dealt with Manitoba requirements for the archaeological, cultural and heritage assessment performed by AECOM, the continuing use of existing water rights licenses, and timing for application for *Environment Act* licenses for the Lalor Mine and Lalor Concentrator, which at that time were expected in the spring of 2012 summer/fall of 2012, respectively.

During the course of the meeting, MCCN elders shared experiences they had on similar sites. For example, Councilor Colomb shared memories of his work in the open pit mine in Leaf Rapids with HBMS's Tony Butt who also had worked at the Ruttan Mine, but at a time later than Councilor Colomb.

Chief Dumas stated that there are many trappers operating in the area directly north of Reed Lake. Elder Caribou remembered that when trap lines were first registered, not all individuals were included in the registration process. In reply, AECOM indicated that they had contacted registered trappers in the area that would be affected.

Mr. Samoiloff from AECOM was asked whether, during the terrestrial review, AECOM had sought input from First Nations, particularly with respect to plants that can be used for traditional medicines. He replied that baseline studies had commenced in September of 2007 and were carried out over multiple years during different growing seasons. Exploration drilling was carried on continuously during that time. HBMS and AECOM were not aware of any First Nation presence on and around the Lalor site. MCCN did not assert a traditional connection to the Snow Lake district until the latter part of 2010.

It also was explained that the Lalor site is a rocky knoll, with little soil cover, quite typical of many kilometers of terrain in the region. When there is soil cover, HBMS practice is to save it for use in reclamation. The team of

AECOM scientists carried out a vegetation assessment in a one-kilometer buffer zone around the Lalor site and access road. This survey produced a catalogue of species observed, which was compared with Provincial records concerning vegetation in the region and information about plant species that are known to have been identified as potentially having medicinal or cultural importance. AECOM's work had not identified any plant or animal that would be unique to the area that has been or potentially will be affected by the Lalor developments.

AECOM was asked whether there is a way to verify that the environmental review includes plants that First Nations consider to be traditional medicines. In reply, AECOM and HBMS requested any comments that MCCN elders or resource harvesters might have about the vegetation on the AECOM list or any other knowledge they may have about the area. HBMS and AECOM invited MCCN elders and resource harvesters to return to the site with AECOM scientists and walk the area together, to determine if there are any environmental sensitivities that AECOM's assessment may need to include. For example, if a resource harvester or elder knows of any plant or animal special habitat that may have been affected by the Lalor development, this information should be factored into the assessment. HBMS committed to paying the costs association with such work on the site by as many elders or resource harvesters as, in the Chief's judgment, may have an interest in this work.

At the end of the meeting, HBMS also offered to attend in Pukatawagan with AECOM to facilitate participation by elders and resource harvesters. HBMS took the view that First Nation elders and resource harvester be retained to participate with HBMS's consultants in the collection of environmental information and share traditional knowledge about resources that could be affected by HBMS's projects. Mr. Sloan disagreed and took the position that the information sharing process would have to include a formal traditional knowledge study.

Detailed notes of the meeting were prepared and shared with MCCN and their counsel. These notes are provided in **Appendix H**. HBMS sent a complete record of environmental and permitting documentation pertinent to current HBMS project planning to Mr. Sloan on January 20, 2012, with a view to facilitating further discussion. On February 10, 2012, HBMS wrote to follow up on the January meeting with further offers, both with respect to business cooperation and sharing information relevant to the potential for effects of the proposed project on traditional activities. Copies of these letters are provided in **Appendix H**.

8.2.3 Correspondence and Meetings with MCCN Legal Counsel – January – September, 2012

On January 27, 2012, HBMS's environmental lawyer received a letter from MCCN's new lawyers, Robert Freedman and Mark Gustafson, of Janes Freedman Kyle (JFK). Over the next several months, correspondence was exchanged between counsel and further meetings were held to discuss how to facilitate further information sharing.

MCCN took the position that MCCN would require HBMS and/or Manitoba to fund: a study of traditional knowledge and use to be carried out by the consultant of their choice, who was identified as Dr. Craig Candler of the Firelight Group; and a third party review of HBMS's environmental impact assessments to be performed by an environmental expert of their choice, Dr. Ginger Gibson (also of the Firelight Group). MCCN provided a preliminary technical memorandum by Firelight on MCCN traditional uses and proposals for the two studies.

Meetings were held in Winnipeg on May 3, 2012 and July 5, 2012. At these meetings and in subsequent telephone conferences, HBMS, Manitoba and MCCN agreed on the terms of reference for the studies that had been proposed by MCCN. Firelight committed to share their report on traditional knowledge and use within six months. The work was to include interviews of First Nation members, followed by mapping and written reports on the First Nation's traditional uses.

MCCN, HBMS and Manitoba committed to return to the table to discuss the results of the studies and any comments prepared by Dr. Gibson. Dr. Gibson was to help the MCCN membership respond to the environmental information presented by HBMS.

The work on both studies began in October, 2012. AECOM worked with Drs. Candler and Gibson to assemble the materials they would need to carry out both pieces of work, including providing assistance with digital mapping of background information needed by Dr. Candler for his work in mapping traditional uses.

AECOM sent their environmental studies concerning the Lalor and Reed Projects directly to Dr. Gibson and reviewed them with her in telephone conferences.

8.2.4 MCCN Meeting #3 – November 23, 2012

On November 23, 2012, HBMS and AECOM held a meeting in Pukatawagan with members of MCCN to discuss the proposed Lalor Concentrator and other HBMS mining projects. The meeting was attended by Stephen West, Jay Cooper and Pam Marsden from HBMS; Clifton Samoiloff, Alison Weiss and Shawna Kjartanson from AECOM; and Dr. Ginger Gibson and Stephen DeRoy from the Firelight Group.

Fifteen (15) members of MCCN were in attendance, including Chief Arlen Dumas and various Council members and elders. AECOM prepared the presentations for that meeting based on direction provided by Dr. Gibson.

The presentation included the environmental assessment and description of the proposed Lalor Mine, Lalor Concentrator and Reed Copper Projects. The only issues raised by MCCN that relate to potential impacts of the Lalor Concentrator were the use of chemicals in the concentrator and spatial distribution of effects of those chemicals and the assessment of waterfowl in the area. HBMS explained that the reagents that will be used in the concentrator are standard chemicals that have been in use for 30 years. With respect to spatial distribution of chemicals, the concern related to their prior experience with the smelter. HBMS explained that a concentrator is very different from a smelter and chemicals from the concentrator will not be dispersed in the air. With respect to waterfowl, AECOM stated that flora and fauna were assessed as a part of the environmental assessment, and confirmed that waterfowl are included in that group.

HBMS answered all the concerns raised that day and promised to facilitate any follow-up requested by Dr. Gibson, including visits by First Nation elders or resource harvesters to the existing HBMS sites in the Snow Lake area.

Notes of this meeting are provided in **Appendix H**.

8.2.5 Completion of Information Sharing Process – December, 2012 – April, 2013

By end of March, 2013, Firelight's work should have concluded. During February, 2013, HBMS, through legal counsel, attempted to set dates for the three-party meetings to resume, in the expectation that information sharing could be continued with the benefit of the completed studies. To the best of HBMS's knowledge, Dr. Candler and his team completed the interviews needed to map MCCN traditional uses. HBMS paid Firelight's invoices, as had been agreed. However, MCCN's legal counsel was unable to obtain instructions to resume the three-party meetings. Subsequently, MCCN terminated its relationship with legal counsel.

On March 26, 2013, HBMS wrote to Dr. Candler to seek information on completion of Firelight's work. On April 4, 2013, Dr. Candler replied that Firelight's work was "on hold based on a request from MCCN received earlier this year." Dr. Candler further indicated that Firelight would require written authorization from MCCN before "picking up pens again."

8.2.6 Conclusion

None of the information provided by MCCN to date, including Dr. Candler's technical memo and the comments made by MCCN members at the meetings of May 2011, January 2012 and November 2012, demonstrates that there is traditional activity currently practiced in the areas which are or could be affected by the proposed Lalor Concentrator project.

On April 16, 2013, both Manitoba and HBMS wrote to MCCN to inquire whether Firelight's work would be completed. HBMS advised that if, at any time, a link is demonstrated between adverse effects of proposed projects and activities practiced by a member(s) of MCCN, HBMS would do all that is necessary to avoid, mitigate or compensate for any loss so occasioned. Manitoba advised of the steps it intends to take to complete its consultation process. Copies of these letters are provided in **Appendix H**.

9. Conclusions and Recommendations

The results of the effects assessment can be summarized as follows:

Topography

Construction and operation of the proposed Lalor Concentrator will have a negligible impact on topography. The Lalor site has already been cleared and leveled during construction of the Lalor AEP, and any blasting, clearing and leveling required for the Pipeline System will be minimal. The closure phase will include restoration of the topography of the site to match the surrounding area to the extent that is practical. Therefore, the changes in topography are assessed to be insignificant.

Soil

The plan for operation of the Lalor Concentrator minimizes the potential to generate ARD on-site, therefore minimizing consequent effects on soil quality. Soil erosion could potentially occur along the Pipeline System ROW during construction due to activities like clearing and grubbing, or during closure, during activities involving application of soil to all disturbed areas. However, with implementation of the measures described in the assessment, residual effect on soil is assessed to be insignificant.

Air

Dust will be generated during construction along the Pipeline System ROW due to activities such as blasting, clearing, and leveling. During operation, dust will be generated at the jaw crusher building, and general equipment and vehicular movement on site. During closure, activities such as leveling, contouring, excavating, and hauling materials will produce dust. However, implementation of measures such as using dust control agents, designing the jaw crusher building to include a wet scrubber, and imposing speed limits on HBMS-owned roadways are expected to mitigate potential adverse effects. Therefore, the effect of dust on air quality is assessed to be negligible.

With respect to exhaust emissions, although the increase in traffic along PR 392 and PR 395 is considered major in relation to the existing level of traffic on these roads, the resulting impact on air quality in the Project Region is assessed to be negligible. The propane heating system in the Concentrator will generate pollutants which may include nitrogen oxides (NOx), carbon monoxide, sulphur dioxide, particulate matter, or greenhouse gases. However, with the measures described in the assessment, such as equipping the heating system with low NOx burners, the effect on air from exhaust emissions is assessed to be insignificant.

With respect to noise, all practices performed on the Project Site will be carried out in accordance with *The Workplace Safety and Health Act* and HBMS' OHSAS 18000 certified management system, which will minimize the risk of occurrences that may affect worker health and safety. Noise levels are not expected to be high enough to cause any significant disturbance in the Project Region. Therefore, effects due to noise are assessed to be negligible.

Climate

Although effects of GHG emissions on climate change are considered irreversible, given the negligible contribution of GHG emissions from the construction, operation and closure phases of the Lalor Concentrator, the residual effect of GHG emissions on climate change is assessed to be insignificant.

Groundwater

Activities such as handling fuels and lubricants, waste and ore management can potentially affect groundwater quality. However, the measures described to avoid groundwater effects from leaks and spills are judged to be sufficient to mitigate any such risk. ARD could also potentially affect soil quality with consequent effects on groundwater quality. However, the ore management practices described in **Section 5.3.1** will appropriately mitigate any potential effects from ARD. Lastly, since groundwater is not being used as a source of process water, no impact on groundwater availability is expected to occur. Therefore, the overall residual effect on groundwater is assessed to be negligible and insignificant.

Surface Water

As the need for freshwater is accommodated within existing approved limits, any effect on surface waterbodies is expected to be negligible. Wastewater generated during the operation phase of the Lalor Concentrator will be managed using existing licensed treatment facilities, and sanitary sewage generated will be treated in an on-site sewage treatment plant until plans for a new treatment plant are in place.

Improper waste management and generation of ARD on site could potentially affect surface water quality (surface runoff and drainage). However, with implementation of measures described in this assessment, potential effects from ARD and wastes are assessed to be appropriately mitigated. Surface water quality in culverts along the Pipeline System ROW may be affected during construction from activities such as blasting, clearing, or replacing culverts. However, with implementation of sediment and erosion control measures described in the assessment, the residual effects are assessed to be negligible and insignificant.

Tailings will be generated during the operation phase and deposited into the Anderson TIA. An accidental spill along the tailings pipe could potentially affect water quality in culverts along the Pipeline System ROW. However, HBMS will implement spill control measures to minimize the risk of this occurring. Effluent from Anderson TIA is discharged into Anderson Creek. Anderson Creek flows into Anderson Bay of Wekusko Lake. Therefore, deposition of tailings in Anderson TIA could potentially affect water quality in these waterbodies. Based on the comparative analysis set out in **Section 4.3.5**, and continued sub-aqueous deposition of tailings, it was concluded that since currently there are no exceedances of MMER criteria in the Anderson TIA, it is expected that the effluent produced in the future from the Lalor Concentrator will also meet the required water quality guidelines. Assuming implementation of the measures described in **Section 5.7.5**, the residual effects on water quality in Anderson Bay of Wekusko Lake are assessed to be negligible.

Protected and Other Flora Species

Although the Lalor Concentrator will result in loss in vegetation in the Project Site, vegetation communities that will be lost are common throughout the Project Region. Further, a majority of the components will be utilizing areas that are already disturbed. During closure, the Project Site will be re-vegetated and returned to native conditions to the extent that is practical. Therefore, the loss of vegetation to the Lalor Concentrator footprint is not considered significant.

Protected and Other Fauna Species

No habitat of specific or critical value to wildlife was observed at the Project Site (such as calving or over-wintering areas), and based on site conditions and limited field observations, it is expected that there is no critical wildlife value in the Project Area. Although, the Lalor Concentrator will result in a loss of habitat due to clearing in the Project Site, the type of habitat that will be lost is common in the Project Region. There will be some noise disturbance during construction and operation, but it is anticipated that wildlife in the area are accustomed to these noise levels, given other development activity in the region. During closure, the Project Site will be restored to native conditions to the extent practical. For these reasons, the residual effect on fauna is assessed to be insignificant.

Aquatic Resources and Protected Species

Changes in sediment quality can potentially affect aquatic invertebrates with secondary effects on organisms higher in the food chain. Fish and fish habitat can be affected directly due to physical activities destroying fish habitat (physical damage of shoreline), changes in water quality, or indirectly through changes in sediment quality. There are no protected species known to occur in the Nelson River watershed, including the waterbodies surrounding the Lalor Concentrator or in Anderson Bay of Wekusko Lake into which effluent discharged from the Anderson TIA eventually flows. However, the mitigation measures described in **Section 5.7.5** for surface water are anticipated to sufficiently mitigate potential effects on aquatic resources.

Land and Resource Use

As presented in **Section 5.12.1**, residual environmental effects on aquatic and terrestrial components have been assessed to be minor to negligible in magnitude. Therefore, the consequential effects on any natural resource harvesting, trapping, and fishing (recreational, subsistence and commercial) are assessed to be insignificant. HBMS will continue to work with the local trappers to ensure that access to their trap lines is not impacted by the proposed development. With respect to snowmobile trails, HBMS will continue to work with Sno-Drifters to discuss any issues with respect to use of HBMS-owned property as recreational trails.

Heritage Resources

There are no known historic or heritage resources at the Project Site or in the immediate surrounding area. Since physical disturbances during construction will be limited to the Project Site, and no further disturbance will occur during operation or closure, no effects on heritage resources are anticipated during construction, operation or closure of the Lalor Concentrator.

Aesthetics

During construction, the Project Site will be kept tidy. The Project Site is accessed by a 3 km long access road and is surrounded by dense vegetation, minimizing the visual impact of the project in the Project Area and Project Region. During the closure phase, the Project Site will be re-vegetated and returned to native conditions to the extent that is practical. Therefore the aesthetics of the region are not expected to significantly change as a result of the proposed Lalor Concentrator.

Aboriginal Peoples

The project does not require access to, use or occupation of, or the exploration, development and production of lands and resources currently used for traditional purposes by Aboriginal peoples. All elements of the proposed Lalor Concentrator will be on land which HBMS holds under lease or in fee simple, and is occupied and used by HBMS for mining purposes.

As discussed above in **Section 8**, during the latter half of 2010, Mathias Colomb Cree Nation (MCCN) began to suggest that its traditional lands encompass a large portion of northwestern Manitoba, including the entire Snow Lake mining district, in which the Lalor projects, including the proposed Lalor Concentrator, are located. HBMS therefore entered into information sharing with MCCN and Manitoba commenced a Crown consultation process in relation to HBMS' proposed Lalor Mine. HBMS information sharing also has included Lalor Concentrator.

As well, HBMS and Manitoba funded a traditional use and knowledge study by an expert of MCCN's choice, but MCCN has instructed the expert to stop work on the report of the study. Therefore it is not known if there are any traditional uses by MCCN in the Project Region. However, any resource that currently is being used for trapping, fishing or hunting in the Project Region will be unaffected by construction or operation of the Lalor Concentrator project.

With respect to commercial trapping, although the potential effect on trapping activities is assessed to be insignificant, HBMS is committed to working with trappers in the area to ensure that access to their trap lines is not impacted by the proposed development. None of these trappers is associated with an Aboriginal community.

For all these reasons, the Lalor Concentrator is not expected to cause any environmental effects that would lead to consequential effects on Aboriginal peoples.

Conclusions Summary

In summary, the residual environmental effects will be negligible to minor in magnitude with the implementation of the design features and the standard operating and mitigation measures described in this report. The measures described to mitigate the risk of occurrence of accidents and malfunctions are deemed to be appropriate in mitigating such risks. Therefore, it is our opinion that based on the available information and documented assumptions, the overall potential adverse effects of the proposed project will be negligible to minor in magnitude, and are assessed to be not significant.

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Figures

Appendix A

Environment Act Proposal Form

Appendix B

Photos

1. Aerial view of the Lalor site, looking northwest and showing the location of the proposed Lalor Concentrator.
2. Location of the proposed Lalor Concentrator, looking north.
3. Corridor of the Pipeline System (along the Lalor Access Road from Lalor site to PR 395).
4. Corridor of the Pipeline System (along the former rail bed).
5. Snow Lake Pumphouse.
6. Anderson Tailings Impoundment Area (TIA).

Appendix C

Process Flow Diagrams

Appendix D

Licenses and Permits

Appendix E

Project Description Submitted to the Canadian Environmental Assessment Agency

Appendix F

Proposed Lalor Concentrator Environmental Baseline Assessment

Appendix G

Record of Public Involvement

Appendix H

Record of Engagement with Mathias Colomb Cree Nation