Hudson Bay Mining and Smelting Co., Limited

# Environmental Assessment of the Proposed Expansion of the Anderson Tailings Impoundment Area

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August 16, 2016

Mr. Jay Cooper
Hudson Bay Mining and Smelting Co., Limited
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Dear Mr. Cooper:

**Project No:** **60331214**

**Regarding:** **Environmental Assessment of the Proposed Expansion of the Anderson Tailings Impoundment Area**

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 Somia Sadiq directly at 204-928-8494.

Sincerely,
**AECOM Canada Ltd.**

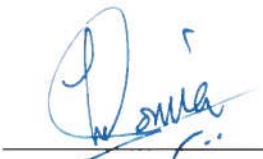


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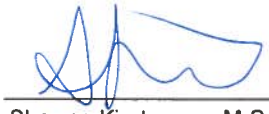
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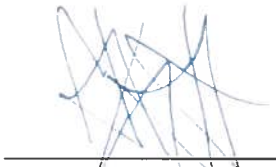


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# Executive Summary

**Project Overview**

Hudson Bay Mining and Smelting Co., Limited's (HBMS) Anderson Tailings Impoundment Area (Anderson TIA) is located in the Snow Lake mining district in northern Manitoba.

The Anderson TIA has been in use since 1979, when a control dam was built at the east end of Anderson Lake across Anderson Creek to control discharge into Anderson Creek. Anderson Creek is a shallow creek that flows into Anderson Bay of Wekusko Lake, which is fed almost entirely from the Anderson TIA decant pipe.

The Anderson TIA is operated in accordance with its Manitoba environmental licence (Clean Environment Commission (CEC) Order 766), and the criteria set out in the Metal Mining Effluent Regulations (MMER) made under the (federal) *Fisheries Act*. As described in Item 1 of Schedule 2 to the MMER, the Anderson TIA is located in "the area bounded by (a) the contour of elevation around Anderson Lake at the 285 m level, and (b) the control dam built at the east end of Anderson Lake."

The purpose of the Anderson TIA is environmental management (storage) of mine tailings produced in the Stall Lake Concentrator (CEC Order 765), which processes ore from HBMS operations in the Snow Lake region. Historically, these operations have included the Photo Lake Mine, Chisel North Mine and other mines in close proximity to the Anderson TIA. Today, in the Snow Lake region, HBMS operates the Lalor Mine (*Environment Act* License No. 3096, dated March 20, 2014), which commenced operation in 2014, and which is projected to have a long-term life of mine of approximately two more decades.

Discharge of water out of the Anderson TIA occurs only during the open-water season (usually May to October). Water quality at the final Anderson TIA discharge point, which includes both the decant pipe and an emergency overflow spillway, is and at all times has been in compliance with applicable regulatory requirements. No treatment, other than retention in the TIA, has ever been required.

In 2011, HBMS commissioned BGC Engineering Inc. (BGC) to complete a study to consider reasonable options for accommodating the additional tailings that would be associated with the operation of the future Lalor Mine. BGC concluded that raising the water level in the Anderson TIA, while continuing with current tailings disposal methods, is the most environmentally and economically feasible means of accommodating the additional tailings storage volume (BGC, 2011).

HBMS now proposes to expand Anderson TIA within the area described in Item 1 of Schedule 2 to the MMER and gives notice of such alteration. The expansion will involve construction of new structures and the gradual inundation of shoreline areas immediately adjacent to the existing Anderson TIA. A three-stage (Stages A, B and C) construction approach will be used to incrementally reach the proposed dam crest elevation (283.75 m). At each Stage, there will be preparation activities (such as cutting trails for temporary access), construction of permanent features, and then gradual inundation of the area contained inside those features.

There are several advantages to the staged approach:

- Customization of expenditures to suit conditions (cost deferral).
- Extension of construction season (each stage is separated by two or three years).
- Accommodating flexibility in long-term facility management.

There will be no physical disruption of any waterway. All of the land to be inundated lies within the active mining area already in use for the existing Anderson TIA and the adjacent Stall Lake Concentrator, and to which access is controlled by HBMS.

These improvements also will provide for better operational control of the water level in the Anderson TIA and significantly increase the flood management capacity from 1 in 1,000 year flood event up to the current standard defined in the Canadian Dam Association (CDA) design criteria, which is the Probable Maximum Flood (PMF) based on the Probable Maximum Precipitation (PMP) event (CDA, 2013).

This Environmental Assessment Report contains the information described in Department of Sustainable Development's *Environment Act Proposal Report Guidelines* (Manitoba Conservation and Water Stewardship, 2015). It has been prepared and is submitted for consideration of the HBMS Notice of Alteration for the expansion of the Anderson TIA.

**Summary of Results of the Assessment**

Anderson Lake, which became the Anderson TIA in 1979, has been well studied since 1965. Results from these studies have been taken into consideration when designing and planning the TIA expansion.

Since 2007, in contemplation of potential future developments resulting from the discovery of the Lalor ore body, HBMS has retained AECOM to undertake environmental investigations in the Snow Lake region. The results of the baseline investigations conducted between 2007 and 2015 are reported in the *Proposed Lalor Concentrator Environmental Baseline Assessment (*AECOM, 2013e), the *Proposed Lalor Mine Baseline Assessment* (AECOM, 2012c) and the Anderson TIA Water Quality Reports (AECOM, 2015b-f, 2014a-b). These investigations dealt broadly with the terrestrial and aquatic resources that could potentially be affected including local geology, soil, vegetation and wildlife, and 14 waterbodies that were initially identified as being located within the potential area of influence of the Anderson TIA Expansion ("the Project").

In 2011, baseline terrestrial and aquatic investigations began in specific anticipation of the proposed Project.

As planning for the Project proceeded, focused field investigations were undertaken in 2011 to 2015 including:

- Terrestrial survey along the former railbed to the north of the Anderson TIA.
- Shoreline survey of the Anderson TIA.
- Terrestrial and stream crossing survey along the proposed dike alignments.
- Water and soil quality sampling and assessments in the Anderson TIA, Anderson Creek and Anderson Bay.
- Fish studies in Anderson Creek, and Anderson Bay and Goose Bay[1] of Wekusko Lake.
- Methylmercury assessment in the Anderson TIA and waterbodies downstream of the Anderson TIA.

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 International Organization for Standardization (ISO) certified safety and environmental management systems and the drafting of the tender documents to include requirements for mitigation measures outlined below). In addition, AECOM has taken into account that this Project consists not of a new development, but rather of an expansion of an on-going mining operation which has been actively managed for over 30 years and operated in compliance with regulatory criteria and well established HBMS operating practices. The Regulatory criteria include the full range of monitoring and reporting requirements contained in the MMER and the Manitoba environmental licence.

[1] *Goose Bay is a reference area outside the Project Region*

The assessment includes AECOM's assessment of the sufficiency of such measures and recommendations for any additional measures which, in our view, would be advisable. Significance of effects is commented on where applicable regulatory criteria exist. In the absence of such criteria, AECOM has provided an overall characterization of the impact taking into consideration the magnitude, reversibility, direction, frequency, and reversibility of the effect and expressed as Negligible, Low, Moderate, or High.

The results of the assessment are as follows:

**Topography**

Sources of changes to site topography include activities such as clearing, blasting, levelling, trenching, and stockpiling materials during site preparation, and installation of laydown areas, temporary trails, dams and spillway. Wherever practicable, existing access roads and laydown areas will be used in order to minimize changes to topography. All changes to topography will occur inside the boundary of HBMS operations on land to which only HBMS has a right of access. The closure phase will include restoration of any changes to topography of the temporary sites (trails, laydown areas) to match the pre-construction condition of the surrounding area to the extent practical. Dam and spillway alignments have been chosen based on proximity to high points and bedrock outcrops to maximize utilization of the existing topography for containment. The alignment selection process resulted in the smallest practicable footprint and change to topography. The dams and spillway structures will be permanent and will not be removed during the closure phase. The change in topography from the dams will be permanent and irreversible, but since the purpose of the dams is to allow for continued environmental management of tailings, this change is unavoidable.

Overall, the residual impact on topography caused by the Project is assessed to be Moderate. The change in topography, while permanent, will impact only features which are limited to the Project Site, and not unique in the Project Region.

**Soils**

High wind and precipitation events can lead to soil erosion, which can consequentially affect other environmental components (e.g., air quality, water quality, or vegetation). Construction activities that can result in elevated potential for soil erosion include clearing, grubbing, stockpiling, excavation, and inundation of the shoreline of Anderson TIA. To the extent practicable, clearing will occur during the winter to minimize disruption to soil and allow sufficient time for soil stabilization prior to the spring freshet. It is anticipated that once the dams are built in each Stage, it will take two to four years for water levels to reach the desired water elevation. Given this length of time, disturbed soils will stabilize naturally and not be susceptible to significant erosion. Stockpiled organic spoils will be compacted and reused, where practicable. Excavation activities will not occur during high rain or wind events, which will minimize the erosion potential of exposed soils.

Wastes such as used oils, rags, drums and miscellaneous garbage can potentially affect soil quality, which can have subsequent effects on other environmental components (e.g., vegetation, groundwater, and surface water). Wastes generated during construction will be collected in garbage bins maintained at specific locations throughout the Project 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.

The overall residual impact on soil as a result of the Project is assessed to be Negligible.

**Air**

Sources of dust include activities such as blasting, clearing, levelling, stockpiling, movement of traffic on roads, and transport of materials. Dust occurs primarily during summer and fall, with greater likelihood for an increase in dust during dry and windy conditions. Dust may be produced during preparation and construction activities (such as clearing, grubbing, blasting, stockpiling, and transporting materials and/or employees, and general use of construction equipment). Clearing activities are temporary and limited to the first portion of the first year of each Stage. Areas to be cleared will be minimized where practicable: for example, previously disturbed areas have been identified and will be used for temporary trails or laydown areas. Stockpiled materials will be compacted and re-used, where practicable. Trucks hauling materials will be covered to minimize dust coming off loads.

Construction traffic may travel along the PR 395, PR 392 and PR 393 and generate dust. The increase in traffic along these roads and at the Project Site is temporary (limited to the first year of each Stage) and if required, dust suppression activities, such as the use of approved dust control agents, will be undertaken. The temporary trails will have a speed limit of 20 km/hr and the speed limits on PR 395 and PR 393 will be adhered to at all times. Vegetated buffers will be maintained to minimize the transport of dust generated on site. There is no anticipated change in dust generation from current conditions during the operation or closure phases of the expansion of the Anderson TIA.

During the preparation and construction phases of the Project, exhaust emissions will be generated during delivery of materials and employees to the site, and other operation of vehicles. Emissions will also be generated during construction of the water retention dams, spillway, seepage collection system, as well as preparation activities (such as clearing and grubbing of laydown areas, temporary trails). These sources of emissions will be generated during the first year of each Stage. Periodic monitoring and inspection of the structures may occur during the inundation periods between Stages. The exhaust emissions as a result of construction activities are temporary. Vehicles and equipment will be well maintained and vehicle idling kept to a minimum.

The second source of exhaust emissions is propane heaters that will be used to heat the contractor trailers during construction. 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. The construction phase of the Project is limited to the first year of each Stage and the heating systems will be equipped with low NOx burners.

There is no anticipated increase in traffic or exhaust emissions during the operation or closure phases of the Project.

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. Sources of noise during construction would be typical of heavy equipment such as bulldozers and excavators. Noise and vibration will also be generated when blasting is undertaken at quarries and, where required, at dams or spillway locations. Blasting is a common occurrence in the region given the other mining activity, however, it will only occur intermittently during the first year of each Stage. HBMS will provide hearing protection as required.

The operation of the Anderson TIA, following the expansion, is not anticipated to be different from the current operating procedures. Therefore, no additional noise or vibration will occur during the operation phases of the Project.

The mitigation measures listed above to minimize the impact on air (due to dust, emissions, and noise and vibration) are deemed sufficient. Therefore, the overall residual impact on air as a result of the Project is assessed to be Negligible.

**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. GHG emissions are expected during construction and closure activities. There is no anticipated change in GHG emissions during the operation phase. GHG emissions are expected to be typical of construction activities and will be limited in duration. Idling at the Project Site will be kept to a minimum (for example, while waiting for quarry trucks to unload) and vehicles and equipment will be maintained in good working condition. The increase in emissions will be for a very short period of time.

Overall, emissions due to newly created flooded lands are anticipated to have a negligible impact to provincial and federal GHG inventories.

**Groundwater**

Activities such as handling fuels and lubricants can potentially affect groundwater quality. There are no withdrawals of groundwater proposed for the Project. Potential surface to groundwater recharge pathways in the direct footprint of the dams, spillway, and collection basins may be affected. However, the shallow groundwater will remain unaffected due to numerous other pathways for recharge. In addition, the level of groundwater (piezometric surface) will increase in the areas that are inundated and will transition to their current levels within a short distance of the TIA. Therefore it is concluded that the Project will not impact groundwater.

**Surface Water**

The results of water quality studies conducted on the Anderson TIA over the course of the operation of the TIA, Anderson Creek and Anderson Bay have not at any time demonstrated any exceedance of an MMER limit. HBMS did note increasing zinc concentrations in 2014 and 2015, when compared to the data from the previous two years (although still within the historic 37 year range). HBMS considered the increase, attempted to analyze causes, and undertook further measures intended to reduce zinc levels in the discharge. In the data taken to date for 2016, the zinc concentration has reduced to half the concentration it was in 2015. HBMS also took into consideration that the capacity to treat tailings in the TIA could be diminishing as the volume of tailings approaches maximum capacity. If that is the case, the TIA expansion will increase the volume of water and provide for continued effective management of the tailings.

Moving forward, it is expected that the effluent from the expanded Anderson TIA will continue to meet the required water quality guidelines, and thus the surface water quality downstream of the Anderson TIA will not change. Water quality may also be affected as a result of improper handling of solid and construction waste however, waste generated on site will be handled and disposed of appropriately and all storage and handling of construction materials will be conducted in accordance with best management practices. Water quality may be affected due to erosion. Appropriate erosion and sediment control and site management will mitigate for erosion and consequent impact on water quality. Water quality may be affected due to the flooding of vegetation surrounding the TIA due to an influx of nutrients and subsequently primary productivity. Clearing of vegetation and soils will minimize this impact. Additionally, the relatively small area of flooding compared to the TIA overall size and the long time frame over which flooding will occur minimizes this threat.

The overall residual impact on surface water quality downstream of the Anderson TIA as a result of the Project is assessed to be Insignificant for the following key reasons:

- The TIA has been the subject of extensive water quality studies since it came into operation 37 years ago. These studies have allowed HBMS to effectively manage tailings through the years and be able to make informed assessment of potential implications of any modification to the existing TIA.

- During expansion of the TIA, the water level will be raised slowly over a period of years (i.e. slow flooding), which will reduce potential effects due erosion and sedimentation that may otherwise be experienced due to rapid flooding.

- HBMS has undertaken an extensive review of other alternatives for tailings deposition, including development of new tailings storage locations, either in other lakes or low-lying basins, or increasing the storage capacity of the existing Anderson TIA itself. Both subaqueous deposition and subaerial (land) deposition options were considered. Undertaking this analysis has allowed for HBMS to make the most feasible, environmentally responsible decision moving forward.

- The processes associated with concentrating ore (which results in production of tailings) are not changing.

- Based on analysis of the ore to be processed, the size and composition of tailings to be deposited into the TIA will be consistent with tailings that have been deposited historically; therefore, the water quality is not expected to change at the discharge, in the Anderson Creek or Anderson Bay.

- Conclusions in a 1990 MEND study (Rescan 1990) made in regards to tailings characteristics within the Anderson TIA are still valid: deposited tailings were not releasing metals into the overlying water; tailings and natural sediments are acting as sinks for metals; at the end of deposition, the tailings will be progressively covered by a blanket of organic-rich natural sediments which will act to preserve the anoxic conditions essentially in perpetuity; and it is unlikely that the tailings on the floor of the Anderson TIA will ever support a benthic efflux of metals to the water contained in the Anderson TIA).

- HBMS will continue regular monitoring as prescribed by the MMER 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).

**Surface Water Quantity**

Following the construction phase of each Stage, the water level in the Anderson TIA will gradually rise based on tailings production, reclaim water usage, precipitation and runoff from the Anderson catchment area. This gradual inundation will take place over approximately two to four years, during which there likely will be little need to discharge out of the Anderson TIA. Any discharge that occurs will be through the newly improved spillway channel, which will be controlled with sluice gate. The interruption of discharge from the TIA will be temporary and mitigation measures, such as the diversion ditch and monitoring, will minimize the impact.

For these reasons, the overall residual impact on surface water quantity in Anderson Creek as a result of the Project is assessed to be Negligible

The operation of the expanded Anderson TIA will be consistent with current operations and therefore the effect on surface water quantity is assessed to be Negligible.

**Aquatic Resources**

Although the habitat of 29 species of special concern listed by the Manitoba CDC (Manitoba Sustainable Development, 2016a) overlaps with the Project Region, none of these species was observed during the biophysical surveys of the Project Area. Of the species of special concern, only one aquatic species is protected federally under the *Species at Risk Act* (SARA): Shortjaw Cisco. The Shortjaw Cisco has been recorded Manitoba lakes including Lake Athapapuskow, Clearwater Lake, Lake Winnipeg, George Lake, Reindeer Lake and Lake Athabasca

(COSEWIC, 2003). However, there have been no reported occurrences in the Grass River sub-basin in the Nelson River Basin, where the Anderson TIA is located.

Given that the potential of occurrence of protected aquatic species within the Project Region is low, there are no effects anticipated as a result of the expansion of the Anderson TIA.

Effects on lower trophic level biota occur primarily through changes in habitat quality and quantity. Reduced quantity and quality of habitat can reduce the abundance, diversity or community composition of aquatic invertebrates, with secondary effects on organisms higher in the food chain. Habitat quality can be affected through changes in sediment quality, through surface runoff (elevated concentration of metals or other contaminants), through air dispersion (dust), or any accidental leaks or spills during the preparation and construction phases of the Project. With application of mitigation measures to minimize impacts on surface water quality and the risk of occurrence of spills and leaks, potential effects on lower tropic level biota are assessed to be Negligible.

Further, habitat quantity for aquatic benthic invertebrates may be impacted as a result in a temporary change in the hydraulic regime of Anderson Creek, as much of its flow is provided by the discharge. However, this effect is assessed to be Negligible given historic conditions of the Creek and disruption of the flow regime being temporary.

**Fish and Fish Habitat**

Effects on fish and fish habitat occur primarily through changes in habitat quality and quantity. Anderson TIA is not considered to be “fish habitat” in accordance with the *Fisheries Act* and fishing would not at any time be permitted in the TIA. Habitat quantity can be affected by the physical alteration of fish habitat and altering the hydraulic regime of Anderson Creek. Effects on aquatic benthic invertebrates can indirectly affect fish habitat quality (reduced diversity or abundance reduces food availability), as can changes to surface water quality. Effects of inundation and potential release of methylmercury, may affect fish health and subsequently human consumption of this fish. Since potential impact on habitat quality, quantity, and surface water quality was assessed to be Negligible to Minor, the subsequent potential impact on fish and fish habitat is assessed to be Minor.

Changes to surface water quality, through deposition of dust, soil erosion, spills or leaks, or effects on surface water quality can impact fish the quality of fish habitat. Fish studies conducted in Anderson Bay have confirmed that water quality downstream of the TIA continues to support high species diversity. Additionally the area of Anderson Creek to be disturbed does not contain unique or rare fish habitat and overland flows previously draining into the TIA will now be directed into the creek which will sustain flows and prevent any fish from becoming stranded. Dust, erosion and spill mitigation measures have all been provided for in the assessment.

Fish populations can also be impacted by changes in the quantity of habitat. Potential sources of impacts to habitat quantity are: any disturbance to the bank and bed of Anderson Creek; and changes to the hydraulic regime of the Creek. There will be a small area of disturbance to the bank and bed of Anderson Creek, in the construction phase of Stage B. Rip rap will be installed at this location to provide dissipation of energy of the water being discharged from the new spillway.

Taking into consideration specific mitigation measures to minimize potential effects on habitat quantity, benthic invertebrates and surface water quality, the residual effects on fish and fish habitat, as a result of the Project, are assessed to be Minor.

**Terrestrial Flora Species**

Effects on protected and other terrestrial flora include clearing and dust deposition. A maximum of 173 ha of additional clearing will be required for the proposed Project. The majority of this clearing will be limited to the first year of each Stage and will include clearing for temporary trails, laydown areas, dams, quarries and borrow pits and

powerlines. The area around the Anderson TIA, in the areas to be inundated by the Project, will also be cleared. 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 increase 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.

Dust generated during the construction and closure phases of the Anderson TIA can potentially affect vegetation in the area by interfering with the photosynthetic ability of the vegetation. However, taking into consideration implementation of appropriate mitigation measures, effects on terrestrial flora due to dust are assessed to be Negligible.

Only one terrestrial flora species is protected federally under the SARA: the Flooded Jellyskin. 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 during the biophysical surveys. Therefore, the residual effect on Flooded Jellyskin as a result of the expansion of the Anderson TIA is assessed to be Negligible.

Considering application of mitigation measures (such as minimizing clearing and controlling dust), the overall residual impact on terrestrial flora species are assessed to be Negligible.

**Terrestrial Fauna Species**

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

Loss of vegetation through clearing and flooding can affect terrestrial fauna by reducing the amount of habitat available. However, no critical wildlife habitat was observed on the Project Site (such as calving or over-wintering areas) and, based on site conditions and field observations, it is assessed that there is no critical wildlife in the Project Area. Nesting birds that may make use of the edge habitat available along the shoreline of the Anderson TIA will be able to continue to use this habitat following development of the Project. Despite clearing along the shoreline and other areas, 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). There were no potential brooding areas for waterfowl observed in the Project Site but there were some within the Project Area (along the Lalor Access Road and former rail bed). 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. To the extent practicable, previously cleared areas will be used for temporary trails and/or laydown areas to minimize the area to be cleared. The natural restoration of vegetation in these temporary areas during closure will provide for restoration of available habitat.

Noise generated during the preparation and construction phases of the expansion of the Anderson TIA has the potential to deter wildlife from the area. During construction, noise will be generated to varying degrees. It is anticipated that local fauna are likely already accustomed to some level of noise based on the existing activity in the area (Lalor Mine, PR 395, PR 392, and the Stall Lake Concentrator). Habitat at the Project Site is common with no specific or critical value to wildlife.

With the anticipated increase in traffic as a result of the project, on local public roads there is potential for increased wildlife collisions. Moose, coyotes and wolves may pass through the Project Area, including Provincial highways and local roads. Edge vegetation and the open nature of these roads allows for ease of migration, making the area attractive to wildlife. As local wildlife populations are considered low, the potential for increased wildlife collisions is

also considered low. HBMS' experience in the local area indicates that wildlife collisions are rare. There will be continued implementation of speed limits on the temporary trails, local roads and Provincial highways.

**Protected Fauna Species**

There are 29 species of Special Concern listed by the Manitoba CDC (Manitoba Conservation, 2012a), none of which were observed in the areas examined during the extensive biophysical surveys of the Project Area. Of the species of Special Concern, eight terrestrial fauna species are protected either federally under the SARA or provincially under the provincial Endangered Species and Ecosystems Act (ESEA): Boreal Woodland Caribou, Monarch butterfly, Northern Leopard Frog, Yellow Rail, Whip-poor-will, Common Nighthawk, Olive-sided Flycatcher and the Rusty Blackbird.

None of the protected species have been observed within the Project Site during terrestrial investigations. It is anticipated that due to the small size and benign nature of habitat within the Project Site that no protected fauna species will be influenced by the Project.

Therefore, the residual impact on terrestrial fauna species (including protected fauna species) as a result of the Project (loss of habitat, noise and risk of vehicle collisions) is assessed to be Minor.

**Socio-Economic Effects**

This assessment considers any socio-economic effects which could result from changes in the biophysical environment. Typically, such effects can arise when a resource used by people is adversely affected by a proposed development. In this case, potential pathways considered are fish consumption in downstream waterbodies, land and resource use, heritage resources, and aesthetics. Results of the assessment are as follows:

**Fish Consumption in Downstream Waterbodies**

The construction of reservoirs typically involves submerging large amount of terrestrial organic matter. The decomposition of submerged organic matter can result in the formation of inorganic mercury (or "methylmercury") that can potentially accumulate along the food chain (Brouard et al., 1990). Methylmercury production is controlled primarily by the amount and composition of the submerged organic matter, but is also influenced by biotic and abiotic factors such as microbiological activity and physicochemical characteristics of water (pH, dissolved oxygen, redox potential, humic and fulvic acids, sulfides, etc.). Among these factors, the amount of submerged organic matter has the most influence on the production of methylmercury in the wake of flooding.

Based on AECOM's study of fish collected and analysed in the Anderson TIA, fish desirable for human consumption are not present in the Anderson TIA. Even if there were such fish there is very limited possibility for small or large bodied fish to migrate downstream of the TIA. Fishing is not now, and will not at any time in the future, be permitted in the Anderson TIA. For these reasons, it is not appropriate to assess the impact of mercury on fish in the Anderson TIA itself.

With respect to the potential impacts of mercury on fish in the downstream waterbodies, primarily Anderson Bay of Wekusko Lake, it is assessed that the impact will be Negligible for the following reasons:

- Removal of trees during the Stage A preparation activities will reduce the inputs of mercury by reducing the amount of organic matter released into the TIA itself. Once the expansion of the TIA has commenced, the water level will be raised slowly over a period of years (i.e. slow flooding), which will further reduce mobilization of mercury within organic matter released in the course of erosion and sedimentation;
- The pipe that comprises the final discharge point provides little opportunity for the transfer of waterborne biota and suspended solids;

- The concentration of mercury in the water column alone is not a major factor in the transfer of mercury to fish desirable for human consumption. Even so, mercury in the dissolved form contained in water discharged from the Anderson TIA would be diluted in Wekusko Lake by a factor of approximately 100; and
- There is little or no fish passage for large or small bodied fish between the Anderson TIA and downstream waterbodies.

The fish collected and analyzed from Wekusko Lake (AECOM, 2015) showed no instances of fish tissue exceeding the 0.5 ppm consumption advisory, and this is not expected to change. In order to confirm this assessment, mercury levels in sport, commercial or subsistence fish in Wekusko Lake will be monitored before and after the final inundation phase (Stage C) of the Project.

**Land and Resource Use**

Land and resource uses in the Project Region that may indirectly be impacted by harvesting and trapping opportunities, fishing (recreational, subsistence and commercial), recreational use of existing trails, and general use of the Project Area and Region. However, the Project Site has been developed for mining purposes for 40 years and the Project will not change the land and/or resource use at the Project Site.

With respect to trapping in the area, HBMS is committed to working with the trappers in the area to ensure that access to their trap lines is not impacted by the proposed development. HBMS has a healthy working relationship with the trappers in the area and have informed all potentially affected trappers within the Project Region of the proposed expansion of the Anderson TIA.

With respect to snowmobile trails, HBMS has discussed the proposed Project with members of the Sno-Drifters snowmobiling club. The club has no concerns with the Project. Prior to commencement of construction, HBMS will notify the club, to allow for advance notification to the club's members.

**Heritage Resources**

Project activities such as clearing, blasting, or excavating can potentially affect heritage resources. There are no known heritage resources at the Project Site and the potential to find any is low. No further disturbance beyond the Project Site will occur. Therefore, no effects on heritage resources are anticipated to occur as a result of the proposed Project.

**Aesthetics**

Project activities during preparation and construction could potentially impact the aesthetics of the Project Site. However, Project components are located primarily in areas that have been previously disturbed as part of the construction of the Anderson TIA or other HBMS activity in the area. A treed buffer will be maintained between the dams and PR 392. 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 temporary areas (trails or laydown areas) will be contoured, where required, and allowed to naturally re-vegetate.

**Effects on Aboriginal Peoples**

HBMS has operated in the Snow Lake district for over 50 years. The Anderson TIA has been in operation for 37 years. HBMS has mining and surface claims throughout much of 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 Project components will be on land which HBMS holds under lease or in fee, and is occupied and used by HBMS for mining purposes.

With respect to trapping, although the potential effect on trapping activities is assessed to be Minor, HBMS is committed to continuing to work with trappers in the Project Region 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 proposed expansion is not expected to cause any environmental effects that would lead to consequential effects on Aboriginal peoples.

**Summary**

In summary, the residual environmental effects will be Negligible to Moderate in magnitude with the implementation of the design features and the standard operating and mitigation measures described in the 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 Moderate in magnitude.

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# 1. Introduction

## 1.1 Project Overview

Hudson Bay Mining and Smelting Co., Limited's (HBMS) Anderson Tailings Impoundment Area (Anderson TIA) is located in the Snow Lake mining district in northern Manitoba. **Figure 01** displays the general location of the Anderson TIA in Manitoba.

Anderson Lake was designated as a TIA in 1979, and has been in operation, along with the Stall Lake Concentrator since that time. A concentrator (sometimes called a mill) processes the ore produced in a mine, extracting the metals from the ore, and leaving behind slurry called "tailings". Tailings from the Stall Lake Concentrator are deposited via a pipeline into the Anderson TIA. Storage of tailings under water has long been understood to provide effective environmental management of tailings.

The Anderson TIA is operated in accordance with its Manitoba environmental licence (Clean Environment Commission (CEC) Order 766), and the criteria set out in the Metal Mining Effluent Regulations (MMER) made under the (federal) *Fisheries Act*. As described in Item 1 of Schedule 2 to the MMER, the Anderson TIA is located in "the area bounded by (a) the contour of elevation around Anderson Lake at the 285 m level, and (b) the control dam built at the east end of Anderson Lake."

The purpose of the Anderson TIA is environmental management (storage) of mine tailings produced in the Stall Lake Concentrator (CEC Order 765), which processes ore from HBMS operations in the Snow Lake region. Historically, these operations have included the Photo Lake Mine, Chisel North Mine and other mines in close proximity to the Anderson TIA. Today, in the Snow Lake region, HBMS operates the Lalor Mine (*Environment Act* License No. 3096, dated March 20, 2014), which commenced operation in 2014, and which is projected to have a long-term life of mine of approximately two more decades.

Anderson TIA and Stall Lake Concentrator are located on lands which the proponent has used for mining purposes since the late 1970's. The properties are behind HBMS gates which control access to the facilities. Points of control to the sites are displayed on **Figure 02.** As discussed below, HBMS holds surface rights which entitle it to exclude all other potential users from the Anderson TIA and Stall Concentrator sites. It is today and in the future will continue to be important to maintain security for operation of these facilities.

Except for brief intervals, the Stall Lake Concentrator has been in continuous use since its construction in 1979, though at varying volumes of production. Over the years, however, various aspects of the operation were taken out of service and parts were removed from the site. In planning Lalor Mine, it had been contemplated that a new concentrator would be constructed on the site of the mine. However, it proved feasible to restore the operation of Stall Lake Concentrator to accommodate processing of the ore from Lalor Mine. In 2013-14, the Stall Lake Concentrator was refurbished and it is now anticipated that it will continue to operate for the life of Lalor Mine. The refurbishment was described in a letter dated February 7, 2014, which was submitted to Manitoba Conservation and Water Stewardship (**Appendix A**).

In 2011, HBMS commissioned BGC Engineering Inc. (BGC) to complete a study to consider reasonable options for accommodating the additional tailings that would be associated with the operation of the future Lalor Mine. BGC concluded that raising the water level in the Anderson TIA, while continuing with current tailings disposal methods, is

the most environmentally responsible and economically feasible means of accommodating the additional tailings storage volume (BGC, 2011).

HBMS now proposes to expand Anderson TIA within the area described in Item 1 of Schedule 2 to the MMER and gives notice of such alteration. The expansion will involve construction of new structures and the gradual inundation of shoreline areas immediately adjacent to the existing Anderson TIA. There will be no physical disruption of any waterway. All of the land to be inundated lies within the active mining area already in use for the existing Anderson TIA and the adjacent Stall Lake Concentrator, and to which access is controlled by HBMS.

These improvements also will provide for better operational control of the water level in the Anderson TIA and significantly increase the flood management capacity from 1 in 1,000 year flood event up to the current standard defined in the Canadian Dam Association (CDA) design criteria, which is the Probable Maximum Flood (PMF) based on the Probable Maximum Precipitation (PMP) event (CDA, 2013).

**Figure 02** displays the Anderson TIA in context with other existing HBMS facilities in the Snow Lake region.

This Environmental Assessment Report contains the information described in Manitoba Conservation's Information Bulletin, "Environment Act Proposal Report Guidelines." (Manitoba Conservation and Water Stewardship, 2015). It has been prepared and is submitted for consideration of the HBMS Notice of Alteration for the expansion of the Anderson TIA.

## 1.2 Proponent Contact Information

**Table 1-1: Proponent Contact Information**

| | |
|---|---|
| **Name of Project:** | Anderson TIA Expansion |
| **Name of Proponent** | Hudson Bay Mining and Smelting Co., Limited (HBMS), a wholly owned subsidiary of HudBay Minerals Inc. (HudBay) |
| **Address of Proponent** | PO Box 1500, #1 Company Road, Flin Flon, Manitoba, R8A 1N9 |
| **Principal Contact Person for the EAP** | **Jay Cooper**<br>Superintendent Environment, HBMS<br>PO Box 1500, #1 Company Road, Flin Flon, Manitoba, R8A 1N9<br>Ph: (204) 687-2667<br>Email: jay.cooper@hudbayminerals.com |

## 1.3 Company Profile

The owner of the Anderson TIA is HBMS, a wholly owned subsidiary of HudBay Minerals Inc. (HudBay). HBMS has active mines in Manitoba, the 777 Mine in Flin Flon, the Lalor Mine near Snow Lake, and the Reed Mine in the Grass River Provincial Park.

Copper and zinc ore from the 777 Mine is concentrated in the Flin Flon Metallurgical Complex (FFMC). Zinc and copper ore produced at the Lalor Mine is processed in the Stall Lake Concentrator. Tailings from the Stall Lake Concentrator are deposited via a pipeline into the Anderson TIA.

Zinc concentrate from both the FFMC and the Stall Lake Concentrator is processed to produce refined zinc in the FFMC (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.

In 2014, HBMS directly employed 1,391 people, with an annual payroll of $148 million in wages and benefits. HBMS paid approximately $19.5 million in municipal taxes and grants as well as making community investments and charitable donations of approximately $665,000.

## 1.4 History of the Snow Lake Region

The Snow Lake region of northern Manitoba 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 mines in the area, including the Photo Lake, Rod, Chisel Lake, Chisel Open Pit, Stall Lake, Osborne Lake, Spruce Point, Ghost Lake, Anderson Lake and Chisel North Mines.

Located at the heart of the Snow Lake mining district, the Anderson TIA has been in operation since 1979, when an earthen control dam (Anderson Dam) was built across Anderson Creek to raise the water level in Anderson Lake by approximately 2.75 m and to provide discharge control. The Stall Lake Concentrator was commissioned at the same time and has been in continuous operation since then, with the exception of brief periods during 1993-94, 1999 and 2009.

# 2. Existing Information

Anderson Lake, which became the Anderson TIA in 1979, has been well studied since 1965. This section lists and summarizes the studies and reports completed over the last 50 years by a variety of agencies, consultants and scientists with an abstract on the information contained in each report (**Table 2-1**). Results from these reports have been taken into consideration when designing and planning the TIA expansion.

## 2.1 Existing Reports

**Table 2-1: Summary of Existing Information**

| Year Published | Author | Report Title | Abstract |
|---|---|---|---|
| **1965** | Allard, L.P. | A Survey of Anderson Lake, 1965. | The lake was studied to investigate the possibility of introducing exotic game fish. The study concluded that the success would be inhibited by mining interests in the area, not being able to assuring that native fish will not enter the lake, and that the lake is too large to remove all existing native fishes. Parts of a Northern Pike and White Suckers were observed in the lake. The outlet flows into a bog, with beaver dams and a natural rock barrier exists prior to passing under the road. Additional beaver dams are located along the length of the creek, and a large one has a 5ft drop, where 200 White Suckers were observed. The creek then breaks into channels before entering Wekusko Lake. Fishing effort revealed no fish in nets; however, a few Brook Stickleback were captured with the use of rotenone. Benthic organisms were also collected and density was relatively low. |
| **1968** | Schlick, R.O | A Survey of Wekusko Lake in 1967. | A standard fisheries survey was conducted on Wekusko Lake, to assess the lake's capacity as a producer of commercial fish. Chironomids were the most abundant benthic organism and was the only organism found in all sampling locations. Seventeen species of fish were captured with gill nets or rotenone. Commercial fishing on the lake has been primarily conducted in the winter since 1931/32. |
| **1975** | Crowe, J.-A. M.E | A 1974 Limnological Survey of Five Lakes in the Snow Lake Area. | Anderson Lake, Chisel Lake, Ghost Lake, Osborne Lake and Stall Lake were sampled for water and sediment chemistry, benthic organisms, and fish population. Anderson was low in dissolved metals. Anderson had the highest benthic density compared to the other lakes examined. |
| **1976** | Blunt, B.A. | A Limnological Survey of Wekusko Lake, 1975. | The objective of the study was to collect baseline data on water quality, benthic organisms and fish populations which may be compared to future data to determine the effects of mining operations on the lake. The study focused on Herb Bay, Puella Bay and the Snow, Anderson, and Berry Bays. Water chemistry was generally uniform across study areas and levels of heavy metals in the sediments were similar to those in nearby lakes (File and Reed). Benthic organism diversity was high and indicative of clean water environments. Variations in benthic density and diversity were attributed to depth and substrate types. Condition factors indicated satisfactory growth rates for fish at this latitude. |
| **1977** | Labarre, G.J. | Stall Lake Ore Concentrator, Snow Lake Manitoba; Revised Environmental Impact Statement. | Proposed alterations to the original application related to change in process configuration, update of tonnages and volumes of waste discharges, and the rationale behind choosing Anderson Lake as the most logical site for tailings disposal and water treatment, form the basis of this impact statement. An appendix containing the results from two limnological studies on Anderson Lake |

| Year Published | Author | Report Title | Abstract |
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| | | | were included in the report. Diatoms dominate the plankton community. Only 1 of 4 stations had benthic organisms present, which was dominated by chironomids. Only small-bodied fish were captured; the lack of larger bodied fish was attributed to shallow depths which would result in winter-kill and restricted accessibility to other waterbodies in the area. |
| **1977** | Bridges, W.R. | Anderson Bay - Wekusko Lake Limnological Survey. | A brief limnological study on Anderson Bay in summer 1976 to collect background data prior to operation of Stall Lake Concentrator. Water and sediments of Anderson Bay contain normal levels of heavy metals. Plankton were diverse and abundant, an indication of high primary productivity. |
| **1980** | Booy, H. | Baseline Biological Survey of Anderson Bay. | The study objective was to collect biological and water quality information on Anderson Bay of Wekusko Lake to provide a baseline for future studies. Suspended solids in the water were elevated as a result of elevated plankton growth, wind, and vegetation decay. Extractable metal concentrations were higher than previous studies, likely a result of a flushing effect from Stall Creek during spring run-off. The majority of the phytoplankton community were blue-green algae, followed by flagellated species. Fishing efforts yielded White Sucker, Northern Pike, Walleye, Yellow Perch, Lake Whitefish, Cisco, Brook Stickleback, Emerald Shiners and Burbot. Shiners were observed in abundance at the mouth of Anderson Creek. There were no obvious spatial trends in benthic organism density or sediment chemistry. |
| **1980** | Brown, D.J. et al | A Limnological Survey of Anderson and Wekusko Lakes, 1977. | In 1977, a limnological survey was conducted in Anderson Lake and areas of Wekusko Lake (Anderson, Berry, Crowduck, Herb and Goose Bays as well as Anderson and Stall Creeks), to collect baseline data against which future data could be compared. Water samples contained chemical constituents at concentrations within drinking water limits. Concentrations of heavy metals in sediments were variable across the areas. The highest numbers of zooplankton were reported in Anderson Bay. Anderson and Stall Creeks were very productive and diverse, and significantly different from other areas surveyed. Anderson Bay, based on phosphorus, chlorophyll *a*, and Secchi disk depth, was considered the most enriched area. |
| **1980** | Brown, D.J. et al | Data Supplement To A Limnological Survey of Anderson and Wekusko Lakes, 1977. | Data supplement containing tables of water and sediment chemistry, phyto and zooplankton, benthos, and fish tissue residual concentrations. |
| **1983** | Booy, H.J. | Anderson Bay Limnology Survey (July 1980 - June 1981) Prior to Discharging from Anderson Lake into Anderson Bay | The objective of the study was to conduct a limnological survey in Anderson Bay of Wekusko Lake to obtain and document additional biological baseline information prior to discharge of any water into Anderson Bay from Anderson Lake. The quality of Anderson Bay had changed little in comparison to previous surveys (1977, 1978). Analysis indicated good water quality in the bay, which also supports an excellent fish population. Dissolved oxygen readings were highest at the surface and near the inflow of Anderson Creek. Water quality was generally consistent with baseline studies conducted by HBMS. The two stations along Anderson Creek had fluctuating concentrations of parameters such as calcium, magnesium, pH and sulphate. Generally, less diversification (but greater abundance) of phytoplankton was found in the vicinity of Anderson Creek inflow. Zooplankton abundance increased with distance from Anderson Creek. Fishing efforts yielded White Sucker, Northern Pike, Walleye, Yellow Perch, Lake Whitefish and Cisco. White Sucker had the highest condition factor (1.65) and Northern Pike had the lowest (0.76). Lake Whitefish had highest copper, zinc, lead and cadmium levels in flesh and mercury and iron levels in liver. White Suckers had higher levels of copper, lead and cadmium in livers. Northern Pike had the highest levels of nickel and iron in the flesh and zinc in the livers. Walleye had the highest levels of mercury in the flesh. Concentrations of arsenic and iron in Anderson Bay sediments were higher further from the inflow (similar to a previous study). Benthic abundance and diversity showed no consistent spatial or temporal trend. |

| Year Published | Author | Report Title | Abstract |
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| **1986** | West, S.P. | Anderson & Berry Bays Reduced Limnology survey (July, 1986). | Samples for water chemistry and metals concentrations in sediment and fish flesh were collected as part of a reduced limnological survey conducted as part of the CEC Order No. 766. Lower pH values were seen in the Stall-Anderson Creek system, which receives drainage from acidic bog areas. All heavy metal concentrations in water were within the drinking water quality standards. Iron, manganese and arsenic levels increased in Anderson Bay with distance from Anderson Creek. None of the metals tested had concentrations that exceeded the limits prescribed by the "Industry Services Branch, Federal Department of Environment" in fish tissues tested (Yellow Perch, Walleye, Northern Pike, and White Sucker). |
| **1990** | Rescan Environmental Services Ltd. | A Preliminary Assessment of Subaqueous Tailings Disposal in Anderson Lake, Manitoba. | A preliminary field assessment of the effects of subaqueous disposal of tailings in Anderson Lake was conducted. The overall lake volume has decreased due to tailings deposition, despite the dam installation which increased the surface area. The surface water had higher conductivity, dissolved solids, sulphate and hardness since tailings deposition began. Dissolved metals and turbidity have increased near the discharge area. Metal concentrations in the sediments increased, with stations near the outfall having metal levels comparable to fresh tailings samples. Areas where tailings have been deposited in the past are developing an organic layer that is biologically active. Extractions of tailings-dominated sediments indicated generally low metals availability, with most of the metals associated with the oxidizable and residual phases. |
| **1993** | HBMS | Anderson Lake Water Quality Discharge Volumes (1979 - 1993). | Historical discharge volumes and water chemistry, includes graphs and tables. |
| **1997** | Rideout, B. | Wekusko Lake (Anderson & Berry Bays) Limnology Survey. | A statistical analysis was conducted on data previously collected (1977, 1990, 1993, and 1996). Concentrations of heavy metals and other parameters appear to be decreasing (almost two-thirds of statistically-significant changes were decreases) compared to results from previous investigations. There is no consistent pattern of metal load in fish (zinc increases in White Sucker, decreases in Lake Whitefish and no change in Northern Pike and Walleye). |
| **2000** | McNeill, R.G. | Wekusko Lake (Anderson & Berry Bays) Limnology Survey. | A statistical analysis was conducted on data previously collected (1977, 1996, and 1999). Changes in water quality were sporadic and insignificant over this time. Sediment concentrations changed over time but were not consistent in direction, magnitude or parameter when compared between the different time series. There was no significant difference in metals in Walleye or White Sucker liver tissue. There was a decrease of nickel in Walleye flesh and an increase in arsenic in White Sucker flesh compared to the results from previous investigations. Northern Pike livers had higher zinc and mercury than previous studies; Lake Whitefish livers had a significant increase in mercury and arsenic. The report concluded that changes in water quality were attributable to natural variation and analytical methods changing. |
| **2004** | West, S.P. | Wekusko Lake (Anderson & Berry Bays) Limnology Survey. | A statistical analysis was conducted on data previously collected (1977, 1999, and 2003). There was a statistically significant increase in heavy metals in the water and sediment over the previous study (1999) and sometimes over the baseline survey (1977). The report concluded that changes in detection limit account for changes in all metals except mercury and arsenic. At the time of the survey, water levels were low and there was little movement in Anderson and Berry bays. There was no discharge in 2003 (June 11 - Aug 6 and Oct 3 to Nov 11 discharge periods in 2002). |
| **2005** | Hughes, C.E. | Water Quality Assessment of Wekusko Lake, Manitoba Canada. | Water quality study of Wekusko Lake in the summer of 2003 was conducted, and focused on the areas near the Taylor, Berry and Anderson Bays. In total, 25 parameters and objectives were used to calculate the Canadian Council of Ministers of the Environment (CCME) water quality index (WQI). Water in Wekusko Lake was rated as “excellent” based on WQI scores. Only phosphorus exceeded the water quality objective at least half the time, was |

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| | | | noted to be higher in the shallower bays and with no significant difference among the three bays or to historical data. |
| **2005** | Stantec Consulting Ltd. | Metal Mining EEM Snow Lake Mill/Anderson Tailings Initial Monitoring Program Final Report. | Report on initial characterization program, included water and sediment sampling, benthic invertebrates, fish survey, tissue tracer analysis, plume delineation and sublethal toxicity testing. Conductivity, hardness, ammonia, arsenic, and nickel were elevated in Anderson Bay compared to Tramping Lake (reference), however no provincial water quality guideline was exceeded. The report concludes that Anderson TIA discharge is not impacting benthic communities in Anderson Bay relative to the reference lake. Differences in fish end points were significant but not consistent between sexes or species. Mean zinc levels in Brook Stickleback were higher in Anderson Bay; copper and zinc were similar between exposure and reference areas. |
| **2005** | Stantec Consulting Ltd. | Metal Mining EEM Snow Lake Mill/Anderson Tailings Initial Monitoring Program Final Report - Appendix A - Program Design and Station Location. | Contains program design information and station location data. |
| **2005** | Stantec Consulting Ltd. | Metal Mining EEM Snow Lake Mill/Anderson Tailings Initial Monitoring Program Final Report - Appendix A1 - Final Study Design. | Copy of final study design. |
| **2005** | Stantec Consulting Ltd. | Metal Mining EEM Snow Lake Mill/Anderson Tailings Initial Monitoring Program Final Report - Appendix A2 - Study Design Addendum. | Copy of addendum to study design. |
| **2005** | Stantec Consulting Ltd. | Metal Mining EEM Snow Lake Mill/Anderson Tailings Initial Monitoring Program Final Report - Appendix B - Receiving Environment Data | Includes raw data tables for plume delineation, effluent monitoring and water quality monitoring undertaken by the province and HBMS, including laboratory reports. |
| **2005** | Stantec Consulting Ltd. | Metal Mining EEM Snow Lake Mill/Anderson Tailings Initial Monitoring Program Final Report - Appendix C - Benthic Invertebrate Data. | Includes the taxonomic keys used for benthic organism identification, taxonomy and QA/QC results, and details on the statistical analyses. |
| **2005** | Stantec Consulting Ltd. | Appendix D - EEM Fish Survey Data (2004) | Raw data tables and graphs related to the fish survey data collected as part of the Environmental Effects Monitoring (EEM) program in 2004. |
| **2005** | Stantec Consulting Ltd. | Appendix E - EEM Sub-Lethal Toxicity Reports (2004) | Results of the sublethal toxicity testing. |
| **2008** | Stantec Consulting Ltd. | Metal Mining EEM Anderson Tailings Periodic Monitoring Program Final Report. | Report on the EEM periodic monitoring program conducted in 2007. Field survey included collection of samples and information on water and sediment quality, benthic invertebrates and fish populations. The purpose of this study was to confirm effects observed during initial EEM program conducted in 2004. Although concentrations of zinc, aluminum, arsenic, and copper, were elevated in Anderson Bay compared to Tramping Lake (reference), they were all well below their respective provincial guidelines. All metals were slightly elevated in the exposure are (except silver) and copper, zinc, cadmium, and arsenic exceeded CCME criteria. Simpsons diversity index was slightly but significantly |

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| | | | higher in the reference area; the relative proportions of taxa groups illustrate diverse un-impacted communities in both areas. Despite a different effect in this round (compared to 2004), the report concluded that Anderson TIA discharge is not impacting benthic communities in Anderson Bay relative to the reference area. There were minor effects observed for Brook Stickleback. Yellow Perch had more effects; effects on females were similar between surveys but not consistent for males. Effects observed were not consistent between species. |
| **2008** | Stantec Consulting Ltd. | Metal Mining EEM Anderson Tailings Periodic Monitoring Program Final Report - Appendix A - Program Designs and Station Location Data. | Includes study design and correspondence with regulators and station location data. |
| **2008** | Stantec Consulting Ltd. | Metal Mining EEM Anderson Tailings Periodic Monitoring Program Final Report - Appendix B - Receiving Environment Data. | Includes raw data tables for plume delineation, effluent monitoring and water quality monitoring by province and HBMS, including laboratory reports. |
| **2008** | Stantec Consulting Ltd. | Metal Mining EEM Anderson Tailings Periodic Monitoring Program Final Report - Appendix C - Benthic Invertebrate Data. | Includes list of taxonomic keys used for benthic identification, taxonomy and QA/QC results, and details on the statistical analyses. |
| **2008** | Stantec Consulting Ltd. | Metal Mining EEM Anderson Tailings Periodic Monitoring Program Final Report - Appendix D - Fish Survey Data. | Raw data tables and graphs related to the fish survey data collected as part of the EEM program in 2007. |
| **2008** | Stantec Consulting Ltd. | Metal Mining EEM Anderson Tailings Periodic Monitoring Program Final Report - Appendix E - Sub-Lethal Toxicity Reports. | Results of the sublethal toxicity testing. |
| **2008** | Stantec Consulting Ltd. | Metal Mining EEM Anderson Tailings Periodic Monitoring Program Final Report - Appendix F - Photo Log. | Photos taken during 2007 field program. |
| **2009** | Frontier Geosciences Inc. | Report on Sub-Bottom Acoustic Profiling Survey, Anderson Lake, Snow Lake Manitoba. | Study consisted of a bathymetric and sub-bottom acoustic profiling survey of the Anderson TIA, as part of the overall planning and assessment program in support of sub-aqueous mining tailings disposal plan. Previous studies were conducted by the authors at the Anderson TIA in 2000, 2003 and 2006. Depths in the TIA ranged from about 1m to 8m. Since the previous survey (three years prior), approximately 1m to 3m of new tailings had been placed at the southwest end of the TIA. A total of about 8.9 million cubic meters of water was calculated to be in the TIA. Sediment depth was about 5m to 6m in the southwest (area of active tailings deposition) and 4m in the northeast section of the TIA. |
| **2010** | Stantec Consulting Ltd. | Metal Mining EEM Anderson Tailings Focused Monitoring Program Final Report. | Report on the focussed EEM on the Anderson tailings facility, including field survey, toxicity tests and statistical analyses of data collected. The purpose of this phase was to determine the magnitude and extent of potentially mine-related effects observed during previous EEM studies. Fish, benthos, water and sediment samples were collected upstream and downstream of the discharge location. Metals of concern in water (e.g., copper, zinc, nickel, and arsenic) were below their respective guidelines in water samples; conductivity, hardness, aluminum, arsenic, and iron concentrations were higher at the exposure areas compared to the reference area. Sediment metal |

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| | | | concentrations (copper, zinc, iron, lead, cadmium, nickel, and arsenic) were higher in near-field exposure than far-field exposure (compared to reference); none were higher than CCME probable effects levels but arsenic and zinc were elevated in Anderson Bay. No significant differences between reference and exposure benthic communities, and the relative proportions of taxa groups are indicative of un-impacted communities at all areas. Some fish differences for Brook Stickleback and Yellow Perch were observed (but effects are minor and infrequent). The report concluded that the liver metals analysis illustrated that fish are exposed to metals unrelated to the Anderson TIA effluent. |
| **2010** | Stantec Consulting Ltd. | Metal Mining EEM Anderson Tailings Focused Monitoring Program Final Report - Appendix A - Program Designs and Station Location Data. | Includes study design and correspondence with regulators and station location data. |
| **2010** | Stantec Consulting Ltd. | Metal Mining EEM Anderson Tailings Focused Monitoring Program Final Report - Appendix B - Receiving Environment Data. | Includes raw data tables for plume delineation, effluent monitoring and water quality monitoring by province and HBMS, including laboratory reports. |
| **2010** | Stantec Consulting Ltd. | Metal Mining EEM Anderson Tailings Focused Monitoring Program Final Report - Appendix C - Benthic Invertebrate Data. | Includes list of taxonomic keys used for benthic identification, taxonomy and QA/QC results, and details on the statistical analyses. |
| **2010** | Stantec Consulting Ltd. | Metal Mining EEM Anderson Tailings Focused Monitoring Program Final Report - Appendix D - Fish Survey Data. | Raw data tables and graphs related to the fish survey data collected as part of the EEM program in 2009. |
| **2010** | Stantec Consulting Ltd. | Metal Mining EEM Anderson Tailings Focused Monitoring Program Final Report - Appendix E - Sub-Lethal Toxicity Reports. | Results of the sublethal toxicity testing. |
| **2010** | Stantec Consulting Ltd. | Metal Mining EEM Anderson Tailings Focused Monitoring Program Final Report - Appendix F - Photo Log. | Photos taken during 2009 field program. |
| **2011** | BGC Engineering Inc. | Anderson Lake Expansion Pre-Feasibility Study Report DRAFT. | Pre-feasibility level assessment of a proposed tailings expansion for the Anderson TIA. The study evaluated alternative disposal sites and variations to the current disposal techniques currently employed at the TIA, in order to meet upcoming storage demands. Expansion of the TIA, using the current disposal methods, was evaluated at the most effective means of accommodating the additional tailings storage volume. |
| **2011** | Campbell, R. | Assessment of Walleye Population in Wekusko Lake - 2011. | Summary of results from a field program to assess the condition of Walleye stocks in Wekusko Lake which have experienced high annual mortality and over-exploitation. |
| **2012** | Stantec Consulting Ltd. | Metal Mining EEM Anderson Tailings Impoundment Area Discharge, Investigation of Cause Program Final Report. | Report on the investigation of cause on the Anderson tailings facility, including field survey, toxicity tests and statistical analyses of data collected. The purpose of this phase was to elucidate the cause of observed effects (mine-related or natural) on fish community end-points in near-field downstream fish communities related to upstream reference communities. Re-analysis of previous benthic community descriptors showed that the Anderson TIA discharge does not appear to have an effect on benthic invertebrate |

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| | | | communities in Anderson Bay. Anderson and Berry Bays support diverse benthic communities similar to Tramping Lake despite intermittent exposure to 0-5% effluent from the Anderson TIA. Metallothione in showed no significant differences among reference and exposure area fish, and the report suggests that the effects observed in the exposure are were not directly related to the TIA discharge, that most of the metals that did show a difference were unrelated to the Anderson TIA effluent and therefore are not indicative of mine effects but of natural variability. |
| **2012** | AECOM Canada Ltd. | Anderson Tailings Impoundment Area Winter Water Sampling. | Memorandum that summarizes the in situ and water chemistry results from winter 2012 field survey in the Anderson TIA. Water chemistry results were compared to CCME protection of aquatic life guidelines; most stations had 5 or 6 exceedances (arsenic, cadmium, iron, lead, selenium, and zinc), with higher frequency of exceedances found in current or historical tailings deposition areas. |
| **2012** | AECOM Canada Ltd. | Anderson Tailings Impoundment Area Winter and Summer Sampling Summary DRAFT. | A memorandum comparing winter and summer results of in situ and water chemistry in the Anderson TIA. Sampling locations exceeding the CCME protection of aquatic life guidelines were within the western portion of the TIA. There was a shift eastward with respect to zinc exceedances; however the report concluded that the reasons for the shift are complex. |
| **2012** | AECOM Canada Ltd. | Proposed Lalor Mine Environmental Baseline Assessment. | Report that summarizes the findings of an environmental baseline assessment conducted over several years (2007, 2008, 2010 and 2011). Terrestrial assessments in the area of the proposed mine and supporting infrastructure were conducted; overall, the areas is naturally dense boreal forest and no rare or endangered vegetation species were observed. There was also no critical wildlife habitat observed at the site and no protected wildlife species were observed. There were some exceedances of applicable water and sediment quality guidelines observed in the area. Biological diversity was typical of the area and historical reports, in terms of benthic invertebrate and fish communities. |
| **2012** | AECOM Canada Ltd. | Lalor Mine Environment Act Proposal Report. | Submission of an *Environment Act* proposal to obtain a licence to construct and operate a new mine. Baseline environmental studies at the site, showed biological diversity and integrity was similar to the region overall. |
| **2012** | AECOM Canada Ltd. | Lalor Mine - Noise Baseline and Impact Assessment. | A report that presents the results of a noise baseline and impact assessment study conducted to support the environmental impact assessment of a proposed mine. The study concluded that the noise impacts on the assessed points of reception in the nearby Town of Snow Lake, due to operations of the proposed mine and supporting facilities, will be negligible and meet regulatory compliance limits. |
| **2012** | AECOM Canada Ltd. | Lalor Vegetation Regional Analysis. | A letter report summarizing the results of a vegetation analysis in the area of the proposed Lalor mine. The study examined the aerial extent of vegetation communities disturbed or lost as a result of project activities. |
| **2013** | AECOM Canada Ltd. | A Summary of 2012 Field Studies at the Anderson Tailings Impoundment Area. | A letter report summarizing the results of a June 2012 shoreline and dike alignment environmental survey. The shoreline vegetation was typical of the area, and 10 species of waterfowl were observed around the area. The proposed dike alignments showed no unique terrestrial vegetation; many areas had been previously cleared or disturbed and new growth was typical of the area. |
| **2013** | AECOM Canada Ltd. | Baseline Water and Sediment Quality Assessment at Anderson Creek. | A memorandum summarizing the results of water and sediment chemistry samples collected in Anderson Creek. Concentrations of selenium and zinc exceed the CCME protection of aquatic life guidelines. Concentrations of metals in water showed no apparent spatial or temporal trend; sediment samples had higher concentrations closer to the PR 392 crossing. Water quality was rated “excellent”, based on CCME WQI calculations. Sediment quality was rated “excellent” to “marginal”, based on CCME sediment quality index (SQI) calculations. |

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| **2013** | BGC Engineering Inc. | 2013 Anderson Tailings Impoundment Area Deposition Plan. | The report describes the deposition plan designed to assist HBMS staff to efficiently store their forecast tailings production, through short-term and long-term plans. |
| **2013** | AECOM Canada Ltd. | Lalor Concentrator Environment Act Proposal. | Submission of an Environment Act proposal to obtain a licence to construct and operate a new concentrator. Baseline environmental studies at the site, showed biological diversity and integrity was similar to the region overall. |
| **2013** | AECOM Canada Ltd. | Anderson TIA Historical Comparison. | A review of the historical and current aerial imagery in the area of Anderson Creek to assess the potential for navigability. Prior to the development of the PR 392 crossing or the Anderson TIA control structure, Anderson Creek was a disseminated channel, whose flows would be intermittent and controlled primarily by spring freshet and large precipitation events. A portage from Anderson Lake to Anderson Bay seen in a 1950 aerial photo was in use at least until 2002, to bypass several beaver dams which would have impeded navigation in Anderson Creek. |
| **2013** | AECOM Canada Ltd. | Proposed Lalor Concentrator Environment Baseline Assessment. | A document describing the physiographic setting of the site of the proposed Lalor Concentrator and baseline environmental conditions for the Project Area. AECOM completed baseline terrestrial surveys in 2007, 2010, 2011 and 2012 that included a review of local geology, vegetation, wildlife, flowering plants, and nesting songbirds in the region. No critical wildlife habitat or species at risk was observed during these investigations. Fourteen waterbodies were sampled for water and sediment chemistry, benthic invertebrates, and fish communities. Water quality was generally rated "good" or "excellent" in waterbodies studied. Sediment quality ranged from "poor" to "excellent" based on CCME SQI calculations and lower ratings were generally found in areas previously disturbed by human activity. |
| **2013** | AECOM Canada Ltd. | Lalor Concentrator - Description of a Designated Project under CEAA, 2012. | A project description submitted to federal regulators of a proposed concentrator. The report describes the project components and activities, the potential environmental effects and mitigation measures, and summary of public engagement programs conducted for the project. |
| **2013** | AECOM Canada Ltd. | Lalor Concentrator - Description of a Designated Project under CEAA, 2012 (Executive Summary, English Version). | An executive summary and supporting report submitted to federal regulators of a proposed concentrator. The report describes the project components and activities, the potential environmental effects and mitigation measures, and summary of public engagement programs conducted for the project. |
| **2014** | AECOM Canada Ltd. | 2013 Anderson Tailings Impoundment Area, Fall Sampling Summary. | Technical memorandum summarizing the water quality sampling activities conducted in the Anderson TIA, Anderson Creek and Anderson Bay in fall 2013. The results of the fall 2013 investigation and comparison to 2012 results were discussed in the memorandum. None of the fall 2013 concentrations exceeded the Metal Mining Effluent Regulations (MMER) limits. In general, metal concentrations in Anderson TIA were higher in summer 2013 and increased again in fall 2013 and extended across a greater portion of the TIA when compared to those measured in 2012. |
| **2014** | AECOM Canada Ltd. | 2014 Anderson Tailings Impoundment Area, Spring Sampling Summary. | Technical memorandum summarizing the water quality sampling activities conducted in the Anderson TIA, Anderson Creek and Anderson Bay in spring 2014. The memorandum focuses on the results of the spring 2014 investigation and illustrate the change in total metals concentrations between summer 2013 and spring 2014. Thiosalt concentrations decreased between fall 2013 and spring 2014. Concentrations of total aluminum, cadmium, copper, lead, mercury, selenium, and zinc increased near the outlet of the TIA between fall 2013 and spring 2014. Some metals (lead, mercury, and silver) decreased to below their respective CCME guidelines. |
| **2015** | AECOM Canada Ltd. | Data Gap Analysis for the Anderson TIA Expansion Mercury Modelling DRAFT. | Technical memorandum summarizing a gap analysis conducted for mercury modelling. The report concluded that there was a significant amount of data available and recommended collecting fish tissue samples from Anderson TIA, Anderson Bay and Goose Bay in 2015 using lower detection limits than was |

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| | | | historically used is recommended (study results presented in **Section 5.3**). |
| **2015** | HBMS | Excel Spreadsheet of HBMS Water Quality Data for Anderson TIA (1995-2015).xls | Data collected at outlet of TIA between 10-May-1995 and 26-May-2015. |
| **2015** | AECOM Canada Ltd. | 2014 Anderson Tailings Impoundment Area, Fall Sampling Summary. | Technical memorandum summarizing the water quality sampling activities conducted in the Anderson TIA, Anderson Creek and Anderson Bay in fall 2014. Samples for methylmercury analysis were collected from Anderson Creek and Bay in fall 2014. The memorandum focused on presenting the results of the fall 2014 and discusses these results in comparison to previous investigations (2012, 2013, spring 2014), specifically differences between spring 2014 and fall 2014. Concentrations of arsenic, cadmium, copper, iron, lead, mercury and zinc generally were lower in fall 2014 compared to spring 2014 in Anderson TIA and Anderson Creek. Lead, mercury and silver decreased to below the CCME protection of aquatic life guidelines in Anderson TIA in fall 2014. |
| **2015** | AECOM Canada Ltd. | 2014 Anderson Tailings Impoundment Area, Winter Sampling Summary. | Technical memorandum summarizing the water quality sampling activities conducted in the Anderson TIA, Anderson Creek and Anderson Bay in winter 2014. The memorandum also compares the winter 2014 results to previous sampling events (2012-2014), specifically between fall 2014 and winter 2014. Overall, concentrations of total metals increased between fall and winter 2014. In fall 2014, a decrease in contaminant concentrations (from summer 2014) was reported but these concentrations increased again in winter 2014 to above the summer 2014 levels. |
| **2015** | AECOM Canada Ltd. | 2015 Anderson Tailings Impoundment Area, March Sampling Summary. | Technical memorandum summarizing the water quality sampling activities conducted in the Anderson TIA, Anderson Creek and Anderson Bay in winter 2015 and comparing these results to previous investigations (2012-2014). In general, the concentrations of total metals decreased over the winter of 2014-2015. Concentrations peaked in summer 2014, to decrease in fall 2014, increase again in winter 2014, and then dropped again by winter 2015. |
| **2015** | AECOM Canada Ltd. | 2015 Anderson Tailings Impoundment Area, June Sampling Summary. | Technical memorandum summarizing the water quality sampling activities conducted in the Anderson TIA, Anderson Creek and Anderson Bay in early summer 2015. Overall, the concentrations of water collected in summer 2015 increased or remained similar to those in March 2015. |
| **2015** | AECOM Canada Ltd. | 2015 Anderson Tailings Impoundment Area, September Sampling Summary. | Technical memorandum summarizing the water quality sampling activities conducted in the Anderson TIA, Anderson Creek and Anderson Bay in fall 2015 and how the results compare to previous AECOM investigations (2012-2015). While metals concentrations exceed several CCME guidelines, and none exceed MMER. Overall, the concentrations of most metals in the TIA and Anderson Creek decreased or remained the same between summer and fall 2015. Metal concentrations in Anderson Bay were below CCME water quality guidelines. |
| **2016** | AECOM Canada Ltd. | 2015 Anderson Tailings Impoundment Area, Summary of Passive Sampling Results. | Technical memorandum summarizing the results from a field investigation to measure the fraction of "bioavailable" metal species in aquatic systems in the Anderson TIA, using passive water samplers. The sampling results were compared to summer and fall 2015 water quality sampling in Anderson TIA and Anderson Creek to identify if this sampling method would be useful to include in future monitoring efforts. The results were not directly comparable and therefore, it was not recommended as an additional monitoring method. |

## 2.2 Contributors

A variety of professionals and experts collaborated and contributed in the development of this EAP. They include, but are not limited to:

| Company | Name | Area of Specialization |
|---|---|---|
| AECOM | **Cliff Samoiloff**, B.Sc., EP(CEA) | Toxicology, Water Quality |
| AECOM | **Somia Sadiq**, B.Env.Sc., EP, MCIP RPP | Environmental Assessment, Engagement |
| AECOM | **Jennie Ryman**, M.Sc., P.Biol., R.P.Bio. | Aquatic Biology |
| AECOM | **James Phibbs**, M.Sc., P.Biol., R.P.Bio. | Risk Assessment, Environmental Science |
| AECOM | **Don McDonald**, M.Sc. | Terrestrial Ecology |
| AECOM | **Shawna Kjartanson**, M.Sc., P.Biol., EP | Environmental Science |
| AECOM | **Mark Hadfield**, B.Sc., Adv.Dip. GIS Tech, C.Tech | Geology |
| AECOM | **Jen Murray**, B.Env.Sc., EP | Environmental Science |
| AECOM | **Atif Bokhari**, P.Eng. | Acoustic Engineer |
| AECOM | **Peter Tkalec**, P.Eng. | Air Quality Engineering |
| AECOM | **Chris Mahe** | GIS |
| Northern Lights Heritage Services Ltd. | **Virginia Petch** | Archeology |
| BGC Engineering Inc. | | Geotechnical Engineering, Dam Design |
| Stantec Consulting Ltd. | | Environmental Effects Monitoring |
| Frontier Geosciences Ltd | | Sub-bottom Acoustic Profiling Survey |
| SRK Consulting | | Closure Planning |
| Maxxam Analytics | | Laboratory Analysis |
| ALS Environmental | | Laboratory Analysis |
| Brooks Applied Labs | | Laboratory Analysis |

# 3. Project Description

## 3.1 Overview of Current Operations

As shown on the inset in **Figure 03,** the structures comprising the Anderson Tailings Impoundment Area (TIA) are the Anderson Dam and a separate emergency overflow spillway, located on the eastern end of the Anderson TIA.

The Anderson TIA has been in use since 1979, when a control dam was built at the east end of Anderson Lake across Anderson Creek to provide water discharge control from the Anderson TIA. Anderson Dam contains a decant pipe that passes discharge from the Anderson TIA into Anderson Creek. Since 1979, tailings have been pumped via a buried pipeline to the north shore of the Anderson TIA. Tailings are then distributed across the northern and western portions of the TIA via a movable floating pipe. The overall concept in operation of the Anderson TIA is to place all tailings into the Anderson TIA underwater, keeping all of the tailings submerged and covered by at least 1.5 m of water cover. Effluent from the Anderson TIA is discharged intermittently to Anderson Creek via the regulated final discharge point in accordance with Clean Environment Commission (CEC) Order 766 and the requirements of the Metal Mining Effluent Regulations (MMER). During winter, discharge is typically shut off at Anderson Dam and remains shut off until the freshet flows commence and ice breakup occurs in spring.

The Anderson TIA also supplies approximately 70% of the process water used currently at the Stall Lake Concentrator. A pumphouse located on the north shore of the TIA provides for the recycling of this water. Power for the pumphouse is supplied via a transmission line running from an HBMS substation located nearby.

To date, approximately 13 M tonnes of tailings have been deposited into the Anderson TIA. Since the construction of Anderson Dam, the Anderson TIA has been operated at a typical water elevation of approximately 277.7 m.

Tailings are transported to the Anderson TIA from the Stall Lake Concentrator in a surface pipeline with an earthen cover. At the TIA, a single 300 mm diameter floating pipeline extends into the Anderson TIA and then splits into two separate 200 mm diameter floating pipelines which discharge the tailings. Tailings are discharged simultaneously through the two pipelines (“tailings discharge”) in accordance with a deposition plan, developed approximately every three years by BGC Engineering Inc. (BGC), a geotechnical firm with expertise in tailings dam integrity and tailings operation. The deposition plan is explained below in **Section 3.5**.

Discharge of water out of the Anderson TIA occurs only during the open-water season (usually May to October). Anderson Creek receives the discharge from both the decant pipe and emergency overflow spillway. Anderson Creek is a shallow creek that flows into Anderson Bay of Wekusko Lake.

Water quality at the final discharge point (including the decant pipe and the emergency overflow spillway which may contain minor amounts of flow during high water events, including spring freshet) is and at all times has been in compliance with applicable regulatory requirements. No treatment, other than retention in the TIA, has ever been required.

## 3.2 Needs and Objectives

HBMS performs forecasting of tailings production, which allows the company to assess storage needs for tailings. This forecasting takes into account current and future operations. The following table (**Table 3-1**) illustrates the forecasted remaining storage capacity in the Anderson TIA, anticipated production tonnages for the life of Lalor Mine, and the anticipated impact on the capacity of the Anderson TIA. As may be seen, it is anticipated that an increase in capacity in the Anderson TIA will be required by 2020. This will allow HMBS to have enough water in the TIA to maintain water cover and continue to meet MMER water quality limits without needing any additional treatment.

**Table 3-1: Forecast Remaining Storage Capacity in Anderson TIA**

| Year | Total Forecast Tailings Production [1] (tonnes) | Storage Required [2] ($m^3$) | Cumulative Storage Required ($m^3$) | Anderson TIA Remaining Capacity (Areas 1-5) [3] ($m^3$) |
|---|---|---|---|---|
| **2012** | 165,132 | 103,208 | 103,208 | 3,054,652 |
| **2013** | 345,047 | 215,654 | 318,862 | 2,951,445 |
| **2014** | 424,225 | 265,141 | 584,003 | 2,686,304 |
| **2015** | 767,846 | 479,904 | 1,063,906 | 2,206,400 |
| **2016** | 875,000 | 546,875 | 1,610,781 | 1,659,525 |
| **2017** | 875,000 | 546,875 | 2,157,656 | 1,112,650 |
| **2018** | 875,000 | 546,875 | 2,704,531 | 565,775 |
| **2019** | 875,000 | 546,875 | 3,251,406 | 18,900 |
| **2020** | 875,000 | 546,875 | 3,798,281 | -527,975 |
| **2021** | 875,000 | 546,875 | 4,345,156 | -1,074,850 |
| **2022** | 875,000 | 546,875 | 4,892,031 | -1,621,725 |
| **2023** | 875,000 | 546,875 | 5,438,906 | -2,168,600 |
| **2024** | 875,000 | 546,875 | 5,985,781 | -2,715,475 |
| **2025** | 875,000 | 546,875 | 6,532,656 | -3,262,350 |
| **2026** | 875,000 | 546,875 | 7,079,531 | -3,809,225 |
| **2027** | 875,000 | 546,875 | 7,626,406 | -4,356,100 |
| **2028** | 875,000 | 546,875 | 8,173,281 | -4,902,975 |
| **2029** | 875,000 | 546,875 | 8,720,156 | -5,449,850 |
| **2030** | 875,000 | 546,875 | 9,267,031 | -5,996,725 |
| **2031** | 875,000 | 546,875 | 9,813,906 | -6,543,600 |
| **2032** | 875,000 | 546,875 | 10,360,781 | -7,090,475 |
| **2033** | 875,000 | 546,875 | 10,907,656 | -7,637,350 |
| **2034** | 875,000 | 546,875 | 11,454,531 | -8,184,225 |
| **2035** | 875,000 | 546,875 | 12,001,406 | -8,731,100 |
| **Total** | **19,202,250** | **12,001,406** | **12,001,406** | **-8,731,100** |

*Notes*

1. *Forecast tailings production values provided by Hudbay and current as of January 20, 2015.*
2. *Storage required based on all tailings production reporting to Anderson TIA (assuming no paste backfill occurs), with a settled dry density of 1.6 t/$m^3$.*
3. *Remaining capacity up to elevation 276.1 m based on bathymetry survey of August 2012. Deficit indicated assumes no dam construction or water level raise.*

# 3.3 Alternatives Analysis

This section describes the alternatives analysis which was carried out in the process of planning for environmental management of the tailings that will be produced over the life of Lalor Mine. The full alternatives analysis can be reviewed in detail in the Anderson Lake Expansion Pre-Feasibility Study Report completed by BGC in 2011. The alternatives considered during the planning effort included development of new tailings storage locations, either in other lakes or low-lying basins, or storage capacity increase of the existing Anderson TIA (BGC, 2011). Both subaqueous deposition and subaerial (land) deposition options were considered. In general, subaqueous deposition is preferred because it limits exposure of tailings to air and subsequent generation of tailings dust, metal leaching, and acid rock drainage (ARD) (when exposed to both air and precipitation). BGC performed this analysis for HBMS to consider. This section summarizes the alternatives for tailings management that were considered, and the result of the evaluation of the alternatives.

## 3.3.1 Low-Lying Basins

Low-lying basins located within the general vicinity of the Stall Lake Concentrator and the Lalor site were considered as an alternative for future impoundment of tailings. Using low-lying basins would involve subaerial disposal methods. Ideally, any feasible low-lying basin would be surrounded by natural high topography along most of the perimeter to provide as much natural containment as possible. This configuration would minimize the height of structures required to contain the tailings. A small pond of water would be retained downstream of the facility to allow for treatment of the effluent prior to discharge to the environment.

This option was rejected for several reasons:

- The subaerial disposal method would result in creation of tailings beaches.
- Exposure of tailings could result in production of ARD from the exposed tailings.
- Exposed tailings could produce dust, posing a risk to human and environmental health from exposure.
- To manage the health risk to human health, the basins would need to be sited away from communities, but this would still not mitigate for risk to the terrestrial environment.
- Due to remote siting, the cost of transportation to the tailings facility would make this option economically nonviable.
- New areas that may not have been previously disturbed would be subject to disturbance.
- New areas also would require property acquisition and other associated permits and approvals.

## 3.3.2 Lakes

Using a new water body for subaqueous tailings disposal was considered as one of the options. This type of system would be similar to the one currently in use. The system would use natural containment provided by the surrounding topography to flood over the tailings, thus minimizing the potential for ARD. In order for this option to be feasible, the following criteria would have to be met:

- Based on the storage needs (described in **Section 3.2**) only water bodies with a surface area greater than Anderson TIA would be desirable (*i.e.,* 3.79 $km^2$).
- Significant bedrock relief along the shore would be desirable as it would allow for water elevation changes within the existing footprint of the waterbody, thereby minimizing dam construction requirements.

- A lake with a generally open configuration would be preferred, as islands and peninsulas would limit pipeline accessibility and manoeuvrability.
- A lake that supports minimal aquatic life, does not have any traditional resource use, and/or no recreational value would be required.

The TIA site should be located within close proximity to the Stall Lake Concentrator to minimize tailings pipeline construction and pumping requirements. Minimizing the distance would assist in limiting the potential environmental impacts of a pipeline corridor. In addition to this, large distances between the Stall Lake Concentrator and the tailings facility may inhibit the ability to monitor the site and would reduce the ease of communication between various operators of each component. On the basis of this criterion, only a site within approximately 10 km radius of the Stall Lake Concentrator and the Lalor Site was considered.

This option was rejected because there is no water body that meets all the above criteria within a radius of 10 km from the Stall Lake Concentrator and the Lalor site.

### 3.3.3 Subaerial Disposal at Anderson TIA

Transitioning from subaqueous to subaerial disposal was considered as one of the options to increase capacity of the Anderson TIA. This transition would require that the existing tailings pipeline be extended around the perimeter of the Anderson TIA, with spigots used to discharge tailings. This would form beaches from the shoreline that would then develop into the body of the TIA. As shown in **Figure 03**, deposition would occur in Areas 1 to 5 of the Anderson TIA, with Areas 6 and 7 providing some form of passive water treatment. This option would also require creation of fresh water diversion channels around the perimeter of the facility to reduce the amount of freshwater entering the TIA and subsequently becoming contaminated. The diversion channels would also help to manage flows during large precipitation events, and therefore likely reduce the need for spillway upgrades. The option would also require a perimeter road to provide access for construction and operation of the tailings pipelines and inspection of the diversion channels.

This option was rejected for several reasons:

- Exposed tailing beaches would result in the generation of acid rock drainage (ARD) within the facility, which could subsequently affect both surface water and groundwater quality.
- Exposed tailings could also result in generation of dust which would be a risk to receptor health (both human receptors and wildlife in the area).
- Water from the Anderson TIA would require active treatment prior to discharge, which is currently not required because the water meets all applicable quality guidelines.
- The option would not allow for a 1.5 m water cover to be maintained at closure. Therefore, closure would require a combination of low-infiltration soil cover and water treatment in perpetuity.

### 3.3.4 Subaqueous Disposal at Anderson TIA

In assessing the option of continued subaqueous disposal at Anderson TIA, HBMS required that any alteration to the Anderson TIA meet the following requirements:

- Any modification of the Anderson TIA must contain tailings within “the area bounded by (a) the contour of elevation around Anderson Lake at the 285 m level, and (b) the control dam built at the east end of Anderson Lake,” as set out in Item 1 in Schedule 2 of the MMER.

- The Anderson TIA must be capable of producing discharge, if any, which complies with the criteria stated in the MMER.
- Any modification to the Anderson TIA must include upgrades to its flood routing capability such that the facility may safely pass the probable maximum flood (PMF) caused by the probable maximum precipitation (PMP) event; and
- Upon closure, a 1.5 m water cover must be maintained over top of the deposited tailings within the Anderson TIA.

This option of continued subaqueous disposal would involve construction of water retention structures in the topographically low areas, allowing the water levels to rise, and the continuation of subaqueous disposal within a slightly larger footprint. This would increase the free water available for tailings deposition and thus increase the overall storage capacity of the Anderson TIA. This option would require raising the existing Anderson Dam and upgrading the existing spillway in order to pass PMF event.

This option was selected because it meets the above-noted requirements and was evaluated to have the following advantages:

- It utilizes well-established techniques for tailings disposal for which the environmental considerations are well-known.
- The existing natural topography (steep shorelines) minimizes the amount of area which would be lost to inundation.
- It requires minimal adjustments to the current operation of the Anderson TIA.
- No significant changes in downstream water quality are expected to occur because there are no anticipated changes to tailings composition, processing or volume and therefore no changes will be required in effluent-management practices.
- Additional closure requirements for the facility would be minimal.
- The capacity can be increased in stages, as required.
- The option allows for continued use of reclaimed water used for current HBMS operations at the Stall Lake Concentrator, which reduces the overall demand for freshwater inputs.

In summary, the optimal option to accommodate the forecasted tailings production is the continued use and expansion of the existing Anderson TIA. The main advantage of this option is that the site is an existing tailings impoundment area which, over the last approximately four decades of operation, has been proven to be an environmentally responsible means of tailings storage with no requirements for water treatment before final discharge from the Anderson TIA to date, and is expected to continue to perform in that manner.

## 3.4 Components and Activities in the Proposed Alteration

The proposed alteration of the Anderson TIA (the “Project”) will involve the construction of new water retention dams and the improvement of the existing Anderson Dam, which by the end of construction will have been incorporated into one of the structures. All the dams will be equipped with seepage collection systems and associated pumphouses. The existing spillway will be replaced with a new spillway designed to meet the PMF event.

The Project will be carried out in three stages (A, B and C), which are described in detail in **Section 3.4.3** below and illustrated in **Figures 04 to 09**.

Before construction can occur, a number of pre-construction (preparation) activities will need to be completed:

- Development of laydown areas (**Figure 10**).
- Development of temporary access trails (**Figure 10**).
- Installing electrical power lines (**Figure 04**).
- Establishment of borrow pits and rock quarries (**Figures 04 to 10**).
- Tree clearing (**Figure 11**).

These pre-construction activities are described in detail in **Section 3.4.3**.

The Project components referenced in the following sections are described using conceptual-level design. Detailed design drawings will be available prior to construction.

## 3.4.1 Project Components

### *3.4.1.1 Water Retention Dams*

High ground is used to the extent possible to provide containment. During 2013 to 2015, Manitoba Infrastructure and Transportation (MIT, now known as Manitoba Infrastructure) undertook realignment of a 3.2 km long section of Provincial Road (PR) 392, adjacent to the eastern end of the Anderson TIA. The realignment increased safety on the road, and also allowed for the maximum use of the natural high ground (former highway embankments) in designing the expansion of the TIA.

The existing Anderson Dam will be raised and ultimately it will be integrated into new dam construction (East Dam). Four new water retention dams will be constructed (Northeast Dam, East Dam, Southwest Dam and South Dam), as illustrated in **Figure 09**. Ultimately, these dams will have an elevation of 283.75 m and allow for a maximum operating water level of 281.25 m.

BGC undertook site investigations (BGC, 2009, 2011 and 2013) at the Anderson TIA to determine the alignments for the proposed water retention dams. In general, alignments have been chosen to avoid thick deposits of overburden, particularly where this material has low strength or where the piezometric surface is artesian. These factors can make construction more difficult as well as increase need for excavation and fill volumes. Dam alignments have also been selected to span the topographic lows between two points of high elevation over the shortest distance. In the Snow Lake region, these high points are typically bedrock outcrops.

The dams will feature an extended downstream rockfill shell (starter dam) built to the full footprint of the dam, which allows large volumes of rockfill to be placed during early periods when quarries are most accessible, as well as to provide pre-loading of *in-situ* soils beneath the downstream shell which will promote consolidation prior to subsequent lifts. Dam raises in the later stages will involve “centreline construction,” which is the placement of earthen dam fill over the footprint of the starter dam. This method of construction is illustrated in **Appendix B** on **Drawings 01 to 08**.

The proposed dams will utilize a combination of two foundation types: a dam core founded on *in-situ* overconsolidated silty clay soils (Foundation Type B); and a dam core founded on bedrock (Foundation Type A). All dams will be constructed using a zoned earth fill construction method. **Appendix B** on **Drawings 01 to 08** illustrates the dam designs.

**Table** 3-2 summarizes the dam and foundation types and the lengths of dams.

**Table 3-2: Proposed Dam and Foundations Types, and Length of Structures**

| Dam | Dam Type | Foundation Type | Approximate Length of Dam (m) |
|---|---|---|---|
| **Northeast Dam** | Zoned Earth Fill | Core Founded on Bedrock | 350 |
| **East Dam (improved Anderson Dam)** | Zoned Earth Fill | Northern Section: *in-situ* Overconsolidated Silty Clay Soils; Remainder: Core Founded on Bedrock | 670 |
| **South Dam** | Zoned Earth Fill | Core Founded on Bedrock | 40 |
| **Southwest Dam** | Zoned Earth Fill | Core Founded on Bedrock | 200 |

*Diversion Ditch*

To protect the structural integrity of the dams, a diversion ditch will be constructed along the east side of the former highway embankment to direct natural surface flows away from the toe of the dams. The proposed alignment of the ditch is illustrated on **Figure 05**.

*Seepage Collection System*

Based on seepage analysis carried out by BGC in 2016, the seepage rates for all dams are expected to be minimal. Estimated seepage rates are outlined in **Table 3-3.**

**Table 3-3: Estimated Seepage at Dam Structures**

| Dam | Estimated Seepage (L/min) | Cumulative Seepage Across All Structures (L/min) |
|---|---|---|
| **Northeast Dam** | 6 | 202 |
| **East Dam (improved Anderson Dam)** | 168 | |
| **South Dam** | 3 | |
| **Southwest Dam** | 25 | |

*Notes: Seepage estimates provided by BGC.*

The design measures that have been employed to achieve the seepage rates noted above include:

- Incorporation of low permeability zone.
- In cases where dams are constructed on *in-situ* silty clay soils, ground improvement will be undertaken on the clay layer upstream of the dams. This ground improvement will be done within the first 30 m of the upstream toe and will involve removing the organics, followed by scarification and re-compaction of the *in-situ* clay layer. This ground improvement is expected to reduce cracks and fissures and hence lower the overall permeability of the foundation.
- All borrow pits will be a minimum of 30 m away from the toe of the dams, and no borrow pits will be created upstream of dams that are founded on *in-situ* silty clay soils.

While any seepage through the proposed dams is expected to have a water quality similar to the water contained by the structures, as a precautionary measure, a seepage collection system has been designed to allow for this water to be collected and pumped back into the Anderson TIA, if required. The seepage collection system consists of:

- Sumps and pumps installed within the shell of each dam; and
- A powerline to power the pumps (to run from PR 392 towards Anderson TIA).

#### *3.4.1.2 Spillway*

An emergency overflow spillway, which allows passing of flows during periods of high precipitation or snow melt, is located south of Anderson Dam. At present, this structure is capable of passing the 1 in 1,000 year storm.

To ensure that the spillway requires limited maintenance and is capable of water level control, a new spillway will be built near the southwest end of the East Dam. In later stages, as the dam is raised, the invert level of the spillway will be raised accordingly and the capacity will be increased to be capable of passing the PMF.

Downstream of the spillway control structure, discharge from the Anderson TIA will flow down the spillway channel towards Anderson Creek (**Figure 09**). The channel will be designed with appropriate measures to dissipate energy and minimize erosion. Additional riprap protection will be provided at the outlet of the spillway channel just before joining Anderson Creek.

#### *3.4.1.3 Relocation of Existing Infrastructure*

The existing Anderson TIA Reclaim Pumphouse and associated infrastructure will be relocated to a higher elevation. As discussed, above, the 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 Anderson TIA and does not relate to any freshwater source.

### 3.4.2 Stability of Structures

The existing Anderson Dam has been in operation for over 37 years and is inspected monthly by HBMS staff and annually by an external geotechnical review team. Based on ongoing geotechnical investigations, the dam has proven to be robust and adequately designed.

#### *3.4.2.1 Compliance with Canadian Dam Association Standards*

The Canadian Dam Association (CDA) is a group of operators, regulators, consultants and suppliers who are interested in dams and reservoirs. Their mission is “to be the recognized leader in advancing knowledge and practices related to dams, consistent with social and environmental values” (CDA, 2016). CDA hosts an annual conference, regional workshops and other events to disseminate and exchange information related to dams and related issues (CDA, 2016). A number of technical committees work to produce guidelines and technical bulletins which are regularly reviewed and updated. The Dam Safety Guidelines and associated technical bulletins referenced above were most recently reviewed in 2013 (CDA, 2013). It is generally recognized that the CDA sets the standard for excellence in the design of dams in the mining industry.

With respect to the new structures, all proposed structures have been designed to meet the stability guidelines of the CDA as follows:

- Constructing the dams on competent foundations: the majority of structures will be constructed directly onto bedrock, while one structure will be constructed on *in-situ* overconsolidated silty clay soils.
- Designing all structures for a minimum factor of safety greater than 1.5 for long-term conditions.
- Incorporating a free-draining downstream shell with filter zones to allow phreatic surface control within the structures and improve stability; the filter zones protect the dam cores from internal erosion and piping failure.
- Designing spillways and dam freeboard accordingly set, to allow precipitation and runoff from significant storm (design flood) events to be passed through the facility without overtopping of the dams. Stage A has been

designed to pass the 1 in 1,000 year precipitation event, while subsequent arrangements have been designed to pass the PMF which is considered to be similar to a 1 in 10,000 year precipitation event.

#### *3.4.2.2 Compliance with Mining Association of Canada Standards*

Hudbay has participated in the Mining Association of Canada's (MAC) Towards Sustainable Mining (TSM) initiative since its inception in 2003. TSM is MAC's commitment to responsible mining. It is comprised of a set of tools and indicators to drive performance and ensure that key mining risks are managed responsibly. This commitment includes adherence to rigorous protocols for tailings management that include annual reporting and external verification (MAC, 2016).

The MAC goal for mines in Canada is to achieve a "C" rating for all indicators contained within the Tailings Management protocol under the TSM program. In 2008, Hudbay's Manitoba operations (encompassing two active tailings facilities) achieved and have since maintained a "AA" rating for all five indicators. This means that the site has conducted, every three years, internal audits of its tailings performance against the criteria defined by the TSM program. The "AAA" rating, which is the highest possible, can only be attained after the internal audit process is well defined and an external audit is conducted. Hudbay plans to attain the maximum score have been temporarily suspended due to MAC's contemplation of changes to the program (driven by recent tailings facility incidents at other operators' locations around the world)**.** Hudbay personnel have also provided input into the Tailings Management protocol and supporting guidance documents by actively participating in the relevant MAC committees.

The expansion of the Anderson TIA will be constructed and designed in compliance with Hudbay's commitments to the TSM program and will contribute to maintaining Hudbay's AA rating.

### 3.4.3 Project Activities for the Proposed Expansion: Detailed Description of Stages A, B and C

A three-stage (Stages A, B and C) construction approach will be used to incrementally reach the proposed dam crest elevation (283.75 m). At each Stage, there will be preparation activities (such as cutting trails for temporary access), construction of permanent features, and then gradual inundation of the area contained inside those features. **Figure 12** displays the areas to be inundated at each Stage.

There are several advantages to the staged approach:

- Customization of expenditures to suit conditions (cost deferral).
- Extension of construction season (each stage is separated by two or three years).
- Accommodating flexibility in long-term facility management.

**Table 3-4** outlines the proposed construction stages, along with their corresponding projected tailings storage capacities.

**Table 3-4: Proposed Elevations, Storage Capacity for Staged-Construction Approach**

| Stage | Maximum Operating Water Level (m) | Minimum Dam Crest Elevation (m) | Total Available Storage Capacity in Areas 1-5 ($m^3$) | Annual Mean Water Surface Area ($km^2$) | Cumulative Increase in Annual Mean Surface Area of Anderson TIA (ha) | Cumulative Increase in Annual Mean Surface Area of Anderson TIA (%) |
|---|---|---|---|---|---|---|
| **Current** | 277.70 | 278.70 | 3,054,652 [1] | 3.73 | - | - |
| **Stage A** | 278.90 | 280.20 | 6,371,191 | 4.04 | 31 | 8.3 |
| **Stage B** | 279.50 | 282.00 | 8,080,666 | 4.23 | 50 | 13.4 |
| **Stage C** | 281.25 | 283.75 | 13,230,324 | 4.75 | 102 | 27.3 |

*Notes:*

1. *Current storage capacity available as of the bathymetric survey of August 2012.*

Each Stage is described in detail in the sections below and summarized in **Table 3-5**.

**Table 3-5: Summary of Activities in Staged-Construction Approach**

| Stage | Year | Water Retention Dam and Seepage Collection System | Spillway | Other Activities | Figures |
|---|---|---|---|---|---|
| **A** | 2016 to 2019 | • Construct East Berm.<br>• Construct Initial Stage of East Dam.<br>• Raise Anderson Dam.<br>• Construct Northeast Dam (south segment).<br>• Install seepage collection system.<br>• Install runoff diversion ditch.<br>• Decommission the decant pipe in Anderson Dam. | • Enhance existing spillway to serve as the final discharge point during Stage A. | • Develop temporary access trails and laydown areas to be used during construction.<br>• Remove trees/bush from areas to be inundated.<br>• Develop borrow pits and rock quarries.<br>• Relocate Anderson TIA Reclaim Pumphouse. | **Figures 04, 05, 11 & 12** |
| **B** | 2020 to 2022 | • Construct East Dam.<br>• Raise Initial Stage of East Dam.<br>• Integrate Anderson Dam into East Dam.<br>• Complete construction of Northeast Dam (north segment).<br>• Construct Southwest Dam.<br>• Extend seepage collection system. | • Install new spillway.<br>• Decommission existing spillway. | • Clear temporary access trails to construction sites.<br>• Develop borrow pit. | **Figures 06, 07, 11 & 12** |
| **C** | 2023 to 2026 | • Raise the Northeast Dam.<br>• Raise the East Dam.<br>• Raise portions of the Southwest Dam.<br>• Construct South Dam. | • Raise Stage B spillway. | • Clear temporary access trails to construction sites.<br>• Develop borrow pit. | **Figures 08, 09, 11 & 12** |

### *3.4.3.1 Stage A*

Stage A is expected to begin in 2016 and will occur over a period of approximately three years (one year of preparation and construction activities, followed by two to four years of water inundation).

**Figure 04** shows the general arrangement of all structures to be completed by the end of Stage A.

*Preparation Activities*

Preparation activities will include the removal of trees in areas that will be inundated by the expansion of the Anderson TIA (**Figure 11**). Trees will be removed to for the safety of future inspections crews, pipeline operators and other users of the area (no deadfall or dead heads submerged). Temporary access trails and laydown areas also will be cleared. Borrow pits and rock quarries will be established for use throughout the three stages of construction.

**Figure 12** shows the extent of the clearing activities in areas that will be inundated in Stages A, B and C. Temporary access trails to be used for construction in Stage A are shown in **Figure 04**.

**Figure 10** shows the locations of borrow pits and rock quarries.

*Construction Activities*

*Construct East Berm*

The East Berm will be located approximately 200 m northeast of the Anderson Dam. The purpose of the East Berm is to prevent water which rises during Stage A inundation from encroaching on the location of the East Dam (which will be built in Stage B). The East Berm will consist of a compacted fill embankment with geomembrane liner along the upstream slope. The berm will have a 6 m crest width and will be constructed on *in-situ* overconsolidated silty clay soils. The East Berm will have a crest elevation of 280.2 m. See **Appendix B** on **Drawings 01 and 06** which illustrates the berm design.

The East Berm structure will remain in place in later Stages, but will lose its functionality and become inundated during Stage B.

*Construct Initial Stage of East Dam*

A portion of the East Dam will be constructed during this stage as shown in **Figure 05**. It will consist of a silty clay core, founded on bedrock, and rockfill shells separated by filter and drainage zones. This portion will be built on bedrock to provide a competent foundation for future elevation of the East Dam in Stage B. See **Appendix B** on **Drawings 01 and 04** which illustrates the dam section.

*Raise Anderson Dam*

Anderson Dam will be raised to a crest elevation of 280.2 m, allowing for a 1.2 m water level raise. This crest elevation will provide 1.3 m of normal freeboard over the normal operating water level and 0.7 m minimum freeboard during the design flood. It will consist of a silty clay core, founded on bedrock, and rock fill shells separated by filter and drainage zones. **Appendix B** on **Drawings 01 and 05** illustrate the method of raising the crest elevation.

Please note that in Stage B, Anderson Dam will be integrated into the newly constructed East Dam and therefore various sections below refer only to the “East Dam.”

*Construct Northeast Dam (south segment)*

A segment of the Northeast Dam will be constructed during this stage as shown in **Figure 05**. This structure will be constructed to the Stage B crest elevation (282.0 m) to protect the foundation from inundation during Stage A operations and improve construction conditions. It will consist of a silty clay core, founded on bedrock, and rock fill shells separated by filter and drainage zones. See **Appendix B** on **Drawings 01 and 07** which illustrates the dam section.

*Install Seepage Collection System*

Seepage collection systems will be constructed at the toe of each of the dams and the berm constructed or improved in Stage A. These systems will allow for collection and pumping back into the Anderson TIA any seepage that comes through the dam. Pumphouses supporting the seepage collection system will be installed at each of the sumps.

*Install Runoff Diversion Ditch*

As shown on **Figure 05**, a runoff diversion ditch will be constructed along the east side of the former highway embankment to direct natural surface runoff flows away from the toe of the dams.

*Enhance Existing Spillway to Serve as the Final Discharge Point During Stage A*

Stage A will include enhancements designed to improve the operator's ability to regulate discharge from the Anderson TIA and improve the integrity of Anderson Dam. The spillway will be sized to allow passage of the 1 in 1,000 year event through a single point.

The spillway will feature a sluice gate for water level and flow control, with invert elevation at 277.7 m, and a mass concrete overflow weir at elevation 279.2 m.

Earthen dams will be constructed on either side of the spillway. Concrete lock block walls, founded on concrete and bedrock, will retain the earthen fill used to construct the dams, defining a 6 m wide channel through the East Dam. **Appendix B** on **Drawing 09** shows the proposed spillway raise in plan and in section.

Thus, during Stage A, the improved spillway will replace both the existing spillway and the decant pipe in Anderson Dam. The improved spillway will discharge into Anderson Creek at the same location as the existing spillway and decant pipe.

*Relocate Anderson TIA Reclaim Pumphouse*

The Anderson TIA Reclaim Pumphouse and associated infrastructure will be moved slightly back from the edge of the TIA to avoid the areas of inundation.

*Decommission the Decant Pipe in Anderson Dam*

The downstream portion of the decant pipe will be removed. The remaining portion of the decant pipe will be plugged with concrete and left in place.

*Water Inundation*

Overall, Stage A will involve increasing the crest elevation of the dams controlling the Anderson TIA to 280.2 m, and provide for a 1.2 m water level raise.

Construction of Stage A will be completed over an approximately one year period, following which the water level in the Anderson TIA will gradually rise based on tailings production, reclaim water usage, precipitation and runoff from the Anderson catchment area. This gradual inundation will take place over an approximate two to four year period, during which there likely will be little need to discharge out of the Anderson TIA. Any water discharged from the TIA into Anderson Creek will go through the newly improved spillway channel, which will be controlled with a sluice gate. It is expected that flow into Anderson Creek will continue because of overland drainage entering it via the diversion ditch.

During operations the new structures will maintain 1.3 m of normal freeboard over the proposed operating water level of 278.9 m. Thus Stage A represents an overall improvement in operational management of the Anderson TIA.

**Figure 12** shows the areas to be inundated in Stage A.

### *3.4.3.2 Stage B*

Stage B is expected to begin approximately three years after the construction activities of Stage A and will occur over a period of approximately two to four years.

**Figure 06** shows the general arrangement of all structures to be completed by the end of Stage B.

*Preparation Activities*

As shown on **Figure 06,** temporary access trails and laydown areas will be cleared. Additional borrow pits will be established for use in Stage B. **Figure 10** shows the location of the borrow pits.

*Construction Activities*

*Construct East Dam*

The East Dam will be constructed to an elevation of 282.0 m by constructing an additional raise on the improved Anderson Dam. The improved Anderson Dam also will be extended south along the centreline, thus increasing its length and straightening its alignment. Construction methods will generally be the same as applied in Stage A. **Appendix B** on **Drawings 02, 04, 05 and 08** illustrates the method of raising the crest elevation.

Thus by the end of Stage B, Anderson Dam will have been partially integrated into the new East Dam.

In addition, a new section will be added to the East Dam, north of these structures, and separated from them by high rock outcrop (which serves the same purpose as the constructed structures). This section will be located slightly downstream of the East Berm constructed in Stage A and will be founded on *in-situ* overconsolidated silty clay soils.

The locations of each of these structures are displayed on **Figure 06**. The construction method used for the new section of the East Dam is illustrated on **Appendix B** on **Drawings 02 and 08**.

*Complete Construction of Northeast Dam (North Segment)*

As shown on **Figure 07**, the north segment of the Northeast Dam will be constructed to an elevation of 282.0 m and will be founded on bedrock. **Appendix B** on **Drawings 02 and 07** illustrates the dam section for the southern segment of the Northeast Dam. A small rock outcrop (which exceeds the elevation of both segments of the

Northeast Dam) will separate the north and south sections of the Northeast Dam. The rock outcrop will be left in place because it serves the same purpose as the dams to be constructed.

*Construct Southwest Dam*

Southwest Dam will be constructed as two segments, separated by high rock outcrops (which will serve the same purpose as the constructed dam segments). As shown on **Figure 07**, the Southwest Dam will be constructed southwest of the East Dam. It will employ similar fill material types and construction methods as the Northeast Dam.

*Extend Seepage Collection System*

As new dams are constructed, the seepage collection system will be extended to manage the seepage through these structures in a similar manner.

*Install New Spillway*

During Stage B, a new spillway will be constructed to take the place of the spillway improved during Stage A. The replacement will be required because it is not practicable to raise the spillway structure in a manner which is commensurate with the requirements that will be associated with the additional raises in dam elevation constructed during Stage B.

The new spillway will be designed for an increased flood handling capability, up to the PMF, with an increased normal freeboard. The new spillway is illustrated on **Figure 07**. **Appendix B** on **Drawings 02 and 09** shows the proposed spillway raise in plan and in section.

The new spillway will be designed in a substantially similar fashion as the Stage A spillway, but the spillway inlet will be relocated to approximately 300 m southwest of the existing spillway. The new alignment will provide for greater length, but it will still discharge into Anderson Creek in substantially the same location as the existing final discharge point. As shown on **Figure 07,** the outlet of the new spillway will be located only slightly downstream of the outlet of the Stage A spillway.

The new spillway will be built through bedrock to the design elevation of 279.5 m. The spillway will be 10 m wide with the capability of passing the PMF without overtopping the dams. Concrete will be placed within the channel to create a raised spillway crest invert which will provide water level control. The location of the new spillway structures is illustrated on **Figure 07**.

*Decommission Existing Spillway*

Once the new spillway is completed, the existing spillway will be decommissioned. The structures comprising the existing spillway (the sluice gate, concrete lock blocks, etc.) will be removed and the area will be backfilled with earthen dam fill.

*Water Inundation*

Overall, Stage B will involve increasing the crest elevation of the dams controlling the Anderson TIA to 282.0 m, or 1.8 m higher than in Stage A, resulting in a 0.6 m water level raise in Stage B.

Construction of Stage B will be completed over an approximately one year period, following which the water level in the Anderson TIA will gradually rise based on tailings production, reclaim water usage, precipitation and runoff from

the Anderson catchment area. This gradual inundation will take place over an approximate two to four year period. Discharge will be controlled through the new spillway channel.

**Figure 12** shows the areas to be inundated in Stage B.

### *3.4.3.3 Stage C*

Stage C is expected to begin approximately three years after the construction activities of Stage B and occur over a period of approximately four years (one year of preparation and construction activities, followed by two to four years of water inundation).

**Figure 08** shows the general arrangement of all structures to be completed by the end of Stage C.

*Preparation Activities*

**Figure 11** shows the extent of the clearing activities for the temporary access trails and laydown areas to be used for construction in Stage C.

*Construction Activities*

The Stage C construction activities will complete the proposed Anderson TIA expansion, raising the dam crests to their full proposed elevation of 283.75 m. **Appendix B** on **Drawings 03 and 04 to 08** illustrate the methods of raising the dam crest elevation.

*Raise the Northeast Dam*

The two segments of Northeast Dam crest elevation will be raised to the elevation of 283.75 m. They will remain segmented by a bedrock outcrop (which will serve the same purpose as the constructed dam segments).

*Raise the East Dam*

Each segment of the East Dam will be raised to the elevation of 283.75 m. As shown on **Figure 09**, this will result in merging of the two segments of the East Dam into one structure (which contains the original Anderson Dam).

*Raise portions of the Southwest Dam*

The two segments of the Southwest Dam will also be raised to an elevation of 283.75 m, but they will remain segmented by a bedrock outcrop.

*Construct South Dam*

The South Dam will be constructed as shown in **Figure 09**. It will employ similar fill material types as the Southwest Dam.

*Raise Stage B Spillway*

The spillway invert will be raised using mass concrete to provide for progressive raising of the water level throughout Stage C, as tailings storage capacity diminishes.

*Water Inundation*

By the end of Stage C, the operating water level will be raised 1.75 m to the full proposed elevation of 281.25 m. Inundation will occur over a period of approximately three to four years, depending on tailings production, reclaim water usage, precipitation and runoff from the Anderson catchment area.

**Figure 12** shows the areas to be inundated in Stage C.

# 3.5 Deposition Plans

In compliance with CEC Order 766, from the outset of operation, every three years, HBMS has conducted and submitted to Manitoba Conservation a bathymetric survey of the Anderson TIA. The bathymetric survey guides development of deposition plans generated by BGC. These plans prescribe the operational aspects of tailings deposition. Their purpose is to optimize the storage capacity within the facility.

This section provides an overview of deposition to date (**Table 3-6**) and it outlines plans for continued deposition in the Anderson TIA.

**Table 3-6: Historic Tailings Deposition into the Anderson TIA, 1979-2015**

| Year | Tailings Production (tonnes) | Tailings to Anderson TIA (tonnes) | Storage Utilized ($m^3$) [2] | Cumulative Storage Utilized ($m^3$) [2] |
|---|---|---|---|---|
| **1979** | 383,093 | 307,483 [1] | 192,177 | 192,177 |
| **1980** | 635,798 | 511,817 [1] | 319,886 | 512,063 |
| **1981** | 657,383 | 529,193 [1] | 330,745 | 842,808 |
| **1982** | 582,149 | 468,630 [1] | 292,894 | 1,135,702 |
| **1983** | 568,267 | 414,835 [1] | 259,272 | 1,394,974 |
| **1984** | 577,240 | 421,385 [1] | 263,366 | 1,658,340 |
| **1985** | 563,065 | 563,065 | 351,915 | 2,010,255 |
| **1986** | 495,955 | 495,955 | 309,972 | 2,320,227 |
| **1987** | 651,225 | 651,225 | 407,016 | 2,727,242 |
| **1988** | 600,180 | 600,180 | 375,113 | 3,102,355 |
| **1989** | 623,154 | 623,154 | 389,471 | 3,491,826 |
| **1990** | 640,688 | 640,688 | 400,430 | 3,892,257 |
| **1991** | 687,344 | 687,344 | 429,590 | 4,321,846 |
| **1992** | 538,494 | 538,494 | 336,559 | 4,658,405 |
| **1993** | 474,646 | 474,646 | 296,654 | 4,955,059 |
| **1994** | 86,625 | 86,625 | 54,141 | 5,009,199 |
| **1995** | 43,788 | 43,788 | 27,368 | 5,036,567 |
| **1996** | 152,660 | 152,660 | 95,412 | 5,131,979 |
| **1997** | 139,276 | 139,276 | 87,048 | 5,219,027 |
| **1998** | 143,180 | 143,180 | 89,487 | 5,308,515 |

| Year | Tailings Production (tonnes) | Tailings to Anderson TIA (tonnes) | Storage Utilized ($m^3$) [2] | Cumulative Storage Utilized ($m^3$) [2] |
|---|---|---|---|---|
| **1999** | 0 | 0 | 0 | 5,308,515 |
| **2000** | 93,240 | 93,240 | 58,275 | 5,366,789 |
| **2001** | 180,670 | 180,670 | 112,919 | 5,479,708 |
| **2002** | 207,727 | 207,727 | 129,830 | 5,609,538 |
| **2003** | 239,038 | 239,038 | 149,399 | 5,758,936 |
| **2004** | 265,962 | 265,962 | 166,226 | 5,925,163 |
| **2005** | 274,709 | 274,709 | 171,693 | 6,096,856 |
| **2006** | 272,057 | 272,057 | 170,036 | 6,266,892 |
| **2007** | 270,172 | 270,172 | 168,857 | 6,435,749 |
| **2008** | 273,708 | 273,708 | 171,068 | 6,606,816 |
| **2009** | 40,352 | 40,352 | 25,220 | 6,632,036 |
| **2010** | 173,090 | 173,090 | 108,181 | 6,740,217 |
| **2011** | 135,475 | 135,475 | 84,672 | 6,824,889 |
| **2012** | 165,132 | 165,132 | 103,208 | 6,928,100 |
| **2013** | 345,047 | 345,047 | 215,654 | 7,143,754 |
| **2014** | 424,225 | 424,225 | 265,141 | 7,408,895 |
| **2015** | 767,846 | 767,846 | 479,904 | 7,888,798 |
| **Total** | **13,372,660** | **12,622,073** | **7,888,798** | **7,888,798** |

*Notes:*

1. *Some tailings used as paste backfill in 1979 to 1984; therefore, there is a difference between tailings produced and tailings sent to Anderson TIA.*
2. *Based on a dry settled density of1.6 t/m³.*
3. *Data is provided by BGC and HBMS.*

As shown on **Figure 03**, the Anderson TIA is divided (for analytical purposes) into seven areas to assist in guiding operations and provide regions for reference. Tailings are deposited in Areas 1 to 5, the western and central regions of the Anderson TIA. Historically, HBMS has avoided depositing tailings in Areas 6 and 7 as a precautionary measure to maintain suitable discharge water quality at Anderson Dam.

Since 2012, HBMS has undertaken numerous water quality investigations to determine the relationship between distance from tailings and the impact on water quality. While recent water quality investigations confirm that tailings can be deposited into Areas 6 and 7 without affecting water quality at the discharge location (AECOM, 2013a, 2014a-b, and 2015b-e), HBMS has decided to continue to take a precautionary approach and limit deposition to Areas 1 to 5. A summary of the results of these investigations is provided in **Section 5.3.3**.

## 3.5.1 Tailings Deposition Plan During Construction

Generally, it is anticipated that, during construction of the proposed expansion of the Anderson TIA, tailings deposition will continue along the same methodologies as have been applied to date. However, as described in **Section 3.4.3**, it is planned that there may be extended periods during which there will be limited discharge out of the Anderson TIA. This will facilitate the rise of the water level inside the Anderson TIA to the desired level.

## 3.6 Mineral and Surface Rights

Currently, the Anderson TIA lies within Surface Lease No. MSC-3792 held by HBMS, which grants HBMS surface rights to the area for the purpose of "a tailings disposal area." With the exception of two mineral claims (P35166 and P35167) originally owned by Linda Mines Limited and currently owned by Thundermin Resources Inc., HBMS also holds all relevant mineral rights underlying the area covered by Surface Lease No. MSC-3792. The surface rights associated with portions of P35166 and P35167 were relinquished at the time of the establishment of the TIA.

As indicated above in **Section 3.4.3**, the proposed expansion of the Anderson TIA will occur in three Stages (A, B, and C). During Stage A of the expansion, all construction works and inundation will lie within Surface Lease No. MSC-3792. During Stages B and C, the area of expansion will lie mostly within Surface Lease No. MSC-3792, but a small area of the expansion (in the southeastern area of Anderson TIA where it flows into Anderson Creek) is subject to three mining claims currently owned by Thundermin (P35165, P35166 and P35167). HBMS has an agreement in principle with Thundermin to provide for acquisition of the additional surface rights needed for the expansion. Before construction of Stage B commences, HBMS will formalize the acquisition of these rights.

**Figure 13** displays these mineral and surface rights.

## 3.7 Land and Water Use

There are no water users in or near the Anderson TIA other than the proponent.

The proposed dam upgrades cross the Registered Trap Lines (RTL) owned by Russell Bartlett with whom HBMS has had an agreement since the creation of the Anderson TIA in 1979. **Figure 14** illustrates the registered trap line districts within the Snow Lake area. HBMS has ongoing discussions and a working relationship with Mr. Bartlett. Most recently, HBMS representatives met with Mr. Bartlett to discuss and review the materials presented at the Open House Public Engagement Sessions in November 2015, discussed in **Section 8**.

## 3.8 Permits and Other Property Rights

HBMS holds Quarry Leases QL2750 to QL2757 for quarries and borrow pits which will be used as the source of rockfill and clay needed for construction of the dams (**Appendix A**). Sand will be obtained from the existing HBMS-owned Edwards Lake and/or Threehouse Lake Sand Borrow Area located in the Snow Lake region (Casual Quarry Permits CP-2016-1008148, CP-2016-1008149, CP-2016-8146 and CP-2016-8147) (**Appendix A**).

Before working Quarry Leases QL2750 to QL2757, HBMS will ensure that any necessary work permit has been acquired and compensation will be paid for any merchantable timber removed from the site.

# 3.9 Environmental Licenses and Federal Approval

## 3.9.1 Background: HBMS Operations in the Area

As shown on **Figure 02**, HBMS has a number of historic and active mining operations and infrastructure in the Snow Lake area.

## 3.9.2 Manitoba Environmental Licences for Anderson TIA and Related Operations

The Anderson TIA is operated in accordance with CEC Order 766. As described above, the operation of the Anderson TIA is ancillary to the operation of the Stall Lake Concentrator (CEC Order 765). It will continue to process ore from the Lalor Mine (*Environment Act* Licence No. 3096). Copies of these licences are included in **Appendix A**.

In 2014, HBMS submitted an updated project description to Manitoba Conservation and Water Stewardship related to the refurbishments required at the Stall Lake Concentrator. As described above, the Stall Lake Concentrator has undergone refurbishment to restore its production capacity to 3,000 short tons per day (stpd), which is below its original production capacity of 3,500 stpd. The refurbishment was described in a letter dated February 7, 2014, which was submitted to Manitoba Conservation and Water Stewardship (**Appendix A**).

## 3.9.3 Federal Approval

### *3.9.3.1 Fisheries Act:* Designation of the Anderson TIA and Compliance with MMER

The Anderson TIA is Item 1 of Schedule 2 to the MMER, in which its location is described as follows: “the area bounded by (a) the contour of elevation around Anderson Lake at the 285 m level, and (b) the control dam built at the east end of Anderson Lake.” The planned expansion will lie entirely within this location.

The Anderson TIA has been and will continue to be operated in accordance with the MMER, with studies conducted in accordance with Environmental Effects Monitoring (EEM) in 2004, 2007, 2009, 2011, and 2014 and at all times meeting all applicable criteria.

Discharge from the Anderson TIA will continue to be regulated under the MMER. As described in **Section 3.4.3,** the outlet of the new spillway will be located only slightly downstream, but it will still discharge into Anderson Creek in substantially the same location. The existing structures at the spillway will be replaced during Stage B and the plans for this change to the final discharge point will be submitted to the (Environment Canada) authorization officer in accordance with sections 9 and 10 of the MMER.

Project activities and components have been reviewed for compliance with section 35 of the *Fisheries Act* and compared to the guidance published by Fisheries and Oceans Canada (DFO) in relation to working in and around water (“Projects Near Water”). DFO has developed a Self-Assessment Tool (DFO, 2015) to provide proponents with criteria which, when met, mean that a project does not require DFO review or Authorization under the *Fisheries Act,* based on DFO’s view that no serious harm to fish or fish habitat will occur. Tailings Impoundment Areas which are

listed in Schedule 2 to the MMER, including the Anderson TIA, are identified as waterbodies that do not require review by DFO and, therefore, works within the TIA are exempt from the *Fisheries Act*.

The Self-Assessment Tool identifies that water outfalls, such as the Anderson TIA spillway, do not require DFO review if the footprint of construction remains above the High Water Mark and no temporary or permanent fill will be placed below the High Water Mark. The new spillway will discharge into Anderson Creek at substantially the same location as the existing spillway. Recent work by MIT on the former PR 392 has introduced rip-rap within the project footprint. The proposed spillway will grade material to provide proper drainage and prevent erosion and sedimentation, thereby improving the existing conditions. It is not anticipated that additional fill will be placed below the High Water Mark and no serious harm to fish or fish habitat will occur.

The proposed Project will include components designed to collect overland drainage, which would otherwise flow towards the downstream side of the dams, and direct it to a diversion ditch which discharges into Anderson Creek. The contribution of the overland drainage will sustain input and flow into Anderson Creek during periods in which discharge from the Anderson TIA is reduced. The new spillway will discharge into Anderson Creek at substantially the same location as the existing emergency spillway and therefore there will be no substantive loss of useable fish habitat. Therefore, it is not anticipated that there will be any serious harm to fish or fish habitat and DFO's review or Authorization under the *Fisheries Act* will not be required.

### *3.9.3.2 Navigation Protection Act*

In 2014, in conjunction with review of the Project Description submitted for Lalor Concentrator (which was contemplated at that time), Transport Canada reviewed the current and historic navigability of the Anderson TIA and concluded that the Anderson TIA is not navigable for the purposes of the *Navigation Protection Act*. The letter received from Transport Canada is provided in **Appendix A.**

### *3.9.3.3 Canadian Environmental Assessment Act, 2012*

The Regulations Designating Physical Activities made under the *Canadian Environmental Assessment Act, 2012* were reviewed, in particular sections 4, 5, and 17(b), to determine if there is a requirement to file a project description for the proposed alteration. The Regulations do not apply to the expansion of the Anderson TIA for the following reasons:

- The TIA is an existing MMER-listed tailings management facility rather than a source of water supply, as "reservoir" is commonly understood to mean, or a "natural water body."
- The proposed alteration will not result in "creation" but rather expansion of the existing facility.
- As demonstrated in **Table 3-4**, at the end of the expansion the total cumulative expansion of the surface area of the TIA will be less than 50% and less than 1500 ha in the annual mean surface area of the existing TIA.
- The TIA is a mining facility, but it is ancillary to the operation of the Stall Lake Concentrator, which has been in operation for 37 years, and which is not being altered. The only mine with which its operation is connected is the Lalor Mine, which has been in operation since 2014 and which is not being altered.
- "Area of operations" includes areas occupied by tailings but, as noted above, the area occupied by the TIA is being expanded by less than 50% and, if other mine operations, such as the Stall Lake Concentrator and Lalor Mine, are included in the calculation of the "area of operations," the percent area of expansion is even smaller.

# 3.10 Continued Use of Existing Approved Facilities

A number of existing facilities will be used in connection with the construction and operation of the proposed expansion of the Anderson TIA:

- The existing access road from the Lalor Mine site to PR 395 will be used for construction activities at the Anderson TIA.
- The communication tower on the Lalor Mine site currently provides wireless phone services and internet access. No separate communications facility will be required for expansion of the TIA.
- The Stall Lake Concentrator will continue to discharge tailings into and recycle process water from the Anderson TIA throughout construction activities at the Anderson TIA.
- The Anderson TIA Reclaim Pumphouse will be used to recycle water from the Anderson TIA to the Stall Lake Concentrator. It pumps only reclaimed water drawn from the Anderson TIA and does not relate to any freshwater source. The relocation of this pumphouse to avoid inundation is described above in **Section 3.4.1.3.**

# 3.11 Clearing Requirements

As described above**, Figures 04, 06, and 08** illustrate the project activities and components constructed at each of the three stages. The clearing requirements associated with the activities at each stage are illustrated in **Figure 11** and presented in **Table 3-7**. Clearing of the inundation zone will be to the top of Stage C dam elevation.

**Table 3-7: Clearing Requirements**

| Stage | | Component or Activity | Clearing Requirement ($m^2$) |
|---|---|---|---|
| **Clearing Inundation Zone (up to Stage C top of dam elevation)** | | | **1,446,074** |
| **Stage A** | **Preparation Activities** | Temporary access trails | 24,700 |
| | | Laydown areas | 10,096 |
| | | Borrow pits | 77,260 |
| | | Quarries | 76,038 |
| | **Construction Activities** | Dams | 15,494 |
| | | Temporary Dams | 1,603 |
| | | Spillway | 1,698 |
| | | Diversion Ditch | 13,529 |
| | **Total** | | **220,419** |
| **Stage B** | **Preparation Activities** | Temporary access trails | 9,455 |
| | | Borrow pits | 89,484 |
| | **Construction Activities** | Dams | 15,687 |
| | | Spillway | 7,841 |
| | **Total** | | **122,467** |
| **Stage C** | **Preparation Activities** | Borrow pits | 15,687 |
| | | Temporary access trails | 39,681 |
| | **Construction Activities** | Dams | 4,419 |

| Stage | | Component or Activity | Clearing Requirement ($m^2$) |
|---|---|---|---|
| | **Total** | | **59,908** |
| **All Stages Total** | | | **402,793** |
| **Grand Total** | | | **1,734,223** |

There is some overlap in clearing requirements as seen on **Figure 11**. The Grand Total presented in **Table 3-7** takes into account these overlapping footprints so the area is not accounted for twice. In total, the clearing requirement for the proposed expansion of the Anderson TIA is approximately 173 ha.

## 3.12 Water Requirements

There are no requirements for water beyond those provided for by existing facilities (**Section 3.10**).

Potable water for construction workers for domestic purposes will be sourced from the water treatment system in the Town of Snow Lake, and hauled to the construction site in portable jugs. Portable toilets will be supplied at the construction site for use during the day and wastewater and sewage generated will be handled and disposed by a licenced company.

## 3.13 Energy

There is no anticipated power requirement for construction. It is anticipated that the construction office will be situated at the Stall Lake Concentrator, near the laydown area.

The new seepage collection system will require powerlines to supply power to new pumps (**Figure 04**). These powerlines will tie into existing Manitoba Hydro powerlines near PR 392.

## 3.14 Materials

As described in **Section 3.8**, local licenced quarries and borrow pits will be used as the sources for materials for construction.

Other construction materials, such as geotextile, steel works, fuel and lubricating oils will be obtained from local vendors, where possible. The exact quantities of materials required for construction will be determined following detailed design. Concrete, required for the installation of the proposed new spillway will be mixed on site.

## 3.15 Personnel

The construction of the proposed Project will require approximately 30 personnel. As the Anderson TIA lies in close proximity to the Town of Snow Lake, it is expected that workers will stay at the Lalor Camp in the Town of Snow Lake.

# 3.16 Construction Equipment

**Table 3-8** presents the equipment use expected during the three phases of construction of the proposed expansion of the Anderson TIA.

**Table 3-8: Units of Equipment to be Used during Construction at the Anderson TIA**

| Equipment | Pre-Stage May-October | Stage A May-October | Stage B May-October | Stage C May-October |
|---|---|---|---|---|
| **Air Compressors** | 2 | 2 | 2 | 2 |
| **Welders/Mechanic** | 1 | 0 | 1 | 1 |
| **Light Stands** | 1-2 | - | - | - |
| **Construction Crew/Supervisor Trucks** | 2-4 | 2-4 | 2-4 | 2-4 |
| **Front End Loader** | 1-2 | 1-2 | 1-2 | 1-2 |
| **Drill Rig** | 1 | - | - | - |
| **Caterpillar dozer** | - | 1-2 | 1-2 | 1-2 |
| **Compactors** | - | 1-2 | 1-2 | 1-2 |
| **Logging Equipment** | 1-8 | - | - | - |
| **Excavator** | 1-2 | 1-2 | 1-2 | 1-2 |
| **Dump Trucks** | 2-4 | 2-4 | 2-4 | 2-4 |

# 3.17 Construction Traffic

**Table 3-9** presents the estimated daily traffic volumes expected during construction and operation of the proposed expansion of the Anderson TIA.

**Table 3-9: Estimated Daily Traffic Volumes**

| Vehicle [1] | Pre-Stage | Stage A | Stage B | Stage C | Total |
|---|---|---|---|---|---|
| **Trucks – equipment [2]** | 5 | 7 | 4 | 4 | 20 |
| **Trucks – delivery warehouse [3]** | 0 | 2 | 2 | 2 | 6 |
| **Cars – pick-ups** | 4 | 8 | 6 | 6 | 24 |
| **Total Traffic** | 9 | 17 | 12 | 12 | 50 |

*Notes:*

1. *Numbers are based on per day, one way.*
2. *Trucks-equipment: includes equipment in operation at the site during an average day.*
3. *Trucks-materials: includes trucks involved in the delivery and transport of materials (fill, pipes, cement, etc).*

# 3.18 Waste and Waste Disposal

## 3.18.1 Solid Wastes

All domestic and non-hazardous waste generated at the construction site and laydown areas will be regularly collected and disposed of at existing HBMS licensed waste disposal facilities now in use or currently under development. 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.).

## 3.18.2 Wastewater and Sewage

On-site portable facilities will be available during construction and maintained by licenced contractors. Construction workers will be housed at the Lalor Camp, which is located in the Town of Snow Lake. The camp water and wastewater is treated by the wastewater treatment facilities operated by the Town of Snow Lake. Therefore, no permits relating to water or wastewater will be required.

# 3.19 Closure Planning

The Stall Lake Concentrator and Anderson Lake TIA Closure Plan, which was filed with the Director of Mines in 2005, will be updated to account for the expansion of the Anderson TIA and submitted to the Director of Mines for approval in accordance with *Manitoba Mine Closure Regulation 67/99*, along with any increase/decrease in financial assurance that may be required.

It is anticipated that the update to the Closure Plan will contemplate the following:

- Removing and appropriately disposing of site refuse.
- Testing, removing and/or remediating any contaminated soils.
- Re-vegetating disturbed areas (laydown areas) in order to restore landscape to the extent possible to their native appearance.
- Conducting regular dam stability inspections.
- Monitoring that adequate water cover is maintained (minimum of 1.5 m water cover).
- Collecting and reporting on water quality analysis during discharge if required to maintain water level or ensure dam stability.

# 3.20 Summary of Project Activities

**Table 3-10** lists all the activities associated with the Project during the construction, operation and maintenance and closure phases. These activities are used to establish a thorough understanding of the Project. A thorough understanding of these activities and their interaction with each environmental component helps characterize potential environmental effects of the overall development.

# 3.21 Project Schedule

The overall Project schedule is proposed below:

| Stage | Project Activity | 2016 | | | | 2017 | | | | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | | | | | | | | | |
| A | Preparation | | | X | X | X | | | | | | | | | | | | |
| | Construction | | | X | X | X | | | | | | | | | | | | |
| | Water Inundation | | | | | X | X | X | X | X | X | | | | | | | |
| B | Preparation | | | | | | | | | | | X | | | | | | |
| | Construction | | | | | | | | | | | X | | | | | | |
| | Water Inundation | | | | | | | | | | | | X | X | | | | |
| C | Preparation | | | | | | | | | | | | | | X | | | |
| | Construction | | | | | | | | | | | | | | X | | | |
| | Water Inundation | | | | | | | | | | | | | | | X | X | X |

## Table 3-10: Project Activities

| Component | Activity | Stage A | Stage B | Stage C |
|---|---|---|---|---|
| **Preparation Activities** | Mobilizing equipment, materials and crew to site | X | X | X |
| | Clearing and grubbing in areas to be inundated | X | - | - |
| | Clearing and grubbing for temporary access trails | X | X | X |
| | Clearing and grubbing for borrow pits and quarries | X | X | - |
| | Clearing and grubbing right-of-way for powerlines | X | X | X |
| | Stockpiling excavated organics | X | X | X |
| | Disposing of removed organics (trees) | X | X | X |
| | Mining materials from quarries and borrow pits | X | X | X |
| | Transporting materials from borrow pits and quarries to site | X | X | X |
| | Disposing miscellaneous construction wastes | X | X | X |
| **Berm and Dams** | Mobilizing equipment, materials and crew to site | X | X | X |
| | Common excavation | X | X | X |
| | Stockpiling excavated organics | X | X | X |
| | Disposing of removed organics (trees) | X | X | X |
| | Preparing foundation of dams and berms | X | X | X |
| | Placing fill materials, geotextile and rip rap | X | X | X |
| | Decommissioning existing decant pipe in Anderson Dam | X | - | - |
| | Constructing East Berm | X | - | - |
| | Constructing East Dam (including raising and extending) | X | X | X |
| | Raising Anderson Dam | X | - | - |
| | Integrating Anderson Dam into East Dam | - | X | X |
| | Constructing Northeast Dam (including raising and extending) | X | X | X |
| | Constructing Southwest Dam (including raising and extending) | - | X | X |
| | Constructing South Dam (including raising and extending) | - | - | X |
| | Disposing miscellaneous construction wastes | X | X | X |
| **Anderson Reclaim Pumphouse** | Mobilizing equipment, materials and crew to site | X | - | - |
| | Prepare existing pumphouse for relocation | X | - | - |
| | Prepare foundation at new location and install pumphouse | X | - | - |
| | Adjust pipeline to and from new location of pumphouse | X | - | - |
| | Install larger capacity pump | X | - | - |
| | Disposing miscellaneous construction wastes | X | - | - |
| **Seepage Collection System** | Mobilizing equipment, materials and crew to site | X | X | X |
| | Commissioning power line | X | X | X |

| Component | Activity | Stage A | Stage B | Stage C |
|---|---|---|---|---|
| | Installing sumps in dams | X | X | X |
| | Installing pumphouses | X | X | X |
| | Disposing miscellaneous construction wastes | X | X | X |
| **Spillway** | Mobilizing equipment, materials and crew to site | X | X | X |
| | Raising and improving existing spillway | X | - | - |
| | Installing earthen dams on either side of existing spillway | X | - | - |
| | Removing structures and filling in with earthen materials at existing spillway | - | X | - |
| | Constructing new spillway (installing concrete structures) | - | X | - |
| | Raising new spillway | - | - | X |
| | Disposing miscellaneous construction wastes | X | X | X |
| **Runoff Diversion Ditch** | Constructing runoff diversion ditch | X | - | - |

# 4. Scope of the Assessment

## 4.1 Temporal Boundaries

The temporal boundaries of the assessment are divided as follows:

- **Preparation Phase**: Includes the activities that occur at the beginning of each stage and mainly involve clearing trails and laydown areas and excavation of material at borrow pits and quarries.
  - **Stage A**: Fall 2016 to 2017
  - **Stage B**: 2020 to 2021
  - **Stage C**: 2023 to 2024

- **Construction Phase**: Includes construction of permanent features and structures.
  - **Stage A**: Fall 2016 to 2017
  - **Stage B**: 2020 to 2021
  - **Stage C**: 2023 to 2024

- **Inundation Phase**: Period of time in which there will be little need to discharge out of the Anderson TIA as water level inside the Anderson TIA is allowed to naturally and gradually rise.
  - **Stage A**: 2017 to 2019
  - **Stage B**: 2021 to 2023
  - **Stage C**: 2024 to 2027

- **Operation and Maintenance Phase**: Continuing deposition of tailings as currently practiced in the Anderson TIA – October 2016 to 2035.

- **Closure Phase** – 2035 to 2038, depending on the time it takes for re-vegetation.

## 4.2 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 the Anderson TIA (at final water elevation of 281.25 m), the temporary trails, laydown areas, the new dams, spillway, seepage collection system, the Anderson TIA Reclaim Pumphouse, and Anderson Creek from the TIA to Anderson Bay of Wekusko Lake. This is intended to take into account areas of direct disturbance. The whole of the Project Site is under active management of HBMS with controlled access, as noted on **Figure 02**.
- **Project Area** – is comprised of an area 2 km beyond the Project Site, which is intended to take into account the indirect effects of the Project (such as noise, fauna, air 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 15**. **Figure 16** provides a closer view of the Project Site and Area.

## 4.3 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" (Manitoba Conservation and Water Stewardship, 2015). SCs include components of the socio-economic environment that may be affected by a change in the environment caused by the Project.

The potential interactions between project components and ECs and SCs are identified in **Table 4-1**. Potential interactions were identified based on the professional judgement of the assessor combined with the assumption that standard environmentally responsible construction techniques and operating procedures will be applied in the course of project construction, operation and closure. The potential interactions identified in **Table 4-1** are assessed in **Section 6**. Mitigation measures and residual effects are also described in **Section 6**.

## Table 4-1: Identification of Potential EC/SC Interactions with Project

| Activity | ENVIRONMENTAL COMPONENTS | | | | | | | | | | SOCIO-ECONOMIC COMPONENTS | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Physical | | | | | Terrestrial | | Aquatic | | | | | | |
| | Topography | Soil | Air | Climate | Groundwater | Flora | Fauna | Surface Water Quality | Surface Water Quantity | Aquatic Life | Land and Resource Use | Heritage Resources | Aesthetics | Effects on Aboriginal Peoples |
| **PREPARATION** | | | | | | | | | | | | | | |
| Mobilizing equipment, materials and crew to site | | X | X | X | | | | | | | | | X | X |
| Clearing and grubbing in areas to be inundated | | X | X | X | | X | | X | | X | | | X | |
| Clearing and grubbing for temporary trails | | X | X | X | | X | | | | | | | | |
| Clearing and grubbing for borrow pits and quarries | | | X | | | | X | | | | | | | |
| Clearing and grubbing right-of-way for powerlines | | X | X | X | | | | | | | | | | |
| Stockpiling excavated organics | X | X | | | | | | | | | | | | |
| Disposing of removed organics (trees) | | | X | | | | | | | | | | X | |
| Mining materials from quarries and borrow pits | X | | X | X | | | X | | | | | | | X |
| Transporting materials from borrow pits and quarries to site | | | X | X | | | X | | | | | | | |
| Disposing miscellaneous construction wastes | | X | | X | X | X | X | X | | X | | | X | |
| **CONSTRUCTION** | | | | | | | | | | | | | | |
| **Berms and Dams** | | | | | | | | | | | | | | |
| Mobilizing equipment, materials and crew to site | | | X | X | | | | | | | | | X | |
| Common excavation | X | | X | X | | | | | | | | | | |
| Stockpiling excavated organics | X | | X | X | | | | | | | | | X | |
| Disposing of removed organics (trees) | | | X | X | | | | | | | | | | |
| Preparing foundation of dams and berms | | | | | | | | | | | | | | |
| Placing fill materials, geotextile and rip rap | | | X | X | | X | | X | | X | | | | |
| Decommissioning existing decant pipe in Anderson Dam | | | | | | | | | | | | | | |
| Constructing East Berm | X | X | X | X | X | | X | | | | | | | |
| Constructing East Dam (including raising and extending) | X | | X | X | X | | | | | | | | | |
| Raising Anderson Dam | X | | X | X | X | | | | | | | | | |
| Integrating Anderson Dam into East Dam | X | X | X | X | X | X | X | X | | X | X | | X | |
| Constructing Northeast Dam (including raising and extending) | X | X | X | | X | X | X | X | | | X | | X | |
| Constructing Southwest Dam (including raising and extending) | X | X | X | X | X | X | X | X | | X | X | | X | |

| Activity | ENVIRONMENTAL COMPONENTS | | | | | | | | | | SOCIO-ECONOMIC COMPONENTS | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Physical | | | | | Terrestrial | | Aquatic | | | | | | |
| | Topography | Soil | Air | Climate | Groundwater | Flora | Fauna | Surface Water Quality | Surface Water Quantity | Aquatic Life | Land and Resource Use | Heritage Resources | Aesthetics | Effects on Aboriginal Peoples |
| Constructing South Dam (including raising and extending) | | | | | | | | | X | X | | | | |
| Disposing miscellaneous construction wastes | | X | | | X | X | X | X | | X | X | | X | |
| **Anderson Reclaim Pumphouse** | | | | | | | | | | | | | | |
| Mobilizing equipment, materials and crew to site | | X | X | X | | | | | | | | | | |
| Prepare existing pumphouse for relocation | | | | | | X | | | | | | | | |
| Prepare foundation at new location and install pumphouse | | X | X | X | | | | | | | | | | |
| Adjust pipeline to and from new location of pumphouse | | X | X | X | X | | | X | | X | | | | |
| Install larger capacity pump | X | | | | | | | | | | | | | |
| Disposing miscellaneous construction wastes | | X | | | X | | | | | | | | | |
| **Seepage Collection System** | | | | | | | | | | | | | | |
| Mobilizing equipment, materials and crew to site | | X | X | X | | | | | | | | | X | |
| Commissioning power line | | | | | | | | | | | | | | |
| Installing sumps in dams | | | X | X | | | | X | | X | | | | |
| Installing pumphouses | | | X | | | | | | | | | | | |
| Disposing miscellaneous construction wastes | | X | | | X | X | X | X | | X | | | X | |
| **Spillway** | | | | | | | | | | | | | | |
| Mobilizing equipment, materials and crew to site | | X | X | X | | | | | | | | | X | |
| Raising and improving existing spillway | X | | | | | | X | | | | | | | |
| Installing earthen dams on either side of existing spillway | X | | | | | | X | | | | | | | |
| Removing structures and filling in with earthen materials at existing spillway | | X | X | | | | X | | | | | | X | |
| Constructing new spillway (installing concrete structures) | | | X | X | | | X | | | | | | | |
| Raising new spillway | | | | | | | | | | | | | | |
| Disposing miscellaneous construction wastes | | X | X | X | X | X | X | X | | X | | | X | |
| **Runoff Diversion Ditch** | | | | | | | | | | | | | | |
| Constructing runoff diversion ditch | X | X | X | X | X | X | X | X | X | X | X | | X | |
| **OPERATION & MAINTENANCE** | | | | | | | | | | | | | | |
| Tailings deposition | | | | | | | | X | X | X | X | | | X |
| Mobilizing equipment, materials and crew to site | | | X | X | | | | | | | | | | |

| Activity | ENVIRONMENTAL COMPONENTS | | | | | | | | | | SOCIO-ECONOMIC COMPONENTS | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Physical | | | | | Terrestrial | | Aquatic | | | | | | |
| | Topography | Soil | Air | Climate | Groundwater | Flora | Fauna | Surface Water Quality | Surface Water Quantity | Aquatic Life | Land and Resource Use | Heritage Resources | Aesthetics | Effects on Aboriginal Peoples |
| Maintaining Anderson TIA & Tailings pipeline system | | X | X | X | | X | X | | | | X | | X | |
| **CLOSURE** | | | | | | | | | | | | | | |
| Demolishing Structures/Disposing Wastes | | X | X | X | X | X | X | X | | X | X | | X | |
| Re-cycling and Restoration | X | X | X | X | | X | X | | | | X | | X | X |

# 5. Environmental Setting

This section provides an overview of the physical, terrestrial and aquatic environment in the Snow Lake region.

## 5.1 Environmental Baseline Studies

Since 2007, in contemplation of potential future developments resulting from the discovery of the Lalor ore body, HBMS has retained AECOM to undertake environmental investigations in the Snow Lake region. The results of the baseline investigations conducted between 2007 and 2015 are reported in the *Proposed Lalor Concentrator Environmental Baseline Assessment (*AECOM, 2013e), the *Proposed Lalor Mine Baseline Assessment* (AECOM, 2012c) and the Anderson TIA Water Quality Reports (AECOM, 2015b-f, 2014a-b). These investigations dealt broadly with the terrestrial and aquatic resources that could potentially be affected including local geology, soil, vegetation and wildlife, and 14 waterbodies that were initially identified as being located within the potential area of influence of the Project.

In 2011, baseline terrestrial and aquatic investigations began in specific anticipation of the proposed Anderson TIA Expansion (the Project).

As planning for the Project proceeded, focused investigations were undertaken in 2011 to 2015 including:

- Terrestrial survey along the former railbed to the north of the Anderson TIA.
- Shoreline survey of the Anderson TIA.
- Terrestrial and stream crossing survey along the proposed dike alignments.
- Water and soil quality sampling and assessments in the Anderson TIA, Anderson Creek and Anderson Bay.
- Fish studies in Anderson Creek, and Anderson Bay and Goose Bay[2] of Wekusko Lake.
- Methylmercury assessment in the Anderson TIA and waterbodies downstream of the Anderson TIA.

The above listed focused investigations are summarized in this section.

## 5.2 Physical Environment

The physiographic setting for the Anderson TIA is defined using the ecological land classification system. This hierarchical system of ecozones, ecoregions, and ecodistricts represents subdivisions of increasing ecological detail. The Anderson TIA 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

[2] *Goose Bay is a reference area outside the Project Region*

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 17** (Smith *et al.*, 1998).

### 5.2.1 Topography

The elevations in the Reed Lake Ecodistrict range from approximately 255 metres above sea level (masl) to 355 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 area surrounding Anderson TIA 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.

### 5.2.2 Geology

Anderson TIA is within 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." (Bailes and Galley, 1999).

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 (Bailes and Galley, 1999).

### 5.2.3 Soil

As noted, 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).

### 5.2.4 Air

There are no air quality monitoring stations in the Snow Lake area. 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 significant air emissions in Snow Lake. The closest significant industrial activity is in the City of Flin Flon, the Town of The Pas, and The City of Thompson, located approximately 124 km, 144 km and 167 km from the Anderson TIA, respectively. Occasionally, regional impediments to air quality, although uncommon, may

occur in the area. This could include smoke from forest fires and wood-burning stoves, emissions from fuel storage tanks and vehicle emissions.

## 5.2.5 Noise and Vibration

Baseline noise assessments were conducted by AECOM in July, 2011 in support of other Hudbay projects occurring in the Snow Lake region (AECOM, 2012e). During these studies, baseline noise data was collected at two Points of Reception (POR) within the Town of Snow Lake. The equivalent day/night sound levels were calculated to be 53 dBA at POR 1 and 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. These measured background levels were determined to be typical of a suburban area where the dominant source of ambient noise and vibration is vehicular traffic (AECOM, 2012e).

The background noise levels at the Anderson TIA are expected to be similar to the levels measured in the 2011 study, since the primary source of noise and vibration is vehicular traffic on PR 392 (which is adjacent to the east end of the Anderson TIA).

Detailed noise methodology, results and discussion can be found in the Lalor Mine Noise Baseline and Impact Assessment prepared by AECOM in 2012 (AECOM, 2012e).

## 5.2.6 Climate

The closest weather station to the site is located at the Flin Flon airport near Baker's Narrows, approximately 121 km west of Anderson TIA. The Flin Flon airport is located at an elevation of 304 masl and is considered to be climatically representative of the Project Site. The mean annual temperature at the Flin Flon airport is 0.2°C. The daily mean temperature ranges between 18°C in July and -20°C in January. Total annual precipitation at the Flin Flon airport is composed of 354.9 mm of rain and 150.2 cm of snow. July has the highest average rainfall (83 mm), whereas November has the highest average snowfall (28 cm). (Environment Canada, 2016).

The average temperature, precipitation and wind conditions at the Flin Flon airport for each month are provided in **Table 5-1**Table 5-1**.**

**Table 5-1: Climate Data for the Flin Flon Airport, Manitoba (1981-2010)**

| Parameter | | Month | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Year | Code |
| Temperature (°C) | Daily Average | -19.8 | -16.2 | -8.9 | 0.8 | 8.4 | 14.9 | 18.2 | 17 | 10.4 | 2.6 | -8.4 | -17.1 | 0.2 | A |
| | Daily Maximum | -15.1 | -10.8 | -2.7 | 6.9 | 14.4 | 20.4 | 23.4 | 22 | 14.7 | 6 | -5.1 | -12.9 | 5.1 | A |
| | Daily Minimum | -24.5 | -21.5 | -15 | -5.3 | 2.3 | 9.5 | 13 | 12 | 6.1 | -0.9 | -11.6 | -21.3 | -4.8 | A |
| Precipitation | Rainfall (mm) | 0.2 | 0.3 | 1.4 | 10.3 | 37.3 | 67.2 | 83.1 | 67.2 | 62.5 | 23.6 | 1.4 | 0.5 | 354.9 | A |
| | Snowfall (cm) | 21.7 | 18.2 | 19.7 | 18.7 | 3.6 | 0 | 0 | 0 | 1.7 | 14.6 | 27.5 | 24.6 | 150.2 | A |
| Wind Conditions (km/h) | Speed | 9.1 | 9.9 | 9.9 | 10.8 | 10.8 | 11.2 | 10.6 | 10.6 | 12 | 12 | 10.9 | 9.3 | 10.6 | D |
| | Most Frequent Direction | NW | N | S | S | S | S | S | S | S | N | N | N | S | D |

*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, 2016).*

*"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, "D": At least 15 years.*

# 5.3 Surface Water

## 5.3.1 Hydrology

The Project lies within the Reed Lake Ecodistrict, which is in the glacial Lake Agassiz basin and is part of the Nelson River drainage system. The region drains generally eastward through medium sized lakes and an irregular bedrock-controlled network of streams to Wekusko Lake that are all part of the Grass River watershed (Smith *et al.*, 1998).

The downstream receptor for the Anderson TIA is Anderson Bay of Wekusko Lake (see **Figure 02**). The Anderson TIA drains to Anderson Creek, which is almost entirely fed from the Anderson TIA discharge pipe, with a smaller amount of water coming from the TIA spillway and surface drainage. The creek crosses Manitoba Provincial Road (PR) 392 and meanders for approximately 1.25 km before merging with Stall Creek and entering Anderson Bay of Wekusko Lake. Stall Creek and Anderson Creek merge approximately 0.2 km from the confluence with Anderson Bay, meandering through a wide wetland area dominated by emergent macrophytes.

Due to varying topography created by hummocky bedrock surfaces, the drainage conditions vary considerably over short distances. Regionally the terrain falls at about 0.6 m to 1.0 m per km. Locally, 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 (Smith *et al.*, 1998). Similar to much of the Boreal Shield Ecozone, contiguous and isolated bogs cover approximately 20% of the Anderson TIA region. Bogs are widespread and stagnant in the region.

## 5.3.2 Anderson Bay Bathymetry

Anderson Bay of 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. The average depth of Anderson Bay is 2.3 m and its maximum depth is 5.3 m. Anderson Bay has a total surface area of 1,106,100 $m^2$ and a total calculated volume of 2,583,400 $m^3$.

## 5.3.3 Surface Water Quality

The purpose of this section is to consider and describe the impact, if any, of the presence of tailings in the TIA on water quality downstream of the TIA. AECOM accomplished this through: its own water quality sampling programs carried out between 2011 and 2015; together with consideration of water quality monitoring data collected by HBMS at the final discharge point in accordance with the MMER and generally over the 37 year record of operation of the TIA; and, as well, the results of EEM studies conducted since 2005 by Stantec on behalf of HBMS in accordance with other requirements of the MMER.

AECOM collected water samples from Anderson Bay and Anderson Creek in years 2011 to 2015 and the Anderson TIA from 2012 to 2015. This section provides the results of the AECOM studies in Anderson TIA, Anderson Creek and Anderson Bay of Wekusko Lake, as well as considering historic trends in the data provided by HBMS.

### *5.3.3.1 Approach to AECOM Water Quality Sampling Programs*

*5.3.3.1.2 Locations of Sampling Events*

**Table 5-2** summarizes the sampling effort by AECOM for 2012 – 2015 for each waterbody by year.

**Table 5-2: Water Sampling effort in Anderson Bay, Anderson Creek and Anderson TIA**

| Waterbody | Date Sampled | Number of Samples Collected |
|---|---|---|
| Anderson Bay | May 2011 | 10 |
| | September 2011 | 10 |
| | June 2013 | 2 |
| | October 2013 | 2 |
| | June 2014 | 2 |
| | September 2014 | 2 |
| | June 2015 | 2 |
| | September 2015 | 2 |
| Anderson Creek | May 2011 | 2 |
| | September 2011 | 2 |
| | June 2012 | 1 |
| | June 2013 | 3 |
| | October 2013 | 3 |
| | June 2014 | 3 |
| | September 2014 | 3 |
| | June 2015 | 3 |
| | September 2015 | 3 |
| Anderson TIA | March 2012 | 21 |
| | June 2012 | 21 |
| | June 2013 | 21 |
| | October 2013 | 21 |
| | June 2014 | 21 |
| | September 2014 | 20 [1] |
| | December 2014 | 19 |
| | March 2015 | 18 |
| | June 2015 | 20 |
| | September 2015 | 19 |

*Notes:*

1. *In fall of 2014 access issues caused the permanent abandonment of four historical locations (AND-04, AND-05, AND-07 and AND-08) and the adoption of three new sample stations (AND-22, AND-23 and AND-24).*

*5.3.3.1.3 Sampling Methodology*

Surface grabs were collected from sample locations less than 3 m while a mid-column water sample was collected in an acrylic Kemmerer bottle sampler at sample locations deeper than 3 m.

*In situ* water quality parameters, including pH, temperature, specific conductance, turbidity, dissolved oxygen, and total dissolved solids were measured with a Horiba U-53 multi-parameter probe. Water samples were collected in clean laboratory containers, handled using new nitrile gloves between samples, and kept cool and shipped to ALS Laboratories in Winnipeg, Manitoba for water quality analysis of the following parameters:

- Routine parameters (*e.g.*, physical and nutrients).
- Major ions (*i.e.*, chloride, sulphate, bromide and silicate).
- Total and dissolved metals by inductively coupled-mass spectrometry (ICP-MS).
- Total and dissolved mercury by cold-vapour atomic fluorescence spectrometry.

- Biological (*i.e.,* chlorophyll *a* and pheophytin *a*) (analyzed in 2011 only).
- Select samples were analysed for methylmercury.

*5.3.3.1.4 Parameters Analyzed*

The Anderson TIA is listed on Schedule 2 (Subsections 5(1) and 27.1(1)) of the *Metal Mining Effluent Regulations* (SOR/2002-222) and water quality effluent discharged from the Anderson TIA is regulated under the MMER-set water quality standards. **Table 5-3** below displays the Authorized Limits of Deleterious Substances listed in Schedule 4 to the MMER and their Maximum Authorized Concentration in a grab sample. In all of the water quality studies undertaken by AECOM from 2011-2015, as well as the 37 year record provided by HBMS, including data collected inside the Anderson TIA itself, no sample exceeded any criterion specified for measurement in Schedule 4 to the MMER.

This assessment also considers Canadian Council of Ministers of Environment (CCME) Water Quality Guidelines (WQG) (2011) for the Protection of Aquatic Life (PAL), Freshwater as a basis for understanding the water quality and trophic status of the TIA in relation to waterbodies downstream. The CCME PAL criteria are shown in the water quality table found in **Appendix C**.

Cyanide and Radium 226 were excluded from the AECOM water quality sampling program. Cyanide was excluded because, in accordance with section 12(3) of the MMER, HBMS does not analyze samples for cyanide (because it is not used as a process reagent in the Stall Lake Concentrator). Radium 226 was excluded because of historically low concentrations in studies conducted by HBMS.

**Table 5-3: Authorized Limits of Deleterious Substances set in Schedule 4 to the MMER**

| Deleterious Substance | Maximum Authorized Concentration in a Grab Sample |
|---|---|
| **Total Suspended Solids** | 30.00 mg/L |
| **Arsenic** | 1.00 mg/L |
| **Copper** | 0.60 mg/L |
| **Cyanide** | 2.00 mg/L |
| **Lead** | 0.40 mg/L |
| **Nickel** | 1.00 mg/L |
| **Zinc** | 1.00 mg/L |
| **Radium 226** | 1.11 Bq/L |

The trophic status of Anderson Bay and Anderson Creek were determined using categories based on total phosphorus concentrations as developed by CCME (2004) (**Table 5-4**).

**Table 5-4: Trophic Categories for Freshwater Aquatic Ecosystems Based on Total Phosphorus (mg/L) Concentrations (CCME, 2004)**

| Trophic Status | Total Phosphorus (mg/L) |
|---|---|
| **Ultra-Oligotrophic** | <0.004 |
| **Oligotrophic** | 0.004 – 0.01 |
| **Mesotrophic** | 0.01 – 0.02 |
| **Meso-eutrophic** | 0.02 – 0.035 |
| **Eutrophic** | 0.035 – 0.10 |
| **Hyper-eutrophic** | >0.10 |

### *5.3.3.2 Summary of Water Quality Results*

This section sets out a summary of the water quality data collected during the aquatic investigations in each waterbody. The entire set of AECOM water quality results is contained in **Appendix C**, which consists of the analytical and *in-situ* results from samples collected by AECOM during 2011-2015 in Anderson Creek and Anderson Bay and during 2012-2015 in Anderson TIA.

Detailed water quality methodology, results and discussion can be found in these documents:

- Anderson Tailings Impoundment Area Winter Water Sampling (AECOM, 2012a).
- Anderson Tailings Impoundment Area Winter and Summer Sampling Summary 2012 (AECOM, 2012b).
- Proposed Lalor Mine Environmental Baseline Assessment (AECOM, 2012c).
- Lalor Mine Environment Act Proposal Report (AECOM, 2012d).
- A Summary of 2012 Field Studies at the Anderson Tailings Impoundment Area (AECOM, 2013a).
- Baseline Water and Sediment Quality Assessment at Anderson Creek (AECOM, 2013b).
- Lalor Concentrator Environment Act Proposal (AECOM, 2013c).
- Proposed Lalor Concentrator Baseline Assessment (AECOM, 2013e).
- 2013 Anderson Tailings Impoundment Area, Fall Sampling Summary (AECOM, 2014a).
- 2014 Anderson Tailings Impoundment Area, Spring Sampling Summary (AECOM, 2014b).
- 2014 Anderson Tailings Impoundment Area, Fall Sampling Summary (AECOM, 2015b).
- 2014 Anderson Tailings Impoundment Area, Winter Sampling Summary (AECOM, 2015c).
- 2015 Anderson Tailings Impoundment Area, March Sampling Summary (AECOM, 2015d).
- 2015 Anderson Tailings Impoundment Area, June Sampling Summary (AECOM, 2015e).
- 2015 Anderson Tailings Impoundment Area, September Sampling Summary (AECOM, 2015f).

#### *5.3.3.2.1 Water Quality in the Anderson TIA*

Water samples and *in-situ* water quality parameters were collected from the Anderson TIA in winter, spring, and fall. Conventional parameters of Anderson TIA were determined based on *in-situ* measurements and laboratory analysis. The purpose of collecting data within the TIA was in part, to monitor potential changes in water quality during the initial years of production of ore from Lalor Mine. Additionally, the data provides some context for AECOM's assessment of downstream water quality and so is discussed here.

Briefly, the *in situ* data indicates:

- The water depths at sampling locations in the Anderson TIA ranged from 0.30 m to 7.60 m.
- The specific conductivity showed little variation between sample locations in Anderson TIA. The average specific conductivity in the Anderson TIA was 0.498 mS/cm in 2012, 0.474 mS/cm in 2013, 0.567 mS/cm in 2014, and 0.749 mS/cm in 2015. There is little in-season variation but it was generally lower in the spring and summer compared to the winter and fall sampling events.
- Turbidity is generally low (<10 NTU) at most locations, although spikes in turbidity are identified at sample locations in close proximity to the tailings discharge[3] location. Near the tailings discharge locations in June 2015, samples reached 43.7 NTU. Anecdotally, it appears that sampling on windy days results in higher turbidity readings due to wind and wave action stirring up sediment.
- Total dissolved solids show little variation within the Anderson TIA ranging from 0.228 mg/L to 0.690 mg/L, with the highest measurements recorded near the tailings discharge pipe.
- Dissolved oxygen levels in the Anderson TIA averaged 7.95 mg/L in spring, 8.87 mg/L in fall and 3.32 mg/L in winter.

**Appendix C** on **Figures 01 to 11** show the sampling locations AECOM visited in the Anderson TIA during the September 2015 sampling event, and also identifies the direction and scale of the percentage change in metals

[3] *The tailings discharge is distinct from the Anderson discharge, as described in Section 3.1 of the Project Description*

concentrations between the September 2015 and the early June 2015 sampling events. Where non-detectable concentrations were present for one of the sampling events, the magnitude of change was not calculated.

**Appendix C** shows the water analytical results compared to CCME PAL guidelines and the MMER limits. Analysis of these results resulted in the selection of the following parameters for further consideration ("contaminants of concern"):

- Aluminum (**Appendix C Figure 01**).
- Arsenic (**Appendix C Figure 02**).
- Cadmium (**Appendix C Figure 03**).
- Copper (**Appendix C Figure 04**).
- Iron (**Appendix C Figure 05**).
- Lead (**Appendix C Figure 06**).
- Mercury (**Appendix C Figure 07**).
- Selenium (**Appendix C Figure 08**).
- Silver (**Appendix C Figure 09**).
- Zinc (**Appendix C Figure 10**).
- Methylmercury (**Appendix C Figure 11**).

Graphical representation of the total metal concentrations for the contaminants of concern (sampling events 2012 - 2015) is located in **Appendix C**.

In general, the late summer/fall sampling conducted in September 2015 indicated that:

- Total aluminum exceeded the CCME PAL guideline (0.1 mg/L) at four locations within the central portion of the TIA (AND-10 to AND-13). Except for the central portion of the TIA (AND-09 to AND-13), all concentrations in the Anderson TIA decreased when compared to Sept 2014 (ranging from 5% to 196%). When compared to early summer 2015, the majority of aluminum concentrations in the TIA decreased (ranging from 13% to 191%) with a few locations throughout the TIA showing increases (ranging from 15% to 41%).
- Total arsenic did not exceed the CCME PAL guidelines (0.005 mg/L) or the MMER limits (1.0 mg/L) in the Anderson TIA or Anderson Creek or Anderson Bay during the September 2015 sampling event. When compared to June 2015, concentrations have decreased across the Anderson TIA (except at AND-24 where concentrations increased by 10%). Compared to September 2014, arsenic concentrations have generally increased (ranging from 2% to 34%) in the central and far eastern portions of the TIA and decreased throughout the rest of the TIA (ranging from 2% to 97%). Arsenic concentrations in Anderson Creek and Anderson Bay increased compared to September 2014 and showed no trend when compared to June 2015 (*i.e.,* both increases and decreases were noted).
- The total cadmium concentrations in September 2015 exceeded the CCME PAL guideline at all nineteen of the locations sampled and thirteen locations through the central portion of the TIA exceeded the guideline by at least five times (5X). When compared to the September 2014 results, all cadmium concentrations in the TIA and Anderson Creek (except AND-24) decreased (ranging from 11% to 131%). The same trend was observed compared to June 2015 with only a few minor increases in the central and eastern portions of the TIA. All three samples from Anderson Creek exceeded the CCME PAL guideline of 0.00009 mg/L. However, samples have generally decreased from concentrations reported in September 2014 and June 2015. Total cadmium concentrations were below CCME PAL guidelines in samples collected from Anderson Bay.
- Total copper concentrations exceeded the CCME PAL guideline at all nineteen sample locations within the Anderson TIA and four of those samples exceeded guidelines by more than five times (5X). Compared to September 2014 and June 2015, all copper concentrations in the Anderson TIA (except AND-24) decreased by 12% to 240%. All three samples from Anderson Creek exceeded the CCME PAL guidelines but Anderson Bay concentrations were below CCME PAL guidelines. Compared to September 2014 and

June 2015 the majority of the copper concentrations in Anderson Creek and Anderson Bay were similar or decreased (ranging from 10% to 143%). Total copper did not exceed the MMER limits at any sampling location.

- Total iron exceeded the CCME PAL guidelines (0.3 mg/L) at four locations in the Anderson TIA and two locations in Anderson Creek. All four exceedances were located within the western portion of the Anderson TIA (AND-10 to AND-13). Except for the central portion of the Anderson TIA (AND-10 to AND-13), all concentrations in the TIA decreased when compared to Sept 2014 (ranging from 27% to 207%). When compared to early summer 2015 the iron concentrations in the TIA decreased (ranging from 5% to 279%), except for AND-22 (7%).
- Total lead exceeded the CCME PAL guideline at four locations in the western portion of the TIA (AND-10 to AND-13). Lead concentrations decreased at all but two locations in the TIA (AND-11 and AND-12) when compared to September 2014 results (ranging from 21% to 761%). When compared to June 2015, lead concentrations decreased at all but one location in the TIA (AND-24) (ranging from 31% to 813%). Anderson Creek and Anderson Bay total lead concentrations were below guidelines and generally decreased compared to September 2014 and June 2015. Total lead did not exceed the MMER limits at any sampling location.
- Overall, total mercury exceeded the CCME PAL guideline at three sampling locations within the Anderson TIA (AND-12, AND-13, and AND-22). At locations in the TIA where detectable total mercury concentrations were identified during September 2014, the concentrations had decreased in September 2015 (Ranging from 2% to 683%). In general, September 2015 concentrations compared to June 2015 total mercury concentrations decreased across the Anderson TIA, except for AND-24 (Ranging from 92% to 400%). Total mercury concentrations in Anderson Creek and Anderson Bay were below CCME PAL guidelines in September 2015 and concentrations were either similar or had decreased compared to June 2015 and September 2014.
- There was no significant trend in total nickel concentrations in the Anderson TIA compared to historical sampling events and nickel concentrations continue to be at or near the laboratory reportable detection limit. Therefore current and historical total nickel concentrations are approximately two orders of magnitude less than the CCME PAL guideline and three orders of magnitude less than the MMER limits.
- Total selenium exceeded the CCME PAL guideline (0.001 mg/L) at all nineteen locations sampled within the TIA, including eleven locations in the central portion of the Anderson TIA, which exceeded by more than five times (5X) (AND-09 to AND-14, AND-16 to AND-18, AND-22 and AND-24). Overall selenium concentrations were similar or had increased across the TIA (Ranging from -10% to 66%). The highest selenium concentrations in the TIA were in the vicinity of the tailings discharge location (AND-13 to AND-15). Anderson Creek concentrations also exceeded the CCME PAL guideline and were similar to the concentrations that were measured in September 2014, but approximately half the value of the concentrations measured in June 2015. Anderson Bay selenium concentrations are below CCME PAL guidelines and have remained below the detection limit since June 2013.
- Silver exceeded the CCME PAL guideline at five locations within the central portion of the TIA (AND-09 to AND-13). The remainder of samples collected, including Anderson Bay and Anderson Creek, had results below the reportable detection limit. Prior to June 2014, the majority of the silver results were less than the reportable detection limit. It is worth noting that the laboratory method detection limit for silver reported during this project and the CCME PAL guideline have been the same (0.001 mg/L). Therefore, any trends in silver concentrations prior to June of 2014 were undetectable.
- Total zinc concentrations during September 2015 were comparable to the March and June 2015 and December 2014 sampling events, exceeding the CCME PAL guideline by more than five times (5X) the throughout the entire Anderson TIA and all three sampling locations in Anderson Creek. In general, total zinc concentrations decreased following the same trend across the Anderson TIA as was observed during September 2014. Compared to June 2015 the total zinc concentrations in the western portion of the TIA were generally lower, whereas concentrations in the eastern portion of the TIA were generally higher. In Anderson Creek, the total zinc concentrations were higher in September 2015 compared to both June 2015 and September 2014. Concentrations in Anderson Bay continue to be below the CCME PAL guideline and no locations exceeded the MMER limits.

- All eleven of the methylmercury samples collected in the Anderson TIA and the two samples collected from Anderson Bay were below reportable detection limits (<0.00000005 mg/L), which is an order of magnitude below the CCME PAL guideline of 0.000004 mg/L. The three sample locations in Anderson Creek registered methylmercury concentrations above the reportable detection limits, but were an order of magnitude below the CCME PAL guideline.

As noted above, in all of the water quality studies undertaken by AECOM from 2012-2015, no sample taken from the Anderson TIA exceeded any criterion specified for measurement in Schedule 4 to the MMER.

*5.3.3.2.2 Water Quality in Anderson Creek*

Anderson Creek is the only receiving waterbody for discharge from the Anderson TIA. Water temperatures in Anderson Creek are highest in the summer, followed by spring, then the fall. Turbidity is generally higher in fall, likely due to the higher primary productivity in fall. Water in Anderson Creek is generally well-oxygenated with the majority of dissolved oxygen concentrations ranging from 6.7 mg/L to 16.0 mg/L. Anderson Creek has a neutral pH ranging from 6.8 to 8.9, with more alkaline pH in the spring. Specific conductivity showed little variation among sampling stations in each sampling event and ranged from 0.135 mS/cm to 0.656 mS/cm, with lowest specific conductivity measured in October 2013. According to the CCME classification scheme for lake trophic status based on total phosphorus concentrations, Anderson Creek was considered *mesotrophic* in 2011, *meso-eutrophic* in 2012 and 2013 and *eutrophic* in 2014 and 2015 (**Table 5-4**).

As noted above, in all of the water quality studies undertaken by AECOM from 2011-2015, no sample exceeded any criterion specified for measurement in Schedule 4 to the MMER. In addition, with the following exceptions, concentrations of most metals and metalloids were low and below the CCME PAL guidelines selected for this assessment:

- Aluminum concentrations exceeded CCME PAL guideline (0.1 mg/L) in Anderson Creek in 2011, 2013, 2014 and 2015. The highest aluminum concentrations were reported in June 2014 (0.778 mg/L), which more than doubled from the previous sampling event and were more than three times (3x) the 2011 levels.
- Cadmium concentrations exceeded CCME PAL guideline (0.000075 mg/L) in 2011, 2014 and 2015. 2014 showed levels more than five times (5X) the CCME PAL and 10 times (10x) 2011 and 2012 levels.
- Copper exceeded CCME PAL guideline (0.004 mg/L) in 2011, 2013, 2014 and 2015. June 2014 reported the highest concentrations among sample events with concentrations more than five times (5X) the CCME PAL guideline and more than 10 times (10x) higher than fall 2013 levels.
- Iron concentrations exceeded CCME PAL guideline (0.3 mg/L) in 2011, 2013, 2014 and 2015. The highest concentration was 0.96 mg/L reported in June 2014.
- All lead samples collected in June 2014 exceeded the CCME PAL guideline (0.007 mg/L). These levels increased by at least forty times (40x) from October 2013 levels and have dropped back to low levels in 2015.
- Selenium concentrations exceeded CCME PAL guideline (0.001 mg/L) in May 2011 at one sample location, June 2012, one sample in June 2013, at all sample locations in June 2014, two sample locations in September 2014 and all locations in 2015. The highest recorded exceedance was 0.0035 mg/L in June 2015.
- Zinc levels in water samples exceeded CCME PAL guideline (0.03 mg/L) in all water samples collected in all sampling events, except October 2013, where one sample was slightly below guidelines. Total zinc concentrations increased by 91% at each of the sampling locations in Anderson Creek in June 2014 when compared to October 2013 levels and remained greater than five times (5X) CCME PAL guideline in 2015.

Relative concentrations of total metals (to the detection limit) show no consistent trend with increasing distance from PR 392.

*5.3.3.2.3 Water Quality in Anderson Bay of Wekusko Lake*

In 2011, where water temperatures were measured at two different depths, 0.25 m and 0.1 m, Anderson Bay was not thermally stratified. Water temperatures ranged from 8.3°C to 13.0°C in May and from 11.4°C to 14.6°C in September 2011. In June 2013, 2014 and 2015, water temperatures were slightly warmer, with surface temperatures ranging from 15.7°C to 18.0°C. In both spring and fall 2011 to 2015, the water was well-oxygenated. Anderson Bay was alkaline with field-measured pH reaching as high as 9.45 in the fall of 2011, but typically has neutral pHs of 6.97 to 7.87 in subsequent years. In 2011, two laboratory measured pH values were outside the CCME PAL guideline range of 6.5 to 9.0 and one of the two pH values were outside the MMER range of 6.0 to 9.5. According to the CCME classification scheme for lake trophic status based on total phosphorus concentrations, Anderson Bay was considered *meso-eutrophic* in 2011 to 2013 and *mesotrophic* in 2014 and 2015 (**Table 5-4**). .

Some variability in water quality was observed within Anderson Bay, with inshore stations showing higher levels of some parameters, including dissolved solids, chloride, and sulfate. Overall, there were no consistent differences in limnological parameters between spring and fall.

As noted above, all of the water quality studies undertaken by AECOM from 2011-2015, no sample exceeded any criterion specified for measurement in Schedule 4 to the MMER. Concentrations of most metals and metalloids were low and below the CCME PAL guidelines that were selected for this assessment. However, exceedances of aluminum, arsenic and iron have been reported in Anderson Bay.

- Aluminum exceeded CCME PAL guideline (0.1 mg/L) at 8 sampling location in spring 2011 but only at 2 in fall 2011. Aluminum also exceeded in 2013 and 2014 at the two long term monitoring sites.
- Arsenic exceeded CCME PAL guideline (0.005 mg/L) at one sampling location in 2015.
- Iron exceeded CCME PAL guideline (0.3 mg/L) at AND-01A in spring 2011, spring 2013 and fall 2013 but has been below guidelines in 2014 and 2015.

For the above-noted parameters (i.e. Aluminum, Arsenic and Iron), given that the water concentrations in Anderson Creek were within the normal range, it does not appear that the higher concentrations in Anderson Bay could be caused by the discharge from the TIA.

*5.3.3.2.4 Characterization of Water Quality at the Anderson TIA Discharge Point Compared to Downstream Receiving Waterbodies*

Discharge from the Anderson TIA flows through a perched discharge pipe that acts as the primary source of water flow for Anderson Creek. HBMS has collected and tested water samples at the final discharge point from the TIA, since May of 1981. The approximately 37 years of data collected by HBMS at the final discharge point is displayed in graphs contained in **Appendix C (Figures 12 to 19)**. No sample taken by HBMS at the final discharge point over the 37 year record, or taken by AECOM at any sample location within the TIA during the course of the study has ever exceeded an MMER limit.

**Appendix C** also contains graphs for the years 2012-2015, which compare the water quality of the samples collected by HBMS at the final discharge point with the water quality of the samples collected by AECOM at the eastern most sampling location in the TIA and in the waterbodies downstream of the final discharge point (Anderson Creek and Anderson Bay of Wekusko Lake).

This section discusses any observations that can be drawn from comparison of the data for those four years and also considers any trends that may be observable over the approximately 37 year record of data. The analysis included consideration of both MMER limits and CCME PAL guidelines.

HBMS monitors lead, nickel, cadmium, manganese and mercury, and also arsenic, copper, iron and zinc. Concentrations of a lead, nickel, cadmium, manganese and mercury, in a majority of the samples collected

over the 37 year records are below the detection limits needed for analysis. Therefore, it is not possible to observe trends in these parameters, except to note that concentrations have remained well below the MMER limits.

For the following parameters, it is possible to observe and comment on trends:

- Arsenic (**Appendix C Figure 12 and 13**).
- Copper (**Appendix C Figure 14 and 15**).
- Iron (**Appendix C Figure 16 and 17**).
- Zinc (**Appendix C Figure 18 and 19**).

Arsenic has periodically risen above the CCME PAL, but has remained below the MMER limit throughout the 37 year record. It has been relatively steady since 1981, with concentrations typically below 0.01 mg/L which is well below the MMER limit of 1.0 mg/L (**Appendix C** on **Figure 12**). The most recent spikes in arsenic concentration in the discharge occurred during the spring of 2015. During June 2015, corresponding increases in arsenic above the CCME PAL guideline were also observed in the TIA discharge and Anderson Bay; however, given that the water concentrations in Anderson Creek were within the normal range, it does not appear that the higher concentrations in Anderson Bay could be caused by the discharge from the TIA (**Appendix C** on **Figure 13**). Arsenic concentrations continue to follow seasonal variation but appear to be on a downward trend since 2012.

Copper concentrations in the TIA discharge frequently exceed the CCME PAL guideline but have never exceeded MMER (**Appendix C** on **Figure 14**). The copper concentration in the TIA discharge has risen above the CCME PAL guideline on a regular basis since approximately 1987. The most recent spikes in the data occurred during both 2014 and 2015 when similar concentrations were observed during in the water samples collected in the TIA and Anderson Creek. However, samples collected from Anderson Bay of Wekusko Lake have been consistently below the CCME PAL guideline (**Appendix C** on **Figure 15**). Copper concentrations appear to be declining since the peak seen in 2014.

Iron has only been monitored in the discharge since May of 1995. Over that time, the iron concentration in the TIA discharge has periodically exceeded the CCME PAL guideline but not the MMER limit (**Appendix C** on **Figure 16**). There were CCME PAL guideline exceedances in Anderson Creek and Anderson Bay during the 2013 sampling events. The concentration of iron in the TIA discharge was lower than that the concentration measures in the samples collected from the Anderson Creek and Anderson Bay and therefore an alternate source of iron may be the cause. Elevated concentrations of iron in Anderson Creek and the TIA discharge appear correlated in 2014 and 2015. Iron concentrations appear to be declining since the peak seen in 2014.

The zinc concentration in the TIA discharge has been higher than the CCME PAL guideline on a regular basis since 1981 but has never exceeded MMER limit (**Appendix C** on **Figure 18**). In general, the concentration of zinc has been consistently observed to be above the CCME PAL guideline in the TIA and in Anderson Creek but has remained below the CCME PAL guideline in Anderson Bay (**Appendix C** on **Figure 19**). Zinc concentrations appear to be declining since the peak seen in 2014

Overall, data indicates that periodically the concentration of metals has risen above the CCME PAL guideline during the approximately 37 years of discharge from the TIA, but has remained well below the MMER limit at all times. Overall, the water sampling dataset from the TIA, Anderson Creek and Anderson Bay (2012 – 2015) indicates that, although at times the concentration of metals in Anderson Creek may exceed a CCME guideline, those guidelines generally are not exceeded in the downstream receiving body, Anderson Bay of Wekusko Bay. The exception to this statement is the concentration of arsenic found in Anderson Bay during June 2015, which is not attributable to discharge from the TIA.

*5.3.3.2.5 Analysis of Recent Water Quality Conditions and HBMS Planning for Continuous Improvement in Water Quality Management*

Throughout the 37 year life of the TIA, there has been a seasonal pattern to water quality in discharge from the TIA, with higher metal concentrations observed in summer and late fall and lower metal concentrations observed in spring and early fall, although all within the MMER limits. Also some years in the 37 year record have displayed higher concentrations of metals measured than in others. The years 2012 and 2013 represent historic lows in metal concentrations measured at the final discharge point**. Figures 18** and **19** in **Appendix C** show both the seasonal pattern and trends over the 37 year record.

In 2014 and 2015, HBMS noted higher metals concentrations, in particular zinc, measured at the final TIA discharge point, when compared to the data from the previous two years (although still within the historic 37 year range). In the data taken to date for 2016, however, the zinc concentration has reduced to half the concentration it was in 2015. This pattern is evident on the graph shown in **Appendix C** on **Figure 19**.

In 2014, although all parameters, including zinc, were still below the MMER limits, HBMS sought to explain and restore, if possible, water quality to the levels observed in the more recent record. HBMS considered the increase and attempted to identify measures to reduce zinc levels in the discharge. HBMS took into consideration that the capacity to treat tailings in the TIA could be diminishing as the volume of tailings approaches maximum capacity. If that is the case, the TIA expansion will increase the volume of water and provide for continued effective management of the tailings.

As well, it was understood that increasing recovery rates at the Stall Concentrator would reduce the volume of metals in tailings entering the TIA. HBMS is implementing this measure by ensuring that effective management and training practices are in place and that the most highly skilled and knowledgeable employees are in charge of processing the ore. There has been a shift in 2016 in the management and staffing at the Concentrator to ensure this is consistently maintained.

Further, innovation in the form of GPS monitoring and mobile real time bathymetric surveys are now being used to verify that the deposition plan developed in the office is feasible on site. Deposition of heavy tailings often displaces the naturally occurring lighter, organic material on the bottom of the TIA so while the previous analysis may have identified a deep hole for tailing deposition, adjacent deposition may have displaced natural substrate into this location. By conducting on-site reconnaissance prior to moving discharge pipes, suitable locations for discharge can be selected as opposed to just following the established plan. This flexibility to modify the deposition plan is crucial to proper tailings management.

Finally, it was noted that, as the tailings pipeline discharge point moved further to the east within the TIA, there was an increase in metals concentrations in the water discharged from the TIA. The deposition area used in 2014 was in a long, open area with a large fetch, which is the length of water over which wind blows. It may be that the high wind action resulted in increased mixing of tailings in the water column. Therefore, starting late 2015 and into early 2016, the tailings pipeline was relocated to a more sheltered location. This appears to have resulted in a noticeable decrease in metals concentrations in TIA water discharge.

HBMS has indicated that it is committed to proper management of tailings to prolong the life of the TIA. In AECOM's opinion, HBMS has the skill, expertise and ability to modify their deposition and processing plans to ensure that tailings management is conducted in such a way that metal concentrations in TIA effluent continue to meet MMER limits. AECOM believes that with commitment to proper tailings management, water quality discharging from the TIA should continue to improve and stabilize.

*5.3.3.2.6 Summary of EEM Water Quality Results*

The EEM study completed in 2011 concluded that monthly effluent monitoring data provided by HBMS, which included pH, arsenic, copper, lead, nickel, zinc, total suspended solids, radium 226 and flow rate as required under the MMER, were within the maximum monthly mean concentrations allowable under the Regulation.

Ten grab samples were collected from the Exposure Area (Anderson Bay) and Reference Areas (Goose Bay and Tramping Lake, both of which are outside the Project Region). Surface water concentrations of conductivity, hardness, total aluminum, calcium, cadmium, copper, iron, zinc, potassium, selenium, sodium and sulfur concentrations were higher in the Anderson Bay when compared to Goose Bay and Tramping Lake and aluminum and zinc were above CCME PAL guidelines in Anderson Bay. Aluminum levels in Anderson Bay had much higher concentrations than the TIA effluent, suggesting a non-point-source of contamination could be present. Dissolved metal concentrations of potassium, rubidium, selenium, sodium, strontium and sulfur significantly differed in Anderson Bay relative to the Goose Bay and Tramping Lake. Mercury concentrations in Goose Bay exceeded both the CCME PAL guidelines and MMER, however it was concluded that due to the decaying vegetation and being surrounded by a low lying and marshy flood plain likely caused the relatively high mercury concentrations. Anderson Bay had the lowest mercury concentration and was well below the CCME PAL guideline.

In general, these studies have indicated the presence of elevated metals in the water in Anderson Bay compared to the reference area, Tramping Lake. However, only zinc and aluminum have been detected above CCME criteria (which is not uncommon in rivers and lakes located throughout Canada). Taken alone, the presence of zinc and aluminum in excess of the CCME criteria is not an indicator of any significant impact from mining activities.

Detailed methodology, results and discussion of the EEM study can be found in:

- Metal Mining Environmental Effects Monitoring Snow Lake Mill/Anderson Tailings Initial Monitoring Program Final Report (Stantec Consulting Ltd., 2005a).
- Metal Mining Environmental Effects Monitoring Anderson Tailings Periodic Monitoring Program Final Report (Stantec Consulting Ltd., 2008a).
- Metal Mining Environmental Effects Monitoring Anderson Tailings Focused Monitoring Program Final Report (Stantec Consulting Ltd., 2010a).
- Metal Mining Environmental Effects Monitoring Anderson Tailings Impoundment Area Discharge, Investigation of Cause Program Final Report (Stantec Consulting Ltd., 2012).

## 5.3.4 Sediment Quality

In spring and fall of 2011, AECOM collected sediment samples from Anderson Bay of Wekusko Lake and Anderson Creek, and in 2012, AECOM collected sediment samples from only Anderson Creek. In this assessment of sediment quality, AECOM considered the results of these samples together with the results of samples and conclusions drawn by Stantec in EEM studies carried out on behalf of HBMS in accordance with requirements of the MMER. This section sets out a summary of the results of the AECOM sampling program and overall conclusions about sediment quality based upon both AECOM's sampling program and the EEM studies.

### *5.3.4.1 Approach to AECOM Sediment Quality Sampling Programs*

The sediment samples were analyzed for the following parameters:

- Total metals.
- Total mercury.
- Nutrients (*i.e.,* phosphorous, nitrogen and total organic carbon).

- Moisture.
- Particle size.

Sediment quality data were compared to the CCME Canadian Soil Quality 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). Sediments with measured chemical concentrations equal to or lower than ISQG are considered by the province to be acceptable quality. Sediments with measured chemical concentrations between the ISQG and the PEL are considered by the province to represent potential hazards to exposed organisms. Sediments with a measured chemical concentration equal to or greater than the PEL are considered to represent significant and immediate hazards to exposed organisms by the province.

Detailed methodology, results and discussion of sediment sampling can be found in:

- Proposed Lalor Mine Environmental Baseline Assessment (AECOM, 2012c).
- Lalor Mine Environment Act Proposal Report (AECOM, 2012d).
- Baseline Water and Sediment Quality Assessment at Anderson Creek (AECOM, 2013b).
- Lalor Concentrator Environment Act Proposal (AECOM, 2013c).
- Proposed Lalor Concentrator Environmental Baseline Assessment (AECOM, 2013e).

### *5.3.4.2 Summary of Sediment Quality Sampling Program Results*

This section sets out the results of the AECOM sediment sampling program and briefly describes the Stantec EEM sediment sampling results.

#### *5.3.4.2.1 Anderson Creek*

AECOM submitted all three replicates from two sample locations in both spring and fall of 2011 and three replicates from one sample location in spring 2012 (15 samples in total).

- Sediment samples were collected for grain size analysis in both spring and fall. All samples were classified as clay and had clay content ranging from 51.6% to 70.0%, silt content ranging from 12.5% to 20.6%, and sand ranging from 17.0% to 27.8%.
- Arsenic concentrations ranged from 40.9 mg/kg to the lowest of 4.66 mg/kg in September 2011. Only one sample exceeded arsenic PEL.
- Cadmium concentrations were highest at 3.72 mg/kg. The cadmium PEL was exceeded at one sampling location and ISQG were exceeded at two locations.
- All mercury concentrations were below laboratory detection limits.
- The highest chromium concentration from a sample location was 92.9 mg/kg. As the sample locations approached PR 392 and the Anderson TIA discharge, chromium concentrations increased. The chromium ISQG was exceeded in all samples and the chromium PEL was exceeded in two samples in May 2011 and June 2012 respectively.
- The copper ISQG was exceeded in two or more replicates from each sample location in 2011 and 2012. The PEL guideline was not exceeded.
- Average lead and zinc concentrations in samples also increased as sample locations approached PR 392 and the Anderson TIA discharge. Lead concentrations ranged from 10.5 mg/kg to 39.5 mg/kg (only one sample at 39.5 mg/kg was recorded which exceeded lead ISQG). The highest zinc concentration was 1,860 mg/kg, with one or more replicates from each sample location having exceeded zinc ISQG. As well, one or more replicates also exceeded both lead and zinc PEL in two locations.

*5.3.4.2.2 Anderson Bay of Wekusko Lake*

Three replicates from ten sample locations in both spring and fall 2011 from Anderson Bay were submitted for laboratory analysis (60 samples in total). Analytical results for the sediments at Anderson Bay were compared against the ISQG and PEL.

- Sediment samples were collected for grain size analysis in both spring and fall. Samples were primarily composed of silt and clay and described as clay, silty clay, silty clay loam and silt loam.
- The majority (70%) of arsenic concentrations were between the ISQG (5.9 mg/kg) and PEL (17.0 mg/kg) sediment guidelines. The lowest concentration of arsenic was 4.00 mg/kg while the highest arsenic concentration recorded was 23.3 mg/kg.
- For chromium, 90% of samples exceeded ISQG, but, none exceeded PEL (90 mg/kg). Chromium concentrations ranged from 18.9 mg/kg to 78 mg/kg.
- For copper, 57% of samples exceeded the ISQG, but none exceeded PEL. In general, increased copper concentrations were observed in sample locations closer to the north end of Anderson Bay and concentrations decreased as sample locations extended further into Wekusko Lake.
- All cadmium samples were below PEL (3.5 mg/kg).
- Lead concentrations were well below both the PEL and ISQG. The highest concentration observed was 17.7 mg/kg and lowest concentration was 4.75 mg/kg.
- The highest zinc concentrations were reported at 1,070 mg/kg and lowest at 31 mg/kg. The stations closest to the outflow of Anderson Creek have zinc concentrations above ISQG (123 mg/kg) and PEL (315 mg/kg). Stations extending further into Wekusko Lake have zinc concentrations above ISQG but below PEL.

*5.3.4.2.3 Summary of EEM Sediment Quality Results*

As reported in the EEM study in 2011, laboratory analysis indicated concentrations of arsenic, cadmium, copper and zinc in the sediment were elevated in the Exposure Area (Anderson Bay) when compared to Reference Areas Goose Bay and Tramping Lake (both of which are outside the Project Region). Zinc was the only parameter that exceeded the PEL in Anderson Bay. Mean total organic carbon was similar in Tramping Lake and Anderson Bay, but concentrations were much lower in Goose Bay (Stantec, 2012).

Detailed methodology, results and discussion of the EEM study can be found in:

- Metal Mining Environmental Effects Monitoring Snow Lake Mill/Anderson Tailings Initial Monitoring Program Final Report (Stantec Consulting Ltd., 2005a).
- Metal Mining Environmental Effects Monitoring Anderson Tailings Periodic Monitoring Program Final Report (Stantec Consulting Ltd., 2008a).
- Metal Mining Environmental Effects Monitoring Anderson Tailings Focused Monitoring Program Final Report (Stantec Consulting Ltd., 2010a).
- Metal Mining Environmental Effects Monitoring Anderson Tailings Impoundment Area Discharge, Investigation of Cause Program Final Report (Stantec Consulting Ltd., 2012).

In general, these studies have indicated the presence of elevated metals in the sediment in Anderson Bay compared to the reference area, Tramping Lake. However, only zinc and aluminum have been detected above CCME criteria (which is not uncommon in rivers and lakes located throughout Canada, and particularly in areas with zinc and aluminum rich substrates). The EEM studies concluded that, taken alone, the presence of zinc and aluminum in excess of the CCME criteria is not an indicator of any significant impact from the discharge out of the TIA. AECOM sediment sampling programs results support the EEM conclusion. AECOM assesses therefore that discharge from the TIA is not impacting the sediment quality in Anderson Bay.

## 5.3.5 Lower Trophic Level Biota

AECOM completed a study of aquatic invertebrate diversity and community composition in order to evaluate potential downstream impacts from discharge from the TIA. Lower trophic level biota includes phytoplankton, zooplankton and benthic invertebrates. There are no provincial regulatory requirements for evaluating impacts to lower trophic level biota in the receiving environment so standard analysis of community structure was completed.

This section sets out a summary of the results of the AECOM sampling program and overall conclusions about lower trophic level biota based upon both AECOM's sampling program and the EEM studies.

### *5.3.5.1 Approach to AECOM Lower Trophic Level Biota Sampling Program*

Phytoplankton, zooplankton, and benthic invertebrate samples were collected from Anderson Creek and Anderson Bay of Wekusko Lake. Samples were then submitted to ALS for taxonomic identification and enumeration. Analysis of presence/absence and abundance was completed.

Detailed methodology, results and discussion of sampling can be found in:

- Lalor Concentrator Environment Act Proposal (AECOM, 2013c).
- Lalor Mine Environment Act Proposal Report (AECOM, 2012d).
- Proposed Lalor Concentrator Environment Baseline Assessment (AECOM, 2013e).
- Proposed Lalor Mine Environmental Baseline Assessment (AECOM, 2012c).

### *5.3.5.2 Summary of Lower Trophic Level Biota Sampling Program Results*

This section sets out the results of the AECOM lower trophic level biota sampling program and briefly describes the Stantec EEM lower trophic level biota sampling results.

*5.3.5.2.1 Anderson Creek*

*Phytoplankton*: Phytoplankton samples for taxonomic identification were collected at one station in Anderson Creek. The analytical laboratory identified nine classes of phytoplankton in the sample collected, with Fragilariophyceae (pennate diatoms) as the most abundant ($8.1 \times 10^5$ n/L) and Chrysophyceae (yellow-green algae) as the second most abundant ($5.1 \times 10^5$ n/L). Euglenophyceae (flagellates) were found to be the least abundant phytoplankton class ($2.0 \times 10^3$ n/L).

*Zooplankton*: One zooplankton sample was submitted from Anderson Creek. The percentage of individuals that were either damaged, too young to identify or unidentified to species was 0.5%. The analytical laboratory identified 17 species in three classes. Monogononta (rotiferans) was the most abundant zooplankton class (70.3 n/L). Not including the unidentified species, the total number of zooplankton species identified was 73.7 n/L.

*Benthic Invertebrates*: Six orders of benthic invertebrates were identified in the samples collected in Anderson Creek. The dominant order identified was Veneroida (bivalves), specifically the Pisiidae family and including the unidentified species. Veneroida accounted for 23% of the total density in Anderson Creek. Total density was 86 n/$m^2$. Family richness was fairly low, with values of 2-3. Evenness values were 0.89 and 1.00. The SDI values for the two samples were 0.63 and 0.50 respectively. There were no Ephemeroptera-Plecoptera-Tricoptera (EPT) taxa and no unidentified organisms in the samples collected.

*5.3.5.2.2 Anderson Bay of Wekusko Lake*

*Phytoplankton*: Phytoplankton samples for taxonomic identification were collected in Anderson Bay. The analytical laboratory identified nine classes of phytoplankton in samples collected, with Chrysophyceae (yellow-green algae) as the most abundant in both spring and fall in Anderson Bay (1.4 x $10^6$ n/L and 3.4 x $10^6$ n/L respectively). In the fall, Euglenophyceae (flagellates) and Dinophyceae (dinoflagellates) tied for being the least abundant overall (2.0 x $10^3$ n/L). Phytoplankton abundance was highest in the fall as compared to spring, three times more, corresponding to higher primary productivity in fall. Seasonal changes in primary productivity, competition and/or water physiochemistry (*e.g.*, temperature, total suspended solids) can cause shifts in phytoplankton community structure and abundance.

*Zooplankton*: One zooplankton sample was submitted from each of two sampling stations in spring and fall from Anderson Bay. The percentage of individuals that were either damaged, too young to identify or unidentified to species was 5.1% in the spring and 0.8% in the fall. The analytical laboratory identified 18 species in four classes and a fifth class was identified (Rotifera), but not to species. Monogononta (5.8 n/L in spring and 137.8 n/L in fall) was the most abundant zooplankton class in spring and fall. Of the classes identified, Branchiopoda was the only class that was identified in the fall and not in the spring. Including the unidentified species, the total number of zooplankton species identified in the spring was 8.3 n/L and in the fall was 202.1 n/L.

*Benthic Invertebrates*: In total, there were 17 orders of benthic invertebrates identified in the samples collected in Anderson Bay. The dominant order identified was Diptera (true flies), specifically the Chironomidae family (non-biting midges). Diptera accounted for 38% of the total density of the benthic invertebrate community (BIC) identified in Anderson Bay. Family richness ranged from 6 to 16 and the highest density recorded was 4,353 n/$m^2$. Evenness ranged from 0.22 to 0.71. The most diverse community had an SDI value of 0.83. The station with the lowest diversity had an SDI value of 0.47 (located near the centre of Anderson Bay, on the east side). EPT taxa were present in low numbers, ranging from 0% to 12%.

*5.3.5.2.3 Lower Trophic Level Biota Summary*

There are approximately 1.6 times more species diversity of phytoplankton in Anderson Bay (25 species) in spring than in Anderson Creek (16 species) and Anderson Bay has approximately 1.3 times more total abundance than Anderson Creek (Anderson Bay = 2.0 x $10^6$ n/L; Anderson Creek = 1.6 x $10^6$ n/L: **Table 5-5** ). However, phytoplankton community structure and abundance is dependent on water flow (*i.e.,* creek versus lake), competition and/or water physiochemistry (*e.g.*, temperature, total suspended solids) and therefore the Anderson Creek and Anderson Bay samples cannot be directly compared.

**Table 5-5: Aquatic Invertebrate Abundance, Diversity and Dominant Class in Anderson Bay and Anderson Creek**

| Waterbody | Phytoplankton Total Abundance (x $10^6$ n/L) | | Zooplankton Total Abundance (x $10^6$ n/L) | | Benthic Invertebrate Average Total Density (n/$m^2$) |
|---|---|---|---|---|---|
| | Spring | Fall | Spring | Fall | Fall |
| Anderson Bay | 2.0 | 7.4 | 8.3 | 202.1 | 2,862 |
| Anderson Creek | 1.5 | - | 74.1 | - | 86 |

The zooplankton in Anderson Creek (74.1 x $10^6$ n/L) was approximately nine times more abundant than Anderson Bay (8.3 x $10^6$ n/L) in spring. Total diversity of zooplankton was also higher in Anderson Creek in spring compared to Anderson Bay and in fall, Anderson Bay had higher diversity than Anderson Creek spring values. Monogononta was the dominant class for both Anderson Creek and Anderson Bay.

Across all sample locations, Anderson Bay (2,862 n/m²) had 33 times more average benthic invertebrate density than Anderson Creek (86 n/m²) and close to three times the number of orders than Anderson Creek (Anderson Bay = 17, Anderson Creek = 6). Evenness of benthic invertebrates in Anderson Creek was highest (0.94) compared to Anderson Bay (0.43), due to the low number of family richness in Anderson Creek (2.5) over Anderson Bay (9.7). Anderson Bay (SDI = 0.71) was more diverse than Anderson Creek (SDI = 0.56) and Anderson Creek had no EPT taxa, where Anderson Bay had 4% EPT over all stations.

Overall, Anderson Bay had more species diversity and density of benthic invertebrates. Lower EPT, species diversity and density can be caused by lower water and sediment quality; however, substrate composition, competition and/or water physiochemistry (*e.g.,* temperature, total suspended solids) can cause shifts in community structure and abundance.

*5.3.5.2.4 Summary of EEM Lower Trophic Level Biota Results*

Detailed methodology, results and discussion of the EEM study can be found in:

- Metal Mining Environmental Effects Monitoring Snow Lake Mill/Anderson Tailings Initial Monitoring Program Final Report (Stantec Consulting Ltd., 2005a).
- Metal Mining Environmental Effects Monitoring Anderson Tailings Periodic Monitoring Program Final Report (Stantec Consulting Ltd., 2008a).
- Metal Mining Environmental Effects Monitoring Anderson Tailings Focused Monitoring Program Final Report (Stantec Consulting Ltd., 2010a).
- Metal Mining Environmental Effects Monitoring Anderson Tailings Impoundment Area Discharge, Investigation of Cause Program Final Report (Stantec Consulting Ltd., 2012).

The EEM study completed by Stantec in 2011 concluded that the community-based (effects-based EEM endpoints) showed a significant difference in the SDI between the Exposure Area (Anderson Bay) and Reference Areas (Tramping Lake and Goose Bay, both of which are outside the Project Region); however, the remaining 'effect' indices did not indicate any effects from the Anderson TIA discharge on benthic communities in the Exposure Areas. These findings are consistent with the data presented as relative proportions of taxonomic groups. The Bray-Curtis Index was calculated for benthic data collected during previous EEM studies (2005, 2008, 2010) and showed an effect. However, subsequent recalculation of the Bray-Curtis Index (Huebert, 2011) revealed that the Bray-Curtis Index was not triggered. None of the benthic endpoints from the first two monitoring studies showed an effect and the conclusion was that benthic monitoring was not actually required during the Focussed Monitoring (Stantec, 2012).

As a result of the EEM study, habitat quality based on the relative sensitivity of organisms to eutrophication and anthropogenic effects on water quality were determined to be virtually identical between Reference and Near-Field Exposure Areas, concluding that the Anderson TIA outfall resulted in no noticeable impacts on receiving benthic communities. Anderson Bay and Berry Bay currently support a diversity of benthic organisms, similar to Tramping Lake. Despite Anderson Bay and Berry Bay's intermittent exposure to the Anderson TIA effluent (0-5%) and slightly elevated iron and aluminum concentrations in the surface water and increased metals in sediment, there were no reported biological impacts on benthic invertebrate communities in the Exposure Areas compared to Tramping Lake.

## 5.3.6 Fish and Fish Habitat

To assess fish and fish habitat for the proposed expansion of the Anderson TIA, AECOM considered the results of baseline assessments carried out in 2011 and 2012 in relation to the potential future development of Lalor Mine,

additional work carried out by AECOM in 2015 and the results of EEM studies performed by Stantec on behalf of HBMS in accordance with requirements of the MMER. This section describes each of these studies.

### *5.3.6.1 Baseline Assessments of Fish and Fish Habitat in the Project Region*

Environmental baseline aquatic assessments conducted by AECOM in 2011 and 2012 assessed the fish community composition in 13 waterbodies in a broad region identified as relevant for the future potential Lalor Mine.

The detailed methodology, results and discussion of these fish and fish habitat baseline studies can be found in:

- Lalor Concentrator Environment Act Proposal (AECOM, 2013c).
- Lalor Mine Environment Act Proposal Report (AECOM, 2012d).
- Proposed Lalor Concentrator Environment Baseline Assessment (AECOM, 2013e).
- Proposed Lalor Mine Environmental Baseline Assessment (AECOM, 2012c).

This section briefly describes the baseline studies of fish and fish habitat for those waterbodies which are downstream of Anderson TIA and which therefore could be relevant to the assessment of continued operation of Anderson TIA. These waterbodies are Anderson Creek, Anderson Bay of Wekusko Lake and Goose Bay of Wekusko Lake, which is outside the Project Region and is used as a reference location.

#### *5.3.6.1.1 Approach to the AECOM Fish and Fish Habitat Program*

Fishing effort included standard gang gill nets, a small gang gill net and minnow traps in Anderson Bay. The studies examined seasonal differences and variability of the fish in the Project Region.

Fish species known to be present in the Nelson River Watershed, where the Project is located, are listed in **Table 5-6**. These are the species anticipated to be present within the Project Region. Therefore these were the species that fishing efforts were designed to capture. Habitat assessments were completed with these species' requirements in mind.

**Table 5-6: Fish Species Known to be Present in the Nelson River Watershed**

| 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* | O |
| | 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* | N Rare |
| **Esocidae** | Northern Pike | *Esox lucius* | N |
| **Umbridae** | Central Mudminnow | *Umbra limi* | O |
| **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 |
| **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* | O |
| | 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.*

*Notes: N=Native species in the watershed; I=The species was introduced to the watershed; O=Unknown from the watershed*

*5.3.6.1.2 Summary of Fish Community*

This section briefly describes the results of the baseline fish sampling program in Anderson Creek and Anderson Bay of Wekusko Lake.

5.3.6.1.2.1 Anderson Creek

Three minnow traps, three electrofishing transects and one dip net was used in Anderson Creek during the baseline study. In total, 215 individuals, representing four fish species, were captured. The fish species captured

were Brook Stickleback, Fathead Minnow, Iowa Darter and Pearl Dace. Brook Stickleback represented 60% of the fish caught and Pearl Dace represented 38% of the fish caught.

Pearl Dace, in spawning condition, and large schools of young-of-year Brook Stickleback were observed in Anderson Creek. Although most fish captured were in good health, there was a general occurrence of a black spot parasite, infesting Brook Stickleback. Black spot parasite is common in earthen bottom waterbodies. As this parasite requires piscivorous birds, snails and fish to complete its life cycle, its presence indicates a healthy ecosystem. In general, the presence of this parasite in a fish does not affect its growth or survival.

Brook Stickleback was selected as a representative species to demonstrate trends in condition, length, and weight between Anderson Creek and Anderson Bay of Wekusko Lake.

5.3.6.1.2.2 Anderson Bay of Wekusko Lake

In spring 2011, two standard gang gill nets, one small gang gill net and seven minnow traps were deployed in Anderson Bay. In fall 2011, one standard gang gill net and one small gang net were utilized and in summer 2012, two small gang gill nets and four minnow traps were deployed in Anderson Bay during the baseline study. A total of 941 individuals, which represented 15 species, were captured in Anderson Bay. In 2011, the most commonly caught species in Anderson bay was Brook Stickleback, followed by Yellow Perch and Fathead Minnows. The most common species caught in 2012 was Brook Stickleback, followed by Emerald Shiner and Yellow Perch.

5.3.6.1.2.3 Summary of Anderson Creek and Anderson Bay of Wekusko Lake Fish Communities

Brook Stickleback was selected as a representative species to demonstrate trends between Anderson Creek and Anderson Bay of Wekusko Lake in condition, length, and weight (**Table 5-7**). Brook Stickleback from Anderson Bay had higher mean length and weight (52 mm and 0.90 g, respectively), but had a lower average condition factor (0.64 g/mm³) than Brook Stickleback from Anderson Creek (0.67 g/mm³). The lower condition factor of Brook Stickleback in Anderson Bay may be due to higher predation of larger fish in the Lake causing higher stress in the fish, resulting in fish that are less plump. The predation levels in Anderson Creek would likely not exist to the same extent as in Anderson Bay, allowing the Brook Stickleback in Anderson Creek to have higher condition factor.

**Table 5-7: Summary Statistics for Brook Stickleback in Anderson Bay and Anderson Creek, 2011-2012**

| Waterbody | Length (mm) | | | | Weight (g) | | | | Condition Factor (g/mm³) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | n | Min | Max | Mean | n | Min | Max | Mean | n | Min | Max | Mean |
| **Anderson Bay (in Wekusko Lake)** | 111 | 39 | 65 | 52.4 | 111 | 0.1 | 1.9 | 0.92 | 111 | 0.07 | 1.35 | 0.64 |
| **Anderson Creek** | 143 | 20 | 65 | 40.9 | 143 | <0.1 | 1.8 | 0.60 | 143 | 0.06 | 1.31 | 0.67 |

*Notes: mm = millimetre; g = gram; n = count; Min = minimum; Max = maximum. Where weight is <0.1 g, a value of 0.1 g is used for mean calculations.*

In general, Brook Stickleback captured in Anderson Bay were larger (longer and heavier) than those captured in Anderson Creek. However, Anderson Creek had higher mean condition factor values than those captured in Anderson Bay. Larger fish observed in Anderson 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).

5.3.6.1.2.4 Goose Bay of Wekusko Lake

Goose Bay was sampled in the fall 2011 and summer 2012 in order to provide an opportunity for comparative analysis on fish health and condition. Goose Bay is located south of Anderson Bay within Wekusko Lake (outside the Project Region). 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. Brook Stickleback were not captured in Goose Bay.

White Sucker fork length, River Shiner weight, and Yellow Perch fork length and condition were greater in Goose Bay in comparison with Anderson Bay. 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).

*5.3.6.1.3 Summary of Fish Habitat*

This section briefly describes the results of the baseline fish habitat assessments. These habitat assessments were conducted concurrently with fish sampling programs in in Anderson Creek and Anderson Bay of Wekusko Lake. Additionally, in 2012, in contemplation that one option for future development could involve expansion of the Anderson TIA, AECOM completed a shoreline assessment on the Anderson TIA and a stream crossing assessment along the potential dike alignments, including the spillway, which are now included in the project description set out in **Chapter 3**.

Habitat indicators, including physical habitat variables (depth, flow, cover, etc.), connectivity to fish bearing waters and water quality (pH, dissolved oxygen) were considered in the evaluation for fish habitat following guidance in DFO (1998). Watercourses provided **Critical**, **Important**, **Marginal** or **No Fish Habitat** as follows:

**Critical Habitats** are rare or unique habitats that support a life stage that is limited to the recruitment of a species, or to the overall productive capacity of a fishery.

**Important Habitats** are those that provide habitat for one or more life stages of one or more fish species, but are not immediately limiting to the fisheries they support. As described by DFO (1998), important habitats include abundant habitat types that are readily available to the local stock. Habitats designated as important may include:

- Habitats in close enough proximity to large, fish-bearing waters, without major barriers to fish passage between habitats.
- Open-water watercourses with cross-sectional areas large enough to carry flows substantively greater than those in the flooded peat fens surrounding them. These watercourses were deemed to have water volumes sufficient to overcome some of the habitat limitations inherent in the smaller headwater fen habitats, although limitations to fish passage were often present in the form of beaver dams.
- Waterbodies that were bordered by vegetated floodplain composed of grasses or other vegetation over mineral soils (as opposed to saturated fen). These habitats were considered to provide potential spawning habitat for Northern Pike.
- Habitats that provided rock substrate. Coarse, hard substrata, generally present only in the larger streams along the pipeline system, provide habitat diversity and possible spawning habitat for species requiring riffle habitats for spawning.

**Marginal Habitats** as described by DFO (1998) have low productive capacity and contribute marginally to fish production. An example is a headwater beaver-pond or fen habitats that have severe limitations to their productivity as fish habitat, and support only a small number of forage species that likely contribute little to the sport and commercial fisheries in the area.

**No Fish Habitat** is described as areas that do not provide one or more of the habitat indictors mentioned above. Such as, habitats that clearly have no fish-passable connection to other open-water habitats are too shallow to

resist freezing solid in winter and have dissolved oxygen concentrations less than approximately 2 mg/L. These habitats include small, isolated pools less than approximately one metre deep, with minimal flow and no beaver lodges present to indicate greater depths.

5.3.6.1.3.1 Shoreline Assessment of Anderson TIA

In 2012, the shoreline of the TIA was surveyed from the water by boat. General habitat observations and photographs were collected. Photographs are attached in **Appendix D**. Shoreline vegetation looks normal for this region. There are few signs of impacts from tailings storage over the years including previous development which resulted in flooded treed areas. It should be remembered that upon designation as a TIA, Anderson Lake ceased to be “fish habitat” in accordance with the *Fisheries Act*.

5.3.6.1.3.2 Stream Crossing Assessment along the Proposed Dike Alignments

The proposed dike alignments around the south-eastern end of the TIA were surveyed on foot between Anderson TIA and PR 392. The only stream crossing along the dike alignment is the existing spillway structure, which consists of a concrete slab that allows water to spill over if the water level in Anderson TIA is high. At the time of the assessment, water was not observed to be flowing from Anderson TIA through the spillway. It did show recent use as there was water pooling in various ponded areas and fish were observed in some of these areas.

The substrate downstream of the spillway was found to be mainly organic with some bedrock present. The vegetation surrounding the channel is largely comprised of grasses and deciduous trees. Ponded areas which contained small fish were sampled with a backpack electro-fisher. Nine Brook Stickleback were collected, but it is unlikely that this channel regularly supports fish, as water is only present in the channel during overflow events. From the spillway structure, the channel dissipates through the forest vegetation. In some locations, there is evidence of water having passed through, but there is no defined channel, fish habitat or cover. The dry path along which water would flow during overflow events connects to a ditch along PR 392 and Anderson Creek. The spillway is assessed to be **No Fish Habitat**.

5.3.6.1.3.3 Anderson Creek

Anderson Creek originates at the Anderson TIA and flows to the east into Anderson Bay of Wekusko Lake. Discharge from the TIA into Anderson Creek is regulated through a decant pipe. The pipe is perched, which creates a barrier to fish passage upstream from Anderson Creek into the TIA. Water flows down a moderately steep bank created by the development of Anderson Dam to impound the TIA. This riffle/run section runs over boulders, fallen trees, gravel, and sand. A large backwater area has developed on the upstream side of the former PR 392. Downstream of the culvert, the channel is uniform in width (1.5 m) and depth (~1.0 m) for approximately 75 m before spreading across a wide floodplain. Near the former PR 392, substrate in the channel is comprised predominantly of sand and gravel, but increases in organic composition downstream. Boulders, overhanging vegetation and woody debris provide cover for fish. When adequate water levels exist, abundant instream and overhanging vegetation provides cover for spawning and foraging by small-bodied species, but use of the area for large-bodied fish is unlikely. Because of the lack of upstream connectivity caused by the perched decant pipe at Anderson Dam, which eliminates access to upstream habitat, this location is assessed as **Marginal** fish habitat.

5.3.6.1.3.4 Anderson Bay of Wekusko Lake

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

*5.3.6.1.4 Summary of Metals in Fish Tissue*

Fishing effort was conducted in June 2012 in Anderson and Goose Bays of Wekusko Lake in order to capture and submit small-bodied fish for metal residue and moisture analysis. Metal residues of whole-body forage fish were compared to *Manitoba Water Quality Standards Objectives, and Guidelines (MWQSOG)* aquatic life tissue residue for human consumption (Williamson, 2011). The use of the human consumption guideline is conservative as the fish being analyzed are forage fish which are not consumed by humans. The two metals with *MWQSOG* include arsenic (3.5 mg/kg) and lead (0.5 mg/kg). Antimony, beryllium, bismuth, lead, lithium, silver, tellurium, thallium, thorium and zirconium were at, or below, detection limits in at least 90% of the fish tested. Lead was detected in only one of the ten samples in Anderson Bay and in one of ten in Goose Bay, with a concentration of 0.042 mg/kg and 0.044 mg/kg respectively, which are well below the *MWQSOG* for aquatic life tissue residue for human consumption of 0.5 mg/kg. Arsenic was detected in all ten fish tissue samples in both Anderson Bay and Goose Bay, with a maximum concentration of 0.326 mg/kg in Anderson Bay and 0.262 mg/kg in Goose Bay, both below the applicable *MWQSOG* of 3.5 mg/kg. Nickel was detected only in four of ten fish (maximum concentration of 0.13 mg/kg) in Anderson Bay and no detections were reported for Goose Bay. Nine of the ten fish had concentrations below the laboratory detection limit in both Anderson Bay and Goose Bay.

**Table 5-8** displays a summary of metal concentrations in fish tissue.

**Table 5-8: Summary Statistics of Fish Meristics and Concentrations of Chemicals of Concern, 2012**

| Waterbody | Parameter | Length (mm) | Weight (g) | Aluminum (mg/kg) | Arsenic (mg/kg) | Cadmium (mg/kg) | Copper (mg/kg) | Iron (mg/kg) | Zinc (mg/kg) |
|---|---|---|---|---|---|---|---|---|---|
| **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 |
| **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 |

## *5.3.6.2 Mercury and Methylmercury in the Project Region*

In contemplation of the shoreline inundation that will be associated with expansion of the Anderson TIA, AECOM carried out a specific program aimed at determining baseline conditions with respect to total mercury and methylmercury concentrations in large-bodied and small-bodied fish. The program included fishing efforts in the Anderson TIA, Anderson Creek and Anderson and Goose Bays of Wekusko Lake in August and October of 2015. It should be remembered however, that the Anderson TIA is not “fish habitat” in accordance with the *Fisheries Act* and fishing would never be permitted.

Ecological models for mercury in aquatic environments are frequently applied in the course of the assessment of the impacts on fish of hydroelectric projects. In each case, these models are suitable for predicting mercury levels in very large reservoir lakes but are poorly suited for predicting effects in small lakes, such as the Anderson TIA, and downstream waterbodies, such as Anderson Creek and Anderson Bay of Wekusko Lake.

Predictions of mercury concentrations in fish tissue in these models were developed for fish species that are not present in the Anderson TIA and no fishery exists in the TIA. These models are not suitable for modeling mercury uptake in the fish species in Wekusko Lake because the exposure pathways for Wekusko fish species are limited to waterborne transfer only. This is because there is little or no fish passage between the two water bodies and because of the limited opportunity for the pipe that comprises the final discharge point to transfer waterborne biota from the TIA to Anderson Creek and ultimately to Anderson Bay of Wekusko lake.

*5.3.6.2.1 Approach to the AECOM Mercury and Methylmercury Programs*

The objective of the 2015 fishing effort was to collect and prepare samples of large-bodied fish (where available) and composite samples of small-bodied fish from each waterbody. Fish sampling was conducted with the same gear during both the August and October 2015 fish sampling events. The specifics are outlined below:

1. August 2015
   - Small-bodied fish were collected in the Anderson TIA using twelve standard minnow traps baited with bread for small bodied fish.
   - Large-bodied fish were collected using two gill nets (small mesh sizes 13/19/25 mm and large mesh sizes 38/51 mm). In the Anderson TIA, the fish sampling targeted a small area within approximately 400 m of the eastern shore and outlet of the Anderson TIA.

2. October 2015
   - Anderson TIA – Large-bodied fish were collected using a large gang gill net (mesh sizes 38, 51, 76, 89, 102, 127 mm) approximately 1.5 km west of the outlet of the Anderson TIA. No attempts were made to collect small-bodied fish in the TIA during this sampling event.
   - Anderson Creek – Small-bodied fish were collected using two stations of two standard minnow traps baited with bread for small-bodied fish.
   - Anderson Bay – Large-bodied fish were collected using a large gang gill net (mesh sizes 38, 51, 76, 89, 102, 127 mm).
   - Goose Bay - Large-bodied fish were collected using a large gang gill net (mesh sizes 38, 51, 76, 89, 102, 127 mm). Small-bodied fish were collected using two stations of two standard minnow traps baited with bread for small-bodied fish.

The locations of the gill net sets and the minnow trap deployment are shown on the following Figures:

- Anderson Creek and the Anderson TIA – **Figure 18**.
- Anderson Bay of Wekusko Lake – **Figure 19**.
- Goose Bay of Wekusko Lake – **Figure 20**.

All fish caught were identified to species, and their bodies were measured for total length or fork length (depending on the species) and weight was recorded. Target species were sacrificed and tissue sampling was conducted immediately upon collection, using nitrile gloves and a clean stainless steel scalpel.

The procedures used for collecting the tissue samples from small bodied fish were based on the sampling procedures that were used in mercury studies for hydroelectric development projects based in northern Manitoba. This included the removal of the head and tail, spiny structures, and all internal organs. The minimum sample weight for analysis was 5 g, but all prepared samples were field weighed at greater than 6 g to ensure adequate sample weight. In instances where individual fish weights did meet the 5 g tissue requirement, composite samples of the same species were collected and submitted for analysis. Samples were rinsed with deionized water and placed into dedicated labelled Ziploc bags and then placed in a second labelled Ziploc bag.

For large bodied fish, any fillet greater than 10 g was removed from the back of the fish, ensuring a clean border of tissue separating skin from muscle. The sample was rinsed with deionized water prior to being placed into the labelled Ziploc bags as described above.

Due to fish size and minimum tissue requirements, only tissue samples from large fish and large individuals from small bodied fish species were submitted as discrete samples. The remaining small fish were submitted as composites of approximately four to eight individual fish.

Collected tissue samples were immediately placed on ice and submitted to the Maxxam Analytics Laboratory (Maxxam) in Winnipeg. Once received by Maxxam in Winnipeg, fish tissue samples were logged and transferred to the Maxxam laboratory in Burnaby, BC, for total mercury analysis; and the Brooks Rand laboratory in Seattle, WA, for low level mercury and methylmercury analysis.

Due to the limited sampling conducted during this program, and the limited number small fish species captured (and subsequent tissue mass collected), no field duplicate samples were collected and submitted for laboratory analysis for quality assurance purposes.

The sections below summarize the fish collection results and the results of tissue analysis from the August and October 2015 fish tissue sampling.

*5.3.6.2.2 Summary of Fish Collection*

5.3.6.2.2.1 Anderson TIA

As noted above, Anderson TIA is not considered to be “fish habitat” in accordance with the *Fisheries Act* and fishing would not at any time be permitted in the TIA. Notwithstanding, fish were recovered from the TIA.
In August 2015, two gill nets were set overnight on August 5, 2015 for a total of approximately 17 hours. Only one fish, a White Sucker, was caught in the small gill net. A total of twelve minnow traps were set in the Anderson TIA between August 4, 2015 and August 6, 2015. Due to shipping constraints, one trap was set for approximately 40 hours and a total of eleven minnow traps were set overnight on August 5, 2015 for approximately 18 hours. A total of 71 small-bodied fish were caught in using the minnow traps. Sampling locations are shown on **Figure 18**.

In October 2015, a large gang gill net was set on the morning of October 23, 2015 for a total of approximately 26 hours. A total of two adult female White Sucker were collected and submitted for mercury analysis. Sampling locations are shown on **Figure 18**.

5.3.6.2.2.2 Anderson Creek

In August 2015, only small bodied fish were targeted in Anderson Creek for the reasons identified in Section 5.3.6.1.3.3. A total of four minnow traps were set in two locations within Anderson Creek (two per station) overnight for approximately 25 hours. A total of 85 Brook Stickleback were caught, but only 38 were retained for mercury analysis. Sampling locations are shown on **Figure 18**.

5.3.6.2.2.3 Anderson Bay of Wekusko

In October 2015, a total of four minnow traps were set in two locations within Anderson Bay (two per station) overnight for approximately 18 hours. The large gang gill net was set on the morning of October 24, 2015 and checked every two hours over the total set time of approximately six hours. A summary of fish species collected in Anderson Bay is provided in **Table 5-9.** Northern Pike and Lake Whitefish were the main species collected followed by White Sucker, Cisco, Lake Chub and Brook Stickleback. Sampling locations are shown on **Figure 19**.

**Table 5-9: Breakdown of Fish Species Collected from Anderson Bay During October 2015**

| Gear Type | White Sucker | Cisco | Lake Whitefish | Northern Pike | Lake Chub | Brook Stickleback |
|---|---|---|---|---|---|---|
| **Gill Net** | 8 | 1 | 15 | 17 | 0 | 0 |
| **Minnow Traps** | 0 | 0 | 0 | 0 | 1 | 7 |

5.3.6.2.2.4 Goose Bay of Wekusko Lake

In October 2015, a total of four minnow traps were set in two locations within Goose Bay (two per station) for approximately 7 hours, but no fish were collected. The large gang gill net was set on the morning of October 25, 2015 and checked every two hours over the total set time of approximately 4.5 hours. A total of 58 fish were collected in Goose Bay for mercury analysis and the species breakdown is provided in **Table 5-10**. Northern Pike, White Sucker, Yellow Perch and Lake Whitefish were the main species collected followed by Walleye and Cisco. Sampling locations are shown on Figure 20.

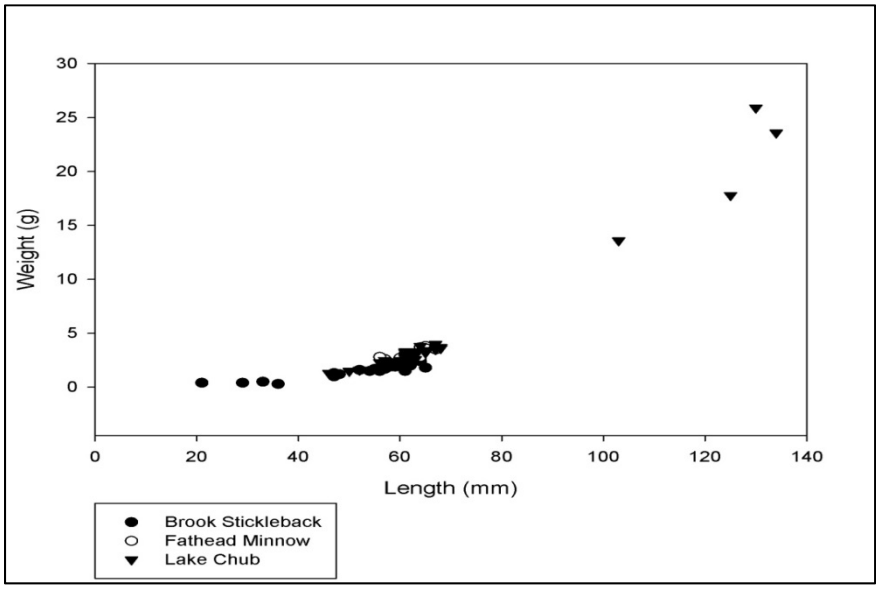
**Table 5-10: Breakdown of Fish Species Collected from Goose Bay During October 2015.**

| Gear Type | White Sucker | Cisco | Yellow Perch | Walleye | Lake Whitefish | Northern Pike |
|---|---|---|---|---|---|---|
| **Gill Net** | 12 | 1 | 12 | 2 | 13 | 18 |

*5.3.6.2.3 Summary of Fish Condition*

5.3.6.2.3.1 Small bodied fish

The lengths and weights of the small bodied fish collected from the Anderson TIA are shown on **Graph 1**. Qualitatively this scatter plot shows that the stickleback were generally the smallest and lightest fish collected whereas the majority of Lake Chub and Fathead Minnow were larger, but body size didn't appear to differ greatly between the latter two species. A few individual Lake Chub were very large and were considerably longer and heavier than the other small bodied fish species collected in the TIA.




**Graph 1: Size Measurements of Small Bodied Fish Collected from the Anderson TIA in 2015**

Fulton's condition factor was calculated for each species and statistical differences were identified for both Lake Chub and Fathead Minnow when compared to Brook Stickleback (**Table 5-11**). The ANOVA results indicate that Brook Stickleback in the TIA have a significantly higher condition factor than from Anderson Creek, and conversely have a significantly lower condition factor than Lake Chub and Fathead Minnow from the TIA (**Table 5-11**).

**Table 5-11: Statistical Comparisons of Condition Factor for Small-Bodied Fish Collected in the Anderson TIA in 2015**

| Condition Factor | Brook Stickleback | Lake Chub | Fathead Minnow |
|---|---|---|---|
| **Anderson TIA** | 1.15[a,c] | 1.20[b] | 1.35[b] |
| **Anderson Creek** | 0.85[d] | - | - |

*Notes:*

*[a,b,c,d] Different letters (a,b,c,d) indicate significant differences in Fulton's condition factor compared using a one-way ANOVA and Dunn's method (Sigmaplot 12; p<0.05).*

5.3.6.2.3.2 Large-bodied Fish

No aging structures were collected from either of the two large bodied fish species caught in Wekusko Lake, and no differences in the condition factor were observed between Northern Pike from Anderson Bay and Goose Bay (**Table 5-12**). In the White Sucker collected from Anderson Bay, the condition factor was significantly larger than in the Anderson TIA, but no significant differences were identified in condition factor between White Sucker from Goose Bay and the Anderson TIA (**Table 5-12**).

**Table 5-12: Statistical Comparisons of Condition Factor for Large-Bodied Fish Collected in Wekusko Lake (Anderson Bay and Goose Bay) in 2015.**

| Species | Anderson TIA | Anderson Bay | Goose Bay |
|---|---|---|---|
| **White Sucker** | 1.10[a] | 1.40[b] | 1.32[a] |
| **Northern Pike** | - | 0.65 [1] | 0.70* |

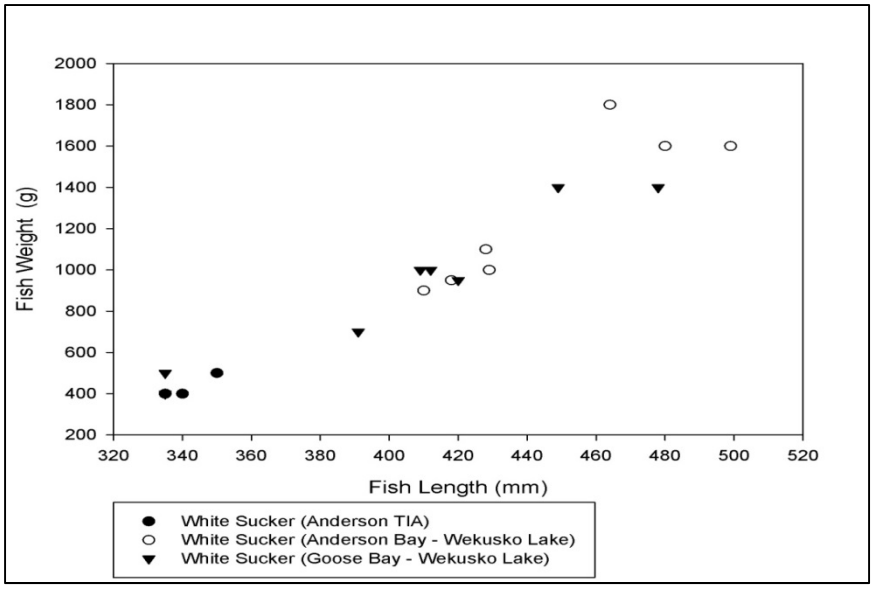
*Notes:*

*[a,b] Different letters (a,b) indicate significant differences in Fulton's condition factor compared using a one-way ANOVA and Tukey's Test (Sigmaplot 12; p<0.05).*

*1. Significant differences in Fulton's condition factor for northern pike and white sucker were compared using a students t-test (Sigmaplot 12; p<0.05).*

5.3.6.2.3.2.1 White Sucker

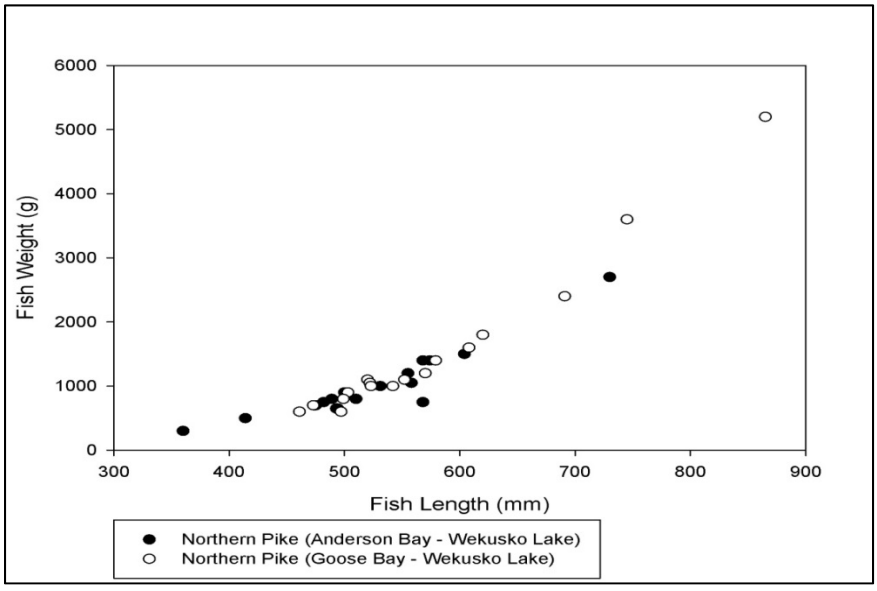
There were distinct size differences between the White Sucker collected from the TIA and the populations sampled in both Anderson Bay and Goose Bay (**Graph 2**). Qualitatively, the White Sucker collected from Goose Bay spanned the range of body sizes observed, with the White Sucker from the Anderson TIA occupying the bottom end of the range and the white sucker from Anderson Bay occupying the middle to upper extent of the range.




**Graph 2: Size Measurements of White Sucker Collected from the Anderson TIA and Wekusko Lake in 2015**

5.3.6.2.3.2.2 Northern Pike

There was no difference in the condition factor between Northern Pike from Anderson Bay and Goose Bay (**Graph 3**). The Northern Pike from Goose Bay had the two largest individuals in the distribution and Anderson Bay had the two smallest individuals. Qualitatively, the populations appeared to be a similar size in both sampling areas.




**Graph 3: Size Measurements of Northern Pike Collected from the Anderson TIA and Wekusko Lake in 2015**

*5.3.6.2.4 Summary of Tissue Analysis Results*

The results of the total mercury and methylmercury analysis of the fish tissue samples collected in August and October 2015 are presented in **Table 5-13**. The results indicate that both total mercury and methylmercury is

present in the tissue of fish collected from the Anderson TIA, but the measured concentrations were orders of magnitude below the concentrations of total mercury and methylmercury observed in the tissues of fish collected from Anderson Bay and Goose Bay of Wekusko Lake.

**Table 5-13: Mercury Concentrations in Fish Tissue from the Anderson TIA, Anderson Creek and Wekusko Lake**

| Relevant Guidelines | | Average Total Mercury Concentration (ng/g) | Average Methylmercury Concentration (ng/g) |
|---|---|---|---|
| [1]Health Canada Commercial Guideline | | 500 ng/g | - |
| [2]CCME Guideline for Wildlife Consuming Aquatic Biota | | - | 33 ng/g |
| **Water Body** | **Fish Species** | | |
| **Anderson TIA** | White Sucker (n=4) | 2.2[a] | 2.4[a] |
| | Lake Chub (n=8) | 3.0 | 3.0 |
| | Fathead Minnow (n=1) | 1.2* | 1.4* |
| | Brook Stickleback (n=1) | 4.6* | 2.8* |
| **Anderson Creek** | Brook Stickleback (n=8) | 3.5 | 2.8 |
| **Anderson Bay (Wekusko Lake)** | Brook Stickleback (n=1) | 11.3* | 16.5* |
| | White Sucker (n=8) | 42.8[b] | 35.9[b] |
| | Northern Pike (n=10) | 114.0** | 94.0* |
| **Goose Bay (Wekusko Lake)** | White Sucker (n=8) | 42.7[b] | 39.8[b] |
| | Northern Pike (n=10) | 119.0** | 98.7* |

*Notes: Red results indicate values that exceed CCME Guidelines for Wildlife Consuming Aquatic Biota*
* *The individual results were reported due to a sample size of n=1.*
1 *Health Canada Guideline for total mercury in commercially sold fish (0.5 parts per million) (Health Canada, 2007).*
2 *CCME methylmercury tissue residue guideline for the protection of wildlife consumers of aquatic biota (CCME, 2000).*
a,b,c *Different letters (a,b) indicate significant differences in average total mercury and methylmercury concentrations in white sucker tissue compared using a one-way ANOVA and Tukey's Test (Sigmaplot 12; p<0.05).*
*,** *Significant differences in average total mercury and methylmercury concentrations in fish tissue were compared using a students t-test (Sigmaplot 12; p<0.05).*

Due to the available tissue mass of the small bodied fish collected, the methylmercury results for Brook Stickleback were based on a single composite sample (n=1) that included each of the individual fish displayed in Graph 1, and no statistical comparisons can be made for small bodied fish in Anderson TIA dataset. No statistical comparisons could be conducted in Anderson Creek and Anderson Bay in Wekusko Lake due to the small sample volume as well (n=1). Qualitative comparisons between small bodied fish species collected in Anderson TIA and Anderson Creek indicated that their mercury concentrations were similar. Whereas, the concentrations of mercury in the one Brook Stickleback sample analyzed from Anderson Bay was 3-5 times greater than the samples from both Anderson Creek and Anderson TIA.

The White Sucker collected from Anderson Bay and Goose Bay were an order of magnitude greater than those collected from Anderson TIA. Furthermore, the mercury concentrations identified for Northern Pike were approximately two orders of magnitude above the concentrations found in small fish from the Anderson TIA. Overall, the mercury concentrations in fish tissue tended to increase from small forage fish to large predatory fish and were higher in Wekusko Lake than in Anderson Creek or the Anderson TIA.

### *5.3.6.3 Summary of EEM Fish and Fish Habitat Results*

For the purpose of this assessment, in addition to considering the baseline studies carried out in 2011 and 2012 and the additional work carried out in 2015, AECOM considered the results of the Stantec EEM studies carried out on behalf of HBMS in accordance with the MMER.

Detailed methodology, results and discussion of the EEM study can be found in:

- Metal Mining Environmental Effects Monitoring Snow Lake Mill/Anderson Tailings Initial Monitoring Program Final Report (Stantec Consulting Ltd., 2005a).
- Metal Mining Environmental Effects Monitoring Anderson Tailings Periodic Monitoring Program Final Report (Stantec Consulting Ltd., 2008a).
- Metal Mining Environmental Effects Monitoring Anderson Tailings Focused Monitoring Program Final Report (Stantec Consulting Ltd., 2010a).
- Metal Mining Environmental Effects Monitoring Anderson Tailings Impoundment Area Discharge, Investigation of Cause Program Final Report (Stantec Consulting Ltd., 2012).

During the EEM study conducted in 2011, Brook Stickleback liver tissues were collected for the analysis of metal bioaccumulation, energetics (glycogen and triglycerides) and metallothionein (biomarker) concentration to determine whether the cause of fish effects observed during previous EEM studies were due to metal exploitation, habitat differences or food resource ability. No significant differences were found in glycogen in livers from Brook Stickleback from Reference and Exposure Areas, indicating that fish from the three Areas had similar energetic status and food resources were similar in each (Stantec, 2012).

Overall, the lowest mean concentrations of metallothionein in Brook Stickleback were from Anderson Bay (Exposure Area) when compared to the Reference Areas (Goose Bay and Tramping Lake). The results of the metal tissue bioaccumulation also showed no significant difference in metal accumulation in Brook Stickleback livers between Reference and Exposure Areas, with the exception of iron which was statistically greater in the Exposure Area compared to only one Reference Area; Tramping Lake. These results indicated that effects observed were likely not caused by metal exploitation and were more indicative of habitat differences (Stantec, 2012).

Weight-at-age, relative gonad weight, condition were analyzed in Yellow Perch in addition to the collection of liver tissues for the analysis of metal bioaccumulation, energetics (glycogen and triglycerides) and metallothionein (biomarker) concentration during the 2011 EEM studies. The greatest number of fish effects (60%) were observed between the two reference lakes; Tramping Lake and Goose Bay. Results showed that weight-at-age, and relative liver weight was greater in both male and female Yellow Perch and condition was greater in females from Goose Bay, whereas relative gonad weight was greater in Tramping Lake in male Yellow Perch compared to Goose Bay (Stantec, 2012).

Approximately 50% of the fish endpoints (weight-at-age, relative gonad weight, condition) significantly differed between Tramping Lake (Reference 1) and Anderson Bay (Exposure Lake). Weight-at-age relative gonad weight and condition were greater in female Yellow Perch from Goose Bay, whereas relative gonad weight was greater in male Yellow Perch in Tramping Lake (Stantec, 2012).

The least number of fish effects (20%) were observed in both males and females from Anderson Bay and Goose Bay results indicated that liver weight was greater in Goose Bay. Despite the large number of effects that were observed among the fish, approximately 80% of these endpoints were below the critical effect size known to cause adverse population-level effects. Therefore, the results suggest that the differences observed are likely due to natural variability among the Reference and Exposure Areas or the fish population (Stantec, 2012).

Overall, Yellow Perch liver glycogen was not significantly different in Perch from the two Reference Areas and the Exposure Area, suggesting that food resources were comparable in all Areas. Liver triglycerides however, were

significantly lower in Yellow Perch liver from Tramping Lake compared to either Anderson Bay or Goose Bay, which may be more an artifact of differences in preferential prey items present at the time of sample collection (Stantec, 2012).

Metallothionine analysis showed that there were no significant differences among Reference and Exposure Areas, which suggests that fish effects observed in the Exposure fish, were not related directly to metal mine exposure. Metal tissue accumulation laboratory results reported that cadmium, lithium, sodium, iron, potassium, rubidium were significantly lower in the Exposure Area compared to both Reference Areas with the exception of selenium. Although selenium was significantly elevated in the Exposure fish, the concentrations found in the livers were well below toxic effect thresholds identified in the literature. No other metals were found to be significantly elevated in the liver of Yellow Perch. Furthermore, most of the metals which differed significantly among the Exposure and Reference areas were unrelated to the Anderson TIA effluent and are not indicative of mine effluent effects but of natural variability among the waterbodies.

# 5.4 Groundwater

Comprehensive reports describing the regional groundwater flow system are not available for the Project Area. However, based on conditions in similar environments, the regional shallow groundwater flow, in particular in the overburden, is likely controlled by the bedrock surface and topography in the Project Region. 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.

There are 37 registered groundwater wells in use within the Project Region as reported in the water well records (Manitoba Conservation and Water Stewardship, 2011). The majority of wells are located within the property development around the Wekusko Lake (Barrs Bay and Berry Bay), the Town of Snow Lake, and Wekusko Falls Provincial Park (Wekusko Falls Campground). According to the Groundwater Information Network database, the closest well to Anderson TIA is located approximately 1.8 km west of Anderson TIA. Its water use is domestic, well purpose is production, water status is active, and the well extends to 92.72 m below ground surface.

# 5.5 Terrestrial Environment

## 5.5.1 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).

The general area of the Anderson TIA and region is a boreal forest biome typical of the rock 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 fairly 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. 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.

The general historical disturbance in this area has opened the forest canopy. However, most of this activity has been limited to narrow cut lines and drag roads that grow in rapidly. Re-growth in such areas is largely hardwoods, but these areas also offer some growth opportunity for shrubs that were largely lacking in other parts of the forest stand. The historical re-growth in this area is a minor part of the forest canopy, however, 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.

### *5.5.1.1 Terrestrial Field Surveys*

AECOM completed a terrestrial survey of the TIA shoreline, dike alignments and Anderson Creek in summer of 2011 and 2012. This survey included a review of local geology, soil, vegetation and wildlife. The survey consisted of a random meander survey by qualified AECOM biologists along the proposed dike alignments, former Anderson Mine Site and around Anderson Creek and a shoreline assessment around Anderson TIA via boat.

Detailed methodology, results and discussion of terrestrial field studies can be found in:

- Lalor Concentrator Environment Act Proposal (AECOM, 2013c).
- Lalor Mine Environment Act Proposal Report (AECOM, 2012d).
- Proposed Lalor Concentrator Environment Baseline Assessment (AECOM, 2013e).
- Proposed Lalor Mine Environmental Baseline Assessment (AECOM, 2012c);
- Lalor Vegetation Regional Analysis (AECOM, 2012f).

#### *5.5.1.1.1 Dike Alignment*

The area along the proposed dike alignments between the south-eastern end of the Anderson TIA and the former PR 392 is a typical upland mixed wood forest with few wet areas. The developed shoreline consists of large trees, extensive shrub growth and rocky uplands bordering the shoreline and extending into the surrounding forest stand, which is dominated by mixed White Spruce and aspen. The forest floor is moss-covered, with typical boreal plant ground cover and some shrub development along the existing dikes and cut lines. The soil is mineral based in this area and, therefore, has high productivity. The specific dike alignments are located in very typical vegetation communities for this region. Overall, the area shows little variety in plant habitats and no unusual floral communities. Spruce stands have a typical mossy understory plant community. Several of the proposed dike alignments have been cleared previously and currently have new growth with vegetation typical of the surrounding area.

#### *5.5.1.1.2 Anderson TIA Shoreline*

The shoreline is largely an upland area with some rock outcrops interspersed with low areas that show evidence of flooding into the forest stands behind the shoreline. Low areas consist of Black Spruce bog with some Tamarack in the open wet stands. The shoreline also consists of mixed wood, with White Spruce and Trembling Aspen. Large rock outcrops are covered with moss and lichen growth. These rock outcrops support tree growth that is more open with less shrubby growth, although the shoreline is dense shrub and forest.

A few low lying areas were observed with stands of dead trees along the shorelines. These areas were predominantly bog with several active beaver lodges. One influent stream was located in the northwest portion of

the TIA that was connected by waterfall from a flooded beaver pond. The north shoreline had many steep cliffs and exposed bedrock.

### 5.5.2 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 Snowshoe Hare (*Lepus americanus*). Various bird species including Sandhill Crane (*Grus canadensis*), grouse, waterfowl (*i.e*., ducks, geese, and pelicans) along with many other birds are found in this ecoregion (Smith *et al.*, 1998).

During the field studies conducted in 2007 - 2012 in the Project Region, signs Black Bear and Moose in the Project Region were apparent. Wildlife directly observed included waterflowl, Common Raven (*Corvus corax*), Coyote (*Canis latranus*), Red Fox (*Vulpes fulva*), Whitetail Deer (*Odocoileus virginianus*), Timber Wolf, River Otter (*Lutra canadensis*), Beaver, eagles, American White Pelican (*Pelicanus erthrorhyncos*), cranes (*Grus* sp.), loons (*Gavia* sp.), and frogs.

The area surrounding Anderson TIA showed a high degree of use by wildlife, particularly birds. In June 2012, during the shoreline survey, ten species of waterfowl were observed in abundance around the area, as well as one Bald Eagle. Young of the year birds were also observed in the area.

### 5.5.3 Migratory Birds

During a survey of the Anderson TIA, four species of ducks, mergansers, loons, grebes, geese and two species of gull were observed. Nesting and brooding of these species is largely confined to the major lakes.

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 Region.

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.

## 5.6 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-nine species of fungi, plants, and vertebrate animals are listed as species of special concern in the Churchill River Upland Ecoregion (**Table 5-14**).

**Table 5-14: List of Species of Special Concern in the Churchill River Upland Ecoregion**

| Common Name | Scientific Name | Rank |
|---|---|---|
| **Flooded Jellyskin** | *Leptogium rivulare* | Globally ranked between demonstrably widespread, abundant, and secure throughout its range to uncommon throughout its range; provincially ranked very rare. |
| **Bog Adder's-mouth** | *Malaxis paludosa* | Globally ranked demonstrably widespread, abundant, and secure throughout its range; provincially ranked very rare. |
| **Few-Flowered Sedge** | *Carex pauciflora* | Globally ranked demonstrably widespread, abundant, and secure throughout its range; provincially ranked uncommon. |
| **Few-Fruited Sedge** | *Carex oligosperma* | Globally ranked demonstrably widespread, abundant, and secure throughout its range; 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. |
| **Arethusa** | *Arethusa bulbosa* | Globally ranked as widespread, abundant and secure throughout its range; provincially ranked rare. |
| **Reed Grass** | *Calamagrostis lapponica* | Globally ranked demonstrably widespread, abundant, secure throughout its range; provincially ranked rare. |
| **Quillwort** | *Isoetes lacustris* | Globally ranked demonstrably widespread, abundant, secure throughout its range; provincially ranked rare. |
| **Limestone Oak Fern** | *Gymnocarpium robertianum* | Globally ranked demonstrably widespread, abundant, secure throughout its range; provincially ranked very rare. |
| **Long-Fruited Sedge** | *Carex michauxiana* | Globally ranked demonstrably widespread, abundant, secure throughout its range; provincially ranked rare. |
| **Moor Rush** | *Juncus stygius ssp. americanus* | Globally ranked demonstrably widespread, abundant and secure throughout its range; 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; 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; provincially ranked very rare. |
| **Pallas Buttercup** | *Ranunculus pallasii* | Globally ranked widespread, abundant, apparently secure throughout its range; provincially ranked rare. |
| **Round-Leaved Bog Orchid** | *Platanthera orbiculata* | Globally ranked demonstrably widespread, abundant, secure throughout its range; provincially ranked uncommon. |
| **Small Water-Lily** | *Nymphaea tetragona* | Globally ranked demonstrably widespread, abundant, secure throughout its range; provincially ranked rare. |
| **Smooth Woodsia** | *Woodsia glabella* | Globally ranked demonstrably widespread, abundant, apparently secure throughout its range; provincially ranked rare. |
| **Spatulate Moonwort** | *Botrychium spathulatum* | Globally ranked uncommon throughout its range;provincially ranked very rare. |
| **Wahlenberg's Wood-rush** | *Luzula wahlenbergii* | Globally ranked widespread, abundant, apparently secure throughout its range; provincially ranked rare. |
| **White Beakrush** | *Rhynchospora alba* | Globally ranked demonstrably widespread, abundant, and secure throughout its range; provincially ranked uncommon but status is uncertain. |
| **Whip-poor-will** | *Caprimulgus vociferus* | Globally ranked demonstrably widespread, abundant, and secure throughout its range; breeding occurrences rated uncommon in province. |

| Common Name | Scientific Name | Rank |
|---|---|---|
| **Common Nighthawk** | *Chordeiles minor* | Globally ranked demonstrably widespread, abundant, and secure throughout its range; breeding occurrences rated uncommon in province. |
| **Olive-sided Flycatcher** | *Contopus cooperi* | Globally ranked widespread, abundant, and secure throughout its range; breeding occurrences rated uncommon or widespread, abundant, and secure in the province. |
| **Western Wood-pewee** | *Contopus sordidulus* | Globally ranked demonstrably widespread, abundant, and secure throughout its range; breeding occurrences rated uncommon in province. |
| **Rusty Blackbird** | *Euphagus carolinus* | Globally ranked widespread, abundant, and secure throughout its range; breeding occurrences rated uncommon or widespread, abundant, and secure in the province. |
| **Great Gray Owl** | *Strix nebulosa* | Globally ranked demonstrably widespread, abundant, and secure throughout its range; breeding occurrences rated as widespread, abundant, and secure in the province. |
| **Boreal Woodland Caribou** | *Rangifer tarandus caribou* | Globally ranked demonstrably widespread, abundant, and 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; provincially ranked uncommon. |

*Source: Manitoba Sustainable Development, 2016a.*

Field observations confirmed that wildlife habitats within the Project Area are 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 29 species listed as species of special concern by the Manitoba CDC (**Table 5-14**), nine 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 provincial *Endangered Species and Ecosystems Act* (*ESEA*) 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 5-15**.

**Table 5-15: List of Protected Species within the Churchill River Upland Ecoregion**

| Common Name | Scientific Name | SARA Status | ESEA Status |
|---|---|---|---|
| **Boreal Woodland Caribou** | *Rangifer tarandus caribou* | Threatened | Threatened |
| **Flooded Jellyskin** | *Leptogium rivulare* | Threatened | Not Ranked |
| **Monarch** | *Danaus plexippus* | Special Concern | Not Ranked |
| **Whip-poor-will** | *Caprimulgus vociferus* | Not Ranked | Threatened |
| **Common Nighthawk** | *Chordeiles minor* | Threatened | Threatened |
| **Olive-sided Flycatcher** | *Contopus cooperi* | Threatened | Threatened |
| **Rusty Blackbird** | *Euphagus carolinus* | 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 Sustainable Development, 2016b and Government of Canada, 2016.*

According to Manitoba Conservation Fact Sheets, Manitoba recognizes three varieties of caribou: Coastal, Barren Ground and Boreal Woodland (Manitoba Sustainable Development, 2016c). The Boreal Woodland Caribou was designated as threatened under *MESA* in June 2006 (Manitoba Boreal Woodland Caribou Management

Committee, 2015). Such factors as habitat destruction, hunting, disturbance by humans (including construction of roads and pipelines), and predation (by wolves, coyotes, and bears) have all contributed to the decline of caribou. In many parts of their range, anthropogenic activities have resulted in the loss and alteration of important caribou habitat. Other factors, such as weather and climate change, are also influential, but are also more difficult to control. One of the current challenges in caribou management is to learn more about how these factors interact and how to decrease their threat to caribou populations (Environment Canada, 2015).

The Provincial recovery strategy plan for Woodland Boreal Caribou identifies 15 known ranges of the species (Manitoba Boreal Woodland Caribou Management Committee, 2015). One of the Management Units, the Atikaki-Berens, overlaps with the Project Region. 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 range of the Monarch Butterfly can extend to the $54^0$ Latitude of the Prairie Provinces. However, the bulk of occurrences are south of the $50^0$ Latitude. Recorded occurrences are limited in the northern regions such as 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, but no monarch butterflies were recorded during the terrestrial investigations.

The Northern Leopard Frog range overlaps with the Project Region (COSEWIC, 2009a); however, none were observed during the terrestrial investigations.

The Shortjaw Cisco has been recorded Manitoba lakes including Lake Athapapuskow, Clearwater Lake, Lake Winnipeg, George Lake, Reindeer Lake and Lake Athabasca (COSEWIC, 2003). However, there have been no reported occurrences in the Grass River sub-basin in the Nelson River Basin.

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

The Whip-poor-will is a well-known, nocturnal bird. It is an aerial foraging insectivore. The Whip-poor-will breeds in southern Manitoba and would be on the edge of its range in the Project Region (COSEWIC, 2009c).

The Common Nighthawk is breeds across western Canada, including in Manitoba below the treeline. The breeding habitat includes ground devoid of vegetation such as sand dunes, beaches, logged areas, burned-over areas, forest clearings, rocky out crops, rock barrens, prairies, peat bogs and pastures. They have not been observed in the Project Region and are unlikely to nest within the Project Site (COSEWIC, 2007)

The Olive-sided Flycatcher breeds in boreal, sub-boreal, interior and coastal forest regions, including Manitoba (Environment Canada, 2015). There have been no observations in the Project Region during terrestrial investigations

The Rusty Blackbird breeding range includes a large portion of North America (COSEWIC, 2006). There have been no observations in the Project Region during terrestrial investigations.

# 5.7 Socio-Economic Environment

## 5.7.1 Parks and Natural Areas

There are no national or provincial parks in the Project Site or Project Area. The Wekusko Falls Provincial Park (0.88 $km^2$), is located approximately 6 km south of Anderson TIA. 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 Sustainable Development, 2016d).

Approximately 25 km southwest of the Anderson TIA is the Grass River Provincial Park (2,279 $km^2$). 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 (Manitoba Sustainable Development, 2016e). As a Natural Park, Grass River Provincial Park will accommodate commercial resources, including mining, where such activities do not compromise other park purposes. For example, the HBMS Reed Property is categorized for "resource management" in the park under *Provincial Parks Designation Regulation* (*Manitoba Regulation 37/97*)).

The Cormorant Provincial Forest (1,479 $km^2$) is located approximately 67 km southwest of the Anderson TIA. The provincial forest was established in 1947, and is the most northern provincial forest. The forest includes Clearwater Lake Provincial Park, extensive cross country ski trails and a ski chalet used by Manitoba Forestry for education (Manitoba Sustainable Development, 2016f).

The Clearwater Lake Provincial Park (593 $km^2$) is located approximately 100 km southwest of the Anderson TIA. 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 Sustainable Development, 2016f).

The Saskeram Wildlife Management Area (WMA) is located approximately 122 km southwest of the Anderson TIA, 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 Sustainable Development, 2016g).

The Tom Lamb WMA boundary is located approximately 80 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 Sustainable Development, 2016g).

**Figure 21** shows the above-mentioned parks and natural areas.

## 5.7.2 Heritage Resources

Information from the Historic Resources Branch of Manitoba Culture, Heritage and Tourism does not indicate any known historic or heritage resources within the Project Site. **Figure 22** illustrates the location of known sites found within the Project Area and Project Region.

## 5.7.3 Economy

### *5.7.3.1 Town of Snow Lake*

In the 2011 census conducted by Statistics Canada, the population of Snow Lake was 723 residents (Statistics Canada, 2012) 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 over 50 years. HBMS has played an integral part in this history since the late 1950s, by operating ten mines in the area including: Photo Lake, Chisel Lake, Stall Lake, Osborne Lake, Spruce Point, Ghost Lake, Anderson Lake, Chisel North and Lalor.

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, fishing and hunting are also popular activities in the region.

## 5.7.4 Community Services

The Town of Snow Lake has various community services including: a health facility that is staffed by a doctor, 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 10 km northeast of the Anderson TIA that is designed to accommodate air ambulances for medical evacuations. Other services include a Royal Canadian Mounted Police (RCMP) station and a volunteer fire department. There are also numerous recreational opportunities including camping, hiking trails, fishing, hunting, snowmobiling and all-terrain vehicle trails (Snow Lake, 2016).

## 5.7.5 Personal, Family and Community Life

Events held in Snow Lake include the Sno-Drifters Radar Runs and the Winter Whoot Festival. As well, there are Bingo and Texas Hold'em events run by the Royal Canadian Legion #241 (Snow Lake, 2016). Other community organizations include the Snow Lake Senior Centre and the Aurora Borealis Arts Council.

## 5.7.6 Regional Resource Use

### *5.7.6.1 Trappers*

The Manitoba Sustainable Development office in Snow Lake has confirmed that there is one registered trap line (RTL) in the vicinity of the Project Site. Manitoba Conservation and Water Stewardship (now known as Manitoba Sustainable Development) has confirmed that the area of Anderson Creek and Wekusko Bay is registered as RTL 13. This trap line is owned by Russell Bartlett. **Figure 14** shows these trap line boundaries.

### *5.7.6.2 Cottages or Remove Residences*

There are no cottages or residences on the Anderson TIA. The closest cottages and remote residences are the Wekusko Lake cabin subdivisions on Berry Bay, Taylor Bay, and Bartlett's Landing. There are approximately ten

residences on Anderson Bay. 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 Province of Manitoba, five cabins is the maximum allocation for that lake.

#### *5.7.6.3 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 3 km northwest of the Anderson TIA. Wekusko Falls Lodge and Tawow Lodge Ltd. (Herb Lake Landing) are located approximately 10 km and 25 km southeast of the Anderson TIA, respectively. Burntwood Lodge is a fly in fishing lodge located on Burntwood Lake and is estimated to be approximately 60 km northwest of the TIA. Grass River Lodge is located on Reed Lake and is approximately 28 km southwest of the Anderson TIA, with outpost cabins on Dolomite Lake (55 km southwest of the Anderson TIA) and Moody Lake (55 km northwest of the Anderson TIA).

#### *5.7.6.4 Snowmobilers*

The Snow Lake area is home to the Snow Lake Sno-Drifters snowmobiling club. The club maintains snowmobile trails in and around the Town of Snow Lake.

#### *5.7.6.5 Forestry*

The Cormorant Provincial Forest is located approximately 95 km southwest of the Anderson TIA 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. 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 Sustainable Development, 2016h).

Tolko Industries Ltd. (Manitoba Solid Wood Division, Woodlands), located in The Pas, Manitoba has three Forest Sections (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., 2016).

#### *5.7.6.6 Fisheries – Recreational and/or Commercial*

Given the proximity to the Town of Snow Lake, there are recreational opportunities such as fishing, swimming, canoeing and snowmobiling in and around the Project Region. Recreational fishing in Wekusko Lake increased after 1960 with the completion of PR 392.

Personal communications with Grant McVittie, Regional Fisheries Manager in The Pas, indicated a commercial gill net fishery operated in Snow Lake from 1989 to 1990 targeting Lake Whitefish, but was suspended due to the high bycatch (~41% of round weight) of Walleye and Northern Pike. The commercial fishery in Snow Lake is not currently active. Wekusko Lake has an active commercial fishery for Walleye, Sauger, Whitefish and Northern Pike.

### 5.7.7 First Nations

Based on Government of Manitoba and Federal sources, there is no Indian Reserve, 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, Nisichawayasihk Cree

Nation, Mosakahiken Cree Nation, Opaskwayak Cree Nation, Cross Lake First Nation and Norway House Cree Nation. **Figure 23** illustrates the locations of these First Nations relative to the Anderson TIA.

# 6. Environmental Effects Assessment and Mitigation Measures

## 6.1 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 3** of this application); AECOM determined the potential for each component of the proposed Project to interact with each environmental component (presented in **Table 4-1** above). The assessment includes any effects on social components resulting from residual adverse environmental effects.

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 International Organization for Standardization (ISO) certified safety and environmental management systems and the drafting of the tender documents to include requirements for mitigation measures outlined below). In addition, AECOM has taken into account that this Project consists not of a new development, but rather of an expansion of an on-going mining operation which has been actively managed for over 30 years and operated in compliance with regulatory criteria and well established HBMS operating practices. The Regulatory criteria include the full range of monitoring and reporting requirements contained in the MMER and the Manitoba environmental licence.

The assessment includes AECOM's assessment of the sufficiency of such measures and recommendations for any additional measures which, in our view, would be advisable. Significance of effects is commented on where applicable regulatory criteria exist. In the absence of such criteria, AECOM has provided an overall characterization of the impact taking into consideration the magnitude, reversibility, direction, frequency, and reversibility of the effect and expressed as Negligible, Low, Moderate, or High.

Environmental effects that may be caused as a result of accidents and malfunctions are discussed separately in **Section 6.12**. Definitions of the terms used to guide the effects assessment are provided in **Table 6-1**.

**Table 6-1: Terms Used in Effects Assessment**

| TERM | DEFINITION |
|---|---|
| **Project Phase:** | Refers to the phase of the Project as construction, operation and maintenance ("Operation"), or closure. |
| **Potential Effect:** | Potential change that the proposed Project may cause in the environment. |
| **Magnitude of Effect:** | Refers to the estimated percentage of population or resource that may be affected by activities associated with the construction, operation and closure of the Anderson TIA. 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.<br><br>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 |

| TERM | DEFINITION | | | |
|---|---|---|---|---|
| | 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. | | | |
| | Negligible (immeasurable) | Minor (<1%) | Moderate (1 to 10%) | Major (>10%) |
| **Direction of Effect:** | Refers to whether an effect on a population or a resource is considered to have a positive, adverse or neutral effect. | | | |
| | Positive | Adverse | Neutral | |
| **Duration of Effect:** | 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). | | | |
| | Short term (< 1 year) | Moderate (1 to 10 years) | Long term (>10 years) | |
| **Frequency** | Refers to the number of times an activity occurs over the Project phase, and is identified as once, rare, intermittent, or continuous. | | | |
| | Once | Rare | Intermittent | Continuous |
| **Scope of Effect:** | Refers to the spatial area potentially affected by the effect and categorized as Project Site, Project Area or Project Region as defined in **Section 4.2**. Where possible, quantitative estimates of the resource affected were provided. | | | |
| | Project Site | Project Area | Project Region | |
| **Reversibility:** | Refers to the extent to which an adverse effect is reversible or irreversible over a 10-year period. | | | |
| | Reversible | Irreversible | | |
| **Residual Effect:** | A qualitative assessment of the residual effect remaining after implementing appropriate mitigation measures. | | | |

# 6.2 Topography

**Magnitude of Effect:** Low
**Direction of Effect:** Neutral
**Duration of Effect:** Long term
**Frequency:** Once
**Scope of Effect:** Project Site
**Reversibility:** Irreversible

Sources of changes to site topography include activities such as clearing, blasting, levelling, trenching, and stockpiling materials during site preparation, and installation of laydown areas, temporary trails, dams and spillway. Changes in topography caused by the Project are assessed to be Moderate in magnitude for the following reasons:

- Wherever practicable, existing access roads and laydown areas will be used in order to minimize changes to topography.
- All changes to topography will occur inside the boundary of HBMS operations on land to which only HBMS has a right of access

With respect to temporary trails, the relocated pumphouse and the powerline, clearing and levelling will be required. Effects on topography from levelling are assessed to be Negligible for the following reasons:

- The closure phase will include restoration of any changes to topography of the temporary sites (trails, laydown areas) to match the pre-construction condition of the surrounding area to the extent practical.

The expansion of the Anderson TIA requires the installation of four new dams and a spillway. The impact on topography from installation of the dams and spillway is assessed to be Moderate for the following reasons:

- Dam and spillway alignments have been chosen based on proximity to high points and bedrock outcrops to maximize utilization of the existing topography for containment.
- The alignment selection process resulted in the smallest practicable footprint and change to topography. The dams and spillway structures will be permanent and will not be removed during the closure phase.
- The change in topography from the dams will be permanent and irreversible, but since the purpose of the dams is to allow for continued environmental management of tailings, this change is unavoidable.

### 6.2.1 Overall Impact to Topography

Overall, the residual impact on topography caused by the Project is assessed to be Moderate. The change in topography, while permanent, will impact only features which are limited to the Project Site, and not unique in the Project Region.

## 6.3 Soil

### 6.3.1 Erosion

**Magnitude of Effect:** Negligible
**Direction of Effect:** Adverse
**Duration of Effect:** Short term
**Frequency:** Intermittent
**Scope of Effect:** Project Site
**Reversibility:** Reversible

High wind and precipitation events can lead to soil erosion, which can consequentially affect other environmental components (*e.g.,* air quality, water quality, or vegetation). Construction activities that can result in elevated potential for soil erosion include clearing, grubbing, stockpiling, excavation, and inundation of the shoreline of Anderson TIA.

Clearing and grubbing will be required for dams and spillway, temporary trails, laydown areas, powerline and around Anderson TIA for areas to be inundated. At the end of each stage there will be a total cleared area of 0.17 km² (16.7 ha), 0.08 km² (7.8 ha), and 0.03 km² (3.12 ha). The impact of soil erosion from preparation activities is assessed to be Negligible for the following reasons:

- To the extent practicable, clearing will occur during the winter to minimize disruption to soil and allow sufficient time for soil stabilization prior to the spring freshet.
- It is anticipated that once the dams are built in each Stage, it will take two to four years for water levels to reach the desired water elevation. Given this length of time, disturbed soils will stabilize naturally and not be susceptible to significant erosion.

The effect on soil erosion from stockpiling and excavation is assessed to be Negligible for the following reasons:

- Stockpiled organic spoils will be compacted and reused, where practicable.
- Excavation activities will not occur during high rain or wind events, which will minimize the erosion potential of exposed soils.

There is potential for soil erosion to occur during the preparation activities (such as clearing and grubbing) and construction of the dams and spillway, which could consequentially affect water quality downstream (in Anderson Creek). The impact of soil erosion with subsequent effects on water quality is assessed to be Negligible because:

- Erosion and Sediment Control (ESC) methods will be in place to prevent the generation and movement of sediment-laden water, which is deemed sufficient to appropriately mitigate for erosion.

Erosion may also occur during construction of the dams and in between construction stages. This effect has been assessed to be Minor for the following reasons:

- The dams are designed to incorporate filter zones within the dam to protect the dam cores from internal erosion.
- Geotextile will be placed between the silty clay core and the rockfill layers of any temporary berms to provide containment and minimize erosion between construction stages.
- Seepage collection systems will be constructed at the toe of each dam and berm, allowing for collection and pumping back into the Anderson TIA, any seepage that comes through the dam.

At the time of Closure, HBMS will undertake the following measures for effective reversibility of the Project Site to the extent possible:

- Apply soil to previously disturbed laydown areas and temporary trails (those not required for future inspections).
- Allow all disturbed areas to naturally re-vegetate.
- Contour disturbed areas to match the surrounding topography to the extent possible.

### 6.3.2 Materials and Waste Management

**Magnitude of Effect:** Negligible
**Direction of Effect:** Adverse
**Duration of Effect:** Short term
**Frequency:** Intermittent
**Scope of Effect:** Project Site
**Reversibility:** Reversible

Wastes such as used oils, rags, drums and miscellaneous garbage can potentially affect soil quality, which can have consequential effects on other environmental components (*e.g.,* vegetation, groundwater, and surface water).

The impact on soil quality from wastes is assessed to be Negligible when taking into account the following HBMS waste management practices which will be followed:

- Wastes generated during construction will be collected in garbage bins maintained at specific locations throughout the Project 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.

### 6.3.3 Overall Impact on Soil

The mitigation measures listed above to minimize the impact on soil (due to erosion and materials and wastes) are deemed sufficient. Therefore, the overall residual impact on soil as a result of the Project is assessed to be Negligible.

## 6.4 Air

### 6.4.1 Dust

**Magnitude of Effect:** Negligible
**Direction of Effect:** Adverse
**Duration of Effect:** Short term
**Frequency:** Intermittent
**Scope of Effect:** Project Site
**Reversibility:** Reversible

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

Dust may be produced during preparation and construction activities (such as clearing, grubbing, blasting, stockpiling, transporting materials and/or employees, and general use of construction equipment). The effect of dust from preparation activities is assessed to be Negligible for the following reasons:

- Clearing activities are temporary and limited to the first portion of the first year of each Stage.
- Areas to be cleared will be minimized where practicable: for example, previously disturbed areas have been identified and will be used for temporary trails or laydown areas.
- Stockpiled materials will be compacted and re-used, where practicable.
- Trucks hauling materials will be covered to minimize dust coming off loads.

**Section 3.17** outlines traffic volumes expected during the preparation and construction phases. The vehicles may travel along the PR 395, PR 392 and PR 393. Of these, only PR 392 is paved. Dust generation from construction traffic along the main roads and temporary trails is therefore expected to be Negligible because:

- The increase in traffic along these roads and at the Project Site is temporary (limited to the first year of each Stage).
- If required, dust suppression activities, such as the use of approved dust control agents, will be undertaken.
- The temporary trails will have a speed limit of 20 km/hr. The speed limits on PR 395 and PR 393 will be adhered to at all times.
- Vegetated buffers will be maintained to minimize the transport of dust generated on site.

There is no anticipated change in dust generation from current conditions during the operation or closure phases of the expansion of the Anderson TIA.

## 6.4.2 Emissions

**Magnitude of Effect:** Negligible
**Direction of Effect:** Adverse
**Duration of Effect:** Short term
**Frequency:** Intermittent
**Scope of Effect:** Project Site
**Reversibility:** Reversible

As indicated in **Section 3.17**, it is expected that, during construction, a maximum of 17 vehicles will access public roads in the Project Site and Project Area. **Table 6-2** presents the percentage changes associated with these numbers.

**Table 6-2: Traffic Changes**

| Project Stage | | PR 395 | PR 392 (south of PR 393, from Flin Flon) | PR 392 (north of PR 396, from Snow Lake) | PR 393 |
|---|---|---|---|---|---|
| **AADT (MIT, 2013)** | | 420 | 410 | 730 | 330 |
| **Stage A** | Maximum Vehicles | 17 | 17 | 17 | 17 |
| | Percent Change | 3.9% | 4.0% | 2.3% | 4.9% |
| **Stage B** | Maximum Vehicles | 12 | 12 | 12 | 12 |
| | Percent Change | 2.8% | 2.8% | 1.6% | 3.5% |
| **Stage C** | Maximum Vehicles | 12 | 12 | 12 | 12 |
| | Percent Change | 2.8% | 2.8% | 1.6% | 3.5% |

*Source: MIT, 2013.*

During the preparation and construction phases of the Project, exhaust emissions will be generated during delivery of materials and employees to the site, and other operation of vehicles. Emissions will also be generated during construction of the water retention dams, spillway, seepage collection system, as well as preparation activities (such as clearing and grubbing of laydown areas, temporary trails). These sources of emissions will be generated during the first year of each Stage. Periodic monitoring and inspection of the structures may occur during the inundation periods between Stages. The effect of emissions from operation of vehicles during preparation and construction phases of the Project is assessed to be Negligible for the following reasons:

- The percent change in exhaust emissions as a result of construction activities is temporary (limited to the first year of each Stage).
- Vehicles and equipment will be well maintained.
- Vehicle idling will be kept to a minimum.
- All vehicles used for the proposed Project 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 contractor trailers during construction. 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. The effect of exhaust emissions from operation of propane heaters is assessed to be Negligible for the following reasons:

- The construction phases of the Project are limited to the first year of each Stage (*i.e.,* the effect is temporary)
- The heating systems will be equipped with low NOx burners.
- HBMS will maintain ongoing compliance with *The Workplace Safety and Health Act*.

There is no anticipated increase in traffic or exhaust emissions during the operation or closure phases of the Project because:

- The operation of the Anderson TIA, following the expansion, is not anticipated to be different from the current operating procedures.

The closure activities associated with the proposed expansion are not anticipated to be different from what is currently planned for the Anderson TIA.

### 6.4.3 Noise and Vibration

**Magnitude of Effect:** Negligible
**Direction of Effect:** Adverse
**Duration of Effect:** Short term
**Frequency:** Intermittent
**Scope of Effect:** Project Site
**Reversibility:** Reversible

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 6.10.2**.

Sources of noise during construction would be typical of heavy equipment such as bulldozers and excavators. Noise and vibration will also be generated when blasting is undertaken at quarries and, where required, at dams or spillway locations.

Other locations with human receptors within the general vicinity of the Project Area include cottages, remote residences and lodges. The closest residences are along Anderson Bay (approximately 1 km southeast of the Project Site). 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. For these reasons, the focus of the assessment of noise-related effects is for employees working at the Project Site. The effect of noise on employees is assessed to be Negligible for the following reasons:

- Blasting at the quarries will occur only intermittently during the first year of each Stage
- 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 area.
- Blasting will occur infrequently outside of the quarries and in accordance with applicable regulations made under *The Workplace Safety and Health Act*.
- HBMS will provide hearing protection as required to protect employees working on site from noise during construction 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.

The operation of the Anderson TIA, following the expansion, is not anticipated to be different from the current operating procedures. Therefore, no additional noise or vibration will occur during the operation phases of the Project.

### 6.4.4 Overall Impact on Air

The mitigation measures listed above to minimize the impact on air (due to dust, emissions, and noise and vibration) are deemed sufficient. Therefore, the overall residual impact on air as a result of the Project is assessed to be Negligible.

## 6.5 Climate

**Magnitude of Effect:** Negligible
**Direction of Effect:** Adverse
**Duration of Effect:** Short term
**Frequency:** Intermittent
**Scope of Effect:** Project Site
**Reversibility:** Irreversible

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. GHG emissions are expected during construction and closure activities. There is no anticipated change in GHG emissions during the operation phase.

GHG emissions are expected to be typical of construction activities and will be limited in duration. The effect of GHG emissions from the Project is assessed to be Negligible for the following reasons:

- Idling at the Project Site will be kept to a minimum (for example, while waiting for quarry trucks to unload).
- Vehicles and equipment will be maintained in good working condition.
- The increase in emissions will be for a very short period of time.
- All vehicles used for the proposed Project will comply with Environment Canada's *On-Road Vehicle and Engine Emission Regulations* as required.

### 6.5.1 Overall Impact on Climate

The mitigation measures listed above to minimize the impact on climate (due to GHG emissions) are deemed sufficient. Therefore, the overall residual impact on climate as a result of the Project is assessed to be Negligible.

The Intergovernmental Panel on Climate Change (IPCC) has published guidance on the effects that flooding of a terrestrial vegetation area has on atmospheric releases in tonnes of carbon (primarily methane and carbon dioxide) (IPCC, 2000). The guidance indicates that flooding of a terrestrial vegetation area may act as a GHG source while organic material is decomposing (short term) and then become a small carbon sink due to sedimentation deposition (IPCC, 2000).

The guidance specifies rate of carbon gain and does not differentiate on the chemical nature of releases (or negative gains); underwater decomposition is expected to release carbon primarily as methane.

A range of carbon release rates is provided that generally corresponds to the amount of biological matter that is flooded and subsequently decomposes; a small amount of flooded vegetation would correspond to the smaller end of the range of carbon released.

In the proposed Project, approximately 1.02 km² (102 ha) will be flooded after a number of dikes have been raised. In the short term, it is anticipated that the proposed flooded area will generate GHG emissions between 10.2 t Carbon/year and 204 t Carbon/year. Due to the small quantity of vegetation on the proposed flooded area, and the fact that areas to be inundated will be cleared of trees prior to inundation itself, the carbon releases are anticipated to be on the lower end of this range. In the long-term, the creation of new flooded lands will create a small greenhouse gas sink of approximately 0 to 5.1 t Carbon/year due to sediment deposition. The range of possible Project effects is summarized in **Table 6-3** below.

**Table 6-3: Rate of potential carbon gain for creation of new flooded lands for wetland management activity.**

| Timeframe | Hectares of new flooded lands | Rate of Carbon Gain (t Carbon/ha•yr) | Source/Sink | Proposed Project Anticipated Carbon Gain (t Carbon/yr) |
|---|---|---|---|---|
| **Short Term** | 102 | -0.1 to -2 | Source | -10.2 to -204 |
| **Long Term** | 102 | 0-0.05 | Sink | 0 to 5.1 |

Overall, emissions due to newly created flooded lands are anticipated to have a Negligible impact to provincial and federal GHG inventories.

# 6.6 Groundwater

Activities such as handling fuels and lubricants can potentially affect groundwater quality. Measures to avoid groundwater effects from leaks and spills are addressed in **Section 6.12.2**.

There are no withdrawals of groundwater proposed for the Project. Potential surface to groundwater recharge pathways in the direct footprint of the dams, spillway, and collection basins could be affected. However, the shallow groundwater will remain unaffected due to numerous other pathways for recharge. In addition, the level of groundwater (piezometric surface) will increase in the areas that are inundated and will transition to their current levels within a short distance of the TIA. Therefore it is concluded that the Project will not impact groundwater.

## 6.6.1 Overall Impact on Groundwater

The Project will not impact groundwater.

# 6.7 Surface Water

Surface water quality may be affected by tailings deposition and discharge, waste management, construction activities and the storage and handling of materials, and erosion.

## 6.7.1 Surface Water Quality

This component of the assessment comments on significance based on consideration of the MMER limits and the CCME guidelines for water quality.

**Magnitude of Effect:** Negligible
**Direction of Effect:** Adverse
**Duration of Effect:** Long term
**Frequency:** Intermittent
**Scope of Effect:** Project Site/Area
**Reversibility:** Reversible
**Significance:** Insignificant

As indicated in **Section 5.3.3**, the results of water quality studies conducted on the Anderson TIA, Anderson Creek and Anderson Bay do not demonstrate any exceedance of MMER limits. HBMS did note increasing zinc concentrations in 2014 and 2015, when compared to the data from the previous two years (although still within the historic 37 year range). HBMS considered the increase and attempted to identify measures to reduce zinc levels in the discharge. HBMS took into consideration that the capacity to treat tailings in the TIA could be diminishing as the volume of tailings approaches maximum capacity. If that is the case, the TIA expansion will increase the volume of water and provide for continued effective management of the tailings.

**Section 5.3.3.2.5** describes the HBMS analysis of why the metal concentrations increased in 2014 and 2015 and outlines measures taken in the management of Stall Lake Concentrator and Anderson TIA, which include:

- Increasing ore recovery rates through effective management and training practices, using the most highly skilled and knowledgeable employees;

- Using GPS monitoring and real time bathymetric surveys to ensure that the deposition plan developed in the office is feasible on site, and modifiable in real time, if required; and

- Relocating the tailings pipeline to a more sheltered location to reduce the degree of influence of wind action on mixing of tailings in the water column and consequential increase in metals concentration in the TIA discharge.

In the data taken to date for 2016, the zinc concentration has reduced to half the concentration it was in 2015.

Moving forward, for the following reasons, AECOM assesses that the effluent from the expanded Anderson TIA will continue to meet the required water quality guidelines, and thus the surface water quality downstream of the Anderson TIA will not change:

- As noted above, if capacity has become an issue, expansion of the Anderson TIA will increase the volume of water and provide for continued effective management of the tailings.
- The processes associated with concentrating ore (which results in production of tailings) are not changing.
- Based on analysis of the ore to be processed, the size and composition of tailings to be deposited into the TIA will be consistent with tailings that have been deposited historically; therefore, the water quality is not expected to change at the discharge, in the Anderson Creek or Anderson Bay.
- Conclusions in the 1990 MEND study (Rescan 1990) made in regards to tailings characteristics within the Anderson TIA are still valid: deposited tailings were not releasing metals into the overlying water; tailings and natural sediments are acting as sinks for metals; at the end of deposition, the tailings will be progressively covered by a blanket of organic-rich natural sediments which will act to preserve the anoxic conditions essentially in perpetuity; and it is unlikely that the tailings on the floor of the Anderson TIA will ever support a benthic efflux of metals to the water contained in the Anderson TIA).

- HBMS will continue regular monitoring as prescribed by the MMER 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).

Water quality may also be affected by improper handling of solid and construction waste. The risk of this occurring is assessed to be appropriately mitigated because:

- All waste generated on the Project Site will be handled and disposed of by a licenced contractor to a licenced waste disposal facility.
- Storage and handling of construction materials will be conducted in accordance with best management practices established by HMBS and the selected contractor.
- Measures listed in **Section 6.12.2** will be implemented to minimize risks of spills and leaks.

Water quality may also be affected by erosion. The effect of erosion on water quality is assessed to be Minor because the mitigation measures outlined in **Section 6.3.1** are assessed to effective and sufficient.

Water quality downstream may be affected by inundation of the TIA shoreline because:

- Flooded soil and vegetation release greenhouse gases (CO2 and CH4), nutrients (nitrogen and phosphorus), methylmercury and other contaminants, organic matter, and oxygen-demanding materials into the water.

- Elevated nutrients and organic matter may promote primary productivity, which may increase turbidity and oxygen. Excessive algal growth could result in toxic cyanobacterial blooms. Decomposition of organic matter in the soil as well as dead algal blooms would then deplete oxygen levels, promoting the release of other contaminants from the soil.

However, for the following reasons, it is anticipated that the impact of such inundation on water quality downstream of the TIA will be Minor:

- It has been found that the area of inundation (particularly the area proportional to the size of the reservoir), the rate of flooding, and the composition of soils and vegetation in areas to be inundated all are factors which will affect the magnitude and duration of the release of the constituents noted above (Rosenberg et al., 1995). In the case of the proposed expansion of the Anderson TIA, the relative increase in surface area (27% increase) and the time estimated to reach this surface area (approximately **nine to ten years** to the end of Stage C inundation) work together to minimize the potential effects of release of nutrients and other constituents into the water column. Because the water level will rise gradually, it is anticipated that the release of nutrients will not result in a drastic or sudden change in the productivity of the surface waters in Anderson TIA or downstream receiving waterbodies.

- Secondly, the storage volume already retained within the Anderson TIA will assist in assimilating these constituents and thus further minimize their potential to result in adverse effects downstream of the discharge point.

- The shoreline of Anderson TIA that will be inundated is dominated by low-lying areas, particularly in the southern portions of the Anderson TIA. These bog or fen areas are rich in organics and will proportionally release more nutrients than other shorelines (*e.g.,* bedrock, sand). However, trees on the shoreline will be harvested prior to inundation. A further mitigation measure might be to remove all vegetation and organic soil layers, but this mitigation measure is not recommended because the degree to which this mitigation is successful has not been experimentally validated (Rosenberg et al., 1995; Mailman et al., 2006) and is judged to be impractical for the TIA

#### *6.7.1.1 Overall Impact on Surface Water Quality*

For the reasons presented above, the overall residual impact on surface water quality downstream of the Anderson TIA is assessed to be Negligible and Insignificant.

### 6.7.2 Surface Water Quantity

**Magnitude of Effect:** Minor
**Direction of Effect:** Adverse
**Duration of Effect:** Short term
**Frequency:** Intermittent
**Scope of Effect:** Project Site
**Reversibility:** Reversible

Following the construction phase of each Stage, the water level in the Anderson TIA will gradually rise based on tailings production, reclaim water usage, precipitation and runoff from the Anderson catchment area. This gradual inundation will take place over approximately two to four years, during which there likely will be little need to discharge out of the Anderson TIA. Any discharge that occurs will be through the newly improved spillway channel, which will be controlled with sluice gate. For the following reasons, the effect of the altered Anderson TIA discharge regime on the surface water quantity in Anderson Creek is assessed to be Minor:

- Historically, Anderson Creek was a discontinuous channel through a flooded fen area with intermittent flow primarily by the spring freshet and larger precipitation events (AECOM, 2013d).
- The interruption of discharge from the TIA will be temporary, and thus the subsequent change in the flow and water level of Anderson Creek will also be temporary. Once discharge is resumed, the flow and water levels will return to the current levels.

Changes in surface water quantity may have consequential effects on fish and fish habitat in Anderson Creek. Potential impacts on fish and fish habitat are discussed in **Section 6.8.4**.

#### *6.7.2.1 Overall Impact on Surface Water Quantity*

For the reasons presented above, the overall residual impact on surface water quantity in Anderson Creek as a result of the Project is assessed to be Negligible.

### 6.7.3 Overall Impact on Surface Water

The operation of the expanded Anderson TIA will be consistent with current operations and therefore the effect on surface water quantity is assessed to be Negligible.

## 6.8 Aquatic Resources

Aquatic resources are living species present in a surface water body, including lower trophic level biota, macrophytes and fish, and their habitat. Aquatic resources may be affected directly or indirectly by changes in surface water quality.

## 6.8.1 Protected Aquatic Species

**Magnitude of Effect:** Negligible
**Direction of Effect:** Adverse
**Duration of Effect:** Moderate term
**Frequency:** Intermittent
**Scope of Effect:** Project Site/Area
**Reversibility:** Reversible

As noted in **Section 5.6**, there are 29 species of special concern listed by the Manitoba CDC (Manitoba Sustainable Development, 2016a), none of which were observed in the areas examined during the biophysical surveys of the Project Area. Of the species of special concern, only one aquatic species is protected federally under *SARA*: Shortjaw Cisco.

The Shortjaw Cisco has been recorded Manitoba lakes including Lake Athapapuskow, Clearwater Lake, Lake Winnipeg, George Lake, Reindeer Lake and Lake Athabasca (COSEWIC, 2003). However, there have been no reported occurrences in the Grass River sub-basin in the Nelson River Basin.

Given that the potential of occurrence of protected aquatic species within the Project Region is low, there are no effects anticipated as a result of the expansion of the Anderson TIA.

## 6.8.2 Lower Trophic level Biota

**Magnitude of Effect:** Negligible
**Direction of Effect:** Adverse
**Duration of Effect:** Moderate term
**Frequency:** Intermittent
**Scope of Effect:** Project Site/Area
**Reversibility:** Reversible

Effects on lower trophic level biota occur primarily through changes in habitat quality and quantity. Reduced quantity and quality of habitat can reduce the abundance, diversity or community composition of aquatic invertebrates, with secondary effects on organisms higher in the food chain. Effects on habitat quantity can occur through changes to the hydraulic regime of Anderson Creek. Habitat quality can be affected through changes in sediment quality, through surface runoff (elevated concentration of metals or other contaminants), through air dispersion (dust), or any accidental leaks or spills during the preparation and construction phases of the Project. For the following reasons, the potential effect of the Project on aquatic benthic invertebrates is assessed to be Negligible:

- Application of mitigation measures for surface water quality listed in **Section 6.7.1**.
- Application of mitigation measures to minimize the risk of occurrence of skills and leaks listed in **Section 6.12.2**.

Habitat quantity for aquatic benthic invertebrates may be impacted as a result in a temporary change in the hydraulic regime of Anderson Creek, as much of its flow is provided by the discharge. However, this effect is assessed to be Negligible for the reasons outlined in **Section 6.7.2** (historic conditions of the Creek and disruption of the flow regime being temporary).

## 6.8.3 Overall Impact on Aquatic Resources

For the reasons listed in the sections above, the residual effects on protected aquatic species and aquatic benthic invertebrates, as a result of the Project, are assessed to be Negligible.

## 6.8.4 Fish and Fish Habitat

**Magnitude of Effect:** Minor
**Direction of Effect:** Adverse
**Duration of Effect:** Moderate term
**Frequency:** Intermittent
**Scope of Effect:** Project Site
**Reversibility:** Reversible

Effects on fish and fish habitat occur primarily through changes in habitat quality and quantity. Habitat quantity can be affected by the physical alteration of fish habitat and altering the hydraulic regime of Anderson Creek (see **Section 6.7.2**). Effects on aquatic benthic invertebrates (see **Section 6.8.2**) can indirectly affect fish habitat quality (reduced diversity or abundance reduces food availability), as can changes to surface water quality (**Section 6.7.1**). Effects of inundation and potential release of methylmercury, may affect fish health and subsequently human consumption of this fish (see **Section 6.11.1**).

For the following reasons, the potential impact on fish and fish habitat is assessed to be Minor:

- The potential impact on habitat quality has been assessed to be Minor (see **Section 6.8.5** below).
- Potential effects on benthic invertebrates were assessed to be Negligible (see **Section 6.8.2**).
- Changes to water quality were assessed to be Negligible (see **Section 6.7**).

## 6.8.5 Habitat Quality

Changes to surface water quality, through deposition of dust (**Section 6.4.1**), soil erosion (**Section 6.3.1**), spills or leaks (**Section 6.12.2**) or effects on surface water quality (**Section 6.7.1**) can impact fish the quality of fish habitat. For the following reasons, the potential impact on fish and fish habitat is assessed to be Minor:

- Fish studies of Anderson Bay (carried out pursuant to regulatory requirements over 37 years of operation) have confirmed that water quality downstream of the Anderson TIA continues to support high species diversity.
- As assessed in **Section 3.9.3.1.1**, the spillway realignment will not result in serious harm to fish in Anderson Creek, and therefore DFO review or Authorization under the *Fisheries Act* will not be required.
- Overland flows which have been draining into the TIA will now be directed into Anderson creek which will sustain flows and prevent any stranding of fish.
- Application of measures to mitigate dust outlined in **Section 6.4.1**.
- Application of measures to mitigate soil erosion outlined in **Section 6.3.1**.
- Application of measures to mitigate the risk of occurrence of spills and leaks outlined in **Section 6.12.2**.

### 6.8.6 Overall Impact on Fish and Fish Habitat

For the reasons listed in the sections above, the residual effects on fish and fish habitat, as a result of the Project, are assessed to be Minor.

## 6.9 Terrestrial Flora Species

Effects on protected and other terrestrial flora include clearing and dust deposition.

### 6.9.1 Clearing

**Magnitude of Effect:** Negligible
**Direction of Effect:** Adverse
**Duration of Effect:** Moderate term
**Frequency:** Once
**Scope of Effect:** Project Site
**Reversibility:** Reversible

As noted in **Section 3.11**, a maximum of 173 ha of additional clearing will be required for the proposed Project. Most of this clearing will be limited to the first year of each Stage and will include clearing for temporary trails, laydown areas, dams, quarries and borrow pits and powerlines. The area around the Anderson TIA, in the areas to be inundated by the Project, will also be cleared. For the reasons described in the paragraphs below, the effects of clearing are assessed to be Moderate:

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 (156.9 ha) from the FMU that covers the Project Area (5,347.8 ha) and surrounding Project Region (47,811.5 ha). The Project Site includes a total of 15 different cover classes: 12 vegetated cover classes, a disturbed area cover class, and two water cover classes (small islands and open water) as shown in **Table 6-4**.

**Table 6-4: 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 |
| **Pine Jack** | **40-70% with Spruce** | 1.9 | 659.4 | 4,614.7 | 0.3% | 0.0% |
| **Spruce Black** | **40-70% with Balsam Fir and White Spruce** | 20.0 | 168.1 | 1,073.7 | 11.9% | 1.9% |
| **Spruce Black** | **40-70%with Jack Pine** | 19.6 | 720.5 | 6,098.6 | 2.7% | 0.3% |
| **Spruce Black** | **51% or more** | 6.4 | 33.0 | 391.2 | 19.3% | 1.6% |

| Cover Class | Species Composition or Subtype | Area (ha) of Cover Class | | | Project Site as a % of | |
|---|---|---|---|---|---|---|
| **Spruce Black** | **71-100%** | 20.7 | 852.5 | 3,935.9 | 2.4% | 0.5% |
| **Spruce White** | **40-70% with Balsam Fir, Jack Pine, and Black Spruce** | 2.1 | 22.0 | 423.2 | 9.4% | 0.5% |
| **Spruce White** | **50%or less with Balsam Fir, Jack Pine, and Black Spruce** | 0.5 | 175.0 | 493.0 | 0.3% | 0.1% |
| **Spruce White** | **51%or more** | 4.5 | 23.9 | 120.6 | 19.1% | 3.8% |
| **Trembling Aspen** | **with Spruce, Balsam Fir, and Tamarack Larch** | 28.6 | 323.2 | 1,552.0 | 8.8% | 1.8% |
| **Trembling Aspen** | **71-100%** | 6.7 | 149.6 | 760.7 | 4.5% | 0.9% |
| **Willow** | | 3.7 | 3.9 | 118.4 | 94.6% | 3.1% |
| **Black Spruce Treed Muskeg** | | 3.2 | 782.9 | 8,183.3 | 0.4% | 0.0% |
| **Small Islands** | **Not defined** | 0.3 | 9.6 | 58.1 | 2.8% | 0.5% |
| **Disturbed** | | 11.7 | 234.5 | 818.5 | 5.0% | 1.4% |
| **Water** | | 36.1 | 958.7 | 13,874.3 | 3.8% | 0.3% |
| **Classes not found within Project Site** | | | 231.1 | 5,295.5 | | |
| **Total** | | 165.9 | 5,347.8 | 47,811.5 | | |

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 13 vegetated cover classes were calculated and the percentages of each within the Project Area and Project Region were determined. It is worth noting that the Project Area and Project Region contain cover classes not found in the Project Site (with combined area over 5,347.8 ha and 47,811.5 ha respectively). The results are as follows:

- Of the 13 different vegetated cover classes, the largest area within the footprint of the Project Site was Trembling Aspen with Spruce (*Picea* sp.), Balsam Fir (*Abies balsamea*), and Tamarack Larch (28.6 ha); the smallest cover class disturbed was White Spruce 50% or less with Balsam Fir, Jack Pine, and Black Spruce (0.05 ha). Five percent (5%) of the Project Site was composed of existing disturbed areas.
- The least common cover class in the Project Area was Willow (3.9 ha) (*Salex* sp.) with 3.7 ha disturbed by the Project Site (representing 94.6% of the total available in the Project Area). The least common cover class in the Project Region was Willow (118.4 ha) with 3.7 ha disturbed by the Project Site (representing 3.1% of the total available in the Project Region).
- The loss of this cover classes still leaves a significant amount remaining within the 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 122.1 ha of Willow remains within the Project Region.
- These cover classes are common to the area surrounding the Project Area and Project Region. In addition to that, where possible 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.

### 6.9.2 Dust Deposition

**Magnitude of Effect:** Negligible
**Direction of Effect:** Adverse
**Duration of Effect:** Short term
**Frequency:** Intermittent
**Scope of Effect:** Project Site
**Reversibility:** Reversible

As noted in **Section 6.4.1**, dust generated during the construction and closure phases of the Anderson TIA 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 6.9**, effects on terrestrial flora due to dust are assessed to be Negligible.

### 6.9.3 Protected Flora Species

**Magnitude of Effect:** Negligible
**Direction of Effect:** Neutral
**Duration of Effect:** Moderate term
**Frequency:** Once
**Scope of Effect:** Project Site
**Reversibility:** Reversible

As described in **Section 5.6**, of the species of special concern listed by the Manitoba CDC (Manitoba Conservation, 2012a), only one terrestrial flora species is protected federally under the *Species at Risk Act* (*SARA*): the Flooded Jellyskin.

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 during the biophysical surveys in the Project Area. Therefore, the residual effect on Flooded Jellyskin as a result of the expansion of the Anderson TIA is assessed to be Negligible.

### 6.9.4 Overall Impact on Terrestrial Flora Species

For the reasons presented above in **Section 6.9.1** to **Section 6.9.3**, the overall residual impact on terrestrial flora species (including protected flora species) due to clearing and dust deposition are assessed to be Negligible.

## 6.10 Terrestrial Fauna Species

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

## 6.10.1 Loss of Habitat

**Magnitude of Effect:** Negligible
**Direction of Effect:** Adverse
**Duration of Effect:** Moderate term
**Frequency:** Once
**Scope of Effect:** Project Site
**Reversibility:** Reversible

Loss of vegetation through clearing and flooding can affect terrestrial fauna by reducing the amount of habitat available. The potential impact of loss of habitat on terrestrial fauna species (including migratory birds) is assessed to be Minor for the following reasons:

- No critical wildlife habitat was observed on the Project Site (such as calving or over-wintering areas) and, based on site conditions and field observations, it is assessed that there is no critical wildlife in the Project Area. As discussed in **Section 5.5.1**, the Project Site is characterized by little variety in plant habitats.
- Nesting birds that may make use of the edge habitat available along the shoreline of the Anderson TIA will be able to continue to use this habitat following development of the Project. Despite clearing along the shoreline and other areas, 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).
- There were no potential brooding areas for waterfowl observed in the Project Site but there were some within the Project Area (along the Lalor Access Road and former rail bed). 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.
- To the extent practicable, previously cleared areas will be used for temporary trails and/or laydown areas to minimize the area to be cleared.
- The natural restoration of vegetation in these temporary areas during closure will provide for restoration of available habitat.

## 6.10.2 Noise

**Magnitude of Effect:** Negligible
**Direction of Effect:** Adverse
**Duration of Effect:** Moderate
**Frequency:** Intermittent
**Scope of Effect:** Project Site
**Reversibility:** Reversible

As described in **Section 6.10.2**, noise generated during the preparation and construction phases of the expansion of the Anderson TIA has the potential to deter wildlife from the area. During construction, noise will be generated to varying degrees as described above. The potential impact on terrestrial fauna as a result of noise is assessed to be Minor for the following reasons:

- It is anticipated that local fauna are likely already accustomed to some level of noise based on the existing activity in the area (Lalor Mine, PR 395, PR 392 and the Stall Lake Concentrator).
- 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 substantially affect wildlife as similar habitats are available in the Project Area and Region.

## 6.10.3 Risk of Vehicle Collisions

With the anticipated increase in traffic on local public roads (discussed in more detail in **Section 6.4.2**), there is potential for increased wildlife collisions. Moose, coyotes and wolves may pass through the Project Area, including Provincial highways and local roads. Edge vegetation and the open nature of these roads allows for ease of migration, making the area attractive to wildlife. The potential risk of collisions as a result of the Project is assessed to be Low for the following reasons:

- As local wildlife populations are considered low, the potential for increased wildlife collisions is also considered low.
- HBMS' experience in the local area indicates that wildlife collisions are rare.
- Continued implementation of speed limits on the temporary trails, local roads and Provincial highways.

## 6.10.4 Protected Fauna Species

**Magnitude of Effect:** Negligible
**Direction of Effect:** Adverse
**Duration of Effect:** Moderate
**Frequency:** Once
**Scope of Effect:** Project Site/Area
**Reversibility:** Reversible

As noted in **Section 5.6**, there are 29 species of Special Concern listed by the Manitoba CDC (Manitoba Conservation, 2012a), none of which were observed in the areas examined during the extensive biophysical surveys of the Project Area. Of the species of Special Concern, four terrestrial fauna species are protected either federally under the *SARA* or provincially under the provincial *Endangered Species and Ecosystems Act* (*ESEA*): Boreal Woodland Caribou, Monarch butterfly, Northern Leopard Frog, Yellow Rail, Whip-poor-will, Common Nighthawk, Olive-sided Flycatcher, and Rusty Blackbird. The potential impact of the Project on protected fauna species is assessed to be Minor for the following reasons:

- The Provincial recovery strategy plan for Woodland Boreal Caribou identifies 15 known ranges of the species (Manitoba Boreal Woodland Caribou Management Committee, 2015). One of the Management Units, the Atikaki-Berens, overlaps with the Project Region. 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 range of the Monarch butterfly can extend to the 54$^{o}$ Latitude of the Prairie Provinces. However, the bulk of occurrences are south of the 50$^{o}$ Latitude. Recorded occurrences are limited in the northern regions such as Thompson, The Pas and Grand Rapids, and these are generally considered vagrants (COSEWIC, 2010). The Project Region falls within the limits of the species' distribution, but no monarch butterflies were recorded during the terrestrial investigations.
- The range for the Northern Leopard Frog overlaps with the Project Region, but none were spotted during the terrestrial investigations (COSEWIC, 2009a).
- The Yellow Rail distribution in Manitoba is scattered through locations south of the Boreal Shield Ecozone and is concentrated in the Boreal Plains and Aspen Parkland portions of the Prairie Ecozone (COSEWIC, 2009b). Although there is potential for the Yellow Rail to occur in the Ecozone, there are no known occurrences of Yellow Rail within the Project Region.
- The Whip-poor-will is a well-known, nocturnal bird. It is an aerial foraging insectivore. The Whip-poor-will breeds in southern Manitoba and would be on the edge of its range in the Project Region (COSEWIC, 2009c).
- The Common Nighthawk is breeds across western Canada, including in Manitoba below the treeline. The breeding habitat includes ground devoid of vegetation such as sand dunes, beaches, logged areas, burned-

over areas, forest clearings, rocky out crops, rock barrens, prairies, peat bogs and pastures. They have not been observed in the Project Region and are unlikely to nest within the Project Site (COSEWIC, 2007)
- The Olive-sided Flycatcher breeds in boreal, sub-boreal, interior and coastal forest regions, including Manitoba (Environment Canada 2015). There have been no observations in the Project Region during terrestrial investigations
- The Rusty Blackbird breeding range includes a large portion of North America (COSEWIC, 2006). There have been no observations in the Project Region during terrestrial investigations.

### 6.10.5 Overall Impact on Terrestrial Fauna Species

For the reasons outlined above, the residual impact on terrestrial fauna species (including protected fauna species) as a result of the Project (loss of habitat, noise and risk of vehicle collisions) is assessed to be Minor.

## 6.11 Socio-Economic Effects

### 6.11.1 Fish Consumption in Downstream Waterbodies

#### *6.11.1.1 Mercury and Methylmercury in Fish*

**Magnitude of Effect:** Negligible
**Direction of Effect:** Adverse
**Duration of Effect:** Moderate term
**Frequency:** Continuous
**Scope of Effect:** Project Site/Area
**Reversibility:** Reversible

The construction of reservoirs typically involves submerging large amount of terrestrial organic matter. The decomposition of submerged organic matter can result in the formation of organic mercury (or “methylmercury”) that can potentially accumulate along the food chain (Brouard *et al*., 1990). Methylmercury production is controlled primarily by the amount and composition of the submerged organic matter, but is also influenced by biotic and abiotic factors such as microbiological activity and physicochemical characteristics of water (pH, dissolved oxygen, redox potential, humic and fulvic acids, sulfides, etc.). Among these factors, the amount of submerged organic matter has the most influence on the production of methylmercury in the wake of flooding.

Mercury concentrations in fish tissue can increase five-fold following the creation of a new reservoir (Azimuth, 2010). Depending on the species and size of fish in reservoirs, it can take between 10 and 35 years before natural levels of mercury are restored in fish tissues (Therrien and Schetagne, 2009). In the case of this assessment, the condition of fish in the reservoir itself is not relevant because: no fishing is now or at any time in the future will be permitted in the Anderson TIA (because it is a tailings impoundment area designated under the *Fisheries Act*); and because of the limited connectivity between the Anderson TIA and downstream waterbodies.

However, research also indicates that fish in waters downstream of reservoirs have shown evidence of mercury accumulation. This assessment does consider the potential impacts of mercury on fish downstream of the Anderson TIA.

Migration of mercury normally occurs when the mercury and/or methylmercury is bound to suspended particles or exists in the dissolved phase in the water column. The accumulation of mercury and methylmercury in fish tissue is

primarily regulated through the food that the fish eat. Plant debris, phytoplankton, zooplankton, benthos, and smaller fish also can contribute to the migration of mercury downstream. These factors largely account for the accumulation of mercury in the fish that people consume. The concentration of mercury in the water column alone is not a major factor.

Fish are an excellent source of protein and omega-3 fatty acids, and in many areas of Canada fish is the primary source of protein in the daily diet. Fish consumption is also the primary exposure pathway to methylmercury in humans. As a result, Health Canada advises that the benefits and risks of eating fish should be balanced. Health Canada (Health Canada, 2007) has developed guidelines designed to evaluate mercury uptake from fish tissue. For example, Health Canada has established a guideline of 0.5 parts per million of total mercury in fish tissue for most fish sold commercially; and Canadians are advised to limit consumption of several ocean sport fish (combined) that typically have high mercury concentrations to 150 g **per week.**

The province of Manitoba has created guidelines for the consumption of recreationally angled fish in the province's river systems affected by hydroelectric development. This provincial program focuses on consumption limits which were based on detailed fish population studies and provide consumption limits relative to toxicological endpoints and a Tolerable Daily Intake (TDI) limit for methylmercury which is standardized for the body weight and applicable to adults that are not pregnant (*e.g.,* mg/kg/day). The Wekusko Lake watershed is not included in the sport fish consumption limit guideline program, and therefore there is no methylmercury TDI for Wekusko Lake.

#### *6.11.1.2 The Overall Impact of Mercury on Fish Consumption*

Based on the 2015 AECOM study of fish collected and analysed in the Anderson TIA, fish desirable for human consumption are not present in the Anderson TIA. Even if there were such fish there is very limited opportunity for small or large bodied fish to migrate downstream of the TIA. Fishing is not now, and will not at any time in the future, be permitted in the Anderson TIA. For these reasons, it is not appropriate to assess the impact of mercury on fish in the Anderson TIA itself.

With respect to the potential impacts of mercury on fish in the downstream waterbodies, primarily Anderson Bay of Wekusko Lake, it is assessed that the impact will be Negligible for the following reasons:

- Removal of trees during the Stage A preparation activities will reduce the inputs of mercury by reducing the amount of organic matter released into the TIA itself. Once the expansion of the TIA has commenced, the water level will be raised slowly over a period of years (i.e. slow flooding), which will further reduce mobilization of mercury within organic matter released in the course of erosion and sedimentation;
- The pipe that comprises the final discharge point provides little opportunity for the transfer of waterborne biota and suspended solids;
- As noted above, the concentration of mercury in the water column alone is not a major factor in the transfer of mercury to fish desirable for human consumption. Even so, mercury in the dissolved form contained in water discharged from the Anderson TIA would be diluted in Wekusko Lake by a factor of approximately 100; and
- There is little or no fish passage for large or small bodied fish between the Anderson TIA and downstream waterbodies.

The fish collected and analyzed from Wekusko Lake in 2015 showed no instances of fish tissue exceeding the 0.5 parts per million consumption advisory, and this is not expected to change. As stated in **Section 7.3**, in order to confirm this assessment, mercury levels in sport, commercial or subsistence fish in Wekusko Lake will be monitored before and after the final inundation phase (Stage C) of the Project.

## 6.11.2 Land and Resource Use

**Magnitude of Effect:** Minor
**Direction of Effect:** Neutral
**Duration of Effect:** Moderate term
**Frequency:** Once
**Scope of Effect:** Project Site/Area
**Reversibility:** Reversible

Land and resource uses in the Project Region that may indirectly be impacted by environmental effects of the proposed Project include:

- Harvesting and trapping opportunities.
- Fishing (recreational, subsistence and commercial).
- Recreational use of existing trails.
- General use of the Project Area and Region.

The potential impact on land and resource use as a result of the Project is assessed to be Minor for the following reasons:

- The Project Site has been developed for mining purposes for 40 years. The Project will not change the land and/or resource use at the Project Site.
- As presented in this report, residual environmental effects on environmental components have been assessed to be Minor to Negligible in magnitude.

With respect to trapping in the area, HBMS is committed to working with the trappers in the area to ensure that access to their trap lines is not impacted by the proposed development. HBMS has a healthy working relationship with the trappers in the area and have informed all potentially affected trappers within the Project Region of the proposed expansion of the Anderson TIA.

With respect to snowmobile trails, HBMS has discussed the proposed Project with members of the Sno-Drifters snowmobiling club. The club has no concerns with the Project. Prior to commencement of construction, HBMS will notify the club, to ensure advance notification to the club's members.

## 6.11.3 Heritage Resources

Project activities such as clearing, blasting, or excavating can potentially affect heritage resources. However, as described in **Section 5.7.2**, there are no known heritage resources at the Project Site and the potential to find any is low. No further disturbance beyond the Project Site will occur. 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 or 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.

### 6.11.4 Aesthetics

**Magnitude of Effect:** Negligible
**Direction of Effect:** Neutral
**Duration of Effect:** Short term
**Frequency:** Once
**Scope of Effect:** Project Site
**Reversibility:** Reversible

Project activities during preparation and construction could potentially impact the aesthetics of the Project Site. This potential impact is assessed to be Negligible for the following reasons:

- Project components are located primarily in areas that have been previously disturbed as part of the construction of the Anderson TIA or other HBMS activity in the area.
- A treed buffer will be maintained between the dams and PR 392.
- 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 temporary areas (trails or laydown areas) will be contoured, where required, and allowed to naturally re-vegetate.

### 6.11.5 Effects on Aboriginal Peoples

As noted above in **Section 1.4**, HBMS has operated in the Snow Lake district for over 50 years (**Figure 02**). The Anderson TIA has been in operation for 37 years. HBMS has mining and surface claims throughout much of 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 Project components will be on land which HBMS holds under lease or in fee**,** and is occupied and used by HBMS for mining purposes as follows:

- The Anderson Dam and spillway were developed in 1978, and tailings produced at Stall Lake Concentrator have been deposited in Anderson TIA since 1979.
- The Project components (water retention dams, spillway, seepage collection system) constructed in Stage A are all located on HBMS-owned surface or mining claims and leases (**Section 3.6**).

With respect to trapping, although the potential effect on trapping activities is assessed to be Minor, HBMS is committed to continuing to work with trappers in the Project Region 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 proposed expansion is not expected to cause any environmental effects that would lead to consequential effects on Aboriginal peoples.

## 6.12 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.

## 6.12.1 Worker Health and Safety

Worker protection in Manitoba is regulated through standards, procedures and training required under *The Workplace Safety and Health Act*. Safety equipment and personal protective equipment will either be supplied to the employees or be located at the safety office at the Lalor Mine, where needed.

## 6.12.2 Spills and Leaks

Environmental effects may occur due to fuel and chemical spills from diesel fuel, lubricants, oils, hydraulic fluids and explosives. An accidental release of hazardous materials and/or equipment fluids could occur from improper storage and handling procedures (including transporting materials such as explosives). 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 at the quarries will be stored in areas equipped with spill containment measures and in accordance with *The Explosives Act*. Explosives will likely be stored at designated areas at the Lalor Mine site.
- 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 Sustainable Development 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.

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.

## 6.12.3 Fires/Explosions

The presence of mechanical equipment, fuels and explosives 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 Project components have the potential to be affected by off-site forest fires during the summer months. Effects could include loss of infrastructure or affect access to the site. All infrastructures at the Project Site will be built on crushed rock pads. This crushed rock is anticipated to act as a fire barrier for the site. The surrounding trees, if burned, could limit access to or reduce the function of the spillway or seepage collection system.

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

- Explosives required at the quarries will be provided in “just-in-time” deliveries, with longer-term storage provided at designated areas.
- The mine rescue team at the 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 the Anderson TIA.
- 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.

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.

## 6.12.4 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 6.10.3**. Transportation accidents can consequently result in release of pollutants in the environment (diesel, oils, etc.), or materials that the vehicles colliding are transporting (concrete, explosives, 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).

As discussed in **Section 6.4.2**, the increase in traffic during the construction phase is considered Minor. This increase in traffic potentially increases the risk of transportation accidents occurring. To mitigate for the increase, HBMS will implement the following measures:

- The temporary trails will have a speed limit of 20 km/hr. The speed limits on PR 395 and PR 393 will be adhered to at all times.
- Appropriate road signage will be provided along the temporary trails, where necessary.

- 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 393, and PR 392 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.

There is no anticipated increase in traffic during the operation phase of the Project, from the traffic volumes currently observed at site. Traffic volume is expected to substantially decrease during the closure phase (due to a reduction in the 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.

## 6.13 Summary of Environmental Effects and Mitigation Measures

**Table 6-5** summarizes potential environmental effects of the proposed Project and the design features, standard operating procedures and other mitigation measures that will be implemented.

**Table 6-6** summarizes potential accidents and malfunctions and measures to reduce the risk of such occurrences.

**Table 6-5: Summary of Environmental Assessment and Mitigation Measures**

| Environmental and Social Component | Project Phase | Sources of Potential Effects | Summary of Measures | Residual |
|---|---|---|---|---|
| **Topography** | Construction | Clearing, blasting, leveling, trenching, stockpiling materials during site preparation, and installation of laydown areas. | Whenever practicable, existing access roads and laydown areas will be used in order to minimize changes to topography. | Moderate |
| | | | All changes to topography will occur inside the boundary of HBMS operations on land which only HBMS has a right to access. | |
| | | Temporary trails, the relocated pumphouse and powerline – clearing and leveling will be required. | Closure phase will include restoration of any changes to topography of the temporary sites (trails, laydown areas) to match the pre-construction condition of the surrounding area to the extent practical. | |
| | | Installation of four new dams and a spillway | Dam and spillway alignments have been chosen based on proximity to high points and bedrock outcrops to maximize utilization of the existing topography for containment. | |
| | | | The alignment selection process resulted in the smallest practicable footprint and change to topography. The dams and spillway structures will be permanent and will not be removed during the closure phase. | |
| | | | While the change in topography from the dams will be permanent and irreversible, the purpose of the dams is to allow for continued environmental management of tailings. | |
| **Soil - Erosion** | Construction | Clearing and grubbing will be required for dams and spillway, temporary trails, laydown areas, powerline, and around Anderson TIA for areas to be inundated. | To the extent practicable, clearing will occur during the winter to minimize disruption to soil and allow sufficient time for soil stabilization prior to the spring freshet. | Negligible |
| | | | It is anticipated that once the dams are built in each Stage, it will take two to four years for water levels to reach the desired water elevation. Given this length of time, disturbed soils will stabilize naturally and not be susceptible to significant erosion. | |
| | | Stockpiling and excavation. | Stockpiled organic spoils will be compacted and reused, where practicable. | |
| | | | Excavation activities will not occur during high rain or wind events, which will minimize the erosion potential of exposed soils. | |
| | | Soil erosion during the preparation activities (such as clearing and grubbing) and construction of the dams and spillway, which could consequentially affect water quality downstream (in Anderson Creek). | Erosion and Sediment Control (ESC) methods will be in place to prevent the generation and movement of sediment-laden water, which is deemed sufficient to appropriately mitigate for erosion. | |
| | | Erosion may also occur during construction of the dams between construction stages. | The dams are designed to incorporate filter zones within the dam to protect the dam cores from internal erosion. | |
| | | | Geotextile will be placed between the silty clay core and the rockfill layers of any temporary berms to provide containment and minimize erosion between construction stages. | |
| | | | Seepage collection systems will be constructed at the toe of each dam and berm, allowing for collection and pumping back into the Anderson TIA, any seepage that comes through the dam. | |
| | Closure | In order to ensure reversibility of the Project Site, HBMS will undertake the following (to the extent possible). | Apply soil to previously disturbed laydown areas and temporary trails (those not required for future inspections). | |
| | | | Allow all disturbed areas to naturally re-vegetate. | |
| | | | Contour disturbed areas to match the surrounding topography to the extent possible. | |
| **Soil – Materials and Waste Management** | Construction and Closure | Wastes such as used oils, rags, drum and miscellaneous garbage can potentially affect soil quality, which can have subsequent effects on other environmental components (*e.g.,* vegetation, groundwater, and surface water). | Wastes generated during construction will be collected in garbage bins maintained at specific locations throughout the Project 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. | |
| **Air - Dust** | Construction | Dust may be produced during preparation and construction activities (clearing, grubbing, blasting, stockpiling, transporting materials and/or employees, and general use of construction equipment). | Clearing activities are temporary and limited to the first portion of the first year of each Stage. | Negligible |
| | | | Areas to be cleared will be minimized where practicable: for example, previously disturbed areas have been identified and will be used for temporary trails or laydown areas. | |
| | | | Stockpiled materials will be compacted and re-used, where practicable. | |
| | | | Trucks hauling materials will be covered to minimize dust coming off loads. | |
| | | Dust generation from construction traffic along the main roads and temporary trails. | The increase in traffic along these roads and at the Project Site is temporary (limited to the first year of each Stage). | |
| | | | If required, dust suppression activities, such as the use of approved dust control agents, will be undertaken. | |

| Environmental and Social Component | Project Phase | Sources of Potential Effects | Summary of Measures | Residual |
|---|---|---|---|---|
| | | | The temporary trails will have a speed limit of 20 km/hr. The speed limits on PR 395 and PR 393 will be adhered to at all times. | |
| | | | Vegetated buffers will be maintained to minimize the transport of dust generated on site. | |
| **Air - Emissions** | Construction | Exhaust emissions will be generated during delivery of materials and employees to the site, and other operation of vehicles. Emissions will also be generated during construction of the water retention dams, spillway, seepage collection system, as well as preparation activities (such as clearing and grubbing of laydown areas, temporary trails). | The percent change in exhaust emissions as a result of construction activities is temporary (limited to the first year of each Stage). | |
| | | | Vehicles and equipment will be well maintained. | |
| | | | Vehicle idling will be kept to a minimum. | |
| | | | All vehicles used for the proposed Project will comply with Environment Canada's *On-Road Vehicle and Engine Emission Regulations* as required. | |
| | | Exhaust emissions from propane heaters that will be use to heat the contractor trailers during construction. | The construction phases of the Project are limited to the first year of each Stage (i.e., the effect is temporary) | |
| | | | The heating systems will be equipped with low NOx burners | |
| | | | HBMS will maintain ongoing compliance with *The Workplace Safety and Health Act*. | |
| **Air – Noise and Vibration** | Construction and Closure | Sources of noise would be typical of heavy equipment such as bulldozers and excavators, blasting (includes vibration) at quarries and where required, at dams or spillway locations. | Blasting at the quarries will occur intermittently during the first year of each Stage. | |
| | | | 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 area. | |
| | | | Blasting will occur infrequently outside of the quarries and in accordance with applicable regulations made under *The Workplace Safety and Health Act*. | |
| | | | HBMS will provide hearing protection as required to ensure employees working on site are protected from noise during construction 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. | |
| **Climate** | Construction and Closure | Sources of GHG emissions 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. | Idling at the Project Site will be kept to a minimum (for example, while waiting for quarry trucks to unload). | Negligible |
| | | | Vehicles and equipment will be maintained in good working condition. | |
| | | | The increase in emissions will be for a very short period of time. | |
| **Surface Water – Quality** | Construction and Closure | It is expected that the effluent from the expanded Anderson TIA will continue to meet the required water quality guidelines, and thus the surface water quality downstream of the Anderson TIA will not change. | The processes associated with concentrating ore (which results in production of tailings) is not changing. | Negligible & Insignificant |
| | | | Based on analysis of the ore to be processed, the size and composition of tailings to be deposited into the TIA will be consistent with tailings that have been deposited historically. | |
| | | | Conclusions in the 1990 MEND study (Rescan 1990) made in regards to tailings characteristics within the Anderson TIA are still valid: deposited tailings were not releasing metals into the overlying water; tailings and natural sediments are acting as sinks for metals; at the end of deposition, the tailings will be progressively covered by a blanket of organic-rich natural sediments which will act to preserve the anoxic conditions essentially in perpetuity; and it is unlikely that the tailings on the floor of the Anderson TIA will ever support a benthic efflux of metals to the water contained in the Anderson TIA). | |
| | | | HBMS will continue regular monitoring as prescribed by the MMER 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). | |
| | | Water quality may also be affected as a result of improper handling of solid and construction waste. | All waste generated on the Project Site will be handled and disposed of by a licenced contractor to a licenced waste disposal facility. | |
| | | | Storage and handling of construction materials will be conducted in accordance with best management practices established by HMBS and the selected contractor. | |
| | | | Measures listed in **Table** 6-6 will be implemented to minimize risks of spills and leaks. | |
| | Construction and Closure | Water quality may be affected dye to erosion. | Measures listed in **Section 6.3.1** will be implemented to minimize risks of erosion. | |
| | Construction | Flooded soil and vegetation release greenhouse | To minimize nutrient release into the TIA, vegetation and soil will be removed to reduce the severity of the problem. In addition, the water levels | |

| Environmental and Social Component | Project Phase | Sources of Potential Effects | Summary of Measures | Residual |
|---|---|---|---|---|
| | | gases ($CO_2$ and $CH_4$), nutrients (nitrogen and phosphorus), methylmercury and other contaminants, organic matter, and oxygen-demanding materials into the water. | will rise so gradually and over a relatively small surface area, the effect will be further reduced. | |
| | | Elevated nutrients and organic matter may promote primary productivity, which may increase turbidity and oxygen. | | |
| | | Excessive algal growth could result in toxic cyanobacterial blooms. | | |
| | | Decomposition of organic matter in the soil as well as dead algal blooms would then deplete oxygen levels, promoting the release of other contaminants from the soil. | | |
| **Surface Water – Quantity** | Construction | Following the construction phase of each Stage, the water level in the Anderson TIA will gradually rise based on tailings production, reclaim water usage, precipitation and runoff from the Anderson catchment area. This gradual inundation will take place over approximately two to four years, during which there likely will be little need to discharge out of the Anderson TIA. Any discharge that occurs will be through the newly improved spillway channel, which will be controlled with sluice gate. | Historically, Anderson Creek was a discontinuous channel through a flooded fen area with intermittent flow primarily by the spring freshet and larger precipitation events (AECOM, 2013d). | Minor |
| | | | The interruption of discharge from the TIA will be temporary, and thus the subsequent change in the flow and water level of Anderson Creek will also be temporary. Once discharge is resumed, the flow and water levels will return to the current levels. | |
| **Aquatic Resources – Protected Aquatic Species** | Construction and Closure | Shortjaw Cisco is a federally-listed species under SARA, may occur in the Project Region. | This species was not observed during the biophysical surveys and has not been reported in the Grass River sub-basin in the Nelson River Basin. | Minor |
| **Aquatic Resources – Lower Trophic Level Biota** | Construction and Closure | Effects on habitat quantity can occur through changes to the hydraulic regime of Anderson Creek. Habitat quality can be affected through changes in sediment quality, through surface runoff (elevated concentration of metals or other contaminants), through air dispersion (dust), or any accidental leaks or spills during the preparation and construction phases of the Project. | Measures listed in **Section 6.7** will be implemented to minimize risks of changes to surface water quality and quantity. | Negligible |
| | | | Measures listed in **Table** 6-6 will be implemented to minimize risks of spills and leaks. | |
| | | Water quality may also be affected as a result of improper handling of solid and construction waste. | Measures listed in **Table** 6-6 will be implemented to minimize risks of spills and leaks. | |
| **Aquatic Resources – Fish and Fish Habitat: Habitat Quality** | Construction and Closure | Changes to surface water quality (**Section 6.7.1**), through deposition of dust (**Section 6.4.1**), soil erosion (**Section 6.3.1**), spills or leaks (**Section 6.12.2**), effects on surface water quality (**Section 6.7.1**), or changes to the lower trophic level biota (**Section 6.8.2**) can impact fish the quality of fish habitat. | Fish studies of Anderson Bay (carried out pursuant to regulatory requirements over 34 years of operation) have confirmed that water quality downstream of the Anderson TIA continues to support high species diversity. | Minor |
| | | | The area to be disturbed in Anderson Creek does not contain unique or rare fish habitat. | |
| | | | Overland flows previously draining into the TIA will now be redirected into the creek which will sustain flows and prevent any stranding of fish. | |
| | | | Measures listed in **Section 6.7** will be implemented to minimize risks of changes to surface water quality and quantity. | |
| | | | Measures listed in **Section 6.4.1** will be implemented to minimize risks of dust. | |
| | | | Measures listed in **Section 6.3.1** will be implemented to minimize risks of soil erosion. | |

| Environmental and Social Component | Project Phase | Sources of Potential Effects | Summary of Measures | Residual |
|---|---|---|---|---|
| | | | Measures listed in **Section 6.8.2** will be implemented to minimize risks of effects on lower trophic level biota. | |
| | | | Measures listed in **Table** 6-6 will be implemented to minimize risks of spills and leaks. | |
| **Aquatic Resources – Fish and Fish Habitat: Habitat Quantity** | Construction and Closure | Potential sources of impacts to habitat quantity are: any disturbance to the bank and bed of Anderson Creek; and changes to the hydraulic regime of the Creek. There will be a small area of disturbance to the bank and bed of Anderson Creek, in the construction phase of Stage B. | In general, the larger waterbodies, such as Anderson Bay of Wekusko Lake, provide the highest diversity of fish species. Aquatic investigations suggest availability of spawning habitat in these waterbodies despite being in a region that has been disturbed. | Minor |
| | | | Measures listed in **Section 6.7.2** will be implemented to minimize risks of changes to surface water quantity. | |
| | | | Measures listed in **Section 6.3.1** will be implemented to minimize risks of soil erosion. | |
| **Terrestrial Flora Species - Clearing** | Construction and Closure | The majority of this clearing will be limited to the first year of each Stage and will include clearing for temporary trails, laydown areas, dams, quarries and borrow pits and powerlines. The area around the Anderson TIA, in the areas to be inundated by the Project, will also be cleared. | The cover classes disturbed by the Project are common to the area surrounding the Project Area and Project Region. | Negligible |
| | | | Where possible 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. | |
| | | | 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. | |
| **Terrestrial Flora Species – Dust Deposition** | Construction and Closure | Dust may be produced during preparation and construction activities (clearing, grubbing, blasting, stockpiling, transporting materials and/or employees, and general use of construction equipment). | Measures listed in **Section 6.4.1** will be implemented to minimize risks of dust. | |
| **Terrestrial Flora Species – Protected Flora Species** | Construction and Closure | The federally-protected Flooded Jellyskin (lichen species) is known to occur in the Churchill River Upland Ecoregion, and may occur in the Project Region. | This lichen species was not observed during the biophysical surveys. | |
| **Terrestrial Fauna Species – Loss of Habitat** | Construction and Closure | Loss of vegetation through clearing and flooding can affect terrestrial fauna by reducing the amount of habitat available. | No critical wildlife habitat was observed on the Project Site (such as calving or over-wintering areas) and, based on site conditions and field observations, it is assessed that there is no critical wildlife in the Project Area. As discussed in **Section 5.5.1**, the Project Site is characterized by little variety in plant habitats. | |
| | | | Nesting birds that may make use of the edge habitat available along the shoreline of the Anderson TIA will be able to continue to use this habitat following development of the Project. Despite clearing along the shoreline and other areas, 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). | |
| | | | There were no potential brooding areas for waterfowl observed in the Project Site but there were some within the Project Area (along the Lalor Access Road and former rail bed). 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. | |
| | | | To the extent practicable, previously cleared areas will be used for temporary trails and/or laydown areas to minimize the area to be cleared. | |
| | | | The natural restoration of vegetation in these temporary areas during closure will provide for restoration of available habitat. | |
| **Terrestrial Fauna Species – Noise** | Construction and Closure | Sources of noise would be typical of heavy equipment such as bulldozers and excavators, blasting (includes vibration) at quarries and where required, at dams or spillway locations (discussed in more detail in **Section 6.4.3**). | It is anticipated that local fauna are likely already accustomed to some level of noise based on the existing activity in the area (Lalor Mine, PR 395, PR 392 and the Stall Lake Concentrator). | |
| | | | 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 substantially affect wildlife as similar habitats are available in the Project Area and Region. | |
| **Terrestrial Fauna Species – Risk of Vehicle Collisions** | Construction and Closure | With the anticipated increase in traffic on local public roads (discussed in more detail in **Section 6.4.2**), there is potential for increased wildlife collisions. | As local wildlife populations are considered low, the potential for increased wildlife collisions is also considered low. | |
| | | | HBMS' experience in the local area indicates that wildlife collisions are rare. | |
| | | | Continued implementation of speed limits on the temporary trails, local roads and Provincial highways. | |
| **Terrestrial Fauna** | Construction and | Boreal Woodland Caribou is a provincially-listed | There are no known herds whose range overlaps with the Project Region. | Minor |

| Environmental and Social Component | Project Phase | Sources of Potential Effects | Summary of Measures | Residual |
|---|---|---|---|---|
| **Species – Protected Fauna Species** | Closure | mammal which a Management Unit which overlaps with the Project Region. | | |
| | | Monarch butterfly, a federally-listed insect has a range which overlaps with the Project Region. | The Project Region falls within the limits of the species' distribution, but no monarch butterflies were recorded during the terrestrial investigations. | |
| | | Norther Leopard Frog is a federally-listed amphibian whose range overlaps with the Project Region. | The range overlaps with the Project Region, but none were observed during the terrestrial investigations. | |
| | | Yellow Rail is a federally-listed bird whose range extends into the Ecozone. | Although there is potential for the Yellow Rail to occur in the Ecozone, there are no known occurrences of Yellow Rail within the Project Region. | |
| | | Whip-poor-will is a federally listed bird whose range extends into the Ecozone. | Although there is potential for the Whip-poor-will to occur in the Ecozone, there are no known occurrences within the Project Region. | |
| | | Common Nighthawk is a federally listed bird whose range extends into the Ecozone. | Although there is potential for the Common Nighthawk-will to occur in the Ecozone, there are no known occurrences within the Project Region. | |
| | | Olive-sided Flycatcher is a federally listed bird whose range extends into the Ecozone. | Although there is potential for the Olive-sided Flycatcher to occur in the Ecozone, there are no known occurrences within the Project Region. | |
| | | Rusty Blackbird is a federally listed bird whose range extends into the Ecozone. | Although there is potential for the Rusty Blackbird to occur in the Ecozone, there are no known occurrences within the Project Region. | |
| **Socio-Economic – Mercury and Fish Consumption** | Construction and Closure | Flooding of Anderson TIA and the accumulation of mercury and methylmercury in fish tissue. | There is the potential for fish-eating wildlife (ospreys, mergansers, gulls, loons, otters and mink) to prey on small-bodied fish located between Anderson TIA and Wekusko Lake (in Anderson Creek for example), this area is likely too small to have significant impact on the wildlife population. | Negligible |
| | | | Water flowing from Anderson Creek into Anderson Bay of Wekusko Lake should be monitored prior to and following the inundation of Anderson TIA to assess mercury and methylmercury concentration in local fish populations. | |
| | | | The mercury migrating from the Anderson TIA in the dissolved and suspended solids would be diluted in Wekusko Lake by a factor of approximately 100. | |
| | | | Based on the results of the fish collected and analyzed from Wekusko Lake in 2015, there are no instances of fish tissue exceeded the 0.5 parts per million consumption advisory. | |
| | | | Mercury levels in sport, commercial or subsistence fish in Wekusko Lake will be monitored before and after the final inundation phase (Stage C) of the Project to evaluate mercury levels. This program will include analysis for both mercury and methylmercury levels in fish tissue. | |
| | | | Mercury monitoring will be conducted five years following inundation. Monitoring include the capture and analysis of fish tissue obtained from fish in Anderson TIA, Anderson Creek, and Wekusko Lake. | |
| | | | Monitoring will also include a characterization of the discharge (water quality and flow rate) from the Anderson TIA in order to evaluate the migration potential of mercury from Anderson TIA. | |
| **Socio-Economic – Land and Resource Use** | Construction | Land and resource uses in the Project Region that may indirectly be impacted by environmental effects of the proposed Project include; harvesting and trapping opportunities; fishing (recreational, subsistence and commercial); recreational use of existing trails; and general use of the Project Area and Region. | The Project Site has been developed for mining purposes for 40 years. The Project will not change the land and/or resource use at the Project Site. | Minor |
| | | | As presented in this report, residual environmental effects on environmental components have been assessed to be Minor to Negligible in magnitude. | |
| | | | With respect to trapping in the area, 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. HBMS has a healthy working relationship with the trappers in the area and have informed all potentially affected trappers within the Project Region of the proposed expansion of the Anderson TIA. | |
| | | | With respect to snowmobile trails, HBMS has discussed the proposed Project with members of the Sno-Drifters snowmobiling club. The club has no concerns with the Project. Prior to commencement of construction, HBMS will notify the club, to ensure advance notification to the club's members. | |
| **Socio-Economic – Heritage Resources** | Construction | Project activities such as clearing, blasting, or excavating can potentially affect heritage resources. | There are no known heritage resources at the Project Site and the potential to find any is low. | None |
| | | | If artefacts or 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 | |

| Environmental and Social Component | Project Phase | Sources of Potential Effects | Summary of Measures | Residual |
|---|---|---|---|---|
| | | | work. | |
| | | | If skeletal remains are encountered, the find will be immediately reported to the site supervisor and the RCMP. | |
| **Socio-Economic – Aesthetics** | Construction | Project activities during preparation and construction could potentially impact the aesthetics of the Project Site. | Project components are located primarily in areas that have been previously disturbed as part of the construction of the Anderson TIA or other HBMS activity in the area. | None |
| | | | A treed buffer will be maintained between the dams and PR 392. | |
| | | | 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 temporary areas (trails or laydown areas) will be contoured, where required, and allowed to naturally re-vegetate. | |

**Table 6-6: 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) | Worker protection in Manitoba is regulated through standards, procedures and training required under *The Workplace Safety and Health Act*. | 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 at the quarries will be stored in areas equipped with spill containment measures and in accordance with *The Explosives Act*. Explosives will likely be stored at designated areas at the Lalor Mine site. | |
| | | | 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. | |
| **Fires and Explosions** | Construction, operation and closure | Fires (loss of infrastructure, 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, with longer-term storage provided at designated areas. | Risk is assessed to be appropriately mitigated |
| | | | The mine rescue team at the 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 the Anderson TIA. | |
| | | | 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. | |
| **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) | The temporary trails will have a speed limit of 20 km/hr. The speed limits on PR 395 and PR 393 will be adhered to at all times. | Risk is assessed to be appropriately mitigated |
| | | | Appropriate road signage will be provided along the temporary trails, where necessary. | |
| | | | Personnel retained to drive vehicles will have a valid Manitoba Driver’s License with a copy provided to HBMS personnel. | |
| **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 |

# 7. 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 expansion of the Anderson TIA, 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 and/or required for the Anderson TIA are described in the following sections. Mitigation requirements identified for the Project are summarized in **Table 6-5**.

## 7.1 EEM

The Anderson TIA has been and will continue to be operated in accordance with the MMER, with studies conducted in accordance with EEM in 2004, 2007, 2009, 2011, and 2014 and at all times meeting all applicable criteria. These monitoring activities will continue through operation and following closure until it can be demonstrated that no adverse effects are occurring. EEM components include monitoring of:

- Water quality.
- Sediment quality.
- Lower trophic level biota.
- Fish community and health including fish tissue analysis (metals and mercury).

## 7.2 Water Quality Monitoring

HBMS collects water samples at the TIA discharge point once a week while water discharges from the TIA. While the TIA continues to discharge, samples will to be collected at the discharge point. During Stage A the existing decant pipe will be decommissioned and the existing spillway will be enhanced serve as a final discharge point. The sample collection point will shift to the spillway once it is the primary source of discharge. Once the dams are built, water will be retained within the TIA to increase the volume and capacity. At this time there will be no discharge to Anderson Creek from the TIA. A runoff diversion ditch is anticipated to route overland drainage that would previously drain to the TIA towards Anderson Creek, thereby providing suitable input to maintain natural flow within the creek. HBMS commits to monitoring the water level and flow of Anderson Creek during this stage. If water levels reduce to less than half of the normal elevation or water ceases flowing due to inadequate inputs, HBMS will release water from the TIA through the spillway. During the pre-construction and construction stage of the Project, HBMS will monitor water elevation and flow in the creek to establish a baseline reference. It is understood that releasing water from the TIA will prolong the amount of time required to reach the desired operation elevation, but maintaining water quality, quantity and flow in Anderson Creek for fish, fish habitat, lower trophic level biota, vegetation and wildlife is priority.

In addition to the discharge data, water quality has been monitored throughout the TIA and in Anderson Creek and Anderson Bay by AECOM in winter, spring and fall since 2012. These sampling events and locations are important to elucidate trends and potential impacts to the receiving environment. Modifications will be made moving forward to strengthen the dataset which includes lowering detection limits for total dissolved solids to 0.2 mg/L from 5 mg/L, alkalinity to 0.1 mg/L from 20 mg/L and total phosphorus to 0.001 mg/L from 0.01 mg/L. It is anticipated that these will be useful factors to monitor at lower detection limits as construction and operation of the Project takes place.

HBMS commits to developing a detailed water quality monitoring plan including erosion and sediment control measures prior to commencing construction. Monitoring of Anderson Creek should occur with increased frequency as the decant pipe is removed and spillway modified for use as they activities may directly impact water quality downstream. In-situ measurements of total suspended solids can be collected with a detailed response plan to implement when levels exceed a pre-determined limit. Proper sediment and erosion control measures, such as the use of turbidity curtains, will ensure there are no issues with water quality due to the Project. These measures will be outlined in the erosion and sediment control plan.

## 7.3 Mercury Monitoring

Follow-up monitoring for mercury levels in fish (outlined in **Section 5.3.6.1.4**) will continue in Anderson Creek, Anderson Bay and Goose Bay (reference) for total mercury. Mercury monitoring will be done annually during inundation, and every five years after water elevation has reached operational levels for that Stage.

AECOM started measuring methylmercury in fall of 2015 as a part of the ongoing water quality monitoring in the TIA, Anderson Creek and Anderson Bay. It is recommended that methylmercury monitoring continue in spring and fall, every year, during construction and operation, to verify that water quality downstream of the TIA is continuing to to meet all applicable guidelines.

## 7.4 Environment Act Licence Monitoring

Monitoring programs required under existing *Environment Act* licence/CEC Orders for Anderson TIA and other infrastructure (Chisel North water treatment plant and Chisel Lake pumphouse), and the Lalor Mine will continue to be conducted by HBMS. HBMS will comply with any additional monitoring requirements outlined in the amended CEC Order for the expansion of the Anderson TIA.

## 7.5 Success of Re-vegetation Efforts

Vegetation in temporary areas is expected to naturally encroach and establish. If, during periodic inspections of the water retention dams and other project components, these areas have not successfully been re-vegetated, artificial revegetation efforts may occur to encourage re-vegetation. 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.

# 7.6 Closure Plan Review

The Anderson TIA Closure Plan will be amended and submitted for approval to the Director of Mines in accordance with *Manitoba Mine Closure Regulation 67/99*. The Anderson TIA Closure Plan, including the information required to calculate the financial assurance to be paid to Manitoba, will be updated prior to construction.

# 8. Public Engagement

## 8.1 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 expansion of the Anderson TIA. Some of these events include:

- Town Hall presentation of 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.
- Interview with local trapper – Snow Lake, October 25, 2011.
- Meetings with local trapper – Snow Lake, May 7, 2012, February 12, 2013, and November 2015.
- Town Hall Presentation – Snow Lake, June 26, 2012.
- Information Session(s) – Snow Lake, August 8, 2012, November 13, 2015.
- Information Session – Flin Flon, November 14, 2015.
- Meeting with Snow Lake Cabin Owners Association – Snow Lake, August 8, 2012.
- Meeting with Snow Lake Sno-Drifters snowmobiling club – Snow Lake, December 7, 2012, and February 2016.

## 8.2 Proponent Led Public Involvement

It was determined that the Town of Snow Lake would benefit from 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.

HBMS also undertook public involvement activities in Flin Flon, due to the City's continued interest in HBMS operations.

Engagement activities specific to the proposed expansion of the Anderson TIA have included two recent Community Information Sessions and a formal Meeting with the Town of Snow Lake council members.

## 8.2.1 Community Information Sessions

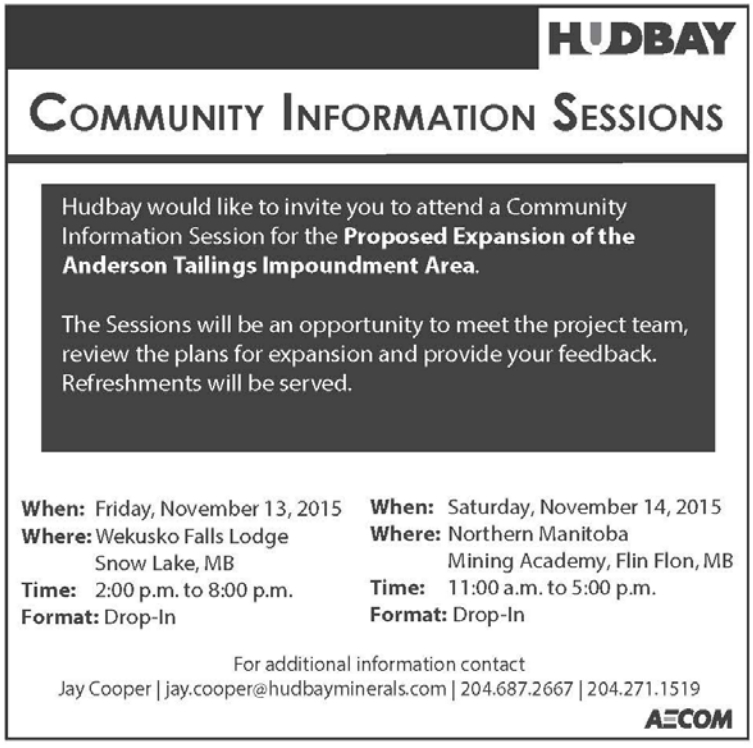
The Community Information Sessions were designed to provide those interested in the Project an opportunity to meet with HBMS and AECOM representatives, review Project information and discuss any questions or concerns related to the Project.

Information materials made available for review and discussion at the Community Information Sessions included the following:

- Background information on the Anderson TIA and other sites associated with the TIA.
- Information on why an expansion of the Anderson TIA is required.
- The methods for expansion that were explored prior to the selection of the alternative presented.
- An overview of the proposed infrastructure for the Anderson TIA Expansion, including information on the three stages of infrastructure.

### *8.2.1.1 Notification for Community Information Sessions*

Advertisements were developed and placed in local newspapers within Flin Flon and the Town of Snow Lake. An advertisement was placed in the November 5, 2015 edition of *The Underground Press* which is a Town of Snow Lake newspaper. Additionally, advertisements were also placed in the *Flin Flon Reminder* November 6, 2015 edition and November 13, 2015 edition. A sample advertisement is included below.



## 8.2.2 Community Information Session in the Town of Snow Lake

On November 13, 2015, HBMS held a Community Information Session in the Town of Snow Lake, at Wekusko Falls Lodge. The Session was attended by twelve people and was led by HBMS and AECOM to provide information about the Anderson TIA Expansion, including proposed construction activities, need for the expansion and an overview of the proposed infrastructure that would be included during each stage of the Project. During the Community Information Session, the public had an opportunity to view Project materials including printed information boards and photos of the construction of the existing Anderson TIA structures.

A summary of all feedback and discussions is provided in **Section 8.2.6**.

## 8.2.3 Community Information Session in Flin Flon, Manitoba

On November 14, 2015, HBMS held a Community Information Session in Flin Flon, at the Northern Manitoba Mining Academy. The Session was attended by two people and was led by HBMS and AECOM representatives to provide information about the Anderson TIA Expansion, including proposed construction activities, need for the expansion and an overview of the proposed infrastructure that would be included during each stage of the Project. During the Community Information Session, the public had an opportunity to view Project materials including printed information boards and photos of the construction of the existing Anderson TIA structures.

A summary of all feedback and discussions is provided in **Section 8.2.6**.

## 8.2.4 Meeting with Council for the Town of Snow Lake

During the November 16, 2015 Town Council meeting in Snow Lake, it was recommended that a request to meet with HBMS be expressed, to further discuss the proposed expansion of the Anderson TIA.

On December 1, 2015, a representative of HBMS attended to discuss the proposed expansion of the Anderson TIA and answer some outstanding questions brought forward during the Community Information Session held on November 13, 2015 in the Town of Snow Lake. During the meeting, Councillors and a local resident requested information relating to the following:

- Water quality information, including what metals and other substances are found within tailings.
- Baseline study information used to evaluate the tailings.
- Parameters evaluated when determining aquatic health of the nearby water bodies and sites where water sampling occurs.
- Additional information on why the Community Information Session that was not held within the Town of Snow Lake and at a location closer to the Anderson TIA.
- Current height of the dam which was constructed when the Anderson TIA was built and the proposed height of the Anderson TIA upon completion of the new dam arrangement.

## 8.2.5 Other Meetings

HBMS has routine communication with the local snowmobile association (Snow Lake Sno-Drifters). The club is aware of the Project, and have not expressed any concerns regarding its development.

As noted above, the proposed dam upgrades cross the Registered Trap Lines (RTL) owned by Russell Bartlett with whom HBMS has had an agreement since the creation of the Anderson TIA in 1979 (**Section 5.7.6.1**; **Figure 14**). HBMS has ongoing discussions and a working relationship with Mr. Bartlett. Most recently, HBMS representatives met with Mr. Bartlett to discuss and review the materials presented at the Open House Public Engagement Sessions in November 2015. HBMS has advised Mr. Bartlett of its intent to file this Notice of Alteration and confirmed that he has no concerns in this regard.

## 8.2.6 Summary of Feedback Collected at Community Information Sessions

A Feedback Form was developed for the Community Information Sessions to better understand attendee's feedback on the engagement process and the Project activities. In addition to the feedback forms completed, HBMS and AECOM staff summarized their conversations with attendees. This section summarizes the information obtained through feedback forms and discussions with the public at the Community Information Sessions.

In total, 6 attendees completed feedback forms at the Community Information Sessions. **Table 8-1** summarizes the responses received.

**Table 8-1: Summary of Feedback Form Responses**

| Feedback Form Question | Summary of Responses |
|---|---|
| ***How did you hear about the Community Information Session?*** | • Two respondents indicated they heard by newspaper.<br>• Three respondents indicated they heard by word of mouth.<br>• One respondent indicated that HBMS informed him of the event. |
| ***Did you find the Community Information Session useful?*** | • All six respondents indicated that the Sessions were useful. |
| ***Were we able to answer your questions today?*** | • Five respondents indicated that HBMS was able to answer their questions.<br>• One respondent indicated that the HBMS representatives were unavailable when they arrived. |
| ***Do you have any specific interests relating to the Project going forward?*** | • Municipal government<br>• Town resident<br>• What are the plans, if any, for sewage treatment where expansion starts?<br>• Ensuring safety of our water and environment.<br>• Impact on surrounding snowmobile trails (tourism and guiding guests).<br>• Water quality and fisheries sampling. |
| ***Additional Comments*** | • Informative presentation.<br>• Presentation and question/answers very helpful.<br>• Thanks for explain everything and answering my questions! Good luck with the expansion. |

A summary of the questions and key discussion points as documented by HBMS and AECOM representatives is included in **Table 8-2.** Representatives at the Community Information Sessions were able to provide appropriate responses to the questions outlined below. Each of the comments and concerns was addressed in full at the time.

**Table 8-2: Summary of Discussions at Community Information Sessions**

| Topic of Discussion | Question/Feedback Received | More Information Available in: |
|---|---|---|
| ***Construction and Infrastructure*** | • How much is the water going to rise?<br>• How can people obtain the water quality results?<br>• What will be the height of the dams?<br>• Is additional information available regarding employment opportunities for the Anderson TIA Expansion?<br>• Concern noted regarding the construction plans which include a reliance on natural elevations to contain tailings. | • Section 3.4.3, Table 3-4<br>• Water quality results can be obtained from HBMS. Please contact the environment group in Flin Flon or at the Lalor Mine for more information. |
| ***Environmental Considerations/Water Quality*** | • Will trees be cleared for the Anderson TIA Expansion?<br>• What will happen to the trees and is there an estimated quantity?<br>• Do we know if other metals are entering Wekusko Lake from the TIA that isn't being monitored?<br>• Are the environmental effects monitoring data available?<br>• How often is the water quality monitoring done? | • Section 3.4.3 gives detailed descriptions of each stage of the Project, including clearing.<br>• All applicable metals are being monitored as per regulatory requirements (Section 3.9).<br>• A summary of EEM data is provided in Section 5.3.3.1, Section 5.3.4.3, Section 5.3.5.4 and Section 5.3.6.8.<br>• Water quality is monitored by HBMS weekly at the TIA discharge point. |
| ***Mining Process and Existing Anderson TIA*** | • What causes the odour that is emitted during the spring?<br>• What is the current water level that is maintained for the Anderson TIA? | • The TIA is currently operating at 277.70 m elevation water level (Table 3-4). |
| ***Recreation and Resource Use*** | • The snowmobile club in Snow Lake is very interested in their routes near the Anderson TIA and whether they will be affected by the expansion?<br>• Are there opportunities for people to harvest the trees removed during clearing for the Anderson TIA Expansion? | • Meeting with Snow Lake Sno-Drifters snowmobiling club – Snow Lake, December 7, 2012, and February 2016.<br>• To maintain site safety, access to the site for harvesting cannot be permitted. |
| ***Engagement Process*** | • Attendees indicated that selecting a venue outside of Snow Lake may have detracted some people from attending the Session.<br>• Larger maps could have been utilized during the Session.<br>• Town of Snow Lake Council attendee indicated that the Council would be interested in additional opportunities to meet with HBMS and discuss this Project and other opportunities within the Town of Snow Lake. | • Noted for future public events organized y HBMS |

| Topic of Discussion | Question/Feedback Received | More Information Available in: |
|---|---|---|
| ***General Comments/Feedback*** | • Hudbay should become more involved with local schools and interacting with the kids to let them know of future of mining.<br>• Question/comment regarding a tailings expansion area that is not owned by HBMS. | • Noted for HBMS consideration as they plan future activities |

## 8.2.7 Summary of Media Coverage for the Project

An article was published in the December 17, 2015 edition of The Underground Press, which summarized the discussions regarding the proposed expansion of the Anderson TIA at the December 1, 2015 Town of Snow Lake Council meeting (**Appendix E**).

# 9. Conclusions

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

## 9.1 Topography

Sources of changes to site topography include activities such as clearing, blasting, levelling, trenching, and stockpiling materials during site preparation, and installation of laydown areas, temporary trails, dams and spillway. Wherever practicable, existing access roads and laydown areas will be used in order to minimize changes to topography. All changes to topography will occur inside the boundary of HBMS operations on land to which only HBMS has a right of access. The closure phase will include restoration of any changes to topography of the temporary sites (trails, laydown areas) to match the pre-construction condition of the surrounding area to the extent practical. Dam and spillway alignments have been chosen based on proximity to high points and bedrock outcrops to maximize utilization of the existing topography for containment. The alignment selection process resulted in the smallest practicable footprint and change to topography. The dams and spillway structures will be permanent and will not be removed during the closure phase. The change in topography from the dams will be permanent and irreversible, but since the purpose of the dams is to allow for continued environmental management of tailings, this change is unavoidable.

Overall, the residual impact on topography caused by the Project is assessed to be Moderate. The change in topography, while permanent, will impact only features which are limited to the Project Site, and not unique in the Project Region.
Soils

### 9.1.1 Erosion

High wind and precipitation events can lead to soil erosion, which can consequentially affect other environmental components (*e.g.,* air quality, water quality, or vegetation). Construction activities that can result in elevated potential for soil erosion include clearing, grubbing, stockpiling, excavation, and inundation of the shoreline of Anderson TIA. To the extent practicable, clearing will occur during the winter to minimize disruption to soil and allow sufficient time for soil stabilization prior to the spring freshet. It is anticipated that once the dams are built in each Stage, it will take two to four years for water levels to reach the desired water elevation. Given this length of time, disturbed soils will stabilize naturally and not be susceptible to significant erosion. Stockpiled organic spoils will be compacted and reused, where practicable. Excavation activities will not occur during high rain or wind events, which will minimize the erosion potential of exposed soils.

Erosion and Sediment Control (ESC) methods will be in place to prevent the generation and movement of sediment-laden water, which is deemed sufficient to appropriately mitigate for erosion. The dams are designed to incorporate filter zones within the dam to protect the dam cores from internal erosion. Geotextile will be placed between the silty clay core and the rockfill layers of any temporary berms to provide containment and minimize erosion between construction stages. Seepage collection systems will be constructed at the toe of each dam and berm, allowing for collection and pumping back into the Anderson TIA, any seepage that comes through the dam.

At the time of Closure, HBMS will apply soil to previously disturbed laydown areas and temporary trails (those not required for future inspections), allow all disturbed areas to naturally re-vegetate and contour disturbed areas to match the surrounding topography to the extent possible.

### 9.1.2 Materials and Waste Management

Wastes such as used oils, rags, drums and miscellaneous garbage can potentially affect soil quality, which can have subsequent effects on other environmental components (*e.g.,* vegetation, groundwater, and surface water). Wastes generated during construction will be collected in garbage bins maintained at specific locations throughout the Project 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.

### 9.1.3 Soils Summary

The overall residual impact on soil as a result of the Project is assessed to be Negligible.

## 9.2 Air

### 9.2.1 Dust

Sources of dust include activities such as blasting, clearing, levelling, stockpiling, movement of traffic on roads, and transport of materials. Dust occurs primarily during summer and fall, with greater likelihood for an increase in dust during dry and windy conditions. Dust may be produced during preparation and construction activities (such as clearing, grubbing, blasting, stockpiling, transporting materials and/or employees, and general use of construction equipment). Clearing activities are temporary and limited to the first portion of the first year of each Stage. Areas to be cleared will be minimized where practicable: for example, previously disturbed areas have been identified and will be used for temporary trails or laydown areas. Stockpiled materials will be compacted and re-used, where practicable. Trucks hauling materials will be covered to minimize dust coming off loads.

Construction traffic may travel along the PR 395, PR 392 and PR 393 and generate dust. The increase in traffic along these roads and at the Project Site is temporary (limited to the first year of each Stage) and if required, dust suppression activities, such as the use of approved dust control agents, will be undertaken. The temporary trails will have a speed limit of 20 km/hr and the speed limits on PR 395 and PR 393 will be adhered to at all times. Vegetated buffers will be maintained to minimize the transport of dust generated on site. There is no anticipated change in dust generation from current conditions during the operation or closure phases of the expansion of the Anderson TIA.

### 9.2.2 Emissions

During the preparation and construction phases of the Project, exhaust emissions will be generated during delivery of materials and employees to the site, and other operation of vehicles. Emissions will also be generated during construction of the water retention dams, spillway, seepage collection system, as well as preparation activities (such as clearing and grubbing of laydown areas, temporary trails). These sources of emissions will be generated during the first year of each Stage. Periodic monitoring and inspection of the structures may occur during the inundation periods between Stages. The exhaust emissions as a result of construction activities is temporary. Vehicles and equipment will be well maintained and vehicle idling kept to a minimum.

The second source of exhaust emissions is propane heaters that will be used to heat the contractor trailers during construction. 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. The construction phases of the Project is limited to the first year of each Stage and the heating systems will be equipped with low NOx burners.

There is no anticipated increase in traffic or exhaust emissions during the operation or closure phases of the Project.

### 9.2.3 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. Sources of noise during construction would be typical of heavy equipment such as bulldozers and excavators. Noise and vibration will also be generated when blasting is undertaken at quarries and, where required, at dams or spillway locations. Blasting is a common occurrence in the region given the other mining activity, however, it will only occur intermittently during the first year of each Stage. HBMS will provide hearing protection as required.

The operation of the Anderson TIA, following the expansion, is not anticipated to be different from the current operating procedures. Therefore, no additional noise or vibration will occur during the operation phases of the Project.

### 9.2.4 Air Summary

The mitigation measures listed above to minimize the impact on air (due to dust, emissions, and noise and vibration) are deemed sufficient. Therefore, the overall residual impact on air as a result of the Project is assessed to be Negligible.

## 9.3 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. GHG emissions are expected during construction and closure activities. There is no anticipated change in GHG emissions during the operation phase. GHG emissions are

expected to be typical of construction activities and will be limited in duration. Idling at the Project Site will be kept to a minimum (for example, while waiting for quarry trucks to unload) and vehicles and equipment will be maintained in good working condition. The increase in emissions will be for a very short period of time.

Overall, emissions due to newly created flooded lands are anticipated to have a Negligible impact to provincial and federal GHG inventories.

# 9.4 Groundwater

Activities such as handling fuels and lubricants can potentially affect groundwater quality. There are no withdrawals of groundwater proposed for the Project. Potential surface to groundwater recharge pathways in the direct footprint of the dams, spillway, and collection basins may be affected. However, the shallow groundwater will remain unaffected due to numerous other pathways for recharge. In addition, the level of groundwater (piezometric surface) will increase in the areas that are inundated and will transition to their current levels within a short distance of the TIA. Therefore it is concluded that the Project will not impact groundwater.

# 9.5 Surface Water

## 9.5.1 Surface Water Quality

As indicated in **Section 5.3.3**, the results of water quality studies conducted on the Anderson TIA, Anderson Creek and Anderson Bay do not demonstrate any exceedance of MMER limits; however HBMS noted increasing metal concentrations in 2014 and 2015, when compared to the data from the previous two years (although still within the historic 37 year range). **Section 0** outlines the results of HBMS' analysis and determination as to why the metal concentrations increased in 2014 and 2015 and how their processing and tailings management modifications have resulted in lower concentrations in 2016. In the data taken to date for 2016, the zinc concentration has reduced to half the concentration it was in 2015.

Moving forward, it is expected that the effluent from the expanded Anderson TIA will continue to meet the required water quality guidelines, and thus the surface water quality downstream of the Anderson TIA will not change. Water quality may also be affected as a result of improper handling of solid and construction waste however, waste generated on site will be handled and disposed of appropriately and all storage and handling of construction materials will be conducted in accordance with best management practices. Water quality may be affected due to erosion. Appropriate erosion and sediment control and site management will minimize erosion and consequential impact on water quality. Water quality may be affected due to the flooding of vegetation surrounding the TIA due to an influx of nutrients and subsequently primary productivity. Clearing of vegetation and soils will minimize this impact. Additionally, the relatively small area of flooding compared to the TIA overall size and the long time frame over which flooding will occur minimizes this threat.

The overall residual impact on surface water quality downstream of the Anderson TIA as a result of the Project is assessed to be Insignificant.

### 9.5.2 Surface Water Quantity

Following the construction phase of each Stage, the water level in the Anderson TIA will gradually rise based on tailings production, reclaim water usage, precipitation and runoff from the Anderson catchment area. This gradual inundation will take place over approximately two to four years, during which there likely will be little need to discharge out of the Anderson TIA. Any discharge that occurs will be through the newly improved spillway channel, which will be controlled with sluice gate. The interruption of discharge from the TIA will be temporary and mitigation measures, such as the diversion ditch and monitoring, will minimize the impact.

For the reasons presented above, the overall residual impact on surface water quantity in Anderson Creek as a result of the Project is assessed to be Negligible.

### 9.5.3 Surface Water Summary

The operation of the expanded Anderson TIA will be consistent with current operations and therefore the effect on surface water quantity is assessed to be Negligible.

## 9.6 Aquatic Resources

### 9.6.1 Protected Aquatic Species

As noted in **Section 5.6**, there are 29 species of special concern listed by the Manitoba CDC (Manitoba Sustainable Development, 2016a), none of which were observed in the areas examined during the biophysical surveys. Of the species of special concern, only one aquatic species is protected federally under *SARA*: Shortjaw Cisco. The Shortjaw Cisco has been recorded Manitoba lakes including Lake Athapapuskow, Clearwater Lake, Lake Winnipeg, George Lake, Reindeer Lake and Lake Athabasca (COSEWIC, 2003). However, there have been no reported occurrences in the Grass River sub-basin in the Nelson River Basin.

Given that the potential of occurrence of protected aquatic species within the Project Region is low, there are no effects anticipated as a result of the expansion of the Anderson TIA.

### 9.6.2 Lower Trophic Level Biota

Effects on lower trophic level biota occur primarily through changes in habitat quality and quantity. Reduced quantity and quality of habitat can reduce the abundance, diversity or community composition of aquatic invertebrates, with secondary effects on organisms higher in the food chain. Effects on habitat quantity can occur through changes to the hydraulic regime of Anderson Creek. Habitat quality can be affected through changes in sediment quality, through surface runoff (elevated concentration of metals or other contaminants), through air dispersion (dust), or any accidental leaks or spills during the preparation and construction phases of the Project.

### 9.6.3 Aquatic Resources Summary

For the reasons listed in the sections above, the residual effects on protected aquatic species and aquatic benthic invertebrates, as a result of the Project, are assessed to be Negligible.

## 9.7 Fish and Fish Habitat

Effects on fish and fish habitat occur primarily through changes in habitat quality and quantity. Habitat quantity can be affected by the physical alteration of fish habitat and altering the hydraulic regime of Anderson Creek (see **Section 6.7.2**). Effects on aquatic benthic invertebrates (see **Section 6.8.2**) can indirectly affect fish habitat quality (reduced diversity or abundance reduces food availability), as can changes to surface water quality (**Section 6.7.1**). Effects of inundation and potential release of methylmercury, may affect fish health and subsequently human consumption of this fish (see **Section 6.11.1**). Since potential impact on habitat quality, quantity, and surface water quality was assessed to be Negligible to Minor, the subsequent potential impact on fish and fish habitat is assessed to be Minor.

### 9.7.1 Habitat Quality

Changes to surface water quality, through deposition of dust (**Section 6.4.1**), soil erosion (**Section 6.3.1**), spills or leaks (**Section 6.12.2**) or effects on surface water quality (**Section 6.7.1**) can impact fish the quality of fish habitat. Fish studies conducted in Anderson Bay have confirmed that water quality downstream of the TIA continues to support high species diversity. Additionally the area of Anderson Creek to be disturbed does not contain unique or rare fish habitat and overland flows previously draining into the TIA will now be directed into the creek which will sustain flows and prevent any fish from becoming stranded. Dust, erosion and spill mitigations have all been previous addressed.

### 9.7.2 Habitat Quantity

Fish populations can also be impacted by changes in the quantity of habitat. Potential sources of impacts to habitat quantity are: any disturbance to the bank and bed of Anderson Creek; and changes to the hydraulic regime of the Creek. There will be a small area of disturbance to the bank and bed of Anderson Creek, in the construction phase of Stage B. Rip rap will be installed at this location to provide dissipation of energy of the water being discharged from the new spillway.

### 9.7.3 Fish and Fish Habitat Summary

For the reasons listed in the sections above, the residual effects on fish and fish habitat, as a result of the Project, are assessed to be Minor.

# 9.8 Terrestrial Flora Species

## 9.8.1 Clearing

Effects on protected and other terrestrial flora include clearing and dust deposition. A maximum of 173 ha of additional clearing will be required for the proposed Project. The majority of this clearing will be limited to the first year of each Stage and will include clearing for temporary trails, laydown areas, dams, quarries and borrow pits and powerlines. The area around the Anderson TIA, in the areas to be inundated by the Project, will also be cleared. Details on the vegetation types found in the Project Site, Area and Region can be found in Section 6.9.1. 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.

## 9.8.2 Dust Deposition

As noted in **Section 6.4.1**, dust generated during the construction and closure phases of the Anderson TIA 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 6.9.2**, effects on terrestrial flora due to dust are assessed to be Negligible.

## 9.8.3 Protected Flora Species

Only one terrestrial flora species is protected federally under the *Species at Risk Act* (*SARA*): the Flooded Jellyskin. 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 during the biophysical surveys. Therefore, the residual effect on Flooded Jellyskin as a result of the expansion of the Anderson TIA is assessed to be Negligible.

## 9.8.4 Terrestrial Flora Species Summary

For the reasons presented above, the overall residual impact on terrestrial flora species (including protected flora species) due to clearing and dust deposition are assessed to be Negligible.

# 9.9 Terrestrial Fauna Species

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

### 9.9.1 Loss of Habitat

Loss of vegetation through clearing and flooding can affect terrestrial fauna by reducing the amount of habitat available. However, no critical wildlife habitat was observed on the Project Site (such as calving or over-wintering areas) and, based on site conditions and field observations, it is assessed that there is no critical wildlife in the Project Area. Nesting birds that may make use of the edge habitat available along the shoreline of the Anderson TIA will be able to continue to use this habitat following development of the Project. Despite clearing along the shoreline and other areas, 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). There were no potential brooding areas for waterfowl observed in the Project Site but there were some within the Project Area (along the Lalor Access Road and former rail bed). 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. To the extent practicable, previously cleared areas will be used for temporary trails and/or laydown areas to minimize the area to be cleared. The natural restoration of vegetation in these temporary areas during closure will provide for restoration of available habitat.

### 9.9.2 Noise

Noise generated during the preparation and construction phases of the expansion of the Anderson TIA has the potential to deter wildlife from the area. During construction, noise will be generated to varying degrees as described in Section 6.4.3. It is anticipated that local fauna are likely already accustomed to some level of noise based on the existing activity in the area (Lalor Mine, PR 395, PR 392, and the Stall Lake Concentrator). Habitat at the Project Site is common with no specific or critical value to wildlife.

### 9.9.3 Risk of Vehicle Collisions

With the anticipated increase in traffic on local public roads there is potential for increased wildlife collisions. Moose, coyotes and wolves may pass through the Project Area, including Provincial highways and local roads. Edge vegetation and the open nature of these roads allows for ease of migration, making the area attractive to wildlife. As local wildlife populations are considered low, the potential for increased wildlife collisions is also considered low. HBMS' experience in the local area indicates that wildlife collisions are rare. There will be continued implementation of speed limits on the temporary trails, local roads and Provincial highways.

### 9.9.4 Protected Fauna Species

There are 29 species of Special Concern listed by the Manitoba CDC (Manitoba Conservation, 2012a), none of which were observed in the areas examined during the extensive biophysical surveys in the Project Area. Of the species of Special Concern, eight terrestrial fauna species are protected either federally under the *SARA* or provincially under the provincial *Endangered Species and Ecosystems Act* (*ESEA*): Boreal Woodland Caribou, Monarch butterfly, Northern Leopard Frog, Yellow Rail, Whip-poor-will, Common Nighthawk, Olive-sided Flycatcher and the Rusty Blackbird.

None of the protected species have been observed within the Project Site during terrestrial investigations. It is anticipated that due to the small size and benign nature of habitat within the Project Site that no protected fauna species will be influenced by the Project.

### 9.9.5 Terrestrial Fauna Species Summary

For the reasons outlined above, the residual impact on terrestrial fauna species (including protected fauna species) as a result of the Project (loss of habitat, noise and risk of vehicle collisions) is assessed to be Minor.

## 9.10 Socio-Economic Effects

This assessment considers any socio-economic effects which could result from changes in the biophysical environment. Typically, such effects can arise when a resource used by people is adversely affected by a proposed development. In this case, potential pathways considered are fish consumption in downstream waterbodies, land and resource use, heritage resources, and aesthetics. Results of the assessment are as follows:

### 9.10.1 Fish Consumption in Downstream Waterbodies

The construction of reservoirs typically involves submerging large amount of terrestrial organic matter. The decomposition of submerged organic matter can result in the formation of inorganic mercury (or “methylmercury”) that can potentially accumulate along the food chain (Brouard *et al*., 1990). Methylmercury production is controlled primarily by the amount and composition of the submerged organic matter, but is also influenced by biotic and abiotic factors such as bacterial activity and physicochemical characteristics of water (pH, dissolved oxygen, redox potential, humic and fulvic acids, sulfides, etc.). Among these factors, the amount of submerged organic matter has the most influence on the production of methylmercury in the wake of flooding.

The effect of mercury released from the Anderson TIA on the fish populations in Wekusko Lake is expected to be Negligible following inundation, as the mercury migrating from the Anderson TIA in the dissolved and suspended solids would be diluted in Wekusko Lake by a factor of approximately 100. Based on the results of the fish collected and analyzed from Wekusko Lake in 2015, there are no instances of fish tissue exceeded the 0.5 parts per million consumption advisory, and this is not expected to change.

### 9.10.2 Land and Resource Use

Land and resource uses in the Project Region that may indirectly be impacted by harvesting and trapping opportunities, fishing (recreational, subsistence and commercial), recreational use of existing trails, and general use of the Project Area and Region. However, the Project Site has been developed for mining purposes for 40 years and the Project will not change the land and/or resource use at the Project Site.

With respect to trapping in the area, HBMS is committed to working with the trappers in the area to ensure that access to their trap lines is not impacted by the proposed development. HBMS has a healthy working relationship with the trappers in the area and have informed all potentially affected trappers within the Project Region of the proposed expansion of the Anderson TIA.

With respect to snowmobile trails, HBMS has discussed the proposed Project with members of the Sno-Drifters snowmobiling club. The club has no concerns with the Project. Prior to commencement of construction, HBMS will notify the club, to allow for advance notification to the club's members.

### 9.10.3 Heritage Resources

Project activities such as clearing, blasting, or excavating can potentially affect heritage resources. There are no known heritage resources at the Project Site and the potential to find any is low. No further disturbance beyond the Project Site will occur. Therefore, no effects on heritage resources are anticipated to occur as a result of the proposed Project.

### 9.10.4 Aesthetics

Project activities during preparation and construction could potentially impact the aesthetics of the Project Site. However, Project components are located primarily in areas that have been previously disturbed as part of the construction of the Anderson TIA or other HBMS activity in the area. A treed buffer will be maintained between the dams and PR 392. 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 temporary areas (trails or laydown areas) will be contoured, where required, and allowed to naturally re-vegetate.

### 9.10.5 Effects on Aboriginal Peoples

HBMS has operated in the Snow Lake district for over 50 years. The Anderson TIA has been in operation for nearly 40 years. HBMS has mining and surface claims throughout much of 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 Project components will be on land which HBMS holds under lease or in fee**,** and is occupied and used by HBMS for mining purposes.

With respect to trapping, although the potential effect on trapping activities is assessed to be Minor, HBMS is committed to continuing to work with trappers in the Project Region 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 proposed expansion is not expected to cause any environmental effects that would lead to consequential effects on Aboriginal peoples.

## 9.11 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.

### 9.11.1 Worker Health and Safety

Worker protection in Manitoba is regulated through standards, procedures and training required under *The Workplace Safety and Health Act*. Safety equipment and personal protective equipment will either be supplied to the employees or be located at the safety office at the Lalor Mine, where needed.

### 9.11.2 Spills and Leaks

Environmental effects may occur due to fuel and chemical spills from diesel fuel, lubricants, oils, hydraulic fluids and explosives. An accidental release of hazardous materials and/or equipment fluids could occur from improper storage and handling procedures (including transporting materials such as explosives). 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. Mitigation measures can be found in **Section 6.12**.

### 9.11.3 Fires/Explosions

The presence of mechanical equipment, fuels and explosives 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 Project components have the potential to be affected by off-site forest fires during the summer months. Effects could include loss of infrastructure or affect access to the site. All infrastructures at the Project Site will be built on crushed rock pads. This crushed rock is anticipated to act as a fire barrier for the site. The surrounding trees, if burned, could limit access to or reduce the function of the spillway or seepage collection system. The Project Site will be equipped with appropriate fire control measures.

### 9.11.4 Transportation Accidents

An increase in traffic has the potential to increase the likelihood for transportation accidents, including vehicular and wildlife collisions. Transportation accidents can consequently result in release of pollutants in the environment (diesel, oils, etc.), or materials that the vehicles colliding are transporting (concrete, explosives, 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). Appropriate road signage will be provided along temporary trails, where necessary and speed limits will be adhered to at all times on all roadways.

There is no anticipated increase in traffic during the operation phase of the Project, from the traffic volumes currently observed at site. Traffic volume is expected to substantially decrease during the closure phase (due to a reduction in the 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.

## 9.12 Summary

In summary, the residual environmental effects will be Negligible to Moderate in magnitude with the implementation of the design features and the standard operating and mitigation measures described in the 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.

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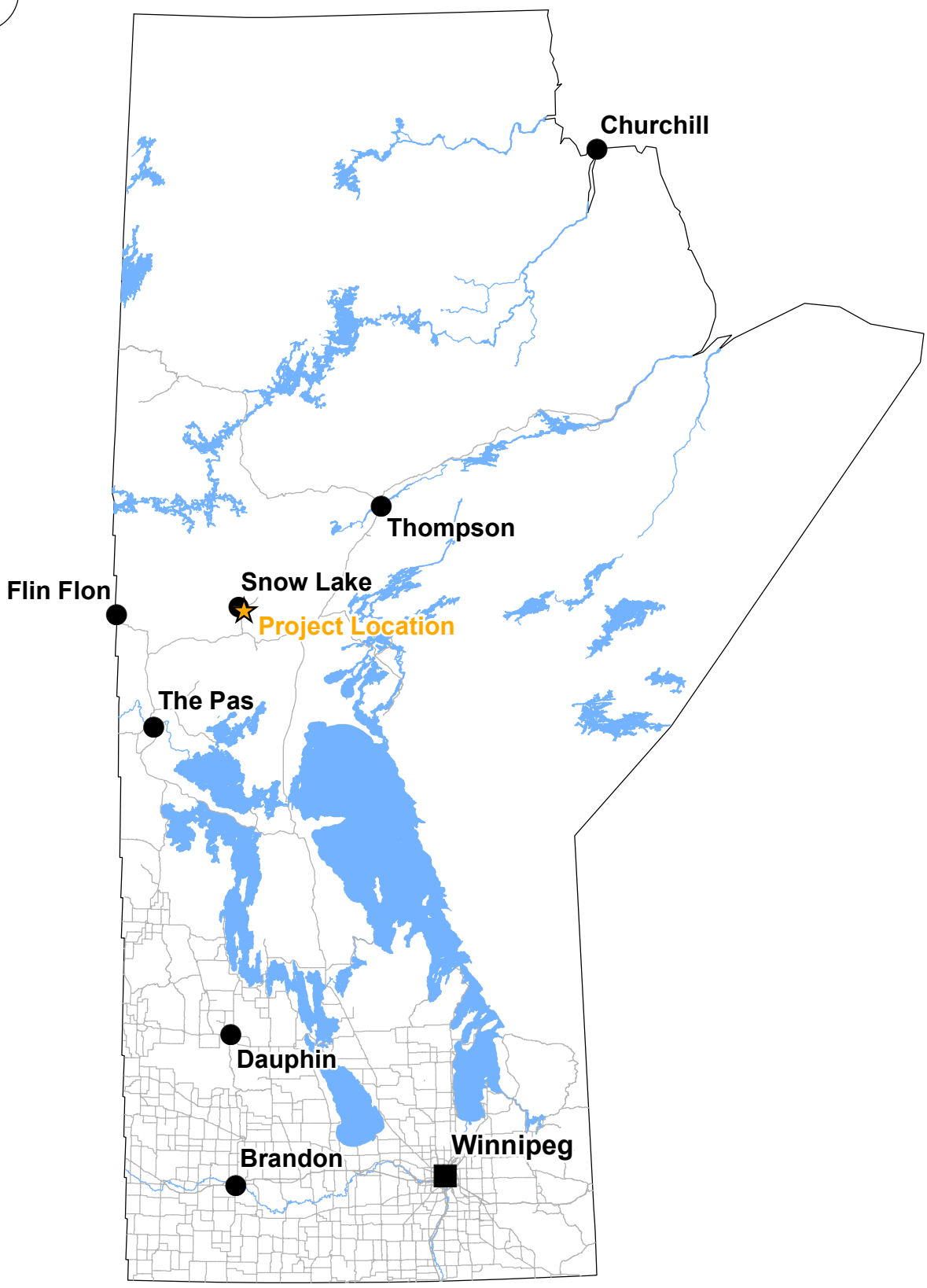
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Workplace Safety and Health Act C.C.S.M. c. W210. Retrieved from the Manitoba Laws Website: http://web2.gov.mb.ca/laws/statutes/ccsm/_pdf.php?cap=w210.

# Figures




ANSI A 215.9mm x 279.4mm
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Last saved by: MAHEC (2016-02-16)
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**Anderson Tailings Impoundment Area Expansion**
Hudson Bay Mining and Smelting Co., Limited, Snow Lake, MB

**General Project Location**

AECOM

**Figure: 01**

ANSI B 279.4mm x 431.8mm
Project Management Initials: Designer:
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N

Herbiet Lake

Anderson TIA

Hurlin Lake

Tern Lake

Town of Snow Lake

Snow Lake

Lalor Mine

392

395

Lalor Lake

Chisel North (Photo Lake)

Anderson Lake Mine

393

Rod Mine

Noteme Lake

Stall Lake

Anderson TIA

Stall Lake Mine

Stall Lake Concentrator

Arm Lake

Chisel Lake

Ghost Lake

Gaspard Lake

Nut Lake

Anderson Dam

Threehouse Lake

Anderson Creek

Collyer Lake

Ghost Lake Mine (Lost Lake)

Chisel Open Pit Mine

Moore Lake

Kontzie Lake

Anderson Bay

Wekusko Lake

**Anderson TIA**

Current Anderson TIA - Water Level EL. 277.70 m

Anderson TIA 285 m Elevation Contour Line

**HBMS Mines**

Operating HBMS Mine

Closed HBMS Mine

**HBMS Infrastructures**

Concentrator

HBMS Gate

500 0 500 1,000 m

1:50,000

NAD 1983 UTM Zone 14N

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AECOM

Figure: 02

**HBMS Activity in Snow Lake Area**

**Anderson Tailings Impoundment Area Expansion**

Hudson Bay Mining and Smelting Co., Limited, Snow Lake, MB

ANSI B 279.4mm x 431.8mm

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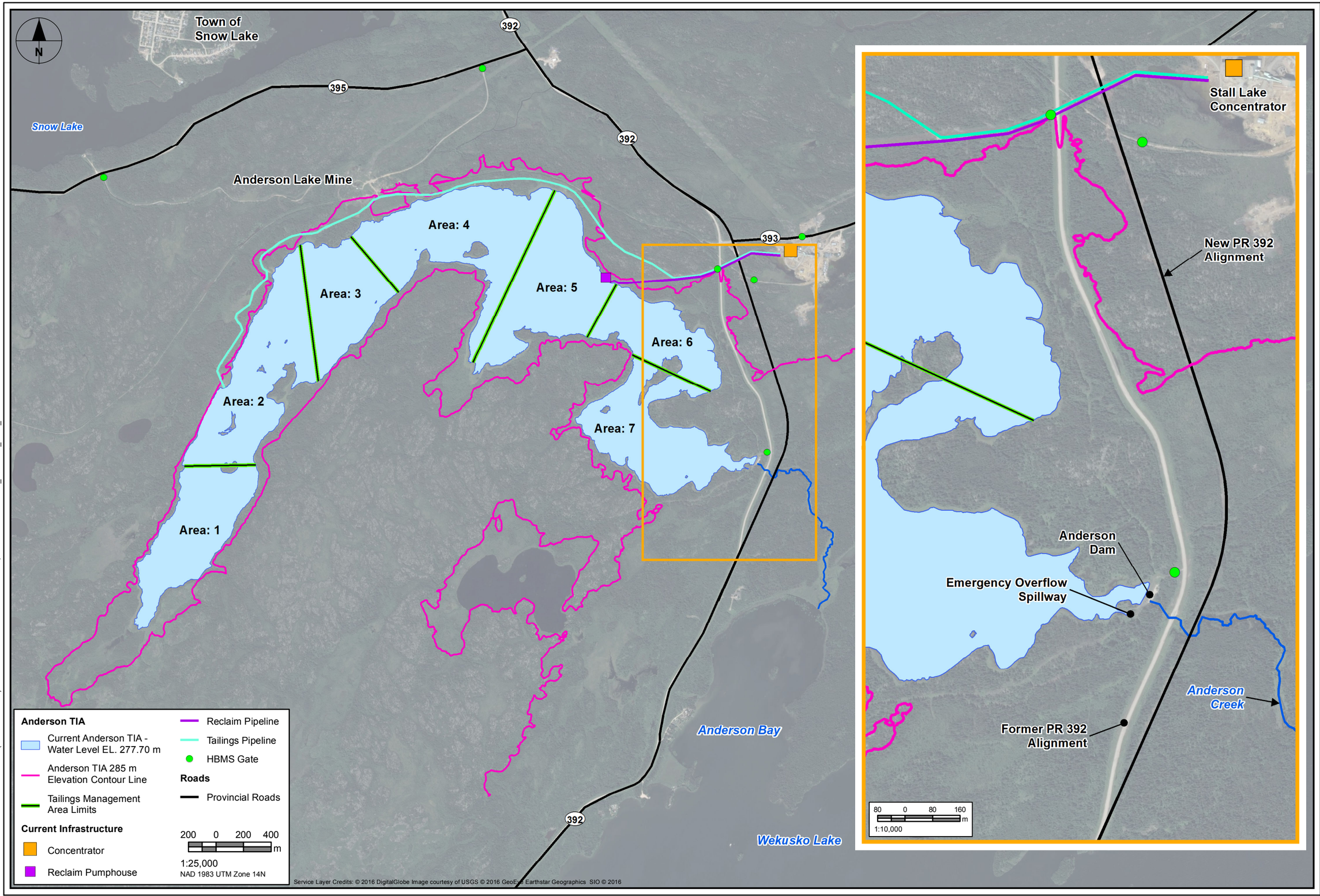
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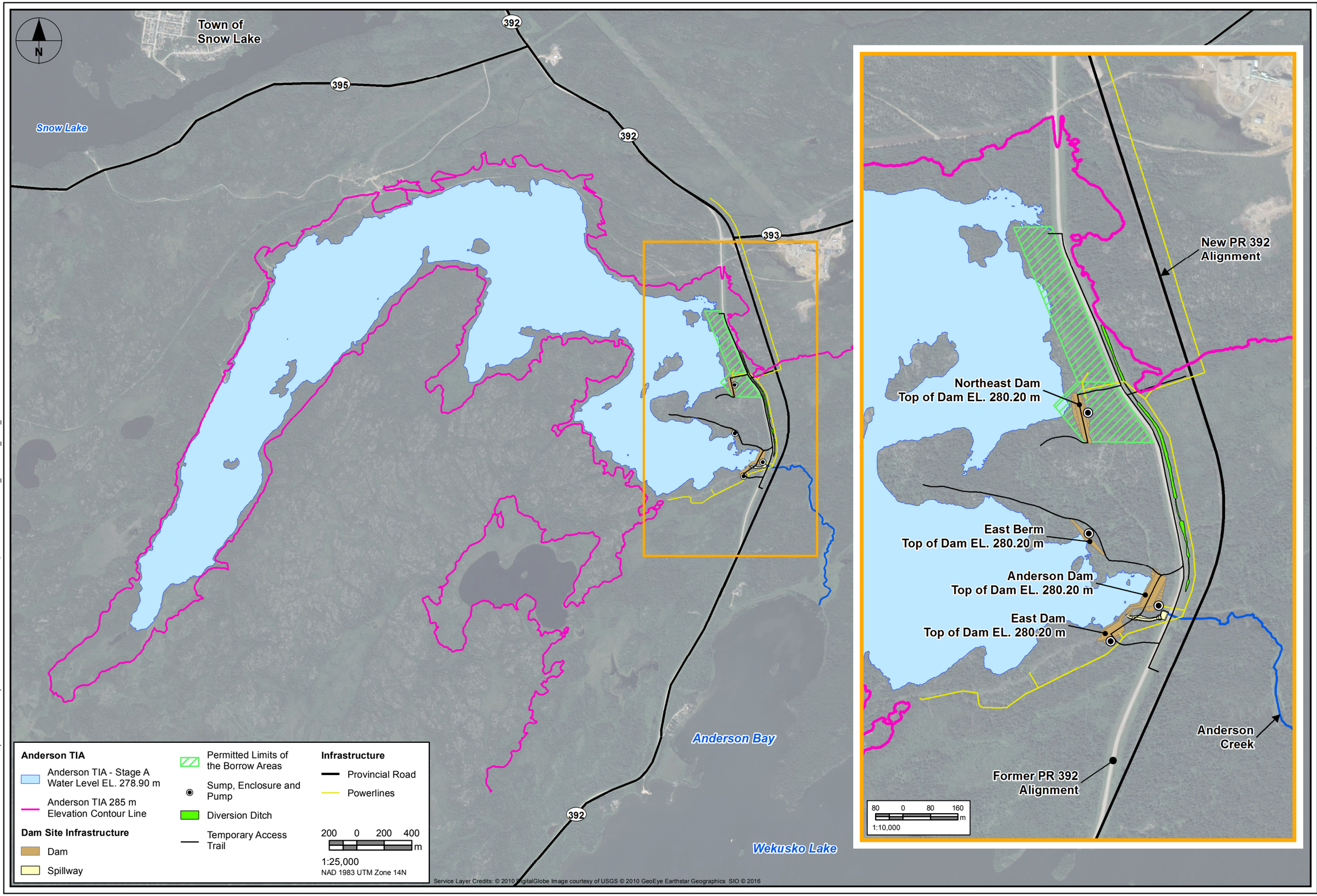
Figure: 03

Anderson TIA

**Anderson Tailings Impoundment Area Expansion**

Hudson Bay Mining and Smelting Co., Limited, Snow Lake, MB






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Project Management initials: Designer: Checked: Approved:

ANSI B 279.4mm x 431.8mm

AECOM

Figure: 04

**Anderson Tailings Impoundment Area Expansion** **Proposed Expansion of the Anderson TIA - Stage A**

Hudson Bay Mining and Smelting Co., Limited, Snow Lake, MB

ANSI B 279.4mm x 431.8mm
Project Management Initials: Designer: Checked: Approved:
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N

## Inset A

Northeast Dam
Top of Dam
EL. 282.0 m

Quarry

20 0 20 40 m
1:2,500

## Inset B

East Berm
Top of Dam EL. 280.2 m

20 0 20 40 m
1:2,500

## Inset C

Raise Anderson Dam
Top of Dam EL. 280.2 m

East Dam
Top of Dam
EL. 280.2 m

Stage A
Spillway

20 0 20 40 m
1:2,500

Northern Access
To Project Area

Inset A

Inset B

Inset C

New PR 392 Alignment

Southern Access
To Project Area

Former PR 392
Alignment

Anderson Creek

**Anderson TIA**

- Current Anderson TIA - Water Level EL. 277.70 m
- Anderson TIA - Stage A Water Level EL. 278.90 m
- Anderson TIA 285 m Elevation Contour Line

**Dam Site Infrastructure**

- Dam
- Spillway
- Permitted Limits of the Borrow Areas
- Sump, Enclosure and Pump
- Diversion Ditch
- Temporary Access Trail

**Infrastructure**

- Provincial Road
- Powerlines

100 0 100 200 m
1:10,000
NAD 1983 UTM Zone 14N

AECOM

**Figure: 05**

**Anderson TIA - Stage A**

**Anderson Tailings Impoundment Area Expansion**

Hudson Bay Mining and Smelting Co., Limited, Snow Lake, MB

Town of Snow Lake

Snow Lake

Anderson Bay

Wekusko Lake

392

395

393

New PR 392 Alignment

Northeast Dam
Top of Dam EL. 282.0 m

East Dam
Top of Dam EL. 282.0 m

East Dam
Top of Dam EL. 282.0m

Southwest Dam
Top of Dam
EL. 282.0 m

Anderson Creek

Former PR 392 Alignment

80 0 80 160 m
1:10,000

**Anderson TIA**
- Anderson TIA - Stage B Water Level EL. 279.50 m
- Anderson TIA 285 m Elevation Contour Line

**Dam Site Infrastructure**
- Dam
- Spillway
- Permitted Limits of the Borrow Area
- Sump, Enclosure and Pump
- Diversion Ditch
- Temporary Access Trail

**Infrastructure**
- Provincial Road
- Powerlines

200 0 200 400 m
1:25,000
NAD 1983 UTM Zone 14N

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**Anderson Tailings Impoundment Area Expansion** **Proposed Expansion of the Anderson TIA - Stage B**

Hudson Bay Mining and Smelting Co., Limited, Snow Lake, MB

AECOM

**Figure: 06**

ANSI B 279.4mm x 431.8mm

Project Management initials: Designer: Checked: Approved:

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N

## Inset A

Northeast Dam
Top of Dam
EL. 282.0 m

40 0 40 80 m
1:5,000

## Inset B

East Dam
Top of Dam EL. 282.0 m

East Dam
Top of Dam EL. 282.0 m

Stage B
Spillway

40 0 40 80 m
1:5,000

## Inset C

Southwest
Dam
Top of Dam
EL. 282.0 m

40 0 40 80 m
1:5,000

See Inset A

See Inset B

See Inset C

New PR 392
Alignment

Anderson Creek

**Anderson TIA**
- Anderson TIA - Stage A Water Level EL. 278.90 m
- Anderson TIA - Stage B Water Level EL. 279.50 m
- Anderson TIA 285 m Elevation Contour Line

**Dam Site Infrastructure**
- Dam Site Infrastructure
- Spillway
- Permitted Limits of the Borrow Area
- Sump, Enclosure and Pump
- Diversion Ditch
- Temporary Access Trail

**Infrastructure**
- Provincial Road
- Powerlines

100 0 100 200 m
1:10,000
NAD 1983 UTM Zone 14N

AECOM

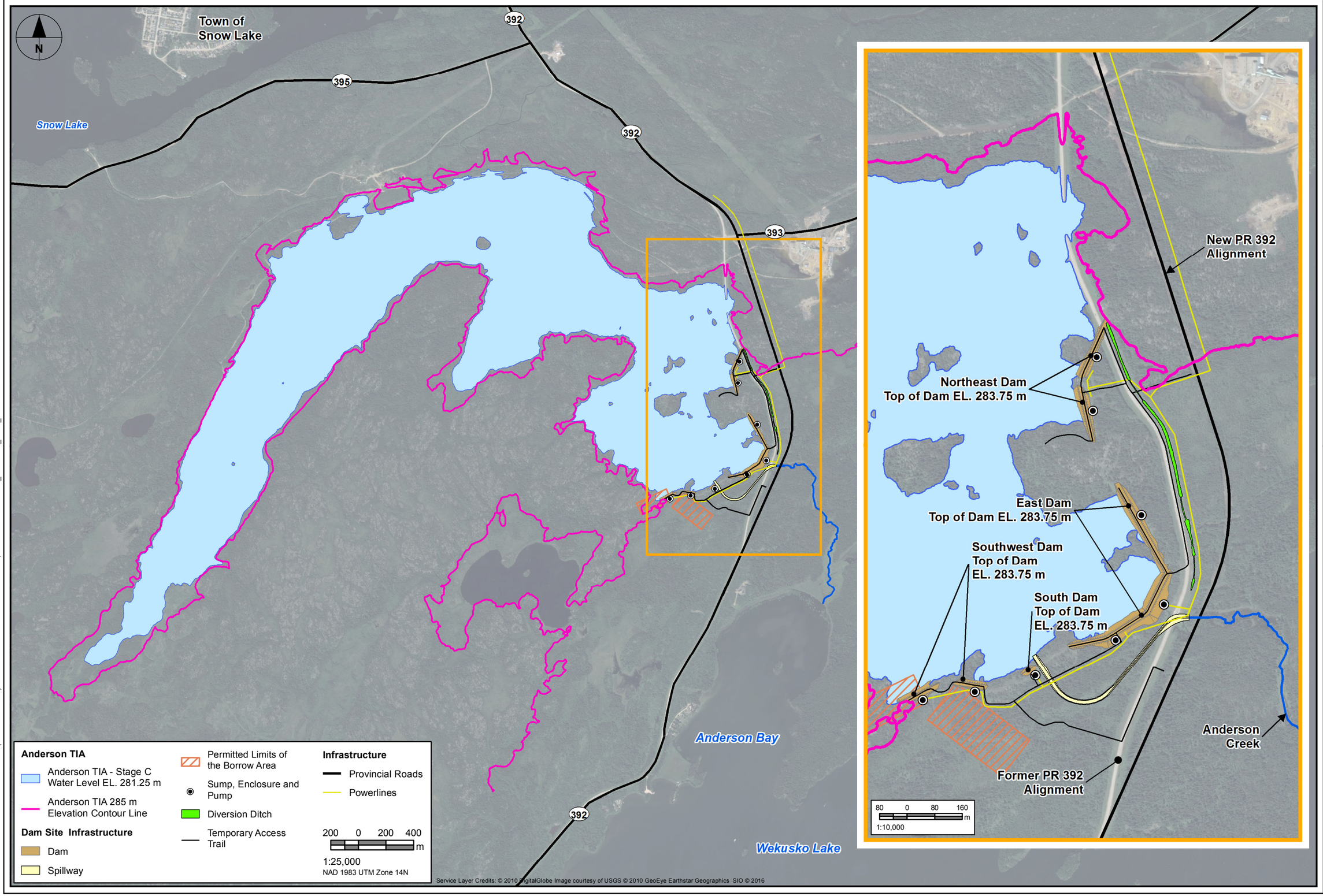
Figure: 07

**Anderson TIA - Stage B**

**Anderson Tailings Impoundment Area Expansion**

Hudson Bay Mining and Smelting Co., Limited, Snow Lake, MB

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Project Management Initials: Designer: Checked: Approved:
ANSI B 279.4mm x 431.8mm




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AECOM

**Figure: 08**

**Anderson Tailings Impoundment Area Expansion** **Proposed Expansion of the Anderson TIA - Stage C**

Hudson Bay Mining and Smelting Co., Limited, Snow Lake, MB

AECOM

Figure: 09

Anderson TIA - Stage C

Anderson Tailings Impoundment Area Expansion

Hudson Bay Mining and Smelting Co., Limited, Snow Lake, MB

N

Inset A

Northeast Dam
Top of Dam
EL. 283.75 m

40 0 40 80 m
1:5,000

Inset B

East Dam
Top of Dam EL. 283.75 m

South Dam
Top of Dam EL. 283.75 m

40 0 40 80 m
1:5,000

Inset C

Southwest Dam
Top of Dam
EL. 283.75 m

40 0 40 80 m
1:5,000

See Inset A

See Inset B

See Inset C

New PR 392
Alignment

Former PR 392
Alignment

Anderson Creek

**Anderson TIA**

- Anderson TIA - Stage B Water Level EL. 279.50 m
- Anderson TIA - Stage C Water Level EL. 281.25 m
- Anderson TIA 285 m Elevation Contour Line

**Dam Site Infrastructure**

- Dam
- Spillway
- Permitted Limits of the Borrow Area
- Sump, Enclosure and Pump
- Diversion Ditch
- Temporary Access Trail

**Infrastructure**

- Provincial Road
- Powerlines

100 0 100 200 m

1:10,000

NAD 1983 UTM Zone 14N

ANSI B 279.4mm x 431.8mm

Approved:

Checked:

Designer:

Project Management Initials:

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Town of Snow Lake

Snow Lake

Anderson Bay

Wekusko Lake

Anderson Creek

New PR 392 Alignment

Former PR 392 Alignment

392

395

393

N

**Anderson TIA**
- Current Anderson TIA - Water Level EL. 277.70 m
- Anderson TIA 285 m Elevation Contour Line

**Laydown Areas**
- Laydown Area

**Stage A**
- Permitted Limits of the Borrow Area

Permitted Limits of the Quarry Areas

**Stage B**
- Permitted Limits of the Borrow Area

**Stage C**
- Permitted Limits of the Borrow Area

**Roads**
- Provincial Roads

Temporary Access Trail

**Utility**
- Powerlines

200 0 200 400 m

1:25,000

NAD 1983 UTM Zone 14N

80 0 80 160 m

1:10,000

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AECOM

**Figure: 10**

**Anderson Tailings Impoundment Area Expansion**

**Quarries, Borrow Areas and Laydown Area**

Hudson Bay Mining and Smelting Co., Limited, Snow Lake, MB

ANSI B 279.4mm x 431.8mm

Project Management Initials: Designer:
Checked:
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Town of Snow Lake

Snow Lake

395

392

393

Anderson Bay

Wekusko Lake

New PR 392 Alignment

Former PR 392 Alignment

Anderson Creek

80 0 80 160 m

1:10,000

**Tree Clearing**

- Total Tree Clearing: 1,734,223 m²
- Stages A, B and C of Dam Site Tree Clearing: 404,385 m²
- Stages A, B and C of Dam Site Minus the Tree Clearing Around Anderson TIA: 288,149 m²
- Tree Clearing Around Anderson TIA Based on Inundation of Stage C: 1,446,074 m²

**Anderson TIA**

- Current Anderson TIA - Water Level EL. 277.70 m
- Anderson TIA 285 m Elevation Contour Line

200 0 200 400 m

1:25,000

NAD 1983 UTM Zone 14N

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Figure: 11

**Tree Clearing Around Anderson TIA**

**Anderson Tailings Impoundment Area Expansion**

Hudson Bay Mining and Smelting Co., Limited, Snow Lake, MB

ANSI B 279.4mm x 431.8mm

Approved:

Checked:

Designer:

Project Management Initials:

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Last saved by: MAHEC (2016-07-18) Last Plotted: never

Town of Snow Lake

Snow Lake

395

392

393

Anderson TIA

Anderson Bay

Wekusko Lake

392

New PR 392 Alignment

Former PR 392 Alignment

Anderson Creek

80 0 80 160 m

1:10,000

**Anderson TIA**

Current Anderson TIA - Water Level EL. 277.70 m

Anderson TIA 285 m Elevation Contour Line

**Operating Water Levels**

Stage A - Water Level EL. 278.90 m

Stage B - Water Level EL. 279.50 m

Stage C - Water Level EL. 281.25 m

**Land**

Land Above the Stage C Flooding Elevation

250 0 250 500 m

1:25,000

NAD 1983 UTM Zone 14N

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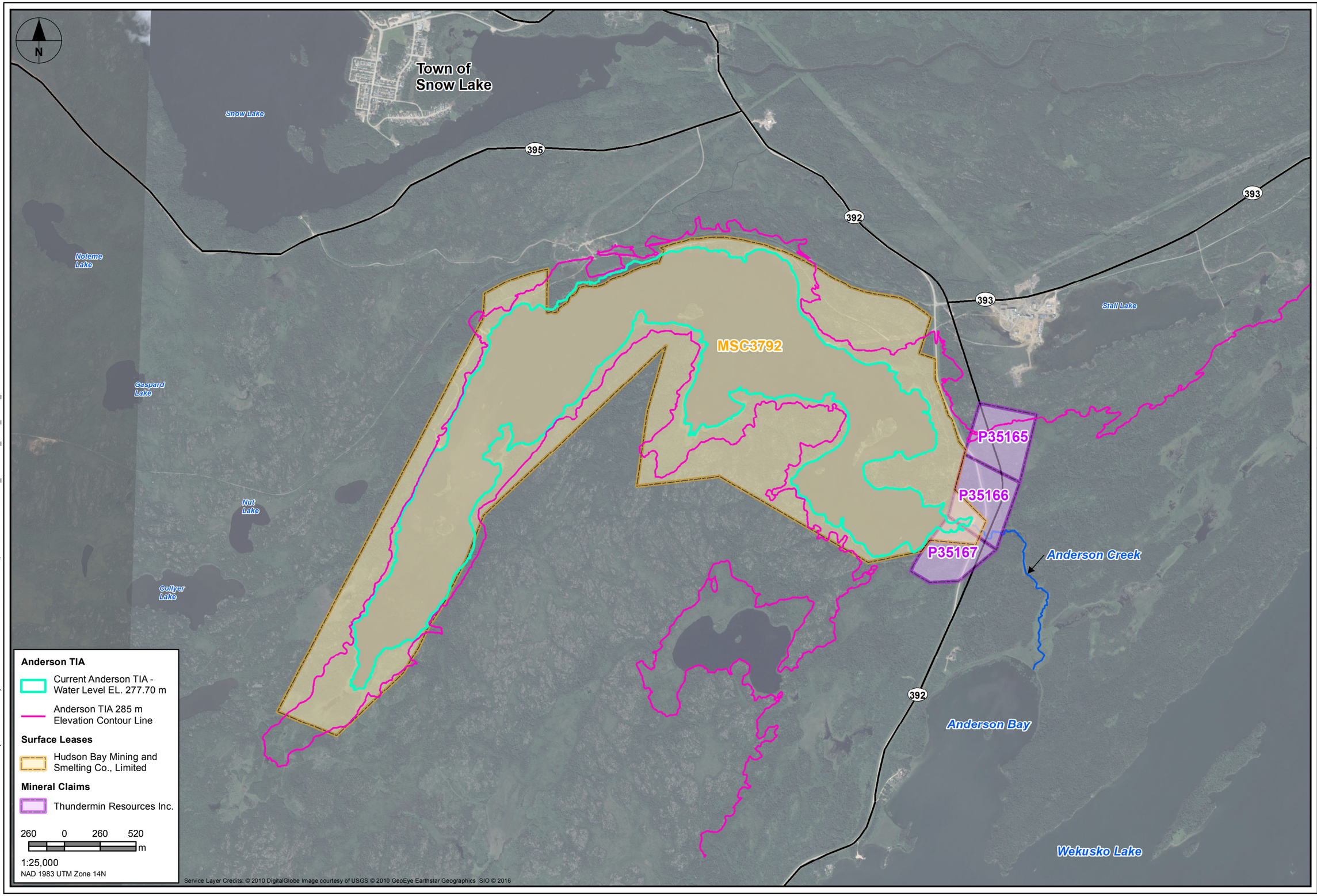
Figure: 12

**Areas to be Inundated**

**Anderson Tailings Impoundment Area Expansion**

Hudson Bay Mining and Smelting Co., Limited, Snow Lake, MB

ANSI B 279.4mm x 431.8mm
Project Management Initials: Designer: Checked: Approved:
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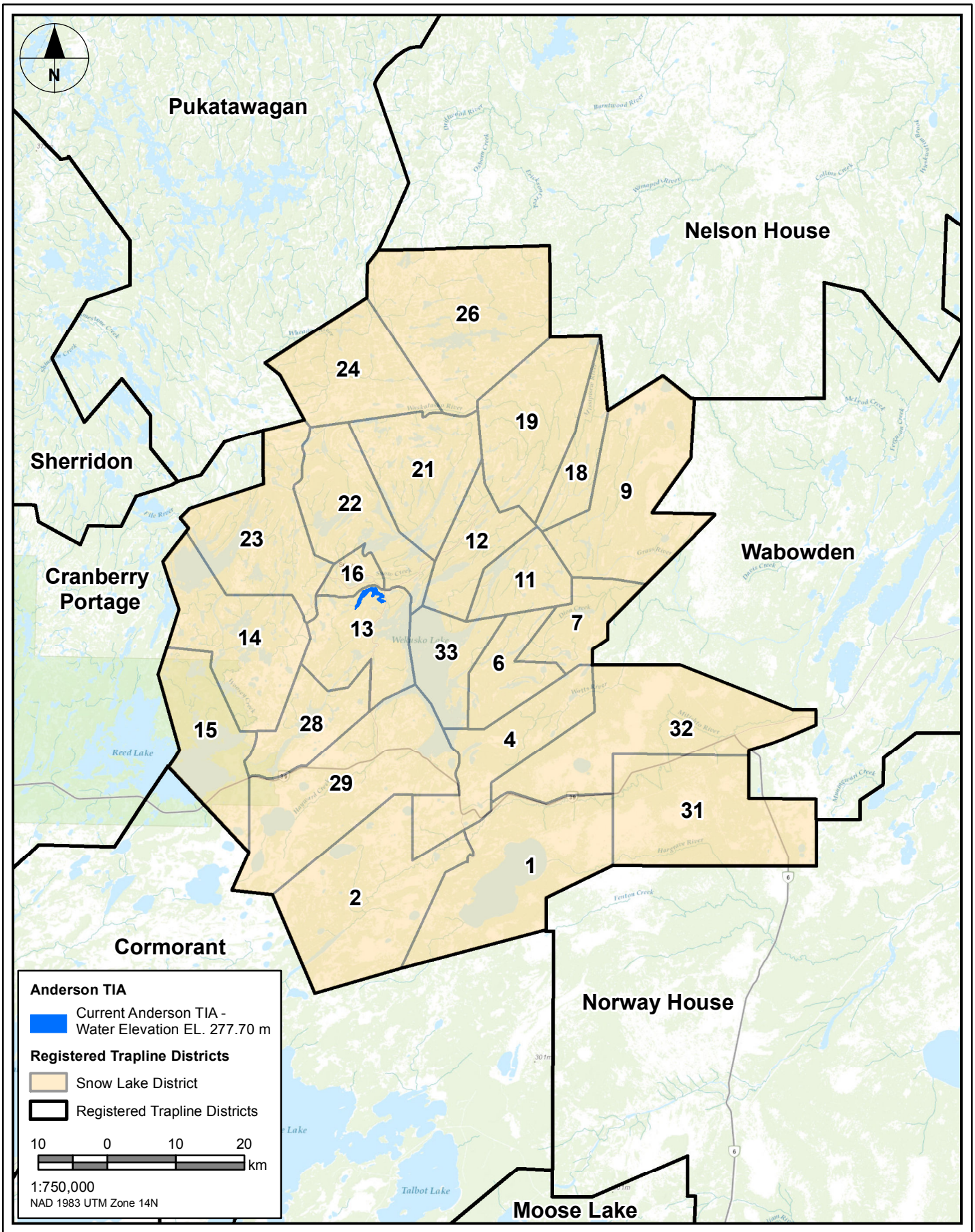

AECOM

Figure: 13

HBMS Surface Leases

Anderson Tailings Impoundment Area Expansion

Hudson Bay Mining and Smelting Co., Limited, Snow Lake, MB




ANSI A 215.9mm x 279.4mm

Approved:

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Project Management Initials: Designer:

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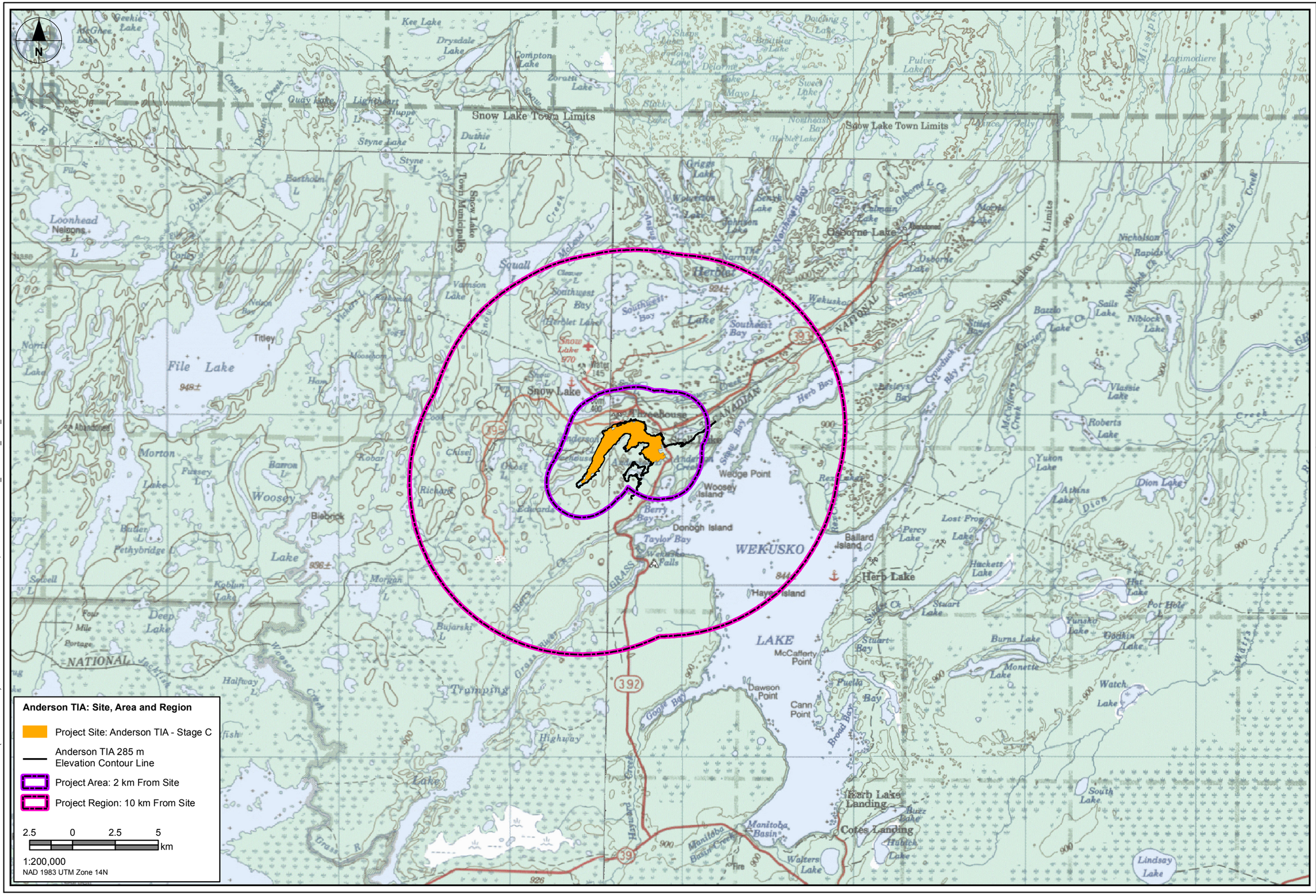
**Anderson Tailings Impoundment Area Expansion**

Hudson Bay Mining and Smelting Co., Limited, Snow Lake, MB

**Registered Trap Lines**

AECOM

**Figure: 14**




**Anderson TIA: Site, Area and Region**

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Project Management Initials: Designer: Checked: Approved:

ANSI B 279.4mm x 431.8mm

AECOM

**Figure: 15**

**Project Site, Area and Region**

**Anderson Tailings Impoundment Area Expansion**

Hudson Bay Mining and Smelting Co., Limited, Snow Lake, MB

Figure: 16

AECOM

Project Site and Area

Anderson Tailings Impoundment Area Expansion

Hudson Bay Mining and Smelting Co., Limited, Snow Lake, MB

Anderson TIA

Snow Lake

Stall Lake

Snow Bay

Anderson Bay

Vikers Bay

Berry Bay

Taylor Bay

Woosey Island

Rice Island

English Island

Donogh Island

Wedge Point

Kormans Lake

Tern Lake

Hurlin Lake

Stolz Lake

Sock Lake

Purple Sandy Beach

Notenie Lake

Arm Lake

Gaspard Lake

Threehouse Lake

Nutt Lake

Collyer Lake

Kontzie Lake

Moore Lake

Communication

Domestic

Kerr Liftover

Berry Creek

Anderson Creek

Snow Creek

Tern Creek

Narrows

Landing

395

393

392

**Anderson TIA: Site and Area**

- Project Site: Anderson TIA - Stage C
- Anderson TIA 285 m Elevation Contour Line
- Project Area: 2 km From Site

500 0 500 1,000 m

1:40,000

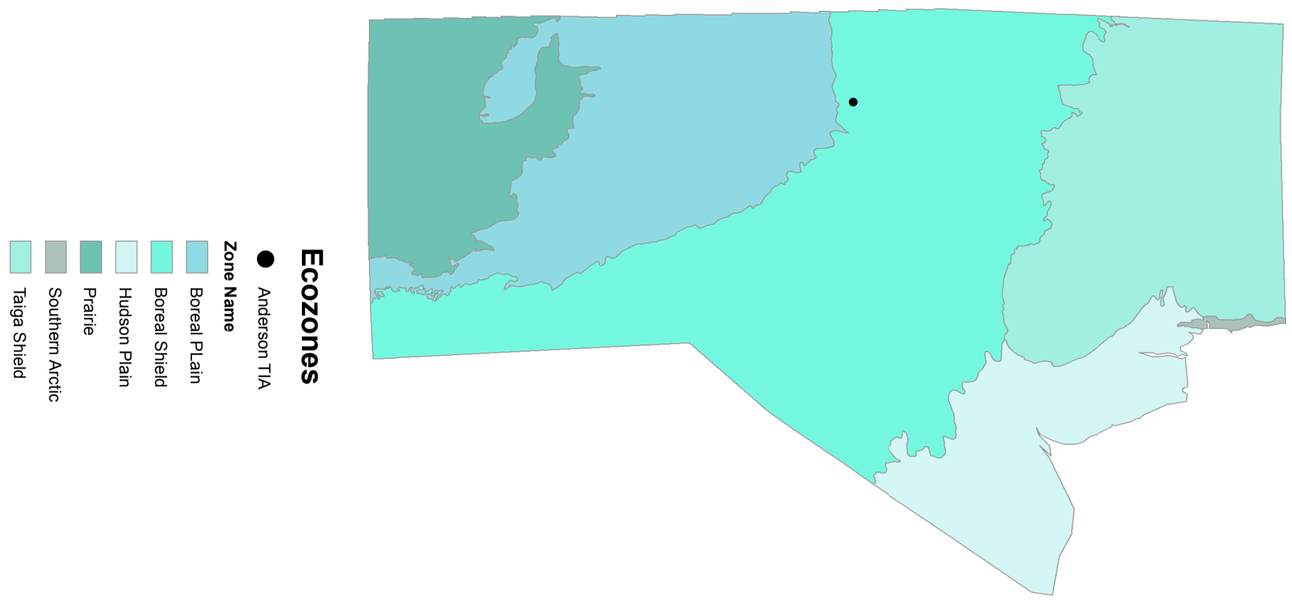
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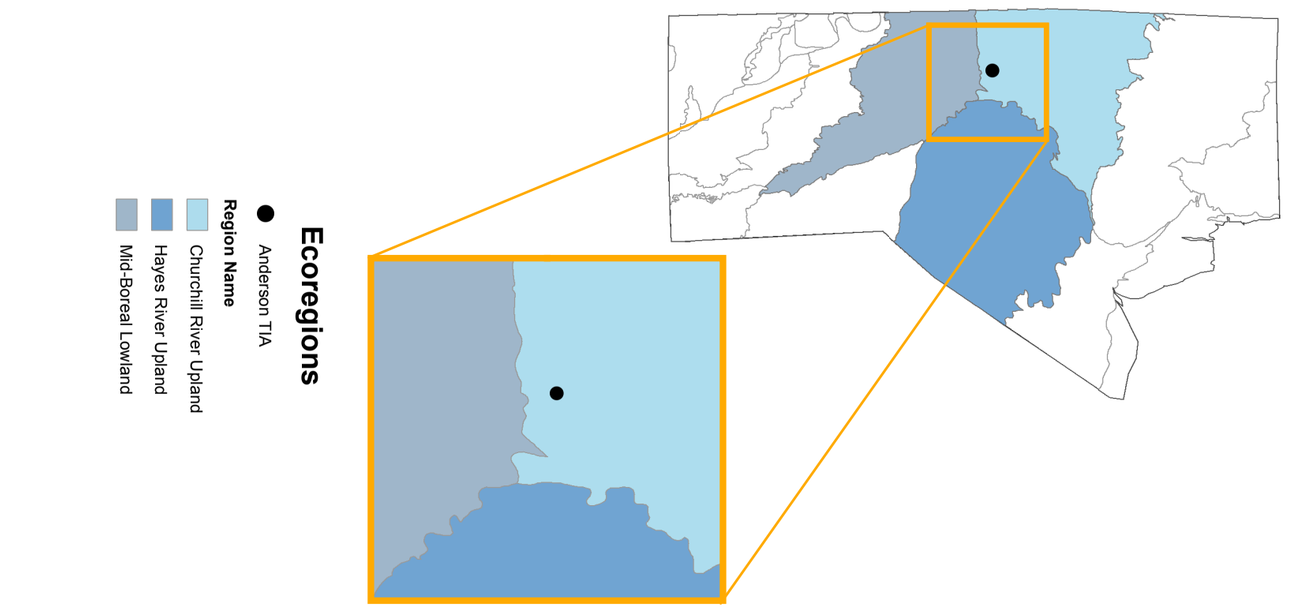
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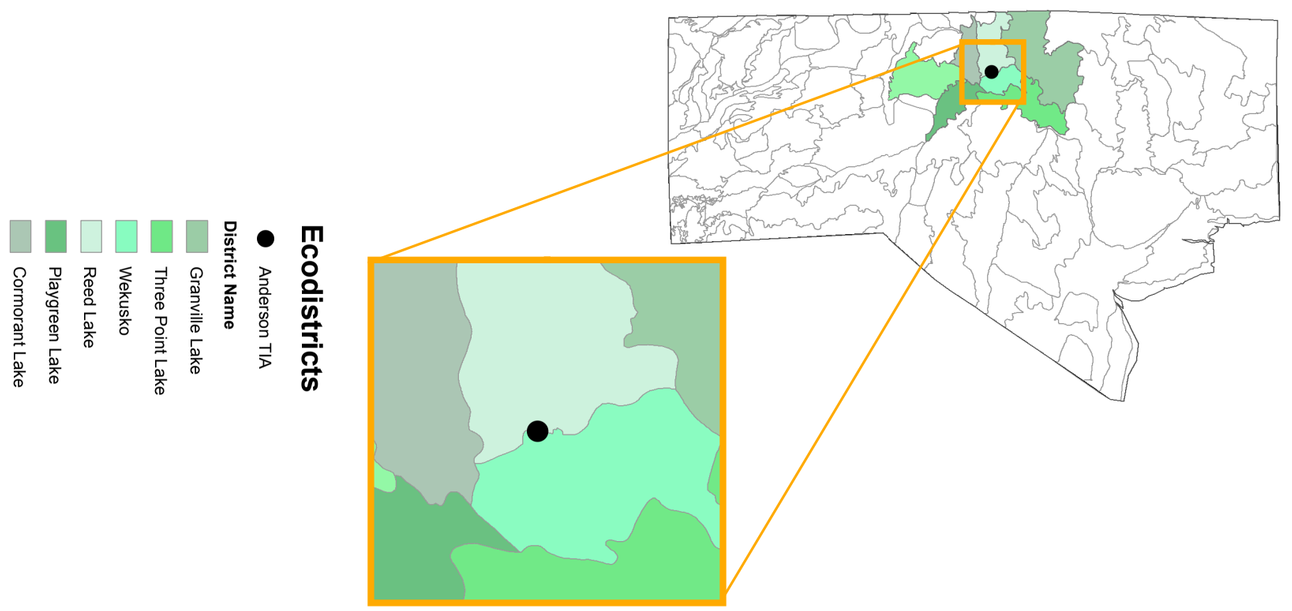
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**Anderson Tailings Impoundment Area Expansion**

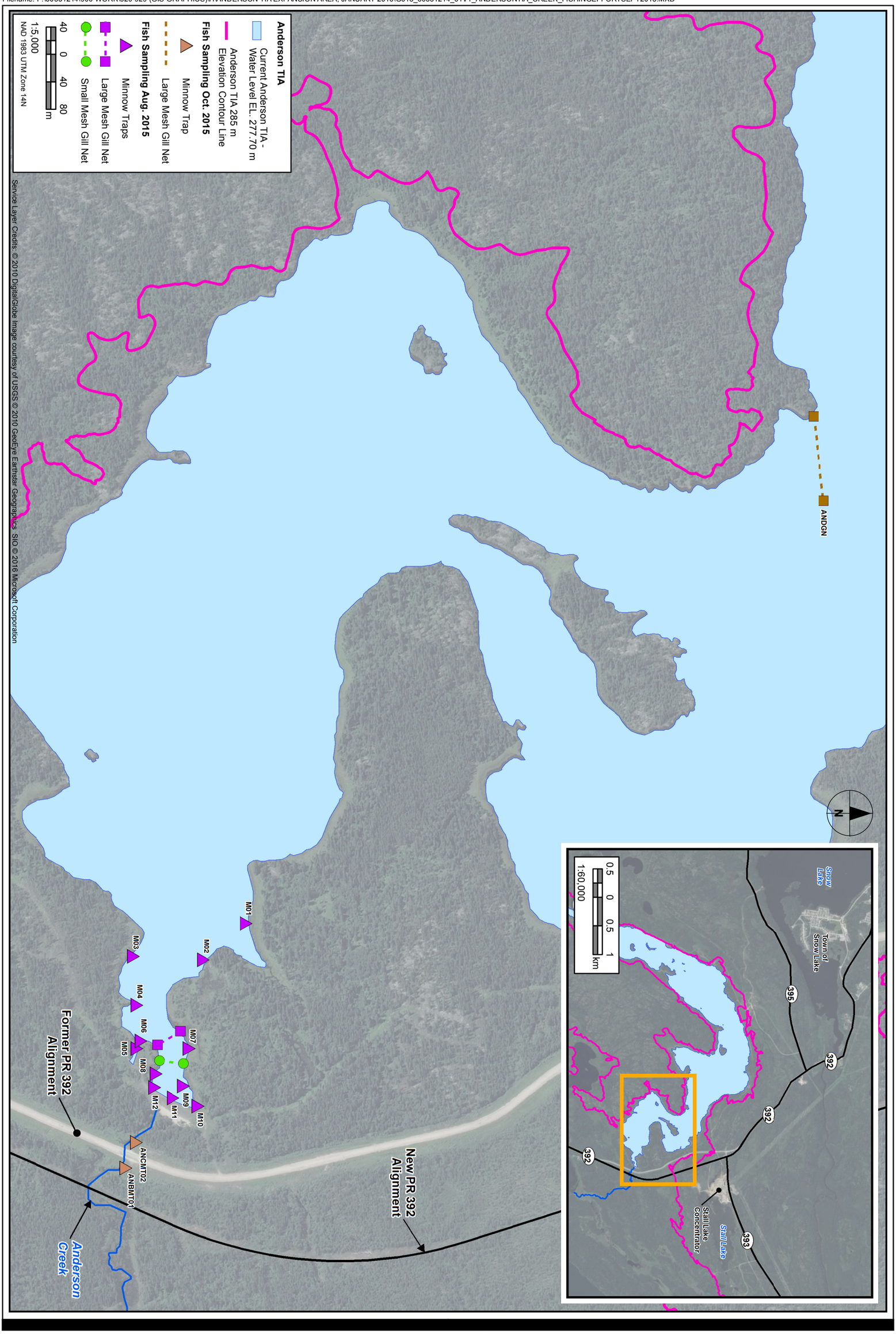
Hudson Bay Mining and Smelting Co., Limited, Snow Lake, MB

**Ecodistrict**

AECOM

**Figure: 17**

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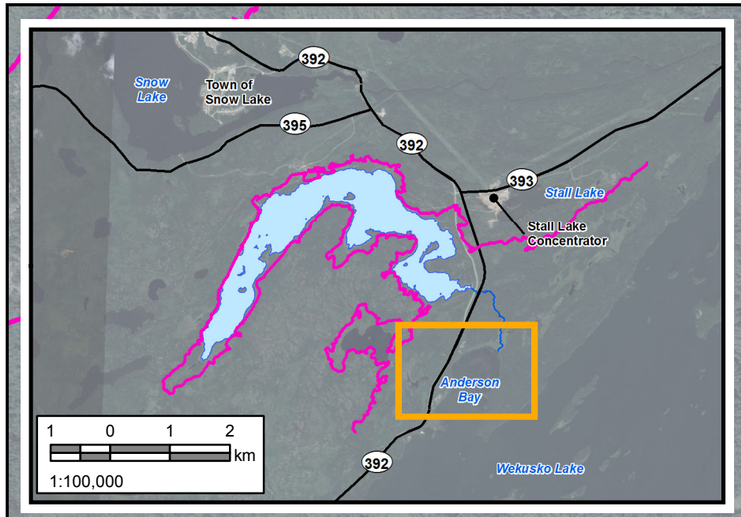

**Anderson Tailings Impoundment Area Expansion** **Anderson TIA Fish Sampling Locations**

Hudson Bay Mining and Smelting Co., Limited, Snow Lake, MB

AECOM

**Figure: 18**

ANSI B 279.4mm x 431.8mm
Project Management Initials: Designer:
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N

Anderson Creek

ANBMT04

ANBMT01

PR 392

GSBMT01A

ANBMT03

ANBGN01

ANB02

Anderson Bay

Wekusko Lake

**Anderson TIA**

Current Anderson TIA - Water Level EL. 277.70 m

Anderson TIA 285 m Elevation Contour Line

**Fish Sampling Oct. 2015**

Minnow Trap

Large Mesh Gill Net

50 0 50 100
m

1:6,000

NAD 1983 UTM Zone 14N

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AECOM

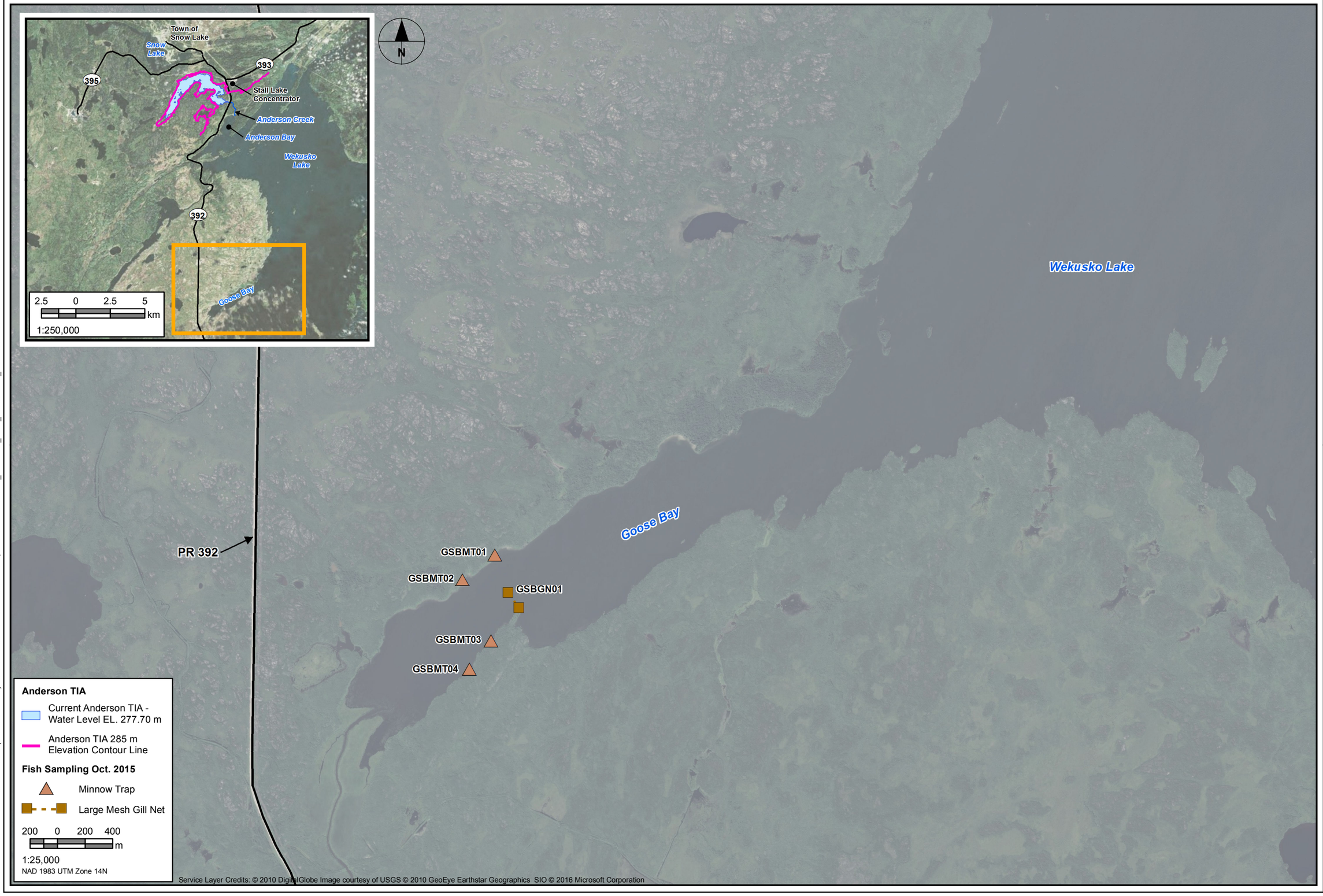
**Figure: 19**

**Anderson Bay Fish Sampling Locations**

**Anderson Tailings Impoundment Area Expansion**

Hudson Bay Mining and Smelting Co., Limited, Snow Lake, MB

ANSI B 279.4mm x 431.8mm
Project Management Initials: Designer:
Checked:
Approved:
Last saved by: MAHEC (2016-07-18) Last Plotted: 2013-07-15
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AECOM

**Figure: 20**

**Goose Bay Fish Sampling Locations**

**Anderson Tailings Impoundment Area Expansion**

Hudson Bay Mining and Smelting Co., Limited, Snow Lake, MB

AECOM

Figure: 21

Provincial Parks and WMAs

Anderson Tailings Impoundment Area Expansion

Hudson Bay Mining and Smelting Co., Limited, Snow Lake, MB

Bakers Narrows Provincial Park

Wekusko Falls Provincial Park

Grass River Provincial Park

Clearwater Lake Provincial Park

Cormorant Provincial Forest

Saskeram Wildlife Management Area

Tom Lamb Wildlife Management Area

**Anderson TIA**

- Project Region: 10 km From Site
- Anderson TIA 285 m Elevation Contour Line
- Project Area: 2 km From Site
- Project Site: Anderson TIA - Stage C

**Provincial Parks**

- Provincial Park

**Wildlife Management Area**

- Wildlife Management Area

**Provincial Forest**

- Provincial Forest

5 0 5 10 km

1:500,000

NAD 1983 UTM Zone 14N

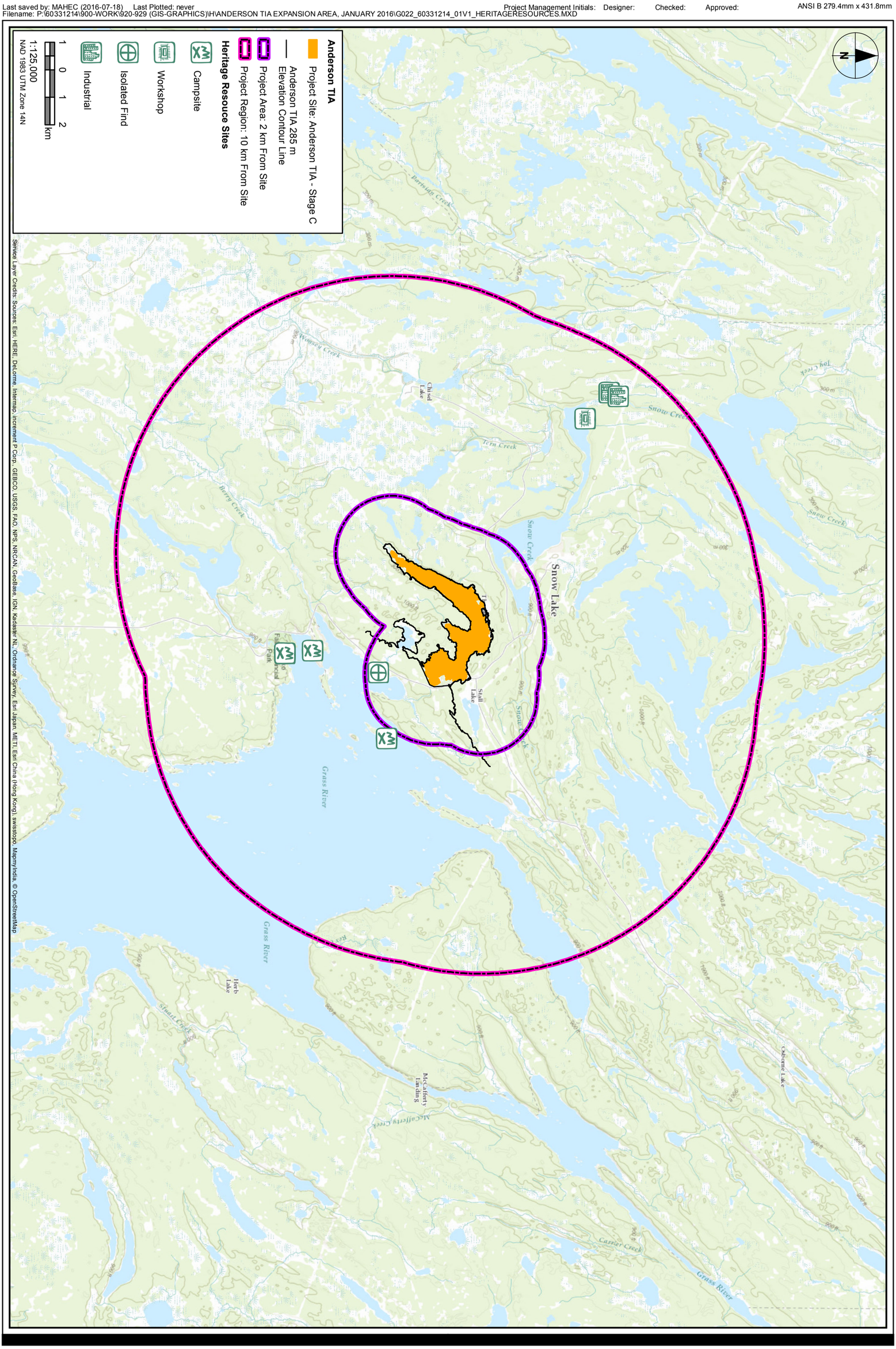
Service Layer Credits: Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the

ANSI B 279.4mm x 431.8mm

Project Management Initials: Designer: Checked: Approved:

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Project Management Initials: Designer: Checked: Approved:
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**Anderson Tailings Impoundment Area Expansion**

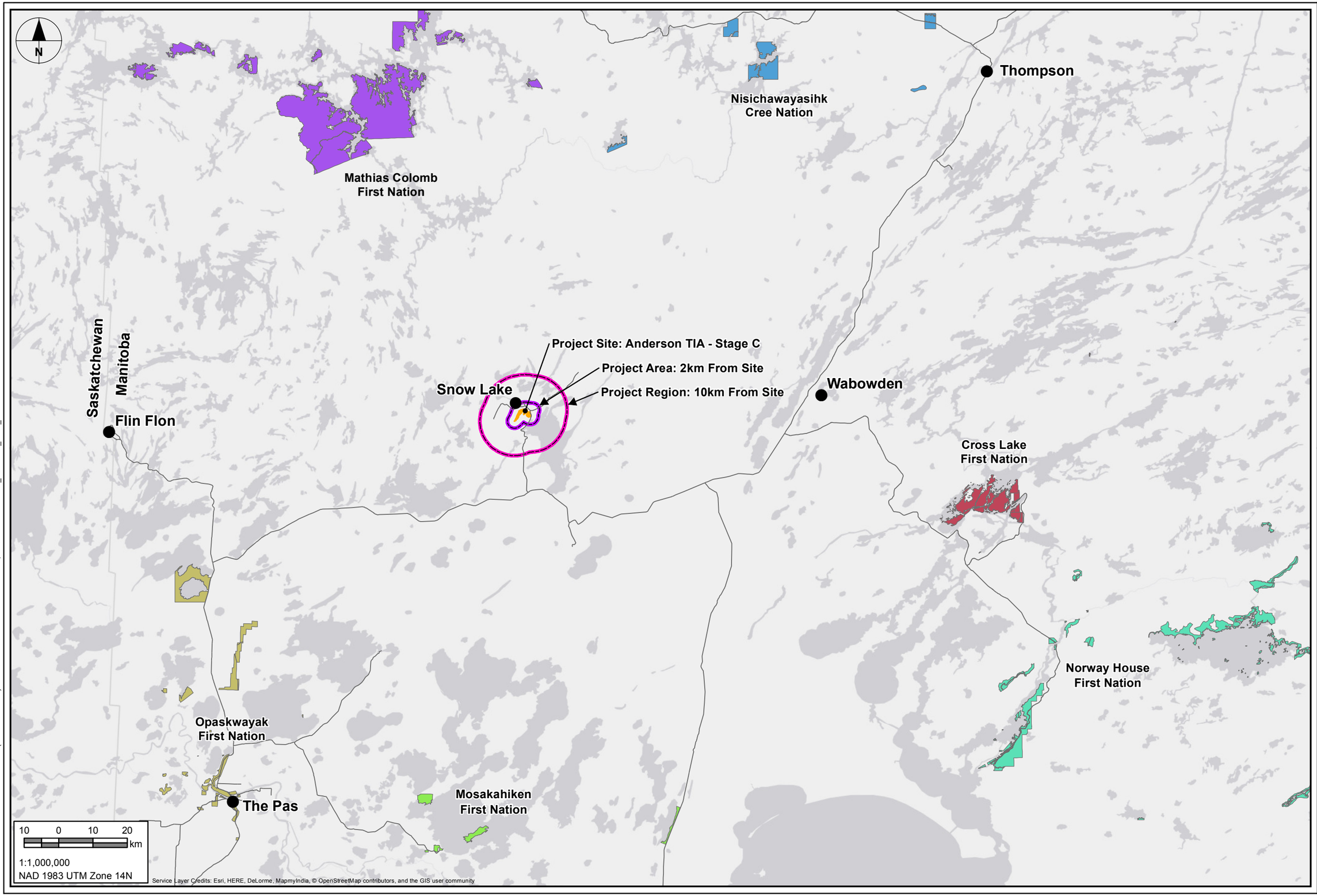
Hudson Bay Mining and Smelting Co., Limited, Snow Lake, MB

**Heritage Resources**

AECOM

**Figure: 22**

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Project Management Initials: Designer: Checked: Approved:
Last saved by: MAHEC (2016-07-18) Last Plotted: never
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AECOM

Figure: 23

First Nations

**Anderson Tailings Impoundment Area Expansion**

Hudson Bay Mining and Smelting Co., Limited, Snow Lake, MB

# Appendix A

- Document 1: Refurbishment Letter to Manitoba Conservation and Water Stewardship
- Document 2: Quarry Leases
- Document 3: Casual Quarry Permits
- Document 4: CEC Order 765
- Document 5: Letter from Transport Canada

# Document 1: Refurbishment Letter to Manitoba Conservation and Water Stewardship

February 07, 2014

Ms. Tracey Braun
Director, Environmental Approvals,
Conservation and Water Stewardship,
Government of Manitoba
123 Main Street, Suite 160
Winnipeg, MB R3C 1A5

Attn: Jennifer Winsor

Dear Ms. Braun,

**Re: Updated Project Description for Stall Lake Concentrator**

**Introduction**

We write to provide an updated project description for the Stall Lake Concentrator operated by Hudson Bay Mining and Smelting Co., Limited (HBMS) located in Snow Lake, Manitoba (see location on **Figure 1**). **Figure 2** shows the layout of the site of the Stall Lake Concentrator.

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 processes (crushing and grinding) and chemical processes (flotation) to extract target metals from the ore. The Stall Lake Concentrator was commissioned in 1979, at the same time as the Anderson Tailings Impoundment Area, after a Clean Environment Commission process and the issuance of CEC Orders 765 and 766. Since being commissioned, the Stall Lake Concentrator has processed ore from ten former HBMS-owned mines located in the Snow Lake area.

Apart from brief periods during 1993-94, 1998-2000 and 2009, the Stall Lake Concentrator has been in continuous operation. However, its design production capacity of 3,500 short tons per day (stpd) has been greatly degraded through the age of equipment and the removal of circuits which have not been in continuous use. Equipment must be replaced in order to restore the capacity of the Concentrator to operate at levels closer to its original production capacity than it has been able to do in recent years.

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

For the last several months, the Stall Lake Concentrator has been undergoing refurbishments intended to restore its production capacity to 3,000 short tons per day (stpd), which is still below its original production capacity of 3,500 stpd. The refurbishments are being carried out within the building housing the Stall Lake Concentrator. This restoration of capacity is needed to accommodate ore from the proposed Lalor Mine until such time as the proposed Lalor Concentrator is permitted, constructed, and ready for commissioning.

Once the refurbishments are complete, the Stall Lake Concentrator will operate 24 hours per day, 7 days per week, with scheduled downtime for maintenance as required.

**Process**

The Stall Lake Concentrator processes ore to produce both zinc and copper concentrates. **Figures 3a**, **3b** and **3c** illustrate the processes used in the Stall Lake Concentrator.

**List of Refurbishments**

**Figures 3a, 3b, and 3c** also illustrate the replacements/refurbishments in the process used in the Stall Lake Concentrator as follows:

- Refurbishing the grinding circuit,
- Increasing copper and zinc cleaner flotation capacities,
- Increasing copper re-grind circuit capacity,
- Upgrading slurry pumping systems,
- New zinc vacuum disc filtering system and,
- Upgrading electrical/instrumentation control systems.

There are no changes being made to the crusher circuit (see **Figure 3a**).

A detailed list of equipment being installed and/or refurbished is provided in **Appendix A**.

**Water Use**

The Stall Lake Concentrator has used and will continue to use approximately 638,344 US gallons per day (gpd) (230 million US gallons per year) of freshwater which is pumped from Snow Lake, pursuant to *The Water Rights Act* license (No. 2011-110), which permits HBMS to withdraw 1,150 cubic decametres (approximately 304 million US gallons per year).

The Stall Lake Concentrator also will continue to use approximately 1,750,000 US gpd of Reclaim water, which is pumped from the Anderson Tailings Impoundment Area (TIA).

**Materials Use**

The primary reagents which have been and are continuing to be used at the Stall Lake Concentrator are:

- Lime,
- Cytec 3418A,
- Cytec 7279,
- Copper sulfate,
- MIBC (Methyl Isobutyl Carbinol),
- Percol.

**Tailings**

Tailings produced in the concentrating processes are pumped by a pipeline to the Anderson TIA in accordance with the Clean Environment Commission (CEC) Order No. 766. The current volume of tailings generated at the Stall Concentrator is 1,150 dry tons per day (dtpd). By summer of 2014, the amount of tailings is expected to be 1,500 dtpd, and by 2015, the amount of tailings is expected to be 2,700 dry tons per day. Tailings will continue to be pumped at a rate of approximately 2,300 US gallons per min.

**Inspections**

HBMS conducts daily inspections along the tailings pipeline to the Anderson TIA. This involves a visual inspection along the length of the tailings pipeline. Further, HBMS has installed pressure and flow meters on the tailing line, which allows for any leaks to be detected. If a leak is detected, the feed to the Concentrator is shut off immediately and personnel are dispatched to inspect the tailings pipeline. If a leak is observed, appropriate measures in accordance with HBMS' Spill Response Plan are implemented.

**Equipment Re-Use**

Old equipment that is being removed from the existing Stall Lake Concentrator is being salvaged. Some of the newer equipment may be transferred for use at the proposed Lalor Concentrator. Other pieces of equipment are being stored in laydown areas at the Stall Lake Concentrator site to be used in other HBMS facilities when required.

**Traffic**

**Table 1** provides an outline of the anticipated volume of traffic once Lalor ore is being processed at the refurbished Stall Lake Concentrator and before the proposed Lalor Concentrator has been placed into operation.

**Table 1 – Traffic**

| Truck Type | Current Traffic Volume (per day) | Anticipated Traffic Volume (per day) |
|---|---|---|
| Ore trucks from Lalor | 4 | 8 |
| Copper Concentrate to FlinFlon | 3 | 5 |
| Zinc Concentrate to FlinFlon | 8 | 12 |
| Employee Vehicles and Delivery Trucks | 20 | 30 |

## Employees

The Stall Lake Concentrator currently employs 51 people. It is anticipated that once the refurbishments have been fully implemented, 10 additional employees will be hired.

## Schedule

It is anticipated that the Stall Lake Concentrator will have the desired production capacity of 3,000 stpd prior to the third quarter of 2014.

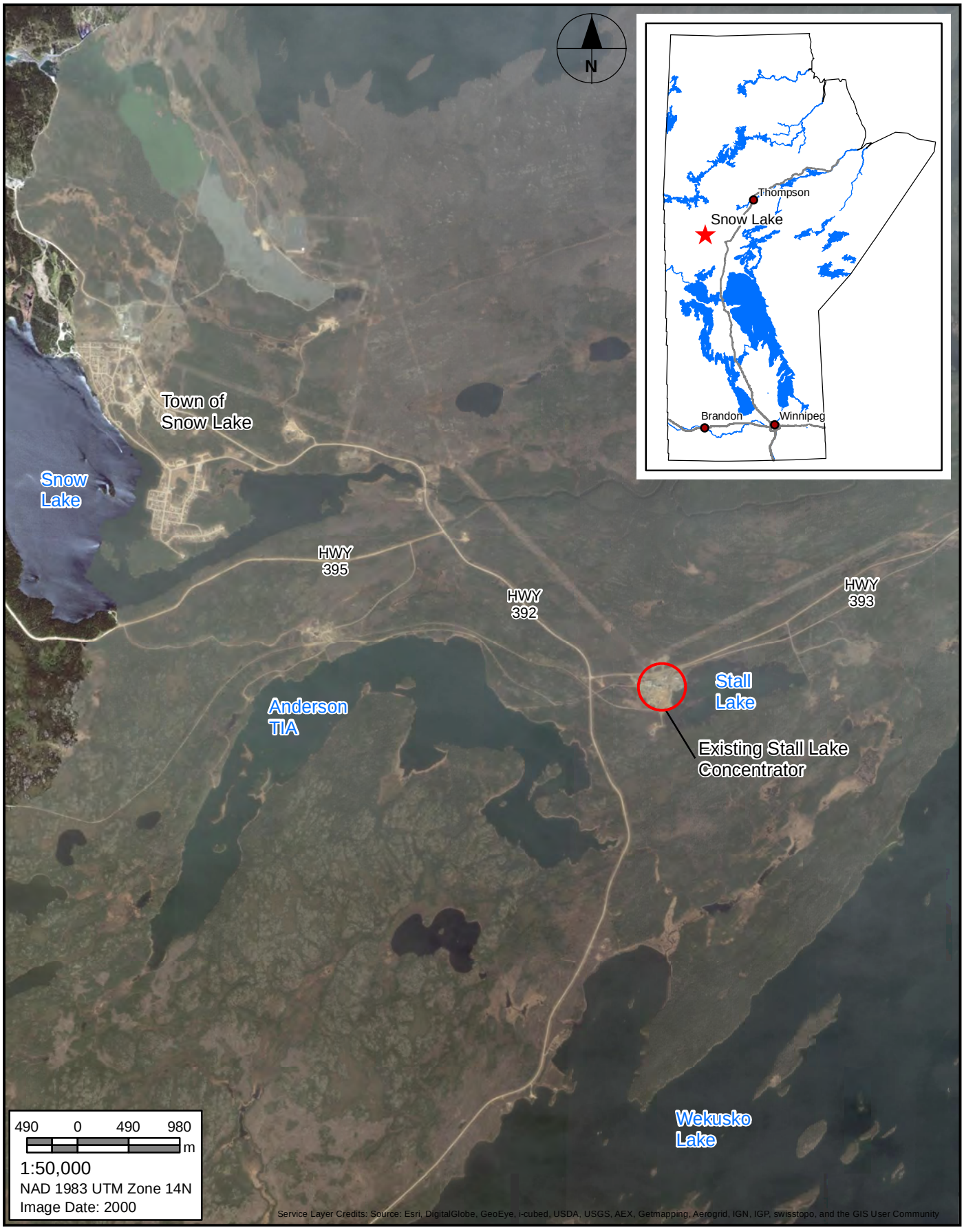
## Conclusion

We trust that this updated project description will be useful to you in ensuring the accuracy of information contained in your file. We would be pleased to provide any clarifications that you might request.

Sincerely,

**Jay Cooper**

Superintendent Environment




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Approved:
Checked:
Designer:
Project Management Initials:
Last Plotted: 2013-10-15
Last saved by: MAHEC (2013-10-15)
Filename: P:\60287252\000-CAD\06-GIS\STALL LAKE-LALOR CONCENTRATOR\G001_60287252_01V1_PROJECTLOCATION.MXD

**Stall Lake Concentrator Refurbishments**

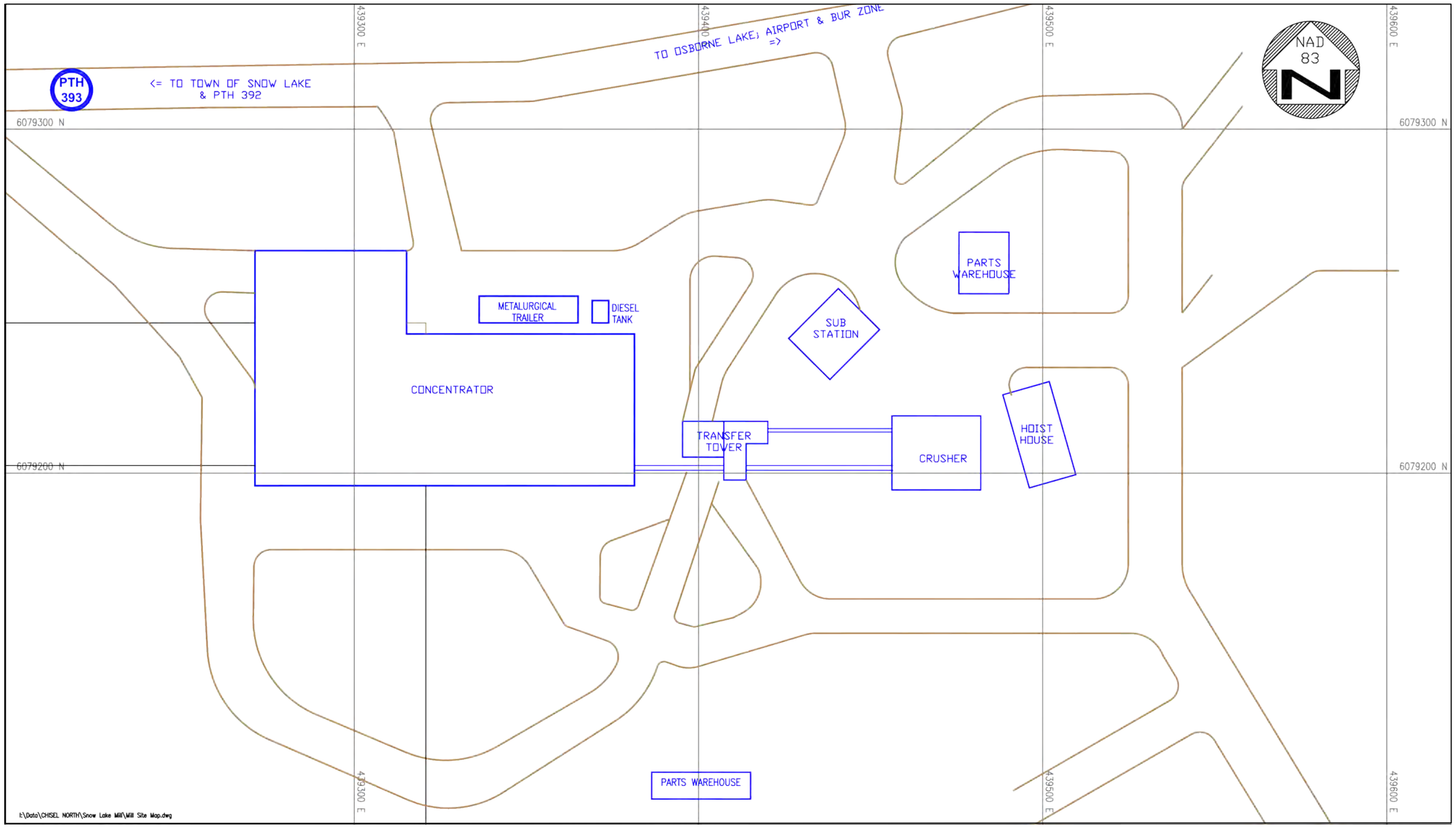
Hudson Bay Mining and Smelting Co., Ltd., Snow Lake, MB

**Location of Existing Stall Lake Concentrator**

AECOM

**Figure: 1**

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Project Management Initials: Designer: Checked: Approved: ANSI B 279.4mm x 431.8mm




Scale: NTS

Image supplied by Hudson Bay Mining and Smelting Co., Ltd.

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**Figure: 2**

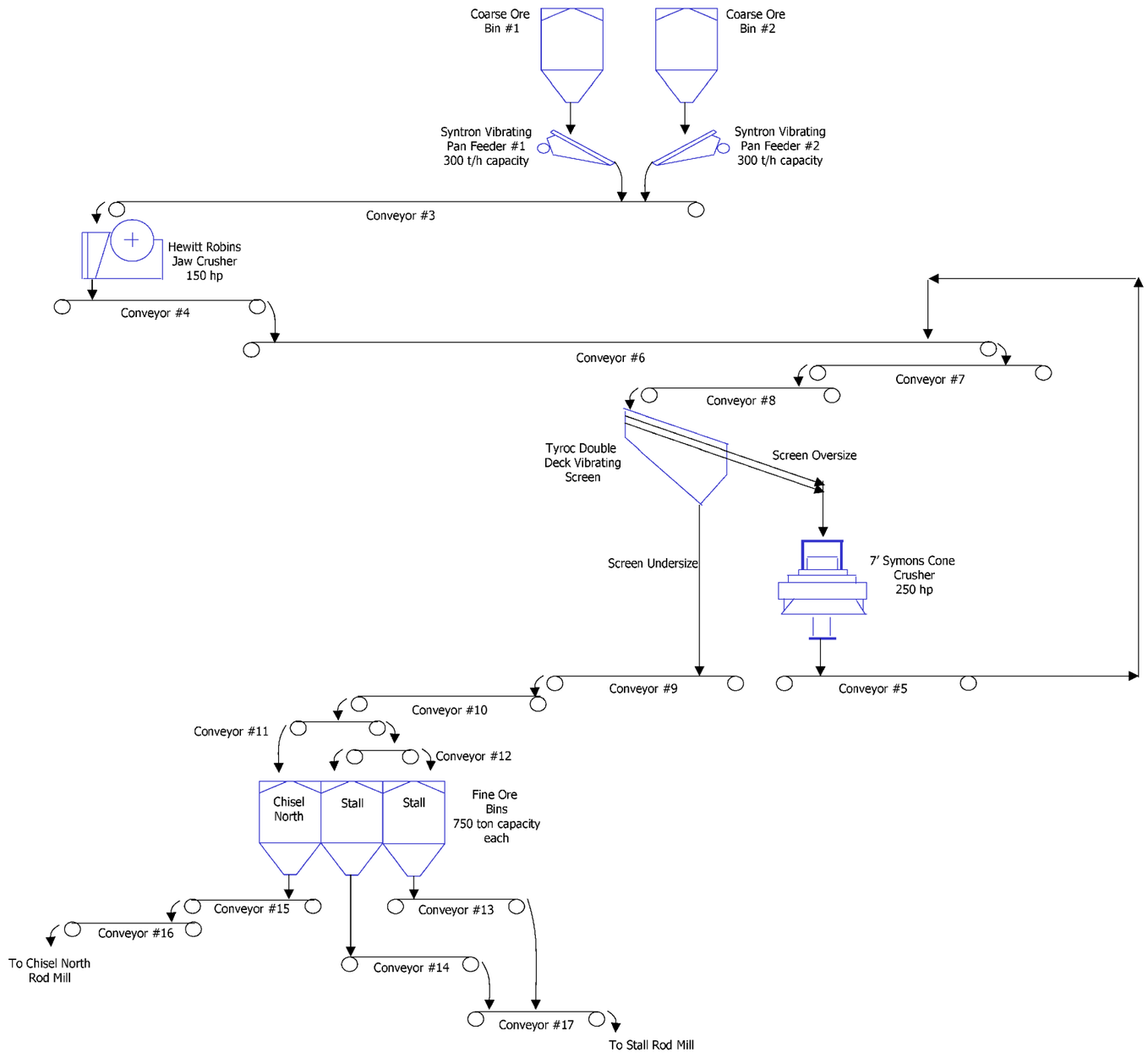
**Site Plan of the Existing Stall Lake Concentrator**

**Stall Lake Concentrator Refurbishments**

Hudson Bay Mining and Smelting Co., Ltd., Snow Lake, MB

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Project Management Initials: Designer: Checked: Approved: ANSI B 279.4mm x 431.8mm

## CRUSHER CIRCUIT




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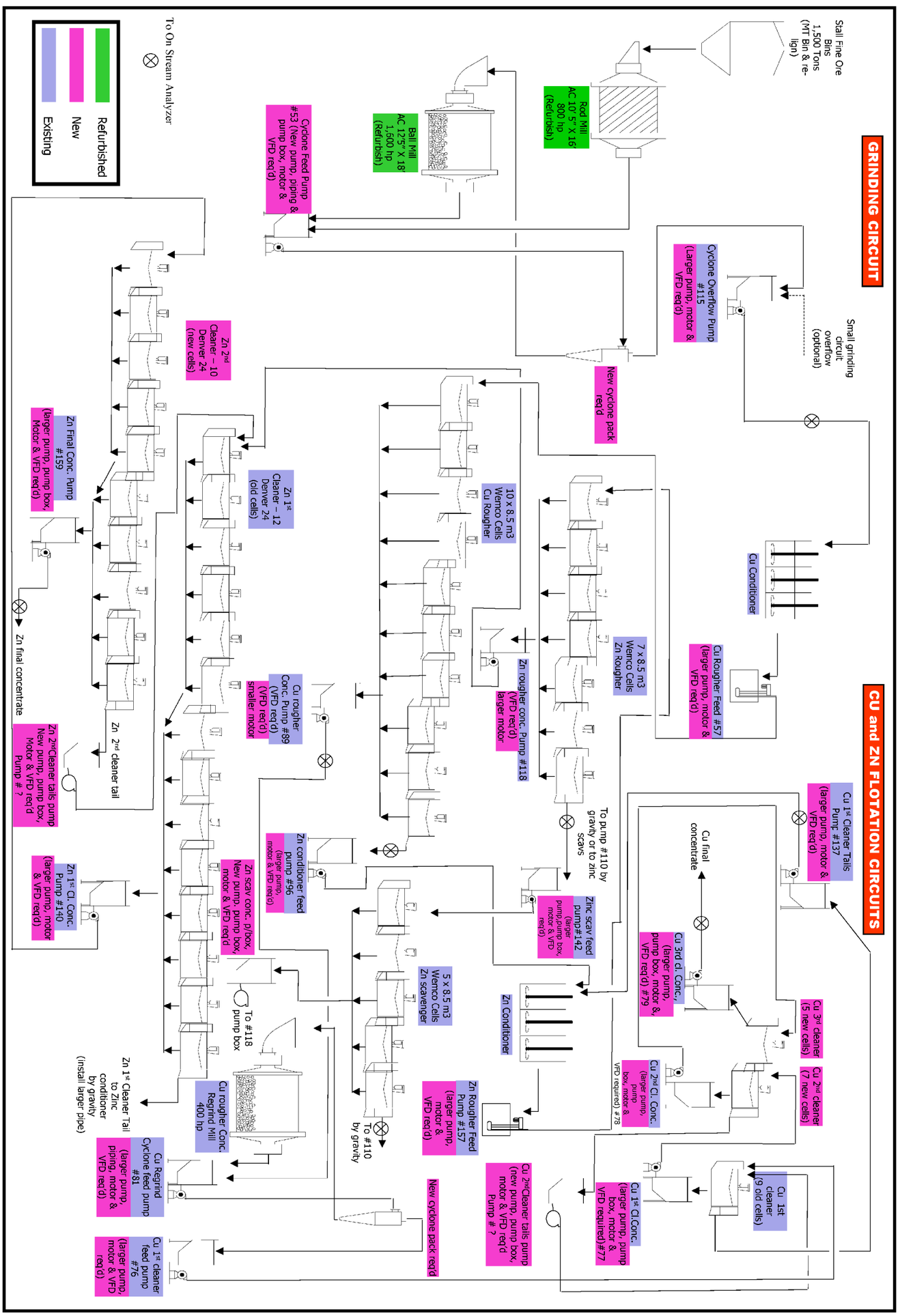
**Figure: 3a**

**Crusher Circuit Process Flow Diagram**

**Stall Lake Concentrator Refurbishments**

Hudson Bay Mining and Smelting Co., Ltd., Snow Lake, MB

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**Stall Lake Concentrator Refurbishments**

Hudson Bay Mining and Smelting Co., Ltd., Snow Lake, MB

**Lalor Ramp Ore Grinding and Flotation Circuit Process Flow Diagram**

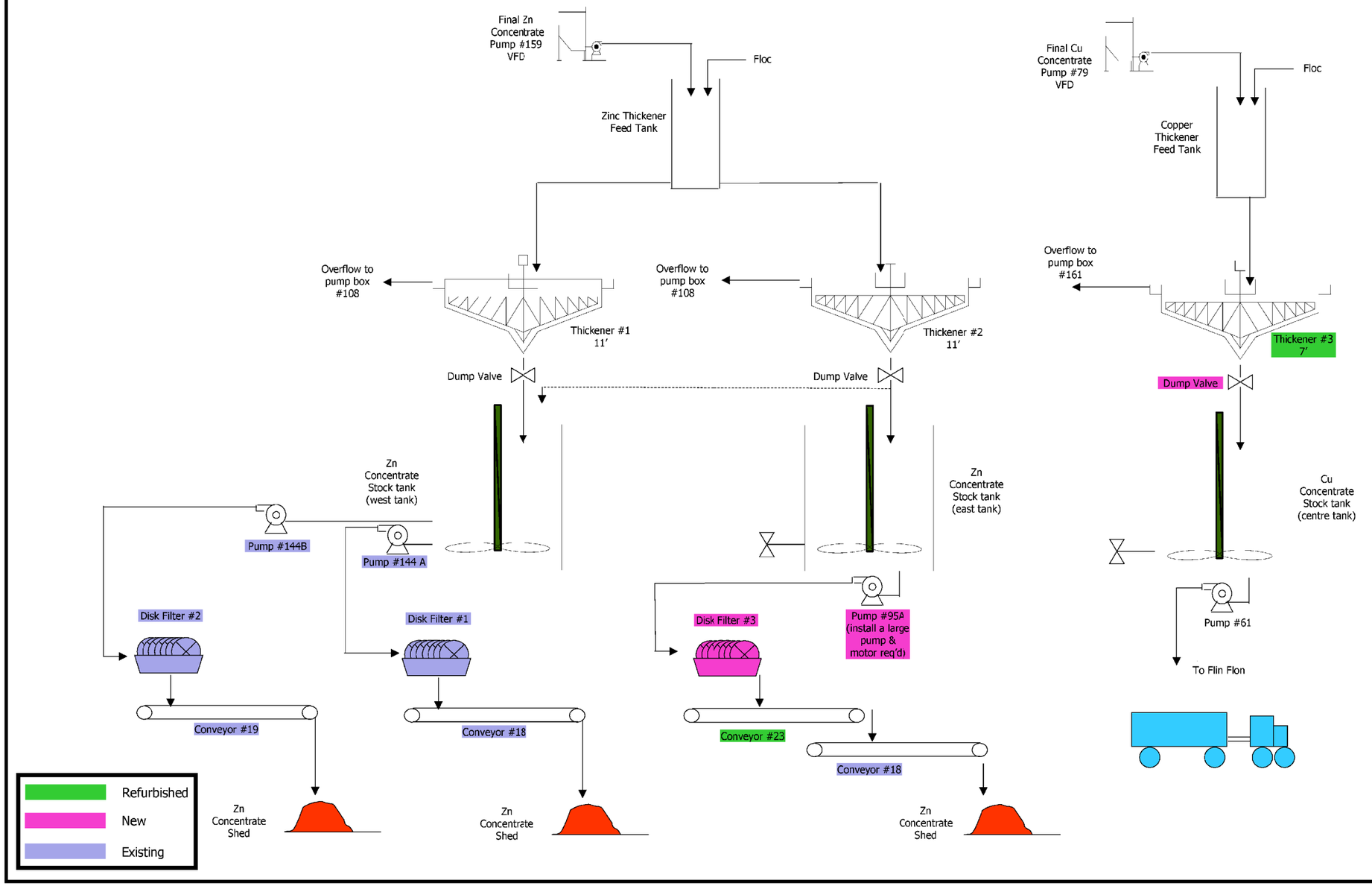
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**Figure: 3b**

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Filename: P:\60287252\000-CAD\03-SKETCHES\HISTALL LAKE-LALOR CONCENTRATOR\60287252-FIG-00-0000-H-CUZNDEWATERING FILTERINGPROCESS.DWG

Project Management Initials: Designer: Checked: Approved: ANSI B 279.4mm x 431.8mm

# THICKENING AND FILTERING CIRCUITS




**Stall Lake Concentrator Refurbishments**

Hudson Bay Mining and Smelting Co., Ltd., Snow Lake, MB

**Thickening and Filtering Circuits**
**Process Flow Diagram**

AECOM

**Figure: 3c**

# APPENDIX A

## List of Equipment Being Installed and/or Refurbished

**Refurbishing the large Stall Grinding Circuit**

- Clean bull gears & trays
- Refurbish #14, #15, #17 conveyor systems
- Install new weigh scale on #17 conveyor
- Install new cyclone feed pump box, d/c box & chutes
- Clean, inspect & refurbish existing clutches
- Clean / inspect / refurbish drive box - replace bearings
- Rod & ball mill clutches
- Rod & ball mill pinions
- Install refurbished mill motors
- Install refurbished mill trunion bearings
- Replace mill trunion liners
- Install new trommel screens
- Inspect / repair bull gear and pinion lube systems
- Install new trunion bearing lube and lift pump package
- Lube piping
- Install new cyclone feed pump, motor, etc.
- Install new VFD on cyclone feed pumping system
- Install a second new cyclone feed pump, motor, etc.
- Install a second new VFD on cyclone feed pumping system
- Install new primary grind cyclone pack
- Cyclone u'ftup piping to ball mill feed
- Cyclone o/f tub and piping to pumpbox #115 by gravity
- Upgrade #115 pump system two accept two grinding o/f's
- Install a second new pump for cyclone o/f
- VFD for cyclone o/f pump #115
- Install new trash screen
- Rod & Ball mill feed chute
- Rod & Ball mill feed spout
- Piping
- Remove two cyclone o/f pumps
- Mill power / electrics

- Install rails for rod charger
- Refurbish rod charger
- Rod & ball mill first fills of grinding media

**Increasing copper and zinc cleaner flotation capacities: Copper Cleaner Flotation**

- Install refurbished flotation cells, 7 cells & 5 respectively
- Install Cu 1st cleaner concentrate pump, piping, motor, valves, etc.
- Install Cu 2nd cleaner concentrate pump, piping, motor, valves, etc.
- Install Cu 3rd cleaner concentrate pump, piping, motor, valves, etc.
- Purchase and install three VFD's
- Purchase and install three pumpboxes
- Install a larger copper 1st cleaner tails pumping system to pumpbox # 137
- Install a copper 2nd cleaner tails pumping system and pumpbox
- Install a VFD
- Blower piping to supply for Denver flotation cells
- Automate lime addition ph control loop
- Install larger piping
- Remove four pumps and piping
- Install new sample pump, motor, piping, etc.

**Increasing copper and zinc cleaner flotation capacities: Zinc Flotation Cleaning**

- Install refurbished flotation cells, 5 cells & 5 respectively
- Install a larger zinc 1st cleaner concentrate pumping system on pumpbox #140
- Install a larger zinc 2nd cleaner concentrate pumping system on pumpbox #159
- Install new zinc 2nd cleaner tail pumping system
- Install two pumpboxes
- Replace zinc 1st cleaner concentrate pumpbox
- Install three VFD's
- Install zinc 2nd cleaner tails piping
- Install 1st cleaner tail piping to zinc conditioner by gravity
- Blower piping to supply for Denver flotation cells
- Install larger piping
- Remove two pumps and piping
- Install new sample pump, motor, piping, etc.

**Increasing copper regrind circuit capacity**

- Install larger pumping system on cyclone feed pump #81

- Install larger VFD
- Install new cyclone pack
- Install larger pumping system on cyclone o/f pumpbox # 76
- Install larger VFD
- Remove two pumps and piping
- Install larger piping

**Upgrading slurry pumping systems: Zinc De-Watering**

- Modify zinc thickner feed tank to use two stock tanks
- Replace east stock tank agitator drive
- Remove #3 disk filter, vacuum pump & old pastefill disk filter
- Install new vacuum disk filter
- Mobile crane rental
- Refurbish #23 conveyor system
- Install disk filter #1 & #2 return piping to east and west stock tank
- Install pumping system on east stock tank to west stock tank
- Install new zinc disk filtering system

**Upgrading slurry pumping systems: Copper De-Watering**

- Refurbish small copper thickener
- Refurbish #161 pumpbox to use as a copper thickener o/f settling tank
- Piping to #161 pump box
- Floc delivery system upgrade
- Install new u/f valve, timers, etc
- New zinc vacuum disc filtering system:  Copper Rougher Flotation
- Install new VFD on existing pump #89
- Install a larger tails line

**New zinc vacuum disc filtering system:  Zinc Rougher Flotation**

- Install a larger pumping system on #96
- Install a new VFD on pump #96
- Install a larger pumping system on zinc rougher feed sump #157
- Install a new VFD on pump #157
- Install a larger pumping system on zinc scavenger feed pumpbox #142
- Install a larger pump box for #142
- Install a new pumping system for zinc scavenger feed pump # ?
- Install a new pump box

- Install a larger rougher & scavenger tails line
- Remove three pumps and piping
- Install new VFD on #110 pump

**Upgrading electrical/instrumentation control systems**

- Switch gear upgrades
- Cable, trays, switches, etc.
- PLC upgrade - automate all pumping systems
- Automate all reagent systems to PLC
- Automate lime addition ph control loop
- Miscellaneous electrical
- Miscellaneous instrumentation

# Document 2: Quarry Leases

Manitoba
Innovation, Energy and Mines
Mines Branch

# QUARRY LEASE

Quarry Lease No.QL-2750

THIS LEASE made in duplicate September 24, 2013

BETWEEN:

Her Majesty the Queen in right of the
Province of Manitoba, represented by the
Minister of Innovation, Energy and Mines

(the "Minister")

- and - of the First Part

HUDSON BAY MINING AND SMELTING
CO., LIMITED
PO BOX 1500
FLIN FLON, MB, R8A 1N9
CA

(the "Lessee")

of the Second Part

The parties agree as follows:

In this Lease:

1. (a) "Act" means The Mines and Minerals Act , Cap. M162 C.C.S.M., as amended, revised or substituted from time to time;

   (b) "regulations" means regulations made pursuant to the Act, and as amended, revised or substituted from time to time;

2. Subject and pursuant to the Act and regulations, the Minister conveys to the lessee the exclusive right to explore for, develop, and produce the following quarry minerals, namely

   ROCK OR STONE (COMMON STONE),ROCK OR STONE (PROCESSED STONE),

   that are the property of the Crown and are found on or under the land described as:

   In the Province of Manitoba and being all that portion of unsurveyed Township 67, Range 17 WPM contained within the following limits described by grid coordinates from NAD 83 (CSRS 98) being in UTM 6 degree Zone 14 expressed in metres and further described as follows:

   Commencing at a point with coordinates 438924 E, 6078065 N;
   thence north westerly to point with coordinates of 438713 E, 6078196 N;
   thence south westerly to point with coordinates of 438621 E, 6078047 N;
   thence south easterly to a point with coordinates of 438832 E, 6077916 N;
   thence north easterly to the point of commencement, Excepting:
   Firstly: Road Plan 5289 PLTO (N Div.)
   Secondly: Director of Surveys Plan 18298.
   (ROCK B)

(the Lands) and being 4.35 hectares, more or less, for a term of 10 years, commencing September 24, 2013 renewable in accordance with the Act.

3. The Lessee shall comply with the Act and regulations; including, without restricting the generality of the foregoing, the payment of rent, royalty and rehabilitation levy prescribed thereunder.

4. The Lessee shall and does hereby indemnify and save harmless the Minister against any and all actions, suits, claims or demands that may be brought or made against the Minister for or by reason of any act or thing done or omitted to be done by the Lessee or its agents with respect to the Lands.

5. To be effective and binding, any waiver by the Minister of a breach by the Lessee of any term or condition of this Lease, the Act or the regulations must be in writing. Any such waiver shall extend only to the events of breach enumerated therein and shall not limit or affect the Minister's rights with respect to any other breach.

6. If the Lessee defaults, breaches, fails to perform or observe any term or condition of this Lease, the Act or the regulations, and any such event is not remedied within such notice period as the Minister may give, the Minister may cancel this Lease. Notwithstanding any such cancellation by the Minister, the rights of the Minister against the Lessee shall not be prejudiced and the Minister shall have the full remedies against the Lessee as if the Lease remained in full force and effect.

7. Any notice to a party hereto shall be in writing and may be delivered personally, sent by telegram, telex, telecopier or other means of electronic communication, or may be forwarded by mail subject to Canada Post confirmation of delivery to that party at the following address:

| To the Minister: | To the Lessee: |
|---|---|
| Innovation, Energy and Mines<br>Unit 360-1395 Ellice Avenue<br>Winnipeg, Manitoba<br>R3G 3P2 | HUDSON BAY MINING AND SMELTING CO., LIMITED<br>PO BOX 1500<br>FLIN FLON, MB, R8A 1N9<br>CA |

8. This lease shall be interpreted in accordance with the laws of Manitoba.

9. Any amendments to this Lease shall be in writing and signed by both parties.

10. The Lessee shall not assign this lease except with the prior written consent of the Minister which shall not be unreasonably withheld. Any obligations of the Lessee outstanding at the date of any assignment shall remain the responsibility of the Lessee, to the extent the obligations are not performed by the permitted assignee.

11. This Lease shall enure to the benefit of and be binding upon the heirs, executors, administrators, successors and permitted assigns of the parties.

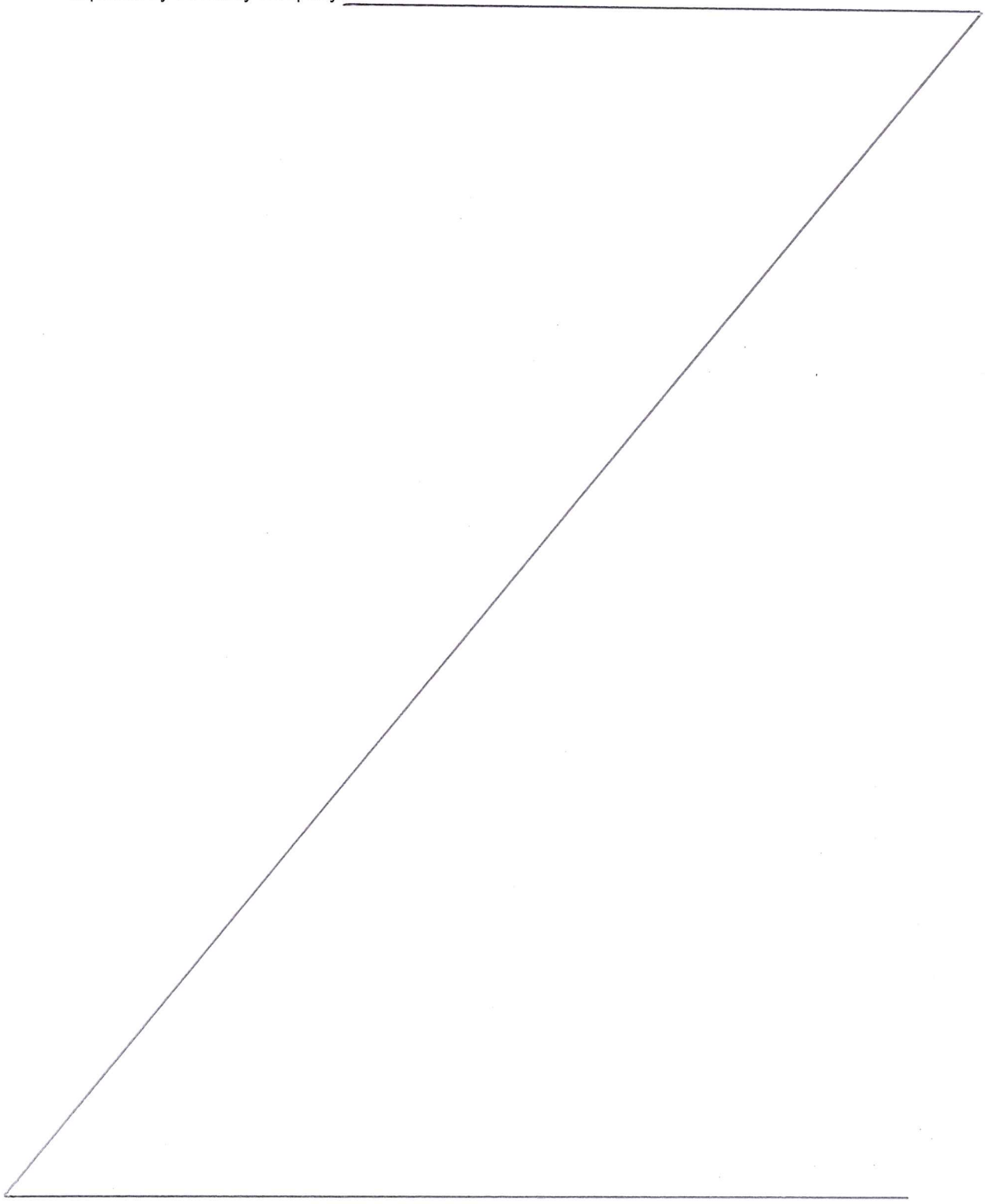
12. Additional clauses:

This lease is issued pursuant to Subsection 14(6) of The Mines and Minerals Act on Crown mineral land that is withdrawn.

The lessee shall comply with The Workplace Safety and Health Act and Regulation.

It is the lessee's responsibility to locate all utilities, (including but not limited to gas, electric and

telecommunications) that may exist within the limits of this disposition prior to any excavation. "Call Before You Dig" and "611 Cable Locate Service". The lessee shall comply with all requirements imposed by the utility company.



Manitoba
Innovation, Energy and Mines
Mines Branch

In witness whereof the Minister and the Lessee have executed this Lease on the dates shown below their respective signatures.

Signed, sealed and delivered
in the presence of:

Her Majesty the Queen in right of the Province of Manitoba

Witness

Minister of Innovation, Energy and Mines

Oct 15, 2013
Date

Witness

Lessee HUDSON BAY MINING AND SMELTING CO., LIMITED
Brad Lantz, Vice President, Manitoba Business Unit

October 8, 2013
Date

Mary-Lynn Oke, Chief Financial Officer, Manitoba Business Unit

IN ACCORDANCE WITH SECTION 141(3) OF THE MINES AND MINERALS ACT, THIS QUARRY LEASE IS HEREBY RECORDED AND THIS STAMP SHALL CONSTITUTE A CERTIFICATE OF FILING AND RECORDING.

Oct 15/13
Dated

Mining Recorder

Manitoba
Innovation, Energy and Mines
Mines Branch

# QUARRY LEASE

Quarry Lease No.QL-2751

THIS LEASE made in duplicate September 24, 2013

BETWEEN:

Her Majesty the Queen in right of the
Province of Manitoba, represented by the
Minister of Innovation, Energy and Mines

(the "Minister")

- and - of the First Part

HUDSON BAY MINING AND SMELTING
CO., LIMITED
PO BOX 1500
FLIN FLON, MB, R8A 1N9
CA

(the "Lessee")

of the Second Part

The parties agree as follows:

In this Lease:

1. (a) "Act" means The Mines and Minerals Act , Cap. M162 C.C.S.M., as amended, revised or substituted from time to time;

(b) "regulations" means regulations made pursuant to the Act, and as amended, revised or substituted from time to time;

2. Subject and pursuant to the Act and regulations, the Minister conveys to the lessee the exclusive right to explore for, develop, and produce the following quarry minerals, namely

ROCK OR STONE (COMMON STONE),ROCK OR STONE (PROCESSED STONE),

that are the property of the Crown and are found on or under the land described as:

In the Province of Manitoba and being all that portion of unsurveyed Township 67, Range 17 WPM contained within the following limits described by grid coordinates from NAD 83 (CSRS 98) being in UTM 6 degree Zone 14 expressed in metres and further described as follows:

Commencing at a point with coordinates 438512 E, 6078136 N;
thence north westerly to point with coordinates of 438465 E, 6078168 N;
thence south westerly to point with coordinates of 438295 E, 6078133 N;
thence south westerly to point with coordinates of 438238 E, 6078050 N;
thence south easterly to a point with coordinates of 438385 E, 6077950 N;
thence north easterly to the point of commencement, Excepting:
Firstly: Road Plan 5289 PLTO (N Div.)
Secondly: Director of Surveys Plan 18298
(ROCK A)

(the Lands) and being 3.25 hectares, more or less, for a term of 10 years, commencing September 24, 2013 renewable in accordance with the Act.

3. The Lessee shall comply with the Act and regulations; including, without restricting the generality of the foregoing, the payment of rent, royalty and rehabilitation levy prescribed thereunder.

4. The Lessee shall and does hereby indemnify and save harmless the Minister against any and all actions, suits, claims or demands that may be brought or made against the Minister for or by reason of any act or thing done or omitted to be done by the Lessee or its agents with respect to the Lands.

5. To be effective and binding, any waiver by the Minister of a breach by the Lessee of any term or condition of this Lease, the Act or the regulations must be in writing. Any such waiver shall extend only to the events of breach enumerated therein and shall not limit or affect the Minister's rights with respect to any other breach.

6. If the Lessee defaults, breaches, fails to perform or observe any term or condition of this Lease, the Act or the regulations, and any such event is not remedied within such notice period as the Minister may give, the Minister may cancel this Lease. Notwithstanding any such cancellation by the Minister, the rights of the Minister against the Lessee shall not be prejudiced and the Minister shall have the full remedies against the Lessee as if the Lease remained in full force and effect.

7. Any notice to a party hereto shall be in writing and may be delivered personally, sent by telegram, telex, telecopier or other means of electronic communication, or may be forwarded by mail subject to Canada Post confirmation of delivery to that party at the following address:

| To the Minister: | To the Lessee: |
|---|---|
| Innovation, Energy and Mines<br>Unit 360-1395 Ellice Avenue<br>Winnipeg, Manitoba<br>R3G 3P2 | HUDSON BAY MINING AND SMELTING CO., LIMITED<br>PO BOX 1500<br>FLIN FLON, MB, R8A 1N9<br>CA |

8. This lease shall be interpreted in accordance with the laws of Manitoba.

9. Any amendments to this Lease shall be in writing and signed by both parties.

10. The Lessee shall not assign this lease except with the prior written consent of the Minister which shall not be unreasonably withheld. Any obligations of the Lessee outstanding at the date of any assignment shall remain the responsibility of the Lessee, to the extent the obligations are not performed by the permitted assignee.

11. This Lease shall enure to the benefit of and be binding upon the heirs, executors, administrators, successors and permitted assigns of the parties.

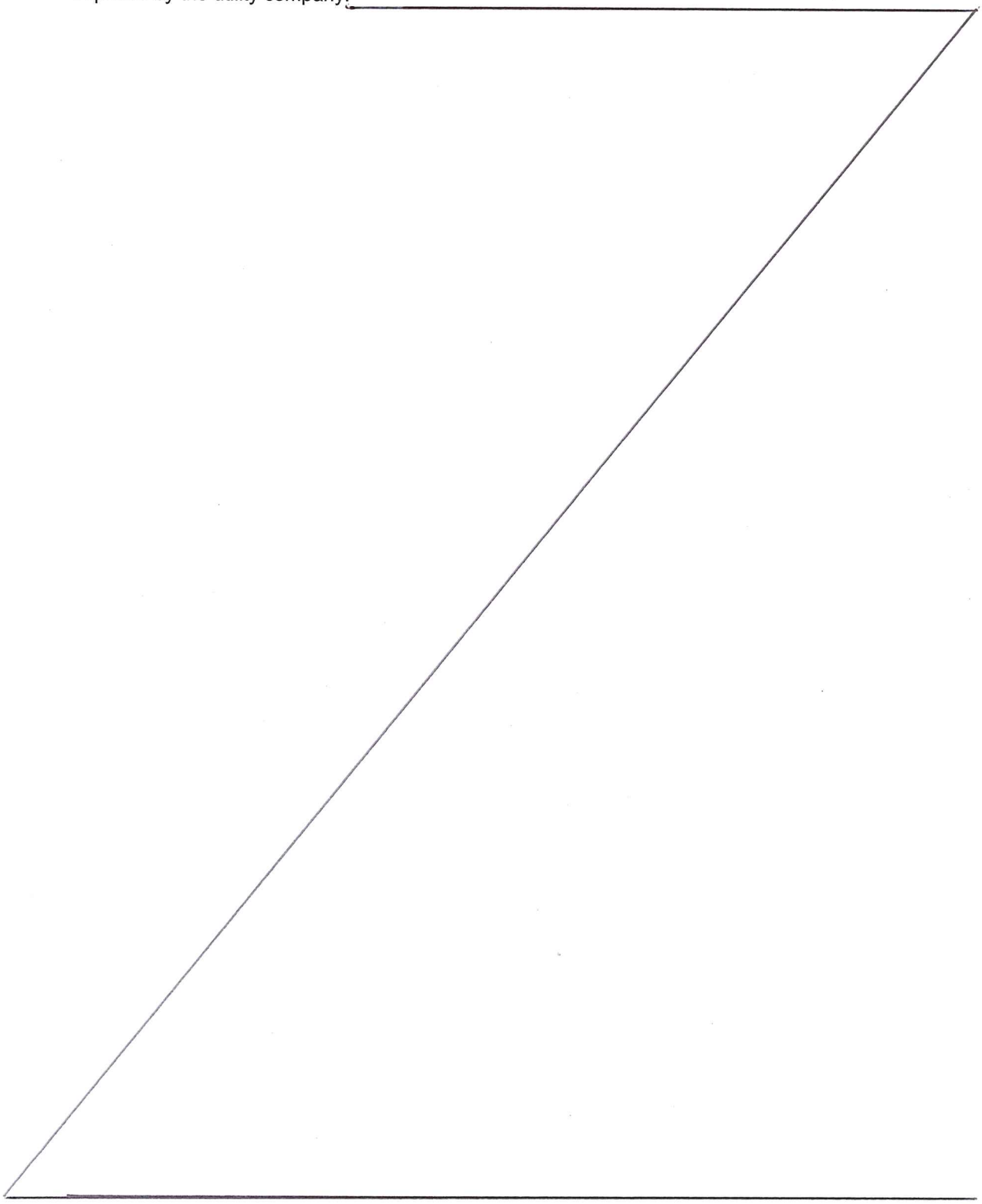
12. Additional clauses:

This lease is issued pursuant to Subsection 14(6) of The Mines and Minerals Act on Crown mineral land that is withdrawn.

The lessee shall comply with The Workplace Safety and Health Act and Regulation.

It is the lessee's responsibility to locate all utilities, (including but not limited to gas, electric and

telecommunications) that may exist within the limits of this disposition prior to any excavation. "Call Before You Dig" and "611 Cable Locate Service". The lessee shall comply with all requirements imposed by the utility company.



Manitoba
Innovation, Energy and Mines
Mines Branch

In witness whereof the Minister and the Lessee have executed this Lease on the dates shown below their respective signatures.

Signed, sealed and delivered
in the presence of:

Her Majesty the Queen in right of the Province of Manitoba

Witness

Minister of Innovation, Energy and Mines

Oct 15, 2013
Date

Witness

Lessee HUDSON BAY MINING AND SMELTING CO., LIMITED
Brad Lantz, Vice President, Manitoba Business Unit

October 8, 2013
Date

Mary-Lynn Oke, Chief Financial Officer, Manitoba Business Unit

IN ACCORDANCE WITH SECTION 141(3) OF THE MINES AND MINERALS ACT, THIS QUARRY LEASE IS HEREBY RECORDED AND THIS STAMP SHALL CONSTITUTE A CERTIFICATE OF FILING AND RECORDING.

Oct 15/13
Dated

Mining Recorder

Manitoba
Innovation, Energy and Mines
Mines Branch

# QUARRY LEASE

Quarry Lease No.QL-2752

THIS LEASE made in duplicate September 24, 2013

BETWEEN:

Her Majesty the Queen in right of the
Province of Manitoba, represented by the
Minister of Innovation, Energy and Mines

(the "Minister")

- and - of the First Part

HUDSON BAY MINING AND SMELTING
CO., LIMITED
PO BOX 1500
FLIN FLON, MB, R8A 1N9
CA

(the "Lessee")

of the Second Part

The parties agree as follows:

In this Lease:

1. (a) "Act" means The Mines and Minerals Act , Cap. M162 C.C.S.M., as amended, revised or substituted from time to time;

(b) "regulations" means regulations made pursuant to the Act, and as amended, revised or substituted from time to time;

2. Subject and pursuant to the Act and regulations, the Minister conveys to the lessee the exclusive right to explore for, develop, and produce the following quarry minerals, namely

GRAVEL,CLAY,ROCK OR STONE (COMMON STONE),ROCK OR STONE (PROCESSED STONE),

that are the property of the Crown and are found on or under the land described as:

In the Province of Manitoba and being all that portion of unsurveyed Township 67 and 68, Range 17 WPM contained within the following limits described by grid coordinates from NAD 83 (CSRS 98) being in UTM 6 degree Zone 14 expressed in metres and further described as follows:

Commencing at a point with coordinates 438774 E, 6078762 N;
thence westerly to point with coordinates of 438664 E, 6078460 N;
thence south easterly to point with coordinates of 438850 E, 6078311 N;
thence easterly to a point with coordinates of 438955 E, 6078309 N;
thence north westerly to the point of commencement, Excepting:
Firstly: Road Plans 5289, 4257, 4825, 4571, 4268 PLTO (N Div.)
Secondly: Director of Surveys Plan 18298.

Thirdly: CNR Plan 794 NLTO
(CLAY A)

(the Lands) and being 4.85 hectares, more or less, for a term of 10 years, commencing September 24, 2013 renewable in accordance with the Act.

3. The Lessee shall comply with the Act and regulations; including, without restricting the generality of the foregoing, the payment of rent, royalty and rehabilitation levy prescribed thereunder.

4. The Lessee shall and does hereby indemnify and save harmless the Minister against any and all actions, suits, claims or demands that may be brought or made against the Minister for or by reason of any act or thing done or omitted to be done by the Lessee or its agents with respect to the Lands.

5. To be effective and binding, any waiver by the Minister of a breach by the Lessee of any term or condition of this Lease, the Act or the regulations must be in writing. Any such waiver shall extend only to the events of breach enumerated therein and shall not limit or affect the Minister's rights with respect to any other breach.

6. If the Lessee defaults, breaches, fails to perform or observe any term or condition of this Lease, the Act or the regulations, and any such event is not remedied within such notice period as the Minister may give, the Minister may cancel this Lease. Notwithstanding any such cancellation by the Minister, the rights of the Minister against the Lessee shall not be prejudiced and the Minister shall have the full remedies against the Lessee as if the Lease remained in full force and effect.

7. Any notice to a party hereto shall be in writing and may be delivered personally, sent by telegram, telex, telecopier or other means of electronic communication, or may be forwarded by mail subject to Canada Post confirmation of delivery to that party at the following address:

| To the Minister: | To the Lessee: |
|---|---|
| Innovation, Energy and Mines<br>Unit 360-1395 Ellice Avenue<br>Winnipeg, Manitoba<br>R3G 3P2 | HUDSON BAY MINING AND SMELTING CO., LIMITED<br>PO BOX 1500<br>FLIN FLON, MB, R8A 1N9<br>CA |

8. This lease shall be interpreted in accordance with the laws of Manitoba.

9. Any amendments to this Lease shall be in writing and signed by both parties.

10. The Lessee shall not assign this lease except with the prior written consent of the Minister which shall not be unreasonably withheld. Any obligations of the Lessee outstanding at the date of any assignment shall remain the responsibility of the Lessee, to the extent the obligations are not performed by the permitted assignee.

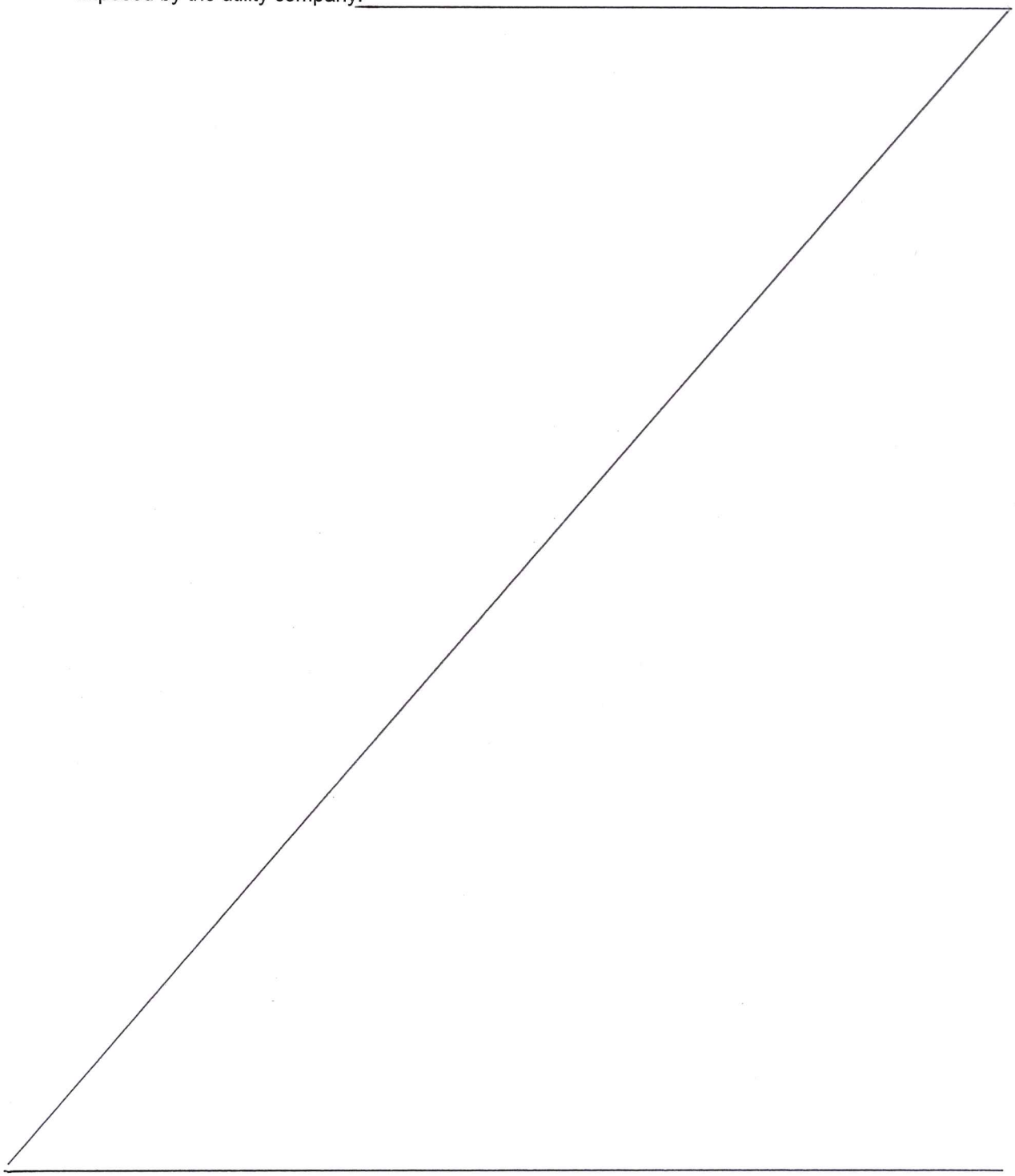
11. This Lease shall enure to the benefit of and be binding upon the heirs, executors, administrators, successors and permitted assigns of the parties.

12. Additional clauses:

This lease is issued pursuant to Subsection 14(6) of The Mines and Minerals Act on Crown mineral land that is withdrawn.

The lessee shall comply with The Workplace Safety and Health Act and Regulation.

It is the lessee's responsibility to locate all utilities, (including but not limited to gas, electric and telecommunications) that may exist within the limits of this disposition prior to any excavation. "Call Before You Dig" and "611 Cable Locate Service". The lessee shall comply with all requirements imposed by the utility company.



Manitoba
Innovation, Energy and Mines
Mines Branch

In witness whereof the Minister and the Lessee have executed this Lease on the dates shown below their respective signatures.

Signed, sealed and delivered
in the presence of:

Her Majesty the Queen in right of the Province of Manitoba

Witness

Minister of Innovation, Energy and Mines

Oct 15, 2013
Date

Witness

Lessee HUDSON BAY MINING AND SMELTING CO., LIMITED
Brad Lantz, Vice President, Manitoba Business Unit

October 8, 2013
Date

Mary-Lynn Oke, Chief Financial Officer, Manitoba Business Unit

IN ACCORDANCE WITH SECTION 141(3) OF THE MINES AND MINERALS ACT, THIS QUARRY LEASE IS HEREBY RECORDED AND THIS STAMP SHALL CONSTITUTE A CERTIFICATE OF FILING AND RECORDING.

Oct 15/13
Dated

Mining Recorder

Manitoba
Innovation, Energy and Mines
Mines Branch

# QUARRY LEASE

Quarry Lease No.QL-2753

THIS LEASE made in duplicate September 24, 2013

BETWEEN:

Her Majesty the Queen in right of the
Province of Manitoba, represented by the
Minister of Innovation, Energy and Mines

(the "Minister")

- and - of the First Part

HUDSON BAY MINING AND SMELTING
CO., LIMITED
PO BOX 1500
FLIN FLON, MB, R8A 1N9
CA

(the "Lessee")

of the Second Part

The parties agree as follows:

In this Lease:

1. (a) "Act" means The Mines and Minerals Act , Cap. M162 C.C.S.M., as amended, revised or substituted from time to time;

(b) "regulations" means regulations made pursuant to the Act, and as amended, revised or substituted from time to time;

2. Subject and pursuant to the Act and regulations, the Minister conveys to the lessee the exclusive right to explore for, develop, and produce the following quarry minerals, namely

CLAY,GRAVEL,ROCK OR STONE (COMMON STONE),ROCK OR STONE (PROCESSED STONE),

that are the property of the Crown and are found on or under the land described as:

In the Province of Manitoba and being all that portion of unsurveyed Township 67, Range 17 WPM contained within the following limits described by grid coordinates from NAD 83 (CSRS 98) being in UTM 6 degree Zone 14 expressed in metres and further described as follows:

Commencing at a point with coordinates 438955 E, 6078309 N;
thence westerly to point with coordinates of 438850 E, 6078311 N;
thence south westerly to point with coordinates of 438781 E, 6078241 N;
thence south easterly to a point with coordinates of 438868 E, 6078137 N;
thence easterly to a point with coordinates of 439071 E., 6078133 N;
thence north westerly to the point of commencement, Excepting:
Firstly: Road Plans 5289 PLTO (N Div.)
Secondly: Director of Surveys Plan 18298

(CLAY B)

(the Lands) and being 3.34 hectares, more or less, for a term of 10 years, commencing September 24, 2013 renewable in accordance with the Act.

3. The Lessee shall comply with the Act and regulations; including, without restricting the generality of the foregoing, the payment of rent, royalty and rehabilitation levy prescribed thereunder.

4. The Lessee shall and does hereby indemnify and save harmless the Minister against any and all actions, suits, claims or demands that may be brought or made against the Minister for or by reason of any act or thing done or omitted to be done by the Lessee or its agents with respect to the Lands.

5. To be effective and binding, any waiver by the Minister of a breach by the Lessee of any term or condition of this Lease, the Act or the regulations must be in writing. Any such waiver shall extend only to the events of breach enumerated therein and shall not limit or affect the Minister's rights with respect to any other breach.

6. If the Lessee defaults, breaches, fails to perform or observe any term or condition of this Lease, the Act or the regulations, and any such event is not remedied within such notice period as the Minister may give, the Minister may cancel this Lease. Notwithstanding any such cancellation by the Minister, the rights of the Minister against the Lessee shall not be prejudiced and the Minister shall have the full remedies against the Lessee as if the Lease remained in full force and effect.

7. Any notice to a party hereto shall be in writing and may be delivered personally, sent by telegram, telex, telecopier or other means of electronic communication, or may be forwarded by mail subject to Canada Post confirmation of delivery to that party at the following address:

| To the Minister: | To the Lessee: |
|---|---|
| Innovation, Energy and Mines<br>Unit 360-1395 Ellice Avenue<br>Winnipeg, Manitoba<br>R3G 3P2 | HUDSON BAY MINING AND SMELTING CO., LIMITED<br>PO BOX 1500<br>FLIN FLON, MB, R8A 1N9<br>CA |

8. This lease shall be interpreted in accordance with the laws of Manitoba.

9. Any amendments to this Lease shall be in writing and signed by both parties.

10. The Lessee shall not assign this lease except with the prior written consent of the Minister which shall not be unreasonably withheld. Any obligations of the Lessee outstanding at the date of any assignment shall remain the responsibility of the Lessee, to the extent the obligations are not performed by the permitted assignee.

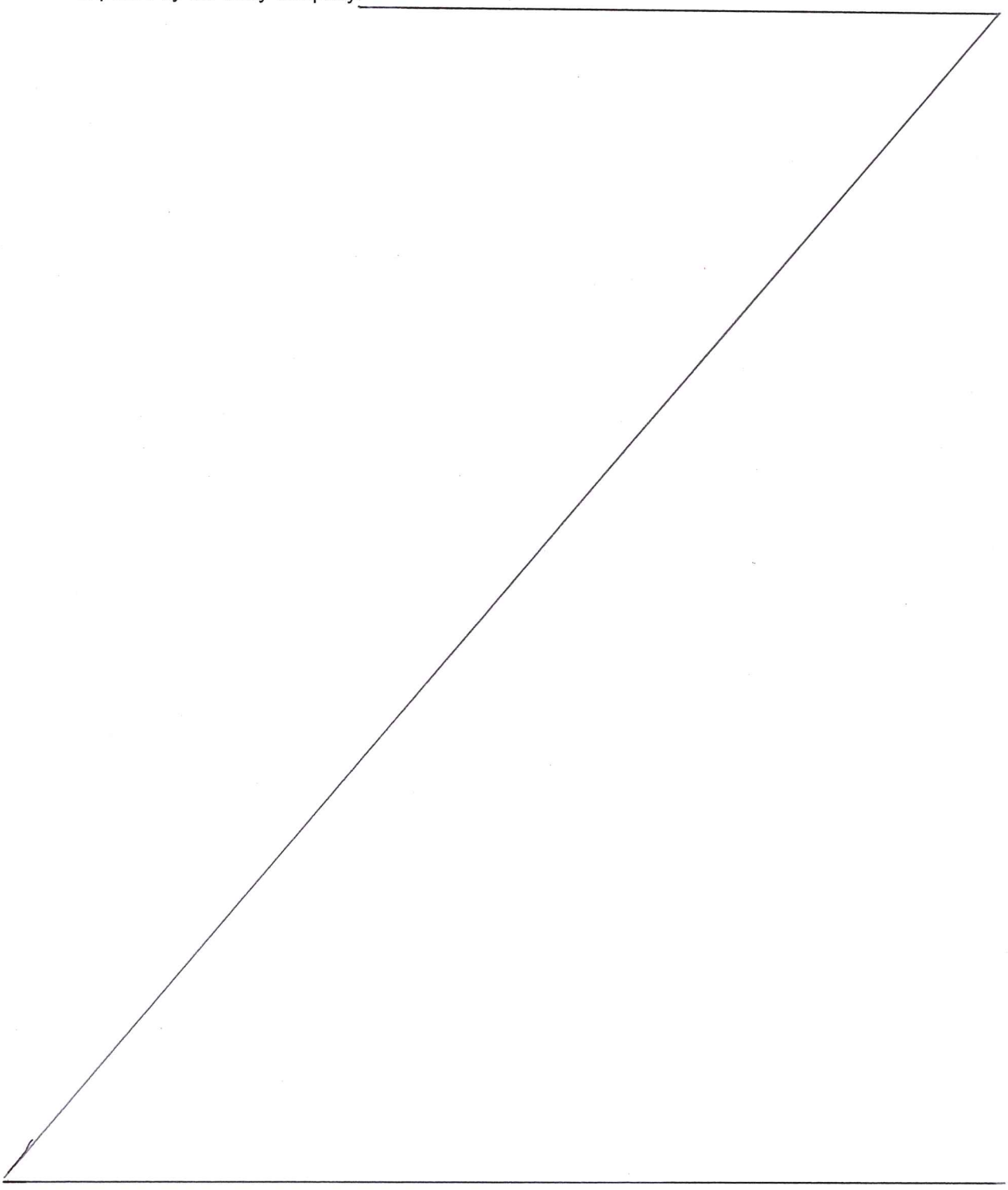
11. This Lease shall enure to the benefit of and be binding upon the heirs, executors, administrators, successors and permitted assigns of the parties.

12. Additional clauses:

This lease is issued pursuant to Subsection 14(6) of The Mines and Minerals Act on Crown mineral land that is withdrawn.

The lessee shall comply with The Workplace Safety and Health Act and Regulation.

It is the lessee's responsibility to locate all utilities, (including but not limited to gas, electric and telecommunications) that may exist within the limits of this disposition prior to any excavation. "Call Before You Dig" and "611 Cable Locate Service". The lessee shall comply with all requirements imposed by the utility company.



Manitoba
Innovation, Energy and Mines
Mines Branch

In witness whereof the Minister and the Lessee have executed this Lease on the dates shown below their respective signatures.

Signed, sealed and delivered
in the presence of:

Her Majesty the Queen in right of the Province of Manitoba

Witness

Minister of Innovation, Energy and Mines

Oct 15, 2013
Date

Witness

Lessee HUDSON BAY MINING AND SMELTING CO., LIMITED
Brad Lantz, Vice President, Manitoba Business Unit

October 8, 2013
Date

Mary-Lynn Oke, Chief Financial Officer, Manitoba Business Unit

IN ACCORDANCE WITH SECTION 141(3) OF THE MINES AND MINERALS ACT, THIS QUARRY LEASE IS HEREBY RECORDED AND THIS STAMP SHALL CONSTITUTE A CERTIFICATE OF FILING AND RECORDING.

Oct 15/13
Dated

Mining Recorder

Manitoba
Innovation, Energy and Mines
Mines Branch

# QUARRY LEASE

Quarry Lease No.QL-2754

THIS LEASE made in duplicate September 24, 2013

BETWEEN:

Her Majesty the Queen in right of the
Province of Manitoba, represented by the
Minister of Innovation, Energy and Mines

(the "Minister")

- and - of the First Part

HUDSON BAY MINING AND SMELTING
CO., LIMITED
PO BOX 1500
FLIN FLON, MB, R8A 1N9
CA

(the "Lessee")

of the Second Part

The parties agree as follows:

In this Lease:

1. (a) "Act" means The Mines and Minerals Act , Cap. M162 C.C.S.M., as amended, revised or substituted from time to time;

   (b) "regulations" means regulations made pursuant to the Act, and as amended, revised or substituted from time to time;

2. Subject and pursuant to the Act and regulations, the Minister conveys to the lessee the exclusive right to explore for, develop, and produce the following quarry minerals, namely

   GRAVEL,CLAY,ROCK OR STONE (COMMON STONE),ROCK OR STONE (PROCESSED STONE),

   that are the property of the Crown and are found on or under the land described as:

   In the Province of Manitoba and being all that portion of unsurveyed Township 67, Range 17 WPM contained within the following limits described by grid coordinates from NAD 83 (CSRS 98) being in UTM 6 degree Zone 14 expressed in metres and further described as follows:

   Commencing at a point with coordinates 439090 E, 6078031 N;
   thence westerly to point with coordinates of 438884 E, 6077992 N;
   thence southerly to point with coordinates of 438922 E, 6077789 N;
   thence easterly to a point with coordinates of 439128 E, 6077828 N;
   thence northerly to the point of commencement, Excepting:
   Firstly: Road Plans 5289 PLTO (N Div.)
   Secondly: Director of Surveys Plan 18298
   (CLAY C)

(the Lands) and being 4.33 hectares, more or less, for a term of 10 years, commencing September 24, 2013 renewable in accordance with the Act.

3. The Lessee shall comply with the Act and regulations; including, without restricting the generality of the foregoing, the payment of rent, royalty and rehabilitation levy prescribed thereunder.

4. The Lessee shall and does hereby indemnify and save harmless the Minister against any and all actions, suits, claims or demands that may be brought or made against the Minister for or by reason of any act or thing done or omitted to be done by the Lessee or its agents with respect to the Lands.

5. To be effective and binding, any waiver by the Minister of a breach by the Lessee of any term or condition of this Lease, the Act or the regulations must be in writing. Any such waiver shall extend only to the events of breach enumerated therein and shall not limit or affect the Minister's rights with respect to any other breach.

6. If the Lessee defaults, breaches, fails to perform or observe any term or condition of this Lease, the Act or the regulations, and any such event is not remedied within such notice period as the Minister may give, the Minister may cancel this Lease. Notwithstanding any such cancellation by the Minister, the rights of the Minister against the Lessee shall not be prejudiced and the Minister shall have the full remedies against the Lessee as if the Lease remained in full force and effect.

7. Any notice to a party hereto shall be in writing and may be delivered personally, sent by telegram, telex, telecopier or other means of electronic communication, or may be forwarded by mail subject to Canada Post confirmation of delivery to that party at the following address:

| To the Minister: | To the Lessee: |
|---|---|
| Innovation, Energy and Mines<br>Unit 360-1395 Ellice Avenue<br>Winnipeg, Manitoba<br>R3G 3P2 | HUDSON BAY MINING AND SMELTING CO., LIMITED<br>PO BOX 1500<br>FLIN FLON, MB, R8A 1N9<br>CA |

8. This lease shall be interpreted in accordance with the laws of Manitoba.

9. Any amendments to this Lease shall be in writing and signed by both parties.

10. The Lessee shall not assign this lease except with the prior written consent of the Minister which shall not be unreasonably withheld. Any obligations of the Lessee outstanding at the date of any assignment shall remain the responsibility of the Lessee, to the extent the obligations are not performed by the permitted assignee.

11. This Lease shall enure to the benefit of and be binding upon the heirs, executors, administrators, successors and permitted assigns of the parties.

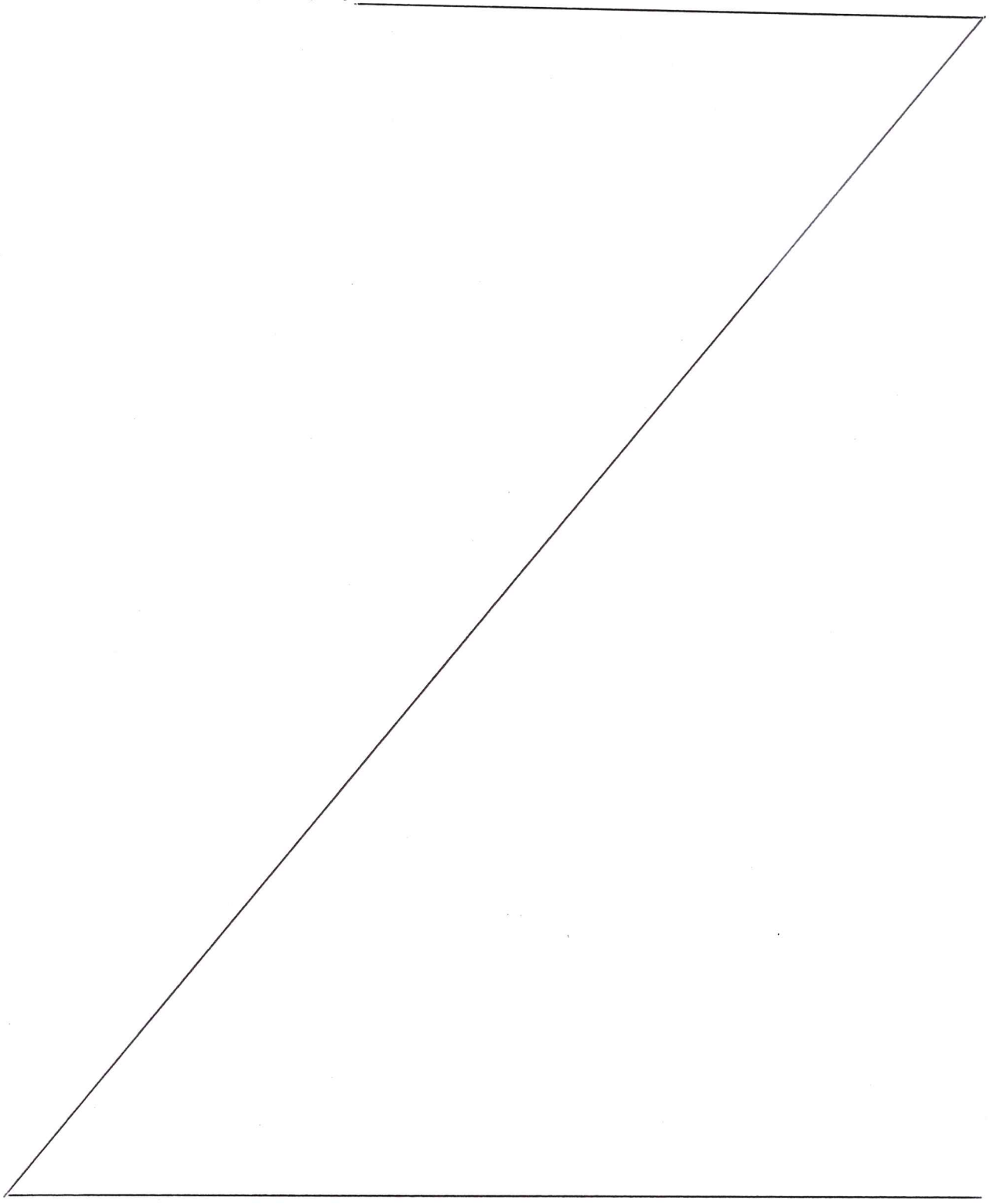
12. Additional clauses:

This lease is issued pursuant to Subsection 14(6) of The Mines and Minerals Act on Crown mineral land that is withdrawn.

The lessee shall comply with The Workplace Safety and Health Act and Regulation.

It is the lessee's responsibility to locate all utilities, (including but not limited to gas, electric and

telecommunications) that may exist within the limits of this disposition prior to any excavation. "Call Before You Dig" and "611 Cable Locate Service". The lessee shall comply with all requirements imposed by the utility company.



Manitoba
Innovation, Energy and Mines
Mines Branch

In witness whereof the Minister and the Lessee have executed this Lease on the dates shown below their respective signatures.

Signed, sealed and delivered
in the presence of:

Her Majesty the Queen in right of the Province of Manitoba

Witness

James Payne
Minister of Innovation, Energy and Mines

Oct 15, 2013
Date

Witness

Lessee HUDSON BAY MINING AND SMELTING CO., LIMITED
Brad Lantz, Vice President, Manitoba Business Unit

October 8, 2013
Date

Mary-Lynn Oke, Chief Financial Officer, Manitoba Business Unit

IN ACCORDANCE WITH SECTION 141(3) OF THE MINES AND MINERALS ACT, THIS QUARRY LEASE IS HEREBY RECORDED AND THIS STAMP SHALL CONSTITUTE A CERTIFICATE OF FILING AND RECORDING.

Oct 15/13
Dated

Mining Recorder

Manitoba
Innovation, Energy and Mines
Mines Branch

# QUARRY LEASE

Quarry Lease No.QL-2755

THIS LEASE made in duplicate September 24, 2013

BETWEEN:

Her Majesty the Queen in right of the
Province of Manitoba, represented by the
Minister of Innovation, Energy and Mines

(the "Minister")

- and - of the First Part

HUDSON BAY MINING AND SMELTING
CO., LIMITED
PO BOX 1500
FLIN FLON, MB, R8A 1N9
CA

(the "Lessee")

of the Second Part

The parties agree as follows:

In this Lease:

1. (a) "Act" means The Mines and Minerals Act , Cap. M162 C.C.S.M., as amended, revised or substituted from time to time;

   (b) "regulations" means regulations made pursuant to the Act, and as amended, revised or substituted from time to time;

2. Subject and pursuant to the Act and regulations, the Minister conveys to the lessee the exclusive right to explore for, develop, and produce the following quarry minerals, namely

   CLAY,GRAVEL,ROCK OR STONE (COMMON STONE),ROCK OR STONE (PROCESSED STONE),

   that are the property of the Crown and are found on or under the land described as:

   In the Province of Manitoba and being all that portion of unsurveyed Township 67, Range 17 WPM contained within the following limits described by grid coordinates from NAD 83 (CSRS 98) being in UTM 6 degree Zone 14 expressed in metres and further described as follows:

   Commencing at a point with coordinates 439074 E, 6077570 N;
   thence westerly to point with coordinates of 438668 E, 6077437 N;
   thence southerly to point with coordinates of 438723 E, 6077270 N;
   thence easterly to a point with coordinates of 438977 E, 6077351 N;
   thence northerly to the point of commencement, Excepting:
   Firstly: Road Plans 5289 PLTO (N Div.)
   Secondly: Director of Surveys Plan 18298
   (CLAY D)

(the Lands) and being 6.14 hectares, more or less, for a term of 10 years, commencing September 24, 2013 renewable in accordance with the Act.

3. The Lessee shall comply with the Act and regulations; including, without restricting the generality of the foregoing, the payment of rent, royalty and rehabilitation levy prescribed thereunder.

4. The Lessee shall and does hereby indemnify and save harmless the Minister against any and all actions, suits, claims or demands that may be brought or made against the Minister for or by reason of any act or thing done or omitted to be done by the Lessee or its agents with respect to the Lands.

5. To be effective and binding, any waiver by the Minister of a breach by the Lessee of any term or condition of this Lease, the Act or the regulations must be in writing. Any such waiver shall extend only to the events of breach enumerated therein and shall not limit or affect the Minister's rights with respect to any other breach.

6. If the Lessee defaults, breaches, fails to perform or observe any term or condition of this Lease, the Act or the regulations, and any such event is not remedied within such notice period as the Minister may give, the Minister may cancel this Lease. Notwithstanding any such cancellation by the Minister, the rights of the Minister against the Lessee shall not be prejudiced and the Minister shall have the full remedies against the Lessee as if the Lease remained in full force and effect.

7. Any notice to a party hereto shall be in writing and may be delivered personally, sent by telegram, telex, telecopier or other means of electronic communication, or may be forwarded by mail subject to Canada Post confirmation of delivery to that party at the following address:

| To the Minister: | To the Lessee: |
|---|---|
| Innovation, Energy and Mines<br>Unit 360-1395 Ellice Avenue<br>Winnipeg, Manitoba<br>R3G 3P2 | HUDSON BAY MINING AND SMELTING CO., LIMITED<br>PO BOX 1500<br>FLIN FLON, MB, R8A 1N9<br>CA |

8. This lease shall be interpreted in accordance with the laws of Manitoba.

9. Any amendments to this Lease shall be in writing and signed by both parties.

10. The Lessee shall not assign this lease except with the prior written consent of the Minister which shall not be unreasonably withheld. Any obligations of the Lessee outstanding at the date of any assignment shall remain the responsibility of the Lessee, to the extent the obligations are not performed by the permitted assignee.

11. This Lease shall enure to the benefit of and be binding upon the heirs, executors, administrators, successors and permitted assigns of the parties.

12. Additional clauses:

This lease is issued pursuant to Subsection 14(6) of The Mines and Minerals Act on Crown mineral land that is withdrawn.

The lessee shall comply with The Workplace Safety and Health Act and Regulation.

It is the lessee's responsibility to locate all utilities, (including but not limited to gas, electric and

telecommunications) that may exist within the limits of this disposition prior to any excavation. "Call Before You Dig" and "611 Cable Locate Service". The lessee shall comply with all requirements imposed by the utility company.

Manitoba
Innovation, Energy and Mines
Mines Branch

In witness whereof the Minister and the Lessee have executed this Lease on the dates shown below their respective signatures.

Signed, sealed and delivered
in the presence of:

Her Majesty the Queen in right of the Province of Manitoba

Witness

Minister of Innovation, Energy and Mines

Oct 15, 2013
Date

Witness

Lessee HUDSON BAY MINING AND SMELTING CO., LIMITED
Brad Lantz, Vice President, Manitoba Business Unit

October 8, 2013
Date

Mary-Lynn Oke, Chief Financial Officer, Manitoba Business Unit

IN ACCORDANCE WITH SECTION 141(3) OF THE MINES AND MINERALS ACT, THIS QUARRY LEASE IS HEREBY RECORDED AND THIS STAMP SHALL CONSTITUTE A CERTIFICATE OF FILING AND RECORDING.

Oct 15/13
Dated

Mining Recorder

Manitoba
Innovation, Energy and Mines
Mines Branch

# QUARRY LEASE

Quarry Lease No.QL-2756

THIS LEASE made in duplicate September 24, 2013

BETWEEN:

Her Majesty the Queen in right of the
Province of Manitoba, represented by the
Minister of Innovation, Energy and Mines

(the "Minister")

- and - of the First Part

HUDSON BAY MINING AND SMELTING
CO., LIMITED
PO BOX 1500
FLIN FLON, MB, R8A 1N9
CA

(the "Lessee")

of the Second Part

The parties agree as follows:

In this Lease:

1. (a) "Act" means The Mines and Minerals Act , Cap. M162 C.C.S.M., as amended, revised or substituted from time to time;

(b) "regulations" means regulations made pursuant to the Act, and as amended, revised or substituted from time to time;

2. Subject and pursuant to the Act and regulations, the Minister conveys to the lessee the exclusive right to explore for, develop, and produce the following quarry minerals, namely

CLAY,GRAVEL,ROCK OR STONE (COMMON STONE),ROCK OR STONE (PROCESSED STONE),

that are the property of the Crown and are found on or under the land described as:

In the Province of Manitoba and being all that portion of unsurveyed Township 67, Range 17 WPM contained within the following limits described by grid coordinates from NAD 83 (CSRS 98) being in UTM 6 degree Zone 14 expressed in metres and further described as follows:

Commencing at a point with coordinates 438696 E, 6077265 N;
thence north westerly to point with coordinates of 438483 E, 6077429 N;
thence south westerly to point with coordinates of 438402 E, 6077323 N;
thence south easterly to a point with coordinates of 438616 E, 6077159 N;
thence northerly to the point of commencement, Excepting:
Firstly: Road Plans 5289 PLTO (N Div.)
Secondly: Director of Surveys Plan 18298
(CLAY E)

(the Lands) and being 3.58 hectares, more or less, for a term of 10 years, commencing September 24, 2013 renewable in accordance with the Act.

3. The Lessee shall comply with the Act and regulations; including, without restricting the generality of the foregoing, the payment of rent, royalty and rehabilitation levy prescribed thereunder.

4. The Lessee shall and does hereby indemnify and save harmless the Minister against any and all actions, suits, claims or demands that may be brought or made against the Minister for or by reason of any act or thing done or omitted to be done by the Lessee or its agents with respect to the Lands.

5. To be effective and binding, any waiver by the Minister of a breach by the Lessee of any term or condition of this Lease, the Act or the regulations must be in writing. Any such waiver shall extend only to the events of breach enumerated therein and shall not limit or affect the Minister's rights with respect to any other breach.

6. If the Lessee defaults, breaches, fails to perform or observe any term or condition of this Lease, the Act or the regulations, and any such event is not remedied within such notice period as the Minister may give, the Minister may cancel this Lease. Notwithstanding any such cancellation by the Minister, the rights of the Minister against the Lessee shall not be prejudiced and the Minister shall have the full remedies against the Lessee as if the Lease remained in full force and effect.

7. Any notice to a party hereto shall be in writing and may be delivered personally, sent by telegram, telex, telecopier or other means of electronic communication, or may be forwarded by mail subject to Canada Post confirmation of delivery to that party at the following address:

| To the Minister: | To the Lessee: |
|---|---|
| Innovation, Energy and Mines<br>Unit 360-1395 Ellice Avenue<br>Winnipeg, Manitoba<br>R3G 3P2 | HUDSON BAY MINING AND SMELTING CO., LIMITED<br>PO BOX 1500<br>FLIN FLON, MB, R8A 1N9<br>CA |

8. This lease shall be interpreted in accordance with the laws of Manitoba.

9. Any amendments to this Lease shall be in writing and signed by both parties.

10. The Lessee shall not assign this lease except with the prior written consent of the Minister which shall not be unreasonably withheld. Any obligations of the Lessee outstanding at the date of any assignment shall remain the responsibility of the Lessee, to the extent the obligations are not performed by the permitted assignee.

11. This Lease shall enure to the benefit of and be binding upon the heirs, executors, administrators, successors and permitted assigns of the parties.

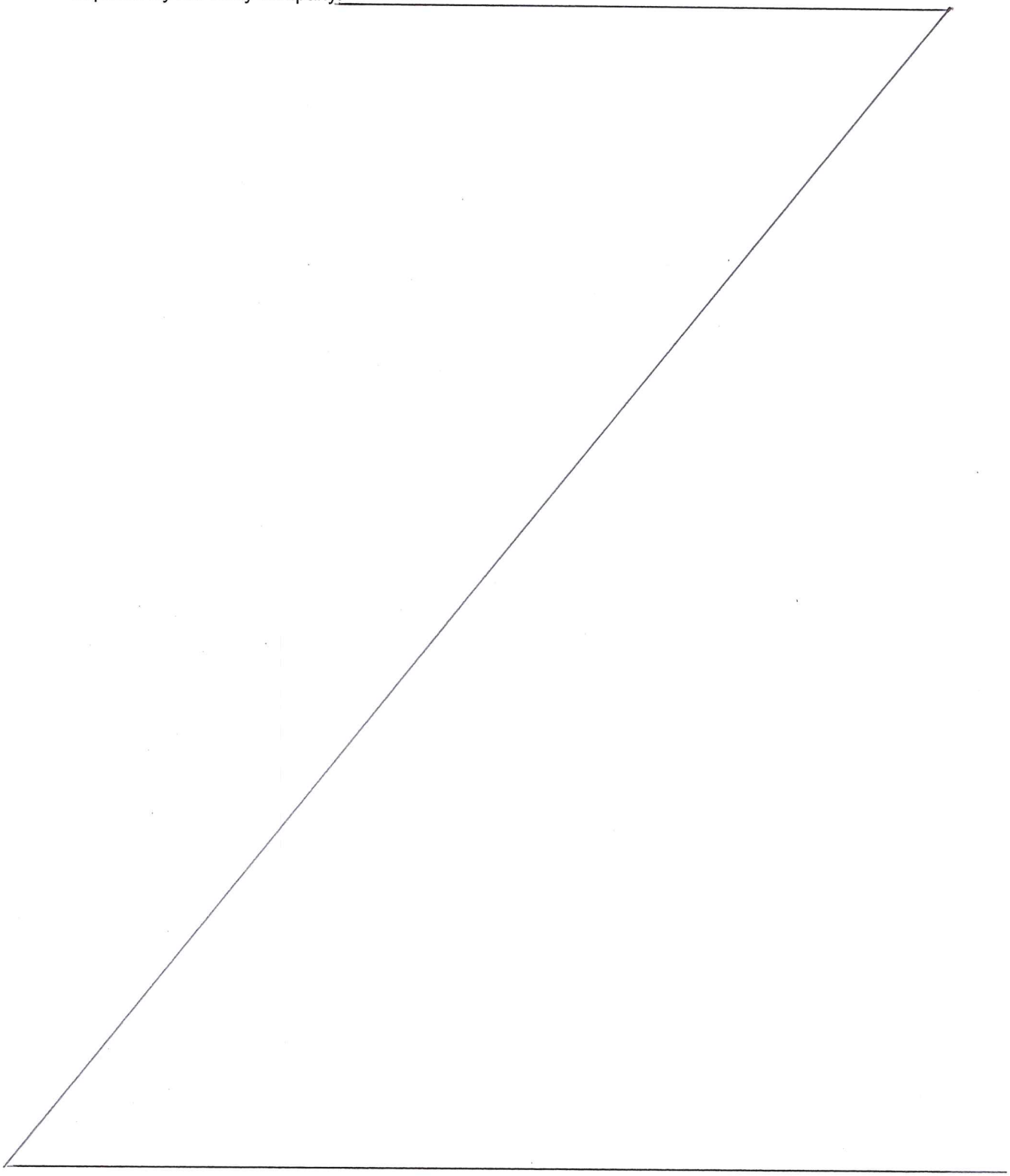
12. Additional clauses:

This lease is issued pursuant to Subsection 14(6) of The Mines and Minerals Act on Crown mineral land that is withdrawn.

The lessee shall comply with The Workplace Safety and Health Act and Regulation.

It is the lessee's responsibility to locate all utilities, (including but not limited to gas, electric and

telecommunications) that may exist within the limits of this disposition prior to any excavation. "Call Before You Dig" and "611 Cable Locate Service". The lessee shall comply with all requirements imposed by the utility company.



Manitoba
Innovation, Energy and Mines
Mines Branch

In witness whereof the Minister and the Lessee have executed this Lease on the dates shown below their respective signatures.

Signed, sealed and delivered
in the presence of:

Her Majesty the Queen in right of the Province of Manitoba

Witness

Minister of Innovation, Energy and Mines

Oct 15, 2013
Date

Witness

Lessee HUDSON BAY MINING AND SMELTING CO., LIMITED
Brad Lantz, Vice President, Manitoba Business Unit

October 8, 2013
Date

Mary-Lynn Oke, Chief Financial Officer, Manitoba Business Unit

IN ACCORDANCE WITH SECTION 141(3) OF THE MINES AND MINERALS ACT, THIS QUARRY LEASE IS HEREBY RECORDED AND THIS STAMP SHALL CONSTITUTE A CERTIFICATE OF FILING AND RECORDING.

Oct 15/13
Dated

Mining Recorder

Manitoba
Innovation, Energy and Mines
Mines Branch

# QUARRY LEASE

Quarry Lease No.QL-2757

THIS LEASE made in duplicate September 24, 2013

BETWEEN:

Her Majesty the Queen in right of the
Province of Manitoba, represented by the
Minister of Innovation, Energy and Mines

(the "Minister")

- and - of the First Part

HUDSON BAY MINING AND SMELTING
CO., LIMITED
PO BOX 1500
FLIN FLON, MB, R8A 1N9
CA

(the "Lessee")

of the Second Part

The parties agree as follows:

In this Lease:

1. (a) "Act" means The Mines and Minerals Act , Cap. M162 C.C.S.M., as amended, revised or substituted from time to time;

(b) "regulations" means regulations made pursuant to the Act, and as amended, revised or substituted from time to time;

2. Subject and pursuant to the Act and regulations, the Minister conveys to the lessee the exclusive right to explore for, develop, and produce the following quarry minerals, namely

CLAY,GRAVEL,ROCK OR STONE (COMMON STONE),ROCK OR STONE (PROCESSED STONE),

that are the property of the Crown and are found on or under the land described as:

In the Province of Manitoba and being all that portion of unsurveyed Township 67, Range 17 WPM contained within the following limits described by grid coordinates from NAD 83 (CSRS 98) being in UTM 6 degree Zone 14 expressed in metres and further described as follows:

Commencing at a point with coordinates 438360 E, 6077453 N;
Thence south westerly to point with coordinates of 438144 E, 6077348 N;
thence south easterly to point with coordinates of 438183 E, 6077268 N;
thence north easterly to a point with coordinates of 438399 E, 6077373 N;
thence north westerly to the point of commencement, Excepting:
Firstly: Road Plans 5289 PLTO (N Div.)
Secondly: Director of Surveys Plan 18298
(CLAY F)

(the Lands) and being 2.14 hectares, more or less, for a term of 10 years, commencing September 24, 2013 renewable in accordance with the Act.

3. The Lessee shall comply with the Act and regulations; including, without restricting the generality of the foregoing, the payment of rent, royalty and rehabilitation levy prescribed thereunder.

4. The Lessee shall and does hereby indemnify and save harmless the Minister against any and all actions, suits, claims or demands that may be brought or made against the Minister for or by reason of any act or thing done or omitted to be done by the Lessee or its agents with respect to the Lands.

5. To be effective and binding, any waiver by the Minister of a breach by the Lessee of any term or condition of this Lease, the Act or the regulations must be in writing. Any such waiver shall extend only to the events of breach enumerated therein and shall not limit or affect the Minister's rights with respect to any other breach.

6. If the Lessee defaults, breaches, fails to perform or observe any term or condition of this Lease, the Act or the regulations, and any such event is not remedied within such notice period as the Minister may give, the Minister may cancel this Lease. Notwithstanding any such cancellation by the Minister, the rights of the Minister against the Lessee shall not be prejudiced and the Minister shall have the full remedies against the Lessee as if the Lease remained in full force and effect.

7. Any notice to a party hereto shall be in writing and may be delivered personally, sent by telegram, telex, telecopier or other means of electronic communication, or may be forwarded by mail subject to Canada Post confirmation of delivery to that party at the following address:

| To the Minister: | To the Lessee: |
|---|---|
| Innovation, Energy and Mines<br>Unit 360-1395 Ellice Avenue<br>Winnipeg, Manitoba<br>R3G 3P2 | HUDSON BAY MINING AND SMELTING CO., LIMITED<br>PO BOX 1500<br>FLIN FLON, MB, R8A 1N9<br>CA |

8. This lease shall be interpreted in accordance with the laws of Manitoba.

9. Any amendments to this Lease shall be in writing and signed by both parties.

10. The Lessee shall not assign this lease except with the prior written consent of the Minister which shall not be unreasonably withheld. Any obligations of the Lessee outstanding at the date of any assignment shall remain the responsibility of the Lessee, to the extent the obligations are not performed by the permitted assignee.

11. This Lease shall enure to the benefit of and be binding upon the heirs, executors, administrators, successors and permitted assigns of the parties.

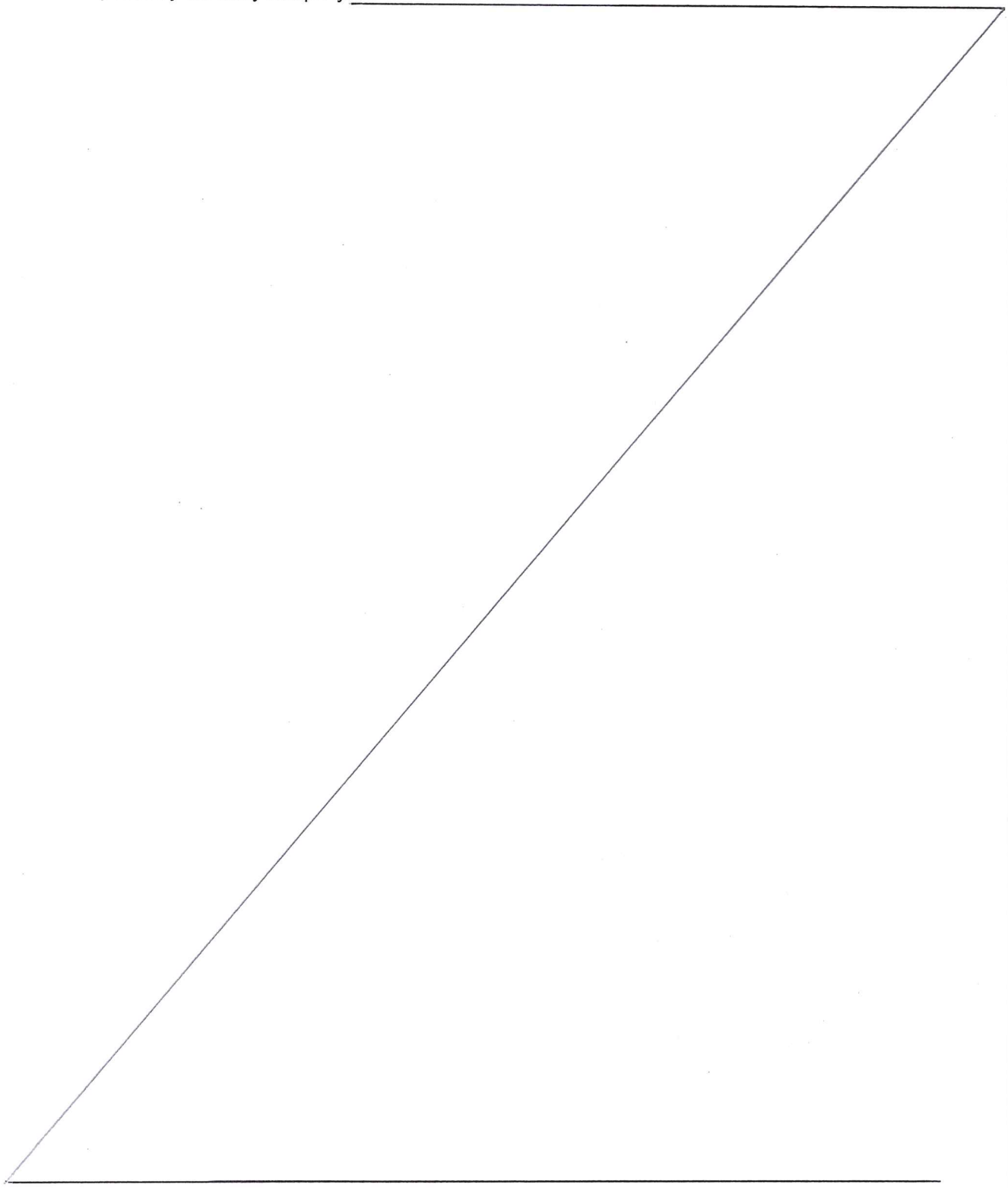
12. Additional clauses:

This lease is issued pursuant to Subsection 14(6) of The Mines and Minerals Act on Crown mineral land that is withdrawn.

The lessee shall comply with The Workplace Safety and Health Act and Regulation.

It is the lessee's responsibility to locate all utilities, (including but not limited to gas, electric and

telecommunications) that may exist within the limits of this disposition prior to any excavation. "Call Before You Dig" and "611 Cable Locate Service". The lessee shall comply with all requirements imposed by the utility company.



Manitoba
Innovation, Energy and Mines
Mines Branch

In witness whereof the Minister and the Lessee have executed this Lease on the dates shown below their respective signatures.

Signed, sealed and delivered
in the presence of:

Her Majesty the Queen in right of the Province of Manitoba

Witness

James Payne
Minister of Innovation, Energy and Mines

Oct 15, 2013
Date

Witness

Lessee HUDSON BAY MINING AND SMELTING CO., LIMITED
Brad Lantz, Vice President, Manitoba Business Unit

October 8, 2013
Date

Mary-Lynn Oke, Chief Financial Officer, Manitoba Business Unit

IN ACCORDANCE WITH SECTION 141(3) OF THE MINES AND MINERALS ACT, THIS QUARRY LEASE IS HEREBY RECORDED AND THIS STAMP SHALL CONSTITUTE A CERTIFICATE OF FILING AND RECORDING.

Oct 15/13
Dated

Mining Recorder

# Document 3: Casual Quarry Permits

Manitoba
Mineral Resources
Mines Branch

HUDSON BAY MINING AND SMELTING CO., LIMITED

PO BOX 1500
FLIN FLON, MB R8A 1N9

CA

# Casual Quarry Permit No.CP-2016-1008149

for GRAVEL

The Permittee named above is authorized in accordance with Part 2 of Quarry minerals Regulation, 1992 to produce not more than 15000.0 tonnes of GRAVEL from the following location:

NE1/4 SEC 11 TWP 067 RGE 018 W1

subject to the following conditions:

a) this casual quarry permit expires on November 30, 2015 and all production shall be completed by this date.

b) operations shall be conducted in accordance with The Mines and Minerals Act and Regulations thereunder as amended from time to time.

c) the permittee shall comply with The Workplace Safety and Health Act and Regulation, and
(i) provide orientation, instruction, training and competent supervision to all employees, and
(ii) identify and correct all hazards found at the workplace.

d) where the right to use the surface is vested in a person other than Permittee, the Permittee shall not enter upon the lands described in the permit, unless
(i) the Permittee has written authorization to do so from the owner or occupant of the land and a copy of such authorization has been filed with the Mining Recorder; or
(ii) the Permittee has been granted right-of-entry pursuant to the provisions of The Mines and Minerals Act.

e) all material produced shall be subject to a royalty of 50.0 cents per tonne.

f) all material produced shall be subject to a rehabilitation levy of 12 cents per tonne.

g) the quarry return attached hereto shall be forwarded to the recorder within 30 days of the expiry of this permit,detailing the quantities of materials produced, accompanied by royalty payment of Certificate of Exemption, and if applicable, a rehabilitation levy.

h) additional clauses on attached page.

This Casual Quarry Permit is issued on behalf of the Mining Recorder on February 17, 2016

1. Prior to the commencement of mining, a work permit shall be obtained from the local Natural Resource Officer and notice of the commencement date shall be given to the Mines Inspector:

   TRACY GREXTON-VAN WYNSBERGHE, (204) 648-3808

2. The permit holder shall maintain an accurate daily record of the quantity of material removed from the site and shall make this information available to the Mines Inspector upon request. If the permit was applied for on the basis of a contract for the Department of Infrastructure & Transportation, material can only be used for the purposes of that project.

3. Mining operations shall not encroach within 4 metres of any property boundary adjoining private, municipal or crown-leased land and the depth of mine excavation shall not exceed one-third of the distance to any such property boundary.

4. No clearing of vegetation, excavation, or stockpiling of material shall be undertaken within 50 metres of a developed public road, right-of-way or natural water body, including a river or stream.

5. Mining activity shall not interfere with other mine operations at the site and existing stockpiles of processed material shall not be mined without written authorization from this department.

6. Slash and timber material shall be cleared in advance of overburden stripping and excavation, and separated from stripping stockpiles and standing timber by at least 4 metres. It shall be disposed of in a manner prescribed by the Mines Inspector.

7. The stripping of overburden shall be maintained in advance of the face for a distance not less than twice the height of the working face. Overburden shall be stockpiled at a location where it will not interfere with future mining operations and at least 4 metres from any standing timber.

8. Any undepleted slope resulting from this operation shall be left in a safe condition satisfactory to the Mines Inspector. The pit floor shall be cleared of any available material.

9. Any damage to roads or trails occurring as a result of mining shall be repaired before leaving the mining site.

10. The area shall be maintained and left in a clean and orderly condition satisfactory to the Mines Inspector.

11. It is the permittee's responsibility to locate all utilities, (including but not limited to gas, electric and telecommunications) that may exist within the limits of this disposition prior to any excavation. "Call Before You Dig" and "611 Cable Locate Service". The permittee shall comply with all requirements imposed by the utility company.

# Document 4: CEC Order 765

5 Copies

MANITOBA

CLEAN ENVIRONMENT COMMISSION

Office of the Chairman
Box 4, 139 Tuxedo Avenue
Winnipeg, Manitoba
R3N 0H6

C-b-1644

December 29, 1977

REGISTERED

Mr. W. W. Fraser, P. Eng.
Supt. Environmental Control
and Process Technology
Hudson Bay Mining and
Smelting Co., Limited
P.O. Box 1500
FLIN FLON, Manitoba
R8A 1N9

Dear Mr. Fraser:

Herewith Orders No. 765 and No. 766 of The Clean Environment Commission dated December 29, 1977, issued in relation to an application filed with the Department of Mines, Resources and Environmental Management by Hudson Bay Mining and Smelting Co., Limited in connection with the operation of a proposed ore concentrator to be located adjacent to the present Stall Lake Mine near Snow Lake, in the Local Government District of Snow Lake, discharging metallurgical tailings and mine effluent to Anderson Lake and with associated noise and particulate emissions.

Should you require any clarification with respect to any of the Clauses of these Orders, please contact the Environmental Control Branch, of the Department of Mines, Resources and Environmental Management, 139 Tuxedo Avenue, at Telephone Number 489-4511 Local 134.

Yours truly,

Guy E. Moore
Chairman
The Clean Environment Commission

GEM/dr

AN ORDER OF THE CLEAN ENVIRONMENT COMMISSION

UNDER THE CLEAN ENVIRONMENT ACT

RE: THE CLEAN ENVIRONMENT COMMISSION and HUDSON BAY MINING AND SMELTING CO., LIMITED, Applicant;

WHEREAS pursuant to the provisions of The Clean Environment Act, Hudson Bay Mining and Smelting Co., Limited filed a proposal with the Department of Mines, Resources and Environmental Management in connection with the operation of a proposed ore concentrator to be located adjacent to the present Stall Lake Mine near Snow Lake, in the Local Government District of Snow Lake with associated noise and particulate emissions;

AND WHEREAS in the absence of limits being prescribed by a Regulation under the said Act, the proposal was referred to The Clean Environment Commission for the prescribing of limits;

AND WHEREAS the Commission received notices of representation from persons who are or who are likely to be affected by an Order of the Commission prescribing limits in connection with the said operation;

AND WHEREAS the Commission held a public hearing in Snow Lake, Manitoba, on the 19th and 20th days of September, 1977;

AND WHEREAS the Commission considered the proposal and evidence submitted at the hearing on the 14th day of November, 1977;

IT IS HEREBY ORDERED THAT

1. The Applicant shall ensure that total particulate emissions from any area of the said concentrator, to the atmosphere, do not exceed 0.23 grams per standard cubic meter.[1]

2. The Applicant shall ensure that fugitive dust emissions from vehicle traffic on the site of the said operation and/or wind entrainment of dust are minimized by surface treatment of roads, covering stockpiles and/or applying dust control products to sources of fugitive dust emissions associated with the operation of the said concentrator.

3. The Applicant shall, within 21 days of receiving a written request from the Environmental Management Division of the Department of Mines, Resources and Environmental Management, conduct emission tests on the sources of emission of particulates to the atmosphere in accordance with the method detailed in Appendix "A" to this Order.

4. The Applicant shall ensure that a high standard of maintenance and housekeeping is maintained on the site of the said concentrator.

5. The Applicant shall ensure that sounds emitted from the site or sites of the said operation including the water intake pumphouse and tailings discharge facilities do not result in one-hour equivalent continuous sound levels, as measured beyond the property line of the site or sites of the said operation and within 15 meters of a permanent or seasonal residence or a cottage located on a subdivision approved by the Manitoba Department of Tourism, Recreation and Cultural Affairs and which was in existance on the date of issuance of this Order, in excess of the sound level limits[2] contained in the following table:

| | (i) May to September inclusive | | (ii) October to April inclusive | |
|---|---|---|---|---|
| | Day-Time 07:00 to 22:00 | Night-Time 22:00 to 07:00 | Day-Time 07:00 to 22:00 | Night-Time 22:00 to 07:00 |
| (a)For continuous or intermittent sounds which have neither significant impulsive characteristics[3] nor prominent discrete tones[4] | 55 dBA | 45 dBA | 60 dBA | 50 dBA |

5. Continued . . .

| | (i)May to September inclusive | | (ii)October to April inclusive | |
|---|---|---|---|---|
| | Day-Time 07:00 to 22:00 | Night-Time 22:00 to 07:00 | Day-Time 07:00 to 22:00 | Night-Time 22:00 to 07:00 |
| (b)For continuous or intermittent sounds which have significant impulsive characteristics[3] and/or prominent discrete tone(s)[4] | 50 dBA | 40 dBA | 55 dBA | 45 dBA |

Order No. 765

Dated at the City of Winnipeg

this 29th day of December, 1977

Chairman,
The Clean Environment Commission.

C-b-1644

[1] - "standard cubic meter" means the volume of air occupying a cubic meter at ~~20°~~ 15 Celsius and 760 mm of mercury.

[2] - as measured in terms of the equivalent continuous sound level averagedover a one hour period (60 minutes), using a sound level monitoring device which equals or surpasses the requirements of Canadian Standards Association Standard Z 107.1 - 1973 - (or the equivalent) for Type 2 sound level meters, operated on the "A - weighting network" and "slow" meter response.

. . . . 4

3 - "impulsive characteristics" means hammering type sounds having peaks one second or more apart - ie. less than 60 impacts per minute.

4 - "prominent discrete tone(s)" means a sound having a one-third octave band sound level which, when measured in a one-third octave band, exceeds the arithmetic average of the sound levels on the two adjacent one-third octave bands on either side of such one-third octave band by:

(a) 5 dB for such one-third octave band with a centre frequency from 500 Hertz to 20,000 Hertz, inclusive, provided such one-third octave band sound level exceeds the sound level of each adjacent one-third octave band, or;

(b) 8 dB for such one-third octave band with a centre frequency from 160 Hertz to 400 Hertz, inclusive, provided that such one-third octave band sound level exceeds the sound level of each adjacent one-third octave band, or;

(c) 15 dB for such one-third octave band with a centre frequency from 25 Hertz to 125 Hertz, inclusive, provided such one-third octave band sound level exceeds the sound level of each adjacent one-third octave band.

## Source Testing for Particulate Emissions

Testing of sources of emission of particulates to the atmosphere shall be carried out in accordance with the "Standard Reference Methods of Source Testing: Measurement of Emissions of Particulates from Stationary Sources - EPS 1-AP-74-1" or an alternate method approved, in writing, by the Environmental Management Division of the Department of Mines, Resources and Environmental Management. Each emission test shall consist of at least three valid test runs and be carried out under normal plant operating conditions. All emission tests shall be observed by an inspector designated by the Environmental Management Division of the Department of Mines, Resources and Environmental Management and a copy of the test results shall be forwarded to the inspector within 21 days of completion of the testing.

# Document 5: Letter from Transport Canada

Transport Canada / Transports Canada

Transport Canada
1100 3700 Jasper Ave
Edmonton, Alberta
T5J 4E6

*Our file* *Notre référence*

8200-2013-600183

Mr. Stephen West,
Hudson Bay Mining and Smelting Co. Ltd
PO Box 1500
Flin Flon, MB R8A 1N9

May 8, 2014

Dear Mr. West,

**SUBJECT:** **Applicability of the Navigation Protection Act to Anderson Lake**

Further to our correspondence of July 15, 2013, we would like to provide you with an update on our final review of the applicability of the *Navigation Protection Act*, to the *Anderson Lake Tailings Impoundment Area.*

Transport Canada (TC) has completed the navigability assessment of Anderson Lake for the purposes of the Navigation Protection Act (NPA). Further to this assessment, TC is satisfied that while Anderson Lake is physically capable of supporting navigation, the waterway does not appear to be currently used by the public, there is no record of it being historically used as an aqueous route for navigation purposes and there is a low likelihood for future potential use. Accordingly, TC has determined that Anderson Lake is not navigable for the purposes of the NPA.

In conclusion, TC will proceed to close the file pertaining to the Lalor Concentrator and ongoing deposit of tailing into Anderson Lake. Should you have any questions, please do not hesitate to contact Officer Kelly Hunnie at 204-984-2720.

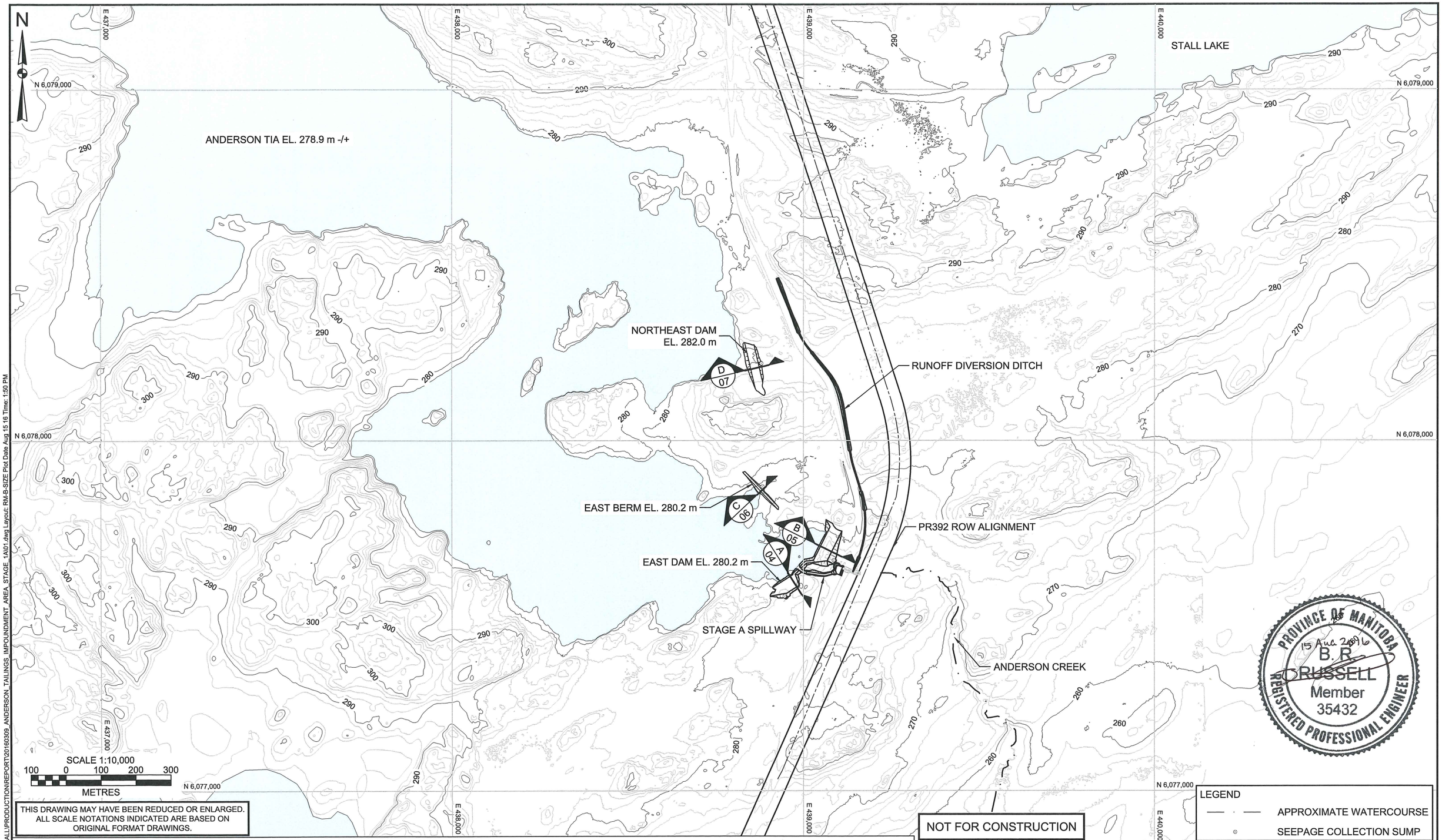
Yours sincerely,

Matt Klaverkamp
Regional Manager
Navigation Protection Program

# Appendix B

## Drawings of Proposed Project Components Provided by BGC Engineering Inc.

# BGC Drawings




SCALE 1:10,000

100 0 100 200 300

METRES

THIS DRAWING MAY HAVE BEEN REDUCED OR ENLARGED. ALL SCALE NOTATIONS INDICATED ARE BASED ON ORIGINAL FORMAT DRAWINGS.

PROVINCE OF MANITOBA
15 Aug 2016
B. R. RUSSELL
Member
35432
REGISTERED PROFESSIONAL ENGINEER

LEGEND

- APPROXIMATE WATERCOURSE
- SEEPAGE COLLECTION SUMP

NOT FOR CONSTRUCTION

NOTES:

1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.
2. BASE TOPOGRAPHIC DATA BASED ON LIDAR PROVIDED BY ATLIS GEOMATICS, DATED 2006 AND 2012. CONTOUR INTERVAL IS 2.0 m.
3. PR392 RIGHT OF WAY (ROW) PROVIDED BY MANITOBA INFRASTRUCTURE AND TRANSPORTATION, DATED OCTOBER 24, 2012.
4. PROJECTION IS UTM NAD 83 ZONE 14N.
5. UNLESS BGC AGREES OTHERWISE IN WRITING, THIS DRAWING SHALL NOT BE MODIFIED OR USED FOR ANY PURPOSE OTHER THAN THE PURPOSE FOR WHICH BGC GENERATED IT. BGC SHALL HAVE NO LIABILITY FOR ANY DAMAGES OR LOSS ARISING IN ANY WAY FROM ANY USE OR MODIFICATION OF THIS DOCUMENT NOT AUTHORIZED BY BGC. ANY USE OF OR RELIANCE UPON THIS DOCUMENT OR ITS CONTENT BY THIRD PARTIES SHALL BE AT SUCH THIRD PARTIES' SOLE RISK.

| | |
|---|---|
| SCALE: | 1:10,000 |
| DATE: | MAR 2016 |
| DRAWN: | RSG |
| CHECKED: | CRD |
| APPROVED: | BRR |

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

CLIENT: HUDBAY

PROJECT: ANDERSON TAILINGS IMPOUNDMENT AREA

TITLE: STAGE A GENERAL ARRANGEMENT

PROJECT No.: 0077-033

DWG No.: 01

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E 437,000 E 438,000 E 439,000 E 440,000

N 6,079,000

N 6,078,000

N 6,077,000

ANDERSON TIA EL. 279.5 m -/+

STALL LAKE

NORTHEAST DAM
EL. 282.0 m

D
07

RUNOFF DIVERSION DITCH

EAST DAM EL. 282.0 m

E
08

EAST BERM EL. 280.2 m
(INACTIVE)

B
06

A
04

EAST DAM EL. 282.0 m

PR392 ROW ALIGNMENT

ANDERSON CREEK

SOUTH WEST DAM
EL. 282.0 m

STAGE B SPILLWAY

290 280 300 260 270

SCALE 1:10,000

100 0 100 200 300

METRES

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ORIGINAL FORMAT DRAWINGS.

PROVINCE OF MANITOBA
15 Aug 2016
B.R.
RUSSELL
Member
35432
REGISTERED PROFESSIONAL ENGINEER

NOT FOR CONSTRUCTION

LEGEND

APPROXIMATE WATERCOURSE

SEEPAGE COLLECTION SUMP

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| APPROVED: | BRR |

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

CLIENT: HUDBAY

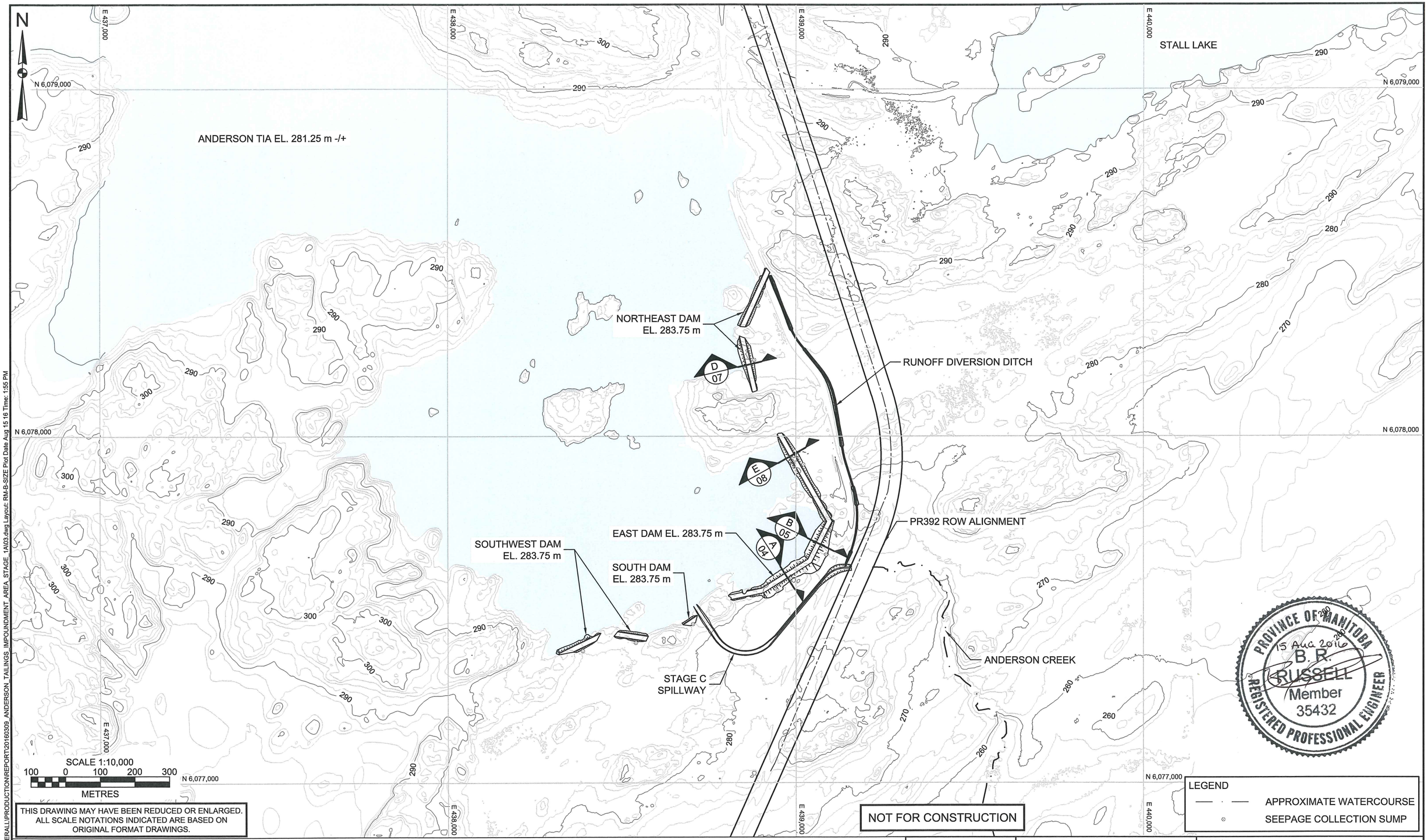
PROJECT: ANDERSON TAILINGS IMPOUNDMENT AREA

TITLE: STAGE B GENERAL ARRANGEMENT

PROJECT No.: 0077-033

DWG No.: 02

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SCALE 1:10,000

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METRES

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PROVINCE OF MANITOBA
15 Aug 2016
B. R. RUSSELL
Member
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REGISTERED PROFESSIONAL ENGINEER

NOT FOR CONSTRUCTION

LEGEND

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AN APPLIED EARTH SCIENCES COMPANY

CLIENT: HUDBAY

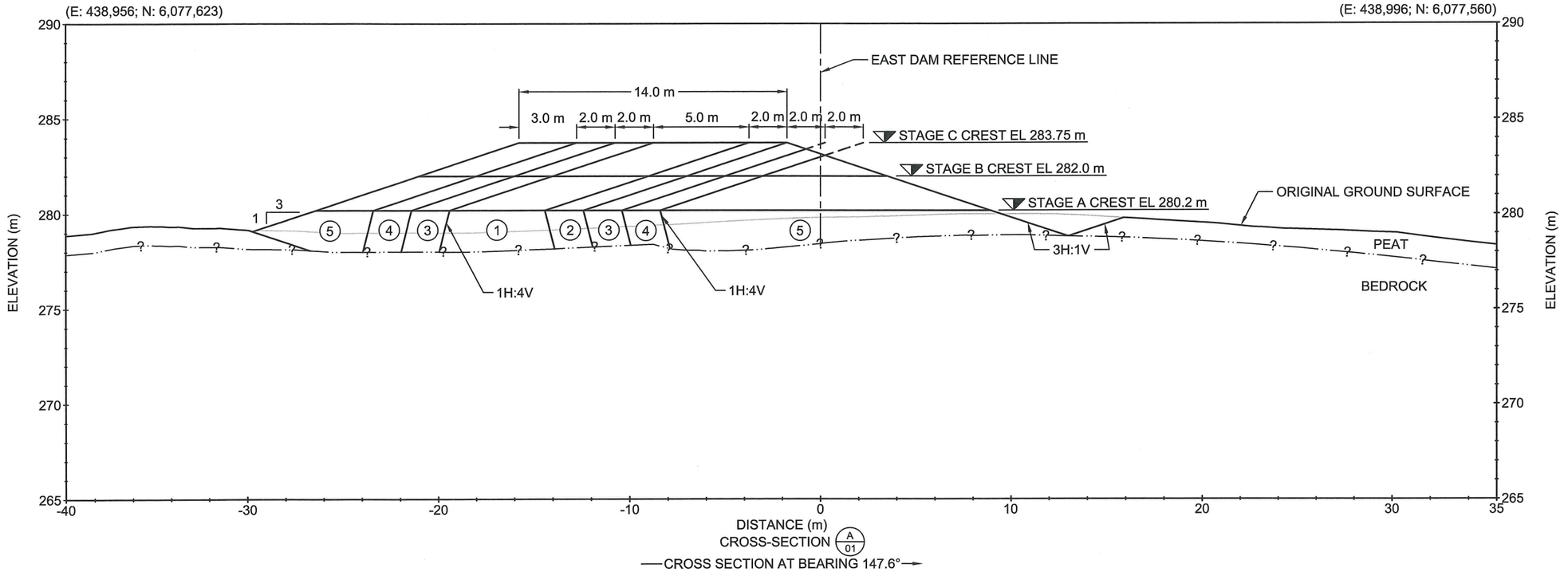
PROJECT: ANDERSON TAILINGS IMPOUNDMENT AREA

TITLE: STAGE C GENERAL ARRANGEMENT

PROJECT No.: 0077-033

DWG No.: 03

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SCALE 1:250

2.5 0 2.5 5 7.5

METRES

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15 Aug 2016
B. R. RUSSELL
Member
35432
REGISTERED PROFESSIONAL ENGINEER

NOT FOR CONSTRUCTION

MATERIALS
1. LOW PERMEABILITY FILL
2. SAND FILTER
3. SAND AND GRAVEL FILTER
4. TRANSITION ROCKFILL
5. ROCKFILL
—?— ESTIMATED MATERIAL CONTACT

| | |
|---|---|
| SCALE: | 1:250 |
| DATE: | MAR 2016 |
| DRAWN: | LS |
| CHECKED: | CRD |
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PROJECT: ANDERSON TAILINGS IMPOUNDMENT AREA

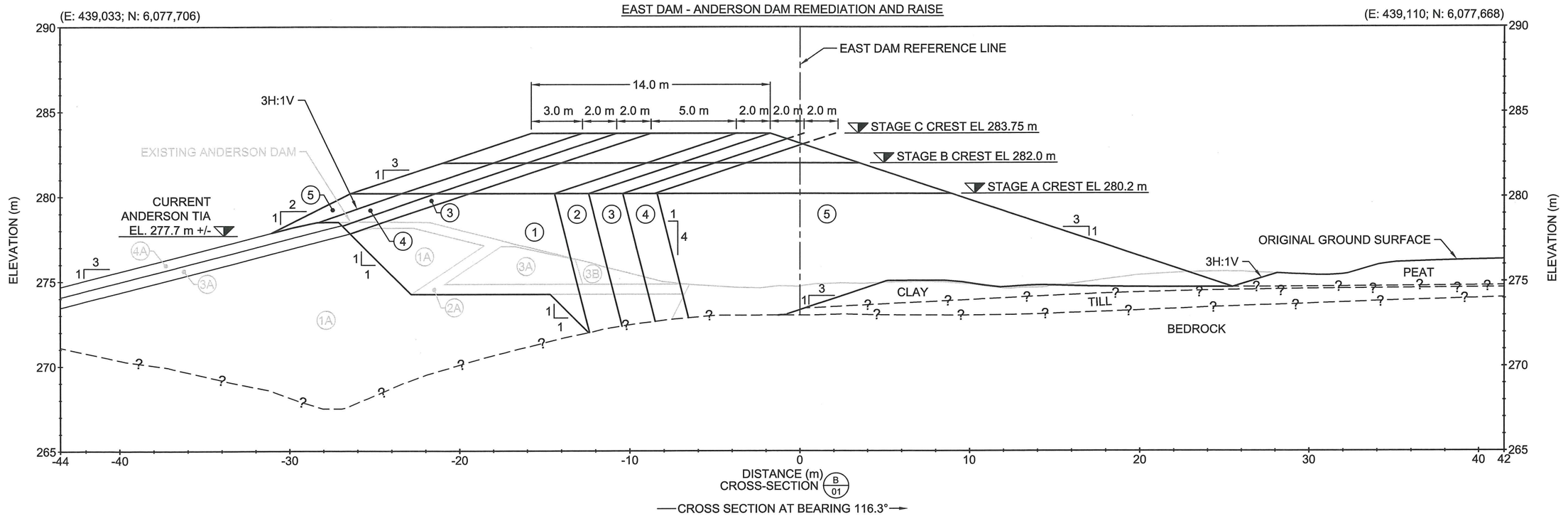
TITLE: EAST DAM CROSS SECTION A

PROJECT No.: 0077-033

DWG No.: 04

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# EAST DAM - ANDERSON DAM REMEDIATION AND RAISE




SCALE 1:250

2.5 0 2.5 5 7.5

METRES

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Member
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MATERIALS
- (1) LOW PERMEABILITY FILL
- (2) SAND FILTER
- (3) SAND AND GRAVEL FILTER
- (4) TRANSITION ROCKFILL
- (1A) EXISTING LOW PERMEABILITY FILL
- (2A) EXISTING SAND FILTER
- (3A) EXISTING ROCKFILL
- (3B) EXISTING LIMESTONE ROCKFILL
- (4A) EXISTING RIPRAP
- (5) ROCKFILL
- — ? — ESTIMATED MATERIAL CONTACT

| | |
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| DATE: | MAR 2016 |
| DRAWN: | LS |
| CHECKED: | CRD |
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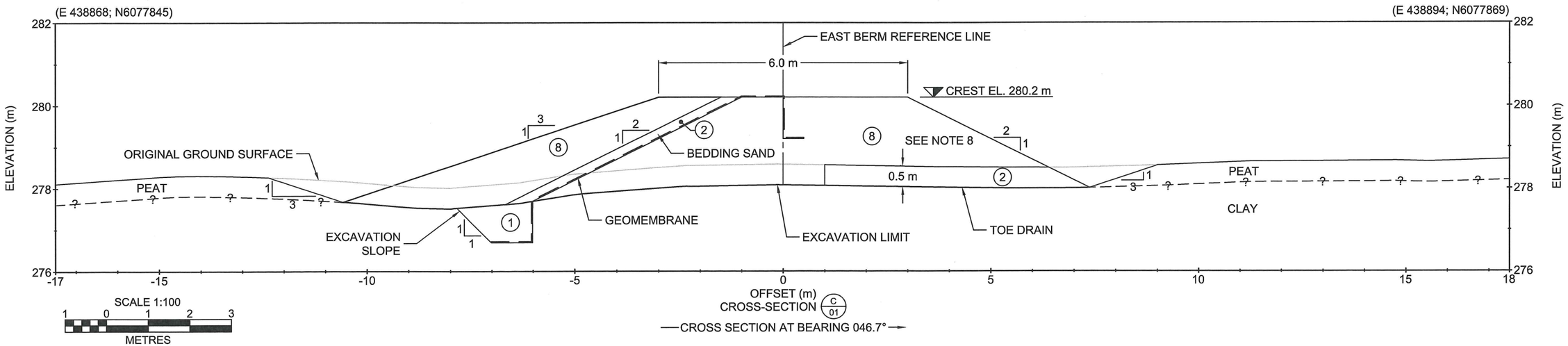
PROJECT: ANDERSON TAILINGS IMPOUNDMENT AREA

TITLE: EAST DAM CROSS SECTION B

PROJECT No.: 0077-033

DWG No.: 05

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SCALE 1:100

1 0 1 2 3

METRES

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MATERIALS

1 LOW PERMEABILITY FILL
2 SAND FILTER
8 GENERAL FILL
GEOMEMBRANE
ESTIMATED MATERIAL CONTACT

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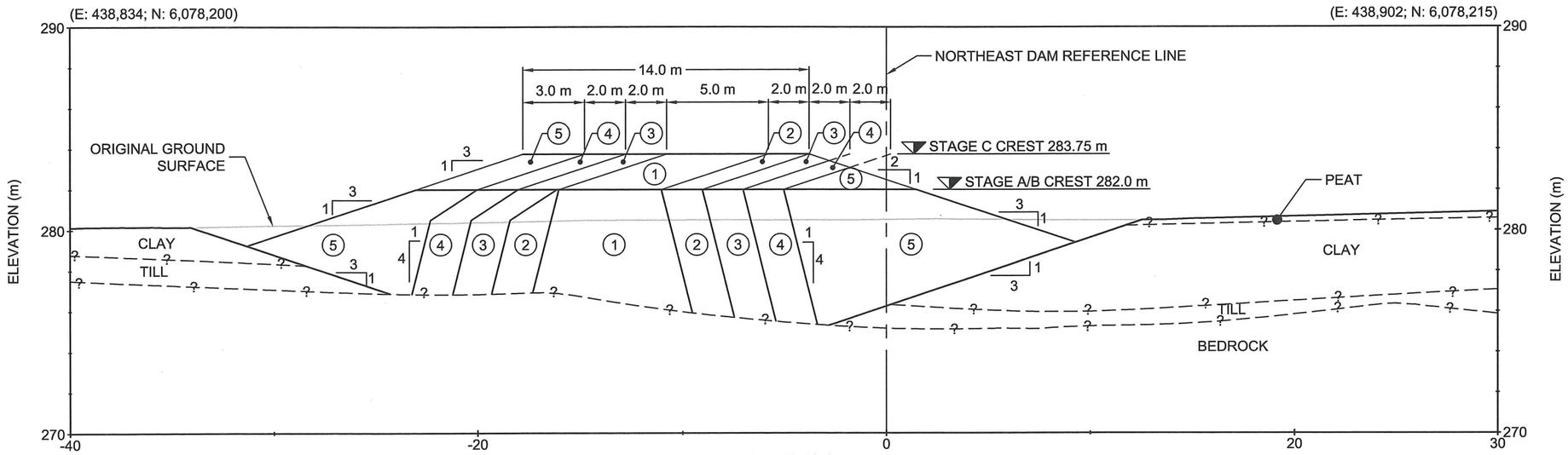
PROJECT: ANDERSON TAILINGS IMPOUNDMENT AREA

TITLE: EAST BERM CROSS SECTION C

PROJECT No.: 0077-033

DWG No.: 06

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SCALE 1:250

2.5 0 2.5 5 7.5

METRES

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MATERIALS

1. LOW PERMEABILITY FILL
2. SAND FILTER
3. SAND AND GRAVEL FILTER
4. TRANSITION ROCKFILL
5. ROCKFILL
- ? - ESTIMATED MATERIAL CONTACT

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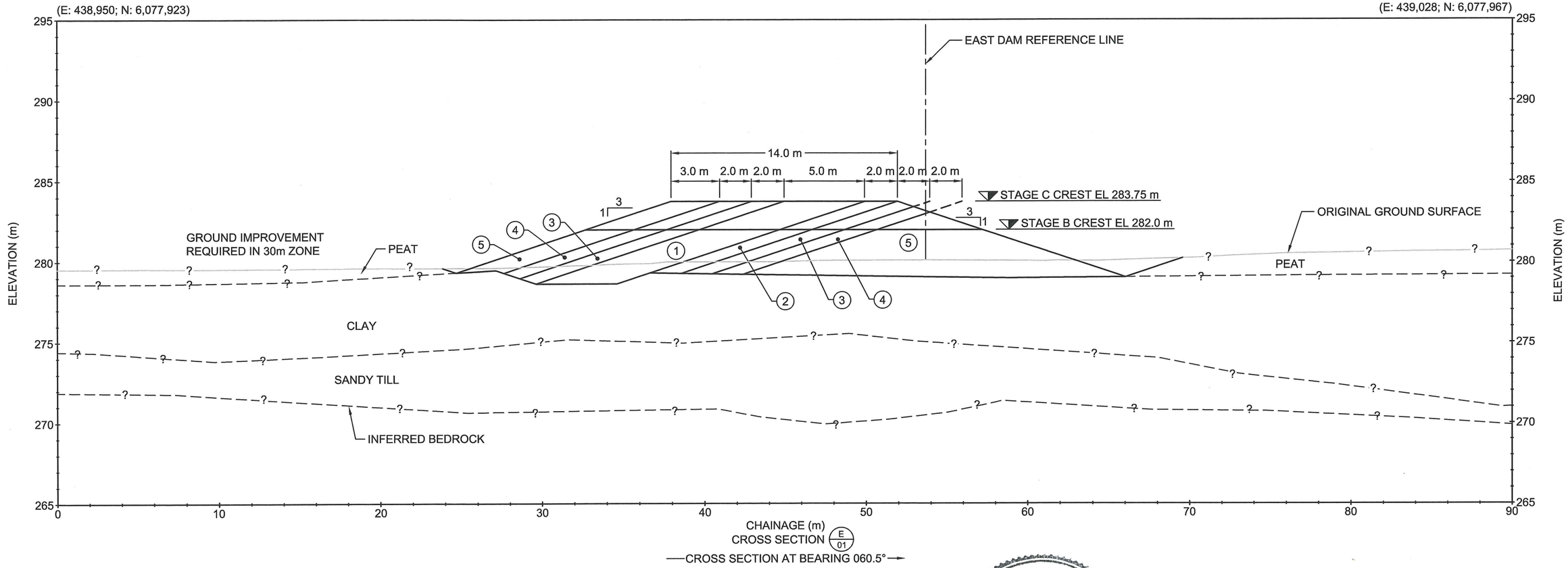
PROJECT: ANDERSON TAILINGS IMPOUNDMENT AREA

TITLE: NORTHEAST DAM CROSS SECTION D

PROJECT No.: 0077-033

DWG No.: 07

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SCALE 1:250

2.5 0 2.5 5 7.5

METRES

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MATERIALS

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2. SAND FILTER
3. SAND AND GRAVEL FILTER
4. TRANSITION ROCKFILL
5. ROCKFILL

— ? — ESTIMATED MATERIAL CONTACT

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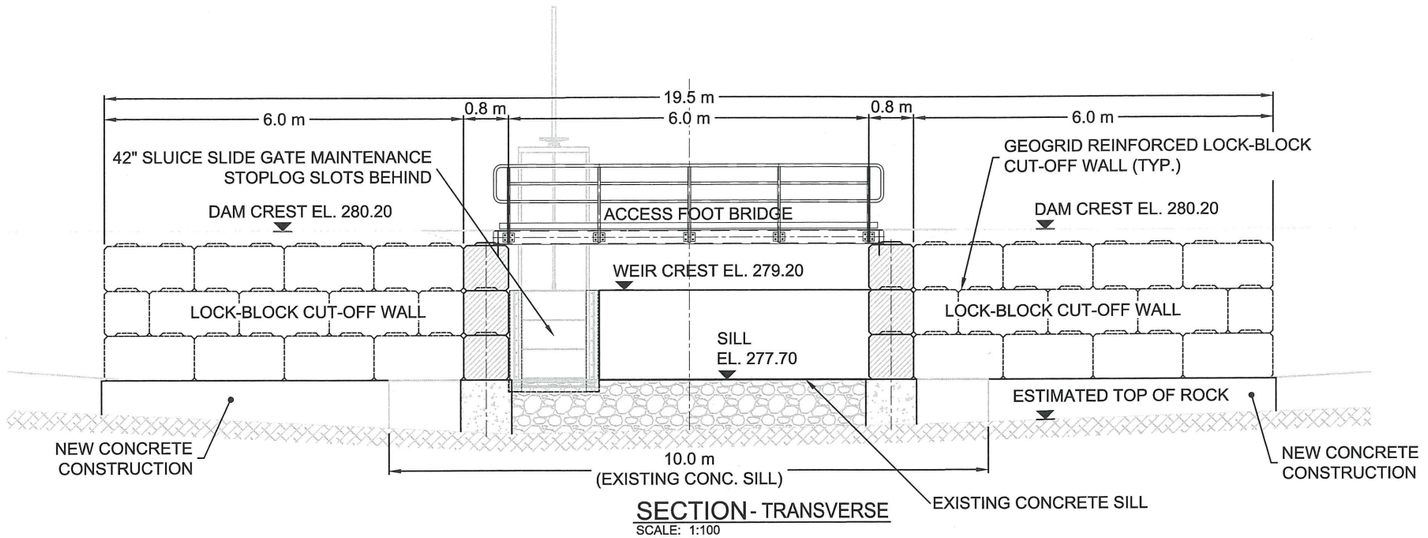
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TITLE: EAST DAM CROSS SECTION E

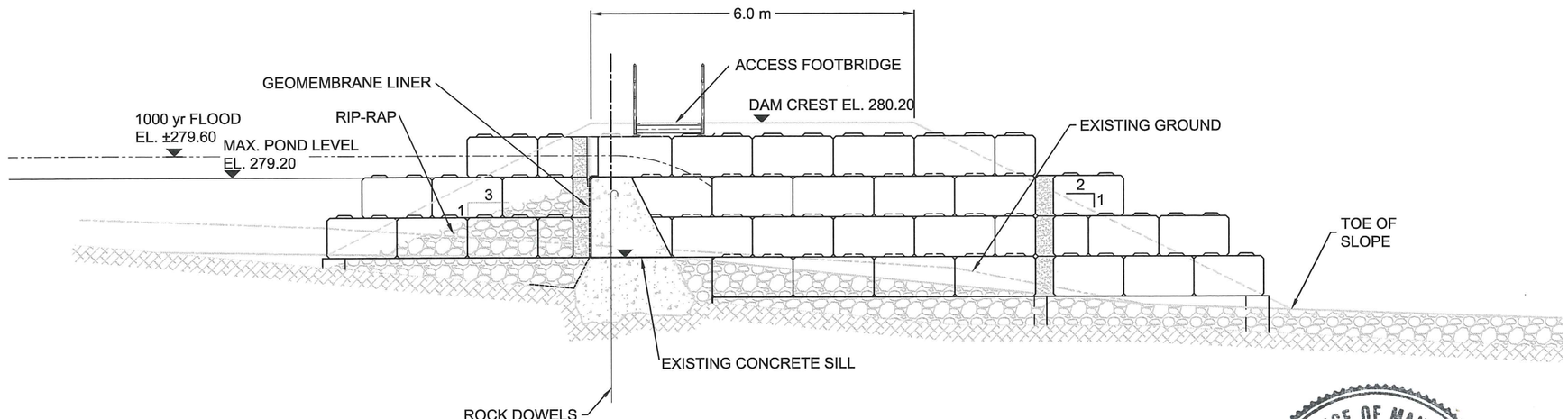
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SECTION - TRANSVERSE
SCALE: 1:100




SECTION - LONGITUDINAL
SCALE: 1:100

SCALE 1:100
1 0 1 2 3
METRES

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| CHECKED: | CRD |
| APPROVED: | BRR |

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CLIENT: HUDBAY

PROJECT: ANDERSON TAILINGS IMPOUNDMENT AREA

TITLE: STAGE A SPILLWAY TRANSVERSE AND LONGITUDINAL SECTIONS

PROJECT No.: 0077-033

DWG No.: 09

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# Appendix C

## AECOM Water Quality Supporting Information

- **Document 1: Water Quality Tables**
- **Document 2: Figures 01-19**
- **Document 3: Graphs of Metal Concentrations**

# Document 1: Water Quality Tables

2015 Anderson Tailings Impoundment Area
June Water Quality Summary

**Table 01. Anderson TIA, Anderson Creek and Anderson Bay Water Analytical Results**

| Parameter | Units | RDL | CCME WQG [a] | 5X CCME WQG | MMER [b] | AND-01 | | | | | | | | | | | AND-02 | | | | | | | | | | | AND-03 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date** | | | | | | 7-Mar-12 | 15-Jun-12 | 18-Jun-13 | 5-Oct-13 | 17-Jun-14 | 30-Sep-14 | 9-Dec-14 | 4-Mar-15 | 4-Mar-15 | 17-Jun-15 | 22-Sep-15 | 7-Mar-12 | 15-Jun-12 | 18-Jun-13 | 5-Oct-13 | 17-Jun-14 | 30-Sep-14 | 9-Dec-14 | 4-Mar-15 | 17-Jun-15 | 22-Sep-15 | 7-Mar-12 | 15-Jun-12 | 18-Jun-13 | 5-Oct-13 | 17-Jun-14 | 30-Sep-14 | 30-Sep-14 | 9-Dec-14 | 4-Mar-15 | 17-Jun-15 | 22-Sep-15 |
| **Conventional Parameters** | | | | | | | | | | | | | | Dup-01 (AND-01) | | | | | | | | | | | | | | | | | | DUP-01 (AND 03) | | | | |
| Colour, True | CU | 5 | - | | | 37.4 | - | 13.5 | 20.8 | 34.1 | 10.5 | 14.9 | 10.3 | 12.3 | 12.5 | 28.2 | 41.9 | | 14 | 24.4 | 32.7 | 10.5 | 13.9 | 11.4 | 15.1 | 29.6 | 15.7 | | 11.9 | 18.6 | 33.5 | 9.9 | 9.4 | 12.6 | 9.7 | 16.2 | 29.5 |
| Conductivity | umhos/cm | 20 | - | | | 549 | 486 | 615 | 625 | 550 | 658 | 816 | 793 | 801 | 716 | 756 | 544 | 485 | 616 | 622 | 553 | 658 | 809 | 870 | 693 | 742 | 607 | 494 | 624 | 647 | 548 | 659 | 675 | 832 | 893 | 725 | 755 |
| pH | pH units | 0.1 | 6.5 - 9.0 | | | 7.86 | 7.91 | 6.67 | 7.54 | 7.64 | 7.62 | 7.45 | 7.25 | 7.26 | 7.29 | 7.54 | 7.84 | 7.87 | 7.5 | 7.54 | 7.68 | 7.62 | 7.44 | 7.25 | 7.26 | 7.54 | 7.85 | 7.94 | 7.55 | 7.57 | 7.7 | 7.65 | 7.65 | 7.44 | 7.28 | 7.29 | 7.54 |
| Total Suspended Solids | mg/L | 5 | - | | 30.00 | <5.0 | <5.0 | 9 | <5.0 | 6 | <5.0 | 11 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | 5 | <5.0 | <5.0 | <5.0 | <5.0 | 6 | 5 | <5.0 | <5.0 | <5.0 | <5.0 | 13 | <5.0 | <5.0 |
| Total Dissolved Solids | mg/L | 5 | - | | | 388 | 350 | 479 | 446 | 389 | 464 | 604 | 638 | 810 | 593 | 595 | 406 | 346 | 464 | 447 | 386 | 464 | 607 | 750 | 580 | 576 | 438 | 352 | 490 | 467 | 387 | 468 | 485 | 605 | 999 | 580 | 589 |
| Turbidity | NTU | 0.1 | - | | | 4.66 | 2.45 | 5.52 | 3.02 | 3.2 | 3.79 | 7.88 | 1.21 | 1.37 | 2.6 | 2.3 | 6.72 | 2.42 | 5.2 | 2.61 | 3.2 | 3.79 | 2.82 | 2.75 | 2.5 | 1.56 | 1.11 | 2.53 | 4.92 | 3.01 | 3 | 3.97 | 3.54 | 2.11 | 1.3 | 2.6 | 1.58 |
| Hardness (as CaCO3) | mg/L | 0.3 | - | | | 249 | 229 | | | 262 | | | | | 387 | 357 | 248 | 238 | | | 262 | | | | | 388 | 382 | 271 | 244 | | | 266 | | | | 390 | 368 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Anions and Nutrients** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Acidity (as CaCO3) | mg/L | 2 | - | | | 11.6 | - | 1.8 | 2.4 | 6 | 1.9 | 7.8 | 12.2 | 8.3 | 2.7 | 4 | 8.6 | | 1.8 | 2.3 | 3.9 | 2 | 7.1 | 15.1 | 2.6 | 5.2 | 6.6 | | 1.7 | 2.2 | 4.6 | 1.7 | 3.4 | 5.6 | 11.2 | 2.7 | 3.4 |
| Alkalinity, Total (as CaCO3) | mg/L | 20 | - | | | 104 | 47 | 29 | 35 | 34 | 40 | 57 | 57 | 58 | 29.1 | 27.3 | 101 | 47 | 34 | 35 | 33 | 40 | 57 | 65 | 30 | 27.9 | 64 | 47 | 33 | 34 | 34 | 38 | 39 | 48 | 65 | 29.4 | 28.1 |
| Bicarbonate (HCO3) | mg/L | 24 | - | | | 127 | 58 | 35 | 42 | 41 | 48 | 70 | 69 | 71 | 35.5 | 33.3 | 123 | 58 | 41 | 42 | 40 | 48 | 69 | 79 | 36.6 | 34 | 78 | 57 | 41 | 41 | 41 | 46 | 47 | 58 | 80 | 35.9 | 34.3 |
| Carbonate (CO3) | mg/L | 12 | - | | | <12 | <12 | <12 | <12 | <12 | <12 | <12 | <12 | <12 | <0.60 | <0.60 | <12 | <12 | <12 | <12 | <12 | <12 | <12 | <12 | <0.60 | <0.60 | <12 | <12 | <12 | <12 | <12 | <12 | <12 | <12 | <12 | <0.60 | <0.60 |
| Chloride | mg/L | 0.2 | 120 - 640 | | | 59.4 | 14.9 | 15 | 15.2 | 10.8 | 12.8 | 15.7 | 16.7 | 16.8 | 13.3 | 12.6 | 16 | 15.1 | 15.2 | 15.1 | 11 | 12.7 | 15.7 | 18.5 | 12.8 | 12.5 | 19.9 | 15.3 | 15.2 | 15.9 | 10.6 | 13 | 13 | 16.5 | 19.3 | 13.5 | 12.7 |
| Fluoride | mg/L | 0.02 | | | | 0.103 | 0.222 | 0.247 | 0.262 | 0.17 | 0.26 | 0.284 | 0.285 | 0.289 | 0.251 | 0.266 | 0.21 | 0.218 | 0.25 | 0.26 | 0.17 | 0.26 | 0.289 | 0.322 | 0.243 | 0.264 | 0.271 | 0.224 | 0.251 | 0.271 | 0.17 | 0.27 | 0.27 | 0.307 | 0.346 | 0.25 | 0.257 |
| Hydroxide (OH) | mg/L | 6.8 | - | | | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <0.34 | <0.34 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <0.34 | <0.34 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <0.34 | <0.34 |
| Silica, Reactive (as SiO2) | mg/L | 0.25 | - | | | 4.69 | - | - | - | - | - | - | - | - | - | - | 5.51 | - | - | - | - | - | - | - | - | - | 2.47 | - | - | - | - | - | - | - | - | - | - |
| Sulfate | mg/L | 0.5 | - | | | 74.2 | 165 | 255 | 258 | 0.0211 | 0.026 | 0.0336 | 0.0353 | 0.0355 | 348 | 344 | 158 | 165 | 256 | 256 | 0.0212 | 0.0262 | 0.0337 | 0.0392 | 335 | 339 | 218 | 170 | 259 | 270 | 0.0211 | 0.0269 | 0.0268 | 0.0357 | 0.0406 | 352 | 345 |
| Ammonia, Total (as N) | mg/L | 0.01 | 2.33 - 7.32 | | | 0.468 | 0.119 | 0.98 [c] | 0.204 | 0.241 | <0.010 | 0.307 | 0.358 | 0.347 | 0.64 [c] | 0.17 | 0.494 | 0.119 | 0.82 [c] | 0.185 | 0.237 | <0.010 | 0.257 | 0.423 | 0.65 [c] | 0.173 | 0.407 | 0.12 | 0.81 [c] | 0.196 | 0.224 | 0.018 | 0.015 | 0.208 | 0.343 | 0.78 [c] | 0.156 |
| Nitrate-N | mg/L | 0.005 | 13 | | | 0.0067 | 0.29 | 0.566 | 0.33 | 0.303 | 0.116 | 0.228 | 0.253 | 0.253 | 0.381 | 0.394 | 0.0475 | 0.329 | 0.559 | 0.324 | 0.303 | 0.115 | 0.253 | 0.253 | 0.362 | 0.383 | 0.308 | 0.3 | 0.576 | 0.349 | 0.3 | 0.143 | 0.142 | 0.32 | 0.245 | 0.378 | 0.39 |
| Nitrate and Nitrite as N | mg/L | 0.0051 | - | | | 0.0098 | 0.287 | 0.591 | 0.331 | 0.303 | 0.116 | 0.228 | 0.253 | 0.253 | 0.447 | 0.394 | 0.0496 | 0.326 | 0.577 | 0.324 | 0.303 | 0.115 | 0.253 | 0.253 | 0.425 | 0.383 | 0.313 | 0.297 | 0.594 | 0.35 | 0.3 | 0.143 | 0.142 | 0.32 | 0.245 | 0.447 | 0.39 |
| Nitrite-N | mg/L | 0.001 | 0.06 | | | 0.0031 | 0.0028 | 0.0251 | 0.0012 | <0.050 | <0.050 | <0.010 | <0.010 | <0.010 | 0.066 | <0.010 | 0.0021 | 0.0027 | 0.0184 | <0.0010 | <0.050 | <0.050 | <0.010 | <0.010 | 0.063 | <0.010 | 0.0056 | 0.0028 | 0.0181 | 0.0011 | <0.050 | <0.050 | <0.050 | <0.010 | <0.010 | 0.069 | <0.010 |
| Phosphorus (P)-Total | mg/L | 0.01 | - | | | 0.059 | 0.015 | 0.018 | 0.065 | 0.03 | 0.03 | 0.048 | 0.036 | 0.033 | 0.049 | 0.034 | 0.013 | 0.011 | 0.016 | 0.026 | 0.028 | 0.032 | 0.043 | 0.042 | 0.047 | 0.034 | <0.010 | 0.012 | 0.017 | 0.024 | 0.03 | 0.032 | 0.033 | 0.041 | 0.054 | 0.049 | 0.037 |
| Thiosulphate (S203) [e] | mg/L | 2.5 | | | | | | | 3.4 | <2.5 | | 3.5 | <2.5 | | 3.5 | | | | | 3.4 | <2.5 | | 3.5 | <2.5 | 3.5 | | | | | 3.4 | <2.5 | | | 3.5 | <2.5 | 3.5 | |
| **Dissolved Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aluminum | mg/L | 0.002 | 0.1 | 0.5 | | 0.0141 | 0.067 | 0.0144 | 0.015 | 0.0107 | 0.0067 | 0.0049 | <0.0020 | <0.0020 | 0.0061 | 0.0117 | 0.0162 | 0.08 | 0.0121 | 0.0155 | 0.0096 | 0.0068 | 0.0049 | <0.0020 | 0.0059 | 0.0147 | 0.0162 | 0.078 | 0.0152 | 0.0146 | 0.0094 | 0.0052 | 0.0052 | 0.0041 | 0.0037 | 0.0055 | 0.0121 |
| Antimony | mg/L | 0.0002 | | | | 0.00892 | 0.0171 | 0.00717 | 0.00553 | 0.00343 | 0.00615 | 0.00675 | 0.00598 | 0.00558 | 0.00528 | 0.00397 | 0.00679 | 0.0165 | 0.0057 | 0.00576 | 0.0034 | 0.00636 | 0.00672 | 0.00618 | 0.00515 | 0.00414 | 0.018 | 0.0174 | 0.00736 | 0.00583 | 0.00329 | 0.00573 | 0.00586 | 0.0068 | 0.00669 | 0.00533 | 0.00392 |
| Arsenic | mg/L | 0.0002 | 0.005 | 0.025 | | 0.00358 | 0.004 | 0.00259 | 0.00181 | 0.00187 | 0.00342 | 0.00253 | 0.00118 | 0.0012 | 0.00215 | 0.00212 | 0.00329 | 0.004 | 0.00242 | 0.00193 | 0.00198 | 0.00332 | 0.002 | 0.00115 | 0.00206 | 0.00228 | 0.00375 | 0.0039 | 0.0025 | 0.00185 | 0.00188 | 0.00287 | 0.00253 | 0.00202 | 0.00141 | 0.00197 | 0.00202 |
| Barium | mg/L | 0.0002 | | | | 0.0261 | 0.0188 | 0.0215 | 0.0243 | 0.0192 | 0.0279 | 0.0364 | 0.0371 | 0.0379 | 0.0251 | 0.0258 | 0.0254 | 0.02 | 0.0265 | 0.0247 | 0.0204 | 0.0287 | 0.0373 | 0.0426 | 0.0232 | 0.0227 | 0.0211 | 0.02 | 0.0226 | 0.0248 | 0.0206 | 0.0292 | 0.0282 | 0.0287 | 0.0388 | 0.0454 | 0.0235 | 0.025 |
| Beryllium | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Bismuth | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Boron | mg/L | 0.01 | 1.5 | 7.5 | | 0.026 | <0.10 | 0.027 | 0.023 | 0.026 | 0.039 | 0.028 | 0.021 | 0.02 | 0.012 | 0.016 | 0.025 | <0.10 | 0.039 | 0.024 | 0.016 | 0.037 | 0.026 | 0.022 | 0.014 | 0.017 | 0.027 | <0.10 | 0.023 | 0.025 | 0.016 | 0.035 | 0.03 | 0.028 | 0.023 | 0.013 | 0.016 |
| Cadmium | mg/L | 0.00001 | 0.00009 | 0.00045 | | 0.000019 | 0.00035 | 0.000621 | 0.00064 | 0.000654 | 0.000275 | 0.000832 | 0.000898 | 0.000901 | 0.000554 | 0.000448 | 0.000014 | 0.00031 | 0.000495 | 0.00063 | 0.000688 | 0.000152 | 0.000218 | 0.000087 | 0.000475 | 0.000483 | 0.000486 | 0.00031 | 0.000658 | 0.000669 | 0.000638 | 0.000523 | 0.000511 | 0.00113 | 0.00142 | 0.000524 | 0.000456 |
| Calcium | mg/L | 0.05 | | | | 81.3 | 73.5 | 116 | 94.7 | 89.8 | 108 | 147 | 128 | 125 | 134 | 138 | 81.7 | 79.1 | 105 | 97.8 | 82.2 | 103 | 155 | 140 | 132 | 140 | 92 | 79.8 | 106 | 101 | 83.3 | 110 | 107 | 152 | 129 | 133 | 145 |
| Cesium | mg/L | 0.0001 | | | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | 0.00011 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Chromium | mg/L | 0.002 | | | | <0.0020 | <0.020 | <0.0020 | <0.0020 | <0.0020 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0020 | <0.020 | <0.0020 | <0.0020 | <0.0020 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0020 | <0.020 | <0.0020 | <0.0020 | <0.0020 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Cobalt | mg/L | 0.0002 | | | | 0.00237 | <0.0020 | 0.00061 | 0.00025 | 0.00038 | <0.00020 | 0.00091 | 0.00037 | 0.00038 | <0.00020 | <0.00020 | 0.00282 | <0.0020 | 0.001 | 0.00026 | 0.00033 | <0.00020 | 0.00051 | 0.0007 | <0.00020 | 0.00021 | 0.00082 | <0.0020 | 0.00065 | 0.00026 | 0.00031 | <0.00020 | <0.00020 | 0.00027 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Copper | mg/L | 0.0002 | 0.004 | 0.02 | | 0.00191 | 0.0118 | 0.0219 | 0.00957 | 0.0193 | 0.00575 | 0.00415 | 0.00718 | 0.00711 | 0.00811 | 0.00517 | 0.00124 | 0.0134 | 0.0184 | 0.00784 | 0.0226 | 0.0042 | 0.0026 | 0.0021 | 0.0074 | 0.0050 | 0.0126 | 0.0133 | 0.0227 | 0.0113 | 0.0219 | 0.0087 | 0.00794 | 0.00905 | 0.0124 | 0.00819 | 0.00581 |
| Iron | mg/L | 0.1 | 0.3 | 1.5 | | 0.82 | <1.0 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | 1.37 | <1.0 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <1.0 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Lead | mg/L | 0.00009 | 0.007 | 0.035 | | 0.000166 | 0.00217 | 0.00113 | 0.00169 | 0.0008 | 0.00208 | 0.00157 | <0.000090 | <0.000090 | <0.000090 | 0.000549 | <0.000090 | 0.00258 | 0.000933 | 0.000885 | 0.000811 | 0.000944 | 0.000501 | <0.000090 | <0.000090 | 0.000565 | 0.000705 | 0.00221 | 0.00104 | 0.000859 | 0.000753 | 0.0021 | 0.00075 | 0.000654 | 0.000266 | <0.000090 | 0.000469 |
| Lithium | mg/L | 0.002 | | | | 0.0035 | <0.020 | 0.0063 | 0.0056 | 0.0051 | 0.0059 | 0.0063 | 0.0054 | 0.0051 | 0.0047 | 0.0053 | 0.003 | <0.020 | 0.0074 | 0.0057 | 0.0044 | 0.0056 | 0.0067 | 0.0054 | 0.0041 | 0.0055 | 0.0045 | <0.020 | 0.0059 | 0.0057 | 0.0041 | 0.0058 | 0.0058 | 0.0069 | 0.0058 | 0.0037 | 0.0052 |
| Magnesium | mg/L | 0.01 | | | | 11.1 | 7.78 | 8.72 | 8.54 | 7.51 | 9.25 | 11.3 | 10.4 | 10.3 | 8.43 | 7.12 | 10.7 | 8.52 | 7.84 | 8.63 | 7.5 | 9.3 | 11.9 | 12 | 8.06 | 7.88 | 10.1 | 8.36 | 9.03 | 8.77 | 7.47 | 9.28 | 9.04 | 11.2 | 11.9 | 8.1 | 6.98 |
| Manganese | mg/L | 0.0001 | | | | 2.41 | 0.0153 | 0.125 | 0.0238 | 0.0986 | 0.021 | 0.211 | 0.201 | 0.2 | 0.0483 | 0.0336 | 2.25 | 0.0218 | 0.126 | 0.0243 | 0.103 | 0.023 | 0.145 | 0.268 | 0.0456 | 0.037 | 0.28 | 0.0194 | 0.127 | 0.0247 | 0.093 | 0.0157 | 0.0158 | 0.0411 | 0.156 | 0.0449 | 0.0312 |
| Molybdenum | mg/L | 0.0001 | 0.073 | 0.365 | | 0.00074 | 0.0012 | 0.00668 | 0.00338 | 0.00246 | 0.00272 | 0.00247 | 0.00222 | 0.00221 | 0.00421 | 0.00353 | 0.00071 | 0.0012 | 0.007 | 0.00337 | 0.00252 | 0.00265 | 0.00262 | 0.00241 | 0.00411 | 0.00356 | 0.00108 | 0.0013 | 0.00687 | 0.00354 | 0.00247 | 0.00269 | 0.00277 | 0.00288 | 0.00207 | 0.00438 | 0.0035 |
| Nickel | mg/L | 0.001 | 0.15 | 0.75 | | <0.0010 | <0.010 | 0.0019 | 0.0011 | 0.0013 | 0.0012 | 0.0018 | 0.0016 | 0.0014 | 0.0015 | <0.0010 | <0.0010 | <0.010 | 0.0017 | 0.001 | 0.0014 | 0.0013 | 0.0018 | 0.002 | 0.0013 | <0.0010 | 0.0011 | <0.010 | 0.002 | 0.001 | 0.0015 | 0.0012 | 0.0013 | 0.0018 | 0.002 | 0.0014 | <0.0010 |
| Phosphorus | mg/L | 0.1 | | | | <0.10 | <0.30 | <0.030 | <0.030 | <0.030 | <0.030 | 0.035 | 0.036 | <0.030 | 0.055 | <0.030 | <0.10 | <0.30 | <0.030 | <0.030 | <0.030 | 0.032 | 0.033 | <0.030 | 0.049 | 0.049 | <0.10 | <0.30 | <0.030 | <0.030 | <0.030 | 0.032 | <0.030 | 0.039 | 0.03 | 0.049 | <0.030 |
| Potassium | mg/L | 0.02 | | | | 0.714 | 5.57 | 6.95 | 5.79 | 5.24 | 6.48 | 7.86 | 7.91 | 7.7 | 8.16 | 6.87 | 0.463 | 5.91 | 7.03 | 5.88 | 5.17 | 6.15 | 7.75 | 8.54 | 7.61 | 7.31 | 1.96 | 6.06 | 6.98 | 6.04 | 4.98 | 6.29 | 6.23 | 8.21 | 8.76 | 8.09 | 6.81 |
| Rubidium | mg/L | 0.0002 | | | | 0.00378 | 0.0039 | 0.00478 | 0.00494 | 0.00377 | 0.00468 | 0.00568 | 0.0056 | 0.00545 | 0.00543 | 0.00488 | 0.00371 | 0.0041 | 0.00434 | 0.00492 | 0.00403 | 0.00493 | 0.00576 | 0.00602 | 0.00501 | 0.00503 | 0.00494 | 0.0041 | 0.00494 | 0.00516 | 0.00379 | 0.00483 | 0.00494 | 0.00597 | 0.00658 | 0.00525 | 0.00472 |
| Selenium | mg/L | 0.001 | 0.001 | 0.005 | | 0.0017 | <0.010 | 0.0042 | 0.0021 | 0.0014 | 0.0016 | 0.0017 | 0.0014 | 0.0013 | 0.0025 | 0.0032 | 0.002 | <0.010 | 0.0038 | 0.0025 | 0.0017 | 0.0015 | 0.0018 | 0.0015 | 0.0025 | 0.0033 | 0.0011 | <0.010 | 0.0041 | 0.0027 | 0.0016 | 0.0016 | 0.0016 | 0.002 | 0.0015 | 0.0026 | 0.0032 |
| Silicon | mg/L | 0.05 | | | | 3.24 | 0.57 | 0.155 | 0.672 | 0.65 | 0.1 | 0.89 | 0.76 | 0.76 | 0.28 | 0.6 | 2.95 | 0.92 | 0.401 | 0.659 | 0.68 | 0.12 | 1.03 | 0.88 | 0.31 | 0.61 | 1.4 | <0.50 | 0.098 | 0.568 | 0.61 | <0.10 | <0.10 | 0.45 | 0.75 | 0.25 | 0.57 |
| Silver | mg/L | 0.0001 | 0.0001 | 0.0005 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Sodium | mg/L | 0.02 | | | | 17.2 | 8.9 | 12 | 9.69 | 8.1 | 10.2 | 11.5 | 12.5 | 11.7 | 11.3 | 9.8 | 9.29 | 9.82 | 9.96 | 9.59 | 8.23 | 9.82 | 11.4 | 13.2 | 10.7 | 10.4 | 11.7 | 9.76 | 12.2 | 9.96 | 8.03 | 10.1 | 9.98 | 11.8 | 14.1 | 10.7 | 9.83 |
| Strontium | mg/L | 0.0001 | | | | 0.163 | 0.168 | 0.191 | 0.182 | 0.166 | 0.175 | 0.231 | 0.259 | 0.235 | 0.218 | 0.209 | 0.165 | 0.18 | 0.252 | 0.184 | 0.146 | 0.172 | 0.235 | 0.274 | 0.2 | 0.211 | 0.193 | 0.184 | 0.195 | 0.19 | 0.156 | 0.188 | 0.188 | 0.252 | 0.263 | 0.215 | 0.216 |
| Tellurium | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Thallium | mg/L | 0.0001 | 0.0008 | 0.004 | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00015 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | 0.0001 | 0.00011 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | 0.0001 | <0.00010 | 0.00012 | 0.00011 | 0.00012 | 0.00012 | <0.00010 | <0.00010 |
| Thorium | mg/L | 0.0001 | | | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Tin | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | 0.00041 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | 0.00041 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Titanium | mg/L | 0.0002 | | | | 0.00087 | 0.0031 | 0.00575 | 0.00469 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | 0.0008 | 0.0041 | 0.00524 | 0.00473 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | 0.0009 | 0.0034 | 0.00582 | 0.00487 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| Tungsten | mg/L | 0.0002 | | | | 0.00024 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00036 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00039 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Uranium | mg/L | 0.0001 | 0.015 | 0.075 | | 0.00011 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | 0.00011 | 0.00014 | 0.00014 | 0.00014 | <0.00010 | <0.00010 | 0.00012 | <0.0010 | 0.00023 | <0.00010 | <0.00010 | 0.00011 | 0.00011 | 0.00016 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | 0.00011 | 0.00011 | 0.00011 | 0.00022 | <0.00010 | <0.00010 |
| Vanadium | mg/L | 0.0002 | | | | 0.00048 | <0.0020 | 0.00021 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | 0.00029 | <0.0020 | 0.00026 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Zinc | mg/L | 0.002 | 0.03 | 0.15 | | 0.0885 | 0.112 | 0.265 | 0.3 | 0.327 | 0.27 | 0.633 | 0.593 | 0.581 | 0.272 | 0.255 | 0.0164 | 0.122 | 0.21 | 0.311 | 0.357 | 0.259 | 0.648 | 0.592 | 0.252 | 0.275 | 0.226 | 0.124 | 0.264 | 0.314 | 0.335 | 0.283 | 0.281 | 0.656 | 0.786 | 0.256 | 0.244 |
| Zirconium | mg/L | 0.0004 | | | | <0.00040 | <0.0040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.0040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.0040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 |

*RDL = reportable detection limit; TDS = total dissolved solids; TSS = total suspended solids; µmhos/cm = micromhos per centimetre; mg/L = milligrams per litre; TCU = true color unit; NTU = Nephelometric Turbidity Units; µg/L = micrograms per litre.*

Notes:

[a] *Canadian Council of Ministers of Environment (CCME) Water Quality Guidelines (2011) for the Protection of Freshwater Aquatic Life.*

[b] *Metal Mining Effluent Regulation (MMER) SOR/2002-222 Maximum authorized concentration in a grab sample*

[c] Detection limit adjusted for required dilution - ALS Lab Note

[d] AND-04, AND-05, AND-07 and AND-08 were not accessible in September 2014 due to low water levels and higher tailings

[e] Analysis conducted at Hudbay Laboratories

[1] Cadmium and Copper standards represented are based on average hardness within the Anderson TIA

[2] Aluminum standard presented is based on average hardness within the Anderson TIA pH >6.5

[3] The long-term exposure CWQG for the protection of freshwater life is 15 µg·L-1 for uranium

Exceeds CCME WQG Guideline
Exceeds 5 X CCME Guideline
Exceeds MMER Guideline

**Table 01. Anderson TIA, Anderson Creek and Anderson Bay Water Analytical Results**

| Parameter | Units | RDL | CCME WQG [a] | 5X CCME WQG | MMER [b] | AND-04 | | | | | AND-05 | | | | | AND-06 | | | | | | | | | | AND-07 | | | | | AND-08 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | | | | | | 7-Mar-12 | 15-Jun-12 | 18-Jun-13 | 5-Oct-13 | 17-Jun-14 | 7-Mar-12 | 15-Jun-12 | 18-Jun-13 | 5-Oct-13 | 17-Jun-14 | 7-Mar-12 | 15-Jun-12 | 18-Jun-13 | 5-Oct-13 | 17-Jun-14 | 30-Sep-14 | 9-Dec-14 | 4-Mar-15 | 17-Jun-15 | 22-Sep-15 | 7-Mar-12 | 15-Jun-12 | 18-Jun-13 | 5-Oct-13 | 17-Jun-14 | 7-Mar-12 | 15-Jun-12 | 18-Jun-13 | 5-Oct-13 | 17-Jun-14 |
| **Conventional Parameters** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Colour, True | CU | 5 | - | | | <5.0 | | 6.5 | 17.9 | 33.6 | <5.0 | | 9.5 | 18.2 | 35.4 | 5.1 | | 8 | 17.4 | 28 | 10.2 | 8.9 | 11 | 15.3 | 26.3 | 5 | | 8.6 | 15.2 | 31.2 | 5.9 | | 8.2 | 7.2 | 30.8 |
| Conductivity | umhos/cm | 20 | - | | | 634 | 502 | 643 | 645 | 555 | 634 | 504 | 640 | 644 | 552 | 621 | 504 | 638 | 650 | 583 | 694 | 886 | 849 | 728 | 824 | 627 | 525 | 644 | 669 | 560 | 635 | 559 | 641 | 714 | 572 |
| pH | pH units | 0.1 | 6.5 - 9.0 | | | 8.02 | 7.93 | 7.53 | 7.58 | 7.72 | 8.03 | 7.95 | 6.54 | 7.6 | 7.73 | 7.95 | 7.96 | 7.53 | 7.58 | 7.54 | 7.65 | 7.41 | 7.07 | 7.3 | 7.42 | 7.97 | 8 | 7.59 | 7.59 | 7.56 | 7.99 | 8.17 | 7.58 | 7.56 | 7.51 |
| Total Suspended Solids | mg/L | 5 | - | | 30.00 | 17 | 5 | 8 | 8 | <5.0 | 8 | 6 | 6 | 9 | 5 | <5.0 | 15 | 10 | 9 | 6 | 5 | 9 | <5.0 | <5.0 | <5.0 | <5.0 | 5 | 8 | 9 | <5.0 | <5.0 | 9 | 8 | 8 | 6 |
| Total Dissolved Solids | mg/L | 5 | - | | | 450 | 356 | 510 | 466 | 400 | 466 | 356 | 509 | 469 | 397 | 436 | 350 | 504 | 456 | 413 | 492 | 691 | 648 | 587 | 630 | 448 | 374 | 512 | 470 | 380 | 488 | 392 | 514 | 492 | 397 |
| Turbidity | NTU | 0.1 | - | | | 25.4 | 2.34 | 5.4 | 2.68 | 3.1 | 22.5 | 3.16 | 5.18 | 2.86 | 3.2 | 8.71 | 2.87 | 5.98 | 3.67 | 4 | 4.4 | 7.07 | 1.63 | 2.7 | 1.48 | 4.91 | 4.6 | 5.76 | 4.96 | 3.1 | 3.37 | 8.81 | 5.38 | 4.48 | 4 |
| Hardness (as CaCO3) | mg/L | 0.3 | - | | | 284 | 247 | | | 233 | 295 | 250 | | | 261 | 287 | 229 | | | 268 | | | | 380 | 383 | 291 | 253 | | | 248 | 296 | 265 | | | 246 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Anions and Nutrients** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Acidity (as CaCO3) | mg/L | 2 | - | | | 3.4 | | 1.5 | 2.1 | 4.6 | 3.8 | | 1.6 | 2.1 | 5.1 | 3.6 | | 1.5 | 2.1 | 4.7 | 1.6 | 4.5 | 13 | 2.9 | 3.4 | 3.6 | | 1.6 | 2.1 | 5.6 | 3.8 | | 1.7 | 2.6 | 4.5 |
| Alkalinity, Total (as CaCO3) | mg/L | 20 | - | | | 54 | 46 | 34 | 34 | 33 | 54 | 47 | 27 | 34 | 33 | 55 | 47 | 36 | 34 | 33 | 36 | 42 | 51 | 29.2 | 25.1 | 54 | 47 | 32 | 33 | 34 | 58 | 47 | 31 | 33 | 35 |
| Bicarbonate (HCO3) | mg/L | 24 | - | | | 66 | 57 | 42 | 42 | 41 | 66 | 57 | 33 | 41 | 40 | 68 | 57 | 44 | 41 | 40 | 44 | 51 | 62 | 35.6 | 30.6 | 66 | 57 | 39 | 40 | 42 | 71 | 58 | 38 | 40 | 43 |
| Carbonate (CO3) | mg/L | 12 | - | | | <12 | <12 | <12 | <12 | <12 | <12 | <12 | <12 | <12 | <12 | <12 | <12 | <12 | <12 | <12 | <12 | <12 | <12 | <0.60 | <0.60 | <12 | <12 | <12 | <12 | <12 | <12 | <12 | <12 | <12 | <12 |
| Chloride | mg/L | 0.2 | 120 - 640 | | | 22.4 | 15.7 | 16 | 15.8 | 10.9 | 22.6 | 15.7 | 16.1 | 15.8 | 10.8 | 21.5 | 15.8 | 16.9 | 16 | 11.4 | 13.1 | 17.4 | 17.8 | 13.3 | 14.1 | 21.9 | 17 | 16.1 | 16.5 | 10.9 | 22.3 | 18.4 | 16.2 | 17.8 | 11.2 |
| Fluoride | mg/L | 0.02 | | | | 0.284 | 0.229 | 0.263 | 0.271 | 0.18 | 0.297 | 0.228 | 0.279 | 0.271 | 0.18 | 0.277 | 0.228 | 0.292 | 0.274 | 0.19 | 0.25 | 0.325 | 0.315 | 0.242 | 0.276 | 0.29 | 0.239 | 0.294 | 0.281 | 0.18 | 0.292 | 0.245 | 0.3 | 0.297 | 0.18 |
| Hydroxide (OH) | mg/L | 6.8 | - | | | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 |
| Silica, Reactive (as SiO2) | mg/L | 0.25 | - | | | 1.43 | | | | | 1.4 | | | | | 1.47 | | | | | | | | | | 0.969 | | | | | 1.07 | | | | |
| Sulfate | mg/L | 0.5 | - | | | 233 | 174 | 269 | 269 | 0.0214 | 235 | 174 | 260 | 268 | 0.0213 | 227 | 175 | 254 | 272 | 0.0228 | 0.0279 | 0.0393 | 0.0389 | 349 | 386 | 231 | 188 | 261 | 282 | 0.0216 | 233 | 203 | 259 | 307 | 0.0222 |
| Ammonia, Total (as N) | mg/L | 0.01 | 2.33 - 7.32 | | | 1.24 | 0.121 | 1.05 [c] | 0.179 | 0.233 [c] | 1.34 | 0.122 | 0.70 [c] | 0.177 | 0.225 | 0.98 | 0.121 | 0.61 [c] | 0.191 | 0.298 | 0.066 | 0.316 | 0.377 | 0.65 [c] | 0.279 | 1.09 | 0.191 | 0.70 [c] | 0.233 | 0.241 | 0.87 | 0.343 | 0.67 [c] | 0.352 | 0.249 |
| Nitrate-N | mg/L | 0.005 | 13 | | | 1.1 | 0.312 | 0.58 | 0.339 | 0.306 | 1.15 | 0.311 | 0.651 | 0.339 | 0.3 | 0.898 | 0.304 | 0.55 | 0.343 | 0.337 | 0.205 | 0.41 | 0.274 | 0.383 | 0.51 | 0.897 | 0.378 | 0.653 | 0.364 | 0.311 | 0.794 | 0.487 | 0.629 | 0.427 | 0.327 |
| Nitrate and Nitrite as N | mg/L | 0.0051 | - | | | 1.16 | 0.309 | 0.599 | 0.34 | 0.306 | 1.2 | 0.308 | 0.674 | 0.34 | 0.3 | 0.941 | 0.301 | 0.572 | 0.345 | 0.337 | 0.205 | 0.41 | 0.274 | 0.451 | 0.51 | 0.941 | 0.373 | 0.676 | 0.366 | 0.311 | 0.832 | 0.481 | 0.651 | 0.429 | 0.327 |
| Nitrite-N | mg/L | 0.001 | 0.06 | | | 0.0529 | 0.0035 | 0.0196 | 0.0011 | <0.050 | 0.054 | 0.0032 | 0.0233 | 0.0011 | <0.050 | 0.043 | 0.0032 | 0.0218 | 0.0017 | <0.050 | <0.050 | <0.010 | <0.010 | 0.067 | <0.010 | 0.0442 | 0.005 | 0.0234 | 0.0016 | <0.050 | 0.0383 | 0.0068 | 0.0225 | 0.0021 | <0.050 |
| Phosphorus (P)-Total | mg/L | 0.01 | - | | | <0.010 | 0.012 | 0.018 | 0.021 | 0.028 | 0.013 | 0.012 | 0.018 | 0.02 | 0.027 | <0.010 | 0.011 | 0.014 | 0.021 | 0.031 | 0.035 | 0.047 | 0.041 | 0.049 | 0.036 | <0.010 | 0.011 | 0.016 | 0.022 | 0.031 | 0.01 | 0.03 | 0.015 | 0.037 | 0.03 |
| Thiosulphate (S203) [e] | mg/L | 2.5 | | | | | | | 3.4 | <2.5 | | | | 3.4 | <2.5 | | | | 3.4 | <2.5 | | 3.5 | <2.5 | 3.5 | | | | | 3.4 | <2.5 | | | | 3.4 | <2.5 |
| **Dissolved Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aluminum | mg/L | 0.002 | 0.1 | 0.5 | | 0.0378 | 0.086 | 0.0137 | 0.0141 | 0.0095 | 0.043 | 0.09 | 0.0166 | 0.0141 | 0.0104 | 0.0219 | 0.088 | 0.0133 | 0.0146 | 0.0054 | 0.002 | 0.0029 | <0.0020 | 0.0058 | 0.014 | 0.0276 | 0.168 | 0.0147 | 0.0141 | 0.0093 | 0.0261 | 0.284 | 0.0159 | 0.0139 | 0.0102 |
| Antimony | mg/L | 0.0002 | | | | 0.0333 | 0.0174 | 0.00766 | 0.00581 | 0.00346 | 0.0332 | 0.0187 | 0.00734 | 0.00578 | 0.00343 | 0.0281 | 0.0174 | 0.008 | 0.00579 | 0.00595 | 0.0002 | 0.00636 | 0.00598 | 0.00502 | 0.00444 | 0.0281 | 0.0233 | 0.00741 | 0.00591 | 0.00355 | 0.026 | 0.0326 | 0.0076 | 0.00647 | 0.00326 |
| Arsenic | mg/L | 0.0002 | 0.005 | 0.025 | | 0.00447 | 0.0039 | 0.00255 | 0.00183 | 0.00168 | 0.00483 | 0.0035 | 0.00291 | 0.00184 | 0.00172 | 0.00499 | 0.0035 | 0.00248 | 0.00188 | 0.00273 | 0.0002 | 0.00208 | 0.00148 | 0.0018 | 0.002 | 0.00584 | 0.0042 | 0.00267 | 0.00175 | 0.00167 | 0.00642 | 0.0042 | 0.0026 | 0.00177 | 0.00176 |
| Barium | mg/L | 0.0002 | | | | 0.0163 | 0.0199 | 0.0228 | 0.025 | 0.0199 | 0.0163 | 0.0209 | 0.0233 | 0.025 | 0.0199 | 0.0182 | 0.0205 | 0.023 | 0.0252 | 0.0291 | 0.0002 | 0.0417 | 0.0403 | 0.0228 | 0.027 | 0.0177 | 0.0198 | 0.0234 | 0.0256 | 0.0198 | 0.0194 | 0.0179 | 0.0234 | 0.0262 | 0.0202 |
| Beryllium | mg/L | 0.0002 | | | | 0.0002 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | 0.0002 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | 0.00024 | <0.0020 | <0.00020 | <0.00020 | <0.00020 |
| Bismuth | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | 0.0002 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 |
| Boron | mg/L | 0.01 | 1.5 | 7.5 | | 0.03 | <0.10 | 0.023 | 0.024 | 0.023 | 0.027 | <0.10 | 0.022 | 0.024 | 0.024 | 0.029 | <0.10 | 0.022 | 0.025 | 0.032 | 0.01 | 0.028 | 0.023 | 0.022 | 0.017 | 0.027 | <0.10 | 0.021 | 0.025 | 0.022 | 0.03 | <0.10 | 0.021 | 0.026 | 0.02 |
| Cadmium | mg/L | 0.00001 | 0.00009 | 0.00045 | | 0.000161 | 0.00041 | 0.000648 | 0.000685 | 0.000724 | 0.000132 | 0.00038 | 0.000663 | 0.00069 | 0.000679 | 0.000228 | 0.00035 | 0.000503 | 0.000683 | 0.000562 | 0.00001 | 0.00129 | 0.00134 | 0.000532 | 0.000534 | 0.000173 | 0.00032 | 0.000677 | 0.000738 | 0.000723 | 0.000182 | 0.00034 | 0.000682 | 0.000796 | 0.000743 |
| Calcium | mg/L | 0.05 | | | | 101 | 77.2 | 114 | 103 | 89.8 | 105 | 79.3 | 113 | 104 | 88.6 | 101 | 79.2 | 107 | 105 | 117 | 0.05 | 173 | 141 | 150 | 152 | 103 | 83.6 | 114 | 108 | 89.9 | 103 | 89.2 | 109 | 116 | 81.4 |
| Cesium | mg/L | 0.0001 | | | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.0001 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Chromium | mg/L | 0.002 | | | | <0.0020 | <0.020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.020 | <0.0020 | <0.0020 | <0.0010 | 0.001 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0020 | <0.020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.020 | <0.0020 | <0.0020 | <0.0020 |
| Cobalt | mg/L | 0.0002 | | | | 0.0002 | <0.0020 | 0.00069 | 0.00028 | 0.00041 | <0.00020 | <0.0020 | 0.00067 | 0.00026 | 0.00038 | 0.00058 | <0.0020 | 0.00047 | 0.0003 | <0.00020 | 0.0002 | 0.00038 | 0.00038 | <0.00020 | 0.00029 | 0.00032 | <0.0020 | 0.0007 | 0.00036 | 0.00041 | 0.00036 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 |
| Copper | mg/L | 0.0002 | 0.004 | 0.02 | | 0.0149 | 0.0138 | 0.0208 | 0.0113 | 0.0208 | 0.0195 | 0.0137 | 0.0234 | 0.0111 | 0.0209 | 0.013 | 0.0138 | 0.0176 | 0.0117 | 0.00922 | 0.0002 | 0.0133 | 0.0137 | 0.00791 | 0.00803 | 0.0106 | 0.0167 | 0.0224 | 0.014 | 0.0197 | 0.00683 | 0.018 | 0.0212 | 0.0175 | 0.0211 |
| Iron | mg/L | 0.1 | 0.3 | 1.5 | | <0.10 | <1.0 | <0.10 | <0.10 | <0.10 | <0.10 | <1.0 | <0.10 | <0.10 | <0.10 | <0.10 | <1.0 | <0.10 | <0.10 | <0.10 | 0.1 | <0.10 | <0.10 | <0.10 | <0.10 | <1.0 | <0.10 | <0.10 | <0.10 | <0.10 | <1.0 | <0.10 | <0.10 | <0.10 | <0.10 |
| Lead | mg/L | 0.00009 | 0.007 | 0.035 | | 0.00209 | 0.00295 | 0.00103 | 0.000819 | 0.000642 | 0.00165 | 0.00279 | 0.00281 | 0.000787 | 0.000647 | 0.00189 | 0.00434 | 0.00083 | 0.000853 | 0.00233 | 0.00009 | 0.00114 | 0.000193 | <0.000090 | 0.000627 | 0.00144 | 0.00668 | 0.00108 | 0.000962 | 0.000448 | 0.00111 | 0.00849 | 0.000955 | 0.00192 | 0.000733 |
| Lithium | mg/L | 0.002 | | | | 0.0038 | <0.020 | 0.0064 | 0.006 | 0.0051 | 0.0024 | <0.020 | 0.006 | 0.0059 | 0.005 | 0.0033 | <0.020 | 0.0059 | 0.0059 | 0.0058 | 0.002 | 0.0073 | 0.0066 | 0.006 | 0.0056 | 0.0026 | <0.020 | 0.0058 | 0.0061 | 0.005 | 0.0031 | <0.020 | 0.006 | 0.0065 | 0.0046 |
| Magnesium | mg/L | 0.01 | | | | 7.85 | 8.42 | 9.53 | 8.89 | 7.37 | 7.78 | 8.28 | 9.05 | 8.86 | 7.26 | 8.68 | 8.4 | 9.5 | 8.91 | 9.22 | 0.01 | 11.3 | 11.2 | 8.35 | 7.46 | 8.47 | 8.57 | 9.52 | 9.04 | 7.49 | 9.09 | 8.46 | 9.54 | 9.62 | 7.76 |
| Manganese | mg/L | 0.0001 | | | | 0.0847 | 0.0248 | 0.136 | 0.0262 | 0.103 | 0.0776 | 0.0257 | 0.138 | 0.0249 | 0.0987 | 0.147 | 0.0229 | 0.108 | 0.0281 | 0.0232 | 0.0001 | 0.0717 | 0.214 | 0.0456 | 0.0515 | 0.0974 | 0.0374 | 0.142 | 0.0323 | 0.104 | 0.107 | 0.0487 | 0.138 | 0.0427 | 0.114 |
| Molybdenum | mg/L | 0.0001 | 0.073 | 0.365 | | 0.00138 | 0.0013 | 0.00689 | 0.00353 | 0.00251 | 0.00137 | 0.0011 | 0.00705 | 0.00348 | 0.00245 | 0.00128 | 0.001 | 0.00612 | 0.00364 | 0.00292 | 0.0001 | 0.00311 | 0.00216 | 0.00434 | 0.00398 | 0.00129 | 0.0013 | 0.00707 | 0.00366 | 0.0025 | 0.00129 | 0.0014 | 0.00693 | 0.00424 | 0.00235 |
| Nickel | mg/L | 0.001 | 0.15 | 0.75 | | <0.0010 | <0.010 | 0.0018 | 0.0011 | 0.0014 | <0.0010 | <0.010 | 0.0023 | 0.0012 | 0.0013 | <0.0010 | <0.010 | 0.0017 | 0.0011 | 0.0013 | 0.001 | 0.0019 | 0.0019 | 0.0014 | <0.0010 | <0.0010 | <0.010 | 0.0022 | 0.0013 | 0.0014 | 0.001 | <0.010 | 0.0019 | 0.0013 | 0.0014 |
| Phosphorus | mg/L | 0.1 | | | | <0.10 | <0.30 | <0.030 | <0.030 | <0.030 | <0.10 | <0.30 | <0.030 | <0.030 | <0.030 | <0.10 | <0.30 | <0.030 | <0.030 | 0.035 | 0.03 | 0.045 | 0.035 | 0.048 | <0.030 | <0.10 | <0.30 | <0.030 | <0.030 | <0.030 | <0.10 | <0.30 | <0.030 | <0.030 | <0.030 |
| Potassium | mg/L | 0.02 | | | | 3.2 | 5.9 | 7.42 | 6.16 | 5.13 | 3.43 | 5.94 | 7.27 | 6.22 | 5.15 | 2.44 | 5.87 | 7.38 | 6.31 | 6.66 | 0.02 | 8.86 | 8.45 | 7.35 | 7.82 | 2.45 | 6.15 | 7.46 | 6.42 | 5.18 | 2.47 | 6.31 | 7.38 | 6.88 | 5.26 |
| Rubidium | mg/L | 0.0002 | | | | 0.00527 | 0.0041 | 0.00512 | 0.00518 | 0.00384 | 0.00535 | 0.0041 | 0.00507 | 0.00513 | 0.00387 | 0.00509 | 0.0042 | 0.00513 | 0.00521 | 0.00524 | 0.0002 | 0.00668 | 0.00596 | 0.00504 | 0.0056 | 0.00517 | 0.0044 | 0.00514 | 0.00526 | 0.00392 | 0.00525 | 0.0045 | 0.00527 | 0.00563 | 0.00393 |
| Selenium | mg/L | 0.001 | 0.001 | 0.005 | | 0.0051 | <0.010 | 0.0045 | 0.0025 | 0.0015 | 0.0054 | <0.010 | 0.0052 | 0.0029 | 0.0014 | 0.0043 | <0.010 | 0.0047 | 0.0024 | 0.0019 | 0.001 | 0.0022 | 0.0016 | 0.0023 | 0.0043 | 0.0046 | <0.010 | 0.0045 | 0.0027 | 0.0017 | 0.0048 | <0.010 | 0.004 | 0.0031 | 0.0016 |
| Silicon | mg/L | 0.05 | | | | 0.952 | <0.50 | 0.083 | 0.532 | 0.62 | 0.946 | <0.50 | 0.085 | 0.523 | 0.62 | 1.01 | 0.51 | 0.132 | 0.527 | <0.10 | 0.1 | 0.31 | 0.57 | 0.27 | 0.5 | 0.889 | <0.50 | 0.08 | 0.482 | 0.64 | 0.961 | <0.50 | 0.082 | 0.473 | 0.68 |
| Silver | mg/L | 0.0001 | 0.0001 | 0.0005 | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.0001 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Sodium | mg/L | 0.02 | | | | 12.5 | 9.6 | 12.8 | 10.1 | 8.21 | 12.7 | 9.49 | 12.5 | 10.1 | 7.86 | 12.8 | 9.64 | 12.4 | 10.2 | 10.5 | 0.02 | 12.2 | 12.9 | 10.9 | 10.8 | 11.6 | 10.1 | 12.6 | 10.6 | 8.14 | 12.2 | 10.7 | 12.6 | 11.4 | 8.43 |
| Strontium | mg/L | 0.0001 | | | | 0.22 | 0.175 | 0.201 | 0.19 | 0.166 | 0.222 | 0.181 | 0.194 | 0.189 | 0.165 | 0.21 | 0.177 | 0.204 | 0.191 | 0.191 | 0.0001 | 0.271 | 0.252 | 0.205 | 0.227 | 0.212 | 0.189 | 0.202 | 0.195 | 0.165 | 0.214 | 0.194 | 0.205 | 0.207 | 0.155 |
| Tellurium | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | 0.0002 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 |
| Thallium | mg/L | 0.0001 | 0.0008 | 0.004 | | <0.00010 | <0.0010 | <0.00010 | 0.00011 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | 0.0001 | 0.00013 | 0.0001 | 0.00012 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | 0.00011 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | 0.0001 | <0.00010 |
| Thorium | mg/L | 0.0001 | | | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | 0.0001 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 |
| Tin | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | <0.00020 | 0.0005 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | 0.00052 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | 0.0002 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | 0.00038 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | 0.0006 | <0.00020 |
| Titanium | mg/L | 0.0002 | | | | 0.00079 | 0.0067 | 0.00637 | 0.00502 | <0.00050 | 0.00068 | 0.0021 | 0.00583 | 0.00498 | <0.00050 | 0.0008 | 0.0032 | 0.00616 | 0.00537 | <0.00050 | 0.0005 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | 0.00074 | 0.0034 | 0.0064 | 0.00528 | <0.00050 | 0.00088 | 0.0039 | 0.00627 | 0.00587 | <0.00050 |
| Tungsten | mg/L | 0.0002 | | | | 0.00155 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | 0.00162 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | 0.00132 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | 0.0001 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00138 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | 0.00127 | <0.0010 | <0.00010 | <0.00010 | <0.00010 |
| Uranium | mg/L | 0.0001 | 0.015 | 0.075 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | 0.0001 | 0.00011 | 0.00013 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 |
| Vanadium | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | 0.0002 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | 0.0002 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 |
| Zinc | mg/L | 0.002 | 0.03 | 0.15 | | 0.0287 | 0.142 | 0.281 | 0.323 | 0.336 | 0.0209 | 0.131 | 0.291 | 0.323 | 0.331 | 0.063 | 0.133 | 0.221 | 0.327 | 0.32 | 0.002 | 0.729 | 0.748 | 0.264 | 0.285 | 0.0526 | 0.093 | 0.298 | 0.332 | 0.335 | 0.0632 | 0.071 | 0.32 | 0.306 | 0.359 |
| Zirconium | mg/L | 0.0004 | | | | <0.00040 | <0.0040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.0040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.0040 | <0.00040 | <0.00040 | <0.00040 | 0.0004 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.0040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.0040 | <0.00040 | <0.00040 | <0.00040 |

*RDL = reportable detection limit; TDS = total dissolved solids; TSS = total suspended solids; µmhos/cm = micromhos per centimetre; mg/L = milligrams per litre; TCU = true color unit; NTU = Nephelometric Turbidity Units; µg/L = micrograms per litre.*

Notes:

[a] *Canadian Council of Ministers of Environment (CCME) Water Quality Guidelines (2011) for the Protection of Freshwater Aquatic Life.*

[b] *Metal Mining Effluent Regulation (MMER) SOR/2002-222 Maximum authorized concentration in a grab sample*

[c] Detection limit adjusted for required dilution - ALS Lab Note

[d] AND-04, AND-05, AND-07 and AND-08 were not accessible in September 2014 due to low water levels and higher tailings

[e] Analysis conducted at Hudbay Laboratories

[1] Cadmium and Copper standards represented are based on average hardness within the Anderson TIA

[2] Aluminum standard presented is based on average hardness within the Anderson TIA pH >6.5

[3] The long-term exposure CWQG for the protection of freshwater life is 15 µg·L-1 for uranium

Exceeds CCME WQG Guideline
Exceeds 5 X CCME Guideline
Exceeds MMER Guideline

**Table 01. Anderson TIA, Anderson Creek and Anderson Bay Water Analytical Results**

| Parameter | Units | RDL | CCME WQG [a] | 5X CCME WQG | MMER [b] | AND-09 | | | | | | | | | | AND-10 | | | | | | | | | | AND-11 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | | | | | | 7-Mar-12 | 15-Jun-12 | 18-Jun-13 | 5-Oct-13 | 17-Jun-14 | 29-Sep-14 | 9-Dec-14 | 4-Mar-15 | 17-Jun-15 | 23-Sep-15 | 7-Mar-12 | 15-Jun-12 | 18-Jun-13 | 5-Oct-13 | 17-Jun-14 | 29-Sep-14 | 9-Dec-14 | 4-Mar-15 | 17-Jun-15 | 23-Sep-15 | 8-Mar-12 | 15-Jun-12 | 18-Jun-13 | 6-Oct-13 | 17-Jun-14 | 29-Sep-14 | 9-Dec-14 | 4-Mar-15 | 17-Jun-15 | 23-Sep-15 | 8-Mar-12 |
| **Conventional Parameters** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Colour, True | CU | 5 | - | | | 5.8 | | <5.0 | 5.8 | 26.3 | 5.4 | <5.0 | <5.0 | 6.7 | 12.5 | <5.0 | | <5.0 | <5.0 | 15.4 | 5.1 | <5.0 | <5.0 | 5.5 | 8 | <5.0 | - | 5.2 | <5.0 | 16.2 | 5.6 | <5.0 | <5.0 | <5.0 | 7.2 | <5.0 |
| Conductivity | umhos/cm | 20 | - | | | 620 | 521 | 631 | 762 | 614 | 819 | 980 | 1020 | 830 | 946 | 593 | 510 | 634 | 776 | 690 | 822 | 983 | 1210 | 853 | 1040 | 601 | 506 | 616 | 766 | 682 | 807 | 985 | 1140 | 878 | 1030 | 592 |
| pH | pH units | 0.1 | 6.5 - 9.0 | | | 7.95 | 8.03 | 7.64 | 7.64 | 7.5 | 7.27 | 7.34 | 7.23 | 7.18 | 7.02 | 7.49 | 8 | 6.95 | 7.7 | 7.47 | 7.3 | 7.23 | 7.27 | 7.24 | 7.03 | 7.47 | 7.97 | 7.67 | 7.61 | 7.54 | 7.27 | 7.26 | 7.2 | 7.11 | 6.87 | 7.5 |
| Total Suspended Solids | mg/L | 5 | - | | 30.00 | <5.0 | 7 | 8 | 11 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | 28 | 7 | 5 | <5.0 | 6 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | 5 | 5 | 7 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| Total Dissolved Solids | mg/L | 5 | - | | | 428 | 352 | 498 | 520 | 424 | 609 | 748 | 819 | 675 | 755 | 412 | 380 | 486 | 571 | 494 | 608 | 756 | 989 | 708 | 784 | 422 | 358 | 451 | 569 | 490 | 594 | 756 | 919 | 730 | 804 | 416 |
| Turbidity | NTU | 0.1 | - | | | 0.69 | 3.75 | 8.95 | 7.9 | 4.3 | 2.71 | 6.11 | 5.36 | 8.20 | 2.00 | 0.67 | 2.54 | 16.4 | 7.07 | 7.5 | 2.7 | 11.2 | 5.26 | 12.7 | 3.5 | 0.62 | 1.56 | 6.11 | 7.69 | 7.1 | 2.08 | 16.5 | 7.67 | 12.6 | 3.8 | 0.36 |
| Hardness (as CaCO3) | mg/L | 0.3 | - | | | 285 | 224 | | | 299 | | | 540 | 478 | 524 | 304 | 235 | | | 320 | | | 649 | 591 | 566 | 308 | 243 | - | | 328 | | | 530 | 565 | 568 | 309 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Anions and Nutrients** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Acidity (as CaCO3) | mg/L | 2 | - | | | 3.6 | | 1.7 | 2.1 | 4.6 | 2.7 | 5.6 | 9.9 | 3.4 | 3.3 | 6.8 | | 1.7 | 1.8 | 4.3 | 2.6 | 4.2 | 7.3 | 2.6 | 3.2 | 4.6 | - | 1.6 | 2.1 | 3.7 | 2.6 | 5.7 | 7.9 | 3.6 | 3.1 | 4.2 |
| Alkalinity, Total (as CaCO3) | mg/L | 20 | - | | | 56 | 49 | 37 | 34 | 42 | 27 | 31 | 36.2 | 27.5 | 15.8 | 55 | 49 | 36 | 35 | 35 | 26 | 27 | 38.6 | 27 | 13 | 56 | 49 | 42 | 34 | 39 | 26 | 27 | 33.5 | 27.4 | 12 | 55 |
| Bicarbonate (HCO3) | mg/L | 24 | - | | | 68 | 60 | 46 | 42 | 52 | 32 | 38 | 44.1 | 33.6 | 19.3 | 68 | 60 | 44 | 43 | 43 | 32 | 33 | 47.1 | 32.9 | 15.9 | 69 | 60 | 52 | 42 | 48 | 32 | 33 | 40.9 | 33.4 | 14.6 | 67 |
| Carbonate (CO3) | mg/L | 12 | - | | | <12 | <12 | <12 | <12 | <12 | <12 | <12 | <0.60 | <0.60 | <0.60 | <12 | <12 | <12 | <12 | <12 | <12 | <12 | <0.60 | <0.60 | <0.60 | <12 | <12 | <12 | <12 | <12 | <12 | <12 | <0.60 | <0.60 | <0.60 | <12 |
| Chloride | mg/L | 0.2 | 120 - 640 | | | 20.7 | 16.8 | 16.8 | 18.9 | 12.1 | 14.8 | 18.6 | 18.8 | 15.3 | 18.3 | 19.9 | 16.4 | 17.2 | 19.1 | 13.9 | 14.9 | 18.2 | 29.2 | 15.8 | 18.5 | 20.5 | 16.3 | 17.3 | 19 | 13.6 | 14.8 | 18.1 | 19.8 | 16 | 20.2 | 20.1 |
| Fluoride | mg/L | 0.02 | | | | 0.29 | 0.232 | 0.284 | 0.312 | 0.19 | 0.29 | 0.344 | 0.314 | 0.283 | 0.352 | 0.285 | 0.225 | 0.287 | 0.316 | 0.21 | 0.27 | 0.336 | 0.46 | 0.293 | 0.293 | 0.287 | 0.232 | 0.296 | 0.313 | 0.21 | 0.27 | 0.339 | 0.342 | 0.295 | 0.33 | 0.294 |
| Hydroxide (OH) | mg/L | 6.8 | - | | | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <0.34 | <0.34 | <0.34 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <0.34 | <0.34 | <0.34 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <0.34 | <0.34 | <0.34 | <6.8 |
| Silica, Reactive (as SiO2) | mg/L | 0.25 | - | | | 0.547 | | | | | | | | | | 0.578 [c] | | | | | | | | | | 0.763 [c] | | | | | | | | | 0.484 |
| Sulfate | mg/L | 0.5 | - | | | 231 | 182 | 249 | 330 | 0.0243 | 0.0347 | 0.0453 | 0.0463 | 405 | 509 | 225 | 176 | 247 | 337 | 0.0281 | 0.0348 | 0.0457 | 0.0717 | 424 | 509 | 228 | 174 | 238 | 333 | 0.0277 | 0.0345 | 0.0456 | 0.0513 | 429 | 559 | 225 |
| Ammonia, Total (as N) | mg/L | 0.01 | 2.33 - 7.32 | | | 0.284 | 0.163 | 0.55 [c] | 1.21 [c] | 0.463 | 0.497 | 0.58 | 0.91 [c] | 1.06 [c] | 0.65 | 0.194 | 0.109 | 0.55 [c] | 1.03 [c] | 0.87 | 0.45 [b] | 0.77 | 1.45 [c] | 1.22 [c] | 0.94 | 0.304 | 0.09 | 0.456 | 1.18 [c] | 0.72 | 0.446 | 0.82 | 1.09 [c] | 1.43 [c] | 0.94 | 0.199 |
| Nitrate-N | mg/L | 0.005 | 13 | | | 0.255 | 0.337 | 0.548 | 0.502 | 0.363 | 0.588 | 0.78 | 0.661 | 0.552 | 0.778 | 0.17 | 0.268 | 0.554 | 0.545 | 0.428 | 0.597 | 0.956 | 1.37 | 0.606 | 0.903 | 0.261 | 0.243 | 0.432 | 0.508 | 0.413 | 0.563 | 1.11 | 1.09 | 0.634 | 1.01 | 0.183 |
| Nitrate and Nitrite as N | mg/L | 0.0051 | - | | | 0.26 | 0.333 | 0.569 | 0.505 | 0.363 | 0.588 | 0.78 | 0.661 | 0.668 | 0.778 | 0.17 | 0.265 | 0.575 | 0.549 | 0.428 | 0.597 | 0.956 | 1.38 | 0.758 | 0.903 | 0.257 | 0.241 | 0.453 | 0.512 | 0.413 | 0.563 | 1.11 | 1.1 | 0.8 | 1.04 | 0.182 |
| Nitrite-N | mg/L | 0.001 | 0.06 | | | 0.0049 | 0.0041 | 0.0208 | 0.0036 | <0.050 | <0.050 | <0.010 | <0.010 | 0.116 | <0.020 | <0.0010 | 0.0032 | 0.0206 | 0.0046 | <0.050 | <0.050 | <0.010 | 0.011 | 0.153 | <0.020 | 0.0038 | 0.0024 | 0.0204 | 0.0036 | <0.050 | <0.050 | <0.010 | 0.01 | 0.166 | 0.03 | 0.001 |
| Phosphorus (P)-Total | mg/L | 0.01 | - | | | <0.010 | 0.012 | 0.014 | 0.027 | 0.033 | 0.042 | 0.055 | 0.055 | 0.054 | 0.041 | <0.010 | 0.011 | 0.015 | 0.033 | 0.034 | 0.043 | 0.058 | 0.083 | 0.057 | 0.041 | <0.010 | 0.011 | 0.012 | 0.027 | 0.035 | 0.083 | 0.06 | 0.061 | 0.053 | 0.043 | <0.010 |
| Thiosulphate (S203) [e] | mg/L | 2.5 | | | | | | | 4.5 | <2.5 | | 3.5 | <2.5 | 3.5 | | | | | 5.1 | <2.5 | | 3.5 | <2.5 | 3.5 | | | | | 3.4 | <2.5 | | 20.8 | <2.5 | 3.5 | | |
| **Dissolved Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aluminum | mg/L | 0.002 | 0.1 | 0.5 | | 0.0095 | 0.122 | 0.0198 | 0.0162 | 0.0092 | 0.0063 | 0.0045 | 0.0025 | 0.0091 | 0.0161 | 0.0065 | 0.052 | 0.0236 | 0.0177 | 0.0074 | 0.006 | 0.0045 | 0.0028 | 0.0132 | 0.0213 | 0.0095 | 0.031 | 0.0132 | 0.0127 | 0.0072 | 0.006 | 0.0046 | 0.003 | 0.014 | 0.0204 | 0.0055 |
| Antimony | mg/L | 0.0002 | | | | 0.0183 | 0.0223 | 0.00812 | 0.00649 | 0.00416 | 0.00445 | 0.00572 | 0.00525 | 0.00613 | 0.00461 | 0.0155 | 0.0186 | 0.0081 | 0.00648 | 0.00429 | 0.00504 | 0.00559 | 0.00653 | 0.00637 | 0.0058 | 0.0174 | 0.0169 | 0.00845 | 0.00654 | 0.00384 | 0.0045 | 0.00554 | 0.00612 | 0.00678 | 0.00575 | 0.0164 |
| Arsenic | mg/L | 0.0002 | 0.005 | 0.025 | | 0.00413 | 0.0044 | 0.00263 | 0.00168 | 0.0018 | 0.00165 | 0.00162 | 0.00123 | 0.00198 | 0.00237 | 0.00357 | 0.0038 | 0.00226 | 0.00175 | 0.00186 | 0.00157 | 0.00172 | 0.00181 | 0.00196 | 0.00242 | 0.00387 | 0.0036 | 0.00252 | 0.00174 | 0.00179 | 0.00179 | 0.00155 | 0.00184 | 0.00212 | 0.00233 | 0.00334 |
| Barium | mg/L | 0.0002 | | | | 0.023 | 0.0193 | 0.023 | 0.0259 | 0.0213 | 0.0291 | 0.0361 | 0.0343 | 0.0248 | 0.0294 | 0.0234 | 0.0202 | 0.0224 | 0.0255 | 0.0235 | 0.0296 | 0.033 | 0.0384 | 0.0266 | 0.0311 | 0.0227 | 0.0193 | 0.0222 | 0.0261 | 0.0235 | 0.0287 | 0.0305 | 0.0331 | 0.026 | 0.0307 | 0.0217 |
| Beryllium | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Bismuth | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Boron | mg/L | 0.01 | 1.5 | 7.5 | | 0.024 | <0.10 | 0.024 | 0.026 | 0.027 | 0.03 | 0.028 | 0.021 | 0.022 | 0.018 | 0.046 | <0.10 | 0.02 | 0.027 | 0.027 | 0.034 | 0.027 | 0.026 | 0.022 | 0.022 | 0.04 | <0.10 | 0.022 | 0.025 | 0.024 | 0.03 | 0.026 | 0.023 | 0.022 | 0.021 | 0.037 |
| Cadmium | mg/L | 0.00001 | 0.00009 | 0.00045 | | 0.000241 | 0.00021 | 0.000619 | 0.000945 | 0.000957 | 0.0011 | 0.00151 | 0.00162 | 0.000664 | 0.000688 | 0.000242 | 0.00015 | 0.000666 | 0.00109 | 0.00137 | 0.00109 | 0.0014 | 0.00198 | 0.000709 | 0.000763 | 0.000245 | 0.00015 | 0.000403 | 0.000871 | 0.00128 | 0.00103 | 0.00127 | 0.00176 | 0.000706 | 0.0008 | 0.000244 |
| Calcium | mg/L | 0.05 | | | | 97.3 | 83.1 | 109 | 126 | 106 | 130 | 189 | 180 | 168 | 167 | 98.6 | 82 | 107 | 131 | 121 | 142 | 199 | 232 | 174 | 217 | 99.9 | 80.6 | 106 | 121 | 116 | 128 | 195 | 205 | 183 | 207 | 96.7 |
| Cesium | mg/L | 0.0001 | | | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Chromium | mg/L | 0.002 | | | | <0.0020 | <0.020 | <0.0020 | <0.0020 | <0.0020 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | 0.002 | <0.020 | <0.0020 | <0.0020 | <0.0020 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0020 | <0.020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0020 |
| Cobalt | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | 0.00062 | 0.00063 | 0.00068 | 0.00024 | 0.00045 | 0.00102 | 0.00038 | 0.00059 | <0.00020 | <0.0020 | 0.00078 | 0.00078 | 0.00102 | 0.00023 | 0.00044 | 0.0011 | 0.00056 | 0.00069 | <0.00020 | <0.0020 | 0.00026 | 0.00062 | 0.00098 | <0.00020 | 0.00046 | 0.00097 | 0.0006 | 0.00067 | <0.00020 |
| Copper | mg/L | 0.0002 | 0.004 | 0.02 | | 0.00852 | 0.0152 | 0.0214 | 0.0337 | 0.0277 | 0.0247 | 0.0312 | 0.029 | 0.014 | 0.0131 | 0.00963 | 0.0097 | 0.0214 | 0.0415 | 0.0416 | 0.0252 | 0.0485 | 0.051 | 0.0182 | 0.0172 | 0.00971 | 0.0083 | 0.0155 | 0.0318 | 0.0395 | 0.0218 | 0.0417 | 0.0549 | 0.0196 | 0.017 | 0.0124 |
| Iron | mg/L | 0.1 | 0.3 | 1.5 | | <0.10 | <1.0 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <1.0 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <1.0 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Lead | mg/L | 0.00009 | 0.007 | 0.035 | | <0.000090 | 0.00815 | 0.00231 | 0.00127 | 0.00145 | 0.000781 | 0.00205 | 0.00038 | 0.00029 | 0.000972 | <0.000090 | 0.0017 | 0.000898 | 0.000927 | 0.00234 | 0.000964 | 0.00192 | 0.000737 | 0.000668 | 0.00175 | <0.000090 | <0.00090 | 0.000351 | 0.000886 | 0.00212 | 0.00134 | 0.00187 | 0.00106 | 0.000809 | 0.0018 | <0.000090 |
| Lithium | mg/L | 0.002 | | | | 0.0024 | <0.020 | 0.0058 | 0.007 | 0.0059 | 0.0062 | 0.0077 | 0.0064 | 0.0064 | 0.0062 | 0.004 | <0.020 | 0.0055 | 0.0071 | 0.0065 | 0.0067 | 0.0078 | 0.008 | 0.0062 | 0.0077 | 0.0089 | <0.020 | 0.0054 | 0.0065 | 0.0061 | 0.006 | 0.0074 | 0.007 | 0.0065 | 0.0076 | 0.0041 |
| Magnesium | mg/L | 0.01 | | | | 10.1 | 8.21 | 9.31 | 9.94 | 8.1 | 9.2 | 10.9 | 10.9 | 8.38 | 8.02 | 10.4 | 8.62 | 10 | 10.3 | 8.44 | 9.21 | 10.4 | 12.9 | 8.28 | 8.31 | 10.5 | 8.45 | 9.19 | 9.66 | 8.31 | 9.13 | 10.1 | 11.9 | 8.05 | 8.21 | 10.3 |
| Manganese | mg/L | 0.0001 | | | | 0.0163 | 0.0237 | 0.107 | 0.0649 | 0.158 | 0.0434 | 0.078 | 0.323 | 0.143 | 0.0903 | 0.0062 | 0.008 | 0.106 | 0.0754 | 0.229 | 0.0434 | 0.0834 | 0.324 | 0.187 | 0.106 | 0.0194 | 0.0052 | 0.0613 | 0.0641 | 0.22 | 0.0369 | 0.0862 | 0.282 | 0.196 | 0.104 | 0.00368 |
| Molybdenum | mg/L | 0.0001 | 0.073 | 0.365 | | 0.00112 | 0.0011 | 0.00594 | 0.00472 | 0.00312 | 0.00401 | 0.00436 | 0.00388 | 0.00586 | 0.00516 | 0.00133 | 0.001 | 0.00614 | 0.00495 | 0.00381 | 0.0045 | 0.00548 | 0.00573 | 0.00662 | 0.00736 | 0.00124 | 0.0012 | 0.00507 | 0.00476 | 0.00367 | 0.00392 | 0.00617 | 0.00597 | 0.00715 | 0.00743 | 0.00125 |
| Nickel | mg/L | 0.001 | 0.15 | 0.75 | | <0.0010 | <0.010 | 0.0021 | 0.0013 | 0.0016 | 0.0013 | 0.0018 | 0.002 | 0.0015 | 0.0011 | <0.0010 | <0.010 | 0.0022 | 0.0014 | 0.0019 | 0.0013 | 0.0018 | 0.0026 | 0.0015 | 0.001 | <0.0010 | <0.010 | 0.0017 | 0.0012 | 0.0019 | 0.0012 | 0.0018 | 0.0024 | 0.0015 | 0.001 | <0.0010 |
| Phosphorus | mg/L | 0.1 | | | | <0.10 | <0.30 | <0.030 | <0.030 | <0.030 | 0.047 | 0.036 | 0.056 | 0.041 | 0.04 | <0.10 | <0.30 | <0.030 | <0.030 | <0.030 | 0.037 | 0.047 | 0.06 | 0.046 | 0.045 | <0.10 | <0.30 | <0.030 | <0.030 | <0.030 | 0.055 | 0.05 | 0.059 | 0.038 | 0.039 | <0.10 |
| Potassium | mg/L | 0.02 | | | | 0.986 | 6.13 | 7.38 | 7.18 | 5.96 | 7.81 | 9.57 | 9.81 | 8.44 | 9 | 7.18 | 6.09 | 7.4 | 7.52 | 6.47 | 7.67 | 9.32 | 12.1 | 9.24 | 9.96 | 7.38 | 5.89 | 7.4 | 6.95 | 6.39 | 7.26 | 9.63 | 10.8 | 8.86 | 9.68 | 6.94 |
| Rubidium | mg/L | 0.0002 | | | | 0.00475 | 0.0041 | 0.00502 | 0.00587 | 0.0044 | 0.00598 | 0.00695 | 0.00671 | 0.00563 | 0.00645 | 0.00478 | 0.0041 | 0.00514 | 0.00593 | 0.0047 | 0.00593 | 0.00677 | 0.00856 | 0.00587 | 0.00681 | 0.00497 | 0.0042 | 0.00482 | 0.00601 | 0.00476 | 0.00559 | 0.00669 | 0.00726 | 0.006 | 0.00685 | 0.00484 |
| Selenium | mg/L | 0.001 | 0.001 | 0.005 | | 0.0032 | <0.010 | 0.0036 | 0.0046 | 0.002 | 0.0042 | 0.0046 | 0.0033 | 0.0049 | 0.0078 | 0.0036 | <0.010 | 0.004 | 0.0051 | 0.0028 | 0.0043 | 0.0058 | 0.0054 | 0.0065 | 0.0108 | 0.003 | <0.010 | 0.0024 | 0.0049 | 0.0026 | 0.0041 | 0.0061 | 0.0053 | 0.0078 | 0.0106 | 0.0023 |
| Silicon | mg/L | 0.05 | | | | 0.405 | <0.50 | 0.132 | 0.55 | 0.88 | 0.26 | 0.45 | 0.66 | 0.52 | 0.31 | 0.424 | <0.50 | 0.188 | 0.591 | 1.21 | 0.27 | 0.52 | 0.83 | 0.7 | 0.31 | 0.519 | <0.50 | 0.149 | 0.542 | 1.18 | 0.25 | 0.53 | 0.72 | 0.78 | 0.29 | 0.413 |
| Silver | mg/L | 0.0001 | 0.0001 | 0.0005 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00024 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00017 | <0.00010 | <0.00010 | 0.00024 | <0.00010 |
| Sodium | mg/L | 0.02 | | | | 10.8 | 10.1 | 12.8 | 11.8 | 8.96 | 11.9 | 13.2 | 14.7 | 12.4 | 12.3 | 12.5 | 9.92 | 13.2 | 12.2 | 9.75 | 11.8 | 13.1 | 18 | 12.6 | 13.5 | 12.6 | 9.71 | 12.3 | 11.8 | 9.62 | 11.7 | 13 | 16.4 | 12.9 | 13.3 | 12.5 |
| Strontium | mg/L | 0.0001 | | | | 0.197 | 0.188 | 0.203 | 0.217 | 0.191 | 0.215 | 0.28 | 0.287 | 0.241 | 0.232 | 0.213 | 0.189 | 0.215 | 0.221 | 0.216 | 0.237 | 0.285 | 0.355 | 0.249 | 0.298 | 0.219 | 0.184 | 0.204 | 0.224 | 0.212 | 0.21 | 0.282 | 0.317 | 0.253 | 0.296 | 0.212 |
| Tellurium | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | 0.0003 |
| Thallium | mg/L | 0.0001 | 0.0008 | 0.004 | | <0.00010 | <0.0010 | <0.00010 | 0.00011 | <0.00010 | 0.00014 | 0.00012 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | 0.00011 | 0.00015 | 0.00016 | 0.00011 | 0.00012 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | 0.00011 | 0.00013 | 0.00013 | <0.00010 | 0.00012 | 0.0001 | <0.00010 | <0.00010 |
| Thorium | mg/L | 0.0001 | | | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Tin | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | 0.00051 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Titanium | mg/L | 0.0002 | | | | 0.00091 | 0.0033 | 0.00588 | 0.00622 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | 0.00079 | 0.0026 | 0.00651 | 0.00663 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | 0.00035 | 0.0034 | 0.00581 | 0.00609 | <0.00050 | <0.00050 | <0.00050 | 0.00065 | <0.00050 | <0.00050 | <0.00050 | 0.00101 |
| Tungsten | mg/L | 0.0002 | | | | 0.00033 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00011 | 0.00012 | 0.00053 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | 0.0001 | 0.00014 | <0.00010 | 0.00015 | 0.0002 | 0.00021 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00017 | 0.0001 | 0.00018 | 0.00019 | <0.00020 |
| Uranium | mg/L | 0.0001 | 0.015 | 0.075 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Vanadium | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Zinc | mg/L | 0.002 | 0.03 | 0.15 | | 0.132 | 0.068 | 0.246 | 0.22 | 0.421 | 0.442 | 0.702 | 0.747 | 0.267 | 0.326 | 0.169 | 0.052 | 0.246 | 0.225 | 0.518 | 0.429 | 0.567 | 0.857 | 0.247 | 0.327 | 0.16 | 0.054 | 0.154 | 0.207 | 0.504 | 0.428 | 0.464 | 0.702 | 0.229 | 0.33 | 0.158 |
| Zirconium | mg/L | 0.0004 | | | | <0.00040 | <0.0040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.0040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.0040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 |

*RDL = reportable detection limit; TDS = total dissolved solids; TSS = total suspended solids; µmhos/cm = micromhos per centimetre; mg/L = milligrams per litre; TCU = true color unit; NTU = Nephelometric Turbidity Units; µg/L = micrograms per litre.*

Notes:

[a] *Canadian Council of Ministers of Environment (CCME) Water Quality Guidelines (2011) for the Protection of Freshwater Aquatic Life.*

[b] *Metal Mining Effluent Regulation (MMER) SOR/2002-222 Maximum authorized concentration in a grab sample*

[c] Detection limit adjusted for required dilution - ALS Lab Note

[d] AND-04, AND-05, AND-07 and AND-08 were not accessible in September 2014 due to low water levels and higher tailings

[e] Analysis conducted at Hudbay Laboratories

[1] Cadmium and Copper standards represented are based on average hardness within the Anderson TIA

[2] Aluminum standard presented is based on average hardness within the Anderson TIA pH >6.5

[3] The long-term exposure CWQG for the protection of freshwater life is 15 µg·L-1 for uranium

Exceeds CCME WQG Guideline
Exceeds 5 X CCME Guideline
Exceeds MMER Guideline

**Table 01. Anderson TIA, Anderson Creek and Anderson Bay Water Analytical Results**

| Parameter | Units | RDL | CCME WQG [a] | 5X CCME WQG | MMER [b] | AND-12 | | | | | | | | | | AND-13 | | | | | | | | | | AND-14 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | | | | | | 15-Jun-12 | 18-Jun-13 | 6-Oct-13 | 17-Jun-14 | 29-Sep-14 | 9-Dec-14 | 4-Mar-15 | 17-Jun-15 | 23-Sep-15 | | 8-Mar-12 | 15-Jun-12 | 18-Jun-13 | 6-Oct-13 | 17-Jun-14 | 29-Sep-14 | 10-Dec-14 | 3-Mar-15 | 17-Jun-15 | 23-Sep-15 | | 8-Mar-12 | 15-Jun-12 | 18-Jun-13 | 6-Oct-13 | 17-Jun-14 | 17-Jun-14 | 29-Sep-14 | 17-Jun-15 | 22-Sep-15 |
| **Conventional Parameters** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | Dup 01 (AND-14) | | | |
| Colour, True | CU | 5 | - | | | | <5.0 | <5.0 | 15.8 | 8 | <5.0 | <5.0 | 5 | 7.1 | | <5.0 | | 5.2 | <5.0 | 14.7 | 5.1 | <5.0 | <5.0 | 5.2 | 7.2 | | <5.0 | | <5.0 | <5.0 | 12.3 | 14.7 | <5.0 | 6.9 | 9.1 |
| Conductivity | umhos/cm | 20 | - | | | 507 | 607 | 757 | 689 | 805 | 981 | 1220 | 881 | 1020 | | 601 | 507 | 610 | 756 | 700 | 817 | 1030 | 1090 | 0882 | 1030 | | 582 | 504 | 591 | 722 | 724 | 724 | 843 | 885 | 995 |
| pH | pH units | 0.1 | 6.5 - 9.0 | | | 7.99 | 7.74 | 7.6 | 7.48 | 7.32 | 7.27 | 7.14 | 7.12 | 7.04 | | 7.46 | 7.98 | 7.76 | 7.59 | 7.45 | 7.32 | 7.66 | 6.84 | 7.20 | 7.06 | | 7.49 | 8 | 7.84 | 7.64 | 7.52 | 7.53 | 7.35 | 7.23 | 7.31 |
| Total Suspended Solids | mg/L | 5 | - | | 30.00 | <5.0 | 6 | 6 | 7 | <5.0 | <5.0 | <5.0 | <5.0 | 5 | | <5.0 | <5.0 | 10 | <5.0 | 6 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | | <5.0 | <5.0 | 15 | <5.0 | 11 | 13 | 5 | <5.0 | <5.0 |
| Total Dissolved Solids | mg/L | 5 | - | | | 346 | 443 | 553 | 497 | 593 | 764 | 1010 | 715 | 767 | | 420 | 346 | 455 | 533 | 504 | 603 | 781 | 843 | 713 | 794 | | 392 | 342 | 430 | 518 | 537 | 522 | 624 | 702 | 803 |
| Turbidity | NTU | 0.1 | - | | | 1.55 | 5.76 | 5.83 | 7.1 | 2.5 | 10.6 | 6.77 | 12.3 | 4 | | 0.34 | 1.35 | 5.71 | 7.22 | 8.3 | 3.39 | 14.6 | 7.73 | 12.50 | 3.30 | | 0.38 | 1.27 | 2.82 | 1.83 | 13.4 | 17.2 | 3.89 | 5.2 | 1.36 |
| Hardness (as CaCO3) | mg/L | 0.3 | - | | | 232 | | | 329 | | | 609 | 593 | 568 | | 299 | 233 | | | 341 | | | 496 | 532 | 538 | | 287 | 228 | | | 334 | 334 | | 464 | 493 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Anions and Nutrients** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Acidity (as CaCO3) | mg/L | 2 | - | | | | 1.4 | 2.1 | 5.1 | 2.6 | 4.4 | 9 | 3.7 | 4.9 | | 4 | | 1.6 | 2.1 | 4.5 | 2.3 | 5.8 | 6.9 | 3.6 | 3.5 | | 4.6 | | 1.2 | 2 | 4.3 | 5.6 | 2.4 | 3.5 | 5.1 |
| Alkalinity, Total (as CaCO3) | mg/L | 20 | - | | | 49 | 43 | 34 | 35 | 26 | 27 | 41.6 | 27.2 | 13.3 | | 57 | 49 | 43 | 33 | 35 | 26 | 30 | 32.7 | 27.1 | 13.1 | | 57 | 50 | 45 | 38 | 36 | 36 | 27 | 28.6 | 15.6 |
| Bicarbonate (HCO3) | mg/L | 24 | - | | | 60 | 53 | 41 | 43 | 32 | 33 | 50.7 | 33.2 | 16.2 | | 69 | 60 | 53 | 40 | 43 | 32 | 36 | 39.9 | 33.1 | 16.0 | | 70 | 61 | 55 | 46 | 44 | 44 | 33 | 34.9 | 19 |
| Carbonate (CO3) | mg/L | 12 | - | | | <12 | <12 | <12 | <12 | <12 | <12 | <0.60 | <0.60 | <0.60 | | <12 | <12 | <12 | <12 | <12 | <12 | <12 | <0.60 | <0.60 | <0.60 | | <12 | <12 | <12 | <12 | <12 | <12 | <12 | <0.60 | <0.60 |
| Chloride | mg/L | 0.2 | 120 - 640 | | | 16.2 | 17.3 | 18.8 | 13.8 | 14.7 | 18.2 | 23.4 | 16.1 | 20.1 | | 20.3 | 16.3 | 17.4 | 18.9 | 14 | 14.8 | 18.5 | 19.3 | 16.1 | 21.1 | | 19.8 | 16.3 | 17.3 | 19 | 14.4 | 14.5 | 15.1 | 16.8 | 18.8 |
| Fluoride | mg/L | 0.02 | | | | 0.224 | 0.27 | 0.309 | 0.21 | 0.29 | 0.35 | 0.379 | 0.304 | 0.332 | | 0.285 | 0.229 | 0.268 | 0.309 | 0.21 | 0.3 | 0.326 | 0.339 | 0.313 | 0.347 | | 0.279 | 0.218 | 0.268 | 0.294 | 0.22 | 0.22 | 0.28 | 0.31 | 0.336 |
| Hydroxide (OH) | mg/L | 6.8 | - | | | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <0.34 | <0.34 | <0.34 | | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <0.34 | <0.34 | <0.34 | | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <0.34 | <0.34 |
| Silica, Reactive (as SiO2) | mg/L | 0.25 | - | | | | | | | | | | | | | 0.878 [c] | | | | | | | | | | | 0.652 [c] | | | | | | | | |
| Sulfate | mg/L | 0.5 | - | | | 174 | 232 | 328 | 0.0281 | 0.0341 | 0.0454 | 0.0579 | 434 | 556 | | 228 | 174 | 234 | 328 | 0.0287 | 0.0346 | 0.046 | 0.0494 | 435.0000 | 581.0000 | | 220 | 172 | 222 | 304 | 0.0298 | 0.0298 | 0.0359 | 427 | 503 |
| Ammonia, Total (as N) | mg/L | 0.01 | 2.33 - 7.32 | | | 0.114 | 0.401 | 0.77 [c] | 0.75 | 0.436 | 0.76 | 1.29 [c] | 1.44 [c] | 0.92 | | 0.255 | 0.117 | 0.433 | 0.99 [c] | 0.8 | 0.485 | 0.92 [c] | 1.08 [c] | 1.46 [c] | 0.93 | | 0.174 | 0.068 | 0.324 | 0.488 | 0.92 | 0.87 | 0.61 [b] | 1.34 [c] | 0.92 |
| Nitrate-N | mg/L | 0.005 | 13 | | | 0.232 | 0.382 | 0.483 | 0.42 | 0.557 | 1.01 | 1.02 | 0.644 | 1 | | 0.214 | 0.235 | 0.393 | 0.474 | 0.425 | 0.6 | 1.14 | 0.976 | 0.646 | 1.060 | | 0.109 | 0.176 | 0.29 | 0.299 | 0.436 | 0.438 | 0.613 | 0.512 | 0.606 |
| Nitrate and Nitrite as N | mg/L | 0.0051 | - | | | 0.229 | 0.4 | 0.486 | 0.42 | 0.557 | 1.01 | 1.02 | 0.815 | 1 | | 0.212 | 0.232 | 0.411 | 0.477 | 0.425 | 0.6 | 1.14 | 0.976 | 0.816 | 1.090 | | 0.105 | 0.174 | 0.305 | 0.301 | 0.436 | 0.438 | 0.613 | 0.655 | 0.606 |
| Nitrite-N | mg/L | 0.001 | 0.06 | | | 0.0022 | 0.0184 | 0.0029 | <0.050 | <0.050 | <0.010 | <0.010 | 0.171 | <0.020 | | 0.0013 | 0.0025 | 0.0185 | 0.003 | <0.050 | <0.050 | <0.010 | <0.010 | 0.17 | 0.027 | | 0.004 | 0.0019 | 0.0146 | 0.0021 | <0.050 | <0.050 | <0.050 | 0.142 | <0.020 |
| Phosphorus (P)-Total | mg/L | 0.01 | - | | | 0.011 | 0.01 | 0.025 | 0.035 | 0.043 | 0.057 | 0.07 | 0.059 | 0.042 | | <0.010 | 0.011 | 0.012 | 0.025 | <0.010 | 0.041 | 0.058 | 0.064 | 0.057 | 0.044 | | <0.010 | 0.031 | <0.010 | 0.02 | <0.010 | 0.035 | 0.044 | 0.06 | 0.05 |
| Thiosulphate (S203) [d] | mg/L | 2.5 | | | | | | 2.9 | <2.5 | | 6.6 | <2.5 | 3.5 | | | | | | 2.9 | <2.5 | | 9.5 | <2.5 | 3.5 | | | | | | 2.9 | <2.5 | | 3.5 | |
| **Dissolved Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aluminum | mg/L | 0.002 | 0.1 | 0.5 | | 0.129 | 0.0372 | 0.0107 | 0.0071 | 0.0055 | 0.0039 | 0.0031 | 0.0159 | 0.0192 | | 0.0064 | 0.036 | 0.0132 | 0.0097 | 0.0081 | 0.0087 | 0.0037 | 0.0027 | 0.015 | 0.0197 | | 0.0032 | <0.020 | 0.0074 | 0.0035 | 0.0095 | 0.0116 | 0.0086 | 0.0095 | 0.0088 |
| Antimony | mg/L | 0.0002 | | | | 0.0162 | 0.0088 | 0.00652 | 0.00394 | 0.00447 | 0.00548 | 0.00749 | 0.00748 | 0.00582 | | 0.0171 | 0.0158 | 0.00902 | 0.00665 | 0.00426 | 0.00438 | 0.00601 | 0.00588 | 0.00673 | 0.00574 | | 0.0133 | 0.0157 | 0.0084 | 0.00714 | 0.00391 | 0.00396 | 0.00456 | 0.00635 | 0.00528 |
| Arsenic | mg/L | 0.0002 | 0.005 | 0.025 | | 0.0041 | 0.00279 | 0.00165 | 0.0018 | 0.00161 | 0.00163 | 0.00203 | 0.00207 | 0.00234 | | 0.00389 | 0.0038 | 0.00255 | 0.00167 | 0.00182 | 0.00167 | 0.0016 | 0.00176 | 0.0021 | 0.00242 | | 0.00308 | 0.0039 | 0.00323 | 0.00228 | 0.00191 | 0.00187 | 0.00157 | 0.0022 | 0.00178 |
| Barium | mg/L | 0.0002 | | | | 0.0196 | 0.0223 | 0.0257 | 0.0231 | 0.0292 | 0.033 | 0.0451 | 0.025 | 0.0308 | | 0.0219 | 0.0195 | 0.0224 | 0.0272 | 0.0242 | 0.029 | 0.0309 | 0.0325 | 0.0258 | 0.0306 | | 0.0225 | 0.0191 | 0.0195 | 0.0268 | 0.0245 | 0.0234 | 0.0292 | 0.025 | 0.032 |
| Beryllium | mg/L | 0.0002 | | | | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | 0.00029 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Bismuth | mg/L | 0.0002 | | | | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Boron | mg/L | 0.01 | 1.5 | 7.5 | | <0.10 | 0.022 | 0.025 | 0.025 | 0.03 | 0.027 | 0.03 | 0.024 | 0.022 | | 0.031 | <0.10 | 0.022 | 0.026 | 0.026 | 0.029 | 0.023 | 0.024 | 0.022 | 0.022 | | 0.027 | <0.10 | 0.021 | 0.027 | 0.024 | 0.022 | 0.03 | 0.022 | 0.021 |
| Cadmium | mg/L | 0.00001 | 0.00009 | 0.00045 | | 0.00013 | 0.000316 | 0.000815 | 0.00133 | 0.00104 | 0.00129 | 0.00216 | 0.000605 | 0.000787 | | 0.000245 | 0.00014 | 0.000354 | 0.000748 | 0.00145 | 0.00105 | 0.0013 | 0.00175 | 0.000703 | 0.000774 | | 0.000142 | <0.00010 | 0.000145 | 0.00005 | 0.00165 | 0.00159 | 0.00109 | 0.000583 | 0.000706 |
| Calcium | mg/L | 0.05 | | | | 79.5 | 98.5 | 118 | 116 | 128 | 192 | 258 | 186 | 211 | | 102 | 79.9 | 103 | 125 | 124 | 125 | 181 | 195 | 173 | 220 | | 97.9 | 79.7 | 99.6 | 117 | 121 | 122 | 148 | 179 | 199 |
| Cesium | mg/L | 0.0001 | | | | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Chromium | mg/L | 0.002 | | | | <0.020 | <0.0020 | <0.0020 | <0.0020 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | | <0.0020 | <0.020 | <0.0020 | <0.0020 | <0.0020 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | | <0.0020 | <0.020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0010 | <0.0010 | <0.0010 |
| Cobalt | mg/L | 0.0002 | | | | <0.0020 | <0.00020 | 0.00054 | 0.00102 | 0.0002 | 0.00046 | 0.00128 | 0.00061 | 0.00069 | | <0.00020 | <0.0020 | <0.00020 | 0.0005 | 0.00111 | 0.00021 | 0.00051 | 0.00094 | 0.0006 | 0.0007 | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | 0.00132 | 0.00131 | 0.00028 | 0.00028 | 0.0002 |
| Copper | mg/L | 0.0002 | 0.004 | 0.02 | | 0.0091 | 0.013 | 0.0281 | 0.0414 | 0.0209 | 0.0393 | 0.0533 | 0.0203 | 0.017 | | 0.0103 | 0.0079 | 0.0133 | 0.0256 | 0.0459 | 0.026 | 0.0464 | 0.0506 | 0.02 | 0.0174 | | 0.00546 | 0.0065 | 0.00771 | 0.00287 | 0.0539 | 0.0533 | 0.0301 | 0.0152 | 0.0066 |
| Iron | mg/L | 0.1 | 0.3 | 1.5 | | <1.0 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | | <0.10 | <1.0 | <0.10 | <0.10 | <0.10 | <1.0 | <0.10 | <0.10 | <0.10 | <0.10 | | <0.10 | <1.0 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Lead | mg/L | 0.00009 | 0.007 | 0.035 | | 0.00105 | 0.00068 | 0.000777 | 0.00222 | 0.00046 | 0.00155 | 0.000868 | 0.000946 | 0.00168 | | <0.000090 | <0.00090 | 0.00027 | 0.000673 | 0.00281 | 0.000838 | 0.00292 | 0.0009 | 0.000879 | 0.00156 | | <0.000090 | <0.00090 | 0.000257 | <0.000090 | 0.00482 | 0.00502 | 0.00245 | 0.000178 | 0.000168 |
| Lithium | mg/L | 0.002 | | | | <0.020 | 0.0056 | 0.0064 | 0.0061 | 0.006 | 0.0074 | 0.0091 | 0.0072 | 0.0076 | | 0.0076 | <0.020 | 0.0053 | 0.0067 | 0.0065 | 0.0059 | 0.007 | 0.0073 | 0.0066 | 0.0076 | | <0.0020 | <0.020 | 0.0054 | 0.0062 | 0.0061 | 0.0056 | 0.0069 | 0.0065 | 0.0072 |
| Magnesium | mg/L | 0.01 | | | | 8.44 | 9.13 | 9.46 | 8.62 | 9.27 | 10.1 | 15 | 8.3 | 8.08 | | 10.6 | 8.5 | 8.83 | 9.86 | 8.26 | 9.11 | 10.7 | 11.4 | 8.52 | 8.22 | | 10.5 | 8.73 | 8.58 | 9.47 | 8.72 | 8.22 | 8.88 | 8.49 | 8.48 |
| Manganese | mg/L | 0.0001 | | | | 0.0172 | 0.0282 | 0.0594 | 0.227 | 0.0377 | 0.0856 | 0.441 | 0.199 | 0.107 | | 0.0312 | 0.0068 | 0.04 | 0.0585 | 0.234 | 0.0411 | 0.0899 | 0.299 | 0.199 | 0.107 | | 0.00125 | 0.0061 | 0.0008 | 0.0116 | 0.251 | 0.245 | 0.0542 | 0.14 | 0.0501 |
| Molybdenum | mg/L | 0.0001 | 0.073 | 0.365 | | <0.0010 | 0.00468 | 0.00462 | 0.00367 | 0.00389 | 0.00575 | 0.00646 | 0.00759 | 0.00757 | | 0.00099 | <0.0010 | 0.00456 | 0.00465 | 0.00406 | 0.00416 | 0.00652 | 0.00557 | 0.00704 | 0.00768 | | 0.001 | 0.001 | 0.00381 | 0.00378 | 0.00408 | 0.00404 | 0.00441 | 0.00681 | 0.00578 |
| Nickel | mg/L | 0.001 | 0.15 | 0.75 | | <0.010 | 0.0016 | 0.0014 | 0.0019 | 0.0013 | 0.0017 | 0.0027 | 0.0015 | 0.001 | | 0.0015 | <0.010 | 0.0019 | 0.0011 | 0.002 | 0.0014 | 0.002 | 0.0023 | 0.0015 | 0.001 | | <0.0010 | <0.010 | <0.0010 | <0.0010 | 0.0022 | 0.0021 | 0.0012 | 0.0014 | <0.0010 |
| Phosphorus | mg/L | 0.1 | | | | <0.30 | <0.030 | <0.030 | <0.030 | 0.039 | 0.063 | 0.088 | 0.054 | 0.041 | | <0.10 | <0.30 | <0.030 | <0.030 | 0.03 | 0.048 | 0.037 | 0.065 | 0.041 | 0.041 | | <0.10 | <0.30 | <0.030 | <0.030 | 0.03 | 0.036 | 0.042 | 0.041 | 0.061 |
| Potassium | mg/L | 0.02 | | | | 5.99 | 7.32 | 6.84 | 6.39 | 7.42 | 9.26 | 14 | 8.95 | 9.78 | | 7.43 | 5.91 | 6.91 | 7.24 | 6.56 | 7.52 | 9.42 | 10.3 | 8.66 | 9.85 | | 7 | 6.01 | 6.4 | 6.9 | 6.58 | 6.41 | 7.86 | 8.86 | 10.2 |
| Rubidium | mg/L | 0.0002 | | | | 0.0041 | 0.00463 | 0.00593 | 0.00483 | 0.00562 | 0.00674 | 0.00931 | 0.00609 | 0.0069 | | 0.0047 | 0.0041 | 0.00457 | 0.00587 | 0.00489 | 0.00573 | 0.00687 | 0.00707 | 0.00577 | 0.00711 | | 0.00474 | 0.004 | 0.00446 | 0.00557 | 0.00502 | 0.00496 | 0.00596 | 0.00586 | 0.00659 |
| Selenium | mg/L | 0.001 | 0.001 | 0.005 | | <0.010 | 0.0027 | 0.0043 | 0.0028 | 0.004 | 0.0076 | 0.0056 | 0.0081 | 0.0112 | | 0.0019 | <0.010 | 0.0025 | 0.0042 | 0.003 | 0.0046 | 0.0067 | 0.0047 | 0.0078 | 0.0112 | | 0.0036 | <0.010 | 0.0027 | 0.0029 | 0.0036 | 0.0038 | 0.005 | 0.0066 | 0.0071 |
| Silicon | mg/L | 0.05 | | | | <0.50 | 0.118 | 0.523 | 1.19 | 0.24 | 0.68 | 0.95 | 0.78 | 0.3 | | 0.515 | <0.50 | 0.13 | 0.554 | 1.25 | 0.27 | 0.48 | 0.75 | 0.75 | 0.29 | | 0.42 | <0.50 | 0.073 | 0.454 | 1.3 | 1.27 | 0.35 | 0.59 | 0.21 |
| Silver | mg/L | 0.0001 | 0.0001 | 0.0005 | | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00011 | <0.00010 | <0.00010 | 0.00025 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00015 | <0.00010 | <0.00010 | 0.00025 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Sodium | mg/L | 0.02 | | | | 9.99 | 12.3 | 11.8 | 9.68 | 11.5 | 13.4 | 21 | 13.1 | 13 | | 12.8 | 10.1 | 12 | 12.1 | 9.62 | 11.5 | 14.8 | 15.9 | 13.3 | 13.3 | | 12.4 | 10.3 | 11.1 | 11.8 | 10.1 | 9.98 | 11.7 | 13.1 | 14.2 |
| Strontium | mg/L | 0.0001 | | | | 0.182 | 0.202 | 0.22 | 0.206 | 0.217 | 0.28 | 0.409 | 0.271 | 0.306 | | 0.217 | 0.184 | 0.194 | 0.217 | 0.222 | 0.215 | 0.299 | 0.299 | 0.248 | 0.305 | | 0.21 | 0.186 | 0.198 | 0.211 | 0.211 | 0.216 | 0.224 | 0.25 | 0.285 |
| Tellurium | mg/L | 0.0002 | | | | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Thallium | mg/L | 0.0001 | 0.0008 | 0.004 | | <0.0010 | <0.00010 | 0.0001 | 0.00014 | 0.00013 | <0.00010 | 0.00012 | 0.0001 | <0.00010 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.0001 | 0.00011 | <0.00010 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | 0.00017 | 0.00017 | 0.00014 | <0.00010 | <0.00010 |
| Thorium | mg/L | 0.0001 | | | | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Tin | mg/L | 0.0002 | | | | <0.0020 | <0.00020 | 0.00045 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | 0.0002 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Titanium | mg/L | 0.0002 | | | | 0.0027 | 0.00555 | 0.00589 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | | 0.00089 | 0.0026 | 0.00523 | 0.00616 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | | 0.00118 | 0.0028 | 0.00479 | 0.00581 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| Tungsten | mg/L | 0.0002 | | | | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00016 | <0.00010 | 0.00021 | 0.00019 | | <0.00020 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00019 | <0.00010 | 0.00018 | 0.00019 | | <0.00020 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00012 | 0.00013 | <0.00010 |
| Uranium | mg/L | 0.0001 | 0.015 | 0.075 | | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00011 | <0.00010 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.0001 | <0.00010 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Vanadium | mg/L | 0.0002 | | | | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Zinc | mg/L | 0.002 | 0.03 | 0.15 | | 0.058 | 0.119 | 0.21 | 0.515 | 0.428 | 0.506 | 0.935 | 0.224 | 0.335 | | 0.172 | 0.052 | 0.126 | 0.203 | 0.521 | 0.417 | 0.527 | 0.697 | 0.225 | 0.333 | | 0.118 | 0.047 | 0.0665 | 0.0837 | 0.51 | 0.519 | 0.439 | 0.256 | 0.382 |
| Zirconium | mg/L | 0.0004 | | | | <0.0040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | | <0.00040 | <0.0040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | | <0.00040 | <0.0040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 |

*RDL = reportable detection limit; TDS = total dissolved solids; TSS = total suspended solids; µmhos/cm = micromhos per centimetre; mg/L = milligrams per litre; TCU = true color unit; NTU = Nephelometric Turbidity Units; µg/L = micrograms per litre.*

Notes:

[a] *Canadian Council of Ministers of Environment (CCME) Water Quality Guidelines (2011) for the Protection of Freshwater Aquatic Life.*

[b] *Metal Mining Effluent Regulation (MMER) SOR/2002-222 Maximum authorized concentration in a grab sample*

[c] Detection limit adjusted for required dilution - ALS Lab Note

[d] AND-04, AND-05, AND-07 and AND-08 were not accessible in September 2014 due to low water levels and higher tailings

[e] Analysis conducted at Hudbay Laboratories

[1] Cadmium and Copper standards represented are based on average hardness within the Anderson TIA

[2] Aluminum standard presented is based on average hardness within the Anderson TIA pH >6.5

[3] The long-term exposure CWQG for the protection of freshwater life is 15 µg·L-1 for uranium

| |
|---|
| Exceeds CCME WQG Guideline |
| Exceeds 5 X CCME Guideline |
| Exceeds MMER Guideline |
| |

**Table 01. Anderson TIA, Anderson Creek and Anderson Bay Water Analytical Results**

| Parameter | Units | RDL | CCME WQG [a] | 5X CCME WQG | MMER [b] | AND-15 | | | | | | | | | | AND-16 | | | | | | | | | | | | AND-17 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date** | | | | | | 8-Mar-12 | 15-Jun-12 | 18-Jun-13 | 6-Oct-13 | 17-Jun-14 | 29-Sep-14 | 10-Dec-14 | 3-Mar-15 | 17-Jun-15 | | 8-Mar-12 | 15-Jun-12 | 18-Jun-13 | 6-Oct-13 | 17-Jun-14 | 29-Sep-14 | 10-Dec-14 | 10-Dec-14 | 3-Mar-15 | 16-Jun-15 | 22-Sep-15 | | 8-Mar-12 | 15-Jun-12 | 18-Jun-13 | 5-Oct-13 | 17-Jun-14 | 29-Sep-14 | 10-Dec-14 | 3-Mar-15 | 21-Sep-15 | 17-Jun-15 | 21-Sep-15 |
| **Conventional Parameters** | | | | | | | | | | | | | | | | | | | | | | | DUP-01 (AND-16) | | | | | | | | | | | | | | |
| Colour, True | CU | 5 | - | | | 5.1 | | <5.0 | <5.0 | 17.6 | 5.2 | <5.0 | <5.0 | 5.3 | | 5.6 | | <5.0 | <5.0 | 7.6 | 5.7 | <5.0 | <5.0 | <5.0 | <5.0 | 8.9 | | 6.5 | | <5.0 | <5.0 | 7.4 | 5.4 | <5.0 | 5.8 | 7.6 | <5.0 | 7.6 |
| Conductivity | umhos/cm | 20 | - | | | 583 | 505 | 592 | 723 | 709 | 849 | 1020 | 1110 | 912 | | 580 | 505 | 583 | 736 | 722 | 841 | 1030 | 1060 | 1160 | 822 | 1000 | | 655 | 504 | 581 | 722 | 722 | 836 | 1020 | 1160 | 997 | 886 | 997 |
| pH | pH units | 0.1 | 6.5 - 9.0 | | | 7.49 | 7.99 | 7.8 | 7.67 | 7.49 | 7.15 | 7.68 | 7.14 | 7.07 | | 7.48 | 8.01 | 7.88 | 7.62 | 7.48 | 7.27 | 7.38 | 7.72 | 7.21 | 7.13 | 7.31 | | 7.53 | 8 | 7.06 | 7.66 | 7.46 | 7.36 | 7.35 | 6.77 | 7.27 | 7.3 | 7.27 |
| Total Suspended Solids | mg/L | 5 | - | | 30.00 | <5.0 | <5.0 | 14 | <5.0 | 7 | 8 | 8 | <5.0 | <5.0 | | <5.0 | <5.0 | 6 | <5.0 | 8 | 5 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | | <5.0 | <5.0 | 5 | <5.0 | 8 | <5.0 | 5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| Total Dissolved Solids | mg/L | 5 | - | | | 396 | 334 | 434 | 524 | 528 | 634 | 766 | 907 | 743 | | 394 | 344 | 429 | 535 | 530 | 616 | 783 | 801 | 939 | 715 | 804 | | 456 | 342 | 433 | 519 | 525 | 615 | 790 | 889 | 785 | 657 | 785 |
| Turbidity | NTU | 0.1 | - | | | 0.89 | 1.3 | 3.26 | 2.02 | 12.2 | 5.47 | 12.2 | 10.4 | 10.9 | | 0.46 | 1.59 | 1.8 | 2.85 | 11.2 | 3.66 | 7.1 | 7.67 | 3.40 | 3.90 | 1.69 | | 0.66 | 1.5 | 1.53 | 1.62 | 9 | 2.98 | 8.5 | 3.55 | 1.5 | 4.5 | 1.5 |
| Hardness (as CaCO3) | mg/L | 0.3 | - | | | 292 | 230 | | | 308 | | | 518 | 540 | | 287 | 224 | | | 329 | | | | 539 | 478 | 507 | | 331 | 241 | | | 331 | | | 534 | 520 | 456 | 520 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Anions and Nutrients** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Acidity (as CaCO3) | mg/L | 2 | - | | | 4.2 | | 1.3 | 2 | 4.2 | 1.5 | 3.4 | 5.8 | 3.5 | | 4.2 | | 1.3 | 2.1 | 4.9 | 2.6 | 5.3 | 5.8 | 7.7 | 3.3 | 3.5 | | 4.6 | | 1.2 | 2 | 4.6 | 2.7 | 6.5 | 8.9 | 3.3 | 2.8 | 3.3 |
| Alkalinity, Total (as CaCO3) | mg/L | 20 | - | | | 58 | 50 | 46 | 37 | 35 | 22 | 28 | 33 | 26.2 | | 58 | 50 | 47 | 35 | 36 | 25 | 32 | 33 | 37.9 | 28.4 | 16.1 | | 66 | 51 | 41 | 37 | 36 | 26 | 33 | 42.9 | 15.8 | 27.7 | 15.8 |
| Bicarbonate (HCO3) | mg/L | 24 | - | | | 71 | 61 | 56 | 46 | 43 | 27 | 35 | 40.2 | 32 | | 71 | 61 | 57 | 43 | 44 | 31 | 39 | 40 | 46.3 | 34.6 | 19.6 | | 81 | 62 | 50 | 45 | 44 | 32 | 41 | 52.3 | 19.3 | 33.8 | 19.3 |
| Carbonate (CO3) | mg/L | 12 | - | | | <12 | <12 | <12 | <12 | <12 | <12 | <12 | <0.60 | <0.60 | | <12 | <12 | <12 | <12 | <12 | <12 | <12 | <12 | <0.60 | <0.60 | <0.60 | | <12 | <12 | <12 | <12 | <12 | <12 | <12 | <0.60 | <0.60 | <0.60 | <0.60 |
| Chloride | mg/L | 0.2 | 120 - 640 | | | 19.6 | 16.3 | 17.4 | 19 | 14.1 | 15 | 18.4 | 20.1 | 16.6 | | 19.8 | 16.2 | 17.3 | 18.9 | 14.5 | 15.1 | 19.4 | 19.4 | 21.7 | 16.6 | 19.4 | | 23.5 | 16.3 | 17.4 | 18.9 | 14.6 | 15.2 | 19.6 | 21 | 19.1 | 17 | 19.1 |
| Fluoride | mg/L | 0.02 | | | | 0.274 | 0.226 | 0.255 | 0.294 | 0.21 | 0.27 | 0.326 | 0.352 | 0.331 | | 0.275 | 0.227 | 0.252 | 0.299 | 0.22 | 0.26 | 0.336 | 0.336 | 0.364 | 0.295 | 0.334 | | 0.309 | 0.228 | 0.258 | 0.295 | 0.22 | 0.27 | 0.337 | 0.338 | 0.351 | 0.298 | 0.351 |
| Hydroxide (OH) | mg/L | 6.8 | - | | | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <0.34 | <0.34 | | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <0.34 | <0.34 | <0.34 | | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <0.34 | <0.34 | <0.34 | <0.34 |
| Silica, Reactive (as SiO2) | mg/L | 0.25 | - | | | 0.493 [c] | | | | | | | | | | 0.602 [c] | | | | | | | | | | | | 0.635 [c] | | | | | | | | | | |
| Sulfate | mg/L | 0.5 | - | | | 218 | 173 | 223 | 304 | 0.0291 | 0.0358 | 0.0459 | 0.0519 | 442 | | 218 | 172 | 218 | 313 | 0.0298 | 0.0357 | 0.0479 | 0.0479 | 0.055 | 433 | 510 | | 253 | 172 | 216 | 304 | 0.0297 | 0.0358 | 0.0477 | 0.052 | 500 | 430 | 500 |
| Ammonia, Total (as N) | mg/L | 0.01 | 2.33 - 7.32 | | | 0.18 | 0.072 | 0.355 | 0.423 | 0.85 | 0.49 [b] | 0.89 [c] | 1.17 [c] | 1.54 [c] | | 0.197 | 0.069 | 0.289 | 0.94 [c] | 0.95 | 0.61 [b] | 1.07 [c] | 1.13 [c] | 1.55 [c] | 1.41 [c] | 0.92 | | 0.193 | 0.066 | 0.276 | 0.476 | 0.92 | 0.64 | 1.09 [c] | 2.00 [c] | 0.92 | 1.46 [c] | 0.92 |
| Nitrate-N | mg/L | 0.005 | 13 | | | 0.098 | 0.197 | 0.299 | 0.306 | 0.43 | 0.709 | 1.12 | 1.13 | 0.784 | | 0.101 | 0.182 | 0.255 | 0.364 | 0.419 | 0.61 | 1.17 | 1.17 | 1.19 | 0.497 | 0.697 | | 0.12 | 0.151 | 0.237 | 0.302 | 0.406 | 0.567 | 0.982 | 0.611 | 0.648 | 0.484 | 0.648 |
| Nitrate and Nitrite as N | mg/L | 0.0051 | - | | | 0.098 | 0.195 | 0.314 | 0.308 | 0.43 | 0.709 | 1.13 | 1.14 | 0.95 | | 0.101 | 0.18 | 0.269 | 0.366 | 0.419 | 0.61 | 1.17 | 1.17 | 1.25 | 0.646 | 0.697 | | 0.12 | 0.149 | 0.249 | 0.304 | 0.406 | 0.567 | 0.982 | 0.718 | 0.648 | 0.603 | 0.648 |
| Nitrite-N | mg/L | 0.001 | 0.06 | | | <0.0010 | 0.0024 | 0.0148 | 0.0019 | <0.050 | <0.050 | 0.014 | 0.012 | 0.166 | | <0.0010 | 0.0025 | 0.0133 | 0.002 | <0.050 | <0.050 | <0.010 | <0.010 | 0.056 | 0.149 | <0.020 | | <0.0010 | 0.0021 | 0.0121 | 0.002 | <0.050 | <0.050 | <0.010 | 0.107 | <0.020 | 0.119 | <0.020 |
| Phosphorus (P)-Total | mg/L | 0.01 | - | | | <0.010 | 0.011 | <0.010 | 0.02 | 0.037 | 0.049 | 0.058 | 0.091 | 0.056 | | <0.010 | 0.012 | <0.010 | 0.022 | 0.039 | 0.045 | 0.061 | 0.063 | 0.069 | 0.06 | 0.049 | | <0.010 | 0.012 | <0.010 | 0.021 | 0.039 | 0.051 | 0.059 | 0.068 | 0.049 | 0.06 | 0.049 |
| Thiosulphate (S203) [e] | mg/L | 2.5 | | | | | | | 2.9 | 2.5 | | 6.6 | <2.5 | 3.5 | | | | | 2.9 | 2.5 | | 9.2 | | 3.4 | 3.5 | | | | | | 2.9 | 2.5 | | 3.5 | <2.5 | | 3.5 | |
| **Dissolved Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aluminum | mg/L | 0.002 | 0.1 | 0.5 | | <0.0020 | 0.021 | 0.0086 | 0.0038 | 0.0114 | 0.0158 | 0.0048 | 0.0023 | 0.0305 | | 0.0025 | 0.024 | 0.0058 | 0.0049 | 0.0078 | 0.0082 | 0.0045 | 0.0044 | 0.0031 | 0.0077 | 0.0101 | | <0.0020 | <0.020 | 0.0054 | 0.0038 | 0.0074 | 0.0067 | 0.0043 | 0.0036 | 0.0076 | 0.0079 | 0.0076 |
| Antimony | mg/L | 0.0002 | | | | 0.0132 | 0.0148 | 0.00865 | 0.00705 | 0.004 | 0.00422 | 0.00622 | 0.00589 | 0.00708 | | 0.0126 | 0.0141 | 0.00885 | 0.00703 | 0.004 | 0.00437 | 0.0065 | 0.00652 | 0.0067 | 0.00648 | 0.00532 | | 0.0143 | 0.0139 | 0.00864 | 0.00703 | 0.00395 | 0.00468 | 0.007 | 0.00594 | 0.0053 | 0.00625 | 0.0053 |
| Arsenic | mg/L | 0.0002 | 0.005 | 0.025 | | 0.00308 | 0.0038 | 0.00288 | 0.00227 | 0.00215 | 0.0017 | 0.0018 | 0.00189 | 0.00243 | | 0.00306 | 0.0037 | 0.00338 | 0.00206 | 0.00184 | 0.00151 | 0.00177 | 0.00178 | 0.00236 | 0.00237 | 0.0019 | | 0.00346 | 0.0036 | 0.0036 | 0.00236 | 0.00192 | 0.0015 | 0.00162 | 0.00196 | 0.00181 | 0.00218 | 0.00181 |
| Barium | mg/L | 0.0002 | | | | 0.0234 | 0.0188 | 0.0198 | 0.0264 | 0.0262 | 0.0286 | 0.0304 | 0.0316 | 0.0267 | | 0.023 | 0.0183 | 0.019 | 0.0264 | 0.0244 | 0.0297 | 0.0316 | 0.0312 | 0.0328 | 0.0257 | 0.0326 | | 0.0265 | 0.0183 | 0.0192 | 0.0264 | 0.0251 | 0.0296 | 0.0359 | 0.0347 | 0.0336 | 0.0248 | 0.0336 |
| Beryllium | mg/L | 0.0002 | | | | 0.00022 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Bismuth | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Boron | mg/L | 0.01 | 1.5 | 7.5 | | 0.021 | <0.10 | 0.02 | 0.026 | 0.025 | 0.034 | 0.023 | 0.023 | 0.022 | | 0.027 | 0.11 | 0.024 | 0.026 | 0.023 | 0.032 | 0.025 | 0.023 | 0.024 | 0.019 | 0.02 | | 0.026 | <0.10 | 0.025 | 0.026 | 0.023 | 0.035 | 0.026 | 0.025 | 0.02 | 0.021 | 0.02 |
| Cadmium | mg/L | 0.00001 | 0.00009 | 0.00045 | | 0.000095 | <0.00010 | 0.000217 | 0.000111 | 0.00179 | 0.000993 | 0.00126 | 0.00173 | 0.000562 | | 0.000095 | <0.00010 | 0.000106 | 0.000342 | 0.00158 | 0.00112 | 0.00135 | 0.00136 | 0.00119 | 0.000581 | 0.000727 | | 0.000086 | <0.00010 | 0.000093 | 0.000139 | 0.00158 | 0.00107 | 0.00131 | 0.000942 | 0.000685 | 0.000581 | 0.000685 |
| Calcium | mg/L | 0.05 | | | | 97.3 | 79.3 | 101 | 116 | 116 | 149 | 173 | 209 | 186 | | 100 | 80.2 | 91.5 | 119 | 125 | 145 | 188 | 183 | 221 | 168 | 200 | | 110 | 81.7 | 89.3 | 116 | 118 | 138 | 184 | 214 | 191 | 180 | 191 |
| Cesium | mg/L | 0.0001 | | | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Chromium | mg/L | 0.002 | | | | <0.0020 | <0.020 | <0.0020 | <0.0020 | <0.0020 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | | 0.0021 | <0.020 | <0.0020 | <0.0020 | <0.0020 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | | 0.0022 | <0.020 | <0.0020 | <0.0020 | <0.0020 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Cobalt | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | 0.00139 | 0.00026 | 0.0005 | 0.00086 | 0.00047 | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | 0.00119 | 0.00027 | 0.00063 | 0.00064 | 0.00089 | 0.00023 | 0.00027 | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | 0.00116 | 0.00027 | 0.00066 | 0.00115 | 0.00023 | 0.00023 | 0.00023 |
| Copper | mg/L | 0.0002 | 0.004 | 0.02 | | 0.00496 | 0.0072 | 0.00952 | 0.00356 | 0.0601 | 0.0346 | 0.0445 | 0.0524 | 0.0162 | | 0.00469 | 0.0066 | 0.00536 | 0.00801 | 0.0477 | 0.0289 | 0.059 | 0.0578 | 0.0439 | 0.0146 | 0.00805 | | 0.00563 | 0.0054 | 0.00499 | 0.00375 | 0.04 | 0.0252 | 0.0405 | 0.0164 | 0.00499 | 0.0153 | 0.00499 |
| Iron | mg/L | 0.1 | 0.3 | 1.5 | | <0.10 | <1.0 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | | <0.10 | <1.0 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | | <0.10 | <1.0 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Lead | mg/L | 0.00009 | 0.007 | 0.035 | | <0.000090 | <0.00090 | 0.000112 | <0.000090 | 0.00478 | 0.00294 | 0.00188 | 0.0012 | 0.000735 | | <0.000090 | <0.00090 | <0.000090 | 0.000113 | 0.00266 | 0.00121 | 0.0017 | 0.00159 | 0.00154 | 0.000129 | 0.000346 | | <0.000090 | <0.00090 | 0.000114 | <0.000090 | 0.00231 | 0.000976 | 0.0014 | 0.000152 | 0.000118 | 0.000124 | 0.000118 |
| Lithium | mg/L | 0.002 | | | | 0.0069 | <0.020 | 0.0055 | 0.0063 | 0.006 | 0.0068 | 0.0068 | 0.0071 | 0.0064 | | 0.0065 | <0.020 | 0.0058 | 0.0065 | 0.0059 | 0.0066 | 0.0074 | 0.0069 | 0.0074 | 0.0053 | 0.0069 | | 0.0043 | <0.020 | 0.0057 | 0.0064 | 0.0058 | 0.0064 | 0.0075 | 0.008 | 0.0069 | 0.0064 | 0.0069 |
| Magnesium | mg/L | 0.01 | | | | 10.5 | 8.41 | 9.06 | 9.39 | 9.54 | 8.72 | 10.7 | 11.1 | 8 | | 10.7 | 8.78 | 9.69 | 9.68 | 8.37 | 8.85 | 11.2 | 11.4 | 11.6 | 8.68 | 8.53 | | 12 | 9.01 | 9.59 | 9.51 | 8.67 | 9.13 | 12.2 | 11.6 | 8.59 | 8.33 | 8.59 |
| Manganese | mg/L | 0.0001 | | | | 0.00263 | 0.0082 | 0.00661 | 0.0102 | 0.279 | 0.0455 | 0.0877 | 0.268 | 0.167 | | 0.0028 | 0.0045 | 0.00019 | 0.0286 | 0.246 | 0.0534 | 0.113 | 0.112 | 0.241 | 0.135 | 0.0548 | | 0.00421 | 0.0033 | 0.00031 | 0.00542 | 0.247 | 0.0525 | 0.12 | 0.356 | 0.0507 | 0.13 | 0.0507 |
| Molybdenum | mg/L | 0.0001 | 0.073 | 0.365 | | 0.00113 | <0.0010 | 0.00403 | 0.00378 | 0.00395 | 0.00504 | 0.00653 | 0.00652 | 0.00819 | | 0.00114 | <0.0010 | 0.00367 | 0.00414 | 0.00394 | 0.00443 | 0.00704 | 0.00731 | 0.00789 | 0.00674 | 0.00601 | | 0.00113 | 0.0011 | 0.00338 | 0.0038 | 0.00387 | 0.00418 | 0.00643 | 0.00626 | 0.00561 | 0.00707 | 0.00561 |
| Nickel | mg/L | 0.001 | 0.15 | 0.75 | | <0.0010 | <0.010 | <0.0010 | <0.0010 | 0.0024 | 0.0011 | 0.0019 | 0.0026 | 0.0013 | | <0.0010 | <0.010 | <0.0010 | 0.001 | 0.0021 | 0.0013 | 0.0022 | 0.0021 | 0.0023 | 0.0014 | <0.0010 | | <0.0010 | <0.010 | 0.001 | <0.0010 | 0.0021 | 0.0013 | 0.002 | 0.002 | <0.0010 | 0.0014 | <0.0010 |
| Phosphorus | mg/L | 0.1 | | | | <0.10 | <0.30 | <0.030 | <0.030 | <0.030 | 0.048 | 0.036 | 0.057 | 0.044 | | <0.10 | <0.30 | <0.030 | <0.030 | <0.030 | 0.038 | 0.036 | 0.045 | 0.064 | 0.055 | 0.046 | | <0.10 | <0.30 | <0.030 | <0.030 | <0.030 | 0.044 | 0.051 | 0.054 | 0.045 | 0.042 | 0.045 |
| Potassium | mg/L | 0.02 | | | | 6.89 | 5.67 | 6.41 | 7.02 | 7.26 | 7.61 | 9.58 | 10.8 | 9.26 | | 7.12 | 5.86 | 6.82 | 7.05 | 6.6 | 7.79 | 10.2 | 9.93 | 11.2 | 9.38 | 9.71 | | 8.2 | 5.92 | 6.78 | 7.02 | 6.61 | 7.72 | 10.4 | 10.7 | 9.69 | 8.92 | 9.69 |
| Rubidium | mg/L | 0.0002 | | | | 0.00449 | 0.0041 | 0.00475 | 0.00556 | 0.00558 | 0.00588 | 0.00683 | 0.00739 | 0.00625 | | 0.00449 | 0.004 | 0.00451 | 0.00571 | 0.00497 | 0.00589 | 0.00725 | 0.00704 | 0.0077 | 0.0059 | 0.00649 | | 0.00524 | 0.004 | 0.00473 | 0.00555 | 0.00514 | 0.0057 | 0.00733 | 0.00776 | 0.00673 | 0.00592 | 0.00673 |
| Selenium | mg/L | 0.001 | 0.001 | 0.005 | | 0.0028 | <0.010 | 0.0026 | 0.0029 | 0.0032 | 0.0062 | 0.0068 | 0.0051 | 0.0118 | | 0.0012 | <0.010 | 0.002 | 0.00038 | 0.0035 | 0.0047 | 0.0068 | 0.0069 | 0.0057 | 0.0068 | 0.0077 | | 0.0023 | <0.010 | 0.0023 | 0.0031 | 0.0038 | 0.0045 | 0.0059 | 0.004 | 0.0065 | 0.0063 | 0.0065 |
| Silicon | mg/L | 0.05 | | | | 0.428 | 1.14 | 0.09 | 0.46 | 1.23 | 0.32 | 0.47 | 0.73 | 0.77 | | 0.465 | 1.28 | 0.065 | 0.51 | 1.3 | 0.34 | 0.55 | 0.55 | 0.92 | 0.56 | 0.22 | | 0.471 | 1.58 | 0.089 | 0.466 | 1.43 | 0.33 | 0.56 | 1.17 | 0.19 | 0.56 | 0.19 |
| Silver | mg/L | 0.0001 | 0.0001 | 0.0005 | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00013 | 0.00017 | <0.00010 | 0.00011 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00025 | 0.00024 | <0.00010 | <0.00010 | <0.00010 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Sodium | mg/L | 0.02 | | | | 12.4 | 9.98 | 12.3 | 11.9 | 11.4 | 11.7 | 15.1 | 16.2 | 13.6 | | 12.7 | 10.6 | 13 | 11.9 | 9.85 | 11.5 | 15.9 | 16.2 | 17.3 | 13.4 | 14 | | 14.2 | 10.7 | 12.8 | 12 | 10.3 | 11.6 | 15.9 | 16.4 | 14 | 13.2 | 14 |
| Strontium | mg/L | 0.0001 | | | | 0.21 | 0.188 | 0.206 | 0.21 | 0.207 | 0.22 | 0.289 | 0.323 | 0.263 | | 0.209 | 0.184 | 0.201 | 0.214 | 0.213 | 0.215 | 0.304 | 0.308 | 0.338 | 0.251 | 0.295 | | 0.238 | 0.186 | 0.208 | 0.21 | 0.212 | 0.226 | 0.331 | 0.332 | 0.28 | 0.259 | 0.28 |
| Tellurium | mg/L | 0.0002 | | | | <0.00045 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | 0.00052 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | 0.00022 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Thallium | mg/L | 0.0001 | 0.0008 | 0.004 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | 0.00016 | 0.00015 | <0.00010 | 0.00012 | <0.00010 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | 0.00017 | 0.00013 | 0.0001 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | 0.00016 | 0.00013 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Thorium | mg/L | 0.0001 | | | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Tin | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | 0.00023 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | <0.00020 | <0.0020 | <0.00020 | 0.00038 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Titanium | mg/L | 0.0002 | | | | 0.00094 | 0.0026 | 0.00494 | 0.00574 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | | 0.00056 | 0.0028 | 0.00469 | 0.00587 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | | 0.00072 | <0.0020 | 0.00478 | 0.00592 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| Tungsten | mg/L | 0.0002 | | | | <0.00020 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | 0.00023 | 0.00018 | 0.00012 | 0.00028 | | <0.00020 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | 0.00011 | 0.00022 | 0.00021 | 0.00018 | 0.00014 | <0.00010 | | <0.00020 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00017 | 0.00012 | <0.00010 | 0.00013 | <0.00010 |
| Uranium | mg/L | 0.0001 | 0.015 | 0.075 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Vanadium | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Zinc | mg/L | 0.002 | 0.03 | 0.15 | | 0.114 | 0.049 | 0.0873 | 0.0963 | 0.593 | 0.335 | 0.52 | 0.675 | 0.162 | | 0.116 | 0.043 | 0.0485 | 0.134 | 0.524 | 0.447 | 0.529 | 0.524 | 0.448 | 0.257 | 0.377 | | 0.114 | 0.038 | 0.0443 | 0.0948 | 0.516 | 0.439 | 0.568 | 0.397 | 0.382 | 0.255 | 0.382 |
| Zirconium | mg/L | 0.0004 | | | | <0.00040 | <0.0040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | | <0.00040 | <0.0040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | | <0.00040 | <0.0040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 |

*RDL = reportable detection limit; TDS = total dissolved solids; TSS = total suspended solids; µmhos/cm = micromhos per centimetre; mg/L = milligrams per litre; TCU = true color unit; NTU = Nephelometric Turbidity Units; µg/L = micrograms per litre.*

Notes:

[a] *Canadian Council of Ministers of Environment (CCME) Water Quality Guidelines (2011) for the Protection of Freshwater Aquatic Life.*

[b] *Metal Mining Effluent Regulation (MMER) SOR/2002-222 Maximum authorized concentration in a grab sample*

[c] Detection limit adjusted for required dilution - ALS Lab Note

[d] AND-04, AND-05, AND-07 and AND-08 were not accessible in September 2014 due to low water levels and higher tailings

[e] Analysis conducted at Hudbay Laboratories

[1] Cadmium and Copper standards represented are based on average hardness within the Anderson TIA

[2] Aluminum standard presented is based on average hardness within the Anderson TIA pH >6.5

[3] The long-term exposure CWQG for the protection of freshwater life is 15 µg·L-1 for uranium

Exceeds CCME WQG Guideline
Exceeds 5 X CCME Guideline
Exceeds MMER Guideline

**Table 01. Anderson TIA, Anderson Creek and Anderson Bay Water Analytical Results**

| Parameter | Units | RDL | CCME WQG [a] | 5X CCME WQG | MMER [b] | AND-18 | | | | | | | | | | AND-19 | | | | | | | | | | AND-20 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | | | | | | 8-Mar-12 | 15-Jun-12 | 18-Jun-13 | 5-Oct-13 | 17-Jun-14 | 29-Sep-14 | 10-Dec-14 | 3-Mar-15 | 17-Jun-15 | 17-Jun-15 | 22-Sep-15 | 8-Mar-12 | 15-Jun-12 | 18-Jun-13 | 5-Oct-13 | 5-Oct-13 | 17-Jun-14 | 29-Sep-14 | 10-Dec-14 | 3-Mar-15 | 17-Jun-15 | 21-Sep-15 | 8-Mar-12 | 15-Jun-12 | 18-Jun-13 | 5-Oct-13 | 17-Jun-14 | 29-Sep-14 | 10-Dec-14 | 3-Mar-15 | 17-Jun-15 | 21-Sep-15 | 8-Mar-12 |
| **Conventional Parameters** | | | | | | | | | | | | | | DUP-01 (AND-18) | | | | | | | DUP-01 (AND-19) | | | | | | | | | | | | | | | |
| Colour, True | CU | 5 | - | | | 7.5 | | <5.0 | 5.2 | 9.3 | 5.3 | <5.0 | 14.8 | <5.0 | 5.6 | 9.2 | 8.4 | | <5.0 | 8.6 | 9.1 | 10.6 | 5.3 | 5.5 | 10.4 | 5.3 | 9.4 | 6.7 | | 5.1 | 8.1 | 10.8 | 6 | 6.3 | 11.4 | 5.4 | 9.5 | 7.4 |
| Conductivity | umhos/cm | 20 | - | | | 604 | 505 | 574 | 723 | 722 | 832 | 1040 | 1130 | 896 | 901 | 997 | 607 | 503 | 563 | 676 | 677 | 723 | 802 | 1040 | 1090 | 870 | 947 | 615 | 505 | 564 | 678 | 723 | 799 | 1030 | 1120 | 863 | 949 | 635 |
| pH | pH units | 0.1 | 6.5 - 9.0 | | | 7.37 | 7.97 | 7.92 | 7.69 | 7.48 | 7.37 | 7.28 | 6.85 | 7.23 | 7.16 | 7.29 | 7.47 | 8.04 | 7.47 | 7.71 | 7.77 | 7.57 | 7.55 | 7.3 | 7.18 | 7.26 | 7.46 | 7.72 | 8.06 | 7.92 | 7.78 | 7.58 | 7.56 | 7.37 | 7.00 | 7.30 | 7.47 | 7.43 |
| Total Suspended Solids | mg/L | 5 | - | | 30.00 | <5.0 | <5.0 | <5.0 | <5.0 | 6 | 5 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | 5 | 5 | 5 | <5.0 | <5.0 | <5.0 | 5 | <5.0 | <5.0 | 7 | <5.0 | <5.0 | 6 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | 7 |
| Total Dissolved Solids | mg/L | 5 | - | | | 424 | 348 | 422 | 525 | 526 | 606 | 797 | 863 | 661 | 681 | 796 | 416 | 346 | 415 | 488 | 452 | 524 | 585 | 805 | 857 | 633 | 750 | 438 | 342 | 411 | 492 | 518 | 586 | 777 | 863 | 644 | 722 | 444 |
| Turbidity | NTU | 0.1 | - | | | 0.64 | 2.14 | 1.75 | 1.93 | 7.6 | 3.2 | 8.62 | 70.5 | 3.4 | 3.5 | 1.98 | 0.42 | 1.74 | 1.7 | 1.2 | 1.23 | 5.6 | 1.64 | 6.46 | 63.8 | 1.71 | 1.28 | 0.98 | 2.05 | 1.88 | 1.26 | 5.6 | 1.67 | 4.24 | 48.0 | 1.7 | 1.2 | 1.92 |
| Hardness (as CaCO3) | mg/L | 0.3 | - | | | 299 | 225 | | | 321 | | | 509 | 445 | 439 | 495 | 310 | 219 | | | | 335 | | | 517 | 439 | 484 | 310 | 232 | | | 353 | | | 599 | 440 | 483 | 327 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Anions and Nutrients** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Acidity (as CaCO3) | mg/L | 2 | - | | | 6.8 | | 1.2 | 2 | 3.9 | 2.8 | 7.7 | 9.7 | 3.3 | 3.7 | 5.3 | 5 | | 1 | 2.1 | 2.1 | 5.9 | 2.6 | 8.7 | 16 | 2.9 | 3.4 | 4 | | <1.0 | 1.9 | 4.7 | 2.8 | 9.8 | 14.3 | 2.9 | 3.6 | 5.4 |
| Alkalinity, Total (as CaCO3) | mg/L | 20 | - | | | 64 | 51 | 48 | 38 | 37 | 27 | 33 | 82.4 | 27.2 | 26.7 | 16.7 | 64 | 52 | 44 | 46 | 46 | 39 | 33 | 36 | 72 | 27.7 | 22.8 | 65 | 52 | 51 | 46 | 39 | 33 | 47 | 86.5 | 27.8 | 23.3 | 69 |
| Bicarbonate (HCO3) | mg/L | 24 | - | | | 78 | 62 | 58 | 47 | 45 | 33 | 40 | 101 | 33.2 | 32.6 | 20.4 | 78 | 63 | 53 | 56 | 56 | 47 | 40 | 44 | 87 | 33.8 | 27.8 | 79 | 63 | 62 | 57 | 47 | 41 | 58 | 106 | 33.9 | 28.4 | 85 |
| Carbonate (CO3) | mg/L | 12 | - | | | <12 | <12 | <12 | <12 | <12 | <12 | <12 | <0.60 | <0.60 | <0.60 | <0.60 | <12 | <12 | <12 | <12 | <12 | <12 | <12 | <12 | <12 | <0.60 | <0.60 | <12 | <12 | <12 | <12 | <12 | <12 | <12 | <0.60 | <0.60 | <0.60 | <12 |
| Chloride | mg/L | 0.2 | 120 - 640 | | | 20.7 | 16.4 | 17.5 | 19.1 | 14.7 | 15.3 | 20.2 | 26 | 16.8 | 17.2 | 20.6 | 20.9 | 16.2 | 17.1 | 18.2 | 18.2 | 14.7 | 15.3 | 20.1 | 21.3 | 16.3 | 16.8 | 21.3 | 16.3 | 17.2 | 18.3 | 14.7 | 15.3 | 20.9 | 22.4 | 16.3 | 17.7 | 22.1 |
| Fluoride | mg/L | 0.02 | | | | 0.287 | 0.216 | 0.256 | 0.294 | 0.22 | 0.3 | 0.349 | 0.364 | 0.296 | 0.295 | 0.394 | 0.293 | 0.225 | 0.252 | 0.277 | 0.277 | 0.22 | 0.27 | 0.343 | 0.314 | 0.284 | 0.335 | 0.295 | 0.227 | 0.253 | 0.279 | 0.22 | 0.28 | 0.341 | 0.333 | 0.281 | 0.327 | 0.3 |
| Hydroxide (OH) | mg/L | 6.8 | - | | | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <0.34 | <0.34 | <0.34 | <0.34 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <0.34 | <0.34 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <0.34 | <0.34 | <0.34 | <6.8 |
| Silica, Reactive (as SiO2) | mg/L | 0.25 | - | | | 0.65 [c] | | | | | | | | | | | 0.9 [c] | | | | | | | | | | | 0.631 [c] | | | | | | | | | | 0.0061 |
| Sulfate | mg/L | 0.5 | - | | | 225 | 170 | 213 | 302 | 0.0296 | 0.0355 | 0.049 | 0.0557 | 431 | 429 | 535 | 228 | 169 | 207 | 272 | 272 | 0.0295 | 0.0336 | 0.0483 | 0.0465 | 420 | 455 | 233 | 170 | 207 | 272 | 0.0295 | 0.0333 | 0.0474 | 0.0472 | 416 | 468 | 239 |
| Ammonia, Total (as N) | mg/L | 0.01 | 2.33 - 7.32 | | | 0.21 | 0.063 | 0.253 | 0.48 | 0.96 | 0.61 [b] | 1.11 [c] | 2.34 [c] | 1.48 [c] | 1.38 [c] | 0.91 | 0.195 | 0.029 | 0.205 | 0.393 | 0.337 | 1.02 | 0.62 [b] | 1.2 [c] | 2.45 [c] | 1.35 [c] | 0.84 | 0.126 | 0.038 | 0.205 | 0.337 | 1.02 | 0.61 [b] | 1.75 [c] | 2.46 [c] | 1.37 [c] | 0.85 | 0.178 |
| Nitrate-N | mg/L | 0.005 | 13 | | | 0.0742 | 0.14 | 0.2 | 0.292 | 0.39 | 0.498 | 1.01 | <0.020 | 0.508 | 0.485 | 0.62 | 0.185 | 0.0503 | 0.113 | 0.134 | 0.133 | 0.306 | 0.291 | 0.912 | 0.06 | 0.338 | 0.351 | 0.0771 | 0.0425 | 0.0873 | 0.114 | 0.308 | 0.269 | 0.511 | 0.031 | 0.327 | 0.411 | 0.0953 |
| Nitrate and Nitrite as N | mg/L | 0.0051 | - | | | 0.0742 | 0.138 | 0.211 | 0.294 | 0.39 | 0.498 | 1.01 | <0.070 | 0.654 | 0.603 | 0.62 | 0.185 | 0.0481 | 0.12 | 0.136 | 0.134 | 0.306 | 0.291 | 0.912 | <0.070 | 0.414 | 0.351 | 0.0771 | 0.0411 | 0.0925 | 0.116 | 0.308 | 0.269 | 0.511 | <0.070 | 0.4 | 0.411 | 0.0953 |
| Nitrite-N | mg/L | 0.001 | 0.06 | | | <0.0010 | 0.0019 | 0.0103 | 0.0021 | <0.050 | <0.050 | <0.010 | <0.010 | 0.145 | 0.119 | <0.020 | <0.0010 | 0.0022 | 0.0064 | 0.0019 | 0.0015 | <0.050 | <0.050 | <0.010 | <0.010 | 0.076 | <0.020 | <0.0010 | 0.0014 | 0.0052 | 0.0022 | <0.050 | <0.050 | <0.010 | <0.010 | 0.073 | <0.020 | <0.0010 |
| Phosphorus (P)-Total | mg/L | 0.01 | - | | | <0.010 | 0.012 | <0.010 | 0.021 | 0.038 | 0.043 | 0.062 | 0.071 | 0.057 | 0.059 | 0.048 | <0.010 | 0.017 | 0.013 | 0.02 | 0.021 | 0.036 | 0.042 | 0.061 | 0.08 [c] | 0.062 | 0.053 | 0.012 | 0.017 | 0.014 | 0.02 | 0.035 | 0.042 | 0.058 | 0.072 [c] | 0.059 | 0.05 | 0.044 |
| Thiosulphate (S203) [e] | mg/L | 2.5 | | | | | | | 2.9 | 2.5 | | 5.8 | <2.5 | | 3.5 | | | | | 2.9 | | 2.5 | | 4.6 | 2.6 | 3.5 | | | | 2.9 | 2.5 | | 3.5 | 2.6 | 3.5 | | | |
| **Dissolved Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aluminum | mg/L | 0.002 | 0.1 | 0.5 | | <0.0020 | <0.020 | 0.0054 | 0.0035 | 0.0063 | 0.0047 | 0.0048 | 0.0113 | 0.007 | 0.006 | 0.0067 | <0.0020 | <0.020 | 0.0063 | 0.0089 | 0.0085 | 0.0043 | 0.0042 | 0.0043 | 0.0085 | 0.0045 | 0.0071 | <0.0020 | <0.020 | 0.0058 | 0.0059 | 0.0042 | 0.003 | 0.0028 | 0.0072 | 0.0051 | 0.0069 | <0.0020 |
| Antimony | mg/L | 0.0002 | | | | 0.0128 | 0.0127 | 0.00827 | 0.00694 | 0.00455 | 0.00482 | 0.00695 | 0.00238 | 0.00628 | 0.00636 | 0.00552 | 0.013 | 0.0109 | 0.00711 | 0.00668 | 0.00662 | 0.00423 | 0.00578 | 0.00701 | 0.00204 | 0.00653 | 0.00566 | 0.0143 | 0.0107 | 0.00696 | 0.00685 | 0.00464 | 0.00585 | 0.00886 | 0.0028 | 0.00649 | 0.00549 | 0.014 |
| Arsenic | mg/L | 0.0002 | 0.005 | 0.025 | | 0.00324 | 0.0036 | 0.00322 | 0.0023 | 0.00181 | 0.00148 | 0.00166 | 0.00207 | 0.0021 | 0.00209 | 0.00182 | 0.00336 | 0.0031 | 0.00302 | 0.00267 | 0.00271 | 0.00179 | 0.00151 | 0.00155 | 0.00149 | 0.00191 | 0.0016 | 0.00351 | 0.0028 | 0.003 | 0.00276 | 0.00178 | 0.00141 | 0.00158 | 0.00121 | 0.00194 | 0.00153 | 0.00409 |
| Barium | mg/L | 0.0002 | | | | 0.0255 | 0.0184 | 0.0201 | 0.0262 | 0.0244 | 0.0298 | 0.0348 | 0.0429 | 0.0251 | 0.0254 | 0.0329 | 0.0245 | 0.02 | 0.0205 | 0.0263 | 0.0266 | 0.025 | 0.0299 | 0.0351 | 0.0423 | 0.0243 | 0.0299 | 0.0264 | 0.0202 | 0.0199 | 0.0267 | 0.0247 | 0.03 | 0.0395 | 0.0459 | 0.0242 | 0.029 | 0.0275 |
| Beryllium | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.10 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Bismuth | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00010 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Boron | mg/L | 0.01 | 1.5 | 7.5 | | 0.039 | <0.10 | 0.025 | 0.026 | 0.026 | 0.03 | 0.025 | 0.023 | 0.022 | 0.022 | 0.021 | 0.032 | <0.10 | 0.025 | 0.026 | 0.026 | 0.025 | 0.028 | 0.024 | 0.023 | 0.023 | 0.019 | 0.03 | <0.10 | 0.025 | 0.026 | 0.026 | 0.029 | 0.025 | 0.025 | 0.023 | 0.019 | 0.026 |
| Cadmium | mg/L | 0.00001 | 0.00009 | 0.00045 | | 0.000128 | <0.00010 | 0.0000038 | 0.000035 | 0.0014 | 0.000869 | 0.00126 | <0.000010 | 0.000453 | 0.000473 | 0.000326 | 0.000068 | <0.00010 | 0.000011 | 0.000017 | 0.000016 | 0.000892 | 0.000181 | 0.00122 | <0.000010 | 0.000292 | 0.000025 | 0.000022 | <0.0010 | 0.000016 | 0.000013 | 0.000847 | 0.000061 | 0.00004 | <0.000010 | 0.000306 | 0.000023 | <0.000010 |
| Calcium | mg/L | 0.05 | | | | 103 | 81.1 | 95.9 | 116 | 130 | 134 | 184 | 198 | 174 | 172 | 200 | 107 | 80.6 | 95.7 | 107 | 110 | 123 | 129 | 179 | 193 | 175 | 188 | 108 | 81.9 | 91 | 108 | 127 | 129 | 183 | 200 | 177 | 185 | 111 |
| Cesium | mg/L | 0.0001 | | | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0020 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Chromium | mg/L | 0.002 | | | | <0.0020 | <0.020 | <0.0020 | <0.0020 | <0.0020 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0020 | <0.020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0020 | <0.020 | <0.0020 | <0.0020 | <0.0020 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0020 |
| Cobalt | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | 0.00103 | 0.00025 | 0.00063 | 0.00051 | 0.00022 | 0.00022 | 0.00026 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <1.0 | <0.00020 | <0.00020 | 0.00054 | <0.00020 | 0.00043 | 0.00033 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Copper | mg/L | 0.0002 | 0.004 | 0.02 | | 0.00368 | 0.0045 | 0.00366 | 0.00269 | 0.0222 | 0.00936 | 0.0379 | <0.00020 | 0.0084 | 0.00856 | 0.00293 | 0.00405 | 0.0035 | 0.00186 | 0.00148 | 0.00158 | 0.0115 | 0.00742 | 0.0182 | <0.00020 | 0.00351 | 0.00178 | 0.00282 | 0.0029 | 0.00196 | 0.00129 | 0.0109 | 0.00232 | 0.00204 | <0.00020 | 0.00339 | 0.00171 | 0.0014 |
| Iron | mg/L | 0.1 | 0.3 | 1.5 | | <0.10 | <1.0 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | 0.54 | <0.10 | <0.10 | <0.10 | <0.10 | <1.0 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | 0.37 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | 0.26 | <0.10 | <0.10 | <0.10 |
| Lead | mg/L | 0.00009 | 0.007 | 0.035 | | <0.000090 | <0.00090 | 0.000095 | <0.000090 | 0.00247 | 0.000537 | 0.00131 | <0.000090 | 0.000096 | 0.000091 | 0.000253 | <0.000090 | <0.00090 | <0.000090 | <0.000090 | <0.000090 | 0.00081 | 0.000558 | 0.00149 | <0.000090 | <0.000090 | <0.000090 | <0.000090 | <0.00090 | <0.000090 | <0.000090 | 0.000749 | <0.000090 | 0.000155 | <0.000090 | <0.000090 | <0.000090 | <0.000090 |
| Lithium | mg/L | 0.002 | | | | 0.0082 | <0.020 | 0.0057 | 0.0063 | 0.0063 | 0.0062 | 0.0072 | 0.0073 | 0.0065 | 0.0065 | 0.0073 | 0.0065 | <0.020 | 0.0056 | 0.006 | 0.0063 | 0.0058 | 0.0061 | 0.0069 | 0.0072 | 0.0067 | 0.0066 | 0.0082 | <0.020 | 0.0056 | 0.0061 | 0.0062 | 0.006 | 0.0073 | 0.0076 | 0.0064 | 0.0064 | 0.0108 |
| Magnesium | mg/L | 0.01 | | | | 10.9 | 8.91 | 8.71 | 9.58 | 8.44 | 9.27 | 11.8 | 12.8 | 8.49 | 8.45 | 8.7 | 11.3 | 8.88 | 8.96 | 9.1 | 9.17 | 8.45 | 9.06 | 12.2 | 12.9 | 8.33 | 7.96 | 11.3 | 9.19 | 9.16 | 9.07 | 8.22 | 9.27 | 13.1 | 14.3 | 8.46 | 7.63 | 11.8 |
| Manganese | mg/L | 0.0001 | | | | 0.0173 | 0.0073 | 0.00035 | 0.00865 | 0.237 | 0.0499 | 0.12 | 0.63 | 0.112 | 0.118 | 0.0548 | 0.00835 | 0.0182 | 0.00027 | 0.0277 | 0.0275 | 0.186 | 0.0353 | 0.127 | 0.477 | 0.0495 | 0.0237 | 0.0197 | 0.0076 | 0.00028 | 0.0242 | 0.187 | 0.0336 | 0.141 | 0.526 | 0.0489 | 0.0236 | 0.0195 |
| Molybdenum | mg/L | 0.0001 | 0.073 | 0.365 | | 0.00138 | 0.0011 | 0.00303 | 0.00376 | 0.00422 | 0.00381 | 0.00636 | 0.00175 | 0.00661 | 0.00652 | 0.00554 | - | 0.0011 | 0.00244 | 0.00287 | 0.00293 | 0.00378 | 0.00339 | 0.00584 | 0.00104 | 0.00612 | 0.0052 | 0.00105 | <0.30 | 0.00229 | 0.00286 | 0.00414 | 0.00333 | 0.00428 | 0.001 | 0.00629 | 0.00506 | 0.00105 |
| Nickel | mg/L | 0.001 | 0.15 | 0.75 | | <0.0010 | <0.010 | <0.0010 | <0.0010 | 0.002 | 0.0013 | 0.002 | 0.001 | 0.0014 | 0.0014 | <0.0010 | <0.0010 | <0.010 | 0.001 | <0.0010 | <0.0010 | 0.0018 | <0.0010 | 0.002 | 0.001 | 0.0012 | <0.0010 | <0.0010 | <0.010 | <0.0010 | <0.0010 | 0.0017 | 0.0011 | 0.0019 | 0.0011 | 0.0012 | <0.0010 | <0.0010 |
| Phosphorus | mg/L | 0.1 | | | | <0.10 | <0.30 | <0.030 | <0.030 | <0.030 | 0.041 | 0.051 | 0.043 | 0.041 | 0.048 | 0.058 | <0.10 | <0.30 | <0.030 | <0.030 | <0.030 | 0.035 | 0.038 | 0.049 | 0.059 | 0.05 | 0.055 | <0.10 | <0.30 | <0.030 | <0.030 | <0.030 | 0.042 | 0.044 | 0.048 | 0.054 | 0.038 | <0.10 |
| Potassium | mg/L | 0.02 | | | | 7.34 | 5.8 | 6.56 | 7 | 6.61 | 7.66 | 10.5 | 10.6 | 8.54 | 8.92 | 10 | 7.61 | 5.81 | 6.56 | 6.59 | 6.7 | 6.69 | 7.11 | 10.2 | 10.5 | 8.58 | 8.9 | 7.73 | 5.89 | 6.61 | 6.62 | 6.86 | 7.1 | 10.3 | 10.9 | 8.58 | 8.46 | 8.1 |
| Rubidium | mg/L | 0.0002 | | | | 0.00486 | 0.0039 | 0.00428 | 0.00558 | 0.00507 | 0.00568 | 0.00726 | 0.00719 | 0.00576 | 0.00608 | 0.00638 | 0.00473 | 0.0039 | 0.00442 | 0.00512 | 0.00516 | 0.00497 | 0.00566 | 0.00725 | 0.00721 | 0.00608 | 0.00612 | 0.00494 | 0.0041 | 0.00435 | 0.00516 | 0.00508 | 0.00553 | 0.00729 | 0.00755 | 0.00582 | 0.00596 | 0.00508 |
| Selenium | mg/L | 0.001 | 0.001 | 0.005 | | 0.0015 | <0.010 | 0.0021 | 0.0026 | 0.0032 | 0.0041 | 0.0066 | 0.0011 | 0.0065 | 0.0057 | 0.0065 | 0.0012 | <0.010 | 0.0011 | 0.0015 | 0.0019 | 0.0027 | 0.0021 | 0.006 | <0.0010 | 0.004 | 0.002 | 0.0012 | <0.0010 | <0.0010 | 0.0018 | 0.0028 | 0.0023 | 0.0033 | <0.0010 | 0.004 | 0.0039 | 0.0016 |
| Silicon | mg/L | 0.05 | | | | 0.472 | 1.7 | 0.13 | 0.458 | 1.34 | 0.33 | 0.6 | 2.16 | 0.48 | 0.49 | 0.25 | 0.446 | 1.28 | 0.222 | 0.546 | 0.556 | 1.25 | 0.18 | 0.69 | 2.06 | 0.19 | 0.24 | 0.403 | 1.54 | 0.223 | 0.446 | 1.31 | 0.17 | 0.55 | 1.73 | 0.19 | 0.21 | 0.401 |
| Silver | mg/L | 0.0001 | 0.0001 | 0.0005 | | 0.0001 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Sodium | mg/L | 0.02 | | | | 13 | 10.7 | 11.5 | 12 | 10.5 | 12 | 16.8 | 16.8 | 13.1 | 13.4 | 14.1 | 13.3 | 10.5 | 11.9 | 11.5 | 11.6 | 10.1 | 11.5 | 16.9 | 17 | 13.5 | 12.3 | 13.5 | 10.8 | 12.2 | 11.5 | 9.92 | 11.3 | 17 | 17.1 | 13 | 11.8 | 14.4 |
| Strontium | mg/L | 0.0001 | | | | 0.22 | 0.184 | 0.186 | 0.212 | 0.235 | 0.214 | 0.304 | 0.32 | 0.251 | 0.252 | 0.279 | 0.217 | 0.181 | 0.195 | 0.198 | 0.2 | 0.226 | 0.216 | 0.301 | 0.327 | 0.246 | 0.272 | 0.23 | 0.184 | 0.19 | 0.2 | 0.238 | 0.21 | 0.317 | 0.338 | 0.253 | 0.274 | 0.234 |
| Tellurium | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Thallium | mg/L | 0.0001 | 0.0008 | 0.004 | | 0.00013 | <0.0010 | <0.00010 | <0.00010 | 0.00016 | 0.00011 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | 0.0001 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00020 | <0.00010 | <0.00010 | <0.00010 | 0.00011 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Thorium | mg/L | 0.0001 | | | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00020 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Tin | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | <0.00020 | 0.00048 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | 0.00046 | 0.00045 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0010 | <0.00020 | 0.00055 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Titanium | mg/L | 0.0002 | | | | 0.0008 | <0.0020 | 0.00481 | 0.00578 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | 0.00063 | <0.0020 | 0.00441 | 0.00527 | 0.00524 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | 0.00085 | <0.0010 | 0.00458 | 0.00523 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | 0.00075 |
| Tungsten | mg/L | 0.0002 | | | | <0.00020 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00017 | 0.00046 | 0.00011 | 0.00011 | <0.00010 | <0.00020 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00015 | 0.00028 | <0.00010 | <0.00010 | <0.00020 | <0.0020 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.0002 | <0.00010 | <0.00010 | <0.00020 |
| Uranium | mg/L | 0.0001 | 0.015 | 0.075 | | 0.00014 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.020 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Vanadium | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0040 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Zinc | mg/L | 0.002 | 0.03 | 0.15 | | 0.0981 | 0.033 | 0.0281 | 0.0539 | 0.489 | 0.393 | 0.56 | 0.0035 | 0.231 | 0.239 | 0.345 | 0.108 | 0.021 | 0.0104 | 0.0146 | 0.0139 | 0.374 | 0.227 | 0.545 | 0.0038 | 0.157 | 0.146 | 0.0954 | <0.020 | 0.0104 | 0.0106 | 0.372 | 0.2 | 0.397 | 0.0051 | 0.158 | 0.132 | 0.0507 |
| Zirconium | mg/L | 0.0004 | | | | <0.00040 | <0.0040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.0040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.0040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 |

*RDL = reportable detection limit; TDS = total dissolved solids; TSS = total suspended solids; µmhos/cm = micromhos per centimetre; mg/L = milligrams per litre; TCU = true color unit; NTU = Nephelometric Turbidity Units; µg/L = micrograms per litre.*

Notes:

[a] *Canadian Council of Ministers of Environment (CCME) Water Quality Guidelines (2011) for the Protection of Freshwater Aquatic Life.*

[b] *Metal Mining Effluent Regulation (MMER) SOR/2002-222 Maximum authorized concentration in a grab sample*

[c] Detection limit adjusted for required dilution - ALS Lab Note

[d] AND-04, AND-05, AND-07 and AND-08 were not accessible in September 2014 due to low water levels and higher tailings

[e] Analysis conducted at Hudbay Laboratories

[1] Cadmium and Copper standards represented are based on average hardness within the Anderson TIA

[2] Aluminum standard presented is based on average hardness within the Anderson TIA pH >6.5

[3] The long-term exposure CWQG for the protection of freshwater life is 15 µg·L-1 for uranium

Exceeds CCME WQG Guideline
Exceeds 5 X CCME Guideline
Exceeds MMER Guideline

**Table 01. Anderson TIA, Anderson Creek and Anderson Bay Water Analytical Results**

| Parameter | Units | RDL | CCME WQG [a] | 5X CCME WQG | MMER [b] | AND-21 | | | | | | | | | | AND-22 | | | | AND-23 | | | | | | AND-24 | | | | | ANC-01 | | ANC-02 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | | | | | | 15-Jun-12 | 18-Jun-13 | 5-Oct-13 | 17-Jun-14 | 29-Sep-14 | 10-Dec-14 | 3-Mar-15 | 17-Jun-15 | 21-Sep-15 | | 29-Sep-14 | 10-Dec-14 | 17-Jun-15 | 22-Sep-15 | 29-Sep-14 | 10-Dec-14 | 3-Mar-15 | 17-Jun-15 | 22-Sep-15 | 22-Sep-15 | 30-Sep-14 | 9-Dec-14 | 4-Mar-15 | 17-Jun-15 | 23-Sep-15 | 30-May-11 | 15-Sep-11 | 22-May-11 | 17-Sep-11 |
| **Conventional Parameters** | | | | | | | | | | | | | | | | | | | | | | | | DUP-01 | | | | | | | | | | |
| Colour, True | CU | 5 | - | | | | <5.0 | 6.4 | 11.2 | 7.3 | 6 | 6.2 | <5.0 | 8.6 | | <5.0 | <5.0 | <5.0 | 9.8 | 5.4 | 5.3 | 13 | 6.7 | 8 | 6.1 | 8.4 | 8.3 | 9.3 | 10.3 | 11.8 | 11.5 | 10.2 | 13.5 | 7.5 |
| Conductivity | umhos/cm | 20 | - | | | 503 | 560 | 680 | 723 | 792 | 974 | 1110 | 862 | 945 | | 835 | 1020 | 903 | 1000 | 822 | 1020 | 1110 | 876 | 1000 | 995 | 725 | 915 | 909 | 770 | 926 | 501 | 498 | 492 | 503 |
| pH | pH units | 0.1 | 6.5 - 9.0 | | | 8.08 | 8.03 | 7.81 | 7.55 | 7.55 | 7.03 | 7.09 | 7.25 | 7.46 | | 7.18 | 7.41 | 7.57 | 7.33 | 7.42 | 7.28 | 7.08 | 7.27 | 7.31 | 7.3 | 7.51 | 7.35 | 7.01 | 7.32 | 6.92 | 7.86 | 7.93 | 8.02 | 7.39 |
| Total Suspended Solids | mg/L | 5 | - | | 30.00 | <5.0 | 6 | 5 | <5.0 | 6 | <5.0 | <5.0 | <5.0 | <5.0 | | 6.0 | <5.0 | <5.0 | 6.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | 7.0 | 11.0 | 14.0 | 7.0 |
| Total Dissolved Solids | mg/L | 5 | - | | | 336 | 401 | 491 | 520 | 570 | 787 | 885 | 653 | 713 | | 628 | 780 | 720 | 794 | 612 | 772 | 839 | 645 | 774 | 774 | 525 | 710 | 704 | 605 | 687 | 330 | 332 | 320 | 344 |
| Turbidity | NTU | 0.1 | - | | | 2.02 | 1.84 | 2.19 | 5.5 | 1.89 | 4.33 | 3.22 | 2 | 1.41 | | 2.76 | 10.9 | 4.4 | 1.9 | 2.47 | 7.16 | 31.4 | 2.7 | 1.22 | 1.43 | 3.58 | 5.36 | 3.19 | 3.3 | 2.2 | 3.23 | 2.93 | 3.42 | 6.26 |
| Hardness (as CaCO3) | mg/L | 0.3 | - | | | 229 | | | 345 | | | 527 | 457 | 468 | | | | 459 | 534 | | | 546 | 414 | 537 | 479 | - | - | - | 421 | 504 | 226 | 241 | 212 | 256 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Anions and Nutrients** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Acidity (as CaCO3) | mg/L | 2 | - | | | | 1.1 | 2 | 4 | 4.3 | 8.8 | 8.3 | 3.5 | 5.9 | | 2.2 | 4.9 | 3 | 3.7 | 2.3 | 6.1 | 1.2 | 3.4 | 3.5 | 3.8 | 2.7 | 4.6 | 8.1 | 2.8 | 3.5 | 2.3 | 1.4 | 1.6 | 2.8 |
| Alkalinity, Total (as CaCO3) | mg/L | 20 | - | | | 52 | 50 | 46 | 39 | 35 | 43 | 61.7 | 27.7 | 23.6 | | 24 | 31 | 27.8 | 16.2 | 28 | 33 | 73.7 | 27.4 | 17 | 16.2 | 35 | 41 | 48 | 28.7 | 14.7 | 54.5 | 53.5 | 53.6 | 55.1 |
| Bicarbonate (HCO3) | mg/L | 24 | - | | | 63 | 61 | 57 | 47 | 43 | 52 | 75.3 | 33.8 | 28.8 | | 30 | 38 | 33.9 | 19.8 | 34 | 40 | 89.9 | 33.4 | 20.7 | 19.8 | 43 | 51 | 58 | 35 | 17.9 | 66.5 | 65.3 | 65.3 | 67.2 |
| Carbonate (CO3) | mg/L | 12 | - | | | <12 | <12 | <12 | <12 | <12 | <12 | <0.60 | <0.60 | <0.60 | | <12 | <12 | <0.60 | <0.60 | <12 | <12 | <0.60 | <0.60 | <0.60 | <0.60 | <12 | <12 | <12 | <0.60 | <0.60 | <0.60 | <0.60 | <0.60 | <0.60 |
| Chloride | mg/L | 0.2 | 120 - 640 | | | 16.2 | 17 | 18.4 | 14.7 | 15.3 | 20.3 | 22.4 | 16.3 | 17.7 | | 15.2 | 19 | 16.8 | 19.3 | 15.1 | 19.7 | 21.7 | 16.5 | 19.5 | 18.9 | 13.6 | 17.8 | 18.8 | 14.1 | 17.3 | 16.3 | 17.2 | 15.5 | 17.2 |
| Fluoride | mg/L | 0.02 | | | | 0.222 | 0.25 | 0.28 | 0.22 | 0.29 | 0.324 | 0.337 | 0.285 | 0.329 | | 0.30 | 0.33 | 0.30 | 0.34 | 0.27 | 0.337 | 0.327 | 0.281 | 0.34 | 0.333 | 0.28 | 0.33 | 0.335 | 0.264 | 0.333 | 0.23 | 0.25 | 0.182 | 0.24 |
| Hydroxide (OH) | mg/L | 6.8 | - | | | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <6.8 | <0.34 | <0.34 | <0.34 | | <6.8 | <6.8 | <0.34 | <0.34 | <6.8 | <6.8 | <0.34 | <0.34 | <0.34 | <0.34 | <6.8 | <6.8 | <6.8 | <0.34 | <0.34 | <0.40 | <0.40 | <0.40 | <0.40 |
| Silica, Reactive (as SiO2) | mg/L | 0.25 | - | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0.159 | 0.957 | 0.258 | 0.859 |
| Sulfate | mg/L | 0.5 | - | | | 169 | 204 | 273 | 0.0295 | 0.0329 | 0.0466 | 0.0504 | 419 | 468 | | 0.0362 | 0.0472 | 433 | 513 | 0.0353 | 0.0479 | 0.0483 | 423 | 508 | 476 | 0.0294 | 0.0409 | 0.0428 | 369 | 482 | 171 | 179 | 163 | 178 |
| Ammonia, Total (as N) | mg/L | 0.01 | 2.33 - 7.32 | | | 0.022 | 0.168 | 0.252 | 1.09 | 0.63 [c] | 1.35 [c] | 1.88 [c] | 1.3 [c] | 0.82 | | 0.70 [c] | 0.98 [c] | 1.44 [c] | 1.13 | 0.68 [c] | 1.11 [c] | 2.28 [g] | 1.4 [c] | 0.89 | 0.91 | 0.131 | 0.443 | 0.54 [c] | 0.74 [c] | 0.61 | <0.050 | <0.050 | <0.050 | <0.050 |
| Nitrate-N | mg/L | 0.005 | 13 | | | 0.0296 | 0.0811 | 0.103 | 0.299 | 0.236 | 0.532 | 0.122 | 0.335 | 0.399 | | 0.618 | 1.17 | 0.508 | 0.678 | 0.501 | 0.935 | 0.024 | 0.416 | 0.596 | 0.588 | 0.284 | 0.468 | 0.458 | 0.416 | 0.703 | <0.050 | <0.050 | - | <0.050 |
| Nitrate and Nitrite as N | mg/L | 0.0051 | - | | | 0.028 | 0.0861 | 0.106 | 0.299 | 0.236 | 0.532 | 0.14 | 0.408 | 0.399 | | 0.618 | 1.17 | 0.657 | 0.678 | 0.501 | 0.935 | <0.070 | 0.514 | 0.596 | 0.588 | 0.284 | 0.468 | 0.458 | 0.495 | 0.703 | <0.071 | <0.071 | 0.060 | <0.071 |
| Nitrite-N | mg/L | 0.001 | 0.06 | | | 0.0016 | 0.005 | 0.0023 | <0.050 | <0.050 | <0.010 | 0.018 | 0.073 | <0.020 | | <0.050 | <0.010 | 0.149 | <0.020 | <0.050 | <0.010 | 0.014 | 0.097 | <0.020 | <0.010 | <0.050 | <0.010 | <0.010 | 0.079 | <0.020 | <0.050 | <0.050 | - | <0.050 |
| Phosphorus (P)-Total | mg/L | 0.01 | - | | | 0.018 | 0.013 | 0.026 | 0.036 | 0.065 | 0.057 | 0.072 [c] | 0.063 | 0.05 | | 0.046 | 0.06 | 0.057 | 0.049 | 0.046 | 0.058 | 0.02 | 0.058 | 0.048 | 0.048 | 0.034 | 0.049 | 0.047 | 0.05 | 0.045 | 0.014 | 0.016 | 0.017 | 0.017 |
| Thiosulphate (S203) [e] | mg/L | 2.5 | | | | | | 2.9 | 2.5 | | 3.5 | <2.5 | 3.5 | | | | 9.2 | 3.5 | | | 4.6 | <2.5 | 3.5 | | | | 3.5 | <2.5 | 3.5 | | | | | |
| **Dissolved Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aluminum | mg/L | 0.002 | 0.1 | 0.5 | | <0.020 | 0.0054 | 0.0046 | 0.0043 | 0.003 | 0.003 | 0.002 | 0.0041 | 0.006 | | 0.0108 | 0.0047 | 0.0081 | 0.0094 | 0.0056 | 0.0043 | 0.0093 | 0.0058 | 0.0062 | 0.0057 | 0.0052 | 0.003 | 0.0025 | 0.0064 | 0.0145 | 0.0070 | 0.0030 | 0.0071 | 0.0027 |
| Antimony | mg/L | 0.0002 | | | | 0.0101 | 0.00693 | 0.00688 | 0.00484 | 0.00594 | 0.00867 | 0.00627 | 0.00628 | 0.00563 | | 0.00439 | 0.00635 | 0.00627 | 0.00533 | 0.0049 | 0.0069 | 0.0033 | 0.0063 | 0.0055 | 0.0054 | 0.00582 | 0.00625 | 0.00583 | 0.00529 | 0.00521 | 0.0111 | 0.00733 | 0.0112 | 0.00755 |
| Arsenic | mg/L | 0.0002 | 0.005 | 0.025 | | 0.0028 | 0.00286 | 0.00263 | 0.00179 | 0.00143 | 0.00146 | 0.00119 | 0.00179 | 0.00149 | | 0.0016 | 0.0017 | 0.0022 | 0.0019 | 0.00145 | 0.00155 | 0.00164 | 0.0021 | 0.00167 | 0.00175 | 0.00255 | 0.00207 | 0.00144 | 0.00176 | 0.0025 | 0.00289 | 0.00225 | 0.00321 | 0.00247 |
| Barium | mg/L | 0.0002 | | | | 0.0199 | 0.0206 | 0.0265 | 0.0255 | 0.0294 | 0.0403 | 0.0435 | 0.0243 | 0.0288 | | 0.03 | 0.0316 | 0.0251 | 0.033 | 0.0299 | 0.0342 | 0.0413 | 0.0249 | 0.0318 | 0.031 | 0.0297 | 0.0426 | 0.0428 | 0.0239 | 0.0298 | 0.0195 | 0.0239 | 0.0178 | 0.0241 |
| Beryllium | mg/L | 0.0002 | | | | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Bismuth | mg/L | 0.0002 | | | | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Boron | mg/L | 0.01 | 1.5 | 7.5 | | <0.10 | 0.025 | 0.027 | 0.026 | 0.03 | 0.024 | 0.024 | 0.022 | 0.019 | | 0.035 | 0.027 | 0.022 | 0.021 | 0.035 | 0.024 | 0.023 | 0.023 | 0.021 | 0.02 | 0.032 | 0.029 | 0.022 | 0.021 | 0.022 | 0.026 | 0.021 | 0.021 | 0.023 |
| Cadmium | mg/L | 0.00001 | 0.00009 | 0.00045 | | <0.00010 | 0.000018 | 0.000013 | 0.000793 | 0.000103 | 0.000809 | 0.000049 | 0.000194 | 0.000013 | | 0.00112 | 0.00133 | 0.000601 | 0.000718 | 0.00899 | 0.00125 | <0.000010 | 0.000436 | 0.000165 | 0.000172 | 0.000545 | 0.00128 | 0.00139 | 0.000555 | 0.000656 | <0.000010 | 0.000014 | <0.000010 | <0.000010 |
| Calcium | mg/L | 0.05 | | | | 80.2 | 88.4 | 108 | 135 | 125 | 176 | 197 | 173 | 182 | | 144 | 186 | 174 | 200 | 144 | 179 | 202 | 175 | 196 | 196 | 118 | 181 | 152 | 152 | 194 | 76.8 | 82.1 | 73.2 | 88.2 |
| Cesium | mg/L | 0.0001 | | | | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Chromium | mg/L | 0.002 | | | | <0.020 | <0.0020 | <0.0020 | <0.0020 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0020 | <0.0020 | <0.0020 | <0.0020 |
| Cobalt | mg/L | 0.0002 | | | | <0.0020 | <0.00020 | <0.00020 | 0.00052 | <0.00020 | 0.00039 | 0.00099 | <0.00020 | <0.00020 | | 0.00028 | 0.00055 | 0.00025 | 0.00023 | 0.00025 | 0.00066 | 0.00045 | <0.00020 | 0.00023 | 0.00024 | 0.00021 | 0.00047 | 0.00068 | <0.00020 | 0.0006 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Copper | mg/L | 0.0002 | 0.004 | 0.02 | | 0.003 | 0.00199 | 0.0016 | 0.00802 | 0.00225 | 0.0126 | 0.00125 | 0.00258 | 0.00169 | | 0.0305 | 0.0509 | 0.0156 | 0.00812 | 0.0149 | 0.0375 | <0.00020 | 0.00681 | 0.00236 | 0.00233 | 0.00912 | 0.0141 | 0.0153 | 0.00854 | 0.0117 | 0.00307 | 0.00156 | 0.00276 | 0.00140 |
| Iron | mg/L | 0.1 | 0.3 | 1.5 | | <1.0 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | 0.54 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Lead | mg/L | 0.00009 | 0.007 | 0.035 | | <0.00090 | <0.000090 | <0.000090 | 0.000968 | <0.000090 | 0.00105 | <0.000090 | <0.000090 | <0.000090 | | 0.00246 | 0.00174 | 0.000144 | 0.000305 | 0.000603 | 0.00149 | <0.000090 | <0.000090 | 0.000165 | 0.000146 | 0.00234 | 0.00111 | 0.00035 | <0.000090 | 0.0011 | <0.000090 | <0.000090 | <0.000090 | <0.000090 |
| Lithium | mg/L | 0.002 | | | | <0.020 | 0.0052 | 0.0061 | 0.0062 | 0.006 | 0.0072 | 0.0072 | 0.0063 | 0.0063 | | 0.0066 | 0.0076 | 0.0066 | 0.0071 | 0.0065 | 0.0071 | 0.0072 | 0.0065 | 0.0077 | 0.0067 | 0.0059 | 0.0075 | 0.0064 | 0.0058 | 0.0075 | 0.0082 | 0.0053 | 0.0047 | 0.0067 |
| Magnesium | mg/L | 0.01 | | | | 9.22 | 8.72 | 9.09 | 8.25 | 9.21 | 12.7 | 13.3 | 8.35 | 7.88 | | 9.02 | 11.1 | 8.26 | 8.77 | 9.1 | 12.2 | 12.7 | 8.15 | 8.6 | 8.33 | 9.1 | 11.6 | 11 | 8.13 | 8.01 | 8.35 | 8.68 | 7.15 | 8.59 |
| Manganese | mg/L | 0.0001 | | | | 0.0104 | 0.00026 | 0.0169 | 0.184 | 0.0312 | 0.13 | 0.644 | 0.0439 | 0.0205 | | 0.0544 | 0.0992 | 0.137 | 0.0523 | 0.0504 | 0.1180 | 0.4820 | 0.0886 | 0.0543 | 0.0530 | 0.0265 | 0.1 | 0.272 | 0.062 | 0.101 | 0.00159 | 0.00530 | 0.00245 | 0.0107 |
| Molybdenum | mg/L | 0.0001 | 0.073 | 0.365 | | <0.0010 | 0.0021 | 0.00285 | 0.00429 | 0.00318 | 0.00395 | 0.00277 | 0.00621 | 0.005 | | 0.00431 | 0.00699 | 0.00683 | 0.00587 | 0.00404 | 0.006 | 0.00181 | 0.00639 | 0.00543 | 0.00553 | 0.00308 | 0.00332 | 0.00254 | 0.00452 | 0.00573 | 0.00088 | 0.00046 | 0.00084 | 0.00082 |
| Nickel | mg/L | 0.001 | 0.15 | 0.75 | | <0.010 | <0.0010 | <0.0010 | 0.0017 | <0.0010 | 0.0019 | 0.0014 | 0.0012 | <0.0010 | | 0.0013 | 0.002 | 0.0014 | <0.0010 | 0.0013 | 0.0019 | 0.0012 | 0.0013 | <0.0010 | <0.0010 | 0.0013 | 0.002 | 0.0017 | 0.0014 | 0.001 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Phosphorus | mg/L | 0.1 | | | | <0.30 | <0.030 | <0.030 | <0.030 | 0.039 | 0.033 | 0.053 | 0.045 | 0.045 | | 0.042 | 0.045 | 0.048 | 0.054 | 0.039 | 0.04 | 0.061 | 0.052 | 0.057 | 0.047 | <0.030 | 0.043 | 0.035 | 0.052 | 0.04 | <0.10 | <0.10 | <0.10 | <0.10 |
| Potassium | mg/L | 0.02 | | | | 5.8 | 6.54 | 6.6 | 6.5 | 7.03 | 9.85 | 10.4 | 8.63 | 8.49 | | 7.71 | 10.20 | 9.04 | 10.50 | 7.63 | 10.4 | 11 | 8.68 | 10.4 | 9.67 | 6.72 | 9.31 | 8.94 | 7.96 | 9.11 | 5.88 | 5.91 | 5.10 | 6.07 |
| Rubidium | mg/L | 0.0002 | | | | 0.004 | 0.00438 | 0.00515 | 0.00503 | 0.00549 | 0.00702 | 0.00694 | 0.00587 | 0.00594 | | 0.00593 | 0.00698 | 0.00592 | 0.00647 | 0.00579 | 0.0072 | 0.00747 | 0.00601 | 0.00642 | 0.00654 | 0.0054 | 0.0067 | 0.00649 | 0.00536 | 0.00665 | 0.00360 | 0.00371 | 0.00311 | 0.00383 |
| Selenium | mg/L | 0.001 | 0.001 | 0.005 | | <0.010 | 0.0016 | 0.0011 | 0.0026 | 0.0023 | 0.0035 | 0.0019 | 0.0038 | 0.0033 | | 0.0051 | 0.0066 | 0.0065 | 0.0074 | 0.0038 | 0.0062 | <0.0010 | 0.0048 | 0.0059 | 0.0058 | 0.0019 | 0.0024 | 0.0019 | 0.0026 | 0.0069 | 0.0013 | <0.0010 | 0.0014 | <0.0010 |
| Silicon | mg/L | 0.05 | | | | 2.17 | 0.188 | 0.361 | 1.26 | 0.14 | 0.59 | 1.08 | 0.16 | 0.17 | | 0.35 | 0.52 | 0.58 | 0.2 | 0.31 | 0.62 | 1.91 | 0.35 | 0.24 | 0.21 | 0.11 | 0.37 | 0.64 | 0.28 | 0.32 | 0.122 | 0.439 | 0.151 | 0.435 |
| Silver | mg/L | 0.0001 | 0.0001 | 0.0005 | | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | <0.00010 | 0.00023 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Sodium | mg/L | 0.02 | | | | 10.9 | 12 | 11.6 | 9.83 | 11.3 | 16.1 | 16.8 | 12.6 | 11.9 | | 11.8 | 15.3 | 13 | 14.2 | 11.7 | 16.1 | 17.2 | 13.2 | 14.0 | 13.3 | 10.5 | 12.7 | 13.2 | 11.5 | 12.2 | 10.5 | 10.2 | 8.76 | 10.1 |
| Strontium | mg/L | 0.0001 | | | | 0.183 | 0.194 | 0.2 | 0.245 | 0.213 | 0.307 | 0.322 | 0.243 | 0.265 | | 0.216 | 0.29 | 0.247 | 0.288 | 0.223 | 0.297 | 0.328 | 0.24 | 0.278 | 0.286 | 0.197 | 0.272 | 0.274 | 0.22 | 0.278 | 0.178 | 0.184 | 0.179 | 0.186 |
| Tellurium | mg/L | 0.0002 | | | | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Thallium | mg/L | 0.0001 | 0.0008 | 0.004 | | <0.0010 | <0.00010 | <0.00010 | 0.00011 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | 0.00014 | 0.0001 | <0.00010 | <0.00010 | 0.00011 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00012 | 0.00012 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Thorium | mg/L | 0.0001 | | | | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Tin | mg/L | 0.0002 | | | | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Titanium | mg/L | 0.0002 | | | | 0.0028 | 0.00434 | 0.00779 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | 0.00206 | 0.00066 | 0.00069 | 0.00064 |
| Tungsten | mg/L | 0.0002 | | | | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | 0.00012 | 0.00021 | 0.00013 | <0.00010 | <0.00010 | 0.00015 | 0.0003 | 0.0001 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00012 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Uranium | mg/L | 0.0001 | 0.015 | 0.075 | | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.0001 | 0.0001 | 0.00014 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Vanadium | mg/L | 0.0002 | | | | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | 0.00072 | 0.00026 | 0.00026 | 0.00046 |
| Zinc | mg/L | 0.002 | 0.03 | 0.15 | | <0.020 | 0.009 | 0.0183 | 0.356 | 0.182 | 0.588 | 0.291 | 0.14 | 0.126 | | 0.446 | 0.521 | 0.263 | 0.381 | 0.393 | 0.568 | 0.0057 | 0.204 | 0.334 | 0.334 | 0.332 | 0.719 | 0.745 | 0.273 | 0.337 | 0.0332 | 0.0272 | 0.0405 | 0.0298 |
| Zirconium | mg/L | 0.0004 | | | | <0.0040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 |

*RDL = reportable detection limit; TDS = total dissolved solids; TSS = total suspended solids; µmhos/cm = micromhos per centimetre; mg/L = milligrams per litre; TCU = true color unit; NTU = Nephelometric Turbidity Units; µg/L = micrograms per litre.*

Notes:

[a] *Canadian Council of Ministers of Environment (CCME) Water Quality Guidelines (2011) for the Protection of Freshwater Aquatic Life.*

[b] *Metal Mining Effluent Regulation (MMER) SOR/2002-222 Maximum authorized concentration in a grab sample*

[c] Detection limit adjusted for required dilution - ALS Lab Note

[d] AND-04, AND-05, AND-07 and AND-08 were not accessible in September 2014 due to low water levels and higher tailings

[e] Analysis conducted at Hudbay Laboratories

[1] Cadmium and Copper standards represented are based on average hardness within the Anderson TIA

[2] Aluminum standard presented is based on average hardness within the Anderson TIA pH >6.5

[3] The long-term exposure CWQG for the protection of freshwater life is 15 µg·L-1 for uranium

Exceeds CCME WQG Guideline
Exceeds 5 X CCME Guideline
Exceeds MMER Guideline

2015 Anderson Tailings Impoundment Area
June Water Quality Summary

**Table 01. Anderson TIA, Anderson Creek and Anderson Bay Water Analytical Results**

| Parameter | Units | RDL | CCME WQG [a] | 5X CCME WQG | MMER [b] | ANC-02A | | | | | | ANC-05 | | | | | | ANC-06 | | | | | | ANB-01 | | ANB-01A | | | | | | ANB-02 | | ANB-03 | | ANB-04 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | | | | | | 18-Jun-13 | 5-Oct-13 | 18-Jun-14 | 30-Sep-14 | 17-Jun-15 | 21-Sep-15 | 18-Jun-13 | 6-Oct-13 | 18-Jun-14 | 30-Sep-14 | 17-Jun-15 | 21-Sep-15 | 20-Jun-13 | 6-Oct-13 | 18-Jun-14 | 30-Sep-14 | 17-Jun-15 | 21-Sep-15 | 23-May-11 | 15-Sep-11 | 18-Jun-13 | 6-Oct-13 | 18-Jun-14 | 30-Sep-14 | 18-Jun-15 | 23-Sep-15 | 23-May-11 | 15-Sep-11 | 23-May-11 | 17-Sep-11 | 23-May-11 | 16-Sep-11 |
| **Conventional Parameters** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Colour, True | CU | 5 | - | | | 17.4 | 127 | 12 | 20 | 14 | 79 | 15.9 | 144 | 13 | 21.8 | 14.8 | 79.7 | 9.7 | 112 | 11.1 | 18.6 | 52.6 | 117 | 18.9 | 23.2 | 73.5 | 17 | 16.4 | 12.3 | 30.2 | 30.2 | 15.7 | 36.2 | 16.3 | 23.6 | 14.9 | 25.3 |
| Conductivity | umhos/cm | 20 | - | | | 557 | 342 | 724 | 756 | 823 | 635 | 562 | 337 | 723 | 759 | 832 | 635 | 573 | 205 | 723 | 784 | 852 | 393 | 430 | 432 | 402 | 173 | 197 | 173 | 267 | 213 | 244 | 247 | 159 | 274 | 223 | 165 |
| pH | pH units | 0.1 | 6.5 - 9.0 | | | 6.92 | 8.09 | 7.65 | 7.94 | 7.28 | 7.94 | 7.79 | 7.54 | 7.64 | 7.9 | 7.34 | 7.88 | 7.77 | 7.8 | 7.57 | 7.82 | 7.28 | 7.86 | 8.06 | 7.93 | 6.77 | 8.03 | 8 | 7.85 | 7.62 | 7.72 | 8.13 | **9.67** | 8.17 | 8.42 | 8.15 | 9.23 |
| Total Suspended Solids | mg/L | 5 | - | | 30.00 | 10 | 5 | 16 | <5.0 | <5.0 | 6 | 13 | 14 | 11 | <5.0 | <5.0 | 11 | 11 | <5.0 | 5 | <5.0 | <5.0 | <5.0 | 13.0 | 5.0 | 13 | 11 | 8 | 6 | <5.0 | <5.0 | <5.0 | 5.0 | <5.0 | 5.0 | <5.0 | 7.0 |
| Total Dissolved Solids | mg/L | 5 | - | | | 419 | 242 | 512 | 564 | 641 | 445 | 422 | 258 | 527 | 548 | 610 | 455 | 440 | 181 | 521 | 568 | 485 | 373 | 262 | 270 | 299 | 116 | 124 | 128 | 191 | 136 | 126 | 160 | 84.0 | 198 | 128 | 112 |
| Turbidity | NTU | 0.1 | - | | | 6.97 | 5.53 | 17.1 | 0.94 | 622 | 10 | 6.95 | 11.4 | 9.2 | 1.83 | 620 | 11.8 | 1.65 | 1.14 | 5.5 | 2.01 | 640 | 3.8 | 8.97 | 1.49 | 6.12 | 6.78 | 2.4 | 4.2 | 176 | 2.6 | 3.89 | 1.52 | 3.58 | 2.36 | 4.60 | 2.13 |
| Hardness (as CaCO3) | mg/L | 0.3 | - | | | | | 346 | | 440 | 277 | | | 351 | | 430 | 299 | | | 342 | | 444 | 340 | 193 | 209 | | | 98.6 | | 142 | 107 | 109 | 128 | 71.7 | 146 | 101 | 85.8 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Anions and Nutrients** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Acidity (as CaCO3) | mg/L | 2 | - | | | <1.0 | 1.7 | 4.9 | 3.0 | 5.1 | 2.9 | 1.5 | 5.9 | 4.6 | 3.4 | 5.2 | 3.5 | 1.2 | 2.7 | 3.6 | 6.7 | 9.5 | 3.2 | 1.6 | 1.3 | <1.0 | 1.3 | 4.8 | 2.5 | 5.3 | 2.3 | 1.3 | <1.0 | 1.0 | <1.0 | 1.3 | <1.0 |
| Alkalinity, Total (as CaCO3) | mg/L | 20 | - | | | 49 | 108 | 41 | 94 | 37 | 86.1 | 55 | 105 | 40 | 84 | 36.5 | 82.3 | 52 | 82 | 40 | 78 | 31.9 | 116 | 60.3 | 67.1 | 60 | 76 | 67 | 76 | 71 | 73.8 | 67.4 | 79.6 | 70.0 | 79.9 | 67.8 | 80.9 |
| Bicarbonate (HCO3) | mg/L | 24 | - | | | 59 | 132 | 50 | 115 | 45.1 | 105 | 68 | 128 | 49 | 103 | 44.5 | 100 | 64 | 100 | 49 | 95 | 38.9 | 141 | 73.5 | 81.8 | 73 | 93 | 81 | 93 | 86.6 | 90 | 82.2 | 30.6 | 85.4 | 89.5 | 82.7 | 57.7 |
| Carbonate (CO3) | mg/L | 12 | - | | | <12 | <12 | <12 | <12 | <0.60 | <0.60 | <12 | <12 | <12 | <12 | <0.60 | <0.60 | <12 | <12 | <12 | <12 | <0.60 | <0.60 | <0.60 | <0.60 | <12 | <12 | <12 | <12 | <0.60 | <0.60 | <0.60 | 31.5 | <0.60 | 2.75 | <0.60 | 19.0 |
| Chloride | mg/L | 0.2 | 120 - 640 | | | 21.3 | 29.3 | 15 | 23.6 | 18.5 | 21.1 | 21.1 | 30.9 | 15.1 | 24.3 | 18.5 | 22 | 16.8 | 8.12 | 15.1 | 26.4 | 16.9 | 36.1 | 13.0 | 14.2 | 11.8 | 4.9 | 4.88 | 4.92 | 6.49 | 5.6 | 6.88 | 8.27 | 4.22 | 9.14 | 6.18 | 4.84 |
| Fluoride | mg/L | 0.02 | | | | 0.239 | 0.128 | 0.22 | 0.24 | 0.266 | 0.2 | 0.241 | 0.1 | 0.22 | 0.25 | 0.264 | 0.197 | 0.221 | 0.068 | 0.22 | 0.25 | 0.272 | 0.091 | 0.145 | 0.21 | 0.16 | 0.071 | <0.10 | <0.10 | 0.097 | 0.073 | 0.078 | 0.12 | <0.050 | 0.13 | 0.069 | <0.10 |
| Hydroxide (OH) | mg/L | 6.8 | - | | | <6.8 | <6.8 | <6.8 | <6.8 | <0.34 | <0.34 | <6.8 | <6.8 | <6.8 | <6.8 | <0.34 | <0.34 | <6.8 | <6.8 | <6.8 | <6.8 | <0.34 | <0.34 | <0.40 | <0.40 | <6.8 | <6.8 | <6.8 | <6.8 | <0.34 | <0.34 | <0.40 | <0.40 | <0.40 | <0.40 | <0.40 | <0.40 |
| Silica, Reactive (as SiO2) | mg/L | 0.25 | - | | | | | | | | | | | | | | | | | | | | | 0.437 | 1.20 | | | | | | | 0.792 | 0.472 | 1.16 | 1.10 | 0.793 | 1.65 |
| Sulfate | mg/L | 0.5 | - | | | 189 | 237 | 0.0292 | 0.0264 | 385 | 209 | 191 | 19.9 | 0.0292 | 0.0273 | 388 | 212 | 207 | 10.8 | 0.0293 | 0.0282 | 406 | 27.9 | 129 | 134 | 102 | 6.39 | 0.0022 | 0.00063 | 66.7 | 28.6 | 43.8 | 52.8 | 5.00 | 60.9 | 33.7 | 7.83 |
| Ammonia, Total (as N) | mg/L | 0.01 | 2.33 - 7.32 | | | 0.141 | <0.010 | 0.95 | <0.010 | 0.94 [c] | 0.216 | 0.151 | 0.036 | 0.99 | 0.166 | 0.95 [c] | 0.274 | 0.142 | <0.010 | 1.01 | 0.274 | 1.00 [c] | 0.22 | <0.050 | <0.050 | 0.042 | <0.010 | <0.010 | <0.010 | 0.026 | <0.010 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| Nitrate-N | mg/L | 0.005 | 13 | | | 0.107 | 0.0345 | 0.503 | 1.44 | 0.66 | 0.518 | 0.0965 | 0.0136 | 0.44 | 1.46 | 0.599 | 0.501 | 0.0617 | 0.0068 | 0.439 | 2.91 | 0.459 | 1.39 | - | <0.050 | 0.0668 | <0.0050 | <0.050 | <0.050 | 0.077 | <0.020 | - | <0.050 | - | <0.050 | - | <0.050 |
| Nitrate and Nitrite as N | mg/L | 0.0051 | - | | | 0.115 | 0.0345 | 0.503 | 1.44 | 0.721 | 0.534 | 0.104 | 0.0149 | 0.44 | 1.46 | 0.659 | 0.511 | 0.0661 | 0.0068 | 0.439 | 2.91 | 0.525 | 1.39 | <0.050 | <0.071 | 0.0734 | <0.0051 | <0.071 | <0.071 | 0.077 | <0.070 | <0.050 | <0.071 | <0.050 | <0.071 | <0.050 | <0.071 |
| Nitrite-N | mg/L | 0.001 | 0.06 | | | 0.0084 | <0.0010 | <0.050 | <0.050 | 0.061 | 0.016 | 0.0073 | 0.0013 | <0.050 | <0.050 | 0.061 | 0.01 | 0.0043 | <0.0010 | <0.050 | <0.050 | 0.066 | <0.010 | - | <0.050 | 0.0066 | <0.0010 | <0.050 | <0.050 | <0.010 | <0.010 | - | <0.050 | - | <0.050 | - | <0.050 |
| Phosphorus (P)-Total | mg/L | 0.01 | - | | | 0.019 | 0.019 | 0.045 | 0.033 | 0.056 | 0.035 | 0.02 | 0.044 | 0.047 | 0.038 | 0.058 | 0.042 | 0.02 | <0.010 | 0.039 | 0.039 | 0.055 | 0.025 | 0.021 | 0.018 | 0.031 | 0.027 | 0.017 | 0.03 | 0.035 | 0.022 | 0.020 | 0.036 | 0.016 | 0.019 | 0.021 | 0.030 |
| Thiosulphate (S203) [e] | mg/L | 2.5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Dissolved Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aluminum | mg/L | 0.002 | 0.1 | 0.5 | | 0.0051 | 0.0618 | 0.0031 | 0.0027 | 0.0042 | 0.0207 | 0.0052 | 0.0772 | 0.0062 | 0.0043 | 0.0048 | 0.0238 | 0.0042 | 0.0376 | 0.0044 | 0.0064 | 0.0055 | 0.0322 | 0.0049 | 0.0038 | 0.0071 | 0.0134 | 0.0026 | 0.0096 | 0.0040 | 0.0044 | 0.0044 | 0.0060 | 0.0054 | 0.0043 | 0.0043 | 0.0131 |
| Antimony | mg/L | 0.0002 | | | | 0.00594 | 0.00169 | 0.00422 | 0.00386 | 0.00586 | 0.00271 | 0.00608 | 0.00101 | 0.00412 | 0.00413 | 0.00434 | 0.00274 | 0.00703 | <0.00020 | 0.00399 | 0.00420 | 0.00593 | 0.00117 | 0.00932 | 0.00516 | 0.00301 | 0.00023 | 0.00031 | <0.00020 | 0.00118 | 0.00038 | 0.00290 | 0.00198 | 0.00031 | 0.00237 | 0.00231 | 0.00030 |
| Arsenic | mg/L | 0.0002 | 0.005 | 0.025 | | 0.00239 | 0.00306 | 0.00175 | 0.00108 | 0.00168 | 0.00191 | 0.00242 | 0.00437 | 0.00179 | 0.00133 | 0.00175 | 0.00198 | 0.00259 | 0.0021 | 0.00183 | 0.00137 | 0.00170 | 0.00225 | 0.00248 | 0.00190 | 0.00162 | 0.00133 | 0.00126 | 0.00128 | 0.00112 | 0.00163 | 0.00140 | 0.00207 | 0.00090 | 0.00186 | 0.00122 | 0.00112 |
| Barium | mg/L | 0.0002 | | | | 0.0218 | 0.0135 | 0.0259 | 0.0332 | 0.0271 | 0.0254 | 0.0232 | 0.0175 | 0.0253 | 0.0346 | 0.0266 | 0.0259 | 0.0234 | 0.00908 | 0.0281 | 0.0441 | 0.0264 | 0.0216 | 0.0182 | 0.0191 | 0.0178 | 0.0111 | 0.0127 | 0.0116 | 0.0149 | 0.0115 | 0.0125 | 0.0136 | 0.0104 | 0.0146 | 0.0122 | 0.00904 |
| Beryllium | mg/L | 0.0002 | | | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Bismuth | mg/L | 0.0002 | | | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Boron | mg/L | 0.01 | 1.5 | 7.5 | | 0.028 | 0.018 | 0.024 | 0.029 | 0.025 | 0.021 | 0.028 | 0.016 | 0.023 | 0.029 | 0.025 | 0.026 | 0.022 | <0.010 | 0.024 | 0.033 | 0.025 | 0.018 | 0.021 | 0.019 | 0.026 | 0.013 | 0.01 | 0.016 | 0.019 | 0.014 | 0.014 | 0.013 | 0.011 | 0.014 | 0.013 | 0.010 |
| Cadmium | mg/L | 0.00001 | 0.00009 | 0.00045 | | 0.000014 | 0.000033 | 0.000733 | 0.000146 | 0.000230 | 0.000064 | 0.000019 | 0.000032 | 0.000813 | 0.000244 | 0.000230 | 0.000077 | 0.000014 | 0.000049 | 0.000904 | 0.000370 | 0.000228 | 0.000077 | <0.000010 | <0.000010 | 0.000011 | <0.000010 | 0.000015 | <0.000010 | 0.000021 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| Calcium | mg/L | 0.05 | | | | 89.2 | 36.9 | 118 | 124 | 168 | 095 | 90.9 | 33.2 | 117 | 125 | 114 | 101 | 80.3 | 20.9 | 121 | 124 | 166 | 053 | 63.9 | 69.8 | 57.8 | 19.5 | 22.1 | 20.6 | 44.8 | 28.4 | 31.1 | 35.9 | 17.0 | 41.9 | 28.6 | 20.3 |
| Cesium | mg/L | 0.0001 | | | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Chromium | mg/L | 0.002 | | | | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0010 | <0.0010 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0010 | <0.0010 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0010 | <0.0010 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0010 | <0.0010 | 0.0022 | <0.0020 | 0.0027 | <0.0020 | <0.0020 | <0.0020 |
| Cobalt | mg/L | 0.0002 | | | | <0.00020 | <0.00020 | 0.00045 | <0.00020 | <0.00020 | 0.00021 | <0.00020 | 0.00024 | 0.00048 | <0.00020 | <0.00020 | 0.00028 | <0.00020 | <0.00020 | 0.00053 | 0.00026 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Copper | mg/L | 0.0002 | 0.004 | 0.02 | | 0.0014 | 0.00503 | 0.00809 | 0.00526 | 0.00332 | 0.00455 | 0.00131 | 0.00432 | 0.00836 | 0.00594 | 0.00328 | 0.00527 | 0.00193 | 0.00902 | 0.00841 | 0.00677 | 0.00315 | 0.00758 | 0.00233 | 0.00125 | 0.00116 | 0.00059 | 0.00207 | 0.00060 | 0.00141 | 0.00067 | 0.00128 | 0.00067 | 0.00076 | 0.00083 | 0.00161 | 0.00050 |
| Iron | mg/L | 0.1 | 0.3 | 1.5 | | <0.10 | 0.17 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | 0.23 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | 0.1 | <0.10 | <0.10 | 0.11 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Lead | mg/L | 0.00009 | 0.007 | 0.035 | | <0.000090 | <0.000090 | 0.000494 | 0.000122 | <0.000090 | <0.000090 | <0.000090 | <0.000090 | 0.000108 | 0.000689 | 0.000262 | <0.000090 | 0.000146 | <0.000090 | 0.000127 | 0.000707 | 0.000278 | <0.000090 | <0.000090 | <0.000090 | <0.000090 | <0.000090 | <0.000090 | <0.000090 | <0.000090 | <0.000090 | <0.000090 | <0.000090 | <0.000090 | <0.000090 | <0.000090 | <0.000090 |
| Lithium | mg/L | 0.002 | | | | 0.0047 | 0.0045 | 0.0056 | 0.0063 | 0.0069 | 0.0057 | 0.0046 | 0.0047 | 0.0055 | 0.0066 | 0.0068 | 0.0053 | 0.0049 | 0.004 | 0.0059 | 0.0058 | 0.0068 | 0.0040 | 0.0045 | 0.0048 | 0.0045 | 0.0029 | 0.0026 | 0.0030 | 0.0037 | 0.0032 | 0.0034 | 0.0040 | 0.0034 | 0.0039 | 0.0038 | 0.0041 |
| Magnesium | mg/L | 0.01 | | | | 9.2 | 10.6 | 8.43 | 14.5 | 09.6 | 11.9 | 9.05 | 11.2 | 8.7 | 14.1 | 09.8 | 12.8 | 7.84 | 9.67 | 8.96 | 15.5 | 09.7 | 12.4 | 8.17 | 8.47 | 10.9 | 7.66 | 7.14 | 8.18 | 8.95 | 8.76 | 7.70 | 9.24 | 7.12 | 10.0 | 7.21 | 8.54 |
| Manganese | mg/L | 0.0001 | | | | 0.00164 | 0.0114 | 0.171 | 0.0218 | 0.0546 | 0.0453 | 0.00172 | 0.0547 | 0.178 | 0.0985 | 0.0482 | 0.0451 | 0.00039 | 0.00813 | 0.189 | 0.0711 | 0.0441 | 0.0164 | 0.0117 | 0.00281 | 0.0224 | 0.0007 | 0.00022 | 0.00074 | 0.01920 | 0.00154 | 0.00339 | 0.00373 | 0.00071 | 0.00131 | 0.00398 | 0.00126 |
| Molybdenum | mg/L | 0.0001 | 0.073 | 0.365 | | 0.00188 | 0.00049 | 0.00372 | 0.00217 | 0.00553 | 0.00228 | 0.00191 | 0.00035 | 0.00365 | 0.00234 | 0.00407 | 0.00229 | 0.00229 | <0.00010 | 0.00373 | 0.00262 | 0.00546 | 0.00110 | 0.00072 | 0.00058 | 0.00097 | 0.00016 | 0.00031 | 0.00019 | 0.00099 | 0.00044 | 0.00027 | 0.00025 | 0.00010 | 0.00030 | 0.00023 | 0.00011 |
| Nickel | mg/L | 0.001 | 0.15 | 0.75 | | <0.0010 | 0.0012 | 0.0016 | <0.0010 | 0.0012 | <0.0010 | <0.0010 | <0.0010 | 0.0011 | 0.0017 | 0.0011 | 0.0011 | <0.0010 | <0.0010 | <0.0010 | 0.0018 | 0.0011 | 0.0012 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Phosphorus | mg/L | 0.1 | | | | <0.030 | <0.030 | <0.030 | <0.030 | 0.047 | <0.030 | <0.030 | <0.030 | <0.030 | <0.030 | 0.041 | <0.030 | <0.030 | <0.030 | <0.030 | <0.030 | 0.053 | <0.030 | <0.10 | <0.10 | <0.030 | <0.030 | <0.030 | <0.030 | <0.030 | <0.030 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Potassium | mg/L | 0.02 | | | | 5.99 | 2.88 | 6.51 | 6.46 | 7.92 | 5.14 | 5.9 | 3.12 | 6.27 | 6.84 | 8.20 | 5.50 | 5.67 | 1.19 | 6.93 | 7.21 | 8.51 | 4.80 | 4.76 | 4.21 | 3.58 | 1.29 | 1.53 | 1.33 | 2.60 | 1.63 | 2.14 | 2.36 | 1.16 | 3.01 | 1.87 | 1.25 |
| Rubidium | mg/L | 0.0002 | | | | 0.00396 | 0.00119 | 0.00508 | 0.00386 | 0.00534 | 0.00325 | 0.00393 | 0.00204 | 0.0047 | 0.00459 | 0.00528 | 0.00342 | 0.00414 | 0.00096 | 0.00514 | 0.00507 | 0.00542 | 0.00306 | 0.00277 | 0.00275 | 0.00232 | 0.00103 | 0.00126 | 0.00112 | 0.00182 | 0.00132 | 0.00143 | 0.00187 | 0.00092 | 0.00197 | 0.00133 | 0.00122 |
| Selenium | mg/L | 0.001 | 0.001 | 0.005 | | 0.0012 | <0.0010 | 0.0026 | 0.0013 | 0.0032 | 0.0018 | 0.0014 | <0.0010 | 0.0025 | 0.0016 | 0.0033 | 0.0017 | 0.002 | <0.0010 | 0.0023 | 0.0018 | 0.0033 | 0.0011 | 0.0011 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Silicon | mg/L | 0.05 | | | | 0.524 | 3.95 | 1.25 | 0.96 | 0.54 | 2.52 | 0.489 | 4.38 | 1.24 | 1.15 | 0.50 | 2.64 | 0.281 | 4.72 | 1.12 | 1.41 | 0.46 | 2.56 | 0.226 | 0.580 | 0.962 | 0.738 | 0.81 | 0.18 | 0.54 | 0.57 | 0.464 | 0.213 | 0.786 | 0.560 | 0.456 | 0.857 |
| Silver | mg/L | 0.0001 | 0.0001 | 0.0005 | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Sodium | mg/L | 0.02 | | | | 12 | 19.3 | 10.1 | 14.5 | 13.2 | 14.5 | 12 | 19.7 | 10.3 | 15.0 | 13.6 | 15.6 | 8.87 | 6.89 | 10.6 | 16.0 | 13.9 | 16.5 | 9.06 | 8.35 | 10.3 | 3.95 | 3.87 | 3.82 | 6.11 | 4.83 | 4.94 | 6.16 | 3.34 | 7.38 | 4.39 | 4.24 |
| Strontium | mg/L | 0.0001 | | | | 0.18 | 0.0749 | 0.216 | 0.215 | 0.242 | 0.158 | 0.178 | 0.0672 | 0.217 | 0.207 | 0.174 | 0.160 | 0.197 | 0.047 | 0.224 | 0.221 | 0.247 | 0.093 | 0.164 | 0.141 | 0.125 | 0.0471 | 0.0544 | 0.0474 | 0.0807 | 0.0659 | 0.0841 | 0.0904 | 0.0451 | 0.100 | 0.0772 | 0.0509 |
| Tellurium | mg/L | 0.0002 | | | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Thallium | mg/L | 0.0001 | 0.0008 | 0.004 | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Thorium | mg/L | 0.0001 | | | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Tin | mg/L | 0.0002 | | | | <0.00020 | 0.00024 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | 0.00046 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | 0.00053 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | 0.00051 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Titanium | mg/L | 0.0002 | | | | 0.00387 | 0.00295 | <0.00050 | <0.00050 | <0.00050 | 0.00074 | 0.00333 | 0.00296 | <0.00050 | <0.00050 | <0.00050 | 0.00094 | 0.00336 | 0.001 | <0.00050 | <0.00050 | <0.00050 | 0.00061 | 0.00066 | 0.00049 | 0.00233 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | 0.00034 | 0.00023 | <0.00020 | 0.00033 | 0.00032 | <0.00020 |
| Tungsten | mg/L | 0.0002 | | | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00020 | <0.00020 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Uranium | mg/L | 0.0001 | 0.015 | 0.075 | | <0.00010 | 0.00028 | <0.00010 | 0.00040 | 0.00013 | 0.00040 | <0.00010 | 0.00026 | <0.00010 | 0.00038 | 0.00012 | 0.00033 | <0.00010 | 0.00018 | <0.00010 | 0.00044 | 0.00012 | 0.00021 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Vanadium | mg/L | 0.0002 | | | | <0.00020 | 0.00059 | <0.00020 | <0.00020 | <0.00020 | 0.00031 | 0.0002 | 0.00063 | <0.00020 | 0.00021 | <0.00020 | 0.00024 | <0.00020 | 0.00032 | <0.00020 | <0.00020 | <0.00020 | 0.00034 | 0.00040 | 0.00039 | 0.00027 | 0.00026 | <0.00020 | 0.00021 | 0.00021 | 0.00022 | 0.00071 | 0.00054 | <0.00020 | 0.00040 | 0.00041 | 0.00051 |
| Zinc | mg/L | 0.002 | 0.03 | 0.15 | | 0.0244 | 0.0276 | 0.326 | 0.110 | 0.146 | 0.222 | 0.0172 | 0.0412 | 0.346 | 0.199 | 0.153 | 0.245 | 0.0285 | 0.0405 | 0.391 | 0.245 | 0.156 | 0.145 | 0.0267 | 0.0091 | 0.0141 | <0.0020 | 0.009 | <0.0020 | 0.0227 | 0.0044 | 0.0085 | <0.0020 | <0.0020 | 0.0039 | 0.0055 | <0.0020 |
| Zirconium | mg/L | 0.0004 | | | | <0.00040 | 0.00044 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | 0.00047 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 |

*RDL = reportable detection limit; TDS = total dissolved solids; TSS = total suspended solids; µmhos/cm = micromhos per centimetre; mg/L = milligrams per litre; TCU = true color unit; NTU = Nephelometric Turbidity Units; µg/L = micrograms per litre.*

Notes:

[a] *Canadian Council of Ministers of Environment (CCME) Water Quality Guidelines (2011) for the Protection of Freshwater Aquatic Life.*

[b] *Metal Mining Effluent Regulation (MMER) SOR/2002-222 Maximum authorized concentration in a grab sample*

[c] Detection limit adjusted for required dilution - ALS Lab Note

[d] AND-04, AND-05, AND-07 and AND-08 were not accessible in September 2014 due to low water levels and higher tailings

[e] Analysis conducted at Hudbay Laboratories

[1] Cadmium and Copper standards represented are based on average hardness within the Anderson TIA

[2] Aluminum standard presented is based on average hardness within the Anderson TIA pH >6.5

[3] The long-term exposure CWQG for the protection of freshwater life is 15 µg·L-1 for uranium

Exceeds CCME WQG Guideline
Exceeds 5 X CCME Guideline
Exceeds MMER Guideline

**Table 01. Anderson TIA, Anderson Creek and Anderson Bay Water Analytical Results**

| Parameter | Units | RDL | CCME WQG [a] | 5X CCME WQG | MMER [b] | ANB-05 | | ANB-06 | | ANB 07 | | ANB-07A | | | | | | ANB 08 | | ANB 09 | | ANB 10 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | | | | | | 23-May-11 | 15-Sep-11 | 23-May-11 | 16-Sep-11 | 24-May-11 | 16-Sep-11 | 18-Jun-13 | 6-Oct-13 | 18-Jun-14 | 30-Sep-14 | 18-Jun-15 | 23-Sep-15 | 24-May-11 | 16-Sep-11 | 24-May-11 | 16-Sep-11 | 24-May-11 | 16-Sep-11 |
| **Conventional Parameters** | | | | | | | | | | | | | | | | | | | | | | | |
| Colour, True | CU | 5 | - | | | 16.3 | 24.7 | 12.2 | 15.7 | 16.4 | 13.5 | 10.6 | 10.9 | 16.6 | 12.1 | 9.4 | 13.1 | 14.6 | 10.5 | 14.1 | 17.0 | 12.2 | 11.4 |
| Conductivity | umhos/cm | 20 | - | | | 158 | 180 | 159 | 155 | 155 | 157 | 174 | 173 | 184 | 165 | 154 | 158 | 157 | 154 | 158 | 153 | 157 | 151 |
| pH | pH units | 0.1 | 6.5 - 9.0 | | | 8.14 | 8.78 | 8.16 | 8.34 | 7.91 | 8.34 | 8.17 | 8.15 | 8 | 7.98 | 7.7 | 8.1 | 8.18 | 8.32 | 8.18 | 8.24 | 8.19 | 8.26 |
| Total Suspended Solids | mg/L | 5 | - | | 30.00 | <5.0 | 8.0 | 9.0 | 7.0 | 7.0 | 7.0 | <5.0 | 6 | 6 | <5.0 | <5.0 | <5.0 | 5.0 | 6.0 | 5.0 | <5.0 | <5.0 | 8.0 |
| Total Dissolved Solids | mg/L | 5 | - | | | 74.0 | 104 | 88.0 | 90.0 | 102 | 92.0 | 110 | 110 | 126 | 140 | 78.3 | 86 | 106 | 88.0 | 94.0 | 90.0 | 108 | 80.0 |
| Turbidity | NTU | 0.1 | - | | | 2.47 | 3.10 | 3.55 | 4.56 | 4.09 | 1.44 | 2.8 | 2.93 | 2.3 | 3.78 | 85.5 | 3.3 | 2.87 | 2.08 | 2.89 | 2.83 | 2.16 | 2.32 |
| Hardness (as CaCO3) | mg/L | 0.3 | - | | | 75.9 | 82.8 | 73.4 | 83.7 | 72.7 | 80.4 | | | 89.5 | | 79.7 | 83.9 | 72.7 | 71.1 | 72.2 | 82.0 | 72.2 | 77.3 |
| | | | | | | | | | | | | | | | | | | | | | | | |
| **Anions and Nutrients** | | | | | | | | | | | | | | | | | | | | | | | |
| Acidity (as CaCO3) | mg/L | 2 | - | | | 1.2 | <1.0 | 1.2 | <1.0 | 1.8 | <1.0 | <1.0 | <1.0 | 4.9 | 1.9 | 3.9 | <2.0 | 1.7 | <1.0 | 1.9 | <1.0 | 2.0 | <1.0 |
| Alkalinity, Total (as CaCO3) | mg/L | 20 | - | | | 70.2 | 79.6 | 70.0 | 77.3 | 69.6 | 77.0 | 73 | 77 | 67 | 74 | 72.9 | 68.8 | 70.4 | 76.9 | 70.3 | 77.2 | 70.9 | 76.9 |
| Bicarbonate (HCO3) | mg/L | 24 | - | | | 85.6 | 75.4 | 85.3 | 88.3 | 84.9 | 87.8 | 90 | 94 | 82 | 90 | 88.9 | 83.9 | 85.9 | 88.6 | 85.8 | 94.2 | 86.5 | 93.8 |
| Carbonate (CO3) | mg/L | 12 | - | | | <0.60 | 9.49 | <0.60 | 1.83 | <0.60 | 1.90 | <12 | <12 | <12 | <12 | <0.60 | <0.60 | <0.60 | 1.44 | <0.60 | <0.60 | <0.60 | <0.60 |
| Chloride | mg/L | 0.2 | 120 - 640 | | | 4.23 | 5.39 | 4.21 | 4.40 | 4.56 | 4.48 | 5.19 | 4.91 | 4.66 | 4.67 | 4.56 | 4.86 | 4.67 | 4.43 | 4.69 | 4.32 | 5.14 | 4.41 |
| Fluoride | mg/L | 0.02 | | | | <0.050 | <0.10 | <0.050 | <0.10 | <0.10 | <0.10 | 0.071 | 0.074 | <0.10 | <0.10 | 0.063 | 0.072 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Hydroxide (OH) | mg/L | 6.8 | - | | | <0.40 | <0.40 | <0.40 | <0.40 | <0.40 | <0.40 | <6.8 | <6.8 | <6.8 | <6.8 | <0.34 | <0.34 | <0.40 | <0.40 | <0.40 | <0.40 | <0.40 | <0.40 |
| Silica, Reactive (as SiO2) | mg/L | 0.25 | - | | | 1.17 | 2.62 | 1.15 | 3.42 | 1.25 | 3.04 | | | | | | | 1.28 | 2.66 | 1.25 | 3.63 | 1.51 | 2.53 |
| Sulfate | mg/L | 0.5 | - | | | 5.15 | 14.5 | 5.75 | 4.03 | 6.05 | 5.03 | 10.7 | 5.6 | 0.00162 | 0.000469 | 5.54 | 5.49 | 6.02 | 3.83 | 6.27 | 3.75 | 4.24 | 3.50 |
| Ammonia, Total (as N) | mg/L | 0.01 | 2.33 - 7.32 | | | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| Nitrate-N | mg/L | 0.005 | 13 | | | - | <0.050 | - | <0.050 | <0.050 | <0.050 | <0.0050 | <0.0050 | <0.050 | <0.050 | <0.020 | <0.020 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| Nitrate and Nitrite as N | mg/L | 0.0051 | - | | | <0.050 | <0.071 | <0.050 | <0.071 | <0.071 | <0.071 | <0.0051 | <0.0051 | <0.071 | <0.071 | <0.070 | <0.070 | <0.071 | <0.071 | <0.071 | <0.071 | <0.071 | <0.071 |
| Nitrite-N | mg/L | 0.001 | 0.06 | | | - | <0.050 | - | <0.050 | <0.050 | <0.050 | <0.0010 | <0.0010 | <0.050 | <0.050 | <0.010 | <0.010 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| Phosphorus (P)-Total | mg/L | 0.01 | - | | | 0.017 | 0.024 | 0.018 | 0.030 | 0.012 | 0.030 | 0.011 | 0.024 | 0.018 | 0.029 | 0.027 | 0.02 | 0.012 | 0.029 | 0.042 | 0.027 | 0.019 | 0.028 |
| Thiosulphate (S203) [e] | mg/L | 2.5 | | | | | | | | | | | | | | | | | | | | | |
| **Dissolved Metals** | | | | | | | | | | | | | | | | | | | | | | | |
| Aluminum | mg/L | 0.002 | 0.1 | 0.5 | | 0.0046 | 0.0036 | 0.0051 | 0.0055 | 0.0052 | 0.0033 | 0.0027 | 0.0076 | 0.004 | 0.0070 | 0.0054 | 0.0050 | 0.0048 | 0.0030 | 0.0067 | 0.0041 | 0.0023 | 0.0022 |
| Antimony | mg/L | 0.0002 | | | | 0.00035 | 0.00053 | 0.00040 | <0.00020 | 0.00044 | <0.00020 | 0.00031 | <0.00020 | 0.00028 | <0.00020 | <0.00020 | <0.00020 | 0.00039 | <0.00020 | 0.00044 | <0.00020 | 0.00022 | <0.00020 |
| Arsenic | mg/L | 0.0002 | 0.005 | 0.025 | | 0.00094 | 0.00103 | 0.00087 | 0.00095 | 0.00088 | 0.00120 | 0.00114 | 0.00143 | 0.001 | 0.00145 | - | 0.00199 | 0.00092 | 0.00200 | 0.00087 | 0.00092 | 0.00099 | 0.00228 |
| Barium | mg/L | 0.0002 | | | | 0.0107 | 0.00990 | 0.0103 | 0.0101 | 0.0105 | 0.00958 | 0.0106 | 0.0113 | 0.0113 | 0.0117 | 0.0114 | 0.0102 | 0.0104 | 0.00815 | 0.0106 | 0.0104 | 0.0105 | 0.00903 |
| Beryllium | mg/L | 0.0002 | | | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Bismuth | mg/L | 0.0002 | | | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Boron | mg/L | 0.01 | 1.5 | 7.5 | | <0.010 | <0.010 | 0.010 | <0.010 | <0.010 | <0.010 | 0.013 | 0.012 | 0.016 | 0.015 | 0.012 | 0.013 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Cadmium | mg/L | 0.00001 | 0.00009 | 0.00045 | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | 0.00001 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| Calcium | mg/L | 0.05 | | | | 18.2 | 20.3 | 17.5 | 19.6 | 17.1 | 18.9 | 20.8 | 18.9 | 24.6 | 19.2 | 19.1 | 19.2 | 17.1 | 16.4 | 17.0 | 19.1 | 16.8 | 18.0 |
| Cesium | mg/L | 0.0001 | | | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Chromium | mg/L | 0.002 | | | | 0.0027 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0010 | <0.0010 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 |
| Cobalt | mg/L | 0.0002 | | | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Copper | mg/L | 0.0002 | 0.004 | 0.02 | | 0.00071 | 0.00036 | 0.00075 | 0.00065 | 0.00069 | 0.00062 | 0.00059 | 0.00048 | 0.00148 | 0.00055 | 0.00059 | 0.00050 | 0.00107 | 0.00055 | 0.00079 | 0.00064 | 0.00106 | 0.00057 |
| Iron | mg/L | 0.1 | 0.3 | 1.5 | | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Lead | mg/L | 0.00009 | 0.007 | 0.035 | | <0.000090 | <0.000090 | <0.000090 | <0.000090 | <0.000090 | <0.000090 | <0.000090 | <0.000090 | <0.000090 | <0.000090 | <0.000090 | <0.000090 | <0.000090 | <0.000090 | <0.000090 | <0.000090 | <0.000090 | <0.000090 |
| Lithium | mg/L | 0.002 | | | | 0.0029 | 0.0032 | 0.0035 | 0.0033 | 0.0027 | 0.0031 | 0.0028 | 0.0029 | 0.0031 | 0.0029 | 0.0030 | 0.0029 | 0.0029 | 0.0030 | 0.0021 | 0.0029 | 0.0026 | 0.0035 |
| Magnesium | mg/L | 0.01 | | | | 7.39 | 7.78 | 7.23 | 8.44 | 7.28 | 8.10 | 8 | 7.6 | 6.94 | 7.92 | 8.07 | 7.71 | 7.30 | 7.33 | 7.21 | 8.31 | 7.35 | 7.83 |
| Manganese | mg/L | 0.0001 | | | | 0.00062 | 0.00053 | 0.00060 | 0.00027 | 0.00027 | 0.00023 | 0.00013 | 0.00036 | 0.00099 | 0.00048 | 0.00030 | 0.00043 | 0.00022 | 0.00021 | 0.00025 | 0.00022 | 0.00017 | 0.00020 |
| Molybdenum | mg/L | 0.0001 | 0.073 | 0.365 | | <0.00010 | 0.00015 | <0.00010 | 0.00011 | <0.00010 | 0.00011 | 0.0002 | 0.00012 | 0.00029 | 0.00011 | 0.00012 | 0.00018 | <0.00010 | 0.00011 | <0.00010 | 0.00012 | <0.00010 | 0.00011 |
| Nickel | mg/L | 0.001 | 0.15 | 0.75 | | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Phosphorus | mg/L | 0.1 | | | | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.030 | <0.030 | <0.030 | <0.030 | <0.030 | <0.030 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Potassium | mg/L | 0.02 | | | | 1.24 | 1.32 | 1.23 | 1.27 | 1.21 | 1.26 | 1.34 | 1.22 | 1.32 | 1.22 | 1.23 | 1.17 | 1.21 | 1.09 | 1.22 | 1.26 | 1.14 | 1.18 |
| Rubidium | mg/L | 0.0002 | | | | 0.00093 | 0.00131 | 0.00095 | 0.00127 | 0.00090 | 0.00118 | 0.00115 | 0.00105 | 0.00121 | 0.00108 | 0.00098 | 0.00111 | 0.00093 | 0.00101 | 0.00094 | 0.00123 | 0.00091 | 0.00116 |
| Selenium | mg/L | 0.001 | 0.001 | 0.005 | | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Silicon | mg/L | 0.05 | | | | 0.768 | 1.24 | 0.775 | 1.71 | 0.766 | 1.50 | 0.629 | 0.702 | 0.8 | 0.20 | 0.62 | <0.10 | 0.876 | 1.29 | 0.839 | 1.77 | 0.942 | 1.21 |
| Silver | mg/L | 0.0001 | 0.0001 | 0.0005 | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Sodium | mg/L | 0.02 | | | | 3.52 | 4.00 | 3.59 | 3.79 | 3.40 | 3.68 | 3.89 | 3.67 | 3.74 | 3.65 | 3.48 | 3.30 | 3.51 | 3.30 | 3.38 | 3.71 | 3.72 | 3.49 |
| Strontium | mg/L | 0.0001 | | | | 0.0500 | 0.0541 | 0.0477 | 0.0503 | 0.0433 | 0.0467 | 0.0502 | 0.0471 | 0.0666 | 0.0458 | 0.0454 | 0.0496 | 0.0447 | 0.0405 | 0.0447 | 0.0473 | 0.0459 | 0.0457 |
| Tellurium | mg/L | 0.0002 | | | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Thallium | mg/L | 0.0001 | 0.0008 | 0.004 | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Thorium | mg/L | 0.0001 | | | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Tin | mg/L | 0.0002 | | | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | 0.00043 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Titanium | mg/L | 0.0002 | | | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | 0.00022 | <0.00020 | <0.00020 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Tungsten | mg/L | 0.0002 | | | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Uranium | mg/L | 0.0001 | 0.015 | 0.075 | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Vanadium | mg/L | 0.0002 | | | | <0.00020 | 0.00070 | 0.00039 | 0.00065 | 0.00065 | 0.00044 | 0.00022 | 0.00024 | <0.00020 | 0.00025 | <0.00020 | 0.00024 | 0.00078 | 0.00045 | 0.00071 | 0.00061 | 0.00051 | 0.00042 |
| Zinc | mg/L | 0.002 | 0.03 | 0.15 | | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | 0.0048 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 |
| Zirconium | mg/L | 0.0004 | | | | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 |

*RDL = reportable detection limit; TDS = total dissolved solids; TSS = total suspended solids; µmhos/cm = micromhos per centimetre; mg/L = milligrams per litre; TCU = true color unit; NTU = Nephelometric Turbidity Units; µg/L = micrograms per litre.*

Notes:

[a] *Canadian Council of Ministers of Environment (CCME) Water Quality Guidelines (2011) for the Protection of Freshwater Aquatic Life.*

[b] *Metal Mining Effluent Regulation (MMER) SOR/2002-222 Maximum authorized concentration in a grab sample*

[1] Detection limit adjusted for required dilution - ALS Lab Note

[2] AND-04, AND-05, AND-07 and AND-08 were not accessible in September 2014 due to low water levels and higher tailings

[4] Analysis conducted at Hudbay Laboratories

[1] Cadmium and Copper standards represented are based on average hardness within the Anderson TIA

[2] Aluminum standard presented is based on average hardness within the Anderson TIA pH >6.5

[3] The long-term exposure CWQG for the protection of freshwater life is 15 µg·L-1 for uranium

Exceeds CCME WQG Guideline
Exceeds 5 X CCME Guideline
Exceeds MMER Guideline

2015 Anderson Tailings Impoundment Area
June Water Quality Summary

**Table 01. Anderson TIA, Anderson Creek and Anderson Bay Water Analytical Results**

| Parameter | Units | RDL | CCME WQG [a] | 5X CCME WQG | MMER [b] | AND-01 | | | | | | | | | | AND-02 | | | | | | | | | | AND-03 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 7-Mar-12 | 15-Jun-12 | 18-Jun-13 | 5-Oct-13 | 17-Jun-14 | 30-Sep-14 | 9-Dec-14 | 4-Mar-15 | Dup-01 (AND-01) | 17-Jun-15 | 22-Sep-15 | 7-Mar-12 | 15-Jun-12 | 18-Jun-13 | 5-Oct-13 | 17-Jun-14 | 30-Sep-14 | 9-Dec-14 | 4-Mar-15 | 17-Jun-15 | 22-Sep-15 | 7-Mar-12 | 15-Jun-12 | 18-Jun-13 | 5-Oct-13 | 17-Jun-14 | 30-Sep-14 | 9-Dec-14 | 4-Mar-15 | 17-Jun-15 | 22-Sep-15 |
| **Total Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aluminum | mg/L | 0.005 | 0.1 | 0.5 | | 0.0553 | 0.126 | 0.105 | 0.0974 | 0.0553 | 0.111 | 0.239 | 0.014 | 0.014 | 0.051 | 0.044 | 0.131 | 0.128 | 0.0844 | 0.123 | 0.0602 | 0.112 | 0.061 | 0.013 | 0.055 | 0.048 | 0.04 | 0.132 | 0.0981 | 0.126 | 0.062 | 0.0962 | 0.0964 | 0.0543 | 0.4110 | 0.0398 | 0.0590 |
| Antimony | mg/L | 0.0002 | | | | 0.00861 | 0.0166 | 0.00703 | 0.00562 | 0.00366 | 0.00624 | 0.00673 | 0.00518 | 0.00524 | 0.00529 | 0.00362 | 0.00717 | 0.0163 | 0.00701 | 0.00548 | 0.00317 | 0.00627 | 0.00697 | 0.00628 | 0.00522 | 0.00365 | 0.0167 | 0.0168 | 0.00675 | 0.00556 | 0.00376 | 0.00569 | 0.00567 | 0.00681 | 0.00656 | 0.00529 | 0.00359 |
| Arsenic | mg/L | 0.0002 | 0.005 | 0.01 | 1.00 | 0.00654 | 0.0045 | 0.00363 | 0.00245 | 0.0022 | 0.00464 | 0.00618 | 0.00164 | 0.00159 | 0.00268 | 0.00239 | 0.00673 | 0.00449 | 0.00367 | 0.00269 | 0.00296 | 0.00492 | 0.00344 | 0.00221 | 0.00275 | 0.00250 | 0.00481 | 0.0045 | 0.00351 | 0.00276 | 0.00276 | 0.00393 | 0.00378 | 0.00311 | 0.00392 | 0.00251 | 0.00231 |
| Barium | mg/L | 0.0002 | | | | 0.028 | 0.0203 | 0.0225 | 0.0246 | 0.0198 | 0.0297 | 0.0376 | 0.0324 | 0.0355 | 0.0251 | 0.0229 | 0.0269 | 0.0203 | 0.0219 | 0.0244 | 0.0228 | 0.0317 | 0.0387 | 0.0418 | 0.0249 | 0.0247 | 0.0217 | 0.0202 | 0.0213 | 0.025 | 0.0224 | 0.0301 | 0.0265 | 0.0376 | 0.0479 | 0.0246 | 0.0229 |
| Beryllium | mg/L | 0.0002 | | | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Bismuth | mg/L | 0.0002 | | | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Boron | mg/L | 0.01 | 1.5 | 7.5 | | 0.029 | 0.02 | 0.023 | 0.022 | 0.022 | 0.028 | 0.027 | 0.022 | 0.017 | 0.019 | 0.019 | 0.025 | 0.021 | 0.022 | 0.02 | 0.017 | 0.024 | 0.026 | 0.029 | 0.021 | 0.020 | 0.025 | 0.019 | 0.022 | 0.02 | 0.019 | 0.022 | 0.020 | 0.026 | 0.025 | 0.020 | 0.017 |
| Cadmium | mg/L | 0.00001 | 0.00009 | 0.00045 | | 0.000234 | 0.000345 | 0.000657 | 0.000672 | 0.000656 | 0.000491 | 0.00121 | 0.000835 | 0.000861 | 0.000542 | 0.000441 | 0.000189 | 0.000935 | 0.000661 | 0.000643 | 0.000713 | 0.000543 | 0.00123 | 0.000863 | 0.000536 | 0.000449 | 0.000525 | 0.00036 | 0.000637 | 0.000701 | 0.000701 | 0.000528 | 0.000497 | 0.00119 | 0.00141 | 0.000576 | 0.000425 |
| Calcium | mg/L | 0.1 | | | | 89.8 | 77 | 106 [c] | 97 [c] | 92.5 | 107 | 143 | 134 | 125 | 142.000 | 131.000 | 89.4 | 80 | 105 [c] | 98 [c] | 91.3 | 107 | 147 | 170 | 143 | 141 | 107 | 83 | 104 [c] | 104 [c] | 93.7 | 104 | 103 | 155 | 163 | 143 | 135 |
| Cesium | mg/L | 0.0001 | | | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Chromium | mg/L | 0.001 | | | | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Cobalt | mg/L | 0.0002 | | | | 0.00279 | 0.00098 | 0.00069 | 0.00035 | 0.00054 | 0.00025 | 0.00106 | 0.00038 | 0.00036 | 0.00033 | 0.00023 | 0.00323 | 0.00102 | 0.00068 | 0.00038 | 0.0006 | 0.00027 | 0.00057 | 0.00076 | 0.00033 | 0.00024 | 0.00096 | 0.00109 | 0.00063 | 0.00039 | 0.00055 | <0.00020 | <0.00020 | 0.00029 | 0.0005 | 0.00031 | 0.00021 |
| Copper | mg/L | 0.0002 | 0.004 | 0.02 | 0.60 | 0.00702 | 0.0147 | 0.0299 | 0.0201 | 0.0269 | 0.0144 | 0.0213 | 0.0099 | 0.0095 | 0.0132 | 0.0092 | 0.0109 | 0.0147 | 0.0298 | 0.019 | 0.0304 | 0.0144 | 0.0171 | 0.0121 | 0.0127 | 0.0091 | 0.0186 | 0.0153 | 0.0293 | 0.0213 | 0.0282 | 0.0144 | 0.0139 | 0.0169 | 0.0192 | 0.0129 | 0.0090 |
| Iron | mg/L | 0.1 | 0.3 | 1.5 | | 2.37 | 0.15 | 0.22 | 0.27 | 0.19 | 0.22 | 0.61 | 0.11 | 0.11 | 0.16 | 0.12 | 2.3 | 0.14 | 0.19 | 0.23 | 0.21 | 0.23 | 0.19 | 0.26 | 0.17 | 0.13 | 0.22 | 0.15 | 0.17 | 0.28 | 0.19 | 0.22 | 0.22 | 0.12 | 0.74 | 0.14 | 0.13 |
| Lead | mg/L | 0.00009 | 0.007 | 0.035 | 0.40 | 0.000793 | 0.00389 | 0.00943 | 0.00534 | 0.00473 | 0.00789 | 0.0155 | 0.0009 | 0.0010 | 0.0038 | 0.0023 | 0.000521 | 0.00386 | 0.00984 | 0.00529 | 0.00452 | 0.00806 | 0.00609 | 0.00182 | 0.00399 | 0.00230 | 0.0016 | 0.0041 | 0.00941 | 0.00615 | 0.00495 | 0.00751 | 0.00743 | 0.00501 | 0.00773 | 0.00359 | 0.00215 |
| Lithium | mg/L | 0.002 | | | | 0.0062 | 0.0056 | 0.0055 | 0.0059 | 0.0048 | 0.0060 | 0.0063 | 0.0053 | 0.0031 | 0.0062 | 0.0049 | 0.0059 | 0.0055 | 0.0054 | 0.0052 | 0.0047 | 0.0058 | 0.0065 | 0.0060 | 0.0059 | 0.0055 | 0.0068 | 0.0056 | 0.0051 | 0.0053 | 0.0051 | 0.0055 | 0.0050 | 0.0067 | 0.0051 | 0.0057 | 0.0048 |
| Magnesium | mg/L | 0.01 | | | | 12.4 | 8.88 | 9.32 | 9.46 | 7.41 | 9.03 | 11.40 | 9.64 | 10.40 | 8.08 | 7.07 | 11.5 | 9.03 | 8.05 | 10.7 | 8.15 | 9.52 | 12.30 | 13.50 | 7.63 | 7.38 | 10.8 | 8.91 | 8.94 | 10.8 | 7.8 | 9.13 | 8.28 | 11.80 | 13.40 | 8.12 | 7.58 |
| Manganese | mg/L | 0.0003 | | | | 2.74 | 0.036 | 0.146 | 0.0291 | 0.116 | 0.0273 | 0.2230 | 0.2000 | 0.2040 | 0.0876 | 0.0374 | 2.46 | 0.0344 | 0.15 | 0.0322 | 0.132 | 0.0291 | 0.1560 | 0.3060 | 0.0846 | 0.0383 | 0.357 | 0.0368 | 0.146 | 0.033 | 0.121 | 0.0211 | 0.0192 | 0.0454 | 0.1950 | 0.0888 | 0.0350 |
| Mercury | mg/L | 0.000001 | 0.000026 | 0.00013 | | <0.000050 | - | <0.000020 | <0.000020 | 0.000077 | <0.000020 | 0.0000564 | 0.0000020 | 0.0000023 | 0.0000123 | 0.0000059 | <0.000050 | - | <0.000020 | <0.000020 | 0.000111 | <0.000020 | 0.0000082 | 0.0000027 | 0.0000117 | 0.0000053 | <0.000050 | - | <0.000020 | <0.000020 | 0.000055 | <0.000020 | <0.000020 | 0.0000086 | 0.0000342 | 0.0000103 | 0.0000049 |
| Molybdenum | mg/L | 0.0002 | 0.073 | 0.365 | | 0.00083 | 0.00102 | 0.0075 | 0.00351 | 0.0026 | 0.00281 | 0.00258 | 0.00235 | 0.00266 | 0.00442 | 0.00305 | 0.00079 | 0.00106 | 0.00746 | 0.00345 | 0.00232 | 0.00273 | 0.00278 | 0.00284 | 0.00424 | 0.00310 | 0.00123 | 0.00111 | 0.00754 | 0.00368 | 0.00272 | 0.00270 | 0.00282 | 0.00298 | 0.00237 | 0.00439 | 0.00308 |
| Nickel | mg/L | 0.002 | 0.15 | 0.75 | 1.00 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | 0.0025 | <0.0020 | <0.0020 |
| Phosphorus | mg/L | 0.2 | | | | <0.20 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.20 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.20 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Potassium | mg/L | 0.02 | | | | 6.78 | 6.9 | 7.28 | 6.44 | 5.07 | 6.42 | 7.62 | 7.39 | 7.91 | 7.44 | 6.51 | 6.68 | 6.82 | 7.27 | 7.24 | 5.63 | 6.43 | 7.83 | 9.54 | 6.72 | 6.70 | 8.46 | 6.84 | 7.17 | 7.46 | 5.6 | 6.66 | 5.99 | 8.14 | 10.00 | 7.40 | 6.60 |
| Rubidium | mg/L | 0.0002 | | | | 0.004 | 0.00414 | 0.00534 | 0.00459 | 0.00372 | 0.00485 | 0.00557 | 0.00566 | 0.00516 | 0.00524 | 0.00487 | 0.00409 | 0.00411 | 0.00548 | 0.00485 | 0.00447 | 0.00514 | 0.00604 | 0.00615 | 0.00502 | 0.00484 | 0.00532 | 0.0042 | 0.00532 | 0.005 | 0.00424 | 0.00506 | 0.00476 | 0.00624 | 0.00717 | 0.00523 | 0.00512 |
| Selenium | mg/L | 0.001 | 0.001 | 0.005 | | 0.0015 | 0.002 | 0.0035 | <0.0010 | 0.0015 | 0.0015 | 0.0016 | 0.0014 | 0.0012 | 0.0023 | 0.0032 | 0.0014 | 0.0019 | 0.004 | 0.002 | 0.0015 | 0.0014 | 0.0018 | 0.0012 | 0.0023 | 0.0029 | <0.0010 | 0.0016 | 0.0037 | 0.0018 | 0.0017 | 0.0017 | 0.0018 | 0.0019 | 0.0016 | 0.0023 | 0.0030 |
| Silicon | mg/L | 0.05 | | | | 3.57 | 0.224 | 0.377 | 0.82 | 0.73 | 0.32 | 1.32 | 0.80 | 0.63 | 0.43 | 0.63 | 3.14 | 0.186 | 0.427 | 0.958 | 0.74 | 0.29 | 1.18 | 0.94 | 0.47 | 0.64 | 1.56 | 0.152 | 0.373 | 0.861 | 0.8 | 0.26 | 0.33 | 0.55 | 1.55 | 0.35 | 0.60 |
| Silver | mg/L | 0.0001 | 0.0001 | 0.0005 | | <0.00010 | <0.00010 | 0.0001 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.0001 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Sodium | mg/L | 0.03 | | | | 10.7 | 10.6 | 12.4 | 10.7 | 7.76 | 9.96 | 11.40 | 11.20 | 12.40 | 10.20 | 9.43 | 10.5 | 10.8 | 10.2 | 11.7 | 8.83 | 10.2 | 12.1 | 14.1 | 10.0 | 09.5 | 12.5 | 10.6 | 12.4 | 12.1 | 8.85 | 10.2 | 9.44 | 11.60 | 15.00 | 10.50 | 9.54 |
| Strontium | mg/L | 0.0001 | | | | 0.171 | 0.186 | 0.209 | 0.188 | 0.163 | 0.178 | 0.236 | 0.242 | 0.230 | 0.219 | 0.215 | 0.178 | 0.188 | 0.213 | 0.187 | 0.141 | 0.182 | 0.241 | 0.277 | 0.207 | 0.209 | 0.215 | 0.187 | 0.203 | 0.194 | 0.175 | 0.184 | 0.185 | 0.254 | 0.282 | 0.227 | 0.211 |
| Tellurium | mg/L | 0.0002 | | | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Thallium | mg/L | 0.0001 | 0.0008 | 0.004 | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00015 | 0.00011 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.0001 | <0.00010 | 0.00011 | 0.00012 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00011 | <0.00010 | 0.00013 | 0.00013 | 0.00012 | 0.00014 | <0.00010 | <0.00010 |
| Thorium | mg/L | 0.0001 | | | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00014 | <0.00010 | <0.00010 |
| Tin | mg/L | 0.0002 | | | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Titanium | mg/L | 0.0002 | | | | 0.00217 | 0.00545 | 0.00779 | 0.0103 | 0.00128 | 0.00286 | 0.00498 | <0.00050 | 0.00053 | 0.00146 | 0.00109 | 0.00636 | 0.0052 | 0.00631 | 0.00698 | 0.00164 | 0.00309 | 0.00185 | <0.00050 | 0.00142 | 0.00132 | 0.0133 | 0.00509 | 0.00651 | 0.00814 | 0.00191 | 0.00298 | 0.00296 | 0.00172 | 0.01710 | 0.00108 | 0.00188 |
| Tungsten | mg/L | 0.001 | | | | <0.0010 | 0.00026 | <0.00010 | <0.00010 | <0.00010 | 0.00010 | 0.00015 | <0.00010 | 0.00010 | <0.00010 | <0.00010 | <0.0010 | 0.00023 | <0.00010 | <0.00010 | <0.00010 | 0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00025 | 0.0001 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00015 | <0.00010 | <0.00010 |
| Uranium | mg/L | 0.0001 | 0.015 | 0.075 | | 0.00011 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00012 | 0.00015 | 0.00013 | 0.00012 | <0.00010 | <0.00010 | 0.00011 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00011 | 0.00013 | 0.00016 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00012 | 0.00012 | 0.00011 | 0.00024 | <0.00010 | <0.00010 |
| Vanadium | mg/L | 0.0002 | | | | 0.00041 | <0.00020 | 0.00027 | <0.00020 | <0.00020 | 0.00027 | 0.00041 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | 0.00064 | <0.00020 | 0.00027 | 0.00026 | <0.00020 | 0.00030 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | 0.00032 | <0.00020 | 0.00024 | 0.00029 | <0.00020 | 0.00028 | 0.00030 | 0.00024 | 0.00082 | <0.00020 | <0.00020 |
| Zinc | mg/L | 0.005 | 0.03 | 0.15 | 1.00 | 0.139 | 0.147 | 0.257 | 0.329 | 0.351 | 0.296 | 0.707 | 0.573 | 0.539 | 0.278 | 0.247 | 0.127 | 0.151 | 0.259 | 0.325 | 0.393 | 0.295 | 0.7 | 0.649 | 0.271 | 0.248 | 0.262 | 0.151 | 0.266 | 0.333 | 0.365 | 0.299 | 0.284 | 0.667 | 0.831 | 0.277 | 0.244 |
| Zirconium | mg/L | 0.0004 | | | | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 |
| **Speciated Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Methyl Mercury - Total | mg/L | 0.00000005 | 0.000004 | 0.00002 | | - | - | - | - | - | - | 0.00000006 | <0.000000050 | <0.000000050 | <0.000000050 | <0.000000050 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | <0.000000050 | <0.000000050 | <0.000000050 | <0.000000050 |

*RDL = reportable detection limit; TDS = total dissolved solids; TSS = total suspended solids; µmhos/cm = micromhos per centimetre; mg/L = milligrams per litre; TCU = true color unit; NTU = Nephelometric Turbidity Units; µg/L = micrograms per litre.*

Notes:

[a] *Canadian Council of Ministers of Environment (CCME) Water Quality Guidelines (2011) for the Protection of Freshwater Aquatic Life.*

[b] *Metal Mining Effluent Regulation (MMER) SOR/2002-222 Maximum authorized concentration in a grab sample*

[c] Detection limit adjusted for required dilution - ALS lab note

[d] AND-04, AND-05, AND-07 and AND-08 were not accessible in September 2014 due to low water levels and higher tailings

[e] Sample preserved at ALS Laboratories - ALS lab note

[1] Cadmium and Copper standards represented are based on average hardness within the Anderson TIA

[2] Aluminum standard presented is based on average hardness within the Anderson TIA pH >6.5

[3] The long-term exposure CWQG for the protection of freshwater life is 15 µg·L-1 for uranium

Exceeds CCME WQG Guideline
Exceeds 5 X CCME Guideline
Exceeds MMER Guideline

**Table 01. Anderson TIA, Anderson Creek and Anderson Bay Water Analytical Results**

| Parameter | Units | RDL | CCME WQG [a] | 5X CCME WQG | MMER [b] | AND-04 | | | | | AND-05 | | | | | AND-06 | | | | | | | | | | AND-07 | | | | | AND-08 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 7-Mar-12 | 15-Jun-12 | 18-Jun-13 | 5-Oct-13 | 17-Jun-14 | 7-Mar-12 | 15-Jun-12 | 18-Jun-13 | 5-Oct-13 | 17-Jun-14 | 7-Mar-12 | 15-Jun-12 | 18-Jun-13 | 5-Oct-13 | 17-Jun-14 | 30-Sep-14 | 9-Dec-14 | 4-Mar-15 | 17-Jun-15 | 22-Sep-15 | 7-Mar-12 | 15-Jun-12 | 18-Jun-13 | 5-Oct-13 | 17-Jun-14 | 7-Mar-12 | 15-Jun-12 | 18-Jun-13 | 5-Oct-13 | 17-Jun-14 |
| **Total Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aluminum | mg/L | 0.005 | 0.1 | 0.5 | | 0.224 | 0.137 | 0.0699 | 0.147 | 0.0557 | 0.255 | 0.157 | 0.0886 | 0.113 | 0.0499 | 0.122 | 0.131 | 0.103 | 0.137 | 0.0559 | 0.0954 | 0.1340 | 0.0406 | 0.0400 | 0.0497 | 0.0952 | 0.276 | 0.119 | 0.186 | 0.0535 | 0.0875 | 0.497 | 0.0901 | 0.468 | 0.0554 |
| Antimony | mg/L | 0.0002 | | | | 0.0319 | 0.0178 | 0.00728 | 0.00567 | 0.00335 | 0.0308 | 0.0174 | 0.00714 | 0.00575 | 0.00344 | 0.0274 | 0.0169 | 0.00772 | 0.00568 | 0.00368 | 0.00556 | 0.00643 | 0.00618 | 0.00532 | 0.00384 | 0.0273 | 0.0237 | 0.00712 | 0.00589 | 0.00333 | 0.0254 | 0.0324 | 0.00713 | 0.00652 | 0.00336 |
| Arsenic | mg/L | 0.0002 | 0.005 | 0.01 | 1.00 | 0.00658 | 0.00449 | 0.00347 | 0.00302 | 0.0021 | 0.00722 | 0.00447 | 0.00384 | 0.0028 | 0.00213 | 0.00698 | 0.008 | 0.00416 | 0.00299 | 0.00245 | 0.00421 | 0.00375 | 0.00211 | 0.00252 | 0.00235 | 0.00748 | 0.0054 | 0.00414 | 0.00383 | 0.00205 | 0.00771 | 0.0071 | 0.00371 | 0.00581 | 0.00223 |
| Barium | mg/L | 0.0002 | | | | 0.0167 | 0.0213 | 0.0221 | 0.0331 | 0.0194 | 0.0163 | 0.0212 | 0.0225 | 0.0278 | 0.0196 | 0.019 | 0.0192 | 0.0221 | 0.0256 | 0.0198 | 0.0307 | 0.0437 | 0.0431 | 0.0247 | 0.0247 | 0.0185 | 0.02 | 0.0231 | 0.0266 | 0.0195 | 0.0198 | 0.0187 | 0.0227 | 0.028 | 0.0199 |
| Beryllium | mg/L | 0.0002 | | | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 |
| Bismuth | mg/L | 0.0002 | | | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 |
| Boron | mg/L | 0.01 | 1.5 | 7.5 | | 0.033 | 0.021 | 0.025 | 0.021 | 0.022 | 0.035 | 0.021 | 0.022 | 0.021 | 0.022 | 0.031 | <0.10 | 0.022 | 0.021 | 0.016 | 0.021 | 0.027 | 0.019 | 0.020 | 0.017 | 0.035 | <0.10 | 0.022 | 0.023 | 0.019 | 0.033 | <0.10 | 0.025 | 0.023 | 0.019 |
| Cadmium | mg/L | 0.00001 | 0.00009 | 0.00045 | | 0.000378 | 0.000405 | 0.000685 | 0.000722 | 0.000699 | 0.0003 | 0.000402 | 0.000705 | 0.000715 | 0.000732 | 0.000324 | 0.00039 | 0.000576 | 0.000706 | 0.000791 | 0.000592 | 0.00139 | 0.00134 | 0.000562 | 0.000502 | 0.00025 | 0.00041 | 0.000721 | 0.000835 | 0.000728 | 0.000244 | 0.00041 | 0.000712 | 0.00105 | 0.000811 |
| Calcium | mg/L | 0.1 | | | | 111 | 84 | 114 [c] | 101 [c] | 81.1 | 113 | 85 | 110 | 102 [e] | 92.8 | 111 | 77.3 | 111 | 106 [c] | 94.5 | 107 | 163 | 162 | 139 | 142 | 110 | 87.3 | 117 | 109 [c] | 87.8 | 113 | 92 | 111 | 117 [c] | 86.4 |
| Cesium | mg/L | 0.0001 | | | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Chromium | mg/L | 0.001 | | | | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.010 | <0.0010 | <0.0010 | <0.0010 |
| Cobalt | mg/L | 0.0002 | | | | 0.00027 | 0.00132 | 0.0007 | 0.00045 | 0.00053 | 0.00029 | 0.00137 | 0.00071 | 0.0004 | 0.00052 | 0.00069 | <0.0020 | 0.00079 | 0.00046 | 0.00068 | 0.00030 | 0.00047 | 0.00044 | 0.00031 | 0.00031 | 0.00036 | <0.0020 | 0.00082 | 0.00064 | 0.00054 | 0.00046 | 0.0025 | 0.00078 | 0.00082 | 0.00058 |
| Copper | mg/L | 0.0002 | 0.004 | 0.02 | 0.60 | 0.0456 | 0.0153 | 0.029 | 0.0232 | 0.0274 | 0.038 | 0.0168 | 0.0312 | 0.0211 | 0.027 | 0.0307 | 0.016 | 0.0297 | 0.0226 | 0.0324 | 0.0162 | 0.0216 | 0.0178 | 0.0129 | 0.0106 | 0.0272 | 0.0227 | 0.0336 | 0.0302 | 0.0286 | 0.0218 | 0.0237 | 0.0298 | 0.0485 | 0.031 |
| Iron | mg/L | 0.1 | 0.3 | 1.5 | | 0.63 | 0.14 | 0.2 | 0.41 | 0.17 | 0.57 | 0.2 | 0.24 | 0.3 | 0.17 | 0.39 | <1.0 | 0.54 | 0.35 | 0.28 | 0.28 | 0.39 | 0.13 | 0.14 | 0.13 | 0.25 | <1.0 | 0.39 | 0.72 | 0.19 | 0.23 | <1.0 | 0.3 | 1.49 | 0.21 |
| Lead | mg/L | 0.00009 | 0.007 | 0.035 | 0.40 | 0.0539 | 0.00477 | 0.0104 | 0.00667 | 0.00392 | 0.0365 | 0.00571 | 0.0105 | 0.00599 | 0.00444 | 0.0199 | 0.00499 | 0.0114 | 0.00651 | 0.00682 | 0.00946 | 0.00950 | 0.00222 | 0.00355 | 0.00270 | 0.0095 | 0.0165 | 0.0118 | 0.0111 | 0.00455 | 0.00521 | 0.0249 | 0.0104 | 0.0247 | 0.00538 |
| Lithium | mg/L | 0.002 | | | | 0.0068 | 0.0055 | 0.0058 | 0.0055 | 0.0047 | 0.0066 | 0.0061 | 0.0055 | 0.0055 | 0.0048 | 0.006 | <0.020 | 0.0053 | 0.0057 | 0.0037 | 0.0053 | 0.0071 | 0.0035 | 0.0054 | 0.0049 | 0.0063 | <0.020 | 0.0058 | 0.0061 | 0.0045 | 0.006 | <0.020 | 0.0057 | 0.0064 | 0.0045 |
| Magnesium | mg/L | 0.01 | | | | 8.61 | 9.15 | 9.14 | 10.9 | 7.5 | 8.41 | 8.87 | 9.78 | 11 | 7.11 | 8.41 | 8.78 | 9.63 | 10.9 | 7.74 | 8.86 | 11.50 | 12.40 | 7.76 | 7.20 | 8.27 | 8.47 | 9.51 | 11 | 7 | 8.65 | 8.47 | 9.59 | 11.5 | 7.29 |
| Manganese | mg/L | 0.0003 | | | | 0.11 | 0.0411 | 0.157 | 0.0349 | 0.121 | 0.107 | 0.0393 | 0.156 | 0.0337 | 0.117 | 0.175 | 0.0381 | 0.133 | 0.0363 | 0.136 | 0.0300 | 0.0750 | 0.2410 | 0.0876 | 0.0525 | 0.113 | 0.0457 | 0.154 | 0.0422 | 0.117 | 0.126 | 0.0573 | 0.14 | 0.0621 | 0.125 |
| Mercury | mg/L | 0.000001 | 0.000026 | 0.00013 | | <0.000050 | - | <0.000020 | <0.000020 | 0.000035 | <0.000050 | - | <0.000020 | <0.000020 | 0.000025 | <0.000050 | - | <0.000020 | <0.000020 | 0.000027 | <0.000020 | 0.0000244 | 0.0000047 | 0.0000117 | 0.0000054 | <0.000050 | - | 0.000022 | 0.000027 | 0.000023 | <0.000050 | - | <0.000020 | 0.000031 | 0.000027 |
| Molybdenum | mg/L | 0.0002 | 0.073 | 0.365 | | 0.00153 | 0.00109 | 0.00758 | 0.00372 | 0.00233 | 0.00149 | 0.00114 | 0.0077 | 0.00377 | 0.00259 | 0.00141 | <0.0020 | 0.0068 | 0.00377 | 0.00281 | 0.00290 | 0.00324 | 0.00247 | 0.00423 | 0.00354 | 0.00143 | <0.0020 | 0.00769 | 0.00402 | 0.00258 | 0.0014 | <0.0020 | 0.00763 | 0.00454 | 0.00265 |
| Nickel | mg/L | 0.002 | 0.15 | 0.75 | 1.00 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.020 | <0.0020 | <0.0020 | <0.0020 |
| Phosphorus | mg/L | 0.2 | | | | <0.20 | <0.10 | <0.10 | <0.10 | <0.10 | <0.20 | <0.10 | <0.10 | <0.10 | <0.10 | <0.20 | <1.0 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.20 | <1.0 | <0.10 | <0.10 | <0.10 | <0.20 | <1.0 | <0.10 | <0.10 | <0.10 |
| Potassium | mg/L | 0.02 | | | | 9.39 | 7.21 | 7.16 | 7.59 | 5.37 | 8.97 | 6.84 | 7.27 | 7.67 | 5.31 | 8.61 | 6.52 | 7.51 | 7.37 | 5.42 | 6.44 | 8.91 | 9.85 | 7.51 | 7.17 | 8.62 | 6.26 | 7.5 | 7.6 | 5.29 | 8.38 | 6.73 | 7.2 | 8.15 | 5.37 |
| Rubidium | mg/L | 0.0002 | | | | 0.00561 | 0.00425 | 0.00548 | 0.00521 | 0.00384 | 0.00545 | 0.00421 | 0.00558 | 0.00523 | 0.00365 | 0.00541 | 0.0043 | 0.00547 | 0.00521 | 0.00403 | 0.00532 | 0.00671 | 0.00624 | 0.00537 | 0.00524 | 0.00548 | 0.0043 | 0.00568 | 0.00536 | 0.00387 | 0.00547 | 0.0043 | 0.00536 | 0.0057 | 0.00399 |
| Selenium | mg/L | 0.001 | 0.001 | 0.005 | | 0.0052 | 0.0018 | 0.0038 | 0.0019 | 0.0017 | 0.0049 | 0.002 | 0.0039 | 0.0023 | 0.0015 | 0.0043 | <0.010 | 0.0029 | 0.0019 | 0.0015 | 0.0017 | 0.0022 | 0.0016 | 0.0023 | 0.0042 | 0.0046 | <0.010 | 0.0049 | 0.0025 | 0.0016 | 0.0043 | <0.010 | 0.0049 | 0.0029 | 0.0016 |
| Silicon | mg/L | 0.05 | | | | 1.06 | 0.141 | 0.247 | 0.88 | 0.82 | 1.18 | 0.197 | 0.361 | 0.843 | 0.72 | 1.08 | <0.50 | 0.377 | 0.842 | 0.75 | 0.22 | 0.54 | 0.54 | 0.38 | 0.51 | 0.924 | <0.50 | 0.393 | 0.884 | 0.72 | 0.967 | <0.50 | 0.369 | 1.26 | 0.75 |
| Silver | mg/L | 0.0001 | 0.0001 | 0.0005 | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00011 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | 0.00011 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | 0.00011 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | 0.00018 | <0.00010 |
| Sodium | mg/L | 0.03 | | | | 13.4 | 11.1 | 12.7 | 12.4 | 8.23 | 13.4 | 10.9 | 12.1 | 12.4 | 7.57 | 13 | 10.7 | 12.7 | 12.4 | 8.4 | 10.3 | 12.7 | 14.0 | 10.3 | 9.66 | 13 | 10.2 | 12.4 | 12.6 | 7.65 | 13.5 | 10.3 | 12.1 | 13.2 | 8.22 |
| Strontium | mg/L | 0.0001 | | | | 0.239 | 0.195 | 0.208 | 0.203 | 0.15 | 0.235 | 0.19 | 0.22 | 0.202 | 0.166 | 0.23 | 0.188 | 0.219 | 0.201 | 0.166 | 0.191 | 0.268 | 0.272 | 0.217 | 0.216 | 0.231 | 0.191 | 0.22 | 0.21 | 0.163 | 0.229 | 0.206 | 0.213 | 0.222 | 0.161 |
| Tellurium | mg/L | 0.0002 | | | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 |
| Thallium | mg/L | 0.0001 | 0.0008 | 0.004 | | <0.00010 | <0.00010 | <0.00010 | 0.00011 | 0.0001 | <0.00010 | <0.00010 | 0.00011 | 0.00011 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | 0.00012 | 0.0001 | 0.00013 | 0.00013 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | 0.00014 | <0.00010 | <0.00010 | <0.0010 | 0.00019 | <0.00010 |
| Thorium | mg/L | 0.0001 | | | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 |
| Tin | mg/L | 0.0002 | | | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | 0.00023 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 |
| Titanium | mg/L | 0.0002 | | | | 0.00291 | 0.005 | 0.0207 | 0.00955 | 0.0015 | 0.00408 | 0.00556 | 0.00661 | 0.00749 | 0.00164 | 0.00236 | 0.0063 | 0.00616 | 0.00839 | 0.0012 | 0.00376 | 0.00383 | 0.00211 | 0.00097 | 0.00128 | 0.00187 | <0.0050 | 0.00722 | 0.00868 | 0.00167 | 0.00211 | <0.0050 | 0.0069 | 0.0142 | 0.0016 |
| Tungsten | mg/L | 0.001 | | | | 0.0019 | 0.00027 | <0.00010 | <0.00010 | <0.00010 | 0.0019 | 0.00028 | 0.00014 | <0.00010 | <0.00010 | 0.0014 | <0.0010 | 0.00012 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.0014 | <0.0010 | 0.00013 | <0.00010 | <0.00010 | 0.0013 | <0.0010 | 0.00011 | 0.00023 | <0.00010 |
| Uranium | mg/L | 0.0001 | 0.015 | 0.075 | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | 0.00011 | 0.00011 | 0.00013 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | 0.0001 | <0.00010 |
| Vanadium | mg/L | 0.0002 | | | | 0.00036 | <0.00020 | 0.00021 | 0.00035 | <0.00020 | 0.00044 | <0.00020 | 0.00025 | 0.00028 | <0.00020 | 0.00031 | <0.0020 | 0.00029 | 0.00031 | <0.00020 | 0.00027 | 0.00038 | <0.00020 | <0.00020 | <0.00020 | 0.00024 | <0.0020 | 0.00031 | 0.0004 | <0.00020 | 0.00025 | <0.0020 | 0.00026 | 0.00097 | <0.00020 |
| Zinc | mg/L | 0.005 | 0.03 | 0.15 | 1.00 | 0.142 | 0.172 | 0.261 | 0.358 | 0.257 | 0.113 | 0.171 | 0.278 | 0.35 | 0.347 | 0.112 | 0.168 | 0.241 | 0.353 | 0.391 | 0.338 | 0.736 | 0.752 | 0.261 | 0.27 | 0.0867 | 0.147 | 0.299 | 0.39 | 0.355 | 0.0925 | 0.16 | 0.304 | 0.438 | 0.376 |
| Zirconium | mg/L | 0.0004 | | | | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.0040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.0040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.0040 | <0.00040 | <0.00040 | <0.00040 |
| **Speciated Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Methyl Mercury - Total | mg/L | 0.00000005 | 0.000004 | 0.00002 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

*RDL = reportable detection limit; TDS = total dissolved solids; TSS = total suspended solids; µmhos/cm = micromhos per centimetre; mg/L = milligrams per litre; TCU = true color unit; NTU = Nephelometric Turbidity Units; µg/L = micrograms per litre.*

Notes:

[a] *Canadian Council of Ministers of Environment (CCME) Water Quality Guidelines (2011) for the Protection of Freshwater Aquatic Life.*

[b] *Metal Mining Effluent Regulation (MMER) SOR/2002-222 Maximum authorized concentration in a grab sample*

[c] Detection limit adjusted for required dilution - ALS lab note

[d] AND-04, AND-05, AND-07 and AND-08 were not accessible in September 2014 due to low water levels and higher tailings

[e] Sample preserved at ALS Laboratories - ALS lab note

[1] Cadmium and Copper standards represented are based on average hardness within the Anderson TIA

[2] Aluminum standard presented is based on average hardness within the Anderson TIA pH >6.5

[3] The long-term exposure CWQG for the protection of freshwater life is 15 µg·L-1 for uranium

Exceeds CCME WQG Guideline
Exceeds 5 X CCME Guideline
Exceeds MMER Guideline

**Table 01. Anderson TIA, Anderson Creek and Anderson Bay Water Analytical Results**

| Parameter | Units | RDL | CCME WQG [a] | 5X CCME WQG | MMER [b] | AND-09 | | | | | | | | | | AND-10 | | | | | | | | | | AND-11 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 7-Mar-12 | 15-Jun-12 | 18-Jun-13 | 5-Oct-13 | 17-Jun-14 | 29-Sep-14 | 9-Dec-14 | 4-Mar-15 | 17-Jun-15 | 22-Sep-15 | 7-Mar-12 | 15-Jun-12 | 18-Jun-13 | 5-Oct-13 | 17-Jun-14 | 29-Sep-14 | 9-Dec-14 | 4-Mar-15 | 17-Jun-15 | 23-Sep-15 | 8-Mar-12 | 15-Jun-12 | 18-Jun-13 | 5-Oct-13 | 17-Jun-14 | 29-Sep-14 | 9-Dec-14 | 4-Mar-15 | 17-Jun-15 | 23-Sep-15 | 8-Mar-12 |
| **Total Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aluminum | mg/L | 0.005 | 0.1 | 0.5 | | 0.0203 | 0.171 | 0.148 | 0.257 | 0.0602 | 0.0575 | 0.0972 | 0.0472 | 0.1180 | 0.0657 | 0.0112 | 0.095 | 0.229 | 0.497 | 0.0687 | 0.0578 | 0.0888 | 0.0204 | 0.2370 | 0.1070 | 0.0227 | <0.050 | 0.106 | 0.164 | 0.0729 | 0.0478 | 0.0738 | 0.0314 | 0.2650 | 0.1290 | 0.0155 |
| Antimony | mg/L | 0.0002 | | | | 0.0173 | 0.0213 | 0.00776 | 0.00652 | 0.00383 | 0.00435 | 0.00617 | 0.00572 | 0.00637 | 0.00534 | 0.0157 | 0.0176 | 0.00808 | 0.00643 | 0.00377 | 0.00475 | 0.00554 | 0.00733 | 0.00644 | 0.00592 | 0.0172 | 0.0165 | 0.00813 | 0.00647 | 0.00377 | 0.00418 | 0.00578 | 0.00638 | 0.00647 | 0.00590 | 0.0165 |
| Arsenic | mg/L | 0.0002 | 0.005 | 0.01 | 1.00 | 0.0043 | 0.0047 | 0.00481 | 0.00518 | 0.00241 | 0.00252 | 0.00313 | 0.00218 | 0.00458 | 0.00298 | 0.00385 | 0.0043 | 0.00623 | 0.00918 | 0.0027 | 0.00247 | 0.00371 | 0.00272 | 0.00642 | 0.00370 | 0.00433 | 0.0042 | 0.00446 | 0.00387 | 0.00277 | 0.00254 | 0.00351 | 0.00285 | 0.00678 | 0.00390 | 0.00398 |
| Barium | mg/L | 0.0002 | | | | 0.0229 | 0.0181 | 0.0233 | 0.0266 | 0.0209 | 0.0301 | 0.0380 | 0.0382 | 0.0273 | 0.0348 | 0.0235 | 0.0191 | 0.0231 | 0.0265 | 0.0229 | 0.0289 | 0.0336 | 0.0438 | 0.0296 | 0.0323 | 0.0231 | 0.0192 | 0.0229 | 0.0261 | 0.0234 | 0.0304 | 0.0312 | 0.0366 | 0.0282 | 0.0322 | 0.0233 |
| Beryllium | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Bismuth | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Boron | mg/L | 0.01 | 1.5 | 7.5 | | 0.034 | <0.10 | 0.026 | 0.024 | 0.019 | 0.021 | 0.027 | 0.026 | 0.081 | 0.023 | 0.045 | <0.10 | 0.026 | 0.024 | 0.02 | 0.022 | 0.026 | 0.031 | 0.074 | 0.024 | 0.037 | <0.10 | 0.028 | 0.026 | 0.02 | 0.020 | 0.025 | 0.027 | 0.057 | 0.023 | 0.037 |
| Cadmium | mg/L | 0.00001 | 0.00009 | 0.00045 | | 0.000267 | 0.00025 | 0.000731 | 0.00126 | 0.00101 | 0.00116 | 0.00167 | 0.00167 | 0.000876 | 0.000707 | 0.000279 | 0.00021 | 0.000908 | 0.00186 | 0.00145 | 0.00107 | 0.00148 | 0.00206 | 0.00107 | 0.000864 | 0.000298 | 0.00016 | 0.000479 | 0.000989 | 0.00137 | 0.00114 | 0.00134 | 0.00184 | 0.00109 | 0.00091 | 0.000267 |
| Calcium | mg/L | 0.1 | | | | 109 | 77.2 | 111 | 131 [c] | 106 | 128 | 190 | 197 | 177 | 195 | 103 | 80.7 | 109 | 126 [c] | 115 | 136 | 201 | 237 [c] | 220 | 212 | 104 | 83.1 | 111 | 124 [c] | 118 | 121 | 190 | 193 [c] | 210 | 212 | 105 |
| Cesium | mg/L | 0.0001 | | | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Chromium | mg/L | 0.001 | | | | <0.0010 | <0.010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Cobalt | mg/L | 0.0002 | | | | 0.00022 | <0.0020 | 0.00093 | 0.00102 | 0.00076 | 0.00031 | 0.00053 | 0.00109 | 0.00073 | 0.00064 | <0.00020 | <0.0020 | 0.00126 | 0.00164 | 0.00116 | 0.00031 | 0.00056 | 0.00116 | 0.00096 | 0.00083 | 0.00029 | <0.0020 | 0.00074 | 0.00082 | 0.00118 | 0.00028 | 0.00057 | 0.00102 | 0.00100 | 0.00086 | <0.00020 |
| Copper | mg/L | 0.0002 | 0.004 | 0.02 | 0.60 | 0.0119 | 0.0165 | 0.039 | 0.0791 | 0.0414 | 0.0330 | 0.0417 | 0.0361 | 0.0302 | 0.0179 | 0.0124 | 0.0121 | 0.0546 | 0.124 | 0.067 | 0.0338 | 0.0691 | 0.0587 | 0.0407 | 0.024 | 0.0131 | 0.0097 | 0.0297 | 0.0656 | 0.0651 | 0.0291 | 0.0646 | 0.0644 | 0.0447 | 0.0254 | 0.0193 |
| Iron | mg/L | 0.1 | 0.3 | 1.5 | | <0.10 | <1.0 | 0.89 | 1.29 | 0.26 | 0.29 | 0.29 | 0.18 | 0.72 | 0.19 | 0.1 | <1.0 | 1.68 | 2.97 | 0.38 | 0.33 | 0.55 | 0.14 | 1.32 | 0.35 | 0.11 | <1.0 | 0.72 | 0.63 | 0.41 | 0.25 | 0.49 | 0.17 | 1.36 | 0.50 | <0.10 |
| Lead | mg/L | 0.00009 | 0.007 | 0.035 | 0.40 | 0.000333 | 0.0127 | 0.02 | 0.0355 | 0.0108 | 0.0113 | 0.0130 | 0.0042 | 0.0186 | 0.00562 | 0.000144 | 0.00545 | 0.0385 | 0.0505 | 0.0203 | 0.0129 | 0.0166 | 0.0045 | 0.0310 | 0.0104 | 0.000342 | 0.00181 | 0.015 | 0.0276 | 0.0192 | 0.00815 | 0.02160 | 0.00556 | 0.03360 | 0.01120 | 0.000143 |
| Lithium | mg/L | 0.002 | | | | 0.006 | <0.020 | 0.0055 | 0.007 | 0.0048 | 0.0054 | 0.0076 | 0.0066 | 0.0070 | 0.0073 | 0.0093 | <0.020 | 0.0054 | 0.0072 | 0.0052 | 0.0057 | 0.0076 | 0.0082 | 0.0069 | 0.0077 | 0.0092 | <0.020 | 0.0053 | 0.0072 | 0.005 | 0.0051 | 0.0075 | 0.0071 | 0.0069 | 0.0074 | 0.0091 |
| Magnesium | mg/L | 0.01 | | | | 9.8 | 7.65 | 9.54 | 12 | 8.14 | 8.19 | 11.20 | 11.50 | 8.86 | 8.82 | 11.2 | 8.17 | 9.27 | 12.2 | 8.1 | 8.08 | 10.20 | 13.80 | 10.20 | 8.92 | 11.4 | 8.51 | 9.03 | 11.2 | 8.17 | 8.39 | 10.10 | 11.70 | 9.75 | 9.23 | 11.3 |
| Manganese | mg/L | 0.0003 | | | | 0.0237 | 0.0317 | 0.12 | 0.0849 | 0.165 | 0.0457 | 0.0824 | 0.3250 | 0.1760 | 0.0966 | 0.0135 | 0.031 | 0.113 | 0.104 | 0.229 | 0.0440 | 0.0877 | 0.3440 | 0.2330 | 0.1120 | 0.0375 | 0.0345 | 0.086 | 0.0782 | 0.227 | 0.0425 | 0.0903 | 0.2830 | 0.2370 | 0.1130 | 0.00964 |
| Mercury | mg/L | 0.000001 | 0.000026 | 0.00013 | | <0.000050 | - | 0.000028 | 0.000065 | 0.000026 | 0.000037 | 0.000041 | 0.0000178 | 0.0000565 | 0.0000113 | <0.000050 | - | 0.000055 | 0.000134 | 0.000059 | 0.000027 | 0.000158 [f] | 0.0000204 | 0.0000981 | 0.0000227 | <0.000050 | - | <0.000020 | 0.000054 | 0.000066 | <0.000020 | 0.000192 [f] | 0.0000264 | 0.000105 | 0.0000248 | <0.000050 |
| Molybdenum | mg/L | 0.0002 | 0.073 | 0.365 | | 0.00129 | <0.0020 | 0.00676 | 0.0051 | 0.00335 | 0.00399 | 0.00473 | 0.00427 | 0.00625 | 0.00580 | 0.00138 | <0.0020 | 0.00662 | 0.0053 | 0.00371 | 0.00438 | 0.00579 | 0.00635 | 0.00644 | 0.00705 | 0.00132 | <0.0020 | 0.00557 | 0.00511 | 0.00379 | 0.00378 | 0.00657 | 0.00670 | 0.00672 | 0.00708 | 0.00127 |
| Nickel | mg/L | 0.002 | 0.15 | 0.75 | 1.00 | <0.0020 | <0.020 | 0.0023 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | 0.0021 | <0.0020 | <0.0020 | <0.0020 | <0.020 | 0.0022 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | 0.0027 | <0.0020 | <0.0020 | <0.0020 | <0.020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | 0.0025 | <0.0020 | <0.0020 | <0.0020 |
| Phosphorus | mg/L | 0.2 | | | | <0.20 | <1.0 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.20 | <1.0 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.20 | <1.0 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.20 |
| Potassium | mg/L | 0.02 | | | | 7.61 | 5.77 | 7.23 | 8.48 | 5.52 | 7.32 | 9.75 | 10.90 | 9.56 | 9.85 | 8.03 | 6.00 | 6.99 | 8.61 | 6.31 | 6.94 | 9.33 | 14.20 | 12.30 | 10.60 | 8.25 | 6.26 | 6.72 | 7.85 | 6.43 | 7.27 | 9.63 | 12.40 | 12.10 | 10.70 | 8.03 |
| Rubidium | mg/L | 0.0002 | | | | 0.00523 | 0.004 | 0.00536 | 0.00589 | 0.00418 | 0.00589 | 0.00741 | 0.00705 | 0.00603 | 0.00638 | 0.00503 | 0.0041 | 0.00517 | 0.00608 | 0.00458 | 0.00561 | 0.00708 | 0.00901 | 0.00675 | 0.00675 | 0.00512 | 0.0041 | 0.00505 | 0.00579 | 0.00466 | 0.00587 | 0.00692 | 0.00778 | 0.00666 | 0.00678 | 0.00516 |
| Selenium | mg/L | 0.001 | 0.001 | 0.005 | | 0.0029 | <0.010 | 0.0039 | 0.0044 | 0.002 | 0.0044 | 0.0048 | 0.0032 | 0.0053 | 0.0072 | 0.0083 | <0.010 | 0.0046 | 0.0046 | 0.0029 | 0.0045 | 0.0061 | 0.0053 | 0.0065 | 0.0106 | 0.0037 | <0.010 | 0.0029 | 0.0036 | 0.0033 | 0.0042 | 0.0065 | 0.0051 | 0.0072 | 0.0111 | 0.003 |
| Silicon | mg/L | 0.05 | | | | 0.401 | <0.50 | 0.391 | 0.941 | 0.97 | 0.31 | 0.64 | 0.83 | 0.78 | 0.36 | 0.39 | <0.50 | 0.564 | 1.36 | 1.3 | 0.32 | 0.68 | 0.98 | 1.39 | 0.40 | 0.485 | <0.50 | 0.301 | 0.851 | 1.44 | 0.33 | 0.62 | 0.85 | 1.43 | 0.41 | 0.391 |
| Silver | mg/L | 0.0001 | 0.0001 | 0.0005 | | <0.00010 | <0.0010 | 0.00012 | 0.00014 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00013 | <0.00010 | <0.0010 | 0.00012 | 0.00022 | 0.00011 | <0.00010 | 0.00011 | <0.00010 | <0.00010 | 0.00019 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | 0.0001 | <0.00010 | 0.00015 | <0.00010 | <0.00010 | 0.00021 | <0.00010 |
| Sodium | mg/L | 0.03 | | | | 12.8 | 9.34 | 11.6 | 13.8 | 8.78 | 11.0 | 13.6 | 14.5 | 13.3 | 13.9 | 13.8 | 9.87 | 11.5 | 14.2 | 9.5 | 10.7 | 13.3 | 19.1 | 14.3 | 15.3 | 13.6 | 9.86 | 11.2 | 13.1 | 9.1 | 11.0 | 13.4 | 16.4 | 14.1 | 15.5 | 14.1 |
| Strontium | mg/L | 0.0001 | | | | 0.218 | 0.179 | 0.218 | 0.239 | 0.193 | 0.205 | 0.291 | 0.293 | 0.263 | 0.257 | 0.212 | 0.185 | 0.21 | 0.237 | 0.197 | 0.224 | 0.289 | 0.352 | 0.249 | 0.276 | 0.216 | 0.193 | 0.214 | 0.235 | 0.202 | 0.208 | 0.288 | 0.315 | 0.248 | 0.275 | 0.214 |
| Tellurium | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | 0.00023 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Thallium | mg/L | 0.0001 | 0.0008 | 0.004 | | <0.00010 | <0.0010 | 0.0001 | 0.00014 | 0.00011 | 0.00015 | 0.00013 | <0.00010 | 0.00011 | <0.00010 | <0.00010 | <0.0010 | 0.00013 | 0.00019 | 0.00013 | 0.00016 | 0.00012 | 0.00013 | 0.00012 | 0.00011 | <0.00010 | <0.0010 | <0.00010 | 0.00013 | 0.00013 | 0.00014 | 0.00011 | 0.00012 | 0.00013 | 0.00012 | <0.00010 |
| Thorium | mg/L | 0.0001 | | | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Tin | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Titanium | mg/L | 0.0002 | | | | 0.00148 | 0.0053 | 0.00738 | 0.00943 | 0.00137 | 0.00147 | 0.00298 | 0.00169 | 0.00211 | 0.00110 | 0.00124 | <0.0050 | 0.00819 | 0.0136 | 0.00168 | 0.00159 | 0.00166 | <0.00050 | 0.00412 | 0.00140 | 0.00146 | <0.0050 | 0.00614 | 0.00783 | 0.00164 | 0.00142 | 0.00113 | 0.00062 | 0.00428 | 0.00182 | 0.00145 |
| Tungsten | mg/L | 0.001 | | | | <0.0010 | <0.0010 | 0.00013 | 0.00016 | <0.00010 | 0.00013 | 0.00012 | <0.00010 | 0.00015 | 0.00013 | <0.0010 | <0.0010 | 0.00019 | 0.00025 | <0.00010 | 0.00013 | 0.00018 | 0.00011 | 0.00019 | 0.00020 | <0.0010 | <0.0010 | <0.00010 | 0.00015 | <0.00010 | <0.00010 | 0.00022 | 0.00013 | 0.00022 | 0.00021 | <0.0010 |
| Uranium | mg/L | 0.0001 | 0.015 | 0.075 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00010 | <0.00010 | 0.00011 | <0.0010 | 0.00011 | 0.00011 | <0.00010 | <0.00010 | <0.00010 | 0.00011 | 0.00011 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Vanadium | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | 0.00041 | 0.0005 | <0.00020 | <0.00020 | 0.00022 | <0.00020 | 0.00026 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | 0.00063 | 0.00097 | 0.0002 | <0.00020 | 0.00023 | <0.00020 | 0.00039 | <0.00020 | <0.00020 | <0.0020 | 0.00032 | 0.00037 | <0.00020 | <0.00020 | <0.00020 | 0.00041 | 0.00021 | <0.00020 |
| Zinc | mg/L | 0.005 | 0.03 | 0.15 | 1.00 | 0.152 | 0.094 | 0.295 | 0.395 | 0.438 | 0.455 | 0.737 | 0.765 | 0.367 | 0.231 | 0.169 | 0.08 | 0.327 | 0.73 [e] | 0.554 | 0.449 | 0.633 | 0.881 | 0.453 | 0.351 | 0.165 | 0.07 | 0.194 | 0.274 | 0.556 | 0.455 | 0.53 | 0.729 | 0.449 | 0.375 | 0.169 |
| Zirconium | mg/L | 0.0004 | | | | <0.00040 | <0.0040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.0040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.0040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 |
| **Speciated Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Methyl Mercury - Total | mg/L | 0.000000005 | 0.000004 | 0.00002 | | - | - | - | - | - | - | - | - | - | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.000000069 | 0.000000055 | <0.000000050 | <0.000000050 | - |

*RDL = reportable detection limit; TDS = total dissolved solids; TSS = total suspended solids; µmhos/cm = micromhos per centimetre; mg/L = milligrams per litre; TCU = true color unit; NTU = Nephelometric Turbidity Units; µg/L = micrograms per litre.*

Notes:

[a] *Canadian Council of Ministers of Environment (CCME) Water Quality Guidelines (2011) for the Protection of Freshwater Aquatic Life.*

[b] *Metal Mining Effluent Regulation (MMER) SOR/2002-222 Maximum authorized concentration in a grab sample*

[c] Detection limit adjusted for required dilution - ALS lab note

[d] AND-04, AND-05, AND-07 and AND-08 were not accessible in September 2014 due to low water levels and higher tailings

[e] Sample preserved at ALS Laboratories - ALS lab note

[1] Cadmium and Copper standards represented are based on average hardness within the Anderson TIA

[2] Aluminum standard presented is based on average hardness within the Anderson TIA pH >6.5

[3] The long-term exposure CWQG for the protection of freshwater life is 15 µg·L-1 for uranium

Exceeds CCME WQG Guideline
Exceeds 5 X CCME Guideline
Exceeds MMER Guideline

**Table 01. Anderson TIA, Anderson Creek and Anderson Bay Water Analytical Results**

| Parameter | Units | RDL | CCME WQG [a] | 5X CCME WQG | MMER [b] | AND-12 | | | | | | | | | | AND-13 | | | | | | | | | | AND-14 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 15-Jun-12 | 18-Jun-13 | 6-Oct-13 | 17-Jun-14 | 29-Sep-14 | 9-Dec-14 | 4-Mar-15 | 17-Jun-15 | 23-Sep-15 | | 8-Mar-12 | 15-Jun-12 | 18-Jun-13 | 6-Oct-13 | 17-Jun-14 | 29-Sep-14 | 10-Dec-14 | 3-Mar-15 | 17-Jun-15 | 23-Sep-15 | | 8-Mar-12 | 15-Jun-12 | 18-Jun-13 | 6-Oct-13 | 17-Jun-14 | 17-Jun-14 | 29-Sep-14 | 17-Jun-15 | 22-Sep-15 |
| **Total Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aluminum | mg/L | 0.005 | 0.1 | 0.5 | | <0.050 | 0.0769 | 0.156 | 0.0675 | 0.0560 | 0.0743 | 0.0325 | 0.2640 | 0.1250 | | 0.0156 | <0.050 | 0.104 | 0.127 | 0.0767 | 0.0721 | 0.0855 | 0.0537 | 0.2250 | 0.115 | | 0.0083 | <0.050 | 0.0399 | 0.0348 | 0.139 | 0.132 | 0.0756 | 0.0811 | 0.0284 |
| Antimony | mg/L | 0.0002 | | | | 0.0155 | 0.00831 | 0.00644 | 0.00396 | 0.00509 | 0.00543 | 0.00716 | 0.00670 | 0.00603 | | 0.0172 | 0.0162 | 0.00824 | 0.00648 | 0.00412 | 0.00478 | 0.00620 | 0.00594 | 0.00690 | 0.00605 | | 0.0141 | 0.0158 | 0.0087 | 0.00691 | 0.00398 | 0.00399 | 0.00437 | 0.00634 | 0.00486 |
| Arsenic | mg/L | 0.0002 | 0.005 | 0.01 | 1.00 | 0.0042 | 0.00416 | 0.00364 | 0.00285 | 0.00256 | 0.00346 | 0.00297 | 0.00682 | 0.00386 | | 0.00428 | 0.004 | 0.00483 | 0.00339 | 0.00295 | 0.00274 | 0.00402 | 0.00323 | 0.00675 | 0.00396 | | 0.00328 | 0.0041 | 0.00389 | 0.00303 | 0.00393 | 0.00359 | 0.00258 | 0.00384 | 0.00207 |
| Barium | mg/L | 0.0002 | | | | 0.0183 | 0.0227 | 0.0263 | 0.023 | 0.0284 | 0.0321 | 0.0459 | 0.0293 | 0.0322 | | 0.0228 | 0.0198 | 0.0232 | 0.0261 | 0.0235 | 0.0279 | 0.0339 | 0.0356 | 0.0264 | 0.0323 | | 0.0235 | 0.0194 | 0.0227 | 0.0266 | 0.0247 | 0.025 | 0.0291 | 0.0270 | 0.0279 |
| Beryllium | mg/L | 0.0002 | | | | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Bismuth | mg/L | 0.0002 | | | | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Boron | mg/L | 0.01 | 1.5 | 7.5 | | <0.10 | 0.028 | 0.025 | 0.02 | 0.026 | 0.025 | 0.031 | 0.047 | 0.022 | | 0.038 | <0.10 | 0.03 | 0.024 | 0.02 | 0.023 | 0.020 | 0.029 | 0.026 | 0.024 | | 0.033 | <0.10 | 0.031 | 0.026 | 0.02 | 0.02 | 0.020 | 0.022 | 0.020 |
| Cadmium | mg/L | 0.00001 | 0.00009 | 0.00045 | | 0.00018 | 0.000382 | 0.000899 | 0.00144 | 0.00104 | 0.00139 | 0.00199 | 0.00111 | 0.000888 | | 0.000302 | 0.00016 | 0.000458 | 0.000791 | 0.0016 | 0.00112 | 0.00156 | 0.0017 | 0.00114 | 0.000912 | | 0.000158 | 0.00012 | 0.000212 | 0.000215 | 0.00192 | 0.00182 | 0.00123 | 0.000734 | 0.000709 |
| Calcium | mg/L | 0.1 | | | | 79.5 | 104 | 122 [c] | 118 | 136 | 196 | 220 [c] | 221 | 213 | | 102 | 79.9 | 103 | 118 [c] | 123 | 132 | 171 | 179 [c] | 198 | 201 | | 97.7 | 77.9 | 99 | 115 [c] | 120 | 121 | 129 | 172 | 184 |
| Cesium | mg/L | 0.0001 | | | | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Chromium | mg/L | 0.001 | | | | <0.010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | | <0.0010 | <0.010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | | <0.0010 | <0.010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Cobalt | mg/L | 0.0002 | | | | <0.0020 | 0.00055 | 0.00077 | 0.00117 | 0.00029 | 0.00058 | 0.00117 | 0.00101 | 0.00084 | | 0.00035 | <0.0020 | 0.00075 | 0.00069 | 0.00127 | 0.00035 | 0.00067 | 0.00098 | 0.00103 | 0.00081 | | <0.00020 | <0.0020 | 0.00031 | 0.00027 | 0.00162 | 0.00149 | 0.00039 | 0.00057 | 0.00025 |
| Copper | mg/L | 0.0002 | 0.004 | 0.02 | 0.60 | 0.009 | 0.024 | 0.0576 | 0.0684 | 0.0278 | 0.0579 | 0.0565 | 0.0464 | 0.0248 | | 0.0109 | 0.0088 | 0.0302 | 0.0489 | 0.0762 | 0.0368 | 0.0745 | 0.0577 | 0.0476 | 0.0243 | | 0.00651 | 0.0072 | 0.0131 | 0.0133 | 0.0948 | 0.0911 | 0.0425 | 0.0288 | 0.0125 |
| Iron | mg/L | 0.1 | 0.3 | 1.5 | | <1.0 | 0.47 | 0.59 | 0.41 | 0.27 | 0.48 | 0.22 | 1.37 | 0.46 | | <0.10 | <1.0 | 0.78 | 0.5 | 0.51 | 0.43 | 0.70 | 0.24 | 1.31 | 0.43 | | <0.10 | <1.0 | 0.22 | 0.12 | 1.14 | 0.91 | 0.42 | 0.37 | <0.10 |
| Lead | mg/L | 0.00009 | 0.007 | 0.035 | 0.40 | 0.00171 | 0.011 | 0.0257 | 0.0228 | 0.00944 | 0.0168 | 0.0061 | 0.0334 | 0.0117 | | 0.000207 | 0.00183 | 0.0135 | 0.021 | 0.0287 | 0.0127 | 0.0191 | 0.0113 | 0.0353 | 0.0105 | | <0.000090 | 0.00123 | 0.00462 | 0.00232 | 0.0455 | 0.046 | 0.0155 | 0.0101 | 0.0019 |
| Lithium | mg/L | 0.002 | | | | <0.020 | 0.0048 | 0.0068 | 0.0051 | 0.0065 | 0.0075 | 0.0081 | 0.0072 | 0.0072 | | 0.009 | <0.020 | 0.0052 | 0.0067 | 0.0051 | 0.0057 | 0.0061 | 0.0073 | 0.0071 | 0.0074 | | 0.0079 | <0.020 | 0.005 | 0.0067 | 0.0053 | 0.0054 | 0.0051 | 0.0063 | 0.0057 |
| Magnesium | mg/L | 0.01 | | | | 8.06 | 9.51 | 11.7 | 8.45 | 8.45 | 10.00 | 14.30 | 9.98 | 8.72 | | 10.9 | 8.16 | 9.16 | 11.4 | 8.46 | 8.41 | 11.60 | 11.70 | 9.01 | 9.01 | | 10.5 | 8.14 | 8.74 | 11.2 | 8.25 | 7.99 | 8.21 | 8.68 | 8.07 |
| Manganese | mg/L | 0.0003 | | | | 0.0319 | 0.068 | 0.0772 | 0.232 | 0.0417 | 0.0875 | 0.4080 | 0.2430 | 0.1120 | | 0.0462 | 0.0307 | 0.0727 | 0.0729 | 0.241 | 0.0423 | 0.1010 | 0.3040 | 0.2270 | 0.1130 | | 0.0102 | 0.0268 | 0.0436 | 0.0467 | 0.248 | 0.249 | 0.0547 | 0.1730 | 0.0546 |
| Mercury | mg/L | 0.000001 | 0.000026 | 0.00013 | | - | <0.000020 | 0.000038 | 0.000079 | 0.000027 | 0.000196 [c] | 0.0000243 | 0.000107 | 0.0000266 | | <0.000050 | - | 0.000022 | 0.000057 | 0.000113 | 0.000036 | 0.000170 [c] | 0.0000323 | 0.000113 | 0.0000266 | | <0.000050 | - | <0.000020 | <0.000020 | 0.000164 | 0.000139 | 0.000051 | 0.000034 | 0.000008 |
| Molybdenum | mg/L | 0.0002 | 0.073 | 0.365 | | <0.0020 | 0.00513 | 0.00495 | 0.00394 | 0.00400 | 0.00617 | 0.00619 | 0.00711 | 0.00710 | | 0.00131 | <0.0020 | 0.00533 | 0.00483 | 0.00396 | 0.00426 | 0.00653 | 0.00646 | 0.00757 | 0.00702 | | 0.00124 | <0.0020 | 0.00435 | 0.00413 | 0.00399 | 0.00397 | 0.00416 | 0.00697 | 0.00517 |
| Nickel | mg/L | 0.002 | 0.15 | 0.75 | 1.00 | <0.020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | 0.0026 | <0.0020 | <0.0020 | | <0.0020 | <0.020 | 0.0022 | <0.0020 | 0.0021 | <0.0020 | 0.0021 | 0.0025 | <0.0020 | <0.0020 | | <0.0020 | <0.020 | <0.0020 | <0.0020 | 0.0024 | 0.0021 | <0.0020 | <0.0020 | <0.0020 |
| Phosphorus | mg/L | 0.2 | | | | <1.0 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | 0.11 | <0.10 | <0.10 | | <0.20 | <1.0 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | | <0.20 | <1.0 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Potassium | mg/L | 0.02 | | | | 5.81 | 6.76 | 8.29 | 5.97 | 7.22 | 9.27 | 13.90 | 12.10 | 10.50 | | 7.98 | 6.09 | 6.64 | 7.85 | 6.53 | 7.16 | 10.30 | 12.00 | 9.94 | 10.50 | | 7.15 | 5.95 | 6.43 | 8.13 | 6.04 | 6.42 | 7.24 | 9.46 | 8.88 |
| Rubidium | mg/L | 0.0002 | | | | 0.004 | 0.00497 | 0.00573 | 0.00471 | 0.00563 | 0.00679 | 0.00879 | 0.00680 | 0.00681 | | 0.00529 | 0.0039 | 0.00498 | 0.00557 | 0.00484 | 0.00578 | 0.00747 | 0.00755 | 0.00688 | 0.00667 | | 0.00482 | 0.0039 | 0.00481 | 0.00555 | 0.00477 | 0.00473 | 0.00577 | 0.00607 | 0.00648 |
| Selenium | mg/L | 0.001 | 0.001 | 0.005 | | <0.010 | 0.0024 | 0.0039 | 0.0028 | 0.0041 | 0.0063 | 0.0051 | 0.0075 | 0.0105 | | 0.003 | <0.010 | 0.0031 | 0.0037 | 0.0032 | 0.0047 | 0.0072 | 0.0045 | 0.0077 | 0.0140 | | 0.0023 | <0.010 | 0.0028 | 0.0018 | 0.0038 | 0.0037 | 0.0056 | 0.007 | 0.0067 |
| Silicon | mg/L | 0.05 | | | | <0.50 | 0.248 | 0.82 | 1.2 | 0.31 | 0.63 | 1.02 | 1.44 | 0.40 | | 0.487 | <0.50 | 0.31 | 0.78 | 1.27 | 0.39 | 0.65 | 0.88 | 1.30 | 0.60 | | 0.353 | <0.50 | 0.218 | 0.612 | 1.36 | 1.41 | 0.46 | 0.75 | 0.26 |
| Silver | mg/L | 0.0001 | 0.0001 | 0.0005 | | <0.0010 | <0.00010 | <0.00010 | 0.00012 | <0.00010 | 0.00012 | <0.00010 | <0.00010 | 0.00018 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | 0.00012 | 0.00011 | 0.00015 | <0.00010 | 0.00011 | 0.00017 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | 0.00016 | 0.00015 | 0.00010 | <0.00010 | <0.00010 |
| Sodium | mg/L | 0.03 | | | | 9.39 | 11.2 | 13.6 | 9.47 | 11.2 | 13.0 | 18.7 | 14.8 | 15.4 | | 13.2 | 9.51 | 11.2 | 13.3 | 9.68 | 11.0 | 16.4 | 17.7 | 12.8 | 14.4 | | 12.3 | 9.55 | 10.9 | 13.4 | 9.52 | 9.22 | 11.7 | 14.4 | 13.0 |
| Strontium | mg/L | 0.0001 | | | | 0.178 | 0.212 | 0.232 | 0.203 | 0.214 | 0.292 | 0.350 | 0.253 | 0.280 | | 0.221 | 0.183 | 0.21 | 0.226 | 0.211 | 0.217 | 0.290 | 0.282 | 0.273 | 0.274 | | 0.203 | 0.178 | 0.207 | 0.229 | 0.207 | 0.206 | 0.204 | 0.257 | 0.264 |
| Tellurium | mg/L | 0.0002 | | | | <0.0020 | <0.00020 | <0.00020 | <0.00020 | 0.00026 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | 0.00074 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Thallium | mg/L | 0.0001 | 0.0008 | 0.004 | | <0.0010 | <0.00010 | 0.00011 | 0.00015 | 0.00017 | 0.00010 | 0.00013 | 0.00013 | 0.00011 | | <0.00010 | <0.0010 | <0.00010 | 0.00011 | 0.00016 | 0.00016 | 0.00012 | 0.00012 | 0.00014 | 0.00013 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | 0.00019 | 0.00018 | 0.00015 | <0.00010 | <0.00010 |
| Thorium | mg/L | 0.0001 | | | | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Tin | mg/L | 0.0002 | | | | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Titanium | mg/L | 0.0002 | | | | <0.0050 | 0.00565 | 0.00786 | 0.00185 | 0.00147 | 0.00139 | 0.00067 | 0.00418 | 0.00191 | | 0.0013 | <0.0050 | 0.00734 | 0.00761 | 0.00149 | 0.00127 | 0.00165 | 0.00113 | 0.00370 | 0.00177 | | 0.00124 | <0.0050 | 0.00439 | 0.00603 | 0.00218 | 0.002 | 0.00190 | 0.00233 | 0.00065 |
| Tungsten | mg/L | 0.001 | | | | <0.0010 | <0.00010 | 0.00014 | <0.00010 | 0.00015 | 0.00020 | 0.00011 | 0.00023 | 0.00020 | | <0.0010 | <0.0010 | 0.0001 | 0.00012 | <0.00010 | 0.00016 | 0.00023 | 0.00025 | 0.00023 | 0.00020 | | <0.0010 | <0.0010 | <0.00010 | <0.00010 | 0.0001 | 0.00011 | 0.00015 | 0.00017 | <0.00010 |
| Uranium | mg/L | 0.0001 | 0.015 | 0.075 | | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00011 | 0.00011 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00012 | <0.00010 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | 0.0001 | 0.0001 | <0.00010 | <0.00010 | <0.00010 |
| Vanadium | mg/L | 0.0002 | | | | <0.0020 | 0.00027 | 0.00031 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | 0.0004 | 0.00021 | | <0.00020 | <0.0020 | 0.00035 | 0.00025 | 0.0002 | 0.00020 | <0.00020 | <0.00020 | 0.00041 | 0.00021 | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | 0.00039 | 0.00036 | 0.00024 | <0.00020 | <0.00020 |
| Zinc | mg/L | 0.005 | 0.03 | 0.15 | 1.00 | 0.065 | 0.149 | 0.275 | 0.564 | 0.438 | 0.559 | 0.861 | 0.444 | 0.371 | 0.17 | 0.067 | 0.182 | 0.243 | 0.575 | 0.472 | 0.642 | 0.705 | 0.456 | 0.370 | 0.116 | 0.053 | 0.0889 | 0.105 | 0.624 | 0.604 | 0.489 | 0.309 | 0.381 |
| Zirconium | mg/L | 0.0004 | | | | <0.0040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | | <0.00040 | <0.0040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | | 0.00044 | <0.0040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 |
| **Speciated Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Methyl Mercury - Total | mg/L | 0.00000005 | 0.000004 | 0.00002 | | - | - | - | - | - | - | - | - | | | - | - | - | - | - | - | 0.000000061 | <0.000000050 | <0.000000050 | <0.000000050 | | - | - | - | - | - | | - | - | |

*RDL = reportable detection limit; TDS = total dissolved solids; TSS = total suspended solids; µmhos/cm = micromhos per centimetre; mg/L = milligrams per litre; TCU = true color unit; NTU = Nephelometric Turbidity Units; µg/L = micrograms per litre.*

Notes:

[a] *Canadian Council of Ministers of Environment (CCME) Water Quality Guidelines (2011) for the Protection of Freshwater Aquatic Life.*

[b] *Metal Mining Effluent Regulation (MMER) SOR/2002-222 Maximum authorized concentration in a grab sample*

[c] Detection limit adjusted for required dilution - ALS lab note

[d] AND-04, AND-05, AND-07 and AND-08 were not accessible in September 2014 due to low water levels and higher tailings

[e] Sample preserved at ALS Laboratories - ALS lab note

[1] Cadmium and Copper standards represented are based on average hardness within the Anderson TIA

[2] Aluminum standard presented is based on average hardness within the Anderson TIA pH >6.5

[3] The long-term exposure CWQG for the protection of freshwater life is 15 µg·L-1 for uranium

Exceeds CCME WQG Guideline
Exceeds 5 X CCME Guideline
Exceeds MMER Guideline

**Table 01. Anderson TIA, Anderson Creek and Anderson Bay Water Analytical Results**

| Parameter | Units | RDL | CCME WQG [a] | 5X CCME WQG | MMER [b] | AND-15 | | | | | | | | | | AND-16 | | | | | | | | | | AND-17 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 8-Mar-12 | 15-Jun-12 | 18-Jun-13 | 6-Oct-13 | 17-Jun-14 | 29-Sep-14 | 10-Dec-14 | 3-Mar-15 | 17-Jun-15 | | 8-Mar-12 | 15-Jun-12 | 18-Jun-13 | 6-Oct-13 | 17-Jun-14 | 29-Sep-14 | 10-Dec-14 | 10-Dec-14 | 3-Mar-15 | 16-Jun-15 | 22-Sep-15 | | 8-Mar-12 | 15-Jun-12 | 18-Jun-13 | 5-Oct-13 | 17-Jun-14 | 29-Sep-14 | 10-Dec-14 | 3-Mar-15 | 21-Sep-15 | 17-Jun-15 | 21-Sep-15 |
| **Total Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aluminum | mg/L | 0.005 | 0.1 | 0.5 | | 0.0079 | <0.050 | 0.0572 | 0.0506 | 0.0854 | 0.127 | 0.077 | 0.036 | 0.274 | | 0.0098 | <0.050 | 0.0224 | 0.0615 | 0.107 | 0.0737 | 0.0601 | 0.0597 | 0.0193 | 0.0710 | 0.0501 | | 0.0124 | <0.050 | 0.0194 | 0.0316 | 0.0756 | 0.0708 | 0.0649 | 0.0185 | 0.0239 | 0.0695 | 0.0239 |
| Antimony | mg/L | 0.0002 | | | | 0.0139 | 0.0161 | 0.00857 | 0.0068 | 0.00353 | 0.00452 | 0.00586 | 0.00642 | 0.00699 | | 0.0138 | 0.0154 | 0.00875 | 0.00702 | 0.00389 | 0.00469 | 0.00640 | 0.00669 | 0.00681 | 0.00643 | 0.00492 | | 0.016 | 0.0154 | 0.00875 | 0.00693 | 0.0037 | 0.00479 | 0.00717 | 0.00598 | 0.00486 | 0.00622 | 0.00486 |
| Arsenic | mg/L | 0.0002 | 0.005 | 0.01 | 1.00 | 0.00335 | 0.0041 | 0.0043 | 0.00303 | 0.00304 | 0.00353 | 0.00376 | 0.00313 | 0.00612 | | 0.00336 | 0.004 | 0.0037 | 0.00332 | 0.00345 | 0.00261 | 0.00328 | 0.00326 | 0.00298 | 0.00375 | 0.00257 | | 0.00398 | 0.0039 | 0.00359 | 0.00305 | 0.00307 | 0.00244 | 0.00323 | 0.00266 | 0.00199 | 0.00375 | 0.00199 |
| Barium | mg/L | 0.0002 | | | | 0.0247 | 0.0196 | 0.0232 | 0.0255 | 0.0234 | 0.0277 | 0.0317 | 0.0355 | 0.0258 | | 0.0243 | 0.0198 | 0.0203 | 0.0263 | 0.0239 | 0.0286 | 0.0332 | 0.0337 | 0.0348 | 0.0270 | 0.0296 | | 0.029 | 0.0194 | 0.0205 | 0.0255 | 0.0244 | 0.0297 | 0.0365 | 0.0382 | 0.0298 | 0.0260 | 0.0298 |
| Beryllium | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Bismuth | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Boron | mg/L | 0.01 | 1.5 | 7.5 | | 0.034 | <0.10 | 0.029 | 0.025 | 0.019 | 0.020 | 0.021 | 0.027 | 0.026 | | 0.035 | <0.10 | 0.026 | 0.026 | 0.02 | 0.020 | 0.025 | 0.021 | 0.028 | 0.024 | 0.020 | | 0.039 | <0.10 | 0.028 | 0.026 | 0.02 | 0.021 | 0.023 | 0.029 | 0.021 | 0.020 | 0.021 |
| Cadmium | mg/L | 0.00001 | 0.00009 | 0.00045 | | 0.000158 | 0.00014 | 0.000299 | 0.000226 | 0.00174 | 0.00126 | 0.00135 | 0.0018 | 0.000815 | | 0.00015 | 0.00012 | 0.000137 | 0.00038 | 0.00165 | 0.00126 | 0.00143 | 0.00142 | 0.00114 | 0.000659 | 0.000746 | | 0.000132 | 0.00013 | 0.000121 | 0.000207 | 0.00156 | 0.00113 | 0.00132 | 0.000934 | 0.000663 | 0.000688 | 0.000663 |
| Calcium | mg/L | 0.1 | | | | 99.4 | 78.3 | 101 | 118 [c] | 110 | 135 | 169 | 189 [c] | 203 | | 97.2 | 76.3 | 99 | 126 [c] | 118 | 136 | 163 | 183 | 196 [c] | 178 | 188 | | 112 | 82.4 | 98 | 115 [c] | 118 | 140 | 166 | 194 [c] | 195 | 169 | 195 |
| Cesium | mg/L | 0.0001 | | | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Chromium | mg/L | 0.001 | | | | <0.0010 | <0.010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | | <0.0010 | <0.010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | | <0.0010 | <0.010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Cobalt | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | 0.0004 | 0.00029 | 0.00137 | 0.00049 | 0.00060 | 0.00086 | 0.00074 | | <0.00020 | <0.0020 | 0.0002 | 0.00047 | 0.00139 | 0.00039 | 0.00070 | 0.00070 | 0.00090 | 0.00050 | 0.00037 | | <0.00020 | <0.0020 | <0.00020 | 0.00027 | 0.00129 | 0.00036 | 0.00073 | 0.00119 | 0.00026 | 0.00052 | 0.00026 |
| Copper | mg/L | 0.0002 | 0.004 | 0.02 | 0.60 | 0.00628 | 0.0079 | 0.0183 | 0.0142 | 0.0821 | 0.0586 | 0.0619 | 0.0619 | 0.0405 | | 0.00636 | 0.0069 | 0.00892 | 0.0238 | 0.0907 | 0.0421 | 0.0771 | 0.0769 | 0.055 | 0.025 | 0.0157 | | 0.00874 | 0.0065 | 0.0075 | 0.0132 | 0.0843 | 0.0356 | 0.0611 | 0.0412 | 0.0114 | 0.0283 | 0.0114 |
| Iron | mg/L | 0.1 | 0.3 | 1.5 | | <0.10 | <1.0 | 0.35 | 0.16 | 0.56 | 0.95 | 0.57 | 0.24 | 1.12 | | <0.10 | <1.0 | 0.13 | 0.24 | 0.7 | 0.43 | 0.38 | 0.39 | 0.11 | 0.30 | 0.14 | | <0.10 | <1.0 | 0.1 | 0.13 | 0.47 | 0.35 | 0.43 | 0.28 | <0.10 | 0.30 | <0.10 |
| Lead | mg/L | 0.00009 | 0.007 | 0.035 | 0.40 | 0.000164 | 0.0012 | 0.00765 | 0.00284 | 0.0311 | 0.0297 | 0.0176 | 0.0071 | 0.0335 | | 0.000091 | 0.00114 | 0.0017 | 0.0071 | 0.0384 | 0.0164 | 0.0146 | 0.0143 | 0.0093 | 0.0090 | 0.00314 | | 0.000144 | 0.00094 | 0.0012 | 0.00241 | 0.0299 | 0.0136 | 0.0116 | 0.00351 | 0.00158 | 0.00899 | 0.00158 |
| Lithium | mg/L | 0.002 | | | | 0.0083 | <0.020 | 0.0049 | 0.0064 | 0.005 | 0.0053 | 0.0062 | 0.0070 | 0.0071 | | 0.0085 | <0.020 | 0.0064 | 0.0067 | 0.0053 | 0.0053 | 0.0052 | 0.0061 | 0.0073 | 0.0073 | 0.0058 | | 0.009 | <0.020 | 0.0072 | 0.0065 | 0.0052 | 0.0055 | 0.0052 | 0.0074 | 0.0067 | 0.0059 | 0.0067 |
| Magnesium | mg/L | 0.01 | | | | 10.7 | 8.28 | 8.98 | 11 | 8.41 | 7.59 | 10.50 | 11.20 | 8.37 | | 10.7 | 8.08 | 9.46 | 11.4 | 8.3 | 8.39 | 11.50 | 11.60 | 12.00 | 8.36 | 9.13 | | 12.6 | 8.47 | 9.54 | 10.9 | 8.68 | 7.79 | 12.50 | 12.00 | 8.20 | 8.52 | 8.20 |
| Manganese | mg/L | 0.0003 | | | | 0.014 | 0.0291 | 0.0539 | 0.0457 | 0.254 | 0.0476 | 0.0897 | 0.2600 | 0.1850 | | 0.0233 | 0.0262 | 0.0402 | 0.0569 | 0.243 | 0.0541 | 0.1160 | 0.1180 | 0.2550 | 0.1660 | 0.0674 | | 0.0235 | 0.028 | 0.0387 | 0.0439 | 0.252 | 0.0530 | 0.1240 | 0.3570 | 0.0571 | 0.1670 | 0.0571 |
| Mercury | mg/L | 0.000001 | 0.000026 | 0.00013 | | <0.000050 | - | <0.000020 | <0.000020 | 0.000136 | 0.000068 | 0.000158 [e] | 0.000043 | 0.0000995 | | <0.000050 | - | <0.000020 | <0.000020 | 0.000141 | 0.000051 | 0.000154 [e] | 0.000151 [e] | 0.000035 | 0.0000305 | 0.0000104 | | <0.000050 | - | <0.000020 | <0.000020 | 0.000132 | 0.000034 | 0.000154 | 0.0000289 | 0.0000059 | 0.0000325 | 0.0000059 |
| Molybdenum | mg/L | 0.0002 | 0.073 | 0.365 | | 0.00125 | <0.0020 | 0.00471 | 0.00412 | 0.00357 | 0.00520 | 0.00643 | 0.00701 | 0.00870 | | 0.00124 | <0.0020 | 0.00394 | 0.00452 | 0.00388 | 0.00448 | 0.00711 | 0.00702 | 0.00856 | 0.00670 | 0.00539 | | 0.00146 | <0.0020 | 0.00347 | 0.00424 | 0.00382 | 0.00452 | 0.00636 | 0.00652 | 0.00512 | 0.00707 | 0.00512 |
| Nickel | mg/L | 0.002 | 0.15 | 0.75 | 1.00 | <0.0020 | <0.020 | <0.0020 | <0.0020 | 0.0022 | <0.0020 | <0.0020 | 0.0024 | <0.0020 | | <0.0020 | <0.020 | <0.0020 | <0.0020 | 0.0022 | <0.0020 | 0.0021 | 0.0021 | 0.0022 | <0.0020 | <0.0020 | | <0.0020 | <0.020 | <0.0020 | <0.0020 | 0.0022 | <0.0020 | 0.002 | <0.0020 | <0.0020 | <0.0020 | <0.0020 |
| Phosphorus | mg/L | 0.2 | | | | <0.20 | <1.0 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | | <0.20 | <1.0 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | | <0.20 | <1.0 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Potassium | mg/L | 0.02 | | | | 7.37 | 6.03 | 6.23 | 7.73 | 6.58 | 7.36 | 9.61 | 12.00 | 10.40 | | 7.38 | 5.83 | 6.81 | 7.95 | 6.24 | 7.06 | 10.20 | 10.10 | 12.40 | 8.68 | 10.30 | | 8.84 | 5.93 | 7.25 | 7.6 | 6.64 | 7.15 | 10.60 | 13.40 | 9.78 | 8.61 | 9.78 |
| Rubidium | mg/L | 0.0002 | | | | 0.00505 | 0.0038 | 0.00488 | 0.00539 | 0.0049 | 0.00562 | 0.00661 | 0.00740 | 0.00678 | | 0.00497 | 0.0039 | 0.00468 | 0.00555 | 0.00479 | 0.00584 | 0.00705 | 0.00710 | 0.00802 | 0.00602 | 0.00726 | | 0.00608 | 0.0039 | 0.00447 | 0.00538 | 0.00496 | 0.00568 | 0.00743 | 0.00768 | 0.00655 | 0.00605 | 0.00655 |
| Selenium | mg/L | 0.001 | 0.001 | 0.005 | | 0.0022 | <0.010 | 0.0025 | 0.0022 | 0.004 | 0.0074 | 0.0071 | 0.005 | 0.0112 | | 0.0023 | <0.010 | 0.0016 | 0.0029 | 0.0036 | 0.0052 | 0.0073 | 0.0073 | 0.0056 | 0.0062 | 0.0076 | | 0.0025 | <0.010 | 0.0017 | 0.0023 | 0.0039 | 0.0048 | 0.0069 | 0.0042 | 0.0064 | 0.0068 | 0.0064 |
| Silicon | mg/L | 0.05 | | | | 0.389 | <0.50 | 0.233 | 0.641 | 1.49 | 0.55 | 0.64 | 0.86 | 1.31 | | 0.43 | <0.50 | 0.135 | 0.697 | 1.4 | 0.48 | 0.70 | 0.72 | 1.03 | 0.72 | 0.27 | | 0.441 | 2 | 0.122 | 0.588 | 1.53 | 0.43 | 0.73 | 1.29 | 0.23 | 0.69 | 0.23 |
| Silver | mg/L | 0.0001 | 0.0001 | 0.0005 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | 0.0001 | 0.00018 | 0.00014 | <0.00010 | 0.00011 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | 0.00013 | 0.00013 | 0.00016 | 0.00015 | 0.00014 | <0.00010 | <0.00010 | | 0.00016 | <0.0010 | <0.00010 | <0.00010 | 0.00013 | 0.00011 | 0.00018 | 0.00011 | <0.00010 | <0.00010 | <0.00010 |
| Sodium | mg/L | 0.03 | | | | 12.6 | 9.7 | 10.8 | 13 | 9.72 | 10.6 | 14.8 | 15.6 | 12.7 | | 12.2 | 9.65 | 12.3 | 13.2 | 9.53 | 11.0 | 16.4 | 16.2 | 17.2 | 12.1 | 15.0 | | 14.9 | 10.1 | 12.7 | 12.9 | 10.3 | 10.8 | 17.1 | 17.1 | 12.4 | 13.2 | 12.4 |
| Strontium | mg/L | 0.0001 | | | | 0.213 | 0.184 | 0.204 | 0.227 | 0.192 | 0.223 | 0.289 | 0.314 | 0.277 | | 0.208 | 0.179 | 0.194 | 0.235 | 0.201 | 0.220 | 0.303 | 0.308 | 0.331 | 0.251 | 0.279 | | 0.247 | 0.182 | 0.189 | 0.225 | 0.213 | 0.230 | 0.303 | 0.302 | 0.270 | 0.264 | 0.270 |
| Tellurium | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Thallium | mg/L | 0.0001 | 0.0008 | 0.004 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | 0.00015 | 0.00019 | 0.00011 | 0.00013 | 0.00014 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | 0.00016 | 0.00015 | 0.00011 | 0.00011 | <0.00010 | <0.00010 | <0.00010 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | 0.00015 | 0.00014 | 0.00011 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Thorium | mg/L | 0.0001 | | | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Tin | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Titanium | mg/L | 0.0002 | | | | 0.00132 | <0.0050 | 0.00518 | 0.0064 | 0.00145 | 0.00344 | 0.00126 | 0.00104 | 0.00411 | | 0.00145 | <0.0050 | 0.00476 | 0.00669 | 0.00196 | 0.00579 | 0.00175 | 0.00116 | <0.00050 | 0.00164 | 0.00123 | | 0.00167 | <0.0050 | 0.00453 | 0.00588 | 0.00134 | 0.00209 | 0.00130 | <0.00050 | 0.00059 | 0.00148 | 0.00059 |
| Tungsten | mg/L | 0.001 | | | | <0.0010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | 0.00027 | 0.00024 | 0.00013 | 0.00032 | | <0.0010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | 0.00016 | 0.00027 | 0.00025 | 0.00022 | 0.00018 | <0.00010 | | <0.0010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | 0.00017 | 0.00021 | 0.00019 | <0.00010 | 0.00017 | <0.00010 |
| Uranium | mg/L | 0.0001 | 0.015 | 0.075 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.0001 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Vanadium | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | 0.0002 | <0.00020 | 0.00023 | 0.00027 | <0.00020 | <0.00020 | 0.00041 | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | 0.0003 | 0.00023 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | 0.00023 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Zinc | mg/L | 0.005 | 0.03 | 0.15 | 1.00 | 0.115 | 0.058 | 0.11 | 0.105 | 0.584 | 0.470 | 0.567 | 0.688 | 0.317 | | 0.116 | 0.053 | 0.0602 | 0.145 | 0.59 | 0.501 | 0.559 | 0.595 | 0.455 | 0.286 | 0.429 | | 0.12 | 0.049 | 0.0541 | 0.0977 | 0.568 | 0.495 | 0.602 | 0.404 | 0.251 | 0.315 | 0.251 |
| Zirconium | mg/L | 0.0004 | | | | <0.00040 | <0.0040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | | <0.00040 | <0.0040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | | <0.00040 | <0.0040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 |
| **Speciated Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Methyl Mercury - Total | mg/L | 0.00000005 | 0.000004 | 0.00002 | | - | - | - | - | - | - | 0.000000072 | 0.000000063 | <0.000000050 | | - | - | - | - | - | - | - | 0.000000094 | 0.000000097 | <0.000000050 | <0.000000050 | | - | - | - | - | - | - | - | - | - | - | - |

*RDL = reportable detection limit; TDS = total dissolved solids; TSS = total suspended solids; µmhos/cm = micromhos per centimetre; mg/L = milligrams per litre; TCU = true color unit; NTU = Nephelometric Turbidity Units; µg/L = micrograms per litre.*

Notes:

[a] *Canadian Council of Ministers of Environment (CCME) Water Quality Guidelines (2011) for the Protection of Freshwater Aquatic Life.*

[b] *Metal Mining Effluent Regulation (MMER) SOR/2002-222 Maximum authorized concentration in a grab sample*

[c] Detection limit adjusted for required dilution - ALS lab note

[d] AND-04, AND-05, AND-07 and AND-08 were not accessible in September 2014 due to low water levels and higher tailings

[e] Sample preserved at ALS Laboratories - ALS lab note

[1] Cadmium and Copper standards represented are based on average hardness within the Anderson TIA

[2] Aluminum standard presented is based on average hardness within the Anderson TIA pH >6.5

[3] The long-term exposure CWQG for the protection of freshwater life is 15 µg·L-1 for uranium

Exceeds CCME WQG Guideline
Exceeds 5 X CCME Guideline
Exceeds MMER Guideline

2015 Anderson Tailings Impoundment Area
June Water Quality Summary

**Table 01. Anderson TIA, Anderson Creek and Anderson Bay Water Analytical Results**

| Parameter | Units | RDL | CCME WQG [a] | 5X CCME WQG | MMER [b] | AND-18 | | | | | | | | | | | AND-19 | | | | | | | | | | | AND-20 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 8-Mar-12 | 15-Jun-12 | 18-Jun-13 | 5-Oct-13 | 17-Jun-14 | 29-Sep-14 | 10-Dec-14 | 3-Mar-15 | 17-Jun-15 | 17-Jun-15 | 22-Sep-15 | 8-Mar-12 | 15-Jun-12 | 18-Jun-13 | 5-Oct-13 | 5-Oct-13 | 17-Jun-14 | 29-Sep-14 | 10-Dec-14 | 3-Mar-15 | 17-Jun-15 | 21-Sep-15 | 8-Mar-12 | 15-Jun-12 | 18-Jun-13 | 5-Oct-13 | 17-Jun-14 | 29-Sep-14 | 10-Dec-14 | 3-Mar-15 | 17-Jun-15 | 21-Sep-15 | 8-Mar-12 |
| | | | | | | | | | | | | | | | DUP-01 (AND-18) | | | | | | | | | | | | | | | | | | | | | | | |
| **Total Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aluminum | mg/L | 0.005 | 0.1 | 0.5 | | 0.0083 | <0.050 | 0.0177 | 0.0404 | 0.0528 | 0.0673 | 0.0545 | 0.0218 | 0.0453 | 0.0453 | 0.0551 | 0.0111 | <0.050 | 0.017 | 0.0296 | 0.0352 | 0.0404 | 0.0404 | 0.0492 | 0.0248 | 0.0757 | 0.0271 | 0.0077 | <0.050 | 0.0174 | 0.0215 | 0.0412 | 0.0337 | 0.0329 | 0.0147 | 0.0182 | 0.0262 | 0.0294 |
| Antimony | mg/L | 0.0002 | | | | 0.0133 | 0.0136 | 0.00843 | 0.00681 | 0.00374 | 0.00422 | 0.00697 | 0.00256 | 0.00613 | 0.00643 | 0.00488 | 0.0139 | 0.0114 | 0.00746 | 0.00658 | 0.00672 | 0.00412 | 0.00578 | 0.00717 | 0.00271 | 0.00681 | 0.00495 | 0.0141 | 0.0111 | 0.00724 | 0.00672 | 0.00414 | 0.00586 | 0.00880 | 0.00391 | 0.00612 | 0.00525 | 0.0139 |
| Arsenic | mg/L | 0.0002 | 0.005 | 0.01 | 1.00 | 0.00365 | 0.0038 | 0.00362 | 0.00299 | 0.00276 | 0.00226 | 0.00303 | 0.00370 | 0.00328 | 0.00325 | 0.00227 | 0.00353 | 0.003 | 0.00318 | 0.00281 | 0.00286 | 0.00238 | 0.00193 | 0.00281 | 0.00286 | 0.00299 | 0.00170 | 0.00402 | 0.0029 | 0.00316 | 0.00285 | 0.00235 | 0.00158 | 0.00215 | 0.00269 | 0.00241 | 0.00184 | 0.00457 |
| Barium | mg/L | 0.0002 | | | | 0.0265 | 0.0192 | 0.0211 | 0.0262 | 0.0253 | 0.0292 | 0.0365 | 0.0469 | 0.0258 | 0.0267 | 0.0283 | 0.0268 | 0.0216 | 0.0217 | 0.0266 | 0.0273 | 0.0244 | 0.0351 | 0.0384 | 0.0475 | 0.0257 | 0.0278 | 0.0269 | 0.0217 | 0.0221 | 0.0268 | 0.0252 | 0.0287 | 0.0410 | 0.0499 | 0.0251 | 0.0285 | 0.0288 |
| Beryllium | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Bismuth | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Boron | mg/L | 0.01 | 1.5 | 7.5 | | 0.034 | <0.10 | 0.025 | 0.026 | 0.02 | 0.019 | 0.023 | 0.027 | 0.020 | 0.019 | 0.020 | 0.037 | <0.10 | 0.026 | 0.026 | 0.025 | 0.022 | 0.018 | 0.022 | 0.028 | 0.019 | 0.020 | 0.034 | <0.10 | 0.027 | 0.026 | 0.022 | 0.019 | 0.027 | 0.030 | 0.019 | 0.020 | 0.037 |
| Cadmium | mg/L | 0.00001 | 0.00009 | 0.00045 | | 0.000107 | <0.00010 | 0.000104 | 0.000194 | 0.00149 | 0.000961 | 0.0013 | 0.000523 | 0.000516 | 0.000549 | 0.00065 | 0.000109 | <0.00010 | 0.000058 | 0.000072 | 0.000069 | 0.000993 | 0.000488 | 0.00124 | 0.00051 | 0.000466 | 0.000211 | 0.000094 | <0.00010 | 0.000054 | 0.000052 | 0.000935 | 0.000345 | 0.000779 | 0.000467 | 0.000349 | 0.000208 | 0.000093 |
| Calcium | mg/L | 0.1 | | | | 101 | 76.4 | 94 | 113 [c] | 115 | 120 | 170 | 182 [c] | 164 | 161 | 184 | 105 | 74.2 | 94 | 110 [c] | 105 [c] | 120 | 118 | 177 | 185 [c] | 162 | 180 | 106 | 79 | 96 | 105 [c] | 127 | 120 | 182 | 216 | 162 | 178 | 111 |
| Cesium | mg/L | 0.0001 | | | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Chromium | mg/L | 0.001 | | | | <0.0010 | <0.010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | 0.0018 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Cobalt | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | <0.00020 | 0.00022 | 0.0011 | 0.00035 | 0.00070 | 0.00094 | 0.00046 | 0.00047 | 0.00034 | <0.00020 | <0.0020 | 0.0002 | <0.00020 | <0.00020 | 0.0008 | 0.00028 | 0.00070 | 0.00059 | 0.00043 | <0.00020 | <0.00020 | <0.0020 | 0.00021 | <0.00020 | 0.00083 | 0.00024 | 0.00045 | 0.00060 | 0.00026 | <0.00020 | 0.00025 |
| Copper | mg/L | 0.0002 | 0.004 | 0.02 | 0.60 | 0.00632 | 0.0054 | 0.00682 | 0.0124 | 0.0756 | 0.0305 | 0.0598 | 0.0227 | 0.0221 | 0.0227 | 0.0137 | 0.00637 | 0.0034 | 0.00414 | 0.00449 | 0.0049 | 0.0573 | 0.0169 | 0.0529 | 0.0223 | 0.0202 | 0.0051 | 0.00471 | 0.0083 | 0.00358 | 0.00345 | 0.0592 | 0.0130 | 0.0273 | 0.0178 | 0.0138 | 0.0055 | 0.00521 |
| Iron | mg/L | 0.1 | 0.3 | 1.5 | | <0.10 | <1.0 | 0.11 | 0.14 | 0.38 | 0.28 | 0.39 | 0.64 | 0.20 | 0.20 | 0.14 | <0.10 | <1.0 | 0.12 | <0.10 | 0.11 | 0.26 | <0.10 | 0.3 | 0.43 | 0.27 | <0.10 | <0.10 | <1.0 | 0.13 | <0.10 | 0.28 | <0.10 | 0.12 | 0.31 | <0.10 | <0.10 | 0.14 |
| Lead | mg/L | 0.00009 | 0.007 | 0.035 | 0.40 | 0.000114 | <0.00090 | 0.00074 | 0.00206 | 0.0239 | 0.00822 | 0.01100 | 0.00445 | 0.00591 | 0.00612 | 0.00259 | <0.000090 | <0.00090 | 0.000363 | 0.000463 | 0.00046 | 0.0151 | 0.00269 | 0.0157 | 0.0031 | 0.0045 | 0.0005 | 0.000099 | <0.00090 | 0.000356 | 0.000298 | 0.0155 | 0.00234 | 0.00411 | 0.00267 | 0.00180 | 0.00048 | 0.000149 |
| Lithium | mg/L | 0.002 | | | | 0.0081 | <0.020 | 0.0067 | 0.0065 | 0.0052 | 0.0048 | 0.0055 | 0.0071 | 0.0057 | 0.0055 | 0.0060 | 0.008 | <0.020 | 0.0065 | 0.0062 | 0.0062 | 0.0055 | 0.0048 | 0.0055 | 0.0072 | 0.0054 | 0.0065 | 0.0075 | <0.020 | 0.0064 | 0.0061 | 0.0055 | 0.0048 | 0.0070 | 0.0076 | 0.0054 | 0.0060 | 0.0081 |
| Magnesium | mg/L | 0.01 | | | | 11.2 | 8.34 | 10.4 | 10.9 | 8.27 | 8.18 | 12.40 | 13.20 | 8.52 | 8.78 | 8.60 | 11.5 | 8.3 | 9.87 | 10.8 | 11 | 8.6 | 9.14 | 12.00 | 13.60 | 8.47 | 8.31 | 11.2 | 8.48 | 10.3 | 10.8 | 8.51 | 8.06 | 13.50 | 14.60 | 8.39 | 9.04 | 12 |
| Manganese | mg/L | 0.0003 | | | | 0.0448 | 0.0314 | 0.0439 | 0.0426 | 0.237 | 0.0518 | 0.1250 | 0.6480 | 0.1470 | 0.1480 | 0.0608 | 0.0324 | 0.0296 | 0.0566 | 0.0355 | 0.0362 | 0.204 | 0.0510 | 0.1290 | 0.4980 | 0.1010 | 0.0475 | 0.039 | 0.0309 | 0.064 | 0.0336 | 0.213 | 0.0440 | 0.1450 | 0.5680 | 0.0982 | 0.0543 | 0.0545 |
| Mercury | mg/L | 0.000001 | 0.000026 | 0.00013 | | <0.000050 | - | <0.000020 | <0.000020 | 0.00008 | 0.000023 | 0.00014 [c] | 0.0000227 | 0.0000218 | 0.0000207 | 0.0000093 | <0.000050 | - | <0.000020 | <0.000020 | <0.000020 | 0.000056 | <0.000020 | 0.000114 [c] | 0.0000224 | 0.0000103 | 0.0000028 | <0.000050 | - | <0.000020 | <0.000020 | 0.000053 | <0.000020 | 0.0000141 | 0.0000128 | 0.0000098 | 0.0000022 | <0.000050 |
| Molybdenum | mg/L | 0.0002 | 0.073 | 0.365 | | 0.00121 | <0.0020 | 0.00334 | 0.0042 | 0.00375 | 0.00363 | 0.00651 | 0.00277 | 0.00677 | 0.00680 | 0.00495 | 0.00125 | <0.0020 | 0.00259 | 0.0033 | 0.00347 | 0.00377 | 0.00325 | 0.00615 | 0.00246 | 0.00657 | 0.00437 | 0.00128 | <0.0020 | 0.00252 | 0.00324 | 0.00374 | 0.00318 | 0.00415 | 0.00209 | 0.00649 | 0.00470 | 0.00129 |
| Nickel | mg/L | 0.002 | 0.15 | 0.75 | 1.00 | <0.0020 | <0.020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | 0.0021 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 |
| Phosphorus | mg/L | 0.2 | | | | <0.20 | <1.0 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.20 | <1.0 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.20 | <1.0 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.20 |
| Potassium | mg/L | 0.02 | | | | 7.86 | 5.91 | 7.33 | 7.61 | 6.64 | 7.12 | 10.30 | 12.20 | 8.61 | 8.69 | 9.45 | 8.07 | 5.83 | 6.84 | 7.39 | 7.69 | 6.74 | 7.97 | 10.70 | 12.20 | 8.41 | 8.61 | 7.72 | 6 | 6.98 | 7.46 | 6.76 | 6.68 | 11.00 | 12.90 | 8.27 | 10.00 | 8.56 |
| Rubidium | mg/L | 0.0002 | | | | 0.00527 | 0.0039 | 0.00478 | 0.00553 | 0.00475 | 0.00602 | 0.00748 | 0.00737 | 0.00618 | 0.00633 | 0.00673 | 0.00518 | 0.0037 | 0.0046 | 0.00522 | 0.00537 | 0.0049 | 0.00626 | 0.00715 | 0.00733 | 0.00605 | 0.00661 | 0.00528 | 0.0038 | 0.00471 | 0.00525 | 0.00482 | 0.00533 | 0.00745 | 0.00791 | 0.00593 | 0.00685 | 0.00562 |
| Selenium | mg/L | 0.001 | 0.001 | 0.005 | | 0.0021 | <0.010 | 0.0015 | 0.0018 | 0.0036 | 0.0040 | 0.0071 | <0.0010 | 0.0058 | 0.0061 | 0.0060 | 0.0023 | <0.010 | 0.0014 | 0.0011 | 0.0013 | 0.0026 | 0.0019 | 0.0063 | <0.0010 | 0.0028 | 0.0020 | 0.0022 | <0.010 | 0.0012 | 0.0013 | 0.0025 | 0.0022 | 0.0023 | <0.0010 | 0.0039 | 0.0020 | 0.0023 |
| Silicon | mg/L | 0.05 | | | | 0.441 | 2 | 0.176 | 0.604 | 1.43 | 0.43 | 0.73 | 2.32 | 0.52 | 0.59 | 0.32 | 0.42 | <0.50 | 0.261 | 0.684 | 0.712 | 1.26 | 0.23 | 0.82 | 2.36 | 0.37 | 0.30 | 0.342 | 2 | 0.251 | 0.575 | 1.25 | 0.25 | 0.68 | 1.96 | 0.23 | 0.28 | 0.435 |
| Silver | mg/L | 0.0001 | 0.0001 | 0.0005 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | 0.00013 | <0.00010 | 0.00018 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | 0.0001 | <0.00010 | 0.00015 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | 0.00011 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Sodium | mg/L | 0.03 | | | | 13.2 | 10.1 | 14.1 | 13.1 | 9.68 | 10.9 | 17.1 | 17.5 | 13.1 | 13.2 | 13.5 | 13.7 | 9.51 | 13.1 | 12.7 | 13.2 | 9.97 | 11.9 | 17.1 | 17.0 | 12.7 | 12.7 | 13.8 | 9.96 | 13.6 | 13 | 9.98 | 10.0 | 17.7 | 18.0 | 12.6 | 13.5 | 15 |
| Strontium | mg/L | 0.0001 | | | | 0.218 | 0.182 | 0.199 | 0.231 | 0.198 | 0.207 | 0.318 | 0.312 | 0.260 | 0.260 | 0.267 | 0.218 | 0.174 | 0.197 | 0.222 | 0.23 | 0.214 | 0.205 | 0.316 | 0.322 | 0.259 | 0.252 | 0.224 | 0.179 | 0.201 | 0.227 | 0.213 | 0.204 | 0.310 | 0.331 | 0.262 | 0.262 | 0.233 |
| Tellurium | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Thallium | mg/L | 0.0001 | 0.0008 | 0.004 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | 0.00014 | 0.00010 | 0.00011 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | 0.0001 | <0.00010 | 0.00011 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.0001 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Thorium | mg/L | 0.0001 | | | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.0001 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Tin | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Titanium | mg/L | 0.0002 | | | | 0.00178 | <0.0050 | 0.00463 | 0.00615 | 0.00091 | 0.00258 | 0.00111 | <0.00050 | 0.00099 | 0.00108 | 0.00163 | 0.00117 | <0.0050 | 0.00439 | 0.00535 | 0.00717 | 0.00116 | 0.00116 | 0.00108 | <0.00050 | 0.00250 | 0.00076 | 0.00112 | <0.0050 | 0.00449 | 0.00555 | 0.001 | 0.00121 | 0.00114 | <0.00050 | 0.00050 | 0.00070 | 0.00255 |
| Tungsten | mg/L | 0.001 | | | | <0.0010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00022 | 0.00048 | 0.00014 | 0.00014 | <0.00010 | <0.0010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00019 | 0.00029 | 0.00011 | <0.00010 | <0.0010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00021 | 0.0001 | <0.00010 | <0.0010 |
| Uranium | mg/L | 0.0001 | 0.015 | 0.075 | | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Vanadium | mg/L | 0.0002 | | | | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | 0.0002 | <0.00020 | <0.00020 | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | 0.00021 |
| Zinc | mg/L | 0.005 | 0.03 | 0.15 | 1.00 | 0.0997 | 0.041 | 0.0447 | 0.0941 | 0.517 | 0.414 | 0.594 | 0.245 | 0.269 | 0.277 | 0.373 | 0.104 | 0.022 | 0.0248 | 0.0369 | 0.0377 | 0.405 | 0.266 | 0.575 | 0.273 | 0.222 | 0.186 | 0.0949 | 0.023 | 0.0214 | 0.0299 | 0.408 | 0.205 | 0.599 | 0.317 | 0.178 | 0.199 | 0.0891 |
| Zirconium | mg/L | 0.0004 | | | | <0.00040 | <0.0040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.0040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.0040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 |
| **Speciated Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Methyl Mercury - Total | mg/L | 0.00000005 | 0.000004 | 0.00002 | | - | - | - | - | - | - | 0.00000009 | 0.000000121 | <0.000000050 | <0.000000050 | <0.000000050 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | <0.000000050 | 0.000000107 | <0.000000050 | <0.000000050 | - |

*RDL = reportable detection limit; TDS = total dissolved solids; TSS = total suspended solids; µmhos/cm = micromhos per centimetre; mg/L = milligrams per litre; TCU = true color unit; NTU = Nephelometric Turbidity Units; µg/L = micrograms per litre.*

Notes:

[a] *Canadian Council of Ministers of Environment (CCME) Water Quality Guidelines (2011) for the Protection of Freshwater Aquatic Life.*

[b] *Metal Mining Effluent Regulation (MMER) SOR/2002-222 Maximum authorized concentration in a grab sample*

[c] Detection limit adjusted for required dilution - ALS lab note

[d] AND-04, AND-05, AND-07 and AND-08 were not accessible in September 2014 due to low water levels and higher tailings

[e] Sample preserved at ALS Laboratories - ALS lab note

[1] Cadmium and Copper standards represented are based on average hardness within the Anderson TIA

[2] Aluminum standard presented is based on average hardness within the Anderson TIA pH >6.5

[3] The long-term exposure CWQG for the protection of freshwater life is 15 µg·L-1 for uranium

Exceeds CCME WQG Guideline
Exceeds 5 X CCME Guideline
Exceeds MMER Guideline

**Table 01. Anderson TIA, Anderson Creek and Anderson Bay Water Analytical Results**

| Parameter | Units | RDL | CCME WQG [a] | 5X CCME WQG | MMER [b] | AND-21 | | | | | | | | AND-22 | | | | | AND-23 | | | | | | AND-24 | | | | | ANC-01 | | ANC-02 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 15-Jun-12 | 18-Jun-13 | 5-Oct-13 | 17-Jun-14 | 29-Sep-14 | 10-Dec-14 | 3-Mar-15 | 17-Jun-15 | 21-Sep-15 | 29-Sep-14 | 10-DEC-14 | 17-Jun-15 | 22-Sep-15 | 29-Sep-14 | 10-Dec-14 | 3-Mar-15 | 17-Jun-15 | 22-Sep-15 | 22-Sep-15 (Dup -01 AND-23) | 30-Sep-14 | 9-Dec-14 | 4-Mar-15 | 17-Jun-15 | 23-Sep-15 | 30-May-11 | 15-Sep-11 | 22-May-11 | 17-Sep-11 |
| **Total Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aluminum | mg/L | 0.005 | 0.1 | 0.5 | | <0.050 | 0.019 | 0.0714 | 0.0446 | 0.0466 | 0.0601 | 0.0271 | 0.0251 | 0.0428 | 0.0719 | 0.0783 | 0.0587 | 0.0687 | 0.0605 | 0.0550 | 0.0202 | 0.0356 | 0.0331 | 0.0318 | 0.0747 | 0.0851 | 0.0314 | 0.0464 | 0.0704 | 0.204 | 0.103 | 0.269 | 0.180 |
| Antimony | mg/L | 0.0002 | | | | 0.0109 | 0.00719 | 0.0066 | 0.00422 | 0.00542 | 0.00844 | 0.00630 | 0.00628 | 0.00524 | 0.00460 | 0.00624 | 0.00631 | 0.00505 | 0.00537 | 0.00708 | 0.00353 | 0.00614 | 0.00497 | 0.00478 | 0.00516 | 0.0068 | 0.0058 | 0.0055 | 0.0054 | 0.0106 | 0.00754 | 0.0107 | 0.00682 |
| Arsenic | mg/L | 0.0002 | 0.005 | 0.01 | 1.00 | 0.0026 | 0.00295 | 0.0027 | 0.00241 | 0.00162 | 0.00198 | 0.00163 | 0.00232 | 0.00165 | 0.00252 | 0.00347 | 0.00359 | 0.00242 | 0.00224 | 0.00277 | 0.00322 | 0.00288 | 0.00190 | 0.00196 | 0.00372 | 0.00375 | 0.00230 | 0.00291 | 0.00322 | 0.00309 | 0.00263 | 0.00376 | 0.00288 |
| Barium | mg/L | 0.0002 | | | | 0.0208 | 0.0219 | 0.0268 | 0.0251 | 0.0328 | 0.0429 | 0.0485 | 0.0255 | 0.0281 | 0.0297 | 0.0326 | 0.0261 | 0.0283 | 0.0310 | 0.0378 | 0.0440 | 0.0247 | 0.0290 | 0.0286 | 0.0296 | 0.04340 | 0.04400 | 0.02560 | 0.03040 | 0.0213 | 0.0276 | 0.0201 | 0.0252 |
| Beryllium | mg/L | 0.0002 | | | | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Bismuth | mg/L | 0.0002 | | | | <0.0020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Boron | mg/L | 0.01 | 1.5 | 7.5 | | <0.10 | 0.03 | 0.025 | 0.022 | 0.020 | 0.024 | 0.029 | 0.019 | 0.019 | 0.024 | 0.029 | 0.021 | 0.021 | 0.024 | 0.022 | 0.028 | 0.018 | 0.023 | 0.019 | 0.020 | 0.028 | 0.017 | 0.019 | 0.024 | 0.021 | 0.024 | 0.024 | 0.023 |
| Cadmium | mg/L | 0.00001 | 0.00009 | 0.00045 | | <0.00010 | 0.000045 | 0.000044 | 0.000946 | 0.000332 | 0.000834 | 0.000451 | 0.000319 | 0.000169 | 0.00119 | 0.00142 | 0.00068 | 0.00076 | 0.000960 | 0.00131 | 0.00059 | 0.00047 | 0.000614 | 0.00063 | 0.000560 | 0.00138 | 0.00141 | 0.00065 | 0.00071 | 0.000077 | 0.000027 | 0.000110 | 0.000028 |
| Calcium | mg/L | 0.1 | | | | 78.4 | 93 | 106 [c] | 124 | 116 | 173 | 189 [c] | 169 | 174 | 146 | 164 | 170 | 200 | 139 | 160 | 197 [c] | 152 | 202 | 179 | 104 | 0.000192 | 171 | 154 | 188 | 75.4 | 78.2 | 73.2 | 73.3 |
| Cesium | mg/L | 0.0001 | | | | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Chromium | mg/L | 0.001 | | | | <0.010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Cobalt | mg/L | 0.0002 | | | | <0.0020 | <0.00020 | <0.00020 | 0.00082 | 0.00023 | 0.00041 | 0.00100 | 0.00025 | <0.00020 | 0.00038 | 0.00068 | 0.00049 | 0.00034 | 0.00034 | 0.00072 | 0.00082 | 0.00037 | 0.00030 | 0.00030 | 0.00032 | 0.00052 | 0.00069 | 0.00038 | 0.00069 | 0.00027 | 0.00022 | 0.00024 | 0.00028 |
| Copper | mg/L | 0.0002 | 0.004 | 0.02 | 0.60 | 0.003 | 0.00319 | 0.00307 | 0.0575 | 0.0170 | 0.0304 | 0.0120 | 0.0134 | 0.0047 | 0.0420 | 0.0728 | 0.0270 | 0.0149 | 0.0299 | 0.0556 | 0.0263 | 0.0189 | 0.0113 | 0.0112 | 0.0152 | 0.02080 | 0.02100 | 0.01610 | 0.01670 | 0.00594 | 0.00179 | 0.00704 | 0.00256 |
| Iron | mg/L | 0.1 | 0.3 | 1.5 | | <1.0 | 0.11 | 0.11 | 0.28 | <0.10 | 0.13 | 0.24 | <0.10 | <0.10 | 0.38 | 0.55 | 0.28 | 0.30 | 0.25 | 0.36 | 0.62 | 0.15 | <0.10 | <0.10 | 0.31 | 0.2600 | 0.1800 | 0.2100 | 0.20 | 0.31 | 0.24 | 0.34 | 0.28 |
| Lead | mg/L | 0.00009 | 0.007 | 0.035 | 0.40 | <0.00090 | 0.000218 | 0.000233 | 0.0149 | 0.00193 | 0.00441 | 0.00112 | 0.00155 | 0.00034 | 0.0171 | 0.0149 | 0.0089 | 0.0038 | 0.0110 | 0.00981 | 0.00342 | 0.00414 | 0.00159 | 0.00154 | 0.00878 | 0.01 | 0.0040 | 0.0048 | 0.0055 | 0.000269 | 0.000144 | 0.000382 | 0.000244 |
| Lithium | mg/L | 0.002 | | | | <0.020 | 0.0068 | 0.0061 | 0.0055 | 0.0054 | 0.0062 | 0.0072 | 0.0054 | 0.0058 | 0.0064 | 0.0052 | 0.0061 | 0.0062 | 0.0063 | 0.0054 | 0.0072 | 0.0052 | 0.0071 | 0.0058 | 0.0050 | 0.0077 | 0.0033 | 0.0056 | 0.0073 | 0.0053 | 0.0058 | 0.0051 | 0.0061 |
| Magnesium | mg/L | 0.01 | | | | 8.15 | 10.2 | 10.8 | 8.26 | 8.86 | 12.60 | 13.60 | 8.38 | 8.09 | 8.63 | 11.80 | 8.46 | 8.53 | 8.60 | 11.80 | 13.40 | 8.58 | 8.26 | 7.96 | 7.81 | 11.8000 | 12.0000 | 8.9000 | 8.5800 | 8.41 | 9.52 | 8.56 | 9.24 |
| Manganese | mg/L | 0.0003 | | | | 0.0267 | 0.0477 | 0.0279 | 0.21 | 0.0505 | 0.1340 | 0.6930 | 0.0886 | 0.0484 | 0.0572 | 0.1050 | 0.1650 | 0.0560 | 0.0550 | 0.1190 | 0.5120 | 0.1260 | 0.0590 | 0.0593 | 0.0313 | 0.11 | 0.30 | 0.11 | 0.10 | 0.0217 | 0.0232 | 0.0202 | 0.0292 |
| Mercury | mg/L | 0.000001 | 0.000026 | 0.00013 | | - | <0.000020 | <0.000020 | 0.000055 | <0.000020 | 0.0000162 | 0.0000043 | 0.0000091 | 0.0000019 | 0.000046 | 0.000141 [c] | 0.0000331 | 0.0000267 | 0.000036 | 0.000124 [c] | 0.0000239 | 0.0000164 | 0.0000062 | 0.0000046 | 0.000021 | 0.000016 | 0.0000095 | 0.0000161 | 0.0000185 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Molybdenum | mg/L | 0.0002 | 0.073 | 0.365 | | <0.0020 | 0.00227 | 0.0032 | 0.00383 | 0.00310 | 0.00403 | 0.00307 | 0.00636 | 0.00460 | 0.00446 | 0.00696 | 0.00705 | 0.00540 | 0.00409 | 0.00624 | 0.00332 | 0.00633 | 0.00507 | 0.00484 | 0.00286 | 0.00367 | 0.00288 | 0.00485 | 0.00544 | 0.00078 | 0.00069 | 0.00090 | 0.00075 |
| Nickel | mg/L | 0.002 | 0.15 | 0.75 | 1.00 | <0.020 | <0.0020 | <0.0020 | <0.0020 | 0.0028 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | 0.0023 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | 0.0022 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 |
| Phosphorus | mg/L | 0.2 | | | | <1.0 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.20 | <0.20 | <0.20 | <0.20 |
| Potassium | mg/L | 0.02 | | | | 5.81 | 6.68 | 7.33 | 6.89 | 7.08 | 10.60 | 12.10 | 8.45 | 8.63 | 7.77 | 10.20 | 8.58 | 9.03 | 7.87 | 10.20 | 12.30 | 8.44 | 9.14 | 8.87 | 6.45 | 9.23 | 10.6 | 8.2 | 9.44 | 6.28 | 6.15 | 6.01 | 6.46 |
| Rubidium | mg/L | 0.0002 | | | | 0.0037 | 0.00443 | 0.00525 | 0.00482 | 0.00564 | 0.00729 | 0.00720 | 0.00581 | 0.00613 | 0.00582 | 0.00702 | 0.00600 | 0.00632 | 0.00596 | 0.00704 | 0.00738 | 0.00604 | 0.00623 | 0.00648 | 0.00522 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00421 | 0.00375 | 0.00396 | 0.00424 |
| Selenium | mg/L | 0.001 | 0.001 | 0.005 | | <0.010 | 0.0015 | 0.0014 | 0.0024 | 0.0023 | 0.0037 | 0.0016 | 0.0037 | 0.0021 | 0.0051 | 0.0072 | 0.0066 | 0.0070 | 0.0042 | 0.0065 | <0.0010 | 0.0051 | 0.0046 | 0.0047 | 0.0022 | 0.00250 | 0.00190 | 0.00280 | 0.00540 | <0.0010 | <0.0010 | 0.0013 | <0.0010 |
| Silicon | mg/L | 0.05 | | | | 2.1 | 0.226 | 0.566 | 1.25 | 0.26 | 0.76 | 1.25 | 0.25 | 0.33 | 0.44 | 0.69 | 0.71 | 0.25 | 0.42 | 0.74 | 2.10 | 0.38 | 0.29 | 0.29 | 0.28 | 0.5100 | 0.5900 | 0.4100 | 0.3200 | 0.491 | 0.897 | 0.641 | 0.825 |
| Silver | mg/L | 0.0001 | 0.0001 | 0.0005 | | <0.0010 | <0.00010 | <0.00010 | 0.00011 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00011 | 0.00020 | <0.00010 | <0.00010 | <0.00010 | 0.00017 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Sodium | mg/L | 0.03 | | | | 9.57 | 13.5 | 12.9 | 10.2 | 11.2 | 16.9 | 16.9 | 12.9 | 11.7 | 11.7 | 17.0 | 12.6 | 13.4 | 11.7 | 16.1 | 16.9 | 13.0 | 12.5 | 13.3 | 9.33 | 12.9 | 15.2 | 12.6 | 13.2 | 9.88 | 10.5 | 10.3 | 8.62 |
| Strontium | mg/L | 0.0001 | | | | 0.18 | 0.187 | 0.229 | 0.215 | 0.204 | 0.324 | 0.318 | 0.258 | 0.258 | 0.220 | 0.298 | 0.256 | 0.301 | 0.224 | 0.314 | 0.334 | 0.247 | 0.294 | 0.264 | 0.185 | 0.30 | 0.27 | 0.24 | 0.25 | 0.175 | 0.181 | 0.195 | 0.192 |
| Tellurium | mg/L | 0.0002 | | | | <0.0020 | <0.00020 | <0.00020 | <0.00020 | 0.00021 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Thallium | mg/L | 0.0001 | 0.0008 | 0.004 | | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00015 | 0.00011 | <0.00010 | <0.00010 | 0.00013 | 0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00012 | 0.00013 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Thorium | mg/L | 0.0001 | | | | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Tin | mg/L | 0.0002 | | | | <0.0020 | <0.00020 | <0.00020 | <0.00020 | 0.00060 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Titanium | mg/L | 0.0002 | | | | <0.0050 | 0.00481 | 0.00792 | 0.00104 | 0.00209 | 0.00190 | 0.00094 | 0.00083 | 0.00186 | 0.00138 | 0.00154 | 0.00131 | 0.00127 | 0.00184 | 0.00109 | <0.00050 | 0.00076 | 0.00104 | 0.00103 | 0.00205 | 0.00246 | 0.00091 | 0.00096 | 0.00121 | 0.0119 | 0.00499 | 0.0107 | 0.00984 |
| Tungsten | mg/L | 0.001 | | | | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00016 | 0.00027 | 0.00017 | <0.00010 | 0.00012 | 0.00019 | 0.00033 | 0.00012 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00013 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Uranium | mg/L | 0.0001 | 0.015 | 0.075 | | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00012 | 0.00014 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Vanadium | mg/L | 0.0002 | | | | <0.0020 | 0.0002 | 0.00027 | 0.00021 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | 0.00022 | 0.00021 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | 0.00021 | 0.00023 | <0.00020 | <0.00020 | <0.00020 | 0.00065 | 0.00049 | 0.00065 | 0.00063 |
| Zinc | mg/L | 0.005 | 0.03 | 0.15 | 1.00 | <0.020 | 0.017 | 0.0248 | 0.395 | 0.193 | 0.585 | 0.38 | 0.163 | 0.163 | 0.483 | 0.568 | 0.307 | 0.397 | 0.418 | 0.599 | 0.296 | 0.236 | 0.339 | 0.340 | 0.325 | 0.73300 | 0.74800 | 0.30900 | 0.33800 | 0.0608 | 0.0340 | 0.0717 | 0.0392 |
| Zirconium | mg/L | 0.0004 | | | | <0.0040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | 0.00133 |
| **Speciated Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Methyl Mercury - Total | mg/L | 0.000000005 | 0.000004 | 0.00002 | | - | - | - | - | - | <0.000000050 | <0.000000050 * | <0.000000050 | <0.000000050 | | | - | - | - | 0.000000079 | 0.000000105 | <0.000000050 | <0.000000050 | <0.000000050 | - | <0.000000050 | <0.000000050 | <0.000000050 | <0.000000050 | - | - | - | - |

*RDL = reportable detection limit; TDS = total dissolved solids; TSS = total suspended solids; µmhos/cm = micromhos per centimetre; mg/L = milligrams per litre; TCU = true color unit; NTU = Nephelometric Turbidity Units; µg/L = micrograms per litre.*

Notes:

** Canadian Council of Ministers of Environment (CCME) Water Quality Guidelines (2011) for the Protection of Freshwater Aquatic Life.*

[b] *Metal Mining Effluent Regulation (MMER) SOR/2002-222 Maximum authorized concentration in a grab sample*

[c] Detection limit adjusted for required dilution - ALS lab note

[d] AND-04, AND-05, AND-07 and AND-08 were not accessible in September 2014 due to low water levels and higher tailings

[e] Sample preserved at ALS Laboratories - ALS lab note

[1] Cadmium and Copper standards represented are based on average hardness within the Anderson TIA

[2] Aluminum standard presented is based on average hardness within the Anderson TIA pH >6.5

[3] The long-term exposure CWQG for the protection of freshwater life is 15 µg·L-1 for uranium

Exceeds CCME WQG Guideline
Exceeds 5 X CCME Guideline
Exceeds MMER Guideline

**Table 01. Anderson TIA, Anderson Creek and Anderson Bay Water Analytical Results**

| Parameter | Units | RDL | CCME WQG [a] | 5X CCME WQG | MMER [b] | ANC-02A | | | | | | ANC-05 | | | | | | ANC-06 | | | | | | ANB-01 | | ANB-01A | | | | | | ANB-02 | | ANB-03 | | ANB-04 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 18-Jun-13 | 5-Oct-13 | 18-Jun-14 | 30-Sep-14 | 17-Jun-15 | 21-Sep-15 | 18-Jun-13 | 5-Oct-13 | 18-Jun-14 | 30-Sep-14 | 17-Jun-15 | 21-Sep-15 | 20-Jun-13 | 6-Oct-13 | 18-Jun-14 | 30-Sep-14 | 17-Jun-15 | 21-Sep-15 | 23-May-11 | 15-Sep-11 | 18-Jun-13 | 6-Oct-13 | 18-Jun-14 | 30-Sep-14 | 18-Jun-15 | 23-Sep-15 | 23-May-11 | 15-Sep-11 | 23-May-11 | 17-Sep-11 | 23-May-11 | 16-Sep-11 |
| **Total Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aluminum | mg/L | 0.005 | 0.1 | 0.5 | | 0.309 | 0.331 | 0.778 | 0.0268 | 0.2820 | 0.4950 | 0.324 | 0.565 | 0.344 | 0.0684 | 0.1320 | 0.5830 | 0.0407 | 0.059 | 0.0888 | 0.0794 | 0.0544 | 0.1040 | 0.519 | 0.0393 | 0.276 | 0.334 | 0.0847 | 0.210 | 0.091 | 0.072 | 0.199 | 0.0140 | 0.131 | 0.0674 | 0.178 | 0.0656 |
| Antimony | mg/L | 0.0002 | | | | 0.00631 | 0.00167 | 0.00447 | 0.00408 | 0.00560 | 0.00238 | 0.00666 | 0.00101 | 0.00429 | 0.00418 | 0.00557 | 0.00242 | 0.00652 | <0.00020 | 0.00412 | 0.00449 | 0.00581 | 0.00325 | 0.00852 | 0.00578 | 0.00322 | 0.00025 | 0.00036 | <0.00020 | 0.00098 | 0.00044 | 0.00261 | 0.00191 | <0.00020 | 0.00226 | 0.00209 | 0.00031 |
| Arsenic | mg/L | 0.0002 | 0.005 | 0.01 | 1.00 | 0.00283 | 0.00295 | 0.0026 | 0.00122 | 0.00217 | 0.00210 | 0.0027 | 0.00411 | 0.00253 | 0.00154 | 0.00210 | 0.00213 | 0.00287 | 0.00204 | 0.00233 | 0.00149 | 0.00215 | 0.00197 | 0.00280 | 0.00225 | 0.00188 | 0.00152 | 0.00138 | 0.00143 | 0.00675 | 0.00171 | 0.00150 | 0.00214 | 0.00093 | 0.00206 | 0.00138 | 0.00274 |
| Barium | mg/L | 0.0002 | | | | 0.0258 | 0.0147 | 0.0324 | 0.0297 | 0.0297 | 0.0281 | 0.0288 | 0.0196 | 0.0284 | 0.0325 | 0.0288 | 0.0293 | 0.0225 | 0.00873 | 0.0263 | 0.0411 | 0.0293 | 0.0259 | 0.0225 | 0.0247 | 0.0229 | 0.0142 | 0.014 | 0.0124 | 0.0146 | 0.0127 | 0.0141 | 0.0162 | 0.0118 | 0.0151 | 0.0137 | 0.0113 |
| Beryllium | mg/L | 0.0002 | | | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Bismuth | mg/L | 0.0002 | | | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Boron | mg/L | 0.01 | 1.5 | 7.5 | | 0.026 | 0.017 | 0.026 | 0.029 | 0.029 | 0.023 | 0.034 | 0.015 | 0.025 | 0.028 | 0.018 | 0.023 | 0.02 | <0.010 | 0.026 | 0.036 | 0.023 | 0.019 | 0.021 | 0.020 | 0.03 | 0.012 | 0.013 | 0.014 | 0.017 | 0.017 | 0.014 | 0.014 | 0.011 | 0.013 | 0.015 | 0.010 |
| Cadmium | mg/L | 0.00001 | 0.00009 | 0.00045 | | 0.000059 | 0.000048 | 0.000908 | 0.000168 | 0.000332 | 0.000237 | 0.000066 | 0.000058 | 0.000896 | 0.000353 | 0.000336 | 0.000252 | 0.000065 | 0.000043 | 0.000908 | 0.000418 | 0.000337 | 0.000317 | 0.000072 | 0.000015 | 0.000039 | 0.000011 | 0.000024 | <0.000010 | 0.000039 | 0.000013 | 0.000023 | <0.000010 | <0.000010 | 0.000018 | <0.000010 | <0.000010 |
| Calcium | mg/L | 0.1 | | | | 97 | 38.7 | 123 | 122 | 160 | 090 | 97.3 | 34.7 | 125 | 124 | 156 | 099 | 91 | 21.4 | 121 | 122 | 162 | 118 | 66.2 | 64.9 | 58.6 | 22.2 | 26.8 | 19.0 | 42.0 | 27.0 | 33.4 | 39.5 | 18.9 | 48.3 | 29.0 | 22.4 |
| Cesium | mg/L | 0.0001 | | | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Chromium | mg/L | 0.001 | | | | <0.0010 | <0.0010 | 0.0013 | <0.0010 | <0.0010 | 0.001 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | 0.0012 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | 0.0013 | <0.0010 | <0.0010 | 0.001 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Cobalt | mg/L | 0.0002 | | | | 0.00029 | <0.00020 | 0.00103 | <0.00020 | 0.00037 | 0.00044 | 0.00023 | 0.00038 | 0.00089 | 0.00026 | 0.00029 | 0.00053 | <0.00020 | <0.00020 | 0.00082 | 0.00035 | 0.00024 | 0.00039 | 0.00031 | <0.00020 | 0.00021 | 0.00024 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Copper | mg/L | 0.0002 | 0.004 | 0.02 | 0.60 | 0.00353 | 0.00537 | 0.0095 | 0.00702 | 0.01280 | 0.00722 | 0.00313 | 0.00553 | 0.0603 | 0.00913 | 0.01290 | 0.00744 | 0.00283 | 0.00908 | 0.0567 | 0.0109 | 0.0131 | 0.0062 | 0.00529 | 0.00111 | 0.00189 | 0.00158 | 0.00289 | 0.00100 | 0.00221 | 0.00091 | 0.00231 | 0.00042 | 0.00101 | 0.00094 | 0.00189 | 0.00062 |
| Iron | mg/L | 0.1 | 0.3 | 1.5 | | 0.35 | 0.39 | 0.96 | <0.10 | 0.34 | 0.54 | 0.31 | 0.62 | 0.55 | 0.14 | 0.19 | 0.58 | <0.10 | 0.11 | 0.3 | 0.15 | 0.12 | 0.13 | 0.64 | 0.16 | 0.47 | 0.33 | 0.11 | 0.18 | 0.16 | 0.11 | 0.18 | <0.10 | 0.14 | <0.10 | 0.20 | <0.10 |
| Lead | mg/L | 0.00009 | 0.007 | 0.035 | 0.40 | 0.000263 | 0.000191 | 0.0159 | 0.000283 | 0.001490 | 0.000384 | 0.000265 | 0.000355 | 0.015 | 0.000693 | 0.001000 | 0.000418 | 0.00022 | 0.000157 | 0.014 | 0.000784 | 0.001300 | 0.000218 | 0.000334 | <0.000090 | 0.000223 | 0.000232 | 0.000276 | 0.000124 | 0.000141 | <0.000090 | 0.000136 | <0.000090 | 0.000092 | <0.000090 | 0.000136 | <0.000090 |
| Lithium | mg/L | 0.002 | | | | 0.0066 | 0.0047 | 0.0069 | 0.0065 | 0.0068 | 0.0063 | 0.0062 | 0.0049 | 0.0064 | 0.0065 | 0.0049 | 0.0067 | 0.005 | 0.0041 | 0.0063 | 0.0065 | 0.0061 | 0.0057 | 0.0046 | 0.0048 | 0.0055 | 0.003 | 0.0033 | 0.0030 | 0.0035 | 0.0031 | 0.0032 | 0.0037 | 0.0031 | 0.0039 | 0.0040 | 0.0042 |
| Magnesium | mg/L | 0.01 | | | | 10.5 | 11.7 | 9.46 | 15.8 | 09.8 | 12.7 | 10.5 | 12.7 | 9.32 | 14.6 | 09.9 | 12.7 | 9.35 | 10.9 | 9.65 | 17.1 | 9.89 | 10.80 | 8.48 | 10.7 | 11.4 | 9.29 | 7.69 | 8.26 | 9.06 | 9.52 | 8.04 | 10.2 | 7.48 | 10.6 | 7.70 | 8.88 |
| Manganese | mg/L | 0.0003 | | | | 0.0568 | 0.0216 | 0.219 | 0.0261 | 0.0904 | 0.0631 | 0.0465 | 0.0711 | 0.217 | 0.108 | 0.080 | 0.060 | 0.051 | 0.00864 | 0.218 | 0.0809 | 0.0765 | 0.0444 | 0.0263 | 0.0191 | 0.049 | 0.0233 | 0.0157 | 0.0131 | 0.0291 | 0.0303 | 0.0186 | 0.0257 | 0.0179 | 0.0213 | 0.0220 | 0.0381 |
| Mercury | mg/L | 0.000001 | 0.000026 | 0.00013 | | <0.000020 | <0.000020 | 0.000082 | 0.0000031 | 0.0000086 | 0.0000036 | <0.000020 | <0.000020 | <0.00020 | 0.000005 | 0.0000075 | 0.0000039 | <0.000020 | <0.000020 | <0.00020 | 0.0000052 | 0.0000084 | 0.0000039 | <0.000050 | <0.000050 | <0.000020 | <0.000020 | <0.000020 | <0.0000010 | 0.0000016 | <0.000001 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Molybdenum | mg/L | 0.0002 | 0.073 | 0.365 | | 0.002 | 0.0005 | 0.00378 | 0.00215 | 0.00544 | 0.00207 | 0.00216 | 0.00041 | 0.00379 | 0.00240 | 0.00583 | 0.00225 | 0.0023 | <0.00020 | 0.00372 | 0.00259 | 0.00572 | 0.00282 | 0.00070 | 0.00052 | 0.00097 | 0.00029 | 0.00035 | <0.00020 | 0.00098 | 0.00043 | 0.00027 | 0.00023 | <0.00020 | 0.00032 | 0.00024 | <0.00020 |
| Nickel | mg/L | 0.002 | 0.15 | 0.75 | 1.00 | <0.0020 | <0.0020 | 0.0024 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | 0.0021 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | 0.0026 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 |
| Phosphorus | mg/L | 0.2 | | | | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.20 | <0.20 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 |
| Potassium | mg/L | 0.02 | | | | 6.62 | 3.12 | 6.89 | 7.02 | 8.27 | 5.34 | 6.27 | 3.44 | 6.73 | 7.06 | 8.56 | 5.55 | 6.75 | 1.25 | 6.9 | 7.82 | 8.64 | 6.31 | 4.95 | 5.30 | 3.69 | 1.51 | 1.64 | 1.37 | 2.41 | 1.74 | 2.34 | 2.55 | 1.26 | 3.39 | 2.09 | 1.35 |
| Rubidium | mg/L | 0.0002 | | | | 0.00435 | 0.00155 | 0.00639 | 0.00378 | 0.00611 | 0.00426 | 0.0047 | 0.00289 | 0.00554 | 0.00460 | 0.00563 | 0.00446 | 0.00457 | 0.00099 | 0.00505 | 0.00499 | 0.00564 | 0.00435 | 0.00354 | 0.00287 | 0.00284 | 0.00174 | 0.00146 | 0.00153 | 0.00184 | 0.00145 | 0.00175 | 0.00174 | 0.00116 | 0.00225 | 0.00164 | 0.00151 |
| Selenium | mg/L | 0.001 | 0.001 | 0.005 | | <0.0010 | <0.0010 | 0.0027 | 0.0013 | 0.0032 | 0.0016 | 0.002 | <0.0010 | 0.0026 | 0.0016 | 0.0035 | 0.0016 | <0.0010 | <0.0010 | 0.003 | 0.0017 | 0.0034 | 0.0019 | 0.0012 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Silicon | mg/L | 0.05 | | | | 1.18 | 4.54 | 3.66 | 1.10 | 1.16 | 3.73 | 1.31 | 5.71 | 2.23 | 1.42 | 0.87 | 3.92 | 0.373 | 4.94 | 1.87 | 1.65 | 0.54 | 2.21 | 1.34 | 0.910 | 1.64 | 1.66 | 1.09 | 0.76 | 0.74 | 0.76 | 0.829 | 0.270 | 0.984 | 1.89 | 0.971 | 2.16 |
| Silver | mg/L | 0.0001 | 0.0001 | 0.0005 | | <0.00010 | <0.00010 | 0.00012 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00011 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Sodium | mg/L | 0.03 | | | | 15.5 | 20.1 | 11.1 | 15.4 | 14.8 | 14.6 | 13.8 | 20.5 | 10.5 | 15.4 | 14.8 | 15.2 | 10.2 | 7.23 | 11.4 | 16.6 | 15.2 | 14.0 | 8.83 | 10.0 | 11.3 | 4.34 | 4.09 | 3.81 | 6.18 | 5.21 | 5.19 | 6.71 | 3.59 | 7.84 | 4.70 | 4.39 |
| Strontium | mg/L | 0.0001 | | | | 0.179 | 0.0797 | 0.206 | 0.212 | 0.231 | 0.135 | 0.184 | 0.0734 | 0.204 | 0.201 | 0.246 | 0.145 | 0.201 | 0.0504 | 0.209 | 0.214 | 0.244 | 0.164 | 0.162 | 0.153 | 0.125 | 0.0501 | 0.0655 | 0.0475 | 0.0792 | 0.0608 | 0.0842 | 0.0911 | 0.0511 | 0.111 | 0.0756 | 0.0555 |
| Tellurium | mg/L | 0.0002 | | | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Thallium | mg/L | 0.0001 | 0.0008 | 0.004 | | <0.00010 | <0.00010 | 0.00011 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00011 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Thorium | mg/L | 0.0001 | | | | <0.00010 | 0.00012 | 0.00024 | <0.00010 | <0.00010 | 0.00014 | 0.00011 | 0.00017 | 0.00012 | <0.00010 | <0.00010 | 0.00016 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00015 | <0.00010 | 0.0001 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Tin | mg/L | 0.0002 | | | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | 0.00097 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Titanium | mg/L | 0.0002 | | | | 0.0176 | 0.0108 | 0.0399 | 0.00101 | 0.01440 | 0.02200 | 0.0189 | 0.0242 | 0.0162 | 0.00280 | 0.00608 | 0.02540 | 0.00534 | 0.0017 | 0.00348 | 0.00319 | 0.00225 | 0.00405 | 0.0259 | 0.00185 | 0.0134 | 0.0134 | 0.00303 | 0.00714 | 0.00302 | 0.00251 | 0.00957 | 0.00058 | 0.00511 | 0.00325 | 0.00762 | 0.00197 |
| Tungsten | mg/L | 0.001 | | | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Uranium | mg/L | 0.0001 | 0.015 | 0.075 | | <0.00010 | 0.00027 | 0.00012 | 0.00038 | 0.00014 | 0.00033 | <0.00010 | 0.00025 | 0.00011 | 0.00037 | 0.00011 | 0.00032 | <0.00010 | 0.00018 | 0.0001 | 0.00042 | 0.00013 | 0.00024 | 0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Vanadium | mg/L | 0.0002 | | | | 0.00075 | 0.00096 | 0.0015 | 0.00021 | 0.00068 | 0.00112 | 0.00073 | 0.00133 | 0.00076 | 0.00036 | 0.00035 | 0.00128 | <0.00020 | 0.00035 | 0.00024 | 0.00032 | <0.00020 | 0.00034 | 0.00118 | 0.00034 | 0.00075 | 0.00083 | 0.00034 | 0.00055 | 0.00038 | 0.00043 | 0.00057 | 0.00048 | 0.00042 | 0.00047 | 0.00059 | 0.00051 |
| Zinc | mg/L | 0.005 | 0.03 | 0.15 | 1.00 | 0.038 | 0.0284 | 0.401 | 0.121 | 0.188 | 0.234 | 0.0357 | 0.0442 | 0.414 | 0.227 | 0.175 | 0.26 | 0.0379 | 0.0418 | 0.403 | 0.265 | 0.179 | 0.352 | 0.0551 | 0.0131 | 0.0198 | 0.0049 | 0.0124 | 0.0041 | 0.0224 | 0.0069 | 0.0167 | <0.0050 | <0.0050 | 0.0073 | 0.0111 | <0.0050 |
| Zirconium | mg/L | 0.0004 | | | | <0.00040 | 0.00068 | 0.00088 | <0.00040 | <0.00040 | 0.00103 | <0.00040 | 0.00088 | 0.00054 | <0.00040 | <0.00040 | 0.0007 | <0.00040 | <0.00040 | <0.00040 | 0.00154 | <0.00040 | <0.00040 | 0.00060 | <0.00040 | 0.00041 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 |
| **Speciated Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Methyl Mercury - Total | mg/L | 0.000000005 | 0.000004 | 0.00002 | | - | - | - | <0.000000050 | <0.000000050 | 0.000000085 | - | - | - | 0.000000055 | <0.000000050 | 0.000000052 | - | - | - | <0.000000050 | <0.000000050 | 0.000000078 | | | - | - | - | <0.000000050 | <0.000000050 | <0.000000050 | - | - | - | - | - | - |

*RDL = reportable detection limit; TDS = total dissolved solids; µmhos/cm = micromhos per centimetre; mg/L = milligrams per litre; TCU = true color unit; NTU = Nephelometric Turbidity Units; µg/L = micrograms per litre.*

Notes:

[a] *Canadian Council of Ministers of Environment (CCME) Water Quality Guidelines (2011) for the Protection of Freshwater Aquatic Life.*

[b] *Metal Mining Effluent Regulation (MMER) SOR/2002-222 Maximum authorized concentration in a grab sample*

[c] Detection limit adjusted for required dilution - ALS lab note

[d] AND-04, AND-05, AND-07 and AND-08 were not accessible in September 2014 due to low water levels and higher tailings

[e] Sample preserved at ALS Laboratories - ALS lab note

[1] Cadmium and Copper standards represented are based on average hardness within the Anderson TIA

[2] Aluminum standard presented is based on average hardness within the Anderson TIA pH >6.5

[3] The long-term exposure CWQG for the protection of freshwater life is 15 µg-L-1 for uranium

Exceeds CCME WQG Guideline
Exceeds 5 X CCME Guideline
Exceeds MMER Guideline

**Table 01. Anderson TIA, Anderson Creek and Anderson Bay Water Analytical Results**

| Parameter | Units | RDL | CCME WQG [a] | 5X CCME WQG | MMER [b] | ANB-05 | | ANB-06 | | ANB 07 | | ANB-07A | | | | | | ANB 08 | | ANB 09 | | ANB 10 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 23-May-11 | 15-Sep-11 | 23-May-11 | 16-Sep-11 | 24-May-11 | 16-Sep-11 | 18-Jun-13 | 6-Oct-13 | 18-Jun-14 | 30-Sep-14 | 18-Jun-15 | 23-Sep-15 | 24-May-11 | 16-Sep-11 | 24-May-11 | 16-Sep-11 | 24-May-11 | 16-Sep-11 |
| **Total Metals** | | | | | | | | | | | | | | | | | | | | | | | |
| Aluminum | mg/L | 0.005 | 0.1 | 0.5 | | 0.136 | 0.0580 | 0.193 | 0.0468 | 0.226 | 0.0727 | 0.0936 | 0.127 | 0.0675 | 0.222 | 0.259 | 0.090 | 0.141 | 0.137 | 0.139 | 0.150 | 0.0673 | 0.0838 |
| Antimony | mg/L | 0.0002 | | | | 0.00021 | 0.00052 | 0.00023 | <0.00020 | 0.00024 | <0.00020 | 0.00033 | <0.00020 | 0.00028 | <0.00020 | <0.00020 | <0.00020 | 0.00022 | <0.00020 | 0.00026 | <0.00020 | <0.00020 | <0.00020 |
| Arsenic | mg/L | 0.0002 | 0.005 | 0.01 | 1.00 | 0.00097 | 0.00245 | 0.00098 | 0.00283 | 0.00101 | 0.00279 | 0.00136 | 0.00151 | 0.00108 | 0.00169 | 0.00111 | 0.00220 | 0.00098 | 0.00276 | 0.00099 | 0.00275 | 0.00101 | 0.00287 |
| Barium | mg/L | 0.0002 | | | | 0.0119 | 0.0140 | 0.0121 | 0.0116 | 0.0129 | 0.0111 | 0.0136 | 0.0119 | 0.0121 | 0.0127 | 0.0135 | 0.0110 | 0.0123 | 0.0110 | 0.0123 | 0.0123 | 0.0116 | 0.0108 |
| Beryllium | mg/L | 0.0002 | | | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Bismuth | mg/L | 0.0002 | | | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Boron | mg/L | 0.01 | 1.5 | 7.5 | | 0.011 | 0.011 | 0.011 | <0.010 | 0.010 | <0.010 | 0.016 | 0.012 | 0.014 | 0.012 | 0.013 | 0.013 | 0.011 | <0.010 | 0.010 | <0.010 | <0.010 | <0.010 |
| Cadmium | mg/L | 0.00001 | 0.00009 | 0.00045 | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| Calcium | mg/L | 0.1 | | | | 18.8 | 23.8 | 18.0 | 20.1 | 17.6 | 19.9 | 22 | 21.8 | 23.5 | 18.0 | 18.1 | 19.3 | 17.8 | 19.5 | 18.4 | 19.6 | 17.0 | 19.5 |
| Cesium | mg/L | 0.0001 | | | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Chromium | mg/L | 0.001 | | | | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Cobalt | mg/L | 0.0002 | | | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Copper | mg/L | 0.0002 | 0.004 | 0.02 | 0.60 | 0.00099 | 0.00036 | 0.00110 | 0.00120 | 0.00107 | 0.00095 | 0.00078 | 0.00076 | 0.00207 | 0.00080 | 0.00083 | 0.00061 | 0.00096 | 0.00103 | 0.00168 | 0.00134 | 0.00137 | 0.00135 |
| Iron | mg/L | 0.1 | 0.3 | 1.5 | | 0.16 | <0.10 | 0.21 | <0.10 | 0.28 | 0.11 | <0.10 | 0.14 | <0.10 | 0.23 | 0.27 | 0.14 | 0.19 | 0.21 | 0.18 | 0.19 | 0.10 | 0.12 |
| Lead | mg/L | 0.00009 | 0.007 | 0.035 | 0.40 | <0.000090 | <0.000090 | 0.000117 | <0.000090 | 0.000128 | 0.000090 | <0.000090 | <0.000090 | 0.000152 | 0.000127 | 0.000127 | <0.000090 | <0.000090 | 0.000103 | 0.000117 | 0.000130 | <0.000090 | <0.000090 |
| Lithium | mg/L | 0.002 | | | | 0.0032 | 0.0033 | 0.0028 | 0.0040 | 0.0029 | 0.0047 | 0.0034 | 0.0029 | 0.0031 | 0.0030 | 0.0030 | 0.0026 | 0.0025 | 0.0034 | 0.0023 | 0.0048 | 0.0025 | 0.0042 |
| Magnesium | mg/L | 0.01 | | | | 7.42 | 9.13 | 7.25 | 8.17 | 7.69 | 8.16 | 8.82 | 9.34 | 7.47 | 8.20 | 8.35 | 8.69 | 7.69 | 8.01 | 7.67 | 8.02 | 7.58 | 8.30 |
| Manganese | mg/L | 0.0003 | | | | 0.0164 | 0.0488 | 0.0179 | 0.0378 | 0.0196 | 0.0349 | 0.0189 | 0.0195 | 0.014 | 0.0204 | 0.0221 | 0.0264 | 0.0162 | 0.0381 | 0.0177 | 0.0386 | 0.0207 | 0.0401 |
| Mercury | mg/L | 0.000001 | 0.000026 | 0.00013 | | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000020 | <0.000020 | <0.000020 | <0.000010 | 0.0000016 | <0.000001 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Molybdenum | mg/L | 0.0002 | 0.073 | 0.365 | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | 0.00026 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Nickel | mg/L | 0.002 | 0.15 | 0.75 | 1.00 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 |
| Phosphorus | mg/L | 0.2 | | | | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 |
| Potassium | mg/L | 0.02 | | | | 1.24 | 1.61 | 1.27 | 1.32 | 1.31 | 1.29 | 1.44 | 1.43 | 1.38 | 1.26 | 1.30 | 1.28 | 1.32 | 1.27 | 1.31 | 1.33 | 1.20 | 1.40 |
| Rubidium | mg/L | 0.0002 | | | | 0.00120 | 0.00146 | 0.00130 | 0.00133 | 0.00152 | 0.00143 | 0.00137 | 0.00137 | 0.00131 | 0.00149 | 0.00158 | 0.00130 | 0.00132 | 0.00142 | 0.00130 | 0.00158 | 0.00111 | 0.00142 |
| Selenium | mg/L | 0.001 | 0.001 | 0.005 | | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Silicon | mg/L | 0.05 | | | | 1.07 | 1.71 | 1.13 | 2.05 | 1.17 | 2.19 | 1.01 | 1.13 | 1.09 | 0.81 | 1.27 | 0.30 | 1.07 | 2.10 | 1.04 | 2.63 | 0.939 | 1.98 |
| Silver | mg/L | 0.0001 | 0.0001 | 0.0005 | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Sodium | mg/L | 0.03 | | | | 3.46 | 4.61 | 3.48 | 3.78 | 3.52 | 3.80 | 4.54 | 4.08 | 3.67 | 3.83 | 3.86 | 3.85 | 3.58 | 3.51 | 3.77 | 3.66 | 3.83 | 3.77 |
| Strontium | mg/L | 0.0001 | | | | 0.0498 | 0.0548 | 0.0511 | 0.0499 | 0.0454 | 0.0486 | 0.0532 | 0.0506 | 0.0571 | 0.0475 | 0.0480 | 0.0458 | 0.0445 | 0.0464 | 0.0467 | 0.0476 | 0.0461 | 0.0475 |
| Tellurium | mg/L | 0.0002 | | | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Thallium | mg/L | 0.0001 | 0.0008 | 0.004 | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Thorium | mg/L | 0.0001 | | | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Tin | mg/L | 0.0002 | | | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Titanium | mg/L | 0.0002 | | | | 0.00567 | 0.00223 | 0.00783 | 0.00210 | 0.00998 | 0.00331 | 0.00376 | 0.00557 | 0.00324 | 0.00788 | 0.01010 | 0.00362 | 0.00644 | 0.00423 | 0.00613 | 0.00671 | 0.00302 | 0.00393 |
| Tungsten | mg/L | 0.001 | | | | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Uranium | mg/L | 0.0001 | 0.015 | 0.075 | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Vanadium | mg/L | 0.0002 | | | | 0.00042 | 0.00049 | 0.00052 | 0.00058 | 0.00064 | 0.00055 | 0.00038 | 0.0005 | 0.00031 | 0.00062 | 0.00061 | 0.00053 | 0.00046 | 0.00054 | 0.00049 | 0.00070 | 0.00033 | 0.00055 |
| Zinc | mg/L | 0.005 | 0.03 | 0.15 | 1.00 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | 0.0054 | <0.0020 | <0.0020 | 0.0071 | 0.0030 | <0.0020 | 0.0024 | <0.0050 | 0.0068 | <0.0050 | <0.0050 | <0.0050 | <0.0050 |
| Zirconium | mg/L | 0.0004 | | | | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 | <0.00040 |
| **Speciated Metals** | | | | | | | | | | | | | | | | | | | | | | | |
| Methyl Mercury - Total | mg/L | 0.00000005 | 0.000004 | 0.00002 | | - | - | - | - | - | - | - | - | - | <0.000000050 | <0.000000050 | <0.000000050 | - | - | - | - | - | - |

*RDL = reportable detection limit; TDS = total dissolved solids; TSS = total suspended solids; µmhos/cm = micromhos per centimetre; mg/L = milligrams per litre; TCU = true color unit; NTU = Nephelometric Turbidity Units; µg/L = micrograms per litre.*

Notes:

[a] *Canadian Council of Ministers of Environment (CCME) Water Quality Guidelines (2011) for the Protection of Freshwater Aquatic Life.*

[b] *Metal Mining Effluent Regulation (MMER) SOR/2002-222 Maximum authorized concentration in a grab sample*

[c] Detection limit adjusted for required dilution - ALS lab note

[d] AND-04, AND-05, AND-07 and AND-08 were not accessible in September 2014 due to low water levels and higher tailings

[e] Sample preserved at ALS Laboratories - ALS lab note

[1] Cadmium and Copper standards represented are based on average hardness within the Anderson TIA

[2] Aluminum standard presented is based on average hardness within the Anderson TIA pH >6.5

[3] The long-term exposure CWQG for the protection of freshwater life is 15 µg·L-1 for uranium

Exceeds CCME WQG Guideline
Exceeds 5 X CCME Guideline
Exceeds MMER Guideline

# Document 2: Figures 01-19

ANSI B 279.4mm x 431.8mm

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N

Snow Lake

PR 395

Former Anderson Mine

PR 392

PR 392

Stall Lake

Stall Mine

AND-15

AND-14
▼ 186%

AND-22
▲ 15%

AND-13
▼ 96%

AND-12
▼ 111%

AND-11
▼ 105%

AND-16
▼ 42%

AND-17
▼ 191%

AND-18
▲ 18%

AND-10
▼ 121%

AND-09
▼ 80%

AND-23
▼ 12%

AND-08

AND-24
▲ 34%

AND-07

AND-19
▼ 179%

AND-06
▲ 20%

AND-05

AND-04

AND-20
▲ 31%

AND-21
▲ 41%

ANC-06
▲ 48%

ANC-05
▲ 77%

ANC-02A
▲ 43%

AND-03
▲ 33%

AND-02
▼13%

AND-01
▼ 16%

ANB-01A
▼ 27%

PR 392

Anderson Bay

ANB-07A
▼ 188%

Wekusko Lake

**Aluminum**

- Discontinued Sample Locations
- Does Not Exceed CCME Standards
- Exceeds CCME Guidelines
- Exceeds 5X CCME Guidelines
- 2015 - Approximate Tailings Discharge Location

NC: Not Calculated as one or both of the results < RDL

Note: Percentages are compared to June 2015 concentrations.

250 0 250 500 m

1:20,000

NAD 1983 UTM Zone 14N

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Figure: 01

**Percentage Change of Total Aluminum in Surface Water**
**September 2015**

**Water Quality Baseline Study**
**Anderson Tailings Impoundment Area**
Hudson Bay Mining and Smelting Co., Limited

ANSI B 279.4mm x 431.8mm

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AECOM

Figure: 02

Percentage Change of Total Arsenic in Surface Water
September 2015

**Water Quality Baseline Study**
**Anderson Tailings Impoundment Area**
Hudson Bay Mining and Smelting Co., Limited

N

Snow Lake

PR 395

Former Anderson Mine

PR 392

PR 392

Stall Lake

Stall Mine

AND-15

AND-14
▼ 86%

AND-13
▼ 70%

AND-22
▼ 48%

AND-12
▼ 77%

AND-11
▼ 74%

AND-16
▼ 46%

AND-17
▼ 88%

AND-10
▼ 74%

AND-18
▼ 44%

AND-09
▼ 54%

AND-23
▼ 47%

AND-08

AND-24
▲ 10%

AND-07

AND-19
▼ 76%

AND-06
▼ 7%

AND-04

AND-05

AND-20
▼ 31%

AND-21
▼ 41%

ANC-06
▼ 9%

ANC-05
▲ 1%

ANC-02A
▼ 3%

AND-03
▼ 9%

AND-02
▼ 10%

AND-01
▼ 12%

ANB-01A
▼ 295%

PR 392

Anderson Bay

ANB-07A
▲ 50%

Wekusko Lake

**Arsenic**

- Discontinued Sample Locations
- Does Not Exceed CCME Standards
- Exceeds CCME Guidelines
- Exceeds 5X CCME Guidelines
- 2015 - Approximate Tailings Discharge Location

NC: Not Calculated as one or both of the results < RDL

Note: Percentages are compared to June 2015 concentrations.

250 0 250 500 m

1:20,000

NAD 1983 UTM Zone 14N

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ANSI B 279.4mm x 431.8mm

Project Management Initials: Designer: Checked: Approved:

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N

Snow Lake

PR 395

Former Anderson Mine

PR 392

PR 392

Stall Lake

Stall Mine

AND-15

AND-14 ▼ 4%

AND-13 ▼ 25%

AND-22 ▲ 13%

AND-12 ▼ 25%

AND-11 ▼ 20%

AND-16 ▲ 12%

AND-17 ▼ 4%

AND-10 ▼ 24%

AND-18 ▲ 21%

AND-09 ▼ 24%

AND-23 ▲ 26%

AND-08

AND-24 ▲ 8%

AND-07

AND-19 ▼ 121%

AND-06 ▼ 12%

AND-05

AND-04

AND-20 ▼ 68%

AND-21 ▼ 89%

ANC-06 ▼ 6%

ANC-05 ▼ 33%

ANC-02A ▼ 40%

AND-03 ▼ 36%

AND-02 ▼ 19%

AND-01 ▼ 23%

ANB-01A ▼ 200%

PR 392

Anderson Bay

ANB-07A NC

Wekusko Lake

**Cadmium**

- Discontinued Sample Locations
- Does Not Exceed CCME Standards
- Exceeds CCME Guidelines
- Exceeds 5X CCME Guidelines
- 2015 - Approximate Tailings Discharge Location

NC: Not Calculated as one or both of the results < RDL

Note: Percentages are compared to June 2015 concentrations.

250 0 250 500 m

1:20,000

NAD 1983 UTM Zone 14N

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AECOM

**Figure: 03**

**Percentage Change of Total Cadmium in Surface Water**
**September 2015**

**Water Quality Baseline Study**
**Anderson Tailings Impoundment Area**
Hudson Bay Mining and Smelting Co., Limited

ANSI B 279.4mm x 431.8mm

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AECOM

Figure: 04

Percentage Change of Total Copper in Surface Water
September 2015

Water Quality Baseline Study
Anderson Tailings Impoundment Area
Hudson Bay Mining and Smelting Co., Limited

N

Snow Lake

PR 395

Former Anderson Mine

PR 392

PR 392

Stall Lake

Stall Mine

AND-15

AND-14 ▼ 130%

AND-22 ▼ 81%

AND-13 ▼ 96%

AND-12 ▼ 87%

AND-11 ▼ 76%

AND-16 ▼ 59%

AND-17 ▼ 148%

AND-10 ▼ 70%

AND-18 ▼ 61%

AND-09 ▼ 69%

AND-23 ▼ 69%

AND-08

AND-24 ▲ 4%

AND-07

AND-19 ▼ 294%

AND-06 ▼ 22%

AND-05

AND-04

AND-20 ▼ 150%

AND-21 ▼ 188%

ANC-06 ▼ 111%

ANC-05 ▼ 73%

ANC-02A ▼ 77%

AND-03 ▼ 43%

AND-02 ▼ 40%

AND-01 ▼ 43%

ANB-01A ▼ 143%

PR 392

Anderson Bay

ANB-07A ▼ 36%

Wekusko Lake

**Copper**

- Discontinued Sample Locations
- Does Not Exceed CCME Standards
- Exceeds CCME Guidelines
- Exceeds 5X CCME Guidelines
- 2015 - Approximate Tailings Discharge Location

NC: Not Calculated as one or both of the results < RDL

Note: Percentages are compared to June 2015 concentrations.

250 0 250 500 m

1:20,000

NAD 1983 UTM Zone 14N

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ANSI B 279.4mm x 431.8mm
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N

Snow Lake

PR 395

Former Anderson Mine

PR 392

PR 392

Stall Lake

Stall Mine

AND-15

AND-14
NC

AND-13
▼ 205%

AND-22
▲ 7%

AND-12
▼ 198%

AND-11
▼ 172%

AND-16
▼ 114%

AND-17
NC

AND-10
▼ 277%

AND-18
▼ 43%

AND-09
▼ 279%

AND-23
NC

AND-08

AND-24
▼ 5%

AND-07

AND-19
NC

AND-06
▼ 8%

AND-05

AND-04

AND-20
NC

AND-21
NC

ANC-06
▲ 8%

ANC-05
▲ 67%

ANC-02A
▲ 37%

AND-03
▼ 8%

AND-02
▼ 31%

AND-01
▼ 33%

ANB-01A
▼ 45%

PR 392

Anderson Bay

ANB-07A
▼ 93%

Wekusko Lake

**Iron**

- Discontinued Sample Locations
- Does Not Exceed CCME Standards
- Exceeds CCME Guidelines
- Exceeds 5X CCME Guidelines
- 2015 - Approximate Tailings Discharge Location

NC: Not Calculated as one or both of the results < RDL

Note: Percentages are compared to June 2015 concentrations.

250 0 250 500 m

1:20,000

NAD 1983 UTM Zone 14N

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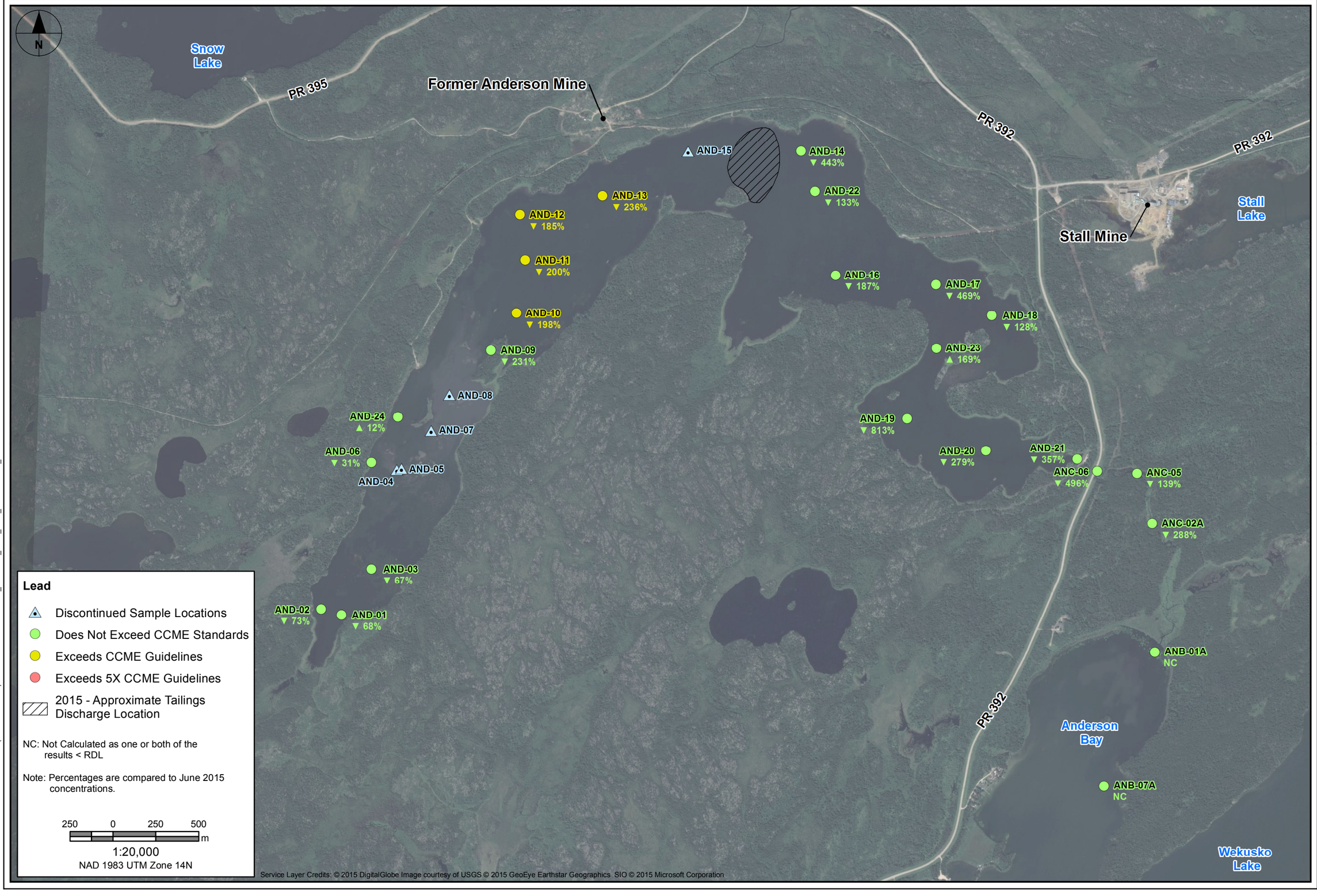
AECOM

**Figure: 05**

**Percentage Change of Total Iron in Surface Water**
**September 2015**

**Water Quality Baseline Study**
**Anderson Tailings Impoundment Area**
Hudson Bay Mining and Smelting Co., Limited

ANSI B 279.4mm x 431.8mm
Approved:
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Designer:
Project Management Initials:
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AECOM

Figure: 06

Percentage Change of Total Lead in Surface Water
September 2015

Water Quality Baseline Study
Anderson Tailings Impoundment Area
Hudson Bay Mining and Smelting Co., Limited

ANSI B 279.4mm x 431.8mm

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N

Snow Lake

PR 395

Former Anderson Mine

PR 392

PR 392

Stall Lake

Stall Mine

AND-15

AND-14
▼ 324%

AND-13
▼ 325%

AND-22
▼ 24%

AND-12
▼ 302%

AND-11
▼ 323%

AND-16
▼ 193%

AND-17
▼ 451%

AND-10
▼ 332%

AND-18
▼ 134%

AND-09
▼ 400%

AND-23
▼ 257%

AND-08

AND-24
▲ 13%

AND-07

AND-19
▼ 268%

AND-06
▼ 117%

AND-05

AND-04

AND-20
▼ 345%

AND-21
▼ 379%

ANC-06
▼ 115%

ANC-05
▼ 92%

ANC-02A
▼ 139%

AND-03
▼ 110%

AND-02
▼ 121%

AND-01
▼ 108%

ANB-01A
NC

PR 392

Anderson Bay

ANB-07A
NC

Wekusko Lake

**Mercury**

- Discontinued Sample Locations
- Does Not Exceed CCME Standards
- Exceeds CCME Guidelines
- Exceeds 5X CCME Guidelines
- 2015 - Approximate Tailings Discharge Location

NC: Not Calculated as one or both of the results < RDL

Note: Percentages are compared to June 2015 concentrations.

250 0 250 500 m

1:20,000

NAD 1983 UTM Zone 14N

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AECOM

Figure: 07

Percentage Change of Total Mercury in Surface Water
September 2015

**Water Quality Baseline Study**
**Anderson Tailings Impoundment Area**
Hudson Bay Mining and Smelting Co., Limited

ANSI B 279.4mm x 431.8mm
Approved:
Checked:
Designer:
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N

Snow Lake

PR 395

Former Anderson Mine

PR 392

PR 392

Stall Lake

Stall Mine

AND-15

AND-14 ▼ 4%

AND-13 ▲ 45%

AND-22 ▲ 6%

AND-12 ▲ 29%

AND-11 ▲ 35%

AND-16 ▲ 18%

AND-17 ▼ 6%

AND-10 ▲ 39%

AND-18 ▲ 3%

AND-09 ▲ 26%

AND-23 ▼ 9%

AND-08

AND-24 ▲ 48%

AND-07

AND-19 ▼ 40%

AND-06 ▲ 45%

AND-05

AND-04

AND-20 ▼ 95%

AND-21 ▼ 76%

ANC-06 ▼ 79%

ANC-05 ▼ 119%

ANC-02A ▼ 100%

AND-03 ▲ 23%

AND-02 ▲ 21%

AND-01 ▲ 28%

ANB-01A NC

PR 392

Anderson Bay

ANB-07A NC

Wekusko Lake

**Selenium**

- Discontinued Sample Locations
- Does Not Exceed CCME Standards
- Exceeds CCME Guidelines
- Exceeds 5X CCME Guidelines
- 2015 - Approximate Tailings Discharge Location

NC: Not Calculated as one or both of the results < RDL

Note: Percentages are compared to June 2015 concentrations.

250 0 250 500 m

1:20,000

NAD 1983 UTM Zone 14N

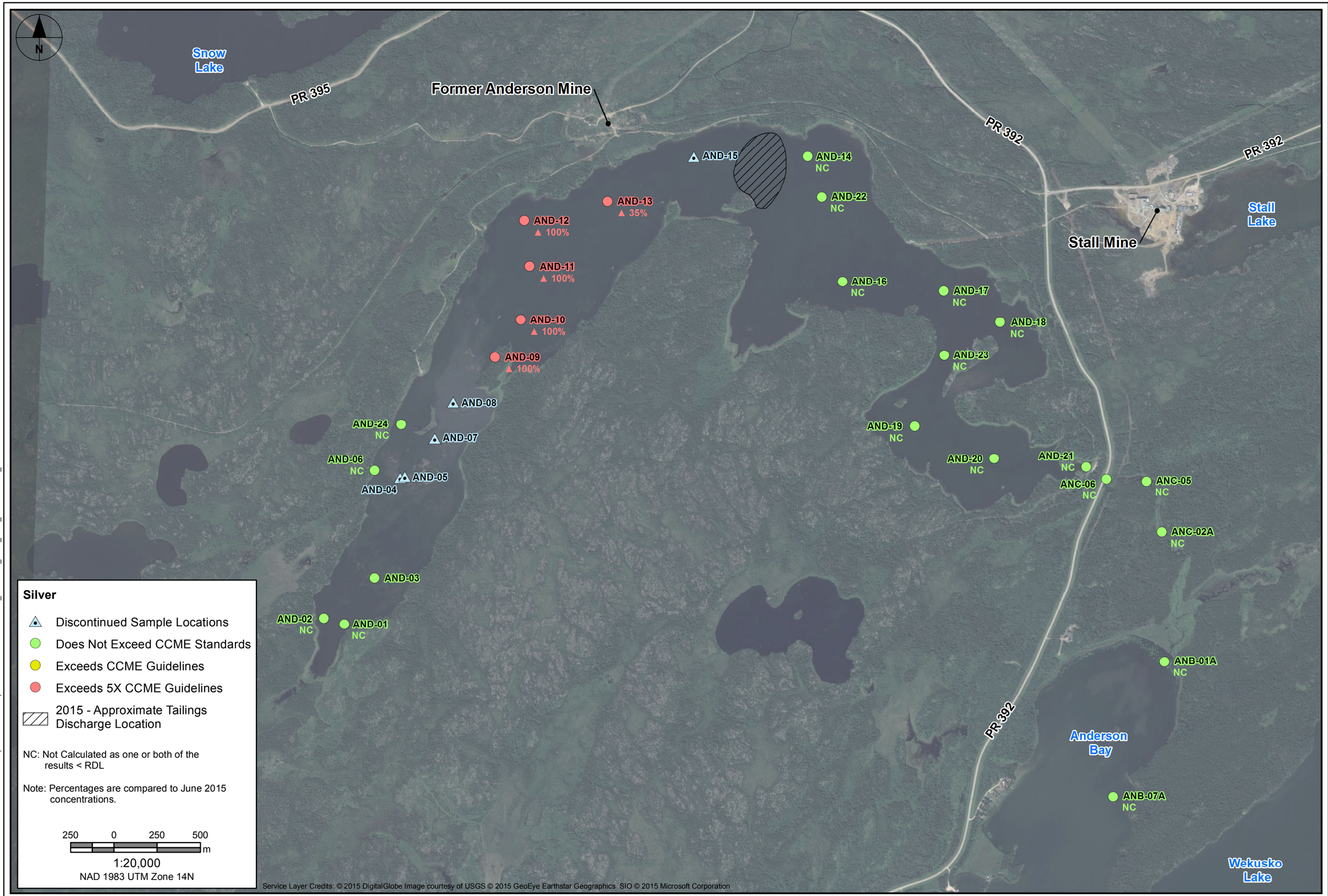
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Figure: 08

Percentage Change of Total Selenium in Surface Water
September 2015

**Water Quality Baseline Study**
**Anderson Tailings Impoundment Area**
Hudson Bay Mining and Smelting Co., Limited




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ANSI B 279.4mm x 431.8mm

Project Management Initials: Designer: Checked: Approved:

AECOM

**Figure: 09**

**Percentage Change of Total Silver in Surface Water**
**September 2015**

**Water Quality Baseline Study**
**Anderson Tailings Impoundment Area**
Hudson Bay Mining and Smelting Co., Limited

Snow Lake
PR 395
Former Anderson Mine
PR 392
PR 392
Stall Lake
Stall Mine
AND-15
AND-14
▲ 19%
AND-22
▲ 23%
AND-13
▼ 23%
AND-12
▼ 20%
AND-11
▼ 20%
AND-16
▲ 33%
AND-17
▲ 10%
AND-10
▼ 29%
AND-18
▲ 28%
AND-09
▼ 11%
AND-23
▲ 31%
AND-08
AND-24
▲ 9%
AND-07
AND-19
▼ 19%
AND-06
▼ 4%
AND-05
AND-04
AND-20
▲ 11%
AND-21
▲ 0%
ANC-06
▲ 49%
ANC-05
▲ 33%
ANC-02A
▲ 28%
AND-03
▼ 14%
AND-02
▼ 9%
AND-01
▼ 13%
ANB-01A
▼ 225%
PR 392
Anderson Bay
ANB-07A
NC
Wekusko Lake

**Zinc**

- Discontinued Sample Locations
- Does Not Exceed CCME Standards
- Exceeds CCME Guidelines
- Exceeds 5X CCME Guidelines
- 2015 - Approximate Tailings Discharge Location

NC: Not Calculated as one or both of the results < RDL

Note: Percentages are compared to June 2015 concentrations.

250 0 250 500 m

1:20,000

NAD 1983 UTM Zone 14N

Service Layer Credits: © 2015 DigitalGlobe Image courtesy of USGS © 2015 GeoEye Earthstar Geographics SIO © 2015 Microsoft Corporation

Last saved by: MAHEC (2015-11-26) Last Plotted: 2013-07-15
Filename: P:\60328209\900-WORK\920-929 (GIS-GRAPHICS)\HSEPTEMBER 2015\GI010_60328209_01V1_2015_SEPTEMBER_ZINC.MXD

ANSI B 279.4mm x 431.8mm
Approved:
Checked:
Designer:
Project Management Initials:

AECOM

Figure: 10

**Percentage Change of Total Zinc in Surface Water**
**September 2015**

**Water Quality Baseline Study**
**Anderson Tailings Impoundment Area**
Hudson Bay Mining and Smelting Co., Limited

ANSI B 279.4mm x 431.8mm

Project Management Initials: Designer: Checked: Approved:

Last saved by: MAHEC (2015-11-26) Last Plotted: 2013-07-15
Filename: P:\60328209\900-WORK\920-929 (GIS-GRAPHICS)\HSEPTEMBER 2015\G011_60328209_01V1_2015_SEPTEMBER_METHYLMERCURY.MXD

AECOM

Figure: 11

**Percentage Change of Total Methyl Mercury in Surface Water**
**September 2015**

**Water Quality Baseline Study**
**Anderson Tailings Impoundment Area**
Hudson Bay Mining and Smelting Co., Limited

N

Snow Lake

PR 395

Former Anderson Mine

PR 392

PR 392

Stall Lake

Stall Mine

AND-15 NC
AND-14 NC
AND-22 NC
AND-13 NC
AND-12 NC
AND-11 NC
AND-16 NC
AND-17 NC
AND-18 NC
AND-10 NC
AND-09 NC
AND-23 NC
AND-08
AND-24 NC
AND-07
AND-19 NC
AND-06 NC
AND-05
AND-04
AND-20 NC
AND-21 NC
ANC-06 NC
ANC-05 NC
ANC-02A NC
AND-03 NC
AND-02 NC
AND-01 NC
ANB-01A NC
PR 392
Anderson Bay
ANB-07A NC
Wekusko Lake

**Methyl Mercury**

- Discontinued Sample Locations
- Does Not Exceed CCME Standards
- Exceeds CCME Guidelines
- Exceeds 5X CCME Guidelines
- 2015 - Approximate Tailings Discharge Location

NC: Not Calculated as one or both of the results < RDL

Note: Percentages are compared to June 2015 concentrations.

250 0 250 500 m

1:20,000

NAD 1983 UTM Zone 14N

Service Layer Credits: © 2015 DigitalGlobe Image courtesy of USGS © 2015 GeoEye Earthstar Geographics SIO © 2015 Microsoft Corporation

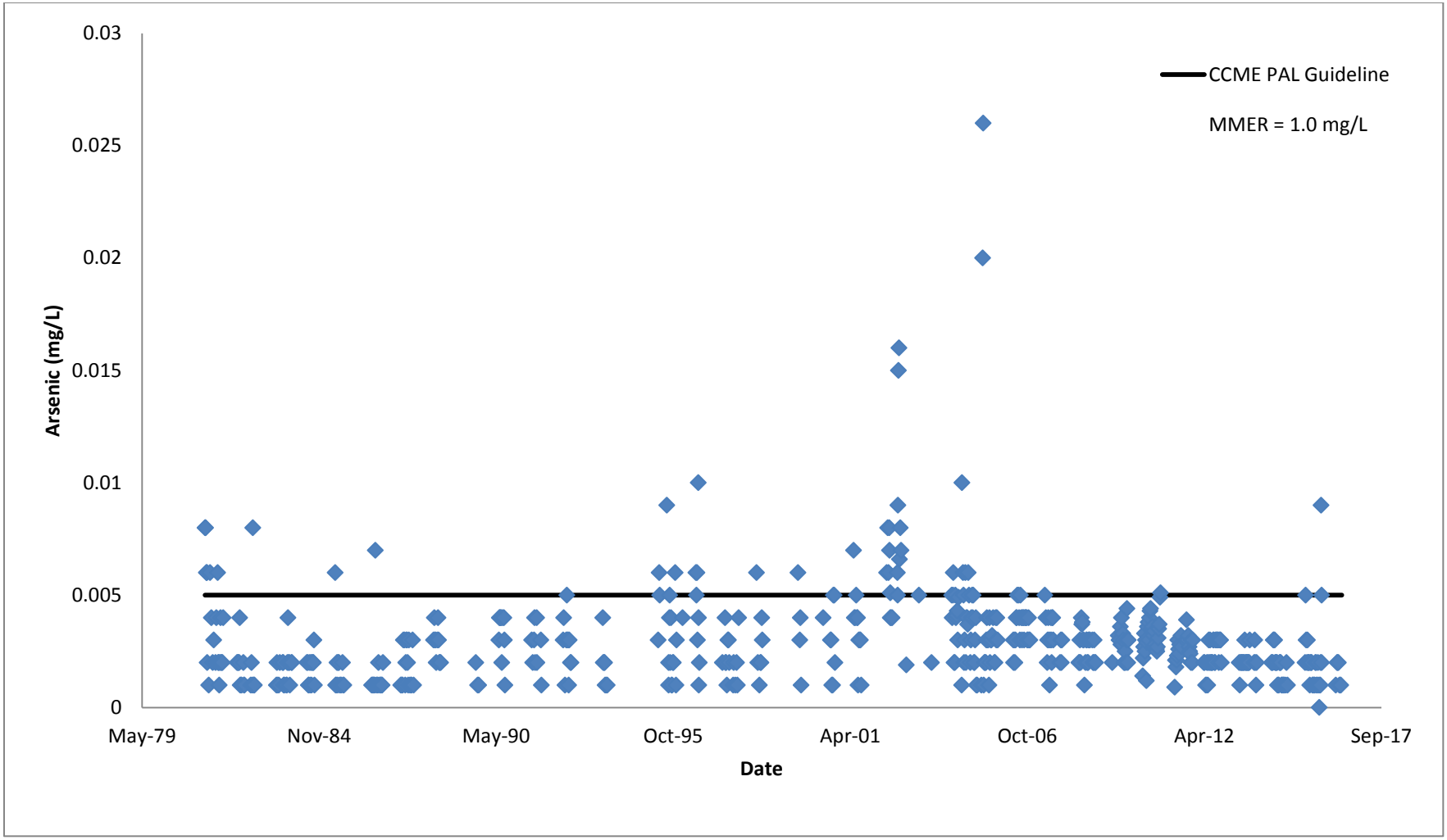



Figure 12. Arsenic concentrations in Anderson TIA Discharge water.

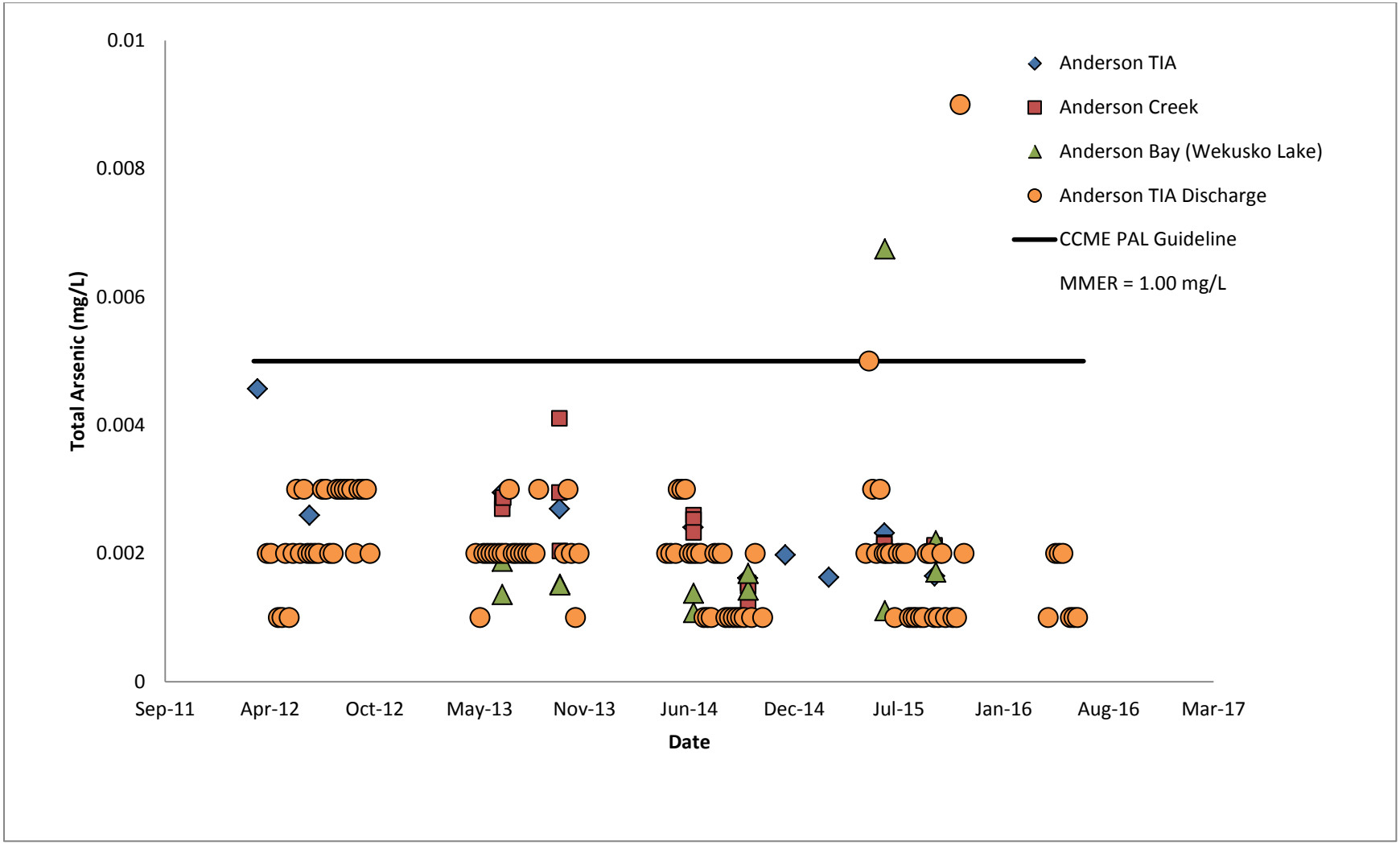



Figure 13. Arsenic concentrations in Anderson TIA, Anderson Creek, Anderson Bay of Wekusko Lake and at the Anderson TIA Discharge point.

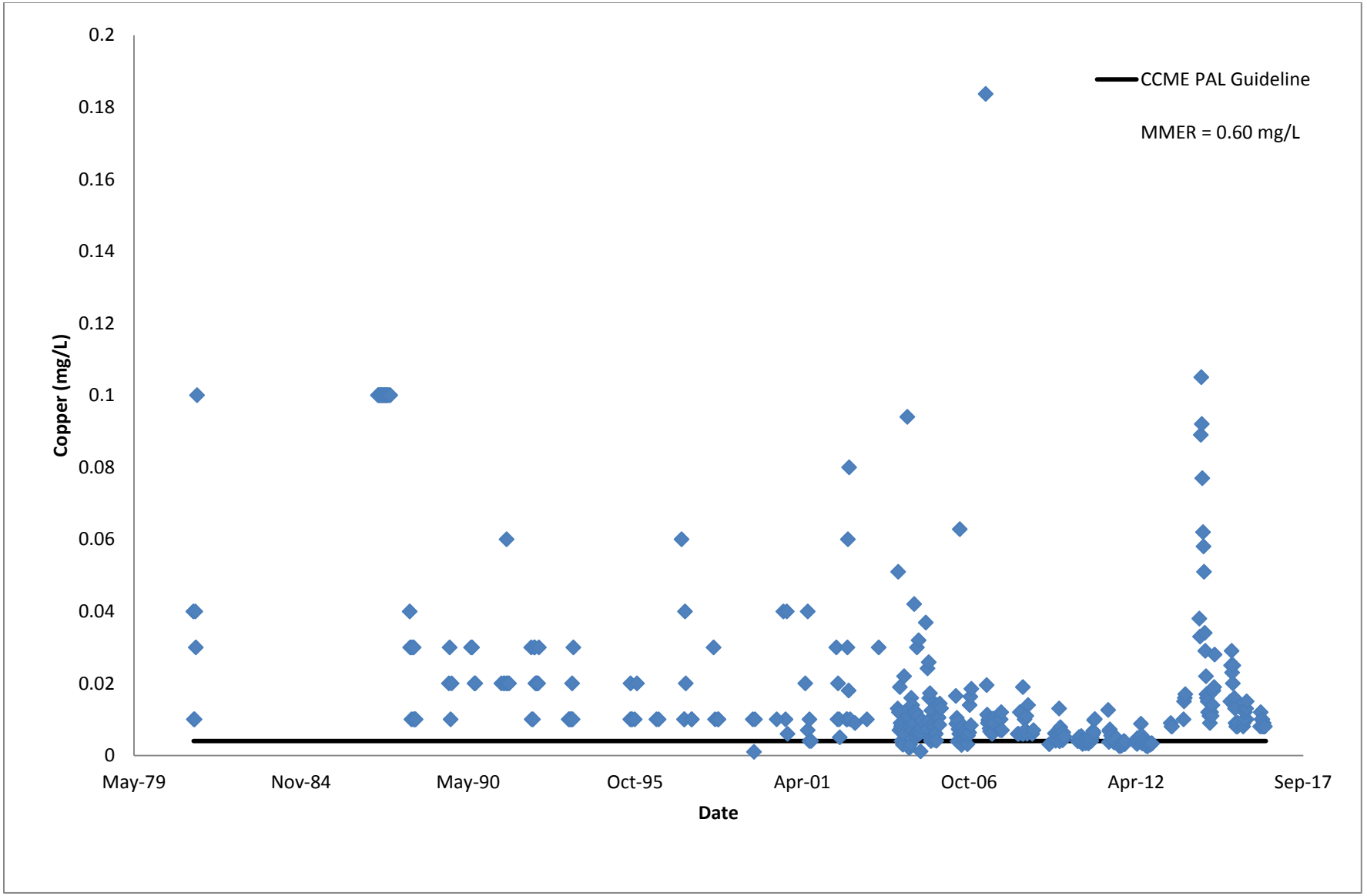



Figure 14. Copper concentrations in Anderson TIA Discharge water.

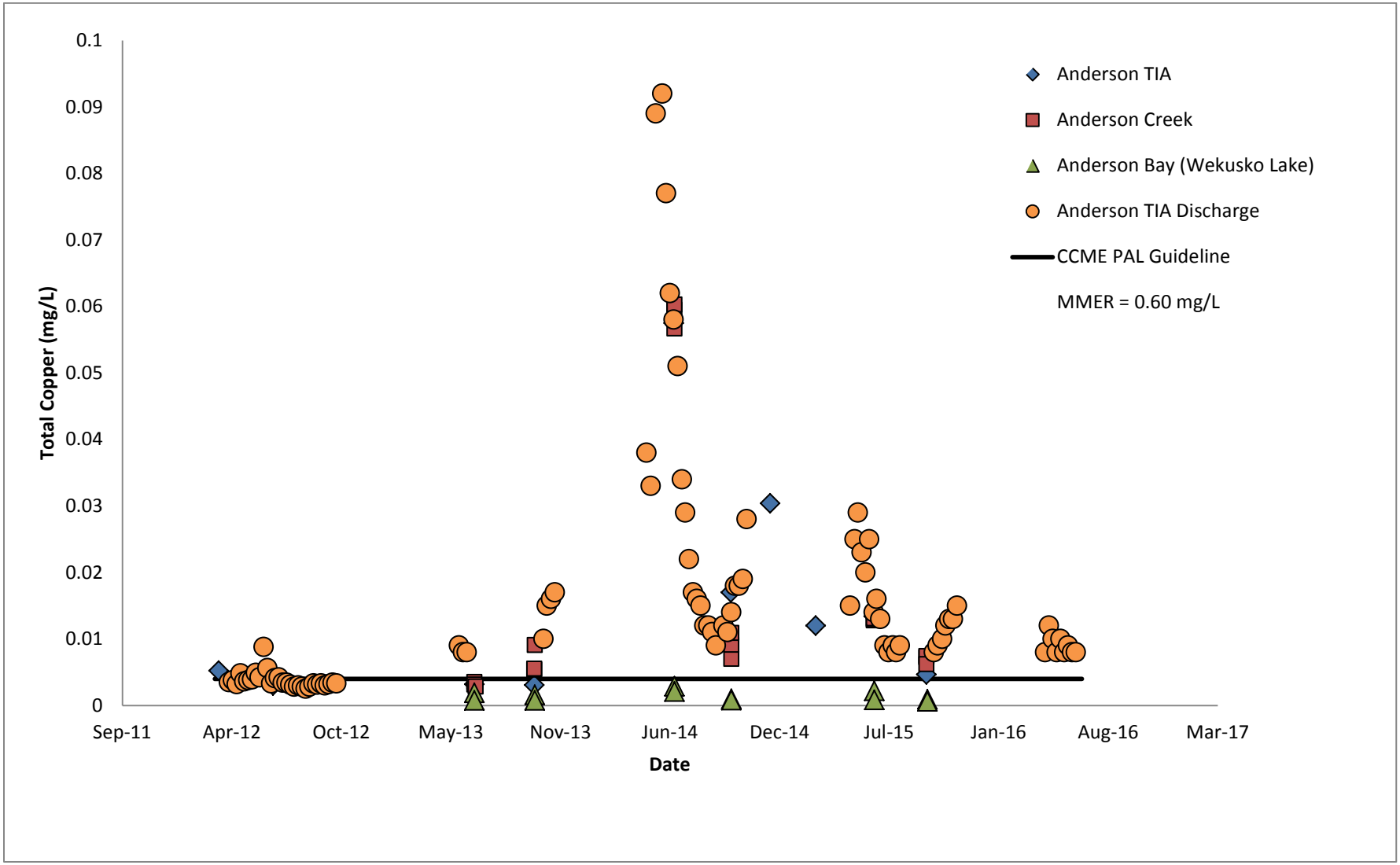



Figure 15. Copper concentrations in Anderson TIA, Anderson Creek, Anderson Bay of Wekusko Lake and at the Anderson TIA Discharge point.

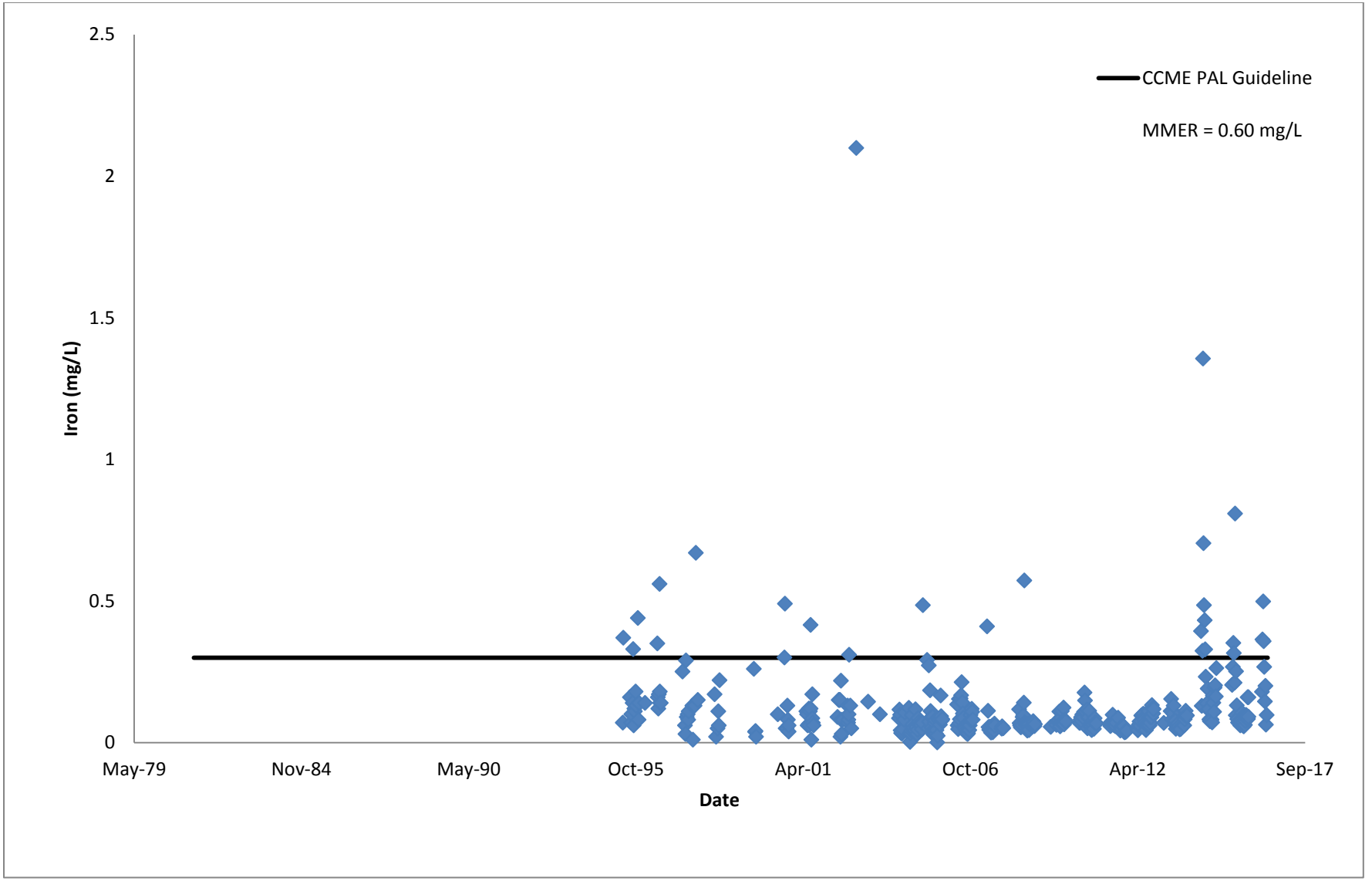



Figure 16. Iron concentrations in Anderson TIA Discharge water.

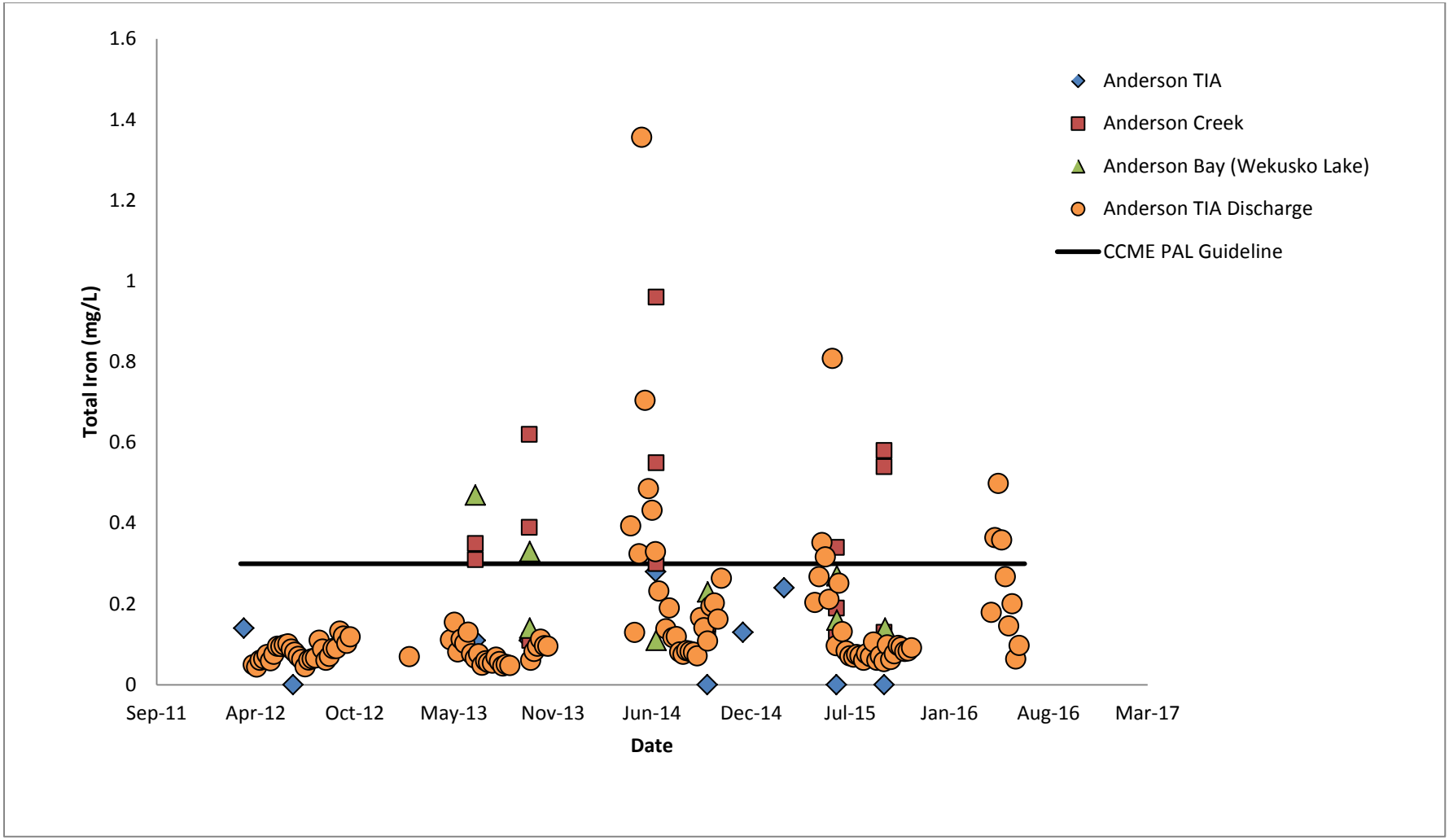



Figure 17. Iron concentrations in Anderson TIA, Anderson Creek, Anderson Bay of Wekusko Lake and at the Anderson TIA Discharge point.

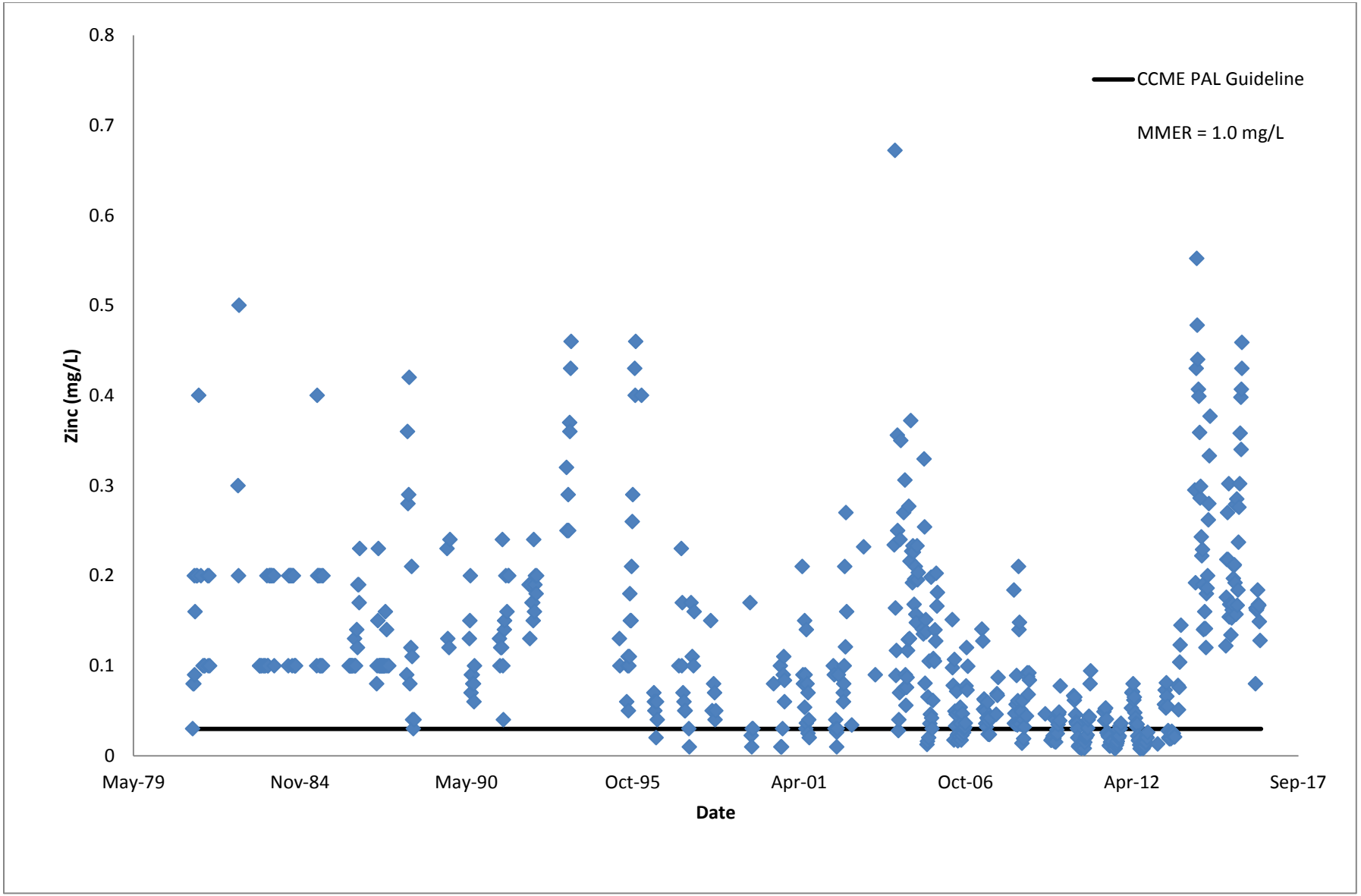



Figure 18. Zinc concentrations in Anderson TIA Discharge water.

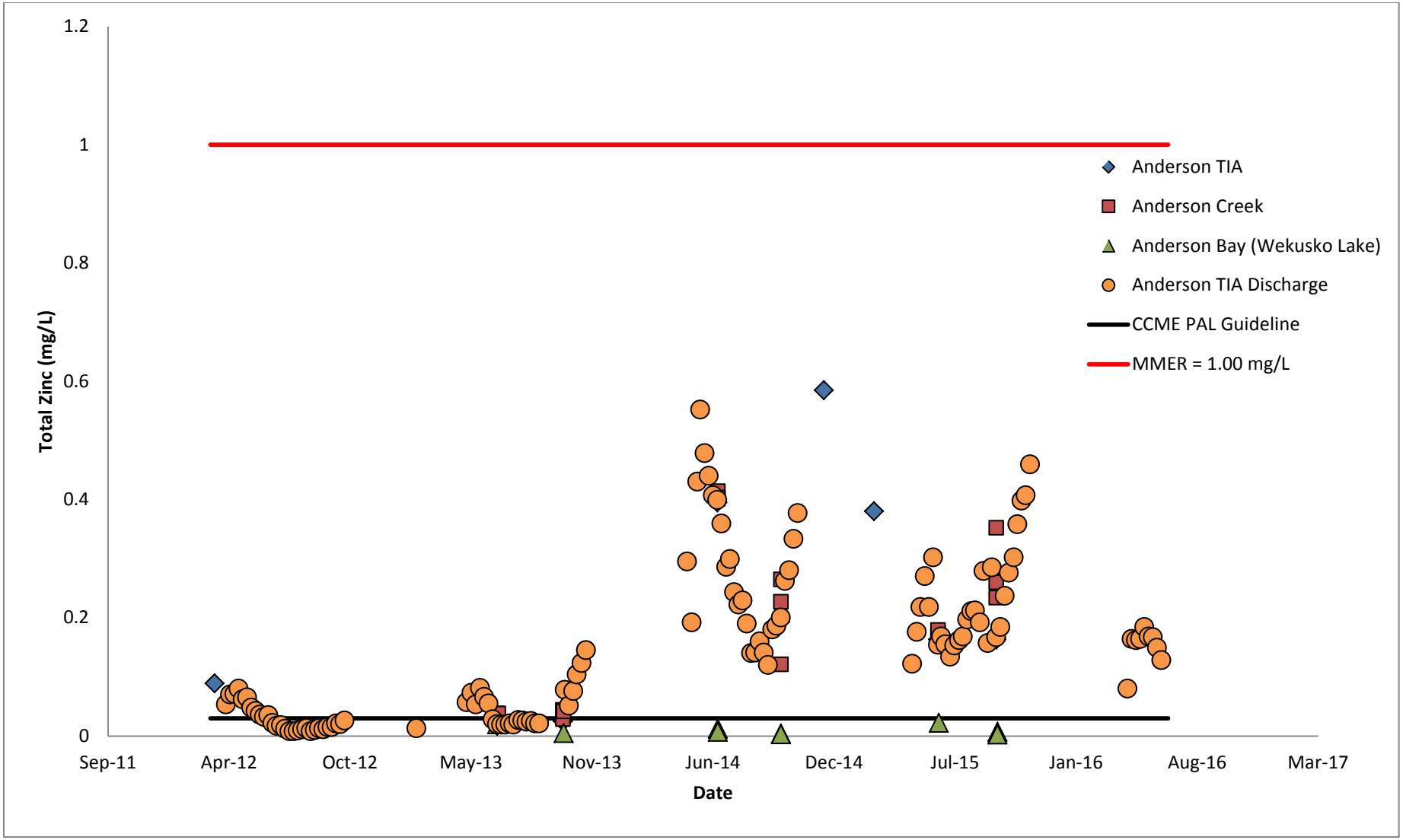
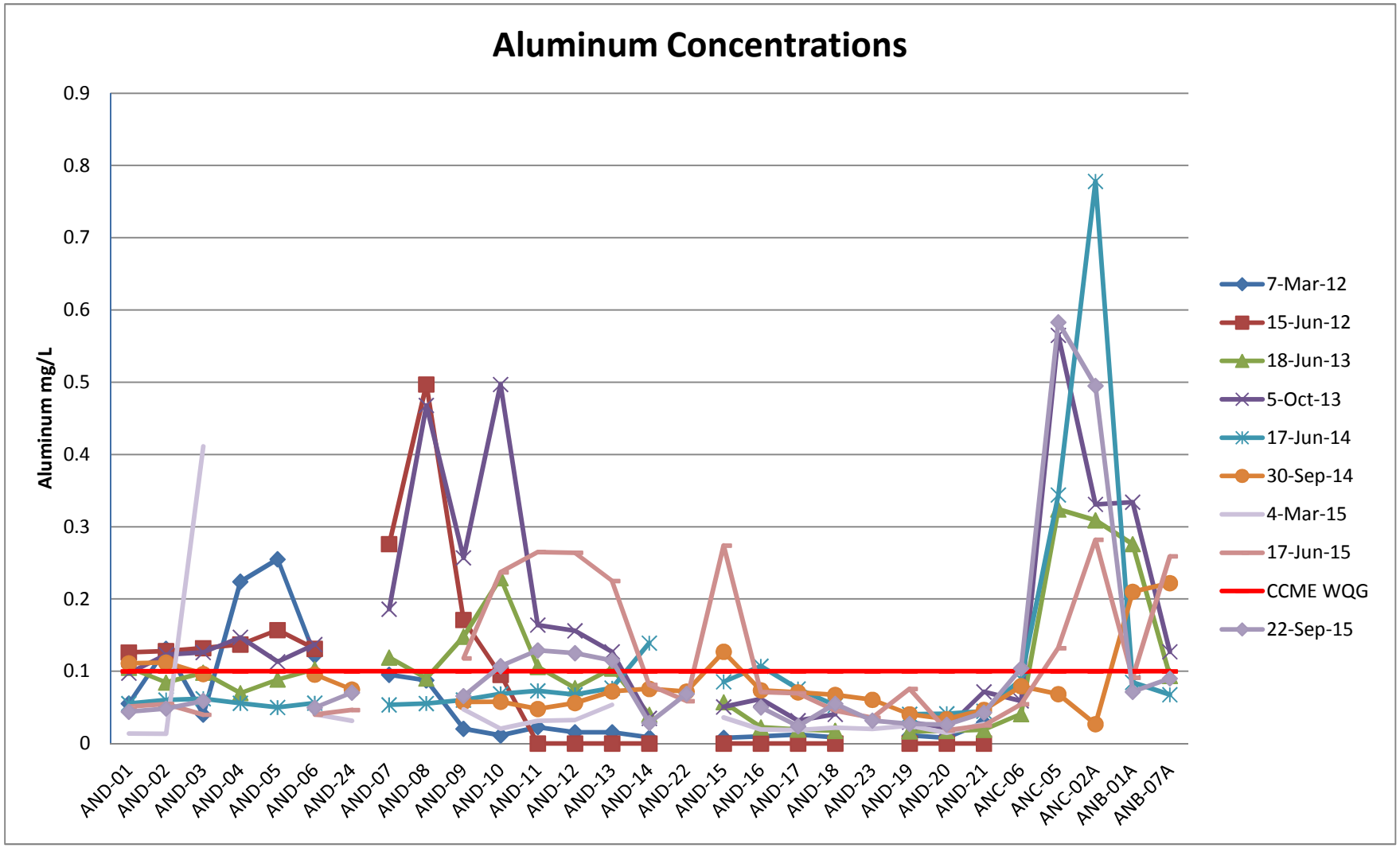
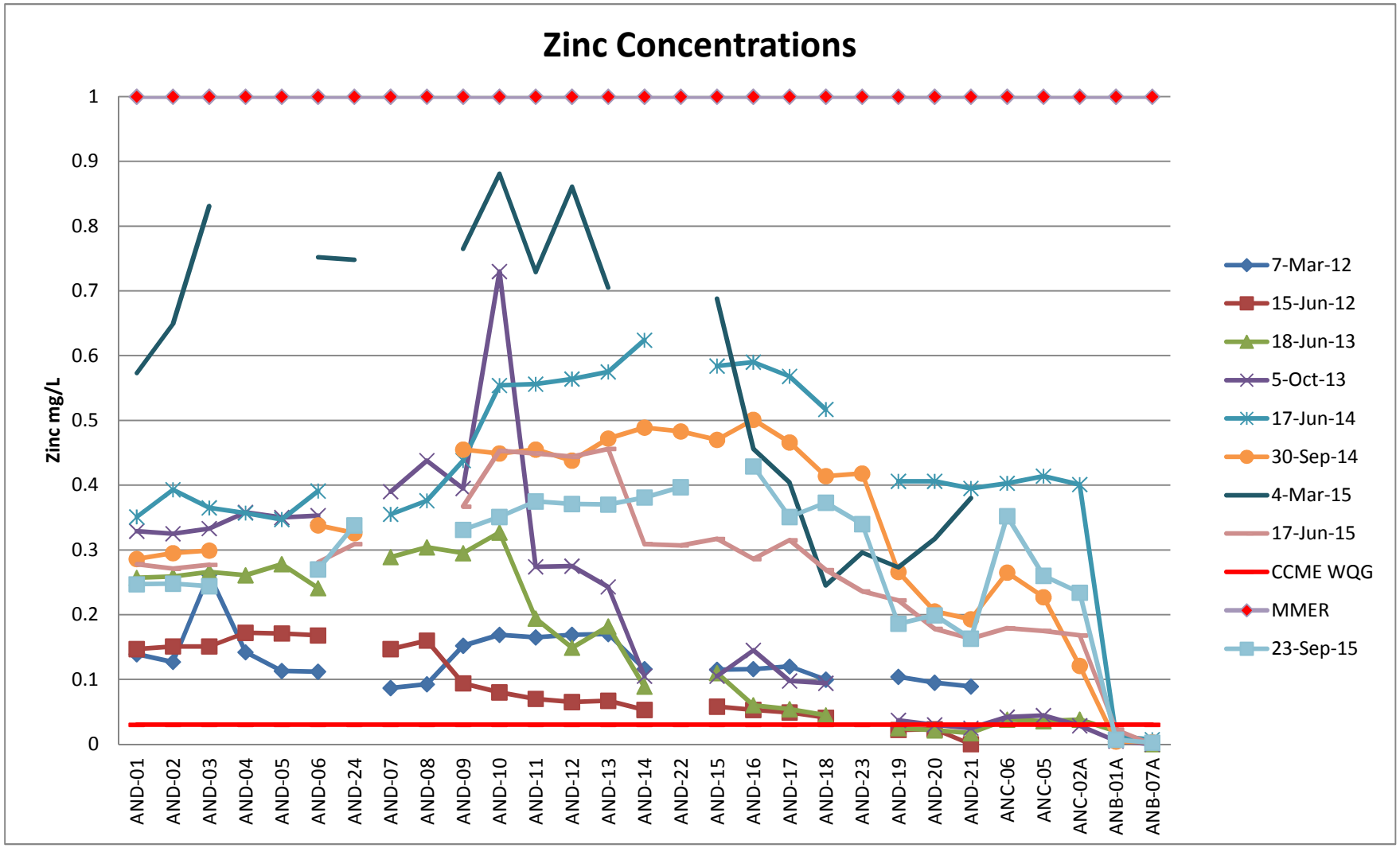



Figure 19. Zinc concentrations in Anderson TIA, Anderson Creek, Anderson Bay of Wekusko Lake and at the Anderson TIA Discharge point.

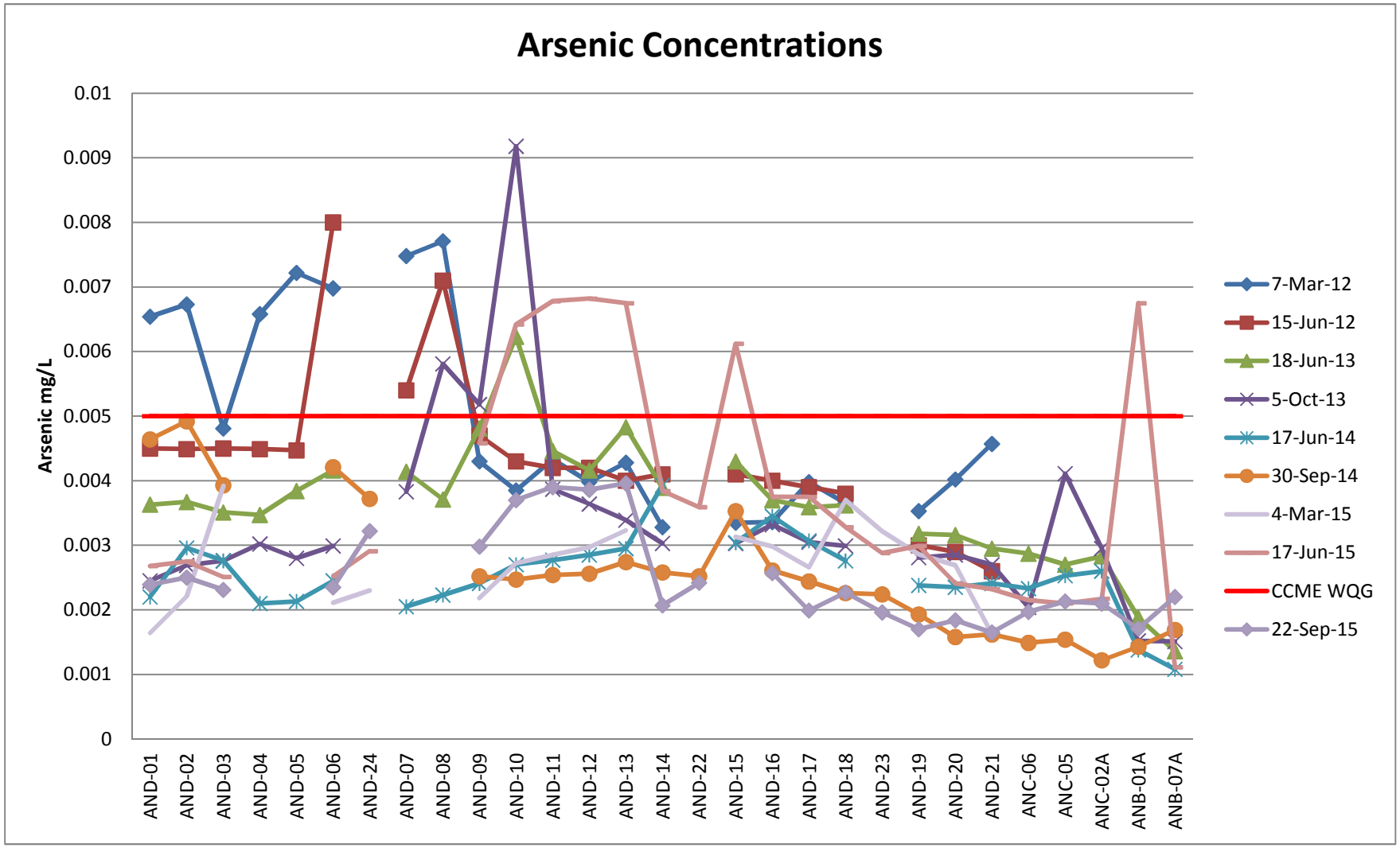
# Document 3: Graphs of Metal Concentrations



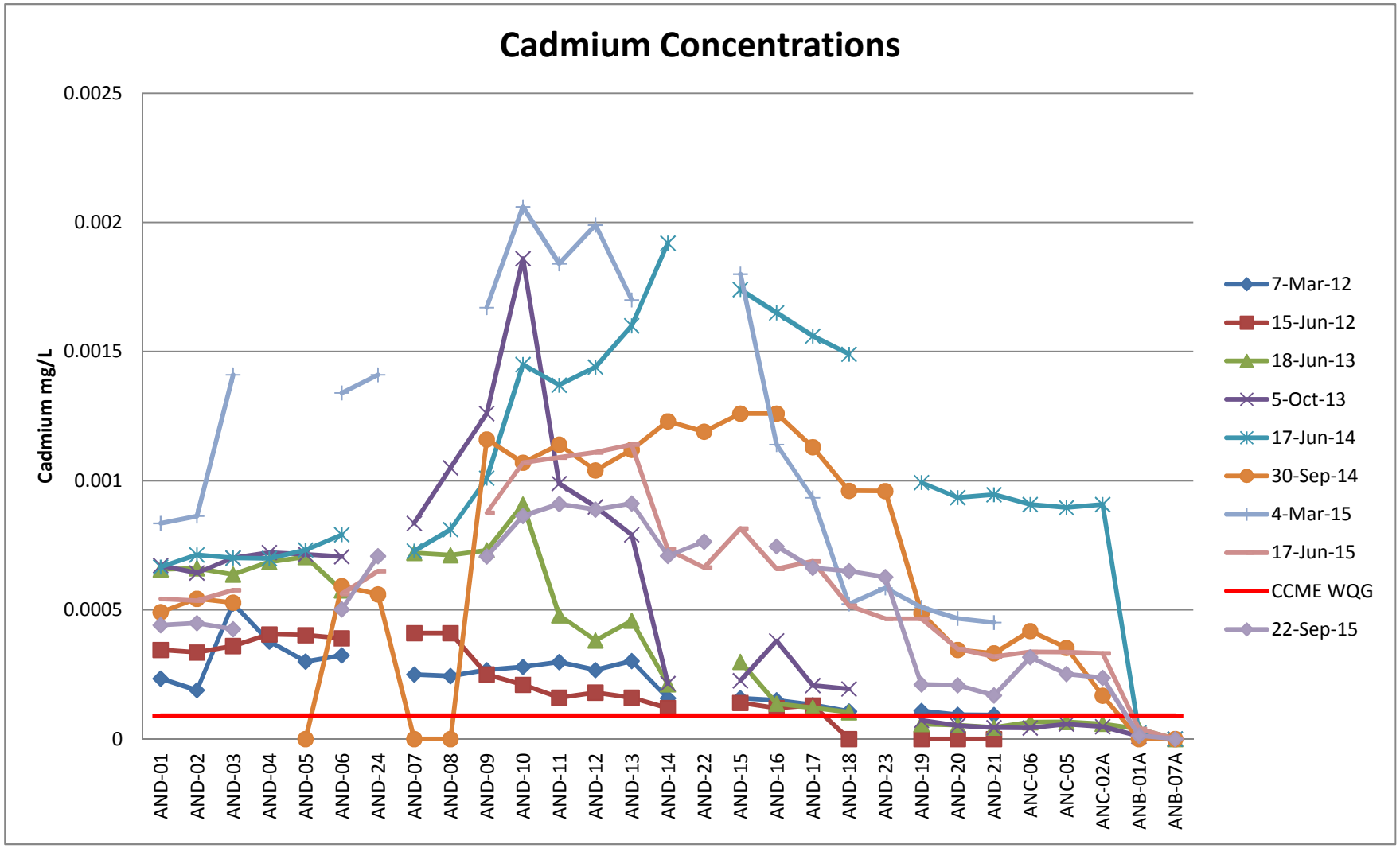

Note: The CCME Water Qualtiy Guideline for aluminum is 0.1 mg/L and the Anderson Creek (ANC) and Anderson Bay (ANB) are regulated under this guideline. There is no MMER guideline for aluminum.



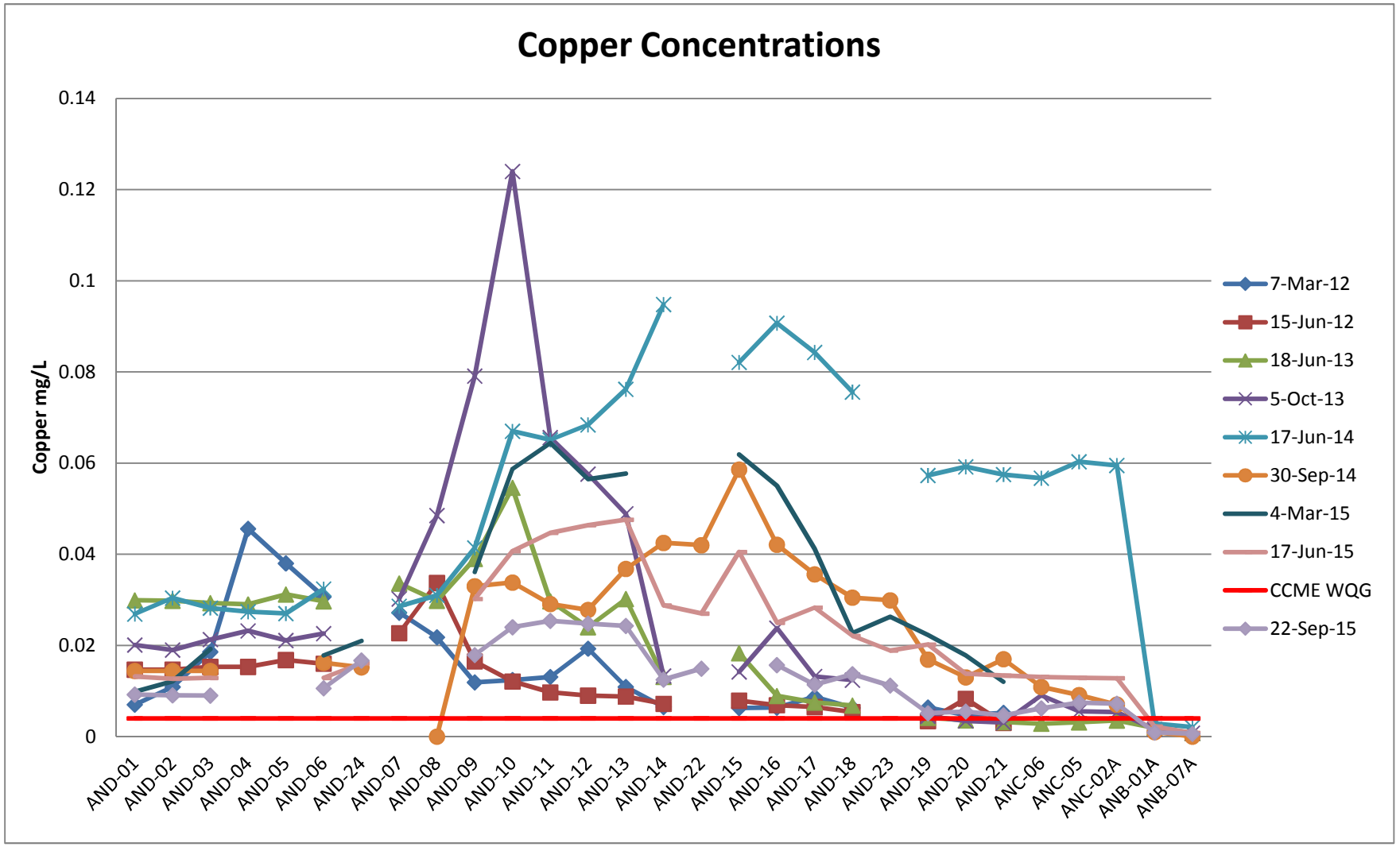

Note: The CCME Water Qualtiy Guideline for zinc is 0.03 mg/L and the Anderson Creek (ANC) and Anderson Bay (ANB) are regulated under this guideline. The MMER Water Quality Guideline for zinc is 1.0 mg/L (not indicated on graph) and applies to the Anderson TIA (AND).



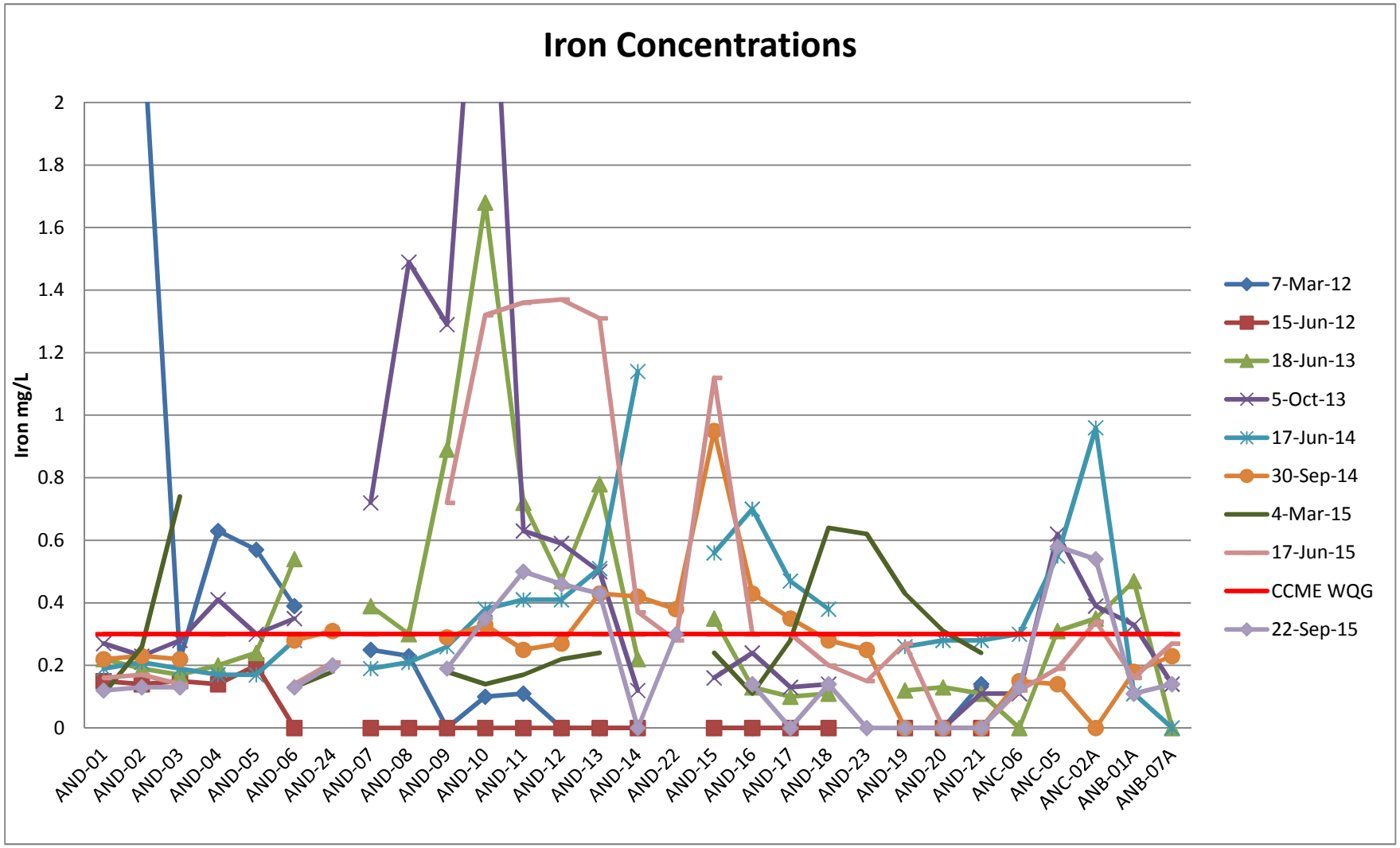

Note: The CCME Water Qualtiy Guideline for arsenic is 0.1 mg/L and the Anderson Creek (ANC) and Anderson Bay (ANB) are regulated under this guideline. The MMER Water Quality Guideline for arsenic is 1.0 mg/L and applies to the Anderson TIA (AND).



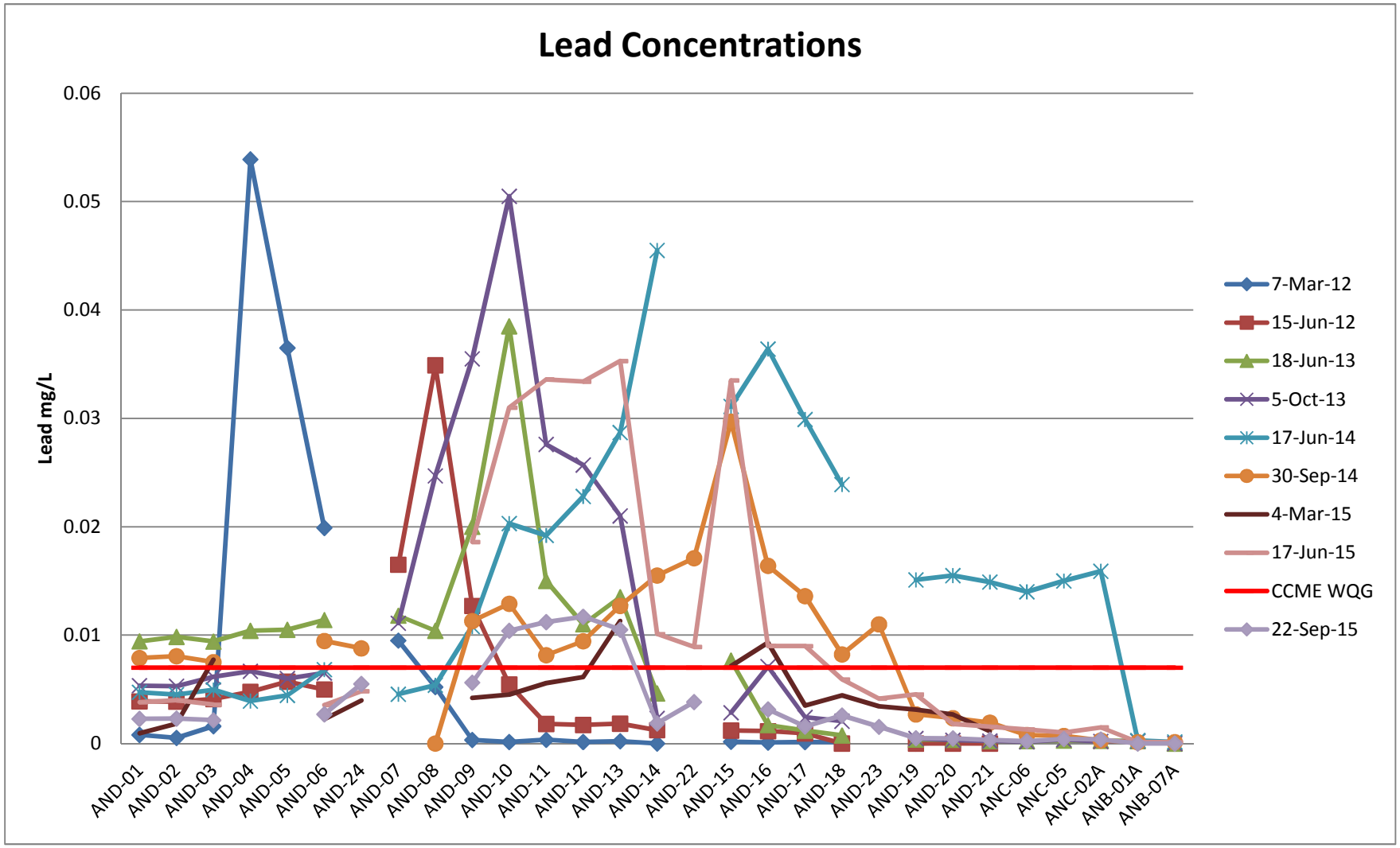

Note: The CCME Water Qualtiy Guideline for cadmium is 0.00009 mg/L and the Anderson Creek (ANC) and Anderson Bay (ANB) are regulated under this guideline. There is no MMER guideline for cadmium.



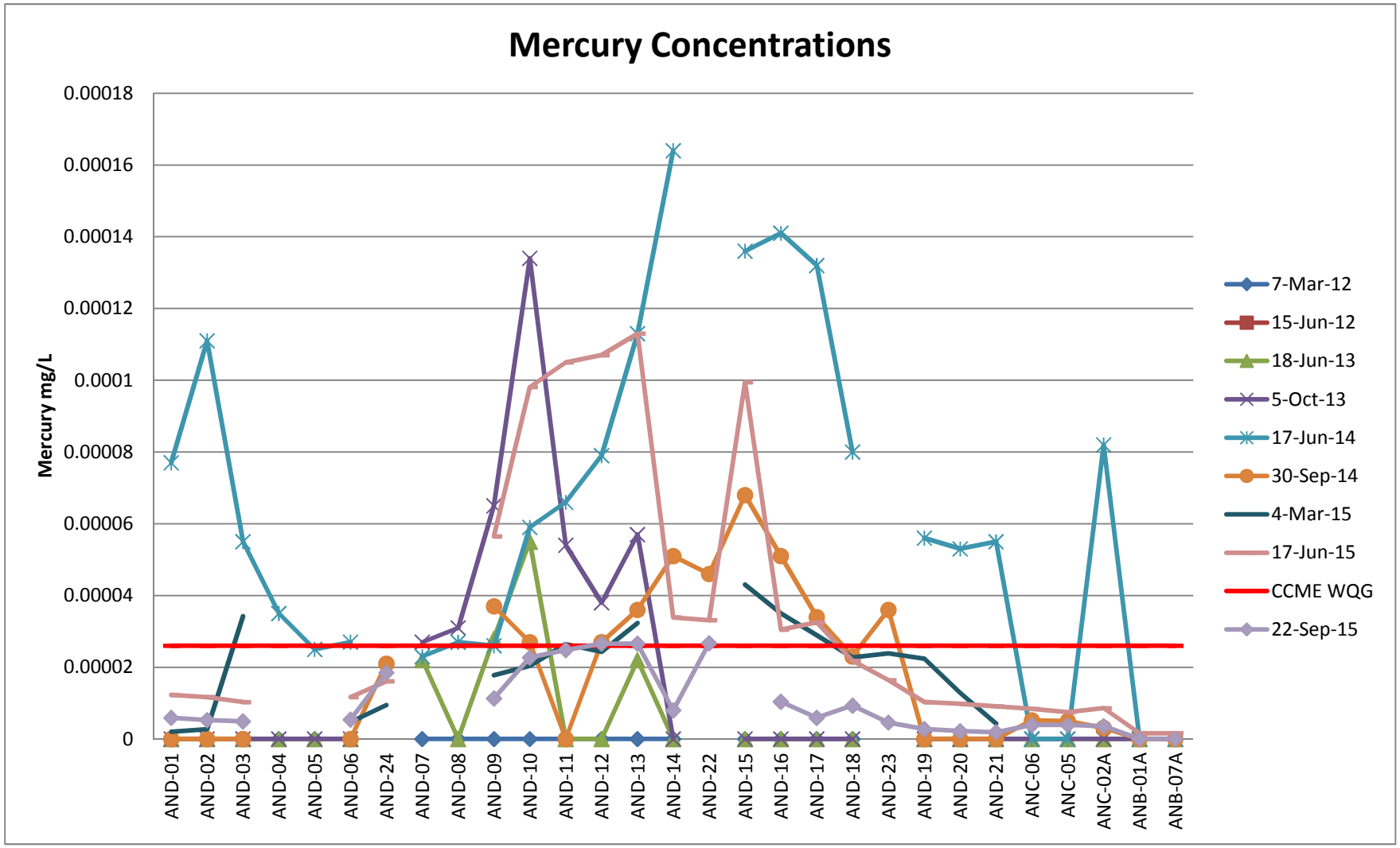

Note: The CCME Water Qualtiy Guideline for copper is 0.004 mg/L and the Anderson Creek (ANC) and Anderson Bay (ANB) are regulated under this guideline. The MMER Water Quality Guideline for copper is 0.6 mg/L (not indicated on the graph) and applies to the Anderson TIA (AND).



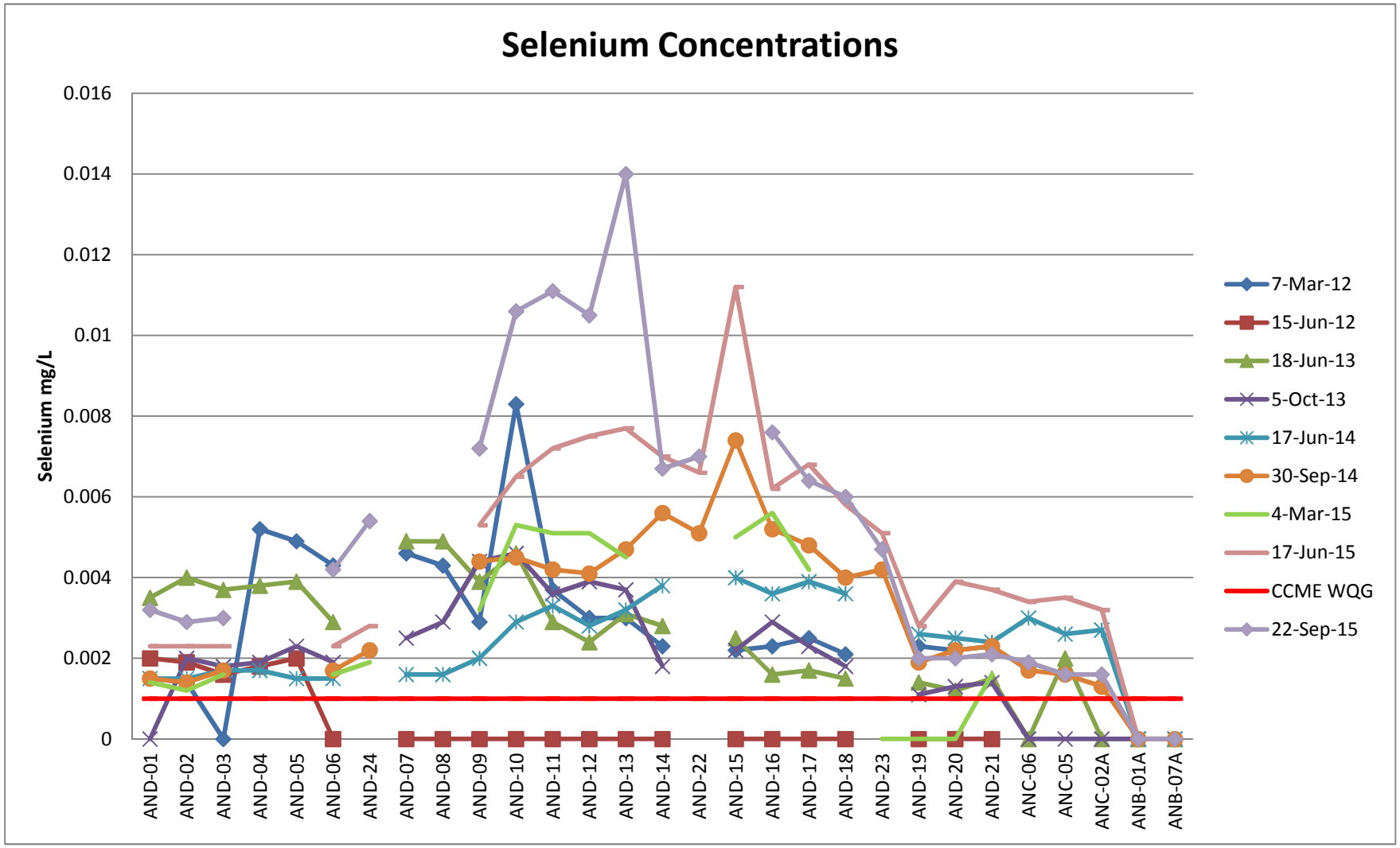

Note: The CCME Water Qualtiy Guideline for iron is 0.3 mg/L and the Anderson Creek (ANC) and Anderson Bay (ANB) are regulated under this guideline. There is no MMER Water Quality Guideline for iron.



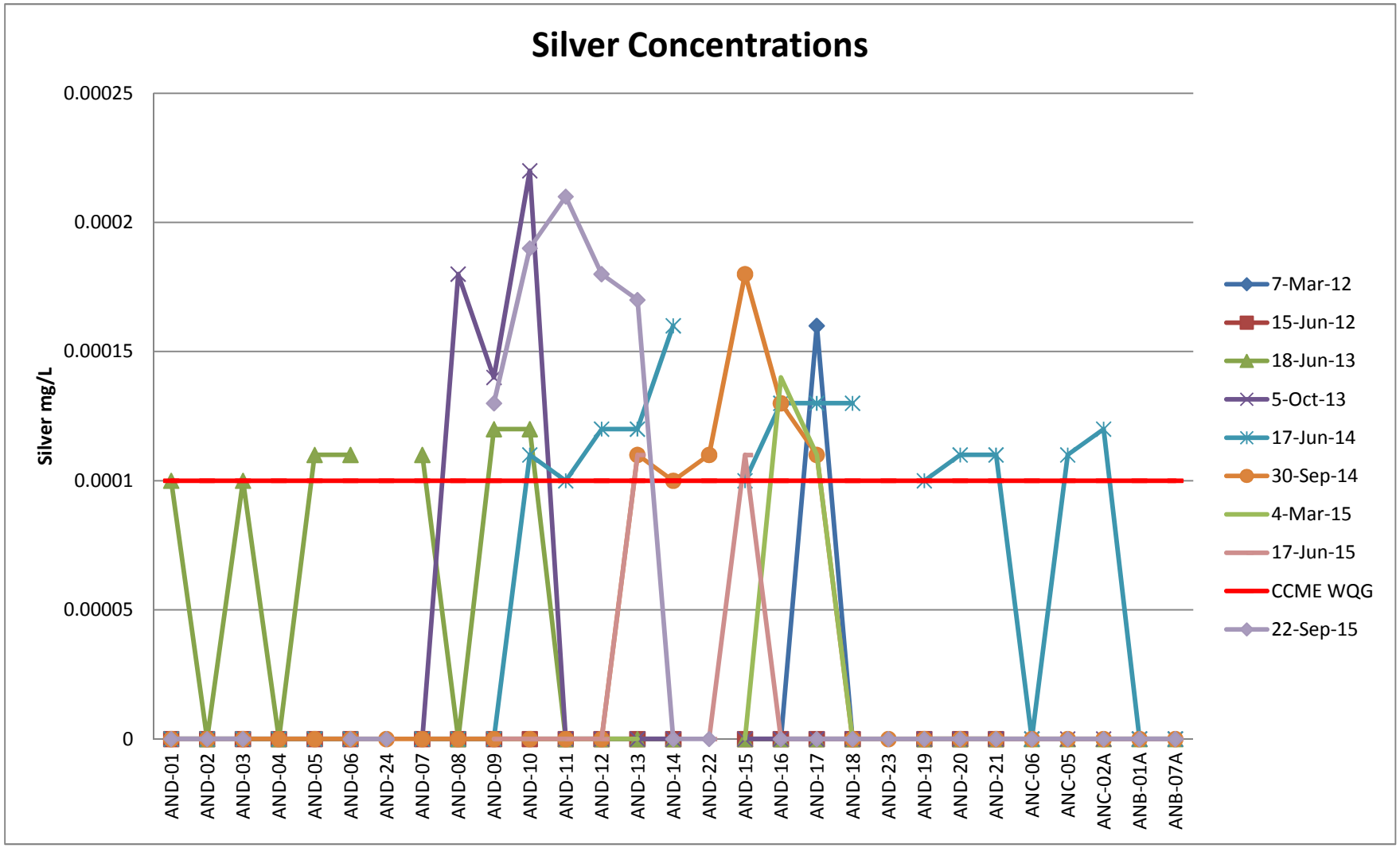

Note: The CCME Water Qualtiy Guideline for lead is 0.007 mg/L and the Anderson Creek (ANC) and Anderson Bay (ANB) are regulated under this guideline. The MMER Water Quality Guideline for lead is 0.4 mg/L (not indicated on the graph) and applies to the Anderson TIA (AND).




Note: The CCME Water Qualtiy Guideline for mercury is 0.000026 mg/L and the Anderson Creek (ANC) and Anderson Bay (ANB) are regulated under this guideline. There is no MMER Water Quality Guideline for mercury.




Note: The CCME Water Qualtiy Guideline for selenium is 0.001 mg/L and the Anderson Creek (ANC) and Anderson Bay (ANB) are regulated under this guideline. There is no MMER Water Quality Guideline for selenium.




Note: The CCME Water Qualtiy Guideline for silver is 0.0001 mg/L and the Anderson Creek (ANC) and Anderson Bay (ANB) are regulated under this guideline. There is no MMER Water Quality Guideline for silver.

# Appendix D

## Photographic Log of Anderson TIA Shoreline Assessment

# Photo Log of Anderson Shoreline Assessment




**Photograph 1** ↑
South-west shoreline.




**Photograph 2.** ↑
South-west shoreline.




**Photograph 3.** ↑
South shoreline.




**Photograph 4.** ↑
Dead tree stand along south-east shoreline.




**Photograph 5.** ↑
Overflow structure, near AD-01.




**Photograph 6.** ↑
Anderson TIA Dam at south-east end.




**Photograph 7.** ↑
Low lying area with emergent vegetation.




**Photograph 8.** ↑
Dead tree stand partly submerged in water.




**Photograph 9.**
Bald Eagle.




**Photograph 10.**
Inflow stream in North-east corner of Anderson TIA.




**Photograph 11.**
Low lying area with emergent vegetation.




**Photograph 12.**
Steep rock cliff on North shoreline.




**Photograph 13.** ↑
Downstream of overflow structure on Anderson TIA, AD-01.




**Photograph 14.** ↑
Portion of proposed dike alignment, South of Anderson TIA.




**Photograph 15.** ↑
Portion of proposed dike alignment, South of Anderson TIA.

# Appendix E

## Media Coverage of Public Engagement

# The Underground Press December 17 Article

...CHRISTMAS from page 3

latter had the little folks accompanying the tune with sign language. There was a collection of the very shy and the somewhat bold on the stage along with coordinator Judy Menge and several parent helpers. Keeping this many little folks on task is somewhat reminiscent of wrangling cats, but they sang their tunes wonderfully and made a marked impression. At the close of their numbers, Ms. Otto called forward the Snow Lake Community Library's (SLCL) Librarian, Vivian Bennett and the two of them drew the winner of the SLCL's 50/50 draw – Jack Forsyth is now $410 richer, as is the Community Library.

The act that followed was comprised of Tara Semaniuk on vocals and Skylar Plante complimenting on guitar. They did 'Santa Baby' and Semaniuk showed notable range and excellent presence in a very soulful rendering of the classic Etha Kitt tune. Plante's accompaniment cemented a performance that set the stage for a fine evening of entertainment.

Next up was the young gentleman who, along with his father, stole last year's show. Zach Roberts took to the stage on his own this year and played and sang two tunes: Eddie Raven's 'Thank God for Kids' and Leonard Cohen's 'Hallelujah'. Although it's always a pleasure to listen to Pete, Zach has proved more than worthy of his own billing. This young man sings with so much feeling... the power and tremolos of his voice literally coax goosebumps. As he closed his performance, he smiled slightly and nodded thanks for the outpouring of applause.

Newcomer, Heidi Geloa followed Roberts to the stage and once positioned on the stool in front of the mic, one of the sweetest voices to ever grace the 'Centennial Stage' emanated from the young lady. She sang two numbers, 'Wexford Carol' and 'O Holy Night'. High notes were not a problem here and it often times sounded like there was more than one person singing. More thunderous applause...

Closing out the first half of the show, JH Kerr Fiddling students Christian Fisher and Kyla Spruyt rosined their bows and showed why they are two of the more accomplished fiddlers in the school's program. They played three songs, all of them with pride and precision: 'Joy to the World', 'Snow Deer', and 'O Come all ye Faithful'.

During the 15 minute intermission, the Book Club sold coffee, hot apple cider, and baking, with all the proceeds going to the Community Library. When folks were back in their seats, Ms. Otto drew for three door prizes which were donated by former club member Joanne Bradley and the Snow Lake Pharmacy. The winners were: Keith Scott, Rebecca Zosa, and Kim Stephen. While the stage was being set up for the final acts, from behind the closed curtain, Cathy Stabback recited a Christmas Poem written from a grandmother's perspective. It was met with 'sound' approval!

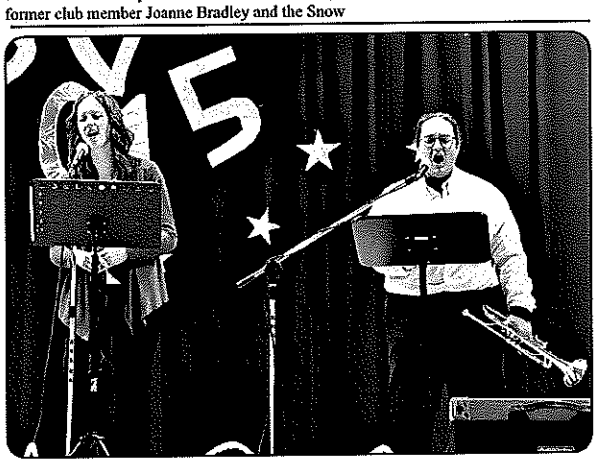
Moving on with the program and doing a reprise of his performance from last year's Christmas Concert, Vaughn Deduke performed 'The Huron Carol' with accompaniment on guitar by Dennis Yates. Deduke's pleasant baritone lends itself well to this selection. He did Tom Jackson proud with his rendition!

Following Deduke, another performer who needs little introduction took his spot in front of the mic. Terry Hornyak sang Chuck Berry's 'Run Rudolph Run' and showed how his years of performing in bands and concerts, lends to a sense of ease on the stage. Hornyak, picked, strummed and sang the song perfectly... and short of a 'duck walk' across the stage, he paid fine homage to the tune's author.

Next up was another person new to the community, Jennifer Pakula. Like Heidi Geloa, Ms. Pakula also has an amazing voice. She sang a song on her own prior to Tony Butt, Heidi Geloa, and Bev Krul joining her. As added entertainment, Geloa played the flute, Pakula the trumpet, Krul the piano, while Butt strummed in with his guitar. When these three ladies harmonized, it seemed like a choir had taken the stage.

There it was, the final act had played, we showed our grateful appreciation with applause and before we knew it the concert had ended... folks left the hall wanting for more and eagerly awaiting next year's lineup.

The proceeds from the door and confections totalled $933 and it was donated, in its entirety, to the Snow Lake Community Library. On a closing note, it was very gratifying to see the many parents on hand rein in their children during the performances and just as rewarding to see the enjoyment on their faces at being able to run and have fun during the intermission and prior to the event getting underway... after all, the hall is most of all for kids! *MJ*



*(L): Heidi Geloa and Jennifer Pakula who sang like angels ~ photo by Marc Jackson*

# North loses two good ones...

Snow Lake in general and the North in particular were served notice of the loss of two longstanding advocates in the past weeks. Flin Flon MLA Clarence Pettersen and Hudbay President and CEO David Garofalo.

Pettersen lost in a challenge to his NDP nomination for the Flin Flon Constituency to well-known Labour Activist Tom Lindsey, and Garofalo, stepped down taking a position with Gold Corp. He will be replaced by Hudbay Sr. VP and COO Alan Hair.

Both men were friends of the community and strong promoters of the mining industry... they will both be truly missed. *MJ*

PINE VIEW REALTY LTD.

Wishing you all the joys of the Holiday Season and happiness and prosperity throughout the coming year!

From Jim Lamontagne and the staff at Pine View Realty Ltd.

REALTOR®

# 'Out -n- About'

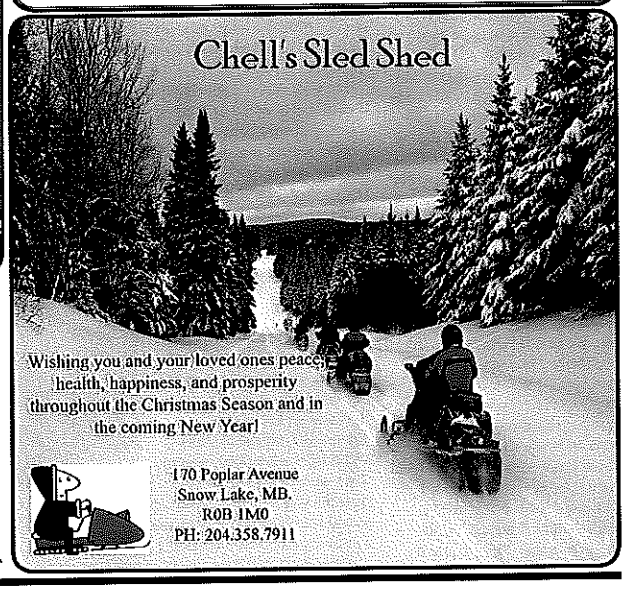
### Special Events

**Town of Snow Lake Office is open Mondays and through the lunch hour!**
**RC Legion #241 Whist Nights,** 7:30 p.m., Dec.18th (Clubroom)
**RC Legion #241 Meat Draws,** 4:00 p.m., Dec. 19th, 26th & Jan. 2nd (Clubroom)
**Legion Ladies Auxiliary Monthly Meeting,** 7:00 p.m., Jan. 11th, 2016 (Clubroom)
**RC Legion #241 Fun Bingos,** 7:00 p.m., dates in New Year (Clubroom)
**RC Legion #241 General Meeting,** 11:00 a.m., January 16th, 2016 (Clubroom)
**Elks' Club Chase the Ace,** 5:00 p.m., Dec. 19th, 26th & Jan. 2nd (Motor Inn)
**Senior Soup and Sandwich Day,** 11:00 a.m. to 1:00 p.m., Jan. 15th, 2016(Sr. Centre)
**50th Boxing Day Game,** 1 - 4 p.m. December 26th (Wilf Lipton Rink)

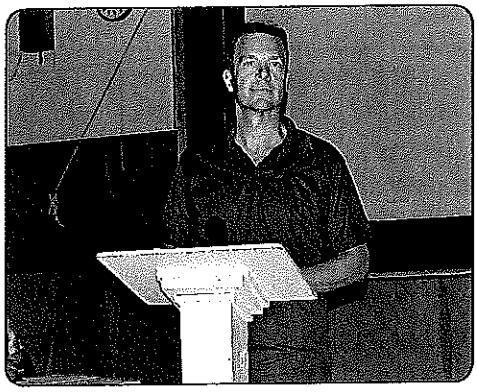
### Ongoing Events

**Anglican United Church,** 11:00 a.m., Sun. (Anglican-United Church)
**Snow Lake Christian Centre,** 10:30 a.m., Sun. (Christian Centre)
**Our Lady of the Snows Catholic Church Mass,** 10:30 a.m., Sun. (Catholic Church)
**Snow Lake Baptist Church,** 11:00 a.m., Sun. (101 - Lipsey Drive)
**TOPS,** Weigh-in 5 - 5:30, meeting at 5:30 p.m. Thurs. (Ang-United Church Basement)
**Town Council Meetings** – 6:30 p.m., 1st and 3rd Tues. (Council Chambers)
**MMF Monthly Meetings,** 2nd Monday each month, 7 - 9 p.m. (Reading Room)

HUDBAY *courtesy of Hudbay*



# Cooper answers questions on Anderson TIA



*Hudbay's Jay Cooper ~ file photo from August 2012*

At the November 16, 2015 meeting of the Snow Lake Town Council, Councilor Forsyth-Flamand brought up the recently held Community Information Session that Hudbay and AECOM held on the Anderson Tailings Impoundment Area (TIA). She related a conversation she had with Ernie Guiboche, stating that he had concerns about the proposed elevations for Anderson Lake and the reliance on using natural elevation in some areas to contain the tailings. Guiboche also wanted to see a list of contaminants going into the pond and wondered how often they are checked. Forsyth-Flamand also said that holding the meeting outside the town proper (it was held at the Wekusko Falls Lodge) wasn't conducive for attendance by many. As a result, it was suggested a letter be written to Hudbay's Jay Cooper and that he be invited to a meeting to explain the situation further.

Cooper received the information and appeared as a delegation at the very next meeting. Ernie Guiboche was also in attendance. Once he'd arrived at the meeting, Mayor Kim Stephen welcomed him and framed the discussion.

Prior to starting, Cooper stated that he was quite happy to attend the meeting, reflecting on his previous offer to answer any questions, of a Hudbay environmental nature, that the council was faced with. He said that he was pleased to be able to talk to Mr. Guiboche and fill in gaps in respect to discussion that took place at the AECOM/Hudbay presentation on November 13th.

He said that some of the questions about the water level at Anderson Lake were echoed from others he's since talked to. He said the dam's level is currently 278.7 meters above sea level. "We're gonna be raising it incrementally, so at the end of the day when we are able to house all of the tails from Lalor Mine, the water level will raise about 3.5 meters, but the dams themselves will be raised about 5 meters," Cooper explained. "Right now it is able to withstand a one in a hundred year storm. The newer dams will be able to withstand something called a 'probable maximum precipitation event', which is sort of like the biblical rainfall event with massive wind storms... standards get changed through time, so it is more robust." Cooper said that the company looked at the catchment area - what actually drains into Anderson, and even projected future requirements 60 years from now. He said that scenario would see the dams raised to the 285m level. However, he noted that wasn't what they are proposing right now, but it was looked at and determined that if they continue raising the dams in the general area on the east side of the lake everything would still be adequate.

"When we looked at the topographical maps and the drainage features and whatnot, the TIA would drain through the existing spillway area and through Anderson Creek, into Wekusko... even at that absolute (projected) high elevation 60 years from now," he said. "So the raise that we are talking about right now, 3.5m, at the end of the life of mine Lalor would not cause any other drainage issues and should all drain through the existing control structure into Anderson Creek and into Anderson Bay on Wekusko."

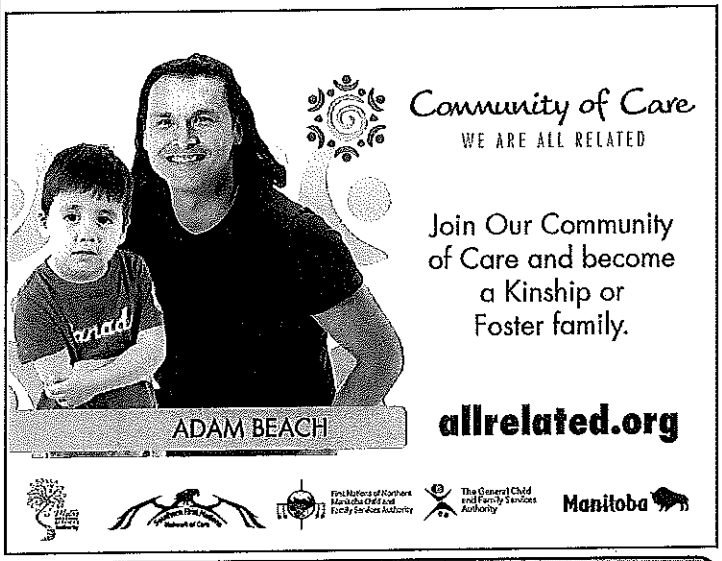
Mr. Guiboche asked what the elevation was at the dam above the culvert at Anderson Creek. Cooper replied that the top of the dam was at the 278.7 meter level. "What I was questioning about was the southwest end of the lake, where they had three points where the (natural) elevation is 290m."

"No, even at 50 years from now, we would never go above the 285m level. So 290 would be sufficient if we were to continue operating for the next 50 years... even if we were to find another Lalor Mine and continue to process the tails and store them in Anderson and if we were to get approval to raise the west end of the lake, it would inundate further back into a swampy area, but it wouldn't actually drain in the opposite direction and it would never hit that 290m level that would cause it to drain back."

Guiboche seemed satisfied with this, but also noted that he'd seen the water at the Anderson Dam flow around the dam and into the culvert. Cooper stated that this spillway was part of the design. In the spring or during major rainstorms (3 inches or so), the piping system that is currently in place wouldn't be able to move as much water, so it goes over the spillway. Cooper said that the company is getting away from the 'pipe through the dam' design currently used and going to a cement spillway with stop logs.

Guiboche also had a question about the quality of water going into Wekusko Lake and what type of contaminants were going into Anderson Lake. "When I worked for HB we used to send stuff out to be assayed for 18 different metals... I can't

*See ANDERSON on page 7...*






...ANDERSON from page 6

recall the results right now... so what is going into Anderson Lake as far as contaminants," he asked?

"Everything that is included in tails, so that's every imaginable metal, the one that we are most concerned of is zinc. There is a long list of metals we check for: Copper, Zinc, Arsenic, at times we check for mercury..."

Cooper said that prior to building the Anderson TIA; they did the baseline studies on the lakes involved. "By today's standards they are much more involved than 40 years ago, but we did have fairly substantial baseline studies done on Wekusko, and a good understanding of what Anderson was like for fish, sediments, water quality," he said. "Part of our provincial licence, which has since been harmonized with federal laws, we did limnology studies, (looked at fish and the small bugs in the water, sediment) and that type of thing to determine the overall aquatic health. There are limits for contaminants in the effluent. Further to that, about every three years, we are required to present a report to the federal government involving the environmental effects monitoring. That's when we go up and capture a bunch of fish, look at the bugs in the water and the sediment... we also do this in the 'far field' exposure area, which is Goose Bay on Wekusko and also a reference lake, which is Tramping Lake. We then get biologists comparing Tramping Lake to Anderson Bay to figure if there is an impact and if so what it is. We have been doing that since about 1978. The actual field study was done two years ago, but we'll be submitting the latest report to Environment Canada on Anderson's discharge in June 2016."

Guiboche also asked where the water samples were taken. Cooper replied that they are taken from the discharge of Anderson and also in Anderson Bay on Wekusko. Guiboche asked how they varied. Cooper replied that they vary seasonally and he didn't know off the top of his head what the results were for Anderson Bay, but in the TIA they notice changes over the course of the discharge season; due to something biological, plant growth, or the uptake of metals in the sediment. "So it starts out low, climbs a bit, and then once all the (assumed) plant growth in the lake begins it starts tapering off, then in the fall it climbs again," Cooper said. "That is very consistent for the last couple of years, going back though time. Production rates change, but it is seasonal when it goes up and down, within the three years."

Council members wanted to know if they could receive the information from the government reports. Cooper said that it could be available from the government if there were no proprietary information in it, but it would take time.

Cooper was also asked if it would have been better if the recent presentation they put forward with AECOM had been held in Snow Lake. He replied that he'd heard the comment that it would have been better in town, but they thought that they would like to have it closer to Wekusko itself; as well with the heavy use of the Lawrie Marsh Hall the lodge allowed them more flexibility. It was pointed out there would have been better attendance had they held it in Snow Lake. *MJ*

# REGULAR COUNCIL MEETING 12-01-2015

The Town of Snow Lake held their regular council meeting, beginning at 6:30 p.m. on the evening of Tuesday, December 1, 2015. Those in attendance were: Mayor Kim Stephen, Deputy Mayor (DM) Richard Jones, Councilors Peter Roberts, Jodi Wilson, Robin Turnbull (by telephone), Brenda Forsyth-Flamand, Student Councilor Alexander Fisher, and CAO Jordan Willner. Absent: Councilor Aldon Kowalchuk

The meeting began with a resolution to accept the minutes from the regular council meeting on November 16, 2015, as well as another to approve the agenda for the current meeting. The next item, 'Accounts' was skipped over in order to go into a Public Hearing.

Council adjourned the meeting to allow for a Public Hearing on By-Law 939/15, which is a zoning amendment for the Gardewine property located at 112 Cedar Ave. There was no representation for, or against the amendment, so the public hearing was adjourned and council resumed the scheduled meeting.

Back to the agenda, a resolution was put forward to review and accept the period's accounts. There were no comments or questions on the accounts.

The council then moved to 'Communications'. 1) A letter advising of the resignation of Councilor Aldon Kowalchuk, effective November 30th – Accepted. 2) A letter from Manitoba Hydro advising they will be continuing with construction of the Bipole III Transmission Project with an anticipated inservice date in 2018, and that throughout the remainder of 2015 and into 2016, construction activities will be undertaken along the entire transmission line route – filed as information. 3) A letter was received from the Minister of Tourism, Culture, Heritage, Sport, and Consumer Protection advising of a grant of $2,152.64 from the 2015-16 Rural Library Technological Sustainability Grant program to the Snow Lake Community Library – filed as information. 4) Taylor McCaffrey Law Offices advising that the Town of Snow Lake is now the registered owner of the Mining Museum Property – filed as information.

Under 'By-Laws', by-law 939/15, a zoning by-law changing the zoning designation on 112 Cedar Ave from 'Limited Development' to 'Industrial' was given 2nd and 3rd readings and passed unanimously. Councilors were advised that Gardewine will request a variance on the property and once dealt with, a building permit will be issued and construction will follow.

Chris Chell was on the agenda as a delegation for 7:45 p.m., as he had already arrived at the chambers, council asked if he would like to proceed. He did. Chell advised that he would like to purchase a 200' x 100' lot near the Gardewine property on Cedar Ave/Dunlop Drive. He would use the property as truck storage and possibly rent out storage and office space to others. Councilor Forsyth-Flamand asked about a construction timeline for the property. Chell replied that he would build a $150 - $200k building on the property within two years. Discussion of zoning and variance requirements ensued. Chell questioned the amount of property that Gardewine own in the area as opposed to how much they currently use. Chell also queried about road access to the back of the lots and pointed out the unsuitability of some of the property that is for sale in the lot area. He invited council members to walk the land with him. Further discussion will take place once this happens.

Back to 'By-Laws' council gave second and third reading to By-laws 942/15 and 943/15, respectively, by-laws that close the Berry Bay Road loop and Public Reserve. They passed unanimously. Council gave first reading to by-law 944/15, a by-law that establishes water and sewer rates for the community. It passed unanimously.

Council closed the meeting once more and moved into a public hearing on By-Law 941/15, a borrowing by-Law, which provides for the expenditure and borrowing of funds to replace the water and wastewater distribution lines for 2016. CAO Willner advised that notice of the by-law was mailed to all area ratepayers. He received several responses and read them into the record. Letters received from Gerald and Charmain de la Roche, Hazel Kitzler, Glenn and Jody Young, Clara Young, and Angela Enright, and all wrote in opposition to the Local Improvement for a variety of reasons. Clarence Fisher was on hand for the meeting and was asked if he would like to address the meeting. Fisher began by congratulating the council on the cost sharing deal they have with the government for line replacement. "I know the challenges and it is tough to get funding from government," said Fisher. "This is another piece of the puzzle." Fisher stated that he understood the infrastructure needed to be addressed, but asked, in

See COUNCIL on page 12...

WEKUSKO FALLS LODGE
Withdraw to the Wilderness

May the Peace, Joy, and Love of Jesus given to us, find you throughout the year!

Merry Christmas,
Wekusko Falls Lodge



*May all your hopes and dreams come true for you and yours this season and beyond.*

*Season's Greetings*

from the Board & Staff

NORTHERN HEALTH REGION

...COUNCIL from page 12

per Rd. and applying for an extension.

The Recreation Maintenance Supervisor's Report was put forward. In it he noted: 1) Christmas lights were put up around town. 2) Programming and ice maintenance has been performed at the arena. 3) Workers shoveled the steps of the fire escape exits and wheelchair ramps at the arena, curling rink, and Community Hall. 4) Snow was cleared at the cemetery, the parking lots at the curling rink, the arena, and the Community Hall. 5) Blades were changed on the Zamboni. 6) A burnt out heating element in the hot water tank at the curling rink was replaced. 7) They received the price quotes for chairs for the Community Hall. 8) They hooked up a cordless mic system to the new sound system at the Community Hall. 9) A heater in the basement of the Community Hall was repaired. 10) A toilet in the ladies' washroom at the Community Hall was repaired. 11) Fire extinguisher checks were done at the arena and Community Hall. 12) They started cleaning air filters in the air conditioners/heat exchange units at the Community Hall. 13) They assisted public works with snaking a plugged sewer line at the Town Office and cleaned up the mess after snaking the line. 14) Performed office administration and building maintenance as required. Under his 'Two Week Plan' the Rec Maintenance Supervisor states they will: 1) Plug in Christmas lights around town. 2) Put up Christmas lights at Anderson Bay, Taylor Bay, and Berry Bay. 3) Arena programming and ice maintenance as required. 4) Change water filters on weak lines at the arena and Community Hall. 5) Put up and decorate the Christmas tree at the Community Hall as per request. 6) Finish cleaning air filters in the air conditioners/heat exchange units at the Community Hall. 7) Assist public works as required. 8) Office administration and building maintenance as required. Councilor Forsyth-Flamand asked when the town would take delivery of the community hall chairs. The CAO stated that he was working on quotes and aware that they had to be ordered by year end. Councilor Turnbull stated that he liked the breakdown that Ms. Erickson was using to track use at the arena. Willner said he would pass this on.

The Fire Chief's Report was received for filing. The Chief reported that there were no callouts during the period covered by the report: Practices: November 18, 2015 - on this night the department discussed and prepped for an upcoming mock incident at Lalor mine involving Hudbay, Stittco, and the Department. "The incident would have been regarding a leak in a large propane tank. The mock didn't take place due to poor weather," said the Chief. November 25, 2015 - On this night the department changed out all of the old gas from generators, ice auger, Jaws of Life, etc. There were no comments on the report.

Under 'Delegates' there were three reports 1) The delegate's report on the RCMP Detachment Meeting held November 12, 2015 was received for filing. 2) The oral report of the Mayor was received as presented.

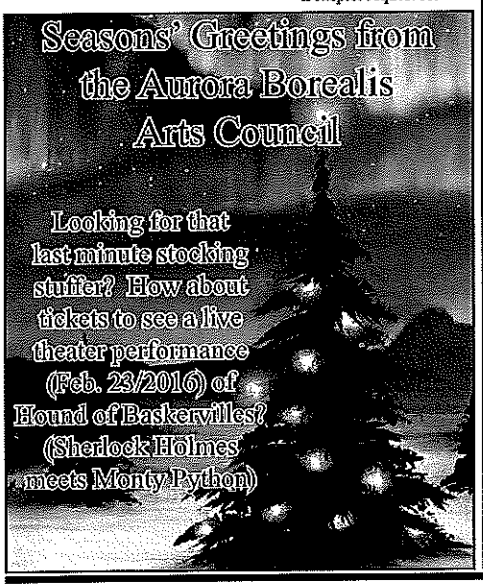
Under 'Administrator's Report' there was no report; however, the unaudited financials as of November 30, 2015 were received for filing.

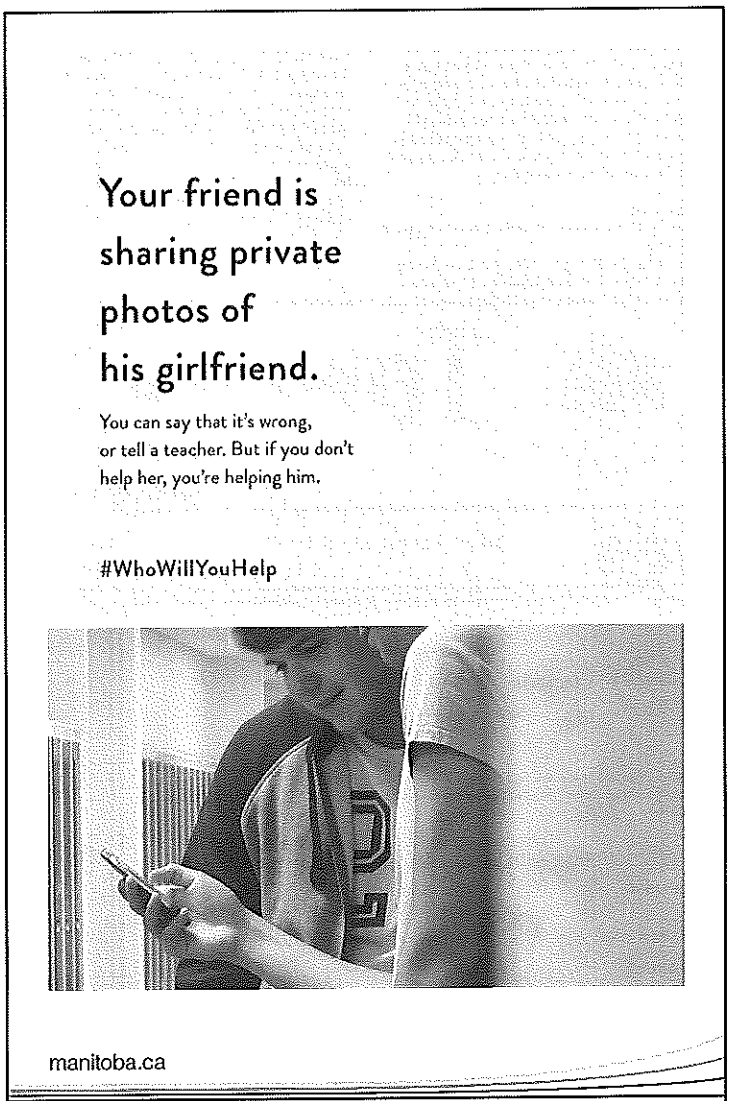
Under 'Policies', Policy GG-108 - Council Member Ethics was reviewed, approved and placed in the Town of Snow Lake Policy and Procedures Manual. Policy SR-910 - Anti-Harassment was updated and placed in the Town of Snow Lake Policy and Procedures Manual. Policy 'PD-Land Pricing' was noted on the agenda, but there was nothing brought forward on this.

Under 'General Business': 1) A request by Kirk Melnick to attend the MWWA 2016 Annual Conference and Tradeshow was dealt with. Councilor Roberts stated that attendance at this helps Mr. Melnick maintain his qualifications. Roberts felt the Foreman should attend as well. Council approved Mr. Melnick's attendance. 2) Senior Election Officer Appointment - Council appointed Sharon Meuse as Senior Elections Officer for the Town of Snow Lake. 3) Snow Lake Curling Club Ladies Open Bonspiel request for donation - Council approved a grant of $100.00 to the Snow Lake Annual Ladies Open Bonspiel on February 5-7, 2016, with the cheque to be issued in 2016. 4) Waste Disposal Grounds Attendant Contract - Council renewed Bob Alcorn's contract for 'Waste Disposal Grounds-Attendant' under a new agreement ending December 31, 2018.

In 'Other Matters': Councilor Forsyth-Flamand advised that she attended the Mining and AMM Conventions, she said a report would follow at the next meeting. Forsyth-Flamand also stated that there would be a Library Meeting the following week, and noted that the Book Club would be hosting a Community Christmas concert Friday with proceeds going to the library. Councilor Roberts had nothing to report; Councilor Wilson said there would be a Chamber of Commerce luncheon on December 3rd; Deputy Mayor Jones stated that the Mining Museum held their annual overview meeting; he stated how proud he was of the group and the good and important work they do in preserving the community's heritage. Jones added that another safety meeting would be held in the next week or two involving safe work procedures, and examining the gas detector; Councilor Turnbull stated that he is pleased to see the Arena attendance for November 2015; Youth Councilor Fisher informed council that he attended the WE Day Concert, stated that the Senior Girls Volleyball Team went to Provincials, noted students would be attending Frontier Games in Grand Rapids, and that the last day of classes before Christmas Break is December 18, 2015. He also reported that the School is currently surveying parents to address some issues; Mayor Stephen attended a HOPE meeting at the Hospital the previous Friday, and she has invited Forbes Bros. Powerline Construction to the December 15 Council Meeting.

Jay Cooper the Superintendent of Environment at Hudbay attended the meeting as did Ernie Guiboche. Questions ensued regarding the elevation of the dam at Anderson Lake, and water quality samples. An overview is covered elsewhere in the paper. The meeting went incamera after Mr. Cooper exited and I left. *MJ*



*About AECOM*

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