BMC MINERALS (NO.1) LTD.

KUDZ ZE KAYAH PROJECT

RESPONSE #3 TO YESAB EXECUTIVE COMMITTEE INFORMATION REQUEST KZK

PROJECT PROPOSAL

June 2018

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ACRONYMS

Acronym	Definition
AF	Amortization Factor
BMC	BMC Minerals (No 1.) Ltd.
BW	Body Weight
CAC	Criteria Air Contaminant
cm	Centimetre
CMP	Conceptual Cyanide Management Plan
CO	Carbon Monoxide
COPC	Contaminants of Potential Concern
CRA	Commercial Recreational or Aboriginal
EAP	Employee Assistance Program
ECCC	Environment and Climate Change Canada
ENV	Department of Environment
FCH	Finlayson Caribou Heard
FOP	Fish Offsetting Plan
FQ	Frequency of Consumption
g	Gram
ha	Hectare
HDV	Heavy Duty Vehicle
HQ	Hazard Quotient
hr	Hour
HSS	Health and Social Services
HVAC	Heating, Ventilation and Air Conditioning
ILCR	Incremental Lifetime Cancer Risk
IR	Information Request
ISO/IEC	International Organization for Standardization/International Electrotechnical Commission
km	Kilometre
km^2	Square kilometre
KZK	Kudz Ze Kayah
L/s	Litre per second
LDV	Light Duty Vehicle
LFN	Liard First Nation
LNG	Liquefied Natural Gas
m	Metre
mbgs	Metres below ground surface
m/s	Metre per second

Acronym	Definition
m^2	Square metre
m^3	Cubic metre
m^3/day	Cubic metre per day
mg/day	Milligram per day
mg/kg	Milligram per kilogram
MIF	Mine Infrastructure Footprint
Mm^3	Million cubic metre
MRB	Mineral Resource Branch
Mt	Million tonnes
NA	Not applicable/available
NaCN	solid sodium cyanide
NOC	National Occupational Classification
NO_x	Nitrogen Oxides
NSF/ANSI	National Sanitation Foundation/American National Standards Institute
PM_{10}	Coarse Particulate Matter
$PM_{2.5}$	Fine Particulate Matter
POI	Maximum Point of Impingement
ppm	Part per million
ppvb	Parts per billion by volume
PQRA	Preliminary Quantitative Risk Assessment PQRA
PTSC	Preliminary Tissue Screening Concentrations
RCH	Robert Campbell Highway
RRDC	Ross River Dena Council
RsD	Risk Specific Dose
S	South
SO_x	*Sulphur Oxides*
SPAG	Strongly Potentially Acid Generating
SS	Serving Size
SW	South west
t/m^3	Tonne per cubic metre
TR	Target Risk
TRV	Toxicity Reference Value
TSP	Total Suspended Particulates
UCLM	Upper Confidence Level of the Mean
WMP	Water Management Pond
YAAQS	Yukon Ambient Air Quality Standards
YCS	Yukon Conservation Society
YEMS	Yukon Emergency Medical Services

Acronym	**Definition**
YESAA	*Yukon Environmental and Socio-economic Assessment Act*
YESAB	Yukon Environmental and Socio-economic Assessment Board
µg/g	Microgram per gram
$\mu g/m^3$	Microgram per cubic metre
µg/kg bw/d	Microgram per kilogram and body weight per day
µg/L	Microgram per litre
$\mu g/m^2/s$	Microgram per metre cubed per second

1 INTRODUCTION

BMC Minerals (No.1) Ltd (BMC) has submitted the Kudz Ze Kayah (KZK) Project Proposal to the Yukon Environmental and Socio-economic Assessment Board (YESAB) for a Screening level assessment. In January 2018 BMC received confirmation from YESAB that the Executive Committee considered the Project Proposal to be adequate for screening. A 60-day public comment period occurred from January 16th to March 16th, 2018. The Executive Committee reviewed the comments received during the public comment period as part of the screening and determined that supplementary information is required regarding the proposed Project before preparing the Draft Screening Report (YESAB, 2018). This Response Report provides the additional information requested by YESAB.

For clarity and ease of understanding BMC have listed the information requests (IRs) from YESAB's Information Request No.3 (in black text) followed BMC's response (in blue text). The requests and responses follow the same headings and numbering adopted by YESAB.

2 WATER

YESAB ISSUE

In both the Adequacy Review Reports Information Request No. 1 and No. 2, the Executive Committee had requested that BMC provide additional water related information prior to the Executive Committee drafting the screening report. In its responses to our information requests, BMC committed to providing the required information within that timeframe.

The Executive Committee received numerous comments during the public comment period in relation to water. We are of the opinion that many of these comments, questions, and concerns may be addressed in the information being provided by BMC in the upcoming weeks. As such, in this information request, we are formally asking that BMC provide that updated water related information. Once we have received and reviewed the updated information there may be additional information requests related to water.

We note that BMC has provided some updated modelling as part of their Response #2 to YESAB Executive Committee Adequacy Review of KZK Project Proposal, including:

- Updated background water quality, water quality objectives, and source terms in Appendix R2-C KZK Project – Project Optimizations and Updated Water Quality Performance Expectations
- Updated ("corrected") water balance model in their Revised – Response to IR R2-35 – Operational Water Balance and Climate Variability and Sensitivity Analysis (December 12, 2017)

It is expected that, where appropriate, this information will be incorporated in the updated information provided to the Executive Committee prior to drafting the Screening Report.

R3-1

Provide updated hydrometric baseline information, water quality baseline information, water quality objectives, and water models (e.g., water quality model, site and watershed balance models, surface water flows, etc.) for the site.

In response to this information request, BMC has updated a number of water related baseline and modelling reports. Table 2-1 presents a table of concordance for the reports that have been updated and included in this Response Report.

Table 2-1: Table of Concordance for Water Related Reports That Have Been Updated

Report Title	Appendix from Project Proposal	Updated Appendix in this Response Report
Kudz Ze Kayah Surface Water Quality Report	Appendix D-1	Appendix R3-A
Hydrometeorology Analysis Report	Appendix D-2	Appendix R3-B
Hydrogeology Baseline Report	Appendix D-3	Appendix R3-C
Acid Rock Drainage and Metal Leaching Characterisation Report	Appendix D-5	Appendix R3-D
Preliminary Water Quality Objectives Report	Appendix D-8	Appendix R3-E
Water Quality Model Report	Appendix D-7	This report is still in progress and will be submitted under a separate cover.
Receiving Environment Water Balance Report	Appendix D-6	This report is still in progress and will be submitted under a separate cover.

a) Updated baseline sampling should:

i. Be conducted and reported on at least two sampling events, including one during low-flow conditions and one during high-flow conditions, for each year in which 5 samples are collected in 30 days.

Appendix D-1 of the Project Proposal (Kudz Ze Kayah Surface Water Quality Report) has been updated to include 3 years of consecutive baseline data collection (**Appendix R3-A**). This report includes the results of two sampling events, including one during low-flow conditions and one during high-flow conditions, for each year in which 5 samples are collected in 30 days

b) Updated water quality objectives should:

i. Include, at minimum, the background water quality dataset used in Appendix R2-C KZK Project – Project Optimizations and Updated Water Quality Performance Expectations.

Appendix D-8 of the Project Proposal (Preliminary Water Quality Objectives Report) has been updated (**Appendix R3-E**) and incorporates the entire baseline data set presented in the updated surface water quality report (**Appendix R3-A)** (which also includes the data presented in Appendix R2-C) (BMC, 2017a).

c) The updated water balance model should:

i. Include a sensitivity analysis for run-off coefficients.

This report is still in progress and will be submitted under a separate cover. The estimated time for delivery to YESAB is late July 2018.

d) Updated water quality modelling should:

ii. Include, at minimum, updated COPI source terms updated based on laboratory-based kinetic tests reported to August 10, 2017, developed for Appendix R2-C KZK Project – Project Optimizations and Updated Water Quality Performance Expectations;

iii. Incorporate, where possible, additional kinetic tests results from tests described in Section 2.1 of Appendix R2-C KZK Project – Project Optimizations and Updated Water Quality Performance Expectations;

iv. Include most recent site and receiving environment water balance assumptions;

v. Include most recent assumptions for long term loadings including acidic drainage from Class A and B materials;

vi. Provide water quality predictions for Geona Creek (KZ-37), Upper Finlayson Creek (KZ-15), Lower Finlayson Creek (KZ-26) and South Creek (KZ-13);

vii. Provide water quality predictions for all phases of the Project;

viii. Provide water quality predictions for closure with and without CWTS for Geona Creek (KZ-37), Upper Finlayson Creek (KZ-15), and Lower Finlayson Creek (KZ-26); and

ix. Compare water quality predictions to most recent pWQOs.

This report is still in progress and will be submitted under a separate cover.

3 GEOTECHNICAL AND ENGINEERING

YESAB ISSUE

The surficial geology maps presented in the report (Figs. 11-2 and -3) are extracted from a 1:100 000 scale surficial geology map of the Geological Survey of Canada. The map is of regional scale and does not present a level of detail sufficient for the Project. Of particular concern is the absence of glaciolacustrine sediments on the map, although glaciolacustrine sediments are reported in the local study area.

The presence of glaciolacustrine sediments stratigraphically below other surface sediments is of concern in the local study area because their potential to fail or liquefy could result in damage to infrastructure and impacts on the environment.

The presence of glaciolacustrine sediments near the site of the proposed lower water management pond is of concern because they likely correspond to the low density soils with potential for liquefaction identified in the west slope and valley bottom of the lower management pond area.

R3-2

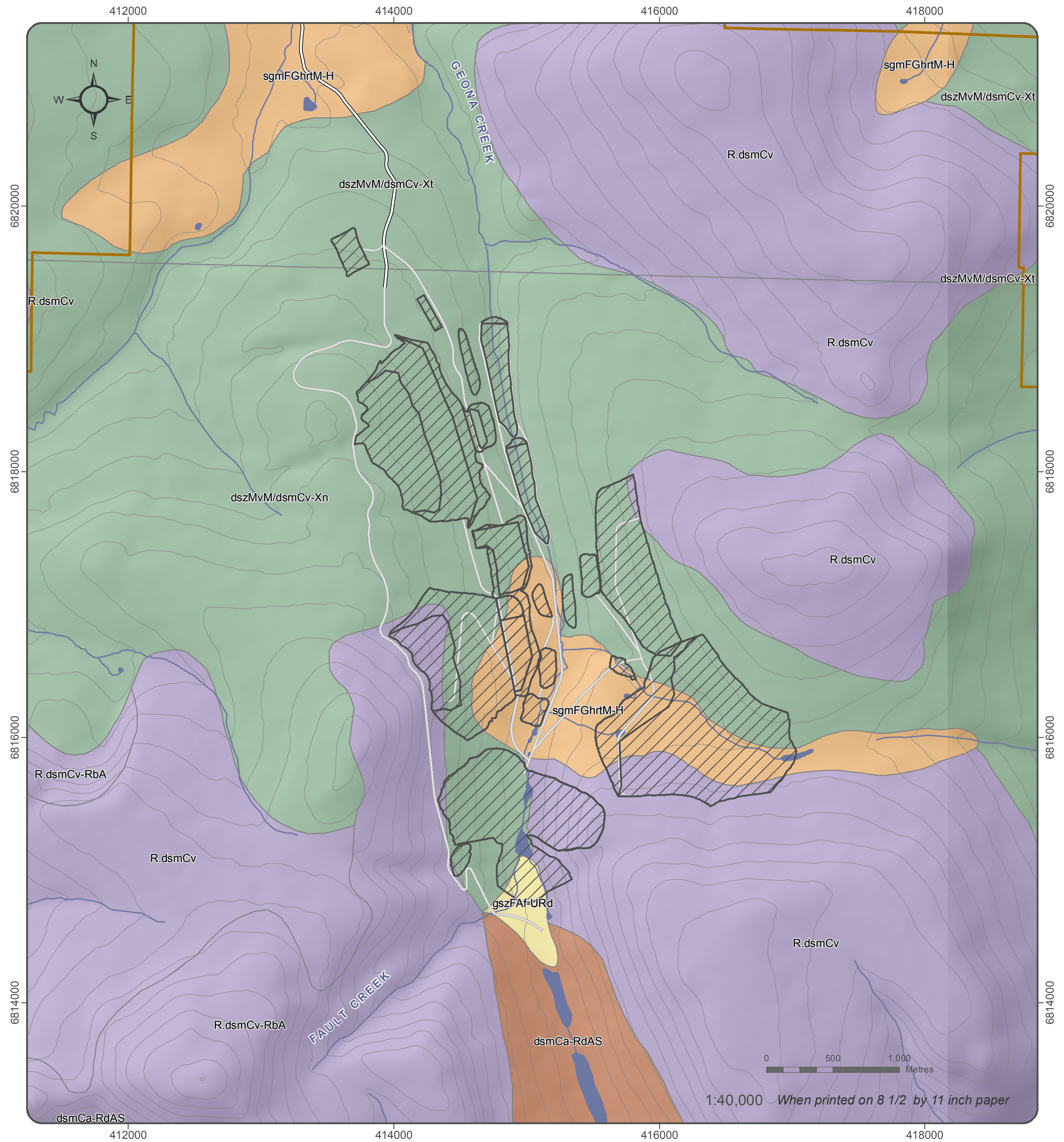
Provide a surficial geology map (1:10,000) for the footprint of the mine with the following:

a) a description of the surficial geology elements;

b) surface extent of glaciolacustrine sediments; and

c) greater detail for surface and sub-surface extent and the thickness of glaciolacustrine sediments than what is currently provided in Fig. 11-2 [2017-0083-034-1].

During the adequacy review stage of the assessment process BMC provided YESAB with a Terrain Stability and Hazard Assessment Report (Appendix R2-H of Response Report #2) (BMC, 2017a). This report includes a description of the surficial geology elements, surface extent of till sediments and includes greater detail of the surface and sub-surface extent and the thickness of these sediments than what was provided in Figure 11-2 of the Project Proposal. For clarity this information is summarized below and illustrated in Figure 3-1. Figure 3-1 is at the scale of 1:10,000.



Colluvium
Fluvial
Glaciofluvial
Morainal
Bedrock
Location of Proposed Infrastructure
BMC Minerals (No.1) Ltd. Mineral Claim Areas
Tote Road/Proposed Access Road
Proposed Mine Road
Contour (40 m interval)

KUDZ ZE KAYAH PROJECT RESPONSE #3 TO YESAB EXECUTIVE COMMITTEE INFORMATION REQUEST

FIGURE 3-1 SURFICIAL GEOLOGY PROJECT AREA

MAY 2018

Datum: NAD 83; Projection: UTM Zone 9N

AEG

BMC MINERALS

D:\Project\AllProjects\Kudz_Ze_Kayah\Maps\01_Overview\03-SpecificTopics\Surfical_Geology\Project_Area_Letter_20170215.mxd
(Last edited by: mducharme; 2/15/2017/10:23 AM)

Morainal (Till) Deposits

Morainal deposits are accumulations of till, a diamicton deposited directly from glacial ice. Approximately 58% of the study area exhibits till as the dominant surficial material, although this proportion under-represents its actual extent due to the commonness of its burial beneath a mantle of glaciofluvial or colluvial material. Most of the till within the study area appears to have been deposited beneath the ice sheet (i.e., subglacial till), although ablation till was likely also deposited in areas of stagnant and down-wasting ice, commonly in association with areas of ice-contact glaciofluvial deposits. Till thicknesses varies greatly. Till veneers (<1 m) are common around the proposed mine area, especially on rounded ridges and gentle upper slopes. Till thickness generally increases northward, such that blankets (>1 m) are more common along the road corridor. Most blankets, in the road access corridor, are probably in the order of a few metres thick, based on road cuts, but areas of blankets in excess of 10 m are indicated by exposures in stream-cut banks along the northern portion of the access corridor.

The till within the study area generally has a silty fine sand to fine sandy silt matrix and a low (10-15%) clast content. In some areas, the till has sufficient clay content to be manually rolled to 3 mm without cracking (~plastic limit). Clasts range from granule to boulder in size and are generally sub-angular to sub-rounded. Field observations suggest that the thinner tills around the proposed mine area may be slightly sandier than the thicker tills along the access road corridor.

Glaciofluvial Deposits

Glaciofluvial deposits are the result of sedimentation in flowing glacial meltwater. Glaciofluvial deposits occupy approximately 16% of the study area and are concentrated in a number of locations, locally representing the dominant surficial material. Glaciofluvial landforms originate in two distinct settings: ice-contact and proglacial. Both occur within the study area. Large complexes of ice-contact glaciofluvial deposits, forming kame-and-kettle topography, occupy lowland settings at several locations within the study area. Relief (i.e. the quantitative measurement of vertical elevation change in the landscape) of these ice-contact deposits is typically less than a few tens of metres. Eskers and hummocky kames likely formed in relatively high-energy environments, given their sandy gravel composition. Deposits are clast-supported and dominated by rounded stones. Many of the kames, especially smaller and lower-relief ones, are best described as 'dirty' sand and gravel; they are more poorly sorted, commonly contain a notable silt fraction, and exhibit more sub rounded clasts. Outwash deposits were deposited in comparatively low-energy environments, based on their better-sorted, gravelly sand composition. Along the northern portion of the access corridor, a veneer to blanket of outwash sediments commonly covers underlying till. Isolated glaciofluvial deposits occur throughout the study area, including within the proposed mine area (Figure 3-1).

Colluvial Deposits

Colluvium is material that has been transported and subsequently deposited by gravity. Minor colluviation (e.g., soil creep) is widespread throughout the study area on gentle to moderate slopes. Colluvial materials are most pronounced and mappable within approximately 14% of the study area. Colluvial veneers (<1 m) are widespread on moderately steep to steep slopes, exhibiting evidence of downslope movement of materials. In some areas, veneers of colluvium overlie another material such as till instead of bedrock. Colluvial veneers are mainly encountered on mountainsides within the proposed mine area. Colluvial blankets (>1 m) and aprons are more common on lower slopes and at prominent concave slope-breaks, respectively. Thicker colluvial deposits generally contain more silt and are less well drained. The eastern valley side near the proposed open pit exhibits a conspicuous colluvial apron at its base which has been considered in the Project design.

Colluvial materials derive their properties largely from the materials from which they originate. Therefore, colluvium derived primarily from weathered bedrock in the study area tends to be angular, clast-supported granules to large blocks, with a matrix of silty sand. Bedrock-derived colluvium is generally well-drained and permafrost-free. Colluvium derived primarily from the downslope movement of till tends to exhibit subrounded to angular clasts supported within a silty sand matrix, much like its parent material but with a looser, less compact structure. Where sufficiently thick and silty, colluvial deposits contain permafrost. Colluvium commonly exhibits crude stratification parallel to the slope, including buried organic horizons, indicating the incremental movement and layering of materials downslope.

Fluvial Deposits

Fluvial deposits have been transported and subsequently deposited by modern (post-glacial) streams. Fluvial deposits invariably occur along modern creeks and localized widenings along their tributary drainages, representing <1% of the study area. Most of the Geona and Finlayson Creek valley bottoms are mapped as active fluvial plains, which exhibit sinuous to irregularly meandering channels within a level floodplain and localized organic cover. Remnants of former channel deposits, now perched above the floodplain, are mapped as terraces. Several active fluvial fans from tributaries project into the floodplains, indicating that material deposition from the tributaries is outpacing the erosional capacity of the main creeks. Some of the tributary drainages and even the slope wash runnels descending the gentle valley sides exhibit evidence of fluvial transport and deposition; as such, they have been mapped as having fluvial veneers.

The grain size distribution of fluvial deposits is a function of the source material and the channel morphology, namely energy gradient (slope). Most fluvial deposits within the study area are a mixture of sub rounded to rounded, pebble- to cobble-sized clasts along the active channel and interbedded silt, sand and organics in adjacent floodplain areas. Fluvial fan deposits tend to be coarser gravels and have a lower silt fraction, mainly due to the comparatively steeper gradient than on plains. Evidence of beaver activity is widespread along the bottoms of both main creeks; many of the small on-line or riparian ponds may actually relate to former beaver activity. Open meadows have established in areas once impounded by beaver dams, and clusters of dead or dying trees are commonly a sign of drowning behind existing or former beaver dams.

Organic Terrain

Organic terrain, composed of peat and muck, occurs wherever organic material has accumulated with thicknesses of at least half a metre. Organic material accumulates in poorly drained areas where water slows the decomposition of plant matter, generally in closed depressions, in riparian zones or on gentle ground with a thin active layer (shallow permafrost). Mappable organic terrain represents <1% of the study area. The thickness of organic material is variable, and generally expected to be less than a metre or two. KP (2016a), however, notes one of the test pits near the proposed Lower Water Management Pond penetrating more than 5 m of organics. Organic terrain is mapped as veneers (<1 m), blankets (>1 m) or plains, depending on the inferred thickness and relation of the organic surface to underlying topography. These organics will be removed and saved for reclamation.

Organic material can be described according to its general degree of decomposition: fibric (poorly decomposed), mesic (moderately decomposed) or humic (well decomposed). All three degrees of decomposition occur within the study area, although fibric to mesic decomposition predominates. Organic soils (>40 cm) were encountered in many areas where there was no seepage or particular wetness at the bottom of hand-dug soil pits, possibly reflecting thickening of the active layer or end-of-summer conditions when the groundwater table is relatively low.

Bedrock Terrain

Bedrock exposure within the study area is limited to isolated outcrops along ridges and spurs, mid-slope bluffs and stream-cut banks, overall representing only about 5% of the study area. Relatively weak schists that underlie most of the mine area and the southern portion of the access corridor are contrasted by competent limestone that forms prominent outcrops and bluffs along the northern portion of the corridor. The schists, in particular, are weathered in their upper few metres, such that backhoes can generally excavate road cuts by ripping. Bedrock outcrops are commonly ringed by angular fragments that have become detached through frost-shattering and thermal cracking.

Surficial glaciolacustrine deposits were not identified in the mapping carried out in support of the Terrain Stability and Hazard Assessment Report referenced above.

The lack of glaciolacustrine sediments may be a result of the required depositional environment not being present. Glaciolacustrine sediments are deposited by glacial meltwater in lakes. Sediments in the bedload and suspended load of meltwater streams are carried into lakes and deposited. Particles in the suspended load tend to be larger in summer, when glacier melt results in high amounts of turbid meltwater entering the lake. During the winter, freezing temperature reduces discharge of inbound streams and may result in a frozen lake surface. The lake water is very calm and this is when the finer particles, typically silts and clays, settle, and create the layered varves that are associated with glaciolacustrine deposits. The topography in the project area does not enable the formation of large lakes. There may have been a number of small lakes in the past, similar to the current situation however these would tend to limit the size of potential glaciolacustrine deposits and thus limit any surface expression.

R3-3

Provide an indication of the presence of glaciolacustrine sediments stratigraphically below other surface sediments based on the geotechnical drill holes completed in the local study area. This information is required only for sites where surface sediments will not be removed to bedrock prior to the construction of infrastructure.

There have been extensive geotechnical investigations at the KZK Project since 1995. The following enumerates some of the investigations:

- *1995*: 75 geotechnical drill holes and 78 test pits completed by Golder Associates Ltd. (Golder) in 1995 for the proposed mine, waste dump, tailings, and Mill Site locations. The site investigation program also included piezometer installations, temperature measurements, and laboratory testing of overburden samples (Golder, 1996a).

- *1996*: The site investigation program included forty-nine test pits and laboratory testing of overburden samples (Golder, 1996b).

- *2015 and 2016*: Knight Piésold Ltd. (KP) conducted additional geotechnical and hydrogeological site investigations, which included logging of overburden and bedrock conditions in a further 53 test pits and 22 geotechnical drill holes (KP, 2016).

- *2017:* Additional KP site investigation program included*;* excavation and logging of an additional, 14 test pits, drilling and logging of 18 geotechnical drill holes, Standard Penetration Testing (SPT) in overburden, laboratory testing of select soil and rock core samples from test pits and drill holes, material index testing of 8 test pit samples and 37 SPT samples, and UCS testing of 10 rock core samples (KP, 2017).

These extensive investigations have identified isolated samples that have particle size distributions indicative of glaciolacustrine sediments. There are small volumes of fine-grained glaciolacustrine material encountered at lower elevations in the Open Pit area as well as indications of glaciolacustrine material in discrete drill holes in the vicinity of Geona Creek, as would be expected.

The 2017 Geotechnical Site Investigation (KP, 2017) was targeted at all the major infrastructure facilities with the following results:

- Class A Storage Facility:
  Encountered overburden depths ranged from 0.4 to 1.4 mbgs with depths increasing towards the valley bottom. The typical overburden profile consists of an organic SILT layer ranging from 0 to 0.3 m overlying silty, gravelly SAND and sandy SILT deposits with varying amounts of gravel and cobbles.
- Class B Storage Facility:
  Encountered overburden depths ranged from 1.3 to 10.5 mbgs, with the deepest deposits encountered in the northeast corner of the facility, which is a natural topographic depression. The typical overburden profile consists of an organic SILT layer overlying silty, gravelly SAND deposits with varying amounts of cobbles.
- Class C Storage Facility:
  Encountered overburden depths ranged from 1.4 to greater than 5 mbgs. The typical profile consists of an organic SILT layer overlying silty SAND and silty, gravelly SAND deposits with varying amounts of cobbles.
- Upper Water Management Pond:
  Encountered overburden depths ranged from 5.8 to 13.5 mbgs, with the deepest deposits observed on the eastern side of the Geona Creek valley bottom. The typical profile

consists of an organic SILT layer overlying silty SAND and GRAVEL deposits with varying amounts of cobbles.

- Overburden Stockpile:
  Encountered overburden depths ranged from 4.8 to 6.5 mbgs with the deeper deposits observed towards the south. The typical profile consists of an organic SILT layer overlying silty, gravelly SAND and sandy SILT deposits.
- Open Pit and Process Plant:
  Encountered overburden depths ranged from 1.2 to 4.8 mbgs with depths increasing towards the valley bottom. The typical profile consists of an organic SILT layer overlying silty, gravelly SAND deposits with varying amounts of cobbles.

R3-4

In the event that glaciolacustrine sediments are present below infrastructure, discuss the potential implications of liquefaction and what measures will be implemented to avoid or mitigate this risk.

BMC's engineers have considered the impact that glaciolacustrine sediments may potentially have for infrastructure. Typically, issues such as static liquefaction have the potential to occur when undrained glaciolacustrine soils are loaded. BMC has carried out a number of investigations in areas of proposed infrastructure (see response to R3-3) and the detailed engineering for these areas will incorporate the results of these investigations to appropriately account for these types of potential problems. As part of this engineering, in order to mitigate any residual risk, BMC is planning to excavate any "at risk" overburden underlying key structures prior to construction, this includes (but is not limited to): the Class A Buttress, the Lower Water Management Pond embankment, and the Upper Water Management Pond embankment and the Process Plant. Any potential for weak foundation conditions will also be mitigated by buttressing embankments with excess construction material available on site, thereby increasing the factor of safety of the embankment.

YESAB ISSUE

Once again this project has yet to fully define the type of technology to be used on a critical aspect of the mine. Depending on the type of liner to be used, different water quality issues downstream of the Class A Storage Facility can arise. Yukon Conservation Society (YCS) recognizes that technology and costs could change thus resulting in something other than vacuum filtration being used, however it does raise the issue of a radically different process being used. This process will not have gone through the YESAB assessment and could have impacts on the amount of tailings being created and/or the water being discharged from the Class A Waste Storage Facility.

BMC notes that part of the "Issue" stated above has not been formulated into a question and that it appears that two separate matters are combined into one. For the avoidance of doubt we note that:

(a) There is no practical difference between the use of Vacuum filters and Pressure filters when it comes to the production of filtered tailings. The critical matter for concern is the certainty of achieving the target moisture content of the tailings that are delivered to the Class A

Storage Facility, rather than the type of filter to be used. Vacuum filters will "suck" the moisture from the cake to dry it, while Pressure filters will "press" the cake to dry it. The preferred methodology is to use a Vacuum filter due to its cost efficiency, however if this does not deliver the desired results BMC is prepared to incur the extra cost of replacing the Vacuum filters with Pressure filters. BMC expects that this decision will be made prior to construction; however, in the worst-case scenario where a decision is made after commencement of production, the processing plant will simply run at a lower throughput rate that fits the filtration capacity (i.e. where the desired moisture quality can be achieved) until the filter is replaced. Both filter types remove moisture which is then clarified and recycled within the processing plant. The environmental footprint of vacuum and pressure filters is identical. The type of filter chosen will have no impact on the quantity of tailings produced.

(b) The froth flotation process being proposed within this Project Proposal is fundamental to the Project and there is no possibility of a "radically different" process being used.

R3-5

Provide details on how the synthetic pond liners will be inspected, deficiencies repaired and the liner replaced.

Pond liners are included as part of the design of all water ponds that store contact water (Section 4.9 of the Project Proposal). The design half-life of HDPE 1.5 mm geosynthetic liner material when exposed to constant UV light has been found to approach 100 years and this can increase to close to 450 years in certain circumstances when covered *(Lifetime Predictions of Exposed Geotextiles and Geomembranes, Koerner et al, Geosynthetic institute and Drexel University, 2016, PA USA)* and these liners are routinely used throughout the world for this purpose. The pond liners will consist of a geomembrane installed on a compacted glacial till bedding layer. The Operations, Maintenance, and Surveillance Plan, which will be completed prior to the start of operations, will include liner inspection requirements, including details on the inspection frequency, inspection method, and reporting requirements. Inspections by a qualified person will be carried out on a regularly scheduled basis (e.g. weekly) and will include visual inspections taken from the dam crests or perimeter, associated access roads, and may include maneuvering a small boat around the pond to check for liner damage.

Identified deficiencies will either be repaired by mining staff where feasible, or a specialized liner installation contractor if required.

Full replacement of a geomembrane liner is not anticipated during the mine life as it would entail a catastrophic failure of the liner system. However, in the unlikely event a geomembrane liner requires full replacement, a potential mitigation measure may include a temporary sump to collect runoff during the replacement period. Collected water would be routed to a similar pond (i.e. if the Class A Storage Facility pond was out of service, water from the Class A Storage Facility would be pumped to the Class B Storage Facility pond) prior to use in the process plant or the water treatment plant. The glacial till material would provide a low permeability barrier during the replacement of the geomembrane liner. The water ponds will be decommissioned during the closure phase so the long-term integrity of the liner is not considered to be an issue for the Project water ponds.

By volume the majority of the water collection is contained within the Upper and Lower Water Management Ponds (WMP's). By inference a failure of the WMP liner would represent the greatest risk of uncontrolled discharge. However, the quality of the water contained within the Upper and Lower WMP's is also the closest to the preliminary Water Quality Objectives (i.e. it is relatively clean water). The WMP's are also the two dams that have the shortest design life for the Project of 10 years. As such, the real risk of failure, of the liner (whether catastrophic or minor repair) in these dams is the lowest of all dams on site. In the unlikely event of a failure requiring the full replacement of the liner of the Lower WMP (the absolute worst-case scenario) strategies that can be used include;

1. The water from the lower WMP could be pumped to the upper WMP. All water normally flowing to the lower WMP would be redirected and held in the upper WMP whilst the liner is replaced; and
2. Should the capacity of the upper WMP be insufficient then the excess water can be redirected back "up the circuit". This means that water can be held in the Class A, B, C and Pit Rim ponds rather than being treated and discharged into the WMP's. In an extreme case, water can also be held within the pit and underground (i.e. pumping from these areas can cease) for short periods (typically 1-3 weeks) while the liner was replaced; or
3. In the absolute worst-case scenario, the mine would cease to operate for the required period and the water in the WMP's would be utilised in the process plant whilst it treated the ore stockpiles. During this period water would build up in the pit or underground. Depending on the timing of the failure, the pit would have the capacity of acting as a reservoir for up to ten years which is more than long enough to replace all the liners of every pond and dam on the site.
4. It should be noted that the mine design parameters are considered robust enough to handle any of the above scenarios.

R3-6

In the event that pond(s) need to be taken out of operation for liner repair or replacement, describe measures that will be taken to ensure water collection can continue.

In the event liner repair is required, water will be re-directed to a similar pond (i.e. if the Class A Storage Facility pond is out of service, water from the Class A Storage Facility would be redirected and pumped to the Class B Storage Facility pond) prior to use in the process plant or water treatment plant and vice versa. This strategy would not impact flows to the water treatment plant and the mining and processing schedules have sufficient "float" to allow for such short term matters. . Repairs to the liner can then be safely carried out. Further information regarding this request is presented in response to R3-5.

YESAB ISSUE

Mineral Resource Branch (MRB) recommends the Proponent describe changes, if any, to the geotechnical stability and net percolation of the Class A Storage Facility during operations and closure if tailings are deposited underground as paste backfill during part of the mine life and a portion of the Class A waste rock is not comingled or encapsulated by tailings.

Cemented paste tailings is mentioned as an activity of the Krakatoa Underground Mining project Component in the project Description (Statement of Scope with Maps – Jan 15). MRB acknowledges that cemented paste tailings can be an effective tailings storage strategy during operations and closure that would reduce the volume of tailings stored on surface and the long-term environmental liability. However, the estimated volumetric tailings to Class A waste ratio of 5:4 for the project suggests there could be a deficit of tailings to fully encapsulate all of the Class A waste rock. The Proponent described the Class A waste rock to be comingled and encapsulated by tailings throughout the project proposal: "a minimum setback distance from the outer limits of the final facility profile will be incorporated into the deposition plan where Class A waste will not be placed" (R2- 4 in the Proponent's response to the YESAB Executive Committee Adequacy Review Request No.2).

R3-7

Describe how geotechnical stability and net percolation of the Class A Storage Facility will be ensured and what measures will be implemented if there is insufficient tailings to meet design requirements.

Dewatered tailings using filter press or vacuum technology and Strongly Potentially Acid Generating (SPAG) rock will be co- disposed in the Class A Storage Facility. The tonnes, volumes and density were supplied in the Project Proposal but are restated in Table 3-1 for clarification.

Table 3-1: Summary of Tailings and Waste Rock Generated at the Class A Storage Facility

Parameter	Value	Source
Class A Rock Tonnage	11.6 Mt	BMC-Project Proposal
Filtered Tailings Tonnage	15.1 Mt	BMC-Project Proposal
Class A Rock Density	2.0 t/m^3	BMC-Project Proposal
Filtered Tailings Density (dry)	2.1 t/m^3	Based on tailings test work to date
Class A Rock Volume	5.8 Mm^3	Calculated
Filtered Tailings Volume	7.2 Mm^3	Calculated
Designed storage of Class A Storage Facility	15 Mm^3	BMC-Project Proposal
Ratio Tailings: Rock by Volume	1.24 to 1.0	Calculated from above

The designed storage of the Class A Storage Facility was in excess of the combined modelled tonnages of the Class A waste rock and the filtered tailings to account for any potential increases in tonnages of Class A rock through reclassification of rock types, or variations from the modelled tonnages during actual mining. It is also noted that the filtered tailings that will be used as underground cemented backfill were included in the tonnage calculations for the Class A Storage Facility, to ensure that there was adequate capacity, in the Class A Storage Facility, for all possible scenarios.

Underground excavations in ore will be backfilled with a mixture of cement and tailings to enhance the stability of the underground workings and minimise the amount of filtered tailings that will be stored on the surface. Approximately 2 Mt of ore will be mined from the Krakatoa underground mine. Assuming that all the ore workings were completely filled with cemented tailings this would indicate that approximately 1 Mt of filtered tailings will be used to backfill the stoped areas. The variance between mined ore tonnage and tailings to fill in the excavated areas is due to the difference in density between the in-situ ore (4.0 t/m^3), and the tailings (2.1 t/m^3). The use of the tailings underground will result in an approximate 7% decrease in the amount of filtered tailings stored in the Class A Storage Facility, to 14 Mt.

Assuming that 100% of available voids underground are backfilled, the reduction in filtered tailings placed in the Class A Storage Facility lowers the overall filtered tailings to waste rock ratio from 1.24 to 1.15 m^3 (filtered tailings per 1 m^3 of waste rock).

Comingling methods for waste rock and filtered tails in the Class A Storage Facility could include one or more of the following options:

- Waste rock and tailings placed in lifts;
- Waste rock placed in cells and surrounded by tailings; and
- Waste rock mixed with tailings and placed in lifts.

International use of co-disposal has successfully utilised all three of these methods and it is reasonable to expect that all three will be successful from a technical perspective at the Project.

The selected method is interstitial free placement. This co-disposal method has been selected because:

- It allows the handling of variable tonnages of blasted waste rock and tailings without complicated scheduling;
- It is unlikely to exceed the blasted waste rock short range limits;
- No planned re-handle, or sorting is required with this method;
- There is a lower overall permeability; and
- Overall, it is the simplest method which reduces the likelihood for human error and therefore is the most likely method to deliver the desired outcomes with least risk.

Methodology of Interstitial Free Placement

1. The blasted waste rock and filtered tailings will be placed on the inside of the Class A Storage Facility, closest to the natural topography in lifts approximately 1.0 m to 2.0 m in height.

2. Blasted waste rock will be dumped in piles on a flat area, alternating with filtered tails at a ratio so that when dozed together they will mix and form a high compaction co-disposed layer.
3. Filtered tailings will be placed in 30 cm compacted lifts, between these layers, and always on the external faces of the storage facility (side slopes and upper slope surface).

The method is illustrated in plan view in Figure 3-2 and section view in Figure 3-3 and Figure 3-4.

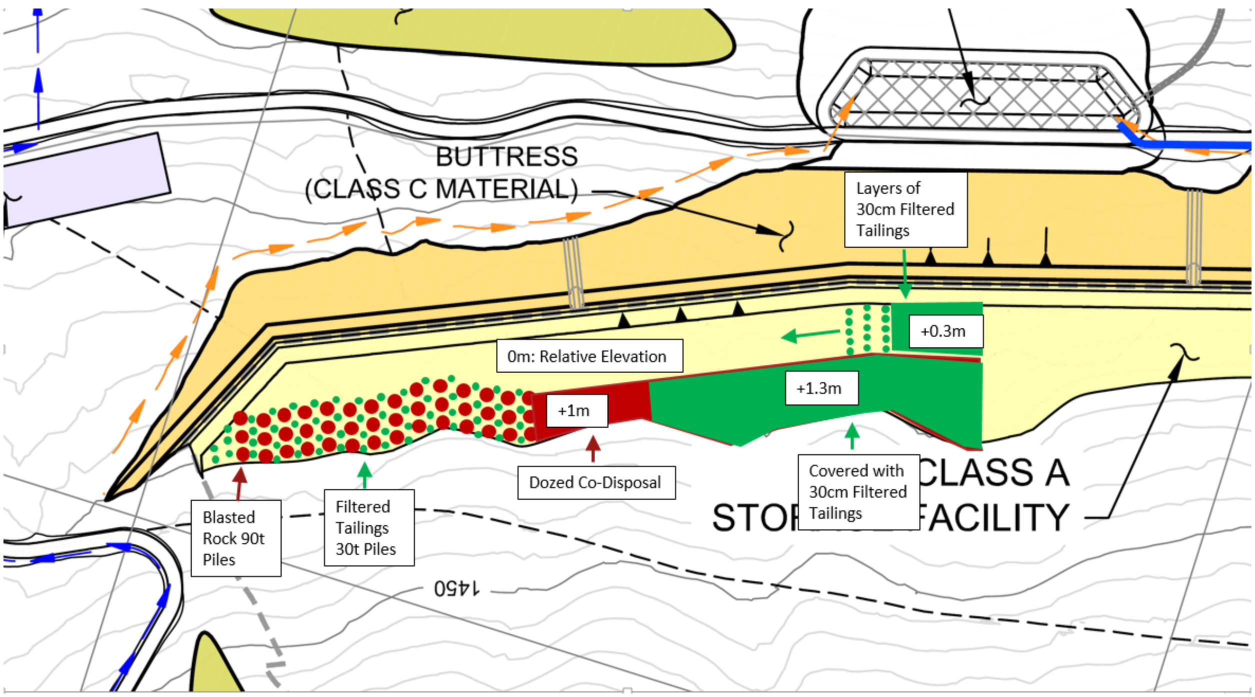


Figure 3-2: Example of Interstitial Placement

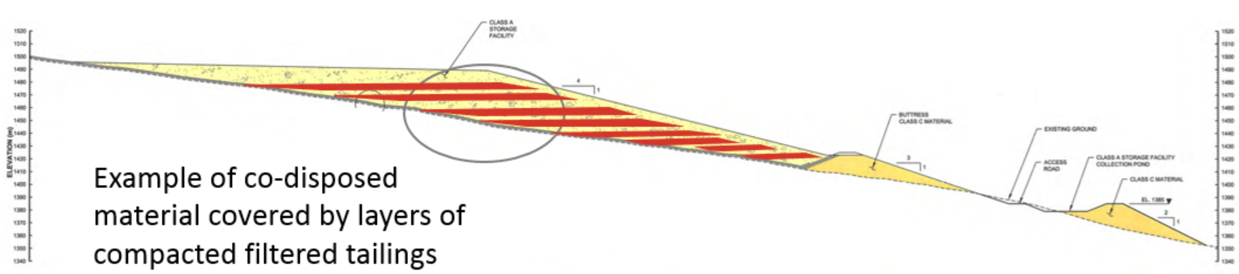


Figure 3-3: Cross Section of Class A Storage Facility

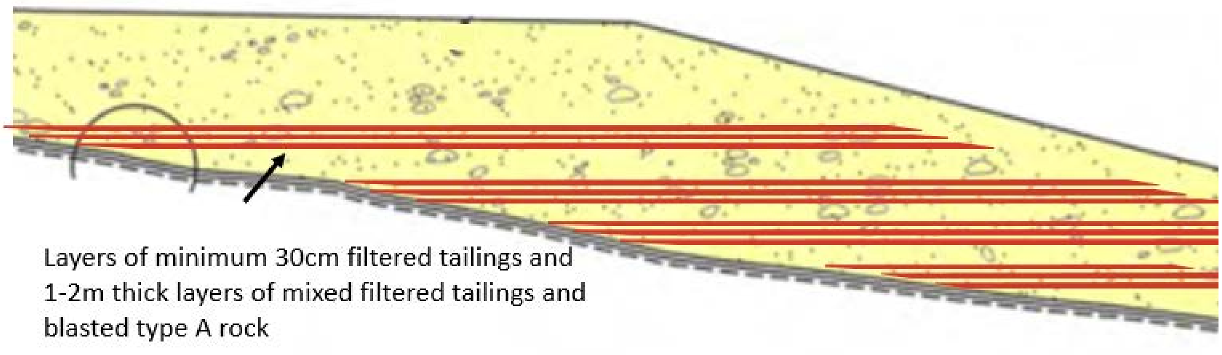


Figure 3-4: Expanded View of Cross Section Through the Class A Storage Facility

The ideal ratio to achieve the high compaction low permeability layers will depend on the size of the blasted material and the degree of mixing achieved prior to compaction; however, the illustrated mix of three 90 tonne trucks of rock to four 30 tonne trucks of filtered tailings will approximate the ratio until field test work can confirm this. Compaction will fill the voids between the pieces of blasted rock with tailings infill. The layers will be hydraulically isolated from each other by the intermediate layers of relatively impermeable compacted fill layers and any areas that do not achieve required compaction during construction, can be isolated, and remedied, while deposition can continue in other working areas.

A mixing ratio of 270 tonnes of rock to 180 tonnes of filtered tailings (50% more tailings than illustrated above) gives a volumetric ratio of 0.63 m^3 filtered tailings to 1 m^3 of blasted rock in the compacted rock-tailings layers. Excluding the tailings used around the perimeter, with a minimum setback distance of nominally 10 m, and the minimum 0.3 m layers of compacted tailings between the rock layers there remains an excess tailings tonnage of 3.75 Mt, or approximately 25% of the total filtered tailings available. This will be progressively placed on the upper levels of the Storage Facility as a compacted layer of pure tailings with a nominal thickness of approximately 2.5 m. This layer will be directly beneath the multi-layer cover system thus ensuring a compacted low permeability layer above the rock/filtered tailings layers. For clarity, this means that all rock in the Class A facility will have the voids between the fragments filled with tailings and be 100% encapsulated with compacted filtered tailings with an excess of 25% tailings remaining for placement as required.

The geotechnical stability of the Class A Storage Facility is based on the conservative assumption that the tailings shear strength parameters will control stability. This assumes that the Class A waste rock will be encapsulated in a matrix of Class A tailings with no point-to-point contact between particles of waste rock. In reality, the interstitial method illustrated above will have multiple point to point contacts in the mixed layers and thus the geotechnical stability of the Class A Storage Facility will be partially or totally controlled by the waste rock shear strength parameters which are considerably higher than the filtered tailings parameters.

There are sufficient tailings to construct the Class A Storage Facility in the above described method after accounting for amounts used underground for backfilling mined areas. Although they are not predicted to be required (based on the above), in the event that insufficient tailings are available for the appropriate encapsulation of the Class A waste rock there are the following possible solutions:

- Dispose amounts of Class A waste rock in areas of the Krakatoa or ABM open pit that have reached final depths;
- Mix Class A waste rock with cement and dispose of the rock in mined areas of the Krakatoa underground mine. This has two benefits: a decrease in the amount of waste rock stored in the Class A Storage Facility and an increase in the filtered tailings available for encapsulation; and
- Use of suitable overburden to provide encapsulation material for the Class A blasted rock.

The above mitigations have not been included in the environmental assessment as they are not considered necessary. However, prior to any of these mitigation measures being adopted, BMC would carry out further assessment work.

4 ADAPTIVE MANAGEMENT PLANS

YESAB ISSUE

Adaptive management plans are referenced throughout proposal documentation in relation to wildlife. The proposal indicates that species specific details in relation to adaptive management plans are to be determined at a later stage of the project.

Further, the proposal also indicates that adaptive management plans will be used for unforeseen effects. However, adaptive management plans anticipate potential effects through the use of thresholds and corrective actions.

Without any details on the thresholds/triggers and corresponding actions, the Executive Committee is unable to consider adaptive management plans as reducing, controlling, or eliminating effects of the project.

R3-8

Provide available triggers and corresponding actions related to any adaptive management plans for wildlife to be considered in this assessment.

Additional triggers and action items for adaptive management for wildlife were included in the Draft Wildlife Protection Plan which was included as Appendix R2-J of BMC's November 2017 Response to Information Requests #2 (BMC, 2017a). The adaptive management table was presented as Table 7-1 in Appendix R2-J and 7-1 and is presented as Table 4-1below. A few additions (indicated in red text) have been made since the November 2017 version in response to this information request. The monitoring and adaptive management program and triggers are a result of the effects assessment (Chapter 13 of the Project Proposal) and will be updated through ongoing discussions with Kaska, commitments made during the environmental assessment process and eventually the requirements from the *Yukon Environmental and Socio-economic Assessment Act* (*YESAA*) Decision Document.

Table 4-1: Wildlife Subcomponents, Monitoring Parameters, Triggers, Corrective Action

Subcomponents	Monitoring Parameters	Triggers	Initial Corrective Action
Finlayson Caribou Herd (FCH)	Habitat - Fall rut survey and post-calving survey distribution and numbers.	Caribou not using areas more than 3 km from Project. Reported avoidance greater than 3 km from Project. (Statistically significant reduction of observations at varying distance beyond the 3 km of expected effects from the Project footprint based on year on year analysis of densities at varying distance from the Project and relative to suitable habitat.) (Polfus et al.,2011)	Review mine activities potentially causing more disturbance than anticipated, identify potential options. Also discuss with Conservation Officers, Regional Biologists, and Kaska as to whether any additional mitigation measures are needed. Further corrective action options could include additional studies during the project life cycle, more stringent seasonal restrictions on operations and access.
	Movement - Aerial surveys; wildlife records program and incident report; Yukon Government incident and survey reports on Little Rancheria herd.	Changes in FCH distribution from aerial surveys. (Statistically significant change in distribution based on year on year analysis of distribution of groups and individuals relative to the Project; and review of the number and types of caribou encounters and incidents over time.) Significant changes in YG reported Little Rancheria herd population over time related to road traffic.	Check if reduction of sightings is due to reduced reporting and strengthen records program. If the root cause is traffic then modify traffic patterns to allow for longer periods without traffic during movement periods. Discuss and cooperate with YG on further mitigation options to reduce road effects on the Little Rancheria herd.
	Mortality - Wildlife records program; facility monitoring	Caribou injury or mortality recorded.	Investigate root cause (including discussions with Conservation Officers, Regional Biologists, and Kaska) and make adjustment to access controls, egress structures, signage, speed, training, and/or enforcement.
	Health condition - Wildlife records program	Reports of poor condition of caribou that appear to have a connection to the Project, based on aerial surveys, outfitters, trappers, staff or contractors.	Investigate root cause by reviewing soil, water and air quality emission data, other activities not related to the Project. Mitigate the source of the problem.
Moose	Habitat - Moose distribution from fall and late winter aerial ungulate surveys	Moose not using areas more than 3 km from Project. Reported avoidance greater than 3 km from Project.	Review mine activities potentially causing more disturbance than anticipated, identify potential options. Also discuss with Conservation Officers, Regional Biologists, and Kaska as to whether any additional mitigation measures are needed.
	Movement - Aerial surveys	Changes in moose distribution from aerial surveys. (Statistically significant change in distribution based on year on year analysis of distribution of groups and individuals relative to the Project; and review of the number and types of moose encounters and incidents over time.)	Check if reduction of sightings is due to reduced reporting and strengthen records program. If not from reporting then modify traffic patterns to allow for longer periods without traffic during movement periods.
	Mortality - Wildlife records program; facility monitoring	Moose injury or mortality recorded.	Investigate root cause (including discussions with Conservation Officers, Regional Biologists, and Kaska) and make adjustment to access controls, egress structures, signage, speed, training, and/or enforcement.
	Health condition - Wildlife records program	Reports of poor condition of moose from aerial surveys, outfitters, trappers, staff or contractors that appear to have a connection to the Project.	Investigate root cause by reviewing water and air quality emission data, external activities. Mitigate root cause.
Grizzly Bear (and Black Bear)	Habitat - Wildlife records program; Incidental sightings during aerial surveys	Significant changes in number of observations over time.	Investigate root cause (including discussions with Conservation Officers, Regional Biologists, and Kaska) and make modifications to mitigation measures if Project is the cause and if necessary.
	Movement - Wildlife records program	Reduced bear sightings on road over time. Significant changes in number of observations in records over time.	Check if reduction of sightings is due to reduced reporting and strengthen records program. If not from reporting, then modify traffic patterns to allow for longer periods without traffic during movement periods.
	Mortality - Wildlife incidents reports in wildlife records program; facility monitoring	Grizzly bear - human conflict reported or mortality recorded	Investigate root cause and carry out corrective action which could include measures such as better enforcement of waste or hazardous materials management, better training, better control structures, etc.
	Health condition	Reports of poor condition of bears from aerial surveys, outfitters, trappers, staff or contractors that appear to have a connection to the Project.	Investigate root cause by reviewing water and air quality emission data, external activities. If information and data indicate a need, cooperate with regional health tracking programs with government or Northern Contaminants Program or similar.

Subcomponents	Monitoring Parameters	Triggers	Initial Corrective Action
Grey Wolf	Prey availability - ungulate aerial surveys; Wildlife records program	Ungulate's distributions have changed. Wolf missing from incidental observations during aerial surveys. Grievances or comments from trapline holders or Kaska community members.	Investigate root cause and discuss with Conservation Officers, Regional Biologists, and Kaska as to whether any additional mitigation measures are needed. Check for wolf more intensively during next scheduled aerial survey.
	Mortality - Wildlife records program; facility monitoring	Recorded incidents of injuries or fatalities.	Investigate root cause and carry out corrective action which could include measures such as better enforcement of waste or hazardous materials management, better training, better control structures, etc.
	Health condition - Wildlife records program	Grievances or comments from trapline holders or Kaska community members.	Investigate root cause by reviewing water and air quality emission data, external activities. If information and data indicate a need, cooperate with regional health tracking programs with government or Northern Contaminants Program or similar.
Wolverine and other Small Mammals	Habitat disturbance - incidental observations during aerial surveys; tracking surveys; Wildlife records program	Expected species missing from incidental observations during aerial surveys or in records. Species noted during baseline is not recorded in snow tracking survey. Grievances or comments from trapline holders or Kaska community members.	Check for missing species more intensively during next scheduled aerial survey. Expand snow tracking survey lengths and frequency to determine extent of change in relative abundance. If actual change is suspected, investigate root cause and determine if and what remedial measures are required. Depending on the cause, measures could include changes to the reclamation program revegetation species or methods, improved emission controls, changes in mine activity patterns or timing, etc. Discuss with Regional Biologists and Kaska to further assess root cause.
	Mortality - Wildlife records program; facility monitoring	Recorded incidents of injuries or fatalities.	Investigate root cause and carry out corrective action which could include measures such as better enforcement of waste or hazardous materials management, better training, better control structures, etc.
	Health condition - Wildlife records program	Grievances or comments from trapline holders or Kaska community members.	Investigate root cause by reviewing water and air quality emission data, external activities. If information and data indicate a need, cooperate with regional health tracking programs with government or Northern Contaminants Program or similar.
Birds	Habitat - breeding birds survey	Relative abundance reduced from baseline in survey areas.	Investigate root cause. Potential corrective actions could include adjusting activity locations and schedules, adjusting the reclamation program, etc.
	Mortality - Wildlife records program; facility monitoring	Reported injuries or fatalities.	Investigate root cause of mortality and determine corrective action if necessary. Additional measures could include changing access controls, adding deterrents, changing the reclamation program, etc.
	Health - breeding bird surveys; wildlife records program	Qualitative - no observable deterioration of physical condition.	Investigate root cause by reviewing water and air quality emission data.
Waterfowl	Habitat - Waterfowl surveys of total counts from standardized locations	Relative abundance lower than baseline around Fish Offset Ponds and post-closure wetland habitat.	Adjust monitoring frequency and locations to more fully assess use. Make adjustments to the restoration program vegetation species and habitat complexity to improve abundance and diversity.
	Mortality - Wildlife records program; facility monitoring	Noted injuries or fatalities directly attributed to mine activity.	Investigate root cause and determine corrective action if necessary. Additional measures could include changing access controls, adding deterrents, changing the reclamation program, etc.
	Health - waterfowl surveys; wildlife records program	Qualitative - no observable deterioration of physical condition.	Investigate root cause by reviewing water and air quality emission data.

5 GRIZZLY BEARS

YESAB ISSUE

Department of Environment (ENV) finds the assessment of grizzly bear use in the non-denning season inadequate. The Proponent states that the main purpose of the grizzly bear monitoring program is to prevent the disturbance of mining on hibernating bears. ENV does not concur that the grizzly bear monitoring program should be limited as such.

The Proponent suggests that they cannot complete habitat suitability mapping for growing habitat in spring, summer, and fall since habitat data are not available; however, examples exist of Proponents of large scale projects in Yukon providing adequate data, at the appropriate scale to be utilized for habitat mapping.

Secondly, the Proponent rationalizes that there is insufficient information on grizzly bear distribution and habitat use in the regional study area to validate the model.

This is often the case for many environmental assessments in many jurisdictions; however, models are built and utilized as the best available information. It is accepted that there will likely not be substantial data (GPS locations from bears, etc.) to validate models, and models are often based on relationships that are understood and have been examined/validated in literature. The concept is to utilize best available information and methodologies to inform mitigation measures. Furthermore, the Proponent assesses direct and indirect growing season habitat loss; however, there is no indication of how that has been, or will be, measured.

R3-9

Identify seasonally important habitats (foraging, travel corridors, etc.), and indicate how disturbance to these important habitats will be avoided or minimized.

Assessment of project impacts should not be limited to the denning season.

Seasonally important habitat, including foraging habitat, for spring, summer and fall is identified in the Habitat Effectiveness section (Section 3.2) of the Grizzly Bear Habitat Model Report (**Appendix R3-F**). Secure areas for grizzly bears to forage without human disturbance are identified in Section 3.3 of the Grizzly Bear Habitat Model Report. The linkage zone model identifies areas that bears can safely travel through a landscape (Section 3.4; **Appendix R3-F**). Important denning habitat was identified in the Grizzly Bear Denning Habitat Suitability that was previously provided in Section 6.5 of Appendix A-8 (Wildlife Baseline Report) of the Project Proposal.

Mitigation measures for minimizing effects on grizzly bears in all seasons are included in the Draft Wildlife Protection Plan presented in Appendix J of the IR#2 Response Report (BMC, 2017a). Mitigations include Bear Awareness Training (Section 5.1.4), Species Specific Mitigations for Grizzly Bear (Section 5.3.2), Mine and Infrastructure Design (Section 5.4), Attractants Management (Section 5.5), Traffic and Access Management (Section 5.6), and Problem Wildlife Management (Section 5.7).

It should be noted that mitigation measures for other wildlife species that are proposed to minimize effects on disturbance, movement, and mortality around the Project and Access Road will also mitigate loss and disturbance of grizzly bear habitat during the growing season, minimize effects on movement, and minimize mortality.

Mitigations related to minimizing or eliminating Project effects on seasonally important grizzly bear habitat include:

Yukon Management Practice Guidelines and Industry Standards

- Guidelines for Industrial Activity in Bear Country (MPERG, 2008);
- How you Can Stay Safe in Bear Country (Yukon Government, 2018); and
- Proponent's Guide: Assessing and Mitigating the Risk of Human-Bear Encounters (Yukon Government, 2012).

Mitigation Measures

- The Project Footprint was designed to cover as little area as practicable to minimize habitat loss and disturbance;
- Clearing will be kept to a minimum and only include areas needed to safely construct and operate the Project;
- The construction of new roads and exploration trails will be avoided to the extent possible (LQ00424b, Appendix C, 2015-0028, p. 2 and 2017-0002, p.8);
- Drill site cuts will be sloped to allow for personnel and wildlife to exit safely (LQ00424b, Appendix C, 2015-0028, p. 2);
- Cut brush must not be piled so that it blocks movement of wildlife or people (LQ00424b, Condition 45);
- Drill sites built near the gravel tote road will be re-vegetated with non-palatable plants to avoid attracting wildlife to the roadside (LQ00424b, Appendix C, 2015-0028, p.3);
- The lessee shall implement progressive reclamation plans with the objective of minimizing impacts and duration of habitat loss associated with disturbed areas that are no longer required for mine-related activities. The lessee shall report annually on the extent of surface disturbances and reclaimed areas (Lease Agreement 105G07-001, Schedule 2, 4.5; LQ00424b, Appendix C, 2017-0002, p.8);
- Pre-denning monitoring in the areas of planned exploration activities will be conducted each year. If bear activity indicates they may be preparing to den in an area that could be disturbed by exploration activities, the YG conservation officer and RRDC Land Stewards will be consulted to determine measures to mitigate potential human-bear interactions (LQ00424b, Appendix C, 2017-0002, p.8);

- Avoid construction in and around sensitive areas, such as den sites during important seasonal periods;
- Sensory disturbances will be minimized where practicable throughout the year;
- As part of safety training, all personnel and contractors will be provided wildlife safety and awareness training, including bear awareness and how to avoid disturbing sensitive species including bear dens or know feeding areas (LQ00424b, Appendix C, 2015-0028, p.1);
- Fugitive dust will be controlled using water sprays or approved dust suppressant (environmentally-benign that do not contain salts that would attract wildlife) to minimize the Project's zone of influence over the surrounding landscape;
- Flight path routes will be determined to best avoid disturbing wildlife and active hunting areas. Consultation with the Kaska Nation and Outfitters will be ongoing throughout the field season to aid in avoiding sensitive areas (LQ00424b, Appendix C, 2015-0028, p.3 and 2017-0002, p.9);
- Flying will be avoided over areas where wildlife has been observed in past seasons (based on publicly available information from the Yukon Zinc Studies in the vicinity of the Project and Yukon Government data), and areas sensitive to wildlife at certain times will be avoided (LQ00424b, Appendix C, 2015-0028, p.3 and 2017-0002, p.9);
- Flights will be conducted at minimum of 300 m (1000 ft.) above ground level elevations to minimize disturbance to wildlife, except where required for work, safe landing approaches/ flight path, etc. (LQ00424b, Appendix C, 2015-0028, p.3 and 2017-0002, p.9);
- Purposefully flying towards, hovering and circling wildlife will not be permitted (LQ00424b, Appendix C, 2015-0028, p.3);
- The Wildlife Protection Policies shall include BMC's policy prohibiting recreational use by employees and contractors of all-terrain vehicles and snowmobiles. The lessee shall prohibit access and use of ATVs and snowmobiles for recreational purposes on the mine haul road and the mine site (Lease Agreement 105G07-001, Schedule 2, 1.1(iii));
- In addition to any remedial action required in relation to re-establishment of the vegetative mat, temporary trails must be blocked to prevent further vehicular access (LQ00424b, Condition 63);
- The authorized use of on-road and off-road vehicles will be restricted to established roads and designated trails at the exploration site except to access monitoring sites and remote communications equipment. Use of private and recreational vehicles will be prohibited at all times (LQ00424b, Appendix C, 2015-0028, p.3); and
- The lessee, in consultation with the Regional Biologist, shall establish appropriate measures to carry out blasting activities at the mine in a manner that avoids disturbance of wildlife during critical lifecycle activities (Lease Agreement 105G07-001, Schedule 2, 4.3.

R3-10

Provide maps at an appropriate scale that show modeling of security (including core security areas) and linkage zones.

Security areas and linkage zone models for grizzly bears are provided in the attached Grizzly Bear Habitat Models Report (Appendix R2-F). Within the model report the maps showing the security areas are Figures 3-5 and 3-6 and the maps showing the linkage zones are Figures 3-7 and 3-8.

R3-11

Assess population metrics, such as density, mortality rates, and trends at the scale of the Bear Management Unit.

Regional grizzly bear densities and mortality rates were discussed in response to R1-213 and R2-103 during Adequacy Review (BMC, 2017b and 2017a). At the request of and after discussions with Yukon Government, further information is presented below at the scale of the Cassiar Bear Management Unit, the regional Game Management Subzones (GMS), and the Bear Assessment Units as shown in Figure 5-1. Table 5-1 presents the estimated number of bears in the Project's Bear Assessment Units based on a density of 14.1 bears/1000 km^2 for the Cassiar Bear Management Unit (Yukon Government, unpublished data). Further description of the assessment units is presented in Appendix R3-F.

Table 5-1: Estimated Number of Grizzly Bears in the Bear Assessment Unit

Bear Assessment Unit	BAU Area (km^2)	Estimated Number of Grizzly Bears
1	495	7.0
2	506	7.1
3	535	7.5
4	361	5.1
5	394	5.6
6	488	6.9
7	439	6.2
Total	3,218	45.4

The estimated densities appear to be supported by observations on site. During environmental baseline surveys, and during exploration work, 46 bears observations were reported in the Project area between May 4, 2015 and October 3, 2017. These included eight sightings of females with cubs. Some of these sightings were likely the same bear observed on one or more occasions.

Harvest

Environment Yukon monitors the number of bears harvested including resident, non-resident and special-guided harvest, but does not include First Nation harvest. Reported kills in defense of life and property, vehicle kills, and illegal kills are also monitored.

Mortality information collected by Environment Yukon is used to determine sustainable mortality rates, which in Yukon is 2% for females, with no more than 25% of total harvest being females, and up to 6% for males (COSEWIC, 2012). Assuming a 50:50 sex ratio, that means that in the Cassiar BMU, five females and 15 males can be killed every year while still maintaining a sustainable bear population. Environment Yukon reports that the harvest levels for both males and females has not exceeded sustainable limits (A. Francis, pers. comm).

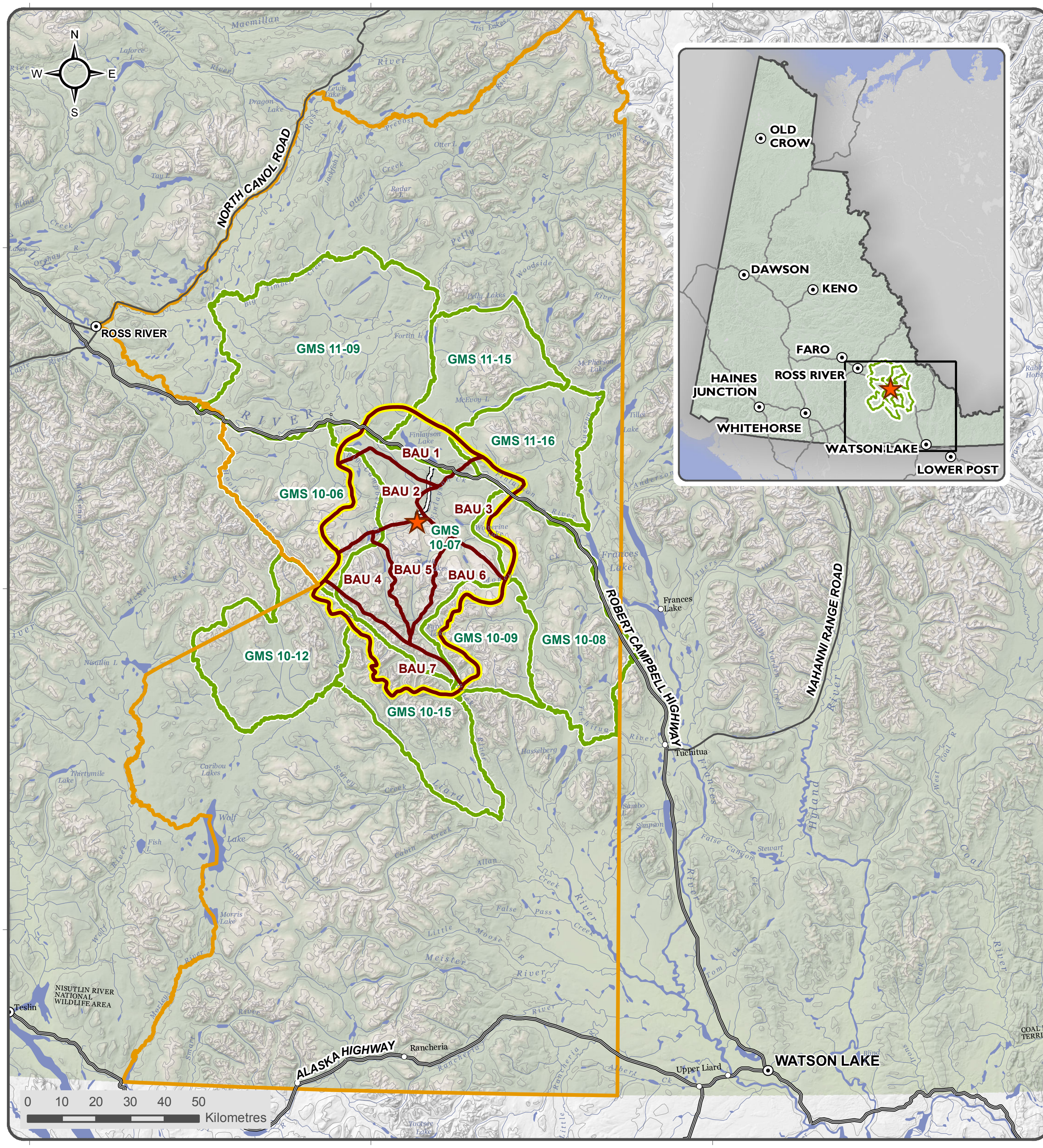
Harvest data for 1995 to 2017 is presented in Table 5-2 for the larger Cassiar BMU and for the Game Management Subzones (GMS) that overlap with, or are within close proximity to, the Project. It should be noted that data for the GMS listed are also captured in the Cassiar BMU data since all of these GMSs are within the Cassiar BMU. All bear mortality data were provided by Environment Yukon (unpublished data).

Between 1995 and 2017, 106 bear mortalities (34 females, 71 males and one unknown) were reported in the Cassiar BMU, which encompasses an area of 35,572 km^2. Of these, 89 bears were harvested and 17 were killed as a result of defense of life and property or other unknown causes. On average, over the 23-year period, 4.6 bears/year were killed (or 0.9% of the Cassiar BMU population). Looking at mortality ratios by sex, 0.6% of the female population was killed and 1.2% of the male population was killed. Both of which are within sustainable mortality rates for grizzly bears.

Table 5-2: Grizzly Bear Mortality Information for the Cassiar Bear Management Unit (1995 to 2017)

Metric	Total	Females	Males
Size of area (km^2)	35,572	n/a	n/a
Estimated Population Size (# of bears)	502	251	251
Total Mortality (# of bears)	106	34	71
Mortality from Harvest (# of bears)	89	29	60
Other Mortality (# of bears)	17	5	11
Average Number of Bears Killed/Year	4.6	1.5	3.1
Mortality Ratio (% of population)	0.9%	0.6%	1.2%

Following further discussions with Yukon Government, the mortality rates for all GMSs that surround the Project were combined to further assess the average mortality rate. These GMSs included GMS 10-06, 10-07, 10-08, 10-09, 10-12, 10-15, 11-09, 11-15 and 11-16; as shown in Figure 5-1. The total combined area for these GMSs is 13,546 km^2. The combined morality for these GMSs between 1995 and 2017 is 47 bears (13 female and 34 male) (Table 5-3). Of these, 43 bears were killed by harvest and four bears killed by other means. The average number of bears killed per year between 1995 and 2017 is 2, or 1.1% of the population. Female mortality for this period was 0.6% of the female population and male mortality was 1.5% of the male population. GMS 10-07 had the highest mortality pressure with a total of 17 bears killed over that period, whereas most other between one and seven bears were killed.



Kudz Ze Kayah Project

Cassiar Bear Management Unit

Grizzly Bear Assessment Unit (BAU)

Grizzly Bear Study Area

Game Management Subzones (GMS)

Tote Road/Proposed Access Road

Watercourse

Waterbody

National topographic Data Base (NTDB) compiled by Natural Resources Canada at a scale of 1:50,000. Reproduced under license from Her Majesty the Queen, as represented by the Minister of Natural Resources Canada. All rights reserved.
Datum: NAD 83; Projection: UTM Zone 9N

AEG

BMC MINERALS

KUDZ ZE KAYAH PROJECT
RESPONSE #3 TO YESAB EXECUTIVE COMMITTEE INFORMATION REQUEST KZK

FIGURE 5-1
CASSIAR BEAR MANAGEMENT UNIT AND GAME MANAGEMENT SUBZONES BOUNDARIES

JUNE 2018

D:\Project\AllProjects\Kudz_Ze_Kayah\Maps\03_Study\Wildlife\Bear\05-Habitat_Suitability\IR3\Figures\CassiarBearManagement\GMA_BAU_20180522_Option2.mxd

Table 5-3: Grizzly Bear Mortality Information for GMS* Surrounding the Project (1995 to 2017)

Metric	Total	Females	Males
Size of area (km^2)	13,546	n/a	n/a
Estimated Population Size (# of bears)	191	95	95
Total Mortality (# of bears)	47	13	34
Mortality from Harvest (# of bears)	43	13	30
Other Mortality (# of bears)	4	0	4
Average Number of Bears Killed/Year	2.0	0.6	1.5
Mortality Ratio (% of population)	1.1%	0.6%	1.5%

*Includes: GMS 10-06, 10-07, 10-08, 10-09, 10-12, 10-15, 11-09, 11-15 and 11-16

At a more local scale, for the same period, 17 bear mortalities (six female and 11 male) were reported for GMS 10-07 (16 bears harvested, and one bear was killed in defense of life or property), with an average of 0.7 bears/year (or 2.5% of the estimated population of 29 bears for GMS 10-07 with an area of 2,063 km^2) (Table 5-4). By sex, 1.8% of the female population was harvested and 3.3% of the male population was harvested, which are within sustainable limits (as defined by YG).

Table 5-4: Grizzly Bear Mortality Information for GMS 10-07 (1995 to 2017)

Metric	Total	Females	Males
Size of area (km^2)	2063	n/a	n/a
Estimated Population Size (# of bears)	29	15	15
Total Mortality (# of bears)	17	6	11
Mortality from Harvest (# of bears)	16	6	10
Other Mortality (# of bears)	1	0	1
Average Number of Bears Killed/Year	0.7	0.3	0.5
Mortality Ratio (% of population)	2.5%	1.8%	3.3%

The mortality data for the other GMS surrounding the Project are summarized in Table 5-5.

Table 5-5: Grizzly Bear Mortality Data for the Cassiar Bear Management Unit and Local Game Management Subzones (1995 to 2017)

Year	Cassiar BMU		10-06		10-07		10-08		10-09		11-09		11-15		11-16	
	Harvest[1]	Non-Harvest[2]	Harvest	Non-Harvest	Harvest	Non-Harvest	Harvest	Non-Harvest	Harvest	Non-Harvest	Harvest	Non-Harvest	Harvest	Non-Harvest	Harvest	Non-Harvest
1995	7	1	-	-	5	1	-	-	-	-	1	-	-	-	-	-
1996	4	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
1997	6	2	-	-	-	-	-	1	-	-	-	-	-	-	-	-
1998	3	-	-	-	-	-	-	-	2	-	-	-	1	-	-	-
1999	4		1	-	1	-	-	-	-	-	1	-	-	-	-	-
2000	1	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-
2001	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2002	4	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
2003	6	-	-	-	-	-	-	-	-	-	2	-	1	-	-	-
2004	2	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-
2005	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2006	3	3	-	-	1	-	-	-	-	-	-	-	-	-	-	-
2007	7	4	1	-	2	-	-	-	-	-	-	-	-	-	-	-
2008	3	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-
2009	3	1	-	-	1	-	-	-	-	-	1	-	-	-	-	-
2010	3	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
2011	3	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
2012	2	1	-	-	2	-	-	-	-	-	-	-	-	1	-	-
2013	6	1	1	-	-	-	-	1	-	-	1	-	-	-	-	-
2014	3	-	1	-	-	-	-	-	-	-	–	-	1	-	-	-
2015	4	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
2016	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2017	7	1	2		-	-	1	-	-	-	-	-	-	-	1	-
Total Harvest	89	17	7	0	16	1	1	2	2	0	7	0	7	1	1	0

[1]Includes resident, non-resident and special guide harvest.

[2]Includes reported kills related to defense of life or property by Conservation Office and public, road kill and other found dead bears.

6 FISH

YESAB ISSUE

Pertaining to the proponent's plan involving restoration of fish passage for the Robert Campbell Highway culvert crossing of Finlayson Creek, sufficient baseline data will be required to demonstrate that the proposed offsetting measure is actually an offsetting measure.

R3-12

Provide information on the types and amounts of fish habitat to made accessible by the restoration of fish passage for the Robert Campbell Highway culvert crossing of Finlayson Creek and a habitat assessment of areas of stream habitat to be made accessible.

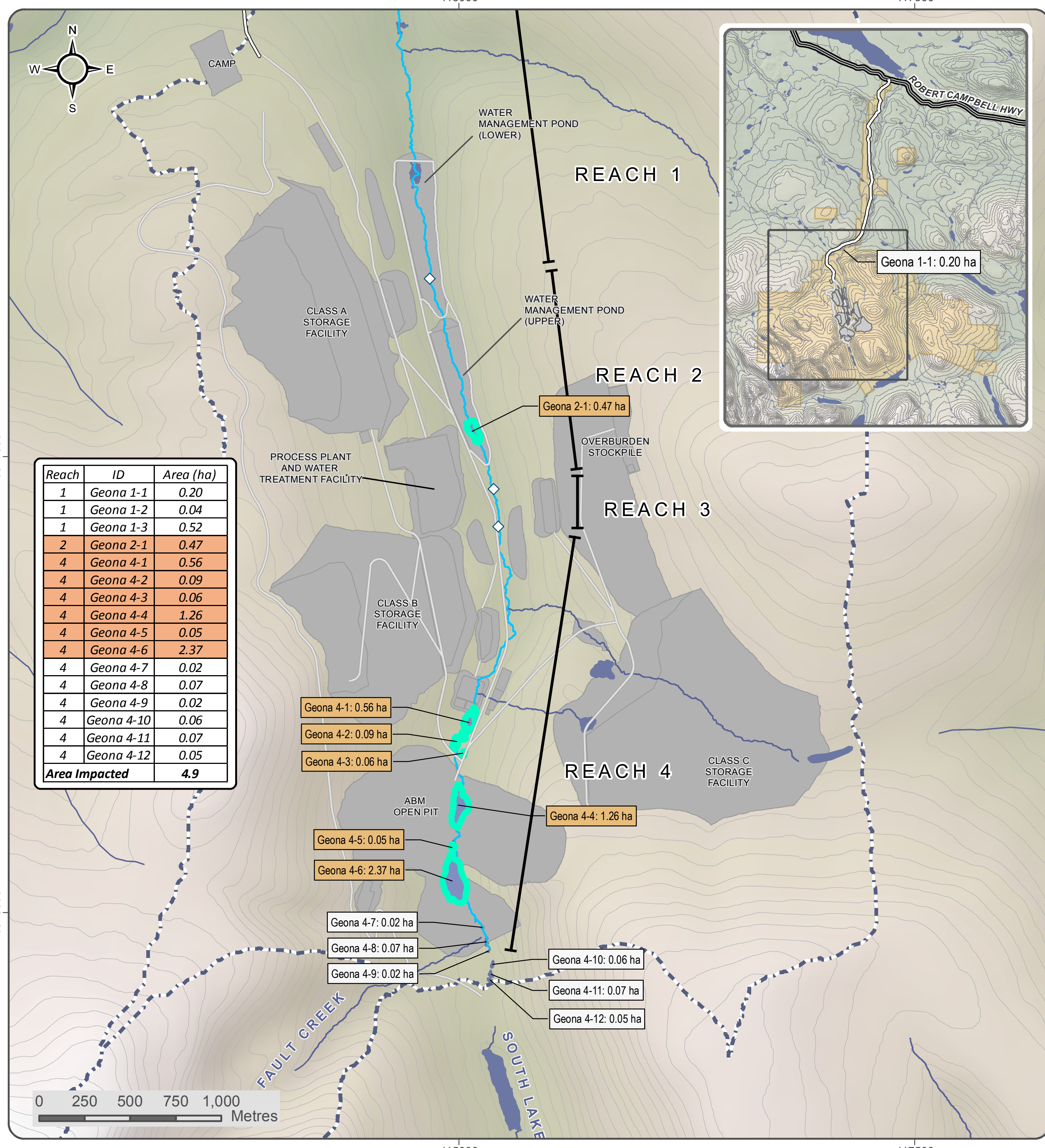
Impacts to Fish and Fish Habitat

BMC has determined that although the proposed design reduces impacts to the extent practicable, the potential risk of serious harm to fish (as defined by the *Fisheries Act*) cannot be avoided and therefore, BMC must apply for authorization under Section 35(2) of the *Fisheries Act*.

The Project is predicted to result in removal or isolation of approximately 5.4 linear km of fish habitat in upper Geona Creek. This habitat begins in the upstream section of reach 1 near KZ-9, to the headwaters at the confluence with Fault Creek (Figure 6-1). Isolation will occur as a result of establishing water management ponds towards the downstream section of the mines development. Habitat that will be impacted includes mainly ponds and riffle habitat that would be considered marginal fish habitat. This habitat is described in detail in the Aquatic Ecosystems and Resources Baseline Report (Appendix E-3 of the Project Proposal).

With respect to ponds, approximately 4.85 ha of pond surface area will be isolated and/or removed from fish use in the Geona Creek watershed. This pond habitat loss consists of seven ponds below the Fault Creek confluence. One of those ponds is located at the south end of the proposed open pit and is approximately 2.4 ha or about 50% of the total pond area that will be isolated from fish use.

Based on what is known to date about the fish habitat and usage in Geona Creek, as per Section 35(2) of the *Fisheries Act*, BMC is required to provide habitat replacement for all life stages (spawning, incubation and early rearing, rearing, and overwintering), in its efforts to offset the impacted habitat.



Reach	ID	Area (ha)
1	Geona 1-1	0.20
1	Geona 1-2	0.04
1	Geona 1-3	0.52
2	Geona 2-1	0.47
4	Geona 4-1	0.56
4	Geona 4-2	0.09
4	Geona 4-3	0.06
4	Geona 4-4	1.26
4	Geona 4-5	0.05
4	Geona 4-6	2.37
4	Geona 4-7	0.02
4	Geona 4-8	0.07
4	Geona 4-9	0.02
4	Geona 4-10	0.06
4	Geona 4-11	0.07
4	Geona 4-12	0.05
Area Impacted		**4.9**

LAKES AND PONDS IN STUDY AREA

- Not Impacted/Not Considered as Fish Habitat
- Directly Impacted
- Reach Break
- Geona Creek
- Other watercourse
- Geona and Fault Creek Catchments
- Tote Road/Proposed Access Road
- Proposed Mine Road
- Location of Proposed Infrastructure

Reach characteristics from field observations or from 2015 LiDAR data analysis (with the exception of for reach 1, for which LiDAR data was not available and so lenghts and heights taken from CANVEC data (50k)
Datum: NAD 83; Projection: UTM Zone 9N

AEG

BMC MINERALS

KUDZ ZE KAYAH PROJECT
RESPONSE #3 TO YESAB EXECUTIVE COMMITTEE INFORMATION REQUEST

FIGURE 6-1

FISH HABITAT AFFECTED BY PROPOSED MINE DEVELOPMENT

MAY 2018

D:\Project\AllProjects\Kudz_Ze_Kayah\Maps\03_Study\Aquatic\Impacted_Lks_Ponds\IR\Impacted_Lakes_And_Ponds_20180528.mxd
(Last edited by: mducharme; 5/28/2018/14:04 PM)

Fish Habitat Compensation

Restoration of fish passage at the Robert Campbell Highway culvert crossing of Finlayson Creek received the highest rating according to the comparison of potential Fish Offsetting Plans (FOPs). This was based on the fact that it would provide a high environmental benefit by allowing migratory fish to once again access fish habitat in the Finlayson Creek watershed, including Geona Creek, and provide a community benefit with an increase in recruitment in the watershed by opening up a large area of potential spawning and rearing habitat. This is discussed further in the following sections and Section 7.2 of the FOP (Appendix E-4 of the Project Proposal and BMC's responses to R143, R2-69, R2-70, and R2-71).

The Finlayson system is a high elevation stream with low inputs of allochthonous sediment and is characterized by a run, riffle, pool habitat and gravel/cobble substrates. Finlayson Creek and its tributaries would appear to provide high quality fish habitat for all life stages of fish able to access the system. More details on fish and fish habitat in Finlayson can be found in the Aquatic Ecosystems and Resources Baseline Report (Appendix E-3 of the Project Proposal).

Methods

Using image data and existing sample locations, BMC calculated an estimate of stream length upstream of the Robert Campbell Highway (RCH) as well as an estimate of surface area and habitat type (i.e. stream, wetland or lake/pond). Where BMC was unable to determine the width of the creek using the imagery (i.e. small tributaries) a creek width of 0.75 m was used. The main stem of Finlayson Creek and its largest tributary East Creek was analysed separately, as well as the tributaries of each.

Results

The proposed Project is estimated to result in the loss of approximately 5.4 km of fish habitat in Geona Creek, covering an area of 15.35 km^2, which cannot be avoided (Figure 6-1; Table 6-1). An additional 4.85 ha of wetland/pond habitat in the headwaters of Geona is also predicted to be lost.

To offset these losses BMC has proposed to remove the fisheries passage barrier at the RCH on Finlayson Creek as part of the offsetting plan. Preliminary results indicate that potential habitat available upstream of the RCH in Finlayson Creek itself, is a total stream length of 36.56 km and an estimated a total wetted perimeter area of 225.4 km^2 (Table 6-1; Figure 6-2). Available wetland/pond habitat in the headwaters of Finlayson Creek has a total surface area of 36.47 ha. Although the percentage of Finlayson Creek tributaries that would be accessible to fish following the implementation of the fish passage plan at the RCH is currently unknown, they could provide an additional stream area of 26.63 km^2, and a total length of 31.51 km.

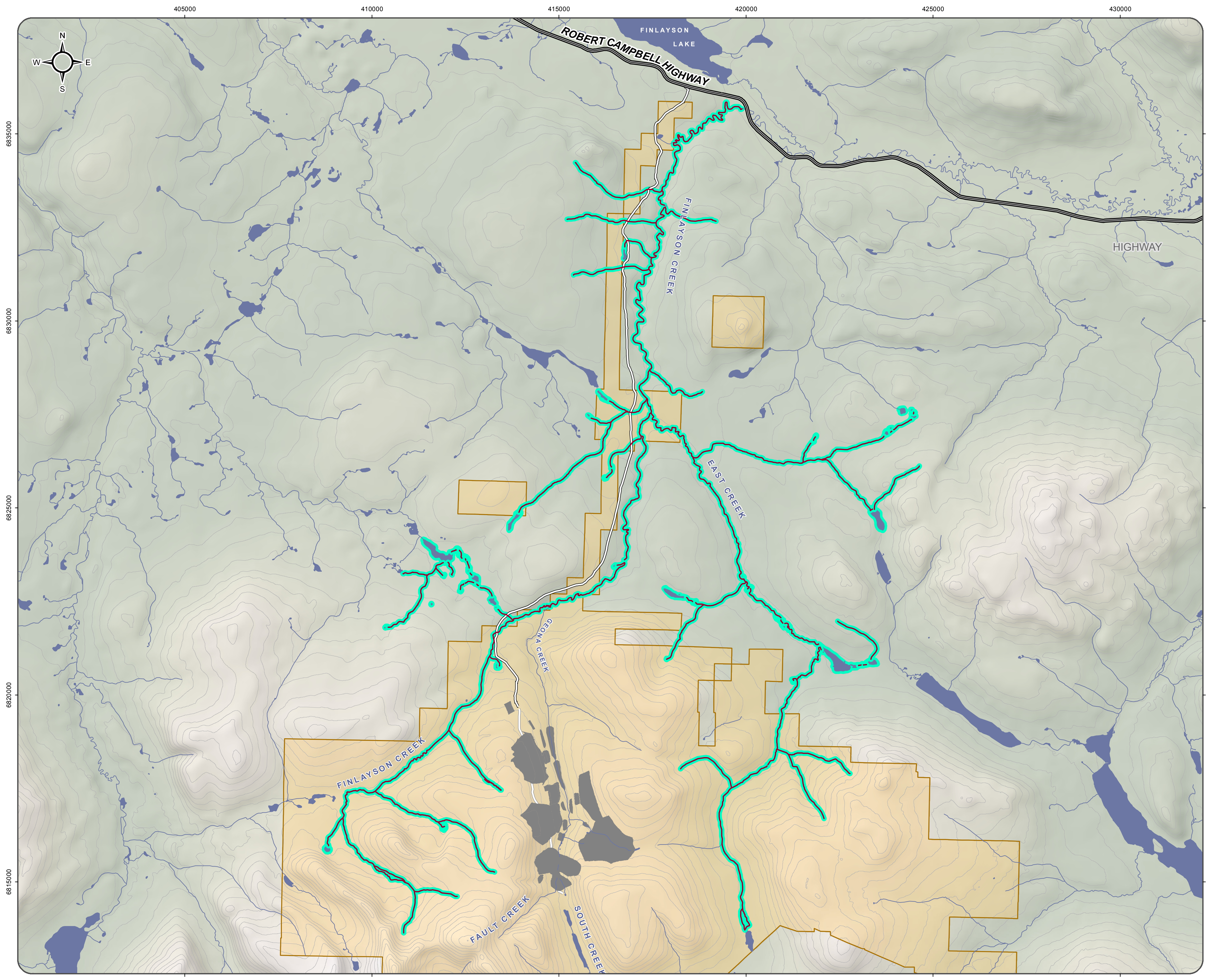
The largest tributary of Finlayson Creek, East Creek, has an estimated pond/wetland habitat of approximately 48.89 ha (Table 6-1; Figure 6-2). Depending on the presence and location of any impoundments in East Creek, a maximum of 51.24 km^2 of wetted perimeter surface area and a total length of 18.02 km could become accessible to migratory fish and its tributaries could provide an additional wetted perimeter area of 19.10 km^2, with a length of 24.28 km.

Table 6-1: Fish Habitat Upstream of the Fish Migratory Barrier at the Robert Campbell Highway on Finlayson Creek

Stream/Watershed	Type of Habitat	Length/Area
Geona Creek Impacted Habitat	Stream Length	5.4 km
	Stream Area	15.35 km^2
	Wetland/Pond Area	4.90 ha
Finlayson Creek Main Stem	Stream Length	36.56 km
	Stream Area	225.40 km^2
	Wetland/Pond Area	36.47 ha
Finlayson Creek Tributaries	Stream Length	31.50 km
	Stream Area	26.63 km^2
	Wetland/Pond Area	0
East Creek main Stem	Stream Length	18.02 km
	Stream Area	51.24 km^2
	Wetland/Pond Area	48.89 ha
East Creek Tributaries	Stream Length	24.28 km
	Stream Area	19.10 km^2
	Wetland/Pond Area	0
Change in maximum total available migratory fish habitat following the provision of fish passage at the RCH	**Stream Length**	**110.36 km**
	Stream Area	**307.02 km^2**
	Wetland/Pond Area	**80.46 ha**

The amount of habitat available following the completion of the RCH fish passage plan will result in a maximum net gain of 110 km of available fish habitat and 80 ha of wetland/pond habitat.

Although the state of fish passage in the tributaries of Finlayson and East Creeks is currently unknown, the main stem of Finlayson Creek had no observed impoundments during an aerial assessment in 2016. Therefore, following the completion of the RCH fish passage plan, and only considering the amount of habitat accessible to fish in Finlayson Creek itself, will result in a 7-fold net increase in both high quality stream habitat and wetland/pond habitat (Table 6-1). These calculations will be included in BMC's final FOP that will be submitted to DFO.



BMC MINERALS

KUDZ ZE KAYAH PROJECT
RESPONSE #3 TO YESAB EXECUTIVE COMMITTEE INFORMATION REQUEST

FIGURE 6-1
POTENTIAL AVAILABLE HABITAT UPSTREAM OF THE RCH FOLLOWING THE PROVISION OF FISH PASSAGE

MAY 2018

- Surface Water Area Estimated by AEG
- Tote Road/Proposed Access Road
- Contour (40 m interval)
- Watercourse
- Waterbody
- Location of Proposed Infrastructure
- BMC Minerals (No.1) Ltd. Mineral Claim Areas

ALEXCO ENVIRONMENTAL GROUP

Digital elevation model created by the Yukon Department of the Environment interpolated from the digital 1:50,000 Canadian National Topographic Database (NTDB Edition 2) contour and watercourse layers. Obtained from Geomatics Yukon.

Datum: NAD 83; Projection UTM Zone 9N

1:100,000 when printed on 11 x 17 inch paper

0 1 2 3 4 5
Kilometres

YESAB ISSUE

Flow alterations have the potential to impact fish and fish habitat depending on the magnitude, timing and duration of the alterations as well as the spatial extent of the changes. The Proponent has characterized impacts to fish habitat in terms of alterations in water flow.

Example: The Proponent has identified that 800 m² of fish habitat will be created from the diversion of Fault Creek into South Creek during the operations phase. During the closure phase, when Fault Creek flow is directed back into the Genoa Creek watershed, this 800 m² of habitat will be lost.

R3-13

In order to understand the potential impacts to fish habitat from flow alterations, the following information is requested: the monthly percent change in flow from existing conditions at each phase in flow changes and at a series of locations within impacted watercourses to demonstrate downstream attenuation and extent; a consideration of and accounting for potential effects between each phase of flow alterations; Information on the magnitude and areal extent (m²) of altered fish habitat likely resulting in negative impacts to fish or fish habitat, including an accounting of this area by habitat type and reach.

The Project will be situated in the upper half of the Geona Creek watershed. Structures such as the open pit and water management ponds will be situated directly in the creek and floodplain. A portion of the creek above the water management ponds will not be altered in a significant way, but will be isolated from fish access as the ponds will have dam structures controlling water discharge.

Geona Creek currently flows through the proposed open pit, which includes the Fault Creek catchment, a small headwater tributary of Geona Creek. Fault Creek will be re-directed to an adjacent watershed (South Creek) as was proposed in Cominco Ltd.'s original mine plan. This will result in reduced flow to Geona Creek and a corresponding increase in flow to South Creek. The reduction of flow to Geona Creek from the diversion of Fault Creek will however, be partially offset by dewatering of the ABM open pit during mine construction and operations, water that will ultimately be discharged to Geona and Finlayson Creeks. During active closure, the water management strategy also involves discharging a portion of water from the water management ponds directly into Finlayson Creek.

The following describes how Geona, South and Finlayson Creek's hydrology will be impacted from a fish and fish habitat perspective and the extent of the anticipated impacts.

Impact on Local and Regional Hydrology

The KZK Project Proposal submitted for environmental assessment is considered in three phases; construction, operations and closure. Each phase will influence local and regional hydrology in different ways. Therefore, hydrological effects to fish habitat are considered for each phase separately and considered how flow will be altered in the following locations:

- Geona Creek at KZ-37 – located north of the Upper Water Management Pond and is the beginning of the receiving environment that includes treated flows reporting from the mine site upstream, clean non-contact water conveyed around mine infrastructure and flow from KZ-18, a small tributary located on the east side of Geona Creek just upstream of KZ-37;
- South Creek at KZ-13 – located in lower South Creek downstream of South Lakes; and
- Finlayson Creek at KZ-15 – located immediately downstream of the Geona Creek confluence and at KZ 26 – located in lower Finlayson at the Robert Campbell Highway.

The resulting influence each phase will have on hydrology of the area is also dependant on annual regional precipitation. Thus, hydrological predictions have been developed for three precipitation scenarios; mean year, 1/50 wet year and 1/10 dry year. Details regarding how these scenarios were developed are available in the "Receiving Environment Water Balance Report" (Appendix D-6 of the Project Proposal).

Construction Phase

The duration of the construction phase of the Project is approximately two years. Activities and developments that will affect area hydrology during construction include:

- Development of fish habitat offsetting structures in lower Geona Creek as described in the FOP (Appendix E-4 of Project Proposal);
- Re-direction of Fault Creek and a portion of the upper Geona Creek catchment to South Creek (Figure 10-6 of Project Proposal);
- Development within upper Geona Creek watershed including construction of the Upper and Lower Water Management Ponds, site water diversion ditches and development/commissioning of water treatment facilities. The developments will isolate fish habitat above KZ-37 (Figure 10-7 of Project Proposal); and
- ABM open pit dewatering. This will involve capture and pumping of volumes of water contained within a shallow water aquifer in the overburden to a sump during the construction phase. Captured water from the pit bedrock dewatering during operations will be directed first to the Pit Rim Pond and then to the Upper Water Management Pond. Water will be pumped continuously throughout the mine construction and operational phases with volumes of water moved on a daily basis illustrated in Figure 6-3 below. As depicted, daily flux (pumping rates) are highest during the construction phase (Pre-mining) and predicted to be as high as 7,000 m^3/day.

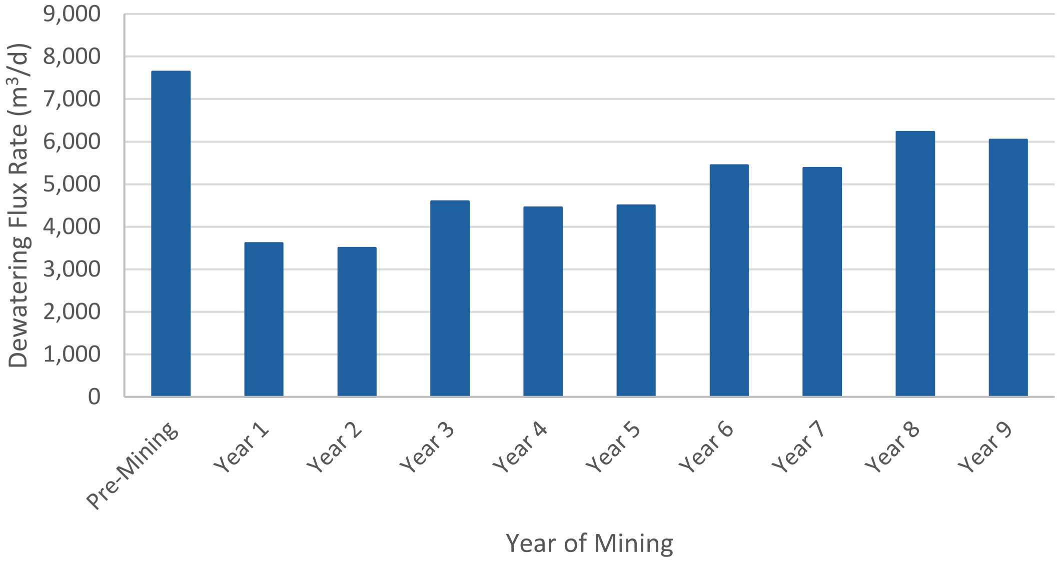


Figure 6-3: Estimated Total Flux Rates for Dewatering of the Mine Workings

Figure 6-4, Figure 6-5 and Figure 6-6 illustrate how flows are predicted to be altered (monthly % difference) on Geona, South and Finlayson Creeks during a mean, 1/50 wet and 1/10 dry year respectively during the construction phase of the Project.

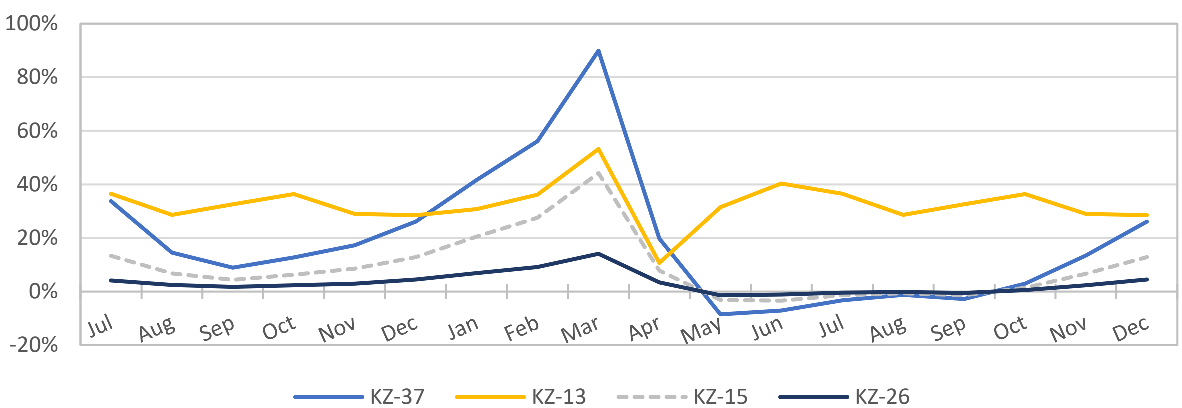


Figure 6-4: Construction - Difference (%) Between Baseline and Monthly Runoff for Mean Scenario

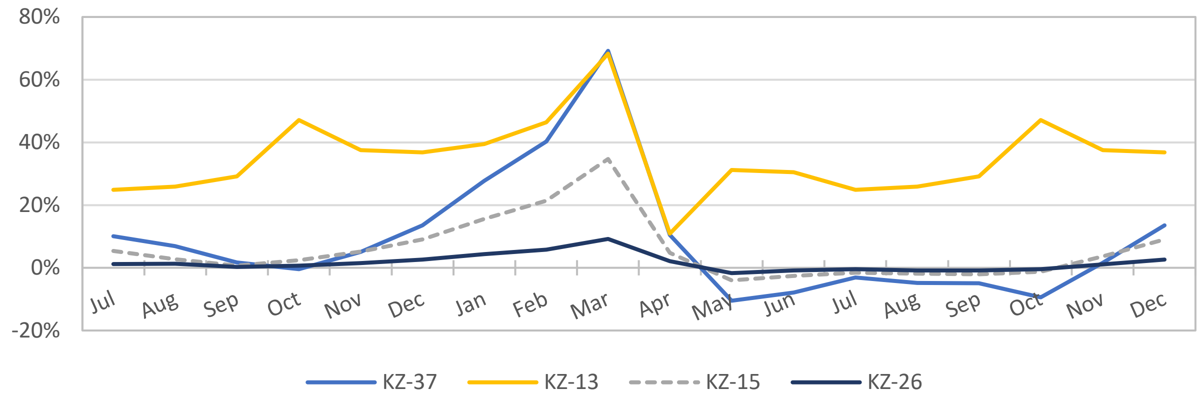


Figure 6-5: Construction - Difference (%) Between Baseline and Monthly Runoff for 1/50 Wet Scenario

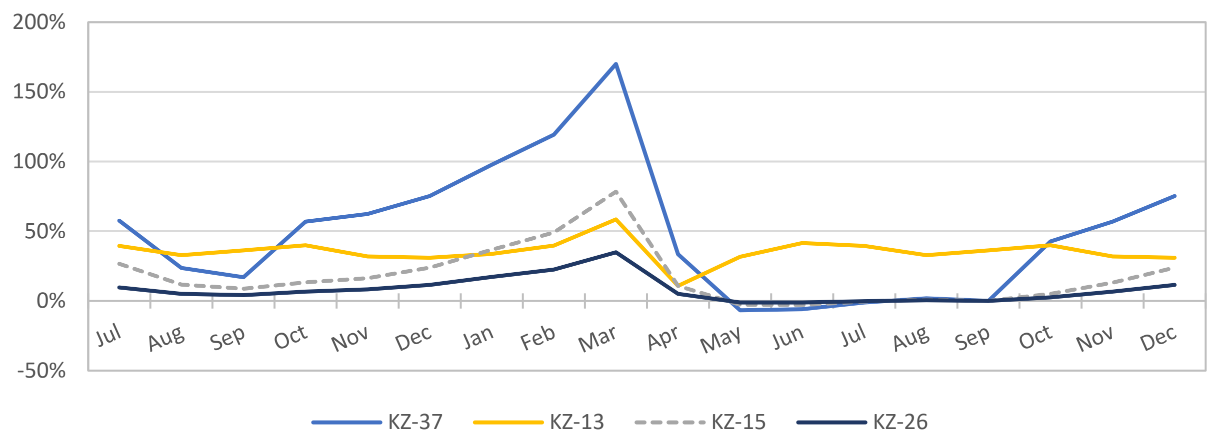


Figure 6-6: Construction - Difference (%) Between Baseline and Monthly Runoff for 1/10 Dry Scenario

<u>Operations Phase</u>

The duration of the operations phase is approximately 10 years. Activities and developments that will affect hydrology during operations include:

- Discharge of water from the Lower Water Management Pond into Geona Creek at approximately a 3:1 ratio (Creek Flow: Discharge);
- Discharge from the Lower Water Management Pond via a pipeline into Finlayson Creek (at a ratio of 2:1);
- Discharge into Geona Creek from the ditches and diversions (Figure 10-6 of Project Proposal);

- Flows to the south from the diversions from Fault Creek and south and southwest non-contact diversions to the South Creek drainage; and
- Ongoing dewatering of ABM open pit and underground workings, however at a lower rate than the construction phase.

Figure 6-7, Figure 6-8 and Figure 6-9 illustrate how flows are predicted to be altered (monthly % difference) on Geona, South and Finlayson Creeks during a mean, 1/50 wet and 1/10 dry year respectively during the operations phase of the Project.

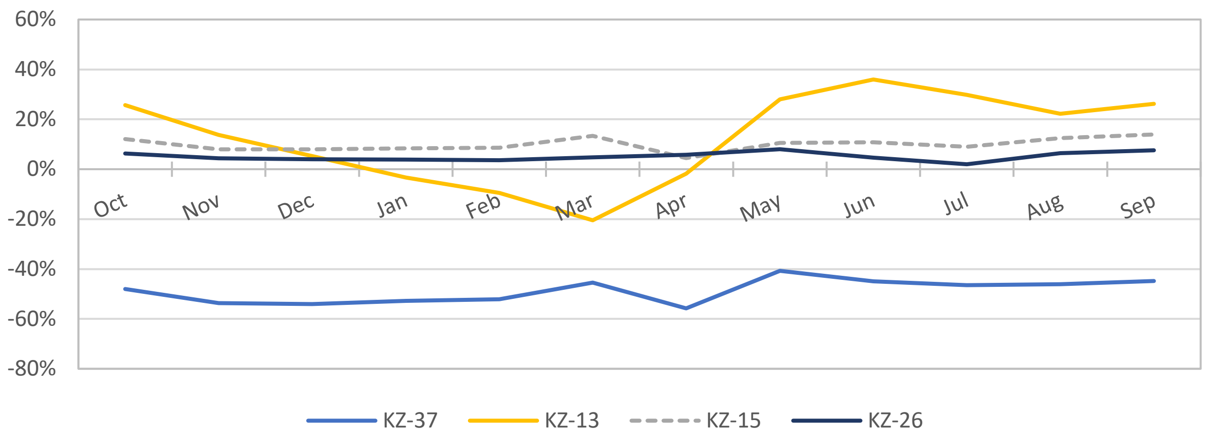


Figure 6-7: Operation - Difference (%) Between Baseline and Monthly Runoff for Mean Scenario

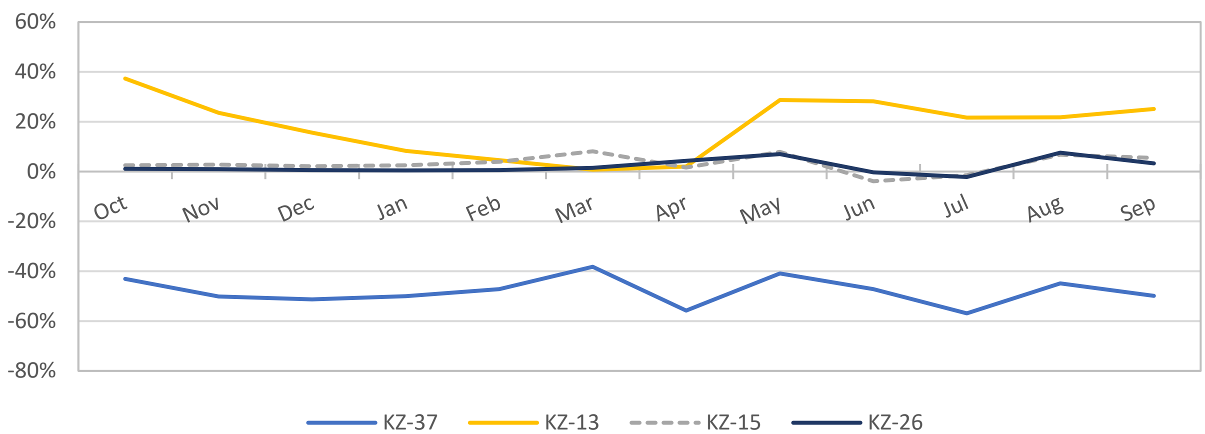


Figure 6-8: Operation - Difference (%) Between Baseline and Monthly Runoff for 1/50 Wet Scenario

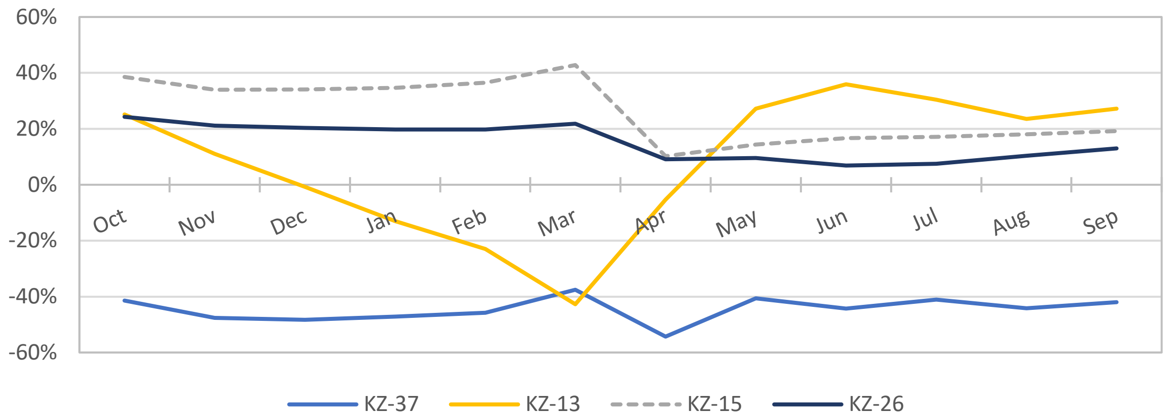


Figure 6-9: Operation - Difference (%) Between Baseline and Monthly Runoff for 1/10 Dry Scenario

Closure Phase

The closure and post-closure phases of the Project are divided into three periods: active, transition and monitoring. During the active closure period (approximately three years) the following activities will occur or cease:

- ABM open pit dewatering will cease allowing the ABM open pit to fill;
- Fault Creek will be re-directed back to the Geona Creek watershed and contribute to filling of the ABM open pit;
- Direct discharge to Finlayson Creek will cease; and
- Wetlands for passive treatment will be constructed.

Following active closure (3 years), the post-closure phase will commence with a transitional period, which is expected to last about 13 years. During this period, the passive wetland treatment system will be commissioned, the ABM open pit will continue to fill, but the hydraulic head is expected to be high enough to contribute additional groundwater flow to Geona Creek.

The post-closure phase monitoring period will begin at approximately year 26 of the Project life. At this stage, water flowing from the site will rely on passive treatment (wetlands) to meet compliance discharge limits. Flow in Geona Creek, South Creek, and Finlayson Creek will more or less return to baseline flow, albeit with some permanent changes.

Figure 6-10 to Figure 6-15 show how flows are predicted to be altered (monthly % difference) on Geona Creek, South Creek and Finlayson Creeks during a mean, 1/50 wet and 1/10 dry year respectively during the active and transition closure, and post closure phases of the Project.

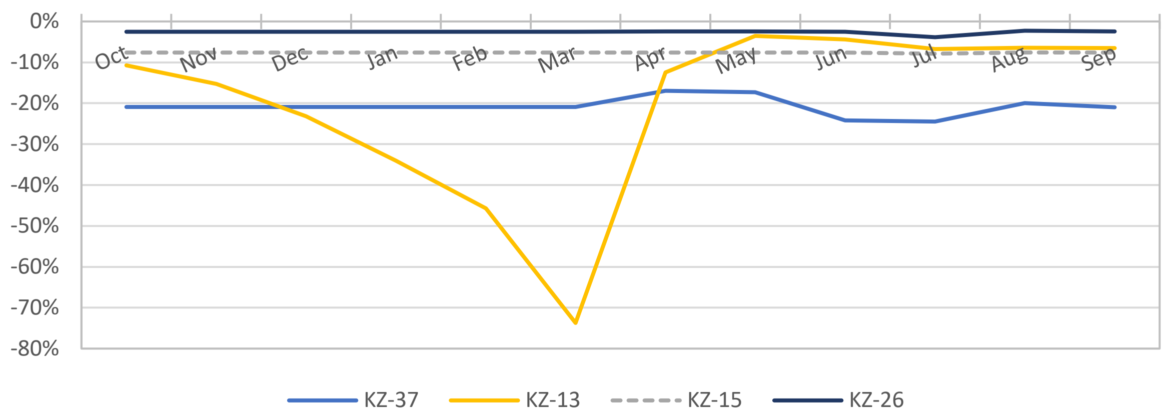


Figure 6-10: Active and Transition Closure - Difference (%) Between Baseline and Monthly Runoff for Mean Scenario

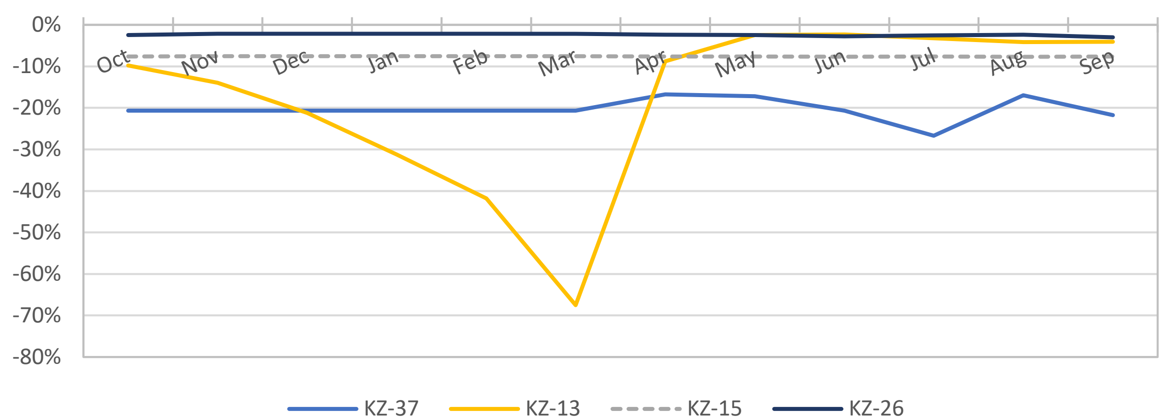


Figure 6-11: Active and Transition Closure - Difference (%) Between Baseline and Monthly Runoff for 1/50 Wet Scenario

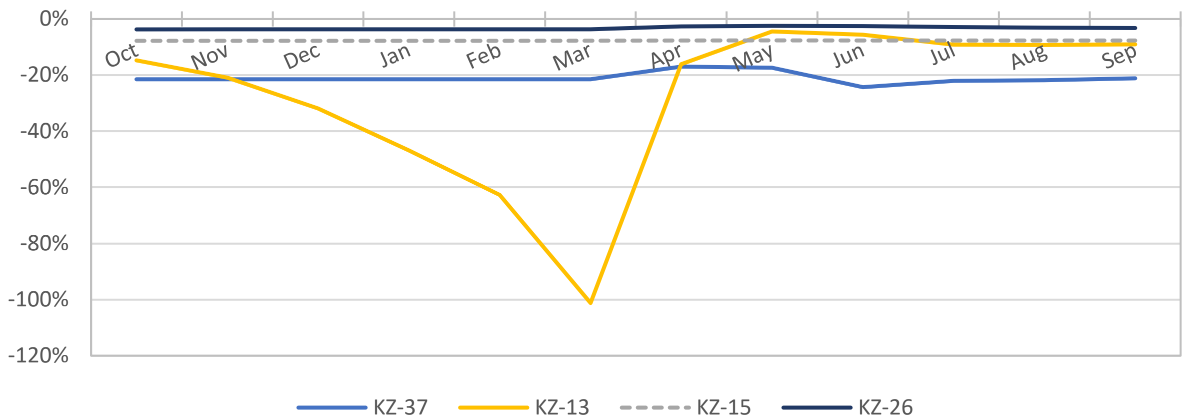


Figure 6-12: Active and Transition Closure - Difference (%) Between Baseline and Monthly Runoff for 1/10 Dry Scenario

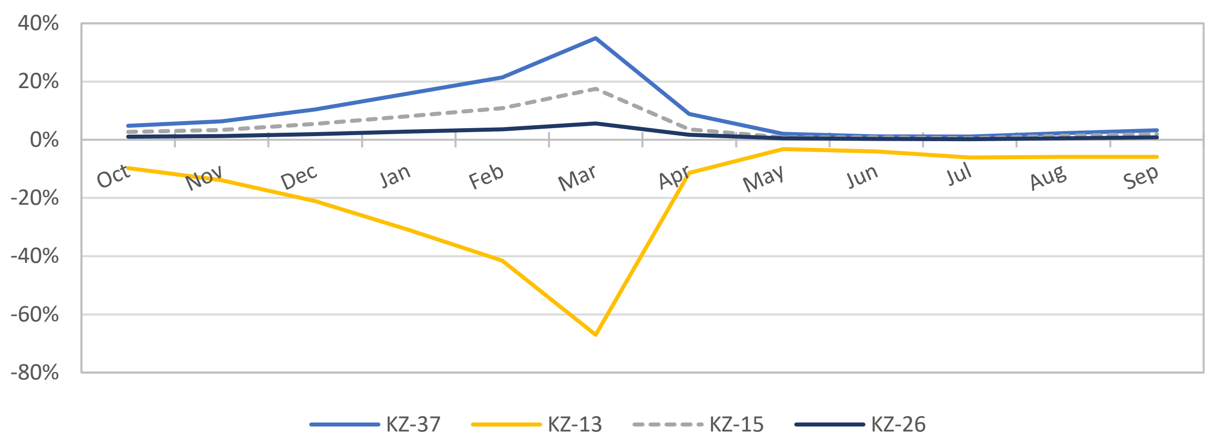


Figure 6-13: Post Closure - Difference (%) Between Baseline and Monthly Runoff for Mean Scenario

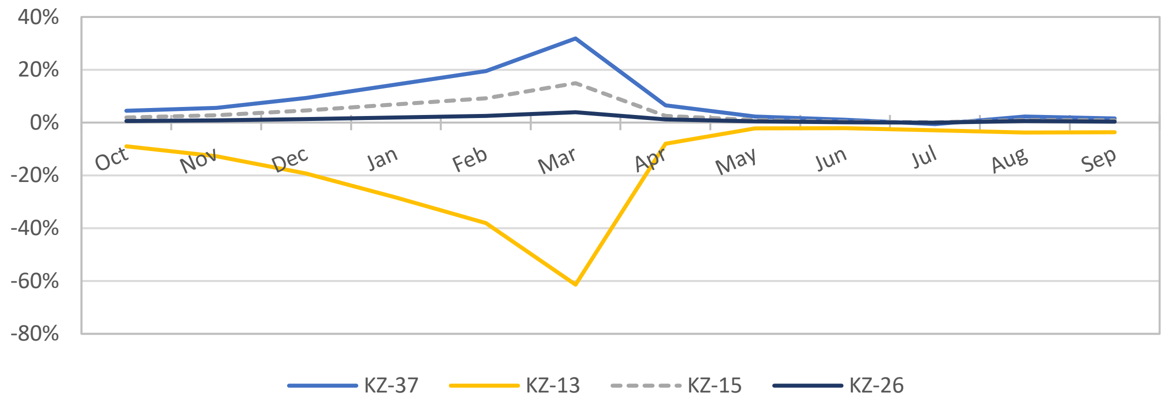


Figure 6-14: Post Closure - Difference (%) Between Baseline and Monthly Runoff for 1/50 Wet Scenario

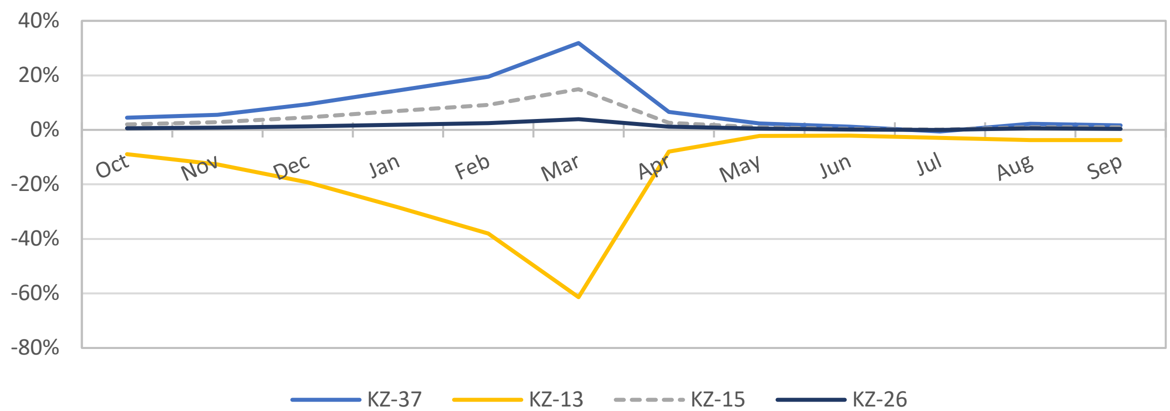


Figure 6-15: Post Closure - Difference (%) Between Baseline and Monthly Runoff for 1/10 Dry Scenario

Hydrological Impact to Geona Creek

Water draining from the mine footprint area into Geona Creek will continue to accumulate during and following development of mine structures and will need to be conveyed downstream. Surface waters (contact water) originating in the immediate vicinity of the waste storage facilities will be collected, stored and treated if necessary prior to release. Water accumulating within the upper watershed (above the proposed sediment and water management ponds) but not coming in direct contact with mine infrastructure can be considered non-contact water. As part of the mitigative measures, water conveyance systems will be developed to collect the non-contact water and deliver it downstream to a settling pond situated directly below the water management ponds. Water from this structure will be subsequently discharged into lower Geona Creek to maintain adequate flow to support downstream fish habitat. Once mine construction is initiated fish will be isolated to lower Geona Creek below KZ-37 and this section of Geona Creek will become the receiving environment. This section, upper portion of reach 1, also receives the benefit of discharge from a small tributary on the east side of the creek that flows into Geona at KZ-18, which will not be impacted by mine development. Geona Creek reaches are described in the Aquatic Ecosystems and Resources Baseline Report (Appendix E-3 of the Project Proposal) and in the FOP (Appendix E-4 of Project Proposal). Geona Creek was delineated into 4 reaches. The mine footprint will occur in the three upper reaches. As described above these reaches will be isolated from fish and therefore, although the habitat in these reaches will not all necessarily be disturbed by mine development it will become inaccessible by fish. An accounting of the habitat that will be either be removed or isolated from fish use is presented in the FOP and summarized above in response to R3-12.

The drainage area above the water management ponds account for approximately 50% of the total Geona Creek watershed. The proposed plan involves re-direction of Fault Creek into the South Creek system as the proposed ABM open pit will be situated near the Fault Creek confluence with upper Geona Creek. Thus, water flow delivered to Geona Creek from Fault Creek will no longer occur during mine construction and operations. Fault Creek drainage is approximately 193 ha or 8% of the total Geona Creek drainage. In addition to Fault Creek, additional catchment areas at the top of Geona Creek will also be redirected southward. These areas are referred to as the south and southwest diversion catchments, which will add an additional 188 ha of catchment area that will be diverted to the South Lakes system. In total, approximately 381 ha or 15% of catchment in the upper Geona watershed will be re-directed.

The loss of flow from Fault Creek into Geona Creek will be offset by water derived from dewatering of the ABM open pit. A substantial volume of water is present in the aquifer within the overburden material that requires removal in order to develop the pit. This water will be captured in a series of wells and/or trenches and pumped to the Pit Rim Pond constructed near the pit prior to discharge to Geona Creek via the water management ponds. During the operational phase, water will continue to be removed from the pit and underground workings and ultimately released into Geona Creek but at a lower volume than what will be produced during dewatering of the overburden. Figure 6-3 shows the predicted daily volumes of water that will be pumped from the ABM open pit during mine construction and operations. At closure, dewatering will be halted allowing the pit to flood. At this stage, Fault Creek will be re-directed back to the Geona Creek watershed, discharging directly into the ABM open pit. Thus, it will not contribute to discharge in lower Geona Creek until the pit is flooded. This is predicted to take approximately 16 years. More detail on pit dewatering and influence on adjacent watersheds is available in Hydrogeological Model (Appendix D-4 of Project Proposal) and the Receiving Environment Water Balance (Appendix D-6 of Project Proposal).

Since the storage facilities and other mine infrastructure will be established on both sides of Geona Creek, water conveyance systems will have to be established on both the west and east sides of these structures. Therefore, Geona Creek flow above the Operations Water Management Ponds has been divided according to the areas they drain on either side of the creek, less the Fault Creek and additional upper Geona Creek catchment flow, and less the drainage that would normally be derived from the footprint of the proposed open pit, process plant and waste rock storage areas. Using LiDar data, contact water areas within the watershed were delineated and include the proposed footprint of the facilities as well as a buffer region around the facilities that are not likely to avoid contact or be re-directed easily into one of the channels. This delineation accounts for approximately 19% of the total watershed or 30% of the area above the Operations Water Management Ponds.

Table 6-2: Approximate Surface Area of Various Components of the Geona Creek Watershed (During Mine Operations at Year 10) and Relative % Of Drainage Area to the Entire Watershed and Upstream from the Water Management Ponds

Area Description	Total ha	% of total Geona Creek watershed	% of area upstream of end of diversion structures
Entire Geona Creek watershed (including Fault Creek)	2571	100	NA
Geona Creek Catchment from end of diversion structures (excluding Fault Creek, S and SW Diversion Catchments)	1288	50	78
Geona Creek Catchment from end of diversion structures (including Fault Creek, S. and SW Diversion Catchments)	1669	65	100
Fault Creek Watershed	193	8	12
Fault Creek, South and SW Diversion Catchments combined	381	15	23
Geona Creek East from end of lower water management pond and above (both contact and non-contact but excluding S. Diversion Catchment)	695	27	42
Geona Creek West from end of lower water management pond and above (both contact and non-contact but excl. Fault Creek and SW Diversion Catchment)	593	23	36
Mine infrastructure Footprint (MIF) - total	499	19	30
MIF - East side	232	9	14
MIF - West side	268	10	16
Geona Creek Catchment East less MIF and excl. Fault Creek, S. and SW Diversion Catchment	463	18	28
Geona Creek Catchment West side less MIF and excl. Fault Creek and S. and SW Diversion Catchment	325	13	20

Once areas of potential contact water, Fault Creek and upper Geona Creek diversion areas are removed, the total drainage area above the water management ponds will be approximately 8.0 km^2 or approximately 31% of the total watershed. This in turn will result in east and west Geona Creek water conveyance systems discharging 18% and 13% of Geona Creek watershed, respectively (Table 6-2). When considering only the discharge area above the sediment/polishing pond this translates into 28% and 20% of catchment east and west of Geona Creek, respectively.

The predicted change to baseline flow in lower Geona Creek due to mining activity vary depending on the phase of development (construction, operations or closure) and type of year with respect to precipitation rates as illustrated in Figure 6-4 to Figure 6-15 above.

During the construction phase, baseline flow in Geona Creek will be affected largely by the diversion of Fault Creek and dewatering of the overburden aquifer. During a mean precipitation year this will result in an approximate 34% increase in flow during the first month (anticipated to be July). Dewatering rates are expected to be highest when dewatering begins and then reduce over time. The initial effect on Geona Creek flow varies between 10% for a wet year (Figure 6-5) when relative contribution from dewatering is lower, to 58% in a dry year (Figure 6-6) when contribution to baseline flow from dewatering is more significant. Predicted effect on baseline flow at KZ-37 falls in Aug/Sept as they tend to be wetter months. Once freezing conditions develop, the relative influence on baseline flow increases as dewatering will continue through the winter at a fairly stable rate while surface flow diminish. Following the first 12 months of dewatering, flux rates drop as much of the water rich overburden has been dewatered. As a result, Geona Creek flows are predicted to fall between 1.0 to 8.5% below baseline flow in the second summer of development in a mean precipitation year with slightly higher or lower affect during a wet or dry scenario year.

During operations, ABM open pit dewatering flow rates fall by approximately 50% as eventually dewatering will result in an equilibrium state where aquifer inflow will equal dewatering outflow as outlined above. In addition, the Process Plant will consume water with approximately 9-10% of water used in the processing plant being contained within the concentrate as it is trucked offsite. At the same time, the water management strategy will include direct discharge of a portion of water from the water management ponds directly into Finlayson Creek near the Geona Creek confluence (above KZ-15). This combined with the loss of input from Fault Creek results in a predicted reduction of baseline flow in Geona Creek of about 50% with slightly higher or lower numbers depending on the month and type of precipitation year (Figure 6-7 to Figure 6-9).

At closure, the onset of active closure pumping from the ABM open pit ceases and it begins to fill with groundwater and the additional surface flow from the removed south diversions. Active closure will occur over three years (Years 11 through 13), during which time machinery will be removed and other infrastructure decommissioned as well as construction of a wetland. The transition closure period will last from the end of active closure until the ABM Lake is formed (years 14 through 26). Downstream runoff is expected to be below baseline during this period and was calculated the same as the active closure period; although, small variations are likely as covers become more well established and flow paths change in response to the removal of diversion ditches. While surface flow will begin to increase as the filling lake starts to discharge through the subsurface to Geona Creek, the impact is expected to be negligible and it is modelled as an average case. The post closure period begins in year 26 and is characterized by the beginning of ABM Lake outflow, which will begin contributing flow to Geona Creek, thereby reconnecting Fault Creek and the other south diversion areas to Geona Creek. As a result of the additional deep groundwater influx, runoff is expected to be slightly higher than baseline in Geona Creek and downstream in perpetuity. Runoff in South Creek at KZ-13 is expected to decrease as a result of the removal of the diversions plus the drawdown of water from the upper pond/lake at the headwaters. This drawdown effect will remain once the lake is full, but the impact will be lower in post closure than at the beginning of active closure. Figure 6-10 to Figure 6-15 present the percent change in total annual flow at the various sites in each closure phase for the mean, 1/50 wet and 1/10 dry scenario.

With respect to the higher flow Geona Creek will experience as a result of mining activities, the system is already responsive to rainfall events, experiencing relatively high flow during and subsequent to these events as well as during freshet. Under natural conditions Geona Creek flow can be upwards of 1,000 L/s during freshet. Following mine development high flow will be tempered as a result of the Fault Creek diversion and water management on site. During operations water will be discharged at a maximum rate of 3:1 (Geona Creek: site discharge) year round to Geona Creek.

The lower flow predicted for lower Geona creek (in the 50% range) during operations will be adequate to sustain the small arctic grayling population in Geona creek and are not expected to impede fish passage or movement within the system. The lowest flow will occur during late winter during the operational phase. At this time, the water management strategy involves sending a portion of water from the water management ponds directly to Finlayson Creek. The distribution of water can be adjusted if it is determined that flow have fallen too low and place the Geona fish at risk.

Currently there is very little pond or spawning habitat in lower Geona Creek. The FOP (Appendix E-4 of Project Proposal) proposes to construct this habitat to offset losses of this type of habitat in upper Geona. The ponds will be constructed such that their volume will be stable regardless of discharge in the creek. Spawning habitat will be developed at the heads of these ponds and will be developed such that it will remain viable during all discharge scenarios.

Accounting of fish habitat loss is described in the FOP (Appendix E-4 of Project Proposal) with supplemental information provided during YESAB IR#1 submitted in June 2017 (see Section 10 – Aquatic Ecosystem Resources) (BMC, 2017b).

Hydrological Impact to South Creek

As described above, Fault Creek, a tributary of Geona Creek will be temporarily re-directed to accommodate the development of the open pit. Fault Creek will be diverted to South Creek and South Lakes, which will create a temporarily increased flow into that system. The South Creek/Geona Creek watershed divide is basically at the same elevation and there is some evidence that Fault Creek previously discharged into South Creek (Norecol, Dames & Moore, 1996). Some additional water from catchments at the top end of the Geona Creek watershed will also be diverted to Fault Creek via constructed diversion channels. This will encompass approximately 188 ha and therefore, the total catchment area to be diverted to South Creek system will be 381 ha or approximately 22.8% of the Geona Creek watershed.

Based on mean, maximum, and minimum flow measured for Fault and South Creeks during the baseline studies, Fault Creek flow ranges from about 20% to 80% of the flow in South Creek. Fault Creek flows are lowest relative to South Creek in the winter and highest during spring freshet. This is consistent with the hydrogeological investigations that suggest a portion of flow in South Creek is attributed to daylighting groundwater flow.

The ABM open pit dewatering will reduce groundwater input into South Creek. This reduction will increase as the pit is developed deeper. This in turn will to a certain extent temper the additional flow from Fault Creek that will be directed to the system. Based on the Groundwater Quality and Flow effects assessment (Chapter 9 of the Project Proposal), baseline flow in South Creek is sustained in part as a result of groundwater inputs. Once dewatering in and around the ABM open pit is initiated, baseline flow into South Creek will be reduced. The predicted monthly percentage change in flow in South Creek during the construction, operation and closure phases of the mine life are depicted in Figure 6-10 to Figure 6-15. As reflected in the figures, flow in South Creek (at KZ-13) during a mean or wet precipitation year is expected to increase between 11 to 68% depending on the month during the construction phase of the Project. During a dry year, flow rates in South Creek are predicted to increase by 30% to 40%. During a dry year, Fault Creek flow would be reduced substantially.

During the operational phase, flow in South Creek becomes more reliant on flow from Fault Creek as the groundwater aquifer is no longer feeding as much flow into South Creek. As a result, there is a negative effect on winter flow predicted during a mean or dry scenario year and more neutral affect during a wet year.

At closure, Fault Creek will be re-directed back to the Geona Creek watershed. The resultant flow in South Creek (KZ-13) is predicted to be on average 18% to 28% lower annually than baseline flow during the active and transition closure phase. During this phase the dewatering of the ABM open pit will cease and all of the flow from Fault Creek will report to the pit slowly increasing the hydraulic head in the surrounding aquifer. Once the pit is filled at the post-closure phase the resultant flow in South Creek is predicted to be closer to baseline flow but will remain 16% to 25% lower on average annually.

It is important to note and as described in the FOP (Appendix E-4 of Project Proposal) Fault Creek is a non-fish bearing creek. Once diverted a barrier will be placed at its lower end to prevent fish from using the creek so that it doesn't become temporary fish habitat.

Increased flow during operations into South Creek and South Lakes may cause some degradation of existing non-active beaver dams or structures (located below the lakes and upstream of the North River) and possibly some additional erosion in the system. However, this should be short-lived following diversion of the system and mitigated by diverting the water during a low flow period. It is not certain how the increased flow in the system from the Fault Creek diversion will impact fish habitat; however, it is expected it may slightly enhance the habitat with additional food (drift invertebrates) being distributed into the lakes.

Based on the modelling and as illustrated in Figure 6-10 to Figure 6-12 impact to flow in the upper South Creek system at KZ-13 will be greatest during late winter months, during the active and transition closure phase, after Fault Creek has been re-diverted to the ABM pit and hydraulic head in the pit is too low to contribute to baseline flow. During a dry season scenario (Figure 6-12) the model indicates that flow could potentially cease in the system (i.e. 100% reduction) due to reduced or lack of groundwater input. It is important to note however that the prediction is based on an annual hydrogeology model and therefore has some uncertainties on its integration into the monthly hydrology time step. This does flag the fact that hydrology in South Creek, during the active and transition closure phase, will need to be monitored closely. Monitoring during the operations phase may allow for validation of the of the flow predictions in advance of the Fault Creek re-diversion. The lakes in the upper South Creek system support a healthy Arctic grayling population, and as the lakes do not appear to provide fish passage to downstream habitats, it is likely that each of the two lakes support these populations throughout their entire life cycle. Although flows appear to be greatly reduced during winter months, the lakes are deep enough (i.e. > 4 m) to sustain fisheries populations throughout the winter. Studies have demonstrated that the small lakes within the Canadian Arctic that possess sufficient depth to provide at least 2 m of water below the ice cover in winter also provide overwintering habitat potential for large-bodied fish species, such as lake trout and Arctic grayling (J. Faithful, 2016), despite the undersaturated conditions for oxygen. As there is currently minimal winter flow into the upper South Lakes, negligible impacts to fish and fish habitat should result from a reduced winter flow during the Active and Transition Closure phase. Further, although a slightly reduced volume of groundwater entering the uppermost lake is predicted, lake levels are primarily controlled by very old beaver impoundments and therefore any reduction in lake surface area, due to the reduction in groundwater inputs, would be considered negligible.

Hydrological Impact to Finlayson Creek

Geona Creek resides in the upper Finlayson Creek watershed. Total catchment of Finlayson Creek above KZ-26 is 215 km^2. Geona Creek catchment is approximately 25 km^2 or about 11.6% of the watershed above KZ-26. The Finlayson catchment basin above Geona Creek is 41 km^2 and if Geona Creek is included, the basin in the upper Finlayson catchment is 66 km^2. Geona Creek contributes about 38% of the flow in Finlayson Creek where it enters the creek (KZ-15). Finlayson Creek is a north flowing tributary, which meets the outflow of Finlayson Lake below the Robert Campbell Highway to become the Finlayson River. The Finlayson River flows east to eventually join the Frances River and ultimately the Mackenzie River.

While the majority of the annual precipitation is received as rainfall during the summer months, the long period of snow accumulation usually ensures a snowmelt driven peak annual flood in this region, typically occurring in May / June.

During the construction phase, flows in Geona Creek are anticipated to increase above baseline initially due to dewatering (limited by the extent to which this offsets the loss of flow from Fault Creek) at least during the first 10 months, after which a decrease in flow will result during the open water season. During the winter, water pumped as a result of dewatering makes up a larger portion of the net flow and as such this translates into an overall increase in base flow from freeze-up until spring melt. This predicted flow pattern in Geona Creek translates into a similar pattern in Finlayson Creek but with a proportionally lower percentage influence as reflected in Figure 6-4 to Figure 6-6. The effect is more pronounced at KZ-15 (immediately downstream of the Geona Creek confluence) than at KZ-26 in lower Finlayson Creek during the open water months. Overall the difference in flow from baseline during open water season is a maximum of 13% for a mean year scenario at KZ-15. The difference in winter flow rates is more important and again this is due to dewatering input which will remain at a high level throughout mine construction, while winter baseline flow are substantially lower due to freezing.

During operations, flow in Finlayson Creek at KZ-15 and KZ-26 will generally be higher throughout the year. During a mean precipitation year, flows are predicted to increase between 4% and 14% at KZ-15 and between 2% and 8% at KZ-26 (Figure 6-7). The increase in flow is more pronounced during a dry scenario year and less during a wet year (Figure 6-8 and Figure 6-9). The increase in flow in Finlayson Creek during operations is in contrast to a decrease in Geona Creek because of the water management strategy that will release a portion of compliant water from the water management ponds directly into Finlayson Creek above KZ-15, circumventing lower Geona Creek.

During active closure, flow in Finlayson Creek are predicted to decrease from baseline in the range of 8% at KZ-15 and 3% at KZ-26 due to cessation of pit dewatering. Once the pit is filled (i.e., after the closure transition phase) flow in Finlayson Creek will return to near baseline conditions.

The marginal increase or decrease of flow in Finlayson Creek are not anticipated to have a significant impact on the fish or fish habitat in the system. Finlayson Creek is very responsive to rainfall events and freshet resulting in very large natural fluctuations in flow rates over short periods of time. The increase in flow during winter due to mining development is much more pronounced but this also aligns with when flow rates are substantially lower overall. The water management strategy will provide a more stable flow regime throughout the year that could be beneficial to the biota in the system.

YESAB ISSUE

A discussion of the impacts on fish and fish habitat and the associated affects to Commercial, Recreational or Aboriginal (CRA) Fisheries that would result from a catastrophic failure of the water management ponds on Genoa Creek has not been provided. The expectations for this analysis would be a robust assessment of potential impacts and risks to CRA Fisheries that would include modelling of wave inundation and erosional forces associated with an event that occurred during a dry or wet year in combination with a dry (piping) or wet (precipitation) event. This assessment would include discussion of how far the inundation wave would travel, how far erosional forces would extend, the range of potential effects.

R3-14

Provide a discussion of the impacts on fish and fish habitat and the associated effects to Commercial, Recreational or Aboriginal Fisheries that would result from catastrophic failure of the water management ponds in Genoa Creek.

R3-14 is the same question asked of BMC during the Adequacy stage of the assessment process:

- *R274 "Provide a discussion of the impacts on fish and fish habitat and the associated affects to Commercial, Recreational or Aboriginal (CRA) Fisheries that would result from a catastrophic failure of the water management ponds on Genoa Creek."*
- *R2-124 "Provide an assessment of catastrophic failure of the water management ponds on Genoa Creek. This may be included in the response to R2-45 which requests an assessment of impacts associated with the Project on erosion, stream morphology and riparian vegetation of all affected drainages from projected downstream flow changes during all Project phases."*

BMC's response to these information requests (BMC, 2017a) was as follows:

> *"This assessment has been undertaken, and is provided in Appendix R2-O of this Response Report. It presents an evaluation of potential impacts to the downstream aquatic and riparian receiving environment from a 'worst-case' scenario of both (full) water management ponds breaching during a high runoff natural event when the downstream waters are already flowing at bankfull depths. Section 2.1 of the assessment discusses how the likelihood of all of these events co-occurring at the same time to produce the worst-case scenario evaluated in extremely low. In a classic risk assessment context, this extremely low likelihood does not produce a recommendation for substantial changes to planned management to reduce overall risk, regardless of the consequence identified."*

Appendix R2-O of Response Report #2 (BMC, 2017a) is entitled *"Assessment of the Impact of a Hypothetical Catastrophic Failure of the Proposed Water Management Ponds at the Kudz Ze Kayah Mine Site on Fish and Fish Habitat in Geona Creek"*.

Given that this question had been previously addressed BMC contacted DFO to see if they had reviewed Appendix R2-O. BMC subsequently sent Appendix R2-0 to DFO. DFO has acknowledged that they had not seen or reviewed the Appendix prior to re-submitting the question to YESAB for IR3. DFO has now seen and reviewed the memo and are expected to submit comments to YESAB concerning the response. To date via email DFO have indicated two concerns:

1. The memo states that there is no CRA fishery within the area considered for the memo. As the systems involved are covered under the recreational fishery regulations for the Yukon, these systems are deemed by DFO to be part of a recreational fishery. This results in them being considered as a CRA fishery. Further, Indigenous community members have raised the issue of fish passage through the Robert Campbell Highway culvert crossing of Finlayson Creek. As there is a CRA fishery involved, the conclusions in the memo regarding impacts to CRA fisheries should be revisited.
2. The memo only considers the watercourses down to the Robert Campbell Highway culvert crossing of Finlayson Creek despite the information indicating that the inundation wave and effects will still occur to this point. The areas that will be affected downstream and the effects that will have there should also be revisited.

With respect to concern 1, BMC agrees with DFO that the system should be regarded as or has potential to support recreational and aboriginal fisheries. This was recognized in the Fisheries Offsetting Plan (Appendix E-4 of the Project Proposal).

With respect to concern 2, additional work is underway to consider impacts beyond the culvert at the Robert Campbell Highway. For clarity Appendix R2-O will be revised to include the additional assessment and will also acknowledge that the Geona Creek and Finlayson Creek system is or has potential as a recreational or aboriginal fishery.

7 BIRDS

YESAB ISSUE

The South Lakes system is expected to have lower than baseline water levels at closure as a result of pit dewatering and reduction of the aquifer. During Construction and Operations the flows are expected to increase as a result of the diversion of Fault Creek and the inputs from the south diversions.

Fluctuating water levels may impact the nesting success of shorebirds and waterfowl. This was not discussed in the effects assessment for waterfowl and shorebirds.

The South Lakes system was included in the baseline surveys for wetlands. The Proponent has determined that there will be no significant impacts to waterfowl and shorebirds.

R3-15

Discuss the extent of water level fluctuation expected in the South Lakes system over the duration of the project in terms of potential impacts to nesting waterfowl and shorebirds.

It is agreed that the timing of operation of the diversion could result in a fluctuating water level in the pond that might affect nesting success. Therefore, the diversion of Fault Creek during construction and at closure will be scheduled to minimize fluctuations during nesting periods as much as practicable (ideally during the late fall or through the winter). Where impacts on nesting birds cannot be avoided, BMC will obtain the necessary permit under Section 6 of the *Migratory Birds Regulations.* Any residual effects from fluctuating flows would expected to be temporary (i.e., one season) and in a relatively small area (the first south pond).

Waterfowl and shorebird habitat is directly related to effects on wetlands and riparian areas. The effect on wetland and riparian areas was assessed in Section 12.4.1.2 of the Project Proposal, which showed the pond area that would be affected by the open pit drawdown and the diversion of Fault Creek. Figure 12-5 from the Project Proposal is included below as Figure 7-1 for reference. As discussed in the wetland effects assessment, groundwater, surficial materials, and bedrock conditions were assessed for this area and it was calculated that the open pit and diversion would result in an overburden aquifer drop of approximately one metre in the area of the uppermost pond and wetland. Following closure, Fault Creek will be rerouted into the Geona Creek valley to fill the open pit and then flow to Geona Creek after the pit is filled. As a result, flows in the South Creek drainage will drop to approximately 89% of their baseline flows and rebound to approximately 90% of their baseline flows once the pit is filled. The resulting effects on the wetlands and riparian areas of the South Creek are difficult to predict. For the purposes of this assessment, it is estimated that the flow changes and reductions will result in a loss of 10% of wetland and riparian vegetation in this area.

This expected loss of wetland and riparian habitat in this area was captured in the calculation of indirect loss of waterfowl habitat presented in Table 13-18 and Figure 13-19 of the Project Proposal and repeated below as Table 7-1 and Figure 7-2 for clarity.

Table 7-1: Change in Waterfowl Habitat Quality Due to Project Effects in the LSA

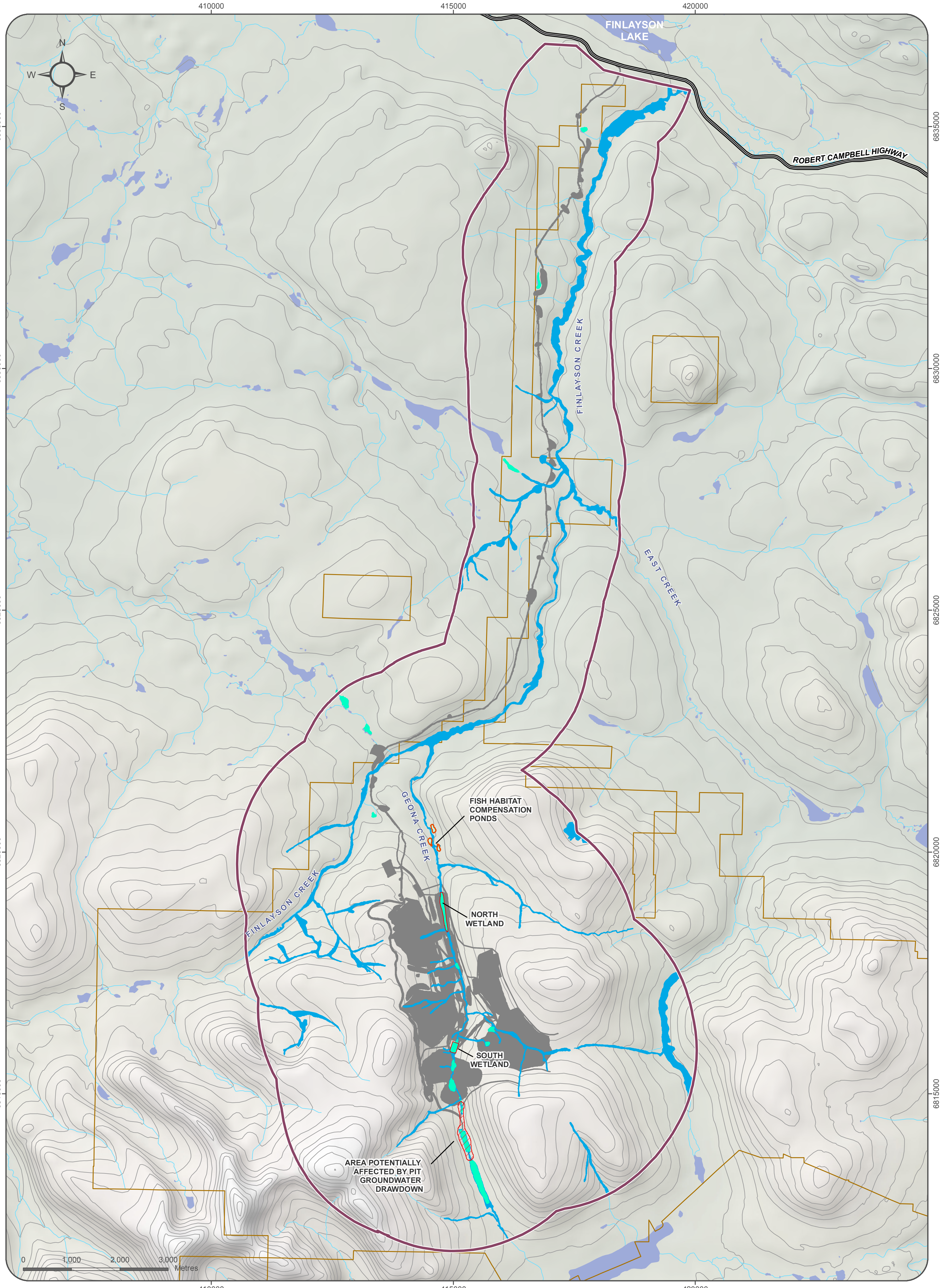
Suitability Ranking	Baseline Conditions[1] (km^2)	Direct Habitat Loss[2] (km^2)	Indirect Habitat Loss[3] (km^2)	Total Habitat Change[4] (%)
High	18.2	1.92	3.4	-20
Moderate	16.2	1.51	3.0	-19
Low	90.0	6.36	11.1	-13

[1] Amount of habitat prior to any construction

[2] Area of habitat lost to the Project Footprint, including Access Road

[3] Area of habitat lost located with a 300 m buffer around the Project Footprint and Access Road

[4] Percent change after direct and 50% of indirect habitat loss



Wetland
Riparian Ecosystem
Constructed Replacement Riparian and Wetland Ecosystems
Riparian and Wetland Ecosystems Potentially Affected by Pit Groundwater Drawdown
Local Study Area
Location of Proposed Mine Infrastructure Footprint
BMC Minerals (No.1) Ltd. Mineral Claim
Watercourse
Contour (40 m interval)

Contours, waterbodies and watercourses compiled by Natural Resources Canada at a scale of 1:50,000. Reproduced under license from Her Majesty the Queen, as represented by the Minister of Natural Resources Canada.

Datum: NAD 83; Projection: UTM Zone 9N

BMC MINERALS

ALEXCO ENVIRONMENTAL GROUP

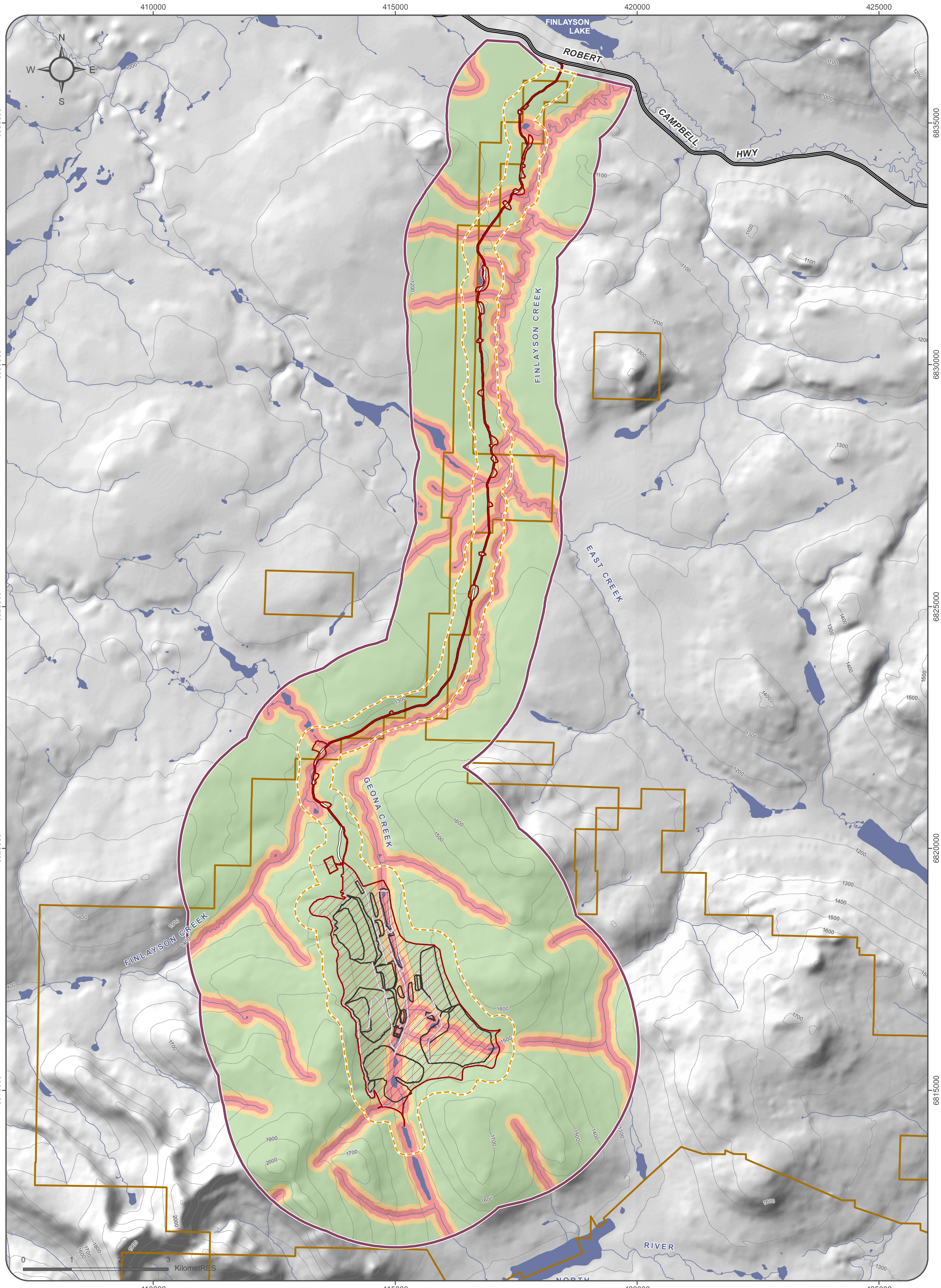
KUDZ ZE KAYAH PROJECT
RESPONSE #3 TO YESAB EXECUTIVE COMMITTEE INFORMATION REQUEST

FIGURE 7-1

RIPARIAN AND WETLAND INTERACTION WITH PROJECT FOOTPRINT

MAY 2018

D:\Project\AllProjects\Kudz_Ze_Kayah\Maps\03_Study\Vegetation\YESAB-DNU\IR3_Fig7-1_wetland_riparian20180528_TitleBlckEditOnly.mxd



Waterfowl Nesting / Feeding Habitat

- High
- Moderate
- Low/Nil

- Tote Road/Proposed Access Road
- Proposed Mine Road
- Contour (100 m interval)
- Watercourse
- Local Study Area
- Location of Proposed Infrastructure
- BMC Minerals (No.1) Ltd. Mineral Claim Areas
- 300m General Disturbance Area
- Direct Disturbance Area

BMC MINERALS

ALEXCO ENVIRONMENTAL GROUP

KUDZ ZE KAYAH PROJECT
RESPONSE #3 TO YESAB EXECUTIVE COMMITTEE INFORMATION REQUEST

FIGURE 7-2

WATERFOWL HABITAT SUITABILITY WITHIN LOCAL STUDY AREA

MAY 2018

D:\Project\AllProjects\Kudz_Ze_Kayah\Maps\03_Study\Wildlife\Small_Mammals_Birds\09-Env_Assessment\HSI\IR3\HSI_WF_20180528.mxd
(Last edited by: mducharme;5/28/2018/13:24 PM)

8 SOCIO-ECONOMIC

YESAB ISSUE

While ongoing exploration activities by the Proponent and other companies may delay the decline of mining activities in the area, an eventual decrease in the level of mining activity is inevitable. If this is not replaced by other sources of income/employment for the local area and Yukon at large, this may result in some of the adverse effects associated with a boom and bust cycle.

YESAB has stated that "the eventual decrease in the level of mining activity is inevitable". BMC notes that on a worldwide basis, mining activity is increasing as demands for metals such as copper, lead and zinc has increased (on average) by approximately 1-3% per annum for the last 100 years. In the case of zinc (the dominant metal at the project) this equates to approximately 140,000 – 420,000 tonnes of new metal supply being required every year. Broadly speaking, this means that a new mine the size of Kudz Ze Kayah is required to be opened every 2-6 months somewhere in the world over the next generation. There is no doubt that mining is a cyclical industry where mining exploration activity is linked to world economic conditions however the phrase "boom and bust cycle" is a populist phrase that has been coined by non-industry persons and it does not properly describe the reality of either the growing world wide need for the metals being mined from KZK or a modern operating mine that has undergone rigorous feasibility, environmental and socio-economic analysis.

R3-16

Describe measures to mitigate potentially significant adverse effects associated with the loss of employment at the end of the mine's operational life.

BMC notes that the Project life cycle is expected to be as set out below. The Project life cycle will broadly match the equivalent working life of an adult. That is, the Project will be expected to provide employment and career opportunities for a generation.

1. BMC exploration/drillout and feasibility: 2.5 years
2. Permitting: 2.5 years
3. Construction: 2 years
4. Operation (approximate): 10 years
5. Active Closure: 3 years
6. Transition Closure (estimated): 13 years
7. Passive Closure Period (estimated): 10 years
8. Total project life cycle: 43 years

The period of maximum employment at the Project will be from commencement of Construction through to the end of the Transitional Closure. This is a period of approximately 28 years. The YESAB question therefore relates to the company's planned actions approximately 13 -28 years from today.

Any answer to this must take into account the context of the timeframe and the uncertainty that this introduces.

There are a number of tried and successfully executed methods for the orderly closure of mining projects. The following outlines one that is common and that the proponents have utilised before. The key to successful mine closure is for clarity, and communication with, the workforce so that the Project phases are well understood as early as possible. In this way the company and its current and potential employees can and will make decisions on employment in full knowledge of both the risks and consequences.

During the last one to two years of the operational phase of the Project, mining activity will reduce steadily as follows;

- In the underground mine, mine development will reduce and then cease and only production stoping will continue. During this period, a number of personnel will naturally cease working for the company of their own accord and take up positions elsewhere. This is typical in the last year or two of both mining and non-mining industries. The company will regularly assess its employment needs and as underground mine development reduces, mine development personnel will be redeployed into the mine production crews (where their skills are readily transferrable) to fill ongoing vacancies. During this period, the company shall commence removal of fixed equipment from mined out areas and this will be undertaken by former development personnel. The company acknowledges that at times it will be slightly over or understaffed and has accommodated this in its schedules and financial calculations.

- In the open pit, as the pit gets deeper and work areas become restricted, the mining (drill/blast/excavate) sequence will be modified, waste to ore strip ratios will be reduced and activity in the pit will gradually reduce. At the same time, reclamation activity on the mining waste rock storage areas will be increased and when mining activity is low in the open pit, personnel will be redeployed to carrying out the reclamation earthworks. In this way it is expected that overall activity for mining personnel will be kept relatively constant.

- At the end of the open pit mining period, specialist drill and blast personnel will be offered employment termination packages (see below). Most other mine earthmoving personnel will move to fulltime roles in reclamation. This work shall continue for 1-2 years.

- From a mineral processing perspective, the company will continue at full processing production until late in the final year of operations at which point the company will most likely transition to an operating cycle that fits with the remnant production capacity of the mine. In the company's experience, it is likely that personnel will commence to find other permanent roles from approximately 12 months prior to this period. The company will therefore need to adopt a strategy to deal with a steadily reducing workforce during this period. The company may need to modify its processing activity slightly earlier than expected if employee numbers dictate. In any event, this will not appreciably impact the company's financial models and will be easily accommodated.

- Once the Project has processed all the available ore stockpiles, the processing team will commence closure operations which will ensure employment continuity for the majority of the operators. The remainder will be offered termination packages (see below).

- At some point during the Active Closure period the company will offer voluntary redundancy packages to general employees. Employees with critical skills that are required for the Active, Transitional and Passive closure periods will not be offered termination packages. In this way the company expects to reduce employees on site to those number required for the next stage (i.e. Transitional or Passive) of closure.

- Given that the Transitional and Passive closure period runs for 23 years past this point (i.e. starting in approximately 13-14 years from now) any prediction past that point will have limited accuracy. In addition, the company estimates that the natural attrition of employees leaving employment during that time will largely balance the declining need for personnel hence whilst at some point a number of redundancy packages may be offered it is likely these will be limited.

- Throughout the steps above, the company will take into account the unique circumstances of every employee and will give retention preference to locally based employees. This will not preclude locally based employees from requesting a termination package if they wish to take advantage of another employment opportunity elsewhere.

- Redundancy packages typically include the following elements:

    - Relocation/transfers into other roles within the company (for example into exploration or environmental monitoring roles).

    - Retention bonus so that employees finish their employment at a time that suits the company's operational needs.

    - Retraining allowances to help the employees upskill to fit their future desired roles;

    - Employment outsourcing support, where the company pays for third party support for new employment roles. The degree of this support will vary depending upon the level of employment activity that is prevalent in the Yukon and Canada at the time but typically these packages are provided for 3-12 months. Outsourcing support typically includes assistance with preparing resumes, letters of application, career counselling and advice, sourcing of opportunities and coaching for interviews. It can be as comprehensive as the employee needs;

    - References will be provided for all employees;

    - Termination redundancy payments will vary depending upon circumstances but typically these payments will vary from 1-6 months of the average annual wage of the employee; and

- Employee Assistance Programs (EAP) to provide counselling and emotional support on an as required basis for both employees and their immediate family members for a period of 3-6 months after closure of the Project.

R3-17

How will employees and contractors be meaningfully supported through the transition from operations to closure and closure to post-closure?

Please see BMC's response to R3-16.

YESAB ISSUE

Health and Social Services (HSS) suggests that there may be adverse effects on housing availability and affordability associated with the project. Housing is an important determinant of health, and impacts on availability and affordability may be felt most severely by low income / vulnerable households. In addition to potential adverse effects on these households, this could result in increased demand on income supports and/or relevant other social services.

R3-18

Provide a quantitative analysis that includes the following:

a) The estimated workforce by National Occupational Classification (NOC) classification, will be hired from local communities. The proportion should be based on local capacity to fill each classification. If former Wolverine Mine employees are assumed as potential employees, evidence should be given to support their availability.

b) A justifiable prediction of what proportion of the workforce, by NOC classification, is expected to live outside Yukon.

c) A justifiable prediction of what proportion of the workforce, by NOC classification, is expected to move to Yukon.

d) Rationale supporting the assumption that local hires will have adequate housing within their communities of residence.

BMC notes that the definition of a "local hire" is somebody that already lives locally. We therefore offer in general terms the following comments.

BMC has adopted a position of preferential hire for local people. The point of hire for most personnel is expected to be in the Yukon. The three closest towns to the Project are Ross River (115 km), Faro (170 km) and Watson Lake (185 km). BMC expects to supply an appropriate method of transport from each of these towns to the Project site where employees will stay during their rostered work cycle. Appropriate transport will include a combination of road transport and/or air transport. BMC will also provide transport to the project from Whitehorse. Air transport will utilise the Finlayson airstrip some 5 km from the intersection of the project access road and the Robert Campbell Highway.

BMC considers it unlikely that new employees will relocate to the towns of Ross River and Watson Lake due to current housing supply constraints. However, BMC is already fielding enquiries from existing residents in these towns regarding current and future employment opportunities. Some of these people are former employees of the Minto, Cantung and Wolverine mines (or their service contractors) which have shut down or downsized over the last three years. Our observation is that the former employees of these mines that have contacted us, generally have well developed skills that are directly applicable to BMC's requirements at KZK.

Direct employment by the company at the Project site during mining operations is expected to average approximately 300 people. As requested, Table 8-1 breaks down the expected employment roles by NOC. It should be noted that the NOC classification was designed as a general tool and BMC does not consider it suitable for detailed analysis. BMC also notes that the classification itself is imperfect because, as the NOC system acknowledges, many roles on a mine site may be filled by a technically qualified person, but they can also be filled by an experienced person with "on the job" training but no technical qualifications. Table 8-1 below therefore represents a "best estimate" of personnel occupational classifications as determined under the NOC.

Table 8-1: KZK Site Labour Requirements

KZK Site Labour Requirements

Department	Preproduction Year						Production Year											
	-2			-1			1			2			3			4		
NOC	82	84	86	82	84	86	82	84	86	82	84	86	82	84	86	82	84	86
Open Pit	11	28	72	11	28	75	11	28	119	11	28	111	11	28	111	11	28	102
Underground										6	7	29	11	14	53	11	14	59
Processing							9	21	44	9	21	44	9	21	44	9	21	44
Administration					3	14	7	7	30	7	7	30	7	7	30	7	7	30
Total Per NOC	11	28	72	11	31	89	27	56	193	33	63	214	38	70	238	38	70	235
Total Per Year	111			131			276			310			346			343		

Department	Production Year																	
	5			6			7			8			9			10		
NOC	82	84	86	82	84	86	82	84	86	82	84	86	82	84	86	82	84	86
Open Pit	11	28	100	11	28	89	11	28	89	11	28	89	11	28	86			
Underground	11	14	59	11	14	59	6	13	38	6	7	29	6	7	29			
Processing	9	21	44	9	21	44	9	21	44	9	21	44	9	21	44	9	21	44
Administration	7	7	30	7	7	30	7	7	30	7	7	30	7	7	30	7	7	30
Total Per NOC	38	70	233	38	70	222	33	69	201	33	63	192	33	63	189	16	28	74
Total Per Year	341			330			303			288			285			118		

On the matter of predicting numbers of local employees in each classification BMC notes as follows:

a) The majority of roles in the "86" classification can be filled by unskilled personnel with on the job training. This represents approximately 60-70% of the expected site-based workforce.

b) The majority of the roles in the "84" classification are technicians and tradespeople. A number of these roles can be filled by apprentices and skilled labourers with on the job training (e.g. laboratory, survey and geological technicians, carpenters, welders, electricians and mechanics) with appropriate supervision. This classification represents approximately 20-25% of the expected site-based workforce.

c) The roles in the "82" classification generally require degrees or other tertiary qualifications. These roles constitute approximately 10-15% of the workforce however it is worth noting that most roles are flexible in that diploma qualified personnel do have the capacity to fill most roles.

d) BMC in conjunction with Ross River Dena Council (RRDC) has established the Kaska-BMC Scholarship program. In its first two years, this program supported over 50 Kaska students through completion of their final year of secondary school, completion of diplomas and certificates at Yukon College and through Mining related and other University degree courses. BMC plans to continue to work with both Ross River Dena Council and Liard First Nation and to increase the scope of this program over the next 3 years; however, even without this increased program scope it is expected that upwards of 130 people will have been supported by the current program prior to the commencement of production. Depending on the time taken to permit the Project and any changes to the Scholarship program this number could be as high as 200 people. The intention of the program is to ensure that the opportunity for local Kaska to take up supervisory, technical and managerial roles at the project is maximised. i.e. those roles covered by the "82" and "84" classification rather than just the "86" classification. Importantly, the program has already started to bear fruit with BMC engaging a number of local degree qualified scholarship recipients in permanent roles from May 1st, 2018.

e) Several months prior to commencement of operations, BMC intends to employ the operations crew for the project. At least three months of intensive training will be provided to "new mine" employees prior to operations commencement. This training will cover all areas of the project operations and will ensure that at the point of commissioning, that personnel are well trained and capable of fulfilling their roles. In this way, BMC intends to ensure that all personnel are trained in correct procedures and processes from day one. BMC has already received approaches from a number of locally based supervisory personnel that would be covered under the "84" classification and it is likely that many of the shift supervisors in the processing plant for example would be locally based.

The current unemployment level in both Ross River and Watson Lake is very high and this is not represented in the "official" statistics. BMC notes that in the 2017 Yukon Employment Annual Review, published by Yukon Bureau of Statistics, non-Whitehorse unemployment for First Nations members is listed at less than 200 people. At a recent meeting between BMC and Liard First Nation (LFN) BMC were advised by Name Redacted that approximately 250 of their members currently resident in the Watson Lake region are unemployed. This does not include non LFN members and people that are "underemployed" which is a category that is typically difficult to capture in official statistics. This matter was referenced in the original proposal submission.

A comparable situation exists in Ross River where estimates recently provided by the Ross River Dena Council are that approximately 100 to 150 RRDC members are either unemployed or underemployed.

This anecdotal evidence from the leaders of the local communities therefore suggests that BMC could theoretically cover its entire "84 & 86" workforce from the ranks of unemployed and underemployed persons currently resident in the towns of Faro, Ross River and Watson Lake. As noted, BMC is already employing graduates from its scholarship program who will take up some of the managerial and technical roles covered under the "82" classification. The key in relation to the questions posed by YESAB is that these people are already resident in the local area and so their employment at KZK will not necessarily place stress on the existing housing situation.

It is impossible to accurately predict the number of employees who will be sourced from outside the Yukon; however, it is likely that the largest proportion of these personnel initially will be in the managerial and technical roles. Over time, as scholarship graduates become more plentiful and more experienced, the company will be able to preferentially fill managerial and technical positions with local people.

From the above table, the company estimates that between 20-30% of the total site-based personnel may initially be employed from sources external to the Yukon. Over time this will reduce to possibly as low as 5-10% depending on the success of the programs that BMC is putting in place.

The town of Faro is different from Watson Lake and Ross River since the number of available houses in Faro outnumbers that number of residents likely to seek employment with BMC. The raw data on the numbers of empty houses currently available at Faro have previously been provided within the project proposal and this represents an opportunity for BMC to offer relocation packages for prospective employees to Faro. BMC will work with the community and town council at Faro to turn this opportunity into a reality. BMC has provided a proposal to the Town of Faro for the purchase of a number of the available Lots for sale at Faro, containing approximately 16 dwellings. These dwellings will be renovated and available for relocating staff as required. Excess dwellings will be made available to locals requiring accommodation.

The housing supply situation in Whitehorse and the surrounding district has been well discussed both in the Project Proposal and the subsequent responses to information requests. BMC has already noted the very public programs that are being adopted by the Whitehorse Council in relation to housing and the councils publicly stated housing targets.

BMC is committed to working with the towns of Faro, Watson Lake and Whitehorse as well as RRDC and LFN Chiefs and Councils to ensure that employment opportunities and housing outcomes for locally employed BMC employees are optimised.

BMC also accepts that the local hire policy will not always be successful and that it will be required from time to time to source workers on a fly-in fly-out basis. This will be particularly true of the early years of the project. The reality is that where housing is available, BMC will relocate people to the Yukon. When it is not available, BMC will be required to transport these personnel on a long-distance commute basis. This has been incorporated into the operational budget contingencies for the Project.

YESAB ISSUE

The Proponent has indicated that blasting will occur four times per week, but it is not clear whether there would be multiple blasts per day – as a result, it is difficult to assess the significance of sleep-related adverse effects associated with this activity.

R3-19

During days with blasting, during what hours and how frequently will blasting occur?

During operations open pit blasting will occur approximately 4 times a week or on average once every 2 days. The blast will consist of a single blast where all connected holes will be initiated and exploded in sequence and will likely take a maximum of 3-5 seconds to be completed after initiation. The blasts will occur at shift change at the end of Day Shift prior to Night Shift starting work, nominally this will be between 4 and 6 pm.

On the day of the blast all personnel will be advised at the beginning of the shift when and where the blast will occur and the appropriate procedures to follow. Clearing of all personnel from the working area and surrounding areas, sounding of the appropriate warning sirens and announcements will occur prior to the blast. Due to the disruption to production activities, blasting during the shift will be kept to an absolute minimum though on occasion it may be necessary, for safety reasons, to reprime and blast misfires on shift. This is not expected to occur with any frequency and generally the misfire will be barricaded and then blasted with the next scheduled blast.

Underground blasting will similarly occur at shift change; however, it will occur more frequently with blasting possible twice a day, once at the end of Day Shift and again at the end of Night Shift. The amount of explosives initiated with each blast will be substantially less than the amount used with the open pit blasts and blasting noise, after initial decline development, will be contained within the underground workings.

Due to the proposed blasting schedule being at shift change there will be no adverse sleep related effects for employees. Day Shift employees will be coming off shift while Night Shift employees will be preparing to go on shift and there will be no personnel attempting to sleep at the time of the blasts.

YESAB ISSUE

While some level of on-site first aid / medical support is identified in this conceptual plan, it is also clear that there will be some reliance on external services. The level and type of care provided by the on-site medic is not outlined in detail, leaving uncertainty as to the effectiveness of these measures. Inadequate planning and/or on-site resources may place pressure on local and regional health care services, resulting in a potential reduced quality of services. Workers and/or other citizens may be at risk if adequate and appropriate care cannot be provided in a timely fashion.

R3-20

Provide information on the level and capacities of medical care that will be available on site (including for multiple casualty events). Include any proposed infrastructure, staffing requirements, etc.

The location of the proposed Project, being both geographically and logistically isolated, requires that the Project be largely self-supporting in all manners including the provision of medical services.

The provision of medical services on site will cover all services required from an occupational health, personnel health, and emergency preparedness standpoint.

There will be a dedicated dressing station at each work area; the Process Plant and Administration complex, Open Pit and Underground Workshops and Camp. The main First Aid room will be based at the Process Plant and Administration complex and there will be secondary First Aid room at the camp, which will also be used as a clinic for personal health queries and treatment.

Staff on site that will be members of the Health and Safety team consist of:

- On site Registered Nurse, responsible for managing occupational health requirements as well as patient care. The position will be rostered so that there is always a person on site filling this role. This role will be responsible for non-work related health issues as well as work related issues.
- On site EMT/Paramedic will be responsible for the day to day treatment and responses to work related incidents as well as assisting the registered nurse with day to day operations of the clinic. This position will be staffed 365 days/year and will be available 24hr/day.
- Off site Physician available 24/7 through an arrangement with a medical provider. The offsite physician will ensure that the on site medical staff have immediate access to advanced medical advice in emergency situations as well as medical advice for day to day operations.

On site staff will be provided with occupational health training as well as health screening such as hearing tests, fit testing of respirators, blood lead level testing, and other occupational health requirements. In some cases it may be necessary to mobilise off-site, contract, occupational health professionals to site for specific screening or training programs.

All supervisors and staff will be required to have had first aid training to a level at least the equivalent of a first aid attendant. The Company shall run local first aid courses and employees will be encouraged to further their training through the provision of training programs and incentives.

There will be at least one fully equipped ambulance available on site at all times and there will be alternative emergency transport plans in place for when travel conditions are not safe. The ambulance will be staffed by the onsite medic and nurse and a driver. The site will have a dedicated water cart equipped with a minimum capacity of 30,000 litres. This will be fitted with a water cannon and high pressure, high flow firefighting hose attachments for use during any fire emergency. The site will also have specialist foam firefighting equipment for use both underground and on the surface. Emergency staff will be appropriately trained and there will be staff available to operate the equipment 24/7.

There will be a fully equipped Mine Rescue team on site at all times with adequate personnel trained in Mine Rescue on site to provide backup and secondary teams as required. Mine Rescue training will be held regularly, and all teams will be trained in all facets of Mine Rescue.

Prior to construction Mutual Aid Agreements will be signed with mining operations in the region for assistance in the case of a serious extended emergency. Mine rescue teams train for the availability of a minimum of three teams, for a continuous response, with the addition of more teams if a response extends beyond 6-8 hours. Mutual Aid Agreements with other mining operations may meet this need for additional teams by providing access to pre-planned mobilization of additional mine rescue teams and equipment.

There will be times when there is a need to evacuate personnel for medical reasons, whether work related or personal medical emergencies. These evacuations will be handled, where possible, by using existing Project travel equipment and personnel. Where immediate evacuation is required, and the available site facilities are inadequate, then the services of Yukon Emergency Medical Services (YEMS) will be utilised. Prior to construction, an emergency preparedness plan will be developed in conjunction with YEMS and Yukon medical providers to ensure that there is adequate emergency preparedness.

In the extremely unlikely case of an incident involving multiple casualties then all involved medical resources will be stretched to their limits. This not only includes the resources available at the Kudz Ze Kayah site but medical resources Yukon-wide. However, with the Mutual Aid Agreements in place and suitable planning between the Yukon medical providers and BMC the effects can be minimised. The concept of a multi-casualty event is not limited to the site and could happen anywhere within Yukon. The advantage of having a facility with the medical and rescue capabilities available at KZK will benefit the entire Yukon, both industrial sites and highways, and will extend the current network of providers further. This was demonstrated in 2016 when a seriously injured Yukoner was injured in a shooting accident and was driven to the Kudz Ze Kayah site by his wife. BMC's emergency team responded and stabilised the man's condition before arranging an airlift to hospital in Whitehorse. The quick actions of all concerned saved the injured man's life. Personnel involved were awarded the Commissioners Medal for their actions.

YESAB ISSUE

In order to validate calculations, confirm whether the number of heavy duty vehicles (HDVs) and light duty vehicles (LDVs) per day is the number of trips per day for each road segment. If not, please provide the number of trips per day.

R3-21

Provide the number of one-way trips per day for both heavy-duty vehicles (HDVs) and light duty vehicles (LDVs) for each road segment. Road segments include:

a) the Robert Campbell Highway between Watson Lake and the start of the Tote Road,

b) the start of the Tote Road to the mine site,

c) the start of the Tote Road to the Finlayson Lake airstrip,

d) Highway 37 from Watson Lake to Stewart,

e) the start of the Tote Road to Faro.

f) the start of the Tote Road to Whitehorse via the Klondike Highway, and

g) other major road segments used to conduct mining activities for the duration of the project.

The original information presented in Chapter 4 of the Project Proposal (pp 112, Table 4-33) referred to average number of round trips per day for truck haulage of supplies in and concentrate out (i.e. pertained to heavy haulage vehicles that had a greater than 20 tonne haulage capacity). The number of one-way trips would be twice the numbers quoted in Table 4-33.

To expand Table 4-33 to account for the entire traffic load some assumptions were made:

- Light Duty Vehicles (LDVs) will consist of passenger vehicles and vans, while all other vehicles will be classed as Heavy-Duty Vehicles (HDVs).
- A daily average for the year will be used although there will be wide seasonal variations as well as climatic caused variations. An example of this is that there is expected to be substantially more LDV traffic during summer than in winter due to site specific projects and site visits being slated for climatically favourable conditions.
- Labour requirements and transportation methods are as laid out in the Project Proposal and the backup alternatives are not used.
- Allowance has been made for the impact of load restrictions on the Yukon Highways imposed by YG during spring break up. This will have the effect of lowering HDV traffic during the restriction period but will also increase HDV traffic above the yearly average immediately prior to and after the restrictions are imposed.

Table 8-2 presents the average daily one-way trips, for both HDV and LDV, for the road segments listed in the information request.

Table 8-2: Average Daily One Way Trips for LDVs and HDVs

		Construction		Operations		Active Closure		Post Closure	
		HDV Total	LDV Total	HDV Total	LDV Total	HDV Total	LDV Total	HDV Total	LDV Total
Robert Campbell Hwy West									
Gatehouse to:	Finlayson Airstrip	-	4	-	6	-	4	-	0.1
	Ross River	4	2.3	4	8	4	2.3	-	0.6
	Faro	-	0.3	-	0.3	-	0.3	-	-
	Whitehorse	2	6	2	6	2	6	-	0.6
	Total	**6**	**12.6**	**6**	**21**	**6**	**12.6**	-	**1.3**
Robert Campbell Hwy South									
Gatehouse to:	Watson Lake	12	2.3	46	2	12	2.3	-	-
	Total	**12**	**2.3**	**46**	**2**	**12**	**2.3**	-	-
Highway 1 and 37									
Watson Lake to:	Stewart	-	-	38	-	-	-	-	-
	Other BC Destinations	10	-	8	-	10	-	-	-
Gatehouse to Mine site		**18**	**14.9**	**52**	**23**	**18**	**14.9**	-	**1.3**

YESAB Issue

Groundwater monitoring should be conducted on the camp drinking water supply, ensuring that criteria are below the applicable Drinking Water Standards (or that treatment effectively brings the criteria below those levels). In case water does not meet the criteria at any point during the project activities, the Proponent shall identify an alternate safe supply for drinking water and other potable water needs.

R3-22

Describe the process for testing to ensure that drinking water is potable for the life of the Project.

Filtration, disinfection and monitoring of the groundwater (used for drinking water) for the life of the Project will be consistent with the procedures that have been successfully used at KZK for the past three years.

The drinking water filtration and disinfection (i.e., UV units) equipment is and will continue to be National Sanitation Foundation/American National Standards Institute (NSF/ANSI) certified and is/will be regularly tested and serviced according to manufacturer's guidelines. Note this system includes a solenoid shutoff valve that is triggered by malfunction of the UV sterilizer unit.

Drinking water is and will continue to be sampled on a monthly basis and sent to an International Organization for Standardization/International Electrotechnical Commission (ISO/IEC) 17025 accredited laboratory for testing of all chemical and physical parameters listed in Schedule B of the *Drinking Water Regulations* (Yukon Order in Council, 2007) as well as the Guidelines for Canadian Drinking Water Quality (Health Canada, 2014). BMC will monitor the water more frequently if required. The results of the water testing are and will continue to be posted in the kitchen, showers and washrooms on a monthly basis.

In the event that the water does meet the drinking water regulations or guidelines, signs will be posted indicating the water is not potable and not to drink the water. Once the issue is resolved the notices will be removed and all staff and contractors will resume utilizing the water for drinking.

R3-23

Identify an alternate safe supply for drinking water and other potable water needs.

In the unlikely event that an alternative safe supply of water is needed:

- BMC can install an additional groundwater well at the site, which would consist of filtration, disinfection and monitoring of the groundwater (as described in response to R3-22); or
- BMC is currently planning for two water treatment plants on site to produce potable water. If the camp water supply fails, then water from the other unit can be trucked to the camp until it is repaired.

YESAB ISSUE

The project proposal states:

"...given the low levels of particulate that are predicted in the Air Quality Model (Chapter 6 of the Project Proposal). It is unlikely that concentrations in soils (from dust from the Project facilities) will increase. As such, there is low potential for changes in soil quality to affect the quality of country foods (i.e. vegetation or wildlife) during all Project phases."

There is not adequate justification within the assessment to claim that particulate matter accumulation over time would not result in any appreciable increase in metals in the impacted environment and no subsequent changes to vegetation concentrations from soil uptake.

Note that in Chapter 6 (Air Quality), it is referenced that modelled TSP concentrations at the camp receptor location exceed Yukon Ambient Air Quality Standards (YAAQS) during the operations phase, and that annual concentrations in the operations phase are 15-16 times greater than baseline conditions.

R3-24

Provide rationale and references to support the claim that levels of particulate would not result in appreciable increases to metal concentrations in soil.

In addition to ambient air concentration modelling presented in Chapter 6 of the Project Proposal, TSP deposition rates were modeled. The results of this modelling for the operation phase (worst case) were presented and discussed Chapter 12 (Vegetation) of the Project Proposal and are reproduced below for easier reference.

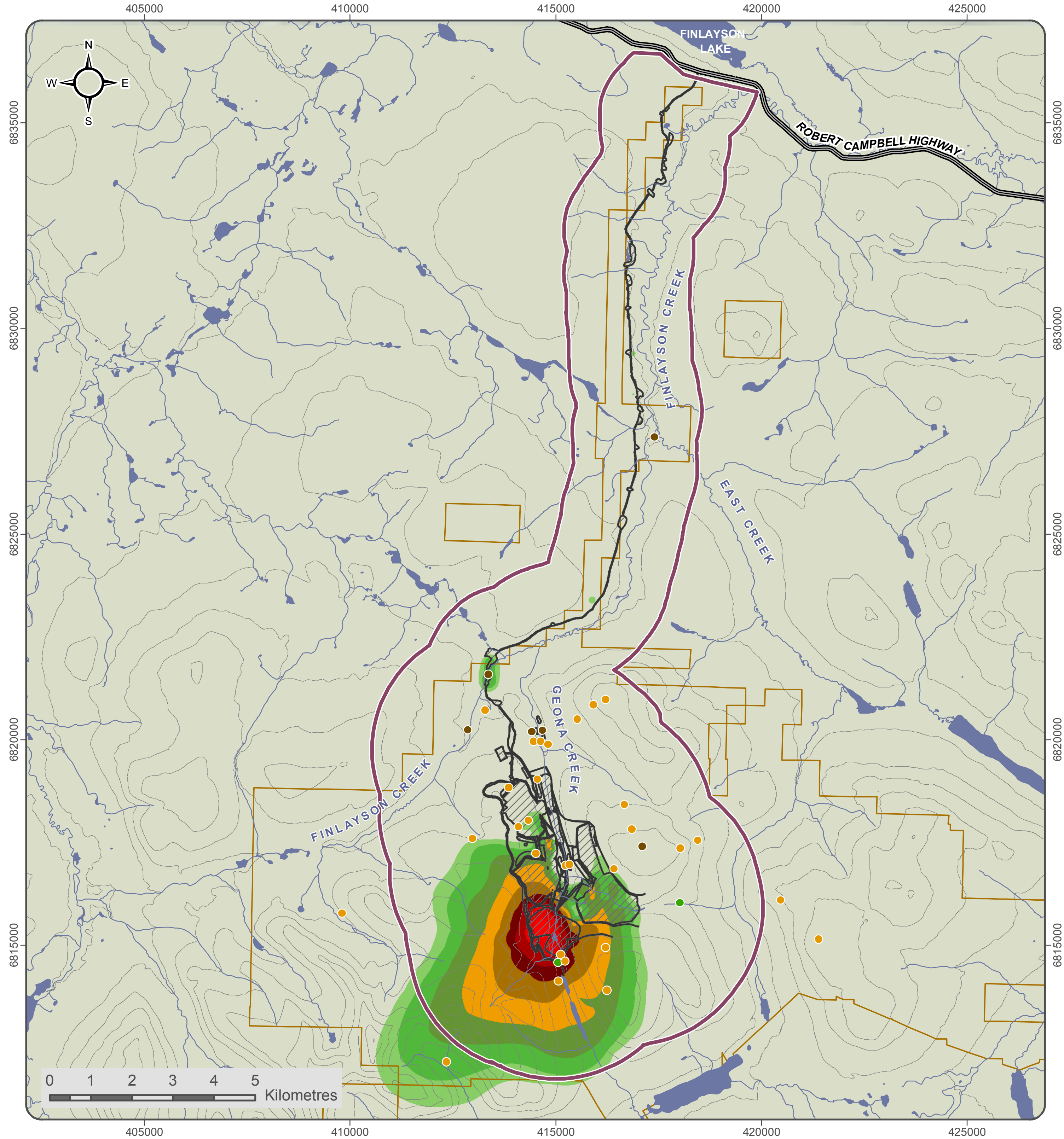
Project related activities occurring in the construction and operation phases may cause a potential short-term impact on metal concentrations in plants used for traditional purposes and wildlife browse. More specifically, the construction activity of pit development and operation activities of open pit operations, ore processing, and storage facilities operations can generate dust that disperses in the prevailing wind currents and settles on soil and vegetation and thereby can be absorbed or transported into the plant. Figure 12-7 of Chapter 12 of the Project Proposal shows the results of the dust dispersion model (for the operations phase when there is maximum dust generation) and is included here as Figure 8-1 for clarity. The model input parameters and results are outlined in Appendix E-1 of the Project Proposal. Based on the modelling, open pit blasting is the primary source of dust and dust dispersion patterns spread some to the east, but mostly to the southwest due to the prevailing northeast winds. It should be noted that the pit is expected to contain reasonable quantities of water and that pure 'dry' blasting is not expected. This model therefore predicts a worst-case scenario that includes the conservative assumption that all equipment will be operating at once (which will not occur during the life of the Project) and that blasts are at the surface for the life of the Project (which will only occur during a portion of the construction period). Atmospheric transport of dust is also expected from the Class A and Class B Storage Facilities, the ROM Pad, and Low Grade Ore Pad and unpaved roads, these sources were included in the model.

Vegetation metal concentrations are typically affected by airborne dust accumulation on plant tissue and the surrounding soils. Metals are a necessary micronutrient for plants, but at high concentrations can impair plant growth (Csavina et al., 2011). Lichens and mosses in particular are more sensitive to airborne metals and road dust (Walker and Everett, 1987; Farmer, 1993). Road dust also has the potential to reduce plants that prefer acidic environments (Walker and Everett, 1987).

Effects of metals in vegetation on wildlife varies widely depending on the plant species being consumed, foraging range, quantity of plant material consumed, climate, and the wildlife species (Roggeman et al., 2013).

The Project is a proposed polymetallic operation that can potentially result in dispersion of mineralized dust; therefore, there is the potential for the Project to be a source of various heavy metals that could adversely affect surrounding vegetation and indirectly human, and wildlife health. However, the risk of metals reaching detrimental concentrations is considered to be low because the operation is not located near an urban centre (i.e., receptors are distant). The majority of metals and metalloids in airborne emissions from the Project will be from open pit dust for which a worst- case scenario has been modelled. In addition, a more realistic case was modelled in response to R3-25, which indicates deposition will be low and limited to the Project footprint. The majority of the other dust is likely to be sourced from road use and dust from this source is unlikely to contain the deleterious elements in question due to the composition of its construction materials. In addition, the wildlife (i.e., receptors) browsing on vegetation surrounding the Project have large ranges and are unlikely to consume nearby vegetation in quantities that would cause detrimental effects to the wildlife or any humans consuming these animals (Roggeman et al., 2013). This is particularly true when evaluating the model results for the realistic case which shows deposition being localized to the project footprint.

Based on the above, the Project Proposal concluded that there would be no appreciable increases to metal concentrations in soil and thus no significant adverse effects. The company also committed to monitoring soil concentrations at the site for the life of the Project and to developing adaptive management thresholds during permitting. If during the Project lifetime, concentrations in soils reach the adaptive management thresholds (that will be defined during permitting) the PQRA will be updated and additional management measures to reduce dust will be implemented as per the adaptive management plan (i.e. road watering and/or installing misters at certain key locations). In addition, based on comments received from YESAB and RRDC, during the Adequacy stage, BMC will be installing 5 air quality monitoring stations at the site in 2018. These stations will monitor TSP, PM_{10}, $PM_{2.5}$ and metals. The results of the 2018/2019 monitoring program will be used to confirm the assumed baseline concentrations of TSP, PM_{10} and $PM_{2.5}$ that were presented in the Project Proposal. The stations will also be used in the monitoring program during construction, operations, and active closure.



TSP Deposition Annual Average (µg /m²/Day)

- < 400
- 400 - 500
- 500 - 700
- 700 - 1,000
- 1,000 - 1,800
- 1,800 - 3,500
- 3,500 - 6,500
- 6,500 - 13,500
- 13,500 - 27,500
- 27,500- 55,600

- Baseline Vegetation Sample
- Baseline Soil Sample
- Baseline Vegetation and Soil Sample

- Location of Proposed Infrastructure
- Local Study Area
- BMC Minerals (No.1) Ltd. Mineral Claim Areas
- Waterbody
- Watercourse
- Contour (100 m interval)

KUDZ ZE KAYAH PROJECT
RESPONSE #3 TO YESAB EXECUTIVE COMMITTEE INFORMATION REQUEST

FIGURE 8-1
EXTENT OF DUST DEPOSITION DURING OPERATIONS (WORST CASE)

JUNE 2018

Predicted annual depositions shown on this map were produced with CALPUFF Version 5.8.5
National topographic Data Base (NTDB) compiled by Natural Resources Canada at a scale of 1:50,000. Reproduced under license from Her Majesty the Queen, as represented by the Minister of Natural Resources Canada. All rights reserved.
Datum: NAD 83; Projection: UTM Zone 9N

AEG

BMC MINERALS

D:\Project\AllProjects\Kudz_Ze_Kayah\Maps\03_Study\Air_Quality\TSP_for_Vegetation\Extent_of_TSP_Oper_Worst_20180606.mxd
(Last edited by: amatlashevska; 06/06/2018/13:36 PM)

R3-25

Provide a sensitivity analysis to demonstrate how any changes to the assumptions would impact the resulting conclusions and which of these changes will have the biggest impact on total suspended particles (TSP) levels in air and soil.

In addition to the results presented in response to R3-24 above for operations, average annual TSP deposition rates were also modeled and mapped for the worst case scenario for construction and closure and are presented in Figure 8-2 and Figure 8-3 below. The figures show contours of predicted annual average deposition rates. The only difference in the model between the Project phases is location, area and/or intensity of dust sources, the meteorological data input and other modeling parameters were kept the same for the three runs. The results show that the main factor affecting ambient air concentrations and deposition rates is whether or not there is blasting occurring in the open pit. The amount, frequency and type of traffic on unpaved roads also varies considerably between Project phases and deposition rates results along roads vary accordingly. Details on dust sources modeled for each Project phase are available in the Air Dispersion Model Report (Appendix E-1 of the Project Proposal).

Since blasting activities appeared to have an important impact on the resulting ambient concentrations and depositions rates, and parameters used in the model were chosen for a worst-case blasting scenario, the CALPUFF air dispersion model was rerun based on a more realistic blasting scenario. In the original model (results shown in Figures 8-1 to 8-3, the TSP emission factor for fugitive dust emissions from blasting, was calculated according to the following equation (EPA, 1995):

$$E = 0.000014(A)^{1.5}$$

where:
E = TSP emission factor in lb/blast
A = horizontal area (ft2), with blasting depth ≤ 70 ft (21.3 m)

For the operations phase, the area assumed for the emission factor calculation was 2,500 m² per blast; however, the resulting factor was applied to the entire open pit area.

Because the above calculation doesn't account for soil moisture or for blasting depths greater than 70 ft (or ~ 21 meters), the equation below, previously recommended by the EPA (Sinclair Knight Merz, 2005), was used to re-calculate the emission factor.

$$E = 344(A^{0.8})(M^{-1.9})(D^{-1.8})$$

where:
E = TSP emission factor in kg/blast
A = area of the blast (m2)
M = moisture content (%)

D = blast depth

The moisture content was assumed to be 5.4% by weight based on the ore moisture content from the mill water balance. The blasting depth for the operations phase was assumed to be 100 m to produce a more realistic representation of depths expected during the operations phase. The area of the blast was still assumed to be 2,500 m^2, however the resulting factor was applied to that same area rather than the entire pit. It was assumed that there would be four blasts per week.

Resulting deposition rates for the realistic case for the operations phase is shown in Figure 8-4. Although not representative of long term accumulation, maximum 24-hr ranked results are compared in Table 8-3 for the worst case (original model run) and realistic case (model rerun) blasting parameters. It shows that by changing the blasting emission factor to account for moisture content and for a greater blasting depth, and changing how the factor is applied to the area (2,500 m^2 at a time), resulting deposition rates are considerably reduced (by a factor of 2.6 to 3.7 for the first four ranks).

Similarly, the realistic case was modelled for the construction phase (assuming a blasting depth of 20 m, three blasts per week, a blasting area of 1,500 m^2 and the same moisture content as above) and the results are presented in Figure 8-5, showing considerably reduced deposition rates compared to the worst-case scenario.

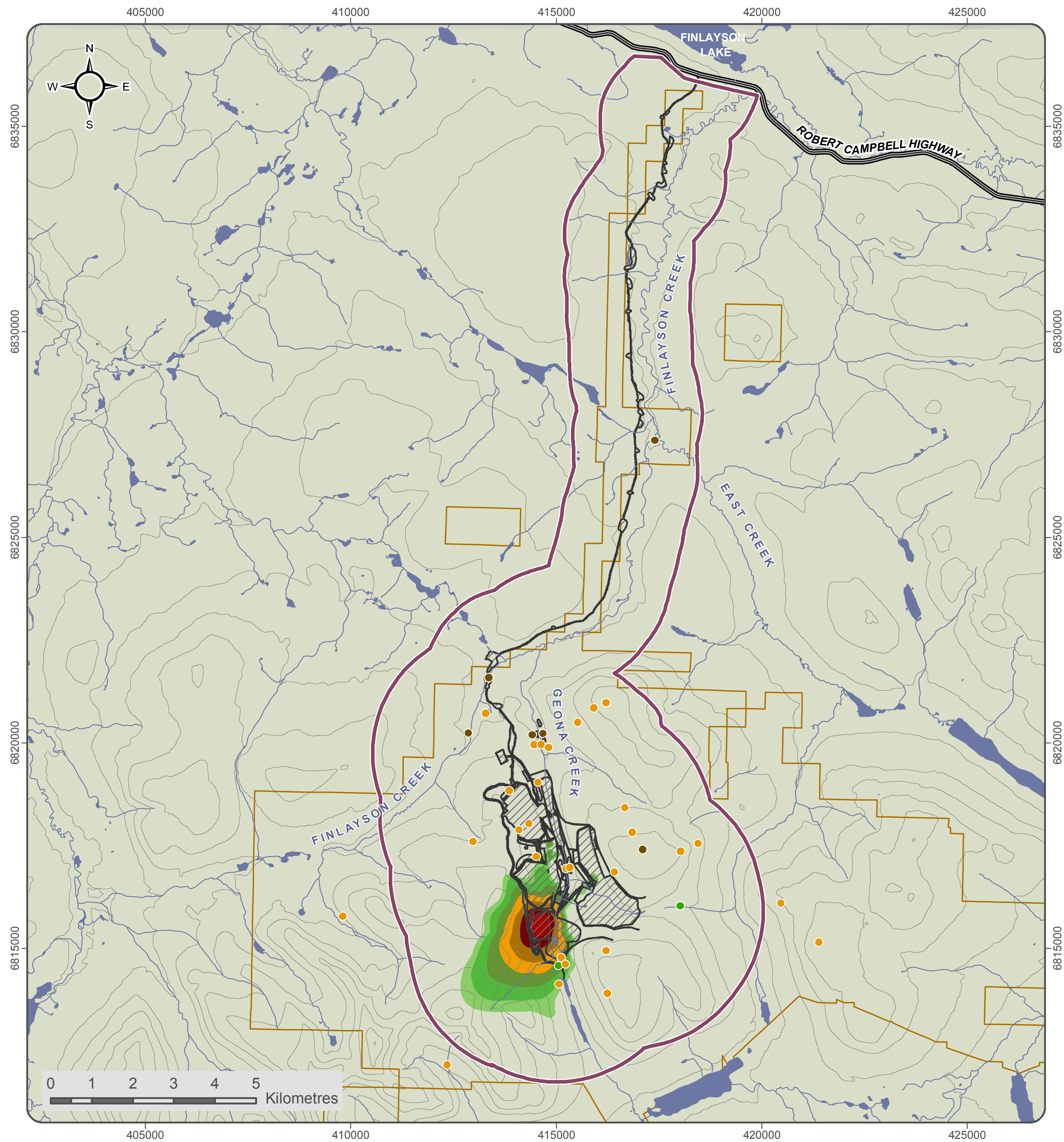
Another factor that plays a key role in dust dispersion and deposition rates is meteorological conditions. Although not representative of long term accumulation, maximum 24-hr ranked results can be used to evaluate model sensitivity to meteorological parameters input. They are based on worst case meteorological conditions and results indicate that deposition rates at the maximum point of impingement (POI) decrease rapidly with more favourable meteorological conditions, of which the most important factors are wind speed and direction. Table 8-4 presents ranked 24-hr deposition rate results for the operation phase (original worst case model run) and associated meteorological parameters; note that rank 10 represents about 52% of rank 1.

Table 8-3: Ranked 24-hr Deposition Rates at Maximum POI, Worst Case and Realistic Case

Rank	Operations Phase, Worst Case Blasting Scenario					Operations Phase, Realistic Blasting Scenario				
	Peak Deposition Rate (µg/m²/s)	Year, Julian Day	Easting (m)	Northing (m)	Receptor	Peak Deposition Rate (µg/m²/s)	Year, Julian Day	Easting (m)	Northing (m)	Receptor
1	2.31	2015, 330	414,607	6,815,621	467	0.90	2015, 269	414,807	6,817,521	284
2	1.95	2015, 316	414,607	6,815,371	450	0.53	2016, 201	414,807	6,817,521	284
3	1.73	2016, 026	414,607	6,815,621	467	0.49	2015, 244	414,807	6,817,521	284
4	1.66	2015, 325	414,607	6,815,621	467	0.47	2016, 110	414,807	6,817,521	284

Table 8-4: Ranked 24-hr Deposition Rates at Maximum POI, Operations Phase (Worst-Case Blasting Scenario)

Rank	Peak Deposition Rate (µg/m²/s)	Year, Julian Day	Easting (m)	Northing (m)	Receptor	Average Daily Air Temperature (°C)	Average Daily Wind Speed (m/s)	Maximum Wind Speed (m/s)	Direction of Maximum Wind Speed (°)
1	2.31	2015, 330	414,607	6,815,621	467	-0.8	14.12	21.75	31.9
2	1.95	2015, 316	414,607	6,815,371	450	-8.4	11.72	16.39	343.6
3	1.73	2016, 026	414,607	6,815,621	467	-3.5	13.77	19.03	38.4
4	1.66	2015, 325	414,607	6,815,621	467	-2.9	14.57	18.47	55.5
5	1.63	2015, 324	414,607	6,815,621	467	-5.8	12.25	16.93	32.3
6	1.54	2015, 272	414,607	6,815,621	467	6.7	12.15	18.37	14.5
7	1.45	2015, 272	414,607	6,815,371	450	6.7	12.15	18.37	14.5
8	1.39	2015, 269	414,607	6,815,371	450	-4.1	10.25	14.99	100.2
9	1.22	2015, 351	414,607	6,815,371	450	-12.9	8.79	11.72	315.9
10	1.21	2015, 324	414,607	6,815,371	450	-5.8	12.25	16.93	32.3



TSP Deposition Annual Average (µg /m²/Day)

- <400
- 400 - 500
- 500 - 700
- 700 - 1,000
- 1,000 - 1,800
- 1,800 - 3,500
- 3,500 - 6,500
- 6,500 - 13,500
- 13,500 - 27,500

- Baseline Vegetation Sample
- Baseline Soil Sample
- Baseline Vegetation and Soil Sample

- Location of Proposed Infrastructure
- Local Study Area
- BMC Minerals (No.1) Ltd. Mineral Claim Areas
- Waterbody
- Watercourse
- Contour (100 m interval)

Predicted annual depositions shown on this map were produced with CALPUFF Version 5.8.5
National topographic Data Base (NTDB) compiled by Natural Resources Canada at a scale of 1:50,000. Reproduced under license from Her Majesty the Queen, as represented by the Minister of Natural Resources Canada. All rights reserved.
Datum: NAD 83; Projection: UTM Zone 9N

AEG

BMC MINERALS

KUDZ ZE KAYAH PROJECT
RESPONSE #3 TO YESAB EXECUTIVE COMMITTEE INFORMATION REQUEST

FIGURE 8-2
EXTENT OF DUST DEPOSITION DURING CONSTRUCTION (WORST CASE)

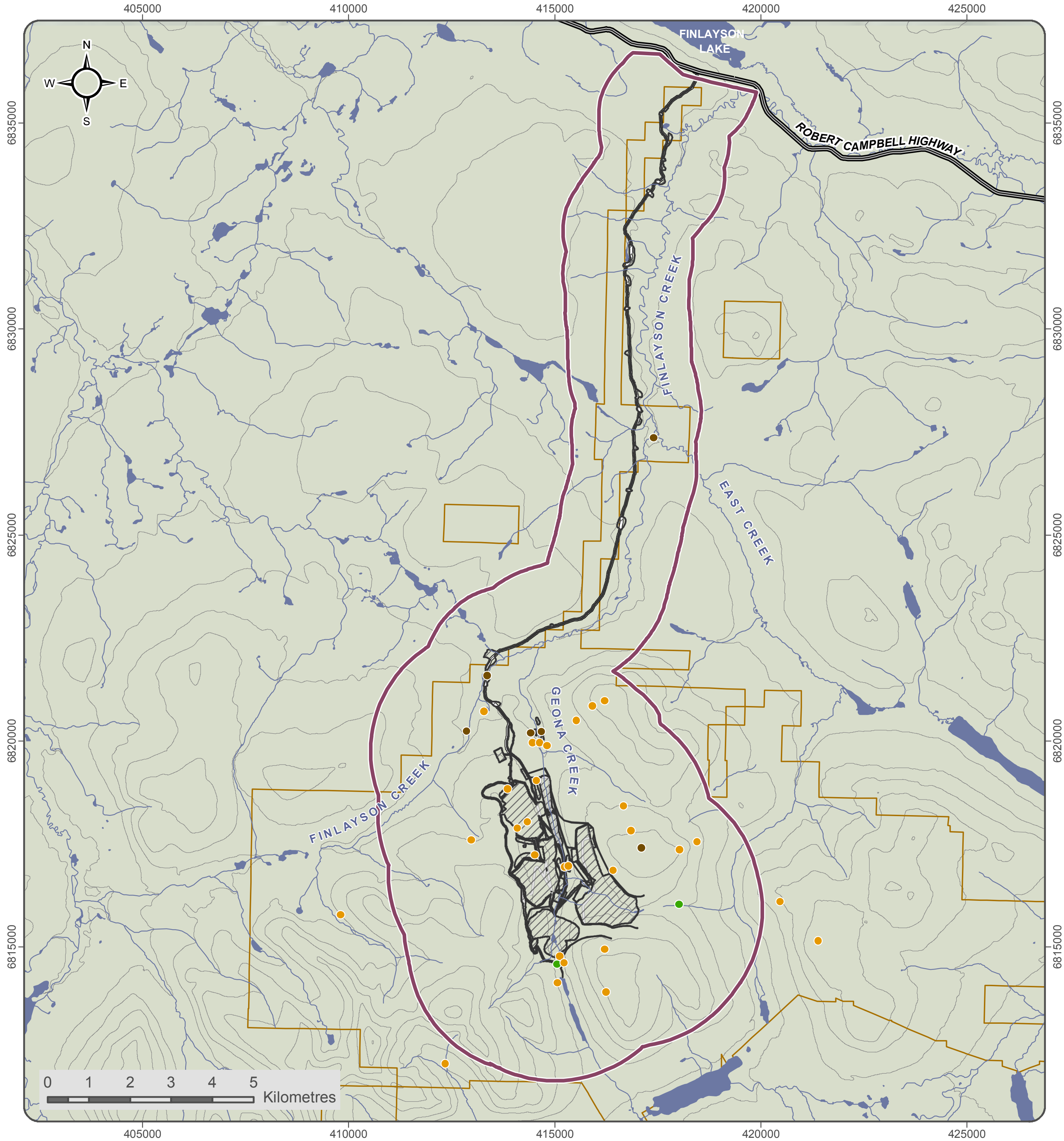
JUNE 2018

D:\Project\AllProjects\Kudz_Ze_Kayah\Maps\03_Study\Air_Quality\TSP_for_Vegetation\Extent_of_TSP_Construction_20180430.mxd
(Last edited by: amatlashevska; 06/06/2018/13:37 PM)

KUDZ ZE KAYAH PROJECT
RESPONSE #3 TO YESAB EXECUTIVE COMMITTEE INFORMATION REQUEST

FIGURE 8-3

EXTENT OF DUST DEPOSITION DURING CLOSURE



TSP Deposition Annual Average (µg /m²/Day)

- <50

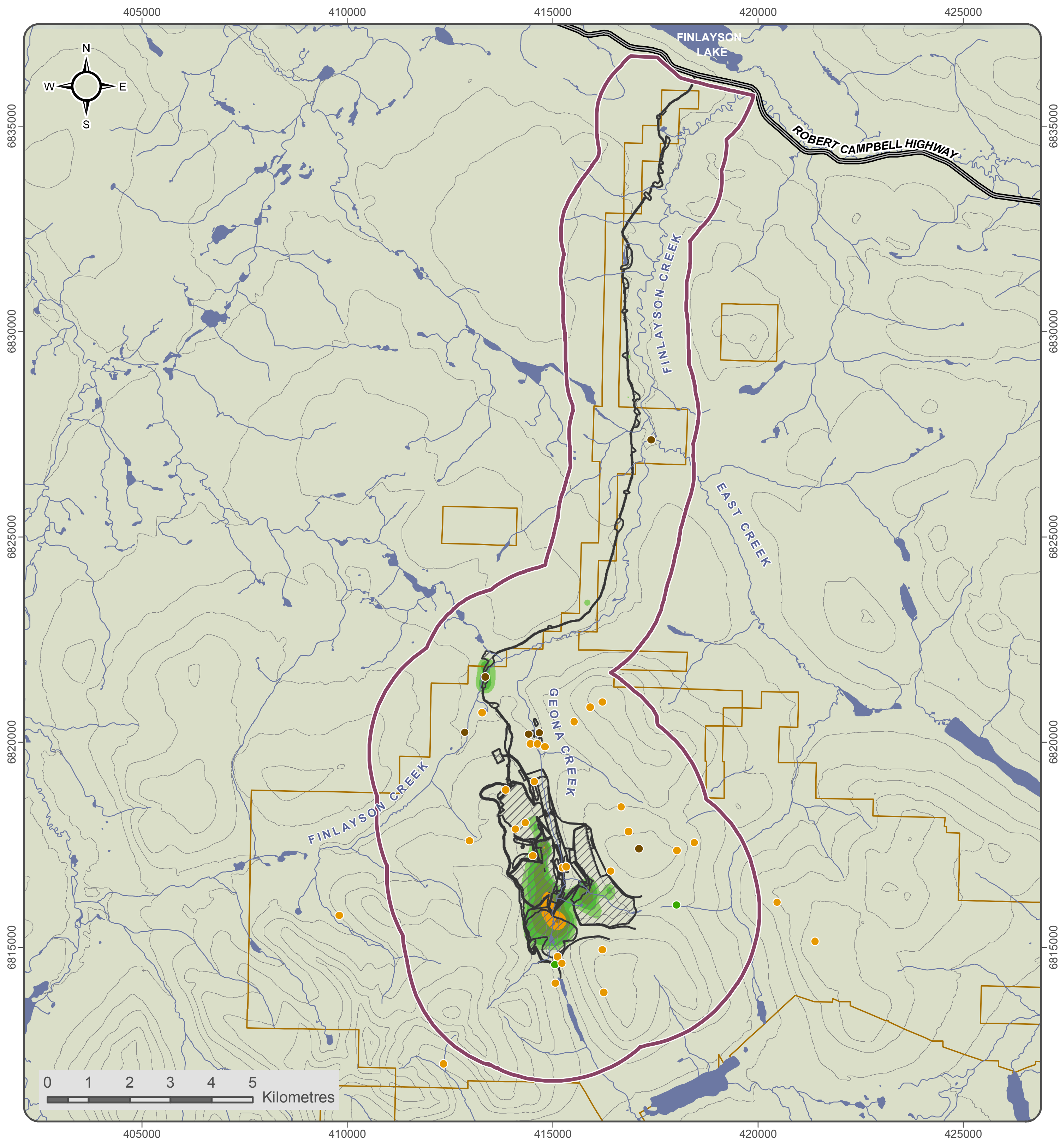
- Baseline Vegetation Sample
- Baseline Soil Sample
- Baseline Vegetation and Soil Sample
- Local Study Area
- Location of Proposed Infrastructure
- BMC Minerals (No.1) Ltd. Mineral Claim Areas
- Waterbody
- Watercourse
- Contour (100 m interval)

Predicted annual depositions shown on this map were produced with CALPUFF Version 5.8.5

Datum: NAD 83; Projection: UTM Zone 9N

JUNE 2018

D:\Project\AllProjects\Kudz_Ze_Kayah\Maps\03_Study\Air_Quality\TSP_for_Vegetation\Extent_of_TSP_Closure_20180430.mxd
(Last edited by: amatlashevska; 06/06/2018/13:43 PM)



Deposition Annual Average (µg /m²/Day)

- <400
- 400 - 500
- 500 - 700
- 700 - 1,000
- 1,000 - 1,800
- 1,800 - 3,500

- Baseline Vegetation Sample
- Baseline Soil Sample
- Baseline Vegetation and Soil Sample
- Location of Proposed Infrastructure

- Local Study Area
- BMC Minerals (No.1) Ltd. Mineral Claim Areas
- Waterbody
- Watercourse
- Contour (100 m interval)

KUDZ ZE KAYAH PROJECT
RESPONSE #3 TO YESAB EXECUTIVE COMMITTEE INFORMATION REQUEST

FIGURE 8-4
EXTENT OF DUST DEPOSITION DURING OPERATIONS (REALISTIC CASE)

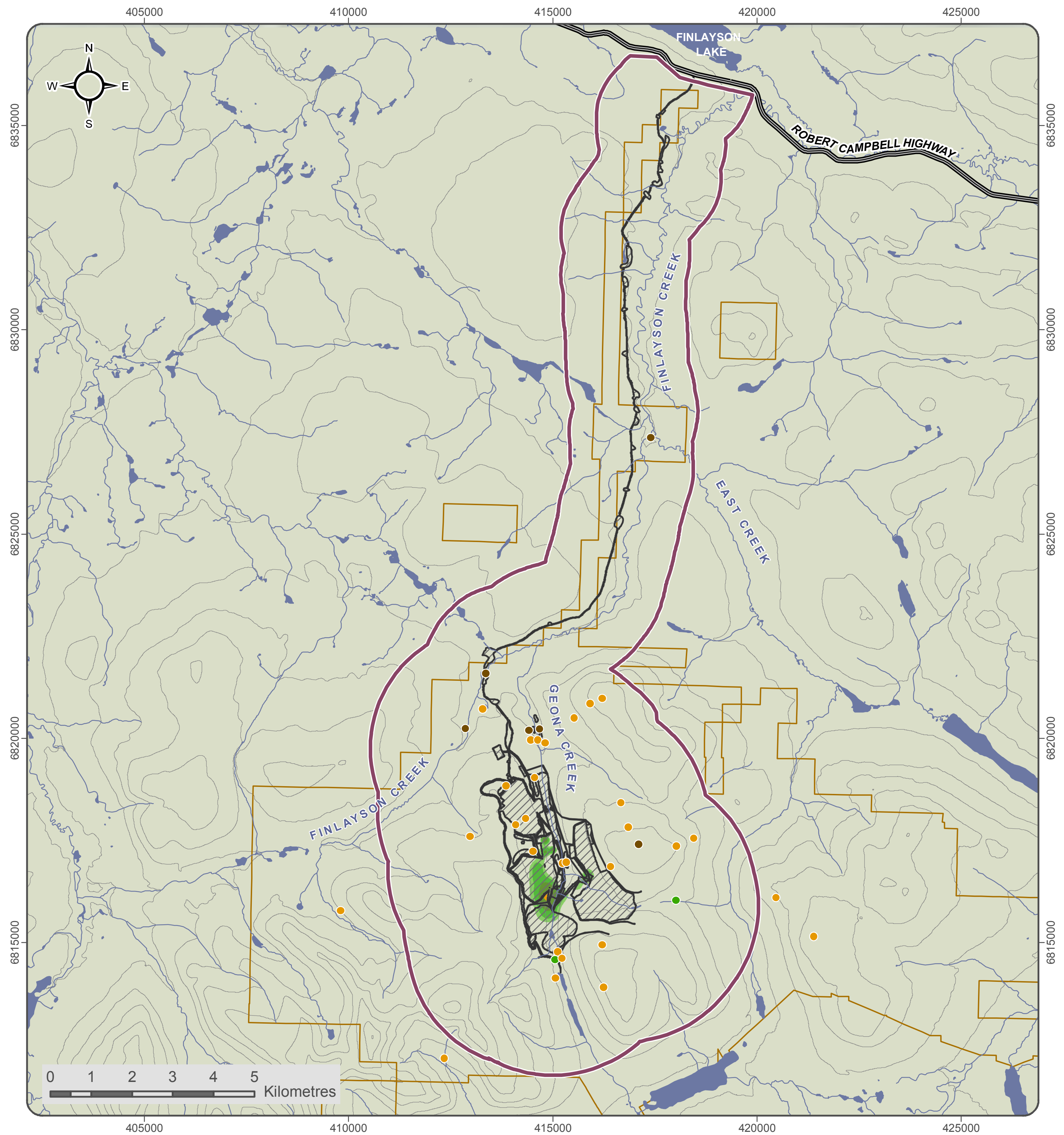
JUNE 2018

Predicted annual depositions shown on this map were produced with CALPUFF Version 5.8.5
National topographic Data Base (NTDB) compiled by Natural Resources Canada at a scale of 1:50,000. Reproduced under license from Her Majesty the Queen, as represented by the Minister of Natural Resources Canada. All rights reserved.
Datum: NAD 83; Projection: UTM Zone 9N

AEG

BMC MINERALS

D:\Project\AllProjects\Kudz_Ze_Kayah\Maps\03_Study\Air_Quality\TSP_for_Vegetation\Extent_of_TSP_Oper_Best_20180606.mxd
(Last edited by: amatlashevska; 06/06/2018/13:41 PM)



Deposition Annual Average (µg /m^2/Day)

- <400
- 400 - 500
- 500 - 700
- 700 - 1,000
- 1,000 - 1,800

- Baseline Vegetation Sample
- Baseline Soil Sample
- Baseline Vegetation and Soil Sample

- Location of Proposed Infrastructure
- Local Study Area
- BMC Minerals (No.1) Ltd. Mineral Claim Areas
- Waterbody
- Watercourse
- Contour (100 m interval)

KUDZ ZE KAYAH PROJECT
RESPONSE #3 TO YESAB EXECUTIVE COMMITTEE INFORMATION REQUEST

FIGURE 8-5
EXTENT OF DUST DEPOSITION DURING CONSTRUCTION (REALISTIC CASE)

JUNE 2018

Predicted annual depositions shown on this map were produced with CALPUFF Version 5.8.5
National topographic Data Base (NTDB) compiled by Natural Resources Canada at a scale of 1:50,000. Reproduced under license from Her Majesty the Queen, as represented by the Minister of Natural Resources Canada. All rights reserved.
Datum: NAD 83; Projection: UTM Zone 9N

AEG

BMC MINERALS

D:\Project\AllProjects\Kudz_Ze_Kayah\Maps\03_Study\Air_Quality\TSP_for_Vegetation\Extent_of_TSP_Construction_Revised_20180605.mxd
(Last edited by: amatlashevska; 06/06/2018/13:42 PM)

R3-26

Discuss how the increases of total suspended particles (TSP) as a result of the project will not cause increases of metal in soil over the life of the project.

TSP resulting from windblown dust from unpaved roads is expected to have similar metal content as natural soils in the area. Soil samples were collected at 32 locations in the Local Study Area. Metal concentrations in soil samples were compared to Canadian Council of Ministers of the Environment (CCME) soil guidelines for metal concentrations at industrial sites (Table 12-5 of the Project Proposal and are presented in Table 8-4 below for clarity). Of all the metals in which guidelines have been established (i.e., 19), four exceeded the guidelines including arsenic, copper, selenium, and zinc. The arsenic guideline was exceeded at 16 out of 32 sites. Copper, zinc, and selenium exceeded the guidelines at three, two, and one site, respectively. Similar metal concentration ranges as presented in Table 8-4 are expected from windblown dust from unpaved roads during the Project phases.

Table 8-5: Soil Metal Concentrations Compared to CCME Guidelines

Element	Units	CCME Industrial Guideline	Sites Exceeding CCME Guideline	Min	Max	Mean	Standard Deviation	95th Percentile
Aluminum	mg/kg	-	-	7,570	27,300	13,605	4,392	25,430
Antimony	mg/kg	40	None	<0.10	1.78	0.38	0.30	1.21
Arsenic	mg/kg	12	PA01, PA02, PA04, PA06, PA09, PA10, PA15, PA20, PA45, PA51, PA52, PA55, PA57, PA58, PA59, PA72	2.39	96	17	18	71
Barium	mg/kg	2,000	None	54	838	170	141	591
Beryllium	mg/kg	8	None	<0.40	0.61	0.26	0.26	0.59
Bismuth	mg/kg	-	-	0.13	1.03	0.27	0.16	0.71
Cadmium	mg/kg	22	None	0.09	7.84	0.91	1.42	4.89
Calcium	mg/kg	-	-	1,370	19,900	5,269	3,542	16,215
Chromium	mg/kg	87	None	15	80	37	16	79
Cobalt	mg/kg	300	None	4.41	38	14	7.20	32
Copper	mg/kg	91	PA02, PA16, PA17	3.52	192	40	37	145
Iron	mg/kg	-	-	14,500	58,100	30,993	11,455	56,340
Lead	mg/kg	600	None	10	72	28	17	70
Lithium	mg/kg	-	-	5.90	23	14	4.09	23
Magnesium	mg/kg	-	-	2,510	21,200	7,721	3,834	17,020
Manganese	mg/kg	-	-	112	1,320	572	288	1,282
Mercury	mg/kg	50	None	<0.05	0.14	<0.05	--	--
Molybdenum	mg/kg	40	None	0.63	9.11	1.89	1.54	6.11
Nickel	mg/kg	89	None	9.96	71	32	15	68
Phosphorus	mg/kg	-	-	439	3,930	1,061	638	2,775
Potassium	mg/kg	-	-	439	4,540	1,340	961	4,133

Element	Units	CCME Industrial Guideline	Sites Exceeding CCME Guideline	Min	Max	Mean	Standard Deviation	95th Percentile
Selenium	mg/kg	2.9	PA02	<0.5	6.52	<0.5	--	--
Silver	mg/kg	40	None	<0.05	1.45	0.28	0.38	1.44
Sodium	mg/kg	-	-	<100	159	<100	--	--
Strontium	mg/kg	-	-	9.24	72	24	16	67
Thallium	mg/kg	1	None	0.06	0.43	0.15	0.08	0.35
Tin	mg/kg	300	None	0.15	1.14	0.47	0.23	0.97
Titanium	mg/kg	-	-	122	1,350	606	344	1,323
Uranium	mg/kg	300	None	0.66	9.50	1.77	1.65	6.12
Vanadium	mg/kg	130	None	19	122	51	26	122
Zinc	mg/kg	360	PA16, PA20	28	784	161	141	593
Zirconium	mg/kg	-	-	<0.5	4.98	1.37	1.19	4.50

* 95th percentile is equivalent to maximum concentration

Other sources of TSP and atmospheric metals are predicted from residual ore dust from blasting, open haul trucks going to the crusher, the live ore stockpile, tailings dust from the Class A Storage Facility where the material has dried but is not yet covered, and earthmoving activities in an area with naturally higher mineralization. The main dust deposition areas are located within the Project footprint (see Figure 8-1, Figure 8-2 and Figure 8-3). Predicting the exact potential concentrations in the TSP associated with these sources is not possible; however, given the low levels of TSP deposition predicted for the Project phases, BMC has concluded there would be no appreciable increases to metal concentrations in soil and thus no significant adverse effects.

Mitigation measures that will be implemented to reduce fugitive dust will also be effective in reducing dust deposition and metal increase in soils (see Air Quality Management Plan in Section 18.11 of the Project Proposal). A vegetation and soil monitoring plan will be implemented to track the effects of dust deposition relating to the mine area and Access Road. The monitoring plan is scheduled to be conducted every three years starting in the construction phase and will track change in soil metal concentrations from baseline conditions. The company has committed to developing adaptive management thresholds during permitting. If soil metals in soil exceed guidelines or are consistently higher than baseline concentrations, then additional mitigations measures will be taken to reduce emissions (as per the adaptive management plan – to be developed during permitting). In addition, the PRQRA would be updated.

In addition, based on comments received from YESAB and RRDC, during the review process, BMC will be installing 5 air quality monitoring stations at the site in 2018, these stations will monitor TSP, PM_{10}, $PM_{2.5}$ and metals. The results of the 2018/2019 monitoring program will be used to confirm the assumed baseline concentrations that were presented in the Project Proposal. The stations will also be used in the monitoring program during construction, operations, and active closure.

YESAB ISSUE

The project proposal states:

"Based on this review, changes in air, soil, water and vegetation are not likely to result in a change in the quality of country foods.[...]*Monitoring programs for the environmental media will confirm this and an adaptive management program will be implemented (threshold values will be developed during the preparation of the application materials to support the permitting of the Project)."*

Health Canada suggests that human health based target levels or screening levels (and the rationale for the selection of such levels) be developed so that action can be taken if monitoring shows that levels are approaching or exceeding target values. Moreover, target values should be set at levels lower than those that pose risks so that action can be taken prior to putting human health at risk.

R3-27

Provide human health based target levels or screening levels and rationale explaining why these levels are appropriate in respect to the potential for adverse human health effects.

At the request of Health Canada, BMC has developed preliminary tissue screening concentrations for protection of human health in a variety of country foods.

However, it is stressed that the tissue screening concentrations are considered to be preliminary based on (but not limited to) the following:

- Firstly, the local baseline concentrations in these foods are currently not known and it would be unreasonable and perhaps harmful to the health of the local Kaska to develop tissue screening concentrations that are less than background. In the case of fish, there are currently no edible-sized fish available for sampling while in the case of moose and caribou, it was not considered to be responsible to encourage hunting of these animals for our program and is against BMC's no hunting policy. BMC is aware that the Kaska are discussing development of a tissue sampling program with a researcher and BMC is willing to fund a portion of the analytical component of this program. Nevertheless, at the current time, background concentrations of the metals in moose, caribou and edible-sized fish remain unknown.

- There is also concern regarding the lack of detailed Health Canada guidance on development of tissue screening concentrations for country foods. In some cases, Health Canada's contaminated site group use different toxicity reference values and different target risk values than Health Canada's Food Branch and, in these cases, it is unclear which values take precedent. Whereas Health Canada's contaminated site group provides more detailed written guidance, it seems that the Health Canada Food Branch guidance is more case-by-case and provided only after country food data have been collected. It would seem that the Food Branch has decided it is important to not unnecessarily scare people away from healthy country foods and, consequently, no tissue concentrations/standards for comparison of results are provided by Health Canada for country foods (instead, the case-by-case approach seems preferred).

- Access to the Geona Creek valley for country foods harvesting is currently limited due to active exploration and therefore land-use and consumption rates are likely very low. This may change during post-closure.

For these reasons, the tissue screening concentrations provided below are considered to be preliminary and it is proposed that these will be revisited after country food monitoring data have been collected by the Kaska, agency, comments are provided and there is more certainty regarding use of the Geona Creek Valley for country foods harvesting. It is likely more prudent to develop screening values during the closure period when the Geona Creek Valley becomes accessible again for country food harvesting and more reliable consumption data are available.

Approach

To develop preliminary tissue screening concentrations, it was necessary to: 1) identify the country food groups of concern; 2) identify upper end consumption rates for the identified country foods for various age groups; 3) identify toxicity reference values (TRVs) and amortization factors associated with these TRVs; and, 4) identify reasonable target Hazard Quotient (HQ) values and Incremental Lifetime Cancer Risk (ILCR) estimates for the various foods. These aspects are discussed below.

Country Foods of Concern

It is stressed that discussions with the Kaska are planned and thus food types and consumption estimates and screening values may be revised. Nevertheless, in the interim, the key country food types of concern were considered to be the following:

- Caribou;
- Moose;
- Fish; and
- Berries.

It was considered unnecessary to include animals that are trapped since trapping occurs in the next valley and not within the Geona Creek valley or the Project Area. Land-use disruptions payments are made (as per the Socio-Economic Participation Agreement) due to the unavailability of the Project area for trapping.

In the case of moose and caribou, it is acknowledged that caribou and moose organs are consumed by Kaska; however, these tissue were excluded from the development of preliminary tissue screening values. Background concentrations of various metals in the organs of these animals remains a concern across Canada that is monitored by Health Canada (particularly cadmium concentrations in kidney). BMC has not identified a formal policy from Health Canada on what level of cadmium in the organs of these animals is considers acceptable; however, we suspect that the approach used likely considers a number of factors beyond the toxicological calculations (since it can be the case that even a meal per month of some background concentrations of organs across Canada can approach or exceed some TRVs). To avoid confusion of mixed messages regarding the safe consumption of moose and caribou organs, we have not calculated preliminary tissue screening concentrations for the organs.

Consumption Rates

Based on local knowledge and professional judgement, the following rates were considered to be reasonably representative of higher end consumption frequency (however, please see the note above regarding harvest from the Geona Creek Valley):

- Caribou: 3 times per week, all year long for a lifetime (75 g serving for toddler and 200 g serving for adult);
- Moose: 3 times per week, all year long for a lifetime (75 g serving for toddler and 200 g serving for adult);
- Fish meat: 1 times per week, 6 months per year for a lifetime (75 g serving for toddler and 200 g serving for adult); and
- Berries: 7 times per week, up to 15 days per month per year for a lifetime (75 g serving for toddler and 200 g serving for adult).

Toxicity Reference Values and Amortization Factors

In addition to the use of the TRVs recommended in Health Canada (2010; 2011) and cited in Table 3-4 of Appendix R2-N (Preliminary Quantitative Risk Assessment) of Response Report #2 (BMC, 2017a), TRVs that have been recommended by Health Canada's Food Branch were reviewed. Briefly, although published with caveats, Health Canada (2013) Food Branch offered TRVs for the following metals:

- Arsenic: no value provided
- Cadmium: no value provided; however, a TDI of 0.83 µg/kg bw/day based on a WHO (2011) Tolerable Monthly Intake of 25 µg/kg bw/month was identified and was considered to be likely preferable for use in food risk assessments by Health Canada.
- Copper: a TDI of 125 µg/kg bw/day was provided in Health Canada (2013)
- Fluoride: no value provided
- Lead: no value provided
- Selenium: a TDI of 10.6 µg/kg bw/day was identified (based on TDI of 750 µg/person/day and an assumption of 70.7 kg body weight)
- Zinc: a TDI of 700 µg/kg bw/day was identified.

Since the Health Canada (2013) Food Branch TRVs are specific to food, the TRVs for copper, selenium and zinc and WHO (2011) for cadmium were used to develop tissue screening concentrations. For arsenic, a TDI of 0.3 µg/kg bw/day was used for evaluation of non-cancer risk (i.e., US EPA (2018) reference dose while a Risk Specific Dose (RsD) of 0.006 µg/kg bw/d was estimated for an ILCR of 1 x 10^{-5} based on the potency factor used in the Preliminary Quantitative Risk Assessment (PQRA); however, it is stressed that this RsD is for inorganic arsenic and does not apply to total arsenic measurements in country foods. For the remainder of the COPCs, the TRVs recommended in Health Canada (2010; 2011) were used to develop the preliminary tissue screening concentrations.

For most chemicals, the maximum amortization factor was one week, the exposure was effectively assumed to be once per week for the purposes of calculation of screening concentrations. The exceptions were arsenic cancer risks (which were amortized over a lifetime) and cadmium and lead where non-cancer risks were amortized over a month due to the toxicokinetics of these substances which indicated justification for the approach (for non-cancer risk, this only affects organ concentrations).

Acceptable Risk Values

One of the more difficult aspects of the development of tissue screening concentrations is the identification of acceptable risk values. In the case of soil and drinking water, Health Canada has traditionally used Hazard Quotient (HQ) values in the range of 0.2 and Incremental Lifetime Cancer Risk (ILCR) estimates in the range of 1×10^{-5}; however, there is less guidance on values that should arise from country foods and it seems that Health Canada may base its decisions more on a case-by-case basis and consider local background tissue concentrations which are not currently available.

With the above in mind, in the case of non-cancer risks, the target risk was considered to be an HQ value of 0.2 for caribou meat, moose meat, fish meat and berries.

In the case of cancer risks, the target risk was considered to be an ILCR of 1×10^{-5} for caribou meat, moose meat, fish meat and berries.

Calculation of Preliminary Tissue Screening Concentrations

Based on the above and the risk assessment principles discussed in the Preliminary Quantitative Risk Assessment (PQRA), the equation for estimation of preliminary tissue screening concentrations (PTSC) for non-carcinogens was:

$$PTSC\ non\text{-}cancer = \frac{TDI \times BW \times AF \times TR}{SS \times FQ}$$

Where:

PTSC non-cancer = preliminary tissue screening concentration for protection of non-cancer risks (µg/g; wet weight)

TDI = tolerable daily intake (µg/kg bw/day) (see Table 3-4 of PQRA)

BW = body weight (16.5 kg for toddlers; 70.7 kg for adults)

AF = amortization factor (days) (7 days for all chemicals except 30 days for cadmium and lead in berries)

TR = target risk (HQ = 0.2 for all foods)

SS = serving size (75 g for toddlers and 200 g for adults)

FQ = frequency of consumption in the amortization period (days)

- 3 days per week for moose/caribou meat
- 1 day per week for fish from local creek

- 7 days per week for berries, for all metals except cadmium and lead which were amortized as 15 days of consumption per month

The equation for estimation of tissue screening concentrations for carcinogens (i.e., arsenic) was as follows:

$$\text{PTSC cancer} = \frac{RsD \times BW \times AF \times TR}{SS \times FQ}$$

Where:

PTSC non-cancer = preliminary tissue screening concentration for protection of non-cancer risks (µg/g; wet weight)

RsD = Risk Specific Dose (0.006 µg/kg bw/day for arsenic; the only carcinogen evaluated) (derived for an ILCR of 1×10^{-5} from potency factor in Table 3-4 of PQRA)

BW = body weight (70.7 kg for adults)

AF = amortization factor (days) (365 days)

TR = target risk (ILCR = 1×10^{-5} for all foods)

SS = serving size (200 g for adults)

FQ = frequency of consumption in the amortization period (days)

- 156 days for moose/caribou meat (i.e., 3 days per week x 52 weeks)
- 26 days for fish from local creek (i.e., 1 day per week for 6 months per year)
- 30 days for berries (i.e., 7 days per week x 1 month per year)

In the case of arsenic, where tissue concentrations were estimated for both non-cancer and cancer risks were estimated, the lower of the two concentrations was selected as the preliminary tissue screening concentration (arsenic cancer risks were more sensitive than non-cancer risks for all foods other than berries).

<u>Results</u>

Based on the above, preliminary tissue screening concentrations were estimated for non-carcinogens (toddler receptor characteristics) and carcinogens (adult receptor characteristics). These tissue concentrations are the arithmetic mean or 95% upper confidence limit of the mean (UCLM) values and are considered to be protective of non-cancer risks (i.e., HQ of 0.2 for all foods) and cancer risks (i.e., ILCR of 1×10^{-5} for all foods) (Table 8-6).

Table 8-6: Preliminary Tissue Screening Concentration for Protection of Human Health

Substance	Preliminary Tissue Screening Concentration for Protection of Human Health (µg/g; wet weight)
Moose and Caribou Meat	
Arsenic (as inorganic As; not total As)	0.0049

Substance	Preliminary Tissue Screening Concentration for Protection of Human Health (µg/g; wet weight)
Cadmium	0.085
Copper	13
Fluoride	11
Lead	0.062
Selenium	1.1
Zinc	72
Fish Meat	
Arsenic (as inorganic As; not total As)	0.030
Cadmium	0.26
Copper	38
Fluoride	32
Lead	0.18
Selenium	3.3
Zinc	220
Berries	
Arsenic (as inorganic As; not total As)	0.013
Cadmium	0.073
Copper	5.5
Fluoride	4.6
Lead	0.053
Selenium	0.47
Zinc	31

It is stressed that these are preliminary due to a variety of reasons, including but not limited to:

1. Uncertainties regarding baseline concentrations in animal tissue;

2. Uncertainty in applicable Health Canada TRV's; and

3. Uncertainty in types of foods and consumption frequency of foods harvested from the Geona Creek valley due to active exploration activities minimizing the ability to actively harvest in the valley.

Proposed Application of the Preliminary Tissue Screening Concentrations

It is stressed that it is important to not scare Kaska away from country foods which are most often considered to be substantially healthier than many store-bought food options. Consequently, under this approach, the preliminary tissue screening concentrations are proposed to be used in the following manner:

- Tissue monitoring data collected (with Kaska assistance or lead by Kaska as described above for ungulates and BMC lead studies on vegetation and fish);
- Tissue data (arithmetic mean and 95% UCLM concentrations) will be reviewed by a toxicologist/risk assessor who will compare these results to preliminary tissue screening concentrations but also background concentrations for that tissue (where available) (the higher of the two will be primarily used);
- Draft interpretation memo prepared and shared with Kaska and agencies;

- Finalize interpretation memo; and
- Work with Kaska and agencies to communicate results in a manner that meets the needs of the community and encourages continued harvesting of country foods.

YESAB ISSUE

Inadequate rationale is provided in the Revised Preliminary Quantitative Risk Assessment (PQRA) to support the claim that all single exposure pathways (soil ingestion, soil dermal absorption, particulate inhalation, vapor inhalation, water dermal exposure, water ingestion, berry ingestion, fish ingestion, and wild game ingestion) are inoperable for Receptors of Concern as summarized in Tables 3-1 and 3-2.

R3-28

Provide additional rationale to support single exposure pathways shown in Table 3-1 and Table 3-2 as inoperable.

Health Canada has requested rationale for why many pathways were designated as "no pathway due to the lack of predicted contamination". We agree with the comment, inappropriate wording was used in Tables 3-1 and 3-2 of the PQRA (Appendix R2-N of Response Report #2) (BMC, 2017a). It would have been more accurate to have indicated that these pathways were all evaluated when data were available, and rather than "no pathway" there was no change to risks from many of these pathways because there was no expected change to environmental concentrations at the nearest residents and recreational receptors. Consequently, revisions to Tables 3-1 and 3-2 are presented as Table 8-5 and Table 8-6 below.

Table 8-7: Conceptual Model for Nearest Residents

Critical receptor	Exposure pathways	
Toddler/ Adult	√	Soil Ingestion
	√	Soil dermal absorption
	√	Particulate inhalation
	NPC	Vapour inhalation
	√	Water dermal exposure
	√	Water ingestion
	√	Berry ingestion
	√*	Fish ingestion
	√*	Wild game ingestion

√ – Requires evaluation in the human health risk assessment

√* – Requires evaluation in the human health risk assessment; however, no media concentration currently available

NPC - No pathway due to the lack of predicted contamination

Table 8-8: Conceptual Model for Nearest Recreational Receptor

Critical receptor	Exposure pathways	
Toddler/Adult	√	Soil Ingestion
	√	Soil dermal absorption
	√	Particulate inhalation
	NPC	Vapour inhalation
	√	Water dermal exposure
	√	Water ingestion
	√	Berry ingestion
	√*	Fish ingestion
	√*	Wild game ingestion

√ – Requires evaluation in the human health risk assessment

√* – Requires evaluation in the human health risk assessment; however, no media concentration currently available

NPC - No pathway due to the lack of predicted contamination

It is stressed that these revisions to Tables 3-1 and 3-2 do not affect the subsequent risk estimates provided in the PQRA. More specifically and as apparent in review of the spreadsheet risk estimates and worked example calculations of the PQRA, the values provided were in a manner that is consistent with the revised Tables 3-1 and 3-2.

YESAB ISSUE

The PQRA with combined multi-media risks may still underestimate health risks as the assessment does not evaluate other media that may be relevant. For example,

Contaminants of Potential Concern (COPCs) that may be present in the air as a result of contaminated windblown dust from on-site soils impacted by site activities and/or direct emissions (e.g. ore dust from blasting, stockpiles, tailings, etc.) are not addressed. Health Canada suggests including COPCs that exceed soil quality guidelines (or may exceed soil quality guidelines if soils are impacted over time) and may be elevated in air, as well as including COPCs that may be emitted directly to air for which there were no criteria. Measured or predicted (modelled) point-of-impingement concentrations of the COPCs are compared with applicable air quality guidelines/ standards where they exist. If the measured or predicted concentration exceeds the screening air quality concentration or guideline/ standard, the COPC is retained for further evaluation in the HHRA. However, the absence of an applicable guideline/standard is not a sound rationale for excluding a chemical from further assessment. This is discussed in greater detail in Health Canada's "Supplemental Guidance on Human Health Risk Assessment of Air Quality, Version 2.0" (2017).

R3-29

Provide rationale as to why additional media and additional contaminants of potential concerns (COPCs) were not considered.

Baseline metals concentrations in soil collected from the Project area have shown exceedances of arsenic (at several locations) and copper, selenium and zinc (at one to three locations) (Table 12-5 of the Project Proposal and are presented in Table 8-4, above, in response to R3-26). These COPCs have been included the PQRA.

Not only are there no air quality guidelines for metals, there are no reliable models to predict air concentrations of metals (as a component of dust). Subsequently PM_{10} and $PM_{2.5}$ are typically assessed (of which metals are a component). PM_{10} and $PM_{2.5}$ have been assessed in the PQRA and have been further assessed in response to R3-32.

The proposed air, soil and vegetation monitoring program will include metals. If additional COPCs are identified through these monitoring programs, the PRQRA will be updated to include them. Preliminary screening values would also be developed for any additional COPCs.

YESAB ISSUE

The PQRA does not currently address COPC exposure through fish and wild game ingestion. Rather, integrating COPC exposure from potential key country foods is currently proposed to be contingent on outcomes of the vegetation and tissue monitoring and adaptive management strategies during the permitting phase. As a result, the current assessment may underestimate the human health risks resulting from the Project. A sensitivity analysis for each exposure pathway (e.g. soil ingestion, soil dermal absorption, particulate inhalation, vapor inhalation, water dermal exposure, water ingestion, berry ingestion, fish ingestion, wild game ingestion) may be warranted to be included in the uncertainty analysis of the PQRA in order to identify and anticipate which pathways carry the most weight to the overall risk.

R3-30

Provide a sensitivity analysis, included as part of the uncertainty analysis for each exposure pathway (e.g. soil ingestion, soil dermal absorption, particulate inhalation, vapor inhalation, water dermal exposure, water ingestion, berry ingestion, fish ingestion, wild game ingestion) in order to identify and anticipate which pathways carry the most weight to the overall risk. Explain how results of the sensitivity analysis have been incorporated into the effects assessment.

A sensitivity/uncertainty analysis was provided in the PQRA (Chapter 5 of Appendix R2-N of Response Report #2) (BMC, 2017a); however, this earlier analysis did not seem to meet Health Canada's expectations and, as a result, an expanded response is provided below.

The PQRA was completed using a series of upper-bound assumptions intended to overestimate human health risks and thereby ensure a conservative assessment. Given the conservative assumptions used in this assessment, it is quite possible that actual risks may be substantially lower than estimated herein. Nevertheless, certain assumptions were key determinants in the acceptability of risks. The following analysis discusses some of the most important assumptions that had key influences on the results and conclusions of the PQRA.

Chemical Concentrations in the Environment

One source of uncertainty is the concentrations of the chemicals in soil that a person may be exposed to through their typical daily activities. The PQRA was based on both mean and maximum estimates of concentrations. In the case of the latter, it is likely that concentrations will be lower than assumed in the PQRA.

Toxicity Reference Values

The approach that health agencies use to estimate acceptable or "safe" levels of exposure are typically very conservative and employ considerable safety factors to ensure protection to the general population. In most cases, Health Canada values were used as the primary source of information when available. In some cases, Health Canada did not have TRVs available (i.e., antimony, arsenic for non-cancer effects and nitrite) and in such cases alternate values recommended by major agencies were used. It is considered unlikely that such regulatory agency-derived TRVs would underestimate health risks. Overall, the TRVs used in this assessment represent dose rates that are unlikely to present unacceptable health risks and may overestimate health risks.

Time Spent at Site

For evaluation of carcinogens, it was assumed that people spend one week per year for an entire lifetime at the site.

In the case of non-carcinogens, exposures were not amortized on a yearly or lifetime basis and instead were essentially assumed to occur over the whole year. For example, even though berries may be available for only 4 weeks per year, non-cancer risks were not adjusted by a factor of 4 weeks over 52 weeks since this may understate risks that could occur during the 4 week exposure period and, thus, HQ estimates did not include such amortization.

It is clear that intakes do not occur at the assumed rate for the entire year and, thus, this contributes to the conservativeness of the PQRA. Annual and lifetime amortization is considered by Health Canada to be an acceptable approach for cancer risk estimation and, thus, such amortization was incorporated in ILCR estimation.

It is considered unlikely that this approach for either non-carcinogens or carcinogens underestimate health risks.

Age Groups Evaluated

The key age groups evaluated were toddlers for non-cancer risks and adult receptors for cancer risks. These are the defaults in the PQRA spreadsheet tool and are consistent with the development of CCME soil quality guidelines. It is noted that Health Canada (2010; 2012) risk assessment guidance also discusses the composite receptor representing all age groups for evaluation of carcinogens; however, this was not an option in the PQRA spreadsheet tool. It is further stressed that none of the substances that will have increased post-closure concentrations (i.e., antimony, fluoride or nitrite) were considered to be carcinogens and, consequently, not using a composite receptor was considered to be an insensitive decision.

Soil Ingestion Rate

Health Canada guidance was the primary source of information used to characterize receptors at the site. One of the most important input parameters was soil ingestion rate of toddlers. For toddlers, a soil ingestion rate of 80 mg/day was assumed which is recommended by Health Canada (2012) and used in the Health Canada (2011) PQRA spreadsheet tool. As noted by Wilson et al. (2013) (a paper with Health Canada co-authors), it would seem the assumed values are greater than 95^{th} percentile for toddlers. Consequently, the selected soil ingestion rate is considered to be likely to substantially overestimate intakes.

Implementation of the Mitigation and Management Measures

The PQRA was based on the mitigation and management measures presented in the Project Proposal as being implemented to ensure the key elements remain in place. If certain elements are not in place, it is possible that greater risks will exist than estimated in the current PQRA. Consequently, it is considered extremely important that the mitigation and management measures are implemented and monitored throughout the life of the Project (as per the permit requirements that will be in place prior to construction and operations).

Overall Uncertainty in the Risk Assessment

Overall, it is unlikely that human health risks have been underestimated in the risk assessment and it is quite possible that risks have been overestimated due to the conservatism in the assumptions made in the risk calculations.

As shown in Appendix B of the PQRA (Appendix R2-N of Response Report #2) (BMC, 2017a) the sources of risk for the two elements driving the risk assessment (i.e., lead and arsenic) are provided in the table below.

Table 8-9: Drivers of the Preliminary Quantitative Risk Assessment

	Arsenic	Lead (Pb)
Pathway driving risks	Drinking water ingestion (63% of risk), soil ingestion (25% of risk), dermal contact with soil (7% of risk) and berry ingestion (5% of risk)	Soil ingestion (70% of risk), drinking water (23% of risk) and berry ingestion (7% of risk)
Overall risk estimate	ILCR = 2.2 x 10^{-6} (based on maximum concentrations) ILCR = 4.51 x 10^{-6} (based on maximum concentrations)	HQ = 0.33 (based on arithmetic mean concentrations) HQ = 0.83 (based on maximum concentrations)

At the current time, only drinking water concentrations are expected to have measurable changes to the concentrations due to the Project. Nevertheless, monitoring of concentrations in various media is proposed. In the case of arsenic, the current maximum soil concentration of 98 µg/g does exceed the CCME soil quality guideline of 12 µg/g; however, it is considered unlikely that people would only be exposed to maximum soil concentration. In the case of drinking water, the predicted post-closure surface water concentration of 3.19 µg/L meets current drinking water guidelines of 10 µg/L for arsenic.

In the case of lead, an unexpected change in soil concentrations is expected to have the greatest effect on risks since it was the media driving the results of the PQRA; however, it is stressed that the values provided in the table above are for a soil concentration of lead of 72 µg/g which is a low concentration and below current CCME soil quality guidelines for protection of human health (i.e., 140 µg/g). Similarly, the predicted post-closure surface water concentration of lead of 3.1 µg/L meets current drinking water guidelines of 10 µg/L for lead such that there could be a substantial increase beyond expected without any exceedance of the guidelines.

It is also noted that use of the arithmetic mean and 95% UCLM concentrations would be more consistent with such PQRA.

It is noted that the limited time spent at the site was a key factor in estimation of arsenic risks. With persons being present one week per year for a lifetime, cancer risks were amortized by this factor. This type of amortization is appropriate and considered to meet Health Canada guidance.

Furthermore, certain other factors related to arsenic and lead that were not included in the PQRA were:

- No use of the *in vitro* bioaccessibility literature which have suggested that default values of 40% for arsenic and 80% for lead could be considered.
- No amortization of non-cancer risk of lead over a 1 month period which has been suggested in the literature would be acceptable based on the toxicokinetics of lead.

With this noted, it is still possible (but not likely) that risks may have been underestimated for certain receptors in some cases. The two main conditions where risks may have been underestimated would include:

- Any situation where environmental modelling has underestimated concentrations; and
- Any situation where people are not accurately represented by the assumed receptor assumptions.

Monitoring will be undertaken to ensure that neither of the conditions described above occur. If such conditions do occur, additional risk analysis would be recommended to address potential increases in human health risks.

YESAB ISSUE

The proponent chose a toddler for the evaluation of non-carcinogenic risks and adult for the evaluation of carcinogenic risk. However, no workers were included in the assessment as they are protected by "...worker health and safety plan and associated WBC regulations…". Health Canada considers worker camps as residential communities, as off-duty workers spend a portion of their time at the camp for meals, recreation and sleeping, and advises the assessment of the potential impacts of the project on the health of off-duty workers. Due to the close proximity of the camp to airborne emission sources, inhalation of airborne emissions is likely to be the main route of exposure of off-duty workers to particulate matter and other airborne contaminants. Additionally, the PQRA indicates that off-duty workers are exposed to modelled air quality that has exceedances during the operation phase. Although these exceedances are mentioned to be less than 1% of the time over a 24-hour period, this is not sufficient rationale to omit this receptor and pathway in the PQRA. For example, short term increases in particulate matter have been associated with increased morbidity and mortality in epidemiological studies. It is stressed that short-term health effects may range from slight and reversible (mild irritation) to severe and irreversible effects (including death), and therefore the full range of effects needs to be considered. The potential for acute and sub-chronic effects should not be ignored, if relevant, and should be evaluated in a thorough and scientifically defensible manner in a quantitative risk assessment. All receptor exposure populations and scenarios should be thoroughly assessed before ruling them out.

R3-31

Include off-duty workers as a receptor in the human health risk assessment.

The only operable exposure pathway for off-duty workers is particulate inhalation. An assessment of potential risks from this pathway is provided in response to R3-32.

Shift workers will work 12 hour shifts while on-site and will not be permitted access to the mine site when off-shift for recreational purposes; therefore, the following pathways have been excluded from the assessment:

- Soil ingestion / soil dermal ingestions – impacts to soil at the camp from deposition of metals is not predicted. See responses to R3-24, R3-25 and R3-26 for additional information regarding dust deposition.
- Vapour inhalation – no vapours are predicted from the Project activities at the camp.
- Water dermal exposure and water ingestion - access to the Project water bodies when off-shift will not be permitted for recreational purposes. The only water related exposure will be from the camp well. See response to R3-23 which relates to ensuring the water from the camp well is potable.
- Country food ingestion – ingestion of berries, fish and wild game will not occur because during operations off-shift workers will not be permitted on the mine site for recreational purposes and all employee and contractors will be required to adhere to BMC's no hunting and fishing policy.

R3-32

Provide additional rationale as to why the inhalation pathway is excluded from the assessment.

In the case of metals, there is no predicted change in soil concentrations at the camp and, thus, there would be no expected change in risks from soil resuspension into the air at this location. See responses to R3-24, R3-25 and R3-26 for additional information regarding dust deposition. A monitoring program is planned that is expected to confirm an absence of appreciable change of metals in the soil and air at the camp.

In the case of the criteria air contaminants (CACs), it was possible to predict these concentrations at the camp and these results were previously provided in Chapter 6 of the Project Proposal (Section 6.4.1.1). These results were summarized in the PQRA and although the pathway was considered in the assessment it was not carried forward to the risk calculations stage as the air quality predictions were typically within the guidelines (i.e. exceedances were only predicted for TSP and PM_{10} less than 1% of the year under a worst case climate scenario).

Considering TSP and PM_{10}, there are no clearly established toxicity reference values (TRV) for use in the evaluation of human health risks. As opposed to this fraction, more recent focus of major agencies is on particulate matter that is $PM_{2.5}$ (e.g., air quality guidelines/objectives from Health Canada and World Health Organization are focussed on this latter fraction as opposed to TSP and PM_{10}) and there are no $PM_{2.5}$ standard exceedances predicted. Furthermore, it is noted that there are only an estimated 3 to 4 days per year where the Yukon TSP and PM_{10} standards are exceeded whereas annual concentrations of TSP will be approximately 4-times below this standard and predicted annual concentrations of PM_{10} will be less than even the $PM_{2.5}$ standard (there is no annual PM_{10} standard for comparison). In addition, it is stressed that the demographic at the Camp will be healthy adults as opposed to young children and elderly with heart/lung problems who are the normal focus of particulate standard development. Overall, the TSP and PM_{10} standard exceedances would likely be a nuisance effect and it would seem more reasonable to use the $PM_{2.5}$ data for prediction of health risks.

For ease of review, model results and additional risk interpretation are provided below.

Total Suspended Particulates (TSP)

Predicted maximum 24-hour and mean annual ambient concentrations at the camp receptor location for all Project phases are presented in Table 8-10 below. Short duration (24-hour) exceedances could occur at camp during operations under the worst-case meteorological and operational conditions. The ranked model results (for maximum predicted 24-hour concentrations) indicate that only the top three 24-hour concentrations would be in exceedance of the YAAQS on an annual basis, with a predicted fourth ranked value in camp of 113 μg/m³. Overall, TSP YAAQS exceedances in camp are predicted to occur less than 1% of the time.

Table 8-10: Predicted TSP Concentrations

Receptor	Maximum 24-hr Concentration (μg/m³)			Annual Concentration (μg/m³)		
	Construction Phase	Operations Phase	Closure Phase	Construction Phase	Operations Phase	Closure Phase
YAAQS	120			60		
Baseline	7			1		
Camp	43	148	8	2	15	1
Baseline + Camp	50	154	15	3	16	2

Values in red exceed the YAAQS

Coarse Particulate Matter (PM_{10})

Predicted maximum 24-hour and mean annual ambient concentrations at the camp receptor location for all Project phases are presented in Table 8-11. While short duration (24-hour) exceedances could occur at camp during operations under the worst-case meteorological and operational conditions, ranked model results indicate that only the top four 24-hour concentrations would be in exceedance of the YAAQS on an annual basis, with a predicted fifth ranked value in camp of 47 μg/m³. Overall, PM_{10} YAAQS exceedances in camp are predicted to occur approximately 1% of the time.

Table 8-11: Predicted PM_{10} Concentrations

Receptor	Maximum 24-hr Concentration (μg/m³)			Annual Concentration (μg/m³)		
	Construction Phase	Operations Phase	Closure Phase	Construction Phase	Operations Phase	Closure Phase
YAAQS	50			N/A		
Baseline	6			1		
Camp	15	67	5	1	5	1
Baseline + Camp	21	73	11	2	6	2

Values in red exceed the YAAQS

Fine Particulate Matter ($PM_{2.5}$)

Predicted maximum 24-hour and mean annual ambient concentrations at the camp receptor for all Project phases are presented in Table 8-12. No exceedances of the YAAQS are predicted at the camp receptor location.

Table 8-12: Predicted $PM_{2.5}$ Concentrations

Receptor	Maximum 24-hr Concentration (µg/m³)			Annual Concentration (µg/m³)		
	Construction Phase	Operations Phase	Closure Phase	Construction Phase	Operations Phase	Closure Phase
YAAQS	28			10		
Baseline	4			1		
Camp	4	6	4	<1	<1	<1
Baseline + Camp	8	10	8	1	1	1

Carbon Monoxide (CO)

Predicted maximum 1-hour and 8-hour ambient concentrations at the camp receptor location for all Project phases are presented in Table 8-13. No exceedances of the YAAQS are predicted at the camp receptor location.

Table 8-13: Predicted CO Concentrations

Receptor	Maximum 1-hr Concentration(ppm)			Maximum 8-hr Concentration (ppm)		
	Construction Phase	Operations Phase	Closure Phase	Construction Phase	Operations Phase	Closure Phase
YAAQS	13			5		
Baseline	0			0		
Camp	<1	<1	<1	<1	<1	<1

Nitrogen Oxides (NO_X)

To provide a conservative estimate and to enable comparison with the YAAQS, a 100% conversion ratio between from NO_X to NO_2 was assumed. Predicted maximum 1-hour, 24-hour, and mean annual ambient concentrations at the camp receptor location for all Project phases are presented in Table 8-14. No exceedances of the YAAQS are predicted at the receptor location; therefore, no further refinement of the NO_X to NO_2 conversion factor was carried out, as per the BC MOE recommendations (BC MOE, 2008). Note, however, that actual NO_2 concentrations are expected to be well below concentrations shown in Table 8-14, and could range from 5% (within 1 km of the source) to 37% (at 7 km from the source) of NO_X concentrations (Janssen et al., 1988).

Table 8-14: Predicted NO_2 Concentrations

Receptor	Maximum 1-hour Concentration (ppbv)			Maximum 24-hour Concentration (ppbv)			Annual Concentration (ppbv)		
	Construction Phase	Operations Phase	Closure Phase	Construction Phase	Operations Phase	Closure Phase	Construction Phase	Operations Phase	Closure Phase
YAAQS	213			106			32		
Baseline	0			0			0		
Camp	161	120	149	56	14	56	5	1	2

It should be noted that higher ambient concentrations at the camp receptor during construction and closure compared to operations are associated with the use of diesel generators in camp, which will be replaced with dual-fuel generators located at the process plant facility during the operations phase.

Sulphur Oxides (SO_X)

Assuming 100% conversion of SO_X to SO_2 as a conservative estimate, predicted maximum 1-hour, 24-hour, and mean annual ambient SO_2 concentrations at the camp location for all Project phases are presented in Table 8-15. No exceedances of the YAAQS are predicted at the receptor location.

Table 8-15: Predicted SO_2 Concentrations

Receptor	Maximum 1-hour Concentration (ppbv)			Maximum 24-hour Concentration (ppbv)			Annual Concentration (ppbv)		
	Construction Phase	Operations Phase	Closure Phase	Construction Phase	Operations Phase	Closure Phase	Construction Phase	Operations Phase	Closure Phase
YAAQS	172			57			11		
Baseline	0			0			0		
Camp	<1	<1	<1	<1	<1	<1	<1	<1	<1

Risk Interpretation of the CACs

As shown above, the only situations with predicted exceedances were the upper bound 24 hour concentrations of TSP and PM_{10} (under a reasonable worst case scenario); however, these exceedances would only occur about 1% of the time and are only marginally above the YAAQS. Furthermore, it is noted that workers are not expected to be continuously present at the camp (i.e., 2 weeks on and 1 week off and only present during non-shift hours where they will spend the majority of their time in the camp sleeping rather than outside in the camp yard) such that this further ameliorates these marginal exceedances.

Perhaps most importantly, however, no exceedances of maximum 24 hour concentrations of $PM_{2.5}$ were predicted. $PM_{2.5}$ rather than PM_{10} and TSP has been the focus of recent CCME efforts for protection of human health (see: https://www.ccme.ca/en/resources/air/pm_ozone.html) and $PM_{2.5}$ is widely considered to be a better indicator of health risks than these other particulate matter fractions. As such, there is high confidence in no unacceptable risks from particulates since $PM_{2.5}$ is not predicted to exceed the standards even when PM_{10} and TSP do exceed on occasion.

Finally, it is stressed that the standards for the CACs were developed for protection of the general population which focuses on susceptible individuals such as asthmatic children and elderly with heart/lung disease. Such susceptible individuals would not be expected to be present at the camp, rather the camp receptors would be comprised of healthy adult workers. As a result, these exceedances present even less of a concern.

Overall, no unacceptable risks are predicted from the CACs. In cases where the predicted air concentrations will not meet the YAAQS (i.e., only the upper bound concentrations of PM_{10} and TSP under a reasonable worst case scenario), $PM_{2.5}$ meets standards and is considered to be a better predictor of health risks. Furthermore, the frequency and duration of the exceedances are low and persons not present on a full-time basis nor representing the susceptible population for particulate matter concerns. Overall, it can be confidently concluded that the predicted air concentrations for the CACs are low and will not result in measurable health effects.

YESAB ISSUE

A Liquefied Natural Gas (LNG) facility shall have a risk assessment performed that addresses risks to members of the public, personnel, the environment and property.

R3-33

Describe how the effects assessment of accidents and malfunctions considered the risks associated with the LNG/Diesel power plant facility.

The effects assessment of accidents and malfunctions was detailed in Chapter 17 of the Project Proposal and elaborated upon further in response R285 (BMC, 2017b) and also by the risk register provided in response to R2-3 (BMC, 2017a). With respect to the power generation facility, these responses primarily focused on spills of LNG and diesel fuels both during transportation to site and on site during operations. In reviewing the responses provided to date it has been determined that additional context should be provided to demonstrate BMC's understanding and management of the risks associated with the LNG / diesel power plant facility.

Methane venting is a potential environmental risk that was not specifically detailed previously and could arise under a number of scenarios. Management of this risk will primarily be addressed through engineering design to reduce the risk to as low a level as is practicable. The second key risk relates to that should an LNG pool fire occur, what the risk will be to the diesel storage facility. Both of these risks, their management and the resulting risk rating are detailed in Table 8-16. These are in addition to the risk register provided as Appendix R2-B of Response Report #2 (BMC, 2017a).

Table 8-16: Additional Risk Register Items Related to the LNG Facility

RISK NO.	CATERGORY	PHASE	RISK DESCRIPTION	CONSEQUENCE	TYPE	KEY DEFENSIVE MEASURES IN PLACE	RISK RATING			CLASSIFICATION
							L	C	SCORE	
36	Infrastructure	Operations	Methane venting during LNG transfer from supply tank truck to storage tanks	Venting of methane to the environment	EI	● The LNG offloading system will be designed with a vapour return line from the LNG transfer pump to ensure that vapour resulting from cooldown is returned to the LNG delivery tanker	3	2	6	Low
37	Infrastructure	Operations	LNG spill	Venting of methane to the environment	EI	● The LNG facility will be designed to be compliant with CSA Z276 LNG Production, Storage and Offloading, Annex B (2018 edition) for small facilities. The Code requirements shall be met to ensure the risk of spills is minimized. ● An impoundment will be provided to capture spills from LNG storage tanks. Use of proven cryogenic materials, piping design, gas and fire detection will be provided to detect any spills and minimize any volume spilled.	3	2	6	Low
38	Infrastructure	Operations	Loss of vacuum on tank or tank repair	Venting of methane to the environment	EI	● The LNG facility design will include means of transferring LNG from LNG storage tank 1 to LNG storage tank 2 and vice versa. Provision will also be made to offload LNG from storage tanks to LNG transportation trailers if required. ● If tank vacuum is lost or deteriorates there will be increased boil off. However as the power generation demand is significant the additional boil off gas will be consumed in the generators. This will also limit the potential for venting to the environment on vacuum loss.	3	2	6	Low
39	Infrastructure	Operations	Build up of pressure from boil off gas	Venting of methane to the environment	EI	● The boil off gas generated from the facility is expected to be less than 0.1% per day based on using vacuum insulated tanks. LNG consumption by the power generation facility will be more than adequate to maintain gas pressures, eliminating the need to vent during normal operation. ● The LNG facility will also be designed and equipped with economiser lines to ensure that boil off gas is used preferentially over vaporizing LNG. ● If all generators were taken offline for a prolonged period of time for planned maintenance or shutdown, the LNG storage would be planned and managed operationally to ensure venting does not occur.	3	2	6	Low

RISK NO.	CATERGORY	PHASE	RISK DESCRIPTION	CONSEQUENCE	TYPE	KEY DEFENSIVE MEASURES IN PLACE	RISK RATING			CLASSIFICATION
							L	C	SCORE	
40	Infrastructure	Operations	LNG pool fire puts diesel storage at risk	Thermal radiation causes fire at diesel storage facility	EI / CC / HHS	● The set backs of the diesel storage facility be greater than the prescribed minimum distance as defined in CSAZ276 Annex B to eliminate the risk of thermal radiation in the event of a LNG pool fire. Based on the proposed tank size and pipe size the minimum setback of the diesel storage from the impoundment area is 24 m. This will be incorporated into the final site design. ● Thermal radiation analysis will be completed as part of the application process for licencing under the *Oil and Gas Act* and *Gas Processing Plant Regulations*.	2	5	10	Medium

9 ROADS AND TRANSPORTATION

YESAB ISSUE

BMC has indicated that for a period of approximately 6 weeks in the spring/early summer, portions of the Robert Campbell Highway have load restrictions in place to ensure safety and limit long term impacts to the infrastructure. BMC identified that an optional reload facility would be established to "top-up" from the 75% restricted load to the 100% load outside of the road weight restriction areas during this period.

R3-34

Describe the optional reload facility, including details on:

a) location, storage capacity, and size,

b) timeline of construction, operations, decommissioning

c) any associated infrastructure that would be required,

d) equipment required for reloading and top-up, and

e) the number of vehicles that would be "topped" up at a given time.

The use of a reload facility was one of a number of mitigation strategies identified in Section 4.12.3 of the Project Proposal to manage load restrictions that are established on certain sections of the Robert Campbell Highway during the spring thaw break up period. This is typically a six week period between April and May, although it varies from year to year.

The mitigation strategies identified included:

- Scheduling processing facility maintenance shutdowns for this period;
- Allowing concentrate stocks to temporarily build up in the processing plant circuit;
- Storage of concentrate in bulk containers on site in an appropriate location at the processing plant building;
- Scheduling processing of lower grade ores during this period to reduce the quantity of concentrate produced;
- Negotiate an agreement with Yukon Transportation to upgrade the relevant sections of the Robert Campbell Highway to achieve 100% legal axle loading; and
- Operate a reload facility at Watson Lake.

The use of a reload facility is the least likely and least preferred of the above scenarios. However, for the sake of completeness BMC has included the following:

Should it be determined that a reload facility is required to maintain continuity of operations during this period, the concentrate haulage contractor would construct, operate, and decommission the facility within their base of operations in Watson Lake.

To meet the 75% load restriction limit, BMC could use an alternative trailer design during this period to allow transportation of a near full container of concentrate from the mine site to Watson Lake and still meet the 75% load restriction axle limit. Alternatively, BMC could preferentially light load the regular containers.

At the reload facility, full containers of concentrate would be removed from the trucks transporting containers between the mine site to Watson Lake and transferred to trucks completing the transportation of concentrate between Watson Lake and Stewart.

The reload facility would be a container transfer facility only. Containers loaded with concentrate would be transferred between truck trailers with a forklift capable of lifting and transferring sealed 30 tonne containers. No loose concentrate would be handled or transferred at the proposed reload facility.

It is expected that the size of the reload facility would be sufficient to store approximately 10 containers of concentrate as well as allow sufficient working area for loading and unloading of containers from trucks. The size of the reload facility will be determined by the concentrate haulage contractor to ensure that sufficient space is allocated to safely and effectively complete the transfer works, however BMC expects that the facility will be approximately 1,000 m^2 in size.

The reload facility would be constructed to be ready for use prior to the first spring thaw break up period once operations have commenced, should it be determined that the use of a reload facility is required for operations. On current development expectations, this will be by February 2022, although could move one year forward or backward as project development continues to advance. The reload facility would be utilised throughout the project life and be decommissioned once concentrate production at the KZK site had ceased.

As noted, a forklift capable of lifting 30 tonne containers will be required for the facility. The only other infrastructure that is expected to be required are a fenced storage area, which will be available within the concentrate haulage contractor's facilities.

The number of trucks that would be reloaded at the facility could be as high as 19 per day; however, as noted above BMC intends to implement a number of other mitigation factors available to reduce concentrate haulage requirements during this period and therefore the number of trucks requiring reloading are likely to be less than that (i.e. overall less concentrate will be hauled to Stewart during this six week period).

R3-35

Describe the anticipated impact that this facility would have on projected traffic volume on the highway.

BMC has provided traffic volumes based on the average daily truck movements over the course of a year in Table 4-33 of the Project Proposal. Site based storage capacity and the mitigation methods outlined in response to R3-34 are expected to be sufficient to ensure that transport levels during the period in question are not materially different to the average daily movements in Table 4-33 of the Project Proposal albeit the loads will be lighter than normal. BMC considers it highly unlikely that it will be necessary to establish a container transfer yard in Watson Lake but if it is necessary it will be small in area and will be used sparingly. No additional disruptions to Watson Lake residents are expected.

R3-36

Describe any safety measures that will be implemented to ensure safety risks have been addressed.

Safety measures that would be implemented for the reload facility would be based around the operation of heavy equipment for unloading and loading of concentrate containers. As containers will remain sealed at the reload facility, no specific safety measures are required or planned for the management of loose concentrate other than what would normally be expected across the rest of Canada should a spill of a non-toxic powder from a containerised load occur in normal road operations.

Safety measures will include segregation of personnel from actively working machinery and the use of audible and visual alarms on the container forklift to ensure personnel are aware of its operation.

As the haul contractor would develop construct, operate, and decommission the facility, they will also develop and implement a Health and Safety program for the facility that meets the requirements of BMC's H&S management system and Yukon's transport of good regulations.

YESAB ISSUE

While the deactivation of the access road has been identified, there are concerns about the long term tenure of the road and how access will continue to be limited. The ultimate end use is therefore uncertain; it is likely unreasonable to plan for the road to be completely deactivated (to a point of it being inaccessible) given the continual long term monitoring associated with a mine and other exploration in this area. Resulting in additional concerns related to increased hunter access and harvest mortalities.

R3-37

The proposal confirms that the road will be reclaimed and decommissioned when access to the site is no longer required. This proposed measure poses three questions.

a) First, this deactivation and associated techniques will be implemented over time. Outline the projected timelines and how the below two elements are considered as part of these timelines.

b) Second, this project requires long-term water treatment and/or monitoring. Confirm that the access road will continue to have restricted access and the nature of that restricted access (e.g. a manned-gate) during the post- closure stage to support water treatment and/or monitoring activities.

c) Third, this road potentially provides access to other resources in the area. Describe how the proposed measure to reclaim and decommission the road have considered other uses for the road, potential requests to maintain its existence and the roles of BMC, Yukon Government and First Nations in determining its end use.

The current Tote Road is leased under lease 105G07-001 from the Government of Yukon as represented by Land Management Branch of the Department of Energy Mines and Resources.

Clause 66 of the current lease states:

> *"That on the termination or expiration of this lease, the Lessee will deliver up possession of the land in a condition satisfactory to Yukon. In particular, Yukon may require the Lessee to remove any improvements affixed to or placed on the land, and any chattels or other property placed on the land, and otherwise to restore the land. In the event the Lessee does not carry out such removals and restoration within ninety (90) days of termination of the lease, despite being requested to do so, Yukon may carry out the removals and restoration and may recover the cost of so doing from the Lessee."*

The lease specifies that the leased land must be returned to a condition that is satisfactory to Yukon. BMC's intention is to relinquish the road lease at the time that road access is no longer required to the Kudz Ze Kayah Project site.

Until the road is relinquished BMC will continue to restrict access to it. During reclamation and closure activities, public access will be restricted to the same extent as it currently is. The security station and gate at the access to the road from the Robert Campbell Highway will be manned and maintained and only authorized vehicles will be allowed on the road. Over the winter period, if there are limited site operations, the gate will be locked. Post-closure the access restriction strategies may include: additional gates, signs and barriers until the monitoring period is completed at which time the road will be fully reclaimed unless BMC is otherwise instructed by the Yukon Government.

As stated in the conceptual reclamation and closure plan the Passive-Closure period will commence with the spilling of the ABM Lake water into Geona Creek. It is currently planned to be a 10-year period of primarily monitoring and maintenance. It is expected that a year or two will be required to ensure that the passive water treatment systems are achieving performance expectations with the new water contribution from the ABM Lake. Once these objectives and performance criteria are achieved, the active water treatment plant and remaining infrastructure will be demobilized/decommissioned, and site water management will be passive in nature.

The road will remain in use until all the site infrastructure has been demobilized/ decommissioned and the storage facility covers and the constructed wetland treatment systems are meeting performance criteria. At this stage there will be routine monitoring and the road can be decommissioned and reclaimed prior to relinquishing the lease. Access for the continuing monitoring will be by helicopter and there will be no infrastructure remaining on site.

BMC realizes that there are other resources in the area and that the access road could potentially be used to access and exploit these, and similarly that there is First Nation's interest in maintaining the existence of the road as an access to the region. However, under the current lease it is the responsibility of the lessee to return the land to Yukon in a condition satisfactory to the Yukon. Thus, it is Yukon Government's decision whether the lease could be relinquished with the access road un-reclaimed, but it must be emphasized that this a Yukon Government decision not one that BMC can, or will, make.

YESAB ISSUE

The Robert Campbell Highway is narrow in many areas, with poor sightlines, limited passing opportunities, pull outs, turning lane and presents travel concerns in all seasons. An increase in truck traffic throughout the construction, operation and active closure of the mine has resulted in a series of safety concerns being raised.

R3-38

Describe the various safety concerns with the proposed use of the Robert Campbell Highway and BMC's role in addressing those concerns.

BMC is aware of limitations of the Robert Campbell Highway and this has been reiterated by the communities that use it. While there has been substantial work undertaken in previous years by YG, which is ongoing, the Robert Campbell Highway remains an all season gravel highway with certain limitations.

The Robert Campbell Highway (Highway 4) has a total length of 583.6 km consisting of 355.2 km dual lane gravel, 60 km single lane seal coated highway, and 168.4 km double lane seal coated highway. From Watson Lake, the first 100 km is seal coated; the balance is gravel until the Faro intersection. It is generally considered a well maintained road but can experience rough/wet operating conditions during rainy periods from May until freeze up in early October. Historically, weight restrictions are in place from early April until late May and occasionally during prolonged wet, rainy periods in summer/fall.

The primary area of concern of the highway is south from the KZK Access Road to Tuchitua, a length of approximately 170 km. The section of highway from Tuchitua to Watson Lake has been widened and chip sealed which has assisted in the abatement of a majority of the deficiencies that exist in the 60 km to 232 km section.

Prior to construction and operations BMC commits to discuss with the local communities BMC's preliminary plans and request any suggestions on ways to assist with managing the increased traffic to maximise safety and minimise disruptions that they may have.

Safety concerns that have been identified prior to use of the road for haulage of concentrates and supplies are centred on two main issues:

1. *Road Conditions- current conditions and likely changes with increased traffic*
2. *Traffic- An increase in traffic volumes will increase the potential for vehicle interactions*

The amount of truck traffic estimated during operations is 52 one way trips per day or approximately 2 one way trips per hour if the trucks are operated for 24 hours per day. The majority of these one-way trips will be concentrate trucks (38 one way trips per day) which will be operated 24 hours a day. All concentrate traffic and the majority of supply trucks will use the Watson Lake to kilometre 232 stretch of the Robert Campbell Highway.

The expected number of trucks and assuming an average speed of 55km/hr suggests that at any one time there will be 4 Project related trucks travelling in each direction on the highway.

BMC will have some control over the actions of certain portions of the traffic using the highway such as the haulage trucks, supply trucks, and light vehicles driven by employees, and contractors, of BMC. However, BMC has no control over other users of the roads and must rely on these users to abide by Yukon's road rules and to drive in a manner that takes into consideration road conditions. With this limited control it may be possible to mitigate some of the potential safety concerns:

1. Communications: All Project related heavy traffic on the Robert Campbell Highway will be equipped with radio communication. The radios will be used to advise of relative positions on the highway and advise others about oncoming traffic and road conditions. These radios can also be used to call for assistance if there have been mechanical or road problems. This communication network could also be of advantage to non-company users of the road in cases where assistance is needed and no communication is available due to the lack of cell coverage on the highway.
2. There are limited locations where vehicles can pass traffic going in the same direction safely, as the road has numerous blind curves and is generally too narrow for safe overtaking. Prior to construction and operations, the locations of safe passing zones will be identified and drivers associated with the Project will be advised of these locations. A list will be provided and appropriate actions to take at the passing areas will be outlined. These actions may include reducing speed, or even stopping, to allow traffic to pass at these locations.
3. Dust can be reduced by limiting the speeds of vehicles travelling the road however this also could lead to unsafe passing by traffic travelling in the same direction. Vehicles will be advised to allow other users to pass as early as it is safe to do. Yukon Highways can help limit this problem by judicious use of chemical sealants. Chemical sealants may also decrease the overall cost of road maintenance if applied correctly.
4. Traffic travelling on the Robert Campbell Highway will have to pass approximately 4 Project related heavy vehicles travelling in the opposite direction when driving on the stretch of the highway under discussion. Radio communications will warn the trucks of oncoming traffic however there will be no warning for private vehicles and other road

users. Prior to construction and operations, it is suggested that BMC travels a number of times to the local communities and asks for their suggestions on ways to assist with managing the increased traffic to maximise safety.

5. One possible way to limit encounters on the highway is for the trucks to travel in convoys, rather than individually. This, however can also lead to increased safety issues both for opposing traffic and passing traffic. This is an area where community input will be requested and where there may need to be trials to evaluate the effectiveness of each strategy.
6. Increased traffic will degrade road conditions more rapidly than at present. The worsening can be minimised by reducing the speed that traffic uses the road and using proper driving techniques such as; minimising the use of brakes and selecting appropriate gears on sections with steep grades. The company and contract drivers using the road will have appropriate skillsets and training on handling large vehicles on gravel roads.
7. Yukon Highways, and contractors working for them, are continually upgrading and maintaining the highway and BMC realizes that communications with the various work crews is essential. BMC commits to maintaining communications with Yukon Highways at all stages of the Project and working with them to minimise disruption to their projects. This will mean informing Highways of trucking schedules and may mean scheduling trucking to certain times of the day to minimise effects on the various activities.
8. Winter driving: In winter the driveable width of the highway may be decreased due to high snow amounts and the associated snow plowing activities by the Highways department. This will increase the risk to all travel on the highway. There will be less non Project related traffic on the highway however the decreased road widths will mean that extra restrictions may have to be implemented. This could include speed restrictions applied to company traffic as well as more frequent mapping of potential passing zones.
9. The Robert Campbell Highway is prone to washouts during high rainfall events and ice "glaciers" during the spring melt. The glaciers will occur during the highway weight restriction period and during this period there will be less site specific traffic and thus less potential risk for vehicles passing at specific icy locations. Potential washouts can be identified by company traffic prior to actual road closure. If this information is forwarded to Yukon Highways, then there is the possibility that the potential problem may be resolved prior to the washout causing a highway closure. High rainfall events will be monitored and if there is a chance of road closures then company traffic will be restricted from highway use. In the event of a highway closure, due to washouts or other causes, BMC will provide any assistance required and will advise all company users of the closure and prevent all project related traffic from entering the affected stretch.

It is apparent that success in minimising effects of the increased traffic on the Robert Campbell Highway will rely on continued communication between all the relevant parties including, but not limited to, BMC, Yukon Highways, the people of Ross River and Watson Lake, and all service providers that use the road. With this communication in place and the appropriate procedures and action plans in place negative effects of the increased traffic can be minimised.

10 HAZARDOUS MATERIALS

YESAB ISSUE

Currently it is not specified if glycol heating fluid will be used for LNG vaporization. Concerns pertaining to the contamination of ground and surface water – as a result of a Glycol spill. Ensure that glycol containment is provided for equipment and the site.

R3-39

Demonstrate how glycol will be contained and managed on site if glycol is proposed to be used for LNG vaporization. Where glycol will be used, specify the type of glycol considered.

Glycol will not be used to provide the heat for the LNG vaporisation. After conducting a Heating, Ventilation and Air Conditioning (HVAC) study for the Project it has been determined to use alternative means of providing heat for the LNG vaporisation process (gas or electrical powered).

Waste heat from the power generation facility will instead be used to provide heating to the processing plant and administration facilities, and will utilise glycol as the transfer mechanism. Heat recovery from the generators will be used for building heating or process heating purposes. Each generating unit will have a heat recovery jacket and the heat that is removed from each jacket will be circulated through a heat recovery module provided by the engine supplier. Similarly, the flue gases that will be emitted by each engine will pass through a heat recovery boiler, supplied by the engine supplier, and the flue gas temperature will be reduced by circulating glycol through the boiler. This circuit will use a glycol/ demineralised water mix to transfer heat in this loop.

A separate heat recovery loop will be pumped through each heat recovery module and pumped to each area of the plant that will be heated.

When the building heating demands are less than the heat produced by the engines, the excess heat will be automatically rejected to the atmosphere via air to liquid radiators, supplied by the engine supplier.

The fluid that will be pumped (on the secondary side of the heat recovery module) will be physically separated from the heat recovery distribution loop in order to prevent issues in either section from affecting the other, and will be a mixture of 40% demineralized water and 60% inhibited propylene glycol. The fluid will be delivered to site as a pre-mixed fluid to ensure that the heating system will operate without issues related to the fluid. Dowfrost Propylene HD has been identified as the optimal fluid to be used. Propylene Glycol while having a marginally lower heat transfer coefficient than Ethylene Glycol is substantially less toxic.

Glycols can typically be expected to last 12 years or longer, providing corrosion inhibitor strength is maintained. Glycol fluid pH can be a good barometer for the condition of the glycol and as such regular monitoring of the system pH will be part of the operating plan as well as inhibitor analysis, normally offered as a free service by glycol manufacturers.

Standard system materials can be used with DOWFROST heat transfer fluids. Steel, cast iron, copper, brass, bronze, solder and most plastic piping materials are all generally acceptable for use as piping valves and pumps. Centrifugal pumps are commonly used with solutions of DOWFROST fluids. Reciprocating pumps are necessary where fluids must be pumped at high head pressures. Pumps can be made of ordinary steel or ductile iron because the fluids are inhibited. All of the glycol heat recovery piping will be thermally insulated to minimize heat losses, and where the pipes are located outdoors the insulated pipes will also be clad to protect the insulation from damage and from the weather.

Because both of the loops are closed systems the amount of make-up fluid required to keep the loop operational will be used as indication of any losses in the systems and will be monitored to give a warning of possible breaches in the loops. All spills will be handled according to the procedures in the Spill Contingency Plan (Section 18.4 of the Project Proposal).

YESAB ISSUE

The power plant layout may be impacted by certain hazards and risks associated with LNG operations. Information should be provided on the analyses performed to identify and mitigate these hazards and risks in the design of the power plant.

For example, the proximity of the diesel tank and LNG facility must be of sufficient distance to prevent the diesel tank from being impacted by thermal radiation in the event of an LNG pool fire.

This additional information will enable the Executive Committee a more complete understanding of potential significant risks and the proponent's ability to mitigate for those effects

R3-40

Provide a map of the power plant showing proposed equipment layout and LNG storage area with supporting rationale for positioning in relation to other facilities and site features.

The governing standard for LNG facilities is CSA Z276 – LNG Production, Storage and Handling. All LNG designs for the Project have been completed to follow the requirements of this code. As noted in R3-33, based on the proposed tank size and pipe size, the minimum setback of the diesel storage from the impoundment area is 24 m. The relevant CSA-Z276 requirements regarding separation distances from potential ignition sources are excerpted below. As indicated below, most of these provisions require that sources of ignition be at least 15 m from process equipment containing LNG.

Excerpts from CSA-Z276:

5.2.6.1

Process equipment containing LNG, refrigerants, flammable liquids, or flammable gases shall be located at least 15 m (50 ft.) from sources of ignition, a property line that can be built upon, control rooms, offices, shops, and other occupied structures; however, control rooms may be located in a building housing flammable gas compressors, provided that the building construction complies with Clause 5.3.1.

5.2.6.2

Fired equipment and other sources of ignition shall be located at least 15 m (50 ft.) from any impounding area or container drainage system.

5.2.7.2

LNG and flammable refrigerant loading and unloading connections shall be at least 15 m (50 ft.) from uncontrolled sources of ignition, process areas, storage containers, control buildings, offices, shops, and other occupied or important plant structures; however, this requirement shall not apply to structures or equipment directly associated with the transfer operation.

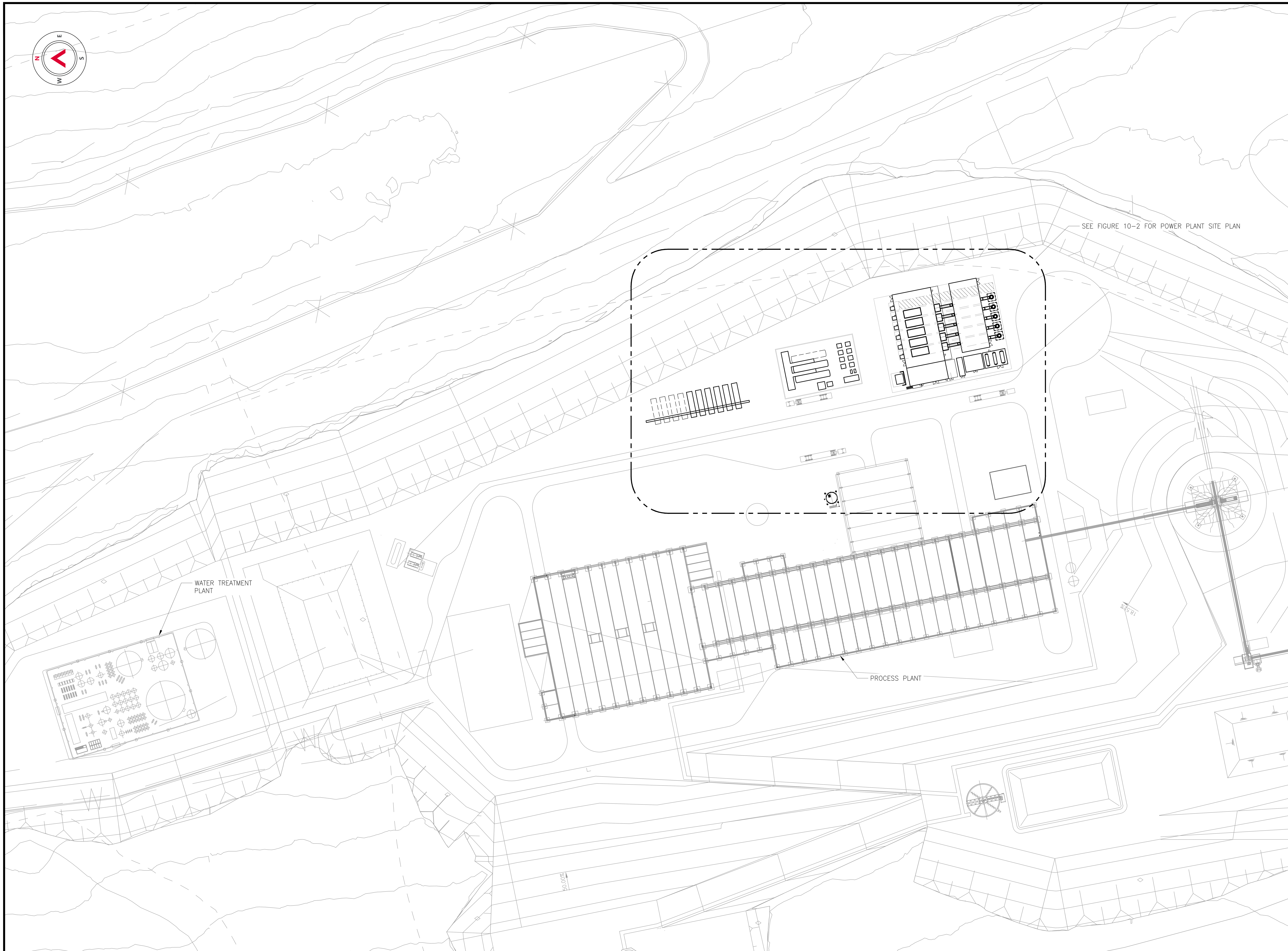
13.3.4.4

Vehicles and other mobile equipment that constitute potential ignition sources shall be prohibited within impounding areas or within 15 m (50 ft.) of containers or equipment containing LNG or flammable liquids, gases, or refrigerants, except when the vehicle or equipment is specifically authorized and under constant supervision or is located at loading or unloading facilities

13.3.11.3 Tank car or tank vehicle

The following requirements shall apply: (a) While tank car or tank vehicle loading or unloading operations are in progress, rail and vehicular traffic shall be prohibited within 7.6 m (25 ft.) of LNG facilities or within 15 m (50 ft.) of refrigerants whose vapours are heavier than air.

These distances described above been built into the layout detailed in Figure 10-1: LNG Facility Overall Site Plan and Figure 10-2: LNG Facility Layout with Offsets.



REFERENCE DRAWINGS

DRAWING NO	DRAWING DESCRIPTION/TITLE	REF

NOT FOR CONSTRUCTION

ISSUED FOR
INFORMATION
Date:2018/JUN/04

REV	YY/MM/DD	DESCRIPTION	DRWN	APVD
B	18/06/04	ISSUED FOR INFORMATION	SB	MM
A	18/05/14	ISSUED FOR INFORMATION	SB	MM

CLIENT:

Allnorth

CLIENT NO:	-	DRWN:	SB	DATE:	18/05/14
PROJECT NO:	18VA0080	DSGN:	AS	DATE:	18/05/14
DRAWING SIZE:	ANSI "D"	CHKD:	MM	DATE:	18/05/14
SCALE:	1:1000	APVD:	DP	DATE:	18/05/14

PROJECT:

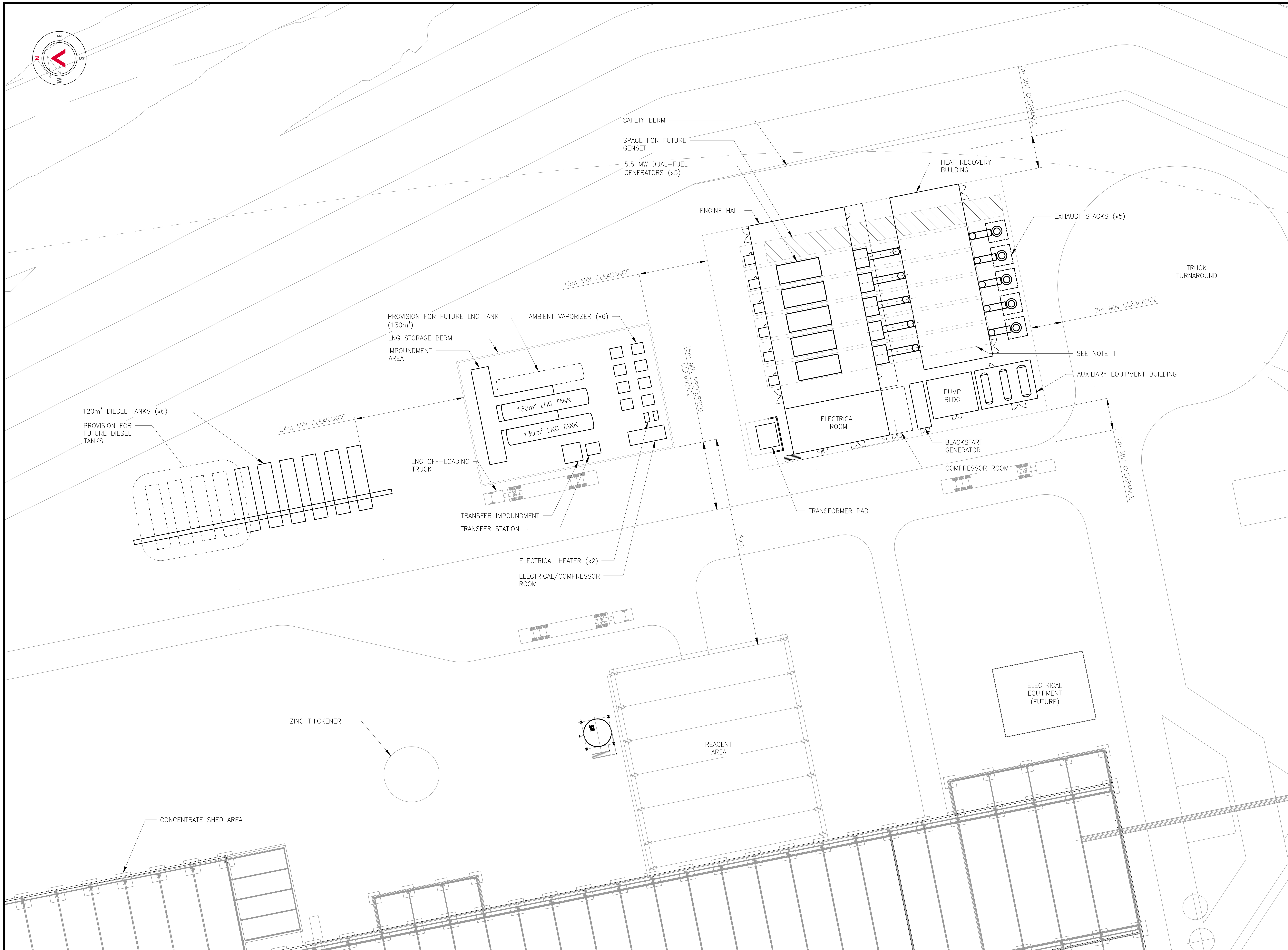
KUDZ ZE KAYAH PROJECT

TITLE:

FIGURE 10-1 LNG FACILITY OVERALL SITE PLAN

DWG NO: **FIGURE 10-1** REV: **B**

Date: 2018/06/05 11:51 AM | User: Sameer Bilkhu | File: P:\VA\2017\17VA0080 BMC - Kudz Ze Kayah Project FS\1000-Drawings\1016-Electrical\02-Sketches\LNG Facility Layout\17VA0080-XXX-1600-SK1 | Layout: _RX | Paper Size: 863.6mm x 558.8mm



REFERENCE DRAWINGS		
DRAWING NO	DRAWING DESCRIPTION/TITLE	REF

NOTE:

1. POWERHOUSE LAYOUT SHOWN IS BASED ON TWO LARGE BUILDINGS FOR ENGINES AND HEAT RECOVERY TO REFLECT A CONSERVATIVE FOOTPRINT REQUIRED FOR POWERHOUSE. AN ALTERNATE OPTION AS SHOWN BY DASHED LINE FOR INDIVIDUAL MODULAR GENERATOR ENCLOSURES, COULD BE CONSIDERED TO PROVIDE A SMALLER FOOTPRINT FOR THE POWERHOUSE.

NOT FOR CONSTRUCTION

ISSUED FOR INFORMATION
Date:2018/JUN/04

REV	YY/MM/DD	DESCRIPTION	DRWN	APVD
B	18/06/04	ISSUED FOR INFORMATION	SB	MM
A	18/05/14	ISSUED FOR INFORMATION	SB	MM

CLIENT:

Allnorth

CLIENT NO:	-	DRWN:	SB	DATE:	18/05/14
PROJECT NO:	18VA0080	DSGN:	AS	DATE:	18/05/14
DRAWING SIZE:	ANSI "D"	CHKD:	MM	DATE:	18/05/14
SCALE:	1:400	APVD:	DP	DATE:	18/05/14

PROJECT:

KUDZ ZE KAYAH PROJECT

TITLE:

FIGURE 10-2 LNG FACILITY LAYOUT WITH OFFSETS

DWG NO: **FIGURE 10-2** REV: **B**

Date: 2018/06/05 11:55 AM | User: Sameer Bilkhu | File: P:\VA\2017\17VA0080 BMC - Kudz Ze Kayah Project FS\1000-Drawings\1016-Electrical\02-Sketches\LNG Facility Layout\17VA0080-XXX-1600-SK2 | Layout: _RX | Paper Size: 863.6mm x 558.8mm

YESAB Issue

Environment Canada suggests BMC Develop a comprehensive Cyanide Management Plan that aims to prevent the release of cyanide to the environment via applicable mitigation and management measures, principles and standards of practice. Specifically, such a management plan should ideally include the transportation, handling, storage, use, emergency spill response measures, environmental monitoring and facility decommissioning. The International Cyanide Management Code (http://www.cyanidecode.org/) is a good reference for this.

Environment and Climate Change Canada (ECCC) is of the opinion that the Proponent's project proposal does not currently meet adequacy requirements. The "consideration of the effects" of malfunction or accidents cannot be adequately understood without the Proponent demonstrating their ability to mitigate potential environmental consequences via their emergency preparedness planning abilities and associated response capacities.

R3-41

Provide details on BMC Minerals overall cyanide management strategy for the Project. Details should include:

d) timeline for the development of the Cyanide Management Plan and other required cyanide management-related plans and procedures;

e) transportation of cyanide including description of transportation route(s) and security of shipments;

f) description of unloading process for solid sodium cyanide (NaCN);

g) details on storage of NaCN;

h) details on transferring and use of NaCN at the site; and

i) safety requirements at site.

BMC's proposed cyanide management strategy for the Project is presented in **Appendix R3-G** (Conceptual Cyanide Management Plan).

The Cyanide Management Plan has been detailed at a conceptual level to inform the assessment of effects currently underway at a screening level under YESAB and will be updated and subsequently provided in conjunction with several other plans to meet the requirements for a Quartz Mining License application and a Water Use Licence application under the *Quartz Mining Act* and the *Waters Act*, respectively. The Cyanide Management Plan has also been written to include commitments under the International Cyanide Management Code (Cyanide Code).

R3-42

Provide a list of key training requirements (i.e. general CN awareness, CMP, specific standard operating procedures, cyanide emergency preparedness and response, etc.) that the cyanide management plan (CMP) and cyanide-related plans and procedures will require to be given to employees and other workers during the construction phase, operations phase, and project decommissioning phase.

Employees and workers include the following classifications: 1) cyanide truck drivers, 2) BMC's in-house First Responders, 3) processing plant personnel, 4) Open pit mine operations personnel, 5) Mineshop / warehouse personnel, 6) Camp and kitchen workers, 7) Technical staff, 8) visitors, 9) Contractors.

BMC's proposed cyanide management strategy (including training requirements) for the Project is presented in **Appendix R3-G** (Conceptual Cyanide Management Plan).

11 REFERENCES

BC MOE (Ministry of Environment). 2008. *Guidelines for air quality dispersion modelling in British Columbia*. Environmental Protection Division, Environmental Quality Branch, Air Protection Section. Victoria, BC., pp. 139. Retrieved on January 12, 2017 from http://www.bcairquality.ca/reports/pdfs/air_disp_model_08.pdf.

BMC, 2017a. Kudz Ze Kayah Project, Response Report #2 to YESAB Executive Committee Adequacy Review of KZK Project Proposal. November 2017.

BMC, 2017b. Kudz Ze Kayah Project, Response Report #1 to YESAB Executive Committee Adequacy Review of KZK Project Proposal. July 2017.

Boyce, M.S., A.E. Derocher, D.L. Garshelis, 2016. Scientific Review of Grizzly Bear Harvest Management System in British Columbia. 55 pp. Available at http://www.env.gov.bc.ca/fw/wildlife/management-issues/docs/grizzly-bear-harvest-management-2016.pdf.

COSEWIC. 2012. COSEWIC assessment and status report on the Grizzly Bear Ursus arctos in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xiv + 84 pp. (www.registrelepsararegistry.gc.ca/default_e.cfm).

Csavina, J., Landazuri, A., Wonaschutz, A., Rine, K., Rheinheimer, P., Barbaris, B., et al. 2011. *Metal and metalloid contaminants in atmospheric aerosols from mining operations*. Water, Air, and Soil Pollution, 221, 145-157.

Faithful, J.W. 2016*. Physico-chemical changes in two northern headwater lakes in the Northwest Territories, Canada, during winter to spring seasonal transitions.* J. Great Lakes Research. Vol. 42-2, pp 166-172.

Farmer, A.M. 1993. *The effects of dust on vegetation – A review*. Environmental Pollution, 79, 63-75.

Golder Associates Ltd. 1996a. *Feasibility level geotechnical and hydrogeological site investigation, ABM Deposit, Kudz Ze Kayah Project*. Prepared for Cominco Ltd.

Golder Associates Ltd. 1996b. *1996 Geotechnical Site Investigations for the ABM Deposit*. Prepared for Cominco Ltd.

Health Canada, 2010. Federal Contaminated Site Risk Assessment in Canada – Part II: Toxicological Reference Values (TRVs) and Chemical-Specific Factors. Environmental Health Assessment Services, Safe Environments Programme, Health Canada, Ottawa, Ontario.

Health Canada, 2011. Federal Contaminated Site Risk Assessment in Canada – Part IV: Spreadsheet Tool for Human Health Preliminary Quantitative Risk Assessment (PQRA). Environmental Health Assessment Services, Safe Environments Programme, Health Canada, Ottawa, Ontario. Version: July 13, 2011.

Health Canada, 2012. Federal Contaminated Site Risk Assessment in Canada – Part I: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA). Environmental Health Assessment Services, Safe Environments Programme, Health Canada, Ottawa, Ontario.

Health Canada. 2013. Toxicological Reference Values, Estimated Daily Intakes, or Dietary Reference Values for Trace Elements. Obtained through communication with Health Canada's Bureau of Chemical Safety. Health Canada, Ottawa, Ontario.

Health Canada, 2014. *Guidelines for Canadian Drinking Water Quality* Prepared by the Federal-Provincial-Territorial Committee on Drinking Water of the Federal-Provincial-Territorial Committee on Health and the Environment.

Janssen L.H., Van Wakeren, J.H, Van Duuren, H., Elshout, A.J. 1988. *A classification of NO oxidation rates in power plant plumes based on atmospheric conditions*. Atmospheric Environment, 22, 43-53.

Knight Piesold Ltd. 2016. *2016 Geotechnical Site Investigation Data Report*. Retrieved from Unpublished Technical Document Submitted to BMC Minerals (No.1) Ltd.

Knight Piesold Ltd. 2017. *2017 Geotechnical Site Investigation Data Report*. Retrieved from Unpublished Technical Document Submitted to BMC Minerals (No.1) Ltd.

Larsen, D.G. & Markel, R.L. 1989: A preliminary estimate of grizzly bear abundance in the southwest Yukon. - Unpublished report, Yukon Fish and Wildlife Branch, Whitehorse, 52 pp.

Mining and Petroleum Environmental Research Group (MPERG). 2008. *Guidelines for Industrial Activity in Bear Country*. Whitehorse, YT.

Norecol, Dames and Moore. 1996. Initial environmental evaluation Kudz Ze Kayah project, Yukon. Territory. Prepared for Cominco Ltd. by Norecol, Dames and Moore Inc.

Polfus, J.L., Hebblewhite, M., Heinemeyer, K. 2011. *Identifying indirect habitat loss and avoidance of human infrastructure by northern mountain woodland caribou*. Biological Conservation, 144, 2637-2646.

Roggeman, S., van den Brink, N., Van Praet, N., Blust, R., Bervoets, L. 2013. *Metal exposure and accumulation patterns in free-range cows (*Bos taurus*) in a contaminated natural area: Influence of spatial and social behavior*. Environmental Pollution, 172, 186-199.

Sinclair Knight Merz. 2005. Improvement of NPI Fugitive Particulate Matter Emission Estimation Techniques. RFQ NO. 0027/2004. Final May 2005.

United States Environmental Protection Agency (EPA). 1995. Compilation of Air Pollutant Emissions Factors. Volume I: Stationary Point and Area Sources. AP-42 Fifth Edition. Office of Air Quality Planning and Standards. January 1995.

Walker, D.A., and Everett, K.R. 1987. *Road dust and its environmental impact on Alaskan taiga and tundra.* Arctic and Alpine Research, 19, 479-489.

WHO. 2011. WHO Food Additive Series: 64 – Safety Evaluation of Certain Food Additives and Contaminants. Prepared by the seventy-third meeting of JECFA, Joint FAO/WHO Expert Committee on Food Additives, ISBN 978 924 166064 8. Geneva, Switzerland.

Wilson, R., Jones-Otazo, H., Petrovic, S., Mitchell, I., Bonvalot, Y., Williams, D. and Richardson, G.M. 2013. *Revisiting dust and soil ingestion rates based on hand-to-mouth transfer. Human and Ecological Risk Assessment* Volume 19(1):158-188.

Yukon Environmental and Socio-economic Assessment Board (YESAB). 2018. *Request for Supplementary Information – Information Request No.3 Report.* Project Assessment 2017-0083. BMC Minerals Inc. Kudz Ze Kayah Mine. April 9, 2018.

Yukon Order in Council, 2007, *Drinking water regulation, YOIC 2007/139,* <http://canlii.ca/t/krmd> retrieved on 2015-01-20.

Yukon Government. 2012. *Proponent's guide: Assessing and mitigating the risk of human-bear encounters.* Department of Environment, pp. 5. Retrieved on January 25, 2017 from http://www.env.gov.yk.ca/environment-you/bearsafety.phpYukon Government. 2016. Staying Safe in Bear Country. http://www.env.gov.yk.ca/publications-maps/documents/BearCountry_2016_ENG_WEB.pdf.

Yukon Government. 2018. How you Can Stay Safe in Bear Country. Whitehorse, YT. http://www.env.gov.yk.ca/publications-maps/documents/BearCountry.pdf.

Yukon Water Board. 2016. Type B Water Licence QZ16-085 for the Kudz Ze Kayah Property for Quartz Undertakings, BMC Minerals (No.1) Ltd.