CANADIAN ZINC CORPORATION

# DEVELOPER'S ASSESSMENT REPORT
# ALL SEASON ROAD PROJECT
# PRAIRIE CREEK MINE

# DAR ADDENDUM

**SUBMITTED IN SUPPORT OF:**

Environmental Assessment of
Prairie Creek Mine EA 1415-01

**SUBMITTED TO:**

Mackenzie Valley Review Board
Yellowknife, NT X1A 2N7

**SUBMITTED BY:**

Canadian Zinc Corporation
Vancouver, BC V6B 4N9

September 2015

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| 5.1.1 Terrain, Geology, Soils, and Permafrost | 1 | topography and geology, including key terrain features such as rivers, lakes, karst features and wetlands and other important processes and features | 4.1 | DAR Adden. Appendices A (Section 2.2) & F (Section 2.7) |
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| | 11 | borrow ownership | | DAR Adden., Appendix A - Section 2.3 Appendix C BPMRP |
| | 12 | probable permafrost distribution (thickness and lateral extent) on land, water, shoreline and slope crossings | | DAR Appendix 2, Section 5, p.17-63; Section 5.4, p. 62-63. DAR Adden., Appendix F, p.7. |

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| **Sub-Sec.** | **Item** | **Description** | **DAR Section** | **Additional Reference** |
| 5.1.1 Terrain, Geology, Soils, and Permafrost | 13 | permafrost distribution and stability beneath waterbodies | | DAR Appendix 2, Section 5, p.17-63; Section 5.4, p. 62-63. DAR Adden., Appendix F, p.7. |
| | 14 | permafrost processes, features and landforms and their stability, including slopes, shorelines and stream banks | | DAR Appendix 2, Section 5, p.17-63; Section 5.4, p. 62-63. DAR Adden., Appendix F, Section 2.5 |
| | 15 | probable ground ice conditions, temperature and ground thermal regime | | |
| | 16 | probable active layer thickness, seasonal frost, penetration, thaw sensitivity and frost susceptibility | | DAR Appendix 2, Section 5, p.17-63; Section 5.4, p. 62-63. DAR Adden., Appendix F, p.5, 8. |
| | 17 | how fires may affect ground temperature regimes and permafrost | | DAR Appendix 2, Section 5, p.17-63; Section 5.4, p. 62-63. DAR Adden., Appendix F, p. 8, 10-11. |
| | 18 | thaw slumps in the project area | | DAR Appendix 2, Section 5, p.17-63; Section 5.4, p. 62-63. DAR Adden., Appendix F, Section 2.5, Table 2.7-1 |
| | 19 | how regional climate variation and documented warming of ground temperatures in the region may affect ground conditions. | | DAR Appendix 2, Section 6, p.63-65. DAR Adden. Appendix F, Section 2.5 |
| 5.1.2 Climate | 1 | the location of recording stations, length of record for any meteorological data presented, and the quality of the data | 4.2 | DAR Appendix 2, Section 5.3 (p.61-62). DAR Adden. Appendix D (Section 3.1). |
| | 2 | prevailing climatic conditions, seasonal variations, predominant winds including direction and velocity, temperature and precipitation (snowfall, snow depth, rain, fog, wind) | | |
| | 3 | spatial and temporal boundaries for the description of climate | | |
| | 4 | any current climate-related extreme events that may affect the project and frequency of occurrence | | DAR Adden. Appendix D (Section 3.1). |
| | 5 | define the variability and trends within the “current” climate normal period and within the historical period of instrumental record | | DAR Appendix 2, Sections 5.3 and 6.0 (p.61-65). DAR Adden. Appendix D (Section 3.1). |
| | 6 | discuss the contribution of traditional knowledge to the understanding of climate conditions and variability | 4.2 (p.72) | DAR Appendix 2, Section 5.3 (p.62). DAR Adden. Appendix D. |
| 5.1.3 Water Quality and Quantity | 1 | surface water bodies, watercourses and major drainage areas including the total number of crossings and the stream order of the watercourse crossings | 4.3.1 | |
| | 2 | groundwater and subsurface water sources with particular attention to water within karst features | 4.3.3 | |
| | 3 | watercourses that have year-round flow | 4.3.1 | |
| | 4 | the extent of connectivity to adjacent watercourses including any potential seasonal variation | | DAR Pages 78 & 84 |
| | 5 | seasonal and perennial springs including ephemeral streams located within or near the boundaries of the development | | |
| | 6 | naturally occurring icings | | DAR Page 78 |

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|---|---|---|---|---|
| **Sub-Sec.** | **Item** | **Description** | **DAR Section** | **Additional Reference** |
| 5.1.3 Water Quality and Quantity | 7i | surface water flow regimes, variability and seasonal patterns | 4.3.1 | |
| | 7ii | channel characteristics including channel width, normal water depth, and high water depth, with consideration of inter-annual variability (e.g. consideration of the changes between low flow and peak flow conditions) | | DAR Appendices 1, 3, 4 and 5. DAR Adden. Appendices A (Section 2.2 & Appendix B) and B. |
| | 7iii | estimated peak flow rates, water surface elevation, and erosion potential for flood events (considering multiple events from a 1 in 10 year event to a 1 in 250 year event) | | |
| | 7iv | channel and bed morphology and stability | | DAR Appendix 2 (Section 5, p.17-63, Appendix C). DAR Adden., Section 7.6, Appendices A (Section 2.2) & F (Section 2.6). |
| | 7v | bank stability and areas of erosion | | DAR Appendix 1 (Section 6). DAR Adden., Section 7.6, Appendices A (Section 2.2 & F (Section 2.6) |
| | 7vi | sediment load – suspended and bed load | | DAR Table 4-2; Appendix 9, Attachment B. |
| | 8 | sediment quality (type of sediment and concentrations of organics and inorganics in sediment) | 4.3.2 | |
| | 9 | water quality, including seasonal variability in quality | | DAR Adden. Appendix B Section 6 |
| | 10 | active and historical floodplains | | DAR Appendix 1, Section 6; DAR Adden., Appendics A (Table 2) and F (p.6). |
| | 11 | freeze and thaw timing | 4.3.1 | DAR Page 79 |
| | 12 | the role of wetlands (e.g., bogs, fens and peat plateaus) | 4.3.1 & 4.6.4 | DAR Pages 78 and 112, respectively |
| | 13i | subsurface and groundwater flow paths with particular attention to flow within karst features | 4.3.3 | |
| | 13ii | hydraulic conductivity | | DAR Page 84 |
| 5.1.4 Species at Risk | 1 | wildlife species presence, distribution and abundance | 4.4 | DAR Adden., Appendix B Section 2, and Appendices C (Sections 15.2 & 16, and Appendix B Section 1) & E (Section 4.3 (Wildlife species at risk)) |
| | 2 | seasonal movements, habitat requirements (e.g., breeding, calving, feeding) and sensitive time periods | | |
| | 3 | population status and trends, limits and size, sensitivity and any other limiting factors | | |
| | 4 | habitat types including local and regional distribution and abundance | | |
| | 5 | habitat or sites of special value or sensitivity, including species use and timing | | |
| | 6 | migratory patterns, routes and timing in relation to all season road route alternatives, construction activities, and operation | | DAR Adden., Appendix E: Sections 2 & 4.3 |
| | 7 | harvest pressures (subsistence, resident and non-resident harvesting) by species, season and geographic area | | DAR Adden., Appendix E: Section 4.3 (Wildlife species at risk) |
| | 8 | current and historic levels of natural and human-caused fragmentation and connectivity | | DAR Adden., Appendix E: Section 4.1.1 (Current and historic levels of habitat fragmentation) |

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| **Sub-Sec.** | **Item** | **Description** | **DAR Section** | **Additional Reference** |
| 5.1.4 Species at Risk | 9 | baseline contaminant concentrations in harvested species that may change as a result of the all season road using existing data | 4.4 | DAR Adden., Appendices C (Attachment C) & E (Section 4.3) |
| | 10 | any known issues with respect to the health (e.g. parasites, diseases, condition) using existing data | | DAR Adden., Appendix E: Section 4.3 (Wildlife species at risk) |
| | 11 | location of raptor nesting sites within 1km of the proposed project footprint | | |
| | 12 | use of the project area by resident and migratory birds | | |
| 5.1.5 Fish and Aquatic Habitat | 1 | a description of fish habitat present at each of the planned water crossings and realignments, including references (such as photographs and diagrams) at those locations with particular emphasis on riparian areas | 4.5.3, Appendix 8, 9, 10 | DAR Adden., Appendix C, Attachments A and B |
| | 2 | fish species including forage fish (non-harvested) and any other aquatic resources of value present | 4.5.1 | DAR Adden., Appendix C, Attachments A and B |
| | 3 | seasonal and life cycle movements and sensitive periods | 4.5 | DAR Adden., Appendix C, Section 15.2 (bull trout) |
| | 4 | habitat requirements for each life stage | | DAR Adden., Appendix C: Section 15.2, App. B Sec. 1, Atmnt A |
| | 5 | local and regional abundance, distribution and use of habitat types, including aquatic and riparian vegetation | | DAR Adden., Appendix C, Attachments A and B |
| | 6 | known sensitive or important areas in terms of habitat type (e.g., spawning, overwintering, refugia, feeding), species and timing of use | 4.5.3 | DAR Adden., Appendix C, Attachments A and B |
| | 7 | existing baseline contaminant concentrations in harvested species that may change as a result of the all season road and as available | | DAR Adden., Appendix C (Appendix B Section 8, and Attachment C) |
| | 8 | any known issues with respect to health of harvested species (e.g. parasites, disease, condition) | | DAR Adden., Appendix C, Attachment D |
| | 9 | locations and species of particular importance to subsistence harvesters (including Bluefish creek, Tetcela River, and Fishtrap creek) | 4.5.2 | DAR Adden., Appendix C, Attachments A and B |
| | 10 | harvest pressures by species, season and geographic area | 4.5.2 | DAR Adden., Appendic C: Sections 6.3 and 15.2 |
| | 11 | a listing of existing invasive species | | DAR Adden., Appendix C: App. B Sec. 7 |
| 5.1.6 Wildlife and Wildlife Habitat | 1 | wildlife species presence, distribution and abundance | Appendix 7 | DAR Adden., Appendix E: Sections 4.3 & 4.4 |
| | 2 | seasonal movements, habitat requirements (e.g., breeding, calving, feeding) and sensitive time periods | | DAR Addendum, Appendix E: Sections 4.3 & 4.4 |
| | 3 | habitat types including local and regional distribution and abundance | | |
| | 4 | species of importance to subsistence harvesters | | |
| | 5 | habitat or sites of special value or sensitivity, including species use and timing | | |

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| **Sub-Sec.** | **Item** | **Description** | **DAR Section** | **Additional Reference** |
| 5.1.6 Wildlife and Wildlife Habitat | 6 | migratory patterns, routes and timing in relation to all season road route alternatives, construction activities, and operation as well as in relation to construction activities and operation of the airstrip | Appendix 7 | DAR Adden., Appendix E: Sections 2, 4.3 & 4.4 |
| | 7 | harvest pressures (subsistence, resident and non-resident harvesting) by species, season and geographic area | | DAR Adden., Appendix E: Section 4.3 & 4.4 |
| | 8 | listing and location(s) of existing invasive species | | DAR Adden., Appendix E: Sections 7.6, 7.7 & 8.2.4 |
| | 9 | current and historic levels of natural and human-caused fragmentation and connectivity | | DAR Adden., Appendix E: Section 4.1.1 (Current and historic levels of habitat fragmentation) |
| | 10 | existing baseline contaminant concentrations in harvested species that may change as a result of the all season road | | DAR Adden., Appendix E: Sections 4.3 & 4.4 |
| | 11 | any known issues with respect to the health of harvested species (e.g. parasites, diseases, condition) | | |
| | 12 | use of the project area by resident and migratory birds | | DAR Adden., Appendix E: Section 4.4.4 (Forest birds) |
| | 13 | location of known raptor nesting sites or potential raptor nesting habitat within 1 km of the proposed project footprint | | DAR Adden., Appendix E: Section 4.4.6 (Raptors) |
| 5.1.7 Vegetation | 1 | vegetation and vegetation assemblages | Appendix 7 | DAR Adden., Appendix E: Section 4.5.4.2 (Current EOSD cover units) |
| | 2 | any classification system followed, as appropriate | | DAR Adden., Appendix E: Section 4.5.4 (Vegetation cover description) |
| | 3 | identification of species or assemblages that are rare, valued, protected or designated (e.g., vulnerable, threatened, endangered) | | DAR Adden., Appendix E: Sections 4.5.4, 4.5.6, 4.5.7 & 4.5.8 |
| | 4 | location and abundance of rare plants | | DAR Adden., Appendix E: Section 4.5.4 (Species at risk) |
| | 5 | historic and current human use of vegetation, including subsistence and commercial harvesting, (e.g., berry picking, forestry) | | DAR Adden. Appendix B Section 10, and Appendix E (Section 4.5.9 (Traditionally harvested plants)) |
| | 6 | existing baseline contaminant concentrations in harvested species or vegetation (e.g. berries) that may change as a result of the all season road and as available | | DAR Adden., Appendix E: Section 4.5.10 (Existing contaminant concentrations in traditionally harvested plants) |
| | 7 | locations and quantities of merchantable timber | | DAR Adden., Appendix E: Section 4.5.12 (Merchantible timber resources) |
| | 8 | listing and location(s) of existing invasive species | | DAR Adden., Appendix E: Section 4.5.11 (Invasive species) |
| | 9 | frequency of forest fires and post-fire vegetation succession | | DAR Adden., Appendix E: Section 4.5.13 (Fire regime) |
| 5.2.1 | 1 | Education, Training and Skills | 5.1 | |
| 5.2.2 | 1 | Harvesting | 5.2 | DAR Adden. Appendix B Section 4 |
| 5.2.3 Cultural and Heritage Resources | 1 | archaeological, paleontological and historic sites and resources | 5.2, 5.3 | |
| | 2 | culturally important sites | | DAR Section 11.9.2 |
| | 3 | burial sites | | |
| | 4 | heritage resource potential | | |
| 5.2.4 Tourism | 1 | | 5.4 | DAR Adden., Section 20.1 |

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| **Sub-Sec.** | **Item** | **Description** | **DAR Section** | **Additional Reference** |
| 5.2.5 Regional and Local Economies | 1 | employment rate | 5.5 | DAR Adden., Section 20.2 |
| | 2 | employment by industry and occupation, including occupations related to traditional activities | | |
| | 3 | job vacancy and unfilled positions, labour force growth, participation and balance between wage and non-wage sector activities and earnings growth | | |
| | 4 | poverty levels and annual level of social assistance benefits and recipients | | |
| | 5 | the level of local households consuming harvested meat and fish and current harvest activities | | |
| | 6 | current and projected land-based enterprises and economic activities, including those related to tourism, recreation, renewable and non-renewable resources | | |
| 5.2.6 Existing Transportation Routes and | 1 | fuel services | 5.6 | |
| | 2 | road transportation routes including current usage | | DAR Adden., Appendix A -Section 2.12 |
| | 3 | water transportation routes and navigable waters | | |
| 6.1 Project Components and Activities | 1 | design standards (for all project components) | 6.3 & Table 6-1 | DAR Appendix 1 (Section 4.3) |
| | 2 | land requirements (footprint, location, permanent or temporary, ownership, zoning) | | DAR Appendix 1, DAR Adden. Appendix A (Appendix E, Table 16) |
| | 3 | right of way clearing | | DAR Appendix 1, DAR Adden. Appendix A (Appendix E, Table 2) |
| | 4 | road construction methods | | DAR Appendices 1 (Section 4) and 2 (Section 8.1.3, p.79-81). DAR Adden., Appendices A (Appoendix E, Tables 5 & 6) & F (p.11-12) |
| | 5 | cut and fill estimates and plans for excess material disposal/storage | | DAR Appendix 1 (Section 7), DAR Adden. Appendix A (Section 2,2; Appendix E, Table 8) |
| | 6 | water crossing structures and locations | | DAR Appendix 1 (Section 6), DAR Adden. Appendix A (Section 2,2; Appendix E, Table 11) |
| | 7 | alterations to stream flow | | DAR Section 6.4 & Appendix 1 (Section 6.3). DAR Adden. Section 7.6 & Appendix A (Section 2.2) |
| | 8 | borrow source locations, quality and quantities, activities and methods (including gravel crushing) | | DAR Appendix 1 (Section 7). DAR Adden. Appendix A (Appendix A, Table 15) |
| | 9 | temporary winter or all season access roads to borrow areas | | DAR Appendix 1 (Section 7.3). DAR Adden. Appendix A (Appendix A, Table 15) |
| | 10 | camps, staging areas, laydown areas, access roads and other support facilities | | DAR Appendix 1 (Section 4.8.1) |
| | 11 | fuel storage and management | | DAR Section 6.3.2, Appendix 1 (Section 4.8.2) |
| | 12 | explosives manufacturing, storage, transportation, and use | | DAR Appendix 1 (Section 4.3) |
| | 13 | toxic or hazardous materials to be used | | |
| | 14 | equipment requirements (by phase) | | DAR Table 6-2 |
| | 15 | concentrate containment | | DAR Section 6.3.1 |
| | 16 | solid, liquid, and gas waste management | | DAR Section 9.3.2; Appendix 1 Section 4.8.3 |

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| **Sub-Sec.** | **Item** | **Description** | **DAR Section** | **Additional Reference** |
| 6.1 Project Components and Activities | 17 | water use | 6.3 & Table 6-1 | DAR Adden. Section 4.11 |
| | 18 | wastewater treatment | | DAR Appendix 1 Section 4.8.3 |
| | 19 | mobilization and demobilization (this should include a discussion of related activities and land requirements which are necessary for construction but not a part of the project) | | DAR Appendix 1 |
| | 20 | frequency of vehicle and aircraft movement during construction | | DAR Section 6.3.3 |
| | 21 | routine maintenance activities | | DAR Appendix 1 Section 9. DAR Adden. Appendix A (ROP, RCMP) |
| | 22 | expected traffic volumes and weights during all phases | | DAR Adden. Sections 4.2 & Appendix A (2.4) |
| | 23 | clean-up and restoration of work areas during construction phase | | DAR Appendix 1 Section 10 DAR Adden. Appendix A (RCMP, SECP) |
| | 24 | reclamation | | DAR Appendix 1 Section 10 DAR Adden. Appendix A (RCMP) |
| | 25 | procurement and implementation approach | | DAR Appendix 1 Section 4.8.6 |
| | 26 | training, employment and business opportunities | | DAR Section 5.1. DAR Adden. Sections 20.4 & 20.8 |
| | 27 | ongoing operations and maintenance of the all season road (including access control) | | DAR Appendix 1 Section 9. DAR Adden. Appendix A (ROP, RCMP) |
| | 28 | land ownership and jurisdiction | | |
| 6.2 Road Design Considerations | 1 | design standards | 6.4 | DAR Appendix 1 (Section 4.3), DAR Adden. Appendix A |
| | 2 | longitudinal slope of the road | | DAR Appendix 1, DAR Adden. Appendix A |
| | 3 | runaway lanes | | DAR Appendix 1. DAR Adden. Appendix A (Section 2.4) |
| | 4 | safety railings | | DAR Appendix 1, DAR Adden. Appendix A (Section 2.5) |
| | 5 | side slopes | | DAR Appendix 1 (Section 6). DAR Adden. Appendix A (Section 2.2 & Appendix B) |
| | 6 | channel bank reinforcement | | |
| | 7i | freeboard when adjacent to or crossing watercourses for multiple flood events | | |
| | 7ii | crossing type and structure design given the hydrologic and hydraulic characteristics of the watercourse and the proposed road design standards | | |
| | 8 | pull-outs | | DAR Appendix 1, DAR Adden. Appendix A (Section 2.7) |
| | 9 | dust control | | DAR Adden. Section 4.11, Appendices A (Appendix E ROP) & D |
| | 10 | geotechnical stability | | DAR Appendix 2, Section 8.1.3, p.79-81. DAR Adden., Appendix F, p.11-12. |
| | 11 | sediment and erosion control especially where immediately adjacent to a waterbody | | DAR Adden. Appendix A (Appendix C SECP) |
| | 12 | landslide and avalanche protection | | DAR Appendix 2 (Sections 7.1 & 7.3.2). DAR Adden. Appendix A (Appendix C RCMP, ROP) |
| 6.3 Construction Phases and Schedule | 1 | | 6.5 | DAR Appendix 1 (Table 6), DAR Adden. Appendix A (Section 2.9) |

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|---|---|---|---|---|
| **Sub-Sec.** | **Item** | **Description** | **DAR Section** | **Additional Reference** |
| 6.4 Existing Infrastructure, Facilities | 1i | operation of the airstrip, frequency of use, type of aircraft, and estimated number of passengers and volume of material | 6.3.3 | DAR Adden. Section 4.4 |
| | 1ii | potential increase in the number of vehicles travelling along existing roads and highways | 6.6 | DAR Adden., Appendix A (Section 2.12) |
| | 2 | how it will be used in the context of the proposed development | 6.3.3 & 6.6 | |
| | 3 | the capacity of existing facilities and infrastructure to handle the proposed development | 6.6 | DAR Adden., Appendix A (Sections 2.5 & 2.12) |
| | 4 | any changes to the existing infrastructure or facilities that will occur as a result of the project | | DAR Appendix 1, Table 5 & 6. DAR Adden. Appendix A (Section 2.6). |
| 6.5 Existing Management Plans | 1 | | 6.7 | DAR Adden. 4.17 & Appendices A (Appendix C), C (Section 4.17), D (Section 4) & E (Sections 7.7 & 10) |
| 7.2.1 Traditional Harvesting and Traditionally Harvested Species | 1 | sensitive or important harvesting areas or habitat both inside and outside the Nahanni 1.National Park Reserve | Appendix 7 | DAR Adden., Appendix E: Section 6.8 |
| | 2 | direct and indirect alteration of habitat including all season road footprint impact | | DAR Adden., Appendix E: Sections 6.3 & 6.4 |
| | 3 | sensory disturbance, and predicted changes in behaviour (including habitat avoidance and effective habitat loss in relation to all season road facilities or activities), energetics, health and condition | | DAR Adden., Appendix E: Sections 6.4, 6.5, 6.6 & 6.7.1 |
| | 4 | wildlife movement patterns, home ranges, distribution and abundance | | DAR Adden., Appendix E: Sections 6.5 & 6.6 |
| | 5 | wildlife mortality due to harvesting and vehicle collisions | | DAR Adden., Appendix E: Section 6.7.2 & 6.8 |
| | 6 | disruption of sensitive life stages or habitat (e.g., migration, calving, denning, overwintering) | | DAR Adden., Appendix E: Section 6.5 |
| | 7 | effect to population cycles | | DAR Adden., Appendix E: Section 6.7.4 |
| | 8 | effects to predator-prey relationships | | DAR Adden., Appendix E: Section 6.7.5 |
| | 9 | increased human-wildlife interactions | | DAR Adden., Appendix E: Section 6.7.2 |
| | 10 | contaminant levels in harvested species that could be impacted by the all season road | | DAR Adden., Appendix E: Section 6.4 |
| | 11 | changes in access, including increased access to the land and surrounding waters, as well as increased access to environmentally and culturally sensitive areas | | DAR Adden., Appendix E: Section 6.8 |
| | 12 | changes in hunting and fishing pressures from people who do not reside in the region and how road-related changes in harvest pressures could impact the resource | 8.11 | DAR Adden., Appendices C (Section 6.3 (fish)) & E (Section 6.9 (wildlife)) |

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| **Sub-Sec.** | **Item** | **Description** | **DAR Section** | **Additional Reference** |
| 7.2.1 Traditional Harvesting and Traditionally Harvested Species | 13 | changes in the abundance and distribution of harvested resources, including caribou, moose, sheep, and other wildlife (e.g. furbearers, waterfowl) that would adversely affect harvesting | Appendix 7 | DAR Addendum, Appendix E (Section 6.5) |
| | 14i | changes to harvest effort as perceived by harvesters | | DAR Adden., Appendix E: Section 6.8 |
| | 14ii | changes in harvester travel patterns | | |
| | 14iii | changes in harvest levels | | |
| | 14iv | changes in harvesters' costs | | |
| | 14v | changes in seasonal harvesting patterns | | |
| | 15 | competition among harvesters within and between communities as a result of increased access and loss or alteration to the land resulting from the project | | DAR Adden., Appendix E: Section 6.9 (Risk of harvesting pressure) |
| | 16 | changes in the quality of harvested species (including contamination) that would negatively affect their consumption | | DAR Adden., Appendix E: Sections 6.4 & 6.7.1 |
| | 17 | measures to avoid or minimize changes in the abundance, distribution, or quality of harvested species, or mitigate the consequences of such changes | | DAR Adden., Appendix E: Section 6.5 (Effects on the abundance and occurrence of harvested species) & Table 1 |
| | 18 | mechanisms to control project workforce-related hunting, fishing, or disturbance of wildlife | | DAR Adden., Appendix E: Section 6.9 (Risk of harvesting pressure) Table 1 |
| | 19 | other traditional harvesting activities such as for berries or medicinal plants | | DAR Adden., Appendix E: Section 6.10.1 (Berries and medicinal plants) |
| | 20i | mechanisms to manage hunting, and fishing by resident hunters and fishers | | DAR Adden., Appendix E: Section 6.9 (Risk of harvesting pressure) & Table 1 |
| | 20ii | mechanisms to manage hunting, and fishing by non-resident hunters and fishers | | |
| | 20iii | mechanisms to manage hunting, and fishing by Aboriginal harvesters | | |
| 7.2.2 Effects of Potential Accidents and Malfunctions | 1 | contamination to soil from concentrate aerial dispersal and spills along the road | 9.3.1 | DAR Adden. Section 7.1. Also Appendix A (Appendix C - plans) |
| | 2 | contamination of surface water, groundwater, and subsurface water from concentrate aerial dispersal and spills along the road | | |
| | 3 | spills of concentrate at transfer facilities | 9.3.3 | |
| | 4 | leaks of fuel or other materials during transport | 9.3.2 | |
| | 5 | fuel leaks during extraction for road building | | |
| | 6 | fuel or contaminant leaks at storage facilities | | |

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| Terms of Reference | | | Location | |
|---|---|---|---|---|
| **Sub-Sec.** | **Item** | **Description** | **DAR Section** | **Additional Reference** |
| 7.2.2 Effects of Potential Accidents and Malfunctions | 7i | how flooding may contribute to potential accidents, malfunctions, and spills | | DAR Appendix 2, Section 7.1, p.65-68. DAR Adden.. Section 7.1 |
| | 7ii | how overland flow may contribute to potential accidents, malfunctions, and spills | | |
| | 7iii | how landslides may contribute to potential accidents, malfunctions, and spills | | |
| | 7iv | how seismic activity may contribute to potential accidents, malfunctions, and spills | | |
| | 7v | how avalanche activity may contribute to potential accidents, malfunctions, and spills | | |
| | 8 | A risk assessment using best practices for the Project including components, systems, hazards, and failure modes | 9.4 & 9.5 | DAR Appendix 2, Section 7.2, p.68-74. DAR Adden. Section 7.1 |
| | 9i | A map of high risk zones | | DAR Fig. 9-1 |
| | 9ii | Site-specific contingencies for high risk areas | 9.5 | DAR Appendix 2, Section 7.3, p.74-76. |
| | 10 | A description of contingency plans for accidents, malfunctions, or unforeseen impacts of the environment on the development and the development on the environment | | |
| | 11 | A description of emergency response plans that will be in place | | Spill Contingency Plan; DAR Adden. Appendix A (Road Ops. Plan) |
| 7.2.3 Impacts to NNPR | 1 | ecosystem and habitat loss | 10.1 | DAR Adden., Appendix E: Section 7.2 (Ecosystem and habitat loss) |
| | 2 | wilderness quality | 10.11 | DAR Adden.: Section 8.1 & Appendix E (Section 7.11) |
| | 3 | habitat fragmentation and barriers to movement and gene flow | 10.2 | DAR Adden., Appendix E: Section 7.4 |
| | 4 | ability of habitat or species to recover | 10.7 & 10.8 | DAR Adden., Appendix E: Section 7.8 & 7.9 |
| | 5 | response to edge effects | | DAR Adden. Appendix E, Section 7.4 |
| | 6 | changes to species distribution and abundance | 10.3 & 10.4 | DAR Adden., Appendix E: Section 7.3 |
| | 7 | changes to the karst formations | 10.10 | DAR Appendix 2, Section 5, p.17-63. DAR Adden., Appendix F, Section 2.7 |
| | 8 | invasive species (vegetation and wildlife) | 10.5 & 10.6 | DAR Adden., Appendix E: Section 7.6 & 7.7 |
| | 9 | ecosystem functioning | 10.9 | DAR Adden., Appendix E: Section 7.10 |
| | 10 | overall visitor experience | 10.11 | |
| | 11 | long term changes to Nahanni National Park Reserve | 10.12 | DAR Adden., Appendix E: Section 7.12 |
| 7.3.1 Terrain, Soils, Permafrost and Karst Topography | 1 | slope and soil stability, erosion and subsidence | 11.1 | DAR Appendix 2, Section 5, p.17-63; Section 8, p. 77-81. |
| | 2 | the effect of changes in road bed weight relative to the winter road, drainage, traffic volume, traffic speed, and borrow site development on karst topography | | DAR Appendix 2, Section 5, p.17-63; Section 8.1.3, p. 79-81. DAR Adden., Appendix F, p.3. |
| | 3 | the effects on wetlands with particular attention to the wetland areas | | DAR Appendix 2, Section 5, p.17-63; Section 8, p. 77-81. |

## TABLE A: CONCORDANCE TABLE

| Terms of Reference | | | Location | |
|---|---|---|---|---|
| **Sub-Sec.** | **Item** | **Description** | **DAR Section** | **Additional Reference** |
| 7.3.1 Terrain, Soils, Permafrost and Karst Topography | 4 | thaw slumps, compaction of organic peat lands, and potential for melt of ice rich ground | 11.1 | DAR Appendix 2, Section 5, p.17-63; Section 8, p. 77-81. |
| | 5 | snow distribution and consequences on ground thermal regime | | DAR Appendix 2, Section 5, p.17-63; Section 6, p. 63-65; Section 8, p. 77-81. DAR Adden., Appendix F, p.7. |
| | 6 | drainage beside and beneath the road, channelization and non-channelization flow and permafrost degradation | | DAR Appendix 2, Section 7, p.65-76; Section 8, p. 77-81. DAR Adden., p.8. |
| | 7 | avalanche risks and the effect of avalanche management on the environment. | | DAR Appendix 2, Section 7, p. 65-76. DAR Adden., Appendix F, p.7-8. |
| | 8 | permafrost as a design feature in the road bed, failure modes analysis and associated contingency plans | | DAR Appendix 2, Section 8, p. 77-81. |
| | 9 | changes to permafrost beneath the Tetcela Transfer Facility | | DAR Appendix 2, Section 5, p.33-38. |
| | 10 | thermal conditions, active layer thickness, thaw depth, distribution and stability | | DAR Appendix 2, Section 5, p.17; Section 6, p. 63-65; Section 8, p. 77-81. |
| | 11 | ice rich soils (thaw settlement, thermokarst) permafrost thaw and related settlement | | DAR Appendix 2, Section 5, p.17-63; Section 6, p. 63-65; Section 8, p. 77-81. |
| | 12 | frost heave or frost susceptible soils in thin permafrost as well as seasonally frozen soils | | DAR Appendix 2, Section 5, p.17-63; Section 6 (p. 63-65); Section 8, p. 77-81. DAR Adden., Appendix F, p.8. |
| | 13 | thaw or settlement-related impacts on drainage and surface hydrology | | DAR Appendix 2, Section 5, p.17-63; Section 6 (p. 63-65); Section 8, p. 77-81. DAR Adden., Appendix F, p.8. |
| | 14 | shorelines and channels | | DAR Appendix 2, Section 5, p.17-63. DAR Adden., Appendix F, p.8. |
| | 15 | combined impacts of the all season road and fires | | DAR Appendix 2, Section 5 p.17-63; Section 5.4 p.62-63; Section 6 p. 63-65; Section 8 p. 77-81. DAR Adden., Appendix F p.8. |
| | 16 | how warming ground temperatures and deepening active layers will affect the all season road and how mitigation measures will remain effective in various climate warming scenarios. | | DAR Appendix 2, Section 5 p.17-63; Section 5.4 p.62-63; Section 6 p. 63-65; Section 8 p. 77-81. DAR Adden., Appendix F p.8-9. |
| 7.3.2 Granular Materials | 1 | locations, areas and volumes of material from each proposed borrow site. | 11.2 | DAR Appendix 1; Table 14, Appendix I. DAR Adden. Appendix A (Section 2.3 & Table 14) |
| | 2 | potential for excavation and use of hot rocks | | DAR Appendix 1, Section 7.4.1. DAR Adden. Appendix A (Section 2.3 & Table 14) |
| | 3 | measures to limit the effect on the surrounding environment | | DAR Appendix 2, Section 8 p. 77-81. DAR Adden., Appendix A (Appendix C BPMRP) |
| | 4 | excavation requirements | | DAR Appendix 1 (Section 4.7 & 7, Table 8). DAR Adden. Appendix A (Section 2.3 & Table 14) |
| | 5 | talus slope stability | | DAR Appendix 2, Section 5, p.17-63. DAR Adden., Appendices F (p.9) & A (Section 2.3 & Table 14) |
| | 6 | ownership and operation of borrow pits | | |
| | 7 | remediation and reclamation of borrow pits | | DAR Appendix 1, Section 7.4.3. DAR Adden. Appendix A, Appendix C (BPMRP) |
| | 8 | potential for acid rock drainage. | | DAR Appendix 1, Section 7.4.1. DAR Adden. Appendix A (Appendix C BPMRP) |

## TABLE A: CONCORDANCE TABLE

| Terms of Reference | | | Location | |
|---|---|---|---|---|
| **Sub-Sec.** | **Item** | **Description** | **DAR Section** | **Additional Reference** |
| 7.3.3 Air Quality | 1 | dust and carbon emissions from vehicles, equipment and stationary sources | 11.3.1 | DAR Adden. Appendix D |
| | 2 | emissions by source for each phase (construction, operation and maintenance, and closure), including quantity, timing and duration, normal operation conditions and upsets | | |
| | 3 | how changes in air quality could have an impact on humans, wildlife, vegetation, and waterbodies | 11.3.2 | DAR Adden. Appendices D & E (Sections 8.3.4 & 8.3.5) |
| | 4 | methods of dust suppression | 11.3.3 | DAR Adden. Section 4.11 & Appendix A (Appendix C RCMP) |
| 7.3.4 Noise | 1 | road (including borrow pits and gravel crushing) and airstrip components and activities that could produce undesirable noise including source location, timing and duration | 6.3.3 | DAR Appendix 1. DAR Adden. Appendix A |
| | 2 | sensory disturbance to fish, birds and wildlife, including caribou and moose | 11.4.1 and 11.4.2 | DAR Adden., Appendices C (Section 8.4) & E (Section 7.11) |
| | 3 | disturbance of harvest and recreational activities, including tourism | 11.4.3 | DAR Adden. Sections 6.4, 8.1 and 13.2 |
| | 4 | potential impacts to wildlife harvesting activities and impacts to communities | 8.5 | |
| 7.3.5 Water Quality and Quantity | 1 | changes to surface drainage patterns and surface water hydrology including changes caused by road-related impacts on terrain, soils and permafrost | 11.5.1 | DAR Appendix 2, Section 8 p. 77-81. DAR Adden., Section 14.2 & Appendix F, p.10. |
| | 2 | alterations to streamflow | | DAR Appendix 1 (Section 6). DAR Adden., Section 14.2 & Appendix A (Section 2.2 & Appendix B) |
| | 3 | possible contamination to surface water, subsurface water and groundwater including within karst features | 9.4 & 11.5.2 | DAR Adden. Section 14.3 |
| | 4 | drinking water quality for humans and wildlife | 11.5.2 | |
| | 5 | recreational water quality | | |
| | 6 | discharge or seepage of wastewater effluent, contaminants, chemical additives, etc. | | |
| | 7 | changes to water quality at water crossings and realignments (bridges, culverts and other wetted areas) | | DAR Appendix 1 (Section 6). DAR Adden. Section 14.3 & Appendix A (Appendix C, SECP, RCMP) |
| | 8 | changes to water quality due to thaw slumps and other slope instability at water crossing | | DAR Appendix 2, Section 8 p. 77-81. DAR Adden., Section 14.3 & Appendix F, p.10. |
| | 9 | changes to snow distribution and potential impacts on drainage | | DAR Appendix 2, Section 5.3 p.62; Section 6 p. 63, Section 7 p.66, Section 8 p. 78-80. DAR Adden., Appendix F, p.7. |
| | 10 | issues related to borrow extraction including melting of ground ice and potential changes to drainage patterns etc. | | DAR Appendix 2, Section 5, p.17-63. DAR Adden., Appendices A (Appendix C BPMRP) & F (p.7) |
| | 11 | erosion, sediment deposition, sediment re-suspension | 11.5.1 | DAR Adden., Section 14.3 & Appendix A (Appendix C RCMP, SECP) |
| | 12 | changes to flow or water levels including potential for glaciation and icings at watercourse crossings | 4.3.1 & 11.5.1 | DAR Appendices 3 & 4 |

## TABLE A: CONCORDANCE TABLE

| Terms of Reference | | | Location | |
|---|---|---|---|---|
| **Sub-Sec.** | **Item** | **Description** | **DAR Section** | **Additional Reference** |
| 7.3.5 Water Quality and Quantity | 13 | water withdrawal and volume of withdrawal (e.g., for potable water, dust suppression) | 11.5.4 | DAR Adden. Section 4.11 |
| | 14 | potential effects on the aquatic environment including invertebrates | 11.6.1 & 11.6.3 | |
| 7.3.6 Species at Risk | 1 | methods to minimize the effect of the project on the species including strategies for mitigation and monitoring | Appendix 7 | DAR Adden., Appendices C (Section 15.2, bull trout)& E (Section 8.0 and Table 1) |
| | 2 | direct and indirect alteration of habitat including direct road footprint impact | 10.1 | DAR Adden., Appendices C (Section 15.2, bull trout) & E (Sections 8.2 & 8.3) |
| | 3 | visual or auditory disturbance, including habitat avoidance and effective habitat loss in relation to all season road facilities or activities | Appendix 7 | DAR Adden., Appendices C (Section 8.4) & E (Section 8.4) |
| | 4 | effect of construction and pre-construction activities, including aircraft effects | | DAR Adden., Appendix E: Sections 8.1 to 8.6 |
| | 5 | mortality due to harvesting and vehicle collisions | | DAR Adden., Appendix E: Sections 6.8, 6.9 & 8.6.1 |
| | 6 | disruption of sensitive life stages or habitat (e.g., migration, calving, denning, overwintering) | | DAR Adden., Appendix E: Section 8.4 & 8.5 |
| | 7 | changes to movement patterns and corridors, home ranges, distribution and abundance | | |
| | 8 | effects to sensitive or important areas of habitat | | DAR Adden., Appendices C (Sections 8.4 (noise - fish) & 16.5 (riparian veg)) & E (Section 8.4) |
| | 9 | habitat fragmentation | 11.6.1 | DAR Adden., Appendices C (Section 15.2 (bull trout) & E (Section 8.2) |
| | 10 | effects to population cycles | Appendix 7 | DAR Adden., Appendix E: Section 8.6.2 (Effects to population cycles) |
| | 11 | effects to predator-prey relationships | | DAR Adden., Appendix E: Section 8.6.3 (Effects from predator-prey relationships) |
| | 12 | attraction to predators of birds and bird eggs | | DAR Adden., Appendix E: Sections 8.6.1 & 8.6.3 |
| | 13 | increased human-wildlife conflicts (e.g. bear encounters) | | DAR Adden., Appendix E: Section 8.6.1 (Risk of project-related mortality) |
| | 14 | mortality from collisions with temporary or permanent structures and wires | | **Not applicable**, as infrastructure approved as part of the winter road. The proposed Project and the approved winter road does not include wires. |
| | 15 | potential disturbance to raptors nesting within 1km of the proposed project footprint | Appendix 7 | DAR Adden., Appendix E: Sections 8.1 to 8.6 |
| | 16 | use of the project area by resident and migratory birds protected by the Migratory Birds Convention Act, 1994 | | DAR Adden., Appendix E: Sections 4.3, 4.4.4, 7.2 to 7.9, 8.1 to 8.6 |
| | 17 | how road-related changes in harvest pressures could impact the resource | | DAR Adden., Appendix E: Sections 6.5, 6.8, 6.9, 7.2 to 7.9 |
| | 18 | ability of habitat or species to recover | | DAR Adden., Appendix E: Sections 7.9 & 8.6.5 |
| | 19 | response to edge effects | | DAR Adden., Appendix E: Sections 8.2, 8.4, 8.6.1 & 8.6.3 |
| | 20 | invasive species (vegetation, wildlife and other threats) | | DAR Adden., Appendices A (Appendix C BPMRP, RCRP) & E (Sections 8.6.4 & 8.7.7) |

## TABLE A: CONCORDANCE TABLE

| Terms of Reference | | | Location | |
|---|---|---|---|---|
| **Sub-Sec.** | **Item** | **Description** | **DAR Section** | **Additional Reference** |
| 7.3.7 Fish and Aquatic Habitat | 1 | alteration or loss of fish habitat due to development activities during all project phases | 11.6.1, 11.6.2 | DAR Adden., Appendix C, 4.16 (fragmentation), 16.3 (habitat), 16.2 (fish and fish habitat), Attachment E (matrix) |
| | 2 | the estimated time to redevelop habitat | 10.8 | DAR Adden., Appendix C, 4.16 (fragmentation), 16.3 (fish habitat), 16.2 (assessment steps), Attachment E (matrix) |
| | 3 | effects of proposed watercourse crossings, realignments and temporary vehicle crossing methods | 10.9.3 | DAR Adden., Appendices A (Appenbdix C RCMP) & C (4.16 (fragmentation), 16.3 (fish habitat), 16.2 (assessment steps), Attachment E (matrix)) |
| | 4 | standards or guidelines related to watercourse crossings and realignments that would be applied | 11.6 | DAR Adden., Appendices A (Appendix C RCMP) & C (Section 16.4) |
| | 5 | relevant policies, management plans or other measures to protect or enhance fish and aquatic habitat, including timing restrictions, protected areas or regulations | 11.6 | DAR Adden., Appendices A (Appendix C RCMP) & C (16.4 (mitigation)) |
| | 6 | disruption of sensitive life stages or habitat (e.g., spawning and incubation, rearing, overwintering) including loss of substrate habitat and known sensitive or important site | 10.9.3 | DAR Adden., Appendix C, 4.16 (fragmentation), 16.3 (fish habitat), 16.2 (assessment steps), Attachment E (matrix) |
| | 7 | effects on riparian areas | 11.6 | DAR Adden., Appendices A (Appendix C RCMP, RCRP) & C (16.5 (effects on riparian veg)) |
| | 8 | effects to locations and species of particular importance to subsistence harvesters (including Bluefish creek, Tetcela River, and Fishtrap creek) | | DAR Adden., Appendix C, 6.3 |
| | 9 | impacts related to changes in water quality or quantity | | DAR Adden.: Section 4.11; Appendix C, Sec. 15.2, Sec. 16.2 |
| | 10 | changes to distribution or abundance | 11.6.2 | DAR Adden., Appendix C, 4.16 (fragmentation), 16.3 (fish habitat), 16.2 (assessment steps), Attachment E (matrix) |
| | 11 | effects to sensitive or important areas or habitat | 11.6 | DAR Adden., Appendix C, 4.16 (fragmentation), 16.3 (fish habitat), 16.2 (assessment steps), Attachment E (matrix) |
| | 12 | contaminant levels in harvested species that could be changed by the all season road, if applicable | | DAR Adden., Appendix C, Attachment C (assessment matrix) |
| | 13 | potential effects on fish health | 11.6.2 | DAR Adden., Appendix C (Appendix B Section 9, and Attachment D (assessment matrix)) |
| | 14 | blockages to movement | 11.6.2 | DAR Adden., Appendix C, 4.16 (fragmentation) |
| | 15 | effects of blasting (if required) | 11.6 | DAR Adden., Appendix C, 16.2 |
| | 16 | dredging or disposal of sediments | 11.6.1 | DAR Adden., Appendix C, 16.6 (effects of dredging) |
| | 17 | effects of water withdrawal | 8.6 | DAR Adden.: Section 4.11 |
| | 18 | potential for increased pressure on the resource that could arise from improved access | 8.11 | DAR Adden., Appendix C, 6.3 (traditional harvesting) |
| | 19 | reclamation of in-stream and riparian work areas during construction and also during maintenance operations | 11.6.3 | DAR Adden., Appendices A (Appendix C RCMP, RCRP) & C (24.4 (reclaimation of in-stream and riparan areas)) |
| | 20 | criteria for evaluating the success of mitigation or reclamation measures and indicate when and how this evaluation would be conducted | 15 | DAR Adden., Appendices A (Appendix C RCRP) & C (4.17 (AEMP)) |

## TABLE A: CONCORDANCE TABLE

| Terms of Reference | | | Location | |
|---|---|---|---|---|
| **Sub-Sec.** | **Item** | **Description** | **DAR Section** | **Additional Reference** |
| 7.3.8 Wildlife and Wildlife Habitat | 1 | methods to minimize the effect of the project on the species including strategies for mitigation and monitoring | Appendix 7 | DAR Adden., Appendix E: Section 8.0 and Table 1 |
| | 2 | direct and indirect alteration of habitat including direct road footprint impact | | DAR Adden., Appendix E: Sections 8.2 & 8.3 |
| | 3 | visual or auditory disturbance, including habitat avoidance and effective habitat loss in relation to all season road facilities or activities | | DAR Adden., Appendix E: Section 8.4 (Effects to abundance and occurrence) |
| | 4 | effect of construction and pre-construction activities, including aircraft effects on wildlife | | DAR Adden., Appendix E: Sections 8.1 to 8.6 |
| | 5 | wildlife mortality due to increased harvesting and vehicle collisions | | DAR Adden., Appendix E: Sections 6.8, 6.9 & 8.6.1 |
| | 6 | disruption of sensitive life stages or habitat (e.g., migration, breeding, calving, denning, overwintering) | | DAR Adden., Appendix E: Sections 8.4 & 8.5 |
| | 7 | wildlife movement patterns and corridors, home ranges, distribution and abundance | | |
| | 8 | effects to sensitive or important areas or habitat | | DAR Adden., Appendix E: Section 8.4 (Effects to abundance and occurrence) |
| | 9 | habitat fragmentation | | DAR Adden., Appendix E: Section 8.2 (Effects of habitat loss and fragmentation) |
| | 10 | effects to population cycles | | DAR Adden., Appendix E: Section 8.6.2 (Effects to population cycles) |
| | 11 | effects to predator-prey relationships | | DAR Adden., Appendix E: Section 8.6.3 (Effects from predator-prey relationships) |
| | 12 | attraction to predators of birds and bird eggs | | DAR Adden., Appendix E: Sections 8.6.1 & 8.6.3 |
| | 13 | increased human-wildlife conflicts (e.g. bear encounters) | | DAR Adden., Appendix E: Section 8.6.1 (Risk of project-related mortality) |
| | 14 | mortality from collisions with temporary or permanent structures and wires | | **Not applicable**, as infrastructure approved as part of the winter road. The proposed Project and the approved winter road does not include wires. |
| | 15 | potential disturbance to raptors nesting within 1km of the proposed project footprint | | DAR Adden., Appendix E: Sections 8.1 to 8.6 |
| | 16 | use of the project area by resident and migratory birds protected by the Migratory Birds Convention Act, 1994 | | DAR Adden., Appendix E: Sections 4.3, 4.4.4, 7.2 to 7.9, 8.1 to 8.6 |
| | 17 | how road-related changes in harvest pressures could impact the resource | | DAR Adden., Appendix E: Sections 6.5, 6.8, 6.9, 7.2 to 7.9 |
| | 18 | ability of habitat or species to recover | | DAR Adden., Appendix E: Sections 7.9 & 8.6.5 |
| | 19 | response to edge effects | | DAR Adden., Appendix E: Sections 8.2, 8.4, 8.6.1 & 8.6.3 |
| | 20 | invasive species (vegetation and wildlife) | | DAR Adden., Appendix E: Sections 8.6.4 & 8.7.7 |
| 7.3.9 Vegetation | 1 | alteration or loss of species, or vegetation assemblages that are rare, valued, protected or designated sensitive or important areas or habitat | Appendix 7 | DAR Adden., Appendix E: Section 8.7.1 (Effects of land clearing on terrestrial ecosystems) |
| | 2 | amount of merchantable timber removed during right of way clearing and the potential for facilitating use of waste timber by communities | | DAR Adden., Appendices A (Appendix E Table 2) & E (Section 8.7.2 (Effects to merchantible timber resources)) |
| | 3 | amount of vegetation clearing | | DAR Adden., Appendices A (Appendix E Table 2) & E (Section 8.7.1 (Effects of land clearing on terrestrial ecosystems)) |
| | 4 | introduction of invasive species and threats | | DAR Adden., Appendix E: Section 8.7.8 (Introduction of invasive plants) |
| | 5 | effects to rare plants | | DAR Adden., Appendix E: Section 8.7.7 (Effects on rare plants) |

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| Terms of Reference | | | Location | |
|---|---|---|---|---|
| **Sub-Sec.** | **Item** | **Description** | **DAR Section** | **Additional Reference** |
| 7.3.9 Vegetation | 6 | effects of fire management practices | Appendix 7 | DAR Adden., Appendices A (Appendix C RCMP) & E (Section 8.7.3 (Effects from fire)) |
| | 7 | potential changes to fire risk | | |
| | 8 | effects of road emissions including dust | | DAR Adden., Appendix E: Sections 8.7.4 & 8.7.5 |
| | 9 | how changes in right of way clearing might impact permafrost and the all season road itself | | DAR Adden., Appendix E: Section 8.7.9 (Effects to soil, hydrology and permafrost regimes) |
| | 10 | changes to the soil, hydrological or permafrost regimes related to vegetation changes | | |
| | 11 | re-establishment of vegetation and reclamation of borrow sites and other disturbances (particularly identification of vegetation types and seed mixes to be used, and identification of the specific borrow site to be re-vegetated, and those borrow sites that will not be re-vegetated) | | DAR Adden., Appendices A (Appendix C BPMRP) & E (Section 8.7.10.2 (Revegetation during reclamation)) |
| | 12 | vegetation control during operations | | DAR Adden., Appendices A (Appendix C RCMP) & E (Section 8.7.10.3) |
| 7.3.10 Cultural and Heritage Resources | 1 | traditional lifestyles, values and culture | 5.2 & 11.9.1 | DAR Pages 125-126, 268 |
| | 2 | cultural and spiritual sites and activities | 11.9.2 & 11.9.3 | |
| | 3 | impacts to archaeological sites | 11.9.3 | |
| 7.3.11 Employment and Benefits to the Community | 1 | direct and indirect employment opportunities generated by the development and the potential for uptake of these opportunities locally by Aboriginal peoples and within the North | 11.10 | |
| | 2 | current or proposed socio-economic initiatives or agreements (please list and provide the non-confidential details) | | DAR Adden. Section 20.3 |
| | 3 | the effectiveness of past or present socio-economic benefit initiatives including levels of success in improving recruitment, retention, and advancement of workers from potentially affected communities | | |
| | 4 | employment and income for every phase and year of construction and operation, with particular reference to wage and salary employment by length of employment, form of employment (full time, part time, seasonal), and skills category | | DAR Adden. Section 20.4 |
| | 5 | location of camps (new or existing, temporary or permanent) and size of crews (number of individuals) working at each camp | | DAR Section 4.8.1. DAR Adden. Section 20.5 & Appendix A (Section 2.9) |
| | 6 | employee drug and alcohol policy | | |
| | 7 | security personnel at the sites | | DAR Adden., Appendix A (Appendix C ROP) |
| | 8 | anticipated access of crews to surrounding communities | | DAR Adden. Section 20.6 |
| | 9 | potential negative effects of the project such as crime and substance abuse | | |

## TABLE A: CONCORDANCE TABLE

| Terms of Reference | | | Location | |
|---|---|---|---|---|
| **Sub-Sec.** | **Item** | **Description** | **DAR Section** | **Additional Reference** |
| 7.3.11 Employment and Benefits to the Community | 10 | changes to policing demands | 11.10 | DAR Adden. Section 20.7 |
| | 11 | measures, plans and commitments for maximizing local and Aboriginal employment and businesses | | |
| | 12 | effects on tourism activities (including potential opportunities for increased tourism) in the region from all season access | | |
| | 13 | potential for increased exploration in the area | | |
| | 14 | speculative migration into the area | | |
| | 15 | changes to the cost of living in the area | | |
| | 16 | how local and Aboriginal participation in contractor and sub-contractor business opportunities will be maximized | | DAR Adden. Section 20.8 |
| | 17 | effects on capacity of local businesses to service other sectors during the construction phase | | DAR Adden. Section 20.9 |
| | 18 | the timing and duration of education and skills development programs that would be.required for road-related employment | | |
| | 19i | training required for use of the proposed road | | |
| | 19ii | local and regional training opportunities | | |
| | 19iii | timing and duration of programs, in relation to the development schedule | | |
| | 19iv | skills and experience gained that could be applied to other available projects or sectors | | |
| | 19v | the number of people expected to be employable and available | | |
| | 19vi | the potential for local development of skills for senior professional positions (e.g. labourer or heavy equipment operator vs. supervisor or manager) | | |
| | 19vii | proposed programs that would be provided by or sponsored by the developer | | |
| 7.3.12 Impacts on Existing Transportation Infrastructure | 1i | possible accidents with tourist traffic and wildlife | 11.11 | DAR Adden. Section 21.1 & 21.2 |
| | 1ii | increased dust along the highway and the effect on adjacent properties | | DAR Adden., Appendix A (Section 2.12) |
| | 1iii | safety along the highway | | |
| | 1iv | spills along the highway | | |
| | 1v | highway integrity | | |
| | 2 | effects on existing water transportation routes and navigation on navigable waters (i.e. Liard River crossing) | | DAR Adden. Section 21.3 |

## TABLE A: CONCORDANCE TABLE

| Terms of Reference | | | Location | |
|---|---|---|---|---|
| **Sub-Sec.** | **Item** | **Description** | **DAR Section** | **Additional Reference** |
| 8 Effects of the Environment on the Project | 1 | long-term climate change scenarios9 (e.g., loss of permafrost, increased evaporation and evapotranspiration, greenhouse gas emissions) | 12 | DAR Appendix 2, Section 6 p. 63-65. DAR Adden., Section 22.1 & Appendix F, p.11. |
| | 2 | how likely changes in permafrost will affect the amount the granular material required for care and maintenance of the all season road | | DAR Appendix 2, Section 5.4 p. 62-63, Section 6 p. 63-65, Section 8 p. 77-81. DAR Adden., Appendices A (Section 2.3) & F, p.11-12. |
| | 3 | short-term climatic and extreme weather events (e.g., major precipitation, wind, fog, drought) | | DAR Appendix 2, Section 7.1 p.65-68, 7.3 p.74-76. |
| | 4 | changes in permafrost regime | | DAR Appendix 2, Section 5.4 p. 62-63, Section 6 p. 63-65, Section 8 p. 77-81. DAR Adden., Appendix F, p.8-9. |
| | 5 | subsidence | | DAR Appendix 2, Section 5, p.17; Section 8.1.3 p. 79-81. DAR Adden., Appendix F, p.11-12. |
| | 6 | fires | 13 | DAR Appendix 2, Section 5, p.17; Section 5.4 p. 63. Appendix C. DAR Adden., Section 22.1 & Appendix F, p.11. |
| | 7i | map of high risk zones | | DAR Appendix 2, Section 7.2 p.71-73. DAR Adden., Appendix F, p.13-16. |
| | 7ii | site-specific contingencies for high risk areas | | DAR Appendix 2, Section 7.3 p.74-76; Section 7.3.3. DAR Adden. Sections 22.1 & 22.2 |
| | 8 | description of contingency plans | | |
| | 9 | a description of emergency response plans that will be in place | 6.7 (Spill Plan) | DAR Adden. Appendix A (Appendix C; ROP) |
| 9 Potential Accidents and Malfunctions | 1 | explosions | 13 | |
| | 2 | transportation, storage, manufacture and use of explosives | | |
| | 3 | fires | | DAR Adden., Appendix A (Appendix C RCMP, ROP) |
| | 4 | a risk assessment using best practices for the project including components, systems, hazards, and failure modes | | DAR Appendix 2, Section 7.2 p.68-74. DAR Adden., Appendix F, p.12-16. |
| | 5 | assessment of the likelihood and severity of each risk identified | | DAR Appendix 2, Section 7.2 p.68-74. |
| | 6 | a description of contingency plans for accidents, malfunctions, or unforeseen impacts of the environment on the development and the development on the environment | | DAR Appendix 2, Section 7.3 p.74-76; Section 7.3.3. DAR Adden. Appendix C (RCMP, ROP) |
| | 7 | a description of emergency response plans that will be in place | 6.7 (Spill Plan) | DAR Adden. Appendix C (RCMP, ROP) |
| 10 Cumulative Effects | 1 | identify the valued components, or their indicators, on which the cumulative effects 1.assessment is focused, including the rationale for their selection. These are valued components affected by the all season road in combination with other past, present or reasonably foreseeable future human activities and developments. Present spatial and temporal boundaries for the cumulative effect assessment for each valued component selected. Emphasize valued components with special environmental sensitivities or where significant risks could be involved. | 8.13, 9.7, 10.14 & 14 | DAR Appendices 2 (Section 9) & 7 (Section 8). DAR Adden. Appendix E (Section 9) |

## TABLE A: CONCORDANCE TABLE

| Terms of Reference | | | Location | |
|---|---|---|---|---|
| **Sub-Sec.** | **Item** | **Description** | **DAR Section** | **Additional Reference** |
| 10 Cumulative Effects | 2 | identify the sources of potential cumulative effects. Specify other past, present or reasonably foreseeable future human activities and developments that may substantially affect the valued components identified above. These may be in the vicinity of the road or may affect a mobile resource that moves into its vicinity (like a river or a caribou herd). | 8.13, 9.7, 10.14 & 14 | DAR Appendices 2 (Section 9) & 7 (Section 8). DAR Adden. Appendix E (Section 9) |
| | 3 | predict the combined effects of the road and the other activities identified above. | | |
| | 4 | identify how the developer or others will mitigate the identified cumulative impacts | | |
| 11 Follow-Up and Monitoring | 1 | clearly describe the regulatory and non-regulatory monitoring requirements for the life of the project | 15.1 | DAR Adden., Appendices A (Appendix C), C & E (Section 10) |
| | 2 | provide a description of the purpose of each program, responsibilities for data collection, analysis and dissemination, and how results will be used in an adaptive management process | 15.1 & 15.2 | DAR Adden. Section 23.2 & Appendix A (Appendix C, RCMP) |
| | 3 | describe how project-specific monitoring will be compatible with the NWT Cumulative Impact Monitoring Program or other regional monitoring and research programs | 15.1 | DAR Adden. Section 23.3 |
| | 4 | describe how the results of follow-up monitoring and the management response framework would be used and incorporated into land use permit and water licence applications in support of the all season road construction and operations | 15.1 & 15.3 | DAR Adden. Section 23.2 & Appendices A (Appendix C plans) & E (Section 10). Note: These applications have already been made |
| 12 Closure and Reclamation | 1 | what the proposed closure and intermediate closure plans are, including the duration of the activities | 16 | DAR Adden. Section 24.2 & Appendix A (Appendix C: RCMP) |
| | 2 | identify areas where pre-project conditions will not be returned | | |
| | 3 | identify how pre-project conditions will be reinstated (i.e.: surface drainage, water courses, topography, vegetation, floodplain extent) | | DAR Adden. Appendix A (Appendix C: RCMP) |
| | 4 | discuss long-term physical integrity of any permanent features | | DAR Adden. Section 24.3 & Appendix A (Section 2.15 & Appendix C: RCMP) |
| | 5 | discuss monitoring plans during reclamation | | DAR Adden. Appendix A (Appendix C: RCMP) |
| | 6 | identify how potentially-affected communities were engaged in determining end land use and water objectives for reclamation. | | DAR Adden. Section 24.5 |

# 1.0 INTRODUCTION

The Mackenzie Valley Review Board (MVRB) completed an Adequacy Review (AR), dated May 22, 2015, of the Developer's Assessment Report (DAR) submitted by Canadian Zinc Corporation (CZN) in support of environmental assessment (EA1415-001) of the proposed all season access road to the Prairie Creek Mine.

CZN had a number of concerns with respect to the contents of the AR. These were discussed with Review Board staff on June 15, 2015 in meetings in Yellowknife, and subsequently put in writing in a letter to the Board dated June 16, 2015. The Board issued a response to CZN on June 24, 2015 clarifying a number of points. These letters are posted on the MVRB's on-line EA registry.

These above-noted documents serve as a basis for CZN's response to the AR in the form of this DAR Addendum.

# 2.0 CONCORDANCE TABLE

See Table A above.

# 3.0 ALTERNATIVES TO THE DEVELOPMENT

The purpose of the all season road is to be able to transport all of the mineral concentrates produced at the Mine out to market in a timely manner (less than 1 year) and resupply the mine with necessary materials to maintain efficient operations on a continuous basis. The Review Board's letter of June 24, 2015 notes that "The Review Board needs to clearly understand what has changed since the last EA such that a winter road is no longer considered the best alternative for moving concentrate to market". As explained in the DAR, CZN's proposed winter road development plan for EA0809-002 was based on the need to open the western portion of the road early in the winter in order to start hauling to the Tetcela Transfer Facility. This early opening requirement raised some concerns from some regulators and other parties. We also recognize that there is some operational risk with this plan, since the early opening is contingent on suitable weather and ground conditions, and on snow availability. We also believe there is operational risk regarding the total length of the available winter haul window, a risk that continues to grow as the potential for significant climate change becomes more apparent. CZN also recognized the risks associated with the concentrated volume of traffic over the winter with respect to the potential for accidents and, specifically, spills. These were the reasons that prompted CZN to apply for all season road permits in April 2104, 2 years and 5 months after the conclusion of the Mine and winter road EA.

In the 2 years since the receipt of a Water Licence for the Mine in September 2013, CZN has been undertaking studies to refine and optimize the project, and to determine more accurate estimates for construction and operating costs, and revenue projections. These indicate that the Mine's financial viability will be significantly enhanced with an all season road. This is a change since the last EA, but was not part of the original reasoning for applying for all season road permits.

In addition the reception of the Water Licence enabled the company to engage in advanced discussions with metal processors and intermediaries, which included smelters and traders. Processors have indicated a strong preference to receive the concentrate products on a consistent basis throughout the year to enable smelters to blend in the feed without building up a large inventory. The all season road would lower the logistical challenge of handling significant volumes of concentrate and also lowers the risk of the smelter not receiving the product if winter road haulage is cut short.

The AR states that "The purpose of the alternatives analysis was to compare alternatives to the project which could accomplish the same objective. For the purposes of this project, the objective is to transport mineral concentrates to market. The DAR stated that the quantified objective is to transport 120,000 tonnes of concentrate per annum (tonnes/yr)". Given the potential for a restricted winter road operating window as discussed above, we estimated that it might only be possible to transport 90,000 tonnes out under normal circumstances. The Mine would not be viable if this occurred, and this "base case" would not achieve the objective. Hence, it was not considered. Nevertheless, as requested, we have included it in the revised analysis below.

The scenarios assessed in the DAR were:

- an all season road which would transport concentrate continuously;
- Alternative 1, a winter road with additional contractor trucks acquired at a cost premium; and
- Alternative 2, flying out excess concentrate.

The AR stated that alternatives 1 and 2 do not accomplish the same objective alone, and would need to be used in conjunction. This is not correct. Alternative 1 would transport 90,000 tonnes/yr under normal circumstances, with the remaining 30,000 tonnes/yr transported out by additional contractor trucks (i.e. a greater traffic intensity) acquired at a cost premium (necessary because of the high demand of trucks at that time of year). In Alternative 2, it is assumed that 30,000 tonnes/yr is flown out. Therefore, both alternatives have been retained in the analysis below.

The proposed **Phase 1** road development includes an all season road to the TTF, an airstrip and an expanded TTF. The object of this is to allow concentrates to be hauled to the TTF year round, thus reducing the total transportation required in winter to take the concentrates the rest of the way to the Liard Transfer Facility (LTF) near the highway. The scenarios considered are:

- Scenario 1.0, Proposed project All season road to TTF;
- Scenario 1.1 Alternative 1 – Additional contractor trucks;
- Scenario 1.2 Alternative 2 – Fly out excess concentrates; and,
- Scenario 1.3 The original winter road.

The **Phase 2** road development would see an all season road built to the LTF. The scenarios for this development would be the same, but would be termed 2.0, 2.1, 2.2 and 2.3, respectively.

The analysis of the scenarios follows the *Multiple Accounts Analysis* (MAA) method described by Robertson and Shaw (2004).

For each scenario, the indicators to be ranked will be technical feasibility, cost-benefit, socio-economic effects, and environmental effects. A scaled value will be assigned for each indicator. The authors found that a 9-point scale is readily understandable and typically provides the range and discretion well suited to this type of evaluation. The best scenario for any indicator is always given a scalar value of '9'. If the second best scenario is only half as good as the best scenario, it would be given a value of '4-5' and so on. The cumulative 'score' of a scenario is obtained by averaging the scalar values of the indicators for that scenario. The higher the score, the more favorable the scenario is.

**Analysis of Phase 1 Scenarios**

*Technical feasibility*

Technical feasibility is defined as the ability of the scenario to fulfill the objective of transporting out 120,000 tonnes of concentrate.

Scenario 1.0, all season road construction to the TTF and use year-round, is considered to be very feasible from an engineering perspective. An all season road bed is considered to exist from the Mine to Km 40 (Cat Camp). Bridges need to be installed to cross certain creeks, and the current main channel on the Sundog Creek floodplain needs to be induced to revert to an old channel over a ~3 km length, something it does naturally periodically. The Km 40-54 section would require subgrade to cross compressible soils, and includes a re-alignment from the old winter road to avoid bisecting the polje karst features. Km 54-58 is also a new section, but crosses firm ground as the road climbs the edge of the Ram Plateau, before joining the old winter road alignment at Km 58 and continuing to cross high ground on the plateau to the TTF at Km 86.

Scenario 1.1, using a winter road only and relying on extra contractor trucks, is considered to have questionable feasibility. This is a time of the year when there are multiple winter roads in the north, and there is a high demand for trucks. CZN would be reliant on the availability of a contractor fleet, and this poses a risk in terms of acquiring enough trucks to transport all of the concentrates out before winter road closure. The timing of the seasonal opening and closure is also in doubt because it is weather dependent.

Scenario 1.2, flying out excess concentrates, is considered feasible if suitable aircraft are available. Such aircraft would need to be able to carry a heavy payload and be able to land and take-off from the Prairie Creek airstrip which has limited length and mountainous approaches. The best aircraft for this is the de Havilland Canada DHC-5 Buffalo, although even this aircraft is limited to a payload from Prairie Creek of 6,800 kg. Summit Air had two such planes, but one has been sold and the other is to be sold, which will mean none will be readily available in northern Canada, and therefore the feasibility of this scenario will be diminished.

Scenario 1.3, is considered to have very questionable feasibility given the uncertainty of the length of the winter road operating window, uncertainty regarding late opening and early closure, and the potential for the situation to worsen with climate change.

The most feasible scenario is considered to be Scenario 1.0, which is assigned a score of 9. Scenario 1.1 is considered to be a little better than half as feasible as 1.0, so was scored a 5. The feasibility of Scenario 1.2 has suffered from the loss of suitable aircraft, and was also scored a 5. Scenario 1.3 is considered the least feasible and was scored a 3.

*Cost-Benefit*

The indicator of cost-benefit is essentially the impact on project economics from each of the four concentrate transport scenarios.

The capital cost of all season road construction would be much greater than the winter road scenario. The cost of all season road maintenance will likely be less than annual winter road construction. Hauling using Mine trucks would be cheaper than contractor trucks. Hauling on an all season road would also be cheaper than on a winter road due to less wear and tear.

CZN has estimated comparative costs using information from recent winter road construction bids, transportation estimates, all season road construction estimates and economic projections for the Mine. While the estimates are subject to some variation, we believe they are realistic, although the variations will likely differ in magnitude between the different items. However, we believe the estimates are adequate for this comparative analysis.

An industry rule-of-thumb for all season road construction is $250,000/km. For a 175 km road, this equates to approximately $44 million. However, the actual cost is site-specific, and dependent on factors such as the number and length of bridges. A number of large bridges would be required for the Prairie Creek road. Therefore, the Prairie Creek all season road construction cost is estimated at ~$50 million. The construction cost from the Mine to the TTF (Phase 1) would be approximately $25 million (this section is marginally shorter (86 km) but has more bridges). The construction cost for a full winter road is $2 million. The annual maintenance cost of a full all season road is estimated at $1 million, compared to $2 million for a winter road. Therefore, the Phase 1 all season road maintenance cost would be $1.5 million ($0.5 million for the all season portion and $1 million for the winter portion).

Haulage costs have been estimated at $100/tonne on an all season road, and $150/tonne on a winter road (ref., Allnorth). At full production, the Mine is expected to produce 120,000 tonnes of concentrates annually. Therefore, the Phase 1 annual haulage cost for a winter road is $18 million, and for an all season/winter road combination $15 million.

The net present cost (NPC) for the two scenarios assuming an 11 year mine life and discount rate of 10% is coincidentally the same at $132 million. These costs are reflected in the table below:

| Road | Winter | All Season/Winter |
|---|---|---|
| Capital Cost ($M) | 2 | 25 |
| Annual Maintenance ($M) | 2 | 1.5 |
| Annual Haul ($M) | 18 | 15 |
| NP C (11 year mine life, 10% discount rate) | **132** | **132** |

For Scenario 1.1, the winter road cost does not account for the additional use of contractor trucks, and if there is a high demand due to warmer than usual winter conditions, haul costs are likely to be higher. Haul costs on the all season road would be the same because the trucks would either be mine-owned, or contractor-owned on a long-term contract.

Regarding flying out 30,000 tonnes of excess concentrates (Scenario 1.2), the cost would be approximately $8/tonne/km. If the concentrate were flown to the nearest airstrip at Nahanni Butte some 90 km away, the annual cost would be $21.6 million. Therefore the annual winter road haul cost of $18 million for 120,000 tonnes would become $35.6 million ($13.5 million for 90,000 tonnes by road plus $21.6 million for flying out 30,000 tonnes). Therefore, flying out concentrate doubles the transportation cost, and is economically prohibitive. As a result, any concentrate that could not be transported out by road would remain at the Mine until the next transport season.

For the cost-benefit indicator, scenarios 1.0 (all season road) and 1.3 (winter road) are assessed to be the same as they achieve the objective at the same overall cost, and superior to the other scenarios, and hence are scored a 9. Scenario 1.1 (additional trucks at higher cost) is considered somewhat inferior and was scored a 7. Scenario 1.2 (fly out excess) was considered very inferior and was scored a 3.

*Socio-Economic Effects*

Socio-economic effects could include a number of components, as follows:

- employment and business opportunities
- timing of employment and social disruption
- improved access for traditional activities
- interference with traditional activities
- perception of impacts on the land
- perception of impacts on wildlife and fish

The third and fourth components will not be subject to significant variation between the scenarios because the Phase 1 development only includes an all season road to the TTF, thus access is not improved for traditional harvesters from Nahanni Butte, and there would be no interference with traditional activities since they have not ventured beyond Grainger Gap into the interior for over a decade. Only the remaining components are analysed in the scoring matrix below:

| Component | Scenario 1.0 | Scenario 1.1 | Scenario 1.2 | Scenario 1.3 |
|---|---|---|---|---|
| | All Season Road | More Trucks | Fly Out Excess | Original Winter Road |
| Employment/Business | 9 | 6 | 6 | 7 |
| Employment timing | 9 | 6 | 6 | 7 |
| Perceived land impacts | 8 | 9 | 9 | 9 |
| Perceived wildlife/fish impacts | 8 | 9 | 9 | 9 |
| Socio-economic Average Score | 8.5 | 7.5 | 7.5 | 8 |

In terms of employment and business opportunities for aboriginals and northerners, the all season road is considered to be the best scenario because there will be opportunity for involvement in construction and annual maintenance, but more importantly, a greater opportunity for year-round participation in loading and hauling the concentrate to the TTF. Although there would be employment and business opportunities for aboriginals and northerners in winter road construction, the concentrate haul is expected to be carried out primarily by contractors, many of whom may not reside in the north. Hence, this scenario is scored lower than the all season road scenario at 7. Scenario 1.1 would see more trucks provided, likely from the south, which would incrementally reduce the workload of local trucks. This would similarly occur if excess concentrates are flown out to a nearby airstrip, and trucked from there. Hence, these scenarios were scored a 6.

Year-round employment is considered to offer more stability in terms of lifestyle and social disruption (family, community) than more intense employment over the limited winter window. For that reason, the potential involvement of aboriginals and northerners in the load and haul of concentrates on the all season road leads to a score of 9 for Scenario 1.0 compared to a score of 7 for Scenario 1.3. The potential for social impacts associated with the possible presence of more southern contractors from the south is considered to be incrementally higher with Scenarios 1.1 and 1.2 compared to Scenario 1.3, hence the scores of 6.

Some local aboriginals perceive that an all season road, including some limited blasting for bridge abutments and approaches, will mean a greater impact on the land compared to a winter road. However, others likely agree with CZN's belief that use of an all season road through the mountains will be inherently safer than only winter use, and that as a result, the risk of accidents and spills will be less. Year-round haulage will mean a higher potential for employment of a local work force, whose skill and knowledge of road conditions can be developed through hands-on experience, and should be invaluable in reducing the risks of accidents and spills. It is difficult to reconcile these differing opinions, but overall, we believe most will perceive the all season road to be a marginally greater impact on the land. Hence, all winter road scenarios were scored a 9, and the all season road an 8.

Similar to the component above, some local aboriginals may perceive that all season road construction and operations will mean a greater impact on wildlife and fish compared to a winter road, while others may perceive that an all season road poses less of a threat because all season road traffic is unlikely to affect wildlife in the mountains significantly. Again, it is difficult to reconcile these differing opinions, but overall, we believe most will perceive the all season road

to be a marginally greater impact. Hence, all winter road scenarios were again scored a 9, and the all season road an 8.

*Environmental Effects*

Environmental effects could include a number of components, as follows:

- Effects on wildlife
- Effects on water quality and fish
- Effects from spills
- Effects on terrain
- Effects of terrain

These components are analysed in the scoring matrix below:

| Component | Scenario 1.0 | Scenario 1.1 | Scenario 1.2 | Scenario 1.3 |
|---|---|---|---|---|
| | All Season Road | More Trucks | Fly Out Excess | Original Winter Road |
| Effects on Wildlife | 8 | 9 | 9 | 9 |
| Effects on Water/Fish | 8 | 9 | 9 | 9 |
| Effects from Spills | 9 | 5 | 7 | 6 |
| Effects on Terrain | 7 | 9 | 9 | 9 |
| Effects of Terrain | 9 | 7 | 7 | 7 |
| Environmental Effects Average Score | 8.2 | 7.8 | 8.2 | 8 |

Regarding effects on wildlife, important species that could potentially be affected by the Phase 1 all season road are mountain caribou, grizzly bear, Dall's sheep and moose. Dall's sheep occur in mountainous upland areas from Km 0-20. They do not appear to be perturbed by present mine and road activities. Mountain caribou are infrequently seen, largely because their preferred range is to the north. A few grizzly bears are seen each summer in the Prairie Creek drainage, moving either upstream or downstream. They are rarely seen along the road east of Km 7. Moose may be seen in the Polje Creek drainage, and in the ponds proximal to Mosquito Lake, and in the lake itself. Tetra Tech EBA concluded that construction and operation of the all season road would have only moderately significant effects on grizzly bear and moose. It should be noted that the all season portion of the existing winter road could be subject to road maintenance work during the summer under the existing Land Use Permit. Also, the greater amount of traffic on a winter road during operations could be marginally more disruptive to mountain caribou proximal to the road. Therefore, the all season road is seen as only marginally inferior to a winter road in terms of wildlife effects and is scored an 8. All winter road scenarios are scored a 9 because their effects are essentially the same. Flying concentrate means less truck trips and potentially less effects to caribou, but potentially greater effects to Dall's sheep.

Regarding effects to water quality and fish, it should be noted that an all season road bed already exists through the mountains, including along Prairie and Funeral Creeks that host bull trout. Also, bridges were previously permitted for the winter round, six crossing upper Sundog Creek

and one crossing Polje Creek. Construction and mitigation approaches for the all season road are expected to effectively control sediment production. Therefore, the additional effects from Phase 1 all season road construction and operation should be relatively small by comparison to the approved winter road. The proposed re-alignment of Sundog Creek is not expected to cause significant negative effects to Arctic grayling and slimy sculpin, the only species found there. As a result, the all season road was scored only marginally less than the winter scenarios at 8. All winter road scenarios were scored a 9.

In considering the effects from spills, it is necessary to assess the potential for spills to occur, and then the effects if they do occur. CZN considers there is a greater potential for spills associated with heavy traffic in winter on a winter road verses much less traffic year-round on an all season road when driving conditions are considerably better most of the time. Hauling can also be completed by drivers familiar with the terrain and who are more likely to strictly obey operating directives than third party contract drivers. If a spill occurs on land and does not enter water, effects are expected to be less in winter than in other seasons because snow will act as a natural migration barrier, and frozen ground will limit penetration. Nevertheless, effects in any season are expected to be very limited following spill response and clean-up. If a spill occurs into water or enters water, effects are expected to occur in winter and summer, although in summer, greater water flows could lead to greater spill dispersal. Spill avoidance is considered to carry more weight in this analysis, and is the reason the all season road scenario is scored a 9. For the winter road alternatives, flying out concentrates is scored highest (7) because the number of truck trips is reduced. The normal winter road scenario is scored a 6, while the additional trucks scenario, which could also mean a higher traffic intensity, is scored lowest at 5.

Many of the effects on terrain for the Phase 1 all season road will be the same as for the winter road. This includes the existing all season road bed, new alignments from the original winter road, and the already approved bridge crossings. Some all season road development components will be additional, such as the Km 25-28 road re-alignment to avoid talus slopes in Sundog Creek. The all season road crosses the karst terrain of the Ram Plateau from Km 54 to approximately Km 84, but only Km 54-58 is new alignment compared to the old winter road. The plateau ground is quite firm and should not require significant subgrade for the all season road. Specific karst features have been avoided by the selected alignment. Therefore, significant effects on karst are not expected to occur. All winter road scenarios were scored a 9 regarding effects. The all season road was scored a 7 because effects on terrain are considered to be only marginally greater.

Effects of terrain on the road are possible from slope failures, rock falls, avalanches and road bed instability. For the Phase 1 road section, side slopes have been stable since at least 1980 when the winter road was built, apart from the naturally ravelling talus slopes. The latter is more of an issue for the winter road which crosses these slopes whereas the all season road largely avoids them. Sporadic rock falls are more common in summer than in winter for the mountainous sections, but the amount of rock fall has been witnessed from year to year during studies conducted along the road using ATV’s, and is quite small. Avalanches are similarly not common, but the potential for them is obviously greater in winter and spring, and the winter road alignment crosses several high avalanche potential paths. Much of the road bed already exists to the TTF, or the ground is quite firm. Km 40-54 is over soft soils prone to some slumping, but

disturbed areas will be stabilized. Overall, the all season road scenario is considered the best (scored 9) because of the avoidance of talus slopes and many avalanche chutes, and the number of trips being less in the winter period. All winter road scenarios were scored 7.

*Summary of Scores*

A summary of values and average scores for each scenario is as follows:

| Indicator | Scenario 1.0 | Scenario 1.1 | Scenario 1.2 | Scenario 1.3 |
|---|---|---|---|---|
| | All Season Road | More Trucks | Fly Out Excess | Original Winter Road |
| Technical Feasibility | 9 | 5 | 5 | 3 |
| Cost-Benefit | 9 | 7 | 3 | 9 |
| Socio-economic Effects | 8 | 9 | 9 | 9 |
| Environmental Effects | 8.2 | 7.8 | 8.2 | 8 |
| Phase 1 Average Scores | 8.55 | 7.2 | 6.3 | 7.25 |

**Analysis of Phase 2 Scenarios**

*Technical Feasibility*

The analysis of scenarios is similar to that for the Phase 1 road. Scenario 2.0, all season road construction to the Nahanni access road and use year-round, is considered to be very feasible from an engineering perspective, although the eastern section is considered to be slightly less feasible than the Phase 1 section because of the muskeg terrain to be crossed between the Ram Plateau and Silent Hills, and between the Silent Hills and Grainger Gap. In addition, the steep western slope of the Silent Hills must be traversed with the aid of two switchbacks. Nevertheless, in terms of achieving the objective of consistently transporting 120,000 tonnes of concentrates, Scenario 2.0 is considered to be the most feasible scenario, and is assigned a score of 9. Scores for the other scenarios were increased from Phase 1 to account for the slightly more arduous constructability of the Phase 2 road in Scenario 2.0. Scenario 2.1 was scored a 6, Scenario 2.2 was also scored a 6, and Scenario 2.3 is considered the least feasible and was scored a 4.

*Cost-Benefit*

The winter road – all season road comparison described above is used again, however this time, a full all season road will allow year-round hauling. An all season road will mean less working capital required to purchase supplies because they can be purchased and brought in as needed throughout the year instead of a large purchase at the beginning of each year. Economics would also be improved due to revenue being received throughout the year instead of after the subsequent winter. The annual estimated supplies cost saving and revenue increase are shown below. The values are negative as they are a subtraction in the overall NPC life-of-mine calculation. The NPC of the all season road is $56 million, significantly less than the NPC of the winter road at $132 million.

| Road | Winter | All Season |
|---|---|---|
| Capital Cost ($M) | 2 | 50 |
| Annual Maintenance ($M) | 2 | 1 |
| Annual Haul ($M) | 18 | 12 |
| Annual Saving on Supplies ($M) | | -3 |
| Annual Increase in Revenue ($M) | | -9 |
| NP C (11 year mine life, 10% discount rate) | **132** | **56** |

Therefore, the cost-benefit of the all season road is much higher. Scaled values assigned for the cost-benefit indicator for scenarios 2.0, 2.1, 2.2 and 2.3 are 9, 4, 3 and 5, respectively.

*Socio-Economic Effects*

The full list of socio-economic effects components noted for Phase 1 above are analysed in this section.

| Component | Scenario 1.0 | Scenario 1.1 | Scenario 1.2 | Scenario 1.3 |
|---|---|---|---|---|
| | All Season Road | More Trucks | Fly Out Excess | Original Winter Road |
| Employment/Business | 9 | 6 | 6 | 7 |
| Employment timing | 9 | 6 | 6 | 7 |
| Improved access | 9 | 5 | 5 | 5 |
| Traditional activity interference | 8 | 9 | 9 | 9 |
| Perceived land impacts | 5 | 9 | 9 | 9 |
| Perceived wildlife/fish impacts | 5 | 9 | 9 | 9 |
| Socio-economic Average Score | 7.5 | 7.3 | 7.3 | 7.7 |

The employment and business opportunity, and employment timing, components were scored the same as for Phase 1.

CZN heard from elders and harvesters in Nahanni Butte that traditional hunting and trapping has not occurred along the road corridor west of Grainger Gap for some time, at least 10 years. Raymond Vital has a cabin at the Gap, and used to operate trap-lines and fish nearby. He says it's been about 10 years since he's been there. The problem is difficulty, and cost, of access. An all season road would provide easy and cheap access. A winter road, by definition, would only provide improved access in winter. For these reasons, Raymond supports an all season road. Therefore, the all season road scenario is scored a 9, while all of the winter road scenarios are scored a 5.

There is the potential for the all season road to cause interference of traditional activities and life over and above that of a winter road. Presence of the road might encourage unwanted visitors into the area. It would provide another access point to the river, unless that access could be legally denied (one of the options CZN is pursuing). On the other hand, if the road is used to promote tourism in a carefully controlled manner, demand for arts and crafts and traditional services will likely increase, which would be a benefit. River crossings using a barge in summer

are unlikely to significantly impact traditional river use because neither are high capacity and the river is large enough for dual use without conflicts. Road users would not be able to enter Nahanni Butte because a river crossing would be needed in summer (the village is an 'island' between the confluence of the Liard and South Nahanni Rivers, and the proposed all season road crossing is downstream of the confluence). There will be some traffic noise associated with the road, but the road would be 4.4 km away from the village at its nearest point, and there is frequent vehicle traffic in the community, so noise disturbance from trucks on the road is unlikely. Consequently, the all season road is considered to be potentially only marginally worse than a winter road in terms of interference of traditional activities.

The full all season road will cross some wetlands. Overall, the arguments made for Phase 1 are the same, except we believe most will perceive the full all season road to have a greater impact compared to a winter road. Hence, all winter road scenarios were scored a 9, and the all season road a 5.

Further to the Phase 1 analysis of perceived wildlife/fish effects, there is concern that the all season road could provide access to out of area hunters outside of the winter period, and that this could affect numbers of moose negatively. The concern varies depending on the perceived effectiveness of the different deterrent proposals. However, to account for this, all winter road scenarios were again scored a 9, and the all season road a 5.

*Environmental Effects*

The environmental effects components listed in Phase 1 are analysed in the Phase 2 scoring matrix below:

| **Component** | **Scenario 1.0** | **Scenario 1.1** | **Scenario 1.2** | **Scenario 1.3** |
|---|---|---|---|---|
| | **All Season Road** | **More Trucks** | **Fly Out Excess** | **Original Winter Road** |
| Effects on Wildlife | 5 | 8 | 9 | 8 |
| Effects on Water/Fish | 7 | 9 | 9 | 9 |
| Effects from Spills | 9 | 5 | 7 | 6 |
| Effects on Terrain | 7 | 9 | 9 | 9 |
| Effects of Terrain | 9 | 9 | 9 | 9 |
| Environmental Effects Average Score | 7.4 | 8.0 | 8.6 | 8.2 |

Regarding effects on wildlife, important species that could potentially be affected in addition to those listed for the Phase 1 all season road are trumpeter swans, boreal caribou and wood bison. A few trumpeter swan pairs are often found in the wetland areas east and west of the Silent Hills in summer. All season road construction and operation could disturb nesting pairs. The disturbance should be temporary, since once the road is built, swan pairs will likely relocate to the extensive wetland areas both north and south of the road alignment. The western edge of boreal caribou range was officially the Front Range. The range was recently extended west to the Silent Hills, although it is unclear why. During wildlife surveys conducted for CZN, and CZN's other studies along the proposed all season road alignment, no caribou have been noted east of

the Silent Hills. Apart from a short section where the proposed alignment crosses a valley to get to Grainger Gap, the road mostly traverses sparsely-treed sloping terrain along the foothills of neighbouring uplands, terrain typically not favoured by boreal caribou. Wood bison are commonly seen near and in Nahanni Butte. They do not appear to be disturbed by anthropogenic activity, rather the opposite. Dall's sheep were known to occur in the Front Range mountains, although none have been seen by local aboriginals or CZN in the recent past. Moose may be seen in the valleys and on the slopes east of the TTF, especially in the fall. The all season road is seen as inferior to a winter road in terms of wildlife effects and is scored a 5. Winter road scenarios 2.1 and 2.3 are scored an 8 because their effects are essentially the same. Flying concentrate means less truck trips and potentially less effects, so was scored a 9.

Regarding effects to water quality and fish, the eastern part of the road crosses primarily lowland terrain. The Tetcela and Grainger Rivers host fish, but the majority of the other, smaller watercourses are not fish-bearing because they feed into wetland systems dominated by beaver dams. With appropriate watercourse crossing designs, construction and sediment control, significant impacts on water quality or fish from the all season road are not expected, and should not be greatly different from a winter road. Consequently, the all season road was scored a 7. All winter road scenarios were scored a 9.

Regarding the effects from spills, the arguments for Phase 1 are considered equally applicable to Phase 2. In addition, a full all season road will enable consideration of an alternative fuel for power generation, and it is likely that some form of gas would be used instead of diesel. This would reduce the potential for effects from a spill. However, the scores for Phase 1 were retained.

In addition to the effects on terrain for the Phase 1 all season road, effects along the eastern section of the road that primarily crosses lowland terrain are expected to be limited, the only difficult section being the western slope of the Silent Hills. Therefore, the scores for Phase 1 were retained. Effects of terrain on the road due to road bed instability are considered more likely along the eastern section of the all season road as it crosses more lowland terrain. Some of this terrain may be in a state of long-term thaw related to climate change. As a result, scores for the Phase 1 road section have been tempered and all scenarios were scored a 9 for Phase 2.

*Summary of Scores*

A summary of values and average scores for each scenario is as follows:

| **Indicator** | **Scenario 2.0** | **Scenario 2.1** | **Scenario 2.2** | **Scenario 2.3** |
|---|---|---|---|---|
| | **All Season Road** | **More Trucks** | **Fly Out Excess** | **Original Winter Road** |
| Technical Feasibility | 9 | 6 | 6 | 4 |
| Cost-Benefit | 9 | 4 | 3 | 5 |
| Socio-economic Effects | 7.5 | 7.3 | 7.3 | 7.7 |
| Environmental Effects | 7.4 | 8.0 | 8.6 | 8.2 |
| Phase 2 Average Scores | 8.23 | 6.33 | 6.23 | 6.23 |

**Summary of Scores for both Phases**

| Scenario | 1.0 and 2.0 | 1.1 and 2.1 | 1.2 and 2.2 | 1.3 and 2.3 |
|---|---|---|---|---|
| | All Season Road | More Trucks | Fly Out Excess | Original Winter Road |
| Phase 1 Average Scores | 8.55 | 7.2 | 6.3 | 7.25 |
| Phase 2 Average Scores | 8.23 | 6.33 | 6.23 | 6.23 |

# 4.0 DEVELOPMENT DESCRIPTION

## 4.2 Concentrate and Traffic Estimates

On page 143 of the DAR we stated "The Mine will produce ~120,000 tonnes of concentrate per annum when the Mine is producing at maximum capacity. Therefore, approximately 330 tonnes will be produced daily. A conservative estimate of truck payload capacity is 40 tonnes. This would translate into approximately 8 trips/day. However, this is increased to 9 trips/day to allow for approximately 10% of the time when travel does not occur due to road maintenance issues (rockfalls, avalanches, wash-outs) or poor conditions (white outs or intense rainfall)". This number would apply to the Phase 1 road to the TTF.

On page 144 of the DAR we stated "With the Phase 2 road built, concentrates would be hauled out of the Mine daily to travel the 175 km of the all season road and on to the LTF (Km 182) near the Liard Highway (Km 185), and subsequently to Fort Nelson (303 km of highway travel). Hauling will not occur during periods when crossings of the Liard River (Km 160) are not possible. At the Liard River crossing near Fort Simpson, the 10 year average (1998-2008) dates for ferry operation are May 13 to November 4 (157 days), and for ice bridge operation November 28 to April 21 (142 days). However, 60 tonne ice bridge crossings are only possible from January 15, and likely have to end before April 21. We can assume March 31 (75 days). This means 232 days for hauling (157 plus 75). However, this should be reduced by 10% to allow for days when travel does not occur due to road maintenance issues or poor conditions. Therefore, we can assume that 210 days are available for hauling at the normal capacity in an average year. Based on this, moving 120,000 tonnes of concentrate using trucks with 40 tonne loads would require 14.3 trips per day, say 15 given that an additional load could be hauled periodically, as necessary".

In Appendix 1 of the DAR, Allnorth noted 10 to 14 trucks per day based on an annual concentrate production of 107,000 tonnes, and 225 days of haulage. These numbers are generally consistent with those in the DAR main report, which estimated 15 trucks per day and were more conservative by assuming concentrate production **at maximum capacity** of 120,000 tonnes and 210 days of haulage. Allnorth were correct in noting that there would be a small number of additional hauls of unique loads, such as explosives. Note that if concentrate haulage is behind schedule for any reason, such as due to an extended period of poor road conditions, or a forest fire in summer, one or two additional trucks usually held in reserve or on maintenance could be used for a period to catch up.

## 4.3 Traffic Estimates

See Allnorth's report in Appendix A (Section 2.4).

## 4.4 Existing Infrastructure - Airstrip

With the absence of an airstrip on the Ram Plateau to support road construction and maintenance, in all probability there would be less flights and a greater use of the road for access. Also, it was previously assumed that most of the road construction would occur in summer. This is not the case now as it is expected that most of the road construction would occur in winter.

Table 4-1 below is a modified version of Table 6-3 from the DAR. The flights listed in the columns under the heading "Winter Road" are those currently expected for the already permitted Mine and winter road activities. Flights that might occur to support all season road construction would replace the flights listed for the winter road associated with the road, and would be fewer in number over the winter. Only a limited number of flights are likely outside of the winter period. Approximately 1 flight per week might occur in summer associated with all season road maintenance. Flights associated with all season road reclamation are likely to be similar or somewhat less than flights for construction. Flights associated with the all season road during all phases would likely use the Mine and Nahanni Butte airstrips roughly equally, except in winter when flights might also use a winter strip just east of Wolverine Pass, as occurred historically.

**TABLE 4-1: FREQUENCY OF FLIGHTS**

| Month | Winter Road | | All Season Road | |
|---|---|---|---|---|
| | Mine | Road | Construct | Maintain |
| January | 20 | 8 | 4 | |
| February | 20 | 4 | 4 | |
| March | 20 | 4 | 4 | |
| April | 20 | | 2 | |
| May | 20 | | 1 | 4 |
| June | 20 | 2 | 1 | 4 |
| July | 20 | | 1 | 4 |
| August | 20 | | 1 | 4 |
| September | 20 | | 1 | 4 |
| October | 20 | | 2 | |
| November | 20 | | 4 | |
| December | 20 | 8 | 4 | |
| **Total** | **240** | **26** | **29** | **20** |

The largest aircraft to use the Mine strip is a Dash 7. This aircraft seats approximately 30 people and could be used for Mine crew changes. Some crew could be associated with the road construction. Flights specific to the road would likely use smaller aircraft, such as a Twin Otter

seating up to 17, a Cessna Caravan seating up to 10, or a Piper Navajo seating up to 6. All of these aircraft and smaller ones might be used for flights to the Nahanni and Wolverine strips, except for the Dash 7.

Flights related to the road will be mainly for crew changes, but also could be used to transport urgent spare parts. Bulky or heavy items would be brought in by road.

## 4.5 Runaway Lanes

See Allnorth's report in Appendix A (Section 2.5).

## 4.6 Safety Railings

See Allnorth's report in Appendix A (Section 2.6).

## 4.7 Pull-Outs

See Allnorth's report in Appendix A (Section 2.7).

## 4.8 Freeboard at Watercourse Crossings

See Allnorth's report in Appendix A (Section 2.2).

## 4.9 Estimated Peak Flow Rates and Water Surface Elevations

Regarding peak flow rates and the 2006 and 2007 floods noted in the Prairie Creek watershed, CZN noted that they were abnormal in that they had not occurred in over 25 years. The AR assumed that these events were "dismissed". This is not the case. This is further explained in the reply to this item in Tetra Tech EBA's letter contained in Appendix B.

Allnorth provide additional comments on channel stability and erosion protection in their report in Appendix A (Section 2.2 and Appendix B).

## 4.10 Sediment and Erosion Control

See Allnorth's report in Appendix A (Appendix C, Sediment and Erosion Control Plan (SECP)).

## 4.11 Water Withdrawal

Water needed in winter will be drawn from the approved water sources defined during permitting for LUP's MV2012F0007 and Parks2012-L001. Quantity limits in $m^3$ for each location, based on the DFO 10% winter withdrawal limit, are as follows:

**TABLE 4-2: WATER WITHDRAWAL SOURCES**

| Location | ($m^{3)}$ |
|---|---|
| Cat Camp | 5,750 |
| Mosquito Lake | 33,528 |
| Km 70 | 52,475 |
| Km 100-OR4 | 2,448 |
| Km 115 | 5,773 |
| Km 121 | 4,090 |
| Km 139 | 5,382 |
| Km 141 | 16,803 |
| **Total** | **126,249** |

Information supporting these numbers and maps showing water source locations can be found here:

http://www.mvlwb.ca/Boards/mv/Registry/2012/MV2012F0007/MV2012F0007 - CZN - Report on Water Sources - Dec28-12.pdf

The lake/pond water sources are discussed from west to east below according to winter road Km marker:

- At Cat Camp (Km 40), a pit will be dug more than 100 m from the active channel of Sundog Creek, and not in proximity to the location of known soil contamination associated with the fuel tanks. The pit will be located in a thinly vegetated area. Because the creek consists of outwash gravels at this location, and gravels are expected in adjacent, old floodplain areas, groundwater is expected to be shallow and plentiful. The actual size and depth of the pit will depend on the depth to water. The pit would be fenced off using snow fence to deter any wildlife. The proposed extraction volume of 5,750 $m^3$ is very small compared to the volume of groundwater in alluvial storage, and would have no effects.

- Mosquito Lake at Km 63.5 is part of the Polje system which has no surface outlet for water. Consequently, the lake cannot host migrating fish. Also, it is a large lake, and water demand will be much less than the volume represented by 10% of lake volume.

- A lake at Km 70 also has a large volume, and water demand will be much less than the volume represented by 10% of lake volume.

- Ponds east of Wolverine Pass are part of an extensive system of wetlands and beaver dams extending north from the Grainger Gap area, unlikely hosts for fish. Extracted water would readily be replenished from upstream.

- A small lake east of Km 115 is also part of the same wetlands system draining north.

- Gap Lake at Km 122 is part of the Grainger River headwater system. It is fed by wetlands to the south and west. The lake is fish-bearing. Extraction of 10% of lake volume is unlikely to cause effects given the upstream potential for replenishment.

- The small lakes at Km 142 and 144 are on tributaries of the Grainger River, and there is extensive beaver activity downstream with multiple dams. Therefore, the lakes are unlikely to host migrating fish.

In the non-winter period, the same sources with the same limits as for winter may be used. No significant effects are anticipated for the reasons provided above.

Also in the non-winter period, the larger watercourses crossed by or adjacent to the road (Prairie, Fast, Casket, upper Funeral (Km 13.4-15.8), Sundog, Polje, Fishtrap, Tetcela, Grainger) may be used for water supply. For extraction from watercourses, no more than 10% of instantaneous flow would be drawn. Given the approximate nature of flow estimation in the absence of specialized flow estimation equipment, conservative assumptions will be made to ensure the rate or volume of extraction is less than the 10% limit. For all extractions, DFO's Measures to Avoid Causing Harm to Fish and Fish Habitat will be followed, specifically those for fish protection:

http://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures/index-eng.html

Nearly all of the listed watercourses are large systems with considerable flow, and the extracted water will be much less than 10% of the flow. The exceptions are Funeral and Fishtrap Creeks. Water extraction from Funeral would be from upstream tributaries that are not fish-bearing due to downstream obstructions to migration. At the Fishtrap Creek wetland crossing, no fish were found in previous surveys, presumably due to the poor habitat and extensive beaver dam system downstream. Therefore, no significant effects are anticipated from the proposed extraction.

Another alternate source of water could be recently developed borrow pits where water has subsequently pooled.

During construction, water may be needed for three applications: potable use; for soil compaction in culvert installation; and, for dust control.

For potable use, the rule-of-thumb for water consumption is 270 L/person/day. With a construction crew size of 80 (see Section 20.5), this equates to 21.6 $m^3$/day. For a 90 day winter construction period, the volume is 1,944 $m^3$.

Allnorth estimates that, over a three-year construction period, 34 large diameter culverts (>/= 1000 mm) would be installed annually, requiring 1000 L at 50% of the crossings, or 17 $m^3$ annually.

For construction dust control in summer, Allnorth estimated 4000 L per km per day for 60 days and 15 km. This generates a volume of 3,600 $m^3$.

During operations, for dust control in summer, Allnorth estimated 4,000 L per km per day over a twelve week period, watering 70 km three days per week. This generates a volume of 10,080 $m^3$. If all 70 km was watered in a day, the quantity would be 280 $m^3$.

All of the above noted water volumes are small relative to the total water resource identified.

## 4.13 Location of Borrow Areas

Borrow areas are shown on drawings contained in the Allnorth report in Appendix 1 of the DAR, and described in the body of that report and in Appendix 4 to it. Tetra Tech EBA addressed those borrow pits requiring discussion from a terrain perspective in their report in Appendix 2 (Section 5) of the DAR. Borrows defined on July 8, 2015 are described in Allnorth's report in Appendix A (Appendix D).

## 4.14 Scope of Development

See Allnorth's report in Appendix A (Section 2.8).

## 4.15 Construction Phases and Schedule

Construction activities and durations are described in the Allnorth report contained in Appendix A (Section 2.9).

Regarding the effects of construction on valued ecosystem components, only fish were discussed in the DAR because this is the main component considered likely to be subject to significant effects. We noted that the period not preferred for road construction is April to mid-June, the period covering freshet, but that depending on the snow pack, and prevailing weather conditions at the time, spring conditions could be suitable for road construction, with appropriate precautions in proximity to fish-bearing streams.

The revised road construction schedule shows that the majority of construction is likely to occur in winter. This is a less sensitive time for fish, and any effects will be minimized. The majority of fish hosted by fish-bearing streams between the Liard River and the Km 17 mountain pass are spring spawners, so construction in the summer and fall will also be during less sensitive times.

Work on the lower Sundog channel re-alignment would be completed in the late summer or fall when typically significant stretches of the creek are dry, and the only fish present are limited numbers of grayling associated with deep pools, which are also expected to be completely dry later in the fall and winter (this was noted in deep pools near Cat Camp which had water in mid-September 2014, but were dry 1 week later). The channel re-alignment work and road construction in this area is not expected to be complicated and is expected to be completed in approximately 1 month. Therefore, it is highly unlikely that the construction window before spring would be missed.

As has been noted elsewhere, the access road is south of areas where caribou are known to congregate. Mountain caribou concentrations have been noted well to the north of the road, although a few may occasionally be seen proximal to the road. Boreal caribou are rarely if ever seen near the road alignment. A few grizzly bears are seen in the Prairie Creek drainage each summer, where the road is already built. Bears are rarely seen east of the high mountain pass. Dall's sheep occupy high mountain areas near the Mine, and do not appear to be disturbed by activities. Moose are common in areas east of the Polje Creek valley. A few trumpeter swan pairs are common in the lowlands both sides of the Silent Hills in summer.

To illustrate the above points, incidental observations made during road engineering and environmental studies conducted by CZN over the period September 16-26, 2014 are worthy of note. Five to seven 2-man crews were flown out daily to different parts of the alignment from the Mine to Nahanni Butte. An extensive number of flights were made. For the total period, one group of 3 mountain caribou were seen in the uplands south of Cat Camp, and over 30 moose were seen between Polje Creek and Grainger Gap. Two trumpeter swan pairs were spotted in eastern wetlands off the alignment. No sheep or grizzly bears were observed.

Further work was undertaken along the whole road this 2015 year on July 7-8. Two trumpeter swan pairs were again spotted off the alignment, and 2 moose were seen near Grainger Gap.

In their report in Appendix E, Tetra Tech EBA has proposed timing restrictions for boreal caribou, Dall's sheep and trumpeter swans regarding specific construction works. These are in the spring and summer, and therefore unlikely to significantly affect the road construction schedule. Summer construction work can be completed around (spatially and temporally) the timing restrictions.

## 4.16 Impacts on Fish Habitat due to Development during all Project Phases

See Hatfield's report in Appendix C (Sections 4.16, 16.2, 16.3, Attachment E).

## 4.17 Existing Management Plans

Existing plans available in draft form are:

- Spill Contingency Plan
- AEMP (for the Prairie Creek drainage)
- Contaminant Loading Management Plan
- Sediment and Erosion Control Plan
- Waste Management Plan
- Wildlife Mitigation and Monitoring Plan
- Air Quality Monitoring Plan

The spill risk analysis contained in the DAR, and revised in this DAR Addendum, supersedes the spill risk analysis completed for EA0809-002, which was not formalized into a plan.

The Spill Contingency Plan can be found here, starting on page 136:

http://www.mvlwb.ca/Boards/mv/Registry/2012/MV2012F0007/MV2012F0007 - CZN - Application - Additional Information - Apr05-12.pdf

The plan was written to address spills on land, snow, ice and open water, and therefore it is considered applicable for the all season road.

The existing draft AEMP can be found here:

http://www.mvlwb.ca/Boards/mv/Registry/2008/MV2008L2-0002/MV20008L2-0002 - CZN - Draft AEMP Design Plan - Jan31-14.pdf

The plan relates to bull trout and mine water discharge to Prairie Creek during mine operations. The plan includes monitoring of the trout population in Funeral Creek. The access road does not cross Funeral Creek where it is fish-bearing. Proposed changes to the AEMP for the access road are considered by Hatfield Consultants in their report in Appendix C (Section 4.17).

The Contaminant Loading and Management Plan was developed after EA0809-002 in response to a commitment made by CZN during the EA. It can be found here, starting on page 545:

http://www.mvlwb.ca/Boards/mv/Registry/2008/MV2008L2-0002/MV2008D0014 MV2008T0012 MV2008L2-0002 - CZN - Directive Response - Sept_28_12.pdf

Required revisions to the plan are considered by Golder Associates in their report in Appendix D (Section 4).

It is our understanding that Quarry Management Plans are specific to each borrow site to be developed. Since borrow sites can have very different site-specific conditions, a generic single plan is not very helpful. Borrow site investigations would be conducted during detailed design. Quarry Management Plans would logically be developed after this, and reviewed and approved before use as a condition of a permit. However, a generic approach to quarry management is discussed by Allnorth in their report in Appendix A.

The existing Sediment and Erosion Control Plan (SECP) is not considered appropriate for the all season road. An appropriate plan is provided by Allnorth in their report in Appendix A (Appendix C).

A draft Road Operations Plan (ROP) was written for the winter road and includes an emergency response plan. The plan can be found here, starting on page 18:

http://www.mvlwb.ca/Boards/mv/Registry/2012/MV2012F0007/MV2012F0007 - CZN - Application - Additional Information - Apr05-12.pdf

However, an appropriate plan for the all season road is provided by Allnorth in their report in Appendix A (Appendix C). The final plan (completed after road construction and before

operations) will include items such as traffic speeds along different sections of the road, signage for this and hazards, specific procedures for poor visibility, wildlife encounters and accidents and malfunctions, operation of the security check-point, as well as other driver-oriented information.

A Construction, Operations and Maintenance Plan has not yet been written for the winter road. The plan would include items such as the timing of seasonal construction and closure, in-season closure, protection of stream banks, mitigation for crossings and ice bridges, manpower and machinery requirements for maintenance, how repairs will be conducted, and managing drainage and runoff. A plan for the all season road is provided by Allnorth in their report in Appendix A (Appendix C). The plan has been renamed 'Road Construction and Maintenance Plan' since road operations are addressed in the ROP.

An Interim Closure and Reclamation Plan has not yet been written for the winter road. Closure concepts were presented during the EA process. The plan is to be submitted to the Water Board for approval 90 days prior to construction, and we would expect the same for the all season road. A Road Closure and Reclamation Plan is provided by Allnorth in their report in Appendix A (Appendix C).

A Waste Management Plan was provided with the application for a new winter road permit. It can be found here, starting on page 9:

http://www.mvlwb.ca/Boards/mv/Registry/2012/MV2012F0007/MV2012F0007 - CZN - Application - Additional Information - Apr05-12.pdf

Note, we have proposed to manage sewage from all season road construction camps by disposal in sumps (soak-aways) where such camps are not proximal to receiving water and where there is little risk of sewage discharge to such water.

CZN has a draft Wildlife Mitigation and Monitoring Plan (WMMP) for the winter road. It can be found here, starting on page 37:

http://www.mvlwb.ca/Boards/mv/Registry/2012/MV2012F0007/MV2012F0007 - CZN - Application - Additional Information - Apr05-12.pdf

This plan is expected to be largely suitable for an all season road. Tetra Tech EBA has reviewed the plan and discusses modifications as appropriate in their report in Appendix E (Section 10). The AR implies that CZN is to prepare two new wildlife-related management plans (Wildlife and Wildlife Habitat Protection Plan (WWHPP), and Wildlife Effects Monitoring Plan (WEMP)). We note that the GNWT is in the process of completing a second draft of guidelines relating to the preparation of the two new plans, with release slated for summer 2015 followed by further consultations. One recommendation made relating to the first draft was to combine the two plans. Therefore, it is premature to consider the preparation of these plans. We understand that our WMMP is broadly comparable to a WWHPP. Also, in the draft guidelines, a WEMP is not required in all cases.

The Controlled Road Use Plan was re-named the Road Operations Plan during EA0809-002 and the subsequent winter road permitting.

Appropriate approaches and mitigation for an Invasive Species Management Plan are discussed in Tetra Tech EBA's report in Appendix E (Section 7.7).

We believe the only air quality issue of significance related to the all season road is dust control. Golder Associates have reviewed the existing Air Quality Monitoring and Management Plan for adequacy. The plan can be found in this file available for download, and starts on page 675:

http://www.mvlwb.ca/Boards/mv/Registry/2008/MV2008L2-0002/MV2008L2-0002 - CZN - 2nd Directive Response Oct_16_12.pdf

However, rather than subsequently incorporating any additions for dust control into the plan, it may be more appropriate to incorporate them into the Road Construction and Maintenance Plan.

CZN's Socio-Economic Agreement with the GNWT is posted here:

http://www.reviewboard.ca/upload/project_document/EA0809-002_CZN-GNWT_Socio-Economic_Agreement.PDF

There are no non-confidential details of the IBA's CZN has with the NDDB and LKFN. See Section 20.3 for further comment.

# 5.0 CONSIDERATION OF PROJECT PHASES

The effects assessments herein, and in appendices provided by consultants, describe which project phase the largest effects refer to. Where there are differences in the effects between phases, these are discussed.

# 6.0 TRADITIONAL HARVESTING AND TRADITIONALLY HARVESTED SPECIES

## 6.2 Impact Assessment Steps

See Tetra Tech EBA's report in Appendix E (Sections 4 and 6).

## 6.3 Impacts to Traditional Harvesting and Traditionally Harvested Species

See Hatfield and Tetra Tech EBA's reports in Appendices C (Section 6.3) and E (Sections 6.4, 6.5, 6.7.1, 6.8 and 6.9), respectively.

In the June 24, 2015 letter from the Review Board, it is noted that:

> "A rigorous effects assessment for this key line of inquiry is required because the proposed construction and operation of a new all season access into a currently inaccessible area may have the potential to adversely impact traditional harvesting opportunities and harvested species due to increased harvest pressure. The Review Board suggests that CanZinc gather information to complete the requirements of section 6.3 of the Adequacy Review by speaking directly with the members of the Nahanni Butte Dene Band in Nahanni Butte. One suggested option to gather this information is for CanZinc to host a community workshop in Nahanni Butte".

Firstly, the area will be accessible by road once the approved winter road is built. Secondly, CZN held a workshop in the community on January 20, 2015. More than seven members of the Band participated, including elders, hunters and trappers. CZN laid out road maps and showed the alignment and notable locations as a basis for the discussion. Our objective was to get a broad sense of traditional activities and where they occur currently, and cross-reference the information with what we were told by Leon Konisenta on January 27, 2010. A summary of the main results specific to this discussion was provided in the DAR on pages 125-126, but is repeated here:

- Only Raymond Vital and a few others (Jim, Francis and Tommy Betsaka), have conducted trapping in proximity to the access road in the recent past. The trapping occurred in the Bluefish Lake and Grainger Gap areas, and the species trapped were marten, beaver, lynx, mink and wolverine. Raymond said that he used to go trapping perhaps once a year, but he hasn't used his trap lines since 2005/6;
- Trapping and hunting used to be common from the village to Grainger Gap and through the Gap. They used to hunt moose and caribou. The caribou would only be found east of Grainger Gap. More recently, only moose have been hunted (this may be because hunting is now primarily closer to the village and along the river, and hunters don't venture too far inland (CZN conclusion));
- Raymond Vital said he used to harvest Dall sheep along the Front Range in the 1970's. He remembers harvesting 3 near Granger Gap, and 2 near Bluefish Lake. He says he has never seen mountain goats there; and,
- Raymond Vital fished in Gap Lake (he has a cabin there) about 5 years ago (he couldn't remember), catching jackfish (pike) and grayling. He has also fished in Bluefish Lake and the triangular lake at Km 140, catching grayling, but this was more than 10 years ago.

In our opinion, the information confirms what we were told by Mr. Konisenta, and gives a reasonably clear picture of recent traditional activities proximal to the road. We concluded that it has been some time (>10 years) since traditional hunting has occurred proximal to the proposed road west of Grainger Gap, and that current activities are primarily focussed on moose hunting near the village and along the river i.e. easily accessible areas. Historical traditional activities were summarized in the DAR. It is not clear to us why CZN is being asked to collect additional information. Any further interaction with the NDDB on this matter would produce the same results.

## 6.4 Sensory Disturbance – Effects on Harvesting Activities and Communities

The AR requests a discussion of potential or planned mitigation or remediation measures to reduce potential adverse effects of noise on humans and human activities. In the rationale for the request, the AR implies that it is standard procedure to adopt mitigation measures to minimize potential effects. We would agree with this **provided** it is determined that the potential effects are significant enough to warrant mitigation, and that mitigation is necessary in the context of the receptor of the effects. CZN does not believe either of these requirements are met in this case.

Harvesters in the area typically use the Liard River and travel by speedboat outside of the winter period. Such boats make noise comparable to road trucks, if not louder. As noted above, Nahanni Butte is approximately 4.4 km from the nearest point of the road, and traffic (trucks, ATV's) is common in the village. Therefore, potential effects are not considered to be significant, and it is considered unlikely that noise from road traffic would be bothersome to harvesters or the community. We also reiterate that it was the community's preference to locate the proposed road where it is instead of the original route to the highway near Lindberg Landing.

As noted in the DAR, currently, very few tourists use the area proximal to the road, although we accept the road may be a stimulus for greater use since it will greatly reduce the cost of access. We consider it to be unlikely that such tourists would consider noise effects to be significant.

Truck noise that does seem to travel a greater distance is braking using engine retarders. Despite the lack of significant noise effects noted above, we believe it is practical to include mitigation in the form of discouraging the use of engine retarders for braking. However, we emphasize that engine retarders should only be discouraged, not prohibited, since some road sections contain steeper portions, and drivers should retain the option to use any form of braking if necessary for safety.

# 7.0 EFFECTS OF POTENTIAL ACCIDENTS AND MALFUNCTIONS

## 7.1 Risk Assessment

A revised risk assessment has been completed for the proposed project. This is based on the Failure Modes and Effects Analysis (FMEA) approach developed by Robertson and Shaw (http://technology.infomine.com/enviromine/issues/cls_fmea.html)". The FMEA description on the Infomine website lists the following components of an FMEA analysis: 'Mine Area/Component', ID', 'Failure Mode', 'Effect', 'Project Stage', 'Likelihood', 'Consequences', 'Level of Confidence' and 'Mitigation/Comments'. The analysis of likelihood and consequence are considered to be the most important items, since they are intended to inform subsequent mitigation. The authors note that there can be greatly differing severities of consequence.

**Screening**

Accidents and malfunctions can take various forms and have a number of different triggers. They can also be short and sudden, as well as longer and more persistent, if not detected. Short and sudden events could include the following:

- a truck accident
- loss of a load
- a spill on the road resulting from either of these
- a spill at the TTF
- ignition of a flammable liquid or explosives

Longer and more persistent events could include the following:

- concentrate aerial dispersal along the road and at the TTF
- concentrate tracking along the road and at the TTF
- leaks from trucks, during construction, operations and closure
- leaks at storage facilities during construction and at the TTF during operations

The potential for the occurrence of these events can be minimized by adopting appropriate management strategies. In order to determine what strategies would likely be effective, there is a need to consider the possible triggers of the events.

**Truck Accident**. There are many possibilities that could cause a truck accident. A driver could inadvertently drive off the road, fall asleep, be driving too fast, or collide with an oncoming vehicle or bank. The truck could lose brakes or steering, or have a tire blow-out. Management strategies that will minimize the risk of these occurrences include ensuring drivers do not exceed daily driving limits, get enough sleep, are familiar with the road route and are fit to drive each day. Speed limits will be set on all sections of the road and enforced. Minimum visibility requirements will also be specified, and driving will be suspended if these are not met due to intense fog, low cloud, intense rainfall or white-out. Drivers will be in contact with control and each other for safety and to coordinate passing, minimizing the risk of collision. Vehicles will be checked and maintained frequently for road worthiness. Accidents are also possible as a result of geohazards. These are discussed below.

**Loss of a Load**. A load could be completely or partially lost for a number of reasons, including a sudden stop or accident, failure to secure the load properly, or failure to secure the box containing the load. Accidents were discussed above. There will be predominantly two types of trailers: the custom-made ‘convey ore’ system for containerized bulk concentrate transport; and, a trailer box with internal tie-downs for bulk bags, with a box cover consisting of a tie-down tarp. The bulk concentrate containers are integral to the trailer, so can’t be ‘lost’. The lid-locking mechanisms are multiple and robust to prevent opening. Bags would be strapped-down inside the trailer boxes, but if one came loose, it would remain inside the box. Concentrate would not escape the box due to the dual containment by the bag and the tarp cover.

**Spill on the Road**. A spill on the road could occur as a result of an accident or malfunction event in connection with one of the scenarios described above (truck accident, loss of load). The risk of spills can be minimized by adopting the management strategies noted, and designing and building the road (grades, turns) as best as possible. However, some residual risk will remain.

**Spill at the TTF**. The TTF would only be used in any significant way in the Phase 1 development. Concentrates may be hauled there in bags, and a 10,000 gallon fuel storage facility may exist to fuel trucks. A spill at the TTF could consist of a concentrate bag being dropped during offloading or loading, or during storage tank filling or truck refuelling. If a concentrate bag is dropped and splits, it will be rebagged and the spilled material recovered from the gravel surface of the facility. Storage tank filling or truck refuelling would occur over a containment area, so any spill would be contained and recovered. The TTF will be built in a relatively flat location away from watercourses and with underlying clay from decomposed shale. The consequences of a spill are considered to be very low.

**Ignition of a flammable liquid or explosives**. Fuel and oil are flammable and will ignite if exposed to an ignition source. Standard industry best practices will need to be followed for transportation, storage and fuelling. If an accident occurs and there is a fuel spill, response actions will need to include removal of ignition sources. Explosives would be transported by a dedicated, licenced contractor. Detonators and blasting agents are transported separately. The risk of an explosion is low.

**Concentrate aerial dispersal along the road and at the TTF**. As explained in EA0809-002, the premise for transporting bagged concentrate is that the outside of the bags are clean leaving the Mine. They will further be contained in a truck box with a tarp cover. Bulk concentrate would be transported in sealed containers. Therefore, the risk of concentrate dispersal is low. In addition, soil samples will be collected along the road and at the TTF on a regular basis to verify the absence of dispersal. This program is expected to provide an early warning of any problem developing. Bag rehandling at the TTF should not cause dispersal as the bags will be sealed and the outsides should be clean. This will be verified by soil sampling.

**Concentrate tracking along the road and at the TTF**. Also defined in EA0809-002, concentrate trucks being loaded at the Mine will not enter the storage building, and will drive through a wheel wash before leaving the loading area. The trucks will also periodically be washed at a dedicated wash bay with water collection. Trucks at the TTF would also not enter the concentrate storage area. They would be offloaded and loaded in a bay adjacent to the storage.

**Leaks from trucks, during construction, operations and closure**. Leaks of fuel and/or oil could occur from trucks on the road. This risk will be minimized by regularly inspecting and maintaining trucks, and requiring drip pans be placed under the engine when parked in excess of 30 minutes. Any localized stained soil from hydrocarbons will be collected and taken to the Mine for remediation (a biocell was included in the facilities to be built at the Mine for operations).

**Leaks at storage facilities during construction and at the TTF during operations**. All fuel storage facilities will have secondary containment.

A screening of the potential accidents and malfunctions noted above can be made in terms of risk. Events assumed to have a low risk **after** the adoption of management strategies and monitoring are screened out at this stage from further assessment. Accidents leading to spills along the road may still occur despite the management strategies adopted, and may have a significant consequence. Therefore, the risk of accidents leading to spills is potentially greater than low, and will now be further assessed.

**Likelihood of Accidents Leading to Spills**

Despite the best application of management approaches, and a suitably designed and built road, there remains the potential for spills. Given that most triggers of an accident can be mitigated by sound management controls, we believe the likelihood of spills is primarily related to the nature of the road itself, in terms of grade and alignment. This was the focus of the assessment presented in Table 9-2 of the DAR. However, geohazards can also have an influence on spill likelihood.

Tetra Tech EBA performed a risk assessment of geohazards (Appendix 2 of the DAR) and estimated that about 7.2 km of the terrain along the proposed all-season route represents a high risk in terms of safety or the road route with respect to slope instabilities or other ground movements (by thawing, sliding, flowing, falling, settling or collapsing), and 54.9 km represents a moderate risk, out of a total of 174.1 km evaluated. The Liard River crossing has a high risk with respect to flooding, and 20.65 km of the route has a moderate risk. Other moderate risks include 4.3 km of the route for overland flow, 29.6 km for seismic activity, and 17.8 km for avalanche activity. Since there is considerable overlap in the moderate risk designations, a total of 76.7 km was estimated to represent a moderate risk to the road, and 7.4 km was estimated to represent a high risk to the road.

Of the hazards assessed by Tetra Tech EBA, those that could trigger sudden events and potentially cause an accident, and subsequently a spill, are of most interest. Sudden ground movements fall into this category, while gradual changes from permafrost, for example, which would necessitate a road maintenance response would not. Seismic activity could trigger a sudden landslide, however Tetra Tech EBA assessed the likelihood of this occurring to be low for the entire road route. Avalanches could also be sudden, and road sections with a moderate to high likelihood of occurrence were noted. Flooding is possible along certain sections of the road, notably near the Mine, Polje Creek and the Liard River. These events are typically not sudden, and if they occurred, may necessitate suspension of hauling, but they are not considered to be a significant threat regarding causing an accident and triggering a spill. Overland flow is similarly not particularly sudden, although more so than flooding as flashy flow conditions are possible in the mountains in response to torrential rain. However, such events would trigger a road maintenance inspection ahead of any hauling to check for wash-outs, plugged culverts, bridge approach erosion, etc. If intense rainfall occurs during a daily haul period, inspections would be instigated to check for any road damage. Advice would also be relayed to drivers to reduce normal speeds and use extra precautions at stream crossings and other locations where erosion might have occurred. In extreme circumstances, hauling may be temporarily suspended until the ‘all clear’ is given. Therefore, overland flow is also not considered to be a significant threat regarding an accident and the triggering of a spill.

As a result of the above, Table 9-2 from the DAR was modified to produce Table 7-1 which includes only those factors considered relevant to the likelihood of a spill. Road sections assessed by Tetra Tech EBA as having a moderate or high likelihood of occurrence of ground movement or avalanche events are included. The road sections from Table 9-2 were mostly retained in Table 7-1, and Tetra Tech EBA's road section rankings were fitted as closely as possible. The likelihood of an accident leading to a spill was ranked as either low, moderate or high. Rankings were mostly weighted based on road grade and alignment since those conditions would exist all the time, whereas sudden ground movements occur very infrequently, and the chances of there being a truck present on the particular road section at the time are remote. It should also be noted that avalanche risks are greater in winter and spring, and traffic will be much less on the all season road in winter compared to a winter road, which CZN already has a permit for. In spring, hauling would be suspended until a barge crossing of the Liard River is possible.

**Consequence of Accidents Leading to Spills**

Table 7-2 summarizes the consequence assessment and is also a modified version of Table 9-2 from the DAR, including those factors considered applicable to the assessment of the consequence of an accident leading to a spill. As discussed in Section 9.4 of the DAR, spill consequence is considered to be related to proximity to a watercourse, the nature of the ground, and whether a spill could be quickly and easily contained. In the consequence assessment, the focus is on water quality and fish. A spill would have some consequence for vegetation and thus wildlife, but this is considered to be relatively minor by comparison. Effects are considered later. Consequence in terms of driver injury is also factored into the assessment. An accident is generally considered to have a greater consequence in terms of injury in the more mountainous, steeper sections of the road. Discussion in terms of consequence on water quality and fish by road section is provided in Section 9.4 of the DAR.

**Risk of Accidents Leading to Spills**

Table 7-3 provides the likelihood and consequence rankings by road section, and the resulting risk rank in five categories from very low to very high. In considering these rankings, it should be noted that a very high risk does not necessarily mean a spill is likely to happen and that a significant, long-term effect will occur as a result. It merely indicates that the risk is high relative to other road sections, and serves to focus mitigation and spill response planning. To put the assessment into context, approximately 800 loads were brought into the Mine in the early 1980's over two winter roads in order to construct the Mine. Following two reviews of INAC (as AANDC was known at that time, now part of GNWT) files in Fort Simpson, and conversations with site personnel and drivers from that time, there is no record or any indication of any significant accidents or spills having occurred on the road.

## TABLE 7-1: LIKELIHOOD OF ACCIDENTS LEADING TO SPILLS

| Km from Mine | | Grade | Alignment | Landslides/ Ground Movements | Avalanches | Likelihood |
|---|---|---|---|---|---|---|
| From | To | | | | | |
| **Prairie/Fast Creek** | | | | | | |
| 0 | 3.5 | Flat | Broad curves | Moderate | Low | Low |
| 3.5 | 4.2 | | | | | |
| 4.2 | 5.3 | | | | | |
| 5.3 | 5.5 | | Straight | | | |
| 5.5 | 6.2 | | | | | |
| 6.2 | 7.4 | | | | Moderate | |
| **Funeral Creek** | | | | | | |
| 7.4 | 12.0 | Gentle | Broad curves | Moderate | Moderate | Moderate |
| 12.0 | 17.2 | Steep | Straight | High | High | High |
| **Sundog Creek** | | | | | | |
| 17.2 | 23.3 | Gentle | Straight | High | High | Low |
| 23.3 | 23.5 | Steep | | Moderate | Moderate | Moderate |
| 23.5 | 28.1 | Gentle | | | | |
| 28.1 | 40.2 | Flat | | High | High | |
| **Sundog Creek tributaries** | | | | | | |
| 40.2 | 53.6 | Flat | Straight | High | Low | Low |
| 53.6 | 59.9 | Gentle | | | | Moderate |
| 59.9 | 64.5 | Flat | | Moderate | | Low |
| **Tetcela & Fishtrap** | | | | | | |
| 64.5 | 86.8 | Gentle | Straight | Moderate | Low | Low |
| 86.8 | 95.8 | Flat | | High | | |
| 95.8 | 102.0 | Steep | Curves | | | High |
| **Wolverine Pass to Grainger Gap** | | | | | | |
| 102.0 | 119.5 | Flat | Straight | Moderate | Low | Low |
| 119.5 | 124.5 | Flat | Straight | Moderate | Low | Low |
| **Grainger Gap to Liard** | | | | | | |
| 124.5 | 133.0 | Flat | Straight | Moderate | Low | Low |
| 133.0 | 159.8 | | | High | | |
| **Liard Crossing** | | | | | | |
| 159.8 | 160.4 | Flat | Straight | - | - | Low |
| **Old Logging Road** | | | | | | |
| 160.4 | 174.5 | Flat | Straight | - | - | Low |

## TABLE 7-2: CONSEQUENCE OF ACCIDENTS LEADING TO SPILLS

| Km from Mine | | Proximity to Water | Ground Type | Containment | Consequence |
|---|---|---|---|---|---|
| From | To | | | | |
| **Prairie/Fast Creek** | | | | | |
| 0 | 3.5 | 30-80 | Silty sand | Readily contained | Low |
| 3.5 | 4.2 | 1 | Sandy gravel | No containment | High |
| 4.2 | 5.3 | 10-50 | | Can be contained | Moderate |
| 5.3 | 5.5 | 1 | | No containment | High |
| 5.5 | 6.2 | 20-100 | Silty sand | Can be contained | Moderate |
| 6.2 | 7.4 | 10-50 | Sandy gravel | No containment | High |
| **Funeral Creek** | | | | | |
| 7.4 | 12.0 | 1-50 | Silty sand | No containment | High |
| 12.0 | 17.2 | 1-30 | Sandy gravel | | |
| **Sundog Creek** | | | | | |
| 17.2 | 23.3 | 1-30 | Sandy gravel | Can be contained | Moderate |
| 23.3 | 23.5 | 1-50 | | No containment | |
| 23.5 | 28.1 | 20-100 | | | High |
| 28.1 | 40.2 | 1-5 | Gravel | | |
| **Sundog Creek tributaries** | | | | | |
| 40.2 | 53.6 | 1-1000 | Silt/organic | Readily contained | Low |
| 53.6 | 59.9 | 300-1000 | | | Moderate |
| 59.9 | 64.5 | | | | |
| **Tetcela & Fishtrap** | | | | | |
| 64.5 | 86.8 | 100-1000 | Silt/organic | Readily contained | Moderate |
| 86.8 | 95.8 | 1-1000 | | Can be contained | High |
| 95.8 | 102.0 | 300-2000 | | Containment toe of slope | Moderate |
| **Wolverine Pass to Grainger Gap** | | | | | |
| 102.0 | 119.5 | 1000-2000 | Silt/organic | Readily contained | Low |
| 119.5 | 124.5 | | Organic/gravel | Limited containment | High |
| **Grainger Gap to Liard** | | | | | |
| 124.5 | 127.0 | 1-200 | Silty sand | Can be contained | Moderate |
| 127.0 | 159.8 | 200-2000 | | Readily contained | Low |
| **Liard Crossing** | | | | | |
| 159.8 | 160.4 | 0 | Ice/Water | No containment | High |
| **Old Logging Road** | | | | | |
| 160.4 | 174.5 | 200-1000 | Silt | Can be contained | Low |

## TABLE 7-3: RISK OF ACCIDENTS LEADING TO SPILLS

| Km from Mine | | Likelihood | Consequence | Risk | |
|---|---|---|---|---|---|
| From | To | | | | |
| **Prairie/Fast Creek** | | | | | |
| 0 | 3.5 | Low | Low | Very Low | |
| 3.5 | 4.2 | | High | Moderate | |
| 4.2 | 5.3 | | Moderate | Low | |
| 5.3 | 5.5 | | High | Moderate | |
| 5.5 | 6.2 | | Moderate | Low | |
| 6.2 | 7.4 | | High | Moderate | |
| **Funeral Creek** | | | | | |
| 7.4 | 12.0 | Moderate | High | High | |
| 12.0 | 17.2 | High | | Very High | |
| **Sundog Creek** | | | | | |
| 17.2 | 23.3 | Low | Moderate | Low | |
| 23.3 | 23.5 | Moderate | | Moderate | |
| 23.5 | 28.1 | | High | High | |
| 28.1 | 40.2 | | | | |
| **Sundog Creek tributaries** | | | | | |
| 40.2 | 53.6 | Low | Low | Very Low | |
| 53.6 | 59.9 | Moderate | Moderate | Moderate | |
| 59.9 | 64.5 | Low | | Low | |
| **Tetcela & Fishtrap** | | | | | |
| 64.5 | 86.8 | Low | Moderate | Low | |
| 86.8 | 95.8 | | High | Moderate | |
| 95.8 | 102.0 | High | Moderate | High | |
| **Wolverine Pass to Grainger Gap** | | | | | |
| 102.0 | 119.5 | Low | Low | Very Low | |
| 119.5 | 124.5 | | High | Moderate | |
| **Grainger Gap to Liard** | | | | | |
| 124.5 | 127.0 | Low | Moderate | Low | |
| 127.0 | 159.8 | | Low | Very Low | |
| **Liard Crossing** | | | | | |
| 159.8 | 160.4 | Low | High | Moderate | |
| **Old Logging Road** | | | | | |
| 160.4 | 174.5 | Low | Low | Very Low | |

**Severity/Duration of Spills and Injury**

Table 9-3 from the DAR (Spill Severity and Duration) has been modified based on the risk assessment herein, and is provided as Table 7-4. As before, road sections with an assessed risk of moderate or higher are included. Spill severity and duration based on the substance spilled are ranked according to the definitions given in Section 9.5 of the DAR. In addition to the discussion of rankings in that section, road section Km 53.6 to 59.9 is discussed here. This road section is from Polje Creek in the west to Mosquito Lake in the east. The road climbs onto the Ram Plateau from the west. Karst features occur in this area, notably the poljes, and depressions which may develop into sinkholes exist to the south where the old winter road alignment is located.

The karst features were created as a result of dissolution of carbonate over tens of thousands of years. The rock itself is quite hard, and is the reason for the mountain peaks and ridges locally where the rock exists. Because of the potential for cavities, karst can host a much greater quantity of groundwater in storage compared to other rocks. Interconnected cavities would allow the water to flow at a relatively rapid rate. In the event of a spill of liquid into karst-hosted groundwater, while the spilled liquid could be transported quite quickly, the large storage volume will mean that the liquid will disperse and dissipate quite quickly also, depending on the nature of the liquid. Karst terrain is referred to by some as a ‘sensitive environment’. Karst rock is hard and less sensitive than other rocks to weathering. Karst groundwater is not particularly sensitive because of the large volume in storage, although contaminants could be transported at a faster rate. What we can say is that the North Nahanni karst landform is unique and an excellent example of karst, and that the karst features it hosts should not be impacted. Therefore, we believe the discussion regarding karst ‘environment’ should focus on karst features.

The spill severity and duration rankings for road section Km 53.6 to 59.9 reflect the above considerations. The road traverses solid ground with a soil cover. A spill would likely be readily contained. A liquid spill might lead to some loss of liquid through the subsurface, ultimately to groundwater, but the amount should be small. Upon reaching groundwater, the liquid should quickly dissipate, although hydrocarbons would be more persistent.

Table 7-4 contains a column labelled ‘Access’. This is to indicate the relative ease of access for spill response activities. Most locations are easily accessed as the road is located in the valley bottom or on flat terrain, or access is moderate where the road is upslope somewhat and access to downslope locations is more difficult. Access downslope of the Km 12-17.2 section would be difficult because the road is well above the valley bottom and the slopes are steep. For spill response planning, refer to Section 9.5 of the DAR.

Table 7-4 also contains a column labelled ‘Injury Potential. This is to indicate the relative threat of serious injury that might result to a driver from an accident. Injury potential is considered to be low where the road is located in the valley bottom or on flat terrain, and deep water or large trees are not adjacent. Moderate potential is where deep water and/or moderate slopes occur adjacent to the road. High potential is where steep slopes and/or large trees occur adjacent to the road, and at the Liard crossing in summer due to deep, potentially fast-flowing water.

## TABLE 7-4: ASSESSMENT OF SPILL SEVERITY AND DURATION

| Km from | | Proximity | Containment | Risk | Substance | Severity | Duration | Access | Injury |
|---|---|---|---|---|---|---|---|---|---|
| From | To | to Water | | | | | | | Potential |
| **Prairie/Fast Creek** | | | | | | | | | |
| 3.5<br>5.3<br>6.2 | 4.2<br>5.5<br>7.4 | 1-100 | Some areas no containment | Moderate | Diesel/oil | High | Moderate | Easy | Moderate |
| | | | | | Sulphuric | Low | Short | | |
| | | | | | Concentrate | Low | Long | | |
| | | | | | AN/Sulphide | High | Short | | |
| **Funeral Creek** | | | | | | | | | |
| 7.4 | 12.0 | 1-50 | No containment | High | Diesel/oil | High | Moderate | Easy | Low |
| | | | | | Sulphuric | Moderate | Short | | |
| | | | | | Concentrate | Low | Long | | |
| | | | | | AN/Sulphide | High | Short | | |
| 12.0 | 17.2 | 1-30 | No containment | Very High | Diesel/oil | High | Moderate | Difficult | High |
| | | | | | Sulphuric | Moderate | Short | | |
| | | | | | Concentrate | Low | Long | | |
| | | | | | AN/Sulphide | High | Short | | |
| **Sundog Creek** | | | | | | | | | |
| 23.3 | 40.2 | 1-100 | Some areas no containment | Moderate-High | Diesel/oil | Moderate | Moderate | Easy-Moderate | Low-High |
| | | | | | Sulphuric | Low | Short | | |
| | | | | | Concentrate | Low | Long | | |
| | | | | | AN/Sulphide | Moderate | Short | | |
| **Sundog Creek tributaries** | | | | | | | | | |
| 53.6 | 59.9 | 300-1000 | Readily contained | Moderate | Diesel/oil | Moderate | Long | Easy-Moderate | Low-Moderate |
| | | | | | Sulphuric | Low | Short | | |
| | | | | | Concentrate | Low | Long | | |
| | | | | | AN/Sulphide | Moderate | Short | | |
| **Tetcela & Fishtrap** | | | | | | | | | |
| 86.8 | 95.8 | 1-1000 | Can be contained | Moderate | Diesel/oil | High | Moderate | Moderate | Low |
| | | | | | Sulphuric | Low | Short | | |
| | | | | | Concentrate | Low | Long | | |
| | | | | | AN/Sulphide | High | Short | | |
| 95.8 | 102.0 | 300-2000 | Containment toe of slope | High | Diesel/oil | Moderate | Moderate | Moderate | High |
| | | | | | Sulphuric | Low | Short | | |
| | | | | | Concentrate | Low | Long | | |
| | | | | | AN/Sulphide | Low | Short | | |
| **Wolverine Pass to Grainger Gap** | | | | | | | | | |
| 119.5 | 124.5 | 1000-2000 | Limited containment | Moderate | Diesel/oil | High | Moderate | Easy | Low |
| | | | | | Sulphuric | Low | Short | | |
| | | | | | Concentrate | Low | Long | | |
| | | | | | AN/Sulphide | High | Short | | |
| **Liard Crossing** | | | | | | | | | |
| 159.8 | 160.4 | 0 | No containment | Moderate | Diesel/oil | High | Moderate | Easy | Low-High |
| | | | | | Sulphuric | Low | Short | | |
| | | | | | Concentrate | Low | Long | | |
| | | | | | AN/Sulphide | Moderate | Short | | |

**Effects**

An assessment of effects to the environment from accidents and malfunctions is presented here. The first part of this assessment considers the effects of accidents leading to spills, and is a continuation of the forgoing risk assessment. Spills could have effects on water quality, fish, soil, vegetation and wildlife. Effects on the first two of these components are closely linked, and are considered to be highly dependent on spill location in terms of road section. An effects matrix for these two components by road section is given in Table 7-5.

In terms of the number of trips and cargo volume of materials of environmental significance to be hauled for Mine construction and operations, fuel and concentrates are by far the largest (see Table 9-1 in the DAR). Trips to haul mill and water treatment reagents, and explosives, will be few, and the size of each package will be relatively small (e.g. sulphuric acid – 1,400 litre totes). Therefore, fuel and concentrates have been included in Table 7-5, and effects assessed separately.

For effects significance, a fuel spill that could reach a fish-bearing stream is considered to have high significance in terms of both water quality and fish. However, there are non-fish bearing streams along the road, and in that case significance is considered high for water quality and low or moderate for fish, depending on the location of fish downstream and probable success of spill response actions. A concentrate spill is considered to have low significance in terms of water quality because the material has a limited leaching capacity, and any leachate reaching or in a stream will readily disperse in the flowing water. The significance for fish is considered to be moderate because if concentrate is spilled into a stream, some may not be recovered and could negatively affect sediments, benthos and thus fish.

For effects uncertainty, the effects significance on water quality and fish could be less than high, and so uncertainty is considered moderate. For a concentrate spill, uncertainty is considered to be low for water quality, but moderate for fish, since effects could be less or more than estimated.

Timing is essentially duration of effects, and the data on duration were imported from Table 7-4 and based on the same definitions as in the DAR. Similarly, magnitude is considered to be similar to severity, and data on severity were also imported from Table 7-4.

A fuel spill is considered to be relatively highly reversible in terms of water quality, although moderately reversible for exposed fish which may exhibit longer effects. Reversibility of a concentrate spill is considered to be low for water quality and fish because, although effects should not be particularly significant, they could last for an extended period.

Likelihood of effects is considered to be related to the likelihood of a spill, therefore data from Table 7-1 were imported. In reality, the likelihood of effects will be less than indicated because an accident may not result in a spill, and any spilled material may not reach a stream or groundwater.

**TABLE 7-5: EFFECTS MATRIX, ACCIDENTS BY KM LEADING TO SPILLS - WATER AND FISH**

| Spill | Valued Component | Significance | Uncertainty | Geographic Range | Timing | Magnitude | Reversibility | Likelihood |
|---|---|---|---|---|---|---|---|---|
| Fuel | Water | High | Moderate | 3.5-7.4 | Moderate | High | High | Low |
| | Fish | High | Moderate | | | | Moderate | |
| Concentrate | Water | Low | Low | | Long | Low | Low | |
| | Fish | Moderate | Moderate | | | | Low | |
| Fuel | Water | High | Moderate | 7.4-12 | Moderate | High | High | Moderate |
| | Fish | High | Moderate | | | | Moderate | |
| Concentrate | Water | Low | Low | | Long | Low | Low | |
| | Fish | Moderate | Moderate | | | | Low | |
| Fuel | Water | High | Moderate | 12-17.2 | Moderate | High | High | High |
| | Fish | Moderate | Moderate | | | | Moderate | |
| Concentrate | Water | Low | Low | | Long | Low | Low | |
| | Fish | Low | Moderate | | | | Low | |
| Fuel | Water | High | Moderate | 23.3-40.2 | Moderate | Moderate | High | Moderate |
| | Fish | High | Moderate | | | | Moderate | |
| Concentrate | Water | Low | Low | | Long | Low | Low | |
| | Fish | Moderate | Moderate | | | | Low | |
| Fuel | Water | Moderate | Moderate | 53.6-59.9 | Long | Moderate | High | Moderate |
| | Fish | Low | Moderate | | | | Moderate | |
| Concentrate | Water | Low | Low | | Long | Low | Low | |
| | Fish | Low | Moderate | | | | Low | |
| Fuel | Water | Moderate | Moderate | 86.8-95.8 | Moderate | High | High | Low |
| | Fish | Moderate | Moderate | | | | Moderate | |
| Concentrate | Water | Low | Low | | Long | Low | Low | |
| | Fish | Low | Moderate | | | | Low | |
| Fuel | Water | Moderate | Moderate | 95.8-102 | Moderate | Moderate | High | High |
| | Fish | Low | Moderate | | | | Moderate | |
| Concentrate | Water | Low | Low | | Long | Low | Low | |
| | Fish | Low | Moderate | | | | Low | |
| Fuel | Water | High | Moderate | 119.5-124.5 | Moderate | High | High | Low |
| | Fish | High | Moderate | | | | Moderate | |
| Concentrate | Water | Low | Low | | Long | Low | Low | |
| | Fish | Moderate | Moderate | | | | Low | |
| Fuel | Water | High | Moderate | 159.8-160.4 | Moderate | High | High | Low |
| | Fish | High | Moderate | | | | Moderate | |
| Concentrate | Water | Low | Low | | Long | Low | Low | |
| | Fish | Moderate | Moderate | | | | Low | |

Following on from Table 7-5, an assessment of other effects to the environment from accidents and malfunctions is presented in Table 7-6. In addition to the effects on water quality and fish being closely linked, those for soil, vegetation and wildlife are also considered to be closely linked. Therefore, these components are considered in two groups in the assessment. The geographic scope for this assessment is the whole road, except for spills at the TTF. Assessment duration is life of Mine, including road construction and closure.

A fuel spill is considered to have a low significance in terms of effects on soil, vegetation and wildlife (SVW) because the spill is likely to be limited in extent, occur for only a short time, and be completely remediated. While a fuel spill of some kind is likely over the life of the Mine, the magnitude of effects should be low. The same can be said for a concentrate spill, which would also be readily cleaned-up.

The likelihood of an acid spill is considered to be low because of the small size of the storage totes and strength of the vessel. If a spill occurred at all, it is likely to be very small. Hence, effects on water and fish (WF), and SVW, are not expected to be significant. However, uncertainty for WF was ranked as high because of the small risk of an acid spill directly into a stream where fish are present. A spill would only cause effects for a short time, they would likely not be of a significant magnitude, and completely reversible. Considerations are much the same for an ammonium nitrate or sodium sulphide spill, which would also be transported in small packages and have a low likelihood of spilling. However, if either of these compounds were spilled into a stream, effects could be high to WF, and the spill moderately significant.

As noted, the TTF would be in a relatively isolated location distant from watercourses. Although some type of spill is likely at the TTF over the Mine's life, any kind of spill there would have low effects and low significance, would last for only a short period and be completely cleaned-up.

Because of the transport approaches described above, the likelihood of concentrate aerial dispersal is considered to be low. If it did occur, it is expected that it would be detected early by monitoring before any significant effects of any magnitude. However, during the detection period, limited effects might occur to SVW due to dust accumulation. The same accumulation would not be expected in WF. If dispersal did occur, a remedial program may be required, but either way, some residual may be left for a long time.

Concentrate tracking along the road from the Mine and TTF after loading is possible, but unlikely. Loading would be completed in a bay outside the storage location. Trucks leaving the Mine would go through a wheel wash as a precaution. Trucks leaving the TTF would only carry bags as bulk concentrate storage would not occur at the TTF, and the bags would be handled directly into the truck box from storage (see Figure 6-11 in the EA0809-002 DAR). Monitoring would confirm the absence of tracking. If any tracking had occurred, effects would be low at the time of detection. Recovery and response actions may occur, but like aerial dispersal, some residual may be left for a long time.

**TABLE 7-6: EFFECTS MATRIX, ACCIDENTS LEADING TO SPILLS, ALL TYPES**

| Impact | Valued Component | Significance | Uncertainty | Timing | Magnitude | Reversibility | Likelihood |
|---|---|---|---|---|---|---|---|
| Fuel spill | Soil/veg/wildlife | Low | Moderate | Short | Low | High | High |
| Concentrate spill | Soil/veg/wildlife | Low | Moderate | Short | Low | High | High |
| Acid spill | Water/fish | Low | High | Short | Moderate | High | Low |
| | Soil/veg/wildlife | Low | Moderate | Short | Low | High | Low |
| AN/sulphide spill | Water/fish | Moderate | Moderate | Short | High | High | Low |
| | Soil/veg/wildlife | Low | Moderate | Short | Low | High | Low |
| Spill at the TTF | Water/fish | Low | Low | Short | Low | High | High |
| | Soil/veg/wildlife | Low | Low | Short | Low | High | High |
| Concentrate aerial dispersal | Water/fish | Low | Moderate | Long | Low | Low | Low |
| | Soil/veg/wildlife | Moderate | Moderate | Long | Low | Moderate | Low |
| Concentrate tracking | Water/fish | Low | Moderate | Long | Low | Low | Low |
| | Soil/veg/wildlife | Moderate | Moderate | Long | Low | High | Low |
| Leaks from trucks | Water/fish | Low | Moderate | Short | Low | High | High |
| | Soil/veg/wildlife | Low | Low | Short | Low | High | High |
| Leaks from storage | Water/fish | Low | Low | High | Low | Moderate | Low |
| | Soil/veg/wildlife | Low | Low | High | Low | Moderate | Low |
| Sewage leaks/disposal | Water/fish | Low | Low | Moderate | Low | High | Low |
| | Soil/veg/wildlife | Low | Low | Moderate | Low | High | Moderate |

Some leaks from trucks building or using the road are likely. However, these are expected to be small, likely too small to warrant remediation. Any obvious stained soil can be collected and taken to the Mine for treatment. Effects will be low as storage will be in safe locations, short-lived and reversible. Leaks from storage tanks are unlikely given that they will be in secondary containment. Any leaks evading containment will be small and cleaned-up, although their discovery may be delayed due to concealment by the containment.

Sewage will be held in small tanks for later disposal by tanker truck or soak-away in sumps, located distant from watercourses. Spills and leaks are not likely, but sump disposal will result in limited local effects to SVW, which may occur for an extended period but would be reversible.

**Spill Response Addendum**

Section 9.5 in the DAR discusses spill response. Response approaches and spill equipment locations are discussed with respect to road section. Since an accident or malfunction could occur anywhere on the road, flexibility has been provided so that responders and response equipment can be dispatched to a spill location at short notice. Responders will be located at the Mine, along the road in the form of a maintenance crew, at the TTF if it is in operation, and at the LTF. Response equipment will be stored in a number of locations along the road, and at designated control points for high risk locations. With this approach, responders and response equipment can be brought to the spill site even if part of the road is inaccessible. In the unlikely event that the road is inaccessible in multiple locations, isolating a spill site, a helicopter can be summoned to facilitate access. CZN has proposed to maintain spill equipment in portable trailers. We will ensure that these or other similar units are heli-portable.

## 7.2 Existing Topography – Characterization of Geohazards

See Allnorth's report in Appendix A (Section 2.2, bridge sites) and Tetra Tech EBA's report in Appendix F (Section 2.7).

## 7.3 Unconsolidated Surficial Materials

See Tetra Tech EBA's report in Appendix F (Section 2.3).

## 7.4 Soil Types

See Tetra Tech EBA's report in Appendix F (Section 2.4).

## 7.5 Stability of Landforms with respect to Permafrost

See Tetra Tech EBA's report in Appendix F (Section 2.5, Table 2.7-1).

## 7.6 Channel Morphology and Stability

Air photo interpretation is addressed by Tetra Tech EBA in their report in Appendix F (Section 2.6). Crossing location selection and engineering considerations are covered by Allnorth in Appendix A (Section 2.2). Comments on the Sundog Creek re-alignment are given below

The proposed Sundog Creek re-alignment would be maintained for the life of the road. Thereafter, the creek would either continue in the same channel, or cut a new one, as it does naturally at present.

It will be important to maintain the creek in the new channel. Although the new road bed will be suitably armoured, if the channel moved from the new channel back to its old alignment, it would scour and could under-mine the road. Erosion would be limited to begin with, but would increase progressively. Measures would be required to either upgrade the amour or return the creek to the re-aligned channel.

Following further discussion with the project hydrologist (Bill Rozeboom, Tetra Tech EBA), it has been decided that the best approach to maintain the re-aligned channel is to armour the southern bank of the channel where necessary to divert flows to the north, away from the road. This change was made for two reasons: 1) placing large boulders in the new channel could cause flows to divert to the south, which would be counter-productive, and 2) sourcing large boulders might prove difficult. The armour would consist of the largest material available. We expect that scour will occur, maintaining the pool habitat in armour locations that will be constructed when the channel is re-aligned. Over time, the armour may continue to embed in the alluvium, to the point where some pieces might disappear. These pieces would be replaced by armour at higher elevations, as most armour is designed to do. Additional armour may need to be placed at the top of the ‘conveyor’ at some point. This would be done when the channel is dry in the fall or winter. The number and length of armour locations will be determined during detailed design. We expect that the pool habitat created will be well in excess of that currently in existence.

Regarding channel dimensions, the intent during construction would be to create the shape of the existing channel. The important consideration is elevation of the base of the new channel to ensure that spring flows enter and remain in the new channel preferentially. The base elevation should be the same or slightly less than the old channel at any given point along the re-alignment. The dimensions of the new channel will depend on flows, but would be comparable to the old channel, which would be filled to minimize the potential for it continuing to be a flow location. During further site investigation/detailed design, we expect that a series of floodplain cross-section profiles would be surveyed and elevation markers installed in order to serve as a reference for excavations. The channel would be deepened where the armour is to be placed to create pool habitat. These locations would be determined by the project hydrologist.

# 8.0 IMPACTS TO NNPR

## 8.1 Impact Assessment

Changes to karst formations are discussed by Tetra Tech EBA in Appendix F (Section 2.7). Long term changes to NNPR ecology are addressed by Tetra Tech EBA in Appendix E (Sections 7.11 and 7.12). Comments on wilderness quality and visitor experience are given below.

As discussed in the DAR, we can consider three different groups of people potentially visiting the NNPR: day and rafting trips to the river and central portion of the park; the few who occasionally hike on the Ram Plateau proximal to the road; and, those that might take advantage of road access to visit the area.

Effects may occur in the form of noise or visual impacts (seeing trucks). Of these, noise is considered the main effect because the effect can be detected at some distance and is not reliant on line of sight. Visual effects are considered minor because line of sight is required, and observing trucks is not considered to be a significant effect.

Effects on wilderness quality for the first group noted above are considered to be negligible since these visitors fly over or around the area of the road. There would be some effects on the second group if they are proximal to the road since one of the objectives of these visitors is likely a wilderness experience with limited un-natural noise. There would be limited effects on the third group because they are more likely to be visiting the area for general recreation rather than specifically for wilderness quality. Regarding mitigation, deterring the use of engine retarders for braking has been discussed above. Other than that, there is little in the way of other opportunities for mitigation. For example, it is not practical for trucks to travel in convoy. Truck traffic in summer, which is the timing of nearly all visitors to NNPR, is determined by barge availability on the Liard River. Trucks have to be staggered as they would not be able to cross the river at the same time, and cannot wait because the maximum shift length is only sufficient for a trip from the Mine to the LTF and back without delay for river crossings. It would also seem illogical to disrupt the most efficient trucking schedule because of the wilderness concerns of a very limited number of people.

Regarding visitor experience, the discussion is very similar to the above since it is influenced by wilderness experience. Other aspects of visitor experience could include recreation other than for wilderness, and perhaps interest in specific features, such as the karst on the Ram Plateau or the Sundog area into the mountains. There is also the potential for aboriginal hunting using the road, although since hunting does not occur in the area currently because of difficulty of access, we believe aboriginals would not consider road use to be an ‘impact’. Mitigation re wilderness experience was discussed above. The road is not considered to have any significant effects in terms of other visitor experience elements.

Since the majority of road construction is expected to occur in winter, and would be localized in terms of activity also, effects will mainly occur during operations. Effects during road closure should be less, and also localized. A summary of effects during operations is given in Table 8-1 below.

**TABLE 8-1: NNPR EFFECTS SUMMARY**
**WILDERNESS QUALITY AND VISITOR EXPERIENCE**

| Impact Element | Significance | Road Phase | Uncertainty | Geographic Range | Timing | Magnitude | Reversibility | Likelihood |
|---|---|---|---|---|---|---|---|---|
| **Wilderness Quality** | | | | | | | | |
| Central park | Low | Both | Low | Km 17-102 | Mine Life | Low | High | Low |
| Ram hikers | Low | | Low | | | Moderate | High | Moderate |
| Road users | Low | | Moderate | | | Low | High | Low |
| **Visitor Experience** | | | | | | | | |
| Central park | Low | Both | Low | Km 17-102 | Mine Life | Low | High | Low |
| Ram hikers | Low | | Low | | | Moderate | High | Moderate |
| Road users | Low | | Moderate | | | Low | High | Low |

## 8.2 Cumulative Effects Assessment

See Tetra Tech EBA's report in Appendix E (Section 9).

## 8.3 Effects of Introduction of Invasive Species

See Tetra Tech EBA's report in Appendix E (Section 8.7.8).

## 8.4 Sensory Disturbance to Fish, Birds and Wildlife

See Hatfield's report in Appendix C (Section 8.4, fish) and Tetra Tech EBA's report in Appendix E (Section 7.11, birds and wildlife).

# 9.0 CLIMATE

## 9.1 Climatic Conditions, Trends and Extremes

See Golder's report in Appendix D (Section 3.1).

# 12.0 AIR QUALITY

See Golder's report in Appendix D.

# 13.0 NOISE

## 13.2 Impact Assessment Steps

See Hatfield's report in Appendix C (Section 8.4, fish) and Tetra Tech EBA's report in Appendix E (Section 7.11, wildlife).

Regarding noise effects on harvesting, communities and traditional activities, refer to the discussion in Section 6.4 of this document. In addition, refer to the discussion in Section 8.1 which relates to harvesting and tourism in the NNPR, but is similarly applicable to the road outside the NNPR. In Section 6.4, noise effects on the community of Nahanni Butte were considered not to be significant because of distance from the road, the common occurrence of such noise in the community, and the fact that the community indicated that the road alignment location was preferred to the old alignment that joins the Liard Highway at Lindberg Landing. We also proposed a practical mitigation approach in the form of deterring truckers from using engine retarders for braking.

# 14.0 WATER QUANTITY AND QUALITY

## 14.2 Effects to Drainage and Surface Hydrology

Comments were provided in the AR regarding potential changes in flow due to the Sundog Creek re-alignment, the road being perpendicular to runoff, and permafrost thaw. Each will be discussed in turn.

As noted in the AR, a portion of Sundog creek will be re-aligned. The concern is that this may result in a change to the surface area for flow to be conveyed, and in turn, the volumetric flow rate. As discussed in Section 7.6 above, the intent is to recreate the same channel currently in use by diverting flow to an old channel after that channel has been deepened to ensure flows continue to preferentially remain in the revised location. This will be aided by placing excavated material in the current channel so that it is no longer available for flow. The surface area for flow and flow rate is always determined by recent climate conditions and runoff. Channel re-alignment will not alter that. The engineered creek re-alignment would be performing a task that normally occurs naturally as a result of sediment deposition, alteration of flow velocities and direction, and consequent channel shifting or relocation. Terrain mapping using historical air photos will show that channel locations have changed over time naturally. This is also clear from studying any set of photos which show multiple channels in some locations, some of which are dry and some carrying water. CZN has seen first-hand channel changes in Prairie Creek near the Mine. Main channel locations change within a space of a few years, and can move from one bank to the other. It is also worth noting that the Sundog system is a low productivity system for fish, and low numbers of grayling and sculpins are found mainly in pool habitat adjacent to the main channel. As a result, changes in channel dimensions are not particularly significant in terms of impacts.

Where the road is perpendicular to natural drainage flow paths, flow will be diverted through culverts. There will be a change to the natural flow pattern on a micro-scale, but overall, the macro-scale will be the same. Road engineering design will need to provide an adequate number required number of culverts for the particular road section will provide for flow passage and energy dissipation to avoid erosion, with erosion protection as necessary. These are standard approaches. Few culverts will be needed for the Sundog section between Km 29-40 because the talus and alluvial material is very porous and permeable. The section from Km 47-52 by comparison will need a much greater number of culverts by comparison because the alignment is perpendicular to flow and the ground is muskeg or soil and not very permeable.

Potential changes to permafrost are discussed by Tetra Tech EBA in the terrain sections. There is an expectation that some sections of the road may have frozen ground, which could thaw over time, either due to the road or climate change. Fine-grained material is more prone. Most of that material is in lowland areas, which are dominated by wetlands and muskeg. Therefore, thaw in these areas may locally change flow patterns, but those patterns are already poorly defined because of the relatively flat, boggy terrain. Where the road crosses slopes prone to thaw, there may be some settling and ponding of water upslope, but this will either percolate through the road base or flow along the toe to the nearest culvert. Hence, again, flow changes may occur locally, but overall drainage flow paths are unlikely to change.

Effects will mainly occur after the road is built i.e. during operations. A summary of effects during operations is given in Table 14-1 below.

**TABLE 14-1: EFFECTS SUMMARY – DRAINAGE AND SURFACE HYDROLOGY**

| Impact Element | Significance | Road Phase | Uncertainty | Geographic Range | Timing | Magnitude | Reversibility | Likelihood |
|---|---|---|---|---|---|---|---|---|
| Sundog re-alignment | Low | Both | Low | Km 0-175 | Mine Life | Low | High | Low |
| Flow paths | Low | | Low | | | Moderate | Moderate | Moderate |
| Permafrost changes | Low | | Low | | | Moderate | Moderate | Moderate |

## 14.3 Effects to Water and Sediment Quality

Non-spill sources of contamination are not expected to be significant in terms of water quality. This was the conclusion of the screening provided in Section 9 of the DAR. Wastewater (grey and brown) from construction and maintenance camps was discussed. Water quality impacts from any concentrate loss would be detected in the form of soil contamination first, and adaptive and response actions would be implemented. In any event, significant effects on water quality would be unlikely. Spills are considered to represent a risk to water quality on a short-term basis until spill response and clean-up have been completed.

Road construction and operations pose risks regarding sediment production and water quality impact. Exposed surfaces can produce sediment, and therefore the construction and early operating period is the time of potentially greatest impact. However, for the most part, the road is not proximal to fish-bearing streams, but there are exceptions.

The road is already built along Prairie Creek and Funeral Creek. The road is close to these creeks with limited opportunity to settle out sediment in runoff. The slopes above Prairie do not produce a lot of flow over the road with consequent sediment production, and there are few watercourses. Funeral is different in that there are a number of small streams that currently cross the road bed and are causing some erosion. Most of this is filtered out by creek-side vegetation, but some is not. Funeral is also host to spawning bull trout. Not enough culverts were installed during the original construction. Allnorth have noted this in their traverses and this will be rectified. From Km 15-40, slopes are predominantly rock or coarse material, and the road bed is similarly coarse

and non-erodable. The remainder of the road is then generally not proximal to watercourses except at crossings, and there are long sections of the road that cross terrain that probably does not host fish (Km 56-86, 91-121, 130-150). Therefore, even if sediment was produced, there would be little impact. Nevertheless, standard mitigation techniques will need to be incorporated into road construction and operation until pre-construction conditions have stabilized, including bars and swales to divert runoff to percolation areas, silt-fence in ditches, and where certain surfaces are producing sediment, the placement of non-erodable cover material. The development and close attention to a good Sediment and Erosion Control Plan is also key.

The greatest risk of significant sedimentation is likely associated with crossings, where structures will have been installed and natural surfaces disturbed. Localized slopes may need to be stabilized in these areas by flattening and covering. Abutment areas will need to be suitably armoured.

A summary of effects is given in Table 14-1 below.

**TABLE 14-2: EFFECTS SUMMARY – WATER AND SEDIMENT QUALITY**

| Impact Element | Significance | Road Phase | Uncertainty | Geographic Range | Timing | Magnitude | Reversibility | Likelihood |
|---|---|---|---|---|---|---|---|---|
| Non-spill contaminant | Low | Both | Low | Km 0-175 | Mine Life | Low | High | Low |
| Spill contaminant | High, depending on location | | Moderate | | | High, depending on location | Moderate, depending on location | Moderate |
| Construction sediment | Moderate | | Moderate | | | Low | High | Moderate |
| Operations sediment | Moderate | | Moderate | Km 0-8, 15-175 | | Low | High | Moderate |
| Operations sediment | High | | Moderate | Km 8-15 | | Moderate | High | Moderate |
| Crossings | High | | Moderate | Km 0-175 | | Moderate | High | Low |

## 14.4 Effects from Water Crossings

This item was addressed in Section 14.3 above. Also, see the Allnorth report in Appendix A (Sections 2.1 & 2.2) for more discussion on crossing location selection and considerations.

# 15.0 SPECIES AT RISK

See Hatfield's report in Appendix C (Section 15.2, fish) and Tetra Tech EBA's report in Appendix E (Section 8, wildlife).

# 16.0 FISH AND AQUATIC HABITAT

See Hatfield's report in Appendix C.

# 17.0 WILDLIFE AND WILDLIFE HABITAT

See Tetra Tech EBA's report in Appendix E (Section 8).

# 18.0 VEGETATION

See Tetra Tech EBA's report in Appendix E (Section 8.7).

# 19.0 CULTURAL AND HERITAGE RESOURCES

Please refer to the information provided in Section 6.3, and Section 13.2 with respect to the effects of noise. In addition, Section 7.3.10 of the TOR listed the following items for consideration:

- traditional lifestyles, values and culture
- cultural and spiritual sites and activities
- impacts to archaeological sites

We believe Sections 5.2 and 5.3 of the DAR provided the necessary details. We draw your attention to the last paragraph on page 127 of the DAR which provided details of further advice given to CZN at the January 20, 2015 'workshop' regarding burial sites.

# 20.0 EMPLOYMENT AND BENEFITS TO THE COMMUNITY

## 20.1 Baseline Tourism

Updated visitation data for the NNPR are provided in Table 20-1. According to Parks Canada (J. Tsetso), the NNPR had 20 staff positions prior to expansion of the park, and there are currently 31 positions. Annual revenues have been consistently around $65,000, although do vary from year to year. An IBA is currently being negotiated between Parks Canada and Dehcho First Nations (DCFN) regarding the NNPR. DCFN represent the interests of the NDDB also.

## 20.2 Baseline Regional and Local Economies

Table 5-6 from the DAR was updated where possible and is provided here as Table 20-2. There are more recent population and traditional activity data. Updates of the labour data were not available, but new data on Dehcho employment by industry are provided in Table 20-3.

## 20.3 Socio-Economic Initiatives and Agreements

CZN concluded a Socio-Economic Agreement (SEA) with the GNWT on August 22, 2011. See Section 4.17 for a link to download the SEA. The key items in the SEA are as follows (note, NAEC stands for Nahendeh Aboriginal Economic Council and is a grouping of the development arms of western Dehcho communities):

## TABLE 20-1: UPDATED NNPR VISITATION STATISTICS

| Year | Total Park Visitors | Total Day Visitors | Total Over-night Visitors | # Guided Over-night Visitors | # Non-Guided Over-night Visitors | # Guided Over-night Trips | #Non-guided Over-night Trips | Total Over-night Trips | Average Over-night Group Size | Average Over-night Trip Length (days) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1984 | 888 | 352 | 536 | - | - | - | - | - | | |
| 1985 | 923 | 448 | 475 | - | - | - | - | - | 5.2 | 10 |
| 1986 | 724 | 260 | 464 | - | - | - | - | - | 5.0 | 12 |
| 1987 | 851 | 310 | 541 | - | - | - | - | - | - | - |
| 1988 | 936 | 431 | 505 | 301 | 204 | 33 | 58 | 94 | 5.6 | |
| 1989 | 1016 | 487 | 529 | 275 | 254 | 39 | 66 | 105 | 5.6 | 11.3 |
| 1990 | 858 | 279 | 579 | 241 | 338 | 38 | 75 | 113 | 5.9 | 11.3 |
| 1991 | 969 | 295 | 647 | 371 | 276 | 37 | 64 | 101 | 6.3 | 13.4 |
| 1992 | 1323 | 665 | 658 | 356 | 303 | 36 | 80 | 116 | 5.7 | 11.1 |
| 1993 | 1391 | 728 | 663 | 341 | 322 | 36 | 85 | 121 | 5.5 | - |
| 1994 | 1137 | 425 | 712 | 409 | 303 | 43 | 86 | 129 | 5.5 | - |
| 1995 | 1207 | 405 | 802 | 443 | 359 | 44 | 106 | 150 | 5.3 | 10.5 |
| 1996 | 1227 | 455 | 772 | 450 | 378 | 42 | 83 | 125 | 6.2 | 11.0 |
| 1997 | 1062 | 300 | 762 | 429 | 333 | 42 | 75 | 117 | 6.5 | - |
| 1998 | 791 | 185 | 606 | 326 | 280 | 34 | 59 | 93 | 6.5 | - |
| 1999 | 861 | 300 | 561 | 354 | 207 | 34 | 56 | 100 | 6.2 | 10.6 |
| 2000 | 929 | 350 | 579 | 398 | 181 | 38 | 49 | 82 | 6.6 | 11.7 |
| 2001 | 936 | 295 | 641 | 439 | 202 | 45 | 44 | 89 | 7.2 | 12.3 |
| 2002 | 977 | 491 | 486 | 272 | 214 | 29 | 48 | 77 | 6.3 | 11.4 |
| 2003 | 1018 | 395 | 623 | 383 | 240 | 43 | 43 | 86 | 7.2 | 10.5 |
| 2004 | 887 | 322 | 565 | 270 | 295 | 38 | 67 | 105 | 5.3 | 11.0 |
| 2005 | 1020 | 306 | 705 | 400 | 305 | 39 | 57 | 96 | 7.3 | 13.0 |
| 2006 | 796 | 215 | 581 | 365 | 216 | 39 | 44 | 83 | 7.0 | 11.2 |
| 2007 | 970 | 236 | 734 | 521 | 213 | 49 | 44 | 93 | 6.0 | 14.2 |
| 2008 | 810 | 269 | 541 | 284 | 257 | 28 | 48 | 77 | 7.0 | 12.0 |
| 2009 | 754 | 297 | 457 | 246 | 154 | 25 | 36 | 61 | 6.6 | 13.0 |
| 2010 | 778 | 235 | 543 | 334 | 209 | 32 | 39 | 71 | 7.4 | 14.1 |
| 2011 | 974 | 414 | 560 | 348 | 212 | 37 | 48 | 85 | 6.6 | 13.0 |
| 2012 | 794 | 416 | 374 | 240 | 134 | 30 | 27 | 57 | 6.6 | - |
| 2013 | 760 | 264 | 496 | 334 | 162 | 34 | 42 | 76 | 6.5 | 13.5 |
| 2014 | 802 | 407 | 395 | 289 | 106 | 33 | 35 | 68 | 5.8 | 13.6 |
| **Avg.** | **947.3** | **362.5** | **583.6** | **348.8** | **246.5** | **37.0** | **58.0** | **95.2** | **6.3** | **12.0** |
| **10 Year Avg.** | **849.5** | **307.4** | **541.0** | **330.1** | **205.7** | **34.9** | **44.3** | **79.3** | **6.6** | **12.9** |

## TABLE 20-2: SOUTH-WEST DEHCHO POPULATION AND EMPLOYMENT STATISTICS

| | | NWT | Nahanni Butte | Fort Simpson | Trout Lake | Fort Liard |
|---|---|---|---|---|---|---|
| **POPULATION (2014)** | Total | 43,623 | 97 | 1,244 | 104 | 619 |
| | Aboriginal | 22,425 | x | 915 | 95 | 527 |
| | Non-Aboriginal | 21,198 | x | 329 | x | 92 |
| **INCOME ASSISTANCE (2012)** | | 2,240 | 5 | 58 | 3 | 29 |
| **TRADITIONAL ACTIVITIES (2013)** | No. | 34,086 | 92 | 990 | 72 | 500 |
| Hunted or Fished (%) | | 44.7 | 64.1 | 52.1 | 84.7 | 62.8 |
| Trapped (%) | | 6.1 | 9.8 | 7.4 | 47.2 | 14.6 |
| Produced Arts & Crafts (%) | | 23.3 | 22.8 | 30.9 | 47.2 | 29.8 |
| **LABOUR FORCE** | | | | | | |
| *Participation Rate* | 2001 | 77.1 | .. | 78.1 | 75.0 | 69.3 |
| | 2004 | 75.6 | 69.5 | 73.3 | 69.1 | 66.7 |
| | 2006 | 76.5 | 58.8 | 77.3 | 76.9 | 61.4 |
| | 2009 | 75.1 | 53.3 | 72.9 | 69.6 | 67.1 |
| *Unemployment Rate* | 2001 | 9.5 | .. | 12.9 | 22.2 | 19.2 |
| | 2004 | 10.4 | 24.6 | 11.0 | 29.8 | 19.0 |
| | 2006 | 10.4 | 20.0 | 12.1 | 20.0 | 27.5 |
| | 2009 | 10.3 | 18.4 | 10.5 | 18.2 | 14.3 |
| *Employment Rate* | 2001 | 69.8 | .. | 68.0 | 58.3 | 56.0 |
| | 2004 | 67.8 | 52.4 | 65.2 | 48.5 | 54.0 |
| | 2006 | 68.6 | 47.1 | 67.4 | 53.8 | 44.6 |
| | 2009 | 67.3 | 43.5 | 65.3 | 57.0 | 57.5 |
| *Selected Employment Rates (2009)* | Aboriginal | 49.8 | 41.9 | 56.2 | 52.9 | 53.2 |
| | Non-Aboriginal | 83.1 | 66.7 | 86.7 | 88.9 | 92.2 |
| *Labour Force Activity (2009)* | | | | | | |
| Population 15 & Over | | 33,730 | 92 | 1,008 | 79 | 438 |
| Employed | | 22,702 | 40 | 658 | 45 | 252 |
| Available Labour Supply | | 2,616 | 9 | 77 | 10 | 42 |
| Not in the Labour Force | | 8,412 | 43 | 273 | 24 | 144 |
| *Employment Profile (2009)* | % Full-Time | 87.9 | 67.5 | 83.9 | 68.9 | 87.3 |
| | % Part-Time | 11.2 | 30.0 | 14.1 | 28.9 | 12.7 |
| *Employment Profile (2009)* % Gov't, Health, Social Serv, Education | | 43.2 | 62.5 | 51.2 | 73.3 | 44.8 |
| % Goods Producing | | 15.5 | 27.5 | 13.8 | 2.2 | 40.1 |
| % Other Industries | | 39.2 | 10.0 | 32.7 | 22.2 | 13.9 |

Source: NWT Bureau of Statistics

**TABLE 20-3: 2014 DEHCHO EMPLOYMENT, 15 YEARS AND OVER BY INDUSTRY**

| | |
|---|---|
| **Total** | **1,038** |
| Mining, quarrying, and oil and gas extraction | 23 |
| Construction | 145 |
| Other goods industries | 36 |
| Wholesale trade & Retail trade | 59 |
| Transportation and warehousing | 32 |
| Educational services | 127 |
| Health care and social assistance | 95 |
| Public administration | 326 |
| Other services | 146 |
| Not stated | 49 |

Source: NWT Bureau of Statistics

- Giving priority to hiring members of the following groups in the following order:
  - Members of the IBA Communities;
  - Members of the NAEC Communities;
  - Members of the Dehcho Communities;
  - NWT Residents who have been continuously resident in the Northwest Territories at least six months prior to being hired;
  - All others residing in or relocating to the NWT; and then
  - All others.
- Use best efforts to ensure that:
  - Employment of NWT Residents, including employment by Contractors, will be at least 30% of the total employment throughout Construction;
  - Employment of NWT Residents, including employment by Contractors, will be at least 60% of the total employment on an annual basis throughout Operations; and
  - Employment of NWT Residents, including employment by Contractors, will be at least 75% of the total employment on an annual basis throughout Closure
- Cause Contractors to meet employment and recruitment targets consistent with CZN commitments

- Provide transportation to employees between the following communities and the Project location:

    a . Nahanni Butte, NWT;
    b. Fort Simpson, NWT;
    c. Fort Liard, NWT;
    d. Hay River, NWT;
    e. Yellowknife, NWT; and
    f. Fort Nelson, BC

- Maintain a human resources development plan that includes pre-employment programs, wellness initiatives, financial management skills development, and initiatives for advancement in the labour force.

- Establish a recruitment, training and employment strategy that will include Northwest Territories recruitment plans, and development of career plans for employees during Construction and Operations.

CZN previously concluded Impact Benefit Agreements (IBA's) with the Naha Dehe Dene Band (NDDB) and Liidlii Kue First Nation (LKFN). As Nahanni Butte is the nearest, and smaller, of the two communities, the premise for the NDDB IBA was that preference will be given to hiring suitably qualified workers from Nahanni Butte, and identifying set-aside contracts for certain activities. Fort Simpson is larger, therefore the focus of the IBA was on maximizing employment and developing and using businesses. While the details of the IBA's are confidential, some of the components included are as follows:

*NDDB IBA*

- Commitment to hire environmental monitors
- Contributions to an education fund
- Providing access to training programs
- Preference for qualified workers
- Opportunities for apprentices
- Opportunities to supply goods and services
- Encourage all Contractors to use NDDB suppliers and contractors
- Set-aside agreements for the supply of specific goods and services
- Financial provisions – lump sum and profit-related payments

*LKFN IBA*

- Commitment to hire environmental monitor
- Facilitate training and education programs
- Hire a liaison officer
- Seek to maximize employment of Band members
- Assist with business capacity building and use preferentially if competitive
- Financial provisions – lump sum and profit-related payments

## 20.4 Employment and Income

Anticipated employment requirements and potential income levels for construction and operation of the all season road are indicated in Table 20-4. Contract amounts, and therefore wage rates, will be subject to competitive forces. The rates provided are an indication of current levels. Although the project is in the NWT, proximity to BC and other lower wage centres will likely mean that wages are similar to northern BC levels rather than the NWT norm.

**TABLE 20-4: EMPLOYMENT REQUIREMENTS**

| **Construction** | | | |
|---|---|---|---|
| **No.** | **Job Description** | **Job Status** | **~Wage ($/hr)** |
| 6 | Dozer operator | Seasonal full-time | 40 |
| 4 | Excavator operator | | 40 |
| 3 | Grader operator | | 40 |
| 2 | Loaders operator | | 40 |
| 6 | Rock Truck operator | | 34 |
| 2 | Fuel Truck operator | | 34 |
| 4 | Service Truck operator | | 32 |
| 2 | Water truck operator | | 32 |
| 1 | Tractor operator | | 40 |
| 30 | Tractor/trailer unit driver | | 28 |
| 2 | Tree mulcher operator | | 20 |
| 2 | Crushing Plant operator | | 22 |
| 2 | Snow Plow operator | | 30 |
| 6 | Supervisor | | 60 |
| 2 | Monitor | | 16 |
| 2 | Mechanic | | 28 |
| 2 | Ice bridge builder | | 20 |
| **Operations** | | | |
| **No.** | **Job Description** | **Job Status** | **~Wage ($/yr)** |
| 2 | Ice bridge builder | Seasonal full-time | 40,000 |
| 1 | Excavator operator | Full-time | 80,000 |
| 2 | Rock Truck operator | | 68,000 |
| 1 | Grader operator | | 80,000 |
| 1 | Supervisor | | 120,000 |
| 2 | Monitor | | 32,000 |
| 30 | Tractor/trailer unit driver | | 56,000 |
| 2 | Check-point operator | | 28,000 |
| 2 | Barge operator | Seasonal full-time | 52,000 |
| 2 | Liard Transfer Facility operator | Full-time | 40,000 |

The construction period is expected to cover 2-3 years. Initially, the majority of the work will be conducted in winter, and consist of route clearing and subgrade placement. Towards the end of the period, more work would be completed in summer, and would be mainly top surface placement and bridge installation. The employment positions in the table are considered to be generally relevant to the whole period, although some job descriptions will change (e.g. tree mulcher operators would be replaced by operators of other equipment). Bridge installation would be conducted by a specialist subcontractor, so has not been included.

Employment for operations covers year-round maintenance of the road, seasonal ice bridge construction and barge operation, and year-round hauling and use of the Liard Transfer Facility (LTF).

## 20.5 Location of Camps and Size of Crews

Construction camp locations were indicated in Table 9 of Allnorth's report in Appendix 1 of the DAR. The nearest camp to Nahanni Butte would be at the Liard River crossing. The main camp would be on the west side of the river, supporting construction to the north. However, a smaller camp may be used on the east side also to support completion of road building to the Nahanni access road, ramp construction on the river, and seasonal ice bridge building. The LTF would also initially support a camp for construction, both for the LTF itself and the road section to the river.

As indicated in Allnorth's report (p. 43), a typical camp would support up to 50 people. Peak road construction activities could see a labour force of approximately 80, and with different road construction activities occurring at different locations, there may be one main camp and two smaller camps in operation at any one time, with locations changing as work progresses.

## 20.6 Anticipated Access to Surrounding Communities

CZN will restrict road crews from accessing Nahanni Butte (the only proximal community) by including this requirement in contracts for the work. The only exceptions would be if construction personnel are leaving or arriving at the Nahanni Butte airstrip, in which case they will be required to go directly to and from the airstrip only, and if personnel are invited by, and accompanied by, community members.

Note that access to the village is mainly an issue in winter when there is an ice bridge to the west side of the Liard River upstream of the confluence with the South Nahanni River. In summer, the village is only accessible by boat. Note also that CZN already has a winter road permit, and the potential for effects associated with this item will be less with an all season road.

## 20.7 Crime and Substance Abuse

Data on the incidence and rates of crime recorded in the NWT, Dehcho, Fort Liard and Fort Simpson over the period 2005-2013 (ref. NWT Bureau of Statistics) are provided in Table 20-5.

## TABLE 20-5: INCIDENCE AND RATES OF CRIME BY DETACHMENT

| Detachment | Type of Incident | 2013 | 2012 | 2011 | 2010 | 2009 | 2008 | 2007 | 2006 | 2005 |
|---|---|---|---|---|---|---|---|---|---|---|
| NWT | All Incidents | 21,189 | 22,367 | 22,751 | 22,325 | 19,973 | 20,963 | 20,252 | 18,877 | 20,169 |
| | Crimes of Violence | 3,233 | 3,467 | 3,730 | 3,717 | 3,740 | 3,839 | 4,025 | 3,527 | 3,694 |
| | Property Crimes | 10,533 | 10,406 | 10,134 | 9,814 | 8,639 | 8,881 | 8,807 | 8,292 | 8,357 |
| | Other Criminal Code | 6,158 | 6,943 | 7,185 | 6,895 | 5,949 | 6,377 | 5,942 | 5,695 | 6,492 |
| Deh Cho | All Incidents | 2,043 | 1,912 | 1,872 | 1,762 | 1,441 | 1,752 | 1,775 | 1,440 | 1,643 |
| | Crimes of Violence | 476 | 489 | 436 | 373 | 372 | 473 | 491 | 361 | 434 |
| | Property Crimes | 952 | 850 | 921 | 897 | 604 | 662 | 694 | 569 | 594 |
| | Other Criminal Code | 472 | 428 | 393 | 364 | 335 | 422 | 457 | 406 | 467 |
| Fort Liard | All Incidents | 578 | 496 | 519 | 429 | 337 | 373 | 329 | 345 | 399 |
| | Crimes of Violence | 136 | 113 | 137 | 83 | 85 | 99 | 85 | 115 | 131 |
| | Property Crimes | 276 | 189 | 214 | 154 | 111 | 108 | 133 | 169 | 171 |
| | Other Criminal Code | 143 | 153 | 121 | 141 | 104 | 119 | 94 | 43 | 65 |
| Fort Simpson | All Incidents | 830 | 747 | 772 | 700 | 676 | 849 | 995 | 751 | 877 |
| | Crimes of Violence | 158 | 167 | 179 | 151 | 168 | 197 | 226 | 131 | 175 |
| | Property Crimes | 351 | 329 | 385 | 376 | 295 | 372 | 404 | 281 | 301 |
| | Other Criminal Code | 235 | 184 | 169 | 131 | 161 | 198 | 297 | 288 | 318 |

### Number of Incidents per 1,000 Persons by Detachment

| Detachment | Type of Incident | 2013 | 2012 | 2011 | 2010 | 2009 | 2008 | 2007 | 2006 | 2005 |
|---|---|---|---|---|---|---|---|---|---|---|
| NWT | All Incidents | 487 | 513 | 523 | 516 | 463 | 484 | 467 | 437 | 465 |
| | Crimes of Violence | 74 | 79 | 86 | 86 | 87 | 89 | 93 | 82 | 85 |
| | Property Crimes | 242 | 239 | 233 | 227 | 200 | 205 | 203 | 192 | 193 |
| | Other Criminal Code | 141 | 159 | 165 | 159 | 138 | 147 | 137 | 132 | 150 |
| Deh Cho | All Incidents | 615 | 574 | 562 | 533 | 435 | 534 | 540 | 429 | 489 |
| | Crimes of Violence | 143 | 147 | 131 | 113 | 112 | 144 | 149 | 108 | 129 |
| | Property Crimes | 286 | 255 | 277 | 271 | 183 | 202 | 211 | 170 | 177 |
| | Other Criminal Code | 142 | 129 | 118 | 110 | 101 | 129 | 139 | 121 | 139 |
| Fort Liard | All Incidents | 1,003 | 872 | 937 | 761 | 598 | 656 | 561 | 569 | 669 |
| | Crimes of Violence | 236 | 199 | 247 | 147 | 151 | 174 | 145 | 190 | 220 |
| | Property Crimes | 479 | 332 | 386 | 273 | 197 | 190 | 227 | 279 | 287 |
| | Other Criminal Code | 248 | 269 | 218 | 250 | 184 | 209 | 160 | 71 | 109 |
| Fort Simpson | All Incidents | 683 | 596 | 604 | 549 | 532 | 681 | 804 | 597 | 706 |
| | Crimes of Violence | 130 | 133 | 140 | 118 | 132 | 158 | 183 | 104 | 141 |
| | Property Crimes | 289 | 263 | 301 | 295 | 232 | 298 | 327 | 224 | 242 |
| | Other Criminal Code | 193 | 147 | 132 | 103 | 127 | 159 | 240 | 229 | 256 |

Data for other western Dehcho settlements was not available. The incidence of crime and crime rates have increased somewhat in the NWT, Dehcho and Fort Liard since 2010, largely due to property crime increases. The same increase was not seen in Fort Simpson. Crime rates are highest in Fort Liard, but all Dehcho rates are higher than the NWT average.

In the "Socio-Economic Impact Assessment for the Prairie Creek Mine" prepared by Impact Economics, January 29, 2010, the following comments were made:

> "The current crime rates in the Dehcho region are high relative to the territorial average and extremely high in comparison to the national average. Crime occurs for many reasons. The increased employment opportunities and greater community wealth should not be viewed as an instigator of crime. Greater wealth brings with it financial security. The opportunities for employment will bring about important social changes through increased productivity throughout the Study Area society.
>
> There will be an increase in stress levels at the family and community level as described earlier. And it must be reiterated that people who are not in a position to work at the mine site will have other opportunities. Nevertheless, the stress levels of some families will increase as a result of an absent parent. Community stresses could arise due to income disparities. But over time, through mitigation efforts and adaptation of the local population, the ability to cope with these changes will effectively lower their influence on crime.
>
> Other stressors, such as the pressures of the modern economic world and the social changes coming about through a greater diversity of interests within the youth population and new technologies such as improved access to broad-band and the Internet will remain. Education and community-based support are needed to address these issues."

Therefore, the author concluded that there will initially be a period of 'adjustment' when there will be some impacts, which will lessen over time. Note that this assessment was based on mine and winter road operations. Some employees are expected to be drawn from Nahanni Butte, but a greater number from Fort Simpson because of the larger size of the community and a greater availability of workers with skills. It might be expected that in the adjustment period, the incidence of crime might be slightly greater in Fort Simpson, but perhaps more noticeable in Nahanni Butte. Policing demands may increase temporarily, and resources would need to respond accordingly. Currently, there is no police presence in Nahanni Butte. Incidents are managed from the nearby detachments.

If an all season road is approved, it will replace the winter road, and the social effects should remain much the same. Effects might be felt to a greater extent with a winter road since activity is concentrated over that period, instead of spread throughout the year.

Regarding substance abuse, the same Impact Economics 2010 study advised the following:

> "There is a concern in the NWT that the increased income that comes with economic growth results in increased drug and alcohol usage. This is a concern for Canadian Zinc. The National Population Health Survey and Canadian Community Health Survey show that the Territory has a lower percentage of residents that drink compared to the rest of Canada, but that those who do consume alcohol have a greater tendency to drink a lot.

The *2006 NWT Addictions Report* produced by the GNWT indicates that rates of drug usage in the Territory are relatively stable. It is nevertheless a concern of Study Area residents and one that the Project proponent takes seriously.

Drug and alcohol counselling will be a part of employees' compensation package, though it is acknowledged that this is not sufficient to help people with addictions. At the same time, industry is not well equipped to administer programs in this field. The Human Resources Management Plan outlines the details related to alcohol and drug usage during an employee's time at Prairie Creek. In addition, the company will engage with the Study Area communities and encourage cooperation with government and non-government officials on a strategy that might limit the severity of this impact and ensure these people receive the help they need."

The effects of substance abuse, and consequent policing demands, may be felt more greatly in local communities initially with mine development. Again, these effects are unlikely to be greatly different between the mine and winter road verses the mine and all season road.

At the conclusion of EA0809-002, CZN compiled a full list of commitments, which were summarized in Table 3-1 of a Consolidated Project Description (CPD) dated February 2012 and submitted to the MVLWB. A copy of the document can be found here:

http://www.mvlwb.ca/Boards/mv/Registry/2008/MV2008L2-0002/MV2008L2-0002 - Consolidated Project Description FINAL - Feb15-12.pdf

Commitments 15, 17, 21, 66 and 71-75 address mitigation steps relevant to the above discussion.

## 20.8 Local and Aboriginal Participation in Business Opportunities

Documents that provide information on programs and socio-economic commitments are those described in Section 20.3 above, the SEA and IBA's. Relevant points are listed in the section, with additional points from the SEA related to business provided below:

- CZN will source procurement needs from NWT Businesses as much as possible during Construction, Operations and Closure.

- CZN will use its best efforts to ensure that special emphasis and priority will be placed on developing business opportunities arising from the Project within the NAEC Communities.

- CZN will use its best efforts to ensure that:

    a. purchases of goods and services through or from NWT Businesses during Construction will be at least 30% of the total annual value of goods and services purchased associated with Construction;

b. purchases of goods and services through or from NWT Businesses during Operations will be at least 60% of the total annual value of goods and services purchased associated with Operations; and

c. purchases of goods and services through or from NWT Businesses during Closure will be at least 70% of the total annual value of goods and services purchased associated with Closure.

- CZN will use its best efforts to provide opportunities for sourcing procurements in the following order of priority:

  a. Aboriginal Businesses of IBA Communities; and then, following a reasonable amount of time,
  b. Aboriginal Businesses of NAEC Communities; and then, following a reasonable amount of time,
  c. Aboriginal Businesses of Dehcho Communities; and then, following a reasonable amount of time,
  d. NWT Businesses and industry and business associations in the Northwest Territories other than those referred to above; and then, following a reasonable amount of time,
  e. other businesses.

- CZN will cause its Contractors to make similar commitments.

- CZN will take the following measures to maximize Project-related business opportunities for NWT Businesses:

  a. developing a Northwest Territories business policy that supports the objectives and commitments in this Agreement;

  b. designating a CZN employee to act as a liaison between CZN, GNWT, and NWT Business; CZN is wholly responsible for selection of this position, which position will remain throughout mine Construction, Operations and Closure;

  c. designing and communicating clear business development strategies for NAEC Communities and communicating the scope and scale of business opportunities and project requirements in a timely and effective manner;

  d identifying project components, at all stages of Construction, Operations and Closure of the Project, that should be targets for a business development strategy;

  e identifying possible opportunities for joint ventures with NWT Businesses;

  f. providing business-related expertise with its industry contacts to Northwest Territories mine-related business initiatives;

g. ensuring the size and scope of available contracts matches the capacity of NWT Businesses where feasible;

h. preparing an annual business opportunities forecast that will identify the reasonably foreseeable procurement requirements of the Project, and providing it to NWT Businesses in accord with the priorities set out in clause 5.3.1;

i. making available business opportunity information related to CZN business objectives and service requirements that will enable the completion of business plans or proposals by NWT Businesses in seeking development support services through existing public and private sector programs;

j. ensuring broad communications of business opportunities arising from the Project to NWT Businesses, and business-industry associations in the Northwest Territories.

These and other commitments are also listed in Table 3-1 of the CPD.

## 20.9 Capacity of Local Businesses

There is one major contractor in the western Dehcho, Rowe's Construction, based in Fort Simpson and Hay River, but the development arms of local communities also have some personnel and heavy equipment capacity that could be involved in road construction and maintenance. There is Nogha Construction (Fort Simpson), Beaver Enterprises (Fort Liard), and limited available equipment/manpower in Nahanni Butte, Jean Marie River and Trout Lake. Apart from Rowe's Construction, none of the other groups by themselves have enough capacity for the road contract.

Rowe's is reasonably busy with existing long-term contracts, but is also always looking for extra work. We are frequently advised by local communities that their development arms are ready to assist with construction. This is the basis for our conclusion that local businesses are under-utilized, and could manage work additional to what they have currently.

About a year ago, CZN tendered a contract for winter road construction. Bidders were Rowe's and Kledo Construction from Fort Nelson. Tenderers were notified that a component of the selection criteria was local and northern content, and they were encouraged to maximize the use of aboriginal businesses. Rowe's was notified that they had the superior bid, although a contract has not been awarded. Rowe's bid included contributions of equipment/manpower from Nahanni Butte, Nogha Construction and Beaver Enterprises. We would expect Nahanni Butte to be responsible for ice bridge construction, and be involved in route clearance.

# 21.0 IMPACTS ON EXISTING TRANSPORTATION INFRASTRUCTURE

## 21.1 Highway 7 Improvements

Improvements to Highway #7 that have been promised by the GNWT are expected to catalyze greater use by locals and tourists. CZN is proposing to use the highway with or without the improvements, although we would certainly welcome the improvements. Note, CZN would use the highway in all seasons to move materials in and out of the LTF during mine operations supported by the permitted winter road. The exceptions to normal traffic would be seasonal shoulder periods (spring, fall) when weight restrictions are in effect. Thus, activities on the highway related to the Mine will be essentially the same for an all season road.

## 21.2 Additional Roadway Use

See Allnorth's report in Appendix A.

## 21.3 Existing Water Transportation Routes and Navigable Waters

For summer barge crossings of the Liard River, the barge that would be used would be not much longer than a concentrate truck and trailer combination, ~25 m. An example of the size of such a barge is shown below:


The Liard River crossing is approximately 500 m. However, in summer and with low water levels, the crossing could be as little as 300 m. At an average speed of 10 kph, a crossing would be made in about 2 minutes.

The length of the barge (25 m) compared to the length of the crossing (300 m min.), in addition to the slow barge speed, indicates that there is ample opportunity for other vessels to move up or down river, even if the barge is in mid-stream.

From Table 20-1, the total number of overnight trips in the NNPR per year is about 80. We can assume these are all river trips that end at Lindberg Landing i.e. pass the proposed road crossing. River trips typically occur during the months July-September. Therefore, the frequency is approximately 1 trip/day.

The frequency of river use by the Nahanni Butte community is unknown, but trips to and from the Blackstone River occur, and the river is used as a travel route for hunting. Based on our own experience working on the river and flying over the area, there could be a boat trip up to once per hour.

Barge operations would not be continuous during the day but would be concentrated at times when concentrate trucks are first out-bound, and then in-bound. At these times, the barge can give precedence to existing river traffic. If no vessels are proximal, the barge can quickly cross the river. If a community speed boat is approaching, the barge can wait for it to pass. If a flotilla of canoes is approaching, their speed of approach will be slow, and several barge crossings may be possible before the barge would need to wait for them to pass.

This analysis is the basis for our conclusion that summer barge crossings will have no significant impacts on existing uses of the river. Even if the barge is in continuous operation, at the end of each transit the barge has to become stationary, a vehicle off-loaded and a vehicle brought aboard, during which time any other river traffic would be able to pass.

# 22.0 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

## 22.1 Fires

Effects of fires on permafrost are discussed in numerous places in Tetra Tech EBA's report (Appendix 2 of the DAR): for specific road sections; and, in Section 5.4, Permafrost. Additional observations are recorded in Appendix C of their report.

Forest fires are a seasonal, frequent and natural occurrence in the north. Most are caused by lightning strikes, but some are caused by humans. Fires commonly occur in summer during prolonged dry spells when the soil and vegetation are very dry. The last few years have seen quite a number of fires in the NNPR and Dehcho. Fires have been noted recently in proximity to the road alignment, notably in the Mosquito Lake area of the Ram Plateau. Several years ago, a fire occurred that burned up to the road, the previously cleared winter road alignment acting as a fire break. Evidence of past fires is common, including several older burns in the Polje Creek valley.

With climate change, there is the possibility of longer, drier summers, which could lead to a greater incidence of fires. However, the fires that occur are typically active for a few days, then either peter out or smoulder. Fires are locally tracked by local commercial aircraft operators, either on deliberate missions or coincidentally with other activities. The NNPR has a warning

system with email bulletins. CZN and the NNPR relay information back and forth. Therefore, intelligence on the location and severity of fires is good. In terms of road operations, the main issue is expected to be visibility rather than risk of a fire engulfing a road section carrying traffic.

Road conditions would be reviewed on a daily basis prior to hauling to assess conditions. In summer, this would include incidence and proximity of fires. Depending on fire proximity and prevailing wind directions, a decision would be made to either proceed with hauling with caution, or temporarily suspend hauling. If hauling proceeds and fires are either in the proximity or possible with the prevailing weather, further review would occur during the day at a frequency commensurate with the hazards. Information would be relayed by drivers back to control. These procedures will be included in the Road Operations Plan. Also included in the plan will be advice regarding human fire ignition prevention (e.g. avoid stray cigarette butts and other sources of ignition).

The potentially increased incidence of fires is not expected to have a significant impact on annual hauling operations. There is enough flexibility in the schedule and daily total haul capacity to compensate for lost days. For example, one or two trucks held in reserve or withdrawn for scheduled maintenance could be added to the schedule for a period to catch-up. In a worst case, some concentrates may leave the Mine weeks late. This would have some financial impact, but very little logistical impact, and no environmental impact.

## 22.2 Changes to Permafrost and Subsidence

See Allnorth's report in Appendix A (Section 2.3) re granular material, and Tetra Tech EBA's report in Appendix E.

# 23.0 FOLLOW-UP AND MONITORING

## 23.2 Monitoring and Management Requirements

Management plans referred to in Section 6.7 of the DAR that have monitoring components are the Sediment and Erosion Control Plan (SECP), Road Operations Plan (ROP), Road Construction and Maintenance Plan (RCMP), and Wildlife Mitigation and Monitoring Plan (WMMP). Draft plans for these, apart from the WMMP, are provided in Allnorth's report in Appendix A (Appendix C). This information includes consideration of monitoring, responsibilities, data dissemination and adaptive management. The monitoring components in the WMMP are reviewed by Tetra Tech EBA in their report in Appendix E.

In addition to this, soil and water quality monitoring has been discussed herein regarding the issues of concentrate dispersal and receiving water quality, specifically turbidity. The former is part of the CLMP, and the latter can be part of the SECP or RCMP.

It is expected that the majority of monitoring will be completed by road maintenance staff, environmental staff and environmental monitors. Wildlife sightings made by truck drivers is also considered to be an important monitoring component. Results will be reviewed by the Road Operations Manager and mine management and any required adjustments made accordingly. In

terms of distribution of results to regulators and interested parties, CZN previously described its intention to hold Technical Advisory Committee meetings three times per year to facilitate this process. See Appendix J of CZN's 2nd round of Information Request Responses for EA0809-002:

http://www.reviewboard.ca/upload/project_document/EA0809-002_Canadian_Zinc_2nd_round_Information_Request_Responses.PDF

Regarding road maintenance monitoring, see the RCMP in Allnorth's report in Appendix A (Appendix C).

## 23.3 Compatibility with other Monitoring and Research Programs

The following was extracted from GNWT ENR's Cumulative Impact Monitoring (NWT CIMP) website:

> "The NWT Cumulative Impact Monitoring Program (NWT CIMP) aims to watch and understand the land and use it respectfully forever, in an effort to ensure environmental information is collected and available to Northerners, decision-makers and industry.
>
> The program coordinates, supports and conducts monitoring-related initiatives in the NWT by incorporating both scientific and traditional knowledge while taking into consideration both human and biophysical environments.
>
> "Valued Components" (VC's) are important parts of the environment Northerners think should be monitored.
>
> Through the Working Group and community consultations, NWT CIMP has identified the following VC's:
>
> - water and sediment quality
> - water quantity
> - snow, ground ice and permafrost
> - fish habitat, population and harvest
> - fish quality
> - caribou
> - moose
> - other mammals (terrestrial)
> - other wildlife (avian)
> - marine mammals
> - vegetation
> - climate
> - air quality
> - ***human health and community wellness***

**Although NWT CIMP uses a broad definition of 'environment' to include both biophysical (land, water and air) and human (social, economic, and cultural), it currently places an emphasis on the biophysical environment.**

In a priority setting exercise, NWT decision makers directed NWT CIMP to focus on the following three VC's over the next three to five years: water; fish; and, caribou".

The NWT Discovery Portal includes qualitative and quantitative information, traditional knowledge, baseline studies and monitoring, as well as scientific research. The Portal may also contain monitoring information generated through land-use planning, project-specific environmental impact assessments, and regulatory processes.

A variety of file types can be uploaded to the portal, including .doc, .xls, .pdf, .xml, .kml, .rtf, .txt, .docx, and .xlsx. Other file types such as .shp and .dbf can also be uploaded by using a zip file.

During all season road construction and operations, project specific monitoring will be conducted, and will include data on the following:

- Water quality
- Soil metals concentrations
- Wildlife types and numbers

Monitoring reports are likely to be submitted to regulators on a regular basis. The reports and the data could also be uploaded to the Discovery Portal in one or more of the formats listed.

# 24.0 CLOSURE AND RECLAMATION

## 24.2 Closure Plans and Timing

See Allnorth's report in Appendix A (Appendix C, RCRP).

## 24.3 Long-Term Integrity of Permanent Features

See Allnorth's report in Appendix A (Section 2.15).

## 24.4 Reclamation of In-Stream and Riparian Areas

See Allnorth's report in Appendix A (Appendix C, RCMP, RCRP), and Hatfield's in Appendix C (Section 24.4).

## 24.5 Engagement with Potentially Affected Communities

On page 330 of the EA0809-002 DAR, we said "CZN has requested comment from the Nahanni Butte Dene Band and Parks Canada regarding future uses, and reclamation, of the site. No

comments have been received as yet". This statement remains true. There was also some informal discussion with DCFN on this matter. During the analysis phase of that EA in response to information requests, CZN also said "We agree that a more detailed closure and reclamation plan (CRP) should include a comprehensive list of all structures/facilities on and off site and the intended closure strategy. We believe the appropriate timing for this detail is after further consultation has occurred regarding uses of the site after closure. CZN proposes that this occurs at the time of Water Licence renewal, at which time a more detailed CRP can be produced" (1st IR round replies, September 15, 2010, reply to EC-7, p. 48).

http://www.reviewboard.ca/upload/project_document/EA0809-002_2010-09__Responses_to_Information_Requests.PDF

## 25.0 REQUIRED DRAFT OR CONCEPTUAL PLANS

Please refer to our comments in 4.17 above. The Incident Command System and emergency response plan are parts of the existing draft Spill Contingency Plan. The winter driving policy is specific to tire chains. This and other driving policies are components of the Road Operations Plan (see Appendix A (Appendix C)). A wildlife right of way policy is already part of the draft Wildlife Mitigation and Monitoring Plan.

## APPENDIX B: SUMMARY OF OUTSTANDING BASELINE INFORMATION

### 1 Species at Risk

Of the drainages proximal to, or crossed by, the access road, bull trout are only found in the Prairie Creek drainage, including Funeral Creek. Baseline data for, and impacts to, bull trout were considered in EA0809-002. See Hatfield's report in Appendix C (Appendix B Section 1) for more information.

### 2 Species at Risk, Distribution and Abundance

The following reports are relevant regarding wildlife and vegetation baseline:

- Beak 1981, vegetation and wildlife, surveys cover a 10 km strip from the Liard River to the Mackenzie Mountains, as well as the mine area. Covers the old winter road and extends as far south as Bluefish Lake
- Beak 1982, Dall sheep lambing areas near the mine
- Robertson Environmental Services for Rescan, 1994, summary of vegetation and wildlife data, old winter road
- CZN June 2006, wildlife only, mine claim areas http://www.mvlwb.ca/Boards/mv/Registry/2004/MV2004C0030/reports/MV04C30-WildlifeSurvey-Jun9-06.pdf
- Chillborne 2007, airborne wildlife survey of winter road and re-alignment to Nahanni Butte

- EBA July 2009, rare plant and wildlife survey, winter road (Appendix 13 of the 2010 DAR)
  http://www.reviewboard.ca/upload/project_document/EA0809-002_Developer_s_Assessment_Report__Vol_3_of_4__Appendices_11_to_18_.PDF
- EBA August 2010, invasive plant survey winter road, rare plant survey road re-alignments (Appendix 2 to first IR round reply, EA0809-002)
  http://www.reviewboard.ca/upload/project_document/EA0809-002_Invasive_and_Rare_Plant_Survey_Report_April_2011.PDF
- Golder 2010, vegetation and wildlife impact assessment (Appendix 17 of 2010 DAR)
  http://www.reviewboard.ca/upload/project_document/EA0809-002_Developer_s_Assessment_Report__Vol_3_of_4__Appendices_11_to_18_.PDF
- Golder, December 2010 and February 2011, airborne caribou occupancy survey, new winter road
  http://www.reviewboard.ca/upload/project_document/EA0809-002_Wildlife_Survey_December_2010.PDF
  http://www.reviewboard.ca/upload/project_document/EA0809-002_Wildlife_Suvey_December_2010_figures.PDF
  http://www.reviewboard.ca/upload/project_document/EA0809-002_Wildlife_Survey_February_2011.PDF
- Golder, 2014a (February-March), airborne caribou occupancy, new winter road
- Golder, 2014b (September), ground caribou occupancy survey, all season road

Digital copies will be provided for those documents listed above without a download link, except for Golder 2014b which was provided previously.

# 3 Vegetation Baseline, Contaminant Concentrations

The AR states “Please provide the baseline requirements of ToR 5.1.7 item 6 in order to meet conformity requirements”. It is not clear if this item is requesting simply a description of existing contaminant concentrations, which would be confirmation that there are no data, or that CZN acquire data. It was subsequently confirmed that CZN was not being asked “to collect baseline contaminant data”. Therefore, we assume this item is satisfied as there are no existing data on contaminant concentrations in vegetation.

# 4 Baseline Information Requirements – Harvesting

In our discussion with the NDDB during the workshop on January 20, 2015 no comments were made regarding encroachments or restrictions on harvesting activities. Some comments were made about a few visitors from outside the region using the Nahanni access road between the highway and the river for hunting and camping, and using the highway itself, but none were made about any encroachment further west. In our discussion with Leon Konisenta on January 27, 2010 he said the main reason hunting was generally confined to the village area and waterways was because of ease of access and the cost (gas) and difficulty of going further afield. We believe the latter is the main reason for the decline in rates of harvest. We also note that the

statistics provided in Section 20.2 indicate a region-wide decline in trapping. The main cause may be lower pelt demand leading to lower prices.

## 5 Baseline Information Requirements – Harvest Pressures

See Hatfield's report in Appendix C (Sections 6.3 and 15.2) and Tetra Tech EBA's report in Appendix E (Sections 4.3 and 4.4).

## 6 Baseline Information Requirements – Water and Sediment Quality

Regarding water quality baseline, in the DAR, CZN presented data on the major watercourses crossed by the road for the summer (July 28) and fall (September 26) seasons of 2014. There is additional data for Prairie Creek, Casket Creek and Funeral Creek in the 2010 DAR, Appendix 8, Tables A8-1 to A8-3 (http://www.reviewboard.ca/upload/project_document/EA0809-002_Developer_s_Assessment_Report__Vol_2_of_4__Appendices_1_to_10.PDF).

Major watercourses crossed by the road were sampled on September 17, 2009. Key data is provided in Table A7-1.

Major and subsidiary watercourses crossed by the road were sampled on July 7-8, 2015. Key data is provided in Table A7-2. Laboratory certificates are given in Appendix G. Samples were collected after a prolonged dry period. Polje Creek was dry at the time of sampling.

While most of the samples taken along the road were taken at crossing locations, they are representative of upstream water quality since the crossing structures are not yet present, and any effects from the historical winter road have long since diminished as the ground has revegetated and stabilized. The existing data is considered to adequately characterize baseline water quality conditions along the road for the purpose of impact assessment. The baseline data are considered suitable for the subsequent monitoring of project effects.

## 7 Baseline Information Requirements – Fish and Aquatic Habitat

See Hatfield's report in Appendix C (Attachments A & B).

## 8 Baseline Information Requirements – Baseline Contaminant Concentrations

See Hatfield's report in Appendix C (Appendix B Section 8, and Attachment C).

## 9 Baseline Information Requirements – Effects on Fish Health

See Hatfield's report in Appendix C (Appendix B Section 9, and Attachment D).

**TABLE A7-1: WATER QUALITY, MAJOR WATERCOURSES (September 17, 2009)**

| | Units | Prairie Km 2.7 | Fast Km 6.9 | Funeral Km 7.5 | Polje Km 53.4 | Tetcela Km 89.8 | Grainger Km 124.6 |
|---|---|---|---|---|---|---|---|
| Alkalinity (Total as CaCO3) | mg/L | 170 | 170 | 160 | 150 | 170 | 140 |
| Bicarbonate (HCO3) | mg/L | 210 | 210 | 190 | 190 | 210 | 170 |
| Dissolved Sulphate (SO4) | mg/L | 69 | 72 | 50 | 16 | 58 | 10 |
| Dissolved Chloride (Cl) | mg/L | 0.7 | 0.5 | 0.7 | <0.5 | 1.8 | 3.5 |
| Conductivity | uS/cm | 465 | 458 | 385 | 322 | 433 | 322 |
| pH | pH Uni | 8.3 | 8.2 | 8.2 | 8.1 | 8.2 | 8.3 |
| Total Suspended Solids | mg/L | <4 | <4 | <4 | 7 | 59 | 46 |
| Total Hardness (CaCO3) | mg/L | 255 | 249 | 206 | 174 | 234 | 167 |
| Nitrate (N) | mg/L | 0.154 | 0.187 | 0.164 | 0.152 | 0.069 | 0.057 |
| Ammonia (N) | mg/L | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | 0.005 |
| Total Antimony (Sb) | ug/L | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| Total Arsenic (As) | ug/L | <0.1 | <0.1 | 0.5 | <0.1 | 0.6 | 0.4 |
| Total Cadmium (Cd) | ug/L | 0.03 | 0.03 | 0.08 | 0.09 | 0.06 | 0.03 |
| Total Copper (Cu) | ug/L | 0.4 | 0.3 | 0.5 | 0.4 | 1.7 | 1.5 |
| Total Iron (Fe) | ug/L | 10 | 10 | 8 | 40 | 727 | 567 |
| Total Lead (Pb) | ug/L | <0.2 | <0.2 | 0.3 | <0.2 | 0.3 | 0.4 |
| Total Mercury (Hg) | ug/L | 0.03 | 0.04 | 0.02 | 0.03 | 0.05 | 0.03 |
| Total Selenium (Se) | ug/L | 1.4 | 1.2 | 1.1 | 1.3 | 0.9 | 0.3 |
| Total Zinc (Zn) | ug/L | 20 | <5 | 38 | 30 | 12 | 17 |
| Total Calcium (Ca) | mg/L | 63.7 | 61.6 | 46.5 | 53.8 | 68.9 | 46.5 |
| Total Magnesium (Mg) | mg/L | 23.4 | 23.2 | 21.9 | 9.76 | 15.0 | 12.3 |
| Dissolved Antimony (Sb) | ug/L | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| Dissolved Arsenic (As) | ug/L | 0.1 | 0.1 | 0.5 | 0.2 | 0.4 | 0.3 |
| Dissolved Cadmium (Cd) | ug/L | 0.04 | 0.03 | 0.08 | 0.12 | 0.03 | 0.01 |
| Dissolved Copper (Cu) | ug/L | 0.5 | 0.7 | 0.4 | 0.8 | 1.2 | 0.9 |
| Dissolved Iron (Fe) | ug/L | 6 | <5 | <5 | 65 | 67 | 103 |
| Dissolved Lead (Pb) | ug/L | 0.3 | 0.3 | 0.4 | 0.7 | 0.3 | 0.2 |
| Dissolved Mercury (Hg) | ug/L | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| Dissolved Selenium (Se) | ug/L | 1.3 | 1.3 | 1.1 | 1.4 | 0.8 | 0.2 |
| Dissolved Zinc (Zn) | ug/L | 7 | 6 | 36 | 7 | <5 | <5 |
| Dissolved Calcium (Ca) | mg/L | 65.5 | 63.3 | 48.4 | 53.5 | 68.1 | 44.4 |
| Dissolved Magnesium (Mg) | mg/L | 24.8 | 24.0 | 23.4 | 9.98 | 14.9 | 11.8 |

## TABLE A7-2: SURFACE WATER QUALITY RESULTS (July 7, 2015)

| Client Sample ID | Units | Casket | Funeral @Fast | Funeral @13.4 | Funeral @15.8 | Sundog @20.4 | Sundog @23.4 | Sundog @28.2 | Sundog @39.4 Trib | Sundog @39.4 | Sundog @43.2 | Polje @46.2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alkalinity, Total (as CaCO3) | mg/L | 202 | 165 | 153 | 114 | 122 | 115 | 116 | 195 | 112 | 177 | 156 |
| Sulfate (SO4) | mg/L | 122 | 76.4 | 68.2 | 65.7 | 21.8 | 41.4 | 35.2 | 2.65 | 18.0 | 3.76 | 6.67 |
| Chloride (Cl) | mg/L | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Conductivity | uS/cm | 579 | 443 | 403 | 334 | 260 | 287 | 289 | 344 | 249 | 325 | 291 |
| pH | pH | 8.41 | 8.39 | 8.35 | 8.27 | 8.31 | 8.30 | 8.34 | 8.41 | 8.28 | 8.24 | 8.26 |
| Total Suspended Solids | mg/L | <3.0 | <3.0 | <3.0 | 4.5 | <3.0 | <3.0 | <3.0 | <3.0 | 10.1 | <3.0 | <3.0 |
| Total Dissolved Solids | mg/L | 398 | 282 | 255 | 216 | 151 | 176 | 171 | 208 | 141 | 198 | 176 |
| Hardness (as CaCO3) | mg/L | 323 | 241 | 221 | 185 | 142 | 157 | 161 | 200 | 137 | 187 | 164 |
| Ammonia, Total (as N) | mg/L | <0.0050 | 0.101 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | 0.0299 | <0.0050 | <0.0050 | <0.0050 |
| Nitrate (as N) | mg/L | 0.136 | 0.145 | 0.177 | 0.217 | 0.207 | 0.204 | 0.210 | <0.0050 | 0.219 | 0.0173 | 0.0122 |
| Antimony (Sb)-Total | mg/L | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| Arsenic (As)-Total | mg/L | 0.0013 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Cadmium (Cd)-Total | mg/L | <0.000050 | <0.000050 | <0.000050 | 0.00127 | 0.000057 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Copper (Cu)-Total | mg/L | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Iron (Fe)-Total | mg/L | <0.030 | <0.030 | <0.030 | 0.132 | <0.030 | <0.030 | <0.030 | 0.164 | <0.030 | 0.180 | 0.082 |
| Lead (Pb)-Total | mg/L | <0.0010 | <0.0010 | <0.0010 | 0.0022 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Mercury (Hg)-Total | mg/L | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Selenium (Se)-Total | mg/L | 0.0013 | 0.0011 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Zinc (Zn)-Total | mg/L | 0.0190 | 0.0304 | <0.0050 | 0.341 | 0.0084 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 |
| Calcium (Ca)-Total | mg/L | 70.8 | 54.4 | 51.2 | 40.1 | 31.8 | 35.1 | 34.8 | 67.9 | 38.4 | 67.3 | 51.7 |
| Magnesium (Mg)-Total | mg/L | 37.2 | 25.8 | 23.9 | 24.1 | 16.6 | 17.9 | 17.8 | 9.54 | 15.8 | 6.17 | 9.76 |
| Antimony (Sb)-Dissolved | mg/L | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| Arsenic (As)-Dissolved | mg/L | 0.0012 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Cadmium (Cd)-Dissolved | mg/L | <0.000050 | <0.000050 | <0.000050 | 0.00104 | 0.000054 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Copper (Cu)-Dissolved | mg/L | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Iron (Fe)-Dissolved | mg/L | <0.030 | <0.030 | <0.030 | <0.030 | <0.030 | <0.030 | <0.030 | <0.030 | <0.030 | 0.039 | <0.030 |
| Lead (Pb)-Dissolved | mg/L | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Mercury (Hg)-Dissolved | mg/L | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Selenium (Se)-Dissolved | mg/L | 0.0012 | 0.0011 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Zinc (Zn)-Dissolved | mg/L | 0.0196 | 0.0309 | <0.0050 | 0.317 | 0.0075 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 |
| Calcium (Ca)-Dissolved | mg/L | 69.5 | 54.4 | 50.2 | 37.2 | 30.6 | 34.5 | 34.9 | 65.3 | 33.3 | 65.1 | 50.2 |
| Magnesium (Mg)-Dissolved | mg/L | 36.2 | 25.6 | 23.3 | 22.3 | 16.0 | 17.3 | 17.9 | 9.04 | 13.1 | 6.00 | 9.49 |

## TABLE A7-2: SURFACE WATER QUALITY RESULTS (July 7, 2015)

| Client Sample ID | Units | Polje @49.6 | Polje @53.3 | Tetcela @87.2 | Tetcela @89.8 | Fishtrap | Grainger @122.1 | Grainger @123.1 | Grainger @124.6 | Grainger @130.7 | Grainger @132.6 | Liard @154.5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alkalinity, Total (as CaCO3) | mg/L | 231 | 279 | 170 | 235 | 185 | 225 | 222 | 172 | 208 | 201 | 275 |
| Sulfate (SO4) | mg/L | 18.4 | 9.07 | 43.8 | 118 | 153 | 2.50 | 8.49 | 19.9 | 9.18 | 4.42 | 7.75 |
| Chloride (Cl) | mg/L | <0.50 | <0.50 | <0.50 | 4.41 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Conductivity | uS/cm | 431 | 484 | 390 | 647 | 632 | 395 | 378 | 344 | 366 | 356 | 483 |
| pH | pH | 8.32 | 7.97 | 8.39 | 8.38 | 8.08 | 8.32 | 8.20 | 8.35 | 8.44 | 8.44 | 8.41 |
| Total Suspended Solids | mg/L | <3.0 | <3.0 | 5.6 | 9.7 | 4.3 | 3.3 | <3.0 | <3.0 | <3.0 | <3.0 | 3.6 |
| Total Dissolved Solids | mg/L | 260 | 274 | 258 | 437 | 421 | 237 | 227 | 206 | 203 | 205 | 286 |
| Hardness (as CaCO3) | mg/L | 250 | 279 | 219 | 354 | 286 | 219 | 211 | 196 | 210 | 209 | 275 |
| Ammonia, Total (as N) | mg/L | 0.0132 | <0.0050 | 0.0077 | 0.0055 | 0.0103 | 0.0140 | 0.0164 | 0.0070 | <0.0050 | <0.0050 | 0.0095 |
| Nitrate (as N) | mg/L | 0.0157 | 0.158 | 0.0604 | 0.0286 | <0.0050 | 0.0166 | 0.0675 | 0.230 | 0.173 | 0.184 | 0.0288 |
| Antimony (Sb)-Total | mg/L | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| Arsenic (As)-Total | mg/L | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Cadmium (Cd)-Total | mg/L | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Copper (Cu)-Total | mg/L | <0.0010 | <0.0010 | 0.0019 | 0.0013 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Iron (Fe)-Total | mg/L | 1.21 | <0.030 | 0.308 | 0.420 | 0.088 | 0.099 | 0.404 | <0.030 | 0.030 | 0.059 | <0.030 |
| Lead (Pb)-Total | mg/L | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Mercury (Hg)-Total | mg/L | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Selenium (Se)-Total | mg/L | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Zinc (Zn)-Total | mg/L | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 |
| Calcium (Ca)-Total | mg/L | 75.5 | 89.7 | 75.1 | 104 | 73.4 | 67.9 | 64.1 | 56.0 | 52.4 | 56.4 | 75.1 |
| Magnesium (Mg)-Total | mg/L | 15.8 | 13.3 | 11.4 | 22.6 | 28.2 | 13.2 | 14.8 | 15.3 | 20.4 | 18.3 | 26.1 |
| Antimony (Sb)-Dissolved | mg/L | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| Arsenic (As)-Dissolved | mg/L | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Cadmium (Cd)-Dissolved | mg/L | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Copper (Cu)-Dissolved | mg/L | <0.0010 | <0.0010 | 0.0014 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Iron (Fe)-Dissolved | mg/L | <0.030 | <0.030 | <0.030 | <0.030 | 0.033 | <0.030 | 0.037 | <0.030 | <0.030 | <0.030 | <0.030 |
| Lead (Pb)-Dissolved | mg/L | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Mercury (Hg)-Dissolved | mg/L | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| Selenium (Se)-Dissolved | mg/L | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Zinc (Zn)-Dissolved | mg/L | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 |
| Calcium (Ca)-Dissolved | mg/L | 74.6 | 89.9 | 70.3 | 105 | 71.5 | 66.5 | 61.1 | 54.2 | 51.2 | 54.5 | 70.1 |
| Magnesium (Mg)-Dissolved | mg/L | 15.6 | 13.3 | 10.6 | 22.6 | 26.1 | 12.9 | 14.3 | 14.8 | 20.0 | 17.7 | 24.4 |

# 10 Baseline Information Requirements – Historic and Current Use of Vegetation

The following information was obtained during the discussion on January 27, 2010 with Leon Konisenta, and was noted in the EA0809-002 DAR on p. 157:

> "Harvesting of berries and medicinal plants was and still is prevalent in the area. Berries include cranberries, blueberries and strawberries. Plants include white moss and Labrador tea. This harvesting used to occur as far away as Yohin Lake and Wolverine Pass. Currently, the harvesting occurs nearer to the village and mountains due to ease of access".

Locations of traditional hunting and trapping in the interior valleys are described in Section 5.7.1 of the EA0809-002 DAR. It is reasonable to assume that berries and plants may have been harvested in these locations historically also.

Ed Lindberg used to operate a small sawmill at Lindberg Landing some years ago. Trees were sourced from both sides of the Liard River. There is still some evidence of cut areas on the west bank of the river near the old winter road alignment. The lumber produced was used locally. There is no evidence or information on any other commercial forestry activities in the area.

# 11 Baseline Information Requirements – Frequency of Forest Fires and Post-Vegetation Succession

See Tetra Tech EBA's report in Appendix E (Section 4.5.13).