



December 2016

WOOD BUFFALO NATIONAL PARK HIGHWAY 5 ROADWAY REHABILITATION

Basic Impact Analysis

Submitted to:

Highway Engineering Services, Parks Canada
PO Box 900
Banff, AB T1L 1K2

REPORT



Report Number: 1656958_RP0002_Rev 2





Table of Contents

1.0 PROJECT TITLE AND LOCATION	1
2.0 PROPONENT INFORMATION	1
3.0 PROPOSED PROJECT DATES	1
4.0 INTERNAL FILE NUMBER.....	1
5.0 PROJECT DESCRIPTION	1
5.1 Project Justification	1
5.2 Project Details	1
6.0 VALUED COMPONENTS LIKELY TO BE AFFECTED	4
6.1 Aquatic Resources.....	7
6.1.1 Fish and Fish Habitat	11
6.1.2 Hydrology.....	14
6.1.3 Surface Water Quality	15
6.2 Vegetation	15
6.3 Wildlife and Wildlife Habitat	16
6.3.1 Amphibians	19
6.3.2 Migratory Birds.....	19
6.3.3 Bats.....	21
6.3.4 Carnivores / Furbearers	21
6.3.5 Ungulates.....	22
6.4 Terrain and Soils.....	24
6.5 Air Quality	24
6.6 World Heritage Values and Cultural Resources	25
6.7 Visitor Experience.....	25
7.0 POTENTIAL EFFECTS ANALYSIS	26
7.1 Aquatic Resources.....	28
7.1.1 Fish and Fish Habitat	28
7.1.2 Hydrology.....	29
7.1.3 Surface Water Quality	29



BASIC IMPACT ANALYSIS FOR WOOD BUFFALO NATIONAL PARK HIGHWAY 5 ROADWAY REHABILITATION

7.2	Vegetation	30
7.3	Wildlife and Wildlife Habitat	31
7.3.1	Canadian Toad	31
7.3.2	Migratory Birds.....	31
7.3.3	Bats.....	32
7.3.4	Carnivores / Furbearers	32
7.3.5	Ungulates.....	33
7.4	Terrain and Soils.....	33
7.5	Visitor Experience.....	34
8.0	MITIGATION MEASURES.....	34
8.1	Aquatic Resources.....	37
8.2	Vegetation	38
8.3	Wildlife and Wildlife Habitat	39
8.4	Terrain and Soils.....	40
8.5	Visitor Experience.....	40
9.0	PUBLIC / STAKEHOLDER ENGAGEMENT AND ABORIGINAL CONSULTATION	41
10.0	SIGNIFICANCE OF RESIDUAL EFFECTS	41
11.0	SURVEILLANCE	43
12.0	FOLLOW-UP MONITORING	43
13.0	SARA NOTIFICATION.....	43
14.0	EXPERTS CONSULTED	44
15.0	DECISION.....	45
16.0	RECOMMENDATION AND APPROVAL.....	46
17.0	ATTACHMENTS.....	47
18.0	NATIONAL IMPACT ASSESSMENT TRACKING SYSTEM.....	47
19.0	REFERENCES.....	48



BASIC IMPACT ANALYSIS FOR WOOD BUFFALO NATIONAL PARK HIGHWAY 5 ROADWAY REHABILITATION

TABLES

Table 1: Summary of Project Phases and Activities	3
Table 2: Valued Components and Selection Rationale	5
Table 3: Culvert Locations and Associated Aquatic Features, Highway 5 km 106 to km 170	8
Table 4: Summary of in situ Water Quality Parameters at Highway 5 km 151.6 (Klewi River)	12
Table 5: Documented Fish Species in the Klewi River	12
Table 6: Summary of in situ Water Quality Parameters at Highway 5 km 166.6 (unnamed tributary)	13
Table 7: Documented Fish Species in the Sass River	13
Table 8: Wildlife Valued Components and their Potential for Project Interactions	18
Table 9: Potential Project Effects	26
Table 10: Significance of Residual Effects	42

APPENDICES

APPENDIX A

Figures

APPENDIX B

Environmental Impact Analysis Tools – Effects Identification Matrix

APPENDIX C

Vegetation Elements and Wildlife Species of Management Concern with Potential to Occur in the Local Study Area

APPENDIX D

Watercourse Crossing Photos

APPENDIX E

Cultural Resources Report: Archaeological Overview Assessment

APPENDIX F

Definition of Criteria Used to Describe Predicted Residual Effects for Valued Components



BASIC IMPACT ANALYSIS FOR WOOD BUFFALO NATIONAL PARK HIGHWAY 5 ROADWAY REHABILITATION

1.0 PROJECT TITLE AND LOCATION

Wood Buffalo National Park – Roadway Rehabilitation – Highway 5 (the Project). The primary location of the Project will be between km 106 and km 174 on Highway 5 in Wood Buffalo National Park (WBNP), between Hay River and Fort Smith in the Northwest Territories. In addition to aggregate and borrow pits within this section of Highway 5, additional pits outside WBNP will likely be used as a supplemental source of aggregate material.

2.0 PROPONENT INFORMATION

Proponent: Parks Canada Agency	Gilles Lussier (Project Manager)	Phone: (250) 837-7526 Email: Gilles.lussier@pc.gc.ca
BIA Author: Golder Associates Ltd.	Golder Internal Filing Number: 1656958_3101	

3.0 PROPOSED PROJECT DATES

Planned commencement: Fall 2016

Planned completion: Fall 2017

4.0 INTERNAL FILE NUMBER

Southwest Northwest Territories Field Unit (SNNWT FU) Internal Project File Number: WBS2016-022

5.0 PROJECT DESCRIPTION

5.1 Project Justification

Highway 5 is a key transportation route that provides the only all-season access for the community of Fort Smith. Of the 118.1 km of Highway 5 that are within Park boundaries, currently 50.1 km are chip sealed and 64 km are gravel surface. The gravel section is a two-lane undivided highway with a speed limit of 90 km/hr, extending from km 106 to km 170 between the towns of Hay River (near km 0) and Fort Smith. The 64 km of Highway 5 in Wood Buffalo National Park (WBNP) that are gravel surface require road widening, chip sealing, and drainage and slope stability improvements to reduce risk to public safety and improve asset conditions by enhancing the road infrastructure. The work will help ensure safe vehicle access and transportation of commodities to WBNP and the community of Fort Smith.

5.2 Project Details

The objective of the Project is to perform roadway rehabilitation and improvement work on the 64 km-long gravel surface section of Highway 5 in WBNP in Northwest Territories. The general scope of this rehabilitation is to widen and chip seal the gravel section, replace drainage culverts, and address any slope stability and drainage issues that may threaten the durability of the highway. Environmental alignment sheets depicting the Project in relation to the surrounding area are provided in Appendix A.



BASIC IMPACT ANALYSIS FOR WOOD BUFFALO NATIONAL PARK HIGHWAY 5 ROADWAY REHABILITATION

The gravel section of Highway 5 in WBNP is currently as narrow as 7.1 m, which will be widened to 8.0 m. Road widening activities will occur within the existing highway right-of-way (RoW), and will not require a widening of the RoW. Full depth highway widening will occur only on the side of the highway opposite from the fibre-optic cable, which runs on the south side of the highway west of km 138.0, and the north side of the highway to the east of that point. Clearing and grubbing within the existing highway RoW will be required to accommodate the wider roadway. Minimal site preparation will be required for laydown areas. Any other site preparation work will be part of construction.

The total aggregate quantities needed are approximately 110,000 m³ of general fill, 83,000 m³ of granular base material, and 16,500 m³ of 16 mm chip seal / seal coat. Chip seal will be conventional overlay, using 16 mm chips and bituminous materials for double asphaltic surface treatment, 19 mm granular base course production for resurfacing, and 76 mm gravel fill for the widening. Gravel fill will be sourced from some combination of the km 113.5 and km 136 borrow pits, which have entrances at km 113.4 and km 136.8 of Highway 5 in WBNP, respectively. Additional gravel fill from a source outside WBNP will be required, and these materials will be stockpiled adjacent to the roadway at the km 162 and km 136 borrow pits, which has an entrance at km 162.0 and km 136.8 of Highway 5 in WBNP.

To provide necessary gravel fill, the km 113.5 and km 136 borrow pits will need to be expanded. The area and shape of the expansion of these borrow pits will be determined through a geotechnical assessment of the type of material present and the quantities, with consideration of development limitations presented by the boundary of Zone 1 Special Preservation Whooping Crane Nesting Area in WBNP, within which Whooping Crane (*Grus americana*) Critical Habitat (CH) occurs (EC 2007; PCA 2010). The existing km 136 borrow pit already intrudes into Zone I, but expansion of the pit will only occur outside of Zone 1. The existing km 113.5 borrow pit extends into Zone IV Outdoor Recreation, and pit expansions are expected to intrude further into Zone IV. For the purposes of this BIA, expansion areas have been conservatively estimated to be 27 ha for the km 113.5 borrow pit and 7 ha for km 136. Depleted borrow pits may be reclaimed, where practicable and appropriate. The km 162 borrow pit also intrudes into Zone I under existing conditions, but will not be used for gravel and will not be expanded. The area intruding into Zone I represents 4 ha that are proposed to be reclaimed after the construction phase of the Project is complete.

Equipment and vehicles used in improvement activities include dump trucks, paver, loaders, grader, excavator, dozer, crusher, screener and small vehicles. Toxic or hazardous materials include bituminous materials for chip seal production, non-toxic water-based traffic paint, and fuel for construction equipment and vehicles. Culverts will be replaced and temporary drainage will be in place, as required. Drainage improvements will be via ditching.

A detailed breakdown of Project Activities is provided in Table 1.



BASIC IMPACT ANALYSIS FOR WOOD BUFFALO NATIONAL PARK HIGHWAY 5 ROADWAY REHABILITATION

Table 1: Summary of Project Phases and Activities

	Phases	Examples of Associated Activities	Details
Project Components	Construction / Site Preparation	Preparation of Environmental Protection Plan (EPP)	Successful contractor to prepare EPP in collaboration with the SWNWT Field Unit. The EPP includes: Pollution Management, Erosion and Sediment Control, Waste Management, Equipment Maintenance and Fuel Management, Relics and Antiques, Noxious Weed Control, Protection of work limits). The EPP will be completed and approved by the SWNWT Field Unit at least one week prior to the start of work. Wetlands and associated vegetated buffers must be flagged prior to the start of work, if applicable.
		Mobilize Equipment	Mobilize equipment to site.
		Temporary facilities	Temporary construction management facilities and a staging area will be permitted at one of the three borrow pits (km 113.5, km 136 and km 162) as approved by the Departmental Representative and ESO.
		Supply and storage of materials	Materials storage will be established within a laydown area at a location to be determined and at the km 136 borrow pit as approved by the Departmental Representative and ESO. Aggregate fill brought in from outside the park will be stored at one or a combination of all three existing Pits at Km 113.5, 136 and 162 as space permits and within the existing disturbed area.
		Clearing and grubbing	Clearing and grubbing will be required to accommodate road widening and the expansion of borrow pits. Felled trees, uprooted trees and stumps, roots, and other wood debris will be chipped and burnt. Standard heavy equipment will be used, where appropriate (e.g., feller/buncher, excavator, bulldozer, rock truck, grader, roller).
		Stripping	Top soil will be stripped in advance of excavation activities. Stripped soil materials (e.g., fine forest litter) will be placed and stored at approved sites, for later reclamation use.
		Grading	Grading of the gravel surface and coarse surface road base will be required to prepare roadway for chip sealing. Grading will be required to maintain positive draining and natural appearance after roadway widening.
		Demolition	Removal of culverts or culvert sections for repair and/or replacement.
		Excavation	Typical excavation and backfill activities will be required for replacing culverts and removing unsuitable material for highway improvement and widening. Roadway embankment and road structure will require typical excavation and backfill activities for rehabilitation and widening. The excavation of materials will utilize standard heavy machinery (e.g., excavator, bulldozer, and trucks).
		Disposal of waste	Construction, trade, hazardous waste, fuel and domestic waste materials will be loaded and hauled out of WBNP to disposal sites approved by the Departmental Representative. Stockpiled organics, trees, grubbed materials, stumps, and topsoil will be segregated and stored independently of other materials.
		Culvert installation	Culvert replacement as directed by the Department Representative. Sediment control measures may be necessary to ensure that sediments do not enter watercourses. Work requires isolation if activities are carried out during fish restricted activity periods.
		Use of machinery	Machinery will be typical road construction equipment (e.g., excavator, bulldozer, dump truck, roller and vibration compaction equipment, crusher, screener, loader, paving machine, light vehicle) and clearing equipment (e.g., feller/buncher, excavator, bulldozer, rock truck, grader, roller).
		Transport of materials/ equipment	Transport of construction materials to site (aggregates, asphaltic surfacing material, construction equipment) and removal of construction wastes.
		Use of Chemicals	Asphalt cement in asphalt concrete pavement, fuel and oil for construction equipment and vehicles, non-toxic traffic paint.
		Traffic management / road signs	Traffic controllers and signs will be present on the roadway during construction activities.
		Drainage	Ditching along the 64 km of Highway 5 will be rehabilitated, and culverts will be repaired or replaced, as appropriate.
		Backfilling	Backfilling will be conducted for culvert and road structure repair excavations, and for road widening.
		Use of machinery	For asphaltic surfacing, excavation, clearing, backfilling, grading, hauling.
	Operation	Maintenance	On-going monitoring and maintenance of the roadway by Parks Canada using typical heavy equipment (e.g., snowplows, pavers) as required.
		Use/Removal of temporary facilities	Temporary facilities will be removed (e.g., at km 136 borrow pit).
		Road signs	All temporary traffic control and road signs will be removed.
		Vehicle Traffic	General public, visitor and commercial vehicles will use the roadway as directed by Parks Canada.
		Re-vegetation/Planting	Reseeding the edge of the highway with native seed approved by the SWNWT Field Unit.



6.0 VALUED COMPONENTS LIKELY TO BE AFFECTED

Desktop searches were conducted for background information pertaining to components that may be potentially directly or indirectly affected by the Project and associated activities.

The list of sources searched included:

- Parks Canada publications:
 - Wood Buffalo National Park Management Plan (Parks Canada 2010);
 - Wood Buffalo National Park cultural history website (Parks Canada 2015a);
 - National Best Management Practices: Roadway, Highway, Parkway and Related Infrastructure BMP (Parks Canada 2015c);
 - Parks Canada Agency (PCA): Fish Species Found in Rivers & Streams in and near Wood Buffalo National Park (Area 1) (Irwin 2016); and
 - Parks Canada Biotics Web Explorer Database (PCA 2013).
- Data provided by the SWNWT Field Unit;
- Government of the Northwest Territories publications:
 - Northwest Territories Species at Risk Infobase (GNWT 2016);
 - Department of Environment and Natural Resources. Air Quality Report (GNWT 2015a); and
 - Department of Transportation Annual Traffic Report (GNWT 2015b).
- Government of Canada publications:
 - Federal Species at Risk Public Registry which lists species currently at risk under the *Species at Risk Act* (SARA) (ECCC 2016a).
- Geological Survey of Canada maps and reports (2016; 2015; 1965c).

Information obtained during the background search was used to identify valued components (VCs) considered to be 'carried forward' in the BIA. Rationale for the inclusion or exemption of a component to be considered as a VC is provided in the sections below.

VCs potentially affected by the Project were identified through the Effects Identification Matrix (Appendix B). VCs were selected based on the following criteria:

- the sensitivity or vulnerability of the VC;
- the uniqueness or rarity of the VC;
- the value attributed to the VC by stakeholders and Aboriginal communities;
- recognition of the importance of a VC by a statute, policy, regulation, or court;



BASIC IMPACT ANALYSIS FOR WOOD BUFFALO NATIONAL PARK HIGHWAY 5 ROADWAY REHABILITATION

- risks to the health, safety or well-being of people;
- the likelihood to affect visitor experience; and
- the likelihood of an indirect effect on an associated VC (i.e., a link exists between the affected VC and another VC, such as water quality affecting fish habitat).

VCs that met a minimum of one of these criteria were carried forward through the impact analysis for the Project. A summary of VCs and the rationale for their selection is presented in Table 2 and discussed in the following section.

Table 2: Valued Components and Selection Rationale

Resource Class	Valued Component	Rationale for Selection
Aquatic Resources	Fish and Fish Habitat	<ul style="list-style-type: none"> ■ Regulatory requirement; potential to cause serious harm to fish as defined under the federal <i>Fisheries Act</i> (GoC 1985). ■ Potential effects on fish populations. ■ Consideration of ecosystem conservation concerns; importance to ecosystem diversity and inter-relation to other environmental components (e.g., wildlife).
	Hydrology	<ul style="list-style-type: none"> ■ Potential for changes to existing flow patterns and quantity, as well as to vertical and lateral stability of watercourses.
	Surface Water Quality	<ul style="list-style-type: none"> ■ Consideration for the maintenance of water quality for the protection of aquatic life. ■ Potential for effects on ecological communities.
Vegetation	Vegetation Communities	<ul style="list-style-type: none"> ■ Potential for effects on species- and community-level biodiversity.
	Vegetation Elements of Management Concern (VEMC)	<ul style="list-style-type: none"> ■ Regulatory requirement: potential adverse effect on federally listed (Committee on the Status of Endangered Wildlife in Canada [COSEWIC] [ECCC 2016a]; <i>Species at Risk Act</i> [SARA] ECCC 2016a) or territorially listed plant species of management concern (GNWT 2016). ■ Potential for effects on species and community level biodiversity.
Wildlife	Canadian Toad	<ul style="list-style-type: none"> ■ Representative of amphibians. ■ Regular occurrence in Wood Buffalo National Park. ■ Project has the potential to alter habitat.
	Migratory Birds	<ul style="list-style-type: none"> ■ Federal Regulation - <i>Migratory Birds Convention Act</i> (GoC 1994). ■ Species of federal conservation concern. ■ Project activities potentially occurring within the nesting period for migratory birds. The Project occurs within Zone B7, in which the general nesting period is May 3 to August 20 (ECCC 2016b). ■ Project has the potential to alter habitat and result in mortality due to incidental take of nests, eggs and young. ■ Potential implications to species and community level biodiversity.



BASIC IMPACT ANALYSIS FOR WOOD BUFFALO NATIONAL PARK HIGHWAY 5 ROADWAY REHABILITATION

Resource Class	Valued Component	Rationale for Selection
Wildlife (cont.)	Whooping Crane	<ul style="list-style-type: none"> Species of federal conservation concern. Listed as Endangered by COSEWIC and Endangered on Schedule 1 of SARA (ECCC 2016a). SARA CH has been defined near the Project area. Regular occurrence in Wood Buffalo National Park. Project has the potential to alter habitat.
	Little Brown Myotis and Northern Myotis	<ul style="list-style-type: none"> Species of federal conservation concern. Little Brown Myotis and Northern Myotis are listed as Endangered by COSEWIC and Endangered on Schedule 1 of SARA. Regular occurrence in Wood Buffalo National Park. Project has the potential to alter habitat (i.e., maternity sites, day roosts and foraging habitat).
	Wolverine	<ul style="list-style-type: none"> Species of federal conservation concern. Listed as Special Concern by COSEWIC, but is not SARA-listed. Sensitive to anthropogenic disturbance. Likely to occur regularly in low densities in WBNP.
	Wood Bison	<ul style="list-style-type: none"> Species of federal conservation concern. Listed as Special Concern by COSEWIC and Threatened on Schedule 1 of SARA. Regular occurrence in Wood Buffalo National Park. Project has the potential to alter habitat and result in collisions with construction vehicles.
	Woodland Caribou (Boreal population)	<ul style="list-style-type: none"> Species of federal conservation concern. Listed as Threatened by COSEWIC and Threatened on Schedule 1 of SARA. SARA CH has been defined near the Project area. Regular occurrence in Wood Buffalo National Park. Project has the potential to alter habitat and result in collisions with construction vehicles.
Terrain and Soils		<ul style="list-style-type: none"> Ecosystem conservation concern; importance to ecosystem diversity and interrelation with other components (e.g., groundwater, vegetation). Importance of soil productivity in maintaining forest capability.
Visitor Experience		<ul style="list-style-type: none"> Potential to improve reliability of traffic movement and safety along Highway 5 during operations. Potential to create traffic delays during construction. Temporary restricted access to hiking trails, day use areas, and viewpoints. Potential alteration of the existing viewscape and wilderness character.



Spatial boundaries define the geographic extents within which the potential environmental effects of the Project are considered and are used to define the study areas for the BIA. The description of environmental setting and assessment of potential Project effects on the VCs *considers* the following defined study areas:

Project footprint: 39.7 ha

Local Study Area: 508.9 ha

The Project footprint, associated with construction and operation of the Project, assesses physical disturbance due to the Project on the local environment, while the local study area (LSA) was established to assess the potential, largely indirect effects of the Project within the vicinity of the footprint. The LSA is composed of the culvert, road widening and borrow pit expansion footprints surrounded by 30 m buffers.

6.1 Aquatic Resources

Waterbodies in the LSA consist of three rivers, Nyarling, Klewi and Sass Rivers, and their tributaries and wetland drainages, which cross Highway 5 between km 106 and km 170. Watercourses range in size from small drainages without defined bed and banks to larger defined watercourses, and therefore vary in their ability to support fish and in their sensitivity to disturbance. The watercourses and drainages cross Highway 5 through culverts and flow downstream into multiple, large wetland areas that are part of the Nyarling, Klewi, and Sass Rivers catchments. These rivers are part of the Little Buffalo River watershed, which flows into Great Slave Lake (PCA 2016).

Golder conducted a site reconnaissance and aquatic habitat assessment along Highway 5 in WBNP between km 106 and km 170 in late June 2016. In addition, a review of existing fish habitat information and water quality information was completed.

A total of 80 culverts (twin culverts are counted as one) were identified along the Highway 5 route, with four identified as watercourses with fish habitat and 77 identified as ephemeral drainages (i.e., with no defined bed or banks and no fish habitat), (Table 3; Appendix A). These watercourses and drainages generally flow from upstream wetlands and from runoff during snowmelt or precipitation periods. Water generally either seeps or flows into roadside ditches on the upstream side of the highway, and then drains through culverts under Highway 5, before flowing into downstream wetlands or drainages of the three river systems within the LSA.



BASIC IMPACT ANALYSIS FOR WOOD BUFFALO NATIONAL PARK HIGHWAY 5 ROADWAY REHABILITATION

Table 3: Culvert Locations and Associated Aquatic Features, Highway 5 km 106 to km 170

Highway 5 Kilometer Marker	Associated Aquatic Feature	UTN NAD 83 (11 U)	
		Easting (m)	Northing (m)
Ephemeral drainages with no defined channel or fish habitat			
106.5	Dry culvert. No defined channel or fish habitat.	648185	6702849
107.3	Dry culvert. No defined channel or fish habitat.	648668	6702250
108.3	Dry culvert. No defined channel or fish habitat.	649314	6701450
109.3	Dry culvert. No defined channel or fish habitat.	649901	6700724
110.1	Dry culvert. No defined channel or fish habitat.	650443	6700053
110.8	Dry culvert. No defined channel or fish habitat.	650876	6699518
111.8	Dry culvert. No defined channel or fish habitat.	651480	6698769
112.4	Dry culvert. No defined channel or fish habitat.	651878	6698276
113.1	Dry culvert. No defined channel or fish habitat.	652303	6697748
114.2	Dry culvert. No defined channel or fish habitat.	652987	6696898
114.7	Dry culvert. No defined channel or fish habitat.	653342	6696457
116.1	Dry culvert. No defined channel or fish habitat.	654212	6695375
116.4	Dry culvert. No defined channel or fish habitat.	654409	6695129
117.4	Dry culvert. No defined channel or fish habitat.	655031	6694357
118.0	Dry culvert. No defined channel or fish habitat.	655399	6693900
118.3	Dry culvert. No defined channel or fish habitat.	655603	6693646
118.8	Dry culvert. No defined channel or fish habitat.	655904	6693272
119.2	Nyarling River crossing. Dry culvert. Historic channel that is now dry and vegetated. Only subsurface flow known to exist at this crossing location.	656166	6692946
121.2	Dry culvert. No defined channel or fish habitat.	657392	6691470
121.8	Dry culvert. No defined channel or fish habitat.	657840	6690992
122.6	Dry culvert. No defined channel or fish habitat.	658361	6690436
122.9	Dry culvert. No defined channel or fish habitat.	658613	6690167
123.5	Dry culvert. No defined channel or fish habitat.	659020	6689732
124.3	Dry culvert. No defined channel or fish habitat.	659518	6689201
124.9	Dry culvert. No defined channel or fish habitat.	659955	6688735
125.3	Dry culvert. No defined channel or fish habitat.	660258	6688412
126.8	Dry culvert. No defined channel or fish habitat.	661537	6687658
127.7	Dry culvert. No defined channel or fish habitat.	662321	6687253
128.4	Dry culvert. No defined channel or fish habitat.	662956	6686924
129.3	Dry culvert. No defined channel or fish habitat.	663688	6686544



BASIC IMPACT ANALYSIS FOR WOOD BUFFALO NATIONAL PARK HIGHWAY 5 ROADWAY REHABILITATION

Highway 5 Kilometer Marker	Associated Aquatic Feature	UTN NAD 83 (11 U)	
		Easting (m)	Northing (m)
129.5	Dry culvert. No defined channel or fish habitat.	663938	6686415
129.9	Dry culvert. No defined channel or fish habitat.	664268	6686244
130.4	Dry culvert. No defined channel or fish habitat.	664689	6686026
130.9	Dry culvert. No defined channel or fish habitat.	665147	6685789
132.4	Dry culvert. No defined channel or fish habitat.	666514	6685080
133.1	Dry culvert. No defined channel or fish habitat.	667123	6684764
134.1	Dry culvert. No defined channel or fish habitat.	667975	6684323
135.0	Dry culvert. No defined channel or fish habitat.	668760	6683915
136.0	Dry culvert. No defined channel or fish habitat. Close to proposed gravel pit location	669625	6683467
136.4	Dry culvert. No defined channel or fish habitat. Small wetland pond 85 m downstream of highway. No surface flow connectivity present.	670031	6683257
137.2	Dry culvert. No defined channel or fish habitat.	670759	6682879
138.3	Dry culvert. No defined channel or fish habitat. Historic pit site with ponded water on the upstream side of highway. No surface flow connectivity present.	671681	6682399
139.5	Wet culvert. Pooled rainwater. No channel or fish habitat. Close proximity to historic pit site with ponded water on the upstream side of highway. No surface flow connectivity present.	672736	6681852
140.4	Wet culvert. Pooled rainwater. No channel or fish habitat. Close proximity to historic pit site with ponded water on the upstream side of highway. No surface flow connectivity present.	673573	6681416
141.4	Dry culvert. No defined channel or fish habitat.	674465	6680980
141.9	Dry culvert. No defined channel or fish habitat.	674919	6680766
142.8	Wet culvert. Pooled rainwater. No channel or fish habitat.	675721	6680391
144.8	Dry culvert. No defined channel or fish habitat.	677544	6679537
145.7	Dry culvert. Pooled rainwater in upstream ditch. No channel or fish habitat. Twin culverts.	678369	6679148
146.1	Dry culvert. No defined channel or fish habitat.	678667	6678903
146.3	Dry culvert. No defined channel or fish habitat.	678819	6678770
146.8	Dry culvert. No defined channel or fish habitat.	679226	6678416
147.1	Dry culvert. No defined channel or fish habitat.	679430	6678238
147.6	Dry culvert. No defined channel or fish habitat.	679774	6677937
148.7	Wet culvert. Pooled rainwater. No channel or fish habitat. Small wetland pond 15 m upstream of highway. No downstream connectivity present.	680622	6677196
149.0	Wet culvert. Pooled rainwater. No channel or fish habitat. Small wetland pond 15 m upstream of highway. No downstream connectivity present.	680876	6676974
150.0	Wet culvert. Pooled rainwater. No channel or fish habitat. Upstream and downstream wetland ponds present.	681614	6676329



BASIC IMPACT ANALYSIS FOR WOOD BUFFALO NATIONAL PARK HIGHWAY 5 ROADWAY REHABILITATION

Highway 5 Kilometer Marker	Associated Aquatic Feature	UTN NAD 83 (11 U)	
		Easting (m)	Northing (m)
151.3	Dry culvert. Pooled rainwater in upstream ditch. No channel or fish habitat.	682582	6675485
153.5	Dry culvert. No defined channel or fish habitat.	684263	6674052
153.9	Dry culvert. No defined channel or fish habitat.	684641	6673933
154.6	Dry culvert. No defined channel or fish habitat based on desktop review.	685279	6673736
155.5	Dry culvert. No defined channel or fish habitat.	686138	6673470
155.8	Dry culvert. No defined channel or fish habitat.	686473	6673367
156.3	Dry culvert. No defined channel or fish habitat.	686908	6673233
157.3	Dry culvert. No defined channel or fish habitat.	687860	6672938
158.5	Dry culvert. No defined channel or fish habitat.	689021	6672729
160.2	Dry culvert. No defined channel or fish habitat based on desktop review.	690752	6672936
160.7	Dry culvert. No defined channel or fish habitat.	691271	6672990
161.5	Dry culvert. No defined channel or fish habitat.	691999	6673085
162.6	Dry culvert. No defined channel or fish habitat.	693119	6673221
163.2	Dry culvert. No defined channel or fish habitat.	693726	6673294
164.2	Dry culvert. No defined channel or fish habitat.	694720	6673413
165.2	Dry culvert. No defined channel or fish habitat.	695705	6673529
165.5	Dry culvert. No defined channel or fish habitat.	696000	6673460
167.5	Dry culvert. Pooled rainwater in upstream ditch. No channel or fish habitat.	697767	6672506
168.6	Dry culvert. No defined channel or fish habitat.	698752	6671974
Watercourses with defined channel or fish habitats			
144.2	Unnamed Watercourse. Tributary to Klewi River. Ephemeral creek with seasonal fish habitat.	676966	6679808
151.6	Klewi River Crossing. Slow-moving stream with pooled habitats. Small fish observed. Twin culverts.	682849	6675252
152.8	Unnamed Watercourse. Tributary to Klewi River. Shallow water depth limits fish habitat. Twin culverts.	683698	6674509
166.6	Unnamed Watercourse. Tributary to Sass River. Shallow water depth limits fish habitat.	696944	6672950



6.1.1 Fish and Fish Habitat

Between Highway 5 km 106 and km 170, various crossings have been identified for widening/culvert work. The proposed crossings range from permanent watercourses with high quality fish habitat and the presence of fish, to ephemeral drainages without defined bed and banks and no potential fish habitat.

Along this route, 77 ephemeral drainages were identified (including those located near the km 113.5, km 136, and km 162 borrow pits) (Table 3). Of these 77 ephemeral drainages, 71 (including the Nyarling River at km 119.2 and those located near the borrow pit locations at km 113.5, km 136, and km 162) were determined to be ephemeral and dry at the time of survey with no defined channels or fish habitats, despite heavy rainfall during the field program (Table 3). The Nyarling River, despite being a named watercourse, was completely dry at the time of the field program. This was expected based on information provided by the SWNWT Field Unit, which indicated that this area consisted of subsurface flows, even during peak flow periods (Irwin 2016). The river flows underground for 26 km through karst terrain (PCA 2016). The remaining six ephemeral drainages had either shallow pooled or flowing water present, as a result of rainwater, but had no defined channel or fish habitats.

Four watercourses with fish habitat were identified in the LSA:

- An unnamed tributary to the Klewi River at km 144.1. This small ephemeral creek was flowing at the time of the field program and had seasonal fish habitat.
- Klewi River at km 151.6. This permanent watercourse was identified as a slow-moving, meandering river with pooled habitats. Small fish were observed at this site during the field program.
- An unnamed tributary to the Klewi River at km 152.8. This small and shallow ephemeral creek was flowing at the time of the field program and had limited fish habitat.
- An unnamed tributary to the Sass River at km 166.6. This shallow ephemeral creek was flowing at the time of the field program and had limited fish habitat.

A summary of existing fish and fish habitat information and the data collected during the June 2016 field program is provided below for the four identified watercourses with fish habitat (three in the Klewi River catchment, and one in the Sass River catchment). Existing information was only available for the Klewi River and the Sass River at these locations along Highway 5 (PCA 2013; Irwin 2016). Site photos of these four watercourses are provided in Appendix D.

Klewi River Catchment

At km 144.1, an unnamed tributary of the Klewi River consists of a small poorly-defined ephemeral creek that flows downstream into a large wetland complex and then downstream into a larger unnamed tributary of the Klewi River. The substrate at the highway crossing is predominantly fine sand and gravel. Very little instream cover for fish was documented, with only submergent and emergent vegetation being present. In defined sections, the bankfull width was approximately 1.2 m with a wetted width of 1 m and a maximum depth of 0.1 m at the time of the field program (Appendix D, Figure D-1).



BASIC IMPACT ANALYSIS FOR WOOD BUFFALO NATIONAL PARK HIGHWAY 5 ROADWAY REHABILITATION

At km 151.6, the Keweenaw River crosses Highway 5 through two culverts. The channel has defined bed and banks and was flowing at the time of the field program. Fish habitat includes deep, slow-moving pooled habitat that forms a large meandering system on both sides of the highway. The substrates are predominantly fine sands and gravel, with cobble located around the culvert inlet and outlet. Limited instream cover for fish was documented, with submergent and emergent vegetation and woody debris being present. Some overhanging trees are present on the upstream side of the highway, about 50 m from the culvert inlet. The bankfull width was approximately 15 m on the upstream side and 21.5 m on the downstream side of Highway 5, with a wetted width of 11 m on the upstream side and 18 m on the downstream side, and a maximum depth of 1.2 m at the time of the field program. No fish passage restrictions at the culverts were identified at this location (Appendix D, Figures D-2 and D-3). A summary of in situ water quality parameters recorded at this site is provided in Table 4.

Table 4: Summary of in situ Water Quality Parameters at Highway 5 km 151.6 (Keweenaw River)

Water Depth (m)	pH	Temperature (°C)	Specific Conductivity (µS/cm)
0.3	7.4	19.2	1,365

Note: µS/cm: microSiemens per centimetre.

At km 152.8, an unnamed tributary of the Keweenaw River consists of a small ephemeral creek that flows into a downstream wetland with limited connection downstream to the Keweenaw River. The substrate is predominantly fine sand and gravel. Limited instream cover for fish was documented with submergent and emergent vegetation and woody debris present. The bankfull width was approximately 9 m on the upstream side and 4 m on the downstream side of Highway 5, with a wetted width of 6 m on the upstream side and 4 m on the downstream side, and a maximum depth of 0.4 m at the time of the field program (Appendix D, Figures D-4 and D-5).

Three fish species have been documented in the Keweenaw River system (Irwin 2016; Table 5); these are small-bodied forage fish with a known wide distribution range and wide habitat tolerance (Nelson and Paetz 1972a,b; Zaidan 2007). None of these three fish species is federally listed under the *Species at Risk Act* (SARA) (ECCC 2016a), nor in the territorial NWT Species at Risk Infobase (GNWT 2016).

Table 5: Documented Fish Species in the Keweenaw River

Common Name	Scientific Name	COSEWIC Status ^(a)	Federal SARA Legal Status ^(a)	Territorial SAR Rank ^(b)
Brook Stickleback	<i>Culaea inconstans</i>	n/a	n/a	Secure
Finescale Dace	<i>Phoxinus neogaeus</i>	n/a	n/a	Secure
Pearl Dace	<i>Margariscus margarita</i>	n/a	n/a	Secure

Source: Irwin (2016)

^(a) ECCC 2016a

^(b) GNWT 2016

Due to the shallow depths (0.1 m to 0.4 m) and ephemeral nature of the tributaries at km 144.1 and km 152.8, and the fact that these two watercourses have limited potential connection to the Keweenaw River via large wetland complexes, it is unknown if these fish species are present at the km 144.1 and km 152.8 crossing locations. Small juvenile fish were observed in the Keweenaw River at km 151.6 during the June 2016 field program; however, the species was not determined during the assessment. Based on the habitat descriptions, it is possible that one or more of the forage fish species documented in the Keweenaw River could be present at these three crossing locations. For example, Brook Stickleback are known to occur in ditches and shallow pool habitats (Stewart et. al. 2007).



BASIC IMPACT ANALYSIS FOR WOOD BUFFALO NATIONAL PARK HIGHWAY 5 ROADWAY REHABILITATION

Sass River Catchment

At km 166.6, an unnamed tributary to the Sass River consisted of a deep, slow-flowing and meandering creek that flows into downstream wetland habitats, which are connected to the Sass River. Upstream and downstream of Highway 5, the fish habitat was predominantly pool habitat. A small, buried culvert was found on the upstream (eastbound) side of Highway 5 and was restricting flow. Substrates were predominantly fine sands and gravel. Instream cover for fish was abundant, with submerged and emergent vegetation, woody debris, water depth and overhanging vegetation being present. The bankfull width was approximately 15 m on the upstream side and 12 m on the downstream side of Highway 5, with a wetted width of 8 m on the upstream side and 5 m on the downstream side. A maximum depth of 2 m was measured for the reach at the time of the field program. Connectivity to the downstream Sass River was undetermined, as the area downstream of the culvert appeared isolated, in terms of surface flows, with wetland vegetation blocking the downstream flows (Photo D-6 and D7, Appendix D). A summary of in situ water quality parameters recorded at this site is provided in Table 6.

Table 6: Summary of in situ Water Quality Parameters at Highway 5 km 166.6 (unnamed tributary)

Water Depth (m)	pH	Temperature (°C)	Specific Conductivity (µS/cm)
0.3	7.0	18.3	750

Note: µS/cm: microSiemens per centimetre.

Eight fish species have been documented in the Sass River system (Irwin 2016; Table 7). Seven of these are small-bodied forage fish with a known wide distribution range and wide habitat tolerance (Allen 1956; Nelson and Paetz 1972a, b; Zaidan 2007), while one species (Longnose Sucker) is a large-bodied fish species. None of these fish species is federally listed under the *Species at Risk Act* (SARA) (ECCC 2016a), nor in the territorial NWT Species at Risk Infobase (GNWT 2016).

Table 7: Documented Fish Species in the Sass River

Common Name	Scientific Name	COSEWIC Status ^(a)	Federal SARA Legal Status ^(a)	Territorial SAR Rank ^(b)
Brook Stickleback	<i>Culaea inconstans</i>	n/a	n/a	Secure
Fathead Minnow	<i>Pimephales promelas</i>	n/a	n/a	Undetermined
Finescale Dace	<i>Phoxinus neogaeus</i>	n/a	n/a	Secure
Lake Chub	<i>Couesius plumbeus</i>	n/a	n/a	Secure
Longnose Sucker	<i>Catostomus catostomus</i>	n/a	n/a	Secure
Northern Redbelly Dace	<i>Phoxinus eos</i>	n/a	n/a	Secure
Pearl Dace	<i>Margariscus margarita</i>	n/a	n/a	Secure
Spottail Shiner	<i>Notropis hudsonius</i>	n/a	n/a	Secure

Source: Irwin (2016)

^(a) ECCC 2016a

^(b) GNWT 2016

Based on the habitats found at the km 166.6 crossing location and the proximity to the Sass River, it is possible that the observed small-bodied fish species (Table 5) may be present. It is unlikely that Longnose Suckers are present at the km 166.6 crossing location due to the large wetland complex downstream limiting migration from downstream habitats.



The potential effects of the Project on fish and fish habitat include direct disturbance of the bed and banks of watercourses and alteration of the riparian area for culvert replacements and extensions at each location, as well as the use of isolation structures and diversions during instream construction, if required. Additional potential effects of the Project on fish and fish habitat are sediment entrainment and transport downstream during disturbance of the bed and banks or through surface runoff during construction, resulting in increased levels of suspended sediment and sediment deposition. Fish and fish habitat has been selected as a VC and carried through to the effects analysis. No specific species have been selected within the fish and fish habitat VC group because any effects of the Project on fish and/or fish habitat are likely to apply to all species.

6.1.2 Hydrology

As described in the section above, of the 81 culverts identified along the route, 77 were ephemeral drainages that did not have defined channels (Table 3). For the four watercourses with fish habitat, visual observation of flows at each crossing were made:

- The unnamed tributary to the Klewi River at km 144.1 flows through a single culvert that was not restricting flows at the time of the field site visit and had adequate depth (i.e., would not restrict fish passage for small-bodied fish). The maximum water depth of the assessed reach was measured at 0.1 m, with observed flow being estimated at less than 0.1 m/s.
- The twin culverts at the Klewi River crossing at km 151.6 are new culverts and do not restrict flow or fish passage. The maximum water depth of the assessed reach was measured at 1.2 m, with observed flow being estimated at less than 0.1 m/s.
- The unnamed tributary to the Klewi River at km 152.8 flows through twin culverts that were not restricting flows at the time of the field site visit and had adequate depth (i.e., would not restrict fish passage). The maximum water depth of the assessed reach was measured at 0.4 m, with observed flow being estimated at less than 0.1 m/s.
- The unnamed tributary to the Sass River at km 166.6 flows through a single culvert that was restricting flows at the time of the field site visit. The culvert was completely submerged at the upstream, inlet side of the highway where a small whirlpool was observed in the pool at the culvert inlet. The maximum water depth of the assessed reach was measured at 2 m, with observed flow being estimated at less than 0.1 m/s, except at the culvert inlet and outlet, where flows were observed to be faster.

Potential effects of the Project on hydrology are most likely to include temporary diversions during construction (i.e., isolation construction techniques such as flumes, instream diversions, or pumps) to divert the water flow around any isolated construction areas. Flow paths around diversions will be modified. During operations, changes to channel gradient, channel capacity, flow paths, or the culvert inlet or outlet conditions may create preferential flow paths, alter the existing flow patterns where culverts are replaced and potentially reduce the quantity of surface water in the LSA; therefore, hydrology has been selected as a VC and carried through to the effects analysis.



6.1.3 Surface Water Quality

During the June 2016 reconnaissance, the watercourses and drainages identified at the crossing locations were primarily dry or with limited water from recent precipitation. Basic in situ water quality parameters (conductivity, pH, temperature) were measured at two crossings (km 151.6 and km 166.6; Tables 4 and 6). Measured pH values were 7.0 and 7.4, which are within the pH guideline (6.5 to 9.0) (CCME 2008). Water temperatures were 18.3 and 19.2°C, and specific conductivity measurements were 750 and 1,365 microSiemens per centimetre (µS/cm). Dissolved oxygen (DO) concentrations were not measured due to a malfunction with the meter.

The potential effects of the Project on water quality include sediment entrainment and transport downstream during disturbance of the bed and banks or from soil erosion from surface runoff during construction activities. This could result in increased turbidity and levels of suspended sediments in watercourses. There is also a potential for spills to affect water quality from machinery working in or close to watercourses along the route. Therefore, surface water quality has been selected as a VC and carried through to the effects analysis.

6.2 Vegetation

Vegetation Communities

The LSA is located in the Slave Upland portion of the Taiga Plains Mid-Boreal Ecoregion (ECG 2007 [rev2009]) (Figure 1). The Taiga Plains Mid-Boreal Ecoregion is a low relief region with extensive peatland areas. Uplands tend to be level to undulating, often with variably textured glacial deposits. Within the Slave Upland, vegetation distribution is largely driven by patterns in surficial landforms and the underlying geology. A complex mosaic of upland vegetation and wetlands result from glacial landforms and deposits overlying highly calcareous limestone bedrock. Jack Pine (*Pinus banksiana*) and White Spruce (*Picea glauca*) are dominant on uplands, with Trembling Aspen (*Populus tremuloides*) and a minimal shrub and herbaceous understorey becoming prevalent on the driest of sites. Black Spruce (*Picea mariana*) and White Spruce stands with the occasional Larch (*Larix laricina*) form transitional areas in lower landscape positions between uplands and wetlands and ponds. Calcareous fen wetlands are dominated by Dwarf Birch (*Betula glandulosa*) or Sedges (*Carex spp.*), while poorer peatland areas are characterized by stunted Black Spruce, Labrador Tea (*Ledum groenlandicum*) and lichen and Peat Moss (*Sphagnum spp.*), Sedges and Cotton-grass (*Eriophorum spp.*) communities in a complex of peat plateaus and collapse scars, respectively (ECG 2007 [rev 2009]).

The LSA contains primarily upland, open to sparsely treed coniferous vegetation communities, as well as areas that have been recently burned by forest fires. Wetlands and open water are common within this portion of WBNP, though have lesser areal extent in the LSA. Wetlands within the LSA consist of treed, herbaceous and shrub-dominated wetland types and associated transitional riparian habitats. Riparian vegetation communities are transitional zones between wetlands or ponds and terrestrial ecosystems, and are ecologically important within the LSA. Because riparian areas provide habitat for plants, invertebrates, fish, amphibians, birds, and mammals, they contribute substantially to local and regional biodiversity. Exposed land is also a common landcover type within the LSA, consisting of the largely unvegetated or sparsely vegetated areas adjacent to Highway 5 that have been previously affected during development of the Highway and seasonal snow and ice management activities (Kinley 2016).

Invasive plant species (i.e., weeds) may be present within the LSA. Invasive plant species may also be introduced and / or spread by construction equipment and other vehicles carrying seeds or plant propagules from other work sites.



To accommodate portions of the roadway expansion, clearing and grubbing of vegetation will be required. Vegetation clearing is also proposed for the three gravel pit expansion sites, which will result in losses of terrestrial vegetation communities within the LSA. Additionally, there may be direct or indirect effects to adjacent wetland and riparian communities through culvert extensions or replacements and potential erosion or sedimentation from the Highway 5 road widening work. Therefore, vegetation communities have been selected as a VC and carried forward to the effects analysis.

Vegetation Elements of Management Concern

Golder queried the Parks Canada Biotics Explorer (PCA 2013) and the Northwest Territories Species at Risk Infobase (GNWT 2016) to identify plants species that have been previously identified or have the potential to occur in the LSA. Listed plants are defined as meeting one or more of the following criteria:

- ranked as 'Sensitive', 'May be at Risk' or 'At Risk' by the Northwest Territories Species at Risk Infobase (GNWT 2016);
- assessed as 'Special Concern', 'Threatened', or 'Endangered' by COSEWIC (ECCC 2016a); or
- listed as 'Special Concern', 'Threatened', or 'Endangered' under SARA (ECCC 2016a).

No territorially or federally listed species occurrences have been documented by Parks Canada within the Project footprint or LSA.

Specific rare plant surveys have not been completed within the Project footprint or LSA for this Project given the existing level of vegetation disturbance within the proposed Project footprint.

A list of VEMCs with the potential to occur in the LSA was compiled, based on known habitat associations (Appendix C Table C-1). This summary is not intended to be an exhaustive list of all possible VEMCs that could be in the LSA; however, it was intended to help characterize high potential VEMC habitat within the LSA. Forested areas were determined to have low potential for VEMCs within the LSA; however, wetlands, riparian and very dry (i.e. sandy or exposed rock) areas have higher potential for VEMCs based on habitat associations. To be precautionary, wetland, riparian and very dry VEMCs have been selected to carry forward in the impact analysis.

6.3 Wildlife and Wildlife Habitat

Located within WBNP, the LSA is located in the Slave Upland portion of the Taiga Plains Mid-Boreal Ecoregion. More than 50 species of mammals and over 250 species of birds occur in the Taiga Plains (ECG 2007 [rev 2009]). WBNP was created in 1922 to protect the last free roaming herds of wood bison (*Bison bison athabasca*) in northern Canada (Parks Canada 2010). Whooping Crane nesting areas in the park were listed on the Ramsar List of Wetlands of International Importance in 1982 (PCA 2010).



BASIC IMPACT ANALYSIS FOR WOOD BUFFALO NATIONAL PARK HIGHWAY 5 ROADWAY REHABILITATION

Habitat within the LSA is largely altered by Highway 5 and the adjacent RoW. However, beyond this disturbance, habitat is primarily upland, open to sparsely treed coniferous vegetation communities, as well as areas that have been recently burned by forest fires (ECG 2007 [rev 2009]). Small groups of the boreal ecotype of Woodland Caribou (*Rangifer tarandus caribou*) are scattered throughout the Mid-Boreal Ecoregion, usually in association with peatlands that support good lichen growth (ECG 2007 [rev 2009]). Moose (*Alces alces*) occur primarily in early-successional mixed-wood forest and riparian areas where forage opportunities are most plentiful, and White-Tailed Deer (*Odocoileus virginianus*) also occur in this ecoregion (ECG 2007 [rev 2009]). Canada Lynx (*Lynx canadensis*) are also attracted to post-fire early successional forest, which provides optimal habitat for Snowshoe Hares (*Lepus americanus*), the Lynx's primary prey (ECG 2007 [rev 2009]). Other carnivores in the region include Black Bear (*Ursus americanus*), Gray Wolf (*Canis lupus*), coyote (*Canis latrans*) and Red Fox (*Vulpes vulpes*) (ECG 2007 [rev 2009]). American Marten (*Martes americana*) and Fisher (*Martes pennanti*) occur in coniferous and mixed-wood forests with high continuous canopy cover, and Wolverine (*Gulo gulo*) range widely (ECG 2007 [rev 2009]).

Wetlands and open water are common in the Taiga Plains, though have lesser areal extent in the LSA compared to surrounding areas. Wetlands in the LSA consist of treed, herbaceous and shrub-dominated wetland types and associated transitional riparian habitats. Mink (*Neovison vison*) inhabit riparian areas and river otters (*Lontra canadensis*) occur primarily along larger rivers (ECG 2007 [rev 2009]). Beavers (*Castor canadensis*) are common along watercourses with woody deciduous vegetation and muskrats (*Ondatra zibethicus*) in marshy wetlands (ECG 2007 [rev 2009]). Wetlands provide nesting habitat for many waterfowl species, as well as migratory stop over habitat for waterfowl that breed further north (ECG 2007 [rev 2009]). Wetlands also provide suitable breeding habitat for several species of amphibians.

Over 250 species of birds occur in the Taiga Plains. Few bird species reside year-round due to limited food availability in the winter. The majority of birds breeding in the Taiga Plains migrate south for the winter to tropical or subtropical destinations (ECG 2007 [rev 2009]). Many species nesting in the Arctic either winter in the Taiga Plains or pass through during migration. Certain owl species and some songbird species that rely on tree seeds as a year-round food supply, such as Pine Grosbeaks (*Pinicola enucleator*) and White-Winged Crossbills (*Loxia leucoptera*), occupy the region year-round (ECG 2007 [rev 2009]).

Golder compiled a list of species of management concern that have been previously identified or have the potential to occur in and around the Project footprint by querying the Parks Canada Biotics Web Explorer for regularly occurring species in WBNP (PCA 2013) and the Northwest Territories Species at Risk Infobase (NWT DENR 2012). A total of 38 wildlife species of conservation concern occur or have the potential to occur in the LSA; two amphibian species, 29 bird species, and seven mammalian species (Appendix C; Table C-2). Species or species groups selected as wildlife VCs for the Project are those that are of conservation or management concern, have a moderate or high potential of occurring within the LSA, and have potential to be affected by the Project (Table 8). These wildlife VCs have therefore been selected to be carried forward to the effects analysis.



BASIC IMPACT ANALYSIS FOR WOOD BUFFALO NATIONAL PARK HIGHWAY 5 ROADWAY REHABILITATION

Table 8: Wildlife Valued Components and their Potential for Project Interactions

Common Name	Scientific Name	NWT Status	COSEWIC Status ^(a)	SARA ^{a)}	Regularity within WBNP ^(b)	Population ^(c)	Potential for Project Interactions
Amphibians							
Canadian Toad	<i>Anaxyrus hemiophrys</i>	Sensitive	Not at Risk	n/a	Regularly occurring	Year-round	Moderate – potential habitat present in the LSA, which may be impacted by the Project.
Birds							
Migratory Birds	n/a	n/a	n/a	n/a	Regularly occurring	Breeding	High – habitat present in the LSA, which may be impacted by the Project. Potential for incidental take.
Whooping Crane	<i>Grus americana</i>	At Risk	Endangered	Schedule 1 / Endangered	Regularly occurring	Breeding	Moderate – Potential nesting habitat and known nesting sites are kilometres away from Project activities, but birds may move through the LSA.
Bats							
Little Brown Myotis Northern Myotis	<i>Myotis lucifugus</i> <i>Myotis septentrionalis</i>	May Be At Risk	Endangered	Schedule 1 / Endangered	Regularly occurring	Year-round	Moderate – habitat present in the LSA, which may be impacted by the Project. Generally, found in low densities with patchy distribution, reducing the likelihood of Project interactions.
Carnivore/ Furbearer							
Wolverine	<i>Gulo gulo</i>	Sensitive	Special Concern (western population)	No Schedule / No Status	Regularly occurring	Year-round	Moderate – habitat is known to be present in the LSA and may be impacted by the Project due to sensory disturbance during construction. Generally, found in very low densities.
Ungulates							
Wood Bison	<i>Bison bison athabasca</i> (<i>Bos bison athabasca</i>)	At Risk	Special Concern	Schedule 1 / Threatened	Regularly occurring	Breeding	High – habitat is known to be present in the LSA and may be impacted by the Project. Observed in the LSA.
Woodland Caribou (Boreal population)	<i>Rangifer tarandus caribou</i>	Sensitive	Threatened	Schedule 1 / Threatened	Regularly occurring	Year-round	Moderate – habitat is known to be present in the LSA and may be impacted by the Project. Generally, found in low densities.

^(a) **COSEWIC** - Committee on the Status of Endangered Wildlife in Canada; **SARA** - *Species at Risk Act* (ECCC 2016a).

^(b) **Regularly occurring** - Occurrence of the Element is consistent in the Managed Area (e.g., it may migrate in and out of the area, but it returns on a regular basis). **Accidental/Nonregular** - The Element does not persist or return regularly in the Managed Area. **Unknown/Undetermined** - Regularity of the Element in the Managed Area has not been, or cannot be, determined.

^(c) **Year-round** - A significant proportion of individuals of the Element are non-migratory or remain in the Managed Area throughout the year. **Breeding** - Individuals of the Element occur in this Managed Area as part-time (seasonal) residents when breeding, and they are not year-round residents in any significant numbers. **Nonbreeding** - Individuals of the Element occur in this Managed Area as part-time (seasonal) residents when not breeding, and they are not year-round or breeding season residents in any significant numbers. **Transient** - Individuals of the Element are long distant migrants that regularly occur in the Managed Area as a transient during migration. **Unknown** - The residency status of the individuals of the Element in the Managed Area has not been, or cannot be, determined.





6.3.1 Amphibians

Two amphibian species of conservation concern have potential to occur in the LSA; Northern Leopard Frog (*Lithobates pipiens*), and Canadian Toad (*Anaxyrus hemiophrys*). Northern Leopard Frog is federally listed as Special Concern on Schedule 1 of SARA (ECCC 2016a), although available data do not confirm their occurrence within WBNP (PCA 2013). Canadian toad is not federally listed, but is listed as Sensitive in the NWT (GNWT 2016) and is known to occur within WBNP (PCA 2013). Canadian toads occupy a wide variety of wetlands during the breeding season, then move to adjacent uplands up to two kilometers from their breeding pond (Hamilton et al. 1998; Westworth 2002). In winter, Canadian toads burrow below the frost line to avoid subzero winter temperatures and hibernate. Hibernacula occur in upland areas with loose, coarse-textured, well-drained soils that have a low soil moisture content, which are necessary soil conditions to enable digging and over-winter survival (Golder 2006; Hamilton et al. 1998). In the LSA, sand cuts that may provide suitable overwintering habitat for Canadian Toad were observed within km 106, km 143, km 151 and km 161 (Appendix A).

Canadian Toads are limited by the need for a combination of suitable breeding, foraging and over-wintering habitat within a limited spatial area (Kuyt 1991; Roberts and Lewin 1979). Draining and alteration of wetlands, modification to adjacent upland area and hibernacula disturbance are all threats to the Canadian toad (Browne 2009; Hamilton et al., 1998). Timoney (1996) found disturbance to part of a hibernacula in WBNP by road maintenance equipment had deterred its use by Canadian Toads. Pathogens, acidification and climate change may be other limiting factors (Browne 2009; Hamilton et al., 1998). The Project has the potential to affect Canadian Toads and their habitat, and Canadian Toad has been selected as a VC to carry forward through the effects analysis.

Like Canadian Toads, Northern Leopard Frogs also breed in a range of wetlands (COSEWIC 2009). Therefore, although Northern Leopard Frogs are more limited in their use of terrestrial habitat in summer and overwinter at the bottom of ponds rather than in hibernacula, assessed effects of the Project on Canadian Toads will effectively represent the effects of the Project on Northern Leopard Frog. Although limited in extent in the LSA, wetlands may function as suitable habitat for breeding, and adjacent terrestrial habitat may function as foraging habitat.

6.3.2 Migratory Birds

Several species of migratory birds, some of which are of conservation concern (Appendix C, Table C-2), may use the Project footprint for breeding, nesting and foraging and may be directly impacted by vegetation clearing and ground disturbance associated with Project construction. Migratory birds utilize a range of habitat types for foraging and breeding. Vegetation clearing and ground disturbance activities associated with Project construction may result in limited direct habitat loss for some migratory bird species, and has the potential to result in the destruction of nests, eggs, and young birds if construction occurs during the general migratory bird nesting season (i.e., May 3 to August 20 for nesting zone B7 [ECCC 2016b]).



BASIC IMPACT ANALYSIS FOR WOOD BUFFALO NATIONAL PARK HIGHWAY 5 ROADWAY REHABILITATION

Of the migratory birds that have potential to occur in the LSA, Rusty Blackbird, Peregrine Falcon and Yellow Rail are listed as Special Concern, Common Nighthawk and Olive-sided Flycatcher are listed as Threatened, and Whooping Crane is listed as Endangered on Schedule 1 of SARA. Although not listed by SARA, COSEWIC lists Bank Swallow and Barn Swallow as Threatened, and Horned Grebe and Red-necked Phalarope as Special Concern. Unlike the other migratory birds of conservation concern mentioned, Short-eared Owl is not protected by the Migratory Birds Convention Act, 1994 (MBCA) (GoC 1994), but is migratory in the northern part of its range and is also listed as Special Concern on Schedule 1 of SARA. No other migratory birds with potential to occur in the LSA are COSEWIC or SARA-listed as Extirpated, Endangered, Threatened or Special Concern. Highway widening activities will occur within the existing Highway 5 RoW, but could impact ground nesting species such as Common Nighthawk and Short-eared Owl and species nesting in low vegetation in and around wetlands (e.g., Rusty Blackbird, Yellow Rail, Horned Grebe, and Red-necked Phalarope). Tree and shrub clearing may be required for borrow pit expansion, which could impact tree nesting species such as Olive-sided Flycatcher. In addition, bank swallows excavate nest burrows at artificial and natural sites with vertical sand-silt banks and may nest in old borrow pits provided suitable substrate is present (Garrison 1999). A Bank Swallow colony was observed in the km 113.5 borrow pit. Both bank and barn swallow are aerial insectivores (Garrison 1999, Brown and Brown 1999) and may forage over the Project. Peregrine falcon may hunt over the LSA, but cliffs for nesting are not present. Although there are differences in habitat associations and the likelihood of Project interactions, impacts to migratory birds in the LSA can be effectively generalized for the purposes of conducting the impact assessment. Therefore, migratory birds as a group have been selected as a VC to carry forward through the effects analysis.

Whooping Crane

Whooping crane is listed as Endangered on Schedule 1 of SARA (ECCC 2016a). The only wild, self-sustaining population of Whooping Cranes breeds in WBNP, occupying a unique wetland complex characterized by small ponds with a soft substrate, fringed by aquatic vegetation such as sedges, soft-stemmed bulrush (*Schoenoplectus tabernaemontani*) and cattail (*Typha spp.*) (COSEWIC 2010, Urbanek and Lewis 2015). Home ranges are estimated to be between 3.2 and 12 km² (COSEWIC 2010). Whooping cranes arrive on their breeding grounds in late-April, with nesting beginning shortly thereafter, and depart on their fall migration around mid-September (COSEWIC 2010). This population winters in estuarine marshes along the Texas Gulf Coast, primarily at the Aransas National Wildlife Refuge (COSEWIC 2010). During migration, whooping cranes use a variety of wetlands and croplands for feeding and roosting (COSEWIC 2010, Urbanek and Lewis 2015). Although Whooping Crane populations had dropped to near-extinction in the early 20th century, through protection of their wintering habitat in Texas and their nesting habitat in WBNP, the species had rebounded to 270 birds as of 2008 (COSEWIC 2010).

Loss of suitable breeding habitat is likely a primary reason why the breeding range is restricted to WBNP (COSEWIC 2010). However, only about 10% of suitable breeding habitat is currently utilized, suggesting that suitable nesting habitat is likely not a limiting factor for continued population growth within the Park (COSEWIC 2010, Urbanek and Lewis 2015). Risk of catastrophic events, including severe weather, drought and fire is present for breeding grounds in WBNP. Whooping Cranes are considered most vulnerable on their wintering grounds in Texas due to ongoing loss and degradation of coastal wetland habitat, as well as due to their dependence on blue crab (*Callinectes sapidus*), which can vary in availability (COSEWIC 2010, Urbanket et al. 2015).



The Project LSA is kilometres away from identified Whooping Crane CH, as defined in the Recovery Strategy for the Whooping Crane in Canada (EC 2007). The closest historical nest locations have been 10.9 km from the km 113.5 borrow pit in 2015, 8.3 km from the km 136 borrow pit in 1976, and 8.0 km from the km 162 borrow pit in 2000. However, expansion of the km 136 borrow pit will occur adjacent to the Zone 1 Special Preservation Whooping Crane Nesting Area in WBNP, within which CH occurs. Because of conservation concern regarding Whooping Crane and the proximity of the Zone 1 Special Preservation area, the whooping crane has been selected as a VC to carry forward through the effects analysis.

6.3.3 Bats

Two bats of conservation concern have been documented in Wood Buffalo National Park; Little Brown Myotis (*Myotis lucifugus*) and Northern Myotis (*Myotis septentrionalis*) are listed as Endangered on Schedule 1 of SARA and are known to occur within WBNP (PCA 2013).

Both Little Brown Myotis and Northern Myotis overwinter in cold and humid hibernacula (e.g. caves, mine shafts). Maternity colonies are usually established in large-diameter trees, although human-made structures (e.g., buildings) are also used by little brown myotis (COSEWIC 2013a). A wide variety of structures are used for day roosts, including buildings, rock crevices, flaking bark and tree cavities (COSEWIC 2013a). A preference for old growth forest with large diameter trees and increased snag availability appears more important for roosting than type of forest (COSEWIC 2013a). Both species forage over water or along the edges of lakes and streams, and forest gaps, consuming insects or other invertebrates (COSEWIC 2013a).

White-nose syndrome (WNS) constitutes the single most serious threat for both species (COSEWIC 2013a). WNS is a fungal disease caused by an introduced pathogen that interrupts hibernation, increasing their metabolism and resulting in starvation, dehydration and exposure (COSEWIC 2013a).

A hibernaculum for Little Brown Myotis and Northern Myotis is known to occur in WBNP, but well outside the LSA in northwest Alberta (Reimer et al. 2014). The LSA contains suitable forest for roosting, as well as suitable foraging habitat. Because Little Brown and Northern Myotis roosting and/or forage sites may be affected by the Project, these species been selected together as a VC as representative bats to be carried forward through the effects analysis.

6.3.4 Carnivores / Furbearers

The carnivores or furbearers of conservation concern likely to occur in WBNP are Fisher (*Martes pennanti*) and Wolverine (*Gulo gulo*). These species are not SARA-listed, but Wolverine is listed as Special Concern by COSEWIC (ECCC 2016a).

Wolverine is a wide-ranging species that requires continuous tracts of undisturbed land. Suitable habitats must have an adequate year-round supply of food, mainly consisting of small mammals and the carcasses of large ungulates (COSEWIC 2014). Generally, wolverine density and habitat use is influenced by food availability, especially ungulate carrion in winter, rather than any specific habitat characteristics (COSEWIC 2014). Wolverine reproduce in areas with persistent spring snow cover, and females typically den under snow-covered rocks, logs or within snow tunnels (COSEWIC 2014).



Wolverines inhabit a variety of treed and treeless vegetation types but tend to avoid areas of human disturbance, especially roads and areas where recreation activities occur (Krebs et al. 2007; Bowman et al. 2010; COSEWIC 2014). Optimal habitat for wolverine is ecologically intact areas where prey and other carnivore species are common and diverse (COSEWIC 2014), making them an effective VC for the assessment of Project effects on other carnivores and furbearers in the region (Cluff and Paquet 2003). The Project may have some limited impacts on Wolverine habitat, and may also result in impacts due to sensory disturbance along Highway 5. Wolverine has been selected as a VC to be carried forward to the effects analysis.

6.3.5 Ungulates

Two ungulates of conservation concern are known to occur in WBNP; Wood Bison and Woodland Caribou.

Wood Bison

Wood Bison is federally listed as Threatened on Schedule 1 of SARA, although COSEWIC has downgraded its listing of the species to Special Concern (ECCC 2016a). Wood Buffalo National Park was established in 1922 and now represents the largest meta-population of wild Wood Bison, which range over 58,000 km² (COSEWIC 2013b).

Wood Bison in WBNP and surrounding subpopulations represent the largest meta-population of wild Wood Bison in Canada (COSEWIC 2013b). Wood Bison prefer open habitats during all seasons, particularly grasslands and sedge meadows associated with watercourses and the fringes of waterbodies (COSEWIC 2013b). Forested areas are used primarily for thermal and escape cover (COSEWIC 2013b). Forage availability and thus habitat selection varies across the range of landscapes they occupy during their seasonal movements. In winter, when food is most limited, Wood Bison forage almost exclusively in meadows and graminoid-dominated shrublands (COSEWIC 2013b). Summer diet consists of a more diverse selection of grasses, sedges, shrubs, and lichen (COSEWIC 2013b).

Wood Bison in and around WBNP are infected by the cattle diseases bovine tuberculosis and bovine brucellosis, as well as anthrax (COSEWIC 2013b). Bison control areas have been created to reduce the spread of bovine tuberculosis and brucellosis from the greater WBNP meta-population, and limit range expansion (COSEWIC 2013b).

Wood bison have been observed in the LSA, which contains suitable foraging habitat, including winter foraging habitat. The Project has the potential to affect Wood Bison and their habitat, and Wood Bison has been selected as a VC to carry forward through the effects analysis.



Woodland Caribou

The Boreal ecotype of Woodland Caribou (*Rangifer tarandus caribou*) is federally listed as Threatened on Schedule 1 of SARA (ECCC 2016a) and is known to occur within WBNP (PCA 2013). The LSA occurs within the Northwest Territories Range, which is considered to be 66% undisturbed and within which the Woodland Caribou population is considered likely self-sustaining (Ziervogel 2016, pers. comm.). Critical habitat for Woodland Caribou in the Northwest Territories Range is the area required to maintain at least 65% 'undisturbed' habitat. 'Undisturbed' habitat in the specific context of Woodland Caribou CH is defined as any area within a defined Woodland Caribou range that is not within an area burned within the last 40 years or within 500 m of human disturbance (EC 2012). Therefore, to be conservative, any habitat outside of a burn or further than 500 m from human disturbance in the Northwest Territories Range should be considered CH. Critical habitat for Woodland Caribou does not occur in the LSA. Expansions of disturbed areas (e.g., borrow pits) will put more habitat within 500 m of human disturbance, reducing the amount of 'undisturbed' habitat. However, less than 0.001% of the Woodland Caribou CH that is present under existing conditions is predicted to be affected by the Project, and expansion of the borrow pits will not reduce the amount of the range that is undisturbed below the 65% threshold. In addition, the majority of affected habitat has been recently burned, and habitat burned in the last 40 years is not critical habitat (EC 2012). Existing seismic lines radiate out from the km 113.5 borrow pit within the planned borrow pit expansion footprint, and the km 136 borrow pit will only expand parallel to Highway 5; therefore, expansion of the borrow pits will not increase access for predators into Woodland Caribou habitat beyond that present under existing conditions. The expansion of the km 113.5 and km 136 borrow pits are not likely to attract or support alternate prey species such as Moose or White-Tailed Deer. As the expansion of the borrow pits is not likely to reduce the amount of the range that is undisturbed below the 65% threshold, increase access for predators, attract or support alternate prey species, or fragment habitat, the functionality of Woodland Caribou CH will not be affected and CH will not be destroyed by the Project (Casimir 2016, pers. comm.).

Woodland Caribou require large, continuous tracts of undisturbed habitat, with a preference for mature or old-growth coniferous forest with abundant lichens within large peatland complexes (EC 2012). Caribou select habitat that provides food, particularly terrestrial and arboreal lichens, and avoid early stage, successional forests and recently disturbed areas where other ungulate species and their predators tend to concentrate (EC 2012). Connectivity of habitat both within a range and between ranges is important for boreal caribou persistence on the landscape (EC 2012).

Boreal Woodland Caribou shift their use of habitat and their distribution within the range in response to natural processes (e.g., fire, blowdown) and human activities (e.g., development, logging, recreation) (EC 2012). The primary threat to most boreal caribou local populations is unnaturally high predation rates as a result of anthropogenic and natural habitat loss, degradation, and fragmentation (EC 2012). Early successional forests resulting from habitat alteration is attractive to other ungulate species (e.g. moose, deer), which then support an increased density of predators and result in increased predation pressure on caribou, particularly by wolves (Latham et al. 2011; EC 2012).

Woodland caribou are known to occur in WBNP and may occur in the LSA. Woodland caribou tend to avoid areas near anthropogenic disturbances such as Highway 5, but may move through the area. The Project has the potential to affect Woodland Caribou and their habitat, and Woodland Caribou has been selected as a VC to carry forward through the effects analysis.



6.4 Terrain and Soils

The terrain surrounding the Project is typically flat to gently rolling with an elevation range typically between 260 m and 280 m. Based on the Geological Survey of Canada Map 220, “*Surficial Geology of Edmonton*” (Geological Survey of Canada 2016a), Map 219 “*Surficial Geology of Klewi River*” (Geological Survey of Canada 2015) and a report entitled “*Glacial Lake McConnell, and the Surficial Geology of Parts of Slave River and Redstone River Map-Areas, District of Mackenzie*” (Geological Survey of Canada 1965), the near surface geological profile in the northern section of the highway (near km 106) is characterized by till blankets and shallower veneers. Boreholes at the northern end of the Project reveal sandy, gravelly soils with some silt content, and generally low plasticity and cohesion. Moving towards the southeast the surficial materials become more dominated by glaciolacustrine veneers and blankets with till deposits exposed in certain areas. Eolian dunes occasionally cross the highway. Near-surface soils along the Project RoW are typically sandy (clay sand and silty sand), with some areas of clayey gravel, and lean clay. Silt and clay are more prevalent in deeper soils.

Sink-holes are present in the LSA, but none was identified during the field program to be affecting the highway. All sink-holes in the LSA are underlain by gypsiferous beds of Middle Devonian age. Gypsiferous soils contain high contents of gypsum which is soluble in water. As rainfall or groundwater come into contact with these soils they are leached downward or during instances of capillary rise they can move upwards. If enough water passes through these deposits underground voids are created that can ultimately lead to sink-holes.

Considering the erosive potential of soils exposed by Project activities, construction materials, and the risk of sedimentation to drainages, wetlands and streams, terrain and soils has been selected as a VC to be carried forward through the effects analysis.

6.5 Air Quality

Existing anthropogenic impacts to air quality in WBNP are mainly a result of light vehicle traffic along Highway 5, including both diesel and gasoline vehicles. These impacts would be minimal, given the relatively low volumes of traffic on the highway. Forest fires contribute more to reductions in air quality, particularly during the summer months in the southwestern portion of the NWT near Fort Smith and the Project. Exceedances of fine (PM_{2.5}) and coarse (PM₁₀) particulate matter commonly occur between July and August (GNWT 2015a). Other contributors to air quality contamination (e.g., Sulphur Dioxide, Ground Level Ozone, Nitrogen Dioxide, Carbon Monoxide) are not typically in exceedance of guideline maximums.

The Project is anticipated to have a limited, incremental contribution to air quality within the LSA during construction. Effects associated with increased traffic and vehicle use are expected to extend beyond the LSA as vehicles and machinery are mobilized to and from the Project site. Dust and traffic associated with construction is expected to be limited and restricted to the LSA. These effects will be limited to the construction phase. During operation/maintenance phases, equipment and truck use are likely to be equivalent to existing conditions. The effect of the Project on dust will be positive after Project construction, because traffic on the chip sealed road will produce much less dust than traffic on the existing gravel road. Therefore, air quality has not been carried forward though the effects analysis.



6.6 World Heritage Values and Cultural Resources

Wood Buffalo National Park was designated a United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Site in 1983 for its numerous natural elements, including the presence of:

- Ramsar Wetlands of International Importance (Peace-Athabasca Delta and Whooping Crane nesting area);
- world's largest herd of free-roaming Wood Bison;
- salt plains;
- gypsum karst; and
- large expanses of undisturbed grassland and sedge meadows.

Eleven Indigenous groups of Chipewyan, Cree, and Métis decent are present in and around WBNP (PCA 2010). The historical record of over 8,000 years of Indigenous occupation of lands in the park is preserved in its cultural resources (PCA 2015 a). The WBNP Management Plan notes that the park's cultural resources inventory is incomplete, and that a formal system for monitoring their condition is not yet in place. Those that have been identified are typically considered threatened (PCA 2010).

The Project has been designed to avoid all known historic sites and components important to WBNP's designation as a UNESCO World Heritage Site, and is not anticipated to have an effect on these cultural resource components. Construction has been planned to avoid potential adverse impacts to Whooping Crane nesting habitat or the Peace-Athabasca Delta. The Project does not fall within key Wood Bison grazing and calving grounds. The Project will be within an existing disturbance area, and so will not affect undisturbed expanses of grassland or sedge meadows, salt plains, or gypsum karsts. An Archeological Overview Assessment (AOA) will be completed by the Archaeology and History Branch of PCA for this Project. However, as the Project is within an existing disturbed highway ROW, the presence of historical resources is considered unlikely (Appendix E). Therefore, disturbance to cultural resources is not anticipated, and cultural resources have not been carried forward to the effects analysis.

6.7 Visitor Experience

Administration and operation of WBNP is the responsibility of the Southwest Northwest Territories (SWNWT) Field Unit. Under the park's current management plan (PCA 2010), increasing visitation to the park is a priority. Most visitors to the park are local or regional in origin, using the park primarily for recreation. Highway 5 is the main access road to several tourist sites in the northern extent of WBNP. Average Annual Daily Traffic (AADT)¹ on Highway east of the park is typically around 170, while Peak Summer Average Daily Traffic (PSADT)² is 210 (GNWT 2015 b). Traffic volumes to the west of the park on Highway 5 are slightly higher, with an AADT of 240, while PSADT is 310 (GNWT 2015b). Both AADT and PSADT have grown over the past decade, indicating a greater volume of traffic flow through WBNP via Highway 5.

There are three tourism sites along Highway 5; however, only two of these occur with access points in the proposed Project RoW. The Angus Sinkhole is accessible via Highway 5 at km 106 (i.e., the terminal west end of the Project). The site is host to informational signage and a day use/picnic area (Parks Canada 2015b). The Nyarling Pull-off, located between km 118 and km 119 on the Highway, offers educational signage about the park.

¹ AADT is an estimate of mean daily traffic for a period of one year.

² PSADT is an estimate of the mean daily traffic for the months of June, July and August.



BASIC IMPACT ANALYSIS FOR WOOD BUFFALO NATIONAL PARK HIGHWAY 5 ROADWAY REHABILITATION

The construction phase of the Project will include vegetation clearing, rock deposition, chip sealing, and the presence of machinery along the Highway 5 ROW. Construction activities will occur within the existing Highway disturbance corridor. Given that Project construction has the potential to affect traffic flow, access to trails and sightseeing locations, and wilderness character, visitor experience has been selected as a VC to be carried forward through the effects analysis.

7.0 POTENTIAL EFFECTS ANALYSIS

For this BIA, potential effects were analyzed with the information available at the time of writing (i.e., 5 August, 2016) and based on professional judgment. Effects were characterized using parameters such as direction (positive, negative or neutral), expected magnitude (e.g., negligible to high), geographic extent (i.e., spatial extent of the effect), duration/ reversibility (i.e., reversible in the short-term to permanent effects), frequency (i.e., number of times the effect happens per unit time) and probability (i.e., likelihood the effect will happen) (Appendix F).

The effects analysis considers the possible interactions between Project infrastructure components and activities and the VCs within the identified spatial boundaries, prior to the implementation of mitigation measures. Project interactions may be direct (e.g., as a result of vegetation clearing for the Project affecting a VC), or indirect (i.e., as a result of a change to one VC affecting another VC). Potential effects of the Project on the VC are determined by comparing the existing conditions to those that are expected to result from the implementation of the Project.

A preliminary identification of potential Project interactions was undertaken to focus the assessment on the issues of key importance (Appendix B). The interactions identified in the matrix were used to focus the analysis of potential effects (Section 8) and the design of appropriate mitigations (Section 9). All relevant Project activities were analyzed individually to determine if there was a plausible mechanism for an effect on each VC during normal Project conditions. The analyses were based on the professional judgment and experience of the BIA team.

Potential effects of the Project on VCs are described in the paragraphs below and are summarized in Table 9. A determination of the significance of these effects after the implementation of mitigation is provided in Section 11.

Table 9: Potential Project Effects

Resource Class	Valued Component	Project Phase	
		Construction/ Installation	Operation/ Maintenance
Aquatic Resources	Fish and Fish Habitat	Disturbance or alteration of instream fish habitat from construction and/or diversions.	n/a
		Changes to fish habitat from culvert extensions or replacements.	n/a
	Hydrology	Changes to natural flow pattern and water quantity.	n/a
		Potential changes to lateral and vertical stability of watercourses in the LSA.	Potential continued changes to lateral and vertical stability of watercourses in the LSA
	Surface Water Quality	Changes in water quality from increases in suspended sediment load and sediment deposition.	n/a
		Potential for spills/deleterious substances from construction equipment.	n/a



BASIC IMPACT ANALYSIS FOR WOOD BUFFALO NATIONAL PARK HIGHWAY 5 ROADWAY REHABILITATION

Resource Class	Valued Component	Project Phase	
		Construction/ Installation	Operation/ Maintenance
Vegetation	Vegetation Communities	Change in habitat quantity and/ or quality due to disturbance and removal of vegetation.	n/a
		Change in habitat quantity and/ or quality due to deleterious substances from construction equipment.	n/a
		Change in habitat quality and/ or quantity due to changes in hydrology.	n/a
		Changes in community composition due to increased invasive plant species.	n/a
	Vegetation Elements of Management Concern (VEMC)	Change to VEMC habitat quantity and/ or quality due to vegetation clearing, deleterious substances, and changes in hydrology.	n/a
		Change in VEMC abundance due to loss of individuals.	n/a
		Change in VEMC abundance due to increased invasive plant species.	n/a
Wildlife	Canadian Toad	Change in habitat quantity and / or quality due to vegetation clearing and ground disturbance.	n/a
		Change in habitat quality and/or quantity due to increase in suspended sediment load and sediment deposition.	n/a
		Change in abundance due to wetland disturbance during the breeding season.	n/a
	Migratory birds	Change in habitat quantity and / or quality due to vegetation clearing, ground disturbance and sensory disturbance.	n/a
		Change in abundance due to vegetation and ground disturbance during the nesting period.	n/a
	Whooping Crane	Change in habitat quantity and / or quality due to vegetation clearing, ground disturbance and sensory disturbance.	n/a
	Little Brown Myotis and Northern Myotis	Change in habitat quantity and / or quality due to vegetation clearing and sensory disturbance.	n/a
		Change in abundance due to tree clearing.	n/a
	Wolverine	Change in habitat quality and quantity due to vegetation clearing and sensory disturbance.	n/a
	Wood Bison	Change in habitat quality and quantity due to vegetation clearing and sensory disturbance.	n/a
	Woodland Caribou	Change in habitat quality and quantity due to vegetation clearing and sensory disturbance. CH not likely to be affected.	n/a
Soils and Landform		Change in soil quality through compaction, erosion, and contamination by spills.	Change in soil quality through erosion



BASIC IMPACT ANALYSIS FOR WOOD BUFFALO NATIONAL PARK HIGHWAY 5 ROADWAY REHABILITATION

Resource Class	Valued Component	Project Phase	
		Construction/ Installation	Operation/ Maintenance
Visitor Experience		Temporary traffic delays due to traffic control during construction. Temporary loss of natural aesthetic appeal during construction.	Increased visitor safety through operation

7.1 Aquatic Resources

Without mitigation, the Project is anticipated to have a negative effect on fish and fish habitat, hydrology, and surface water quality due to either temporary (construction activities) or permanent (during operation) changes in flows, bank stability, surface erosion and runoff, disturbances to the bed and banks of the watercourses, as well as a potential loss of fish habitat from new culvert footprints.

7.1.1 Fish and Fish Habitat

The Project is anticipated to have a negative effect on fish and fish habitat from instream construction activities and the installation, replacement, repair, or extension of culverts. Additional indirect effects on fish and fish habitat can also occur from changes to hydrology or surface water quality (described in Sections 8.1.2 and 8.1.3).

Instream construction activities have the potential to negatively affect instream fish habitat quality and quantity. Construction activities could affect fish and fish habitat due to instream works, site isolations, diversion pumping, and fish salvages. Of the 80 total crossings identified within the Project footprint, there are four crossings where the watercourses have defined bed and banks and fish habitat. At three of these crossings (km 144.1, km 152.8, and km 166.6), the culverts may require repair, replacement, or extension; however, the twin culverts at the Klewi River crossing at km 151.6 are new culverts, do not restrict flow or fish passage, and will most likely not be replaced because highway widening is not anticipated at this site. The isolation method is a proposed technique for installation, replacement, repair, or extension of culverts where surface water exists at the time of construction. For isolation, temporary diversions may be used (i.e., isolation construction techniques such as flumes, instream diversions, or pumps) to divert the water flow around the isolated construction area. Effects to instream habitat from construction activities, including diversions, are predicted to be negative in direction and low in magnitude. Diversions are anticipated to be required for only three crossings, and the flow patterns at the three crossing locations will be maintained during construction. The geographic extent of the effect is local because the instream disturbance will be limited to the culvert extension footprint on either side of the highway, and short-term in duration because any instream construction and diversion activity will be restricted to the construction phase of the Project.

The extension and/or replacement of culverts associated with the widening of Highway 5 will require the footprint of the culvert to be increased in some watercourses, permanently impacting sections of fish habitat where the culvert is located. There are three culverts in streams with fish habitat that may require repair, replacement, or extension (km 144.1, km 152.8, and km 166.6). The magnitude of the effect is considered low, as the extent of the footprint will be limited to a reasonably small area immediately adjacent to the existing highway and as fish and fish habitat is limited throughout the Project area. The geographic extent of the effect is local as the loss of habitat is limited to the culvert extension footprint on either side of the highway. The duration of the effect is considered permanent because fish habitat will be permanently affected.



7.1.2 Hydrology

The Project is anticipated to have a negative effect on the existing flow pattern and water quantity due to watercourse diversions during culvert replacement/extension and associated construction in watercourses. These diversions will locally alter the flow paths of the watercourses during construction. The predicted effect of Project construction on the natural flow patterns of the crossed watercourses is described as negative because the flow paths will be temporarily modified from their natural course. The magnitude of the effect is considered low because flow will be returned to the watercourse from which it was diverted, maintaining flow downstream. The geographic extent is considered local, as the diversions will be limited to the area of construction immediately around the existing highway. Diversions are only anticipated for three watercourses with fish habitat, of the 81 total crossings identified within the Project footprint. The effect is considered to be short-term in duration because the diversion or dewatering activity will be restricted to the construction phase of the Project.

Vegetated areas adjacent to a watercourse are important in stabilizing stream banks and preventing erosion. Vegetation clearing along Highway 5 could contribute to a reduction in the lateral and vertical bank stability of ephemeral and permanent watercourses within the LSA and a reduction in the ecological value of riparian habitat. The Project could have a negative effect on the vertical and lateral stability of watercourses in the form of potential localized scour or bank erosion, which could occur continuously through construction and operations until stream bed and banks have stabilized. The predicted effect of Project construction on the lateral and vertical stability of watercourses is described as negative because disturbance to riparian vegetation and modification of natural channel geometry will increase the potential for erosion until re-vegetation is complete. Without mitigation, including design features, the magnitude of the effect is considered low (i.e., limited to minor scour or bank erosion at a small number of crossings with defined bed and banks and fish habitat). The geographic extent is considered local, as the disturbance will be limited to watercourse crossings along the Project footprint. The effect is considered to be medium to long-term in duration. The disturbed areas will be re-vegetated; however, it may take several years for the vegetation to be considered fully established.

7.1.3 Surface Water Quality

The Project is anticipated to have a negative effect on surface water quality. Increased erosion, sedimentation, and contamination due to spills are all effects with potential to occur as a result of the Project.

Disturbance to stream bed and banks of watercourses, to existing road surfaces, shoulder soils and adjacent areas, as a result of construction activities, has the potential to result in increased surface runoff to ditches, ephemeral drainages and watercourses. This could increase total suspended solids and turbidity within the downstream aquatic ecosystems and result in a negative effect on surface water quality. The introduction of fine sediment to watercourses from runoff from the deposit sites, and slope or channel erosion, can have sub-lethal (e.g., irritation of gill tissue) and lethal (e.g., suffocation of developing embryos) effects on fish (CCME 2002). This fine sediment can also result in downstream sediment deposition that alters substrate composition and modifies the suitability of habitat for spawning, overwintering, and rearing. Without mitigation, moderate magnitude, short-term, effects are expected because of erosion and sedimentation.

Spills during construction activities and operations could result in negative effects to water quality, which in turn could potentially result in downstream effects to habitat quality for fish and other aquatic and species. The introduction of deleterious substances to the watercourse could also have adverse effects on fish and other aquatic organisms depending on the substance. Without mitigation, moderate magnitude, short-term effects would be expected because of spills. Effects will be localized and continuous; however, reversible within the short-term.



7.2 Vegetation

Without mitigation, Project activities are anticipated to have a negative effect on vegetation community habitat quality and quantity, VEMC habitat quality and quantity and VEMC abundance associated with clearing, and accidental damage associated with laydown areas. The Project may result in effects on terrestrial vegetation communities during construction through clearing of the Project footprint associated with widening. The Project will not require tree clearing to expand the RoW, but clearing of low vegetation (i.e. shrubs, forbs and grasses) will be required adjacent to Highway 5 for widening or culvert replacement. Tree clearing may be required for borrow pit expansion. During grading, vegetation may be affected due to the disturbance of soil and terrain in graded areas due to stripping of vegetation roots with the uppermost organic layer of soil, including associated herbaceous and non-vascular layers, and propagules. The effect is expected to be low magnitude and local, because direct losses will primarily be in areas within the Highway 5 RoW that have little vegetation cover and that have low potential for containing VEMC.

The Project is predicted to have a negative effect on vegetation community and VEMC habitat quality due to the introduction of deleterious substances (i.e., spills). Accidental spills or leaks of hydrocarbons (e.g., gasoline and diesel fuel) could occur during equipment operation, maintenance, fueling, or fuel storage during clearing, construction, and operation, resulting in local contamination of vegetation and soil. Without mitigation, moderate magnitude, medium-term effects would be expected because of spills. Effects will be localized and continuous; however, reversible within the medium-term.

Operation of the Project is not anticipated to have an adverse effect on vegetation community habitat quality and quantity, VEMC habitat quality and quantity and VEMC abundance. The Project will likely have a positive effect on VEMC habitat quality by reducing the amount of dust produced by traffic, because traffic on the chip sealed road will produce much less dust than traffic on the existing gravel road.

The Project is anticipated to have a negative effect on vegetation community composition and VEMC abundance due to the introduction of invasive plant species. Vegetation community diversity may also be affected by the introduction of invasive plant species on construction equipment and other vehicles carrying seeds or plant propagules from other work sites. Project activities, including the movement of machinery or equipment from and to the site, ground disturbance and vegetation clearing, could introduce invasive plants or add to existing infestations within the study area. Bare soil, where reclamation has not been initiated or is unsuccessful, is susceptible to encroachment by invasive plant species. Although invasive species are likely to only be introduced during construction, any species that become established on available soil may persist through operations. Invasive plant species are able to colonize quickly and proficiently adjacent to areas of disturbance; therefore, the magnitude is predicted to be moderate. It is expected that invasive plant species will remain in and around existing disturbance, and effects on vegetation community composition and VEMC abundance would be local and primarily limited to terrestrial vegetation communities. Therefore, the effects on community composition would be long-term and continuous. The Project might affect wetland, riparian and dry site VEMC abundance through the introduction of invasive species. Although no noxious or invasive plant species occurrences are known from the LSA, species introduced during construction would have the potential to compete with wetland, riparian and dry site VEMC.

The operation phase of the Project is not anticipated to increase the potential for invasive plant species introduction or spread.



7.3 Wildlife and Wildlife Habitat

Project activities have the potential to affect wildlife during Project construction and operation phases (Table 2).

7.3.1 Canadian Toad

Both wetland and upland vegetation communities occur in the LSA. Wetlands have the potential to be used as breeding habitat by Canadian toads and other amphibians. Upland vegetation communities have the potential to be used as summer foraging and overwintering habitats by Canadian toads. Disturbance to wetlands may occur due to culvert excavation, repair and/or replacement. Upland summer foraging habitat may be impacted by the expansion of borrow pits, and highway widening activities may impact sandcuts that have potential to be used as overwintering habitat. Therefore, the Project has potential to have a negative effect on Canadian toad habitat quality and quantity in the LSA. The potential effects of the Project on Canadian Toad habitat quality and quantity are predicted to be low in magnitude because of the limited area affected relative to regional habitat availability. The degradation or loss of habitat is considered to be permanent, because although habitat around culvert modifications will recover and some borrow pit areas may be reclaimed, highway widening will be permanent and may affect overwintering habitat (i.e., sand cuts).

The Project has the potential to result in increased suspended sediment load in small watercourses due to culvert excavation, repair and/or replacement, which would be negatively affecting toad breeding habitat. Without mitigation, low magnitude effects on potential Canadian Toad habitat quality are expected because of sedimentation. Effects on potential Canadian Toad habitat due to sedimentation will be localized, short-term and reversible.

Culvert excavation, repair and/or replacement in and around wetlands has the potential to result in Canadian toad mortality and reduce abundance if activities occur during the spring and summer. Adult toads are more mobile, but tadpole mortalities would be more likely to occur. However, impacts are not expected to exceed a low magnitude due to the limited extent of wetlands likely to be affected. The potential effects of the Project on Canadian Toad abundance are predicted to be localized and short-term.

The operation phase of the Project is not anticipated to have an effect on Canadian Toad.

7.3.2 Migratory Birds

Migratory birds utilize a wide range of upland and wetland habitat types for foraging and breeding. Therefore, vegetation clearing and ground disturbance due to the Project has the potential to result in a reduction in habitat quality and quantity for migratory birds. In addition, sensory disturbance due to construction activities may result in a reduction in effective habitat quality. The potential negative effects of the Project on migratory bird habitat have the potential to be low in magnitude because of the limited area affected relative to regional habitat availability. The loss of habitat quality and quantity is considered to be long-term, because habitat around culvert modifications will recover, borrow pit expansions may persist but can be reclaimed, and the area affected by 1 m of permanent highway widening is unlikely to be suitable habitat under existing conditions.



Migratory birds are highly mobile and adults can typically avoid interactions with Project activities that could result in direct mortality. However, the Project has the potential to result in the destruction of nests, eggs, and young birds if construction occurs during the general migratory bird nesting season (i.e., May 3 to August 20 for nesting zone B7 [ECCC 2016b]). In the absence of mitigation, the Project has the potential to result in a low magnitude effect on migratory bird abundance because of the limited area of habitat affected relative to regional habitat availability. This effect on abundance would be localized and short-term.

The operations phase of the project is not likely to have an incremental effect on migratory birds.

Whooping Crane

The Project LSA is kilometres away from identified Whooping Crane CH, as defined in the Recovery Strategy for the Whooping Crane in Canada (EC 2007), as well as known nest locations. Expansion of the km 136 borrow pit will occur adjacent to the Zone 1 Special Preservation Whooping Crane Nesting Area, within which CH occurs. Sensory disturbance due to the Project has the potential to have a negative effect on Whooping Crane habitat quantity and quality that is negligible in magnitude. Designated CH could not be affected by the Project. This effect on habitat is local, long-term, and reversible.

The operations phase of the Project is not likely to have an effect on Whooping Crane.

7.3.3 Bats

Little Brown Myotis and Northern Myotis may use large diameter trees and snags within the LSA for maternity and/or day roost sites, and a variety of habitat types for foraging. Therefore, the Project has the potential to have a negative effect on Little Brown Myotis and Northern Myotis habitat quantity and quality due to vegetation clearing. Bats may also be attracted to artificial light sources during construction, which may negatively affect foraging success (Stone et al. 2015). The negative effects of the Project on Little Brown Myotis and Northern Myotis habitat have the potential to be low in magnitude because of the limited area affected relative to regional habitat availability. This effect on habitat is local, long-term, and reversible.

Bat mortality may occur if clearing removes trees that are being actively used as maternity or day roosts. In the absence of mitigation, the Project has the potential to result in a low magnitude effect on Little Brown Myotis and Northern Myotis abundance because of the limited area of habitat affected relative to regional habitat availability. This effect on abundance would be localized and short-term.

The operation phase of the Project is not anticipated to have an effect on bats.

7.3.4 Carnivores / Furbearers

Wolverine occur in a range of habitat types, but tend to avoid human disturbance. Therefore, the Project has the potential to have a negative effect on Wolverine habitat quantity and quality due to vegetation clearing and associated sensory disturbance during construction. The effects of the Project on Wolverine habitat have the potential to be negligible in magnitude because habitat near the highway is likely already avoided by Wolverine. This effect on habitat is local, long-term, and reversible.



7.3.5 Ungulates

Wood Bison

Wood bison have been observed in the LSA, which contains suitable foraging habitat, including winter foraging habitat. Therefore, the Project has the potential to have a negative effect on Wood Bison habitat quantity and quality due to vegetation clearing and associated sensory disturbance during construction. The potential effects of the Project on Wood Bison habitat quality and quantity are predicted to be low in magnitude because of the limited area affected relative to regional habitat availability. This effect on habitat is local, long-term, and reversible.

The operations phase of the project is not likely to have an effect on Wood Bison.

Woodland Caribou

Woodland caribou tend to avoid areas near anthropogenic disturbances such as Highway 5, but may move through the area. Therefore, the Project has the potential to have a negative effect on Woodland Caribou habitat quantity and quality due to vegetation clearing and associated sensory disturbance during construction. In addition, the expansion of borrow pits will reduce the amount of habitat within the Northwest Territories Range that is further than 500 m from human disturbance, and could therefore affect Woodland Caribou CH. However, the expansion of the borrow pits is not likely to reduce the amount of the range that is undisturbed below the 65% threshold, increase access for predators, attract or support alternate prey species, or fragment habitat, the functionality of Woodland Caribou CH will not be affected and CH will not be destroyed by the Project (Casimir 2016, pers. comm.; Section 6.3.5). In addition, PCA is proposing to complete reclamation activities associated with Pits 136 and 162, which will in time serve to restore previously lost Woodland Caribou CH. Nevertheless, the effects of the Project on Woodland Caribou habitat quality and quantity have the potential to be high in magnitude due to the potential effect on CH in the absence of mitigation such as minimizing disturbance footprints and conducting reclamation activities related to borrow pit areas. This potential effect on habitat is local, long-term, and reversible.

The operations phase of the project is not likely to have an effect on Woodland Caribou.

7.4 Terrain and Soils

The Project is anticipated to have a negative effect on soils and terrain through an increase in erosion and sedimentation prior to the implementation of mitigation measures. Erosion risk will increase due to vegetation removal during construction. A reduction in soil quality also has the potential to occur due to compaction and spills during the construction phase of the Project. Erosion potential within construction areas will increase where exposed soil and construction materials are present, and is generally determined by:

- rainfall and runoff;
- soil erodibility (i.e., texture, structure, permeability);
- slope length and gradient;
- vegetation cover; and
- erosion control mitigations.



The greatest potential for a reduction in soil quality will occur due to culvert replacement in areas that have active watercourses or potential water flow during storm events, which increase the risk of erosion. The effects of the Project on soils have the potential to be moderate in magnitude, local and long-term as a result of erosion and sedimentation. Changes to soil quality would continue until disturbed areas are revegetated and stabilized.

7.5 Visitor Experience

During construction, there will be temporary effects on visitor experience through traffic delays, site access and temporary loss of natural aesthetic within the LSA. Temporary traffic delays to accommodate equipment mobilization, construction or demobilization may affect visitor experience. Construction activities will occur from summer of 2016 to fall of 2017, overlapping with peak park use periods during June, July and August. However, peak traffic in this period is low (i.e., AADT of between 210 and 310). Speed reductions due to Project construction activities are not expected to result in significant traffic delays associated with road construction on high traffic volume roadways.

Trail and facility closures for public safety can negatively affect visitor experiences. Access to the Angus Sinkhole day-use area and Nyarling Pull-off may be restricted where these areas intersect the Project ROW; however, effects are determined to be low magnitude given the limited time frame of access restrictions. Effects are expected to be limited to a short portion of the construction phase of the Project (i.e., short-term) and will be reversible.

Visibility of construction equipment and materials along Highway 5 will have a negative effect on the natural aesthetic of the surrounding area. However, the culvert and road widening site are largely within the existing disturbed Highway ROW, which has low visual quality. Noise and odour from construction activities will negatively affect wilderness character in the vicinity of the Project and users' enjoyment of the park, including at the two tourism locations along the Project ROW.

While traffic delays and trail closures are expected to have only a minor, short-term adverse effect on visitor experience, noise and odour associated with road construction activities during the long duration of construction have the potential to have a more moderate, sustained effect on user enjoyment of the park. Once operational, the Project will likely have a positive impact on visitor experience by reducing Highway closures in the long term as a result of culvert replacement and maintenance and road widening activities.

8.0 MITIGATION MEASURES

In general, the Parks Canada National Best Management Practices: Roadway, Highway, Parkway and Related Infrastructure BMP (PCA 2015c) will be applied. Considering the BMP (PCA 2015c), Project effects and Project requirements, general mitigation measures, which apply to more than one VC, and mitigation measures specific to VCs to reduce Project effects have been compiled below.

- 1) The Contractor is required to prepare and have SWNWT Field Unit approval of an Environmental Protection Plan (EPP) in accordance with Parks Canada Environmental Procedures before initiation of construction. The EPP will be prepared by a Qualified Environmental Professional (QEP) and will outline:
 - a) Details on how the work limits will be marked and procedures to ensure operations will remain within the clearing boundaries to minimize damage to vegetation and soil damage.



BASIC IMPACT ANALYSIS FOR WOOD BUFFALO NATIONAL PARK HIGHWAY 5 ROADWAY REHABILITATION

- b) A Spill Response Plan will be prepared and will detail the containment and storage, security, handling, use and disposal of empty containers, surplus fuels or other hydrocarbon products to the satisfaction of the Departmental Representative and WBNP Environmental Surveillance Officer (ESO) and in accordance with all applicable federal and territorial legislation. The Spill Response Plan will include a list of products and materials to be used or brought to the work site that are considered or defined as hazardous or toxic to the environment. Such products may include, but are not limited to fuels and lubricants. The Safety Data Sheets (SDS) for all chemicals used will be made available on-site. Appropriately sized and stocked spill kits will be on site capable of dealing with 110% of the largest potential spill. All Contractor's staff must be aware of their location(s) on site and must be trained on spill response procedures.
 - c) An Emergency Response Plan that outlines procedures to follow in the case of an emergency (e.g., wildlife encounter, equipment malfunction/failure, fire).
 - d) A Fire Prevention Plan which describes the fire prevention equipment (e.g., fire extinguishers) and procedures on-site in the event of a fire. Should a fire occur, The Parks Dispatch and the Fire Duty Officer must be notified immediately.
- 2) The Contractor will ensure that works are completely contained such that deleterious substances (e.g., sediment, spills or leaks, etc.) will not be released into the environment.
- a) Prior to use on the Project sites and during daily use, equipment and fuel lines will be inspected for leaks and structural integrity, and inspections will be recorded. Any detected leaks will be addressed immediately, and spills over 1 L or any spill quantity in water are to be reported to Parks Dispatch and the WBNP ESO immediately.
 - b) Hazardous or toxic products (fuels, lubricants etc.) will be stored no closer than 100 m from any watercourse. Do not refuel closer than 100 m from a water-body. Store all fuels and hazardous liquids in 110% capacity secondary containment vessels.
 - c) Any absorbent materials used in spill clean-up or soils contaminated by a spill will be disposed of in the appropriate facilities and transported in accordance with the Transportation of Dangerous Goods (TDG) Regulations.
- 3) A QEP will create a detailed reclamation plan for borrow pit areas once clear reclamation requirements are determined by the SWNWT Field Unit. Reclamation will be required to mitigate impacts to Woodland Caribou habitat (Section 8.3). This plan will also include direction for revegetation of exposed soil and stockpiles to reduce erosion and the risk of introduction and spread of invasive species. Revegetation will include use of an approved WBNP seed mixture and other approved plant species.
- 4) All equipment will be stored either on the road or on previously hardened surfaces in order to avoid trampling roadside vegetation and compaction of soils.



BASIC IMPACT ANALYSIS FOR WOOD BUFFALO NATIONAL PARK HIGHWAY 5 ROADWAY REHABILITATION

- 5) Vegetation removal will occur outside the breeding bird restricted activity period for the park (ECCC 2016b). The breeding bird window coincides with the bat breeding period.
 - a) Where removal of vegetation cannot occur outside of the restricted activity period, pre-clearance nest surveys should be conducted by QEP with an appropriate level of experience identifying birds and conducting nest sweeps using a bird nest sweep protocol endorsed by the SWNWT Field Unit. Should active nests be detected during surveys, consultation will occur with SWNWT Field Unit staff to determine the appropriate course of action. Most migratory birds, their nests and eggs are protected under the Migratory Birds Convention Act, 1994 (MBCA) (GoC 1994).
 - b) Where removal of vegetation cannot occur outside of the restricted activity period, a pre-disturbance bat assessment will be conducted by QEP. A survey will first determine whether there are trees that would function as high-potential roosting habitat within the LSA. If high-potential habitat is identified, then a follow-up survey will be completed to determine whether bats are present. Should active bat roosts be detected during surveys, consultation will occur with SWNWT Field Unit staff to determine the appropriate course of action.
- 6) As part of the EPP, the QEP will develop and implement an Erosion and Sediment Control Plan for the site that minimizes risk of sedimentation during all phases of the project. The plan will include:
 - a) Installation of appropriate erosion and sediment control methods before starting work to protect sensitive aquatic habitats and riparian areas.
 - b) Use of sediment fencing and/or other appropriate erosion control materials to prevent sediment transport to watercourses. The intended end result is to avoid the release of sediments into any watercourse in levels that may cause harm to fish or other aquatic biota. The target is 0 mg/L of TSS over background levels, with a maximum allowable instantaneous increase of 25 mg/L over background levels when background levels are <250 mg/L or a maximum allowable instantaneous increase of 10% over background levels where background levels are >250 mg/L (CCME 2002).
 - c) Maintenance of erosion and sediment control measures until all disturbed ground has been permanently stabilized, suspended sediment has resettled to the bed of the waterbody or settling basin and runoff water is clear.
 - d) Management of water flowing onto the sites such that sediment is settled or filtered out prior to the water entering a waterbody.
 - e) Follow-up monitoring requirements, including schedule, criteria for inspection, and timelines.



8.1 Aquatic Resources

- 7) Before construction commences, the engineering design consultant will finalize the proposed construction details, including the footprint and culvert replacement designs associated with the project.
- 8) The Contractor will employ the services of a QEP to advise and monitor construction activities that occur within or adjacent to watercourses. Activities such as culvert installations and road widening work adjacent to watercourses require the oversight of a QEP. The QEP will advise the Contractor on proper erosion and sediment control measures and the installation of these measures, monitoring of sediment loads into watercourses, isolation measures for culvert installations and fish salvage if required. In general the QEP will advise the Contractor on measures to prevent serious harm to fish and fish habitat, which can include sediment loading into non-fishing bearing watercourses that are connected to fish bearing watercourses.
- 9) The information collected in the field will facilitate any required DFO Request for Review needed for culvert extensions or installations at crossing locations with fish habitat present (i.e. km 144.1, km 151.6, km 152.8 and km 166.6). If required, any culverts that channel permanent or fish-bearing streams will be extended during dry or frozen conditions (low-flow), or in isolation of flowing water and only after the work zone has been isolated and a fish salvage has been completed by the Contractor's QEP. Water diversion will require a water diversion permit. The site will be isolated from flows by pumping flow around the work zone to ensure downstream habitat is not dewatered. Pumping must include screened intakes consistent with DFO Freshwater Intake End-of-Pipe Fish Screen Guidelines (DFO 1995). Culverts for roadside drainage that do not have seasonal flow patterns will not be limited to replacement during low-flow periods, and can be extended as directed by the Department Representative.
- 10) If diversion is required during construction, water intakes or outlet pipes will be screened to prevent entrainment or impingement of fish. Entrainment occurs when a fish is drawn into a water intake and cannot escape. Impingement occurs when an entrapped fish is held in contact with the intake screen and is unable to free itself. Measures for freshwater design and installation of intake end-of-pipe-fish screens will be followed to protect fish where water is extracted from fish-bearing waters (DFO 2016b).
- 11) Culverts extension will be designed and constructed (i.e., with proper size and gradient) such that flows and flow paths maintain or improve connectivity. WBNP Resource Conservation staff will be consulted during the development of designs for any culvert modifications.
- 12) The Project will be designed to ensure beds and banks of watercourses are restored to their original contour and gradient; if the original gradient cannot be restored due to instability, a stable gradient that maintains water runoff patterns will be developed.
- 13) If required, timing for any instream work will be confirmed with the WBNP Resource Conservation staff and Fisheries and Oceans Canada in advance of construction.
 - a) Activities modifying water features will be scheduled to occur outside high flow periods. High flows are typical in May and June during snowmelt runoff, and in response to summer and fall rainfall events.
 - b) No restricted activity timing windows are applicable for the Project LSA. None of the spawning fish species listed for Zone 1 in the Northwest Territories Restricted Activity Timing Windows for the Protection of Fish and Fish Habitat (DFO 2016a) occur in the area.



- 14) Mitigation measures will be in accordance with DFO's Measures to Avoid Causing Harm to Fish and Fish Habitat (DFO 2016b).
- 15) Construction activities at culverts km 144.1, km 151.6, km 152.8 and km 166.6 will not be undertaken without approval from the SWNWT Field Unit and DFO.

8.2 Vegetation

- 16) Efforts will be made to ensure the minimum amount of vegetation is cleared or disturbed at each site. Mature trees and wildlife trees will be avoided, when possible.
- 17) The Contractor will control/restrict the spread of invasive plant species within the construction and staging areas.
 - a) Ensure vehicles, machinery and equipment arrives on site in a clean condition free of, invasive species, noxious weeds and soils from off-site.
 - b) Construction staff and others entering the Project site will be required to scrape mud off their boots and brush seeds and dirt from their clothing before entering the Project site.
 - c) Discussion about sites of concern where special attention must be paid to invasive species control will take place between the contractor and the Field Unit before work commences.
- 18) The contractor will be responsible for ensuring that all disturbed areas be reseeded with a Field Unit approved seed mix and that reseeded areas be relatively free of invasive plant species to the satisfaction of the SWNWT Field Unit. A Warranty Period of one year will be specified within the tender specifications and the Contractor will be required to employ all of the necessary measures to establish and maintain all seeding in an acceptable, vigorous and healthy growing condition free of invasive plant species. Hand pulling of invasive plants may be required to achieve this.
- 19) For construction adjacent to and within wetlands:
 - a) Reduce the removal of vegetation in wetlands to the extent possible.
 - b) Conduct ground level cutting / mowing / mulching of wetland vegetation instead of grubbing.
 - c) Direct grading away from wetlands.
 - d) Reduce grading within wetland boundary. Do not use temporary workspace within the boundaries of wetlands, unless required for site specific purposes.
 - e) Employ minimal (blade width) stripping within wetlands.
 - f) Install berms, cross ditches and / or silt fences between wetlands and disturbed areas when deemed necessary.
 - g) Reduce grubbing near watercourses, muskeg, and other wet areas to facilitate the restoration of shrub communities.
 - h) Use geotechnical matting, rig mats, swamp mats, access mats, or other approved methods for access through wet areas if not under frozen or dry conditions.



- i) Undertake all grading with the understanding that original contours and drainage patterns will be re-established during clean-up.
- j) Remove all mats and ramps used so that they do not impede the restoration of natural drainage patterns.

8.3 Wildlife and Wildlife Habitat

- 20) Where practicable, vegetation removal should occur outside of the general migratory bird nesting period, which is May 3 to August 20 in the LSA (Zone B7; ECCC 2016b). Where removal of vegetation cannot occur outside of this restricted activity period, pre-clearance nest surveys should be conducted by QEP with an appropriate level of experience identifying migratory birds and migratory bird nesting behaviour. Should active nests be detected during surveys, consultation will occur with the Field Unit staff to determine the appropriate course of action, which may include species-specific setback distances until nestlings have fledged. Most migratory birds, their nests and eggs are protected under the Migratory Birds Convention Act, 1994 (MBCA) (GoC 1994).
- 21) Pre-clearance nest surveys will also search for evidence of bat roosts and mammal dens. Any active nests, roosts, or dens of wildlife species will not be disturbed, and consultation with the Field Unit will occur to determine appropriate mitigation.
- 22) Canadian Toads may be affected by construction activities associated with culvert repair and replacement. If construction is to occur within wetland/watercourse areas during the Canadian toad breeding period (approximately May 1 to August 31; Dodd 2013, Hamilton et al. 1998), QEPs will complete pre-disturbance surveys to assess the LSA for Canadian Toads/Canadian Toad habitat. All amphibian habitat will be flagged along the route. If eggs, tadpoles or toads are found, the Field Unit will be notified to develop an avoidance or mitigation plan that may require amphibian salvage, if necessary. The Erosion and Sediment Control Plan that will be developed and implemented by the QEP (Section 8.0) will minimize risk of downstream effects of sedimentation on potential amphibian breeding habitat.
- 23) Wildlife will be prevented from obtaining food, garbage or other domestic wastes by the Contractor and contract staff. Wildlife attractants will be stored away from animal access and will not be stored at the work site overnight. Existing Parks Canada waste receptacles will not be used for disposal of such wastes without prior arrangement with PCA. Incidents involving wildlife accessing garbage or attractants will be reported immediately to the Environmental Surveillance Office (ESO) or Resource Conservation staff.
- 24) Wildlife encountered at or near Project locations will be allowed to passively disperse without undue harassment.
- 25) Parks Canada will be notified in the event of human-wildlife interactions, or activity or encounters with bears, Canada Lynx, Wolves, Wolverines, and any species at risk, dens and/or nests. Work will be stopped if there is the potential for the harassment, displacement or destruction of these wildlife species or important wildlife features. The following will be reported immediately to the ESO:
 - a) aggressive encounters involving any species;
 - b) sightings of large carnivores;
 - c) toad migration;



- d) bat roost or hibernacula;
 - e) bird nest; or
 - f) observations of carcasses.
- 26) Once Project construction is complete, some borrow pit areas will be reclaimed to restore Woodland Caribou CH by increasing the amount of area within the Northwest Territories Woodland Caribou Range that is considered 'undisturbed' according to the Boreal Woodland Caribou recovery strategy (EC 2012). Borrow pits will be reclaimed to the extent that is practicable. For example, the 4 ha of the km 162 borrow pit that intrudes into Zone 1 will be reclaimed. Habitat loss will still occur, but some loss will be temporary and all will be of reduced concern because habitat disturbed is adjacent to the highway and therefore of low quality. Vegetation planting prescriptions for borrow pit reclamation will emphasize the use of species that do not provide quality forage for White-tailed Deer and Moose or the associated attraction that high prey densities may have for Wolves.
- 27) A Bank Swallow nesting colony is present at the km 113.35 borrow pit. To allow use of the borrow pit for Project construction, the soil pile being used for nesting will be restructured outside of the nesting period (i.e., Zone B7, May 3 to August 20; ECCC 2016b) so that no steep exposed faces are present and nesting will not occur during construction. Once construction is complete the soil pile will be reconstructed in such a way that it will be stable and present a steep, exposed face for Bank Swallow nesting.
- 28) To minimize loss of Whooping Crane habitat, borrow pit expansion will occur outside of Zone 1 Special Preservation, Whooping Crane Nesting Area.

8.4 Terrain and Soils

- 29) Work will be scheduled to avoid storm events. Soil disturbance will not occur during high precipitation, or runoff events. Contingency plans for isolating worksites during high precipitation, high wind and runoff events will be identified in the EPP.
- 30) Topsoil, if encountered, will be retained to facilitate recovery of construction areas.

8.5 Visitor Experience

- 31) Construction activities will take place within the designated hours which will be determined in consultation with PCA. These timing restrictions will be determined to reduce impacts to vehicle traffic and visitor experience.
- 32) Maximum duration of 10 minutes and/ or traffic lineups of no more than 2 km.
- 33) The Departmental Representative reserves the right to stop work in the case of excessive traffic delays during peak travel times.
- 34) The Contractor will keep the SWNWT FU apprised of timelines, work periods and construction activities so that their staff (e.g., visitor centre and media) can provide information to the public to prevent additional safety risks for recreational users in the vicinity of the Project Sites during construction.



- 35) The Contractor will keep the Departmental Representative apprised of construction advisories for posting to the GNWT Department of Transport Highway Condition website and update advisories regularly to reflect the current and planned construction activities and highway closures.
- 36) Road signs will be posted (e.g., trucks turning, reduced speed) to ensure public safety.
- 37) Construction equipment will be turned off when not in use, equipment and vehicles will be operated at optimal efficiency and performance, and carpooling of personnel to staging areas and Project sites will be encouraged.
- 38) All trees between existing gravel pits and the highway will be retained in order to preserve the aesthetics of the viewscape from the highway

9.0 PUBLIC / STAKEHOLDER ENGAGEMENT AND ABORIGINAL CONSULTATION

Indicate whether public/stakeholder engagement was undertaken in relation to potential adverse effects of the proposed project:

☒ No

☐ Yes (describe the process to involve relevant parties and indicate how comments were taken into consideration).

Indicate whether Aboriginal consultation was undertaken in relation to potential adverse effects of the proposed project:

☒ No

☐ Yes (describe the process to involve relevant parties and how the results were taken into consideration).

10.0 SIGNIFICANCE OF RESIDUAL EFFECTS

For each VC, a determination of significance was made based on the residual effects characterization (Table 10). Residual adverse effects are defined as effects that occur during construction and / or operations and remain after the mitigation measures are applied (Section 6). Residual effects were characterized using direction (positive, negative or neutral), expected magnitude (i.e., negligible to high), geographic extent (i.e., spatial extent of the effect), duration/reversibility (i.e., reversible in the short-term to permanent effects), frequency (i.e., number of times the effect happens per unit time), and probability (i.e., likelihood the effect will happen). These criteria were considered together, along with context identified within Section 4, to estimate the overall effects from the Project on each VC. Definitions and ranking of the above listed criteria are provided in Appendix F.

For natural resource-valued components (e.g., fish and fish habitat, vegetation communities, wildlife species), the residual effect was determined to be significant if the VC was expected to be altered to a point where it was no-longer self-sustaining. For cultural resources, the residual effect was determined to be significant if the VC was expected to be altered to a point where the resource is highly modified or destroyed.

Project impacts that can be avoided or completely mitigated were not considered to have a residual impact, and therefore, were not rated or incorporated into the Signification of Residual Adverse Effects Table (Table 10), below.

Overall, it is anticipated that there will be no significant adverse residual effects because of the Project, provided mitigation measures are implemented (Table 10).



BASIC IMPACT ANALYSIS FOR WOOD BUFFALO NATIONAL PARK HIGHWAY 5 ROADWAY REHABILITATION

Table 10: Significance of Residual Effects

Resource Classes	Valued Component	Residual Effects ^(a)	Residual Impact Criteria Rating						Significance
			Direction	Magnitude	Geographic Extent	Duration/ Reversibility	Frequency	Probability	
Aquatic Resources	Fish and Fish Habitat	Disturbance or alteration of instream fish habitat from construction and/or diversions	Negative	Low	Local	Short-term	Continuous	Certain	Not Significant
		Changes to fish habitat from culvert extensions or replacements	Negative	Low	Local	Permanent	Continuous	Certain	Not Significant
		Net Residual Effects	Negative	Low	Local	Permanent	Continuous	Certain	Not Significant
	Hydrology	Changes to natural flow pattern and water quantity	Negative	Low	Local	Short-term	Continuous	Certain	Not Significant
		Potential changes to lateral and vertical stability of watercourses in the LSA	Negative	Low	Local	Medium to Long-term	Continuous	Unlikely	Not Significant
		Net Residual Effects	Negative	Low	Local	Medium-term	Continuous	Possible	Not Significant
	Surface Water Quality	Changes in water quality from increases in suspended sediment load and sediment deposition	Negative	Low	Local	Short-term	Infrequent	Possible	Not Significant
		Potential for spills/deleterious substances from construction equipment	Negative	Low	Local	Short-term	Infrequent	Unlikely	Not Significant
		Net Residual Effects	Negative	Low	Local	Short-term	Infrequent	Possible	Not Significant
Vegetation	Vegetation Communities	Change in habitat quantity and/ or quality due to disturbance and removal of vegetation	Negative	Negligible	Local	Long-term	Continuous	Certain	Not Significant
		Change in habitat quantity and / or quality due to deleterious substances from construction equipment	Negative	Low	Local	Short-term	Infrequent	Unlikely	Not Significant
		Change in habitat quality and / or quantity due to changes in hydrology	Negative	Negligible	Local	Long-term	Continuous	Possible	Not Significant
		Change in vegetation community composition due to increased invasive plant species	Negative	Low	Local	Long-term	Continuous	Unlikely	Not Significant
		Net Residual Effects	Negative	Negligible	Local	Long-term	Continuous	Certain	Not Significant
	Vegetation Elements of Management Concern	Change to VEMC habitat quantity and/ or quality due to vegetation clearing, deleterious substances, and changes in hydrology / Net Residual Effects	Negative	Negligible	Local	Long-term	Continuous	Possible	Not Significant
Wildlife	Canadian Toad	Change in habitat quantity and / or quality due to vegetation clearing	Negative	Low	Local	Permanent	Continuous	Certain	Not Significant
		Change in habitat quality and/or quantity due to increase in suspended sediment load and sediment deposition	Negative	Low	Local	Short-term	Continuous	Possible	Not Significant
		Decreased abundance due to vegetation clearing	Negative	Negligible	Local	Short-term	Continuous	Possible	Not Significant
		Net Residual Effects	Negative	Low	Local	Permanent	Continuous	Certain	Not Significant
	Migratory Birds	Change in habitat quantity and / or quality due to vegetation clearing	Negative	Low	Local	Short-term	Continuous	Certain	Not Significant
		Decreased abundance due to vegetation clearing	Negative	Negligible	Local	Short-term	Continuous	Possible	Not Significant
		Net Residual Effects	Negative	Low	Local	Short-term	Continuous	Certain	Not Significant
	Whooping Crane	Change in habitat quantity and / or quality due to vegetation clearing and sensory disturbance / Net Residual Effects	Negative	Negligible	Local	Short-term	Continuous	Certain	Not Significant
	Little Brown Myotis and Northern Myotis	Change in habitat quantity and / or quality due to vegetation clearing	Negative	Low	Local	Short-term	Continuous	Certain	Not Significant
		Decreased abundance due to vegetation clearing	Negative	Negligible	Local	Short-term	Continuous	Possible	Not Significant
		Net Residual Effects	Negative	Negligible	Local	Short-term	Continuous	Possible	Not Significant
	Wolverine	Change in habitat quantity and / or quality due to vegetation clearing and sensory disturbance / Net Residual Effects	Negative	Low	Local	Short-term	Continuous	Certain	Not Significant
	Wood Bison	Change in habitat quantity and / or quality due to vegetation clearing / Net Residual Effects	Negative	Low	Local	Short-term	Continuous	Certain	Not Significant
	Woodland Caribou (Boreal Population)	Change in habitat quantity and / or quality due to vegetation clearing / Net Residual Effects	Negative	Moderate	Local	Short-term	Continuous	Certain	Not Significant
Terrain and Soils		Change in soil quality through compaction, erosion, and contamination by spills / Net Residual Effects	Negative	Low	Local	Medium-term	Continuous	Possible	Not Significant
Visitor Experience	Changes in access to tourist sites		Negative	Low	Local	Short-term	Continuous	Likely	Not Significant
	Changes in traffic flow though WBNP during operations		Positive	n/a	n/a	n/a	n/a	n/a	n/a
	Changes in traffic flow through WBNP during construction		Negative	Low	Local	Short-term	Continuous	Likely	Not Significant
	Aesthetics and wilderness character of WBNP		Negative	Low	Local	Short-term	Continuous	Certain	Not Significant
	Net Residual Effects		Positive	n/a	n/a	n/a	n/a	n/a	n/a

^(a) Residual effects are those that remain after mitigations have been applied to avoid or reduce potential effects. Net residual effects are assessed for VCs impacted by more than one residual effect.

Note: If a residual effect was identified as positive or neutral, no additional assessment criteria other than likelihood were summarized for that VC. See Appendix F for Residual Effects Definitions.



11.0 SURVEILLANCE

- ☐ Surveillance is not required
- ☒ Surveillance is required (provide details such as the proposed schedule and the focus of inspections)

Inspection Program Details:

In keeping with the mitigation measures described in Section 8, an on-site WBNP ESO or other SWNWT Field Unit Representative will be available to oversee the construction activities along Highway 5 and determine whether Project operations are being conducted in accordance with all identified environmental protection measures. The ESO will complete periodic and unscheduled site visits. The ESO maintains the right to halt any work that does not comply with all Project work plans, Approvals, Permits, or Authorizations.

12.0 FOLLOW-UP MONITORING

Follow-up monitoring is:

- ☐ not required
- ☐ required by legislation or policy (indicate basis of requirement – e.g. required by the *Species at Risk Act*, *Fisheries Act*, or the *Parks Canada Cultural Resource Management Policy*)
- ☒ required to evaluate effectiveness of mitigation measures and/or assess restoration success

13.0 SARA NOTIFICATION

Notification is:

- ☒ not required
- ☐ required under the *Species at Risk Act* (outline the nature of and response to any notification)



BASIC IMPACT ANALYSIS FOR WOOD BUFFALO NATIONAL PARK HIGHWAY 5 ROADWAY REHABILITATION

14.0 EXPERTS CONSULTED

Include Parks Canada experts. Add as many entries as necessary for the project.

Department/Agency/Institution: Golder Associates Ltd.	Date of Request: May through July 2016
Expert's Name & Contact Information: Trevor Kinley P.O. Box. 220, Radium Hot Springs, BC V0A 1M0 Telephone: 250-347-6634 trevor.kinley@pc.gc.ca	Title: Environmental Assessment Specialist
Expertise Requested: Clarification on BIA requirements for the Project, site visit information and observations.	
Response: Provided reports, data and clarification on BIA requirements for Project.	
Department/Agency/Institution: McElhanney Consulting Services Ltd.	Date of Request: June and July 2016
Expert's Name & Contact Information : Mathieu Lachapelle	Title: Project Manager
Expertise Requested: Clarification on project design and requirements.	
Response: Clarification on project design and requirements.	
Department/Agency/Institution: Parks Canada Agency	Date of Request: 2016-07-13
Expert's Name & Contact Information: Sharon Irwin PO Box 750, Fort Smith, NWT, X0E 0P0 Telephone: 867-872-7948	Title: Ecologist Team Leader
Expertise Requested: Telephone discussion with Sharon from Wood Buffalo National Park, on the three tributaries along Highway 5.	
Response: Use of fish information in a Microsoft Excel spreadsheet, supplied by PCA, titled: Fish Species Found in Rivers & Streams in and near Wood Buffalo National Park (Area 1).	
Department/Agency/Institution: Parks Canada Agency	Date of Request: 2016-06-01
Expert's Name & Contact Information: John McKinnon PO Box 750, Fort Smith, NWT, X0E 0P0 Telephone: 867-872-7934	Title: Ecosystem Geomatics Technician
Expertise Requested: Request for available data to inform survey planning, the BIA, and associated mitigation planning for the Project. Examples of data requested are wildlife locations, important habitat features (e.g., mineral licks, dens), rare plant locations, ecosystem/habitat classification mapping, forest cover maps (including stand age / seral stage), and aquatics data regarding fish presence.	
Response: Available data were provided.	
Department/Agency/Institution: Parks Canada Agency	Date of Request: 2016-10-03
Expert's Name & Contact Information: Diane Casimir 300 – 300 West Georgia Street Vancouver, BC Telephone: 604-666-8708	Title: Species Conservation Specialist
Expertise Requested: Request for information regarding impacting Woodland Caribou Critical Habitat and implications for SARA.	
Response: Project footprint including borrow pit expansions will not reduce woodland caribou Critical Habitat below the 65% threshold, increase access for predators, attract or support alternate prey species, or fragment habitat; therefore CH is not affected and an Authorization under SARA is not required.	



15.0 DECISION

Taking into account implementation of mitigation measures outlined in the analysis, the project is:

- ☐ not likely to cause significant adverse environmental effects
- ☐ likely to cause significant adverse environmental effects

NOTE: If the project is identified as likely to cause significant adverse effects, CEAA 2012 prohibits approval of the project unless the Governor in Council (Cabinet) determines that the effects are justified in the circumstances. A finding of significant effects therefore means the project CANNOT go ahead as proposed.

FOR SARA REQUIREMENTS:



- ☒ There are no residual adverse effects to species at risk and therefore the SARA-Compliant Authorization Decision Tool was not required

OR, the SARA-Compliant Authorization Decision Tool was used and determined:

- ☐ There is no contravention of SARA prohibitions
- ☐ Project activities contravene a SARA prohibition and CAN be authorized under SARA
- ☐ Project activities contravene a SARA prohibition and CANNOT be authorized



16.0 RECOMMENDATION AND APPROVAL

Prepared by:	
Brock Simons, M.Sc., Associate, Senior Wildlife Biologist	2016-12-22
Signature: 	
Reviewed by:	
Martin Jalkotzy, M.E.Des., P.Biol. Principal, Senior Wildlife Ecologist	2016-12-22
Signature: 	
Recommended by:	
Name:	
Signature:	
Approved by:	
Name:	
Signature:	



17.0 ATTACHMENTS

Appendix A – Figures

Appendix B – Effects Identification Matrix

Appendix C – Vegetation and Wildlife Elements of Management Concern with Potential to Occur Near Project Sites

Appendix D – Watercourse Crossing Photos

Appendix E – Cultural Resources Report: Archaeological Overview Assessment

Appendix F – Definition of Criteria Used to Describe Predicted Residual Effects for Valued Components

18.0 NATIONAL IMPACT ASSESSMENT TRACKING SYSTEM

- ☐ Project registered in tracking system
- ☐ Not yet registered (*CEAA 2012 requires PCA submit a report to Parliament annually. EIAs must be entered in the tracking system **by the end of April** to enable reporting.*)

*****Ensure that all required mitigation measures and conditions (e.g. follow-up monitoring requirements) are included in project permits and authorizations*****



19.0 REFERENCES

- Altman, B. and R. Sallabanks. 2012. Olive-sided Flycatcher (*Contopus cooperi*). Cornell Lab of Ornithology, Ithaca, NY. Available at: <http://bna.birds.cornell.edu/bna/species/502>. Accessed July 2016.
- Allen RP. 1956. A Report on the Whooping Cranes Northern Breeding Grounds. Supplement to Research Report No. 3, National Audobon Society. 60 pp.
- Avery, M.L. 2013. Rusty Blackbird (*Euphagus carolinus*), The Birds of North America Online (A. Poole, Ed.). Cornell Lab of Ornithology, Ithaca, NY. Available at: <http://bna.birds.cornell.edu/bna/species/200>.
- Bowman, J., J.C. Ray, A.J. Magoun, D.S. Johnson and F.N. Dawson. 2010. Roads, logging, and the large-mammal community of an eastern Canadian boreal forest. Canadian Journal of Zoology. 88:454-467.
- Brown, C.R. and M.B. Brown. 1999. Barn Swallow (*Hirundo rustica*), The Birds of North America Online (A. Poole, Ed.). Cornell Lab of Ornithology, Ithaca, NY. Available at: <http://bna.birds.cornell.edu/bna/species/452>.
- Brigham, R.M., J. Ng, R.G. Poulin and S.D. Grindal. 2011. Common Nighthawk (*Chordeiles minor*), The Birds of North America Online (A. Poole, Ed.). Cornell Lab of Ornithology, Ithaca, NY. Available at: <http://bna.birds.cornell.edu/bna/species/213>.
- Browne, C. 2009. Distribution and Population Trends of the Canadian Toad (*Anaxyrus hemiophrys*) in Alberta. Alberta Sustainable Resource Development, Fish and Wildlife Division. Alberta Species at Risk Report No. 126, Edmonton, AB. 20 pp.
- Casimir, D. 2016. Species Conservation Specialist, Natural Resources Conservation Branch, Parks Canada Agency. Email to Michael Stefanyk, Environmental Assessment Scientist, Highway Engineering Services, Parks Canada. 30 September 2016.
- CCME (Canadian Council of Ministers of the Environment). 2002. Canadian water quality guidelines for the protection of aquatic life: Total particulate matter. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.
- CCME. 2008. Canadian water quality guidelines for the protection of aquatic life. Canadian Council of Ministers of the Environment, Winnipeg. Available at: http://www.ccme.ca/files/Resources/supporting_scientific_documents/cwqg_pn_1040.pdf. Accessed July 2016.
- Cluff, D., and P. Paquet. 2003. Large carnivores as umbrellas for reserve design and selection in the north. In Designing Protected Areas: Wild Places for Wild Life. Proceedings Summary of the 2003 Canadian Council on Ecological Areas (CCEA) and Circumpolar Protected Areas Network (CPAN) Workshop, September 9-10, 2003, Yellowknife, NWT.
- COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2009. COSEWIC assessment and update status report on the Northern Leopard Frog (*Lithobates pipiens*), Rocky Mountain population, Western Boreal/Prairie populations and Eastern populations, in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. Vii + 69 pp.



BASIC IMPACT ANALYSIS FOR WOOD BUFFALO NATIONAL PARK HIGHWAY 5 ROADWAY REHABILITATION

- COSEWIC. 2010. COSEWIC Assessment and Status Report on the Whooping Crane *Grus americana* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. x + 36 pp.
- COSEWIC. 2012. COSEWIC Assessment and Status Report on the Western Toad *Anaxyrus boreas* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xiv + 71 pp.
- COSEWIC. 2013a. COSEWIC assessment and status report on the Little Brown Myotis *Myotis lucifugus*, Northern Myotis *Myotis septentrionalis* and Tri-colored Bat *Perimyotis subflavus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xxiv + 93 pp
- COSEWIC. 2013b. COSEWIC assessment and status report on the Plains Bison *Bison bison bison* and the Wood Bison *Bison bison athabasca* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. Xv + 109 pp.
- COSEWIC. 2014. COSEWIC assessment and status report on the Wolverine *Gulo gulo* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xi + 76 pp.
- DFO (Fisheries and Oceans Canada). 1995. Freshwater Intake End-of-Pipe Fish Screen Guideline. Department of Fisheries and Oceans. Ottawa, ON. ISBN 0-662-23168-6.
- DFO. 2016a. Northwest Territories Restricted Activity Timing Windows for the Protection of Fish and Fish Habitat. Available at: <http://www.dfo-mpo.gc.ca/pnw-ppe/timing-periodes/nwt-eng.html>. Accessed July 15, 2016.
- DFO. 2016b. Measures to avoid causing harm to fish and fish habitat. Available at: <http://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures/measures-mesures-eng.html>. Accessed July 15, 2016.
- Dodd, C. K. 2013. Frogs of the United States and Canada. Volume 1. John Hopkins University Press, Baltimore, Maryland, USA.
- EC (Environment Canada). 2007. Recovery Strategy for the Whooping Crane (*Grus americana*) in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. vii + 27 pp.
- EC. 2012. Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal population, in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. Xi + 138 pp.
- EC. 2013. How Much Habitat is Enough? Third Edition. Environment Canada, Toronto, Ontario.
- EC. 2014. General nesting periods of migratory birds in Canada. Available at: <http://www.ec.gc.ca/paom-itmb/default.asp?lang=En&n=4F39A78F-1>. Accessed July 2016.
- ECCC (Environment and Climate Change Canada). 2016a. Species at Risk Public Registry. Available at: http://sararegistry.gc.ca/search/SpeciesSearch_e.cfm [updated July 18, 2016]. Accessed July 25, 2016.
- ECCC. 2016b. General nesting period of migratory birds in Canada. Available at: <http://www.ec.gc.ca/paom-itmb/default.asp?lang=En&n=4F39A78F-1>. Accessed July 2016.
- ECG (Ecosystem Classification Group). 2007 (rev. 2009). Ecological Regions of the Northwest Territories – Taiga Plains. Department of Environment and Natural Resources, Government of the Northwest Territories, Yellowknife, NT, Canada. viii + 173 pp.



BASIC IMPACT ANALYSIS FOR WOOD BUFFALO NATIONAL PARK HIGHWAY 5 ROADWAY REHABILITATION

- Garrison, B.A. 1999. Bank Swallow (*Riparia riparia*), The Birds of North America Online (A. Poole, Ed.). Cornell Lab of Ornithology, Ithaca, NY. Available at: <http://bna.birds.cornell.edu/bna/species/414>.
- Geological Survey of Canada. 1965. Bulletin 122, 1965; 44 pages, doi:10.4095/100639
- Geological Survey of Canada. 2015. Canadian Geoscience Map 219, 2015; 1 sheet, doi:10.4095/297244
- Geological Survey of Canada. 2016. Canadian Geoscience Map 220, 2016; 1 sheet, doi:10.4095/296509
- Golder (Golder Associates Ltd.). 2006. Canadian Toad Life History and Regional Habitat Model. Prepared for the Sustainable Ecosystem Working Group (SEWG) Cumulative Environmental Management Association (CEMA), Fort McMurray, AB. 45 pp. + appendices.
- GoC (Government of Canada). 1985. Fisheries Act [R.S.C., 1985]. Current to February 3 2016. Last amended on February 26, 2015. Available at: <http://laws-lois.justice.gc.ca/PDF/F-14.pdf>.
- GoC. 1994. Migratory Birds Convention Act. SC 1994, c. 22. Available at: <http://laws.justice.gc.ca/eng/acts/M-7.01/index.html>
- GNWT (Government of the Northwest Territories). 2015a. Department of Environment and Natural Resources. Air Quality Report. Available at: http://www.enr.gov.nt.ca/sites/default/files/128-air_quality_report_2014-proof.pdf. Accessed July 2016.
- GNWT. 2015b. Department of Transportation. Highway Traffic, 2014. Available at: <http://www.dot.gov.nt.ca/Documents>. Accessed July 2016.
- GNWT. 2016. Species at Risk Infobase. <http://www.nwtspeciesatrisk.ca/content/search-infobase>. Accessed July 15, 2016.
- Hamilton, I.M., Skilnick, J.L., Troughton, H., Russell, A.P., and Powell, G.L. 1998. Status of the Canadian Toad (*Bufo hemiophrys*) in Alberta. Alberta Conservation Association. Alberta Wildlife Status Report No.12.
- Irwin, S. 2016. Telephone discussion with Sharon Irwin from Wood Buffalo National Park, on the three tributaries along Highway 5. Use of fish information in a Microsoft Excel spreadsheet, supplied by PCA, titled: Fish Species Found in Rivers & Streams in and near Wood Buffalo National Park (Area 1) [pers. comm.]. July 13, 2016.
- Kinley, T. 2016. Telephone discussion with Trevor Kinley of Highway Engineering Service, Parks Canada Agency, regarding recent site visit to Highway 5 [pers. comm.]. May 10, 2016.
- Krebs, J., E.C. Lofroth, and I. Parfitt. 2007. Multiscale habitat use by wolverines in British Columbia, Canada. Journal of Wildlife Management 71:2180-2192.
- Kuyt, E. 1991. A Communal Overwintering Site for the Canadian Toad, *Bufo americanus hemiophrys*, in the Northwest Territories. The Canadian Field-Naturalist. 105: 118-121.
- Latham, A.D.M., M.C. Latham, N.A. McCutchen and S. Boutin. 2011. Invading White-Tailed Deer Change Caribou-Wolf Dynamics in Northeastern Alberta. Journal of Wildlife Management 75(1): 204-212.



BASIC IMPACT ANALYSIS FOR WOOD BUFFALO NATIONAL PARK HIGHWAY 5 ROADWAY REHABILITATION

- Nelson, J.S. and Paetz, M.J. 1972a. Fishes of the Northwestern Wood Buffalo National Park Region, Alberta and Northwest Territories. Canadian Field Naturalist 86: 133-144
- Nelson, J.S. and Paetz, M.J. 1972b. Summary Report of Fish Investigations in Wood Buffalo National Park June, 1972.
- PCA (Parks Canada Agency). 2010. Wood Buffalo National Park of Canada Management Plan, 81 pp.
- PCA. 2013. Parks Canada Biotics Web Explorer. Available at: http://www.pc.gc.ca/apps/bos/BOSFieldSelection_E.asp?oqqc=aqs. Accessed July 2016.
- PCA. 2015a Cultural History. Available at: <http://www.pc.gc.ca/eng/pn-np/nt/woodbuffalo/natcul/natcul2.aspx>. Accessed July 2016.
- PCA. 2015b. Wood Buffalo National Park of Canada. Available at: <http://www.pc.gc.ca/eng/pn-np/nt/woodbuffalo/visit/visit7/visit8.aspx>. Accessed July 2016.
- PCA. 2015c. Parks Canada National Best Management Practices. Roadway, Highway, Parkway and Related Infrastructure BMP. May 2015.
- PCA. 2016. Parks Canada. Wood Buffalo National Park. Visitor Information. Map of Wood Buffalo National Park. Available at: <http://www.pc.gc.ca/eng/pn-np/nt/woodbuffalo/visit/visit7/visit8.aspx>. Accessed July 2016.
- Reimer, J.P., C.L. Lausen, R.M.R. Barclay, S. Irwin and M.K. Vassal. 2014. Bat activity and use of hibernacula in Wood Buffalo National Park, Alberta. Northwestern Naturalist 95: 277-288.
- Roberts, W. and Lewin, V. 1979. Habitat Utilization and Population Densities of the Amphibians of Northeastern Alberta. The Canadian Field-Naturalist 93: 144-154.
- Stone, E.L., Harris, S., and Jones, G. 2015. Impacts of artificial lighting on bats: a review of challenges and solutions. Mammalian Biology 80(3): 213-219.
- Stewart, D.B., Reist, J.D., Carmichael, T.J., Satwatzky, C.D. and Mochnacz, N.J. 2007. Fish Life History and Habitat Use in the Northwest Territories: Brook Stickleback (*Culaea inconstans*). Fisheries and Oceans Canada. Winnipeg, MB R3T 2N6
- Timoney, K.P. 1996. Canadian Toads Near Their Northern Limit in Canada: Observations and Recommendations. Alberta Naturalist. 26: 49-50.
- Urbanek, R.P. and Lewis, J.C. 2015. Whooping Crane (*Grus americana*). The Birds of North American Online (A. Poole, Ed.). Cornell Lab of Ornithology, Ithaca, NY. Available at: <http://bna.birds.cornell.edu/bna/species/502>.
- Westworth (Westworth Associates Environmental Ltd.). 2002. A Review and Assessment of Existing Information for Key Wildlife and Fish Species in the Regional Sustainable Development Strategy Study Area: Volume I Wildlife. Prepared for Cumulative Environmental Management Association Wildlife and Fish Working Group.
- Zaidan, R. 2007. 6 minnow traps set Klewi River for 2 hours. Parks Canada.
- Ziervogel, A. 2016. Resource Management Officer II, Wood Buffalo National Park, Parks Canada Agency. Email communication. 15 September 2016.



APPENDIX A

Figures

RESOURCE BAND	PROJECT SITE NAME		Wood Buffalo National Park Chip Sealing Project KM 106-174			
	AQUATICS		106.5 Dry Culvert, No Channel	107.3 Dry Culvert, No Channel	108.3 Dry Culvert, No Channel	
	WETLANDS					
	LISTED PLANTS					
	FIBRE-OPTIC CABLE		South Side of Highway			
	WEEDS					
	SENSITIVE ECOSITE					
	WILDLIFE OBSERVATIONS					
	WILDLIFE AREAS		MBNZ B7, Boreal Woodland Caribou NWT Range	Sandcut: Potential Canadian Toad Overwintering Habitat	MBNZ B7, Boreal Woodland Caribou NWT Range	
	SOILS AND TERRAIN					
	HISTORIC RESOURCES					
VISITOR EXPERIENCE						

KILOMETRE POSTS (KP)

LEGEND

- BANK SWALLOW NESTING COLONY
- CULVERT
- KILOMETRE POST
- WATERCOURSE CROSSING
- HIGHWAY 5
- SANDCUT
- WATERCOURSE
- EXISTING BORROW PIT
- FIBRE-OPTIC CABLE TRANSITION AREA
- LOCAL STUDY AREA
- POTENTIAL BORROW PIT
- EXPANSION BOUNDARY

PARK ZONES

- ZONE I - SPECIAL PRESERVATION
- WHOOPIING CRANE NESTING AREA
- ZONE IV - OUTDOOR RECREATION

Map Labels:

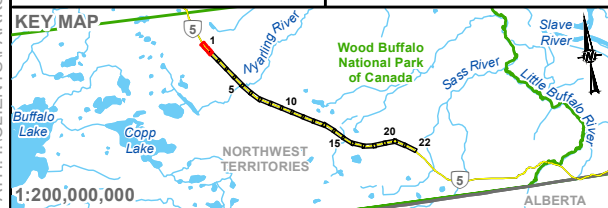
- Sec. 27 60-90 N 114-15 W
- Sec. 17 60-90 N 114-15 W
- Sec. 16 60-90 N 114-15 W
- Sec. 15 60-90 N 114-15 W
- Sec. 8 10-90 N 114-15 W
- MATCHLINE STA 106+000.0
- MATCHLINE STA 108+809.7
- Sheet 002
- No Sheet

Scale: HIGHWAY PLAN (SCALE 1:10,000)

North Arrow: N

Scale Bar: 0 50 100 200 300 400 Metres

MITIGATIONS	WATERCOURSES		N/A		N/A		N/A	
	AQUATICS RESTRICTED ACTIVITY PERIOD		No RAP		No RAP		No RAP	
	WETLANDS							
	VEGETATION MITIGATION	LISTED PLANTS AND SENSITIVE ECOSITES						
		WEEDS						
	WILDLIFE	RESTRICTED ACTIVITY PERIOD	Zone B7 - Migratory Bird Nesting Period May 3 to August 20					
		MITIGATION						
	SOIL AND TERRAIN CRITERIA							
	HISTORIC RESOURCES							
	DESIGN CRITERIA							



<p>References Imagery obtained from McElhanney. Additional Imagery Copyright © 19990115 Esri and its licensors. Source: Earthstar Geographics Terracolor. Used under license, all rights reserved.</p>	
<p>Notes 1. Use appropriate aquatic mitigation measures (BIA Section 9.1). 2. Avoid or minimize impacts to wetlands using appropriate mitigations (BIA Section 9.3).</p>	<p>Acronyms MBNZ Migratory Bird Nesting Zone NWT Northwest Territories RAP Restricted Activity Period</p>

CLIENT
PARKS CANADA

CONSULTANT



YYYY-MM-DD	2016-09-23
DESIGNED	VBS
PREPARED	RC
REVIEWED	VBS
APPROVED	MGJ

PROJECT
WOOD BUFFALO NATIONAL PARK HIGHWAY 5
ENVIRONMENTAL ALIGNMENT SHEET

— STA. 106+000.0 TO STA. 108+809.7

TITLE
Sheet 001

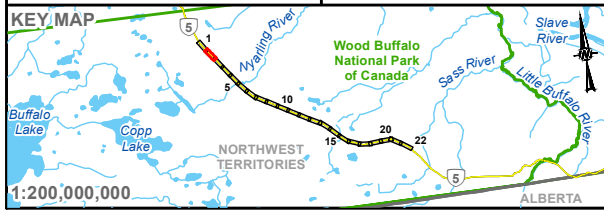
PROJECT NO.	CONTROL	REV.	FIGURE
1656958	3102	0	001 of 022

I:\CLIENTS\PARTS_CANADA\1656958\Mapping\Templates\1656958_WOODBUFFALO_TEMPLATE_20160629.mxd
PATH: I:\CLIENTS\PARTS_CANADA\1656958\Mapping\MXD\Alignment\Sheets\20160923\Sheet 002.mxd PRINTED ON: 2016-09-23 AT: 8:52:53 AM

RESOURCE BAND	PROJECT SITE NAME	Wood Buffalo National Park Chip Sealing Project KM 106-174			
	AQUATICS	109.3 Dry Culvert, No Channel		110.1 Dry Culvert, No Channel	110.8 Dry Culvert, No Channel
	WETLANDS				
	LISTED PLANTS				
	FIBRE-OPTIC CABLE	South Side of Highway			
	WEEDS				
	SENSITIVE ECOSITE				
	WILDLIFE OBSERVATIONS				
	WILDLIFE AREAS	MBNZ B7, Boreal Woodland Caribou NWT Range			
	SOILS AND TERRAIN				
	HISTORIC RESOURCES				
	VISITOR EXPERIENCE				



MITIGATIONS	WATERCOURSES		N/A		N/A		N/A		
	AQUATICS RESTRICTED ACTIVITY PERIOD		No RAP		No RAP		No RAP		
	WETLANDS								
	VEGETATION MITIGATION	LISTED PLANTS AND SENSITIVE ECOSITES							
		WEEDS							
	WILDLIFE	RESTRICTED ACTIVITY PERIOD		Zone B7 - Migratory Bird Nesting Period May 3 to August 20					
		MITIGATION							
	SOIL AND TERRAIN CRITERIA								
	HISTORIC RESOURCES								
DESIGN CRITERIA									



References
Imagery obtained from McElhanney. Additional Imagery Copyright © 19990115 Esri and its licensors. Source: Earthstar Geographics Terracolor. Used under license, all rights reserved.

Notes
1. Use appropriate aquatic mitigation measures (BIA Section 9.1).
2. Avoid or minimize impacts to wetlands using appropriate mitigations (BIA Section 9.3).

Acronyms
MBNZ Migratory Bird Nesting Zone
NWT Northwest Territories
RAP Restricted Activity Period

CLIENT
PARKS CANADA

CONSULTANT

Golder Associates

PROJECT
WOOD BUFFALO NATIONAL PARK HIGHWAY 5
ENVIRONMENTAL ALIGNMENT SHEET

STA. 108+809.7 TO STA. 111+795.9

TITLE
Sheet 002

PROJECT NO. 1656958 CONTROL 3102 REV. 0

FIGURE
002 of 022

KILOMETRE POSTS (KP)	115	116	117
----------------------	-----	-----	-----

LEGEND

- BANK SWALLOW NESTING COLONY
- CULVERT
- KILOMETRE POST
- WATERCOURSE CROSSING
- HIGHWAY 5
- SANDCUT
- WATERCOURSE
- EXISTING BORROW PIT
- FIBRE-OPTIC CABLE TRANSITION AREA
- LOCAL STUDY AREA
- POTENTIAL BORROW PIT
- EXPANSION BOUNDARY
- PARK ZONES**
 - ZONE I - SPECIAL PRESERVATION
 - WHOOPIING CRANE NESTING AREA
 - ZONE IV - OUTDOOR RECREATION

0 50 100 200 300 400 Metres

HIGHWAY PLAN (SCALE 1:10,000)

Sheet 003 MATCHLINE STA 114+814.4

Sec. 63 60-80 N 114-00 W

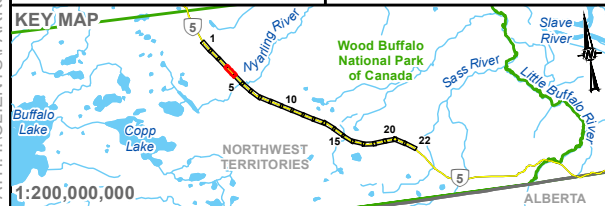
115 116 117

Sec. 62 60-80 N 114-00 W

Sec. 52 60-80 N 114-00 W

Sheet 005 MATCHLINE STA 117+812.1

MITIGATIONS	WATERCOURSES		N/A	N/A	N/A	N/A	
	AQUATICS RESTRICTED ACTIVITY PERIOD		No RAP	No RAP	No RAP	No RAP	
	WETLANDS						
	VEGETATION MITIGATION	LISTED PLANTS AND SENSITIVE ECOSITES					
		WEEDS					
	WILDLIFE	RESTRICTED ACTIVITY PERIOD		Zone B7 - Migratory Bird Nesting Period May 3 to August 20			
		MITIGATION					
	SOIL AND TERRAIN CRITERIA						
	HISTORIC RESOURCES						
DESIGN CRITERIA							



References
Imagery obtained from McElhanney. Additional Imagery Copyright © 19990115 Esri and its licensors. Source: Earthstar Geographics Terracolor. Used under license, all rights reserved.

Notes
1. Use appropriate aquatic mitigation measures (BIA Section 9.1).
2. Avoid or minimize impacts to wetlands using appropriate mitigations (BIA Section 9.3).

Acronyms
MBNZ Migratory Bird Nesting Zone
NWT Northwest Territories
RAP Restricted Activity Period

Acronyms
 MBNZ Migratory Bird Nesting Zone
 NWT Northwest Territories
 RAP Restricted Activity Period

CLIENT
PARKS CANADA

CONSULTANT



YYYY-MM-DD	2016-09-23
DESIGNED	VBS
PREPARED	RC
REVIEWED	VBS
APPROVED	MGJ

PROJECT
WOOD BUFFALO NATIONAL PARK HIGHWAY 5
ENVIRONMENTAL ALIGNMENT SHEET

STA. 114+814.4 TO STA. 117+842.1

TITLE
Sheet 004

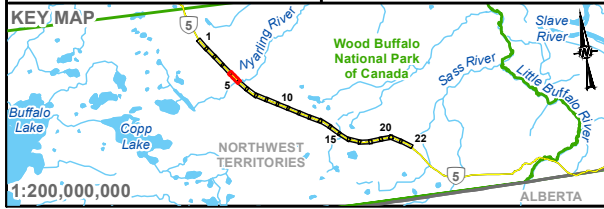
PROJECT NO.	CONTROL	REV.	FIGURE
1656958	3102	0	004 of 022

I:\CLIENTS\PARKS_CANADA\1656958\Mapping\Templates\1656958_WOODBUFFALO_TEMPLATE_20160629.mxd
PATH: I:\CLIENTS\PARKS_CANADA\1656958\Mapping\MXD\Alignment\Sheets\20160923\Sheet 005.mxd PRINTED ON: 2016-09-23 AT: 8:54:25 AM

RESOURCE BAND	PROJECT SITE NAME	Wood Buffalo National Park Chip Sealing Project KM 106-174			
	AQUATICS	118 Dry Culvert, No Channel	118.3 Dry Culvert, No Channel	118.8 Dry Culvert, No Channel	119.2 Dry Culvert, No Channel
	WETLANDS				
	LISTED PLANTS				
	FIBRE-OPTIC CABLE	South Side of Highway			
	WEEDS				
	SENSITIVE ECOSITE				
	WILDLIFE OBSERVATIONS				
	WILDLIFE AREAS	MBNZ B7, Boreal Woodland Caribou NWT Range			
	SOILS AND TERRAIN				
	HISTORIC RESOURCES				
	VISITOR EXPERIENCE				



MITIGATIONS	WATERCOURSES		N/A	N/A	N/A	N/A	
	AQUATICS RESTRICTED ACTIVITY PERIOD		No RAP	No RAP	No RAP	No RAP	
	WETLANDS						
	VEGETATION MITIGATION	LISTED PLANTS AND SENSITIVE ECOSITES					
		WEEDS					
	WILDLIFE	RESTRICTED ACTIVITY PERIOD		Zone B7 - Migratory Bird Nesting Period May 3 to August 20			
		MITIGATION					
	SOIL AND TERRAIN CRITERIA						
	HISTORIC RESOURCES						
DESIGN CRITERIA							



References
Imagery obtained from McElhanney. Additional Imagery Copyright © 19990115 Esri and its licensors. Source: Earthstar Geographics Terracolor. Used under license, all rights reserved.

Notes
1. Use appropriate aquatic mitigation measures (BIA Section 9.1).
2. Avoid or minimize impacts to wetlands using appropriate mitigations (BIA Section 9.3).

Acronyms
MBNZ Migratory Bird Nesting Zone
NWT Northwest Territories
RAP Restricted Activity Period

CLIENT
PARKS CANADA



YYYY-MM-DD	2016-09-23
DESIGNED	VBS
PREPARED	RC
REVIEWED	VBS
APPROVED	MGJ

PROJECT WOOD BUFFALO NATIONAL PARK HIGHWAY 5 ENVIRONMENTAL ALIGNMENT SHEET	
STA. 117+842.1	TO STA. 120+840.1
TITLE Sheet 005	
PROJECT NO. 1656958	CONTROL 3102
REV. 0	
FIGURE 005 of 022	

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM A4S/B

RESOURCE BAND	PROJECT SITE NAME		Wood Buffalo National Park Chip Sealing Project KM 106-174										
	AQUATICS		121.2 Dry Culvert, No Channel		121.8 Dry Culvert, No Channel		122.6 Dry Culvert, No Channel	122.9 Dry Culvert, No Channel		123.5 Dry Culvert, No Channel			
	WETLANDS												
	LISTED PLANTS												
	FIBRE-OPTIC CABLE		South Side of Highway										
	WEEDS												
	SENSITIVE ECOSITE												
	WILDLIFE OBSERVATIONS												
	WILDLIFE AREAS		MBNZ B7, Boreal Woodland Caribou NWT Range										
	SOILS AND TERRAIN												
	HISTORIC RESOURCES												
	VISITOR EXPERIENCE												

KILOMETRE POSTS (KP)

LEGEND

- BANK SWALLOW NESTING COLONY
- CULVERT
- KILOMETRE POST
- WATERCOURSE CROSSING
- HIGHWAY 5
- SANDCUT
- WATERCOURSE
- EXISTING BORROW PIT
- FIBRE-OPTIC CABLE TRANSITION AREA
- LOCAL STUDY AREA
- POTENTIAL BORROW PIT
- EXPANSION BOUNDARY

PARK ZONES

- ZONE I - SPECIAL PRESERVATION
- WHOOPING CRANE NESTING AREA
- ZONE IV - OUTDOOR RECREATION

Map Labels:

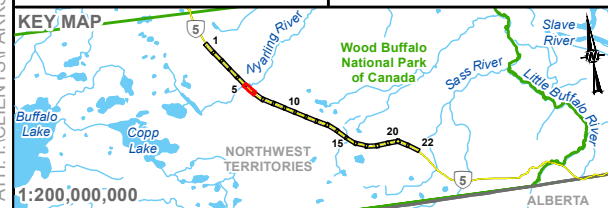
- Sheet 005
- MATCHLINE STA 120+840.1
- Sec. 50 60-20 N 114-00 W
- 121
- 122
- 123
- Sec. 40 60-20 N 114-00 W
- Sec. 30 60-20 N 114-00 W
- Sec. 40 60-20 N 114-00 W
- MATCHLINE STA 123+830.9
- Sheet 007

Scale: 0 50 100 200 300 400 Metres

Highway Plan Scale: 1:10,000

North Arrow: N 114° 40' W

MITIGATIONS	WATERCOURSES		N/A	N/A	N/A	N/A	N/A
	AQUATICS RESTRICTED ACTIVITY PERIOD		No RAP	No RAP	No RAP	No RAP	No RAP
	WETLANDS						
	VEGETATION MITIGATION	LISTED PLANTS AND SENSITIVE ECOSITES					
		WEEDS					
	WILDLIFE	RESTRICTED ACTIVITY PERIOD	Zone B7 - Migratory Bird Nesting Period May 3 to August 20				
		MITIGATION					
	SOIL AND TERRAIN CRITERIA						
	HISTORIC RESOURCES						
	DESIGN CRITERIA						



References Imagery obtained from McElhanney. Additional Imagery Copyright © 19990115 Esri and its licensors. Source: Earthstar Geographics Terracolor. Used under license, all rights reserved.	
Notes 1. Use appropriate aquatic mitigation measures (BIA Section 9.1). 2. Avoid or minimize impacts to wetlands using appropriate mitigations (BIA Section 9.3).	Acronyms MBNZ Migratory Bird Nesting Zone NWT Northwest Territories RAP Restricted Activity Period

CLIENT
PARKS CANADA

CONSULTANT



YYYY-MM-DD	2016-09-23
DESIGNED	VBS
PREPARED	RC
REVIEWED	VBS
APPROVED	MGJ

PROJECT
WOOD BUFFALO NATIONAL PARK HIGHWAY 5
ENVIRONMENTAL ALIGNMENT SHEET

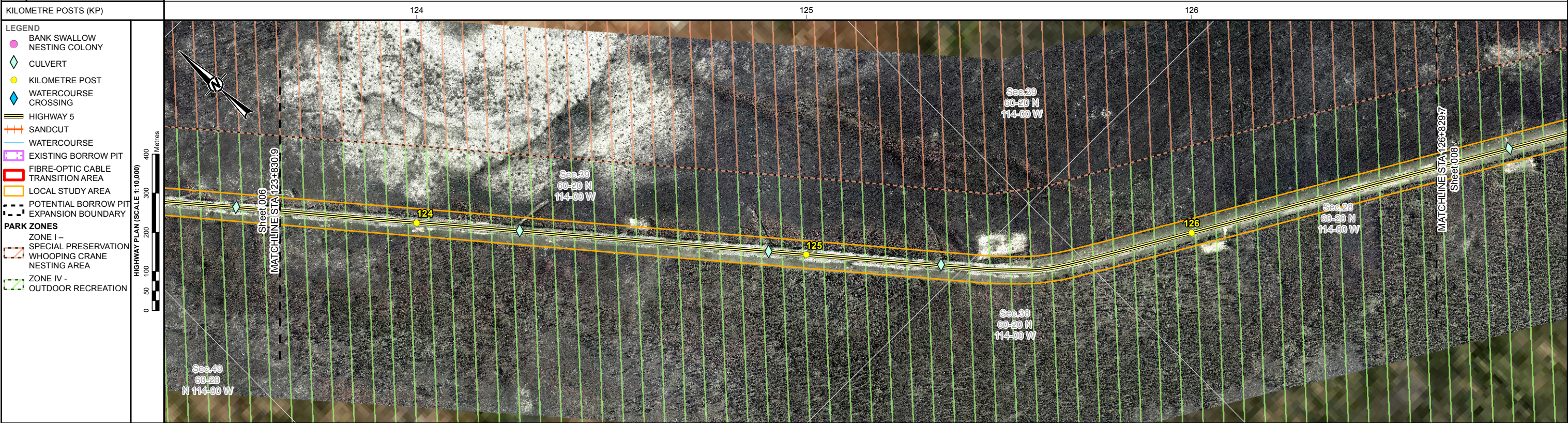
— STA. 120+840.1 TO STA. 123+830.9

TITLE
Sheet 006

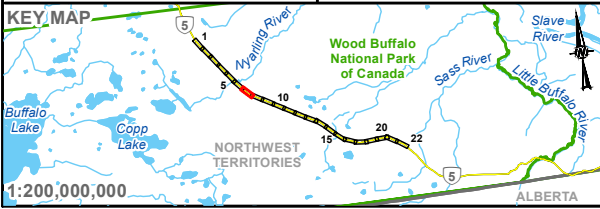
PROJECT NO.	CONTROL	REV.	FIGURE
1656958	3102	0	006 of 022

I:\CLIENTS\PARTS_CANADA\1656958\Mapping\Templates\1656958_WOODBUFFALO_TEMPLATE_20160629.mxd
PATH: I:\CLIENTS\PARTS_CANADA\1656958\Mapping\MXD\Alignment\Sheets\20160923\Sheet 007.mxd PRINTED ON: 2016-09-23 AT: 8:55:26 AM

RESOURCE BAND	PROJECT SITE NAME	Wood Buffalo National Park Chip Sealing Project KM 106-174			
	AQUATICS	124.3 Dry Culvert, No Channel	124.9 Dry Culvert, No Channel	125.3 Dry Culvert, No Channel	
	WETLANDS				
	LISTED PLANTS				
	FIBRE-OPTIC CABLE	South Side of Highway			
	WEEDS				
	SENSITIVE ECOSITE				
	WILDLIFE OBSERVATIONS				
	WILDLIFE AREAS	MBNZ B7, Boreal Woodland Caribou NWT Range			
	SOILS AND TERRAIN				
	HISTORIC RESOURCES				
	VISITOR EXPERIENCE				



MITIGATIONS	WATERCOURSES		N/A		N/A		N/A		
	AQUATICS RESTRICTED ACTIVITY PERIOD		No RAP		No RAP		No RAP		
	WETLANDS								
	VEGETATION MITIGATION	LISTED PLANTS AND SENSITIVE ECOSITES							
		WEEDS							
	WILDLIFE	RESTRICTED ACTIVITY PERIOD		Zone B7 - Migratory Bird Nesting Period May 3 to August 20					
		MITIGATION							
	SOIL AND TERRAIN CRITERIA								
	HISTORIC RESOURCES								
	DESIGN CRITERIA								



References
Imagery obtained from McElhanney. Additional Imagery Copyright © 19990115 Esri and its licensors. Source: Earthstar Geographics Terracolor. Used under license, all rights reserved.

Notes
1. Use appropriate aquatic mitigation measures (BIA Section 9.1).
2. Avoid or minimize impacts to wetlands using appropriate mitigations (BIA Section 9.3).

Acronyms
MBNZ Migratory Bird Nesting Zone
NWT Northwest Territories
RAP Restricted Activity Period

CLIENT
PARTS CANADA



YYYY-MM-DD	2016-09-23
DESIGNED	VBS
PREPARED	RC
REVIEWED	VBS
APPROVED	MGJ

PROJECT
WOOD BUFFALO NATIONAL PARK HIGHWAY 5
ENVIRONMENTAL ALIGNMENT SHEET

STA. 123+830.9 TO STA. 126+829.7

TITLE
Sheet 007

PROJECT NO.	CONTROL	REV.	FIGURE
1656958	3102	0	007 of 022

RESOURCE BAND	PROJECT SITE NAME		Wood Buffalo National Park Chip Sealing Project KM 106-174					
	AQUATICS		126.8 Dry Culvert, No Channel		127.7 Dry Culvert, No Channel		128.4 Dry Culvert, No Channel	129.3 Dry Culvert, No Channel 129.5 Dry Culvert, No Channel
	WETLANDS							
	LISTED PLANTS							
	FIBRE-OPTIC CABLE		South Side of Highway					
	WEEDS							
	SENSITIVE ECOSITE							
	WILDLIFE OBSERVATIONS							
	WILDLIFE AREAS		MBNZ B7, Boreal Woodland Caribou NWT Range					
	SOILS AND TERRAIN							
	HISTORIC RESOURCES							
	VISITOR EXPERIENCE							

LEGEND

- BANK SWALLOW NESTING COLONY
- CULVERT
- KILOMETRE POST
- WATERCOURSE CROSSING
- HIGHWAY 5
- SANDCUT
- WATERCOURSE
- EXISTING BORROW PIT
- FIBRE-OPTIC CABLE TRANSITION AREA
- LOCAL STUDY AREA
- POTENTIAL BORROW PIT
- EXPANSION BOUNDARY

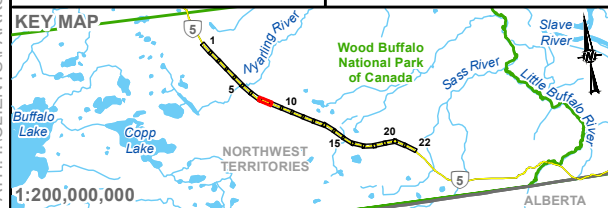
PARK ZONES

- ZONE I – SPECIAL PRESERVATION
- WHOOPIING CRANE NESTING AREA
- ZONE IV - OUTDOOR RECREATION

Map Details:

- Scale:** 1:10,000
- Matchlines:** STA 126+829.7 (Sheet 007) and STA 129+827.3 (Sheet 009)
- Section Markers:**
 - Sec. 23: 60-20 N 114-00 W
 - Sec. 18: 60-20 N 114-00 W
 - Sec. 17: 60-20 N 114-00 W
 - Sec. 8: 60-20 N 114-00 W
 - Sec. 7: 60-20 N 114-00 W
- Highway 5 Expansion:** Indicated by a dashed line and a solid line.
- Local Study Area:** Indicated by a yellow shaded area.
- Park Zones:** Indicated by different colors and patterns.

MITIGATIONS	WATERCOURSES		N/A	N/A	N/A	N/A	N/A
	AQUATICS RESTRICTED ACTIVITY PERIOD		No RAP	No RAP	No RAP	No RAP	No RAP
	WETLANDS						
	VEGETATION MITIGATION	LISTED PLANTS AND SENSITIVE ECOSITES					
		WEEDS					
	WILDLIFE	RESTRICTED ACTIVITY PERIOD		Zone B7 - Migratory Bird Nesting Period May 3 to August 20			
		MITIGATION					
	SOIL AND TERRAIN CRITERIA						
	HISTORIC RESOURCES						
DESIGN CRITERIA							



<p>References Imagery obtained from McElhanney. Additional Imagery Copyright © 19990115 Esri and its licensors. Source: Earthstar Geographics Terracolor. Used under license, all rights reserved.</p>	
<p>Notes 1. Use appropriate aquatic mitigation measures (BIA Section 9.1). 2. Avoid or minimize impacts to wetlands using appropriate mitigations (BIA Section 9.3).</p>	<p>Acronyms MBNZ Migratory Bird Nesting Zone NWT Northwest Territories RAP Restricted Activity Period</p>

CLIENT
PARKS CANADA

CONSULTANT



YYYY-MM-DD	2016-09-23
DESIGNED	VBS
PREPARED	RC
REVIEWED	VBS
APPROVED	MGJ

PROJECT
WOOD BUFFALO NATIONAL PARK HIGHWAY 5
ENVIRONMENTAL ALIGNMENT SHEET

— STA. 126+829.7 TO STA. 129+827.3

TITLE
Sheet 008

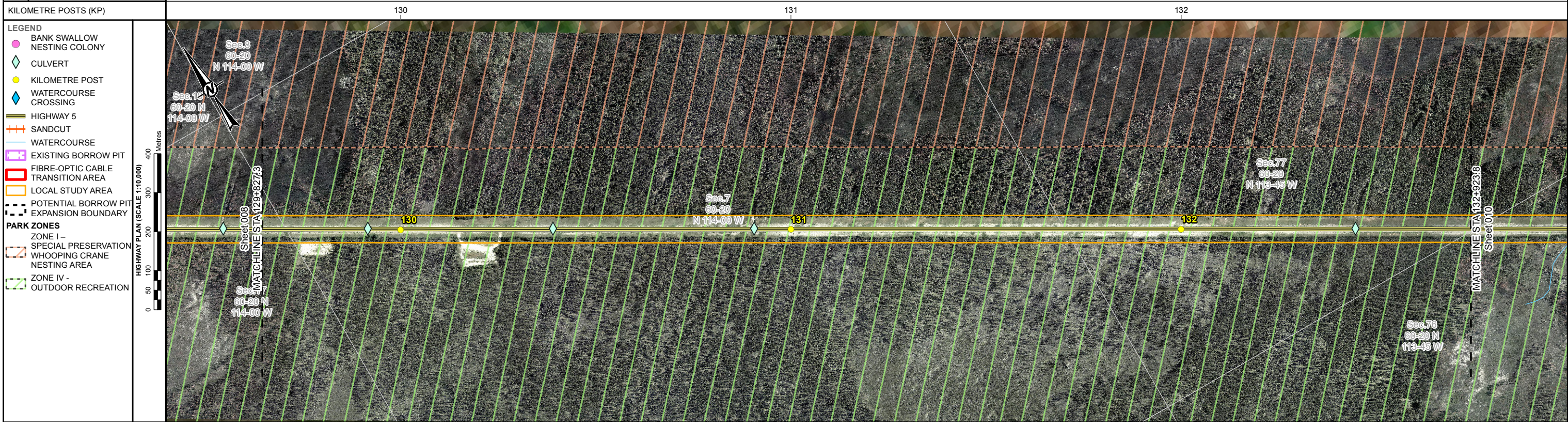
PROJECT NO
1656958

CONTROL
3102

REV.
0FIGURE
008 of 022

I:\CLIENTS\PARKS_CANADA\1656958\Mapping\Templates\1656958_WOODBUFFALO_TEMPLATE_20160629.mxd
PATH: I:\CLIENTS\PARKS_CANADA\1656958\Mapping\MXD\Alignment\Sheets\20160923\Sheet 009.mxd PRINTED ON: 2016-09-23 AT: 8:56:29 AM

RESOURCE BAND	PROJECT SITE NAME	Wood Buffalo National Park Chip Sealing Project KM 106-174				
	AQUATICS	129.9 Dry Culvert, No Channel		130.4 Dry Culvert, No Channel	130.9 Dry Culvert, No Channel	132.4 Dry Culvert, No Channel
	WETLANDS	Wetland				
	LISTED PLANTS					
	FIBRE-OPTIC CABLE	South Side of Highway				
	WEEDS					
	SENSITIVE ECOSITE					
	WILDLIFE OBSERVATIONS					
	WILDLIFE AREAS	MBNZ B7, Boreal Woodland Caribou NWT Range				
	SOILS AND TERRAIN					
	HISTORIC RESOURCES					
	VISITOR EXPERIENCE					



RESOURCE BAND	PROJECT SITE NAME		Wood Buffalo National Park Chip Sealing Project KM 106-174			
	AQUATICS		133.1 Dry Culvert, No Channel	134.1 Dry Culvert, No Channel	135 Dry Culvert, No Channel	
	WETLANDS		Wetland			
	LISTED PLANTS					
	FIBRE-OPTIC CABLE		South Side of Highway			
	WEEDS					
	SENSITIVE ECOSITE					
	WILDLIFE OBSERVATIONS					
	WILDLIFE AREAS		MBNZ B7, Boreal Woodland Caribou NWT Range			
	SOILS AND TERRAIN					
	HISTORIC RESOURCES					
	VISITOR EXPERIENCE					

LEGEND

- BANK SWALLOW NESTING COLONY
- CULVERT
- KILOMETRE POST
- WATERCOURSE CROSSING
- HIGHWAY 5
- SANDCUT
- WATERCOURSE
- EXISTING BORROW PIT
- FIBRE-OPTIC CABLE TRANSITION AREA
- LOCAL STUDY AREA
- POTENTIAL BORROW PIT
- EXPANSION BOUNDARY

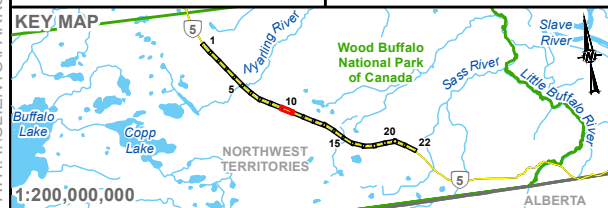
PARK ZONES

- ZONE I – SPECIAL PRESERVATION
- WHOOPIING CRANE NESTING AREA
- ZONE IV - OUTDOOR RECREATION

Map Details:

- Scale:** 1:10,000
- Highway Plan:** Scale 1:10,000
- Matchlines:** STA 132+923.8 (Sheet 009) and STA 136+000.2 (Sheet 011)
- Kilometre Posts:** 133, 134, 135, 136
- Section Labels:**
 - Sec.77 60-20 N 113-45 W
 - Sec.76 60-20 N 113-45 W
 - Sec.66 60-20 N 113-45 W
 - Sec.56 60-20 N 113-45 W
 - Sec.65 60-20 N 113-45 W
 - Sec.55 60-20 N 113-45 W

MITIGATIONS	WATERCOURSES		N/A		N/A		N/A		
	AQUATICS RESTRICTED ACTIVITY PERIOD		No RAP		No RAP		No RAP		
	WETLANDS		See Note 2						
	VEGETATION MITIGATION	LISTED PLANTS AND SENSITIVE ECOSITES							
		WEEDS							
	WILDLIFE	RESTRICTED ACTIVITY PERIOD		Zone B7 - Migratory Bird Nesting Period May 3 to August 20					
		MITIGATION							
	SOIL AND TERRAIN CRITERIA								
	HISTORIC RESOURCES								
DESIGN CRITERIA									



References	
Imagery obtained from McElhanney. Additional Imagery Copyright © 19990115 Esri and its licensors. Source: Earthstar Geographics Terracolor.	
Used under license, all rights reserved.	
Notes	Acronyms
1. Use appropriate aquatic mitigation measures (BIA Section 9.1).	MBNZ Migratory Bird Nesting Zone
2. Avoid or minimize impacts to wetlands using appropriate mitigations (BIA Section 9.3).	NWT Northwest Territories
	RAP Restricted Activity Period

CLIENT
PARKS CANADA

CONSULTANT



YYYY-MM-DD	2016-09-23
DESIGNED	VBS
PREPARED	RC
REVIEWED	VBS
APPROVED	MGJ

PROJECT
WOOD BUFFALO NATIONAL PARK HIGHWAY 5
ENVIRONMENTAL ALIGNMENT SHEET

— STA. 132+923.8 TO STA. 136+000.4

TITLE
Sheet 010

PROJECT NO.	CONTROL	REV.	FIGURE
1656958	3102	0	010 of 022

KILOMETRE POSTS (KP)	136	137	138
----------------------	-----	-----	-----

LEGEND

- BANK SWALLOW NESTING COLONY
- CULVERT
- KILOMETRE POST
- WATERCOURSE CROSSING
- HIGHWAY 5
- SANDCUT
- WATERCOURSE
- EXISTING BORROW PIT
- FIBRE-OPTIC CABLE
- TRANSITION AREA
- LOCAL STUDY AREA
- POTENTIAL BORROW PIT
- EXPANSION BOUNDARY

PARK ZONES

- ZONE I - SPECIAL PRESERVATION
- WHOOPING CRANE NESTING AREA
- ZONE IV - OUTDOOR RECREATION

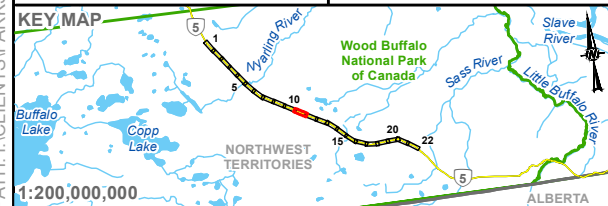
Map Labels:

- Sheet 010
- MATCHLINE STA 136+000.4
- Sec. 56 60-20 N 113-45 W
- 136
- Sec. 55 60-20 N 113-45 W
- 137
- 138
- Sec. 45 60-20 N 113-45 W
- 139
- Sheet 012
- MATCHLINE STA 139+067.6
- Sec. 66 60-20 N 113-45 W
- Sec. 65 60-20 N 113-45 W

Scale: HIGHWAY PLAN (SCALE 1:10,000)

Metres: 0, 50, 100, 200, 300, 400

MITIGATIONS	WATERCOURSES		N/A	N/A	N/A	N/A
	AQUATICS RESTRICTED ACTIVITY PERIOD		No RAP	No RAP	No RAP	No RAP
	WETLANDS		See Note 2		See Note 2	
	VEGETATION MITIGATION	LISTED PLANTS AND SENSITIVE ECOSITES				
		WEEDS				
	WILDLIFE	RESTRICTED ACTIVITY PERIOD	Zone B7 - Migratory Bird Nesting Period May 3 to August 20			
		MITIGATION				
	SOIL AND TERRAIN CRITERIA					
	HISTORIC RESOURCES					
	DESIGN CRITERIA					



<p>References Imagery obtained from McElhanney. Additional Imagery Copyright © 19990115 Esri and its licensors. Source: Earthstar Geographics Terracolor. Used under license, all rights reserved.</p>	
<p>Notes 1. Use appropriate aquatic mitigation measures (BIA Section 9.1). 2. Avoid or minimize impacts to wetlands using appropriate mitigations (BIA Section 9.3).</p>	<p>Acronyms MBNZ Migratory Bird Nesting Zone NWT Northwest Territories RAP Restricted Activity Period</p>

CLIENT
PARKS CANADA

CONSULTANT



YYYY-MM-DD	2016-09-23
DESIGNED	VBS
PREPARED	RC
REVIEWED	VBS
APPROVED	MGJ

PROJECT
WOOD BUFFALO NATIONAL PARK HIGHWAY 5
ENVIRONMENTAL ALIGNMENT SHEET

— STA. 136+000.4 TO STA. 139+067.6

TITLE
Sheet 011

PROJECT NO.	CONTROL	REV.	FIGURE
1656958	3102	0	011 of 022

I:\CLIENTS\PARKS_CANADA\1656958\Mapping\Templates\16569584_WOODBUFFALO_TEMPLATE_20160629.mxd
PATH: I:\CLIENTS\PARKS_CANADA\1656958\Mapping\MXD\Alignment\Sheets\20160923\Sheet 012.mxd PRINTED ON: 2016-09-23 AT: 8:57:58 AM

RESOURCE BAND	PROJECT SITE NAME	Wood Buffalo National Park Chip Sealing Project KM 106-174											
	AQUATICS	139.5 Wet Culvert, No Channel			140.4 Wet Culvert, No Channel			141.4 Dry Culvert, No Channel		141.9 Dry Culvert, No Channel			
	WETLANDS	Wetland											
	LISTED PLANTS												
	FIBRE-OPTIC CABLE	North Side of Highway											
	WEEDS												
	SENSITIVE ECOSITE												
	WILDLIFE OBSERVATIONS												
	WILDLIFE AREAS	MBNZ B7, Boreal Woodland Caribou NWT Range											
	SOILS AND TERRAIN												
	HISTORIC RESOURCES												
	VISITOR EXPERIENCE												



I:\CLIENTS\PARKS_CANADA\1656958\Mapping\Templates\1656958_WOODBUFFALO_TEMPLATE_20160629.mxd
PATH: I:\CLIENTS\PARKS_CANADA\1656958\Mapping\MXD\Alignment\Sheets\20160923\Sheet 013.mxd PRINTED ON: 2016-09-23 AT: 8:58:24 AM

RESOURCE BAND	PROJECT SITE NAME	Wood Buffalo National Park Chip Sealing Project KM 106-174			
	AQUATICS	142.8 Wet Culvert, No channel or Fish Habitat		144.2 Unnamed Watercourse, Tributary to Klewi River, Potential for Fish Habitat	144.8 Dry Culvert, No Channel
	WETLANDS	Wetland		Wetland	
	LISTED PLANTS				
	FIBRE-OPTIC CABLE	North Side of Highway			
	WEEDS				
	SENSITIVE ECOSITE				
	WILDLIFE OBSERVATIONS				
	WILDLIFE AREAS	MBNZ B7, Boreal Woodland Caribou NWT Range		Sandcut: Potential Canadian Toad Overwintering Habitat	MBNZ B7, Boreal Woodland Caribou NWT Range
	SOILS AND TERRAIN				
	HISTORIC RESOURCES				
	VISITOR EXPERIENCE				



I:\CLIENTS\PARTS_CANADA\1656958\Mapping\Templates\1656958_WOODBUFFALO_TEMPLATE_20160629.mxd
PATH: I:\CLIENTS\PARTS_CANADA\1656958\Mapping\MXD\Alignment\Sheets\20160923\Sheet 014.mxd PRINTED ON: 2016-09-23 AT: 8:58:55 AM

RESOURCE BAND	PROJECT SITE NAME	Wood Buffalo National Park Chip Sealing Project KM 106-174											
	AQUATICS			145.7 Dry Culvert, No Channel	146.1 Dry Culvert, No Channel	146.3 Dry Culvert, No Channel	146.8 Dry Culvert, No Channel	147.1 Dry Culvert, No Channel	147.6 Dry Culvert, No Channel				
	WETLANDS						Wetland					Wetland	
	LISTED PLANTS												
	FIBRE-OPTIC CABLE		North Side of Highway										
	WEEDS												
	SENSITIVE ECOSITE												
	WILDLIFE OBSERVATIONS												
	WILDLIFE AREAS		MBNZ B7, Boreal Woodland Caribou NWT Range										
	SOILS AND TERRAIN												
	HISTORIC RESOURCES												
	VISITOR EXPERIENCE												

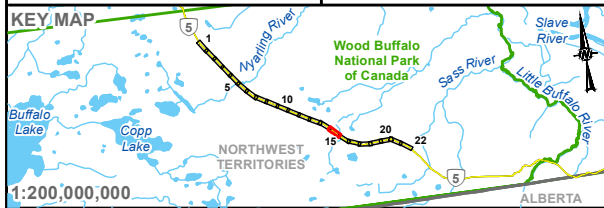


I:\CLIENTS\PARKS_CANADA\1656958\Mapping\Templates\1656958_WOODBUFFALO_TEMPLATE_20160629.mxd
PATH: I:\CLIENTS\PARKS_CANADA\1656958\Mapping\MXD\Alignment\Sheets\20160923\Sheet 015.mxd PRINTED ON: 2016-09-23 AT: 8:59:22 AM

RESOURCE BAND	PROJECT SITE NAME		Wood Buffalo National Park Chip Sealing Project KM 106-174											
	AQUATICS					148.7 Wet Culvert, No Channel	149 Wet Culvert, No Channel	150 Wet Culvert, No Channel						
	WETLANDS		Wetland		Wetland		Wetland						Wetland	
	LISTED PLANTS													
	FIBRE-OPTIC CABLE		North Side of Highway											
	WEEDS													
	SENSITIVE ECOSITE													
	WILDLIFE OBSERVATIONS													
	WILDLIFE AREAS		MBNZ B7, Boreal Woodland Caribou NWT Range											
	SOILS AND TERRAIN													
	HISTORIC RESOURCES													
	VISITOR EXPERIENCE													



MITIGATIONS	WATERCOURSES				N/A		N/A		N/A				
	AQUATICS RESTRICTED ACTIVITY PERIOD				No RAP		No RAP		No RAP				
	WETLANDS			See Note 2		See Note 2		See Note 2		See Note 2			
	VEGETATION MITIGATION	LISTED PLANTS AND SENSITIVE ECOSITES											
		WEEDS											
	WILDLIFE	RESTRICTED ACTIVITY PERIOD		Zone B7 - Migratory Bird Nesting Period May 3 to August 20									
		MITIGATION											
	SOIL AND TERRAIN CRITERIA												
	HISTORIC RESOURCES												
	DESIGN CRITERIA												



References
Imagery obtained from McElhanney. Additional Imagery Copyright © 19990115 Esri and its licensors. Source: Earthstar Geographics Terracolor. Used under license, all rights reserved.

Notes
1. Use appropriate aquatic mitigation measures (BIA Section 9.1).
2. Avoid or minimize impacts to wetlands using appropriate mitigations (BIA Section 9.3).

Acronyms
MBNZ Migratory Bird Nesting Zone
NWT Northwest Territories
RAP Restricted Activity Period

CLIENT
PARKS CANADA



YYYY-MM-DD	2016-09-23
DESIGNED	VBS
PREPARED	RC
REVIEWED	VBS
APPROVED	MGJ

PROJECT
WOOD BUFFALO NATIONAL PARK HIGHWAY 5
ENVIRONMENTAL ALIGNMENT SHEET

STA. 148+083.7 TO STA. 151+105.9

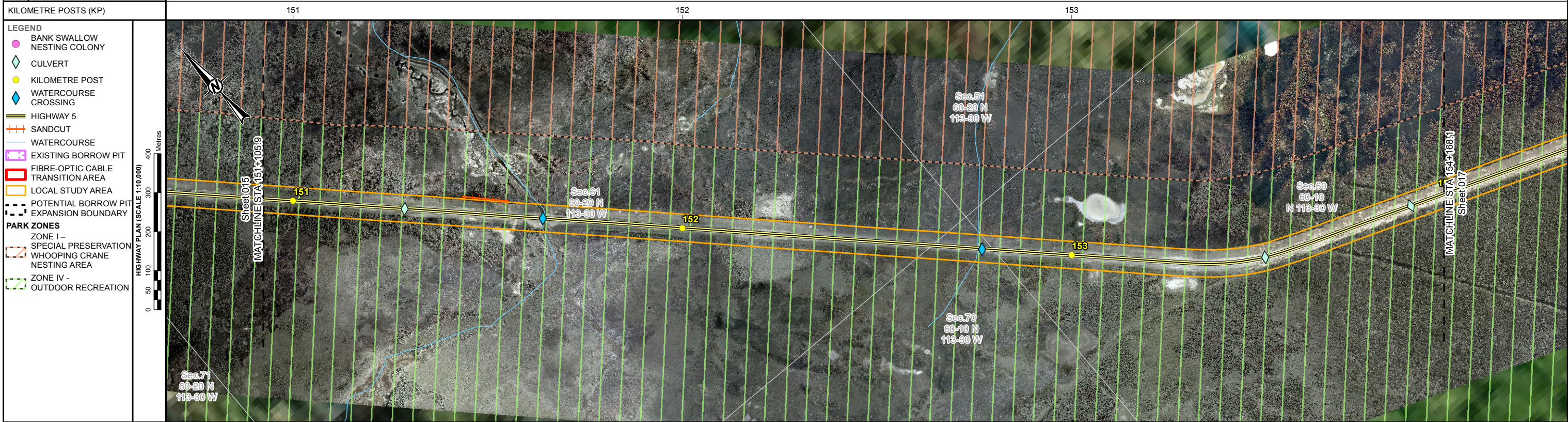
TITLE
Sheet 015

PROJECT NO.	CONTROL	REV.	FIGURE
1656958	3102	0	015 of 022

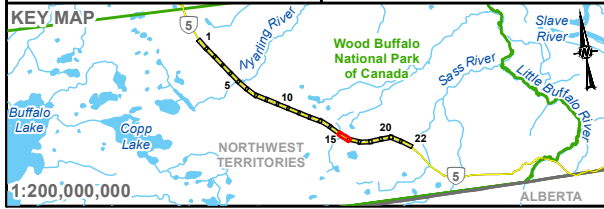
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM A4S/B

I:\CLIENTS\PARKS_CANADA\1656958\Mapping\Templates\1656958_WOODBUFFALO_TEMPLATE_20160629.mxd
PATH: I:\CLIENTS\PARKS_CANADA\1656958\Mapping\MXD\Alignment\Sheets\20160923\Sheet 016.mxd PRINTED ON: 2016-09-23 AT: 8:59:54 AM

RESOURCE BAND	PROJECT SITE NAME	Wood Buffalo National Park Chip Sealing Project KM 106-174												
	AQUATICS			151.3 Dry Culvert, No channel or Fish Habitat	151.6 Klewi River, Watercourse, Potential for Fish Habitat	152.8 Unnamed Watercourse, Tributary to Klewi River, Potential for Fish Habitat			153.5 Dry Culvert, No Channel	153.9 Dry Culvert, No Channel				
	WETLANDS		Wetland		Wetland									
	LISTED PLANTS													
	FIBRE-OPTIC CABLE		North Side of Highway											
	WEEDS													
	SENSITIVE ECOSITE													
	WILDLIFE OBSERVATIONS													
	WILDLIFE AREAS		MBNZ B7, Boreal Woodland Caribou NWT Range	Sandcut: Potential Canadian Toad Overwintering Habitat			MBNZ B7, Boreal Woodland Caribou NWT Range							
	SOILS AND TERRAIN													
	HISTORIC RESOURCES													
	VISITOR EXPERIENCE													



MITIGATIONS	WATERCOURSES		N/A	See Note 1	See Note 1	N/A	N/A
	AQUATICS RESTRICTED ACTIVITY PERIOD		No RAP	No RAP	No RAP	No RAP	No RAP
	WETLANDS		See Note 2	See Note 2			
	VEGETATION MITIGATION	LISTED PLANTS AND SENSITIVE ECOSITES					
		WEEDS					
	WILDLIFE	RESTRICTED ACTIVITY PERIOD		Zone B7 - Migratory Bird Nesting Period May 3 to August 20			
		MITIGATION					
	SOIL AND TERRAIN CRITERIA						
	HISTORIC RESOURCES						
	DESIGN CRITERIA						



References
Imagery obtained from McElhanney. Additional Imagery Copyright © 19990115 Esri and its licensors. Source: Earthstar Geographics Terracolor. Used under license, all rights reserved.

Notes
1. Use appropriate aquatic mitigation measures (BIA Section 9.1).
2. Avoid or minimize impacts to wetlands using appropriate mitigations (BIA Section 9.3).

Acronyms
MBNZ Migratory Bird Nesting Zone
NWT Northwest Territories
RAP Restricted Activity Period

CLIENT
PARKS CANADA



YYYY-MM-DD	2016-09-23
DESIGNED	VBS
PREPARED	RC
REVIEWED	VBS
APPROVED	MGJ

PROJECT
WOOD BUFFALO NATIONAL PARK HIGHWAY 5
ENVIRONMENTAL ALIGNMENT SHEET

STA. 151+105.9 TO STA. 154+168.1

TITLE
Sheet 016

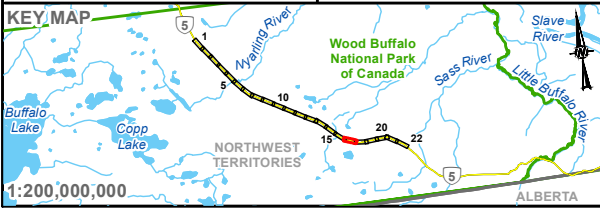
PROJECT NO.	CONTROL	REV.	FIGURE
1656958	3102	0	016 of 022

I:\CLIENTS\PARKS_CANADA\1656958\Mapping\Templates\1656958_WOODBUFFALO_TEMPLATE_20160629.mxd
PATH: I:\CLIENTS\PARKS_CANADA\1656958\Mapping\MXD\Alignment\Sheets\20160923\Sheet 017.mxd PRINTED ON: 2016-09-23 AT: 9:00:28 AM

RESOURCE BAND	PROJECT SITE NAME	Wood Buffalo National Park Chip Sealing Project KM 106-174			
	AQUATICS	154.6 Dry Culvert, No channel or Fish Habitat		155.5 Dry Culvert, No Channel	155.8 Dry Culvert, No Channel
	WETLANDS	Wetland			
	LISTED PLANTS				
	FIBRE-OPTIC CABLE	North Side of Highway			
	WEEDS				
	SENSITIVE ECOSITE				
	WILDLIFE OBSERVATIONS				
	WILDLIFE AREAS	MBNZ B7, Boreal Woodland Caribou NWT Range			
	SOILS AND TERRAIN				
	HISTORIC RESOURCES				
	VISITOR EXPERIENCE				

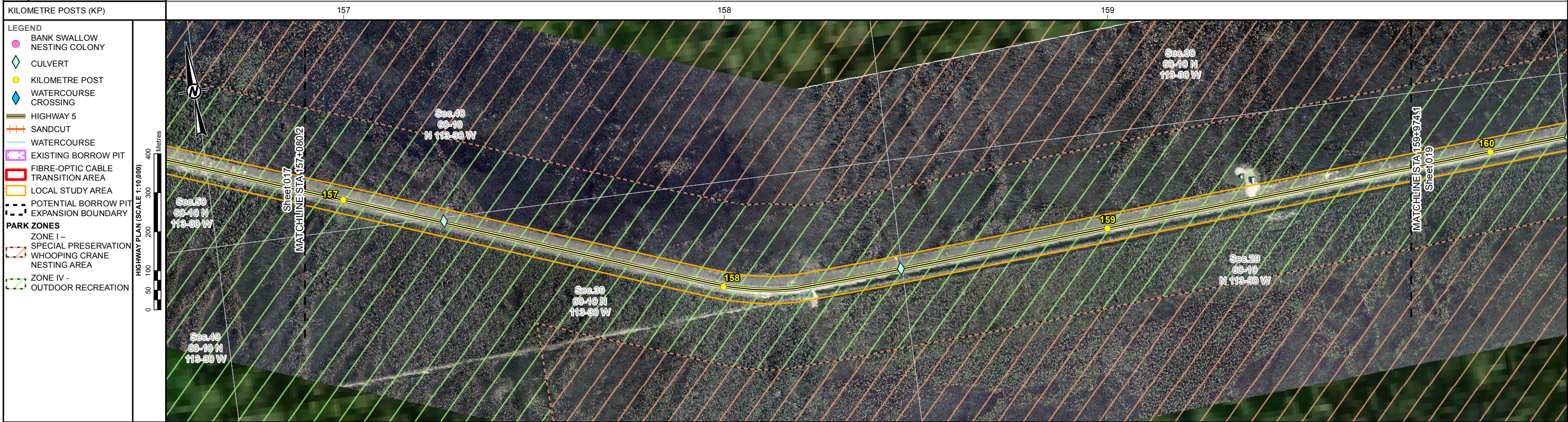


MITIGATIONS	WATERCOURSES		N/A		N/A		N/A		N/A			
	AQUATICS RESTRICTED ACTIVITY PERIOD		No RAP		No RAP		No RAP		No RAP			
	WETLANDS		See Note 2									
	VEGETATION MITIGATION	LISTED PLANTS AND SENSITIVE ECOSITES										
		WEEDS										
	WILDLIFE	RESTRICTED ACTIVITY PERIOD		Zone B7 - Migratory Bird Nesting Period May 3 to August 20								
		MITIGATION										
	SOIL AND TERRAIN CRITERIA											
	HISTORIC RESOURCES											
	DESIGN CRITERIA											

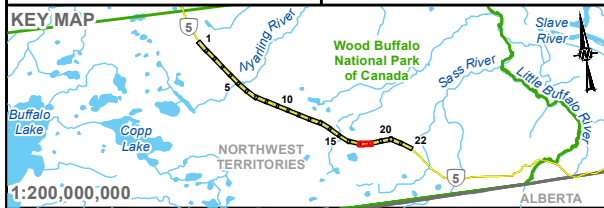


I:\CLIENTS\PARKS_CANADA\1656958\Mapping\Templates\1656958_WOODBUFFALO_TEMPLATE_20160629.mxd
PATH: I:\CLIENTS\PARKS_CANADA\1656958\Mapping\MXD\Alignment\Sheets\20160923\Sheet 018.mxd PRINTED ON: 2016-09-23 AT: 9:00:58 AM

RESOURCE BAND	PROJECT SITE NAME	Wood Buffalo National Park Chip Sealing Project KM 106-174		
	AQUATICS	157.3 Dry Culvert, No Channel	158.5 Dry Culvert, No Channel	
	WETLANDS			
	LISTED PLANTS			
	FIBRE-OPTIC CABLE	North Side of Highway		
	WEEDS			
	SENSITIVE ECOSITE			
	WILDLIFE OBSERVATIONS			
	WILDLIFE AREAS	MBNZ B7, Boreal Woodland Caribou NWT Range		
	SOILS AND TERRAIN			
	HISTORIC RESOURCES			
	VISITOR EXPERIENCE			



MITIGATIONS	WATERCOURSES	N/A	N/A
	AQUATICS RESTRICTED ACTIVITY PERIOD	No RAP	No RAP
	WETLANDS		
	VEGETATION MITIGATION	LISTED PLANTS AND SENSITIVE ECOSITES	
		WEEDS	
	WILDLIFE	RESTRICTED ACTIVITY PERIOD	Zone B7 - Migratory Bird Nesting Period May 3 to August 20
		MITIGATION	
	SOIL AND TERRAIN CRITERIA		
HISTORIC RESOURCES			
DESIGN CRITERIA			



References
Imagery obtained from McElhanney. Additional Imagery Copyright © 19990115 Esri and its licensors. Source: Earthstar Geographics Terracolor. Used under license, all rights reserved.

Notes
1. Use appropriate aquatic mitigation measures (BIA Section 9.1).
2. Avoid or minimize impacts to wetlands using appropriate mitigations (BIA Section 9.3).

Acronyms
MBNZ Migratory Bird Nesting Zone
NWT Northwest Territories
RAP Restricted Activity Period

CLIENT
PARKS CANADA

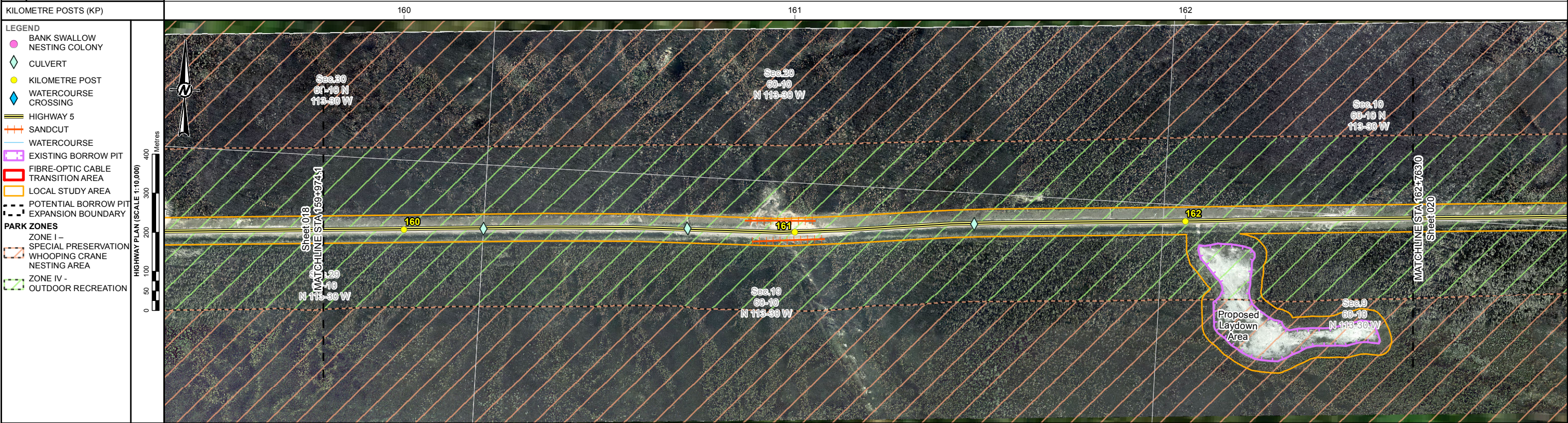


YYYY-MM-DD	2016-09-23
DESIGNED	VBS
PREPARED	RC
REVIEWED	VBS
APPROVED	MGJ

PROJECT WOOD BUFFALO NATIONAL PARK HIGHWAY 5 ENVIRONMENTAL ALIGNMENT SHEET			
STA. 157+080.2		TO	STA. 159+974.1
TITLE Sheet 018			
PROJECT NO.	CONTROL	REV.	FIGURE
1656958	3102	0	018 of 022

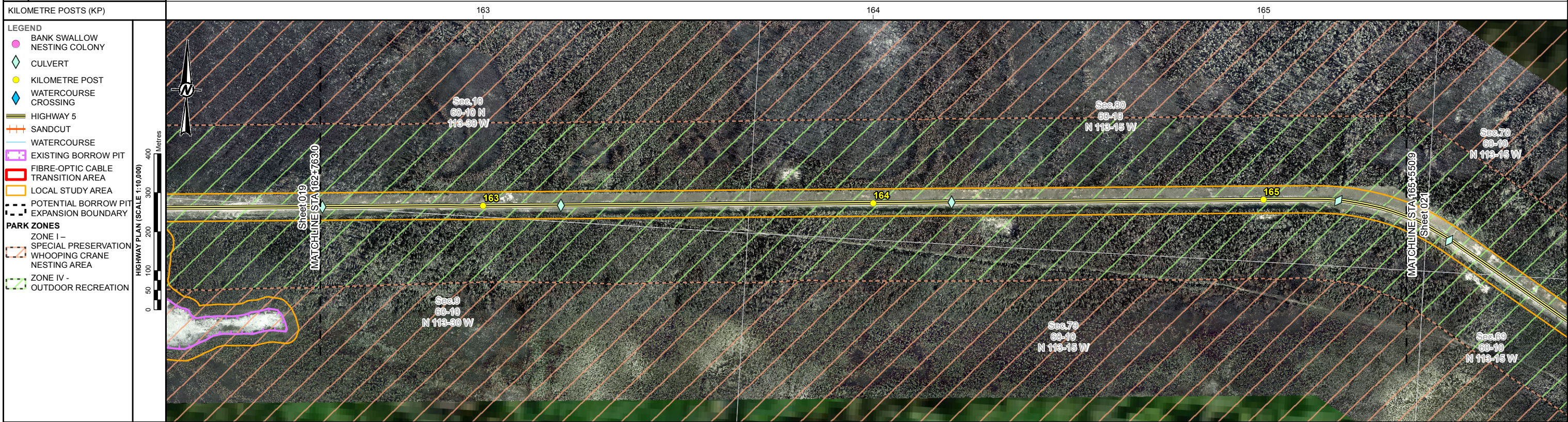
I:\CLIENTS\PARKS_CANADA\1656958\Mapping\Templates\1656958_WOODBUFFALO_TEMPLATE_20160629.mxd
PATH: I:\CLIENTS\PARKS_CANADA\1656958\Mapping\MXD\Alignment\Sheets\20160923\Sheet 019.mxd PRINTED ON: 2016-09-23 AT: 9:01:26 AM

RESOURCE BAND	PROJECT SITE NAME	Wood Buffalo National Park Chip Sealing Project KM 106-174			
	AQUATICS	160.2 Dry Culvert, No channel or Fish Habitat	160.7 Dry Culvert, No Channel	161.5 Dry Culvert, No Channel	
	WETLANDS				
	LISTED PLANTS				
	FIBRE-OPTIC CABLE	North Side of Highway			
	WEEDS				
	SENSITIVE ECOSITE				
	WILDLIFE OBSERVATIONS				
	WILDLIFE AREAS	MBNZ B7, Boreal Woodland Caribou NWT Range	Sandcut: Potential Canadian Toad Overwintering Habitat	MBNZ B7, Boreal Woodland Caribou NWT Range	
	SOILS AND TERRAIN				
	HISTORIC RESOURCES				
	VISITOR EXPERIENCE				

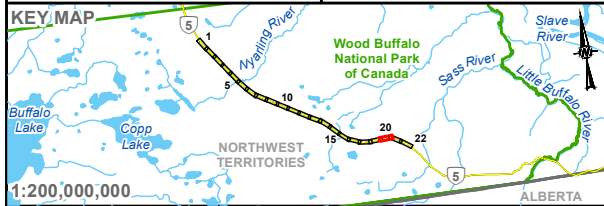


I:\CLIENTS\PARTS_CANADA\1656958\Mapping\Templates\1656958_WOODBUFFALO_TEMPLATE_20160629.mxd
PATH: I:\CLIENTS\PARTS_CANADA\1656958\Mapping\MXD\Alignment\Sheets\20160923\Sheet 020.mxd PRINTED ON: 2016-09-23 AT: 9:01:54 AM

RESOURCE BAND	PROJECT SITE NAME	Wood Buffalo National Park Chip Sealing Project KM 106-174				
	AQUATICS	162.6 Dry Culvert, No Channel	163.2 Dry Culvert, No channel or Fish Habitat	164.2 Dry Culvert, No channel or Fish Habitat	165.2 Dry Culvert, No channel or Fish Habitat	
	WETLANDS					
	LISTED PLANTS					
	FIBRE-OPTIC CABLE	North Side of Highway				
	WEEDS					
	SENSITIVE ECOSITE					
	WILDLIFE OBSERVATIONS					
	WILDLIFE AREAS	MBNZ B7, Boreal Woodland Caribou NWT Range				
	SOILS AND TERRAIN					
	HISTORIC RESOURCES					
	VISITOR EXPERIENCE					

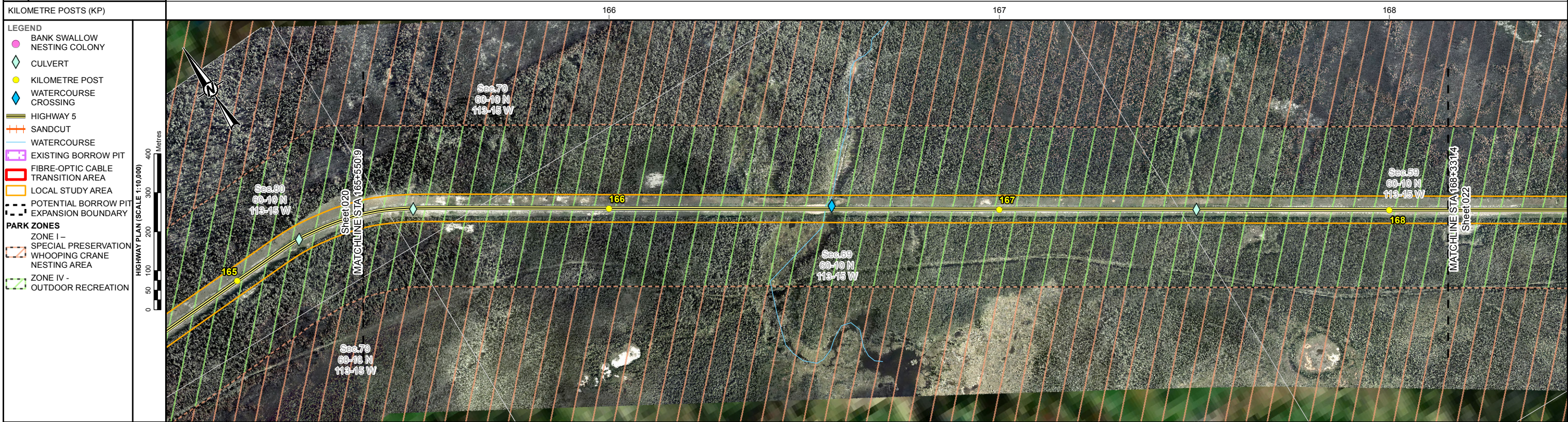


MITIGATIONS	WATERCOURSES		N/A	N/A	N/A	N/A
	AQUATICS RESTRICTED ACTIVITY PERIOD		No RAP	No RAP	No RAP	No RAP
	WETLANDS					
	VEGETATION MITIGATION	LISTED PLANTS AND SENSITIVE ECOSITES				
		WEEDS				
	WILDLIFE	RESTRICTED ACTIVITY PERIOD		Zone B7 - Migratory Bird Nesting Period May 3 to August 20		
		MITIGATION				
	SOIL AND TERRAIN CRITERIA					
	HISTORIC RESOURCES					
	DESIGN CRITERIA					

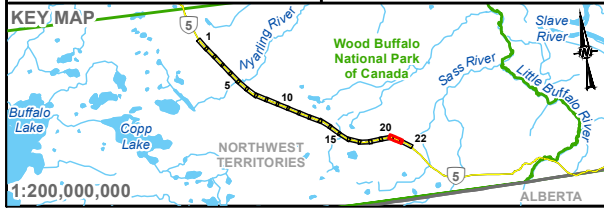


I:\CLIENTS\PARTS_CANADA\1656958\Mapping\Templates\1656958_WOODBUFFALO_TEMPLATE_20160629.mxd
PATH: I:\CLIENTS\PARTS_CANADA\1656958\Mapping\MXD\Alignment\Sheets\20160923\Sheet 021.mxd PRINTED ON: 2016-09-23 AT: 9:02:23 AM

RESOURCE BAND	PROJECT SITE NAME	Wood Buffalo National Park Chip Sealing Project KM 106-174				
	AQUATICS	165.5 Dry Culvert, No Channel		166.6 Watercourse. Tributary to Sass River, Potential for Fish Habitat.		167.5 Dry Culvert, No channel or Fish Habitat
	WETLANDS		Wetland		Wetland	
	LISTED PLANTS					
	FIBRE-OPTIC CABLE	North Side of Highway				
	WEEDS					
	SENSITIVE ECOSITE					
	WILDLIFE OBSERVATIONS					
	WILDLIFE AREAS	MBNZ B7, Boreal Woodland Caribou NWT Range				
	SOILS AND TERRAIN					
	HISTORIC RESOURCES					
	VISITOR EXPERIENCE					



MITIGATIONS	WATERCOURSES		N/A		See Note 1		N/A			
	AQUATICS RESTRICTED ACTIVITY PERIOD		No RAP		No RAP		No RAP			
	WETLANDS				See Note 2		See Note 2			
	VEGETATION MITIGATION	LISTED PLANTS AND SENSITIVE ECOSITES								
		WEEDS								
	WILDLIFE	RESTRICTED ACTIVITY PERIOD		Zone B7 - Migratory Bird Nesting Period May 3 to August 20						
		MITIGATION								
	SOIL AND TERRAIN CRITERIA									
	HISTORIC RESOURCES									
	DESIGN CRITERIA									



References
Imagery obtained from McElhanney. Additional Imagery Copyright © 19990115 Esri and its licensors. Source: Earthstar Geographics Terracolor. Used under license, all rights reserved.

Notes
1. Use appropriate aquatic mitigation measures (BIA Section 9.1).
2. Avoid or minimize impacts to wetlands using appropriate mitigations (BIA Section 9.3).

Acronyms
MBNZ Migratory Bird Nesting Zone
NWT Northwest Territories
RAP Restricted Activity Period

CLIENT

PARKS CANADA

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-09-23
DESIGNED	VBS
PREPARED	RC
REVIEWED	VBS
APPROVED	MGJ

PROJECT

WOOD BUFFALO NATIONAL PARK HIGHWAY 5 ENVIRONMENTAL ALIGNMENT SHEET

STA. 165+550.9 TO STA. 168+331.4

TITLE

Sheet 021

PROJECT NO. 1656958

CONTROL 3102

REV. 0

FIGURE 021 of 022

I:\CLIENTS\PARKS_CANADA\1656958\Mapping\Templates\1656958_WOODBUFFALO_TEMPLATE_20160629.mxd
PATH: I:\CLIENTS\PARKS_CANADA\1656958\Mapping\MXD\Alignment\Sheets\20160923\Sheet 022.mxd PRINTED ON: 2016-09-23 AT: 9:02:48 AM

RESOURCE BAND	PROJECT SITE NAME	Wood Buffalo National Park Chip Sealing Project KM 106-174	
	AQUATICS	168.6 Dry Culvert, No channel or Fish Habitat	
	WETLANDS		
	LISTED PLANTS		
	FIBRE-OPTIC CABLE	North Side of Highway	
	WEEDS		
	SENSITIVE ECOSITE		
	WILDLIFE OBSERVATIONS		
	WILDLIFE AREAS	MBNZ B7, Boreal Woodland Caribou NWT Range	
	SOILS AND TERRAIN		
	HISTORIC RESOURCES		
	VISITOR EXPERIENCE		





APPENDIX B

Environmental Impact Analysis Tools – Effects Identification Matrix



APPENDIX B
Environmental Impact Analysis Tools - Effects Identification Matrix

Table B-1 focuses on direct effects of the project and Section B on indirect effects that are caused by changes to the environment.

Table B-1: Direct Effects

	Project Phases	Project Activities	Valued Components Potentially Directly Affected by the Proposed Project							Cultural Resources	Visitor Experience
			Natural Resources								
			Fish and Fish Habitat	Hydrology	Surface Water Quality	Vegetation (vegetation communities, listed plant species)	Wildlife (Amphibians, Migratory Birds, Bats, Ungulates, SAR [Canadian Toad, Whooping Crane, Myotis, Woodland Caribou])	Terrain and Soils	General	General	
Project Components	Site Preparation / Construction	Preparation of Environmental Protection Plan (EPP)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
		Mobilization of Equipment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
		Supply and Storage of Materials	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
		Temporary Facility	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
		Clearing and Grubbing	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
		Stripping	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
		Grading	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
		Demolition	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
		Excavation	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
		Disposal of Waste	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
		Culvert Installation	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
		Use of Machinery	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
		Transport of Materials/Equipment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
		Use of Chemicals	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
		Traffic Management	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
		Drainage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
		Backfilling	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
		Operation/ Implementation/ Decommissioning	Maintenance	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
			Use/Removal of Temporary Facilities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	Road Signs		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
	Vehicle traffic		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
	Re-vegetation/Planting		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	



APPENDIX B
Environmental Impact Analysis Tools - Effects Identification Matrix

Section B of the matrix should be used to identify potential indirect effects that may result from impacts of the project to components of the environment you have identified on the preceding pages (see Section A - direct effects to natural resources). Consideration of indirect effects is required under CEAA 2012 Sections 5(1)(c) and 5(2)(b), and by the PCA mandate. For example:

- If the proposed project could lead to adverse effects to water quality and quantity, could this then effect the quantity and quality of water resources (e.g. potable water) used by an Aboriginal community?
- Could there also be adverse socio-economic effects to a community that relies on recreational fishing tourism?
- Could changes to the environment (e.g. digging, clearing) affect visitor access, opportunities, or safety?

Table B-2: Indirect Effects (all phases)

Project Components	Project Phase	Natural Resource Components Affected by the Project	Impacts as a Result of Changes to the Environment					
			With respect to non-Aboriginal peoples	With respect to Aboriginal peoples		With respect to visitor experience		
			Health and socio-economic conditions	Health & socio-economic conditions	Current use of lands and resources for traditional purposes	Access & services	Recreation & accommodation opportunities	Safety
	Preparation /construction operation / implementation /decommissioning	None Identified	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		-	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		-	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		-	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		-	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		-	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



APPENDIX C

Vegetation Elements and Wildlife Species of Management Concern with Potential to Occur in the Local Study Area



APPENDIX C

Vegetation Elements and Wildlife Species of Management Concern with Potential to Occur in the Local Study Area

Table C-1: Vegetation Elements of Management Concern with Potential to Occur in the Local Study Area

Scientific Name	Common Name	Status				Habitat
		NWT Status	COSEWIC	SARA	Global	
<i>Agastache foeniculum</i>	Blue Giant Hyssop	May Be At Risk	n/a	n/a	G4G5	Thickets and grassy clearings
<i>Alisma triviale</i> (<i>Alisma plantago-aquatica</i> var. <i>americanum</i>)	Northern Water Plantain	Sensitive	n/a	n/a	G5	Marshes, lakes, sloughs, ponds, ditches and streams
<i>Almutaster pauciflorus</i> (<i>Aster pauciflorus</i>)	Marsh Alkali Aster	May Be At Risk	n/a	n/a	G4	Wet, marshy and usually saline meadows or lake shores
<i>Antennaria neglecta</i> (<i>Antennaria campestris</i>)	Field Pussytoes	Sensitive	n/a	n/a	G5	Dry sandy plains and prairies
<i>Arabidopsis salsuginea</i> (<i>Thellungiella salsuginea</i>)	Saltwater Cress	May Be At Risk	n/a	n/a	G5?	Flat, moist, saline ground by springs and lakes, open, sandy alkaline soils in dry lakes and in salt plains and meadows
<i>Artemisia dracunculus</i>	Dragon Sagebrush	May Be At Risk	n/a	n/a	G5	Dry open habitats, including prairies, rocky slopes, and roadsides
<i>Artemisia ludoviciana</i>	White Sagebrush	May Be At Risk	n/a	n/a	G5	Open woodland, grassland, prairies
<i>Astragalus agrestis</i>	Meadow Milk-vetch	Sensitive	n/a	n/a	G5	Damp prairies and floodplain meadows
<i>Betula pumila</i> (<i>Betula pumila</i> var. <i>glandulifera</i>)	Bog Birch	Sensitive	n/a	n/a	G5T5	Shrubby and treed fens, swamps along lakeshores and riverbanks
<i>Botrychium multifidum</i>	Leathery Grape-fern	May Be At Risk	n/a	n/a	G5	Moist sandy areas, open areas
<i>Carex crawfordii</i>	Crawford sedge	Sensitive	n/a	n/a	G5	Damp, well drained lake and river meadows
<i>Carex praticola</i>	Northern Meadow Sedge	Sensitive	n/a	n/a	G5	Dry, open grasslands
<i>Carex sartwellii</i>	Sartwell's Sedge	Sensitive	n/a	n/a	G4G5	Wet prairie or lakeshore meadows
<i>Carex sychnocephala</i>	Many-headed Sedge	Sensitive	n/a	n/a	G4	Wet places in prairie and open wooldand meados, by cold springs or moose-licks
<i>Chimaphila umbellata</i>	Pipsissewa (Common Wintergreen)	May Be At Risk	n/a	n/a	G5	Dry coniferous forests or clearings
<i>Cinna latifolia</i>	Slender Wood Reed Grass	Sensitive	n/a	n/a	G5	Rich, moist and somewhat shady, deciduous woods
<i>Cirsium foliosum</i>	Leafy Thistle	May Be At Risk	n/a	n/a	G5	Moist meadows and woodlands, prairies and foothills
<i>Collomia linearis</i>	Narrow-leaved Collomia	Sensitive	n/a	n/a	G5	Disturbed areas
<i>Distichlis spicata</i>	Coastal Salt Grass	May Be At Risk	n/a	n/a	G5	Salt plains, west of Fort Smith, salt or alkaline plains
<i>Dodecatheon pulchellum</i>	Few-flower Shooting-star	Sensitive	n/a	n/a	G5	Wet meadows and saline flats in the southwestern NWT
<i>Draba nemorosa</i> (<i>D. nemorosa</i> var. <i>leiocarpa</i>)	Wood Whitlow-grass	Sensitive	n/a	n/a	G5	Disturbed, open areas
<i>Geum triflorum</i>	Prairie-smoke	May Be At Risk	n/a	n/a	G5	Dry, grassland areas
<i>Grindelia hirsutula</i> (<i>Grindelia squarrosa</i>)	Broadleaf Gumweed	May Be At Risk	n/a	n/a	G5	Dry, somewhat saline flats
<i>Lappula occidentalis</i> (<i>Lappula redowskii</i>)	Western Stickseed	Sensitive	n/a	n/a	G5	Roadside, clearings and fields
<i>Lycopodium dendroideum</i> (<i>Lycopodium obscurum</i>)	Tree Clubmoss	Sensitive	n/a	n/a	G5	Moist, wooded areas or thickets
<i>Muhlenbergia richardsonis</i>	Matted Muhly	Sensitive	n/a	n/a	G5	Wet, calcareous and gravelly lake shores and river banks
<i>Najas flexilis</i>	Slender Naiad	Sensitive	n/a	n/a	G5	In shallow fresh or brackish water
<i>Nymphaea leibergii</i> (syn <i>Nymphaea tetragona</i> ssp. <i>leibergii</i>)	Dwarf White Waterlily	May Be At Risk	n/a	n/a	G5	Open water, with a neutral or slightly alkaline pH, over a rich, organic substrate in ponds, shallow lakes, slow-moving streams, and edges of slow, open water channels through marshes
<i>Nymphaea tetragona</i>	Pygmy White Waterlily (Small White Water-lily)	Sensitive	n/a	n/a	G5	Open water, with a neutral or slightly alkaline pH, over a rich, organic substrate in ponds, shallow lakes, slow-moving streams, and edges of slow, open water channels through marshes
<i>Oryzopsis asperifolia</i>	White-grained Mountain Rice Grass	Sensitive	n/a	n/a	G5	Open, dry pine stands and thickets
<i>Physostegia ledinghamii</i> (<i>Physostegia parviflora</i>)	Ledingham's False Dragonhead	May Be At Risk	n/a	n/a	G4G5	Low, moist to wet woods; swampy, somewhat exposed areas along lake/pond shores, river and stream banks; river floodplains and flats; sloughs and ditches; and wet meadows and marshes. Habitats are often subject to intermittent flooding
<i>Polygonum fowleri</i> (<i>Polygonum fowleri</i> B. L. Robinson subsp. <i>hudsonianum</i> , <i>Polygonum hudsonianum</i>)	Fowler Knotweed	May Be At Risk	n/a	n/a	G5	Gravelly shores
<i>Potentilla arguta</i>	Tall Cinquefoil	Sensitive	n/a	n/a	G5	Prairies, grassy riverbanks or road-sides
<i>Ranunculus abortivus</i>	Kidney-leaved Buttercup	Sensitive	n/a	n/a	G5	Damp grassy places, pastures and roadsides
<i>Ranunculus rhomboideus</i>	Prairie Buttercup	May Be At Risk	n/a	n/a	G5	Salt marshes and damp hollows of of prairies and plains
<i>Rumex fueginus</i> (<i>Rumex maritimus</i> var. <i>fueginus</i>)	Tierra del Fuego Dock	Sensitive	n/a	n/a	G5	Saline or alkaline seepage areas
<i>Salicornia rubra</i>	Red Glasswort	May Be At Risk	n/a	n/a	G5	Saline flats, often indicating upperlevel of spring inundation



APPENDIX C
Vegetation Elements and Wildlife Species of Management Concern with Potential to Occur in the Local Study Area

Scientific Name	Common Name	Status				Habitat
		NWT Status	COSEWIC	SARA	Global	
<i>Salix petiolaris (Salix gracilis)</i>	Meadow Willow (slender willow)	Sensitive	n/a	n/a	G5	Slough edges, sedge meadows, lakeshores and streambanks
<i>Scolochloa festucacea</i>	Common River Grass	Sensitive	n/a	n/a	G5	Shallow water or wet marshes
<i>Senecio eremophilus</i>	Desert Ragwort	Sensitive	n/a	n/a	G5	Damp woodland, meadows and roadsides
<i>Sibbaldiopsis tridentata (Potentilla tridentata)</i>	Three-toothed Cinquefoil	Sensitive	n/a	n/a	G5	Dry, rocky, gravelly or sandy places on Precambrian rock
<i>Spartina gracilis</i>	Alkali Cordgrass	Sensitive	n/a	n/a	G5	Salt plains
<i>Spergularia salina (Spergularia marina)</i>	Saltmarsh Sandspurry	May Be At Risk	n/a	n/a	G5	Edge of salt springs on Salt plains west of Slave River
<i>Suaeda calceoliformis</i>	Horned Sea-blite	Sensitive	n/a	n/a	G5	Seashores and saline prairie depressions
<i>Trientalis europaea</i>	Arctic Starflower	Sensitive	n/a	n/a	G5	Spruce-poplar mixedwood forests
<i>Veronica peregrina</i>	Purslane Speedwell	May Be At Risk	n/a	n/a	G5	Moist places
<i>Veronica scutellata</i>	Marsh Speedwell	Sensitive	n/a	n/a	G5	Wet thickets, often near springs
<i>Zannichellia palustris</i>	Horned pondweed	May Be At Risk	n/a	n/a	G5	Shallow, fresh of mildly saline ponds or sluggish streams

Notes:
n/a: not listed by COSEWIC or SARA.
Data was compiled based on queries of the Parks Canada Biotics Web Explorer for regularly occurring species in WBNP (PCA 2013), the Northwest Territories Species at Risk Infobase (NWT DENR 2012).



APPENDIX C
Vegetation Elements and Wildlife Species of Management Concern with Potential to Occur in the Local Study Area

Table C-2: Wildlife Species of Management Concern with the Potential to Occur in the Local Study Area

Common Name	Scientific Name	Status				Regularity within WBNP ^(b)	Population ^(c)
		NWT Status ^(a)	COSEWIC Status ^(a)	SARA Schedule ^(a)	SARA Legal Status ^(a)		
Amphibians							
Canadian Toad	<i>Anaxyrus hemiophrys (Bufo hemiophrys)</i>	Sensitive	Not at Risk	n/a	n/a	Regularly occurring	Unknown
Northern Leopard Frog (western Boreal/Prairie population)	<i>Lithobates pipiens (Rana pipiens)</i>	Special Concern	Special Concern	Schedule 1	Special Concern	Unknown/Undetermined	Unknown
Birds							
American Bittern	<i>Botaurus lentiginosus</i>	Sensitive	n/a	n/a	n/a	-	-
American Golden-Plover	<i>Pluvialis dominica</i>	Sensitive	n/a	n/a	n/a	Migration	Nonbreeding
American White Pelican	<i>Pelecanus erythrorhynchos</i>	May Be At Risk	n/a	n/a	n/a	Regularly occurring	Breeding
Bank Swallow	<i>Riparia riparia</i>	Secure	Threatened	No Schedule	No status	-	-
Barn Swallow	<i>Hirundo rustica</i>	Sensitive	Threatened	No schedule	No status	Regularly occurring	Breeding
Black Tern	<i>Chlidonias niger</i>	Sensitive	Not At Risk	n/a	n/a	-	-
Blackpoll Warbler	<i>Dendroica striata</i>	Sensitive	n/a	n/a	n/a	-	-
Boreal Chickadee	<i>Poecile hudsonica (Parus hudsonicus)</i>	Sensitive	n/a	n/a	n/a	-	-
Caspian Tern	<i>Hydroprogne caspia (Sterna caspia)</i>	Sensitive	Not at Risk	n/a	n/a	-	-
Common Nighthawk	<i>Chordeiles minor</i>	At Risk	Threatened	Schedule 1	Threatened	Regularly occurring	Breeding
Horned Grebe	<i>Podiceps auritus</i>	Sensitive	Special Concern	No schedule	No status	Regularly occurring	Breeding
Hudsonian Godwit	<i>Limosa haemastica</i>	Sensitive	n/a	n/a	n/a	Migration	Nonbreeding
Least Sandpiper	<i>Calidris minutilla</i>	Sensitive	n/a	n/a	n/a	-	-
Lesser Scaup	<i>Aythya affinis</i>	Sensitive	n/a	n/a	n/a	-	-
Lesser Yellowlegs	<i>Tringa flavipes</i>	Sensitive	n/a	n/a	n/a	-	-
Long-tailed Duck	<i>Clangula hyemalis</i>	Sensitive	n/a	n/a	n/a	Migration	Nonbreeding
Northern Pintail	<i>Anas acuta</i>	Sensitive	n/a	n/a	n/a	-	-
Olive-sided Flycatcher	<i>Contopus cooperi (formerly Contopus borealis)</i>	At Risk	Threatened	Schedule 1	Threatened	Regularly occurring	Breeding
Peregrine Falcon (<i>anatum/tundrius</i> subspecies)	<i>Falco peregrinus</i>	Sensitive	Special Concern	Schedule 1	Special Concern	Regularly occurring	Breeding
Pied-billed Grebe	<i>Podilymbus podiceps</i>	Sensitive	n/a	n/a	n/a	-	-
Red-necked Phalarope	<i>Phalaropus lobatus</i>	Sensitive	Special Concern	No schedule	No status	-	-
Rusty Blackbird	<i>Euphagus carolinus</i>	Sensitive	Special Concern	Schedule 1	Special Concern	Regularly occurring	Breeding
Semipalmated Sandpiper	<i>Calidris pusilla</i>	Sensitive	n/a	n/a	n/a	Migration	Nonbreeding
Short-eared Owl	<i>Asio flammeus</i>	Sensitive	Special Concern	Schedule 1	Special Concern	Unknown/Undetermined	Unknown
Surf Scoter	<i>Melanitta perspicillata</i>	Sensitive	n/a	n/a	n/a	-	-
White-throated Sparrow	<i>Zonotrichia albicollis</i>	Sensitive	n/a	n/a	n/a	-	-
White-winged Scoter	<i>Melanitta fusca</i>	Sensitive	n/a	n/a	n/a	-	-
Whooping Crane	<i>Grus americana</i>	At Risk	Endangered	Schedule 1	Endangered	Regularly occurring	Breeding
Yellow Rail	<i>Coturnicops noveboracensis</i>	May Be At Risk	Special Concern	Schedule 1	Special Concern	Unknown/Undetermined	Unknown
Bats							
Little Brown Myotis	<i>Myotis lucifugus</i>	May Be At Risk	Endangered	Schedule 1	Endangered	Regularly occurring	Year-round
Northern Myotis	<i>Myotis septentrionalis</i>	May Be At Risk	Endangered	Schedule 1	Endangered	Regularly occurring	Year-round
Ungulates							
Wood Bison	<i>Bison bison athabascaae (Bos bison athabascaae)</i>	At Risk	Special Concern	Schedule 1	Threatened	Regularly occurring	Breeding
Woodland Caribou (Boreal population)	<i>Rangifer tarandus</i>	Sensitive	Threatened	Schedule 1	Threatened	Regularly occurring	Year-round
Carnivores/Fur Bearers							
Fisher	<i>Martes pennanti</i>	Sensitive	n/a	n/a	n/a	-	-
Wolverine	<i>Gulo gulo</i>	Sensitive	Special Concern	No schedule	No status	Regularly occurring	Year-round

Notes:

^(a) NWT - Northwest Territories (GNWT 2016); COSEWIC - Committee on the Status of Endangered Wildlife in Canada (ECCC 2016a); SARA - Species at Risk Act (ECCC 2016a).

^(b) **Regularly occurring** - Occurrence of the Element is consistent in the Managed Area (e.g., it may migrate in and out of the area, but it returns on a regular basis).
Accidental/Nonregular - The Element does not persist or return regularly in the Managed Area.
Unknown/Undetermined - Regularity of the Element in the Managed Area has not been, or cannot be, determined.

^(c) **Year-round** - A significant proportion of individuals of the Element are non-migratory or remain in the Managed Area throughout the year.
Breeding - Individuals of the Element occur in this Managed Area as part-time (seasonal) residents when breeding, and they are not year-round residents in any significant numbers.
Nonbreeding - Individuals of the Element occur in this Managed Area as part-time (seasonal) residents when not breeding, and they are not year-round or breeding season residents in any significant numbers.
Transient - Individuals of the Element are long distant migrants that regularly occur in the Managed Area as a transient during migration.
Unknown - The residency status of the individuals of the Element in the Managed Area has not been, or cannot be, determined.





APPENDIX D

Watercourse Crossing Photos



APPENDIX D

Watercourse Crossing Photos

WATERCOURSE SITE PHOTOS

Klewi River Catchment

Highway 5: km 144.3 (unnamed tributary to the Klewi River)



Figure D-1: View of the downstream culvert outlet (left) and the aquatic habitat downstream of the culvert (right) of the unnamed tributary to the Klewi River at Highway 5 km 144.3. Typo for km marker in the embedded note descriptions (kp 143.3 is actually km 144.3).

Highway 5: km 151.9 (Klewi River)



Figure D-2: View of the upstream culvert inlet (left) and the downstream culvert outlet (right) of the Klewi River at Highway 5 km 151.9.



APPENDIX D

Watercourse Crossing Photos



Figure D-3: View of the aquatic habitats of the Klewi River, upstream of the culvert inlet (left) and downstream of the culvert outlet (right) at Highway 5 km 151.9.

Highway 5: km 152.9 (unnamed tributary to the Klewi River)



Figure D-4: View of the upstream culvert inlet (left) and the downstream culvert outlet (right) of the unnamed tributary of the Klewi River at Highway 5 km 152.9. Typo for km marker in the embedded note descriptions (kp 153.1 is actually km 152.9).



APPENDIX D

Watercourse Crossing Photos

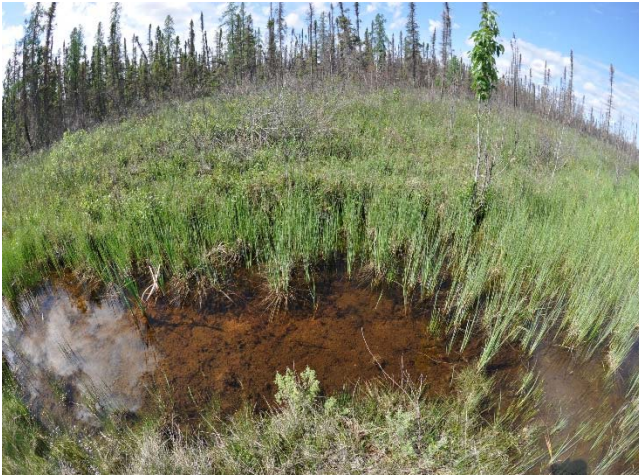


Figure D-5: View of the aquatic habitats of the unnamed tributary of the Klewi River, upstream of the culvert inlet (left) and downstream of the culvert outlet (right) at Highway 5 km 152.9.

Sass River Catchment

Highway 5: km 166.7 (unnamed tributary to the Sass River)



Figure D-6: View of the upstream culvert inlet (left) and the downstream culvert outlet (right) of the unnamed tributary of the Sass River at Highway 5 km 166.7. Note the whirlpool generated by poor and restricted flows through the buried culvert inlet (left photo). Typo for km marker in the embedded note descriptions (kp 167 is actually km 166.7).



APPENDIX D

Watercourse Crossing Photos



Figure D-7: View of the aquatic habitats of the unnamed tributary of the Sass River, upstream of the culvert inlet (left) and downstream of the culvert outlet (right) at Highway 5 km 166.7.



APPENDIX E

Cultural Resources Report: Archaeological Overview Assessment

Archaeological Overview Assessment (AOA)
Highway 5 Road Rehabilitation Phase I: Km 106 to Km 169.6 (Project # 975)
Wood Buffalo National Park, Fort Smith, Northwest Territories

Brian Smith (FII)
Terrestrial Archaeology, IACHD
August 26, 2016

Introduction

The Southwest NWT Field Unit (SSFU) will be undertaking rehabilitation of Highway 5 within Wood Buffalo National Park (WBNP) between km 106 and km 169.6 (Figure 1) in order to ensure safe and reliable road infrastructure in order to decrease visitor safety risks in WBNP. The work is scheduled to be completed in several phases. Following an AOA of assessing gravel sources at existing gravel sites and geo technical testing of the existing road bed (June 1, 2016) that determined that this initial work would have a low potential to negatively impact on archaeological / cultural resources, this Archaeological Overview Assessment (AOA) will evaluate the archaeological potential of the project areas and the potential for the surface rehabilitation and culvert replacement / installation along Highway 5 to impact cultural resources. It will determine if an Archaeological Impact Assessment (AIA), or like mitigation measures and any specific archaeological requirements are necessary prior to, or in conjunction with this work in order to protect the park's cultural resources.

Highway 5 Rehabilitation Km 106 to 169.6

The proposed Highway 5 rehabilitation entails: replacement or installation of twenty-two road culverts and eleven access culverts along the existing Highway 5 road bed between Km 106 and Km 169.6. It also includes minor grading and grubbing on the east periphery / existing shoulder allowing the road surface to be widened 0.70 m, but these activities are contained within the existing ROW. No construction is proposed outside the existing Hwy 5 footprint (See attached paving checklist).

Assessment and Archaeological Requirements

Highway 5 Rehabilitation Km 106 to 169.6

It has been determined from this Archaeological Overview Assessment that construction activities will be largely limited to existing road way and ROW. Additionally, the ROW on the western periphery of Hwy 5, previously subjected to grading, has also been disturbed by the installation of a buried communications cable. The present work will therefore have a very low potential to negatively impact on archaeological / cultural resources. **Therefore no Archaeological mitigation measures prior to construction work commencing will be required.** However it is noted that Hwy 5 does cross some fish bearing streams that may have attracted human activity in the past, and road work outside the existing ROW within the vicinity the stream-crossing areas is to be avoided during construction. Additionally, the following requirements will apply.

Change of Scope

Any changes to the proposed plans or locations must be submitted to Terrestrial Archaeology for review.

Accidental Finds Protocol

There could be a chance, however low, that features or artifact concentrations are encountered during construction activities. If significant features (i.e., previously unknown structural remains and/or high artifact concentrations) or human remains are encountered, work should cease in the immediate area, the work area in relation to the findings photo documented and geo-referenced, and the Parks Canada project manager informed. The project manager should then contact Parks Canada's Terrestrial Archaeology section for advice and assessment of significance that will in turn determine what will be required to mitigate the chance find.



Brian Smith
Federal Infrastructure Investments Project Archaeologist
Archéologue de projet - Investissement pour les infrastructures fédérales
Archaeology and History Branch/Direction de l'archéologie et de l'histoire
Indigenous Affairs and Cultural Heritage Directorate/Direction générale des affaires autochtones et du patrimoine culturel
Parks Canada | Parcs Canada
145 McDermot Ave. | 145, avenue McDermot
Winnipeg, Manitoba R3B 0R9
BrianJ.Smith@pc.gc.ca
Telephone | Téléphone (204) 984-8276
Facsimile | Télécopieur (204) 983-0031

August 26, 2016



parkscanada.gc.ca
parcscanada.gc.ca

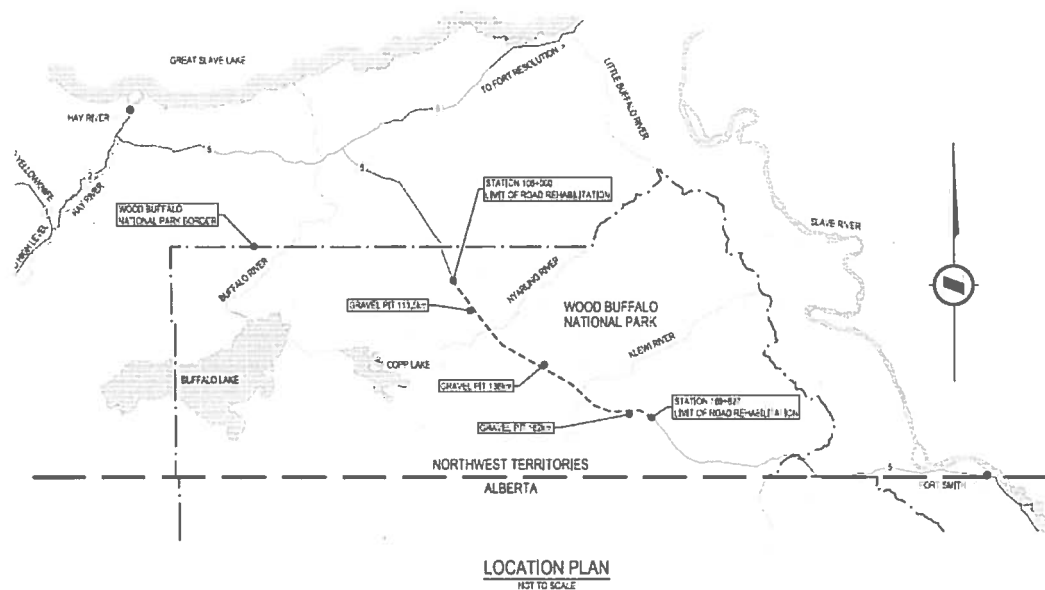


Figure 1: Location of Highway 5 Rehabilitation project (Km 106 to 169.6) within WBNP.

Archaeological Resources and Highway Re-Paving Projects

Preliminary Examination Checklist

PREAMBLE:

Highway 5 Roadway Rehabilitation, Project #975, by Southwestern NWT Field Unit within Wood Buffalo National Park has been identified as needing a preliminary examination to determine whether or not the project will require more detailed information to be supplied to Terrestrial Archaeology for their review in order to determine the potential impact of the project, if any, on cultural resources.

As per Parks Canada's CRM Policy, the Field Unit's Superintendent is accountable for applying the requirements of CRM Policy to all the Heritage Places under their management, such as assessing impacts of interventions to cultural resources. This checklist has been designed specifically to streamline the process of assessing the impacts of paving projects on highways and is to be used a complement to the *National BMP for Roadway, Highway, Parkway and Related Infrastructure*.

The following checklist must be completed and signed by the project manager. Please circle Yes or No in response to each of the following questions 1-7. This list must be re-examined if the project plans change. The completed form must be sent to virginia.sheehan@canada.ca (Federal Infrastructure Investments Archaeologist - National Coordinator) and to the appropriate HCCD CRM advisor for audit purposes.

1.	Does the current project involve more than resurfacing an existing paved road / highway (as opposed to a new surface treatment of an existing, but non-paved roadway)?	YES	NO
2.	Will the current resurfacing project spill outside the pre-existing road-bed and encroach on additional lands including those lands beyond the current roadbed and outside the existing Right of Way (ROW)?	YES	NO
3.	Are any staging areas used for heavy equipment and material either: a) new locations, b) pre-existing unpaved locations/un-gravelled locations or c) will the enlarging of any pre-existing staging areas be required?	YES	NO
4.	Will the current resurfacing project include the addition or expansion of new roadway access points or run away lanes?	YES	NO
5.	Will the resurfacing project involve any of the following activities along the roadway or within the existing ROW:		
	Widening	YES	NO
	Grading	YES	NO
	Re-alignment (curve modification; straightening)	YES	NO
	Scaling and or grading of adjacent hillsides or rock faces	YES	NO
	Culvert removal, installation, replacement	YES	NO
	Bridge installation, or modification	YES	NO
	Vegetation removal / clearing	YES	NO
	Drainage modification	YES	NO
	Fence or guardrail installation	YES	NO
	New installation or replacement of signage	YES	NO
6.	Will the current project require the creation and use of new borrow/extraction locations?	YES	NO
7.	Will access to the borrow areas be achieved through newly created roadways or access points?	YES	NO

If YES to any of the above questions, a Terrestrial Archaeologist will require that descriptive details be provided for that work prior to construction start in order to determine the potential impact, if any, on cultural resources.

Archaeology Checklist for Highway Repaving Projects

SIGN OFF

With regard to the above mentioned roadway resurfacing / paving project I have reviewed the above list regarding the current project description, work activities, work areas, and work that may concern Terrestrial Archaeology and:

1. Have not identified any items in the project's description, or locations, work areas, and work activities that will require additional information to be supplied to Terrestrial Archaeology for further review.
_____ (signed, dated by project manager)
2. Have identified the above noted items in the project that will require additional information to be supplied to Terrestrial Archaeology for further review.

 May 24, 2016 (signed, dated by project manager)



APPENDIX F

Definition of Criteria Used to Describe Predicted Residual Effects for Valued Components



APPENDIX F

Definition of Criteria Used to Describe Predicted Residual Effects for Valued Components

Table F-1: Definition of Criteria Used to Describe Predicted Residual Effects for Valued Components

Criteria	Definition	Natural Resources Description	Cultural Resources Description
Direction	Direction relates to the value of the effect in relation to the environment.	■ Positive – net gain or benefit; effect is desirable	■ Positive – an improvement over existing values or conditions
		■ Neutral – no change compared with existing conditions and trends	■ Neutral – no change compared with existing conditions and trends
		■ Negative – net loss or adverse effect; effect is undesirable	■ Negative – a less favourable change relative to existing values or conditions
Magnitude	Magnitude is the intensity of the effect, or a measure of the degree of change from existing (baseline) conditions.	■ Negligible – no detectable change is expected from existing values	■ Negligible – no detectable change is expected from existing values
		■ Low – effect occurs that might be detectable, but is expected to be within the range of existing or guideline values, or within the range of natural variability	■ Low – the change has no effect on the cultural resources setting beyond that of a nuisance (annoyance) value
		■ Moderate – effect is expected to be at or to slightly exceed the limits of existing or guideline values – clearly an effect, but unlikely to be a management concern ^(a)	■ Moderate – the change modifies the cultural resources setting, but there is no change in the system
		■ High – effect is expected to exceed the limits of existing or guideline values – the effect can pose a serious risk and represents a management concern ^(a)	■ High – the change is large enough to result in a change of cultural resources
Geographic Extent	Geographic extent refers to the spatial extent over which an environmental or socio-economic effect will occur.	■ Local – the effect is confined to the Local Study Area	■ Local – the effect is confined to the LSA
		■ Regional – the effect extends beyond the LSA but is confined within the region (i.e., Yoho National Park)	■ Regional – the effect extends to users throughout Yoho National Park
		■ Beyond regional – the effect extends beyond Yoho National Park	■ Beyond regional – the effect extends beyond Yoho National Park
Duration/reversibility	Duration is the period of time over which the natural or cultural resource effect will be present. The amount of time between the start and end of a Project activity or stressor, plus the time required for the effect to be reversed. Duration and reversibility are functions of the length of time the valued component (VC) are exposed to Project activities.	■ Short-term – the effect occurs during construction or during operation as a result of maintenance activities, and is reversible before or during operation	■ Short-term – the effect occurs during construction or during operation as a result of maintenance activities, and is reversible before or during operation
	Reversibility is an indication of the potential for recovery of the VC from the Project effect. Reversible implies that the effect will not result in a permanent change of state of the VC compared to similar environments not influenced by the Project (similar being an environment of the same type, region and time period). For effects that are permanent, the effect is determined to be irreversible.	■ Medium-term – the effect occurs during construction or operation and is reversible on completion	■ Medium-term – the effect occurs during construction or operation and is reversible on completion
		■ Long-term – the effect occurs during construction or operation and persists beyond completion, but is reversible	■ Long-term – the effect occurs beyond the operational life of the Project, but is reversible
		■ Permanent – the effect occurs during construction or operation and is irreversible	■ Permanent – the effect occurs during construction or operation and is irreversible
Frequency	Frequency refers to the number of times the effect happens per unit time	■ Infrequent – the effect is expected to occur rarely	■ Infrequent – the effect is expected to occur rarely
	Discussions on seasonal considerations are made when they are important in the evaluation of the effect.	■ Frequent – the effect is expected to occur intermittently	■ Frequent – the effect is expected to occur intermittently
	-	■ Continuous – the effect is expected to occur continually	■ Continuous – the effect is expected to occur continually
Probability	Probability of occurrence is a measure of the likelihood that a Project activity will result in an effect.	■ Unlikely – the effect is not likely to occur	■ Unlikely – the effect is not likely to occur
		■ Possible – the effect may occur, but is not likely	■ Possible – the effect may occur, but is not likely
		■ Probable – the effect is likely to occur	■ Probable – the effect is likely to occur
		■ Certain – the effect will occur	■ Certain – the effect will to occur

Notes:

^(a) Effects that pose a management concern can require actions such as research, monitoring or recovery initiatives.

If a residual effect was identified as positive or neutral, no additional assessment criteria other than likelihood were summarized for that VC.



APPENDIX F
Definition of Criteria Used to Describe Predicted Residual Effects for Valued Components

Table F-2: Definitions of the Significance Determination of Predicted Residual effects on Valued Components

Significance	Definition
Natural Resources Valued Components	
Not significant	The effect might be detectable, but is not predicted to result in a change that will alter the sustainability of the valued component (VC) beyond an acceptable level.
Significant	The effect is measurable, and is predicted to result in a change to the VC that will alter its sustainability beyond an acceptable level.
Cultural Resources Valued Components	
Not significant	The degree of change is considered to be either no change or negligible to minor changes (very minor changes, or slight changes to the resource).
Significant	The degree of change is considered to be moderate change (resource is clearly modified) or major change (resource is totally altered and removed/destroyed).

As a global, employee-owned organisation with over 50 years of experience, Golder Associates is driven by our purpose to engineer earth's development while preserving earth's integrity. We deliver solutions that help our clients achieve their sustainable development goals by providing a wide range of independent consulting, design and construction services in our specialist areas of earth, environment and energy.

For more information, visit golder.com

Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 44 1628 851851
North America	+ 1 800 275 3281
South America	+ 56 2 2616 2000

solutions@golder.com
www.golder.com

Golder Associates Ltd.
102, 2535 - 3rd Avenue S.E.
Calgary, Alberta, T2A 7W5
Canada
T: +1 (403) 299 5600

