January 2017

JASPER NATIONAL PARK HIGHWAY 93N

Bat Suitable Wintering Habitat Study - Desktop Review

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REPORT

Report Number: 1659727

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EXECUTIVE SUMMARY

The purpose of this bat suitable wintering habitat study is to define and identify potential suitable wintering habitat (i.e., hibernacula) for Little Brown *Myotis* (*Myotis lucifugus*) and Northern *Myotis* (*Myotis septentrionalis*) along the proposed alignment for the Jasper Icefields Parkway Trail (the Trail). These bat species were emergency listed under Schedule 1 of the Federal Species at Risk Act (SARA) in 2014 due to the sudden decline in populations across eastern Canada as the result of white-nose syndrome (Environment Canada 2014). The desktop review of biophysical attributes will focus on areas along both proposed Trail alignments dated June 10 and August 15, 2016. The review will focus on a study area within 100 metres of either side of the proposed alignments, delineated in the shape files provided by Public Works and Government Services Canada (PWGSC) and the Parks Canada Agency (PCA).

Information regarding characteristics and locations of hibernacula in the Rocky Mountains, and Alberta in general, is very limited and not well understood (COSEWIC 2013; Environment Canada 2015; Horne 2013; Olsen et al. 2011). Suitable wintering habitat is not restricted to only caves, there is a limitless number of sub-human size cracks and crevices in the Rocky Mountains that may be used as hibernacula (Horne 2013).

Research suggests that bats may migrate to larger hibernacula. For example banding records from Cadomin Cave indicate that bats fly to and from Cadomin from a wide summer range throughout central Alberta (Timoney et al., 1998). It has also been proposed that bats may migrate to the northern United States or southern British Columbia (AEP 2014), though this remains speculative without banding records (Horne 2016, pers. comm). Migration and the fact that both of these species of bats have been known to hibernate singularly could explain why there are so few known hibernacula in Alberta (COSEWIC 2013).

With the exception of approximately the first 25 km south of Jasper, many of the rocks along the proposed route are composed of limestone (calcium carbonate) or dolomite (calcium magnesium carbonate). Carbonate rocks are particularly susceptible to erosion and the solution process can create and enlarge cavities within rocks. Although carbonate rocks have been identified along the proposed route, this desktop review is not able to determine whether there are any karst areas within the project area. Bedrock exposures along the highway viewed on Google Earth Pro have numerous small cracks, fissures and clefts within the bedrock and these may lead to larger caves at depth.

Due to the presence of small cracks, fissures and clefts along the proposed alignment for the Jasper Icefields Parkway Trail it is recommended that the proposed ground-truthing be conducted in the late summer or early fall in areas where rock drilling, scaling or blasting will occur. Not only will the geology of the trail be noted, but swarming activities will also be underway and may be observed. Swarming activities have been proposed to commonly occur at the entrances of hibernaculum and the observation of this behaviour may play an important role in identifying suitable wintering habitat (van Schaik et. al., 2015).

Table of Contents

TABLES

FIGURES

1.0 INTRODUCTION

The purpose of this bat suitable wintering habitat study is to define and identify potential suitable wintering habitat (i.e., hibernacula) for Little Brown *Myotis* (*Myotis lucifugus*) and Northern *Myotis* (*Myotis septentrionalis*) along the proposed alignment for the Jasper Icefields Parkway Trail (the Trail). The Trail is proposed to be situated in the vicinity of Highway 93, and expand approximately 100 km from the town of Jasper to the Icefield Center (KM 130 to KM 233).

The desktop review of biophysical attributes will focus on areas along the both the proposed June 10 alignment and the August 15 alternate alignment. The review will focus on a study area within 100 m of either side of the proposed and alternate alignments, delineated in the shape files provided by Public Works and Government Services Canada (PWGSC) and Parks Canada Agency (PCA). Moderate and high potential areas for potential suitable wintering habitat will be highlighted in Figure 1.

2.0 BACKGROUND INFORMATION ON *LITTLE BROWN MYOTIS* AND *NORTHERN MYOTIS*

Three bat species were emergency listed under Schedule 1 of the Federal Species at Risk Act (SARA) in 2014; two of those species being the Little Brown *Myotis* and Northern *Myotis*. These species were listed due to the sudden decline in populations across eastern Canada as the result of white-nose syndrome (WNS) (Environment Canada 2015). It was originally expected that WNS would spread across Canada within 12 to 18 years (Environment Canada 2015); however, on March 11, 2016 the first infected Little Brown *Myotis* was discovered in King County, Washington (Lorch et al., 2016). Researchers expected the Pacific coast to be one of the last places that WNS would reach as it was not known if natural barriers such as the Rocky Mountains will slow down the spread of this disease from east to west across North America (Environment Canada 2015). White-nose syndrome is spread through fungal spores, and when these spores are present in a hibernacula the structural habitat becomes a population sink due to the high risk of contamination (COSEWIC 2013).

Out of the two myotis species that are the focus of this study, the Little Brown *Myotis* is more common in Alberta with a provincial population estimate of 1 to 1.5 million (ESRD 2014). Little Brown *Myoti*s is currently listed as *secure* in Alberta, while the Northern *Myotis* is listed as *may be at risk* (ESRD 2016). It is believed that there are currently an adequate number of healthy individuals in the Prairies and Western Canada to sustain the current population of these species, or increase their abundances (Environment Canada 2015).

Suitable wintering habitat (i.e., hibernacula) is essential for the overwinter survival of bats. Generally, examples of hibernacula for the Little Brown *Myotis* and Northern *Myotis* include cold and humid caves, abandoned mines, deep cracks, wells and tunnels. The ambient temperature of hibernacula usually ranges between 2 degrees Celsius (°C) and 10°C and optimal relative humidity levels are >80% (Environment Canada 2015). Adaptations to colder environments might mean that western and northern bat populations could be using hibernacula with minimum ambient temperatures closer to 0°C, though little is known about site specific microclimates (Horne 2016, pers. comm.). There are certain structural features that can influence the stability and levels of humidity and temperature, such as number of openings, cave size and length and the angle of chambers. The specific microclimates required by hibernating bats must be stable throughout the winter season, therefore hibernacula are likely to be reused annually by hibernating bats (Environment Canada 2015). COSEWIC (2013) and Environment Canada (2015) highlight that the characteristics and locations of hibernacula for Little Brown *Mytois* and Northern *Myotis* are not well understood in the Prairies and Western Canada. Only 5% of the recorded information regarding hibernating bats is from the western provinces and northern territories of Canada, which emphasizes how little is known about suitable wintering habitat for these myotis species in Alberta. Fewer hibernacula have been recorded in western provinces and northern territories, and they generally contain less individuals per site (<1,000 per site) compared to hibernacula of eastern Canada (>10,000) (Environment Canada 2015).

The Canadian Rockies have few known caves with large bat populations, and the location(s) of where the majority of bats in Alberta hibernate is currently unknown. Known bat hibernacula in north-western North America account for a small proportion of the total bat population (Olson et al., 2011). A small number of hibernating bats have been recorded in caves near Cadomin, Nordegg and Jasper National Park (JNP) (ESRD 2014). In March 2016 two new hibernacula were discovered containing 103 Little Brown *Myotis* and Northern *Myotis* in the foothills of Alberta during cave visits (Horne 2016, pers. comm.) in caves that were believed to be hibernacula. This is evidence that the program of using cavers to deploy monitors has potential to be a success in discovering unknown hibernacula. The discovery of hibernacula is important in the preparation for WNS to monitor the health of colonies (Hume 2016).

Procrastination Plot, a bat hibernaculum in Jasper National Park, was surveyed in the winter of 2011 with 700 bats observed (ESRD 2011) and in March 2015 with 673 bats observed (Horne 2016, pers. comm.). Vast quantities of bat bones were recorded in the cave, suggesting that it has been used as a hibernaculum for an extended period of time (Jass et al., 2013). In 2014 Parks Canada Agency located one new hibernacula in Jasper National Park, northeast of Jasper near Pocahontas (Horne 2016, pers. comm.) and also used passive acoustic monitoring to document species and habitat distribution in Jasper National Park (PCA 2014).

3.0 DESCRIPTION OF RESEARCH METHODS

3.1 Literature Review Methods

The Recovery Strategy for Little Brown *Myotis (Myotis lucifugus),* Northern *Myotis (Myotis septentrionalis*), and Tri-colored Bat *(Perimyotis subflavus)* in Canada ([The Recovery Strategy] Environment Canada, 2015) was the first document that was reviewed for this desktop study. The Recovery Strategy and Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Assessment and Status Report on the Little Brown *Myotis* (*Myotis lucifugus*), Northern *Myotis* (*Myotis septentrionalis*) and Tri-colored Bat (*Perimyotis subflavus*) in Canada (COSEWIC, 2013) provided most of the required background information relating to the Little Brown *Mytotis* and Northern *Myotis*, WNS and characteristics of suitable wintering habitat.

Additional resources were reviewed to provide background information of cave and karst areas in the Rocky Mountains, to achieve an idea of what types of caves have been recorded in JNP and if there have been any recent discoveries of hibernacula in Alberta or the Rocky Mountains. Lastly, information specific to hibernacula in JNP, or neighbouring parks such as Banff National Park, or Alberta in general was reviewed. Please see references (Section 8.0) for a full list of information sources.

3.2 Bedrock Geology Mapping Methods

The bedrock geology of Alberta by Prior et al. (2013) was reviewed along the proposed alignment and areas of carbonate rocks (e.g., limestone, dolomite) were noted. Topographic maps including the LiDAR data provided by PWGSC/PCA were also reviewed to determine if any caves or karst areas were identified on the maps, and finally the ‘street view’ of Google Earth Pro was used to identify where bedrock was exposed at the surface along highway 93.

4.0 DESCRIPTION OF BIOPHYSICAL ATTRIBUTES IDENTIFIED

The definition of a cave may be subjective, therefore it is important to clarify this term. Horne (2013) describes a cave as a natural underground opening in bedrock or talus that is large enough for humans to enter. Total darkness is not mandatory, but if it exists then the location is by default a cave. Caves can be partially or completely water filled (seasonally or year round). Cave passages are formed by dissolution process rather than through weathering and freeze-thaw cycles. Frost pockets are a surface exposure that has been enlarged by weathering, and although frost pockets may take on the appearance of cave entrances they rarely extend deep enough for all daylight to be lost. These frost pockets may give the landscape the appearance of more caves than are present, and unlike caves they are not suitable hibernacula (Horne 2013).

Caves in the Rocky Mountains are often grouped together in karst areas, although not exclusively. The Snaring karst in JNP is an example of a surface karst with an underlying cave system, while Maligne Canyon Cave (JNP) is an example of a cave that developed as a result of an abandoned spring (Rollins 1995). Jasper National Park boasts a number of other caves, which are described in Rollins' (2004) book *Caves of the Canadian Rockies and Columbia Mountains.* Additional details are provided in Section 5.1.

5.0 RESULTS AND COMMENTS

5.1 Literature Review

Upon reviewing the recorded caves in JNP as outlined in *Caves of the Canadian Rockies and Columbia Mountains* (Rollins, 1995) it was noted that many of the recorded caves require significant effort to gain access. For example, Yves' Drop is accessed along Highway 93, north of Sunwapta Pass near Wilcox Pass Campground. Access can take hours to days of travel on foot (Horne 2016, pers. comm.). Caves of the Rocky Mountains are described to be different than those in other areas of Canada and North America because they are almost all alpine with entrances at, or above the treeline, though all have similar karst formations and caves (Horne 2016, pers. comm.). Many of these caves require technical skills to access, and are cold most of the year with ice present at entrances of some caves (Alberta Speleological Society 2016; Horne 2016, pers. comm.). These high elevation caves and cool temperatures may contribute to the low number of hibernacula recorded in JNP. In the study completed by Jass et al. (2013), only one (Procrastination Plot) out of the four caves that were studied in the area revealed signs that bats have been using the structure as hibernacula. This cave was located on a ridge below the tree line at 1,650 m.

The winter bat population of Cadomin Cave, east of Jasper National Park, is estimated at 2,000 to 5,000 bats, whereas the swarming population during mating season is estimated at 10,000 to 20,000 bats (Timoney et al. 1998). In February 2014 the highest count of bats to date was obtained, at 1,592 bats (Horne 2016, pers. comm.). Five species have been recorded as using this cave as a hibernaculum, including the Little Brown *Myotis* and Northern *Myotis*. Currently it is one of only two known hibernacula for Northern *Myotis* in Alberta. Banding records indicate that bats fly to and from Cadomin from a wide summer range throughout central Alberta (Timoney et al., 1998). It has also been proposed that bats may migrate to the northern United States or southern British Columbia (AEP 2014), though this remains speculative without banding records (Horne 2016, pers. comm).

As previously discussed, suitable wintering habitat is not exclusive to caves. The number of potential possibilities for sub-human size cracks and crevices suitable for overwintering habitat in the Canadian Rocky Mountains is very difficult to estimate (Horne 2013). The Northern *Myotis* is more tolerant of cold compared to the Little Brown *Myotis*, and have been reported to hibernate singularly in narrow crevices near the entrances of mines and caves

(Horne, 2013). The Little Brown *Myotis* has also been discovered in deep cracks, which makes detection difficult (COSEWIC 2013). In the temperate rainforest of southeast Alaska, the Little Brown *Myotis* has been discovered hibernating solitarily in rock scree on steep forested hillsides, and beneath root wads of trees and stumps (Environment Canada 2015).

It has been suggested that potential overwintering habitat may be documented by monitoring swarming activities during the late summer or fall (COSEWIC 2013), as mating and socializing activities often occur around the entrances of hibernacula. Van Schaik et. al. (2015) also proposed that swarming behaviour may not only be a promiscuous mating system, but could also be related to the localization and assessment of suitable wintering habitat. The relative abundance of a species during swarming season (August – September) was significantly correlated with the relative abundance of that species during hibernation. The results of this study suggest that the observation of swarming activities may play an important role in recording and monitoring suitable wintering habitat (van Schaik et. al., 2015).

The Little Brown *Myotis* and Northern *Myotis* both require very specific microclimatic conditions throughout hibernation, as described in Section 2.0. Therefore any activity that results in an alteration of these conditions, such as temperature, humidity and airflow may destroy or degrade the suitable wintering habitat. Blasting activities during the winter months also poses as a threat to hibernating bats (Abbott et al., 2015). Road or other blasting work within 1.6 km of hibernacula have potential to disrupt hibernating bats, therefore any work being conducted in proximity to hibernating bats should generally be conducted from June through September (Bat Caver 2016). Additionally, sensitive hibernacula entrances may also collapse as a result of heavy machinery being used within a close proximity to the hibernacula. Noise, light and vibrations near hibernacula as a result of machinery, may also threaten bats and cause them to arouse from torpor (Abbott et al., 2015; Environment Canada 2015).

Suitable wintering habitat has been discussed to a great extent in this report, however, other components of habitat for the Little Brown *Myotis* and Northern *Myotis* have not been discussed. Aside from hibernacula, these species also require foraging habitat, summer roost and maternity colony structures (COSEWIC 2013). It may be worth noting that aside from still water and rivers, the Little Brown *Myotis* and Northern *Myotis* forage in forest gaps/edges, and along trails. This is true for all three species, especially the Northern *Myotis* (COSEWIC 2013).

5.2 Bedrock Geology Mapping

The bedrock geology of Alberta (Prior et al. 2013) was reviewed along the proposed alignment and areas of carbonate rocks (e.g., limestone, dolomite) were noted. Table 1 shows the bedrock geology underlying the original route of the proposed Icefields Trail from Jasper south to the Icefield Centre. The bedrock geology in relation to both the original and alternate routes is presented in Figure 1.

With the exception of approximately the first 25 km south of Jasper, many of the rocks along the proposed route are composed of limestone (i.e., calcium carbonate) or dolomite (i.e., calcium magnesium carbonate) which formed in a shallow marine environment during the Cambrian Period (543 to 490 million years ago). These rocks form from the accumulation of shell, coral, algal and fecal debris. For the first 25 km south of Jasper, the bedrock is comprised of sandstones, conglomerate, siltstone and slate.

Table 1: Bedrock geology underlying the original route of the proposed Icefields Trail (after Prior et al. 2013)

Section of Icefield Trail	KPs along Hwy 93	Bedrock Unit	Lithology
Start – Whistlers Camp Ground	201.3 - 226.1 (from 226.1 the trail continues for approximately 2.5 km east and north of the highway)	Miette Group	Sandstone, conglomerate, siltstone and slate
Whistler – Valley of the Five			
Valley of the Five - Wabasso			
Wabasso – Athabasca Pass Viewpoint			
Athabasca Pass Viewpoint – Kerkeslin Creek			
Athabasca Pass Viewpoint – Kerkeslin Creek	177.2 - 201.3	Gog Group	Sandstone and limestone
Kerkeslin – Athabasca Falls Hostel			
Athabasca Falls – Goat Lick			
Brussels – Honeymoon Lake			
Honeymoon Lake – Sunwapta Station	168.6 - 177.2	Middle Cambrian Strata	Dolomite and siltstone
Honeymoon Lake – Sunwapta Station	164.5 – 168.8	Gog Group	Sandstone and Limestone
Honeymoon Lake – Sunwapta Station	164.1 – 164.5	Lynx Group	Limestone and shale
Honeymoon Lake – Sunwapta Station	163.3 – 164.1	Gog Group	Sandstone and Limestone
Honeymoon Lake – Sunwapta Station	160.4 – 163.3	Lynx Group	Limestone and shale
Honeymoon Lake – Sunwapta Station	159.05 – 160.4 (extends from 174.0)	Middle Cambrian Strata	Dolomite and siltstone
Spur trail to Sunwapta Falls			
Honeymoon Lake – Sunwapta Station	157.0 – 159.05	Gog Group	Sandstone and Limestone
Sunwapta Falls - Beauty Creek	140.05 – 157.0	Middle Cambrian Strata	Dolomite and siltstone
Beauty Creek - Stutfield			
Beauty Creek - Stutfield	135.7 – 140.05	Lynx Group	Limestone and shale
Beauty Creek - Stutfield	133.0 – 1335.7	Middle Cambrian Strata	Dolomite and siltstone
Tangle Hill - road			
Tangle Hill – road	130.6 – 133.0	Lynx Group	Limestone and shale
Tangle to Icefield Centre beside road	125.7 – 130.6	Middle Cambrian Strata	Dolomite and siltstone
Spur trail to Forefield Trail	Extends from 125.5	Lynx Group	Limestone and shale
Icefield Centre – Sunwapta Pass	123.7 – 125.7	Lynx Group	Limestone and shale
Icefield Centre – Sunwapta Pass	122.0 – 123.7	Ordovician Strata	Dolostone, sandstone, limestone, and shale
Icefield Centre – Sunwapta Pass	121.1 – 122.0	Devonian (undivided)	Limestone, dolostone, and shale
Icefield Centre – Sunwapta Pass	120.95 – 121.1	Ordovician Strata	Dolostone, sandstone, limestone, and shale
Icefield Centre – Sunwapta Pass	120.85 – 120.95	Devonian (undivided)	Limestone, dolostone, and shale

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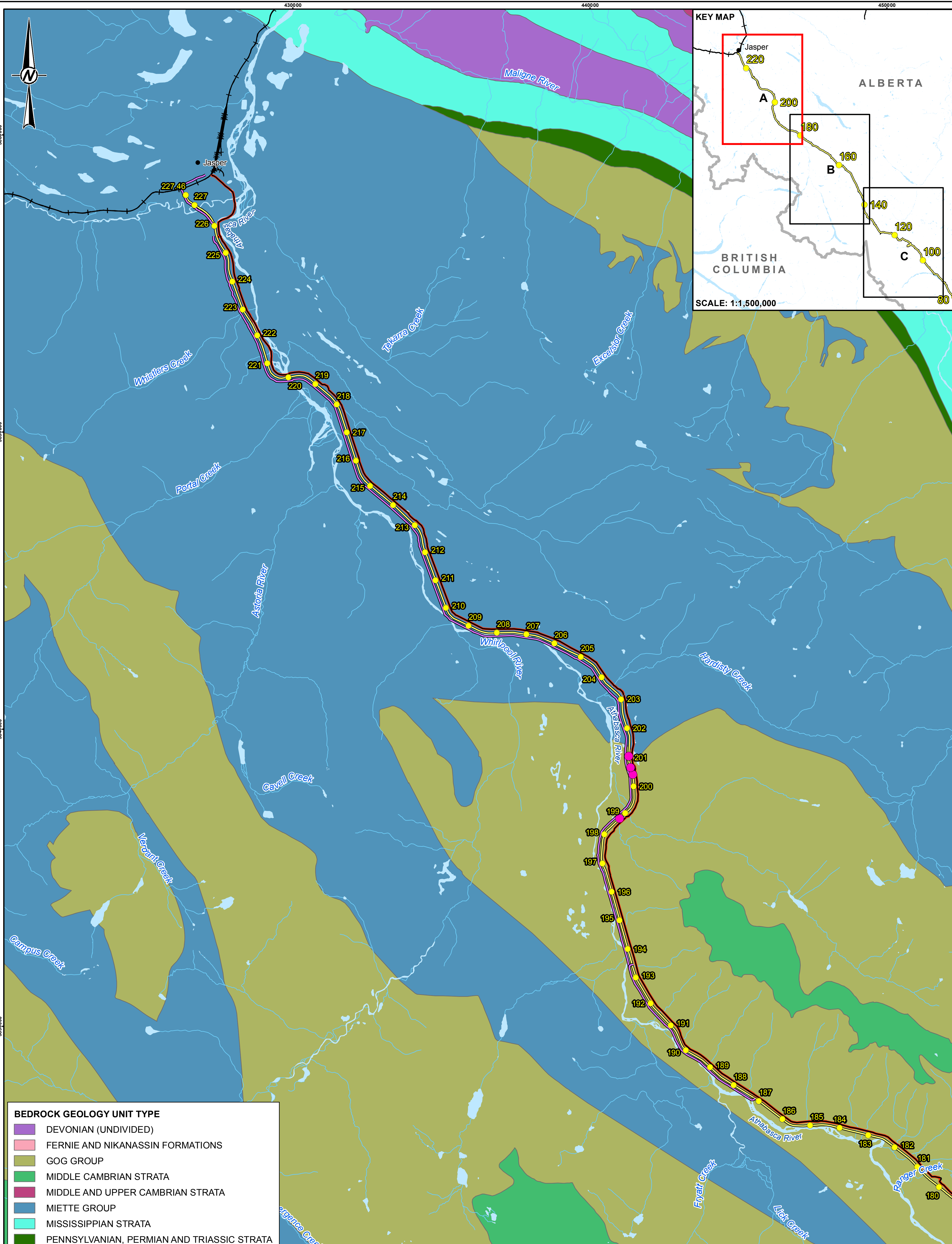

LEGEND

- BEDROCK EXPOSURE
- JASPER
- KILOMETRE POST
- HIGHWAY 93N
- RAILROAD
- WATERCOURSE
- WATERBODY

ROUTE OPTIONS

- ALTERNATE AUGUST 15 ALIGNMENT
- ORIGINAL JUNE ALIGNMENT

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REFERENCE(S)

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3. ALL OTHER DATA OBTAINED FROM MCELHANNEY, TANNUS, TETRA TECH EBA OR PARKS CANADA.

DATUM: NAD 83 PROJECTION: UTM ZONE 11

CLIENT
PARKS CANADA AGENCY

PROJECT
JASPER ICEFIELDS PARKWAY TRAIL, JASPER NATIONAL PARK
HIGHWAY 93N

TITLE
BEDROCK GEOLOGY ALONG THE ORIGINAL TRAIL ROUTE AND ALTERNATE TRAIL ROUTE – HIGHWAY 93N

CONSULTANT

Golder Associates

YYYY-MM-DD	2017-01-31
DESIGNED	CV
PREPARED	SS
REVIEWED	AS
APPROVED	CDM

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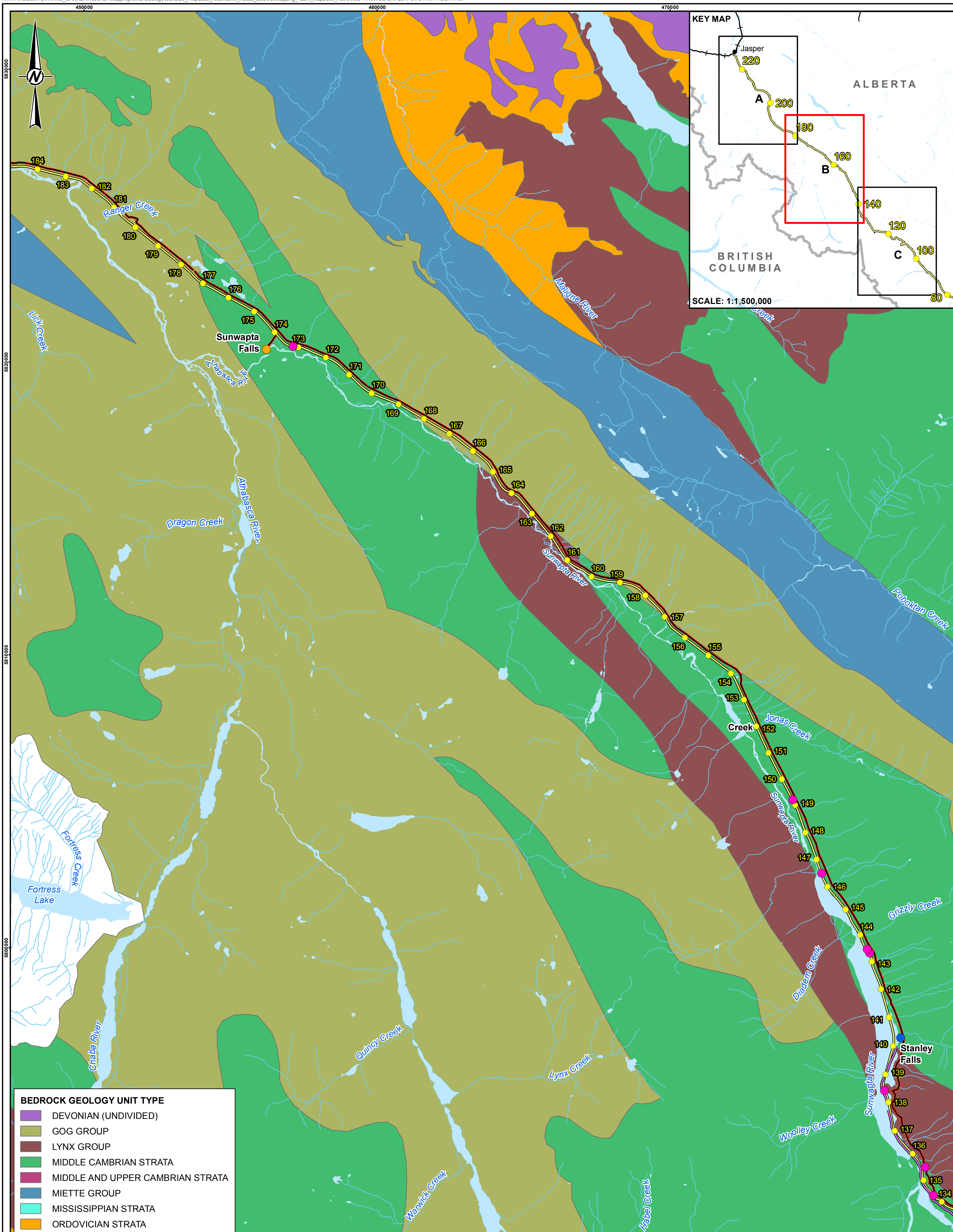

LEGEND

- BEDROCK EXPOSURE
- STANLEY FALLS
- SUNWAPTA FALLS
- KILOMETRE POST
- HIGHWAY 93N
- WATERCOURSE
- WATERBODY

ROUTE OPTIONS

- ALTERNATE AUGUST 15 ALIGNMENT
- ORIGINAL JUNE ALIGNMENT

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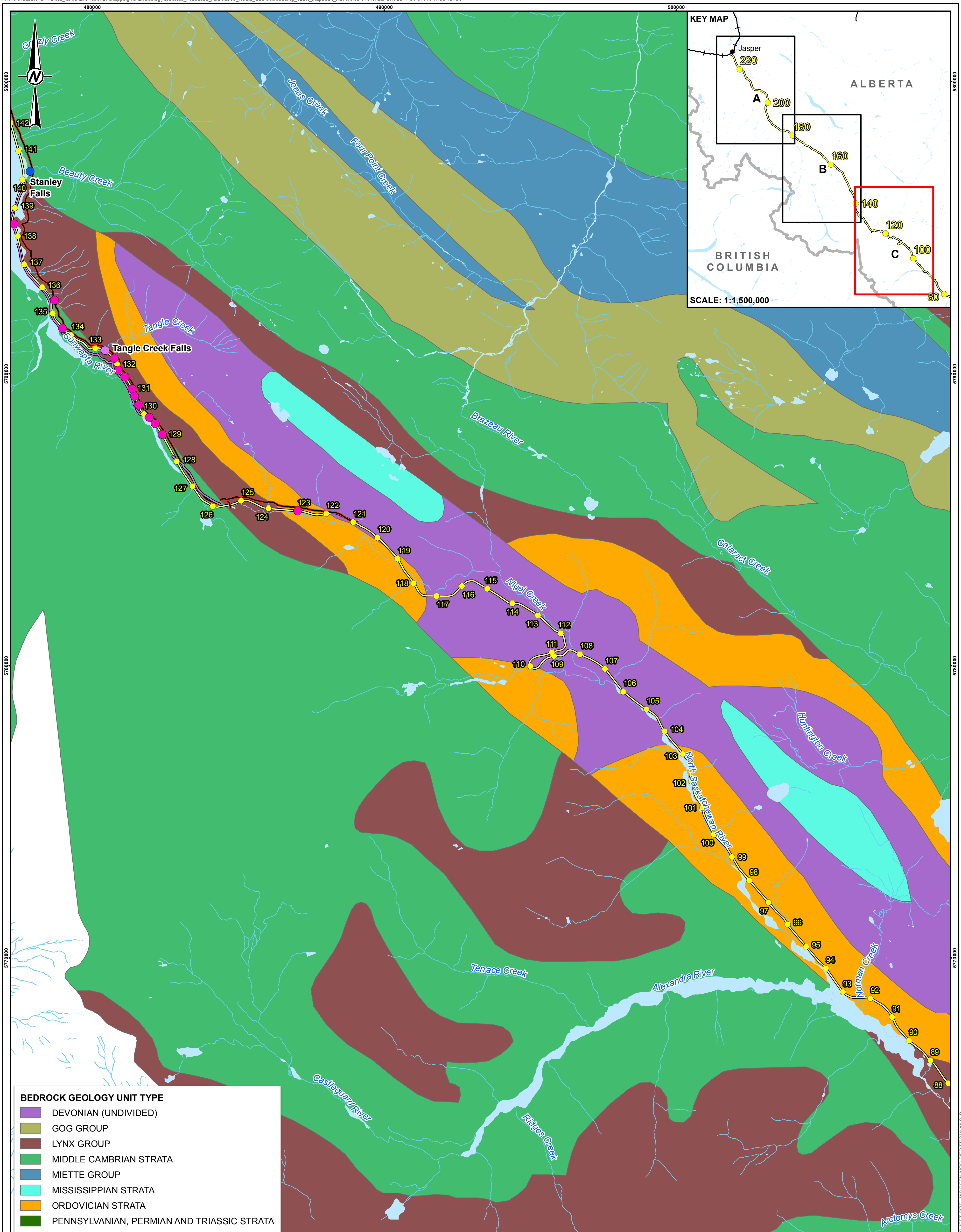

LEGEND

- BEDROCK EXPOSURE
- STANLEY FALLS
- TANGLE CREEK FALLS
- KILOMETRE POST
- HIGHWAY 93N
- WATERCOURSE
- WATERBODY

ROUTE OPTIONS

- ALTERNATE AUGUST 15 ALIGNMENT
- ORIGINAL JUNE ALIGNMENT

0 5 10

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HIGHWAY 93N

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CONSULTANT
Golder Associates

YYYY-MM-DD	2017-01-31
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REVIEWED	AS
APPROVED	CDM

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In regions where there are carbonate rocks, weathering and erosion can produce unique landforms and drainage called karst, formed by the chemical and sometimes mechanical action of water on limestone, dolomite or gypsum bedrock (Parker 1994). Carbonate rocks are particularly susceptible to erosion and the solution process can create and enlarge cavities within rocks. For example, Maligne Canyon is carved into the Palliser Formation, a limestone layer deposited during the Devonian period (391 to 354 million years ago), and the Athabasca Falls are the result of limestone bedrock being eroded beneath a layer of hard quartzite. Streams which disappear into the ground in limestone areas can indicate the presence of an underground drainage system. Limestone caves may also be an indication of an underground drainage system and away from their entrances usually provide a relatively constant temperature and humidity over a long period of time.

Although carbonate rocks have been identified by Prior et al. (2013) along the proposed route from KP 120.85 to 201.3 (based on kilometer postings along Highway 93), it is not possible to determine whether there are any karst areas within the project area. Prior et al. (2013) is mapped at a scale of 1:1,000,000 and although it incorporates bedrock geology mapping at finer scales (e.g., 1:250,000, 1:50,000, etc.), the available maps for the Project area have no additional information on karst areas. The 1:50,000 Quaternary geology mapping does exist for the Project area (Holland and Coen 1982), however, because of its relatively small scale, the maps suggest that the lower slopes adjacent to Hwy 93 are overlain by soft surficial sediments (e.g., till); these maps do not identify any caves, sinkholes, fissures and clefts that may be suitable overwintering habitat. The nearest known cave to Highway 93 is 350 m west of the highway across the Sunwapta River (Horne 2016, pers. comm.).

Waterfalls within an area of carbonate rock (e.g., limestone) may indicate possible caves in the area. Watercourses may go underground by dissolving and eroding weaker parts of the bedrock, then come to the surface again further downstream, creating caves that may be potential bat hibernacula. Topographic maps at a scale of 1:50,000 were reviewed and two creeks with waterfalls were identified. The Tangle Creek Falls at KP 132.7 (Lat: 52.267255 Long: -117.324588) is immediately adjacent to Highway 93 while Stanley Falls on Beauty Creek is located approximately 235 m east of Highway 93 at KP 140.3 (Lat: 52.322171 Long: -117.324588). The proposed trail follows the old road between KP 138.0 and 141.8; Stanley Falls is near the old road and within the 200 m wide corridor. Part of the Sunwapta Falls on the Sunwapta River also lies within the Spur Trail to Sunwapta Falls section of the proposed trail corridor. The trail extends in a southwesterly direction from KP 174.0 and it is currently paved. Potential bat hibernacula could be associated with these waterfalls if rock dissolution and erosion have created caves in the area.

Google Earth Pro was used to identify any areas where bedrock is exposed at the surface along Highway 93. Twenty-six points were identified and these are shown on Figure 1 and in Table 2. Each point was placed at or close to the middle of the area of exposed bedrock. The points do not indicate the lateral extent (i.e., length) of the exposures along the highway. Three of the points represent Tangle Creek Falls, Stanley Falls and Sunwapta Falls. No caves were identified, however, it is possible that caves may exist within the tree line and are not obvious from the Google Earth imagery. This is especially true for streams and creeks within carbonate rich bedrock areas. Small cracks, fissures and clefts within the bedrock may lead to larger caves at depth. Where the proposed trail uses the old road, it was not possible to identify if bedrock was at the surface.

Table 2: Centre point coordinates of areas along or near the proposed trail where potential bat hibernacula have been identified

Site	Zone	Easting	Northing	Comments
Bedrock exposure 1	11	487039	5785306	Bedrock exposed at top of slope. Possibly within proposed corridor.
Bedrock exposure 2	11	482406	5787915	At edge of proposed corridor.
Bedrock exposure 3	11	482161	5788291	Bedrock exposed within proposed corridor
Bedrock exposure 4	11	481954	5788495	Bedrock exposed within proposed corridor.
Bedrock exposure 5	11	481603	5788917	Bedrock exposed within proposed corridor. Some rockfall.
Bedrock exposure 6	11	481447	5789228	Possibility of bedrock further upslope.
Bedrock exposure 7	11	481369	5789487	Bedrock exposed within proposed corridor.
Bedrock exposure 8	11	481118	5789888	Clefts in bedrock upslope.
Bedrock exposure 9	11	480903	5790113	Exposure likely due to road cut.
Bedrock exposure 10	11	480751	5790522	Likely exposed due to road cut. Small clefts still possible.
Bedrock exposure 11	11	478985	5791543	Likely just exposed due to road cut
Bedrock exposure 12	11	478711	5792506	Bedrock exposed just outside proposed corridor
Bedrock exposure 13	11	477320	5795125	Bedrock exposed - area also treed
Bedrock exposure 14	11	476810	5799824	Not a high exposure of bedrock but small clefts within it.
Bedrock exposure 15	11	476725	5799947	Not a high exposure but small clefts within bedrock.
Bedrock exposure 16	11	475168	5802541	Small exposure of bedrock
Bedrock exposure 17	11	474185	5805048	Bedrock exposed in road cut
Bedrock exposure 18	11	457129	5820533	Small bedrock exposure due to road cut. Clefts within rock face
Bedrock exposure 19	11	440997	5836990	Bedrock exposed from road cut
Bedrock exposure 20	11	441443	5838468	Small section of bedrock exposed due to road cut
Bedrock exposure 21	11	441367	5838708	Bedrock near surface and exposed in small road cut.
Bedrock exposure 22	11	441303	5839082	Bedrock exposed in road cut.
Creek 23	11	472947	5807532	Bedrock possibly exposed in this area due to creek.
Stanley Falls 24	11	477876	5796921	Bedrock exposed in falls
Sunwapta Falls 25	11	456215	5820426	Part of Sunwapta Falls is within proposed corridor.
Tangle Creek Falls 26	11	480447	5790794	Waterfall, exposed bedrock on slope.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Overall, it may be concluded that information regarding characteristics and locations of hibernacula in the Rocky Mountains, and Alberta in general, is very limited and not well understood (COSEWIC 2013; Environment Canada 2015; Horne 2013; Olsen et al., 2011). Suitable wintering habitat is not restricted to caves, there are a limitless number of sub-human size cracks and crevices in the Rocky Mountains that may be used as hibernacula (Horne 2013). Adaptations to colder environments might mean that western and northern bat populations could be using hibernacula with minimum ambient temperatures closer to 0°C, though little is known about site specific microclimates (Horne 2016, pers. comm.).

It has been suggested that bats may migrate to larger hibernacula, for example banding records from Cadomin Cave indicate that bats fly to and from Cadomin from a wide summer range throughout central Alberta (Timoney et al., 1998). It has also been proposed that bats may also migrate to the northern United States or southern British Columbia (AEP 2014), though this remains speculative without banding records (Horne 2016, pers. comm). Migration and the fact that both of these species of bats have been known to hibernate singularly could explain why there are so few known hibernacula in Alberta (COSEWIC 2013).

There are numerous small cracks, fissures and clefts within areas of carbonate rocks (e.g., limestone, dolomite) along the proposed alignment for the Jasper Icefields Parkway Trail and these may lead to larger caves at depth. It is recommended that the proposed ground-truthing be conducted along the moderate and high potential areas outlined in Figure 1, in areas where rock drilling, scaling or blasting may be required. Ground-truthing may occur in the late summer or early fall to not only allow the geology of the trail to be noted, but swarming activities will also be underway and may be observed. Swarming activities have been proposed to commonly occur at the entrances of hibernacula and the observation of this behaviour may play an important role in identifying suitable wintering habitat (van Schaik et. al., 2015).

7.0 LIMITATIONS

The lack of knowledge regarding known hibernacula in Jasper National Park, and Alberta in general, may be viewed as a limitation for this study. It is difficult to cross reference relevant information to the geology of the proposed alignment for the Jasper Icefields Parkway Trail when characteristics of hibernacula are not fully understood (COSEWIC 2013; Environment Canada 2015; Horne 2013; Olsen et al., 2011).

Once hibernacula are located it is also difficult to estimate the number of individuals within the hibernacula due to efforts associated with minimizing the disturbance of hibernating bats, and the difficulty in locating bats within complex overwintering structures Additionally, the discovery of one hibernating individual usually results in the occurrence of more undetected individuals (Hume 2016).

8.0 CLOSURE

We trust the above meets the present requirements. If you have any questions or require additional details, please contact the undersigned.

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https://capws.golder.com/sites/p1659727icefieldstrailbiophysicalfieldsurveys/field_studies/batsuitablehabitat/batsuitablehabitat_report.docx

9.0 REFERENCES

AEP (Alberta Environment and Parks). 2014. Little brown bat *(Myotis lucifugus)* [modified 8 January 2014; accessed 30 December 2016]. http://aep.alberta.ca/fish-wildlife/wild-species/mammals/bats/little-brown-bat.aspx.

Alberta Speleological Society. Caves and Karst of the Canadian Rockies. Web. http://www.caving.ab.ca/caves_and_karst. Accessed August 23, 2016.

Alberta Environment and Sustainable Resource Development (ESRD). 2011. Western Canadian Bat Network Newsletter. Issue 18. Web. http://esrd.alberta.ca/fish-wildlife/wildlife-management/alberta-bat-action-team/documents/WesternCanadaBatNetwork-Newsletter018A-Spring2011.pdf. Accessed August 19, 2016.

Abbott, I. M., A. Berthinussen, E. Stone, M. Boonman, M. Melber, and J. Altringham. 2015. Bats and Roads. Handbook of Road Ecology. John Wiley & Sons, Ltd. Chichester, UK.

Bat Caver. Web. http://programs.wcs.org/batcaver/. Accessed August 23, 2016.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2013. COSEWIC Assessment and Status Report on the Little Brown Myotis Myotis lucifugus, Northern Myotis Myotis septentrionalis and Tri-colored Bat Perimyotis subflavus in Canada. Ottawa. Web. http://www.registrelep-sararegistry.gc.ca/virtual_sara/files/cosewic/sr_Little%20Brown%20Myotis%26Northern%20Myotis%26Tri-colored%20Bat_2013_e.pdf. Accessed August 15, 2016.

Environment Canada. 2015. Recovery Strategy for Little Brown Myotis (Myotis lucifugus), Northern Myotis (Myotis septentrionalis), and Tri-colored Bat (Perimyotis subflavus) in Canada [Proposed]. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. Web. http://www.sararegistry.gc.ca/default.asp?lang=En&n=2A04680B-1. Accessed August 15, 2016.

ESRD. 2014. Little Brown Bat (*Myotis lucifugus*). Web. http://esrd.alberta.ca/fish-wildlife/wild-species/mammals/bats/little-brown-bat.aspx. Accessed August 22, 2016.

ESRD. 2016. Wild Species Status Search. Web. http://esrd.alberta.ca/fish-wildlife/species-at-risk/wild-species-status-search.aspx. Accessed August 22, 2016.

Holland, W.D and G.M Coen 1982. Ecological (Biophysical) Land Classification of Banff and Jasper National Parks. Environment Canada, Alberta Institute of Pedology Publication No. SS82-44.

Horne G. March 31, 2013. Status of Bats (Chiroptera) in 2013, Banff National Park, Alberta, Canada. Web. http://www.bowvalleynaturalists.org/resources/Horne-2013-Summary-of-Bats-in-Banff-2013-04-12.pdf. Accessed August 19, 2016.

Horne G. 2016. Edits suggested for the technical memorandum: Jasper National Park highway 93N, bat suitable wintering habitat study - desktop review. [edits and suggestions written as comments in pdf of technical memo, pers. comm.].

Hume, M. March 11. 2016. Researchers Hope Hibernating Bats Hold Key to Tracking Deadly Disease. The Globe and Mail. Web. http://www.theglobeandmail.com/news/british-columbia/researchers-hope-hibernating-bats-hold-key-to-tracking-deadly-disease/article29193185/. Accessed August 23, 2016.

Jass, C.N., Horne, G. and Critchley, D. 2013. Postglacial Faunal Records from Cave Deposits in Jasper National Park, Alberta, Canada. 20th National Cave and Karst Management Symposium: 19-22.

Lorch, J.M., Palmer, J.M., Lindner, D.L., Ballmann, A.E., George, K.G., Griffin, K., Knowles, S. Huckabee, J.R., Haman, K.H., Anderson, C.D., Becker, P.A, Buchanan, J.B. Foster, J.T., Blehert, D.S. 2016. First Detection of Bat White-Nose Syndrome in Western North America. mSphere: 1(4).

Olson, C. R., D. P. Hobson, and M. J. Pybus. 2011. Changes in population size of bats at a hibernaculum in Alberta, Canada, in relation to cave disturbance and access restrictions. Northwestern Naturalist 92(3): 224-230.

PCA. 2014. Jasper National Park of Canada Annual Report 2014. Web. http://www.pc.gc.ca/eng/pn-np/ab/jasper/plan/~/media/pn-np/ab/jasper/pdfs/plan/rapports-reports/EN_Annual%20Report%202014.ashx. Accessed August 19 2016.

Prior, G.J., B. Hathway, P.M. Glombick, D.I. Dana, C.J. Banks, D.C. Hay, C.L. Schneider, M. Grobe. R. Elgr and J.A. Weiss. 2013. Bedrock Geology of Alberta. Alberta Geological Survey, Map 600. Web. http://www.ags.gov.ab.ca/publications/abstracts/MAP_600.html. Accessed August 18 2016.

Rollins, J.1995. Caves of the Rocky Mountains. A Forum for Natural, Cultural and Social Studies 3(1). Parks Canada, Alberta and Pacific-Yukon Regions. Web. http://parkscanadahistory.com/series/rl/R61-16-3-1E.pdf Accessed August 18, 2016.

Rollins, J. 2004. Caves of the Canadian Rockies and Columbia Mountains. Rock Mountain Books. Surrey, British Columbia. 336 pp.

Timoney, K., Park, S. and Protection, A.E., 1998. Environmentally significant areas inventory of the Rocky Mountain natural region of Alberta. *Prepared for: Corporate Management Service, Alberta Environmental Protection, Edmonton, Alberta.*

van Schaik J, Janssen R, Bosch T, Haarsma A-J, Dekker JJA, Kranstauber B. 2015. Bats Swarm Where They Hibernate: Compositional Similarity between Autumn Swarming and Winter Hibernation Assemblages at Five Underground Sites. PLoS ONE 10(7).

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