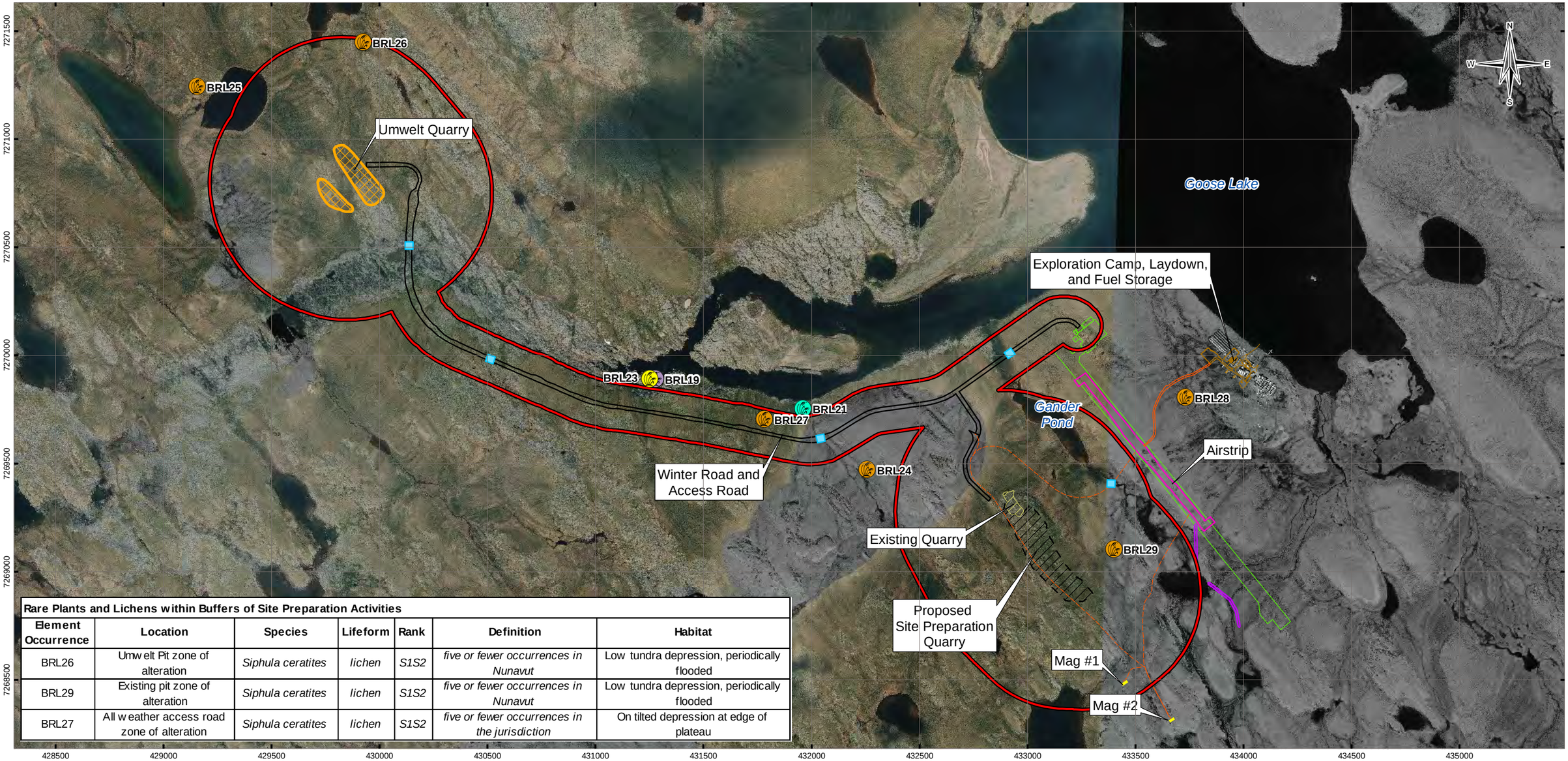

Rare Plants and Lichens within Buffers of Site Preparation Activities

Element Occurrence	Location	Species	Lifeform	Rank	Definition	Habitat
BRL26	Umwelt Pit zone of alteration	*Siphula ceratites*	*lichen*	*S1S2*	*five or fewer occurrences in Nunavut*	Low tundra depression, periodically flooded
BRL29	Existing pit zone of alteration	*Siphula ceratites*	*lichen*	*S1S2*	*five or fewer occurrences in Nunavut*	Low tundra depression, periodically flooded
BRL27	All weather access road zone of alteration	*Siphula ceratites*	*lichen*	*S1S2*	*five or fewer occurrences in the jurisdiction*	On tilted depression at edge of plateau

LEGEND

Rare Plant Observation

- *Bryoria tenuis*
- *Placynthium flabellosum*
- *Ramalina intermedia*
- *Siphula ceratites*
- Site Preparation Activities Buffer

- Proposed Access Road
- Rascal Stream Realignment Berm
- Proposed Airstrip Extension
- Proposed Umwelt Quarry
- Proposed Site Preparation Quarry
- Water Crossing / Culvert Location
- Winter Road
- Airstrip Access Road
- Laydown Area / Existing Camp / Fuel Storage
- Explosive Magazine Location
- Existing Quarry
- Existing Airstrip

NOTES
Base data source:
Imagery from Sabina (2006/2011)
Infrastructure provided by JDS Energy and Mining Inc. (2014)

STATUS
ISSUED FOR REVIEW

SABINA BACK RIVER PROJECT, NUNAVUT

Rare Plant Observations near Goose Property Infrastrcuture

PROJECTION UTM Zone 13			**DATUM** NAD83		**CLIENT** Sabina
Scale: 1:18,000 (200 100 0 200 Metres)					
FILE NO. V15103033-02_Figure8-4-1_RarePlantGoose.mxd					
PROJECT NO. V15103033-02	**DWN** MEZ	**CKD** SL	**APVD** DM	**REV** 0	**Figure 8.4-1**
OFFICE Tt EBA-VANC	**DATE** October 9, 2014				

Q:\Vancouver\GIS\ENGINEERING\V151\V15103033-02_SabinaMaps\V15103033-02_Figure8-4-1_RarePlantGoose.mxd modified 10/9/2014 by morgan.zondervan

8.4.2.3 Mitigation and Management

Mitigation measures will be implemented to minimize the effects of the road on the ecosystems and vegetation of the area, including:

- Minimizing the size of the overall footprint;
- Avoiding sensitive ecosystems or ecosystems supporting rare plant habitat, where possible;
- Applying appropriate dust suppression measures, as per the *Environmental Guideline for Dust Suppression* (Nunavut Department of Sustainable Development, Environmental Protection Service 2002);
- Verifying machinery and equipment destined for use at the site is clean prior to being dispatched (as a means of reducing the introduction of invasive plant material to the area);
- Immediate containment and clean-up of spills, as per the established Spill Contingency Plan;
- Installing sufficient cross drainage to prevent or minimize water ponding as well as to limit the alteration of the surface water hydrology regime; and
- During use of the all-weather road and quarries, dust suppression will be undertaken, when feasible and within the limits of allowable water use.

8.4.3 Caribou

8.4.3.1 Baseline Summary

The Project is located within the range of three barren-ground caribou herds. The most important is the Bathurst caribou herd, which is present primarily during post-calving and occasionally during spring migration. The Ahiak herd (also known as the Queen Maud herd) has also been observed in general region of the Project, primarily during the late summer, fall and winter but also during spring migration. The Dolphin and Union herd is named after the Dolphin and Union Strait which this herd crosses each spring and fall to summer on Victoria Island. The southern extent of the winter range on the mainland likely overlaps with the MLA.

Collaring data indicate that Bathurst herd caribou are found predominantly in and around the Project area during the mid-summer months. Bathurst caribou winter below the tree line in Nunavut and the NWT. During spring migration, caribou move quickly north to the calving grounds between the Hood and Burnside Rivers. The Project is located on the eastern edge of the migration route to the calving grounds and approximately 100 km to the south-east of the calving grounds. During post-calving and summer, caribou leave the calving grounds and move south and south-east to the summer grounds. Some of these caribou move through the Wildlife Regional Study Area (RSA, as presented in the Back River DEIS, Volume 5, Chapter 5), predominantly to the south and west of the Project.

Ahiak caribou are found in the RSA primarily during the summer and early fall, but may be found in the RSA during winter and spring at low densities. Ahiak caribou winter both above and below the treeline, generally southeast of the Project. During spring migration, some caribou move through the eastern border of the RSA. Calving is conducted in the Queen Maude Gulf to the northeast, outside of the RSA. The Ahiak caribou move southwest to their summer range which overlaps the RSA between mid-July and the end of August. A smaller portion of collared Ahiak caribou remain in the southern portion of the RSA during the fall and throughout the winter.

Collar data for Dolphin and Union caribou indicate that this herd has potential to interact with the RSA during winter only. A low number of collared caribou used the northern RSA; it is possible that un-collared caribou (males and juveniles) may use the RSA during the winter season especially in the northern portion of the RSA near the MLA. Dolphin and Union caribou calve and summer on Victoria Island prior to their fall migration. In the fall, the herd migrates to the southern coast of Victoria Island for the rut, before migrating back across sea ice between October and late November to over-winter on the mainland. Dolphin and Union caribou are likely present at low densities in the northern extent of the RSA, near the MLA in the winter. The Dolphin Union caribou herd uses the ice to cross Coronation Gulf on their spring and fall migration to and from Victoria Island (Gunn 2005).

Within the immediate vicinity of the Goose Property, both the Bathurst Herd and the Ahiak Herd have been observed. The Bathurst herd are present in the area during post-calving (mid-June to mid/late July) and to a lesser extent, during spring migration. Ahiak caribou are most likely to be present in the region of Goose Camp during summer (mid-July to late August), but have been observed throughout the year.

Caribou detected in the region using remote digital cameras were most frequently associated with freshwater/riparian and lower elevation habitats, and secondarily with tundra and esker habitat (Rescan 2013a). Lake edges and high elevation sites are used during summer for insect relief. The proposed all-weather road traverses primarily mid-elevation tundra habitat.

8.4.3.2 Potential Effects

Potential effects on the VEC caribou related to site preparation activities include the following:

- Habitat loss;
- Disturbance due to noise (e.g., displacement from areas of habitat);
- Disruption to movement;
- Direct mortality and injury from Project activities;
- Indirect mortality (e.g., due to increased access and associated increase in hunting);
- Attraction (e.g., altered inter-species relationships);
- Exposure to contaminants; and
- Reduction in reproductive productivity due to all effects of the Project combined.

Potential interactions of these effects with site preparation activities were assessed and are presented in Table 8.4-4. The all-weather road has the most potential to negatively affect caribou.

Table 8.4-4. Potential Effects to Caribou in the Goose Property Area and the Marine Laydown Area

Site Development Activity	Habitat Loss	Disturbance due to noise	Disruption to Movement	Direct Mortality and Injury	Indirect Mortality	Attraction	Exposure to Contaminants	Reduction in Reproductive Productivity
All-weather Road	X	X	X	X	X			X
Quarries	X	X						X
All-weather Airstrip Extension	X	X						
Ice Road		X	X	X	X			X
Temporary Laydown Area		X						

8.4.4 Grizzly Bear

8.4.4.1 Baseline Summary

Barren-ground grizzly bears (*Ursus arctos horribilis*), inhabit the northern edge of the grizzly bear range in North America. Habitats at these high latitudes are relatively low in forage productivity. As a result, barren-ground grizzly bears have large home ranges and exist at low densities compared to other grizzly bear populations in more productive ecosystems (McLoughlin 2000).

Inuit TK indicates that barren-ground grizzly bears (hereafter, grizzly bears) are found throughout the RSA, especially in association with major river systems, watersheds and coastal areas (KIA 2012). Grizzly bears were hunted for meat and fat (food and oil) typically in spring or fall before denning. These mammals are also important and respected by Inuit as many legends and stories exist about them (KIA 2012).

The northern extremity of the range of the barren ground grizzly bear is within the area of the Project. These bears require large home ranges due to low biomass production of the landscape. Average home range sizes vary from 2,100 km^2 for females to 7,245 km^2 for males, and home ranges of individuals overlap more than they do in southern latitudes (McLoughlin, Ferguson, and Messier 2000).

Populations of barren-ground grizzly bear in the central Canadian Arctic are structured into three spatially distinct groups, located in the Kugluktuk region, Bathurst Inlet region, and North Slave region (McLoughlin, Cluff, and Messier 2002a). Grizzly bears in the terrestrial RSA are part of the Bathurst Inlet population cluster and there is no official estimate on grizzly bear population size for the West Kitikmeot region of Nunavut. However, a crude estimate of 800 grizzly bears was determined for a 200,000 km^2 portion of the northwestern mainland of Nunavut, which includes the terrestrial RSA (Ross 2002). This estimate assumed a density of four bears per 1,000 km^2 based on grizzly bear densities in nearby areas (Ross 2002).

Three types of baseline surveys have been conducted for grizzly bears in the RSA: population-estimation using DNA mark-recapture, den surveys, and incidental observations. In 2012, 111 bears were identified in the RSA with the highest numbers of bears on the lower reaches of the Western River (>10 bears), along the Back River. These numbers indicate approximately twice the density of grizzly bears in the Project area relative to the assumed density previously thought (Ross 2002).

Den surveys were conducted in 2007, 2011 and 2012. In total, two dens were identified, including two along the Western River.

8.4.4.2 Potential Effects

Interactions of grizzly bears with site preparation components were evaluated to determine which of the following potential effects may occur (Table 8.4-5):

- Habitat loss;
- Disturbance due to noise (e.g. displacement from areas of habitat);
- Disruption to movement;
- Direct mortality and injury from Project activities;
- Indirect mortality (e.g. due to increased access and associated increase in hunting);
- Attraction (e.g., altered inter-species relationships);
- Exposure to contaminants; and
- Reduction in reproductive productivity due to all effects of the Project combined.

Table 8.4-5. Potential Effects to Grizzly Bears in the Goose Property Area and the Marine Laydown Area

Site Development Activity	Habitat Loss	Disturbance due to Noise	Disruption to Movement	Direct Mortality and Injury	Indirect Mortality	Attraction	Exposure to Contaminants	Reduction in Reproductive Productivity
All-weather Road	X	X	X	X	X			X
Quarries	X	X						X
All-weather Airstrip Extension	X	X	X	X				X
Ice Road								
Temporary Laydown Area								

8.4.5 Muskox

8.4.5.1 Baseline Summary

The global range of muskox extends across most of the Arctic islands, northern Greenland, and most of the Canadian tundra, including the Kitikmeot region of Nunavut (Gunn 2003). Overall, in Nunavut and the NWT, the number of muskox was estimated at 134,000 to 144,000 individuals in 2001. The Government of Nunavut estimates that there are 19 populations totalling approximately 50,000 muskox within the Kitikmeot Region (Dumond 2006).

In 2005 the number of muskox between northeast Contwoyto Lake and southwestern Bathurst Inlet, an area that includes the RSA, was estimated at 604 ± 225 animals (Dumond 2007) down from 3,400 ± 460 animals in 1986 (Gunn 1990). Muskox that occur within the RSA are referred to as the central mainland population. Muskox are found throughout the region at relatively low densities (Gunn 1990; Dumond 2007). Average summer home range size is 223 km^2 and they move an average of 2.6 km/day (Reynolds 1998).

Field data for muskox were collected during aerial surveys for caribou in 2007, 2008 and 2010. Surveys followed pre-determined parallel transect lines that were spaced 8 km apart within the RSA. In 2007, five aerial surveys were conducted in May, June, early July, late July, and September and a total of 50 muskox were observed on transects with an additional 82 observed off transect (> 500 m from the plane). In 2008, two adults were observed during the May survey and two during the July survey and an additional 98 muskox (84 adults and 14 young) were observed incidentally.

In 2010, aerial surveys were conducted in May, June, and July and a total of 53 muskox were observed with an additional 34 muskox recorded off transect. Each aerial survey typically observed 2 to 3 groups of muskox. In addition to aerial surveys, three muskox were observed incidentally in the RSA in 2011, and ten separate incidental observations totaling 114 muskox were observed in the RSA in 2012 (Rescan 2013). Typically, a group was observed each year on the low hills to the west of Bathurst inlet, while the other 1 to 2 herds were observed at various locations in the southern portion of the RSA. Productivity (calves and juveniles per adult) of muskox herds observed was very low, frequently with 1-2 calves per 20-30 adults in the spring.

8.4.5.2 Potential Effects

Interactions of muskox with Project components were evaluated to determine which of the following potential effects may occur (Table 8.4-6):

- Habitat loss;
- Disturbance due to noise (e.g., displacement from areas of habitat);
- Disruption to movement;
- Direct mortality and injury from site preparation activities;
- Indirect mortality (e.g., due to increased access and associated increase in hunting);
- Attraction to infrastructure;
- Exposure to contaminants; and
- Reduction in reproductive productivity due to combined effects of the Project.

Table 8.4-6. Potential Effects to Muskox in the Goose Property Area and the Marine Laydown Area

Site Development Activity	Habitat Loss	Disturbance due to Noise	Disruption to Movement	Direct Mortality and Injury	Indirect Mortality	Attraction	Exposure to Contaminants	Reduction in Reproductive Productivity
All-weather Road	X	X	X	X	X			X
Quarries	X	X						X
All-weather Airstrip Extension	X	X	X	X				X
Ice Road		X	X	X	X			X
Temporary Laydown Area	X							X

8.4.6 Wolverines/Furbearers

8.4.6.1 Baseline Summary

Arctic furbearers in the Kitikmeot region include wolverines, wolves, red and Arctic foxes, and Arctic ground squirrels. Wolverines and grey wolves are two species representative of furbearers in the environmental assessment with wolves acting as a proxy for foxes (both canids).

Wolverines are members of the mustelid family, which includes weasels, badgers, and marten. Like other mustelids, wolverines are carnivorous, and are both scavengers and predators on a wide range of prey (COSEWIC 2003). Very large home ranges and low population densities are characteristic of this solitary species (Persson, Wedholm, and Segerstrom 2010; Inman et al. 2012). In Nunavut, wolverines have very large territories ranging from 100 km2 for an adult female to over 600 km2 for an adult male (Feldhamer, Thompson, and Chapman 2003). Wolverine populations in the central Arctic appear to be stable, though recent estimates are lacking (COSEWIC 2003). The total population size of wolverines in Nunavut is estimated at 2,000 to 2,500 individuals (COSEWIC 2003; Slough 2007).

The grey wolf is the largest member of the *Canis* genus and is widespread throughout much of northern Canada, including the West Kitikmeot region of Nunavut. Populations are stable or increasing within their Canadian range, except in northern Alberta and some parts of the NWT (Hayes 1995; Frame 2008). In Nunavut, wolf reproductive success and population size are largely regulated by the availability of caribou.

Three types of baseline surveys have been conducted for wolverine and furbearers in the RSA including: i) population-estimation using DNA mark-recapture for wolverines; ii) carnivore den surveys; and iii) incidental observations. The DNA-based mark-recapture program was conducted over two years; 2012 and 2013 in two areas approximately 2,000 km^2 each, surrounding the Project location. In 2012 and 2013, a 35 km by 35 km survey grid, divided into 49 cells (5 km X 5 km) was located north of the Goose Property. An additional grid consisting of 50 cells (5 km X 5 km) was centered around the proposed MLA during 2013. A baited post was located within each cell and re-baited during three checks (approximately 10 days between checks) during March and April. A total of 12 individuals were detected in 2012, including 4 females and eight males. Only one male wolverine was detected during other wolverine surveys conducted in Nunavut or the NWT and results indicate that the Project area supports a moderately sized wolverine population. A formal population estimate will be made after analysis of the 2013 samples and included in the FEIS.

Carnivore dens surveys were conducted in the RSA via low level aerial surveys in esker and glacial-fluvial habitat in 2007, 2011, 2012 and 2013 to identify dens that are active and to identify resident carnivore species using the RSA. No wolverine dens were observed during the aerial surveys in the RSA; however, in 2012 two active wolverine dens were found incidentally within rocky boulder habitat and located within 1 km of proposed site infrastructure. One of these dens was active in 2013. In 2007, five active wolf dens were recorded with pups observed at four of the dens in the RSA, one of the wolf dens were located about 40 km from the Goose Property. No wolf dens were found in 2011, and those revisited from the 2007 surveys were unoccupied. In 2012, two active wolf dens were found both greater than 25 km from proposed infrastructure.

Incidental observations of wolverine have been recorded in the RSA between 2001 and 2013. Nearly 20 incidental observations of wolves and pups have been recorded between 2007 and 2012.

Thirty remote cameras located in the RSA in 2012 recorded 51 observations of wolverine between March and April and 74 observations of wolves totaling 92 individuals between late-May/early June to late-August. Several of these detections are likely repeated observations of individuals at the same or multiple cameras

8.4.6.2 Potential Effects

Interactions of wolverine and grey wolf with site preparation components were evaluated to determine which of the following potential effects may occur (Table 8.4-7):

- Habitat loss;
- Disturbance due to noise (e.g., displacement from areas of habitat);
- Disruption to movement;
- Direct mortality and injury from Project activities;
- Indirect mortality (e.g., due to increased access and associated increase in hunting);
- Attraction (e.g., altered inter-species relationships);
- Exposure to contaminants; and
- Reduction in reproductive productivity due to all effects of the Project combined.

Table 8.4-7. Potential Effects to Wolverine and Wolves in the Goose Property Area and the Marine Laydown Area

Site Development Activity	Habitat Loss[1]	Disturbance due to Noise	Disruption to Movement	Direct Mortality and Injury	Indirect Mortality	Attraction	Exposure to Contaminants	Reduction in Reproductive Productivity[2]
All-weather Road	X	X	X	X	X	X		X
Umwelt and Goose Quarry	X	X	X			X		X
All-weather Airstrip Extension	X	X	X	X				X
Ice Road		X	X	X	X			
Temporary Laydown Area		X	X					

8.4.7 Migratory Birds

8.4.7.1 Baseline Summary

Migratory birds including waterbirds and upland breeding birds travel long distances to breed on the Arctic tundra during the short summer season. Migratory birds and their nests are protected under the Canadian *Migratory Birds Convention Act* (1994), the *Canada Wildlife Act* (1985) and the Nunavut *Wildlife Act*.

A total of 24 waterbird species belonging to several species groups including ducks (dabbling and diving), geese, swans, loons, terns/gulls, cranes, jaegers, and grebes were detected during waterbird surveys conducted in the terrestrial and marine RSAs (see Section 5.4.6 of this Chapter) between 2007 and 2012. Of the species recorded, five species of conservation concern listed as “Sensitive” in Nunavut (CESCC 2010) were observed including, long-tailed duck, Arctic tern, glaucous gull, common eider, and king eider.

A much greater number of flocks and birds were observed during staging periods in the survey blocks near the Goose Property. Flocks of birds were well distributed on waterbodies in this area, with the highest abundance of geese observed in the fall of 2012 within 2 km of Goose Lake and Propeller Lake.

Waterbird breeding surveys were conducted during the summer (June and July), when resident birds are laying eggs and rearing young. Very few breeding birds were observed. Long-tailed duck pairs were the most commonly observed, and the majority of pairs occurred in the survey blocks near the Goose Property. Confirmed breeding has been documented for some species in the terrestrial RSA including Canada goose, northern pintail, and sandhill crane. Canada geese were the most commonly detected.

Upland breeding birds are ground-nesting species that include migratory songbirds and shorebirds, and resident ptarmigan. Surveys for upland breeding birds were conducted in 2007, 2011, 2012 and 2013 using the methods established for the Program for Regional and international Shorebird Monitoring (PRISM) and point counts to identify what species are present (including listed species), and to determine territory densities and habitat associations. The numbers and locations of the surveyed PRISM plots were stratified in the RSA in different habitat types. Thirty PRISM plots were surveyed in 2011, 54 in 2012, and 8 in 2013. In addition, 60 point count surveys were conducted in 2013 near the MLA.

Twenty-one upland breeding bird species (10 songbirds, 9 shorebirds, and 2 ptarmigan) were observed in the RSA during PRISM surveys. Ten of these are listed as “Sensitive” in Nunavut due to concern for long term population declines or require special attention or protection to prevent them from becoming at risk. The 10 Sensitive species are: American golden-plover, American pipit, American tree sparrow, dunlin, Harris’s sparrow, hoary redpoll, least sandpiper, red-necked phalarope, semipalmated sandpiper, and white-crowned sparrow. Songbirds were detected on average five times more often than shorebirds and ptarmigan. Breeding evidence was confirmed for nine species. The Lapland longspur was the most commonly detected species, and combined with the savannah sparrow, made up approximately 78% of all songbird territories recorded. The American tree sparrow was the most common “Sensitive” species recorded.

Three distinct habitat communities were noted for songbirds. One community, which includes the savannah sparrow, is primarily associated with wet habitat types such as wetlands and sedge meadow. A second community, including the American tree sparrow and white-crowned sparrow was associated with moist habitats with tall shrubs, and a third group of birds was associated with dry, upland, heath habitat including species such as the horned lark, American pipit and Harris’s sparrow. Shorebird species, except the American golden plover, were observed more often associated with moist and wet habitat. Ptarmigan were predominantly observed in dry and moist habitat types.

8.4.7.2 Potential Effects

Interactions of migratory birds with site preparation components were evaluated to determine which of the following potential effects may occur (Table 8.4-8):

- Direct habitat loss;
- Disturbance (e.g., displacement, behavioural effects leading to negative energetic balance, physiological stress);
- Disruption to movement;
- Direct mortality and injury from Project activities;
- Indirect mortality due to increased access and associated increase in hunting;
- Attraction;
- Exposure to contaminants; and
- Reduction in reproductive productivity due to all potential effects of the Project combined.

Table 8.4-8. Potential Effects to Migratory Birds in the Goose Property Area and the Marine Laydown Area

Site Development Activity	Habitat Loss[1]	Disturbance	Disruption to Movement	Direct Mortality and Injury	Indirect Mortality	Attraction	Exposure to Contaminants	Reduction in Reproductive Productivity
All-weather Road	X	X		X	X	X		X
Umwelt and Goose Quarries	X	X		X	X	X		X
Winter Road								
All-weather Airstrip Extension	X	X		X	X	X		X
Temporary Laydown Area		X						

8.4.8 Raptors

8.4.8.1 Baseline Summary

Nine raptor species (including Common Ravens which are considered a "functional" raptor) are known to occur in the Project area (Rescan 2013a). Of these, five species have special conservation status (Table 8.4-9). These species are considered Special Concern and/or Sensitive since their populations may become threatened or endangered because of a combination of its biological characteristics and identified threats, and or, may require special attention or protection to prevent them from becoming at risk.

Table 8.4-9. Raptor Species with Special Conservation Status in the Project Area

Common Name	Scientific Name	Conservation Status*
Golden Eagle	*Aquila chrysaetos*	Territorial Rank = Sensitive COSEWIC = Not At Risk
Gyrfalcon	*Falco rusticolus*	Territorial Rank = Sensitive COSEWIC = Not At Risk
Rough-legged Hawk	*Buteo lagopus*	Territorial Rank = Sensitive COSEWIC = Not At Risk
Peregrine Falcon	*Falco peregrinus anatum/tundrius*	Territorial Rank = Secure COSEWIC = Special Concern SARA = Special Concern Schedule 1
Short-eared Owl	*Asio flammeus*	Territorial Rank = Sensitive COSEWIC = Special Concern SARA =Special Concern Schedule 1

* (Canadian Endangered Species Conservation Council (CESCC) 2012; COSEWIC 2013; Government of Canada 2012)
Committee on the Status of Endangered Wildlife in Canada (COSEWIC)
Species at Risk Act (SARA)

In 2012, a total of 124 raptor nests were detected and monitored in the Project RSA. In the vicinity of the Goose Camp and proposed road infrastructure, one (1) nest occupied by a gyrfalcon pair was located on the western edge of Goose Lake, approximately 100 to 300 m away from the proposed all-weather road alignment (Figure 8.4-2). In May 2012, eggs were reported in this nest; however, by July 2012 the nest was considered unproductive (Rescan 2013a). No other raptor nests are known within 5 km of the proposed all-weather road alignment and existing quarry (Rescan 2013a). Throughout the region, raptor nest success (where known) was estimated at 77% (Rescan 2013a).

LEGEND

- Gyrfalcon Nest (Unproductive, 2012)
- Proposed Access Road
- Winter Road
- Proposed Site Preparation Quarry
- Existing Quarry
- Water Crossing / Culvert Location

NOTES
Base data source:
Imagery from Sabina (2006/2011)
Infrastructure provided by
JDS Energy and Mining Inc. (2014)
Realignment from
SRK Consulting (2014)

STATUS
ISSUED FOR REVIEW

SABINA BACK RIVER PROJECT, NUNAVUT

Location of Gyrfalcon Nest in relation to the All-weather Access Road

PROJECTION	DATUM	CLIENT
UTM Zone 13	NAD83	Sabina GOLD & SILVER CORP.

Scale: 1:15,000
200 100 0 200
Metres

FILE NO. V15103033-02_Figure8-4-2_Gyrfalcon.mxd

PROJECT NO.	DWN	CKD	APVD	REV
V15103033-02	MEZ	SL	DM	0

OFFICE	DATE
Tt EBA-VANC	October 8, 2014

Figure 8.4-2

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8.4.8.2 Potential Effects

Interactions of raptors with Project components were evaluated to determine which of the following potential effects may occur (Table 8.4-10):

- Direct habitat loss;
- Disturbance (e.g., displacement, behavioural effects leading to negative energetic balance, physiological stress);
- Disruption to movement;
- Direct mortality and injury from Project activities;
- Indirect mortality due to increased access and associated increase in hunting;
- Attraction; and
- Exposure to contaminants.

Table 8.4-10. Potential Effects to Raptors in the Goose Property Area and the Marine Laydown Area

Site Development Activity	Habitat Loss[1]	Disturbance	Disruption to Movement	Direct Mortality and Injury	Indirect Mortality	Attraction	Exposure to Contaminants
All-weather Road		X		X		X	
Umwelt and Goose Quarries		X		X		X	
All-weather Airstrip Extension		X		X			
Winter Road							
Temporary Laydown Area							

8.4.9 General Wildlife Potential Effects and Mitigation

The following section outlines best management practices to eliminate or minimize the more important effects of site preparation activities on wildlife. This is summarized in this manner as many of the mitigation measures recommended are similar across species.

8.4.9.1 Mitigation for Habitat Loss

Mitigation measures specific to reducing or eliminating the effects of habitat loss to wildlife may include the following:

- Project infrastructure designed to avoid, where possible, identified wildlife sensitive areas such as caribou calving grounds and caribou high use areas; and
- Consideration of the location of windbreaks to minimize dustfall, to reduce habitat degradation for wildlife.

8.4.9.2 Mitigation for Disturbance

Wildlife specific measures to minimize the effect of disturbance to wildlife may include:

- Pre-construction ground clearing conducted outside of sensitive periods where possible to reduce disturbance;
- Managing above ground blasting (see Quarry Management Plan, Appendix F of the Site Preparation Application Package) activities if large groups of female caribou with young (> 100 animals) occur within 500 m (or line of sight) of the site, until caribou pass through the area to minimize sensory disturbance to caribou;
- Ground-based observations for caribou conducted prior to blasting during the calving and post-calving periods if incidental observations from helicopters indicate that caribou are in the area;
- Above ground blasting scheduled outside of the peak periods of Bathurst caribou presence in the Project area, where possible;
- Vehicles restricted to site roads, winter roads and quarry footprints during construction and operations to avoid unnecessary disturbance to wildlife habitat;
- Helicopters will remain above prescribed flight altitudes when possible, as recommended in the draft caribou protection measure guidelines. Landing and takeoff will only be conducted when herds of caribou are not present in the immediate area; and
- Pilot education to instruct pilots as to the negative effects of overflights on wildlife species and maintaining a minimum prescribed altitude, when possible, wherever wildlife species are observed.

8.4.9.3 Mitigation for Disruption to Movement

Mitigation for disruption of movement involves minimizing the number of trips on the road, including the all-weather road. This can be done by using the largest trucks feasible in order to maximize loads.

8.4.9.4 Mitigation for Direct Mortality and Injury

Measures to minimize the effect of mortality and injury may include:

- Truck speed limits developed, signage installed to alert drivers of speed limits, and enforcement of speed limits to reduce vehicle-related mortality and injury to caribou (See Transportation Management Plan, Appendix G of the Site Preparation Application Package);
- Wildlife will be given the right-of-way on all roads at all times;
- Stopping trucks when groups of caribou are crossing the road to allow small groups (< 10) or individual wildlife standing on the road to move off the road unalarmed; and
- Participation by all contractors and employees working on the Project with the Project orientation. Access road restrictions and operating protocols (e.g., wildlife right-of-way, speed limits, check-ins, and road-wildlife reporting programs) covered during the education/orientation.

8.4.9.5 Mitigation for Indirect Mortality

Measures to minimize the effect of mortality and injury to wildlife may include:

- Access road closed to the public including private vehicles (snowmobile, all-terrain vehicles, etc.) and all foot traffic, and road use restricted only to persons required for construction, operations and maintenance; and
- A policy prohibiting hunting by Project staff and contractors while on site and enforced to prevent an increase in mortality to wildlife.

8.4.9.6 Mitigation for Attraction

The following mitigation measures and best management practices may be applied to minimize the effects of attraction:

- A policy of no feeding and no intentional attraction of wildlife developed, and disseminated to all Project and contractor employees during employee orientation and enforced;
- Management of wastes in accordance with the Waste Management Plan (Appendix D of the Site Preparation Application Package);
- A policy of no littering developed and disseminated to all Project and contractor employees during employee orientation, continued throughout the life of the Project, and enforced; and
- A protocol for human-wildlife interactions developed and disseminated to all employees and contractors as part of orientation with lead management responses undertaken by identified supervisors, wildlife biologists and conservation officers.

8.4.9.7 Mitigation for Exposure to Contaminants

Mitigation and management measures to minimize the potential for effects to wildlife from contaminants due to Project infrastructure, activities, or emissions in:

- Use of wildlife-attracting dust suppressants avoided wherever possible;
- Site roads and winter roads closed to the public and restricted to only persons required for the constructions, operation, and maintenance of the Project;

- A policy of no feeding and no intentional attraction of wildlife developed and disseminated to all Project and contractor employees;
- A no-littering policy developed, to minimize exposure of wildlife to contaminants that may be found in either the product or packaging;
- Management of wastes in accordance with the Waste Management Plan (Appendix D of the Site Preparation Application Package); and
- Appropriate measures taken to exclude wildlife from areas where water or waste could pose a risk to wildlife.

8.4.10 Specific Wildlife Mitigation Measures

Recommended mitigation measures include:

- Implement the following mitigation measures to minimize potential effects at the known raptor nest site:
  - Restrict road construction and blasting/crushing operations to outside sensitive raptor nesting seasons, particularly for Gyrfalcons (late-April for early nesting species such as gyrfalcons to late August for later nesting species).
  - Monitor the known nest site during the nesting season as part of the overall wildlife effects monitoring program.
- Implement the following mitigation measures to minimize potential effects at the known wolverine den site:
  - Monitor the known wolverine den near the proposed road alignment prior to construction to determine occupation.
  - Commence road construction as early as possible (given appropriate freeze conditions and other engineering constraints) prior to the natal denning period (February) to encourage relocation to another den site before parturition (if occupying the known den site).
  - Maintain the monitoring program at the known den site when construction operations are within 2 km of the den and as part of the overall wildlife effects monitoring program.
  - Continue open discussions with Nunavut Department of Environment associated with the wolverine den monitoring program throughout the pre, during, and post-construction operations.
- Establish a warning system to drivers when wildlife are along or near the road, and temporary road closures when caribou and muskox with calves are within 500 m of the road during post-calving season (June to late-July); and
- Monitor the effectiveness of mitigation to avoid or minimize negative effects to species with special conservation status during the overall wildlife effects monitoring program.

8.5 Freshwater and Marine Environment

VECs or subjects of note identified for the Freshwater and Marine Environment include Surface Hydrology, Groundwater, Water Quality, Sediment Quality, Fish/Aquatic Habitat and Fish Community. For the works proposed for site preparation in 2015, potential effects were identified include Surface Hydrology, Water Quality,

Sediment Quality and Fish/Aquatic Habitat for the Freshwater and Marine Environment. Freshwater Fish and Fish habitat is discussed separately in Section 8.6.

The freshwater environment is characterized by extensive networks of lakes and streams within a hummocky landscape with low elevation relief and exposed bedrock uplands. Winter is characterized by extreme cold (mean monthly temperatures -33°C), and ice cover is present on lakes between October and July. Air temperatures are highest in July, reaching a mean monthly temperature of 14°C. Regional meteorological stations report total annual precipitation between 125 mm (2009) to 344 mm (2007) for the interval 2006 to 2012. Ice depths on waterbodies are typically 1.5 to 2 metres thick, and shallow waterbodies (< 1.5 m) freeze to the bottom.

Hydrology is snowmelt dominated, with peak flows occurring from early May to mid-June in most watersheds. Occasional rainfall-driven high flow events may occur between June and September. The climate and the presence of permafrost results in one major flood period (freshet) in June, followed by a rapid return to base flow and peak flow events throughout the rest of the summer and early fall periods in response to storms. Winter flow is absent because of negligible groundwater reserves outside of the permafrost and a lack of unfrozen surface water. Streams are generally small and shallow and tend to have low flow and low water levels during summer. Many streams are ephemeral, flowing only during freshet.

8.5.1 Surface Hydrology

The discussion and assessment of effects of the proposed site preparation activities is confined to the Goose Property, as no interactions between surface hydrology and activities at the MLA are anticipated.

8.5.1.1 Baseline Summary

Project infrastructure for the Goose Property is within the Ellice River Watershed, while the MLA is located on a narrow strip of land that drains directly to the west side of Bathurst Inlet. The Ellice River drains an area of 16,900 km^2 into the Arctic Ocean. It winds 287 km north from its headwaters between Beechey Lake and Pelly Lake to its mouth at Queen Maud Gulf. The Western River drains an area of 4,034 km^2 north to Bathurst Inlet approximately 80 km from the MLA. The Back River Watershed, which lies to the south of the Project, drains an area of 106,500 km^2 and flows more than 974 km northeast to its mouth at Cockburn Bay on the Arctic Ocean in the eastern portion of the Kitikmeot Region, south of Gjoa Haven.

The Project lies within the continuous permafrost zone of the continental Canadian Arctic. The presence of permafrost is hydrologically significant, as it has very low hydraulic conductivity, and thus acts as a barrier to deep groundwater recharge. This physical restriction tends to increase surface water runoff and decrease sub-surface flows.

Compared to non-permafrost regions, permafrost watersheds tend to have higher peak flow and lower base flow (Kane 1997). Streamflow in the continuous permafrost zone is dominated by high, snowmelt-driven flows in spring (the freshet), after which flow declines throughout the summer and early fall, with the exception of rare and episodic rainfall-generated runoff (Church 1974). Base flow is low, and is supported primarily by inputs from the shallow upper active layer of the soil profile, which is the only portion of the soil profile that thaws in the summer months.

Channel freeze-up typically occurs between late October and early November. In smaller drainage basins, stream channels typically freeze to their bottom, with zero flow occurring in winter. In very large catchments, and larger lake outlets, flow energy and water turbulence may be sufficient to maintain streamflow and prevent downstream reaches from freezing completely.

The Goose Property has approximately 18% lake coverage, an average ground slope of 1.4%, and a total relief of 85 m. The gauged channels within the study area range from small ephemeral channels, less than 1 m in width, to larger rivers with widths exceeding 50 m.

The hydrometric monitoring network in the Goose Property consisted of two stations in 2010, and was expanded to 9 stations in 2011, 12 stations in 2012 and 17 stations in 2013. (Table 8.5-1). The 2010 data were not used in the hydrologic analyses due to its limited temporal (July to September) and spatial (two stations) coverage.

The hydrologic regime in the Goose Property is characterized by the Arctic nival flow regime. Most streams experienced zero or extreme low flow conditions in August during the open-water period. Flow duration analysis demonstrated that, on average, there was streamflow during 30% of the year for most of the monitored streams.

8.5.1.2 Potential Effects

The following site preparation activities could have potential interactions with the VEC surface water hydrology and affect the quantity of water used, streamflows, and lake volumes:

- Water Use. Water withdrawals from Goose Lake for domestic and industrial uses are planned during the site preparation. These activities could affect the quantity of water used, streamflows, and lake volumes;
- Stream Diversions at Rascal Stream East – please see Appendix K for an analysis of effects; and
- Modification of Natural Drainage; road construction, airstrip construction and quarry development can all alter natural drainage patters.

8.5.1.3 Identification of Mitigation and Management Measures

Mitigation measures that will either eliminate or reduce the effects of the Project activities on surface water hydrology include the following:

- Water withdrawal will follow Fisheries & Oceans Canada's (DFO's) Protocol for Winter Water Withdrawal from Ice-covered Waterbodies in the Northwest Territories and Nunavut (DFO 2010) and DFO's Operational Statement on Mineral Exploration Activities (DFO 2009). That is, the quantity of water used will be within the thresholds identified in these DFO documents;
- Water management measures as described in the Transportation Management Plan (Appendix G of the Site Preparation Application Package) will be implemented;
- Site preparation infrastructure at the Goose Property will be confined to the local watersheds; and
- These watersheds are not within the regional Upper Back River Watershed, thereby confining potential changes to water quantity (hydrology) to the local drainage areas.

8.5.2 Water Quality

Water quality and sediment quality are assessed together in the following section as the potential negative effects to both water and sediment quality are related to the same project activities, with mitigation measures also being the same. Thus, mitigating the effects requires the same management activities.

8.5.2.1 Baseline Summary

Freshwater baseline studies have been carried out in the Project area since 1993, with the most continuous sampling from 2010 to 2013. Baseline studies were conducted from 2010 and 2013. Results from site-specific data indicate that lakes in the area have slightly acidic to alkaline pH waters, ranging from 6.3 to 8.3 (Rescan 2012a).

Dissolved oxygen concentrations are typically above Canadian Council of Ministers of the Environment (CCME) guidelines for the protection of aquatic life in early life stages (9.5 mg O_2/L) but some lakes naturally have lower oxygen levels during the winter or summer. Lakes are very clear with low turbidity values, and generally have low nutrient concentrations (e.g. ammonia and nitrate are considerably lower than the CCME guidelines). Based on the CCME recommended trigger ranges for total phosphorus, most lakes would range from ultra-oligotrophic to mesotrophic.

Metal concentrations in lakes are generally low, and tend to be lower in the summer than in winter. Metal concentrations are below CCME guidelines for the protection of freshwater quality life, with the exceptions of aluminum, arsenic, chromium, cadmium, and copper. These metals can show naturally elevated concentrations, sometimes near or just above the CCME guidelines, depending on the location and season of sampling. Aluminium and copper are the metals that are most frequently found naturally elevated

Results from site-specific data indicate that streams in the area have similar water quality to lakes, with the exception of having more occurrences of naturally elevated metal concentrations. Copper was the metal that was most frequently found to be naturally elevated in streams.

Baseline water quality data are available from southern Bathurst Inlet from 2007, 2008, and 2012 to 2013. Historical information is also available from 2001.

The water of southern Bathurst Inlet is typical of pristine Arctic marine waters, with low concentrations of nutrients, suspended solids, and metals. Nutrients are higher in the winter and lower or depleted in the summer when they are being used by phytoplankton. Nitrate concentrations are near or below detection limits in the summer, while phosphorus concentrations are still measureable in surface waters (> 0.01 mg P/L). Southern Bathurst Inlet is considered oligotrophic based on phytoplankton biomass levels.

Metal concentrations in southern Bathurst Inlet are generally below the CCME guidelines for the protection of marine aquatic life and often undetectable. Near-shore sites near river outflows or in regions of shallow bathymetry sometimes have elevated levels of suspended material and metal concentrations. Metals which have been found to be naturally elevated above CCME marine guidelines in a small subset of samples include cadmium, chromium, and mercury.

Baseline sediment quality data are available from the area from 2007 to 2013. The sediment of lakes and streams is typical of pristine Arctic freshwater systems.

Results from site-specific data indicate that sediments tended to be moderately to slightly acidic. The organic content of the sediments in both lakes and streams tended to be low. Lake sediments were composed of silt and sand particles, with the larger gravel and the smaller clay particles generally comprising <15% of the total. Stream sediments tended to be dominated by larger sand and gravel particles.

Lake sediments have naturally elevated metal concentrations that are often greater than CCME guidelines for arsenic, cadmium, chromium, copper, and/or zinc. The majority of lakes that have been sampled have sediment arsenic concentrations greater the CCME interim sediment quality guideline (ISQG), and many lakes have sediment arsenic concentrations greater than the CCME probable effect level (PEL) guideline.

Stream sediments have naturally elevated metal concentrations that are often greater than CCME guidelines for arsenic, cadmium, chromium, and copper. Similar to lakes, stream sediment arsenic concentrations are naturally elevated.

The sediment quality in Bathurst Inlet has been sampled in 2001, 2002, 2007, 2010, 2012, and 2013. Sampling near the proposed MLA was conducted in 2013. The sediments of Bathurst Inlet are heterogeneous as a result of local physical processes. Sediments ranged from sandy (>90% sand particles) through loose clay-silt sediments (70% clay with the remainder silt). Sand tends to predominate in the shallower sites (<5 m), with silts and clays become more frequent in the deeper near-shore sites.

Marine sediment metal concentrations are generally below the CCME interim marine sediment quality guidelines. However, near-shore sites with high silt/clay content frequently have naturally elevated concentrations of arsenic, chromium, and copper, with elevated levels of arsenic and copper being the most common. Marine sediment metal concentrations have not been found to be greater than the CCME marine probably effect level guidelines which are higher than the marine interim sediment quality guidelines.

8.5.2.2 Potential Effects

Construction and Use of Site Preparation Infrastructure

Excavation required to construct site preparation infrastructure has the potential for effects on freshwater water quality. The primary pathway for these potential effects would be runoff. This would occur primarily during snowmelt and freshet in the spring, during precipitation events in the summer and fall, and would be absent in the winter. Some in-water or near-water activities required during site preparation also carry the potential for effects on water quality. Additional effects may occur via dust deposition.

The pathway of interaction between quarries and the freshwater environment is through runoff, and this may occur during site preparation. Contact water in quarries may transport metals and suspended sediments into the freshwater environment. Runoff from quarries could affect the VEC freshwater water quality by changing pH (interaction with surficial material), and contributing TSS (erosion), metals (TSS and dissolution), nutrients (contact with blasting residues), and hydrocarbons (mechanical use of fuel, oil, and grease) into the freshwater environment.

Geochemical characterization of the Umwelt quarry was carried out in 2014 to determine the suitability of the material for construction purposes. In general, these results indicate that the majority of the upper greywacke samples representing the proposed quarry areas within the Umwelt pit are classified as non-PAG or low S material with a limited potential for ARD. Additionally, based on low solid phase arsenic concentrations, metal leaching is unlikely to be an issue. For these reasons, upper greywacke from the proposed Umwelt quarry area is considered suitable for use in construction. Details are presented in Appendix A.

Ammonium nitrate (AN) and fuel oil (FO) will be used as the explosive for quarries and possible road and airstrip construction. Both components of the ANFO explosive have the potential for effects on freshwater water quality—AN dis-associates in water into ammonia and nitrate and FO is a mixture of petroleum hydrocarbons. The pathways of interaction between explosives and the freshwater environment are runoff and aerial deposition. Runoff and deposition of explosives (or blasting residues) into the freshwater environment can affect water quality by increasing the concentrations of ammonia, nitrate, and petroleum hydrocarbons.

Fuels, Oils, and PAH

The primary pathways of interactions between these sources of hydrocarbons and the freshwater environment are runoff and aerial deposition. The primary pathway for contamination in the marine environment are spills during barge transport to the TLA. Activities at facilities, laydown areas, fuel storage areas, and waste management areas can deposit hydrocarbon compounds, such as oil or grease, onto surfaces that can subsequently be transported into freshwater environments in runoff.

Combustible waste, including the solids from sewage treatment, will be combusted using an incinerator. Incomplete combustion can create airborne hydrocarbons that can be deposited into freshwater environment via deposition or runoff.

8.5.2.3 Mitigation and Management

The Project will minimize runoff and the transport of material into the freshwater environment by the following planning and design measures:

- Infrastructure will be located, whenever feasible, on competent bedrock or appropriate base material that will limit permeability and the transport of potentially lower quality water into the active layer and ultimately to the freshwater environment;
- Water management measures as described in the Transportation Management Plan (Appendix G of the Site Preparation Application Package) will be implemented;
- Infrastructure will be designed to minimize the footprint area, such as being located near the deposits; and;
- Restoration of the landscape will occur as soon as possible to minimize erosion potential.

Activities undertaken will use Best Management Practices (BMP) drawn from governmental organizations and specific Arctic experience to minimize erosion. Temporary stream crossings will be constructed according to the DFO Nunavut Operational Statement for Temporary Stream Crossings (Fisheries and Oceans Canada 2009). In-water work will be conducted during approved timing windows presented in the DFO Nunavut Operational Statement for Timing Windows (Fisheries and Oceans Canada 2009). Only geochemically suitable rock quarries and borrow sources (i.e., using non-potentially acid-generating rock) will be used to construct the road, pads, and structures. Exposed landscape surfaces will be protected, where possible, by the installation of covering material like riprap, aggregate, or rolled erosion control products. Runoff flow may be controlled by a combination of measures, including:

- Slope texturing/grading to slow runoff and reduce effect slope lengths;
- Installation of synthetic permeable barriers and/or fibre rolls to reduce runoff velocities and retain sediments; and
- Check dams, gabions, and energy dissipation structures to reduce flow velocities in channels.

Sediment levels in runoff will be minimized, where applicable, by intercepting sediment before it reaches the freshwater environment. In addition to measures aimed at controlling runoff flow, the quantity of transported material in runoff may be controlled by measures including:

- Preservation of riparian zones to trap sediment and to reduce flow velocities;
- Installation of synthetic permeable barriers, fibre rolls, and/or silt fences as required;

- Installation of check dams, gabions, and sediment basins to reduce flow velocities and encourage sediment deposition; and
- Refuelling and maintenance activities will not occur, were possible, within 30 m of a watercourse or waterbody except where required due to equipment breakdown or approved activities near water.

Potential effects from explosives will interact with the freshwater environment through the runoff and aerial deposition pathways. Deposition of explosives and blasting residues on surfaces, with the subsequent possibility of transport in runoff to freshwater environments, will be mitigated and managed by:

- Storing explosive products in accordance with Territorial and Federal regulations (1990; C.R.C., c. 599);
- The handling and manufacture of explosives will be contracted to a licensed operator;
- Runoff from explosive storage and manufacture facilities will be intercepted and collected before reaching the freshwater environment ; and
- BMP will be adopted for blasting and the handling of explosives to avoid spillage and minimize ammonium and nitrate residues after blasting.

The mitigation and management measures for runoff are focused on preventing hydrocarbons from being transported in runoff and may consist of the follow measures:

- Machinery will be routinely inspected for leaks and refuelling will occur, when feasible, at a designated refuelling point with drainage capture/collection installed. In the event that refuelling occurs elsewhere, drip trays may be used under vehicles and equipment;
- Appropriate secondary containment systems will be used for petroleum product storage tanks to prevent spills and releases to water, including the prevention of diesel release from pickups carrying tidy-tanks. Storage of fuel at the TLA will be done using double wall storage tanks;
- Bulk fuel storage areas and hazardous materials storage areas will be bermed and lined with impermeable barriers to minimize leaks and spills; and
- Oily water treatment plants at equipment maintenance facilities will be used to minimize water and surface hydrocarbon compounds.

In the event that hydrocarbons are transported in runoff, runoff from camp pads, laydown areas, and waste management areas will be directed to the water management structures and will not be discharged into the freshwater environment. Prior to the completion of the water management infrastructure during Site Preparation, runoff will be collected in sumps and discharged only if it meets water quality standards.

8.6 Fish and Fish Habitat Assessment

8.6.1 Baseline Summary

The Goose Property contains many lentic waterbodies that range in size from large lakes to small ponds and wetlands. Most lakes in the region feature littoral habitat well suited for northern fish species, i.e., shorelines dominated by mixed rock, with occasional outcrops of bedrock (Rescan 2013c). However, deeper lake areas (> 2.5 m depth), which serve as fish overwintering habitat, are uncommon in the Goose Property and may limit fish population sizes in many lakes and ponds (Rescan 2013c). The maximum depth of most lakes averages

between 4 and 6 m. Most of the lakes surveyed support fish spawning, rearing, and feeding, with fewer supporting overwintering.

Pond habitat in the Goose Property is generally shallow and many of the ponds featured ephemeral inflows or outflow that would limit fish migration into and out of these waterbodies. Owing to their shallow depths, these ponds freeze all the way to the bottom in winter, making them unsuitable for overwintering habitat.

Umwelt Lake is in the Llama watershed, upstream of Goose Lake and downstream of Llama Lake. The lake is relatively shallow, with a maximum depth of 3.0 m that limits the potential area for fish overwintering as much of the lake freezes to the bottom during winter. Mixed rock shorelines may provide spawning and rearing habitat for Arctic Grayling, and fish may use the lake for summer spawning, rearing and feeding. The limited connection and low flow between Umwelt Lake to Llama and Goose lakes late in summer indicates that Arctic Grayling do use Umwelt to overwinter. The deeper areas of the lake are dominated by sandy substrate. In many places, the transition between rocky shoreline substrate and sandy lake bottom is abrupt.

Goose Lake is the lake most central to proposed infrastructure for the Goose Property. This lake, along with many other lakes and streams in the immediate area, has been surveyed for fish from 1997, and 2007 to 2013. Fish have been present in all lakes that have been sampled to date. However, some of the shallow ponds are not fish-bearing due to their shallow depth and ephemeral connectivity to other waterbodies.

For the Goose Property, lake and stream freshwater fish communities consist of nine species, with Lake Trout and Arctic Grayling being the most numerous. The species that have been found in lakes by site-specific baseline studies include Lake Trout (Salvelinus namaycush), Round Whitefish (Prosopium cylindraceum), Lake Cisco (Coregonus artedi), Longnose Sucker (Catostomus catostomus), Ninespine Stickleback (Pungitius pungitius), and Lake Whitefish (C. clupeaformis). The species that have been found in streams are Arctic Grayling (Thymallus arcticus), Slimy Sculpin (Cottus cognatus), and Burbot (Lota lota) (Rescan 2013c, Rescan 2013d, Rescan 2013e, Rescan 2014a, Rescan 2014b).

8.6.2 Potential Effects

The proposed alignment of the all-weather road will cross four watercourses, three of which are fish bearing. As well, the airstrip extension will result in the realigning of Rascal Stream East, This report provides a fish and fish habitat description of each crossing site based on existing information, and an evaluation of the potential habitat quality at each location. Figure 5.0-2 identifies the locations of the four proposed watercourse crossings.

8.6.2.1 Gander Pond Inflow Stream

The road is proposed to cross the Gander Pond Inflow stream approximately 200 m upstream of Gander Pond. Under high water conditions, which generally exist during freshet, this stream consists of poorly defined banks and multiple channels. Under low flow summer conditions, the bank-full width is about 1.5 m.

The stream morphology can be described as riffle-glide-pool, although pools tend to be shallow. The substrate is dominated by boulder and cobble; cover consists of in-stream vegetation and boulders. Photo 8.6-1 provides a view of the Gander Pond Inflow stream under freshet conditions (Rescan 2012b).

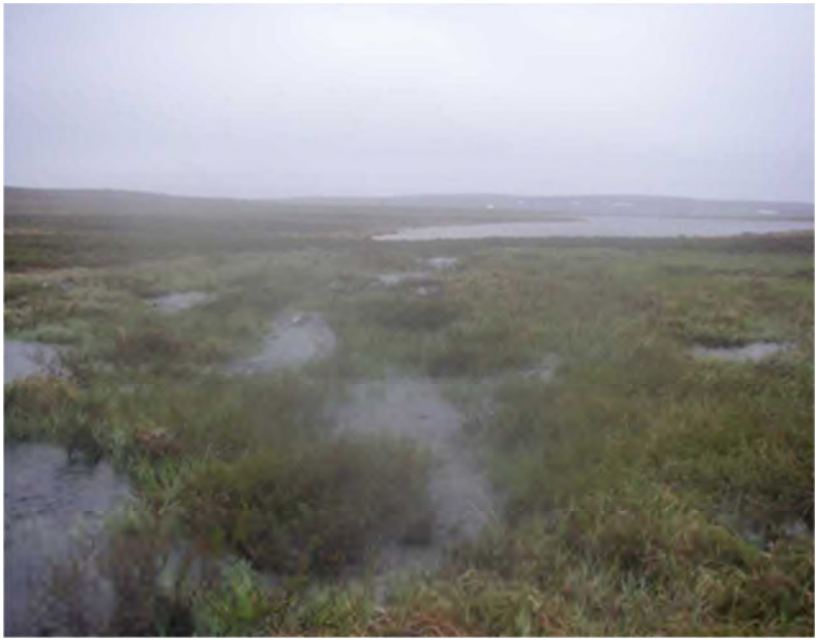

Photo 8.6-1. Gander Pond Inflow Stream, looking downstream toward Gander Pond

Electrofishing was carried out in the Gander Pond Inflow stream in June, 2011 and again in June, 2013. Only one slimy sculpin (*Cottus cognatus*) was observed during the 2011 sampling and no fish were captured during the 2013 survey. It is important to note that Gander Pond is very shallow with a maximum depth of 0.5 m. As such, this pond provides no overwintering habitat opportunities and generally has very limited fish habitat potential. The outflow stream from Gander Pond has also been electrofished and no fish were captured or observed.

Gander Pond Inflow stream provides suitable rearing habitat conditions for small bodied forage fish (e.g. sculpin), although limited overwintering and spawning habitat likely restricts the productive capacity for these fish. While Arctic grayling (*Thymallus arcticus*) may have the potential to ascend The Gander Pond Inflow Stream from Goose Lake via Gander Pond, access by these fish is unlikely due to the minimal availability of suitable spawning gravels and the steep decline in flows following freshet, which commonly occurs in small streams in this area (Rescan 2012a). Analysis of 2012 data from the streamflow gauge installed at the downstream end of the Gander Pond Outflow stream indicated that flow was present in the stream only 31% of the year, with almost all of the flow occurring in June.

Due to poor habitat and flow conditions in the Gander Pond Inlet Stream, a culvert at this site is not expected to result in a HADD and/or a significant change in habitat productive capacity, provided that the culvert is sized and installed to provide fish passage during June and July, to accommodate fish migrations should this occur.

8.6.2.2 Echo Lake Outflow Stream

The Echo Lake Outflow Stream is a small watercourse that drains Echo Lake, which is approximately 1.5 km upstream of the proposed road crossing location. The drainage area of this system is very small, 1.4 km^2. Echo Lake has a depth of less than one metre. Field observations have shown that the Echo Lake Outflow Stream goes dry in the summer, as shown in Photo 8.6-2.

Photo 8.6-2. Gander Pond Inflow Stream, looking downstream toward Gander Pond

Analysis of water quality samples collected from the Echo Outflow Stream during freshet conditions indicates relatively poor water quality conditions in this stream. Mean pH levels were lower than 6.0, which is below the level set by the Canadian Council of Ministers of the Environment (CCME) for the protection of aquatic life. In addition, water samples had concentrations of aluminum, cadmium and copper that exceeded CCME guidelines (Rescan 2012a).

Existing information indicates that this stream is ephemeral, has poor water quality when flowing, and does not provide any overwintering or rearing habitat. As such, no fish or fish habitat concerns are indicated for the construction of a road culvert crossing at this location.

8.6.2.3 Umwelt Lake Outflow Stream

The Umwelt Lake outflow stream drains Llama Lake, Umwelt Lake, Rabbit Lake, and Fox Lake before emptying into the western, narrow end of Goose Lake. At the location of the proposed road crossing (Figure 5.0-2) the stream flows through a wide (up to 200 m) scoured canyon and can be characterized as a boulder garden, with little surface flow occurring past July, as shown in the hydrograph for this stream (Figure 8.7-1) (Rescan 2012a).

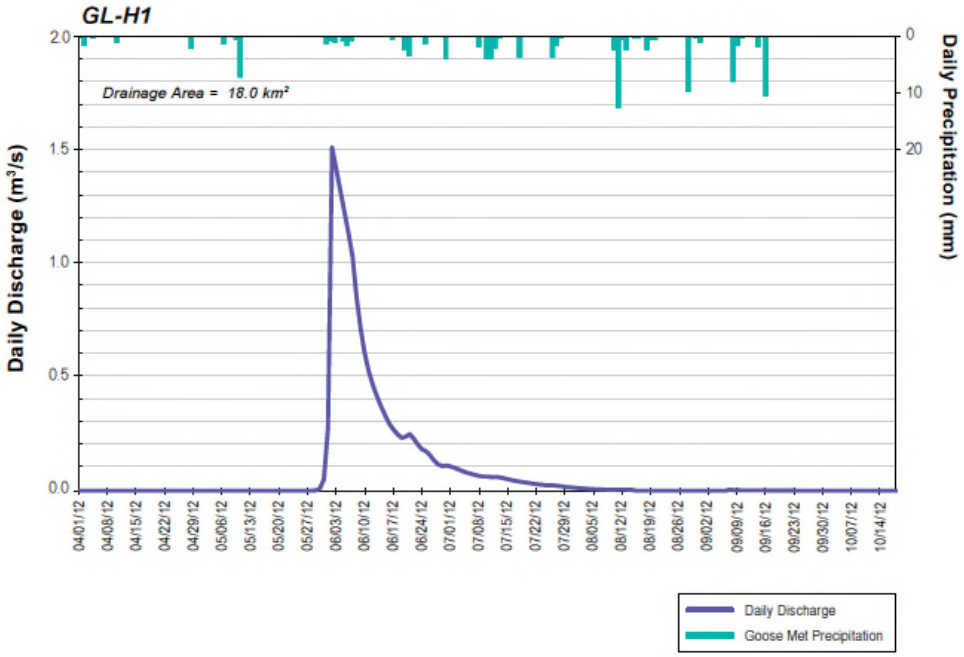

Figure 8.6-1. Hydrograph for 2012 for the Umwelt Outflow Stream based on a stream gauge located 100 m upstream from Goose Lake.

A 4 m high boulder barrier exists approximately 100 m upstream of the inflow to Goose Lake (Photo 8.7-3) and almost 900 metres downstream of the road crossing. This barrier results in a complete obstruction to upstream and downstream fish passage (Rescan 2012a, Rescan 2012b). Even in the absence of this barrier, fish passage and fish utilization in the area of the road crossing is unlikely due to dispersed, subsurface and ephemeral flow conditions.

The above stream characteristics preclude fish use and fish passage in the area of the proposed stream crossing. As such, no fish or fish habitat issues or concerns are indicated at this site.