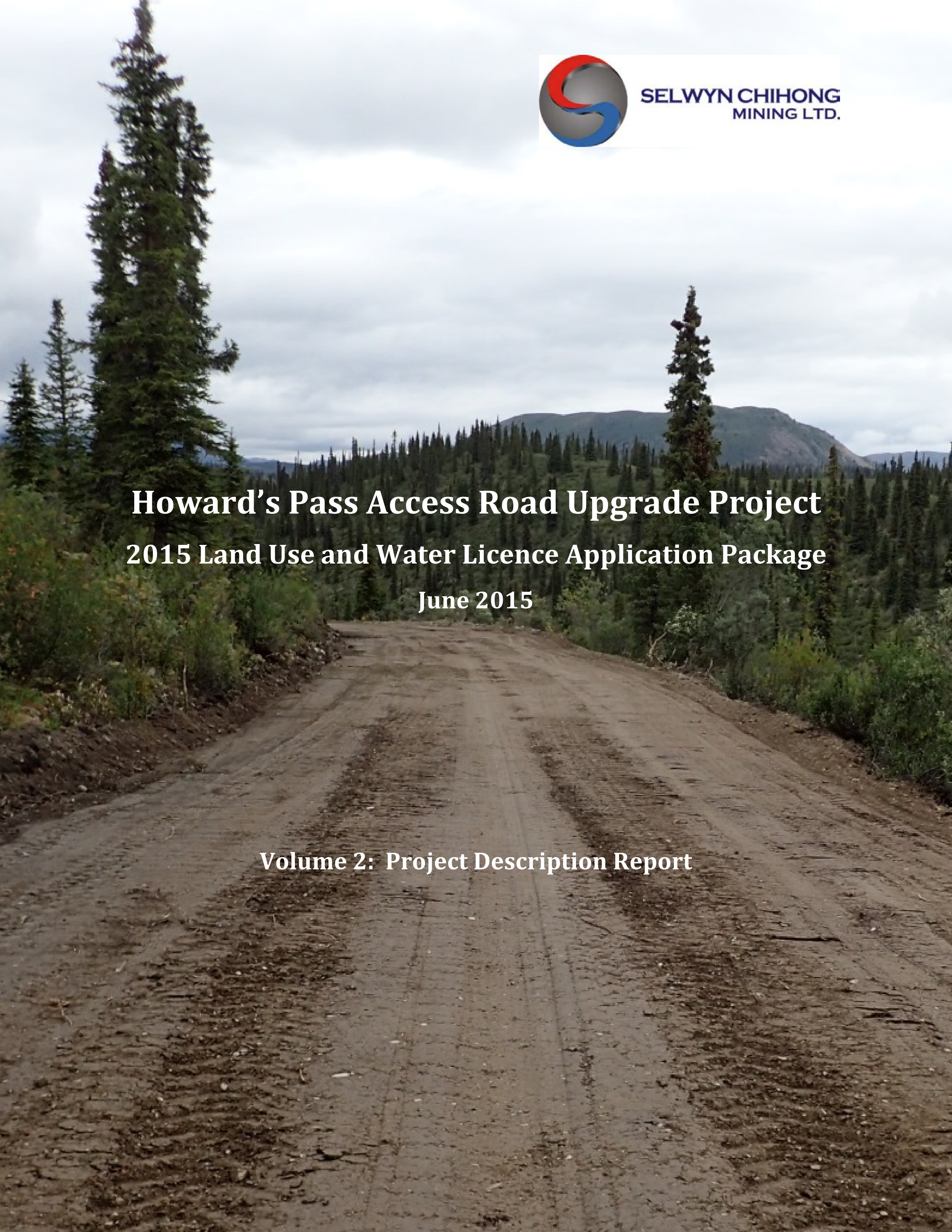

SELWYN CHIHONG MINING LTD.

Howard's Pass Access Road Upgrade Project

2015 Land Use and Water Licence Application Package

June 2015

Volume 2: Project Description Report

Howard's Pass Access Road Upgrade Project
2015 Project Description Report

June 22, 2015

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Volume II of Howard's Pass Access Road Upgrade Project 2015 Land Use and Water Licence Applications Package

EXECUTIVE SUMMARY

The Howard’s Pass Access Road (HPAR) is a 79 km gravel road located in southwestern Northwest Territories. It was originally built in the late 1970s for access to the extensive zinc-lead deposit that straddles the Yukon-NWT border at Howard’s Pass in the Selwyn Mountains. When mineral exploration activity declined in the 1980s, the road fell into disuse and gradually deteriorated. Renewed interest in the Howard’s Pass mineral deposit since 2005 has also renewed the need for access to this potential mine site, both for exploration and mine development, and as part of a route for transporting ore concentrates to market when the mine is operational.

Selwyn Chihong Mining Ltd. (SCML), a Vancouver-based mineral exploration and development company, is currently conducting a pre-feasibility study for a proposed zinc-lead mine on the Yukon side of Howard’s Pass, referred to as the Selwyn Project. SCML held authorizations that allowed for the maintenance, reconstruction and use of the HPAR to provide access to the Selwyn Project. The road was reconstructed to a single-lane all-season road under these authorizations during 2014.

The HPAR was in a deteriorated condition before its reconstruction in 2014. The purpose of the reconstruction was to return the road to its original purpose as an all-season mining access road. As part of this reconstruction, new bridges and culverts were installed. SCML is now applying to the Mackenzie Valley Land and Water Board and to Parks Canada to upgrade the HPAR to a two-lane road that is suitable for commercial use, and to use the access road to support mine construction and operations at Howard’s Pass, including the bulk haul of mine concentrates.

While the mine is under development, the upgraded HPAR would be used for transportation of equipment and supplies. Once the mine is in operation, the zinc and lead ore concentrate would be hauled by truck and trailer from the mine along the HPAR to the road’s beginning near Tungsten, NWT, then southwest along the Nahanni Range Road and the Robert Campbell Highway, joining the Alaska Highway near Watson Lake, Yukon. The trucks would then travel south along Highway 37 through northern British Columbia to port facilities at Stewart, BC, a distance of about 1,000 km from Howard’s Pass. Fuel and supplies would be hauled to the site from Watson Lake and other locations, also via the HPAR.

Upgrading the HPAR

SCML is proposing to widen the HPAR from its current 4 m to 8.5 m. With the exception of the bridge crossings, the HPAR will be a two-lane road for its entire length. In addition to widening, the road alignment and surface will be improved to provide safe travel conditions at speeds of up to 70 km/hr. Other improvements include extending or realigning many of the culverts to provide stream crossings for the wider road, and work to improve drainage to make the roadbed more stable for heavier loads. The new single-lane bridges installed in 2014 are already designed to meet the haul road requirements and haul truck loading, so they do not need to be altered.

Sources of borrow material for road upgrading have been identified and initial testing to see if the materials are suitable has been completed. Follow-up testing will be conducted prior to upgrading to ensure clean and suitable material is used for the upgrades. Borrow sites developed for material for construction purposes will be reclaimed progressively as the construction proceeds.

The proposed upgrading will take one pre-construction season (winter, 2016) and two construction seasons (2017 and 2018). Temporary construction camps will be needed for three crews. In 2016 and 2017, one camp will be in the Yukon (at the Selwyn Project site) and two will be along the HPAR. In 2018, all three construction camps will be along the HPAR to be closer to the areas where roadwork is taking place. Construction timing and activities will be scheduled to avoid or take into account sensitive periods in the life cycles of caribou, fish and birds. For example, vegetation clearing is planned for winter, prior to the calving, spawning and nesting periods.

Use of the HPAR as a Haul Road

Current plans indicate that, when the mine is in operation, about 100 trucks per day would be travelling on the HPAR in each direction. This includes trucks hauling zinc and lead concentrates to port, and trucks hauling equipment, fuel and other supplies to the mine. About 12 of these trucks per day would be hauling liquefied natural gas (LNG) to power the mine generators. Mine personnel will generally use air travel to access the site.

The two categories for ore shipment will be zinc concentrates and lead concentrates. There will be a specific truck/trailer configuration for each of these. Zinc will be hauled in covered side-dumping trailers and lead concentrate will be contained using sealed “super sacks”. Concentrate load-out facilities will be designed to ensure that the concentrate haul trucks do not have zinc or lead concentrate dust on the wheels or outside body of the tractors and trailers to prevent any release of concentrate contaminants on the roadways.

Traffic control systems will be used for the safety of all road users and to protect wildlife. Measures and protocols will be developed in more detail, as planning and engineering progresses, for several aspects of haul road operation, including general road maintenance, dust abatement, avalanche control, monitoring and mitigation of impacts on wildlife, protection of watercourses and fish, and spill prevention and response. An Integrated Road Use Plan will consolidate many of these measures.

The HPAR Route

The HPAR runs through a succession of valley bottoms for much of its route. The first 12 km of the road follow alongside Divide Lake, then past streams, wetlands and lakes at the headwaters of the Little Nahanni River. For the next 48 km, the road runs mainly along the southwest side of the Little Nahanni River. In this road section, the terrain alternates between hummocky and rolling terrain, consisting of unconsolidated sediments within glacial landforms, and bedrock and colluvium on valley wall slopes. The road then climbs onto an extensive glaciofluvial terrace near the confluence of Steel Creek and Little Nahanni River. Beyond this, the road follows the southwestern hillslope of the Steel Creek valley and then crosses Steel Creek. North of this crossing, the road runs a short distance along the inactive floodplain of Steel Creek, then starts to climb the Placer Creek valley, traversing the eastern hill slopes of the valley. It then leaves the valley and climbs along gentle slopes to reach Howard's Pass.

Along this route, the HPAR first passes through Dehcho Traditional Territory, then the Sahtu Settlement Area. It also crosses through traditional territory of the Kaska Dena. In addition, the HPAR traverses portions of both Nahanni and Nááts'ihch'oh National Park Reserves.

Conditions along the Route

The HPAR route lies in a zone of discontinuous permafrost. Potential for permafrost has been mapped along the entire route, as have potential terrain hazards, including avalanche areas, slow mass movement areas, and rockfall and landslide areas. This information will be factored into the detailed road design and road management plans.

Drainage basins that intersect with the HPAR road corridor were mapped in 2011 as part of a hydrological study. The HPAR has 32 stream crossings of varying sizes. Hydrological characteristics have been established for each of the stream crossings. The bridges and culverts associated with the 2014 reconstruction were sized to accommodate a one-in-two-hundred-year flood event, based on this study.

Terrestrial ecosystem mapping was completed for a 2 km-wide corridor along the HPAR in 2011. The corridor has four broad ecological zones: subalpine; parkland; upland; and lowland. Nearly 60% of the HPAR route lies within the upland ecological zone, which occurs on lower mountain slopes below the subalpine zone. The upland zone typically has a cover of open forests of white spruce and subalpine fir. Approximately 30% of the HPAR route runs through meadow ecosystems. Wetlands account for about 1% of the road corridor, while five lakes plus a number of ponds cover about 2% of the corridor.

Three vegetation types that are forage for ungulates and bears were sampled and analysed for metals content. Results showed that the baseline metals levels are within average background ranges for the broader region.

An analysis of the ecosystem types present indicated that there is relatively low potential for rare plants in the HPAR corridor; a survey is planned for 2016 to ground-truth this assessment. A survey to document any invasive plant species along the HPAR will take place in 2015. To date, no invasive plants have been noted during other ecological survey or monitoring work. However, as the road has been in place since the early 1970s, there is the potential that invasive species have already become established.

Fisheries and aquatic habitat values were assessed in 2014 for streams crossing or adjacent to the HPAR. The streams varied widely in habitat and in their suitability for fish species. Arctic grayling, burbot and sculpins are present in many of these streams.

Wildlife present near the HPAR and in the vicinity of the proposed mine at Howard's Pass have been documented over a period of several years through systematic wildlife surveys, as well as through incidental wildlife observations by biologists and wildlife monitors. Terrestrial ecosystem mapping conducted in 2011 was used to assess habitat suitability for several species, including woodland caribou, moose, grizzly bear, wolverine, beaver and marten.

The Nahanni Caribou Herd includes the HPAR corridor within its annual range, and caribou surveys have been conducted for the areas around the mine site and the road since 2007. Caribou move into the area during the spring. Calving takes place in late spring, and at this time the caribou are dispersed throughout the area in a variety of habitat types. During the fall, the caribou move to alpine and subalpine areas, and then to their winter range along the South Nahanni River. Moose are known to frequent parts of the road corridor, based on ungulate surveys and documented observations. Further ungulate surveys and caribou studies are underway to improve understanding of seasonal use by ungulates of the HPAR corridor and surrounding regions.

The habitat suitability assessment predicted low to moderate grizzly bear densities with some high density areas associated with valley bottoms. A bear den survey was undertaken in the spring of 2015. Wolverine have been observed a number of times in the HPAR corridor, and 45% of the area is rated as moderate to moderately high suitability for marten denning. A wolverine and marten survey is planned for the winter of 2015/2016. Beavers are present in the HPAR corridor, and a survey will be conducted in 2015 to inventory lodges and areas used by beavers.

A preliminary list of 55 bird species was developed, based on reliable records from incidental sightings from 2011 to 2014. Trumpeter swans with cygnets were noted in the Flat Lakes area in August of two years. Several bird species with special conservation status have also been observed in the corridor. Baseline surveys of songbirds, raptors and waterfowl are planned for 2015. The ranges of two endangered bat species extend to this area, and a survey will be conducted in 2015 to see if bats are present along the HPAR corridor and, if so, what habitat and locations they use.

Interviews conducted for a traditional knowledge study with Sahtu people from Tulita indicate that the region in the vicinity of the HPAR was used in the past for traditional pursuits, but the current level of use is low. There are no known archaeological sites within the HPAR area. A Heritage Resource Overview Assessment undertaken in 2014 concluded that a large portion of the area along the HPAR has low pre-contact heritage potential. This initial assessment work will be followed up during 2015 by a Heritage Resource Impact Assessment, which will include ground-based assessment of areas identified as having elevated heritage potential in the road corridor.

Potential Effects and Mitigation

Upgrading the HPAR has the potential for environmental and socio-economic effects at any of its phases: construction, operation, closure and decommissioning, and post closure. Physical components that may be affected are: air quality; noise; surface hydrology; water and sediment quality; groundwater; land; soils; and non-renewable resources. Ecological components that may be affected are: vegetation and plant communities, and fish and wildlife and their habitat. Measures that are in place to mitigate these effects are set out in the body of this report and in the appendices, and include standard operating procedures and plans for protection of heritage resources, waste management, spill prevention and response, avalanche mitigation, fish, wildlife and habitat protection, and prevention of erosion. Additional and more detailed plans and procedures that contain mitigation measures, including for road operations and traffic control, will be developed in consultation with Parks Canada and other land managers and users.

The HPAR project may affect various aspects of the local economy. It may also affect traditional and cultural pursuits on the land, such as hunting, trapping and gathering. Heritage resources may also be affected. Socio-economic effects of the project are relevant for the NWT communities of Tulita, Norman Wells and Nahanni Butte, as well as for the Kaska Dena. Upgrading the road will provide employment and contracting opportunities, as has past work on the road. The upgraded road may provide additional opportunities for hunters and fishers. Upgrading of the road may also provide access for visitors to the adjacent areas of the two National Park Reserves. The outfitting business operating in the area may be affected by the road and traffic along it. Trappers may also use the road for access to areas not previously trapped. There are active mineral claims in and adjacent to the HPAR corridor; an upgraded road may serve as an incentive to explore and develop such claims.

SCML is committed to working with communities and others potentially affected by the upgrading project to ensure that concerns are taken into account in all aspects of planning and implementation, and to ensure that the project brings economic opportunities to First Nations and northern communities. These commitments are set out in the company's Social and Environmental Policy and its Aboriginal Relations Policy. In addition, management plans, open and transparent reporting, mitigation measures and monitoring, in combination with regular consultation, are proposed to minimize potential effects at all stages of this proposed project.

The overall environmental effects of construction and operational phases are considered to be low. The road has been in existence for almost 40 years, so it is not a new linear development. It is anticipated that the proposed management and monitoring programs have addressed these environmental effects and will be robust enough to identify any unexpected effects that can then be minimized through adaptive management on an as-needed basis. The socio-economic effects are expected to be positive overall, given the employment and contracting opportunities.

As the area is not in regular use for traditional pursuits, the effect of the upgrade on traditional lifestyles may be considered neutral or potentially positive, due to improved access.

Potential cumulative effects of the HPAR project on the biophysical and human environment acting together with past, current and future projects in the region have also been considered.

Community Cooperation and Engagement

SCML has formal Cooperation Agreements with both Sahtu (Tulita District) and Dehcho (Naha Dehé Dene Band) communities that cover the life of the project. Through these agreements, SCML and Sahtu/Dehcho communities have committed to work together in a spirit of cooperation and mutual respect. The communities have been involved with the HPAR work at every step along the way.

A Community Engagement Plan to explain the HPAR Upgrade Project and elicit input on perspectives and advice from the affected communities, including Kaska Dena communities in the Yukon, was prepared and implemented. The results of this community engagement program are presented in this report.

Cooperation with Parks Canada

SCML is committed to working collaboratively with Parks Canada to achieve the two parties' respective goals of successful operation of the HPAR and of the two National Park Reserves. To that end, Parks and SCML signed a Memorandum of Understanding (MOU) that will guide the relationship. Under the MOU, a technical team will be established, with the goal of identifying and considering issues of common interest.

Regulatory Status

This Project Description Report has been prepared in support of land use permit and water licence applications to the Mackenzie Valley Land and Water Board (MVLWB) and Parks Canada. The applications to the MVLWB apply to two HPAR sections, from km 0 to km 14, and from km 60 to 79, and to the two temporary construction camps to be located in those sections. The applications to Parks Canada apply to the HPAR from km 14 to km 60 and to the temporary construction camps to be located near km 37.

The land use permits would enable the construction-related activities required for the upgrading of the HPAR. The water licences are required for grey water disposal at the temporary construction camps and for water withdrawal for camp use and dust control in National Parks Reserves. SCML held authorizations from the MVLWB and Parks Canada that permitted the 2014 rehabilitation of the road back to its original condition. SCML currently holds a Licence of Occupation for the HPAR, securing the company's access rights for a period of 30 years on the road outside the Nahanni National Park Reserve. The company is currently seeking a similar tenure instrument for the road within Nahanni National Park Reserve.

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1. INTRODUCTION

Selwyn Chihong Mining Ltd. (Selwyn Chihong or SCML) is a Canadian base metals exploration and development company owned by Chihong Canada Mining Ltd, a subsidiary of Yunan Chihong Zinc and Germanium Co Ltd of China. SCML holds mineral rights and surface rights in the Howard’s Pass area, on both sides of the border between Yukon Territory (YT) and Northwest Territories (NWT). The Howard’s Pass base metal deposit is one of the largest undeveloped lead-zinc deposits in the world.

The Selwyn Project consists of two key developments: 1) the Mine Development Site at Howard’s Pass in Yukon, and 2) the Howard’s Pass Access Road (HPAR) in Northwest Territories. Current mine planning for the project is an initial 11 years of production in eight open pits with a daily production of 35,000 t/day using conventional grinding and flotation.

The HPAR is an historical access corridor that was built prior to the expansion of Nahanni National Park Reserve. As a result, Selwyn Chihong has grandfathered rights in both Nahanni National Park Reserve and the newly created Nááts’ihch’oh National Park Reserve. Selwyn Chihong and Parks Canada are working collaboratively through a Memorandum of Understanding on permitting, operations, management and access related to this road corridor.

Selwyn Chihong is guided by a number of principles in the development of all aspects of the Selwyn Project, including:

- Protect the environment.
- Respect the people and places where we operate.
- Build long-term relationships and find ways for local communities to benefit from what we do.
- Create and sustain a healthy and safe environment for communities and our employees.

2. PROJECT INFORMATION

2.1. Project Purpose

The purpose of this proposed project is to:

1) upgrade the current access road so it is suitable for commercial use; and
2) use the access road to support mine operations, including bulk haul of mine concentrates.

The HPAR upgrade is needed for the development of the Selwyn Project. Goods and supplies such as bulk fuel, heavy equipment, and building materials will need to be transported to Howard’s Pass as the Selwyn Project evolves. The timing of the road upgrade is critical, as access to the Selwyn Project needs to be in place to support pre-construction and construction activities once the approvals are received in Yukon (see Section 2.4). Furthermore, the mine development schedule requires an upgraded road as an integral part of managing the risks associated with investment decisions in this project.

The road upgrade also includes preparation for the eventual hauling of zinc and lead concentrate to tidewater and global markets. The proposed upgrade is sufficient to meet the needs of the Selwyn Project. There is no intent for additional upgrades, such as further widening or paving, at a later stage.

2.2. Licences of Occupation

SCML holds a Licence of Occupation (LOC) for km 0–14 and km 60–79 from the Government of Northwest Territories Department of Lands. For sections of the road within the Nahanni National Park Reserve (km 14–36) and Nááts'ihch'oh National Park Reserve (km 36–60), licences of occupation are administered by Parks Canada. SCML currently holds an LOC for the section of road within the Nááts'ihch'oh National Park Reserve, and is in the process of negotiating with Parks Canada to obtain an LOC for the section of road within the Nahanni National Park Reserve.

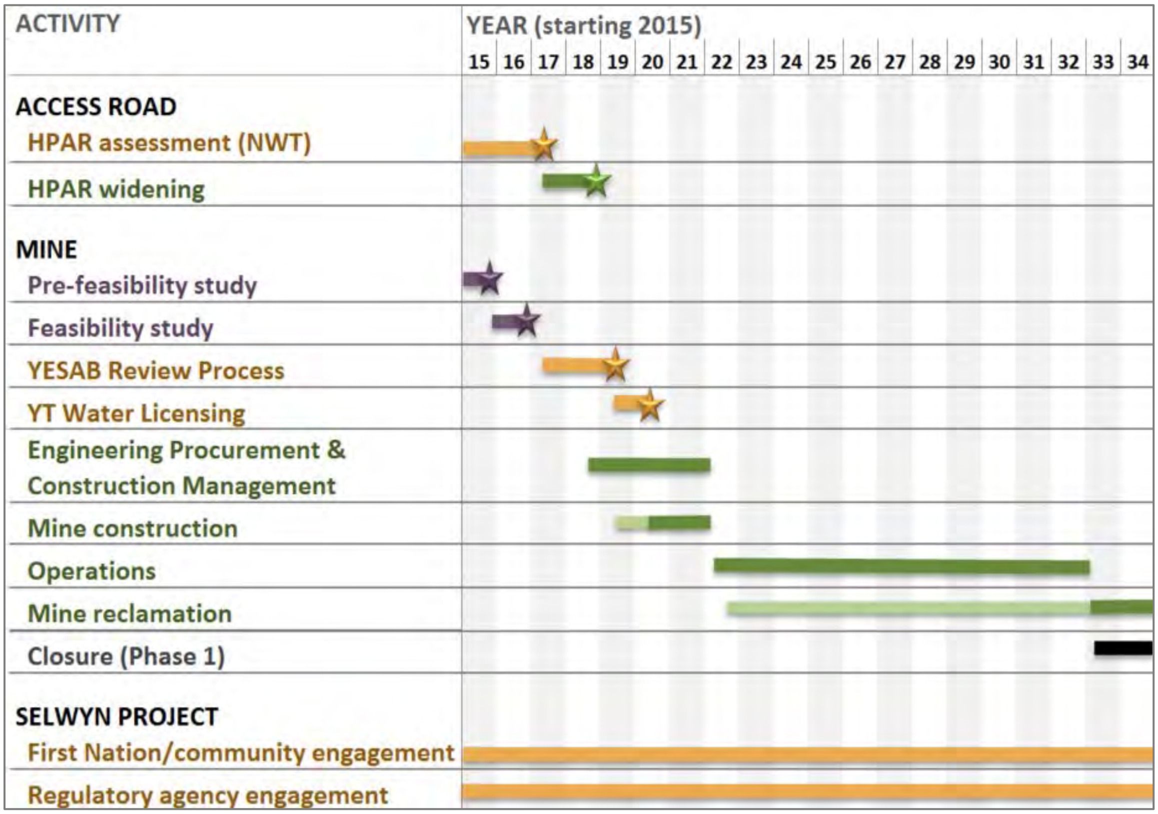
2.3. Project Overview

Selwyn Chihong is proposing to upgrade the HPAR from a single-lane access road to a two-lane commercial-use road. The upgraded HPAR will follow the existing road alignment, with some minor sections of re-alignment and an overall improvement of road features, such as the grade, road bed, ditches, culverts, pull-out areas and other upgrades as required to bring this into a full two-lane, all-season road. The upgraded HPAR will provide infrastructure support for pre-construction and construction activities of the Selwyn Project, as well as for the health and safety of employees, contractors and the general public using HPAR. An improved road corridor also improves the ability of Selwyn Chihong and Parks Canada to manage environmental risks and health and safety concerns during operations.

2.4. Project Schedule

A development schedule for the Selwyn Project, including the Howard's Pass Access Road, is presented in Table 2.4-1. The goal for the HPAR upgrade project is to complete the road widening and associated upgrades within two construction years, starting in the construction season of 2017 and completing by the end of the construction season of 2018. This schedule reflects current planning and sequencing of the different aspects of development and may be adjusted.

Table 2.4-1: Project Schedule for the Selwyn Project: 2015-2034



Note: Stars are milestones; lightly shaded bars are pre-construction or partial activities and solid bars are the duration for each activity.

2.5. Project Location

The Howard's Pass Access Road is approximately 79 km long and is entirely within the Northwest Territories. It originates near Tungsten at kilometre post 188 of the Nahanni Range Road (km 0 for HPAR) and runs northwest to Howard's Pass (Figure 2.5-1 and Figure 2.5-2). Starting from its intersection with the Nahanni Range Road, the HPAR follows the valley alongside Divide Lake and Flat Lakes, then follows the southwest side of the Little Nahanni River northeast for about 55 km, turns west up the south side of Steel Creek for about 8 km, and then turns north along Placer Creek to Selwyn Chihong's mineral tenure in NWT and the Howard's Pass area, YT (km 79).

Nearby developments include North American Tungsten's Cantung Mine and the Tungsten townsite, which are approximately 10 km southeast of the start of the HPAR (km 0). A trail to Playfair Mining Ltd.'s claims/leases branches from the HPAR at approximately km 54.

Portions of the HPAR are within Nahanni National Park Reserve and Nááts'ihch'oh National Park Reserve. The Nahanni National Park Reserve, established in 1972, was expanded in 2009 by an Act of Parliament from its original size of 5,000 km^2 to over 30,000 km^2 (Government of Canada, 2009). The expansion overlapped the HPAR between km 14 and km 36 (Figure 2.5-2). All of the Nahanni National Park Reserve is within the traditional territory of the Dehcho First Nations. The Nááts'ihch'oh National Park Reserve, created through an Act of Parliament in 2014, covers an area of 4,895 km^2. This newly established Park Reserve overlaps the HPAR between km 36 and km 60 (Figure 2.5-2). All of the

Nááts'ihch'oh National Park Reserve is within the Sahtu Settlement Area. The combined area of Park Reserves in the Nahanni watershed in now more than 35,000 km^2.The HPAR is within Outfitter Management Area S/OT/03 (Ram Head Outfitters).The road also provides access to recreational cabins located in the vicinity of Flat Lakes, and is used by the general public for both recreational and subsistence pursuits.

The HPAR transects three classifications of land:

- Dehcho Traditional Territory: km 0–36 (36 km)
- National Park Reserve:
    - Nahanni National Park Reserve: km 14–36 (22 km)
    - Nááts'ihch'oh National Park Reserve: km 36–60 (24 km)
- Sahtu Settlement Area: km 36–79 (43 km)

In addition to the above, the road passes through Kaska Dena Traditional Territory (Figure 2.5-1).

Figure 2.5-1: Project Location of Howard's Pass Access Road: Regional View

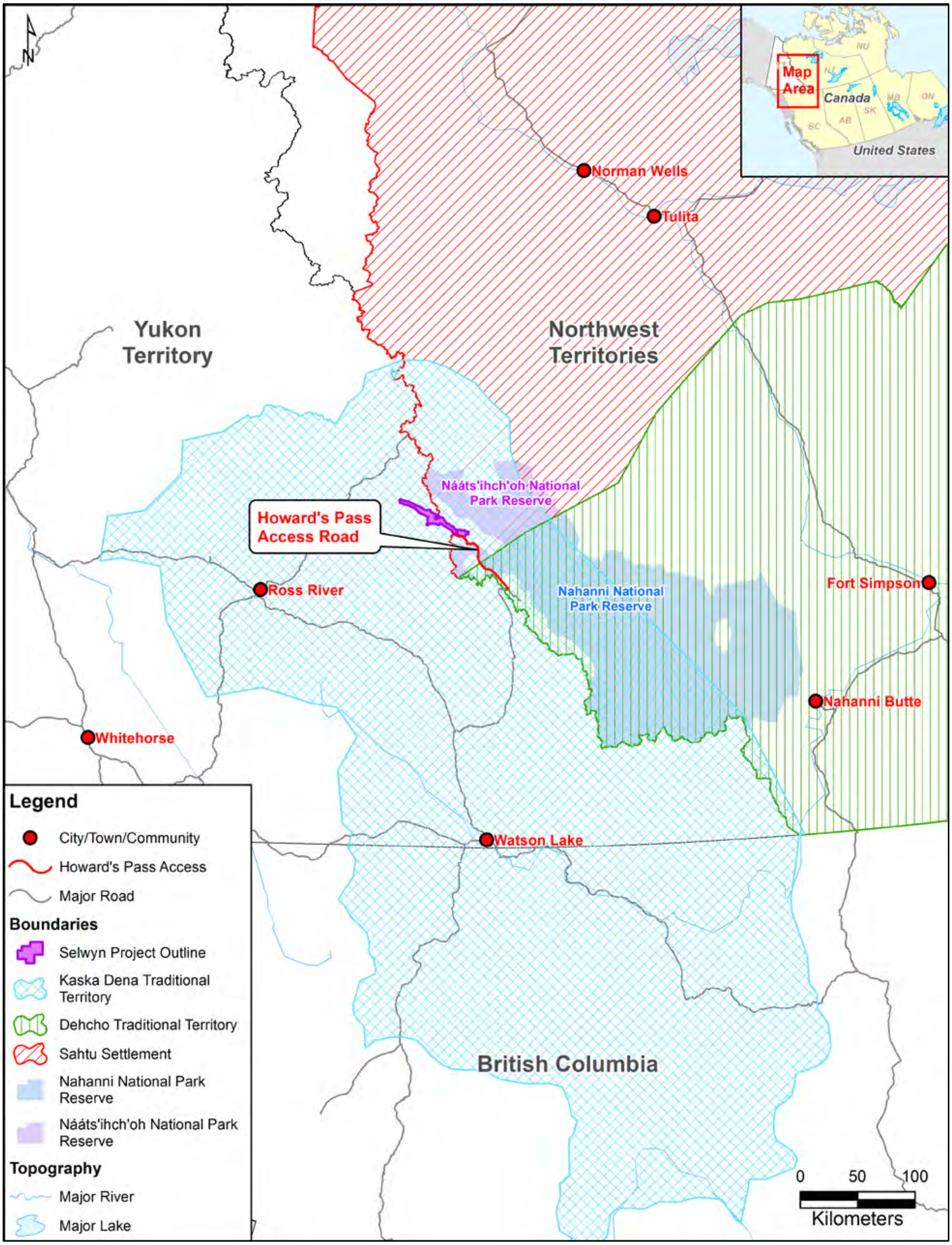
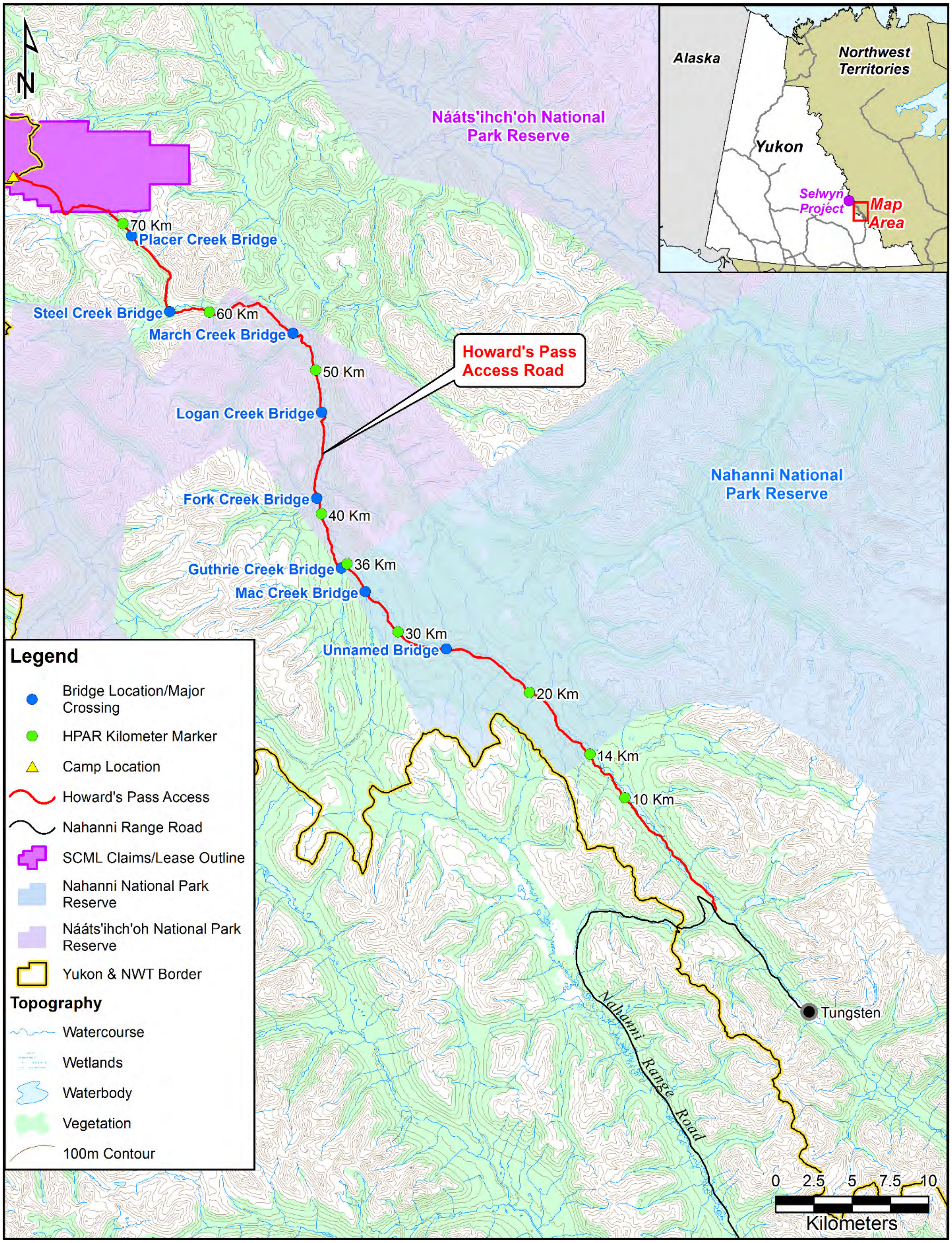


Figure 2.5-2: Howard's Pass Access Road: Route Map



3. DEVELOPER INFORMATION

Yunnan Zinc and Germanium Co Ltd, through its Canadian subsidiary Chihong Canada Mining Ltd, is the sole owner of Selwyn Chihong Mining Ltd. Selwyn Chihong is a Canadian company with a corporate office in Vancouver, British Columbia.

Selwyn Chihong is the proponent for the proposed upgrading of the HPAR.

3.1. Organizational Structure

Selwyn Chihong's Management Team, shown in Table 3.1-1, is located in the company's corporate office in Vancouver, BC

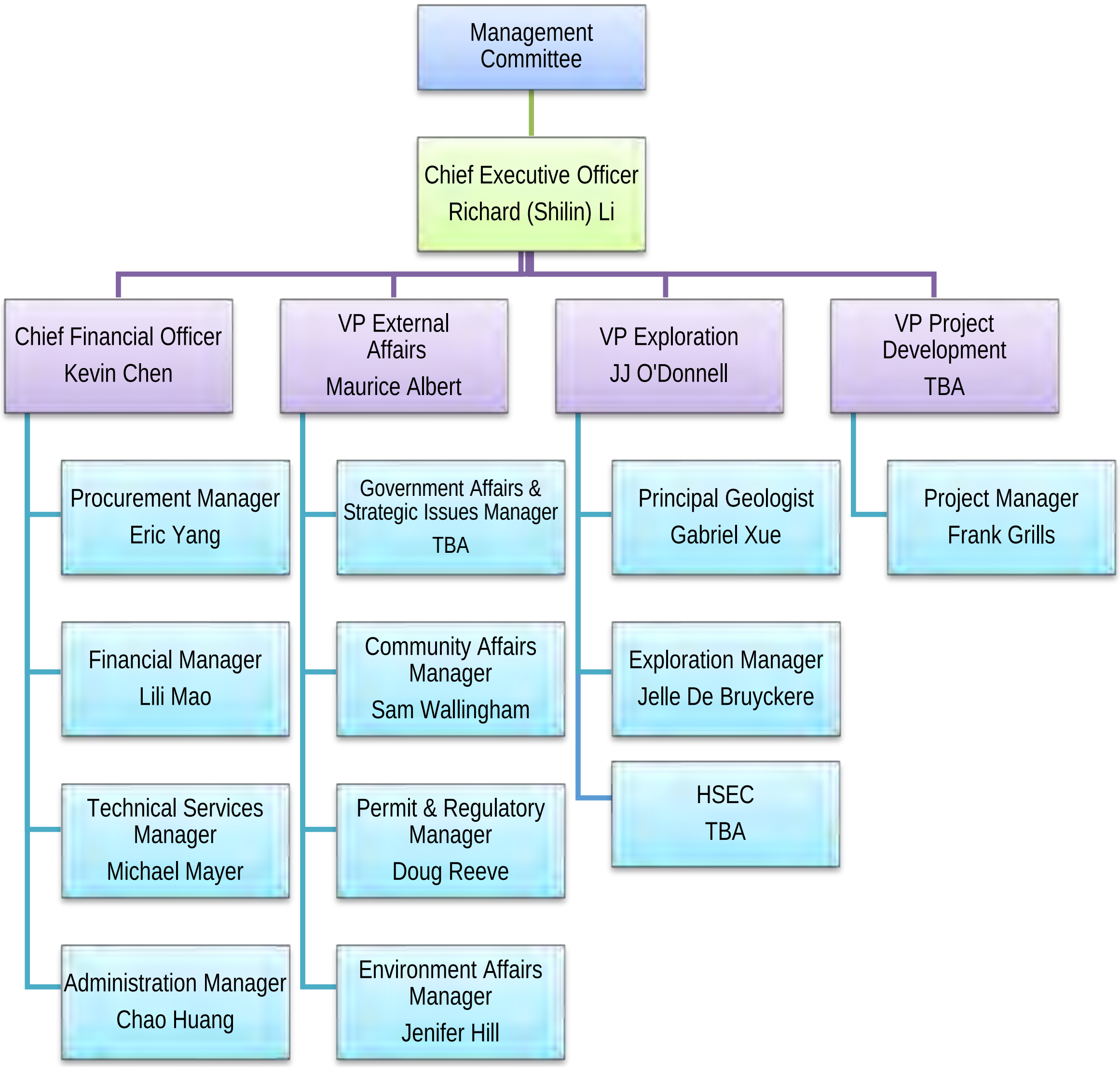
Table 3.1-1: Selwyn Project Corporate Management Structure

Management Team
President, Chief Executive Officer, Director Mr. Richard (Shilin) Li Chief Financial Officer Mr. Kevin Chen Vice President External Affairs Mr. Maurice Albert Vice President Exploration Mr. John J. O'Donnell

3.2. Project Management Structure

The project management structure for the Selwyn Project is outlined in Figure 3.2-1.

Figure 3.2-1: Selwyn Project Management Structure



3.3. Primary and Secondary Contacts

For the purposes of the Land Use and Water Licence applications, the primary and secondary contacts are:

Primary Contact
Mr. Doug Reeve
Manager, Permitting and Regulatory Affairs
Selwyn Chihong Mining Ltd.
Tel: (604) 620-6188 ext. 805
Fax: (604) 681-8344
Email: dreeve@chihongmining.com

Secondary Contact
Ms. Jenifer Hill
Manager, Environmental Affairs
Selwyn Chihong Mining Ltd.
Telephone: (604) 620-6188 ext. 824
Fax: (604) 681-8344
Email: jhill@chihongmining.com

3.4. Corporate Social Responsibility Policies

3.4.1. Social and Environmental Policy

Selwyn Chihong Mining Ltd. is committed to the responsible exploration and development of mineral resources. This commitment creates an expectation of excellence in our social and environmental performance, for all our activities, that is aligned with the evolving priorities of our communities of interest. To achieve this high expectation, SCML commits to the following in the areas of social and environmental responsibility:

Social Responsibility

We will:

- Work with communities to understand their interests and consider those interests in the planning and management of our activities.
- Work with affected communities to ensure that heritage sites are preserved.
- Proactively seek, engage and support dialogue with regulators, stakeholders, Aboriginal Peoples and the public regarding our activities.
- Undertake all aspects of our business with excellence, transparency, accountability and ethical conduct.
- Protect the health and safety of our employees, contractors, and communities.
- Respect the cultures, customs and values of people with whom our activities interact.
- Recognize and respect the unique role, contribution and concerns of Aboriginal Peoples in our project areas in accordance with our Aboriginal Relations Policy.
- Provide opportunities and benefits to local communities through policies and programs that are designed to enhance economic, social, educational, health and environmental standards.
- Respect human rights and treat those with whom we deal fairly and with dignity.
- Support the capability of communities to participate in opportunities provided by our activities.
- Be responsive to community priorities, needs and interests in all our activities.

Environmental Responsibility

We will:

- Seek to minimize the impact of our activities on the environment through all stages of exploration, development, operations and closure.
- Seek to prevent accidental release of pollutants into the environment.
- Practice continuous improvement through the application of new technology, innovation and reasonable best practices in all facets of our operation.
- Comply with all laws and regulations and adhere to our guiding principles to ensure reasonable best practices are followed.

3.4.2. Aboriginal Relations Policy

Selwyn Chihong Mining Ltd. recognizes that our activities are located within the traditional territory of a number of Aboriginal communities. We are committed to responsible resource development that takes into account the rights and interests of Aboriginal People including their traditional and current uses of lands and resources. We live our commitment through ongoing engagement, meaningful consultation and negotiation of agreements with affected Aboriginal communities, wherever possible, and by implementing rigorous environmental, safety and socio-economic policies.

We respect and embrace our Aboriginal neighbours as true partners in our agreements and in our activities. Resource development creates opportunities for, and impacts on, Aboriginal communities. By this Policy, our agreements and our actions, we will strive to maximize socio-economic opportunities and minimize negative impacts of our activities.

By this Aboriginal Relations Policy, SCML commits to the development of enduring relationships with Aboriginal People as follows:

Respect Rights and Traditions: We recognize the unique legal and constitutional rights of Aboriginal Peoples in Canada. We seek to understand and respect their history, knowledge, customs, values, beliefs and traditions.

Share in Economic Success: We want communities to share in our successes and benefit from socio-economic opportunities associated with our activities. We are committed to supporting ongoing education, training, skills development and life-long learning as well as employment and economic business development opportunities for Aboriginal Peoples.

Communicate Regularly and Openly: We will listen to, and communicate directly and openly with, communities affected by our activities. We seek meaningful consultation that is timely, informative, interactive, responsive and culturally appropriate. We are willing to be influenced in our decisions and strive to keep communities informed of how we integrate community concerns into the planning and management of our activities.

Minimize Environmental Impacts: We recognize the importance of the land to Aboriginal Peoples. We accept our obligations towards the land and our neighbours. We commit to conducting our activities in an ethical and environmentally responsible manner over the long term.

Support Social Well-Being: We believe in healthy communities and healthy employees. We will implement workplace policies and practices for employees that support safety and wellness. We will work collaboratively on initiatives that support healthy living and wellness for people, families and communities.

3.5. Compliance with Commitments and Environmental Record

Selwyn Chihong is committed to sound environmental management.

Selwyn Chihong has established Standard Operating Procedures (SOPs) to manage environmental risks associated with development activities. These procedures are developed and reviewed by in-house specialists, including professional biologists, geologists, engineers and other professionals and are based on accepted industry best practices and regulatory guidance documents such as the Fisheries and Oceans Canada's (DFO) Measures to Avoid Causing Harm to Fish and Fish Habitat (DFO, 2013). Selwyn Chihong's SOPs that are applicable to the project are reproduced in Appendix I of this application.

The term "best practices" refers to standard benchmarks that work to protect worker and community health and safety and protect the environment. These standards come from a variety of sources, including federal or territorial government guidelines and industry associations. The term best practices is often used to account for changes in guidelines and benchmarks over time as technology improves and more information becomes available. For the HPAR construction and operation, examples of best practices include the GNWT Northern Land Use Guidelines[1] for Pits and Quarries (GNWT, undated-a); Access: Roads and Trails (GNWT, undated-b); Camp and Support Facilities (GNWT, undated-c); and the 2012 Emergency Response Guidebook (Transport Canada and US Department of Transportation, 2012).

SOP adequacy and performance are monitored throughout field operations by company staff from the SCML External Affairs Department. SOPs are reviewed and amended periodically based on a continuous improvement process.

Crew and contractors are educated on SOP contents through appropriate communication vehicles such as contract terms and conditions and on-site orientations. Selwyn Chihong staff are present and available throughout all aspects of operations to monitor crew and contractor performance and provide guidance where needed.

Selwyn Chihong has developed a good track record in completing approved activities along the HPAR, including equipment mobilization in the fall of 2010 and winter road operations in early 2011. The fall 2010 work involved moving six pieces of heavy equipment up the road. Swamp mats were utilized to reduce potential damage to sensitive sites (Photo 3.5-1). No environmental issues occurred during this work. In March of 2011, Selwyn Chihong operated a winter road atop the HPAR alignment. Ninety-five loads of equipment and supplies were trucked up to the mine site on the winter road. One spill occurred during the winter operation as a result of equipment failure. The spill was reported (though it was not a reportable quantity) and cleaned up.

In 2014, Selwyn Chihong continued work on the HPAR by installing eight permanent bridges and reconstructing the 79 km of road to provide year-round access to Howard's Pass.

Full-time community monitors (from the Sahtu and the Dehcho) were present during all activities. See Section 8: Community Engagement for more information.

[1] Northern Land Use Guidelines are available at http://www.lands.gov.nt.ca/northern-land-use-guidelines

Photo 3.5-1: Application of swamp mats to reduce potential damage of sensitive sites during use of the HPAR in the fall of 2010.

4. CURRENT CONDITIONS ALONG THE HPAR CORRIDOR

4.1. Physical Environment

The HPAR runs through a succession of valley bottoms for most of its length. For the first 12 km the road runs along the southwest side of Divide Lake, then Flat Lakes and tributaries to this wetland complex. For the next 48 km the road runs mainly on the southwest side of the Little Nahanni River, where the surficial geology alternates between hummocky to rolling terrain consisting of glacial drift and morainal mantles overlying bedrock on lower valley hill slopes. From about km 50 to km 53 the road climbs onto an extensive glaciofluvial terrace near the junction of Steel Creek and Little Nahanni River. Beyond this, the road follows the southwestern hillslope of the Steel Creek valley until the creek crossing near km 63. North of this crossing, the road runs along 400 m of inactive floodplain of Steel Creek, then starts to climb the western side of Placer Creek to approximately km 70, where it crosses to the eastern side. The road then traverses the eastern hill slopes of the Placer Creek valley and continues to climb towards Howard's Pass. At about km 74 it leaves the valley of Placer Creek, and climbs up into the alpine, on gentle south and southwest facing slopes. The road terminates at the height of land at Howard's Pass at about km 79.

4.1.1. Geology, Soils and Terrain Hazards

4.1.1.1. Bedrock Geology

The HPAR lies within the Selwyn Basin, which is within the Omineca Belt of the Canadian Cordillera (Gabrielse and Yorath, 1992). The Omineca Belt comprises a number of mountain ranges, including the Selwyn and Mackenzie mountains. The belt consists of Proterozoic-aged, variably metamorphosed sedimentary rocks (Hart, 2005). The Selwyn Basin formed along continental margins along the western margin of continental North America in the late Proterozoic, and is composed of Ordovician and Cambrian Limestone, and Devonian and Mississippian Earn Group sedimentary rocks (Turner et al., 2008).

The HPAR lies just east of the continental divide and is within the Mackenzie Mountains. The road is east of the drainage divide that forms the boundary between the Nahanni River in the NWT and the Pelly, Ross and Hyland rivers in the Yukon. In the NWT, bedrock consists of the Devonian-Mississippian Earn Group, containing shale, sandstone and conglomerate. Also present are rocks of the Road River Group, which are clastic sedimentary rocks, dominated by mudstones. In places, the sedimentary rocks are intruded by granitic rocks of the mid-Cretaceous Selwyn Plutonic Suite (Yukon Geological Survey, 2002).

4.1.1.2. Terrain Stability Mapping

Terrain stability mapping of the HPAR corridor has been completed at a 1:30,000 scale (Madrone Environmental Services Ltd., 2011b). These maps provide a detailed picture of surficial geology and terrain hazards for a 300 m wide corridor along the HPAR alignment. The maps show landscape features (such as wetlands and eskers) and terrain classification by surficial material type and texture, surface expression (slopes, material thickness, shapes), geomorphological processes, mass movement classes and avalanche tracks, terrain stability classification, soil erosion potential, probability of permafrost, and drainage characteristics. The discussion on surficial geology and terrain hazards that follows draws on data from these maps to provide an overview of conditions along the HPAR corridor.

4.1.1.3. Surficial Geology

The surficial geology along the HPAR corridor is largely a reflection of the most recent cycle of glaciation—the McConnell glaciation, which began around 24,000 years before present (BP). A thick layer of ice covered the region until about 10,000 BP (Yukon Geological Survey, 2002). Today, small Holocene era glaciers, cirques, arêtes and other features associated with glaciers still occur at high elevations.

Till is abundant along hillslopes of valleys and rolling uplands. Further away from the valley bottoms, till is found in the form of a mantle of varying depth overlying bedrock. The till at the valley bottom is a mixture of gravel with sand, silt and clay. Soils derived from tills are fine-textured, poorly sorted and moderately cohesive.

On valley bottoms, till deposits are often buried under glaciofluvial (outwash) deposits in various forms, such as terraces, eskers, kames and kettles. Valley-bottom glaciofluvial deposits may also take the form of undulating hills, formed as gravel and sands were deposited on, beside or beneath stagnant and melting ice during deglaciation. In places, glaciofluvial deposits are complexed with finer-textured soils derived from local till deposits. Glaciofluvial materials are the most widespread substrate along the road corridor (Table 4.1-1).

Table 4.1-1: Surficial Materials Present along Howard's Pass Access Road

Surficial Material	Area (ha)	Percent of Study Area
Till (M)	653	27.8%
Bedrock (R)	2.2	0.1%
Glaciofluvial (FG)	1,450	61.7%
Fluvial (F)	96.2	4.1%
Organics (O)	145	6.1%

At some points along the HPAR, the route traverses floodplain deposits associated with modern, or Holocene era, streams or rivers. This fluvial (in contrast to glaciofluvial) material consists of sands and/or silts with variable amounts of gravel. Some of these deposits are considered active deposits generated from periodic modern flooding, while others are inactive, having been deposited during the early Holocene but not affected by modern flooding. Modern flood frequency varies from location to location.

Alluvial fans are a unique type of fluvial deposit that is also encountered along the HPAR. The stream channels that create the fan shift over time. Some fans are relatively stable, with entrenched stream channels that have not moved for decades or centuries. Others are shallowly incised and are subject to changing course.

Fluvial deposits along the valley of the Little Nahanni River are occasionally covered with mantles of organic soils. These areas support wetland vegetation. The HPAR largely avoids these areas by hugging valley sides. Nevertheless, approximately 6% of the surficial material present along the road is organic material.

4.1.1.4. Permafrost

The HPAR corridor lies within the discontinuous permafrost zone (Ecosystem Classification Group, 2010). Permafrost can be observed in localized areas along the route. Its distribution is governed by terrain setting, soil type, vegetation cover, aspect and drainage. Permafrost most commonly occurs on north and northeast aspects, on medium to fine-textured soils, and underlying spruce moss ecosystems with thick, peaty mantles. Areas within the HPAR corridor likely to have permafrost were identified and mapped according to three Permafrost Probability Classes that define the likelihood that permafrost is present to a significant extent in the area. An overview of this analysis is presented in Table 4.1-2.

Table 4.1-2: Areas of Likely Permafrost Present along Howard's Pass Access Road

Permafrost Probability Class	Area (ha)	Percent of Study Area
Low (< 30% probability)	278	12%
Moderate (30 – 60% probability)	1,831	78%
High (>60% probability)	239	10%

The majority of the HPAR corridor was classified as having a moderate probability of permafrost. Areas with moderate probability typically are areas of morainal parent material with north or northeast aspects. Low probability areas were on glaciofluvial and fluvial landforms with coarse-textured soils. Higher probability areas were identified on moderate to steep north-facing slopes formed in morainal parent materials.

4.1.1.5. Soils and Erosion Potential

The soil types along the HPAR are a reflection of the parent material. Brunisol soils derived from till parent materials have a gravelly silty loam to silty clay loam texture. These soils can be either well drained or imperfectly drained. They reflect the relatively acid nature of the parent materials, namely tills derived from clastic sedimentary rocks.

The soils are weakly developed and not productive, due to climate factors such as low average temperatures and short summers. Exceptions are in areas with a concentration of nutrients in the litter horizons and a shallow, organically enriched surface A horizon. At higher elevations in the subalpine and alpine areas, till-derived soils are generally classified as Regosols.

Static or Turbic Cryosols are more prevalent on till-derived than outwash-derived soils, and also on north or northeast aspects. Soils derived from floodplains are typically Regosols, reflecting the local flood regime. Frequently flooded areas contain Cumulic Regosols associated with periodic deposition of new sediment. The HPAR does not traverse areas containing these soils; however, they are present within 300 m of the road.

Soils derived from organic veneers overlying fluvial deposits are classed as Typic or Terric Mesisols if the depth of organics is thick, or as Humic Gleysols if the organic veneer is shallow.

In general, soils derived from tills have a relatively low erosion potential, but, nonetheless, erosion can occur where long, steep grades drain into streams. Within the 300 m wide HPAR assessment corridor, 38% of the area was mapped as having low erosion potential and 52% as having moderate potential. Only 6% of the area had high erosion potential: all consisting of short segments where the road crossed fluvial fans, floodplains or traversed moderately steep slopes in glaciofluvial deposits.

4.1.1.6. Snow Avalanche Hazards

A snow avalanche hazard assessment was undertaken for the HPAR (Alpine Solutions Avalanche Services, 2010). Table 4.1-3 provides a summary of the 27 significant avalanche paths identified along the route. An example of an identified avalanche path is shown in Photo 4.1-1.

Table 4.1-3: Summary of the Snow Avalanche Hazard Assessment

Path Name	Approximate Location	Estimated Length of Road Affected (m)	Aspect	Magnitude/ Frequency[1]
44	3 km north of Fork Ck.	300	East	Size 2 – 1:1; Size 3 – 1:3
44.5	3 km north of Fork Ck.	450	East	Size 2 – 1:1; Size 3 - 1:3
46	5 km north of Fork Ck.	750	East	Size 2 – 1:1; Size 3 – 1:3
47	6 km north of Fork Ck.	250	East	Size 3 – 1:3
48	7 km north of Fork Ck.	200	East	Size 3 – 1:1; Size 4 – 1:10
50	3 km south of March Ck.	650	East	Size 2 – 1:1; Size 3 - 1:3
56	7 km east of Steel Ck. crossing	200	Northeast	Size 2 – 1:3
57	6 km east of Steel Ck. Crossing	150	North	Size 2 – 1:1
57.5	5.5 km east of Steel Ck. crossing	150	North	Size 3 – 1:3
59	4 km east of Steel Ck. crossing	300	Northwest	Size 3 – 1:1
59.5	4 km east of Steel Ck. crossing	300	Northwest	Size 3 – 1:1
60	3 km east of Steel Ck. crossing	500	North	Size 2 – 1:1; Size 3 – 1:3
61	2 km east of Steel Ck. crossing	450	North	Size 3 – 1:1; Size 4 – 1:3
61.5	2 km east of Steel Ck. crossing	500	North	Size 3 – 1:1
62	0.5 km east of Steel Ck. crossing	600	North	Size 2 – 1:1; Size 3 – 1:3
64	1 km north of Steel Ck. crossing	750	East	Size 2 – 1:1; Size 3 1:3
65	3 km north of Steel Ck. crossing	200	East	Size 2 – 1:3; Size 3 – 1:10
66	4 km north of Steel Ck. crossing	1,200	Southwest	Size 3 – 1:3; Size 4 – 1:10
67	5 km north of Steel Ck. crossing	200	Northeast	Size 3 – 1:10
68	6 km north of Steel Ck. crossing	1,000	Northeast	Size 3 – 1:3
69	7 km north of Steel Ck. crossing	350	Northeast	Size 3 – 1:3
70	7 km north of Steel Ck. crossing	350	Northeast	Size 3 – 1:3
72	9 km north of Steel Ck. crossing	1,000	Northeast	Size 3 – 1:10
73	10 km north of Steel Ck. crossing	400	Southwest	Size 2 – 1:1; Size 3 – 1:3
75	5 km SE of Howard's Pass	750	South	Size 2 – 1:1; Size 3 – 1:3
76	4 km SE of Howard's Pass	250	South	Size 2 – 1:1; Size 3 – 1:3
77	3 km SE of Howard's Pass	100	South	Size 2 > 1:1; Size 3 – 1:3

[1] Magnitude: defined according to the Canadian avalanche size classification system (5 size classes). Size 2 has a typical mass of 1,000 tonnes and could bury, injure or kill a person. Size 3 has a typical mass of 10,000 tonnes and could bury a car, destroy a small building, or break a few trees. Frequency: estimated occurrence in a year (e.g., 1:3 means frequency of approximately 1 in 3 years.)

Source: Alpine Solutions Avalanche Services (2010)

Photo 4.1-1: Example of an avalanche path
This is path 47, about 6 km north of Fork Creek. A size 3 avalanche is expected to occur about once in three years, affecting 250 m of the road
Source: Alpine Solutions Avalanche Services (2010)

Overall, no significant avalanche paths were identified south of Fork Creek (km 0 to km 41). Avalanche paths were identified north of Fork Creek to within 3 km of Howard's Pass. Although some of the paths are individual paths, many are clustered together along specific road segments. In general, avalanche paths that are clustered together pose greater risk than individual paths. Most paths have the potential to affect the road annually or within a return period of three years. Some paths present significant risk from large avalanches, although on a more infrequent basis.

4.1.1.7. Slow Mass Movement Hazards

Slow mass movement refers to areas of unstable terrain that can produce slumping or earthflow activity. A qualitative assessment of the potential for slow mass movement events was undertaken along the HPAR during fieldwork and using ortho-photography.

Overall, there was no visible evidence of significant earth movement along the HPAR. In many sections of the road, and in particular where the road crossed till slopes on north or northeast aspects, banks formed during the original road construction had exhibited very small-scale and localized slumping due to permafrost melting. Localized undermining of upper slopes and tilting of trees within about 10 m of road cuts was observed. Slumping was also identified in areas where soils were saturated, most commonly by diverted or impounded drainage.

4.1.1.8. Rapid Mass Movement or Landslide Hazards

Rapid mass movement or landslides in the form of debris flows and debris avalanches are fairly common in the Selwyn Mountains, but are largely confined to steep upper slopes on mountainsides. No evidence of past landsliding was noted in the 300 m wide HPAR assessment corridor. A terrain stability analysis along the HPAR route was undertaken to assess potential for rapid mass movement or landslides. The analysis used a standard five class system, in which Class V represents a high potential of unstable slopes and rapid mass movement, and Class I represents the lowest potential. Over 90% of the corridor area was rated as Class I or II, with a negligible to very low potential for landslide within the HPAR corridor (Table 4.1-4). The only exceptions are in steep-walled gullies that in places approach the road corridor from upslope. In a few locations, these steep areas impinge on the 300 m wide corridor, but do not affect the road alignment itself.

Table 4.1-4: Terrain Stability Classes along Howard's Pass Access Road

Terrain Stability Class	Likelihood of Landslide Initiation	Area (ha)	Percent of Study Area
I	Negligible	1,139	48%
II	Very Low	1,013	43%
III	Low	193	8.2%
IV	Moderate to High	1.4	0.1%
V	High to Very High	3.1	0.1%

4.1.1.9. Rockfall and Rockslide Hazards

Rockfall and rockslides are common in the Selwyn Mountains, but like other forms of rapid mass movement, they are confined in general to steep, upper slopes of valleys and mountains. Certain steep gully sidewalls are subject to highly localized rockslides or debris slides. The HPAR crosses minor, short sections of colluvial material (scree slopes or talus), which was deposited by a combination of previous slides and avalanches.

4.1.1.10. Rill, Gully and Sheet Erosion

Rill and gully erosion is caused by high volumes of water moving through a narrow channel. Rills are small features less than 1m deep which are often precursors to gullies. Large natural gullies have been created along the HPAR corridor at seven locations (km 7, 8, 9, 12, 26, 44, and 59). Smaller gullies are also present along the route.

Gully erosion was observed along the road corridor during an initial assessment in 2007. This occurred where installed pipe culverts had plugged (with ice) and were thus washed out by erosion. Rill erosion was also noted along ditches in certain sections of road. This occurred where a large volume of water was diverted along the road without adequate ditch blocks and cross-drains, as well as plugging of some culverts. Rill and gully erosion was most observed on steeper road grades (above 5%) where the road traverses glaciofluvial parent materials.

Sheet erosion occurs when water is flowing near surface in the form of a "sheet" that entrains a layer of soil without forming channels. Evidence of sheet erosion was observed in some locations on the road prior to its rehabilitation. Sheet flow also occurs along slopes that intercept the road.

4.1.2. Climate, Air Quality and Noise Levels

4.1.2.1. Regional Meteorological Stations

Since the early 1940s, Environment Canada has operated 14 meteorological stations in the broad region of the Selwyn mine site and HPAR, with varying periods of record. The locations of these stations are shown on Figure 4.1-1 and information about each station is in Table 4.1-5 (Knight Piésold, 2011).

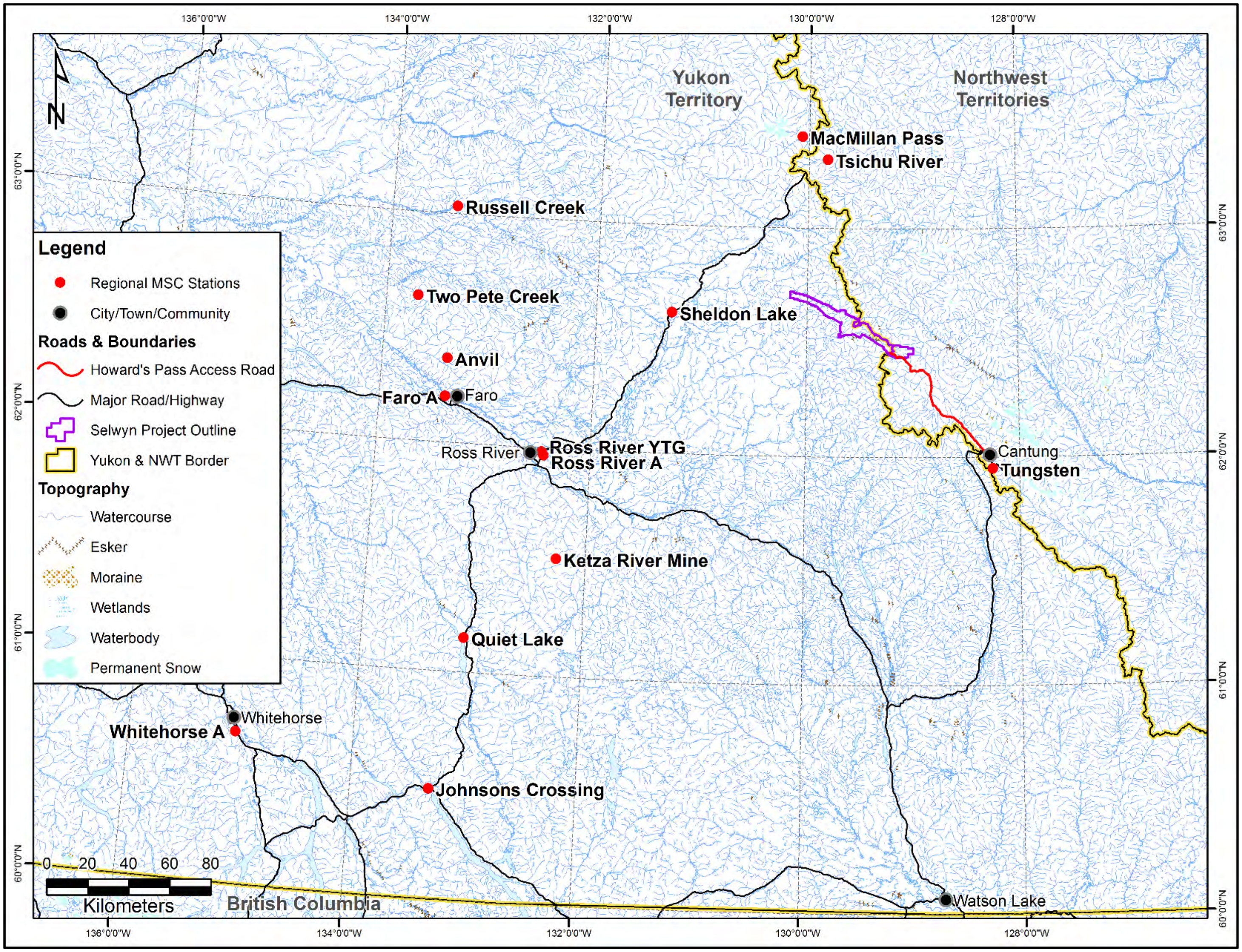
Of these stations, Ross River A, Faro A, and Whitehorse A have the longest periods of record. These stations are located several hundreds of kilometres away from the HPAR corridor and are at lower elevations than sections of the corridor itself. The MacMillan Pass, Tungsten, and Tsichu River stations are most likely the closest representation to the conditions along the HPAR, despite having a more limited period of record. They are no longer operational.

Table 4.1-5: Regional Meteorological Stations Summary

MSC Station	Station ID	Years of Record	No. Years Complete Record	Start Year	End Year	Latitude	Longitude	Elevation (m)
Anvil	2100120	25	5	1967	1991	62˚22'	133˚23'	1,158
Faro A	2100517	31	21	1977	2007	62˚12'	133˚23'	717
MacMillan Pass	2100693	10	6	1998	2007	63˚24'	130˚04'	1,379
Ross River A	2100940	34	18	1961	1994	61˚58'	132˚26'	705
Ross River YTG	2100941	15	4	1993	2007	61˚59'	132˚27'	698
Russell Creek	2100942	5	3	1989	1993	63˚02'	133˚23'	686
Tsichu River	2203891	9	5	1974	1982	63˚18'	129˚49'	1,265
Tungsten	2203922	25	9	1966	1990	61˚57'	128˚15'	1,143
Ketza River Mine	2100FPP	11	0	1985	1995	61˚31'	132˚16'	1,380
Quiet Lake	2100910	27	1	1966	1992	61˚09'	133˚04'	820
Two Pete Creek	2101138	6	0	1979	1984	62˚38'	133˚42'	960
Sheldon Lake	2100948	23	0	1970	1992	62˚37'	131˚17'	884
Johnsons Crossing	2100670	33	24	1963	1995	60˚29'	133˚18	690
Whitehorse A	2101300	69	62	1942	2009	60˚42'	135˚04'	706

For comparison, the elevations along the HPAR corridor are: southern portion, along the Little Nahanni valley, from about 1,150 m to slightly over 900 m. The route through the Steel Creek valley varies from about 900 m to 970 m. The north section climbs to Howard's Pass at 1,560 m.

Figure 4.1-1: Regional Meteorological Stations



Source: Knight Piésold (2011)

4.1.2.2. Temperature

Based on analyses of regional climate data, temperatures are typically warmest in July, with mean monthly temperatures in the low teens and daily maximum temperatures as high as 34°C. The coldest month is January, with mean monthly temperatures in the minus twenties, and daily minimum temperatures as low as -59°C (Knight Piésold, 2011).

4.1.2.3. Precipitation (Rainfall/Snow)

Regional precipitation data are available for several meteorological stations. Precipitation as rainfall is generally highest in July and August. From October to April, precipitation commonly falls as snow, while the shoulder months of May and September show mixed rain and snow conditions.

Snowfall comprises about 50% of the annual precipitation. The MacMillan Pass station reported the highest annual snowfall at 340.8 cm, with Tungsten reporting just slightly lower annual mean snowfall value of 316.4 cm. These two stations are the closest to the terminus of the HPAR at the mine site. Based on the vegetation types, the ecoregion that the HPAR corridor traverses is considered to be among the wettest in the NWT, as moisture-bearing Pacific systems approaching from the west are forced upward by high mountain ranges (Ecosystem Classification Group, 2010; see Section 0).

4.1.2.4. Wind Speed/Direction

There are no long-term regional wind speed or direction data available for this region.

4.1.2.5. Climate Change

The Intergovernmental Panel on Climate Change (IPCC, 2013) and national climate trend reviews (e.g., Bush et al., 2014) document the increases in temperatures, and precipitation in northern Canada in recent decades. The Yukon and NWT have experienced the steepest warming trends in Canada, and are projected to continue to do so in the future. Precipitation trends are less clear, with more variability due to local conditions. Overall, climate change projections for the area are increased magnitude and frequency of precipitation events. Observed changes in temperature and precipitation for northwestern Canada have been greatest in the winter season, with winter mean increases at all meteorological stations with sufficient length of record exceeding 2.5°C since 1950 (Bush et al., 2014).

Increases in temperatures and precipitation have the potential to affect run-off conditions, stream flows, permafrost distribution and the likelihood of flooding and of landslides. For example, increases in precipitation may not necessarily lead to increases in run-off as they may be offset by higher evaporation rates driven by warmer temperatures. Similarly, a shorter winter season resulting from warmer temperatures may not lead to smaller spring freshet flows because higher winter precipitation may offset the shortened snow accumulation period. Even if the future volumes of freshet flows are similar to current conditions, the timing of run-off may be earlier. Increased rainfall intensity can be expected to result in increased flooding and landslides or debris flows in areas susceptible to such events.

Trends in climate, as well as effects on ecosystems, are strongly influenced by local conditions, and there are no data on trends and effects specifically related to the HPAR corridor. Some studies have been carried out in nearby areas and are relevant to the HPAR region:

- A long-term permafrost monitoring station is located at Wrigley, NWT. Permafrost temperature at 12 m depth has increased at a rate of 0.1° C per decade from 1985 to 2007 (Smith, 2011).
- A long-term study in the Mackenzie Mountains to the north of the HPAR corridor shows loss of frozen peat landforms since 1944, related to documented permafrost collapse and increased permafrost temperatures (ESTR Secretariat, 2011).
- The areal extent of glaciers in the Nahanni National Park Reserve and surrounding area decreased about 30% from 1982 to 2008 (Haggarty and Tate, 2009). The short-term effect of retreating glaciers may be an increase in seasonal river flows, reversing as the glaciers disappear to long-term flow reductions and loss of seasonal water storage (ESTR Secretariat, 2011).

4.1.2.6. Air Quality and Noise

HPAR is within a remote wilderness area that is generally not subject to anthropogenic influences that would affect air quality and noise levels. It is assumed for the purpose of establishing baseline conditions for the project area that air quality and noise are within the normal background level ranges for Canadian northern regions.

No on-site monitoring of background air quality for the road has taken place. However, a proxy baseline assessment can be conducted using data from stations located in similar climatic and geographic locations.

The National Air Pollution Surveillance Program (NAPS) has stations set up throughout Canada to monitor ambient air quality for the purpose of baseline analyses. Data from four NAPS stations (circled stations on Figure 4.1-2) were used to produce a proxy baseline air quality assessment for the Selwyn Project that was used as input to models for projecting potential impacts on air quality from the mine and along the HPAR (Levelton, 2011). Air quality will be monitored along the HPAR prior to and during road construction.

Figure 4.1-2: National Air Pollution Surveillance (NAPS) Stations in the Yukon, NWT and Northeast British Columbia

Source: Levelton (2011)

4.1.2.7. Noise Levels

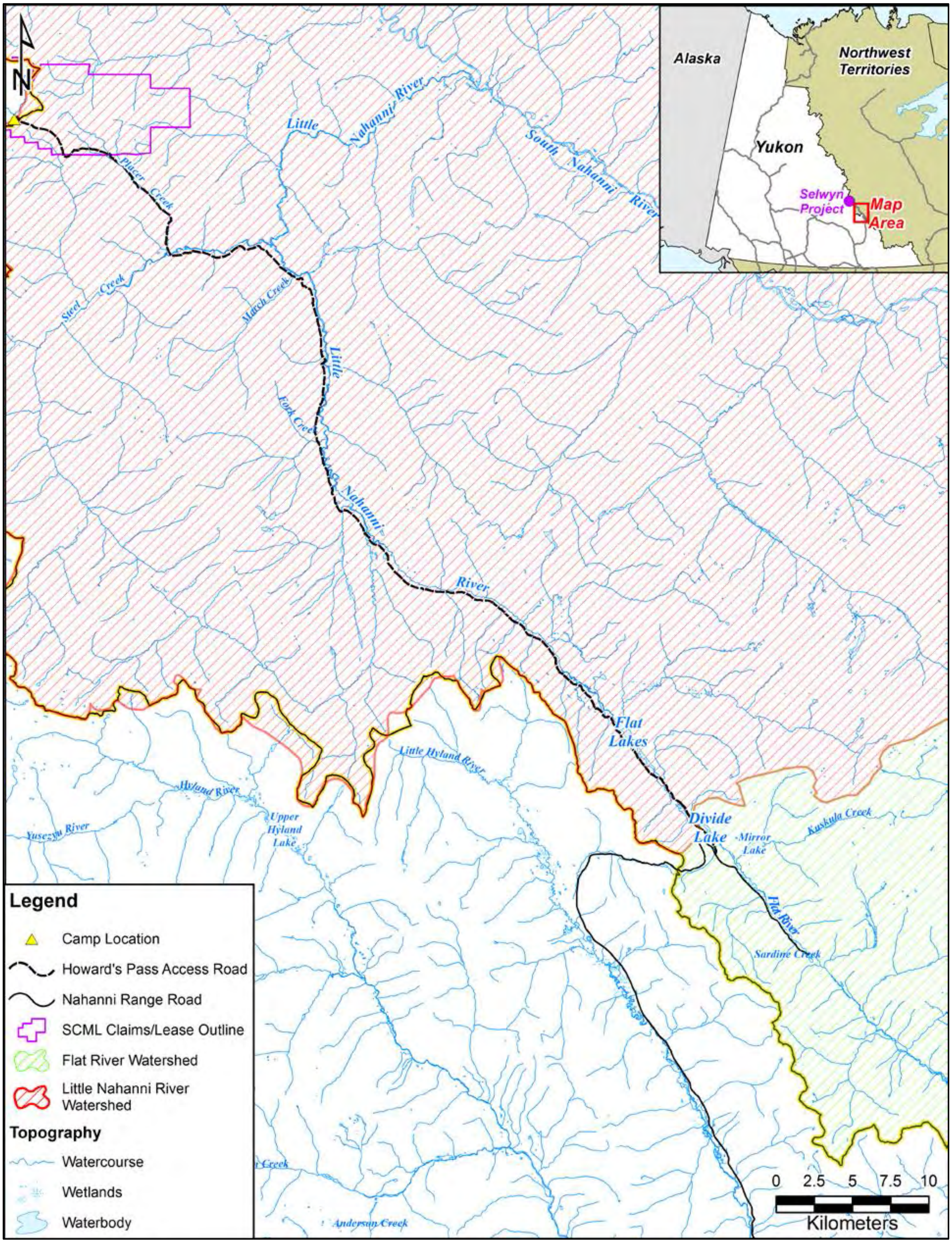
Noise is defined as unwanted sounds and is measured in A- weighted decibels (dBA) to approximate the frequency of response to the human ear (Matrix, 2011). A number of acoustical studies have been conducted in remote wilderness areas, with average ambient noise levels being measured from 25 to 35 dBA. The Alberta Energy Resources Conservation Board (ERCB) Noise Directive 030 recommends using 30 dBA as the ambient noise level for remote areas (where there is no requirement for baseline studies) (Matrix, 2011).

Background ambient noise levels within the HPAR corridor are expected to be within the 25 to 35 dBA range (Matrix, 2011). No baseline studies have been carried out for HPAR. The nearest community to the HPAR corridor is Tungsten, about 10 km south-southeast from km 0 of the HPAR.

4.1.3. Hydrology and Water Quality

Water within the HPAR corridor drains to the Mackenzie River via two main tributaries of the South Nahanni River: the Flat River (at the start of the HPAR) and the Little Nahanni River (Figure 4.1-3). The Little Nahanni River flows northwest from Flat Lakes, then turns northeast after it is joined by Steel Creek. Its confluence with the South Nahanni is shown at the top of the map. The Flat River flows south from Divide Lake, picking up several major tributaries before its confluence with the South Nahanni River downstream of Virginia Falls.

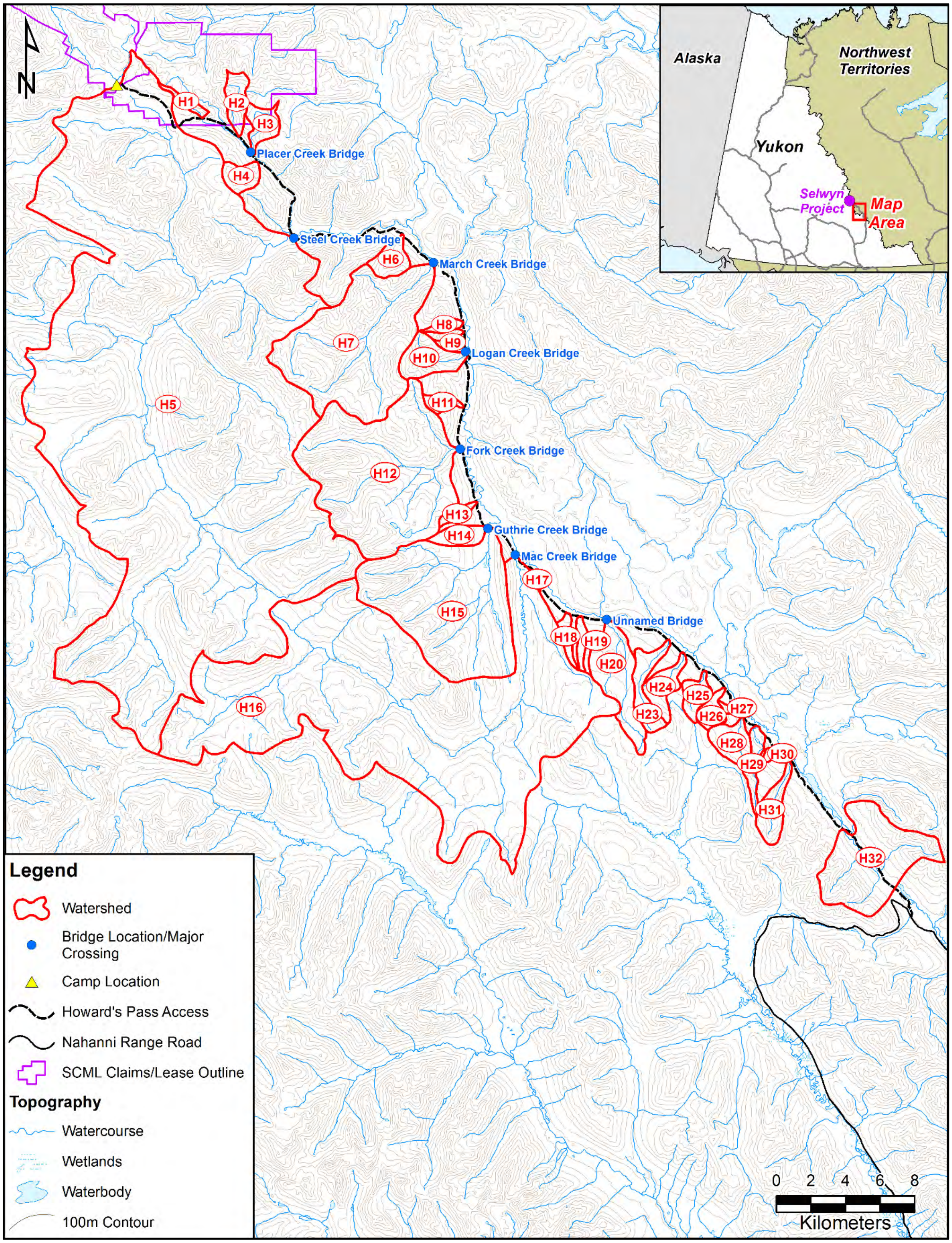
Figure 4.1-3: Regional Hydrology Map Showing the Little Nahanni and Flat River Watersheds



Stream morphology types in the HPAR corridor vary from low gradient, low energy systems meandering through broad, U-shaped valleys to moderate to high gradient, high energy channels confined in V-shaped valleys. The HPAR crosses streams at 32 locations. Eight of these crossings are by permanent bridges installed during 2014. The catchment areas of the larger streams range from 19.2 to 440.8 km^2, while those of the smaller streams range from 0.4 to 12.2 km^2. Where these smaller streams intersect with the road, they are conveyed downstream via culverts.

Figure 4.1-4 shows the hydrology network along the HPAR and indicates the site of the stream crossings. The identification code preceding the stream numbers (H_) is the naming convention developed by Associated Engineering to refer to crossings for the HPAR Conceptual Road Design Plan (Attachment 3 of Volume 1). The naming convention was adopted by Allnorth and Madrone in the hydrological peak flow analysis described in Section 4.1.3.2 below (Madrone Environmental Services Ltd., 2011a).

Figure 4.1-4: HPAR Hydrology Network



Source: Madrone Environmental Services Ltd. (2011a)

4.1.3.1. Streams

Most of the HPAR is within the Little Nahanni River sub-basin, which drains an area of 1,670 km^2 and meanders through a broad, U-shaped valley fed by tributaries flowing from steep mountain streams on either side (Envirocon, 1976). The average channel width varies between 18 to 22 m in the side channels, and up to 57.5 m in the main-stem. The southern portion of the road starts near the divide between the Flat and Little Nahanni Rivers—Divide Lake is at the headwaters of Flat River, and Flat Lakes are at the headwaters of the Little Nahanni River. The road then parallels the Little Nahanni River northwest, following roughly along its west side to the confluence of the Little Nahanni River with Steel Creek at km 62.7.

Major streams (those with catchment areas >10 km^2) that the HPAR crosses are described below.

Flat Creek (H32)	
Flows into	Lower Flat Lake
Catchment area	24.0 km^2
Road crossing	Km 6.8; crossed by multiple culverts (200 mm and 2x 800 mm) upstream of the lower Flat Lakes
Description	A low gradient, partially confined connecting channel between upper and lower Flat Lakes. The Flat Lakes lake-wetland complex extends along the east side of the road from approximately km 7 to km 10.9.

Unnamed Creek at km 26.5 (H20)	
Flows into:	Little Nahanni River
Catchment area:	12.2 km^2
Road crossing:	Km 26.5; crossed by a 15.2 m long clear span bridge 150 m upstream of the Little Nahanni River.
Description:	A moderate gradient, irregularly meandering channel with an average width of 5.7 m.

Mac Creek (H16)	
Flows into:	Little Nahanni River
Catchment area:	197.2 km^2
Road crossing:	Km 33.6, crossed by a 48.4 m long multi-span bridge with one instream pier.
Description:	A low gradient, wide channel with mid-channel bars, with an average width of 23.9 m. Second largest system after Steel Creek.

Guthrie Creek (H15)	
Flows into:	Little Nahanni River
Catchment area:	53.1 km^2
Road crossing:	Km 36.0; crossed by a 18.3 m long clear span bridge
Description:	A low gradient, irregularly meandering channel with mid and side channel bars, with an average width of 10.3 m. Lack of channel confinement has resulted in a low energy, broad flow across the landscape.

Fork Creek (H12)	
Flows into:	Little Nahanni River
Catchment area:	61.1 km^2
Road crossing:	Km 41.0; crossed by a 24.4 m long clear span bridge. The bridge location is in an alluvial outwash fan downstream of a narrow canyon. The steep bank immediately downstream of the canyon is actively eroding and contributes a significant amount of material to the bed load in downstream areas. Evidence of active substrate movement and lack of development of riparian vegetation indicates the crossing area is highly active and is susceptible to naturally occurring impacts from high energy flows.
Description:	A moderate gradient, occasionally confined channel with an average width of 14.8 m.

March Creek (H7)	
Flows into:	Little Nahanni River
Catchment area:	51.3 km^2
Road crossing:	Km 53.3; crossed by a 18.3 m long clear span bridge 450 m upstream of the Little Nahanni River
Description:	Confined, moderate gradient, straight channel. Boulder and cobble till substrate indicates that this stream is likely subject to regular high velocity flows. The straight channel configuration, lack of deposition and erosion on stream banks or islands and gravel bars indicate that the channel has a naturally high hydraulic conductance and likely functions much like a storm aqueduct moving occasional high volume flows quickly to the downstream receiving area.

Steel Creek (H5)	
Flows into:	Little Nahanni River
Catchment area:	440.8 km^2 (including Canex and Placer Creeks)
Road crossing:	Km 62.7, crossed by a 73.2 m long multi-span bridge with two instream piers. Steel Creek is in a wide U-shaped valley; A steep rocky canyon flowing over a series of rapids and a 2 to 3 m high waterfall are 1.5 km upstream of the Little Nahanni River. At this location the stream is tightly constricted in a bedrock channel and stream velocities are likely very high.
Description:	Steel Creek (also known as Lidia Creek), the largest tributary to Little Nahanni River, is a broad (up to 39.8 m), irregularly meandering and generally braided stream which flows around vegetated gravel bars, and is interspersed with short stretches of rapids flowing through small canyons.

Placer Creek (H3)	
Flows into:	Steel Creek
Catchment area:	19.2 km^2
Road crossing:	Km 68.9, crossed by a 15.1m long clear span bridge.
Description:	A moderate gradient channel confined within a long narrow V-shaped valley; experiences high seasonal flows

4.1.3.2. Peak Flow Analysis

Stream flows in the region are typically highest through May and June, with maximum daily and instantaneous flows typically occurring in response to snowmelt and rain-on-snow events. On smaller streams, peak instantaneous flows may occur during the freshet or in late summer and early autumn, due to intense rain or rain-on-snow events. Annual low flows tend to occur in late winter to early spring as water tables drop over the long winters (SCML, 2014).

A hydrological peak flow analysis of the 32 stream crossings along the HPAR road corridor was conducted in 2011 (Allnorth, 2011; updated in Madrone Environmental Services Ltd., 2011a). This study provided estimates of peak discharges (100-year: Q100 and 200-year: Q200 expected peak flows) in order to advise appropriate bridge and culvert sizing. The analysis involved estimation of drainage areas for the 32 catchments, based on GIS data with 5 m contour intervals interpolated from NTS topographic data (Table 4.1-6).

Table 4.1-6: Estimated Catchment Areas along the Howard's Pass Access Road

Catchment	Area (km^2)	Catchment	Area (km^2)	Catchment	Area (km^2)
H1	1.6	**H12**	**61.1**	H23	6.1
H2	3.7	H13	1.9	H24	4.2
H3	**19.2**	H14	2.4	H25	3.2
H4	3.1	**H15**	**53.1**	H26	2.6
H5	**440.8**	**H16**	**197.1**	H27	0.4
H6	3.8	H17	1.0	H28	4.5
H7	**51.3**	H18	1.2	H29	3.6
H8	1.3	H19	2.8	H30	1.1
H9	1.1	**H20**	**12.2**	H31	5.2
H10	7.9	H21	0.5	**H32**	**24.0**
H11	2.0	H22	0.9		

Bolded catchment areas indicate main tributaries discussed in Section 4.1.3.1 above
Source: Madrone Environmental Services Ltd. (2011a)

4.1.3.3. Lakes and Open Water Bodies

There are five lakes within the HPAR corridor, including the Flat and Divide Lakes (locations are shown on Figure 4.2-5). Lakes are defined as water bodies at least 2 m deep and more than 10 ha in size. The larger, deeper lakes usually have little to no aquatic or emergent vegetation, but smaller lakes typically have a marsh fringe or other wetland types adjacent.

Open water bodies are defined as less than 10 ha. These include ponds and water bodies that are smaller than lakes, typically shallower than 2 m, or occurring in complexes with riparian areas or other wetland types. Emergent vegetation is sparse in these areas.

SCML has not conducted lake level or flow monitoring of the lakes within the HPAR corridor and thus cannot provide data with respect to the hydrological dynamics of these systems. Flat Lakes, Divide Lake and open water bodies are important habitat for waterfowl. Incidental observations confirm that these lakes provide habitat for swans (Section 4.2.8.9).

4.1.3.4. Water Quality

Water quality in the South Nahanni watershed is identified as a key measure of Nahanni National Park Reserve's ecological integrity, with a goal of ensuring that quality remains at a high standard (Haggarty and Tate, 2009; Parks Canada, 2010). Site specific water quality guidelines, adapted from the Canadian Council of Ministers of the Environment water quality guidelines (CCME 2001 and 2003), have been developed for the South Nahanni watershed to take into account the high background levels of some metals (Halliwell and Cato, 2003; Haggarty and Tate, 2009).

Water sampling stations are established on the South Nahanni River and lower reaches of tributaries and the data extend back to 1993, with irregular sampling. Sampling locations were selected to provide representative data on the South Nahanni River and tributaries potentially affected by upstream mining development (past and future), (Halliwell and Cato, 2003). The Flat River is sampled well downstream of the HPAR, at the original park reserve boundary and at its confluence with the South Nahanni River. Water quality of the South Nahanni River and the Flat River was rated as between fair and good, with levels of some metals exceeding guidelines on occasion. Baseline water quality characteristics in general were: neutral to weakly alkaline; high conductivity due to high concentrations of calcium and magnesium ions; high turbidity, colour and suspended and dissolved solids, especially during spring freshet and following storms; naturally contains high levels of trace metals, including zinc and copper, throughout the year (Halliwell and Cato, 2003).

Limited water quality measurements were conducted during a fish and fish habitat survey along the HPAR corridor in 2014 (Triton Environmental Consultants, 2014, see Section 4.2.6). Parameters measured were temperature, pH and conductivity.

4.2. Ecosystems and Biota

4.2.1. Regional Overview of Ecosystem Characteristics

The HPAR corridor is at the edge of the Taiga Cordillera Ecozone (following the Canadian national ecosystem classification system (ESTR Secretariat, 2011). It is also within the Greater Nahanni Ecosystem, the ecological region used by Parks Canada for assessment purposes (Parks Canada, 2015), which consists of the entire South Nahanni River watershed and an area north of the first canyon known as the Nahanni Karst.

Table 4.2-1 outlines the ecosystem classification and describes the landscape traversed by the HPAR corridor, based on the NWT's revised ecosystem classification system (Ecosystem Classification Group, 2010). In this nested system, Level 1 is the broadest landscape division, and Level IV ecoregions are the smallest divisions, defined by a combination of landscape and climate features.

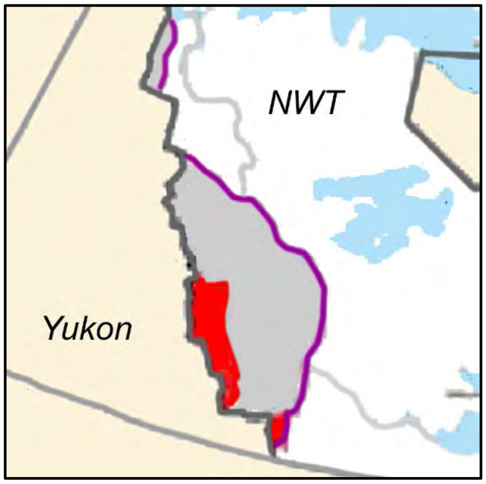
Table 4.2-1: Ecosystem classification of the HPAR corridor area and the surrounding region (NWT classification system)

<table>
<tr><th>Level</th><th>Ecoregion Name</th><th>Description</th></tr>
<tr><td>I</td><td>Northwestern Forested Mountains Ecoregion</td><td rowspan="2">Southern quarter of the NWT's main mountain ranges, along the Yukon-NWT border. The Boreal Cordillera extends from northern British Columbia, through much of the Yukon and to Alaska.</td></tr>
<tr><td>II</td><td>Boreal Cordillera Ecoregion</td></tr>
<tr><td>III</td><td>Mid-Boreal Ecoregion (Figure 4.2-1)</td><td>Defined by short, wet summers; very cold and snowy winters; mean annual temperature minus 4°C to minus 6°C. Average annual precipitation 400–600 mm. Continuous to discontinuous permafrost. Glaciers and icefields at high elevations. Alpine fir and plant species with a Pacific-Cordilleran distribution occur in the Mid-Boreal Ecoregion. Aspen, mixed-wood and spruce forests and sedge-dominated wetlands are common on lower valley slopes and valley floors.</td></tr>
<tr><td>IV</td><td>Mount Pike</td><td>The road corridor is mainly within this alpine and subalpine level IV ecoregion, which extends along the Little Nahanni River and is bounded by the Yukon-NWT border. Defined by rounded shale and sandstone peaks, eroded plateaus, lush, species-rich alpine fir-herb meadow complexes and lichen tundra. Spruce woodlands and conifer forests are widespread. Permafrost is discontinuous. This ecoregion and the two adjacent ones are considered to have the highest precipitation in the NWT, based on the types and lush green characteristics of vegetation present.

The level IV ecoregions are further divided by elevation, into alpine, subalpine, and boreal (forested) zones. The lower elevation parts of the HPAR corridor are in boreal portions of neighbouring ecoregions.</td></tr>
</table>

Source: Ecosystem Classification Group (2010)

Figure 4.2-1: Mid-Boreal Level III Ecoregion



The areas outlined in purple are the NWT's Cordilleran ecoregions. The Mid-Boreal Ecoregion shown in red.
Source: Ecosystem Classification Group (2010)

4.2.2. Ecological Zones and Vegetation

4.2.2.1. Introduction and Methods

The earliest vegetation study of the HPAR corridor was conducted in 1976, prior to the original road development, and consisted of a baseline description of vegetation types found along the road (Envirocon, 1976). For the purposes of assessing the planned road modifications and operations, Terrestrial Ecosystem Mapping (TEM) of a 2 km wide corridor along the road alignment was conducted in 2011 (Madrone Environmental Services Ltd., 2011d).

Mapping was based on a hierarchical classification system developed to characterize the Selwyn Project area (Madrone Environmental Services Ltd., 2008) and used to delineate bioterrain features of the landscape, and to categorize specific vegetation associations in the HPAR corridor area. This ecosystem classification approach was built on existing research from the region to describe vegetation communities with an accurate, readily recognizable, locally relevant approach.

At the highest level of classification, the road study area was stratified into ***broad ecological zones***. The zones reflect regional climate, soils, vegetation, topography, and time. A pattern of undisturbed climax vegetation communities reflect the abiotic features and climatic influences in a consistent and repeatable pattern within a zone. Vegetation associations were classified within the broad ecological zones and assigned an ***ecosystem type*** based on dominant vegetation type, drainage and nutrient regimes. Ecosystem type modifiers (e.g., aspect, slope, structural stage) further allowed stratification of ecosystem types into ***ecosystem units***.

Habitat suitability modeling for the HPAR (Section 4.2.8.2) is based on the mapped ecosystem units described and shown below (Madrone Environmental Services Ltd., 2011e and 2011d).

4.2.2.2. Vegetation Study Area and Broad Ecological Zones

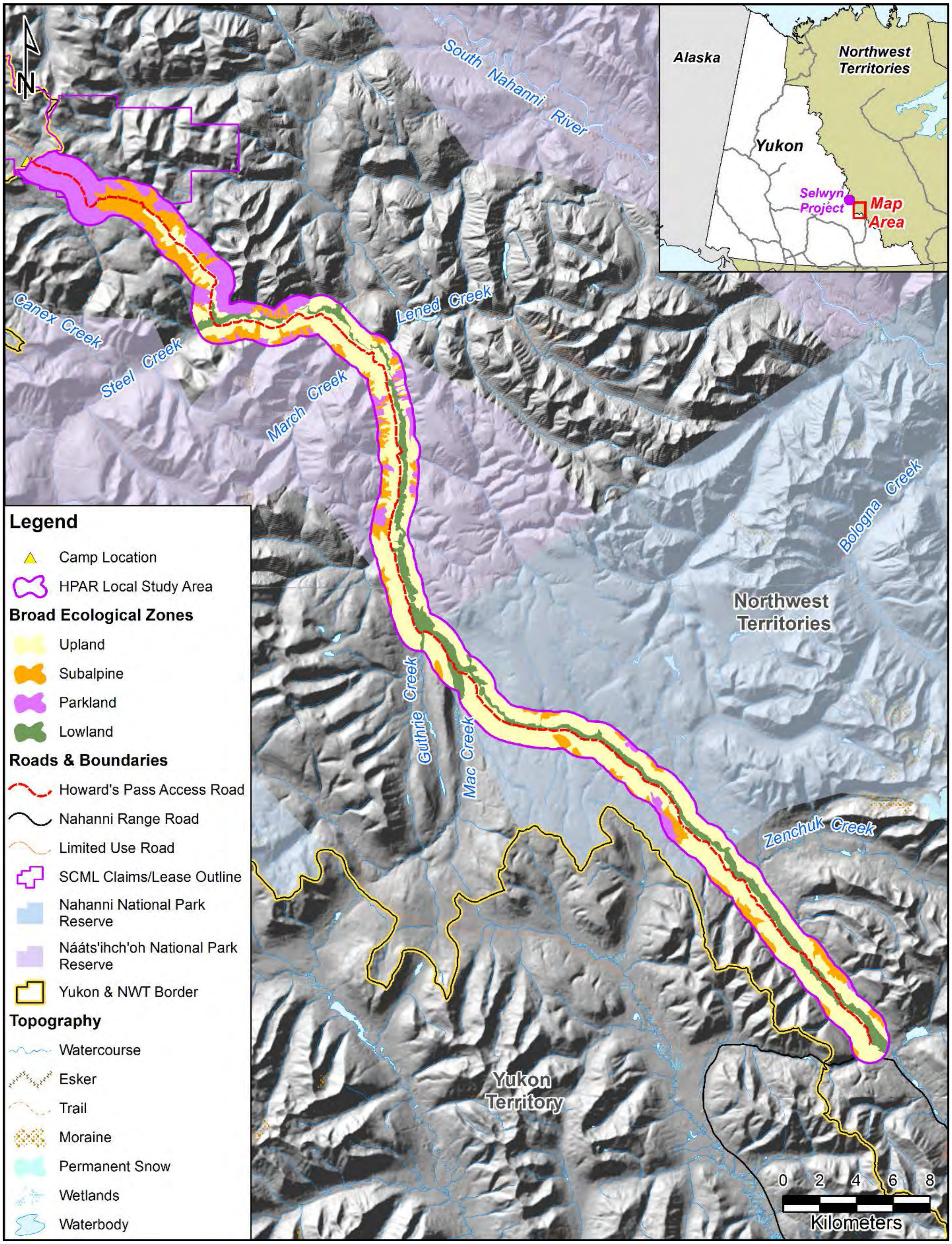
The distribution of the broad ecological zones mapped in the vegetation study area is shown in Table 4.2-2 and in Figure 4.2-2.

Table 4.2-2: Distribution of Broad Ecological Zones in the HPAR Vegetation Study Area

Broad Ecological Zones	Road Corridor	
	Area (ha)	Percent of Study Area
Alpine	0	0%
Parkland	1,249	8%
Sub-alpine	3,291	21%
Upland	9,073	58%
Lowland	2,031	13%
Total	**15,644**	**100%**

Source: Madrone Environmental Services Ltd. (2011d)

Figure 4.2-2: Distribution of Broad Ecological Zones Mapped within the HPAR Corridor



Source: Madrone Environmental Services Ltd. (2011d)

The most common ecological zone in the HPAR corridor is the **Upland** ecological zone (Photo 4.2-1), which occurs on lower mountain slopes below the subalpine (between 1,000 m and 1,200 m above sea level). This ecological zone typically has a cover of open forests of white spruce and subalpine fir, with a shrub understory of willows and scrub birch and a thick ground cover of feather mosses. Lichens are more common in drier areas of this zone than shrubs. Shrub and herb dominated low elevation meadows, as well as fen and marsh wetlands, occur throughout this ecological zone.

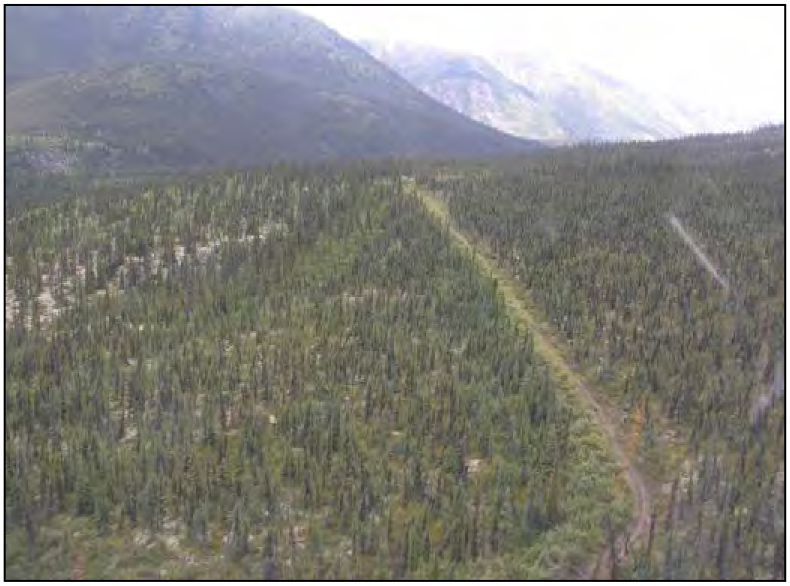


Photo 4.2-1: Typical habitat of the Upland broad ecological zone in the HPAR vegetation study area

Upper slopes and plateaus are characterized as **Subalpine** (Photo 4.2-2), with cover consisting of lichen-dominated tundra, Krummholz (stunted) subalpine fir and white spruce patches mixed with high elevation herbaceous meadows or lichen tundra at or below the treeline.

Above the Subalpine, in the Parkland zone (Photo 4.2-3), a combination of poorly developed soils and climate factors results in forb and dwarf shrub communities, featuring lichen and moss ground cover. The sparsely vegetated **Alpine** zone (outside of the HPAR study area), is characterized by steep talus slopes with rocky peaks. Permafrost processes are apparent in this rock-dominated area.

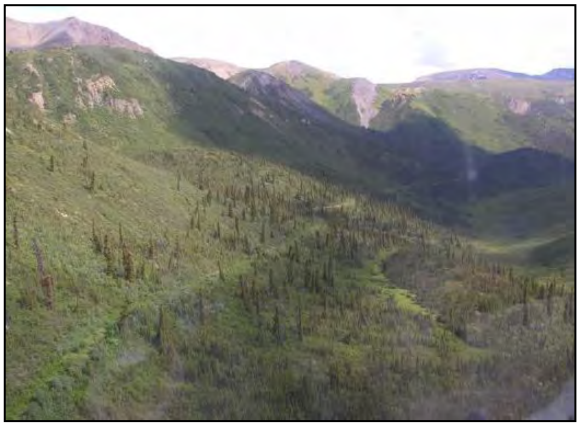


Photo 4.2-2: Typical habitat of the Subalpine broad ecological zone in the HPAR vegetation study area

Photo 4.2-3: Typical habitat of the Parkland broad ecological zone in the HPAR vegetation study area

In **Lowland** areas (Photo 4.2-4), low gradient waterways meander through broad "U" shaped valleys, bordered by white spruce and balsam poplar forest cover, as well as fen and marsh wetlands, and low elevation meadows.

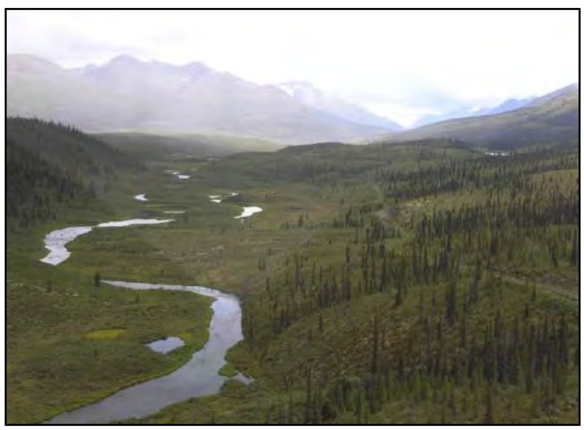


Photo 4.2-4: Typical habitat of the Lowland broad ecological zone in the HPAR vegetation study area

4.2.2.3. Ecosystem Types and Units

Five ecosystem types and 29 vegetated and non-vegetated ecosystem units were identified within the HPAR corridor for the HPAR Terrestrial Ecosystem Mapping. Table 4.2-3 provides a summary description of these units in terms of their dominant characteristics and proportional coverage of the HPAR corridor vegetation study area. This summary is based on analysis of the Terrestrial Ecosystem Maps (mapped at a scale of 1:30,000).

Table 4.2-3: Summary of Ecosystem Type / Unit Distribution in the HPAR Vegetation Study Area

A. Ecosystem Type: Forested

Ecosystem Unit	Description	Mapped Area (ha)	Percent of Study Area
Subalpine Fir – Dwarf Shrub	Subalpine and parkland zones; mature trees 3–5 m; nutrient poor sites, typically include ericaceous shrubs and moss/lichen layer	419	3%
Subalpine Fir – Tall Shrub	Subalpine and parkland zones; mature trees 5–10 m; well-developed shrub layer, sparse herb layer fir-tall shrub; variable nutrient regime	176	1%
Subalpine Fir – Lichen	Subalpine zone; mature trees 3–10 m; very thin dry soils, nutrient poor sites, well-developed moss/lichen layer	6	<1%
Subalpine Fir – Spruce	Transitional forests between subalpine and upland zones; mature trees 5–15 m; variable shrub layer and well developed moss/lichen layer	1,657	11%
White Spruce – Dwarf Shrub	Upland and lowland zones; mature trees 10–20 m; sparse herb layer, well developed moss/lichen layer	3,449	22%
White Spruce – Tall Shrub	Upland and lowland zones; mature trees 10–20 m; occur adjacent to drainages; well-developed shrub layer; horsetails, moss/lichen are common	3,356	21%
Balsam Poplar – White Spruce	Upland and lowland zones, only adjacent to large drainages; mature trees 15–20 m; willow-alder shrub layer; sparse herb layer and moss/lichen layer not well developed	78	<1%
Total Forested		**9,141**	**58%**

B. Ecosystem Type: Meadow

B.1. High Elevation Meadow Ecosystems

Ecosystem Unit	Description	Mapped Area (ha)	Percent of Study Area
Dwarf Shrub	Subalpine and parkland zones; ericaceous shrubs or dwarf willows with graminoids, forbs, lichens and mosses; on till, very thin soils	1,193	8%
Tall Shrub	Subalpine and parkland zones; dense willow shrub layer; sparse herb layer; moss/lichen layer dominated by mosses	1,038	7%
Poor Herbaceous	Subalpine and parkland zones; ericaceous shrubs sparsely distributed; herb layer dominated by grasses; variety of moss/lichen species	288	2%
Lichen	Subalpine and parkland zones; sparse shrub and herb layers; moss/lichen layer dominated by lichen; thin soils	2	< 1%

B.2. Low Elevation Meadow Ecosystems

Birch – Lichen	Upland and lowland zones; herb layer dominated by scrub birch (1-2 m); sparse herb layer; moss/lichen layer dominated by *Cladina spp.*	1,288	8%
Tall Shrub	Upland and lowland zones; shrub layer dominated by willows (2-3 m); moss/lichen layer dominated by moss	1,228	8%
Poor Herbaceous	Upland and lowland zones; very sparse shrub layer; herb layer dominated by grasses; moss/lichen species vary in abundance	21	< 1%
Rich Herbaceous	Upland and lowland zones; sparse shrub layer; wide range of forbs, grasses and sedges in herb layer	2	< 1%
Total Meadows		**5,061**	**32%**

C. Ecosystem Type: Wetland Communities

Ecosystem Unit	Description	Mapped Area (ha)	Percent of Study Area
Water Sedge – Beaked Sedge fen	Upland and lowland zones; poor to very poorly drained organic soils; dense herb layer dominated by sedges	33	< 1%
Scrub Birch – Water sedge fen	Upland and lowland zones; poor to very poorly drained organic soils; shrub layer dominated by scrub birch and willows (<2 m); sedges dominate herb layer	23	< 1%
Water Sedge – Peat Moss fen	Upland and lowland zones; poor to very poorly drained organic soils; sedges dominate herb layer; peat mosses abundant creating hummocky mounds	4	< 1%
Barclay's Willow – Water Sedge – Glow Moss fen	Upland and lowland zones; poor to very poorly drained organic soils; shrub layer dense and dominated by willows (1-2+ m); sedges in herb layer	65	< 1%
Beaked Sedge – Water Sedge	Lowland zone, only along lake edges and open water; standing water present throughout; dense herb layer dominated by sedges	9	< 1%
Total Wetland Communities		**135**	**1%**

D. Ecosystem Type: Riparian

Ecosystem Unit	Description	Mapped Area (ha)	Percent of Study Area
Riparian Tall Shrub	Upland, lowland and subalpine zones, adjacent to small creeks, draws, gullies and larger drainages; shrub layer dominated by willow and alder species	572	4%
Total Riparian		**572**	**4%**

E. Ecosystem Type: Non-vegetated

E.1. Natural

Ecosystem Unit	Description	Mapped Area (ha)	Percent of Mapped Area
Exposed Soil	Occurs at disturbed or sparsely vegetated sites or adjacent to watercourses as a result of erosion	71	< 1%
Gravel Bar	Non-vegetated areas formed by fluvial sorting of cobbles, pebbles, stones and sand; regularly disturbed by seasonal flooding	75	< 1%
Lake	Bodies of water > 2 m deep; larger lakes (> 10 ha) have little aquatic or emergent vegetation; smaller lakes have adjacent marsh or wetland types	109	1%
Open Water	Ponds and water bodies < 2 m deep; typically < 10 ha; sparse emergent vegetation	89	1%
River	Channelized flowing water	217	1%
Rock Outcrop	Occur on ridge crests, or on exposed lower slopes	42	< 1%
Talus	Colluvium with extremely thin soils	52	< 1%

E.2. Anthropogenic

Road Surface	Cleared areas compacted for vehicle use	79	1%
Total Non-Vegetated Units		**743**	**5%**

Total HPAR Study Area	**15,644**	**100%**

Source: Madrone Environmental Services Ltd. (2011d)

4.2.2.4. Forested Ecosystems

Approximately 58% of the HPAR vegetation study area is characterized as forested (9,141 ha). Forested communities are typically open canopy, ranging from 5–20% tree cover. Trees rarely reach heights over 20 m, or diameters larger than 30 cm; although larger snags and woody debris up to 50 cm have been observed in the area, especially in moist draws that have acted as fire refuges. Subalpine fir dominates the canopy at higher elevations, with white spruce becoming more frequent at lower elevations. Deciduous trees, such as balsam poplar, were mapped in lower areas, typically adjacent to streams.

Younger forests were the most common of the mapped forested structural stages, followed by mature forests consisting of white spruce stands found at lower elevations and along drainages such as Steel, March, Guthrie and Mac Creeks. No old growth forests were mapped in the HPAR vegetation study area, although many of the forests likely represent climax seral stage conditions. The least common forested structural stages are early successional shrub/herb stage or shrub communities, and pole/sapling (tree heights <10 m). These early successional forests are primarily associated with the shrubby subalpine forests found at higher elevations.

Forests in the HPAR corridor show little evidence of previous large-scale disturbance. As the corridor is located in a particularly wet region that is snowbound for much of the year, evidence of past forest fires is rare.

The distribution of mature forest ecosystems is shown in Figure 4.2-3.

4.2.2.5. Meadow Ecosystems

Non-forested vegetation communities of the HPAR vegetation study area are primarily characterized as meadows and represent a total of 32%, or 5,061 ha of the mapped ecosystems within the area. Meadows include vegetated communities with less than 3% tree cover. Two groups of meadows were mapped based on elevation: low meadow and high meadow. Low elevation meadows are common on level to gently sloping sites in the Upland and Lowland ecological zones, and often occur in valley bottoms and riparian sites (Madrone Environmental Services Ltd., 2011d). High elevation meadows typically occur on steep upper slopes and crest positions in the Parkland and Subalpine ecological zones. Four high elevation and four low elevation meadows were identified.

The distribution of meadow ecosystems are shown in Figure 4.2-4.

4.2.2.6. Wetland Communities

Wetland communities account for a small proportion of the HPAR corridor (1%, or 135 ha, of the study area). The most common wetland community in the HPAR corridor are fens which are typically associated with organic veneer or blankets, and dominated by sedges, peat mosses and shrubs. Varying nutrients and water levels support different plant communities (Madrone Environmental Services Ltd., 2011d). Four types of fens were identified in the HPAR corridor. Sedge-dominated marsh wetland is present occasionally on the fringes of open water and lakes.

The distribution of lakes, open water and wetlands is shown in Figure 4.2-5.

4.2.2.7. Riparian Ecosystems

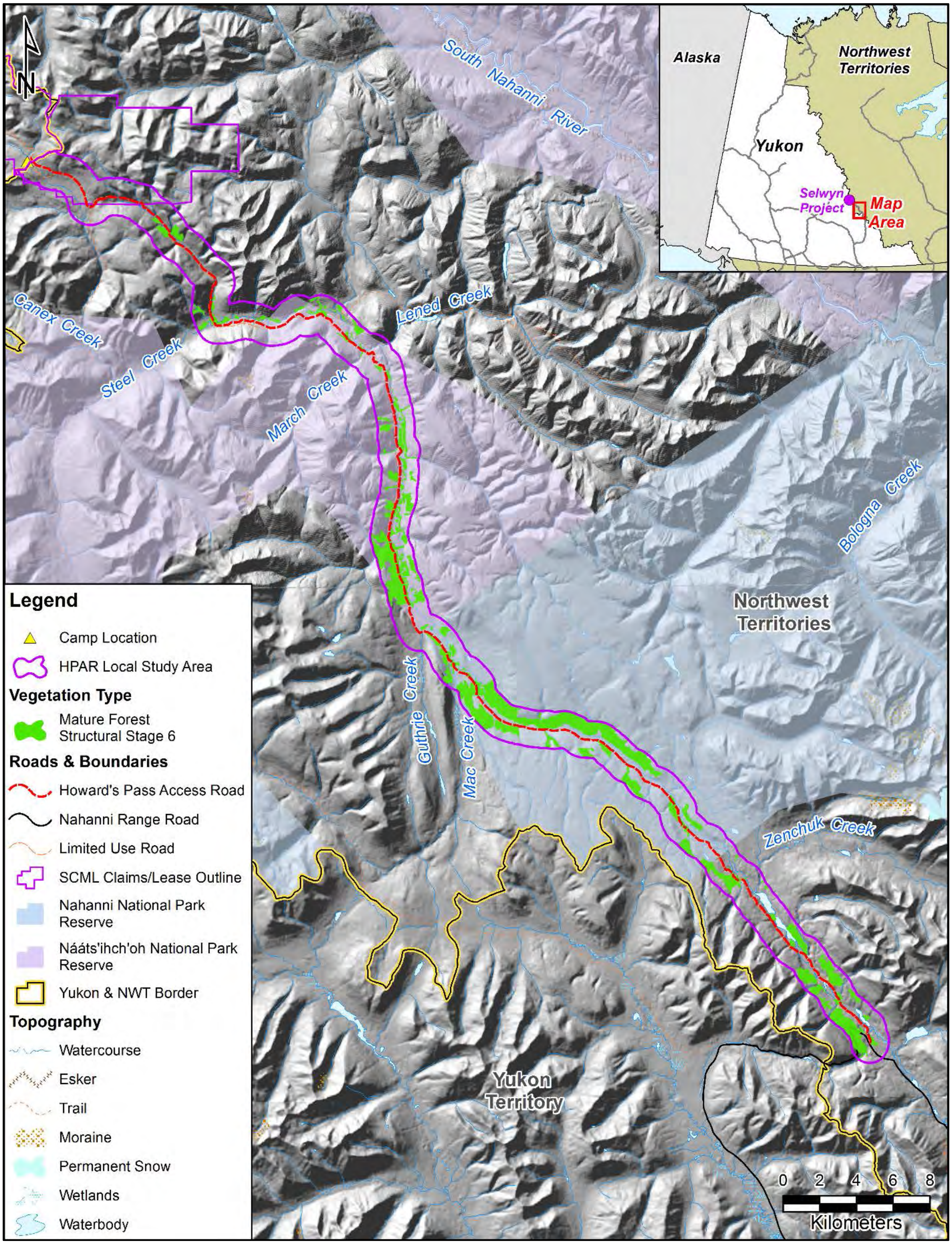
Riparian ecosystems occur rarely, with only one ecosystem unit identified. The willow and alder dominated Riparian-Tall Shrub ecosystem unit covers 572 ha or 4% of the study area. It occurs along rivers, creeks and other drainages. In some cases the Riparian-Tall Shrub unit may be a minor ecosystem component associated with rivers and gravel bars. Riparian units typically occur in valley bottoms associated with creeks and rivers such as Placer Creek and the Little Nahanni River, as well as numerous other drainages within the HPAR corridor. Abundant forage vegetation associated with the Riparian-Tall Shrub ecosystem unit provides high habitat value for moose and caribou (Madrone Environmental Services Ltd., 2011d).

The distribution of riparian ecosystems is shown in Figure 4.2-6.

4.2.2.8. Non-Vegetated Units

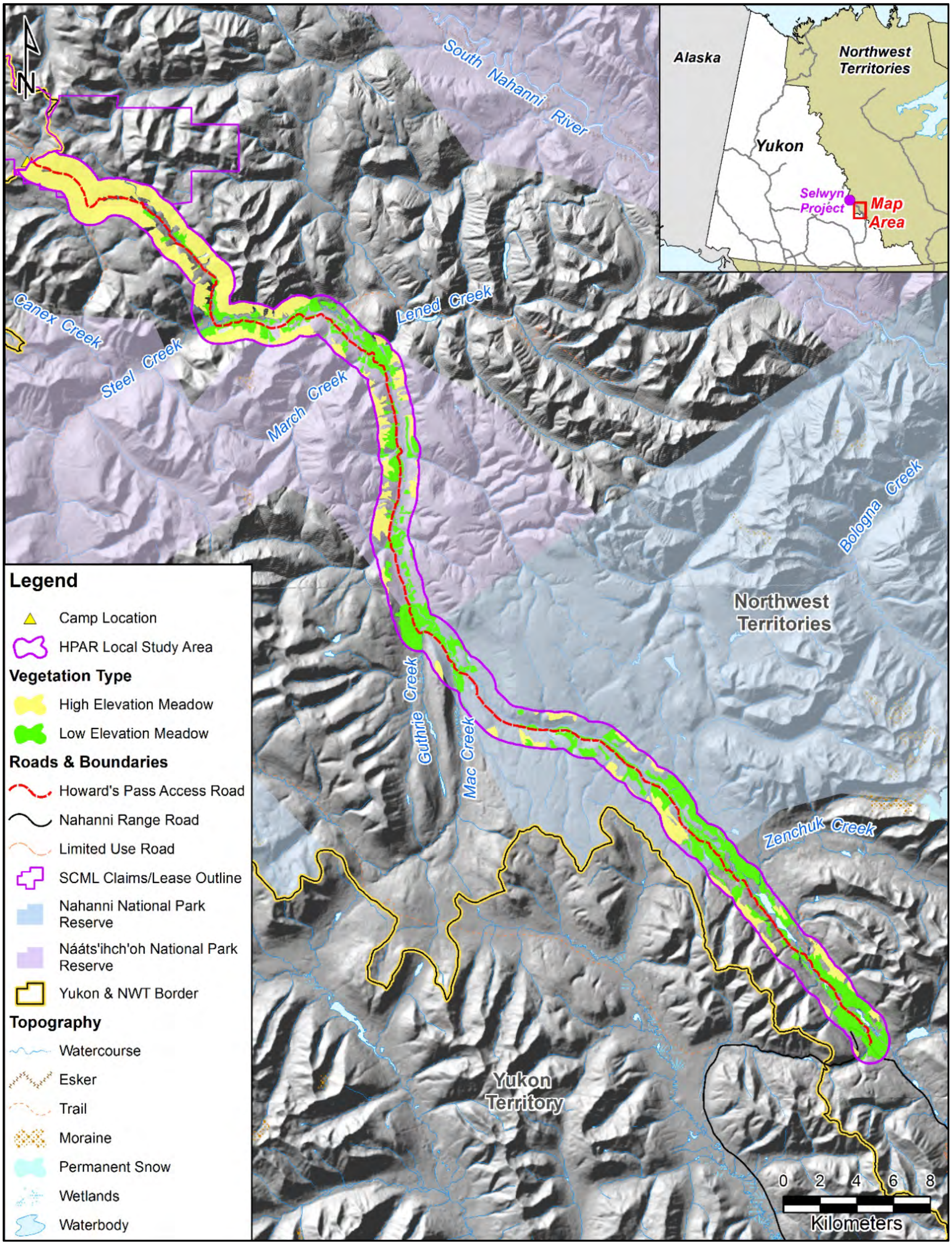
Non-vegetated components (including natural and anthropogenic), within the HPAR corridor were also identified. Non-vegetated units include areas of exposed soil, gravels bars, lakes, open water, river, rock outcrop, talus and road surface. Areas of natural and anthropogenic non-vegetated units total 656 ha (4%), and 79 ha (1%), respectively. Lakes and open water areas are shown on Figure 4.2-5.

Figure 4.2-3: Distribution of Mature Forested Ecosystems Mapped within the HPAR Corridor



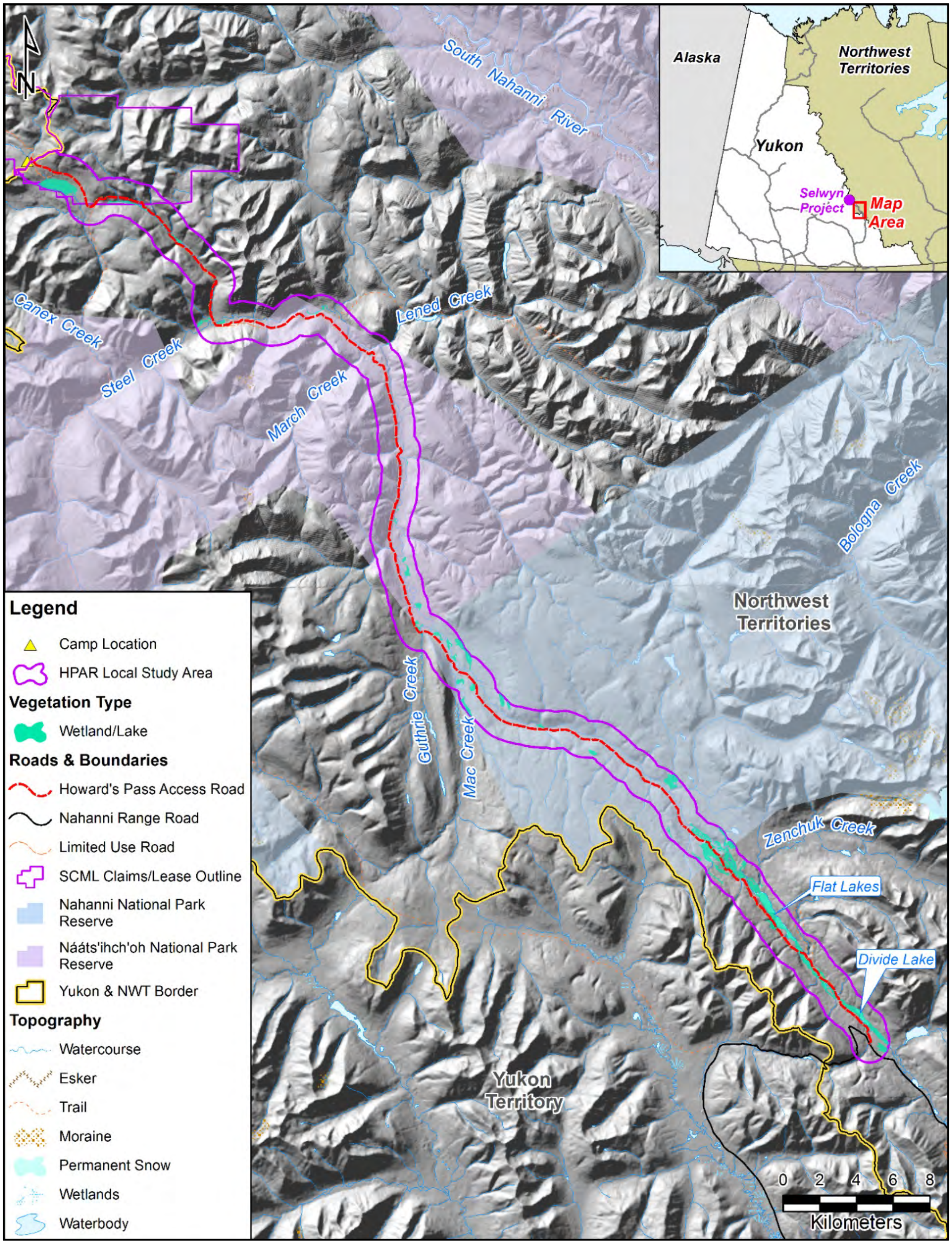
Source: Madrone Environmental Services Ltd. (2011d)

Figure 4.2-4: Distribution of Meadow Ecosystems Mapped within the HPAR Corridor



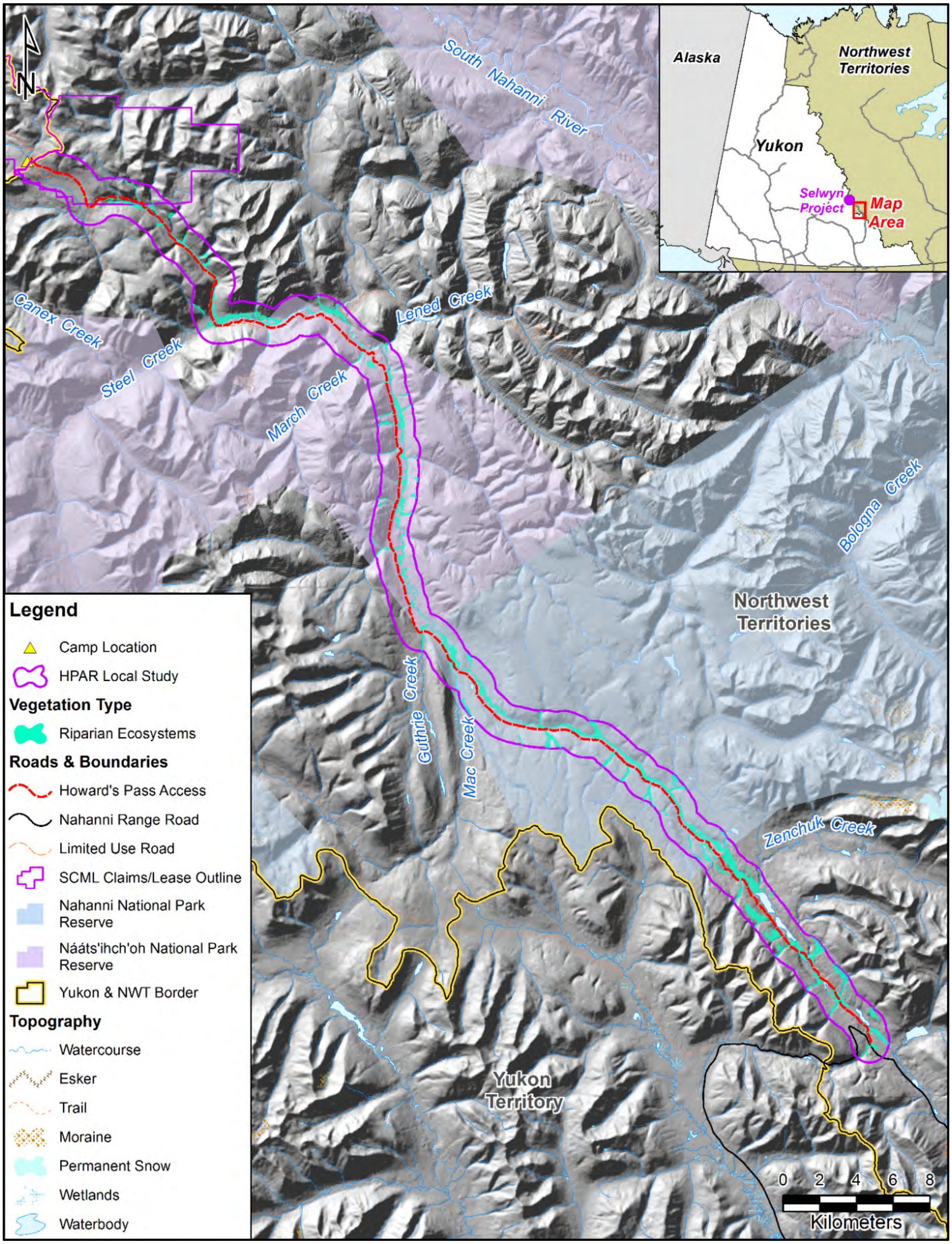
Source: Madrone Environmental Services Ltd. (2011d)

Figure 4.2-5: Distribution of Wetlands, Open Water and Lakes Mapped within the HPAR Corridor



Source: Madrone Environmental Services Ltd. (2011d)

Figure 4.2-6: Distribution of Riparian Ecosystems Mapped within the HPAR Corridor



Source: Madrone Environmental Services Ltd. (2011d)

4.2.3. Ecosystem Potential for Rare Plants

Each ecosystem mapped within the HPAR corridor was ranked for its potential to contain rare plant species, based on habitat types and knowledge of the ecosystems of the area (Madrone Environmental Services Ltd., 2011d). As described in Table 4.2-4, each ecosystem unit was ranked either "High", "Moderate", "Low" or "Nil" for rare plant potential.

Table 4.2-4: Rare Plant Occurrence Potential Ranking System

Rank	Description
High	Would only apply to features known to often support rare species, such as limestone outcrops, patterned fens, hot springs, dry grassy slopes, and other less common features that do not appear to be present in the study area.
Moderate	Indicates that the likelihood is greater that a rare species may occur in the ecosystem.
Low	Indicates that the ecosystem type is unlikely to harbour rare plant populations, although it is possible that a rare species could occur given suitable habitat (e.g., a small seepage area, rock outcrop or an area too small to map, which lies within a larger forested polygon).
Nil	Assigned to anthropogenic features such as road surfaces

Source: Madrone Environmental Services Ltd. (2011d)

Overall, there is a low to moderate potential for rare plant species to occur in the HPAR corridor vegetation study area. Table 4.2-5 provides the rare plant potential ratings for the five ecosystem types and 29 units identified within the HPAR corridor. Total areas of rare plant potential mapped for the HPAR corridor are summarized in Table 4.2-6. A rare plant survey along the HPAR is planned for 2016.

Table 4.2-5: Rare Plant Potential Ratings for Ecosystems Mapped in the HPAR Vegetation Study Area

Ecosystem Type	Ecosystem Unit	Potential
Forested Ecosystems	Subalpine Fir – Dwarf Shrub	Low
	Subalpine Fir – Lichen	Low
	Subalpine Fir – Tall Shrub	Low
	Subalpine Fir – Spruce	Low
	White Spruce – Dwarf Shrub	Low
	White Spruce – Tall Shrub	Low
	Balsam Poplar – White Spruce	Moderate
High Elevation Meadows	Dwarf Shrub	Moderate
	Tall Shrub	Low
	Poor Herbaceous	Moderate
	Lichen	Moderate
Low Elevation Meadows	Birch – Lichen	Low
	Tall Shrub	Low
	Poor Herbaceous	Moderate
	Rich Herbaceous	Moderate
Riparian Ecosystems	Riparian Tall Shrub	Moderate
Wetland Ecosystems	Water Sedge – Beaked Sedge Fen	Low
	Scrub Birch – Water Sedge Fen	Low
	Water Sedge – Peat Moss Fen	Moderate
	Barclay's Willow – Water Sedge – Glow Moss Fen	Low
	Beaked Sedge – Water Sedge	Moderate
Natural Non-Vegetated Units	Exposed Soil	Moderate
	Gravel Bar	Moderate
	Lake	Moderate
	Open Water	Moderate
	River	Moderate
	Rock Outcrop	Moderate
	Talus	Moderate
Anthropogenic Units	Road Surface	Nil

Source: Madrone Environmental Services Ltd. (2011d)

Table 4.2-6: Area of Rare Plant Potential Mapped in the HPAR Vegetation Study Area

Potential	Mapped Area (ha)	Percent of Study Area
High	0	0%
Moderate	6,181	39%
Low	9,384	60%
Nil	79	1%
Total	**15,644**	**100%**

Source: Madrone Environmental Services Ltd. (2011d)

4.2.4. Invasive Plant Species

There are currently 116 vascular plants listed as alien (non-native) species in the NWT (Working Group on General Status of NWT Species, 2011). Of these, only yellow sweetclover (*Melilotus officinalis)* is considered to be moderately invasive in the NWT portion of the Taiga Cordillera Ecozone (this is the national classification that includes the HPAR corridor).

The likelihood of augmenting the distribution and abundance of invasive species is increased by the introduction of road access, increased road traffic and industrial development. For example, in Alaska, white sweetclover (*Melilotus albus)* has spread along many roadsides and, where roadsides intersect with river floodplains, has in some regions spread downriver. This has led to dense sweetclover stands along some river floodplains, with the potential to replace native plants and alter soil and other habitat characteristics (ESTR Secretariat, 2011).

As the HPAR has been in existence since the late 1970s, there is the potential that invasive plant species are already established in the corridor. A formal baseline inventory of invasive species in the HPAR corridor area was not conducted prior to this proposal, but will be conducted in the summer of 2015. To date yellow sweetclover has not been observed during the HPAR work in 2014 (D. Reeve and R. Whitehouse, pers. comm.).

4.2.5. Baseline Levels of Metals in Vegetation

A sampling program was undertaken in 2013 to assess naturally occurring baseline levels of metals in selected wildlife forage plants prior to the HPAR upgrade (Madrone Environmental Services Ltd., 2013). Three vegetation types were selected:

1. Lichen (*Cladina stellaris*). Lichen are important food for caribou. Lichens are also long-lived, sensitive to air pollution, and tend to rapidly accumulate metals, and thus are a good early indicator of contamination.
2. Forbs (*Equisetum arvense* – horsetail), a perennial plant that is a preferred forage species for bears and moose in moist habitats.
3. Shrubs (*Salix planifolia* – willow), browsed by caribou and moose. Willows do not readily accumulate metals in leaves, but higher levels may be found in woody tissue.

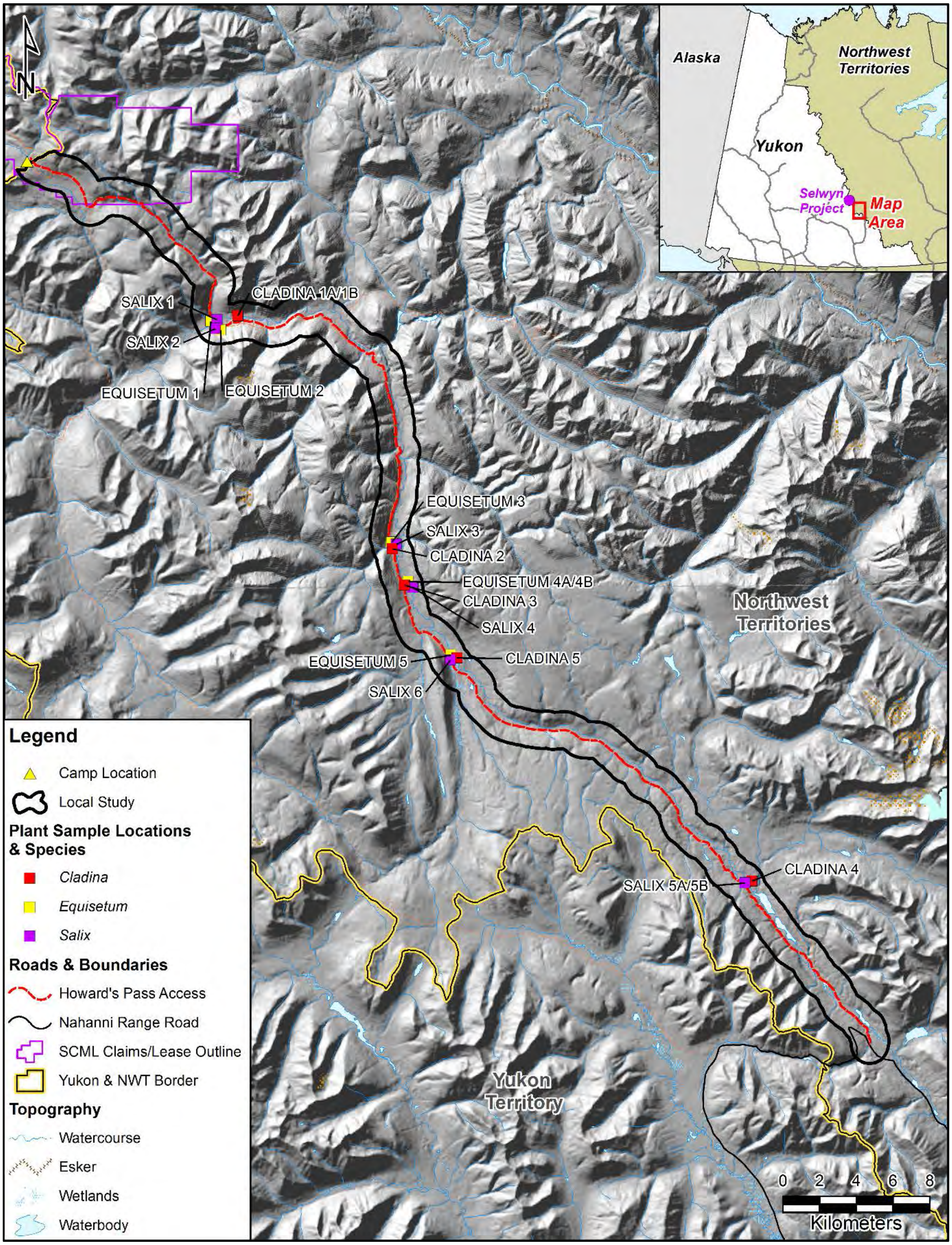
Samples were collected in July, 2013 at locations spread along the length of the HPAR (Figure 4.2-7). Results for metals analyses were within the range typical for the overall region (they were compared with studies in Alaska and the Pacific Northwest) and below levels that are considered "enriched". The predominantly acidic soils throughout the HPAR corridor are associated with increased plant uptake of some metals, including zinc. Lead uptake is not affected by soil pH. Results for selected metals are presented in Table 4.2-7.

Table 4.2-7: Baseline Metals in Vegetation

Concentrations are ppm or mg/kg for total metals, shown as mean (min-max)

	Arsenic	Cadmium	Copper	Lead	Mercury	Selenium	Zinc
Lichen n=6	0.13 (0.08-0.18)	0.07 (0.03-0.13)	2.17 (1.57-2.92)	0.43 (0.2-0.55)	0.01 (0.01-0.02)	<0.05	21.3 (10.9-40.8)
Horsetail n=6	0.63 (0.08-1.36)	4.6 (0.66-9.07)	9.63 (7.11-16.3)	1.84 (0.03-4.62)	0.01 (0.01-0.02)	2.2 (0.16-5.35)	79.0 (56.2-147.0)
Willow n=7	<0.05	6.51 (0.08-22.2)	5.19 (3.68-7.36)	0.07 (0.03-0.11)	<0.01	0.65 (0.08-2.16)	113.7 (73.7-188.0)

Figure 4.2-7: Sampling Locations for Baseline Metals Levels in Vegetation



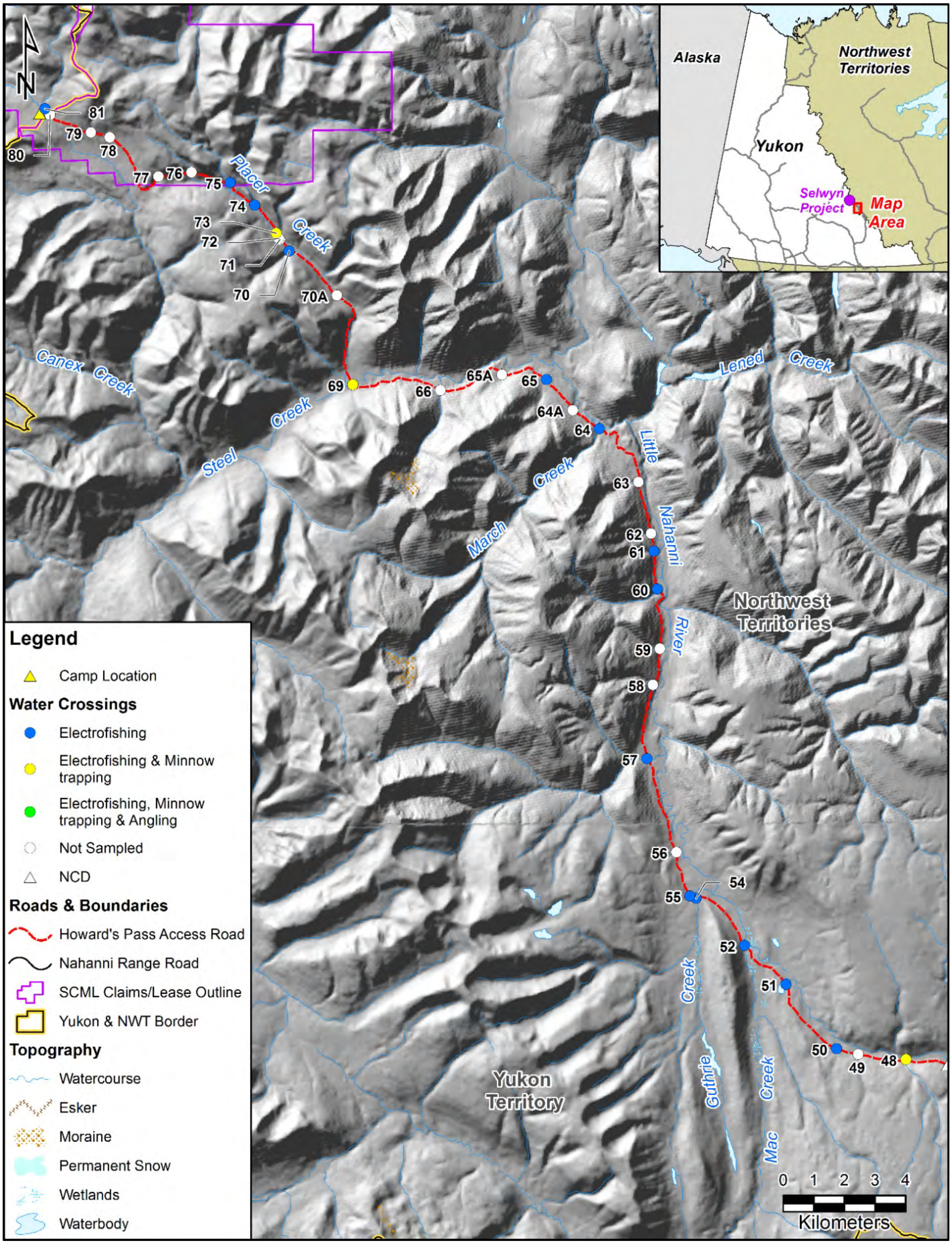
Cladina is a lichen; *Equisetum* is horsetail, a forb; *Salix* is a willow shrub species. Source: Madrone Environmental Services Ltd. (2013)

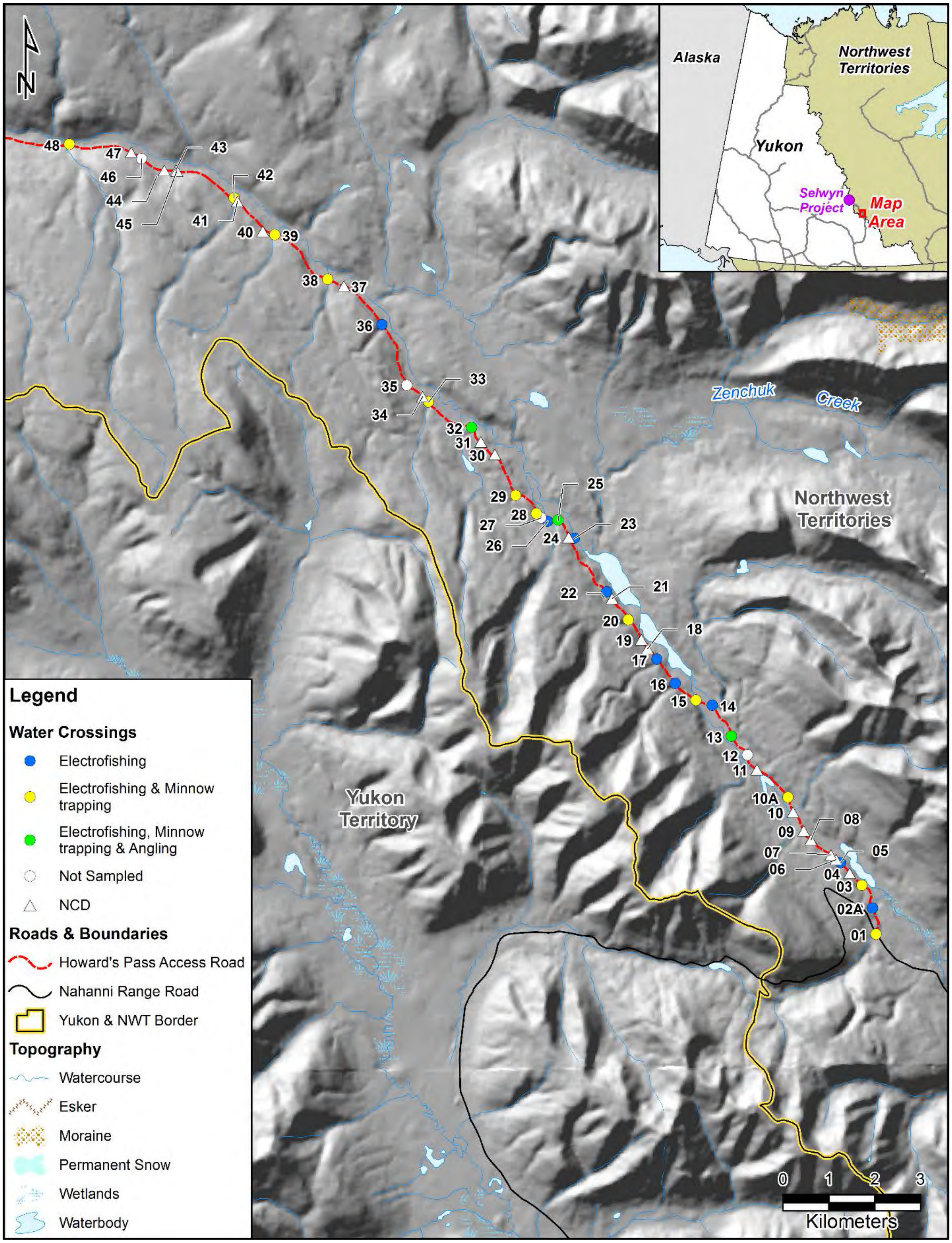
4.2.6. Aquatic Ecosystems

Aquatic habitat and fish assessments were carried out in 2014 for watercourses crossing the HPAR, as well as for waterbodies in proximity to the HPAR that could potentially be affected by road construction or related activities (Triton Environmental Consultants, 2014). Watercourses crossing the HPAR, along with information on sampling sites, are shown on Figure 4.2-8; adjacent waterbodies and sampling locations are shown on Figure 4.2-9. Maps are all based on Triton Environmental Consultants (2014).

Figure 4.2-8: Watercourses Crossed by the HPAR, Showing Fish Sampling Sites (two map sheets)

Numbers refer to watercourses identified as intersecting with the HPAR; NCD = Non-Classified Drainage




Alaska
Northwest Territories
Yukon
Selwyn Project
Map Area
Zenchuk Creek
Northwest Territories
Yukon Territory
48
47
46
44
45
43
42
41
40
39
38
37
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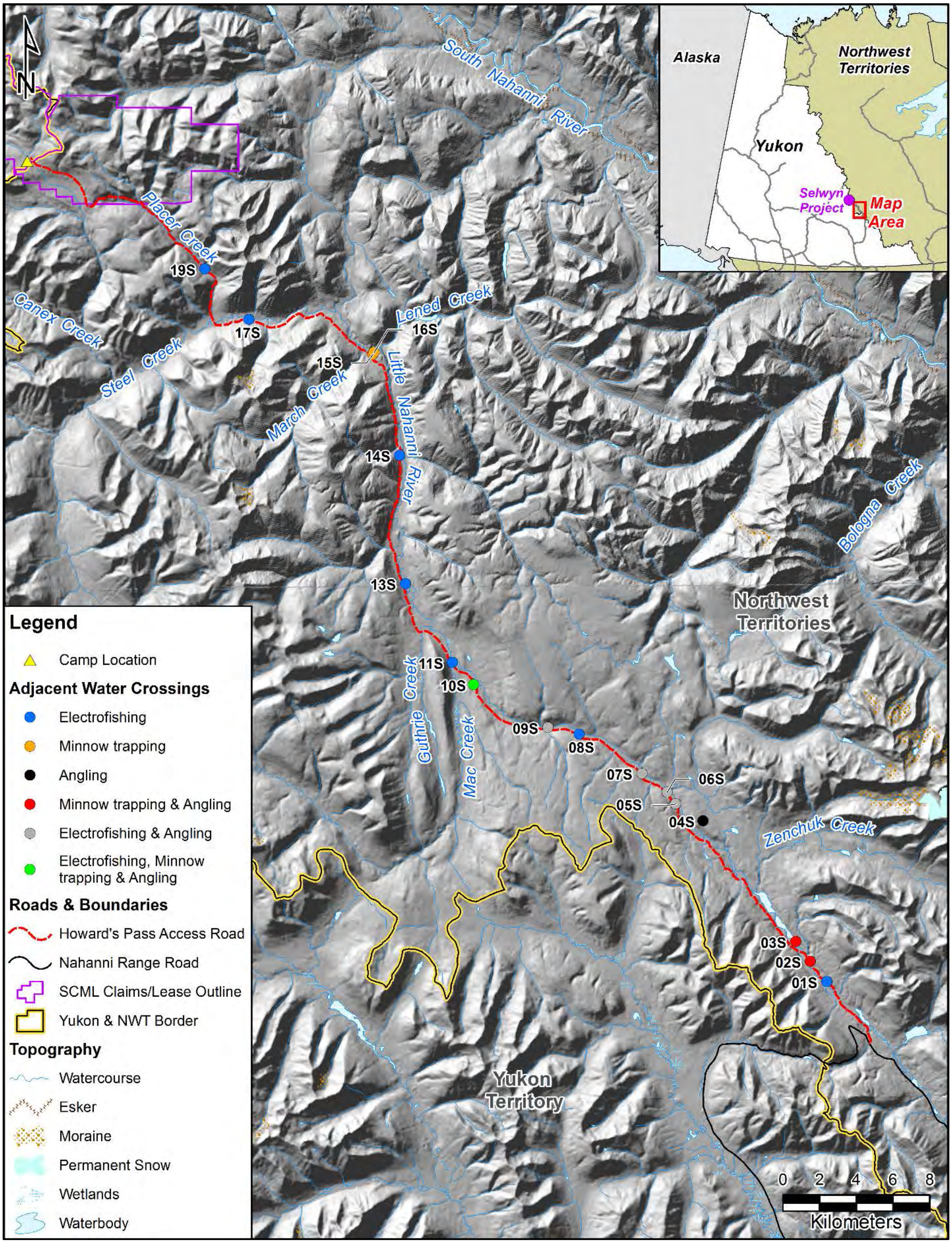
11
10A
10
09
08
07
06
05
04
03
02A
01
0 1 2 3
Kilometers
Legend
Water Crossings
Electrofishing
Electrofishing & Minnow trapping
Electrofishing, Minnow trapping & Angling
Not Sampled
NCD
Roads & Boundaries
Howard's Pass Access Road
Nahanni Range Road
Yukon & NWT Border
Topography
Watercourse
Esker
Moraine
Permanent Snow
Wetlands
Waterbody

Figure 4.2-9: Watercourses Adjacent to the HPAR, Showing Fish Sampling Sites



The majority of watercourses intersected by the HPAR are minor streams with moderate-to-high-gradient channels. Of the 86 watercourse crossings identified along the HPAR, 6 are larger, named streams that flow into Little Nahanni River, 52 are smaller first or second order tributaries[1] to Placer Creek, Steel Creek, or Little Nahanni River, and 23 are minor, ephemeral channels (shown as non-classified drainages on the maps) or surface seeps with no visible channels. The adjacent waterbodies assessed consisted of the Little Nahanni River, lakes and wetlands.

Aquatic habitat assessment was undertaken using a mix of aerial photography, site visits and stream sampling. Aquatic habitats within the HPAR corridor area are mixed, reflecting the diversity of several attributes, including stream gradients, channel characteristics, streambed material, bank characteristics, and cover (areas providing refuge from predators and from strong currents—including pools, vegetation and cut banks).

Habitat assessment, along with fish sampling, led to the recommendation to classify 23 streams that cross the HPAR as fish-bearing, with the recognition that local stream conditions may change annually, altering habitat suitability and accessibility to fish. Three fish species were identified as present: Arctic grayling (*Thymallus arcticus*), burbot (*Lota lota*) and slimy sculpin (*Cottus cognatus*) (see also Section 4.2.7). Arctic grayling presence was confirmed in eight tributaries to the Little Nahanni River, as well as in the river itself and in Divide Lake, adjacent to the HPAR. Lake trout (*Salvelinus namaycush*) were also present in Divide Lake and in a lake basin adjacent to the HPAR at km 9.5. No fish were caught in the other wetlands and small lakes sampled (Figure 4.2-9), and they appeared to have no clear connectivity with fish-bearing waters.

Table 4.2-8 summarizes the results of the habitat suitability and fish sampling program for the Little Nahanni River and major watercourses that intersect the HPAR, as well as an overview of fish caught and habitat suitability for 52 minor watercourses that were assessed. Photos that illustrate stream habitats referred to in the table are shown in Figure 4.2-10. The stream classification system is based on the riparian classification system developed for British Columbia for forested ecosystems. The criteria used are shown in Table 4.2-9.

[1] A first order stream is at the headwaters, with no streams flowing into it. If flows into a second order stream, and so on—the larger the number of the stream order, the bigger the stream.

Table 4.2-8: Habitat Suitability and Fish Species Present in the Major Watercourses along the HPAR

All locations sampled in these watercourses were considered to be fish-bearing, based on habitat characteristics or confirmed fish presence. Habitat was assessed based on suitability for salmonids (which includes Arctic grayling).

Creek Name	Species Confirmed Present	Fish Habitat Suitability	Recommended Classification (**Table 4.2-9**)
Little Nahanni River	Arctic grayling Slimy sculpin	Habitat suitability through the main stem of the Little Nahanni River varies widely between sampled sites. In general, the river provides excellent migration, overwintering, and staging habitat due to the presence of deep glide and frequent pool habitat throughout long stretches of low gradient, sinuous and meandering channel. Rearing habitat is moderate to excellent through areas of complex cover and low gradient. Streambed textures are diverse, with gravels, fines and boulders dominating distinct main stem areas.	S1
Unnamed Creek at Km 15	Arctic grayling Sculpin (too young to identify to species)	Excellent rearing habitat for grayling due to extensive cover, frequent riffles, channel complexity, pool frequency, unimpeded fish access, and low to moderate gradient. There is potential for good spawning and for overwintering habitat use, due to the presence of frequent deep pools, variable sediment textures, and clear access.	S4
Unnamed Creek at Km 26.5	Slimy sculpin	Good rearing and moderate spawning habitats for grayling due to adequate cover, pool depth and frequency, suitable bedload materials, and low gradient. Habitat use for overwintering and staging/holding is poor to moderate as there are few evident deep pools. Ease of access through the stream is facilitated by the unobstructed channel, moderate flow velocities and low gradients.	S2
Mac Creek	Arctic grayling Slimy sculpin Burbot	Excellent rearing, spawning, overwintering and staging habitats for grayling due to abundant instream cover, adequate flows, habitat variability, frequent riffles, and unobstructed access.	S1
Guthrie Creek	Arctic grayling Slimy sculpin Burbot	Excellent rearing, spawning, overwintering, migration, and staging habitats for grayling due to abundant and complex instream cover, deep glide and pool habitat, low gradient, variable substrate textures and instream habitat complexity.	S2
Fork Creek	Arctic grayling	Excellent rearing, spawning, overwintering, and staging habitats for grayling given the abundant and complex instream cover, including deep glide and pool strata, ample spawning substrate, frequent riffles, and unobstructed access throughout.	S2
Logan Creek	None***	Excellent rearing (in calmer sections) and spawning habitats for grayling and sculpins due to abundant cover and riffle habitat, moderate habitat complexity and cover, and clear access from downstream. Poor overwintering habitat due to shallow channel depths with few deep pools.	S3
March Creek	Arctic grayling	Good rearing, staging and overwintering habitat due to frequent riffles, moderate instream cover, deep pools, and unobstructed access. A high incidence of boulders and riffle habitat provides for excellent sculpin spawning.	S2

Creek Name	Species Confirmed Present	Fish Habitat Suitability	Recommended Classification (**Table 4.2-9**)
Steel Creek	Slimy sculpin	Excellent rearing, spawning, overwintering, migration and staging habitats for resident fish due in part to the large channel providing diverse bedload textures and a wide range of habitat types and hydraulic units.	S1
Placer Creek	None	Excellent spawning and rearing conditions for sculpin. Overwintering habitat is adequate. Extensive migration through the system is likely problematic as fish would encounter several areas of low cascade or chute habitat difficult to ascend.	S2
52 smaller creeks assessed	Sampling confirmed fish in 2 creeks draining to Flat Lakes: Site 14 (at km 6.4): Arctic grayling Site 15 (at km 6.8): burbot, Arctic grayling, and slimy sculpin	Spawning: Burbot will migrate to the deeper sections of the larger rivers or lakes for spawning, while the grayling and sculpins may find suitable but limited spawning opportunities in some of these smaller channels. Spawning habitat ratings for these 52 creeks: high 2%; moderate 14%; low 46%; nil 38%. Rearing: Habitat could include low energy areas such as pools, deeper glides and pocket-water, back channels or protected undercuts. As the gradients of these watercourses tend to be moderate to high, with little pool and glide habitat rearing habitat is limited. Rearing habitat ratings for these 52 creeks: high 12%; moderate 17%; poor 71%. Overwintering and staging: Most of these creeks have little or no suitable overwintering habitat due to higher gradient, shallow depth and scarcity of deep pools. Overwintering habitat ratings for these creeks: abundant 8%, limited 27%, nil 65%. For the same reasons, staging habitat is limited. Staging habitat ratings for these 52 creeks: poor 17%, nil 83%. Fish-bearing status (based on sampling and on stream characteristics): 27% rated as fish-bearing; 73% rated as non-fish-bearing.	S2 (4%) S3 (19%) S4 (4%) S5 (13%) S6 (60%)

*** No fish returned from electrofishing upstream and downstream of Logan Creek (referred to as Unnamed Creek at Km 47.1 in the source report). However, fish presence is assumed given the clear, unobstructed access downstream to the Little Nahanni River.

Source: Triton Environmental Consultants (2014)

Table 4.2-9: Criteria for Stream Classification

Riparian Classification	Channel Width (m)	Fish-bearing?
S1	≥20	Yes
S2	>5 and <20	Yes
S3	>1.5 and ≤5	Yes
S4	≤1.5	Yes
5	≥3	No
S6	<3	No

From BC Forest and Range Practices Act (2002) as cited in Triton (2014)

Figure 4.2-10: Photo Collection Illustrating Stream Habitat Types

Upstream view of glide habitat, Little Nahanni R.

Downstream view of glide habitat, Little Nahanni R.

Upstream view of Unnamed Creek at Km 15

Downstream view of Unnamed Creek at Km 15

Upstream view of Unnamed Creek at Km 26.5

Downstream view of Unnamed Creek at Km 26.5

Upstream view of a riffle in Mac Creek

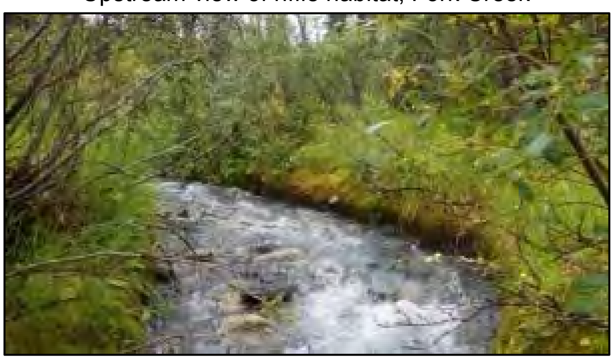
Downstream view of a deep glide in Mac Creek

Upstream view of riffle habitat, Guthrie Creek

Downstream view of riffle and glide habitat, Guthrie Creek

Upstream view of riffle habitat, Fork Creek

Downstream view of riffle habitat, Fork Creek



Upstream view of fast, shallow riffle, Logan Creek.

Downstream view of riffle, Logan Creek.

Photos from Triton Environmental Consultants (2014)

4.2.7. Fish Species

Three species of fish were identified as present in watercourses along the HPAR corridor: slimy sculpin, Arctic grayling and burbot (Table 4.2-8). Sixteen species of fish are known to occur in the South Nahanni watershed, including lake trout, bull trout (Salvelinus confluentus), northern pike (*Esox Lucius*), lake whitefish (*Coregonus clupeaformis*), round whitefish (*Prosopium cylindraceum*) mountain whitefish (*Prosopium williamsoni)* and lake chub (*Couesius plumbeus*) (Parks Canada, 2012 and 2013a; Anions, 2014).

Arctic grayling are common and widespread in Nahanni National Park Reserve and are the fish most commonly caught by sport fishers in the greater Nahanni ecosystem (Anions, 2014; Haggarty and Tate, 2009). Grayling are important in Aboriginal fisheries (e.g., Sahtu Renewable Resources Board: Fish of the Sahtu). Adults migrate upstream in the spring to small, rocky streams to spawn on gravelly substrate. Eggs hatch later in the spring, and grayling fry remain in tributary streams before migrating downstream in late summer or fall (Cott and Moore, 2002). Arctic grayling are visual predators, and, depending on life stage and prey species abundance, their diet consists of pelagic zooplankton, benthic invertebrates and fish. All life stages prefer clear-water habitats (von Finster, 2003).

Slimy sculpins are widely distributed in northern Canada. They are an important forage fish—both Arctic grayling and burbot eat slimy sculpins (Carl et al., 1959; Stewart et al. 2007). Slimy sculpins occupy a range of habitats, preferring cool water and, in streams, areas with large substrate. Slimy sculpins spawn in the spring, attaching their eggs to the undersides of stones or ledges (Carl, 1959). They are abundant and non-migratory, with small home ranges, making them suitable as a sentinel species for environmental effects monitoring (Arciszewski et al., 2010).

Burbot are year-round residents in South Nahanni and Flat rivers (Anions, 2014). The adults live in the deep waters of lakes and large rivers, but may move into smaller tributaries during late winter and early spring. They spawn in the winter under lake ice, and the young-of-the-year burbot may also move into streams in the late winter or early spring and remain there during the open-water season. Burbot are part of Aboriginal fisheries across the Canadian north.

4.2.8. Wildlife Species

4.2.8.1. Sources of Information

Current understanding of the wildlife species and populations that are present in the HPAR corridor and vicinity has developed over several years through systematic wildlife surveys, as well as through recording of incidental or casual wildlife observations.

Most of the systematic wildlife surveys were undertaken in the vicinity of the proposed mine site at Howard’s Pass. For example, during 2008 surveys were flown to ascertain the presence of nesting raptors in the mine site area (Mossop and Russell, 2008). These surveys at the Selwyn Project mine area provide information on likely occurrence of wildlife in the higher elevation, northern section of the HPAR corridor near the mine site, and also provide an indication of species in the general vicinity in other ecosystem types. As well, late winter (March/April) ungulate surveys were carried out over the period 2012 through 2015 along the HPAR corridor (Farnell File Reports, 2012, 2013, 2014).

Incidental wildlife observations were made during 2014 by the EDI environmental monitor based at the road reconstruction camp near km 3 of the HPAR. Additional incidental observations were reported by construction crew members and support staff and documented by the environmental monitor or the on-site (Tulita Renewable Resources Council) wildlife monitor. The environmental monitor compiled a list of bird species that he observed along the HPAR. These wildlife and bird observations took place from July through October, 2014.

Other wildlife surveys not specifically focused on the HPAR corridor were conducted in relation to the proposed expansion of the Nahanni National Park Reserve in 2006 (Weaver, 2006). Limited additional relevant information for about wildlife in the vicinity of the HPAR is available from government studies and information publications, published and unpublished survey and study data (e.g., caribou survey data), and scientific literature sources.

4.2.8.2. Habitat Suitability

Terrestrial ecosystem mapping described in Section 4.2.2 was analyzed in relation to habitat suitability for woodland caribou, moose, grizzly bear, wolverine, marten, American beaver, Trumpeter Swan and

Gyrfalcon. This analysis was conducted both for the mine site area and for HPAR corridor (Madrone Environmental Services Ltd., 2011f, 2011e and 2011d).

A number of relationships between habitat use and ecosystem attributes were determined for each wildlife species, based on current literature, research, and local biologist knowledge. Wildlife habitat ratings relating to broad ecological zones, ecosystem units, structural stages, site modifiers, stand modifiers and site disturbance (e.g., fire) were assigned to ecosystem units mapped for the mine site and the HPAR corridor areas. A six-class rating scheme [high (1), moderately high (2), moderate (3), low (4), very low (5), and nil (6)] expresses the ability of the units to fulfil habitat requirements for the specific life requisites and seasons rated for each wildlife species. This results from this analysis, where relevant for the HPAR, along with other information on these eight species, is summarized below.

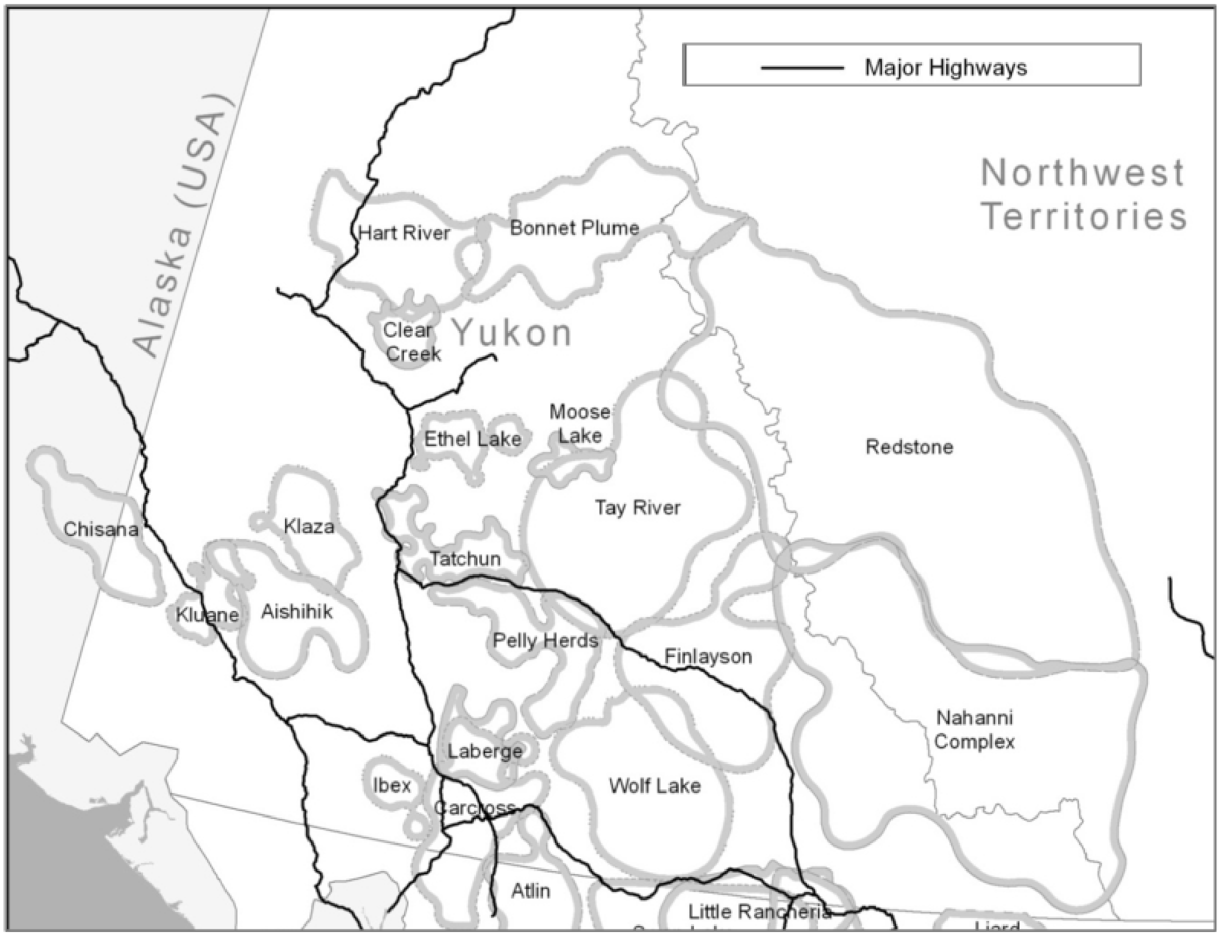
4.2.8.3. Woodland Caribou, Northern Mountain Population: the Nahanni Caribou Herd

Caribou are the wildlife species of most significance for this project. They are ecologically important, as the most abundant herbivore of the North, ranging over elevations and through habitat types over the seasons, converting and transporting vegetation and nutrients through the terrestrial food web and across the landscape (Gunn et al., 2011) and supporting predators and scavengers (Environment Canada, 2012). Caribou are of great importance to First Nations for food, and also for cultural, traditional and spiritual reasons. They are valued by other northern residents and visitors to the Nahanni region and its Park Reserves. Caribou frequent the region of the HPAR, especially in the northern section, primarily from calving through the fall. They are an important source of food for the Naha Dehé Dene Band of Nahanni Butte, who harvest them on their main winter range along the South Nahanni River.

Northern mountain caribou are a population of woodland caribou (*Rangifer tarandus caribou*) (COSEWIC 2011). About 39 herds of northern mountain caribou range over south and central Yukon, southwestern NWT and northern BC, with one herd straddling the Yukon/Alaska border. The Yukon and NWT portion of this range is shown in Figure 4.2-11. The HPAR corridor is within the annual range of the Nahanni Caribou Herd (also referred to as the Nahanni Complex, as shown on the map, comprising the overlapping South Nahanni, Coal River and Labiche herds).

Canadian northern mountain caribou are listed as a species of Special Concern under federal legislation, and a management plan was developed to prevent this caribou population from becoming threatened or endangered (Environment Canada, 2012). The NWT's northern mountain caribou are ranked as Secure in the NWT General Status Ranks (see also Section 4.2.9 Species with Special Conservation Status).

Figure 4.2-11: Annual Ranges of Northern Mountain Caribou Herds in the Yukon and Northwest Territories

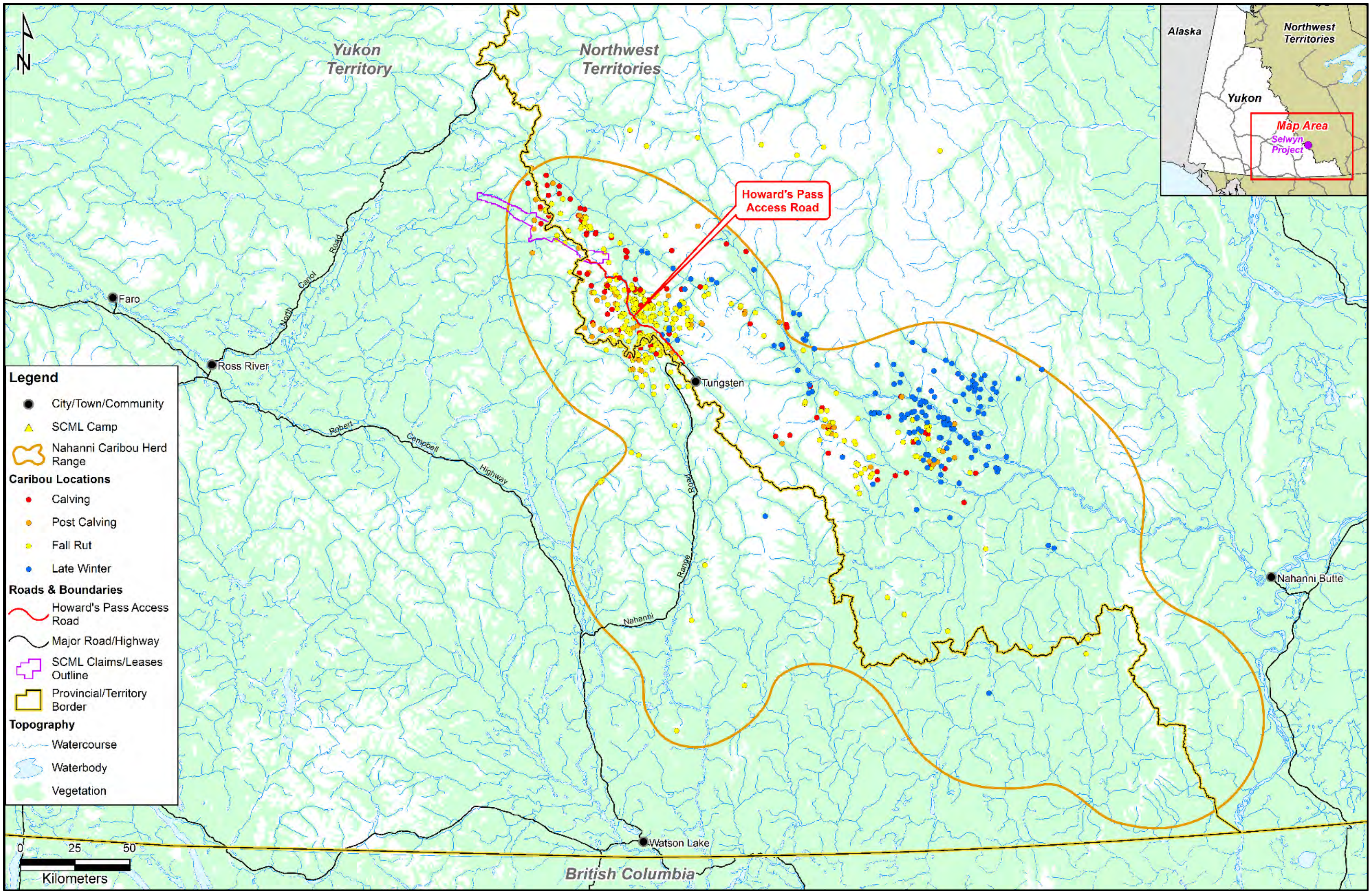


Source: Environment Canada (2012)

The western half of the Nahanni National Park Reserve in the Selwyn-Logan-Mackenzie Mountains contains approximately 18,000 km^2 of the Nahanni caribou herd (NCH) range. The NCH use upper reaches of the South Nahanni River and Little Nahanni River watersheds, Steel Creek and the region around the Yukon border north of Howard's Pass during calving and post-calving periods (Gunn et al., 2002; Gullickson and Manseau, 2000). The remainder of the time the NCH is found in alpine and subalpine plateaus, southern portions of the Ragged Range and the forested lowlands of the lower South Nahanni River above Virginia Falls. Figure 4.2-12 shows the caribou herd seasonal ranges in relation to the HPAR. The locations shown on this map are from studies that tracked radio-collared animals as they moved across the landscape over the seasons, as well as from observations made in caribou count surveys up to about 2007.

The Nahanni Caribou herd uses the area in and around the HPAR corridor, with caribou moving into the area during the spring, likely using the South Nahanni watershed as an access route. Calving takes place in late spring, and at this time the caribou are dispersed throughout the area, in a variety of habitat types at a range of elevations. During the fall, the caribou move to alpine and subalpine areas, and then to their winter range along the South Nahanni River.

Figure 4.2-12: Nahanni Caribou Herd Seasonal Range Use



Source: Farnell (2013)

Nahanni Caribou Herd Studies and Observations Related to the HPAR

The governments of NWT and Yukon and Parks Canada completed a Nahanni caribou population survey in 2009 (Environment Canada, 2012), resulting in a herd population estimate of 2,105 caribou. As part of this study, a habitat suitability survey was completed, with habitat suitability models applied to a study area along the HPAR corridor. The study concluded that, although caribou continue to use the area along the HPAR into mid-winter, good late-winter range habitat is not present along the corridor. However, a small group of caribou has been observed in the HPAR corridor in three of the four years (2012–2015) of late winter surveys. Size of the group ranged from 15 to 58 caribou.

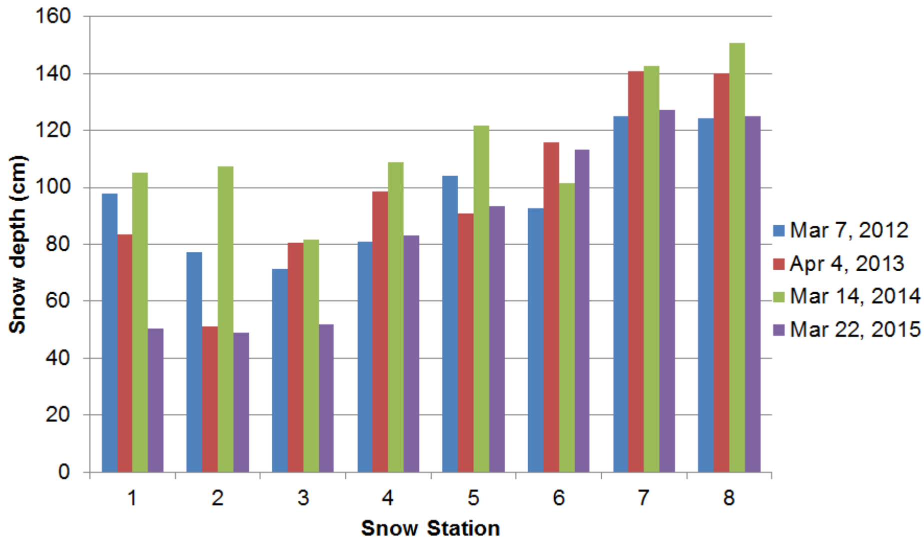
Habitat use in winter is influenced by, and limited by, snow depth, as caribou dig into the snow to access terrestrial lichens. When the snow becomes too deep, caribou switch to arboreal lichens (Environment Canada, 2012). This "cratering" behaviour is also affected by the density of the snow. Caribou not only avoid areas with deep snow, the extra energy used in cratering in difficult snow conditions has a cost to the caribou, affecting their condition and reproductive success (Gunn et al., 2011a and 2011b; Fancy and White, 1985). Studies on caribou foraging and habitat use in northern Yukon and NWT provide estimates of snow depth thresholds for caribou (Russell and Martell, 1984). Based on these findings, Gullickson and Manseau (2000) used the following thresholds to assess seasonal range use for the Nahanni caribou herd:

- Snow depths less than 60 cm are favourable for caribou to dig craters
- Snow depths greater than 74 cm are considered adverse for sedentary forest caribou to dig craters

Russell and Martell (1984) also found that caribou mobility was impeded at depths of greater than 50–60 cm for solitary caribou and greater than 80–90 cm for groups of caribou.

In general, high snowfall in the Selwyn Mountains limits use of the Howard's Pass area during winter. Snow conditions along especially the northern half of the HPAR exceed or approach these threshold levels, based on late winter snow course surveys (Figure 4.2-13). Most caribou observations along the HPAR during the March 2012, April 2013 and March 2015 wildlife surveys corresponded to lower snow depths (<90 cm), along the southern 40 km of the road corridor.

Figure 4.2-13: HPAR Snow Course Surveys, 2012–2015



Snow stations start at km 0 of the HPAR and are located 10 km apart. The average of 10 snow depth measurements spaced 3 m apart was recorded for each snow station.

The habitat suitability study identified high-quality security habitat for post-calving (mid-summer) in the Parkland broad ecological zone within the HPAR study area. Northern mountain woodland caribou favour rugged, mountainous areas that are "secure" because they are spatially separated from alternate prey species, such as moose, and from predators, such as wolves and bears (Bergerud and Page, 1987). The distribution of the Parkland ecological zone is shown on Figure 4.2-2—it is mainly at the northern part of the HPAR corridor. Spring and summer food values are highly suitable for caribou and are unlikely to limit the use of the area around the HPAR.

Caribou have been observed in the HPAR corridor during vegetation/wildlife mapping, during late winter surveys, post-calving surveys and fall and post-rut surveys conducted over the period between 2011 and October 2014. These observations were made in August 2011, March, May and July of 2012, April 2013 and March 2014. Incidental wildlife observations were also recorded during road reconstruction in 2014. Caribou were observed at km 14, 21, 25 and at one unrecorded location along the HPAR. A group of six immature bull caribou was observed at km 21 on October 11, 2014. Three additional observations of lone caribou were recorded on August 12, 13 and September 28, 2014 (EDI, 2014).

Relative Abundance of Caribou Potentially Interacting with the HPAR

Since 2007, SCML has been carrying out systematic post-calving caribou surveys during mid-summer to evaluate potential effects to caribou from mining operations. The survey areas consist of the mine project area, referred to as the Regional Study Area, and include Northern and Southern Control Areas (Figure 4.2-14).

The HPAR area has been included in these surveys since 2012. Figure 4.2-14 shows a typical distribution of caribou over three days of July surveys relative to the HPAR, and including their distribution in the Southern Control Area immediately to the west of the HPAR. These data provide an opportunity to estimate potential interaction by caribou of the Nahanni herd with the HPAR during baseline conditions as the caribou make east-west movements between winter and summer range and likely cross the road or frequent the adjacent area.

Figure 4.2-14: Numbers and Distribution of Caribou in the Vicinity of the HPAR during the 2012 Post-Calving Survey

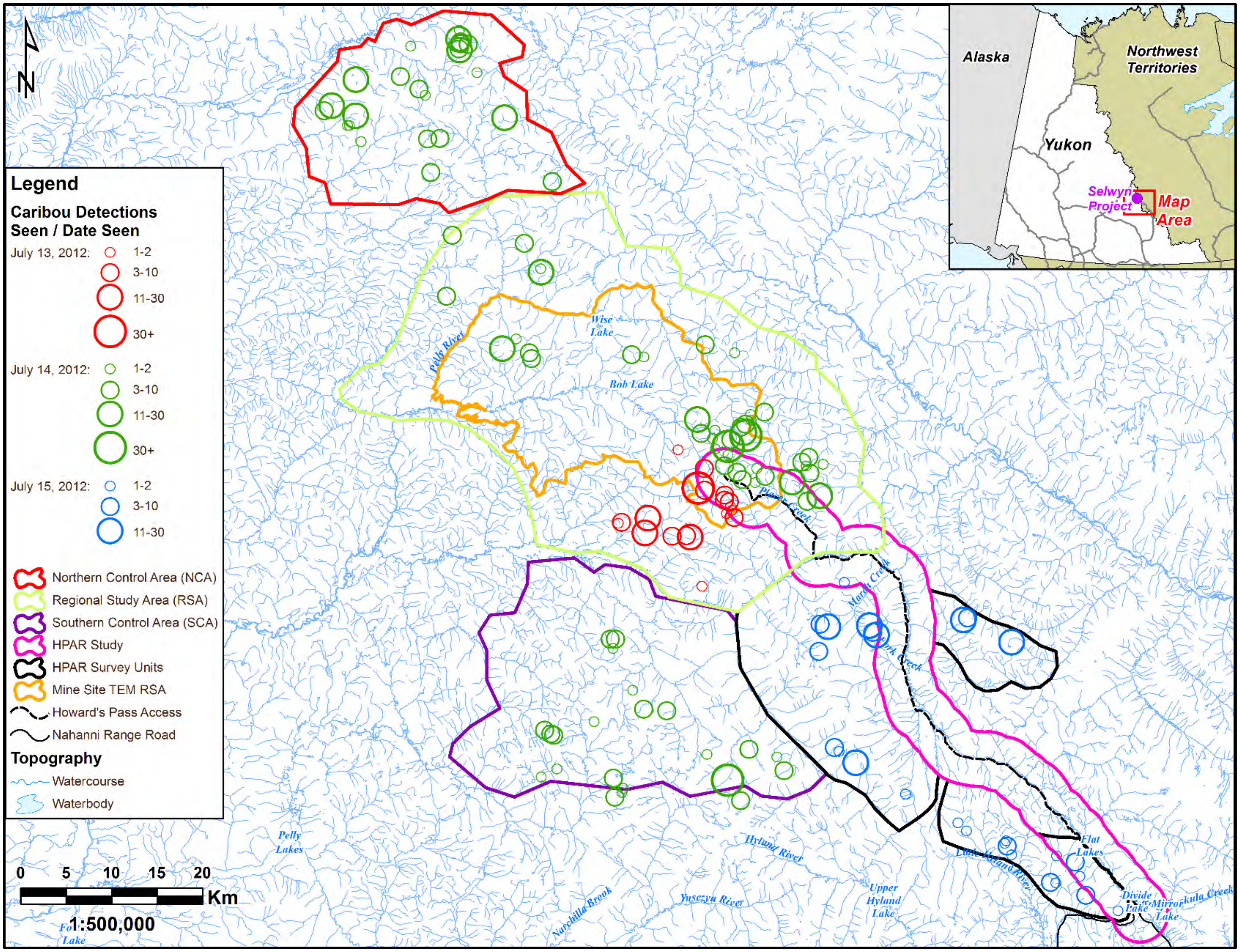


Table 4.2-10 provides a summary of post-calving survey counts from 2007 to 2014. Surveys indicate that, on average, 185 caribou are found in the Southern Control Area (immediately west of the HPAR), with a highly variable range of 47 to 312 caribou. An average of 88 caribou were found in the HPAR corridor, also with the number varying greatly over the survey period. While these findings are not absolute indications of potential interactions with caribou, they provide an idea of the order of magnitude of numbers of caribou in the vicinity of the HPAR that road management planning must, at minimum, take into account.

Table 4.2-10: Caribou Post-Calving Survey Data Summary, 2007–2014

Areas are shown on Figure 4.2-14. Survey results discussed in the text are highlighted (HPAR in yellow and Southern Control Area in green).

Date of Survey	Area[1]	Adult Cow	Calf	Immature Bull	Mature Bull	Total
27-Jun-07	RSA	114	29	32	25	**200**
15-July-07	NCA	81	39	7	0	**127**
15-July-07	RSA	138	49	23	13	**223**
15-July-07	SCA	123	63	45	22	**253**
13/14-July-08	NCA	41	20	5	1	**67**
13/14-July-08	RSA	244	73	17	27	**361**
13/14-July-08	SCA	167	18	22	30	**237**
16/17-July-09	NCA	93	36	4	0	**133**
16/17-July-09	RSA	192	76	9	20	**290**
16/17-July-09	SCA	198	55	39	13	**312**
18-July-10	NCA	43	25	2	2	**72**
17/18-July-10	RSA	155	63	17	24	**266**
18-July-10	SCA	128	31	32	25	**221**
13/14-July-12	RSA	334	67	28	28	**452**
14-July-12	NCA	58	17	0	0	**75**
15-July-12	SCA	81	8	19	19	**127**
15-July-12	HPAR	116	23	19	19	**177**
14-July-13	RSA	181	50	18	15	**264**
14-July-13	HPAR	39	8	0	6	**53**
15-July-13	NCA	97	40	4	0	**141**
15-July-13	SCA	24	3	10	10	**47**
14-July-14	RSA	267	123	14	19	**423**
15-July-14	NCA	74	41	5	0	**120**
15-July-14	SCA	56	11	12	18	**97**
15-July-14	HPAR	24	10	0	1	**35**
Average (range) for all years	SCA	111 (24-198)	27 (3-63)	25 (10-45)	19 (10-30)	**184 (47-312)**
Average (range) for all years	HPAR	59 (24-11)	13 (8-23)	6 (0-19)	8 (1-19)	**88 (35-177)**

[1]Areas (see Figure 4.2-14 for locations): RSA=Regional Study Area; SCA=Southern Control Area; NCA=Northern Control Area; HPAR=survey areas along the HPAR corridor

2015 Surveys

SCML continues to conduct caribou and habitat survey work to improve understanding of seasonal use by caribou of the HPAR corridor and surrounding regions. An aerial post-calving caribou survey is planned for July 2015, and a range-wide rut count survey of the South Nahanni caribou herd will be conducted in October. A late-winter ungulate survey of the HPAR corridor was completed in March of this year. Snow-depth transect surveys were also conducted to provide additional information that helps understand wildlife use of the corridor during the late winter.

4.2.8.4. Moose

Moose (*Alces alces*) is found along the HPAR corridor belong to the Alaska-Yukon subspecies, which can be found across Alaska, the Yukon, extreme northern British Columbia and in the Mackenzie Mountains (Larter and Allaire, 2010). Moose, like caribou, are an important part of the ecosystem, as they provide food for predators, scavengers and human users, as well as providing materials for clothing, arts, and crafts for First Nations.

In the southern Yukon, about two-thirds of all moose are found near the tree line in the subalpine shrub zone. They are also found concentrated in recent burn areas, along waterways with interconnecting marshes, ponds, and streams, and open upland and aquatic areas or along riparian habitat corridors (Environment Yukon, 2007). In the NWT, moose are generally found in areas with semi-open forest cover with willow and aspen stands located close to lakes, river valleys, stream banks and sand bars. Preferred fall and winter food is deciduous shrubs, while conifers are used for cover during winter (Environment and Natural Resources, 2015).

Since 2006, observations of moose have been made in the Selwyn Project area, with the majority of sightings occurring at the mine site. It is expected that the HPAR corridor will have similar populations, with the concentrated use of high and low elevation riparian habitat, thick willows, shallow open water lakes and southern lowlands in the winter with increasing snowpack.

Moose or evidence of moose (tracks, cratering, droppings) were observed in the HPAR corridor during vegetation/wildlife mapping, late winter ungulate surveys, and caribou post-calving surveys in August 2011, March and July of 2012, April 2013 and March 2014. Moose were the most common incidental wildlife observation in 2014, but this could be because moose are easily identified and conspicuous. There were 36 records of moose occurrence, with a total of 58 moose sighted. However, as observations were often in the same few locations, some animals were likely counted multiple times. The majority of records that document multiple moose were observations of cows with calves (EDI, 2014).

Moose distribution, like that of caribou, is affected by snow depth. Peterson (1977) and Mech et al. (1987) stressed the role of snow accumulation as a limiting factor for moose. Coady (1974) indicated that 90 cm of snow represents a critical depth for adults, in that movements for moose are restricted such that accessibility to adequate food may be limited or prevented. Snow depths documented through late winter surveys along the HPAR corridor (Figure 4.2-13 in the caribou section above) indicate that snow conditions can be too deep for moose in some winters, especially in the northern section of the road corridor.

2015 Surveys

A late-winter ungulate survey of the HPAR corridor was completed in March, 2105. Snow-depth transect surveys were also conducted to provide additional information that helps understand wildlife use of the corridor during the late winter. SCML will conduct a post-rut moose stratification survey in November 2015.

4.2.8.5. Grizzly Bear

Grizzly bears (*Ursus arctos*) in the vicinity of the HPAR are part of the northwestern population. It is estimated that there are 6,000 to 7,000 grizzly bears across the Yukon and NWT (Environment Yukon, 2015). Being at the top of the food chain, grizzly bears require a large range with abundant food resources (Miller et al., 1982; Wielgus, 1986). Grizzlies use the main valleys along the South Nahanni and Flat River valleys, as well as mountain landscapes in Nahanni National Park Reserve (Anions, 2014).

Studies in 2005 along the HPAR corridor predicted low to moderate grizzly bear densities with some high density areas associated with valley bottoms.

Within the HPAR corridor, the limiting feature prohibiting bears from populating the area in higher densities is the lack of appropriate hibernating and early spring forage habitats. The lack of available food is another limiting factor for grizzly bears in the corridor. In the early spring, bears move into areas of higher elevation, which have an earlier green-up, usually near denning sites. Bears will move to lower elevations in the early summer as berries ripen, then gradually move back to higher elevations as the summer progresses, consuming later-ripening berries and other foods to put on fat stores required for winter survival during denning (RISC, 1998).

Grizzly bears have been observed along the HPAR as follows: tracks and scat were observed in August, 2011 by the crew doing vegetation mapping, at several locations by creeks and along the road, over a period of three days; during 2012 caribou surveys, two sightings of grizzly bears were recorded on the same day in May and one sighting was recorded in July, one grizzly bear was sighted; and, one grizzly bear was observed at the HPAR road camp (km 3) in October, 2014.

2015 Survey Work
SCML conducted a grizzly bear den survey along the HPAR corridor in the spring of 2015. No evidence was found that bears emerged from dens along the road. From the tracks seen, it looks as though the bears are denning quite high (higher than the XY Camp elevation), then moving down to lower elevations immediately after emerging. One bear traveled through XY Camp and down the HPAR to the river and open, south-facing slopes.

4.2.8.6. Wolverine

Wolverines (*Gulo gulo*) are found in northern and western forested areas of Canada. There are approximately 15,000 to 19,000 wolverines in Canada, with the NWT having approximately 3,000 to 6,000 of this total (GNWT, 2014a). They are present year-round in Nahanni National Park Reserve, though thinly distributed and rarely seen (Anions, 2014). Recent records of wolverines in the park reserve have been based on remote cameras. Wolverine trapping records in the Nahanni area date back to the 1920s.

Wolverines occur in low densities and have a varied home range based on the quality of habitat and on the season. Sub-adult males and females without young tend to have larger ranges than adult males and females with young (Proulx, 2003; Banci, 1994). Within their range, wolverines prey on and scavenge large mammals such as caribou and moose. This makes up the majority of the wolverines' diet. Their diet also includes small and medium sized mammals such as ground squirrels, marmot, ptarmigan and small rodents (Lofroth et al., 2007; Banci, 1994).

Wolverines migrate to areas of higher elevation in the spring and summer. They seek out the lower-elevation ungulate ranges in the winter (Lofroth, 1996; Gardner, 1985). Wolverines will cover large distances during their seasonal migrations. Riparian habitat, ridge tops and timbered corridors all serve as important migratory routes.

Several wolverines were observed during caribou surveys along the HPAR in March and May of 2012. Wolverine tracks were observed during caribou surveys in March, 2012 and six sightings, each of a single wolverine, were recorded during an aerial caribou survey in May of the same year. Incidental wildlife observations made during road work in 2014 included three sightings of wolverines (EDI, 2014).

2015 Survey Work
SCML will conduct a wolverine and marten distribution and abundance survey in the winter of 2015.

4.2.8.7. Marten

Marten (*Martes americana*) are forest animals, preferring mature conifer forests, but also found in other forest types with sufficient food and cover. Marten make use of sparse, open forests with adequate undergrowth and fallen trees for denning, under-snow space for hunting in winter, and habitat for prey species. They generally avoid large clearings unless there is sufficient cover. Most martens have home ranges, the size of which depends on habitat quality and food availability. Home ranges can vary from 2.5 to 15 km^2 for males (GNWT, 2015).

Marten do not typically occur in alpine or upper elevations of parkland, due to harsh winters and the lack of forested habitat. The habitat suitability assessment along the HPAR corridor indicated that 45% of the area is considered to have moderate to moderately high suitability for marten denning (Madrone Environmental Services Ltd., 2011e).

While no marten were observed during surveys in March 2012, marten tracks were observed at five different locations along the HPAR corridor. Marten are known to be widespread through Nahanni National Park Reserve (Anions, 2014).

2015 Survey Work
SCML will conduct a wolverine and marten distribution and abundance survey in the winter of 2015.

4.2.8.8. Beaver

In the Yukon and the NWT, beavers (*Castor canadensis*) inhabit forested and subalpine regions, but the greatest populations are found in mid-successional burn areas with predominately aspen, poplar and willow growth (Environment Yukon, 2005).

Three areas of beaver activity were noted in the NWT portion of the mine site regional study area. All three areas are primarily associated with the tributary to the South Nahanni River that connects to the Wise Lake complex. One is located on the south tributary to Wise Lake, and is associated with the wetland ecosystem type. Another area with beaver activity is located east and downstream of Wise Lake and another along a tributary to this stream complex.

Beavers are also common along the HPAR corridor. In August of 2011, evidence of beavers was found in five different locations along the road. During 2014 the wildlife monitor encountered five or more beavers in relation to obstructions to stream culverts in the lower portion of HPAR. Nine beavers were recorded as incidental wildlife observations in 2014 (EDI, 2014).

2015 Survey Work
SCML will conduct an inventory of beaver lodges and beaver presence in the corridor area in the summer of 2015.

4.2.8.9. Trumpeter Swan

The middle of the Yukon is the northern limit of Rocky Mountain Trumpeter Swan (*Cygnus buccinato*) breeding range. In the past, breeding and non-breeding trumpeter swans have been documented in the Selwyn Project area, south to the Robert Campbell Highway and west to the MacMillian Pass area and North Canol Road. Trumpeter Swans migrate south during the winter, so suitable habitat would be for the migrating and breeding seasons. In April, breeding individuals arrive in the northern parts of their range and remain until after the young have fledged, generally until October (McKelvey et al., 1983, Sinclair et al., 2003).

Habitat suitability during breeding season is limited along the HPAR. The only location likely to have high suitable habitat is Flat and Divide lakes. During 2014 the Tulita Renewable Resources Council wildlife monitor observed an adult pair of swans with cygnets on one of the Flat Lakes during the August through September period. Also during 2014, road construction crew and support workers recorded observations of four swans (EDI, 2014). Several Trumpeter Swans were seen on Divide Lake and Flat Lakes in late August, 2011, during vegetation/wildlife survey work.

A waterfowl survey is planned for 2015.

4.2.8.10. Gyrfalcon

Gyrfalcons (*Falco rusticolus*) are found year-round in arctic and subarctic environments associated with tundra habitats and mountainous areas. The preferred habitat of the Gyrfalcon is open land, such as tundra, but they have also been observed near waterbodies including rivers and wetlands (BC Conservation Data Centre, 2015). One nest was found on a cliff at the Selwyn project study area in 2008. There is limited potential for nesting sites along the HPAR corridor, based on assessment of habitat suitability.

A raptor survey is planned for 2015.

4.2.8.11. Additional Mammal Species That Occur or May Occur in the Vicinity of the HPAR

Dall's Sheep
Dall's sheep (*Ovis dalli dalli*) require alpine tundra near cliffs to escape from predators (Weaver, 2006). There is suitable habitat for Dall's sheep within the Ram Head Outfitter management zone, which the HPAR intersects.

Rocky Mountain Goats
Rocky Mountain goats (*Oreamnos americanus*) are similar to Dall's sheep as they forage for food and habitat near mountain cliffs to escape from predators. The HPAR corridor does not have this type of habitat available, although there is suitable habitat in the area surrounding the corridor, and thus the potential for mountain goats to be in the vicinity of the HPAR corridor. According to Mackenzie Mountain hunter harvest reports, mountain goats inhabit the surrounding region, including Ram Head Outfitter management zone.

Mountain goats have been observed in the vicinity of the HPAR corridor (including in cliff habitat above the corridor). Over 30 adults and over 10 kids were recorded during vegetation/wildlife mapping, late winter surveys, calving and post-calving surveys and fall rut surveys along the HPAR corridor from 2011 to 2013.

Northern Grey Wolf

The northern grey wolf (*Canis lupus occidentalis*), a subspecies of the grey wolf, is found in the Yukon and Northwest Territories. Since 2006, grey wolves have been documented in the Selwyn Project area. During vegetation mapping and late-winter and fall wildlife surveys along the HPAR corridor during 2011 and 2012, wolves were observed four times and wolf tracks were seen at least 12 times.

River Otter

River otters (*Lontra canadensis*) are associated with marine and freshwater habitats. They usually den along shorelines, using abandoned beaver lodges, other species burrows, and openings in stumps or brush piles (Fur Institute of Canada, 2015). No sightings of river otters have been recorded at the mine site or along the HPAR corridor. Otters, however, are known to be widespread in Nahanni National Park Reserve (Anions, 2014).

Red Fox

One of Canada's most widespread mammals, red foxes (*Vulpes vulpes*) take shelter in thickets and heavy bush. They use other animals' burrows for dens, and they will den in a cave, hollow log, or dense bush. Red foxes have been documented in the Selwyn Project mine site area, primarily associated with exploration activities. They also occur in Nahanni National Park Reserve (Anions, 2014).

Weasels

Short-tailed weasels (*Mustela erminea*) tolerate a wide variety of habitats, including forests, alpine meadows and scrub. They make their dens in tree roots, hollow logs or abandoned burrows (Tikhonov et al., 2008). Weasels were seen in 2007 in the Selwyn Project area. In March 2012, during late winter surveys, weasel tracks were seen along the HPAR. Short-tailed weasels are widespread in Nahanni National Park Reserve (Anions, 2014).

Small to Medium-sized Mammals

Small to medium-sized mammals include rodents, lagomorphs, insectivores, and bats. The following species were identified as potentially occurring in the vicinity of the Selwyn Project area, with six of these species confirmed as being present (collared pika, beaver, porcupine, hoary marmot, least chipmunk and red squirrel):

INSECTIVORES

- Black-backed shrew *Sorex arcticus*
- Common shrew *Sorex cinereus*
- Pygmy shrew *Sorex hoyi*
- Dusky shrew *Sorex monticolus*
- Water shrew *Sorex palustris*

BATS

- Little brown myotis (*Myotis lucifugus)*

In addition to little brown myotis and the northern long-eared bat (*Myotis septentrionalis*), which were known to occur in Nahanni National Park Reserve, a bat survey conducted in NNPR and surrounding area in the summer of 2006 found five other species of bats in the region: *Myotis evotis*, the western long-eared bat, *M. volans*, the long-legged bat, *Eptesicus fuscus*, the big brown bat, *Lasiurus cinerus*, the hoary bat, and *Lasiurus borealis*, the eastern red bat (Lausen, 2006). The use of the South Nahanni watershed by bats is not well understood, but wildlife and environmental monitors should be aware of the potential presence of bats of at least some of these species in the HPAR corridor.

LAGOMORPHS

- Collared pika (*Ochotona collaris)*

RODENTS

- Beaver (*Castor canadensis)*
- Porcupine (*Erithizon dorsatum)*
- Brown lemming (*Lemmus trimucronatus)*
- Hoary marmot (*Marmota caligata)*
- Long-tailed vole (*Microtus longicaudus)*
- Singing vole (*Microtus miurus)*
- Tundra vole (*Microtus oeconomus)*
- Meadow vole (*Microtus pennsylvanicus)*
- Taiga vole (*Microtus xanthognathus)*
- Northern red-backed vole (*Myodes rutilus)*
- Least chipmunk (*Neotamias minimus)*
- Bushy-tailed woodrat (*Neotoma cinerea)*
- Deer mouse (*Peromyscus maniculatus)*
- Heather vole (*Phenacomys intermedius)*
- Arctic ground squirrel (*Spermophilus parryii)*
- Northern bog lemming (*Synaptomys borealis)*
- Red squirrel (*Tamiasciurus hudsonicus)*
- Meadow jumping mouse (*Zapus hudsonius)*

A small mammal survey including, small mammal species at risk (pika and bat species) is planned for 2015.

4.2.8.12. Migratory and Resident Birds

Studies in the vicinity of the Selwyn Project mine site and extending along valleys in the Yukon west of Howard's Pass identified a potential for at least 120 species of birds to be present, including raptors, breeding songbirds, game birds, owls and waterfowl (Bulger and Tripp, 2011). Of these 120 potential species, 91 were verified by direct observation, and 53 species were confirmed as breeding in the Yukon study area (Bulger and Tripp, 2011).

The environmental monitor working in the HPAR corridor from July through October, 2014 recorded incidental bird observations, as did other monitors and biologists working in the area since 2007. The report of the environmental monitor noted that incidental records provide an indication of occurrence of conspicuous or priority species, but are inevitably biased by where and when observations were made (EDI, 2014). Breeding status is also not possible to infer from these records. The 55 bird species recorded up to October, 2014 along the HPAR corridor are:

- Alder Flycatcher
- American Dipper
- American Kestrel
- American Pipit
- American Robin
- American Tree Sparrow
- American Wigeon
- Bald Eagle
- Belted Kingfisher
- Black-backed Woodpecker
- Bohemian Waxwing
- Bonaparte's Gull
- Boreal Chickadee
- Bufflehead
- Common Loon
- Common Raven
- Common Redpoll
- Common Yellowthroat
- Dark-eyed Junco
- Golden Eagle
- Gray Jay
- Green-winged Teal
- Lesser Yellowlegs
- Long-billed Dowitcher
- Merlin
- Mew Gull
- Northern Harrier
- Northern Shrike
- Northern Waterthrush
- Northern Hawk Owl
- Olive-sided Flycatcher
- Orange-crowned Warbler
- Peregrine Falcon
- Pine Grosbeak
- Pine Siskin
- Ptarmigan
- Red-breasted Merganser
- Red-necked Phalarope
- Red-tailed Hawk
- Ring-necked Duck
- Ruby-crowned Kinglet
- Rusty Blackbird
- Sandhill Crane
- Savannah Sparrow
- Semipalmated Plover
- Song Sparrow
- Spruce Grouse
- Townsend's Solitaire
- Tree Swallow
- Trumpeter Swan
- White-crowned Sparrow
- White-winged Crossbill
- Willow Ptarmigan
- Wilson's Warbler
- Yellow-rumped Warbler

SCML will conduct a survey of breeding birds, raptors and waterfowl in 2015.

4.2.8.13. Amphibians and Reptiles

The only potential amphibians or reptiles known to occur in the region are the wood frog (*Lithobates sylvaticus*) and the boreal chorus frog (*Pseudacris triseriata maculate*). Although neither have been documented as occurring in the vicinity of the HPAR, the wood frog is abundant and widespread in Nahanni National Park Reserve and the boreal chorus frog is known to be present along the South Nahanni River (Anions, 2014).

An amphibian survey is planned for the HPAR corridor in 2015.

4.2.9. Species with Special Conservation Status

Special status species are wildlife and plant species that are identified as having a level of conservation concern at various geographic scales (e.g., at regional, national or international). Special status plant species (rare plants) in the HPAR vegetation study area are discussed in Section 4.2.3. The following section discusses special conservation status of wildlife and specifies which special status species occur—or have the potential to occur—within the HPAR corridor area.

4.2.9.1. Species at Risk Act (SARA)

The federal *Species at Risk Act* (SARA) is a key national conservation law enacted to prevent Canadian indigenous species, subspecies and distinct populations from being extirpated, and to provide for the recovery of endangered or threatened species (Government of Canada, 2015a). The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) is an independent committee established under SARA to identify and assess wildlife species considered to be at risk in Canada. It uses a process based on science, Aboriginal Traditional Knowledge and community knowledge. COSEWIC makes recommendations to the Government of Canada and the public. Wildlife species designated by COSEWIC are then considered for legal protection and recovery under SARA, and this government decision may take additional factors, such as social and economic concerns, into consideration. The Act applies to species that are on the SARA legal list of species at risk (SARA Schedule 1). Definitions of SARA conservation risk categories are provided in Table 4.2-11.

Table 4.2-11: SARA Conservation Risk Category Definitions (Government of Canada, 2015b)

SARA Risk Category	Definition
Special Concern	Species that may become "Threatened" or "Endangered" because of a combination of biological characteristics and identified threats if no preventative action is taken.
Threatened	Species likely to become "endangered" if nothing is done to reverse factors leading to their extirpation or extinction.
Endangered	Species that face imminent extirpation or extinction.
Extirpated	Species which no longer exist in the wild in Canada, but exist elsewhere in the wild.
Extinct	Species which no longer exist.

In general, the provisions of SARA apply to federal lands, and to migratory birds, aquatic species and terrestrial species on federal lands. Provincial and territorial governments take the lead role for other species. Once critical habitat has been identified in a recovery strategy or action plan, it is protected through the Act. Specific prohibitions against any destruction of wildlife and their habitat apply to species listed as endangered or threatened.

4.2.9.2. NWT Species at Risk Act

The *Species at Risk (NWT) Act (2009)* provides legislative powers similar to SARA. *It applies to any wild animal or plant species managed by the Government of the Northwest Territories. It applies on public and private lands.* The status of species in the NWT is assessed by the Species at Risk Committee (SARC), which can recommend adding a species to the NWT List of Species at Risk. SARC is supported by the NWT Species General Status Ranking Program, a joint program run by government agencies and wildlife co-management boards. This program produces information for SARC to use as a starting point to investigate which species may have higher priority for a more detailed assessment. The detailed assessment is based on traditional, community and scientific knowledge of the biological status of the species (Working Group on General Status of NWT Species, 2011). General Status Ranks of Wild Species in the Northwest Territories are defined in Table 4.2-12.

Table 4.2-12: General Status Ranks of Wild Species in the Northwest Territories

NWT GS Rank	Definition
At Risk	Species for which a detailed assessment has already been completed (e.g., by COSEWIC or jurisdictional status reports) that determined the species to be at risk of extirpation or extinction. This is a special category used only for species that have been assessed as "Endangered" or "Threatened" according to COSEWIC, or according to SARC in the NWT.
May Be At Risk	Species that may be at risk of extinction or extirpation, and are therefore candidates for detailed risk assessment. These species are ranked with the highest priority for a more detailed assessment by COSEWIC in Canada or SARC in the NWT.
Sensitive	Species that are not at risk of extinction or extirpation but may require special attention or protection to prevent them from becoming at risk. These species are ranked with a medium priority for a detailed assessment.
Secure	Species that are not at risk or sensitive. These species have the lowest priority for a detailed assessment.

4.2.9.3. Special Conservation Status Species Considered in the HPAR Corridor Area

As described in Sections 4.2.7 and 4.2.8, a wide variety of terrestrial and aquatic wildlife species occur or have the potential to occur within the HPAR corridor area. Of these, 15 are currently either assigned a special conservation status through the federal system or are assigned a rank other than secure through the NWT General Status Ranks. None of these species are legally listed under the *Species at Risk (NWT) Act* (GNWT, 2014a). Table 4.2-13 lists special status species that have been observed or that may occur within the HPAR corridor area, based on their known ranges.

Table 4.2-13: Special Status Species Considered in the HPAR Corridor Area

English Name	Scientific Name	COSEWIC Status(1) (last COSEWIC assessment)	SARA Schedule 1 Status(2) and SARA plans	NWT GS Rank(3)	Occurrence in the HPAR Vicinity(4)
Northern mountain woodland caribou	*Rangifer tarandus caribou*	Special Concern (2014, reassigned)	Special Concern (management plan in place since 2012)	Secure	Occurrence known*
Rocky Mountain goat	*Oreamnos americanus*	Not assessed	–	May Be At Risk	May occur
Grizzly bear, western population	*Ursus arctos*	Special Concern (2012, reassigned)	(under consideration)	Sensitive	Occurrence known*
Wolverine	*Gulo gulo*	Special Concern (2014, reassigned)	(under consideration)	Sensitive	Occurrence known*
Collared pika	*Ochotona collaris*	Special Concern (2011, new designation)	(under consideration)	Sensitive	Occurrence known*
Little brown myotis Northern myotis	*Myotis lucifugus* *M. septentrionalis*	Endangered (2013, no change—threatened by a fungal disease)	Endangered	May Be At Risk	May occur*
Horned Grebe, western population	*Podiceps auritus*	Special Concern (2009, new designation)	(under consideration)	Sensitive	May occur*
Trumpeter Swan	*Cygnus buccinators*	Not at Risk (1996, no longer at risk)	–	Sensitive	Occurrence known*
Red-necked Phalarope	*Phalaropus lobatus*	Special Concern (2014, new designation)	(under consideration)	Sensitive	Recorded occurrence along HPAR*
Olive-sided Flycatcher	*Contopus cooperi*	Threatened (2007, new designation)	Threatened (recovery strategy to be completed 2015)	At-Risk	Recorded occurrence along HPAR*
Rusty Blackbird	*Euphagus carolinus*	Special Concern (2006, new designation)	Special Concern (proposed management plan released 2014)	Sensitive	Recorded occurrence along HPAR*
Common Nighthawk	*Chordeiles minor*	Threatened (2007, new designation)	Threatened (recovery strategy to be completed 2015)	At Risk	May occur*
Short-eared Owl	*Asio flameus*	Special Concern (2008, no change)	Special Concern (management plan to be completed 2016)	Sensitive	May occur*

English Name	Scientific Name	COSEWIC Status[1] (last COSEWIC assessment)	SARA Schedule 1 Status[2] and SARA plans	NWT GS Rank[3]	Occurrence in the HPAR Vicinity[4]
Peregrine Falcon	*Falco perigrinus anatum/tundrius*	Special Concern (2007, reassigned)	Special Concern (management plan to be completed 2016)	Sensitive	Recorded occurrence along HPAR*

* Baseline survey work relevant to the species marked with asterisks is planned for 2015.

(1) COSEWIC (2015)

(2) SARA Registry (Government of Canada, 2015)

(3) Working Group on the General Status of NWT Species (2011)

(4) Based on species distribution information from the SARA Registry and from 2014 incidental observations (EDI, 2014)

Information about status, threats and habitat use of migratory bird and bat species listed in Table 4.2-13 is provided below.

Little Brown Myotis and Northern Myotis

Both of these bat species are known to occur across Canada (with the exception of Nunavut) and throughout a significant portion of the United States. Both species are insectivorous and forage over lakes, along waterways and forest edges. Females establish summer maternity colonies (roosts) in buildings or large-diameter trees. Overwintering residences are cold and humid hibernacula, such as caves and mines. White-nose syndrome, a fungal disease caused by an introduced pathogen, has caused a significant decline in the population of myotis species in eastern Canada. It is estimated that the entire Canadian population will be affected in 12–18 years (Government of Canada, 2015). Northern myotis is also listed as Endangered on Schedule 1 of SARA. Both species are present in Nahanni National Park Reserve (Anions, 2014).

Horned Grebe

In the NWT, Horned Grebes breed in the Mackenzie River Valley and winter on the Pacific Coast. They nest on small, permanent or semi-permanent ponds, as well as marshes and shallow bays on lake borders, and feed mainly on aquatic insects and fish. Survey data indicate a decrease in population of the western Horned Grebe of 14% over the last three generations (Environment Canada, 2015). The causes of population decline are not known but may include degradation of wetland breeding habitat, predation, incidental netting and disease (Government of Canada, 2015). Horned Grebes are known to breed in Nahanni National Park Reserve (Anions, 2014).

Red-necked Phalarope

The Red-necked Phalarope, a small migratory shorebird, breeds in the tundra and subarctic lowlands of northern Canada. It winters in marine environments, commonly migrating to South America. It prefers shallow, fresh-water ponds and lakes for nesting, typically establishing a site on the ground in low vegetation by the water. Its summer diet consists mainly of insects and small fish. It is believed that the population of this species has declined in the past 40 years, yet little is known regarding potential threats to its survival. Factors such as climate change induced drought and habitat degradation, variation in abundance of feed species and predation may be linked to population decline (Audubon, 2015). One Red-necked Phalarope was observed within the vicinity of the road, km 0–10, in the summer of 2014 (EDI, 2014). This species is a common fall migrant in Nahanni National Park Reserve (Anions, 2014).

Olive-sided Flycatcher

The Olive-sided Flycatcher is a songbird whose breeding range extends through most of northern Canada below the tree-line. Breeding takes place from April to June (predominantly in mid- to late May). Nests are typically in tall coniferous trees within an open area (forest edges, rivers, swamps, logged areas). Tall trees provide elevated perches that assist in intercepting insect prey and avoiding predators. Olive-sided Flycatchers begin fall migration in late July, travelling to South America. The Olive-sided Flycatcher population has been in decline since the 1990s, with populations west of the Rocky Mountains experiencing the greatest decrease in numbers. Threats include habitat loss and alteration, and a decline in insect populations (Government of Canada, 2015). Three Olive-sided Flycatchers were observed within the vicinity of the road at km 12-15, July 30 and 31, 2014, at the beginning of the fall migration period (EDI, 2014). Olive-sided Flycatchers are uncommon summer residents of Nahanni National Park Reserve (Anions, 2014). The first breeding record for the park reserve was in recorded 2013.

Rusty Blackbird

The Rusty Blackbird's range covers most of Canada and Alaska. It is known to nest in areas of the boreal forest in habitat characterized by slow-moving streams, peat bogs, marshes, swamps and beaver ponds. Nesting season begins in April or early May. The female selects a site in riparian vegetation near or above a body of water to build her nest. Rusty Blackbirds also depend on the aquatic environment for food sources such as aquatic invertebrates and occasionally salamanders and small fish. Migration begins towards late August. Conversion of the forests of the Mississippi Valley flood plains (wintering grounds) for agricultural purposes is thought to be a major threat to this species, as well as bird-control programs aimed at reducing birds that damage crops (Government of Canada, 2015). Six Rusty Blackbirds were observed within the vicinity of the road in the summer of 2014, at km 0–1- and km 31–40 (EDI, 2014). Rusty Blackbirds are present but uncommon in Nahanni National Park Reserve. There are no confirmed breeding records, but the birds are difficult to detect (Anions, 2014).

Common Nighthawk

The Common Nighthawk feeds on insects, typically at dawn or dusk. Its breeding range includes most of North America. In the NWT, it breeds along the Alberta and Saskatchewan borders and along the Mackenzie Valley through to Norman Wells. The species is known to breed in Nahanni National Park Reserve (Anions, 2014). Wintering grounds are in parts of South America. The Common Nighthawk nests in a range of open habitats such as, rocky outcrops, grasslands, peat bogs, marshes, lakeshores and river banks, and remains faithful to established nests. Breeding season is between early May and mid-June, and fall migration begins towards mid-August. The Common Nighthawk population is declining at an estimated annual rate of 6.6% per year. Threats are believed to be related to a decline in prey species, habitat loss and modification, and increased predation (Government of Canada, 2015).

Short-eared Owl

The Short-eared Owl breeds in all Canadian provinces, but occurs mainly in the Prairie Provinces or other regions where voles and small rodents are abundant. It is seen annually in the spring, but not in the summer, in Nahanni National Park Reserve (Anions, 2014). The Short-eared Owl prefers nesting sites that are open, such as dense grasslands, marshes, and tundra with areas of small willows. The population decline of this species is believed to be related to reductions in suitable breeding, migration and wintering habitat, due to draining and clearing for agricultural land and urban development (Government of Canada, 2015).

Peregrine Falcon

The Peregrine Falcon breeds throughout the world (with the exception of Antarctica) and in most parts of Canada. The subspecies *P. tundrius* is most likely to occur in the NWT. The Peregrine Falcon may be found in various habitat types, but it typically hatches eggs, without building a nest, on cliff edges or crevices near good foraging areas. Adults will return to the same nest site for decades. Peregrine Falcons migrate to the southern United States, Mexico, Central America and South America in the fall. Populations have recovered significantly since organochlorine pesticides affecting egg shell consistency were banned in the 1970s. Other threats include human disturbance of nesting areas, decline in prey species and poaching (Government of Canada, 2015). One Peregrine Falcon was observed within the vicinity of the HPAR, at km 51–60, in the summer of 2014 (EDI, 2014). Peregrine falcons are seen regularly in Nahanni National Park, but there are no confirmed breeding records (Anions, 2014).

4.3. Human Environment

4.3.1. Communities

The communities that may potentially be affected by the construction and operation of the HPAR are described below. Figure 4.3-1 shows a map of communities in relation to the HPAR.

4.3.1.1. Tulita

Tulita is a small Dene community at the confluence of the Great Bear and Mackenzie rivers (GNWT Bureau of Statistics, 2010a), approximately 320 km northeast of the Selwyn Project. The name Tulita means "where the two rivers meet" in the local Dene language. The Mackenzie River flows north from Great Slave Lake to the Arctic Ocean, and the Great Bear River flows west out of the Great Bear Lake to join the Mackenzie River. The town began as a trading post, established in 1810 by the Northwest Trading Company, which was later taken over by the Hudson's Bay Company. There is no all-season road access—Tulita is a fly-in/fly-out community with river boat access and winter road access only.

Tulita is home to the Sahtu, also with a significant Metis population and a non-Aboriginal population. Tulita has a total population of 567 people (2012) (GNWT Bureau of Statistics, 2012a). Services in the community include an airport, winter road, grocery store and hotel.

4.3.1.2. Norman Wells

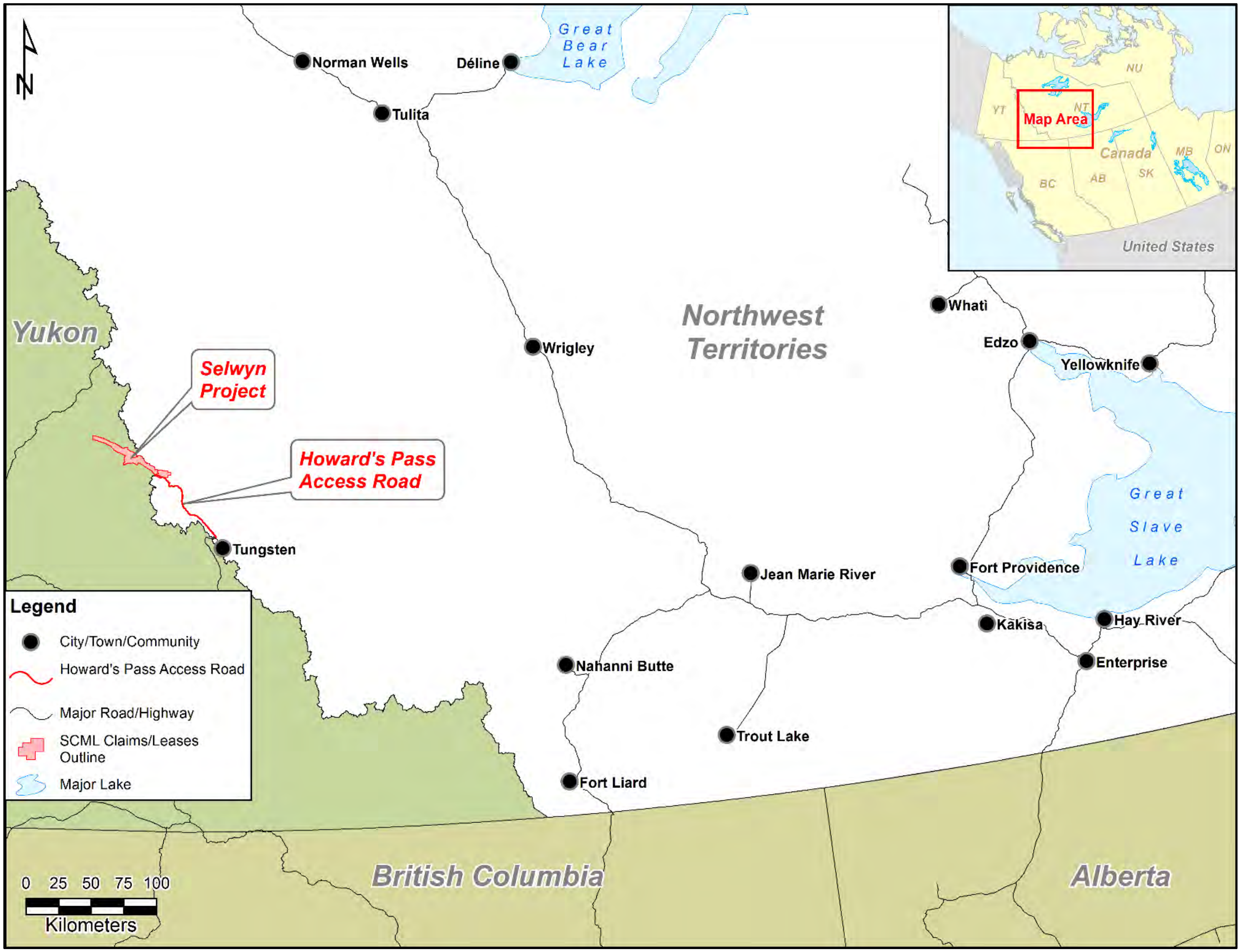
Norman Wells is located in the Mackenzie Valley, approximately 340 km north of the Selwyn Project, bordered by the Franklin Mountains, Norman Range and the Mackenzie River (GNWT Bureau of Statistics, 2010b). The population is about 838 (2012) (GNWT Bureau of Statistics, 2012b). It was the first community in the NWT that was established for non-renewable resource development. Oil seepages were recorded at the end of the 1700s by Alexander Mackenzie when he travelled the river. In the early 1900s, Dene led geologists to the same spot and three claims were staked in 1914. The Dene name for the area, "Le Gohlini," means "where the oil is." A small refinery was built in the early 1920s and supplied down-river communities for about 50 years. During World War II the US Army constructed a pipeline from Norman Wells to Whitehorse as part of the defence against possible Japanese attacks on west coast petroleum facilities. The pipeline was dismantled in 1947.

These facilities have been expanded in modern times, and the refineries at Norman Wells are now connected to the North American oil and gas pipeline infrastructure through the Enbridge Pipeline, which extends south through the Mackenzie River Valley. In addition to major oil and gas production facilities, there is a wide variety of business enterprises, including tourism-related businesses. Facilities in the community include an airport, hotels, RCMP detachment, government offices, museum and community centre.

4.3.1.3. Nahanni Butte

Nahanni Butte is a small, traditional First Nations community of 104 people (2012) located approximately 350 km southeast of the Selwyn Project (GNWT Bureau of Statistics, 2012c). The community is at the end of an all-season access road. A boat or water taxi is required to cross the Liard River to reach the community on the other side (GNWT Bureau of Statistics, 2012c). The river can be crossed during the winter on an ice bridge that connects to the all-season road. There is an airstrip that provides plane access to and from the community. Some members of the community are employed at the Prairie Creek Project, which is located near Nahanni Butte.

Figure 4.3-1: Neighbouring Communities



4.3.2. Land Use

4.3.2.1. Sahtu and Dehcho Land Use Plans

The HPAR crosses through the traditional territories of the Sahtu and Dehcho (see Section 2.5 Project Location and Figure 2.5-1). The Sahtu Dene and Metis Comprehensive Land Claim Agreement covers the area the road transverses at its north end, while the south end of the road falls within the area covered by the Dehcho First Nation Interim Measures Agreement. The Interim Measures Agreement assures the Dehcho of involvement in matters such as the issuance of leases and licences of occupation, and land use planning within their traditional territory. Land use planning has been carried out by both the Sahtu and the Dehcho for their respective lands, and ongoing planning processes are established. The Dehcho 'Final Draft' Land Use Plan is currently pending approval under processes established under Sections 9–11 of the Dehcho First Nations Interim Measures Agreement, while the Sahtu Land Use Plan is currently in force. The entire HPAR corridor is also within Kaska Traditional Territory (Figure 2.5-1).

Sahtu Settlement Area

The Sahtu Land Use Plan, adopted by the Sahtu Land Use Planning Board in April 2013, distinguishes six land uses within the Sahtu Settlement Area (SSA) (Sahtu Land Use Planning Board, 2013a). The majority of the SSA is covered by two land use zones: 1) Special Management Zones cover 47% of the SSA, and 2) General Use Zones cover 31% of the SSA. Conservation Zones cover 11% of the SSA, while the other three zones (Proposed Conservation Initiatives, Established Protected Areas and Community Boundaries) combined account for the remaining 11%. A description of each of these land uses is in Table 4.3-1, and their spatial distribution is shown in Figure 4.3-2.

Table 4.3-1: Sahtu Land Use Zones

Land Use Zones	Percent of SSA	Description of Zone
Special Management Zones	47.5%	Includes all types of land use other than bulk water removal, subject to the general conformity requirements (CRs) and applicable special management CRs outlined in the Land Use Plan.
General Use Zones	30.9%	Allows all land use except bulk water removal, subject to the general CRs outlined in the Land Use Plan.
Conservation Zones	10.7%	Are significant traditional, cultural, heritage and ecological areas in which specified land uses are prohibited. Permitted land uses (anything not prohibited, or grandfathered uses) are subject to the general CRs and applicable special management CRs outlined in the Land Use Plan.
Proposed Conservation Initiatives(1)	8.8%	Areas for which formal legislated protection is being sought through the Protected Areas Strategy, pursuant to commitments under the SDMCLCA, or under Parks Canada's legislation. The establishment of a protected area is the intended use of Proposed Conservation Initiatives (PCIs) and is permitted. PCIs have the same status as Conservation Zones until they are protected under other legislation.
Established Protected Areas	2.0%	An area that is designated as an Established Protected Area; the Plan no longer provides direction to these areas. Instead, they are managed according to their sponsoring legislation and management plans (where applicable).
Community Boundaries	0.14%	Lands within the boundaries of a local government

(1) Note that this plan predates the finalization of the Náátsʼıhchʼoh National Park Reserve, which is therefore categorized as a Proposed Conservation Initiative. The Sahtu Land Use Plan is in the process of being amended to accommodate this change in land status (Sahtu Land Use Planning Board, 2015).

Source: Sahtu Land Use Planning Board (2013a)

About 23 km of the HPAR passes through the Nahanni National Park Reserve and approximately 24 km of the HPAR passes through the newly established Nááts'ihch'oh National Park Reserve (zoned as "Proposed Conservation Initiative Land Use Zone" when the Plan was published). The Plan applies only to the sections of road (kilometres 60-79) outside of the geographic limits of the parks, while the park areas are managed according to the provisions of the *Canada National Parks Act.* Where the Sahtu Land Use Plan applies, all land use activities must conform to "Conformity Requirements" that are applicable to the location and proposed activities (Sahtu Land Use Planning Board, 2013a). Conformity Requirements (CRs) are the rules under which land use may take place and are the means by which the visions and goals for the Sahtu Settlement Area are achieved. The Plan specifies thirteen General and six Special Management CRs.

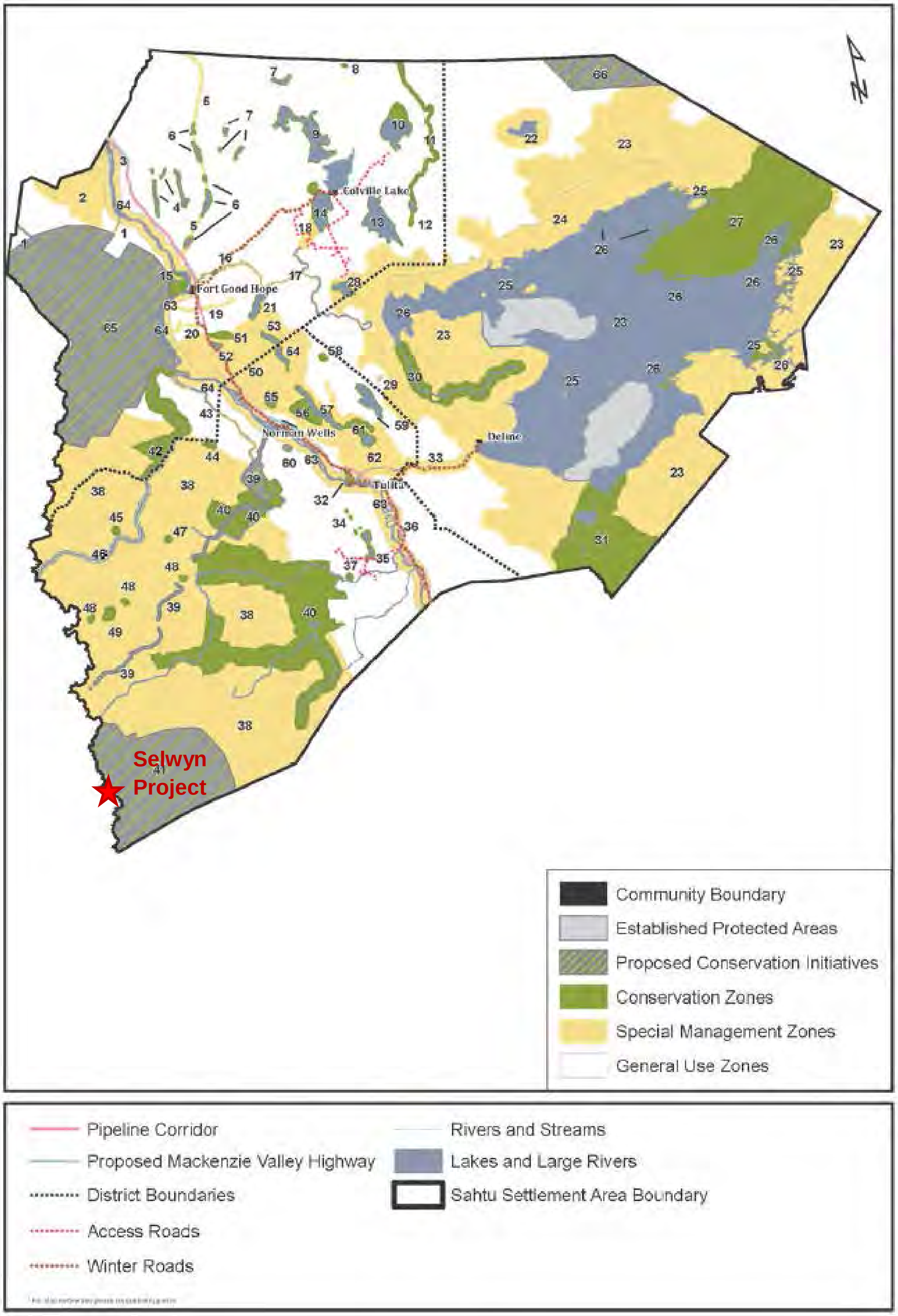
The Sahtu Land Use Plan provides for a number of land use exemptions to application of the Plan, including an exemption for "legacy land use". The HPAR is a legacy land use, defined as "ongoing or proposed land uses for which one or more applicable authorizations have been issued under federal or territorial law prior to the Plan coming into effect…" (Section 2.D.1.1). As such, the HPAR is exempt from the Conformity Requirement related to land use zoning (CR#1). Many of the other Conformity Requirements, however, are both applicable and relevant. SCML anticipates that the HPAR will be in conformity with the Conformity Requirements that govern land use through existing legal and regulatory processes. Table 4.3-2 provides a summary and cross-references to demonstrate how this application meets the criteria established by the Plan and Plan Implementation Guide (Sahtu Land Use Planning Board, 2013a and 2013b) for the determination of conformity.

Table 4.3-2 Sahtu Land Use Plan Conformity Criteria

Conformity Requirements	Applicability to HPAR Upgrade Project	Summary of Actions and Information Related to Compliance
CR # 1 Land use zoning	Not applicable (legacy land use)	--
CR # 2 Community engagement and traditional knowledge	Yes	• See Section 8: Community Engagement • Community Engagement Report (Section 8.3 and Appendix X); • Cooperation Agreement with Tulita District Land Corporations (Tulita Land Corporation, Fort Norman Metis Land Corporation, Norman Wells Land Corporation). The Agreement acknowledges sufficient consultation and accommodation. • An interview-based Traditional Knowledge study was undertaken for the Howard's Pass area (Pacifica Resources, 2006) and a Sahtu Traditional Knowledge Study update will be conducted in 2015
CR # 3 Community benefits	Yes	• See Section 8: Community Engagement • Community Engagement Report (Section 8.3 and Appendix X); • A Cooperation Agreement with Tulita District Land Corporations is the basis for participation of all of the beneficiaries in project exploration and development activities, employment, training and service contracts, and in review of environmental, social and economic matters related environmental assessment and permitting.
CR # 4 Archaeological sites and burial sites	Yes	• See Section 4.3.3: Cultural Heritage • A Heritage Resource Overview Assessment (Stantec Consulting Ltd., 2015) was completed and a Heritage Resource Impact Assessment is to be conducted by Kalo-Stantec in 2015. • Adherence to Standard Operating Procedure for Heritage Resources (Appendix I)

Conformity Requirements	Applicability to HPAR Upgrade Project	Summary of Actions and Information Related to Compliance
CR # 5 Watershed management	Yes	• The Project does not have the potential to substantially alter water quantity or rate of flow • See Section 5.2.1.3: Surface hydrology potential effects and mitigation • The project has the potential to negatively affect water quality • See Section 5.2.1.4: Water quality potential effects and mitigation. Mitigation measures will minimize or eliminate potential impacts to HPAR watersheds, including in Special Management Zones, Conservation Zones and areas of Proposed Conservation Initiatives.
CR # 6 Drinking water	Not relevant	--
CR # 7 Fish and wildlife	Yes	• See Section 5.2, 6.2 and Fish and Wildlife sub-sections therein • Implementation of Wildlife Mitigation and Monitoring Plan (Appendix VI)
CR # 8 Species introductions	Yes	• See Section 5.2.2.1: Vegetation and plant communities potential effects and mitigation • An invasive plant baseline survey is planned for 2015, followed by annual surveys and mitigation as needed. Cleared areas will be revegetated with plant species native to the Sahtu Settlement Area.
CR # 9 Sensitive species and features	Yes	• See Section 4.2.3: Ecosystem potential for rare plants. An initial assessment was completed and a rare plant survey is planned for 2015. • Specific features identified in this section (mineral licks, warm springs or ice patches) are not present in the HPAR corridor.
CR # 10 Permafrost	Yes	• See Section 5.2.1.7: Soils potential effects and mitigation and section for baseline work on permafrost occurrence and 5.1.3: Road design, for compliance with requirements.
CR # 11 Project-specific monitoring	Yes	• See the draft Wildlife Mitigation and Monitoring Plan (Appendix VI), which incorporates community input, and will continue to do so throughout its development and implementation. • Community wildlife monitors will be on-site throughout road upgrading works
CR # 12 Financial security	Yes	• In accordance with land use permit requirements
CR # 13 Closure and reclamation	Yes	• See Section 5.1.5 Borrow sources and 6.1.7: Road closure and reclamation for plans and mitigation

Figure 4.3-2: Sahtu Land Use Zones



Note that this map predates the finalization of the Náátsʼıhchʼoh National Park Reserve, which is therefore shown as a Proposed Conservation Initiative (number 41 on the map).

Source: Sahtu Land Use Plan (Sahtu Land Use Planning Board, 2013a, p. 32; Selwyn Project location added)

Dehcho Traditional Territory

The Final Draft Dehcho Land Use Plan, which is not yet in force, proposes five land use zones (Dehcho Land Use Planning Committee, 2006): 1) Conservation Zones, 38% of the plan area; 2) Special Management Zones, 29%; 3) General Use Zones, 21%.; 4) Edéhzhíe Protected Areas Strategy Zone, 12%; and 5) Special Infrastructure Corridors, which account for less than 1% of the plan area. These calculations exclude Nahanni National Park Reserve and communities. Table 4.3-3 describes each of the zones, and their spatial distribution is shown on Figure 4.3-3. Kilometres 14 through 36 of the HPAR appear to run through Conservation Zone 6 (Greater Nahanni Ecosystem) as set out in the Plan.

Table 4.3-3: Dehcho Land Use Zones

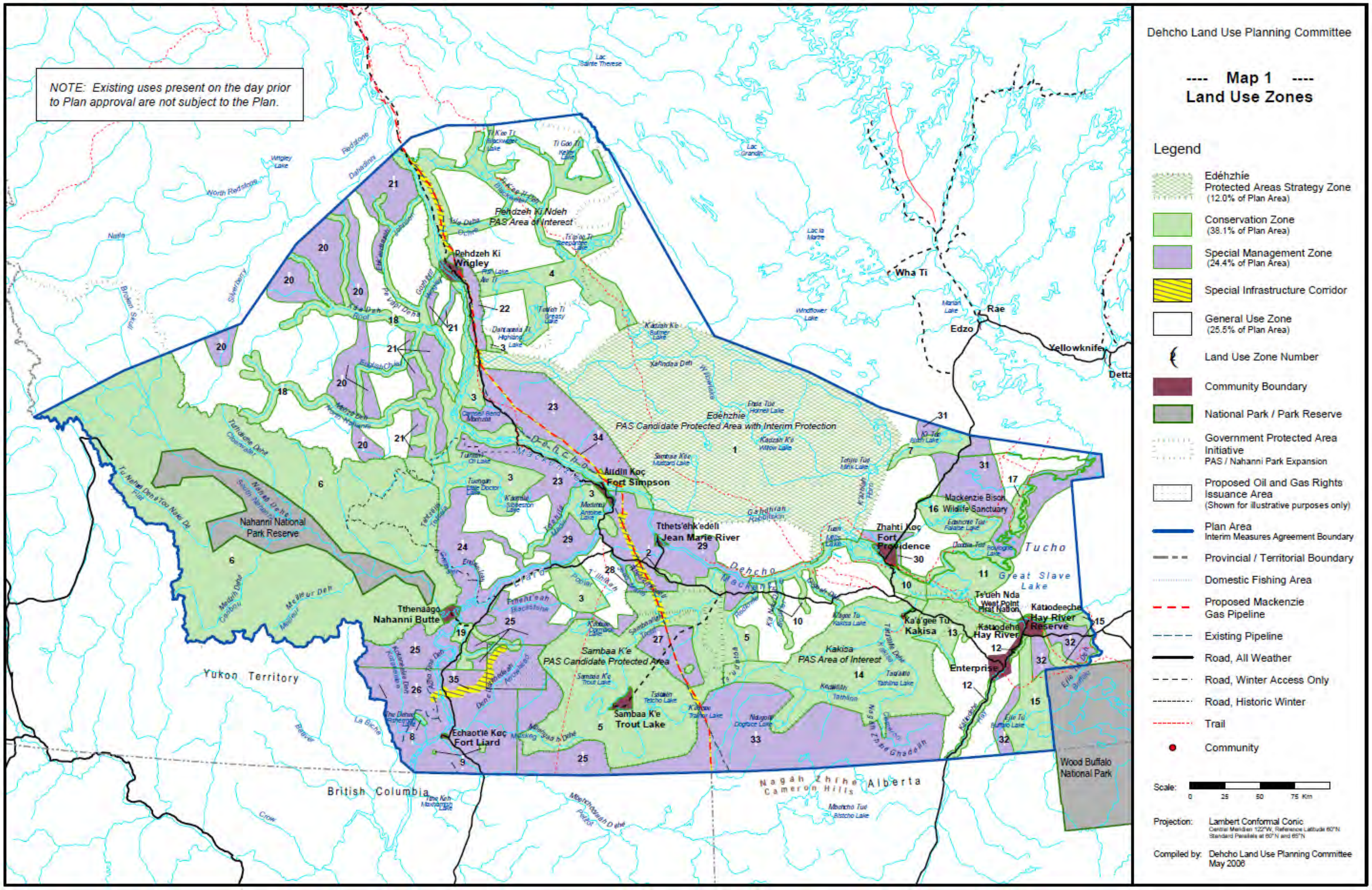
Land Use Zones	Percent of Area	Description of Zone
Conservation Zones	38.3	Areas having significant ecological and cultural values. They are meant to provide flexible protection to lands of important cultural or ecological value. Of the five types of land use controlled by zoning (oil and gas operations, mining, forestry, tourism, agriculture), only tourism is permitted in Conservation Zones, subject to the Plan's Conformity Requirements. Two of the zones prohibit tourism as well. The Mackenzie Valley Special Infrastructure Corridor provides a passage through four Conservation Zones.
General Use Zones	20.8	Permit all land uses, subject to the Plan's Conformity Requirements as presented in the Dehcho Land Use Plan.
Special Management Zones	28.9	Areas where there is significant potential for both conservation and resource development together. Special Management Zones were established to promote certain types of land use or protect values while allowing some forms of land use to proceed. To achieve these goals, each Special Management Zone prohibits at least one of the five land use types addressed, while permitting others, subject to the Plan's other Conformity Requirements.
Protected Areas Strategy Zone	12.0	A separate designation for Candidate Protected Areas with Interim Protection. At the moment, only Edéhzhíe (Zone 1) has this designation. Edéhzhíe has been withdrawn from disposition through the Protected Areas Strategy (PAS) process. Once established as a protected area, it will be managed under the legislation and authority of the sponsoring agency and an applicable Management Plan. In the interim, it is subject to the Plan. The Protected Areas Strategy Zone designation provides the same level of protection as a Conservation Zone.
Special Infrastructure Corridors	-	Two study corridors for proposed pipeline Projects. The construction and operation of a pipeline is permitted within these corridors, subject to the Plan's Conformity Requirements, even where the corridors cross Zones where oil and gas operations are not permitted otherwise. All zone requirements and restrictions continue to apply in the corridors except where and to the extent that the Plan states an exception.
Mackenzie Valley Special Infrastructure Corridor (Zone 34)	0.6	A study corridor for the proposed Mackenzie Valley Pipeline and associated infrastructure based on the routing of the proponent and negotiated corridors through existing land withdrawals.
Netlá-Arrowhead Special Infrastructure Corridor (Zone 35)	0.2	A study corridor for a proposed pipeline and associated infrastructure in the Netlá-Arrowhead and surrounding area, which would allow for the commercialization of existing discoveries.

Source: Dehcho Land Use Planning Committee (2006)

The Draft Dehcho Land Use Plan, which is not yet in effect, provides guidance on how land use activities in Dehcho territory should be conducted to support the social, cultural and well-being objectives for residents and communities. The HPAR is an "existing use" (as defined in Section 1.2, item 5b.i and ii), but, nonetheless, several of the Conformity Requirements specified in Chapter 2 of the Plan are relevant to the HPAR Upgrade Project and were reviewed in the development of the project plans:

CR # 3 Use and Recognition of Traditional and Cultural Knowledge
CR # 4 Protection of Significant Traditional Land Use and Occupancy Sites
CR # 6 Community Involvement
CR # 9 Granular Resources
CR # 15 Water Monitoring / Management (Aquatic Environment)
CR # 18 Revegetation
CR # 24 Cumulative Effects Management

Figure 4.3-3: Dehcho Land Use Zones



Source: Final Draft Dehcho Land Use Plan, June 2, 2006 (based on June 12 revision) (Dehcho Land Use Planning Committee, 2006, p. 15)

4.3.2.2. National Park Reserves

The HPAR corridor passes through the Nahanni National Park Reserve from km 14 to km 36. The original area of land, 4,766 km^2, was set aside in 1972 as a National Park Reserve and it was formally established through an amendment to the *Canada National Parks Act* in 1976. The park boundary, which at that time did not overlap with the HPAR, was influenced by a desire to protect the South Nahanni River and Virginia Falls from hydroelectric development. In 1978, Nahanni National Park Reserve became the first site in the world to be granted World Heritage status by United Nations Education, Scientific and Cultural Organization (UNESCO), and in 1987 the South Nahanni River achieved Canadian Heritage River status (Parks Canada, 2013). In 2009, Nahanni National Park Reserve was expanded to 30,050 km^2, more than six times its original size. The expansion area overlapped the HPAR between km 14 and km 36.

The 2010 Nahanni National Park Reserve Management Plan was developed to “improve and monitor the state of the park, address needs and opportunities, and focus efforts and resources towards achieving the park vision” (Parks Canada, 2010). The plan aims to:

- protect the Naha Dehé watershed and respect the wilderness character of the park;
- become a centre for northern mountain research;
- encourage exploration and discovery of Naha Dehé by visitors and others;
- expand visitor experience opportunities and products;
- build training, employment and business opportunities for Dehcho First Nations;
- develop operational infrastructure in Fort Simpson and Nahanni Butte; and
- create a zoning plan for the park expansion area.

The Nááts'ihch'oh National Park Reserve was established in 2014. The reserve is 4,895 km^2 in size and protects 70% of the upper South Nahanni watershed in the Sahtu Settlement Area. The Nááts'ihch'oh Park Reserve adjoins with the Nahanni Park to the south and borders the Yukon to the west. Nááts'ihch'oh National Park Reserve overlapped the HPAR between km 36 and km 60.

In March 2012, an Impact and Benefit Plan was signed by the Government of Canada and the Sahtu Dene and Metis of the Tulita District. The Impact and Benefit Plan provides economic, cultural and social benefits to the Dene and Metis, as well as preserving wildlife habitat and continued natural resource development in the north (Parks Canada, 2014).

Both National Park Reserves provide visitors with numerous recreational activities including, hiking, camping, rafting, canoeing and fishing.

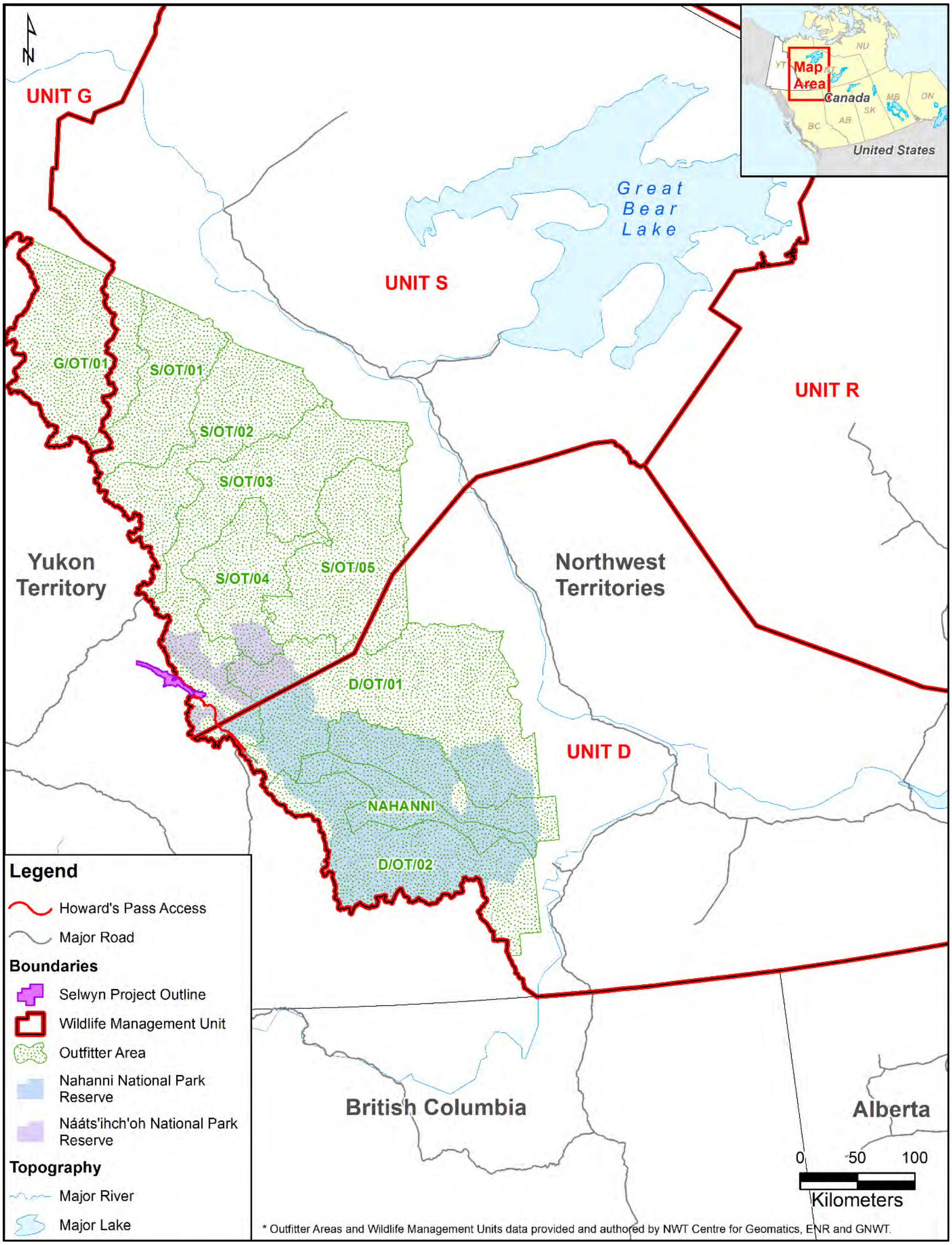
4.3.2.3. Hunting

Hunting (including subsistence) in the HPAR corridor is regulated by the Government of Northwest Territories. The HPAR corridor falls within NWT Wildlife Management Unit S, and Outfitter Management Area S/OT/03 as shown in Figure 4.3-4. There are defined hunting seasons for popular big game species, including woodland caribou (open July 15 to Jan 31 for residents and July 25 to Oct 31 for non-resident), moose (open Sept 1 to Jan 31 for residents and Sept 1 to Oct 31 for non-resident), and grizzly bear (open to residents only Aug 15 to Oct 31).

In the NWT, subsistence hunting is part of a way of life and is an important tradition and cultural practice for First Nations and other residents. Subsistence hunting provides food security for communities as well as providing material for making clothing, arts and crafts. A small proportion of NWT residents also engage in sport hunting.

All hunters require a licence, unless they are beneficiaries of a land claim specifically exempting them from requiring a licence (GNWT, 2015a). Hunting by others may also be affected by Land Claim Agreements.

Figure 4.3-4: NWT Wildlife Management Units and Outfitter Management Area



Data from GNWT, ENR, and NWT Centre of Geomatics

4.3.2.4. Trapping

Trapping of furbearers is another important resource for northern communities as it provides income, local food, material for clothing, arts and crafts and some traditional medicines for the local communities. It is also part of the social and cultural values of communities. In the NWT there are 14 species of furbearers that are actively trapped, of which eight are likely to occur in the HPAR corridor including; beaver, fox, marten, otter, red squirrel, weasel, wolverine, and wolf. While no registered trapping areas are located in the HPAR corridor, First Nations members may trap there under the provisions of the *Wildlife Act* and the *Trapping Regulations*. Information obtained from the Sahtu suggests that none of their people are currently trapping in the area.

4.3.2.5. Fishing

Fishing is a popular activity undertaken for both subsistence and sport. Residents and non-residents are subject to the provisions of the *Fisheries Act* and the *NWT Fishery Regulations* and require a licence to fish. Aboriginal people may fish for food without a licence anywhere in the NWT. In years when main game species, particularly moose and caribou, are in low numbers, fish have become more important in the diet of NWT First Nations. No traditional fish netting activities or subsistence fishing activities have been identified in proximity to the HPAR.

4.3.2.6. Guide Outfitting

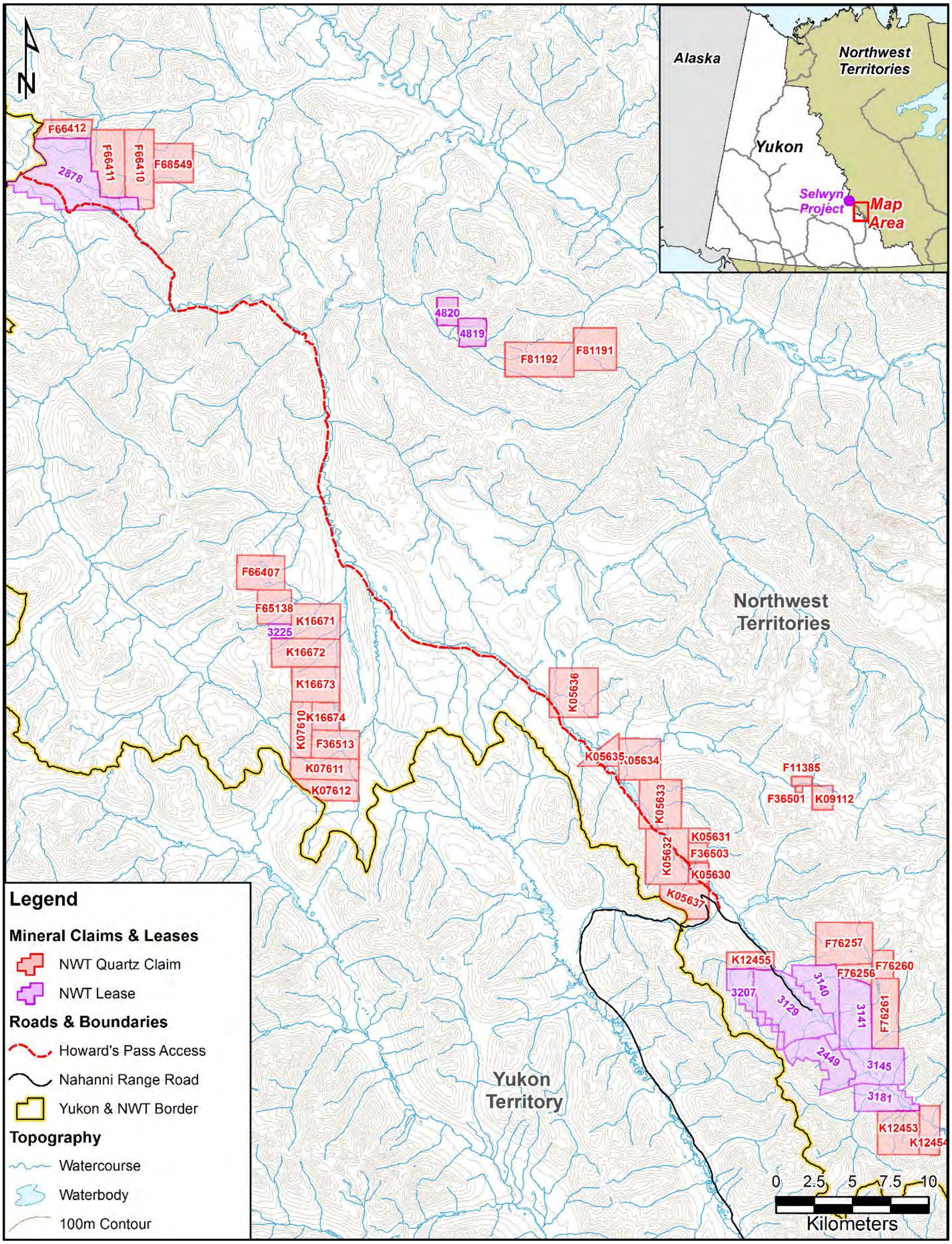
Outfitter Management Areas, as shown in Figure 4.3-4, are areas with legal boundaries that provide the holder of the concession with the exclusive right to guide non-residents for the purpose of hunting big game animals. The NWT rights to an Outfitter Management area are granted under the *Wildlife Act*. Within the study area, the management area is S/OT/03, Ram Head Outfitters, based out of Alberta.

4.3.2.7. Mineral and Forestry Resources

Figure 4.3-5 shows mineral claims and leases in the vicinity of the HPAR. There are a number of companies and individuals holding mineral claims or leases along or near the HPAR. These include North American Tungsten Corporation Ltd.'s claims and leases in the vicinity of Tungsten, claims along the south end of the HPAR, held by Archer Cathro and Associates, and a block of claims to the west of the HPAR, held by War Eagle Mining Company Inc. and Warren LaFave, among others. The claims northeast of the HPAR include Playfair Mining Ltd.'s tungsten property, which is accessed from the HPAR. The NWT claims and lease at the north end of the road are held by SCML.

Forestry in the NWT is managed under the *Forest Resources Act* and the Forest Resources Regulation, administered by NWT Environment and Natural Resources, Forest Management Branch. The Project area does not have any forestry activity or related development.

Figure 4.3-5: Mineral Claims and Leases in the Vicinity of the HPAR



4.3.3. Cultural Heritage

Archaeological sites in the NWT are protected by the *Archaeological Sites Regulations* pursuant to the *Archaeological Sites Act*. In addition heritage resources are protected by the *Mackenzie Valley Land Use Regulation* and archaeological sites in particular are protected under Section 6a and Sections 12a and 12b of this regulation.

In 2008, the Prince of Wales Northern Heritage Centre in Yellowknife was consulted regarding any archaeological sites in the vicinity of the project. The staff at the Heritage Centre stated that there were no known archaeological sites, but that no studies had been conducted within the area.

A Heritage Resource Overview Assessment was completed for the HPAR in 2014. This involved a desktop assessment and helicopter reconnaissance flight. A large portion of the area looked at was considered to have low pre-contact heritage potential. This is because of the absence of well-drained, level ground located near water sources. Locations with these characteristics are known from archaeological records to have larger, more permanent pre-contact sites, whereas upland locations are expected to represent short-term hunting sites with low artifact density. Any remains from pre-contact structures are not expected to be readily found due to vegetative growth and localized fires.

This initial assessment work will be followed up during 2015 by a Heritage Resources Impact Assessment, conducted by Kalo-Stantec. The study will consist of an assessment of areas located within or adjacent to the footprint of the proposed road upgrades and associated developments (e.g., borrow sources). Fieldwork will be conducted within portions of the study area determined to have elevated heritage potential based on local knowledge (e.g., Traditional Knowledge or Traditional Land Use information) and/or based on the Heritage Resource Overview Assessment conducted in 2014 (Stantec Consulting Ltd., 2015). It will involve the identification and documentation of heritage resources so that any potential impacts to heritage resources that may result from the proposed road upgrades can be identified and managed. Evidence of historic activities in the area would likely be in the form of brush structures, drying racks, tent remains, and trapping equipment. There may also be remains from small-scale mining and prospecting activities.

4.3.4. Traditional Activities

Interviews with Sahtu individuals from Tulita were conducted through a Traditional Ecological Knowledge study in 2006 (Pacifica Resources, 2006). The report identified areas to the north of Howard's Pass as being utilized by the Mountain Dene for generations, and as being part of their traditional lands, though the younger generations rarely access this region for subsistence activities in current times. A Sahtu Traditional Knowledge study is planned to begin in August, 2015. The purpose is to gain further insight into traditional values and past and present uses of Sahtu lands surrounding the HPAR, including Howard's Pass.

To our knowledge, no documented Traditional Knowledge pertinent to the HPAR area is available from the Dehcho First Nation. The Naha Dehé Dene of Nahanni Butte do not currently access the area for subsistence activities, but they harvest animals from the Nahanni caribou herd (whose range includes the HPAR corridor) when the caribou are in their winter range along the South Nahanni River (based on community consultations and information provided during the review of this draft report.)

4.4. Additional Baseline and Survey Work

4.4.1. Ecosystems and Biota

Surveys are being undertaken to provide new baseline information that will help in developing a comprehensive environmental management plan with effective mitigation measures during the construction activities associated with the upgrading of the HPAR. The surveys will also augment the current understanding of baseline conditions that is needed for planning for the operational phase of the road. Some of these baseline surveys follow up on, or extend, previous field work or ground-truth previous ecological land classification for habitat suitability. Planned baseline surveys are listed by topic in the preceding sections, and are grouped here for reference.

The 2015 baseline survey program includes the following:

- A snow-depth transect survey to provide additional information that helps explain wildlife use of the HPAR corridor during late winter (2015 survey completed)
- An invasive plant survey (summer, 2015)
- A rare plant survey (this survey may be scheduled for 2016 for logistical reasons)
- An amphibian survey (summer, 2015)
- A survey of breeding birds, raptors and waterfowl (2015)
- A survey of beaver distribution and abundance, including an inventory of beaver lodges (2015)
- A small mammal survey including small mammal species at risk (pika and bat species) (2015)
- Wolverine and martin distribution and abundance surveys (winter, 2015)
- Ungulate surveys—the field work is primarily aerial based, with an objective of collection of local baseline data to supplement existing information for the region:
    - Late winter ungulate (caribou and moose) survey (completed in March 2015). Note that the snow-depth transect survey was carried out at the same time
    - Regional-level ungulate surveys in summer and fall to document woodland caribou and moose use of the study area, as well as identification of important habitat and landscape features (e.g., corridors, trails, mineral licks, rut sites, etc.). Specific surveys for 2015 include:
        - A post-rut (November) moose stratification survey of the mine project area and the HPAR,
        - A caribou post-calving survey (July),
        - A range-wide rut count survey of the South Nahanni caribou herd in fall (October).
- A grizzly bear den survey to better describe grizzly bear use of the footprint area (completed in spring 2015)

4.4.2. Human Environment

Two projects are planned for 2015:

- A Heritage Resource Impact Assessment of areas located within or adjacent to the footprint of the proposed road upgrades and associated developments (e.g., borrow sources). Fieldwork will be conducted within portions of the study area determined to have elevated heritage potential based on local knowledge (e.g., Traditional Knowledge or Traditional Land Use information) and/or based on the completed Heritage Resource Overview Assessment (Stantec Consulting Ltd., 2015). The impact assessment will involve the identification and documentation of heritage resources so that any potential impacts to heritage resources that may result from the proposed road upgrades can be identified and managed.
- Sahtu Traditional Knowledge update (planned to begin in August, 2015). The purpose is to gain further insight into traditional values and past and present uses of the area. The area to be studied will be Sahtu lands surrounding the HPAR, including Howard's Pass.

5. THE HPAR UPGRADE PROJECT: CONSTRUCTION

5.1. Project Information

5.1.1. Overview

The HPAR was constructed in the 1970s as a single-lane, all-season initial mining and exploration access road. From the mid-1980s until 2014 the road had seen little maintenance and was in a deteriorated state only suited for winter use. Bridge crossings over five major creeks were collapsed or deteriorated beyond repair and were unsafe for use.

In 2014, SCML undertook a program of reconstruction along the historical alignment, including the installation of eight new bridges over major streams and improved culvert crossings on all minor stream crossings. Additionally, grade and drainage improvements were made along the entire route.[1]

The HPAR is considered operational, but it is currently only suitable for slow-speed, light vehicle traffic for the support of exploration activities at the proposed mine site, and for staging of future road construction activities. Some sections (e.g., soft areas) will require additional improvements, along with improved surfacing throughout, to be usable for transporting heavy loads after periods of wet weather.

Upgrades required to bring the road up to the proposed two-lane road design standard will include widening of the road top to a width of 8.5 m throughout, as well as improvements to the horizontal and vertical alignments to meet the criteria for a design speed of up to 70 km/hr. In addition, a bypass may be constructed to shorten and straighten a short section at the south end of the road. The new single-lane bridges installed in 2014 are designed to meet haul road requirements and haul truck loading. The existing culvert crossings will need to be extended, and some will need to be realigned to accommodate the upgraded road width and geometric design.

5.1.2. Road Alignment

The starting point of the HPAR is at kilometre post 188 of the Nahanni Range Road, approximately 10 km northwest of Tungsten, NWT (approximate UTM Zone 8 coordinates N 6877117, E 534865) (Figure 5.1-1). From there, the road corridor generally parallels the Yukon/NWT border within the Selwyn Mountain Range to SCML's mining tenures in the Howard's Pass area (approximate UTM Zone 8 coordinates N 6925422, E 489135). See Section 2.5 for a description and map of the route.

Elevations vary along the HPAR corridor. The southern portion of the route, along the Little Nahanni river valley, ranges from about 1,150 m Above Sea Level (ASL) at the drainage divide down to slightly over 900 m ASL before it swings west up Steel Creek. The climb up into the Steel Creek drainage is minimal, but the road does climb the side hill to an elevation of 970 m ASL before descending to the elevation of

[1] Information on the 2014 reconstruction program is in SCML's HPAR 2014 Activity Report, submitted to the Mackenzie Land and Water Board and available at: http://www.mvlwb.ca/Boards/mv/Registry/2006/MV2006L8-0001/MV2006L8-0001%20-%20Selwyn%20Chihong%20-%202014%20Annual%20Report%20-%20Mar4-15.pdf

the Steel Creek crossing at about 925 m ASL. From this point on, the climb is steeper up into the Howard's Pass area, which crests out at an elevation of about 1,560 m ASL.

The proposed two-lane haul road upgrade alignment generally follows the existing one-lane road in order to limit disturbance of new areas. A total of 33 realignment sections, with an average length of 550 m, are needed to upgrade the road geometry to the required standard. These realignments typically consist of straightening slow-speed, tight-radius curves and improving sections with several back-to-back curves to provide adequate sight distance for safe road operations. In addition, a 1.4 km bypass may be constructed to shorten and straighten the south end of the road, as shown on page 25 of the Preliminary Road Design, Volume 1, Attachment 3 of this HPAR Upgrade Project package.

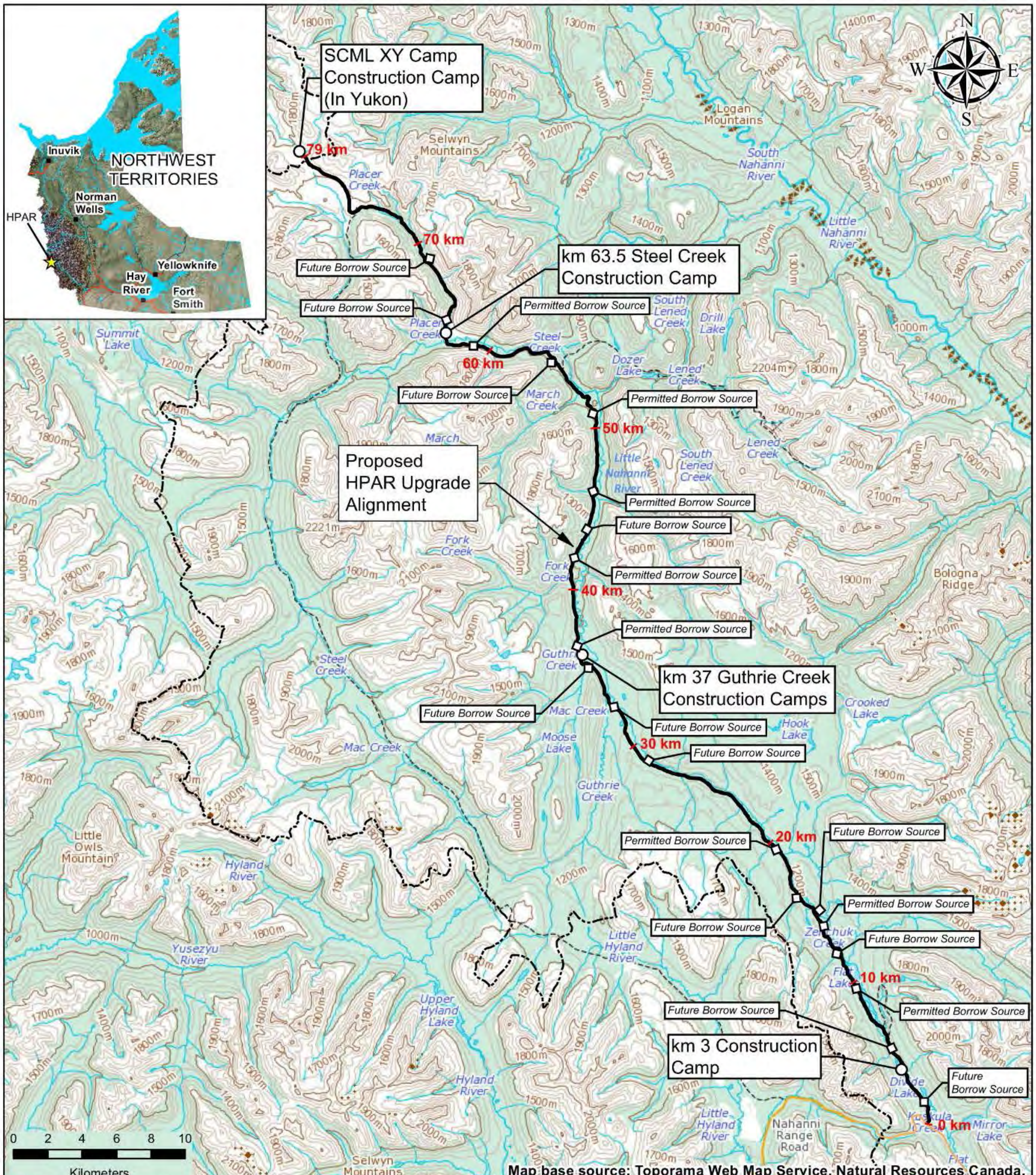
The HPAR Right-of-Way (RoW) widths will remain as established under SCML's Licences of Occupation (see Section 2.2), as shown in Table 5.1-1.

Table 5.1-1: HPAR Right-of-Way Widths

Licence of Occupation	Regulatory Body	HPAR Section	RoW Width (m)
Licence #105I/1-14-2	GNWT Lands	km 0-14	60
No LOC (Nahanni National Park Reserve)	Parks Canada	km 14-36	60[1]
Licence #105I/2-5-2	AANDC, assigned to Parks Canada at devolution	km 36-60	60
Licence #105I/1-14-2	GNWT Lands	km 60-79	60

[1] While this LOC is not yet finalized, Parks Canada has listed a 60 m wide RoW in the latest draft licence.

Figure 5.1-1: Road Alignment, Showing Locations of Temporary Construction Camps and Permitted and Potential Future Borrow Sources



SELWYN CHIHONG MINING LTD.	PROJECT: Selwyn Chihong Mining Ltd. Howard's Pass Access Road Haul Road Upgrade	
	PROJECT NO.: 2013-2520	HPAR Road Alignment
PREPARED FOR: Selwyn Chihong Mining Ltd.	FILE: HPAR PDR	
	DATE: March 2015 / DRAWN BY: AE	

5.1.3. Road Design

5.1.3.1. Design Criteria

A preliminary design has been completed for the proposed haul road upgrades (included as part of the land use permit application, Attachment 3 of Volume 1). Further design development and confirmation of design assumptions will be completed during the detailed design phase.

The following engineering studies and data were used in developing the current road design:

- LiDAR (2011)
- Ortho photos (2011)
- HPAR Hydrologic Peak Flow Analysis (Madrone Environmental Services Ltd., 2011a)
- Terrain Stability Mapping of HPAR (Madrone Environmental Services Ltd., 2011b)
- Surficial Geology (Madrone Environmental Services Ltd., 2011c)
- General Sloping Requirements for Road Design (Madrone Environmental Services Ltd., 2012)
- Existing land and water use permits (Section 9.1)
- Selwyn Project NWT Access Road Avalanche Atlas (Draft Version 100731) (Alpine Solutions Avalanche Services, 2010)
- Associated Engineering field visits (bridge sites only), 2007
- Associated Engineering field visits (entire alignment), 2014

These data were suitable for producing a feasibility-level design for the HPAR project. Associated Engineering collected field notes throughout the bridge and road reconstruction programs in 2014. Information from these field visits has been incorporated into the current proposed design.

The road design is generally based on guidelines in the

- BC Forest Service's Engineering Manual (BC Ministry of Forests, Lands and Natural Resource Operations 2013);
- BC Forest Practices Code Guidebook: Forest Road Engineering Guidebook (BC Ministry of Forests, 2002); and
- BC Supplement to TAC (Transportation Association of Canada) Geometric Design Guide (2007) for low volume roads (BCTAC) (BC Ministry of Transportation, 2007).

The HPAR upgrade design is for year-round, all-season operations. The road will be upgraded to two lanes, with 300 mm thickness of gravel surfacing and an 8.5 m top width.

The road design speed is 70 km/h, with reduced speed sections of 50 km/h required in some locations where the road geometry is constrained by steep slopes or watercourses. Criteria for each design speed are shown in Table 5.1-2 and Table 5.1-3. The criteria tables apply to the entire length of the HPAR alignment, both inside and outside of the Parks Canada boundaries. Vertical curve values are based on the BCTAC Low Volume Road standards in order to minimize the required earthworks along the existing access road. These vertical curve design standards are intended for two-lane roadways.

Table 5.1-2: Roadway Design Criteria: 70 km/h
(Used everywhere except some tight curves and steep road grades)

Road classification	RLU 70[(1)]
Posted speed	70 km/h
Design speed	70 km/h
Design vehicle	B-Train/Tridum truck trailer configurations
Basic lanes	2
Minimum horizontal curve radius	200 m[(2)]
Minimum stopping sight distance (SSD)	110 m[(3)]
Minimum K-factors – Road profile sag curve	24[(3)]
Minimum K-factors – Road profile crest curve	30[(3)]
Maximum grade	6% (8% for <100 m)
Maximum road superelevation	4%[(4)]
Road cross-slope	4%
Lane width	8.5 m
Turnout width (including lane width)	N/A
Turnout spacing	N/A
Clearing width	3 m beyond limit of cut/fill

(1) Rural local undivided roadway

(2) Minimum radius based on BCTAC using 4% superelevation, design speed, and lateral friction of f=0.15 equal to wet pavement (TAC T2.1.2.1) and using TAC Formula 2.1.2 and TAC Table 2.1.2.3

(3) K factors define the degree of sag and crest vertical road curves and are based on BCTAC Low Volume Roads Table 510.1 for design speed and minimum Stopping Site Distance (SSD) for two-lane roads.

(4) Superelevation is the cross-fall of the road when it is banked on corners.

Table 5.1-3: Roadway Design Criteria: 50 km/h
(Only used where tight curves and/or steep road grades are required)

Road classification	RLU 50[(1)]
Posted speed	50 km/h
Design speed	50 km/h
Design vehicle	B-Train/Tridum truck trailer configurations
Basic lanes	2
Minimum horizontal curve radius	100 m[(2)]
Minimum stopping sight distance (SSD)	65 m[(3)]
Minimum K-factors – Road profile sag curve	12[(3)]
Minimum K-factors – Road profile crest curve	11[(3)]
Maximum grade	6% (8% for <100 m)
Maximum road superelevation	4%[(4)]
Road cross-slope	4%
Lane width	8.5 m
Turnout width (including lane width)	N/A
Turnout spacing	N/A
Clearing width	3 m beyond limit of cut/fill

See Table 5.1-2 above for footnotes.

The road will be widened beyond 8.5 m where this is needed on curves to accommodate the off-tracking characteristics of trucks. The road will be narrowed for short sections at the eight one-lane bridges. Bridge flares and pullouts will be provided on both approaches to each bridge crossing.

A low-risk engineering approach was taken for cut and fill slopes. Initial geotechnical recommendations in the document "General Sloping Requirements for Road Design" by Madrone Environmental Services Ltd. (2012) were referenced as a guideline for maximum slopes angle in the various soil types. The cut slopes vary from 1.5H:1V to 1.25H:1V, depending on the soil types, location and design constraints. Fill slopes are generally at 1.5H:1V, with the potential for steeper slopes in some sections. Retaining walls were avoided at the request of SCML. Instead, reinforced slopes as steep as 1H:1V are under consideration in areas where steeper slopes are required.

5.1.3.2. Design for Permafrost and Wet Conditions

Sections of the road pass through areas where permafrost is anticipated. During detailed engineering, special consideration will be required for areas where the road passes over ice-rich, thaw-susceptible permafrost. These special considerations include focusing mainly on "fill only" construction, insulation of any unavoidable cut slopes, and limiting the time open cuts are exposed to the sun and warm temperatures.

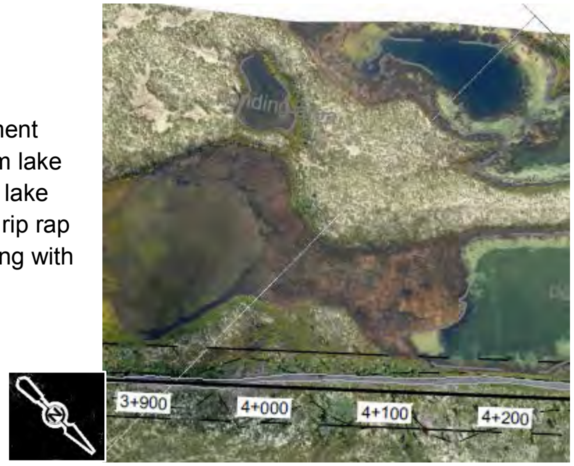
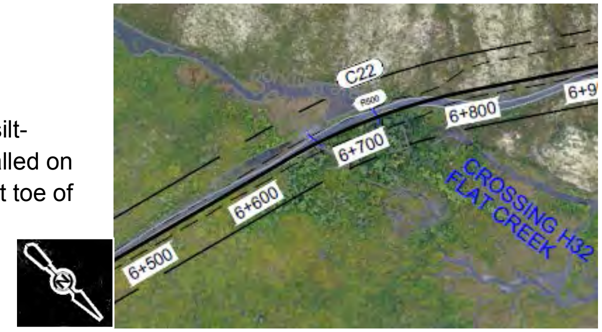
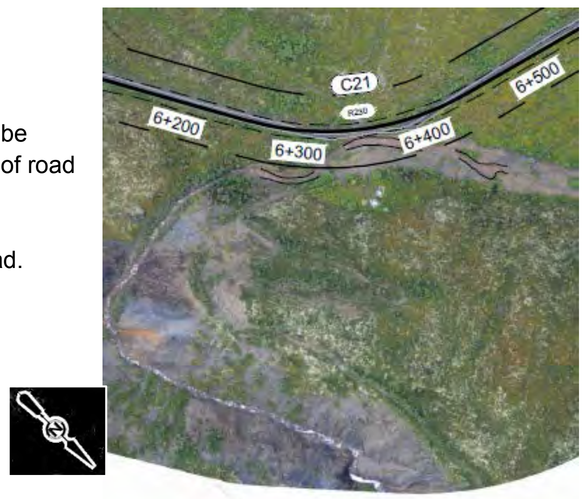
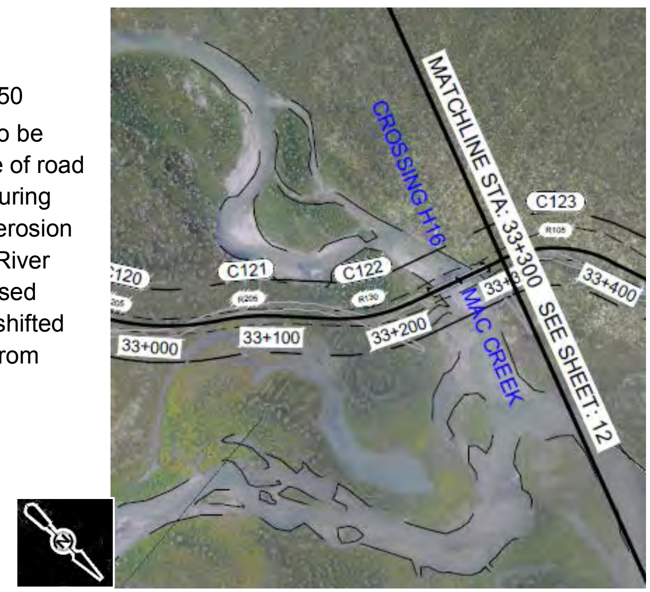
Minimizing the disturbance of permafrost is the preferred option. However, this is not always achievable, due to road geometrics and terrain. Other mitigation techniques that may be used include localized slope flattening and construction of air convection embankments to reduce snow accumulation and allow cold air to propagate into the embankment during the winter. Further geotechnical investigations will be completed during the detailed design phase to determine if other permafrost mitigation measures are required. An example of a further permafrost mitigation measure that could be applied is to add a thick gravel and sand cover as needed to provide insulation. Permafrost is known to be warming in nearby regions where monitoring has been carried out (see Section 4.1.2.5 on climate change), so particular attention will be paid to this component of road design.

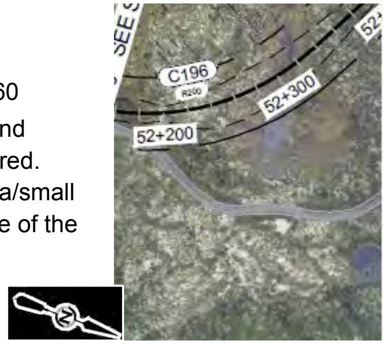
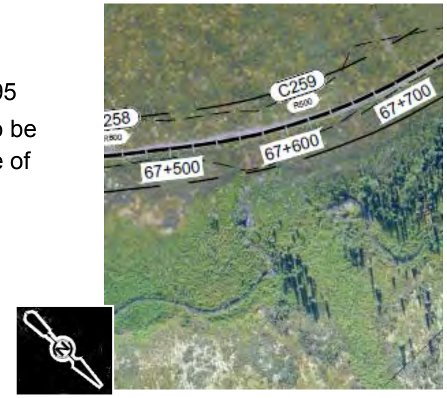
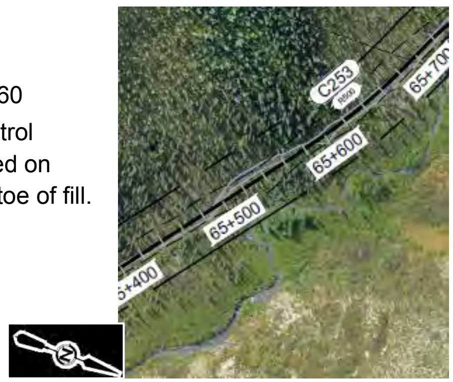
5.1.3.3. Design for Road Sections near Waterbodies

Wet areas or sections of the road passing over soft soils may require soil reinforcing with geotextile or geogrid prior to the construction of road embankments. Geotextile is a type of geosynthetic (man-made) permeable fabric used to separate, filter, reinforce, protect or drain soils, and geogrid is a geosynthetic grid used for soil reinforcing. Geosynthetics may also be used for reinforcing unstable slopes or for construction over permafrost.

Table 5.1-4 identifies sections of the HPAR that are currently close to streams, lakes or wetlands and that will need special attention to stabilization of banks and erosion prevention during road widening. The Preliminary Road Design (Attachment 3 of Volume 1) should be consulted for a view of the road alignment in relation to water bodies. The illustrations of road sections in the table are clipped from the Preliminary Road Design. Note that the design illustrations show the road centre line (solid black) and the right-of-way (dashed line), not the width of the roadwork. The recommendations for stabilization measures outlined in the table below will be reviewed and refined during the detailed design phase.

Table 5.1-4: Stabilization of Road Sections Close to Waterbodies

<table>
<tr><th>Road Section and Recommended Measures(1)</th><th>Section as Shown on Preliminary Road Design(2)</th><th>Road Section and Recommended Measures(1)</th><th>Section as Shown on Preliminary Road Design(2)</th></tr>
<tr><td>Km 4
Sta 3+906 to 4+425
Proposed road alignment moved east away from lake with a sliver fill on the lake side of road, possibly rip rap added at toe of fill along with silt-control fencing.</td><td>
</td><td>Km 6.7
Sta 6+560 to 6+770
Low wetland area, silt-control fencing installed on both sides of road at toe of fill.</td><td>
</td></tr>
<tr><td>Km 6
Sta 6+330 to 6+410
Silt-control fencing to be installed on east side of road at toe of fill. Rip rap armouring required to prevent erosion to road.</td><td>
</td><td>Km 33.1
Sta 33+020 to 33+250
Silt-control fencing to be installed to east side of road at toe. Rip rap armouring required to prevent erosion from Little Nahanni River side channel. Proposed alignment could be shifted slightly west, away from channel.</td><td>
</td></tr>
</table>

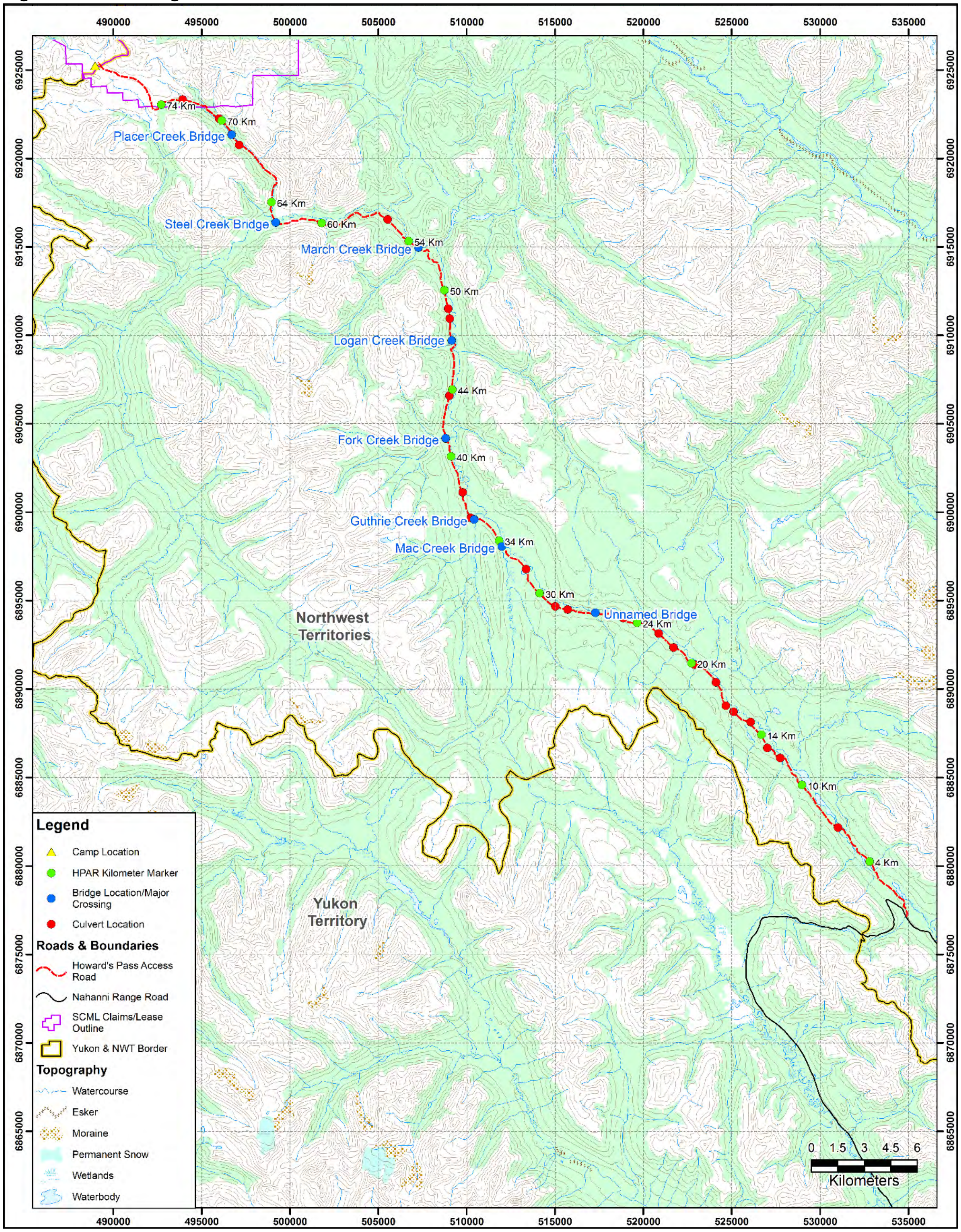
Road Section and Recommended Measures[(1)]	Section as Shown on Preliminary Road Design[(2)]	Road Section and Recommended Measures[(1)]	Section as Shown on Preliminary Road Design[(2)]
Km 52.3 Sta 52+220 to 52+360 Silt-control fencing and erosion control required. This is a low wet area/small pond on the east side of the road**.**		**Km 67.6** Sta 67+550 to 67+595 Silt-control fencing to be installed on east side of road at toe of fill.	
Km 65.5 Sta 65+530 to 65+560 Small creek, silt-control fencing to be installed on east side of road at toe of fill.		**Km 73.65** Sta 73+625 to 73+660 Low wetland area, silt-control fencing to be installed on south side of road at toe of fill.	

(1) Linear referencing along the roadway is by stations (Sta), interpreted as follows: Sta 65+530 is km 65 plus 530 m, or km 65.530.
(2) Design illustrations show the road centre line (solid black) and the right-of-way (dashed line), not the width of the roadwork.

5.1.4. Watercourse Crossings

There are 32 crossings of watercourses along the HPAR. The crossings consist of 8 permanent one-lane bridges and 24 culverts ranging in size from 800 mm to 2,700 mm in diameter (Figure 5.1-2). Note that some of the culvert locations are very close to bridges and thus not visible on the map.

Figure 5.1-2: Bridges and Culverts



5.1.4.1. Bridges

Eight bridge crossings were installed as part of the 2014 HPAR reconstruction project. Each bridge is designed to accommodate the haul truck loading or L-100 highway legal design loading[1] with occasional overloading permitted at slow speeds and controlled conditions.

The bridges consist of steel girders and precast composite concrete deck panels founded on steel pipe pile foundations. The bridge decks are 4.8 m wide, with timber curbing. Scour protection under the bridges is provided by a combination of concrete blocks and rip rap rock embankments. The bridge openings are designed to meet the 1:200 year flood levels with additional freeboard in case of debris flows. Each of the eight bridges is described in more detail in Table 5.1-5.

The bridges are in their ultimate arrangements for hauling operations and no further modifications to the structures are required.

Table 5.1-5: Bridges Installed in 2014

Bridge Name	Location on HPAR Alignment	Components of the Bridge
26.5 km Bridge (Unnamed Bridge on Figure 5.1-2)	km 26.2	• 15.2 m long steel girders • Precast composite concrete deck panels • 4 x 406 mm diameter steel pipe piles
Mac Creek Bridge	km 33.2	• 2 equal spans, each with 24.2 m long spliced steel girders • Precast composite concrete deck panels • 8 x 508 mm diameter steel pipe piles (2 at each abutment and 4 at the centre pier)
Guthrie Creek Bridge	km 35.7	• 18.3 m long steel girders • Precast composite concrete deck panels • 4 x 508 mm diameter steel pipe piles
Fork Creek Bridge	km 40.7	• 24.4 m long spliced steel girders • Precast composite concrete deck panels • 4 x 508 mm diameter steel pipe piles
Logan Creek Bridge	km 46.8	• 15.2 m long steel girders • Precast composite concrete deck panels • 4 x 406 mm diameter steel pipe piles
March Creek Bridge	km 52.8	• 18.3 m long steel girders • Precast composite concrete deck panels • 4 x 508 mm diameter steel pipe piles
Steel Creek Bridge (Photo 5.1-1)	km 62	• 3 spans, 24.4 m long spliced steel girders on the centre span, and 12.2 m long steel girders on each of the two equal end spans • Precast composite concrete deck panels • 4 x 508 mm diameter steel pipe piles (2 at each abutment) • 4 x 610 mm diameter steel pipe piles (2 at each of the 2 piers)
Placer Creek Bridge	km 68.6	• 15.1 m long steel girders • Precast composite concrete deck panels • 4 x 406 mm diameter steel pipe piles

[1] Corresponds to a 100 imperial ton truck load or 90,680 kg. This is a typical resource road bridge design truck load used in the BC forest industry.

Photo 5.1-1: Steel Creek Bridge after installation was completed, March, 2014

5.1.4.2. Culverts

Major culvert crossing repairs and replacements were completed during 2014 as part of the reconstruction program. Several undersized culverts were replaced with larger culverts to convey the water flows estimated for one-in-two-hundred-year storm events (referred to as Q200 flows). Several culverts on fish-bearing streams were replaced with culverts larger than Q200 flow sizes in order to meet the requirements of Fisheries and Oceans Canada and to span the entire stream width. These culverts were embedded in the channel by placing granular material inside the culvert to replicate the natural stream bottom for fish passage (as shown in Photo 5.1-2). Where stream gradients in excess of 8% were measured, fish baffles were installed in the culverts to limit flow velocities to improve the culverts for fish passage and to prevent the in-filled stream bottom material from being washed away.

Photo 5.1-2: Culvert installed in 2014 along the HPAR

To upgrade the geometry and width of the road to achieve the haul road standard, the culverts will need to be extended, and some will need to be relocated. It is anticipated that, at most crossings, the culvert sections under the existing road will not need to be disturbed—additional culvert lengths will be attached and secured using couplers.

Culvert extensions and relocations will be completed outside of the Fisheries and Oceans Restricted Activity Timing Window for arctic grayling streams (mid-May to June) (DFO, 2015), following the SOP for Working in and Around Water (Appendix I) and according to best practices for work site isolation and fish salvage, so that culvert installation work can be completed in the dry.

- Crossings identified as fish bearing will be blocked using stop nets, and fish will be caught and relocated outside the work area as per DFO fish salvage requirements.
- The work area will then be isolated from the flowing water by installing a temporary berm or coffer dam and using pumps to transport the water around the work site for discharge further downstream.
- A second downstream sump or sandbag coffer dam will also be installed to capture any sediment-laden water associated with the work site.
- Any sediment-laden water from both the upstream and downstream sumps will be pumped off-site to a well-vegetated area to prevent sediment from re-entering the stream.
- Once the culvert installation is complete, water will be gradually reintroduced into the new culvert, and care will be taken to remove any sediment-laden water that is captured in the downstream sump.

All culvert installations will require the implementation of erosion and sediment control measures to maintain water quality and prevent sediment from being transported into streams. For example, erosion at the culvert inlet and outlet will be prevented by placing non-woven filter fabric along the immediate banks and overlaying with rock armoring. On-site environmental monitors will assist with planning and field fit of other erosion and sediment control best management practices that are described in the Erosion and Sediment Control Plan (Appendix IV). Supplies such as silt-control fences, non-woven geotextile, sand bags, polyethylene sheeting, tarps, gravel and rip rap material will be readily available.

Culvert installations are expected to be completed within a period of a day or two. Installation will be supervised by environmental monitors. Inspection and maintenance of erosion and sediment measures and structures will take place throughout the construction phase.

The location and diameter of the existing culverts and creek crossings are shown in Table 5.1-6. The table indicates the minimum culvert diameter required for the calculated Q200 storm flows, as well as the actual diameter of each culvert that was installed, as adjusted to account for fish presence or other site-specific conditions. It also specifies culverts requiring relocation and/or extension.

Table 5.1-6: 32 Major Creek Crossings: Locations, Fish Presence, Design Flows, Culvert Sizes, and Information on Culvert Relocations and Extensions

Crossing I.D.	Site Name	Approximate Distance Along HPAR Alignment (km)	Fish Stream (Yes or No)	Q200 1:200 Year Storm Flow (m^3/s)	Minimum Q200 Flow Culvert Diameter (mm)	Adjusted Culvert Diameter (mm)	Culvert Relocations and Extensions(1)
H1	-	72.2	n	0.31	800	1,400	Relocate 51 m length
H2	-	69.8	n	0.79	900	1,400	Relocate 27 m length
H3	Placer Creek	68.6	n	5.06	BRIDGE	BRIDGE	No Change
H4	-	67.8	n	0.65	900	1,200	Relocate 30 m length
H5	Steel Creek	62.3	n	97.7	BRIDGE	BRIDGE	No Change
H6	-	55.3	n	0.82	900	1,000	Extend by 6 m
H7	March Creek	52.9	**Y**	15.3	BRIDGE	BRIDGE	No Change
H8	-	48.7	n	0.25	600	800	Relocate 39 m length
H9	-	48.1	n	0.20	600	1,000	Extend by 9 m
H10	Logan Creek	46.9	**Y**	1.86	1,400	BRIDGE	No Change
H11	-	43.6	n	0.40	700	1,200	Relocate 36 m length
H12	Fork Creek	40.7	**Y**	18.6	BRIDGE	BRIDGE	No Change
H13	-	37.5	n	0.38	700	1,000	Extend by 6 m
H14	-	35.9	**Y**	0.49	800	1,200	Relocate 15 m length
H15	Guthrie Creek	35.7	**Y**	15.9	BRIDGE	BRIDGE	No Change
H16	Mac Creek	33.3	**Y**	69.5	BRIDGE	BRIDGE	No Change
H17	-	31.3	n	SPECIAL (2)	1,000	1,000	Extend by 12 m
H18	-	28.6	n	0.22	600	1,000	Extend by 9 m
H19	-	27.8	**Y**	0.58	800	2,200	Extend by 9 m
H20	26.5 km Unnamed Creek	26.2	**Y**	3.04	BRIDGE	BRIDGE	No Change

Crossing I.D.	Site Name	Approximate Distance Along HPAR Alignment (km)	Fish Stream (Yes or No)	Q200 1:200 Year Storm Flow (m^3/s)	Minimum Q200 Flow Culvert Diameter (mm)	Adjusted Culvert Diameter (mm)	Culvert Relocations and Extensions[(1)]
H21	-	24.8	n	0.08	600	800	Extend by 15 m
H22	-	24.6	n	0.16	600	800	Extend by 12 m
H23	-	22.3	**Y**	1.39	1,200	2,000	Extend by 6 m
H24	-	21.1	**Y**	0.92	1,000	2,200	No Change
H25	-	19.5	**Y**	0.67	900	2,700	Extend by 6 m
H26	-	17.9	**Y**	0.53	800	2,200	Relocate 15 m length
H27	-	16.4	n	0.07	600	1,000	Relocate 30 m length
H28	-	15.9	**Y**	0.99	1,000	2,200	Extend by 12 m
H29	-	14.7	**Y**	0.77	900	1,400	Relocate 30 m length
H30	-	13.0	n	0.20	600	1,000	Relocate 39 m length
H31	-	11.8	**Y**	1.17	1,200	1,200 + 600	Relocate 15 m length
H32	Flat Creek	6.7	**Y**	6.51	-	3 x 1,200 + 2 x 800	Extend by 9 m.

(1) Culvert extension lengths are based on preliminary design work and will be refined during the detailed design stage.

(2) From Madrone Environmental Services Ltd. (2011a): "Catchment H17 is a special case in that the stream crossed is larger than might be expected from its drainage area. The catchment is located between two larger rivers ... the possibility of overbank floodplain flows from outside the apparent catchment area suggests that the peak flows which can be expected at this crossing are larger than would be assumed if that area was used to estimate a peak discharge."

5.1.5. Borrow Sources

5.1.5.1. Selection and Permitting of Borrow Sources

The HPAR haul road upgrade project will use material cut from the road right-of-way for road embankment construction wherever possible. It is anticipated that some of the cut material will not be suitable as aggregate and will be managed appropriately according during construction activities (e.g., buried, engineered cover, left in place). Additional aggregate sources required for road construction will be developed from borrow pits and then hauled to where the aggregate is required.

Initial potential borrow material sites have been identified through interpretation of air photos and follow-up field investigations. These initial locations for borrow pits will be refined and confirmed through additional field investigations that will include mapping and sampling to determine the quantity, quality and overall suitability (including environmental site conditions and presence/absence of cultural materials) of the final locations for all future borrow pit locations. In addition to the above factors, selected potential sites will be located as close as possible to the existing road to reduce haul distances and overall environment effects. Potential borrow pit locations that are in close proximity to active flood plains, watercourses, unstable terrain or environmentally sensitive features have been avoided during the initial planning of this project.

As indicated above, further work, including test pitting and sampling for geochemical analyses, acid base accounting and metal leaching assessment, and other tests, will be carried out to assess in detail the quality and quantity of borrow sources during the detailed road engineering stage of this project. This information is required to ensure that all borrow sources and final locations are appropriate for the widening of the HPAR.

Borrow sites will require site-specific permits from either GNWT or Parks Canada, depending on pit location. As part of the permitting process, regulators typically require a Quarry Operations Plan, as was the case when SCML undertook reconstruction of the HPAR in 2014.

Quarry Operation Plans include site-specific details of borrow sites, such as size of the site, proximity to sensitive areas (streams and wetlands), and information about access. They also include details of quarry operations, such as clearing work needed, set-backs from sensitive areas, types of equipment to be used during borrow-pit operations and dust control. Site closure activities, describing work that will be done to reclaim the site once it is no longer needed, are included in the plans. A sample Quarry Operation Plan from the 2014 HPAR reconstruction program is included as Appendix VII.

Eight of the identified borrow sources were permitted for the 2014 HPAR reconstruction project (Figure 5.1-3). Information about the 22 highest ranking potential borrow sources, including the eight borrow sources that were permitted in 2014, is presented in Table 5.1-7. It is important to note that these locations for borrow pits are based on initial investigations, and future field and laboratory investigations may result in additional borrow sources being identified.

Figure 5.1-3: Highest Ranking Potential Borrow Sources

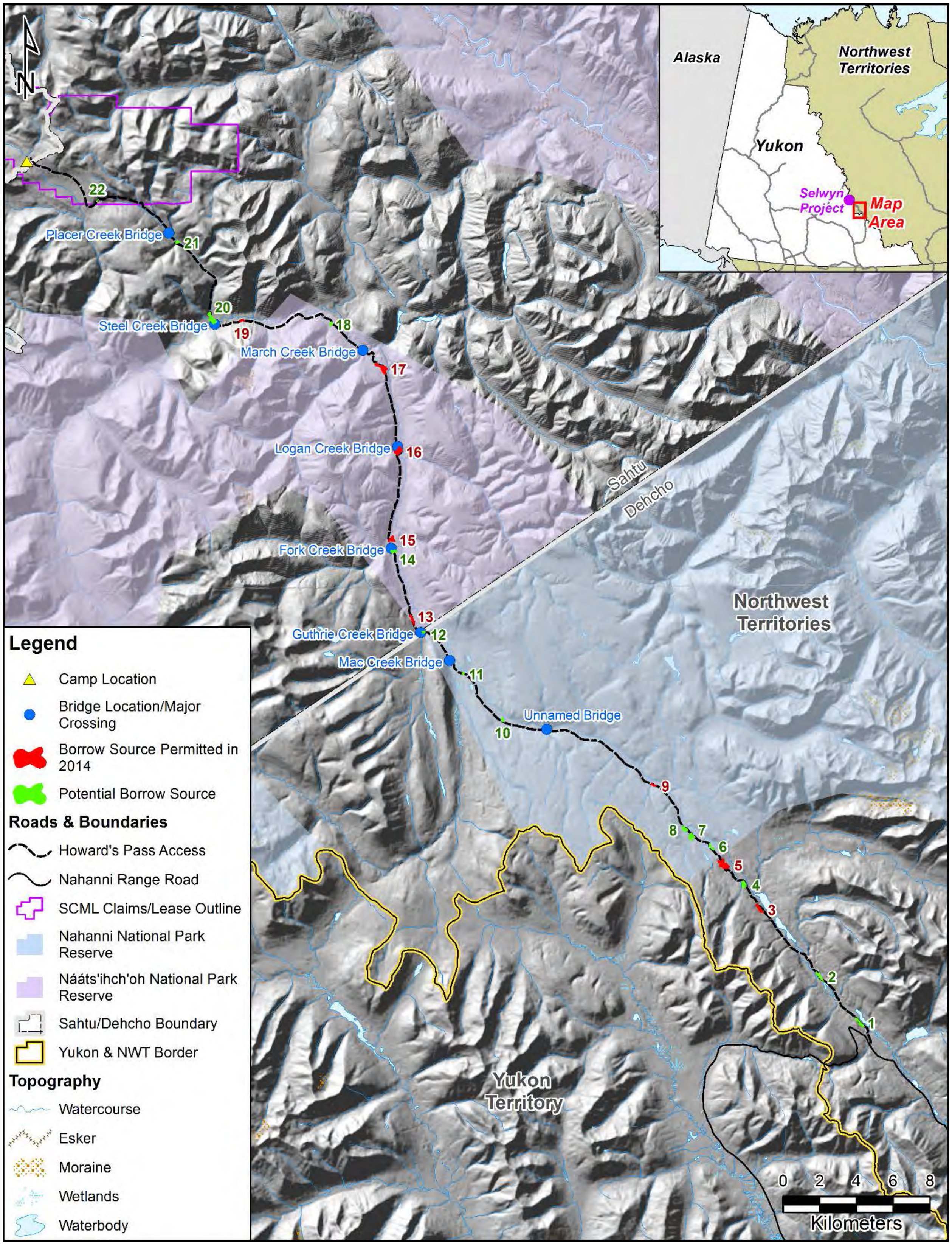


Table 5.1-7: Summary of the 22 Highest Ranking Borrow Sources Including Those Permitted in 2014

Highlighted borrow sources were permitted in 2014. Locations are shown in Figure 5.1-3.

No.	Location (km on HPAR)	Deposit Type	Inferred Texture/Quality	Drainage Conditions	Permafrost/ Ground Ice	Footprint Area of Deposit (ha)	Estimated Workable Thickness (m)	Estimated Volume (1,000 m^3)	Reclam–ation Potential
1	1.25–1.85: adjacent either side	Thin glaciofluvial deposit overlaying hummocky bedrock	Silt, sand, gravel, boulders	Likely well drained	None observed	5.6	1–5	80–400	High
2	4.85–5.55: adjacent either side	Glaciofluvial terrace/esker against bedrock	Silt, sand, gravel, boulders	Likely well drained	None observed	5.1	2–5	100–300	Medium
3	9.6–10.3: road crosses deposit	Outwash blanket on hummocky bedrock	Silt, sand, gravel, boulders	Likely well drained	None observed	6.7	2–5	100–300	Medium
4	11.5–11.675: road crosses deposit (previous borrow)	Small outwash hill	Silt, sand, gravel, boulders	Likely well drained	None observed	0.2	2–5	5–10	Medium
5	13.2–13.8: adjacent either side	Glaciofluvial deposit overlain on hummocky bedrock	Silt, sand, gravel, boulders	Likely well drained	None observed	17.4	2–5 plus	400–1,000	Medium
6	14.4–14.9: downhill to west	Outwash	Silt, sand, gravel, boulders	Likely well drained	None observed	3.4	2–5	50–150	Medium
7	15.7–16.05: uphill of road	Outwash	Silt, sand, gravel, boulders	Likely well drained	None observed	6.7	2–5	100–250	Medium
8	16.3–16.6: beside road (previous borrow)	Small outwash hills	Silt, sand, gravel, boulders	Likely well drained	None observed	4.8	2–5	100–250	Medium
9	19.375–19.7: beside road (previous borrow)	Small outwash hills	Silt, sand, gravel, boulders	Likely well drained	None observed	2.3	2–5	50–150	Medium
10	28.9–29.1: adjacent either side (previous borrow)	Forested hummock	Silt, sand, gravel, boulders	Moist site conditions	None observed	2.2	2–5	30–100	Medium
11	32.45–32.56: adjacent either side (previous borrow)	Small outwash hill	Silt, sand, gravel, boulders	Likely well drained	None observed	1.0	2–5	20–50	Medium

No.	Location (km on HPAR)	Deposit Type	Inferred Texture/Quality	Drainage Conditions	Permafrost/ Ground Ice	Footprint Area of Deposit (ha)	Estimated Workable Thickness (m)	Estimated Volume (1,000 m^3)	Reclam–ation Potential
12	35.75–35.9: adjacent either side (previous borrow)	Small outwash hill	Silt, sand, gravel, boulders	Likely well drained	None observed	1.6	2–4	30–70	Medium
13	36.6–37.2: road skirts western edge–permit adjacent to road	Kettled outwash terrace	Silt, sand, gravel, boulders	Moderate drainage–filled kettles	Possible	4.6	2–5 plus	80–250	High
14	40.8–40.925: HPAR crosses west edge	Portion of outwash terrace	Silt, sand, gravel, boulders	Likely sufficient above water table	None observed	3.5	2–5	50–200	High
15	41.475–41.8: HPAR located to west–requires access trail	Incised outwash terrace by modern river	Silt, sand, gravel, boulders	Likely sufficient above water table	None observed	6.5	2–5	100–250	High
16	46.25–46.85: HPAR goes around lower edge of deposit, above river	Thick, raised alluvial/colluvial/outwash fan	Silt, sand, gravel, boulders	Likely well drained	Only on orthophoto image 2 D	11.5	2–5	200–500	High
17	50.95–51.95: HPAR passes through east edge (previous borrow)	Flat outwash terrace	Silt, sand, gravel, boulders	Likely sufficient above water table	Possible	13.4	2–5	300–800	Medium
18	55.375–55.56: HPAR through centre	Possible glaciofluvial blanket over hummocky bedrock	Silt, sand, gravel, boulders	Likely sufficient above water table	Possible	2	1–3	10–30	Medium
19	60.99–61.1: HPAR through centre (previous borrow)	Talus sheet	Boulders	Likely above water table	Possible	0.8	2–4	10–20	Low
20	62.65–63.35: HPAR crosses centre	Modern/old fluvial floodplain deposit	Silt, sand, gravel, boulders	Likely sufficient above water table	None observed	12.1	2–5	200–400	High
21	68.0–68.3: requires access trail	Alluvial/colluvial fan	Silt, sand to boulders, organic material possible	Likely sufficient above water table	Possible	2.4	1–2	10–30	Medium
22	73.695–73.33: HPAR through centre (previous borrow)	Colluvium / waterlain	Silt, sand to boulders, organic material possible	Likely sufficient above water table	Possible	0.5	1–2	5–10	Medium

5.1.5.2. Borrow Pit Development

The development of borrow pit areas will require the clearing of vegetation and the stripping of organic material. The vegetation and organic material will be set aside for future site reclamation. Granular borrow source material will be excavated, crushed and/or screened as needed, and stockpiled for hauling. Road-building material and surfacing material from bedrock and gravel sources will be prepared using a combination of ripping, blasting, crushing and screening.

Drainage ditches will be constructed at the borrow sources to divert run-off around excavations and to prevent erosion and transport of sediment into nearby watercourses. Borrow pits will be designed to ensure slope stability at all times during active excavation periods, as well as during temporary cessation of activities and for long term reclamation for each facility. In some cases, construction of temporary access roads will be needed to connect the borrow pits to road construction areas. Borrow pit access roads will be 5 m wide and will have a grade surfaced on an embankment designed to stabilize the road over a variety of ground conditions, including areas with poorly drained soils and/or organic material. Road grades will be limited to 15%. The borrow pit access roads will follow the natural topography as closely as possible, while still maintaining the required standards for safe operations of a construction access road.

Late winter/early spring preparation of the borrow pit areas will include initial clearing activities for areas to be developed for borrow production, as well as associated access roads and areas for stationing quarry equipment. The initial clearing activities will temporarily stockpile vegetation and organic deposits for future reclamation activities. Preparing borrow pit areas early in the construction season will ensure the production of aggregate at the start of the summer road construction season. Borrow material production will primarily occur at the same time as road construction. The rate of borrow production will depend on road construction progress and on the demand for aggregate for each segment of the road.

Borrow pits will be progressively reclaimed. This reclamation will include restoration of natural drainage patterns, slope grading, capping with organics/vegetation (from pre-stripping stockpiles), and revegetation with native plant species. Site-specific revegetation plans will be developed in consultation with Parks Canada.

5.1.5.3. Preliminary Geochemical Characterization of Potential Borrow Materials

A preliminary-level geochemical characterization of materials from potential borrow sites has been completed (Appendix VI). The purpose was to provide some initial baseline information of road cut materials as potential aggregate sources for road construction. Additional sampling and testing will be completed as required, based on these initial laboratory results and on the final locations for borrow sources. Future laboratory testing will include both geotechnical and geochemical analyses to help characterize the overall suitability of potential borrow materials. Sites deemed unsuitable as a result of the laboratory characterization work will not be developed.

A total of 43 samples were analyzed for total sulphur, total carbon and total inorganic carbon. In addition, a subset of 16 samples was selected for acid based accounting, metals analysis and metals leach extraction. Table 5.1-8 summarizes the results. Approximately 13% of the samples were considered to be potentially acid generating, while 88% were considered to have limited to no potential for acid generation.

Table 5.1-8: Summary of Modified Acid Base Accounting Results

Classification	Number of Samples	Proportion of Sample Set	Comment
Potentially acid generating (**PAG**): $CaCO_3$ NP/AP<2 and sulphide sulphur >0.1%	2	13%	Negligible neutralization potential and sulphide sulphur content at levels that could produce acidity.
Limited potential for acid generating (**PAG-Low**) $CaCO_3$ NP/AP<2 and sulphide sulphur <0.1%	8	505	Negligible neutralization potential and negligible sulphide content; acid generation considered unlikely and if present, then very localized and limited.
Non-potentially acid generating (**Non-PAG**) $CaCO_3$ NP/AP>2	6	38%	Neutralization potential considered moderate and sulphide content negligible.

$CaCO_3$ NP/AP is the acid potential/ carbonate neutralization potential ratio. Source: pHase Geochemistry Inc. (2015), Appendix VI.

5.1.6. Construction Schedule

SCML's overall mine development schedule requires HPAR upgrades be completed during 2017 and 2018 so that the road can fully support mine site pre-development and development activities starting in early 2019 (see Section 2.4). Failure to complete the HPAR upgrade in a timely manner can have long-term implications on the overall development schedule of the Selwyn Project.

Road construction is scheduled to take place over a minimum two-year period following the completion of permitting and preconstruction activities. This will include portions of three winters and two full summer construction seasons. Activities such as clearing, mobilization and demobilization can be completed during the winter months, while road construction activities will be limited to the summer construction season, typically extending from late June to mid-October, depending on weather conditions.

Road construction will be subject to the following seasonal restrictions:

- Mid-May to early June: Fisheries and Oceans Canada Restricted Activity Timing Window to protect spawning Arctic grayling (DFO, 2015). No instream work on Arctic grayling streams during this period.
- May to mid-August: Nesting period for migratory birds (Zone B8, in Environment Canada, 2014). Road activities will conform to protection measures specified in the Wildlife Mitigation and Monitoring Plan. Vegetation clearing is planned to take place outside of this period.
- May to June: Caribou calving. Road activities will conform to protection measures specified in the Wildlife Mitigation and Monitoring Plan.
- August to October: Caribou rut. Road activities will conform to protection measures specified in the Wildlife Mitigation and Monitoring Plan.

Road construction may be further limited or suspended if particularly poor weather conditions are encountered, such as during periods of rain or snow with high intensity or long duration. Avalanche danger may also influence the construction schedule. Avalanche hazards will be assessed in spring at the start of each season and appropriate prevention and mitigation measures will be taken, as outlined in Section 5.1.9.

Four construction camps will be needed for varying periods over the three years of pre-construction and construction (Table 5.1-9; see also Section 5.1.8). The most northerly camp is the XY camp at the Selwyn mine site in Yukon, near the terminus of the HPAR. Three further camp locations are for temporary construction camps, all located in the NWT, at km 63.5, km 37 and km 3 of the HPAR.

Table 5.1-9: Construction Camp Schedule

Camp Location	Activity Period	Work Undertaken from the Camp
XY Camp at the Selwyn mine site, YT (near km 79)	2016–2017	2016: preconstruction work 2017: construction southward from km 79 to km 68.6
HPAR km 63.5 (Steel Creek)	2016–2017	2016: preconstruction work 2017: construction northward from km 63.5 to km 68.6, and then southward from km 63.5 as far as possible towards km 52.8; also begin water-crossing extension work
HPAR km 37 (two camps) (Guthrie Creek)	2018	2018: one crew works northward from km 37 to km 52.8; one crew works southward from km 37 to km 24
HPAR km 3	2016–2018	2016: preconstruction work 2017: construction northward from km 0 to km 12; also begin water-crossing extension work 2018: construction northward from km 12 km 24

Storage of any explosives needed for road widening will be at a licensed facility in the Yukon, near XY Camp. An explosives magazine (storage facility) for this location is permitted through Natural Resources Canada (Licence U75967), current to March 31, 2016 and renewed annually. Explosives are transported to the site by a licensed supplier.

The following activities would be undertaken during the pre-construction phase and the two-year construction phase. These phases are shown on the HPAR route map, Figure 5.1-4.

Pre-construction Year (2015–2016)

1. Detailed engineering
2. Permitting
3. Maintenance and local improvements to the road surface.
4. Complete final geotechnical and borrow source investigations.
5. Prepare borrow sites (access and pre-stripping) after permitting is complete.
6. Prepare road right-of-way (stripping of vegetation and organics) during the winter, subject to receipt of permits.
7. Mobilize camp and equipment to Km 3 Camp, Km 63.5 Camp, and XY Camp locations prior to 2016 spring break-up (subject to approval).

Note: The preconstruction work will require crews to be based at all three camp locations: Km 3 Camp, Km 63.5 Camp, and XY Camp in the Yukon.

Year One Construction (2017)

1. Begin Year One road construction from three construction fronts:
    a. Supported from Km 3 Camp, construct from km 0 to km 12, or as far as possible along the road.
    b. Supported from Km 63.5 Camp (near Steel Creek), construct km 63.5 to km 68.6 (Placer Creek), and then work south from km 63.5 towards km 52.8 (March Creek), proceeding as far as possible during Year One.
    c. Supported from SCML's existing XY Camp in the Yukon, construct from km 79 back to km 68.6 (Placer Creek).
2. Begin watercourse crossing extensions and realignments supported from Km 63.5 Camp and Km 3 Camp, as described in Section 5.1.4.2. Most of the watercourse crossings are located within the first 50 km of the road. This work is needed in Year One as preparation for road embankment construction in Year Two.

Rationale for Year One Construction Phasing

Upgrades of the road section between Steel Creek and the end of the road (km 62–79) will be the most challenging from both logistical and constructability aspects. It is expected that no access will be maintained to the mine property during construction of this section, due to limited space and challenging terrain. The construction phasing during Year One is intended to restore access to the mine site as soon as possible. Starting construction on the most difficult section of road (at the mine end) first will minimize the amount of time that road access to the mine site will be cut off. Because of this, we propose to commence construction of the road in this area based from construction fronts at both Km 63.5 Camp and XY Camp. The third construction front (supported from Km 3 Camp) will begin construction from the start of the road and proceed far enough up the alignment so that a manageable section of road remains for construction in Year Two.

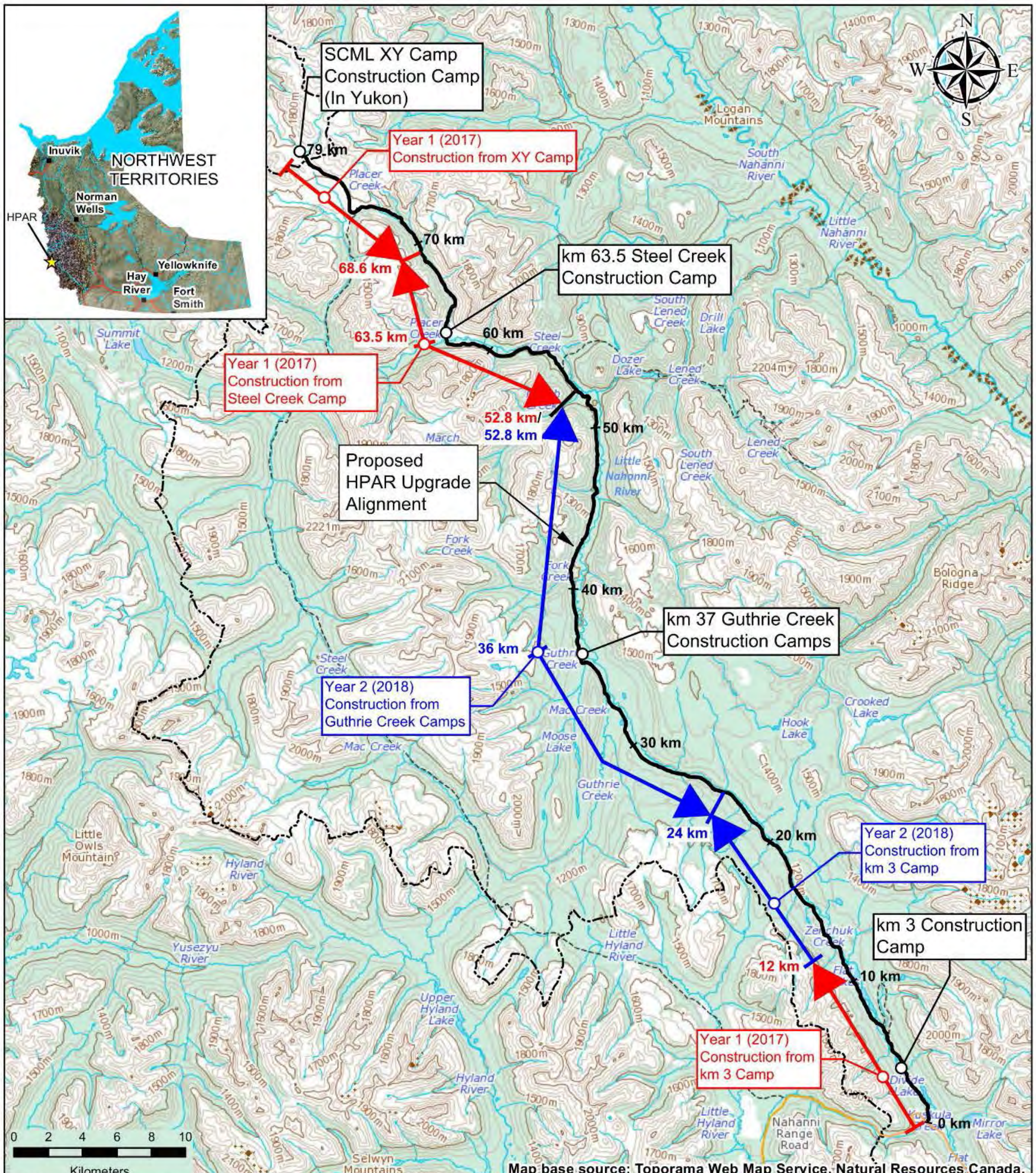
Year Two Construction (2018)

1. Move Km 63.5 Camp to near Guthrie Creek (around km 37) and establish an additional portable trailer camp near Guthrie Creek. This camp set-up will be done during the winter to maximize productivity during the construction season by being prepared in advance. XY Camp will not be used this year.
2. Begin Year Two road construction from three construction fronts:
    a. Supported from Km 3 Camp, continue from where work was completed in Year One, constructing from approximately km 12 to km 24.
    b. Supported from Km 37 Camps (the two camps relocated to the area near Guthrie Creek), construct northward from the camp location to km 52.8 (March Creek), where Year One construction from the north left off.
    c. Also supported from the Km 37 Camps, construct southward from the camp location to km 24.

3. Once road construction is complete, all crews will perform final cleanup of the road corridor and camp areas before demobilizing the camps and equipment. Management of all waste produced from construction activities will follow SCML's Waste Management Plan for the Howard's Pass Access Road (Appendix II). The camp areas will be reclaimed, including restoration of slope angles and drainage patterns, and revegetated with native species. These activities may also continue as part of the first year maintenance activities in 2019.

Note: It is expected that limited road access to the mine can be maintained while the middle section of road is constructed in Year Two. Maintaining some access is desirable so that fuel, equipment and supplies can be delivered to the Selwyn Project site while road construction is underway.

Figure 5.1-4: Proposed Schedule of Construction along the HPAR and Temporary Camp Locations



SELWYN CHIHONG MINING LTD.	PROJECT: Selwyn Chihong Mining Ltd. Howard's Pass Access Road Haul Road Upgrade	
	PROJECT NO.: 2013-2520	HPAR Road Construction Phases
PREPARED FOR: Selwyn Chihong Mining Ltd.	FILE: HPAR PDR	
	DATE: March 2015 DRAWN BY: AE	

5.1.7. Construction Equipment and Materials

Table 5.1-10 includes a list of the typical equipment that will be used for road construction activities. Substitution of equivalent sized equipment may be necessary during the construction phase, depending on equipment availability.

Table 5.1-10: Howard's Pass Road Upgrade: Phase 1 Preliminary Equipment List

Equipment Type and Specifications	Number Required	Purpose
Excavators: Cat 312 to 385 or equivalent (14.5 to 68.5 tonnes)	9	Excavating ditches, culvert installations, placing armouring, excavating borrow sites and loading material into trucks, test pitting, shaping roadway embankment.
Bulldozers: Cat D-5 to D-9 or equivalent (9.5 to 48.5 tonnes)	9	Clearing right-of-way and borrow sites, pushing roadway granular construction material in borrow pits and spreading material on road embankments, leveling material at camp pads
Loaders: Cat 950 to 966 or equivalent (19.2 to 23.2 tonnes) Backhoe Loaders: Cat 420 to 450 or equivalent (11.0 to 12.5 tonnes)	3 3	For loading trucks with material from borrow sites or road cuts, stockpiling material, feeding crushers and screeners
Articulated trucks: Cat 730 to 740 or equivalent (24.0 to 37.0 tonnes)	12	Hauling material from borrow sites and longer distances on road cuts, Hauling rock or gravel for culvert installations.
Tractor trailer trucks with end dump or belly dump trailers	6	Hauling and placing road surfacing material
Tractor trailer trucks with lowbed trailers	3	Transporting equipment and materials to/from and around on the work site
Scraper: Cat 627G to 637G or equivalent (35.5 to 54 tonnes)	3	Used for road cuts and transporting cut material short distances to fill areas or waste areas.
Motor grader: Cat 14 to 16 or equivalent (24 to 30.5 tonnes)	3	For road surface maintenance and repairs, to smooth out ruts and washboard, snow plowing
Small walk-behind compactors: Plate and Roller BPR 50/55D to BW 75H or equivalent (0.4 to 1.1 tonnes)	3	Provide initial compaction on culverts and in hard to access spaces
Large self-propelled compactors • Vibratory roller Cat CB44 to 54 or equivalent • Sheep's foot Cat CP44 to 56 or equivalent (7.0 to 12.0 tonnes)	 3 3	To compact road embankment, subgrade and road surfacing layers, final compaction around culvert installations
Water trucks (5,000 to 18,000 litre capacities)	3	Dust control and water supply
Water pumps: 2" to 4" diameter (500 to 1,500 litres per minute capacities)	9	To dewater trenches, isolate streams for culvert installations, pump sediment laden water away from watercourses
Mobile granular screening plants	3	Tracked equipment with hopper and conveyors used to sort gravel into required gradations and stockpile for use in construction of road structure

Equipment Type and Specifications	Number Required	Purpose
Mobile granular crushing plants	3	Tracked equipment with hopper and conveyors used to crush larger granular material into required sizes and sort for use in construction of road structure
Fuel tanker trucks • Gasoline up to 10,000 litre capacity • Diesel up to 40,000 litre capacity	 3 3	For refueling equipment and resupplying camp storage tanks
Fire/spill containment truck	3	Fire and spill emergency response
Pickups: 4x4 with crew cab and tidy tanks (500L fuel capacity)	18	To transport supervisors and operators and to refuel equipment
ATVs (Single rider or Side-by-side)	3	Road surveillance, transport crews (no off-road use)
Crew vans	3	Transport crews
Flatbed Trucks with Hiab Deck Crane (4.0 to 10.0 tonne capacity)	3	Load/unload and transport materials
Mechanic service truck	3	To repair and maintain all equipment
Parts trailer	3	To store spare equipment parts
First aid truck	3	First aid services

Materials required for road construction will include:

- Geogrid
- Geotextile
- Cross culverts
- Culvert extensions and couplers in various sizes
- Culvert markers and stakes
- Materials for retaining walls (if retaining walls are needed)
- Roadway signs and kilometre markers

5.1.8. Temporary Construction Camps

5.1.8.1. Camp Locations

To support the road preconstruction and construction activities described above (Section 5.1.6), construction camps will be required at three locations in the NWT for varying periods:

1) The cleared area near km 3 of the HPAR, where historical construction camps have been located. Photo 5.1-3 shows a camp at this location in use during the winter of 2014. Km 3 Camp will be used for the preconstruction year and for both construction years.
2) The existing cleared area north of the Steel Creek Bridge (Km 63.5 Camp). This camp location will be used during the preconstruction year and during the first year of construction. The existing cleared area will likely need to be enlarged to accommodate the camp.
3) Along a partially cleared area north of Guthrie Creek (Km 37 Camps). This location will only be used during the second year of construction, when two temporary construction camps will be sited close to one another at this location.

Preparation of camp locations will consist of pre-stripping of vegetation and grubbing of organics from the area, followed by placing imported granular fill as required to raise the site above wet areas and to provide a level, well-drained surface. Pre-stripped vegetation and grub materials will be stockpiled for future reclamation of the area. Camps will be set up a minimum of 30 m from any watercourse. The site embankment will be capped with gravel surfacing to provide adequate site drainage and a suitable driving surface for construction vehicles and heavy equipment.

Photo 5.1-3: Temporary construction camp at HPAR km 3 in 2014

5.1.8.2. Camp Set-up

Each of the temporary construction camps will consist of prefabricated modular trailer units with capacity to accommodate up to 60 people. Facilities will include sleeping accommodations, kitchen, dining area, recreation space, office space, washrooms, showers and a camp dry. Other camp infrastructure will include diesel/propane generators for power and infrastructure for heating, water supply, solid waste disposal, and sewage containment and storage. More details about this infrastructure are provided below.

Typical camp equipment and facilities for each temporary construction camp will include:

- 1 skidded six-unit side-by-side kitchen/diner/sleeper on mats
- 1 or more skidded six-unit side-by-side sleeper on mats
- 2 X ~300 kW skidded generator set/propane combo on mats

- 2 X 50,000 litre double-wall diesel fuel tanks mounted on highway licensed trailer or skids (total 100,00 litres of diesel per camp)
- 1 X 10,000 Litre double-wall gasoline fuel tank on highway licensed trailer or skids (total 10,000 litres of gasoline per camp)
- 2 skidded well site trailers on mats
- 1 skidded, heated 15,000 litre sewage storage tank, complete with heated lift stations
- 1 parts van for storage of mobile equipment parts and lubricants
- 1 skidded double burn incinerator and ash can
- 1 skidded sea can for storage of new lubricants, with a double-wall storage tank for temporary storage of used oils
- 1 or 2 portable light towers for site illumination and safety
- Parking area for overnight storage of crew vehicles
- A coverall type temporary building for mechanic's shop and storage
- Laydown yard for storage of mobile equipment, culverts signs, geosynthetics and materials
- Spill containment and cleanup equipment available in the event of an accidental release.

Fresh water for camp use will be drawn from major creeks along the HPAR, including Flat Creek, Km 26.5 Unnamed Creek, Mac Creek, Guthrie Creek, Fork Creek, Logan Creek, March Creek, Steel Creek, and Placer Creek. To ensure there is no adverse effect on aquatic resources, intake hoses will be screened as per DFO's Freshwater Intake end-of-pipe Fish Screen guidelines (DFO, 1995). Water withdrawal rates will be limited so as not to exceed 5% of total measured flow at any location. The water will be withdrawn using built-in pumping systems on board the water trucks and will be transported in the water trucks to the camp. Water will then be pumped from the water truck and stored in the camp buildings, where it will be treated before use. Camp operations will require approximately 200 L/person/day. Each 60 person camp will therefore require approximately 12,000 L or 12 m^3/day. Water withdrawals will be required daily to meet the demand at each camp.

Each camp will be equipped with lift stations and a sewage storage tank. Camp sewage will be hauled off-site to an authorized and approved disposal site. Grey water from sinks and showers will either be stored and disposed with the camp sewage or pumped to a sump no closer than 30 m to any watercourse. All sumps will be backfilled upon closure of the camp. A water licence is required for on-site grey water disposal.

Camp garbage, including all combustibles (except petroleum products, aerosol containers and plastic products) will be burned in a double-chamber camp incinerator. The non-combustibles will be hauled to an authorized waste station in Watson Lake or Fort Nelson. Petroleum products (oils and grease) will be secured in a sea can container or in the parts van to reduce the likelihood of accidental spill due to collisions. Waste oils will be stored in a double-wall container and removed off-site to Watson Lake or Fort Nelson by an authorized carrier to an authorized recycling facility. Similarly, waste grease tubes, oily rags and 4 litre plastic containers will be collected and hauled off site. Management of all waste produced from construction activities will follow SCML's Waste Management Plan for the Howard's Pass Access Road (Appendix II).

Camp groceries will be supplied every few weeks, and will be delivered by an independent transport company.

Camp first aid services and emergency response plan will be provided by the road construction contractor.

Camp communications, including telephone, internet and television services, will be available for employees, contractors and client representatives.

Access controls for the HPAR will be established at the camp locations during active construction seasons. These will consist of sign boards indicating that all visitors must report to the office at camp before proceeding further up the road. A work-site safety orientation will be provided to all workers and visitors. The checkpoint at Km 3 camp will provide overall access control for the HPAR during construction.

5.1.8.3. Camp Decommissioning

Following the completion of construction activities, the camps will be decommissioned. As part of decommissioning, all structures, equipment and facilities will be removed. The original slope angles and drainage patterns will be restored, vegetation and grub materials that have been stockpiled will be spread over the area, and the site will be revegetated with native species, as appropriate. Parks Canada will be consulted on site-specific revegetation plans. A security assessment for the road construction phase is submitted as part of the land use applications (Volume I).

5.1.9. Avalanche Mitigation during Construction

The avalanche control program that is in place for HPAR operations will continue through the construction period. An Avalanche Management Plan will be developed for the use of the HPAR as a haul road. The current avalanche control program is based on training and preparation, site assessments, communications, and mitigation measures. A full inventory of avalanche hazard zones along the HPAR is available (summarized in Section 4.1.1.6).

Training is provided for all staff and contractors who will be working in avalanche hazard zones. Training is done prior to avalanche season and covers avalanche orientation and awareness, and rescue training. Rescue caches are established at key locations.

Monitoring of avalanche conditions uses a stepped approach. Early in the season, an avalanche specialist monitors conditions remotely by monitoring regional weather conditions and forecasts, augmented by reports from site staff. Once the avalanche potential starts to rise, the avalanche specialist starts making trips to the site for direct assessment of conditions. If the conditions warrant, the specialist stays on-site full time. During avalanche season, daily bulletins are provided to staff contractors advising them of current conditions and any area closures.

When required, avalanche hazards are mitigated through avalanche explosives control. This is needed to stabilize snowpack and reduce potential avalanche debris volumes and worksite avalanche hazard. The control work is done exclusively by the avalanche specialist, and is normally done by dropping explosive charges from a helicopter.

5.2. Potential Effects and Mitigation Measures: Construction

SCML's proposed construction-phase activities in the HPAR corridor have the potential to affect the biophysical and human environment. For the purposes of this report, the following sections identify the key potential effects that could result from construction-phase activities, along with possible mitigation measures.

As was noted previously in this report, the upgraded HPAR will generally follow the existing route (as originally constructed in 1978–79 and reconstructed in 2014), except for local variations required to improve curves, reduce grades, and otherwise improve safety. There are some pre-existing effects from the older access road along the HPAR route. The main potential effects related to the construction phase of the HPAR Project are related to additional physical site disturbance (road widening and local realignments, borrow pits, and camps) and increased road use by workers and construction equipment.

5.2.1. Physical Components

5.2.1.1. Air Quality and Emissions

Potential Effects

Fuel combustion from mobile heavy-duty diesel and gasoline-powered equipment, portable auxiliary equipment, and fugitive dust from soil disturbance are the typical sources of air pollution during the construction phase. For the most part, emissions from the construction phase are likely to be low magnitude and short term in duration. The emissions include greenhouse gases and sulphur and nitrogen compounds. Vehicle movements on the road will also create localized and short-term fugitive dust during dry periods.

Mitigation

To minimize air quality effects during the construction phase, SCML will undertake ongoing monitoring and mitigation. Air quality will be monitored starting immediately prior to construction and will continue throughout the construction period. The monitoring program will include measurement of dust that settles (dustfall) and of particulates that are suspended in the air. The pre-construction measurements will establish baseline conditions that will be needed for comparison with monitoring results both from the construction phase and the operational phase. Details of the monitoring program are still under development.

Mitigation will include the following measures and will be guided by Environment Canada's Best Practices for Reduction of Air Emissions from Construction and Demolition Activities (2005):

- Using low-sulphur, reformulated or emulsified fuels to reduce emissions from construction equipment.
- Undertaking regular cleaning of construction sites to remove construction-caused debris and dust.
- Undertaking dust suppression on susceptible sections of the road. Measures to control dust will provide a number of benefits, including improved visibility and safety, reduced potential for erosion, and reduced environmental impacts on flora, fauna and water courses. Water will be used for dust control, but it is anticipated that additional measures may be needed. Only low-toxicity, environmentally benign products approved by the Environment Division of GNWT's Environment and Natural Resources department would be used. If water is not sufficient for dust suppression, selection of dust control products and design of application procedures would be in consultation with Parks Canada and would be consistent with the GNWT's Guideline for Dust Suppression (Environment and Natural Resources, 2013).
- Covering fine grained materials when transporting them.

- Covering soil, sand and aggregate stockpiles as necessary to prevent or mitigate potential fugitive dust.
- Encouraging and enforcing adherence to speed limits as well as discouraging extended periods of idling by construction vehicles.
- Incineration of camps' putrescible and domestic waste will be conducted as described in the Waste Management Plan (Appendix II) and following MVLWB waste management guidelines (MVLWB, 2011). Incinerators will meet either Canadian Standards Association or Underwriters' Laboratories of Canada (ULC) standards.

5.2.1.2. Noise and Vibration

Potential Effects

The use of construction equipment and vehicles will increase noise levels and cause vibration along the road and at individual construction sites (e.g., borrow pits and camps). Because bridge embankment construction, pile driving and major rock drilling activities were completed during the initial road construction and recent bridge installations, noise and vibration effects during the construction phase are considered limited. Aggregate crushing, however, may lead to sensory disturbance of wildlife and cause some resident species to avoid the road construction and borrow pit areas. Some noise disturbance effects to persons or wildlife present near individual construction sites will be unavoidable.

Mitigation

All equipment will be fitted with appropriate industry-standard muffling equipment. Standard Operating Procedures and regular equipment maintenance schedules will be followed. Aggregate crushing will be of short duration, but noise and consequent short-term disturbance cannot be avoided.

5.2.1.3. Surface Hydrology

Potential Effects

Widening the HPAR has limited potential to further alter drainage patterns, surface water flows in watercourses, and wetlands. Final bridges and major culverts were installed in 2014, all adequately sized for the design 200-year return hydrological event. Where stream gradients in excess of 8% were measured, fish baffles were installed in the culverts to limit flow velocities and to prevent the in-filled stream bottom material from being washed away.

Culverts will need to be extended for the HPAR road widening and some of the culverts require relocation (Table 5.1-6).

As noted previously, fresh water for camp use will be drawn from local watercourses.

Mitigation

Overall, natural drainage patterns and those established with the existing road will be maintained. Culverts, ditches and bridges will be inspected periodically and maintained during the construction phase. Culverts and ditches will be checked regularly and cleared of ice or vegetation debris. No further mitigation is required.

To ensure there is no adverse effect on surface hydrology, water withdrawals will not exceed 5% of total measured flow at any location, and total withdrawal for camp use at each camp location will be kept at less than the maximum 100 m^3 of water per day allowable without a water licence. This maximum allowable water withdrawal without a water licence does not apply to locations within the jurisdiction of Parks Canada.

5.2.1.4. Water Quality and Sediment Quality

Potential Effects

Upgrading of the HPAR has the potential to negatively affect water quality through deposition of deleterious substances to surface waters. Potential sources of deleterious substances include erosion of exposed soils by flowing water (rain fall and snow melt run-off), dust created by the movement of construction equipment and vehicles, and accidental spills during road upgrading. Any changes to water quality and sediment quality could affect aquatic life.

Mitigation

To mitigate potential effects from erosion, Fisheries and Oceans Canada's "Measures to Avoid Causing Harm to Fish and Fish Habitat" (DFO, 2013) will be followed. Mitigation measures specified in the Project Erosion and Sediment Control Plan (Appendix IV) will be implemented, and the SOP for Work in and Around Water (Appendix I) will be adhered to. Specific measures include:

- Site stream crossings in areas of clean cobble substrate.
- Store excavation materials at least 30 m away from a natural water body.
- Keep removal of riparian vegetation, particularly woody vegetation, to the minimum necessary for the project works.
- Properly contain (e.g., within silt-control fencing) any temporarily stockpiled material, and construction or related materials, in areas separated a minimum of 30 m from any waterbody.
- Remove and appropriately dispose of all construction materials and debris following construction.
- Retain as much of the natural vegetation as reasonably possible to help ensure bank stability, control erosion, and expedite the re-colonization of vegetative cover.
- Install erosion-control measures to minimize deposition of sediment into streams.
- Undertake no road work in riparian areas when there are other alternatives. The current HPAR roadway, however, is within 30 m of creeks or wetlands in a number of locations.
- Limit construction activities until after spring freshet.
- Delay major construction activities during high rainfall events.

Additional erosion and sedimentation prevention and mitigation measures are set out in Section 5.1.5.2 for development of borrow pits.

Measures will be taken to avoid any contamination of water by oil and other machine fluids and fuels. Construction equipment will be clean and inspected for leaks before being permitted to operate near or within a waterbody. Fuel will be stored in a designated location, and re-fueling of equipment will not take place within 30 m of a water body. All staff and contractors will adhere to the SOP for Fuel Handling (Appendix I).

Measures set out in the Spill Contingency Plan will be implemented to minimize the effects of any spills (Appendix III).

Measures to prevent contamination of soils will remove potential for transfer of contaminants in soil to water.

5.2.1.5. Groundwater

Potential Effects

The upgrading work anticipated for the HPAR has the potential to affect shallow groundwater by changing flow patterns. However, no measureable adverse effects on local groundwater aquifers are anticipated (in terms of water quality or quantity) beyond the changes that have already resulted from the initial road construction. Effects would likely be limited to creating a local impediment to shallow lateral groundwater flow and groundwater discharge. Such effects would be very localized and temporary.

Mitigation

Best management practices and engineering designs, such as minimizing disruption to subsurface flows through appropriate drainage control, will be applied to all construction activities to limit any potential effects on groundwater flow conditions.

5.2.1.6. Land

Potential Effects

Upgrading of the HPAR is likely to cause localized changes to the terrain through which the road passes, and along the by-pass portion in particular. Construction activities may cause erosion, which may affect slope stability.

Mitigation

Potential effects will be mitigated during the detailed design and construction phases. During detailed design, areas of potential instability will be further assessed. Designs will be prepared to account for these conditions. The primary principles associated with erosion and sediment control protection measures are to

- minimize soil mobilization;
- minimize the duration of soil exposure;
- retain existing vegetation where feasible;
- keep run-off velocities low; and
- trap sediment as close to the source as possible.

More specifically, erosion and sediment control measures will be installed prior to construction and maintained within their effective limits throughout construction and until the restoration of disturbed vegetation, rock revetments, or similar, are successfully completed. A description of all erosion and sediment control measures is provided in the Erosion and Sediment Control Plan (Appendix IV).

5.2.1.7. Soils

Potential Effects

Since the HPAR passes through an area of discontinuous permafrost, there is the potential to locally alter the permafrost regime. Erosion of soils may occur during construction, with the potential for sediment entering water courses. Placement of fill material and spills of fuel are potential sources of soil contamination.

Mitigation

Permafrost zones along the road alignment will be confirmed during the detailed design phase, and disturbance of permafrost will be avoided where feasible. Additional prevention and mitigation measures in relation to ice-rich permafrost zones are set out in Section 5.1.3 Road Design. Exposed slopes will be revegetated using native seed sources (as recommended by Parks Canada) to re-establish ground cover and reduce the likelihood of soil erosion.

The measures specified in the Erosion and Sediment Control Plan (Appendix IV) will be implemented to limit erosion potential and prevent the transport of sediment to watercourses. Additional erosion control measures including installation of geotextile and rip rap will be installed at sites with high erosion potential. This includes the sections of road near Divide Lake at km 3, Flat Lake area at km 5, and the Little Nahanni River side channel approximately 1 km south of the Mac Creek Bridge (Table 5.1-4).

Fill material will come from approved sources and will be clean and free of contaminants. A sampling program of materials from proposed borrow pits is underway, including geotechnical and geochemical analyses (Section 5.1.5.3). Potential borrow sources deemed unsuitable based on these tests will not be developed.

All staff and contractors will adhere to the Standard Operating Procedures for Fuel Handing (Appendix I) to minimize or eliminate accidental fuel spills, and a Spill Contingency Plan is in place (Appendix III).

5.2.1.8. Non-Renewable Natural Resource Depletion

Potential Effects

Road upgrading will of necessity result in the consumption of non-renewable granular material that is available in the HPAR corridor. The amount of granular material to be used is not considered to be sufficient to affect the availability of this resource in the region. While the HPAR will facilitate the mining of a lead-zinc deposit at Howard's Pass, the upgrading activities related to the road itself will not have a significant resource depletion effect.

Mitigation

SCML will limit its use to that necessary for road upgrading and maintenance.

In recognition that granular materials are of value to others in the region, SCML will consult with other potential resource users – Parks Canada, North American Tungsten, and the Sahtu and Dehcho authorities, to determine how the use of granular materials for the HPAR may affect their specific requirements.

5.2.2. Ecological Components

5.2.2.1. Vegetation and Plant Communities

Potential Effects

As the road width is being doubled and additional areas are being cleared for road visibility, borrow sources, camp locations, and for minor road realignments, there will be a loss of vegetation within the HPAR corridor and disturbance to vegetation alongside the road itself (i.e., edge effects). However, this loss is not expected to result in a widespread change in species composition or any effects on plant phenology, growth or reproduction. There is low to moderate potential for rare plant occurrence (Section 4.2.3). The greatest potential for adverse effects is related to physical damage to vegetation caused by equipment operating beyond the work area, from the introduction of invasive species and from dust deposition.

Mitigation

Some of the lost vegetated area will be restored through reclamation. Borrow sites will be reclaimed progressively as they are no longer needed, including revegetation with native plant species to avoid the potential of introduction of invasive species, following revegetation plans developed in consultation with Parks Canada. All camp locations will also be revegetated in accordance with these plans.

A rare plant survey will be undertaken as part of the continuing baseline program, and adaptive measures will be taken, where feasible, to minimize or avoid disturbance.

Means of minimization of air emissions and dust deposition are addressed in Section 5.2.1.1.

5.2.2.2. Wildlife and Wildlife Habitat

Potential Effects

The widening of the road, development of borrow pits and camp facilities are likely to displace individuals and/or their habitat, or obstruct their movement. However, the loss of wildlife habitat is not anticipated to be of sufficient magnitude to result in loss of species, fragmentation of habitat or of wildlife populations.

Construction activities will require the operation of heavy machinery, which has the potential to affect wildlife through stress and changes to movement patterns. These activities may result in some wildlife injury or mortality within the construction zone and disturbance in the vicinity of construction. Species that are sensitive to disturbance and are capable of leaving areas of increased human activity (i.e., most larger mammals) are less likely to be affected by construction. Species that avoid humans through mechanisms other than flight and/or move too slowly to flee disturbance (such as small mammals) are at increased risk from construction activity.

Timing also determines the vulnerability of wildlife to construction-related mortality. The greatest potential for adverse effects is during the spring and summer, when most species are rearing young, and when all species are most active, thus increasing their potential to enter into the construction zone.

Terrestrial wildlife species will vary in their response to crossing the construction zone. Most tolerant species will continue to cross, but will likely adapt their movements to non-construction periods or areas where no construction is occurring. Less mobile species may be deterred at some locations, and may seek other routes. Adjustments and changes in wildlife movements can be anticipated during the construction period.

The northern mountain population of the woodland caribou (which includes the Nahanni Caribou Herd), is listed under the federal *Species at Risk Act* (SARA) as a species of "special concern", and the management plan for the northern mountain population includes reference to the HPAR as a concern for the Nahanni herd (Environment Canada, 2012). Northern Mountain caribou are currently considered secure in the NWT, and both the Yukon and the NWT wildlife management agencies continue to permit the hunting of the Nahanni Caribou Herd. Grizzly bears and wolverines are also listed as species of "special concern" and may also be hunted in the NWT. Increased hunting pressure could occur if accessibility for hunters is increased during the construction period.

Little brown myotis and northern myotis bats occur in Nahanni National Park and may occur within the HPAR corridor. Since these species are listed under SARA as endangered, management measures may need to be implemented to prevent adverse effects on these bat species.

Mitigation

The mitigation of a number of the potential effects, particularly those related to caribou, is addressed in the draft Wildlife Mitigation and Monitoring Plan (Appendix VIII). It deals with traffic control measure, including procedures to be followed when wildlife are in the vicinity of or on the HPAR, speed limits, prevention of use of firearms except by designated personnel in certain circumstances, and recording of incidental wildlife observations. Access control by means of a traffic checkpoint at Km 3 Camp during construction will aid in road safety, provide information on road conditions, and may also reduce risk of increased hunting pressure.

Caribou, grizzlies, wolverines and bats are the only listed mammal species known to occur in the HPAR corridor. One or two endangered species of bats may be present, and beneficial management practices may need to be implemented to protect these species at risk. An evaluation of the potential for bat hibernacula and/or bat roosts will be undertaken in the 2015 to determine their potential presence or likely presence.

A professional environmental monitor will be present during HPAR upgrade construction work to ensure that mitigation measures are carried out effectively and that wildlife encounters are minimized. The environmental monitor will be on site to observe all work carried out in and around streams. Wildlife monitors from community organizations will be utilized during construction activities as appropriate. The monitors will also document observations of wildlife to add to the knowledge base about wildlife and habitat use in the HPAR corridor.

5.2.2.3. Migratory Birds and Bird Habitat

Potential Effects

The widening of the road and development of borrow pits and camp facilities are likely to displace individual birds, their nests and/or habitat. In general, however, the loss of nests and habitat is not anticipated to be of sufficient magnitude to result in population effects or fragmentation of habitat.

Construction activities will require the operation of heavy machinery. These activities are likely to result in disturbance in the vicinity of construction. Birds are generally sensitive to disturbance but are capable of leaving areas of increased human activity. Nevertheless, the greatest potential for adverse effects is during the spring and summer, when breeding migratory birds are present in the HPAR corridor.

Mitigation

SCML will implement the draft Wildlife Mitigation and Monitoring Plan including the following key mitigation measures to protect migratory birds and their habitat:

- Vegetation clearing along the HPAR has been scheduled to occur during winter, prior to the nesting season.
- Should vegetation clearing be required outside winter, pre-clearing nesting surveys will be completed.
- No-work zones will be established where active nesting sites are located.

As part of wildlife management, SCML will implement appropriate beneficial management practices for bird species listed as threatened under SARA. Two species in this category have been identified for consideration: the Olive-sided Flycatcher, which is known to occur as a summer resident or during fall migration, and the Common Nighthawk, which may occur. Prior to road construction, breeding bird surveys will be undertaken to confirm presence along the corridor, and to assess the scope of potential loss of nesting habitat. These surveys will be conducted in 2015.

5.2.2.4. Fish and Fish Habitat

Potential Effects

Upgrading of the HPAR has some potential to cause changes to fish habitat, fish abundance and distribution, and fish health with the installation, relocation and extension of the culverts, and from sediment from earthmoving activities during the construction phase. Arctic grayling, present in many of the streams, are particularly sensitive to loss of habitat through addition of sediment. There is also potential risk to fish from spills.

Mitigation

To mitigate these potential effects, SCML has adhered to, and will continue to adhere to, Fisheries and Oceans Canada's "Measures to Avoid Causing Harm to Fish and Fish Habitat", and all work will be subject to SCML's SOP related to Work in and Around Water (Appendix I). Culverts placed in fish-bearing waters will be installed at a level that maintains the natural contour and flow rates of the streams. No work will take place in or around water from mid-May to June, for the protection of spawning fish. Any riparian areas that may be disturbed will be revegetated following construction.

Other mitigation measures, such as those aimed at reducing soil erosion, sedimentation and degradation of water quality, are also relevant to the mitigation of effects on fish and fish habitat. The Erosion and Sediment Control Plan (Appendix IV), which addresses specific activities involved in the road widening, will be adhered to.

The potential for impacts to fisheries and aquatic resources due to spills will be reduced through implementation of the Spill Contingency Plan (Appendix III).

5.2.3. Social and Economic Components

5.2.3.1. Local Economy and Communities

Potential Effects

The HPAR upgrades have the potential to affect the local economy through the provision of direct and indirect employment opportunities and increased business activity due to project spending on goods and services. The greatest potential for benefits relate to the supply of construction labour, equipment, fuel and contracting related to camp operations. Construction activities may result in increased competition for skilled labour (e.g., equipment operators), but construction is not likely to affect local economic development potential or result in indirect effects on community structure and dynamics, or cultural values.

Construction activities in the section of the HPAR that runs through Nahanni and Nááts'ihch'oh National Park Reserves may disturb the use and enjoyment of those portions of the Park by park visitors due to construction noise, dust and increased human activity.

Mitigation

SCML plans to source services and supplies locally (and across the north) provided these services are competitive.

The HPAR lies within the traditional territories of two NWT First Nations groups: the Sahtu Dene and Metis, and the Dehcho First Nations. These groups are distinct in terms of history, socio-economic character, and treaty negotiation status. SCML has negotiated Co-operation Agreements with the Tulita District (Tulita Land Corporation, Fort Norman Metis Land Corporation and Norman Wells Land Corporation) in the Sahtu and the Naha Dehé Dene Band in the Dehcho. These agreements include sections on consultation, cooperation, employment, training, and business opportunities. The HPAR lies within that portion of the NWT where the Kaska Dena of the Yukon also assert traditional territory. SCML has entered into an Interim Measures Agreement covering exploration and pre-development activities with all Kaska communities, and is working with them to establish a formal Socio-Economic Participation Agreement.

During construction, access to the HPAR will be controlled by a checkpoint at Km 3 Camp. People travelling the road will be informed of access limitations due to construction activities and they will be advised of rules of road use (for example, radio use, and right-of-way for heavy equipment). SCML will conduct its operations in a manner so as to reduce effects on other road users to the extent that safe and efficient operation of the HPAR permits. Safety of staff, contractors and other road users, however, is paramount.

5.2.4. Cultural and Heritage Components

Potential Effects

Construction activities have the potential to disturb cultural practices, such as traditional hunting and trapping, in the region. Areas near construction activity may be less attractive to some individuals for undertaking traditional activities. However, based on interviews with at least some of the Aboriginal groups with knowledge of the region, currently there is very little use of the HPAR corridor for traditional activities (see Section 4.3.4). SCML has not encountered or been made aware of any conflicts with ongoing First Nations land use in the vicinity of the HPAR during the company's use of the road, reconstruction work, or through its community engagement program, ongoing since 2005.

Construction activities have the potential to disturb heritage resources in the corridor. However, a Heritage Resource Overview Assessment (HROA) completed for the HPAR in 2014 (see Section 4.3.3) concluded that a large portion of the corridor is considered to have low pre-contact heritage resource potential, but some areas of moderate to high potential exist.

Mitigation

SCML plans to conduct a Heritage Resource Impact Assessment in 2015, including shovel testing of sites with moderate or higher pre-contact potential, prior to land-altering development. The SOP for Heritage Resources (Appendix I) will be implemented during construction to identify any finds made during earthworks. Any cultural or heritage resources discovered will be managed in accordance with applicable legislation, practices and procedures.

5.2.5. Overview of Potential Effects and Mitigation Measures

Overall, the environmental effects resulting from the construction phase are well understood and can be readily mitigated using known technology, best management practices and procedures. They are largely of low magnitude and will be short-term and highly localized. The socio-economic effects are expected to be positive, given the availability of potential employment and contracting opportunities. The effects on traditional lifestyle may also be considered neutral to positive, based on the lack of regular use of this area for traditional pursuits.

Table 5.2-1 summarizes the environmental effects and mitigation measures described above.

Table 5.2-1: Environmental and Resource Effects and Mitigation Measures – Construction Phase

Environmental Component	Potential Effect	Mitigation
Physical Components		
Air Quality and Emissions	• Fugitive dust and particulate matter • Effect of dust on vegetation and habitat	• Regularly clean the construction sites of construction debris • Undertake dust suppression in areas susceptible to dust (in consultation with Parks Canada) • Cover fine grained materials when transporting them • Cover soil, sand and aggregate stockpiles as necessary to prevent or mitigate fugitive dust • Encourage and enforce speed limits
	• Greenhouse gas emissions • Emissions of sulphur and nitrogen compounds	• Discourage extended period of idling of construction vehicles. • Use low-sulphur, reformulated or emulsified fuels
Noise	• Noise from traffic and equipment operation • Noise from aggregate crushing • Noise from pile driving and major rock drilling	• Fit equipment with industry standard muffling equipment • Complete regular equipment and vehicle maintenance
Surface Hydrology	• Water flow or level changes • Drainage pattern changes in watercourses and wetlands	• Inspect and maintain culverts, ditched and bridges regularly, including clearing of ice and vegetation debris

Environmental Component	Potential Effect	Mitigation
Water and Sediment Quality	• Water quality changes due to erosion and sedimentation • Road dust may affect water quality • Water quality changes due to leaks or spills of contaminants	• Follow DFO's "Measures to Avoid Causing Harm to Fish and Fish Habitat" • Store excavation materials and stockpiled materials a minimum of 30 m from any waterbody • Retain natural vegetation as much as possible • Implement erosion control measures to minimize sediment deposition into a water body • Begin construction after freshet • Ensure equipment is clean and inspected for leaks prior to entering water • Implement the Spill Contingency Plan to minimize effects of spills • Store fuel in a designated location; and do not refuel equipment within 30 m of a stream • Adhere to the SOPs for Fuel Handling and Working in and Around Water
Groundwater	• Changes to groundwater levels and flow patterns	• Apply best management practices and engineering design to limit effects on groundwater
Land	• Changes in existing terrain resulting in increased erosion potential	• Mitigate through detailed design accounting for terrain hazards and follow professional standards • Implement Erosion and Sediment Control Plan
Soils	• Permafrost regime alteration • Increased soil compaction, settling and erosion • Potential soil contamination due to accidental spills	• Confirm permafrost zones along the alignment and avoid or minimize disturbance to permafrost • Use fill materials from an approved source that's clean and free of contaminants, based on testing of potential borrow sources • Revegetate exposed slopes using native species • Implement Spill Contingency Plan • Adhere to the SOPs for Fuel Handling
Non-renewable natural resource depletion	• Granular material removal for road upgrading and maintenance	• Limit use of granular resources to only what is needed • Consult and coordinate with other local resource users
Ecological Components		
Vegetation and Plant Communities	• Loss of vegetated area from clearing • Physical damage to vegetation in construction zone • Introduction of invasive species • Dust deposition	• Minimize clearing and grubbing in riparian areas • Reclaim and revegetate borrow sites, when no longer needed, and all camp sites with native plants (following revegetation plans in Quarry Operations Plan.); conduct annual surveys for invasive species and manually remove as needed • Implement dust control measures (i.e. road watering and application of environmentally benign dust suppressant)
Wildlife and Wildlife Habitat	• Displacement of wildlife and/or habitat • Obstructions to wildlife movement • Increased disturbance to wildlife • Increased wildlife mortality	• Further develop and implement the draft Wildlife Mitigation and Monitoring Plan to avoid or limit impacts to wildlife (including Special Status species) • Evaluate potential for bat hibernacula and/or bat roosts (endangered species) and avoid as necessary • Contract a professional wildlife monitor during construction

Environmental Component	Potential Effect	Mitigation
Birds and Bird Habitat	• Displacement of birds, nests and/or habitat • Increased disturbance to birds	• Further develop and implement the Wildlife Mitigation and Monitoring Plan to avoid or limit impacts to wildlife (including Special Status species). • Clear vegetation outside of the nesting period; conduct pre-clearing surveys and avoid active nests if some clearing is needed during breeding period • Conduct surveys to confirm presence and assess potential nesting habitat loss for endangered bird species
Fish and Fish Habitat	• Minimal additional habitat changes from upgrading • Potential effects on fish from sediment release or spills	• Apply DFO protocols for creek crossings, bridges and culverts • Adhere to SOP for Working in and Around Water • Do not work in or around water from mid-May to June for the protection of spawning fish • Revegetate riparian areas • Develop and implement measures in the Spill Contingency Plan to reduce risk to fish resources from spills • Implement the Erosion and Sediment Control Plan
Social and Economic Components		
Local Economy and Communities	• Provision of direct and indirect employment opportunities • Increased business activity • Increased disturbance to use and enjoyment of parks by visitors	• Source services and supplies locally (and across the north), provided these are competitive • Implement Cooperation Agreements and Interim Measures Agreements with both affected NWT First Nations • Manage road access through a checkpoint at km 3.
Cultural and Heritage Components		
Land Use	• Disturbance of cultural practices in vicinity of HPAR • Potential disturbance of heritage resources in the HPAR corridor	• Implement the SOP for Heritage Resources during construction

6. THE HPAR UPGRADE PROJECT: OPERATIONS

6.1. Project Information

6.1.1. Overview

After the completion of the road upgrades, the HPAR will be used to supply materials and equipment to the mine site during the project feasibility and planning phases, and then to mobilize equipment, materials and supplies during pre-construction and construction activities. Ultimately the HPAR will also be used to move ore concentrate from the mine mill to tidewater shipping ports and to provide necessary supplies and consumables for mine operations. Current mining plans indicate that there will be approximately 100 trucks travelling on the road per day in each direction during mine operation. As plans for the mine site are developed, further refinements will be made to projections of traffic on the HPAR.

6.1.2. Traffic Control

During mine construction, the bulk of truck traffic will consist of loaded vehicles hauling materials and equipment to the mine site and empty trucks leaving the property. In this unidirectional, loaded-haul scenario, the loaded trucks will be given the right of way when meeting opposing (empty) trucks on any single lane road sections. The empty traffic will clear loaded traffic using the constructed turnouts, and will proceed again after the loaded traffic has passed by. In this scenario, outbound traffic yields the right of way to inbound traffic on the single-lane sections. On the double-lane sections, there will be adequate road width for all traffic to meet without one truck having to clear the other.

Once mine construction is complete and concentrate haul begins, the road will have loaded traffic hauling in both directions, with subsequent changes to traffic control protocols to accommodate heavier loads leaving the mine site, while accommodating lighter traffic on steeper grades travelling to the mine site.

At times there may be the need to run truck traffic in a convoy formation to accommodate needs related to environmental concerns, avalanche risks, or other constraints. A truck convoy would pose no significant changes to hauling procedures on the double-lane sections.

Traffic control systems will be required for the safety of all road users and for efficient road operations. SCML is committed to developing traffic control measures as part of the integrated Road Operations Plan (Section 6.1.3) in consultation with Parks Canada and others (e.g., local road users). Traffic control typically includes details of the protocols used to manage road safety and a list of key positions and associated responsibilities to implement the plan. Typical protocols for traffic control include training, access control, fatigue control measures, accident prevention, hazard and wildlife notifications, weather monitoring, signage and reporting. Traffic control will also include protocols for communications related to road safety. This could include using tools such as GPS tracking and data link communications with operations-centre coordination. Redundant backup using standard radio communications could also be used. Additional control and monitoring may be provided by use of remote monitored camera and environmental monitoring systems that can provide data on road conditions and visibility at key hazard locations.

6.1.3. Road Operations Plan

An integrated Road Operations Plan will be developed during the detailed engineering phase, in consultation with Parks Canada and others (e.g., local road users). This plan will include procedures for managing, monitoring, mitigating and reporting on road use issues. It will be supplemented by stand-alone plans that provide more detailed procedures and information on specific aspects of road operations, such as spill response (see Section 11). The following is a draft listing of Road Operations Plan contents:

- Traffic control: see Section 6.1.2
- Road maintenance, including erosion control: see Section 6.1.6
- Safety issues and hazards
- Public safety and public access (augmented by an Access Management Plan)
- Wildlife protection and reporting: measures related to road operations from the Wildlife Mitigation and Monitoring Plan (Appendix VI)
- Dust abatement: see Section 6.1.6 Road Maintenance augmented by an Air Quality Management Plan
- Avalanche safety and control protocols, augmented by an Avalanche Management Plan: see Section 6.1.6 Road Maintenance and the Avalanche Mitigation Strategy (Appendix V)
- Wildfire response: to follow NWT Guidelines for Fire Prevention and Suppression (GNWT, 2001)
- Spill and contaminant loading prevention measures, augmented by a Spill Contingency Plan

6.1.4. Emergency Response

Safe operations on the HPAR will be a priority during mine operations, and a multi-faceted Safety and Emergency Response Plan will be developed prior to the completion of mine construction and will be implemented for mine operations. The plan starts with the truck and equipment operators and includes road maintenance crews, SCML emergency response teams, local emergency response providers and government agencies.

The most important component of the plan will be experienced and trained truck operators. All drivers will require training and certification prior to operating on the haul road with subsequent upgrading and refresher training on a regular basis. One potential training tool is driver simulators. The use of simulators that can realistically simulate actual road conditions and potential emergency situations has become a cost-effective and safe means of substantially reducing traffic-related incidents for heavy haul truckers.

In addition to specialized training in driving skills, all operators will be trained and equipped to be able to provide "first response" in the event of an incident on the road. Standard equipment will include spill and first aid kits on all trucks and maintenance equipment using the road.

Road maintenance crews will provide the next level of emergency response and will also be specially trained and equipped to respond to incidents on the road. Maintenance vehicles will carry emergency equipment and supplies that will complement equipment carried by truckers and allow a higher level of response.

The third level of response will be specialized emergency response crews from the mine site who will be able to quickly respond to incidents such as mechanical breakdowns, vehicle recovery, spill clean-up and emergency medical response.

The final level of emergency response will be from local emergency response agencies, government regulatory agencies, other mines and private companies that can provide additional assistance during an incident.

Regular training is planned, including “table top” and simulated field incidents with all response personnel to ensure clear communication and lines of command in the event of a real incident. The ability to communicate directly with other emergency response resources will be a key component of the Safety and Emergency Response Plan.

The plan will provide clear details on reporting procedures, roles of various parties and notification requirements. It is intended that the SCML operations centre will provide co-ordination, crew and equipment dispatch, and reporting during any incident.

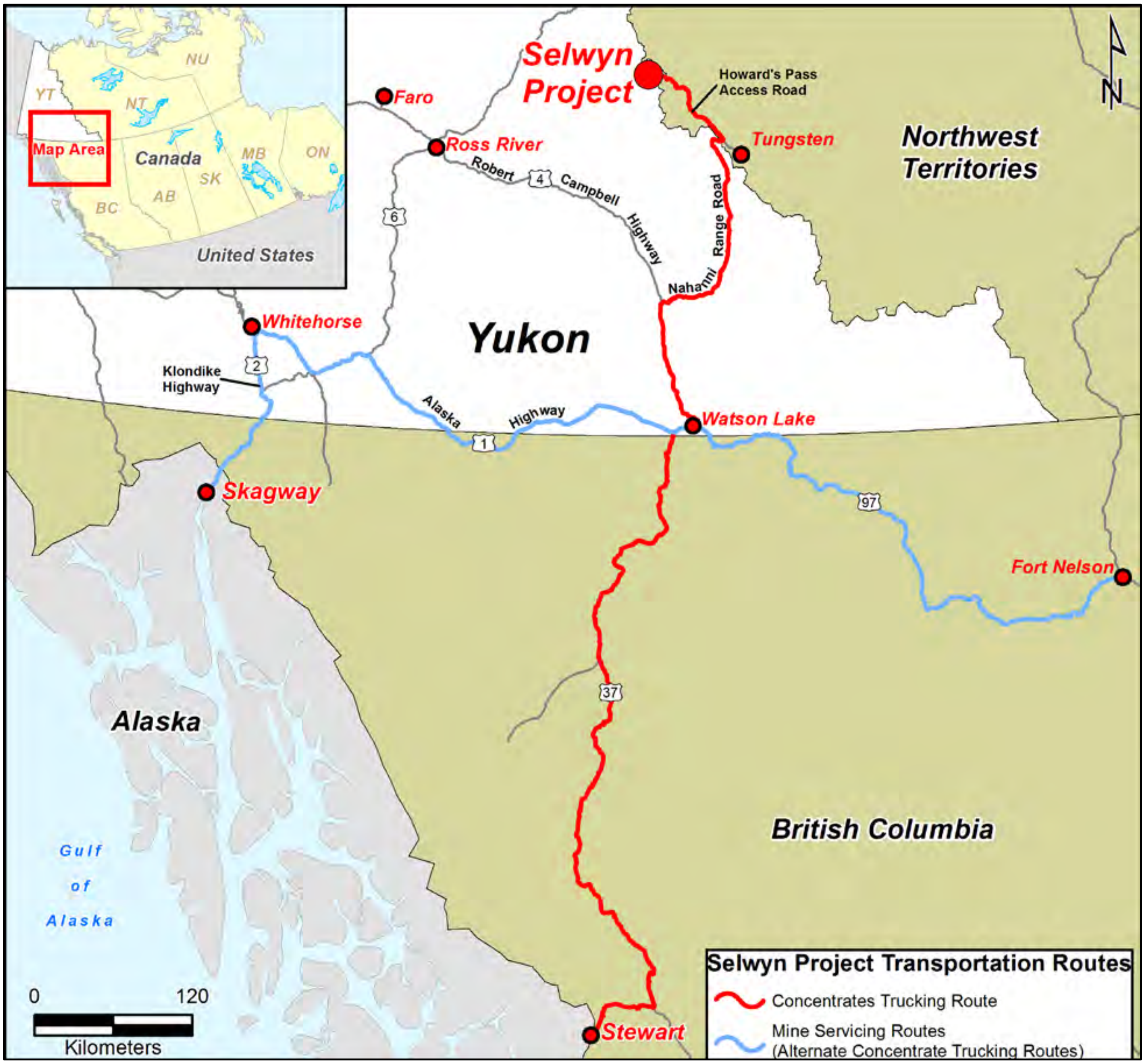
Accepted emergency response protocols, such as standardized checklists for response to different scenarios, incident investigation, debriefing of response personnel and redundant systems, will be implemented as part of the plan.

Through the Safety and Emergency Response Plan, resources and equipment will be reviewed regularly and modified as required for the various stages of mine and road development and use.

6.1.5. Use of the HPAR as a Haul Road

Truck hauling of concentrates and mine supplies will commence when mining and ore processing begins. The current plan is to haul the zinc and lead concentrates to the port at Stewart, BC, a distance of approximately 1,000 km one-way (Figure 6.1-1).

Figure 6.1-1: Selwyn Project Transportation Routes



It is anticipated that the majority of truck traffic on the road will be specialized truck configurations, custom designed for mine concentrate and backhaul requirements. The bulk of resupply of materials for the mine will make use of the return journeys of these trucks. This provides operational economies, and it also reduces traffic on the HPAR. This dual use of trucks will be accommodated by a hybrid trailer design that will allow transportation of both ore concentrates and supplies on the same trailer. The total volume of supplies required for the mine will be based on final mill and mining design, and is currently estimated at 225,000 tonnes per year.

The mine will be powered by liquefied natural gas (LNG) generators. There will be an estimated average of 12 trucks per day required to haul LNG to the site, and an estimated 10 to 15 trucks per day will be required for supplies that cannot be accommodated in the hybrid trailers, including diesel fuel. There will also be miscellaneous traffic, such as contractors' vehicles and transport of building materials. Mine-site personnel will continue to be flown to and from the site, and will not be travelling over the roadway except in unusual circumstances where weather or other factors do not allow for access by air.

The projected maximum haul traffic volume using the 79 km HPAR corridor during mine operations is summarized in Table 6.1-1. Total traffic volumes are estimated to be approximately 100 vehicles per day in each direction. Truck cycle time is based on a 70 km/hr operating speed on the HPAR with speed reductions to 50 km/hr for some sections with sharper corners or steeper terrain and at the approaches to single lane bridges. Slower speeds and longer truck cycle lengths may also be required due to weather conditions and winter road conditions. The daily truck traffic may also vary from the estimates shown in the table to accommodate road maintenance, avalanche control operations and mine operational requirements.

Table 6.1-1: Preliminary HPAR Traffic Allowance

Category	Annual (t)	Truck Pay Load (t or m^3)	Daily Truck (Trips)	Type of Truck
Lead concentrate (wmt)[(1)]	208,615	51	11.4	Flat bed/ Super Sacks
Zinc concentrate (wmt)	1,018,312	51	55.5	Tridem side dump
Grinding media	23,037	51	1.3	Flat bed/ ISO containers[(2)]
Liners	varies	51	0.1	Flat bed/ ISO containers
Reagents	121,682	51	6.6	Flat bed/ ISO containers
LNG		83 m^3	12.0	B Train - LNG truck
Diesel	50,000	30	4.6	Diesel tanker
Ammonium nitrate	15,000	51	0.8	Flat bed/ ISO containers
Explosives	16,000	51	0.9	Flat bed/ ISO containers
Camp freight	varies	varies	0.3	Flat bed/ ISO containers
Total	**1,452,646**		**93.5**	

(1) wet metric tonnes

(2) ISO containers, also known as intermodal containers, are standard-sized shipping containers available in various open and closed configurations. They allow for ease of loading/unloading at shipping ports as the entire container can be lifted off of a truck and into a ship's cargo hold and the truck can quickly be reloaded with another empty container or one containing supplies for backhaul on the return trip to the mine.

Operational traffic associated with the Selwyn Project will overlap with that of other users of the Nahanni Range Road in Yukon, primarily by traffic associated with North America Tungsten's Cantung Mine operation, as well as by hunters and other recreational users. Current estimates of traffic provided by North American Tungsten include up to 18 freight, grocery and fuel trucks per week. Every second week, there are additional ground support and explosives freight trucks. Propane is delivered once a week in the summer and four times per week in the winter, and additional traffic would result from occasional special projects. Seven light duty trucks transport personnel to the site on Wednesdays (L. Willetts, personal communication, 2015). SCML will consult with North American Tungsten during the development of the Road Operations Plan.

Concentrate Haul Details

The two categories for mine product shipments will be zinc concentrates and lead concentrates. There will be a specific truck/trailer configuration for each of these. Zinc will be hauled in covered side-dumping trailers with a 51 tonne load capacity. An example of a zinc concentrate truck is shown in Photo 6.1-1. The tarp covers are 18 oz. weight, side-roll type that provide a tight fit.

Lead concentrate will be contained using “super sacks” at the mine site. An example of the truck and trailer configuration and sealed sacks to be used for lead hauling is shown in Photo 6.1-2. The lead concentrate trucks will have a capacity of 51 tonnes.

Concentrate load-out facilities will be designed to ensure that the concentrate haul trucks do not have zinc or lead concentrate dusts on the wheels or outside body of the tractors and trailers. This is to prevent any release of concentrate contaminants on the roadways.

Photo 6.1-1: Covered side-dumping ore concentrate truck

Photo 6.1-2: Truck and trailer with sealed “super sacks”, configuration to be used for lead concentrate

6.1.6. Road Maintenance

Road maintenance will involve a number of tasks, including

- monitoring of road conditions, weather, traffic use and presence of wildlife;
- road surface grading;
- snow clearing and other winter maintenance;
- shoulder sloping and granular recovery;
- dust control;
- traction control including scarification and sanding;
- inspection and maintenance of drainage works, including culvert thawing;

- slope remediation and stability control;
- avalanche control;
- vegetation control;
- maintenance of traffic guards and signage; and
- maintenance of communication and monitoring systems.

6.1.6.1. Drainage Works

Once the haul road upgrade is complete, there will be an ongoing need to maintain both ditches and the slopes above them. Maintaining unobstructed water flow along the ditches and through the cross-drain culverts is important to prevent possible saturation of the road embankment, which would reduce the load-bearing capacity of the road. Areas with wet or saturated cut slopes or frost action may cause some migration of soil or debris into the ditch line. Ditches will be inspected and cleaned to maintain adequate drainage flow. Excavated soil will normally be sidecast, but may, where needed, be stockpiled or placed in designated areas designed to prevent possible sedimentation of streams and water bodies. Slopes noted as having excessive erosion or soil migration will be identified for additional slope stabilization measures by engineering staff.

Prior to spring freshet, and until temperatures remain above freezing, culverts will be inspected regularly and thawed if required. Glaciation of culverts can result when intermittent flows freeze during warm spring days and accumulate ice in layers overnight or on cold days. Thawing methods include the use of dedicated heat traces that are connected to electric welders, or steaming. A dedicated thaw truck will be assigned during this period. Monitoring and maintenance of culverts will be facilitated by marker posts that will help crews to locate culvert inlets and outlets during periods of snow cover.

The spring drainage works maintenance program will include inspection and repair of culvert inlets and outlets, including clearing of debris and repairing damage from traffic and snow-clearing operations, as well as inspection and repairs to any erosion or undermining that is observed during the inspections.

Ditch blocks, inlet sump holes and outlet settling ponds will be maintained as a part of the regular spring and fall drainage works maintenance program. Maintenance of culvert outlet armouring will also be undertaken regularly—this armouring will be needed in some locations to dissipate culvert discharge in order to prevent erosion, particularly on steep slopes. Additional inspections and maintenance will be undertaken after major rainfall events.

6.1.6.2. Bridge and Stream Monitoring

In addition to routine monitoring by maintenance staff, bridge structures, abutments and stream channels will be inspected on an annual basis by a registered professional engineer licenced to practice in the NWT. Inspection items will include evaluation of river course scour, abutment and bank stability and the structural integrity of each bridge.

6.1.6.3. Snow Removal, Scarification and Sanding

Snow removal, ice scarification and sanding will be carried out as required over the winter months to maintain a safe and efficient roadway. In general, snow removal operations will be undertaken after accumulation of more than 100 mm of snow or when high wind conditions cause drifting. Traction control operations, including ice scarification and sanding, will occur on an on-going basis, with particular attention to steeper grades, bridge crossings and mountain passes.

In addition to routine patrols by maintenance staff and reporting by truck operators, remote monitoring, including video surveillance and weather stations, will assist personnel to plan and implement winter maintenance operations.

Provision for wildlife crossing and road corridor egress will be through breaking snow windrows at regular intervals and building short, snowplowed ramps in areas of reported animal congregation. In areas with deep snow accumulation over the surrounding terrain, this will not be needed. Snow course surveys over four years indicate that snow depths can approach or exceed thresholds for movement of moose and caribou (Section 4.2.8.3 and Figure 4.2-13 and Section 4.2.8.4). Prior to spring freshet, windrows will be "winged" back by a grader to reduce the potential for subgrade saturation.

Wherever practical, stockpile sites for sand and gravel will be co-located with granular borrow sources developed for road construction to minimize the area disturbed by road operations. Additional stockpiles may be required adjacent to areas with steep grades and bridge crossings, but can be co-located with road-side turnouts.

6.1.6.4. Avalanche Control

Alpine Solutions Avalanche Services carried out an avalanche assessment of the HPAR corridor in 2010, with an additional update on avalanche mitigation options in 2013 (Alpine Solutions Avalanche Services, 2010 and 2013, the latter attached as Appendix V). The 2010 assessment report identifies locations and expected magnitudes and occurrence intervals for all the avalanche zones identified (see also Section 4.1.1.6 Snow Avalanche Hazards). The report recommends that an annual operational avalanche management program be implemented to monitor and mitigate the risks.

The assessment identified potential avalanche zones at a number of locations from km 42 to km 74. A certified avalanche control specialist will be retained to assess avalanche risks and assist the maintenance crews with avalanche mitigation operations. Pre-positioned avalanche cannons, remote controlled systems and other avalanche control measures are among the avalanche risk mitigation options available (see the discussion of options in Appendix V).

Truck turnarounds, road widening and gates will be incorporated in the road at either end of the main avalanche hazard section of the HPAR (at km 42 and km 75) to provide holding areas for traffic during avalanche control operation. It is also intended to provide turnouts in safe zones within this avalanche corridor, at km 53 and km 63. These features will be incorporated in the HPAR design during the detailed design phase.

6.1.6.5. Dust Control

Dust control operations provide a number of benefits, including:

- improved visibility and thus improved safety for all road users;
- health benefits for all road users, as fine dust particles are a respiratory irritant;
- reduction in maintenance costs by reducing volume of gravel surfacing displaced by traffic;
- reduction in vehicle operation and maintenance costs, as air filters get plugged up quickly on dusty roads, which makes the engine operate less efficiently;
- improved load-bearing capacity;
- reduced potential for erosion; and,
- reduced environmental impacts on flora, fauna and water courses.

Water and, if needed, additional dust control products will be used for dust control operations. Only low-toxicity, environmentally benign products approved by the Environment Division of GNWT's Environment and Natural Resources department would be used. Selection and application of these products would be in consultation with Parks Canada and would be consistent with the GNWT's Guideline for Dust Suppression (Environment and Natural Resources, 2013).

The tarping systems of the zinc concentrate trailers will also help eliminate sources of fugitive dust by tightly sealing concentrate within the trailer box. Photo 6.1-3, Photo 6.1-4 and Photo 6.1-5 show the features of the concentrate trailer tarp system.

Photo 6.1-3: Tarp securement features

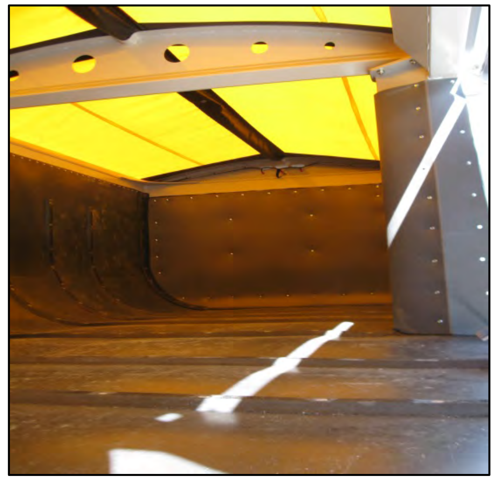


Photo 6.1-4: Interior lining around the doors and seal on tarp

Photo 6.1-5: Spillways that prevent the ore concentrate from spilling onto the tipper or remaining on the trailer

6.1.6.6. Maintenance Personnel and Equipment

Staffing requirements will vary between summer and winter seasons, with additional human resources required during the winter due to the need for 24/7 snow removal. In the winter, maintenance crews will be available 24 hours a day. It is expected that standard shifts can cover summer maintenance duties.

Maintenance personnel will be housed in mine camp facilities in the Yukon. The maintenance garage will also be located at the mine site in the Yukon.

Road maintenance equipment that will be required:

- Pickup trucks
- Stake truck with Hiab crane
- Front-end loader (Cat 966H or equivalent)
- Graders (Cat 14 or equivalent)
- Excavator (for ditch cleaning and local road repairs)
- Culvert steaming truck
- Crawler tractor (Cat D6 or equivalent)
- Snowblower attachment for front-end loader
- Snow wing plow for grader
- Sloper for grader
- Munroe reversible plows
- Frink one-way snow plows
- Highway sander hoppers
- Tandem axle dumps with under plows
- Tractor trailer
- Water tanks with spray bar/pump
- Follow-Me-Wobbly compactor
- Service/culvert thaw cube van
- Generator sets
- Washers, pumps, chainsaws, etc.
- Miscellaneous tools and parts

6.1.7. Road Closure and Reclamation

SCML will put closure and reclamation measures into effect on the basis of operational needs. If use of the road and bridges is expected to be suspended for up to five years, temporary closure measures will be undertaken, as described below. If road and bridge use is planned to be suspended for a period exceeding five years, permanent restoration measures may be enacted, subject to SCML's long-term plans and input from road users (Section 6.1.7.2). The reclamation activities described below are typical procedures and will be reviewed in more detail and revised as needed during the detailed design phase.

Closure and reclamation works will be planned and conducted in consultation with other road users, including Parks Canada and local First Nations users. If road maintenance responsibilities are taken over by other user groups for the purpose of maintaining access, then some or all of the reclamation works may not be necessary on portions of the road.

Further details of road decommissioning will be developed as part of the detailed project decommissioning planning and in accordance with the requirements of an approved Road Decommissioning Plan.

6.1.7.1. Temporary Suspension of Road and Bridge Use

Road Embankment and Culverts

Measures to be undertaken on the road surface during a temporary closure will be limited, with the focus on making the road more self-sustaining. This includes prevention of road washouts and erosion. To achieve this goal:

- Stream culverts will normally be left in place, and will be backed up by cross-ditching. Stream crossings known to have chronic problems (for example, a history of frequently needing to have debris removed from the inlets) may be removed and replaced with an armoured ford crossing.
- Cross-drain culverts would either be backed up by cross-ditching or removed and replaced by a cross-ditch.
- Additional cross-ditches would be added to the road where deemed appropriate.

Restoration measures to be undertaken for temporary suspension of bridge use would aim to reduce the potential for approach-fill erosion. Measures to achieve these purposes would include:

- Installation of cross-ditches in the approach fills as appropriate to ensure that run-off water on the road surface does not transport sediment to the creek. Run-off would be directed into vegetated areas where it would disperse. Run-off may also be directed into settlement ponds if no vegetated areas are located nearby.
- Seeding of exposed and/or disturbed sites within 30 m of the normal high water mark with native species (with seeds of local origin, and with no potentially invasive species) and/or planted with willow cuttings. Cross-ditches would be prepared for natural revegetation and may be planted or seeded with native species to prevent erosion of exposed fine grained soils.

Generally, the road would be passable by 4X4 trucks under a temporary closure scenario. Many of the stream crossings would be cross-ditches. Signs would be installed to warn road users that the road has been deactivated, is not currently being maintained, and may not be safe for use.

6.1.7.2. Permanent Suspension of Road and Bridge Use

Restoration measures to be enacted if road and bridge use is planned to be suspended permanently would depend on decisions made in consultation with road users, as noted above. Planning for full road closure (with reclamation) will be directly linked to decisions on permanent mine closure.

Measures would be designed to stabilize the road footprint and restore natural drainage patterns while maintaining water quality and reducing the risk of landslides. The level of reclamation activities required to achieve these objectives will vary depending on characteristics of each road segment. Factors such as slope failure risks, safety hazards, erosion potential, water quality, water quantity, and fish habitat proximity all influence the chosen mitigation strategies. General restoration measures may include

- complete removal of the bridge and culvert structures;
- pull back of earth fills at bridge approaches;
- pull back road side-cast materials;
- restoration of natural drainage; and
- revegetation of disturbed soils.

Specific descriptions of reclamation and restoration treatments to achieve the goals of stabilization of the road footprint, restoration of natural drainage patterns, maintenance of water quality and reduction of risk of landslides are outlined below.

Under the permanent closure scenario, the road would no longer be passable by motor vehicles.

Road Embankment and Culverts
Removal of stream culverts may require restoration of the natural stream channel width and gradient, and armouring of the stream banks with rock. Cross-culverts would be removed and replaced with cross-

ditches to move surface run-off from the road top and roadside ditches to non-erodible soils downslope. Cross-ditches located on longitudinal grades at regular intervals would require ditch blocks installed to intercept ditch run-off. Cross-ditches located at natural low spots would not require ditch blocks and would be broader and with gentler slopes to capture the converging run-off. Rock armouring would be placed at all cross-ditch outlets.

Where the road is located on steep side slopes or potentially unstable terrain, slope angles may need to be restored by pulling back side-cast material on select sections of road to reduce the risk of slope failure. Any retaining walls and potentially unstable steep fills would be removed. Waterbars, berms, or outsloping of the remaining road structure may also be required in some areas to intercept water running down the road and divert it to the stable slopes below.

Where the road is located in valley bottoms or on stable terrain with gentler side slopes, road fills are expected to be stable and would remain in place. Re-sloping of the road top would be completed in select locations to control surface run-off, limit erosion of fine grained soils, and facilitate the removal of culverts and bridges.

Bridges

All bridges have decks made of prefabricated reinforced concrete deck panels, with integral lifting points. The panels are grouted into place. The grout pockets and grout between panels would be broken up, taking care to contain and collect all concrete debris and prevent any from entering steams. The panels would then be lifted off their supporting structures, placed onto trucks and hauled off site. Once the panels have been removed, the steel girders could be removed from the supports, dismantled into manageable load sizes and hauled off site.

The Mac and Steel Creek bridge sites include mid-span in-stream supports. The remainder of the bridges are single clear span structures with no in-stream supports. These supports are piers composed of a steel piling set (two or more piles at a support point) and a cap beam on which the bridge decks rest. These piers would be dismantled, placed on trucks and removed from site. It is likely that piles will be so tightly lodged into the ground over time that they cannot be removed. Should this occur, remaining portions of the pile(s) would be cut off at ground level.

All bridge abutments are composed of steel pipe piles, bearing plates and concrete abutment walls to support the ends of the bridge and approach fills. Concrete abutment walls and bearing plates would be removed and hauled off site. Steel pipe piles would be removed, if possible, or cut off at ground level. Where rip rap and slope protection is stable, it would be left in place to stabilize the creek banks and avoid new disturbance of the creeks or opening the banks up to erosion. If rip rap is constricting the channel in any way or is found to be unstable, it would be pulled back to restore the natural stream channel. Pulled-back rip rap would be used to armour slopes and ditches next to bridge approaches to prevent erosion. Other manufactured slope protection that is removed would be hauled off site.

Earth fills placed at bridge approaches would be pulled back to natural slope angles. Where possible, stream banks would be reshaped to their pre-development form.

Revegetation

Exposed and/or disturbed sites within 30 m of the normal high water mark would be seeded with native species (with seed of local origin and with no potentially invasive species). Stream bank areas could be further revegetated by planting willow shrub cuttings. Cross-ditches would be prepared for natural revegetation and may be planted or seeded with native species to prevent erosion of exposed fine-grained soils. Along the entire length of the road, the top surface would be scarified and left in a condition that promotes natural revegetation. Any available local windrowed topsoil could be re-used on the surface and seeding or planting of native species might be completed along the road where appropriate. Steep slopes would be revegetated to improve slope stability and re-establish natural vegetation successional pathways.

6.2. Potential Effects and Mitigation Measures: Road Operations

SCML's proposed road operations within the HPAR corridor have the potential to affect the biophysical and human environment. For the purposes of this PDR, the following section identifies the key potential effects that could result from road operation and possible mitigation measures.

6.2.1. Physical Components

6.2.1.1. Air Quality and Emissions

Potential Effects

The use of the HPAR will result in air emissions from fossil fuel combustion by vehicular traffic using the road. These emissions include greenhouse gases, sulphur and nitrogen compounds, and other contaminants of concern (e.g., benzene)

Traffic on the road will also create fugitive dust during dry periods and fine particulate matter (PM_{10} and $PM_{2.5}$). These air emissions could have direct and indirect effects on human health, water and soil quality, vegetation, and wildlife habitat.

An assessment of impacts on air quality from mine traffic on the HPAR was undertaken by Levelton Consultants Ltd. (2011). This assessment was based on modeling of "mobile emissions" and dispersion at three points along the HPAR during its use as a haul road. Pollutants included in the assessment were sulphur dioxide, nitrogen dioxide, carbon monoxide, volatile organic compounds and particulates. The modelling results indicated that only particulate matter (dust) could potentially approach or exceed the applicable guidelines for ambient air quality.

Mitigation

To minimize air quality effects during the operations phase, SCML will develop an Air Quality Management Plan for the mine site and road operations. Mitigation measures applicable to road operations include:

- Use of low sulphur, reformulated or emulsified fuels to reduce emissions from trucks and other equipment.
- Encouraging and enforcing adherence to speed limits as well as discouraging extended periods of idling by trucks and other equipment;
- Undertaking dust suppression in areas and phases of construction where dust levels could become elevated. Measures to control dust will provide a number of benefits, including improved visibility and safety, reduced potential for erosion, and reduced environmental impacts on flora, fauna and water courses. If dust suppressant products are required, only products approved by the Environment Division of Environment and Natural Resources (GNWT), and in consultation with Parks Canada, will be used and applied according to the guidelines for dust suppression issued by GNWT (Environment and Natural Resources, 2013).

- Covering zinc concentrate while in transit.
- Sealed bagging for lead concentrate in transit.
- Ongoing truck and other equipment maintenance.

Monitoring will include:

1) Monitoring of dust emissions along the road. This may include both monitoring of dust that settles along the HPAR corridor (dustfall) and levels of particulates suspended in the air. The baseline for this monitoring will be established prior to the construction phase.
2) Monitoring of soils and of vegetation for mineral uptake from fugitive dust.

6.2.1.2. Noise and Vibration

Potential Effects

Operation of trucks on the HPAR will increase noise and vibration levels in the immediate vicinity of the road. Potentially sensitive receptors include:

- wildlife in the vicinity of the HPAR corridor;
- people using the area near Flat Lakes;
- visitors to the Nahanni and Nááts'ihch'oh National Park Reserves;
- park visitors on river trips on the Little Nahanni River along the HPAR; and
- hunters and trappers in the vicinity of the HPAR corridor.

Mitigation

In an effort to mitigate these potential effects, all equipment will be fitted with appropriate industry-standard muffling equipment. Standard Operating Procedures and regular equipment maintenance schedules will be followed. However, with frequent traffic and large trucks, disturbance from noise cannot be eliminated.

6.2.1.3. Surface Hydrology

Potential Effects

Operation of the HPAR has limited potential to further alter surface water flows given the design of the bridges and culverts and plans for their maintenance. Final bridges and culverts were installed in 2014, all adequately sized for the design 200-year return hydrological event. A few additional culverts will have been installed, relocated or extended during the construction phase. Where stream gradients in excess of 8% were measured, fish baffles will have been installed in the culverts to limit flow velocities and to prevent the in-filled stream bottom material from being washed away.

Mitigation

Culverts, ditches and bridges will be maintained during the operations phase, as described in Section 6.1.6. Culverts and ditches will be checked regularly and cleared of ice or vegetation debris. No further mitigation is required.

Some surface water withdrawals are likely required for road maintenance (e.g., dust suppression). As noted previously, withdrawals will not exceed 5% of total measured flow at any location and total withdrawal will be kept at less than the maximum 100 m^3 of water per day allowable without a water licence unless required for emergency use (e.g., fire control). There is no allowable maximum withdrawal without a licence in areas under the jurisdiction of Parks Canada.

6.2.1.4. Water Quality and Sediment Quality

Potential Effects

Operation of the HPAR has the potential to negatively affect water quality through deposition of deleterious substances to surface waters. Potential sources of deleterious substances during operations include erosion of exposed soils by flowing water (rainfall and snow melt run-off), dust created by vehicle traffic, run-off of sediments from the road surface (e.g., from application of water or other products for dust suppression, or from run-off), and accidental spills during road operations (spills of ore concentrate, hydrocarbon fuels or any other hazardous materials being transported). Any changes to water quality and sediment quality could affect aquatic life.

Mitigation

To mitigate potential effects from erosion, Fisheries and Oceans Canada's "Measures to Avoid Causing Harm to Fish and Fish Habitat" (DFO, 2013) will be followed throughout the operations phase. Particular emphasis will be placed on

- inspections of revegetated areas to confirm successful revegetation;
- ongoing maintenance of erosion control measures;
- regular maintenance and inspection of culverts;
- annual structural inspection of bridges and abutments by a professional engineer; and
- implementation of dust control measures during operations.

Additional erosion and sedimentation prevention and mitigation measures are set out in Section 6.1.6 for road maintenance, and Section 6.1.7 for road temporary suspension or closure.

Measures set out in the operations Spill Contingency Plan (to be developed) will be implemented to minimize the effects of any spills.

All staff and contractors will adhere to the Standard Operating Procedures for Fuel Handling (Appendix I), and measures undertaken to prevent contamination of soils (Section 6.2.1.7) will remove potential for transfer of contaminants in soil to water.

6.2.1.5. Groundwater

Potential Effects

Effects to groundwater during the operations phase are largely limited to potential for contamination as a result of leaks and accidental spills.

Mitigation

Ongoing truck and other equipment maintenance and measures set out in the Spill Contingency Plan (to be developed) will be implemented to minimize the effects on groundwater.

6.2.1.6. Land

Potential Effects

There remains the potential for ongoing erosion along the HPAR during the operations phase.

Mitigation

During road operations, potential effects will be mitigated by appropriate maintenance of culverts, ditches and other road-related infrastructure. Maintenance crews will monitor and report on terrain conditions in the HPAR corridor on an ongoing basis.

6.2.1.7. Soils

Potential Effects

Effects to soils during the operations phase are largely limited to potential for contamination as a result of leaks and accidental spills and the deposition of dust from haul trucks carrying concentrate from the mine along the HPAR.

Mitigation

Concentrate load-out facilities will be designed to ensure that the concentrate haul trucks do not have zinc or lead concentrate dusts on the wheels or outside body of the tractors and trailers in order to prevent any potential for release of concentrate contaminants on the roadways and surrounding environment. Monitoring of metals levels in soils and in vegetation along the roadway will be undertaken, and haul methods will be adapted to address any build-up of contaminants that is detected.

Measures to prevent and respond to spills will be in the Spill Contingency Plan.

All staff and contractors will also adhere to the Standard Operating Procedure for Fuel Handing (Appendix I).

6.2.1.8. Non-renewable Natural Resource Depletion

Potential Effects

Ongoing maintenance of the HPAR will result in the consumption of non-renewable granular material that is available in the HPAR corridor. While the HPAR will facilitate the mining of a lead-zinc deposit at Howard's Pass, the upgrading activities related to the road itself will not have a significant resource depletion effect.

Mitigation

SCML will continue to limit its use of granular materials to that necessary for road maintenance.

6.2.2. Ecological Components

6.2.2.1. Vegetation and Plant Communities

Potential Effects

The operation of the HPAR may result in indirect effects to the adjacent vegetation and plant communities that are retained or located within the corridor. The potential secondary effects to vegetation that may occur during the operation include:

- Damage from spills of contaminants, fuels and other materials that may reach natural areas.
- Damage to adjacent natural vegetation from maintenance activities such as sanding, structure/culvert repairs, and ditch cleanout.
- Increased light, wind and sun exposure within the newly created edges of adjacent vegetation and plant communities, and changes in moisture and temperature regimes due to alteration of local hydrology often lead to:
    - vegetation dieback,
    - changes in the ground flora composition,
    - windthrow, and/or
    - spread of invasive species.
- Severe dust deposition may have adverse effects on plant phenology, growth and reproduction
- Accumulation of metals from concentrate dust can affect vegetation growth, particularly of lichens; high levels of some metals can also be detrimental to wildlife (if they are feeding regularly in the area for prolonged periods).

Mitigation

During the operations phase, it can be expected that some of the lost vegetated area will be restored through reclamation and continue their ecological functions. Particular emphasis will be placed on inspections of restored areas to confirm successful revegetation.

Ongoing maintenance of erosion control measures and implementation of dust control measures during operations will reduce disturbance to adjacent vegetation and plant communities.

An ongoing invasive plant management program will include annual surveys and mitigation as needed. Mitigation will be manual control (crews removing plants).

Concentrate load-out facility design, bagging and container loading are being designed to minimize contact between concentrate and the bodies of the tractors and trailers. Dust levels along the road will be monitored throughout the period of operations. Metals levels in soils and in plants will also be monitored and compared against the established baseline levels. These monitoring programs will provide the information needed to adapt mitigation measures if needed to reduce dust emissions, especially if they are leading to accumulation of metals in soils or vegetation.

6.2.2.1. Wildlife and Wildlife Habitat

Potential Effects

Potential effects on wildlife from the operational phase of the HPAR are quite different from those during the construction phase. When the road is in operation, there will be little to no further direct loss of wildlife habitat, and areas that were disturbed during construction and then revegetated, will be regaining their value to wildlife. The potential for indirect losses of habitat through sensory disturbance, such as from increased noise and dust, will, however, increase, as will the risk of mortality from collisions with trucks, and the potential for restrictions on wildlife movement across the road. Truck traffic at night will increase during the operations phase. Travel during the night may result in greater wildlife mortality due to collisions and greater disturbance from traffic noise than during daylight hours.

Indirect effects to wildlife and local populations may result from loss or changes in habitat quality or function if the impacts are of sufficient magnitude to affect off-site breeding, feeding, shelter quality, and/or movement opportunities for sensitive species. Changes to wildlife health resulting from changes to vegetation and other habitat components, introduction of toxins or heavy metals to soils and vegetation, and reduction in available habitat (through avoidance of the corridor) are also possible over the long term.

The impact on wildlife of persistent noise is of increasing interest in wildlife research and management, although studies are still limited, and conclusions about the nature and extent of effects on wildlife are variable. In general, there is little information on the response of many wildlife groups to noise. It is, however, anticipated that some species will habituate to trucking activities along the HPAR, while others may avoid the road corridor.

Even though there is a tradition of subsistence hunting in the NWT, as new roads are being built and accessed, wildlife populations are now facing pressures from increased access where many areas were previously inaccessible. Access management in relation to hunting pressure was raised as a concern during community meetings. Although the HPAR is not a new road into a previously undeveloped area, the road upgrade may make its use more attractive to some people, thereby facilitating access and increasing use of the area by hunters or others.

The effects of road operations on the Nahanni caribou herd are considered to be the most potentially significant impacts. The herd is of special importance to the Naha Dehé Dene Band of Nahanni Butte. Most of the caribou winter in the central corridor of the South Nahanni River and are traditionally harvested by hunters from that community. Caribou from the Nahanni herd are in the general region of the HPAR corridor from calving season until fall. They are vulnerable to the range of potential effects discussed above, especially during spring and fall.

Mitigation

Mitigation measures to reduce the potential for collisions between traffic on the HPAR and wildlife are addressed in the draft Wildlife Mitigation and Monitoring Plan (Appendix VI). The plan deals with vehicle operation, procedures to be followed when wildlife are in the vicinity of or on the HPAR, speed limits, prevention of use of firearms except by designated personal in certain circumstances, establishment of openings in snow berms along the road to reduce the potential for the road to function as a barrier to wildlife movement, and recording of wildlife observations. Wildlife-related mitigation measures will be included in the Road Operations Plan, which will be developed through consultation, and which will include protocols on traffic flow, road safety and communications along the HPAR.

Containment of ore concentrates in bags and/or closed containers, and clean load-out facilities for haul trucks will serve to reduce the risk of metals being introduced to the road corridor and affecting wildlife. Ongoing truck and equipment maintenance, road maintenance and dust suppression will serve to minimize disturbance to wildlife and changes in habitat.

An Access Management Plan will be developed in consultation with Parks Canada to address issues related to public and worker safety. This plan will also contain provisions to minimize adverse effects on wildlife.

The magnitude and extent of disturbance to wildlife due to increased traffic along the upgraded HPAR will form part of a future wildlife effects monitoring programs, as this information is needed both to evaluate the effectiveness of mitigation measures and for use for adaptive management purposes.

Measures have been developed specifically to address potential effects on the Nahanni caribou herd. Many of these measures, which will be further developed through the Wildlife Mitigation and Monitoring Plan, will also mitigate impacts on other wildlife in the HPAR corridor and vicinity.

1) Operate a staffed gate at or near the start of the HPAR to monitor haul trucks and traffic. This checkpoint would be staffed on a 24-hour basis, all year round. Options for operation of this checkpoint to enhance public safety and Park visitor experience, and for monitoring harvest, will be explored in consultation with Parks Canada, GNWT and First Nations. This measure in part responds to community concerns about documenting the type of non-mine-related traffic on the road, in relation to the potential for increased harvest pressure on caribou.
2) Optimize ore concentrate hauling with the aim of having as few truck trips as possible. This is part of ongoing mine planning, and includes consideration of increasing haul truck capacity and decreasing volume of concentrate hauled through increasing its purity.
3) Reduce truck speeds to 50 km/hour maximum during times of limited visibility.
4) Use two-truck convoys during critical periods of the year (caribou calving/post calving in spring and early summer, and post-rut in the fall) to increase the time intervals between traffic.
5) Operate a GPS-based monitoring system in trucks that includes a "geo-fencing" feature that allows drivers to report caribou (and other wildlife) sightings by pressing a button. Through an automated system, temporary speed control zones are then set and other trucks are immediately informed of these reduced-speed zones. This feature will also provide comprehensive monitoring of presence of caribou along the road and a record of interactions with traffic.
6) Conduct ongoing herd monitoring, as well as monitoring of impacts from the Selwyn mine and the HPAR on caribou, and adapt mitigation measures based on the results.
7) Participate in regional studies on caribou in order to monitor and mitigate potential cumulative effects.

6.2.2.2. Migratory Birds and Bird Habitat

Potential Effects

The potential effects of the HPAR on birds and their habitat include the following: effects on species at risk and game species; changes in bird populations or species diversity; breeding disturbance; population reduction; bird health or behavioural changes; impacts of toxins; and, changes in forest cover or other habitat. Since the HPAR lies within a previously disturbed corridor, some of the potential effects attributable to changes in forest cover or other habitat would have happened when the initial access road was constructed. However, disturbance of birds by traffic on the HPAR will increase over existing conditions.

Mitigation

Adherence to speed limits may serve to minimize bird strikes and disturbance due to truck traffic along the HPAR. Measures taken to reduce disturbance to caribou from traffic may also reduce this effect on birds.

6.2.2.3. Fish and Fish Habitat

Potential Effects

Potential deleterious, localized effects on fish habitat could result from excessive dust emissions. In addition, sedimentation from unchecked road runoff could be a significant source of stream sedimentation. The greatest potential for adverse effects, however, is for an accidental spill of deleterious substances into fish bearing waters.

Mitigation

During road operations, potential effects will be mitigated by appropriate dust control, maintenance of culverts, ditches and other road-related infrastructure. No maintenance will take place in or around water from mid-May to early June for the protection of spawning fish (arctic grayling). Other mitigation measures, such as those that reduce the risk of erosion, sediment and degradation of water quality are relevant to the mitigation of effects on fish and fish habitat.

The potential for unexpected impacts to fisheries and aquatic resources will be reduced through implementation of the operations Spill Contingency Plan that will be an update of the construction stage Spill Contingency Plan (Appendix III).

6.2.3. Social and Economic Components

6.2.3.1. Local Economy and Communities

Potential Effects

The operation of the HPAR has the potential to affect the local economy through the provision of direct and indirect employment opportunities and increased business activity due to project spending on services. The greatest potential for NWT community benefits relate to business opportunities (i.e., road construction and maintenance contracts) and labour (e.g., truck drivers).

Trucking activities in the section of the HPAR that runs through Nahanni and Nááts'ihch'oh National Park Reserves may disturb the use and enjoyment of those portions of the Park by park visitors due to regular truck traffic noise, dust and increased human activity.

Mitigation

SCML plans to source services and supplies locally (and across the north) provided these services are competitive. As part of the mine operations, SCML plans to provide education and training for local residents so that when the project is complete these individuals will have enhanced skills to take back to their communities. Equipment operators and truck drivers are valued and skilled workers.

SCML will implement a broad policy on Social Responsibility (see Section 3.4) with monitoring and reporting mechanisms for local socio-economic impacts and benefits, as well as a continual improvement philosophy on local socio-economic performance.

As noted previously, SCML has negotiated Co-operation Agreements with potentially affected communities. These agreements include sections on consultation, cooperation, employment, training, and business opportunities. SCML has also entered into an Interim Measures Agreement with Kaska communities in the Yukon and BC and is working with them to establish a formal Socio-Economic Participation Agreement.

SCML will work with Parks Canada on access management to facilitate the harmonious use of the park along the HPAR corridor by visitors, Parks staff and mine employees and contractors, while maintaining the priority of worker and public safety. SCML will conduct its operations in a manner so as to reduce effects on visitor experience to the extent that safe and efficient operation of the HPAR permits.

6.2.4. Cultural and Heritage Components

Potential Effects

Operation of the HPAR has the potential to disturb cultural practices, such as traditional hunting and trapping in the region. Areas near the corridor may be less attractive to some individuals for undertaking traditional activities and some may experience less hunting success. However, based on interviews with at least some of the Aboriginal groups who have used the region in the past for these purposes, currently there is very little use of the HPAR corridor for traditional activities (see Section 4.3.4). In addition, no conflicts or linkages with First Nations land use have been identified over the course of the 10-year period of field operations and community consultations.

Any potential disturbance to heritage resources in the corridor will have been managed during the construction phase.

Mitigation

SCML will work cooperatively with affected communities to manage the effects of its operations on traditional activities in the vicinity of the mine and within the HPAR corridor.

6.2.5. Overview of Potential Effects and Mitigation Measures

Many of the environmental effects resulting from the operation of the HPAR can be readily mitigated using best management practices and procedures. The magnitude of other potential effects is more difficult to predict. Increased traffic noise, for example, is largely unavoidable and its effects are not well understood. The approach taken for mitigation in such cases, in particular for potential impacts on caribou, is to develop and implement mitigation measures with input from specialists, including from the communities, to monitor the effectiveness of the measures, and to adapt the mitigation if adverse effects are detected.

Socio-economic effects are expected to be positive, given the availability of potential employment and contracting opportunities. Table 6.2-1 below summarizes the environmental effects and mitigations described above.

Table 6.2-1: Environmental and Resource Effects and Mitigation Measures – Operations Phase

Environmental Component	Potential Effect	Mitigation
Physical Components		
Air Quality and Emissions	• Fugitive dust	• Implement dust suppression measures
	• Greenhouse gas emissions • Emissions such as sulphur and nitrogen compounds, and contaminants of concern	• Implement Air Quality Management Plan • Follow idle time restrictions • Use low-sulphur fuels • Follow regular truck and equipment maintenance schedule
Noise	• Noise from trucks will potentially affect wildlife, park visitors, hunters and trappers	• Follow Standard Operating Procedures • Fit equipment with standard muffling equipment
Surface Hydrology	• Changes to water flow or level	• Culvert, ditch and bridge monitoring and maintenance
Water and Sediment Quality	• Water quality changes due to deposition of deleterious substances from erosion and sedimentation • Road dust from vehicle traffic may affect water quality • Water quality changes due to hydrocarbon or other contaminant spills or leaks	• Follow DFO's "Measures to Avoid Causing Harm to Fish and Fish Habitat" • Follow erosion and sedimentation prevention and mitigation measures • Implement Spill Contingency Plan • Remove potential for transfer of contaminants in soil to water • Adhere to SOPs for Fuel Handling and Working in and Around Water
Groundwater	• Contamination of groundwater from leaks and spills	• Follow Spill Contingency Plan • Follow regular truck and equipment maintenance schedule
Land	• Erosion	• Maintain culverts, ditches and other road-related infrastructure • Monitor and report on terrain conditions
Soils	• Soil contamination as a result of spills or leaks	• Ensure haul trucks do not have zinc or lead on body or wheels • Follow Spill Contingency Plan • Adhere to the SOP for Fuel Handling
Non-renewable natural resource depletion	• Granular material removal for ongoing road maintenance	• Limit use of granular resources to only what is needed
Ecological Components		
Vegetation and Plant Communities	• Secondary effects from spills and leaks, damage from maintenance activities, changes to exposure and increase dust deposition	• Revegetate with native plants • Implement erosion control measures • Implement dust control measures • Ensure haul trucks do not have zinc or lead on body or wheels

Environmental Component	Potential Effect	Mitigation
Wildlife and Wildlife Habitat	• Direct mortality from collision and hunting (legal and illegal) • Restrictions of wildlife movement across the road • Potential changes to wildlife as a result of changes to habitat quality and quantity • Changes to wildlife activity as a result of noise of traffic and dust	• Implement Wildlife Mitigation and Monitoring Plan to avoid or limit impacts to wildlife (including Species at Risk) • Implement traffic control measures of the Road Operations Plan to prevent collisions with wildlife and minimize noise and dust disturbance from vehicle traffic • Follow ongoing truck and road maintenance schedule • Implement Access Management Plan
Birds and Bird Habitat	• Potential effects include changes to bird populations and diversity, breeding, health and behaviour as a result of habitat changes and traffic	• Implement Spill Contingency Plan • Implement Wildlife Mitigation and Monitoring Plan
Fish and Fish Habitat	• Accident spill of deleterious substances into fish bearing waters	• Do not carry out maintenance work around creeks during spawning season • Control erosion and sedimentation • Implement Spill Contingency Plan • Maintain road-related infrastructure
Social and Economic Components		
Local Economy and Communities	• Direct and indirect employment opportunities • Increased business activity • Changes in the population and demographics of local communities • Traffic through National Park may disturb use and enjoyment of Park visitors	• Source services and supplies locally (and across the north), provided these are competitive • As part of the mine operations, provide training/education to local residents so when the project is complete, there are a skilled workers in the community • Implement Social Responsibility Policy • Follow Co-operation Agreements and Interim Measures Agreements with both affected NWT and YT First Nations • Work with Parks Canada on access management planning
Cultural and Heritage Components		
Land Use	• Potential effects on cultural practices such as traditional hunting and trapping	• Work with affected communities to manage the effects of operations on traditional activities

7. POTENTIAL FOR CUMULATIVE EFFECTS

Cumulative effects are those changes to environmental components that are caused by or result from an action or a project in combination with other past, present and foreseeable future actions or projects (MVEIRB, 2004). There exists the potential for HPAR activities to interact with, or combine with, other activities in the region to increase the magnitude or change the nature of the effects of the HPAR project beyond what they might be if the potential effects of the HPAR were considered solely on their own. For the purposes of this PDR, the following discussion considers the potential for cumulative effects of the HPAR’s construction and operations phases together.

The HPAR is the means of access to SCML’s proposed mine, the Selwyn mine, at Howard’s Pass. The Selwyn mine is the most substantial other foreseeable project in the region, although it is located in the Yukon Territory. The footprint of the Selwyn mine project will have an effect on wildlife and wildlife habitat, in particular for the Nahanni caribou herd. The Selwyn mine will also affect air quality and noise levels near the terminus of the HPAR. Thus the potential effects of the HPAR may act cumulatively with those of the mine project.

While the HPAR may have some effect on local surface hydrology, water quality and sediment quality, groundwater, land and soils, fish and fish habitat along the road, these environmental components are located in an entirely different watershed separate from the mine project. The former lies in the Nahanni River watershed, flowing to the Arctic Ocean while, the environmental components potentially affected by the mine are in the Pelly River watershed, flowing to the Pacific Ocean. Thus, these effects are entirely separated, and there is no potential for a cumulative effect on these resources.

It is known that other companies hold mining claims adjacent to the HPAR (Section 4.3.2.7) and some will commence or continue with exploration activities. Based on data from the NWT Mining Recorder’s office, there are a number of companies and individuals holding mineral claims or leases from the south end of the HPAR to its terminus at Howard’s Pass. Given the presence of the HPAR, there may be increased incentive for these companies to explore and develop their properties. Should exploration or development activities proceed on these properties, additional effects on the physical, ecological, social and economic components of the environment in the region may reasonably be expected.

The Nahanni caribou herd (NCH) will likely experience effects from a number of sources, including the future Selwyn Project mine and the HPAR. While SCML is committed, through measures outlined in this report and to be developed in more detail through the Wildlife Mitigation and Monitoring Plan, to limiting effects on the NCH to the extent that it has control, this herd’s range extends into the Yukon and across the Nahanni Range Road. The herd is subject to hunting pressure, environmental disruption and vehicle collision mortality across their home range. The herd is also hunted by clients of Ram Head Outfitters. It is understood that, as a result of the creation of Nááts’ihch’oh National Park Reserve, Ram Head Outfitters have been granted the right to continue operating their business within the new Reserve until 2019, at the end of which their outfitting licence will end. Thus, hunting pressure from guided non-resident hunters will cease at that time. Depending on road management arrangements, other hunters may gain access to the herd in the NWT (outside of the Park Reserves, and where hunting by resident hunters with permits is allowed). In light of this potential cumulative effect, SCML is prepared to coordinate its efforts with those of the NCH managers in the NWT and Yukon to collectively limit impacts on the herd.

Grizzly bears are in the area and, while these bears tend to avoid road corridors, there is the potential for direct mortality from collisions with vehicles on the HPAR. Grizzly bears, whose home ranges may include both the HPAR corridor and the Ram’s Head Outfitter Management Area, may also be subject to hunting pressure from this outfitter's clients. Again, SCML is prepared to coordinate its efforts with others in the NWT and Yukon to collectively limit impacts on the species.

Hunting of other wildlife species, such as upland game birds and waterfowl, along the HPAR corridor outside of Nahanni National Park Reserve, may occur if the road is opened to non-SCML traffic. Trapping may also increase for the same reason. Other users of the HPAR corridor may also fish in waters within or accessible from the HPAR corridor. Such activities could compound whatever effects the road and its mine-related traffic may have.

Depending on road management arrangements that have yet to be worked out, the HPAR may contribute to easier access to the portions of Nahanni and Nááts'ihch'oh National Park Reserves. SCML will work with Parks Canada on an access management plan. Increased visitation could result in direct mortality of wildlife from collisions with visitors' vehicles, wildlife encounters that could result in destruction of the wildlife, and general disturbance of wildlife. It is anticipated that sport fishing would be permitted in the park reserves.

The best approach to the management of cumulative effects is through limiting the direct and indirect effects of the mine and the HPAR. SCML is committed to this objective throughout all phases of development by developing and implementing comprehensive management plans for all its activities. In addition, SCML will coordinate its efforts, share relevant information and knowledge with others in the NWT and Yukon to collectively limit cumulative effects.

8. COMMUNITY ENGAGEMENT

8.1. Selwyn Chihong's Commitment to Engagement

Selwyn Chihong is committed to engaging local communities on all aspects of the Selwyn Project and is committed to building strong relationships with communities through open communication. Selwyn Chihong has signed agreements with communities that outline its commitments to:

- Consultation on permit applications
- Training and employment
- Scholarships, education, and youth engagement
- Business opportunities and contracting
- Environmental management and monitoring
- Culture and traditional knowledge

8.2. Consultation and Engagement, 2006 to 2015

Local communities have been involved throughout the HPAR redevelopment work. Events that have taken place included public hearings for permits, negotiation and signing of Cooperation Agreements, and tours of the site. A timeline of community engagement is presented in Table 8.2-1.

Table 8.2-1: Timeline of Community Engagement, 2006-2015

2006 – 2007	Open houses and public hearings on HPAR permits
2007-2010:	Negotiation and signing of Cooperation Agreement with Tulita District Land Corporation
2010-2011	Site tours for community members Road used as winter access to mobilize heavy equipment. Local contractor used for mobilization. Community wildlife monitors on site throughout. Winter road established on HPAR alignment to haul supplies to Howard's Pass. Local contractor built and maintained the winter road.
2013	Naha Dehé Dene Band and SCML enter into a formal Cooperation Agreement.
2014	Road reopened for all-season use. Communities joint-ventured with contracting companies to do the work. Community wildlife monitors on site throughout.
2015	Community meetings regarding the HPAR upgrade application

SCML has also entered into an Interim Measures Agreement (July, 2012) covering exploration and pre-development activities with all Kaska communities, and is working with the Kaska to establish a formal Socio-Economic Participation Agreement.

SCML also held meetings with community groups leading up to and during the community engagement work on the Land Use Permit Application. These meetings did not specifically address the planned Land Use Permit Application for road widening, but focused generally on updates about the project, reviews of Cooperation Agreement requirements, and discussion of upcoming business opportunities. The meetings did, however, provide opportunity for community members and leaders to gain an understanding of the need for a widened access road in the context of the overall project. Table 8.2-2 provides a summary of these meetings.

Table 8.2-2: Project Update Meetings, 2014 and 2015

Date	Group	Location
July 17, 2014	Sahtu Secretariat Inc.	Vancouver
Oct. 6, 2014	Tulita Land Corporation	Tulita
Oct. 7, 2014	Fort Norman Metis Land Corporation	Tulita
Oct. 7, 2014	Tulita Renewable Resources Council	Tulita
Oct. 14, 2014	Sahtu Secretariat Inc.	Deline
Nov. 13, 2014	Norman Wells Land Corporation	Norman Wells
Nov. 14, 2014	Cooperation Agreement Project Committee	Norman Wells
Nov, 26, 2014	Naha Dehé Dene Band Chief and Council	Vancouver
Jan. 27, 2015	Tulita Land Corporation	Vancouver
Jan. 29, 2015	Tulita District Land Corporation	Vancouver
Feb. 05, 2015	Cooperation Agreement Project Committee	Norman Wells
Feb.17, 2015	Cooperation Agreement Project Committee	Tulita
Apr. 22, 2015	Cooperation Agreement Project Committee	Edmonton

8.2.1. Employment and Business Opportunities

During 2014 alone, over 800 person days of employment were created for Naha Dehé and Tulita District community members on the HPAR. Between 2010 and 2014, local contractors and joint venture companies have been awarded more than $12 million in contracts for work on the road. Employment opportunities included mobilization of heavy equipment, as well as community wildlife monitors on site throughout.

8.3. Report on Community Engagement for the HPAR Upgrade Project Land Use Application

8.3.1. Introduction

As a precursor to permit application submissions, SCML carried out engagement with potentially affected communities. This work was done in accordance with guidelines established by the Mackenzie Valley Land and Water Board (MVLWB, 2014) and following the requirements established in the Cooperation Agreements between SCML and potentially affected communities in the Northwest Territories and the Yukon. This section, supplemented with engagement records in Appendix X, provides the results of this engagement work.

8.3.2. Potentially Affected Communities

The Selwyn Project and its related infrastructure (the HPAR) are located within the boundaries of three First Nation Territories; the Kaska Nations, the Dehcho First Nation, and the Sahtu Dene and Metis (see Figure 2.5-1).

SCML and its predecessors have been active in the area since 2005 (see Section 8.2). Through the history of community engagement on the various licence applications and negotiation of community agreements, each First Nation has identified communities within its Nation to lead consultation and engagement with the company based on the communities that would be most affected by the project development. The Sahtu Dene and Metis identified the communities of Tulita and Norman Wells. The Dehcho identified Nahanni Butte as the lead community. The Kaska identified the communities of Ross River and Liard First Nation. SCML has negotiated agreements with each of these communities and continues to engage on a regular basis regarding project plans and operations.

8.3.3. Community Engagement

8.3.3.1. Northwest Territories

Based on history and experience, community engagement for the HPAR Upgrade Project focused on engagement specifically with NWT communities (Tulita, Norman Wells and Nahanni Butte). Initially the company approached community organizations and representatives for guidance on the engagement approach; appropriate points of contact, timing for meetings, and logistics for open house events in the community (venue, advertising, catering, translator services, etc.). Based on this input, the company developed a Community Engagement Plan (Appendix IX). The plan was circulated or discussed with community representatives for further input and then SCML proceeded with the community engagement events.

Following the guidance received from the communities, SCML carried out in-depth engagement of the NWT communities through meetings with key community leadership organizations and public open houses. Open houses were held at public venues and advertised in each community according to the input from community members. Each open house was held in off-business hours to allow community members to attend without interruption to school or work. Where suggested, translator services were provided by the company. Door prizes (a chainsaw and an iPad) were offered to capture the interest of a cross section of the community. A meal was provided by a local caterer at each event. At each open house, information posters were displayed and a company representative provided an outline of the proposed project using the posters and/or PowerPoint presentations. Time was provided during and after the presentation to answer questions in an open format or one-on-one with company representatives. All attendees received a comment card and were invited to write down comments or questions and hand them in to the Company representatives.

Nation-level organizations (Sahtu Secretariat and Dehcho First Nation) were provided with notice of the company's intentions. Letters were sent to each of these organizations outlining the SCML's plans to file Land Use Permit applications with the MVLWB and Parks Canada.

8.3.3.2. Yukon

The HPAR lies within the asserted traditional territory of the Kaska Nation (Figure 2.5-1). The proposed Selwyn Project mine is also located within their territory. The company and its predecessors have been engaging with the Kaska since 2005, so there is extensive history of Kaska involvement in the project. Through this process, the Kaska have identified Ross River and Liard First Nations as the communities that would most likely be impacted by the project. SCML and the Kaska have a signed Interim Measures Agreement and continue to move forward on the negotiations of a comprehensive life-of-mine Socio-economic Participation Agreement.

Engagement with the Kaska has focused primarily on the mine facility in the Yukon with reference to HPAR as required supporting infrastructure. Open houses were held at public venues and advertised in each community according to the input from community members. Each open house was held during off-business hours to allow community members to attend without interruption to school or work. Door prizes (a chainsaw) were offered as an incentive to attend and a meal was provided by a local caterer at each event. At each open house, information posters were displayed and company representatives provided an outline of the proposed project using the posters and PowerPoint presentations. Time was provided during and after the presentation to answer questions in an open format or one-on-one with company representatives. All attendees received a comment card and were invited to write down and-any comments or questions and hand them in to the company representatives they had with regards to the Project. SCML committed to follow up with the community members that requested follow-up.

The Ross River Dena Council and Liard First Nation governments were provided with notice of the company's intentions. Letters were sent to each of these organizations outlining the company's plans to file Land Use Permit applications with the MVLWB and Parks Canada.

Much of the commentary and questions regarding the project focused on the proposed mine development, since as this activity would take place within the Kaska Territory. Water, wildlife, health and safety, and socio-economic impacts related to the proposed mine project were the key themes identified during the in engagement with the Kaska. Although no concerns were raised that were specific to the HPAR, a number of issues were raised relating to the general aspects of traffic and use of public roads by mine traffic, and effects from increased hunting pressure on wildlife from improved access. For the purposes of this report, the issues noted herein are those related to road use.

8.3.3.3. Engagement Records

Appendix X presents records that summarize the community engagement work completed with each of the potentially affected communities.

Where possible, appropriate community representatives have provided signatures confirming the accuracy of the engagement record. MVLWB guidelines on community engagement suggest that signatures from appropriate community representatives and company officials be included in the Engagement Report for the purposes of confirming the accuracy of the engagement record. Appropriate signatures were requested from each of the community organizations that were approached during this engagement process for their specific engagement record. Signatures from community leaders were not requested for open house engagement records, since community leaders would not be able to confirm all of the comments received during the meeting. Many comments were provided to SCML via comment sheets and were not necessarily raised during public discussion. SCML has provided signatures of company officials on community open house engagement records as confirmation of the accuracy of those records.

9. REGULATORY APPROVAL PROCESS

9.1. Status

The HPAR predates the *Mackenzie Valley Resource Management Act* (MVRMA) of 1984, and thus is subject to its grandfathering provision. The road was authorized for use as an access road to the mineral deposit at Howard's Pass, through Water Licenses and Land Use Permits issued starting in 1977. Section 157.1 of the MVRMA exempts an authorization for an undertaking that was previously authorized (prior to June 22, 1984) from Part 5 of the Act, unless the authorization applied for relates to abandonment, decommissioning, or other significant alteration of the project. Therefore, some activities related to the HPAR Upgrade Project could potentially be exempted from Part 5, which covers matters pertaining to the Mackenzie Valley Environmental Impact Review Board.

Amendments to the *Canada National Parks Act* that came into force with the expansion of Nahanni National Park Reserve and the creation of Nááts'ihch'oh National Park Reserve include clauses (Sections 41.1 and 41.4) that allows the federal Minister responsible for the Parks Canada Agency to enter into leases, licences of occupation of, and easements over, lands for the purpose of a mining access road from Tungsten to Howard's Pass (the HPAR), including facilities connected with the road (Government of Canada, 2009 and 2014).

SCML held authorizations from the MVLWB (Land Use Permit MV2005F0028 and Water Licence MV2006L8-0001) and Parks Canada (Land Use Permit 2009-L01 and Water Licence 2009-W01) that allowed for the reconstruction of the HPAR for its original purpose, as well as for the operation and maintenance of the road. Reconstruction of the HPAR was completed under those authorizations in 2014. All four of those permits/licences expired in June of 2015.

SCML holds an authorization (S07C-003) for exploration drilling on mineral claims and leases held in the NWT. No bonds were required for this NWT exploration licence.

SCML also currently holds a Licence of Occupation #1051-14-2 for the HPAR, a land tenure instrument that secures the company's access rights for a period of 30 years on those portions of the road outside the two National Park Reserves. This Licence of Occupation is valid until December 2041 and allows for construction, operation, maintenance, inspection, replacement, alteration, and repair works to be completed on the road.

HPAR km 36 to about km 60 is now (as of December 16, 2014) part of Nááts'ihch'oh National Park Reserve, and is administered by Parks Canada. Prior to December 16th, it was administered by AANDC. SCML holds LOC # 105I/2-5-2 for this HPAR section from AANDC. This licence will soon be transferred to Parks Canada for administration. The company is currently seeking a similar tenure instrument from Parks Canada to cover those portions of the road currently within Nahanni National Park Reserve boundaries.

9.2. Applications for the HPAR Upgrade Project

This Project Description Report has been prepared to support applications for Land Use Permits and Water Licences for upgrading the current road. As described in Section 8, a community engagement program to support this application has been implemented. An overview of the required authorizations and regulatory approvals for upgrading the access road are outlined in Table 9.2-1.

Two sets of applications are required for the upgrade project; one set for areas in Sahtu/Dehcho and another for areas in the Nahanni and Nááts'ihch'oh National Park Reserves. For the Sahtu/Dehcho areas, the MVRMA applies. Pursuant to s 103(1) of the MVRMA, the HPAR Upgrade Project is considered transboundary and as such applications will be made to the MVLWB. For the Nahanni and Nááts'ihch'oh National Park Reserves, the *Canada National Parks Act* applies. These land categories are shown on Figure 2.5-2.

Accordingly, SCML is submitting Land Use Permit and Water Licence applications:

1) to the MVLWB: for upgrading the HPAR along two sections, approximately from km 0 to km 14 and from km 60 to km 79, and in relation to temporary construction camps to be located near km 3 and near km 63.5 of the HPAR; and
2) to Parks Canada: for upgrading the HPAR approximately from km 14 to km 60, and in relation to two temporary construction camps to be located near km 37.

The applications for Land Use Permits and Water Licences are needed to allow upgrading of the HPAR to a two-lane, 8.5 m wide, year-round mine haul road from km 0 to km 79 at Howard's Pass. The upgrading operation will be supplemental to allowable road use under grandfathering provisions of the MVRMA (see the Section 9.1), and Licences of Occupation. The applications are also for the use of the access road to support mine operations, including bulk haul of mine concentrates.

Work to upgrade the current access road so it is suitable for commercial use will include:

1) clearing of vegetation within the road right-of-way to an average width of 25 m to accommodate the upgraded road;
2) grubbing adjacent to the roadway to accommodate road widening;
3) widening of the road surface to 8.5 m, plus widening at curves, pullouts and bridge approaches where required;
4) road subgrade improvements in localized soft areas, including placement of geogrid, geotextile and granular fill;
5) upgrading of drainage systems, including widening of existing ditches and extension of culverts, as well as relocation of some culverts;
6) localized changes to the road alignment and profile for road safety, i.e., to improve driver sight lines and reduce steep grades, and to allow for improved travel speeds, including a potential bypass at the south end of the road;
7) application of gravel surfacing to the road as required; and
8) development and use of roadside borrow areas.

For the purposes of road upgrade work, three temporary trailer camps will be established in the NWT, each having capacity for approximately 60 people. One existing camp at SCML's operation in the Yukon will also be used to support the upgrade work. It is anticipated that the proposed upgrading will take one pre-construction season (2016) and two construction seasons (2017 and 2018). The camps will initially be set up near road km 3 and near km 63.5 at Steel Creek. As the road upgrade work advances, the Steel Creek camp will be moved so it remains a reasonable travel distance from active work sites. It is expected that the camp, along with a second camp (SCML's XY Camp) would be moved to approximately km 37, just north of the Guthrie Creek bridge site, for the second construction season. Once road upgrades are complete, the trailer camps will be removed. Type B Water Licences are required to facilitate grey water disposal indirectly to surface water by means of an absorption pit in the temporary construction camps. Provisions in the water licence for water withdrawal are not required for the MVLWB licence, as water use is below the threshold that triggers a requirement for a water licence for water withdrawal. For Parks Canada, the water licence is also required for disposal of grey water and water withdrawal for camp use.

Within 42 days of receiving a complete application for a type A Land Use Permit, the MVLWB will either:

- issue a Land Use Permit with conditions;
- conduct a hearing under Section 24 of the MVRMA, or require that further studies or investigation be made; or
- refuse to issue the Land Use Permit if a requirement set out in Section 61 or 61.1 of the MVRMA has not been met, or for any other reason as provided for in legislation.

If the project is of public concern or if the screening process determines the project might cause significant adverse effects on the environment, the application is then referred to the Mackenzie Valley Environmental Impact Review Board (MVEIRB) for an environmental assessment (EA). If the project is not of environmental or public concern then the application proceeds to the regulatory phase.

An application may go directly from the MVLWB application process to the MVEIRB EA process, skipping the screening, if the project is referred directly to the EA process by a government office, an affected community, or if MVLWB determines an EA is required during the application phase.

SCML understands that the HPAR upgrade project will be subject to screening by the MVLWB and Parks Canada, and may be referred to the MVEIRB for further assessment. Regardless of the level of assessment, SCML is committed to working with regulatory agencies to develop terms and conditions of any authorizations required that will minimize the effects on the natural environment from the upgrade and operation of the HPAR.

An approved Land Use Permit has a term of up to five years, with permit holders allowed to apply for a permit extension of up to two years.

In order to begin road upgrading works in early 2017, SCML is presently initiating permit approval procedures to remain within regulatory assessment and procedural timelines.

Table 9.2-1: Required Authorizations/Regulatory Approvals for the Construction and Operations Phases of the Howard's Pass Access Road

Licence/Authorization/Permit	Applicable Regulation/ Legislation	Responsible Agency
Major Licences		
Type A Land Use Permit	Mackenzie Valley Land Use Regulations	Mackenzie Valley Land and Water Board
Land Use Permit	Mackenzie Valley Land Use Regulations, National Parks Act	Parks Canada
Licence of Occupation (Nahanni National Park Reserve)	National Parks Act	Parks Canada
Construction Phase: Permits, Approvals, and Authorizations		
TDG permits for transport of listed substances	Transportation of Dangerous Goods Act	Transport Canada
Quarry Permits		Parks Canada, GNWT Lands
Water Licences	Waters Act	Mackenzie Valley Land and Water Board and Parks Canada
Restricted Activity Permits	Varies by activity	Parks Canada
Operations Phase: Permits, Approvals, and Authorizations		
TDG permits for transport of listed substances	Transportation of Dangerous Goods Act	Transport Canada
Restricted Activity/Resource Use Permit	National Parks Act	Parks Canada

10. CONCLUSIONS

- The HPAR project will have a positive long term socio-economic effect in NWT through the establishment of a long-term all weather road that will be designed and managed as a multi-use facility to support both the Selwyn Project and the Nahanni and Nááts’ihch’oh National Park Reserves.
- The HPAR, as an upgraded year-round and all-weather road corridor, will provide much improved and safer access to traditional territory by First Nations.
- The predicted environmental effects are manageable, as the proposed road improvements are incremental changes to the existing road corridor. Selwyn Chihong will be using best practices throughout the project, included in management plans, adaptive management techniques, monitoring, reporting and consulting at all phases of the proposed development.
- Selwyn Chihong has been consulting with affected communities since 2005 to ensure there is a clear understanding of the road improvement project and that local benefits, issues and concerns are included in the detailed planning.

11. SUMMARY OF PLANS

The list of plans presented below (Table 11.1) provides references to the sections in which they are discussed, and provides a summary of their relationship to the two phases of the HPAR Upgrade Project and the context and status of development of each plan. Triggers for plan release are also added where applicable.

Some plans are preliminary or are not yet developed because they require further input. In most cases, both technical input related to more advanced project planning and engineering design, and input through further consultation, is required.

Table 11.1: Summary of Plans Referred to in this Report

Plan name or description	Section(s)	Phase	Status
Community Engagement Plan	8.3.3	Pre-Construction	Appendix IX (Final) Engagement on the HPAR Upgrade Project outlined in this plan has been completed.
Erosion and Sediment Control Plan	5.1.3, 5.1.4, 5.2.1, 5.2.2, 5.2.5	Construction	Appendix IV (Draft) The main issues around erosion control are for the construction phase, and this plan is specific to construction. For operations, erosion and sediment control planning will be included in the Road Operations Plan.
Quarry Operations Plan	5.1.5	Construction	This plan will be required as part of permitting. An example from 2014 is provided (Appendix VII). It will include site-specific revegetation plans for the borrow pits to be developed in consultation with Parks Canada.
Waste Management Plan for the Howard's Pass Access Road	5.1.6, 5.1.8	Construction	Appendix II (Draft) During the operational phase wastes will not be generated or stored along the HPAR. For minor exceptions to this, e.g. waste disposal associated with the manned check point at the start of the road, procedures will be included in the Road Operations Plan.
Spill Contingency Plan for the Northwest Territories	5.2.1, 5.2.2, 6.2.1, 6.2.2, 6.2.5	Construction (current plan) Operational (to be developed)	Appendix III (Final) The plan will be revised to include contingency planning related to operations, including for potential concentrate spills, fuel spills, and spills of reagents being transported to the mine site. Trigger for plan completion is prior to use of the haul road to supply mine-site construction, and a further revision will be required prior to mine operations. The operational phase plan will be preceded by and build on a spill risk analysis.
Camp first aid and emergency response plan	5.1.8	Construction	Provided by the road construction contractor. Plan to be in place prior to camp set-up.
Construction camp site re-vegetation plans	5.1.8, 5.2.2, 5.2.5	Construction	Site-specific plans developed in consultation with Parks Canada during the pre-construction and construction period. Trigger for plan completion: early in the construction period, so that progressive reclamation can be accomplished.
Wildlife Mitigation and Monitoring Plan	4.3.2, 5.1.6, 5.2.2, 5.2.5, 6.2.2, 6.2.5, 7	Construction and Operational	Appendix VIII (Draft) This plan will continue to be developed in more detail and to evolve through consultation and in accordance with adaptive management practices.

Plan name or description	Section(s)	Phase	Status
Road Operations Plan	6.1.3, 6.1.7	Operational	This integrated plan will be developed so that it can come into effect following the construction period and will be updated prior to use of the road for hauling concentrates. The plan will bring together the plans and procedures needed for road operations during mine operation, including wildlife mitigation measures related to road operations. It will also capture management practices and procedures not covered elsewhere, such as waste management, and revegetation of any areas that might be cleared during operations. The purpose is to have all the essential procedures, guidance and information in one place for reference by staff and contractors. The plan will be reviewed annually and revised as needed.
Access Management Plan	6.1.2, 6.2.2, 6.2.5, 6.2.5, 7	Operational (Measures in place for Construction phase)	As the HPAR is a public road, access management needs to be developed collaboratively between SCML, regulators and road users. SCML will work closely with Parks in developing the AMP. It is anticipated that the AMP will come into effect prior to the road being put into operations. (Access management during construction will be handled through the checkpoint at Km 3 Camp.)
Avalanche Management Plan	5.2.1, 5.2.5, 5.2.6, 6.2.1	Operational	The Avalanche Mitigation strategy (Appendix V) provides mitigation options and is thus the first step in development of this plan. Trigger for completion: in place the season following the construction period.
Safety and Emergency Response Plan	6.1.4	Operational	Will be developed so that it can come into effect following the construction period.
Air quality management plan for mine and haul road operations	6.2.1, 6.2.5	Operational	Will be developed. Trigger for plan release is prior to the start of mine operations and use of the HPAR as a haul road.
Temporary Closure and Decommissioning Plans	6.1.7	Temporary closures, decommissioning	Plans for temporary closures will be developed early in the operational phase. The plan for final decommissioning will be developed and will be built on the measures outlined in this report, and in consultation with Parks Canada.

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