

PRAIRIE CREEK WINTER ROAD – PHASE 1 CONSTRUCTION

RARE PLANT MANAGEMENT PLAN

DECEMBER 2019



Conformity Table – Permits

MV/PC2014F0013 Land Use Permit Condition 83		Sections of Plan
The Permittee shall comply with the Rare Plant Management Plan , once approved. The Plan shall be in accordance with Report of Environmental Assessment Measure 11-1, Part 2 and 15-1, and shall include, but not be limited to the following information for the activities associated with each phase:		
a)	Mitigation measures to be implemented to minimize significant adverse impacts on rare plants or rare plant assemblages;	6.3
b)	Details on how rare plants will be identified and monitored during Construction and operation activities;	6.4
c)	Details on effects monitoring for any identified rare plants or rare plant assemblages;	6.1, 6.4
d)	Identification of actions that will be taken if rare plants are identified during Construction and operation of the Project; and	6.1, 6.4
e)	A description of an adaptive management framework that satisfies the requirements of Report of Environmental Assessment Appendix B, including but not limited to:	6.1
i.	A decision tree which outlines the path of adaptive management decisions based on results of the monitoring program.	6.1

Conformity Table – Directives

Item	Requirement	Review Comment Reference (May 15, 2019)	Sections of Plan
a.	Update to include the results of the Dene Knowledge Study updated by LKFN and NBDB.	LKFN-8	1.2, 6.1.1
b.	Once the detailed design and refined Project footprint is available, compare to the documented locations of rare plants.	PC-204	6.4.2
c.	Add to Table 2: 1) GNWT Status Rank; 2) location of each occurrence relative to the Project footprint. For occurrences near the footprint, provide the distance in metres to the footprint; and 3) jurisdiction (NNPR, GNWT, IAB).	PC-205	4.2.3
d.	Update to include results of further field investigations to establish rare plant Management Units that are adjacent to the alignment, to be conducted before construction in rare plant occurrence areas. This should include re-visiting the locations assessed in 2009.	PC-206; PC-209; Racher-26	4.2.3
e.	Update to include a general framework that outlines how decisions about selecting mitigation approach for rare plants will be made, following the mitigation hierarchy. Apply the decision framework to all of the rare plant occurrences identified. Whenever a less preferred mitigation is selected (lower in the hierarchy), provide supporting rationale. Include a table identifying the mitigation approach (from the hierarchy) and how it will be implemented (specific mitigations) for each rare plant occurrence.	PC-208	6.1, 6.3

Item	Requirement	Review Comment Reference (May 15, 2019)	Sections of Plan
f.	Please resubmit the RPMP with an executable monitoring plan contained within. Please clarify when management units will be identified and surveyed to facilitate the development of the RPMP. The monitoring program does not seem to consider plants that have been relocated, which is identified as part of the mitigation hierarchy. Please clarify. Please clarify if all rare plant occurrences, or only those adjacent to the footprint, will be clearly marked prior to the start of construction.	PC-209	6.4.2, 6.4.4
g.	Update to address all requirements of Measure 11-2 part 2.	PC-210	6.4.4 (Assumed requirement refers to Measure 11-1, Part 2)
h.	Ensure the reference section is complete.	PC-211	References
i.	Please include edits or clarification for the following comment [<i>Note that the use of straw bales for erosion and sediment control will not be permitted in NNPR</i>].	PC-115	The use of straw bales for erosion and sediment control is no longer being considered (per the Invasive Species Management Plan and Sediment and Erosion Control Plan)

Revision History

Revision	Description	Revised By (Initials)	Revision Date
1	Initial Version by Tetra Tech	Tetra Tech (TP)	2019-07-17
2	Updated version to align with draft LUP conditions	Tetra Tech (TP)	2019-10-22
3	Final Permit Revisions by Tetra Tech	Tetra Tech (TP)	2019-12-03
4	Conformity and Independent Panel revisions	Tetra Tech (AM)	2019-12-17

Review and Approval

The following signatures indicate that the undersigned have read and agreed to the contents of this document, and that they approve and accept its distribution and use.

Description	Authority	Signature	Date
Document Owner	David Harpley VP, Environment and Permitting Affairs		
Reviewed by: Full Name, Job Title			
Approved by: Full Name, Job Title			

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PLAIN LANGUAGE SUMMARY

This Rare Plant Management Plan (RPMP) was prepared for Canadian Zinc Corporation (CZN) by Tetra Tech Canada Inc. (Tetra Tech). The RPMP presents best management practices to be employed during the construction of the Prairie Creek Pioneer Winter Road (PWR) and associated infrastructure. Phase 2 consists of the construction of an All-Season Road (ASR); this plan will be updated prior to Phase 2. Rare plant management will be largely applicable during Phase 2; however, certain actions (e.g., construction monitoring in the vicinity of known rare plant locations) will be implemented as part of Phase 1.

The Project is located in the south-west corner of the Northwest Territories (NT), approximately 500 km southwest of Yellowknife in area of Nahanni National Park Reserve (NNPR). The proposed ASR will span 179.5 km through varying mountainous terrain, with approximately 85 km of the proposed route passes through the NNPR.

The RPMP establishes a framework to integrate the protection and management of rare plants identified in the vicinity of the PWR corridor, Prairie Creek Mine, and associated infrastructure with monitoring to determine their condition over the duration of construction. It also provides for the inclusion and management of subsequent new rare plant or rare plant assemblage observations.

Four rare plant surveys have been completed as part of project baseline studies:

- July 2009 – along the Prairie Creek Mine winter road, proposed waste rock storage facility, camp and surrounding area, and beaver pond located south of the camp.
- August 2010 – along the proposed Polje By-Pass realignment.
- July 2016 – along the proposed ASR, borrow pits, road realignment areas, and areas supporting unusual landscape features within NNPR (from KP 17 to KP 101).
- June 2017 – within a 100 m buffer extending from either side of the proposed ASR centreline within NNPR (from km 17 to km 101).

In addition, an invasive plant species survey was conducted in August 2018 that covered where the access road overlapped with the historic winter road and exploration cutlines, the Nahanni Butte community access road that overlaps with the ASR, areas cleared by the Nahanni Butte community in 2017, some of which cover the proposed ASR alignment, and spot checks of undisturbed areas in the vicinity of the broader invasive plant survey areas. While the survey focused on the identification and establishment of invasive plant species, incidental observations of other plant species, particularly those considered rare, were made as well. No rare plants were identified during the invasive species survey.

During the 2009 rare plant survey, nine rare species were identified: few flower meadow rue (*Thalictrum sparsiflorum*), Hornemann willowherb (*Epilobium hornemannii*), linear-leaved willowherb (*Epilobium leptophyllum*), alpine anemone (*Anemone drummondii*), Northern bog birch (*Betula pumila*), lesser black-scaled sedge (*Carex atrosquama*), one-glume spikerush (*Eleocharis uniglumis*), alpine groundsel (*Packera pauciflora*), and yellow mountain heather (*Phylodoce glanduliflora*). With the exception of one-glume spikerush and alpine groundsel (both still listed as Sensitive), these species have since been delisted.

In 2017, 21 meandering transects were carried out within a 100 m buffer extending from either side of the road centreline. Two rare plant species were identified over multiple locations: spleenwort (*Asplenium trichomanes-ramosum*, formerly *A. viride*) listed as May Be At Risk and small round-leaved bog orchid (*Platanthera orbiculata*) listed as Sensitive.

Additional field surveys were carried out in 2019 and resulted in the establishment of nine Rare Plant Management Units (RPMU) for *P. orbiculata* (5 transplant RPMU comprising a combined total of 30 individuals and 4 undisturbed RPMU comprising a combined total of 18 individuals). Two specimens were also collected from within the ASR footprint and prepared for donation to a local herbarium.

No RPMU were established around *A. trichomanes ramosum* as the individuals could not be relocated in the field. The ASR alignment in this area was refined and resulted in a shift away from these individuals so disturbance might now be avoided.

One undisturbed RPMU was established around a previously undetected occurrence of leathery grape-fern (*Sceptridium multifidum* formerly known as *Botrychium multifidum*) currently assigned an NT status rank of “May Be At Risk”. A total of five individuals were identified adjacent a fuel cache at KP 59.

Surveys for one-glume spikerush (*E. uniglumis*) and alpine groundsel (*P. pauciflora*) originally documented in 2009 were also carried out but their presence was not detected.

The management goals and objectives with respect to rare plants are as follows:

- Protect, manage, and monitor rare plant species and their habitat that may be affected by Project construction and/or operations.
 - Collect data (e.g., descriptions of plant distribution (locally and more broadly within the NT), relative abundance, and habitat quality), to allow for the efficient and repeatable detection of changes over time.
- Provide CZN and regulatory agencies with a process and framework for rare plant management and rare plant assemblages within the Project area.

The RPMP applies to rare plants located adjacent to project infrastructure; rare plants that intersect with project disturbance footprints are to be collected and donated to various herbaria and transplanted into undisturbed areas located beyond the primary influence of the ASR. The management strategy is based, in part, on the identification of RPMU, which are ecologically distinct areas of land that focus on populations of rare plants. RPMU are assigned a set of goals and objectives, a desired future condition, and will be used to gauge the overall success of the management plan.

Monitoring will be conducted in individual RPMU after construction of the PWR to verify whether the management strategy is having the expected effect on rare plants. Permanent plots or transects will be established within each RPMU to facilitate consistent, long term collection of data (e.g., the duration of the project).

Monitoring will be conducted at regular time intervals (e.g., during the growing season – June to August) following repeatable methods. Following PWR construction, RPMU will be surveyed at regular intervals. If rare plant densities are shown to be declining over time, habitat degradation (e.g., from dust) or disturbance is evident, or there is increased encroachment by invasive species, more intensive monitoring and adjustments to the management plan and project operations may be required.

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LIST OF ACRONYMS

Acronym/Abbreviation	Definition
ANPC	Alberta Native Plant Council
ASR	Prairie Creek All-Season Road (Phase 2)
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CZN	Canadian Zinc Corporation
DAR	Developers Assessment Report
DK	Dene Knowledge
DM	Dene Monitors
EOSDF	Earth Observation for Sustainable Development of Forests
GNWT	Government of Northwest Territories
KP	Kilometre Post
LKFN	Liidlii Kué First Nation
Mine	Prairie Creek Mine
MVLWB	Mackenzie Valley Land and Water Board
NBDB	Nahanni Butte Dene Band
NNPR	Nahanni National Park Reserve
Project	Prairie Creek Access Road
PWR	Prairie Creek Pioneer Winter Road (Phase 1)
REA	Report of Environmental Assessment
RPMU	Rare Plant Management Units
ROC	Road Oversight Committee
SARA	Species at Risk Act
SARC	Species-at-Risk Committee
Tetra Tech	Tetra Tech Canada Inc.
WLWB	Wek'èezhii Land and Water Board

GLOSSARY OF TERMS

Glossary of Terms	Definition
Bedrock	The consolidated rock (harder than 3 Moh's scale of hardness) underlying the Earth's surface. Bedrock can be encountered at depths ranging from the Earth's surface to hundreds of meters below, depending on the level of exposure to erosion.
Bipinnate	Twice pinnate; with the divisions again pinnately divided.
Borrow Pit	Pit created to provide earth materials to be used as fill (i.e., roadbed) at another site.
Bract	Specialized leaf from the axil of which a flower arises; differing from foliage leaves in size, shape, or texture, but sometimes gradually modified from them.
Bracteole	Often denoting a small bract; better applied to small bract-like organs arising laterally on the pedicel.
Calyx	The outer perianth whorl; collective term for all the sepals of a flower.
Corolla	The second set of floral leaves on the perianth, often conspicuous by its size or colour, but in some plants, small and inconspicuous, or reduced to nectaries, or lacking.
Cut / Fill	Construction practice in which earth materials are excavated from part of an area and used as fill in adjacent areas.
Dene Knowledge	The cumulative, collective body of knowledge, experience, and values built up by the Dene through generations of living in close contact with nature. It builds upon the historic experiences of a people and adapts to social, economic, environmental, spiritual, and political change.
Erosion	The wearing away of soil or rock by water, wind, ice, or other geological agents, including such processes as gravity.
Freshet	Rapid rise in stream flow due to runoff from snowmelt during spring.
Glabrous	Smooth; hairless.
Hydrology	The study water and its movement on land and in the atmosphere, and the effects it has on the earth's surface.
Indusia	A thin membranous covering on a fern leaf that covers the sorus.
Inflorescence	Complete flower-cluster, including the axis and bracts.
Nectary	A gland which secretes nectar, usually on the corolla or disk or within the spur of a flower.
Permafrost	Ground (soil and/or rock) that remains at or below 0°C for at least two consecutive years. Permafrost is defined exclusively based on temperature. It is not necessarily frozen (i.e., does not necessarily contain ground ice).
Pedicel	The stalk of a single flower in an inflorescence.
Pedicellate	Born on a pedicel.
Peduncle	The portion of a stem which bears an inflorescence or a solitary flower, either leafless or with bracts.
Perianth	The corolla and calyx considered together, or either of them if the other is lacking.
Pinna	One of the primary divisions or leaflets of a pinnate leaf.

Glossary of Terms	Definition
Pinnate	Resembling a feather, as in a compound leaf with leaflets arranged on opposite sides of an elongated axis.
Pinnule	The pinnate division of a pinna in a bipinnately compound leaf, or the ultimate divisions of a leaf which is more than twice pinnately compound.
Progressive Reclamation	Action that can be taken during operations before permanent closure to take advantage of cost and operating efficiencies by using resources available from ongoing operations. Enhances environmental protection and shortens the time frame for achieving reclamation objectives.
Raceme	Inflorescence with an elongate unbranched axis and lateral flowers, the lowest opening first.
Rachis	The main axis of a structure, such as a compound leaf or an inflorescence.
Rhizome	A horizontal underground stem; rootstock.
Riparian	Area of land adjacent to a stream, river, lake, or wetland containing vegetation that, due to the presence of water, is distinctly different from the vegetation of adjacent upland areas.
Scape	A peduncle with one or more flowers arising directly from the ground or from a very short stem, and either leafless or with bracts only.
Sepals	A segment of the calyx of a flower, enclosing the petals and usually green and leaflike.
Sheath	The portion of an organ which surrounds, at least partly, another organ, as the leaf base of a grass surrounds the stem.
Slash	Woody debris, such as branches, logs, and brush, that remains on the ground after clearing has been completed.
Spike	Elongate inflorescence of the racemose type with sessile or subsessile flowers; term loosely applied to an inflorescence of different morphological nature but of similar superficial appearance.
Spur	A hollow appendage projecting from the corolla or the calyx and usually nectarial in function.
Sorus/Sori	A cluster of sporangia on the surface of a fern leaf.
Sporangia	A spore-bearing case or sac.
Watercourse	A natural body of flowing or standing water or an area occupied by water during part of the year, and includes streams, springs, swamps, and gulches, but does not include groundwater.

1.0 INTRODUCTION

This Rare Plant Management Plan (RPMP) was prepared for Canadian Zinc Corporation (CZN) by Tetra Tech Canada Inc. (Tetra Tech). It outlines the best management practices to be employed during the Phase 1 construction of the Prairie Creek Pioneer Winter Road (PWR) and its associated infrastructure. Phase 2 will consist of the construction of an All-Season Road (ASR) leading to the Prairie Creek Mine (Mine), NT. This plan will be updated prior to Phase 2.

1.1 Company Name, Location, and Mailing Address

Company Name:

Canadian Zinc Corporation

Head Office:

Address: 1710 – 650 West Georgia Street, Vancouver, BC V6B 4N9

Phone: +1.604.688.2001

Fax: +1.604.688.2043

Email: David.Harpley@NorZinc.com

Prairie Creek Mine:

Iridium 9555 Satellite Phone 1 (yellow) 011.8816.315.30998

Iridium 9505A Satellite Phone 2 (black) 011.8816.315.30997

Iridium 9505A Satellite Phone 3 (orange) 011.8816.315.30996

Ground-To-Air Radio Handheld FREQ 122.800

1.2 Purpose

The purpose of the RPMP is to identify best management practices for the protection, management, and monitoring of rare plant species and their habitats that may be affected by the construction of the full length of the PWR leading to the Mine, both inside of and outside of the Nahanni National Park Reserve (NNPR).

The RPMP will be updated as required to incorporate Traditional Knowledge. Engagement with the Nahanni Butte Dene Band (NBDB) and Liidlii Kué First Nation (LKFN) occurred prior to Plan completion.

1.3 Related Documents

This management plan is linked to a number of other CZN management plans, including:

- *Avalanche Hazard Management Plan;*
- *Closure and Reclamation Plan;*
- *Design and Construction Plan;*
- *Engagement Plan;*
- *Explosives Management Plan;*

- *Invasive Species Management Plan;*
- *Permafrost Management Plan;*
- *Sediment and Erosion Control Plan;*
- *Spill Contingency Plan;*
- *Traffic Control Mitigation, Operations, and Maintenance Plan;*
- *Waste Management Plan;*
- *Water Monitoring Plan; and*
- *Wildlife Management and Monitoring Plan.*

Details of the road, together with the schedule of road construction and maintenance, are provided in the *Design and Construction Plan* and *Traffic Control Mitigation, Operations, and Management Plan*. A map book of the road is provided in Appendix A.

1.4 Regulatory and Permitting Context

In the Northwest Territories (NT), species information is compiled through a collaborative program geared towards reaching a common understanding of general status so that more informed management decisions can be made. The General Status Ranking Program provides a preliminary evaluation of species status. Those species assigned a status of “May Be At Risk” or “At Risk” receive the highest priority for a more detailed assessment by the territorial Species-at-Risk Committee (SARC) or the federal Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Species ranked as “May Be At Risk” may be at risk of extinction or extirpation and are given the highest priority for a more detailed assessment by COSEWIC or SARC. The “May Be At Risk” rank is not a legal designation and has no legal consequences.

Species ranked as “Sensitive” are not at high risk of extinction or extirpation but may require special protection to prevent them from becoming at risk. These species are assigned a medium priority for a detailed assessment (Working Group on General Status of NT Species 2016).

Both the territorial *Species-at-Risk Act* and the federal *Species-at-Risk Act* (SARA) apply in the NT and serve to identify, protect, and help in the recovery of species at risk. The legal listing of a species results in the identification of management or recovery goals for that species. SARA specifically applies to species that are under the management authority of the Government of Northwest Territories (GNWT) and is applicable to both public and private lands as well as private lands subject to a land claims agreement.

The Mackenzie Valley Land and Water Board (MVLWB), within the Report of Environmental Assessment and Reasons for Decision – Canadian Zinc Corp. Prairie Creek All Season Road – Project EA1415-01 (2017, the ‘REA’) included the following measure (Measure 11-1, part 2) with respect to a management plan for rare plants and rare plant assemblages in the NNPR:

In order to prevent significant adverse impacts on rare plants as a result of construction and operation, CZN will develop a Rare Plant Management Plan prior to construction. This plan will include mitigation, monitoring, and adaptive management for rare plants.

- *Mitigation: CZN will use the information gathered in the surveys required by Measure 11-1 part 1, as well as any other relevant information, to identify appropriate mitigation within the plan to minimize significant adverse impacts on rare plants or rare plant assemblages.*
- *Effects monitoring: The plan will include details on how rare plants will be identified and monitored during construction and operations activities. The plan will include effects monitoring for any identified rare plants or rare plant assemblages.*
- *Adaptive management: The plan will include the principles of adaptive management outlined in Appendix B. This will include identifying the actions that will be taken if rare plants are identified at any time during construction and operation of the Project.*

The Rare Plant Management Plan will be reviewed and approved by Parks Canada prior to construction. The developer will operate in accordance with the approved plan.

Additionally, the Review Board suggested (Suggestion 11-2) that “the Mackenzie Valley Land and Water Board consider requiring a Rare Plant Management Plan for the portion of the Project it regulates. The Review Board suggests that this plan could be combined with the one for NNPR and Parks Canada.”

The results of the various rare plant and other vegetation surveys conducted by CZN (see Section 3.2) were used to inform mitigation measures and this RPMP, and to address the above noted Measure and Suggestion.

1.5 Roles and Responsibilities

This RPMP is a living document which incorporates an adaptive management approach. This document will be reviewed at least every five years and updated accordingly. More frequent revisions may be required if new rare species are detected, the number of monitored individuals appears to be in decline, and/or rare plant species legislation changes. CZN’s environmental staff, along with Dene Monitors (DM), in collaboration with affected communities and regulatory agencies, will be responsible for implementing the RPMP. CZN will be responsible for appointing appropriate, qualified staff to carry out the requirements of the RPMP.

CZN’s environmental staff, along with DM will be appropriately trained to detect and manage rare plants and will be responsible for:

- Monitoring for rare plant species;
- Evaluating rare plant species habitat quality;
- Detecting the establishment of invasive plant species in the vicinity of rare plant monitoring locations (see the Invasive Species Management Plan);
- Data entry, reporting, and maintaining a database;
- Trend tracking; and
- Updating this management plan to reflect changes to legislation, adjust for a decline in the number of monitored individuals, or the detection of new rare plant species etc.

All staff utilizing the road should be introduced to the concept and importance of rare plant species and rare plant habitat during orientation so the importance of minimizing potential effects on their environment are understood.

2.0 PROJECT DESCRIPTION

CZN is planning to operate the Prairie Creek Mine, located at approximately 61° 33' north latitude and 124° 48' west longitude adjacent to Prairie Creek, a tributary of the South Nahanni River, southwest Northwest Territories (Figure 1).

A 179.5 km ASR connecting the Mine, at Kilometre Post (KP) 0, to the Liard Trail Highway via the Nahanni Butte Access Road (Figure 2) will generally follow the route of a previously permitted winter road, while reflecting the terrain, site characteristics, and road specifications suitable and preferred for the ASR. Half of the proposed ASR (85 km between KP 17 to KP 102) is located within the NNPR. The NNPR, a world heritage site, is known for its globally-significant karst terrain, as well as the South Nahanni River, a Canadian Heritage River. Approximately half of the ASR alignment will also directly overlap with the alignment of the previously permitted winter road.

Construction of the ASR will take approximately three years to complete. Initial winter roads will be built to gain access to the Mine, allow further investigation of the ASR alignment to complete detailed design, and to provide access for ASR construction. CZN's intent is to build the initial winter roads on the ASR alignment, as much as possible, to minimize the total extent of disturbance

CZN is planning to develop the ASR in two Phases: a PWR (Phase 1) and a ASR (Phase 2). Due to schedule constraints, CZN has decided not to have an operational winter road and the PWR will support geotechnical and geophysical investigation work only using tracked equipment and light vehicles.

3.0 PROJECT SETTING

3.1 Topography and Terrain

The Mine site is located at an elevation of 850 m, and is situated in topography characterized by low mountains and narrow valleys with an average relief of 300 m. The Mine site is located within the Alpine Forest-Tundra section of the Boreal Forest, characterized by stunted fir with limited undergrowth and open areas dominated by lichen.

The access road leaves the Mine site heading north along the Prairie Creek valley for about 7 km before turning east to cross the Mackenzie Mountains. As the road climbs out of the Prairie Creek valley it enters Sub-Alpine Shrub and Alpine Tundra from an elevation of approximately 1,000 m at KP 10. The road continues to climb through the Alpine terrain to a summit of 1,530 m near KP 17 (also the western boundary of the NNPR), then dropping down and leaving the Sub-Alpine terrain again at the 1,000 m elevation around KP 25.

As the road drops from the 1,000 m elevation to the 900 m elevation, it passes through a spruce lichen Alpine forest zone similar to that found at the Mine site and then into Riparian Alluvial habitat in the Sundog tributary valley bottom. From KP 40 to KP 55, the road crosses forest developed on glacial depositional deposits, and crosses Polje Creek (otherwise known as Bubbling Springs Creek) which drains the Poljes before ascending the Ram Plateau.

As the road crosses the Ram Plateau, it passes through an open forest Black Spruce/Pine Parkland setting between the 830 m to 930 m elevations, before dropping down into the Tetcela River valley. The valley consists of a mixed coniferous/deciduous closed forest. The road then passes through a short distance of muskeg open shrub/sedge wetland at the headwaters of Fishtrap Creek, and climbs up and over the Silent Hills, again a closed mixed coniferous/deciduous forest. The road alignment then runs along the eastern slopes of the Silent Hills, an area of black spruce, before passing through mixed coniferous-deciduous-pine parkland prior to entering the Grainger River headwaters at Grainger Gap (Second Gap), staying north of, and never crossing into, the Bluefish Creek basin.

Once through the Grainger Gap, the road alignment turns south along the foothills of the Nahanni Front Range through mixed deciduous coniferous forest towards Nahanni Butte, avoiding the Grainger Tillplain. The road crosses the Liard River downstream near the community and continues through forest to the Nahanni Butte Access Road and on to the Liard Highway.

3.2 Permafrost

Nahanni Butte is mapped near the southern boundary of the “extensive discontinuous” permafrost zone and the route appears to be entirely within that zone (Heginbottom et al. 1995).

Within this zone, 50% to 90% of the land area may be underlain by permafrost. Locally, the likelihood of permafrost will depend on elevation, but also on local soil and ground cover conditions. The very small scale of Heginbottom et al.’s permafrost map makes it difficult to discern the transitions between the areas where anticipated ground ice content is mapped as low (<10%), and where it is mapped as medium (10% to 20%), or low to medium. Based on estimated landmark locations, it appears that the terrain on the east side of the Front Range is more likely to have a low to medium ice content, and the terrain between the Front Range and the Tetcela River is more likely to have a medium ice content. However, there is enough local variation that actual ice content will depend on a series of local factors, including the grain size of the soils encountered, ground cover, and local slope aspects. Recent climate warming may also have generally reduced ice contents and extents.

Where present, the average temperature of the permafrost is expected to be very close to 0°C in the lower elevation areas, and probably less than about -2°C at higher elevations along the route. Therefore, in silty or clayey soils, there may be high unfrozen moisture content (Heginbottom et al. 1995). As well, it is anticipated that locally silty/clayey soils may incorporate some ice lenses or laminations, while granular soils should have relatively low ice content. Rivers or streams or lakes and ponds that have unfrozen water year-round likely moderate the local ground temperature (typically within 10 m to 50 m of the shoreline), as well as providing a potential source of water for ice lens formation. Depending on the type of groundcover, thickness of organic soils, underlying soil types (fine-grained or coarse-grained), degree of site disturbance, and proximity to waterbodies, the active layer is estimated to range between 0.6 m and 3 m thick.

Where streams or ponds are ephemeral or freeze to the bottom every winter, it is anticipated that permafrost could be present regardless of soil or rock type. Where water flows and/or is deep enough to remain unfrozen year-round, a talik or unfrozen zone is likely to be present beneath the stream. The smaller creeks evaluated by Hatfield Consultants Ltd. were considered to have the potential to freeze to the bottom every winter. Even the larger channels were considered to have a high potential of freezing, although these streams might also have some deeper, unfrozen pools, for example, lower Sundog Creek, Tetcela River, and Grainger River.

Streams in gravel along the route appear to have greatly-reduced water levels even before the onset of winter (email communications, March 5, 2015; D.Harpley, C.Jaeggli, R.Kors-Olthof). As noted above, forest fires may affect ground temperature regimes and permafrost due to changes to the protective organic layer over the frozen mineral soils, particularly if the fire burns hot and damages the organic layer. The loss of a forested canopy can also reduce shade and allow the ground to become warmer, accelerating thaw. On steeper slope sections, it is also important to consider the potential for fires resulting in dead trees and the subsequent loss of root strength in helping to retain near-surface soils.

Climate warming can affect ground temperatures and permafrost characteristics and might be expected to have a greater effect on a usually cool slope than on a slope that is already warmer due to slope aspect, especially if that warm slope already has less permafrost.

3.3 Karst Features

The process of karst formation is caused by carbon dioxide dissolved in rain that percolates through the soil as a weak solution of carbonic acid. The infiltrating water naturally exploits any crack or crevice in the rock. Over long periods of time, carbonate rocks (such as limestone) begin to dissolve. However, surface lowering and wall retreat within fissures and caves occur at a rate of no more than a few millimetres per 100 years in tropical conditions, and rates are even less in temperate (colder) climates.

Openings in competent carbonate bedrock increase in size, and an underground drainage system begins to develop allowing more water to pass and further accelerating the formation of karst. Eventually, this can lead to the development of subsurface caves.

3.3.1 Karst Development on the Ram Plateau

The Ram Plateau is defined as the broad geographic area between the Silent Hills Range (east) and the Mackenzie Mountains (west), over 30 km east-west and greater than 100 km north-south. Topography throughout the Ram Plateau is subdued compared to the adjacent mountain ranges; however, many areas within the plateau contain incised, rugged steep-sided canyons, which are especially well developed in the Ram River area.

The steep-sided canyons generally formed as a result of the exposure of thick beds of the competent Nahanni Formation limestones. The Nahanni Formation is susceptible to dissolution or karstification due to its calcium carbonate composition.

Structurally, the Ram Plateau is underlain by a series of gently alternating folded anticlines and synclines. The Nahanni Formation is overlain by shales of the Horn River/Fort Simpson Formation which, by virtue of their very fine-grained nature, are quite impervious to water infiltration.

Dr. Derek Ford, a renowned karst expert from McMaster University in Hamilton, Ontario, has completed numerous studies of the karst landforms and processes within the Ram Plateau and has identified many areas of particular focus within this terrain. The focus of the study is the area generally to the south of the access road where the Nahanni Formation is well exposed and incised. Many karst features were identified and documented and include, but are not limited to the Poljes, sinkholes (dolines), suffosion terraces, caves, labyrinth karst, and tower karst.

3.3.2 The Polje Area

The Polje area is one of the areas of karst development that has been the primary focus of research. The area occurs along the access road near KP 50 where the Nahanni Formation is exposed. At KP 55 to KP 57, the access road crosses the trend of the Poljes which are referred to as the First, Second, and Third Poljes. Figure II-2 in Golder (2010) shows the location of the road route in relation to specific terrain and karst features. This figure also shows recent photographs of the various karst features proximal to the road.

A Polje is defined as a flat floored, steep sided enclosed basin which is fed by groundwater. A Polje does not have any apparent surface water source, such as a creek or river; water enters or leaves via subterranean means. Depending on groundwater flow, water levels within a polje can vary considerably and the feature can either be full of water or empty. Ford et al determined that the poljes are connected hydrologically through subterranean conduits or aquifers.

Dye tracing experiments confirmed the movement of groundwater from south to north, that is, from the Third to the Second to the First Polje, the water finally emanating to the surface as the Bubbling Spring just north of the First Polje. The spring feeds Polje Creek which flows north to Sundog Creek.

In addition to the Polje area, the former winter access road alignment crosses what Ford terms the Southwest Suffosion Terrace (KP 48 to KP 54), which is an elevated plateau above the Polje system. A number of suffosional sinkholes are developed in this area due to dissolution of the Nahanni Formation underneath the shale cap. Due to the elevation difference, groundwater drains to the Poljes and to the Bubbling Springs area. The current revised PWR route avoids the Southwest Suffosion Terrace and the Polje system, crossing Polje Creek more than one km downstream from the Bubbling Springs area.

3.4 Ecosystems and Vegetation

Ecosystem and vegetation descriptions are compiled from various sources including Earth Observation for Sustainable Development of Forests (EOSDF) mapping (Wulder et al. 2004) which informed the Developers Assessment Report (DAR) in 2014 and an ecological land classification developed by Parks Canada (Ponomarenko and Quirouette 2015) for the expanded NNPR in 2015 (this mapping was not available at the time the DAR was being prepared). Efforts have been made to correlate the EOSDF mapping with the ecological land classification of Parks Canada, a summary of which is provided in Table 1 below.

The ASR is located within the Taiga Plain and Taiga Cordillera ecozones of the NT (Ecosystem Classification Group 2009, 2010), which are characterized by several notable topographic features: the Mackenzie Mountains, the Nahanni Ranges, and the Liard floodplain. These features provide an array of growing conditions, and consequently, numerous vegetation assemblages. Wild fires occasionally occur in the region and have influenced forested ecosystems throughout much of the landscape.

Ecosystem descriptions for the ASR are also provided in Table 1 and draw from both the Parks Canada classification by Ponomarenko and Quirouette (2015) as well as Wulder et al. (2004).

Table 1: Land Cover and Ecotype Concordance

Ecosystem Type	EOSDF	Parks Canada	Description
Deciduous	Broadleaf – Dense Broadleaf – Open	Deciduous Forest/Tall Shrub	Generally characterized by early and mid-seral plant communities, representative of post-fire conditions. The tree layer is dominated by deciduous species. The shrub layer is well developed while the herb layer is variable. Mosses and lichen also form a variable ground cover. Tends to occupy submesic to subhygric sites with a medium to rich nutrient regime.
Coniferous	Coniferous – Dense Coniferous – Open Coniferous – Sparse	Coniferous Forest Subalpine Coniferous Woodland Spruce – Lichen – Moss Woodland Spruce – Lichen Woodland	Generally characterized by late seral plant communities in the subalpine zone with a sparse to moderately dense cover of conifers in the tree layer. The shrub layer is moderately to well-developed while the herb layer is variable. The moss layer tends to be well-developed. Often occupies submesic to subhygric sites with a poor to rich nutrient regime. Spruce-Lichen (Moss) Woodland communities often occupy north aspects with spruce forming an open to sparse tree and tall shrub layer. Dwarf shrubs are also present to varying degrees. Fruticose lichens dominate as a ground cover in the Spruce-Lichen variant and sites typically occupy a submesic to mesic moisture regime and poor nutrient regime. A combination of lichen and moss are present as ground cover in the Spruce-Lichen-Moss variant, which tends to occupy mesic to subhygric sites.
Mixedwood	Mixedwood – Dense Mixedwood – Open	Mixed Predominantly Coniferous Forest Mixed Predominantly Deciduous Forest	Generally, a mid-seral group of plant communities with a moderately dense to sparse tree layer consisting of both coniferous and broadleaf species, a well-developed shrub layer, a variable herb layer, and moderate moss cover. Communities often represent a post-fire successional stage and occupy sites with a submesic to subhygric moisture regime and medium to rich nutrient regime.
Shrub – Alluvial Shrub – Fire Regen Shrub – Subalpine	Shrub – Tall Shrub – Low	Subalpine Tall Shrub Low Sparse Shrub Medium – Low Shrub Subalpine Shrub – Sparse Trees	Generally represented by late successional plant communities in subalpine and alpine zones or mid-successional communities in boreal and subalpine zones following disturbance. Sites are characterized by shrubs ranging from dwarf to tall species and the tree layer is generally absent. The herb layer is variable. Occupies mesic to subhygric sites.

Table 1: Land Cover and Ecotype Concordance

Ecosystem Type	EOSDF	Parks Canada	Description
Herb	Herbs	Alpine Herb Tundra and Meadow	Alpine zone communities dominated by herbs, grasses, and dwarf/cushion shrubs. The growth of larger shrubs and trees is generally restricted by the cold climate. Characterized by a submesic to subhygric moisture regime.
Bryoids	Bryoids	Rock – Lichen	Generally characterized by rock outcrops or boulder/fragmented rock fields with little to no soil present. Crustose lichens tend to be the dominant life form, with some smaller occurrences of fruticose and foliose lichens. Characterized by rapidly to well drained moisture regimes.
Wetland	Wetland – Treed Wetland – Shrub Wetland – Herb	Wetland	Variable group of plant communities dominated by graminoids (sedges primarily), shrubs, or trees. Characterized by a hygric to hydric moisture regime and a poor to very rich nutrient regime.
Water	Water	Permanent Water Intermittent Water Water/Terrain Shadow	Lakes, reservoirs, rivers, streams, or salt water.
Non-Vegetated	Rock/Rubble Exposed/Barren Land Snow/Ice Shadow Cloud	Rock Rock/Water Terrain or Cloud Shadow/Water Ice/Snow Alluvial – Non-Vegetated	Bedrock, rubble, talus, blockfield, rubblely mine spoils, or lava beds. River sediments, exposed soils, pond, or lake sediments, reservoir margins, beaches, landings, burned areas, road surfaces, mudflat sediments, cutbanks, moraines, gravel pits, tailings, railway surfaces, buildings and parking, or other non-vegetated surfaces.
Disturbance	Exposed/Barren Land	Recently Burnt	Variable group of early successional plant communities representing post-fire conditions. The tree layer is generally absent but young trees and low, medium, and tall shrubs comprise the shrub layer. Characterized by a submesic to subhygric moisture regime and a poor to very rich nutrient regime.

4.0 RARE PLANT AND OTHER VEGETATION SURVEYS

4.1 Methods

The rare plant studies conducted to date have been a combination of desktop data compilation and field surveys. Given the extent of the ASR alignment study area, more recent studies have made efforts to link rare plant species habitat potential to the ecotype mapping developed by Parks Canada for NNPR (per Ponomarenko and Quirouette 2015) in order to focus field investigations.

4.1.1 Desktop Studies

Desktop studies have consisted of compiling lists of rare plants with the potential to occur within the study area, identifying their likely habitat requirements, reviewing ecosystem maps that overlap with the study area (current at the time), and ultimately linking this information to identify areas with a high potential of supporting rare plant habitat.

Information regarding rare plants and rare plant habitat was compiled from the NT Species at Risk Infobase, COSEWIC, and SARA. Vascular plants in the NT are assigned a General Status Rank as a way of prioritizing management decisions; those identified as being “May Be At Risk”, or “At Risk” receive the highest priority for a more detailed assessment by SARC or COSEWIC.

The species lists compiled for the Mine and ASR were generated periodically between 2009 to 2017 to account for the addition and removal of species, as well as changes to General Status Ranks that have occurred over the years. The most recent list, generated in 2017, included species ranked as being “At Risk”, “May Be At Risk”, as well as “Sensitive” within the Taiga Plain and Taiga Cordillera Ecozones (which broadly characterize the study area). The list was then refined by eliminating species with no habitat potential in the study area (e.g., species occupying coastal beaches), following the review and compilation of rare plant habitat descriptions and species distributions from various floras and literature sources (e.g., Porsild and Cody 1980; McJannet et al. 1995; Kershaw et al. 1998; Cody 2000; Burt 2002; Argus 2004; Aiken et al. 2007; and Ponomarenko and Quirouette 2015).

Ecosystem mapping information available for the study area includes EOSDF mapping (Wulder et al. 2004) as well as ecotype mapping for the expanded NNPR (Ponomarenko and Quirouette 2015). The former dataset was used as the basis of the DAR for the ASR. Once the ecotype information was available, efforts were made to correlate the two mapping products. General ecosystem types were developed that combine the ecotypes of Ponomarenko and Quirouette (2015) with the land cover classes of Wulder et al. (2004). Ecotypes and land cover classes with similar characteristics (e.g., relative moisture status, vegetation cover) were grouped into the same general ecosystem type based on available descriptions as well as from field observations.

Each rare plant species was then assigned at least one general ecosystem type based on the mapping and descriptions developed by Parks Canada (Ponomarenko and Quirouette 2015), Wulder et al. (2004), and the various literature sources listed previously. The results were summarized into classes that present the number of rare plant species potentially supported by each ecotype. This information was then linked to the ecotype mapping using GIS to spatially identify rare plant habitat potential within the study area.

4.1.2 Field Surveys

Four rare plant surveys of the ASR alignment, 1980's winter road, and other areas of proposed development (e.g., borrow sources) have been completed to date (2009, 2010, 2016, and 2017) at various times in the summer (June to August) to capture a range of flowering periods. Recent (2016 and 2017) surveys followed guidelines

developed by the Alberta Native Plant Council (ANPC 2012) and involved meander searches within a 100 m buffer of the proposed ASR centreline (200 m total width). These surveys also had helicopter support which allowed for reconnaissance flights over areas of high rare plant habitat potential as well as the opportunistic identification of unusual or uncommon landscape features (i.e., that were too small to map) from the air which were then surveyed on the ground. Earlier surveys were conducted primarily on foot or by ATV along portions of the existing road and other proposed infrastructure.

Concurrently with the rare plant survey, areas were also assessed for their conformance with the ecotypes mapped for NNPR (per Ponomarenko and Quirouette 2015) as well as the land classification mapping of Wulder et al. (2004).

At each survey location, a species list (irrespective of status) was compiled and an ecosystem unit assigned. Plants were identified to species in the field wherever possible. When a definitive identification in the field could not be achieved, specimens were collected, provided the collection did not appear to threaten the immediate population.

4.1.3 2019 Field Surveys

Additional field surveys were carried out between August 28 and September 3, 2019. The search area around known locations of green spleenwort (*Asplenium trichomanes ramosum*) and small round-leaved bog orchid (*Platanthera orbiculata*) were broadened to identify the presence of additional individuals beyond the current ASR footprint. The search area extended approximately 500 m perpendicular to the ASR alignment and was approximately 200 m wide (dependant on appropriate habitat for each rare species). Rare Plant Management Units (RPMU) measuring 20 m x 20 m (commensurate with the plot size assessed to date during field surveys) were established around individuals or groups of individuals located beyond the current footprint of the ASR (Figures 3a to 3e). At plot centre, geographic location was determined and a metal rod was installed to mark plot centre for future monitoring.

Additional RPMU were established in similar ecotypes as known occurrences, but in areas devoid of rare plants, and served as receiving sites for transplanted rare plants.

Areas that were previously assessed in 2009 were also revisited in 2019 with the intention of re-locating individuals of one-glume spikerush (*Eleocharis uniglumis*) and alpine groundsel (*Packera pauciflora*).

4.2 Results

4.2.1 Desktop Studies

In 2016, a total of 217 rare vascular plants were identified as potentially occurring within the study area according to the NT Species At Risk Infobase. In 2017, the list was refined to 145, due in part to updates to ecozone boundaries and species rankings as well as modifications based on rare plant habitat requirements and the likelihood of those habitats being present within the ASR study area.

The results of the model developed in 2017 to spatially identify rare plant habitat potential using the available ecotype mapping (per Ponomarenko and Quirouette 2015) along the ASR are presented in Table 2, with ecotypes potentially supporting anywhere from 12 rare plant species (aquatic ecotype) to 70 (alpine herb tundra and meadow). The model results were then grouped into classes identifying the approximate number of rare plant species within each class; these classes were used to theme field maps which helped stratify the study area and focus the rare plant survey effort.

Table 2: Rare Plant Habitat Potential along the ASR

Class (Number of Rare Plant Species)	Ecotype ¹	Number of Rare Plant Species Potentially Linked to an Ecotype ²
>45	Alpine Herb Tundra and Meadow	70
	Low Sparse Shrub	67
	Wetland	63
	Medium – Low Shrub	51
31 to 45	Riparian	44
	Subalpine Tall Shrub	42
	Subalpine Shrub – Sparse Trees	38
	Subalpine Coniferous Woodland	37
26 to 30	Alluvial non-vegetated	30
	Mixed Predominantly Coniferous Forest	29
	Mixed Predominantly Deciduous Forest / Tall Shrub	28
	Coniferous Forest	27
16 to 25	Deciduous Forest / Tall Shrub	24
	Spruce – Lichen- Moss Woodland	22
	Rock – Lichen	22
	Spruce – Lichen Woodland	19
<15	Recently Burnt	14
	Aquatic	12
N/A	Water, Rock, Clouds, and Shadow	0

¹Based on ecotype mapping and descriptions per Ponomarenko and Quirouette (2015)

²Based on potentially suitable rare plant habitat within the ecotype

4.2.2 Field Surveys

Four rare plant surveys have been completed to date as follows:

- July 2009 – along the existing Mine access road, the proposed waste rock storage facility, camp and surrounding area, and beaver pond located south of the camp.
- August 2010 – along the proposed Polje By-Pass realignment to the existing access road.
- July 2016 – along the proposed ASR, borrow pits, road realignment areas, and areas supporting unusual landscape features within NNPR (from km 17 to km 101).
- June 2017 – within a 100 m buffer extending from either side of the proposed ASR centreline within NNPR (from km 17 to km 101).

In addition to the rare plant surveys conducted above, an invasive plant species survey was carried out in August 2018, outside NNPR that covered where the access road overlapped with the historic winter road and exploration cutlines, the Nahanni Butte community access road that overlaps with the ASR, areas cleared by the Nahanni Butte community in 2017, some of which cover the proposed ASR alignment, and spot checks of undisturbed areas in the vicinity of the broader invasive plant survey areas. While the survey focused on the

identification and establishment of invasive plant species, incidental observations of other plant species, particularly those considered rare, were made as well. No rare plants were identified during the invasive species survey.

During the 2009 rare plant survey, nine rare species were identified: few flower meadow rue (*Thalictrum sparsiflorum*), Hornemann willowherb (*Epilobium hornemannii*), linear-leaved willowherb (*Epilobium leptophyllum*), alpine anemone (*Anemone drummondii*), bog birch (*Betula pumila*), lesser black-scaled sedge (*Carex atrosquama*), one-glume spikerush (*Eleocharis uniglumis*), alpine groundsel (*Packera pauciflora*), and yellow mountain heather (*Phyllodoce glanduliflora*). With the exception of one-glume spikerush and alpine groundsel (both still listed as Sensitive), these species have since been delisted.

In 2017, 21 meandering transects were carried out within a 100 m buffer extending from either side of the road centreline. Multiple individuals of two rare plant species were identified over several locations (Table 3, Figures 3a to 3e): green spleenwort (*Asplenium trichomanes ramosum*, formerly *A. viride*; Photo 1) listed as May Be At Risk and small round-leaved bog orchid (*Platanthera orbiculata*; Photo 2) listed as Sensitive. Based on the current ASR alignment, all individuals (4 spleenwort and 32 small round-leaved bog orchid) are within the disturbance footprint.

No rare plants were observed during the 2010 or 2016 surveys. In 2016, surveys specifically for Raup's willow (*Salix raupii*), ranked as May Be At Risk, were also conducted along Sundog Creek between km 36 and km 38.

4.2.3 2019 Field Survey Results

Additional field surveys were carried out between August 28 to September 3, 2019 and resulted in the establishment of nine RPMU for *P. orbiculata*, as summarized in Table 4. A total of 30 individuals were transplanted out of the ASR footprint into 5 adjacent RPMU while another 4 RPMU were established around 18 individuals located beyond the ASR footprint ("undisturbed" RPMU). Two specimens were also collected and pressed for donation to a local herbarium.

No RPMU were established for *A. trichomanes ramosum* as the individuals could not be relocated in the field. They are considered delicate perennials (Porsild and Cody 1980) and may have senesced by the time the survey was conducted. The ASR alignment in this area was refined and resulted in a shift away from these individuals (see Figure 3a) so disturbance might now be avoided. This area will be surveyed again when monitoring is conducted in the other RPMU.

One RPMU was established around a previously undetected occurrence of leathery grape-fern (*Sceptridium multifidum* formerly known as *Botrychium multifidum*) currently assigned an NT status rank of "May Be At Risk". A total of five individuals were identified adjacent a fuel cache at KP 59. An "undisturbed" RPMU was established around these individuals and will be monitored in future.

Surveys for one-glume spikerush (*E. uniglumis*) and alpine groundsel (*P. pauciflora*) originally documented in 2009 were also carried out but their presence was not detected.

All RPMU locations are presented in Figures 3a to 3e.

Table 3: Rare Plant Observations

Name	NT Status Rank	Location (UTM – 10V, E, N)	Kilometre Post (KP)	Jurisdiction	General Ecosystem Type	Ecotype	# Individuals	Area (m ²)	Relative to ASR Footprint	Associated Species
Green Spleenwort	May Be At Risk	417202 6828983	24-25	NNPR	Shrub – Subalpine	Medium – Low Shrub	4	5	Within	Yellow Anemone, Pink Pyrola, Alpine Bearberry, Rock Cranberry, Shrubby Cinquefoil, Entire-leaved Mountain Avens, Arctic Sagebrush, Alpine Bilberry, Narrow-leaved Labrador Tea
Small Round-leaved Bog Orchid	Sensitive	454869 6815441	79	NNPR	Mixedwood	Mixed Predominantly Coniferous Forest	1	N/A	Within	Not recorded
Small Round-leaved Bog Orchid	Sensitive	462111 6815853	90	NNPR	Mixedwood	Mixed Predominantly Coniferous Forest	6	100	Within	Trailing Clubmoss, One-sided Wintergreen, Lodgepole Pine, Dwarf Dogwood, Rock Cranberry, Trembling Aspen, Small Round-leaved Bog Orchid, Common Labrador Tea
Small Round-leaved Bog Orchid	Sensitive	462680 6815156	91-92	NNPR	Mixedwood	Mixed Predominantly Coniferous Forest	1	N/A	Within	Not recorded
Small Round-leaved Bog Orchid	Sensitive	462717 6815134	91-92	NNPR	Mixedwood	Mixed Predominantly Coniferous Forest	11	100	Within	Prickly Rose, Black Spruce, Lodgepole Pine, Paper Birch, Northern Comandra, Rock Cranberry
Small Round-leaved Bog Orchid	Sensitive	463460 6815134	92	NNPR	Mixedwood	Mixed Predominantly Coniferous Forest	2	100	Within	Black Spruce, Lodgepole Pine, Paper Birch, Trembling Aspen, Northern Comandra, Pink Pyrola
Small Round-leaved Bog Orchid	Sensitive	463997 6814206	93	NNPR	Mixedwood	Mixed Predominantly Coniferous Forest	5	100	Within	Speckled Alder, Trembling Aspen, Paper Birch, Lodgepole Pine, Dwarf Dogwood, Rock Cranberry
Small Round-leaved Bog Orchid	Sensitive	466239 6812310	97	NNPR	Mixedwood	Mixed Predominantly Coniferous Forest	6	100	Within	Black Spruce, Paper Birch, Lodgepole Pine, Dwarf Dogwood
Leathery Grape-fern	May Be At Risk	443515 6828308	59	NNPR	Shrub – Fire Regen	Low Sparse Shrub	5	5	100 from edge of footprint	Arctic Sweet Coltsfoot, Sand Violet, Tall Jacob's Ladder, Mountain Monkshood, Lodgepole Pine,
One-glume spikerush	Sensitive	Not formally recorded – adjacent to the existing Prairie Creek Mine access road								
Alpine groundsel	Sensitive	Not formally recorded – adjacent to the existing Prairie Creek Mine access road								

Table 4: Rare Plant Management Units Summary

RPMU #	Easting (Zone 10V)	Northing	RPMU Type	Common Name	Scientific Name	NT Status Rank	# of Individuals	Comments
1	463942	6814143	Transplant	Small Round-leaved Bog Orchid	<i>Platanthera orbiculata</i>	Sensitive	5	Limited suitable habitat due to topography
2	454763	6815507	Transplant	Small Round-leaved Bog Orchid	<i>Platanthera orbiculata</i>	Sensitive	2	Limited suitable habitat due to topography
3	462231	6815878	Transplant	Small Round-leaved Bog Orchid	<i>Platanthera orbiculata</i>	Sensitive	6	Good habitat potential
4	462310	6815802	Undisturbed	Small Round-leaved Bog Orchid	<i>Platanthera orbiculata</i>	Sensitive	4 in 3 locations	
5	466326	6812425	Transplant	Small Round-leaved Bog Orchid	<i>Platanthera orbiculata</i>	Sensitive	8 between 4 plugs	
6	466267	6812358	Undisturbed	Small Round-leaved Bog Orchid	<i>Platanthera orbiculata</i>	Sensitive	6 in 4 locations	
7	463488	6815122	Undisturbed	Small Round-leaved Bog Orchid	<i>Platanthera orbiculata</i>	Sensitive	1	
8	462652	6815062	Transplant	Small Round-leaved Bog Orchid	<i>Platanthera orbiculata</i>	Sensitive	9 between 6 plugs	
9	462715	6815045	Undisturbed	Small Round-leaved Bog Orchid	<i>Platanthera orbiculata</i>	Sensitive	7 in 5 locations	
10	443515	6828308	Undisturbed	Leathery Grape-fern	<i>Sceptridium multifidum</i>	May Be At Risk	5 within 1 m ²	Found in fuel cache at KP 59



Photo 1: Green Spleenwort
(*Asplenium trichomanes-ramosum*)



Photo 2: Small Round-leaved Bog Orchid
(*Platanthera orbiculata*)



Photo 3: Leathery Grape-fern (*Sceptridium multifidum*)

5.0 RARE PLANT ASSEMBLAGES

To our knowledge, neither the GNWT nor Parks Canada have formally established tracking lists and/or status ranks for rare plant assemblages in the NT, including within NNPR. In the absence of this information, rare plant assemblages have been identified as described below. Areas in addition to those described below that may support uncommon plant assemblages include those overlying unusual landforms, such as karst, and in areas of glacial refugia.

Alluvial Assemblages – during the 2016 field survey, plots with the highest species richness were found along alluvial flood plains. These habitats are subject to occasional flooding (disturbance) which bring nutrients and seed sources to the site and helps maintain adequate moisture due to the presence of a high water table. These site conditions tend to be uncommon and as such, plant assemblages associated with alluvial areas may be considered rare due to their limited distribution on the landscape. These areas also have higher potential for supporting rare plant species (e.g., the Alluvial non-vegetated ecotype presented in Table 1 was associated with 30 rare plant species). Alluvial areas appear to be relatively uncommon within the Project area according to the mapping data available and were generally avoided during design of the ASR due in part to fish and fish habitat considerations.

Wetlands – wetland ecosystems are frequently biologically diverse areas that provide important habitats for various plants and plant assemblages. Disturbances that affect the features that define wetlands (such as local hydrology or nutrient availability) can change the characteristics of the wetland itself, along with those the plant assemblages that wetlands support. Within the Project area, wetlands appear to be relatively uncommon according to the mapping data available and were generally avoided during design of the ASR due in part to their environmentally sensitive nature.

Alpine – alpine ecotypes can be harsh environments full of tiny microhabitats for specialized plant species. Vegetation growing in alpine and subalpine environments must be adaptable to harsh climate conditions such as extreme temperatures, desiccation, and limited soil development. While alpine herb, tundra, and meadow areas have a restricted distribution within the ASR corridor, they have a broader distribution within the areas currently mapped. New disturbance to alpine areas was generally avoided during the design of the ASR by following the existing road alignment (developed in the 1980's).

6.0 RARE PLANT/ASSEMBLAGE ADAPTIVE MANAGEMENT

This RPMP establishes a framework to integrate the protection and management of rare plants identified in the vicinity of the PWR and ASR corridors, the Mine, and associated infrastructure with monitoring to determine their condition over the duration of construction and operations. No specific management actions are proposed for rare plant assemblages. Wherever feasible, CZN will minimize the disturbance footprint, particularly in areas that may be conducive to supporting rare plant assemblages.

6.1 Adaptive Management

Adaptive Management is a systematic, rigorous approach designed to link environmental monitoring to management actions. Adaptive management will help to evaluate the success of the various programs put in place for the PWR and ASR and confirm that disturbed areas have stabilized and are performing as expected.

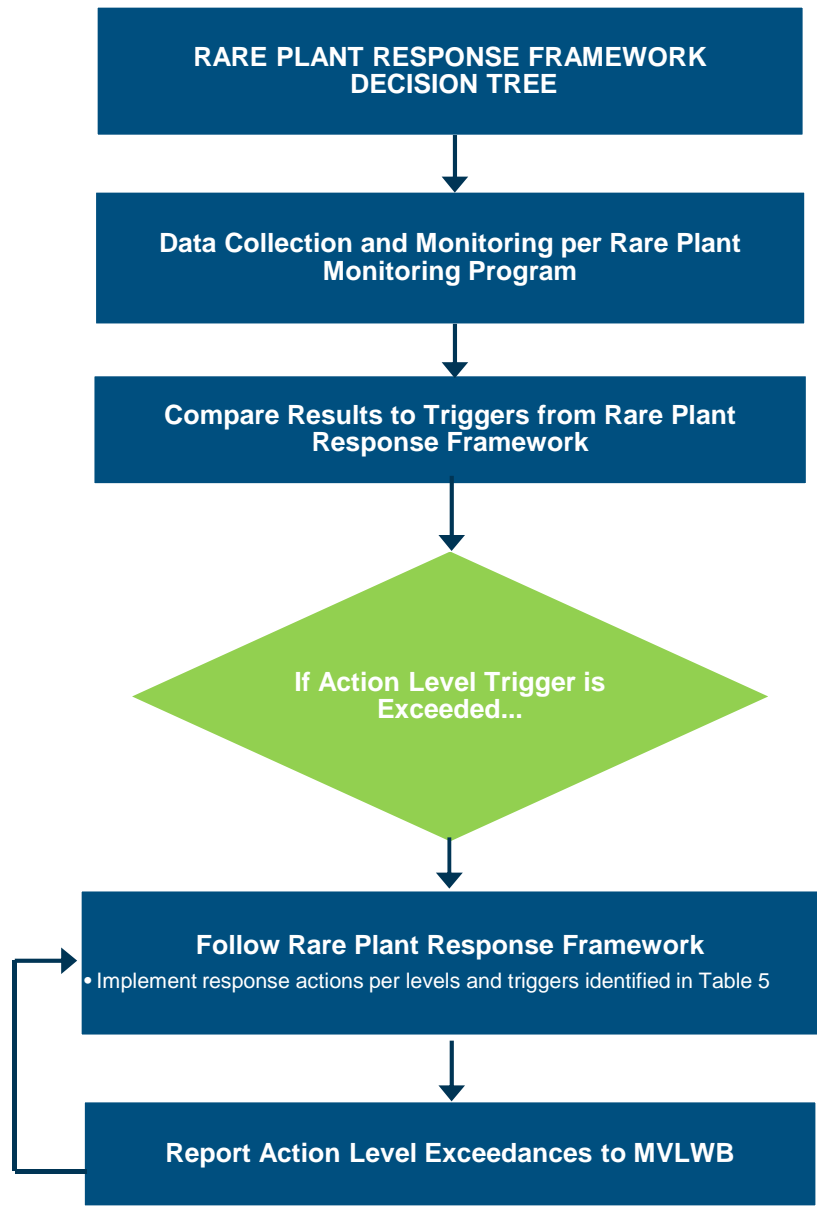


Figure A: Overview of Proposed Response Framework Decision Tree (adapted from WLWB 2010)

For the PWR and ASR, action levels have been defined conceptually in order to avoid reaching established significance thresholds. The proposed approach to action levels and responses, as defined in the framework, is outlined in Table 5.

Table 5: Proposed Action Levels and General Responses

Monitoring Parameter	Action Levels and Triggers			General Response		
	Low	Moderate	High	Low	Moderate	High
Maintain or increase current numbers of rare plants in undisturbed RPMU ¹	Number of plants across RPMU declines by >20% (after minimum three consecutive years of monitoring; 4 out of 18 orchids and/or 1 out of 5 grape-ferns not detected)	Number of plants across RPMU declines by >50% (after minimum three consecutive years of monitoring; 9 out of 18 orchids and/or 3 out of 5 grape-ferns not detected)	Number of plants across RPMU declines by ≥75% (after minimum three consecutive years of monitoring; 14 out of 18 orchids and/or 4 out of 5 grape-ferns not detected)	Identify options for enhancement	Select and implement Action(s) (Monitor)	Further Action(s) if Needed (Monitor, adjust operations of the PWR or ASR)
Monitor survival and/or growth of rare plants transplanted into RPMU ^{1,2}	17% of transplants surviving after 10 years of monitoring (5 out of 30 individuals)	7% of transplants surviving after 10 years of monitoring (2 out of 30 individuals)	No transplants surviving after ≥10 years of monitoring	Identify options for enhancement	Select and implement Action(s) (Monitor)	Further Action(s) if Needed (Monitor, adjust operations of the PWR or ASR)

¹Monitoring will require a longer timeframe in order to distinguish between *Platanthera* and *Sceptridium* survival and potential dormancy, particularly following disturbance from transplanting

²The survival expectations for rare plant transplants are low due to the often low success rates of such endeavours (per Canadian Botanical Association 2014; Maslovat 2009; Fahselt 2007)

The rare plant management plan involves developing species-specific strategies that establish desired ecological conditions, management goals, and measurable objectives. Following the development of the strategy, management and monitoring activities are designed along with evaluation criteria and the requirements for future implementation adjustments, if needed.

6.1.1 Incorporation of Dene Knowledge

In collaboration with other members of the Road Oversight Committee (ROC) composed of representatives of the NBDB and LKFN, CZN has developed an approach to incorporate Dene Knowledge (DK) into required submissions.

DK studies of the area have been done in the past and are currently being updated by an independent consultant. Results of the DK studies are communicated directly to the communities in reports or recordings as appropriate. These studies provide valuable information about how things have changed over time which can then be used to help to understand if additional environmental changes that happen during the Project are natural or not.

Although the DK studies are important, it also needs to be recognized that DK is not static; therefore, it is not possible to write down all the relevant DK for a Project activity in a static plan. As noted by a ROC member: “DK is always with us and in us, so we incorporate it as we go. We know things as we see them, and we change what we do as we go.” For this reason, the ROC believes that the Dene Monitors, who will participate in the day-to-day monitoring of construction and operation of winter and all-season roads, are best-placed to observe activities in context as they happen and then to provide CZN with DK recommendations at that time, or at a later time via the ROC, as appropriate.

Based on the above understanding of DK, the ROC has proposed the following main ways to incorporate DK during all phases of the Project:

1. Management and monitoring plan review by the ROC
 - For NBDB and LKFN, the ROC will act as the primary reviewer of management and monitoring plans for all Project phases.
 - The consultant working on the DK studies has also reviewed the Phase 1 management and monitoring plans and provided suggestions to the ROC with respect to the specific incorporation of DK where appropriate. The ROC will similarly consider plan-specific suggestions from the DK consultant prior to providing comments on Phase 2 and Phase 3 plans.
 - The ROC will provide comments, including suggestions for the incorporation of DK, directly to CZN.
2. Via the MVLWB/Parks Canada regulatory process for review and comment on Project management and monitoring plans
 - Communities will have access to the results of any DK studies undertaken in the Project area. The study results can be used to inform comments from any party to the regulators for consideration.
 - During the regulatory review of plans, the NBDB and LKFN will provide comments, as necessary, on the incorporation of DK to Parks Canada and/or the MVLWB.
3. Ongoing advice from DM and the ROC
 - DM will have the opportunity to provide DK-based advice directly to CZN staff or other contractors during the construction and operations of all phases of the winter and all-season roads. Dene Monitors may also report back to the ROC if there is a need for DK-based adaptive management actions for any Project plan.
 - DK-based input from community members or DM may result in the ROC recommending adaptive management actions for the Project.

6.2 Management Objectives

The management goals and objectives with respect to rare plants are as follows:

- Protect, manage, and monitor rare plant species and their habitat that may be affected by Project construction and/or operations.
 - Collect data (e.g., descriptions of plant distribution (locally and more broadly within the NT), relative abundance, and habitat quality), to allow for the efficient and repeatable detection of changes over time.
- Provide CZN and regulatory agencies with a process and framework for the management of rare plants and rare plant assemblages within the Project area.

Rare plant management will be largely applicable during Phase 2; however, certain actions (e.g., construction monitoring in the vicinity of known rare plant locations) will be implemented as part of Phase 1 as well.

6.3 Mitigation Measures

Mitigation measures offer ways of controlling, reducing, or eliminating potential adverse effects of development or activities on the environment (per terms and definitions provided by the MVLWB. Mitigation measures are often presented as a hierarchy (Figure B), which is a best practice approach to managing environmental risks. Efforts should focus first on avoiding potential effects, followed next by reducing effects, then looking at options such as relocation and restoration. Education is another option presented as part of the mitigation proposed for rare plants identified within the ASR corridor.



Figure B: Mitigation Hierarchy (adapted from PricewaterhouseCoopers LLP [2010])

6.3.1 Protect/Avoid

Protection or avoidance of an environmental resource is the first mitigation option to consider. Specific procedures to avoid effects include the relocation of infrastructure, adjusting the means of implementation (e.g., through alternate uses of technologies or design), adjusting the timing of implementation (e.g., avoiding sensitive times within a season), or not proceeding with the activity (BC MOE 2014).

6.3.2 Reduce/Minimize

If avoidance is not possible as a mitigation measure, the next step in the mitigation hierarchy is to verify whether there is some way to reduce or minimize the size of the potential effect. This includes measures such as reducing the size of the overall disturbance area so that effects are at least avoided in part. Similarly, reducing the effect might involve shortening the length of time an activity might take.

6.3.3 Relocate

The relocation of species is, in simplest terms, the moving of an organism from one location to another. There is increasing interest to incorporate relocation into recovery planning options for species at risk; however, there are levels of uncertainty and risk associated with such that require careful consideration (Maslovat 2009). Relocations often have low success rates, can be expensive, and require considerable pre- and post-relocation planning and follow up to verify established goals and objectives are being met. A total of 30 individuals of small round-leaved bog orchid that were within the development footprint of the ASR were transplanted to adjacent areas. Further details are provided in Sections 4.2 and 6.4.2.

6.3.4 Restore

Restoration measures are usually carried out on-site, within areas that have been disturbed by project construction. Restoration can encompass a range of activities and scales, from localized site stabilization efforts to measures that aim to re-establish ecosystem function and structure. Restoration activities require thoughtful planning, implementation, and monitoring using scientifically defensible methods, including the establishment of restoration targets, so that a determination as to the effectiveness of the restoration program can be made.

6.3.5 Offset

Restoration offsets are similar to on-site restoration, with the exception that restoration activities are instead carried out at an off-site location where another project or activity has resulted in environmental disturbance.

6.3.6 Collect/Educate

In situations where disturbance to rare plants or rare plant habitat cannot be avoided, one option under consideration is the collection of rare plants from within the project disturbance footprint for the furtherance of scientific education. Specimens can be collected ahead of construction and donated to a local or university herbarium where they can contribute to the understanding of plant taxonomy, species distributions, and rare plant population trends (amongst others). Two specimens of small round-leaved bog orchid were collected for submission to local herbaria.

The general status ranks of the rare plants identified in the study area are either “May Be At Risk” or “Sensitive” within the NT, which means they are not at high risk of extinction or extirpation (although plants ranked as “May Be At Risk” are earmarked for more in-depth assessments and possible listing by COSEWIC). The rare plants identified

in the area should be able to withstand some level of disturbance and regular monitoring of the various RPMU that have been established to date per this RPMP will help verify their resilience.

6.4 Management Plan Strategy

The management strategy for rare plants detected within the CZN project study area is based on the establishment of RPMU which serve as the base units of land and biota that will be managed and monitored overall. The steps (adapted from McEachern et al. 2007) associated with developing a management and monitoring plan for rare plants include:

1. Gather information on each rare species, including descriptions of their ecology, distribution (locally and more broadly within the NT), relative abundance, and resilience to disturbance (particularly with respect to transplanting).
2. Identify RPMU (desktop followed by field installation).
3. Establish desired ecological conditions, goals, and objectives for each rare species.
4. Incorporate into the management strategy the collection, analysis, reporting, and storage methods of data generated.

6.4.1 Information Gathering

Information on green spleenwort, small round-leaved bog orchid, leathery grape-fern, one-glume spikerush, alpine groundsel has been compiled in Section 7.0 of the RPMP. Little is known regarding the ecology and resilience of these species to disturbance (e.g., transplanting specifically).

6.4.2 Identification of RPMU

Prior to field verification, candidate RPMU locations were identified spatially using the known locations of rare plants and the ecological land classification information developed by Parks Canada (Ponomarenko and Quirouette 2015). RPMU would be established in the vicinity of known rare plant occurrences in the same (or similar) ecotypes and beyond the disturbance footprint of the ASR. Where possible, RPMU would be established a minimum of 100 m away from the ASR alignment to reduce the potential influence of the road. Two types of RPMU may be established (depending on field conditions): one which supports rare plants (“undisturbed RPMU”) and one which is devoid of rare plants and would serve as a receiving site for individuals transplanted out of the ASR footprint (“transplant RPMU”). Both RPMU types would be monitored over the long-term.

Field work conducted in August to September 2019 resulted in the establishment of five RPMU that supported additional rare plants (“undisturbed”) and five RPMU that received transplanted individuals (see Table 4 above for a complete summary). RPMU were located approximately 100 m away from the ASR on average.

The documented locations of rare plants, and more recently, established RPMU have been provided to the ASR design team so that efforts to avoid these features can be made as part of Project design. Once the design of the ASR reaches the final stages, it will be compared again to known locations of rare plants and established RPMU to verify whether these features have been avoided. Areas that encroach upon or disturb these features may result in additional adjustments to the ASR.

Prior to construction, all rare plant occurrences and RPMU will be clearly marked.

6.4.3 Establishment of Desired Ecological Conditions, Goals, and Objectives

The overall goal of the RPMP is to minimize the overall effect of the ASR on rare plants. The conservation goals presented below should be reviewed more broadly by the ROC and other agencies and updated as required.

In undisturbed RPMU, the goal will be to maintain (or increase) the number of listed individuals present. In transplant RPMU, the goal will be to assess the transplanting success of individuals, with the understanding that transplanting rare plants is highly experimental with unknown levels of success. Particularly with small round-leaved bog orchid and leathery grape-fern, these species can undergo periods of dormancy which may confound monitoring results (in both undisturbed and transplant RPMU). Years where individuals are not detected is not an indication that they may have died.

6.4.4 Data Collection, Analysis, and Reporting

Data collection, analysis, reporting, and storage methods are described in more detail below. Monitoring will be conducted in individual RPMU to verify whether the desired ecological conditions for the rare plant species of interest are being achieved. RPMU will be treated as permanent plots to facilitate the consistent, long term collection of data.

Data collection will initially occur over a period of five consecutive years. After a minimum of three consecutive years, data will be analyzed for trends that would demonstrate whether rare plant densities are increasing, remaining stable, or declining. Trend analyses will continue starting in Year 3 for the duration of the program. If densities are shown to be in decline, further investigation into potential root causes (e.g., loss of local sites or habitat degradation) will be conducted and adjustments to the management strategy will be implemented as required.

6.4.4.1 Data Collection

Data will be collected to detect changes in the spatial extent, occupancy, abundance, and density of rare plants, as well as to characterize the quality of rare plant habitat (e.g., primarily with respect to visible signs of disturbance or habitat alteration). Regardless of the RPMU type, the following attributes will be collected, based on the methods used for this project to date (which are based on BC Ministry of Forests and Range and BC Ministry of Environment 2010):

Required Attributes	Optional Attributes
Plot number	Aspect (°)
Date	Slope (%)
Geographic location (in UTM format)	Relative slope position (e.g., crest, mid-slope, toe etc.)
Ecosite	Estimate of soil drainage (e.g., rapid, well, poor etc.)
Vegetation structure	Soil type (e.g., mineral, organic)
Elevation	Soil texture (e.g., sandy, clay, fibric etc.)
List of indicator plant species complete with estimates of percent cover	Surface organic horizon thickness (cm)
Estimate of % cover by vegetation layer (tree, shrub, herb, moss/lichen)	Soil coarse fragment content (%)
Site photographs	Relative Soil Moisture Regime (1-7)
	Relative Nutrient Regime (A-E)

Both required and optional attributes were collected during the initial survey of each RPMU. Subsequent monitoring years will collect required attributes only; optional attributes would be collected if notable changes in habitat quality are observed (e.g., relative soil drainage or relative soil moisture regime has changed markedly).

During construction, environmental monitors and/or DM will be present to verify activities occurring adjacent to established RPMU are not having adverse effects (e.g., excessive dust production, runoff). Environmental monitors and/or DM will also watch for rare plants that are outside established RPMU; any additional rare plants that are identified will be immediately flagged for follow-up discussions with CZN.

Following construction, RPMU will be surveyed at yearly intervals during the growing season (e.g., June to August) for five consecutive years, with trend analyses commencing after the third year of data collection to establish initial patterns. If after five years rare plant densities are shown to be stable or increasing, the survey interval can be extended to every two years for the next six years (with trend analyses continuing after each survey year). If trends are still stable or positive after this timeframe, the survey interval can be extended again to every five years (see suggested sampling intervals below in Figure C).

If rare plant densities are shown to be in decline, habitat degradation or disturbance is evident, or there is increased encroachment by invasive species, monitoring will continue on (or revert back to) a yearly basis and adjustments to the management plan and project operations may be required.

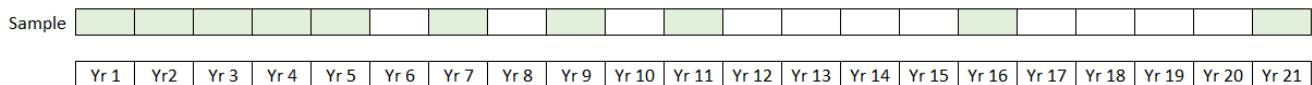


Figure C: Suggested Sampling Interval (Years Sampled in Green).

6.4.4.2 Data Analysis

Data will be entered into a database designed to track activities by RPMU. Data will be analyzed for each RPMU and comparisons between RPMU will also be made for *P. orbiculata*. At a minimum, the number of individuals recorded, area sampled (in m²), density (individuals/m²), population area (m²), and an estimate of population size will be presented annually. Other information (e.g., habitat quality) that might be relevant to the characterization of rare plants will also be presented.

6.4.4.3 Reporting

A summary of activities conducted in accordance with the approved Rare Plant Management Plan will be presented in the Annual Permit Report and will include:

- A summary and interpretation of any monitoring results including any Action Level exceedances; and
- A list of any Action Level exceedances and a description of actions taken in response to Action Level exceedances.

Per the Invasive Species Management Plan (Tetra Tech 2019x), weed control measures that may be required in the vicinity of known rare plant occurrences will be selected based on their ability to limit disturbances to rare plants. Particular effort will also be made to limit the establishment of invasive plant species in the vicinity of established rare plants and known rare plant habitat.

Additionally, per the Sediment and Erosion Control Plan (Tetra Tech 2019y), efforts will be made to prevent or limit soil erosion in the vicinity of rare plants or rare plant habitat.

7.0 MANAGEMENT OF KNOWN RARE PLANT OCCURRENCES

As presented in Section 4.2, five rare plant species were identified during surveys of the various CZN study areas. Location information was not available for one-glume spikerush and alpine groundsel. Surveys in 2019 (nor surveys after 2009) did not detect these species. Avoidance through detailed design of the PWR and ASR is the primary mitigation strategy, followed by transplanting into a suitable RPMU, and collection for donation to a local herbarium.

7.1 *Asplenium trichomanes-ramosum* (*A. viride*) – Green Spleenwort

Status

May Be At Risk (NT GS Rank)

No federal status

Description

Deciduous with clustered leaves. Leaves narrowly lanceolate, 5 cm to 15 cm long, 0.5 cm to 1.2 cm wide, rachis not winged, green throughout, pinnae in pairs, egg-shaped to oblong, 3 mm to 7 mm long, 2 mm to 5 mm wide, with few notches towards the tip. Sori 1-2, narrow, 2 mm to 3 mm long, indusia linear, attached with their sides (Douglas et al. 2000).



Dwarf plants with delicate linear fronds 4 cm to 14 cm long. Rachis green, pinnate, the pinnules round; sori elongate; indusia straight or slightly curved, attached to the upper side of the fertile vein (Porsild and Cody 1980).

Favourable Habitat

Located in Shrub-Subalpine general ecosystem type and Medium-Low Shrub ecotype.

Mesic to moist crevices in limestone and other basic rocks from low elevations to subalpine zones (Klinkenberg 2017).

Rare on wet rocks; Nahanni Range, Mackenzie Mountains (Porsild and Cody 1980).

Options for Transplanting

Little information is available specific to the disturbance and transplanting success of *A. trichomanes-ramosum*. Efforts should be made to capture ample rooting material.

Becker and Becker (2010) report that transplanting *A. scolopendrium* to rocky slopes or boulder heaps was relatively successful. Plants were removed from their natural habitat to a controlled growing environment for approximately nine months prior to being transplanted to their new habitat.

Bristol (2018) reports moderate success with outplanting *A. trichomanes* to rocky sites provided soil acidity, shade conditions, and rock composition are taken into consideration.

7.2 *Platanthera orbiculata* – Small Round-leaved Bog Orchid

Status

Sensitive (NT GS Rank)

No federal status

Description

Leaves two, basal, orbicular-oval, 10 cm to 20 cm in diameter, usually flat on the ground; scape with 1 to several bracts; raceme open, the flowers pedicellate, greenish-white, the lip linear-oblong, blunt, about 10 mm long, the spur club-shaped, twice as long as the lip (Porsild and Cody 1980).

Perennial herb from fleshy, spindle-shaped stem bases, few fibrous roots; stems 20 cm to 50 cm tall without leaves, with 1 to 5 lance-shaped bracts (Klinkenberg 2017).



Inflorescence a terminal, loosely 5 to 25 flowered spike, bracted, the bracts shorter than the flowers; flowers whitish-green, stalks 3 mm to 7 mm long; lower sepals 8 mm to 13 mm long, triangular to broadly lanceolate, somewhat bent back, the upper sepal kidney-shaped to broadly egg-shaped. Petals shorter and lighter than sepals, egg-shaped to broadly lanceolate, bent back; lip 10 mm to 20 mm long, strap-shaped, whitish, hanging downward with slightly up-curved tip; spur somewhat club-shaped, curved, 15 mm to 25 mm long (Klinkenberg 2017).

Favourable Habitat

Located in Mixedwood general ecosystem type and Mixed Predominantly Coniferous Forest ecotype.

Spruce and tamarack woodland in the southern Mackenzie Mountains (Porsild and Cody 1980).

Moist to wet forests, bogs, swamps, and streambanks in the montane zone (Douglas et al. 2001b).

Options for Transplanting

Little information is available specific to the disturbance and transplanting success of *P. orbiculata*. Terrestrial orchids are highly dependent on mycorrhizal fungi throughout their life stages; this relationship is complex and poorly understood (Poff 2016; Sharp 2004; Cotterill 1998). Efforts should be made to capture larger volumes of rooting material/soil while transplanting to maximize the amount of mycorrhizae present in the substrate.

Some orchid species (such as *P. orbiculata*) can be adversely affected by disturbance and may react by going dormant (Fulkerson et al. 2017; Poff 2016; COSEWIC 2003). If individuals are not observed following transplanting, monitoring should be carried out over a sufficient length of time to distinguish whether the absence of individuals is the result of poor survival or dormancy.

7.3 *Eleocharis uniglumis* – One-glume Spikerush

Status

Sensitive (NT GS Rank)

No federal status

Description

Culms 15 cm to 25 cm tall, wiry, summit, or orifice of the sheaths square or barely oblique (Porsild and Cody 1980).

Perennial herb from freely branching rhizomes, stems scattered or in small clusters, slender to very stout, circular in cross-section, tapered or somewhat flattened, 10 cm to 100 cm tall. Leaf sheaths firm, reddish-brown, distinctly oblique, purplish or reddish below, somewhat flaring upwards, blades lacking. Spikes solitary, terminal, lanceolate or narrowly egg-shaped, 5 mm to 23 mm long, light to dark brown or chestnut, several-flowered (Douglas et al. 2001a).



Photo courtesy of Matti Virtala

Favourable Habitat

Calcareous or saline seepages along river banks or lake shores; rarely growing in water (Porsild and Cody 1980).

Wet meadows, ditches, and shorelines at low to montane elevations (Douglas et al. 2001a).

Options for Transplanting

Little information is available specific to the disturbance and transplanting success of *E. uniglumis*. Transplanting efforts should focus on capturing larger volumes of soil to maximize the transfer of below-ground rooting material along with above-ground structures.

7.4 *Packera pauciflora* – Alpine Groundsel

Status

Sensitive (NT GS Rank)

No federal status

Description

Essentially glabrous perennial, 3 cm to 6 cm tall, leaves somewhat fleshy, reddish-orange flower heads (Porsild and Cody 1980).

Perennial herb from fibrous-rooted, simple or slightly branched woody stem base, stems erect, solitary or several, simple or few-branched above, glabrous or nearly so, 10 cm to 50 cm tall (Klinkenberg 2017).



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Basal leaves thick, succulent, elliptic, egg-shaped, or nearly round, stalked, 1.5 cm to 10 cm long, including the stalk, 1 cm to 4 cm wide, glabrous to sparsely white woolly-hairy, toothed; stem leaves similar, lanceolate, variously toothed, cleft, or lobed, progressively reduced upwards, becoming unstalked (Klinkenberg 2017).

Flower heads discoid, solitary to several at the tips of stems or branches; involucre 6 mm to 10 mm tall; involucre bracts linear-lanceolate, reddish-purple throughout or at least above the middle, rarely green, glabrous, or sparsely hairy; bracteoles few, purplish; discoid or rarely short and yellow; disk flowers orange or reddish (Klinkenberg 2017).

Favourable Habitat

Alpine, lakeshores, and herb mats (Porsild and Cody 1980).

Wet to moist meadows in the subalpine and alpine zones (Klinkenberg 2017).

Options for Transplanting

Little information is available specific to the disturbance and transplanting success of *P. pauciflora*. Transplanting efforts should focus on capturing larger volumes of soil to maximize the transfer of below-ground rooting material along with above-ground structures.

7.5 *Sceptridium multifidum* (*Botrychium multifidum*) – Leathery Grape-fern

Status

May Be At Risk (NT GS Rank)

No federal status

Description

Sterile blade 3-pinnate, broadly triangular, leathery, wintergreen, with a long petiole attached at the base of the stipe, frond 5 cm to 20 cm tall (Porsild and Cody 1980).

Evergreen perennial 7 cm to 30 cm tall. Sterile leaf broadly triangular, stalks 2 cm to 15 cm long, wintergreen, thick, leathery, smooth, and 3 to 4 pinnate up to 25 cm to 25 cm long and about as wide. Pinnae to 10 pairs, all in the plane of the blade; pinnules lopsided egg-shaped, rounded with entire margins (Douglas et al. 2000).



Favourable Habitat

Prairie clearings, north to Fort Simpson, widespread but local (Porsild and Cody 1980).

Moist to wet meadows, grassy clearings, lake margins, riverbanks, alluvial forests (Klinkenberg 2017; Douglas et al. 2000; Anderson 2005).

Sandy, subacidic or acidic soils that may be high in organic matter. Soil moisture requirements are generally mesic to moist and in areas where soils may become seasonally dry (Anderson 2005).

Options for Transplanting

Little information is available specific to the transplanting success of *S. multifidum*, although *Botrychium* species in general are very difficult to transplant (Anderson 2005). *S. multifidum* is highly reliant on mycorrhizal interactions in each of its life stages. The below-ground ecology of this species is critical to understanding their growth, reproduction, and overall persistence; however, little is known regarding what factors are of most importance (Anderson 2005). The response of *S. multifidum* to disturbance varies and is dependent on the disturbance type, intensity, and frequency (Anderson 2005).

S. multifidum can also experience periods of dormancy, with some individuals remaining dormant for at least one year; however, this species might be too dependent on photosynthesis to remain dormant for longer periods (Anderson 2005).

Transplanting efforts should focus on capturing larger volumes of soil to maximize the transfer of below-ground rooting material along with above-ground structures.

REFERENCES

- Aiken, S.G., Dallwitz, M.J., Consaul, L.L., McJannet, C.L., Boles, R.L., Argus, G.W., Gillett, J.M., Scott, P.J., Elven, R., LeBlanc, M.C., Gillespie, L.J., Brysting, A.K., Solstad, H., and Harris, J.G. 2007. Flora of the Canadian Arctic Archipelago: Descriptions, Illustrations, Identification, and Information Retrieval. NRC Research Press, National Research Council of Canada, Ottawa. <http://nature.ca/aaflora/data>.
- Alberta Native Plant Council (ANPC). 2006. Plant Collection Guidelines for Researchers, Students, and Consultants. Version 2. Alberta Native Plant Council, Edmonton, AB. Available on-line at https://anpc.ab.ca/wp-content/uploads/2015/01/researchers_students.pdf.
- Alberta Native Plant Council (ANPC). 2012. ANPC Guidelines for Rare Vascular Plant Surveys in Alberta – 2012 Update. Alberta Native Plant Council, Edmonton, AB. Available on-line at <http://www.anpc.ab.ca/content/resources.php>.
- Anderson, D.G. (2005, November 29). *Botrychium multifidum* (Gmel.) Rupr. (leathery grapefern): a technical conservation assessment. [Online]. USDA Forest Service, Rocky Mountain Region. Available: <http://www.fs.fed.us/r2/projects/scp/assessments/botrychiummultifidum.pdf> [Accessed September 2019].
- Argus, G.W. 2004. A Guide to the identification of *Salix* (willows) in Alaska, the Yukon Territory and adjacent regions. July 2004 workshop on willow identification.
- BC Ministry of Forests and Range and BC Ministry of Environment. 2010. Land Management Handbook 25 - Field Manual for Describing Terrestrial Ecosystems – 2nd edition. 266 pp. Available at: <http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh25-2.htm>.
- BC Ministry of Environment (MOE). 2014. Procedures for mitigating impacts on environmental values (environmental mitigation procedures) Version 1.0. BC MOE Ecosystems Branch Environmental Sustainability and Strategic Policy Division. Victoria, BC. May 27, 2014. Available online: https://www2.gov.bc.ca/assets/gov/environment/natural-resource-policy-legislation/environmental-mitigation-policy/em_procedures_may27_2014.pdf.
- Becker, T. and U. Becker. 2010. Successful transplantation of hart's tongue fern population (*Asplenium scolopendrium* L.) with ten years of monitoring. *Tuexenia* 30: 47-58.
- Bristol, M. 2018. Plant Propagation Protocol for *Asplenium trichomanes* L. ESRM 412 – Native Plant Production, University of Washington, Spring 2018. Available online at: <http://courses.washington.edu/esrm412/protocols/ASTR2.pdf>.
- Burt, P. 2002. Barrenland Beauties. Outcrop Ltd. Yellowknife, NT. 238 pp.
- Cody, W.J. 2000. Flora of the Yukon Territory. 2nd Ed. NRC Research Press, Ottawa, Canada.
- COSEWIC 2003. COSEWIC assessment and update status report on the eastern prairie fringed-orchid *Platanthera leucophaea* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 27 pp. Available online at: <https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/cosewic-assessments-status-reports/eastern-prairie-fringed-orchid.html>
- Cotterill, P. 1998. Orchids of Lakeland. A field Guide to Lakeland Provincial Park, Provincial Recreation Area and Surrounding Region. Available online at: <https://anpc.ab.ca/wp-content/uploads/2015/01/Orchid.pdf>.
- Douglas, G.W., G.B. Straley, D.V. Meidinger, and J. Pojar (Editors). 1998. Illustrated Flora of British Columbia, Volume 1: Gymnosperms and Dicotyledons (Aceraceae through Asteraceae). B.C. Min. Environ., Lands and Parks, and B.C. Min. For., Victoria, B.C. 436 pp.
- Douglas, G.W., D.V. Meidinger, and J. Pojar (Editors). 2000. Illustrated Flora of British Columbia, Volume 5: Dicotyledons (Salicaceae through Zygophyllaceae) and Pteridophytes. B.C. Min. Environ., Lands and Parks, and B.C. Min. For., Victoria, B.C. 389 pp.

- Douglas, G.W., D.V. Meidinger, and J. Pojar (Editors). 2001a. Illustrated Flora of British Columbia, Volume 6: Monocotyledons (Acoraceae through Najadaceae). B.C. Min. Environ., Lands and Parks, and B.C. Min. For., Victoria, B.C. 361 pp.
- Douglas, G.W., D.V. Meidinger, and J. Pojar (Editors). 2001b. Illustrated Flora of British Columbia, Volume 7: Monocotyledons (Orchidaceae through Zosteraceae). B.C. Min. Sustain. Res. Manage., and B.C. Min. For., Victoria, B.C. 379 pp.
- EBA Engineering Consultants Ltd. 2009. 2009 Rare Plant and Wildlife Survey, Prairie Creek Mine Area and Winter Road, NT. Report prepared for Canadian Zinc Corporation October 2009.
- EBA Engineering Consultants Ltd. 2011. Reclamation Assessment, Invasive and Rare Plant Survey 2010, Prairie Creek Mine Access Road, NT. Report prepared for Canadian Zinc Corporation April 2011.
- Ecosystem Classification Group. 2007 (rev. 2009). Ecological Regions of the Northwest Territories – Taiga Plains. Department of Environment and Natural Resources, Government of the Northwest Territories, Yellowknife, NT, Canada. Viii + 173 pp. + folded insert map.
- Ecosystem Classification Group. 2010. Ecological Regions of the Northwest Territories – Cordillera. Department of Environment and Natural Resources, Government of the Northwest Territories, Yellowknife, NT, Canada. x + 245 pp. + insert map.
- Environment and Natural Resources (ENR). 2013. NT Species Infobase. Government of the Northwest Territories, Yellowknife, NT. Web access: <http://nwt-species-at-risk.ca> (August 2016).
- J.R. Fulkerson, K. Dillman, and M.L. Carlson. 2017. *Platanthera orbiculata* (Pursh.) Lindl.: Conservation Assessment on the Tongass National Forest, Alaska Region. U.S. Department of Agriculture, and Alaska Natural Heritage Program, University of Alaska Anchorage. Anchorage, Alaska. 43 pp. plus appendix. Available online at: https://accs.uaa.alaska.edu/wp-content/uploads/Platanthera_orbiculata_Assessment_Final.pdf.
- Kershaw, L., A. MacKinnon, and J. Pojar. 1998. Plants of the Rocky Mountains. Lone Pine Publishing, Edmonton, Canada.
- Klinkenberg, B. (Editor) 2017. E-Flora BC: Electronic Atlas of the Plants of British Columbia [eflora.bc.ca]. Lab for Advanced Spatial Analysis, Department of Geography, University of British Columbia, Vancouver. [Accessed: October 2018].
- Maslovat, C. 2009. Guidelines for Translocation of Plant Species at Risk in British Columbia. Report prepared for BC Ministry of Environment, Victoria, BC.
- McEachern, K., B. Pavlik, J., Rebman, and R. Sutter. 2007. San Diego Multiple Species Conservation Program (MSCP) rare plant monitoring review and revision: U.S. Geological Survey Scientific Investigations Report 2007–5016, 68 p.
- McJannet, C.L., G.W. Argus and W.J. Cody. 1995. Rare Vascular Plants in the Northwest Territories. Canadian Museum of Nature, Ottawa. 104 pp.
- NT Species at Risk Infobase. 2018. Available online: <http://nwt-species-at-risk.ca>. Environment and Natural Resources, GNWT, Yellowknife, NT.
- Poff, K. 2016. *Platanthera chapmanii*: culture, population augmentation, and mycorrhizal associations. M.Sc., Thesis submitted to the Graduate Faculty of Texas Tech University.
- Ponomarenko, S. and J. Quirouette. 2015. Ecotype Mapping Report for Nahanni National Park Reserve. Monitoring and Ecological Information. Protected Areas Establishment and Conservation Directorate. Parks Canada. Gatineau, QC. Date: April 29, 2015. Version 1.
- Porsild, A.E. and W.J. Cody. 1980. Vascular Plants of Continental Northwest Territories, Canada. National Museum of Natural Sciences, National Museums of Canada, Ottawa, Canada. Catalogue No. NM92-71/1979.

- PricewaterhouseCoopers LLC. 2010. Biodiversity offsets and the mitigation hierarchy: a review of current application in the banking sector. A study completed on behalf of the Business and Biodiversity Offsets Programme and the UNEP Finance Initiative. Available online: http://www.unepfi.org/fileadmin/documents/biodiversity_offsets.pdf.
- Sharp, P.C., 2004. *Platanthera ciliaris* (L.) Lindl. Yellow-fringed orchis. Conservation and Research Plan for New England. Available online at: <https://www.nativeplanttrust.org/documents/97/platantheraciliaris.pdf>.
- Tetra Tech Canada Inc. 2016. July 2016 Vegetation and Wildlife Baseline Surveys – Prairie Creek All Season Road. Report prepared for Canadian Zinc Corporation August 17, 2016.
- Tetra Tech. 2018. 2017 Baseline Wildlife and Vegetation Field Report, Proposed Prairie Creek All-Season Access Road Revision 01. Report prepared for Canadian Zinc Corporation August 27, 2018.
- Wek'èezhii Land and Water Board (WLWB). 2010. Guidelines for Adaptive Management – a Response Framework for Aquatic Effects Monitoring. DRAFT. Prepared by the Wek'èezhii Land and Water Board, October 17, 2010. Available online at: <https://mvlwb.com/sites/default/files/documents/Final-Draft-Response-Framework-for-Aquatic-Effects-Monitoring-Oct-17-2010.pdf>.
- Working Group on General Status of NT Species. 2016. NT Species 2016-2020 – General Status Ranks of Wild Species in the Northwest Territories, Department of Environment and Natural Resources, Government of the Northwest Territories, Yellowknife, NT. 304 pp.
- Wulder, M., M. Cranny, J. Dechka, and J. White. 2004. An Illustrated Methodology for Land Cover Mapping of Forests with Landsat-7 ETM+ Data: Methods in Support of EOSDF Land Cover, Version 3. Victoria, BC, Canada: Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre. 35 pp.

FIGURES

Figure 1	Prairie Creek Mine Area Overview
Figure 2	Proposed Winter Road Alignment
Figures 3a – 3e	Rare Plant Species Locations and RPMU Establishment

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LEGEND

- ✕ Kilometre Marker
- Existing Access Road to be used for Phase 1 Winter Road

NOTES
 Base data source:
 Kilometre Marker and Winter Road alignment from AllNorth (Dec 2018).
 Imagery from ESRI; DigitalGlobe (2016).



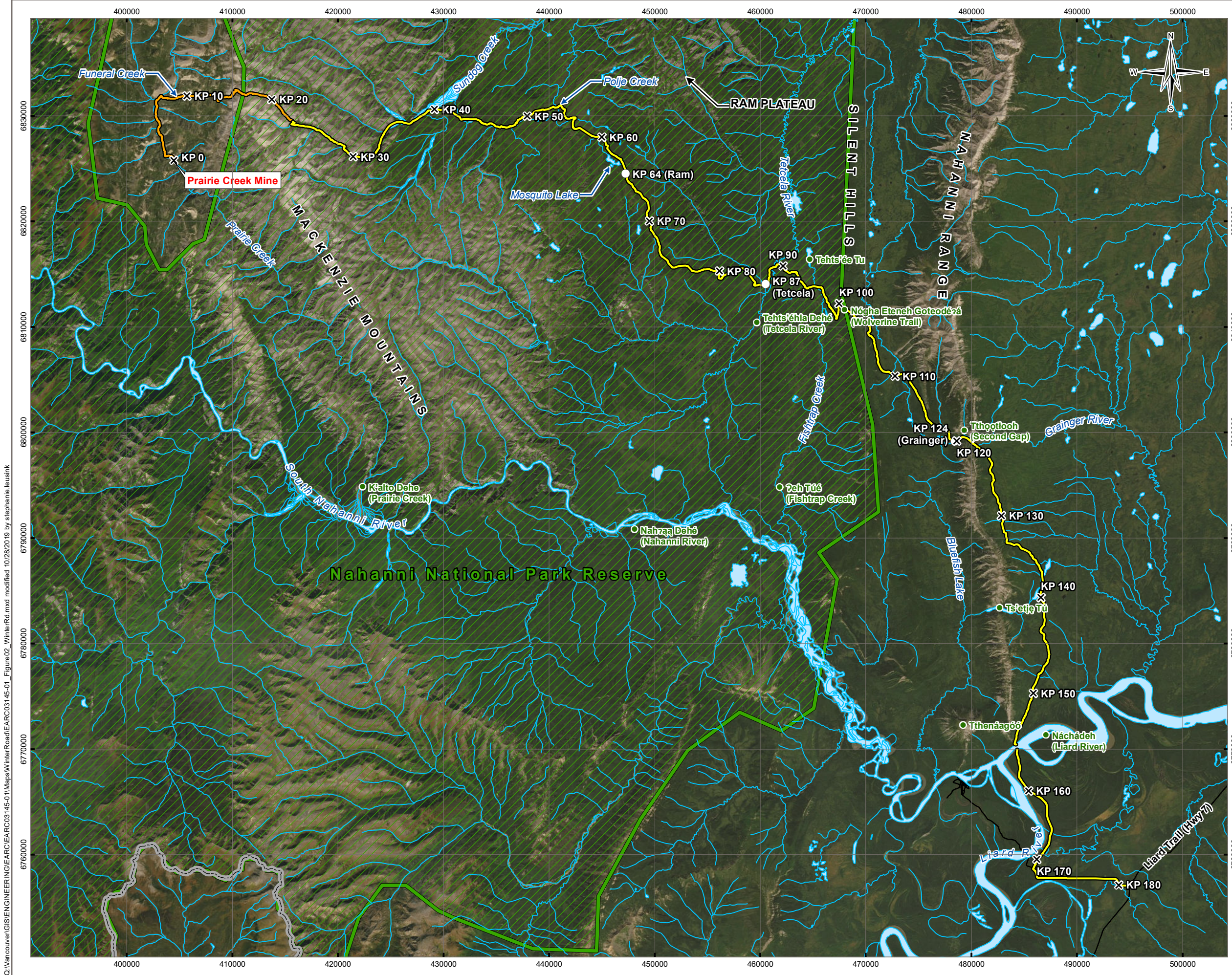
STATUS
 ISSUED FOR REVIEW

PRAIRIE CREEK PHASE 1 WINTER ROAD

Prairie Creek Mine Area Overview

PROJECTION UTM Zone 10	DATUM NAD83	CLIENT CANADIAN ZINC CORPORATION
Scale: 1:15,000 Metres		
FILE NO. EARC03145-01_Figure01_MineArea.mxd		
OFFICE Tl-VANC	DWN SL	CKD YL
DATE June 12, 2019	APVD RH	REV 0
PROJECT NO. ENG.EARC03145-01		Figure 1





LEGEND

- Proposed Camp Location
- ✕ Kilometre Marker
- Proposed Phase 1 Winter Road
- Existing Access Road to be used for Phase 1 Winter Road

Base Features

- Traditional Location
- Existing Road
- Watercourse
- Waterbody
- ▭ Nahanni National Park Reserve Boundary
- ▭ Yukon / NWT Border

NOTES
 Base data source:
 Kilometre Marker and Winter Road alignment from AllNorth (Dec 2018).
 Existing roads from CanVec (1:50,000)
 Watercourses from CanVec (1:250,000)

STATUS
 ISSUED FOR REVIEW

**PRAIRIE CREEK
 PHASE 1 WINTER ROAD**

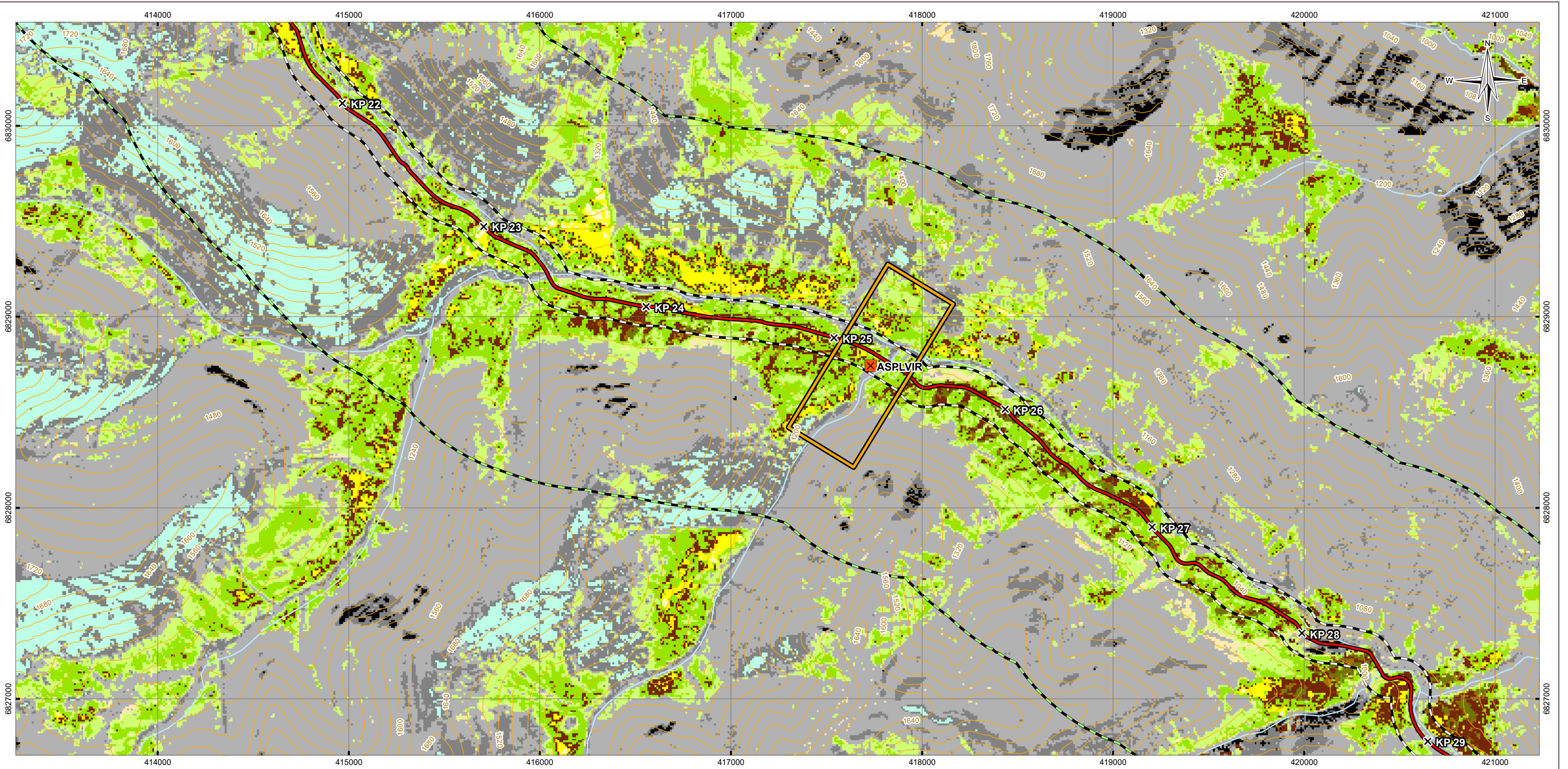
**Proposed Phase 1
 Winter Road Alignment**

PROJECTION UTM Zone 10		DATUM NAD83		CLIENT CANADIAN ZINC CORPORATION	
Scale: 1:350,000 					
FILE NO. EARC03145-01_Figure02_WinterRd.mxd					
OFFICE TL-VANC	DWN SL	CKD YL	APVD RH	REV 0	TETRA TECH
DATE October 28, 2019	PROJECT NO. ENG.EARC03145-01				

Figure 2

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LEGEND

Rare Plant Observation (2017)

- Asplenium viride*
ASPLVIR (4 individuals)
- Expanded Rare Plant Search Area
- 100 m Buffer
- 1 km Buffer

Other Symbols

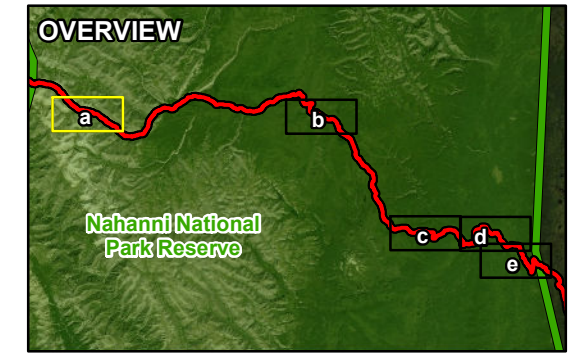
- All-Season Road Kilometre Marker
- Prairie Creek All-Season Road (June 2019)
- Contour (40 m)
- Watercourse
- Nahanni National Park Reserve Boundary

Ecotype Class (Parks Canada)

- 1. Alpine Herb Tundra and Meadow
- 3. Terrain or Cloud Shadow / Water
- 4. Subalpine Tall Shrub
- 7. Low Sparse Shrub
- 8. Rock – Lichen
- 9. Rock
- 10. Mixed Predominantly Coniferous Forest

- 12. Medium – Low Shrub
- 13. Coniferous Forest
- 15. Subalpine Shrub – Sparse Trees
- 16. Spruce – Lichen Woodland
- 17. Spruce – Lichen – Moss Woodland
- 24. Mixed Predominantly Deciduous Forest / Tall Shrub
- 26. Ice / Snow

NOTES
Road alignment provided by AllNorth (June 2019).
Base data source: Parks Canada; CanVec; GeoBase.



STATUS
ISSUED FOR REVIEW

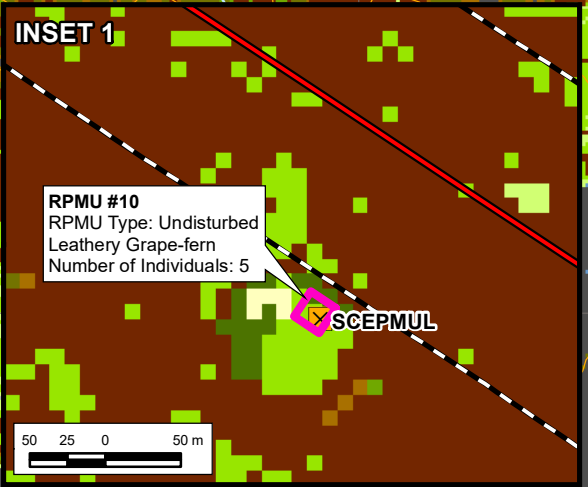
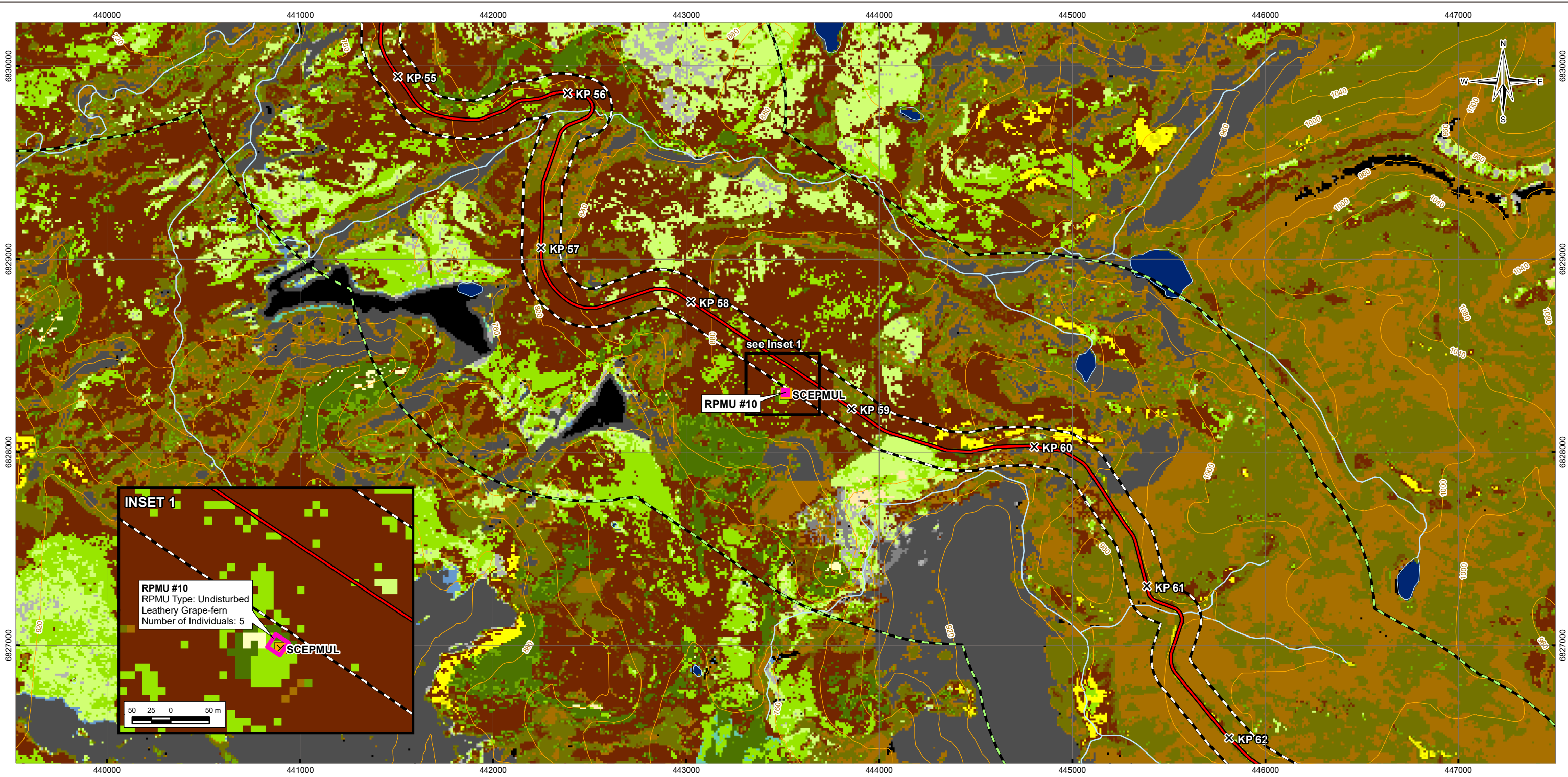
**RARE PLANT MANAGEMENT PLAN
PRAIRIE CREEK ALL-SEASON ROAD**

**Additional Rare Plant Surveys
and RPMU Establishment**

PROJECTION UTM Zone 10		DATUM NAD83		CLIENT 	
Scale: 1:20,000		400 200 0 400		TETRA TECH	
Metres					
FILE NO. EARC03145-01_Figure03a_RarePlantMU.mxd					
OFFICE TI-VANC	DWN SL	CKD MRV	APVD TP	REV 0	
DATE October 2, 2019	PROJECT NO. ENG.EARC03145-01				

Figure 3a

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LEGEND

Rare Plant Observation (2019)

- ✕ Scepstridium multifidum
SCEPMUL (5 individuals)
- Undisturbed RPMU
- ✕ All-Season Road Kilometre Marker
- Prairie Creek All-Season Road (June 2019)
- 100 m Buffer
- 1 km Buffer

- ~ Contour (40 m)
- ~ Watercourse
- Waterbody
- Nahanni National Park Reserve Boundary

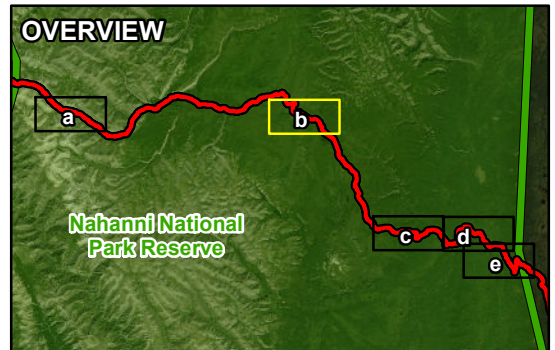
Ecotype Class (Parks Canada)

- 1. Alpine Herb Tundra and Meadow
- 3. Terrain or Cloud Shadow / Water
- 4. Subalpine Tall Shrub
- 7. Low Sparse Shrub

- 8. Rock – Lichen
- 9. Rock
- 10. Mixed Predominantly Coniferous Forest
- 12. Medium – Low Shrub
- 13. Coniferous Forest
- 14. Subalpine Coniferous Woodland
- 15. Subalpine Shrub – Sparse Trees
- 16. Spruce – Lichen Woodland
- 17. Spruce – Lichen – Moss Woodland

- 18. Wetland
- 19. Alluvial Non-vegetated
- 22. Water / Terrain Shadow
- 23. Deciduous Forest / Tall Shrub
- 24. Mixed Predominantly Deciduous Forest / Tall Shrub
- 25. Recently Burnt
- 28. Permanent Water

NOTES
Road alignment provided by AllNorth (June 2019).
Base data source: Parks Canada; CanVec; GeoBase.

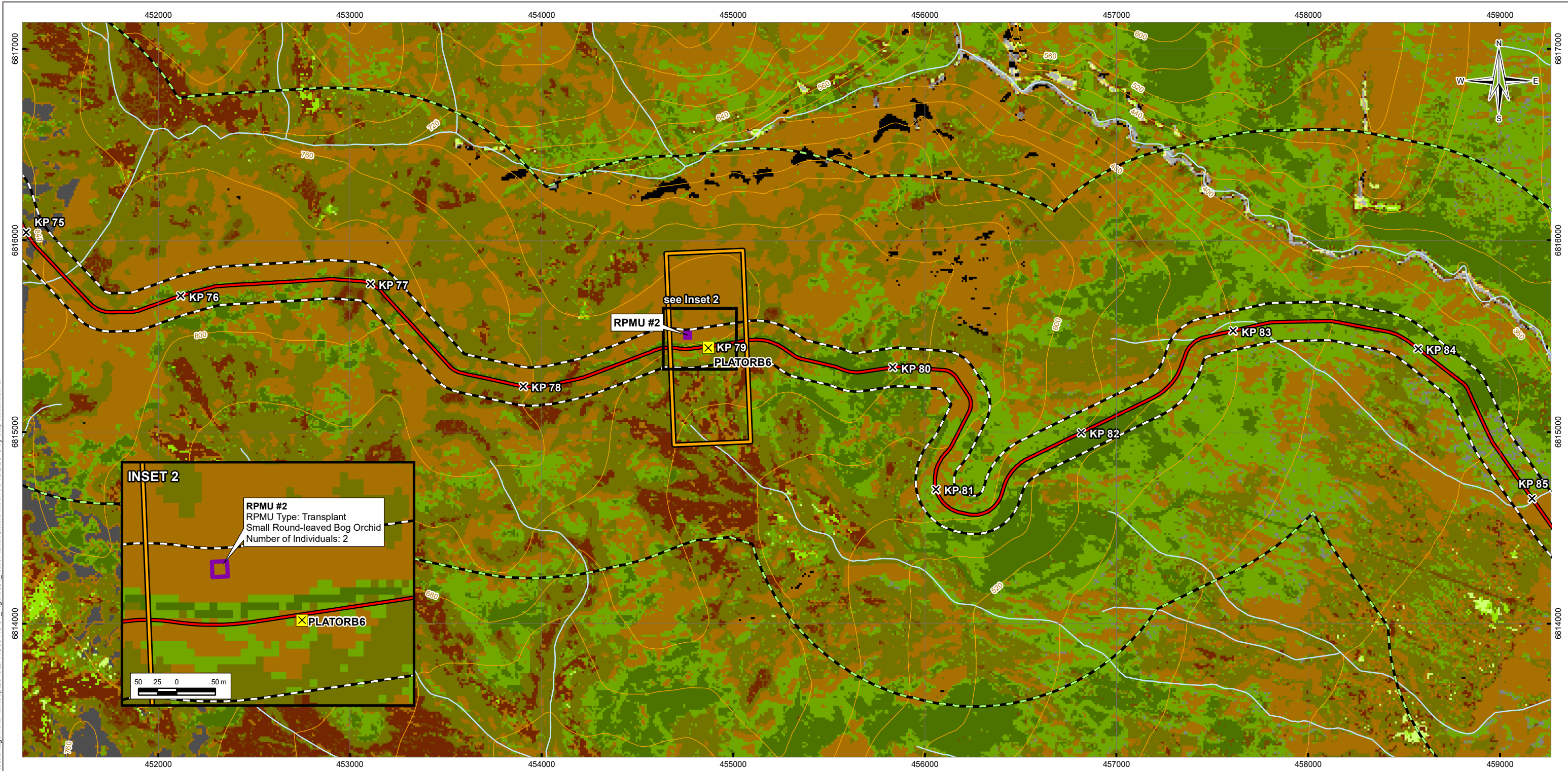


STATUS
ISSUED FOR REVIEW

**RARE PLANT MANAGEMENT PLAN
PRAIRIE CREEK ALL-SEASON ROAD**

**Additional Rare Plant Surveys
and RPMU Establishment**

PROJECTION UTM Zone 10		DATUM NAD83		CLIENT 	
Scale: 1:20,000		400 200 0 400		TETRA TECH	
FILE NO. EARC03145-01_Figure03b_RarePlantMU.mxd		DATE October 2, 2019		PROJECT NO. ENG.EARC03145-01	
OFFICE TI-VANC		DWN SL	CKD MRV	APVD TP	REV 0
Figure 3b					



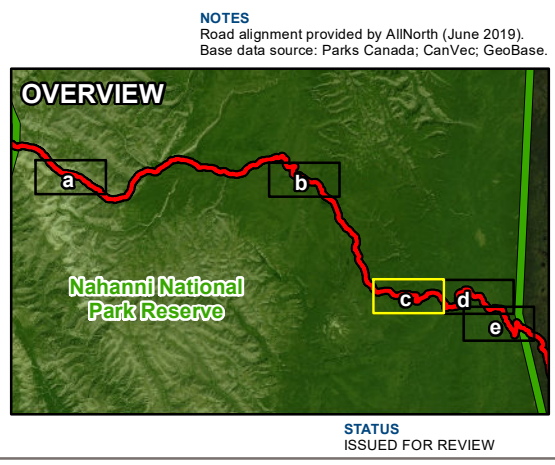
LEGEND

- Rare Plant Observation (2017)**
- ✕ *Platanthera orbiculata* PLATORB6 (1 individual)
 - Transplant RPMU
 - ▭ Expanded Rare Plant Search Area

- ✕ All-Season Road Kilometre Marker
- Prairie Creek All-Season Road (June 2019)
- - - 100 m Buffer
- ⋯ 1 km Buffer
- ~ Contour (40 m)
- ~ Watercourse
- ▭ Nahanni National Park Reserve Boundary

- Ecotype Class (Parks Canada)**
- 1. Alpine Herb Tundra and Meadow
 - 2. Rock / Water
 - 3. Terrain or Cloud Shadow / Water
 - 4. Subalpine Tall Shrub
 - 7. Low Sparse Shrub
 - 8. Rock - Lichen
 - 9. Rock

- 10. Mixed Predominantly Coniferous Forest
- 12. Medium - Low Shrub
- 13. Coniferous Forest
- 16. Spruce - Lichen Woodland
- 17. Spruce - Lichen - Moss Woodland
- 23. Deciduous Forest / Tall Shrub
- 24. Mixed Predominantly Deciduous Forest / Tall Shrub
- 25. Recently Burnt

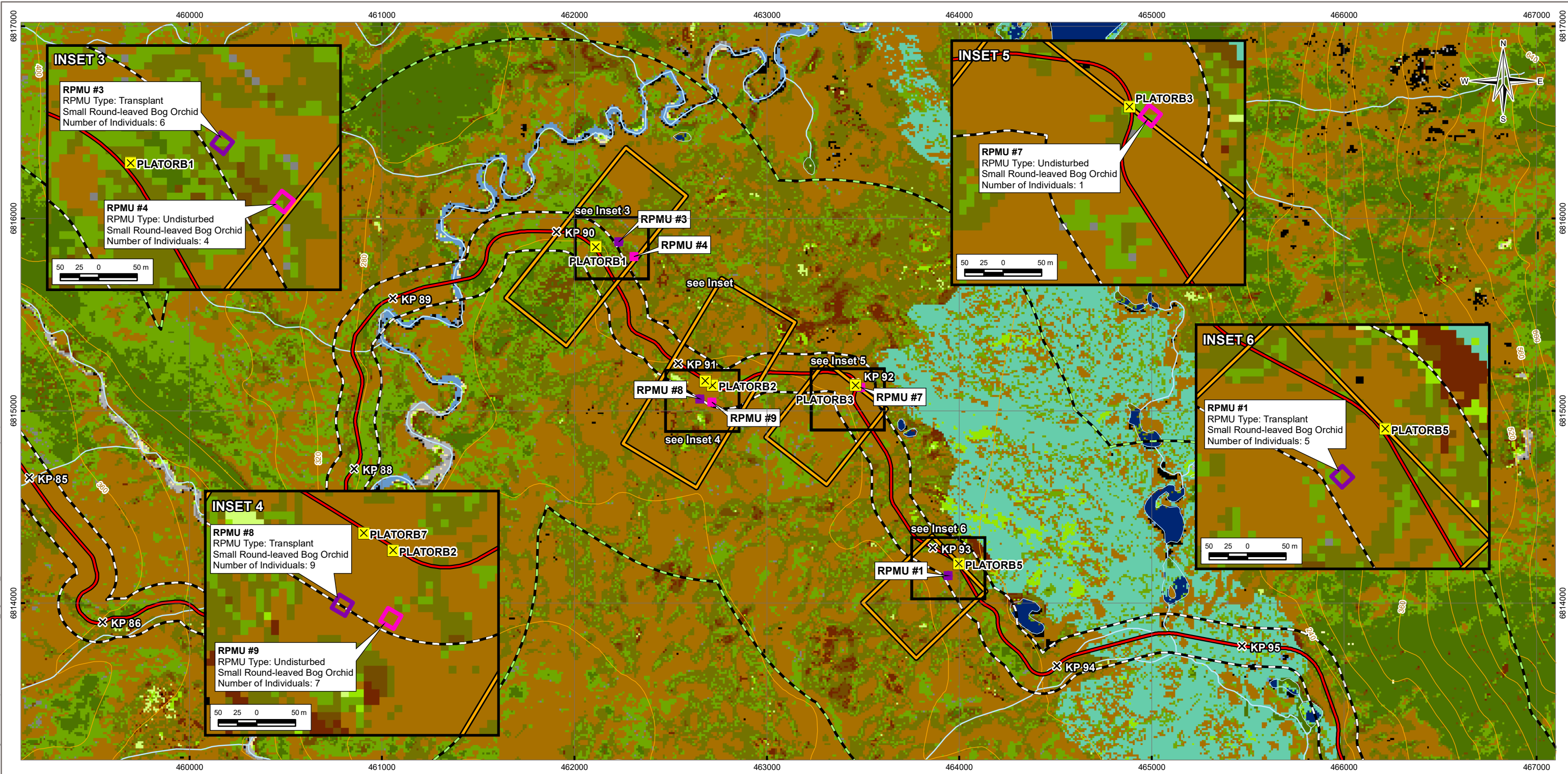


**RARE PLANT MANAGEMENT PLAN
 PRAIRIE CREEK ALL-SEASON ROAD**

**Additional Rare Plant Surveys
 and RPMU Establishment**

PROJECTION UTM Zone 10	DATUM NAD83	CLIENT
Scale: 1:20,000		
400 200 0 400 Metres		
FILE NO. EARC03145-01_Figure03c_RarePlantMU.mxd	PROJECT NO. ENG.EARC03145-01	
OFFICE TI-VANC	DWN SL	CKD MRV
DATE October 2, 2019	APVD TP	REV 0
Figure 3c		

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LEGEND

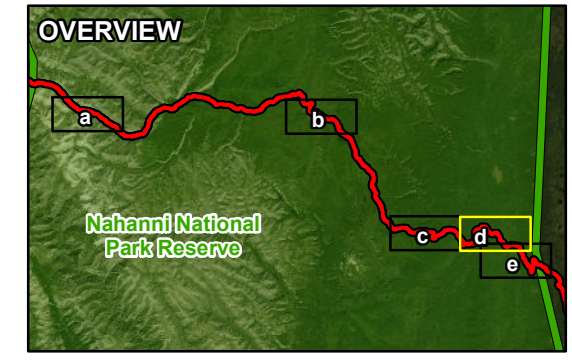
- Rare Plant Observation (2017)**
- X *Platanthera orbiculata*
 - PLATORB1 (6 individuals)
 - PLATORB7 (1 individual)
 - PLATORB2 (11 individuals)
 - PLATORB3 (2 individuals)
 - PLATORB5 (5 individuals)
- Undisturbed RPMU
- Transplant RPMU
- Expanded Rare Plant Search Area

- X All-Season Road Kilometre Marker
- Prairie Creek All-Season Road (June 2019)
- 100 m Buffer
- 1 km Buffer
- Contour (40 m)
- Watercourse
- Waterbody
- Nahanni National Park Reserve Boundary

- Ecotype Class (Parks Canada)**
- 1. Alpine Herb Tundra and Meadow
 - 2. Rock / Water
 - 3. Terrain or Cloud Shadow / Water
 - 4. Subalpine Tall Shrub
 - 7. Low Sparse Shrub
 - 8. Rock – Lichen
 - 9. Rock
 - 10. Mixed Predominantly Coniferous Forest
 - 12. Medium – Low Shrub

- 13. Coniferous Forest
- 16. Spruce – Lichen Woodland
- 17. Spruce – Lichen – Moss Woodland
- 18. Wetland
- 19. Alluvial Non-vegetated
- 22. Water / Terrain Shadow
- 23. Deciduous Forest / Tall Shrub
- 24. Mixed Predominantly Deciduous Forest / Tall Shrub
- 28. Permanent Water
- 29. Intermittent Water

NOTES
 Road alignment provided by AllNorth (June 2019).
 Base data source: Parks Canada; CanVec; GeoBase.



STATUS
ISSUED FOR REVIEW

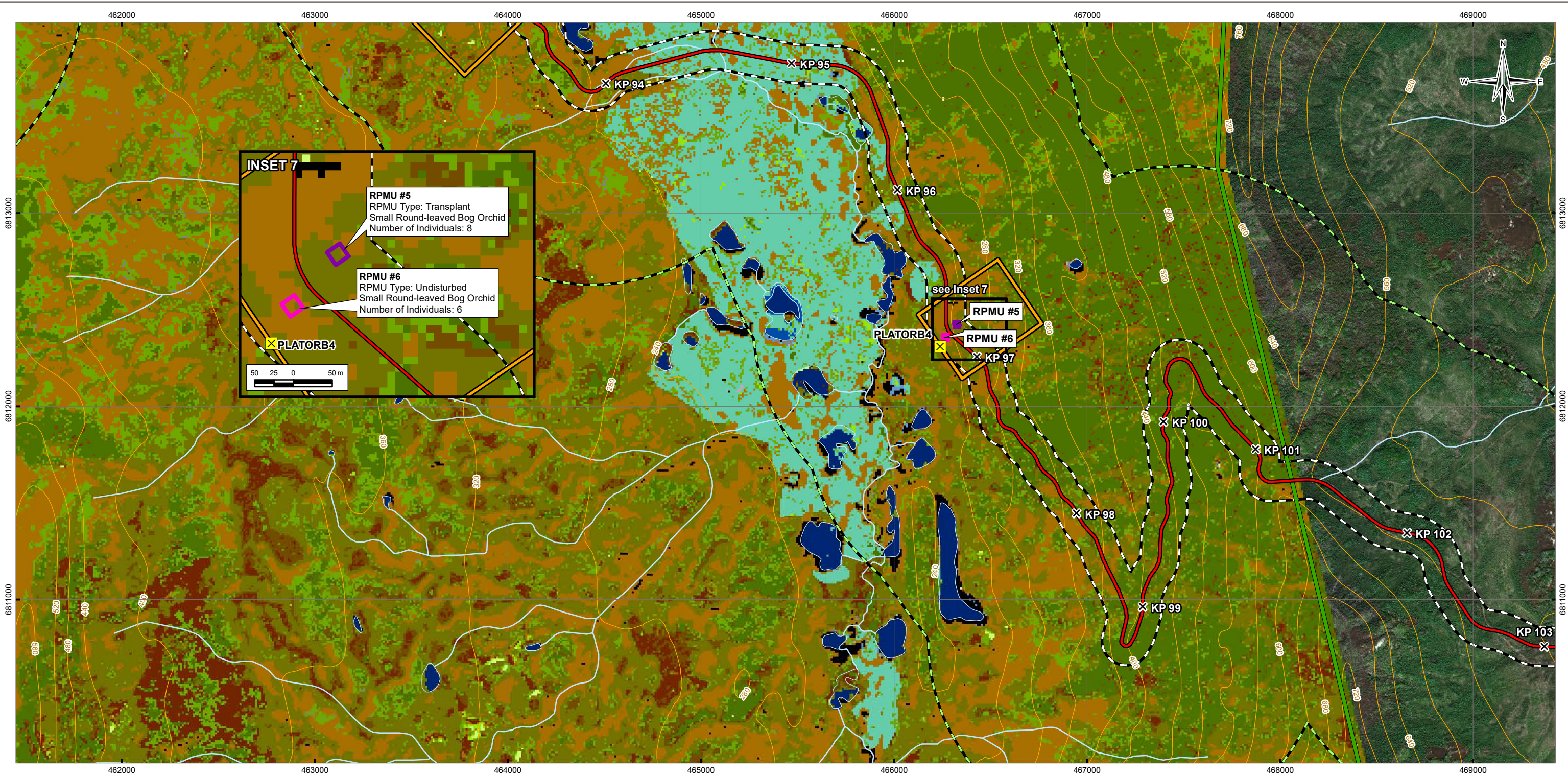
**RARE PLANT MANAGEMENT PLAN
 PRAIRIE CREEK ALL-SEASON ROAD**

**Additional Rare Plant Surveys
 and RPMU Establishment**

PROJECTION UTM Zone 10		DATUM NAD83		CLIENT 	
Scale: 1:20,000		400 200 0 400			
Metres					
FILE NO. EARC03145-01_Figure03d_RarePlantMU.mxd		OFFICE TL-VANC		DATE October 2, 2019	
DWN SL		CKD MRV		APVD TP	
REV 0		PROJECT NO. ENG.EARC03145-01		Figure 3d	

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INSET 7

RPMU #5
RPMU Type: Transplant
Small Round-leaved Bog Orchid
Number of Individuals: 8

RPMU #6
RPMU Type: Undisturbed
Small Round-leaved Bog Orchid
Number of Individuals: 6

PLATORB4

50 25 0 50 m

LEGEND

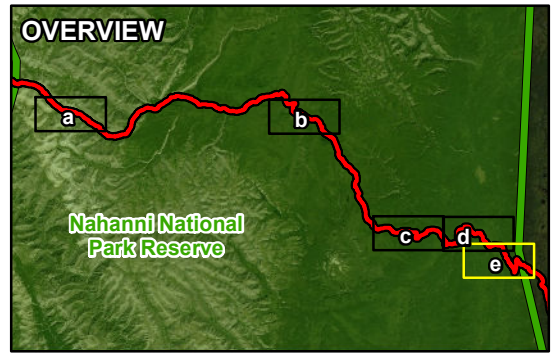
- Rare Plant Observation (2017)**
- X *Platanthera orbiculata*
PLATORB4 (6 individuals)
 - Undisturbed RPMU
 - Transplant RPMU
 - Expanded Rare Plant Search Area

- X All-Season Road Kilometre Marker
- Prairie Creek All-Season Road (June 2019)
- 100 m Buffer
- 1 km Buffer
- Contour (40 m)
- Watercourse
- Waterbody
- Nahanni National Park Reserve Boundary

- Ecotype Class (Parks Canada)**
- 1. Alpine Herb Tundra and Meadow
 - 3. Terrain or Cloud Shadow / Water
 - 4. Subalpine Tall Shrub
 - 7. Low Sparse Shrub
 - 8. Rock – Lichen
 - 9. Rock
 - 10. Mixed Predominantly Coniferous Forest
 - 12. Medium – Low Shrub
 - 13. Coniferous Forest

- 16. Spruce – Lichen Woodland
- 17. Spruce – Lichen – Moss Woodland
- 18. Wetland
- 19. Alluvial Non-vegetated
- 22. Water / Terrain Shadow
- 23. Deciduous Forest / Tall Shrub
- 24. Mixed Predominantly Deciduous Forest / Tall Shrub
- 28. Permanent Water
- 29. Intermittent Water

NOTES
Road alignment provided by AllNorth (June 2019).
Base data source: Parks Canada; CanVec; GeoBase.



STATUS
ISSUED FOR REVIEW

**RARE PLANT MANAGEMENT PLAN
PRAIRIE CREEK ALL-SEASON ROAD**

**Additional Rare Plant Surveys
and RPMU Establishment**

PROJECTION UTM Zone 10	DATUM NAD83	CLIENT
Scale: 1:20,000 400 200 0 400 Metres		TETRA TECH
FILE NO. EARC03145-01_Figure03e_RarePlantMU.mxd	STATUS ISSUED FOR REVIEW	
OFFICE TI-VANC	DWN SL	CKD MRV
DATE October 2, 2019	APVD TP	REV 0
PROJECT NO. ENG.EARC03145-01	Figure 3e	

APPENDIX A

ACCESS ROAD MAP BOOK

Access Road Map Book available on MVLWB Public Registry at the below link:

<http://registry.mvlwb.ca/Documents/PC2014F0013/PC2014F0013%20-%20CZN%20-%20App%201-2%20Access%20Road%20Maps%201-10000%20-%20Feb20-19.pdf>

PRAIRIE CREEK WINTER ROAD – PHASE 1 CONSTRUCTION

