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FIGURES

14.0 SUBJECT OF NOTE: VEGETATION

14.1 Introduction

14.1.1 Context

This section of the Developer's Assessment Report (DAR) for the NICO Cobalt-Gold-Copper-Bismuth Project (NICO Project) consists solely of the Subject of Note (SON) for vegetation. In the Terms of Reference (TOR) for the NICO Project's DAR issued on 30 November 2009, the Mackenzie Valley Review Board (MVRB) identified vegetation as one of 7 top priority valued components requiring a high level of consideration by the developer (MVRB 2009).

All effects on vegetation are assessed in detail in this SON; however, issues addressed in the following Key Lines of Inquiry (KLOI) and SON may overlap with this SON:

- KLOI: Water Quality (Section 7);
- KLOI: Caribou and Caribou Habitat (Section 8);
- KLOI: Closure and Reclamation (Section 9);
- SON: Air Quality (Section 10);
- SON: Water Quantity (Section 11);
- SON: Terrain and Soils (Section 13);
- SON: Wildlife (Section 14);
- SON: Human Environment (Section 16);
- Section 5: Traditional Knowledge; and
- Section 18: Biophysical Environment Monitoring and Management Plans.

14.1.2 Purpose and Scope

The purpose of the SON: Vegetation is to meet the TOR issued by the MVRB. The terms for the SON: Vegetation is shown in Table 14.1-1. The entire TOR document is included in Appendix 1.I and the complete table of concordance for the DAR is in Appendix 1.II of Section 1.

The SON: Vegetation includes an assessment of direct effects on plant populations and communities, including rare plants, cultural or economically valued plants (i.e., merchantable timber), and invasive species. The effects assessment will evaluate all NICO Project phases, including construction, operation, and closure and reclamation. Indirect and cumulative effects have been incorporated throughout this section, where applicable.

Information from other components of the DAR, including air quality, water quality and quantity, terrain and soils, traditional and non-traditional land use, and wildlife as well as information from existing developments, is incorporated in the effects assessment for vegetation. More detailed information on the requirements of the DAR TOR for this SON can be found in Table 14.1-1.

Table 14.1-1: Subject of Note: Vegetation Concordance with the Terms of Reference

Section in Terms of Reference	Requirement	Section in Developer's Assessment Report
3.1.3	**Assessing the Impacts of the Environment on Development** Potential impacts of the physical environment on the development, such as changes in the permafrost regime, other climate change impacts, seasonal flooding and melt patterns, seismic events, geological instability, and extreme precipitation must be considered in each of the applicable items of this *Terms of Reference*. Any changes to the design or management of the NICO Project as a result of considering potential impacts of the environment should be noted in the relevant sections.	19.0
3.2.3	An overall environmental assessment study area and the rationale for its boundaries;	14.1.3
	Fortune's chosen spatial boundaries for the assessment of potential impacts for each of the valued components considered; and	14.1.3
	The temporal boundaries chosen for the assessment of impacts on each valued component.	14.1.3
3.2.4	**Description of Existing Environment** The developer is encouraged to provide a description of the methods used to acquire the information used to describe baseline conditions.	14.2
3.3.1	**Impact Assessment Steps and Significance Determination Factors** In order to facilitate the consideration of the specific questions posed in this section, the developer is required to address the following impact assessment steps. In assessing impacts on the biophysical environment, the *Developer's Assessment Report* will for each subsection:	
	• Identify any valued components used and how they were determined;	14.1.2
	• For each valued component, identify and provide a rationale for the criteria and indicators used;	14.1.2
	• Identify the sources, timelines, and methods used for data collection;	14.2
	• Identify natural range of background conditions (where historic data are available), and current baseline conditions, and analyze for discernible trends over time in each valued component, where appropriate, in light of the natural variability for each;	14.2.1, 14.2.2
	• Identify any potential direct and indirect impacts on the valued components that may occur as a result of the proposed development, identifying all analytical assumptions;	14.3, 14.4, 14.5, 14.6
	o Predict the likelihood of each impact occurring prior to mitigation measures being implemented, providing a rationale for the confidence held in the prediction;	14.3
	o Describe any plans, strategies or commitments to avoid, reduce or otherwise manage the identified potential adverse impacts, with consideration of best management practices in relation to the valued component or development component in question;	14.3.2, 14.4.2
	o Describe techniques, such as models utilized in impact prediction including techniques used where any uncertainty in impact	14.7, 14.9

Table 14.1-1: Subject of Note: Vegetation Concordance with the Terms of Reference (continued)

Section in Terms of Reference	Requirement	Section in Developer's Assessment Report
3.3.1 (continued)	• Assess and provide an opinion on the significance of any residual adverse impacts predicted to remain after mitigation measures; and	14.10
	• Identify any monitoring, evaluation and adaptive management plans required to ensure that predictions are accurate and if not, to proactively manage against adverse impacts when they are encountered.	18.0
	The developer will characterize each predicted impact. These criteria will be used by the developer as a basis for its opinions on the significance of impacts on the biophysical environment. The Review Board will make ultimate determinations of significance after considering all the evidence on the public record later in the environmental assessment.	14.7.2
3.3.10	**Vegetation** The developer will:	
	• Describe the total amount of land cleared (relative to pre-fire conditions).	14.4.2
	• Describe potential impacts on rare plants.	14.4.2.2
	• Describe how Fortune will prevent the introduction of invasive plants.	14.3.2.2
	• Describe mitigation measures related to vegetation.	14.3
Appendix A	**Existing Environment**	
	1) The physical location of the proposed development and identification of associated ecozones and ecoregions	14.1.3
	10) Vegetation and plant communities, including identification of any areas where rare plants are known or suspected to be present.	14.2.3
Appendix I	**Vegetation**	
	While assessing impacts on vegetation, the developer will provide the following:	
	1) Estimate the total amount of land clearing required for the NICO Project, with estimates of losses of trees and other plants. Describe this relative to conditions before and after the recent fire. Include a description of how the soil materials will be removed, conserved or stored, and the likely impacts of loss of soil or compaction on long-term re-growth capacity.	14.2, 14.4.2, 13.4.2.2
	2) Describe the potential for the NICO Project to impact on rare plants.	14.4.2.2
	3) Describe the potential impacts of NICO Project operations on culturally or economically significant harvested plants.	14.4.2.3, 14.4.2.4
	4) Describe the potential impacts of vehicle, mine equipment, and power plant emissions on vegetation around the mine site and roads.	14.3.2.2
	5) Describe the potential impacts of dust generation on vegetation at the mine site, along roads, and downwind of the plateau.	14.3.2.2
	6) Describe the likelihood that invasive species will be introduced, by what means, and potential impacts.	14.3.2.2

Table 14.1-1: Subject of Note: Vegetation Concordance with the Terms of Reference (continued)

Section in Terms of Reference	Requirement	Section in Developer's Assessment Report
Appendix I (continued)	7) Describe best management practices for avoidance of impacts on vegetation, mitigation committed to, and where they differ, the rationale for not adopting best management practices.	14.3.2, 14.4.2
	8) Prepare a vegetation monitoring plan that will assist in achieving objectives described in a Closure and Reclamation Plan.	14.10, 18.0

Valued components (VCs) represent physical, biological, cultural, social, and economic properties of the environment that are considered important to society. The inter-relationships between components of the biophysical and socio-economic (human) environments provide the structure for a social-ecological system (Walker et al. 2004; Folke 2006). Four vegetation VCs were selected to assess the NICO Project-related effects on plant ecosystems (Table 14.1-2). Factors considered when selecting vegetation VCs included the following criteria (Salmo 2006):

- represent important ecosystem processes;
- plant associations or species that reflect the interests of regulatory agencies, First Nations groups, communities, and other people interested in the NICO Project;
- territorial (Government of the Northwest Territories [GNWT] 2010) and federal listed (*Species at Risk Act* [*SARA*] 2010; Committee on the Status of Endangered Wildlife in Canada [COSEWIC] 2010) species;
- can be measured or described with one or more practical indicators (measurement endpoints);
- allow cumulative effects to be considered; and
- current experience with environmental assessments and effects monitoring programs in the Northwest Territories (NWT) and Nunavut.

Table 14.1-2: Vegetation Valued Components

Valued Component	Rationale for Selection
Plant populations and communities including regional-scale biodiversity	characterized within Ecological Landscape Classification (ELC) types, especially those with restricted distribution that may be disproportionately affected by NICO Project activities important for support of ecosystem processes and services, ecosystem resiliency, and spiritual and aesthetic values
Listed (rare) plant species and rare plant habitat potential	plant species of the Northwest Territories (NWT) listed as rare ("At Risk", "May be at Risk", "Sensitive", or "Undetermined") by GNWT(2010), SARA (2010), and (COSEWIC 2010); therefore, may be disproportionately affected by NICO Project activities habitat with the potential to support rare plant species of the NWT
Traditional use plants	plants used in the NWT primarily by aboriginal persons, including edible plants, medicinal plants, and plants used for construction or other purposes
Economic use plants	potential timber resources that can be harvested for various purposes

Plant populations and communities are important to the people of the NWT. Assessment endpoints represent the key properties of the VC that should be protected for their use by future human generations, while measurement endpoints are quantifiable (i.e., measurable) expressions of changes to assessment endpoints (Section 6.2). Assessment and measurement endpoints for vegetation VCs are presented in Table 14.1-3.

Table 14.1-3: Summary of the Valued Components, Assessment, and Measurement Endpoints for the Subject of Note: Vegetation

Valued Component	Assessment Endpoints	Measurement Endpoints
• Plant populations and communities • Listed (rare) plant species and rare plant habitat potential • Traditional use plants • Economic use plants	• Persistence of plant populations and communities • Continued opportunity for use of traditional and economic plants • Persistence of plant species at risk	• Plant community health and diversity • Relative abundance and distribution of plant species • Abundance and distribution of timber resources • Presence of invasive species

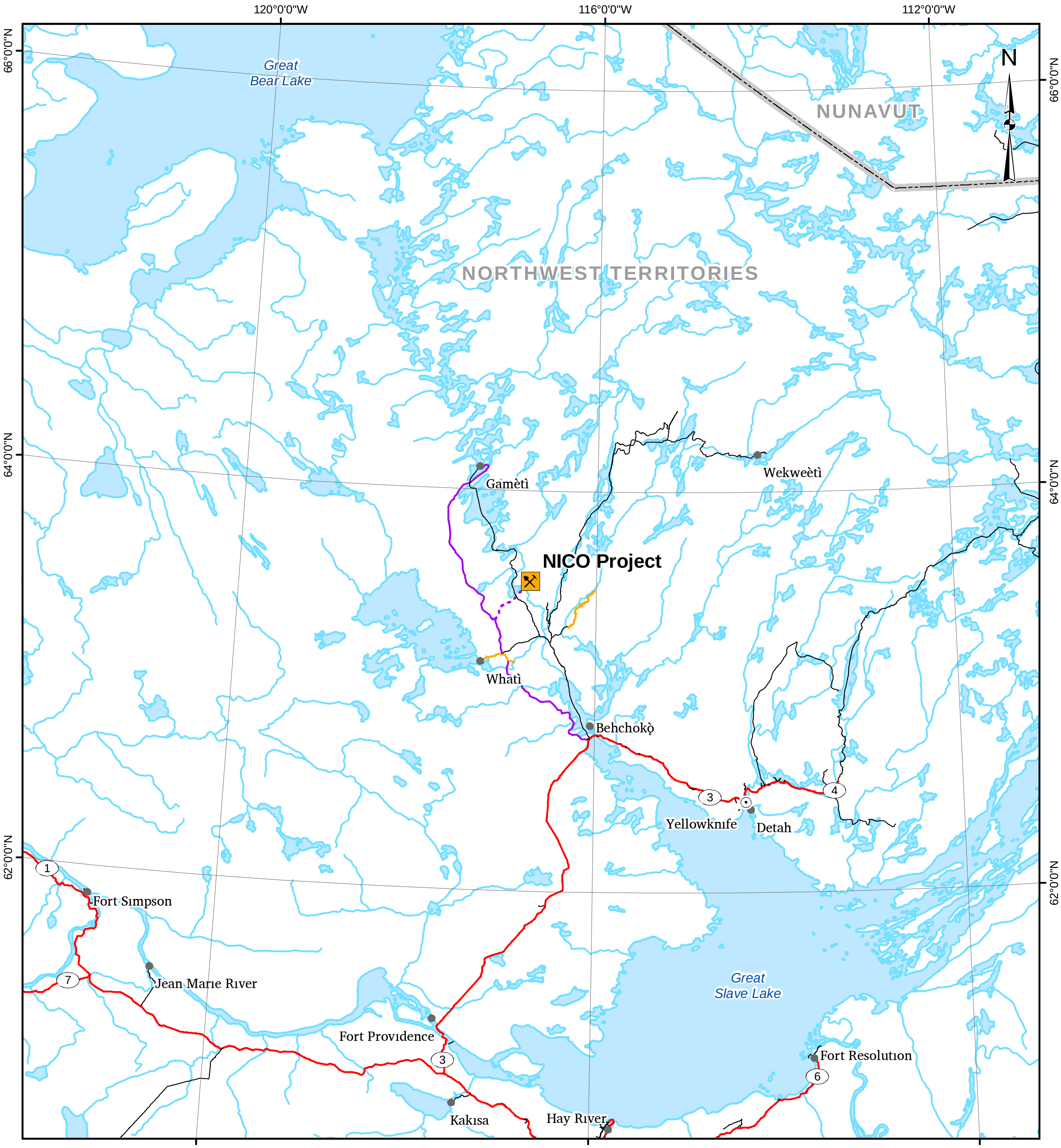
14.1.3 Study Areas

14.1.3.1 General Setting

The NICO Project is located approximately 160 kilometres (km) northwest of the city of Yellowknife in the NWT ($63^{o}33'$ north latitude and $116^{o}45'$ west longitude) (Figure 14.1-1). The NICO Project is located within the Marian River drainage basin, approximately 10 km east of Hislop Lake within the Taiga Shield and Taiga Plains Ecoregions (Ecosystem Classification Group 2007, 2008).

The Level III Taiga Shield High Boreal Ecoregion is bedrock-dominated with jack pine (*Pinus banksiana*) and mixed spruce forests on rock outcrops. White spruce (*Picea glauca*) and trembling aspen (*Populus tremuloides*) stands are found in low-elevation areas with adequate nutrient and water supplies. Peat plateaus and shore and floating fens are scattered throughout the Ecoregion (Ecosystem Classification Group 2008).

The Level III Central Great Bear Plains Low Subarctic Ecoregion within the Level II Taiga Plains Ecoregion is dominated by closed to open white and black spruce (*Picea mariana*) forests with shrub, moss, and lichen understories, or regenerating dwarf birch shrublands. Pond and fen complexes are scattered throughout, while closed mixedwood, white spruce, and jack pine stands occupy rolling to ridged glacial flutings (Ecosystem Classification Group 2007). Permanently frozen peatlands cover vast areas, particularly in the southern part of this Ecoregion. Runnel permafrost forms are common on slopes with permafrost occurring within 30 centimetres (cm) of the organic surface. Polygonal peat plateaus are locally common in the Keller Plain area.



LEGEND

- NICO PROJECT
- TERRITORIAL CAPITAL
- POPULATED PLACE
- HIGHWAY
- EXISTING ALL-WEATHER ROAD
- EXISTING WINTER ROAD
- PROPOSED NICO PROJECT ACCESS ROAD
- PROPOSED TŁĮCHǪ ROAD ROUTE
- RAILROAD
- TERRITORIAL/PROVINCIAL BOUNDARY
- WATERCOURSE
- WATERBODY

100 0 100

SCALE 1:3,000,000 KILOMETRES

REFERENCE

Base data obtained from Atlas of Canada, DMTI, and ESRI.
Projection: Canada Lambert Conformal Conic

FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE

LOCATION OF THE NICO PROJECT

Golder Associates
Edmonton, Alberta

FILE No. E-Section1-002-GIS				
PROJECT No. 09-1373-1004			SCALE AS SHOWN	REV. 0
DESIGN	JG	17 Jan. 2011	FIGURE: 14.1-1	
GIS	CW	17 Jan. 2011		
CHECK	GRA	03 Apr. 2011		
REVIEW	GRA	03 Apr. 2011		

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The NICO Project is located approximately 50 km northeast of Whatì and 70 km south of Gamètì, the nearest communities. Other communities include Behchokǫ̀, approximately 85 km southeast of the NICO Project, and Wekweètì, located approximately 140 km northeast of the NICO Project. All of these communities are within Tłįchǫ lands. The NICO Project is surrounded by Tłįchǫ lands. The mean annual temperature for this region is -4.6 degrees Celcius (°C) (Environment Canada; Yellowknife A Weather Station 2010). July is the warmest month with a mean temperature of 16.8°C, whereas January is typically the coldest month with a mean temperature of -26.8°C. The mean annual precipitation is approximately 280.7 millimetres (mm), with 164.5 mm falling as rain and the remainder as snow (Environment Canada; Yellowknife A Weather Station 2010).

To facilitate the assessment and interpretation of potential effects associated with the NICO Project, it is necessary to define appropriate spatial boundaries. Spatial boundaries were delineated based on the predicted spatial extent of Project-related effects and the life history attributes of plants and plant communities potentially influenced by the NICO Project. The following 2 spatial boundaries were used:

- regional study area (RSA) for the NICO Project-specific and potential cumulative effects on vegetation; and
- local study area (LSA) for small-scale direct and indirect effects from the NICO Project, including the proposed mine site and access road, on vegetation.

14.1.3.2 Regional Study Area

The RSA was selected at a scale large enough to capture the maximum predicted spatial extent of the combined direct and indirect effects (i.e., zone of influence) from the NICO Project on terrain and soils, vegetation, and wildlife (Figure 14.1-2). This area is intended to capture effects that extend beyond the immediate NICO Project footprint, such as fuel emissions from vehicles and aircraft, and dust deposition that can affect the environment at a distance. Cumulative effects from the NICO Project and other developments in the RSA can also be assessed at this scale for VCs that exhibit little to no movement within RSA, such as plants. The assessment of NICO Project effects on plants and plant communities assumes the RSA is large enough to contain all or most plant species and communities present in local populations.

From 2003 to 2006 the RSA for the proposed mine site was 314 square kilometres (km^2) (i.e., a 10 km radius centered on the proposed mine site). This area was increased in 2007 to 706 km^2 (i.e., a 15 km radius centered on the proposed mine site) because of increased knowledge about the effects from disturbance on barren-ground and woodland caribou. For example, studies on the movements of woodland caribou in the boreal forest indicated that caribou avoided mining activities, with avoidance distances of up to 4 km during the summer and 6 km during the late winter, pre-calving, and calving seasons (Weir et al. 2007). Above the treeline, recent analysis has suggested that caribou are 4 times more likely to occur in areas greater than 11 to 14 km from the Ekati-Diavik mine complex (Boulanger et al. 2009).

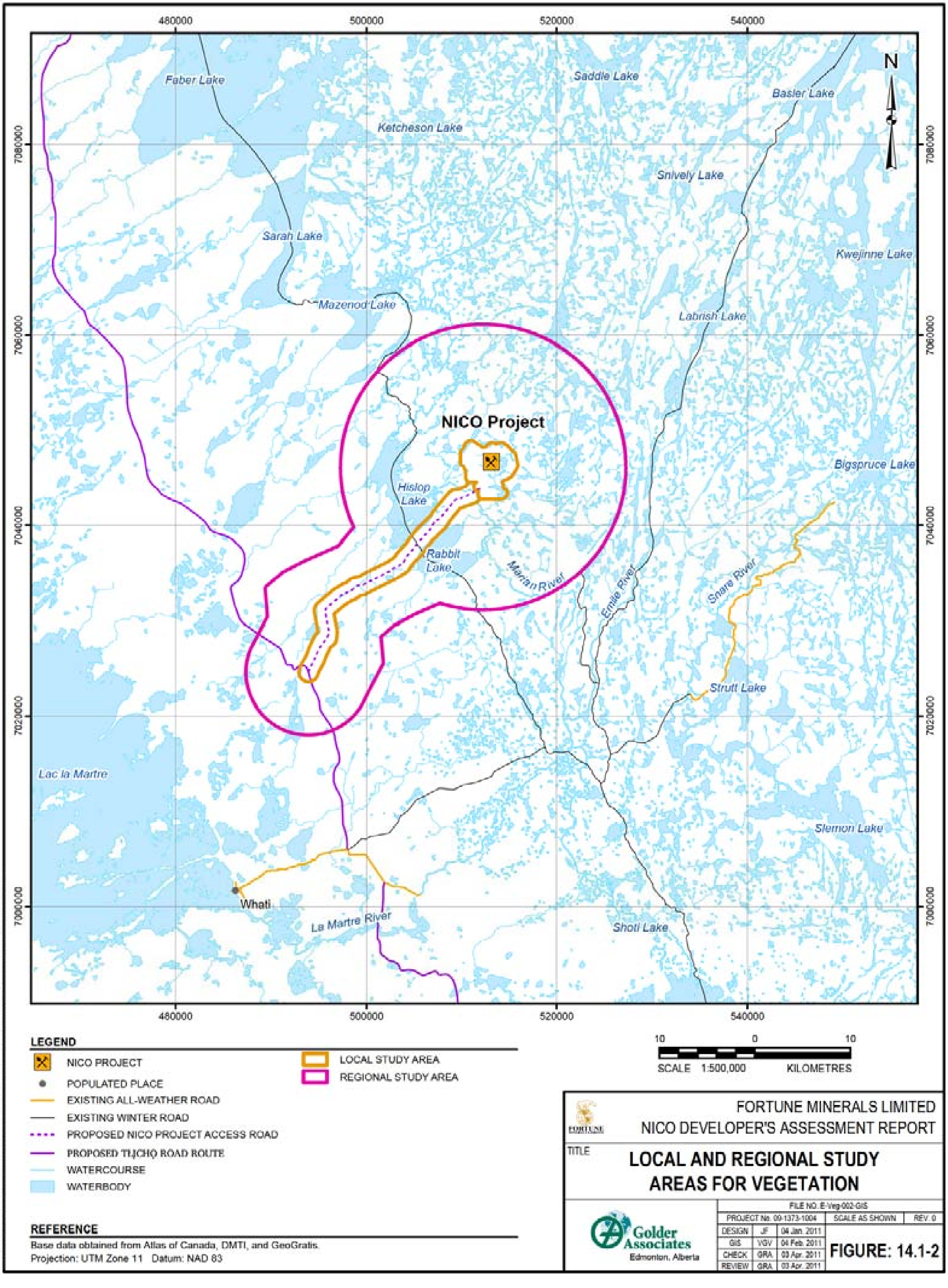
The RSA includes a 6.5 km buffer around the proposed road alignment (Figure 14.1-2). The proposed NICO Project Access Road (NPAR) at the time baseline studies were completed was 50 km long and joined the NICO site to the winter road between Behchokǫ̀ and Gamètì. Although the NPAR has since been reduced to 27 km, the original 50 km NPAR alignment that includes the 27 km portion was evaluated during baseline studies. The TOR (MVRB 2009) stipulates that the assessment for the NICO Project must include all aspects of the 27 km NPAR (e.g., physical footprint and traffic), which will connect the mine to the transportation corridor between Behchokǫ̀ and Gamètì. For the transportation corridor that extends from the NPAR to the intersection with

Highway 3 (approximately 110 km of road) (Figure 14.1-1), the DAR need only consider the effects of traffic from the NICO Project on the environment.

The RSA includes 2, Level II Ecoregions: Taiga Shield and Taiga Plains. The Taiga Shield Ecoregion is located northeast of Rabbit and Hislop lakes (Ecosystem Classification Group 2008), while the Taiga Plains Ecoregion covers the southwest portion of the RSA (Ecosystem Classification Group 2007). The NPAR is located within the Taiga Plains Ecoregion, which has a greater cover of trees than in the northeast portion of the RSA. In the summer of 2008, wildfire burned approximately 10% of the RSA.

14.1.3.3 Local Study Area

The LSA boundary for the proposed mine site and NPAR was defined by the expected spatial extent of the immediate direct (i.e., NICO Project footprint) and indirect effects (e.g., dust deposition) of the NICO Project on terrain and soil, vegetation, and wildlife (Figure 14.1-2). The LSA boundary for the mine site (mine LSA) was defined as a 500 metre (m) buffer around the NICO Project Lease Boundary. The LSA for the NPAR (NPAR LSA) was defined using a 1000 m buffer on either side of the NPAR right-of-way. The mine LSA contains habitat that is characteristic of the region and vegetation that is typical of the Taiga Plains and Taiga Shield Ecoregions.



480000
500000
520000
540000
7080000
7060000
7040000
7020000
7000000
N
Faber Lake
Saddle Lake
Basler Lake
Ketcheson Lake
Snively Lake
Sarah Lake
Kwejinne Lake
Mazenod Lake
Labrish Lake
NICO Project
Bigspruce Lake
Hislop Lake
Rabbit Lake
Marian River
Emile River
Snare River
Strutt Lake
Lac la Martre
Slemon Lake
Whati
La Martre River
Shoti Lake
LEGEND
NICO PROJECT
POPULATED PLACE
EXISTING ALL-WEATHER ROAD
EXISTING WINTER ROAD
PROPOSED NICO PROJECT ACCESS ROAD
PROPOSED TŁĮCHǪ ROAD ROUTE
WATERCOURSE
WATERBODY
LOCAL STUDY AREA
REGIONAL STUDY AREA
10 0 10
SCALE 1:500,000 KILOMETRES
REFERENCE
Base data obtained from Atlas of Canada, DMTI, and GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83
FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT
TITLE
LOCAL AND REGIONAL STUDY AREAS FOR VEGETATION
FILE NO. E-Veg-002-GIS
PROJECT No. 09-1373-1004
SCALE AS SHOWN
REV. 0
DESIGN JF 04 Jan. 2011
GIS VGV 04 Feb. 2011
CHECK GRA 03 Apr. 2011
REVIEW GRA 03 Apr. 2011
Golder Associates
Edmonton, Alberta
FIGURE: 14.1-2

14.1.4 Content

The general organization of this SON is outlined in Table 14.1-4. To verify that the contents of the TOR are addressed in this report, a table of concordance that cross-references the TOR to the information and location in this DAR is contained in Table 14.1-1.

Table 14.1-4: Subject of Note: Vegetation Organization

Section	Content
Section 14.1	**Introduction** – Provides an introduction to the vegetation SON by defining the context, purpose, scope, and study areas, and providing an overview of the SON organization
Section 14.2	**Existing Environment** – Provides a summary of baseline methods and results for vegetation
Section 14.3	**Pathway Analyses** – Provides a screening level assessment of all potential pathways by which the NICO Project may influence vegetation after applying environmental design features and mitigation that reduce or eliminate Project-related effects
Section 14.4	**Effects to Plant Populations and Communities** – Provides a detailed assessment of the effects on plant populations and communities, listed plant species, traditional use plants, and economic use plants
Section 14.5	**Related Effects to People** – Provides a summary of the potential effects from the NICO Project on the continued opportunities for the use of vegetation by people
Section 14.6	**Residual Effects Summary** – Summarizes the effects on vegetation that are predicted to remain after applying environmental design features, mitigation, and reclamation
Section 14.7	**Residual Impact Classification** – Describes the methods used to classify residual effects, and summarizes the classification results
Section 14.8	**Environmental Significance** – Provides a discussion of the environmental significance of the predicted impacts on vegetation
Section 14.9	**Uncertainty** – Provides a discussion of the sources of uncertainty related to predicting effects on vegetation
Section 14.10	**Monitoring and Follow-up** – Summarizes the objectives of the proposed monitoring and follow-up programs used to test the predicted effects, mitigation, and reclamation on vegetation

In addition to the content included in this SON, the following provides additional detailed information on baseline conditions for vegetation and proposed monitoring and follow-up programs:

- Annex J: Vegetation Baseline Report
- Biophysical Environment Monitoring and Management Plans (Section 18)

14.2 Existing Environment

14.2.1 Methods

14.2.1.1 Ecological Landscape Classification

An ELC was developed to determine the abundance and distribution of primary land cover classes within the RSA and LSA for vegetation. A secondary purpose of the ELC was to produce ecological definitions and nomenclature for the land cover classes. These definitions and nomenclature facilitate consistent reporting on the status of the land cover classes for existing and future conditions. The ELC also provides a basis for interpreting or modelling listed plant species habitat and wildlife habitat suitability.

14.2.1.1.1 Regional Study Area

Vegetation classification and mapping were completed in several steps. A preliminary ELC map was developed for the vegetation RSA using Landsat Thematic Mapper satellite imagery (28.5 x 28.5 m resolution) that was captured on 24 July 2001. An aerial reconnaissance survey completed in September 2003 was used to verify a draft land cover classification. This initial classification was updated and finalized using field data collected during vegetation and wildlife surveys carried out at 132 sites between 2003 and 2006.

14.2.1.1.2 Local Study Area

A preliminary ELC map was developed for the vegetation LSA using IKONOS satellite imagery (0.8 m panchromatic resolution) captured on 5 August and 21 August 2006, as this higher resolution imagery was deemed more suitable for mapping at the local scale. An aerial reconnaissance survey completed in July 2006 was used to verify a draft ELC within the LSA. This initial classification was updated and finalized using field data collected during vegetation and wildlife surveys carried out at 132 sites between 2003 and 2006.

In the summer of 2008, a wildfire burned a portion of the LSA and RSA. To update the ELC, a Landsat 7 image captured on 8 August 2008 was obtained. The burned area was classified and isolated from the rest of the imagery. The resulting burn polygon was used to update the ELC polygons.

14.2.1.2 Rare Plants

Prior to undertaking field surveys a number of reference sources were used to develop a list of rare plant species with the potential to occur within the RSA and LSA including the following:

- federal and territorial status documents;
- environmental assessment reports for other northern mining projects;
- vascular plant checklists for the NWT (Porsild and Cody 1980); and
- other public rare plant species reports for the NWT (McJannet et al. 1995).

Additional information compiled for each species included the associated ecozone, habitats, and listed status rank according to applicable jurisdictions.

Rare plant searches were completed at 76 locations within the LSA encompassing the proposed mine site and NPAR within a wide range of habitats. The proposed NPAR at the time baseline studies were carried out was a 50 km alignment that joined the NICO site to the existing access road east of Whatì. Although the NPAR has since been reduced to 27 km, the original 50 km NPAR that includes the 27 km portion was evaluated during rare plant surveys. The greatest effort focused in habitats with the highest potential to support rare plant species (e.g., shrubland and marsh/graminoid fen). Within these areas, surveyors searched for rare plant species using a random meandering technique, focusing the search effort on microhabitats (e.g., pools, habitat edges). The length of each “meander” varied according to the complexity and number of microhabitats present at each location.

14.2.1.3 Plant Species Diversity

Plant species diversity in this context refers to the number of species in a given area (i.e., richness), the ecological function of these species, and how the composition of species changes across a region through processes and interactions between the environment and species. The vegetation data used in the plant species diversity assessment were collected during the field surveys completed in 2005 to 2008 (i.e., rare plant and detailed vegetation inventory surveys). A total of 63 detailed vegetation inventory plots were established in 2006 and 2008 in the LSA encompassing the proposed mine site and NPAR, in part to obtain site-specific, descriptive information on the nature and characteristics of plant communities within the region. Each detailed vegetation plot was established in a representative location within an ELC polygon. A 10 x 10 m plot defined the boundary of the primary plot. Within this plot, species composition and percent cover of the understorey vegetation layers (e.g., tall shrub, low shrub, forb, grass, bryophyte, terrestrial lichen, and epiphyte layer) were recorded. Site characteristics were described within this plot. In certain circumstances, such as a narrow vegetation band alongside a waterbody, the plot shape was adjusted so that all areas within the plot had the same ecological conditions.

After defining and assessing the primary plot, a second 20 x 20 m tree canopy plot (where applicable) was established to estimate tree species composition and canopy cover (i.e., main and secondary canopies). The shape of this plot was adjusted where necessary. For example, a 10 x 40 m tree canopy plot may have been more appropriate for a narrowly shaped plant community alongside a stream. Other vegetation characteristics collected included tree cores (to determine age) and tree diameter at breast height.

Plant species diversity was assessed for each ELC type based on the number and percentage of vascular species, the number of rare species, and the number of vascular species unique to each ELC type. These diversity measures incorporate all available data without standardizing by plot size or sampling intensity. Two additional diversity indices (species richness and evenness) were only calculated from the detailed vegetation inventory plot data to take into consideration variation in sampling intensity. Species richness is simply a count of the total number of species in a plot. Evenness describes the relative abundance and distribution of species in an area. Calculated values range between 0 and 1, with higher values representing a more even distribution of species within a plot (Kent and Coker 1992).

14.2.1.4 Traditional Use Plants

Traditional use plants and plant habitats surrounding the Wekweètì area, as well as areas to the east and north along the barren-lands, were determined from a review of an environmental assessment report for another northern mining project (Diavik 1998). Additional information documenting the location and occurrences of traditional use plants was obtained from other public reports (Dogrib Treaty 11 Council 2001).

14.2.1.5 Economic Use Plants

In the NWT, commercial timber harvesting is limited and typically occurs in localized areas where only small numbers of trees (primarily white spruce, jack pine, and aspen) are harvested (Environment and Natural Resources 2009). No large scale forestry operations exist north of Great Slave Lake and most commercial harvest operations tend to be small-scale local businesses that harvest from 500 cubic metres per year (m^3/y) to 10 000 m^3/y. Most of the timber that is harvested is used for fuel wood by local communities and includes live and dead wood harvested from a variety of trees species including white spruce, black spruce, jack pine, and aspen. Other domestic uses of wood include the use of logs for cabin building, fence posts, and other lumber materials. The nearest area with a woods operation permit is approximately 140 km south of the NICO Project, and is for the cutting and hauling of fire wood.

Information on potential timber resources were collected from 32 plots within the LSA during the 2006 field survey. Trees were identified as harvestable based on overall size and height. In general, harvestable trees were at least 7 m tall and had a diameter at breast height of greater than 10 cm. Two representative tree species were selected for measurement at each vegetation plot and the following data recorded:

- tree species;
- diameter at breast height;
- tree height; and
- tree age.

Diameter at breast height was determined by measuring the circumference of the tree at breast height (1.3 m) using a diameter at breast height measuring tape. Tree height was determined by using a clinometer and calculating height based on the distance of the observer from the tree. Tree age was determined by counting tree rings from tree core samples obtained using an increment borer. Tree species data (e.g., tree height) were summarized by ELC type to provide an indication of potential timber resources that may be present in the LSA.

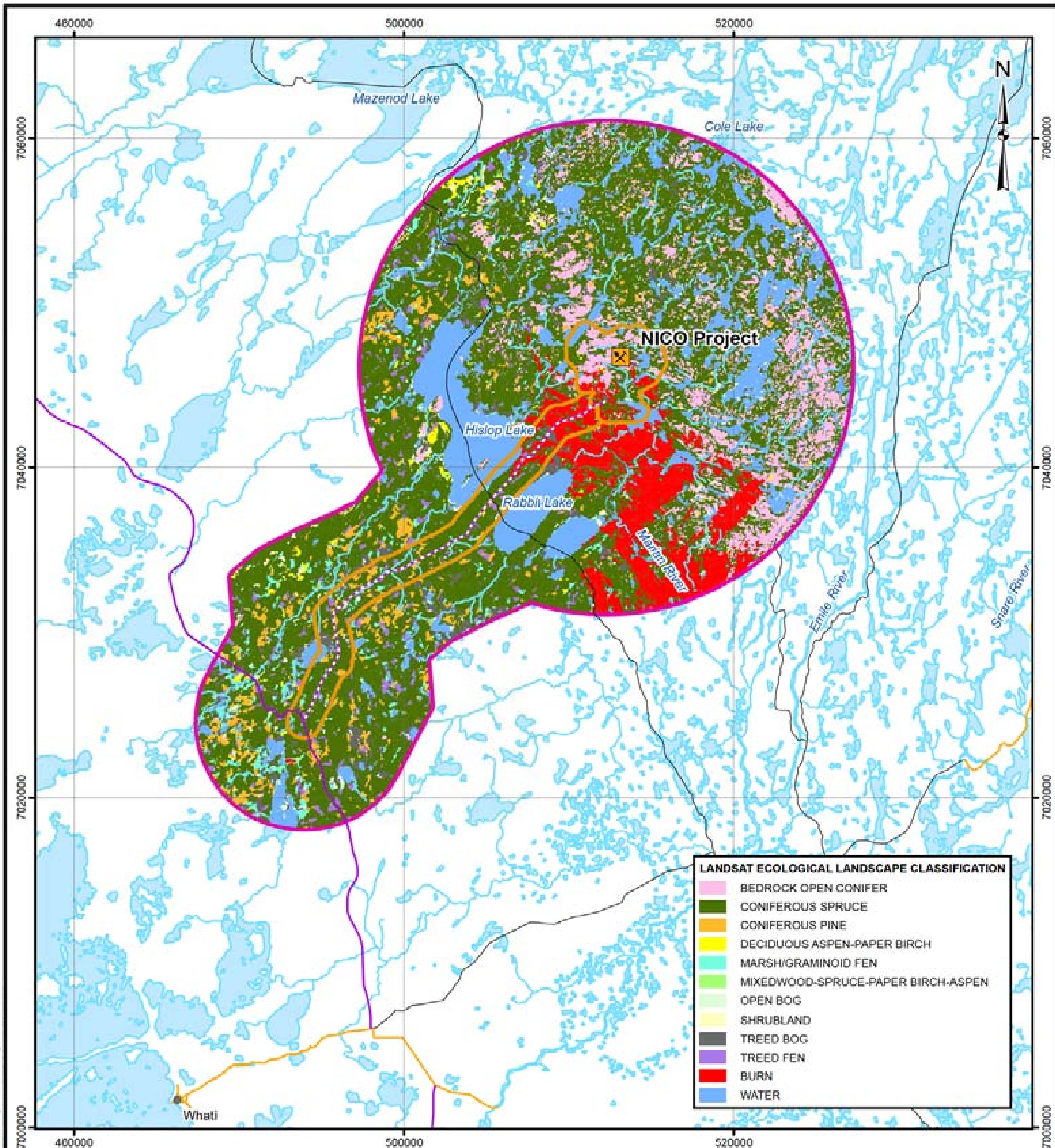
14.2.2 Results

14.2.2.1 Ecological Landscape Classification

14.2.2.1.1 Regional Study Area

The RSA covers 94 859 ha and is classified into 11 ELC types. The resolution of the Landsat imagery did not allow for distinguishing between the mixedwood spruce–paper birch–aspen class and the coniferous spruce class. Consequently, the coniferous spruce class at the RSA scale includes some proportion of mixedwood stands. Disturbance and unclassified (i.e., cloud, haze, and shadow) areas were also not part of the RSA classification.

The mapped distribution of ELC types in the RSA is illustrated in Figure 14.2-1. Upland ELC types compose the majority (67.2%) of the RSA (Table 14.2-1). The dominant upland ELC type is coniferous spruce and covers 50 720 ha (53.5%) of the RSA. The treed bog ELC type is the most prominent wetland ELC type, occupying 4093 ha (4.3%) of the RSA. Water occupies 14 793 ha (15.6%) of the RSA.



LEGEND

- NICO PROJECT
- POPULATED PLACE
- EXISTING ALL-WEATHER ROAD
- EXISTING WINTER ROAD
- PROPOSED NICO PROJECT ACCESS ROAD
- PROPOSED TŁĮCHǪ ROAD ROUTE
- WATERCOURSE
- WATERBODY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

7.5 0 7.5

SCALE 1:325,000 KILOMETRES

REFERENCE

Base data obtained from Atlas of Canada, DMTI, and GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE
ECOLOGICAL LANDSCAPE CLASSIFICATION IN THE REGIONAL STUDY AREA

FILE NO. E-Veg-003-GIS

PROJECT No. 09-1373-1004		SCALE AS SHOWN	REV. 0
DESIGN	JF	04 Jan. 2011	
GIS	VGV	04 Feb. 2011	
CHECK	GRA	03 Apr. 2011	
REVIEW	GRA	03 Apr. 2011	

Golder Associates
Edmonton, Alberta

FIGURE: 14.2-1

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Table 14.2-1: Total Area and Percent Cover of Ecological Landscape Classification Types in the Regional Study Area

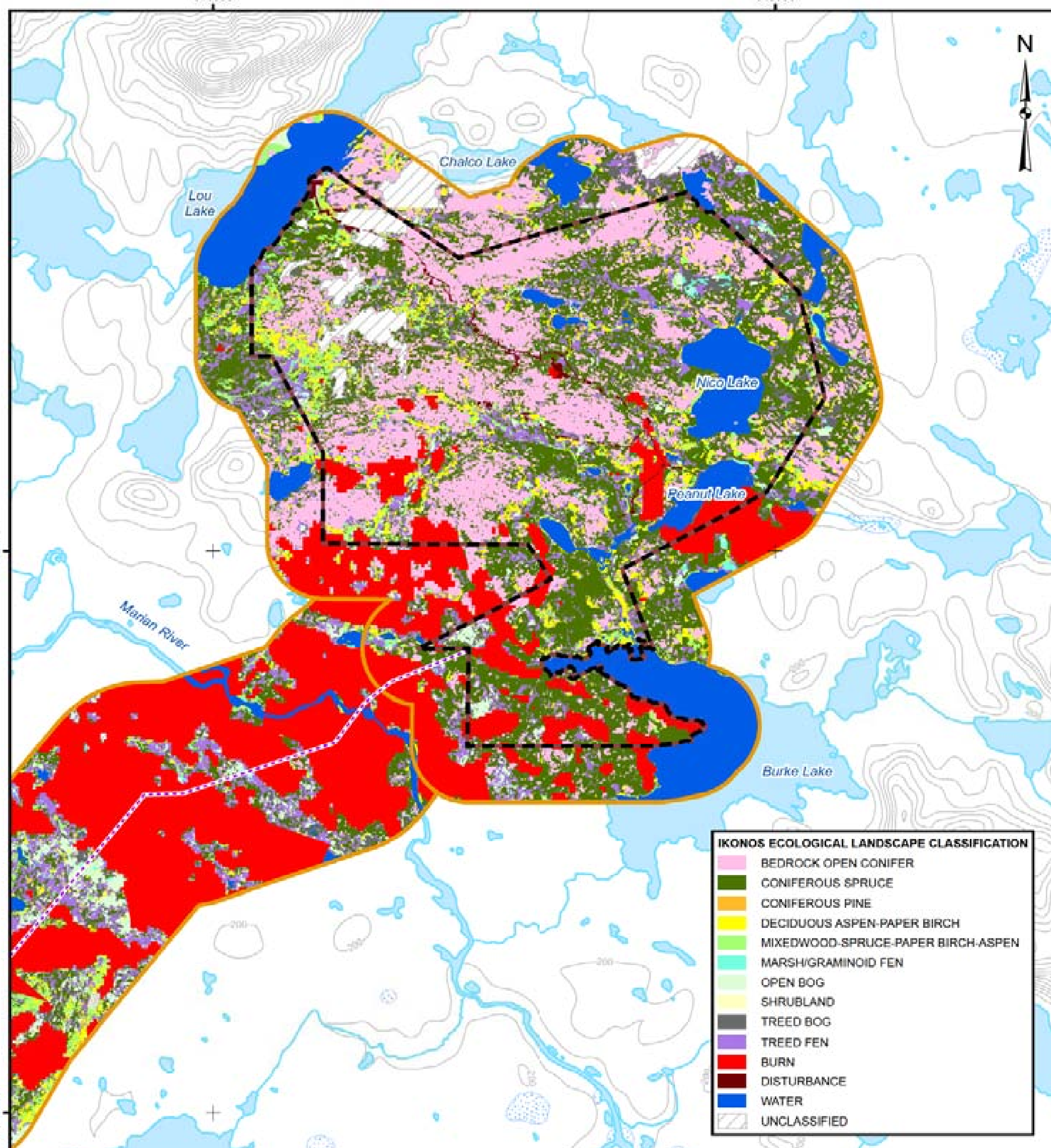
ELC Map Code	Ecological Landscape Classification	Ecological Landscape Classification Description	Area (ha)	% of RSA
Uplands				
UBC	Bedrock open conifer	Subxeric to very xeric moisture regime characterized by exposed bedrock or boulders with a patchy vegetation cover	8 859	9.3
UCP	Coniferous pine	Occurs on sandy, acidic, and very rapidly drained soils, with a xeric moisture regime	3 398	3.6
UCS	Coniferous spruce	Characterized by upland black spruce stands on very rapidly to moderately drained soils, with a submesic moisture regime	50 720	53.5
UDE	Deciduous aspen-paper birch	Occurs on moderately well drained upland soils; moisture regime ranges from mesic to submesic	752	0.8
uplands ELC types subtotal			*63 729*	*67.2*
Wetlands				
WMF	Marsh/graminoid fen	Typically situated along waterbodies or in saturated depressions; substrate varies from mineral soil (marshes) to organic soil (graminoid fens); moisture regime is typically hygric to hydric	1 896	2.0
WOB	Open bog	Hygric moisture regime and a poor nutrient regime, occurring in depressional areas; primarily *Sphagnum* moss dominated	1 238	1.3
WSH	Shrubland	Situated in low lying areas, often in the transition zone between upland and wetlands ELC types; ranges from subhygric (to hydric dominated by willow and dwarf birch	556	0.6
WTB	Treed bog	Hygric moisture regime and a poor nutrient regime, occurring in depressional areas; characterized by stunted black spruce stands	4 093	4.3
WTF	Treed fen	Hygric moisture regime and a rich nutrient regime, occurring in depressional areas; characterized by black spruce and tamarack trees	1 631	1.7
wetlands ELC types subtotal			*9 413*	*9.9*
Miscellaneous Vegetation				
BUR	Burn	Consists of upland or wetlands habitat that has been recently burned	6 924	7.3
miscellaneous ELC types subtotal			*6 924*	*7.3*
Non-vegetated				
WAT	Water	Includes lakes, rivers, streams, ponds, and shallow open water	14 793	15.6
non-vegetated ELC types subtotal			*14 793*	*15.6*
Total			**94 859**	**100**

Note: Numbers are rounded for presentation purposes; therefore, it may appear that the totals do not equal the sum of the individual values.

ELC = Ecological Landscape Classification; % = percent; ha = hectare; RSA=Regional Study Area.

14.2.2.1.2 Local Study Area

The LSA covers 8405 ha and is classified into 14 ELC types (Figure 14.2-2a, b; Table 14.2-2). The proposed mine portion of the LSA covers 2644 ha and the NPAR portion of the LSA covers 5761 ha. Upland ELC types compose the majority (55.9%) of the LSA. The dominant ELC type is the coniferous spruce type and covers 3118 ha (37.1%) of the LSA, with the majority (2397 ha) occurring along the NPAR portion of the LSA. The treed fen is the dominant wetlands ELC type, occupying 945 ha (11.2%) of the LSA, with the majority (775 ha) occurring along the NPAR portion of the LSA. The burn ELC type covers 12.6% of the LSA, and disturbances account for less than 1% of the LSA. Water occupies 614 ha (7.3%) of the LSA. Unclassified areas account for 1.1% of the LSA for which an ELC type could not be assigned due to satellite interference (i.e., cloud, haze, and shadow).



LEGEND

- PROJECT LEASE BOUNDARY
- CONTOUR (10 METRE INTERVAL)
- PROPOSED NICO PROJECT ACCESS ROAD
- WATERCOURSE
- WATERBODY
- WETLAND
- LOCAL STUDY AREA

1 0 1

SCALE 1:50,000 KILOMETRES

NOTE: Unclassified areas are portions of the LSA for which an ELC vegetation class could not be assigned due to satellite interference.

REFERENCE

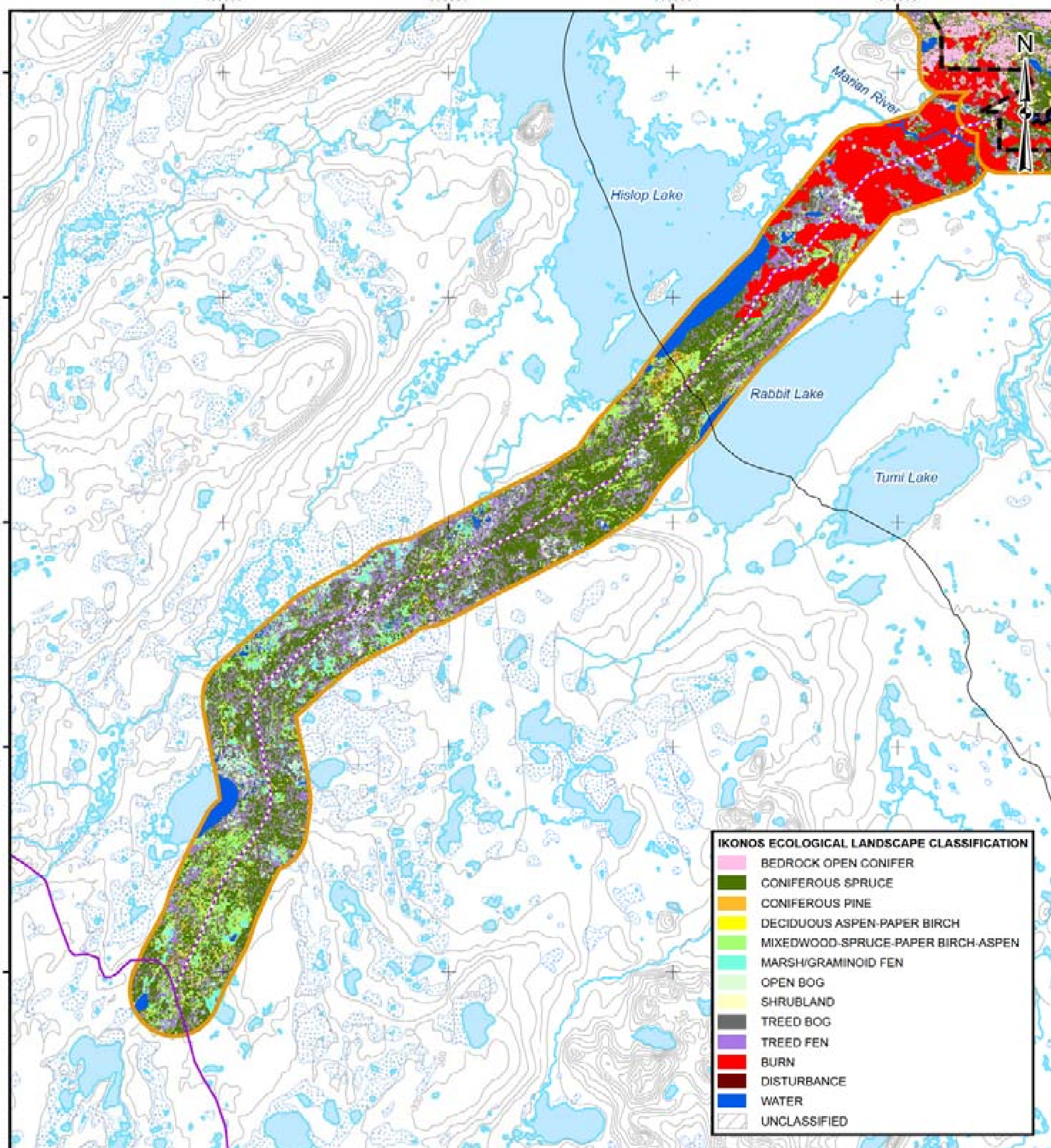
Base data obtained from GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE
ECOLOGICAL LANDSCAPE CLASSIFICATION IN THE LOCAL STUDY AREA

FILE NO. E-Veg-004-GIS				
PROJECT No. 09-1373-1004			SCALE AS SHOWN	REV. 0
DESIGN	JF	04 Jan. 2011	**FIGURE: 14.2-2a**	
GIS	CC	17 Feb. 2011		
CHECK	GRA	03 Apr. 2011		
REVIEW	GRA	03 Apr. 2011		

Golder Associates
Edmonton, Alberta



LEGEND

PROJECT LEASE BOUNDARY	LOCAL STUDY AREA
CONTOUR (10 METRE INTERVAL)	
EXISTING WINTER ROAD	
PROPOSED NICO PROJECT ACCESS ROAD	
PROPOSED TŁĮCHQ ROAD ROUTE	
WATERCOURSE	
WATERBODY	
WETLAND	

3 0 3

SCALE 1:125,000 KILOMETRES

NOTE: Unclassified areas are portions of the LSA for which an ELC vegetation class could not be assigned due to satellite interference.

REFERENCE

Base data obtained from GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE
ECOLOGICAL LANDSCAPE CLASSIFICATION IN THE LOCAL STUDY AREA

Golder Associates
Edmonton, Alberta

FILE NO. E-Veg-005-GIS			
PROJECT No. 09-1373-1004		SCALE AS SHOWN	REV. 0
DESIGN	JF	04 Jan. 2011	
GIS	CC	17 Feb. 2011	
CHECK	GRA	03 Apr. 2011	
REVIEW	GRA	03 Apr. 2011	

FIGURE:14.2-2b

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Table 14.2-2: Total Area and Percent Cover of Ecological Landscape Classification Types in the Local Study Area

ELC Map Code	Ecological Landscape Classification[a]	Mine Portion of LSA		NPAR Portion of LSA		Total LSA	
		Area (ha)	%	Area (ha)	%	Area (ha)	%
Uplands							
UBC	Bedrock open conifer	610	23.1	13	0.2	622	7.4
UCP	Coniferous pine	1	<0.1	228	4.0	228	2.7
UCS	Coniferous spruce	721	27.3	2 397	41.6	3 118	37.1
UDE	Deciduous aspen-paper birch	121	4.6	56	1.0	176	2.1
UMI	Mixedwood spruce-paper birch-aspen	73	2.8	481	8.3	554	6.6
uplands ELC types subtotal		*1 526*	*57.7*	*3 173*	*55.1*	*4 699*	*55.9*
Wetlands							
WMF	Marsh/graminoid fen	9	0.3	194	3.4	203	2.4
WOB	Open bog	49	1.9	292	5.1	342	4.1
WSH	Shrubland	1	<0.1	30	0.5	30	0.4
WTB	Treed bog	121	4.6	282	4.9	403	4.8
WTF	Treed fen	170	6.4	775	13.4	945	11.2
wetlands ELC types subtotal		*351*	*13.3*	*1 573*	*27.3*	*1 924*	*22.9*
Miscellaneous Vegetation							
BUR	Burn	328	12.4	731	12.7	1 059	12.6
miscellaneous ELC types subtotal		*328*	*12.4*	*731*	*12.7*	*1 059*	*12.6*
Non-vegetated							
WAT	Water	344	13.0	270	4.7	614	7.3
non-vegetated ELC types subtotal		*344*	*13.0*	*270*	*4.7*	*614*	*7.3*
Disturbance							
DIS	Disturbance	12	0.5	1	0.0	13	0.2
disturbance ELC types subtotal		*12*	*0.5*	*1*	*0.0*	*13*	*0.2*
Unclassified							
UNC	Unclassified (cloud, haze, and shadow)	83	3.1	12	0.2	96	1.1
unclassified ELC types subtotal		*83*	*3.1*	*12*	*0.2*	*96*	*1.1*
Total		**2 644**	**100**	**5 761**	**100**	**8 405**	**100**

Note: Numbers are rounded for presentation purposes; therefore, it may appear that the totals do not equal the sum of the individual values.

[a] All Ecological Landscape Classification Types are the same as described for the RSA (Table14.2-1), except for Mixedwood spruce-paper birch-aspen and Disturbance. Mixedwood spruce-paper birch-aspen is found in mesic sites and supports deciduous species such as aspen and birch, mixed with white spruce; this ELC was previously combined with the coniferous spruce at the RSA scale. Disturbance areas include exploration facilities and roads/trails.

LSA = local study area; NPAR = NICO Project Access Road; ELC = Ecological Landscape Classifcation; % = percent; < = less than; ha = hectare.

14.2.2.2 Rare Plants

No confirmed rare plant species as listed by the GNWT (2010) or federal listed species (COSEWIC 2010; *SARA* 2010) were identified as occurring within the LSA during the 2005, 2006, and 2008 field programs. Only one species, rock polypody (*Polypodium virginianum*), which is listed as status undetermined by the GNWT (2010) had confirmed occurrences in the LSA. An undetermined status indicates that there is insufficient information or data available on the species to accurately determine its listing status.

14.2.2.2.1 Rare Plant Habitat Potential

Ecological Landscape Classification types within the LSA were ranked according to their potential to support rare plant species. Rankings were assigned to ELC types using field survey information and the typical habitats of rare plant species (Table 14.2-3).

Table 14.2-3: Rare Plant Habitat Potential Rating System

Ecological Landscape Classification Type	Potential Number of Rare Species	Ranking[c]	Rare Plant Habitat Potential
Unclassified	n/a	n/a	n/a
Disturbed[a]	7	1	low
Burn	8	1	low
Deciduous aspen paper birch	8	1	low
Mixedwood-spruce-paper birch-aspen	8	1	low
Treed fen	17	2	moderate
Coniferous spruce	20	2	moderate
Treed bog	21	2	moderate
Open bog	24	2	moderate
Bedrock Open Conifer	25	3	high
Coniferous pine	26	3	high
Water[b]	32	3	high
Shrubland	50	4	very high
Marsh/graminoid fen	57	4	very high

[a] Includes exploration facilities and roads/trails.

[b] Water generally represents deep water, which has a very low rare plant habitat potential. However, it is classed with a high rare plant habitat potential as it is also associated with shallow water (e.g., littoral zones) where a relatively high number of rare plants may be found.

[c] Ranks are based on low (1) to high (4) classification.

n/a = not applicable.

The distribution of rare plant habitat potential classes within the LSA is shown in Table 14.2-4 and Figures 14.2-3a, b. The majority of the LSA (57.2%) was classified as having a moderate potential to support rare plants. Areas of high and very high potential compose 17.4% and 2.8% of the LSA, respectively. Approximately 21.4% of the LSA was classified as having a low potential to support rare plants.

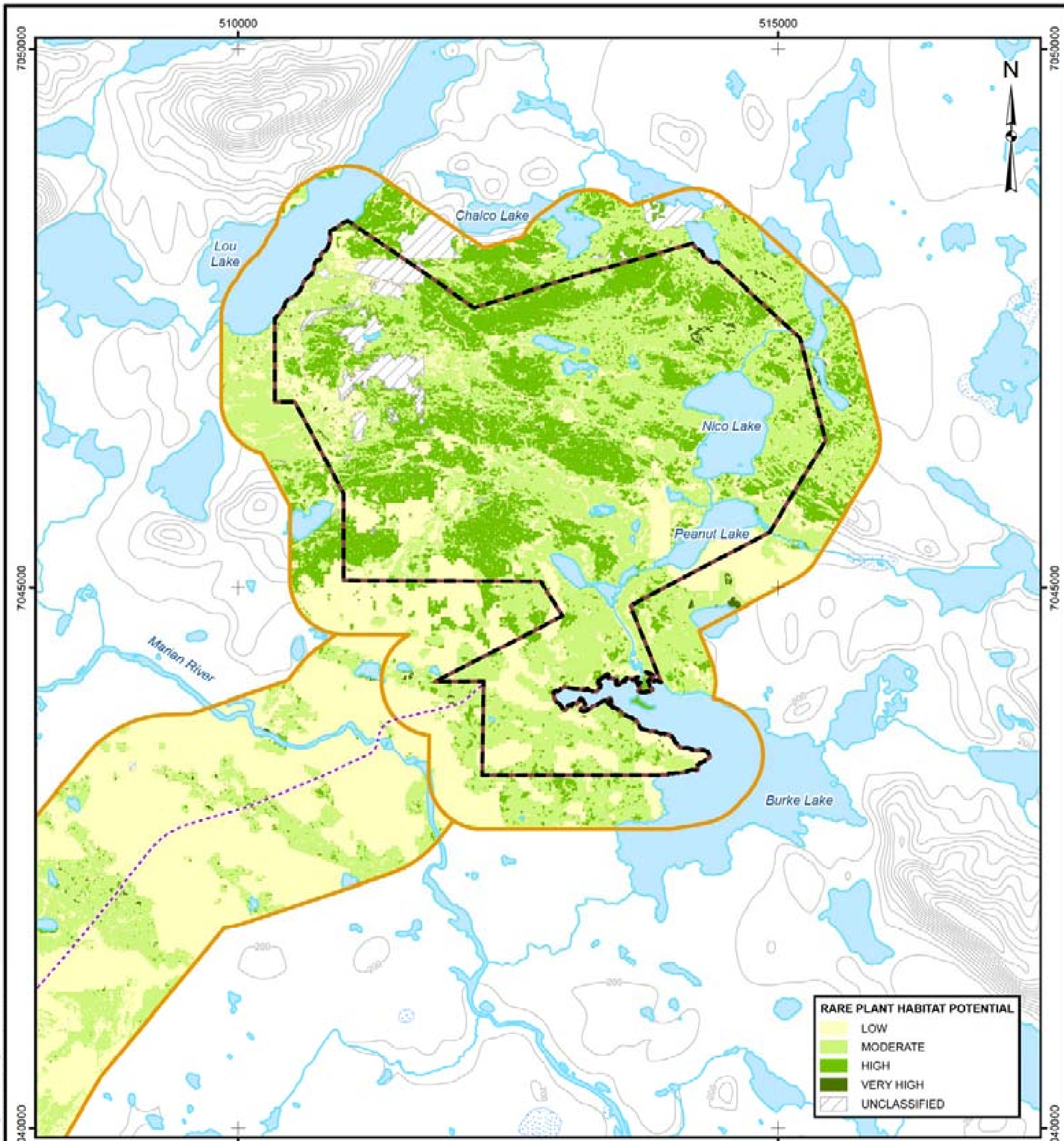
Table 14.2-4: Rare Plant Habitat Potential in the Local Study Area

Rank	Mine Portion of LSA		NPAR Portion of LSA		Total LSA	
	Area (ha)	%	Area (ha)	%	Area (ha)	%
Low[a]	534	20.2	1 268	22.0	1 802	21.4
Moderate	1 062	40.2	3 746	65.0	4 808	57.2
High	955	36.1	510	8.9	1 465	17.4
Very High	10	0.4	224	3.9	234	2.8
Unclassified	83	3.1	12	0.2	96	1.1
Total	**2 644**	**100**	**5 761**	**100**	**8 405**	**100**

Note: Numbers are rounded for presentation purposes; therefore, it may appear that the totals do not equal the sum of the individual values.

[a] Includes disturbance Ecological Landscape Classification types associated with exploration facilities and roads/trails.

LSA = local study area; NPAR = NICO Project Access Road; % = percent; ha = hectare.



LEGEND

- PROJECT LEASE BOUNDARY
- CONTOUR (10 METRE INTERVAL)
- PROPOSED NICO PROJECT ACCESS ROAD
- WATERCOURSE
- WATERBODY
- WETLAND
- LOCAL STUDY AREA

NOTE: Unclassified areas are portions of the LSA for which an ELC vegetation class could not be assigned due to satellite interference.

REFERENCE

Base data obtained from GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

1 0 1
SCALE 1:50,000 KILOMETRES

FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE

RARE PLANT HABITAT POTENTIAL IN THE LOCAL STUDY AREA

Golder Associates
Edmonton, Alberta

FILE NO. E-Veg-006-GIS				
PROJECT No. 09-1373-1004			SCALE AS SHOWN	REV. 0
DESIGN	JF	04 Jan. 2011	FIGURE: 14.2-3a	
GIS	VGV	04 Feb. 2011		
CHECK	GRA	03 Apr. 2011		
REVIEW	GRA	03 Apr. 2011		

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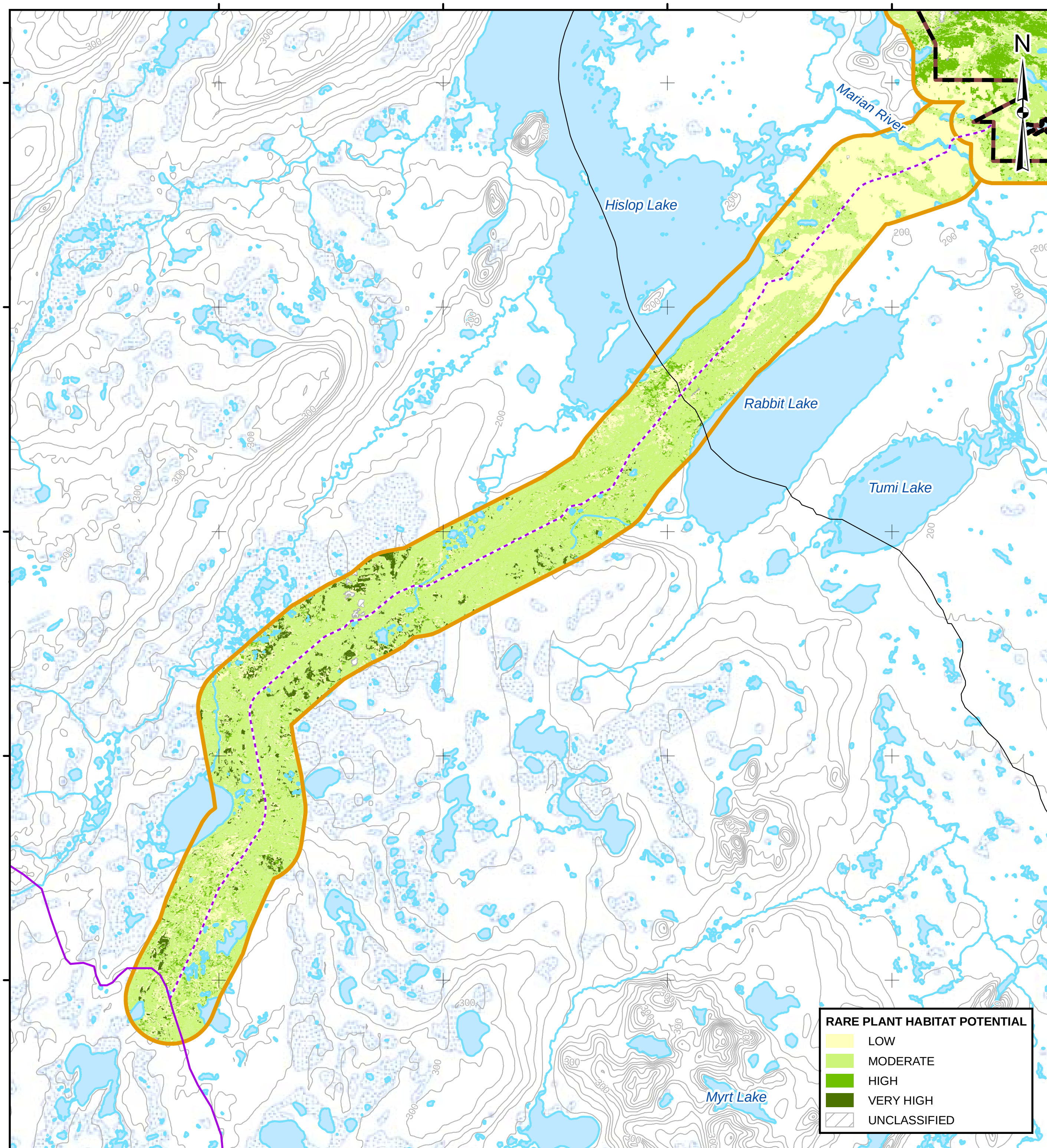

LEGEND

- PROJECT LEASE BOUNDARY
- CONTOUR (10 METRE INTERVAL)
- EXISTING WINTER ROAD
- PROPOSED NICO PROJECT ACCESS ROAD
- PROPOSED TŁĮCHQ ROAD ROUTE
- WATERCOURSE
- WATERBODY
- WETLAND
- LOCAL STUDY AREA

NOTE: N/A areas are portions of the LSA for which an ELC vegetation class could not be assigned due to satellite interference.

REFERENCE

Base data obtained from GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

3 0 3
SCALE 1:125,000 KILOMETRES

FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE

RARE PLANT HABITAT POTENTIAL IN THE LOCAL STUDY AREA

Golder Associates
Edmonton, Alberta

FILE NO. E-Veg-007-GIS			
PROJECT No. 09-1373-1004		SCALE AS SHOWN	REV. 0
DESIGN	JF	04 Jan. 2011	FIGURE:14.2-3b
GIS	VGV	04 Feb. 2011	
CHECK	GRA	03 Apr. 2011	
REVIEW	GRA	03 Apr. 2011	

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14.2.2.3 Plant Species Diversity

Plant species data were collected in 10 ELC types, consisting of 5 upland and 5 wetlands ELC types (Table 14.2-5). In total, 257 plant species (126 vascular species and 131 non-vascular species) were identified within the LSA. This includes 49 woody species (trees and shrubs), 59 forbs, 18 graminoids, 63 mosses, 44 terrestrial lichens, and 24 epiphytes.

14.2.2.3.1 Total Number of Vascular Plant Species

The number of vascular plant species among ELC types was calculated as one measure of species diversity. The highest numbers of vascular plant species occurred within the coniferous spruce upland ELC type (70 species). This was followed by the shrubland and treed fen wetlands ELC types with 59 and 52 vascular species, respectively (Table 14.2-5). A total of 80 vascular plants were observed in all upland ELC types while a total of 90 vascular plants were observed in all wetlands ELC types (Table 14.2-5). The lowest number of vascular plant species occurred within the coniferous pine (26 species), deciduous aspen-paper birch (29 species), and open bog (29 species) ELC types.

Table 14.2-5: Vascular Plant Species Diversity Measures by Ecological Landscape Classification Type in the Local Study Area

ELC Map Code	Ecological Landscape Classification Type	Number of Sites[a]	Number of Vascular Species[b]	Percent of All Vascular Species[b]	Number of Vascular Species Unique to ELC Type[c]
Upland ELC Types					
UBC	Bedrock open conifer	22	43	28	12
UCP	Coniferous pine	7	26	17	0
UCS	Coniferous spruce	30	70	46	5
UDE	Deciduous aspen-paper birch	9	29	19	1
UMI	Mixedwood spruce-paper birch-aspen	14	46	30	3
	upland ELC types subtotal	*82*	*80*	*n/a*	*21*
Wetlands ELC Types					
WMF	Marsh/ graminoid fen	7	31	21	7
WOB	Open bog	10	29	19	2
WSH	Shrubland	11	59	39	11
WTB	Treed bog	11	47	31	6
WTF	Treed fen	18	52	34	7
	wetlands ELC types subtotal	*57*	*90*	*n/a*	*33*
Total		**139**	**126**	**n/a**	**54**

[a] The number of sites are based on rare plant surveys from 2005 and 2006 and Detailed Vegetation Inventory plots from 2008.

[b] Subtotals and totals are numbers of vascular species found in that ELC type. Thus, the same species may occur in more than one Ecological Landscape Classification type, so percentages cannot be calculated for subtotals or totals. The total number of vascular species is 126.

[c] Does not include unidentified species.

ELC = Ecological Landscape Classifcation; n/a = not applicable.

14.2.2.3.2 Total Number of Unique Species

Calculating the total number of unique species for each ELC type is a way of expressing habitat uniqueness. This index of diversity is presented in Table 14.2-6. The bedrock open conifer and shrubland ELC types had the highest numbers of unique species with 12 and 11 species, respectively. The lowest number of unique species occurred in the coniferous pine ELC type where no unique species were found, followed by the deciduous-aspen-paper birch ELC type with one unique species.

14.2.2.3.3 Species Richness and Evenness

Species richness for vascular plants, bryophytes, and lichens are shown in Table 14.2-6. Among the highest values for plant species richness are the coniferous spruce and mixedwood spruce-paper birch-aspen, open bog, and treed fen ELC types. The marsh/graminoid fen wetlands ELC type was found to have the lowest species richness.

Table 14.2-6: Species Richness and Evenness in the Local Study Area

Ecological Landscape Classification Map Code	Ecological Landscape Classification	Number of Detailed Vegetation Plots Sampled	Species Richness (minimum, maximum)[a]	Species Evenness (minimum, maximum)
Upland ELC Types				
UBC	Bedrock open conifer	6	8, 31	0.28, 0.54
UCP	Coniferous pine	4	19, 28	0.41, 0.68
UCS	Coniferous spruce	14	12, 44	0.39, 0.71
UDE	Deciduous aspen-paper birch	8	14, 30	0.27, 0.61
UMI	Mixedwood spruce-paper birch-aspen	6	14, 38	0.44, 0.70
Wetlands ELC Types				
WMF	Marsh/graminoid fen	4	2, 11	0.01, 0.60
WOB	Open bog	4	14, 38	0.44, 0.74
WSH	Shrubland	6	7, 36	0.44, 0.54
WTB	Treed bog	5	27, 30	0.42, 0.62
WTF	Treed fen	6	18, 38	0.49, 0.73

[a] Minimum and maximum values for species richness and evenness are reported and results are only calculated from detailed vegetation inventory plots and do not include results from the rare plant surveys.

Species evenness combines the number of species (richness) and the dominance of the species based on relative cover values. The more species and the more evenly distributed they are, the higher the index value (between 0 and 1). Evenness is expressed as a proportion of maximum diversity for a given number of species. High evenness occurs when the community type is not dominated by one or a few species.

The highest evenness values were recorded in the open bog and treed fen ELC types (Table 14.2-6). Upland ELC types with high evenness values included the coniferous spruce and mixedwood spruce-paper birch-aspen ELC types.

14.2.2.4 Traditional Use Plants

A list of traditional plants applicable to the NICO Project is provided in Table 14.2-7. This list also includes the ELC types associated with these species that represent the most probable ELC types where these plant species will occur with sufficient abundance for traditional use. Many traditional use plants such as black spruce, willow (*Salix* spp.), crowberry (*Empetrum nigrum*), bog cranberry (*Vaccinium vitis-ideae*), Labrador tea (*Ledum groenlandicum*), and prickly rose (*Rosa acicularis*.) are common in a number of different ELC types. However, there are a few traditional use species such as acerbic bulrush (*Schoenoplectus acutus*) and tamarack (*Larix laricina*) that are more restricted in their distribution and tend to only be associated with a single ELC type, though they may be locally abundant within that ELC type.

Traditional berries identified during Traditional Knowledge interviews (Section 5) for the NICO Project included the following:

- blueberries *(Vaccinium myrtilloides)*;
- cranberries (high bush *[Viburnum opulus]* and low bush *[Viburnum edule]*);
- cloudberries (*Rubus chamaemorus*);
- Saskatoon berries (*Amelanchier alnifolia)*;
- Gooseberries (*Ribes Oxyacanthoides)*;
- strawberries (*Fragaria virginiana*); and
- blackberries *Ribes hudsonianum*.

High bush and low bush cranberries, blueberries, and cloudberries were identified as berries harvested for food or as medicine to treat colds, mouth sores, and overall health. As food, cranberries are added to pemmican, and other berries are used in jams and oils. Interview participants reported that juniper roots and branches, pine cones and needles, spruce branches, cones and bark were often boiled for a medicinal broth (Section 5).In the vicinity of the NICO Project, Lou Lake was used as a staging area to harvest berries among the hills. Blueberries, cloudberries, and cranberries (high and low bush) have all been harvested in the LSA in the past (Section 5).

Table 14.2-7: Traditional Plant Use of the Northwest Territories and Associated Ecological Landscape Classification Types

Common Name	Scientific Name	Traditional Use	Bedrock open conifer	Coniferous pine	Coniferous spruce	Deciduous aspen-paper birch	Mixedwood spruce-paper birch-aspen	Marsh/graminoid fen	Open bog	Shrubland	Treed fen	Treed bog
acerbic bulrush	*Schoenoplectus acutus*	food, medicine, baskets[b]						•				
tamarack	*Larix laricina*	medicine, fuel[c]									•	
aspen	*Populus tremuloides*	food, medicine, tools, fuel[b]				•	•					
black currant (blackberry)	*Ribes hudsonianum*[a]	food[c]				•	•					
blueberry	*Vaccinium uliginosum / V. caespitosum*	food, medicine[c]		•	•							
cloudberry	*Rubus chamaemorus*	food[c]							•			•
high-bush cranberry	*Viburnum edule*	food, medicine[b]				•	•					
jack pine	*Pinus banksiana*	food, medicine, tools, shelter, fuel[b]	•	•								
paper birch	*Betula papyrifera*	food, medicine, tools, bait[c]				•	•					
raspberry	*Rubus ideaus*	food[c]				•	•					
white spruce	*Picea glauca*	food, medicine, shelter, fuel, tools[c]			•		•					
black spruce	*Picea mariana*	food, medicine, shelter, fuel, tools[c]			•						•	•
gooseberry	*Ribes oxyacanthoides*[a]	food, medicine[b]			•	•	•					
green alder	*Alnus crispa*	medicine, fuel[c]			•	•	•					

Table 14.2-7: Traditional Plant Use of the Northwest Territories and Associated Ecological Landscape Classification Types (continued)

Common Name	Scientific Name	Traditional Use	Bedrock open conifer	Coniferous pine	Coniferous spruce	Deciduous aspen-paper birch	Mixedwood spruce-paper birch-aspen	Marsh/graminoid fen	Open bog	Shrubland	Treed fen	Treed bog
juniper (berries)	*Juniperus communis*	medicine[c]	●	●	●							
willow (various)	*Salix* spp.	fuel, food, tools, shelter, medicine, tobacco, insect repellent, moth ball, fire starter[c]					●			●	●	
crowberry	*Empetrium nigrum*	food, medicine[c]		●	●				●			●
kinnikinnick (bear berry)	*Arctostaphylos uva-ursi /A. rubra /A. alpina*[a]	food[c]	●	●	●	●						
lichen	*Cladina* spp., *Cetraria* spp., *Parmelia* spp., *Actinogyra* spp.[a]	food, medicine[b]	●	●	●				●			
prickly rose	*Rosa acicularis*	food, medicine[c]		●	●	●	●					
sphagnum moss	*Sphagnum* spp., wetlands species	diapers, cleaner[c]						●	●		●	●
bog cranberry	*Vaccinium vitis-ideae*	food, medicine, dye[c]		●	●		●		●			●
Labrador tea	*Ledum groenlandicum*	food, medicine[c]		●	●				●		●	●

[a] Genus or species not observed during 2005 to 2008 field surveys.

[b] Marles et al. (2000).

[c] Andre and Fehr (2002).

spp. = multiple species.

14.2.2.5 Economic Use Plants

Ecological Landscape Classification types that contain potential timber resources are limited to upland types and include bedrock open conifer, coniferous pine, coniferous spruce, deciduous aspen-paper birch, and mixedwood spruce-paper birch-aspen (Table 14.2-8). It is likely that most of the construction based timber resources will be associated with the coniferous spruce and mixedwood spruce-paper birch-aspen ELC types, where white spruce is of sufficient size that it can be used as saw logs or cabin logs for buildings. However, the other ELC types contain tree species such as jack pine that are much smaller and have less utility for saw logs and are more likely to be used for fuel wood. Aspen and paper birch (*Betula papyrifera*), though present, are typically not used for construction materials, though both species may be used as fuel wood.

Table 14.2-8: Ecological Landscape Classification Types That Contain Timber Resources in the Local Study Area

Ecological Landscape Classification	Potential Timber Resources	Site Index Data						LSA	
		Tree Species	n	Height (m)		Diameter at Breast Height (m)		Area (ha)	%
				Min	Max	Min	Max		
Potential Timber Resources ELC Types									
Bedrock open conifer	Jack Pine[a]	nd	nd	nd	nd	nd	nd	622	7.4
Coniferous pine	Jack Pine, Black Spruce	Jack Pine	6	6.9	20.2	19.5	31.2	228	2.7
Coniferous spruce	White Spruce, Black Spruce, Jack Pine[a]	White Spruce	10	11.5	21.5	16.0	38.5	3 118	37.1
Deciduous aspen-paper birch	Aspen, Paper Birch	Paper Birch	6	7.3	10.86	11.5	21	176	2.1
Mixedwood spruce-paper birch-aspen	Jack Pine, White Spruce, Black Spruce, Aspen, Paper Birch	White Spruce	7	10.9	19.7	16.2	38.8	554	6.6
Potential Timber Resources ELC types subtotal								*4 699*	*55.9*
Potential Non-Timber Resources ELC Types									
Wetlands	None	nd	nd	nd	nd	nd	nd	1 924	22.9
Burn	None	nd	nd	nd	nd	nd	nd	1 059	12.6
Water	None	nd	nd	nd	nd	nd	nd	614	7.3
Disturbance[b]	None	nd	nd	nd	nd	nd	nd	13	0.2
Unclassified (cloud, haze and shadow)	Jack Pine, White Spruce, Black Spruce, Aspen	nd	nd	nd	nd	nd	nd	96	1.1
Potential Non-Timber Resources ELC types subtotal								*3 706*	*44.1*
Total								**8 405**	**100**

Note: Numbers are rounded for presentation purposes; therefore, it may appear that the totals do not equal the sum of the individual values.

[a] Species present, but with low cover.

[b] Includes exploration facilities and roads/trails.

n = number of trees sampled; LSA = local study area; ELC = Ecological Landscape Classification; Min = minimum; Max = maximum; cm = centimetres; m = metres; ha = hectares; % = percent; nd = no data.

14.3 Pathway Analyses

14.3.1 Methods

Pathway analysis identifies and assesses the linkages between NICO Project components or activities, and the correspondent potential residual effects to plant populations and communities. Potential pathways through which the NICO Project could affect plant populations and communities were identified from a number of sources including:

- a review of the development description and scoping of potential effects by the environmental and engineering teams for the NICO Project;
- scientific knowledge and experience with other mines in the NWT;
- engagement with the public, Aboriginal people, communities, and government; and
- consideration of potential effects identified from the TOR for the NICO Project.

The first part of the analysis is to produce a list of all potential effects pathways for the NICO Project (Section 6.4). Each pathway is initially considered to have a linkage to potential effects on plant populations and communities. This step is followed by the development of environmental design features and mitigation that can be incorporated into the development description to remove a pathway or limit (mitigate) the effects to plant populations and communities. Environmental design features include NICO Project design elements, environmental best practices, management policies and procedures, and social programs. Environmental design features are developed through an iterative process between the NICO Project's engineering and environmental teams to avoid or mitigate effects.

Knowledge of the ecological system and environmental design features and mitigation is then applied to each of the pathways to determine the expected amount of Project-related changes to the environment and the associated residual effects (i.e., effects after mitigation) on plant populations and communities. Changes to the environment can alter and measurement endpoints such as presence of invasive plant species (Section 6.2). For an effect to occur there has to be a source (i.e., NICO Project component or activity) that results in a measurable environmental change (pathway) and a correspondent effect on plant populations and communities.

Project activity → change in environment → effect on plant populations and communities

Pathway analysis is a screening step that is used to determine the existence and magnitude of linkages from the initial list of potential effects pathways for the NICO Project. This screening step is largely a qualitative assessment, and is intended to focus the effects analysis on pathways that require a more comprehensive assessment of effects on plant populations and communities. Pathways are determined to be primary, secondary (minor), or as having no linkage using scientific and traditional knowledge, logic, and experience with similar developments and environmental design features. Each potential pathway is assessed and described as follows:

- no linkage – pathway is removed by environmental design features and mitigation so that the NICO Project results in no detectable environmental change and, therefore, no residual effects to plant populations and communities relative to baseline or guideline values;

- secondary – pathway could result in a minor, measurable environmental change, but would have a negligible residual effect on plant populations and communities relative to baseline or guideline values; or
- primary – pathway is likely to result in a measurable environmental change that could contribute to residual effects on plant populations and communities relative to baseline or guideline values.

Primary pathways require further effects analysis and impact classification to determine the environmental significance from the NICO Project on the persistence of plant populations and communities. Pathways with no linkage to plant populations and communities or that are considered minor (secondary) are not analyzed further in the DAR because environmental design features and mitigation will remove the pathway (no linkage) or residual effects to plant populations and communities can be determined to be negligible through a simple qualitative evaluation of the pathway. Pathways determined to have no linkage to plant populations and communities or those that are considered secondary are not predicted to result in environmentally significant effects on plant populations and communities. All primary pathways are assessed in the DAR.

14.3.2 Results

Potential pathways through which the NICO Project could affect plant populations and communities are presented in Table 14.3-1. Environmental design features and mitigation incorporated into the NICO Project to remove a pathway or limit the effects to VCs are listed. The following section discusses the potential pathways relevant to plant populations and communities.

Table 14.3-1: Potential Pathways for Effects to Vegetation

NICO Project Component/Activity	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment
Mine infrastructure footprint (e.g., Open Pit, site roads, Co-Disposal Facility, and airstrip) NICO Project Access Road footprint	Physical loss or alteration of vegetation from the NICO Project footprint	The current layout of the mine footprint will limit the area that is disturbed (updated from 30 January 30 2009). The access road will be as narrow as possible, while maintaining safe construction and operation practices.	Primary
	Loss or alteration of local flows, drainage patterns (distribution) and drainage areas from the NICO Project footprint can cause changes to soils, vegetation and wetlands	Use of culverts and other design features that reduce changes to local flows and drainage patterns and drainage areas.	Secondary
	Physical loss or alteration of permafrost from the NICO Project footprint can lead to changes in vegetation ecosystem structure and composition.	The current layout of the mine footprint will limit the area that is disturbed (updated from 30 January 30 2009). Plant site infrastructure (buildings) foundations will be built on bedrock not susceptible to frost heave and to minimize thawing of permafrost. The NICO Project Access Road will be as narrow as possible, while maintaining safe construction and operation practices. The NICO Project Access Road design will use coarser materials to minimize frost effects. Most construction will likely be completed during winter months, when possible. Organic and/or topsoil horizons will not be stripped in areas containing ice-rich permafrost to reduce potential for an increase in thaw depth and related thaw subsidence.	Secondary

Table 14.3-1: Potential Pathways for Effects to Vegetation (continued)

NICO Project Component/Activity	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment
Operation of Co-Disposal Facility	Vertical and lateral seepage from the Co-Disposal Facility may cause changes to groundwater and surface water quality and soils, which may affect vegetation	Seepage from the Co-Disposal Facility will be captured in the Seepage Collection Ponds and diverted to the Effluent Treatment Facility or recycled through the Surge Pond to the Mineral Process Plant.	No Linkage
	Leaching of dissolved metals from Mine Rock may cause changes to groundwater and surface water quality and soils, which may affect vegetation	Any potential acid-generating Mine Rock will be sequestered within the interior of the Co-Disposal Facility. Overburden directed to the Co-Disposal Facility will be used to cover all areas in the pile where potentially metal leaching Mine Rock is to be sequestered to reduce any infiltration. Runoff from the Co-Disposal Facility will be captured and diverted to the Effluent Treatment Facility or the Mineral Process Plant.	No Linkage
General construction and operation of mine and supporting infrastructure	Air emissions and dust deposition can cause changes to the chemical properties of surface water, soils, wetlands, and vegetation	Watering of roads will suppress dust production. Enforcing speed limits will help reduce dust production. Equipment and fleet equipped with industry-standard emission control systems. Enclosing conveyance systems and processing facilities. Processing equipment with high efficiency bag houses to reduce emissions of particulate matter Operating procedures will be developed that reduce dust generation and air emissions (e.g., regular maintenance of equipment to meet emission standards).	Secondary
	Dust deposition may cover vegetation and lead to physical and/or physiological damage		Secondary

Table 14.3-1: Potential Pathways for Effects to Vegetation (continued)

NICO Project Component/Activity	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment
General construction and operation of mine and supporting infrastructure (continued)	Surface water runoff from the core mine facilities area can affect surface water quality, soils, and vegetation	The Water Management Plan will control surface water on-site. Runoff from the mine site will be captured and diverted to the Effluent Treatment Facility or the Mineral Process Plant. The site will have sufficient storage capacity in Surge Ponds to store both operating flows and storm events. Sewage will be treated in the STP and the effluent will either be re-used during processing or discharged to Peanut Lake through the Effluent Treatment Facility,	No Linkage
	Introduction of non-native plant species can affect native vegetation	Regular cleaning of construction equipment/vehicles. Develop and implement an invasive plant management strategy.	Secondary
	Spills on the mine site or along the NICO Project Access Road can affect soils and vegetation	Hazardous materials and fuel will be stored according to regulatory requirements to protect the environment and workers (i.e., Materials and Waste Management Plan). Smaller storage tanks (e.g., engine oil, hydraulic oil, and waste oil and coolant) will be double walled, and located in lined and bermed containment areas. Reagents and fuel Enviro-Tanks will be located in larger, double-walled containers. Separate areas will be established for the handling and temporary storage of hazardous wastes.	No Linkage

Table 14.3-1: Potential Pathways for Effects to Vegetation (continued)

NICO Project Component/Activity	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment
		Domestic and recyclable waste dangerous goods will be stored on-site in appropriate containers to prevent exposure until they are shipped off site to an approved facility. Individuals working on-site and handling hazardous materials will be trained in the Transportation of Dangerous Goods. Soils from petroleum spill areas will be deposited and spread in a lined landfarm cell for bioremediation. An Emergency Response and Spill Contingency Plan has been developed and will be implemented. Emergency spill kits will be available wherever toxic materials or fuel are stored and transferred. Construction and mining equipment, machinery, and vehicles will be regularly maintained.	
Process water and potable water supply	Process and potable water requirements for the NICO Project may decrease drainage flows and surface water levels, and affect vegetation and wetlands	Capture and reuse site water to reduce fresh water requirements. Water from tailings thickener and from the Tailings Basin will be recycled for Mineral Process Plant operations. Excess water from the Open Pit will be recycled in mill operations.	Secondary

Table 14.3-1: Potential Pathways for Effects to Vegetation (continued)

NICO Project Component/Activity	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment
Post-closure	Residual ground disturbance can cause permanent loss and alteration of vegetation	Limit size of NICO Project footprint. Salvage and store Growth Media for re-vegetation. Implement a Closure and Reclamation Plan. Develop a Re-vegetation Plan.	Primary
	Long-term seepage from the Co-Disposal Facility can change groundwater and surface water quality, which can affect soil and vegetation	Co-Disposal Facility will be capped during closure to isolate Mine Rock and tailings and minimize leaching. Constructed wetlands will be established to treat seepage water.	No Linkage

14.3.2.1 Pathways with No Linkage

A pathway may have no linkage if the pathway is removed by environmental design features and mitigation so that the NICO Project results in no detectable environmental change and no residual effects to vegetation relative to baseline or guideline values. The pathways described in the following bullets have no linkage to vegetation, and will not be carried through the effects assessment.

- **Vertical and lateral seepage from the Co-Disposal Facility may cause changes to groundwater and surface water quality, and soils, which may affect vegetation.**
- **Leaching of dissolved metals from Mine Rock may cause changes to groundwater and surface water quality and soils, which may affect vegetation.**
- **Long-term seepage from the Co-Disposal Facility can change groundwater and surface water quality, which can affect soil and vegetation.**

During the life of the NICO Project, there is the potential for acidic leachate (e.g., metals) from the tailings and mine rock Co-Disposal Facility (CDF) to seep through the co-disposed materials and report as seepage into the Seepage Collection Ponds. Additionally, there is potential for arsenic as well as other metals (i.e., aluminum, arsenic, cadmium, cobalt, lead, selenium, and uranium) to be present in the leachate. Such water-borne elements could adversely affect soils through surface water runoff and seepage. Environmental design features and mitigation have been incorporated into the NICO Project to reduce the potential for water to contact metal leaching Mine Rock, tailings, and potentially acid generating rock and thus, reducing potential effects to the environment from surface water runoff and seepage from the CDF (Table 14.3-1).

The CDF is designed to limit runoff and seepage from contacting metal leaching Mine Rock and tailings by placing this material in the interior of the CDF interlayered with tailings. The cover placed on the top of the CDF at closure, will limit infiltration into the interior of the CDF where potentially acid generating and metal leaching rock is located.

Runoff and seepage from the CDF will not be released directly to the environment during construction, or operations. Runoff and seepage from the CDF will report to one of 5 Seepage Collection Ponds. During operations, water in the Seepage Collection Ponds will be pumped to the Surge Pond. Water from the Surge Pond will be pumped for use in the Plant or pumped to the Effluent Treatment Facility for treatment prior to release into Peanut Lake.

At closure, the entire surface of the CDF will be covered; thereafter, runoff from the CDF will not be in contact with the mine rock or tailings materials. Seepage out of the toe of the CDF will continue to be collected in the Seepage Collection Ponds. Water from Seepage Collection Ponds No. 1, 2, 3, and 5 and the Surge Pond will pass through constructed Wetland Treatment Systems prior to release into Nico Lake. The use of wetland treatment will be subject to demonstration of its technical feasibility by testing during the operating life of the mine. The Open Pit will slowly flood after closure. The water level is expected to reach Elev. 260 m roughly 120 years after closure, at which point it will overflow. At that time the pit lake overflow water will be directed through a ditch to Wetland Treatment System No. 4, which will discharge into Peanut Lake.

At Closure, the top surface of the CDF will be covered with a 0.5 m layer of glacial till underlain by a 0.25 m layer of sand. The top surface of the CDF will be sloped towards the west to shed water and to reduce net infiltration of precipitation. The sand layer will serve as a capillary break to minimize the potential for upward flux of tailings pore water. This will reduce the potential for metal contamination of soil, and subsequent uptake by plants.

The Grid ponds area currently produces measureable natural arsenic loadings into Nico Lake. After construction, all releases from the NICO Project site into Nico or Peanut Lake will be subject to monitoring and treatment by active or passive means. Overall, release of runoff and long-term seepage from the CDF is not expected to result in a detectable change to vegetation and wetlands outside of the NICO Project footprint area relative to baseline conditions. Therefore, these pathways were determined to have no linkage to the persistence of plant populations and communities.

- **Surface water runoff from the core mine facilities area can affect surface water quality, soils, and vegetation.**

Surface water runoff from the Open Pit and Mineral Processing Plant (Plant) facilities area could potentially affect vegetation. These facilities incorporate several environmental design features to prevent release of untreated site water into the receiving environment (Table 14.3-1).

During operations, water that collects in the Open Pit sump, which will include seepage into the Open Pit as well as runoff from rainfall and snow, will be pumped to the Surge Pond. Runoff from the Plant will be collected in a site runoff collection pond and then transferred to the Surge Pond. Sewage will be treated in a Sewage Treatment Plant and treated liquid will also be discharged into the Surge Pond. Water collected in the Surge Pond will be reclaimed to the Plant to the extent that it is needed; all excess water will be pumped to the Effluent Treatment Facility. Following treatment, the water will be discharged through a diffuser into Peanut Lake.

After closure, dewatering of the Open Pit will cease and the Open Pit will slowly fill with water. The water level is expected to reach Elev. 260 m roughly 120 years after closure, at which point it will overflow. At that time, the overflow water from the Open Pit will be treated by one of several potential methods described in Section 3.9.2.3. After treatment, the Open Pit water will discharge into Peanut Lake. At closure, the Plant will be demolished and the area will be covered with till and re-vegetated. Runoff from part of the area will drain into the Surge Pond and then into Wetland Treatment System No. 4. Runoff from the remainder of the area will drain directly into Wetland treatment System No. 4, which will discharge into Nico Lake. Closure of the CDF will focus on reducing the risk of wind and water erosion of tailings. The exposed tailings will be covered with a 0.5 m thick layer of glacial till underlain by a 0.25 m layer of sand. Erosion control practices (e.g., erosion mats) will be used to limit erosion of topsoil stockpiles.

Implementation of these environmental design features is expected to result in no detectable changes to vegetation adjacent to the NICO Project. Subsequently, this pathway was determined to have no linkage to effects on the persistence of plant populations and communities

- **Spills on the mine site or along the NICO Project Access Road can affect soils and vegetation.**

Chemical spills on other northern mine sites are usually localized, and are quickly reported and managed (Tahera 2008; BHPB 2010; DDMI 2010; De Beers 2010). Mitigation identified in the Emergency Response and Spill Contingency Plan (Appendix 3.VI) and other environmental design features will be in place to limit the frequency and extent of spills that result from NICO Project activities (Table 14.3-1). Hazardous materials and fuel will be stored according to regulatory requirements to protect the environment and workers (i.e., Hazardous Substances Management Plan; Appendix 3.V). Smaller storage tanks (e.g., engine oil, hydraulic oil, waste oil, and coolant) will be double walled, and located in lined and bermed containment areas. Individuals working on-site and handling hazardous materials will be trained in the Transportation of Dangerous Goods. Emergency spill kits will be available wherever toxic materials or fuel are stored and transferred.

The implementation of the Emergency Response and Spill Contingency Plan and environmental design features are anticipated to reduce the frequency and severity of spills on the environment. Thus, spills in the mine area and on the NPAR are not predicted to result in detectable changes to soil and vegetation relative to baseline conditions. Consequently, this pathway was determined to have no linkage to the persistence of plant populations and communities.

14.3.2.2 Secondary Pathways

In some cases, both a source and a pathway exist, but the NICO Project is anticipated to result in a minor environmental change, and would have a negligible residual effect on vegetation relative to baseline or guideline values. The pathways described in the following bullets are expected to result in negligible effects to vegetation and will not be carried through the effects assessment.

- **Physical loss or alteration of permafrost from the NICO Project footprint can lead to changes in vegetation ecosystem structure and composition.**

Permafrost across the landscape within the RSA has been mapped and described as containing extensive discontinuous permafrost (Natural Resources Canada 1993). Freeze induced displacement of soil (i.e., frost jacking) and thaw induced displacement of soil (i.e., subsidence) are the main issues related to permafrost degradation (i.e., loss and alteration). Changes to thaw penetration and thickness of the active layer can influence surface stability through thaw settlement, frost heave, and bearing capacity, as well as slope stability (Tarnoicai et al. 2004). Changes to the permafrost active layer can also affect vegetation by altering local hydrology, soil moisture, and nutrient availability conditions. A summary of the analysis of this pathway is provided in Section 13.3.2.2.

Mitigation and environmental design features to reduce the potential for permafrost melting and subsequent subsidence on areas include the following:

- re-vegetate disturbed areas as soon as possible;
- use culverts to maintain surface drainage and reduce pooling of water at the surface;
- limit the mine footprint disturbance area;
- limit the road footprint disturbance area, while maintaining safe construction and operation practices;
- use coarser materials for road construction to minimize frost effects;
- insulate infrastructure, where possible;
- building foundations will be built on bedrock not susceptible to frost heave to minimize thawing of permafrost in sensitive areas; and
- organic and/or topsoil horizons will not be stripped in areas containing ice-rich permafrost to reduce potential for an increase in thaw depth and related thaw subsidence.

By implementing these mitigation practices and environmental design features, the change to permafrost from the NICO Project is anticipated to be minor relative to baseline conditions (secondary; Table 14.3-1); therefore, the residual effects to plant populations and communities are predicted to be negligible.

- **Loss or alteration of local flows, drainage patterns (distribution) and drainage areas from the NICO Project footprint can cause changes to soils, vegetation, and wetlands.**

Water diversions are not required for the development of the NICO Project infrastructure footprint, as the footprint is located near the top of a watershed; however, the CDF will eliminate the Grid Ponds, which are situated in a runoff catchment. The loss of the Grid Ponds is expected to result in represent minor fluctuations in water level relative to baseline values of Nico Lake (Section 11.3.2.2).

Because treated effluent will immediately mix with water from Peanut Lake, flows from Peanut Lake into Burke Lake will be increased during periods of effluent discharge. In general, the influence of discharge from the NICO Project to Peanut Lake is anticipated to result in little to no effect on water levels in downstream waterbodies, including Ponds 11, 12, and 13 and Burke Lake relative to baseline conditions (Section 11.3.2.2). The water management system for the NICO Project has been optimized in terms of internal recycling within the Plant, thickening of the tailings, and high level of reclaim water from the CDF back to the Plant. The implementation of the mitigation practices and environmental design features is expected to result in a minor change (secondary pathway) to the hydrology in the LSA from the NICO Project relative to baseline conditions, which should have a negligible effect on Peanut Lake and downstream waterbodies such as Pond 11, 12, and 13, and Burke Lake.

The NPAR will cross 9 streams. To mitigate effects to local flows, drainage patterns, and drainage areas along the NPAR, a bridge will be built to cross the Marian River, while all other streams, because they are ephemeral, will be culverted. The mine infrastructure and NPAR footprints are not predicted to change local flows, drainage patterns, and drainage areas outside the range of baseline values; ttherefore, the residual effects to the persistence of wetlands and plant populations and communities are predicted to be negligible.

- **Air emissions and dust deposition can cause changes to the chemical properties of surface water, soils, wetlands, and vegetation.**

- **Dust deposition may cover vegetation and lead to physical and/or physiological damage.**

Accumulation of dust (i.e., particulate matter and total suspended particulate deposition) and concentrations of air emissions produced from the NICO Project may result in a local indirect change on the quality of vegetation within the LSA. Air quality modelling was completed to predict the spatial extent of dust deposition and air emissions from the NICO Project (Section 10.4). Sources of dust deposition and air emissions modelled in the application case (maximum effect case) include blasting activities, haul roads, the Plant, activities at the Open Pit and other ancillary facilities (e.g., CDF), and vehicle traffic along the NPAR and Proposed Tłįchǫ Road Route. Environmental design features and mitigation have been incorporated into the NICO Project to reduce potential effects from dust deposition (Table 14.3-1). For example, the watering of roads, Airstrip, and laydown areas during the non-winter period will facilitate dust suppression. In addition, programs will be implemented to review power and heat use to reduce energy use. Although these environmental design features and mitigation should reduce dust deposition and air emissions, assumptions incorporated into the model are expected to contribute to conservative estimates of emission concentrations and deposition rates (Section 10.4).

Deposition of dust onto vegetation can result in a variety of physiological and chemical effects, including reduced water content, increased conductivity, reduced chlorophyll content, reduced respiration, reduced reception of radiation or photosynthesis, and reduced carbon uptake (Spatt and Miller 1981). In some cases visible symptoms such as chlorosis or necrosis of the leaves (e.g., brown or black spots) may occur in affected plants, but in general, there is in overall reduction in plant productivity. Lichens, mosses, and other plants that derive some of their moisture and nutrient requirements from the atmosphere are especially sensitive to the effects of dust (Farmer 1993). Auerbach et al. (1997) found that although plant species composition may change and aboveground biomass is reduced by dust deposition, ground cover is still maintained. Some species such as cloudberry (*Rubus chamaemorus)*, willow, and cottongrass (*Eriophorum spp*.) were observed to be more abundant as a result of dust deposition, as these species have a higher tolerance to dust and may be able to out-compete less tolerant species (Forbes 1995).

Trucks travelling on the winter roads, NPAR, and the Proposed Tłįchǫ Road Route have the potential to transfer dust from vehicles and loads (e.g., dust deposited on wheels and undercarriage while at the NICO Project and in Yellowknife); however, the relative contribution of these loads to the overall dust accumulation in the area along the roads is considered to be negligible (Section 10.4). Similarly, dust generation from NICO Project vehicles along the NPAR and Proposed Tłįchǫ Road Route would occur annually, but would likely be higher during the non-winter period and not continuous (i.e., would occur less frequently during wet and cool conditions). Dust deposition is expected to result in minor and localized changes to vegetation along the right-of-ways for the NPAR and Proposed Tłįchǫ Road Route. For example, Walker and Everett (1987) and Everett (1980) reported that effects were confined to a 50 m buffer on either side of a road. Moreover, Meininger and Spatt (1988) found that most of effects occurred within 5 to 50 m of a road, with less obvious effects observed between 50 and 500 m from a road. Dust deposition from vehicles along the NPAR and Proposed Tłįchǫ Road Route are predicted to result in negligible residual effects to the persistence of plant populations and communities.

Air emissions from vehicles along the NPAR and existing winter roads were included in the application case and assumed that winter roads were in operation for 63 days for construction, after which the NPAR and the Proposed Tłįchǫ Road Route would be open all-year round. In general, emissions from the roads are small, and if extended over the whole year, a negligible effect from annual depositions was predicted (Section 10.4). Annual emissions from vehicles on the roads are anticipated to result in no detectable changes to vegetation.

The results of the air quality modelling predicted that the maximum annual dust deposition resulting from the NICO Project is 1083 grams per square metres per year (g/m^2/y) within the NICO Project Lease Boundary, and 151 g/m^2/y outside of the NICO Project Lease Boundary (Table 14.3-2). Further, modelling showed minimal dust deposition (i.e., <79 g/m^2/y) beyond approximately 280 m from the NICO Project Lease Boundary (i.e., there should be limited dust deposition outside of the LSA) (Figure 14.3-1). The only area that is predicted to receive dust (i.e., total suspended particulate) beyond the NICO Project Lease Boundary is a small area north of the NICO Project Lease Boundary (Figure 14.3-1). The major sources of dust will be associated with the Open Pit and haul roads. The strongest effects from dust are generally confined to the immediate area adjacent to the dust source, such as roads (Walker and Everett 1987). Walker and Everett (1987) and Everett (1980) reported that effects were confined to a 50 m buffer on either side of a road.

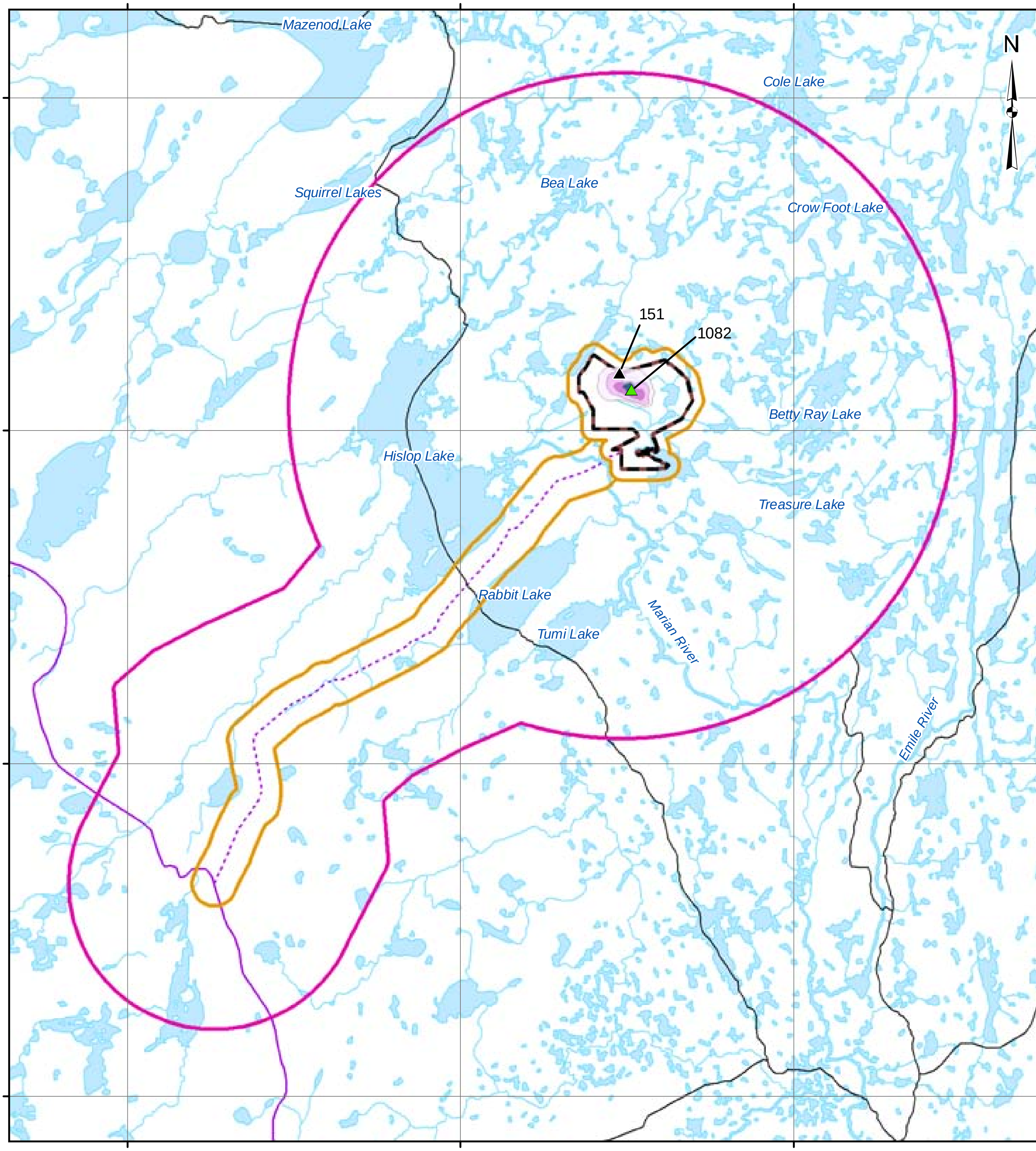
Table 14.3-2: Summary of Predicted Annual Deposition Rates from the NICO Project

Substance	Criteria	Maximum Predicted Deposition Rate			
		Local Study Area Baseline	Application		
			Outside NICO Project Lease Boundary	Distance to Maximum from NICO Project Centre (km)	Approximate Direction to Maximum
TSP	None	0.00 $g/m^2/y$	151 $g/m^2/y$	1.7	NW
PM_{10}	None	0.00 $g/m^2/y$	60 $g/m^2/y$	1.7	NW
$PM_{2.5}$	None	0.00 $g/m^2/y$	0.6 $g/m^2/y$	1.7	NW
PAI	0.25 keq/ha/y[a]	0.06 keq/ha/y	0.3 keq/ha/y	1.7	NW

[a] Criteria is based on the Clean Air Strategic Alliance (CASA 1999)

NW = northwest; m = metre; $g/m^2/y$ = grams per square metres per year; keq/ha/y = kiloequivalent per hectare per year; TSP = total suspended particulate; $PM_{2.5}$ = fine particles of 2.5 micrometres or less in size; PM_{10} = fine particles of 10 micrometres or less in size; PAI = potential acid input.

Acid deposition from air emissions includes the deposition of sulphur oxides, nitrogen oxides, hydrogen, metals, and some organic compounds (Rusek and Marshall 2000) onto soil and vegetation. Potential acid input from air emissions can change the chemical properties of soil and water, which can affect vegetation and wildlife habitat. For potential acid input and the application case, air quality modelling showed that maximum deposition rates reach 2.29 kiloequivalent per hectare per year (keq/ha/y) within the NICO Project Lease Boundary, and 0.34 keq/ha/y for areas beyond the NICO Project Lease Boundary (Section 10.4.2.3). The maximum deposition rates occur in the middle of the NICO Project Lease Boundary in the vicinity of the Plant, Open Pit, and haul roads. The area outside the NICO Project Lease Boundary that is predicted to be above the critical load of 0.25 keq/ha/y is entirely within the LSA and only includes a small section extending up to about 300 m from the north-northwest boundary of the lease (Figure 14.3-2). The majority of the soils in the LSA (53.6%) were categorized as being sensitive (moderate) to acidification, and 25.9% of soils in the LSA were categorized as having a moderate to low sensitivity to acidification. At the potential acid input levels below 0.25 keq/ha/y, it is expected that sensitive soils would likely not be affected by acid deposition relative to baseline conditions (Section 13.3.2.2), which should result in minor changes to vegetation.



LEGEND

- PROJECT LEASE BOUNDARY
- EXISTING WINTER ROAD
- PROPOSED NICO PROJECT ACCESS ROAD
- PROPOSED TŁĮCHǪ ROAD ROUTE
- WATERCOURSE
- WATERBODY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

▲ MAXIMUM PREDICTION WITHIN LOCAL STUDY AREA EXCLUDING PROJECT LEASE BOUNDARY

▲ MAXIMUM PREDICTION WITHIN LOCAL STUDY AREA

DEPOSITION (g/m²/yr)

- >= 631
- 316 to < 631
- 158 to < 316
- 79 to < 158
- 0 to < 79

5 0 5

SCALE 1:250,000 KILOMETRES

REFERENCE

Base data obtained from Atlas of Canada, DMTI, and GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

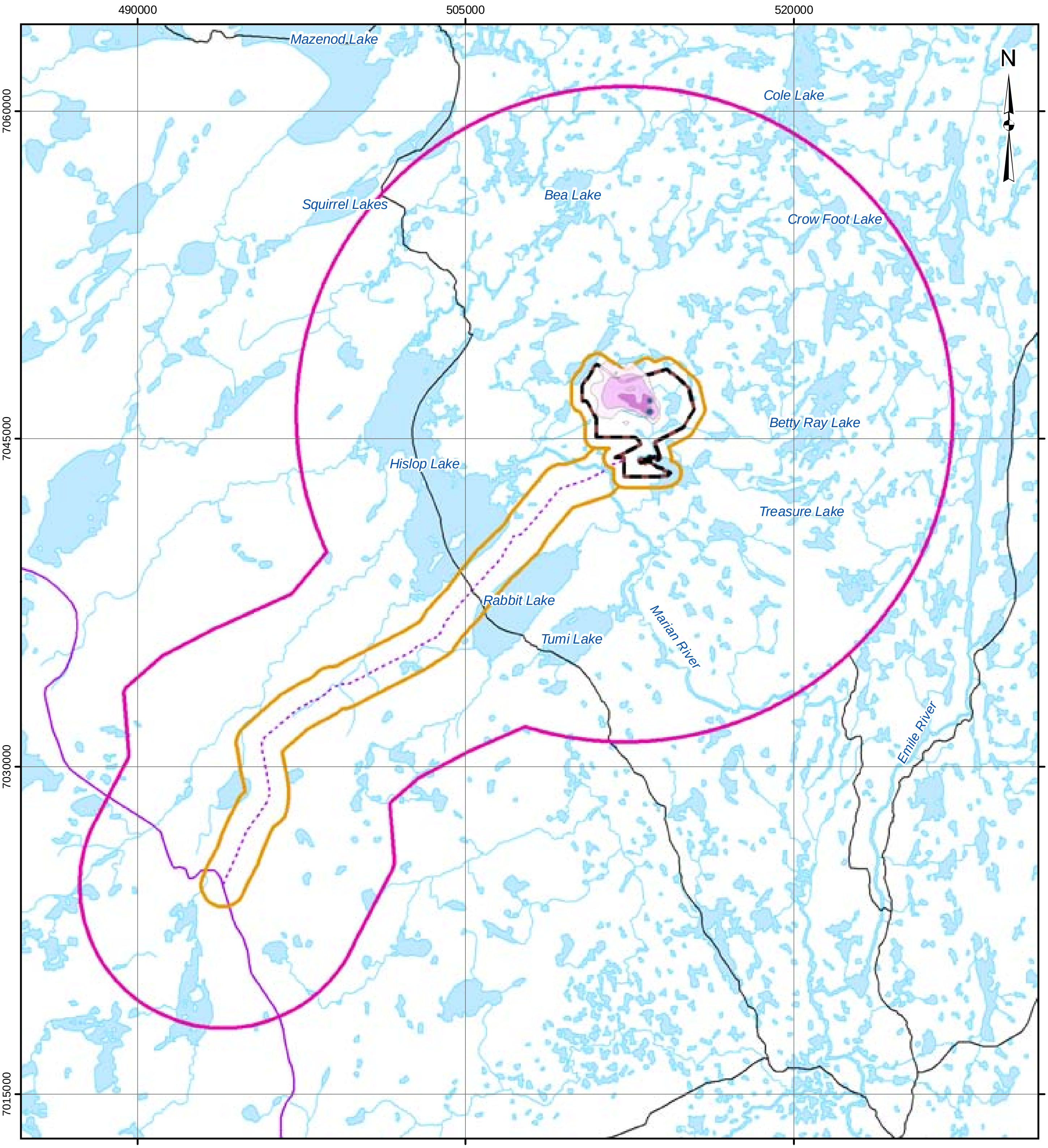
FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE

DISTRIBUTION OF ANNUAL TOTAL SUSPENDED PARTICULATE DEPOSITION RATE DURING NICO PROJECT OPERATIONS

Golder Associates
Edmonton, Alberta

FILE No. E-Veg-016-GIS				
PROJECT No. 09-1373-1004			SCALE AS SHOWN	REV. 0
DESIGN	JV	15 Feb. 2011	FIGURE: 14.3-1	
GIS	MK	23 Feb. 2011		
CHECK	GRA	03 Apr. 2011		
REVIEW	GRA	03 Apr. 2011		



LEGEND

- PROJECT LEASE BOUNDARY
- EXISTING WINTER ROAD
- PROPOSED NICO PROJECT ACCESS ROAD
- PROPOSED TŁĮCHǪ ROAD ROUTE
- WATERCOURSE
- WATERBODY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

DEPOSITION (keq/ha/yr)

- >= 1
- 0.5 to < 1
- 0.25 to < 0.5
- 0.17 to < 0.25
- 0 to < 0.17

5 0 5

SCALE 1:250,000 KILOMETRES

REFERENCE

Base data obtained from Atlas of Canada, DMTI, and GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE

DISTRIBUTION OF ANNUAL POTENTIAL ACID INPUT DURING NICO PROJECT OPERATIONS

Golder Associates
Edmonton, Alberta

FILE No. E-Veg-017-GIS				
PROJECT No. 09-1373-1004			SCALE AS SHOWN	REV. 0
DESIGN	JV	15 Feb. 2011	FIGURE: 14.3-2	
GIS	ANK	16 Feb. 2011		
CHECK	GRA	03 Apr. 2011		
REVIEW	GRA	03 Apr. 2011		

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The air emission modelling results show that predicted peak concentrations for sulphur dioxide during operations are below the Ambient Air Quality Standards for NWT (Table 14.3-3); however, annual peak concentrations for nitrogen dioxide are predicted to slightly exceed guidelines outside of the NICO Project footprint, reaching levels of 68 micrograms per cubic metre (µg/m^3). The predicted distance to maximum nitrogen dioxide predictions is 1.7 km from the NICO Project centre. The spatial extent that is predicted to exceed the NWT standard is 4 ha in size and located north-northwest of the NICO Project Lease Boundary and within the LSA. Nitrogen dioxide concentrations exceed guidelines for a distance of about 250 m from the NICO Project Lease Boundary (Figure 14.3-2). For total suspended particulate, the maximum predicted dust concentration rate will occur within 1.7 km from the NICO Project centre (Table 14.3-3). Total suspended particulate air concentrations are predicted to exceed guidelines within 500 m from the NICO Project Lease Boundary (Figure 14.3-1), but total suspended particulate concentrations will be below recommended guidelines outside of the LSA.

Table 14.3-3: Summary of Predicted Annual Air Quality Concentrations from the NICO Project

Substance	Criteria (µg/m^3)[a]	Maximum Predicted Concentration			
		Baseline	Application		
		Concentrations in the Regional Study Area (µg/m^3)	Concentrations Outside NICO Project Lease Boundary (µg/m^3)	Distance to Peak Predictions from NICO Project Centre (km)	Approximate Direction to Maximum
Nitrogen dioxide	60	2	68.4	1.7	NW
Sulphur dioxide	30	0.5	1.0	1.7	NW
Total Suspended Particulate	60	2.2	166.0	1.7	NW

[a] Standard based on Ambient Air Quality Standards for NWT.

µg/m^3 = micrograms per cubic metre; km = kilometre; NW = northwest

Although concentrations are predicted to be above baseline conditions, the anticipated changes to vegetation are localized and considered minor, which should have a negligible effect on plant populations and communities. Maximum reported values are, in part, a consequence of local topography and a small area northwest of the NICO Project where there were moderate changes in elevation (e.g., hill or cliff). Deposition patterns depend mainly on local topography and plant cover (Rusek and Marshall 2000). The maximum predicted annual deposition rate of potential acid input and maximum concentration of nitrogen dioxide are both expected to occur within 1.7 km of the NICO Project centre and have values exceeding guidelines for only a short distance outside the north-northwest NICO Project Lease Boundary (i.e., all values are below recommended guidelines outside of the LSA). The deposition predictions are considered to be conservative, and therefore the presented deposition rates are most likely overestimated. Overall, changes in vegetation quality due to dust deposition and air emissions are anticipated to be minor relative to baseline conditions (secondary pathway; Table 14.3-1). Consequently, residual effects to the persistence of plant populations and communities from dust deposition and air emissions are predicted to be negligible.

- **Introduction of non-native plant species can affect native vegetation.**

The construction and operation of the NICO Project and its supporting infrastructure have the potential to introduce non-native plant species and disrupt native plant communities (Mack et al. 2000; Truscott et al. 2008). Non-native invasive plant species, or weeds, may alter nutrient cycling, competition, and the energy budget of an ecosystem, which may lead to a decrease in native plant community structure and species diversity (Jager et al. 2009), and lower native species survival and abundance (Mack et al. 2000). Invasive plant species are those species whose rapid establishment and spread can adversely affect ecosystems, habitats and/or other species (Haber 1997). The main contributor to the introduction of invasive and noxious weeds is human transport (Mack et al. 2000). Specific surveys aimed at searching for weeds were not completed during baseline surveys; however, had they been present within vegetation plots they would have been recorded.

The ground disturbance associated with construction activities can create the type of habitat favoured by invasive plant species. Transportation corridors to and from construction areas provide a means of ingress for invasive plant species, as well as additional habitat in the form of disturbed road edges. Vehicles and machinery can serve as dispersal mechanisms for plant propagules (seeds and/or vegetative parts) that can get lodged in tires, the undercarriage, or mud on the surface of the vehicle.

Effective mitigation strategies are required early in NICO Project planning to address the introduction, spread, and effects of invasive species on the environment (Haber 1997). Preventing invasive plant species from entering an area is often more efficient and cost effective than dealing with their removal once established (Clark 2003; Polster 2005; USDA 2006; Carlson and Shephard 2007). To mitigate the transport and introduction of non-native plant species into native plant communities, construction equipment will be regularly cleaned on-site, particularly before moving into sensitive vegetation areas (Table 14.3-1). An invasive plant management strategy will also be designed and implemented to prevent, detect, control (remove), and monitor areas with invasive plant species.

The implementation of mitigation and environmental design features is anticipated to result in minor changes in the abundance and distribution of native plant species relative to baseline conditions (secondary pathway; Table 14.3-1). Therefore, the residual effect to the persistence of plant populations and communities from the introduction of non-native species is predicted to be negligible.

- **Process and potable water requirements for the NICO Project may decrease drainage flows and surface water levels, and affect vegetation and wetlands.**

The NICO Project will withdraw freshwater for dust suppression, potable water, and plant operations from Lou Lake. Department of Fishery and Oceans allowable lake under ice withdrawal volumes are 10% of the available water volume calculated using the appropriate maximum expected ice thickness (DFO 2010). The available water volume of Lou Lake is 9.42 million cubic metres (Mm^3) (Section 11.3.2.2). Thus the allowable volume that could be pumped from Lou Lake in winter is approximately 942 000 m^3. Throughout the life of the NICO Project it is anticipated that fresh water withdrawals during construction and operations will range from 112 000 m^3/year under average climatic conditions up to 146 000 m^3/year during a 1:25 year dry period (Section 11.3.2.2). This is below the allowable volume of water that could be taken from Lou Lake.

Environmental design features that will be implemented to reduce the amount of water required for plant operations and domestic uses include the capture and reuse of site water and excess water from the Seepage

Collection Ponds in mill operations and the recycling of water from tailings thickener in grinding operations (Table 14.3-1). Water requirements for the NICO Project are not expected to decrease drainage flows and surface water levels below baseline conditions (Section 11.2), and should result in a minor change to wetlands and vegetation. Therefore, this pathway is expected to have negligible effects to the persistence of plant populations and communities.

14.3.2.3 Primary Pathways

The following primary pathways were determined for linking NICO Project-related activities to effects on plant populations and communities (Table 14.3-1) and will be carried through the effects analysis:

- physical loss or alteration of vegetation from the NICO Project footprint; and
- residual ground disturbance can cause permanent loss and alteration of vegetation.

14.4 Effects to Plant Populations and Communities

Site clearing and construction for the NICO Project, particularly the process of vegetation removal, will result in the physical loss or alteration of plant populations and communities. Vegetation removal will occur mainly during the construction phase of the NICO Project, and to a lesser extent during operation (e.g., development of the Open Pit). The effect on plant populations and communities includes an assessment of the following:

- effects to plant populations and communities as expressed by changes in ELC types;
- effects to listed plant species and high rare plant habitat potential; and
- effects to traditional use plants and economic use plants.

Areas that are expected to be reclaimed at closure include the CDF and associated areas of disturbance, the laydown area and mine portal, the Plant, Growth Media Stockpiles, borrow sites, and associated site infrastructure. Closure is the period during the decommissioning and reclamation phase of the NICO Project when infrastructure is dismantled and initial reclamation of the NICO Project surface footprint is completed. Areas that are expected not to be reclaimed include the Flooded Open Pit, constructed wetlands, Seepage Collection Ponds, Surge Pond, and excavated ditch. Following closure, it is anticipated that the CDF will be covered with overburden and the NPAR, buildings, and related structures will be dismantled or demolished and removed. It is expected that Growth Media will be returned to the landscape as outlined in the Closure and Reclamation Plan (Section 9), and will be able to support natural plant communities; however, plant populations and communities, traditional use plants, economic use plants, and listed plants can be altered or lost through the following NICO Project components and activities:

- changes to vegetation during development of the underground mine and Open Pit; and
- residual ground disturbance from permanent NICO Project components.

The cumulative effects to vegetation from previous, existing, and future developments were not considered in this assessment because the primary effects to vegetation are limited to direct losses associated with the NICO Project footprint (including the NPAR). Additionally, indirect cumulative changes (e.g., dust deposition and vehicle air emissions) to vegetation from the NICO Project and associated traffic along the Proposed Tłı̨chǫ Road Route are expected to be minor relative to baseline conditions and only occur at the local scale. In other words, the cumulative local scale effects from the NICO Project and other developments should have little influence on the relative abundance and distribution of plant populations in the RSA. Consequently, the potential for cumulative effects from the NICO Project and other previous, existing, and reasonably foreseeable developments on the persistence of plant populations and communities is predicted to be negligible.

14.4.1 Methods

Due to the inherent sensitivity of the subarctic environment to disturbance, all vegetation ecosystems and associated plants were included in the analysis of effects. Particular emphasis was placed on the effects of the NICO Project (including the NPAR) in relation to ELC types or plants considered especially sensitive to disturbance (e.g., wetlands or dwarf birch), those ELC types with a restricted distribution in the study area, plant species listed as being “at risk”, plant species identified from traditional use studies, and economic use plants. The effects to plant populations and communities were assessed using ELC information developed for the LSA, field survey data, and the expected NICO Project footprint.

Economic use plants were assessed by grouping ELC types into 2 classes based on the potential for timber resources to be present. All upland ELC types were assumed to contain trees of sufficient abundance and size to be effectively used as timber resources for construction materials or fuel wood (Section 14.2.2.5). The remaining ELC types, including wetlands, burn, disturbance, water, and unclassified were classified as non-timber resource types. Both the burn and unclassified ELC types are included in this class as it is not known what potential timber resources may be present in these areas. The unclassified ELC type represents 1.1% of the LSA and should have little influence on the projected availability of timber resources (Section 14.2.2.5).

Traditional plant potential was assessed by grouping ELC types into high, medium, and low categories using available data on the number of traditional plant species that occur in each ELC type and professional judgement (Table 14.4-1). Water and disturbance ELC types were considered to have low traditional plant potential as these areas do not typically contain a diversity of vegetation, while the burn ELC type was assigned a moderate traditional plant potential as there is potential for traditional use plant species, including berry producing plants. The unclassified ELC type could not be assigned a traditional plant potential as it is not known which ELC types may be present, but is expected to have little influence on the results given the small proportion of the unclassified ELC type in the LSA (1.1%).

Changes to vegetation are assessed for the maximum predicted point of development of the NICO Project (application case), which should have the largest magnitude and geographic extent of effects to vegetation. Changes to ELC units, rare plant habitat potential, traditional plant potential, and potential timber resource distribution directly affected by the NICO Project were quantified by Geographic Information System analysis using the following process:

- the Geographic Information System quantified areas of ELC types, rare plant habitat potential, traditional plant potential, and potential timber resources within the LSA for the baseline case, application case, and closure; and
- the net changes in ELC types, rare plant habitat potential, traditional plant potential, and potential timber resources distribution were calculated between baseline case and closure.

Table 14.4-1: Traditional Plant Potential Categories

Ecological Landscape Classification	Traditional Plant Potential	Number of Traditional Use Plants with Potential to Occur in Ecological Landscape Classification Type[a]
Coniferous spruce	High	12
Mixedwood spruce-paper birch-aspen	High	10
Deciduous aspen-paper birch	High	9
Coniferous Pine	High	9
Open bog	Moderate	6
Treed bog	Moderate	6
Treed fen	Moderate	5
Burn	Moderate	nd
Bedrock open conifer	Low	4
Marsh/graminoid fen	Low	2
Shrubland	Low	1
Water	Low	nd
Disturbance[b]	Low	nd
Unclassified	nd	nd

[a] Traditional use plant counts based on common name.

[b] Includes exploration facilities and roads/trails.

nd = no data.

14.4.2 Results

14.4.2.1 Effects to Ecological Landscape Classification Types

Construction and operation of the NICO Project (including the proposed mine and NPAR) will result in a maximum disturbance of 485 ha (5.8%) of the LSA including 351 ha of upland ELC types and 80 ha of wetlands ELC types (Table 14.4-2 and Figure 14.4-1a, b). All ELC types will be affected by the NICO Project, resulting in net changes to all types. Of the upland ELC types, the coniferous spruce and bedrock open conifer types will have a net change of 188 ha (6.0% of this map unit; 2.2% of the LSA) and 124 ha (19.9% of this map unit; 1.5% of the LSA), respectively. These are the most abundant upland ELC types in the LSA. Wetlands ELC types will experience a net change of 80 ha (0.9% of the LSA).

Following closure, approximately 402 ha (4.8%) of the LSA of the NICO Project footprint will be reclaimed (Figure 14.4-2a, b). Reclamation trials will be implemented as part of the mitigation and monitoring program to acquire knowledge during operations regarding revegetation processes and techniques that can be applied during the reclamation phase. Thus, at this time, reclaimed lands have not been assigned to specific target ELC types. The area of residual disturbance (i.e., Flooded Open Pit, constructed wetlands, Seepage Collection/Surge Ponds, and excavated ditch) is predicted to be approximately 84 ha (1.0% of the LSA) as these areas will not be reclaimed at closure (Table 14.4-2).

Table 14.4-2: Ecological Landscape Classification Distribution Between the Baseline Case and Closure Case in the Local Study Area

Ecological Landscape Classification	Baseline Case		Application Case		Total Area of Maximum Disturbance[a] (ha)	Closure Case (ha)	Closure Net Change (ha)	Closure Net Change (% unit)	Closure Net Change (% LSA)
	Area (ha)	Proportion of LSA (%)	Mine Footprint[a] (ha)	NPAR[a] (ha)					
Uplands									
Bedrock open conifer	622	7.4	123	0	124	499	-124	-19.9	-1.5
Coniferous pine	228	2.7	0	5	5	223	-5	-2.2	-0.1
Coniferous spruce	3 118	37.1	134	54	188	2 930	-188	-6.0	-2.2
Deciduous aspen-paper birch	176	2.1	14	1	15	161	-15	-8.7	-0.2
Mixedwood spruce-paper birch-aspen	554	6.6	8	11	19	535	-19	-3.5	-0.2
uplands ELC types subtotal	*4 699*	*55.9*	*280*	*71*	*351*	*4 348*	*-351*	*-7.5*	*-4.2*
Wetlands									
Marsh/graminoid fen	203	2.4	2	1	3	201	-3	-1.3	-0.1
Open bog	342	4.1	8	4	12	329	-12	-3.6	-0.1
Shrubland	30	0.4	0	0	0	30	0	-1.0	<-0.1
Treed bog	403	4.8	18	3	22	382	-22	-5.4	-0.3
Treed fen	945	11.2	29	13	43	902	-43	-4.5	-0.5
wetlands ELC types subtotal	*1 924*	*22.9*	*58*	*22*	*80*	*1 844*	*-80*	*-4.1*	*-0.9*
Miscellaneous Vegetation									
Burn	1 059	12.6	11	22	33	1 026	-33	-3.2	-0.4
miscellaneous ELC types subtotal	*1 059*	*12.6*	*11*	*22*	*33*	*1 026*	*-33*	*-3.2*	*-0.4*
Non-vegetated									
Water	614	7.3	7	0	7	607	-7	-1.1	-0.1
non-vegetated ELC types subtotal	*614*	*7.3*	*7*	*0*	*7*	*607*	*-7*	*-1.1*	*-0.1*

Table 14.4-2: Ecological Landscape Classification Distribution Between the Baseline Case and Closure Case in the Local Study Area (continued)

Ecological Landscape Classification	Baseline Case		Application Case		Total Area of Maximum Disturbance[a] (ha)	Closure Case (ha)	Closure Net Change (ha)	Closure Net Change (% unit)	Closure Net Change (% LSA)
	Area (ha)	Proportion of LSA (%)	Mine Footprint[a] (ha)	NPAR[a] (ha)					
Disturbance									
Disturbance[b]	13	0.2	9	0	9	5	-9	-66.1	*-0.1*
disturbance ELC types subtotal	*13*	*0.2*	*9*	*0*	*9*	*5*	*-9*	-66.1	*-0.1*
Unclassified									
Unclassified (cloud, haze and shadow)	96	1.1	5	0	5	90	-5	-5.6	-0.1
unclassified ELC types subtotal	*96*	*1.1*	*5*	*0*	*5*	*90*	*-5*	*-5.6*	*-0.1*
Following closure									
Reclaimed	0	0	0	0	0	402	402	100	4.8
Residual Disturbances[c]	0	0	0	0	0	84	84	100	1.0
Total	**8 405**	**100**	**370**	**115**	**485**	**8 405**	**0**	**n/a**	**0**

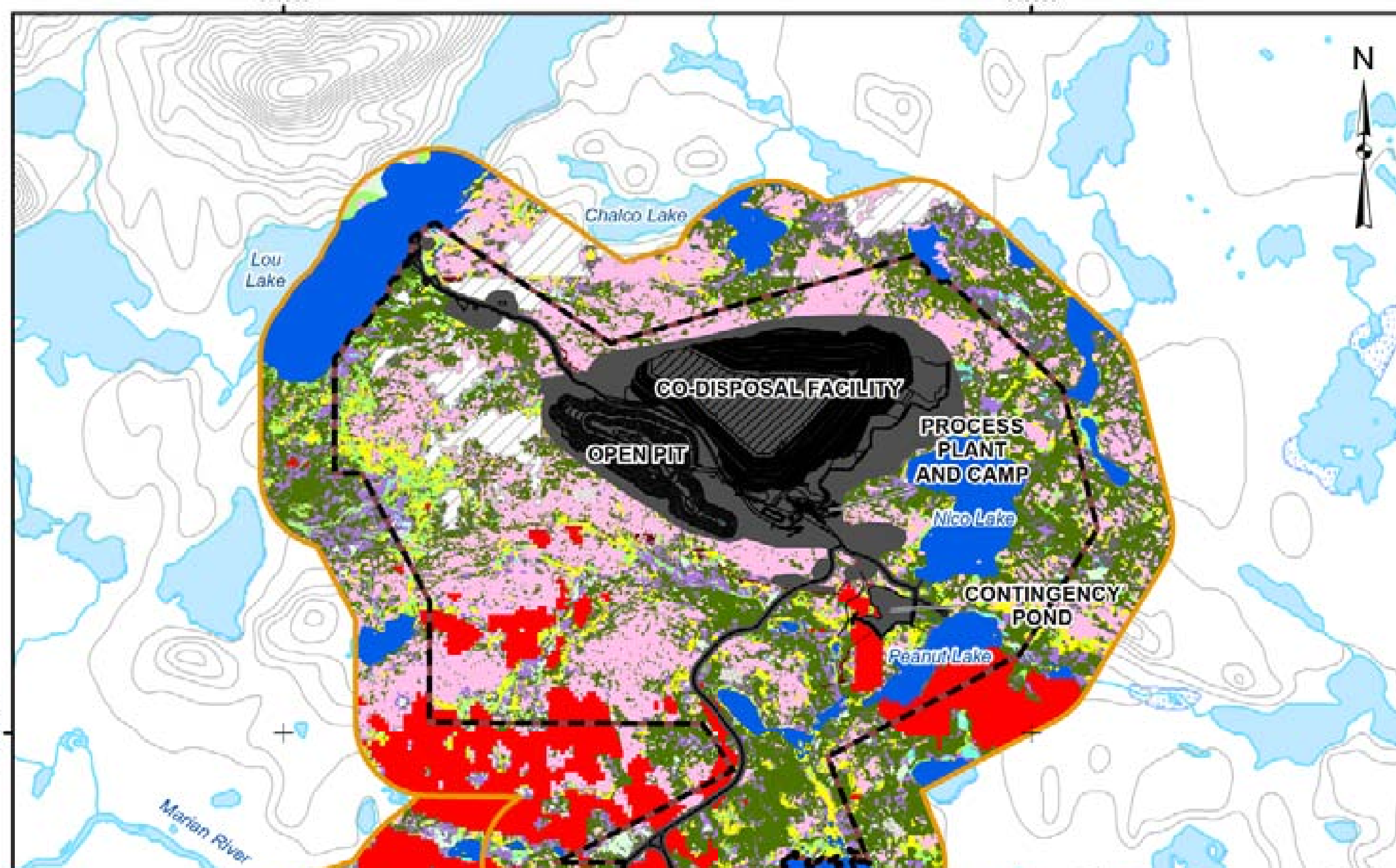
Note: Numbers are rounded for presentation purposes; therefore, it may appear that the totals do not equal the sum of the individual values.

[a] Maximum amount of disturbance during the NICO Project.

[b] Includes exploration facilities and roads/trails.

[c] Includes the Flooded Open Pit, constructed wetlands, Seepage Collection/Surge Ponds, and excavated ditch

ELC = Ecological Landscape Classification; LSA = Local Study Area; NPAR = NICO Project Access Road; ha = hectare; % = percent; < = less than; n/a = not applicable.



LEGEND

- PROJECT LEASE BOUNDARY
- PROPOSED NICO MINE SITE
- CONTOUR (10 METRE INTERVAL)
- WATERCOURSE
- WATERBODY
- WETLAND
- LOCAL STUDY AREA
- POTENTIAL BORROW AREA
- AREA OF MAXIMUM DISTURBANCE FOR NICO PROJECT

1 0 1

SCALE 1:50,000 KILOMETRES

NOTE: Unclassified areas are portions of the LSA for which an ELC vegetation class could not be assigned due to satellite interference.

REFERENCE

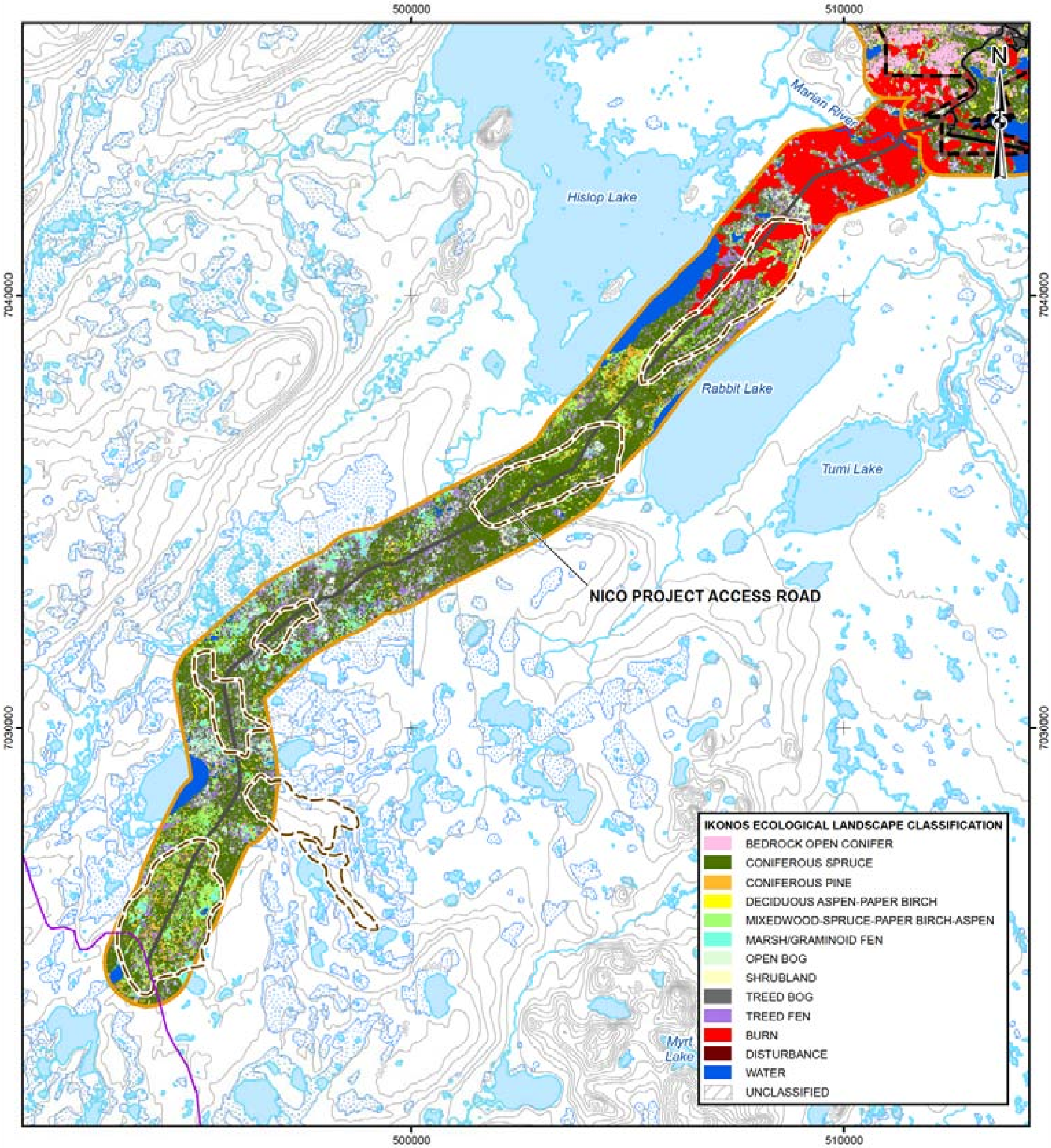
Base data obtained from GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE
ECOLOGICAL LANDSCAPE CLASSIFICATION AT MAXIMUM DISTURBANCE

Golder Associates
Edmonton, Alberta

FILE NO. E-Veg-008-GIS			
PROJECT No. 09-1373-1004		SCALE AS SHOWN	REV. 0
DESIGN	JF	04 Jan. 2011	**FIGURE: 14.4-1a**
GIS	AB	03 Apr. 2011	
CHECK	GRA	03 Apr. 2011	
REVIEW	GRA	03 Apr. 2011	



LEGEND

- PROJECT LEASE BOUNDARY
- PROPOSED NICO MINE SITE
- CONTOUR (10 METRE INTERVAL)
- PROPOSED TLICHO ROAD ROUTE
- WATERCOURSE
- WATERBODY
- WETLAND
- LOCAL STUDY AREA
- POTENTIAL BORROW AREA
- AREA OF MAXIMUM DISTURBANCE FOR NICO PROJECT

NOTE: Unclassified areas are portions of the LSA for which an ELC vegetation class could not be assigned due to satellite interference.

REFERENCE

Base data obtained from GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

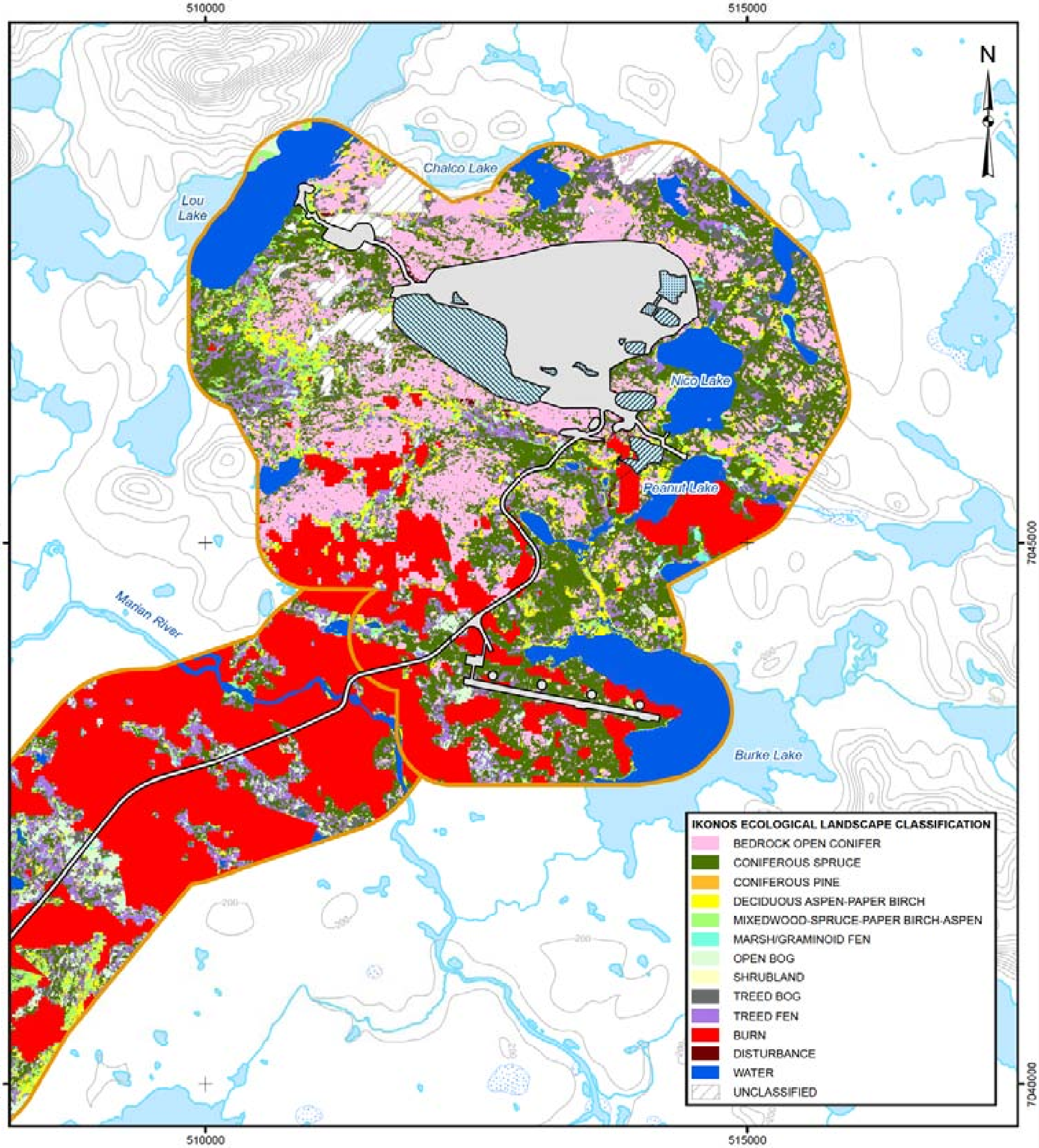
3 0 3
SCALE 1:125,000 KILOMETRES

FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE
ECOLOGICAL LANDSCAPE CLASSIFICATION AT MAXIMUM DISTURBANCE

FILE NO. E-Veg-012-GIS				
PROJECT No. 09-1373-1004			SCALE AS SHOWN	REV. 0
DESIGN	JF	04 Jan. 2011	**FIGURE: 14.4-1b**	
GIS	CC	03 Apr. 2011		
CHECK	LY	03 Apr. 2011		
REVIEW	GA	03 Apr. 2011		

Golder Associates
Edmonton, Alberta



LEGEND

- CONTOUR (10 METRE INTERVAL)
- WATERCOURSE
- WATERBODY
- WETLAND
- LOCAL STUDY AREA
- RECLAIMED AREA

NON-RECLAIMED AREA

- CONSTRUCTED WETLANDS
- FLOODED OPEN PIT
- SEEPAGE COLLECTION/SURGE PONDS AND EXCAVATED DITCH

1 0 1

SCALE 1:50,000 KILOMETRES

NOTE: Unclassified areas are portions of the LSA for which an ELC vegetation class could not be assigned due to satellite interference.

REFERENCE

Base data obtained from GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE
ECOLOGICAL LANDSCAPE CLASSIFICATION FOLLOWING MINE CLOSURE

FILE NO. E-Veg-009-GIS				
PROJECT No. 09-1373-1004			SCALE AS SHOWN	REV. 0
DESIGN	JF	04 Jan. 2011	**FIGURE: 14.4-2a**	
GIS	AB	04 Apr. 2011		
CHECK	GRA	03 Apr. 2011		
REVIEW	GRA	03 Apr. 2011		

Golder Associates
Edmonton, Alberta

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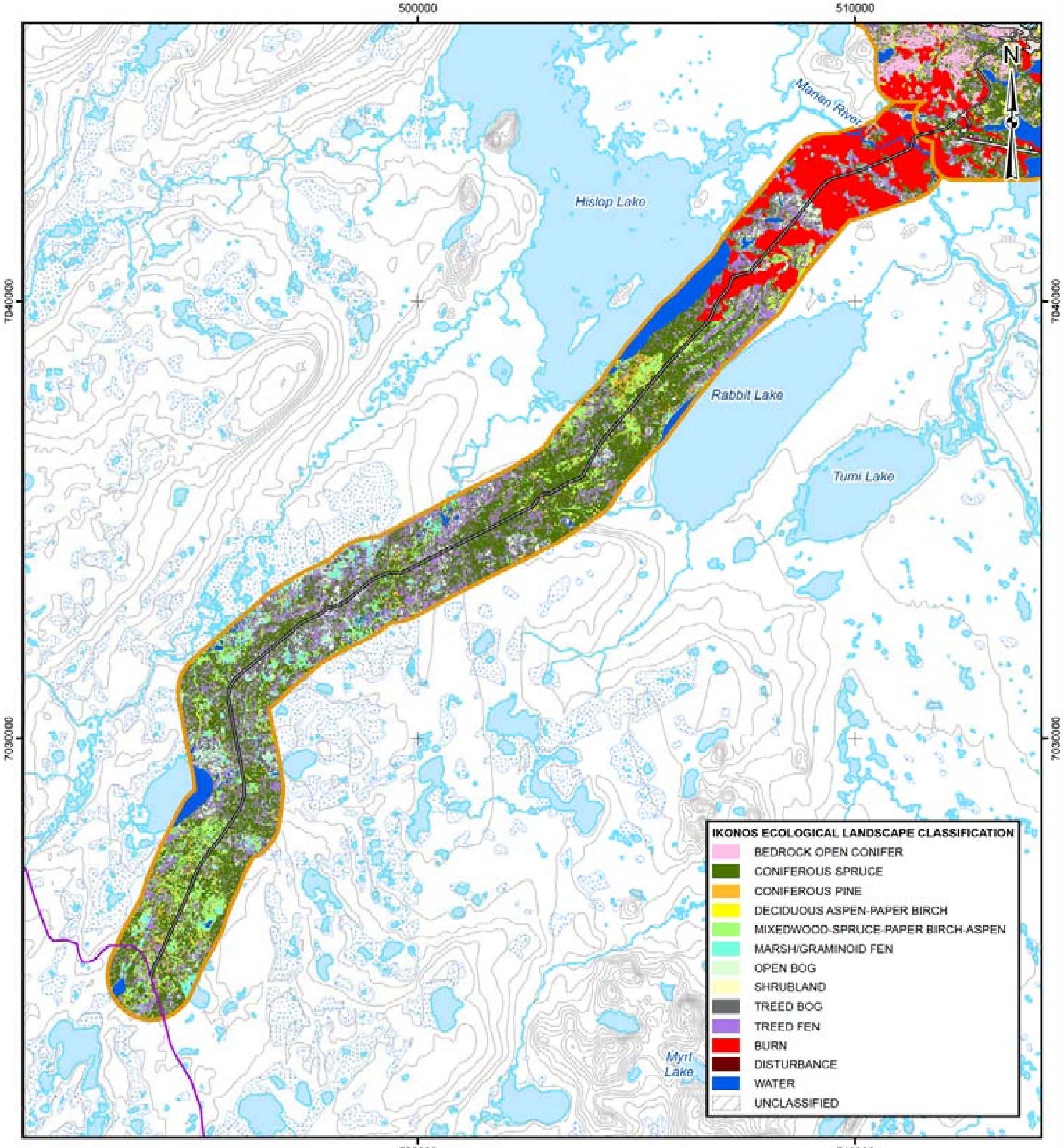

LEGEND

- CONTOUR (10 METRE INTERVAL)
- PROPOSED TŁIÇHǪ ROAD ROUTE
- WATERCOURSE
- WATERBODY
- WETLAND
- LOCAL STUDY AREA
- RECLAIMED AREA

NON-RECLAIMED AREA

- CONSTRUCTED WETLANDS
- FLOODED OPEN PIT

3 0 3

SCALE 1:125,000 KILOMETRES

NOTE: Unclassified areas are portions of the LSA for which an ELC vegetation class could not be assigned due to satellite interference.

REFERENCE

Base data obtained from GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

FORTUNE

FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE
ECOLOGICAL LANDSCAPE CLASSIFICATION FOLLOWING MINE CLOSURE

Golder Associates
Edmonton, Alberta

FILE NO. E-Veg-013-GIS			
PROJECT No. 09-1373-1004		SCALE AS SHOWN	REV. 0
DESIGN	JF	04 Jan. 2011	
GIS	CC	17 Feb. 2011	
CHECK	GRA	03 Apr. 2011	**FIGURE: 14.4-2b**
REVIEW	GRA	03 Apr. 2011	

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14.4.2.2 Effects to Rare Plant Habitat Potential and Listed Plant Species

Construction and operation of the NICO Project (including the NPAR) will result in a maximum disturbance of 485 ha (5.8%) of the LSA (Table 14.4-3 and Figure 14.4-3a, b). The area of maximum disturbance due to the NICO Project includes 135 ha (9.2% of this unit; 1.6% of the LSA) of high rare plant habitat potential and 3 ha (1.2% of this unit; less than 0.1% of the LSA) of very high rare plant habitat potential. Following closure, approximately 402 ha (4.8%) of the LSA of the NICO Project footprint will be reclaimed (Table 14.4-3 and Figure 14.4-2a, b). Reclaimed lands are grouped under the Reclaimed ELC type and at this time it is unknown what the rare plant potential of these lands will be once re-vegetated. Out of the maximum disturbance area of 485 ha, 84 ha (1.0%) of the LSA of residual ground disturbance (i.e., Flooded Open Pit, constructed wetlands, Seepage Collection/Surge Ponds, and excavated ditch) will not be reclaimed at closure resulting in a permanent loss of habitat with any potential to support rare plants.

Table 14.4-3: Distribution of Rare Plant Habitat Potential between the Baseline Case and Closure Case in the Local Study Area

Rare Plant Potential Class	Baseline Case		Loss or Alteration Due to the NICO Project			Closure Case (ha)	Closure Net Change (ha)	Closure Net Change (% unit)	Closure Net Change (% of LSA)
	Area (ha)	Proportion of LSA (%)	Mine Footprint[a] (ha)	NPAR[a] (ha)	Total[a] (ha)				
Low[b]	1 802	21.4	42	34	77	1 726	-77	-4.3	-0.9
Moderate	4 808	57.2	190	75	265	4 543	-265	-5.5	-3.2
High	1 465	17.4	130	5	135	1 330	-135	-9.2	-1.6
Very High	234	2.8	2	1	3	231	-3	-1.2	<-0.1
Unclassified	96	1.1	5	0	5	90	-5	-5.6	-0.1
Following Closure									
Reclaimed	0.0	0.0	0.0	0.0	0.0	402	402	100	4.8
Residual Disturbances[c]	0.0	0.0	0.0	0.0	0.0	84	84	100	1.0
Total	**8 405**	**100**	**370**	**115**	**485**	**8 405**	**0**	**n/a**	**0**

Note: Numbers are rounded for presentation purposes; therefore, it may appear that the totals do not equal the sum of the individual values.

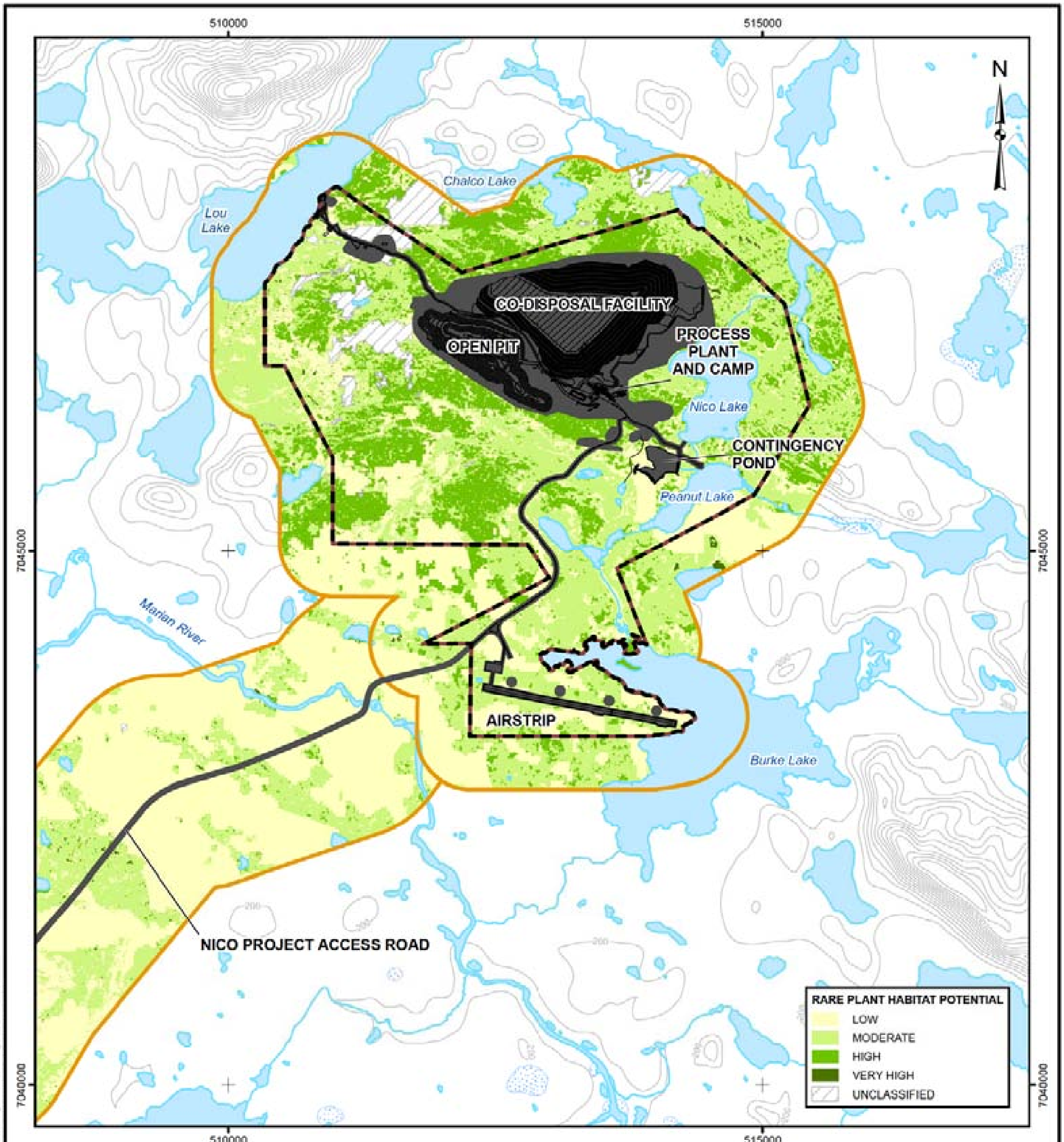
[a] Maximum amount of disturbance during the NICO Project.

[b] Includes the disturbance ELC type that is represented by exploration facilities and roads/trails .

[c] Includes the Flooded Open Pit, constructed wetlands, Seepage Collection/Surge Ponds, and excavated ditch.

LSA = Local Study Area; NPAR = NICO Project Access Road; ha = hectare; % = percent; < = less than; n/a = not applicable.

No confirmed listed plant species identified as “At Risk”, “May be at Risk” or “Sensitive” by the GNWT (2010) or federal listed species (COSEWIC [2010] or *SARA* [*2010*]) were found in the LSA during 2005, 2006, and 2008 (Section 14.2.2.2); however, this does not preclude the potential for rare plant species to be present in the LSA and disturbing habitat that may support higher numbers of rare plant species may negatively affect existing populations. The identification of possible rare plant occurrences within the NICO Project footprint will be further addressed through the proposed follow-up monitoring programs and Vegetation Management Plan (Section 18). Appropriate mitigation practices and protocols will also be implemented should any rare plants be identified during monitoring.



LEGEND

- PROJECT LEASE BOUNDARY
- PROPOSED NICO MINE SITE
- CONTOUR (10 METRE INTERVAL)
- WATERCOURSE
- WATERBODY
- WETLAND
- LOCAL STUDY AREA
- AREA OF MAXIMUM DISTURBANCE FOR NICO PROJECT

NOTE: Unclassified areas are portions of the LSA for which an ELC vegetation class could not be assigned due to satellite interference.

REFERENCE

Base data obtained from GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

1 0 1
SCALE 1:50,000 KILOMETRES

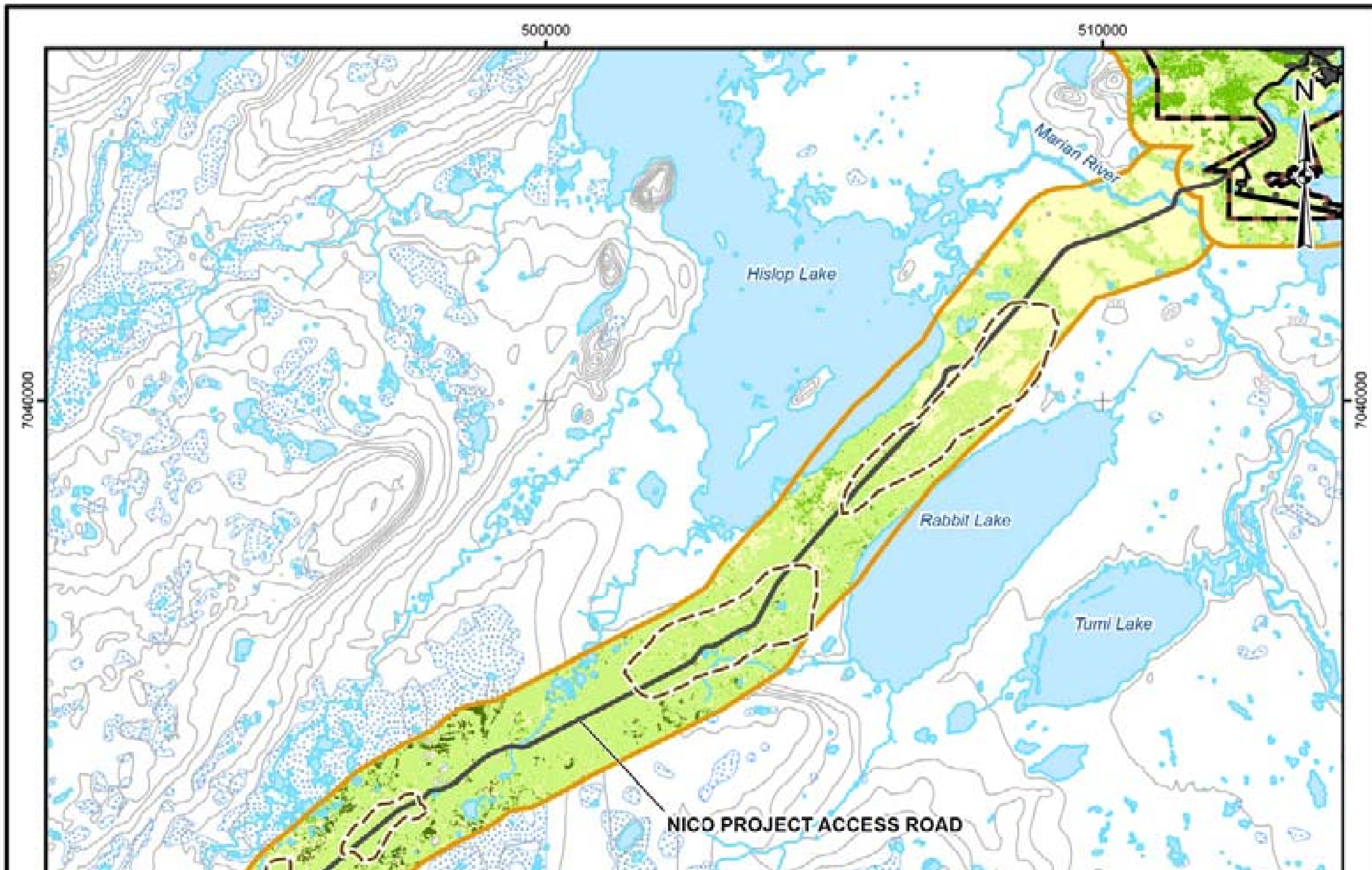
FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE

RARE PLANT HABITAT POTENTIAL AT MAXIMUM DISTURBANCE

Golder Associates
Edmonton, Alberta

FILE NO. E-Veg-010-GIS			
PROJECT No. 09-1373-1004		SCALE AS SHOWN	REV. 0
DESIGN	JF	04 Jan. 2011	FIGURE:14.4-3a
GIS	VGV	04 Feb. 2011	
CHECK	GRA	03 Apr. 2011	
REVIEW	GRA	03 Apr. 2011	



3 0 3

SCALE 1:125,000 KILOMETRES

LEGEND

- PROJECT LEASE BOUNDARY
- PROPOSED NICO MINE SITE
- CONTOUR (10 METRE INTERVAL)
- PROPOSED TŁĮCHǪ ROAD ROUTE
- WATERCOURSE
- WATERBODY
- WETLAND
- LOCAL STUDY AREA
- POTENTIAL BORROW AREA
- AREA OF MAXIMUM DISTURBANCE FOR NICO PROJECT

NOTE: Unclassified areas are portions of the LSA for which an ELC vegetation class could not be assigned due to satellite interference.

REFERENCE

Base data obtained from GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE

RARE PLANT HABITAT POTENTIAL AT MAXIMUM DISTURBANCE

Golder Associates
Edmonton, Alberta

FILE NO. E-Veg-014-GIS

PROJECT No. 09-1373-1004			SCALE AS SHOWN	REV. 0
DESIGN	JF	04 Jan. 2011	FIGURE:14.4-3b	
GIS	AB	03 Apr. 2011		
CHECK	GRA	03 Apr. 2011		
REVIEW	GRA	03 Apr. 2011		

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14.4.2.3 Effects to Traditional Use Plants

There are 23 traditional use plants species known to occur within the RSA and LSA (Section 14.2.3.4). The maximum amount of disturbance from the NICO Project is predicted to be 485 ha (5.8%) of the LSA, affecting 228 ha (2.7%) of high traditional plant potential ELC types and 110 ha (1.3%) of moderate traditional plant potential ELC types (Table 14.4-4). Within the high traditional plant potential group, the coniferous spruce ELC type will have the greatest loss or alteration to traditional use plants with a net change of 188 ha (6.0% of this map unit; 2.2% of the LSA); however, many of the traditional use plant species associated with the coniferous spruce ELC type (e.g., green alder [*Alnus crispa*], juniper [*Juniperus communis*], or prickly rose) can be found in other ELC types, such as coniferous pine or deciduous aspen-paper birch. There are only 2 traditional use plants, acerbic bulrush and tamarack that are unique to one ELC type and the effects of the NICO Project on these traditional use plants will be minimal. Acerbic bulrush is only found in the marsh graminoid/fen ELC type, of which 3 ha (1.3% of this map unit; 0.1% of the LSA) will be disturbed, while tamarack is predominantly in the treed fen ELC type, which will experience a net change of 43 ha (4.5% of this map unit; 0.5% of the LSA) relative to the baseline case.

Although most of this land is expected to be reclaimed to upland habitat, it is not known what the traditional use potential will be on these lands once they are fully re-vegetated. Additionally, 84 ha (1.0%) of the LSA of residual ground disturbance will not be reclaimed at closure resulting in a permanent loss of habitat with any potential to support traditional use plants.

The traditional knowledge studies identified that plants and berries are harvested in the RSA, and LSA, including areas overlapping the NICO Project footprint (Section 5). Concerns indentified included those related to potential effects to human and animal health; air, water, and noise pollution from developments; effects to the environment, animals, fish, and birds; sustainable employment; effects on traditional activities; and relationships between communities and companies who are developing in the area (Section 5). A literature review identified important traditional use plants found in the Wekweètì area; however, it did not specifically identify traditional use plant areas in the LSA (Section 5).

Table 14.4-4: Change in Traditional Plant Potential between the Baseline Case and Closure Case in the Local Study Area

Ecological Landscape Classification	Baseline Case		Loss or Alteration Due to the NICO Project	Closure Case (ha)	Closure Net Change (ha)	Closure Net Change (% unit)	Closure Net Change (% LSA)
	Area (ha)	Proportion of LSA (%)	Area (ha)[a]				
High Traditional Plant Potential							
Coniferous Pine	228	2.7	5	223	-5	-2.2	-0.1
Coniferous spruce	3 118	37.1	188	2 930	-188	-6.0	-2.2
Deciduous aspen-paper birch	176	2.1	15	161	-15	-8.7	-0.2
Mixedwood spruce-paper birch-aspen	554	6.6	19	535	-19	-3.5	-0.2
high traditional plant potential subtotal	*4 077*	*48.5*	*228*	*3 849*	*-228*	*-5.6*	*-2.7*
Moderate Traditional Plant Potential							
Open bog	342	4.1	12	329	-12	-3.6	-0.1
Treed bog	403	4.8	22	382	-22	-5.4	-0.3
Treed fen	945	11.2	43	902	-43	-4.5	-0.5
Burn	1 059	12.6	33	1 026	-33	-3.2	-0.4
moderate traditional plant potential subtotal	*2 749*	*32.7*	*110*	*2 639*	*-110*	*-4.0*	*-1.3*
Low Traditional Plant Potential							
Bedrock open conifer	622	7.4	124	499	-124	-19.9	-1.5
Marsh/graminoid fen	203	2.4	3	201	-3	-1.3	-0.1
Shrubland	30	0.4	0	30	0	-1.0	<-0.1
Water	614	7.3	7	607	-7	-1.1	-0.1
Disturbance[b]	13	0.2	9	5	-9	-66.1	-0.1
low traditional plant potential subtotal	*1 484*	*17.7*	*142*	*1 342*	*-142*	*-9.6*	*-1.7*

Table 14.4-4: Change in Traditional Plant Potential Between the Baseline Case and Closure Case in the Local Study Area (continued)

Ecological Landscape Classification	Baseline Case		Loss or Alteration Due to the NICO Project	Closure Case (ha)	Closure Net Change (ha)	Closure Net Change (% unit)	Closure Net Change (% LSA)
	Area (ha)	Proportion of LSA (%)	Area (ha)[a]				
Unclassified	96	1.1	5	90	-5	-5.6	-0.1
Following Closure							
Reclaimed	0	0	0	402	402	100	4.8
Residual Disturbances[c]	0	0	0	84	84	100	1.0
Total	**8 405**	**100**	**485**	**8 405**	**0**	**n/a**	**0**

Note: Numbers are rounded for presentation purposes; therefore, it may appear that the totals do not equal the sum of the individual values.

[a] Maximum amount of disturbance during the NICO Project.

[b] Includes exploration facilities and roads/trails .

[c] Includes the Flooded Open Pit, constructed wetlands, Seepage Collection/Surge Ponds, and excavated ditch.

LSA = Local Study Area; ha = hectare; % = percent; < = less than; n/a = not applicable.

14.4.2.4 Effects to Economic Use Plants

Effects to economic use plants (i.e., timber resources) are expected to be minimal as there are no large scale forestry operations in the NWT north of Great Slave Lake. The timber that is harvested occurs on a small scale, primarily for fuel wood, logs for cabin building, and fence posts where relatively small numbers of trees (primarily white spruce, jack pine, and aspen) are harvested. A total of 351 ha (4.2% of the LSA) of ELC types with the potential to contain timber resources will be lost or altered due to the NICO Project, of which 188 ha (2.2% of the LSA) is associated with the coniferous spruce ELC type (Table 14.4-5). Although, there is a net increase in the area of potential non-timber resource ELC types at closure this is related to the reclaimed ELC type, which is considered to have an unknown potential to contain timber resources. Given the slow growing nature of tree species in northern boreal landscapes, the reclaimed ELC type is not expected to provide timber resources for local use within the time frame of this assessment and is considered to be part of the potential non-timber resources ELC types.

Table 14.4-5: Change in Potential Timber Resources Between the Baseline Case and Closure Case in the Local Study Area

Ecological Landscape Classification	Potential Timber Resources	Baseline Case		Loss or Alteration Due to the NICO Project	Closure Case (ha)	Closure Net Change (ha)	Closure Net Change (% unit)	Closure Net Change (% LSA)
		Area (ha)	Proportion of LSA (%)	Area (ha)[a]				
Potential Timber Resources ELC Types								
Bedrock open conifer	Jack Pine[b]	622	7.4	124	499	-124	-19.9	-1.5
Coniferous pine	Jack Pine	228	2.7	5	223	-5	-2.2	<-0.1
Coniferous spruce	White Spruce, Black Spruce, Jack Pine[b]	3 118	37.1	188	2 930	-188	-6.0	-2.2
Deciduous aspen-paper birch	Trembling Aspen, Paper Birch	176	2.1	15	161	-15	-8.7	-0.2
Mixedwood spruce-paper birch-aspen	Trembling Aspen, Paper Birch, White Spruce	554	6.6	19	535	-19	-3.5	-0.2
Potential Timber Resources ELC types subtotal		*4 699*	*55.9*	*351*	*4 348*	*-351*	*-7.5*	*-4.2*
Potential Non-Timber Resources ELC Types								
Wetlands	None	1 924	22.9	80	1 844	-80	-4.1	-0.9
Burn	Unknown[c]	1 059	12.6	33	1 026	-33	-3.2	-0.4
Water	None	614	7.3	7	607	-7	-1.1	-0.1
Disturbance[d]	None	13	0.2	9	5	-9	-66.1	-0.1
Unclassified	White Spruce, Black Spruce, Jack Pine, Aspen, Paper Birch	96	1.1	5	90	-5	-5.6	-0.1
Following closure								
Reclaimed	Unknown[c]	0	0.0	0	402	402	100	4.8
Residual Disturbances[e]	None	0	0.0	0	84	84	100	1.0
Potential Non-Timber Resources ELC types subtotal		*3 706*	*44.1*	*134*	*4 058*	*352*	*9.5*	*4.2*
Total		**8 405**	**100**	**485**	**8 405**	**0**	**n/a**	**0**

Note: Numbers are rounded for presentation purposes; therefore, it may appear that the totals do not equal the sum of the individual values.

[a] Maximum amount of disturbance during the NICO Project.

[b] Species present but with low cover.

[c] It is not known what potential timber resources will be present on these sites in the future as the time frame is outside the temporal scope of the assessment

[d] Includes exploration facilities and roads/trails.

[e] Includes the Flooded Open Pit, constructed wetlands, Seepage Collection/Surge Ponds, and excavated ditch

LSA = Local Study Area; ha = hectare; % = percent; n/a = not applicable.

14.5 Related Effects to People

Related effects to people address the use of plants as a resource (e.g., traditional use plants and harvestable timber). The NICO Project footprint (including the NPAR) will alter 485 ha (5.8%) of the LSA, including 228 ha (2.7%) of high traditional plant potential ELC types and 351 ha (4.2%) of ELC types with the potential to contain timber resources (Tables 14.4-4 and 14.4-5). The overall effect from the NICO Project on the use of vegetation resources is expected to be within the range of baseline conditions, as traditional use plants and economic use plants are associated with a range of ELC types that are locally and regionally abundant. Effects from dust deposition and air emissions on vegetation are also expected to be mostly confined to the immediate area around the anticipated mine footprint and the right-of-way along the NPAR and Proposed Tłįchę Road Route.

14.6 Residual Effects Summary

The effect from the NICO Project (including the NPAR) on ELC distribution will be confined to the NICO Project footprint. The type and degree of change consists of the spatial extent of change and the shape of the landscape. The area that will be disturbed during construction and operation is 485 ha (5.8%) of the LSA including 351 ha of upland ELC types, 80 ha of wetlands ELC types, 33 ha of burn, and 7 ha of water. At closure, 402 ha (4.8%) of the LSA will be reclaimed while 84 ha (1.0%) of the LSA will not be reclaimed. Non-reclaimed land is associated with residual disturbances including the Flooded Open Pit, constructed wetlands, Seepage Collection/Surge Ponds, and excavated ditch. Reclamation trials will be implemented as part of the mitigation and monitoring program to acquire knowledge during operations regarding revegetation processes and techniques that can be applied during the reclamation phase. Thus, at this time, reclaimed lands have not been assigned to specific ELC types.

No confirmed listed plant species identified as “At Risk”, “May be at Risk” or “Sensitive” by the GNWT (2010) or federal listed species (COSEWIC [2010] or *SARA* [*2010*]*)* were found in the LSA. A total of 485 ha (5.8%) of the LSA will be directly disturbed by the NICO Project, relative to the baseline case, including 135 ha (1.6%) of high rare plant habitat potential and 3 ha (0.1%) of very high rare plant habitat potential. Although 402 ha (4.8%) of the LSA will be reclaimed following closure it is unknown what the rare plant potential of these lands will be once re-vegetated. An additional 84 ha (1.0% of the LSA) of residual disturbances will result in a permanent loss to rare plant habitat.

The effect to economic and traditional use plants includes the disturbance of 351 ha (4.2% of the LSA) of ELC types with the potential to contain timber resources and a total of 228 ha (2.7% of the LSA) of high traditional plant potential ELC types. Although 402 ha (4.8% of the LSA) will be reclaimed following closure it is not known what the nature and availability of economic and traditional use plants will be in these reclaimed areas once they are re-vegetated. Additionally, 84 ha (1.0% of the LSA) that may contain economic or traditional use plants will be permanently lost due to residual disturbances. Overall, the effect from the NICO Project on the continued use of traditional use plants and timber resources is predicted to be within the range of baseline conditions.

14.7 Residual Impact Classification

The purpose of the residual impact classification is to describe the residual effects from the NICO Project on plant populations and communities using a scale of common words, rather than numbers or units. The use of common words or criteria is a requirement in the TOR (MVRB 2009). The following criteria were used to classify the residual effects from the NICO Project (Table 14.7-1):

- direction;
- magnitude;
- geographic extent;
- duration;
- reversibility;
- frequency; and
- likelihood.

14.7.1 Methods

Generic definitions have been provided for each of the impact criteria in the Assessment Approach (Section 6). For criteria such as geographic extent, duration, frequency, and likelihood, the definitions can be applied consistently across all terrestrial VCs (Table 14.7-1). Similarly, reversibility is defined as the likelihood and time required for a component (e.g., population) to recover after removal of the stressor and is a function of resilience. Reversibility (Table 14.7-1) is applied to all combinations of magnitude, geographic extent, and duration.

The approach used to classify the magnitude of changes in measurement endpoints (and related impacts) was based on scientific literature and professional opinion, and incorporated conservatism. Other environmental assessments often use the universal effect size approach for categorizing magnitude such as negligible changes (0 to 10%), small changes (10 to 25%), and medium changes (25 to 40%) (Munkittrick et al. 2009). Ideally, effect threshold values would be known, and measurement endpoints could be quantified accurately with a high degree of confidence; however, little is known about ecological thresholds, and biological parameters are typically associated with large amounts of natural variation. Therefore, the classification of magnitude included a level of conservatism so that the impacts would not be underestimated.

The definition of magnitude provided in Table 14.7-1 is applicable for more qualitative results (e.g., related impacts to people). For quantitative analyses and results (e.g., loss of ELC types and associated effects to plant populations and communities), the following definition for magnitude is applied:

- negligible: less than a 1% change from the NICO Project relative to baseline values;
- low: 1 to 10% change from the NICO Project relative to baseline values;
- moderate: greater than 10 to 20% change from the NICO Project relative to baseline values; and
- high: more than 20% change from the NICO Project relative to baseline values.

The scale is consistent with and below thresholds identified in a recent review by Swift and Hannon (2010) who found that most empirical studies demonstrated negative effects on insects, plants, birds, and mammals when remaining habitat cover ranged from 10 to 30% (i.e., more than 70% habitat loss).

Table 14.7-1: Definitions of Terms Used in the Residual Impact Classification

Direction	Magnitude	Geographic Extent	Duration	Reversibility[a]	Frequency	Likelihood
Negative: a less favourable change relative to baseline values or conditions **Positive:** an improvement over baseline values or conditions	**Negligible:** no predicted detectable change from baseline values **Low:** impact is predicted to be within the range of baseline values **Moderate:** impact is predicted to be at or slightly exceeds the limits of baseline values **High:** impact is predicted to be beyond the upper or lower limit of baseline values so that there is likely a change of state from baseline conditions	**Local:** small-scale direct and indirect impact from the NICO Project (e.g., footprint) **Regional:** the predicted maximum spatial extent of combined direct and indirect impacts from the NICO Project that exceed local-scale effects (can include cumulative direct and indirect impacts from the NICO Project and other developments at the regional scale) **Beyond Regional:** cumulative local and regional impacts from the NICO Project and other developments extend beyond the regional scale	**Short-term:** impact is reversible at end of construction **Medium-term:** impact is reversible at the end of closure **Long-term:** impact is reversible within a defined length of time beyond closure	**Reversible:** impact will not result in a permanent change of state of plant populations and communities compared to “similar” environments not influenced by the NICO Project **Irreversible:** impact is not reversible within the temporal boundary of the assessment (i.e., duration of impact is undefined or permanent)	**Isolated:** confined to a specific discrete period **Periodic:** occurs intermittently but repeatedly over the assessment period **Continuous:** will occur continually over the assessment period	**Unlikely:** the impact is likely to occur less than once in 100 years **Possible:** the impact is possible within a year; or at least one chance of occurring in the next 100 years **Likely:** the impact is probable within a year; or at least one chance of occurring in the next 10 years **Highly Likely:** the impact is very probable (100% chance) within a year

[a] “similar” implies an environment of the same type, region, and time period.

14.7.2 Results

Direct impacts to vegetation from the NICO Project (including the NPAR) are local in geographic extent (Table 14.7-2). The impacts to vegetation include associated impacts to listed plant species, traditional use plants, and economic use plants. Approximately 5.8% of the existing ELC types in the LSA will be impacted by the NICO Project footprint, where 4.8% of this area will be altered following reclamation. However, the incremental change of each ELC unit relative to baseline conditions is predicted to be between 1.0% and 8.7%, with the exception of bedrock open conifer, which will be reduced by 19.9% relative to baseline conditions. The NICO Project is predicted to impact less than 0.1% and 1.6% of ELC types that have very high and high rare plant habitat potential and no confirmed listed plant species identified as “At Risk”, “May be at Risk” or “Sensitive” by the GNWT were found in the LSA. A total of 228 ha (2.7% of the LSA) of high traditional plant potential ELC types and 351 ha (4.2% of the LSA) of ELC types with the potential to contain timber resources will be impacted by the NICO Project.

Therefore, at the local scale, the magnitude of impacts from the NICO Project footprint on plant communities and populations as defined by ELC types is predicted to be low for most ELC types and moderate for the bedrock open conifer ELC type (Table 14.7-2). The magnitude of impacts to listed plant species and ELC types with high to very high rare plant potential is low. The magnitude of impacts to traditional use and economic use (e.g., potential timber resources) is expected to be low.

The frequency of direct impacts from the NICO Project to vegetation, including plant populations and communities, listed plant species, traditional use species, and economic use species, are considered to be periodic during the life of the NICO Project (i.e., clearing of land during construction activities will occur during the first few years of the NICO Project). The frequency of residual ground disturbance following reclamation is isolated as this activity occurs once. Although reclamation will be integrated into mitigation and management plans for the NICO Project, subarctic terrestrial ecosystems are slow to recover following disturbance; therefore, the duration of these changes should be long-term, but given adequate time, the impacts are predicted to be reversible. Research on arctic ecosystems has shown that it can take from 20 to 75 years for vegetation to recover following disturbance (Forbes et al. 2001; Walker and Everett 1991). However, it is not known what the abundance and distribution of plant species and ELC types will be in reclaimed areas following revegetation. It is not certain that rare plants, traditional use plants, and timber resources will be present in the reclaimed landscape in the same proportion and abundance as they are in a future environment that is not influenced by the NICO Project.

Not all the areas for the NICO Project will be reclaimed; 1.0% of the impacted vegetation communities will be permanently lost. The Flooded Open Pit, constructed wetlands, Seepage Collection/Surge Ponds, and excavated ditch will be permanent features on the landscape, covering approximately 84 ha. Therefore, at the local scale, the magnitude of the impact from residual ground disturbance on plant populations and communities, including listed plant species, traditional use species, and economic use species, is low and the duration of this change is permanent and irreversible (Table 14.7-2).

Table 14.7-2: Summary of Residual Impact Classification of Primary Pathways for Effects from the NICO Project on Vegetation Ecosystems and Plants

Pathway	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Likelihood
Physical loss or alteration of vegetation from the NICO Project footprint affecting plant populations and communities	Negative	Low to Moderate	Local	Long-term	Periodic	Reversible	Highly Likely
Physical loss or alteration of vegetation from the NICO Project footprint affecting listed plant species	Negative	Low	Local	Long-term	Periodic	Reversible	Highly Likely
Physical loss or alteration of vegetation from the NICO Project footprint affecting availability of traditional and economic use plant species	Negative	Low	Local	Long-term	Periodic	Reversible	Highly Likely
Residual ground disturbance can cause permanent loss and alteration of vegetation (including listed, traditional use, and economic use plant species)	Negative	Low	Local	Permanent	Isolated	Irreversible	Highly Likely

14.8 Environmental Significance

14.8.1 Methods

The classification of residual impacts on primary pathways provides the foundation for determining environmental significance from the NICO Project on vegetation assessment endpoints. However, significance is only determined for assessment endpoints, and not individual pathways, as assessment endpoints represent the ultimate ecological properties and services of plant populations and communities that should be protected for use by future human generations (Section 6). Magnitude, geographic extent, and duration are the principal criteria used to predict significance. Duration of impacts, which includes reversibility, is a function of ecological resilience, and these ecological principles are applied to the evaluation of significance. Other criteria, such as frequency and likelihood are used as modifiers (where applicable) in the determination of significance.

The evaluation of significance for plant populations and communities considers the entire set of pathways that influence a particular assessment endpoint (e.g., persistence of listed and traditional use plant populations). The relative contribution of each pathway is then used to determine the significance of the NICO Project on assessment endpoints. For example, a pathway with a high magnitude, large geographic extent, and long-term duration would be given more weight in determining significance relative to pathways with smaller scale effects.

Environmental significance is used to identify predicted impacts that have sufficient magnitude, duration, and geographic extent to cause fundamental changes to plant populations and communities. The following definitions are used for assessing the significance of impacts on the persistence of plant populations and communities, including listed plant species and the associated continued opportunity for traditional and economic use of plants.

Not significant – impacts are measurable at the local or individual level, and strong enough to be detectable at the population level, but are not likely to decrease the resilience and increase the risk to population persistence.

Significant – impacts are measurable at the population level and likely to decrease the resilience and increase the risk to population persistence. A number of high magnitude and irreversible impacts at the population level (regional scale) would be significant.

The evaluation of significance uses scientific and ecological principles, to the extent possible, but also involves professional judgement and experienced opinion.

In summary, the following information is used in the evaluation of the significance of impacts from the NICO Project on vegetation assessment endpoints.

- Results from the residual impact classification of primary pathways.
- Magnitude, geographic extent, and duration of the impact as principal criteria, with frequency and likelihood as modifiers.
- Application of professional judgment and ecological principals, such as resilience, to predict the duration and associated reversibility of impacts.

14.8.2 Results

For all primary pathways influencing plant populations and communities assessment endpoints, the geographic extent of impacts was determined to be local (Table 14.7-2). The impacts are highly likely to occur for all NICO Project pathways. The frequency of impacts to plant populations and communities is anticipated to be periodic and limited to discrete periods throughout the life of the NICO Project. At the local scale, the magnitude of the impact to plant populations and communities from the NICO Project is predicted to be low to moderate. Impacts from the residual ground disturbances that will not be reclaimed (i.e., Flooded Open Pit, constructed wetlands, Seepage Collection/Surge Ponds, and excavated ditch) are irreversible, as these are permanent landscape features, while areas expected to be reclaimed are predicted to be reversible in the long-term (Table 14.7-2). Based on the impacts from the NICO Project on plant populations and communities, it is predicted that the magnitude of impacts to the traditional and economic use of plants will be negligible to low.

The results indicate that the NICO Project should not result in significant adverse impacts to the persistence of plant populations and communities, including listed plant species, and the use of traditional and economic use plants. Changes from the NICO Project are predicted to result in low to moderate local-scale impacts to plant populations and communities, and should be reversible in the long-term (i.e., 50 to 75 years following closure).

14.9 Uncertainty

Like all scientific results and inference, residual impact predictions must be tempered with uncertainty associated with the data and current knowledge of the system. The confidence in impact predictions is related to the adequacy of baseline data for understanding current conditions, accuracy of the local and regional scale ecological landscape classification mapping, the validity of models (e.g., to predict the extent of air emission and dust deposition) and understanding of project-related impacts on the system. The primary sources of uncertainty surrounding the identification of potential effects to subarctic vegetation ecosystems and plants are largely associated with the degree to which effects may occur (e.g., magnitude and duration). It is understood that development activities will disturb plant populations and communities, however, the ecological trajectory and rate at which these communities will recover is somewhat uncertain.

A critical aspect of this assessment is based on ELC cover types that have been interpreted using high resolution satellite imagery. Land cover types were also used to develop a rare plant habitat potential model based on the potential for a given ELC type to support listed plant species. The traditional and economic use plant distributions within these ELC types were also estimated and qualitatively assessed as insufficient empirical data were available to derive numerical models. The ELC was developed from data collected in the field, supporting literature, as well as professional judgement. In general, this classification represents an accurate interpretation of ground conditions, especially at the local scale. The effects associated with air emissions and dust deposition have not been extensively studied in subarctic environments and anticipated effects have been extrapolated from studies completed in more temperate climates. The identified sources of uncertainty affect the magnitude and duration components of the predictions. Where uncertainty exists, conservative estimates were used so that impacts were not underestimated.

Uncertainty can be reduced by collecting additional data, which can be used to validate models, and describe previously undocumented processes that are associated with effects from the NICO Project. Monitoring programs will be designed to reduce uncertainty of effects related to changes from the NICO Project.

14.10 Monitoring and Follow-up

Construction of the NICO Project will lead to the direct loss and alteration of vegetation and other natural features. This includes various types of forest cover, bedrock open conifer, shrubland, ponds, and wetlands. These changes will predominantly occur during construction. Following initial construction of the NICO Project and the NPAR, expansion of the NICO Project footprint will be at a much slower rate and smaller spatial extent, primarily associated with the development of the Open Pit and the Co-Disposal Facility through operations. The Wildlife Effects Monitoring Program includes a survey to delineate the NICO Project footprint at the end of construction to compare the actual loss of vegetation communities (habitats) to that predicted in the DAR and in the land use permit application (Section 18). Analysis of the loss and alteration of vegetation communities would be included in the Vegetation Monitoring Program (Section 18).

It is anticipated that monitoring of re-vegetation techniques and success will be required during the NICO Project, but the objectives, measurement endpoints, and methods of re-vegetation will need to be determined with input from regulators and the communities. Analyzing and assessing the success of re-vegetation techniques would like be a component of the Vegetation Monitoring Program, and provide input into the Closure and Reclamation Plan. Environmental monitoring would include surveys for weeds during construction and operation within the anticipated mine site and the implementation of a weed management plan if required (Section 18).

The NICO Project is anticipated to affect air quality through the release of combustion emissions and fugitive dust, which may influence vegetation. An Air Quality Effects Monitoring Program will be implemented to determine if changes in air and dust emission parameters from the NICO Project are within concentrations predicted from air dispersion modelling (Section 18). Mitigation and changes to mine operation may be suggested to reduce emissions and fugitive dust. Environment Canada confirmed that detailed operational plans and a monitoring plan for air quality should be required when the NICO Project progresses to the permitting stage (D. Fox, Environment Canada, 2010, pers. comm.).

14.11 References

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