



Ecological mapping of the
**VEGETATION OF
NORTHERN QUÉBEC**

Mapping standard

APRIL 2018

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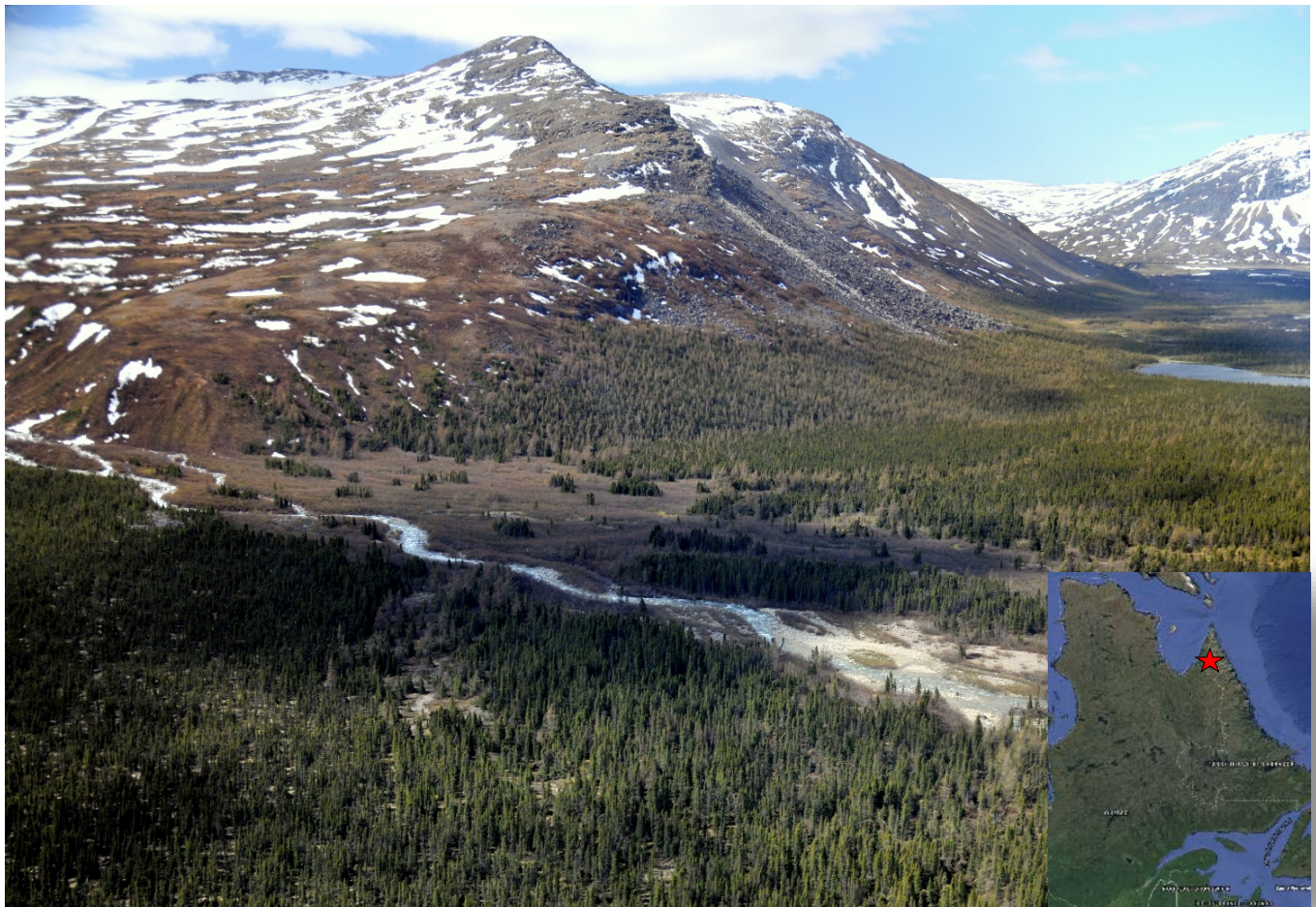
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FOREWORD

The Ministère des Forêts, de la Faune et des Parcs du Québec (MFFP), through its Direction des inventaires forestiers (DIF), has received the mandate to produce an ecological mapping of northern Québec's vegetation as part of the Plan Nord project. This mapping answers a need for basic knowledge of this territory which, until now, had never been the subject of a complete and detailed mapping of its plant cover and physical environments. To this end, the MFFP has developed a new approach for the mapping of vegetation and surficial deposits based on remote detection techniques using Landsat and RapidEye satellite imagery (*see Leboeuf and Fournier 2015 for information on the mapping method*).

This document presents the stratification criteria of the land cover and the different vegetation classes and surficial deposit types used to produce this mapping.



Valley of the Rivière Koroc, MFFP.



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1. Introduction

The major economic, social and environmental development project of the Québec government for the area north of the 49th parallel, known as the Plan Nord, requires the provision of systematic knowledge of this vast territory (Figure 1). To this end, ecological mapping of the vegetation of northern Québec partially meets this need, by providing information on the terrestrial ecosystems, both forest and non-forest. This ecological mapping is based on the application of rigorous criteria for stratification of vegetation and the physical environment. These criteria are presented in this standard. The ecological mapping territory covers 682,000 km² north of the 53rd parallel (Figure 1).

Figure 1 Territory of the ecological map of northern Québec



2. Ecological stratification

In the mapping process, the first step was to differentiate (or stratify) the five major types of land cover, as shown in the diagram in Figure 2. The first criterion enabled a separation of lands that have at least 20% vegetation coverage from those that do not. For lands with more than 20% plant coverage, those characterized by coverage of at least 10% of trees more than 4 m in height (called forested land) were distinguished. Lands not meeting this criterion (called land with non-forest vegetation) were divided according to the presence or absence of recent disturbance (within about 40 years). Thus, three types of land cover with vegetation were created:

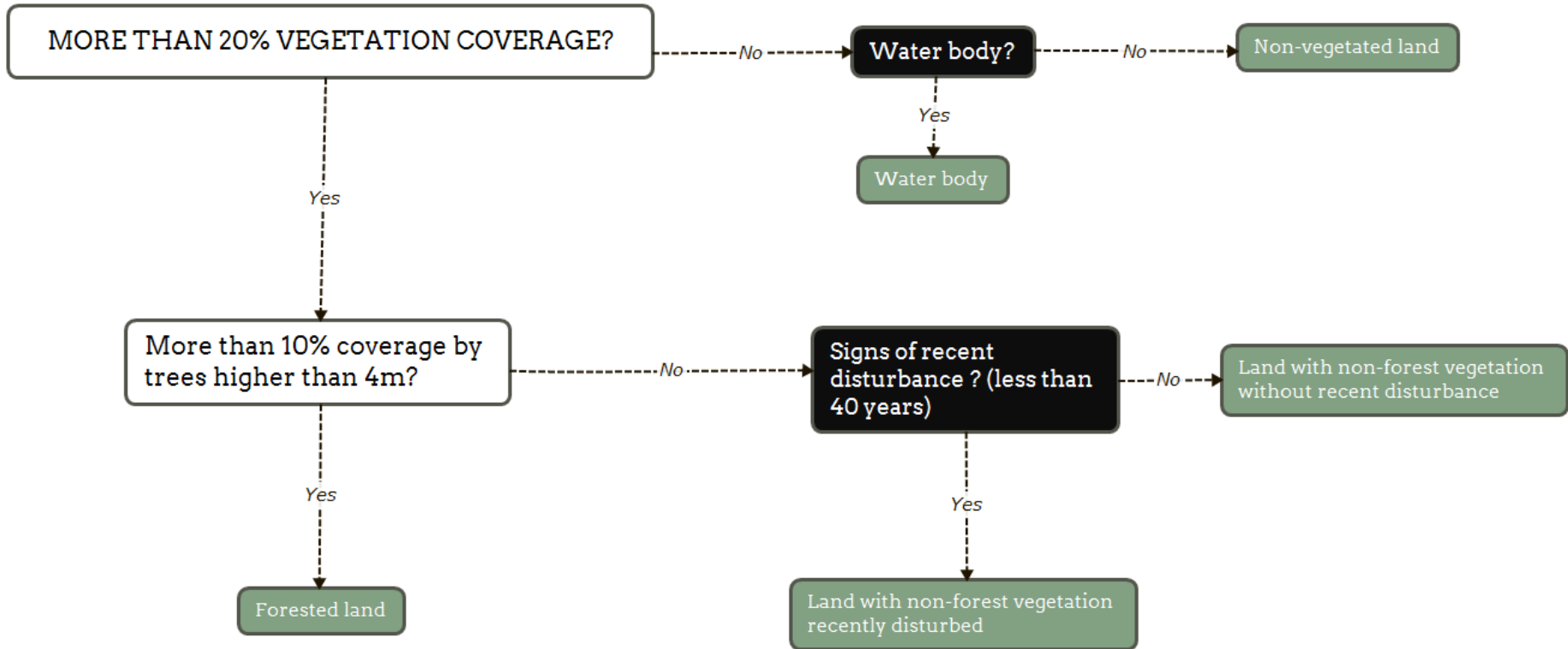
1. land covered more than 10% by trees over 4 m in height;
2. land with non-forest vegetation, characterized by a recent disturbance;
3. land with non-forest vegetation without disturbance or having had an old disturbance (more than about 40 years ago).

Finally, environments not covered by at least 20% of vegetation were divided on the basis of the presence of water bodies, giving rise to two other types of land cover:

4. non-vegetated land;
5. water.



Figure 2 Stratification of the major types of land cover in northern Québec



2.1. Minimum mapping area

The minimum mapping area is not the same for all types of cover. For land with vegetation, the minimum area mapped was 16 ha, with the exception of wetlands, for which the minimum area was set at 3 ha. Most of the contours of wetlands come from the National Topographic Data Base (NTDB) of Natural Resources Canada. The minimum area of 3 ha was also set for mapping water bodies (surface hydrography). The minimum mapping area for surficial deposits was set at 100 ha (Dufour et al. 2016).

The mapping phase of terrestrial ecosystems (or ecological units) is the stratification step itself. Table 1 presents the stratification parameters for vegetation and the physical environment arranged, from left to right, in the hierarchical order of stratification.

Appendix 1 presents a description of the database of the VEG_NORD layer. Appendix 2 details the database of the road network layer (CHE_FOR_CN) of this territory.

2.2. Vegetation stratification parameters

The stratification parameters for this mapping of the northern territory are designated by codes, as are those of the ecoforest mapping produced in southern Québec by the MFFP. When the parameter is the same, for example “type of cover”, the same codes are used, either “R” (for Résineux [*coniferous*]), “F” (for Feuillus [*deciduous*]) and “M” (for Mixte [*mixed*]). In the case of a new parameter, for example “dominant understory vegetation”, new codes are created. Thus, a dominance of deciduous shrubs is designated by the code “a” (for *arbustes*); lichens by the code “c” (for *Cladonia*); a mixture of lichens and mosses by the code “cm”; and mosses and ericaceous shrubs by the code “m” (Table 1).



Table 1 Parameters for stratification of terrestrial ecosystems of northern Québec

			ECOLOGICAL STRATIFICATION PARAMETERS										
Land Cover Classification			Forest cover type	Dominant tree species	Dominant understorey vegetation	Stand crown cover	Stand replacing disturbance	Year of the stand replacing disturbance	Stand age	Partial disturbance	Year of the partial disturbance	Non-forest land cover class	Surficial deposit
With vegetation <i>(more than 20% plant cover)</i>	Forest <i>(more than 10% tree cover)</i>	Type of cover: Deciduous (F), Mixed (M) or Coniferous (R)	●	●	○	●	□	☼	●	□	☼		●
	Non-forest vegetation <i>(less than 10% tree cover)</i>	With recent disturbance <i>(less than 40 years)</i>			■		□	☼				★	●
		Without disturbance or with old disturbance <i>(over 40 years ago)</i>					□	☼				●	●
Without vegetation <i>(less than 20% plant cover)</i>	Non-vegetated land											●	△
	Water											●	

- Mandatory
- △ Mandatory except for IH, ILE
- Mandatory only for coniferous cover (Forest cover type = R)
- Only in the case of a severe disturbance other than "BR" (e.g. mES2000)
- If already mapped or observed on satellite image
- ☼ Mandatory with a stand replacing BR disturbance or a partial BRP disturbance
- ★ Only in the case of burned wetlands and shrublands (regeneration with alder, birch, poplar, willow)

2.3. Description of forest vegetation

The stratification parameters of forest vegetation are described below.

2.3.1. Forest cover type

The forest cover type is defined by the percentage of leaf area (projection of foliage on the ground) of the trees of a stand, considering the proportion of coniferous trees compared to deciduous (Table 2).

Table 2 Forest cover types

Designation	Percentage of leaf area occupied by conifers	Code
Deciduous	less than 25%	F
Mixed	from 25% to 75%	M
Coniferous	over 75%	R

2.3.2. Dominant tree species

There are eight species on the territory that can dominate a stand's cover (Table 3). The dominant species is that for which the percentage leaf area is the largest among the species in the stand (it is rare for a stand to have more than two tree species on the territory).

Table 3 Dominant tree species

Description	Code
Black spruce	EN
White spruce	EB
Balsam fir	SB
Eastern larch	ML
Jack pine	PG
White birch	BP
Trembling aspen or balsam poplar	PT



2.3.3. Dominant understory vegetation

This parameter characterized the understory of coniferous stands. It is determined by the percentage of ground cover of four plant categories (Table 4). Rock, water bodies and bare soil are not included in the percentage assessment.

Table 4 Dominant understory vegetation

Order	Designation	Description	Code
1	Deciduous shrubs	More than 50% dwarf birch, alder or willow	a
2	Lichens	More than 60% lichen cover on the vegetated area that is not under tree foliage	c
3	Lichens and mosses	Between 40 and 60% lichen cover on the vegetated area that is not under tree foliage	cm
4	Mosses and ericaceous shrubs	Less than 40% lichen cover on the vegetated area that is not under tree foliage	m

2.3.4. Stand crown cover class

The stand crown cover is determined by the percentage of leaf area of forest species more than 4 m in height in the stand (Table 5).

Table 5 Stand crown cover class

Designation	Code
over 80%	A
from 61 to 80%	B
from 41 to 60%	C
from 26 to 40%	D
from 10 to 25%	L

2.3.5. Stand replacing disturbance and year of the disturbance

The nature of the disturbance is recorded if more than 75% of the basal area of a stand has disappeared as a result of the disturbance (

Table 6). Satellite images and documents specific to mapping disturbances (e.g. fires and insect outbreaks) have been the main sources of information for determining different stand replacing



disturbances and the year in which they occurred. Table 6 presents the stand replacing disturbances that can be mapped in the territory.

Table 6 Stand replacing disturbances

Designation	Description	Code
Severe insect outbreak	75% of trees killed by an insect	ES
Clear cutting	75% of the basal area cut	CT
Total burn	75% of trees killed by fire	BR
Total windfall	75% of trees felled	CHT
Total dieback	75% of trees killed by unknown cause	DT

2.3.6. Stand age

In this standard, the age of a forest stand corresponds to the number of years elapsed between the year of the last fire and 2013 (fires have been mapped from 1920 to 2013). The stand age is presented in classes of 10 years (Table 7).

Table 7 Stand age classes

Age (year)	Code
0-14	10
15-24	20
25-34	30
35-44	40
45-54	50
55-64	60
65-74	70
75-84	80
85-94	90
95 and more	95+

Example of the stand age for a 1989 fire: $2013 - 1989 = 24$ years, code = 20

2.3.7. Partial disturbance

A partial disturbance is a natural phenomenon that has eliminated 25% to 75% of the basal area of a stand. The residual cover density must be greater than 10%. Table 8 presents the partial disturbances that can be mapped on the territory.



Table 8 Partial disturbances

Designation	Description	Code
Partial burn	from 25 to 75% of trees burned	BRP
Partial windfall	from 25 to 75% of trees felled	CHP
Moderate insect outbreak	from 25 to 75% of trees killed by an insect	EL
Partial dieback	from 25 to 75% of trees killed by unknown cause	DP

2.4. Description of non-forest vegetation and non-vegetated lands

In this standard, the non-forest land cover class is used as a parameter for stratification of the non-forest vegetation, non-vegetated lands and water bodies. In the case of non-forest vegetation, there may be trees, but their total coverage is less than 10%. Table 9 presents the list of non-forest land cover classes that have been identified in the territory. In the table, the classes are grouped by type of environment: wet; boreal and subarctic; arctic; vegetation-free.

Table 9 Non-forest land cover classes

(a) Wetlands

Code	Designation	Description
MR	Freshwater marsh/shrub swamp	Herbaceous or shrub vegetation submerged during springtime high water levels.*
MS	Salt water marsh	Herbaceous vegetation under tidal influence of salty or brackish water.*
TOU	Uniform bog	Homogenous vegetation (flats and plateaus) dominated by herbaceous or shrub vegetation. In boreal and subarctic environments.*
TOS	Patterned bog with pools	Alternating ridges of shrubs and depressions of elongated and arched pools.*
TOR	Patterned bog without pools	Alternating ridges of shrubs and depressions of herbaceous vegetation.*
TOM	Bog with pools	Presence of large pools. Bog of large area generally.*
TMU	Uniform fen	Homogenous vegetation (flats) consisting mainly of herbaceous vegetation.*
TMS	String fen	Alternating herbaceous narrow ridges and depressions of elongated and linear pools.*
TMR	Riparian fen	Fen bordering a watercourse or water body and flooded in spring.
TOP	Palsa peatland	Peatland with many palsas and pools.
TAR	Arctic fen or wet tundra	Peatland located in tundra or tundra on mineral soil with large areas of surface runoff. The peatlands are minerotrophic and the accumulation of peat is reduced due to arctic conditions. Over 50% coverage by wet sites.
TAA	Arctic fen with 30-70% erect shrubs	Arctic fen having 30% to 70% erect shrubs (> 30 cm; dwarf birch, alder, willow).

* Consult the *Guide d'identification des milieux humides du Nord du Québec par images satellites (Leboeuf et al. 2012) [Guide for identification of wetlands in the Nord du Québec by satellite imagery]* for more details.



(b) Dry to subhumid environments in boreal forest or subarctic environments with more than 20% vegetation, less than 10% trees and no recent disturbance (fire).

Code	Designation	Description
AH	High shrub (> 2m)	More than 70% deciduous shrubs* in boreal or subarctic environments. The high shrubs (> 2 m) make up more than 50% of the shrub cover. Always bordering a watercourse.
AB	Low shrub (0.3 to 2 m)	More than 70% deciduous shrubs* in boreal or subarctic environments. The low shrubs (0.3 to 2 m) make up more than 50% of the shrub cover.
ABM	Low shrub and thermokarst ponds	More than 70% deciduous shrubs* and many thermokarst ponds, in boreal or subarctic environments.
LL	Lichen-heath	More than 30% lichens and less than 30% deciduous shrubs*. Corresponds to a treed lichen-heath (< 10% trees) or a stage of development after a fire toward a lichen woodland.
LLA	Lichen-heath with 30-70% deciduous shrubs	Between 30% and 70% deciduous shrubs* among lichens, ericaceous shrubs, mosses and conifers. Generally corresponds to a stage of development after a fire toward a lichen woodland.
LLR	Lichen-heath with > 10% rock substrate	From 10% to 50% of bare outcrops, boulders, stones or mineral soil, among lichens, ericaceous shrubs, mosses and conifers.
LS	Subarctic lichen-heath	Mixture of tundra vegetation (i.e. treeless and consisting of a mix of lichens, shrubs, herbs and mosses) and small forest stands or treed non-forest vegetation. Less than 10% trees and less than 30% deciduous shrubs*. Generally dominated by lichens.
LSA	Subarctic lichen-heath with 30-70% deciduous shrubs	Subarctic lichen-heath having between 30% and 70% deciduous shrubs*.
LSR	Subarctic lichen-heath with 10-50% rock substrate	Subarctic lichen-heath having less than 30% deciduous shrubs* and between 10% and 50% of bare outcrops, boulders, stones or mineral soil.
RLS	Subarctic lichen-heath dominated by the rock substrate	Between 50% and 80% of bare outcrops, boulders, stones or mineral soil, with sparse lichen, shrub, moss and coniferous tree vegetation.
LSM	Subarctic lichen-heath and thermokarst ponds	Subarctic lichen-heath with many thermokarst ponds. The deciduous shrubs* are generally quite abundant. Associated with marine deposits.
LSC	Subarctic lichen-heath of snow bed	Subarctic lichen-heath in a topographical location of high snow accumulation where the vegetation composition differs from adjacent sites due to a delay in the growing season.

* Refers to shrubs > 30 cm in height, including dwarf birch, willow and alder, and excluding ericaceous shrubs.



(c) Dry to subhumid environments in arctic environments (treeless due to the cold) with more than 20% vegetation and no recent disturbance (fire).

Code	Designation	Description
AAH	High shrub in tundra (> 1 m)	More than 70% deciduous shrubs* in arctic environments (tundra). The high shrubs (> 1 m) make up more than 50% of the shrub cover. Always bordering a watercourse.
AAB	Low shrub in tundra (0.3 to 1 m)	More than 70% deciduous shrubs* in arctic environments (tundra). The low shrubs (0.3 to 1 m) make up more than 50% of the shrub cover.
AAM	Low shrub and thermokarst ponds in tundra	More than 70% deciduous shrubs* in arctic environments (tundra) and many thermokarst ponds.
TD	Erect-shrub tundra	Vegetation consisting of a mixture of erect shrubs*, prostrate or creeping shrubs, herbs, lichens and mosses. Less than 30% erect shrubs*.
TDA	Erect-shrub tundra with 30-70% erect shrubs	Erect-shrub tundra having between 30% and 70% erect shrubs*
TDO	Erect-shrub tundra with frost-boils	Erect-shrub tundra having less than 30% erect shrubs* and a large number of frost-boils (between 10% and 50% coverage). Vascular plants are more abundant than in the TD class. On flat or slightly sloping terrain.
TAO	Erect-shrub tundra with frost-boils and 30-70% erect shrubs	Erect-shrub tundra having between 30% and 70% erect shrubs* and a large number of frost-boils (between 10% and 50% coverage). Vascular plants are more abundant than in the TDA class. On flat or slightly sloping terrain.
TDC	Erect-shrub tundra of snow bed	Erect-shrub tundra in a topographical location of high snow accumulation where the vegetation composition differs from adjacent sites due to a delay in the growing.
TDM	Erect-shrub tundra with thermokarst ponds	Erect-shrub tundra with many thermokarst ponds and generally quite abundant erect shrubs*. Associated with marine deposits.
TDR	Erect-shrub tundra with 10-50% rock substrate	Erect-shrub tundra having less than 30% erect shrubs and between 10% and 50% of bare outcrops, boulders, stones or mineral soil.
RTD	Erect-shrub tundra dominated by the rock substrate	Erect-shrub tundra having between 50% and 80% of bare outcrops, boulders, stones or mineral soil.
TP	Prostrate-shrub tundra	Tundra without erect shrubs. Vegetation seldom exceeds 20 cm in height and there are regular outcrops of the mineral substrate (up to 50% of bare outcrops, boulders, stones or mineral soil).
TPO	Prostrate-shrub tundra with frost-boils	Prostrate-shrub tundra having a large number (between 10% and 50% coverage) of frost-boils (or other related periglacial forms). Vascular plants are more abundant than in the TP class. On flat or slightly sloping terrain.
TH	Herb tundra with prostrate shrubs	Prostrate-shrub tundra having more than 10% herbs. Associated to slopes with snowmelt runoff.
RTP	Prostrate-shrub tundra dominated by the rock substrate	Prostrate-shrub tundra having between 50% and 80% of bare outcrops, boulders, stones or mineral soil.

* Refers to shrubs > 30 cm in height, including dwarf birch, willow and alder, and excluding ericaceous shrubs.



(d) Non-vegetated lands (vegetation < 20%) and water bodies

Code	Designation	Description
AR	Rock outcrops and fragments	Bare rock outcrops or fragments, including large boulder fields on hills in the far north. Less than 20% vegetation.
CB	Boulder fields	More than 50% coverage by boulder fields. In sites conducive to wash out of sediments in plains and topographical depressions. Less than 20% vegetation.
SD	Bare ground	Sand, beaches and other vegetation-free areas. Less than 20% vegetation.
NE	Snow	Snow accumulated in topographical depressions at the highest latitudes and altitudes. Seen in July or August.
IH	Human infrastructure	Residences, streets, roads, dams, hydropower stations, etc.
LTE	Power transmission line	
EAU	Water	Lake, watercourse, flooded site
ILE	Island of less than 8 ha	Island present in the NTDB* and less than the minimum mapping area.

** National Topographic Data Base of Natural Resources Canada*

2.5. Parameters for stratification of the physical environment

A single parameter for stratification of the physical environment was used: the type of surficial deposit.

Table 10 shows the list of different types of surficial deposits which are mapped north of the 53rd parallel.



Table 10 Surficial deposits

Class of deposits	Area of deposit	Code	Description	Origin and morphology	Important note
GLACIAL DEPOSITS	UNDIFFERENTIATED TILL	1A	Loose or compact, unsorted, consisting of a rock flour and elements from angular to sub-angular. The particle size of the sediments can vary from clay to boulder, depending on the region.	Forms little or no relief on the underlying rock formations. Originates from the action of a glacier. Till laid down at the base of a glacier (basal till), during glacial advance, or through stagnant ice, during its retreat.	Quasi-absence of rock outcrops, rock structure not exposed or almost not exposed.
	WASHED TILL	1AD	Till with poor fine-matter matrix characterized by a high concentration of coarse elements (pebbles, stones, boulders). The boulders are often sub-angular to angular but can be sub-rounded to rounded.	Found in areas of dead-ice moraine, ribbed moraine, near lakes, drainage areas, in large depressions where water has leached fine particles. Can cover large, generally flat surfaces. It is occasionally encountered on steep slopes and hill tops. The surface is frequently uneven.	Stands out by its location, morphology and characteristic colour on satellite images.
	ABLATION TILL	1BA	Till with poor fine-matter matrix characterized by a high concentration of sand. This till also includes a high proportion of gravel, pebbles, stones and boulders.	Till laid down by stagnant ice as glacier melted. Usually has a topography of rises and hollows, with no specific orientation.	
	ROGEN MORAINE, RIBBED MORAINE	1BC	Ridges composed of till rich in boulders, can contain layers of sediments sorted by water.	Laid down under a glacier, presents a succession of ridges aligned parallel to the glacial front and interspersed with hollows occupied by lakes. Ribbed: lower ridges, separated by depressions that are sometimes wet.	Can sometimes encompass small areas of dead-ice moraine along the moraine borders and/or areas of washed till.
	DRUMLINS, DRUMLINOIDS, PROFILED SHAPES	1BD	Ridges composed of till, may contain a rocky core.	Formed under an advancing glacier, aligned in the direction of glacial flow. Oval or elongated hills, usually clustered. Drumlinooids are distinguished from drumlins by their narrower and more tapered shapes.	
	DEAD-ICE MORAINE	1P	Composed of loose till, washed out and often thin compared to the underlying till. Contains a high proportion of coarse elements (many surface boulders) and may also contain stratified sediment pockets.	Laid down as a glacier melted. Debris usually accumulates on the bottom till. Has a topography of rises and hollows, with no specific orientation.	
	DE GEER MORAINE	1BG	The small ridge that forms a De Geer moraine consists of till, sometimes washed out in area, generally stony and sometimes covered with boulders or gravel.	Laid down in shallow-water bodies at the front of glaciers. Presents a topography of small ridges (from 3 m to 10 m) parallel to the glacial front.	The presence of a De Geer moraine is identified by other deposits when the deposit does not reach the minimum area (e.g.: 5_1BG).
	FRONTAL MORAINE	1BF	Includes a significant accumulation of glacial sediments: sand, gravel and boulders. Deposits layered in some places and with no visible sediment structure elsewhere.	Formed at the glacier front, precisely marks the former position of a glacial front. Sometimes reaches several tens of metres in height and hundreds of kilometres in length.	Includes the thrust, lateral and median moraines from the alpine environments.
	FRONTAL MORAINE COMPOSED OF TILL	1BF_1	Includes a significant accumulation of glacial sediments: sand, gravel and boulders. Deposits layered in some places and with no visible sediment structure elsewhere. Composed of till.	Formed at the glacier front, precisely marks the former position of a glacial front. Sometimes reaches several tens of metres in height and hundreds of kilometres in length.	
	FRONTAL MORAINE COMPOSED OF GLACIOFLUVIAL MATERIALS	1BF_2	Includes a significant accumulation of glacial sediments: sand, gravel and boulders. Deposits layered in some places and with no visible sediment structure elsewhere. Composed of glaciofluvial sediments.	Formed at the glacier front, precisely marks the former position of a glacial front. Sometimes reaches several tens of metres in height and hundreds of kilometres in length.	
GLACIOFLUVIAL DEPOSITS	GLACIOFLUVIAL	2	Composed of heterometric sediments, with shape varying from sub-rounded to rounded. They are stratified and may contain pockets of till (flow till).	Laid down by meltwater from a glacier. The morphology of accumulations varies depending on the proximity of the sedimentary environment and the glacier (glacioproximal and proglacial).	
	GLACIOFLUVIAL WITH ESKER	2_2AE	Esker: Consists of sand, gravel, pebbles, stones and, sometimes, boulders ranging from rounded to sub-rounded. Their stratification is often distorted and forms a fault. The particle size varies considerably depending on the strata.	An esker is formed in a watercourse above, within or under a glacier, as the glacier melts. It is seen as an elongated ridge, straight or sinuous, continuous or discontinuous.	The presence of eskers is identified by glaciofluvial deposits.
	GLACIOFLUVIAL DELTA	2BD	Mainly composed of sand and gravel, sorted and deposited in very distinct layers. Accumulations can be several tens of metres thick.	Laid down at the downstream end of a glaciofluvial watercourse in a lake or in the sea. Its surface is often flat. Seen from the air, it sometimes has a conical shape.	
	ESKER DELTA	2BP	Mainly composed of sand and gravel, sorted and deposited in very distinct layers. Accumulations can be several tens of metres thick.	Laid down in a proglacial lake or a sea at the downstream end of an esker. Its surface is often flat, riddled with kettles and lined with steep slopes (delta front).	Larger surface area than 2BD generally, often linked to sandur-delta complexes.
FLUVIAL DEPOSITS	FLUVIAL	3	Well stratified. They generally consist of gravel and sand as well as a small proportion of silt and clay. They can also contain organic matter.	Carried and laid down by a watercourse. They have a generally flat surface.	
	ALLUVIAL CONE	3DA	Poorly sorted and coarsely stratified, composed of silt, sand and gravel.	Laid down by a watercourse, at the foot of a steep slope. Seen from the air, it has the shape of a "fan." Its longitudinal slope is usually less than 14%.	



	DETRITUS CONE	3DE	Poorly sorted and coarsely stratified, composed of sand and gravel coarser than those of the alluvial cone.	Laid down by a torrent, at the breach of a slope. Seen from the air, it forms a "fan" and its slope is usually more than 14%.	
LACUSTRINE DEPOSITS	LACUSTRINE	4	Composed of organic matter, fine sand, silt and stratified clay, or coarser sediments (sand and gravel).	Laid down by settling (clay, silt), by currents (fine sand, silt) or by waves (sand and gravel).	
	GLACIOLACUSTRINE	4G	Deep-water facies consists of fine sand, silt and clay, undulating (varved). Shallow-water facies consists of sand and sometimes gravel.	With a surface that is generally flat, it is formed in a proglacial lake.	Deep- and shallow-water facies are not distinguished.
	BEACH	4P	Composed of sorted sand and gravel. In some cases, it may contain a proportion of silt.	Laid down by the waves, in the littoral zone of a lake. It has the shape of elongated ridges that mark the lake's current or former levels (raised beaches).	
MARINE DEPOSITS	MARINE	5	Composed of clay, silt, sand and gravel.	Laid down in a sea. Has a relatively flat topography, gullied by watercourses during exposure.	May be a marine deposit with shallow-water or deep-water facies. The sea may have been in contact with the glacial margin.
	DEEP-WATER FACIES	5A	Consists of clay and silt, which sometimes contains stones and glacial boulders.	Laid down in a marine environment.	
	SHALLOW-WATER FACIES	5S	Consists of sand and sometimes gravel, usually well sorted.	Laid down in a marine environment.	
LITTORAL DEPOSITS	LITTORAL	6	Consists of clay, sand, gravel, pebbles, stones and boulders, usually blunt.	Reworked or laid down by water and floating ice, between the highest and lowest tide levels.	Includes raised beaches, raised glacial boulder fields and current littoral deposits.
ORGANIC DEPOSITS	ORGANIC	7	Consists of more or less decomposed organic matter, from sphagnum, moss, forest litter, etc.	It forms in an environment where the rate of accumulation of organic matter exceeds its rate of decomposition. Lakes and wet depressions, which retain water that is almost stagnant, are sites conducive to such accumulations.	Classified in the vegetation map according to nine wetland classes (field = CO_TER).
SLOPE DEPOSITS AND ALTERED DEPOSITS	SLOPES AND ALTERATIONS	8	Consists of sediments, generally angular, with very varied particle size.	Results from alteration of the bedrock, surface water runoff or even gravity.	Fields of alteration boulders are difficult to distinguish on satellite images, so they may be associated with other deposits.
	SCREE	8E	Consists of stones and angular boulders. Coarser sediments at the foot of the slope.	Wholly or partially covers a slope. Laid down by gravity, following mechanical alteration of the bedrock (mainly by frost shattering).	
EOLIAN DEPOSITS	EOLIAN	9	Stratified and well sorted, usually composed of sand with a fine to medium particle size.	In the form of elongated hillocks or "crescents" built by the wind.	Includes deflation areas related to wind activity. When it is not possible to distinguish 9A and 9S. Presence is identified when the deposit does not reach the minimum area (e.g. 5_9).
	ACTIVE DUNE	9A	Stratified and well sorted, usually composed of sand with a fine to medium particle size.	Activated by the wind.	Includes active deflation zones. Presence is identified when the deposit does not reach the minimum area (e.g. 5_9A).
	STABILIZED DUNE	9S	Stratified and well sorted, usually composed of sand with a fine to medium particle size.	No longer activated by the wind and stabilized by vegetation.	Presence is identified when the deposit does not reach the minimum area (e.g. 5_9S).
BEDROCK	ROCK	R	Formation of sedimentary, igneous or metamorphic rocks, sometimes covered with a thin layer of mineral or organic material. Rock can support non-continuous coatings of deposits, but must be regularly exposed outcrops for the most part.	Bedrock consisting of sedimentary, igneous or metamorphic rocks.	Abundant outcrops, less than 50%.
	BARE ROCK	RR	Formation of sedimentary, igneous or metamorphic rocks, sometimes covered with a thin layer of mineral or organic material. Rock occupies more than 50% of the surface. Rock may have been disaggregated by frost shattering.	Bedrock consisting of sedimentary, igneous or metamorphic rocks.	Very abundant outcrops, more than 50% in total.
ANTHROPOGENIC	ANTHROPOGENIC	AN	Reworked by anthropogenic activities.	Of anthropogenic origin (mines, cities, villages, etc.).	



References

Dufour, E., Robitaille, A., Leboeuf, A. 2016. Norme de cartographie des dépôts de surface du Nord Québécois. Ministère des Ressources naturelles et de la Faune du Québec, Direction des inventaires forestiers, 13 p.

Leboeuf, A., Grondin P., Dufour, E. 2012. Guide d'identification des milieux humides du Nord du Québec par images satellites. Ministère des Ressources naturelles et de la Faune du Québec, Direction des inventaires forestiers, 34 p.

Leboeuf, A., Fournier, R. A. 2015. A Multisensor Multiresolution Method for Mapping Vegetation Status, Surficial Deposits, and Historical Fires over Very Large Areas in Northern Boreal Forests of Quebec, Canada. IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, 8, 5199-5211.

NATURAL RESOURCES CANADA, 2010. National Topographic Data Base (NTDB), map <https://open.canada.ca/data/en/dataset?organization=nrcan-rncan>



APPENDIX 1 Description of the VEG_NORD layer

Nomenclature of form files: VEG_NORD

Type of file: SURFACE

CONSTITUENTS						
COMPLEMENTARY (to be imported)						
<i>Codes to be retained under the REFERENCE attribute for all surfaces imported from the NTDB and saved without modification</i>						
<u>Reference</u>	<u>Description</u>					
01020001000	Lake					
01020002000	Hydroelectric reservoir					
DESCRIPTION						
Polygone layer presenting the units of the northern Québec map and the surface hydrography elements of the NTDB						
SPECIAL SPECIFICATIONS						
All hydrographic surfaces must be imported into the NTDB. When new nodes are added, no major displacement (depending on the internal accuracy) must result.						
DESCRIPTIVE DATA						
Attribute	Format	Pre.	Remark	Example	Description	
	L T					
ID_SEQ	8 I	Mand	Unique per delivery	645	Sequential identifier	
AREA	19,1 1 F	Mand		180.4	Area (ha)	
TYPE_COUV	1 C	Opt.	Rem. 1	R	Forest cover type code	
VEG_SBOIS	2 C	Opt.	Rem. 1	m	Understorey vegetation code	
CL_DENS	1 C	Opt.	Rem. 1	D	Stand crown cover class code	
CO_TER	3 C	Opt.	Rem. 1		Non-forest land cover class code	
CL_CARTO	4 C	Mand	Rem. 2	RmD	Land cover class code	
ESS_DOM	2 C	Opt.	Rem. 1	EN	Dominant tree species code	
ORIGINE	3 C	Opt.	Rem. 1	BR	Stand replacing disturbance code	
AN_ORIGINE	4 I	Opt.	Rem. 1	1930	Year of stand replacing disturbance	
STADE_DEV	3 C	Opt.	Rem. 1	80	Stand age	
PERTURB	3 C	Opt.	Rem. 1		Partial disturbance code	
AN_PERTURB	4 I	Opt.	Rem. 1		Year of last partial disturbance	
DEP_SUR	6 C	Opt.	Rem. 1	1A	Surficial deposit code	
TOPONYME	80 C	Opt.	Rem. 3		Toponym (hydrographic surface)	
INDICATIF	11 C	Opt.		0102000 1000	Reference from the NTDB	
AN_SAISIE	4 I	Mand		2018	Year of entry	
PRO_SOU	4 C	Mand		LRRE	Product source code (Landsat and RapidEye [LR] for vegetation and RapidEye for deposits [RE]).	

Note 1: Refer to the section dealing with stratification parameters to obtain the possible domain values and consistency rules.

Note 2: This field results from the concatenation of the following fields: TYPE_COUV, VEG_SBOIS, CL_DENS, CO_TER, ORIGINE (if TYPE_COUV and CO_TER are empty).

Note 3: To be retained (NTDB).

L: Width of field
n1: total number of positions for characters and integers
n1, n2: number of positions for numbers with decimal values
n1 = total number of positions (excluding decimal point and sign)
n2 = number of positions to the right of the decimal point

T: Type of attribute C: character; I: Integer; F: Float

Pre.: Presence Mand: mandatory; Opt: Optional



APPENDIX 2 Description of the CHE_FOR_CN layer

Nomenclature of form files: CHE_FOR_CN

Type of file: LINES

CONSTITUENTS

ORIGINALS (to be entered)

Codes to be entered under the REFERENCE attribute for all linear elements (all elements must be classified)

Reference	Description
02100001000	Railway
02100001001	Primary forest road
02100001002	Secondary forest road
02100001003	Tertiary forest road
02100001004	Winter road
02100003002	Non-passable path

DESCRIPTION

Line layer composed of communication channels mapped by satellite imagery

SPECIAL SPECIFICATIONS

Geographical reference: geographical coordinates and in decimal degree units (North American Datum 1983).

DESCRIPTIVE DATA

Attribute	Format	Pre	Remark	Example	Description
	L	T			
ID_SEQ	8	I	Mand.	Unique per 645 delivery	Sequential identifier
INDICATIF	11	C	Opt.	02100001001	Reference to be entered (new road)
AN_SAISIE	4	I	Mand.	2012	Year of entry
PRO_SOU	4	C	Mand.	RE	Product source code (RapidEye)

L: Width of field
 n1: total number of positions for characters and integers
 n1, n2: number of positions for numbers with decimal values
 n1 = total number of positions (excluding decimal point and sign)
 n2 = number of positions to the right of the decimal point

T: Type of attribute
 C: character
 I: Integer
 N: numeric with decimals.

Pre.: Presence
 Mand: mandatory
 Opt: optional

Reference	Description
Primary forest road (02100001001)	These roads are the main permanent roads accessing the forest. In some cases, the pavement may be asphalted, but they are generally covered with a 30 cm thick layer of gravel.
Secondary forest road (02100001002)	These roads are drivable, but heavy vehicles must slow down due to the narrow lanes and sharp curves.
Tertiary forest road (02100001003)	These roads are drivable, but traffic is slow. Two vehicles pass one another with difficulty.
Winter road (02100001004)	These roads, which can only be driven on in winter, are rudimentary and do not generally have any significant infrastructure.
Non-passable path (02100003002)	Roads that are not accessible for a motor vehicle, either because they have been abandoned or as a result of a bridge that has not been maintained.





**Forêts, Faune
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