Keeyask Generation Project

Environmental Impact Statement

Supporting Volume

Physical Environment

Hydropower Limited Partnership

June 2012

DATA SOURCE:
Province of Manitoba, Manitoba Hydro, Stantec Consulting Ltd., NTS, Natural Resources Canada.

CREATED BY:
Stantec Consulting Ltd.

COORDINATE SYSTEM:	DATE CREATED:	REVISION DATE:
UTM NAD 1983 Z15N	13-JAN-11	10-FEB-12
0 4 8 Kilometres / 0 3 6 Miles	VERSION NO: 1.0	QA/QC: APPROVED

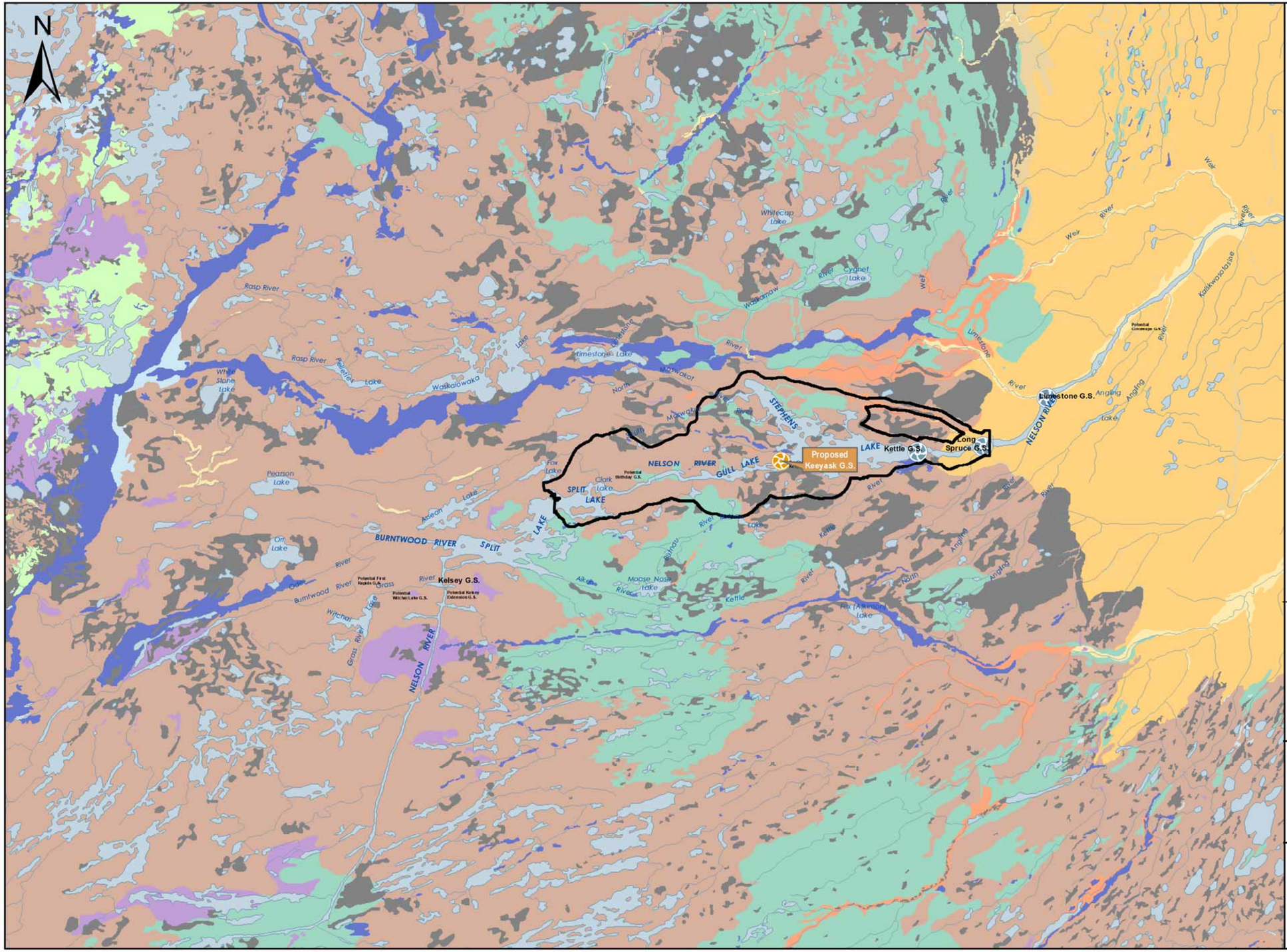
KEEYASK Hydropower Limited Partnership

Legend

- Generating Station (Planned)
- Project Footprint and Surrounding Areas (intensely studied)
- Local Study Area
- Regional Study Area
- Ecozone
- Waterbody

Local and Regional Physiography Study Areas

Map 5.2-1



Legend

Study Areas

- Local Study Area

Soil Parent Material

- Organic Deposits
- Shoreline Sediments
- Colluvium
- Eolian
- Alluvial Sediments
- Marginal Glaciomarine Sediments
- Offshore Glaciomarine Sediments
- Marginal Glaciolacustrine Sediments
- Offshore Glaciolacustrine Sediments
- Distal Glaciofluvial Sediments
- Proximal Glacialfluvial Sediments
- Clay Diamict
- Silt Diamict
- Sand Diamict
- Mesozoic Terrane
- Paleozoic Terrane
- Precambrian Terrane

Generating Stations

- Existing G.S.
- Planned G.S.

Projection: NAD 83, UTM Zn 15N
Data Source: Surficial Geology of Manitoba (Manitoba Geological Survey), Manitoba Hydro, ECOSTEM Ltd.

0 10 20 40 km
0 5 10 20 30 mi

Surface Material Deposition Mode

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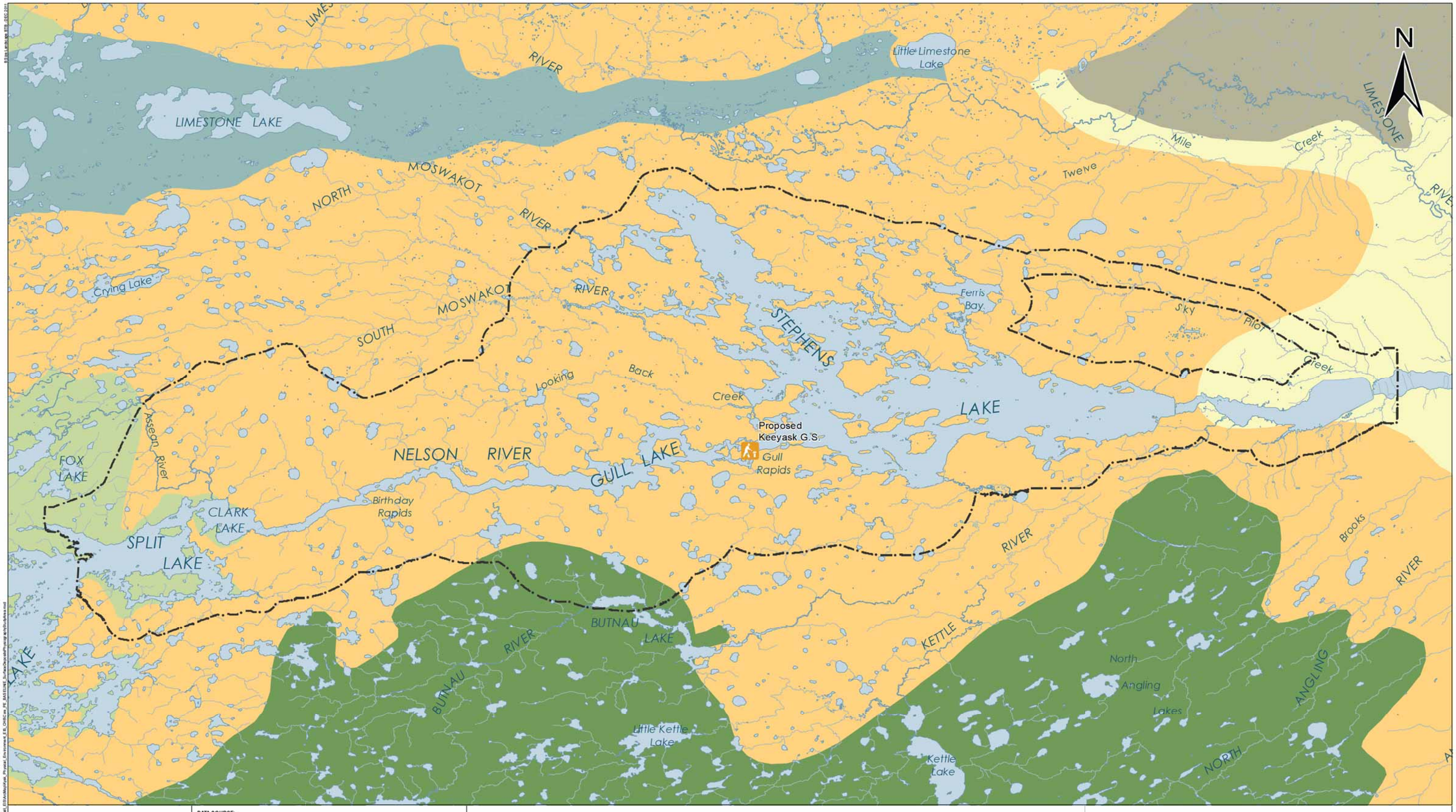
Map 5.3-1



DATA SOURCE:
Province of Manitoba, Manitoba Hydro, Stantec, Consulting Ltd., NTS, Natural Resources Canada, Soil Landscapes of Canada (Version 2.2), Agriculture and Agrifood Canada, ECOSTEM.

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0 3 6 Kilometres / 0 3 6 Miles	VERSION NO: 1.0	QA/QC: APPROVED JD/ZZZ

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Hydropower Limited Partnership

Legend

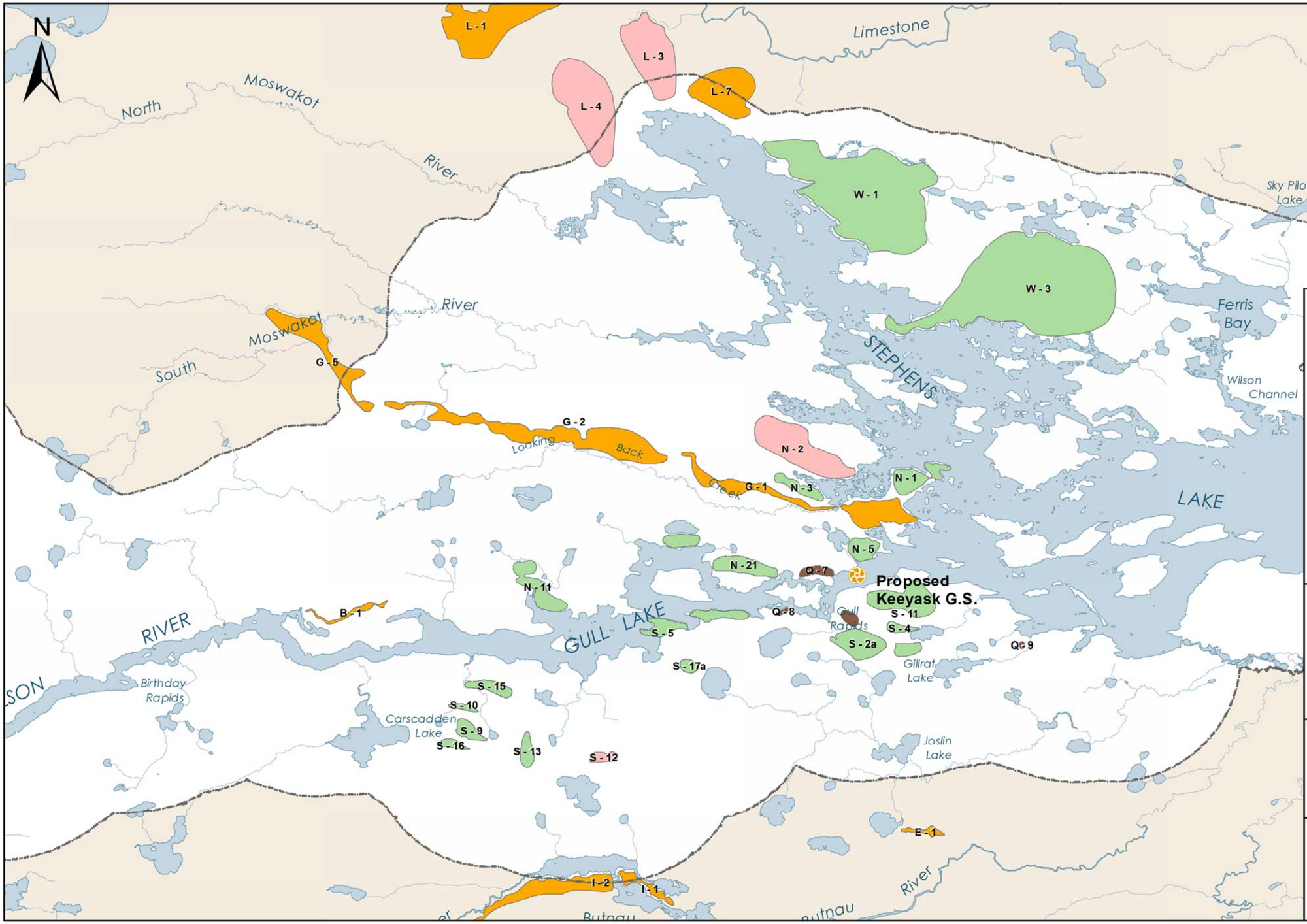
- Generating Station (Planned)
- Local Study Area
- Waterbody

Soil Parent Material

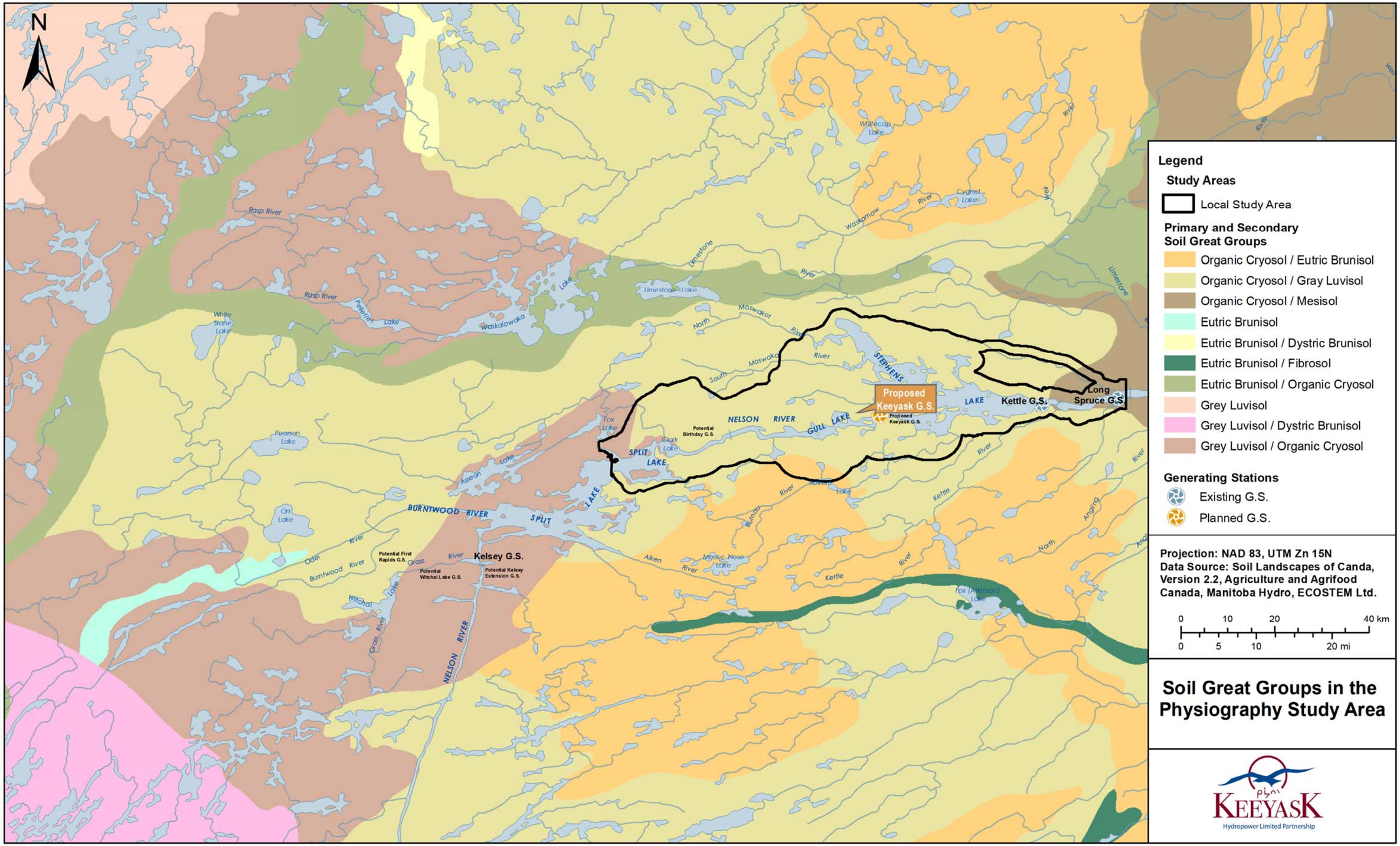
- Fluvioglacial
- Lacustrine
- Lacustrine - Mesic Woody Forest
- Morainal
- Mesic Woody Forest
- Mesic Woody Forest - Morainal
- Mesic Woody Forest - Lacustrine
- Mesic Woody Forest - Mesic Sedge

Surface Deposits in the Physiography Study Area

Map 5.3-2


N
North Moswakot River
South Moswakot River
Limestone
Twelve
Sky Pilot Lake
Ferris Bay
Wilson Channel
STEPHENS LAKE
GULL LAKE
RIVER
Looking Back Creek
Gull Rapids
Gillrat Lake
Joslin Lake
Carscadden Lake
Birthday Rapids
Butnau River
L - 1
L - 3
L - 4
L - 7
W - 1
W - 3
G - 5
G - 2
G - 1
N - 2
N - 3
N - 1
N - 5
N - 21
Q - 7
Q - 8
Q - 9
Proposed Keeyask G.S.
S - 11
S - 4
S - 2a
S - 5
S - 17a
N - 11
B - 1
S - 15
S - 10
S - 9
S - 16
S - 13
S - 12
I - 2
I - 1
E - 1
Legend
Study Areas
Local Study Area
Borrow Deposits
Granular
Impervious
Non Viable Source
Rock
Generating Stations
Existing G.S.
Planned G.S.
Projection: NAD 83, UTM Zn 15N
Data Source: Manitoba Hydro, ECOSTEM Ltd., NTS
0 1 2 4 km
0 0.5 1 2 mi
Borrow Material Deposits
KEEYASK
Hydropower Limited Partnership

Map 5.3-3



Soil Great Groups in the Physiography Study Area

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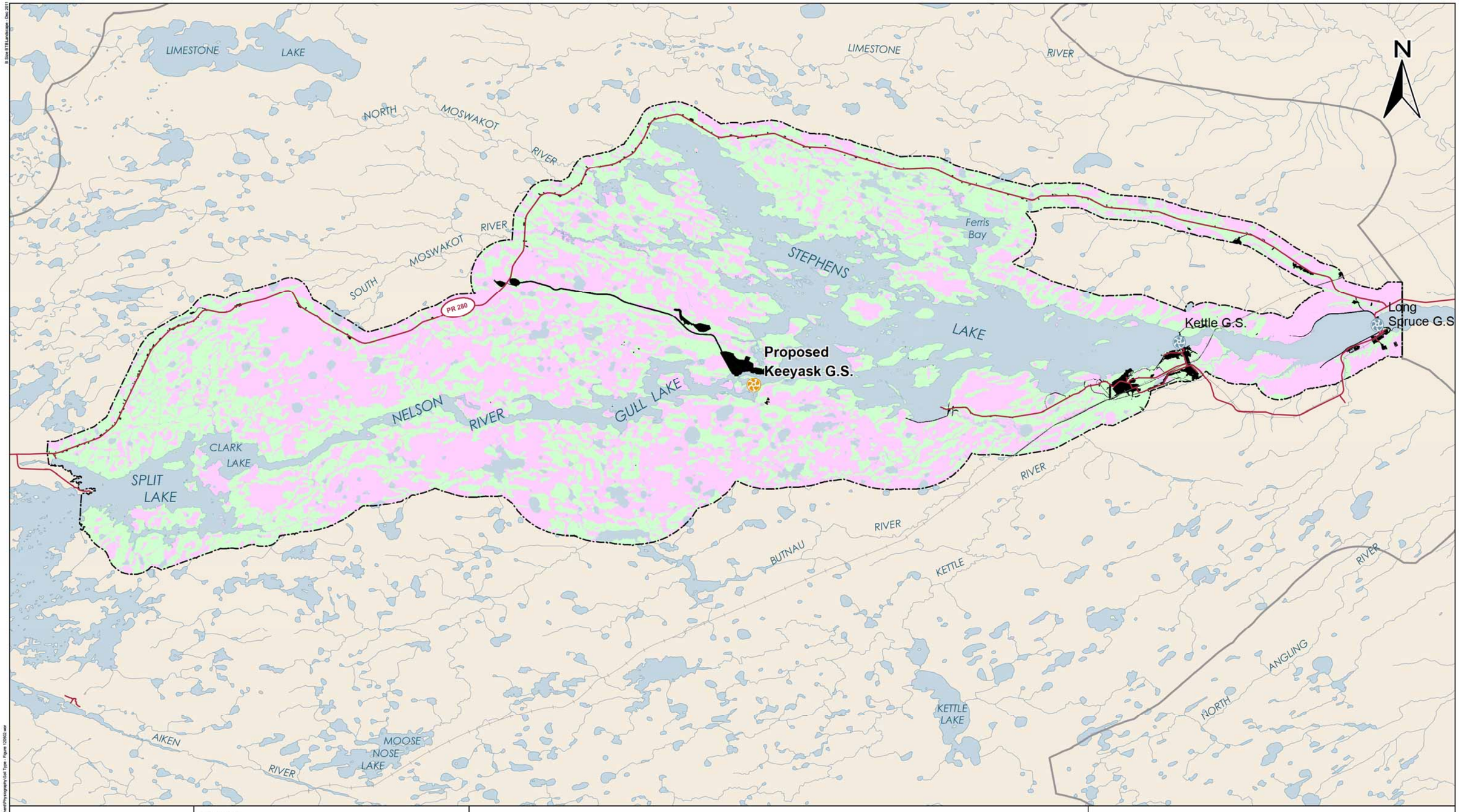
Map 5.3-4



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DATA SOURCE:
Study areas, soil data and Nelson River shoreline - ECOSTEM Ltd.; Water - NTS; Roads and rail - Manitoba Conservation.

CREATED BY:
ECOSTEM Ltd.

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0 4 8 Kilometres / 0 2 4 Miles	VERSION NO: 1.0	QA/QC: APPROVED

Legend

Soil Type

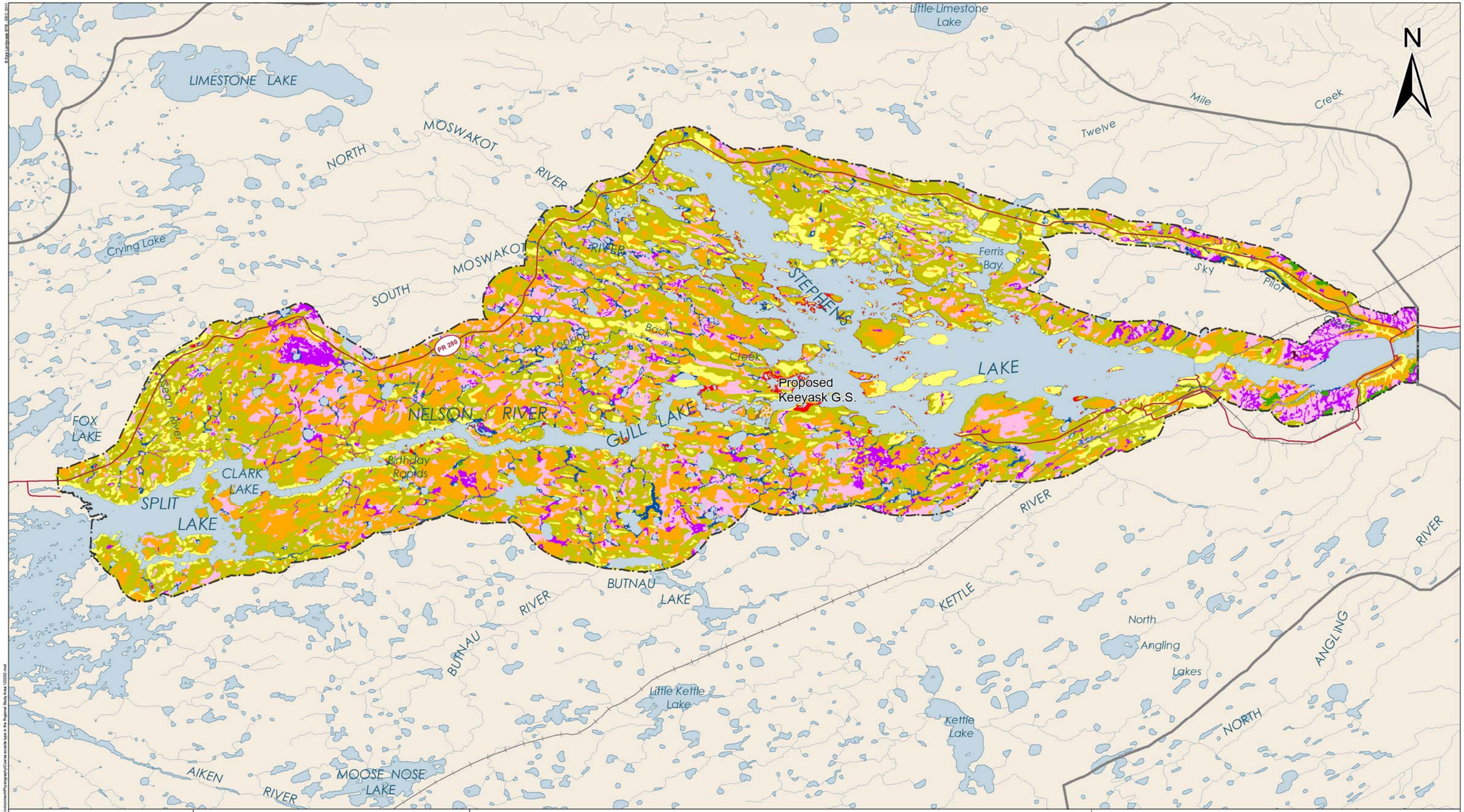
- Non-soil
- Mineral or Thin Peatland
- Peatland
- Water

- Physiography Local Study Area
- Physiography Regional Study Area

Soil Type

Map 5.3-5

File Location: Z:\Workspaces\Keeyask GIS\EISFigures\Physical Environment\Physiography\Soil Type - Figure 100502.mxd



DATA SOURCE:
Study areas, ecosite data and Nelson River shoreline - ECOSTEM Ltd.; Water - NTS; Infrastructure - Manitoba Hydro; Roads and rail - Manitoba Conservation.

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ECOSTEM Ltd.

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0 2 4 Kilometres / 0 2.5 5 Miles	VERSION NO: 1.0	QA/QC: APPROVED

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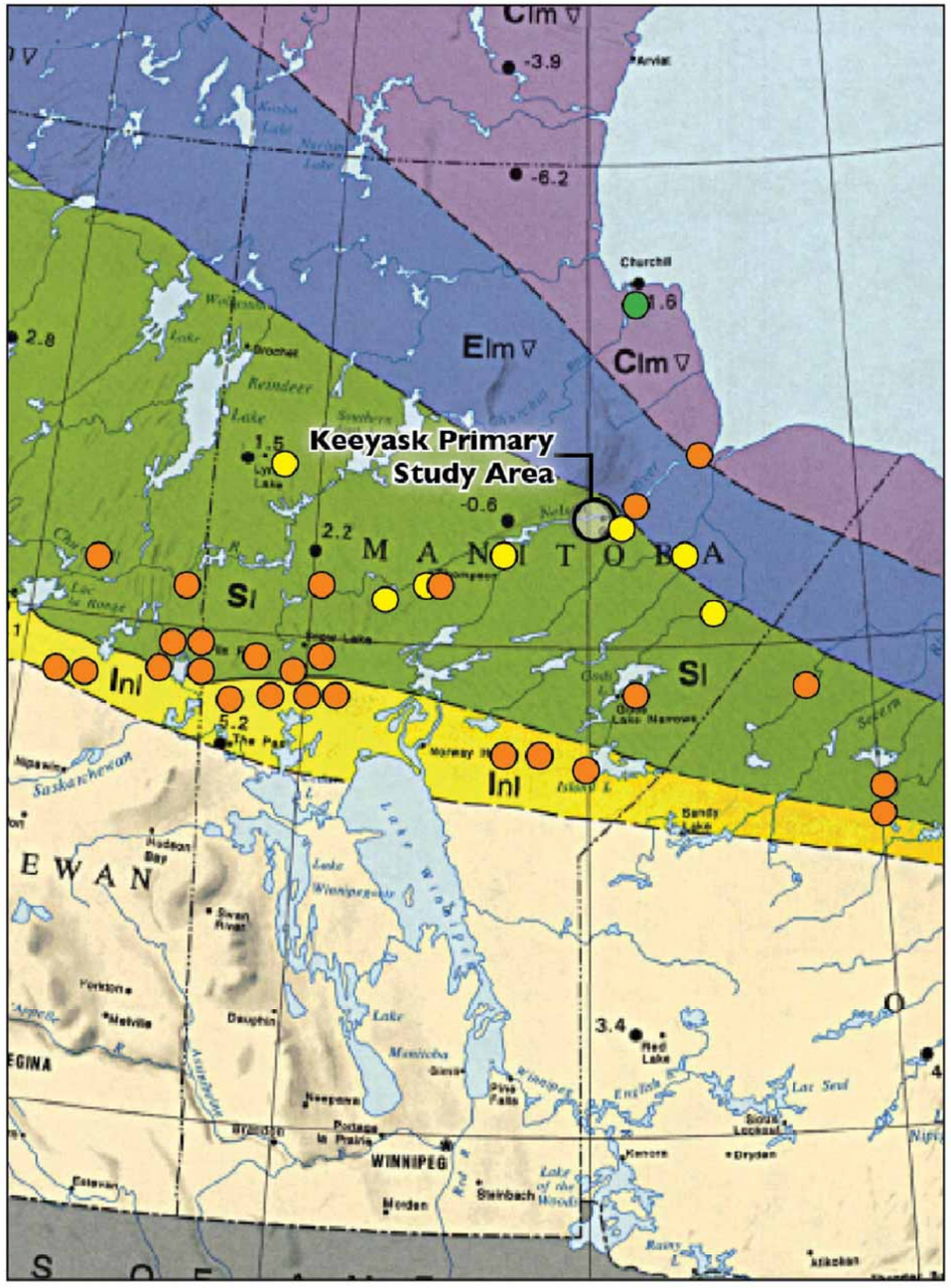
Legend

Coarse Ecosite
- Mineral
- Thin Peatland
- Shallow Peatland
- Ground Ice Peatland
- Permafrost Peatland - Other
- Deep Peatland
- Wet Deep Peatland
- Riparian Peatland
- Ice Scour - Mineral
- Shoreline Wetland
- Waterbody

- Physiography Local Study Area
- Physiography Regional Study Area

Coarse Ecosite
in the Physiography Local Study Area

Map 5.3-6



PERMAFROST AND GROUND ICE

Extent of permafrost (% of land area underlain by permafrost)	Ground ice content in the upper 10-20 m of the ground (% by volume of visible ice). Includes segregated ice, intrusive ice, reticulate ice veins, ice crystals and ice coatings on soil particles						
	High (>20%)		Medium (10-20%)		Low (<10%)		Nil (0%)
Continuous Permafrost (90-100%)	Ch	Cmh	Cm	Clm	Cl		
Extensive Discontinuous Permafrost (50-90%)			Em	Elm	El	Enl	
Sporadic Discontinuous Permafrost (10-50%)				Slm	Sl	Snl	
Isolated Patches (0-10%)				Ilm	Il	Inl	In
No Permafrost (0%)							
Subsea Permafrost				Olm			

Boundaries of permafrost and ground ice units
- Defined (derived from physiographic boundaries, after Bostock, 1970)
- Gradational or estimated (derived in part from permafrost zone boundaries, after Brown, 1978)

General distribution of known occurrences of large bodies of ground ice
- Ice wedges (abundant, sparse)
- Massive ice bodies (abundant, sparse)
- Pingo ice (abundant, sparse)

Permafrost temperature (°C)
- -3.0 Mean annual ground temperature at base of the layer of annual temperature fluctuations

Permafrost thickness (m)
- 100 Measured or interpolated
- (120) Extrapolated or calculated
- 140/175 Range of thickness in nearby boreholes
- 600 Thickness of subsea permafrost

Glaciers

EXPLANATION OF LEGEND

Variations in the extent of permafrost are shown by colours (hues). Variations in the amount of ground ice are shown by colour intensity and, for the large bodies of ground ice, by symbols. Letter codes assist in determining to which basic permafrost and ground ice class any particular unit belongs. The symbols for the large bodies of ground ice are an essential component of the definition of the map units. For example,

Elm ▽ ▰

indicates a unit underlain by extensive discontinuous permafrost with low to moderate ice content, and characterized by sparse ice wedges, no massive ground ice, but abundant pingo ice.

Research by J. A. Heginbottom, Terrain Sciences Division, Geological Survey of Canada, Natural Resources Canada. Additional research and adaptation for the National Atlas of Canada by M. A. Dutzeuil and P. T. Harker, National Atlas Information Service. Geomatics Canada, Natural Resources Canada. Cartography and production support by A. Caron, F. Paul and I. Rose, National Atlas Information Service.

Permafrost Extent Source: National Atlas Information Service, Canada Centre for Mapping, Geomatics Canada, and Terrain Sciences Division , Geological Survey of Canada, Natural Resources Canada. Printed 1995

Permafrost Thickness (m)

- 50-100
- 10-50
- <10

Permafrost Thickness Source: Natural Resources Canada. Geological Survey Canada 2006

KEEYASK Hydropower Limited Partnership

DATA SOURCE:
Natural Resources Canada - Geological Survey of Canada
Printed in 1995, accessed in 2006

Note: Map scale may not be accurate

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0 80 160 Kilometres / 0 60 120 Miles	VERSION NO: 1.0	QA/QC: APPROVED

Permafrost Thickness and Distribution in Manitoba

Map 5.3-7