Local Biophysical Mapping for Integrated Resource Management, Watson Lake Area (NTS 105A/2)

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YUKON GEOLOGICAL SURVEY

Indian and Northern Affairs Canada | Affaires indiennes et du Nord Canada
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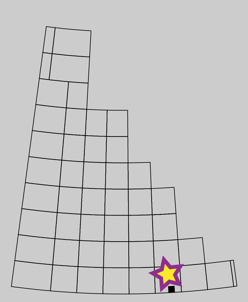
Background

Biophysical or ecosystem mapping is an integrated system of mapping which combines terrain conditions (surfical geology, slope, drainage and permafrost conditions) with ecological values (vegetation communities and ecological moisture and nutrient regimes).

Resource decisions are imminent in southeast Yukon (Figure 1) as it is being considered for forestry, pipeline and railroad development, mineral exploration and oil and gas dispositions.



Integrated resource management involves balancing these development pressures with wildlife management, conservation efforts, First Nations values and effective land use planning in the area. Biophysical maps serve as an essential tool for achieving this.

Figure 1. Location of study area.

Goals and Outcomes

- To document the biophysical mapping process for future project proponents by conducting a pilot project in an area of imminent resource decisions. (See Open File report 2005-6).
- To develop a methodology for digital air photo interpretation using soft copy stereo air photos.
- To develop a surficial geology data model and digital mapping standards for YGS.
- To develop a local scale ecological classification system for southeast Yukon. (See Open File 2005-8 biophysical map).
- To publish a surficial geology map, biophysical map and supporting GIS data. (See Open File maps and report/CD).
- To outline some practical applications of biophysical mapping.

Acknowledgements

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Methodology

- Terrain and ecosystem units were interpreted using 1998/1999 1:40 000 scale hard copy air photos, following the BC terrain classification system (Howes & Kenk, 1997) and the most current ecosystem classification guide for the area (Grods, 2005) (Fig. 3).
- Site characteristics, surficial geology, soils and vegetation communities were documented at over 200 sites to ground truth air photo interpretation.
- Surfical geology and ecosystem map units were modified to fit local field observations. A new ecosystem classification system was devised.
- Revised map units were digitized using digital stereo interpretation of high-resolution scanned air photos in MicroStation DIAP Viewer (Figure 2).

Figure 2. MicroStation DIAP Viewer stereoscopic glasses and work station for digital air photo interpretation.

- Final GIS manipulation and Open File maps were produced using ArcGIS 9.0.

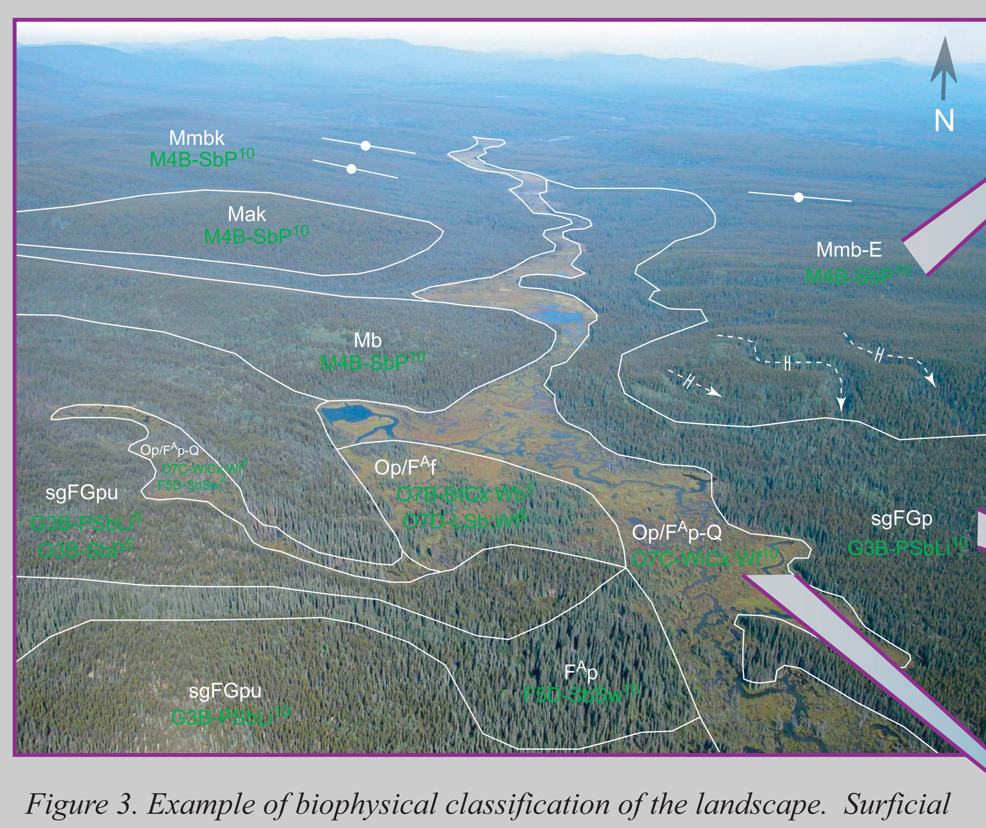

Figure 3. Example of biophysical classification of the landscape. Surficial geology is labelled in white; associated ecosystem units are labelled in green. Typical site conditions for selected units are described to the right. Dotted arrows trace former glacial meltwater channels. Lines with single dots are drumlins indicating direction (east) of ice-flow during last glaciation.

Further Information

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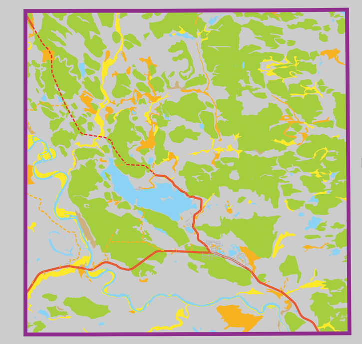

A - Preliminary map of potential granular resources, based on terrain and surficial material criteria listed below:

- fluvial and glaciofluvial deposits
- talus slopes
- colluvial fans
- till blankets or (rolling) plains
- topography < 25°
- no gullying or mass movements

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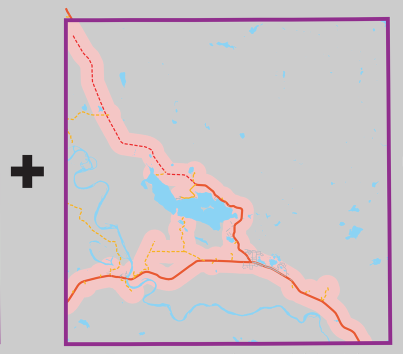

B - Restrict search to within 1 km of existing road network.

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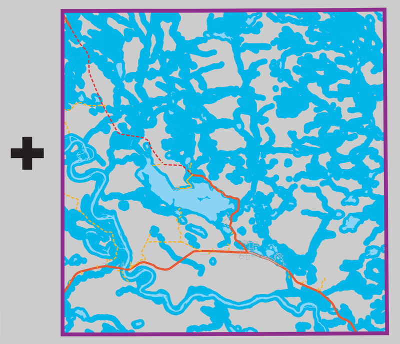

C - Eliminate areas within 250 m of wetlands, lakes or water courses.

LEGEND
- exisiting gravel pits
- 1 km buffer around existing road network
- 250 m buffers around lakes, wetlands and watercourses

Granular resource potential
- till (good low permeability bulk fill material)
- colluvium (possible subgrade material)
- active fluvial deposits (possible aggregate material)
- fluvial / glaciofluvial deposits (good aggregate material)

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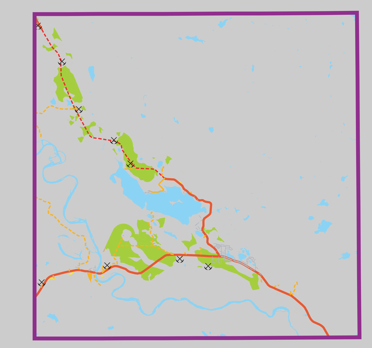


D - Final map of potential granular resources.

Figure 4. Example of basic search for granular resources based on terrain and surficial material properties, proximity to wetlands and waterbodies and proximity to existing infrastructure.

Table 1. Geotechnical land use suitability ratings and potential hazards of various surficial materials.
(based on Ryder and Howes, 1986)

Surficial Material	Map Unit	Constraints	Potential Hazards	Light Found-ations	Heavy Found-ations	Exca-vations	Liquid Waste Disposal	Solid Waste Disposal	Highways Railroads Airfields	Unpaved Roads	Above Ground Water storage
Colluvial	C	slope drainage topography	landslides	2	3	2	3	3	3	2	3
Eolian	E			1	3	1	2	3	1	1	3
Fluvial – active	F^A	drainage	floods, shifting channels	3	3	1	3	3	1	1	2
Fluvial – inactive	F^I			1	1	1	2	3	1	1	3
Glaciofluvial	F^G	topography		1	1	1	2	3	1	1	3
Glaciolacustrine	L^G	drainage	erosion, slumping	1	3	1	2	1	2	1	2
Lacustrine	L	topography	permafrost, thermokarst	1	3	1	2	1	2	1	2
Organic	O	drainage		3	3	3					
Till – basal	M	drainage		1	1	2	2	1	1	1	1
Till - ablation	M	topography		1	1	1	2	3	1	1	3
Bedrock	R			1	1	3	3	3	3	3	3

1 = **Desirable**: terrain is generally capable of supporting the indicated land use.
2 = **Possible problems**: terrain may be suitable for the indicated land use, but potential problems exist.
3 = **Undesirable**: terrain is generally unsuitable for the indicated land use, although substantial modification of existing conditions (e.g., drainage, landfill) may overcome natural constraints.

Mmb-E *(rolling/fluted till blanket, cut by meltwater channels)*

M4B-SbP *(morainal parent material: black spruce – pine)*

Site: mesic moisture; submesotrophic (poor) nutrient regime; moderate to rapidly drained; level to moderately steep slopes; variable aspects

Soils: Orthic and Eluviated Eutric and Dystric Brunisols and Humo-Ferric Podzols in till

Vegetation: black spruce, lodgepole pine, alder, Labrador tea, shrub birch, tall blueberry, lowbush cranberry, bunchberry, northern comandra; step moss, red-stemmed moss, knight's plume

sgFGpu *(undulating plain of glaciofluvial sandy gravel)*

G3B-PSbLi *(glaciofluvial parent material: pine - black spruce – lichen)*

Site: submesic moisture; submesotrophic (poor) nutrient regime; level plains; well to rapidly drained

Soils: generally sandy Orthic or Eluviated Eutric Brunisols in glaciofluvial deposits

Vegetation: lodgepole pine, black spruce, white spruce; Labrador tea; northern comandra, lodgepole pine; kinnickinnick, lowbush cranberry, twinflower; lichen cover >25%; redstemmed moss, stepmoss

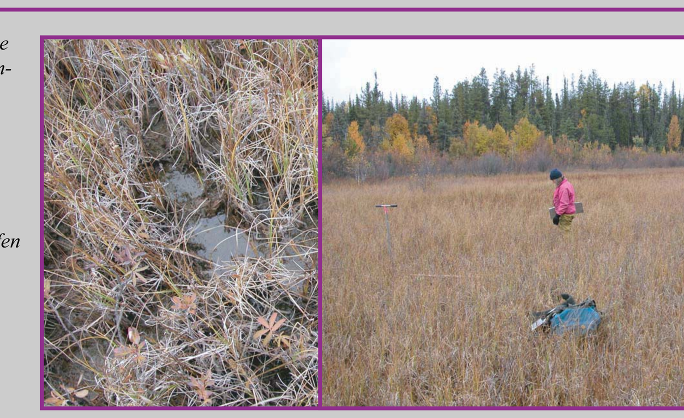
Op/F^Ap-Q *(organic plain with lesser active floodplain deposits modified by beaver damming)*

O7C-WiCx:Wf *(organic parent material: willow - sedge - fen wetland)*

Site: subhydric moisture; mesotrophic (medium) nutrient regime; poorly drained fen wetlands

Soils: likely Typic Fibrisols or Mesisols in organic surficial deposits

Vegetation: willow, sedge, Scheuchzeria, Sphagnum, mosses



Practical Applications

Geotechnical assessments - the surficial geology map allows analysis of material properties (textures and geomorphological processes) and terrain topography to support preliminary geotechnical assessments of:

- granular resources (e.g. Figure 4)
- land use planning (e.g. Table 1)
- terrain hazards and stability
- soil erosion potential
- permafrost conditions
- infrastructure routing

Mineral exploration - the surficial geology map also outlines areas of bedrock outcrop; locations of till blankets and plains suitable for till geochemistry sampling; and ice-flow directions useful for planning drift prospecting programs.

Forest management
Timber resources and seral targets can be defined by identifying tree species found in nutrient-rich environments, within desired successional stages.

Silvicultural planners can identify areas with nutrient and moisture regimes optimal for highly productive forest regeneration.

Road access, cutblock layout and logging methods can be easily planned to avoid unstable terrain and sensitive wildlife habitat.

Wildlife management
Habitat capability/suitability can be modelled based on vegetation species, nutrient and moisture regimes and terrain attributes that are optimal for seasonal diet, shelter and security.

Ecosystems used by various species can be identified based on exisiting tracking data. Upscaling or extrapolation to potential use in other areas can then be made to delineate wildlife use corridors.

Wildlife studies currently underway in Watson Lake can use biophysical data to select ecological monitoring sites for baseline data collection; characterize migratory bird habitat; and model marten habitat in support of local traditional trapping lifestyles.

Conservation - the biophysical map is an essential tool for delineating riparian and wetland buffers and identifying rare and special ecosystems.

First Nations lands - the biophysical map can be used to characterize first nations lands and identify ecosystems important for past and present traditional use.

References

Grods, J., 2005 (unpublished). The other southeast Yukon ecosystem classification field guide (7/8 approximation) 2nd Draft. Currently in preparation by Makonis Consulting Ltd, Kelowna, BC.

Ryder, J.M. and Howes, D.E., 1986. Terrain information: a user's guide to terrain maps in British Columbia. Government of British Columbia.

Howes, D.E. and Kenk, E., 1997. Terrain classification system for British Columbia (version 2). Province of British Columbia, Resource Inventory Branch, Ministry of Environment, Lands and Parks; Recreational Fisheries Branch, Ministry of Environment; and Surveys and Mapping Branch, Ministry of Crown Lands.

Lipovsky, P.S. and McKenna, K., 2005. Local-scale biophysical mapping for integrated resource management, Watson Lake area (NTS 105A/2), Yukon. Yukon Geological Survey, Open File 2005-6, report and CD-ROM, 74 p.

Lipovsky, P.S., McKenna, K. and Huscroft, C.A., 2005. Surficial geology of Watson Lake area (NTS 105A/2), Yukon (1: 50 000 scale). Yukon Geological Survey, Open File 2005-7.

McKenna, K., and Lipovsky, P.S., 2005. Biophysical map of Watson Lake area (NTS 105A/2), Yukon (1: 50 000 scale). Yukon Geological Survey, Open File 2005-8.