KLONDIKE
PLATEAU
(YUKON
PLATEAU)
TINTINA
TRENCH
KLONDIKE
HILLS
YUKON RIVER
Jëjik dhä dënezhu kek'it (Moosehide Village)
Edhä dähecha (Moosehide slide)
Tr'ochëk (Klondike City/Lousetown)
Chu kon' dëk (Yukon River)
Dawson City
Dog Island
Sister Island
MIDNIGHT DOME
KLONDIKE
RIVER
HUNKER
CREEK
BONANZA
NORTH KLONDIKE RIVER
Rock Creek
AUSTRALIAN HILL
DAGO HILL
PREIDO HILL
LOVETT HILL
CRIPPLE HILL
Moosehide Creek
Thirteen Gulch
Fireman Gulch
Benson Creek
Dawson Creek
Thomas Gulch
Wood Gulch
Bear Creek
Falconer Gulch
Examiner Gulch
Jackson Gulch
Lovett Gulch
Quigley Gulch
Cripple Gulch
Sourdough Gulch
Seventy Seven Pup
Pure Gold Gulch
Discovery Pup
Bryant Creek
Sawmill Gulch
Dion Creek
Shovel Creek
Bradley Creek
Coal Creek
Foster Gulch
Rabbit Gulch
Hattie Gulch
Bordeau Gulch
Henry Gulch
Eight Above Pup
Tinhorn Gulch
Germaine Creek
Goring Creek
Leroy Creek
Gilcher Creek
Dognose Creek
Linda Creek
Leotta Creek
Gold Creek
Too Much Gold Creek
Isaacs Gulch
Flat Creek
Ditch
139°35'W
139°30'W
139°25'W
139°20'W
139°15'W
139°10'W
139°5'W
139°0'W
138°55'W
138°50'W
138°45'W
138°40'W
138°35'W
138°30'W
64°5'N
64°0'N

LEGEND

GROUND OBSERVATION SITES

⊕ geological field station
⊙ permafrost borehole
✚ electrical resistivity tomography (ERT) profile station

GEOLOGICAL FEATURES

collapsed open system pingo
thermokarst pond

landslide escarpment
direction of landslide movement

TOPOGRAPHIC FEATURES

roads
trails
transmission line
limit of mapping

contours
streams

waterbodies

wetlands

HAZARD CLASSIFICATIONS

🟩 **Low risk**. Characterized by flat to gently sloped terrain, with south and west-facing slopes. Low-risk terrain is found above modern floodplains, and is often comprised of well-drained gravel or weathered bedrock surface materials. Low-risk terrain may contain permafrost, but is less likely to be ice rich compared with more hazardous terrain.

🟨 **Moderate risk**. Characterized by gentle to moderate slopes, and occurs more commonly on west and south-facing slopes. Moderate-risk terrain is found on the steep edges and cold aspects of low-risk landforms (*i.e.* fluvial terraces and north-facing, high-elevation slopes). Moderate-risk terrain also occurs in coarse-grained (gravel) surficial materials that may be affected by ice-rich permafrost (*i.e.* downtown Dawson).

🟧 **Moderately high risk**. Characterized by moderate to steep slopes, and east to north-facing slopes. Moderately high-risk terrain is found on all aspects in the study area and is common in narrow, steep-sided valleys and on more gentle slopes where permafrost is more likely to be present. The difference between moderate and moderately high-risk terrain in the study area is often based on changes in slope angle and slope aspect.

🟥 **High risk**. Characterized by moderate to steep slopes and coldest east and north-facing slopes. Much of the high-risk terrain in the study area is defined by geological boundaries containing high-hazard processes such as landslides, thermokarst, and active floodplains that may be subject to flooding. High-risk terrain in the study area occurs in valley bottoms (flood risk and high permafrost probabilities), on steep north-facing valley slopes, and where landslide processes have affected large areas of terrain (*i.e.* landslides on the north side of the Klondike Valley).

METHODS

This map was produced for the purposes of community landscape hazard assessment and climate change adaptation planning for the Dawson region. An accompanying report provides additional detail on local surficial geology, stratigraphy, glacial history and landscape hazards (Benkert et al., 2015). The report is published by Yukon College's Northern Climate ExChange and is available for download at yukoncollege.yk.ca/research.

Landscape hazards for the Dawson region are modelled using a Geographic Information System (GIS) to generate an integrated risk ranking for each landscape 'unit' (defined by 30 m x 30 m pixels). Input data for the model include the following datasets: slope angle (steepness); slope aspect (directionality and exposure to sunlight); surface materials (derived from geological maps); and permafrost probability (see Benkert et al., 2015 for additional details).

Attributes of the individual datasets are classified on a 0-9 scale of potential risk, where zero represents low hazard risk and nine represents high hazard risk. High-risk areas include steep or unstable slopes, low-lying areas subject to flooding or inundation by water, and landscape units with a high likelihood of being affected by ice-rich or thaw-unstable permafrost. Low-risk areas are predicted to have favourable conditions for landscape development and include well-drained soils, gentle or moderate slopes, and a low likelihood of containing ice-rich or thaw-unstable permafrost.

Each of the input datasets is assigned a unique weighting value in the model that reflects the degree to which they control cumulative hazard risk. For this model, slope angle was given a weighting of 10%. Slope aspect was also given a weighting of 10%. Surface materials have a significant impact on landscape stability, and this input dataset was given a weighting of 50%. The likelihood of permafrost occurring on the landscape was given a relative weighting of 30% in the model (recognizing that slope aspect also contributes to permafrost presence).

Cumulative Ranking = 0.1(slope angle) + 0.1(slope aspect) + 0.5(materials) + 0.3(probability of permafrost)

By combining the individual rankings of each input raster according to their unique weighting, a cumulative risk ranking for each pixel in the map area is generated. Risk rankings range from 0 (low) to 9 (high). The cumulative rankings are reclassified into four categories (Low, Moderate, Moderately High and High) that represent potential hazard risk due to permafrost, slope stability, and flooding in the map area. The model represents current conditions, and does not integrate any potential changes to landscape stability associated with a changing climate.

LIMITATIONS TO THE MAP

The Dawson hazards map is meant to be used as a preliminary assessment of potential ground conditions in the study area, and does not replace detailed on-site investigations. Cumulative hazard rankings are highly dependent on rankings assigned to surface material units, and both the boundaries of the units and the materials assigned to those units are highly subjective and based on limited field checking conducted during surficial geological mapping studies (see map by McKenna and Lipovsky (2014) in Benkert et al., 2015 for more detail).

Additionally, flood hazard mapping does not yet exist for the study area and flood potential is based on geological units mapped as active floodplains or as being subject to periodic inundation. These units likely represent areas that are subject to regular annual or decadal flooding, but are unlikely to represent the highest and most catastrophic floods with lower recurrence intervals. See Figures 10 and 11 in Benkert et al. (2015) for preliminary flood risk mapping. (Note: this mapping has not been integrated into the hazard risk assessment presented here.)

Finally, the resolution of this map is limited by the 30 m x 30 m pixel size used to calculate slope, aspect, and permafrost probability, and the 1:25 000-scale mapping used to identify surficial materials and landforms. Local variations in all model inputs should be expected, and will be more pronounced for surface materials and permafrost probability.

It is important to note that cumulative hazard rankings are based on general observations of surface materials, drainage, slope angle, vegetation and the presence of permafrost landforms, as well as subsurface information provided by ERT and GPR profiles, drilling and probing of permafrost, and textural analyses of surficial and borehole samples. This has resulted in a projected risk ranking that will require geotechnical and/or engineering analyses to quantify.

RECOMMENDED CITATION

Benkert B.E., Kennedy, K., Fortier, D., Lewkowicz, A.G., Roy, L.-P., Grandmont, K., de Grandpré, I., Laxton, S., McKenna, K., Moote, K., Bond, J., 2015. Dawson City Landscape Hazards: Geoscience Mapping for Climate Change Adaptation Planning. Northern Climate ExChange, Yukon Research Centre, Yukon College. 166 p and 2 maps.

Digital cartography and risk modeling by K. Kennedy, B. Elliot and P. Lipovsky, Yukon Geological Survey.

A digital PDF (Portable Document Format) file of this map may be downloaded free of charge from the Yukon Research Centre by visiting yukoncollege.yk.ca/research or from the Yukon Geological Survey by visiting geology.gov.yk.ca.

TRONDËK HWËCH'IN HÄN NATION

THE CITY OF DAWSON Y.T. INCORPORATED JAN. 9, 1902

uOttawa

Northern Climate ExChange
YUKON RESEARCH CENTRE • Yukon College

Aboriginal Affairs and Northern Development Canada
Affaires autochtones et Développement du Nord Canada

YUKON GEOLOGICAL SURVEY

Université de Montréal

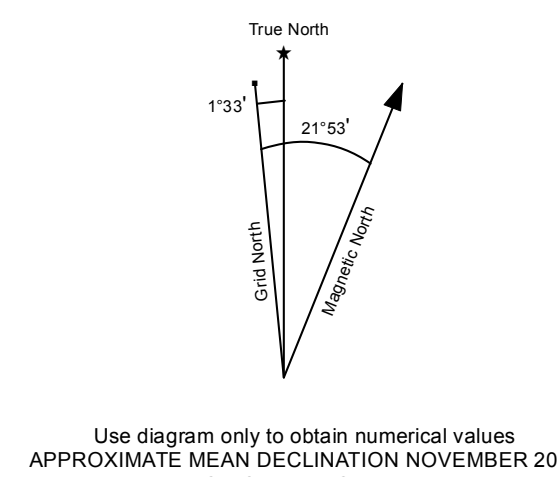
LANDSCAPE HAZARD RISK

DAWSON REGION, YUKON TERRITORY

PARTS OF NTS 115O/14 &15 and 116B/1, 2, 3 & 4

SCALE 1:25 000

0 0.5 1 2
kilometres



True North
1°33'
21°53'
Grid North
Magnetic North

Use diagram only to obtain numerical values
APPROXIMATE MEAN DECLINATION NOVEMBER 2011
FOR CENTRE OF MAP

1:50 000 scale topographic base data produced by
CENTRE FOR TOPOGRAPHIC INFORMATION,
NATURAL RESOURCES CANADA

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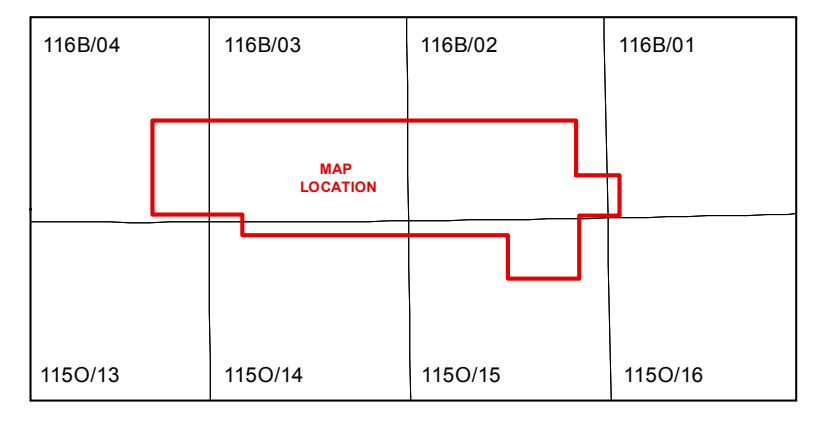
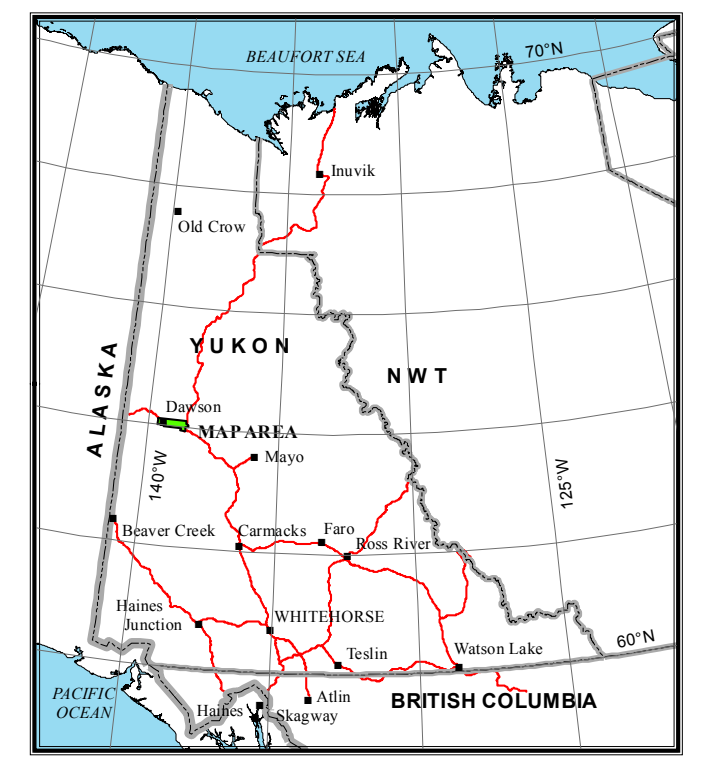
ONE THOUSAND METRE GRID
Universal Transverse Mercator Projection
North American Datum 1983
Zone 7

CONTOUR INTERVAL 20 METRES
Elevations in metres above Mean Sea Level



116B/04
116B/03
116B/02
116B/01
MAP LOCATION
115O/13
115O/14
115O/15
115O/16



BEAUFORT SEA
70°N
Inuvik
Old Crow
YUKON
NWT
ALASKA
Dawson
MAP AREA
Mayo
140°W
125°W
Beaver Creek
Carmacks
Faro
Ross River
Haines Junction
WHITEHORSE
Teslin
Watson Lake
60°N
PACIFIC OCEAN
Haines
Skagway
Atlin
BRITISH COLUMBIA