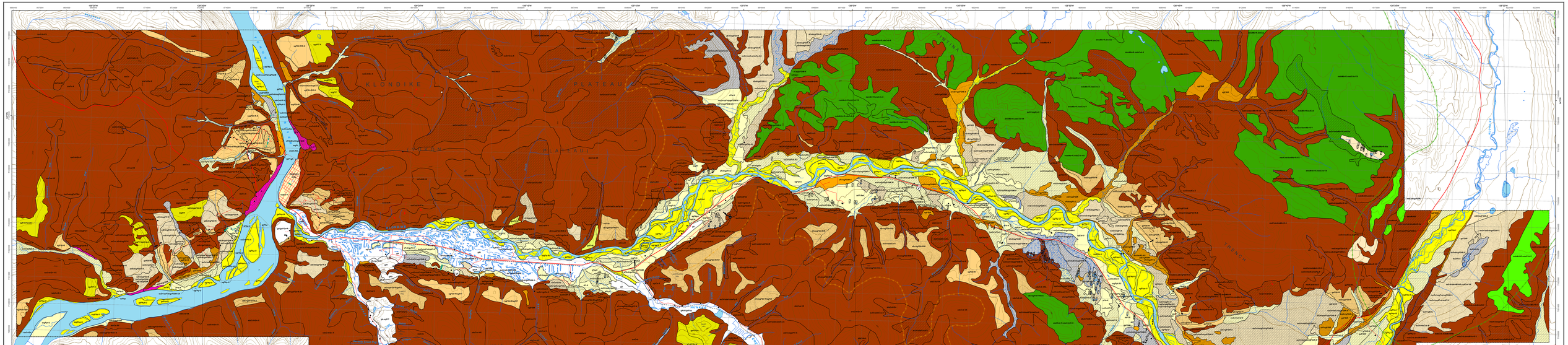

LEGEND

GROUND OBSERVATION SITES:

- field station
- stratigraphic section (labelled with site number)
- measured section
- electrical resistivity tomography (ERT) profile station

GEOLOGICAL FEATURES:

- collapsed open system pingo
- thermokarst pond
- geological boundary limit of mapping
- landslide escarpment direction of landslide movement

GLACIAL LIMITS:

- West (R), defined (after Duk-Rodkin, 1996)
- Pre-West (>R), assumed

TOPOGRAPHIC FEATURES:

- roads
- trails
- transmission line
- contours
- rivers
- waterbodies
- wetlands

116B/04	116B/03	116B/02	116B/01
	107 mile north		
116G/13	116G/14	116G/15	116G/16

SURFICIAL MATERIALS

Surficial materials are non-lithified, unconsolidated sediments. They are produced by weathering, sediment deposition, biological accumulation, and human activity. Surficial materials may be underlain by other surficial materials, or by bedrock. Surficial materials are the parent material of most pedological soils. Note that a single polygon will be coloured only by the dominant surficial material, but other materials may exist in that unit.

A	**Anthropogenic:** Surficial materials modified by human activities such that their original physical properties have been significantly altered. Generally applied to mine and dredge tailings within the map area.
O	**Organic:** Material derived from the accumulation of plant matter, generally consisting of peat with fibric to mesic decomposition. Organic materials cap most surficial materials in the map area and are usually associated with near-surface permafrost. Organic blankets (OI) greater than 1 m thick are commonly found on abandoned floodplains in old meander scars, in pockets on cool north-facing slopes, and in poorly drained depressions and flat areas. Organic veneers (Ov) less than 1 m thick are ubiquitous throughout the map area, however associated polygons are coloured according to the underlying material and organic veneers are represented by a cross-hatched pattern.
E	**Eolian:** Materials transported and deposited by wind. The dominant eolian sediment in the map area is loess, which is predominantly silt-sized sediment transported out of this land. Loess veneers (Ev) and blankets (EO) were deposited over the landscape during the last (McConnell) glaciation (Fraser and Burn, 1997). Ice-rich permafrost is commonly found in gently-sloping eolian blankets. On drier, steeper slopes, loess may be thin or absent, and may not be ice-rich. Ice-rich loess is susceptible to thaw settlement and thaw slumping. Loess is reworked into the soil profile and mixed with underlying sediments. In these cases, the presence of loess is indicated by the 'X' textural symbol. Reworkedmixed loess is a major component of colluvial aprons and fluvial fans in the map area. Where loess has been reworked by fluvial processes, it is coded as EFX, EFAX, or EFTX, depending on the landform. Loess is also a major component of terraces north of the mouth of the North Klondike River. Reworked loess is finer in texture and contains some clay which may be derived from upland till deposits; the texture of this loess is frequently mapped as mul (mx). Where the surface cover consists of an eolian veneer (Ev), it is represented by a dotted pattern and the associated polygon is coloured according to the underlying material.
Ex	
C	**Colluvium:** Material transported and deposited by down-slope, gravity-driven processes such as creep, solifluction, landslides, and rockfall. Colluvial materials are ubiquitous throughout the map area, and are thicker and more widespread than eolian veneers. The Yukon River as most of these areas escaped Pleistocene glaciation. It commonly has a stratified structure with a highly variable texture and composition controlled by the parent material, transport mechanism, and travel distance. Colluvium on uplands and slopes is frequently underlain by weathered bedrock or by a veneer of till and colluvium. Colluvial materials on lower slopes may be thicker and deeper deposits. Colluvium is generally coarser grained, as it has been deposited by rapid mass wasting processes such as rock fall, debris flows, and debris slides. Colluvial materials on upland slopes are finer grained than those on lower slopes, reflecting their composition with greater accumulations of loess and the presence of near-surface permafrost, result in finer grained colluvium. Colluvial materials on lower slopes are coarser grained, reflecting their composition of weathered bedrock, coarse-grained colluvial materials and peat (muck). North of the Klondike River, Pre-West morainal deposits have been extensively modified by slope movement (solifluction) and solifluction and are mapped as complexes of colluvial and morainal deposits.
CO	
F	**Fluvial:** Sediments transported and deposited by modern streams and rivers, found in floodplains, fans, and terraces. Fluvial materials may be subject to occasional flooding, sudden stream migration, and/or incision. Fluvial deposits typically consist of well-stratified sand and gravel, with variable amounts of silt and clay. Coarse-grained fluvial deposits are well drained, but fine-grained or poorly drained areas are confined to very narrow Holocene valleys and their fluvial deposits are generally not mapped due to scale limitations. Fluvial fans (FX), or complexes of coalescing fan-shaped landforms (Ff) are found at the mouths of tributary streams. Where fluvial fans are small, they are not mapped separately from the associated colluvial deposits. Fluvial terraces are mapped if they are derived from bases with minor gravels derived from colluvial or glaciofluvial materials. These fans, though still active, likely formed relatively quickly after the McConnell glaciation. They may be ice-rich and contain ice wedges, especially where they are north-facing. Fluvial terraces are composed of well-stratified sand and gravel, and are usually ice-poor.
FA	
F^{Pl}	**Pre-West Pluvial:** Intermediate and scenic gravel terraces are located near the mouths of West Dutch and Fraser Gulch.
F^{P}	
T	**Tertiary Fluvial:** sandy pebble and cobble gravel deposited by streams having a fluvial source but graded to the margins of pre-Reid glaciers or glacial drainage. thicknesss up to 40 m. The highest terraces along the south side of the Klondike River valley west of Hunker Creek consist of Tertiary gravels known as the White Channel gravels which are capped by Pre-Reid Klondike gravels.
T^{P}	
FO^{P}	**Glaciofluvial:** Sediments transported and deposited by glacial meltwater above, in, below, or adjacent to a glacier. Glaciofluvial materials are deposited in terraces and plains within the map area. Sediments consist of moderately to well-sorted, rounded, stratified sand and gravel. Glaciofluvial materials are well drained, and are usually ice-free. Ice-contact glaciofluvial deposits may be ice-rich and present in glaciofluvial deposits, especially near the edges of terraces where there is less than 20 cm of silty loess and organic material cover.
FO^{Pl}	
FO^{P}	McConnell (late Wisconsinlate Pleistocene) glaciofluvial deposits are expressed as the lowest terraces above the recent (Holocene) fluvial sediments. They are found along the Klondike and Yukon rivers and are commonly covered by a veneer of organic deposits.
FO^{Pl}	Reid (Illinoian) glaciofluvial terraces are found below the McConnell terraces, and are commonly covered by organic veneers or blankets.
FO^{P}	Pre-Reid (early Pleistocene) glaciofluvial terraces are the highest of the glaciofluvial terraces, and two levels are mapped along the Yukon River. These terraces are composed of well-stratified sand and gravel. The highest terraces are found on the south side of the Klondike River and along the Yukon River along the flug of the World Highway in West Dawson are also interpreted as Pre-Reid glaciofluvial deposits.
M	**Morainal:** Morainal (M) materials are diamicts deposited by either primary glacial processes such as lodgement, deformation, and melt-out (ablation) or secondary glacial processes caused by gravity and water. Therefore, this term applies to all types of till including flow tills, which are not directly deposited by glacial ice. Ablation tills are relatively coarse grained and tend to have a hummocky or ridged surface expression. Lodgement tills are finer grained, tend to be more compact, and have a smoother surface expression. Morainal materials are generally colluviated when found on slopes. Permafrost is widespread within morainal deposits. Morainal sediments are only found in the glaciated portion of the map area, north of the Klondike River and east of Rock Creek. Most of these morainal deposits are Pre-Reid in age and are modified by thermo-pedogenic and colluvial processes.
M^{Pl}	McConnell (late Wisconsinlate Pleistocene) Small McConnell alpine glaciers and cirques were limited to higher elevations in the Ogilvie Mountains and in the Klondike Plateau and Dawson Range.
M^{P}	Reid (Illinoian) The local Reid glaciation was centered on the high elevations of the Ogilvie Mountains. Large Reid valley glaciers extended down the Chandindu River valley to the north of the map area and down the North Klondike River to approximately km 8 of the Dempster highway.
M^{Pl}	Pre-Reid (early Pleistocene) glaciers moved in to the map area from the Cordilleran ice sheet to the east and the Ogilvie Mountains to the west. Pre-Reid glaciers in the map area are restricted to the Klondike Plateau, south of the Klondike River, and to the area east of Rock Creek. Stoss features and near-surface permafrost are evidence in these deposits, and very little colluviated in situ material remains. This area is therefore mapped as a complex of till and colluvium.
R	**Bedrock:** Bedrock in the map area primarily consists of Yukon-Tanana terrane Paleozoic schist, quartzite, and gneiss older than 245 million years, as well as some Slide Mountain terrane greenstone, amphibolite, and serpentinized ultramafic rocks. Bedrock is exposed in steep, south-facing slopes along the Klondike and the Yukon river valleys, having been exposed by large landslides, glacial- or glaciofluvial erosion.
D	**Weathered bedrock:** bedrock decomposed or disintegrated in situ by processes of chemical and/or mechanical weathering such as freeze-thaw. Weathered bedrock is common on unglaciated uplands, especially along ridge tops. A silty component may be present due to incorporation of loess by crystallization.

TERRAIN CLASSIFICATION SYSTEM

This surficial geology map was classified using the Terrain Classification System for British Columbia (Howes and Kenk, 1997), with minor modification to meet standards set by the Yukon Geological Survey. For example, we have added some permafrost process subclasses to accomodate the wider variety of permafrost features found in Yukon. We have also added an age classification to distinguish materials deposited during different Pleistocene glaciations.

A sample map unit label is shown below to illustrate the terrain classification system. Surficial materials form the core of the polygon map unit labels and are followed by a slash if more than one process is operating to form the landform. Process, process subclass, and process modifiers are indicated to the right. An upper case activity qualifier (A = active; I = inactive) may be shown immediately following the surficial material designator. The glacial qualifier "D" may alternatively be written immediately following the surficial material to indicate glacially modified materials. Age is indicated by a capital letter after the process subclass. A lowercase letter but precedes the process modifiers. Geomorphological processes (capital letters) and subclasses (lower case letters) always follow a dash (symbol "-").

COMPOSITE SYMBOL DELIMITERS:

Due to scale limitations, up to 4 terrain units may be included in a single map unit label (e.g., sgFGpIM-SWMBMWoCmGpSR-MxV). Each component is separated by a slash, and the dominant surficial material is underlined. Modifiers ("-", "/", "%") or a stratigraphic relationship ("-").

"/" - terrain units on either side of the symbol are of approximately equal proportion
"-" - terrain units(s) before the symbol is more extensive than the unit(s) following
"%" - terrain unit(s) before the symbol are discontinuous and occur within the unit(s) following
"|" - terrain unit(s) before the "|" symbol stratigraphically overlies the unit(s) following

TEXTURE

Texture refers to the size, shape, and sorting of particles in clasts, sediments, and the proportion and degree of decomposition of plant fibre in organic sediments. Texture is indicated by up to three lower case letters, placed immediately before the surficial material designator, listed in order of decreasing abundance.

Specific clastic textures

- a - angular: angular particles >256 mm in size
- b - bouldery: rounded particles >256 mm in size
- c - cobbly: rounded particles >64-256 mm in size
- g - gravelly: rounded particles >2-64 mm in size
- s - sandy: particles between >0.0625-2 mm in size
- z - silt: particles 0.2-0.0625 mm in size
- k - clay: particles <0.2 mm

Common clastic textural groupings

- d - mixed fragments: a mixture of rounded and angular particles >2 mm in size
- m - moraine: a mixture of clay, silt, sand, gravel, cobbles, and boulders (till)
- p - gravel: a mixture of two or more size ranges of rounded particles >2 mm in size (e.g., a mixture of boulders, cobbles, and pebbles); may include interstitial sand
- x - loess: silt and sand particles between 2 and 256 mm; may include interstitial sand
- m - muck: a mixture of silt and clay; may also contain a minor fraction of fine sand
- y - shelly: a sediment consisting dominantly of shells and/or shell fragments

Organic terms

- e - fibric: the least decomposed of all organic materials; it contains amounts of well-preserved fibres (40% or more) that can be identified as to their botanical origin (Fibric Organic)
- o - mesic: organic material at a stage of decomposition intermediate between fibric and humic (Mesic Organic)
- h - humic: organic material at an advanced stage of decomposition; it has the lowest amount of fibre, the highest bulk density, and the lowest saturated water-holding capacity of the organic materials. More fine textured after rubbing (undisturbed fibre from 17% of the volume of the material

SURFACE EXPRESSION

Surface expression refers to the form (expressed in plan and profile) of landforms expressed by a surficial material at the land surface. This three-dimensional shape of the material is equivalent to 'landform' used in a non-genetic sense (e.g., ridges or plain). Surface expression symbols follow the surficial material and are separated from the surficial material by a period (e.g., M.r = moraine ridge). The surface expression hierarchy is indicated by up to three lower case letters, placed immediately following the surficial material designator, listed in order of decreasing extent.

a - apron: a wedge-like slope-toe complex of laterally coalescent colluvial fans and blankets. Longitudinal slopes are generally less than 10° (25%) from apex to toe and in gently convex/concave profile

b - blanket: a layer of unconsolidated material thick enough (>1 m) to mask minor irregularities of the surface on the underlying material, but still conforms to the general underlying topography; outcrops of the underlying unit are rare

c - cone: a cone or sector of a cone, mostly steeper than 10° (25%); longitudinal profile is smooth and straight, or slightly concave/convex; isolated, applied to lake cones

d - depressions: circular or irregular area (hollow) of lower elevation than the surrounding terrain and delimited by an abrupt break in slope; depressions or swales are steeper than surrounding terrain; depressions are two or more metres deep; typically applied to kettle holes, basin, or paving depressions

l - lee: sector of a cone with a slope gradient less than 10° (25%) from apex to toe; longitudinal profile is smooth and straight, or slightly concave/convex

h - hummock: steep sided hillock(s) and hollow(s) with multidirectional slopes dominantly between 15-35° (26-70%) if composed of unconsolidated materials, whereas bedrock slopes may be steeper; local relief >1 m; in plan, an assemblage of non-linear, generally chaotic forms that are rounded or irregular in cross-profile; commonly applied to knob-and-kettle glaciofluvial terrain

r - ridge: landform created at the crest of a river or stream where it flows into a body of water; gently sloping surfaces between 0.5° (0.5%), and sometimes steeper, straight forms between 16-35° (27-70%); glaciofluvial deltas in the map area are typically coarse-grained with steep sides and flat tops; commonly applied to eskers

m - ridge, elongate hillock(s): slopes dominantly between 5-15° (9-26%); local relief >1 m; in plan, an assemblage of parallel or sub-parallel linear forms with subdued relief (commonly applied to bedrock ridges and fluted or streamlined till plains)

p - plain: a level or very gently sloping, unidirectional (planar) surface with slopes 0.5° (0.5%); relief of local surface irregularities generally <1 m; applied to (glaciofluvial floodplains, organic deposits, lacustrine deposits, and till plains

r - ridge: elongate hillock(s) with slopes dominantly 15-35° (26-70%) if composed of unconsolidated materials; bedrock slopes may be steeper; local relief is >1 m; in plan, an assemblage of parallel or sub-parallel linear forms, commonly applied to drumlinoid till plains, eskers, morainal ridges, crevasse fillings, and ridged bedrock

t - terrace: a single or assemblage of step-like forms where each step-like form consists of a scarp face and a horizontal or gently inclined surface above or beyond a river or lacustrine terraces and stepped bedrock topography

u - undulating topography: non-linear hills and hollows with slopes generally less than 10° (26%)

b - solifluction: slow gravitational downslope movement of saturated non-frozen overburden across a frozen or otherwise impermeable substrate

k - permafrost processes: processes controlled by the presence of permafrost, and permafrost aggradation or degradation

Z - general periglacial processes: solifluction, cryoturbation and nivation, possibly occurring in a single polygon

Subclasses: (e) thermokarst erosion; (l) thaw flow slides; (i) segregated ice; (n) pingo; (t) thermokarst subsidence; (c) patterned ground; (o) sheetwash; (w) ice-wedge polygons

HYDROLOGIC PROCESSES

U - inundation: terrain seasonally under standing water for greater than one month per year and resulting from a high watertable

GEOMORPHOLOGICAL PROCESSES

Geomorphological processes are natural mechanisms of weathering, erosion, and deposition that result in the modification of the surficial materials and landforms at the earth's surface. All processes, except for diagical processes, are assumed to be active unless the qualifier "I" (inactive) is added immediately following the process designator. Inactive processes are not expected to occur under the current climate. Process is indicated by up to three lower case letters, placed immediately following the surficial material designator, listed in order of decreasing extent.

S - Slumpt: a layer of unconsolidated material thick enough (>1 m) to mask minor irregularities of the surface on the underlying material, but still conforms to the general underlying topography; outcrops of the underlying unit are rare

C - cone: a cone or sector of a cone, mostly steeper than 10° (25%); longitudinal profile is smooth and straight, or slightly concave/convex; isolated, applied to lake cones

d - depressions: circular or irregular area (hollow) of lower elevation than the surrounding terrain and delimited by an abrupt break in slope; depressions or swales are steeper than surrounding terrain; depressions are two or more metres deep; typically applied to kettle holes, basin, or paving depressions

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m - ridge, elongate hillock(s): slopes dominantly between 5-15° (9-26%); local relief >1 m; in plan, an assemblage of parallel or sub-parallel linear forms with subdued relief (commonly applied to bedrock ridges and fluted or streamlined till plains)

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u - undulating topography: non-linear hills and hollows with slopes generally less than 10° (26%)

b - solifluction: slow gravitational downslope movement of saturated non-frozen overburden across a frozen or otherwise impermeable substrate

k - permafrost processes: processes controlled by the presence of permafrost, and permafrost aggradation or degradation

Z - general periglacial processes: solifluction, cryoturbation and nivation, possibly occurring in a single polygon

Subclasses: (e) thermokarst erosion; (l) thaw flow slides; (i) segregated ice; (n) pingo; (t) thermokarst subsidence; (c) patterned ground; (o) sheetwash; (w) ice-wedge polygons

HYDROLOGIC PROCESSES

U - inundation: terrain seasonally under standing water for greater than one month per year and resulting from a high watertable

EROSIONAL PROCESSES

G - gully erosion: running water; mass movement; and/or snow avalanching, resulting in the formation of parallel and sub-parallel, long, narrow ravines

FLUVIAL PROCESSES

I - irregularly sinuous channel: a clearly defined main channel displaying irregular turns and bends without repetition of similar features; meanders may be common, and more rare channels, and a few turns and bends may be present, but regular and irregular meanders are absent

J - anastomosing channel: a channel zone where channels diverge and converge around many islands. The islands are vegetated and have surfaces that are far above mean maximum discharge levels

M - meandering channel: a clearly defined channel characterized by a regular and repeated pattern of bends with relatively uniform amplitude and wave length

MASS MOVEMENT PROCESSES

F - slow mass movements: slow downslope movement of masses of cohesive or non-cohesive surficial material and/or bedrock by creeping, flowing or sliding

L - mass movement at an unspecified rate

R - rapid mass movements: rapid downslope movement by falling, rolling, sliding, or flowing of dry, moist, or saturated debris derived from surficial material and/or bedrock

Subclasses: (*) initiation zone; (b) rockfall; (d) debris flow; (g) creep; (m) slump in bedrock; (n) rockslide; (o) debris slide; (s) slump in surficial material

PERIGLACIAL PROCESSES

C - cryoturbation: movement of surficial materials by heaving and/or churning due to frost action (repeated freezing and thawing)

S - solifluction: slow gravitational downslope movement of saturated non-frozen overburden across a frozen or otherwise impermeable substrate

X - permafrost processes: processes controlled by the presence of permafrost, and permafrost aggradation or degradation

Z - general periglacial processes: solifluction, cryoturbation and nivation, possibly occurring in a single polygon

Subclasses: (e) thermokarst erosion; (l) thaw flow slides; (i) segregated ice; (n) pingo; (t) thermokarst subsidence; (c) patterned ground; (o) sheetwash; (w) ice-wedge polygons

HYDROLOGIC PROCESSES

U - inundation: terrain seasonally under standing water for greater than one month per year and resulting from a high watertable

BACKGROUND

This map was produced as a base layer for community landscape hazard assessment and climate change adaptation planning. An accompanying report provoking additional detail on local surficial geology, stratigraphy, glacial history, and landscape hazards will be available from Yukon Geological Survey, Energy, Mines and Resources, Government of Yukon. Surficial geology mapping was based on the conversion of the terrain mapping of various scales by several authors, including Duk-Rodkin, 1996; Fraser and Jackson, 2005; Fraser 2005; Rotsal, 1977; Tomirus and Ramdohr, 1982; Rowland et al., 1977; and Westland Resource Group, 1987. This map synthesizes all of these data sources to portray surficial geology for the region at 1:125,000 scale.

METHODS

Surficial geology mapping was based on the conversion of the terrain mapping of various early surveys using Westland Resource Group, 1987) in conjunction with digital air photo interpretation using FugroRoxan Stereo Analyst software. The study area boundary was extended beyond the original Westland Resource Group soil map area to include the uplands north and south of the Klondike Valley and west of the Yukon River. Field reconnaissance was carried out in the Klondike Valley between Dawson City and the Yukon River, and in the Ogilvie Mountains. Air photo coverage and therefore stereo pairs did not always match background photographs and hydrologic features displayed from 1:50 000-scale topographic base maps. Quickbird (2006) and GeoEye (2006) satellite imagery was also used to update areas disturbed by mining.

ACKNOWLEDGEMENTS

This map was produced as part of a community landscape mapping program coordinated by Bronwyn Bennett from the Northern Climate ExChange, Yukon Research Centre, Yukon College. Surficial geology mapping was completed by Karen McKenna (Cryolithologist, Consulting) with the assistance of Sydney van Loon. Kristen Kennedy arranged pre-field logistics. Site specific permafrost investigations were completed by Steve Kennedy (Steve Kennedy Consulting). Logistical support was provided by Fraser Jackson (Yukon Geological Survey, Whitehorse) and Isabelle de Grandpre. Digital cartography and drafting were completed by Patrick Lipovsky. Funding for this project was provided by Canadian Northern Economic Development Agency's (CanNor) Strategic Investments in Northern Economic Development (SINED) program. Dorothy Hedrich's First Nation is gratefully acknowledged for access to their traditional territory.

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RECOMMENDED CITATION

McKenna, K.M. and Lipovsky, P.S., 2014. Surficial geology, Dawson region, Yukon, parts of NTS 115O/14 &15 and 116B/1, 2, 3 & 4. Yukon Geological Survey, Energy, Mines and Resources, Government of Yukon, Open File 2014-12, 1:25 000 scale.

Any revisions or additional geological information known to the user should be welcomed by the Yukon Geological Survey.

Paper copies of this map may be obtained from Yukon Geological Survey, Room 102 - 300 Main St., Whitehorse, Yukon, Y1A 2B5.
Phone: 867-667-3201; E-mail: geology@gov.yk.ca

A digital PDF (Portable Document Format) file of this map may be downloaded free of charge from the Yukon Geological Survey website: http://www.geology.gov.yk.ca

True North
Grid North
Magnetic North
1°
15°

Use diagram only to obtain numerical values
APPROXIMATE MEAN DECLINATION, JULY 1, NOVEMBER 2014
FOR CENTRE OF MAP

SCALE 1:25 000

0 1 2 3 4 5
kilometres

1°30' UHF NAD83/WGS84 TRANS-ERIDIAN GRIDLINE FOR TOPOGRAPHIC INFORMATION
UTM ZONE 8 NAD83/WGS84 CARTESIAN
Copyright Her Majesty the Queen
In Right of Canada

East of 138° 30'
CONTOUR INTERVAL 50 METRES
Elevations in metres above Mean Sea Level

West of 138° 30'
CONTOUR INTERVAL 500 FEET
Elevations in feet above Mean Sea Level

Yukon Geological Survey
Energy, Mines and Resources
Government of Yukon

Open File 2014-12

Surficial Geology, Dawson Region, Yukon
Parts of NTS 115O/14 &15 and 116B/1, 2, 3 & 4
1:25 000 scale

by

Karen M. McKenna and Panya S. Lipovsky