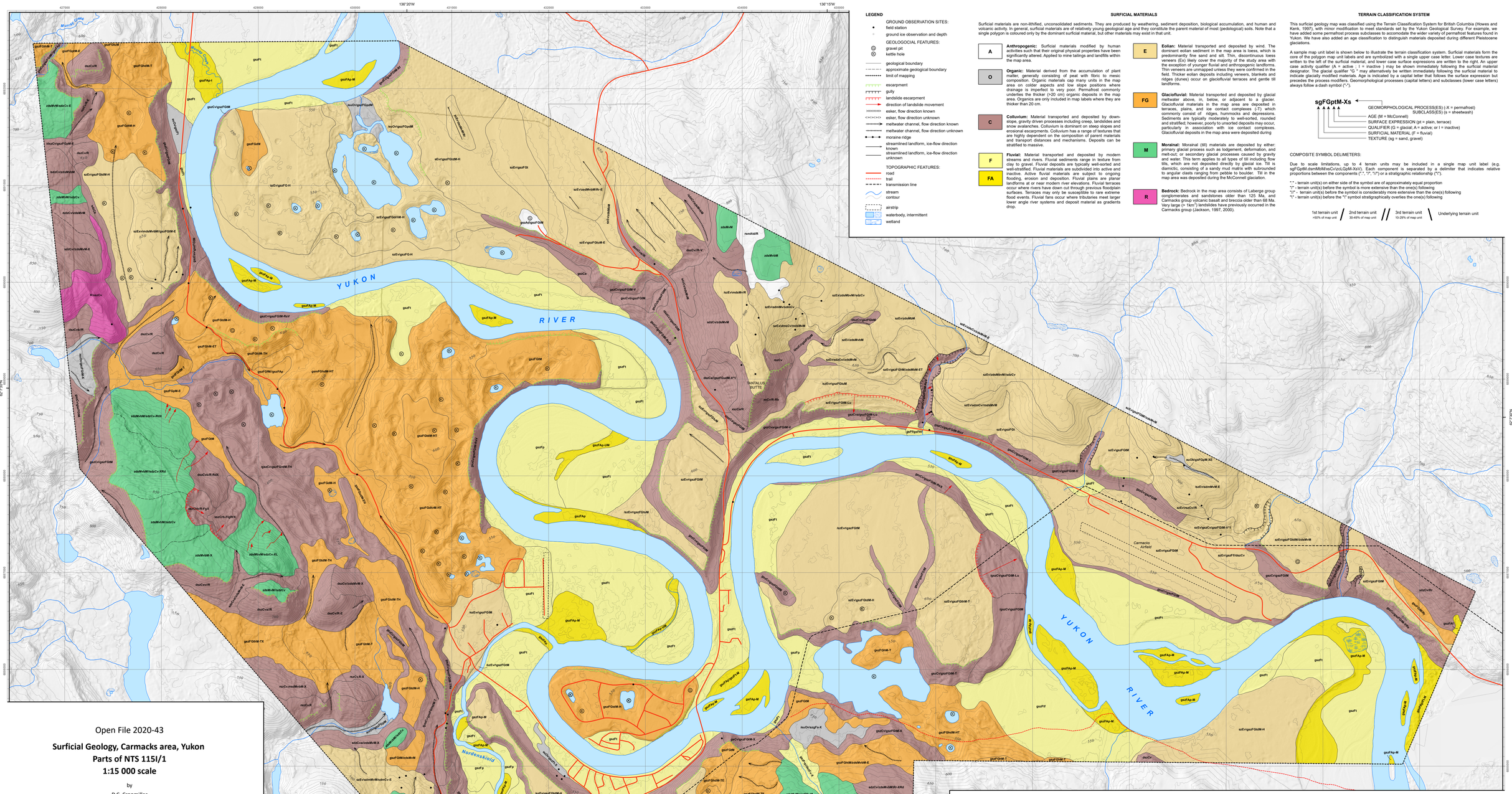

LEGEND

GROUND OBSERVATION SITES:
- field station
- ground ice observation and depth

GEOLOGOCIAL FEATURES:
- gravel pit
- kettle hole
- geological boundary
- approximate geological boundary
- limit of mapping
- escarpment
- gully
- landslide escarpment
- direction of landslide movement
- esker, flow direction known
- esker, flow direction unknown
- meltwater channel, flow direction known
- meltwater channel, flow direction unknown
- moraine ridge
- streamlined landform, ice-flow direction known
- streamlined landform, ice-flow direction unknown

TOPOGRAPHIC FEATURES:
- road
- trail
- transmission line
- stream
- contour
- airstrip
- waterbody, intermittent
- wetland

SURFICIAL MATERIALS

Surficial materials are non-lithified, unconsolidated sediments. They are produced by weathering, sediment deposition, biological accumulation, and human and volcanic activity. In general, surficial materials are of relatively young geological age and they constitute the parent material of most (pedological) soils. Note that a single polygon is 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. Applied to mine tailings and landfills within the map area.

O — **Organic:** Material derived from the accumulation of plant matter, generally consisting of peat with fibric to mesic composition. Organic materials cap many units in the map area on colder aspects and low slope positions where drainage is imperfect to very poor. Permafrost commonly underlies the thicker (>20 cm) organic deposits in the map area. Organics are only included in map labels where they are thicker than 20 cm.

C — **Colluvium:** Material transported and deposited by downslope, gravity driven processes including creep, landslides and snow avalanches. Colluvium is dominant on steep slopes and erosional escarpments. Colluvium has a range of textures that are highly dependent on the composition of parent materials and transport distances and mechanisms. Deposits can be stratified to massive.

F — **Fluvial:** Material transported and deposited by modern streams and rivers. Fluvial sediments range in texture from clay to gravel. Fluvial deposits are typically well-sorted and well-stratified. Fluvial materials are subdivided into active and inactive. Active fluvial materials are subject to ongoing flooding, erosion and deposition. Fluvial plains are planar landforms at or near modern river elevations. Fluvial terraces occur where rivers have down cut through previous floodplain surfaces. Terraces may only be susceptible to rare extreme flood events. Fluvial fans occur where tributaries meet larger lower angle river systems and deposit material as gradients drop.

FA

E — **Eolian:** Material transported and deposited by wind. The dominant eolian sediment in the map area is loess, which is predominantly fine sand and silt. Thin, discontinuous loess veneers (Ev) likely cover the majority of the study area with the exception of younger fluvial and anthropogenic landforms. Thin veneers are unmapped unless they were confirmed in the field. Thicker eolian deposits including veneers, blankets and ridges (dunes) occur on glaciofluvial terraces and gentle till landforms.

FG — **Glaciofluvial:** Material transported and deposited by glacial meltwater above, in, below, or adjacent to a glacier. Glaciofluvial materials in the map area are deposited in terraces, plains, and ice contact complexes (-T) which commonly consist of ridges, hummocks and depressions. Sediments are typically moderately to well-sorted, rounded and stratified; however, poorly to unsorted deposits may occur, particularly in association with ice contact complexes. Glaciofluvial deposits in the map area were deposited during

M — **Morainal:** Morainal (till) materials are deposited by either: primary glacial process such as lodgement, deformation, and melt-out; or secondary glacial processes caused by gravity and water. This term applies to all types of till including flow tills, which are not deposited directly by glacial ice. Till is diamictic, consisting of a sandy mud matrix with subrounded to angular clasts ranging from pebble to boulder. Till in the map area was deposited during the McConnell glaciation.

R — **Bedrock:** Bedrock in the map area consists of Laberge group conglomerates and sandstones older than 125 Ma, and Carmacks group volcanic basalt and breccia older than 68 Ma. Very large (> $1km^3$) landslides have previously occurred in the Carmacks group (Jackson, 1997, 2000).

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 symbolized with a single upper case letter. Lower case textures are written to the left of the surficial material, and lower case surface expressions are written to the right. An upper case activity qualifier (A = active ; I = inactive) may be shown immediately following the surficial material designator. The glacial qualifier "G " may alternatively be written immediately following the surficial material to indicate glacially modified materials. Age is indicated by a capital letter that follows the surface expression but precedes the process modifiers. Geomorphological processes (capital letters) and subclasses (lower case letters) always follow a dash symbol ("-").

sgFGptM-Xs
- GEOMORPHOLOGICAL PROCESS(ES) (-X = permafrost)
- SUBCLASS(ES) (s = sheetwash)
- AGE (M = McConnell)
- SURFACE EXPRESSION (pt = plain, terrace)
- QUALIFIER (G = glacial; A = active; or I = inactive)
- SURFICIAL MATERIAL (F = fluvial)
- TEXTURE (sg = sand, gravel)

COMPOSITE SYMBOL DELIMETERS:

Due to scale limitations, up to 4 terrain units may be included in a single map unit label (e.g. sgFGptM.dsmMbMlAsCv/zcLGpM-XsV). Each component is separated by a delimiter that indicates relative proportions between the components (".", "/", "\"/) or a stratigraphic relationship ("|").

"." - terrain unit(s) on either side of the symbol are of approximately equal proportion
"/" - terrain unit(s) before the symbol is more extensive than the one(s) following
"\" - terrain unit(s) before the symbol is considerably more extensive than the one(s) following
"\" - terrain unit(s) before the "|" symbol stratigraphically overlies the one(s) following

1st terrain unit >50% of map unit / 2nd terrain unit 30-49% of map unit // 3rd terrain unit 10-29% of map unit \ Underlying terrain unit

TEXTURE

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

Specific clastic textures
a - blocks: angular particles >256 mm in size
b - boulders: rounded particles >256 mm in size
k - cobbles: rounded particles >64–256 mm in size
p - pebbles: rounded particles >2–64 mm in size
s - sand: particles between >0.0625–2 mm in size
z - silt: particles 2 µm–0.0625 mm in size
c - clay: particles ≤2 µm in size

Common clastic textural groupings:
d - mixed fragments: a mixture of rounded and angular particles >2 mm in size
x - angular fragments: a mixture of angular fragments >2 mm in size (*i.e.*, a mixture of blocks and rubble)
g - gravel: a mixture of two or more size ranges of rounded particle s >2 mm in size (*e.g.*, a mixture of boulders, cobbles, and pebbles); may include interstitial sand
r - rubble: angular particles between 2 and 256 mm; may include interstitial sand
m - mud: a mixture of silt and clay; may also contain a minor fraction of fine sand

Organic terms:
e - fibric: the least decomposed of all organic materials; it contains amounts of well-preserved fibre (40% or more) that can be identified as to botanical origin upon rubbing
u - mesic: organic material at a stage of decomposition intermediate between fibric and humic
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; fibres that remain after rubbing constitute less than 10% of the volume of the material

SURFACE EXPRESSION

Surface expression refers to the form (assemblage of slopes) and pattern of forms expressed by 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 also describe the manner in which unconsolidated surficial materials relate to the underlying substrate (e.g., veneer). Surface expression 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 15° (26%) from apex to toe with flat or gently convex/concave profiles

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 15° (26%); longitudinal profile is smooth and straight, or slightly concave/convex; typically applied to talus cones

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

f - fan: sector of a cone with a slope gradient less than 15° (26%) 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° and 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

l - delta: landform created at the mouth of a river or stream where it flows into a body of water; gently sloping surfaces between 0° and 3° (0–5%), and moderate to steeply sloping fronts between 16° and 35° (27–70%); glaciofluvial deltas in the map area are typically coarse-grained with steep sides and gently inclined kettled or channeled surfaces

m - rolling: elongate hillock(s); slopes dominantly between 3° and 15° (5–26%); 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)

SURFACE EXPRESSION (CONTINUED)

p - plain: a level or very gently sloping, unidirectional (planar) surface with slopes bewteen 0° and 3° (0–5%); relief of local surface irregularities generally <1 m; applied to (glacio)fluvial flood plains, organic deposits, lacustrine deposits, and till plains

r - ridge: elongate hillock(s) with slopes dominantly between 15° and 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 drumlinized 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 it; applied to fluvial and lacustrine terraces and stepped bedrock topography

u - undulating topography: non-linear rises and hollows with slopes generally less than 15° (26%)

v - veneer: a layer of unconsolidated materials too thin to mask the minor irregularities of the surface of the underlying material; 10 cm – 1 m thick; commonly applied to eolian/loess veneers and colluvial veneers

w - mantle of variable thickness: a layer or discontinuous layer of variable thickness, typically 0 to 3 m, that fills or partly fills depressions in an irregular substrate; generally too thin to mask irregularities in the underlying material

GEOMORPHOLOGICAL PROCESSES

Geomorphological processes are natural mechanisms of weathering, erosion, and deposition that result in the modification of the surficial materials and landforms of the earth's surface. All processes, except for deglacial processes, are assumed to be active unless the qualifier "I" (inactive) is used. All deglacial processes are assumed to be inactive unless the qualifier "A" (active) is used. Up to three upper case letters may be used to indicate processes. These are listed in order of decreasing importance and placed after the surface expression symbol, following a dash (-) symbol.

Subclasses are used to provide more specific information about general geomorphological process, and are represented by lower case letters placed after the related process designator. Up to two subclasses can be associated with each process. Process subclasses used on this map are defined with the related process below.

EROSIONAL PROCESSES

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

FLUVIAL PROCESSES

I - irregularly sinuous channel: a clearly defined main channel displaying irregular turns and bends without repetition of similar features; backchannels may be common, and minor side channels and a few bars and islands 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 for 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: (1) initiation zone; (b) rockfall; (d) debris flow; (g) creep; (m) slump in bedrock; (r) rockslide; (s) debris slide; (u) 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)

GEOMORPHOLOGICAL PROCESSES (CONTINUED)

PERIGLACIAL PROCESSES (CONTINUED)

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

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; (f) thaw flow slides; (i) segregated ice; (n) pingo; (t) thermokarst subsidence; (r) patterned ground; (s) sheetwash; (w) ice-wedge polygons

HYDROLOGIC PROCESSES

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

GLACIAL PROCESSES

E - channeled by meltwater; erosion and channel formation by meltwater alongside, beneath, or in front of a glacier or ice sheet

H - kettled: depressions in surficial materials resulting from the melting of buried glacier ice

T - Ice contact glacial processes

METHODS

Surficial geology mapping was completed using DAT/EM Summit soft copy 3-D photo-interpretation software in conjunction with Esri's ArcGIS. Interpretations used colour air photos from 2010 further refined based on 1 m-resolution LiDAR covering the Freegold road corridor and the Village of Carmacks municipal boundaries, and the 2 m-resolution ArcticDEM (Porter et al., 2018). Mapping was completed for the study area at a scale of 1:15,000. Surficial geology map units were delineated based on surficial material, surface expression, and geomorphic processes in accordance with the Terrain Classification System for British Columbia (Howes and Kenk, 1997), with modifications for use in Yukon (Lipovsky and Bond, 2014). Field checking of select sites was performed in September 2020.

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Open File 2020-43

Surficial Geology, Carmacks area, Yukon
Parts of NTS 115I/1
1:15 000 scale

by
D.C. Cronmiller

0 0.5 1 1.5 2
kilometres

True North
1°01'
18°21'
Grid North
Magnetic North

Use diagram only to obtain numerical values
APPROXIMATE MEAN DECLINATION NOVEMBER 2020
FOR OENH RIS DFAAD

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 8

CONTOUR INTERVAL 10 METRES
Elevations in metres above Mean Sea Level

November 2020

115I/01
MAP LOCATION

Any revisions or additional geological information known to the user would 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. E-mail: geology@gov.yk.ca.

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