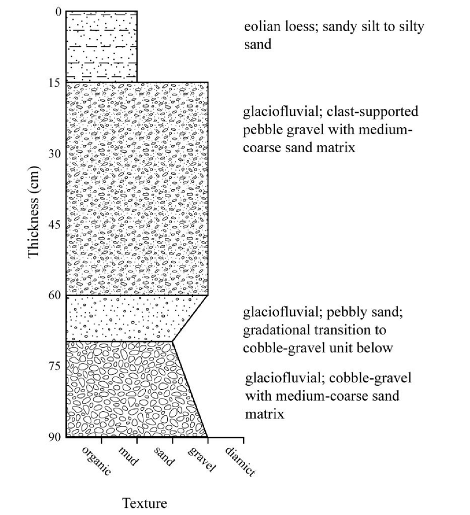
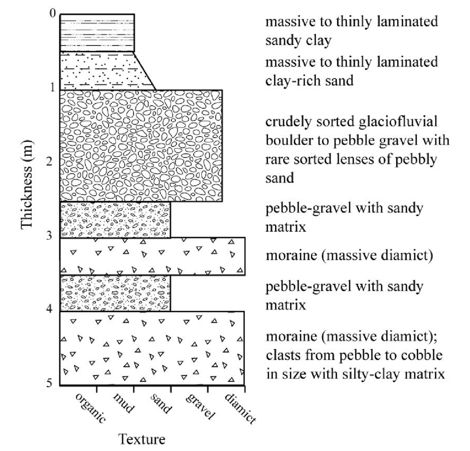
STRATIGRAPHY

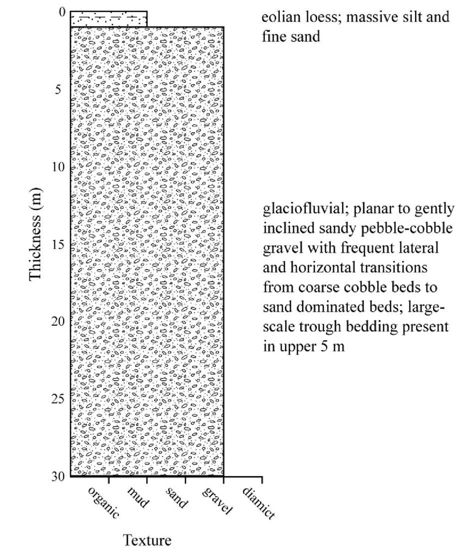
10-KK-076



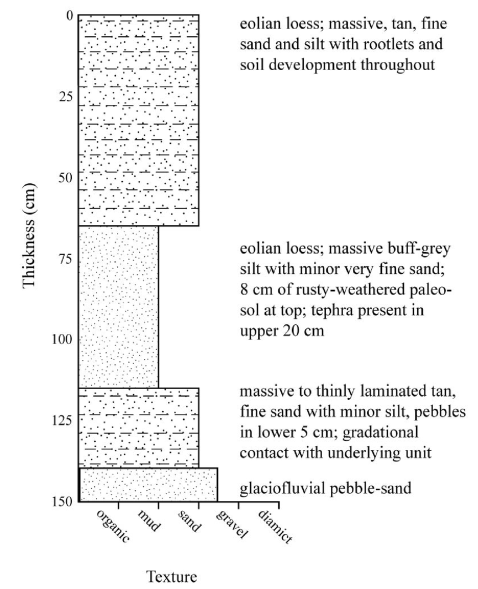
10-KK-088



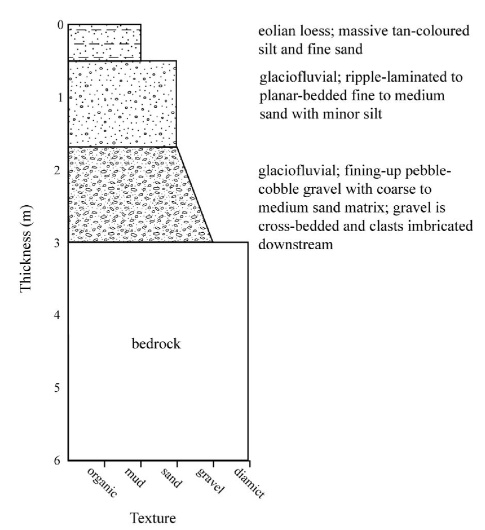
10-KK-068



10-KK-078



10-KK-082



MARGINAL NOTES

Pelly Crossing is located on the banks of the Pelly River in the broad Pelly River valley in the Central Yukon Plateau ecoregion. The physiography of the area is characterized by rounded and rolling hills, plateaus and broad valleys surrounded by higher mountain ranges.

Vegetation in the Pelly Crossing region is dominated by northern mixed deciduous and coniferous forest (boreal forest), consisting predominantly of white spruce (*Picea glauca*) with minor amounts of black spruce (*Picea mariana*) and paper birch (*Betula papyrifera*). Due to frequent forest fires, aspen (*Populus tremuloides*) and lodgepole pine (*Picea contorta*) are prevalent at low elevations. South-facing slopes commonly have artemesia grasslands or steppe vegetation. The understory consists of feathermoss, willows, sagewort and ericaceous shrubs; sphagnum mosses are more common in wetter terrain.

Surficial geology in the Pelly region is dominated by glacial and deglacial sediments deposited over the past ~2.6 million years. The community of Pelly Crossing is located on a broad gravel terrace of the Pelly River that was likely deposited near the end of the last glaciation. The modern Pelly River continues to dominate the erosion, transportation, and deposition of surficial materials in the Pelly River valley today.

Glacial limits in the Pelly region were originally noted by Bostock (1966) and later the surficial geology was mapped by Jackson (1997). Only the penultimate glacial advance (the Reid advance) is easily distinguishable in the Pelly region. The Reid advance was more extensive than the most recent (McConnell) advance, and reached its westward limit in the Pelly River valley some 20 km west of Pelly Crossing near Fort Selkirk. This advance likely took place ~130 000 years before present and inundated all but the highest peaks in central Yukon (Ward *et al.*, 2008; Stroeven *et al.*, 2010).

The Reid glacial advance deposited moraine on valley sides (Fig. 1) and upland surfaces around the community of Pelly Crossing. As the ice sheet receded from the region, it drew back toward the east and continued to discharge meltwater through the Pelly River valley. Some of this meltwater was likely impounded near the margins of the retreating ice and formed small glacial lakes. Proglacial discharge during deglaciation of the Reid glacial advance is probably responsible for the highest terrace surfaces on both sides of the Pelly River above the community of Pelly Crossing (Fig. 2). As deglaciation progressed, the highest terraces would have been incised as the Pelly River attained a lower non-glacial base-level.

The last glacial advance in Yukon, known as the McConnell glacial advance (~20 000 - 25 000 years before present) advanced from the Selwyn Mountains but was not extensive enough to reach the study area. The McConnell glacial advance reached its westward limit only 15 km east of Pelly Crossing near Granite Canyon. During this advance, glacial meltwater flowed within the Pelly River valley and contributed to additional glaciofluvial terraces on either side of the Pelly River near the community of Pelly Crossing. These McConnell-aged terraces are lower in elevation than the previously deposited Reid-aged terraces, but are still above the modern floodplain of the Pelly River (Fig. 3). It is likely that the terrace on which the community is built was deposited shortly after the last glaciation as the Pelly River began to achieve its post-glacial base-level.

After ice retreated and the remaining lakes drained, fine-grained glacially scoured material was available to be transported and reworked by eolian (wind) processes. Fine sand and silt loess deposits form a surface veneer or blanket over most of the map area, but are especially prevalent on morainal and glaciofluvial landforms (Fig. 4). The transport of fine-grained eolian material likely remained a dominant sedimentary process until moister conditions prevailed and vegetation became established ~9000 years ago (Wolfe *et al.*, 2011). Since this time, eolian deposition has been limited to cliff-top loess deposition above unvegetated sediment bluffs. Permafrost growth in poorly drained, fine-grained materials in the Pelly Crossing region likely began during the Holocene (~10 000 years ago until present) and is responsible for some shifts in vegetation cover.

The vertical layering of sediments can be a strong control on landscape stability. Simplified stratigraphy of the Pelly River valley is presented in Fig. 5. The highest terraces on either side of the river have been inset by lower, younger terraces of Reid (R) and McConnell (M) ages, and finally the modern (last 10 000 years) fluvial system (light yellow terrace). Moraine deposits found on upland surfaces are sometimes also visible below glaciofluvial materials on high terraces above the Pelly River (*i.e.* 10-KK-088), however, the stratigraphy visible in sections and via previously acquired test pit and well logs (R. Trimble, EBA Engineering, pers. comm., 2010) more commonly records the vertical layering of fluvial and glaciofluvial deposits (*i.e.* 10-KK-068).

FIGURES

Figure 1. Moraine deposited by the (penultimate) Reid Glaciation is visible on valley sides above Pelly Crossing.

Figure 2. The broad Pelly River valley is characterized by multiple levels of glaciofluvial terraces on both sides of the valley.

Figure 3. The town of Pelly Crossing is built on a low glaciofluvial terrace deposited at the end of the last glaciation (McConnell).

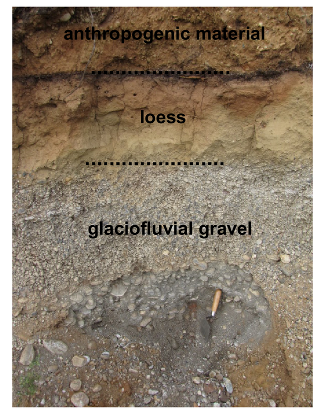


Figure 4. Loess (wind-deposited silt and sand) is commonly deposited above glaciofluvial gravel in the map area.

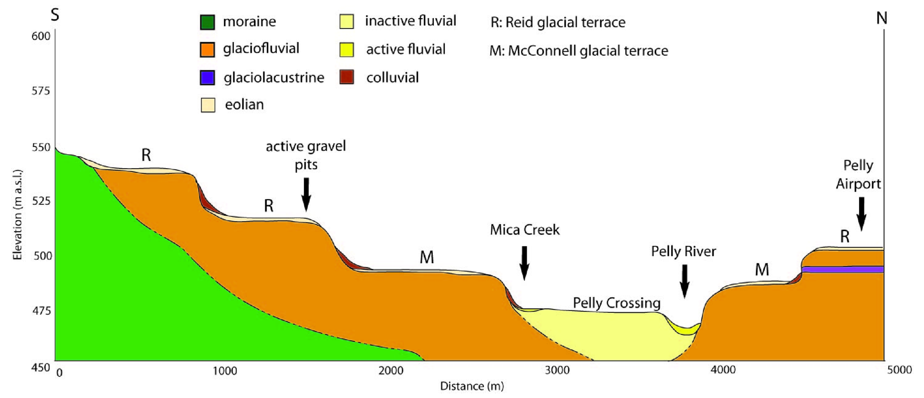
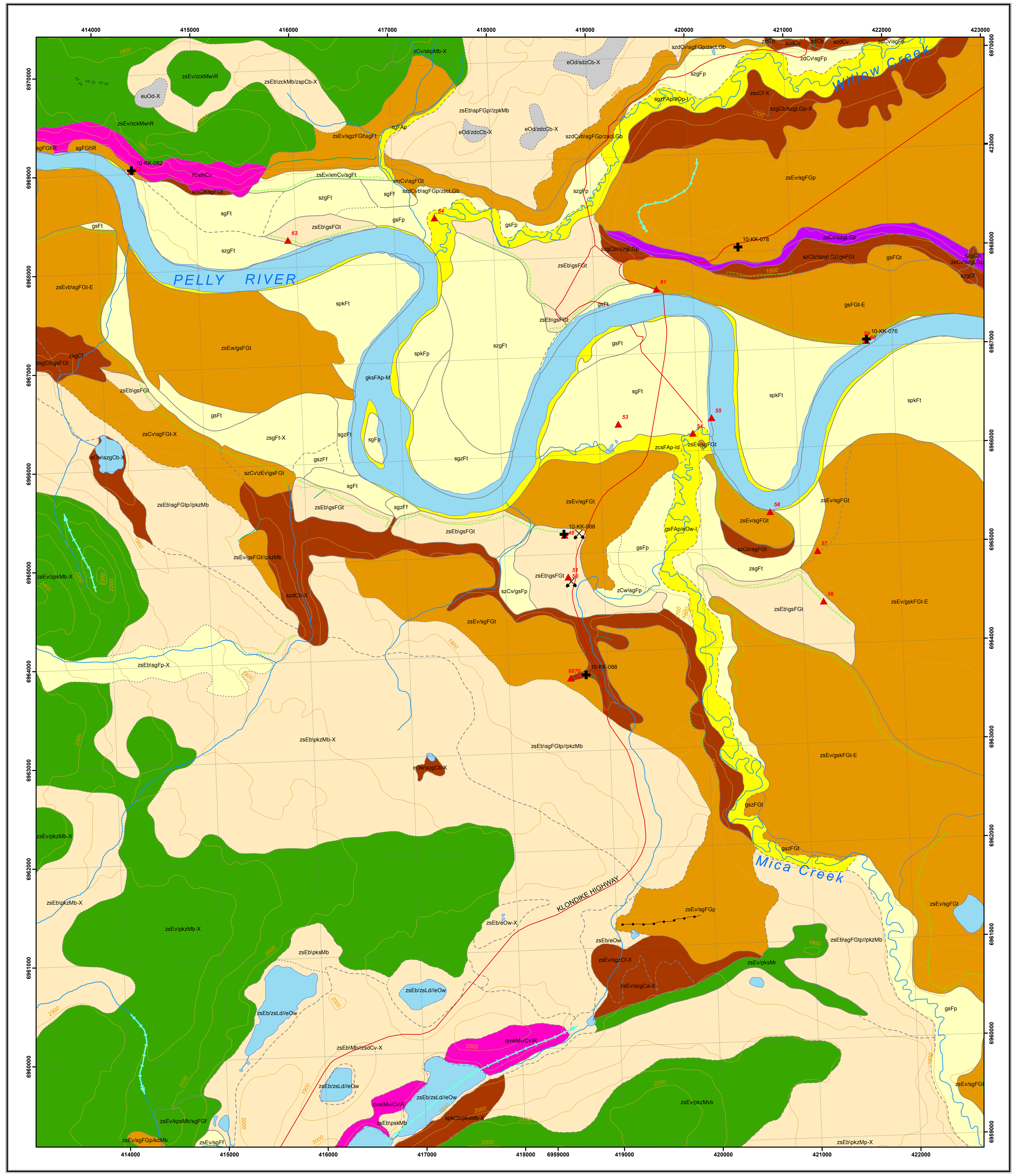
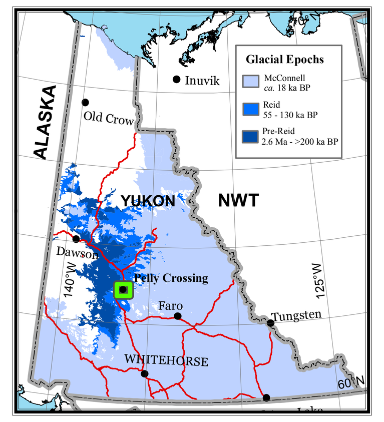
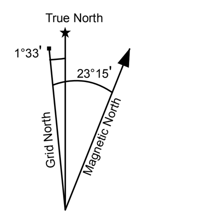


Figure 5. A profile of the distribution of surficial sediments in the Pelly River valley illustrates multiple terrace levels, upland moraine deposits and probable subsurface contacts.







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

SURFICIAL GEOLOGY
PELLY CROSSING
YUKON
part of NTS 115I/15

SCALE 1:20 000

0 0.25 0.5 1 1.5 2
kilometres

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

ONE THOUSAND METRE GRID
Universal Transverse Mercator Projection

CONTOUR INTERVAL 100 FEET
Elevations in feet above Mean Sea Level

115P/03 COLDSPRING MOUNTAIN	115P/02 WILLOW LAKE	115P/01 CRYSTAL LAKE
115I/14 VOLCANO MOUNTAIN	115I/15 MAP LOCATION	115I/16 STODDART CREEK
115I/11 DARK CREEK	115I/10 MINTO	115I/09 PTARMIGAN MOUNTAIN

SURFICIAL GEOLOGY MAP

This surficial geology map was classified using the Terrain Classification System for British Columbia (Howes and Kenk, 1997), with modification to meet standards set by the Yukon Geological Survey. For example, we have added permafrost process subclasses to further account for the breadth of permafrost features on the landscape. Linework for the map was produced from interpretations of 1:40 000-scale aerial photos (1989). Subsequent field checking of the map area was completed in the summer of 2010.

Terrain Classification

1st terrain unit (50-100% of map unit) / 2nd terrain unit (30-49% of map unit) // 3rd terrain unit (10-29% of map unit)

Overlying terrain unit (50-100% of map unit) \ Underlying terrain unit

sgFGpt-Xs
- geomorphological process(es) (permafrost - X) subclass(es) (sheetflow - s)
- surface expression (plain, terrace)
- qualifier (glacial, active)
- surficial material (fluvial)
- texture (sand, gravel)

SURFICIAL MATERIAL

Surficial materials are non-lithified, unconsolidated sediments. They are produced by weathering, sediment deposition, biological accumulation, human and volcanic activity. In general, surficial materials are of relatively young geological age and they constitute the parent material of most (pedological) soils. On the map, surficial materials form the core of the polygon label. They are symbolized with a single upper case letter, with texture written to the left, and surface expression or glacial qualifier to the right. The glacial qualifier "G" is used to describe glacially modified materials. If actual activity state is different than the assumed activity state (indicated in brackets next to the surficial material name below), a qualifier A (active) or I (inactive) must be used as a superscript following the surficial material designator. Note that a single polygon will be coloured only by the dominant surficial material, but other materials may exist in that unit.

C — Colluvium (active): Colluvial deposits include materials that have reached their present positions as a result of direct, gravity-induced movement involving no agent of transportation such as water or ice (Howes and Kenk, 1997). Colluvial deposits in the Pelly Crossing region generally consist of massive to moderately well-stratified, non-sorted to poorly sorted sediments with any range of particle sizes from clay to boulders. Colluvial deposits commonly form near the bottom of moderate to steep slopes, where materials have been moved downslope due to gravity. Colluvial deposits in the map area occur along the base of escarpments formed by glaciofluvial terraces and moraine ridges. Colluvial deposits are gravity-modified versions of pre-existing deposits, and as such, are reflective of regional deposit types. In the Pelly Crossing map area, most colluvial deposits are formed from glaciofluvial and morainal deposits and grain sizes are similar to the original deposit types. On north and east-facing aspects, colluvial deposits are likely to be affected by permafrost.

E — Eolian (inactive): Eolian deposits include materials transported and deposited by wind. These deposits generally consist of medium to fine sand and coarse silt that is well sorted, non compacted, and may contain internal structures such as cross-bedding or ripple laminae, or may be massive (Howes and Kenk, 1997). Loess deposits are typically tan to buff in colour, massive (without bedding structures), and anywhere from ~10 cm to more than 30 cm thick. Loess deposits form a surface veneer or blanket over most of the map area, but are especially prevalent on morainal and glaciofluvial landforms. Eolian deposition in the Pelly Crossing region began shortly after the ice receded and was ongoing until ~9000 years ago when the landforms likely became stabilized by vegetation (Wolfe et al., 2011). Modern eolian deposition is limited to localized pockets above bare sediment cliffs (such as above the steep banks of the Pelly River).

F — Fluvial (inactive): Fluvial deposits are materials that have been transported and deposited by streams and rivers. Inactive fluvial sediments in the map area are predominantly those associated with floodplains, fluvial terraces and back-channels of the Pelly River and its tributaries. These deposits generally consist of stratified beds of gravel and/or sand with sand and/or silt and/or organic materials (and rarely clay). Gravel deposits contain interstitial sand and clasts that are typically rounded. These deposits are commonly moderately to well sorted and display stratification. Silt, sand and organic deposits make up thinly laminated or massive overbank deposits that are commonly interbedded with coarser gravel deposits. Fine-grained lenses and beds in these fluvial deposits may contain ice, although it may be discontinuous over relatively small areas.

FA — Fluvial (active): Fluvial deposits are materials that have been transported and deposited by streams and rivers. Active fluvial sediments in the map area are predominantly those associated with floodplains and channels of the Pelly River and its tributaries. Sediments in the main Pelly River channel are typically coarse cobble gravel with minor sand, silt and clay. Tributary channel deposits generally consist of stratified beds of gravel and/or sand with sand and/or silt and/or organic materials (and rarely clay). Gravel deposits contain interstitial sand and clasts that are typically rounded. Channel deposits are commonly moderately to well sorted and display stratification. Silt, sand and organic deposits make up thinly laminated or massive overbank deposits that are rarely interbedded with coarser gravel deposits in active fluvial environments.

FG — Glaciofluvial (inactive): Glaciofluvial deposits include materials that have been deposited by glacial meltwater either directly in front of, or in contact with, glacier ice (Howes and Kenk, 1997). Glaciofluvial materials typically range from non-sorted and non-bedded gravel made up of a wide range of particle sizes, associated with very rapid aggradation at an ice front, to moderately to well sorted, stratified gravel. Slump structures such as hummocky or irregular terrain are indicative of collapse of the material due to melting of supporting ice. Glaciofluvial materials are abundant in the Pelly Crossing region. They typically form broad, flat terraces on both sides of the Pelly River valley. Glaciofluvial deposits in the Pelly Crossing area formed distal to the ice margin in a dominantly fluvial environment. These deposits are typically moderately to well sorted, consist of sand to pebble gravel and are uniformly deposited in terraces and plains in proglacial environments.

L — Lacustrine (inactive): Sediments that have settled from suspension and underwater gravity flows (i.e. turbidity currents) in bodies of standing fresh water, or sediments that have accumulated at their margins through the action of waves. Lacustrine materials in the Pelly Crossing area are limited to small lakes near the southern part of the map area.

LG — Glaciolacustrine (inactive): Glaciolacustrine materials are deposited in, or along the margins of, glacial (ice-dammed) lakes and include sediments that were released by the melting of floating ice. Glaciolacustrine materials are uncommon in the Pelly Crossing map area and, where present, include lake bed sediments consisting of stratified fine sand, silt and/or clay with rare lenses of till and/or glaciofluvial material. These materials were likely deposited in a glacially dammed lake that existed briefly at the end of the Reid Glaciation.

M — Moraine (inactive): Moraine deposits include materials that have been deposited directly by a glacier or ice sheet without modification by any other agent of transportation. Moraine deposits are typically highly variable and depend upon both the source of material incorporated by the glacier and the mode of deposition (Howes and Kenk, 1997). Moraine deposits in the Pelly Crossing region are characterized by poorly sorted, weakly compacted material lacking stratification and containing a heterogeneous mixture of particle sizes, which is usually in a matrix of sand, silt and clay. In general, moraine deposits in the map area are found on upland surfaces above the Pelly River valley. Moraine deposits on these surfaces are relatively uniform undulating plains and blankets that drape the underlying bedrock. Because moraine deposits contain fine silt and sand, they can be poorly drained landforms and more prone to the development of permafrost and thick organic deposits.

O — Organic (active): Organic materials in the map area are commonly found in low-lying areas where wet ground conditions have facilitated a thick accumulation of vegetative matter. Organic deposits contain at least 30% organic matter by weight and are commonly saturated with water and consist of the accumulated remains of mosses, sedges, or other hydrophytic vegetation (Howes and Kenk, 1997). In the map area, organic deposits form blankets (>1 m) and veneers (<1 m) over inorganic materials that commonly have poor drainage capacity due to a high percentage of silt and clay. Thick organic deposits occur on floodplains of tributary streams and in poorly drained depressions of moraine surfaces. Ice-rich permafrost conditions are common in these deposits.

R — Bedrock: Bedrock outcrops in the map area are limited to a few small areas along the Pelly River Farm Road and at the southern end of the map sheet along a former meltwater channel. Bedrock is not visible in the centre of the Pelly River valley, but likely lies more than 30 m below surface based on records of geotechnical drilling near the bridge (R. Trimble, EBA Engineering, pers. comm., 2010).

SURFACE EXPRESSION

Surface expression refers to the form (assemblage of slopes) and pattern of forms 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, 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 of the underlying material, but still conforms to the general underlying topography; outcrops of the underlying unit are rare.

d - depression: Circular or irregular area of lower elevation (hollow) than the surrounding terrain, >2 m deep and delimited by an abrupt break in slope steeper than the surrounding terrain. This term is commonly applied to kettle holes and pitted outwash plains in glaciofluvial materials.

f - fan: Sector of a cone with a slope gradient less than 15° (26%) from apex to toe; longtitudinal profile is smooth and straight, or slightly concave/convex.

p - plain: A level or very gently sloping, unidirectional (planar) surface with slopes 0-3° (0-5%); relief of local surface irregularities generally <1 m. This term is applied to (glacio)fluvial 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 view, this surface expression makes up an assemblage of parallel or sub-parallel linear forms. This term is 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. This surface expression is applied to fluvial and lacustrine terraces and stepped bedrock topography.

v - veneer: A layer of unconsolidated material too thin (10 cm to 1 m in thickness) to mask the minor irregularities of the surface of the underlying material. This surface expression is commonly applied to eolian/loess veneers and colluvial veneers.

w - mantle of variable thickness: A layer or discontinuous layer of surficial material of variable thickness (0-3 m) that fills or partly fills depressions in an irregular substrate.

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 material.

Specific clastic textures:
a - blocks: angular particles >256 mm in size
b - boulders: rounded particles >256 mm in size
k - cobbles: rounded particles between 64 and 256 mm in size
p - pebbles: rounded particles between 2 and 64 mm in size
s - sand: particles between 0.0625 and 2 mm in size
z - silt: particles between 2 μm and 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 particles >2 mm in size (*eg.*, 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
y - shells: a sediment consisting dominantly of shells and/or shell fragments

Organic terms:
o - organic: unclassified organic materials
e - fibric: the least decomposed of all organic materials; it contains significant 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

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. Unless a qualifier (A (active) or I (inactive)) is used, all processes are assumed to be active, except for deglacial processes. Process is indicated by up to three upper case letters, listed in order of decreasing importance, placed after the surface expression symbol, and separated from the surface expression by a dash (-).

Subclasses can be used to provide more specific information about a general geomorophological process, and are represented by lower case letter(s) placed after the related process designator. Up to three subclasses can be attached to 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 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. Backchannels may be common, and minor side channels and a few bars and islands may be present, but regular and irregular meanders are absent.

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

Subclasses: (d) - ephemeral tributary-fed backchannels: Backchannels normally fed by tributaries, but dry during late summer.

MASS MOVEMENT PROCESSES

L - landslides: Downslope movement by falling, rolling, sliding or flowing of dry, moist or saturated debris derived from surficial material and/or bedrock.

PERIGLACIAL PROCESSES

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

DEGLACIAL PROCESSES

E - channeled by meltwater: Erosion and channel formation by meltwater alongside, beneath, or in front of a glacier or ice sheet.

SYMBOLS

- water courses
- roads
- elevation contours (feet a.s.l.)
- moraine ridge
- meltwater channel (direction indicated)
- escarpment
- esker (unknown direction)
- stratigraphic sections
- texture samples
- gravel pit

GEOLOGICAL BOUNDARIES

- defined boundary
- approximate boundary
- assumed boundary

ACKNOWLEDGEMENTS

The author is grateful to the residents of Pelly Crossing for providing information about the region's geology and natural history. Valuable information related to hydrological conditions in the region was provided by Bronwyn Benkert. Input from Jeffrey Bond greatly improved the map. Assistance in the field was provided by Casey Cardinal.

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RECOMMENDED CITATION

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Digital cartography and drafting by Kristen Kennedy with the Yukon Geological Survey using ArcMap. Mapping based on air photo interpretation using 1:40 000-scale photos. Field checking was performed in summer 2010. Linework for map is based on aerial photography from 1989 and may not match base data (contours, streams) derived from 1:50 000-scale topographic maps.

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

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Yukon Geological Survey
Energy, Mines and Resources
Government of Yukon

Open File 2011-4

Surficial Geology of Pelly Crossing (part of NTS 115I/15) Yukon (1:20 000 scale)

by

Kristen E. Kennedy