

Supplemental Item S4 – GIS Watershed Delineation Data Sources and Methods:

Digital Elevation Model (DEM) Sources and resolution

Alaska:

1 arc-second ($\approx 30\text{m}$) DEMs; USGS NED 1 arc-second 1 x 1 degree ArcGrid
U.S. Geological Survey, 2012, NED 1 arc-second 1 x 1 degree GridFloat 2016,
National Elevation Dataset, Elevation Products (3DEP), <https://viewer.nationalmap.gov/basic>, accessed 11/30/18.

Canada:

0.75 arc-second DEMs (CDEM)
Natural Resources Canada, 2017, Canadian Digital Elevation Model (CDEM) Mosaic, nominal 0.75 arc-second,
<https://open.canada.ca/data/en/dataset/7f245e4d-76c2-4caa-951a-45d1d2051333>, accessed 11/30/18.

Watershed calculations

Pour points (watershed outlets) were established at detrital sediment sampling sites (20 main river sample sites and 9 tributary sample sites on Table 1) by obtaining latitude and longitude coordinates in the field with handheld GPS units. These coordinates were adjusted slightly in GIS such that they fell inside a pixel of high flow accumulation (*i.e.*, the point fell in a calculated stream).

DEMs for Alaska and Canada were mosaicked, mosaicked DEMs sinks were filled, flow direction and flow accumulation analysis were run, individual watershed rasters were calculated and converted to watershed polygon, and watershed areas were calculated.

Table DR4.1. Geologic map data sources and references.

Region	Dataset Code	Dataset Name	Type of map	Used to map	Digital?	Nominal Scale
Alaska	A	Geologic Map of Alaska	bedrock, surficial, ice	QTV, Qs, Ice, Other	Yes	1:250,000
Yukon	B	Yukon Digital Bedrock Geology	bedrock	QTV, Other	Yes	NA
Yukon	C	Surficial Geology Polygons	surficial	Qs, Other	Yes	1:100,000
Yukon	D	Surficial Materials of Canada	surficial	Qs, Other	Yes	1:5,000,000
Yukon	E	Yukon Digital Geology	bedrock	Qs, Other	Yes	NA
Yukon	F	Surficial Materials...Map 13	surficial	QTV	No	1:250,000
Yukon	G	Ice and Snow – 250K – Canvec	ice & snow	Ice	Yes	1:250,000

Datasets: A = Wilson et al., 2016; B = Yukon Geological Survey (YGS), 2018; C = Lipovsky & Bond, 2014; D = Fulton, 1995; E = Gordey & Makepeace, 2003; F = Rampton, 1981; G = Natural Resources Canada, 2016

QTV = Wrangell and Amphitheatre Formation Quaternary/Tertiary volcanic rocks and sparse sedimentary strata. Qs = undifferentiated Quaternary unconsolidated sediments. Other = all other bedrock not including Ice or Qs. Nominal Scale is the reported map scale, if available. A portion of the surficial geology data in the study area from Rampton (1981) were digitized for this study, and surficial deposits from this detailed map were allowed to overlay and take precedence over other datasets showing bedrock.

Consolidation and analysis of geospatial data.

The published geologic map data for Alaska used in this study was from an integrated digital database (Wilson et al., 2015) with faults, bedrock, surficial deposits, glaciers. Geochronologic data from this reference and newer references (refer to text and DR6) were plotted in GIS.

Published data for the Yukon portion of the study area were not integrated into one dataset, so data from five digital maps and one hard copy map (at different scales) were manipulated to obtain a reasonable representation of the extent of QTV bedrock, Qs surficial deposits, glaciers, and other bedrock. The Canadian dataset included a bedrock coverage (Yukon Geological Survey, 2018), some surficial geology data (Lipovsky and Bond, 2014), and ice and snow coverage (Natural Resources Canada, 2016).

A reconciliation was carried out in an attempt to best represent the bedrock/surficial sediment/ice areal proportions. For reasons of scale, presently available digital maps do not depict the known proportions of bedrock/surficial sediment/ice areal in an area surrounding the Duke River fault. We reconciled digital map data using available non-digital maps in an attempt to accurately represent the bedrock/surficial sediment/ice areal proportions. For those areas, Qs (merged C, D, E) and Ice (G) were subtracted from QTV and other bedrock in Dataset B. Undifferentiated bedrock in the far northwest extent of F was digitized and compared to the areas mapped as QTV in Dataset B. The result is that the White, Duke, Donjek, and Slims River watersheds may have up to 30% more unconsolidated sediment cover than had been mapped digitally at the time of this study.

Geologic Map References

Fulton, R.J., 1995, Surficial Materials of Canada, 1:5,000,000, <https://geoscan.nrcan.gc.ca/starweb/geoscan/servlet.starweb?path=geoscan/download.web&search1=R=295462>, accessed 11/30/18.

Gordey, S.P., and Makepeace, A.J., 2003, Yukon Digital Geology, Geological Survey of Canada, Open File 1749, <https://geoscan.nrcan.gc.ca/starweb/geoscan/servlet.starweb?path=geoscan/download.web&search1=R=214639>, accessed Dec. 11, 2018.

Lipovsky, P. and Bond, J.D. (compilers), digital release 1, 08-Apr-2014, Surficial Geology Polygons (1:100-125k), 2014, Yukon Geological Survey, <http://data.geology.gov.yk.ca/Compilation/8>, accessed 11/30/18.

Natural Resources Canada, 2016, digital release, 07-Mar-2016, Ice and Snow – 250K – Canvec, <http://mapservices.gov.yk.ca/GeoYukon/>, accessed 11/30/18.

Rampton, V.N., 1981, Surficial materials and landforms of Kluane National Park, Yukon Territory, Preliminary Map 13-1979, Geological Survey of Canada, Paper no. 79-24. <http://mapservices.gov.yk.ca/GeoYukon/>, accessed 11/30/18.

Wilson, F.H., Hults, C.P.; Mull, C.G., and Karl, S. M., 2015, Geologic map of Alaska, Scientific Investigations Map 3340, 1:250,000, <https://pubs.er.usgs.gov/publication/sim3340>, AKStategeol poly, accessed 11/30/18.

Yukon Geological Survey, 2018, Yukon Digital Bedrock Geology, 1:5000 – 1:150,000,000, http://www.geology.gov.yk.ca/databases_gis.html, accessed 11/30/18.

Consolidation and Analysis Steps Using GIS:

- Merge Datasets C, D, E into one “Yukon Qs” shapefile.
- Clip “Yukon Qs” shapefile to exclude QTV and other bedrock in the area of high-resolution dataset C, thus allowing QTV to supercede Qs mapped at low-resolution producing “Final Yukon Qs” shapefile.

- Clip Yukon QTV (B) by ice (G) and by “Final Yukon Qs” shapefile, producing “Exposed Yukon QTV” and “Exposed Yukon other Bedrock” (one for each of 8 non-QTV bedrock groupings: refer to Figure 4 or Data Repository Item DR5 for groupings) shapefiles.
- Clip Qs, QTV, Water, Ice, and 8 bedrock groupings individually to watersheds and subwatersheds. Calculate areas individually for all 12 groupings (refer to Figure 4 or Data Repository Item DR5 for groupings) in each of watersheds. Tabulate (see DR5) areas and percentages of areas of 12 geologic groups for watersheds (20 main river sample sites and 9 tributary sample sites on Table 1).