

GR-05-034

Dempster Highway Aggregate Survey, km 193 - km 347



Brent Ward
PGeo

July 20/14

July 20/14

EXECUTIVE SUMMARY

An aggregate survey was carried out from km 193 to km 350 along the Dempster Highway. Although numerous gravel resources we observed along the Ogilvie River portion of the survey, little potential aggregate was found in the highest priority area along Eagle Plain. In this portion of the Dempster the road is up on the ridge tops. Geomorphically, this is not a place that gravels usually occur; headwaters of streams within economic transport distance of the road are generally erosive with no significant accumulations of gravel. Bedrock exposed along the Dempster south of the present crushing site at KM 347 did not appear to be of good quality. The relatively young Cretaceous sandstones exposed are poorly lithified and would likely disaggregate fairly quickly after being used for road surfacing or traction control in the winter.

The only potential gravel source associated with the highest priority area is just as the road starts to climb out of the Ogilvie valley at km 245.8. Here a large terrace feature contains gravel. The size of the terrace indicates a large source, but because many of the clasts are sandstone, the durability of the crushed aggregate would have to be evaluated.

The rest of the route has numerous zones of suitable aggregate. Some are in the same terrace level as existing resources. Others are from higher terraces from previous glaciations. These are documented in the report.

OBJECTIVES:

At the request of Brian Tyhy at the Yukon Ministry of Highways and Jeff Bond and Carolyn Relf at the Yukon Geological Survey, an aggregate survey was carried out along a section of the Dempster Highway. Aggregate Resources are in short supply along portions of the Dempster Highway, especially from 245- 350 km where at present bedrock is being crushed. This aggregate is not ideal as it degrades over time. Also resources are becoming scarce along other portions of the Dempster between 193 and 245.

BEDROCK, PHYSIOGRAPHY AND GLACIAL HISTORY

The aggregate study area encompasses the Northern Ogilvie Mountains and the Eagle Lowland/Plains (Matthews, 1986)(Figure 1). The Northern Ogilvies comprise, flat-topped hills commonly with tors; most valleys are narrow and steep sided forming a trellis pattern, while ridges are broad and rounded (Smith et al., 2004; Thomas and Rampton, 1982a). Elevations range up to 875 m. The Eagle Lowland is a rolling low relief area with elevations generally between 300-600 m. The drainage is characteristic of unglaciated areas with a dendritic drainage pattern, with most interfluves having elevations of 450 m. (Smith et al., 2004; Thomas and Rampton, 1982b)

In the area of the Northern Ogilvie mountains the bedrock geology is dominated by Lower Paleozoic, mainly Devonian to Carboniferous, interstratified dark (sandstone, shale) and light colored (shallow water carbonate) sedimentary rock units (Pyle et al., 2007)(Figure 2). These rocks are folded and faulted as noted by the pattern of outcrops reflecting anticlines and synclines. These rocks were subsequently uplifted and eroded and then Cretaceous rocks were deposited above. The aggregate potential of these rocks would be highly variable, with the best potential for crushing being the carbonates.

In the southern portion of the Eagle Plains are flat lying Late Cretaceous (70-100 million years) interbedded shales, siltstone and sandstone that unconformably overlie the Paleozoic sedimentary rocks (Figure 3)(Pyle et al., 2007). The environment of deposition of these Cretaceous rocks is an ancient shoreline comprising tidal flats, coastal plains and shallow marine sediments. Being close to the shoreline is indicated by abundant plant fossils and remains in these rocks. They do not seem to have good crushing aggregate potential as the sandstones are poorly lithified and easily disaggregate. Further to the north, as the Dempster approaches Eagle Plains Lodge, it crosses back into the older Paleozoic sediments. According to Pyle et al. (2007), the present crushing site at ~km 347 is in Carboniferous Hart River Formation. The unit is variable comprising carbonates, conglomerates, sandstones and shales. Some beds such as the light grey, siliceous limestone containing discontinuous beds of carbonate breccia and pebble conglomerate would be excellent aggregate potential. However, the black, soft, silty shale and possibly the sandstone would likely be sub-optimal.

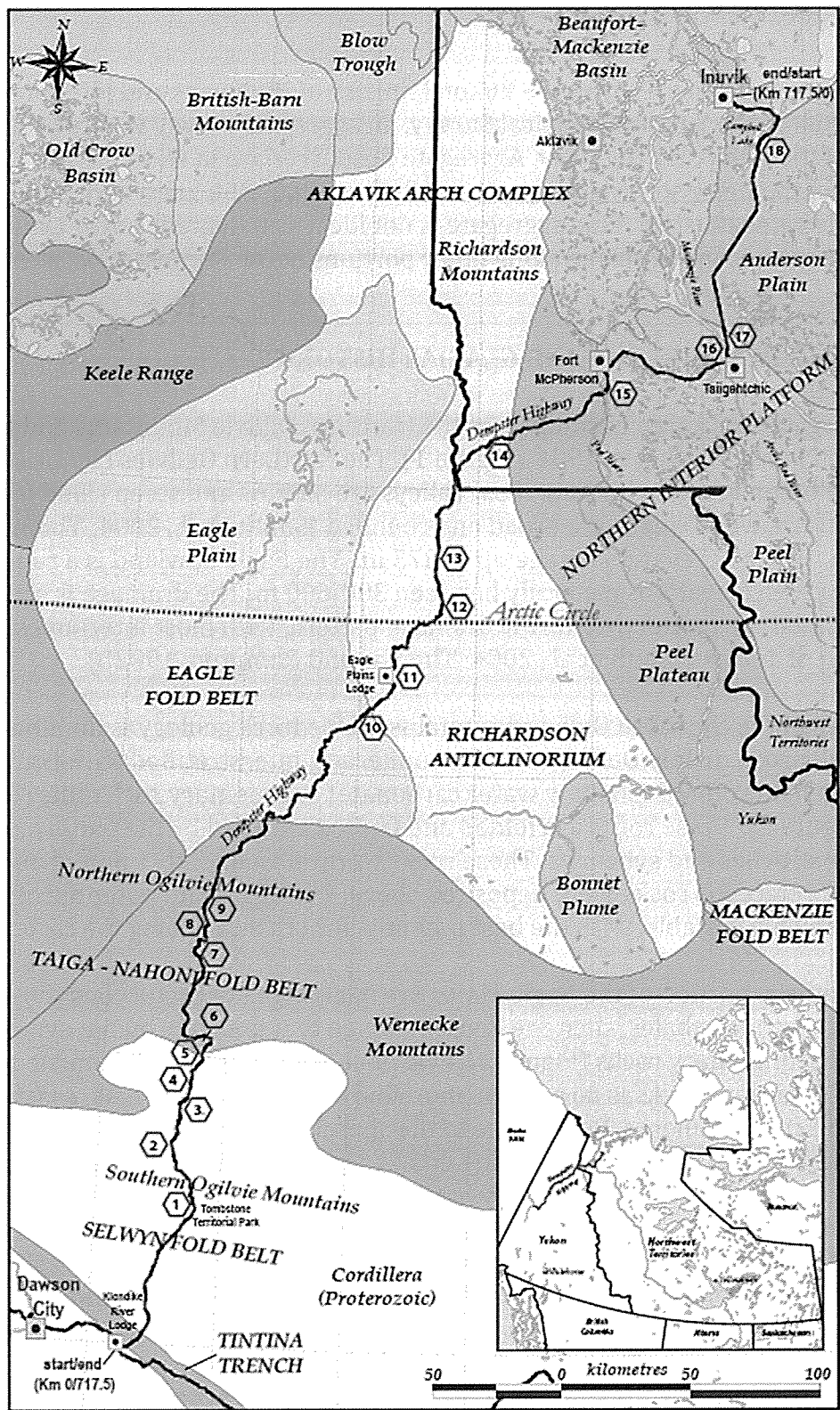


Figure 1: Major physiographic regions of the Dempster Highway. Figure 3 from Pyle et al. (2007).



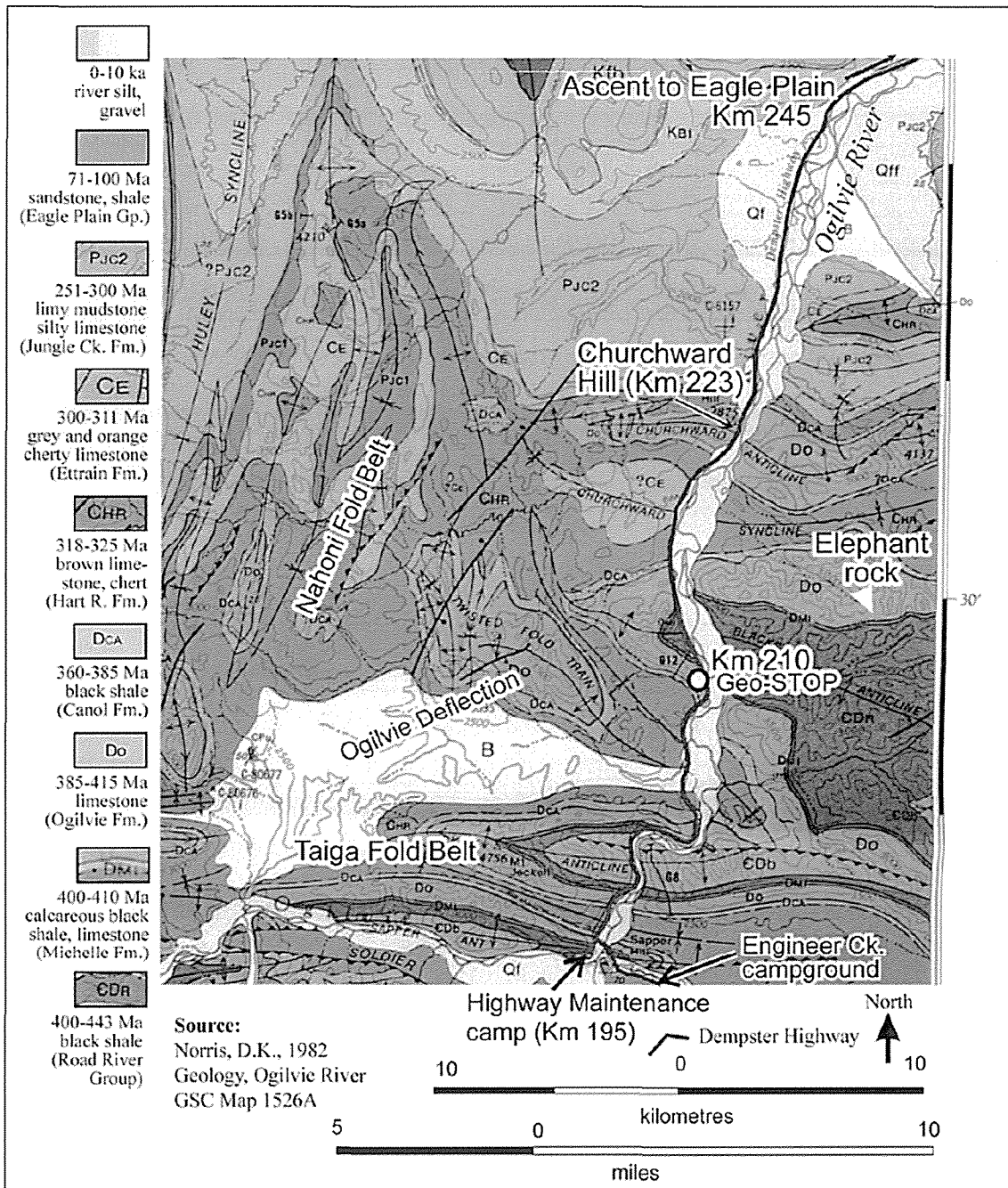


Figure 2: Bedrock geology of a portion of the southern portion of the aggregate area. The majority of the area is underlain by folded and faulted Devonian and Carboniferous sediments. Figure 32 from Pyle et al. (2007).

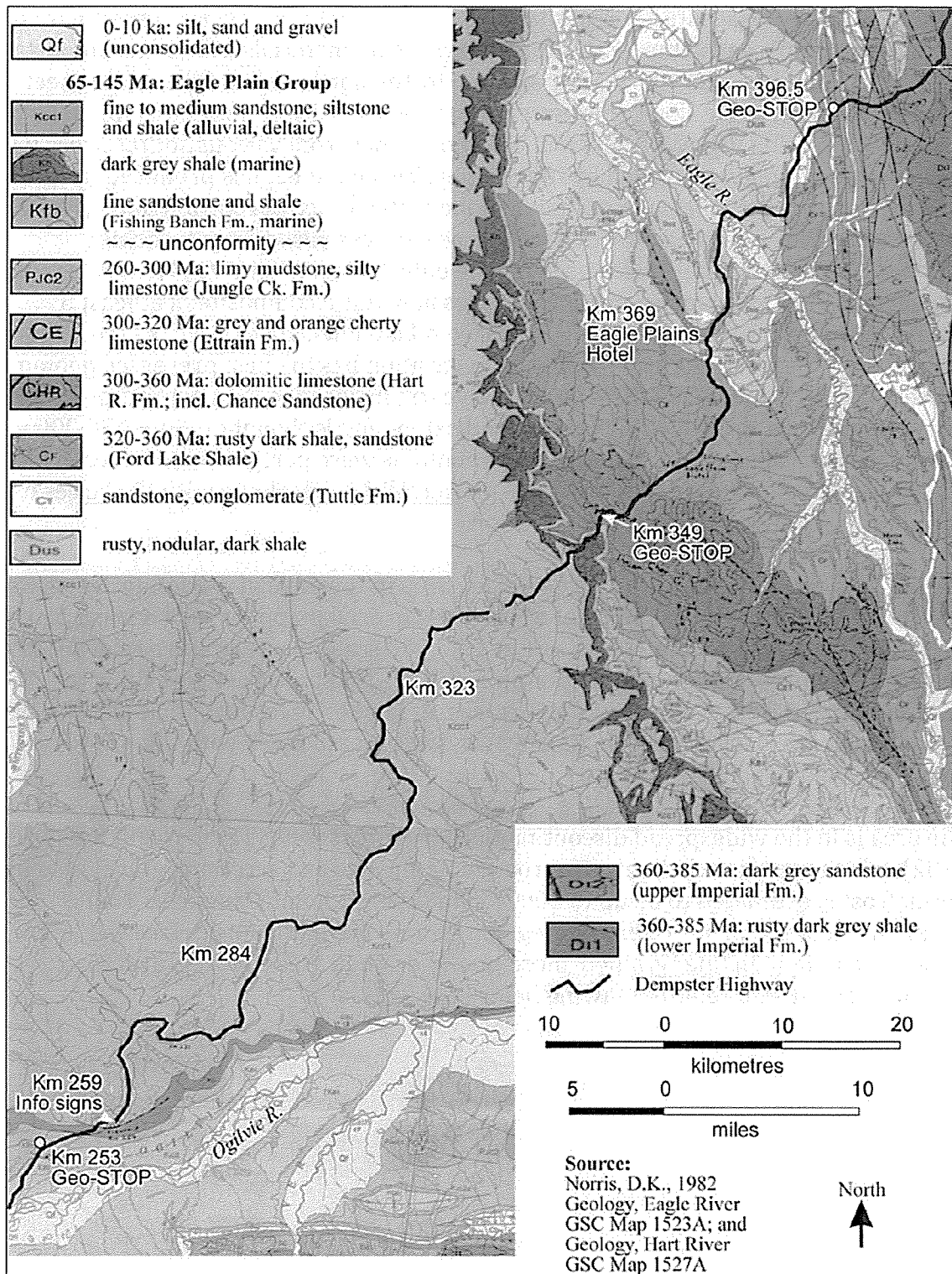


Figure 3: Bedrock Geology of the northern, higher priority portion of the aggregate survey. Figure 37 from Pyle et al. (2007)

Although the aggregate study area is beyond the limit of the last glaciation (Figure 4), glaciation has influenced the distribution of aggregate materials and is thus important. Yukon Territory has been repeatedly affected by the northern Cordilleran ice sheet. Although termed an ice sheet, it is better described as an ice complex, comprised of a series of coalescing valley glaciers and piedmont lobes from various source areas whose ice flow was strongly controlled by topography. This ice sheet has produced irregular, digitate horseshoe-shaped glacial limits on the plateau area of central Yukon (Fig. 4). This glaciated area has been divided into three surfaces based on geomorphic expression. The term pre-Reid is used for the oldest, most extensive glaciated surface that has the most subdued geomorphic expression. It is a composite of at least 5 undifferentiated glaciations ranging in age from Late Pliocene (2.7-2.5 Ma) to Middle Pleistocene. The least extensive McConnell glaciation has the best preserved geomorphic expression and is late Wisconsinan (20,000 years) in age. The Reid glaciation is intermediate in both surface expression and extent and is thought to be ~130,000 years old in the Ogilvie Mountains. The Ogilvie mountains were part of the Cordilleran Ice Sheet for older glaciation but local alpine glaciers did not coalesce with the larger ice sheet during the latest McConnell glaciation.

These glaciation affected the aggregate study area in the form of glaciofluvial terraces and fans than can contain significant aggregate. Surficial mapping has been carried out along the entire length of the Dempster at 1:50,000 scale. Two maps are relevant to the aggregate study area: Thomas and Rampton, 1982, a and b. These maps show the distribution of different elevations of terraces. At1 are terraces from that last glaciation, At2 are from the glaciation before the last, and At3 is associated with the pre-Reid glaciations.

The area is in the widespread discontinuous permafrost zone (Thomas and Rampton, 1982), which provides challenges for road maintenance and accessing gravel resources. Permafrost is estimated to be up to 100-200 m thick with unfrozen areas (taliks) common under the major rivers. Segregated ground ice, in the form of ice wedges and ice lenses, is common in finer grained, more poorly drained areas. Most gravel resources will be frozen and would require thawing before excavation.

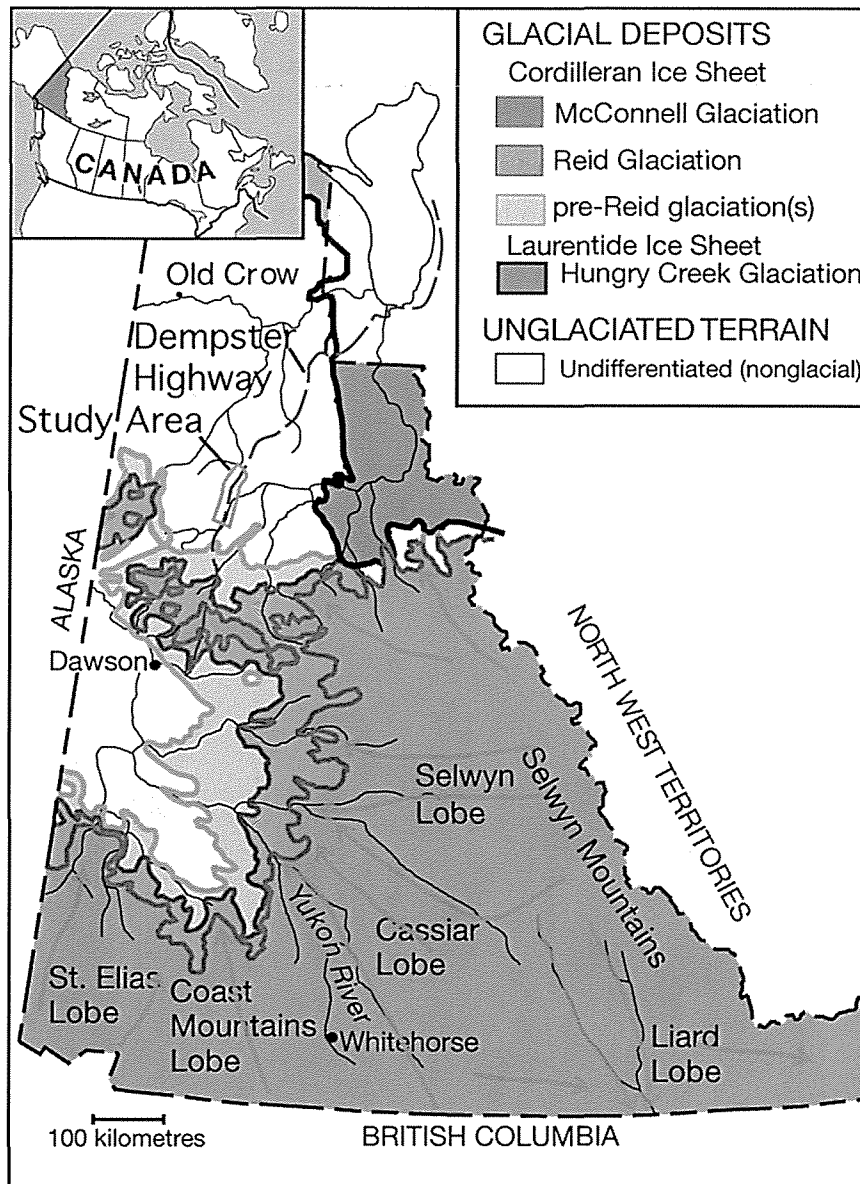


Figure 4: Glacial limits for Yukon (Modified after Duk-Rodkin 1999). Approximate location of Dempster Highway indicated with blue dashed line and the approximate location of the aggregate study area is indicated by the Blue box.

Fieldwork was done on July 8 and 9th. Brent Ward and Sydney van Loon (Yukon Geological Survey) left North Fork campsite the morning of July 8th and worked on the section of the Dempster Highway close to Eagle Plains. Weather on July 8th was excellent. Stayed at Eagle plains lodge that night. Next day they worked their way back towards North Fork campground. Heavy rain began that morning, making fieldwork later in the day more problematic.

km 193.3

65.38398

138.27582

Intermediate terrace ranging from 2-3 m's to ~10 m above road (Figure 5).

Bouldery Gravel (Figure 6)

Clasts subangular to subrounded with low sphericity. Numerous boulders present, dominantly cobbles and pebbles. Matrix medium to coarse sand.



Figure 5: Reid aged (At2) terrace at km 193.3.



Figure 6 Detail of Gravel at km 193.3.

~km 199

65.40118

138.27548

Treed surface ~10 m about river (Figure 7). Likely a gravelly alluvial fan. This surface would be underlain by sand and gravel and if aggregate is required in this area, it would be worth a test pit.



Figure 7: Likely a gravelly alluvial fan at km 199.

From km 216.6 (Bedrock borrow pit) to km 218

Road traveling on low alluvial terrace terrace that would have suitable aggregate resources along it's entire length.

km 219.7-Davis Creek

Fairly large extent of terrace that is ~4 m above river.

Exposure in River bank (Figure 8) should reflect material under terrace.

Pebbly gravel with a sandy granule matrix (Figure 9). Clasts subrounded, some platy, pebbles to cobbles with most clasts being in the small pebble range. Good mix of lithologies so would be good durable aggregate



Figure 8: Exposure of gravel just below surface of low terrace approximately 4 m above river level.



Figure 9: Detail of gravel in low, 4 m terrace at km

Davies Creek to km 221.6

High terrace mapped as Reid (glaciation before the last) glaciofluvial outwash (At2). Most of terrace exposed in roadcut is bedrock (Figure 10) with gravel of ~2 m on top. Access to gravel may be difficult.



Figure 10. High terrace at km 221.6 mapped as Reid glaciation (At2)

km 221.9 to 224

T

Large terrace surface (Figure 11). No exposures but sand and gravel will be under.



Figure 11: Large, low terrace surface that will be underlain by sand and gravel.

km 225.3 Start large terrace.

Bedrock exposed marks the start of terrace complex that extends to ~km 241.5. Structure likely a complex of alluvial terraces and plains of variable elevation. This is a large potential resource that already has active pits in it. Suggest test pits along this surface to find best gravel resources when you need to expand resources. However, it is likely frozen and some wet areas indicate drainage could be an issue. Some details along the terrace described below.

km 226

Large active pit with big stockpile.
Gravel looks very similar to site at 228 but possibly finer grained.

km 228

Exposure along river ~1 m of imbricate gravel (Figure 12). This is a window into the sediments that makes up terrace surface from km 221-224. Gravel is dominantly sub-rounded pebbles with a sandy granule matrix (Figure 13). Clasts appear competent.



Figure 12: Exposure of gravel along river at km 228. Pick is ~60 cm long.



Figure 13: Detail of gravel exposed at km 228. Pick is ~60 cm long.

km 237.6

Active pit

Looks like a relatively thin gravel with some poorly sorted zones representing back channel deposition.

km 241.5

65.70180

138.06886

End of large flat area on either side of road. Mapped as Alluvial Plain.

km 242

65.70589

138.05164

Terrace ~9m above road (Figure 14). Not sure of extent back into slope, may only be 4 m, gravel exposed for at least 160 m along road.

Gravel: Clasts pebble to cobble, subrounded, some platy average size 1-2 cm, medium to coarse sand matrix (Figure 15). Clasts look competent - sandstone, siltstone and limestone. L.C. covered but >3-4 m thick.



Figure 14: Small gravel terrace at km 242



Figure 15: Gravel exposed in terrace at km 242.

km 245.8

65.71844

137.92795

Large alluvial terrace, likely associated with small creek coming in from hillslope.

Exposure where road cuts through terrace.

Gravel, lower contact covered but at least 3 m thick. Clasts pebble to boulders up to 3—40 cm, average size ~ 3-4 cm, subrounded but majority platy. Most are sandstone, matrix dominantly sand. Weak horizontal stratification with silty-sandy matrix zones and some open work granules and very small pebble layers.



Figure 16: Large terrace at km 245.8.

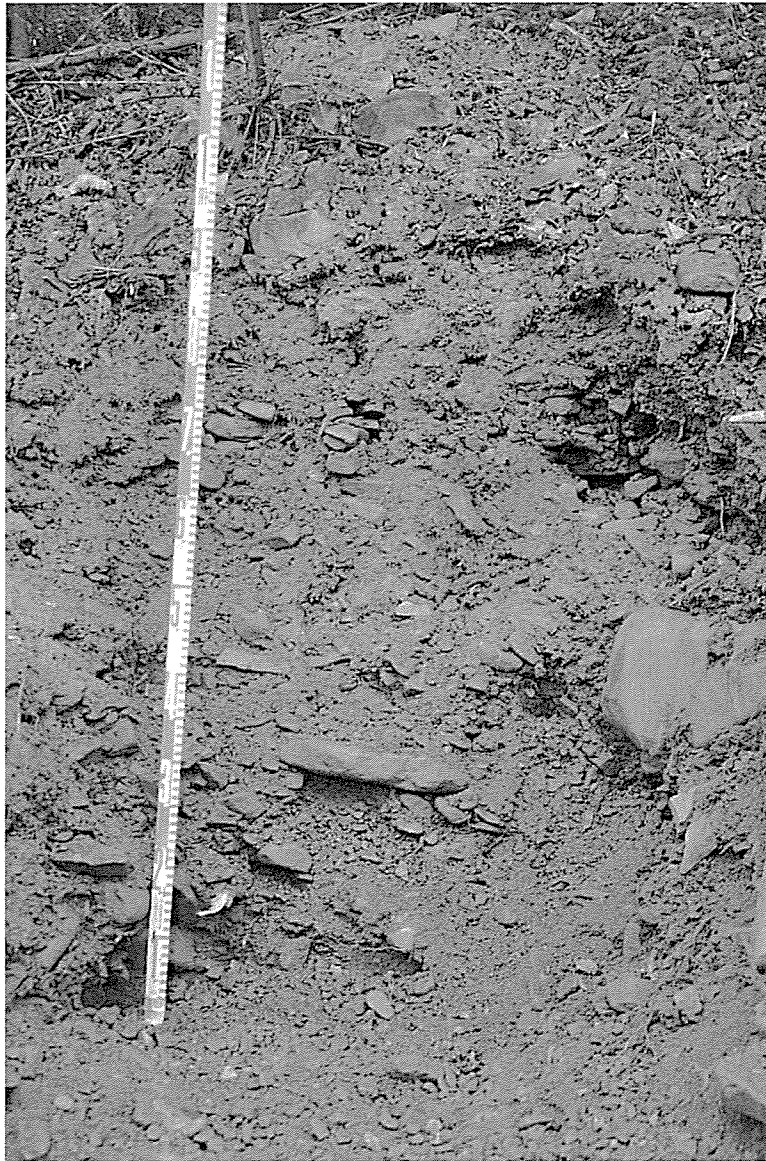


Figure 17: Detail of gravel at road cut through terrace at km 245.8.

km 251.1

65.75545

137.92795

Outcrop ~12 m high and ~200 m long (Figure 18)

High outcrop interstratified siltstones and sandstones.

Sample taken of sandstone and described in the lab:

Fine - grained (0.18-0.3 mm) immature sandstone. Grains are dominantly subrounded with lesser amounts of sub-angular. Lithology is a mix of quartz, feldspar and dark lithic

fragments. The rock is poorly lithified with grains able to be rubbed off with finger. Cement is orange and likely siderite. Porosity is quite high and no visible reaction to HCl.



Figure 18: Outcrop at km 251.1.

km 272.8

65.84269 137.67690

Sandstone outcrop at side of road (Figure 19)

Road cut at least 170 m long.

This outcrop contains interbedded sandstone and siltstones. The more regressive siltstones would not make a good crushed aggregate. As the sandstone is poorly lithified it may not make good crushing aggregate either.

Sample of sandstone collected and described in the lab:

Fine - grained (0.18-0.3 mm) immature sandstone. Grains are dominantly subrounded with lesser amounts of sub-angular. Lithology is a mix of quartz, feldspar and dark lithic fragments. The rock is poorly lithified with grains able to be rubbed off with finger.

Cement is orange and likely siderite. Porosity is quite high and no visible reaction to HCl.



Figure 19. Sandstone outcrop at km 272.8

km 273.5

Outcrop alongside of road. Thickly bedded sandstone up to 7-8 m high (Figure 20, 21).

Two samples taken to reflect the variation and described in the lab:

Majority of outcrop is fine to medium grained immature sandstone (0.125 -0.3 mm) with some areas being medium to coarse grained (0.35-0.7 mm) with areas of very coarse sand and granules (1.0 mm-4 mm). Grains are approximately equal amounts of subrounded sub-angular. Lithology of grains are a mix of quartz, feldspar and dark lithic fragments, some of which are chert. Sandstone is poorly lithified with grains able to be rubbed off with finger. Cement is orange and likely siderite. Porosity is quite high and no visible reaction to HCl.



Figure 20: Detail of outcrop at km 273.5. Rock hammer for scale.

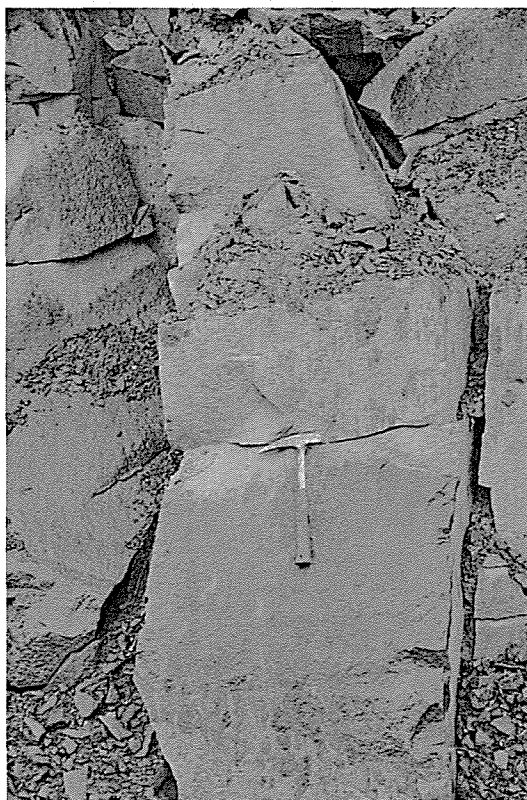


Figure 21: Detail of thickly bedded sandstone.

km ~289

Old borrow pit in sandstone.

It is an immature, lithic rich sandstone that is poorly cemented. Grains rubbing off easily. No sample taken, no photographs.

km 316.2

Active drill pad with a crane. Possible 2-3 m exposure in bedrock, but we have no hard hats or steel toed boots.

km ~324.6

Active drill pad, did not access but did not look like any good bedrock exposures

km 333.4

66.16471N

137.11690E

Old crushing site, bedrock exposed (Figure 22)

Immature carbonaceous sandstone.

Samples taken described in lab:

It is a medium grained (0.3-0.5 mm) immature sandstone. Grains are dominantly sub-angular with lesser amounts of subrounded and angular. Grains are a mix of quartz, feldspar and dark lithic fragments. Sandstone is poorly lithified with grains able to be rubbed off with finger. Cement is orange and likely siderite. Porosity is quite high and no visible reaction to HCl. Organic material present



Figure 22: Bedrock exposed in old crushing site at km 333.4.

km 347

Active crushing site (Figure 23)

Recent blasting has exposed a variety of sedimentary rock types: conglomerate, breccia and sandstone.



Figure 23: Fresh exposure at crushing site.

REFERENCES

Duk-Rodkin, A.J., 1999. Glacial limits map of Yukon Territory. Geological Survey 36 of Canada Open File 3288 and Yukon Geological Survey Open File 1999-2, 37 1:1,000,000 scale

Pyle, L.J., Roots, C., Allen, T.L., Fraser, T.A., Bond, J., Jones, A.L., and Gal, L.P., 2007. Roadside Geology of the Dempster Highway, Northwest Territories and Yukon, A traveler's guide to the Geology of Canada's most northwestern road; Northwest Territories Geoscience Office and Yukon Geological Survey, NWT Open File 2007-05 and YGS Open File 2007-10, 92 p.

Thomas, R.D. and Rampton, V.N. 1982a. Surficial Geology and Geomorphology, Lower Ogilvie River, Yukon Territory. Geological Survey of Canada Map 9-1982. 1:100 000.

Thomas, R.D. and Rampton, V.N. 1982b. Surficial Geology and Geomorphology, Moose Lake, Yukon Territory. Geological Survey of Canada Map 10-1982. 1:100 000.

