GRANULAR-MATERIALS AIRPHOTO STUDY

RICHARDS ISLAND AND ESCARPMENT ABOVE EAST CHANNEL IN VICINITY OF CARIBOU HILLS

J D MOLLARD AND ASSOCIATES LIMITED

CONSULTING CIVIL ENGINEERS AND ENGINEERING GEOLOGISTS

Specializing in airphoto interpretation and ground-water studies

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PURPOSE OF AIRPHOTO STUDY

The objective of this study was to purchase mosaics and available government contact aerial photographs and map potential sand and gravel deposits on Richards Island and along the Caribou Hills escarpment south of Tununuk. The prospects are shown on strip mosaics prepared from contact airphoto prints.

In addition, the prospects have been transferred to two mylar "blow-ups" covering parts of National Topographic Series mapsheets 107 B and C. These enlargements were supplied to us by the client: Mr. Paul G. Ellis, Northern Construction Company, Vancouver.

AREA STUDIED IN AIRPHOTOS

The two areas studied comprise 1) all of Richards Island except a narrow (one-half to one mile wide) north-south band (see Fig 1) and 2) the area of sand-and-gravel-capped upland and adjoining Caribou Hills escarpment west of 134°15' longitude and north of 68°45'. The latter area is bounded on the north by latitude 69°00' and is bounded on the west by the East Channel of the Mackenzie Delta.

REVIEW OF REPORTS ON THE SURFICIAL GEOLOGY

The surface geology of this region was mapped several years ago by Dr J. Ross Mackay of the University of British Columbia and more recently by Dr Vern Rampton of the Geological Survey of Canada in Ottawa. Dr James Shearer

with the G S C in Ottawa has recently studied side-scan sonar imagery showing offshore ocean-bottom markings associated with movements of pack ice on the Beaufort Sea. He was also contacted by phone.

We examined the small-scale maps and reports of these investigators and also reviewed the Canadian Hydrographic Surveys maps of this region.

Dr. Ross Mackay reports that most of the overburden sediments below about elevation 150 to 200 are Pleistocene (or glacial) in age. The last glacier to occupy the Mackenzie Delta melted some 13,000 to 14,000 years ago. This last glacier may not have advanced over Richards Island or the Caribou Hills east of the escarpment.

Both Drs Mackay and Rampton report that the Caribou Hills escarpment east of the East Channel of the Mackenzie River is composed of preglacial shales to the south (toward Reindeer Depot) and preglacial stratified sand, gravel, silt and peat to the north (toward Tununuk).

Exposures of these eroded materials appear on the aerial photographs and I have marked the best places to check them visually in the field using a helicopter. These places are marked with an "X" on the strip mosaics and plans.

MAIN TYPES OF SURFACE MATERIALS

The 1 inch = 2 mile uncontrolled mosaics disclosed the general location of prospective sand and gravel deposits because, in this high arctic tundra region, the sand and gravel deposits are high and dry and windswept, and therefore show light-toned to whitish on good quality aerial photographs.

There are basically four (4) different kinds of granular deposits, each having a different origin and environment of deposition. These four kinds are as follows:

1. Preglacial sand and gravel, older than glacial age -- say, over 1 million years old.

2. Glacial outwash and outwash delta deposits on the upland east of the escarpment and washed out over the upland from glacial meltwater streams originating on the glacier ice occupying the Mackenzie Delta. The streams flowed eastward and deposited preglacial sand and gravel that the glacier had picked up. These whitish-appearing deposits show a dark crack pattern, the cracks being shallow troughs overlying degraded ice wedges.

3. Eskers, kames, and crevasse fillings. The eskers are narrow winding ridges of sand and gravel deposited in a tunnel in stagnant glacier ice. They are complexly bedded and gravel-mining operations may yield sand one day, gravel the next, and possibly even boulders and silt. Layers of enclosed silt are sometimes quite common. Eskers can be highly pockety and variable to work commercially. But they are high (elevated) and locally at least they probably never had very high water and ice contents. In other places the deep thaw depressions suggest melting of blocks of buried ice.

Crevasse fillings are similar to eskers but are wider and are flatter-topped. A crevasse filling occurs east of Yaya Lake. They were formed in a crevasse (channel, canal) on the surface of stagnant glacier ice -- that is, open to the sky rather than in an ice tunnel.

Kames are isolated mounds and groups of mounds composed of stratified sand and gravel with, usually, some silty and cobbly interbeds. Kames are deposited by meltwaters discharging upon, within, under or against stagnant ice and so are called ice-contact forms.

4. The fourth group of granular deposits include narrow beach deposits in coves and bays, offshore barrier beaches and submerged bars, long narrow spits, and exposed point bars along the larger channels of the Mackenzie Delta, as along the East Channel. These deposits are likely to be composed mainly of sand, grading into silt in lower wave-energy environments -- usually in very shoal waters and in protected shoreline stretches. These deposits are relatively easily assessed visually, especially at low tide. Because these deposits are "on tidewater," they should be visually evaluated and shallow auger holes or hand-dug test pits put down. I have wondered about the possibility of submerged sand and gravel bars at the mouth of the East Channel (Kittigazuit Bay).

LARGEST GRANULAR DEPOSITS

Richards Island

Only a few promising-looking granular deposits appear on Richards Island. The largest deposit is situated east of Yaya Lake, with smaller discontinuous esker and kame deposits south and southwest of Yaya Lake (Fig 1). The deposit south of Yaya Lake is being worked and is said to contain little ice, with some material as large as fist size. The most easily assessed granular ridge is an east-west esker south of Yaya Lake. The kame mounds are pockety and probably even more variable than the eskers.

A small narrow winding discontinuous esker -- a more classic-looking one -- lies south of Willow and Crooked Lakes. Other granular-material prospects lie south and east of a large lake east of the north end of Yaya Lake. Existing gravel pits near Tununuk and north of the East Channel at 134°25' should give an indication of the gradation, ice content, and variability one might expect in the larger deposits.

Caribou Hills Upland and Escarpment

a) Upland

Large "plates" of upland outwash and outwash-delta sand and gravel are shown on strip mosaics south of Tununuk. These deposits look extensive, large in volume, and may be a few yards deep -- but their depth is difficult to guess in many places. I have estimated 200,000 cubic yards of granular material per yard of depth per square inch of outlined granular area on strip mosaic D at scale 1 inch = 1400 feet. Thus, if the deposits are 2 or 3 yards deep, a large volume of material is present (see conclusion).

Ice-wedge troughs (ice-filled cracks) and deep steep-sided bowl-shaped depressions indicate that these granular materials likely contained large masses of ice before it melted out. I also expect considerable ice exists at the present time in these upland sands and gravels.

It is not possible to estimate the ratio of sand to gravel sizes because surface slumping and slopewash has obliterated exposures in these sediments.

b) Eroded escarpment wall

There is a noticeable change in the appearance of the high valley wall east of the East River and south of Tununuk. This change occurs about 68°52'

north latitude. North of here the sediments are likely wholly glacial in origin and age whereas south of here preglacial materials appear in eroded valley bluffs. The sand and gravel in the preglacial deposits is reported to vary in gradation and maximum size, with 3/4-inch to 3 inches being common maximum sizes depending on exposure examined. The sand and gravel section contains uniform sand, silty lenses, clay balls, wood fragments, peat, and some layers cemented sand or gravel. If these deposits are similar to those at Inuvik, the cement may be calcium carbonate, or lime (whitish-colored) or iron oxides (rust-colored).

Careful detailed field examination is needed to assess how much silty and peaty material is contained in exposures and how much cementation has occurred. These eroding bluffs of interbedded sand, gravel, silt and peat extend southward and eventually change to eroding shale bluffs some distance north of Reindeer Depot, the exact location being hard to pinpoint on the photos.

Between 68°52' and Tununuk the bluffs along the right (east) bank of East Channel contain little gravelly or cobbly materials and are expected to consist largely of interbedded sandy and silty layers with peat beds and some wood.

FACTORS AFFECTING LARGE-SCALE SAND AND GRAVEL PRODUCTION

1. Richards Island contains numerous pingos, numerous old and active mudflows around lake walls and thaw depressions, and extensive ice-wedge polygons -- especially toward the northwest. Thus the dominant soil type is likely to be fine-grained (clay, silt, fine sand) with minor stones and gravel. This kind of terrain will likely be susceptible to disturbance from heavy hauling over the tundra during the summer. But winter hauling from the

eskers and kames may present no serious problems.

2. The eskers, kames, and crevasse fillings on Richards Island are likely to be variable in gradation of materials -- both vertically and in a horizontal direction. This variation may not be apparent in a small pit. These deposits are likely to be more variable in gradation than the upland outwash deposits south of Tununuk.

3. The preglacial sand and gravel deposits are likely to vary from clean to dirty beds of gravelly to sandy material with silt and peat seams and lenses. Detailed visual examination followed by selective drilling is needed to identify the better "commercial" localities.

4. The content of ice -- occurring in lenses, seams and wedges -- may create problems in operating pits in summer, especially if thawing silty beds are present.

5. The East Channel south of Tununuk is very shallow, with the hydrographic maps indicating less than 3 feet of water in several places between Tununuk and a potential sand and gravel quarry site.

6. Rough estimates of recoverable materials per yard of depth can be made directly from the mosaics and maps (see conclusions). But these estimates can be improved markedly with a little fieldwork at select locations. The big problem is the occurrence of a surficial silty sloughed layer overlying undisturbed sand and gravel beds. This "skin deep" layer will hinder direct field inspection on many non-vegetated valley wall faces.

CONCLUSIONS

1. An approximate and rounded 7,000,000 cubic yards of sand and gravel per yard of recoverable depth is estimated for the eskers, kames, and crevasse fillings on Richards Island. These granular materials are likely to be pockety and variable locally and to contain ice and silt lenses and wedges. If the recoverable deposit averages 3 yards deep, the quantity is 21,000,000 cubic yards.

2. An approximate and rounded 6,000,000 cubic yards per yard of recoverable depth is estimated for the upland outwash and outwash-delta deposits situated within roughly one mile of the top of the escarpment south of Tununuk. These sand and gravel prospects are likely to contain some silt and appreciable ice in the form of wedges and buried sheets and lenses. If the recoverable depth were 3 yards, the quantity would be 18,000,000 cubic yards.

3. It is difficult to estimate crudely the quantity of preglacial sand and gravel in the bluff south of $68^{\circ}52'$ owing to the unknown content of silt and peat. These deposits could be very thick and very extensive, however.

4. No field inspection has been carried out to accompany this office study. Accordingly, questions relating to percentage of fines (silt and clay passing the 200 sieve), gradation of granular materials, percent crushable gravel, amount and distribution of ground ice (permafrost), average workable thickness of deposits, rock type (abrasiveness, durability in freeze-thaw), excavation problems in these frozen materials (wearing of teeth, need to rip, etc.) and methods and timing of extraction require field inspection and, almost unquestionably, some selective field testhole drilling.

5. The shoreline (tidewater) deposits are likely to be fine (sand and silt). But they should be checked because they are unlikely to be frozen, they could be extensive, and they may (I don't know) be amenable to dredging. Considering the geological history of the area, a large volume of sea-bottom sand may occur in Kittigazuit Bay.

6. Of all the granular-material prospects north of Inuvik, it is likely that very few areas lend themselves to critical and useful field inspection as much as those granular deposits on and surrounding Richards Island and on and above the highly eroded 150- to 200-foot high escarpment above the right (east) bank of the East Channel of the Mackenzie River -- say, south of about $68^{\circ}52'$.

7. Granular prospects are shown on xerox prints of the 1 inch = 2 mile mosaics, the 1 inch = 1400 ft contact prints (line D), 1 inch = 3500 ft airphotos and 1 inch = 7500 ft enlarged transparencies that were sent to us by Mr. Paul G. Ellis of Northern Construction Company, Vancouver.

END OF REPORT