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R.M.HARDY & ASSOCIATES LTD.

PRELIMINARY REPORT
1977 GRANULAR MATERIALS INVENTORY
TUKTOYAKTUK, N.W.T.
PHASE II - GEOPHYSICAL DATA ACQUISITION

Prepared For
THE GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT



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1.0 INTRODUCTION

The Government of Canada, through the offices of the Department of Indian Affairs and Northern Development, commissioned R. M. Hardy & Associates Ltd. of Calgary to carry out an assessment of granular material sources in the vicinity of Tuktoyaktuk, N.W.T. The principle objective of the study was to locate at least 10 million cubic yards of sand and gravel. The first phase of the work consisted of investigating granular deposits on land, and a final report on that work was completed in August, 1977.

Gravel and sands are also found in the sediments of Tuktoyaktuk Harbour and they may be available by dredging and other means. The objective of the next efforts of the investigations are to evaluate the quantity, availability, and quality of granular deposits in Tuktoyaktuk Harbour. Some potential sources of borrow suitable for construction purposes, were identified in an off-shore drilling program carried out by E. W. Brooker & Associates Ltd. in 1973 on behalf of Imperial Oil Ltd.



Phase II of the Granular Materials Inventory, Tuktoyaktuk, consist of acquisition of geophysical data over Tuktoyaktuk Harbour. The work was formally authorized by the Department of Supply and Services under Contract Serial Number OSU77-00240. The official communique to proceed with the study was recieved from the Department of Supply and Services by telex on September 20, 1977, and work was initiated immediately. The acquisition of geophysical survey data was subcontracted to Kenting Explorations Services Co. Ltd. of Calgary, Alberta.

This is a preliminary report on the geophysical survey performed in Tuktoyaktuk Harbour between September 29, and October 3, 1977.

2.0 GEOPHYSICAL DATA ACQUISITION

2.1 General

The use of geophysical surveys to assist in the exploration of sand and gravel deposits in Tuktoyaktuk



Harbour was recommended by R. M. Hardy & Associates Ltd. for the following reasons:

- a) On land, likely locations of granular deposits are often obtained from airphoto studies, and the placing of drill holes is based on these studies. Over water, marine geophysical surveys have the same objective as airphoto studies on land, that objective is to identify areas of likely occurrence of sand and gravel for further exploration by drilling.
- b) Airphoto mapping is also used to interpolate information from test holes over larger areas. Marine geophysical surveys serve that purpose over water. Information from an overwater test hole is interpolated over areas with similar acoustic signatures.
- c) Dredging or other means to recover underwater sands and gravel require accurate bathymetric data. Such data is obtained in a geophysical survey.

2.2 Geophysical Surveys Performed

The geophysical data acquired were marine acoustic subbottom soundings. Data were simultaneously obtained with



three systems, independently operating at 7 kilohertz, 30 kilohertz, and 200 kilohertz. In marine acoustic soundings frequency to a large extent determines depth of penetration in the subbottom sediments. Other factors involved in limiting depth of penetration are output power, and dynamic range. The maximum penetration achieved on this survey was in soft sediments with the 7 kilohertz system and that maximum penetration was about 7 meters (20 ft). The 200 kilohertz system does not penetrate subbottom sediments and serves as an accurate fathometer.

The systems used on the survey were:

- a) Ratheon RTT-1000A Profiling System.

The RTT-1000A can be operated at frequencies of either 3.5 and 7 kilohertz. During this survey the 7 kilohertz frequency was used. The transceiver consist of a piezo-electric element mounted in a conical reflector. The transceiver was mounted approximately 0.3 meters beyond the side of the boat. The reflections are recorded on a graphic recorder.



b) Kelvin Hughes MS26B Profiler

This system operates at a frequency of 30 kilohertz. It uses two identical piezo-electric transducers, one for transmitting, and one for receiving. Both elements are placed in housings on circular brass diaphragms. The housings are mounted on the base of one casting. The base of the casting is the reflector and the diaphragms are sound windows in that reflector. The space in the transducer housings between the piezo-electric elements and the brass diaphragms is filled with fresh water. The reflections are recorded on a graphic recorder. The Kelvin Hughes system was mounted 0.3 meters beyond the opposite side of the boat.

c) Furuno Fathometer

The Furuno Fathometer operates at a frequency of 200 kilohertz. It yields accurate bathymetric data. It was mounted from the back of the boat behind the twin outboard engines. The data are displaced on a graphic recorder.



2.3 Positioning and Plotting of Survey Lines

A Mini-Ranger III positioning system was used to locate and determine the location of the survey lines over Tuktoyaktuk Harbour. The Mini-Ranger III is a line-of-sight positioning system operating in the frequency range from 5400 to 5600 MHz. The Mini-Ranger III operates on the principle of pulsed radar. It uses a mobile transmitter on the survey boat and two on-shore reference transmitters. The exact location of the reference transmitters must be known.

The mobile transmitter sends out a pulsed radar signal to interrogate the on-shore reference transmitters. The elapsed time between the transmitted pulse and the reply pulse is recorded for each reference station. This range information together with the known locations of each reference station is trilaterated to provide a position fix of the mobile unit (survey boat). A mini-computer (Hewlett Packard Model 9825) was used to compute and display in real time the position of the survey boat. The real time record of the computer not only yields accurate position data, but also serves as a navigational system. The skipper of the boat uses the real time output of the computer to stay on the predetermined survey line.



The probable range measurement accuracy is better than ± 3 meters. The location of on-shore reference transponders was surveyed in by using the Mini-Ranger III and initially locating 2 reference stations at known benchmarks on-shore.

The survey lines were plotted on a map of Tuktoyaktuk Harbour at a scale of 1 to 5000. The mini-computer provides a record of survey time versus position. The exact time was also recorded on all 3 subbottom survey records, so that the exact location of each record is known.

2.4 Field Operations and Field Logs

The subcontractor, Kenting Exploration Services Ltd., shipped their equipment by air freight to Inuvik, N.W.T. on September 23, 1977. This equipment included all electronic instrumentation plus a 21 foot inflatable Zodiac boat, propelled by twin 35 HP outboard engines. All equipment had arrived in Inuvik, N.W.T. by September 28, 1977. A fixed-wing charter was used to transport personnel plus equipment from Inuvik, N.W.T. to Tuktoyaktuk on September 28, 1977. Accommodations in Tuktoyaktuk, N.W.T. were obtained



at the CANMAR camp. Personnel consisted of two geophysicists from Kenting Exploration Services Co. Ltd. and one geophysicist from R. M. Hardy & Associates Ltd.

Field Logs

September 29, 1977

During the morning the required reference transponders of the Mini-Ranger III were surveyed in by initially locating transponders at benchmarks established by the Canadian Hydrographic Survey and the Canadian Geodetic Survey. During the afternoon the wind rose and due to the sea state work had to be discontinued. The afternoon was used to compute starting and end points of thirty-nine (39) survey lines.

September 30, 1977

Survey lines 31 to 39 were surveyed along with a tie-in line. During most of the day high winds caused a sea state unsuitable for surveying.



October 1, 1977

Poor weather conditions prevented surveying during this entire day.

October 2, 1977

Lines 15, 17, 19, 21, 23 and 25 were surveyed along with two tie-in lines which included a survey of Aveltkok Inlet.

October 3, 1977

Lines 1, 2, 3, 5, 7, 9, 11, 12, 13 and 14 were surveyed during the morning. During the afternoon the sea state made further surveys impossible. Because of the strict budget ceiling imposed on the project, the survey was discontinued at this time. The transponders were collected, and a final calibration of the Mini-Ranger III was made.

October 4, 1977

Equipment and personnel were transported to Inuvik by a fixed-wing charter.



October 5, 1977

Personnel arrived back in Calgary, and demobilization was complete.

2.5 Summary of Survey Data Obtained

The survey data were delivered by Kenting Exploration Services to R. M. Hardy & Associates Ltd. on October 7, 1977. The total amount of survey data collected is 28.2 line miles. This coverage consists of 18.3 line miles of parallel survey lines and 9.9 line miles of tie-in lines. All data is available at the 3 frequencies surveyed, and is of good quality. The coverage is considered adequate to make contour maps of subbottom features. Kenting Exploration Services Co. Ltd. has prepared a map at a scale of 1 to 5000 of Tuktoyaktuk Harbour, superimposed on which is the accurate position of each survey line.

3.0 RECOMMENDATIONS FOR DATA ANALYSIS

The survey data contains the following information directly relevant to further exploration of sand and gravel in Tuktoyaktuk Harbour.



- a) Accurate bathymetric data from the records of the Furuno Fathometer.
- b) Delineation of areas where the subbottom is "hard" (most likely sand and gravel) and areas where the hard bottom is overlain by "soft" sediments from the records of the 7.0 khz Ratheon RTT-1000A, and the 30 khz Kelvin Hughes MS26B.
- c) Thickness of "soft" sediments over hard bottom.

To make these data useful in further exploration the following data processing is recommended:

- a) Produce a contoured bathymetric map of Tuktoyaktuk Harbour.
- b) Produce a map showing areas where the subbottom is hard.
- c) Produce a map showing areas where softer sediments overlay hard bottom.



- d) Produce a map showing thickness of soft sediments over hard bottom.

These maps would be used in the following manner in further exploration of sands and gravels in Tuktoyaktuk Harbour:

- a) Location of test holes. If initial test holes prove that the "hard" bottom consist of sand and gravel, further holes only need to be placed at locations of "hard" bottom or in areas where the thickness of the "soft" bottom is not excessive.
- b) Information from a test hole will be interpolated over areas with similar subbottom acoustic signatures to arrive at quantities of granular materials.
- c) From the information of the bathymetric map areas of deep water or steep gradients can be avoided.



4.0 COST ESTIMATE FOR DATA PROCESSING OF GEOPHYSICAL DATA

The cost estimates for data processing to produce the maps recommended in Section 3.0 are:

a) <u>Salaries</u>	\$8,315.00
b) <u>Printing, Report and Maps</u>	\$1,000.00
c) <u>Miscellaneous, telephone, reproduction, etc.</u>	<u>\$ 200.00</u>
Total	<u>\$9,515.00</u>

5.0 DISCUSSION

Aquisition of geophysical survey data over Tuktoyaktuk Harbour was carried out according to the terms of reference proposed in the contract documents (OSU 77-00240), and was completed within the established financial limitation.



A final report including analysis of the geophysical data as outlined in Section 3.0, would be prepared within approximately two months, following authorization to proceed. It should be noted that costs for separately prepared reports on the geophysical data interpretation and on a field drilling program may exceed the previously estimated cost for a single report, as quoted in our letter of September 7, 1977.

Respectfully submitted,

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Per:

T. J. Fujino
Project Manager

Calgary, Alberta
October, 1977
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