PLAN FOR THE RESERVATION AND DEVELOPMENT OF GRANULAR MATERIALS IN THE VICINITY OF INUVIK, N.W.T.

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Prepared For:

INDIAN AND NORTHERN AFFAIRS CANADA, OTTAWA

Prepared By:

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This project was a joint venture of Hardy BBT Limited,
Calgary, Alberta and Avati Associates,
Yellowknife, N.W.T.

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Albert Adams	President, Inuvik Hunters and Trappers Association
Richard Binder	Land Use Planning Facilitator, The Inuvialuit Land Adminstration
James Cardinal	Executive Director, Mackenzie Delta Tribal Council (also representing Cece McCauley, the President of the Dene Band)
Gordon Campbell	Mayor, Town of Inuvik/North Star Service and Construction
Billy Day	Chief, Inuvik Community Corporation (CC)
Tom Detlor	NOGAP Planning Coordinator, Town of Inuvik
Harry Harrison	Inuvik Working Group
Willie Stefansson	Inuvik CC

The following individuals/organizations were also contacted:

Leslie Huget	Senior Land Officer, Lands Division, Municipal and Community Affairs, GNWT, Yellowknife
Steve Mathews	Environmental Assessment Biologist, Department Renewable Resources, GNWT, Yellowknife
Kevin McCormick	Habitat Biologist, Canadian Wildlife Service, Yellowknife
Erik Val	Special Advisor, Program Development, Tourism and Parks, GNWT, Yellowknife
Evan Birchard	Esso Resources Canada Limited
James McDougall	Esso Resources Canada Limited
Chris Graham	Gulf Canada Resources Limited
Brian Rogers	Gulf Canada Resources Limited
Dave Townsend	Gulf Canada Resources Limited
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Ted McRae	Canadian Marine Drilling Limited

SUMMARY OF RECOMMENDATIONS

This plan was produced as part of the implementation of the Inuvialuit Final Agreement. It recommends a strategy to reserve and develop supplies of sand and gravel in the vicinity of Inuvik, N.W.T. Its goals are the reservation of adequate supplies of granular material for the community's future needs, and the siting and management of these reserves so as to minimize the environmental and social impacts of their development. It was developed with members of the entire community, including representatives of Inuvialuit, the Dene-Metis, and the Town of Inuvik. It is based on existing scientific and community information, and will be reviewed at least every 5 years. The plan assesses 13 potential sources of granular materials in the Inuvik area: sources 2.45 (Noel Creek), 312 (Hans Creek), 314 (Stanley Creek), and 155 (Kittigazuit Creek) north of Inuvik; sources I 407 (Caribou Hills) and Ya-Ya Lakes, northwest of the community; Source AA, southwest of Inuvik; Source I 400 southeast of the community; and sources R28 and R29, I 402 (the DOT quarry), I 403 (the Campbell Lake quarry) and the DPW quarry, in the Campbell Hills.

The recommendations of the plan are as follows:

. Inuvik currently has no nearby and reasonably-priced source of granular materials available to it. In an effort to address this situation, the quantity and quality of materials in Sources 2.45 (near Noel Creek) and AA (southwest of Inuvik) (Figure 5) should be more accurately determined through field investigations. If they contain suitable materials, these sources should be reserved for public community uses in the Inuvik area, with an adequate portion of the reserves set aside to meet the forecast 20-year demand of the community itself.

- Field investigations should also be carried out at sources R28 and R29, in the western part of the Campbell Hills, south of Inuvik, to determine the quantity and quality of materials at each of these sources. Provided that Source R28 contains sufficient Class 5 materials for the region's future needs, every effort should be made to restrict large-scale excavations in the Campbell Hills to this source. The DPW and Campbell Lake quarries should be kept at their current scale of development. In order to minimize disruptions to other uses of the Campbell Hills area, Source R29 should not be developed unless necessary.

- This study could not fully assess the impacts of large-scale development of sites such as sources R28 and R29; the impacts of transporting substantial quantities of material to their ultimate destination in the Beaufort Sea; or the comparative impacts of developing these sources versus sources in the Aklavik area (Nesbitt and Howell 1988a). These issues should be more fully assessed by the responsible authorities prior to any large-scale development of the sources.

- The Regional Land Use Planning Commission(s) for the Mackenzie Delta area may wish to re-visit the questions of the establishment of the Campbell Hills Territorial Park, its boundaries, and the compatibility of the development of sources R28 and R29 with other uses of the area.

- While Source 2.45 (25 km north of Inuvik) is promising as the preferred future source of high and medium-quality materials in Inuvik, it is not currently accessible to the community. Until materials in this source have been verified and made accessible to Inuvik, it may be worthwhile to carry out field investigations and to reserve Source I 407 in the Caribou Hills as well. With the development of access to Source 2.45, however, Source I 407 may become unnecessary for public community requirements. Source I 407 should also be made accessible to the corporate needs of the Inuvialuit and other users.

- Source 155 (Kittigazuit Creek) should be reserved and developed for small and medium-scale projects (demands of less than approximately 100 000 cubic metres) in the Tuktoyaktuk area. The source should be developed as outlined in Section 3.5.9 of this report.

- Granular development and environmental protection plans should be produced for each of the major sources in the Inuvik area, including Sources 2.45, AA, R28 and R29, 155 and I 407 prior to further development. The plans should be produced in consultation with local and regulatory representatives (see Appendices A, B and C). They should lay out a 5-to-10 year strategy for the orderly development of each source, and should ensure the integration of granular planning and other land use planning initiatives. They should also ensure that each source is developed so as to minimize environmental and visual effects, and maximize the amount of materials recovered from the source. In addition, they should lay out procedures for the proper development and restoration of pits. The number of pits under development at any time in the Inuvik area should be kept to a minimum.

- The development of Source 2.45 should be planned and implemented so as to create a buffer zone between the excavated area and the natural drainage and valley of Noel Creek (see Section 3.5.4 and Appendix A).

- Community representatives in Inuvik and Tuktoyaktuk have expressed concerns about the currently-proposed alignment of the Inuvik-Tuktoyaktuk highway, and particularly about its proximity to the Husky Lakes. The ultimate alignment of the highway will have a significant effect on the reservation and development of granular materials throughout the Inuvik-Tuktoyaktuk area. The issue should be addressed by the Mackenzie Delta/Beaufort Sea Land Use Planning Commission and officials of the Highways Planning Division of Indian and Northern Affairs Canada, prior to further reservations of specific sources to service highway construction and maintenance.

- The demands of pipeline(s) construction should be incorporated into future granular demand forecasts. Requirements for the related expansion of the Town of Inuvik should also be incorporated.

- Future Class 5 granular demand forecasts should incorporate a breakdown of the material type and intended usage desired. A breakdown of the substantial Class 5 requirement for the Inuvik portion of the proposed Inuvik-Tuktoyaktuk highway would aid in assessing the demand for alternative sources (such as Source 2.45) of naturally occurring aggregate.

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INTRODUCTION

In March 1988, as part of the implementation of the Inuvialuit Final Agreement, Indian and Northern Affairs Canada (INAC) contracted Hardy BBT of Calgary, Alberta and Thomas Nesbitt and Associates (now Avati Associates) of Yellowknife, N.W.T. to carry out the present study. The INAC departmental representative for the project was R.J. Gowan, Geotechnical Advisor, Land Management Division.

The terms of reference of the study were:

(1) To determine the potential environmental, cultural, and economic implications of the possible future exploitation of selected granular borrow deposits within and adjacent to Inuvialuit lands

(2) To identify and evaluate other community concerns

(3) To prepare recommendations on the establishment of reserves of granular borrow for public community needs

These objectives were met through the preparation of a plan outlining a strategy for the reservation and development of granular materials around each of the six Inuvialuit communities (Aklavik, Holman, Inuvik, Paulatuk, Sachs Harbour, and Tuktoyaktuk). The Inuvik plan is divided into four parts:

Part 1 sets out the scope of the study: why it was undertaken, its objectives, how it was carried out, and how it is intended to be used. It also defines the technical terms used in the plan and outlines the potential impacts of granular development.

Part 2 describes the goals of the plan.

Part 3 presents the factual information upon which the plan is based and assesses different plan options.

Part 4 presents the plan recommendations.

PART 1: SCOPE OF THE STUDY

1.1 REASONS FOR UNDERTAKING THE STUDY

1.1.1 Requirements of the Inuvialuit Final Agreement

With the signing of the Inuvialuit Final Agreement (IFA) and the enactment and proclamation of the Western Arctic (Inuvialuit) Claims Settlement Act in 1984, the Government of Canada granted Inuvialuit title to substantial tracts of land in the vicinity of each of the six Inuvialuit communities. These lands, shown in Figure 1, are commonly known as Inuvialuit 7(1)(a) and 7(1)(b) lands, in reference to the sections of the Final Agreement where their interests are described. They are administered by the Inuvialuit Land Administration (ILA) and the Inuvialuit Land Administration Commission (ILAC).

In the Inuvik area, Inuvialuit lands are situated approximately 2 km northwest of the community. On 7(1) (a) lands, which cover approximately 1970 square kilometres (761 square miles), the Inuvialuit own both surface and subsurface rights. On 7(1)(b) lands, which cover approximately 1220 square kilometres (471 square miles), the Inuvialuit own surface rights only. Granular materials (sand and gravel) are surface resources. The Inuvialuit Final Agreement thus transferred ownership of some of the more accessible sources of sand and gravel in the Inuvik area, and indeed throughout the Western Arctic region, to the Inuvialuit. Because of this, and because of the general scarcity of suitable sand and gravel throughout the region, the Final Agreement also attached several

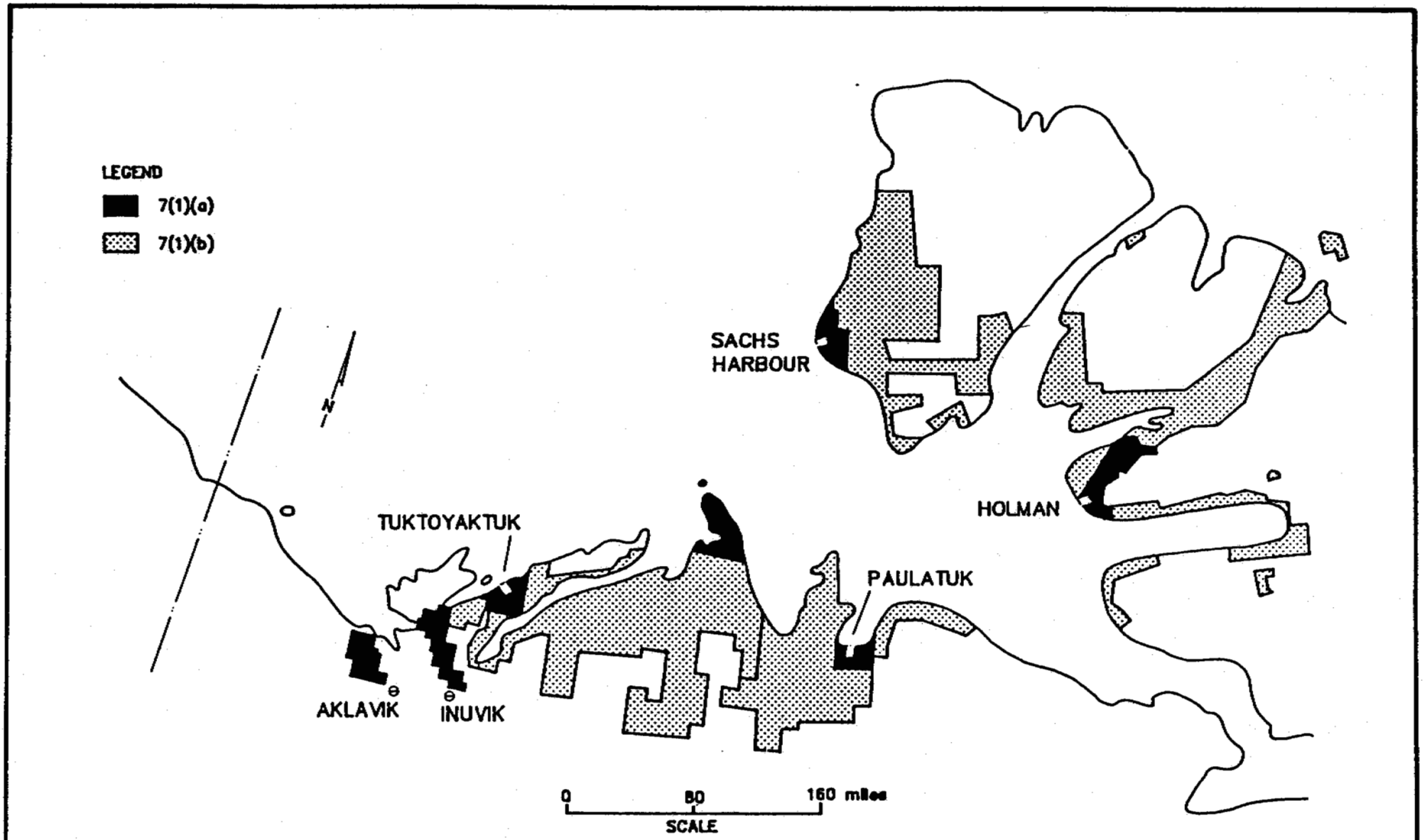

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FIGURE 1. INUVIALUIT LANDS LOCATION PLAN

conditions to Inuvialuit ownership and management of these resources.

The Agreement regulates the price which can be charged for sand and gravel. It also requires that the Inuvialuit establish and maintain reserves of sand and gravel on Inuvialuit lands. In the establishment of these reserves, the first priority is that adequate supplies of suitable materials be set aside to meet public community needs (IFA, Section 7(27)). These needs include granular requirements for the community's roads and airfields, community arenas, firehalls, and sewage lagoons. Reserves are also to be established, as a second priority, for the private and corporate needs of the Inuvialuit (Section 7(28)). Such needs include projects advocated and owned by the Inuvialuit, for example the proposed Tuktoyaktuk gas gathering system. As a third priority, sand and gravel are to be made available for any project approved by the appropriate government agencies (Section 7(29)). Examples of this sort of granular requirement include pads for oil rigs and rip rap for erosion protection on artificial islands.

This study focuses primarily on the establishment of granular reserves to meet Inuvik's public community needs (the first priority above). The Final Agreement requires that the reserves be based upon reasonable 20-year forecasts of the volumes required from Inuvialuit lands. Reserves are to be of an appropriate quantity and quality to meet these forecasts, and are to be within reasonable transport distances of the communities. The demand forecasts upon which the reserves are based are to be

prepared jointly by the Inuvialuit and government. They are to be revised at least every 5 years.

1.1.2 Implementation

In order to implement the above-mentioned requirements of the Final Agreement, the Federal Government established a specific granular materials project as part of the IFA Implementation Program. This project, designated Task 7- Sand and Gravel Inventories, involves a four-phase process developed in consultation with the Territorial Government and the ILA.

(1) An analysis of the projected 20-year demand for sand and gravel and an inventory of potential sources to supply this demand was carried out by EBA Engineering Consultants Ltd. This study, completed in April, 1987, made recommendations on the development of specific sources of supply.

(2) The present study is designed to supplement the EBA information with environmental and socio-economic information, particularly from the community level. It is also designed to develop a plan, with community representatives and other affected parties, for the reservation and future development of granular materials for public community needs in each of the six Inuvialuit communities.

(3) The quality and/or quantity of materials at some of the recommended sources of supply will have to be confirmed by more-detailed site investigations. These investigations will be based on the recommendations of the communities.

(4) In order to assist the Inuvialuit with the preparation and implementation of granular resource development plans which can be managed at the local level, additional studies will be undertaken each year to 1994.

1.2 INVOLVEMENT OF OTHER INTERESTS

The Inuvik area has traditionally been used by the Dene-Metis as well as by the Inuvialuit. Although the present study was carried out as part of the implementation of the Inuvialuit Final Agreement, all local interests were invited to participate in it. There were two reasons for taking this course of action:

(1) A land claims agreement-in-principle between the Dene-Metis and the Government of Canada was signed in September, 1988. While a final agreement and the selection of specific parcels of land have not yet been negotiated, substantial tracts of land will be affected by the future settlement of the Dene-Metis claim. It is also likely that the Dene-Metis claim settlement will include provisions dealing with sand and gravel that are fairly similar to the provisions of the Inuvialuit Final Agreement.

(2) In its search for sources of sand and gravel to serve public community needs, the initial inventory (EBA 1987) considered sources throughout the Inuvik area, irrespective of their ownership. Some of the sources recommended by EBA for reservation and future development lie outside Inuvialuit lands, and may well, in future, fall under the ownership and/or administration of the Dene-Metis. In any case, all local interests should be involved in granular decisions which are the ultimate prerogative of the community as a whole.

In order to ensure their input to decisions affecting the reservation of granular sources in the Inuvik area, other interests, including representatives of the Dene-Metis and the Town of Inuvik, were approached by the authors. They were offered two options:

(1) To take part in the community workshop held in Inuvik

in April 1988, together with the Inuvialuit representatives.

(2) To take part at some later stage in the process, possibly in conjunction with or following the settlement of the Dene-Metis land claim. In the event that this latter option were chosen, the authors promised to note in their report that other interests should be consulted before any final decisions were made on the reservation of granular sources in the Inuvik area.

Representatives of the Dene-Metis and the Town of Inuvik chose to take part in the Inuvik workshop. The results of the workshop thus represent a consensus of the community as a whole.

1.3 OBJECTIVES AND METHODS OF THE PRESENT STUDY

The ultimate objectives of the present study were:

(1) The identification of environmental, cultural, and economic concerns, particularly at the community level, associated with local granular resource development

(2) The development of a fair and reasonable plan which could be understood and managed at the local level

(3) The achievement of a consensus among the affected parties

In order to accomplish these ends, workshops of a full day's duration were carried out in each of the six Inuvialuit communities. The workshops were carried out primarily with members of the existing land use planning working group in each community. Other affected interests were also invited to participate.

The land use planning working groups were established in 1987 to provide each community with an ongoing land use planning capability, and a means of making recommendations on the use of lands surrounding the communities to the Beaufort/Delta Regional Planning Commission and the decision-making bodies at the community level. The Inuvik working group includes nominees from the Inuvik Community Corporation, the Dene Band, the Hunters and Trappers Association and Committee, the Metis Local, and the Town of Inuvik.

The workshops supplemented the supply/demand information and recommendations produced in Phase 1 of the study (EBA 1987). They also identified potential economic, cultural, and environmental impacts of developing the sites identified in Phase I. The workshops were designed to solicit community concerns and to allow the working groups to use the information in a planning context. They were facilitated by Tom Nesbitt, an environmental planning consultant who has worked extensively with the working groups in the past. Technical advice for the workshops as provided by Jim Howell, an environmental consultant and professional geologist.

Unless noted otherwise, the plan detailed in this report represents the consensus of the Inuvik Workshop.

1.4 STATUS AND INTENDED USES OF THE PLAN

The conclusions of this report have the status of recommendations only. They are recommendations to INAC and the ILA/ILAC, the parties implementing the Inuvialuit Final

Agreement and administering Crown and Inuvialuit lands respectively, and to the Town and the GNWT as the administrators of Town and Commissioner's Lands. The results will also be of interest to the various government departments and other granular resource users. Finally, the study can be considered a sectoral plan recommended to the Regional Land Use Planning Commission in the Beaufort/Delta region. As such, the conclusions of the study are subject to changes within the context of the larger planning exercise. Given the community basis of the plan, however, the authors do not expect fundamental changes to it.

1.5 TERMINOLOGY

Several terms describing the kinds of granular materials required by the communities and the confidence of volume estimates are used extensively throughout the plan. These terms are explained in this section.

1.5.1 Classification of Granular Resources

Granular resource supply and demand is discussed in terms of five classes of material:

Class 1 Excellent quality material
Class 2 Good quality material
Class 3 Fair quality material
Class 4 Poor quality material
Class 5 Bedrock, felsenmeer, and talus

The first four classes are defined in terms of the gradation of the deposit. A brief discussion on gradation

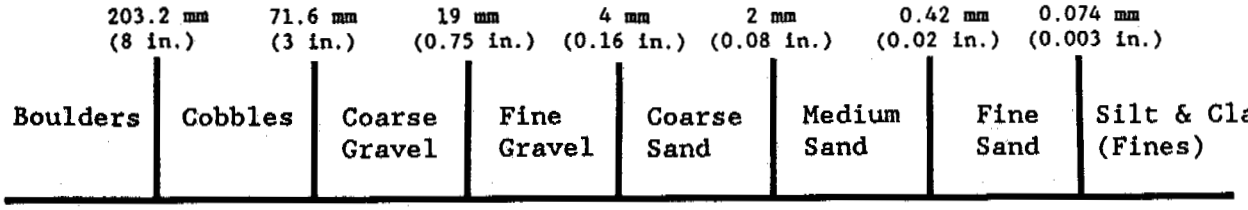
is necessary prior to describing these classes in more detail.

1.5.1.1 Gradation

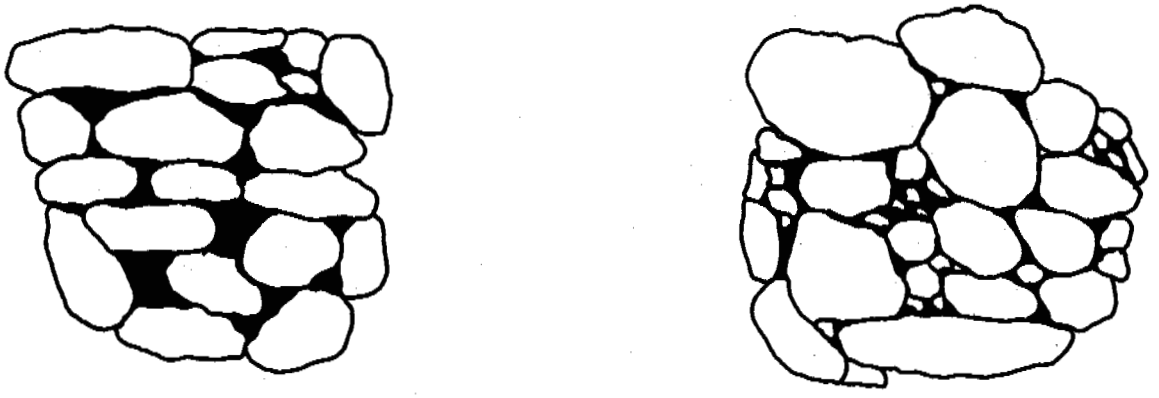
The term gradation refers to the relative size of particles in a deposit. Granular resources can contain particles ranging in size from boulders through clay, as shown in Figure 2. Boulders and cobbles are usually undesirable in a granular deposit. They may be crushed to smaller sizes or discarded as waste. The gravel- and sand-sized particles are the more desirable components of a granular deposit. Silt- and clay-sized particles, also called fines, cannot be seen by the naked eye. These particles are undesirable in high proportions because they hold more water which, in the North, results in higher ice contents and a greater likelihood of frost heaving or thaw slumping.

A well-graded granular deposit has an equal amount of each gravel and sand size and little or no fines. Deposits such as this are called "clean". A poorly-graded granular deposit has an excess of some particle sizes and a shortage or lack of others, or has nearly all particles the same size. Poorly-graded deposits can be processed to improve and upgrade their quality. Screening and washing can be used to remove undesirable particle sizes. Boulders and cobbles can be crushed to produce gravel and sand.

The importance of using well-graded materials for pads on which structures will be built is shown in Figure 2. With well-graded materials, the finer particles tend to fit between the coarse ones, reducing the amount of voids or



2a. Particle size limits for gravel, sand, and fines. A well-graded granular deposit contains an equal amount of each gravel and sand size.



2b. Poorly-graded materials with all particles the same size or with a lack of certain particle sizes (left drawing) have more voids and are less stable than well-graded materials where the voids are filled by the smaller particle (right drawing).

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FIGURE 2. PARTICLE SIZE AND GRADATION

empty spaces to a minimum and forming a strong pad. Pads formed of poorly-graded materials where many voids are present are more likely to shift when the weight of a structure is added.

1.5.1.2 Description of Granular Resource Classes

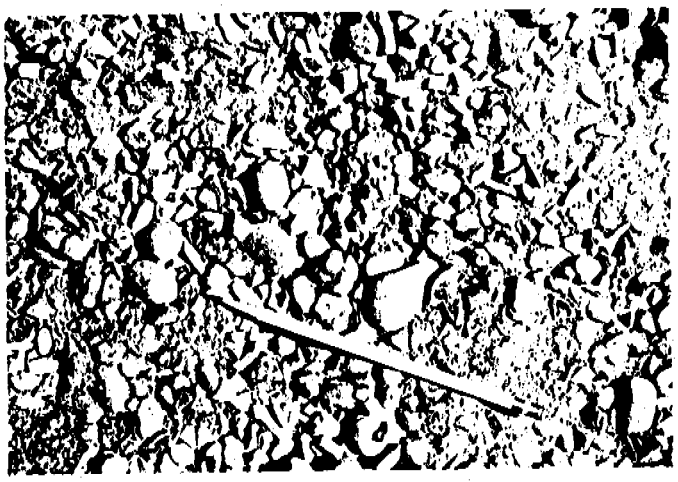
The five granular resource classes are defined below in terms of their gradation and recommended uses. Figures 3 and 4 show photographs of each class and examples of their use.

Class 1. Excellent quality material consisting of clean, well-graded, structurally-sound sands and gravels suitable for use as high-quality surfacing materials, or as asphalt or concrete aggregate, with a minimum of processing.

Class 2. Good quality material generally consisting of well-graded sands and gravels with limited quantities of silt. This material will provide good-quality base and surface-course aggregates or structure-supporting fill. Production of concrete aggregate may be possible with extensive processing, except where weak materials such as shale are present.

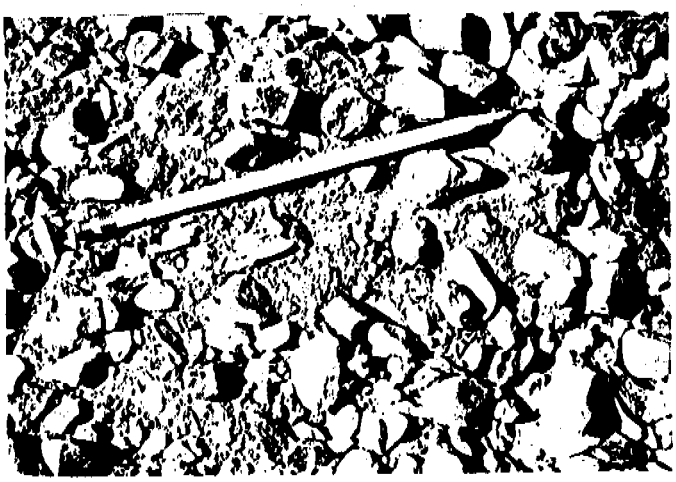
Class 3. Fair quality material consisting of poorly-graded sands and gravels with or without substantial silt content. This material will provide fair-quality general fill for roads, foundation pads, or lay-down yards.

Class 4. Poor quality material generally consisting of silty, poorly-graded, fine-grained sand with minor gravel.

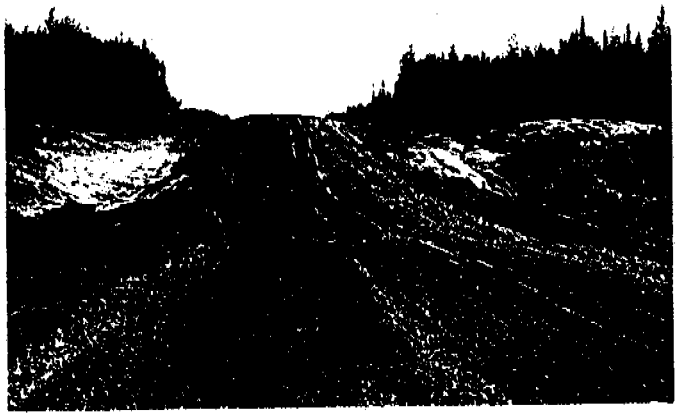


Class 1 - Excellent quality materials; well-graded, no fines.

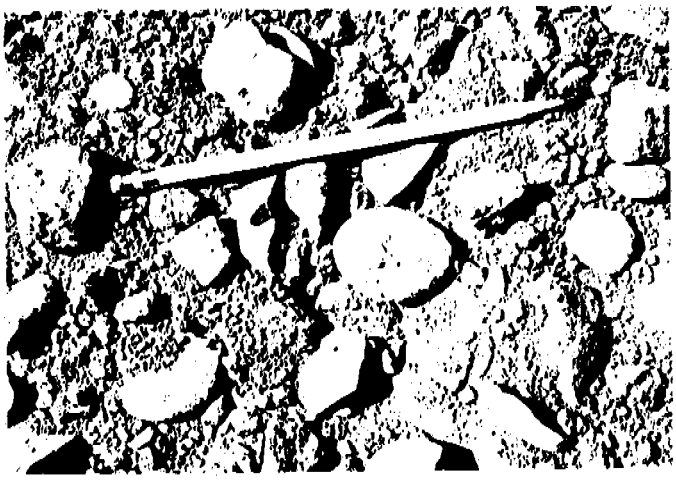
Class 1 material used for a pipeline pumping station pad at Norman Wells



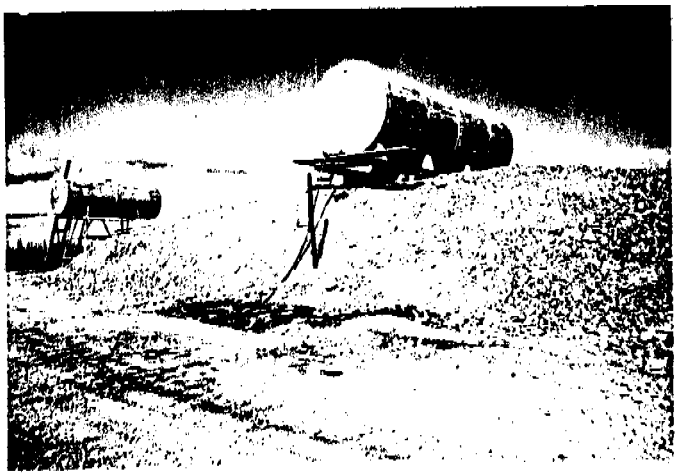
Class 2 - Good quality materials; generally well-graded, some fines



Class 2 material used for surfacing the Mackenzie Highway near Fort Simpson

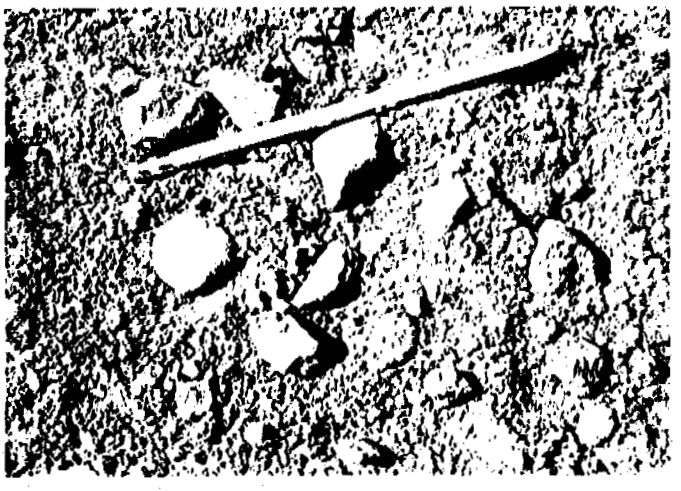


Class 3 - Fair quality materials; poorly-graded with substantial fines



Class 3 material used as a pad for fuel storage tanks

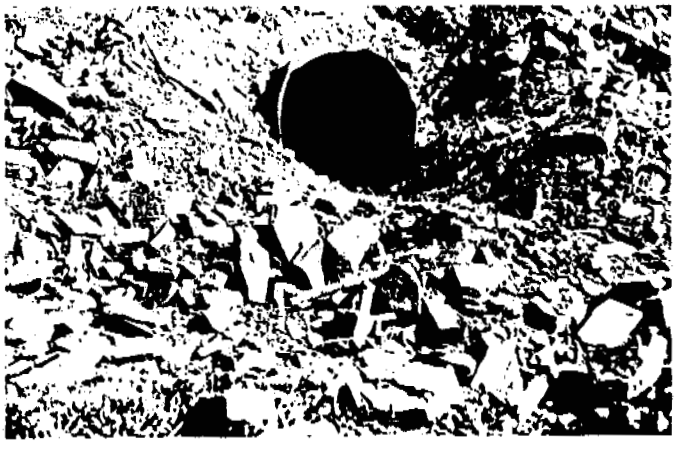
FIGURE 3. CLASS 1,2, AND 3 GRANULAR MATERIALS



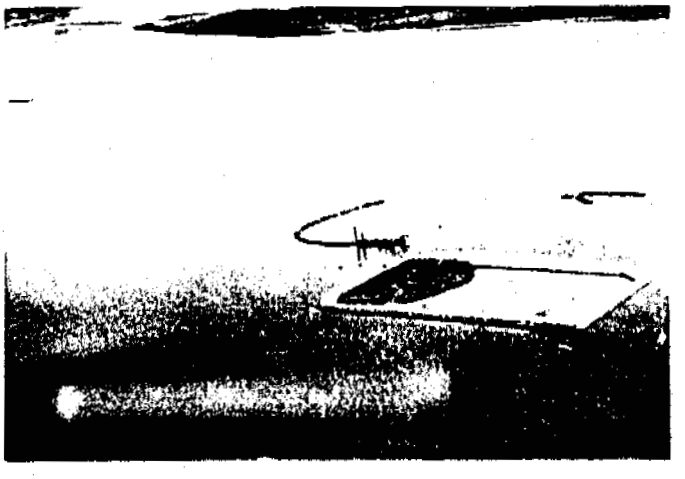
Class 4 - Poor quality materials; poorly-graded with minor gravel and a large proportion of fines

Class 4 material used as a berm around a fuel storage site

Class 5 - Outcropping of bedrock at Holman, N.W.T.



Class 5 material used as rip rap to protect a culvert outlet



Class 5 material used as armour stone around an artificial island in the Mackenzie River at Norman Wells

FIGURE 4. CLASS 4 AND 5 GRANULAR MATERIALS

These deposits may also contain weak particles. These materials are considered suitable for general (non-structural) fill.

Class 5. Bedrock of fair to good quality, felsenmeer (open areas of broken rock), or talus (broken rock at the bottom of a slope). Potentially excellent sources of construction material, ranging from general fill to concrete aggregate or building stone if quarried and crushed. Also includes erosion control materials such as rip-rap or armour stone.

1.5.2 Confidence of Volume Estimates

The volume estimates for the granular material sources identified in the EBA (1987) report are classified as being proven, probable, or prospective.

A proven volume is one whose existence, extent, thickness, and quality is supported by ground truth information such as geotechnical drilling, test-pitting, and/or exposed stratigraphic sections. Usually the thickness of material encountered in a borehole is extrapolated to a radius not exceeding 50 metres around the hole.

A probable volume is one whose existence, extent, thickness, and quality is inferred on the basis of direct and indirect evidence, including topography, landform characteristics, airphoto interpretation, extrapolation of stratigraphy, geophysical data, and limited sampling.

A prospective volume is one whose existence, extent, thickness, and quality is suspected on the basis of limited

direct evidence, such as airphoto interpretation and/or general geological considerations.

1.6 IMPLICATIONS OF GRANULAR MATERIAL EXTRACTION

The development of granular resource deposits normally involves three major tasks:

(1) Obtaining access to the deposit.
(2) Development of the deposit.
(3) Reclamation the pit.

Each of these tasks can have economic, cultural, and environmental implications associated with it.

1.6.1 Obtaining Access to the Deposit

The development of access to a source can involve significant economic costs. These costs will have a strong bearing on the cost of materials delivered to the community and on the ultimate feasibility of developing the source.

There are also several potential social and cultural impacts associated with the development of access to a granular source. The development of access, particularly year-round access, can lead to unforseen development activities in an area, and to long-term changes to an area or region which could not be anticipated at the time of the original development. Hunting, fishing, and trapping pressure on an area may increase, visitors to the region may gain access to an area that was previously accessible

only to the limited population of the community, and there may be some interference with community activities in the area of the source. On the other hand, road construction may open an area to year-round recreational use by the community, or to possible tourism development benefits on the part of the community.

Environmentally, access road construction can create drainage and erosion problems and habitat destruction if proper construction techniques are not followed. Disturbance to the active layer in permafrost terrain can result in thawing and erosion. If eroded sediments enter watercourses, fish habitat can be damaged or destroyed. Furthermore, the development of larger access roads could conceivably affect wildlife movements and result in habitat abandonment.

Access road impacts can be minimized by following guidelines presented in the INAC (1984) publication "Land Use Guidelines Access Roads and Trails".

1.6.2 Development of the Deposit

Development of a deposit involves the stripping of vegetation, the removal of overburden, and the extraction of granular materials. The amount of vegetative stripping and overburden removal required to develop a source will play an important role in the costs of development. A thick covering of silts or clays may make the development of the source unfeasible. Similarly, ease of extraction will affect costs. A dry deposit is much cheaper to

develop than one with substantial volumes of ice which may require blasting.

The opening of a pit may destroy important wildlife and fisheries habitat or may interfere with hunting, trapping, or fishing activities. The pit may be located in an area used for recreation by the community or be near enough to such an area that the presence of the pit will impair the aesthetics of the recreational site. As with the opening of an access road, pit development may lead to the discovery of heritage resource sites, but it also offers the opportunity to destroy such sites if their presence is not noted prior to extraction.

Environmentally, pit development offers the potential for drainage and erosion problems, habitat destruction, and wildlife disturbance. Vegetative stripping and overburden removal expose materials to wind and water erosion. The deposition of eroded materials in streams can result in damage to fish habitat. A high ice content in the deposit can result in further erosion and siltation when thawing occurs during extraction. Noise from equipment used during development can disturb wildlife during critical periods such as calving or nesting.

Guidelines to minimize the impacts of development of the deposits are available in the INAC (1982) publication "Environmental Guidelines Pits and Quarries".

1.6.3 Reclaiming the Pit

The costs of pit abandonment and reclamation should be factored into the costs of developing a source. Pits which have not been properly restored can be subject to unnecessary longer-term erosion and drainage problems. Pit reclamation can enhance the recreational and habitat capabilities of a site.

Reclamation guidelines for pits and quarries are included in the INAC (1982, 1987) publications "Environmental Guidelines Pits and Quarries" and "Reclamation Guidelines for Northern Canada".

PART 2: PLAN GOALS

The definitions, principles and goals of the Inuvialuit Final Agreement from the basis of this plan. The plan should also be interpreted so as to be consistent with any future land claims agreement between the Dene-Metis and the Government of Canada.

Specifically, the goals of this plan are:

(1) To investigate potential sources of granular materials throughout the Inuvik region, and not only on Inuvialuit lands.

(2) To reserve adequate supplies of appropriate quality granular materials for the community's future needs.

(3) To site and manage reserves within reasonable distances of the community, and so as to ensure that granular development does not interfere with wildlife, wildlife habitat, archaeological resources, or with people out camping, hunting, fishing, or trapping.

(4) To minimize the negative environmental and visual effects of granular development (pits and access roads). To prevent drainage problems. To ensure that pits are fully restored when depleted.

(5) To ensure that the development of granular materials is well planned and managed, so as to ensure that the materials in existing and planned pits are fully used. To ensure the integration of granular planning with other planning initiatives.

(6) To produce a plan that is written in clear and concise terms, so that it can be understood, implemented, and revised at the local level.

PART 3: DESCRIPTION AND ASSESSMENT OF RESOURCE INFORMATION

3.1 PHYSICAL SETTING

Inuvik is located at the base of the Caribou Hills at the eastern margin of the Mackenzie Delta. Granular deposits mapped by EBA (1987) lie within the Anderson Plain and Tuktoyaktuk Coastlands (Rampton 1988). The locations of the deposits discussed in this report are shown in Figure 5. They occur on Inuvik 7(1)(a) and Inuvialuit 7(1)(b) lands; Town lands; and Crown lands.

Deposits on the Anderson Plain occur on Richards Island, and in the Caribou Hills, Rocky Hill, and Noel Lake areas. The Richards Island sources occur as ice-contact glaciofluvial deposits and eskers, deposited by streams flowing within and next to the glaciers which occupied the area during the Quaternary Period (the last three million years, approximately). The Caribou Hill sources occur as colluvial deposits on the side of the hills. Those in the Rocky Hill area occur as exposed bedrock and bedrock with a thin veneer of till (less than 1 m). The sources in the Noel Lake area occur as hummocky moraine.

Sources on the Tuktoyaktuk Coastlands occur as alluvial terraces along Hans Creek and glaciofluvial outwash at the mouth of Stanley Creek.

The nature of the materials in the sources is discussed in more detail below.

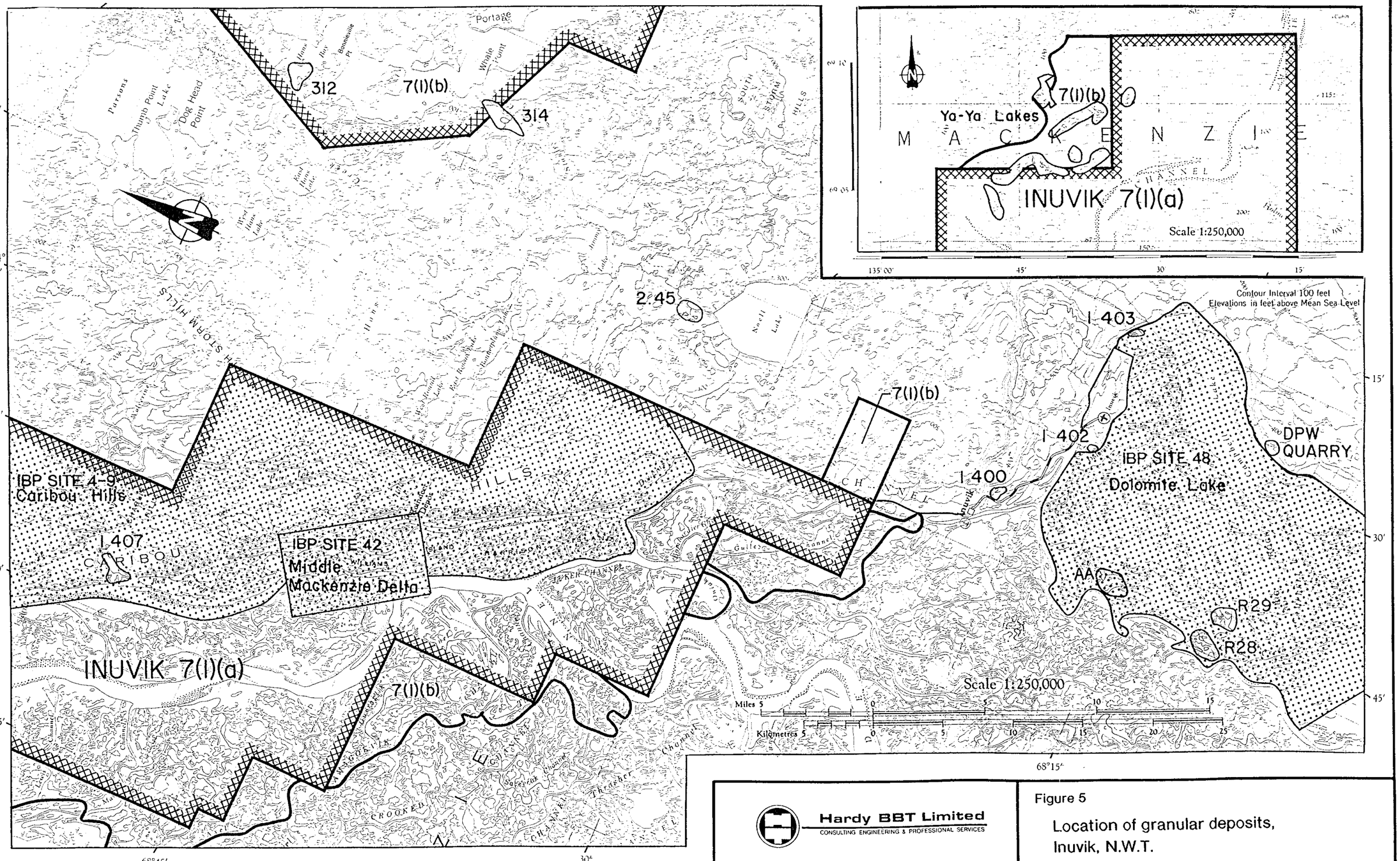


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Figure 5

Location of granular deposits, Inuvik, N.W.T.

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3.2 COMMUNITY SETTING

Inuvik is the largest and most recently-established community in the Beaufort Sea/Mackenzie Delta region. It is below the tree line, on the eastern side of the Mackenzie Delta, and is approximately 55 km by air east of Aklavik and 110 km south of the Arctic Ocean.

Human settlement in the Mackenzie Delta area owes its historical roots to the trapping, whaling, and caribou hunting potential of the region. According to Usher (1976), trapping was introduced into the regional economy in the early part of the century, and by the mid-1920's, with the establishment of Anglican and Roman Catholic missions in Aklavik and the movement of the RCMP post from Herschel Island to that community, Aklavik had become the administrative and trading centre of the region. Between 1930 and 1950, muskrat and fox prices were generally high, and the Delta was intensively trapped. By 1952, the population of Aklavik was 1550. In 1954, however, because of flooding and erosion problems and limitations in the land available for town expansion in Aklavik, the Federal Government began moving its school, hospital, airport, and administrative services to the newly-established Inuvik, and the regional focus of the Delta shifted to the newer community. In 1970, the community acquired Town status. In 1986, its population was 3389 (Statistics Canada 1986).

Inuvik is now the administrative, transportation, and secondary services center of the Western Arctic region. It is the seat of the regional offices of the Government of the Northwest Territories, of several Federal departments

and of the Inuvialuit Regional Corporation, and is a base from which many goods and services are supplied to the oil and gas industry and the region as a whole. Accurate and up-to-date figures on the relative contribution of different sectors to the overall cash economy are not, however, available. In non-quantitative terms, the community derives its income from the oil and gas industry and a diversity of local private businesses; from employment with the Town, the Federal and Territorial governments, the hospital, schools, and the Northwest Territories Power Corporation; from Federal and Territorial transfer payments; and from trapping and the imputed value of the country food harvest (Lutra and Ruitenbeek 1985). In general, the economy of Inuvik is a diverse and dynamic one, which is based predominantly on public and private sector cash income. Like the smaller communities of the region, however, Inuvik continues to look to the hunting, fishing and trapping economy and way of life for a significant proportion of its food, and for many of its cultural and economic values. While the people of Inuvik want to diversify and enhance their local economy, they are also concerned that environmental quality and wildlife populations and habitat be preserved.

3.3 NEED FOR GRANULAR MATERIALS (DEMAND)

Figure 6 presents the forecast 20-year demand for granular materials in Inuvik, based on the EBA (1987) figures. Of a total forecast demand of approximately 7 600 000 cubic metres over 20 years, approximately 107 000 cubic metres will be required for the maintenance of community facilities, 70 600 cubic metres will be required for local

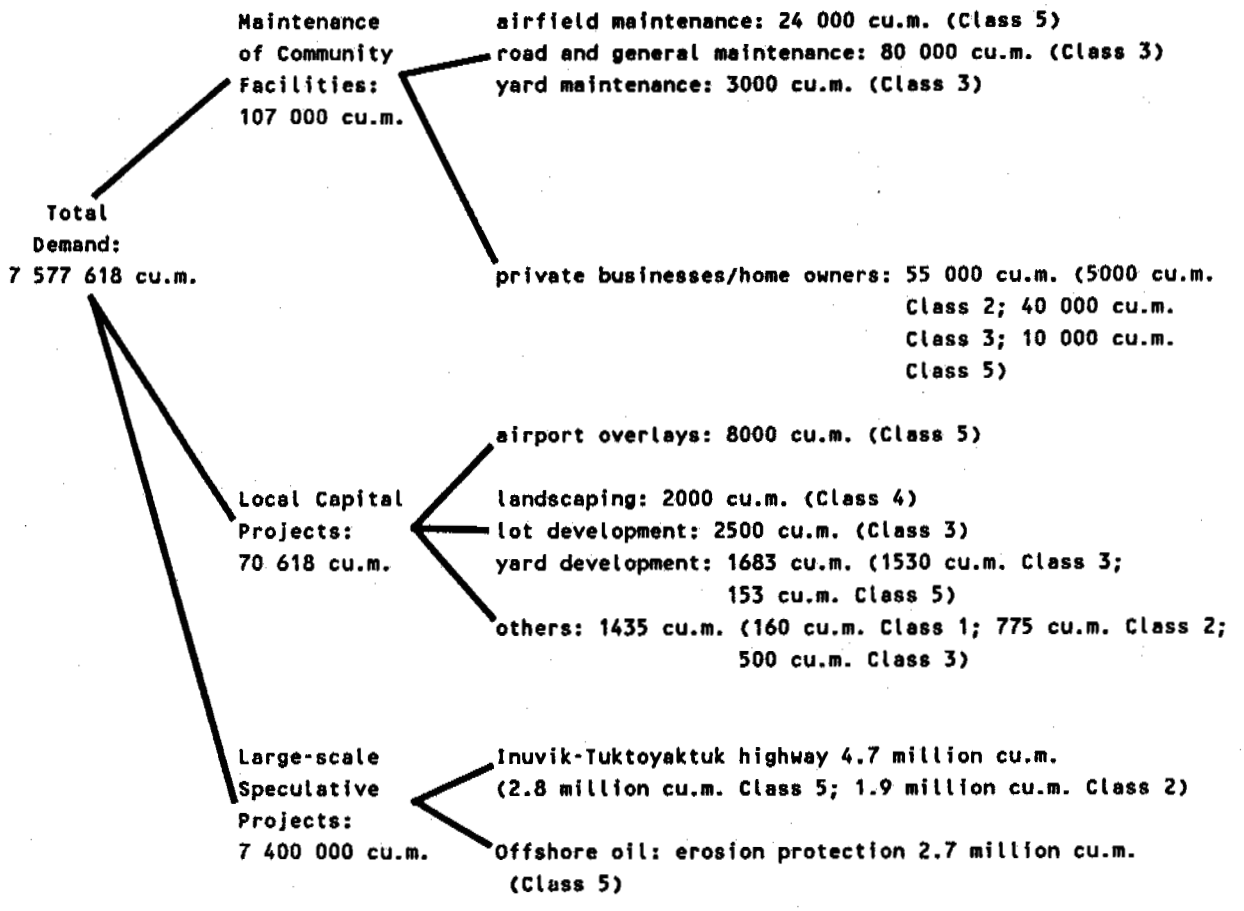

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FIGURE 6.

REQUIRED VOLUMES OF GRANULAR MATERIALS (DEMAND) BY MAIN USERS, INUVIK 1987-2006 (EBA 1987)

capital projects, and fully 7 408 000 cubic metres may be required for large-scale, more speculative projects.

Community maintenance projects include airfield maintenance (24 000 cubic metres, Class 5), road and general maintenance (80 000 cubic metres, Class 3), and yard maintenance (3000 cubic metres, Class 3). The main local capital users, as listed in Figure 6, include private businesses/home owners (55 000 cubic metres, Classes 2, 3, and 5), airport overlays (8000 cubic metres, Class 5), landscaping the nearby Territorial Park (2000 cubic metres, Class 4), lot development (2500 cubic metres, Class 3) and yard development (1683 cubic metres, Classes 3 and 5).

The more speculative demands incorporated into the forecast include the Inuvik portion of the proposed Inuvik-Tuktoyaktuk highway (2.8 million cubic metres of Class 5 and 1.9 million cubic metres of Class 2 materials), and armour stone/rip rap for erosion protection associated with proposed offshore petroleum production facilities in the Beaufort Sea (2.7 million cubic metres of Class 5 materials). With the exception of the armour stone/rip rap and a small number of private business demands, most of the foregoing demands are public in nature.

Tables 1 and 2 focus more specifically on the volumes of different classes of materials that will likely be required from the Inuvik region for each 5-year period to 2006 AD, both with and without the speculative projects. Note that in these Tables and in Figure 6, the term "Class 5", as defined in Section 1.5.1.2, refers to materials ranging

TABLE 1

REQUIRED VOLUMES OF GRANULAR MATERIALS (DEMAND), IN CUBIC METRES, AND RECOMMENDED SOURCES OF SUPPLY, INUVIK, 1987 - 2006, EXCLUDING SPECULATIVE PROJECTS (FROM EBA 1987)

Class	1987-91	1992-96	1997-2001	2002-06	Totals	Recommended Sources
Class 1	200	0	0	0	200	YaYa or I 403
Class 2	5 800	0	0	0	5 800	YaYa or I 407
Class 3	65 300	20 800	20 800	20 800	127 700	YaYa or I 407
Class 4	2 000	0	0	0	2 000	I 400
Class 5	18 200	8 000	8 000	8 000	42 200	I 402 I 403
				TOTAL	177 900	

NOTE: EBA figures used in this table have been rounded off to the nearest 100 cu.m.

TABLE 2

REQUIRED VOLUMES OF GRANULAR MATERIALS (DEMAND), IN CUBIC METRES, AND RECOMMENDED SOURCES OF SUPPLY, INUVIK, 1987 - 2006, INCLUDING SPECULATIVE PROJECTS (FROM EBA 1987)

Class	1987-91	1992-96	1997-2001	2002-06	Totals	Recommended Sources
Class 1	200	0	0	0	200	YaYa or I 403
Class 2	5 800	1,700 000	100 000	100 000	1 905 800	YaYa or I 407, 312,314
Class 3	65 300	20 800	20 800	20 800	127 700	YaYa or I 407
Class 4	2 000	0	0	0	2 000	I 400
Class 5	2 818 200	8 000	908 000	1 808 000	5 542 200	R28/R29 or DPW/I 403 I 402
				TOTAL	7 577 900	

Note: EBA figures used in this table have been rounded to the nearest 100 cu.m.

from armour stone and rip rap, used for erosion protection, to granular materials that are produced by crushing rock.

The preponderance of community demand, excluding speculative projects, will be for Class 3 and 5 materials: approximately 130 000 cubic metres of Class 3, and 45 000 cubic metres of Class 5 materials will likely be required. A further 6000 cubic metres of Classes 1 and 2, and 2000 cubic metres of Class 4 materials will also be required.

Speculative projects constitute fully 97 percent of the total forecast demand for granular materials from the Inuvik region. The speculative demand is exclusively for Class 2 and Class 5 materials. The forecast is that approximately 1.9 million cubic metres of Class 2 materials and 5.5 million cubic metres of Class 5 materials will be required.

The present study was not mandated to revise the forecast demand figures. Demand-related concerns identified in the workshop were, however, noted. Workshop participants identified three concerns:

(1) The granular requirements of potential pipeline construction have not been incorporated into the speculative forecast figures.

(2) Associated requirements for the expansion of the Town of Inuvik have not been identified. The Town of Inuvik's future granular requirements will be strongly dependent upon the oil and gas developments in the Inuvik area. The Town's Expansion Plan projects population increases to the year 2000 (1986 = 3389) ranging from approximately 650 (19 percent) with net zero migration; to 2157 (64 percent) with the construction of a small-diameter (400 mm) pipeline; to as much as 22 760 (671 percent) with the construction

of a large-diameter (1066 mm) pipeline (UMA Engineering Ltd. and Associated Engineering Alberta Ltd. 1985). As EBA (1987) noted, these developments could significantly raise the demand figures for the Inuvik area.

(3) Non-speculative requirements of the Town of Inuvik may be underestimated. No capital projects have been identified for the latter 15 years of the 20-year forecast period.

The Inuvialuit Final Agreement requires, however, that the demand forecasts be revised at least every 5 years. In this context, the EBA figures should be sufficiently accurate for the present purpose of setting aside reserves.

3.4 POTENTIAL SOURCES OF SUPPLY

Granular material sources in the Inuvik area are shown in Figure 5 and described in Table 3. All sources have been rated by EBA (1987) as either Class 2 or Class 5.

3.4.1 Class 1 Materials (Non-Speculative)

Inuvik's Class 1 requirements are entirely non-speculative. To supply these requirements, EBA (1987) has recommended the use of better-quality materials in the Ya-Ya Lakes pit. Alternatively, crushed materials from the Campbell Lake quarry (I 403) are recommended. The Ya-Ya Lakes pit is situated approximately 90 km northwest of Inuvik, primarily on Inuvialuit 7(1)(b) lands. Its access to Inuvik is by a winter ice road along the East Channel of the Mackenzie River. The Campbell Lake quarry is situated on Crown Lands, approximately 18 km southeast of Inuvik. Its access to Inuvik is by an all-weather road.

TABLE 3

GRANULAR MATERIAL SOURCES - INUVIK
(FROM EBA 1987)

Source No.	Location	Estimated Volume	Access	Comments
2.45	25 km northeast of Inuvik	25 million m^3 Class 2 (prospective)	Tundra/ice road in winter	On Crown lands.
312	57 km northeast of Inuvik	2.3 million m^3 Class 1 (probable) 2.3 million m^3 Class 2 (probable)	Tundra/ice road in winter	On Inuvialuit 7(1)(b) lands.
314	42 km northeast of Inuvik	2.3 million m^3 Class 2 (probable)	Tundra/ice road in winter	Partially on Inuvialuit 7(1)(b) lands, partially on Crown lands.
I 400	Within Inuvik	0	All-weather road	Boot Hill Pit on Town lands. Considered depleted but still used as a source for small volumes of Class 3 materials.
I 402	10 km south of Inuvik	4.6 million m^3 Class 5 (proven)	All-weather road	Transport Canada quarry. On Crown lands. Source is on the edge of the proposed Dolomite Lake-Campbell Lake IBP area.
I 403	18 km southeast of Inuvik	2 million m^3 Class 5 (proven)	All-weather road	Campbell Lake quarry. On Crown lands.
I 407	61 km northwest of Inuvik	4.6 million m^3 Class 2 (probable) 15 million m^3 Class 5 (prospective)	Ice road in winter; barge in summer	Source is in the proposed Caribou Hills IBP area, on Inuvik 7(1)(a) lands.
R28 & R29	20 km south of Inuvik	20 million m^3 Class 5 (probable)	Tundra/ice road in winter; barge in summer	On Crown lands. Source is in the proposed Dolomite Lake-Campbell Lake IBP area.
DPW Quarry	22 km southeast of Inuvik	600 000 m^3 Class 5 (proven) 3.5 million m^3 Class 5 (probable)	All-weather road	On Crown lands.
Ya-Ya Lakes	90 km northwest of Inuvik	7.5 million m^3 Class 2 (proven) 8.8 million m^3 Class 2 (probable)	Tundra/ice road in winter	On Inuvik 7(1)(a) and Inuvialuit 7(1)(b) lands.
AA	10 km southwest of Inuvik	Unknown	Tundra/ice road in winter	Potential source suggested by workshop participants. No data available.

The Ya-Ya Lakes pit was originally predicted to contain a volume of 8.8 million cubic metres of Class 2 material. It has, however, been extensively developed, and more current estimates are unavailable. It remains the preferred source of high-quality materials in the Inuvik area. Source I 403 has also been extensively developed, and has a proven volume of 2 million cubic metres of Class 5 materials. This source is not, however, considered to be as good a source of high-quality gravel as the Ya-Ya Lakes pit: crushed dolomite from the Campbell Lake quarry is generally soft and must be washed and supplemented with sand to achieve cement-quality gravel (Gordon Campbell, pers. comm.).

Local representatives have expressed some concern with the Inuvialuit Land Administration's requirements for access to the Ya-Ya Lakes pit. Until recently, the Town of Inuvik has been using stockpiled materials acquired from the Ya-Ya Lakes pit prior to the settlement of the Inuvialuit Final Agreement for its Class 1 requirements. The stockpiled materials have now been depleted. Some local representatives contend that the costs of access to Inuvialuit lands are excessively high, and that the decision-making process and the rules associated with the use of security deposits are unclear.

This study is not an appropriate forum to attempt to resolve the differences described above. It would be preferable that such disputes be resolved at the local level. In the last resort, however, the Inuvialuit Final Agreement sets out an arbitration process for the

resolution of granular-related disputes (Section 7(42) and Section 18).

3.4.2 Class 2 Materials (Non-Speculative)

The non-speculative requirement for Class 2 materials in Inuvik has been forecast at approximately 6000 cubic metres. The materials would be required in the first 5 years of the study period (Table 1). EBA (1987) has recommended that this requirement be supplied from the Ya-Ya Lakes pit or Source I 407. The Ya-Ya Lakes pit is described above. Source I 407 is situated on Inuvialuit 7(1)(a) lands in the Caribou Hills, approximately 61 km northwest of Inuvik. Like the Ya-Ya Lakes pit, it is accessible to Inuvik via the east Channel of the Mackenzie River.

Source I 407 has probable and prospective volumes of class 2 materials of 4.6 million and 15 million cubic metres respectively. The source has been marginally developed in the past: approximately 7500 cubic metres of sand have been taken from the site (Gordon Campbell, pers. comm.). However, other sections of the source might contain higher-quality materials.

While the Ya-Ya Lakes pit and Source I 407 have more than ample materials to supply Inuvik's Class 2 needs, the continuing development of these sources for public community needs would appear to require some resolution of the differences noted under Section 3.4.1.

3.4.3 Class 2 Materials (Speculative)

EBA (1987) recommends the use of Sources 312 (Hans Creek) and 314 (Stanley Creek) to meet Inuvik's speculative requirement for Class 2 materials, subject to the construction of the Inuvik-Tuktoyaktuk highway along the proposed Husky Lakes routing. Source 312 is located on Inuvialuit 7(1)(b) lands in the Husky Lakes area, approximately 55 km north of Inuvik. Source 314 is also located close to the Husky Lakes, on Crown and Inuvialuit 7(1)(b) lands, and is approximately 42 km north of Inuvik. Neither source is currently accessible to Inuvik.

Sources 312 and 314 each have probable volumes of Class 2 material of approximately 2.3 million cubic metres. Source 312 has a further probable volume of 2.3 million cubic metres of Class 1 material. The forecast speculative requirement for Class 2 materials in the Inuvik area is approximately 1.9 million cubic metres (Table 2).

While Sources 312 and 314 appear to have sufficient high-quality materials for the community's future requirements, Source 2.45 should also be considered. This source is situated approximately 25 km northeast of Inuvik, on Crown Lands, and would therefore involve shorter haul distances to Inuvik than either Source 312 or 314.

Like Sources 312 and 314, Source 2.45 is currently undeveloped and without access to Inuvik. It has a prospective volume of 25 million cubic metres of Class 2 materials.

3.4.4 Class 3 Materials (Non-Speculative)

Inuvik's forecast Class 3 requirements are entirely local (non-speculative) in nature. EBA (1987) recommends that the required 130 000 cubic metres of Class 3 materials be supplied from Source I 407 and/or the Ya-Ya Lakes pit, described above.

3.4.5 Class 4 Materials (Non-Speculative)

Inuvik's forecast requirement for Class 4 material is entirely non-speculative in nature. EBA (1987) recommends that the Boot Lake site, Source I 400, be used for these requirements. This source is located at the southern end of Inuvik, on lands administered by the Town.

Source I 400 has been extensively developed and is very near to depletion. While it may be adequate for the 2000 cubic metre requirement forecast by EBA, Town representatives feel that the site should be subsequently restored, and that the lower-classed materials of some other source should be used for any further Class 4 requirements.

3.4.6 Class 5 Materials (Non-Speculative)

EBA (1987) recommends that Inuvik's forecast non-speculative requirement for Class 5 materials continue to be supplied from Sources I 402 (the Transport Canada quarry) and I 403 (the Campbell Lakes quarry). Source I 403 is described above. The Transport Canada quarry is located on DOT-administered lands, just south of the Town.

The Transport Canada quarry has a proven volume of Class 5 materials of 4.6 million cubic metres. It has been extensively developed for DOT requirements in the past. The Town is also granted access to the source. As with the Campbell Lakes quarry, materials taken from this source are somewhat soft in nature (Gord Campbell, pers. comm.). The two sources are more than adequate for the Town's small capital and maintenance requirements (approximately 10 000 cubic metres) as well as for airstrip maintenance requirements (32 000 cubic metres).

3.4.7 Class 5 Materials (Speculative)

Speculative Class 5 requirements from the Inuvik area are relatively large. The Inuvik portion of the Inuvik-Tuktoyaktuk highway and the production of material for erosion protection associated with proposed offshore petroleum production facilities would require 2.8 million and 2.7 million cubic metres of Class 5 materials respectively, for a total of 5.5 million cubic metres. EBA (1987) recommends that the R28/R29 bedrock exposures approximately 20 km south of Inuvik be developed as a major supply of borrow for large projects. Sources R28 and R29 are located on Crown Lands nearby the East Channel of the Mackenzie River. These sources could be made accessible to Inuvik and the Beaufort Sea area by barge in the open-water season, and by ice road in the winter. Alternatively, EBA suggests that large-scale development could occur at the Campbell Lake quarry (Source I 403) and at the DPW quarry. The DPW quarry is located on Crown Lands, approximately 22 km southeast of Inuvik, and is accessible to Inuvik via the

Dempster Highway. Local requirements could be met by Source I 403 and I 402.

Sources R28 and R29 have a probable volume of 20 million cubic metres of Class 5 material. They are currently undeveloped. The DPW quarry is under development, and has a proven volume of 600 000 cubic metres and a probable volume of 3.5 millon cubic metres of Class 5 material. As noted above, the Campbell Lake quarry has a proven volume of 2 million cubic metres of Class 5 material. The DPW and Campbell Lake quarries might therefore have to be extensively developed to supply the projected requirements of speculative projects in the Inuvik area, if the R28, R29 or other potential quarry sites in the western Beaufort region were not developed. For a discussion of alternative sources in the Aklavik area, see Nesbitt and Howell (1988a).

3.4.8 Summary of Potential Sources

There are several potential sources of granular materials in the Inuvik region. To the northwest is the extensive Ya-Ya Lakes source, as well as Source I 407 in the Caribou Hills. While somewhat distant from Inuvik, these sources are more than adequate to serve the community's future local requirements for higher-quality materials. They could also be used, together with other sources in their general vicinity, for construction of the Inuvik-Tuktoyaktuk highway, should it be routed more to the west than is currently proposed. To the north, are sources 2.45, 312 and 314. While none of these sources are currently accessible, they might be made accessible in the

event of the construction of the Inuvik-Tuktoyaktuk highway. Were Source 2.45 made accessible to the community, it would also be the most readily-available, large source of granular materials at the community's disposal. To the south and southeast, there are several sources of Class 5 materials. Source I 402 (the DOT Source), I 403 (the Campbell Lakes quarry) and the DPW quarry have already been developed. A further area, sources R28 and R29, is one of the rare, large sources of armour stone and rip rap available in the Mackenzie Delta/Beaufort Sea area for erosion protection associated with offshore oil and gas development.

While there is an abundance of potential sources in the Inuvik area, community representatives are concerned that there is no local source capable of providing the range of granular materials required by the community at a reasonable price. They would like to see further exploration for a source closer to the community, and have recommended that the area marked AA on Figure 5 be investigated. Alternatively, Source 2.45 might be made accessible and developed.

3.5 ASSESSMENT OF POTENTIAL SOURCES

3.5.1 Source I 407 (Caribou Hills)

Source I 407 has been marginally developed in the past. While materials taken from the source consisted almost exclusively of sand, other parts of the source are expected to contain higher-quality materials.

The source is just within the northern perimeter of the core area of "IBP Site No. 4-9: Caribou Hills, Mackenzie River Delta". The west-facing slopes of the Caribou Hills were recommended for protection by Panel 9 of the International Biological Program because of their unique plant and animal associations, and the diversity of plant and animal species within a relatively small area. The IPB Panel noted that human impact on the area had already been significant, and that the extraction of gravel could seriously endanger already vulnerable populations (Nettleship and Smith, 1975). IBP sites are currently under review and have been afforded no formal protection in Canada. Nor is there any specific reference to IBP sites in the Inuvialuit Final Agreement.

On the other hand, the Source I 407 area is not used for local hunting, fishing, trapping, or camping. And apart from Reindeer Station, 22.5 km south of the source, there are no locally-known archaeological resources in the area. Nor is transportation from the source of concern, since the Inuvik-Tuktoyaktuk winter ice road would be used.

The consensus of the workshop was that Source I 407 could be reserved and developed without locally-significant environmental and social impacts, provided that the developed area was restricted to the immediate area of Source I 407. But while, from the local perspective, the source could acceptably be developed, some minor national concern with the potential development of this source, given its IBP status, might be expected.

3.5.2 Source 312 (Hans Creek)

The Hans Creek area is considered the prerogative of the people of Tuktoyaktuk. As such, this source was not assessed by the Inuvik workshop. It was noted, however, that the source could be significant for the Tuktoyaktuk hunting, fishing, and trapping economy, and that the source is near one of the local camps in the area. For further information see Nesbitt and Howell (1988b).

3.5.3 Source 314 (Stanley Creek)

Source 314 is located on Stanley Creek. The potential development of this source was of concern to community representatives on environmental, social/cultural, and aesthetic grounds. Environmental and harvesting concerns focused on the potential disruption of lake trout, broad whitefish, and grayling migrations along the creek to Jimmy and Noel Lakes, both of which are used by local fishermen. Source 314 is also on the winter travel route to the Husky Lakes, and is considered one of the most scenic places in the general area. Community representatives feel that the visual values of this area could be destroyed by the development of this source. No archaeological concerns were stated.

Associated with the development of Source 314, and also of concern to the workshop participants, was the routing of the proposed Inuvik-Tuktoyaktuk highway in such close proximity of Husky Lakes. The ultimate alignment of the highway will be a significant factor in locating and developing granular material sources in the area. The

proposed routing of the highway would allow greater public access to the Husky Lakes, an area used extensively for fishing, camping, and hunting by Inuvik residents. Community representatives noted concerns with potentially greater fishing pressure on the Husky Lakes, with the potential reductions in fishing resources, and with the potential for disruption of local fishing, camping, and hunting activities in the area. The alignment of the proposed highway near the Husky Lakes was also of concern to representatives of Tuktoyaktuk (Nesbitt and Howell 1988b).

3.5.4 Source 2.45 (Noel Creek)

Like Source 314, Source 2.45 is on a fish migration route and the local travel route to the Husky Lakes. Mitigative measures have, however, been suggested to reduce local concerns with the potential development of this source. Furthermore, access to the Husky Lakes is not an issue with this source, given its distance from the Lakes.

Noel Creek is used by lake trout, broad whitefish, and grayling migrating between the Husky Lakes and Noel Lake. Inuvik residents also use the Noel Lake area for fishing and general camping. Source 2.45 is thus in an area of high value to the community. Community representatives have suggested, however, that Source 2.45 be investigated with a view to excavating only the western portion of the source, so as to create a buffer zone and leave the natural drainage and valley of Noel Creek (east of the excavated area) intact. Provided that this could be done, and that the community could be assured access to a longer-term

source of granular materials, community representatives feel that the environmental and social impacts of the development of the source could be reduced to an acceptable level.

Source 2.45 is not currently accessible to Inuvik. Its prospective development is, however, of considerable interest to the community given the high quality and volume of prospective estimates, the relatively close proximity of the source, and the need for a source of reasonably-priced high-quality materials in Inuvik.

3.5.5 Source I 400 (Boot Lake)

As suggested above, Town representatives consider the Boot Lake pit to be essentially exhausted. While small volumes of low-grade materials may still be recoverable from the source, plans should now be developed for the restoration of the pit. Source I 400 should not be considered a longer-term source of granular material.

3.5.6 Ya-Ya Lakes, the DPW Quarry and Sources I 402 and I 403

While the Ya-Ya Lakes pit and the DPW, DOT (I 402), and Campbell Lake (I 403) quarries have all been extensively developed, community representatives consider this development to have been carried out without significant environmental or social impacts. The consensus of the workshop was that, at the present scale of development, future excavation at these sources would be environmentally and socially acceptable.

As was noted above (Section 3.4.7), however, one of the scenarios described by EBA (1987) suggests the possibility of large-scale development of the I403 and DPW quarries. There are several concerns with this proposal. While the Campbell Hills area is not extensively used for hunting, fishing, or trapping, it is a scenic and potential tourism resource of the community. The Campbell Hills are also part of "IBP Site No. 48: Dolomite Lake - Campbell Lake", an area of some national interest because if its outcroppings of dolomite and its microclimates, plant and animal associations, and relatively high densities of nesting raptors, including the endangered anatum sub-species of the peregrine falcon (Beckel 1975). Because of these values, the Campbell Hills area has also been proposed as the site of a territorial park, and discussions are underway. However, the Campbell Hills area has, as yet, no formal designation as an area of special protection.

The current level of development of the DPW, DOT, and Campbell Lake quarries appears to be compatible with the above values and other potential uses of the Campbell Hills area. The quarries are relatively small and are located only along the perimeter of the proposed park and IBP site. Furthermore, the DOT and DPW quarries are not visible from the Dempster Highway, which services all three quarries and which is a major point of entry of tourists to the Inuvik area. Community representatives are concerned, however, that with any large-scale development of the Campbell Lake and DPW quarries, large volumes of rock (5.5 million cubic metres) would have to be transported along the Dempster Highway between the quarries and Inuvik. This could lead

to a reduction in the tourism value of the eastern side of the Campbell Hills area, as well as to a deterioration in road quality and safety. Town representatives are further concerned that large volumes of granular materials would have to be stockpiled in Inuvik, in preparation for their movement by barge to the Beaufort Sea area.

In summary, while the current scale of development of the above sources was considered environmentally and socially acceptable by workshop participants, the potential large-scale development of the DPW and Campbell Lake quarries is an item of fairly strong community concern.

3.5.7 Sources R28 and R29

Sources R28 and R29 are within the Dolomite Lake - Campbell Hills IBP site and the proposed Campbell Hills Territorial Park. Although the area has no formal designation as a protected area, the possible development of these sources raises several concerns. As noted above, these sources have been recommended as the major source of borrow for the proposed Inuvik-Tuktoyaktuk highway and for erosion protection for offshore petroleum production facilities in the Beaufort Sea. As such, the development of the sources would share some of the concerns associated with the potential large-scale development of the DPW and Campbell Lake quarries. The Department of Renewable Resources (GNWT) has, for example, noted the excellent cliff habitat for a relatively high density of the endangered anatum sub-species of the peregrine falcon in the Campbell Hills area (Appendix B). Mitigative measures for potential impacts to raptors, as used in other major development projects in the

Mackenzie Valley such as the Norman Wells Pipeline Project, have been referenced in Appendix B. There are, however, significant differences in the projected impacts of developing Sources R28 and R29.

On the negative side, Sources R28 and R29 are within the suggested boundaries of the proposed territorial park. The Department of Economic Development and Tourism (GNWT) is concerned that the development of Sources R28 and R29 may be incompatible with other uses of the proposed park (see Appendix C).

On the positive side, however, the isolation of large-scale granular development to the western side of the Campbell Hills would have a lower visual impact for the majority of users, who would approach the Caribou Hills from the eastern, Dempster Highway side. Transportation would be by barge directly from the site, thus avoiding the Dempster Highway and many of the impacts associated with transportation through Inuvik. For these reasons, community representatives would prefer that the R28/R29 site be investigated and considered for development prior to any large-scale development of the DPW and Campbell Lake quarries.

In an effort to mitigate the impacts of developing the R28/R29 site, and its infringement on the proposed territorial park, the feasibility of developing only Source R28 (the western-most source) should be considered. Studies by EBA (1983) and Golden (1987) suggest that Source R28 (Gull Creek Quartzites) is unlikely to be able to supply the largest sizes of armour stone that might be

required for offshore oil and gas production. They also identify Source R29 (Gull Creek Dolomite) as one of only two sources in the western Beaufort region that are able to supply the required materials. The other is Mt. Fitton, in the Yukon, to which access is more difficult. If, however, Source R28 could supply the large-scale projects described above, then that source could be reserved and developed and the boundaries of the proposed territorial park could be drawn so as to exclude Source R28.

3.5.8 Source AA

As noted above, community representatives would like to see Source AA (Figure 5) investigated with a view to its future reservation and development as a nearby source of granular materials for the community at large. The source is not in an area extensively used either by wildlife or by the local hunting, fishing, and trapping economy. Like Source R28, Source AA is within the boundaries of the IBP site and the proposed territorial park. The site is therefore subject to the wildlife and park-related concerns noted above. Community representatives feel, however, that an accommodation could be worked out between the proposed park and the development of granular materials at the site. The consensus of the workshop was that, all things considered, the environmental and social impacts of developing Source AA would be acceptable to the community.

Although there is currently no information on the type, quantity, and quality of material present, it is speculated that Source AA could be the least expensive option available to the community, if it contained the range of

materials required in Inuvik. The site is currently located on Crown Land and is within 10 km of the community.

3.5.9 Source 155 (Kittigazuit Creek)

In the spring of 1988, Gruben's Transport of Tuktoyaktuk began developing Source 155. Approximately 15 000 cubic metres were excavated. While the source holds promise as one of Tuktoyaktuk's primary sources of supply, some concern has been raised by local residents, particularly from Inuvik. Its development was therefore assessed at both the Inuvik and Tuktoyaktuk workshops (Nesbitt and Howell 1988b). In addition, a representative of the Inuvik Community Corporation and Hunters and Trappers Committee (Willie Stefansson) was brought to the Tuktoyaktuk workshop, and excavations at Source 155 were inspected.

Source 155 is located on Inuvialuit 7(1)(b) lands, approximately 95 km (by air) north of Inuvik and 47 km (by ice road) southwest of Tuktoyaktuk. The source is located very close to the headwaters of Kittigazuit Creek. Access from Tuktoyaktuk follows an ice road along the creek for most of the creek's length (15 km) before turning inland for 4 to 8 km to approach the source from its landward side.

Kittigazuit Creek flows from its headwaters north into Kugmallit Bay, on the Beaufort Sea. It is important to local people, particularly from Inuvik, because of its fishing, camping, and archaeological and cultural significance. Kittigazuit (at the mouth of the Creek) was one of the traditional areas around which people in the

Tuktoyaktuk area camped before the establishment of the settlement, and it is still used extensively for whaling and fishing in the summer months, primarily by people from Inuvik. The Inuvik Hunters and Trappers Committee has thus expressed some concern with the development of this source.

Source 155 is being developed so as to maintain a buffer zone between the developed area and drainage into Kittigazuit Creek. While an environmental evaluation by Cockney (1988) initially recommended against the development of the site, the consensus of the Tuktoyaktuk and Inuvik workshops, at which the issue was discussed, was that the environmental and social impacts of development of the source would be acceptable, provided that the following conditions were met:

(1) A long term development/environmental protection plan be produced for the source, demonstrating that the fish populations and fish habitat will not be affected by the source's development. Representatives of the two communities and of the regulatory authorities should work together in the development of this plan (see Appendix A).

(2) All excavation and transport work should be undertaken in the winter, and must ensure that the buffer zone between the developed area and drainage area into Kittigazuit Creek is maintained.

(3) The site should be regularly monitored by the ILA, together with the two communities' Hunters and Trappers Committees.

3.6 COMPARATIVE ASSESSMENT OF SOURCES

A comparative assessment of the granular resource sites near Inuvik is summarized in Table 4 and discussed below.

TABLE 4

COMPARISON OF GRANULAR RESOURCE SOURCES
INUVIK

Source	Use	Environmental and Aesthetic Considerations	Wildlife and Social-Cultural Considerations	Economic Considerations	Comments	Ranking: Significance of Impacts	Ranking: Acceptability of Development
I 407	Class 2 & 3 needs	Within IBP Site 4-9; development could endanger already vulnerable plant and animal populations.	Not used for local hunting, fishing, trapping, or camping.	Inuvik-Tuktoyaktuk ice road could be used for transportation.	Workshop participants agree that development is acceptable; may be national concern if developed because of IBP status.	Insignificant (locally) Significant (nationally)	Acceptable (locally)
314	Class 2 speculative needs	Potential disruption of fish migrations; along scenic route to the Husky Lakes; massive ground ice present-development would result in thermokarst slumping.	Area used by local fishermen; development will open access to Husky Lakes.	42-km winter road required.	Partially on Tuktoyaktuk 7(1)(b) lands.	Significant	Unacceptable
2.45	Class 2 speculative needs	Potential disruption of fish migration; ground ice conditions not known.	Along local travel route to Husky Lakes; area used for fishing and camping.	25-km winter road required; lower royalty costs because not on Inuvialuit land.	Acceptable to workshop participants if western side of deposit developed and eastern side left as a buffer.	Significant	Acceptable if development restricted to western side.
I 408	Class 4 needs	Existing pit, essentially depleted.	None.	None.	Workshop participants felt that plans should be made for pit restoration.	Insignificant	Acceptable for Town's projected 2000 m^3 Class 4 needs; unacceptable for further development.
Ya-Yb	Class 1, 2, and 3 needs	Existing pit; massive ice present.	Existing pit; none identified.	90-km winter road required.	Preferred source of high-quality materials for Inuvik.	Insignificant	Acceptable
DPW Quarry I 402, I 403	Class 5 and Class 1 (crushed rock from I 403) needs; DPW Quarry and I 403 would be used for speculative Class 5 needs	Campbell Hills is part of IBP Site 48, noted for dolomite outcrops, rare plants, and endangered peregrine falcon nesting sites. Increased level of development may have negative impact on plants and falcons and on aesthetics (DPW's quarry and I 402 currently not visible from the road.	Campbell Hills is a scenic and potential tourism resource.	Sites are accessible from the Dempster Highway.	Large-scale development of the DPW Quarry and I 403 concern workshop participants.	Significant	Current level of development acceptable. Large-scale development unacceptable.
R28, R29	Class 5 speculative needs	Within IBP Site 48, noted for dolomite outcrops, rare plants, and endangered peregrine falcon nesting sites. On west side of Campbell Hills, therefore isolated from view of Dempster Highway.	Within the boundaries of a proposed territorial park.	20-km winter road required; barge in summer.	Workshop participants suggest consideration should be given to developing Source R28 only and leaving Source R29.	Significant	Acceptable
AA	Not known	None identified	Close to boundaries of proposed territorial park. Not used extensively by local hunting, fishing, or trapping economy.	Located on Crown Land and within 10 km of Inuvik; 10-km winter road required.	Workshop participants would like to see the potential source investigated further.	Insignificant	Acceptable

With the exception of the Ya-Ya Lakes pit, none of the sources are unequivocally acceptable to the Inuvik Working Group for development. The Ya-Ya Lakes pit is identified as the source of Inuvik's Class 1 needs and also as a source of some of its Class 2 and 3 needs.

Development of Source I 407, targeted to supply part of Inuvik's Class 2 and 3 needs, is acceptable to the community. Its location within IBP Site 4-9, however, may cause some minor national concern if the source were developed. Source 314 has been identified as a potential source of some of the area's Class 2 speculative needs if the Inuvik-Tuktoyaktuk highway is built along the proposed Husky Lakes route. The development of this site is unacceptable to local residents because it will open up access to Husky Lakes, disrupt a local fishing area, and negatively affect the aesthetics along a popular travel route to the lakes. Site 2.45, also identified as a source of Class 2 materials for speculative needs and also on the Husky Lakes route, is considered acceptable for development if activities are restricted to the western side of the deposit. The eastern side of the deposit would serve as a buffer between any pit and the travel route.

Workshop participants found EBA's suggestion of using Source I 400, the Boot Lake site, to supply the Town's projected 2000 cubic metre Class 4 needs acceptable. The development of this source to supply larger quantities of Class 4 materials is not, however, acceptable. The consensus was that lower quality materials from some other source should be used for larger-scale requirements, and

that plans should now be formulated to close and restore the site. Some alternative source to supply additional Class 4 requirements should now be sought.

The DPW quarry, Source I 402 (the DOT quarry), and Source I 403 (the Campbell Lake quarry) were considered acceptable by workshop participants providing the current scale of development is maintained. Increased development of the DPW quarry and Source I 403 to meet Inuvik's speculative Class 5 needs was not acceptable because of tourism-related and scenic impacts, anticipated increases in truck traffic on the Dempster Highway, and the associated decrease in road quality and safety. The development of Source R28 to meet speculative Class 5 needs was considered acceptable. Source R29 should be developed only if necessary. While nothing is known about materials at Source AA, its development would be acceptable to the Working Group were the site able to make a significant contribution to the community's needs.

PART 4: RECOMMENDATIONS

(1) Inuvik currently has no nearby and reasonably-priced source of granular materials available to it. In an effort to address this situation, the quantity and quality of materials in Sources 2.45 (near Noel Creek) and AA (south-west of Inuvik: Figure 5) should be more accurately determined through field investigations. If they contain suitable materials, these sources should be reserved for public community uses in the Inuvik area, with an adequate portion of the reserves set aside to meet the forecast 20-year demand of the community itself.

(2) Field investigations should also be carried out at Sources R28 and R29, in the western part of the Campbell Hills, south of Inuvik, in order to determine the quantity and quality of materials at each of these sources. Provided that Source R28 contains sufficient Class 5 materials for the region's future needs, every effort should be made to restrict large-scale excavations in the Campbell Hills to this source. The DPW and Campbell Lake quarries should be kept at their current scale of development. In order to minimize disruptions to other uses of the Campbell Hills area, Source R 29 should not be developed unless necessary.

(3) This study could not fully assess the impacts of large-scale development of sites such as sources R28 and R29; the impacts of transporting substantial quantities of material to their ultimate destination in the Beaufort Sea; or the comparative impacts of developing these sources versus sources in the Aklavik area (Nesbitt and Howell 1988a). These issues should be more fully assessed by the responsible authorities prior to any large-scale development of the sources.

(4) The Regional Land Use Planning Commission(s) for the Mackenzie Delta area may wish to re-visit the ultimate questions of the establishment of the Campbell Hills Territorial Park, its boundaries, and the compatibility of the development of sources R28 and R29 with other uses of the area.

(5) While Source 2.45 (25 km north of Inuvik) is promising as the preferred future source of high and medium-quality materials in Inuvik, it is not currently accessible to the community. Until materials in this source have been verified and made accessible to Inuvik, it may be worthwhile to carry out field investigations and to reserve Source I 407 in the Caribou Hills as well. With the development of access to Source 2.45, however, Source I 407 may become unnecessary for public community requirements. Source I 407 should also be made accessible to the corporate needs of the Inuvialuit and other users.

(6) Source 155 (Kittigazuit Creek) should be reserved and developed for small and medium-scale projects (demands of less than approximately 100 000 cubic metres) in the Tuktoyaktuk area. The source should be developed as outlined in Section 3.5.9 of this report.

(7) Granular development and environmental protection plans should be produced for each of the major sources in the Inuvik area, including Sources 2.45, AA, R28 and R29, I55, I 407 prior to further development. The plans should be produced in consultation with local and regulatory representatives (see Appendices A, B, and C). They should lay out a 5-to-10 year strategy for the orderly development of each source, and should ensure the integration of granular planning and other land use planning initiatives. They should also ensure that each source is developed so as to minimize environmental and visual effects, and maximize the amount of materials recovered from the source. In addition, they should lay out procedures for the proper development and restoration of pits. The number of pits under development at any time in the Inuvik area should be kept to a minimum.

(8) The development of Source 2.45 should be planned and implemented so as to create a buffer zone between the excavated area and the natural drainage and valley of Noel Creek (see Section 3.5.4 and Appendix A).

(9) Community representatives in Inuvik and Tuktoyaktuk have expressed concerns about the currently-proposed alignment of the Inuvik-Tuktoyaktuk highway, and particularly about its proximity to the Husky Lakes. The ultimate alignment of the highway will have a

significant effect on the reservation and development of granular materials throughout the Inuvik-Tuktoyaktuk area. The issue should be addressed by the Mackenzie Delta/Beaufort Sea Land Use Planning Commission and officials of the Highways Planning Division of Indian and Northern Affairs Canada, prior to further reservations of specific sources to service highway construction and maintenance.

(10) The demands of pipeline(s) construction should be incorporated into future granular demand forecasts. Requirements for the related expansion of the Town of Inuvik should also be incorporated.

(11) Future Class 5 granular demand forecasts should incorporate a breakdown of the material type and intended usage desired. A breakdown of the substantial Class 5 requirement for the Inuvik portion of the proposed Inuvik-Tuktoyaktuk highway would aid in assessing the demand for alternative sources (such as Source 2.45) of naturally occurring aggregate.

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APPENDIX A

LETTER FROM NANCY WITHERSPOON, HABITAT MANAGEMENT BIOLOGIST, WESTERN ARCTIC AREA, FISHERIES AND OCEANS CANADA

Government of Canada / Gouvernement du Canada
Fisheries and Oceans / Pêches et Océans

May 29, 1988

Your file Votre référence

Our file Notre référence

Fisheries & Oceans
Western Arctic Area
Box 1871
Inuvik, NWT
X0E 0T0

Mr. Tom Nesbitt
Thomas Nesbitt and Associates
5210 Lundquist Road
Yellowknife, NWT
X1A 3G2

GRAVEL EXTRACTION IN THE WESTERN ARCTIC AREA

Dear Tom:

We have looked at existing and potential sites for gravel extraction in our area and provide the following comments related to the fisheries resources:

1. Gravel extraction near creeks or lakes should be conducted so that;
   a) silt is not released into the water body
   b) bank disturbances are minimized as are changes to the shape and direction of the watercourse
   c) that watercourses are not dammed as a result of the activity
   d) pounding along side watercourses does not take place
   e) spawning gravels are not removed on creek or river bottoms
   f) refuse does not enter water bodies
   g) winter and summer road construction to the sites are constructed to minimize disruptions to water bodies as outlined above
   h) any summer operations near water bodies should be conducted outside fish migratory or spawning periods if they are conflicting

2. Underwater gravel extractions should be conducted giving consideration to;
   a) type of equipment used for extraction
   b) timing of migration and spawning of species in the area
   c) utilizing of the areas by fish for feeding or rearing

Specific sites identified that have fisheries concerns include:

1. Aklavik area sites 455 and 467

....2

2. Tuk area sites 155, 160, 162 and 158

3. Inuvik area sites 2.45, 2.44, 2.43,314, R28 and R29

4. Sachs Harbour sites 9, 10 and 11

5. Paulatuk sites 14 to 19

All sites could be reviewed in detail as they come up for development.

I hope this will assist you in producing your report and if you have any questions don't hesitate to contact me or Richard Barnes at (403)979-3314.

Yours truly,

Nancy Witherspoon
Habitat Management
Biologist
Western Arctic Area

cc: D.V. Gillman
B. Wong
J. Stein
R. Barnes

APPENDIX B

LETTER FROM STEVEN MATTHEWS,
ENVIRONMENTAL ASSESSMENT BIOLOGIST
WILDLIFE MANAGEMENT DIVISION,
RENEWABLE RESOURCES, GNWT

Northwest Territories Renewable Resources

160 000

12 July 1988

Thomas Nesbitt and Associates
5210 Lundquist Road
Yellowknife, NWT
X1A 3G2

Dear Mr. Nesbitt:

Development of Granular Materials in the Campbell Hills Area

In response to your request for information on the potential conflicts between nesting raptors and the development of granular materials in the Campbell Hills, I would like to provide you with the following information and comments.

1. Land regulation of the Campbell Hills and surrounding area can be found in the following publications:

   a) Larson, R.M. 1985. The Administration of Restricted Lands in the Northwest Territories. NWT Renewable Resources, Yellowknife. 150pp.

   b) Ferguson, R.S. 1987. Wildlife Areas of Special Interest to the Department of Renewable Resources. NWT Renewable Resources, Yellowknife. 207pp.

The Government of the Northwest Territories has regulatory control over lands in the Block Land Transfer only.

2. The question of conflicting land uses in the Campbell Hills should be addressed in a Regional Land Use Plan. The Campbell Hills provides excellent cliff nesting habitat for a relatively high density of endangered anatum sub-species of peregrine falcon. In addition, the Campbell Hills is a proposed Territorial Park.

3. For other major development projects in the Mackenzie Valley such as the Norman Wells Pipeline Project, the following raptor protection measures have been implemented:

.../2

a) Ground and air access within 3.2 km of an identified raptor nest is restricted during the period April 15 to September 15.

b) If overflight of restricted raptor areas cannot be avoided, aircraft will maintain a minimum altitude of 760 m above ground level.

c) Blasting activities which are unavoidable within 3.2 km of raptor nests, and during the restricted times April 15 to September 15, and which are of sufficient magnitude to potentially cause disruption of successful breeding raptors, will be planned in consultation with appropriate environmental representatives.

I hope this information will assist you in your work.

Yours sincerely,

Steven Matthews
Environmental Assessment
Biologist
Wildlife Management Division

cc: A/Supervisor, Habitat Management Section
Regional Biologist, Inuvik

APPENDIX C

LETTER FROM ERIK VAL, SPECIAL ADVISOR, PROGRAM DEVELOPMENT, TOURISM AND PARKS, ECONOMIC DEVELOPMENT AND TOURISM, GNWT

61 830 101

Northwest Territories Economic Development and Tourism

May 11, 1988

Thomas Nesbitt and Associates,
Evironmental Planning
Analysis and Training,
5210 Lundquist Road,
Yellowknife, N.W.T.
X1A 3G2

Dear Tom,

Our brief discussion of May 10, 1988 concerning aggregate deposits and the proposed Campbell Hill/Lake Territorial Park was useful. As agreed please include in your final report this Department's concern that developing granular resources in a territorial park may be incompatible. The park proposal will be further developed by a joint territorial-community management group. As the planning proceeds, the question of developing these granular resources will be discussed and assessed by the management group. The outcome of these discussions will be forwarded to Mr. Robert Gowan, D.I.A.N.D., in Hull, Quebec. Thank you for taking the time to explain your work in this area.

Yours truly,

Erik Val,
Special Advisor,
Program Development,
Tourism & Parks.

cc Don Sandercott,
Inuvik Native Band,
P.O. Box 2570,
Inuvik, N.W.T.
X0E 0T0

Mr. Bob Gowan,
D.I.A.N.D.,
10 Wellington St.,
Hull, Quebec