BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

NANISIVIK MINE, A DIVISION OF CANZINCO LTD.

NANISIVIK MINE CLOSURE PLAN

QUARRY DEVELOPMENT AND RECLAMATION PLAN

(WATER LICENSE PART G ITEM 6)

FINAL

PROJECT NO.: 0255-008-07
DATE: FEBRUARY 6, 2004

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Project No. 0255-008-07
February 6, 2004

Mr. Bob Carreau
Corporate Manager, Environmental Affairs
Breakwater Resources Limited
Suite 950, 95 Wellington Street West
Toronto, ON
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Re: Final Report: Quarry Development and Reclamation Plan, Nanisivik Mine, NU

Dear Bob:

Please find attached four copies of our above referenced report dated February 6, 2004. Should you have any questions or comments please contact BGC at your convenience.

Yours truly,
BGC Engineering Inc.
per:

A.E. Isherwood, M.Sc., P.Geol.
Principal Consultant

encl. Final Report

KFM/AEI/JWC/sf

EXECUTIVE SUMMARY

Under the terms of Water Licence NWB1NAN0208 issued by the Nunavut Water Board (NWB), CanZinco Ltd., the current owner of the Nanisivik Mine is responsible for continuation of on-site environmental protection activities and developing for submission and approval a Reclamation and Closure Plan ("RCP").

The Nanisivik Mine 2004 RCP has been developed, as per the terms of the Water Licence as a series of stand-alone documents, each addressing in detail the information and proposed closure measures for one specific component or topic area. This document and the information presented herein are provided in response to the requirements for report Part G Item 6, the Quarry Development and Reclamation Plan.

In accordance with Part G Item 6 of the Water Licence, this report provides the following requirements for Quarry Development and Reclamation Plan:

The Licensee shall submit to the Board for approval a report assessing all quarries required for shale cover construction, which shall include but not be limited to:

1. *Description of extraction method and rate of production;*
2. *Identification of waste/overburden volumes and disposal sites;*
3. *Description of final quarry geometry and reclamation measures; and*
4. *Maps, where appropriate, showing sources and stockpile locations of all borrow materials.*

In summary, this Quarry Development and Reclamation Plan report provides details for the following components:

- Development plans for four quarries.
- A detailed reclamation and grading plan for the developed quarries at closure.
- A monitoring plan to assess the extracted material used for closure.
- A series of contingency plans that may be implemented should the need for more material arise.

At the current time, Nanisivik Mine has permits for seven shale quarries:

- Landfill Quarry.
- Mt. Fuji Quarry.
- West Twin Quarry.
- Shale Hill Quarry.
- Road Quarry.
- Area 14 Quarry.
- East Twin Quarry.

Quarry permits for these sites are regulated either by the Government of Nunavut or Indian and Northern Affairs Canada.

At closure, shale cover will be required for the following facilities around the mine site:

- Surface Cell tailings and crest of West Twin Dike.
- Downstream face of West Twin Dike (including completion of shale cover for consistent grade).
- Tailings at the toe of West Twin Dike.
- Transition zone tailings at toe of West Twin Dike.
- Test Cell tailings and Test Cell Dike.
- Transition zone tailings at the toe of Test Cell Dike.
- Landfill.
- West Open Pit (including 09 Access Road).
- East open Pit.
- Area 14 Waste Rock Pile (including completion of existing cover with armouring sand & gravel).
- Oceanview Pit.
- Oceanview Portal Site (former ore stockpile pad)
- East Trench.
- Mill Area.

In addition to the shale cover at these locations, a top layer of sand and gravel armouring will be required. This material will be obtained from the Twin Lakes sand and gravel deposit, located between West Twin Lake and East Twin Lakes. The total in-place volume of shale required for the covers is estimated to be about 794,400 m^3. The total in-place volume of sand and gravel armouring required is estimated to be about 180,350 m^3. The volumes are based on the designs, as reviewed in detail in the Cover Design Report, (Part G, Item 4), the Rock Piles and Open Pits Report (Part G, Item 8) and the Land fill Closure Report (Part G, Item 17).

This report describes the quarry development and reclamation plan for four quarries, which have the potential to provide a total in-situ volume of 1,350,000 m^3 of shale cover material. The Twin Lakes sand and gravel Quarry contains an estimated volume of 375,000 m^3 of material within the upper 2 m. Due to the proximity of West Twin and East Twin Lakes, sand and gravel extraction will be limited to the portion of the deposit above the average level of West Twin Lake (elevation 371 m).

All quarries will be operated and reclaimed according to the relevant guidelines and regulations. In general, most of these requirements are embodied within the conditions of the Water Licence and the individual quarry permits. Relevant guidelines include "Guidelines for Abandonment and Restoration Planning for Mines in the Northwest Territories", "Reclamation Guidelines for Northern Canada" and "Environmental Guidelines, Pits and Quarries". The following operational

and design related guidelines have been applied to the Nanisivik quarries:

- All quarrying to be done in accordance with Territorial Mining Safety Act.
- Maintain 30 m buffer distance from adjacent water bodies.
- Plan winter operations in areas where access on firm ground is not possible to avoid rutting.
- Implement drainage and erosion control measures.
- Working benches of 5 m high and minimum 5 m wide.
- Soil slopes $\leq$ 2 Horizontal : 1 Vertical (2H:1V).
- Final rock slopes $\leq$ 1H:1V.
- Implement chemical and hydrocarbon storage, disposal and spill control program.
- Clean up all debris, garbage and unused explosives.
- Prepare plans for eventual abandonment and restoration.
- Re-contouring of excavations wherever practicable.
- Post-closure monitoring.

The shale quarries are all located within the Lower Victor Bay Formation, comprising an interbedded sequence of fissile, dark grey to black shale and light-grey, planar-bedded dolomitic mudstone, approximately 180 m thick. The Twin Lakes sand and gravel consists of quartz sand, gravel and cobbles derived from quartzite. This unit is characteristically stained a reddish colour by hematite and was deposited as reworked glacial material by local streams.

The quantities of shale in each quarry were estimated on the basis of the exposures of shale in the existing working faces, supplemented by several shallow drill holes to confirm the depth of cover and lateral extent of the deposit. More drilling will be carried out during quarrying operations to help delineate the final quarry limits. The quarry development plans provide for 1,350,000 m^3 (in-situ) of shale cover material, which is about 1.5 times the estimated volume required. If the cover quantity needs to be increased, additional volumes are available from the other quarries at the mine.

Core samples and surface grab samples from existing stockpiles were analyzed for Acid-Base Accounting (ABA) and long-term kinetic testing. The test results determined that the shale has significant neutralizing potential and did not release dissolved metals.

The majority of the shale production will come from the Mt. Fuji Quarry and the West Twin Quarry. These two quarries have sufficient resources to supply all the shale required. The East Twin Quarry may be used to provide shale as well, however access is limited to periods of time when the ground is frozen. The Landfill Quarry will be used to provide shale for the landfill cover due to its proximity to the area.

Quarries will be developed using 5 m high benches with a working face of 84° (1H:10V). Upon closure, the benches will be reduced and the final overall rock slope will be 33° (1.5H:1V). Final soil slopes will be 18° (3H:1V). The quarry floors will be sloped at a final grade of 1% to promote drainage. The shale benches will be broken by drilling and blasting or ripping, as required.

The theoretical maximum extraction rate was calculated for each quarry based on the available mine fleet, cycle times, and loads per truck. The calculation was based on actual on-site productivity and equipment data provided by CanZinco for extraction and placement of shale at the West Twin Disposal Area. Assuming the Mt. Fuji Quarry and the West Twin Quarry are both operated simultaneously, the maximum extraction rate is 2,436 m^3/day, based on a 20-hour day. This volume is the in-situ volume in the quarry material. It was assumed that drilling, blasting and ripping production would be able to match this extraction rate.

To estimate a maximum extraction rate for the East Twin Quarry, it was assumed that the other two quarries were exhausted. The maximum extraction rate in this case was estimated to be 2,947 m^3/day. Similarly, the Twin Lakes sand and gravel Quarry was assumed to be in operation only after completion of shale quarry operations. The maximum extraction rate was estimated to be 2,526 m^3/day.

In reality, the actual extraction rates may be less than the above theoretical estimates due to the following factors:

- Scheduling of quarrying and material placement at various locations.
- Equipment availability.
- Weather conditions and access.

During quarrying, technical monitoring personnel, in combination with the Site Supervisor will be present. In the quarry, these personnel will be responsible for visually assessing the material to reject unsuitable rock units such as pyrite, rocks containing sulphides and dolostone rock units. These materials can easily be distinguished from the dark grey –black shale on the basis of colour and physical characteristics. In addition, monitoring personnel will ensure that the material does not contain oversize pieces or excessive fines and that the extracted material conforms to the required specifications. Monitoring and supervisory personnel will also inspect the blasted quarry walls, determining scaling requirements and ensuring that the overburden slopes are graded to the appropriate angle for a safe work area.

During excavation, survey control will be required to lay out pit geometry and grades, as well as permitted boundaries. The locations of all boreholes drilled to verify shale quantities will be recorded.

Reclamation measures have been developed to ensure minimal ongoing maintenance. Due to the sparse vegetation and limited growing season at the mine site, re-vegetation will not be carried out. Final pit slopes and grades will be established and surveyed. Inspection personnel will locate the final configuration of any berms and erosion control requirements. A detailed survey of the area will be undertaken to provide as-built drawings of the final closure of the quarries.

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LIMITATIONS OF REPORT

This report was prepared by BGC Engineering Inc. (BGC) for the account of CanZinco Ltd. The material in it reflects the judgement of BGC staff in light of the information available to BGC at the time of report preparation. Any use which a Third Party makes of this report, or any reliance on decisions to be based on it are the responsibility of such Third Parties. BGC Engineering Inc. accepts no responsibility for damages, if any, suffered by any Third Party as a result of decisions made or actions based on this report.

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1.0 INTRODUCTION

1.1 Development of the Nanisivik Mine Closure and Reclamation Plan

The Nanisivik Mine began production of zinc and lead concentrates in 1976. The current owner of the mine, CanZinco Ltd., has been in possession of the mine since 1996. The mine is located on Northern Baffin Island as shown in Figure 1.

Prior to mid-2002, the Nanisivik Mine was scheduled to operate until the depletion of economic ore reserves in 2004 or 2005. However, depressed international base-metal prices necessitated a re-evaluation of the mine production plan in fall 2001. This assessment resulted in a reduction of economic ore reserves such that these reserves were depleted in September 2002. The mine was permanently closed at that time.

An interim mine reclamation plan had been developed and updated on a regular basis by CanZinco Ltd. However, the announcement of permanent closure in October 2001 triggered a requirement in the (then) current water licence for submission of a Final Closure and Reclamation Plan. In response to this trigger, CanZinco submitted a Closure and Reclamation Plan (C&R Plan) in February 2002 that described the approaches and plans for reclamation of the mine site.

Subsequent to a Public Hearing on renewal of the water licence held in the community of Arctic Bay in July 2002, and a technical meeting held in August 2002, the Nunavut Water Board ("NWB") issued Water Licence No. NWB1NAN0208 (the "Water Licence"). The licence provides for the continuation of on-site environmental protection activities during the development and submission, for approval, of a Reclamation and Closure Plan ("RCP").

The Nanisivik Mine 2004 RCP has been developed, per the terms of the Water License, as a series of stand-alone documents, which provides in detail, information and proposed closure measures for one specific component or topic area. The individual reports that have been developed in this manner are listed under Part G of the Water License.

This document and the information presented herein are provided in response to the requirements for Part G Item 6, the *Quarry Development and Reclamation Plan*.

1.2 Requirements for the Quarry Development and Reclamation

The specific requirements for the Quarry Development and Reclamation Plan come from two sources: Part G Item 6 of the Water Licence and the requirements of CanZinco.

Part G Item 6 of the Water Licence, as excerpted below, provides the following requirements for the Quarry Development and Reclamation Plan:

> *The Licensee shall submit to the Board for approval a report assessing all quarries required for shale cover construction, which shall include but not be limited to:*
>
> 1. *Description of extraction method and rate of production;*
> 2. *Identification of waste/overburden volumes and disposal sites;*
> 3. *Description of final quarry geometry and reclamation measures; and*
> 4. *Maps, where appropriate, showing sources and stockpile locations of all borrow materials.*

CanZinco's specific requirements for the Quarry Development and Reclamation Plan are largely satisfied by those provided in the Water Licence.

At the current time, Nanisivik Mine has permits for seven shale quarries:

- Landfill Quarry.
- Mt. Fuji Quarry.
- West Twin Quarry.
- Shale Hill Quarry.
- Road Quarry.
- Area 14 Quarry.
- East Twin Quarry.

Quarry permits are provided from either the Government of Nunavut or DIAND. Table 1 provides a summary of the current quarry permits. Figure 2 shows the locations of these seven quarry sites. The approximate mine-grid coordinates for these quarries are provided in Appendix I.

Table 1 - Summary of Current Quarry Permits

Permit No.	Regulatory Agency	Location and Approximate Area	Expiration Date
03-708-001	Gov't of Nunavut, CG&T	Landfill Quarry 1.5 ha	August 27, 2004
03-708-002	Gov't of Nunavut, CG&T	Mt. Fuji Quarry 6 ha	August 27, 2004
03-708-003	Gov't of Nunavut, CG&T	West Twin Quarry 3 ha	August 27, 2004
N2003QP0087	INAC, Land Administration	Shale Hill Quarry 8 ha	September 14, 2004
N2003QP0088	INAC, Land Administration	Road Quarry 8 ha	September 14, 2004
N2003QP0089	INAC, Land Administration	Area 14 Quarry 59 ha	September 14, 2004
N2003QP0090	INAC, Land Administration	East Twin Quarry 10 ha	September 14, 2004

At closure, cover material will be required for the following facilities:

- Surface Cell tailings and crest of West Twin Dike.
- Downstream face of West Twin Dike (including completion of shale cover for consistent grade).
- Tailings at the toe of West Twin Dike.
- Transition zone tailings at toe of West Twin Dike.
- Test Cell tailings and Test Cell Dike.
- Transition zone tailings at the toe of Test Cell Dike.
- Landfill.
- West Open Pit (including 09 Access Road).
- East open Pit.
- Area 14 Waste Rock Pile (including completion of existing cover with armouring sand & gravel).
- Oceanview Pit.
- Oceanview Portal Site (former ore stockpile pad)
- East Trench.
- Mill Area.

Table 2 summarizes the in-place volumes of shale and sand and gravel required at each of the above facilities.

Table 2 - Summary of Quarry Requirements

Area	In-Place Shale Cover Quantity (m^3)	In-Place Twin Lakes Sand and Gravel Quantity (m^3)
Surface Cell tailings and crest of West Twin Dike	400,000	95,000
Downstream face of West Twin Dike	5,000	11,000
Tailings at the toe of West Twin Dike	40,000	9,000
Transition zone tailings at the toe of West Twin Dike	2,500	N/A (Riprap)
Test Cell tailings and Test Cell Dike	151,000	27,500
Transition zone tailings at toe of Test Cell Dike	5,000	N/A (Riprap)
Landfill	50,000	17,500
West Open Pit	20,000	2,500
East Open Pit	60,000	8,500
Area 14 Waste Rock Pile (including completion of existing cover with S&G)	3,500	1,400
Oceanview Pit	30,000	4,250
Oceanview Portal Site (former ore stockpile pad)	5,400	750
East Trench	2,500	450
Mill Area	19,500	2,500
Total	794,400	180,350

The estimated total in-place volume of shale fill required is approximately 794,400 m^3. The total in-place volume of armouring sand and gravel required is 180,350 m^3. These volumes are based on the following cover designs, as reviewed in detail in the Reclamation Covers Report:

1. Cover over saturated substrate, 1.0 m of shale fill with 0.25 m of sand and gravel armouring.
2. Cover over unsaturated substrate, 1.95 m of shale fill with 0.25 m of sand and gravel armouring.

The volumes provided in Table 2 allow for some grading of tailings in both the Surface Cell and the Test Cell prior to placement of the shale cover material. these grading plans are detailed in the Covers Report (Part G Item 4). The cover material volumes provided in Table 2 are based on the in-place, compacted volumes required for each cover and should not be used as a basis for haulage or placement production assessments as no bulking factors have been included.

Re-contouring and backfilling of low spots may be done at each of the sites requiring cover using the overburden material stockpiled during the stripping of the shale quarries. This material would be placed prior to construction of the shale cover. Overburden may also be used to reclaim (backfill and re-contour) the quarries upon completion of the quarry development.

1.3 Relevant Guidelines and Regulations

1.3.2 General

Within Nunavut, there is a multi-jurisdictional regulatory regime due to the need to administer lands that are owned by the Inuit through the Nunavut Land Claims Agreement (NLCA) and Crown owned lands, which are federally regulated. Generally, with respect to quarries, the Government of Nunavut (GN) administers quarries that are located on Inuit owned lands or lands administered as Commissioner's land. Indian and Northern Affairs Canada (INAC) administers those quarries located on Crown Lands. Mining operations located on a combination of Inuit-owned and Crown lands are usually dealt with on a cooperative basis between INAC and the local Inuit land-owning organization.

1.3.3 Government of Nunavut Requirements

The GN or the Inuit organizations are private owners of the surface of the land through the NCLA which regulates quarries located on Inuit owned land.

The relevant GN guidelines and regulations include:

- Conditions included in the overall mine site Water Licence.
- Requirements included in the individual quarry permits issued for the existing quarries.
- Guidelines for Abandonment and Restoration Planning for Mines in the Northwest Territories.

The Water Licence requirements, issued by the Nunavut Water Board (NWB) have been outlined in Section 1.2. It should be noted that the NWB's responsibility is for all water related issues and covers both Inuit-owned and Crown owned lands.

The Department of Community Government and Transportation of the GN has currently issued several quarry permits to CanZinco. These permits have been previously noted in Table 1. All quarries are governed by the following operational and design issues:

- All quarrying to be done in accordance with the Territorial Mining Safety Act.
- Slopes in soil should be ≤ 2H:1V.
- Buffer of 30 m between waterbodies.
- Prevent obstruction to natural drainage.
- Excavate and stockpile in designated areas.

- Erosion and sediment control.
- Chemical and hydrocarbon storage, disposal and spill control programs.
- Keep all garbage and debris in a covered metal container until disposed of.

In addition, the GN quarry permits require that the following reclamation measures be carried out:

- Removal of all scrap metal, discarded machinery and parts, barrels and kegs, buildings, equipment and material.
- Clean-up, restoration and stabilization of disturbed areas.

Prior to the creation of Nunavut, the Northwest Territories Water Board and the Department of Indian Affairs and Northern Development (DIAND) jointly published the "Guidelines for Abandonment and Restoration Planning for Mines in the Northwest Territories" (1990). These guidelines are still referenced by GN, especially by the NWB to set Water Licence conditions in the absence of a set of guidelines developed specifically for Nunavut. Guidelines for quarries include:

- Requirement to prepare plans for eventual abandonment and restoration.
- Re-contouring of excavations and replacement of topsoil or overburden wherever practicable.
- Practice progressive reclamation while mine is operational.
- Post-closure monitoring.

1.3.3 Federal Guidelines and Regulations

INAC regulates quarrying operations on federally owned lands. Quarry permits are issued under Section 12(2) of the Territorial Quarrying Regulations. Published environmental guidelines by INAC (1994) for pits and quarries include the following requirements:

- Maintain 30 m buffer distance from adjacent water bodies.
- Plan winter operations in areas where access on firm ground is not possible to avoid rutting.
- Implement drainage and erosion control measures.
- Pits can be flooded if deep and below the water table level.
- Working benches of 5 m high and minimum 5 m wide.
- Soil slopes ≤ 2H:1V,
- Final rock slopes ≤ 1H:1V.
- Clean-up of any debris, garbage and unused explosives.

INAC (1987) also published "Reclamation Guidelines for Northern Canada" to assist permit holders in dealing with erosion control and reclamation under northern conditions, including the presence of permafrost. INAC identified four reclamation regions within the limits of NWT and Nunavut. The Nanisivik site is located within the Polar Desert reclamation region. Due to the severe environment in this region, no re-vegetation species have been identified. Reclamation practices are therefore limited to drainage and erosion control.

1.4 Scope of Work and Authorization to Proceed

BGC was retained to prepare a report to address the requirements stated in Section 1.2. Sub-Arctic Surveys Ltd. (SAS) provided the survey services and plan drawings for the current layouts for the four of the quarries. SAS was directly contracted by CanZinco to undertake these services. Verbal authorization to proceed with the preparation of the work was provided on August 22, 2003 by Mr. Bob Carreau of Breakwater Resources Ltd.

2.0 BACKGROUND INFORMATION

2.1 Geology

2.1.1 Regional Bedrock Geology

The bedrock geology of the area has been mapped in detail by Patterson and Powis (2002). The local bedrock geology map of the area is shown in Figure 3 and the regional bedrock stratigraphy is illustrated on Figure 4. The Nanisivik region is underlain by carbonate and terrigenous clastic strata of the Mesoproterozoic Bylot Supergroup. The Bylot Supergroup is comprised of two terrigenous formations (Adam's Sound and Arctic Bay formations) and two carbonate formations (Society Cliffs and Victor Bay formations) and a mixed carbonate and terrigenous clastic formation (Strathcona Sound Formation). Quartz arenite of the Gallery Formation unconformably overlies the Proterozoic strata.

The Adams Sound Formation is a beige- to light orange-brown, well-cemented, medium- to coarse-grained quartz arenite. It is over 100 m thick and is exposed in the Nanisivik area as shown on Figure 3.

The Arctic Bay Formation is a medium grey to brown, micaceous, fine sandy siltstone interbedded with dark grey micaceous, silty shale. This formation outcrops southeast and southwest of Nanisivik and is approximately 200 m thick.

The Society Cliffs Formation is over 500 m thick and is exposed in the Nanisivik area as shown on Figure 3 This formation has been subdivided into three units:

- Microbial dolostone (lower);
- Intraclastic dolostone (middle); and,
- Laminated dolomitic mudstone (upper).

All components of this formation exhibit dolomite mineralization. Known sulphide deposits in the Nanisivik area are hosted within the middle and upper subdivisions of this formation.

The Victor Bay Formation is characterized by a gradual upward change from organic rich pyretic shale, to dolomitic mudstone, to more intraclastic and dolomitic facies. It is exposed throughout the Nanisivik area and is the host rock in which all the shale quarries are located, as shown on Figure 3. The formation has been subdivided into three units:

- Shale and dolomitic mudstone unit (lower);
- Dolomitic mudstone and intraclast floatstone (middle); and,
- Silty dolomitic mudstone and intraclast rudstone (upper).

The lower unit is approximately 180 m thick and consists of interbedded, organic rich, fissile shale and light-grey, planar-bedded dolomitic mudstone. This is the unit within which the shale quarries are located.

The middle unit is approximately 80 m thick and is marked by the appearance of intraclast rudstone and floatstone. Occasional occurrences of light-grey dolomitic mudstone and black shale similar to those found in the lower unit are observed within the middle unit.

The upper unit is approximately 70 m thick and is characterized by the absence of shale and the prevalence of dolomitic intraclastic carbonate and the presence of terrigenous material within clastic carbonate rocks. This unit forms a transitional unit into the terrigenous Strathcona Sound Formation.

The Strathcona Sound Formation contains two mappable units. A light brown to orange coloured carbonate pebble to boulder conglomerate, with 1 to 50 cm diameter dolomudstone clasts. Its thickness varies from several metres to approximately 50 m. This unit is overlain by a green to dark grey, planar bedded, interbedded quartz wacke and shale unit, forming a thick (>130 m), monotonous succession. The quartz wacke and shale are interbedded at scales ranging from 1 to 200 cm.

The Phanerozoic rocks of the Gallery Formation overlie the Mesoproterozoic strata and are exposed predominantly west of Nanisivik. The Gallery Formation forms a thick (>300 m) succession of interbedded red and white, poorly cemented, medium- to fine-grained quartz arenite. The Gallery Formation is easily identified by its deep red hematite-stained colour and friable texture.

2.1.2 Overburden

Overlying the bedrock, specifically in the area of West Twin Lake, is a combined unit of lakebed sediments (silt and sand, trace to some clay) and glacial till (silty sand with gravel fragments). The lakebed sediments are identified by their red colour, a product of hematite oxidation staining. The till is generally very granular in nature, frozen below the depth of active layer thaw and may contain excess ice content. The thickness of the lakebed sediments/ till unit varies from 1 to 4 m. The lake bed sediments/ till upper surface generally follows the underlying bedrock topography.

The hematite stained gravels and sandy deposits adjacent to the West Twin area and the Arctic Bay road are reworked glacial material deposited locally by streams. Their composition is dominated by quartz sand, gravel, and cobbles derived originally from the Adams Sound Formation quartzite, as the erosional activity has removed most of the softer materials.

3.0 2003 QUARRY INVESTIGATION

In May 2003, BGC supervised a geotechnical drilling program to observe the subsurface soil conditions at various locations around Nanisivik Mine. As part of the program, boreholes were drilled at the East Twin and West Twin Quarries. The drilling was completed using an Atlas Copco Diamec 262 diamond drill rig available at the mine. Chilled brine was used as drilling fluid and BQ size (36.5 mm diameter) core was recovered when possible using a double-tube core barrel. A detailed permafrost/geotechnical log was created for each borehole. Recovered core was logged for lithology, ice content and grain size. The reaction of the drilling equipment as each borehole was advanced through the subsurface was also noted.

Two boreholes were drilled at each of the East Twin (BGC03-25 and 03-26) and West Twin (BGC03-27 and 03-28) quarries. Each borehole was drilled to a depth of between 4 and 6 m. No instrumentation was installed in any of the boreholes. Additional shale samples were collected from surface at the East Twin, West Twin, Mt. Fuji and Shale Hill Quarries. The samples were collected from windrows of shale developed during previous quarry activities. Borehole logs can be found in Appendix II.

In general, the boreholes drilled at the East Twin and West Twin quarries encountered till overlying frost-shattered bedrock, which in turn was underlain by intact bedrock. Both shale and dolostone bedrock were encountered. The quality of the shale rock was poor with the Rock Quality Designation (RQD) ranging between 0% and 57%.