4.5 Survey Layout and Initial Survey

In 2003 and 2004, detailed topographic and bathymetric surveys of many areas was undertaken as part of the reclamation design process. During these surveys, a number of benchmarks were installed to provide survey control. This benchmark data will be provided to the Contractor as required to provide survey control during the construction process.

4.6 Quarry Selection and Preparation

Shale for construction of reclamation covers will be quarried from any of the designated quarry sites identified in BGC (2004b). Quarrying may be undertaken by ripping shale exposures with a dozer, if practical, or drilling and blasting. Armour material will be sourced from the Twin Lakes sand and gravel deposit located between East Twin and West Twin lakes. Quarrying of this material will be undertaken by excavating material with a dozer.

The Mt. Fuji Quarry has been selected to provide the primary source of shale required for the reclamation cover of the Surface Cell and Test Cell. Additional material, as required, will be sourced from the East Twin Quarry. Access to the East Twin Quarry is season dependent, with access being limited to months when the ground surface is sufficiently frozen.

Additional geotechnical investigation of the West Twin Quarry has indicated that the volume of available shale near surface is minimal. As such, this quarry will not be used as a source of shale. If additional fill material is required for the topographic low spots within the Surface Cell and Test Cell, material may be quarried from this location to be used as fill below the top 1.25 m of the cover.

Shale for cover construction at Area 14 can be sourced from either the East Twin Quarry or the Area 14 Quarry. A determination regarding which quarry site to use will be made prior to construction and may depend on reclamation activities and/or environmental conditions at the time of construction. An estimated 3,500 m^3 of shale will be required at this area. Considering the volume is relatively small in comparison to other areas, it is probable that this volume material may be sourced from the Area 14 Quarry by ripping surficial exposures of shale, as opposed to blasting.

Shale for cover construction over the East Open Pit, East Trench, Oceanview Pit, and Oceanview Portal Site will be primarily sourced from the Shale Hill Quarry. An estimated 97,900 m^3 of shale will be required for these areas.

Shale for the Landfill, West Open Pit and Mill Area reclamation cover is expected to come from the Landfill quarry with an expected total of 89,500 m^3 excavated from this location. Any additional fill required to satisfy surficial grade requirements may be sourced locally.

Prior to excavation of shale from any of the quarries on site, the overburden should be stripped as close to the shale surface as possible, and stockpiled in a separate area for potential subsequent use. Potential use includes fill in topographic lows or bedding material (subject to any required processing) beneath the rip rap layer around the Reservoir shoreline. If the overburden cannot be ripped prior to quarry development, it must be removed from the blast material and stockpiled separately.

The footprint of the shale quarries will be outlined prior to quarrying operations and this footprint should remain within the permitted quarry boundaries. The footprint will maintain at least a 50 m buffer distance from adjacent water bodies including ephemeral drainage pathways.

The footprint of the Twin Lakes sand and gravel quarry will be outlined prior to quarrying operations according to the construction drawing. This footprint will maintain a 50 m buffer between quarrying operations and the creek along the east side of the deposit. The quarry development plan will also restrict the depth of the quarrying activities such that no hydraulic connectivity (through active layer depth) is realized between ETL and WTL.

5.0 QUARRYING OPERATIONS

The quarrying activities will be undertaken according to the design plans as outlined in the Quarry Development and Reclamation Plan. The design for quarry development include, but are not limited to, the following:

- Maintain a 50 m buffer distance from adjacent water bodies (note different from initial design requirement in response to Water License).
- The base of the quarry should be free draining and not allowed to collect water during or after quarrying operations.
- Overburden will be stripped and placed in a separate stockpile for alternative use later in reclamation activities subject to approval by the Field Representative.
- All debris, garbage and unused explosives must be cleaned up prior to reclamation of the quarry.
- Drainage and erosion controls may be applied as deemed necessary by the Contractor and the Field Representative to maintain safe working conditions within the quarry area.
- Quarry benches shall be no more that 5 m high and no less than 8 m in width.
- Maintain safe working conditions in accordance with the Territorial Mining Safety Act.

As part of the QA/QC program, the blasted quarry material will be inspected for mineralogical assessment by the Field Representative and the Contractor. If the material is judged to not be of an appropriate lithology or is observed to contain excessive visible sulphides, the material will be stockpiled separately for an alternative use later in the reclamation project, subject to approval by the Field Representative.

At the Twin Lakes sand and gravel quarry, no stripping of overburden will be required. However, if pockets over fine grained material (>30% sand sized particles) are encountered during quarrying operations, the material should be set aside in a separate stockpile for subsequent use as bedding material. If material is encountered larger than 150 mm, this material should be set aside in a separate stockpile for later use as rip rap material, if practical. Since the sand and gravel deposit has the potential to provide appropriate material to be used as riprap, bedding layer and armour layer material, the material may need to be screened to be able to sort appropriate particle sizes.

6.0 CONSTRUCTION SPECIFICATIONS AND QA/QC PROGRAM

6.1 General Responsibilities and Documentation

The QA/QC field program will be overseen by the Field Representative, in concert with the Contractor. A summery of the individual components of the program and the party responsible to undertake each component is included in Table 2.

Table 2 Summary of QA/QC Program

Quality Control		Quality Assurance	
Component	Responsible Party/ Undertaken by	Component	Responsible Party
QC testing (Table 2)	Contractor/ Field Representative	Review of QC Testing Results	Owner/ Field Representative
Visual inspection of quarried rock	Contractor/ Field Representative	Visual observations of quarrying methods	Owner/ Field Representative
Grade staking for covers	Contractor/ Contractor	Visual observations of placement methods	Owner/ Field Representative
Survey layout for quarrying operations	Contractor/ Contractor	Visual inspection of subgrade	Owner/ Field Representative
Survey of intermediate and final construction surfaces	Contractor/ Contractor	Surface grade verification	Owner/ Field Representative

The Field Representative will ensure that the constructed reclamation covers conform to contract documents and the design intent of the reclamation plan. The Field Representative will have the authority to reject any substandard work and order the Contractor to redo the work such that it meets the requirements and the intent of the contract and design documents. The Field Representative will provide daily inspection reports to the Contract Administrator summarizing work undertaken, methodology used, field decisions made and written confirmation of design alterations permitted.

The Site Supervisor, representing the Contractor, will be required to maintain accurate records of all quarry and fill placement operations and shall provide the Contract Administrator with a copy of the daily record at the end of each shift. The following information will be recorded on the fill placement summary sheets:

- Estimated quantity of materials (shale fill and armouring sand and gravel) placed during the shift.
- Location of material borrow source, including bench number in the shale quarry and the aerial location within the Twin Lakes sand and gravel quarry.
- Confirmation if any shale fill was previously placed before the new shale fill was placed
- Number of workers and equipment engaged during the shift.
- Unusual occurrences during fill placement such as unstable soil conditions, extreme precipitation events or variations in fill quality.
- QC measures undertaken during that shift.

6.2 Subgrade Conditions

The condition of the subgrade shall be inspected and approved by the Field Representative prior to any material placement by the Contractor. No fill material will be placed until the subgrade condition has been approved by the Field Representative. In the case of the Surface Cell and Test Cell, if the substrate is saturated to the point that a significant mixing of the tailings and the overlying fill is occurring, construction in that area shall not proceed until the area is deemed sufficiently firm. Any significant build up of snow or ice must be removed prior to placement of fill or cover material. As such, the Field Representative may require ripping and/or excavating of the subgrade to remove surficial snow or ice.

6.3 Material Quality and Mineralogy

The reclamation cover design was developed based on various technical analyses and performance of the test covers. Since thermal and physical characteristics can vary with material type, it is essential that only appropriate material be used in construction of the reclamation covers. This will ensure the cover will perform as anticipated. As such, confirmation of the suitability of the fill material will be the responsibility of the Field Representative, in concert with the Contractor. This includes, but is not limited to, the following:

- Visual confirmation and documentation of the rock lithology (dark grey to black fissile

shale or dolomitic mudstone).

- Visual confirmation and documentation of any sulphide content (shale with visible sulphide content would be rejected).
- Samples of the shale will be collected by the Field Representative for subsequent Acid Base Accounting (ABA) analysis, for documentation purposes.
- Samples of shale incorporated in the landfill and waste rock reclamation covers will be collected by the Field Representative for subsequent freeze-thaw durability analysis.

6.4 Placement, Compaction and Density

Compactive effort must be applied during fill placement to limit post construction surface deformation which could affect the ability of the cover to direct surface water effectively. The compaction process for the shale fill will be performance based and consist of at least three passes with a roller compactor after spreading is completed with a D8 dozer. This specification has been verified based on the results test pits constructed during the initial stages of the construction process and may be modified if required by the Field Representative. Other criteria for the placement and compaction operations will consist of the following general guidelines:

- Fill materials shall be placed in accordance with lines, slopes, grades and elevations as provided on the final construction drawings.
- Any fill material not meeting the required specifications will be removed, remixed, blended or otherwise reworked to meet the specific requirements.
- Compaction of each layer of fill shall proceed in a systematic and continuous manner so that each portion of the layer receives an equal amount of compactive effort.
- Overlap should occur between the various passes of the construction equipment.
- It is expected that the upper surface will be free from ruts or any uneven surface. If any are noted, re-levelling and/or additional passes will be required.
- Any oversized particle sizes will be removed from the fill before proceeding with compactive effort.

The armouring layer will be compacted to a reasonably "tight" final surface as determined by the Field Representative. Any oversize particles should be removed during quarrying or placement operations.

6.5 QC Testing

A testing program to verify the construction specifications are being met will be implemented by the Field Representative. The program requirements are summarized in Table 2. The program will consist of sampling and test pitting and sample collection to document and verify the following:

- physical characteristics (grain size and moisture content),
- geochemical characteristics (ABA),
- shale fill density, and

- constructed depth of cover.

The testing frequencies included on Table 3 reflect the difference in material volumes placed and surface areas covered at the various locations. This program is preliminary and may be subject to change as construction conditions warrant.

Table 3 Summary of QC Testing Requirements

	WTDA			Landfill and Waste Rock/ Open Pits	
Test	**Shale**	**Armour**	**Bedding**	**Shale**	**Armour**
Grain Size Analysis	1 every 10,000 m^3	1 every 10,000 m^3	1 every 100 m^3	1 every 5,000 m^3	1 every 2,500 m^3
Moisture Content	1 every 10,000 m^3	1 every 10,000 m^3	1 every 100 m^3	1 every 5,000 m^3	1 every 2,500 m^3
In-situ Density Test Pits	1 every 40,000 m^3	-	-	1 every 20,000 m^3	-
Thickness Spot Check	1 every 10,000 m^3	1 every 5,000 m^3	1 every 100 m^3	1 every 5,000 m^3	1 every 2,500 m^3
Freeze-Thaw Analysis	-	-	-	1 every 20,000 m^3	-
ABA	1 every 50,000 m^3	1 every 25,000 m^3	-	1 every 20,000 m^3	1 per location

Grain size, moisture, and density tests will be completed on site and in an on-going basis.

Sampling and testing rate may be modified by Field Representative if deemed appropriate.

The grain size distribution of the placed shale fill, armouring material and bedding material must be similar to the specifications provided on Figures 5, 6 and 7, respectively. If the grain size distribution of the placed material is found to be significantly different from the specifications, adjustments may be made to the quarry drill hole pattern, placement method or screening operations to modify the grain size distribution.

Analysis of the grain size distribution of the rip rap will be undertaken utilizing visual observations.

6.6 Shale Thickness and Grading

A construction drawing of the final contours of the shale cover surface will be provided to the Contractor for construction purposes. It will be the Contractors responsibility to ensure that a proper grade staking program is being carried out to maintain the grades and shale thicknesses specified in the construction documents. Due to the grading requirements for many areas, as well as any possible inaccuracies in the original survey, modifications to the grade staking plan will be allowed, if approved, by the Field Representative. Surveying of final re-graded, pre-cover surface, top of final shale surface and top of final armour surface will also be the responsibility of the Contractor. This information should be forwarded to the Field Representative for verification and subsequent inclusion within the as-built report.

Visual observation and spot checking of the shale and armour material thickness will be the responsibility of the Field Representative. Surface grades will be spot checked by the Field Representative as part of the QA program.

At the completion of construction, an as-built survey of the final surface will be completed to verify grades and to ensure that the design intent of the reclamation covers have been met.

7.0 AS-BUILT REPORT

As required in the Water License, an As-Built report will be produced for all reclamation covers placed on the Surface Cell, Test Cell, rock piles, open pits and landfill. These reports will contain the following information:

- Summary of construction schedule;
- Summary of quantities and test results on materials placed;
- Summary of technical decisions and field modifications made to the original design;
- A selection of construction photos; and,
- An As-Built survey of the pre-cover, shale and armour layer surfaces.

As such, it will be necessary for the Contractor's surveyor to record all required as-built survey information and then forward plans and sections to BGC for inclusion within the As-Built Report.

The objective of the As-Built report is to confirm that the covers have been constructed in accordance with the design intent. Any deviations, and the associated rationale, will also be included. This report will be stamped by a professional geotechnical engineer, registered to practice in Nunavut.

8.0 CLOSURE

The QA/QC plan has been developed based on the design intent of the reclamation covers. Consideration has also been given to current site conditions and recent activities undertaken at the mine.

Respectfully submitted,

BGC Engineering Inc.
Per:

Geoff Claypool, B.Sc., P.Eng. (AB)
Geological Engineer

REGISTERED PROFESSIONAL ENGINEER
LICENSEE
N.W.T.

PERMIT TO PRACTICE
BGC ENGINEERING INC.
Signature
Date 04-Nov-18.
PERMIT NUMBER: P 285
The Association of Professional Engineers, Geologists and Geophysicists of the Northwest Territories

James W. Cassie, M.Sc., P.Eng.
Specialist Geotechnical Engineer

FIGURES

22-Jul-04 Photo 018
WTDA
Excavating Test Pit #4 in Test Cell Test Cover #1. Note proximity to thermocouple TC3.

22-Jul-04 Photo 019
WTDA
View of side wall of Test Pit #4. Note surficial layer of tailings overlying layer of red stained silt, sand and gravel, overlying shale.

22-Jul-04 Photo 024
WTDA
View of side wall of Test Pit #4. Note grain size distribution of shale including cobbles, gravel, sand and silt.

22-Jul-04 Photo 025
WTDA
View of ice-saturated layer at base of Test Pit #4 in Test Cell #1.

CLIENT:

Nanisivik Mine, a Division of CanZinco Ltd.

REV.	DATE	REVISION NOTES	DRAWN	CHECKED	APPROVED
	-	-	-	-	-
-	-	-	-	-	-
-		-	-	-	-

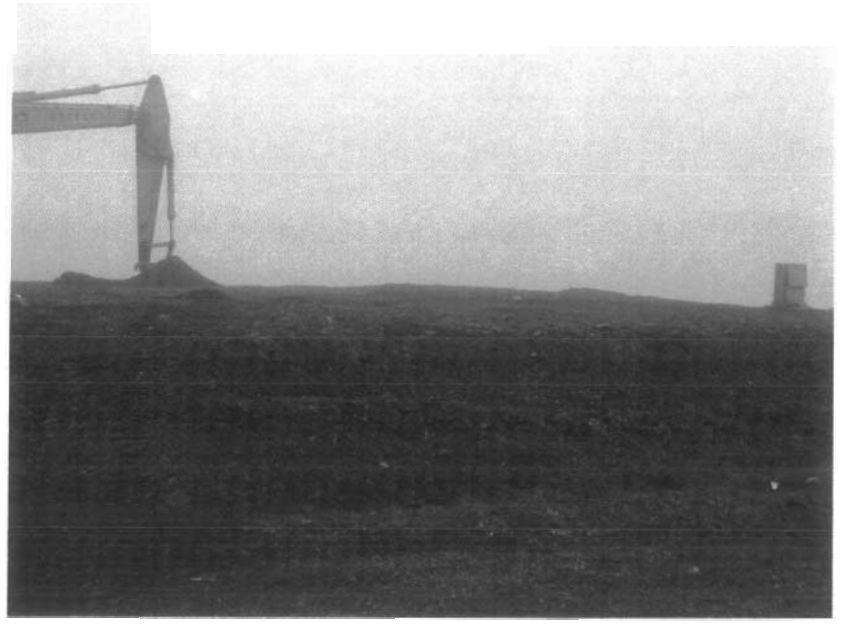
SCALE:	N/A
DATE:	November 2004
DRAWN:	SLF
DESIGNED:	GKC
CHECKED:	GKC
APPROVED:	JWC

PROJECT: QUALITY ASSURANCE/QUALITY CONTROL PLAN

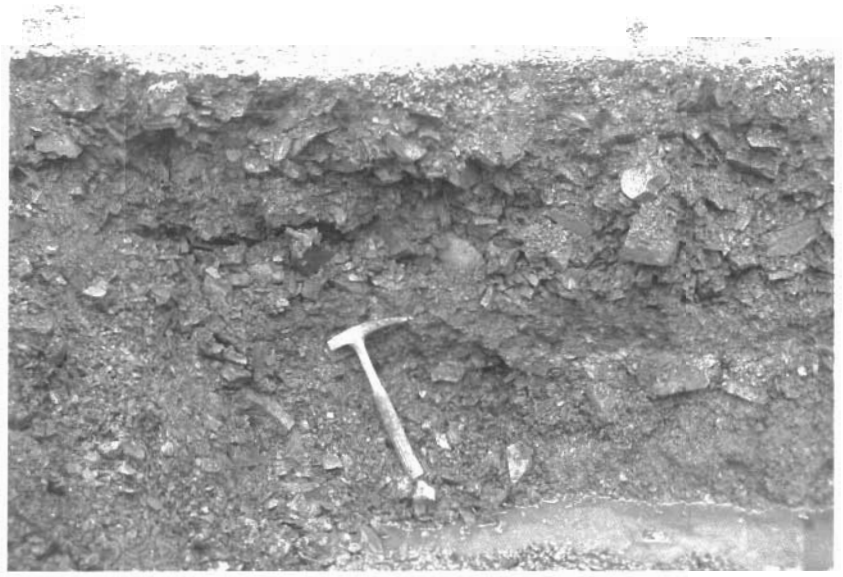
TITLE: TEST PIT INVESTIGATIONS - TEST CELL TEST COVER #1

PROJECT No.	DWG. No.	REV.
0255-009-10		0

BGC Engineering Inc.
AN APPLIED EARTH SCIENCES COMPANY
Calgary Alberta Phone: (403) 250-5185

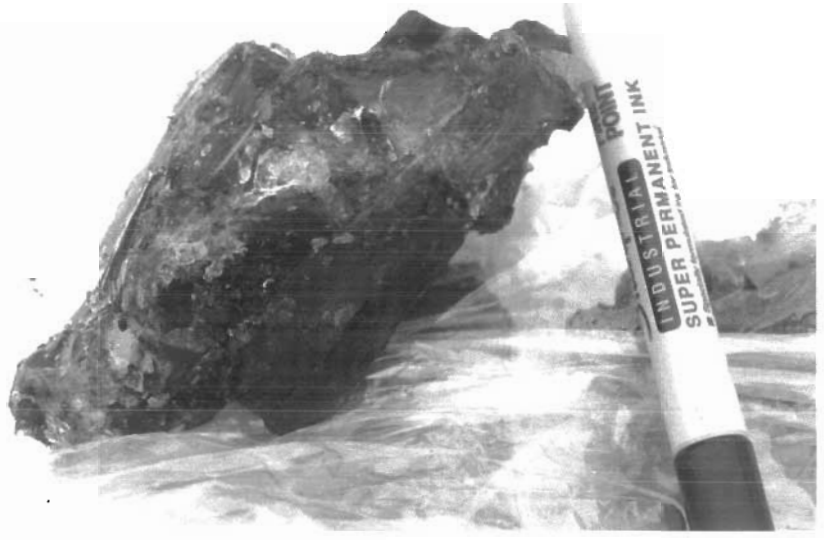


26-Jul-04 Photo 035
Area 14
Excavating Test Pit #1 at Area 14 Waste Rock Cover.



26-Jul-04 Photo 040
Area 14
Side wall of Test Pit #1. Note geological hammer for scale. Also note grain size distribution of shale which was observed to be coarser than the shale observed in test pits excavated in Test Cell Test Cover #1.

26-Jul-04 Photo 046
Area 14
Ice bonded shale in the bottom of Test Pit #2.



26-Jul-04 Photo 041
Area 14
Ice bonded shale recovered from the bottom of Test Pit #1.

CLIENT:

Nanisivik Mine, a Division of CanZinco Ltd.

REV.	DATE	REVISION NOTES	DRAWN	CHECKED	APPROVED
	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-

SCALE:	N/A
DATE:	November 2004
DRAWN:	SLF
DESIGNED:	GKC
CHECKED:	GKC
APPROVED:	JWC

PROJECT: QUALITY ASSURANCE/QUALITY CONTROL PLAN

TITLE: TEST PIT INVESTIGATIONS - AREA 14 WASTE ROCK COVER

PROJECT No.	DWG. No.	REV.
0255-009-10	2	0

BGC Engineering Inc.
AN APPLIED EARTH SCIENCES COMPANY
Calgary Alberta Phone: (403) 250-5185

24-Jul-04 Photo 098
WTDA
Density test pit in lower portion of the 1.0 m lift test fill. Note the top 30 cm of material was remove prior to beginning density portion of the test pit.

23-Jul-04 Photo 026
WTDA
View of density test pit in Test Cell Test Cover #1. Note water filled in the pit lined with PVC.

SCALE:	N/A	DESIGNED:	GKC
DATE:	NOVEMBER 2004	CHECKED:	GKC
DRAWN:	SLF	APPROVED:	JWC

CLIENT: **Nanisivik Mine, a Division of CanZinco Ltd.**

BGC Engineering Inc.
AN APPLIED EARTH SCIENCES COMPANY
Calgary, Alberta. Phone: (403) 250-5185

PROJECT: QUALITY ASSURANCE/ QUALITY CONTROL PLAN

TITLE: IN-SITU DENSITY DETERMINATION

PROJECT No.	DWG. No.	REV.
0255-009-10	3	0

23-Jul-04 Photo 035
WTDA
End dumping for constructing the test fill at north end of Surface Cell.

23-Jul-04 Photo 034
WTDA
Constructing test fill at the Surface Cell. Note the pad is being advanced by a D8 dozer in 0.5 m lifts.

23-Jul-04 Photo 044
WTDA
Constructing the top 0.5 m lift of the test fill.

23-Jul-04 Photo 054
WTDA
View of bottom of test pit excavated into bottom 0.5 m lift of test fill. Note water in bottom of pit indicating excess pore pressure generated in underlying tailings during construction of test fill.

CLIENT

Nanisivik Mine, a Division of CanZinco Ltd.

REV.	DATE	REVISION NOTES	DRAWN	CHECKED	APPROVED
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-

SCALE:	N/A
DATE:	November 2004
DRAWN:	SLF
DESIGNED:	GKC
CHECKED:	GKC
APPROVED:	JWC

PROJECT: QUALITY ASSURANCE/QUALITY CONTROL PLAN

TITLE: TEST COVER CONSTRUCTION

PROJECT No.	DWG. No.	REV.
0255-009-10	4	0

BGC Engineering Inc.
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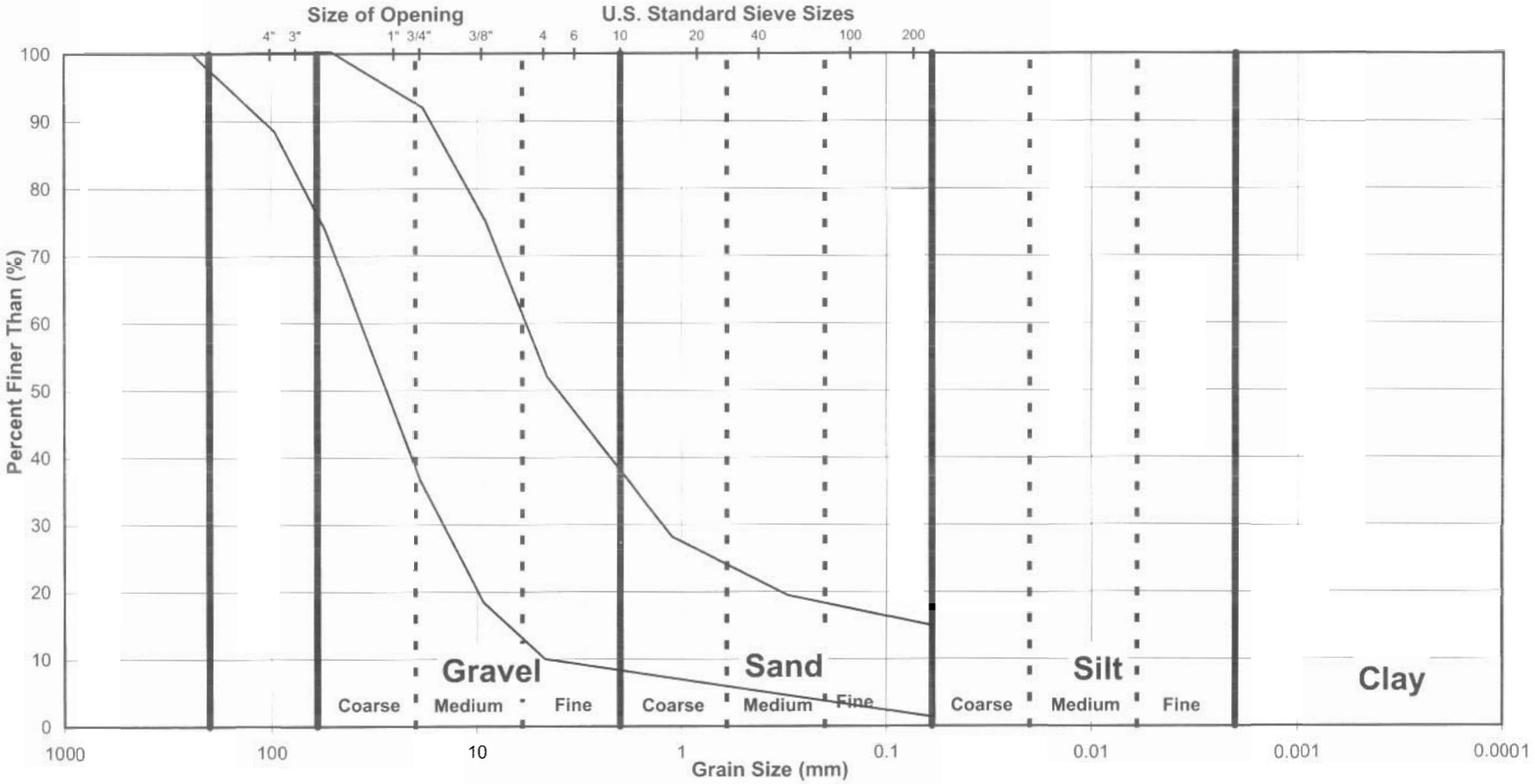
Calgary Alberta Phone: (403) 250-5185



Shale

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

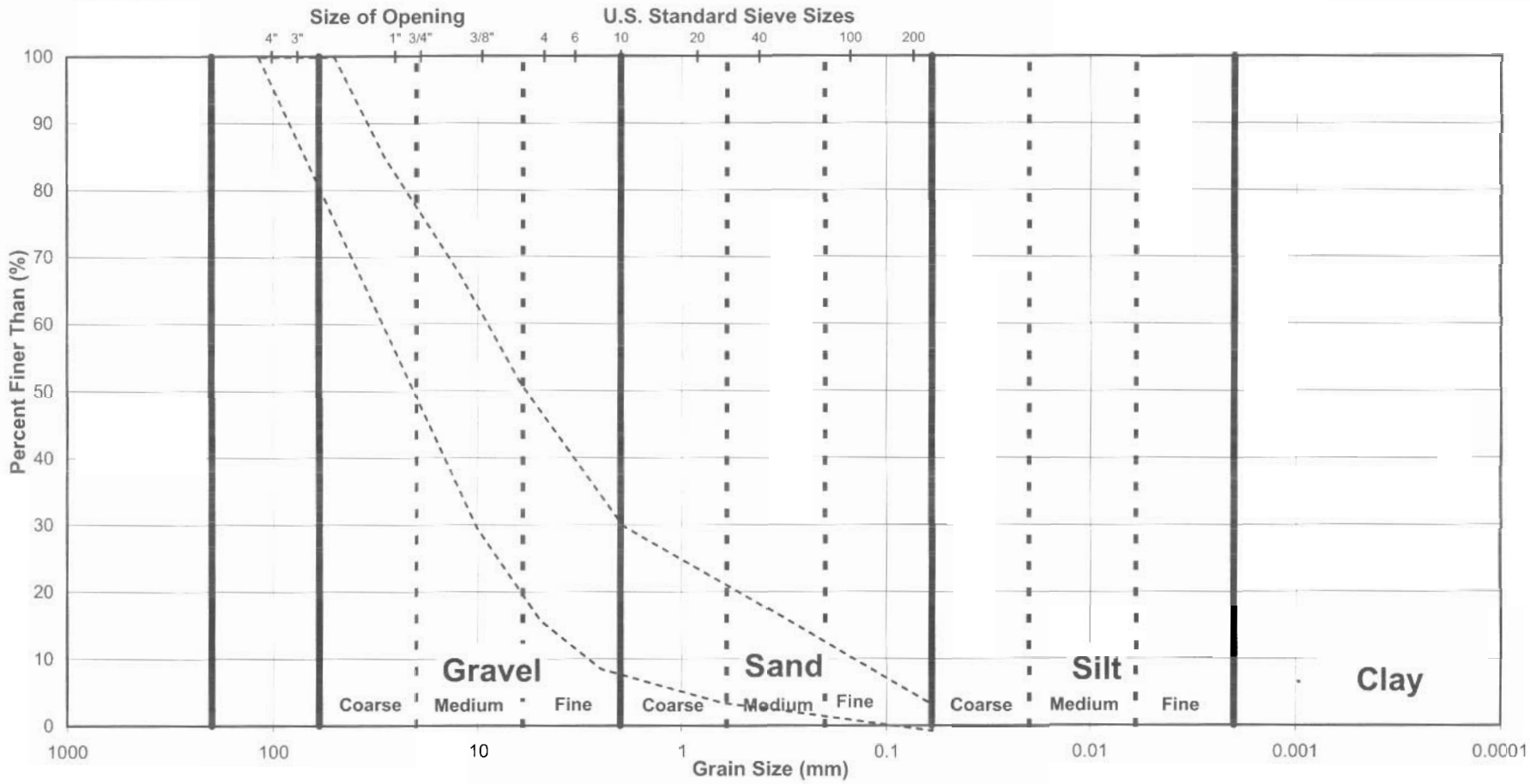
CLIENT: NANISIVIK MINE, A DIVISION OF CANZINCO LTD.

PROJECT: QUALITY ASSURANCE / QUALITY CONTROL PLAN

TITLE: SHALE GRAIN SIZE SPECIFICATIONS

PROJECT NO. 0255-009-10

DWG. NO. 5



BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

CLIENT: NANISIVIK MINE, A DIVISION OF CANZINCO LTD.

PROJECT: QUALITY ASSURANCE / QUALITY CONTROL PLAN

TITLE: TWIN LAKES SAND AND GRAVEL GRAIN SIZE SPECIFICATIONS

PROJECT NO. 0255-009-10

DWG. NO. 6

Particle Diameter (mm)	Material Type and Percent Passing		
	Type 1 Rip Rap (D_{50} - 300 mm)	Type 1A Rip Rap (D_{50} - 200 mm)	Type 2 Bedding/ Erosion Protection (D_{50} - 100 mm)
Maximum Particle Size (mm)	600	450	300
Median Particle Size, D_{50} (mm)	300 min.	200 min.	100 min.
15% Finer than, D_{15} (mm)	450 max.	150 max.	75 max.

Note:

1. The fraction finer than 75 mm shall have less than 5% passing the US No. 200 sieve (0.075 mm)

DATE: Nov 2004	DRAWN SLF	BGC ENGINEERING INC. AN APPLIED EARTH SCIENCES COMPANY Calgary, Alberta Phone: (403) 250-5185	PROJECT QUALITY ASSURANCE/QUALITY CONTROL PLAN
REFERENCED DRAWING DESCRIPTION			TITLE RIP RAP AND BEDDING MATERIAL GRAIN SIZE SPECIFICATIONS
CLIENT **Nanisivik Mine, a Division of CanZinco Ltd.**		PROJECT No. 0255-009-10	DWG. No. 7 / REV. 0