NANISIVIK MINE, A DIV. OF CANZINCO LTD.

PRELIMINARY DESIGN OF THE WEST
TWIN DIKE SPILLWAY FOR CLOSURE

NANISIVIK MINE, NU

FINAL

PROJECT NO.: 0255-004
DATE: FEBRUARY 28, 2002

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Project No. 0255-004
Date: February 28, 2002

Mr. Steven Keenan
Environmental Superintendent
Nanisivik Mine, a Division of CanZinco Ltd.
Box 225
Nanisivik, Nunavut
X0A 0X0

Re: Final Report on Preliminary Design of The West Twin Dike Spillway

Dear Steve:

Please find attached three copies of our above referenced report. In addition, one copy has also been forwarded to Mr. Bob Carreau at Caribou Mine and Mr. Alex Gordine at Golder Associates. As outlined in the report, several tasks need to be undertaken such that final design for the spillway can be initiated. BGC would be pleased to assist you in performing these outlined tasks.

Should you have any questions or comments, please do not hesitate to contact me at the number listed below.

Yours truly,
BGC Engineering Inc.
per:

James W. Cassie, M.Sc., P.Eng.
Specialist Geotechnical Engineer
(direct line 403/250-5185 Ext. 103)

encl. Final Report

JWC/sf

TABLE OF CONTENTS Page

LIST OF TABLES

LIST OF FIGURES

LIMITATIONS OF REPORT

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1.0 INTRODUCTION

Nanisivik Mine is located at the northern end of Baffin Island at approximately 73°N latitude, as shown on Figure 1. The mine is owned and operated by CanZinco Ltd. (an operating division of Breakwater Resources Ltd.), who announced on October 29, 2001 that the mine is closing in September 2002. In the current closure plan for this mine, a spillway is required at the south end of the West Twin Dike. This dike retains tailings solids within the West Twin Disposal Area (WTDA) and the spillway is required to discharge surface run-off from the watershed around this retention structure during closure.

BGC Engineering Inc. (BGC) provided a proposal (P01-079) dated September 27, 2001 to undertake the preliminary design of the proposed spillway at the West Twin Dike. BGC's proposal was restricted to work related to geotechnical, construction methodology, quantity issues and overall project management and co-ordination of the preliminary design. In addition, Golder Associates Ltd. provided a proposal (P11-1356) dated October 11, 2001 to provide hydrological/hydraulic design input to the project.

As such, Nanisivik Mine retained BGC to undertake a preliminary engineering design of the proposed spillway. The objectives of the preliminary design work were as follows:

- Identify spillway alignment options.
- Assess, on a preliminary basis, both geotechnical and hydrotechnical engineering issues.
- Estimate construction quantities and methods (so that Nanisivik Mine could undertake a cost estimate).
- Provide a summary of additional work requirements so that final design of the spillway could be implemented, if so requested by Nanisivik Mine.

This report provides the documentation related to this design work, as undertaken by BGC. This report should be read in conjunction with Golder (2002) that provides hydrological and hydraulic design input for this preliminary design.

2.0 BACKGROUND INFORMATION

2.1 WTDA Operation

The WTDA is comprised of an upper, solids retention pond, named the Surface Cell and a lower, water retention pond, called the Reservoir. An earthen dike, called the West Twin Dike, separates the Surface Cell and the Reservoir. This dike is constructed of frozen compacted shale and settled, frozen tailings. Excess water from the Surface Cell is transferred to the Reservoir by pumping or a siphon system. The Reservoir and a final Polishing Pond are separated by a causeway and stop log structure, which controls the water level in the Polishing Pond. Water from the Polishing Pond is then discharged to Twin Lakes Creek. Excess water from the WTDA is discharged to the environment between July and September of each year, with annual quantities typically ranging from 200,000 to 400,000 m^3.

Generally, a 2 m high lift is added annually to the West Twin Dike, using compacted and frozen shale rockfill. The dike is raised in an upstream manner. Golder (1999b) provides a detailed description and relevant cross-sections for this construction technique. No annual raising of the dike was undertaken during the 1999/2000 or 2000/2001 periods and the dike crest is situated at a nominal elevation of 388 m.

2.2 Proposed Closure Plan for WTDA

The long-term closure plan (for tailings within the Surface Cell) relies on the concept that the tailings will remain frozen and thus will be non-reactive. This means that they must be covered in a manner that prevents thawing and effectively eliminates oxidation and leaching. To date, the abandonment planning has assumed that burial of the tailings will consist of suitable capping materials, likely including the following two layers:

1. Surficial armouring layer of Twin Lakes sand, gravel and cobbles to prevent erosion.
2. An underlying layer of weathered shale placed over the frozen tailings to prevent infiltration of surface run-off and thawing of the underlying frozen tailings.

Both of these materials have been subject to physical durability testing as summarized in Golder (1999a).

Local runoff from the West Twin Dike watershed, shown on Figure 1, will be collected and conveyed over/around the stabilized tailings in the Surface Cell through a proposed program of proper grading (not discussed further in this report). In addition, a spillway will be required at the south abutment in order to transfer, by gravity, the water that collects in the Surface Cell area to the reservoir. The dike face will be contoured and armoured with dolostone or quartzite to prevent erosion.

During closure, the drainage channel from West Twin Lake will be reconstructed to maintain the surface of the Reservoir at approximately Elevation 369 m, that is 2 to 3 m below that of East Twin Lake. This will prevent any subsurface water flow from entering East Twin Lake from the disposal area, which is unlikely in any event due to the presence of permafrost in this area.

Figure 2 provides an aerial view of the WTDA, along with its major components. In addition, two potential spillway alignments are schematically displayed in this figure. Figures 3 and 4 provide some selected views of the general area of the proposed spillway alignments. Photo #1 of Figure 3 shows the topographic high (dolostone outcrop) located at the south abutment area that the proposed spillway alignments either have to go around or through. Photo #3 of Figure 3 illustrates the general area of the proposed inlet to the spillway.

2.3 Location and Proposed Layout

As discussed in Section 2.1, it has been proposed that the tailings in the Surface Cell be covered and contoured to prevent the pooling of surface water thereby preventing thawing and effectively eliminating oxidation and leaching after closure. The proposed final bathymetry/topography of the tailings surface, as provided by mine site staff, behind the dike is illustrated on Figure 5, along with two proposed spillway options. The proposed filling and contouring of the area behind the dike will direct any water draining onto the Surface Cell into the southeast corner of the disposal area. Therefore, the proposed general location of the spillway inlet needs to be located in the south abutment area.

As outlined in Golder (1999b), the West Twin Dike was constructed in an upstream manner with the frozen shale dike being placed over the frozen tailings beach. As reviewed in Section 2.5, the dike is not designed for the long-term storage of water; only the temporary storage of supernatant water. The dike derives it stability, and to some extent its water retention ability, from the fact that the dike and the foundation are frozen.

Experience has shown, that if the retained water level is too high on the upstream side of the dike, then seepage and stability problems can occur. At the current time, the dike crest is situated at the nominal elevation of 388 m. If the 2 m freeboard requirement is used to constrain the water level in the pond during design flood events, then the maximum pond level should not exceed nominal elevation 386 m. Of course, this elevation is for the pond level when filled in response to the design flood event and as such, it was determined that the inlet elevation to the spillway would be set at 384 m for this preliminary design work.

2.4 Geology and Ground Conditions

2.4.1 Regional Geology

Golder (1999b) provides a comprehensive description of the regional geology, based on input provided by site geologists from Nanisivik Mine. Basement rocks in the Nanisivik area are Archean to Aphebian age gneisses. The basement rocks are overlain by rocks of the Bylot Supergroup (Neohelikian age), which are in turn, overlain by flat lying sediments (Lower Paleozoic age). The Bylot Supergroup is comprised of a lower clastic sequence, a middle carbonate platform sequence and an upper clastic sequence, which have been intruded, and slightly metamorphosed, by mafic dikes. The surface is covered with glacial derived overburden.

Rocks of the Bylot Supergroup exposed in the West Twin Lake area include:

- Adams Sound Formation Quartzite;
- Society Cliffs Formation Dolostone; and,
- Victor Bay Shale.

Both the dolostone and the quartzite have been subjected to slight metamorphic conditions resulting in the rocks forming re-crystallised, dense, massive units. Metamorphic conditions have been determined to have been well below greenschist facies.

Outcrops of the Bylot Supergroup in the area of West Twin Lake include:

- Adams Sound Formation Quartzite in the plateau to the south;
- Society Cliffs Formation Dolostone immediately north and south of West Twin Lake; and,
- Victor Bay Shale to the east and west of West Twin Lake.

Hematite stained gravels and sandy deposits (Twin Lakes sand and gravel) in the West Twin area are reworked, glacial materials deposited locally by streams. The composition of the sand and gravel is dominated by quartz sand and pebbles derived from the Adams Sound Quartzite.

Localised deposits of red coloured, silty sand have been observed in the area surrounding the West Twin Lake Dike.

2.4.2 Spillway Geology

The ground conditions within the spillway area have been investigated during geotechnical drilling completed by mine site staff in 2000 and 2001 (borehole locations shown on Figure 5). Unfortunately, of the three boreholes drilled in the area, a borehole log is only available for SW3, as summarized in Table 1 below:

Table 1 Borehole Log for SW3 (prepared by site staff)

Depth (m)	Description
0 - 0.1	Shale
0.1 - 0.9	Frozen Tailings
0.9 - 1.35	Ice
1.35 - 1.75	Frozen Tailings
1.75 - 2.7	Red Sand & Gravel
2.7 - 3.75	Gravel
3.75 - 4.30	Bedrock (unfractured)
4.30	EOH

Figure 6 provides some selected photos of the surficial ground conditions (as observed by BGC personnel) within the proposed spillway area. As can be seen, an outcrop of fractured dolostone is located in the topographic high point at the south abutment. Polygons of sorted surficial materials indicate permafrost conditions, which include ground ice. Based on the limited geological information and surficial observations, the geology along the route is comprised of a thin veneer of soil (wind blown fine material, till, and/or colluvium), underlain by frost shattered and weathered rock overlying dolostone bedrock. The dolostone bedrock is frost shattered in areas where it outcrops at surface and is weathered to varying degrees. Additional geotechnical investigative work will be required to assess the ground conditions within the selected spillway option.

2.5 Dike Stability

BGC (2000a) undertook a subjective risk assessment relative to the stability of the West Twin Dike. As a result of the risk assessment process, a summary of significant design elements and operational criteria were prepared for use at the West Twin Dike, as follows below:

1. West Twin Dike is designed for the permanent retention of tailings solids only. No long term storage of water is to occur on the upstream side of the dike.
2. During operation of the Surface Cell, the freeboard amount on West Twin Dike (from the impounded water level to the physical crest of the dike) will be greater than two metres, except as detailed in Item #3 following.
3. If the freeboard amount needs to be reduced to less than two metres for operational requirements, then a suitably-designed sealing element (similar to the seal placed in 1999) will be placed on the upstream side of the top lift in order to prevent any water infiltration into the dike shale fill.
4. In no case will the freeboard be less than one meter for any dike within the West Twin area.

5. During operation, tailings solids will be discharged such that beaches are formed and deeper areas of supernatant water will be displaced.
6. Thermocouples will be used to monitor the subsurface geothermal regime of the dike and its foundation.
7. Raising of the West Twin dike is possible, if future analytical work shows the increased height to be stable. Placement of tailings solids may also occur within the solids retention dike constructed around the Test Cell area.
8. During the closure phase, suitable cover materials (likely weathered shale and durable cobbles and boulders) will be placed over the tailings solids in order to prevent erosion of the tailings and to aggrade the permafrost table upwards.
9. At closure, no significant pond of water will exist in the Surface Cell, upstream of the dike.
10. A spillway will be designed for the dike at closure in order to convey water around the structure over the long term.

These criteria are used to guide the exact configuration of the dikes, tailings solids deposition and water levels within the facility. In addition, this report recommended stability assessments be performed for the West Twin Dike.

BGC (2000b) undertook some of the recommended analytical modelling and assessments referred to in BGC (2000a). This work consisted of the following three items:

- Rigid Block Stability Analyses (sliding and overturning).
- Conventional Slope Stability Analysis (assuming thawed conditions).
- Susceptibility of the tailings solids and other west twin lake dike (WTLD) soils to frost heave.

Based on the rigid block assessment, the current dike configuration meets or exceeds current static design guidelines for the mechanism of sliding stability. Based on the conventional slope stability analysis for a dry, frozen slope, the Factors of Safety for both static and seismic conditions (PGA=0.05g) also meet or exceed the required values. The review of the soils within the WT dike area and their relative susceptibility to frost heaving revealed that the susceptibility was high for the lake bed sediments, moderate to high for the tailings and low for the shale rock fill. Based on these results, five recommendations for additional work were provided.

One of the recommendations provided concerned the geothermal regime upstream from the West Twin Dike, in the area of the lowest bathymetric contour (previously referred to as the “Deep Hole”). Given the heat source from this retained pond, it was necessary to confirm the frozen tailings upstream from the dike. Thermocouple #35 was placed near the upstream side of the dike recently, but it will still be necessary to place another thermistor cable closer in the current location of the lowest bathymetric contour, if practically possible. The purpose of this instrument is to assess the potential extent of a talik within the lowest bathymetric contour area, in order to quantity stability risks with the dike.

3.0 PRELIMINARY SPILLWAY DESIGN

3.1 Design Criteria

The current water licence for the Nanisivik Mine does not provide any specific criteria for the hydrological design of any closure facilities. Hence, for the design process to proceed, it is first necessary to set the design criteria for closure of the structures. These criteria, along with the design life or closure monitoring period, then define the potential hazard (likelihood of the occurrence of failure). The likelihood of exceedance, based on return period events, is defined by the relationship below:

$$P_n = 1 - [(T - 1)/ T]^n$$

where P_n = probability of exceedance,
T = the return period of the design events (in years) and
n = the design life of the structures (in years).

NWT Water Board (1990) provides design guidelines for the abandonment of tailings structures in the NWT. Within that document, and based on the potential impact of failure, Table 2 provides a summary of the recommended design criteria:

Table 2 Design Criteria for Abandoned Tailings Impoundment Structures (after NWT Water Board 1990)

Impact	Design Criteria
Low	Worst case of 1 in 50 year storm or seismic event
Medium	Worst case of 1 in 100 year storm or seismic event
High	Worst case of 1 in 200 year storm or seismic event

As such, even with a high impact structure, the design criteria according to these guidelines would be the 1 in 200 year return period event. For a nominal closure period of 100 years, and assuming the 200 year return period event, the probability of exceedance would amount to approximately 39%. This value amounts to a relatively high degree of risk.

CDA (1999) provides a summary of suggested dam safety guidelines that are now being applied to tailings dams as they once were to water retention dams. Section 6.0 of those guidelines notes the following:

> "Dams shall be designed and evaluated to safely pass an Inflow Design Flood (IDF). Selection of the IDF for a dam shall be based on the consequences of failure."

The size of the selected IDF increases with the increasing consequences of failures as shown in Table 3:

Table 3 Usual Minimum Criteria for Inflow Design Floods

(after Table 6-1 of CDA 1999)

Consequence Category	Inflow Design Flood (IDF)
Very High	Probable Maximum Flood (PMF)
High	Annual Exceedance Probability (AEP) between 1/100 and PMF
Low	AEP between 1/100 and 1/1000

Again, for a nominal closure period of 100 years, and assuming the 1,000 year return period event, the probability of exceedance amounts to approximately 10%. If the return period criteria for the flood event were increased to a 10,000 year return period, the probability of exceedance reduces to less than 1%.

Golder (2002) notes that the spillway should be designed for a PMP (~PMF) event for the following reasons:

- The watershed area is very limited and hence, the design flood event amounts to a relatively small amount of water.
- Given the practical constraints of spillway construction (e.g. equipment size, blasting requirements. etc.), designing for the PMP flood event has limited cost implications.
- Designing for PMP should simplify the approval process due to the conservative design criteria selected.

It should be noted, that if PMP/PMF criteria is used for preliminary design of the spillway, the entire water conveyance system in the West Twin lakes area would have to be designed to be compatible. This fact may have additional cost consequences.

3.2 Alignment Options and Topography

Topographic and bathymetric information provided by Nanisivik Mine to BGC included the following:

- the current bathymetry of the surface cell, drawing - WTDAv14.dwg;
- the current bathymetry of the reservoir, drawing - 2000 Bathymetrics V14.dwg;
- the proposed final bathymetry of the surface cell, drawing – new final bath v14.dwg; and,
- survey data of the south abutment area, drawing - spillway base mapv14.dwg.

In addition to the data supplied by the mine, BGC also undertook some contouring of the survey data to estimate grades and quantities required for preliminary design. It should be noted that these estimates are preliminary in nature and subject to change as additional survey data is collected.

Currently, the water in the Surface Cell collects in the deep water area in the southeast region. Supernatant water is transported to the Reservoir through the use of siphons. The water level in the Surface Cell was measured in 2001 to be approximately 386 m. In accordance with the water license, the water level in the Reservoir is monitored by mine staff on a daily basis. This water level has been observed to fluctuate between an elevation of 369.5 m and 371.3 m. Therefore, a head difference of approximately 16 m currently exists between the Surface Cell and the Reservoir.

The topography near the south abutment of the Surface Cell allows the water to approach the south abutment of the dike through a natural drainage swale. The swale comes to a high point or "saddle" near the south abutment of the dike. The swale then proceeds through two bedrock outcrops and then down to the reservoir. This area has been investigated for the potential spillway alignment because of the natural drainage paths and proximity to bedrock.

Two potential alignments have been examined. Each alignment satisfies different attributes beneficial to the construction of the spillway.

Alignment #1:

This alignment follows the natural drainage swale around the bedrock outcrop at the south abutment. The alignment would have an inlet elevation of 384 m, a width of 6 m and a gradient of 2.0%. This alignment requires the least amount of excavation. A longitudinal sectional representation of the topography along the alignment is illustrated on Figure 7. This proposed alignment has two corners, both of which will require erosional protection (rip rap) if they are not excavated into bedrock at these locations.

An additional alignment option, Alignment #1A, is illustrated on Figures 2 and 5. The main benefit associated with Alignment #1A is the fact that construction of this alignment option could produce rip rap for use in other portions of the spillway where required. This alignment was not studied in detail but it has been included to demonstrate that the potential rip rap production in combination with spillway construction exists.

Alignment #2:

This alignment follows a curved path along the south edge of the drainage swale. This alignment provides a gradient of 1.8%. A longitudinal representation of the topography along the alignment is illustrated on Figure 8.

The physical characteristics and potential advantages and disadvantages associated with each alignment are further summarized in Table 4.

Table 4 Physical Characteristics and Attributes of Proposed Spillway Alignments

Alignment	Length (m)	Width (m)	Inlet Elev. (m asl)	Outlet Elev. (m asl)	Gradient (%)	In place Excavation Volume (m^3)	Advantages	Disadvantages
Alignment #1	600	6	384	370	2.3	16,900	Follows a natural drainage path Lower excavation volume.	Higher gradient, flow velocities and sharper geometry.
Alignment #2	650	6	384	370	2.15	26,000	Lower gradient and gradual curve.	More excavation volume.

3.3 Estimated Quantities and Construction Issues

The existing topographical information has been used to estimate the excavation quantities associated with each proposed alignment. These quantities are summarized in Table 4. Alignment #1 was determined to have the lowest associated excavation quantity (16,900m^3) while Alignment #2 was determined to have the highest associated excavation quantity (26,000m^3). Due to limited available geological and geotechnical information, separate volumes of soil and rock were not determined. Since the soil is frozen throughout much of the year and would likely have to be drilled, blasted and mucked to be excavated, (just like rock), separate volumes of soil and rock are not expected to have a great deal of influence on the excavation cost of the spillway. Further delineation of subsurface stratigraphy could influence the total construction cost of the spillway because encountering soil along the base of the spillway would require rip rap and hydraulic structures to be placed within the spillway to prevent erosion.

In addition, a constant spillway slope has been assumed for the preliminary design. Ground conditions may dictate variable slopes with the resultant needs for erosion protection and/or bedrock lining of the channel base and sides.

3.4 Additional Design Issues and Options

Given the uncertainty in the geologic conditions along each of the proposed alignments, it is possible that the base of a portion of any of the alignments may be in soil. The gradient associated with each proposed alignment would result in flow velocities ranging between 1.6 m/s and 3.3 m/s. These velocities are such that rip rap with a diameter up to 0.6 m may be required to provide erosion control if the base of the spillway is in soil. Additional erosion protection and/or some form of hydraulic energy dissipater will be required at the outlet of the spillway as it enters the Reservoir.

An assessment of potential ice blockages concerns in the spillway will need to be undertaken. A low-flow pilot channel may be needed to ensure flow under normal operating conditions will not be constrained by ice formation. This will depend on the inflows to the Surface Cell area and the freezing conditions.

Since the proposed spillway is located within a natural drainage area, some amount of runoff and surficial drainage from areas upslope from the Surface Cell will likely enter into the drainage swale and the proposed spillway alignments. Some form of connection detail will be required so that natural drainage can be included within the spillway section.

4.0 RECOMMENDATIONS FOR FINAL DESIGN

Following on from the design summary provided herein, the following tasks need to be undertaken in order that final design for the proposed spillway can be completed:

1. A detailed topographic survey of the proposed spillway area needs to be completed once the majority of the snow has melted. The survey needs to include the tailings beach situated on the upstream area of the West Twin Dike, the south end of the West Twin Dike, the topographic highpoint situated at the south abutment and the entire drainage area located uphill and downhill from the south abutment. A sufficient number of data points need to be collected so that 0.5 m-contour intervals can be produced.
2. Additional geotechnical investigation work needs to be undertaken within the proposed spillway alignment (including the outlet into the Reservoir) so that an assessment of the ground conditions can be undertaken. A drilling and coring program should be undertaken in late winter (April) so that frozen core samples may be recovered. In addition, it may be prudent to install thermistor strings within some of the boreholes to confirm the geothermal regime within the area. Additionally, several test pits should be excavated later in the summer (July) when some active layer thaw has occurred. The test pitting could be done in conjunction with the annual geotechnical inspection program. The location and elevation of each borehole and test pit will need to be surveyed as well.
3. An additional thermocouple or thermistor needs to be installed upstream of the dike, proximal to the lowest bathymetric contour, if practical. This instrument needs to be installed in order to assess the potential extent of a talik within this area.
4. Any changes to the closure contouring of the Surface Cell need to be forwarded to assess any impacts on the spillway design. Additionally, after geological conditions along each of the propose alignment is investigated, the potential spillway alignments and the closure contouring of the Surface Cell should be reassessed to determine if any changes are required.
5. An assessment of the physical and chemical durability of the dolostone unit at the south abutment should be undertaken to determine its potential use as rip rap.
6. A hydrological assessment of PMF event routing through the entire West Twin system needs to be done. This work would would include the spillway, the lower Reservoir (West Twin Lake), the polishing pond outlet structure and the downstream portion of Twin Lakes Creek. This assessment needs to be undertaken in the context of elevation constraints imposed relative to East Twin Lake and expected PMF outflows from this watershed during extreme events.

5.0 CLOSURE

The report provided herein outlines the preliminary design of a proposed spillway required for closure of the West Twin Disposal Area. Additional geotechnical and hydrotechnical work will be required so that final design can be undertaken. Construction drawings and technical specifications will be required to complete the final design process and these will need to be stamped by a professional engineer licenced to practice in NT and NU.

Should you have any questions or comments, or if we can be of additional service, please contact any of the undersigned.

Respectfully submitted,
BGC Engineering Inc.
Per:

Geoff Claypool, E.I.T. (AB)
Geological Engineer in Training

Reviewed by:

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

Gerry Ferris, M.Sc., P.Eng. (AB)
Geotechnical Engineer

REFERENCES

BGC Engineering Inc. 2000a. Risk Assessment of West Twin Disposal Area Dike, Nanisivik Mine, Nunavut. Report submitted to Nanisivik Mine, A Division of CanZinco Ltd., Project No. 0255-001, September 2000, 31 pages including figures.

BGC Engineering Inc. 2000b. Analytical Modeling Results, Nanisivik Mine, Nunavut. Report submitted to Nanisivik Mine, a Division of CanZinco Ltd., Project No 0255-001-02, November 2000.

Canadian Dam Association 1999. Dam Safety Guidelines. Prepared by the Canadian Dam Association, twelve sections, January 1999.

Golder Associates Ltd. 1998. 1998 Geotechnical Inspection of Waste Containment Dykes, Nanisivik Mine, Baffin Island, NWT. Report submitted to Nanisivik Mine, a Division of CanZinco Ltd., Project No.: 982-2432.5100, October 1998, 27 pages plus figures.

Golder Associates Ltd. 1999a. Geotechnical Assessment of Cover Materials for the West Twin Disposal Area, Nanisivik Mine, Baffin Island, NWT. Report submitted to Nanisivik Mine, a Division of CanZinco Ltd., Project No.: 982-2432.5200, February 1999, 11 pages plus tables and figures.

Golder Associates Ltd. 1999b. Geotechnical Data Review and Stability Assessment of West Twin Dyke, Nanisivik Mine, Baffin Island, Nunavut. Report submitted to Nanisivik Mine, a Division of CanZinco Ltd., Project No.: 992-2411.5200, October 1999, 36 pages plus figures and appendices.

Golder Associates Ltd. 2002. Hydrological Study, Nanisivik Spillway Design. Report submitted to Breakwater Resources Ltd., Project No. 011-1838, February 2002, 16 pages plus figure and tables.

Nanisivik Mine 2000. Nanisivik Mine, Interim Abandonment and Reclamation Plan 2000. Report submitted to Nunavut Water Board in compliance with Condition NWB1NAN9702 Part H, February 2000.

Northwest Territories Water Board 1990. Guidelines for Abandonment and Restoration Planning for Mines in the Northwest Territories. Prepared by the Northwest Territories Water Board and Northern Affairs Program, Department of Indian Affairs and Northern Development, September 1990, 13 pages plus appendix.

FIGURES