TABLE 1
COMPONENT FCRP REPORTS

Water License Reference	Report
G3	Final Closure and Reclamation Plan
G4	Reclamation Cover Designs
G5	West Twin Disposal Area Talik Investigation
G6	Borrow Areas Development and Closure Plan
G7	West Twin Disposal Area Surface Cell Spillway Design
G8	Waste Rock and Open Pit Closure Plan
G9	Reclamation and Closure Monitoring Plan
G12	Annual Review of Reports G3 to G9 and Submission, for Approval, of Proposed Modifications
G13	Report on Environmental Site Assessment (ESA) Program
G14	Human Health and Ecological Risk Assessment (HHERA)
G15	West Twin Disposal Area Closure Plan
G16	Underground Mine Solid Waste Disposal Plan
G17	Landfill Closure Plan
G20	Annual Review of Reports G15 to G17 and Submission, for Approval, of Proposed Modifications
G21	Annual Reclamation Liability Cost Update
G22	2007 Terms of Reference for Comprehensive Assessment of Mine Site Remediation

n:\active\2003\1118\03-1118-049 nanisivik detailed design\working files\task4300 spillway design\spillway design report\03-1118-049 table 1 - fcrp component reports 03feb04.doc

TABLE 2
COMPARISON OF SPILLWAY ALTERNATIVES

Location	Option	Inlet Elevation (m)	Over excavation of tailings required?	Estimated Amount of Cover Material Required
1	1a	388	No	Most ≈ 1,000,000 m^3
	1b	386	Yes	≈ 750,000 m^3
2	2a	388	No	≈ 900,000 m^3
	2b	386	Yes	≈ 750,000 m^3
3	3a	387	Yes	≈ 900,000 m^3
	3b	385	Yes	≈ 600,000 m^3
4	4	384.5	No	Least ≈ 550,000 m^3

n:\active\2003\1118\03-1118-049 nanisivik detailed design\working files\task4300 spillway design\spillway design report\03-1118-049 table 2 comparison of spillway alternatives 03feb04 doc

TABLE 3
KEY WATER LEVELS – SURFACE CELL

Surface Cell

Normal Water Level:	Elev. 384 m
Water Level during 100-year storm conditions:	Elev. 394.2 m
Peak Water Level (during design storm (PMP):	Elev. 384.6 m

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TABLE 4
KEY WATER LEVELS – RESERVOIR

Normal Water Level:	Elev. 369.0 m
Water Level during 100-year storm conditions:	Elev. 369.1 m
Peak Water Level (during design storm (PMP):	Elev. 369.3 m

n:\active\2003\1118\03-1118-049 nanisivik detailed design\working files\task4300 spillway design\spillway design report\03-1118-049 table 4 key water levels - reservoir.doc

TABLE 5
SUMMARY OF PEAK FLOWS
VELOCITIES AND DEPTHS

Structure:	Surface Cell Spillway			
Design Conditions:	100-yr		PMP	
Peak flow, m^3/s	1.35		5.2	
Channel Slope, %	1%	5%	1%	5%
Width, m	6	6	6	6
Peak Flow Depth, m	0.23	0.14	0.52	0.31
Peak Flow Velocity, m/s	1.0	1.6	1.7	2.8

TABLE 6
EROSION PROTECTION REQUIREMENTS

Spillway Gradient	Material Exposed	Erosion Protection Layers (Thickness)
0 - 1% Slope	Intact Rock	None
	Frost Shattered Rock	Type 2 (0.45 m)
	Overburden	Type 2 (0.45 m) ON Type 3 (0.3 m)
1% - 5% Slope	Intact Rock	none
	Frost Shattered Rock	Type 1 (0.6 m) ON Type 2 (0.45 m)
	Overburden	Type 1 (0.6 m) ON Type 2 (0.45 m) ON Type 3 (0.3 m)

Notes:

1. Thicknesses are measured perpendicular to slope
2. Material Descriptions
   - Type 1 – Rip Rap – Boulders, D_{50} = 300 mm
   - Type 2 – Erosion Protection – Cobbles and Boulders, D_{50} = 100 mm
   - Type 3 – Filter – Sandy Gravel (i.e. Twin Lakes Gravel)
3. D_{50} – mean particle size

n:\active\2003\1118\03-1118-049 nanisivik detailed design\working files\task4300 spillway design\spillway design report\03-1118-049 table 6 erosion protection.doc

TABLE 7
PRELIMINARY MATERIAL SPECIFICATIONS

Sieve Size	Material Type and Percent Passing		
	Type 1 - Rip Rap	Type 2 - Bedding /Erosion Protection	Type 3 - Filter (Twin Lakes Gravel
600	100	-	-
450	100-0	-	-
300	20-0	100	100
150	0	100-30	100-85
75		28-0	100-75
50		15-0	100-65
25.4		0	70-40
19			67-40
12.5			55-25
9.5			45-12
4.75			35-0
2.38			30-0
1.16			23-0
.6			20-0
.3			13-0
.15			8-0
.075			5-0

n:\active\2003\1118\03-1118-049 nanisivik detailed design\working files\task4300 spillway design\spillway design report\03-1118-049 table 7 preliminary material specifications.doc

TABLE 8
ESTIMATED CONSTRUCTION QUANTITIES

Location	Construction Items					
	Excavation Volumes (m^3)			Fill Volumes (m^3)		
	Overburden Excavation	Frost-Shattered Bedrock	Intact Bedrock	Rip rap (Type 1)	Erosion Protection (Type 2)	Bedding (Type 3)
Inlet / Chute	21,800	9,800	3,400	225	250	75
Plunge Pool	1,500	300	-	200	150	75
Outlet Channel	10,050	1,950	-	1,275	1,200	250
Sub-totals	**33,350**	**12,050**	**3,400**	**1,700**	**1,600**	**400**
Grand total	**48,800 m^3**			**3,700 m^3**		

n:\active\2003\1118\03-1118-049 nanisivik detailed design\working files\task4300 spillway design\spillway design report\03-1118-049 table 7estimated construction quantities.doc

SITE LOCATION MAP SHOWING INFERRED WATERSHED BOUNDARIES

FIGURE 1

LEGEND

INFERRED WATERSHED BOUNDARIES

SURFACE WATER FLOW DIRECTION

DRAINAGE AREAS

EAST TWIN LAKE	34.6 sq.km.
RESERVOIR (WEST TWIN LAKE)	3.0 sq.km.
SURFACE CELL	1.27 sq.km.

REFERENCE

ENERGY, MINES AND RESOURCES, MAP SHEETS 48 C/1 AND 48 B/16, 1986, SCALE 1 : 50,000.

1 0 1 2

SCALE 1:50000 KM

DATE: FEBRUARY, 2004

PROJECT: 03-1118-049

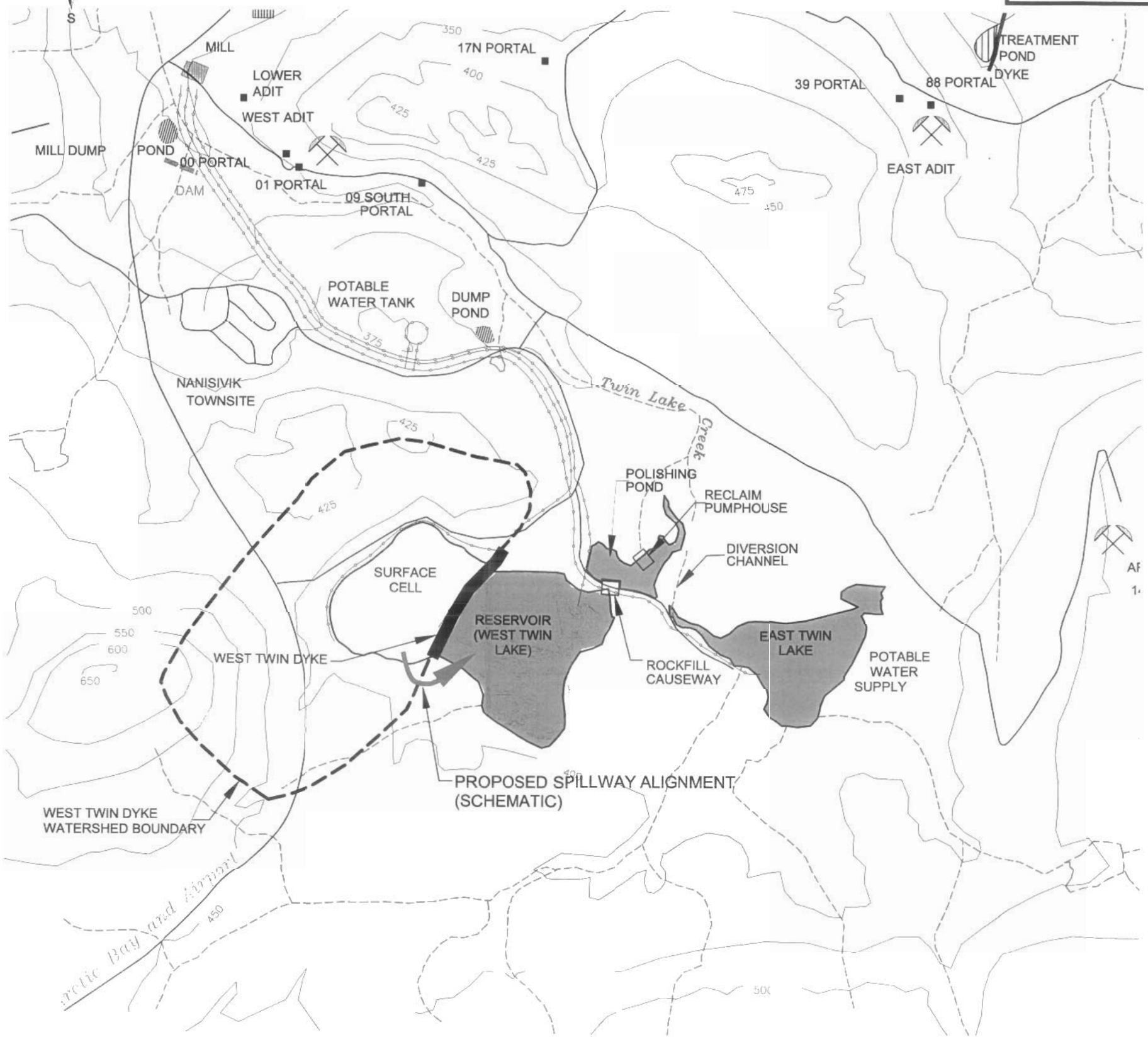
Golder Associates

CAD: TDR

CHK: DGR

SITE ARRANGEMENT PLAN
NANISIVIK MINE TAILINGS AREA

FIGURE 2

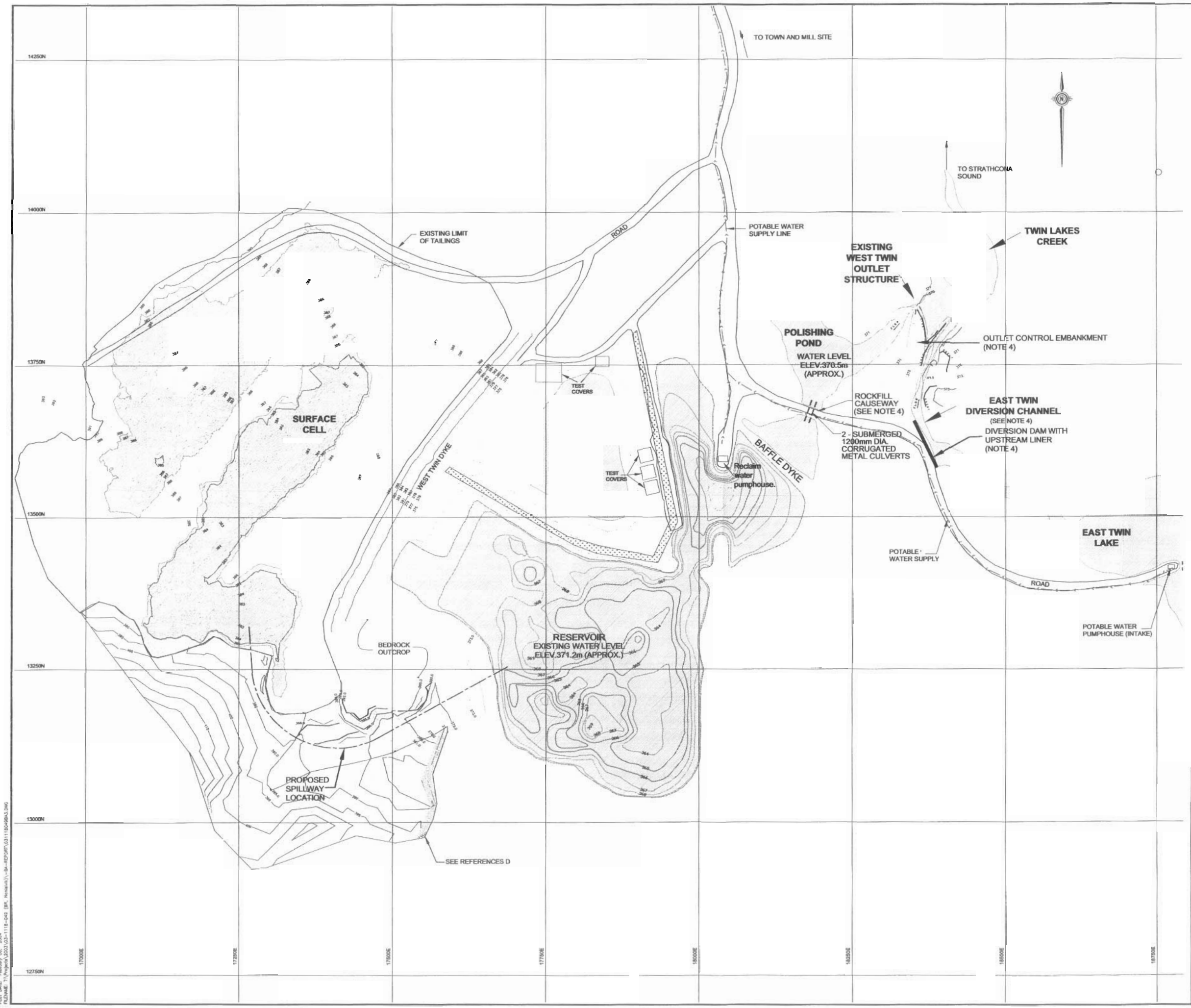


SOURCE: DIGITAL MAP PROVDED BY BGC ENGINEERING

400 0 400 800
SCALE 1:20000 METRES

Golder Associates

PLOT DATE: February
FILENAME: T:\Projects\2003\03-1118-043 - RP, Nanisivik - GA-PERMIT\03111804-GA2.dwg



NOTES

1. GRID IS METRIC REFERENCED TO LOCAL MINE.
2. GRID ELEVATIONS ARE IN METRES REFERENCED TO GEODETIC DATUM.
3. DIVERSION CHANNEL, DIVERSION DAM AND ROCKFILL CAUSEWAY(FOR POTABLE WATER PIPELINE) INFERRED FROM KILBORN DWG. 13-13-7, REV. 1 DATED JAN.1997 (AS-BUILT).
4. DETAILS REGARDING THE CONSTRUCTION OF THE OUTLET CONTROL EMBANKMENT WERE NOT AVAILABLE AT TIME OF DRAWING PREPARATION.

REFERENCES

BASEMAPPING WAS PROVIDED BY BGC IN DIGITAL FORMAT. FILENAME: 0255-008-09 001 Figure_07_alt.dwg DATED 12/22/2003. BGC'S BASEMAPPING COMPILATION LISTS THE FOLLOWING SOURCES:

A. RESERVOIR AND TEST CELL BATHYMETRY DERIVED FROM DRAWING New Final Bath V14.dwg SUPPLIED BY NML.
B. SURFACE CELL, WEST TWIN OUTLET AND PROPOSED SPILLWAY AREA TOPOGRAPHY DERIVED FROM SURVEY CONDUCTED BY SUB-ARCTIC SURVEYS LTD. SEPTEMBER, 2003.
C. BOREHOLE LOCATIONS ARE APPROXIMATE.
D. TOPOGRAPHY INT THE SPILLWAY OF THIS AREA WAS DERIVED BY BGC USING ADDITIONAL DATA SUPPLIED BY NANISIVIK MINE.

REV	DATE	REVISION DESCRIPTION	CAD	CHK	ENG	RVW
B	03/02/2004	ISSUED FOR APPROVAL	TDR	DGR	DGR	KAB
A	26/01/2004	ISSUED FOR REVIEW	TDR	DGR	DGR	KAB

Golder Associates Ltd.
Mississauga, Ontario, Canada

PROJECT

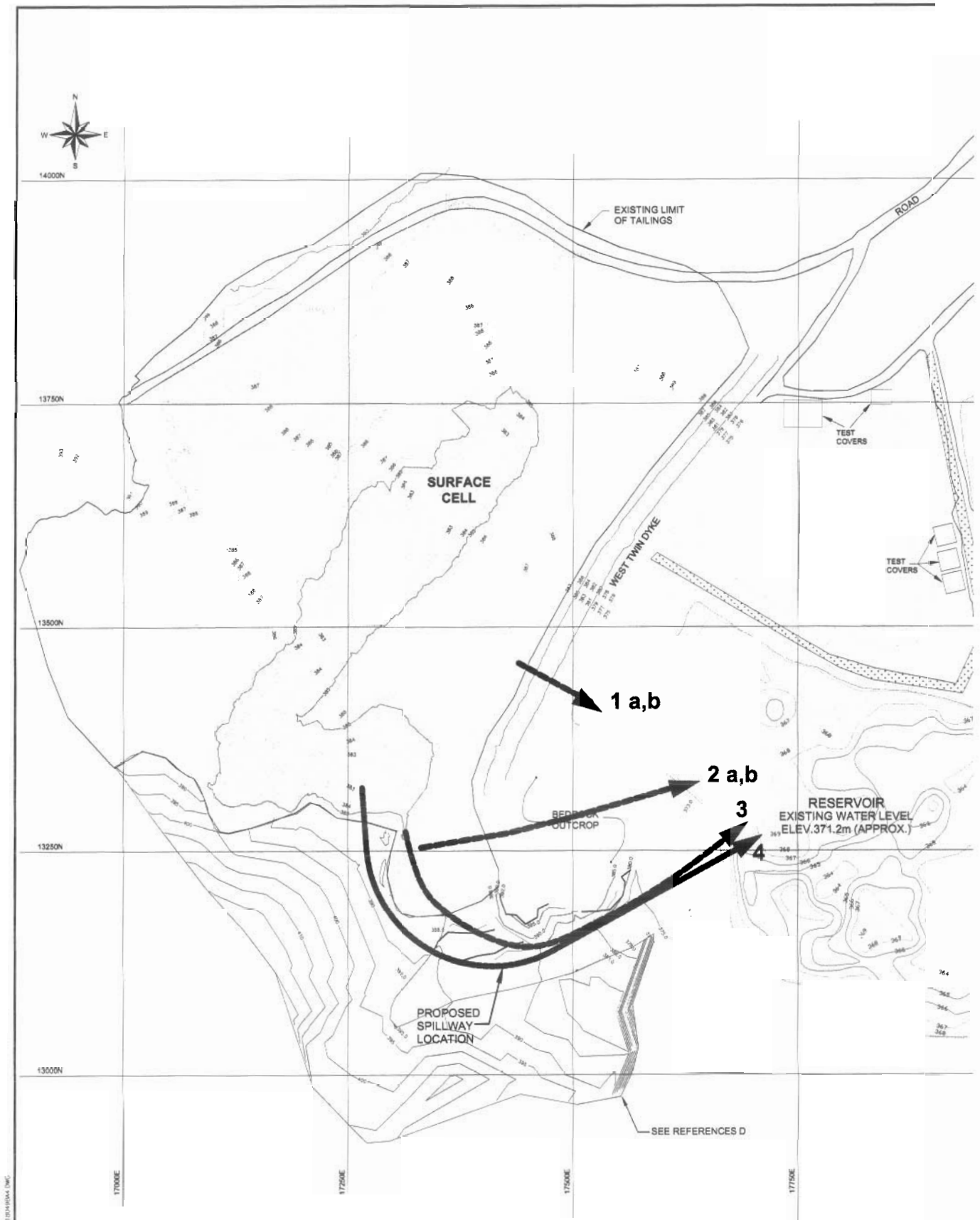
BREAKWATER RESOURCES
NANISIVIK MINE
A DIVISION OF CANZINCO LTD.

TITLE

EXISTING CONDITIONS PLAN WEST TWIN DISPOSAL AREA

PROJECT: 03-1118-049		FILE: 031118049BA3.DWG	
DATE: JANUARY, 2004		FIGURE 3	B
CAD: TDR	ENG: DGR	DRAWING NUMBER	REV
CHK: DGR	RVW: KAB		

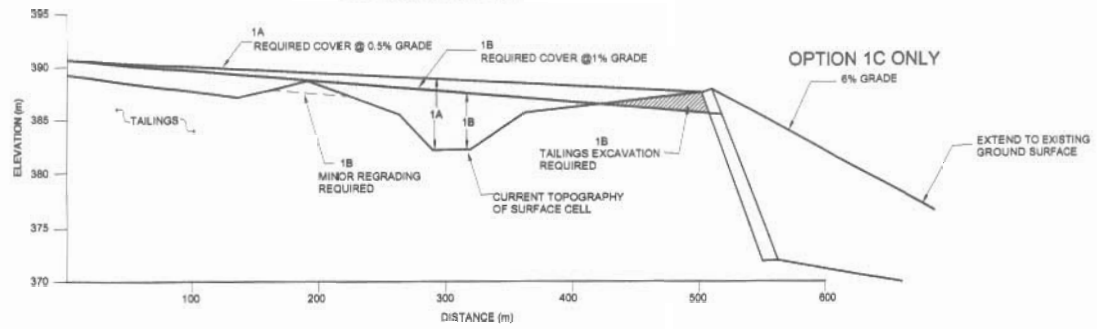
PLOT DATE: February 09, 2004
FILENAME: T:\Projects\2003\03-1118-049 (BR, Nanisivik)\--dw--\EPS\PT\031118049BA3.DWG



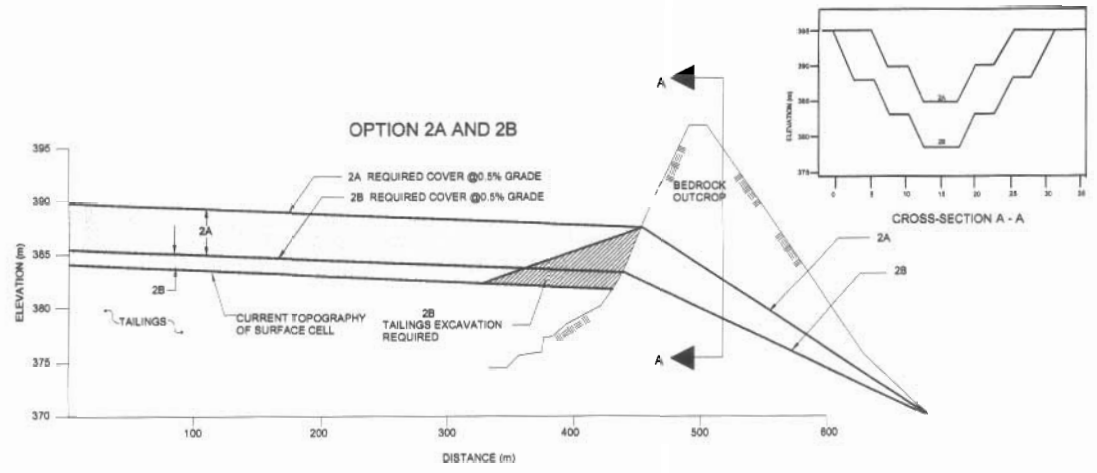
OPTIONS IN PLAN VIEW

SCALE 60 0 60 120 METRES

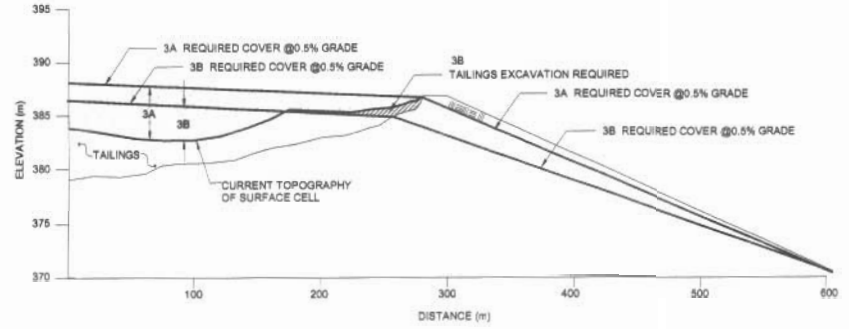
OPTION 1A AND 1B



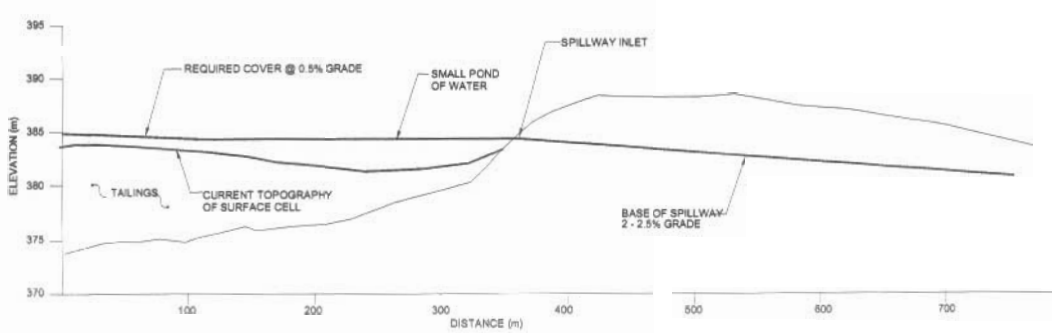
OPTION 2A AND 2B



OPTION 3A AND 3B



OPTION 4



SCHEMATIC SECTION OF OPTIONS
NOT TO SCALE

NOTES

1. GRID IS METRIC REFERENCED TO LOCAL MINE.
2. GRID ELEVATIONS ARE IN METRES REFERENCED TO GEODETIC DATUM.

REFERENCES

BASEMAPPING WAS PROVIDED BY BGC IN DIGITAL FORMAT. FILENAME 0255-008-09 001 Figure_07_alt.dwg DATED 12/22/2003. BGC'S BASEMAPPING COMPILATION LISTS THE FOLLOWING SOURCES:

A. RESERVOIR AND TEST CELL BATHYMETRY DERIVED FROM DRAWING New Final Bath V14.dwg SUPPLIED BY NML
B. SURFACE CELL, WEST TWIN OUTLET AND PROPOSED SPILLWAY AREA TOPOGRAPHY DERIVED FROM SURVEY CONDUCTED BY SUB-ARCTIC SURVEYS LTD. SEPTEMBER, 2003.
C. BOREHOLE LOCATIONS ARE APPROXIMATE.
D. TOPOGRAPHY INT THE SPILLWAY OF THIS AREA WAS DERIVED BY BGC USING ADDITIONAL DATA SUPPLIED BY NANISIVIK MINE.

REV	DATE	REVISION DESCRIPTION	CAD	CHK	ENG	RVW
B	03/02/2004	ISSUED FOR APPROVAL	TDR	DGR	DGR	KAB
A	26/01/2004	ISSUED FOR REVIEW	TDR	DGR	DGR	KAB

Golder Associates Ltd.
Mississauga, Ontario, Canada

PROJECT

BREAKWATER RESOURCES
NANISIVIK MINE
A DIVISION OF CANZINCO LTD.

TITLE

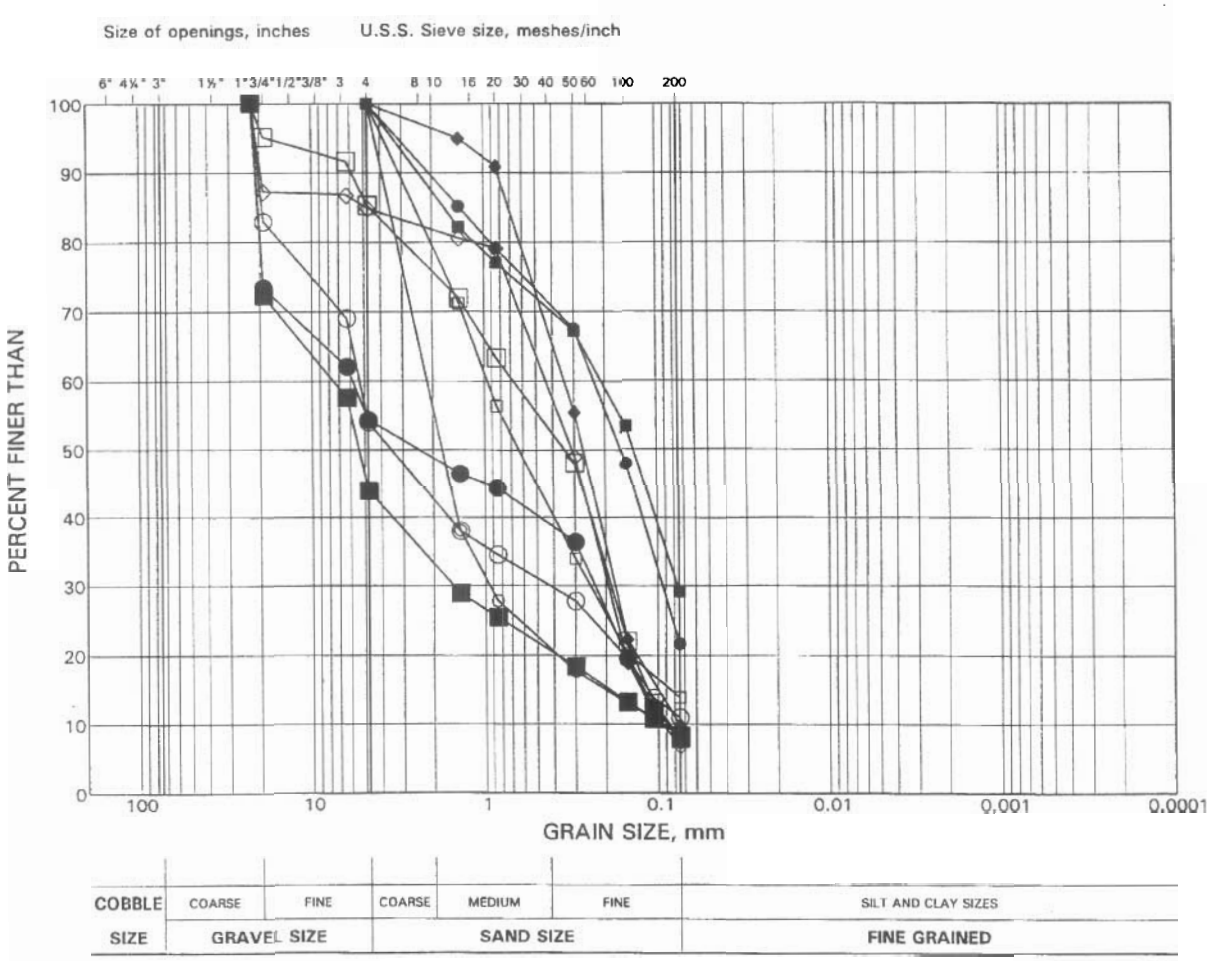
SPILLWAY ALTERNATIVES
WEST TWIN DYKE SPILLWAY

PROJECT:	03-1118-049	FILE: 031118049BA4.DWG	
DATE:	JANUARY, 2004	FIGURE 4	B
CAD: TDR	ENG: DGR	DRAWING NUMBER	REV
CHK: DGR	RVW: KAB		

PLOT DATE: February 06, 2004
FILENAME: I:\Projects\03\03-1118-049\ (SK, Reference*), GIS, REPORTS\031118049BA4.DWG

GRAIN SIZE DISTRIBUTION
Overburden 2002/2003 Spillway Investigations

FIGURE 5



LEGEND

SYMBOL	LOCATION	SAMPLE	DEPTH (m)
●	BGC03-05	25	0.3
■	BGC03-05	27	1.9
◆	BGC03-06	35	2.5
○	BGC03-16	98	1.7
□	BGC03-17	103	7.1
◇	TP02-01	S1	1.4
●	TP02-01	S2	0.7
■	TP02-02	S3	1.6
○	TP02-04	S4	1.1
□	TP02-05	S5	1.4

APPENDIX A

SUMMARY OF GEOTECHNICAL INVESTIGATIONS

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY
1605, 840 – 7 Avenue S.W. , Calgary, Alberta, Canada. T2P 3G2
Phone (403) 250-5185 Fax (403) 250-5330

PROJECT MEMORANDUM

To:	Golder Associates	Fax No.:	Via email
Attention:	Ken Bocking	CC:	
From:	Geoff Claypool (Ext. 104)	Date:	February 6, 2004
Subject:	2002/ 2003 Spillway Area Geotechnical Investigations		
No. of Pages (including this page): 10 + Appendices		Project No:	0255-008-08

1.0 2002/ 2003 GEOTECHNICAL INVESTIGATIONS – PROPOSED SPILLWAY AREA

A staged geotechnical investigation was conducted in 2002 and 2003 to gain a better understanding of the ground conditions in the proposed spillway area near the south abutment of the WT Dike. The staged approach was adopted to make use of people and equipment on site and to concentrate efforts during future investigations on satisfying information requirements identified during previous investigations. This memorandum has been prepared to summarize the results of the geotechnical investigations and subsequent geothermal monitoring conducted in the proposed spillway area.

1.1 Geotechnical Investigations

A total of 14 boreholes were drilled and 8 test pits were excavated in the proposed spillway area in 2002 and 2003. The location of each borehole and test pit is shown on Figure 1. A summary of the relevant borehole information is included in Table 1 and the borehole logs are included in Appendix I. The boreholes and test pits were completed during the investigations conducted in May and July 2002 and May 2003. The following sections describe the activities and results of each investigation.

In May 2002, Nanisivik Mine staff supervised the drilling of 9 boreholes (BH-1 through BH-9) in the proposed spillway area. The locations of each borehole are illustrated on Figure 1. The drilling was completed with the mine's Atlas Copco 262 diamond drill. Chilled brine was used as a drilling fluid and BQ-size (36.5 mm diameter) core was recovered when possible using a double tube sample barrel. Recovered samples were visually logged for lithology by the mine geologist and stored for subsequent review by a geotechnical engineer. Geotechnical logs were produced upon a subsequent review by a geotechnical engineer in July 2002. No instrumentation was installed in any of the boreholes completed during this investigation. The location and elevation of each borehole were surveyed by the mine surveyors.

In July 2002, Mr. Jim Cassie, P.Eng. of BGC Engineering Inc. (BGC) supervised a geotechnical test pit program to observe the near surface soil conditions in the proposed spillway area. A total of 8 test pits (TP-1 through TP-8) were excavated within the proposed spillway area. The test pits were excavated using a John Deere 892E LC excavator from the mine. Recovered samples were visually logged for lithology, grain size and moisture content and a geotechnical log was created for each test pit. Select samples were sent to the mine laboratory for index testing including moisture content and grain size analysis. Coordinates and elevations of the test pits were estimated using field measurements and available topographic information.

In May 2003, Mr. Gerry Ferris, P.Eng. of BGC supervised the drilling of 5 geotechnical boreholes in the proposed spillway area (BGC03-04, 03-05, 03-06, 03-16 and 03-17). The drilling was completed in a similar fashion to that described for the May 2002 investigation. Recovered samples were visually logged for ice content and grain size and a geotechnical log was created for each borehole. Select samples were sent to the mine laboratory for index testing including moisture content and grain size analysis. Additional samples were selected for transport to Calgary and sent to a soil laboratory for additional testing. Thermocouples were installed in the boreholes to monitor ground temperatures. The boreholes drilled in the proposed spillway area during the May 2003 geotechnical investigation were surveyed during the site survey conducted by Sub-Arctic Surveys in May/June 2003.

The thermocouples installed were fabricated as needed on site by the BGC field representative. The thermocouples were constructed using type EXPP-T-20 (copper–nickel extension type) thermocouple wire produced by Omega Industries. The accuracy of this type of thermocouple wire is documented by the manufacturer to be +/-1°C.

1.2 Ground Conditions

1.2.1 Stratigraphy

Ground conditions were observed from the samples retrieved during the drilling and test pitting activities. The observed ground conditions are illustrated on the photos in Figures 2 and 3 and described in detail on the borehole logs in Appendix I. In general, the stratigraphy from surface was:

- Till; overlying,
- Frost shattered bedrock; overlying,
- Competent bedrock.

The till is composed mainly of gravel and sand-size fragments of sandstone, shale and dolostone with cobbles and boulders also encountered. Visible ice was observed within the overburden as lenses, typically surrounding the larger clasts. Ground ice was encountered within the overburden in the boreholes BGC03-06 and 03-17, drilled near the Reservoir. The ice was encountered between 2.6 and 5.8 m, and 3.5 and 7.0 m in boreholes 03-06 and 03-17, respectively.

The bedrock encountered in the proposed spillway alignment was dolostone. The depth to bedrock ranged from 7.3 m in borehole BGC03-17, near the Reservoir, to 0.6 m in borehole BH-7. The Rock Quality Designation (RQD) was observed to range between 0% for the frost shattered bedrock to 100% for the competent bedrock.

1.2.2 Lab Testing

Several samples of the overburden and bedrock were collected from the boreholes and test pits completed within the proposed spillway alignment. Data obtained from the soil and rock lab tests are summarized in Table 2.

The lab results indicate the moisture content of the overburden ranges between 10% and 21% (average 14.7%) and is variable with depth. The grain size distribution of the overburden samples is illustrated in Figure 4. The grain size distribution indicates that the overburden is composed mainly of coarse grained material, containing an average of 80% sand and gravel sized particles.

Several rock core samples were selected for unconfined compressive strength testing. The data obtained from the lab tests are summarized in Table 2. The results of the testing indicate that the unconfined compressive strength (axial direction) of the dolostone in the proposed spillway area varies between 68 and 186 MPa.

1.2.3 Geothermal Monitoring

Regular monitoring of the geothermal instruments has been ongoing since May 2003. The results of the monitoring are illustrated graphically on the plots included in Appendix II. The monitoring data verifies the observations during the 2002 and 2003 drilling and test pitting programs that fully frozen conditions exist along the proposed spillway alignment. Ground temperatures at depth in the permafrost are approximately -12°C. The monitoring data indicates that the depth of the active layer is approximately 1.0 to 2.5 m below ground surface.

2.0 CLOSING

This memo has been developed to summarize the results of the geotechnical investigations conducted in the proposed spillway area in 2002 and 2003. Should you have any questions or comments regarding any of the information presented in this memo please do not hesitate to contact the undersigned.

BGC Engineering Inc.
Per:

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

TABLES

Table 1: Summary of Borehole Information

Borehole/ Test Pit #	Elevation (m)	Surveyed (Y or N)	Location	Depth of Borehole/ Testpit (m)	Instrumentation Installed
BH1	372.6	Y	Spillway	10.0	None
BH2	379.6	Y	Spillway	10.0	None
BH3	384.1	Y	Spillway	10.0	None
BH4	386.7	Y	Spillway	10.0	None
BH5	385.9	Y	Spillway	10.0	None
BH6	388.7	Y	Spillway	10.0	None
BH7	392.0	Y	Spillway	10.0	None
BH8	386.3	Y	Spillway	10.0	None
BH9	N/A	N	Spillway	10.0	None
TP02-01	372.5	N	Spillway	1.4	None
TP02-02	377	N	Spillway	1.6	None
TP02-03	382	N	Spillway	0.8	None
TP02-04	385	N	Spillway	1.1	None
TP02-05	386	N	Spillway	1.4	None
TP02-06	390	N	Spillway	1.4	None
TP02-07	387	N	Spillway	1.3	None
TP02-08	390	N	Spillway	1.1	None
BGC03-04	386.8	Y	Spillway	8.8	Thermocouple
BGC03-05	383.4	Y	Spillway	9.0	Thermocouple
BGC03-06	373.8	Y	Spillway	8.8	Thermocouple
BGC03-16	373.0	Y	Spillway	6.5	Thermocouple
BGC03-17	373.7	Y	Spillway	7.2	Thermocouple

Note: All testpits terminated due to refusal on permafrost.

Table 2: Lab Test Results - Proposed Spillway Area Soil Samples

				Nanisivik Mine Lab			Almor Laboratory Testing		
Borehole	Location	Depth Below Grade (m)	Soil Type	Moisture Content (%)	% Sand and Gravel	% Silt and Clay	Moisture Content (%)	$Is_{(50)}$ Diametral/ Axial (MPa)	Atterberg Limits
BGC03-04		0.8	Till				5.2		
		1.4	Dolostone						
		2.6	Dolostone					172.6	
		3.8	Dolostone					67.5	
		4.7	Dolostone						
BGC03-05		0.3	Till	15.2	78.3	21.7			
		1.4	Till				6.8		
		1.9	Till	10.4	70.8	29.2	7.7		
		2.3	Till						
		4.3	Dolostone						
		5.5	Dolostone					186.2	
		6.6	Dolostone						
		7.4	Dolostone						
BGC03-06		0.6	Till				5.5		
		2.3	Till						
		2.5	Till	18.6	90.2	9.9			
BGC03-16		1.7	Till		91.4	8.6			
		4.1	Dolostone						
		5.0	Dolostone						
BGC03-17		2.0	Till				5.5		
		4.1	Till				18.9		Non-Plastic
		7.1	Till		86.1	13.9			
		7.5	Dolostone						
TP02-01		0.7	Till	9.9	92.2	7.8			
TP02-01		1.4	Till	16.5	93.0	7.0			
TP02-02		1.6	Till	9.8	91.6	8.4			
TP02-04		1.1	Till	14.1	89.0	11.0			
TP02-05		1.4	Till	13.8	92.0	8.0			
TP02-06		1.3	Till	14					
Averages			**Till**	**14.7**	**80**	**20**			

Note: Samples tested by Almor Laboratory not included in average moisture content calculation due to length of time between sample collection and completion of testing.