Photograph No. 6: View of shoreline looking north at Station 1700 N. The fill, which is tapering out at this station, is about a 300 mm minus material. (August 19, 2000).

Photograph No. 7: View of shoreline looking south at Station 1700 N. (August 19, 2000).

Photograph No. 8: View of shoreline looking north at Station 1600 N. The fill is about a 300 mm minus material, with a mean size of 25 mm. (August 19, 2000).

Photograph No. 9: View of shoreline looking south at Station 1600 N. (August 19, 2000).

Photograph No. 10: View of shoreline looking north at Station 1500 N. The shoreline to the north of 1500 N is fill comprised of material with about 300 mm minus material. (August 19, 2000).

Photograph No. 11: View of shoreline looking south at Station 1500 N. The shoreline is covered with rip rap to the south of Station 1500 N, with a mean size of about 300 mm (August 19, 2000).

Photograph No. 12: View of shoreline looking north at Station 1300 N. New riprap has been placed in this area in the last 2 years. (August 19, 2000).

Photograph No. 13: View of shoreline looking south at Station 1300 N. This area has the largest size rock produced from the Little Red Dog Quarry and used as riprap, with a mean size in the range of about 400 mm to 500 mm. (August 19, 2000).

Photograph No. 14: View of shoreline looking north at Station 1200 N. New riprap has been placed between here and the dock in the last 2 years, and has a mean size of about 300 mm. (August 19, 2000).

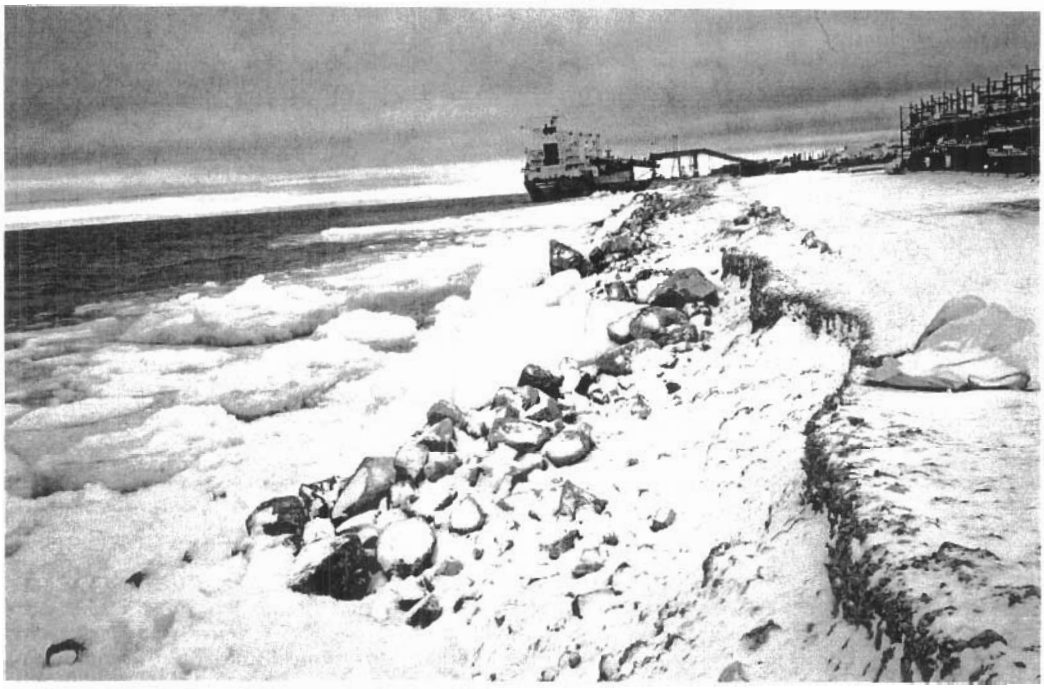
Photograph No. 15: View of shoreline looking south at Station 1200 N. It has been more than two years since riprap has been placed south of Station 1200 N. (August 19, 2000).

Photograph No. 16: View of shoreline looking north at Station 1100 N. (August 19, 2000).

Photograph No. 17: View of shoreline locking south at Station 1100 N. The riprap is failing and the bank behind the riprap is eroding. Some larger pieces of mine rock are in the order of 900 mm cube size, and are deteriorating rapidly due to freeze/thaw cycles. (August 19, 2000).

Photograph No. 18: View of shoreline looking north at Station 1000 N. Most of the riprap has slipped down the slope at this location. (August 19, 2000).

Photograph No. 19: View of shoreline looking south at Station 1000 N. (August 19, 2000).



Photograph No. 20: View of shoreline looking north at Station 900 N. (August 19, 2000).

Photograph No. 21: View of shoreline looking south at Station 900 N. Note the H-Piles at the berth face of the temporary dock. (August 19, 2000).

Photograph No. 22: View of shoreline looking north at Station 800 N. This is the southern extent of the riprap and is immediately south of the H-Piles at the temporary dock. (August 19, 2000).

Photograph No. 23: View of shoreline looking south at Station 800 N. The beach is natural material south of Station 800 N. (August 19, 2000).

Photograph No. 24: View of shoreline looking north at Station 700 N. The beach is comprised of natural material at this location, with some regrading of the top of the bank to form a flat storage area. (August 19, 2000).

Photograph No. 25: View of shoreline looking south at Station 700 N. (August 19, 2000).

APPENDIX C

Datums, Tide Elevations and Currents

DATUMS, TIDE ELEVATIONS AND CURRENTS

Datums

General

A datum is a horizontal plane from which elevations are measured, positive up. Datums for the site include:

- Chart Datum (CD), which is defined as the lowest normal tide.
- Plant Datum (PD), which is approximately 2.3 m above CD.
- Mine Datum (MD), the datum used for surveying in the underground mine. This datum is 1,000 m below the PD in order to maintain positive values of elevation in the mine. MD is approximately 997.7 m below CD.

The datum used in the drawings prepared by Westmar is the present PD.

Establishing the Datum

Elevations to CD of three benchmarks at Polaris Mine were provided to Westmar by the Canadian Hydrographic Service. Based on this information and the measurements by Cominco Surveyors of elevations to PD taken on the same three benchmarks, it was determined that PD is 2.3 m above CD.

It appears that PD has changed since 1981. The top of the fill at the dock was shown as 4.57 m in the design drawings and was recently measured as 3.2 m to the current PD. The present PD is therefore about 1.37 m above the original PD.

Tide Elevations

Tide elevations to Chart Datum at Polaris Mine, are provided in the Canadian Tide and Current Tables (2000). The tide elevations to Chart, Plant and Mine Datums are given in *Table 1* on the following page.

TABLE 1: Tide Elevations to Chart, Plant and Mine Datums

Tide	Tide Elevations to Chart Datum (CD)	Tide Elevations to Plant Datum (PD)[1]	Tide Elevations to Mine Datum (MD)[2]
Higher High Water, Large Tide (HHWL)	1.7 m	-0.6 m	999.4 m
Mean Water Level (MWL)	0.9 m	-1.4 m	998.6 m
Lower Low Water, Large Tide (LLWL)	0.0 m	-2.3 m	997.7 m

Note: 1. PD is 2.3 m above CD.

2. MD is 1,000 m below PD to maintain positive values for all elevations in the underground mine.

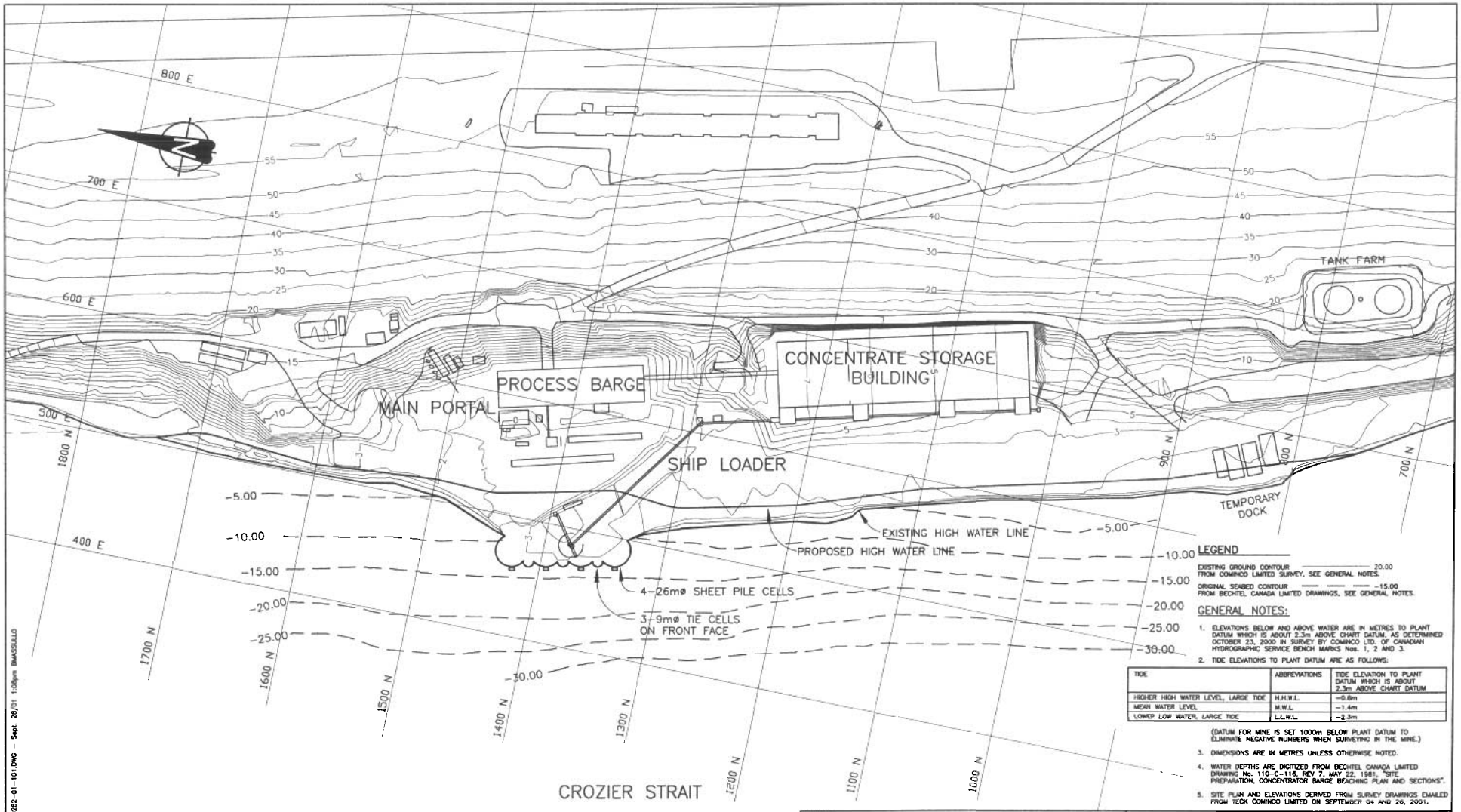
Currents

Wind and tide driven current along Crozier Strait has been observed during the open water period, but the magnitude at these currents is unknown.

During the winter months, the ice is landfast and tidal currents under the ice have been observed by divers. These currents will not affect the shoreline as the ice is landfast at the site during this period.

APPENDIX D

Drawings



PLAN
1:3000

LEGEND

EXISTING GROUND CONTOUR ——— 20.00
FROM COMINCO LIMITED SURVEY. SEE GENERAL NOTES.

ORIGINAL SEABED CONTOUR - - - -15.00
FROM BECHTEL CANADA LIMITED DRAWINGS. SEE GENERAL NOTES.

GENERAL NOTES:

1. ELEVATIONS BELOW AND ABOVE WATER ARE IN METRES TO PLANT DATUM WHICH IS ABOUT 2.3m ABOVE CHART DATUM, AS DETERMINED OCTOBER 23, 2000 IN SURVEY BY COMINCO LTD. OF CANADIAN HYDROGRAPHIC SERVICE BENCH MARKS Nos. 1, 2 AND 3.
2. TIDE ELEVATIONS TO PLANT DATUM ARE AS FOLLOWS:

TIDE	ABBREVIATIONS	TIDE ELEVATION TO PLANT DATUM WHICH IS ABOUT 2.3m ABOVE CHART DATUM
HIGHER HIGH WATER LEVEL, LARGE TIDE	H.H.W.L.	−0.8m
MEAN WATER LEVEL	M.W.L.	−1.4m
LOWER LOW WATER, LARGE TIDE	L.L.W.L.	−2.3m

(DATUM FOR MINE IS SET 1000m BELOW PLANT DATUM TO ELIMINATE NEGATIVE NUMBERS WHEN SURVEYING IN THE MINE.)

3. DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.
4. WATER DEPTHS ARE DIGITIZED FROM BECHTEL CANADA LIMITED DRAWING No. 110-C-116, REV 7, MAY 22, 1981, "SITE PREPARATION, CONCENTRATOR BARGE BEACHING PLAN AND SECTIONS".
5. SITE PLAN AND ELEVATIONS DERIVED FROM SURVEY DRAWINGS EMAILED FROM TECK COMINCO LIMITED ON SEPTEMBER 04 AND 26, 2001.

CLIENT: teckcominco

PROJECT: POLARIS MINE
DECOMMISSIONING OF DOCK

Westmar
Maritime, Structural, Civil and Materials Handling Engineers

TITLE: GENERAL ARRANGEMENT

SCALE	DATE	DRAWING NUMBER
SHOWN	SEP28/01	00282-01-101

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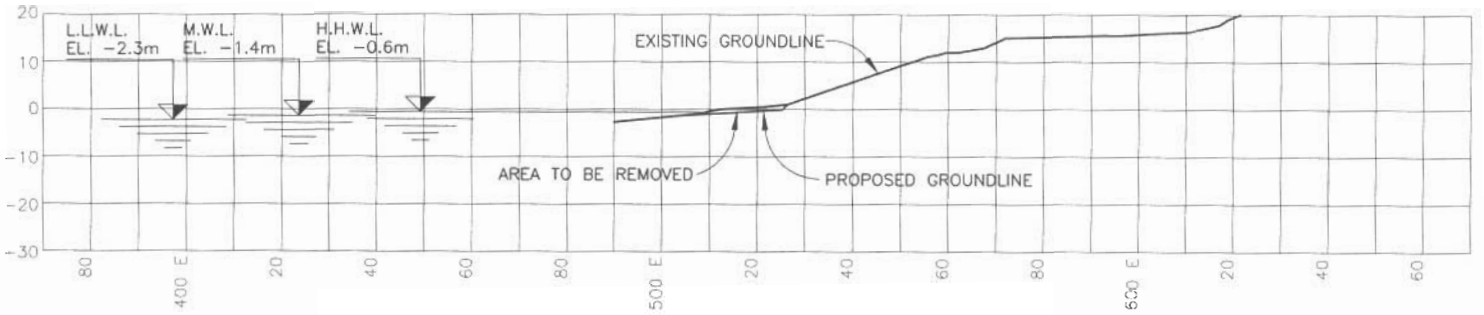
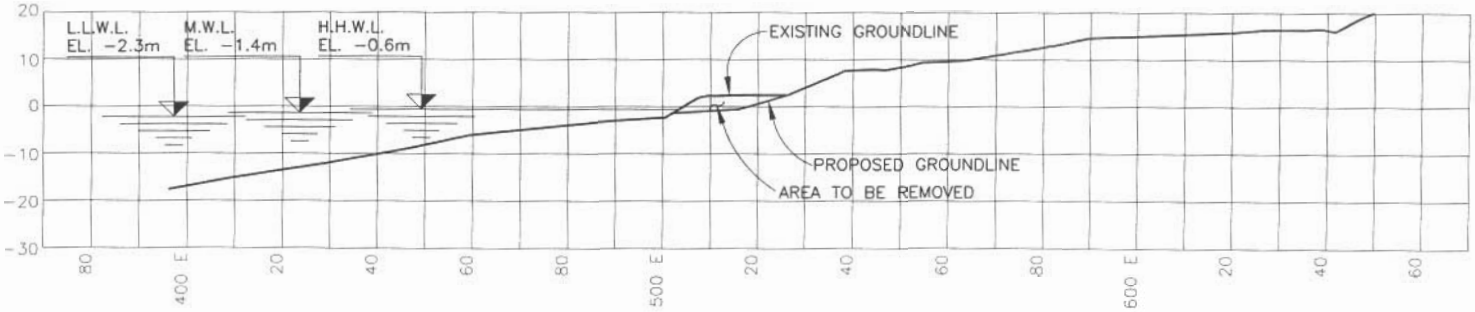


SECTION – 1700 N

1:1000



SECTION – 1600 N

1:1000

NOTES:

1. FOR GENERAL NOTES SEE DWG. -01-101.
2. EXISTING GROUNDLINE ABOVE WATER FROM SURVEY PROVIDED BY TECK COMINCO LIMITED.
3. ORIGINAL GROUNDLINE BELOW WATER FROM INFORMATION PROVIDED ON BECHTEL CANADA DRAWINGS AND INTERPOLATED FROM SURVEY PROVIDED BY TECK COMINCO LIMITED.

CLIENT: teckcominco

PROJECT: POLARIS MINE
DECOMMISSIONING OF DOCK

Westmar
Maritime, Structural, Civil and Materials Handling Engineers

TITLE: SECTIONS – SHEET 1

SCALE	DATE	DRAWING NUMBER
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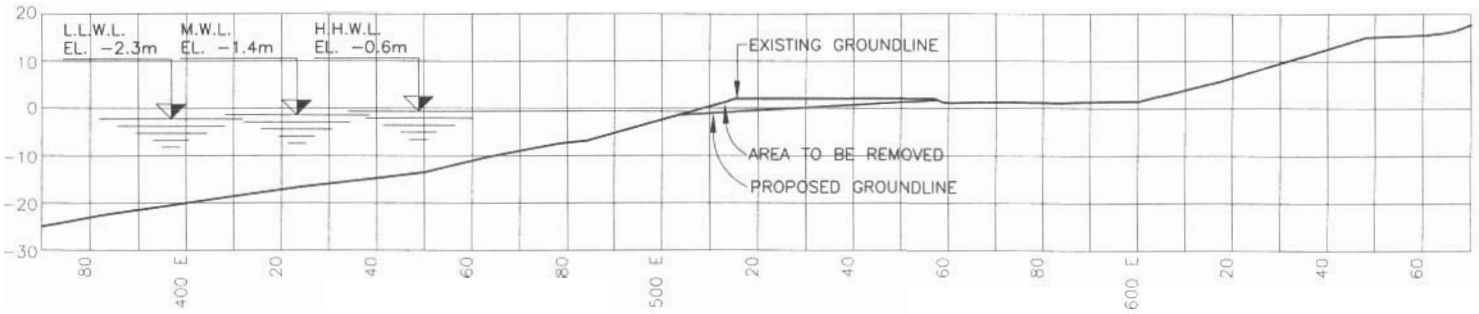
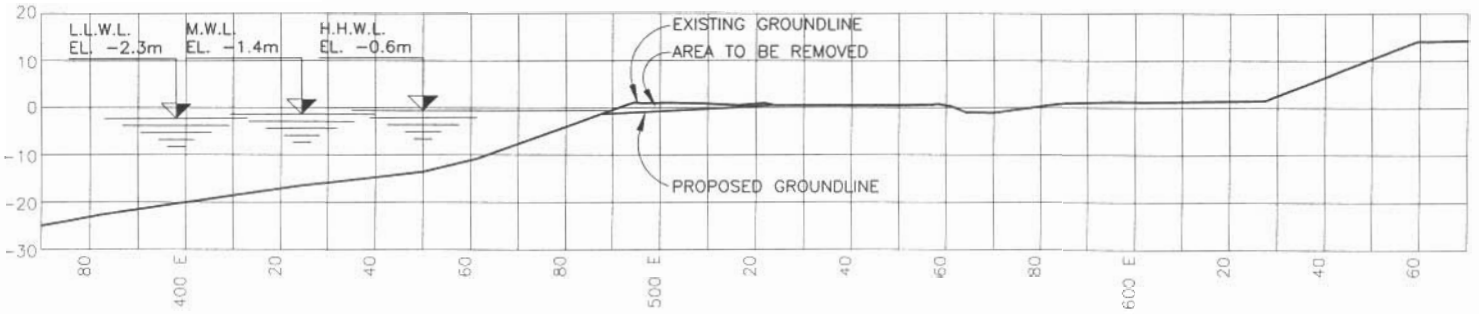


SECTION − 1500 N

1:1000



SECTION − 1450 N

1:1000

NOTES:

1. FOR GENERAL NOTES SEE DWG. −01−101.
2. EXISTING GROUNDLINE ABOVE WATER FROM SURVEY PROVIDED BY TECK COMINCO LIMITED.
3. ORIGINAL GROUNDLINE BELOW WATER FROM INFORMATION PROVIDED ON BECHTEL CANADA DRAWINGS AND INTERPOLATED FROM SURVEY PROVIDED BY TECK COMINCO LIMITED.

CLIENT: teckcominco

PROJECT: POLARIS MINE
DECOMMISSIONING OF DOCK

Westmar
Maritime, Structural, Civil and Materials Handling Engineers

TITLE: SECTIONS − SHEET 2

SCALE	DATE	DRAWING NUMBER
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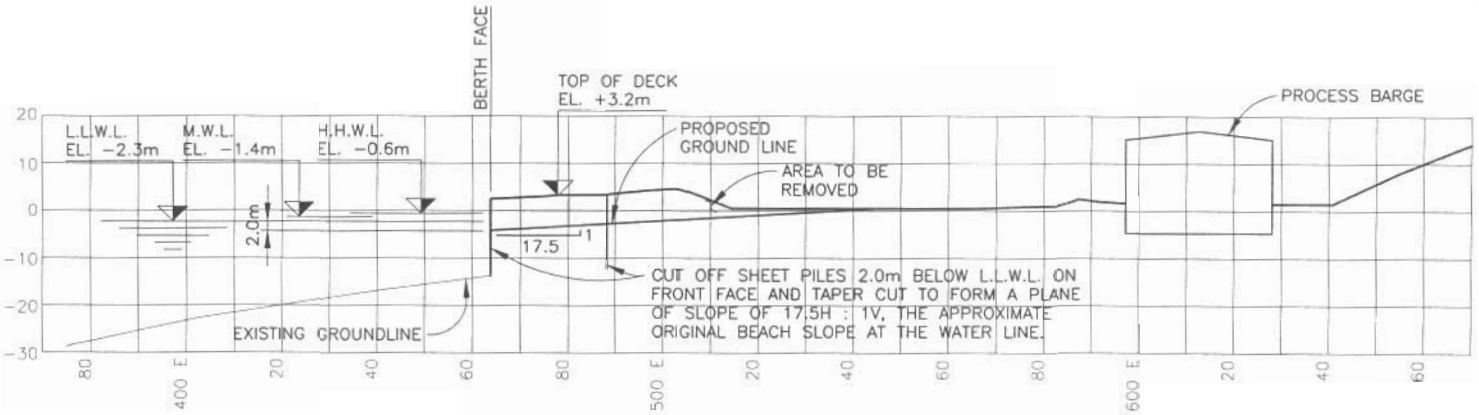
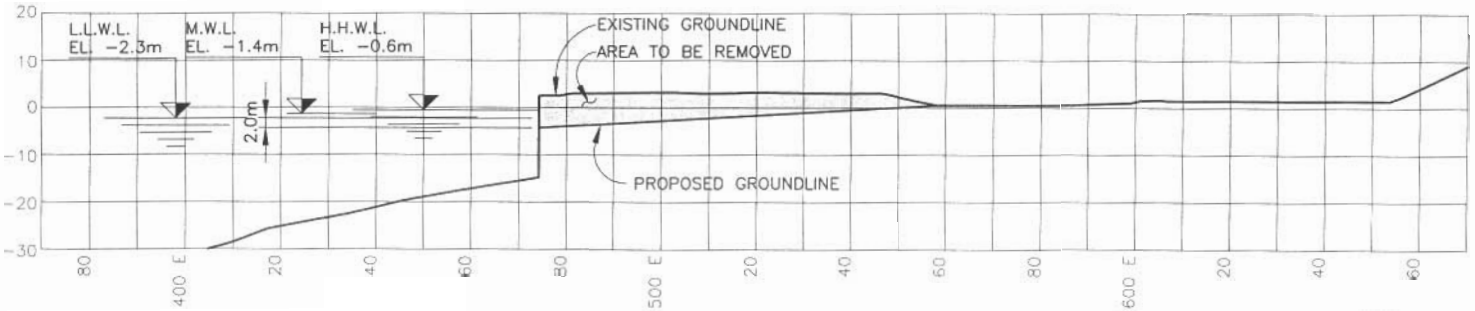


SECTION – 1400 N

1:1000



SECTION – 1350 N

1:1000

NOTES:

1. FOR GENERAL NOTES SEE DWG. −01−101.
2. EXISTING GROUNDLINE ABOVE WATER FROM SURVEY PROVIDED BY TECK COMINCO LIMITED.
3. ORIGINAL GROUNDLINE BELOW WATER FROM INFORMATION PROVIDED ON BECHTEL CANADA DRAWINGS AND INTERPOLATED FROM SURVEY PROVIDED BY TECK COMINCO LIMITED.

CLIENT: teckcominco

PROJECT: POLARIS MINE
DECOMMISSIONING OF DOCK

Westmar
Maritime Structural Civil and Materials Handling Engineers

TITLE: SECTIONS – SHEET 3

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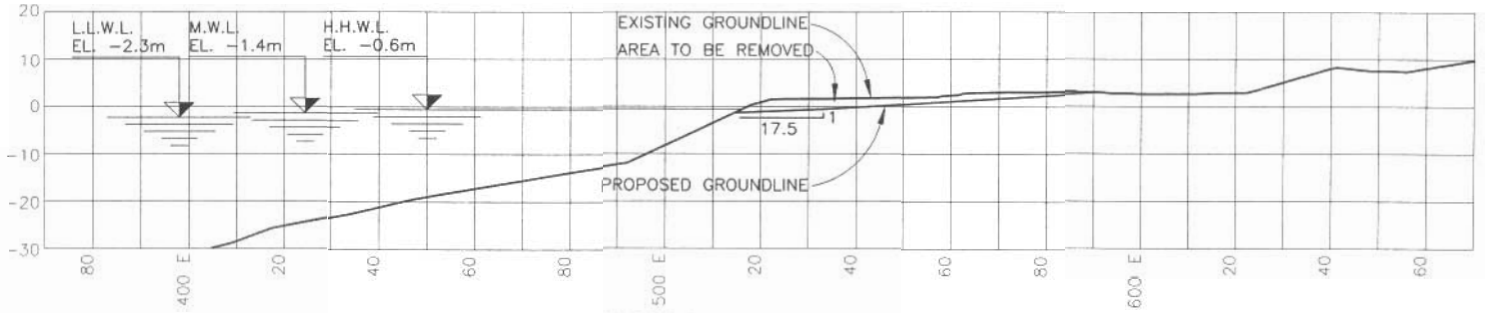
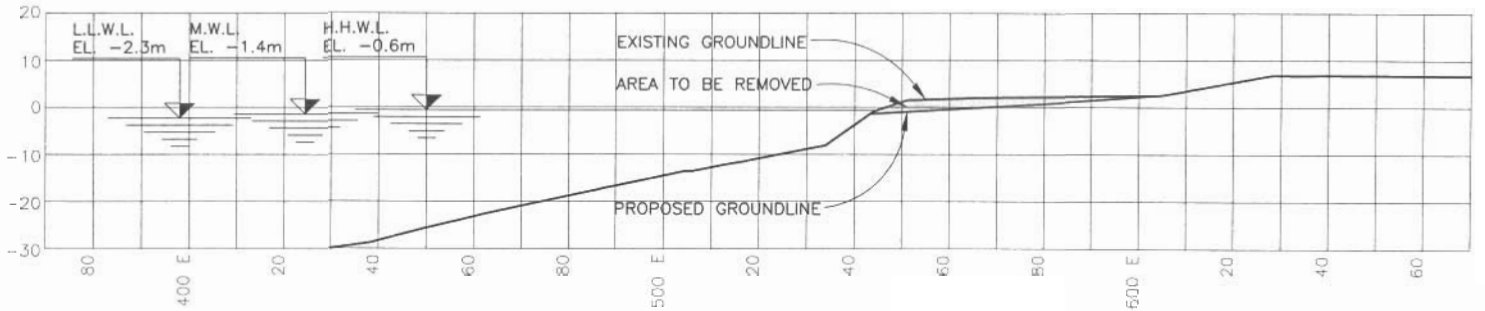


SECTION – 1300 N

1:1000



SECTION – 1200 N

1:1000

NOTES:

1. FOR GENERAL NOTES SEE DWG. -01-101.
2. EXISTING GROUNDLINE ABOVE WATER FROM SURVEY PROVIDED BY TECK COMINCO LIMITED.
3. ORIGINAL GROUNDLINE BELOW WATER FROM INFORMATION PROVIDED ON BECHTEL CANADA DRAWINGS AND INTERPOLATED FROM SURVEY PROVIDED BY TECK COMINCO LIMITED.

CLIENT: teckcominco

PROJECT: POLARIS MINE
DECOMMISSIONING OF DOCK

Westmar
Maritime Structural, Civil and Materials Handling Engineers

TITLE: SECTIONS – SHEET 4

SCALE	DATE	DRAWING NUMBER
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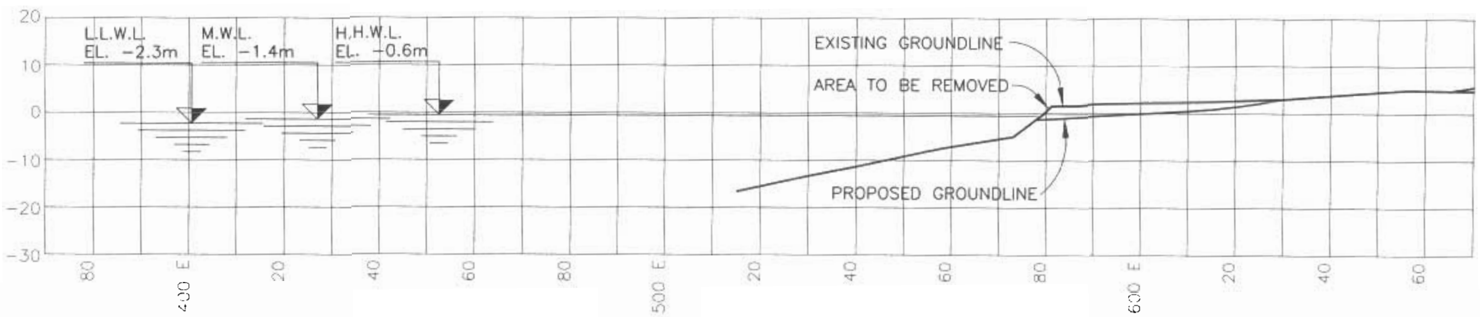
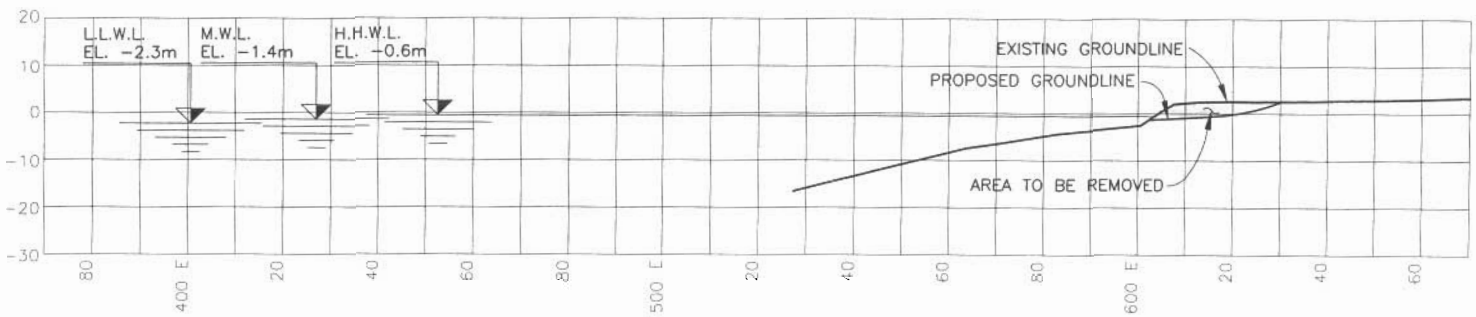


SECTION – 1100 N

1:1000



SECTION – 1000 N

1:1000

NOTES:

1. FOR GENERAL NOTES SEE DWG. -01-101.
2. EXISTING GROUNDLINE ABOVE WATER FROM SURVEY PROVIDED BY TECK COMINCO LIMITED.
3. ORIGINAL GROUNDLINE BELOW WATER FROM INFORMATION PROVIDED ON BECHTEL CANADA DRAWINGS AND INTERPOLATED FROM SURVEY PROVIDED BY TECK COMINCO LIMITED.

CLIENT	Westmar — Maritime, Structural, Civil and Materials Handling Engineers		
teckcominco	TITLE: SECTIONS – SHEET 5		
PROJECT: POLARIS MINE DECOMMISSIONING OF DOCK	SCALE: SHOWN	DATE: SEP28/01	DRAWING NUMBER: 00282-01-106

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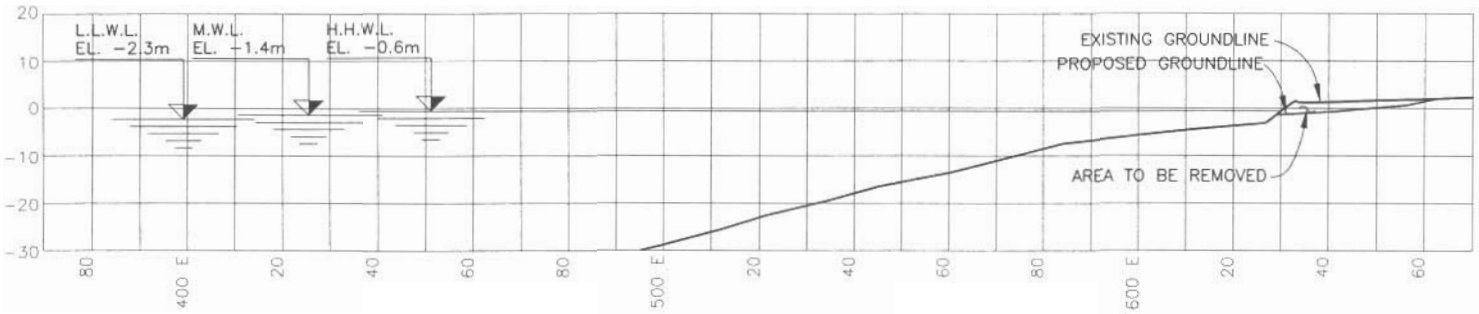
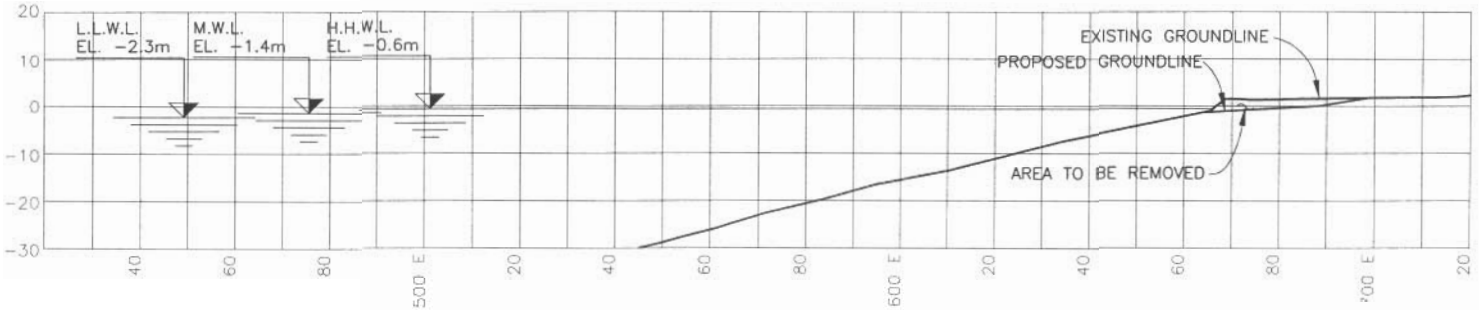


SECTION – 900 N

1:1000



SECTION @ 800 N

1:1000

NOTES:

1. FOR GENERAL NOTES SEE DWG. -01-101.
2. EXISTING GROUNDLINE ABOVE WATER FROM SURVEY PROVIDED BY TECK COMINCO LIMITED.
3. ORIGINAL GROUNDLINE BELOW WATER FROM INFORMATION PROVIDED ON DECMTEC CANADA DRAWINGS AND INTERPOLATED FROM SURVEY PROVIDED BY TECK COMINCO LIMITED.

CLIENT: teckcominco

PROJECT: POLARIS MINE
DECOMMISSIONING OF DOCK

Westmar
Maritime, Structural, Civil and Materials Handling Engineers

TITLE: SECTIONS – SHEET 6

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APPENDIX E

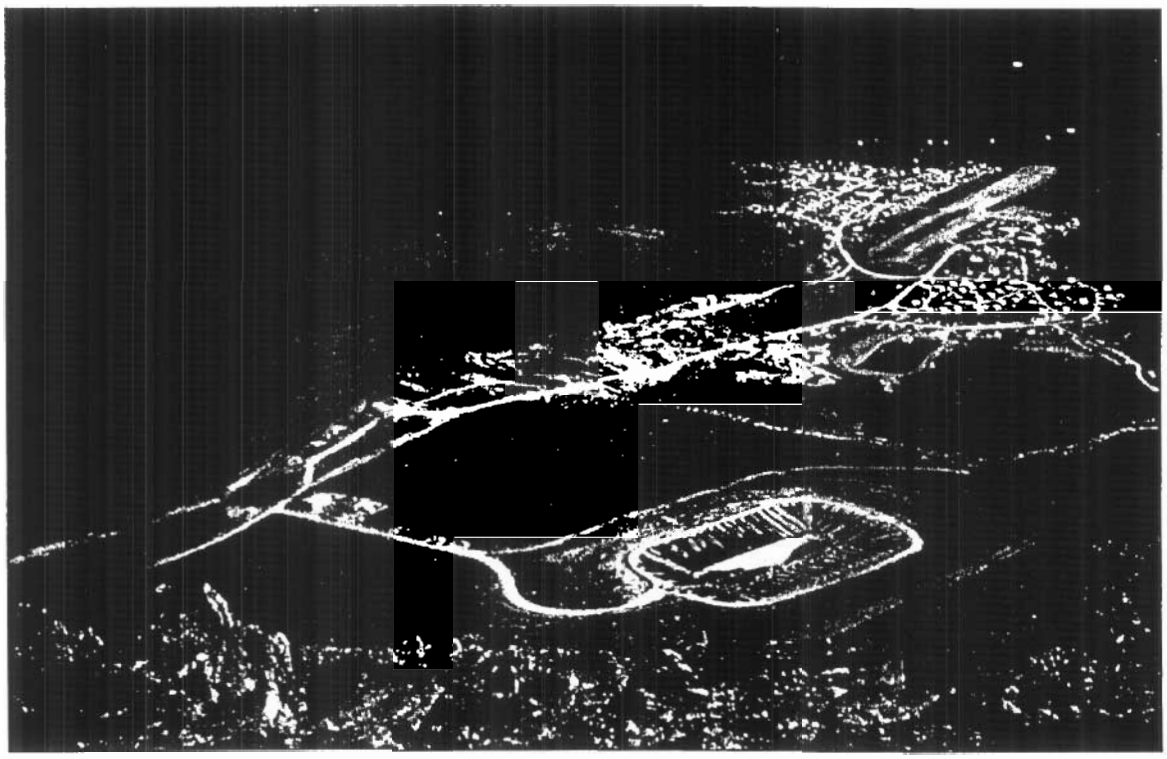
Paper on Construction of Dock

Canadian Civil Engineer

February 1997

L'ingénieur civil canadien

février 1997



CIVIL ENGINEERING IN THE HIGH ARCTIC
LE GÉNIE CIVIL EN RÉGIONS ARCTIQUES

SPECIAL 25TH CSCE ANNUAL CONFERENCE INSERT INSIDE
ENCART SPÉCIAL – 25e CONGRÈS ANNUEL DE LA SCGC

DOCK FACILITIES ON LITTLE CORNWALLIS ISLAND

by
Jean Barthe, Vice-President
Tower Arctic Ltd.

The mining operation of Cominco at Little Cornwallis Island, also named Polaris mine, consists of underground mining for lead and zinc ore. The site installation involves a concentrator, which was fabricated in southern Canada, floated and permanently grounded at the site, a huge ore storage building, an outstanding living accommodation compound and a dock to accommodate the ore handling ships during the short season of sailing through the Arctic archipelago.

The construction of the deep sea dock was awarded to Tower Arctic Ltd. in the fall of 1980. Some heavy construction equipment was already on site, other pieces of equipment were flown in by Hercules from our operation at Resolute Bay.

The dock consisted of the construction of four circular sheet-pile-cells 26 m. in diameter joined together by smaller intermediate cells in 15 m. of water.

After an underwater investigation, the first location was abandoned due to questionable soil conditions.

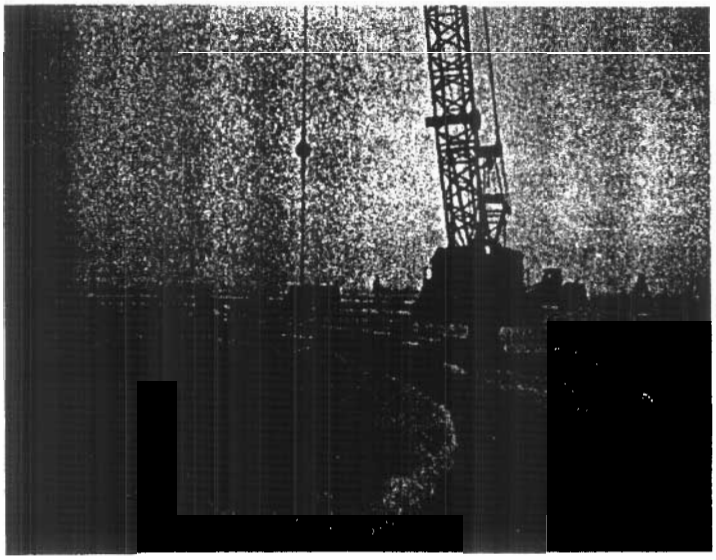
A new site was selected where the bottom of the ocean consisted of two to three meters of silt overlaying fractured limestone.

As soon as the Arctic night was over, being early March, when we could get a few hours of daylight, we started an operation of reinforcing the sea ice in order to develop a platform that would support the heavy pieces of equipment and the construction material.

In order to obtain this platform we started a flooding operation with sea water (-2°C), by pumping four to six cm of water every seven hours over the entire area, in order to develop a depth of 3 meters. An extra long auger was used to drill through the ice in order for our flooding pumps to have access to water.

This platform would allow 100 ton pieces of equipment to manoeuvre for a reasonable period of time. As a rule the heavier pieces of equipment were relocated every day so as not to develop any ice fatigue of cracking in the platform. Steel cables were also embedded in the platform ice to anchor it to shore.

Underwater inspection with divers revealed the presence of a chunk of multi-year old ice frozen into the surface ice exactly in the location of two of the cells. That multi-year old ice had to be removed, which involved a blasting and front-end loader operation. Divers from Arctic Divers Ltd., Yellowknife, were present for the duration of the job. The divers became very friendly with a seal who used to follow them underwater and breathe from their expelled air bubbles.



An exterior guide frame assembled in sections and deposited on the ice surface was our unconventional way of establishing the exact location of each piece of sheet piling. A trench was cut through the ice in order to allow each pile to be placed in the proper location.

Handling the 25 meter piles was a delicate operation. A special multi-grasp bridle was developed so that they could be picked up easily without the risk of developing kinks, as most often winds of up to 50 km/hour were present.

When a few piles were threaded in place, an electric hammer with controls for the amplitude and frequency was used to drive each pile in place through the layer of silt and a few centimetres into limestone in order to socket the bottom. The driving of each pile was carefully monitored and recorded. The closing of each cell was with a Y pile and had to be a very accurate operation so that the cell locked safely in a cylindrical shape. These rigid Y piles were also attaching the main cells to the intermediate cells.

Throughout these operations, the weather conditions would not permit the engines of the equipment to be shut off. On the other hand, the long hours of daylight allowed work in two shifts. We had a great deal of respect for our crew who worked daily in these cold temperatures and almost always under constantly windy conditions.

Due to the level of polar bear activity in the area, watch dogs were used twenty-four hours a day in order to provide warning to the crew if a bear was in the vicinity.

Once the piles of a cell were in place, they reproduced the exact contours of the solid ground below. These piles had to be cut off at an even elevation of five meters above main sea level. The layer of ice that remained inside the cell had to be removed prior to starting the infill operation. That volume of ice, estimated at fifty tons per cell, had to be broken into blocks with a trencher and clammed out of each cell.

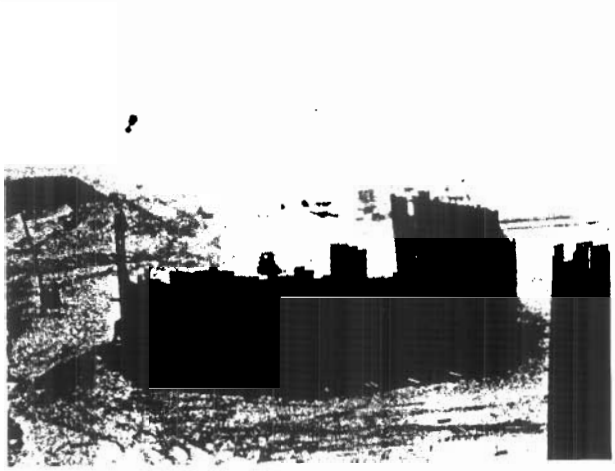
Prior to starting any infill operation, the silt at the front of the cells had to be clammed out and replaced with proper aggregates so as not to develop extreme horizontal pressure on the piles. At the back and sides, the exterior backfill would balance any pressure from the interior. The first fill at the bottom was with coarse material, finer gravely fill completed this operation. The rejects from the mine operation became very useful material for this purpose.

Another consideration given to this dock project was the need for the interior fill to become frozen solid as soon as possible, so a system with pipes and a compressor was installed in order to help nature freeze the material throughout. A layer of styrofoam was also placed against a portion of the interior of the piles so as to retain the fill in the frozen and solid state.

The operation that started in early March was completed by mid-May, just about ten days before the ice started to show serious signs of major movement. The tide at Little Cornwallis Island is in the order of 1.2 meters which was a major consideration for our construction methods.

Also associated with this project Tower Arctic Ltd. installed the H.D.P.E tailings line, and the Ciba Geigy fibreglass water supply line for the mining facility.

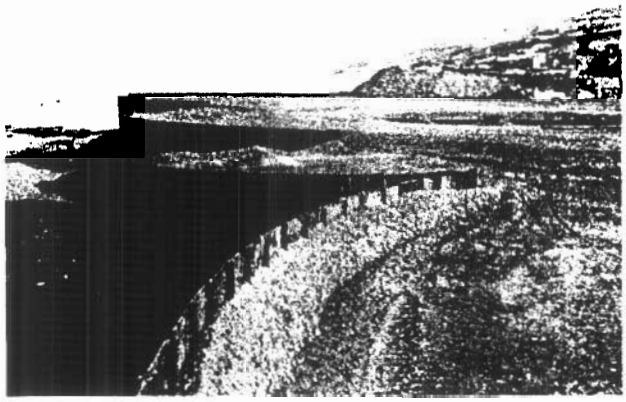
This successful operation required a good knowledge of the extreme forces of nature in the Arctic which demand that very stage of construction be given the most serious attention to detail.



INSTALLATION PORTUAIRES: LITTLE CORNWALLIS ISLAND

par
Jean Barthe, Vice-président
Tower Arctic Ltd.

L'opération minière de la compagnie Cominco à Little Cornwallis, aussi appelée Mine Polaris, consiste à extraire en galerie souterraine le minerai de plomb et de zinc.



La construction du quai en eau profonde fut confiée à la compagnie Tower Arctic Ltd. à l'automne 1980. Bien que des équipements de construction étaient déjà en place, nous eurent à transporter par avion Hercules certains de nos propres équipements à partir de nos opérations de Resolute Bay.

Ce quai devait être construit en eau de 15 mètres de profondeur de façon à pouvoir accommoder les navires transporteurs de minerai.

A l'emplacement originalement désigné, des conditions de sol sous-marin inconsistants nous obligèrent à un déplacement de site.

Au nouveau site, le sol consistait en un dépôt de deux à trois mètres de limon sur calcaire fracturé, lequel servirait à fixer la base des paleplanches.

Au début de mars, là où la longue nuit arctique permet au soleil de commencer à poindre, nous débutions la mobilisation de nos premières équipes. Au grand étonnement des travailleurs qui arrivaient, le Boeing 737 se posait régulièrement sur la surface glacée du lac Garrow. Le terminus, un abri en contreplaqué, avait vite fait de ramener ces arrivants à la réalité des conditions de pionnier en territoire arctique.

Notre premier travail fut de consolider la glace de la plateforme de travail afin de pouvoir circuler et opérer avec les lourdes pièces d'équipement et le matériel de construction.

Cette opération nécessitait des arrosages trois fois par 24 heures afin de submerger de quatre à six centimètres d'eau de mer (-2° C.) à chaque arrosage l'entière surface de la plateforme. Une épaisseur de glace de trois mètres devait être atteinte. L'opération d'une tarrière à glace rallongée nous donnait accès à l'eau de mer. Des pompes de type à spirale donnait le rendement désiré.

La plateforme terminée, des pièces d'équipement lourd de 100 tonnes pouvaient maintenant opérer sécuritairement durant des periodes pratiques. Des poids de 300 tonnes étaient possible pour de courtes périodes. Les pièces d'équipement étaient relocalisées quotidiennement afin d'éviter que des failles se développent dans la glace. La

APPENDIX F

Rock Quality Test Results from Levelton Engineering Ltd.

Appendix F-1: September 21, 2001 – Materials Tests
Appendix F-2: October 4, 2001 – Materials Tests
Appendix F-3: October 4, 2000 – Petrographic Examinations and Table
Appendix F-4: October 31, 2000 – Freeze-Thaw Tests
Appendix F-5: March 13, 2001 – Summary of Rock Quality Tests

APPENDIX F-1

September 21, 2001 – Materials Tests

LEVELTON
Engineering Solutions

Fax Transmittal

Levelton Engineering Ltd.

150-12791 Clarke Place
Richmond, B.C.
Canada V6V 2H9
Tel: 604 278-1411
Fax: 604 278-1042
E-Mail: info@levelton.com

To	Norm Allyn, P. Eng. – WESTMAR	Fax number	985 - 2581
cc		Fax number	
From	Fred Shrimer, P. Geo.	Project number	100-0865
Date	September 21, 2000	Total number of pages (including cover page)	16

PROJECT: **Polaris Mine – Rip Rap Testing**

Norm:

Accompanying this cover sheet are 15 individual test reports for five sets of tests run on the three rock types obtained from Polaris Mine.

There are:

- SG & Absorption (crushed material)
- SG & Absorption (sawn block samples)
- Los Angeles Abrasion
- Petrographic Examination (very preliminary only, at this stage)
- Durability Index

Currently, the lab is running $MgSO_4$ Soundness on both blocks and crushed material. Freeze-Thaw testing has also been initiated.

I hope to get thin-section analyses done next week.

Please call me if you have any questions.

Regards,

Fred Shrimer, P. Geo.

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Please call 604-278-1411 if any pages are missing.

TECHNICAL REPORT

LEVELTON
Engineering Solutions

September 21, 2000
Our file: 100-0865

WESTMAR CONSULTANTS INC.
#400 - 233 West First Street
NORTH VANCOUVER, B.C.
V7M 1B3

ATTENTION: Mr. Norm Allyn, P. Eng.

PROJECT: Rip Rap Testing, Polaris Mine
SUBJECT: **Los Angeles Abrasion Test (CSA A23.2-17A, ASTM C-535)**

Sample: Grey sample ("Limestone") **Sampled by:** Client

Sample	"Limestone"
Grading	'1'
Revolutions	500
No. of Spheres	12
Initial Mass (g)	10004.1
Final Mass (g)	8296.6
Percent loss	17.1

Reported by: _____ DATE: Sept 21, 2000
F. Shrimer, P. Geo

PROVINCE OF BRITISH COLUMBIA
PROFESSIONAL GEOSCIENTIST
F. H. SHRIMER

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TECHNICAL REPORT

LEVELTON
Engineering Solutions

September 21, 2000
Our file: 100-0865

WESTMAR CONSULTANTS INC.
#400 - 233 West First Street
NORTH VANCOUVER, B.C.
V7M 1B3

ATTENTION: Mr. Norm Allyn, P. Eng.

PROJECT: Rip-Rap Testing, Polaris Mine
SUBJECT: **Los Angeles Abrasion Test (CSA A23.2-17A, ASTM C-535)**

Sample: Beige-buff stone ("Dolomite") **Sampled by:** Client

Sample	"Dolomite"
Grading	'1'
Revolutions	500
No. of Spheres	12
Initial Mass (g)	10002.5
Final Mass (g)	8269.7
Percent loss	17.3

Reported by: F. Shrimer, P. Geo. PROFESSIONAL GEOSCIENTIST PROVINCE OF BRITISH COLUMBIA F. H. SHRIMER DATE: Sept 21 2000

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Notice: The test data given herein pertain to the sample provided, and may not be applicable to material from earlier or subsequent production. Reporting of these data constitutes a testing service. Interpretation may be provided upon request.

TECHNICAL REPORT

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September 21, 2000
Our file: 100-0865

WESTMAR CONSULTANTS INC.
#400 - 233 West First Street
NORTH VANCOUVER, B.C.
V7M 1B3

ATTENTION: Mr. Norm Allyn, P. Eng.

PROJECT: Rip-Rap Testing, Polaris Mine
SUBJECT: **Los Angeles Abrasion Test (CSA A23.2-17A, ASTM C-535)**

Sample: Mine Rock **Sampled by:** Client

Sample	"Mine Rock"
Grading	'2'
Revolutions	500
No. of Spheres	12
Initial Mass (g)	10014.6
Final Mass (g)	5523.5
Percent loss	44.8

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F. Shrimer, P. Geo.

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
F. H. SHRIMER
GEOSCIENTIST

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September 21, 2000
Our file: 100-0865

WESTMAR CONSULTANTS INC.
#400 - 233 West First Street
NORTH VANCOUVER, B.C.
V7M 1B3

ATTENTION: Mr. Norm Allyn, P. Eng.

PROJECT: Rip Rap Testing – Polaris Mine
SUBJECT: **Durability Index Test (ASTM D-3744)**

Sample: **Grey rock ("Limestone")**
Sampled by: Client

Sample	Sediment Height (mm)	Durability Index (D_d)
"Limestone"	6	92

Reported by: _____ DATE: Sept 21, 2000
F. Shrimer, P. Geo.

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Notice: The test data given herein pertain to the sample provided, and may not be applicable to material from earlier or subsequent production. Reporting of these data constitutes a testing service. Interpretation may be provided upon request.

TECHNICAL REPORT

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Engineering Solutions

September 21, 2000
Our file: 100-0865

WESTMAR CONSULTANTS INC.
#400 - 233 West First Street
NORTH VANCOUVER, B.C.
V7M 1B3

ATTENTION: Mr. Norm Allyn, P. Eng.

PROJECT: Rip Rap Testing -- Polaris Mine
SUBJECT: **Durability Index Test (ASTM D-3744)**

Sample: **Beige rock ("Dolomite")**
Sampled by: Client

Sample	Sediment Height (mm)	Durability Index (D_d)
"Dolomite"	10	82

Reported by: _____ DATE: Sept 21, 2000
P. Shrimer, P. Geo.

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PROVINCE OF BRITISH COLUMBIA
F. H. SHRIMER
GEOSCIENTIST

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September 21, 2000
Our file: 100-0865

WESTMAR CONSULTANTS INC.
#400 - 233 West First Street
NORTH VANCOUVER, B.C.
V7M 1B3

ATTENTION: Mr. Norm Allyn, P. Eng.

PROJECT: Rip Rap Testing -- Polaris Mine
SUBJECT: **Durability Index Test (ASTM D-3744)**

Sample: **Mine rock**
Sampled by: Client

Sample	Sediment Height (mm)	Durability Index (D_d)
"Mine Rock"	31	71

Reported by: _____ DATE: Sept 21, 2000
F. Shrimer, P. Geo.

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
F. H. SHRIMER
GEOSCIENTIST

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Notice: The test data given herein pertain to the sample provided, and may not be applicable to material from earlier or subsequent production. Reporting of these data constitutes a testing service. Interpretation may be provided upon request.

TECHNICAL REPORT

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September 21, 2000
Our file: 100-0865

WESTMAR CONSULTANTS INC.
#400 - 233 West First Street
NORTH VANCOUVER, B.C.
V7M 1B3

ATTENTION: Mr. Norm Allyn, P. Eng.

PROJECT: Rip-Rap Testing -- Polaris Mine
SUBJECT: **Specific Gravity & Absorption (ASTM C-127)**

Sample: Grey Rock ("Limestone") Sampled by: Client

Sample	Bulk G_s (Dry Basis)	Bulk G_s (SSD Basis)	Absorption (%)
"Limestone"	2.709	2.720	0.43

Note: 1. Test results given are averaged values from two separate test runs.

Reported by: F. Shrimer, P. Geo. DATE: Sept 21, 2000

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WESTMAR CONSULTANTS INC.
#400 - 233 West First Street
NORTH VANCOUVER, B.C.
V7M 1B3

ATTENTION: Mr. Norm Allyn, P. Eng.

PROJECT: Rip-Rap Testing – Polaris Mine
SUBJECT: **Specific Gravity & Absorption (ASTM C-127)**

Sample: Buff-beige Rock ("Dolomite") Sampled by: Client

Sample	Bulk G_s (Dry Basis)	Bulk G_s (SSD Basis)	Absorption (%)
"Dolomite"	2.653	2.689	1.40

Note: 1. Test results given are averaged values from two separate test runs.

Reported by: F. Shrimer, P. Geo. PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA F. H. SHRIMER GEOSCIENTIST DATE: Sept 21, 2000

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WESTMAR CONSULTANTS INC.
#400 - 233 West First Street
NORTH VANCOUVER, B.C.
V7M 1B3

ATTENTION: Mr. Norm Allyn, P. Eng.

PROJECT: Rip-Rap Testing -- Polaris Mine
SUBJECT: **Specific Gravity & Absorption (ASTM C-127)**

Sample: Mine Rock Sampled by: Client

Sample	Bulk G_s (Dry Basis)	Bulk G_s (SSD Basis)	Absorption (%)
"Mine rock"	3.489	3.536	1.35

Note: 1. Test results given are averaged values from two separate test runs.

Reported by: _____ DATE: Sept 24, 2000
F. Shrimer, P. Geo

PROFESSIONAL ENGINEERS AND GEOSCIENTISTS PROVINCE OF BRITISH COLUMBIA F. H. SHRIMER

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TECHNICAL REPORT

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September 21, 2000
Our file: 100-0865

WESTMAR CONSULTANTS INC.
#400 - 233 West First Street
NORTH VANCOUVER, B.C.
V7M 1B3

ATTENTION: Mr. Norm Allyn, P. Eng.

PROJECT: Rip-Rap Testing – Polaris Mine
SUBJECT: **Specific Gravity & Absorption of Block Samples (ASTM C-127)**

Sample: Grey Rock ("Limestone") Sampled by: Client

Sample	Bulk G_s (Dry Basis)	Bulk G_s (SSD Basis)	Absorption (%)
"Limestone"	2.712	2.739	0.985

Note: 1. Test results given are averaged values for five sawn block samples.

Reported by: _____ DATE: Sept 21, 2000
F. Shrimer, P. Geo.

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
F. H. SHRIMER
GEOTECHNICAL

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TECHNICAL REPORT

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Engineering Solutions

September 21, 2000
Our file: 100-0865

WESTMAR CONSULTANTS INC.
#400 - 233 West First Street
NORTH VANCOUVER, B.C.
V7M 1B3

ATTENTION: Mr. Norm Allyn, P. Eng.

PROJECT: Rip-Rap Testing -- Polaris Mine
SUBJECT: **Specific Gravity & Absorption (ASTM C-127)**

Sample: Buff-beige Rock ("Dolomite") Sampled by: Client

Sample	Bulk G_s (Dry Basis)	Bulk G_s (SSD Basis)	Absorption (%)
"Dolomite"	2.585	2.626	1.565

Note: 1. Test results given are averaged for six individual sawn block samples.

Reported by: _____ DATE: Sept 21, 2000
F. Shrimer, P. Geo.

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
F. H. SHRIMER
GEOSCIENTIST

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Levelton Engineering Ltd., #100 - 12791 Clarke Place, Richmond, B.C. Canada V6V 2H9 Tel: 604-278-1411 Fax: 604-278-1042

TECHNICAL REPORT

LEVELTON
Engineering Solutions

September 21, 2000
Our file: 100-0865

WESTMAR CONSULTANTS INC.
#400 - 233 West First Street
NORTH VANCOUVER, B.C.
V7M 1B3

ATTENTION: Mr. Norm Allyn, P. Eng.

PROJECT: Rip-Rap Testing -- Polaris Mine
SUBJECT: **Specific Gravity & Absorption (ASTM C-127)**

Sample: Mine Rock Sampled by: Client

Sample	Bulk G_s (Dry Basis)	Bulk G_s (SSD Basis)	Absorption (%)
"Mine rock"	3.647	3.760	1.723

Note: 1. Test results given are averaged values for six separate block samples sawn from a larger chunk.

Reported by: _____ DATE: Sept 21, 2000
F. Shrimer, P. Geo.

PROFESSIONAL GEOSCIENTIST
PROVINCE OF BRITISH COLUMBIA
F. H. SHRIMER

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APPENDIX F-2

October 4, 2000 – Materials Tests

LEVELTON
Engineering Solutions

Fax Transmittal

Levelton Engineering Ltd.

150-12791 Clarke Place
Richmond, B.C.
Canada V6V 2H9
Tel: 604 278-1411
Fax: 604 278-1042
E-Mail: info@levelton.com

To	Norm Allyn, P. Eng. – WESTMAR	Fax/phone number	985-2581/985-6488
cc		Fax/phone number	
From	Fred Shrimer, P. Geo.	Project number	100-0865
Date	October 4, 2000	Total number of pages (including cover page)	7

PROJECT: Testing of Polaris Rip-Rap

Norm:

Accompanying this cover are Technical Reports which provide results of the Magnesium Sulphate Soundness tests done on the three rock types.

Review of the data provides fairly clear insight that the Mine Rock is unsuitable, while the two carbonate rocks are of much higher quality.

Please note that I have done thin-section analysis of the three rock types and have identified both the grey-brown and the buff-beige rocks as "Limestone". They appear to be mixtures of crystalline and micritic calcite limestone, with between 5% and 30% of fossil fragments. Interestingly, many trilobite remains in a couple of slides, indicating Paleozoic age for these rocks. The Mine Waste samples, of course, were comprised of variable amounts of metallic sulphides (mostly sphalerite and galena) in a matrix of dolomite and calcite. "Colloform" texture to these rocks, interesting characteristic.

The freeze-thaw test is currently underway on the three rock types. I believe it's entering about the 7th cycle or so right now.

I will review the file and see what other outstanding tests I can find and forward to you.

Please call if you have any questions.

Regards,

Fred Shrimer, P. Geo.

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TECHNICAL REPORT

LEVELTON
Engineering Solutions

Our file: 100-0865
October 4, 2000

WESTMAR CONSULTANTS INC.
#400 - 233 West First Street
NORTH VANCOUVER, B.C. V7M 1B3

ATTENTION: Mr. Norm Allyn, P. Eng.

PROJECT: Rip Rap Testing, Polaris Mine
SUBJECT: **Sulphate Soundness Test (CSA A23.2-9A/ASTM C-88)**

Material Tested: Mine Waste

Source: Polaris Minesite **Sampled by:** Westmar
Sample: Sawn blocks, approximately 15 cm x 3.5 cm x 10 cm

Samples	Solution		Number of Cycles
	Magnesium Sulphate		5
	Original Mass (g)	Final Mass (g)	Percent Loss
M1	2505.3	1966.9	21.5%
M5	2469.6	1012.8	59.0%
AVERAGE LOSS BY MASS (%)			40.1%

Notes: 1. Massive disintegration of samples by third cycle.

REPORTED BY: _____ DATE: Oct 4, 2000
F. Shrimer, P. Geo

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
F. H. SHRIMER
GEOSCIENTIST

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