FUEL TANK FARM CONSTRUCTION
AS-BUILT REPORT
BOSTON PROPERTY, NUNAVUT

Project No. 0101-00-14839.002

MAY 2001

FUEL TANK FARM CONSTRUCTION
AS-BUILT REPORT
BOSTON PROPERTY, NUNAVUT

Submitted To:

HOPE BAY JOINT VENTURE
VANCOUVER, BRITISH COLUMBIA

Prepared by:

EBA ENGINEERING CONSULTANTS LTD.
EDMONTON, ALBERTA

Project No. 0101-00-14839.002

MAY 2001

TABLE OF CONTENTS

PHOTOGRAPHS

1.0 INTRODUCTION

This as-built report documents the construction quality assurance services carried out by EBA Engineering Consultants Ltd. (EBA), on behalf of Hope Bay Joint Venture (HBJV), during construction of the Fuel Tank Farm at the Boston Property. The Boston Property is located on the east side of Bathurst Inlet, Nunavut, approximately 670 km northeast of Yellowknife and 170 km southwest of Cambridge Bay. This report complements the "Fuel Tank Farm As-Built Drawings," which are included in Appendix A.

The site visit and construction quality assurance (CQA) program was carried out by Mr. Ed Grozic, P.Eng. of EBA between March 17 and March 24, 2001. The purpose of the CQA program was to ensure that the fuel tank farm satisfied the design requirements and was constructed in accordance with the construction drawings and specifications prepared for this project. The construction specifications are presented in Appendix B.

Procon Mining and Tunnelling Ltd. (Procon) of Vancouver, British Columbia was responsible for construction of the fuel tank farm on behalf of HBJV. Layfield Plastics (Layfield) of Edmonton, Alberta was responsible for the installation of the geosynthetic liner system and associated liner installation quality control program.

Construction of the fuel tank farm began on March 14 and was substantially completed on March 30, 2001. EBA was not on site for the entire construction program; specifically, during initial site preparation and grading, and during covering of the liner system and positioning of the fuel tanks. Daily summaries of construction activities from the period when EBA was on site are presented in Appendix C.

Authorization for the site visit and quality assurance services were provided by Mr. Ted Mahoney, P.Geo., of HBJV.

2.0 PROJECT DESCRIPTION

The fuel tank farm has been constructed to support an ongoing exploration program. The design of the fuel tank farm and associated construction drawings and specifications are presented in an earlier report (EBA 2001). The tank farm comprises eight tanks in total; six of the tanks are 4.5 m in diameter and 4.9 m tall and two of the tanks are 3.0 m in diameter and 4.5 m tall. The total storage capacity of the eight tanks is understood to be 529,000 L (6 – 77,000 L tanks and 2 – 33,500 L tanks).

The tanks were not interconnected to a single loading and dispensing facility, however they may be connected in the future. A mechanical design for interconnecting the tanks was prepared by Thorn Engineering Limited from Yellowknife, NWT, on behalf of EBA, and was presented in an earlier draft design report. It is recommended that the mechanical design be reviewed should the tanks be connected in the future to ensure the design is still appropriate.

The fuel storage tanks were purchased by HBJV from Fred H. Ross and Associates Limited (FHR&A), in Cambridge Bay, Nunavut in the summer of 2000. FHR&A contracted Ranger Inspection Ltd. to provide out-of-service API-Standard 653 tank inspection services for the above ground storage tanks (Ranger Inspection Ltd. 2000a, 2000b).

3.0 FUEL TANK FARM CODES AND REGULATIONS

The National Fire Code (NFC) and the National Building Code of Canada (NBC) are the regulations used in Nunavut for design and construction of fuel storage facilities. The authority having jurisdiction is the Office of the Fire Marshal. In Nunavut, fuel storage and distribution facility reviews also fall under the Nunavut Impact Review Board (NIRB), which must authorize the use of land and water in the Nunavut Territory.

The Department of Public Works and Services, Government of Northwest Territories has developed guidelines for the design, construction and operation of fuel storage facilities based on experience gained over several years. The Design Rationale for Fuel Storage Distribution Facilities and its two companion documents, Specifications for Fuel Storage and Distribution Facilities and Standard Detail Drawings for Fuel Storage and Distribution Facilities (2nd Edition, December 1998) are established guidelines for the design of fuel storage facilities in the north.

The fuel tank farm design and construction has followed recognized engineering principles and practices, and is in conformance with applicable codes and standards that are mandatory for the safe and efficient operation of fuel storage and distribution facilities.

4.0 CONSTRUCTION QUALITY ASSURANCE PROGRAM (CQA)

The CQA program implemented for construction of the fuel tank farm was conducted in accordance with the construction specifications prepared by EBA (EBA 2001), and with

industry accepted assurance procedures. The purpose of the CQA program was to ensure that the fuel tank farm satisfied the design requirements and was constructed in accordance with the drawings and specifications prepared for this project.

5.0 CONSTRUCTION MATERIALS

The following materials were used to construct the fuel tank farm:

- Processed 40 mm Crush (variable gradation and fines content),
- Mine Muck material (variable gradation, typically 150 mm minus with some oversize),
- HDPE Geomembrane (60 mil, smooth on both sides), and
- Non-woven Geotextile (LP10 and LP12).

It should be noted that the granular materials used for the construction of the tank farm containment facility were evaluated for suitability of use only from the perspective of their engineering properties (gradation, moisture content, etc.). EBA was instructed by HBJV to utilize these materials in the construction of the tank farm containment facility. It is assumed that HBJV has carried out minealogical testing that confirms their suitability for use from a chemical perspective (e.g. acid generation capacity).

During design of the fuel tank farm it was understood that Mine Muck material was abundant on site and that 40 mm Crush was limited. At the onset of construction, however, it was discovered that the 40 mm Crush was more readily available and that Mine Mike was less accessible. Thus, the fuel tank farm berms were constructed primarily with 40 mm Crush. Some rough grading and site preparation was done using Mine Muck material that was stockpiled within the proposed fuel tank farm footprint.

5.1 40 mm Crush Material

The 40 mm Crush was generated in 1997 during an on site bulk sampling program. The material is stockpiled in small piles to the north of the construction area. The 40 mm Crush varies somewhat in gradation, and occasionally has oversized rock fragments up to 150 mm in diameter. A sample of the material was collected by HBJV immediately prior to construction and sent to EBA for grain size analysis; the results are presented in Appendix E, Sample 4913.

The 40 mm Crush used to construct the tank farm was finer in gradation and contained a higher percentage of fines than EBA was understood to believe during design, based on a previous sample provided by HBJV in February, 2001. The grain size analysis of the original sample is presented in Appendix E, Sample 4808. The two results essentially represent the material's finer and coarser limits. Typically, the material tended closer to the finer limit.

Eleven (11) moisture contents were conducted on the 40 mm Crush. The moisture contents varied from 4.2 % to 7.4 % with an average of 5.4 %. The results are presented in Appendix E. The moisture in the material and the associated lower than desired compaction will likely result in some settlement of the fuel tank farm berms and pad.

The material contained occasional cobble sized pieces up to 150 mm in size. It is not known how the larger material became mixed in with the 40 mm Crush. HBJV speculates that during crushing and screening of the material in 1997 there could have been a hole in the screen, which allowed the larger material to pass through, or possibly, some Mine Muck material could have become mixed with the 40 mm Crush.

5.2 Mine Muck Material

The Mine Muck is material generated from previous underground exploration at the site. The material comprises angular, fragmented blast-rock and varies in gradation, but is typically less than 150 mm in diameter. The material was to be used to construct the core of the containment berms, but at the time of construction the 40 mm Crush was more readily available and therefore used instead. Mine Muck material was used, however, for preliminary site grading and for the first lift in the base of the berms.

5.3 Liner System

The liner system comprises a smooth, 60 mil High Density Polyethylene (HDPE) geomembrane protected on either side by non-woven geotextile. A 60 mil thickness HDPE geomembrane liner was chosen because it is the accepted material for use in fuel storage facilities, has good cold strain properties and can be installed in cold winter temperatures. The non-woven geotextile was selected to provide protection to the HDPE geomembrane.

The following is the inventory of geomembrane and geotextile materials on site on March 17, 2001:

- HDPE Geomembrane 60 mil, smooth – 1 roll
- Non-woven Geotextile LP12 – 7 rolls
- Non-Woven Geotextile LP10 – 3 rolls

When the liner materials were ordered by HBJV, Layfield did not have the required 10 rolls of LP12 in stock, and therefore substituted 3 rolls of LP10. The LP 10 is slightly thinner, but was considered adequate, given that the 40 mm Crush material was slightly finer in gradation then what was assumed in the design.

Two layers of LP12 non-woven geotextile were placed under the HDPE and one layer of LP12 and a second layer of LP10 non-woven geotextile were placed over top of the geomembrane liner, as shown on the as-built drawings.

The geomembrane and geosynthetic material properties are summarized in Tables 1 and 2 respectively.

Table 1
Minimum Smooth HDPE Geomembrane Properties

Test Parameter	Required Specifications	ASTM Test Method (Or Approved Equal)
Minimum Average Thickness (mm / mil)	1.5 / 60	D5994
Density	.94	D792
Tensile Properties:		D638 Modified Type IV Die 50 mm/minute
Stress @ Yield (kN/m / ppi)	23.1 / 132	
Stress @ Break (kN/m / ppi)	39.9 / 228	
Strain @ Yield (%)	13	
Strain @ Break (%)	.700	
Tear Resistance (N / lbs)	200 / 45	D1004
Low Temperature (°C / °F)	-60 / -76	D746 Procedure B
Dimensional Stability (%)	+/-1.5	D1204
Puncture Resistance (N / lbs)	347 / 78	FTMS No. 1O1B Method 2065
Carbon Black (min)	2	D1603
Carbon Black Dispersion	Category 1 or 2	D5596

Table 2
Minimum Non-Woven Geotextile Properties

Test Parameter	Required Specifications LP10	Required Specifications LP12	ASTM Test Method (Or Approved Equal)
Grab Tensile (N / lbs)	1110 / 250	1330 / 300	D4632
Elongation (%)	50	50	D4632
Tear (N / lbs)	445 / 100	512 / 115	D4533
Puncture (N / lbs)	779 / 175	779 / 175	D4833
AOS (microns / sieve size)	667 / 150	150 / 100	D4571
Permeability (cm/sec)	0.3	0.3	D4491
Weight (g/m^2 / oz/yd^2)	311 / 9.0	390 / 11.5	D5261
Thickness Nominal (mm / mil)	2.5 / 100	2.8 / 110	D5199
UV Resistance	70	70	D4355

6.0 EQUIPMENT CONSTRAINTS

The following is the list of heavy equipment used to construct the Fuel Tank Farm:

- Caterpillar D5H Dozer with ripper,
- Kubota R420 Loader, and
- JS250 Scoop (2.2 yd3).

The limited equipment on site presented some constructability constraints. The berms were built using a D5H Dozer and were constructed wider than designed because of the width of the dozer. The berm slopes were also shaped using the dozer, which resulted in slightly irregular shaped slopes. An anchor trench for the liner system was not constructed because there was no equipment on site that could excavate such a key trench.

The dozer was the primary piece of equipment used to construct the fuel tank farm. The dozer was used to rip the frozen 40 mm Crush, spread the fill in lifts, grade the pad, shape the berms, and cover the liner system.

A JS250 Scoop was the second most frequently used piece of equipment and was used to haul 40 mm Crush from the stockpile to the tank farm location, and to compact the fill to the maximum extent possible, appreciating that the material was frozen.

The Kubota loader was unavailable most of the time because it was being used to clear snow around camp and for other site service activities. The loader was occasionally used to haul granular material, and to remove large frozen chucks from the 40 mm Crush stockpile. It was also used for several hours to place cover material on the crest of the berms and along the inside berm slopes.

7.0 CONSTRUCTION MONITORING ACTIVITIES

EBA maintained daily summaries and a photographic record of the work completed while on site. Photographs were taken using HBJV's digital camera. The detailed daily summaries are present in Appendix C. Select construction photographs are presented in Appendix D. Construction activities are further discussed below.

7.1 Survey Requirements

Surveying was required during construction of the fuel tank farm to ensure that the facility was being constructed in accordance with the construction drawings, as well as to collect the information required for preparation of the as-built report. All surveying control was conducted by HBJV.

The final as-built survey of the fuel tank farm was conducted by HBJV on March 29, 2001. EBA was not on site at the time of the survey. Survey information was provided to EBA via email on April 4, 2001.

7.2 Granular Materials

The granular fill materials used to construct the tank farm were obtained on site, as discussed in Section 5. Mine Muck and 40 mm Crush material was stockpiled within the footprint of the fuel tank farm. This material was used to grade the site and for initial construction of the berms.

The 40 mm Crush contained sufficient fines and moisture content that the material was frozen within the small stockpiles and had to be ripped and repeatedly driven over with the dozer before it could be placed (Photograph Nos. 1 and 2, Appendix D). This required considerable time. Often, frozen chunks could not be broken down and the larger pieces were removed, as best as possible, from the stockpile either by hand or using the Kubota loader (Photograph No. 3).

The additional fines in the 40 mm Crush provided a slightly smoother surface for the liner system. However, it also meant that the retained moisture content of the material was higher, thereby requiring ripping and breakdown before it could be used. The higher frozen moisture content reduced the level of compaction that could be achieved.

7.3 Foundation Preparation

Rough grading and site preparation was conducted between March 14 and 16, 2001 prior to EBA's arrival on the site. Photograph No. 4 shows the condition of the site prior to construction of the fuel tank farm. Photograph No. 5 shows the site preparation and grading work that was done. EBA inspected the rough graded area on March 17, 2001. Overall, the condition of the pad appeared adequate.

Based on visual observations and discussions with HBJV, the thickness of the existing Muck storage pad, upon which the fuel tank farm is constructed, is believed to be between 1 to 2 m. HBJV's records indicate that the pad was constructed in the summer of 1997 during an underground exploration program.

Considering that the Muck Pad is at minimum 1 m thick (may be up to 2 m thick) and that it was constructed in 1997, it is believed that any significant thaw settlement of the underlying overburden soils as a result of construction of the pad has already occurred. Construction of the fuel tank farm is not expected to detrimentally affect the thermal regime of the overburden soils and cause thaw settlements.

The unknown and inherently variable conditions of the Muck Pad mean that there is some risk of poor performance of the facility. This is not considered to be a significant concern, however bearing in mind that the material was not placed and compacted to engineered fill standard, the possibility of some settlement exists and should be noted.

7.4 Granular Material Placement

The containment berms were predominately constructed using 40 mm Crush. Some Mine Muck material was used in the base of the berms.

The 40 mm Crush was hauled to the berms using a Scoop. The material was placed along the berm alignment and spread using the dozer to approximately a 300 mm thick lift (Photograph No 6 and 7). The material was compacted as best as possible by trafficking

over the fill using a Scoop with a bucket full of material (Photograph No. 8). No other compaction equipment was available. Ideally, the material should have been compacted to a minimum of 95% maximum dry density as determined by the Standard Proctor Test. However, given that there was no conventional compaction equipment on site and that the material contained moisture and was frozen, the desired compaction standard could not be achieved.

Snowfall on March 19 and 20 caused some construction delays because the snow accumulations had to be cleared off of the berms and pad before additional material could be placed. Photograph Nos. 9 and 10 show the snowfall accumulations on the morning of March 20 and 21, respectively.

Three berms were constructed simultaneously to allow easier access for the construction equipment and the fourth (west) berm was constructed last (Photograph No. 11). Photograph 12 shows the berms ready for liner installation. Photograph 13 shows the condition of the base of the fuel tank farm prior to liner installation.

The dimensions and elevations of the containment berms are shown on the as-built drawings, Appendix A.

7.5 Liner System Installation

The liner system was installed by Layfield on March 24 and 25, 2001. Mr. Barry Nykolaishyn was the Layfield site representative. Layfield's Quality Control (QC) program was employed during installation of the liner system. The Layfield QC documentation is presented in Appendix F. Procon and HBVJ supplied personnel to assist in the installation.

All HDPE geomembrane field seaming was conducted on March 24 and is detailed in Layfield's QC documentation. The geomembrane was covered with non-woven geotextile on March 25, and granular cover material placement commenced thereafter. Liner system details are presented on the as-built drawings. Photograph 14 shows the non-woven geotextile prior to deploying the HDPE liner. Photograph Nos. 15 and 16 show the installation and seaming of the HDPE liner.

Considerable care was taken when covering the liner system with 40 mm Crush. The full thickness of cover material was placed in one lift to minimize trafficking on the liner and reduce the stresses imposed on the liner. The cover material within the containment berms was placed using the D5H Dozer (Photograph No. 18). Material was brought to the south

end of the facility and stockpiled just inside the south berm (Photograph No. 17). The dozer then pushed the material from the south end across the length and width of the bermed area.

The cover material along the crest of the berms and the inside berm slopes was placed using the Scoop and Kubota, and by hand using shovels and rakes. The Scoop placed buckets of material along the crest of the berms. The material was spread by hand and using the Kubota (Photograph No. 19). The inside berm slopes were covered by stockpiling material along the toe of the berms and then placing it on the slopes. The liner system was covered between March 24 and 27.

7.6 Tank Placement

The fuel tanks were skidded into place using the D5H Dozer and a Challenger 75D, owned and operated by Kitnuna of Cambridge Bay, Nunavut. Kitnuna was contracted by HBJV to haul the fuel from the coast to the Boston Camp. The Challenger is a rubber tracked, low ground pressure, agriculture-type tractor. A ramp was constructed over top of the south berm prior to skidding the tanks into place. The base of the tank farm and the berm slopes were sprayed with water and allowed to freeze to create a bonded surface that was not susceptible to gouging when the tanks were pulled into the containment area. All the tanks were pulled into the facility over top of the south berm (Photograph No. 20). Photograph 21 shows 4 tanks in position. All eight tanks were positioned in the tank farm on March 30 (Photograph 22 and Photograph 23). EBA was not on site during positioning of the tanks.

7.7 Granular Material Quantities

The actual 'in-place' quantity of granular fill material required to construct the fuel tank farm was approximately 1650 m^3. This volume is based on as-built survey information collected by HBJV. The design estimate quantity was approximately 1100 m^3. The discrepancy between the design quantity and actual quantity is the result of building the berms wider than designed because of equipment constructability constraints.

8.0 VARIATIONS FROM DESIGN DRAWINGS AND SPECIFICATIONS

There were a few design changes made during construction of the fuel tank farm. These variations from the design and construction specifications are as follows:

- The 40 mm Crush used to construct the tank farm was finer in gradation than understood during design and contained a greater percentage of fines. The additional fines provided a slightly smoother surface for the liner system, however, the finer material retained more moisture and as a result the frozen material and had to be ripped and broken down before it could be placed. The frozen moisture in the material also reduced the achievable level of compaction. This will result in some settlement of the granular fill.

- The containment berms were designed with a crest width of 0.6 m, but were constructed with an average crest width of 2 m because the only piece of equipment that could construct the berms was a D5H Dozer, which is approximately 2 m wide. The wider berms do not affect the performance or operation of the fuel tank farm, but did require additional material to construct.

- The liner system was designed to have 2 layers of LP12 non-woven geotextile on either side of the HDPE geomembrane. At the time that the liner materials were ordered by HBJV, Layfield did not have in stock the 10 rolls of LP12 estimated for the construction of the tank farm and therefore substituted 3 rolls of LP10. The LP 10 is slightly thinner, but was considered adequate. Two layers of LP12 non-woven geotextile were placed under the HDPE and one layer of LP12 and a second layer of LP10 non-woven geotextile were placed over top of the geomembrane liner, as shown on the as-built drawings.

- No anchor trench was constructed along the crest of the berms to key the liner system as shown on the construction drawings because there was no equipment on site that could construct it. To provide suitable anchor length, the liner system was installed across the entire crest width of the berm (approximately 2 m wide).

- The fuel tank farm design specified a compaction standard of a minimum of 95% maximum dry density as determined by the Standard Proctor Test. However, given that there was no conventional compaction equipment on site and that the material was frozen, the compaction standard could not be achieved. As a result, some settlement of the containment berms should be expected. The pad of the tank farm, upon which the fuel tanks are founded, are expected to settle less because there is a lesser thickness of granular fill.

9.0 OUTSTANDING WORK ITEM

The fuel tank farm was designed with a sump, which serves to collect water accumulations and allow for pumping. The pad area is graded to promote drainage away from the tanks towards the sump.

A sump was not installed during construction of the tank farm because a hole could not be excavated into the frozen cover material. The sump installation is an outstanding work item and HBJV has indicated that the sump will be installed sometime in the summer of 2001.

The sump can be fabricated from a 205 litre steel drum or 610 mm diameter galvanized culvert section, with approximately 15 mm diameter perforations at 100 mm spacing in the sides, as shown on the Construction Drawings and As-built Drawings. The top of the sump should be level with the finished ground elevation. It is of utmost importance that the invert of the sump not come in contact with the liner system. It is therefore recommended that it be excavated by hand.

Note that fluids collecting in the sump must be checked for the presence of hydrocarbons and other contaminants and must subsequently meet the criteria set out in the water license for the site before being discharged from the sump or facility to the environment.

10.0 PERFORMANCE MONITORING

Performance is an integral part of the design, construction and operation of the fuel tank farm. This section outlines the recommended minimum monitoring which should be conducted to document the performance and integrity of the containment berms and pad foundation. This section does not address the monitoring that should be conducted to ensure the safe operation and maintenance of the fuel tanks. These requirements are directed by the Fuel Tank Farm Codes and Regulations and any other regulatory requirements dictated in land use permits.

HBJV should conduct weekly visual inspections of the tank farm. Visual inspections should note the condition of the pad and the containment berms and water accumulations, if any. Inspections should also note any indication of settlement or movement of the berms. Any water accumulations within the tank farm as a result of precipitation should be removed and not allowed to accumulate for long periods.

It is recommended that a level survey of the crest of the containment berms be completed each spring and fall. The elevation of the crest should be measured along centerline and at 5m intervals, and if there is a noticeable depression between adjacent readings, then the elevation of the low point should be established. Level surveys of the fuel tanks should also be conducted to document performance of the base of the tank farm.

11.0 ACCIDENTAL SPILL CONTAINMENT REQUIREMENT

The NFC requires that the fuel storage tanks be contained within a bermed, lined, area capable of accommodating accidental spillage of fuel products. The bermed containment area must be of minimum size to contain a volume of liquid equal to 100% the volume of the largest tank plus 10% of the aggregate volume of all the remaining tanks, or, 110% of the volume of the largest tank, whichever is greater.

The total storage capacity of all eight tanks is 529,000 L. The minimum containment required is 100% of 77,000 L plus 10% of 452,000 L (529,000 L minus 77,000 L), which is equal to 122,200 L. The fuel tank farm was designed to store a minimum containment capacity of 122,200 L (122.2 m^3). The actual containment capacity based on the as-built information has been calculated and compared with the required volume. At the liner crest elevation of 79.9 m the containment volume is approximately 199,000 L (accounts for the volume occupied by the fuel tanks). The actual containment volume is greater than the minimum required. Based on the above calculations, the containment berms could settle up to 0.2 m before there was insufficient containment volume.

12.0 CLOSURE

EBA Engineering Consultants Ltd. has provided construction quality assurances services during construction of the Fuel Tank Farm at the Boston Property. The services were provided between March 17 and March 24, 2001. The tank farm was construction between March 14 and March 30, 2001. This as-built report documents the construction of the tank farm, but only some of the information was collected by EBA while on site, the remainder of the information was collected by HBJV and provided to EBA. EBA has assumed that the provided information is correct.

The CQA program performed and the documentation included in this report indicate that the materials placed/installed to a level that meets industry standards given equipment and environment constraints. Where deviation from the specifications were required, these

have been documented and reviewed by the designers to ensure that they satisfy design intent.

This as-built report and associated drawings provide a record of the construction of the fuel tank farm based on information collected by EBA while on site and records maintained by HBJV.

This report has been prepared in accordance with generally accepted engineering practices and engineering judgement has been applied in preparing the information contained in this report. No other warrant is made, either express or implied.

This report has been prepared for the exclusive use of the owner, Hope Bay Joint Venture for the specific use at the Boston Property. This report pertains to the specific site and development described in Section 1.0. Isolated information should not be reproduced, transferred, or used outside the context of this report unless clearly referenced to the source. EBA Engineering Consultants Ltd. will not be responsible for unauthorized reuse or interpretation of information presented herein.

Respectfully submitted,
EBA Engineering Consultants Ltd.

Ed M. Grozic, P.Eng. (Alberta)
Project Engineer, Frontier Division
(Direct Line: (403) 236-9700, ext. 258)
(e-mail: egrozic@eba.ca)

Kevin W. Jones, P.Eng.
Project Director, Frontier Division
(Direct Line: (780) 451-2130, ext. 271)
(e-mail: kjones@eba.ca)

EMG:KWJ:mvd:ln
X:\0101\Projects\2000\00-14839\002\R.01.May 2001.doc

REFERENCES

EBA Engineering Consultants Ltd., 2001. Fuel Tank Farm Design, Construction Drawings and Specifications, Boston Property, Nunavut. Draft Report. Submitted to Hope Bay Joint Venture February 26, 2001. Project No. 0101-00-14839.

Ranger Inspection Ltd., 2000a. Atmospheric Storage tank API-Standard 653 Inspection Report, Tanks EDM 10528-1 and 10528-2. Submitted to Fred H. Ross & Associates, August 2000.

Ranger Inspection Ltd., 2000b. Atmospheric Storage tank API-Standard 653 Inspection Report, 500 BBL Tanks. Submitted to Fred H. Ross & Associates, August 2000.

APPENDIX A
FUEL TANK FARM AS-BUILT DRAWINGS

7 505 400 N

7 505 300 N

CRUSHER ENCLOSURE

DIESEL FUEL TANKS

HOPPER

MAJOR DRILL

ELEC. SHED

COMPRESSOR

PROCON SHOP

SURVIVAL SHED

TRANSFORMER

NEW COMPRESSOR PAD

WATER LINES

CAMP WATER PUMP

4160 V

4160 V

Spyder Lake

PORTAL

S00-244

S00-242

S00-250

STORAGE LAYDOWN PAD

STORAGE PAD

STORAGE PAD

S00-256

TO AIRSTRIP

POND

BERM

SETTLING POND #1

SETTLING POND #2 TOE

BERM

S00-252

STORAGE PAD

LOCATION OF FUEL TANK FARM

S00-246

S00-248

S00-238

441 100 E

441 200 E

441 300 E

441 400 E

441 350

0 10 50

metres

GENERAL LOCATION PLAN

NOTES:

1. TOPOGRAPHIC SPOT ELEVATIONS OF WASTE ROCK PAD PROVIDED BY HBJV, MARCH 9, 2001.
2. ORIGINAL PAD CONTOURS GENERATED BY EBA FROM SPOT ELEVATIONS USING EAGLE POINT MODELLING SOFTWARE. CONTOUR INTERVAL 0.1m.

A 02

× 78.25

× 77.96

× 78.02

× 78.40

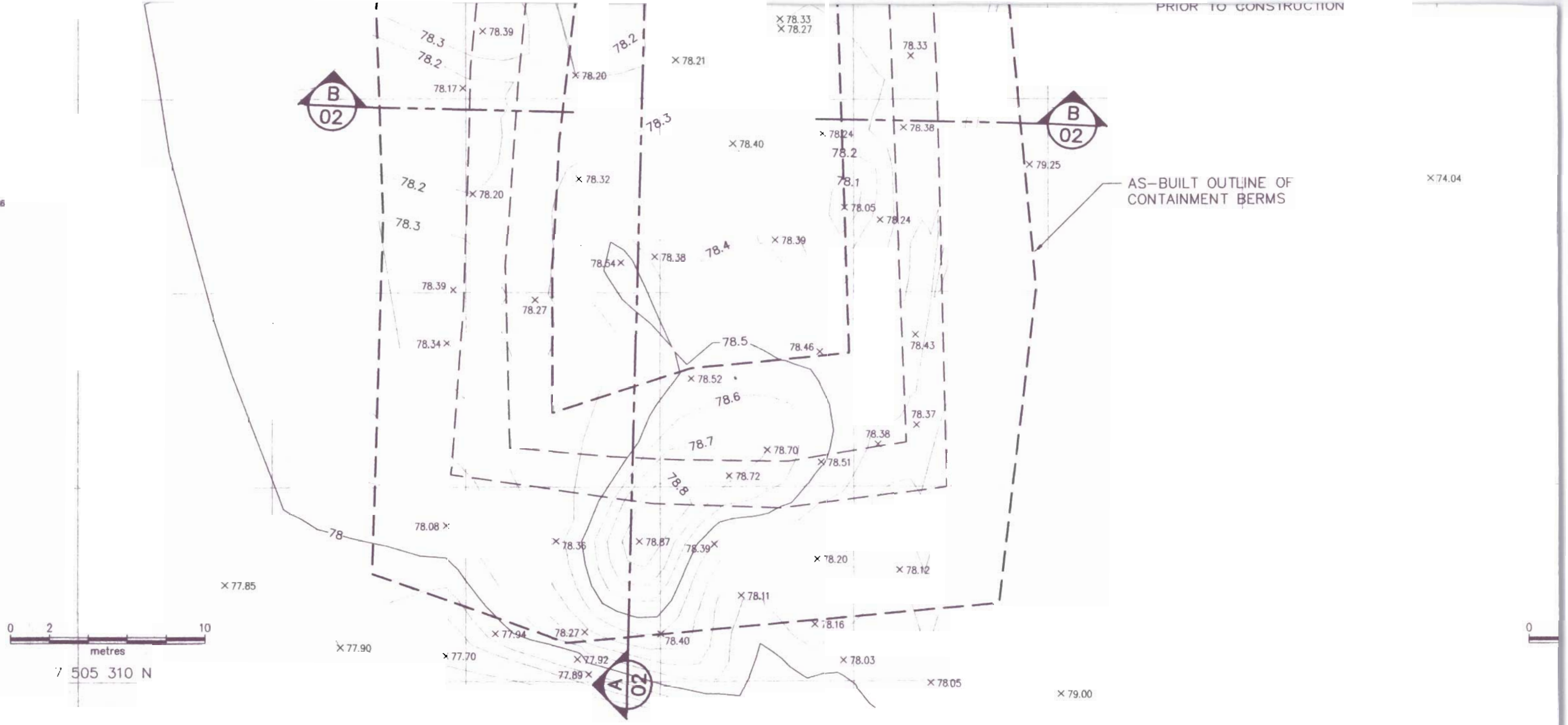
× 78.16

78.2

× 78.19

441 300 E

PRIOR TO CONSTRUCTION



FUEL TANK FARM SITE PLAN TOPOGRAPHY

DRAWING No.	DRAWING TITLE	DATE	REV
–	–	DD/MM/YY	

REFERENCE DRAWINGS

No.	DESCRIPTION	DATE	APP
1	"AS-BUILT" CONSTRUCTION DRAWING	14/05/01	–
0	ISSUED FOR CONSTRUCTION	16/03/01	–

REVISION

NOTES:

1. GENERAL LOCATION PLAN PROVIDED BY HOPE BAY JOINT VENTURE (HBJV), MARCH 9, 2001.
2. UTM COORDINATES (NAD 83).
3. CONSTRUCTION SURVEY CONTROL AND AS-BUILT SURVEY CONDUCTED BY HBJV.

TANK CENTRE COORDINATES				
TANK NO	TANK DIA. (m)	NORTHING (m)	EASTING (m)	ELEVATION (AT TOP OF TANK) (m)
1	4.5	7 505 344.73	441 309.26	84.04
2	4.5	7 505 344.42	441 316.05	84.06
3	4.5	7 505 339.20	441 309.25	84.08
4	4.5	7 505 338.99	441 316.09	84.10
5	4.5	7 505 333.11	441 308.40	84.07
6	4.5	7 505 332.70	441 316.47	84.15
7	3.0	7 505 326.83	441 307.08	84.38
8	3.0	7 505 328.10	441 317.35	84.40

NOTES:

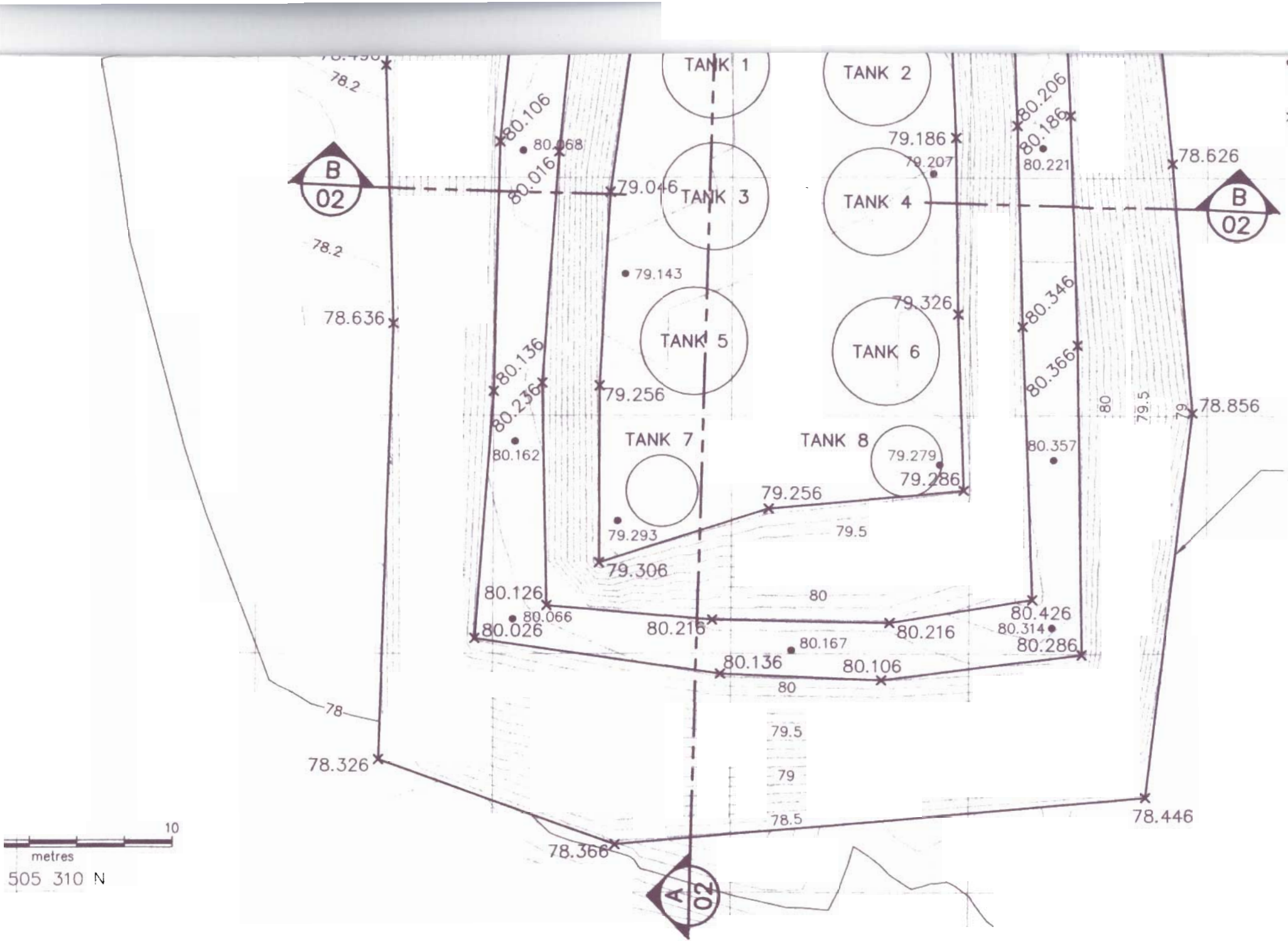
1. NORTHING, EASTING AND ELEVATION OF TANKS TAKEN AT CENTER POINT OF TOP OF TANKS

5:

AS-BUILT SURVEY OF CONTAINMENT BERMS CONDUCTED BY HBJV ON MARCH 29, 2001.

CONTAINMENT BERM CONTOURS GENERATED BY EBA USING EAGLE POINT MODELLING SOFTWARE BASED ON AS-BUILT SURVEY DATA COLLECTED BY HBJV. SEE NOTE 1.

CONTOUR INTERVAL 0.1m.



- 80.221 – ADDITIONAL SPOT ELEVATIONS BASED ON MODELLED CONTOURS.
- × 78.626 – AS-BUILT SURVEY ELEVATIONS OF CONTAINMENT BERMS

AS-BUILT OUTLINE OF BERM

FUEL TANK FARM LAYOUT

EBA Engineering Consultants Ltd.

DESIGNED BY:	E. GROZIC
DRAWN BY:	B. RICHMOND
DATE:	10/05/2001
SCALE:	AS SHOWN
PROJECT No.:	0101-00-14839.002
ACAD FILENAME:	14839R07B.dwg

PERMIT

THE ASSOCIATION OF PROFESSIONAL ENGINEERS, GEOLOGISTS and GEOPHYSICISTS OF THE NORTHWEST TERRITORIES
PERMIT NUMBER
01/05/17 P 018
EBA ENGINEERING CONSULTANTS LTD.

SEAL

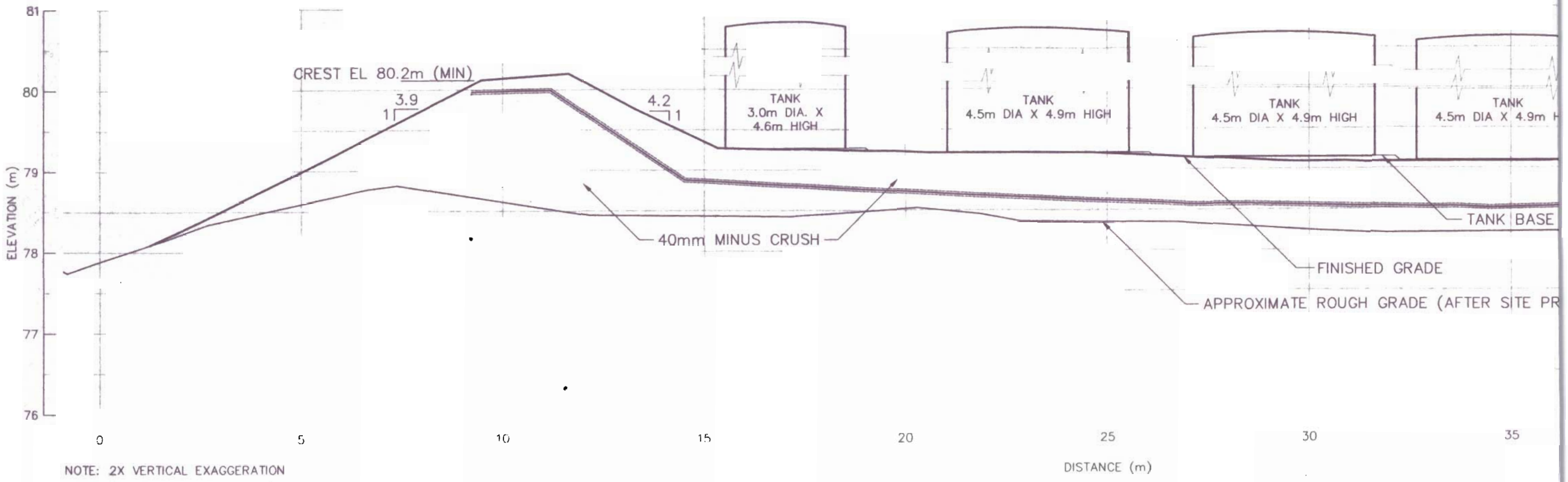
REGISTERED PROFESSIONAL ENGINEER
KEVIN W. JONES
01/05/17
LICENSEE
N.W.T.

HOPE BAY JOINT VENTURE
BOSTON PROJECT SITE
Miramar Mining Corporation - Hope Bay Gold Corporation Inc.

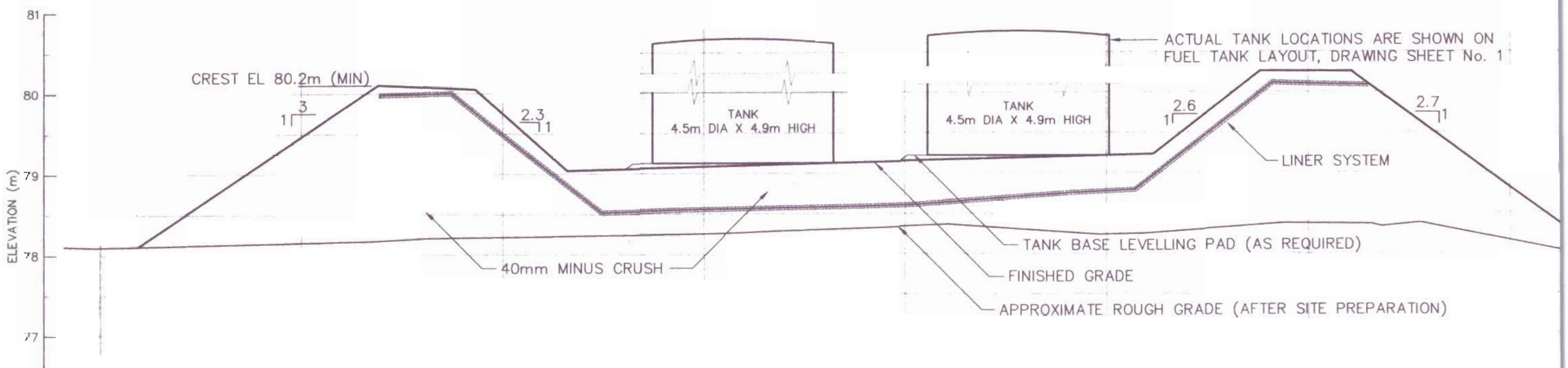
GENERAL LOCATION PLAN, SITE TOPOGRAPHY AND FUEL TANK FARM PLAN "AS-BUILT" (MARCH, 2001)

REVISION ISSUE
1

DRAWING No.
14839-01


81
80
79
78
77
76
ELEVATION (m)
CREST EL 80.2m (MIN)
3.9
1
4.2
1
TANK
3.0m DIA. X
4.6m HIGH
TANK
4.5m DIA X 4.9m HIGH
TANK
4.5m DIA X 4.9m HIGH
TANK
4.5m DIA X 4.9m H
TANK BASE
40mm MINUS CRUSH
FINISHED GRADE
APPROXIMATE ROUGH GRADE (AFTER SITE PR
0
5
10
15
20
25
30
35
DISTANCE (m)
NOTE: 2X VERTICAL EXAGGERATION
0
1
5
metres

SECTION A 01

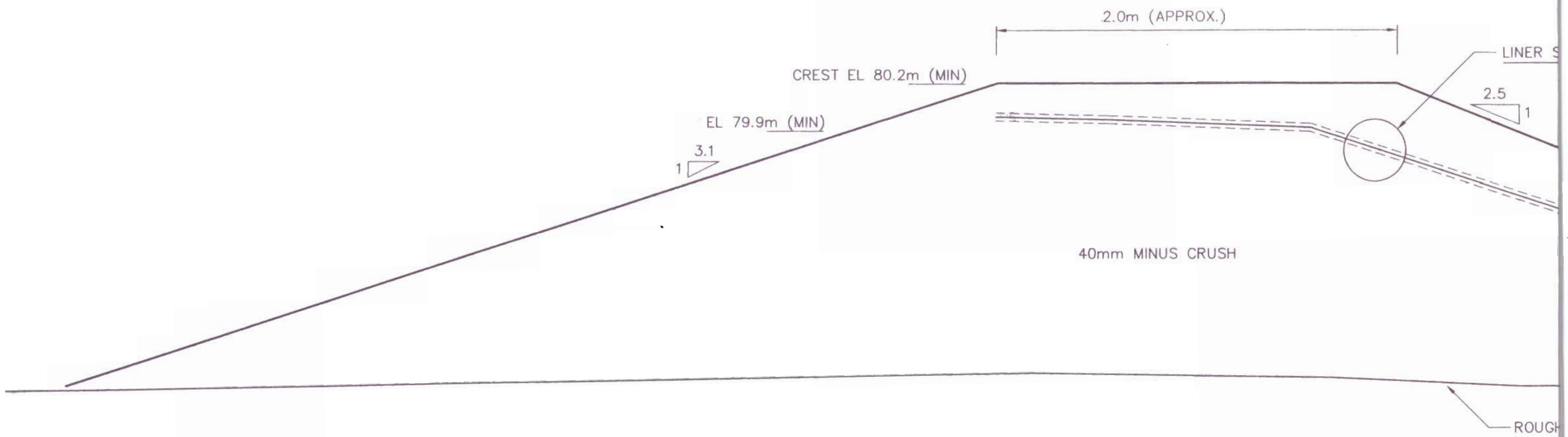

81
80
79
78
77
ELEVATION (m)
CREST EL 80.2m (MIN)
3
1
2.3
1
TANK
4.5m DIA X 4.9m HIGH
TANK
4.5m DIA X 4.9m HIGH
2.6
1
2.7
1
ACTUAL TANK LOCATIONS ARE SHOWN ON
FUEL TANK LAYOUT, DRAWING SHEET No. 1
LINER SYSTEM
TANK BASE LEVELLING PAD (AS REQUIRED)
40mm MINUS CRUSH
FINISHED GRADE
APPROXIMATE ROUGH GRADE (AFTER SITE PREPARATION)

NOTE: 2X VERTICAL EXAGGERATION

0 1 5
metres

DISTANCE (m)

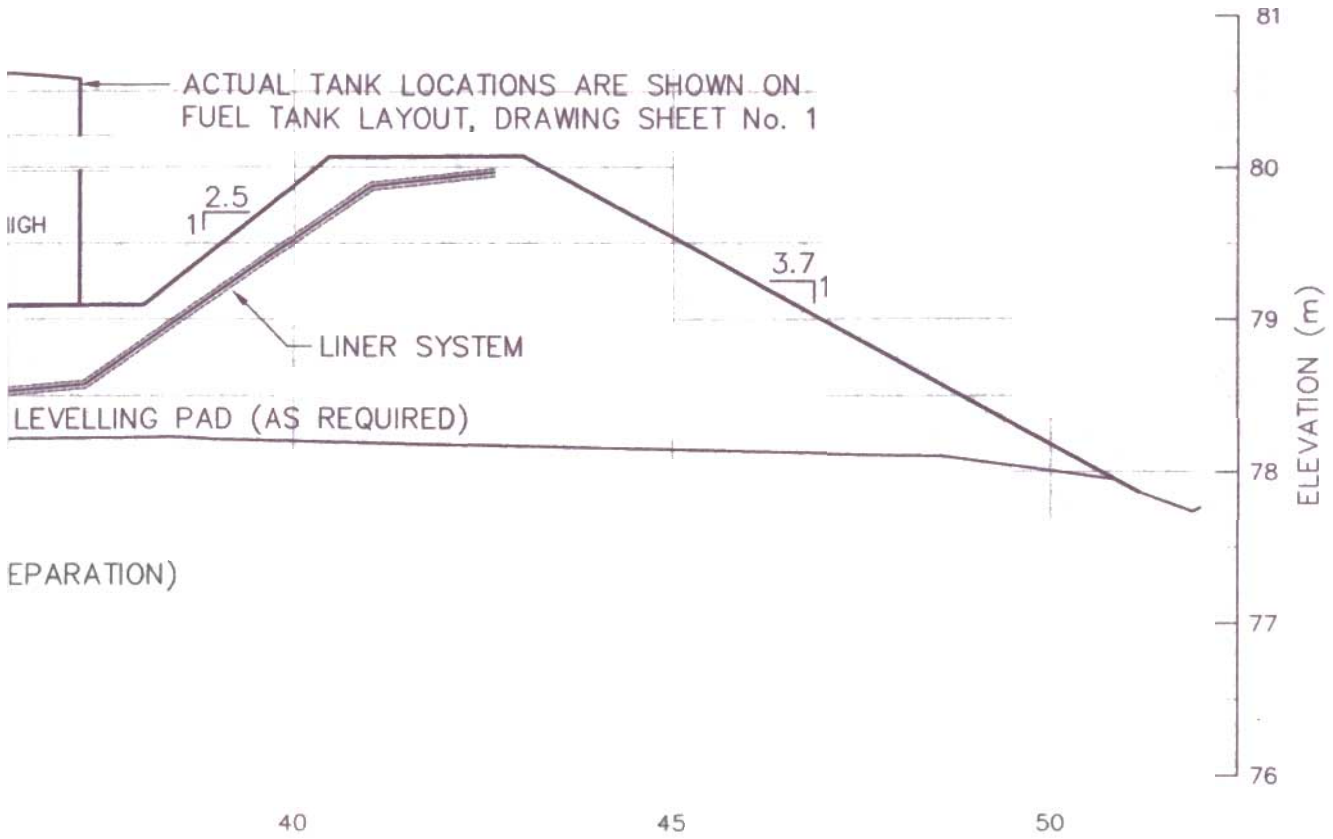
SECTION B/01



0 0.25 1
metres

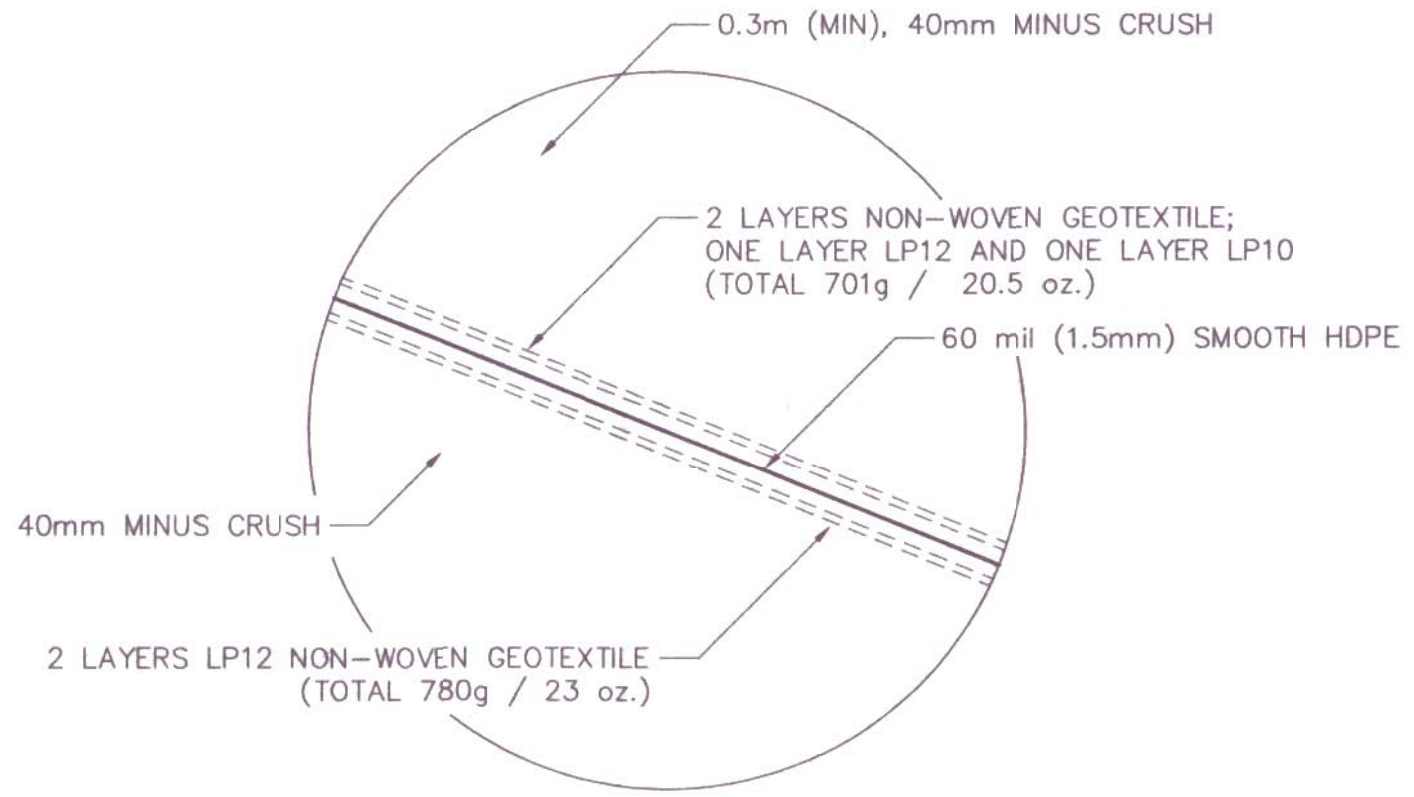
SECTION C/01
TYPICAL CONTAINMENT BERM CONFIGURATION

				1	"AS-BUILT" CONSTRUCTION DRAWING	14/05
–	–	DD/MM/YY		0	ISSUED FOR CONSTRUCTION	16/03
DRAWING No.	DRAWING TITLE	DATE	REV	No.	DESCRIPTION	DAT
REFERENCE DRAWINGS				REVISION		

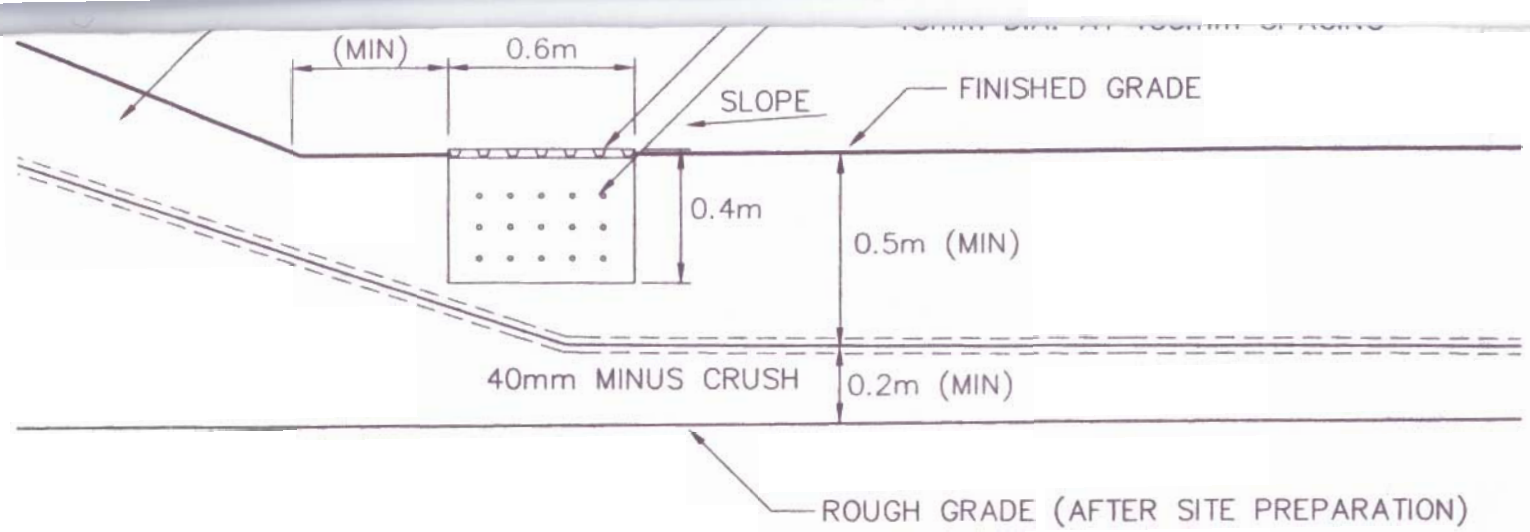


NOTES:

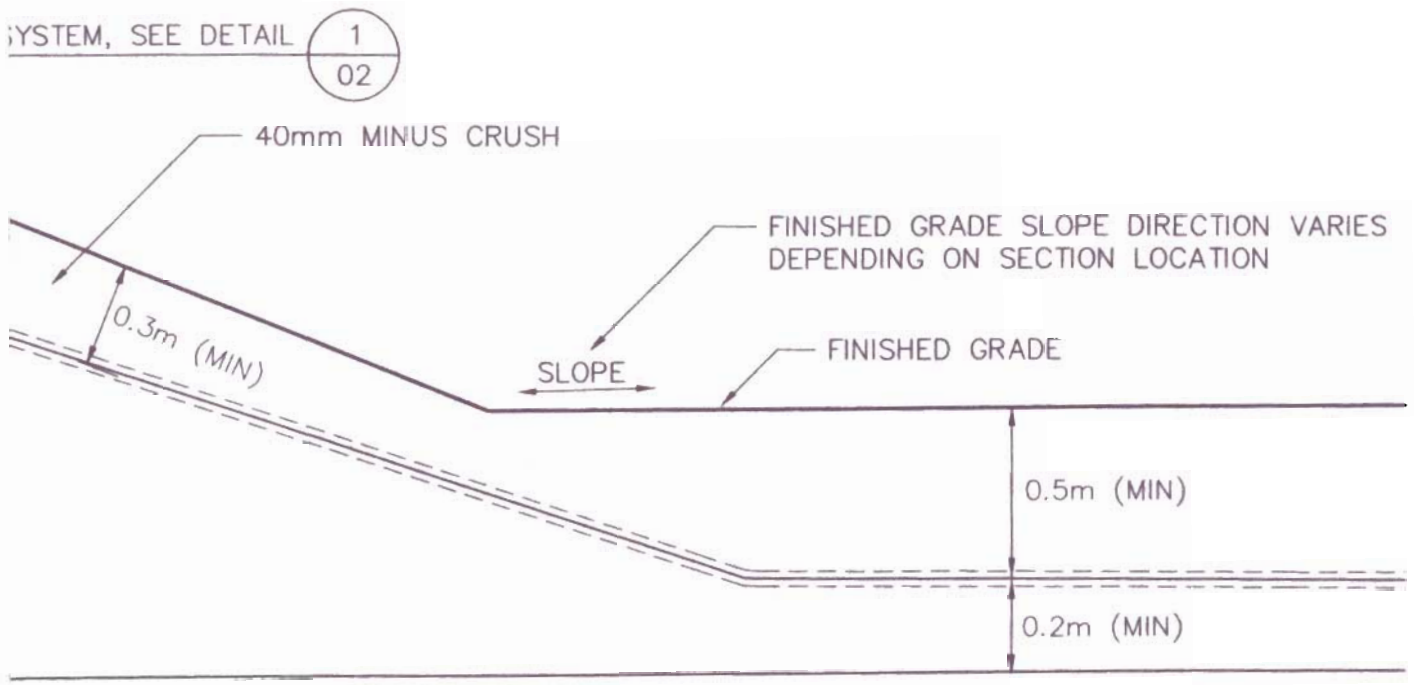
1. CONSTRUCTION SURVEY CONTROL AND "AS-BUILT" SURVEY CONDUCTED BY HBJV.
2. FOR CONSTRUCTION MATERIAL PROPERTIES REFER TO "AS-BUILT" REPORT.



DETAIL 1/02
LINER SYSTEM



DETAIL SUMP 2/01



NOTE: OUTSTANDING WORK ITEM
TO BE INSTALLED BY HBJV IN SUMMER 2001.

/01	---
/01	---
E	APPROVED

EBA Engineering Consultants Ltd.

DESIGNED BY:	E. GROZIC
DRAWN BY:	B. RICHMOND
DATE:	10/05/2001
SCALE:	AS SHOWN
PROJECT No.:	0101-00-14839.002
ACAD FILENAME:	14839P02B.dwg

PERMIT

THE ASSOCIATION OF PROFESSIONAL ENGINEERS, GEOLOGISTS and GEOPHYSICISTS OF THE NORTHWEST TERRITORIES
PERMIT NUMBER P 018
01/05/17
EBA ENGINEERING CONSULTANTS LTD.

SEAL

REGISTERED PROFESSIONAL ENGINEER
KEVIN W. JONES
01/05/17
LICENSEE
N.W.T.

HOPE BAY JOINT VENTURE
BOSTON PROJECT SITE
Miramar Mining Corporation - Hope Bay Gold Corporation Inc.

CROSS-SECTIONS
AND
LINER SYSTEM DETAIL
"AS-BUILT" (MARCH 2001)

REVISION ISSUE
1

DRAWING No.
14839-02

APPENDIX B
CONSTRUCTION SPECIFICATIONS

TECHNICAL SPECIFICATIONS
FUEL TANK FARM
BOSTON PROPERTY, NUNAVUT

Project No.: 0101-01-14839

MARCH 2001

FUEL TANK FARM
BOSTON PROPERTY, NUNAVUT

TECHNICAL SPECIFICATIONS

Submitted To:

HOPE BAY JOINT VENTURE
VANCOUVER, BRITISH COLUMBIA

Prepared by:

EBA ENGINEERING CONSULTANTS LTD.
EDMONTON, ALBERTA

Project No. 0101-00-14839

MARCH 2001

TABLE OF CONTENTS

GENERAL

1.0 General

.1 This specification has been prepared for the construction of the Fuel Tank Farm at the Boston Property, Nunavut and for the exclusive use of the owner, Hope Bay Joint Venture.

.2 The Boston Property is located on the east side of Bathurst Inlet, Nunavut, approximately 670 km northeast of Yellowknife and 170 km southwest of Cambridge Bay.

.3 The Fuel Tank Farm will comprise eight tanks in total. Six of the tanks are 4.5 m in diameter and 4.9 m tall and two of the tanks are 3.0 m in diameter and 4.5 m tall. The total storage capacity of the eight tanks is understood to be 529,000 L (6 – 77,000 L tanks and 2 – 33,500 L tanks). The tanks are to be interconnected to a single loading and dispensing facility.

2.0 Codes and Regulations

.1 The National Fire Code (NFC) and the National Building Code of Canada (NBC) are the regulations used in Nunavut for design and construction of fuel storage facilities. The authority having jurisdiction is the Office of the Fire Marshall.

.2 In Nunavut, fuel storage and distribution facility reviews also fall under the Nunavut Impact Review Board (NIRB), which must authorize the use of land and water in the Nunavut Territory.

3.0 Construction Methods

.1 The elevations and dimensions shown on the Construction Drawings are for the purpose of construction and measurement. The Contractor shall ensure that all grades, elevations and dimensions are adhered to.

.2 The Contractor is responsible for all construction surveys and documentation to verify quantities.

4.0 Material Quantities

.1 The materials required to construct the Fuel Tank Farm are designated on the Construction Drawings. Material quantities have been estimated as follows:

Table 1
Fuel Tank Farm Material Requirements

Material Type	Quantity[(1)(2)]
Mine Muck (Blast Rock)	680 m^3
40 mm Crush	420 m^3
Smooth 60 mil HDPE Geomembrane	880 m^2 [(3)]
Non-Woven Geotextile (2 layers on either side of HDPE Geomembrane)	3520 m^2 [(3)]

Notes:
(1) Quantities have been calculated based on topographic original ground spot elevations provided by HBJV.
(2) Quantities are in-place volumes and do not include allowances for wastage, overbuild that may occur due to constructability constraints as a function of construction equipment selection or availability, unless otherwise noted.
(3) The liner system material quantities include a 25% contingency for overlapping requirements, wastage and repair provisions.

FOUNDATION PREPARATION

1.0 General

.1 Foundation preparation requirements for the construction of the Fuel Tank Farm are presented in this Section.

.2 Ice-rich soils or other soils deemed to be unsuitable by the Engineer shall be removed.

2.0 Site Preparation

.1 Ice, snow, organics and any other soils deemed to be unsuitable by the Engineer shall be removed.

.2 All rock particles resting on the ground in excess of 300 mm in size shall be removed. Buried rock particles in excess of 300 mm in size and so protruding from the grade that they interfere with construction, shall be removed and the hole left in the ground shall be backfilled and compacted.

.3 Level off areas as required and prepare for granular fill placement as outlined in the Specifications in order to reach the design elevations and grades shown on the Construction Drawings.

.4 Carry out an accurate survey to act as a reference for material quantities.

3.0 Foundation Approval

.1 The foundation shall be inspected and approved by the Engineer before any fill material is placed. The Contractor shall give not less than twenty-four (24) hours notice to the Engineer regarding required approval.

GRANULAR FILL MATERIALS

1.0 General

.1 This Section describes the available granular fill materials for construction of the Fuel Tank Farm.

.2 Material quantities are presented in Section 1001.

2.0 Material Sources

.1 Blast rock from underground exploration activities is the only source of granular fill material available on site for construction for the Fuel Tank Farm.

.2 Two types of granular fill material are available; 'Mine Muck' blast rock and 40 mm Crush. The 40 mm Crush is generated from the blast rock.

.3 No material of any type shall be borrowed or excavated without the Owner's prior approval.

.4 Pits and quarries shall be maintained and managed in accordance with the requirements set out in the Owner's Land Use and Quarry Permits.

3.0 Material Specifications

.1 The granular materials shall conform to the grain size distributions presented in this Section, unless otherwise directed by the Engineer.

.2 The 40 mm Crush material shall consist of hard, durable particles, shall be free of roots, topsoil, snow, ice and deleterious material and shall have a grain size distribution finer than that presented in Table 2.

Table 2
Maximum 40 mm Crush Grain Size Distribution

Grain Size (mm)	% Passing
40.0	100
12.5	30
5.0	10
0.63	4
0.08	2

.3 40 mm Crush Material coarser than the grain size distribution presented in Table 2 shall not be used for construction unless approved by the Engineer.

.4 The Mine Muck material shall be free of roots, topsoil, snow, ice and other deleterious material.

.5 The Mine Muck material can have a wide variation in gradation, however should have a typical particle size less than or equal to 100 mm, which has been assumed in the design.

.6 The Mine Muck material shall be approved for construction by the Engineer prior to placement.

GRANULAR FILL PLACEMENT

1.0 General

.1 The placement methods to be used during construction are described in this Section.

.2 Construction shall be performed in accordance with the best modern practice and with equipment best adapted to the work being performed.

.3 Berm materials shall be placed so that each zone is homogeneous, free of stratifications, ice chunks, lenses or pockets.

.4 No fill material shall be placed on any part of the foundation until it has been prepared as specified herein and approved by the Engineer. Placement of fill material shall conform to the lines, grades and elevations shown on the Construction Drawings, as specified herein.

.5 Berms and pad construction shall not proceed when the work can not be performed in accordance with the requirements of the Construction Specifications. Any part of the berms and pad that has been damaged by the action of rain, snow or any other cause shall be removed and replaced with the appropriate material conforming to the requirements stated herein before succeeding layers are placed.

.6 Stockpiling, loading, transporting, placing and spreading of all materials shall be carried out in such a manner to avoid segregation. Segregated materials shall be removed and replaced with the materials meeting the requirements stated herein, as required by the Engineer.

.7 The Contractor shall remove all debris, vegetation or any other material not conforming to the requirements stated herein. The Contractor shall dispose of these materials in an area approved by the Owner.

2.0 40 mm Crush Material (Bedding and Levelling)

.1 The 40 mm Crush material shall be placed in lifts not exceeding 300 mm. The placement method used shall ensure that segregation and nesting of particles is avoided.

.2 The placed 40 mm Crush material shall be compacted to a minimum of 95% of the maximum dry density as determined by test method ASTM D698.

.3 Compaction equipment should consist of a vibratory roller, or other equipment of similar capacity acceptable to the Engineer.

3.0 Mine Muck Material (General Fill)

.1 The Mine Muck material shall be placed in lifts not exceeding 400 mm. The placement method used shall ensure that segregation and nesting of coarse particles is avoided.

.2 The Mine Muck material shall be compacted with a vibratory compactor weighing not less than 1000 kilograms with a minimum of four passes, or other equipment of similar capacity acceptable to the Engineer.

4.0 Placement of Granular Fill Material

.1 Containment Berms

a. The core of the berms shall be built up with Mine Muck material and shall be constructed to the dimensions and elevations as shown on the Construction Drawings.

b. The Mine Muck material shall be compacted as specified herein

c. The crest shall be not less than 600 mm wide.

d. An anchor trench shall be provided on top of the berm for anchoring of the geomembrane liner as per the details on the Construction Drawings.

.2 Area Within Containment Berms

a. A 40 mm Crush material shall be placed to receive the geomembrane liner. This bed shall be placed in a single lift and compacted to 95% SPD. The bedding surface shall be uniform. The bedding surface will overlie the granular pad constructed of Mine Muck material.

b. The bedding surface shall be sloped towards the sump location as indicated on the Construction Drawings, to assure proper drainage of surface water.

c. Prior to installation of the liner system, the Engineer shall inspect the bedding to ensure that it is satisfactory, and any defects noted shall be rectified. The Contractor is responsible for providing notice to the Engineer to ensure that he is available for the inspection.

d. Following the liner installation, a layer shall be placed on top of the liner system in the presence of the Engineer and Liner Technician. All necessary precautions shall be taken during this operation to ensure that no damage is done to the liner system. Any damage to the liner system shall be repaired at the Contractor's expense, to the satisfaction of the Engineer.

.3 Tank Base Levelling Pad

a. Shall be constructed to the details and thickness shown on the Construction Drawings, and approved by the Engineer. 40 mm Crush material shall be placed in lifts no greater than 300 mm and each lift shall be compacted to 95% SPD.

b. The levelling pads will vary in thickness to establish a constant elevation for all tanks. The thickness of the pads will be determined in the field during installation of the tanks.

5.0 Sump

.1 The containment area shall be provided with a drain sump fabricated from a 205 litre steel drum or 610 mm diameter galvanized culvert section, with perforations as shown on the Construction Drawings. The drain sump shall be located at the low point in the bermed area, and the top of the drain sump is to be level with the finished ground elevation.

GEOTEXTILE

1.0 General

.1 The product and installation specifications for the non-woven geotextile is presented in this Section.

2.0 Geotextile

.1 Non-woven, needle punch polypropylene fabric.

.2 The geotextile shall be Layfield Plastics LP12, or equivalent.

.3 Seams shall be lapped in accordance with manufacturer's instructions.

.4 Physical properties:

Table 3
Recommended Minimum Non-Woven Geotextile Properties

Test Parameter	Required Specifications	ASTM Test Method (Or Approved Equal)
Grab Tensile (N / lbs)	1330 / 300	D4632
Elongation (%)	50	D4632
Tear (N / lbs)	512 / 115	D4533
Puncture (N / lbs)	779 / 175	D4833
AOS (microns / sieve size)	150 / 100	D4571
Permeability (cm/sec)	0.3	D4491
Weight (g/m^2 / oz/yd^2)	390 / 11.5	D5261
Thickness Nominal (mm / mil)	2.8 / 110	D5199
UV Resistance	70	D4355

3.0 Construction Methods

.1 The Contractor shall place the geotextile once the bedding surface has been completed and approved by the Engineer.

.2 Place geotextile material by unrolling onto graded surface.

.3 Place geotextile material smooth and free of tension, stress, folds, wrinkles and creases.

.4 Place geotextile material on sloping surfaces in one continuous length from toe of slope to over crest.

.5 Overlap each successive length of geotextile 600 mm, or to manufacturer's instructions.

.6 Protect installed geotextile material from displacement and damage. Replace damaged and deteriorated geotextile.

.7 Do not permit passage of any vehicle directly on geotextile at any time.

1.0 General

.1 This section describes the requirements for the supply and installation of the geomembrane liner for the construction the Fuel Tank Farm.

.2 The Work includes the manufacture, supply and installation of the liner, anchor, trench, connections, field welds and supply and inspection earthworks.

.3 Work under this section will not be measured. The contractor will account for all materials and associated labour. Include all direct costs associated with the supply, installation and testing of the geomembrane.

2.0 Special Requirements

.1 Guarantee of Geomembrane Material

a. The manufacturer or supplier, on a pro-rata basis shall guarantee the HDPE geomembrane liner in writing for a period of 20 years. The guarantee shall be against manufacturing defects of workmanship and against deterioration due to ozone, ultraviolet, or other normal weather ageing.

.2 Experience of Contractor

a. The Contractor shall have demonstrated an ability to perform this work by having previously successfully installed a minimum of 100,000 square metres of similar type flexible liners.

b. The onsite liner supervisor assigned full time to this work shall have directed the installation of a minimum of 50,000 square metres of similar type flexible liner.

.3 Samples and Specifications of Material

a. Prior to ordering any materials, the Contractor shall submit the manufacturer's certification stating that the material proposed for use for this project has physical properties equal to the certified values.

.4 Workmanship Guarantee

a. The Liner Contractor shall guarantee the liner installation to be free of defects in materials and workmanship for a period of 1 year following the date of acceptance by the Owner or its representative.

b. The Contractor shall agree to make, at his expense, any repairs or replacements made necessary by defects in materials or workmanship in the work that became evident within said guarantee period.

c. The Contractor shall make repairs and replacements promptly upon receipt of written order from the Owner or its authorized representative. If the Contractor fails to make repairs and replacements promptly, The Owner may do so and the Contractor shall be liable for the cost of such repairs and replacements.

3.0 Materials

.1 General

a. All materials arriving on site are subject to inspection. Replacement or repair of damaged material will be at no cost to the Owner.

b. The liner material produced shall be free of blisters, holes, undispersed raw materials, or any sign of contamination by foreign matter. Any such defect shall be repaired using welding techniques in accordance with manufacturer's recommendations. Excessive defects, as determined by the Owner's representative, may be grounds for rejection of entire roll of liner.

.2 Material Property

a. The material supplied under these Specifications shall be new, first quality products.

b. The liner material shall be a high density polyethylene (HDPE) geomembrane, and have the following minimum property values:

Table 4
Recommended Minimum Smooth HDPE Geomembrane Properties

Test Parameter	Required Specifications	ASTM Test Method (Or Approved Equal)
Minimum Average Thickness (mm / mil)	1.5 / 60	D5994
Density	.94	D792
Tensile Properties:		D638 Modified Type IV Die 50 mm/minute
Stress @ Yield (kN/m / ppi)	23.1 / 132	
Stress @ Break (kN/m / ppi)	39.9 / 228	
Strain @ Yield (%)	13	
Strain @ Break (%)	.700	
Tear Resistance (N / lbs)	200 / 45	D1004
Low Temperature (°C / °F)	-60 / -76	D746 Procedure B
Dimensional Stability (%)	+/-1.5	D1204
Puncture Resistance (N / lbs)	347 / 78	FTMS No. 1O1B Method 2065
Carbon Black (min)	2	D1603
Carbon Black Dispersion	Category 1 or 2	D5596

c. Extrusion resin used for extrusion joining of sheets and for repairs shall be HDPE from the same resin as the sheet resin. Physical properties shall be the same as the liner sheets.

d. Extrudate rod shall be solid core rod free of voids and free of contamination by moisture or foreign matter.

4.0 Installation

.1 General

a. During installation of the liner, the Quality Assurance (QA) monitor and/or the Owner's representative shall have complete authority to order a stop work due to inclement weather, the use of improper installation

procedures, or for any reason that in his sole opinion, may result in a defective liner.

b. Geomembrane shall be free of holes, pinholes, bubbles, blisters, excessive contamination by foreign matter, and nicks and cuts on roll edges.

c. The geomembrane liners shall be installed in accordance with a panel layout plan approved by the Owner's representative.

d. Horizontal seams on slopes shall not be permitted, unless no other option is available and only as approved by the Owner's representative.

e. Tie-in seam shall be a minimum of 1.5 m beyond the toe of slope on the base of the facility.

.2 Material Transportation And Storage

a. Labelling - Each roll of geomembrane delivered to the site shall be labelled by the manufacturer. The label shall clearly state the manufacturer's name, product identification, thickness, length, width and roll number. The label shall be found on either of the endcaps, an inside edge of the core, and outside the core.

b. Delivery - The rolls of liner shall be packaged and shipped by appropriate means to prevent damage to the material and to facilitate off-loading.

c. Storage - The on-site storage location for the geomembrane material should be level, smooth, elevated and dry (not wooden pallets). The Contractor shall provide a suitable storage site which will protect the geomembrane from punctures, abrasions, excessive moisture and dirt.

d. Handling - The materials are to be handled so as to prevent damage. Use equipment that does not contact the material itself when handling. Slings or other lifting devices shall provide adequate support without damaging the material. Instructions for moving geomembrane rolls shall be provided by the Manufacturer upon request.

.3 Liner Deployment

a. Deploy materials to minimize handling, damage and contamination during installation.

b. Sufficient protection should be placed between the soil surface of the berm and the geomembrane to protect the underside of the geomembrane from damage during deployment.

c. Ensure that the sheet is not folded at any time during manufacturing, shipping or installation.

d. Provide sufficient anchorage against uplift due to wind. Sandbeds are preferred.

e. Adequate thermal slack will be incorporated in all layers of geomembrane, to the approval of the Owner's representative.

f. Information to be documented on the liner throughout the installation, shall be clearly visible to such point that the material is covered or construction is complete and will include:

- On each panel, the panel number, material roll number and date deployed. A panel number will be a simple and logical identifying code. The coding system shall be subject to approval and shall be determined at the job site.

- All repairs shall be given an identification number, the welder, welder operator and date shall be recorded with the identification number.

- All destructive sample locations will be identified an identifying number and date removed.

- All non-destructive test data, and date of test.

g. Key liner system (geomembrane liner and geotextile) completely down along the side and to the back of the anchor trench.

h. Do not allow heavy vehicular traffic directly on geomembrane or geotextile.

5.0 Seams and Joints

.1 Joints between liner sheets shall be field welded using the manufacturer's recommended procedures and equipment. Only repairs and detail welds shall be extrusion welded.

.2 Seaming shall be performed using either the extrusion of double wedge automatic fusion welding equipment and techniques, as recommended by the manufacturer on the liner membrane. Extrusion welding shall be used where double wedge fusion welding is not possible such as for patches, repairs and runs of seams.

a. The weld area shall be free of all dirt, dust, moisture, or other foreign material. Surfaces to be welded shall be wiped with oil-free rags when required to remove any contamination by oil, grease, or excessive dirt.

b. If necessary, grinding of the liner material prior to welding shall be per the manufacturer's recommendations. The weld shall be made immediately after preparation and cleaning is complete. The temperature of the welding apparatus shall be checked a minimum of once every hour during welding.

c. The liner panels shall be welded together through the anchor trench.

.3 An overlap line, a minimum of 150 mm from the edge of the underlying sheet, will be clearly identified on the underlying panel of every fusion seam.

.4 The overlap shall be sufficient to leave a loose flap of geomembrane at least 25 mm wide adjacent to both sides of the seam.

.5 Cross and toe seams shall be staggered a minimum of 1 m.

.6 Completed seams and joints shall have a minimum bonded seam strength shall be as follows.

a. Completed seams shall have a minimum strength in shear of at least 21 N/mm (85% of the specified parent material tensile strength) at yield when tested in accordance with ASTM D 4437, or approved equal.

b. Completed seams shall have a minimum strength in peal of at least 14 N/mm (60% of the specified parent material tensile strength) at yield, and break as a film tear bond or a minimum of 10 % adhesion break when tested in accordance with ASTM D 4437, or approved equal.

.7 Seaming shall not proceed when ambient air temperature or adverse weather conditions jeopardize the integrity of the liner installation. Installer shall demonstrate that acceptable seaming can be performed by completing acceptable trial welds.

.8 Defects and Repairs

a. Examine all seams and non-seam areas of the geomembrane for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter.

b. Repair and non-destructively test each suspect location in both seam and non-seam areas. Do not cover geomembrane at locations which have been repaired until test results with passing values are available.

.9 Seaming and repairs will not be completed without the presence of the QA monitor, or the Owner's representative.

6.0 Welding

.1 All welds will be completed according to the contractors appropriate welding procedure.

a. Deviation from the written weld procedures in any manner may be cause for rejection of the affected welds by the Owner's representative.

b. Any welds that have been rejected shall be remedied to the satisfaction of the Owner's representative, at no additional cost to the Owner.

.2 Welding equipment and accessories shall meet the following requirements.

a. Gauges showing temperatures in apparatus extrusion welders (preheat and barrel) or wedge welders (wedge temperature; travel speed) shall be operational and clearly visible.

b. An adequate number of welding apparatus shall be available to avoid delaying work. There should at all times be an additional wedge welder and extrusion welder not in use, in the case of malfunction of those in use.

c. Power source capable of providing constant voltage under combined line load shall be used.

.3 Qualification of Welders

a. Perform trial, or qualification welds, in the presence of the QA monitor or The Owner's representative, on geomembrane samples to verify welding equipment is operating properly.

b. No welding equipment or welder shall be allowed to perform production welds until equipment and welders have successfully completed a trial weld.

c. Trial welds shall be performed prior to use and at a minimum 4 hour frequency throughout each operating day, or as the origin (existing or new) of the liner panels to be seamed changes.

d. If any welder settings are changed, or maintenance is required other than routine cleaning, the welder will have to be prequalified.

.4 Trial Welds

a. Make trial welds under the same surface and environmental conditions as the production welds, i.e., in contact with subgrade and similar ambient temperature.

b. Trial welds of existing material from representative locations, to new material will be required as directed by the Owner's representative.

c. Each trial weld shall be a minimum of 1.5 m in length.

d. Cut five, 25 mm wide by 150 mm long test strips from the trial weld. Quantitatively test four specimens for peel adhesion, and then one for bonded seam strength (shear).

e. Repeat the trial weld, in its entirety, when any of the trial weld samples fail in either peel or shear.

.5 Extrusion Welding

a. Hot-air bond adjacent pieces together using procedures that do not damage the geomembrane, or underlying material.

b. Purge welding apparatus of heat-degraded extrudate before welding.

c. Extrudate tails shall not be discarded on any geosynthetic surface while still hot, and shall not be left discarded on or below the liner.

d. Clean geomembrane surfaces according to the appropriate manufacturer approved procedures before welding, and weld shortly after.

.6 Wedge Welding

a. Welding apparatus shall be a self-propelled device equipped with an electronic controller which displays applicable temperatures.

b. Protect against moisture build-up between sheets.

c. Continuously clean seam area of dust, mud, moisture and debris immediately ahead of the hot wedge welder.

7.0 Repair Procedures

.1 Any liner area showing injury due to excessive scuffing, puncture, or distress from any cause, shall, as directed by the Owner's representative, be replaced or repaired with an additional piece of HDPE liner welded over the defective area. All patches shall extend a minimum of 150 mm from the affected area.

.2 Remove damaged geomembrane and replace with acceptable geomembrane materials if damage cannot be satisfactorily repaired.

.3 All repairs shall be completed within 24 hours from when they are identified, except by approval of the Owner's representative.

.4 Repair any portion of unsatisfactory geomembrane or seam area failing a destructive or non-destructive test. Installer shall be responsible for repair of damaged or defective areas. Agreement upon the appropriate repair method shall be decided between the Owner's representative and the Installer. Procedures available include the following:

a. Patching - Used to repair large holes, tears, undispersed raw materials, and contamination by foreign matter.

b. Abrading and Re-welding - Used to repair small seam sections.

c. Spot Welding - Used to repair pinholes or other minor, localized flaws or where geomembrane thickness has been reduced.

d. Capping - Used to repair large lengths of failed seams.

e. Flap Welding - Used to extrusion weld the flap (excess outer portion) of a fusion weld in lieu of a full cap.

f. Removing the unacceptable seam and replace with new material.

.5 Repair Verification

a. Number and log each patch repair.

b. Non-destructively test each repair using methods identified in this Specification.

8.0 Contractor Construction Quality Control

.1 A visual inspection of the liner panels and joints shall be made as the installation progresses and again upon completion of the liner. Defective and questionable areas shall be clearly marked and repaired. All areas identified shall be repaired to the satisfaction of the Owner's representative.

.2 The Contractor shall further test all joints and repairs in the HDPE liner by vacuum testing or pressurized dual seams testing (for double hot wedge welds only). All testing shall be done in the presence of or with knowledge of the QA monitor. All defective areas detected shall be repaired to the satisfaction of the Owner's representative.

.3 The Contractor shall perform a vacuum test on all extrusion welded seams and repairs, in the following manner:

a. The area to be tested shall be cleaned of all dirt, debris, and other foreign matter and then a soap and water solution shall be applied.

b. A gasket vacuum box (American Parts and Service Company, Alhambra, California, Series #A100 or approved equal) assembly consisting of a rigid housing, a clean transparent viewing window, and a vacuum gauge shall be immediately placed, in a manner a to ensure a seal over the area of the liner to be tested.

c. A vacuum of 35 kPa shall be induced and held for a minimum of 5 seconds or long enough for the area to be thoroughly examined.

d. Examine the geomembrane through the viewing window for the presence of soap bubbling, all areas where leaks are identified shall be marked and repaired.

e. Any portion of an extrusion seam or repair that cannot be vacuum tested, must be pick tested.

f. The Contractor shall perform pressurized testing of all double wedge weld seams, regardless of length, in the following manner.

.4 Both ends of the seam to be tested shall be sealed.

a. A needle with pressure gage, or other approved pressure feed device equipped with a pressure gauge, shall then be inserted into the channel produced in the middle of the double wedge weld.

b. The channel shall be pressurized to 200 kPa to allow the seam to stretch and stabilize before beginning the test.

c. If the loss of pressure exceeds 28 kPa during the testing period or does not stabilize, then the seam will either be repaired entirely or the faulty area will be located and marked for repair.

d. If blockage is present, locate and test seam on both sides of blockage.

e. Remove needle or other approved pressure feed device and seal all penetration holes by extrusion welding.

.5 Destructive testing will be conducted by the QA monitor, with cooperation of the contractor. The contractor will be responsible for cutting destructive samples as directed by the QA inspector, repairing and testing the repaired area.

a. Sampling procedures are to be performed as follows:

- The installer shall cut samples at locations designated as the installation progresses in order to obtain laboratory test results before the geomembrane is covered.
- The QA monitor will number each sample and mark sample number and location on the installation layout drawing.
- The Installer shall repair all holes in the geomembrane resulting from destructive sampling. Repair and test the continuity of the repair in accordance with these Specifications.
- Samples shall be eight 200 mm wide and a minimum length of 700 mm, with the seam centred lengthwise.

b. Location and frequency of testing of wedge welded seams.

- Collect destructive test samples at a minimum frequency of one every 150 m of seamed length per welder.
- More frequent samples will be required when numerous welders are used, or if welding is conducted during adverse weather conditions.

- Where possible the QA monitor and contractor shall coordinate destructive samples to be extracted from end of seams to be discarded and above the designed maximum fluid level.
- Test locations will be determined after seaming.

9.0 Failed Seam Procedures

.1 The following procedure shall be used when there is a destructive test failure.

a. The installer shall follow one of two options:

- Reconstruct the seam, or seams between any two passed test locations.
- Track the poor weld by extracting additional samples from either side of the failed sample. These samples must be taken a minimum of 3 m from the failed sample in both directions from the location of the failed test.

.2 Check next seam welded using same welding device if required to obtain additional sample, i.e., if one side of the seam is fewer than 3 m long.

.3 If any subsequent sample fails, the process shall be repeated to establish the zone in which the seam shall be reconstructed.

.4 Acceptable seams shall be bounded by two locations from which samples have passed destructive tests.

10.0 Submissions

.1 With the bid, identify the material selected for use.

.2 With delivery of material, provide written certification from the manufacturer of the material properties for each lot of material supplied.

11.0 Liner Acceptance

.1 The geomembrane liner will be accepted by the engineer when:

a. The entire installation is finished.

b. All documentation of installation is completed.

c. Verification of the adequacy of all field seams and repairs and associated testing is complete.

12.0 Cover of Membrane

.1 The Liner Technician shall inspect bedding and protective cover materials prior to placement and shall confirm their suitability. The Liner Technician shall remain on the site throughout the placing of protective material and shall immediately bring to the Engineer's attention any procedures that he considers to be detrimental to the membrane.

.2 The Contractor shall take the necessary steps to ensure that the integrity of the liner system is not compromised during cover material placement.

.3 Any damage to the liner system shall be immediately reported to the Engineer. Repair work shall commence as soon as possible. Fill placement shall cease immediately in an area where the integrity of the liner system has been compromised. Fill surrounding the damaged liner system may have to be excavated, without further damaging the integrity of the liner, to permit repairs to be made. Hand excavation shall be used to expose damaged portions of the liner for repair.

.4 Care shall be taken to avoid any damage to the liner system by making sharp turns, sudden stops or sudden starts adjacent to the liner system during cover placement. Non-essential heavy equipment traffic in the immediate vicinity of the liner system shall be minimized.

.5 The Contractor shall discuss with the Engineer the schedule for liner system cover material placement. The Engineer shall approve all plans and schedules for covering the liner system.

APPENDIX C
EBA SITE VISIT DAILY SUMMARIES

SITE VISIT SUMMARY - FUEL TANK FARM CONSTRUCTION
BOSTON PROPERTY, NUNAVUT
HOPE BAY JOINT VENTURE

To: **Ted Mahoney, HBJV**
From: **Ed Grozic, EBA**
Report Period: **March 17 to March 26, 2001**

HBJV P.O. No.: **5001082**
EBA Project No.: **0101-00-14839.002**

1.0 INTRODUCTION

The following summarizes EBA's site visit to the Boston Property during construction of the Fuel Tank Farm. The purpose of the site visit was to provide quality assurance services during construction of the tank farm to ensure it was constructed according to the design intent, construction drawings and specifications. This report documents the events while on site.

This site visit summary does not document the entire construction of the tank farm. EBA was not on site for the initial site preparation, and for complete covering of the liner system and positioning of the fuel tanks.

2.0 WEATHER CONDITIONS

Weather conditions during the site visit are summarized below.

Temperature and Wind Conditions During Site Visit

Date	Temperature (°C)	Wind		Comments
		Direction (°)	Speed (knots)	
March 17, 2001	-36	--	0	Sunny
March 18, 2001	-35	Westerly	10	Overcast
March 19, 2001	-35	--	0	Afternoon snowfall began, snowed through the night
March 20, 2001	-35	northerly	9	Snowfall all day, with blowing snow
March 21, 2001	-24	northerly	7	Some snowfall with blowing snow
March 22, 2001	-27	northeast	16	Overcast
March 23, 2001	-31	northerly	3	Sunny
March 24, 2001	-37	southerly	1	Sunny
March 25, 2001	-34	northerly	12	Light snowfall, and blowing snow, overcast
March 26, 2001	-32	northerly	8	Partly overcast

The snowfall and blowing snow on March 20 and 21 slowed construction for a few days because each morning the snow that had fallen or drifted onto the berms had to be removed before fill placement could resume.

3.0 PERSONNEL ON SITE

EBA's site representative was Mr. Ed Grozic, P.Eng. The contact for HBJV was Mr. Ted Mahoney, P.Geo.

Procon was responsible for construction of the fuel tank farm on behalf of HBJV. The Procon superintendent was Mr. Dave Stark.

4.0 EQUIPMENT

The following is the list of equipment used, to varying degrees, to construct the tank farm.

- Caterpillar D5H Dozer with ripper,
- Kubota R420 Loader,
- JS350 Scoop (3.5 yd^3), and
- JS250 Scoop (2.2 yd^3).

The limited equipment on site presented some constructability constraints. The berms were built using the D5H Dozer and were constructed wider than designed because of the size of the dozer. The berm slopes were also shaped using the dozer, which resulted in acceptable but slightly irregular slopes.

The dozer was the primary piece of equipment used to construct the tank farm. The dozer was used to rip the frozen granular material, spread the fill in lifts, shape the berms, grade the pad and cover the liner system.

The dozer was also being used by Major Drilling to move drills to new locations during an ongoing exploration program. Drill moves took between 2 and 4 hours.

The JS250 Scoop was the second most frequently used piece of equipment and was used to haul material from the stockpile location to the tank farm location, and to traffic over and compact the placed material as best as possible appreciating that it was frozen.

The Kubota loader was unavailable most of the time because it was being used to clear snow around camp and for other site service activities. The loader however, was occasionally to haul material and was used for several hours to place cover material on the inside berm slopes and along the crest of the berms.

For most of the project the JS350 Scoop was not operable because of a hydraulic pump failure. The JS350 was not repaired until March 22. The Scoop also developed an oil leak which could

not be easily repaired and was not used again except on March 26 for a couple hours to bring fill material to the tank farm. When the Scoop was used, a temporary 'diaper' was made to contain the oil leak.

5.0 CONSTRUCTION MATERIALS

5.1 Granular Fill Materials

The tank farm was designed to be constructed with two types of material; a Mine Muck Material (typically 100 mm minus with some oversize and variable in gradation) and a 40 mm crush (variable gradation and fines content). The Mine Muck material was to be used to construct the core of the berms and for rough grading of the pad. At the time of the design it was understood that Mine Muck material was abundant on site and that 40 mm Crush was limited. However, during construction, it was discovered that the 40 mm Crush was more readily available. As such, the tank farm berms were constructed primarily of the 40 mm Crush. The 40 mm Crush material contained more fines than the sample originally sent to EBA for analysis and used in the design. Also, the crush was typically less than 25 mm in size, but contained occasional cobble sized pieces up to 150 mm in size. It is unknown how the larger material became mixed in with the crush but HBJV speculated that during crushing and screening of the material there must have been a hole in the screen, which allowed the large material to pass through.

Rough grading of the site was done prior to EBA's arrival and was carried out using Mine Muck material.

The 40 mm Crush material was located in small stockpiles along the north side of the tank farm. The material was generated from a previous bulk sampling program conducted in 1997 or 1998. The material was frozen and had to be ripped using the dozer.

Eleven (11) moisture contents were conducted on the material. The moisture contents varied from 4.2 % to 7.4 % with an average of 5.4 %.

40 mm Crush - Moisture Content Determinations

Sample No.	Date	Tare (g)	Wet Sample+Tare (g)	Dry Sample+Tare (g)	Water (g)	Dry Sample (g)	Moisture Content (%)
1	17-Mar-01	16.3	549.1	527.2	21.9	510.9	4.3%
2	17-Mar-01	16.3	544.9	519.8	25.1	503.5	5.0%
3	17-Mar-01	16.5	591.3	557.1	34.2	540.6	6.3%
4	18-Mar-01	16.5	536.3	506.1	30.2	489.6	6.2%
5	18-Mar-01	16.9	562.2	525.2	37.0	508.3	7.3%
6	19-Mar-01	16.6	520.0	499.9	20.1	483.3	4.2%
7	19-Mar-01	17.6	567.5	543.7	23.8	526.1	4.5%
8	20-Mar-01	16.9	536.3	506.1	30.2	489.2	6.2%
9	20-Mar-01	16.4	562.2	525.2	37.0	508.8	7.3%
10	20-Mar-01	16.6	520.0	499.9	20.1	483.3	4.2%
11	20-Mar-01	17.6	567.5	543.7	23.8	526.1	4.5%
						Average	**5.4%**
						Max	**7.3%**
						Min	**4.2%**

Moisture contents were conducted on random sampes of the 40 mm Crush material used to construct the fuel tank farm. The material was located north of the tank farm in 3 to 4 m high stockpiles. The material had to be riped using a dozer and several of the frozen lumps were crushed by the dozer, but some could not be crushed and were wasted. Samples of the lumps and samples of the loose granular fill were taken. The results show that the material does contain up to 7.3% of moisture.

The frozen moisture in the material posed several problems. The material had to be ripped and broken down before it could be placed, which required additional time. Also, the compaction that could be achieved was less because of the frozen moisture. The moisture in the material and the lower than desired compaction will result in some settlement of the fuel tank farm facility.

5.2 Liner Materials

The following is the inventory of geomembrane and geotextile materials delivered to site on March 18, 2001:

- HDPE Geomembrane 60 mil, smooth – 1 roll
- Non-woven Geotextile LP12 – 7 rolls
- Non-Woven Geotextile LP10 – 3 rolls

At the time the material was ordered by HBJV, Layfield did not have in stock 10 rolls of LP12, so in substitute, 3 rolls of LP10 were provided. The LP10 is slightly thinner than the LP12 but was deemed acceptable. The LP10 was used as the second layer of geotextile on top of the HDPE liner. Two layers of LP12 were placed under the liner and one layer of LP12 and a second Layer of LP10 were placed over the liner.

Additional details on the liner materials are provided in Layfield's Quality Control program employed during installation of the liner system.

6.0 CONSTRUCTION ACTIVITIES

The following is a summary of daily events during EBA's site visit.

March 16, 2001 (Friday)

Travel from Calgary to Yellowknife. Arrived in Yellowknife at 10:30pm. Overnight in Yellowknife at the Discovery Inn.

March 17, 2001 (Saturday)

Travel to the Boston site via charter, arrived at 1:30 pm.

Met with Ted Mahoney, Manager of the Boston Property. Conducted a thorough walk of the site with Ted and reviewed the design report and construction drawings.

Supplied HBJV with two copies of the design report along with construction drawings and specifications.

Met with Dave Stark, superintendent for Procon who is responsible for construction the tank farm on behalf of HBJV.

Only the dozer and the loader were operating. The JS350 Scoop was not running because of a pump that needed to be replaced. The pump was to be on today's flight, but did not make it to site. The pump will not arrive until Monday, March 19. HBJV instructed Procon to get the JS250 scoop from Roberts Bay and bring it to the Boston Site so it can be used to construct the tank farm. The JS250 Scoop is scheduled to arrive tomorrow afternoon.

Assessed available construction materials on site. Discovered that the 40 mm crush was abundant on site and that it contained more fines than EBA was understood to believe during design.

Collected three samples of the 40 mm Crush for moisture content determination. Waiting for a scale to arrive from Windy Camp.

Visited the construction site and noted the following:

- The material being used for construction has frozen chunks varying in size, up to 600 mm in diameter. Many of the frozen chunks break down when driven over with

the dozer, but some will have to be picked out. I discussed with Procon that the larger frozen chunks must be removed.

- Procon had windrowed material along the berm alignment on three sides and was placed in piles up to 1 m high. I said that the material as placed was not acceptable and that it would have to be spread flat into 300 mm thick lifts and that each lift would have to be trafficked with the dozer and the Scoop to attain some compaction. Procon levelled the windrowed piles as instructed.

- The pad area within the containment berms was relatively free of snow and appeared to be a good surface. It is EBA's understanding that no new fill was placed on the pad surface and the pad elevation was the existing elevation of the original muck pad.

March 18, 2001 (Sunday)

Changed my return flight to March 24 instead of March 20. I discussed with HBJV that it is important that I remain on site for a few more days to ensure that the berms are properly constructed.

Assisted the HBJV surveyor (Mr. Jay Hallman) to layout grade stakes for the containment berms and the pad.

Only the dozer and the loader were operating. The dozer continued to rip borrow material. The loader was used to remove the larger frozen chunks from the fill stockpile and used to place some fill along the east berm.

To date approximately 300 to 500 mm of fill has been placed along the north, south and east berms.

Collected two additional samples of the 40 mm Crush for moisture content determination.

Made up 100 sand bags that will be used by Layfield during liner installation. Layfield is scheduled to arrive on March 24.

HBJV would prefer that EBA not stay longer than March 24. I suggested that it would be in their best interest if I stayed for the duration of construction, but that the decision was up to them. Also, discussed with Ted Mahoney that EBA's As-built report could only document construction activities while on site.

March 19, 2001 (Monday)

Continued to rip the frozen 40 mm Crush material.

Continued to construct the north, south and east berms.

Conducted several moisture contents on samples of the 40 mm Crush.

Assisted surveyor with layout of grade stakes. Placed grade stakes on the north, east and south berms.

Discussed with HBJV and Procon how best to position the fuel tanks within the tank farm. One idea was to construct three of the fours berms, install part of the liner, position the tanks, and then complete the fourth berm and the liner installation. Another idea was to construct all four berms, completely install the liner system and then skid the tanks into place by going overtop of one of the berms. The consensus was that the tanks would be positioned after all four berms are constructed and the liner installed and covered.

The three berms are within one to two lifts of design grades and elevations.

Major Drilling took the dozer at 4:30pm to make a rig move. The JS250 Scoop continued to compact the berms and to move some material, but little could be done since the dozer was unavailable to spread the material.

Collected two samples of the 40 mm Crush for moisture content determination. Weigh scale arrived from Windy Camp. Conducted tests on samples collected between March 17 and 19.

Began to snow in the afternoon.

March 20, 2001 (Tuesday)

Significant snowfall over night. In the morning, areas of the tank farm were covered with accumulations of 50 to 100 mm and some areas were drifted with up to 400 mm of snow. Most of the morning was spent removing the snow that had accumulated. All snow removal was done using the D5H Dozer and the JS250 Scoop. Some granular material had to be scraped away to ensure that the majority of the snow was removed.

Assisted the surveyor with layout of grade stakes along the north, east and south berms.

The snow continued to fall throughout the day and some drifting continued to be a problem. Whenever possible the drifted snow was removed. This slowed construction.

A lift of fill was placed on the north, east and south berms. The fill was compacted with the JS250 Scoop.

Construction of the west berm has not yet begun.

Major Drilling took the dozer at 4:00 pm to make a rig move.

Collected four samples of 40 mm Crush for moisture content determination.

March 21, 2001 (Wednesday)

Had to remove snow again from the pad area and the berms. This took about 3 hours.

The dozer was taken by Major Drilling from noon till 2:00 pm for a drill move.

Assisted the surveyor with placement of grade stakes. Determined that the north, east and south berms were very close to the design liner elevation.

Dozer worked the afternoon shaping the north and south berms and ripping additional 40 mm Crush material.

Procon worked three additional hours after supper ripping more granular material for construction of the berm tomorrow. Permission to work the additional hours was provided by HBJV.

Construction was slow today due to the snow removal work and due to the drill rig move.

March 22, 2001 (Thursday)

Layfield liner installer (Mr. Barry Nykolaishyn) arrived on site today. Helped Layfield locate equipment and materials and get set up for installation.

Dozer was taken for drill moves at 1:00 pm (for 1 hour) and at 5:00 pm (for 2 hours).

Procon worked an additional 2 hours, 7:00 to 9:00 pm grading and ripping material. Authorization for the additional hours was given by HBJV.

Procon mechanic arrived to site today. The pump on the JS350 scoop was repaired and was used for a couple hours hauling material to the pad.

Assisted surveyor to layout pad grade elevations and check berm crest elevations. Three of the berms are to the design elevation.

Started to construct the west berm today. Started to compact the sideslopes of the berms.

Finished placing the base of the tank farm today.

Hope to start liner placement tomorrow.

Called the office today and spoke with Kevin Jones and updated him on the progress and issues.

March 23, 2001 (Friday)

Layfield liner installer on standby

Finished final grading and shaping of the north, east and south berms. Did some hand work on the berms using rakes. Picked out any rocks that could damage the liner.

Continued constructing the west berm.

Major drilling took the dozer for a drill rig move at 10:00 am. Dozer was gone for 2 hours.

Both Scoops worked the afternoon building the final berm. A couple more hours are required in the morning and the tank farm will be ready for liner deployment.

Spoke to Kevin Jones today to discuss progress and whether I should stay an additional couple days. I decided that I should and discussed it with HBJV. HBJV agreed and I subsequently changed my flight schedule. Re-scheduled to depart site on Monday, March 26.

Assisted with survey of the west berm. Also, helped the surveyor survey a few drill rig locations, which had nothing to do with the tank farm, but he asked for help.

The Procon and Kitnuna operators worked after dinner servicing their machines, so that they would not have to do it first thing in the morning.

March 24, 2001 (Saturday)

Began deploying LP12 non-woven geotextile at 8:30 am. Installed two layers.

Dozer blew a hydraulic hose at 8 am and was not repaired until 2:00 pm. Spent the afternoon ripping additional 40 mm Crush material.

Installed the two layers of geotextile by 11:00 am. Spend the remainder of the morning rigging up a 'splitter-bar' required to support the HDPE liner so that it can be deployed.

HDPE liner was installed today. Liner installer worked an additional 2.5 hours so that everything could be completed. Authorization to work longer was provided by HBJV. All liner QC testing was also completed.

As-built survey of the liner surface. Surveyed inside toe of berms, pad surface, berm crests.

March 25, 2001 (Sunday)

HDPE liner was covered with two layers of non-woven geotextile. One layer of LP12 and a second layer of LP10. Geotextile was deployed by 11:00 am.

Dozer was unavailable until 11:00 am because it was doing some work at the airstrip.

Began covering the liner at 1:00 pm. Started covering the crest of the berm. Covered the north, south and west berms using the JS250 Scoop. The Scoop was able to place material on the crest of the berm from outside of the tank farm. The material was spread by hand using shovels. The east berm was covered using the Kubota because it could not be accessed by the Scoop. The crests of all fours berms were covered.

The JS250 Scoop went down at 2:00 pm because of a motor overheating problem. Scoop was repaired by 3:30 pm. Scoop was again down at 4:30 because of overheating.

Will start placing material inside the tank farm tomorrow.

Dozer spent the rest of the day ripping the additional material required for cover of the liner system.

March 26, 2001 (Monday)

Began covering the liner system within the fuel tank farm. Ramped into the tank farm from the south side of the facility where the berm is lowest in height. The material was hauled to the crest of the berm using the JS250 Scoop and pushed into the pad using the dozer.

Frozen chunks of material were hand picked from the 40 mm crush to minimize potential damage to the liner.

Departed site at 2:00 pm.

At the time I departed site the liner along the crest of the berms had been covered and a ramp had been constructed overtop of the south berm so 40 mm Crush material could be hauled into the bermed area. Placement of the material within the tank farm had just begun as I was departing. The inside slopes of the berms had not yet been covered with 40 mm Crush.

Prior to leaving site, I discussed with Ted Mahoney how the balance of the liner needed to be covered. I recommended that 40 mm Crush material be hauled into the bermed area using the JS350 Scoop and placed in a stockpile along the south berm just within the area. The dozer would then spread the material in a single lift (50 cm thick) across the pad area. I stressed that the dozer had to be very careful not to make sharp turns while placing the cover material.

The remainder of the cover placement and positioning of the fuel tanks would be done by HBJV and Procon without the presence of EBA. I had recommended that HBJV update EBA on the remaining activities to ensure that they were completed according to the design intent.

Prior to positioning the fuel tanks, it was agreed between EBA, HBJV and Procon that the base of the pad would be spayed with water and allowed to freeze. The tanks would then be slid along the surface of the fill and be less likely to gouge into the fill and possibly damage the liner system.

7.0 GENERAL DISCUSSIONS/COMMENTS

There were three primary issues which impacted construction; weather conditions, equipment availability and material availability and suitability. These issues affected the rate of construction and the standards to which the tank farm could be constructed. The tank farm was constructed to the best standards given the above mentioned constraints.

Prepared by:

EBA Engineering Consultants Ltd.

Ed M. Grozic

APPENDIX D
CONSTRUCTION PHOTOGRAPHS

Photo 1
40 mm Crush stockpiles immediately north of fuel tank farm location, as viewed from the south.

Photo 2
Caterpillar D5H Dozer ripping and breaking down the 40 mm Crush stockpiles.

Photo 3
Removing large frozen chunks from the 40 mm Crush stockpile.

Photo 4
Site conditions prior to construction of fuel tank farm, as viewed from the west.

Photo 5
Site preparation and grading work being done prior to EBA's arrival on site.

Photo 6
JS250 Scoop placing 40 mm Crush along north berm.

Photo 7
D5H Dozer spreading 40 mm Crush along north berm.

Photo 8
JS250 Scoop with bucket full of material compacting 40 mm Crush along north berm.

Photo 9
Snowfall and wind blown snow accumulations.
Photo taken on the morning of March 20, 2001.

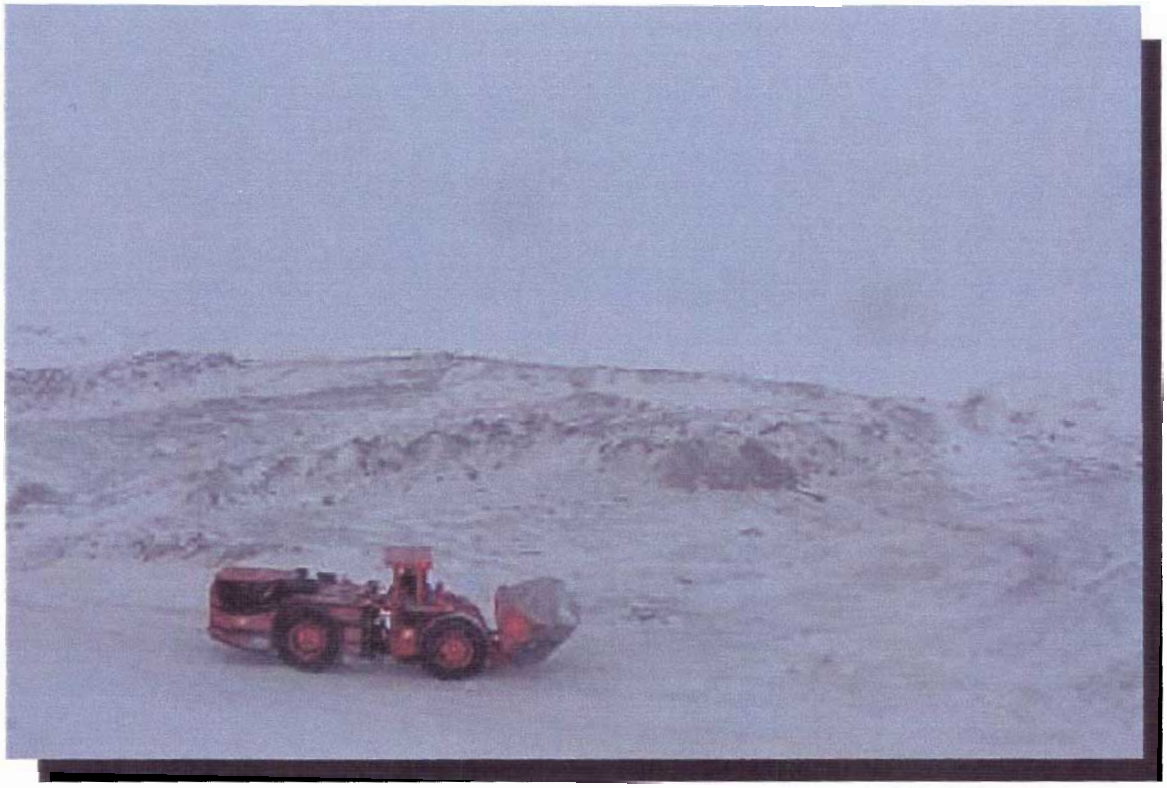


Photo 10
Snowfall and wind blown snow accumulations.
Photo taken on the morning of March 21, 2001.

Photo 11
JS250 Scoop placing 40 mm Crush along west berm alignment. Ramp along south berm under construction.

Photo 12
Tank farm ready for liner installation, as viewed from the southwest (March 24, 2001).

Photo 13
Base of tank farm within containment berms prior to liner installation.

Photo 14
Deployed non-woven geotextile, preparing for HDPE liner installation.

Photo 15
HDPE liner installed, as viewed from the southwest (March24, 2001).

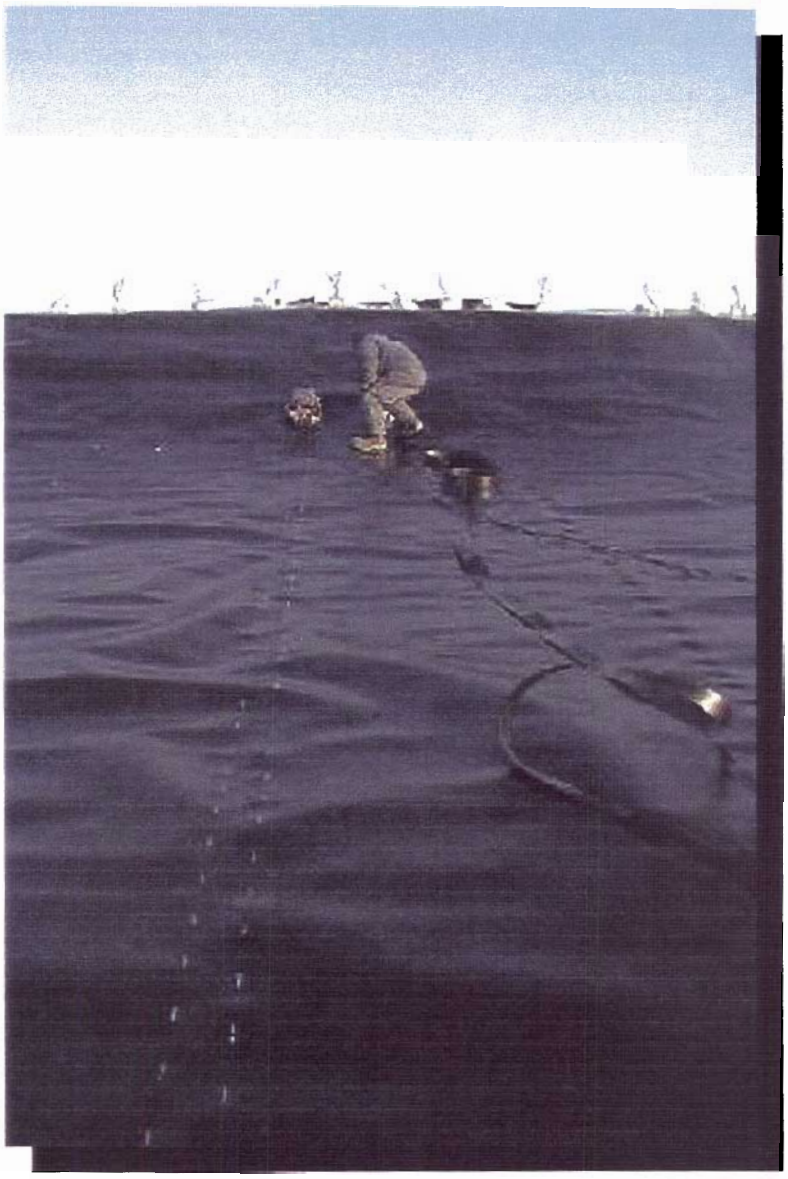


Photo 16
Layfield site representative seaming HDPE panels.

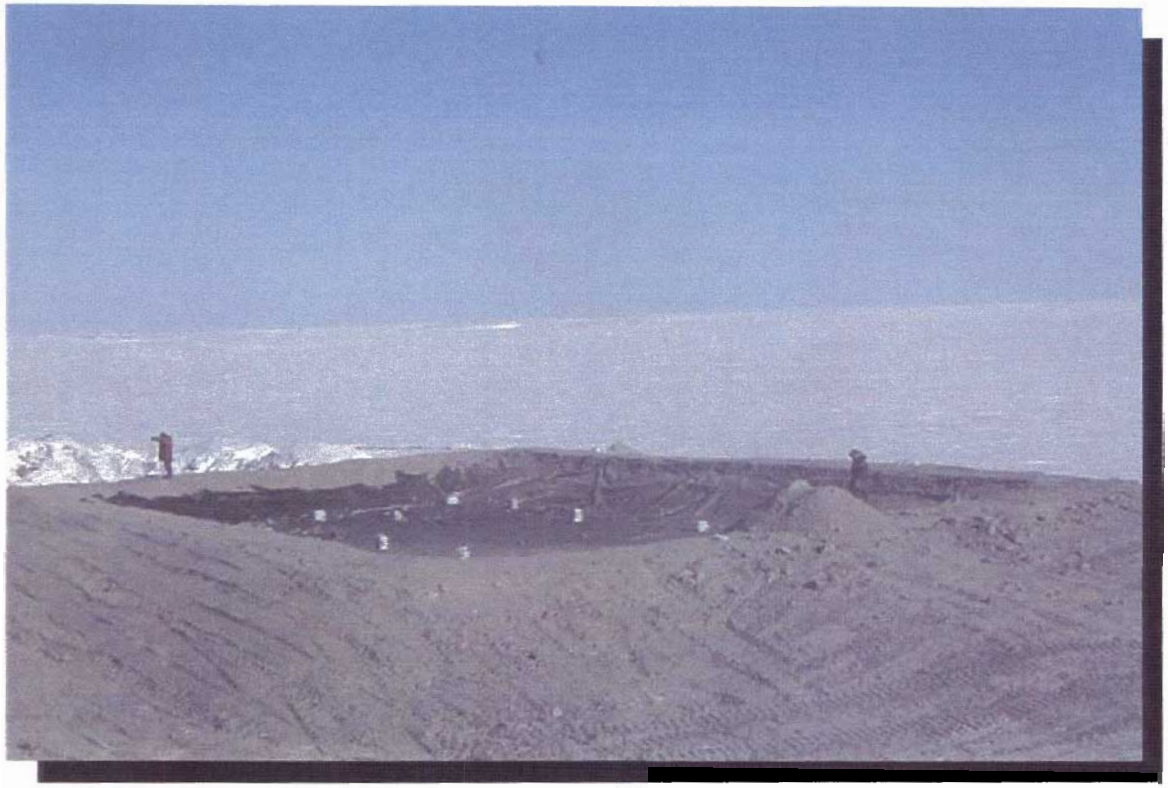


Photo 17
Liner system installed and crest of berms covered with 40 mm Crush, as viewed from the southwest (March 25, 2001).

Photo 18
D5H Dozer spreading 40 mm Crush along base of tank farm. Photo taken by HBJV.

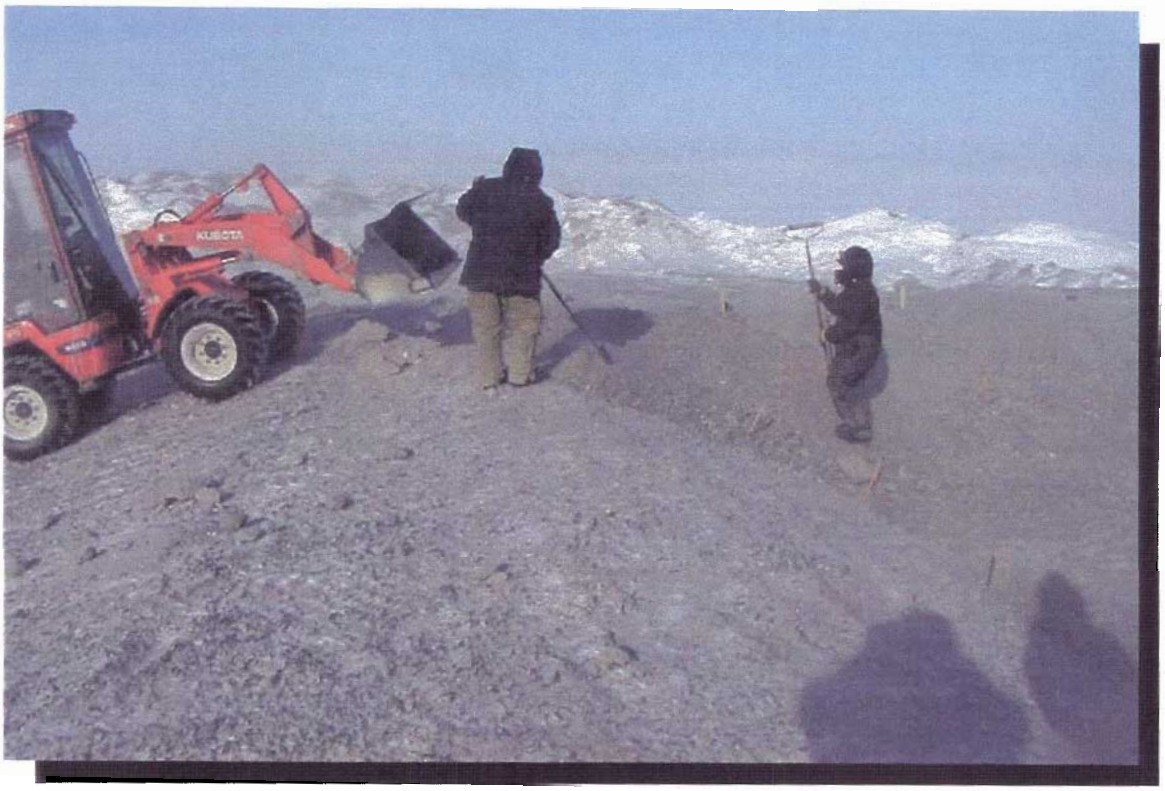


Photo 19
Kubota loader and laborers placing 40 mm Crush along inside of west berm. Photo taken by HBJV.

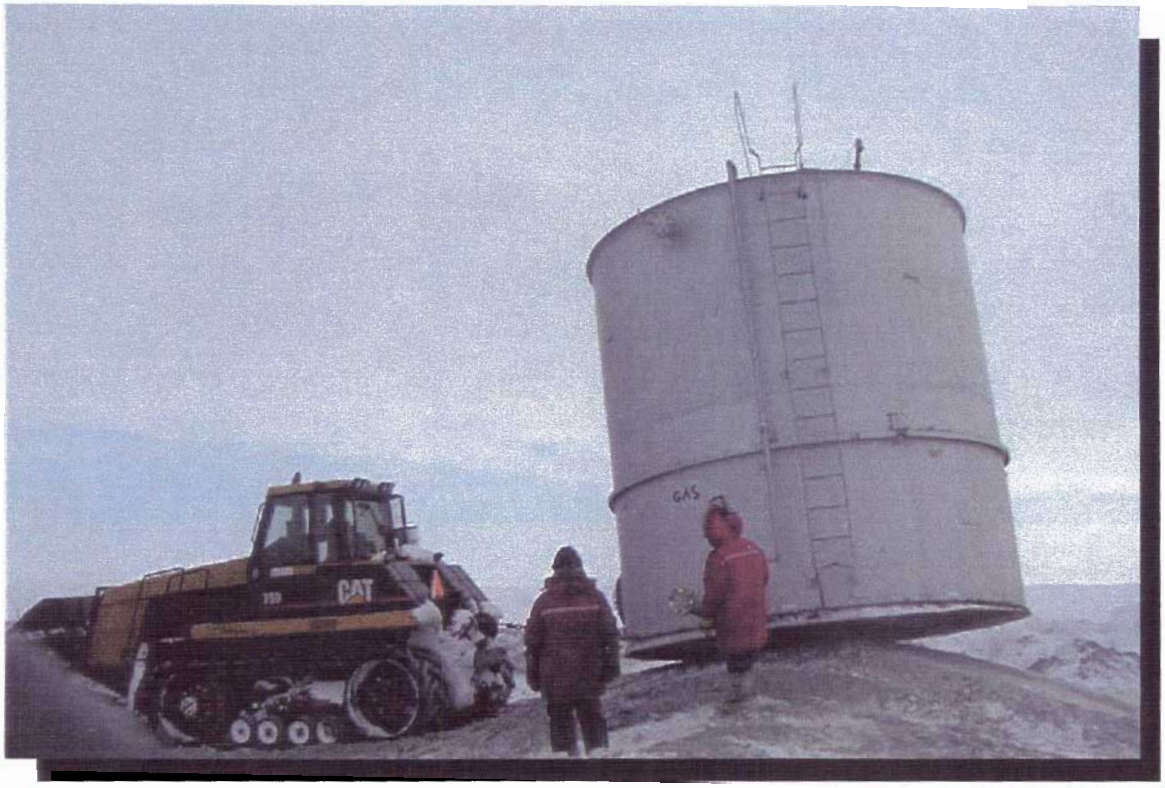


Photo 20
Challenger 75D skidding fuel tank over south berm. Photo taken by HBJV.

Photo 21
Four fuel tanks in position, as viewed from the south. Photo taken by HBJV.

Photo 22
All eight fuel tanks placed inside containment berms, as viewed from the northeast. Photo taken by HBJV.

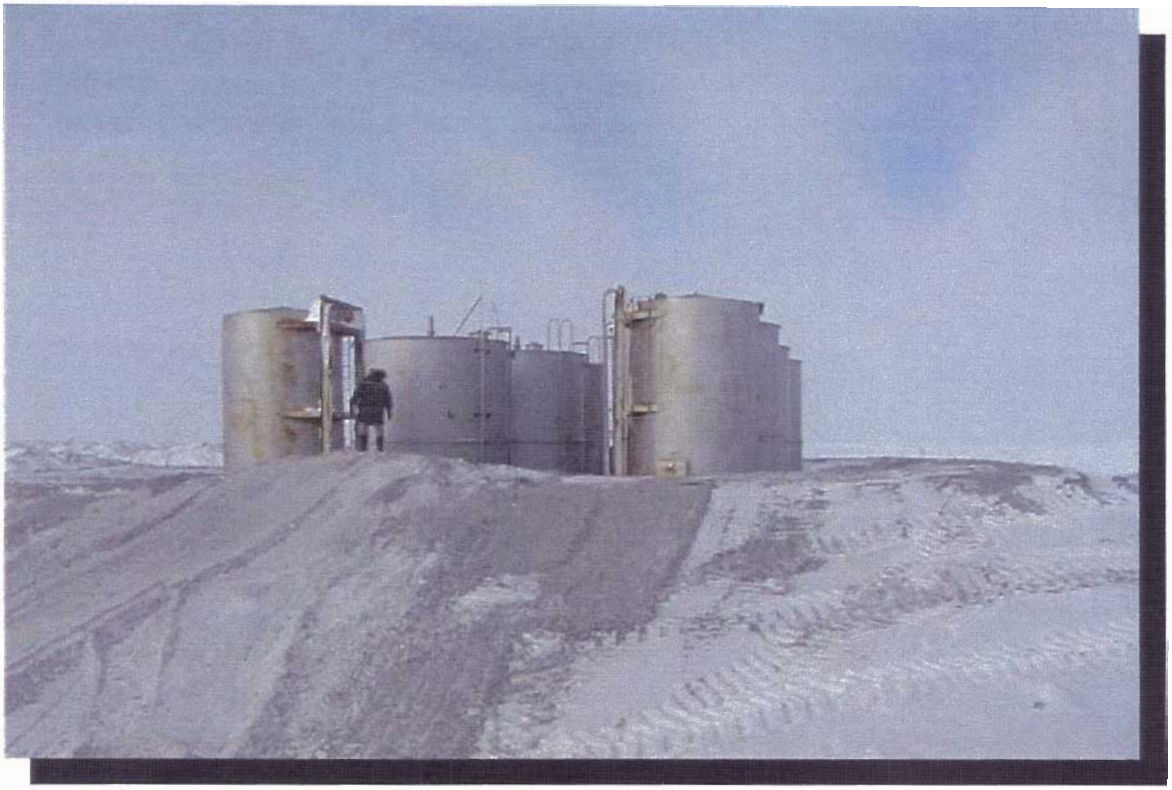


Photo 23
All eight fuel tanks placed inside containment berms, as viewed from the south. Note ramp over south berm used to skid tanks into position. Photo taken by HBJV.

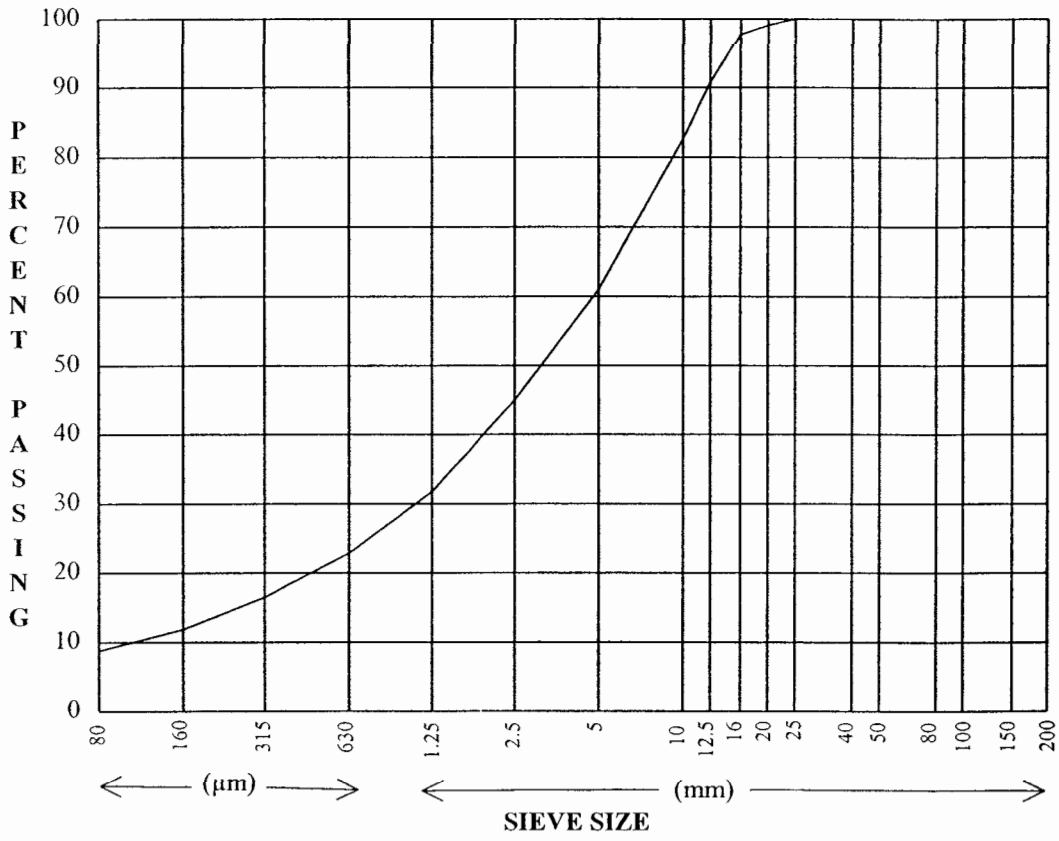
APPENDIX E
EBA LABORATORY TEST RESULTS

EBA Engineering Consultants Ltd.

AGGREGATE ANALYSIS REPORT

PROJECT: **FUEL TANK FARM DESIGN**
CLIENT: HOPE BAY JOINT VENTURE
PROJECT NO.: 0101-00-14839002
DESCRIPTION: CRUSHED BASALT
SOURCE: BOSTON PROPERTY, NUNAVUT
TEST DATE: April 25, 2001
SAMPLE NO.: 4913

SIEVE SIZE	PERCENT PASSING
25 mm	100
20 mm	99
16 mm	98
12.5 mm	91
10 mm	83
5 mm	61
2.5 mm	45
1.25 mm	32
630 µm	23
315 µm	16
160 µm	11.8
80 µm	8.7



REMARKS: PROCESSED MINE MUCK FROM UNDERGROUND EXPLORATION PROGRAM

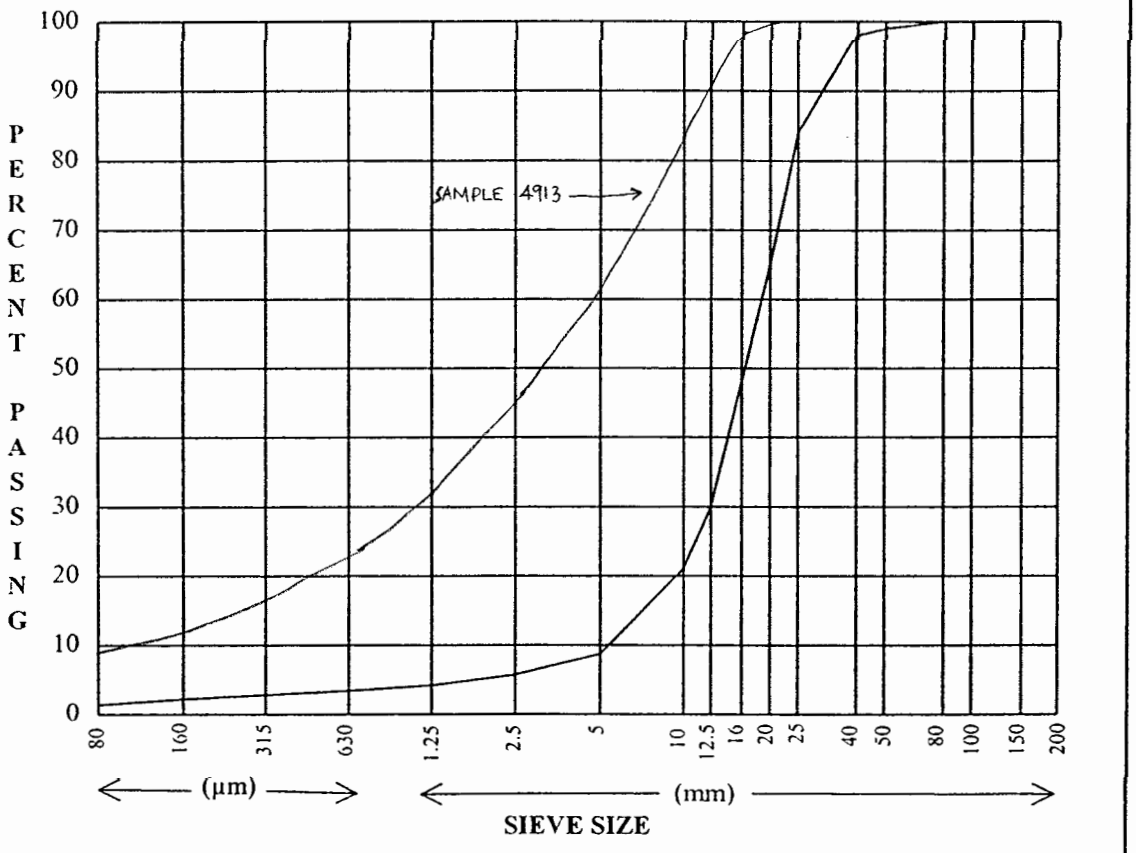
REVIEWED BY: _____

EBA Engineering Consultants Ltd.

AGGREGATE ANALYSIS REPORT

PROJECT: **FUEL TANK FARM DESIGN**
CLIENT: HOPE BAY JOINT VENTURE
PROJECT NO.: 0101-00-14839
DESCRIPTION: CRUSHED BASALT
SOURCE: BOSTON PROPERTY, NUNAVUT
TEST DATE: February 12, 2001
SAMPLE NO.: 4808

SIEVE SIZE	PERCENT PASSING
80 mm	100.0
50 mm	99.0
40 mm	98.0
25 mm	84.0
20 mm	65.0
16 mm	48.0
12.5 mm	30.0
10 mm	21.0
5 mm	8.7
2.5 mm	5.7
1.25 mm	4.2
630 µm	3.4
315 µm	2.8
160 µm	2.2
80 µm	1.4



REMARKS: PROCESSED MINE MUCK FROM UNDERGROUND EXPLORATION PROGRAM

REVIEWED BY: _____

40 mm Crush - Moisture Content Determinations

Sample No.	Date	Tare (g)	Wet Sample+Tare (g)	Dry Sample+Tare (g)	Water (g)	Dry Sample (g)	Moisture Content (%)
1	17-Mar-01	16.3	549.1	527.2	21.9	510.9	4.3%
2	17-Mar-01	16.3	544.9	519.8	25.1	503.5	5.0%
3	17-Mar-01	16.5	591.3	557.1	34.2	540.6	6.3%
4	18-Mar-01	16.5	536.3	506.1	30.2	489.6	6.2%
5	18-Mar-01	16.9	562.2	525.2	37.0	508.3	7.3%
6	19-Mar-01	16.6	520.0	499.9	20.1	483.3	4.2%
7	19-Mar-01	17.6	567.5	543.7	23.8	526.1	4.5%
8	20-Mar-01	16.9	536.3	506.1	30.2	489.2	6.2%
9	20-Mar-01	16.4	562.2	525.2	37.0	508.8	7.3%
10	20-Mar-01	16.6	520.0	499.9	20.1	483.3	4.2%
11	20-Mar-01	17.6	567.5	543.7	23.8	526.1	4.5%
						Average	**5.4%**
						Max	**7.3%**
						Min	**4.2%**

Moisture contents were conducted on random sampes of the 40 mm Crush material used to construct the fuel tank farm. The material was located north of the tank farm in 3 to 4 m high stockpiles. The material had to be riped using a dozer and several of the frozen lumps were crushed by the dozer, but some could not be crushed and were either removed by hand and left. Samples of the lumps and samples of the loose granular fill were taken. The results show that the material contains up to 7.3% of moisture.

APPENDIX F
LAYFIELD PLASTICS QUALITY CONTROL (QC) DOCUMENTATION

LAYFIELD PLASTICS

CERTIFICATE OF FINAL INSPECTION AND ACCEPTANCE OF GEOSYNTHETIC INSTALLATION(S)

PROJECT NAME: HOPE BAY VENTURE TANK FARM
PROJECT NUMBER: _____ **DATE:** MARCH 25/01
OWNER: HOPE BAY VENTURE
LOCATION: BOSTON CAMP BATHERT INLET

Scope of Geosynthetics Installation(s) : THE WORK
APROX 35 METERS X 25 METERS DOUBLE LAYER OF LP12 UNDERCUSHION, 60MIL SMOTH HOPE. DOUBLE LAYER LP 12-10 OVER LAY AND DO ALL LAYFIELD QA-QC TESTing.

Part 1 - LAYFIELD PLASTICS

I, BARRY NYKOLAISHYN *, a duly appointed representative of Layfield Plastics (1978) Ltd. (LPL), have visually observed the geosynthetics installations (as outlined above), and have found the Work to be complete and free of defects and declare that the Work was completed in accordance with the project specifications, Layfield Plastics' QC program and the terms and conditions of the contract.*

Layfield Plastics Representative :

Name: BARRY NYKOLAISHYN
Title: SUPERVISOR
Date : MARCH 25/01 **Signature :** _____

Part 2 - OWNER (or Representative)

I, TIM W. KLUKEWICH *, a duly appointed representative of* HOPE BAY JOINT VENTURE - BOSTON PROPERTY *, do hereby take over and accept the geosynthetic installation(s) described above, and confirm that the work has been completed in accordance with the project specifications and the terms and conditions of the contract.*

I have evaluated and measured the work together with the Layfield Plastics (1978) Ltd. representative, and agree that the measurements shown are both true and correct, and that the installation has met our approval.

Owners Representative :

Name : TIM W. KLUKEWICH
Title: SITE SUPERINTENDENT
Company: HOPE BAY JOINT VENTURE
Date : MAR 25/01 **Signature:** Tim W. Klukewich

Comments : _____

LAYFIELD PLASTICS

CERTIFICATE OF ACCEPTANCE OF SOIL SUBGRADE SURFACE

PROJECT NAME: HOPE BAY VENTURE TANKE FARM
PROJECT NUMBER:
OWNER: HOPEBAY VENTURE
LOCATION: BOSION CAMP BATHERT INLET

I, the undersigned, a duly appointed representative of Layfield Plastics (1978) Ltd. (LPL), have visually observed the soil subgrade surface described below, and found it to be an acceptable surface on which to install geomembrane.

This certification is based on observations of the surface of the subgrade only. No subterranean inspections or tests have been performed by Layfield Plastics, and LPL makes no representations or warranties regarding conditions which may exist below the surface of the subgrade. Layfield Plastics accepts no responsibility for conformance of the subgrade to this projects's specifications.

The soil subgrade surface accepted on this date refers to its present condition. Any changes in the subgrade condition that result from the effects of inclement weather and/or other forces beyond the control of Layfield Plastics and remedial work to correct the resulting deficiencies, will be the direct responsibility of the General Contractor.

Area Being Accepted: ALL OF TANK FARM
LP 12 UNDER LINER
AND LP12-10 ON TOP OF LINER

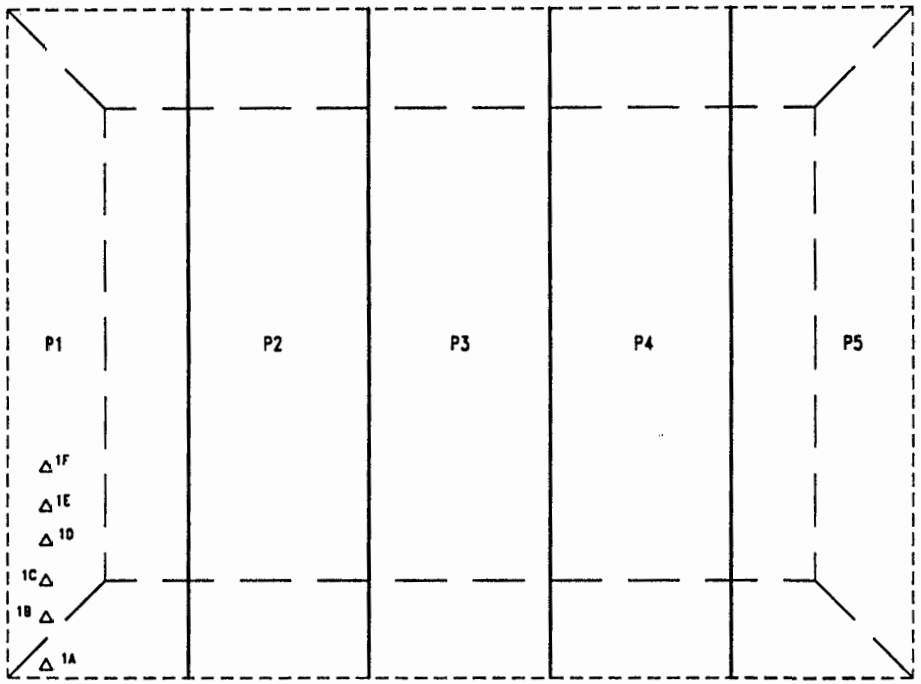
LAYFIELD PLASTICS REPRESENTATIVE :

Date: MARCH 25/01
Signature:
Name: BARRY NYKOLAISHYN
Title: SUPERVISOR

OWNERS REPRESENTATIVE

Date: MARCH 25/01
Name: TIMOTHY KLUKEGNICH
Signature:
Title: SITE SUPERINTENDENT
Company: HOPE BAY JOINT VENTURE

N



FUEL STORAGE TANK FARM

NOTE :
SEAM NUMBERS SHOWN ON TESTING LOG SHEETS REPRESENT THE ADJACENT PANEL NUMBERS.

LEGEND

- CHANGE IN GRADE
- EXTENT OF LINER
- LINER FIELD SEAM
- ANCHORAGE AREA
- XXX EXTRUSION WELD
- ⊗ PIPE PENETRATION
- △ PATCH
- R4 REPAIR NUMBER
- P2 PANEL NUMBER

LAYFIELD PLASTICS

MIRAMAR MINING CORP.
HOPE BAY JOINT VENTURE
FUEL STORAGE TANK FARM
60 MIL HDPE AS-BUILT DRAWING
BATHURST INLET, NUNAVET

SCALE : N.T.S.		PROJECT No. 01C-0015
DWG : 1 OF 1		
DWN: GP	CHKD. GP	APP'D. FC
DATE : APRIL 2, 2001		

GEOSYNTHETICS INVENTORY LOG

PROJECT NUMBER: _____ PROJECT TITLE: TANK FARM 60mil HDPE
OWNER: HOPE BAY JOINT VENTURE CONTRACTOR: _____
LOCATION: BOSTCAMP BATHERT INLET SHEET NUMBER: _____

MATERIAL TYPE: (GEOMEMBRANE) GEONET GEOTEXTILE OTHER _____
DATE OF ARRIVAL: NA DATE OF INVENTORY: MARCH 22/01
UNLOADING METHOD: NA INVENTORY BY: BARRY
PRODUCT TYPE: HDPE 60 mil CONDITION IN TRUCK: NA
MATERIAL MANUFACTURER: _____

Panel / Roll Number	Material Dimensions			QC Certificate Available Y/N	Conf. Sample Removed Y/N	Other _____	Remarks
	Length	Width	Thickness or Weight				
42725	520 FT	23 FT	60 MIL	N	N		

SUBMITTED BY: BN
DATE: MARCH 29/01

GEOMEMBRANE TRIAL SEAM LOG

PROJECT NUMBER: _____ PROJECT TITLE: TANK FARM 60 mil HOPE

OWNER: HOPE BAY JOINT VENTURE CONTRACTOR: _____

LOCATION: BOSTON CAMP BATLERT INLET SHEET NUMBER: _____

✓ TF - # = FUSION ✓ TX - # = EXTRUSION _____ TS - # = SOLVENT

SAMPLE NUM.	APPROX. TIME & DATE	WELDING MACHINE NUMBER	WELD. TECH.	TEMPERATURES				TEST RESULTS			PASS OR FAIL	CHK'D BY	REMARKS
				AMBIENT AIR TEMP.	PREHEAT OR MACHINE SPEED	EXTRUDER	WEDGE TEMP.	INSIDE PEEL MODE / STRENGTH	OUTSIDE PEEL MODE / STRENGTH	SHEAR MODE / STRENGTH			
TF# 1	11:45 AM	1706	BN	-35	20%		355	147 / 1132 137 / 1142	138 / 1160 139 / 1129	199 / /	P	BN	R# 42725
TX# 1	PM	X2	BN	-30	600'	500		130 / 141 /	135 / 134 /	200 / /	P	BN	
								/ / / /	/ / / /	/ /			
								/ / / /	/ / / /	/ /			
								/ / / /	/ / / /	/ /			
								/ / / /	/ / / /	/ /			
								/ / / /	/ / / /	/ /			
								/ / / /	/ / / /	/ /			

SUBMITTED BY: BN

DATE: MARCH 29/01

GEOMEMBRANE SEAM LOG

PROJECT NUMBER: _____ PROJECT TITLE: TANK FARM 60 MIL HDPE
OWNER: HOBE BAY JOINT VENTURE CONTRACTOR: _____
LOCATION: BOSTON CAMP BAYLENT INLET

PASSING TRIAL SEAMS

	NO.	TIME	TECH ID
✓ FUSION	TF #1	AM	BN
EXTRUSION			
SOLVENT			

SHEET NUMBER: _____
DATE: MARCH 25/01

SEAM NUMBER	SEAM SECTION • START POINT	SEAM SECTION • FINISH POINT	APPROX. START TIME	AMB. AIR TEMP.	WELD TECH.	PREHEAT OR MACH. SPEED	MACHINE TEMPERATURES: DIGITAL SET / WEDGE OR BARREL	MACHINE TEMPERATURES: INDICATOR / WEDGE OR BARREL	APPROX. LENGTH WELDED FT	DESTR. NUM.	CHK'D BY	REMARKS	NON-DESTRUCTIVE: TEST DATE	NON-DESTRUCTIVE: CHECKED BY
1	1 2	EEOS - WEOS	1:35	-30	BN	20%	355 -	355 -	75		BN			
2	1 3	WEOS - LEOS	2:11	-30	BN	20%	355 -	355 -	75		BN			
3	1 4	LEOS - WEOS	2:43	-30	BN	20%	355	355 -	75		BN			
4	1 5	WEOS - LEOS	3:15	-30	BN	20%	355 -	355 -	75		BN			
1							-	-						
1							-	-						
1							-	-						
1							-	-						
1							-	-						
1							-	-						
							DAILY TOTAL		300					

REFERENCE SEAM ENDPOINTS FROM AN END OF SEAM (EOS), A REPAIR NUMBER, OR A POINT LOCATION ON THE SEAM.

SUBMITTED BY: BN DATE: MARCH 29/01

GEOMEMBRANE SEAM PRESSURE TEST LOG

PROJECT NUMBER: _____
OWNER: HOPE BAY JOINT VENTURE
LOCATION: BOSTON CAMP BATHCAT INLET

PROJECT TITLE: TANK FARM COMIC HOPE
CONTRACTOR: _____

DATE: _____
SHEET NUMBER: _____

SEAM NUMBER	SEAM SECTION * FROM	TO	TECH. ID	TIME START	FINISH	PRESSURE INITIAL	FINAL	RESULTS PASS / FAIL	SEAM COMPLETE NO	YES	CHECKED BY	REMARKS **
1	1	2	WEOS - EEOS	BN	5:17	5:22	32	31	P		✓	BN	
2	1	3	WEOS - EEOS	BN	5:18	5:23	30	30	P		✓	BN	
3	1	4	WEOS - EEOS	BN	5:19	5:24	35	33	P		✓	BN	
4	1	5	WEOS - EEOS	BN	5:25	5:30	35	33	P		✓	BN	
	/				:	:							
	/				:	:							
	/				:	:							
	/				:	:							
	/				:	:							
	/				:	:							
	/				:	:							
	/				:	:							
	/				:	:							
	/				:	:							
	/				:	:							
	/				:	:							
	/				:	:							

* REFERENCE SEAM ENDPOINTS FROM AN END SEAM (EOS), A REPAIR NUMBER, OR A POINT LOCATION ON THE SEAM.
** RECORD ANY QUANTITY OF LEAKS DETECTED AND REFERENCE NEW DEFECT CODE IN REMARKS.

DATE: MARCH 29/01
SUBMITTED BY: BN

GEOMEMBRANE VACUUM / AIR LANCE TEST LOG

PROJECT NUMBER: _____
OWNER: HOPE BAY JOINT VENTURE
LOCATION: BOSTON CAMP BATHERT INLET

PROJECT TITLE: TANK FARM GOMIC HDPE
CONTRACTOR: _____
DATE: _____

VACUUM BOX ✓ AIR LANCE _____ SHEET NUMBER: _____

SEAMS								REPAIRS					
SEAM NUMBER	SEAM SECTION * FROM TO	TEST DATE	TECH ID	DEFECTS **	SEAM COMPLETE NO YES	CHK'D BY	REMARKS **	DEFECT CODE	TEST DATE	TECH ID	DEFECTS **	CHK'D BY	REMARKS **
	-				|		1-A	03/24/01	BN	N/A	BN	
	-				|		1-B	03/24/01	BN	N/A	BN	
	-				|		1-C	03/24/01	BN	N/A	BN	
	-				|		1-D	03/24/01	BN	N/A	BN	
	-				|		1-E	03/24/01	BN	N/A	BN	
	-				|		1-F	03/24/01	BN	N/A	BN	
	-				|							
	-				|							
	-				|							
	-				|							
	-				|							
	-				|							
	-				|							
	-				|							
	-				|							

* REFERENCE SEAM ENDPOINTS FROM AN END OF SEAM (EOS), A REPAIR NUMBER, OR A POINT LOCATION ON THE SEAM.

** RECORD QUANTITY OF LEAKS DETECTED AND REFERENCE NEW DEFECT CODE IN REMARKS.

SUBMITTED BY: BN

DATE: MARCH 29/01

GEOMEMBRANE DEFECT LOG

PROJECT NUMBER: _____
OWNER: HOPE BAY JOINT VENTURE
LOCATION: BOTON CAMP BAKER INLET

PROJECT TITLE: TANK FARM GOMIC HOPE
CONTRACTOR: _____
SHEET NUMBER: _____

DEFECT CODE	DEFECT LOCATION		DEFECT TYPE	LOG DATE	CHK'D BY	REMARKS	** REPAIR DATE	** TEST DATE
	SEAM, PANEL OR REPAIR NO.	DEFECT LOCATION DESCRIPTION						
1 A	PANEL #1	SE CORNER	EE	MARCH 27/01	BN		MARCH 27/01	MARCH 27/01
1 B	PANEL #1	6 FT WEST OF CORNER R#1A	EE	03/24/01	BN		03/24/01	03/24/01
1 C	PANEL #1	6 FT WEST OF 1-B	EE	03/24/01	BN		03/24/01	03/24/01
1 D	PANEL #1	6 FT WEST OF 1-C	EE	03/24/01	BN		03/24/01	03/24/01
1 E	PANEL #1	6 FT WEST OF 1-D	EE	03/24/01	BN		03/24/01	03/24/01
1 F	PANEL #1	6 FT WEST OF 1-E	EE	03/24/01	BN		03/24/01	03/24/01
G								
H								
I								
J								
K								
M								
N								
P								
Q								
R								
S								
T								
W								
X								

AD - ANIMAL RELATED DAMAGE
B - UNDISPERSED RESIN BEAD
BO - FUSION WELDER BURN
BS - BOOT/SKIRT FROM FML PENETRATION
CO - CHANGE OF OVERLAP
CR - CREASE
D - INSTALLATION DAMAGE
DS-# - DESTRUCTIVE TEST NUMBER
EE - EARTHWORK EQUIPMENT DAMAGE
EXT - EXTENSION
FM - FISHMOUTH
FS - FAILED SEAM LENGTH
FTS - FIELD TEST STRIP
HT - HEAT TACK BURN
IO - INSUFFICIENT OVERLAP (UNDER SPEC.)
MD - MANUFACTURER/DELIVERY DAMAGE
PT - PRESSURE TEST CUT
SI - SOIL SURFACE IRREGULARITY
SL - SLAG ON TEXTURED SHEET
T - THREE PANEL INTERSECTION
VL - VACUUM TEST LEAK
WR - WRINKLE
WS - WELDER RESTART
OTHER _____

** COLUMNS TO BE USED BY THE PROJECT SUPERVISOR OR LEAD TECHNICIAN ONLY.

SUBMITTED BY: BN
DATE: MARCH 29/01

LPL FORM 7

LAYFIELD PLASTICS (1978) LTD.

GEOMEMBRANE REPAIR LOG

PROJECT NUMBER: _____ PROJECT TITLE: TANK FARM 60 MIL H.
OWNER: HOPE BAY JOINT VENTURE CONTRACTOR: _____
LOCATION: BOSTON CAMP BATHURST INLET

PASSING TRIAL SEAMS

NO.	TIME	TECH ID.
TX# 1	PM	BN

MACHINE TYPE AND NUMBER FOR REPAIR: X2
SOLVENT FOR REPAIR: _____
SHEET NUMBER: _____

DEFECT CODE	REPAIR DATE	APPROX. TIME	REPAIR TYPE	APPROX. DIMENSION	WELD. TECH.	CHECKED BY	REMARKS
1-A	03/24/01	PM	G+W	6 IN	BN	BN	
1-B	03/24/01	PM	G+W	6 IN	BN	BN	
1-C	03/24/01	PM	G+W	6 IN	BN	BN	
1-D	03/24/01	PM	G+W	6 IN	BN	BN	
1-E	03/24/01	PM	G+W	6 IN	BN	BN	
1-F	03/24/01	PM	G+W	6 IN	BN	BN	

REPAIR TYPE: P - PATCH, C - CAP, RS - RECONSTRUCTED SEAM, G&W - GRIND WELD

SUBMITTED BY: BN
DATE: MARCH 29/01

SERROT INTERNATIONAL, INC.

Columbia Geosystems Ltd., a subsidiary

Date : 31/07/00

Shipping / Packing List

CUSTOMER: 105-99-49

Bill of Lading: C00468

DESTINATION: NEAR SLAVE LAKE, AB

	Roll Number	Weight (LBS)	Square Feet	Dimensions (FT)	QC
1	PSC 060 638 42681	3,834	11,960.00	23.00 x 520.00	✓
2	PSC 060 638 42682	3,795	11,960.00	23.00 x 520.00	✓
3	PSC 060 638 42683	3,746	11,960.00	23.00 x 520.00	✓
4	PSC 060 638 42684	3,742	11,960.00	23.00 x 520.00	✓
5	PSC 060 638 42685	3,711	11,960.00	23.00 x 520.00	✓
6	PSC 060 638 42687	3,661	11,960.00	23.00 x 520.00	✓
7	PSC 060 638 42688	3,662	11,960.00	23.00 x 520.00	✓
8	PSC 060 638 42692	3,716	11,960.00	23.00 x 520.00	✓
9	PSC 060 638 42693	3,652	11,960.00	23.00 x 520.00	✓
10	PSC 060 638 42694	3,641	11,960.00	23.00 x 520.00	✓
11	PSC 060 638 42698	3,649	11,960.00	23.00 x 520.00	✓
12	PSC 060 638 42699	3,640	11,960.00	23.00 x 520.00	✓
13	PSC 060 638 42701	3,612	11,960.00	23.00 x 520.00	✓
14	PSC 060 638 42702	3,608	11,960.00	23.00 x 520.00	✓
15	PSC 060 638 42703	3,616	11,960.00	23.00 x 520.00	✓
16	PSC 060 638 42704	3,626	11,960.00	23.00 x 520.00	✓
17	PSC 060 638 42707	3,625	11,960.00	23.00 x 520.00	✓
18	PSC 060 638 42708	3,620	11,960.00	23.00 x 520.00	✓
19	PSC 060 638 42709	3,619	11,960.00	23.00 x 520.00	✓
20	PSC 060 638 42716	3,673	11,960.00	23.00 x 520.00	✓
21	PSC 060 638 42717	3,660	11,960.00	23.00 x 520.00	✓
22	PSC 060 638 42720	3,648	11,960.00	23.00 x 520.00	✓
23	PSC 060 638 42721	3,629	11,960.00	23.00 x 520.00	✓
24	PSC 060 638 42725	3,617	11,960.00	23.00 x 520.00	✓
	TOTAL	88,002	287,040.00		

COLUMBIA GEOSYSTEMS
Aug 1/00
Q.C. DEPARTMENT

Columbia Geosystem's computerized data base program controls all inventory for production rolls and QA/QC data. Our customers will receive from us the following standard documentation covering all pertinent information for the project unless otherwise requested.

#1 SHIPPING PACKING LIST (Bill of Lading)
This list contains nominal thickness, resin code, a five digit roll number, roll weight, square footage and dimensions. The shipping packing list was designed to assist our shipping department in quickly viewing nominal thickness and resin code against the ordered materials. The Q.C. stamp at the bottom of the page indicates that our Quality Control Department has checked the load for any damage to the product and verifies the correctness of loaded material versus the order.

2 POLYETHYLENE CERTIFICATE OF ANALYSIS
This certifies the relevant test methods, resin specifications, resin supplier lot number, Columbia's resin batch designation number and resin test results as verified in our laboratory.

3 GEOMEMBRANE CERTIFICATE OF ANALYSIS
This certifies the test methods, minimum test values and frequency of geomembrane testing.

4 GEOMEMBRANE STANDARD TESTING CERTIFICATION
This provides a listing of test roll numbers and all relevant test results from our laboratory. Each test roll listed certifies manufactured rolls based on nominal thickness and full length rolls. Columbia's test frequency is based on a maximum of 50,000 ft² rounded to the nearest full roll.
*For 20 mil - the test roll will certify itself.
*For 30 mil - the test roll will certify itself and the preceding roll (based on full length rolls).
*For 40 mil - the test roll will certify itself and the preceding two rolls (based on full length rolls).
Example, if the test roll is #42355 then it will certify itself and rolls 42354 + 42353
*For 60 mil - the test roll will certify itself and the preceding three rolls (based on full length rolls).
*For 80 mil - the test roll will certify itself and the preceding four rolls (based on full length rolls).
*For 100 mil - the test roll will certify itself and the preceding four rolls (based on full length rolls).

The test results, where applicable, will be recorded as averaged values. The roll numbers located on the geomembrane testing certification can be deciphered as follows:

ex. 623A00-42355
623A00-16475B

623 - first three digits refer to Columbia's resin batch designation number. This corresponds to the resin batch designation number located on the polyethylene certificate of analysis.
A00 - refers to the shift number and the year of production.
42355 - refers to the consecutive roll number produced on Line A.
16475B - refers to the consecutive roll number produced on Line B.

Note: Rolls that appear on the geomembrane standard testing certification may not appear on the shipping packing list. This is due to a test roll certifying an actual shipped roll which falls within its testing group.

POLYETHYLENE CERTIFICATE OF ANALYSIS

Project : 105-99-49

Customer : LAYFIELD PLASTICS LTD. TYPE:CHEVRON

Project Name : SUCKER CREEK LAGOON

Columbia Ref : 105-99-49

We hereby certify that the polyethylene resin for the above identified shipment, meets or exceeds Columbia Geosystem's specifications, below. Testing was performed on each resin blend.

Melt flow index was determined according to ASTM D 1238. Density was determined according to ASTM D 792/1505. Where appropriate, carbon content was determined according to ASTM D 4218. The average test results are listed in the table below.

RESIN SPECIFICATIONS

Melt flow index	1.0 g/10 minutes	Maximum
Density - HDPE	0.930 g/cc	Minimum
Density - LLDPE	0.926 g/cc	Maximum

Lot Number	Columbia Batch #	Melt Flow Index g/10	Density g/cc	Carbon Content %	OIT Min.
J101070	637	0.248	0.931	N/A	131
J101060	638	0.231	0.938	N/A	123
J101073	640	0.243	0.938	N/A	116

Q C. TECHNICIAN

Aug 4/00
DATE

Page 1.1

Chevron

Chevron Chemical Company LLC

December 21, 1999

Greg Sharrun
Columbia Geosystems
Attn:Greg Sharrun
1415 28TH St.N.E.
Calgary, AB T2A-2

CERTIFICATE OF ANALYSIS

Product:	9638	Lot Number:	J101070
Chevron Order #:	243475 - 7000	Destination:	Calgary
Package:	ACFX097747	Weight (lbs):	168,800
Customer Order #:	6725	Ship Date:	12/20/99

Following is the data on the subject material as determined by the Quality Control Department:

Property	Value	Units
Melt Index	0.25	gms/10 min
HLMI	21.0	gms/10 min
Density	0.9382	gms/cc
Gels > 1/32	0	
Gels < 1/32	1	
OIT	136.0	

The data set forth herein has been carefully compiled by Chevron Chemical Company. However, there is no warranty of any kind, either expressed or implied, applicable to its use and the user assumes all risk and liability in connection therewith.

Sincerely,

Gary MacMurtrie

Bat # 637

Gary MacMurtrie
Supervisor
Quality Control

B/L

Customer Fax: 403-235-6864

For inquiry, contact Customer Service at the following number:
Film, Coating, Pipe Applications: 1-800-231-3826
Molding Applications: 1-800-231-3828

Chevron

Chevron Chemical Company LLC

December 21, 1999

Greg Sharrun
Columbia Geosystems
Attn:Greg Sharrun
1415 28TH St.N.E.
Calgary, AB T2A-2

CERTIFICATE OF ANALYSIS

Product:	9638	Lot Number:	J101060
Chevron Order #:	243475 - 5000	Destination:	Calgary
Package:	NAHX057952	Weight (lbs):	166,150
Customer Order #:	6725	Ship Date:	12/20/99

Following is the data on the subject material as determined by the Quality Control Department:

Property	Value	Units
Melt Index	0.23	gms/10 min
HLMI	20.5	gms/10 min
Density	0.9388	gms/cc
Gels >1/32	0	
Gels <1/32	0	
OIT	152.0	

The data set forth herein has been carefully compiled by Chevron Chemical Company. However, there is no warranty of any kind, either expressed or implied, applicable to its use and the user assumes all risk and liability in connection therewith.

Sincerely,

Gary MacMurtrie
Supervisor
Quality Control

B/L CGL BATCH # 6 38

Customer Fax: 403-235-6864

For inquiry, contact Customer Service at the following number:
Film, Coating, Pipe Applications: 1-800-231-3826
Molding Applications: 1-800-231-3828

Chevron

Chevron Chemical Company LLC

December 21, 1999

Greg Sharrun
Columbia Geosystems
Attn:Greg Sharrun
1415 28TH St.N.E.
Calgary, AB T2A-2

CERTIFICATE OF ANALYSIS

Product:	9638	Lot Number:	J101073
Chevron Order #:	243475 - 8000	Destination:	Calgary
Package:	GOCX058779	Weight (lbs):	167,150
Customer Order #:	6725	Ship Date:	12/20/99

Following is the data on the subject material as determined by the Quality Control Department:

Property	Value	Units
Melt Index	0.25	gms/10 min
HLMI	20.3	gms/10 min
Density	0.9381	gms/cc
Gels >1/32	1	
Gels <1/32	0	
OIT	144.0	

The data set forth herein has been carefully compiled by Chevron Chemical Company. However, there is no warranty of any kind, either expressed or implied, applicable to its use and the user assumes all risk and liability in connection therewith.

Sincerely,

Gary MacMurtrie
Supervisor
Quality Control

CGL BATCH # 640

B/L

Customer Fax: 403-235-6864

For inquiry, contact Customer Service at the following number:
Film, Coating, Pipe Applications: 1-800-231-3826
Molding Applications: 1-800-231-3828

GEOMEMBRANE CERTIFICATE OF ANALYSIS

Customer : LAYFIELD PLASTICS LTD.

Project Name : SUCKER CREEK LAGOON

Columbia Ref # : 105-99-49

We hereby certify that the polyethylene geomembrane for the above-identified shipment meets or exceeds Columbia Geosystems' specifications below. Testing was performed at the indicated frequency.

Columbia Geosystems' manufacturing lines are equipped with spark testers for pinhole detection. The raw polymeric material is first quality polyethylene resin.

HD600 SMOOTH GEOMEMBRANE SPECIFICATIONS

Property	Test Method	Test Value	Test Frequency
Thickness (ave)	ASTM D5199	60 mil	47,840 ft²
Thickness (min)	ASTM D5199	54 mil	47,840 ft²
•Lowest individual of 25 values			
Tensile Properties	ASTM D638 Type IV		47,840 ft²
•Yield Strength	(2 ipm)	2100 psi	
•Break Strength		3800 psi	
•Yield Elongation	(1.3" GL)	12 %	
•Break Elongation	(2.0" GL)	700 %	
Tear Resistance	ASTM D1004	700 ppi	47,840 ft²
Puncture Resistance	ASTM D4833	1800 ppi	47,840 ft²
Carbon Dispersion	ASTM D5596/3015	CAT 1 or 2	47,840 ft²
Carbon Content	ASTM D4218/1603	2 - 3 %	47,840 ft²
Dimensional Stab.	ASTM D1204	+/- 2.0 %	Resin Batch
Density	ASTM D792/1505	0.940 g/cc	Resin Batch
NTCL, single point	ASTM D5397 (App)	200 hours	Resin Batch

Bruce Wallace
Quality Control Supervisor

Aug 4/00
Date

GEOMEMBRANE STANDARD TESTING CERTIFICATION

PROJECT # 105-99-49

Roll Number	Thick Min mil	Thick Ave mil	Density g/cc	Carbon Cont. %	Carbon Disp	Stress Yield MD psi	Stress Yield TD psi
637B00-42684	55.0	61.1	0.948	2.24	CAT 1	2618	2801
637B00-42688	55.0	60.8		2.21	CAT 1	2608	2809
637A00-42692	56.0	61.1	0.949	2.47	CAT 1	2640	2833
637C00-42696	55.0	60.8		2.44	CAT 1	2639	2741
637C00-42700	55.0	60.5	0.946	2.26	CAT 1	2713	2825
637D00-42704	55.0	61.2		2.41	CAT 1	2722	2853
637D00-42708	55.0	61.1	0.950	2.46	CAT 1	2599	2745
637D00-42712	54.0	60.3		2.46	CAT 1	2590	2716
637C00-42716	55.0	60.5	0.948	2.35	CAT 1	2593	2700
637C00-42720	54.0	60.1		2.40	CAT 1	2709	2923
638D00-42724	55.0	60.1	0.948	2.26	CAT 1	2694	2848
638D00-42728	55.0	60.7		2.24	CAT 1	2760	2889

Page 1.1 Cont...

GEOMEMBRANE STANDARD TESTING CERTIFICATION

PROJECT # 105-99-49

Roll Number	Stress Break MD psi	Stress Break TD psi	Strain Yield MD %	Strain Yield TD %	Strain Break MD %	Strain Break TD %	Dimen Stabili MD %
637B00-42684	5170	5422	18.6	16.3	914	981	-0.11
637B00-42688	4484	4388	18.9	15.0	784	794	
637A00-42692	4340	4248	18.2	15.2	768	775	-0.06
637C00-42696	4354	4380	18.1	15.8	776	810	-0.07
637C00-42700	4345	4287	17.7	15.6	754	773	
637D00-42704	4442	4276	17.5	15.6	765	766	-0.15
637D00-42708	4136	4327	18.6	15.6	740	791	
637D00-42712	4477	4460	19.2	15.6	790	823	
637C00-42716	4227	4407	19.4	16.0	754	816	-0.27
637C00-42720	4392	4419	17.7	15.1	766	788	
638D00-42724	4606	4347	17.0	15.2	787	792	-0.22
638D00-42728	4411	4318	17.5	15.4	779	796	

Page 1.2 Cont...

GEOMEMBRANE STANDARD TESTING CERTIFICATION

PROJECT # 105-99-49

Roll Number	Dimen Stabili TD %	Tear Resist MD ppi	Tear Resist TD ppi	Punct Resist ASTM ppi
637B00-42684	0.04	875	841	1908
637B00-42688		925	895	2077
637A00-42692	0.02	883	839	2050
637C00-42696	0.03	889	827	2187
637C00-42700		922	955	2137
637D00-42704	0.02	947	925	2150
637D00-42708		881	865	2084
637D00-42712		879	857	2071
637C00-42716	-0.01	875	844	2120
637C00-42720		952	915	2197
638D00-42724	0.04	950	912	2167
638D00-42728		896	819	2240

Page 1.3 Cont...