APPENDIX E

LINER QA/QC DOCUMENTS

WESTERN TANK & LINING LTD.
YOUR CONTAINMENT SPECIALISTS SINCE 1985

Project Details

7192 Vantage Way, Delta, BC V4G 1K7
Tel: 604-241-9487 Fax: 604-241-9485
TFN: 1-800-551-4355
www.wtl.ca

Project Name:	Mary River Mine

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Panel Placement

7192 Vantage Way, Delta, BC V4G 1K7
Tel: 604-241-9487 Fax: 604-241-9485
TFN: 1-800-551-4355
www.wtl.ca

Project Name:	**Mary River Mine**	**Start Date:**	**06-Sep**
Product Type:	**40mil LLDPE**	**Finish Date:**	**08-Sep**

Panel #	Date	Work Area	*(M)* Length	*(M)* Width	Area	Comments
1	6-Sep-20	Pond	47.00	47.00	2209.00	
2	8-Sep-20	Pond	47.00	48.80	2293.60	
3	8-Sep-20	Pond	47.00	37.50	1762.50	
4	8-Sep-20	Pond	47.00	24.00	1128.00	
5	8-Sep-20	Pond	47.00	19.00	893.00	
				Total Area	8,286.10	

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Wedge/Extruder Trials

7192 Vantage Way, Delta, BC V4G 1K7
Tel: 604-241-9487 Fax: 604-241-9485 TFN: 1-800-551-4355
www.wtl.ca

Project Name:	**Mary River Mine**	**Start Date:**	06-Sep
Materials Used:	**40mil LLDPE**	**Finish Date:**	08-Sep

Weld Edge: S.S.-smooth/smooth **T.T.**-Textured/Textured **S.T.**-smooth/textured

HDPE Seam Strengths(PPI)*GM19*:			
MIL	**Shear**	**Peel**	**Ext**
40	**80**	**60**	**50**
60	**120**	**91**	**78**
80	**160**	**121**	**104**
100	**200**	**151**	**130**

LLDPE Seam Strengths (PPI)*GM19*:			
MIL	**Shear**	**Peel**	**Ext**
40	**60**	**50**	**44**
60	90	75	66
80	120	100	88
100	150	125	114

Test #	Date	Time	Machine info			Weld Edge	Temp(°C) / Speed (%)	Peel Strength (ppi)						Shear (ppi)			
			Amb (°C)	ID	Type			#	1	2	3	4	5	#	1	2	Comments
1	06-Sep	10:00	2	MD	WW #10	S.S.	398/75	in	64	65	63	62	64	PPI	69	71	
								out	64	64	64	63	65	%	50	50	
								P/F	Pass	Pass	Pass	Pass	Pass	P/F	Pass	Pass	
2	06-Sep	1:00	2	MD	EXT #24	S.S.	215/215	EXT	64	68	66	67	68	PPI	64	68	
														%	50	50	
								P/F	Pass	Pass	Pass	Pass	Pass	P/F	Pass	Pass	
3	08-Sep	8:00	4	MD	WW #10	S.S.	398/75	in	62	70	62	70	64	PPI	73	75	
								out	70	68	68	66	62	%	50	50	
								P/F	Pass	Pass	Pass	Pass	Pass	P/F	Pass	Pass	
4	08-Sep	9:00	4	MD	EXT #24	S.S.	215/215	EXT	66	67	68	66	68	PPI	67	65	
														%	50	50	
								P/F	Pass	Pass	Pass	Pass	Pass	P/F	Pass	Pass	

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Extruder Detail Log

7192 Vantage Way, Delta, BC V4G 1K7
Tel: 604-241-9487 Fax: 604-241-9485
TFN: 1-800-551-4355
www.wtl.ca

Project Name:	**Mary River Mine**	**Start Date:**	**06-Sep**
Product Type:	**40mil LLDPE**	**Finish Date:**	**08-Sep**

Extrude Codes: **BS** - Penetration / **C** - Capstrip / **DSS** - Destructive Sample / **E** - Extrusion Bead / **EXT** - Extension / **R** - Crease / **P** - Patch / **T** - Three Panel Intersection (Continuous Air channel) / **TE**- Three Panel Intersection (Blocked Air channel) / **O** - Other (Use Comments)

Detail #	Weld Date	Tech	Code	*(m)* Dimensions	*(Panel)* Location	Test Result *(P/F)*	QA Initials	Test Date	Comments
1	06-Sep	MD	E	6	P1	P	KM	08-Sep	Vac Tested
2	06-Sep	MD	E	6	P1	P	KM	08-Sep	Vac Tested
3	06-Sep	MD	P	0.4x0.4	P1	P	KM	08-Sep	Vac Tested
4	06-Sep	MD	P	0.4x0.4	P1	P	KM	08-Sep	Vac Tested
5	06-Sep	MD	P	0.4x0.4	P1	P	KM	08-Sep	Vac Tested
6	06-Sep	MD	P	0.4x0.4	P1	P	KM	08-Sep	Vac Tested
7	06-Sep	MD	E	0.5	P1/P2	P	KM	08-Sep	Vac Tested
8	08-Sep	MD	E	0.2	P2	P	KM	08-Sep	Vac Tested
9	06-Sep	MD	P	1.5x1.5	P2/P3	P	KM	08-Sep	Vac Tested
10	08-Sep	MD	P	0.5x0.5	P3	P	KM	08-Sep	Vac Tested
11	08-Sep	MD	E	0.2	P3	P	KM	08-Sep	Vac Tested
12	08-Sep	MD	E	0.2	P3	P	KM	08-Sep	Vac Tested
13	08-Sep	MD	E	0.2	P3	P	KM	08-Sep	Vac Tested

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Extruder Detail Log

7192 Vantage Way, Delta, BC V4G 1K7
Tel: 604-241-9487 Fax: 604-241-9485
TFN: 1-800-551-4355
www.wtl.ca

Project Name:	**Mary River Mine**	**Start Date:**	**06-Sep**
Product Type:	**40mil LLDPE**	**Finish Date:**	**08-Sep**

Extrude Codes: BS - Penetration / **C** - Capstrip / **DSS** - Destructive Sample / **E** - Extrusion Bead / **EXT** - Extension / **R** - Crease / **P** - Patch / **T** - Three Panel Intersection (Continuous Air channel) / **TE**- Three Panel Intersection (Blocked Air channel) / **O** - Other (Use Comments)

Detail #	Weld Date	Tech	Code	*(m)* Dimensions	*(Panel)* Location	Test Result *(P/F)*	QA Initials	Test Date	Comments
14	08-Sep	MD	E	0.2	P3	P	KM	08-Sep	Vac Tested
15	08-Sep	MD	E	0.2	P3	P	KM	08-Sep	Vac Tested
16	08-Sep	MD	E	0.2	P3	P	KM	08-Sep	Vac Tested
17	08-Sep	MD	E	0.2	P3	P	KM	08-Sep	Vac Tested
18	08-Sep	MD	E	0.2	P3	P	KM	08-Sep	Vac Tested
19	08-Sep	MD	E	0.2	P3	P	KM	08-Sep	Vac Tested
20	08-Sep	MD	E	0.2	P3	P	KM	08-Sep	Vac Tested
21	08-Sep	MD	E	0.2	P3	P	KM	08-Sep	Vac Tested
22	08-Sep	MD	P	0.5x0.5	P3	P	KM	08-Sep	Vac Tested
23	08-Sep	MD	P	0.4x0.4	P3/P4	P	KM	08-Sep	Vac Tested
24	08-Sep	MD	E	0.5	P3/P4	P	KM	08-Sep	Vac Tested
25	08-Sep	MD	P	0.5X0.5	P4	P	KM	08-Sep	Vac Tested
26	08-Sep	MD	P	0.3X0.3	P4	P	KM	08-Sep	Vac Tested
27	08-Sep	MD	E	0.5	P4/P5	P	KM	08-Sep	Vac Tested
28	08-Sep	MD	P	0.3X0.3	P4/P5	P	KM	08-Sep	Vac Tested
29	08-Sep	MD	P	0.3X0.3	P4	P	KM	08-Sep	Vac Tested

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Wedge Seam Log

Project Name:	Mary River Mine	**Start Date:**	6-Sep-20	**Destructive Test Specifications**		
				Length of Seam/Test:	47	m/Test
Product Type:	40mil LLDPE	**Finish Date:**	8-Sep-20	**Total Length of Seams:**	188.00	m/Test
				Total Destructive Tests Required:	4	Tests

Seam Number	Time	Date	Weld Tech	Welder #	*Seam Length*	Comments
1/2	10:00	06-Sep	MD	10	47.0	Took a Destructive test from each end and did a Seam End Cupon test.
2/3	9:00	08-Sep	MD	10	47.0	Took a Destructive test from each end and did a Seam End Cupon test.
3/4	11:00	08-Sep	MD	10	47.0	Took a Destructive test from each end and did a Seam End Cupon test.
4/5	2:00	08-Sep	MD	10	47.0	Took a Destructive test from each end and did a Seam End Cupon test.
				Total	188.00	

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End Seam Coupons

7192 Vantage Way, Delta, BC V6V 1H9
Tel: 604-241-9487 Fax: 604-241-9485 Toll: 800-551-4355

Project Name: Mary River Mine		**Start Date:**	6-Sep	**HDPE Seam Strengths(PPI)*GM19*:**					**LLDPE Seam Strengths (PPI)*GM19*:**				
				MIL	**Shear**	**Peel**	**Ext**		**MIL**	**Shear**	**Peel**	**Ext**	
Materials Used: 40mil LLDPE		**Finish Date:**	8-Sep	**40**	**80**	**60**	**50**		**40**	**60**	**50**	**44**	
				60	**120**	**91**	**78**		**60**	**90**	**75**	**66**	
				80	**160**	**121**	**104**		**80**	**120**	**100**	**88**	
				100	**200**	**151**	**130**		**100**	**150**	**125**	**114**	

Seam Number	Weld Tech	Date	Welder #	Time	QA Tech	Peel Strength (ppi)			Shear (ppi)		
						#	1	Comments	#	1	
1/2	MD	06-09-20	10	10:15	KM	in	65	Start of Seam	PPI	74	Start of Seam
						out	67		%	50	
						FTB	Yes		P/F	Pass	
						P/F	Pass				
1/2	MD	06-09-20	10	10:48	KM	in	63	End of Seam	PPI	72	End of Seam
						out	66		%	50	
						FTB	Yes		P/F	Pass	
						P/F	Pass				
2/3	MD	08-09-20	10	9:20	KM	in	61	Start of Seam	PPI	70	Start of Seam
						out	63		%	50	
						FTB	Yes		P/F	Pass	
						P/F	Pass				
2/3	MD	08-09-20	10	10:25	KM	in	62	End of Seam	PPI	71	End of Seam
						out	64		%	50	
						FTB	Yes		P/F	Pass	
						P/F	Pass				

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End Seam Coupons

7192 Vantage Way, Delta, BC V6V 1H9
Tel: 604-241-9487 Fax: 604-241-9485 Toll: 800-551-4355

Project Name: Mary River Mine	**Start Date:**	6-Sep	
Materials Used: 40mil LLDPE	**Finish Date:**	8-Sep	

HDPE Seam Strengths(PPI)*GM19*:

MIL	Shear	Peel	Ext
40	80	60	50
60	120	91	78
80	160	121	104
100	200	151	130

LLDPE Seam Strengths (PPI)*GM19*:

MIL	Shear	Peel	Ext
40	60	50	44
60	90	75	66
80	120	100	88
100	150	125	114

Seam Number	Weld Tech	Date	Welder #	Time	QA Tech	Peel Strength (ppi) #	1	Comments	Shear (ppi) #	1	
3/4	MD	08-09-20	10	11:18	KM	in	65	Start of Seam	PPI	74	Start of Seam
						out	62		%	50	
						FTB	Yes		P/F	Pass	
						P/F	Pass				
3/4	MD	08-09-20	10	12:14	KM	in	63	End of Seam	PPI	72	End of Seam
						out	62		%	50	
						FTB	Yes		P/F	Pass	
						P/F	Pass				
4/5	MD	08-09-20	10	2:31	KM	in	64	Start of Seam	PPI	73	Start of Seam
						out	67		%	50	
						FTB	Yes		P/F	Pass	
						P/F	Pass				
4/5	MD	08-09-20	10	3:12	KM	in	61	End of Seam	PPI	74	End of Seam
						out	64		%	50	
						FTB	Yes		P/F	Pass	
						P/F	Pass				

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Destructive Test

7192 Vantage Way, Delta, BC V4G 1K7
Tel: 604-241-9487 Fax: 604-241-9485 TFN: 1-800-551-4355
www.wtl.ca

Project Name:	**Mary River Mine**	**Start Date:**	**2020-09-06**	**Destruct Check**		**HDPE Seam Strengths(PPI)*GM19*:**				**LLDPE Seam Strengths (PPI)*GM19*:**			
				Tests Required:	**4**	**MIL**	**Shear**	**Peel**	**Ext**	**MIL**	**Shear**	**Peel**	**Ext**
Materials Used:	**40mil LLDPE**	**Finish Date:**	**2020-09-08**	**Tests Completed:**	**8.00**	**40**	**80**	**60**	**50**	**40**	**60**	**50**	**44**
				Check:	**OK**	**60**	**120**	**91**	**78**	**60**	**90**	**75**	**66**
						80	**160**	**121**	**104**	**80**	**120**	**100**	**88**
						100	**200**	**151**	**130**	**100**	**150**	**125**	**114**

Seam Number	DST #	Date	Time	QA Tech	Peel Strength (ppi)						Shear (ppi)					
					#	1	2	3	4	5	#	1	2	3	4	5
1/2	1	06-09-20	1:15	KM	in	64	66	68	66	67	PPI	73	75	71	74	73
					out	68	64	66	70	67	%	50	50	50	50	50
					FTB	Yes	Yes	Yes	Yes	Yes	P/F	Pass	Pass	Pass	Pass	Pass
					P/F	Pass	Pass	Pass	Pass	Pass	Comments:		Start of Seam			
1/2	2	06-09-20	1:37	KM	in	65	68	66	70	68	PPI	73	72	75	71	74
					out	67	67	65	66	65	%	50	50	50	50	50
					FTB	Yes	Yes	Yes	Yes	Yes	P/F	Pass	Pass	Pass	Pass	Pass
					P/F	Pass	Pass	Pass	Pass	Pass	Comments:		End of Seam			
2/3 Start	3	08-09-20	12:31	KM	in	66	68	70	72	68	PPI	71	73	70	72	76
					out	65	67	66	65	70	%	50	50	50	50	50
					FTB	Yes	Yes	Yes	Yes	Yes	P/F	Pass	Pass	Pass	Pass	Pass
					P/F	Pass	Pass	Pass	Pass	Pass	Comments:		Start of Seam			
2/3 End	4	08-09-20	12:48	KM	in	69	66	68	67	65	PPI	71	74	75	73	74
					out	64	63	65	67	68	%	50	50	50	50	50
					FTB	Yes	Yes	Yes	Yes	Yes	P/F	Pass	Pass	Pass	Pass	Pass
					P/F	Pass	Pass	Pass	Pass	Pass	Comments:		End of Seam			

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Destructive Test

7192 Vantage Way, Delta, BC V4G 1K7
Tel: 604-241-9487 Fax: 604-241-9485 TFN: 1-800-551-4355
www.wtl.ca

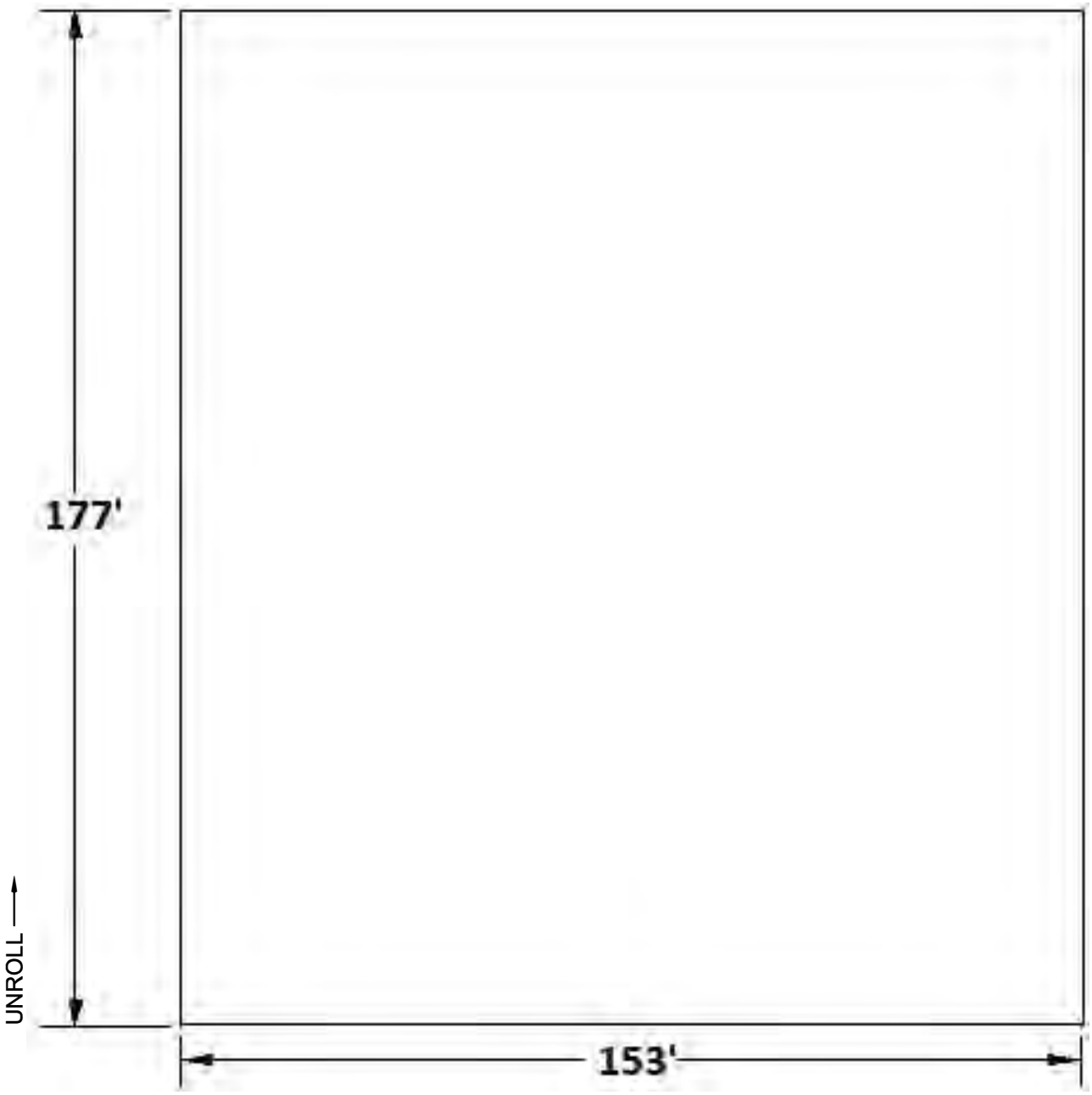
Project Name:	**Mary River Mine**	**Start Date:**	**2020-09-06**	**Destruct Check**		**HDPE Seam Strengths(PPI)*GM19*:**				**LLDPE Seam Strengths (PPI)*GM19*:**			
				Tests Required:	**4**	**MIL**	**Shear**	**Peel**	**Ext**	**MIL**	**Shear**	**Peel**	**Ext**
Materials Used:	**40mil LLDPE**	**Finish Date:**	**2020-09-08**	**Tests Completed:**	**8.00**	**40**	**80**	**60**	**50**	**40**	**60**	**50**	**44**
				Check:	**OK**	**60**	**120**	**91**	**78**	**60**	**90**	**75**	**66**
						80	**160**	**121**	**104**	**80**	**120**	**100**	**88**
						100	**200**	**151**	**130**	**100**	**150**	**125**	**114**

Seam Number	DST #	Date	Time	QA Tech	Peel Strength (ppi)						Shear (ppi)					
					#	1	2	3	4	5	#	1	2	3	4	5
3/4	5	08-09-20	1:13	KM	in	65	67	68	66	65	PPI	72	75	74	71	73
					out	64	65	64	67	65	%	50	50	50	50	50
					FTB	Yes	Yes	Yes	Yes	Yes	P/F	Pass	Pass	Pass	Pass	Pass
					P/F	Pass	Pass	Pass	Pass	Pass	Comments:		Start of Seam			
3/4	6	08-09-20	1:38	KM	in	66	65	64	62	63	PPI	73	75	72	74	73
					out	64	67	67	64	65	%	50	50	50	50	50
					FTB	Yes	Yes	Yes	Yes	Yes	P/F	Pass	Pass	Pass	Pass	Pass
					P/F	Pass	Pass	Pass	Pass	Pass	Comments:		End of Seam			
4/5	7	08-09-20	3:21	KM	in	66	69	70	67	68	PPI	74	75	71	73	72
					out	70	66	68	67	65	%	50	50	50	50	50
					FTB	Yes	Yes	Yes	Yes	Yes	P/F	Pass	Pass	Pass	Pass	Pass
					P/F	Pass	Pass	Pass	Pass	Pass	Comments:		Start of Seam			
4/5	8	08-09-20	3:49	KM	in	65	66	63	66	62	PPI	71	74	72	73	75
					out	67	64	65	68	64	%	50	50	50	50	50
					FTB	Yes	Yes	Yes	Yes	Yes	P/F	Pass	Pass	Pass	Pass	Pass
					P/F	Pass	Pass	Pass	Pass	Pass	Comments:		End of Seam			

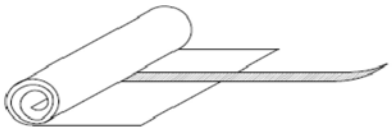
WESTERN TANK & LINING LTD.

Valport
Geopad#1

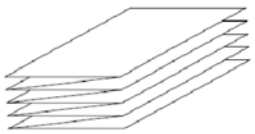
153' x 177' Standard Fan Folded
10 oz Non-woven Geotextile



STANDARD ROLL WITH WEBBING



STANDARD FAN FOLD



VANCOUVER: 7192 Vantage Way, Delta, BC V4G 1K7 T: 604-241-9487 F: 604-241-9485
CALGARY: 105 Stockton Pt., Okotoks, AB T1S 1A5 T: 403-938-4361 F: 403-938-4371

1-800-551-4355

WTL Felt Liner Quality Control Audit

Inspector	Ruth	Crew	Tyree, Trevon, Doug, Anthony, Jordyn, Jordan, Justin	Calculator Liner Size Test Tolerance Date	8/17/2018
		QA Damage Loss Tracker 2018	*Length*	*Width*	*Style*
Work Order #	WO-011898	Size / Style	177	153	Liner
Customer Name	Valport				
Welder #	10	Operator	Tyree	Temp/Speed	860/999
W/Bar Y/N	N				

Width Calculator (enter for size ordered) Sizes are expressed in Decimal feet

Liner Length (feet)	Liner width (Feet)	Roll Width (Inches)	Weld Width (Inches)	Calculated Panels Needed	Even Panel no. (rounded up)	Total Width of Even Panels (Feet)	Material Size removed from Even Panel count	Number of Cut Welds	Total Width Calculated
177	153	180	5	10.9081	11	160.83333	7.5		153.3333

1st panel length verification	178'	Actual Finished Length	177	Actual Finished Width	153.33

Stepped Panel lengths: NA

Step inset: NA

Secondary measurements (Material added for cut welds, or other material that was removed and replaced)

No cut welds

Cross welds: NA Inspected by: NA

Special Instructions: Customer PO # CP18-148(Baffinland#2)/ Mark liner PO- 4500049224/ Weld direction long way

Material: 10 oz ONG TenCate Mirafi Color Out: Black

Rolling		Folding	
Standard Roll		Standard Fan	x
Standard Roll with Webbing	x	Butterfly Fold	
Scroll Rolled center mark W/Webbing		Fan Fold to center 2" web markers	

Core Type Used: Metal x Cardboard x Other

(Standard = mil, size, unroll and unfold arrow)

Standard Information Written on Item: x Other:

refer to E.I.C for standards

Packaging Wrap/ Color : Standard Liner x Other:

refer to E.I.C for standards

Standard Package Labeling: x Other:

Notes

Weight Mass per unit area

Ounces per square yard calculated using a 6"x6" sample

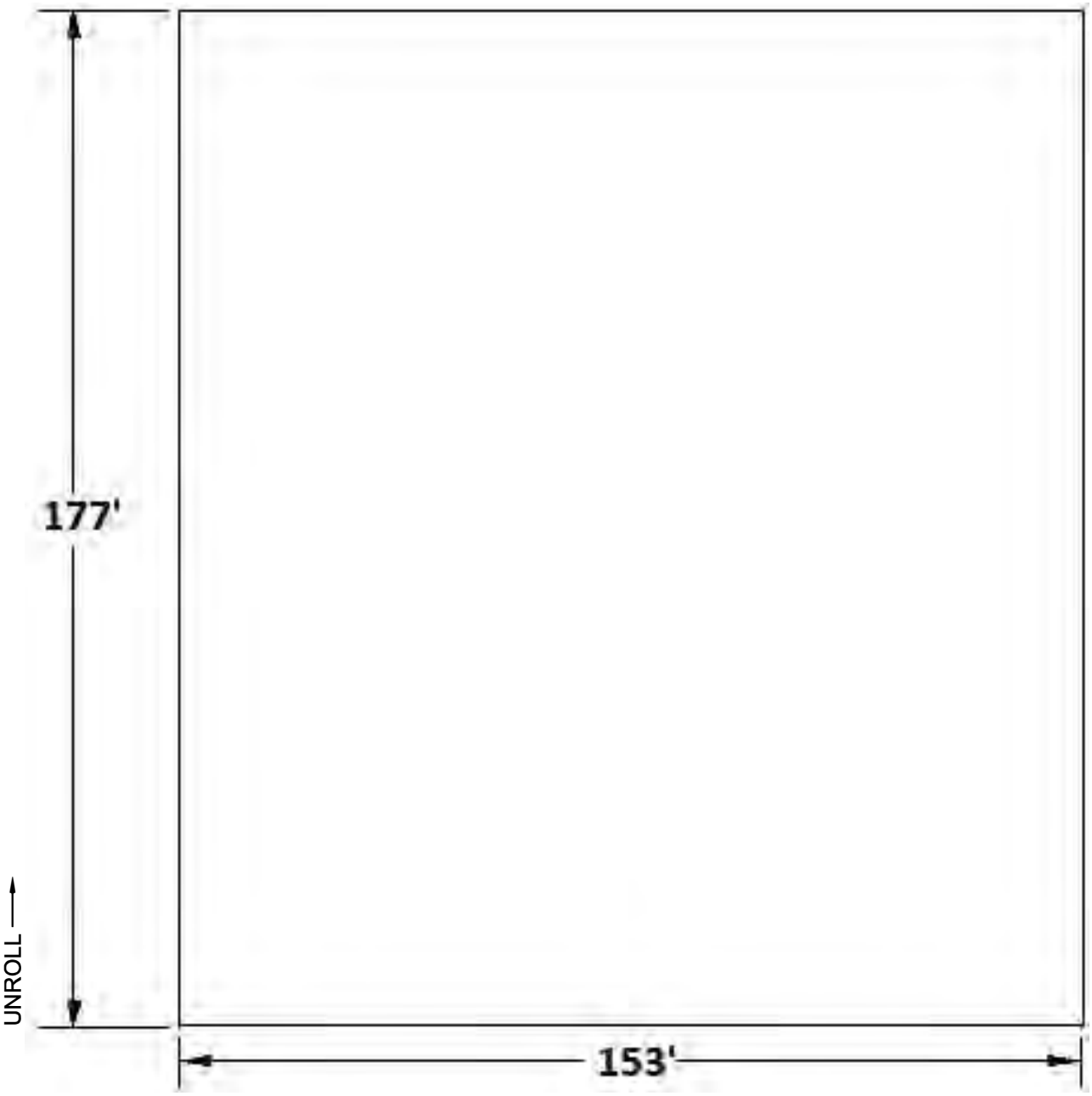
Felt

Date	MFG Date	Ounce Mfg	Roll ID #	Roll Width	sample area	#1	#2	#3	#4	#5	Avg.	QA
8/17/2018	7/11/2018	10 oz ONG TenCate Mirafi	J20503770	15'	Beg	9.503	9.883	9.122	8.869	8.996	9.2744	RD
8/17/2018	7/11/2018	10 oz ONG TenCate Mirafi	J20503778	15'	Beg	8.109	8.742	9.249	8.742	8.109	8.5903	RD
8/20/2018		10 oz ONG TenCate Mirafi	Made from drops	15'	Beg							RD

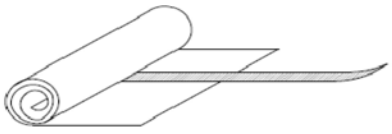
WESTERN TANK & LINING LTD.

Valport
Geopad#2

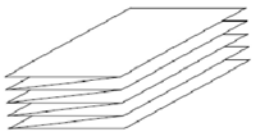
153' x 177' Standard Fan Folded
10 oz Non-woven Geotextile



STANDARD ROLL WITH WEBBING



STANDARD FAN FOLD



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1-800-551-4355

WTL Felt Liner Quality Control Audit

Inspector	Ruth	Crew	Tyree, Trevon, Doug, Anthony, Jordyn, Jordan, Justin	Calculator Liner Size Test Tolerance Date	8/17/2018
		QA Damage Loss Tracker 2018	*Length*	*Width*	*Style*
Work Order #	WO-011897	Size / Style	177	153	Liner
Customer Name	Valport				
Welder #	10	Operator	Tyree	Temp/Speed	860/999
W/Bar Y/N	N				

Width Calculator (enter for size ordered) Sizes are expressed in Decimal feet

Liner Length (feet)	Liner width (Feet)	Roll Width (Inches)	Weld Width (Inches)	Calculated Panels Needed	Even Panel no. (rounded up)	Total Width of Even Panels (Feet)	Material Size removed from Even Panel count	Number of Cut Welds	Total Width Calculated
177	153	180	5	10.9081	11	160.83333	7.5		153.3333

1st panel length verification	178'	Actual Finished Length	177	Actual Finished Width	153.33

Stepped Panel lengths: NA

Step inset: NA

Secondary measurements (Material added for cut welds, or other material that was removed and replaced)

No cut welds

Cross welds: NA Inspected by: NA

Special Instructions: Customer PO # CP18-148(Baffinland#2)/ Mark liner PO- 4500049224/ Weld direction long way

Material: 10 oz ONG TenCate Mirafi Color Out: Black

Rolling		Folding	
Standard Roll		Standard Fan	x
Standard Roll with Webbing	x	Butterfly Fold	
Scroll Rolled center mark W/Webbing		Fan Fold to center 2" web markers	

Core Type Used: Metal x Cardboard x Other

(Standard = mil, size, unroll and unfold arrow)

Standard Information Written on Item: x Other:

refer to E.I.C for standards

Packaging Wrap/ Color : Standard Liner x Other:

refer to E.I.C for standards

Standard Package Labeling: x Other:

Notes

Weight Mass per unit area

Ounces per square yard calculated using a 6"x6" sample

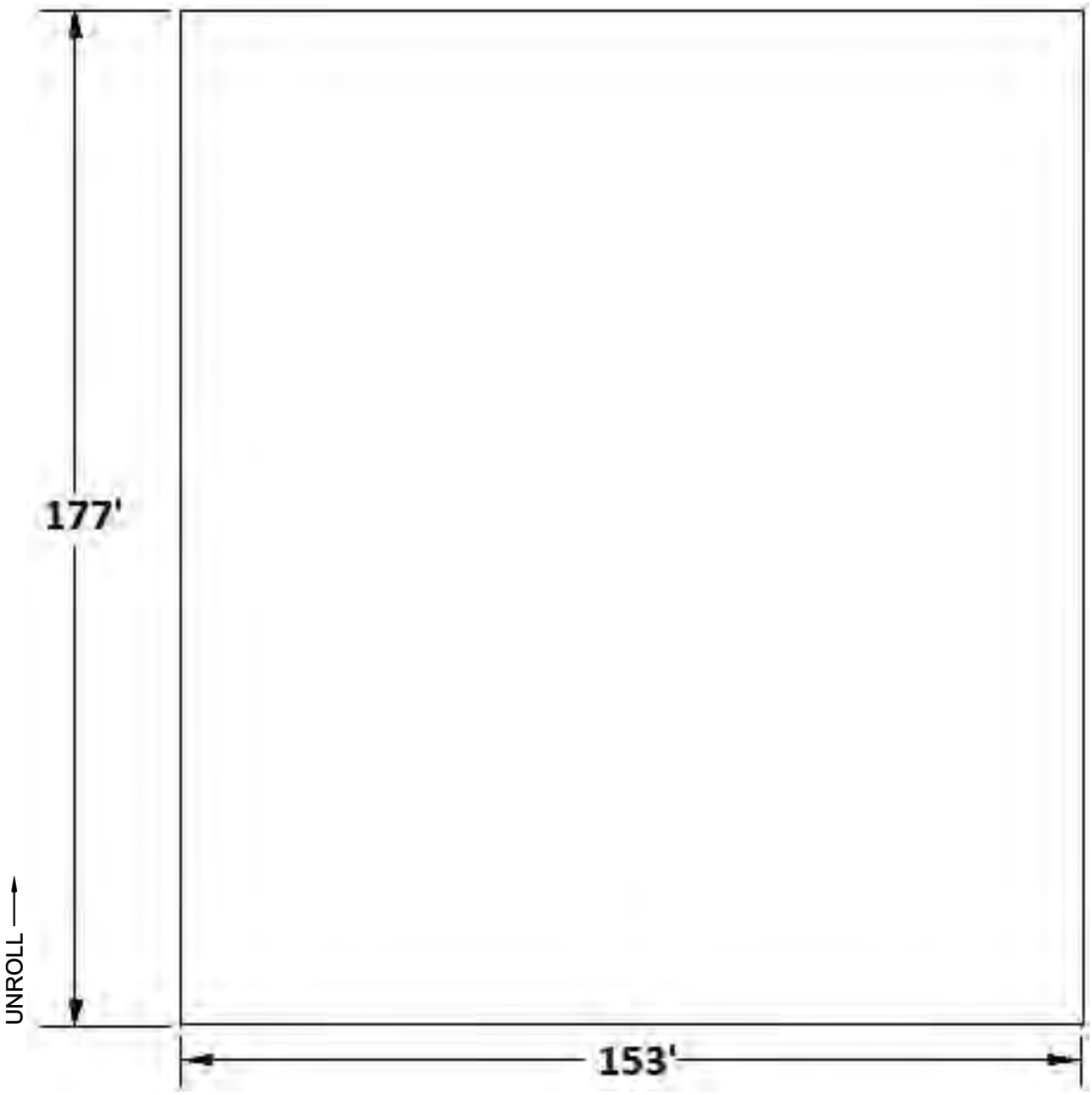
Felt

Date	MFG Date	Ounce Mfg	Roll ID #	Roll Width	sample area	#1	#2	#3	#4	#5	Avg.	QA
8/17/2018	7/11/2018	10 oz ONG TenCate Mirafi	J20503770	15'	Beg	9.503	9.883	9.122	8.869	8.996	9.2744	RD
8/17/2018	7/11/2018	10 oz ONG TenCate Mirafi	J20503778	15'	Beg	8.109	8.742	9.249	8.742	8.109	8.5903	RD
8/20/2018		10 oz ONG TenCate Mirafi	Made from drops	15'	Beg							RD

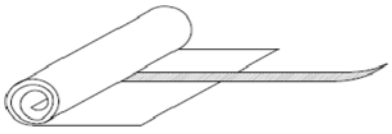
WESTERN TANK & LINING LTD.

Valport
Geopad#3

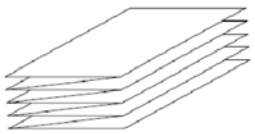
153' x 177' Standard Fan Folded
10 oz Non-woven Geotextile



STANDARD ROLL WITH WEBBING



STANDARD FAN FOLD



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CALGARY: 105 Stockton Pt., Okotoks, AB T1S 1A5 T: 403-938-4361 F: 403-938-4371

1-800-551-4355

WTL Felt Liner Quality Control Audit

Inspector	Ruth	Crew	Justin, Matt, Jordyn, Anthony, Doug, Trevon	Calculator Liner Size Test Tolerance / Date	8/20/2018
		QA Damage Loss Tracker 2018	*Length*	*Width*	*Style*
Work Order #	WO-011897	Size / Style	177	153	Liner
Customer Name	Valport				
Welder #	10	Operator	Justin M.	Temp/Speed	860/999
W/Bar Y/N	N				

Width Calculator (enter for size ordered) Sizes are expressed in Decimal feet

Liner Length (feet)	Liner width (Feet)	Roll Width (Inches)	Weld Width (Inches)	Calculated Panels Needed	Even Panel no. (rounded up)	Total Width of Even Panels (Feet)	Material Size removed from Even Panel count	Number of Cut Welds	Total Width Calculated
177	153	180	5	10.9081	11	160.83333	7.5		153.3333

1st panel length verification	178'	Actual Finished Length	177	Actual Finished Width	153.33

Stepped Panel lengths: NA

Step inset: NA

Secondary measurements (Material added for cut welds, or other material that was removed and replaced)

No cut welds

Cross welds: 1 in every panel — Inspected by: Ruth

Special Instructions: Customer PO # CP18-148(Baffinland#2)/ Mark liner PO- 4500049224/ Weld direction long way

Material: 10 oz ONG TenCate Mirafi — Color Out: Black

Rolling		Folding	
Standard Roll		Standard Fan	x
Standard Roll with Webbing	x	Butterfly Fold	
Scroll Rolled center mark W/Webbing		Fan Fold to center 2" web markers	

Core Type Used: Metal x — Cardboard x — Other

(Standard = mil, size, unroll and unfold arrow)

Standard Information Written on Item: x — Other:

refer to E.I.C for standards

Packaging Wrap/ Color : Standard Liner: x — Other:

refer to E.I.C for standards

Standard Package Labeling: x — Other:

Notes

Weight Mass per unit area

Ounces per square yard calculated using a 6"x6" sample

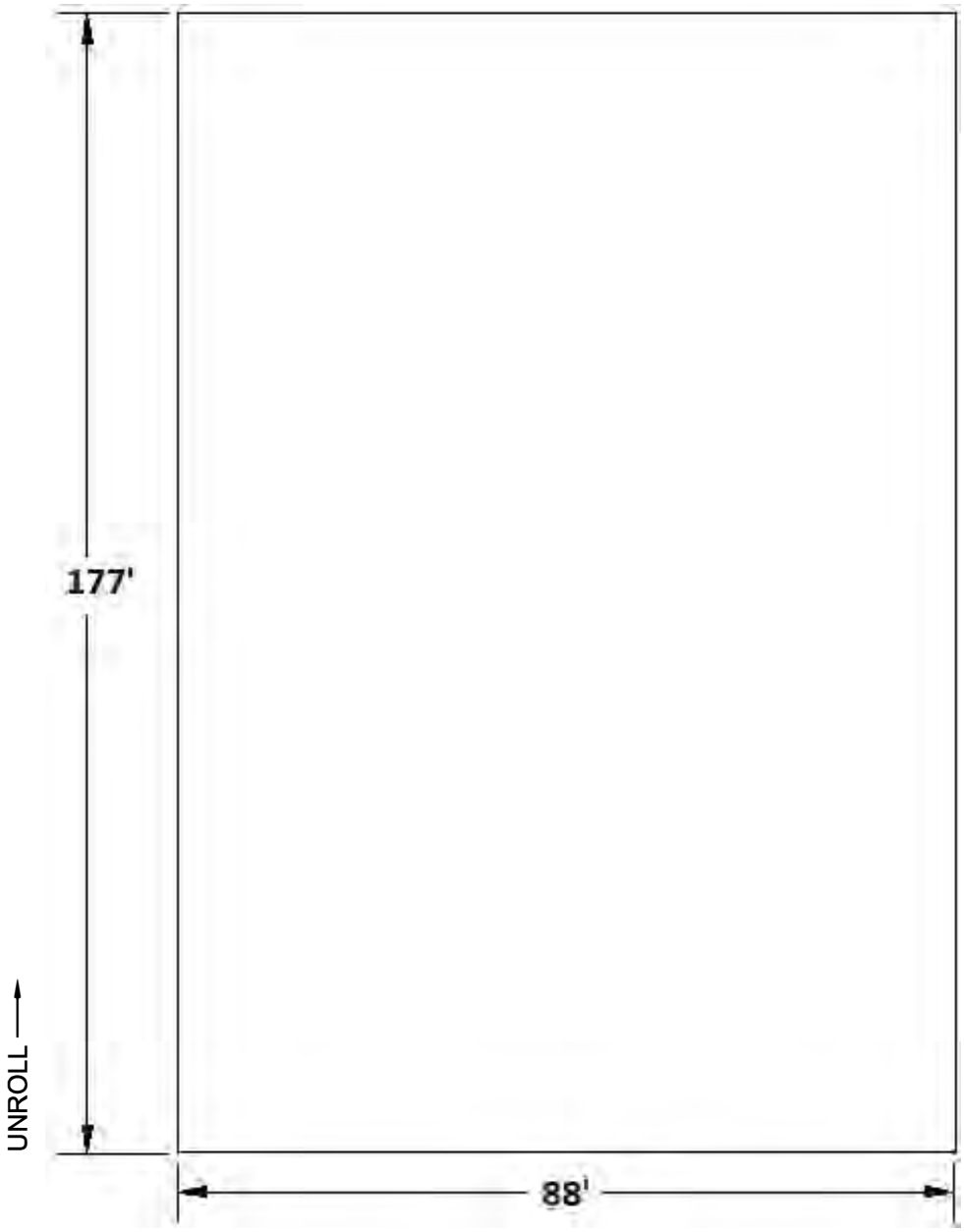
Felt

Date	MFG Date	Ounce Mfg	Roll ID #	Roll Width	sample area	#1	#2	#3	#4	#5	Avg.	QA
8/17/2018	7/11/2018	10 oz ONG TenCate Mirafi	J20503770	15'	Beg	9.503	9.883	9.122	8.869	8.996	9.2744	RD
8/17/2018	7/11/2018	10 oz ONG TenCate Mirafi	J20503778	15'	Beg	8.109	8.742	9.249	8.742	8.109	8.5903	RD
8/20/2018		10 oz ONG TenCate Mirafi	Made from drops	15'	Beg							RD

WESTERN TANK & LINING LTD.

Baffinland
Geopad#4

88' x 177' Standard Fan Folded
10 oz Non-woven Geotextile



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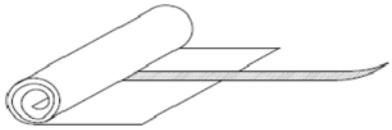
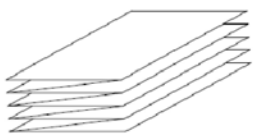


STANDARD FAN FOLD



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WTL Felt Liner Quality Control Audit

Calculator Liner Size Test Tolerance

Inspector	Ruth	Crew	Justin, Sak, Tyrell, Doug, Austin	Date	8/27/2018

QA Damage Loss Tracker 2018

Work Order #	WO-011959	Size / Style	Length: 177	Width: 88	Style: Liner

Customer Name: **Baffinland**

Welder #	10	Operator	Justin	Temp/Speed	860/899	W/Bar Y/N	N

Width Calculator (enter for size ordered) Sizes are expressed in Decimal feet

Liner Length (feet)	Liner width (Feet)	Roll Width (Inches)	Weld Width (Inches)	Calculated Panels Needed	Even Panel no. (rounded up)	Total Width of Even Panels (Feet)	Material Size removed from Even Panel count	Number of Cut Welds	Total Width Calculated
177	88	180	5	6.450952	6	87.916667			87.91667

1st panel length verification	177'6"	Actual Finished Length	177.5	Actual Finished Width	87.91

Stepped Panel lengths: NA

Step inset: NA

Secondary measurements (Material added for cut welds, or other material that was removed and replaced)

No cut welds

Cross welds: NA Inspected by: NA

Special Instructions: PLEASE MARK PANEL #4/ PLEASE USE 6 PANELS FOR WIDTH/ Weld direction long Way

Material: 10 oz ONG TenCate Mirafi Color Out: Black

Rolling		Folding	
Standard Roll		Standard Fan	x
Standard Roll with Webbing	x	Butterfly Fold	
Scroll Rolled center mark W/Webbing		Fan Fold to center 2" web markers	

Core Type Used: Metal [ ] Cardboard [x] Other [ ]

(Standard = mil, size, unroll and unfold arrow)

Standard Information Written on Item [x] Other:

refer to E.I.C for standards

Packaging Wrap/ Color : Standard Liner [x] Other: Packaging Crew

refer to E.I.C for standards

Standard Package Labeling [x] Other:

Notes

Weight Mass per unit area

Ounces per square yard calculated using a 6"x6" sample

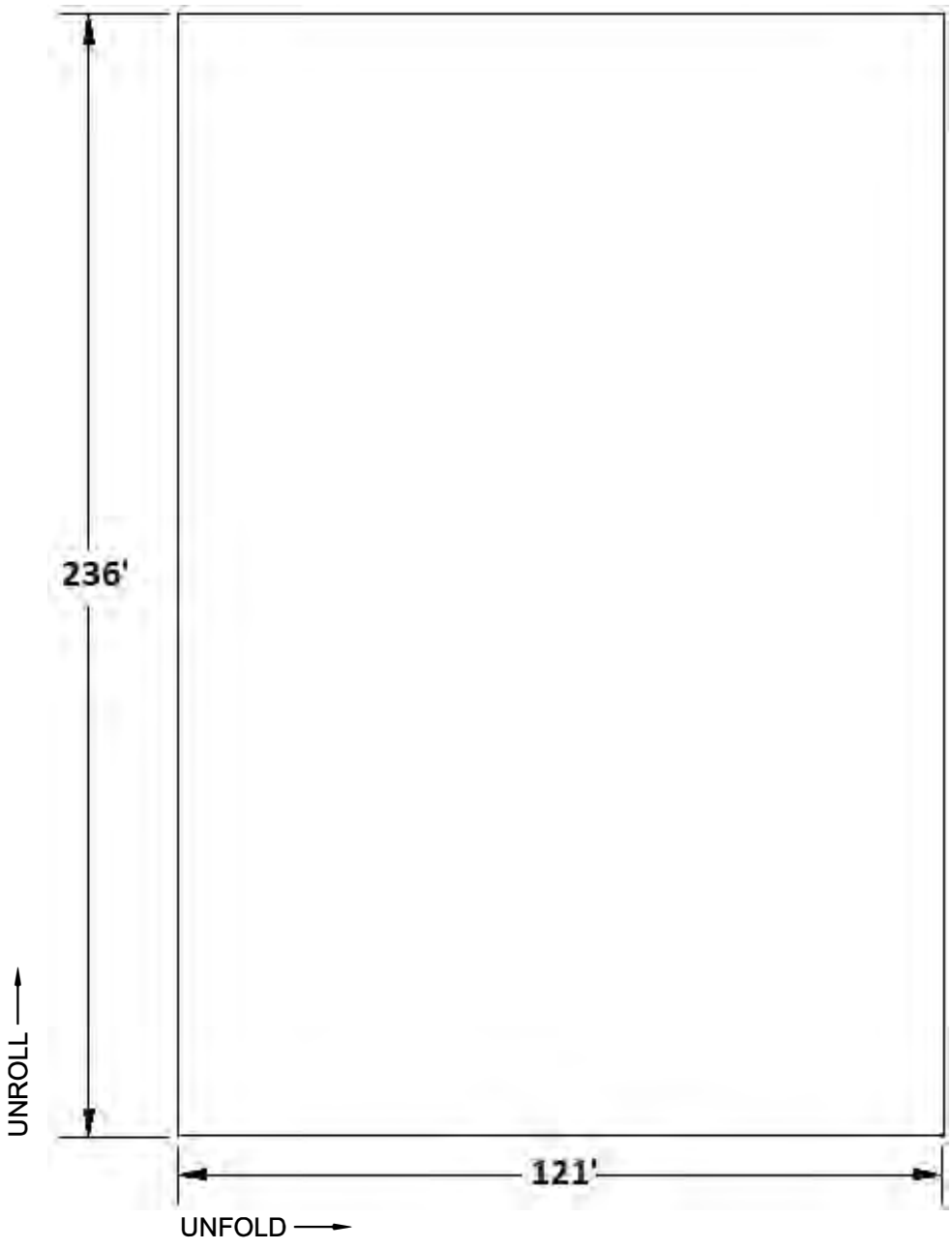
Felt

Date	MFG Date	Ounce Mfg	Roll ID #	Roll Width	sample area	#1	#2	#3	#4	#5	Avg.	QA
8/27/2018	8/15/2018	10 oz ONG TenCAte Mirafi	J20512401	15'	Beg	9.122	8.362	9.249	10.01	8.742	9.0971	RD

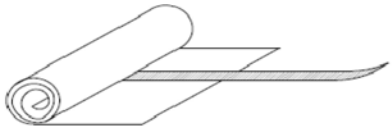
WESTERN TANK & LINING LTD.

Baffinland
Liner#1

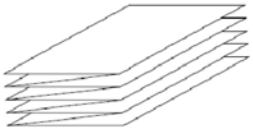
121' x 236' Standard Fan Folded
Atarfil 40mil smooth LLDPE



STANDARD ROLL WITH WEBBING



STANDARD FAN FOLD



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Liner and F.S. Quality Control Audit

Inspector	Val	Crew	Mark,Nick,Luke,Anthony,Matt,Jordy n	Calculator Liner Size Test Tolerance / Date	8/24/2018
		QA Damage Loss Tracker 2018	*Length*	*Width*	*Style*
Work Order #	WO-011955	Size / Style	236	121	Liner
PO#	CP18-148 (B	Customer	Baffinland	Liner #	1

Width Calculator (enter for size ordered) Sizes are expressed in Decimal feet

Liner Length (feet)	Liner width (Feet)	Roll Width (Inches)	Weld Width overlap (Inches)	Calculated Panels Needed	Even Panel no. (rounded up)	Total Width of Even Panels (Feet)	Material Size removed from Even Panel count	Number of Cut Welds	Total Width Calculated
236	121	235	5	6.72971	7	134.58333	9.79		124.7933

1st panel length verification size/persons	238'	Finished Length	236	Actual Width	124.7933
Stepped Panel lengths	NA				
Step inset	NA				
Secondary measurements (cut welds)	No cut weld				
Seam lip pull checks (non-destructive)	5 per weld				
Cross welds:	NA	Inspected by:	NA		
Special Instructions	Please mark panel #1 / please use 6.5 panels for width				
Material	40 mil LLDPE Atarftil B/B	Color Out	Black		

Rolling		Folding	
Standard Roll		Standard Fan	x
Standard Roll with Webbing	x	Butterfly Fold	
Scroll Rolled center mark W/Webbing		Fan Fold to center 2" web markers	

Core Type Used:	Metal	Cardboard	Other
		x	

(Standard = mil, size, unroll and unfold arrow)

Standard Information Written on Item	x	Other:
refer to E.I.C for standards		
Packaging Wrap/ Color : Standard Liner	x	Other:
refer to E.I.C for standards		
Standard Package Labeling	x	Other:

Notes

Wedge/Extrusion Trial

WESTERN TANK & LINING LTD.

7192 Vantage Way
Delta, BC V4G 1K7

Office 604.241.9487 Fax 604.241.9485

Toll-Free 1.800.551.4355

Customer:	Baffinland	PO #	CP18-148 (Baffinland #2)
Production Date:	8/24/2018	Time:	7:44AM
QA Test Person:	Val	W./O.	WO-011955
Welding Tech:	Nick	Crew:	uke,Nick,Anthony,Matt

Welder Qualification For Liners: 1 Time Ending: 11:30AM

size expressed in decimal feet

Material Type:	40 mil LLDPE Atarfil B/B	Liner Size:	*Length* 236	*Width* 121	*Style* Liner

Welder Number:	7	Outside Temp:	55 degrees
Welder Set Temp:	860	Inside Temp:	70 degrees
Welder Set Speed:	599 *Timed FPM* 14	Sheet Temp:	70 degrees
Extrusion Rod:	NA	Welder Set up with bar Y/N	

Peel Data

test speed is 20 in/min unless noted otherwise

	Inside (Lbs)	Outside (Lbs)	Failure Type	Seperation (%)	Comments
1	79	71	SE1	0	Pass
2	68	72	SE1	0	Pass
3	74	72	SE1	0	Pass
4	72	70	SE1	0	Pass
5	72	68	SE1	0	Pass

Shear Data

	Shear (Lbs)	Elongation (%)	Comments
1	73	200+%	PASS/STE
2	77	200+%	PASS/STE
3	75	200+	PASS/STE
4	72	200+	PASS/STE
5	78	200+	PASS/STE

Notes: Tear Back Results on Sample Weld: PASS

STE = sample stretch to end of test
SE1 = sample break in outer edge of seam
SE2= break at seam edge top sheet (extrusion shear only)
SE3= break at seam edge in bottom sheet (extrusion peel only)

Seam End Coupon Log

WESTERN TANK & LINING LTD.

7192 Vantage Way
Delta, BC V4G1K7
Office 604.241.9487 Fax 604.241.9485
Toll-Free 1.800.551.4355

test speed is 20 in/min unless noted otherwise

Customer:	Baffinland	PO#	CP18-148 (Baffinland #2
Production Date:	8/24/2018	Crew:	Mark,Nick,Luke,Matt,Anthony,Jordyn

Welder Settings

Welder #	7	Operator	Nick	Temp/Speed	860/599

Timed welder speed

Distance in feet	19.58	Timed Sec.	82	Feet per min.	14

QA Test Person:	Val	W./O.	WO-011955
Material Type:	40 mil LLDPE Atarfil B/B		

size in dec. ft.	*Length*	*Width*	Style	
Liner Size:	236	121	Liner	Liner # 1

Seam Number	Test # P# / S#	Inside (Lbs)	Outside (Lbs)	Failure Type	Seperation (%)	Shear (Lbs)	Elongation (%)	Comments
W1	P1/S1	75	75	SE1	0	84	200+	PASS/STE
W1	P2/S2	70	69	SE1	0	77	200+	PASS/STE
W2	P1/S1	62	61	SE1	0	67	200+	PASS/STE
W2	P2/S2	56	57	SE1	0	56	200+	PASS/STE

Notes:

STE = sample stretch to end of test

SE1 = sample break in outer edge of seam

Pull Checks (non-destructive seam lip pulls) 5 per weld

WESTERN TANK & LINING LTD.

7192 Vantage Way
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ASTM D 5199 MATERIAL THICKNESS
LLDPE

Date MFG date	Mil Mfg	Roll ID #	Roll Width measured	sample area	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	Avg.	QA
8/24/2018	40 mil LLDPE Atarfil	NO Tag	19.58'/19'7"	Beg	39.2	38.1	38.1	38.8	38.5	38.2	37.8	36.4	39.1	41.8	38.6	Val
8/24/2018	40 mil LLDPE Atarfil	C1V113042P	19.58'/19'7"	Beg	40.9	38.6	39.6	37.7	39.7	38	37.3	37.8	39.3	37.9	38.68	Val
8/24/2018	40 mil LLDPE Atarfil	C4M540066N	19.58'/19'7"	Beg	38.1	36.9	37.5	40.4	36.5	35.5	36.3	36.2	36.2	36.5	37.01	Val

TYPE:GMB ATARFIL LLD 40 MILS BLACK 19.7FT X 999FT

Roll nº: C1V113042P

Roll Data

Length: 999 f ±2% Area: 19,680.30 sqf Weight: 3536 lbs

Width: 19.70 f ±0.7% Nominal Thickness: 40 mils

Geomembrane Characteristics

Properties		Test Method	Value	Units
Thickness		ASTM D 5199.	37.0	mils
Density of Geomembrane		ASTM D 792	0.934	g/cm3
Elongation at Break, GL 2.0 inches	MD	ASTM D 6693, Type IV.	880	%
Elongation at Break, GL 2.0 inches	CMD	ASTM D 6693, Type IV.	1,060	%
Tensile Strength at Break	MD	ASTM D 6693, type IV	184	lb/in
Tensile Strength at Break	CMD	ASTM D 6693, type IV	190	lb/in
Tear Resistance	MD	ASTM D 1004.	24	lb
Tear Resistance	CMD	ASTM D 1004.	23	lb
Puncture Resistance		ASTM D 4833.	85	lb
Carbon Black Content		ASTM D 4218	2.21	%
Carbon Black Dispersion		ASTM D 5596	10	views Cat 1/2
O.I.T. Standard		ASTM D 3895 (200 °C)	>= 100	min
High Pressure OIT		ASTM D 5885	>= 400	min
UV resistance (HP OIT, % retained)		ASTM D 5885	>= 35	%
Dimensional Stability	MD	ASTM D 1204	-0.67	%
Dimensional Stability	CMD	ASTM D 1204	0.18	%

Resin Characteristics

Properties	Test Method	Value	Units
Density	ASTM D 792	<= 0.926	g/cm3
Melt Flow Index	ASTM D 1238 (190/2.16)	< 1.00	gr/10 min

MD=Machine Direction; CMD= Cross Direction;
Note: The dimensions of the roll are conditioned by the factory manufacturing environment and temperature, by dimensional stability and by productive dimensional tolerance. For conversion of N/mm2 to N/mm, kindly multiply by the thickness.This is system-generated document and it does not require original signature or stamp.

Made by (JLP) **Approved by (TSM)**

Certificate printing date 07/02/2018

QC LABORATORY, ATARFIL

ATARFIL

TYPE:

Roll nº: C4M540066N

Roll Data

Length: 999 f ±2% Area: 19,680.30 sqf Weight: 3494 lbs

Width: 19.70 f ±0.7% Nominal Thickness: 40 mils

Geomembrane Characteristics

Properties		Test Method	Value	Units
Thickness		ASTM D 5199.	37.80	mils
Density of Geomembrane		ASTM D 792	0.935	g/cm3
Dimensional Stability	MD	ASTM D 1204	-1.24	%
Dimensional Stability	CMD	ASTM D 1204	0.19	%
Carbon Black Content		ASTM D 4218	2.31	%
Carbon Black Dispersion		ASTM D 5596	1	views Cat1/2
O.I.T. Standard		ASTM D 3895 (200 °C)	>= 100	min
High Pressure OIT		ASTM D 5885	>= 400	min
UV resistance (HP OIT, % retained)		ASTM D 5885	>= 75	%
Elongation at Break, GL 2.0 inches	MD	ASTM D 6693, Type IV	861	%
Elongation at Break, GL 2.0 inches	CMD	ASTM D 6693, Type IV	976	%
Tensile Strength at Break	MD	ASTM D 6693, Type IV.	168	lb/in
Tensile Strength at Break	CMD	ASTM D 6693, Type IV.	180	lb/in
Tear Resistance	MD	ASTM D 1004.	22.5	lb
Tear Resistance	CMD	ASTM D 1004.	22.5	lb
Puncture Resistance		ASTM D 4833.	64	lb
2% Modulus		ASTM D 5323.	1,065	lb/in

Resin Characteristics

Properties	Test Method	Value	Units
Density	ASTM D 792	>= 0.932	g/cm3
Melt Flow Index	ASTM D 1238 (190/2.16)	<= 0.40	gr/10 min

MD=Machine Direction; CMD= Cross Direction;
Note: The dimensions of the roll are conditioned by the factory manufacturing environment and temperature, by dimensional stability and by productive dimensional tolerance. For conversion of N/mm2 to N/mm, kindly multiply by the thickness.This is system-generated document and it does not require original signature or stamp.

Made by (LJC) **Approved by (TSM)**

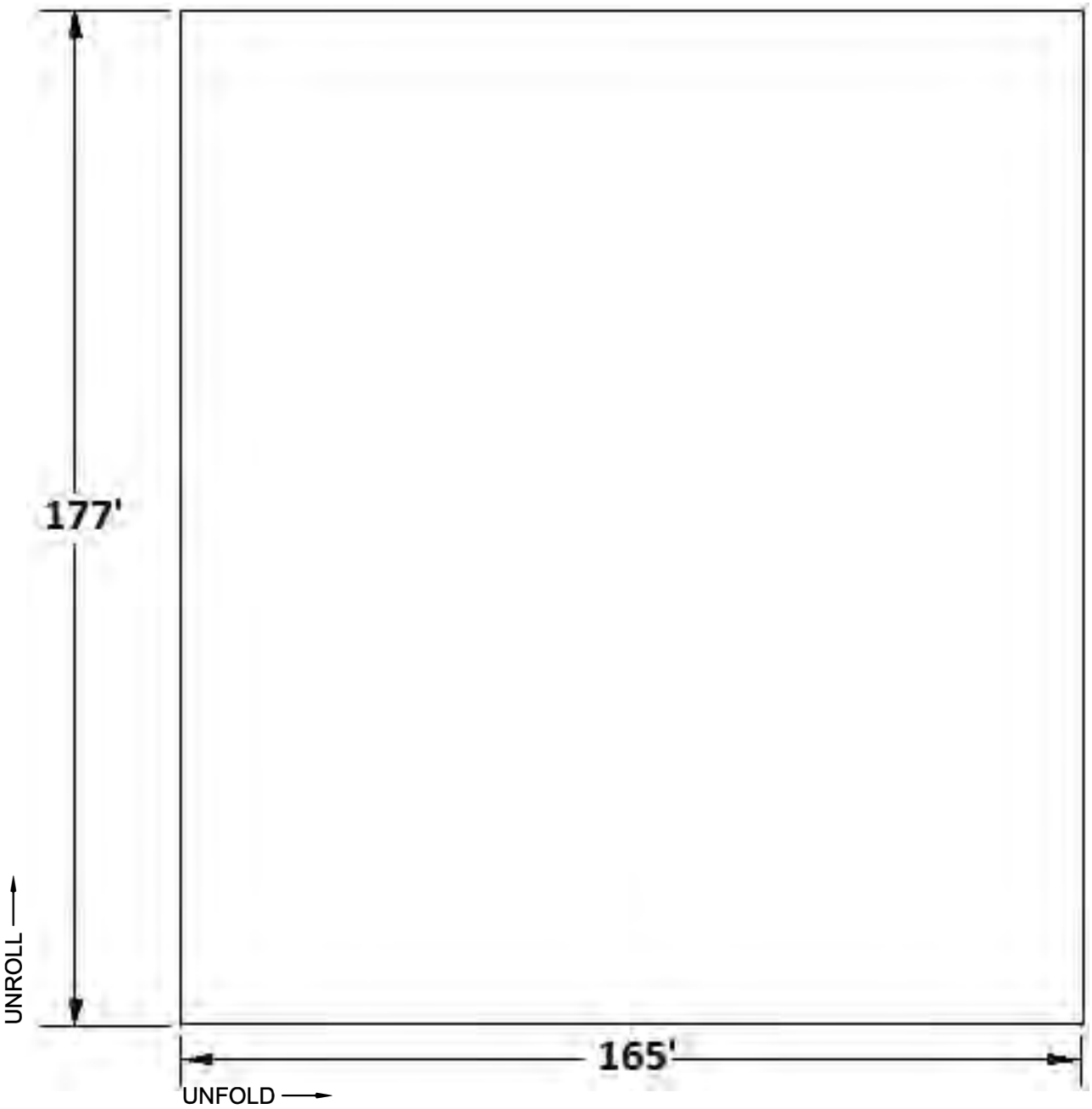
Certificate printing date 07/02/2018

QC LABORATORY, ATARFIL

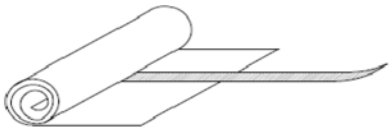
WESTERN TANK & LINING LTD.

Baffinland
Liner#2

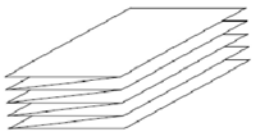
165' x 177' Standard Fan Folded
Atarfil 40mil smooth LLDPE



STANDARD ROLL WITH WEBBING



STANDARD FAN FOLD



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1-800-551-4355

Liner and F.S. Quality Control Audit

Calculator Liner Size Test Tolerance

Inspector	Val	Crew	Nick,Shane,Anthony,Matt,Jordyn	Date	8/27/2018

QA Damage Loss Tracker 2018

			Length	*Width*	*Style*
Work Order #	**WO-011956**	Size / Style	**177**	**165**	**Liner**

PO#	CP18-148 (Baffinland #2)	Customer	Baffinland	Liner #	**2**

Width Calculator (enter for size ordered) Sizes are expressed in Decimal feet

Liner Length (feet)	Liner width (Feet)	Roll Width (Inches)	Weld Width overlap (Inches)	Calculated Panels Needed	Even Panel no. (rounded up)	Total Width of Even Panels (Feet)	Material Size removed from Even Panel count	Number of Cut Welds	Total Width Calculated
177	165	235	5	9.025362	9	172.91667	9.79		163.1267

1st panel length verification size/persons	179'	Finished Length	177	Actual Width	163.1267

Stepped Panel lengths	NA		
Step inset	NA		
Secondary measurements (cut welds)	No cut weld		
Seam lip pull checks (non-destructive)	5 per weld		
Cross welds:	2 in panel 4	Inspected by:	Val
Special Instructions	Please mark panel #2 and panel #3 / please use 8.5 panels for width		
Material	40 mi LLDPE Atarfil B/B	Color Out	Black

Rolling		**Folding**	
Standard Roll		Standard Fan	x
Standard Roll with Webbing	x	Butterfly Fold	
Scroll Rolled center mark W/Webbing		Fan Fold to center 2" web markers	

Core Type Used:	Metal	Cardboard	Other
		x	

(Standard = mil, size, unroll and unfold arrow)

Standard Information Written on Item	x	Other:	

refer to E.I.C for standards

Packaging Wrap/ Color :	Standard Liner	x	Other:

refer to E.I.C for standards

Standard Package Labeling	x	Other:	

Wedge/Extrusion Trial

WESTERN TANK & LINING LTD.

7192 Vantage Way
Delta, BC V4G 1K7

Office 604.241.9487 Fax 604.241.9485

Toll-Free 1.800.551.4355

Customer:	Baffinland	PO #	CP18-148 (Baffinland #2)
Production Date:	8/24/2018	Time:	2:27PM
QA Test Person:	Val	W./O.	WO-011956
Welding Tech:	Matt	Crew:	ıane,Nick,Anthony,Mat

Welder Qualification For Liners: 2 and 3 Time Ending: 3:30PM

size expressed in decimal feet

			Length	*Width*	*Style*
Material Type:	40 mil LLDPE Atarfil B/B	Liner Size:	177	165	Liner

Welder Number:	7		Outside Temp:	73 degrees
Welder Set Temp:	860		Inside Temp:	80 degrees
Welder Set Speed:	599	*Timed FPM* 24	Sheet Temp:	80 degrees
Extrusion Rod:	NA		Welder Set up with bar Y/N	N

Peel Data

test speed is 20 in/min unless noted otherwise

	Inside (Lbs)	Outside (Lbs)	Failure Type	Seperation (%)	Comments
1	64	64	SE1	0	Pass
2	59	60	SE1	0	Pass
3	65	64	SE1	0	Pass
4	59	58	SE1	0	Pass
5	62	62	SE1	0	Pass

Shear Data

	Shear (Lbs)	Elongation (%)	Comments
1	68	200+%	PASS/STE
2	56	200+%	PASS/STE
3	68	200+	PASS/STE
4	61	200+	PASS/STE
5	70	200+	PASS/STE

Notes: Tear Back Results on Sample Weld: PASS

STE = sample stretch to end of test
SE1 = sample break in outer edge of seam
SE2= break at seam edge top sheet (extrusion shear only)
SE3= break at seam edge in bottom sheet (extrusion peel only)

Wedge/Extrusion Trial

WESTERN TANK & LINING LTD.

7192 Vantage Way
Delta, BC V4G 1K7

Office 604.241.9487 Fax 604.241.9485

Toll-Free 1.800.551.4355

Customer:	Baffinland	PO #	P18-148 (Baffinland #
Production Date:	8/27/2018	Time:	7:27AM
QA Test Person:	Val	W./O.	WO-011956
Welding Tech:	Shane	Crew:	e,Nick,Jordyn,Anthony,

Welder Qualification For Liners: 2 and 3 Time Ending: 11:30AM

size expressed in decimal feet

Material Type:	40 mil LLDPE Atarfil B/B	Liner Size:	*Length* 177	*Width* 165	*Style* Liner

Welder Number:	7			Outside Temp:	73 degrees
Welder Set Temp:	860			Inside Temp:	80 degrees
Welder Set Speed:	599	*Timed FPM*	24	Sheet Temp:	80 degrees
Extrusion Rod:	NA			Welder Set up with bar Y/N	N

Peel Data

test speed is 20 in/min unless noted otherwise

	Inside (Lbs)	Outside (Lbs)	SE1	Seperation (%)	Comments
1	64	61	SE1	0	Pass
2	67	62	SE1	0	Pass
3	67	65	SE1	0	Pass
4	64	62	SE1	0	Pass
5	67	64	SE1	0	Pass

Shear Data

	Shear (Lbs)	Elongation (%)	Comments
1	68	200+%	Pass/STE
2	65	200+%	Pass/STE
3	66	200+	Pass/STE
4	69	200+	Pass/STE
5	67	200+	Pass/STE

Notes: Tear Back Results on Sample Weld: NA

STE = sample stretch to end of test
SE1 = sample break in outer edge of seam
SE2= break at seam edge top sheet (extrusion shear only)
SE3= break at seam edge in bottom sheet (extrusion peel only)

Wedge/Extrusion Trial

WESTERN TANK & LINING LTD.

7192 Vantage Way
Delta, BC V4G 1K7

Office 604.241.9487 Fax 604.241.9485

Toll-Free 1.800.551.4355

Customer:	Baffinland	PO #	P18-148 (Baffinland #
Production Date:	8/27/2018	Time:	7:34AM
QA Test Person:	Val	W./O.	WO-011956
Welding Tech:	Nick	Crew:	lick,Jordyn,Anthony,Ma

Welder Qualification For Liners: 2&3 Time Ending: 1:30PM

size expressed in decimal feet

			Length	*Width*	*Style*
Material Type:	40 mil LLDPE Atarfil B/B	Liner Size:	177	165	Liner

Welder Number:	Extruder #2	Outside Temp:	73 degrees
Welder Set Temp:	400/350	Inside Temp:	80 degrees
Welder Set Speed:	*Timed FPM* NA	Sheet Temp:	80 degrees
Extrusion Rod:	4L34227D	Welder Set up with bar Y/N	N

Peel Data

test speed is 20 in/min unless noted otherwise

	Inside (Lbs)	Outside (Lbs)	Failure Type	Seperation (%)	Comments
1	63	NA	SE1	0	Pass
2	62	NA	SE1	0	Pass
3	67	NA	SE1	0	Pass
4	65	NA	SE1	0	Pass
5	68	NA	SE1	0	Pass

Shear Data

	Shear (Lbs)	Elongation (%)	Comments
1	63	200+%	Pass/STE
2	66	200+%	Pass/STE
3	65	200+	Pass/STE
4	62	200+	Pass/STE
5	67	200+	Pass/STE

Notes: Tear Back Results on Sample Weld:

STE = sample stretch to end of test
SE1 = sample break in outer edge of seam
SE2= break at seam edge top sheet (extrusion shear only)
SE3= break at seam edge in bottom sheet (extrusion peel only)

Seam End Coupon Log

WESTERN TANK & LINING LTD.

7192 Vantage Way
Delta, BC V4G1K7
Office 604.241.9487 Fax 604.241.9485
Toll-Free 1.800.551.4355

test speed is 20 in/min unless noted otherwise

Customer:	Baffinland	PO#	CP18-148 (Baffinland #2
Production Date:	8/24/2018	Crew:	Mark,Nick,Shane,Matt,Anthony,Jordyn

Welder Settings

Welder #	7	Operator	Matt/Shane	Temp/Speed	860/799

Timed welder speed

Distance in feet	19.58	Timed Sec.	48	Feet per min.	24

QA Test Person:	Val	W./O.	WO-011956
Material Type:	40 mil LLPDE Atarfil B/B		

size in dec. ft.	*Length*	*Width*	Style	
Liner Size:	177	165	Liner	Liner # 2

Seam Number	Test # P# / S#	Inside (Lbs)	Outside (Lbs)	Failure Type	Seperation (%)	Shear (Lbs)	Elongation (%)	Comments
W1	P1/S1	59	70	SE1	0	80	200+	PASS/STE
W1	P2/S2	53	64	SE1	0	67	200+	PASS/STE
W2	P1/S1	59	64	SE1	0	67	200+	PASS/STE
W2	P2/S2	59	58	SE1	0	65	200+	PASS/STE

Notes:

STE = sample stretch to end of test

SE1 = sample break in outer edge of seam

Pull Checks (non-destructive seam lip pulls) 5 per weld

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ASTM D 5199 MATERIAL THICKNESS
LLDPE

Date MFG date	Mil Mfg	Roll ID #	Roll Width measured	sample area	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	Avg.	QA
8/24/2018	40 mil LLDPE Atarfil	C3V113026P	19.58'/19'7"	Beg	40.5	48.2	43.6	39.2	38.9	38.2	42	43.1	39.3	41.2	41.42	Val
8/24/2018	40 mil LLDPE Atarfil	C1V136050N	19.58'/19'7"	Partial	41.7	41.9	40.1	39.7	40.5	41.3	39.1	39.4	40.6	41.2	40.55	Val
8/27/2018	40 mil LLDPE Atarfil	C4M540067N	19.58'/19'7"	Beg	37.4	38.7	37.6	38.9	36.7	40.1	41.1	39.5	39.2	38.6	38.778	Val
8/27/2018	40 mil LLDPE Atarfil	C2M540074N	19.58'/19'7"	Beg	38.3	38.7	38	37.6	38	38.3	39.2	39.2	39.5	39.1	38.59	Val

ATARFIL

TYPE:

Roll nº: C4M540067N

Roll Data

Length: 999 f ±2% Area: 19,680.30 sqf Weight: 3505 lbs

Width: 19.70 f ±0.7% Nominal Thickness: 40 mils

Geomembrane Characteristics

Properties		Test Method	Value	Units
Thickness		ASTM D 5199.	37.80	mils
Density of Geomembrane		ASTM D 792	0.935	g/cm3
Dimensional Stability	MD	ASTM D 1204	-1.24	%
Dimensional Stability	CMD	ASTM D 1204	0.19	%
Carbon Black Content		ASTM D 4218	2.34	%
Carbon Black Dispersion		ASTM D 5596	1	views Cat1/2
O.I.T. Standard		ASTM D 3895 (200 °C)	>= 100	min
High Pressure OIT		ASTM D 5885	>= 400	min
UV resistance (HP OIT, % retained)		ASTM D 5885	>= 75	%
Elongation at Break, GL 2.0 inches	MD	ASTM D 6693, Type IV	861	%
Elongation at Break, GL 2.0 inches	CMD	ASTM D 6693, Type IV	976	%
Tensile Strength at Break	MD	ASTM D 6693, Type IV.	168	lb/in
Tensile Strength at Break	CMD	ASTM D 6693, Type IV.	180	lb/in
Tear Resistance	MD	ASTM D 1004.	22.5	lb
Tear Resistance	CMD	ASTM D 1004.	22.5	lb
Puncture Resistance		ASTM D 4833.	64	lb
2% Modulus		ASTM D 5323.	1,065	lb/in

Resin Characteristics

Properties	Test Method	Value	Units
Density	ASTM D 792	>= 0.932	g/cm3
Melt Flow Index	ASTM D 1238 (190/2.16)	<= 0.40	gr/10 min

MD=Machine Direction; CMD= Cross Direction;
Note: The dimensions of the roll are conditioned by the factory manufacturing environment and temperature, by dimensional stability and by productive dimensional tolerance. For conversion of N/mm2 to N/mm, kindly multiply by the thickness.This is system-generated document and it does not require original signature or stamp.

Made by (LJC) **Approved by (TSM)**

Certificate printing date 07/02/2018

QC LABORATORY, ATARFIL

ATARFIL

TYPE:

Roll nº: C1V136050N

Roll Data

Length: 999 f ±2% Area: 19,680.30 sqf Weight: 3505 lbs

Width: 19.70 f ±0.7% Nominal Thickness: 40 mils

Geomembrane Characteristics

Properties		Test Method	Value	Units
Thickness		ASTM D 5199.	37.80	mils
Density of Geomembrane		ASTM D 792	0.935	g/cm3
Dimensional Stability	MD	ASTM D 1204	-1.24	%
Dimensional Stability	CMD	ASTM D 1204	0.19	%
Carbon Black Content		ASTM D 4218	2.34	%
Carbon Black Dispersion		ASTM D 5596	1	views Cat1/2
O.I.T. Standard		ASTM D 3895 (200 °C)	>= 100	min
High Pressure OIT		ASTM D 5885	>= 400	min
UV resistance (HP OIT, % retained)		ASTM D 5885	>= 75	%
Elongation at Break, GL 2.0 inches	MD	ASTM D 6693, Type IV	861	%
Elongation at Break, GL 2.0 inches	CMD	ASTM D 6693, Type IV	976	%
Tensile Strength at Break	MD	ASTM D 6693, Type IV.	168	lb/in
Tensile Strength at Break	CMD	ASTM D 6693, Type IV.	180	lb/in
Tear Resistance	MD	ASTM D 1004.	22.5	lb
Tear Resistance	CMD	ASTM D 1004.	22.5	lb
Puncture Resistance		ASTM D 4833.	64	lb
2% Modulus		ASTM D 5323.	1,065	lb/in

Resin Characteristics

Properties	Test Method	Value	Units
Density	ASTM D 792	>= 0.932	g/cm3
Melt Flow Index	ASTM D 1238 (190/2.16)	<= 0.40	gr/10 min

MD=Machine Direction; CMD= Cross Direction;
Note: The dimensions of the roll are conditioned by the factory manufacturing environment and temperature, by dimensional stability and by productive dimensional tolerance. For conversion of N/mm2 to N/mm, kindly multiply by the thickness.This is system-generated document and it does not require original signature or stamp.

Made by (LJC) **Approved by (TSM)**

Certificate printing date 07/02/2018

QC LABORATORY, ATARFIL

TYPE:GMB ATARFIL LLD 40 MILS BLACK 19.7FT X 999FT Roll nº: C2M540074N

Roll Data

Length: 999 f ±2% Area: 19,680.30 sqf Weight: 3516 lbs

Width: 19.70 f ±0.7% Nominal Thickness: 40 mils

Geomembrane Characteristics

Properties		Test Method	Value	Units
Thickness		ASTM D 5199.	37.0	mils
Density of Geomembrane		ASTM D 792	0.936	g/cm3
Elongation at Break, GL 2.0 inches	MD	ASTM D 6693, Type IV.	856	%
Elongation at Break, GL 2.0 inches	CMD	ASTM D 6693, Type IV.	892	%
Tensile Strength at Break	MD	ASTM D 6693, type IV	185	lb/in
Tensile Strength at Break	CMD	ASTM D 6693, type IV	172	lb/in
Tear Resistance	MD	ASTM D 1004.	25	lb
Tear Resistance	CMD	ASTM D 1004.	23	lb
Puncture Resistance		ASTM D 4833.	81	lb
Carbon Black Content		ASTM D 4218	2.42	%
Carbon Black Dispersion		ASTM D 5596	10	views Cat 1/2
O.I.T. Standard		ASTM D 3895 (200 °C)	>= 100	min
High Pressure OIT		ASTM D 5885	>= 400	min
UV resistance (HP OIT, % retained)		ASTM D 5885	>= 35	%
Dimensional Stability	MD	ASTM D 1204	-0.86	%
Dimensional Stability	CMD	ASTM D 1204	0.08	%

Resin Characteristics

Properties	Test Method	Value	Units
Density	ASTM D 792	<= 0.926	g/cm3
Melt Flow Index	ASTM D 1238 (190/2.16)	< 1.00	gr/10 min

MD=Machine Direction; CMD= Cross Direction;
Note: The dimensions of the roll are conditioned by the factory manufacturing environment and temperature, by dimensional stability and by productive dimensional tolerance. For conversion of N/mm2 to N/mm, kindly multiply by the thickness.This is system-generated document and it does not require original signature or stamp.

Made by (JLP) **Approved by (TSM)**

Certificate printing date 07/02/2018

QC LABORATORY, ATARFIL

TYPE:GMB ATARFIL LLD 40 MILS BLACK 19.7FT X 999FT Roll nº: C3V113026P

Roll Data

Length: 999 f ±2% Area: 19,680.30 sqf Weight: 3516 lbs

Width: 19.70 f ±0.7% Nominal Thickness: 40 mils

Geomembrane Characteristics

Properties		Test Method	Value	Units
Thickness		ASTM D 5199.	37.0	mils
Density of Geomembrane		ASTM D 792	0.936	g/cm3
Elongation at Break, GL 2.0 inches	MD	ASTM D 6693, Type IV.	856	%
Elongation at Break, GL 2.0 inches	CMD	ASTM D 6693, Type IV.	892	%
Tensile Strength at Break	MD	ASTM D 6693, type IV	185	lb/in
Tensile Strength at Break	CMD	ASTM D 6693, type IV	172	lb/in
Tear Resistance	MD	ASTM D 1004.	25	lb
Tear Resistance	CMD	ASTM D 1004.	23	lb
Puncture Resistance		ASTM D 4833.	81	lb
Carbon Black Content		ASTM D 4218	2.42	%
Carbon Black Dispersion		ASTM D 5596	10	views Cat 1/2
O.I.T. Standard		ASTM D 3895 (200 °C)	>= 100	min
High Pressure OIT		ASTM D 5885	>= 400	min
UV resistance (HP OIT, % retained)		ASTM D 5885	>= 35	%
Dimensional Stability	MD	ASTM D 1204	-0.86	%
Dimensional Stability	CMD	ASTM D 1204	0.08	%

Resin Characteristics

Properties	Test Method	Value	Units
Density	ASTM D 792	<= 0.926	g/cm3
Melt Flow Index	ASTM D 1238 (190/2.16)	< 1.00	gr/10 min

MD=Machine Direction; CMD= Cross Direction;
Note: The dimensions of the roll are conditioned by the factory manufacturing environment and temperature, by dimensional stability and by productive dimensional tolerance. For conversion of N/mm2 to N/mm, kindly multiply by the thickness.This is system-generated document and it does not require original signature or stamp.

Made by (JLP) **Approved by (TSM)**

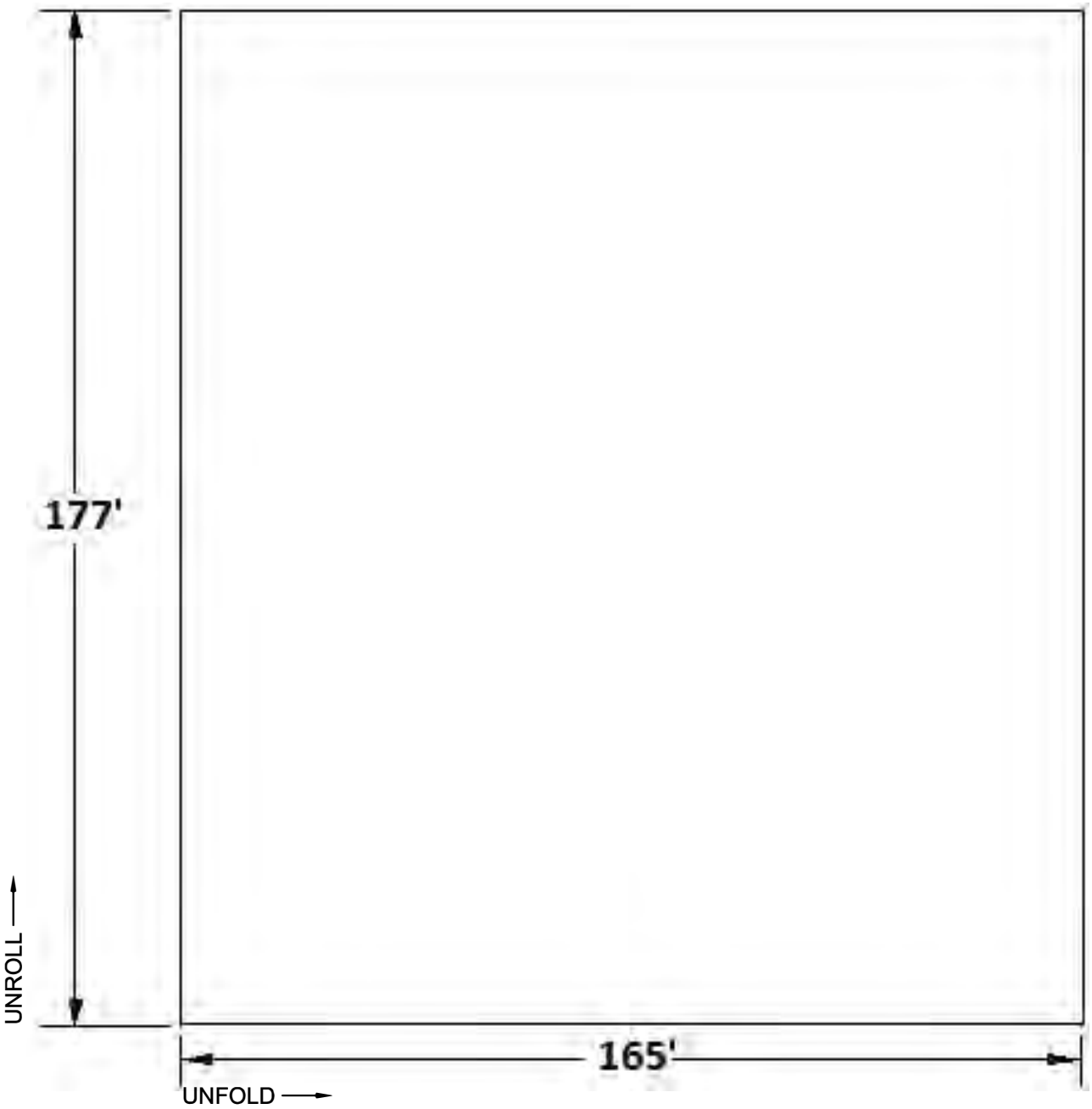
Certificate printing date 07/02/2018

QC LABORATORY, ATARFIL

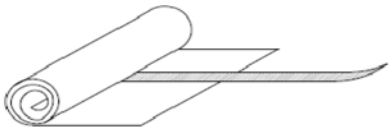
WESTERN TANK & LINING LTD.

Baffinland
Liner#3

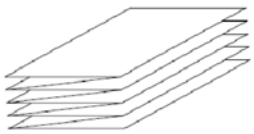
165' x 177' Standard Fan Folded
Atarfil 40mil smooth LLDPE



STANDARD ROLL WITH WEBBING



STANDARD FAN FOLD



VANCOUVER: 7192 Vantage Way, Delta, BC V4G 1K7 T: 604-241-9487 F: 604-241-9485
CALGARY: 105 Stockton Pt., Okotoks, AB T1S 1A5 T: 403-938-4361 F: 403-938-4371

1-800-551-4355

Liner and F.S. Quality Control Audit

Notes

Inspector	Val	Crew	Nick,Shane,Anthony,Matt,Jordyn,Mark	Calculator Liner Size Test Tolerance	Date	8/27/2018
		QA Damage Loss Tracker 2018		*Length*	*Width*	*Style*
Work Order #	**WO-011956**		Size / Style	**177**	**165**	**Liner**
PO#	CP18-148 (Baffinland# 2)	Customer	Baffinland	Liner #		**3**

Width Calculator (enter for size ordered) Sizes are expressed in Decimal feet

Liner Length (feet)	Liner width (Feet)	Roll Width (Inches)	Weld Width overlap (Inches)	Calculated Panels Needed	Even Panel no. (rounded up)	Total Width of Even Panels (Feet)	Material Size removed from Even Panel count	Number of Cut Welds	Total Width Calculated
177	165	235	5	9.025362	9	172.91667	9.79		163.1267

1st panel length verification size/persons	179'	Finished Length	177	Actual Width	163.1267

Stepped Panel lengths	NA
Step inset	NA
Secondary measurements (cut welds)	No cut weld
Seam lip pull checks (non-destructive)	5 per weld

Cross welds: 1 in panel 2,1 in panel 6 Inspected by: Val

Special Instructions: Please mark panel #2 and panel #3 / please use 8.5 panels for width

Material: 40 mi LLDPE Atarfil B/B Color Out: Black

Rolling		Folding	
Standard Roll		Standard Fan	x
Standard Roll with Webbing	x	Butterfly Fold	
Scroll Rolled center mark W/Webbing		Fan Fold to center 2" web markers	

Core Type Used: Metal [ ] Cardboard [x] Other [ ]

(Standard = mil, size, unroll and unfold arrow)

Standard Information Written on Item [x] Other:

refer to E.I.C for standards

Packaging Wrap/ Color : Standard Liner [x] Other:

Standard Package Labeling [x] Other:

refer to E.I.C for standards

Wedge/Extrusion Trial

WESTERN TANK & LINING LTD.

7192 Vantage Way
Delta, BC V4G 1K7

Office 604.241.9487 Fax 604.241.9485

Toll-Free 1.800.551.4355

Customer:	Baffinland	PO #	CP18-148 (Baffinland #2)
Production Date:	8/24/2018	Time:	2:27PM
QA Test Person:	Val	W./O.	WO-011956
Welding Tech:	Matt	Crew:	ıane,Nick,Anthony,Mat

Welder Qualification For Liners: 2 and 3 Time Ending: 3:30PM

size expressed in decimal feet

			Length	*Width*	*Style*
Material Type:	40 mil LLDPE Atarfil B/B	Liner Size:	177	165	Liner

Welder Number:	7		Outside Temp:	73 degrees
Welder Set Temp:	860		Inside Temp:	80 degrees
Welder Set Speed:	599	*Timed FPM* 24	Sheet Temp:	80 degrees
Extrusion Rod:	NA		Welder Set up with bar Y/N	N

Peel Data

test speed is 20 in/min unless noted otherwise

	Inside (Lbs)	Outside (Lbs)	Failure Type	Seperation (%)	Comments
1	64	64	SE1	0	Pass
2	59	60	SE1	0	Pass
3	65	64	SE1	0	Pass
4	59	58	SE1	0	Pass
5	62	62	SE1	0	Pass

Shear Data

	Shear (Lbs)	Elongation (%)	Comments
1	68	200+%	PASS/STE
2	56	200+%	PASS/STE
3	68	200+	PASS/STE
4	61	200+	PASS/STE
5	70	200+	PASS/STE

Notes: Tear Back Results on Sample Weld: PASS

STE = sample stretch to end of test
SE1 = sample break in outer edge of seam
SE2= break at seam edge top sheet (extrusion shear only)
SE3= break at seam edge in bottom sheet (extrusion peel only)

Wedge/Extrusion Trial

WESTERN TANK & LINING LTD.

7192 Vantage Way
Delta, BC V4G 1K7

Office 604.241.9487 Fax 604.241.9485

Toll-Free 1.800.551.4355

Customer:	Baffinland	PO #	P18-148 (Baffinland #
Production Date:	8/27/2018	Time:	7:27AM
QA Test Person:	Val	W./O.	WO-011956
Welding Tech:	Shane	Crew:	e,Nick,Jordyn,Anthony,

Welder Qualification For Liners: 2 and 3 Time Ending: 11:30AM

size expressed in decimal feet

Material Type:	40 mil LLDPE Atarfil B/B	Liner Size:	*Length* 177	*Width* 165	*Style* Liner

Welder Number:	7			Outside Temp:	73 degrees
Welder Set Temp:	860			Inside Temp:	80 degrees
Welder Set Speed:	599	*Timed FPM*	24	Sheet Temp:	80 degrees
Extrusion Rod:	NA			Welder Set up with bar Y/N	N

Peel Data

test speed is 20 in/min unless noted otherwise

	Inside (Lbs)	Outside (Lbs)	SE1	Seperation (%)	Comments
1	64	61	SE1	0	Pass
2	67	62	SE1	0	Pass
3	67	65	SE1	0	Pass
4	64	62	SE1	0	Pass
5	67	64	SE1	0	Pass

Shear Data

	Shear (Lbs)	Elongation (%)	Comments
1	68	200+%	Pass/STE
2	65	200+%	Pass/STE
3	66	200+	Pass/STE
4	69	200+	Pass/STE
5	67	200+	Pass/STE

Notes: Tear Back Results on Sample Weld: NA

STE = sample stretch to end of test
SE1 = sample break in outer edge of seam
SE2= break at seam edge top sheet (extrusion shear only)
SE3= break at seam edge in bottom sheet (extrusion peel only)

Wedge/Extrusion Trial

WESTERN TANK & LINING LTD.

7192 Vantage Way
Delta, BC V4G 1K7

Office 604.241.9487 Fax 604.241.9485

Toll-Free 1.800.551.4355

Customer:	Baffinland	PO #	P18-148 (Baffinland #
Production Date:	8/27/2018	Time:	7:34AM
QA Test Person:	Val	W./O.	WO-011956
Welding Tech:	Nick	Crew:	lick,Jordyn,Anthony,Ma

Welder Qualification For Liners: 2&3 Time Ending: 1:30PM

size expressed in decimal feet

			Length	*Width*	*Style*
Material Type:	40 mil LLDPE Atarfil B/B	Liner Size:	177	165	Liner

Welder Number:	Extruder #2	Outside Temp:	73 degrees
Welder Set Temp:	400/350	Inside Temp:	80 degrees
Welder Set Speed:	*Timed FPM* NA	Sheet Temp:	80 degrees
Extrusion Rod:	4L34227D	Welder Set up with bar Y/N	N

Peel Data

test speed is 20 in/min unless noted otherwise

	Inside (Lbs)	Outside (Lbs)	Failure Type	Seperation (%)	Comments
1	63	NA	SE1	0	Pass
2	62	NA	SE1	0	Pass
3	67	NA	SE1	0	Pass
4	65	NA	SE1	0	Pass
5	68	NA	SE1	0	Pass

Shear Data

	Shear (Lbs)	Elongation (%)	Comments
1	63	200+%	Pass/STE
2	66	200+%	Pass/STE
3	65	200+	Pass/STE
4	62	200+	Pass/STE
5	67	200+	Pass/STE

Notes: Tear Back Results on Sample Weld:

STE = sample stretch to end of test
SE1 = sample break in outer edge of seam
SE2= break at seam edge top sheet (extrusion shear only)
SE3= break at seam edge in bottom sheet (extrusion peel only)

Wedge/Extrusion Trial

WESTERN TANK & LINING LTD.

7192 Vantage Way
Delta, BC V4G 1K7

Office 604.241.9487 Fax 604.241.9485

Toll-Free 1.800.551.4355

Customer: Baffinland | PO # P18-148 (Baffinland #

Production Date: 8/27/2018 | Time: 12:27PM

QA Test Person: Val | W./O. WO-011956

Welding Tech: | Crew: lick,Jordyn,Anthony,Ma

Welder Qualification For Liners: 3 | Time Ending: 1:37PM

size expressed in decimal feet

		Length	Width	Style
Material Type:	40 mil LLDPE Atarfil B/B	Liner Size: 177	165	Liner

Welder Number:	7	Outside Temp:	85 degrees
Welder Set Temp:	860	Inside Temp:	90degrees
Welder Set Speed:	599 *Timed FPM* 24	Sheet Temp:	90 degreees
Extrusion Rod:	NA	Welder Set up with bar Y/N	N

Peel Data

test speed is 20 in/min unless noted otherwise

	Inside (Lbs)	Outside (Lbs)	Failure Type	Seperation (%)	Comments
1	74	69	SE1	0	Pass
2	71	63	SE1	0	Pass
3	75	70	SE1	0	Pass
4	68	68	SE1	0	Pass
5	74	68	SE1	0	Pass

Shear Data

	Shear (Lbs)	Elongation (%)	Comments
1	76	200+%	Pass/STE
2	75	200+%	Pass/STE
3	78	200+	Pass/STE
4	75	200+	Pass/STE
5	79	200+	Pass/STE

Notes: Tear Back Results on Sample Weld: Pass

STE = sample stretch to end of test
SE1 = sample break in outer edge of seam
SE2= break at seam edge top sheet (extrusion shear only)
SE3= break at seam edge in bottom sheet (extrusion peel only)

Seam End Coupon Log

WESTERN TANK & LINING LTD.

7192 Vantage Way
Delta, BC V4G1K7
Office 604.241.9487 Fax 604.241.9485
Toll-Free 1.800.551.4355

test speed is 20 in/min unless noted otherwise

Customer:	Baffinland	PO#	P18-148 (Baffinland #2
Production Date:	8/27/2018	Crew:	Shane,Nick,Jordyn,Anthony,Matt, Mark

Welder Settings

Welder #	7	Operator	Matt	Temp/Speed	860/599

Timed welder speed

Distance in feet	19.58	Timed Sec.	49	Feet per min.	24

QA Test Person:	Val	W./O.	WO-011956
Material Type:	40 mil LLDPE Atarfil B/B		

size in dec. ft.	*Length*	*Width*	Style		
Liner Size:	177	165	Liner	Liner #	3

Seam Number	Test # P# / S#	Inside (Lbs)	Outside (Lbs)	Failure Type	Seperation (%)	Shear (Lbs)	Elongation (%)	Comments
W1	P1/S1	61	65	SE1	0	71	200+	PASS/STE
W1	P2/S2	62	62	SE1	0	67	200+	PASS/STE

Notes:

STE = sample stretch to end of test

SE1 = sample break in outer edge of seam

Pull Checks (non-destructive seam lip pulls) 5 per weld

WESTERN TANK & LINING LTD.

7192 Vantage Way
Delta, BC V4G 1K7
Office 604.241.9487 Fax 604.241.9485
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ASTM D 5199 MATERIAL THICKNESS
LLDPE

Date MFG date	Mil Mfg	Roll ID #	Roll Width measured	sample area	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	Avg.	QA
8/24/2018	40 mil LLDPE Atarfil	C3V113026P	19.58'/19'7"	Beg	40.5	48.2	43.6	39.2	38.9	38.2	42	43.1	39.3	41.2	41.42	Val
8/24/2018	40 mil LLDPE Atarfil	C1V136050N	19.58'/19'7"	Partial	41.7	41.9	40.1	39.7	40.5	41.3	39.1	39.4	40.6	41.2	40.55	Val
8/27/2018	40 mil LLDPE Atarfil	C4M540067N	19.58'/19'7"	Beg	37.4	38.7	37.6	38.9	36.7	40.1	41.1	39.5	39.2	38.6	38.778	Val
8/27/2018	40 mil LLDPE Atarfil	C2M540074N	19.58'/19'7"	Beg	38.3	38.7	38	37.6	38	38.3	39.2	39.2	39.5	39.1	38.59	Val

ATARFIL

TYPE:

Roll nº: C4M540067N

Roll Data

Length: 999 f ±2% Area: 19,680.30 sqf Weight: 3505 lbs

Width: 19.70 f ±0.7% Nominal Thickness: 40 mils

Geomembrane Characteristics

Properties		Test Method	Value	Units
Thickness		ASTM D 5199.	37.80	mils
Density of Geomembrane		ASTM D 792	0.935	g/cm3
Dimensional Stability	MD	ASTM D 1204	-1.24	%
Dimensional Stability	CMD	ASTM D 1204	0.19	%
Carbon Black Content		ASTM D 4218	2.34	%
Carbon Black Dispersion		ASTM D 5596	1	views Cat1/2
O.I.T. Standard		ASTM D 3895 (200 °C)	>= 100	min
High Pressure OIT		ASTM D 5885	>= 400	min
UV resistance (HP OIT, % retained)		ASTM D 5885	>= 75	%
Elongation at Break, GL 2.0 inches	MD	ASTM D 6693, Type IV	861	%
Elongation at Break, GL 2.0 inches	CMD	ASTM D 6693, Type IV	976	%
Tensile Strength at Break	MD	ASTM D 6693, Type IV.	168	lb/in
Tensile Strength at Break	CMD	ASTM D 6693, Type IV.	180	lb/in
Tear Resistance	MD	ASTM D 1004.	22.5	lb
Tear Resistance	CMD	ASTM D 1004.	22.5	lb
Puncture Resistance		ASTM D 4833.	64	lb
2% Modulus		ASTM D 5323.	1,065	lb/in

Resin Characteristics

Properties	Test Method	Value	Units
Density	ASTM D 792	>= 0.932	g/cm3
Melt Flow Index	ASTM D 1238 (190/2.16)	<= 0.40	gr/10 min

MD=Machine Direction; CMD= Cross Direction;
Note: The dimensions of the roll are conditioned by the factory manufacturing environment and temperature, by dimensional stability and by productive dimensional tolerance. For conversion of N/mm2 to N/mm, kindly multiply by the thickness.This is system-generated document and it does not require original signature or stamp.

Made by (LJC) **Approved by (TSM)**

Certificate printing date 07/02/2018

QC LABORATORY, ATARFIL

ATARFIL

TYPE:

Roll nº: C1V136050N

Roll Data

Length: 999 f ±2% Area: 19,680.30 sqf Weight: 3505 lbs

Width: 19.70 f ±0.7% Nominal Thickness: 40 mils

Geomembrane Characteristics

Properties		Test Method	Value	Units
Thickness		ASTM D 5199.	37.80	mils
Density of Geomembrane		ASTM D 792	0.935	g/cm3
Dimensional Stability	MD	ASTM D 1204	-1.24	%
Dimensional Stability	CMD	ASTM D 1204	0.19	%
Carbon Black Content		ASTM D 4218	2.34	%
Carbon Black Dispersion		ASTM D 5596	1	views Cat1/2
O.I.T. Standard		ASTM D 3895 (200 °C)	>= 100	min
High Pressure OIT		ASTM D 5885	>= 400	min
UV resistance (HP OIT, % retained)		ASTM D 5885	>= 75	%
Elongation at Break, GL 2.0 inches	MD	ASTM D 6693, Type IV	861	%
Elongation at Break, GL 2.0 inches	CMD	ASTM D 6693, Type IV	976	%
Tensile Strength at Break	MD	ASTM D 6693, Type IV.	168	lb/in
Tensile Strength at Break	CMD	ASTM D 6693, Type IV.	180	lb/in
Tear Resistance	MD	ASTM D 1004.	22.5	lb
Tear Resistance	CMD	ASTM D 1004.	22.5	lb
Puncture Resistance		ASTM D 4833.	64	lb
2% Modulus		ASTM D 5323.	1,065	lb/in

Resin Characteristics

Properties	Test Method	Value	Units
Density	ASTM D 792	>= 0.932	g/cm3
Melt Flow Index	ASTM D 1238 (190/2.16)	<= 0.40	gr/10 min

MD=Machine Direction; CMD= Cross Direction;
Note: The dimensions of the roll are conditioned by the factory manufacturing environment and temperature, by dimensional stability and by productive dimensional tolerance. For conversion of N/mm2 to N/mm, kindly multiply by the thickness.This is system-generated document and it does not require original signature or stamp.

Made by (LJC) **Approved by (TSM)**

Certificate printing date 07/02/2018

QC LABORATORY, ATARFIL

TYPE:GMB ATARFIL LLD 40 MILS BLACK 19.7FT X 999FT Roll nº: C2M540074N

Roll Data

Length: 999 f ±2% Area: 19,680.30 sqf Weight: 3516 lbs

Width: 19.70 f ±0.7% Nominal Thickness: 40 mils

Geomembrane Characteristics

Properties		Test Method	Value	Units
Thickness		ASTM D 5199.	37.0	mils
Density of Geomembrane		ASTM D 792	0.936	g/cm3
Elongation at Break, GL 2.0 inches	MD	ASTM D 6693, Type IV.	856	%
Elongation at Break, GL 2.0 inches	CMD	ASTM D 6693, Type IV.	892	%
Tensile Strength at Break	MD	ASTM D 6693, type IV	185	lb/in
Tensile Strength at Break	CMD	ASTM D 6693, type IV	172	lb/in
Tear Resistance	MD	ASTM D 1004.	25	lb
Tear Resistance	CMD	ASTM D 1004.	23	lb
Puncture Resistance		ASTM D 4833.	81	lb
Carbon Black Content		ASTM D 4218	2.42	%
Carbon Black Dispersion		ASTM D 5596	10	views Cat 1/2
O.I.T. Standard		ASTM D 3895 (200 °C)	>= 100	min
High Pressure OIT		ASTM D 5885	>= 400	min
UV resistance (HP OIT, % retained)		ASTM D 5885	>= 35	%
Dimensional Stability	MD	ASTM D 1204	-0.86	%
Dimensional Stability	CMD	ASTM D 1204	0.08	%

Resin Characteristics

Properties	Test Method	Value	Units
Density	ASTM D 792	<= 0.926	g/cm3
Melt Flow Index	ASTM D 1238 (190/2.16)	< 1.00	gr/10 min

MD=Machine Direction; CMD= Cross Direction;
Note: The dimensions of the roll are conditioned by the factory manufacturing environment and temperature, by dimensional stability and by productive dimensional tolerance. For conversion of N/mm2 to N/mm, kindly multiply by the thickness.This is system-generated document and it does not require original signature or stamp.

Made by (JLP) **Approved by (TSM)**

Certificate printing date 07/02/2018

QC LABORATORY, ATARFIL

TYPE:GMB ATARFIL LLD 40 MILS BLACK 19.7FT X 999FT Roll nº: C3V113026P

Roll Data

Length: 999 f ±2% Area: 19,680.30 sqf Weight: 3516 lbs

Width: 19.70 f ±0.7% Nominal Thickness: 40 mils

Geomembrane Characteristics

Properties		Test Method	Value	Units
Thickness		ASTM D 5199.	37.0	mils
Density of Geomembrane		ASTM D 792	0.936	g/cm3
Elongation at Break, GL 2.0 inches	MD	ASTM D 6693, Type IV.	856	%
Elongation at Break, GL 2.0 inches	CMD	ASTM D 6693, Type IV.	892	%
Tensile Strength at Break	MD	ASTM D 6693, type IV	185	lb/in
Tensile Strength at Break	CMD	ASTM D 6693, type IV	172	lb/in
Tear Resistance	MD	ASTM D 1004.	25	lb
Tear Resistance	CMD	ASTM D 1004.	23	lb
Puncture Resistance		ASTM D 4833.	81	lb
Carbon Black Content		ASTM D 4218	2.42	%
Carbon Black Dispersion		ASTM D 5596	10	views Cat 1/2
O.I.T. Standard		ASTM D 3895 (200 °C)	>= 100	min
High Pressure OIT		ASTM D 5885	>= 400	min
UV resistance (HP OIT, % retained)		ASTM D 5885	>= 35	%
Dimensional Stability	MD	ASTM D 1204	-0.86	%
Dimensional Stability	CMD	ASTM D 1204	0.08	%

Resin Characteristics

Properties	Test Method	Value	Units
Density	ASTM D 792	<= 0.926	g/cm3
Melt Flow Index	ASTM D 1238 (190/2.16)	< 1.00	gr/10 min

MD=Machine Direction; CMD= Cross Direction;
Note: The dimensions of the roll are conditioned by the factory manufacturing environment and temperature, by dimensional stability and by productive dimensional tolerance. For conversion of N/mm2 to N/mm, kindly multiply by the thickness.This is system-generated document and it does not require original signature or stamp.

Made by (JLP) **Approved by (TSM)**

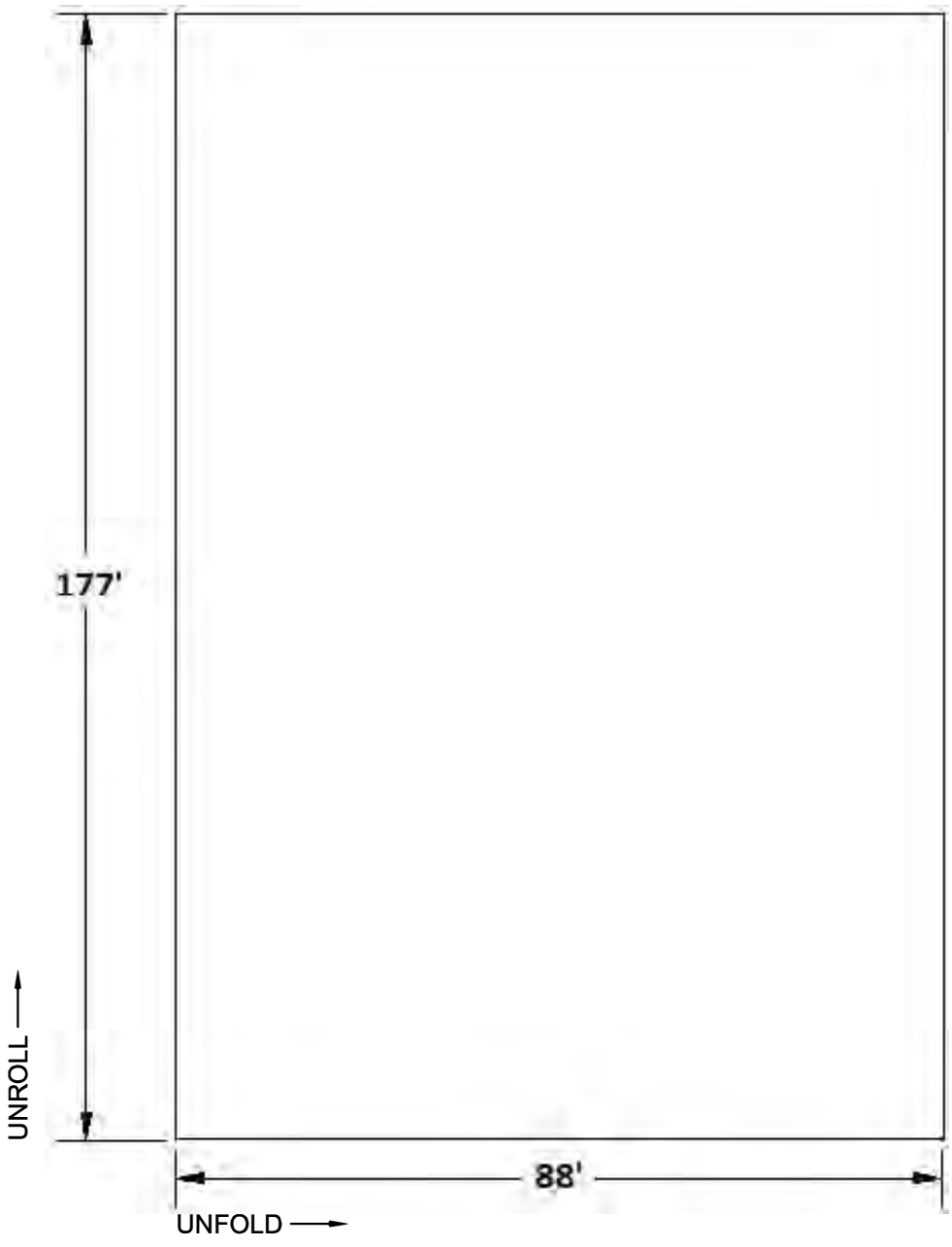
Certificate printing date 07/02/2018

QC LABORATORY, ATARFIL

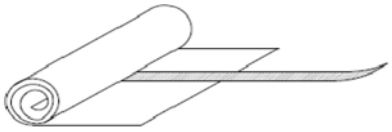
WESTERN TANK & LINING LTD.

Baffinland
Liner#4

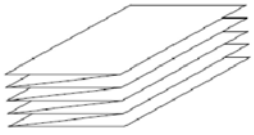
88' x 177' Standard Fan Folded
Atarfil 40mil smooth LLDPE



STANDARD ROLL WITH WEBBING



STANDARD FAN FOLD



VANCOUVER: 7192 Vantage Way, Delta, BC V4G 1K7 T: 604-241-9487 F: 604-241-9485
CALGARY: 105 Stockton Pt., Okotoks, AB T1S 1A5 T: 403-938-4361 F: 403-938-4371

1-800-551-4355

Liner and F.S. Quality Control Audit

Inspector	Val	Crew	Mark,Nick,Shane,Anthony,Matt,Jordyn	Calculator Liner Size Test Tolerance / Date	8/24/2018
		QA Damage Loss Tracker 2018	*Length*	*Width*	*Style*
Work Order #	WO-011957	Size / Style	177	88	Liner
PO#	CP18-148 (B	Customer	Baffinland	Liner #	4

Width Calculator (enter for size ordered) Sizes are expressed in Decimal feet

Liner Length (feet)	Liner width (Feet)	Roll Width (Inches)	Weld Width overlap (Inches)	Calculated Panels Needed	Even Panel no. (rounded up)	Total Width of Even Panels (Feet)	Material Size removed from Even Panel count	Number of Cut Welds	Total Width Calculated
177	88	235	5	5.007971	5	96.25	9.79		86.46

1st panel length verification size/persons	179'	Finished Length	177	Actual Width	86.46
Stepped Panel lengths	NA				
Step inset	NA				
Secondary measurements (cut welds)	No cut Weld				
Seam lip pull checks (non-destructive)	5 per weld				
Cross welds:	2 in panel 2	Inspected by:	Val		
Special Instructions	Please mark panel #4 / Please use 4.5 panels for width				
Material	40 mil LLDPE Atarfil B/B	Color Out	Black		

Rolling		Folding	
Standard Roll		Standard Fan	x
Standard Roll with Webbing	x	Butterfly Fold	
Scroll Rolled center mark W/Webbing		Fan Fold to center 2" web markers	

Core Type Used:	Metal	Cardboard	Other
		x	

(Standard = mil, size, unroll and unfold arrow)

Standard Information Written on Item	x	Other:

refer to E.I.C for standards

Packaging Wrap/ Color : Standard Liner	x	Other:

refer to E.I.C for standards

Standard Package Labeling	x	Other:

Notes

Wedge/Extrusion Trial

WESTERN TANK & LINING LTD.

7192 Vantage Way
Delta, BC V4G 1K7

Office 604.241.9487 Fax 604.241.9485

Toll-Free 1.800.551.4355

Customer: Baffinland | PO #: CP18-148 (Baffinland #2)

Production Date: 8/24/2018 | Time: 12:08PM

QA Test Person: Val | W./O.: WO-011957

Welding Tech: Matt | Crew: ıane,Nick,Anthony,Mat

Welder Qualification For Liners: 4 | Time Ending: 1:57 PM

size expressed in decimal feet

		Length	Width	Style
Material Type:	40 mil LLPDE Atarfil B/B	Liner Size: 177	88	Liner

Welder Number:	7	Outside Temp:	73 degrees
Welder Set Temp:	860	Inside Temp:	80 degrees
Welder Set Speed:	599 *Timed FPM* 24	Sheet Temp:	80 degrees
Extrusion Rod:	NA	Welder Set up with bar Y/N	N

Peel Data

test speed is 20 in/min unless noted otherwise

	Inside (Lbs)	Outside (Lbs)	Failure Type	Seperation (%)	Comments
1	64	64	SE1	0	Pass
2	59	60	SE1	0	Pass
3	65	64	SE1	0	Pass
4	59	58	SE1	0	Pass
5	62	62	SE1	0	Pass

Shear Data

	Shear (Lbs)	Elongation (%)	Comments
1	68	200+%	PASS/STE
2	56	200+%	PASS/STE
3	68	200+	PASS/STE
4	61	200+	PASS/STE
5	70	200+	PASS/STE

Notes: Tear Back Results on Sample Weld: PASS

STE = sample stretch to end of test
SE1 = sample break in outer edge of seam
SE2= break at seam edge top sheet (extrusion shear only)
SE3= break at seam edge in bottom sheet (extrusion peel only)

Wedge/Extrusion Trial

WESTERN TANK & LINING LTD.

7192 Vantage Way
Delta, BC V4G 1K7

Office 604.241.9487 Fax 604.241.9485

Toll-Free 1.800.551.4355

Customer: Baffinland PO # P18-148 (Baffinland #

Production Date: 8/24/2018 Time: 10:30AM

QA Test Person: Val W./O. WO-011957

Welding Tech: Nick Crew: ıane,Nick,Anthony,Mat

Welder Qualification For Liners: 4 Time Ending:

size expressed in decimal feet

			Length	*Width*	*Style*
Material Type:	40 mil LLPDE Atarfil B/B	Liner Size:	177	88	Liner

Welder Number: Extruder
Welder Set Temp: 400/350
Welder Set Speed: *Timed FPM* NA
Extrusion Rod: 4L34227D

Outside Temp: 73 degrees
Inside Temp: 80 degrees
Sheet Temp: 80 degrees
Welder Set up with bar Y/N N

Peel Data

test speed is 20 in/min unless noted otherwise

	Inside (Lbs)	Outside (Lbs)	SE1	Seperation (%)	Comments
1	69	NA	SE1	0	Pass
2	65	NA	SE1	0	Pass
3	72	NA	SE1	0	Pass
4	72	NA	SE1	0	Pass
5	70	NA	SE1	0	Pass

Shear Data

	Shear (Lbs)	Elongation (%)	Comments
1	77	200+%	Pass/STE
2	68	200+%	Pass/STE
3	76	200+	Pass/STE
4	77	200+	Pass/STE
5	77	200+	Pass/STE

p

Notes: Tear Back Results on Sample Weld: NA

STE = sample stretch to end of test
SE1 = sample break in outer edge of seam
SE2= break at seam edge top sheet (extrusion shear only)
SE3= break at seam edge in bottom sheet (extrusion peel only)

Seam End Coupon Log

WESTERN TANK & LINING LTD.

7192 Vantage Way
Delta, BC V4G1K7
Office 604.241.9487 Fax 604.241.9485
Toll-Free 1.800.551.4355

test speed is 20 in/min unless noted otherwise

Customer:	Baffinland	PO#	CP18-148 (Baffinland #2
Production Date:	8/24/2018	Crew:	Mark,Nick,ShaneMatt,Anthony,Jordyn

Welder Settings

Welder #	7	Operator	Nick	Temp/Speed	860/599

Timed welder speed

Distance in feet	19.58	Timed Sec.	48	Feet per min.	24

QA Test Person:	Val	W./O.	WO-011957
Material Type:	40 mil LLDPE Atarfil		

size in dec. ft.	*Length*	*Width*	Style	
Liner Size:	177	88	Liner	Liner # 4

Seam Number	Test # P# / S#	Inside (Lbs)	Outside (Lbs)	Failure Type	Seperation (%)	Shear (Lbs)	Elongation (%)	Comments
W1	P1S1	69	62	SE1	0	69	200+	PASS/STE
W1	P2/S2	57	60	SE1	0	61	200+	PASS/STE

Notes:

STE = sample stretch to end of test

SE1 = sample break in outer edge of seam

Pull Checks (non-destructive seam lip pulls) 5 per weld

WESTERN TANK & LINING LTD.

7192 Vantage Way
Delta, BC V4G 1K7
Office 604.241.9487 Fax 604.241.9485
Toll-Free 1.800.551.4355

ASTM D 5199 MATERIAL THICKNESS
LLDPE

Date MFG date	Mil Mfg	Roll ID #	Roll Width measured	sample area	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	Avg.	QA
8/24/2018	40 mil LLDPE Atarfil	C4M540066N	19.58'/19'7"	Beg	38.1	36.9	37.5	40.4	36.5	35.5	36.3	36.2	36.2	36.5	37.01	Val
8/24/2018	40 mil LLDPE Atarfil	C3V113026P	19.58'/19'7"	Beg	40.5	48.2	43.6	39.2	38.9	38.2	42	43.1	39.3	41.2	41.42	Val
8/24/2018	40 mil LLDPE Atarfil	C4M5400695	19.58'/19'7"	Partial	38.1	40.4	38.9	38.4	37.9	40	41.2	38.7	36.5	40.1	39.02	Val

ATARFIL

TYPE:

Roll nº: C4M540066N

Roll Data

Length: 999 f ±2% Area: 19,680.30 sqf Weight: 3494 lbs

Width: 19.70 f ±0.7% Nominal Thickness: 40 mils

Geomembrane Characteristics

Properties		Test Method	Value	Units
Thickness		ASTM D 5199.	37.80	mils
Density of Geomembrane		ASTM D 792	0.935	g/cm3
Dimensional Stability	MD	ASTM D 1204	-1.24	%
Dimensional Stability	CMD	ASTM D 1204	0.19	%
Carbon Black Content		ASTM D 4218	2.31	%
Carbon Black Dispersion		ASTM D 5596	1	views Cat1/2
O.I.T. Standard		ASTM D 3895 (200 °C)	>= 100	min
High Pressure OIT		ASTM D 5885	>= 400	min
UV resistance (HP OIT, % retained)		ASTM D 5885	>= 75	%
Elongation at Break, GL 2.0 inches	MD	ASTM D 6693, Type IV	861	%
Elongation at Break, GL 2.0 inches	CMD	ASTM D 6693, Type IV	976	%
Tensile Strength at Break	MD	ASTM D 6693, Type IV.	168	lb/in
Tensile Strength at Break	CMD	ASTM D 6693, Type IV.	180	lb/in
Tear Resistance	MD	ASTM D 1004.	22.5	lb
Tear Resistance	CMD	ASTM D 1004.	22.5	lb
Puncture Resistance		ASTM D 4833.	64	lb
2% Modulus		ASTM D 5323.	1,065	lb/in

Resin Characteristics

Properties	Test Method	Value	Units
Density	ASTM D 792	>= 0.932	g/cm3
Melt Flow Index	ASTM D 1238 (190/2.16)	<= 0.40	gr/10 min

MD=Machine Direction; CMD= Cross Direction;
Note: The dimensions of the roll are conditioned by the factory manufacturing environment and temperature, by dimensional stability and by productive dimensional tolerance. For conversion of N/mm2 to N/mm, kindly multiply by the thickness.This is system-generated document and it does not require original signature or stamp.

Made by (LJC) **Approved by (TSM)**

Certificate printing date 07/02/2018

QC LABORATORY, ATARFIL

ATARFIL

TYPE:

Roll nº: C4M5400695

Roll Data

Length: 999 f ±2% Area: 19,680.30 sqf Weight: 3494 lbs

Width: 19.70 f ±0.7% Nominal Thickness: 40 mils

Geomembrane Characteristics

Properties		Test Method	Value	Units
Thickness		ASTM D 5199.	37.80	mils
Density of Geomembrane		ASTM D 792	0.935	g/cm3
Dimensional Stability	MD	ASTM D 1204	-1.24	%
Dimensional Stability	CMD	ASTM D 1204	0.19	%
Carbon Black Content		ASTM D 4218	2.31	%
Carbon Black Dispersion		ASTM D 5596	1	views Cat1/2
O.I.T. Standard		ASTM D 3895 (200 °C)	>= 100	min
High Pressure OIT		ASTM D 5885	>= 400	min
UV resistance (HP OIT, % retained)		ASTM D 5885	>= 75	%
Elongation at Break, GL 2.0 inches	MD	ASTM D 6693, Type IV	861	%
Elongation at Break, GL 2.0 inches	CMD	ASTM D 6693, Type IV	976	%
Tensile Strength at Break	MD	ASTM D 6693, Type IV.	168	lb/in
Tensile Strength at Break	CMD	ASTM D 6693, Type IV.	180	lb/in
Tear Resistance	MD	ASTM D 1004.	22.5	lb
Tear Resistance	CMD	ASTM D 1004.	22.5	lb
Puncture Resistance		ASTM D 4833.	64	lb
2% Modulus		ASTM D 5323.	1,065	lb/in

Resin Characteristics

Properties	Test Method	Value	Units
Density	ASTM D 792	>= 0.932	g/cm3
Melt Flow Index	ASTM D 1238 (190/2.16)	<= 0.40	gr/10 min

MD=Machine Direction; CMD= Cross Direction;
Note: The dimensions of the roll are conditioned by the factory manufacturing environment and temperature, by dimensional stability and by productive dimensional tolerance. For conversion of N/mm2 to N/mm, kindly multiply by the thickness.This is system-generated document and it does not require original signature or stamp.

Made by (LJC) **Approved by (TSM)**

Certificate printing date 07/02/2018

QC LABORATORY, ATARFIL

TYPE:GMB ATARFIL LLD 40 MILS BLACK 19.7FT X 999FT

Roll nº: C3V113026P

Roll Data

Length: 999 f ±2% Area: 19,680.30 sqf Weight: 3516 lbs

Width: 19.70 f ±0.7% Nominal Thickness: 40 mils

Geomembrane Characteristics

Properties		Test Method	Value	Units
Thickness		ASTM D 5199.	37.0	mils
Density of Geomembrane		ASTM D 792	0.936	g/cm3
Elongation at Break, GL 2.0 inches	MD	ASTM D 6693, Type IV.	856	%
Elongation at Break, GL 2.0 inches	CMD	ASTM D 6693, Type IV.	892	%
Tensile Strength at Break	MD	ASTM D 6693, type IV	185	lb/in
Tensile Strength at Break	CMD	ASTM D 6693, type IV	172	lb/in
Tear Resistance	MD	ASTM D 1004.	25	lb
Tear Resistance	CMD	ASTM D 1004.	23	lb
Puncture Resistance		ASTM D 4833.	81	lb
Carbon Black Content		ASTM D 4218	2.42	%
Carbon Black Dispersion		ASTM D 5596	10	views Cat 1/2
O.I.T. Standard		ASTM D 3895 (200 °C)	>= 100	min
High Pressure OIT		ASTM D 5885	>= 400	min
UV resistance (HP OIT, % retained)		ASTM D 5885	>= 35	%
Dimensional Stability	MD	ASTM D 1204	-0.86	%
Dimensional Stability	CMD	ASTM D 1204	0.08	%

Resin Characteristics

Properties	Test Method	Value	Units
Density	ASTM D 792	<= 0.926	g/cm3
Melt Flow Index	ASTM D 1238 (190/2.16)	< 1.00	gr/10 min

MD=Machine Direction; CMD= Cross Direction;
Note: The dimensions of the roll are conditioned by the factory manufacturing environment and temperature, by dimensional stability and by productive dimensional tolerance. For conversion of N/mm2 to N/mm, kindly multiply by the thickness.This is system-generated document and it does not require original signature or stamp.

Made by (JLP) **Approved by (TSM)**

Certificate printing date 07/02/2018

QC LABORATORY, ATARFIL

#1

CALIBRATION CERTIFICATE

Customer Name:		110 Volt	X
Unit Make & Model Number:	Accura-Lite	220 Volt	
Tensiometer Serial Number:	NAL-1394	Lbs.	X
		Kg.	

Device Calibrated:	S-Type load cell	Calibration Apparatus:	
Range:	0 - 500 lbs. Tension	Dead Weight system w/	
Model No:	M2300-500	Fluke Model 187 Multimeter	
Serial No:	184276		
Readout Model No:	2840AG-24123	W1	2
Readout Serial No:	03132773-48	W2	152
Channel No:	N/A	W3	302
		R1	-86
		R2	1900
		R3	3885

Indicator reading with no load: 0

Applied Force lbs.	Output (mv):	Display reading:	Deviation Error:
2	-0.248	2	0.00
52	1.738	52	0.00
102	3.724	102	0.00
152	5.719	152	0.00
202	7.701	202	0.00
252	9.692	252	0.00
302	11.66	302	0.00

Total Deviation Error (%): 0.00%

Temperature at time of calibration: 73 degrees F

Exitation Voltage: 10 V DC

Scale Factor (1):	0.0755	Offset (1):	9
Scale Factor (2):	0.0755	Offset (2):	9
Brake point:	1900	Calibration Check #	290

This calibration conforms to the standards set by ASTM E4 and is traceable to NIST standards

Note: Readout and load cell above have been systems calibrated and are considered a matched pair. In general, calibrated readouts and load cells are not interchangeable.

Calibrated by: JF Date: 02/22/20

WESTERN TANK & LINING LTD.
YOUR CONTAINMENT SPECIALISTS SINCE 1985

7192 Vantage Way,
Delta, B.C. V4G 1K7
PH: (604) 241-9487 FAX: (604) 241-9485
(800) 551-4355

CERTIFICATE OF ACCEPTANCE
SUBGRADE

PROJECT NAME	Baffinland - 106km Stockpile and Pond
PRODUCT DESCRIPTION	Geotextile + 40mil Liner over 3/4" minus bedding
PROJECT NUMBER	PO 9000001508
PROJECT LOCATION	Mary River, Baffin Island, Nunavut

INSTALLTION CONTRACTOR REPRESENTATIVE	Western Tank and Lining Karim Makhloufi
AREA TO BE ACCEPTED	Pond bedding area and anchor trenches Approx. 8136m^2

I, the undersigned, duly authorized representative of the installer do hereby accept the subgrade surface conditions, and shall be responsible for maintaining its integrity and suitability in accordance with the specifications. I do not accept any responsibility for the conditions or character of the subsurface soil, or any effects the soil might have on the lining system.

NAME	Karim Makhloufi
SIGNATURE	
TITLE	Liner Supervisor
DATE (dd/mm/yy)	9/9/20

APPENDIX F

DESIGN SPECIFICATIONS

Knight Piésold CONSULTING

June 20, 2019

Knight Piésold Ltd.
1650 Main Street West
North Bay, Ontario
Canada, P1B 8G5
T +1 705 476 2165
E northbay@knightpiesold.com
www.knightpiesold.com

Mr. Allan Knowlton
Project Manager
Baffinland Iron Mines Corporation
#300-2275 Upper Middle Road East
Oakville, Ontario
Canada, L6H 0C3

Dear Allan,

Re: Design Summary for the KM106 Stockpile and Runoff Management Measures

1.0 INTRODUCTION

Baffinland Iron Mines Corporation (Baffinland) owns and operates the Mary River Project located on northern Baffin Island, Nunavut. As part of Baffinland's mining strategy, a long-term stockpile is required to stockpile run-of-mine ore material. Knight Piésold Ltd. (KP) has been retained to complete the design for the KM106 Stockpile Access Road and runoff management measures, including the Sedimentation Pond. This letter provides a summary of the detailed design for these structures.

2.0 SITE CONDITIONS, DESIGN CRITERIA AND MATERIALS

2.1 GENERAL

The design of the Stockpile Access Road, Sedimentation Pond and runoff management measures have been developed by KP based on the proposed KM106 Stockpile layout (Baffinland, 2019). The KM106 Stockpile area is shown in plan view on Drawing 300. Additional details are provided on other drawings and in the sections below.

2.2 SITE CONDITIONS

KP completed a site investigation at the KM106 Stockpile from May 15 to 16, 2019 (KP, 2019). Baffinland provided topographical contours for the KM106 Stockpile location (Baffinland, 2019). The KM106 site generally consists of exposed bedrock or bedrock covered by shallow overburden up to 4 m thick.

2.3 DESIGN CRITERIA

The project design criteria were previously developed for the KM107 design work (KP, 2018). The design criteria were developed based on the following documents:

- The RFP for the KM107 Design (Caserta, 2018)
- The Mary River Project Civil Design Philosophy and Criteria (Hatch, 2013 and 2018)
- The Crusher Pad Sedimentation Pond expansion design (Golder Associates (Golder), 2017)
- The Mary River Project Water License (NWB, 2014)
- The Nunavut *Mine Safety and Health Act* (MHSA, 2011)

- The *Nunavut Waters and Nunavut Surface Rights Tribunal Act* and Nunavut Waters Regulations (NWNSRTA, 2018)
- The Metal and Diamond Mining Effluent Regulations (MDMER, 2018)
- The *Fisheries Act* (2016)

The design criteria are summarized in Table 1.

2.4 MATERIALS

Baffinland has indicated that the materials currently used (or proposed to be used) to construct other structures at site, including the Haul Road (Golder, 2018a), Waste Rock Dump Sedimentation Pond (Golder, 2018b) and the Crusher Pad Sedimentation Pond (Golder, 2017) will also be available for construction of the KM106 Stockpile Access Road and associated runoff management measures, including the Sedimentation Pond. In general, all fill materials shall meet the following requirements:

- Fill materials used for construction shall not be potentially acid generating (PAG) or metal leaching (ML).
- All materials shall consist of hard, durable fill material, free of clay, loam, tree stumps, roots and other deleterious materials or organic matter, and shall contain no ice.

The material specifications are described as follows:

- KM106 Stockpile Ore (blasted rock)
  - 500 mm minus blasted rock ore
  - Ore to be placed by truck and bulldozer in maximum 1000 mm lifts starting at the end of the Access Road.
  - Nominal compaction to be achieved by routing haulage traffic over the entire surface of the stockpile.
- 500 mm Minus Rockfill
  - To be used for the Access Road, safety berms, and downstream portion of the Sedimentation Pond perimeter berm.
  - Material shall consist of well graded, clean, durable and angular rockfill with a maximum particle size gradation of 500 mm.
  - To be placed in maximum 1000 mm lifts by truck and bulldozer; placement in the Access Road will start at the existing Haul Road.
  - Compaction to be achieved by routing haulage traffic and other construction equipment over the entire surface of the road.
  - Safety berm fill to be placed and nominally compacted to the dimensions shown on the Drawings.
- Berm Fill
  - To be used for the Collection/Diversion Berms and upstream slope of the Sedimentation Pond perimeter berm.
  - Material shall consist of well graded, clean, durable and angular rockfill with a maximum particle size of 150 mm.
  - Sedimentation Pond berm fill to be placed and spread in maximum 300 mm thick layers after compaction with a vibratory roller D9 dozer.
  - Collection/Diversion Berm fill to be placed and spread in maximum 200 mm layers after compaction. Compaction to be nominal.

- Intermediate Bedding
  - To be used for anchor trench backfill, anchor berms, and bedding material for geomembrane.
  - Material shall consist of well graded, clean, durable and angular sand and gravel with a maximum particle size gradation of 32 mm.
  - Material to be placed, spread and moisture conditioned in maximum 200 mm layer after compaction with a vibratory roller or plate packers.
- Fine and Coarse Riprap
  - To be used for Sedimentation Pond spillway inlet and channel, Collection/Diversion Berms, and riprap aprons.
  - Material shall consist of well graded, clean, durable and angular rockfill with a maximum particle size gradation not to exceed one and a half times the specified D50 value and minimal fines content.
  - Fine Riprap to have a D50 of 150 mm.
  - Coarse Riprap to have a D50 of 300 mm.
  - Material to be placed and spread in maximum 300 mm layer (Fine Riprap) or 600 mm layer (Coarse Riprap) and placed to form a tightly interlocking layer.

All materials shall be produced and sourced from an approved construction material source as required under Water License No. 2AM-MRY1325-Ammendment No. 1.

3.0 ACCESS ROAD DESIGN

3.1 GENERAL

The Access Road will provide vehicular access from the main Haul Road to the new KM106 Stockpile. The general layout for the Access Road developed by Baffinland is shown on Drawing 310. The road embankment is planned to be constructed using Road Embankment Fill. The initial fill will be placed by dumping and pushing the material from the existing Haul Road. Subsequent fill will be dumped and pushed from the final design grade of the Access Road. Due to the required fill placement method, the side slopes will be developed at the angle of repose for the rockfill (approximately 1.3H:1V or 37 degrees).

3.2 GEOMETRY

The Access Road is required to provide two-way access for Caterpillar 793 haul trucks (design vehicle) (CAT, 2017). The road cross section is shown on Drawing 310. The following design constraints have been incorporated in the road design:

- Road Width: The minimum width of the road surface between the safety berms is 25.5 m, equal to three times the width of the CAT 793 design vehicle (8.5 m) (Nunavut *Mine Health and Safety Act* (MHSA), 2011).
- Grade: The maximum grade is 10%.
- Radius: The minimum radius for horizontal curves is 50 m.

The connection to the existing Haul Road will be field fit at the time of construction. The portion of the Haul Road that is adjacent to and immediately upslope of the Access Road shall be graded with a minimum uphill cross slope of 3% (Hatch, 2013) to ensure that runoff water from the Haul Road is routed away from the KM106 Stockpile and Access Road.

Vehicle safety berms are included on each side of the road (where required by the MHSA (2011)). The geometry of the safety berms has been designed to meet the minimum requirements set by the MHSA (2011) and the project design criteria, and are described as follows:

- Height: 2.7 m
- Side Slopes: 1H:1V
- Crest Width: 1 m

The design criteria used for the Access Road are included in Table 1.

4.0 KM106 STOCKPILE DESIGN

The general layout for the KM106 Stockpile developed by Baffinland is shown on Drawing 300. The stockpile will be constructed by dumping and pushing the ore material from the Access Road. Due to the required fill placement method, the side slopes will be developed at the angle of repose for the material being placed in the stockpile (approximately 1.3H:1V or 37 degrees).

5.0 SEDIMENTATION POND DESIGN

5.1 GENERAL

The general layout for the Sedimentation Pond is shown on Drawings 300 and 320. The Sedimentation Pond will provide sediment control for runoff originating from the following catchment areas, shown on Figure 1:

- The KM106 Stockpile area.
- The pond itself.
- The localised area between the stockpile and the pond (where it can not be easily diverted around the pond).

This runoff will flow directly to the pond by gravity or be conveyed to the pond by perimeter Collection/Diversion Berms. Unimpacted runoff from upstream catchment areas will be diverted around the KM106 Stockpile and Sedimentation Pond.

5.2 PERIMETER BERM GEOMETRY AND LAYOUT

The Sedimentation Pond will be established by constructing a perimeter berm along the west, south and east sides of the basin, while the north side of the pond will be delineated by the existing ground slope (see Drawing 320).

The perimeter berm will be constructed using compacted 500 mm Minus Rockfill with a layer of compacted Berm Fill and a layer of compacted Intermediate Bedding placed over the upstream slope of the berm. The geometry of the perimeter berm is shown on Drawings 320 and 321 and is generally summarized as follows:

- Upstream Slope: 2.5H:1V
- Downstream Slope: 2H:1V
- Crest Width: 6 m

The Sedimentation Pond basin and upstream slopes of the perimeter berm will be lined with a geomembrane liner underlain by a non-woven geotextile as a cushion layer. The geomembrane liner and non-woven geotextile will extend up the interior (upstream) slope of the perimeter berm (where present) and will be anchored at the crest, as indicated on the Drawings. Where there is no perimeter berm, a mound

of Intermediate Bedding will be placed along the edge of the pond at approximate elevation 268.5 m and the geomembrane and non-woven geotextile placed over the fill. Additional Intermediate Bedding will be placed over the edge of the geomembrane and non-woven geotextile to anchor it in place. Fine riprap will be placed over the Intermediate Bedding to minimize erosion where runoff from the stockpile area reports to the pond.

Where a Diversion Berm is present along the upstream edge of the pond, the Diversion Berm will be constructed on top of the Intermediate Bedding as shown on the Drawings.

5.3 DAM CLASSIFICATION

The Sedimentation Pond is classified as a LOW consequence structure (CDA, 2007) based on the following criteria:

- There is no downstream population at risk.
- There is no potential for loss of life.
- The potential environmental losses are considered to be short term and include erosion and sedimentation of downstream waterways (i.e. the Mary River).
- The potential economic losses are considered to be limited. There is no mine site infrastructure downstream of the Sedimentation Pond. Economic loses are likely to be limited to repairs of the affected structure.

The CDA recommends that LOW consequence dams be designed based an annual exceedance frequency of 1 in 100 years for flood and earthquake hazards.

The 1 in 200-year design storm event (72 mm of rainfall in 24 hours) has been adopted for the design of the runoff management measures, including the Sedimentation Pond spillway and the Collection/Diversion Berms based on the project design criteria.

The peak ground acceleration for the 1 in 100-year earthquake event is 0.019g (NRC, 2015). The PGA is specified for Site Class C (NRCC, 2010) corresponding to firm ground with an average shear wave velocity of 450 m/s in the upper 30 m.

5.4 STORAGE CAPACITY

The Sedimentation Pond capacity has been developed for the following (from bottom to top):

- Temporary sediment storage up to a depth of approximately 0.5 m.
- An operating water pond capacity of approximately 3,500 m^3 to temporarily store runoff collected from the contributing catchment areas resulting from the 1 in 10 year, 24-hour rainfall event (Hatch, 2013). This runoff volume was estimated by multiplying the total contributing catchment area by the rainfall depth by the relevant runoff coefficient of 0.9 for all contributing areas except the pond itself which has a runoff coefficient of 1.0.
- A flow depth of 0.3 m through the Emergency Overflow Spillway which has been sized to safely convey the runoff resulting from the 1 in 200 year, 24-hour rainfall event.
- A freeboard depth of 0.3 m.

Based on the information provided, the 1 in 10 year, 24-hour rainfall event of 41 mm is larger than the 1 in 10 year, one day freshet runoff depth of 32 mm which includes rainfall and snowmelt (Golder, 2018c). The Sedimentation Pond configuration has been developed assuming that the pond is empty when the 1 in 10 year, 24-hour rainfall event occurs.

The Sedimentation Pond has been designed to allow for some settling of total suspended solids (TSS) prior to the runoff being removed from the pond. The pond is sized to temporarily contain runoff resulting from the 1 in 10 year, 24-hour rainfall event, and has a L:W ratio of approximately 5:1 which aids in settling of suspended solids by reducing the potential for short-circuiting (British Columbia Ministry of Environment (BCMOE), 2015). The sedimentation pond should be maintained empty during normal operating conditions. Baffinland will be responsible for implementing appropriate de-watering measures and procedures to remove runoff collected in the Sedimentation Pond. Continuous pumping may be necessary in order to manage potentially higher inflows during freshet.

5.5 LINER

It is understood that Baffinland has purchased geomembrane liner and non-woven geotextile for the pond from Western Tank and Lining Ltd. (Western). The previous design for the KM107 Stockpile Sedimentation Pond (KP, 2018) included 40 mil Atarfil Linear Low Density (LLD) liner above a 10 oz/yd^2 non-woven geotextile liner based on recommendations by Western. The technical specifications for the LLD liner and the non-woven geotextile are provided in Appendix A. KP understands that Western has recent experience installing the Atarfil LLD liner in cold conditions, as cold as -36 °C, and that the liner has cold crack resistance to -40 °C (C. Powell, Western Tank and Lining Ltd, personal communication, August 13, 2018). Based on Baffinland's previous experience with this lining system, the recommendations provided by Western are judged to be suitable for the Sedimentation Pond.

A 0.2 m thick layer of Intermediate Bedding will be placed along the upstream slopes of the perimeter berm and over the basin to act as a cushion layer for the geomembrane liner. It will be necessary to closely monitor the geomembrane liner for holes, tears and other leaks, and to complete any necessary repairs promptly.

It is recommended that all geomembrane liners and non-woven geotextile be stored indoors at temperatures above 0 °C prior to installation in order to maintain maximum workability. The geosynthetics specifications are provided on Drawing 301.

The design provided herein assumes that the upper surface of the geomembrane liner is exposed, consistent with our understanding of other sedimentation ponds on site. When a liner is left exposed, there is potential for physical damage from ice in the pond. As such, the pond should only be drained when there is no ice present. In addition, regular monitoring and maintenance of the liner will be performed consistent with the requirements of the Type A Water License 2AM-MRY1325 for physical damage or degradation.

5.6 SPILLWAY DESIGN

The Sedimentation Pond's Emergency Overflow Spillway has been sized to safely convey the peak flow resulting from the 1 in 200 year, 24-hour rainfall event following the project design criteria (Hatch, 2013). The peak flow resulting from this event was estimated by applying an SCS Type I distribution to the design rainfall depth of 72 mm in HydroCAD® (2015). The peak runoff flow was estimated as 1.22 m^3/s. In order to pass this flow, the spillway is required to have a minimum base width of 5 m and an inlet depth of 0.3 m.

The spillway will consist of a trapezoidal shaped inlet and channel to be constructed through the crest of the perimeter berm, at the location shown on Drawing 320. The spillway inlet and channel on the downstream slope of the perimeter berm will be lined with Riprap. Details are provided on Drawings 320 and 321. A riprap apron will be installed at the base of the spillway outlet channel to dissipate energy as the runoff leaves the spillway. The peak flow estimated from HydroCAD® (2015) was used, with the

Sedimentation Pond spillway section geometry developed in the flood routing model, to estimate the median particle size (D_{50}) of the riprap lining required to resist berm erosion and scour (Smith and Kells, 1995).

5.7 COLLECTION/DIVERSION BERMS

In order to direct runoff originating within the KM106 Stockpile area to the Sedimentation Pond, a series of berms will be constructed around the perimeter of the stockpile, except where the stockpile is directly adjacent to the existing haul road. Additional berms will be constructed between the Sedimentation Pond and undisturbed upstream areas in order to divert runoff from those areas around the pond and to the environment. Construction of each berm will result in the formation of a channel between the berm and the stockpile, or the berm and the natural ground slope. Where existing ground conditions permit, natural overburden material may be excavated to form part of the channel and any suitable excavated material used to form the berm.

The Collection/Diversion Berms were sized for a 1 in 200 year, 24-hour rainfall event by treating the space between the berm's upstream slope and the stockpile slope (or the natural ground) as the two sides of a trapezoidal channel, with a base width of approximately 2.5 m. A freeboard depth of 0.3 m was included in the berm sizing to account for minor variations in the berm cross section and grade following construction.

The peak flows estimated from HydroCAD® (2015) were used in the flood routing model, with the typical Collection/Diversion Berm section details, to estimate the median particle size (D_{50}) of the riprap lining required to resist berm erosion and scour (Smith and Kells, 1995).

A v-shaped channel will be formed between the existing Haul Road and the west side of the KM106 stockpile. Coarser material is expected to collect in this channel due to gravity separation during end dumping activities. This coarser material will partially armour this channel during storm events. There is potential for some erosion of this channel to occur during the design storm event. The erosion, if any, can be repaired by placing additional material in this area during normal dumping activities.

6.0 STABILITY

6.1 GENERAL

Infinite slope and limit equilibrium stability modelling was completed to evaluate the stability of the KM106 Stockpile (including the Access Road) and the Sedimentation Pond berm under the expected loading and foundation conditions. Limit Equilibrium stability analyses were completed using SLOPE/W©, a two-dimensional Limit-Equilibrium slope stability program (Geo-Slope, 2018). The stability models incorporated the proposed embankment/berm configurations and the estimated strength of the foundation and fill materials. Three representative cross sections including two cross sections through the KM106 Stockpile and one cross section through the Sedimentation Pond, shown on Figure 2, were evaluated based on the embankment/berm height and foundation conditions.

The following sections describe the loading conditions, materials and results of the stability analyses.

6.2 LOADING CONDITIONS AND TARGET FACTORS OF SAFETY

The stability models evaluated the following loading conditions:

- **Long-Term, Static Loading**
  - *KM106 Stockpile and Access Road* - The stability models for the KM106 Stockpile and Access Road incorporated the full weight of the Stockpile and Access Road fill and a fully loaded

and stationary CAT 793 truck. The rear axle of the CAT 793 truck was modelled as a surcharge load 9 m wide and 1 m deep with an effective pressure of 265 kN/m^3. The location of the truck load was evaluated at 3 m from the edge of the stockpile based on the Combined Dump Procedures (Baffinland, 2013).

- o *Sedimentation Pond* - The upstream slopes were evaluated with the pond empty. The downstream slopes were evaluated with the water level at El. 267.9 m corresponding to the maximum filling elevation.

- **Pseudo-Static Loading -** A horizontal seismic coefficient equal to the full PGA of 0.019g corresponding to the 1 in 100-year event was applied for the pseudo-static loading condition. Using this method, a FoS greater than 1.0 indicates that the slope is not sensitive to seismic loading. The water levels and surcharge loads applied to the long-term, static loading analyses were adopted for the pseudo-static loading analyses.
- **Post-Earthquake Loading -** Any strength reduction in the fill and foundation materials following an earthquake event is expected to be negligible. As such, post-earthquake loading conditions were not evaluated and are considered to be identical to the long-term, static loading conditions.

The KM106 Stockpile and Access Road will be constructed on a natural slope using material that is end dumped in thick lifts with minimal compaction. This method of fill placement will produce slopes that are at the angle of repose for the material and have a corresponding Factor of Safety (FoS) of 1.0 for surficial slope movement. As such, the slopes are expected to deform over time, and may exhibit surface sloughing and cracking. Winter construction will encourage aggregation of the permafrost into the fill and enhance the overall stability, provided snow and ice are not encapsulated in the fill.

The minimum FoS targets developed for the analysis are summarized in Table 2.

Table 2 Target Minimum FoS for the KM106 Stockpile and Access Road

Loading Condition	FoS
Long-Term, Static Loading	1.2
Pseudo-Static	1.0

The Sedimentation Pond is classified as a dam following the Canadian Dam Association Dam Safety Guidelines (CDA, 2007 and 2013). The recommended minimum FoS for embankment dams following the CDA Guidelines are summarized in Table 3:

Table 3 Recommended Minimum FoS for the Sedimentation Pond (CDA, 2007)

Loading Condition	FoS
Long-Term, Static Loading	1.5
Pseudo-Static	1.0
Post-Earthquake	1.2

6.3 MATERIALS AND PARAMETERS

Site investigations consisting of geotechnical drilling were completed in the area of the proposed KM106 Stockpile and Sedimentation Pond (KP, 2019). The stratigraphy generally consists of

the following geotechnical units:

- Glacial Till - consisting of gravelly SAND, some silt, trace clay with cobbles and boulders. The surficial soils are generally well-graded, non-plastic, medium greyish brown, massive, and moist.
- Bedrock - consisting of very strong and fresh to slightly weathered gneiss.

The Glacial Till was observed to be discontinuous across the site, varying in thickness from less than 0.5 m below the KM106 Stockpile to 4 m in areas south of the proposed stockpile. Bedrock outcrops were observed at surface across the site. Massive ice was not encountered during the drilling. The stability analyses incorporate a foundation consisting of 0.5 m of Glacial Till overlying competent bedrock.

The material parameters for the fill and foundation units were estimated based on typical correlations (Carter and Bentley, 2016) and are summarized in Table 4. The Rockfill for the KM106 Stockpile was modelled using a relationship between the shear strength of rockfill and the applied shear stress following Leps (1970) and modification recommended by Yamaguchi et al (2009). The material parameters are estimated based on thawed conditions and do not include the potential strength contribution of the aggrading permafrost, if any.

6.4 RESULTS

The results of the stability analyses are summarized in Table 5 and illustrated on Figures 3 to 6. The results indicate the following:

- KM106 Stockpile and Access Road (Figures 3 and 4):
  - The target FoS is achieved.
  - The material will be end dumped at the angle of repose with a FoS equal to unity at the edge of the slope. As such, sloughing and cracking may develop in this area and regular monitoring is required. Trimming of the outer slope of the Stockpile and Access Road may be necessary to maintain the design geometry and grading of the Access Road to maintain access.
- Sedimentation Pond (Figures 5 and 6) - The computed FoS exceed the recommended values for all cases.

7.0 CONSTRUCTION DETAILS

7.1 GENERAL

All construction materials must be maintained free of visible ice, snow and other deleterious materials prior to placement. Geotextiles and geomembranes must be protected from UV exposure, and stored and handled in accordance with the manufacturer's recommendations. Snow and ice must be removed from the footprint of the proposed structures prior to construction.

The locations and configurations of the KM106 Stockpile, Access Road, Sedimentation Pond and associated runoff management measures may change based on actual encountered site conditions.

The following sections provide general construction requirements and recommendations related to the Access Road, Sedimentation Pond and associated runoff management measures. Details, including material specifications and compaction requirements, are provided on the Drawings.

7.2 EROSION AND SEDIMENT CONTROL

Baffinland will employ a combination of sediment and erosion control measures as outlined in Baffinland's

Environmental Protection Plan (Baffinland, 2016a), and Surface Water and Aquatic Ecosystems Management Plan (Baffinland, 2016b), to address and manage sedimentation concerns during construction of the KM106 Stockpile, Access Road, Collection/Diversion Berms and Sedimentation Pond.

7.3 SURVEYING

Setting out details are provided on the Drawings for each of the structures. The structures will be located using suitably accurate surveying methods.

As-built surveys will be required following construction of each of the structures. The surveys will be sufficiently detailed to properly document the completed construction.

7.4 FOUNDATION PREPARATION

The site investigation results suggest that overburden soils located in the foundation areas are not ice rich, and that significant layers of organics or other unsuitable materials are not present. As such, disturbance to the original ground (excavation, scarifying, etc.) should be minimized so as to not impact current permafrost conditions. The foundations must be maintained clear of snow, ponded water and ice.

7.5 KM106 STOCKPILE AND ACCESS ROAD

The stockpile and access road will be constructed starting from the edge of the existing Haul Road. The fill material will be dumped and pushed with a bulldozer. The stockpile dumping face will be monitored by Baffinland site personnel and operators working in the area according to standard dumping procedures (Baffinland, 2013). Any potential settlement and cracking of the access road and/or stockpile dump face will be monitored and addressed as necessary with additional fill placement and/or grading.

7.6 SEDIMENTATION POND

Following foundation preparation, 500 mm Minus Rockfill and Berm Fill will be placed and compacted to construct the Sedimentation Pond perimeter berm (Drawings 320 and 321). Intermediate Bedding will be placed over the compacted Berm Fill, along the upstream slope, and over the floor of the pond. The integrated geomembrane and non-woven geotextile will be installed over the Intermediate Bedding layer. Specifications for the geosynthetics installation are shown on Drawing 301.

The Emergency Overflow Spillway will be constructed as part of the pond perimeter berm construction. For the spillway, 12 oz/yd^2 non-woven geotextile (or approved equivalent) will be placed over the prepared foundation of the spillway inlet and channel invert and side slopes. Fine Riprap will be tightly placed over the geotextile along the spillway inlet invert and side slopes. Coarse Riprap will be tightly placed over the geotextile along the spillway channel invert and side slopes, and a Coarse Riprap apron will be tightly placed over the geotextile at the outlet of the spillway channel. Typical sections and details are provided on Drawings 320 and 321.

Prior to placement of the Intermediate Bedding layer, care must be taken to ensure that the final surface of the underlying prepared foundation is smooth and uniform. No angular particles or voids may be present.

7.7 COLLECTION/DIVERSION BERMS

Berm Fill will be placed and compacted to construct the Collection/Diversion Berms. Non-woven geotextile will be placed over the upstream slope of the berm and the crest to provide a barrier against the migration of finer materials. Fine Riprap will be placed over the non-woven geotextile to form a tightly interlocking layer. A typical Collection/Diversion Berm section is provided on Drawing 320.

7.8 MATERIALS AND QUANTITIES

A summary of materials and quantity estimates for the Access Road, Sedimentation Pond and runoff management measures is presented in Table 6. The materials and quantities are based on the drawings included herein. In general, quantities have been estimated using neat line measurements from the Drawings and are based on the typical sections and details provided on the Drawings. No contingencies have been included.

7.9 CONSTRUCTION QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

Construction Quality Assurance/Quality Control (QA/QC) shall be completed in general accordance with the specifications for the Waste Rock Facility Pond Expansion (Golder, 2018c). Technical specifications specific to the KM106 Stockpile and runoff management measures have been provided as notes and details on the attached drawings. The following general comments are provided relative to the QA/QC requirements

- It is assumed that a qualified Engineer will oversee and document construction of the Access Road, Sedimentation Pond and associated runoff management measures.
- Daily inspections should be carried out during construction to verify the suitability of the fill materials.
- The foundation must be approved and documented by the supervising Engineer prior to fill placement.
- Geosynthetic materials shall be installed as per the manufacturer's specifications and recommendations. The geosynthetics contractor will be responsible for performing and documenting the geosynthetics QC program.
- Qualified personnel will be responsible for conducting the QC testing and inspections required on all placed and compacted fill materials.
- A qualified Engineer that is licensed in Nunavut will be responsible for preparing and sealing as-built documentation for the completed work.

8.0 INSPECTIONS AND MAINTENANCE

Material placement and runoff management for the KM106 Stockpile will need to be closely monitored during operation of the stockpile area, including use of the Access Road, and operation of the Sedimentation Pond and runoff management measures. The Sedimentation Pond will need to be emptied in a timely manner following a runoff event or during freshet such that the pond is empty during normal operating conditions. Ongoing inspections and maintenance will be required to ensure that each of these structures are being operated as designed and that the Collection/Diversion Berms and Sedimentation Pond water removal system and Emergency Overflow Spillway are performing as designed. The recommended inspections are described below:

- As required, based on Baffinland's standard operating procedures (In progress)
  - Inspect the Access Road for any cracks, settlement or rutting of the road surface.
  - Inspect the Safety Berms along the Access Road to ensure they are in good condition and have the design configuration.
  - Inspect the water removal system from the Sedimentation Pond to ensure each component is performing as designed.
  - Inspect the Sedimentation Pond to ensure the liner is in good condition, there are no visible holes or leaks, there is no erosion of the berms, and the berms and spillway are performing as designed

- Inspect the Collection/Diversion Berms to ensure there is no erosion of the berms and that no material is blocking flow along the Collection/Diversion Berms.

- Prior to Freshet, Following Freshet and After Any Large Storm Event
  - Inspect Access Road to ensure there is no erosion of fill materials.
  - Inspect the Collection/Diversion Berms to ensure there is no erosion of the berms and that no material is blocking flow along the Collection/Diversion Berms.
  - Inspect the Sedimentation Pond to ensure the liner is in good condition, there are no visible holes or leaks, there is no erosion of the berms, and the berms and spillway are performing as designed.

- Biannually
  - In accordance with Part D., Clause 18 of the Mary River Project Water License (NWB, 2014), "inspections of earthworks and geological and hydrological regimes of the Project" will be conducted "biannually during the summer or as otherwise approved by the Board in writing. These inspections shall be conducted by a Geotechnical Engineer…".

9.0 CLOSING

We trust that this letter provides you with the information you require at this time. Please feel free to contact us if you require any additional information.

Yours truly,
Knight Piésold Ltd.

Prepared:

Amy L. Adams, Ph.D., P.Eng., P.E.
Project Engineer

Prepared:

Deena Duff, P.Eng.
Senior Engineer

REGISTERED PROFESSIONAL ENGINEER
K.E. HAWTON
LICENSEE
June 20/19
NWT/NU

PERMIT TO PRACTICE
KNIGHT PIESOLD LTD.
Signature
Date June 20/2019
PERMIT NUMBER: P 547
The Association of Professional Engineers, Geologists and Geophysicists of NWT/NU

Reviewed:

Kevin Hawton, P.Eng.
Specialist Engineer | Associate

Approval that this document adheres to Knight Piésold Quality Systems:

Attachments:

Table 1 Rev 0	Design Criteria
Table 4 Rev 0	Summary of Material Parameters for Slope Stability Analyses
Table 5 Rev 0	Summary of Slope Stability Results
Table 6 Rev 0	Schedule of Materials and Estimated Quantities
Figure 1 Rev 0	Estimated Catchment Areas
Figure 2 Rev 0	Slope Stability Section Locations
Figure 3 Rev 0	Slope Stability Results - KM106 Stockpile - Section 1
Figure 4 Rev 0	Slope Stability Results - KM106 Stockpile - Section 2
Figure 5 Rev 0	Slope Stability Results - Sedimentation Pond - Static, Long-Term Loading
Figure 6 Rev 0	Slope Stability Results - Sedimentation Pond - Pseudo-Static Loading
Drawing 300 Rev 0	General Arrangement
Drawing 301 Rev 0	Specifications
Drawing 310 Rev 0	Access Road - Plan and Sections
Drawing 320 Rev 0	Sedimentation Pond and Runoff Management Measures - Plan, Section and Details
Drawing 321 Rev 0	Sedimentation Pond and Runoff Management Measures - Sections and Detail
Appendix A	Geomembrane and Non-Woven Geotextile Information

References:

Baffinland Iron Mines Corporation (Baffinland), 2013. *Combined Dumps Procedure.* November 12. Ref. No. BAF-PH1-340-PRO-0004, Rev. 0.

Baffinland Iron Mines Corporation (Baffinland), 2016a. *Environmental Protection Plan*.

Baffinland Iron Mines Corporation (Baffinland), 2016b. *Surface Water and Aquatic Ecosystems Management Plan*.

Baffinland Iron Mines Corporation (Baffinland), 2019. Email from: Allan Knowlton. Email to: Amy Adams, Knight Piésold Ltd. Re: *Proposed revised location for 107km Stockpile to 106 km.* May 1. (NB102-181/57).

British Columbia Ministry of Environment (BCMOE), 2015. *Assessing the Design, Size, and Operation of Sediment Ponds Used in Mining.* December. Version 1.0. Technical Guidance 7 - Environmental Management Act. Environmental Protection Division.

Canadian Dam Association (CDA), 2007. *Dam Safety Guidelines*.

Canadian Dam Association (CDA), 2013. *2007 Dam Safety Guidelines*. 2013 Revision.

Carter, M. and Bentley, S.P., 2016. *Correlations of Soil Properties.* Second Edition. John Wiley and Sons, Ltd., Cardiff University, U.K.

Caserta, L., 2018. Email to: Simon Fleury, Baffinland Iron Mines Corporation. Re: *Class 3 Ore Stockpile - Tender for Hydrological Assessment and Pond Design*. June 27.

Caterpillar Inc. (CAT), 2017. *793F Mining Truck.* Ref. No. AEHQ6868-01 (02-2013). www.cat.com.

Colorado OTR LP, 2019. *Technical Manual.* Retrieved from: https://docplayer.net/20771637-Tread-designs-radial-and-bias.html (accessed June 18, 2019).

Fisheries Act, 2016. R.S.C., 1985, c. F-14. Fisheries and Oceans Canada.

GEO-SLOPE International Ltd. (Geo-Slope), 2018. *GeoStudio 2018 R2*. Calgary, Alberta.

Golder Associates Ltd. (Golder), 2017. Technical Memorandum to: Steven Dew, Baffinland Iron Mines Corporation. Re: Crusher Pad Sedimentation Pond Expansion Detailed Design Brief, Mary River Project, Nunavut. August 28. Mississauga, Ontario. Project No. 1775699.

Golder Associates Ltd. (Golder), 2018a. Technical Memorandum to: Cody Gagne, Mine Superintendent, Baffinland Iron Mines Corporation. Re: Stability Assessment - Hill Side Haul Road. March 27. Mississauga, Ontario. Project No. 1414686.

Golder Associates Ltd. (Golder), 2018b. WRF Pond Expansion Drainage System. June 15. Mississauga, Ontario. Ref. No. 1790951 DOC029, Rev. 0.

Golder Associates Ltd. (Golder), 2018c. WRF Pond Expansion. August 17. Ref. No. 1790951-S, Specification No. 1790951, Rev. 0.

Hatch, 2013. *Design Criteria - Civil.* August 28. Ref. No. H349000-1000-10-122-001, Rev. 1.

Hatch, 2018. *Civil Design Philosophy*. March 12. Ref. No. H353004-00000-200-210-0001, Rev. 2.

HydroCAD® Software Solutions LLC, 2015. *HydroCAD®* Version 10.00-14.

Knight Piésold Ltd. (KP), 2018. Letter to: Mr. Matt Brown, Baffinland Iron Mines Corporation. Re: *KM107 Stockpile Access Road and Runoff Management Designs.* September 18. North Bay, Ontario. Ref. No. NB18-00535 (NB102-181/49).

Knight Piésold Ltd. (KP), 2019. Letter to: Mr. Allan Knowlton, Baffinland Iron Mines Corporation. Re: *KM106 and KM107 Site Investigations Summary.* May 31. North Bay, Ontario. Ref. No. NB19-00431 (NB102-181/57).

Leps, T.M., 1970. *Review of shearing strength of rock fill.* American Society of Civil Engineers. July.

Metal and Diamond Mining Effluent Regulations (MDMER), 2018. *SOR/2002-22*.

Mine Health and Safety Act (MHSA), 2011. Consolidation of Mine Health and Safety Regulations R-125-95. October 17.

Natural Resources Canada (NRC), 2015. *2015 National Building Code of Canada Seismic Hazard Calculator.* Retrieved from: http://www.earthquakescanada.nrcan.gc.ca/hazard-alea/interpolat/index_2015-en.php (accessed August 14, 2018).

National Research Council of Canada (NRCC), 2010. *National Building Code of Canada*. 13th Edition. Ottawa, Canada. ISBN 0-660-19975-7.

Nunavut Water Board (NWB), 2014. Letter to: Honourable Bernard Valcour, PC, QC, MP, Minister of Aboriginal Affairs and Northern Development Canada. Re: *Amendment No.1 to Type "A", Water License No. 2AM-MRY1325, Issue to Baffinland Iron Mines Corporation for the Mary River Project.* July 31. File No. 2AM-MRY1325 / Amendment No. 1.

Nunavut Waters and Nunavut Surface Rights Tribunal Act (NWNSRTA), 2018. S.C. 2002, c.10.

Smith, C.D. and Kells, J.A., 1995. *Stability of Riprap Linings on Steep Gradients.* Proceedings of the CSCE Hydrotechnical Conference. June 1-3. Ottawa, Ontario.

Yamaguchi, Y., Satoh, H., Hayashi, N. and Yoshinaga, H., 2009. *Strength Evaluation of Rockfill Materials Considering Confining Pressure Dependency.* The 1st International Symposium on Rockfill Dams. Journal of the Japan Society of Dam Engineers. Vol. 18, No. 3. 166-181.

Copy To: Roger Doyle, Baffinland Iron Mines Corporation
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/ala

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TABLE 1

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

DESIGN SUMMARY FOR THE KM106 STOCKPILE AND RUNOFF MANAGEMENT MEASURES
DESIGN CRITERIA

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Item No.	Item	Design Criteria	Reference
1.0	**GENERAL**		
1.1	Regulatory	• Water Licence No. 2AM-MRY1325 Amendment No. 1	NWB, 2014
		• Nunavut Mine Health and Safety Act and Regulations	MHSA, 2011
		• Nunavut Waters and Surface Rights Tribunal Act and Nunavut Waters Regulations	NWNSRTA, 2018
		• Metal and Diamond Mining Effluent Regulations (MDMER)	MDMER, 2018
		• Fisheries Act	Fisheries Act, 2016
1.2	Guidelines and Reference	• Civil Design Criteria	Hatch, 2013 and 2018
		• Canadian Dam Association Dam Safety Guidelines (2007, 2013)	CDA, 2007 and 2013
2.0	**WATER MANAGEMENT**		
2.1	General	• Runoff from the upstream catchment areas will be diverted around the KM106 Stockpile and Access Road, and around the Sedimentation Pond	-
		• Meteoric water reporting to the KM106 Stockpile will be collected and temporarily stored in the Sedimentation Pond	-
		• A spillway in the Sedimentation Pond will convey excess runoff from the KM106 Stockpile	-
2.2	Design Storm Events	• Sedimentation Pond designed to provide temporary storage for runoff resulting from the 1 in 10 year, 24-hour rainfall event	Hatch, 2013 and 2018
		• Ditches and berms sized to convey flows resulting from the 1 in 200 year, 24-hour rainfall event	KP (based on Hatch, 2013)
		• Emergency overflow spillway (Sedimentation Pond) sized to convey flows resulting from the 1 in 200 year, 24-hour rainfall event	Hatch, 2013
		• Storm events are rain only events; no snowfall or snowmelt is included	KP Estimate
2.3	Hydrological Parameters	• Catchment Areas:	
		o KM106 Stockpile: approximately 7.4 ha	Estimated from mapping provided by Baffinland
		o Sedimentation Pond: approximately 0.7 ha	Estimated from mapping provided by Baffinland
		o Upstream of Sedimentation Pond: approximately 0.6 ha	Estimated from mapping provided by Baffinland
		• Runoff Coefficients:	
		o KM106 Stockpile: 0.9	Hatch, 2013
		• Time of Concentration Method:	KP Estimate
		o KM106 Stockpile: Kirpich (1940)	-
		o Upstream Areas: Kirpich (1940)	-
		• Rainfall Distribution: SCS Type I	KP Estimate
		• SCS Curve Number:	
		o KM106 Stockpile: 89	KP Estimate
		o Undisturbed/Upstream: 86	KP Estimate
2.4	Meteorological Parameters	• Return Period Rainfall Events:	
		o 1 in 10 year, 24-hour rainfall event: 41 mm	Hatch, 2013
		o 1 in 200 year, 24-hour rainfall event: 72 mm	Hatch, 2013
2.5	Ditch Parameters	• Shape: Trapezoidal cross section	Hatch, 2013
		• Base Width: 0.5 m minimum	Hatch, 2013
		• Side Slopes: 2H:1V (soil)	Hatch, 2013 and 2018
		• Grade: 0.2% minimum	Hatch, 2018
		• Depth: 0.3 m minimum	Hatch, 2013
		• Freeboard: 0.3 m	Hatch, 2013
		• Manning's "n" Value: 0.040 (riprap)	Hatch, 2013
2.6	Diversion Berms	• Shape: Trapezoidal cross section	Hatch, 2013
		• Side slopes: 2H:1V	Hatch, 2018
		• Freeboard: 0.3 m	Hatch, 2018
		• Height: 1 m minimum (including 0.3 m freeboard)	Hatch, 2013
		• Top Width: 0.5 m	Hatch, 2013 and 2018
3.0	**Construction Materials**		
3.1	Source	• Approved sources following Water Licence No. 2AM-MRY1325 Amendment No. 1	NWB, 2014
3.2	Quality	• Clean, free of debris and organics (see Drawing 301)	KP Estimate
3.3	Description	• 500 mm Minus Rockfill: Well graded; consisting of hard, durable, fresh rockfill	KP Estimate
		• Berm Fill: Well graded, 150 mm minus processed rockfill	KP Estimate
		• Intermediate Bedding: 32 mm minus sand and gravel, gradation as per Golder, 2018a	Golder, 2018a
		• Riprap: Maximum particle diameter not exceeding one and a half times the specified D_{50} value, well graded, with a fines content not exceeding 5%	KP Estimate (based on Golder, 2018a)
		o Fine Riprap: D_{50} of 150 mm	
		o Coarse Riprap: D_{50} of 300 mm	
4.0	**KM106 STOCKPILE**		
4.1	Geometry	• Footprint Area: 7.1 ha	Estimated from mapping provided by Baffinland
4.2	Condition	• Not lined; constructed on existing ground after clearing	Baffinland
5.0	**ACCESS ROAD**		
5.1	Design Vehicle	• Caterpillar (CAT) 793F Mining Truck	Baffinland
		• Truck Width: 8.6 m	Caterpillar, 2017
		• Tire Size: 50/80 R57	Colorado OTR, 2019
		• Tire Diameter: 3.6 m	Michelin, 2018
		• Turning Circle Clearance Diameter: 33 m (radius: 16.5 m)	Caterpillar, 2017
5.2	Road Geometry	• Road Width: 3 times width of CAT 793 haul truck (one-way traffic)	Baffinland
		• Design Speed: 30 km/h	Hatch, 2013
		• Posted Speed: 20 km/h	Hatch, 2013
		• Minimum Horizontal Curve C/L Radius: 50 m	Hatch, 2013
		• Minimum Intersection Inner Radius: 30 m	Hatch, 2013
		• Minimum Cross Slope: 3%	Hatch, 2013
		• Maximum Road Grade: 10%	Hatch, 2013
5.3	Vehicle Safety Berms	• Berm Height: 3/4 of the diameter of the largest wheeled vehicle (CAT 793)	Nunavut Mine Health and Safety Regulations, Surface Haulage Roads, Section 1.143
		• Berm Locations: All areas where drop off is greater than 3 m	Nunavut Mine Health and Safety Regulations, Surface Haulage Roads, Section 1.143
		• Side Slopes: 1H:1V	Hatch, 2013
5.4	Stability	• Factors of Safety:	
		o Static: 1.2	KP
		o Pseudo-Static: 1.0	KP
6.0	**SEDIMENTATION POND**		
6.1	Function	• Function: Runoff management and sedimentation control	Baffinland
6.2	Geometry	• Shape: Rectangular; L:W = approximately 5:1	KP Estimate; BCMOE (2015)
		• Pond Depth: 5 m maximum	Hatch, 2013
		• Berm Side Slopes: 2.5H:1V (upstream); 2H:1V (downstream)	KP Estimate
		• Berm Crest: 6 m	Golder, 2017
		• Freeboard: 0.3 m	Golder, 2017
		• Sediment Storage: approximately 0.5 m deep	KP Estimate
6.3	Liner	• Liner: required	Baffinland
		• Liner installation: Liner to be pre-welded in large panels by Western Tank and Lining Ltd.	Baffinland
		• Geomembrane Liner: Atarfil LLD, 40 mil	Baffinland
		• Non-Geotextile: Texel 100P, 10 oz/yd^2	Western Tank and Lining Ltd.
6.4	Dam Hazard Classification	• Potential Loss of Life: None - no downstream population	KP Estimate
		• Potential Loss to Environmental and Cultural Values:	KP Estimate
		o Short Term - Slope erosion and sedimentation of the Mary River	
		o Long Term - None	
		• Potential Economic Loss: Minimal, associated with repairs to the Sedimentation Pond itself	KP Estimate
		• Dam Hazard Classification: LOW	KP Estimate; CDA, 2013
6.5	Stability	• Factors of Safety:	
		o Static: 1.5	CDA, 2007 & 2013
		o Pseudo-Static: 1.0	CDA, 2007 & 2013
		o Post-Earthquake: 1.2	CDA, 2007 & 2013
6.6	Seismic Design Criteria	• 1 in 100 year event: 0.019g (based on Section 6.4)	CDA, 2013 & NRC, 2015

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REV	DATE	DESCRIPTION	PREP'D	RVW'D
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TABLE 4

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

DESIGN SUMMARY FOR THE KM106 STOCKPILE AND RUNOFF MANAGEMENT MEASURES
SUMMARY OF MATERIAL PARAMETERS FOR SLOPE STABILITY ANALYSES

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Material Description	Unit Weight (kN/m3)	Cohesion (kPa)	Effective Friction Angle (°)
Road Embankment Fill	21	0	37
Berm Fill	21	0	37
Rock Fill	21	0	Shear Normal Function [1]
Glacial Till	19	0	34
Bedrock	Impenetrable		

I:\1\02\00181\57\A\Data\Workfiles\WF06 - Updated Stability for KM106 Stockpile\[Summary Tables and Figures -20190618.xlsm]Table 4

NOTES:

1. A SHEAR NORMAL FUNCTION BASED ON AVERAGE VALUES (LEPS, 1970; MODIFIED BY YAMAGUCHI ET AL., 2009) WAS USED TO MODEL THE SHEAR STRENGTH OF THE ROCKFILL.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
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TABLE 5

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

DESIGN SUMMARY FOR THE KM106 STOCKPILE AND RUNOFF MANAGEMENT MEASURES
SUMMARY OF SLOPE STABILITY RESULTS

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Section	Factor of Safety (FoS)			
	Static (Required)	Static (Achieved)	Pseudo-Static (Required)	Pseudo-Static (Achieved)
Stockpile				
Section 1	1.2	1.5	1.0	1.4
Section 2	1.2	1.5	1.0	1.4
Sedimentation Pond				
Upstream	1.5	2.6	1.0	2.4
Downstream	1.5	1.7	1.0	1.6

I:\1\02\00181\57\A\Data\Workfiles\WF06 - Updated Stability for KM106 Stockpile\[Summary Tables and Figures -20190618.xlsm]Table 5

NOTES:

1. STABILITY ANALYSES COMPLETED USING SLOPE/W© (GEO-SLOPE, 2019).
2. STOCKPILE SLOPES ARE 1.3H:1.0V BASED ON THE DESIGN PROVIDED BY BAFFINLAND.
3. DESIGN HAUL TRUCK LOAD ON THE ACCESS ROAD IS THE REAR AXLE OF A FULLY LOADED CAT 793. MODELLED AS A SURCHARGE LOAD 9 m WIDE, 1 m HIGH AT 265 kN/m3.
4. SEDIMENTATION POND EMBANKMENT SIDE SLOPES ARE 2.5H:1.0V UPSTREAM AND 2.0H:1.0V DOWNSTREAM, CREST WIDTH IS 6 m.
5. MAXIMUM DEAD STORAGE ELEVATION OF SEDIMENTS IN SEDIMENTATION POND IS 265 m, MAXIMUM POND ELEVATION IS 268.5 m.
6. A HORIZONTAL SEISMIC COEFFICIENT OF 0.019 g IS APPLIED TO ALL PSEUDO-STATIC ANALYSES (NRCAN, 2015).

REV	DATE	DESCRIPTION	PREP'D	RVW'D
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TABLE 6

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

DESIGN SUMMARY FOR THE KM106 STOCKPILE AND RUNOFF MANAGEMENT MEASURES
SCHEDULE OF MATERIALS AND ESTIMATED QUANTITIES

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Item No.	Description	Unit	Estimated Quantity
SEDIMENTATION POND			
1.0	**Earthworks**		
1.1	**Sedimentation Pond Embankment and Basin**		
1.1.1	Prepare Foundation Area	m^2	10,700
1.1.2	Supply, Haul, Place and Compact - 500mm Minus Rockfill	m^3	15,500
1.1.3	Supply, Haul, Place and Compact - Berm Fill	m^3	1,900
1.1.4	Supply, Haul, Place and Compact - Intermediate Bedding	m^3	1,200
1.2	**Emergency Overflow Spillway**		
1.2.1	Supply, Haul, Place - Fine Riprap - Inlet	m^3	12
1.2.2	Supply, Haul and Place - Coarse Riprap - Channel and Apron	m^3	200
1.3	**Diversion Berms**		
1.3.1	Prepare Foundation Areas	m^2	4,300
1.3.2	Supply, Haul and Place - Berm Fill - Diversion Berms	m^3	2,400
1.3.3	Supply, Haul and Place - Fine Riprap - Diversion Berms	m^3	2,310
	Subtotal Item 1.0		
2.0	**Geosynthetics**		
2.1	**Pond Lining**		
2.1.1	Supply and Install - 40 mil Atarifil LLD Geomembrane	m^2	7,500
2.1.2	Supply and Install - Texel 100 P 10 oz/yd^2 Non-Woven Geotextile	m^2	7,500
2.1.3	Supply and Install - 12 oz/yd^2 Non-Woven Geotextile	m^2	3,300
	Subtotal Item 2.0		
ACCESS ROAD			
3.0	**Earthworks**		
3.1	**Road Fill**		
3.1.1	Supply, Haul and Place - Road Embankment Fill or Rockfill	m^3	0 [2]
3.2	**Safety Berms**		
3.2.1	Supply, Haul and Place - Road Embankment Fill or Rockfill [2]	m^3	2,000
3.3	**Haul Road Culverts**		
3.3.1	Supply, Haul, and Place - Coarse Riprap - Apron	m^3	300
	Subtotal Item 3.0		

I:\1\02\00181\57\A\Data\Workfiles\WF07 - Updated Materials and Quantities\[Materials and Quantities Table - SM - 19JUN'19.xlsm]Table 6

NOTES:

1. MATERIAL QUANTITIES ARE BASED ON NEAT LINE MEASUREMENTS OF THE DRAWINGS AND DO NOT INCLUDE ANY CONTINGENCIES.
2. IT IS ASSUMED THAT THE ACCESS ROAD AND SAFETY BERMS WILL BE CONSTRUCTED USING STOCKPILE MATERIALS (ROCKFILL).

REV	DATE	DESCRIPTION	PREP'D	RVW'D
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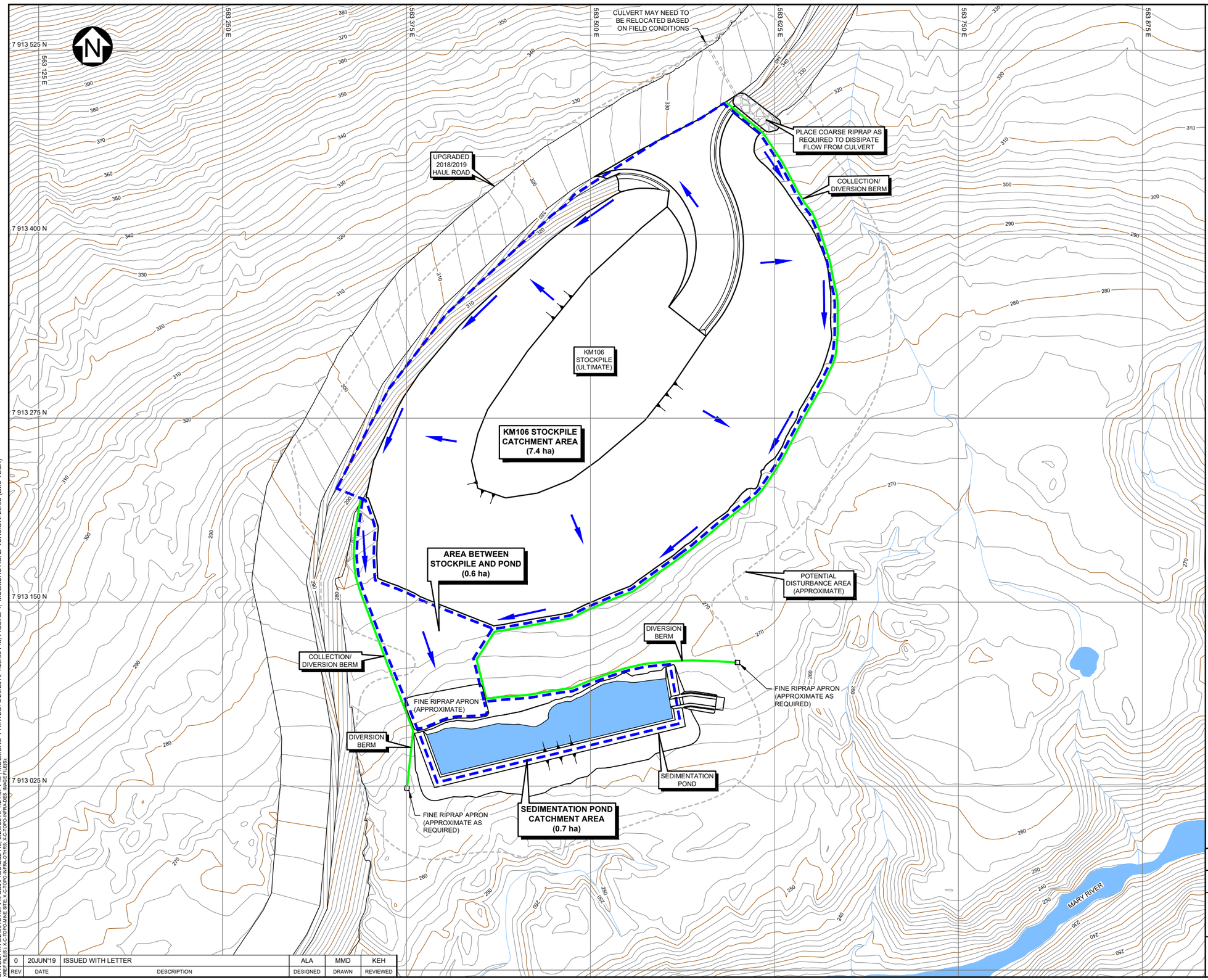


LEGEND:

- WATER
- COARSE RIPRAP
- CULVERT
- COLLECTION/DIVERSION BERM
- ESTIMATED CATCHMENT AREA BOUNDARY
- POTENTIAL DISTURBANCE AREA (APPROXIMATE)
- FLOW DIRECTION

NOTES:

1. COORDINATE GRID IS UTM (NAD83) ZONE 17.
2. TOPOGRAPHY BASED ON INFORMATION PROVIDED BY EAGLE MAPPING (2008).
3. CONTOURS ARE IN METRES. CONTOUR INTERVAL IS 2 m.
4. DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
5. LOCATIONS AND DETAILS OF CONSTRUCTION ITEMS MAY BE MODIFIED TO SUIT ACTUAL SITE CONDITIONS.
6. UPGRADED 2018/2019 HAUL ROAD AND KM106 STOCKPILE PROVIDED BY BAFFINLAND.
7. ALL INFRASTRUCTURE SHOWN IS PROPOSED UNLESS NOTED OTHERWISE.

SCALE A 25 12.5 0 25 50 75 100 125 m

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	20JUN'19	ISSUED WITH LETTER	ALA	MMD	KEH

BAFFINLAND IRON MINES CORPORATION

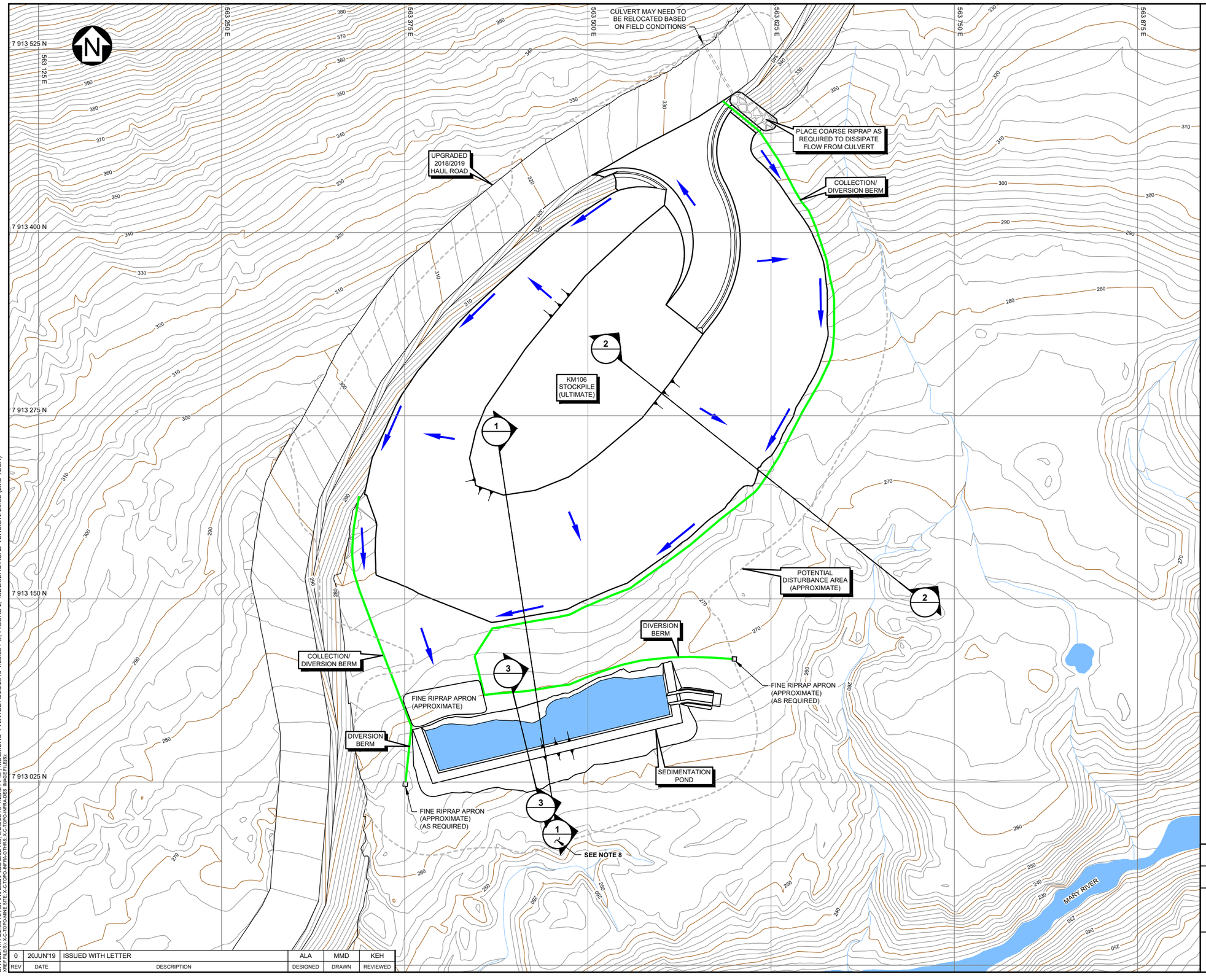
MARY RIVER PROJECT

KM106 STOCKPILE ESTIMATED CATCHMENT AREAS

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-181/57	NB19-00443

FIGURE 1 REV 0



LEGEND:

- WATER
- COARSE RIPRAP
- CULVERT
- COLLECTION/DIVERSION BERM
- POTENTIAL DISTURBANCE AREA (APPROXIMATE)
- FLOW DIRECTION

NOTES:

1. COORDINATE GRID IS UTM (NAD83) ZONE 17.
2. TOPOGRAPHY BASED ON INFORMATION PROVIDED BY EAGLE MAPPING (2008).
3. CONTOURS ARE IN METRES. CONTOUR INTERVAL IS 2 m.
4. DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
5. LOCATIONS AND DETAILS OF CONSTRUCTION ITEMS MAY BE MODIFIED TO SUIT SITE CONDITIONS.
6. UPGRADED 2018/2019 HAUL ROAD AND KM106 STOCKPILE PROVIDED BY BAFFINLAND.
7. ALL INFRASTRUCTURE SHOWN IS PROPOSED UNLESS NOTED OTHERWISE.
8. STABILITY SECTION NO. 1 DOES NOT INCLUDE THE SEDIMENTATION POND.

SCALE A: 25 12.5 0 25 50 75 100 125 m

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

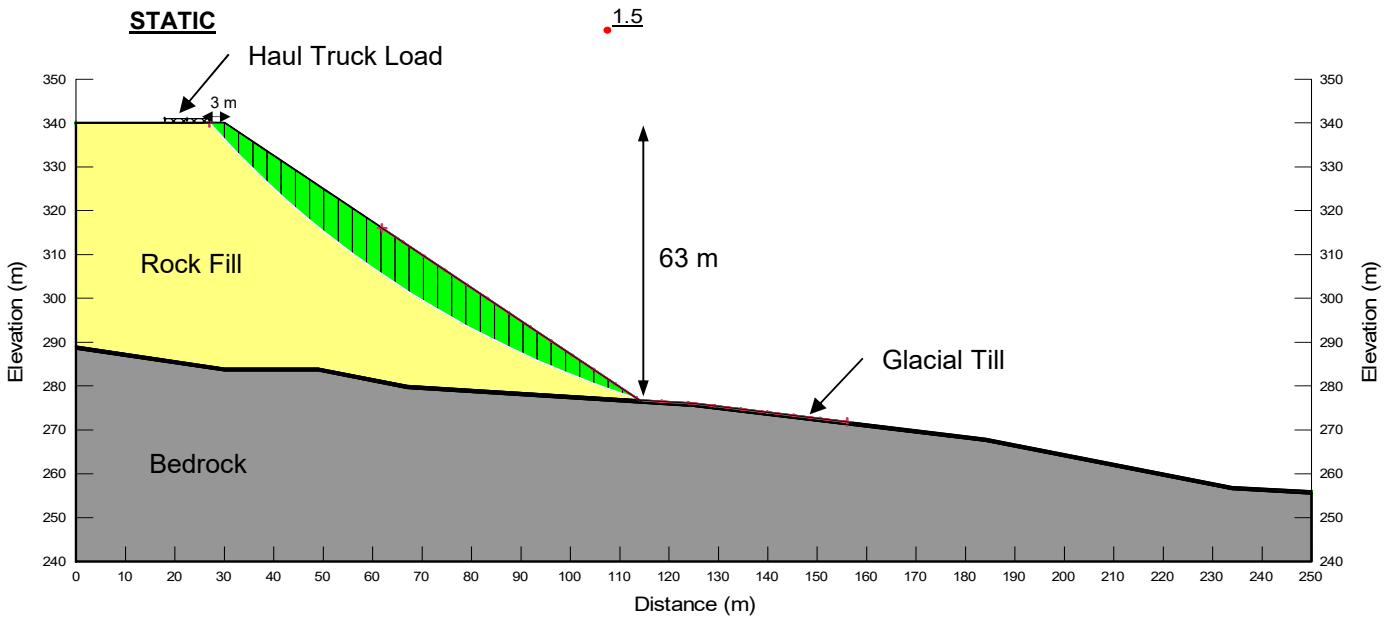
KM106 STOCKPILE SLOPE STABILITY SECTION LOCATIONS

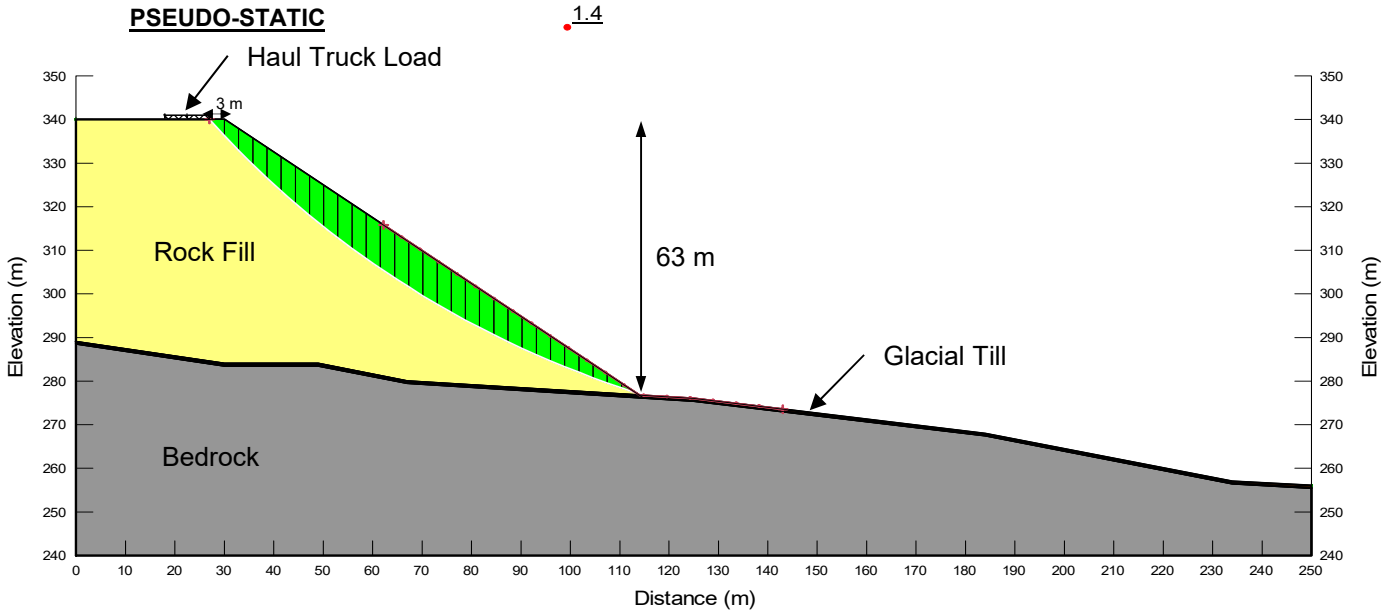
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	20JUN'19	ISSUED WITH LETTER	ALA	MMD	KEH

Knight Piésold CONSULTING

P/A NO. NB102-181/57 | REF NO. NB19-00443

FIGURE 2 | REV 0





NOTES:

1. STOCKPILE SLOPES ARE 1.3H:1.0V AND ARE BASED ON THE DESIGN PROVIDED BY BAFFINLAND.
2. MINIMUM DISTANCE BETWEEN THE EDGE OF THE HAUL TRUCK AND THE EDGE OF THE STOCKPILE IS 3 m.
3. A HORIZONTAL SEISMIC COEFFICIENT CORRESPONDING TO A PGA OF 0.019g WAS APPLIED TO ALL PSEUDO-STATIC ANALYSES (NRCAN, 2015).
4. DESIGN HAUL TRUCK LOAD IS THE REAR AXLE OF A FULLY LOADED CAT 793. MODELLED AS A SURCHARGE LOAD 9 m WIDE, 1 m HIGH AT 265 kN/m^3.
5. MODEL INCLUDES 0.5 m OF GLACIAL TILL OVERLYING BEDROCK.

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

SLOPE STABILITY RESULTS
KM106 STOCKPILE
SECTION 1

Knight Piésold CONSULTING

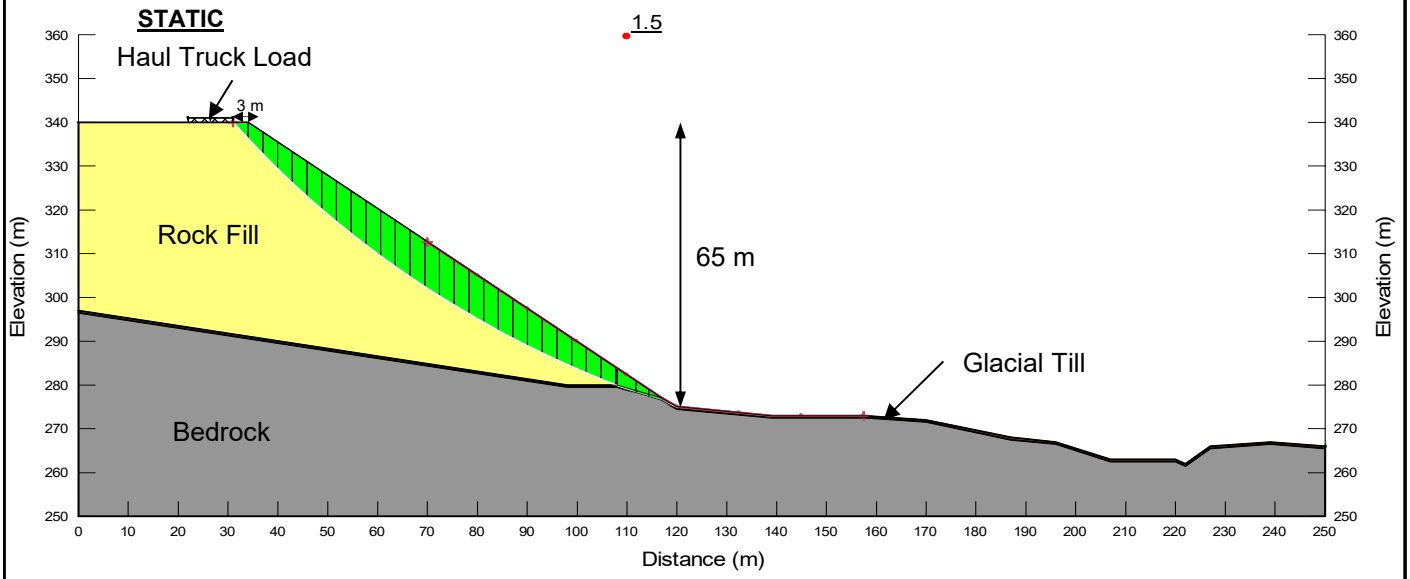
P/A NO. NB102-181/57

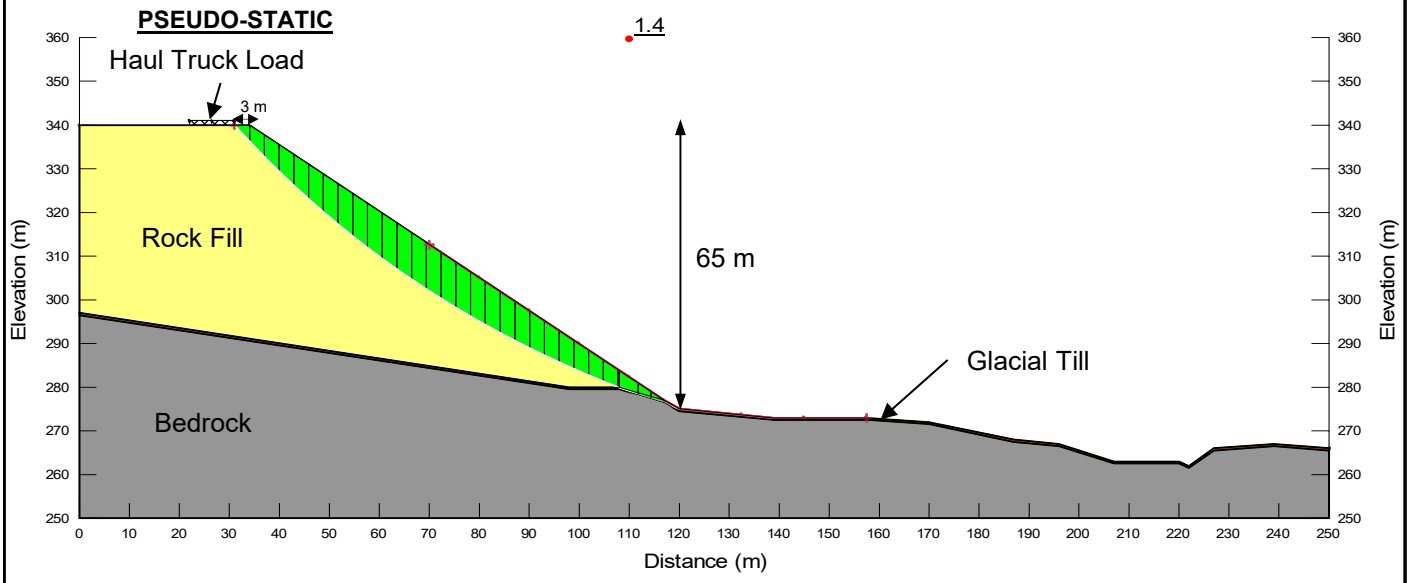
REF. NO. NB19-00443

FIGURE 3

REV 0

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	20JUN'19	ISSUED WITH LETTER	AB	ALA





NOTES:

1. STOCKPILE SLOPES ARE 1.3H:1.0V.
2. HAUL TRUCK TO MAINTAIN A DISTANCE OF 3 m FROM EDGE OF STOCKPILE.
3. A HORIZONTAL SEISMIC ACCELERATION CORRESPONDING TO A PGA OF 0.019g WAS APPLIED TO ALL PSEUDO-STATIC ANALYSES (NRCAN, 2015).
4. DESIGN HAUL TRUCK LOAD IS THE REAR AXLE OF A FULLY LOADED CAT 793. MODELLED AS A SURCHARGE LOAD 9 m WIDE, 1 m HIGH AT 265 kN/m^3.
5. MODEL INCLUDES 0.5 m OF GLACIAL TILL OVERLYING BEDROCK.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	20JUN'19	ISSUED WITH LETTER	AB	ALA

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

SLOPE STABILITY RESULTS
KM106 STOCKPILE
SECTION 2

Knight Piésold CONSULTING

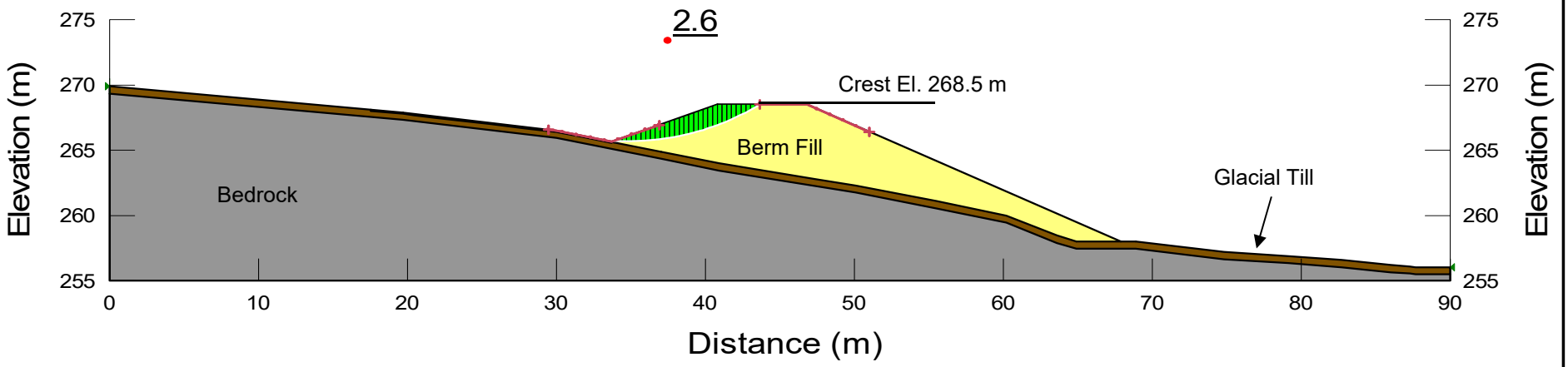
P/A NO. NB102-181/57

REF. NO. NB19-00443

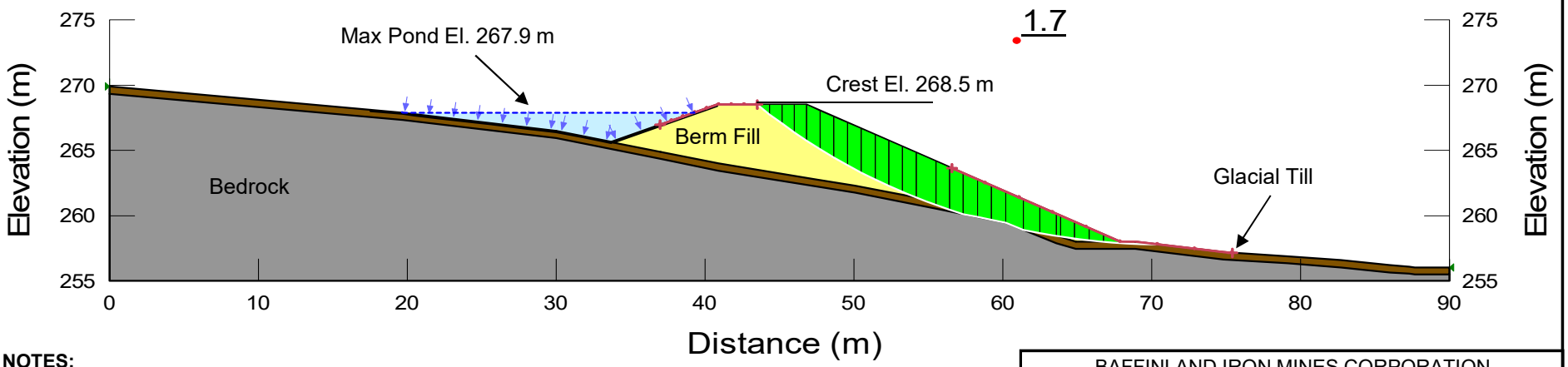
FIGURE 4

REV 0

UPSTREAM SLOPE



DOWNSTREAM SLOPE



NOTES:

1. EMBANKMENT SIDE SLOPES ARE 2.5H:1.0V DOWNSTREAM AND 2.0H:1V UPSTREAM.
2. CREST WIDTH IS 6 m.
3. SEDIMENT DEPOSITS NOT SHOWN IN POND.
4. DOWNSTREAM SLOPE MODELLED AT THE MAXIMUM FILLING LEVEL OF 267.9 m.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	20JUN'19	ISSUED WITH LETTER	AB	ALA

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

SLOPE STABILITY RESULTS
SEDIMENTATION POND
STATIC, LONG-TERM LOADING

Knight Piésold CONSULTING

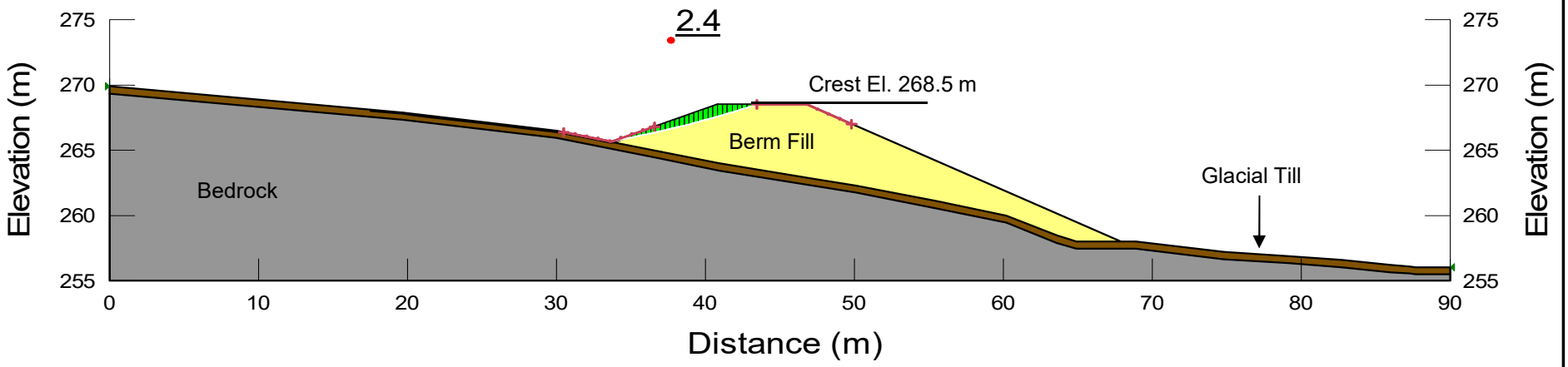
P/A NO. NB102-181/57

REF. NO. NB19-00443

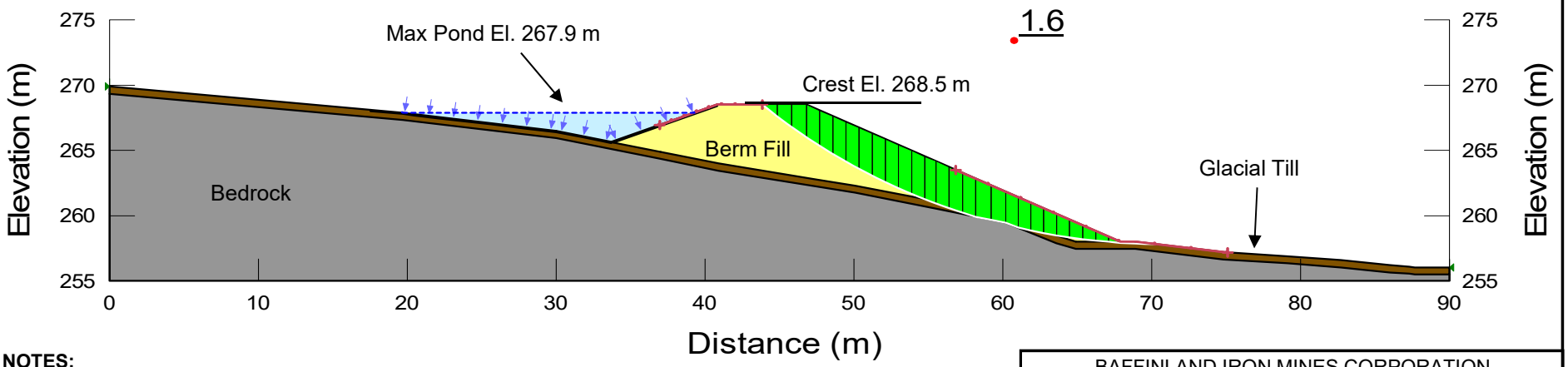
FIGURE 5

REV 0

UPSTREAM SLOPE



DOWNSTREAM SLOPE



NOTES:

1. EMBANKMENT SIDE SLOPES ARE 2.5H:1.0V DOWNSTREAM AND 2.0H:1V UPSTREAM.
2. CREST WIDTH IS 6 m.
3. SEDIMENT DEPOSITS NOT SHOWN IN POND.
4. DOWNSTREAM SLOPE MODELLED AT THE MAXIMUM FILLING LEVEL OF 267.9 m.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	20JUN'19	ISSUED WITH LETTER	AB	ALA

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

SLOPE STABILITY RESULTS
SEDIMENTATION POND
PSEUDO-STATIC LOADING

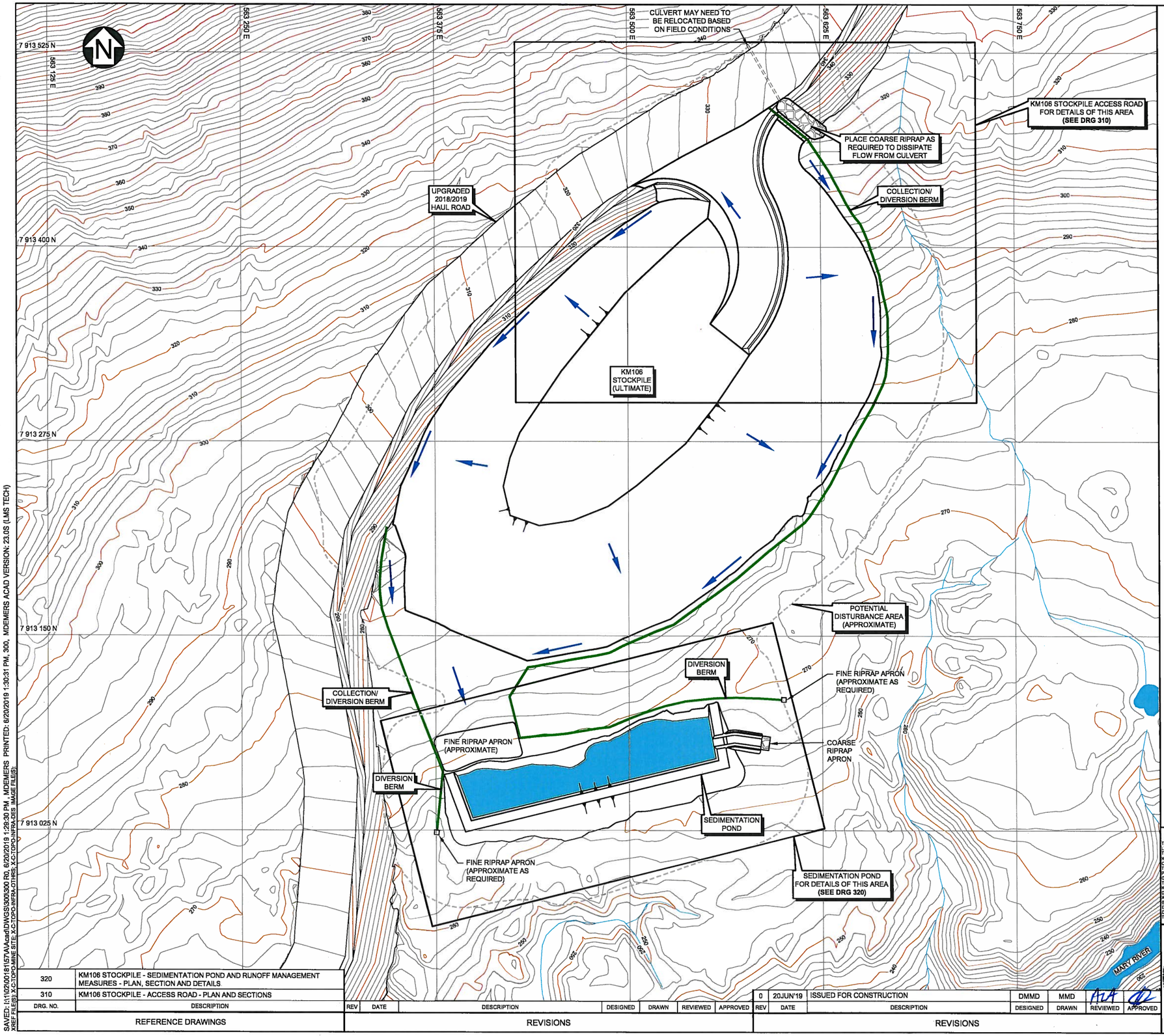
Knight Piésold CONSULTING

P/A NO. NB102-181/57

REF. NO. NB19-00443

FIGURE 6

REV 0



LEGEND:

- WATER
- COARSE RIPRAP
- CULVERT
- COLLECTION/DIVERSION BERM
- POTENTIAL DISTURBANCE AREA (APPROXIMATE)
- FLOW DIRECTION

NOTES:

1. COORDINATE GRID IS UTM (NAD83) ZONE 17.
2. TOPOGRAPHY BASED ON INFORMATION PROVIDED BY EAGLE MAPPING (2008).
3. CONTOURS ARE IN METRES. CONTOUR INTERVAL IS 2 m.
4. DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
5. LOCATIONS AND DETAILS OF CONSTRUCTION ITEMS MAY BE MODIFIED TO SUIT ACTUAL SITE CONDITIONS.
6. UPGRADED 2018/2019 HAUL ROAD AND KM106 STOCKPILE PROVIDED BY BAFFINLAND.
7. FINAL SLOPES SHALL BE TRIMMED TO THE LINES AND TOLERANCES INDICATED ON THE DRAWINGS AND IN THE TECHNICAL SPECIFICATIONS.
8. ALL INFRASTRUCTURE SHOWN IS PROPOSED UNLESS NOTED OTHERWISE.
9. THE DRAWING SHALL BE READ IN CONJUNCTION WITH THE CONTRACT DOCUMENTS AND APPLICABLE TECHNICAL SPECIFICATIONS.
10. FOUNDATION PREPARATION: PROVIDED THE AMOUNT OF ORGANICS AND UNSUITABLE MATERIAL ON THE GROUND IS NEGLIGIBLE, DISTURBANCE TO THE ORIGINAL GROUND (EXCAVATION, SCARIFYING, ETC.) SHOULD BE MINIMIZED SO AS NOT TO IMPACT CURRENT PERMAFROST CONDITIONS. ALTERNATIVE METHODS OF FOUNDATION PREPARATION MAY BE NECESSARY FOR SOME AREAS, AT THE DISCRETION OF THE OWNER'S REPRESENTATIVE. ALL FOUNDATIONS MUST BE MAINTAINED CLEAR OF SNOW, PONDED WATER AND ICE.

ISSUED FOR CONSTRUCTION

SCALE A 25 12.5 0 25 50 75 100 125 m

DRG. NO.	DESCRIPTION
320	KM106 STOCKPILE - SEDIMENTATION POND AND RUNOFF MANAGEMENT MEASURES - PLAN, SECTION AND DETAILS
310	KM106 STOCKPILE - ACCESS ROAD - PLAN AND SECTIONS

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	20JUN'19	ISSUED FOR CONSTRUCTION	DMMD	MMD		

REVISIONS

REGISTERED PROFESSIONAL ENGINEER
K.E. HAWTON
LICENSEE
June 20/19
NWT/NU

Knight Piésold CONSULTING

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

KM106 STOCKPILE GENERAL ARRANGEMENT

PROJECT NO.	DRAWING NO.	REVISION
NB102-181/57	300	0

SAVED: I:\102\00181\57\AA\acad\DWGS\300\300 R0, 6/20/2019 1:29:30 PM , MDEMERS PRINTED: 6/20/2019 1:30:31 PM, 300, MDEMERS ACAD VERSION: 23.0S (LMS TECH)
XREF FILE(S): X-C-TOPO-MINE SITE, X-C-TOPO-INFRA-OTHRS, X-C-TOPO-INFRA-DES IMAGE FILE(S):

GEOSYNTHETICS:

CO-ORDINATION BETWEEN OWNER, ENGINEER AND CONTRACTOR

1. AFTER THE CONTRACTOR HAS COMPLETED PREPARING THE SUBGRADE SURFACE WHICH WILL LIE DIRECTLY BELOW THE GEOSYNTHETICS, THE CONTRACTOR, ENGINEER AND OWNER WILL VERIFY ACCEPTANCE BY SIGNING A FORM WHICH DESCRIBES THE EXTENT OF THE AREA. AT THAT TIME, THE CONTRACTOR ASSUMES RESPONSIBILITY OF PROTECTING THE APPROVED SURFACE, UNTIL IT IS COVERED WITH GEOSYNTHETICS.

2. ANY DAMAGE BY MECHANICAL MEANS CAUSED BY THE CONTRACTOR TO APPROVED SUBGRADE AREAS SHALL BE REPAIRED TO THE SATISFACTION OF THE ENGINEER AT THE EXPENSE OF THE CONTRACTOR. ANY DAMAGE CAUSED BY WEATHER TO APPROVED SUBGRADE AREAS SHALL BE REPAIRED TO THE SATISFACTION OF THE ENGINEER AT THE EXPENSE OF THE OWNER. ANY DAMAGE CAUSED BY WEATHER TO APPROVED SUBGRADE AREAS RESULTING FROM WIND EROSION OR POOR SURFACE RUNOFF CONTROL (E.G. ALLOWING SURFACE RUNOFF ONTO APPROVED AREAS) AS A RESULT OF OPERATIONS OF THE CONTRACTOR SHALL BE REPAIRED TO THE SATISFACTION OF THE ENGINEER AT THE EXPENSE OF THE CONTRACTOR.

3. AFTER INSTALLATION OF THE GEOSYNTHETICS AND FINAL QUALITY CONTROL MEASURES ARE COMPLETED BY THE CONTRACTOR, AREAS RECEIVING COVER MATERIAL SHALL BE CLEARLY IDENTIFIED AND THE ENGINEER SHALL BE NOTIFIED FOR GEOSYNTHETICS INSPECTION. UPON SIGNED ACCEPTANCE BY THE ENGINEER THAT THE GEOSYNTHETICS HAVE BEEN INSTALLED IN ACCORDANCE WITH THE SPECIFICATIONS, IT WILL BE AVAILABLE TO THE CONTRACTOR FOR PLACING THE COVER MATERIAL, WHERE APPLICABLE. AT THAT TIME THE CONTRACTOR WILL ASSUME RESPONSIBILITY FOR MAINTAINING THE CONDITION OF THE PORTION OF THE GEOSYNTHETICS UNTIL IT IS ADEQUATELY COVERED.

4. ANY DAMAGE TO PREVIOUSLY ACCEPTED GEOSYNTHETICS AS A RESULT OF THE CONTRACTOR'S OPERATION WILL BE REPAIRED TO THE SATISFACTION OF THE ENGINEER AT THE CONTRACTOR'S EXPENSE.

5. IN THE EVENT OF CONTRADICTION OR CONFLICT BETWEEN PARTIES MENTIONED ABOVE, QUESTIONS WILL BE TAKEN TO THE ENGINEER AND OWNER FOR FINAL DECISION.

SUBGRADE PREPARATION

1. SUBGRADE PREPARATION SHALL BE CARRIED OUT IN ACCORDANCE WITH THE MANUFACTURER'S SPECIFICATIONS AND INSTALLATION GUIDELINES.

2. SUBGRADE PREPARATION OVER ROCK SURFACES SHALL REQUIRE THE REMOVAL OF ANY PROTRUDING OBJECT SUCH THAT A SMOOTH GEOMEMBRANE SURFACE IS PROVIDED. NO OVERHANGS, PROTRUSIONS, OR LEDGES OF MORE THAN 0.1 m IN HEIGHT SHALL BE ACCEPTED.

3. PLACEMENT AND COMPACTION OF BEDDING OVER EXPOSED BEDROCK SURFACES SHALL BE CONDUCTED USING PLACEMENT AND COMPACTION METHODS TO SUIT THE SPECIFIC FIELD CONDITIONS. WHERE COMPACTION WITH A STANDARD VIBRATORY ROLLER IS NOT POSSIBLE, ALTERNATIVE COMPACTION EQUIPMENT MAY BE ACCEPTED. THE PLACEMENT AND COMPACTION METHODS MUST BE SUBMITTED TO THE ENGINEER FOR APPROVAL PRIOR TO THEIR IMPLEMENTATION.

DELIVERY, HANDLING AND STORAGE

1. DELIVERY, HANDLING AND STORAGE OF GEOSYNTHETICS MATERIAL SHALL BE IN ACCORDANCE WITH THE MANUFACTURER'S PRINTED INSTRUCTIONS.

GEOSYNTHETICS INSTALLATION

1. THE GEOMEMBRANE SHALL BE ATARFIL LLD, 40 mil, OR APPROVED EQUIVALENT. THE GEOTEXTILE SHALL BE TEXEL 100 P, 10 oz/yd², OR APPROVED EQUIVALENT AND SHALL BE INSTALLED IN INTIMATE CONTACT WITH THE GEOMEMBRANE.

2. THE GEOTEXTILE AND GEOMEMBRANE SHALL BE HANDLED IN SUCH A MANNER AS TO ENSURE THAT IT IS NOT DAMAGED IN ANY WAY. THE MATERIALS SHALL BE STORED INDOORS AT TEMPERATURES ABOVE 0 DEGREES CELSIUS PRIOR TO PLACEMENT. SHOULD THE CONTRACTOR DAMAGE THE GEOTEXTILE TO THE EXTENT THAT IT IS NO LONGER USABLE AS DETERMINED BY THESE SPECIFICATIONS OR BY THE ENGINEER, THE CONTRACTOR SHALL REPLACE THE GEOTEXTILE AT THEIR EXPENSE.

3. THE SUBGRADE UNDERLYING THE GEOTEXTILE SHALL BE APPROVED BY THE ENGINEER AND SHALL BE SMOOTH AND FREE OF RUTS OR PROTRUSIONS WHICH COULD DAMAGE THE GEOTEXTILE. THE GEOTEXTILE AND GEOMEMBRANE SHALL BE LAID FLAT AND SMOOTH SO THAT IT IS IN DIRECT CONTACT WITH THE SUBGRADE. THE GEOTEXTILE SHALL BE FREE OF TENSILE STRESSES, FOLDS AND WRINKLES SO THAT THE OVERLYING MATERIALS WILL NOT EXCESSIVELY STRETCH OR TEAR THE FABRIC. ON SLOPES STEEPER THAN 10H:1V, THE GEOTEXTILE SHALL BE LAID WITH THE MACHINE DIRECTION OF THE FABRIC PARALLEL TO THE SLOPE DIRECTION. ANCHORING OF THE TERMINAL ENDS OF THE GEOTEXTILE SHALL BE ACCOMPLISHED THROUGH THE USE OF ANCHOR TRENCHES, ANCHOR BERMS OR APRONS AT THE CREST AND TOE OF THE SLOPE. THE GEOTEXTILE SHALL BE PLACED DIRECTLY ON THE PREPARED SUBGRADE WITH SEAMS UPWARD AND SHALL EXTEND FOR A MINIMUM OF 0.9 m PAST THE DESIGNED SLOPE TOE.

4. UNLESS OTHERWISE NOTED INSTALLATION OF GEOSYNTHETICS SHALL BE IN ACCORDANCE WITH THE FOLLOWING:

   - INTERNATIONAL ASSOCIATION OF GEOSYNTHETICS INSTALLERS - "GUIDELINES FOR INSTALLATION OF FACTORY FABRICATED HEAVY WEIGHT >0.64 mm (25 mil) THICKNESS FABRIC - SUPPORTED GEOMEMBRANES" (MARCH 2014)
   - APPLICABLE GEOSYNTHETICS RESEARCH INSTITUTE STANDARDS, AND THE MANUFACTURER'S "QUALITY CONTROL MANUAL" (JANUARY 2017)
   - GUIDELINES FOR INSTALLATION OF "FACTORY FABRIC SUPPORTED GEOMEMBRANES" (MARCH 2014)

5. THE CONTRACTOR SHALL PROVIDE A WRITTEN GUARANTEE COVERING MATERIALS AND ALL WORKMANSHIP AS WELL AS DEGRADATION DUE TO ULTRAVIOLET LIGHT FOR EXPOSED AREAS. THE MATERIAL SHALL BE WARRANTED AGAINST MANUFACTURER'S DEFECTS FOR A PERIOD OF 5 YEARS FROM THE DATE OF INSTALLATION. THE INSTALLATION SHALL BE WARRANTED AGAINST DEFECTS IN WORKMANSHIP FOR A PERIOD OF 2 YEARS FROM THE DATE OF INSTALLATION.

6. THE GEOSYNTHETICS SHALL BE INSTALLED ON THE AREA SHOWN ON THE DRAWINGS OR AS DIRECTED BY THE ENGINEER.

7. PRIOR TO DEPLOYMENT OF THE GEOSYNTHETICS, THE CONTRACTOR, WITH THE OWNER AND ENGINEER SHALL INSPECT, CERTIFY, AND ACCEPT ALL SURFACES ON WHICH THE GEOTEXTILE AND GEOMEMBRANE IS TO BE PLACED TO ENSURE CONFORMANCE WITH THE DESIGN AND SPECIFICATIONS. SURFACES NOT IN COMPLIANCE WITH THE SPECIFICATIONS SHALL BE RECTIFIED BY THE CONTRACTOR. ACCEPTANCE OF THE ANCHOR TRENCHES FOR PLACEMENT OF THE GEOMEMBRANE SHALL BE INCLUDED IN THE SURFACE PREPARATION ACCEPTANCE.

8. THE CONTRACTOR SHALL PROVIDE THE ENGINEER WITH A FINAL PANEL LAYOUT DRAWING, AND HARDCOPY FORMATS, AT LEAST ONE WEEK PRIOR TO PLACING THE GEOMEMBRANE. NO HORIZONTAL SEAMS ON A SLOPE WILL BE ACCEPTED. NO GEOSYNTHETICS SHALL BE INSTALLED WITHOUT PRIOR APPROVAL BY THE ENGINEER OF THE PROPOSED LAYOUT.

9. THE GEOSYNTHETICS WILL BE PLACED USING METHODS AND PROCEDURES THAT ENSURE A MINIMUM OF HANDLING. THE INSTALLER SHALL PROVIDE ADEQUATE TEMPORARY ANCHORING DEVICES TO PREVENT DAMAGE DUE TO WINDS.

10. THE GEOSYNTHETICS SHALL BE INSTALLED IN A RELAXED CONDITION AND SHALL BE FREE OF TENSION OR STRESS UPON COMPLETION OF THE INSTALLATION. ALL NECESSARY PRECAUTIONS, INCLUDING PROVISIONS FOR INSTALLING EXTRA MATERIAL, SHALL BE TAKEN TO AVOID TRAMPOLINING OF ANY GEOMEMBRANE WHICH MAY REMAIN EXPOSED.

11. SEAMS SHALL BE MADE BY LAPPING THE UPSLOPE MATERIAL OVER THE DOWNSLOPE MATERIAL WITH SUFFICIENT OVERLAP. A MINIMUM OF 1 m IS REQUIRED FROM THE TOE OF THE SLOPE TO ANY HORIZONTAL SEAM ON FLAT AREAS.

12. EXTREME CARE SHALL BE TAKEN BY THE CONTRACTOR IN THE PREPARATION OF THE AREAS TO BE WELDED. THE AREAS TO BE WELDED SHALL BE CLEANED AND PREPARED ACCORDING TO THE APPROVED PROCEDURES, AND ALL SHEETING SHALL BE WELDED TOGETHER BY THERMAL METHODS.

13. THE WELDING EQUIPMENT USED SHALL BE CAPABLE OF CONTINUOUSLY MONITORING AND CONTROLLING THE TEMPERATURES IN THE ZONE OF CONTACT WHERE THE MACHINE IS ACTUALLY FUSING THE GEOMEMBRANE MATERIAL, TO ENSURE CHANGES IN WEATHER CONDITIONS WILL NOT AFFECT THE INTEGRITY OF THE WELD.

14. NO "FISH MOUTHS" SHALL BE ALLOWED WITHIN THE SEAM AREA. WHERE "FISH MOUTHS" OCCUR, THE MATERIAL SHALL BE CUT, OVERLAPPED, AND EXTRUSION WELDED. ALL WELDS ON COMPLETION OF THE WORK SHALL BE TIGHTLY BONDED. ANY GEOMEMBRANE AREA SHOWING DISTRESS DUE TO EXCESSIVE SCUFFING OR PUNCTURE DURING INSTALLATION BE REPLACED OR REPAIRED AT THE CONTRACTOR'S EXPENSE.

15. THE CONTRACTOR SHALL TAKE INTO ACCOUNT THAT RAPID WEATHER CHANGES ARE VERY POSSIBLE, RESULTING IN DELAYS IN CONSTRUCTION OF FIELD SEAMS. JOINTING OF PANELS AND REPAIRS WILL ONLY BE PERMITTED UNDER WEATHER CONDITIONS ALLOWING SUCH WORK WITHIN THE WARRANTY LIMITS IMPOSED BY THE GEOMEMBRANE MANUFACTURER.

FIELD SEAM INSPECTION AND TESTING

1. A MAXIMUM EFFORT SHALL BE MADE TO INSTALL A PERFECT LINER SYSTEM. THIS MEANS THAT ALL SEAMS COMPLETED IN THE FIELD, PATCHES AND EXTRUSIONS SHALL BE INSPECTED, TESTED AND RECORDED.

2. A QUALITY CONTROL TECHNICIAN SHALL INSPECT EACH SEAM, MARKING HIS/HER INITIALS AND THE DATE INSPECTED AT THE END OF EACH PANEL. ANY AREA SHOWING A DEFECT SHALL BE MARKED AND REPAIRED IN ACCORDANCE WITH APPLICABLE GEOMEMBRANE REPAIR PROCEDURES.

3. ALL FIELD SAMPLING AND TESTING SHALL BE DONE BY THE CONTRACTOR AS APPROVED BY THE ENGINEER.

4. THE FIELD INSTALLATION TESTING PROGRAM SHALL CONSIST OF PERIODIC VISUAL OBSERVATIONS, CONTINUITY, AND STRENGTH TESTS. THESE INSPECTIONS AND TESTS ARE TO BE MADE ROUTINELY AND ARE REQUIRED REGARDLESS OF OTHER TYPES OF TESTING THAT MAY BE COMPLETED. THE INSTALLER SHALL PERFORM QUALITY CONTROL TESTING ACCORDING TO THE TYPES AND FREQUENCY INDICATED BELOW.

   - VISUAL OBSERVATIONS ARE TO BE MADE ROUTINELY AND SHALL INCLUDE THE FOLLOWING:
     - VISUALLY CHECK FIELD SEAMS FOR SQUEEZE OUT, FOOT PRINT, MELT AND OVERLAP
     - CHECK MACHINES FOR CLEANNESS, TEMPERATURE AND RELATED ITEMS.
     - ANY AREA OF THE SEAM OR PANEL SHOWING A DEFECT SHALL BE MARKED AND REPAIRED IN ACCORDANCE WITH THE APPLICABLE REPAIR PROCEDURES.

   - CONTINUITY TESTING IS REQUIRED FOR ALL FIELD SEAMS AND REPAIRED AREAS. INTER-SEAM PRESSURE OR "AIR TESTING" AND TESTING USING VACUUM BOX ARE CONSIDERED ACCEPTABLE METHODS FOR CONTINUITY TESTING. THE TEST PROCEDURE FOR INTER-SEAM PRESSURE OR AIR TESTING IS AS FOLLOWS:
     - SEAL BOTH ENDS OF THE SEAM TO BE TESTED BY APPLYING HEAT TO THE END OF THE SEAM UNTIL FLOW TEMPERATURE IS ACHIEVED. CLAMP OFF THE ENDS AND LET COOL.
     - INSERT A PRESSURE GAUGE/NEEDLE ASSEMBLY INTO THE END OF THE SEAM AND SEAL.
     - THE SEAM SHALL BE PRESSURIZED TO AN INITIAL START PRESSURE, MINIMUM 28 psi AND MAXIMUM 30 psi.
     - THE INITIAL START PRESSURE IS READ AFTER A 2-MINUTE RELAXING PERIOD, WHICH ALLOWS THE AIR TO REACH AMBIENT GEOMEMBRANE TEMPERATURE, THE ENDING PRESSURE IS READ AFTER 5 MINUTES.
     - THE ALLOWABLE PRESSURE DROP IS 3 psi LESS THAN THE INITIAL START PRESSURE.
     - THE RESULTS OF THE AIR TEST SHALL BE MARKED AT THE TEST LOCATION AND SHALL BE RECORDED BY THE CONTRACTOR. IF THE TEST FAILS, THE LOCATION OF THE LEAK SHALL BE FOUND AND REPAIRED AND RETESTED OR THE ENTIRE SEAM SHALL BE REPAIRED AND RETESTED.

   - THE TEST PROCEDURE FOR VACUUM BOX TESTING IS AS FOLLOWS:
     - MIX A SOLUTION OF LIQUID DETERGENT AND WATER AND APPLY AN AMPLE AMOUNT TO THE AREA TO BE TESTED. IF A SEAM CONTAINS EXCESS OVERLAP OR LOOSE EDGES IT IS TO BE TRIMMED BEFORE TESTING.
     - PLACE A TRANSLUCENT VACUUM BOX OVER THE AREA AND APPLY A SLIGHT AMOUNT OF DOWNWARD PRESSURE TO THE BOX TO THE SEAL TO THE GEOMEMBRANE.
     - APPLY A VACUUM (3 psi TO 5 psi) TO THE AREA. ANY LEAKS WILL BECOME VISIBLE BY LARGE BUBBLES AND SHALL BE REPAIRED.

5. STRENGTH TESTS ON SEAMS SHALL BE CARRIED OUT ON SAMPLE COUPONS CUT FROM THE INSTALLED GEOMEMBRANE IN ACCORDANCE WITH THE MANUFACTURER'S SPECIFICATIONS AND THE INTERNATIONAL ASSOCIATION OF GEOSYNTHETICS INSTALLERS "GUIDELINES FOR INSTALLATION OF FACTORY FABRICATED HEAVYWEIGHT > 0.64 mm (25 mil) THICKNESS FABRIC - SUPPORTED GEOMEMBRANES" (MARCH, 2014), APPLICABLE GEOSYNTHETICS RESEARCH INSTITUTE STANDARDS AND THE MANUFACTURER'S QUALITY CONTROL MANUAL.

AS-BUILT DOCUMENTATION

1. THE CONTRACTOR SHALL PROVIDE THE OWNER AND ENGINEER WITH COPIES OF ALL THE FABRICATION AND INSTALLATION TEST LOGS AND CONFORMANCE DATA INCLUDING:

   - GEOSYNTHETIC CERTIFICATION
   - DAILY PANEL PLACEMENT LOGS
   - AS-BUILT PANEL LAYOUT DRAWINGS
   - SEAM CONTROL LOGS
   - CONSTRUCTION REPAIR REPORT

2. IN ADDITION, THE CONTRACTOR SHALL SUBMIT AS-BUILT DRAWINGS SHOWING THE INSTALLED GEOMEMBRANE PANEL LAYOUT WITH EACH PANEL OR PORTION OF PANEL IDENTIFIED BY THE MANUFACTURER'S IDENTIFICATION NUMBER. THE EXTENT OF THE INSTALLED GEOSYNTHETICS AND LOCATIONS OF ALL TESTS SHALL BE IDENTIFIED ALONG WITH LOCATIONS OF ANY REPAIRS. THE AS-BUILT DRAWINGS SHALL BE MADE AVAILABLE ELECTRONICALLY TO THE OWNER AND ENGINEER IN A TIMELY FASHION AFTER THE WORK IS COMPLETE.

FILL MATERIALS:

MATERIAL PLACEMENT AND COMPACTION REQUIREMENTS	
ZONE AND MATERIAL TYPE	**PLACING AND COMPACTION REQUIREMENTS**
500 mm MINUS ROCKFILL	MATERIAL SHALL BE WELL GRADED AND CONSIST OF HARD, DURABLE FRESH ROCKFILL FREE OF DELETERIOUS MATERIALS. ACCESS ROAD: MATERIAL TO BE PLACED BY TRUCK AND BULLDOZER STARTING AT THE EXISTING HAUL ROAD. COMPACTION TO BE ACHIEVED BY ROUTING HAULAGE TRAFFIC OVER THE ENTIRE SURFACE OF THE ROAD. SAFETY BERMS: MATERIAL TO BE PLACED AND NOMINALLY COMPACTED TO THE DIMENSIONS SHOWN ON THE DRAWINGS. SEDIMENTATION POND: MATERIAL TO BE PLACED AND SPREAD IN MAXIMUM 1000 mm LAYERS AFTER COMPACTION. COMPACTION TO CONSIST OF MINIMUM 6 PASSES BY A D9 DOZER.
RIPRAP	RIPRAP SHALL BE WELL GRADED AND CLEAN, DURABLE AND ANGULAR IN SHAPE. FINE RIPRAP D_{50} = 150 mm; COARSE RIPRAP D_{50} = 300 mm. MATERIAL TO BE PLACED AND SPREAD IN MAXIMUM 300 mm LAYER (FINE RIPRAP) OR 600 mm LAYER (COARSE RIPRAP). PLACED TO FORM A TIGHTLY INTERLOCKING LAYER.
INTERMEDIATE BEDDING	MATERIAL SHALL CONSIST OF 32 mm MINUS CLEAN SAND AND GRAVEL FREE OF CLAY, LOAM, ORGANICS, AND OTHER DELETERIOUS MATERIAL. MATERIAL SHALL BE PLACED, SPREAD AND MOISTURE CONDITIONED IN MAXIMUM 200 mm LAYER AFTER COMPACTION FROM A VIBRATORY COMPACTOR OR PLATE COMPACTORS.
BERM FILL	MATERIAL SHALL CONSIST OF CLEAN, WELL GRADED, 150 mm MINUS PROCESSED ROCKFILL AND SHALL BE FREE OF CLAY, LOAM, ORGANICS, AND OTHER DELETERIOUS MATERIALS. SEDIMENTATION POND: PLACED AND SPREAD IN MAXIMUM 300 mm LAYERS AFTER COMPACTION FROM A VIBRATORY COMPACTOR. COLLECTION/DIVERSION BERMS: PLACED AND SPREAD IN MAXIMUM 200 mm LAYERS AFTER COMPACTION. NOMINAL COMPACTION.

NOTES:

1. THE DRAWING SHALL BE READ IN CONJUNCTION WITH THE ACCOMPANYING CONTRACT DOCUMENTS AND APPLICABLE TECHNICAL SPECIFICATIONS.
2. 500 mm MINUS ROCKFILL TO BE USED FOR THE ACCESS ROAD, SAFETY BERMS AND THE SEDIMENTATION POND BERMS.
3. FINE RIPRAP TO BE USED FOR THE SEDIMENTATION POND SPILLWAY INLET, COLLECTION/DIVERSION BERMS AND APRONS AS NOTED ON THE DRAWINGS. COARSE RIPRAP TO BE USED FOR EXISTING CULVERT OUTLET AND SEDIMENTATION POND SPILLWAY CHANNEL AND APRON.
4. INTERMEDIATE BEDDING TO BE USED FOR ANCHOR TRENCH BACKFILL AND ANCHOR BERMS; BEDDING MATERIAL FOR GEOMEMBRANE, AND BEDDING AND BACKFILL FOR CULVERTS AND PIPES.
5. BERM FILL TO BE USED FOR THE SEDIMENTATION POND BERMS AND COLLECTION/DIVERSION BERMS.
6. FILL MATERIALS USED FOR CONSTRUCTION SHALL NOT BE POTENTIALLY ACID GENERATING (PAG) OR METAL LEACHING (ML). THROUGHOUT CONSTRUCTION, ADEQUATE INSPECTION AND PERIODIC TESTING SHOULD BE CARRIED OUT TO DEMONSTRATE THE SUITABILITY OF THE FILL MATERIALS.
7. UNLESS OTHERWISE NOTED ALL MATERIALS SHALL CONSIST OF HARD, DURABLE FILL MATERIAL, FREE OF CLAY, LOAM, TREE STUMPS, ROOTS AND OTHER DELETERIOUS MATERIALS OR ORGANIC MATTER, AND CONTAIN NO MASSIVE ICE.

ISSUED FOR CONSTRUCTION

DRG. NO.	DESCRIPTION
REFERENCE DRAWINGS	

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	20JUN'19	ISSUED FOR CONSTRUCTION	DMMD	MMD		
REVISIONS						

REGISTERED PROFESSIONAL ENGINEER
K.E. HAWTON
LICENSEE
June 20/19
NWT/NU

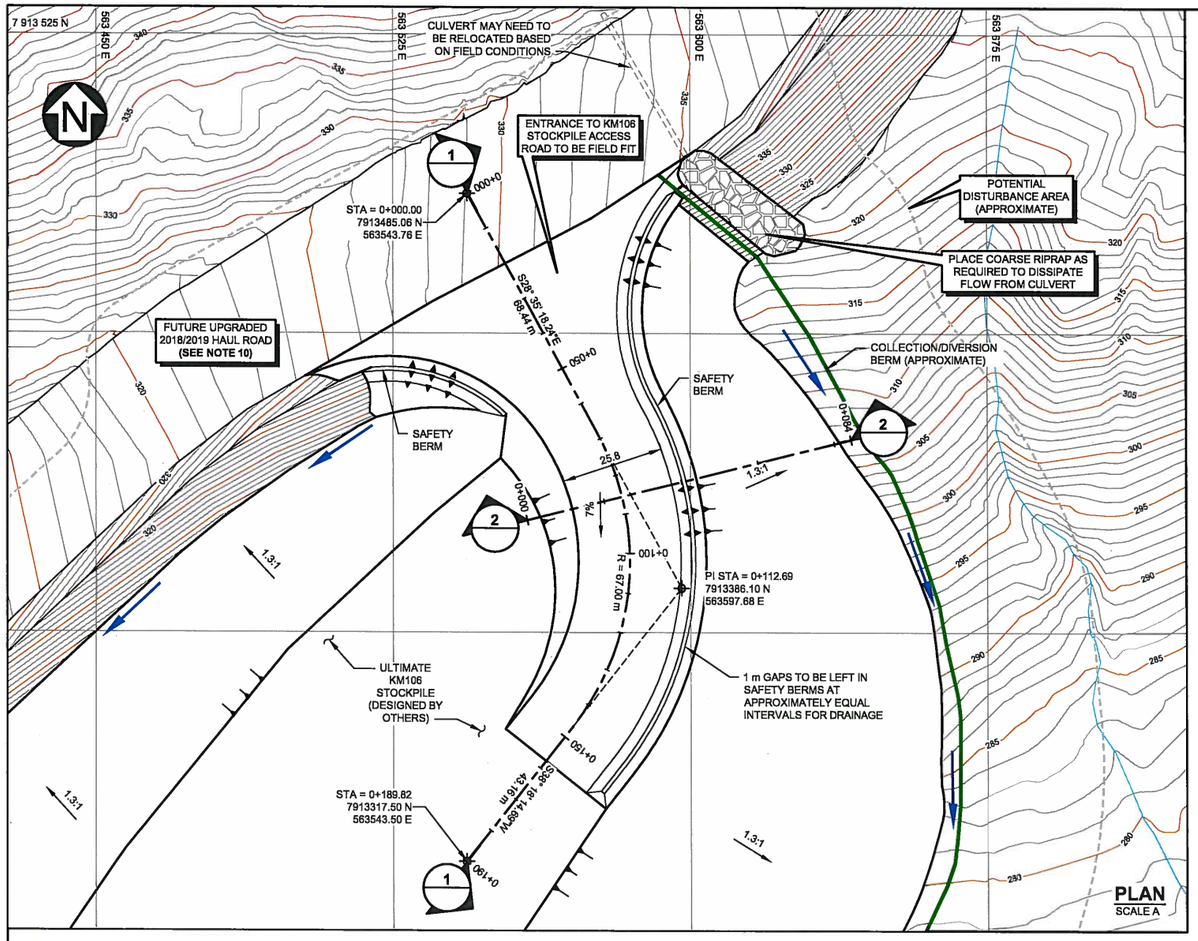
Knight Piésold CONSULTING

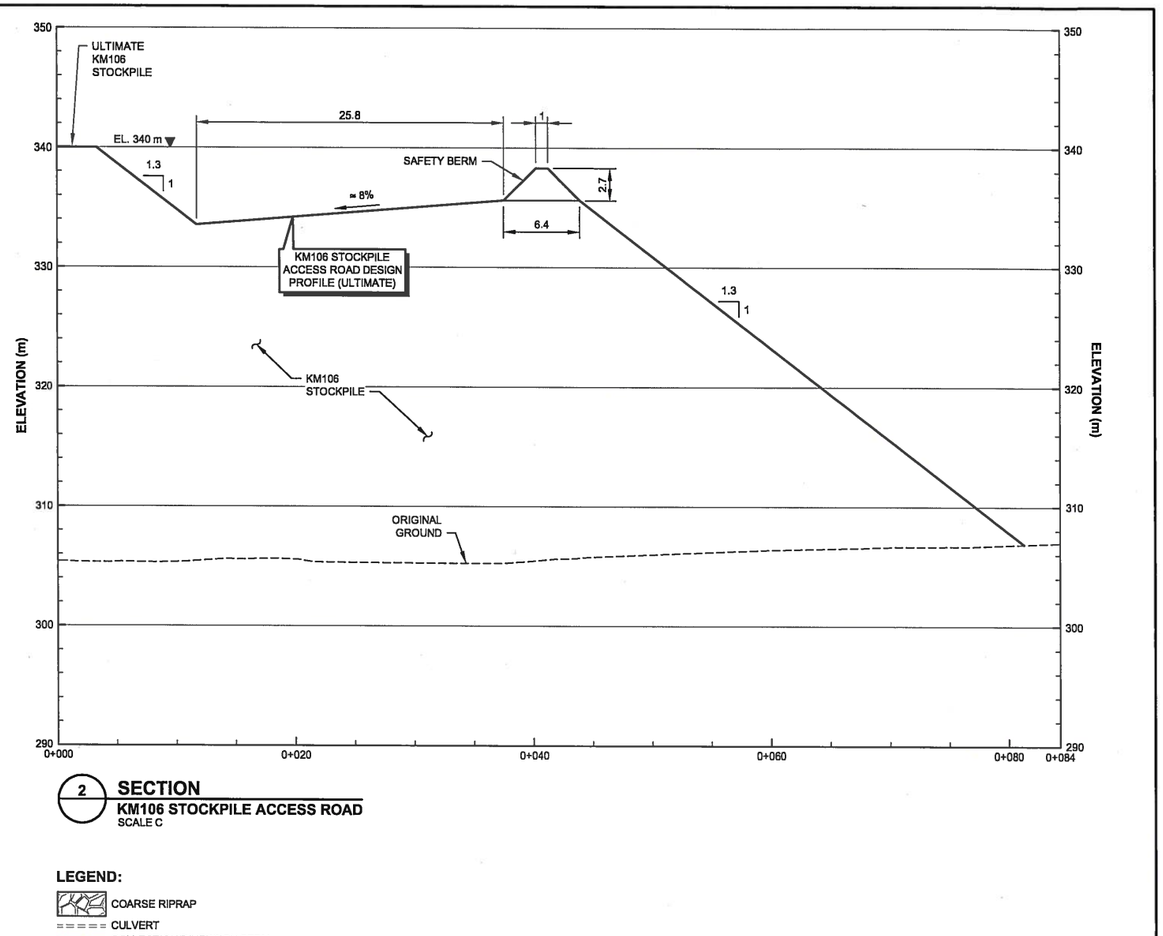
BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

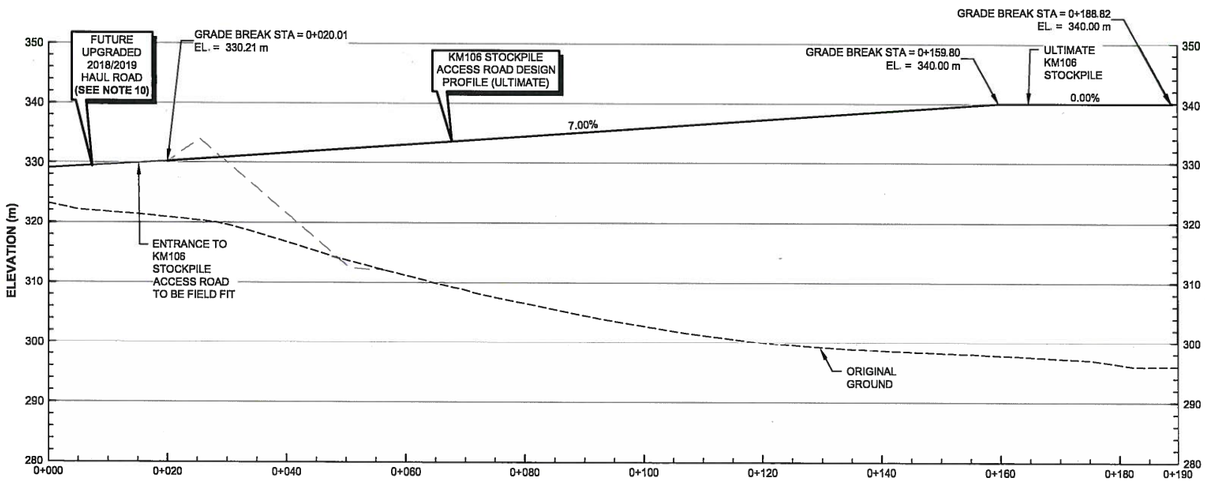
KM106 STOCKPILE SPECIFICATIONS

P/A NO.	DRAWING NO.	REVISION
NB102-181/57	301	0





2 **SECTION**
KM106 STOCKPILE ACCESS ROAD
SCALE C



1 **SECTION**
KM106 STOCKPILE ACCESS ROAD
SCALE B

LEGEND:

- COARSE RIPRAP
- CULVERT
- COLLECTION/DIVERSION BERM
- ORIGINAL GROUND
- POTENTIAL DISTURBANCE AREA (APPROXIMATE)
- FLOW DIRECTION

NOTES:

1. COORDINATE GRID IS UTM (NAD83) ZONE 17.
2. TOPOGRAPHY BASED ON INFORMATION PROVIDED BY EAGLE MAPPING (2008).
3. CONTOURS ARE IN METRES. CONTOUR INTERVAL IS 1 m.
4. DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
5. ALL INFRASTRUCTURE SHOWN IS PROPOSED UNLESS NOTED OTHERWISE.
6. THE DRAWING SHALL BE READ IN CONJUNCTION WITH THE CONTRACT DOCUMENTS AND APPLICABLE TECHNICAL SPECIFICATIONS.
7. FOUNDATION PREPARATION: PROVIDED THE AMOUNT OF ORGANICS AND UNSUITABLE MATERIAL ON THE GROUND IS NEGLIGIBLE, DISTURBANCE TO THE ORIGINAL GROUND (EXCAVATION, SCARIFYING, ETC.) SHOULD BE MINIMIZED SO AS NOT TO IMPACT CURRENT PERMAFROST CONDITIONS. ALTERNATIVE METHODS OF FOUNDATION PREPARATION MAY BE NECESSARY FOR SOME AREAS, AT THE DISCRETION OF THE OWNER'S REPRESENTATIVE. ALL FOUNDATIONS MUST BE MAINTAINED CLEAR OF SNOW, PONDED WATER AND ICE.
8. FINAL SLOPES SHALL BE TRIMMED TO THE LINES AND TOLERANCES INDICATED ON THE DRAWINGS AND IN THE TECHNICAL SPECIFICATIONS.
9. LOCATIONS AND DETAILS OF CONSTRUCTION ITEMS MAY BE MODIFIED TO SUIT ACTUAL SITE CONDITIONS.
10. FUTURE UPGRADED 2018/2019 HAUL ROAD PROVIDED BY BAFFINLAND AUGUST 2018.
11. ACCESS ROAD FILL SLOPES TO BE AT ANGLE OF REPOSE FOR ROAD EMBANKMENT FILL. 1.3H:1V HAS BEEN ASSUMED BASED ON MATERIAL PROPERTIES.

ISSUED FOR CONSTRUCTION

SCALE A 15 7.5 0 25 50 75 m
SCALE B 10 5 0 10 20 30 40 50 m
SCALE C 5 2.5 0 5 10 15 20 25 m

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June 2019
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BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

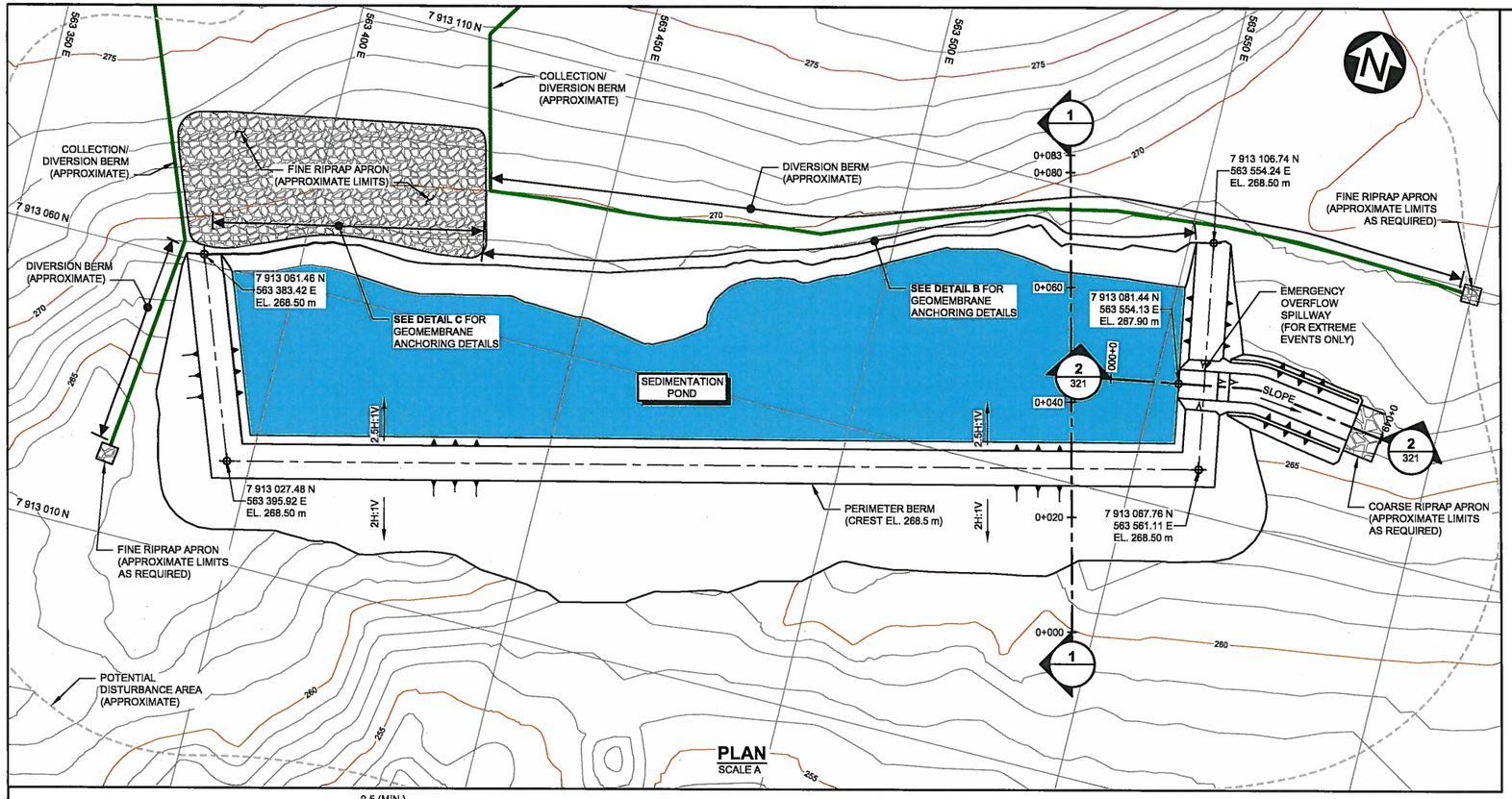
KM106 STOCKPILE ACCESS ROAD PLAN AND SECTIONS

P/A NO.	DRAWING NO.	REVISION
NB102-181/57	310	0

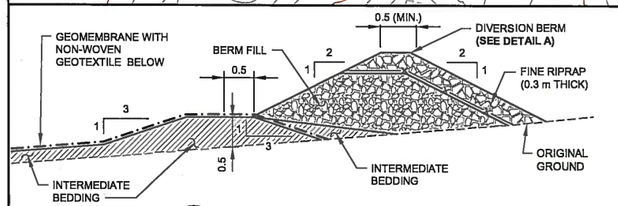
DRG. NO.	DESCRIPTION
REFERENCE DRAWINGS	

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
REVISIONS						

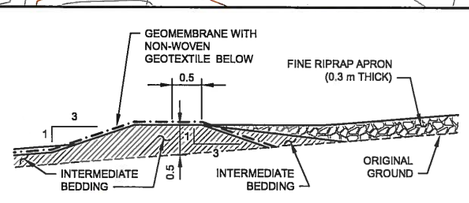
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	20JUN'19	ISSUED FOR CONSTRUCTION	DMMD	MMD	AKA	KH
REVISIONS						



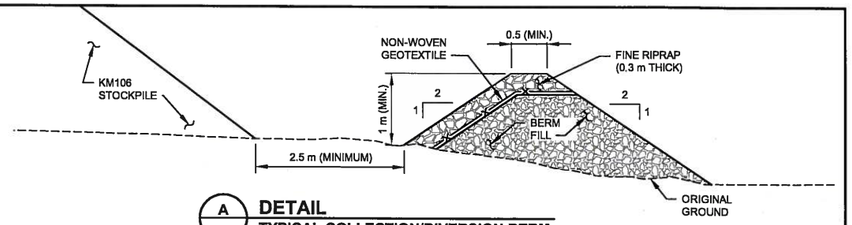
PLAN
SCALE A



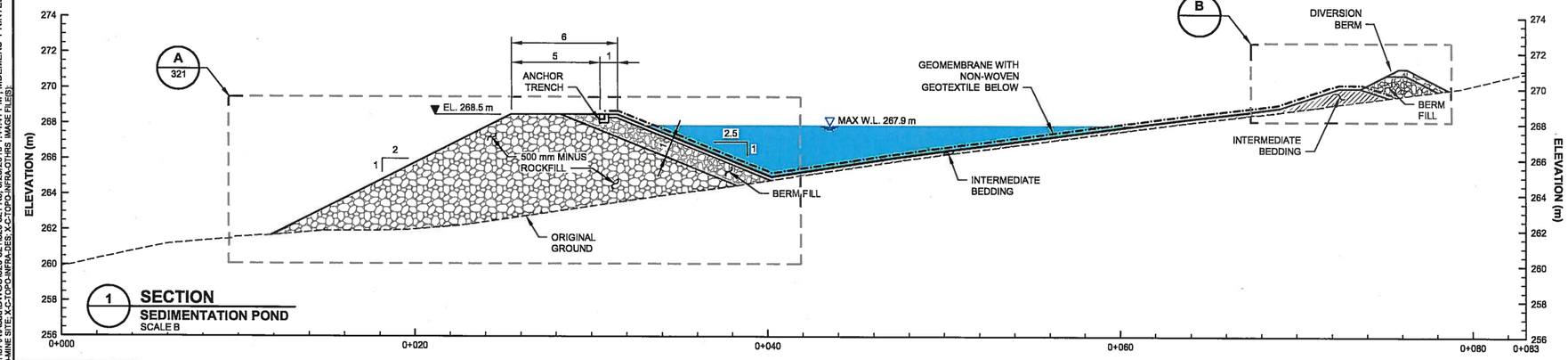
B DETAIL
GEOMEMBRANE ANCHORING DETAIL
SCALE C



C DETAIL
GEOMEMBRANE ANCHORING DETAIL
SCALE C



A DETAIL
TYPICAL COLLECTION/DIVERSION BERM
NTS



1 SECTION
SEDIMENTATION POND
SCALE B

LEGEND:

- WATER
- 500 mm MINUS ROCKFILL
- COARSE RIPRAP
- FINE RIPRAP
- BERM FILL
- INTERMEDIATE BEDDING
- GEOMEMBRANE WITH NON-WOVEN GEOTEXTILE BELOW
- NON-WOVEN GEOTEXTILE
- ORIGINAL GROUND
- COLLECTION/DIVERSION BERM
- POTENTIAL DISTURBANCE AREA (APPROXIMATE)

NOTES:

1. COORDINATE GRID IS UTM (NAD83) ZONE 17.
2. TOPOGRAPHY BASED ON INFORMATION PROVIDED BY EAGLE MAPPING (2008).
3. CONTOURS ARE IN METRES. CONTOUR INTERVAL IS 1 m.
4. ALL INFRASTRUCTURE SHOWN IS PROPOSED UNLESS OTHERWISE NOTED.
5. DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
6. LOCATIONS AND DETAILS OF CONSTRUCTION ITEMS MAY BE MODIFIED TO SUIT ACTUAL SITE CONDITIONS.
7. FOR MATERIAL AND GEOSYNTHETIC SPECIFICATIONS **SEE DRG 301.**
8. GEOMEMBRANE TO BE 40 mil ATARFIL LINEAR LOW DENSITY TEXTURED GEOMEMBRANE OR APPROVED EQUIVALENT AND TO BE INSTALLED AS PER THE MANUFACTURER'S SPECIFICATIONS.
9. NON-WOVEN GEOTEXTILE TO BE TEXEL 100P OR APPROVED EQUIVALENT WHEN PLACED ADJACENT TO GEOMEMBRANE. NON-WOVEN GEOTEXTILE TO BE 12 oz/yd^2 FOR ALL OTHER LOCATIONS. NON-WOVEN GEOTEXTILE TO BE INSTALLED AS PER THE MANUFACTURER'S SPECIFICATIONS.
10. ANCHOR TRENCH TO BE EXCAVATED TO THE APPROXIMATE LIMITS SHOWN (0.5 m x 0.5 m IN SECTION). FOLLOWING GEOTEXTILE AND GEOMEMBRANE INSTALLATION, TRENCH TO BE BACKFILLED WITH COMPACTED INTERMEDIATE BEDDING MATERIAL.
11. DOWNSTREAM SLOPE OF BERM TO BE TRIMMED AND NOMINALLY COMPACTED. UPSTREAM SLOPE OF BERM TO BE PREPARED FOR GEOSYNTHETICS INSTALLATION AS PER THE TECHNICAL SPECIFICATIONS.
12. EXCAVATION SLOPES ARE THE CONTRACTOR'S RESPONSIBILITY.
13. COLLECTION/DIVERSION BERMS TO BE GRADED AT 1% (MINIMUM) IN DIRECTION OF FLOW.
14. FOUNDATION PREPARATION: PROVIDED THE AMOUNT OF ORGANICS AND UNSUITABLE MATERIAL ON THE GROUND IS NEGLIGIBLE, DISTURBANCE TO THE ORIGINAL GROUND (EXCAVATION, SCARIFYING, ETC.) SHOULD BE MINIMIZED SO AS NOT TO IMPACT CURRENT PERMAFROST CONDITIONS. ALTERNATIVE METHODS OF FOUNDATION PREPARATION MAY BE NECESSARY FOR SOME AREAS, AT THE DISCRETION OF THE OWNER'S REPRESENTATIVE. ALL FOUNDATIONS MUST BE MAINTAINED CLEAR OF SNOW, PONDED WATER AND ICE.
15. THE DRAWING SHALL BE READ IN CONJUNCTION WITH THE CONTRACT DOCUMENTS AND APPLICABLE TECHNICAL SPECIFICATIONS.
16. FINAL SLOPES SHALL BE TRIMMED TO THE LINES AND TOLERANCES INDICATED ON THE DRAWINGS AND IN THE TECHNICAL SPECIFICATIONS.
17. RIPRAP TO BE CLEAN, DURABLE AND ANGULAR. RIPRAP TO BE TIGHTLY PLACED AND SPREAD IN MAXIMUM LAYERS AS NOTED ON **DRG 301.**

ISSUED FOR CONSTRUCTION

SCALE A: 10 5 0 10 20 30 40 50 m
SCALE B: 3 1.5 0 5 10 15 m
SCALE C: 1 0.5 0 1 2 3 4 5 m

DRG. NO.	DESCRIPTION
321	KM106 STOCKPILE - SEDIMENTATION POND AND RUNOFF MANAGEMENT MEASURES - SECTIONS AND DETAIL
301	KM106 STOCKPILE - SPECIFICATIONS

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	20JUN'19	ISSUED FOR CONSTRUCTION	DMMD	MMD	MA	KEH

REVISIONS

REGISTERED PROFESSIONAL ENGINEER
K.E. HAWTON
LICENSEE
June 20/19
NWT/NU

Knight Piésold CONSULTING

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

KM106 STOCKPILE SEDIMENTATION POND AND RUNOFF MANAGEMENT MEASURES PLAN, SECTION AND DETAILS

REF. NO.	DRAWING NO.	REVISION
NB102-181/57	320	0

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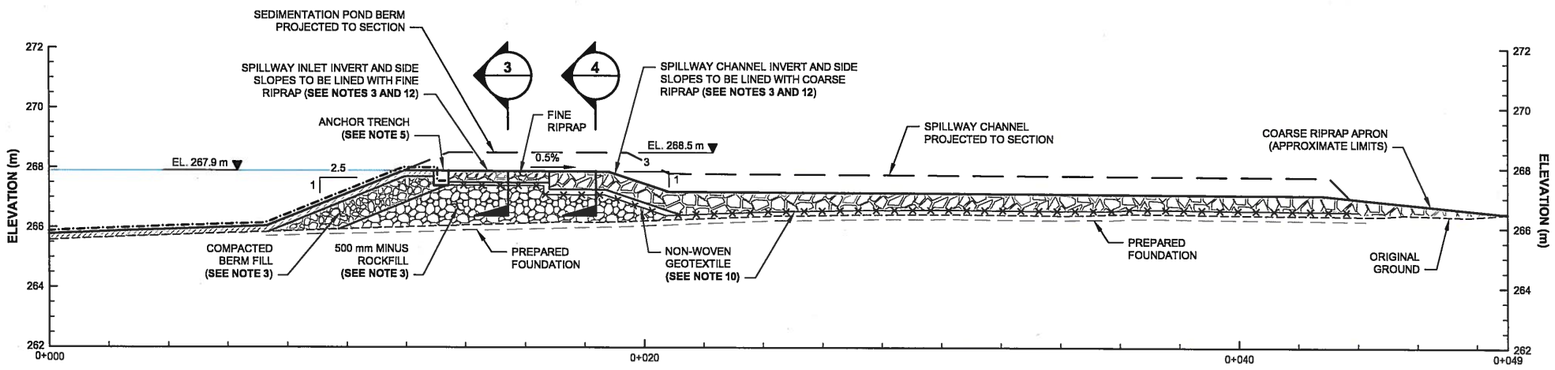
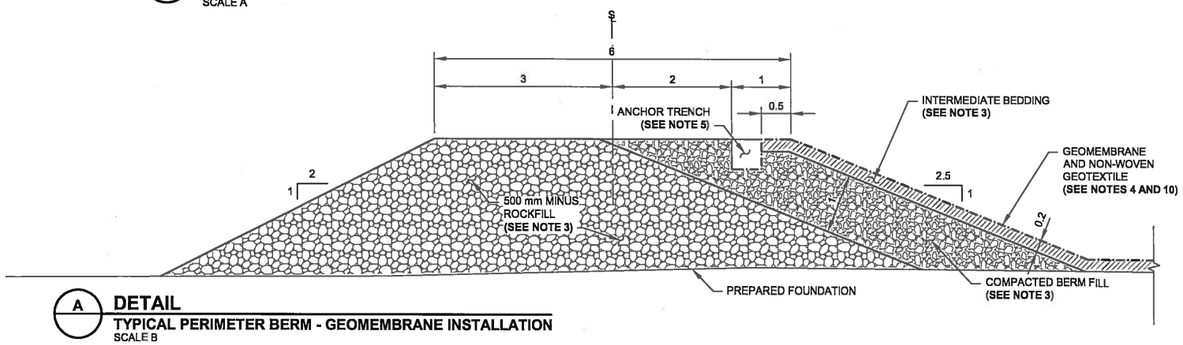
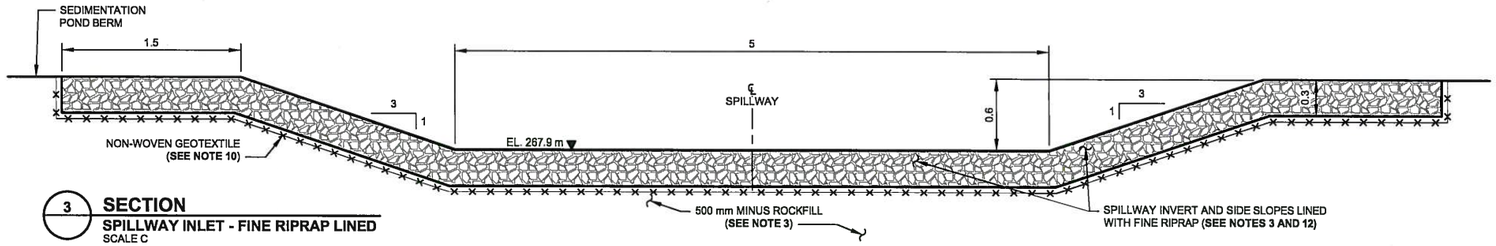


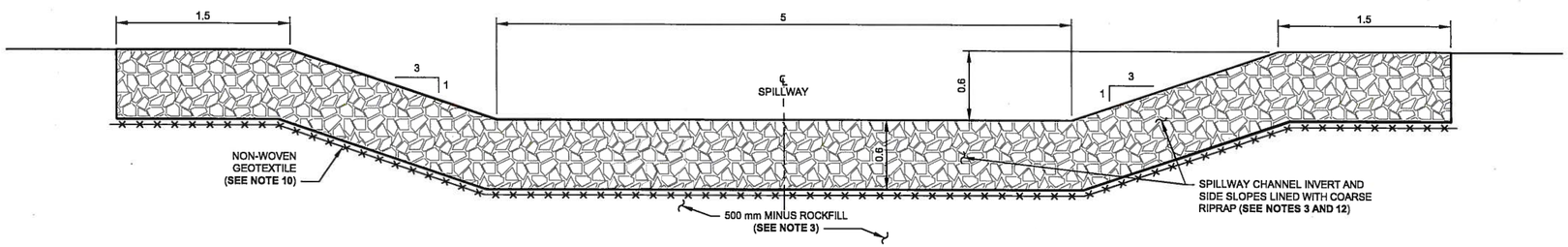
2/320 SECTION
EMERGENCY OVERFLOW SPILLWAY
SCALE A



A DETAIL
TYPICAL PERIMETER BERM - GEOMEMBRANE INSTALLATION
SCALE B



3 SECTION
SPILLWAY INLET - FINE RIPRAP LINED
SCALE C



4 SECTION
SPILLWAY CHANNEL - COARSE RIPRAP LINED
SCALE C

LEGEND:

- BERM FILL
- FINE RIPRAP
- COARSE RIPRAP
- 500 mm MINUS ROCKFILL
- INTERMEDIATE BEDDING
- NON-WOVEN GEOTEXTILE
- GEOMEMBRANE WITH NON-WOVEN GEOTEXTILE ABOVE AND BELOW
- ORIGINAL GROUND
- PREPARED FOUNDATION
- SEDIMENTATION POND / SPILLWAY CHANNEL PROJECTED TO SECTION

NOTES:

1. DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
2. LOCATION AND DETAILS OF CONSTRUCTION ITEMS MAY BE MODIFIED TO SUIT SITE CONDITIONS.
3. FOR MATERIAL AND GEOSYNTHETIC SPECIFICATIONS **SEE DRG 301**.
4. GEOMEMBRANE TO BE 40 mil ATARFIL LINEAR LOW DENSITY TEXTURED GEOMEMBRANE OR APPROVED EQUIVALENT AND TO BE INSTALLED AS PER THE MANUFACTURER'S SPECIFICATIONS.
5. ANCHOR TRENCH TO BE EXCAVATED TO THE APPROXIMATE LIMITS SHOWN (0.5 m x 0.5 m IN SECTION). FOLLOWING GEOTEXTILE AND GEOMEMBRANE INSTALLATION, TRENCH TO BE BACKFILLED WITH COMPACTED INTERMEDIATE BEDDING MATERIAL.
6. DOWNSTREAM SLOPE OF BERM TO BE TRIMMED AND NOMINALLY COMPACTED. UPSTREAM SLOPE OF BERM TO BE PREPARED FOR GEOSYNTHETICS INSTALLATION AS PER THE TECHNICAL SPECIFICATIONS.
7. EXCAVATION SLOPES ARE THE CONTRACTOR'S RESPONSIBILITY.
8. FOUNDATION PREPARATION: PROVIDED THE AMOUNT OF ORGANICS AND UNSUITABLE MATERIAL ON THE GROUND IS NEGLIGIBLE, DISTURBANCE TO THE ORIGINAL GROUND (EXCAVATION, SCARIFYING, ETC.) SHOULD BE MINIMIZED SO AS NOT TO IMPACT CURRENT PERMAFROST CONDITIONS. ALTERNATIVE METHODS OF FOUNDATION PREPARATION MAY BE NECESSARY FOR SOME AREAS, AT THE DISCRETION OF THE OWNER'S REPRESENTATIVE. ALL FOUNDATIONS MUST BE MAINTAINED CLEAR OF SNOW, PONDED WATER AND ICE.
9. THE DRAWING SHALL BE READ IN CONJUNCTION WITH THE CONTRACT DOCUMENTS AND APPLICABLE TECHNICAL SPECIFICATIONS.
10. NON-WOVEN GEOTEXTILE TO BE TEXEL 100P OR APPROVED EQUIVALENT WHEN PLACED ADJACENT TO GEOMEMBRANE. NON-WOVEN GEOTEXTILE TO BE 12 oz/yd^2 FOR OTHER LOCATIONS. NON-WOVEN GEOTEXTILE TO BE INSTALLED AS PER MANUFACTURER'S SPECIFICATIONS.
11. FINAL SLOPES SHALL BE TRIMMED TO THE LINES AND TOLERANCES INDICATED ON THE DRAWINGS AND IN THE TECHNICAL SPECIFICATIONS.
12. RIPRAP TO BE CLEAN, DURABLE AND ANGULAR. RIPRAP TO BE TIGHTLY PLACED AND SPREAD IN MAXIMUM LAYERS, AS NOTED ON **DRG 301**.

ISSUED FOR CONSTRUCTION

SCALE A: 2 1 0 2 4 6 8 10 m
SCALE B: 1 0.5 0 1 2 3 4 5 m
SCALE C: 0.5 0.25 0 0.5 1.0 1.5 2.0 2.5 m

DRG. NO.	DESCRIPTION
320	KM106 STOCKPILE - SEDIMENTATION POND AND RUNOFF MANAGEMENT MEASURES - PLAN, SECTION AND DETAILS
301	KM106 STOCKPILE - SPECIFICATIONS

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	20JUN'19	ISSUED FOR CONSTRUCTION	DMMD	MMD		

REVISIONS

REGISTERED PROFESSIONAL ENGINEER
K.E. HAWTON
LICENSEE
June 20/19
NWT/NU

Knight Piésold CONSULTING

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

KM106 STOCKPILE SEDIMENTATION POND AND RUNOFF MANAGEMENT MEASURES SECTIONS AND DETAIL

PA NO.	DRAWING NO.	REVISION
NB102-181/57	321	0

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XREF FILES): X-C-TOPO-MINE SITE; X-C-TOPO-INFRA DES; X-C-TOPO-INFRA-OTHRS; IMAGE FILES):

APPENDIX A

Geomembrane and Non-Woven Geotextile Information

(Pages A-1 to A-29)

ATARFIL LLD V1

Raw Material	Linear Low Density Polyethylene

ATARFIL LLD is a geomembrane manufactured from maximum quality linear low density polyethylene LLDPE resins, duly contrasted, that comply with the most rigurous requirements established for their use.
ATARFIL LLD contains 97,5% of pure polymer, and approximately 2,5% of Carbon Black, antioxidants and thermal stabilizers. The product does not contain plasticizers or fillers that can migrate over time.
The geomembrane **ATARFIL** LLD is manufactured under permanent quality controls.

Surface	Smooth	Colour	Black
		RAL Code	-

Raw Material Identification

Tested Property	Unit	Test Method	Value
Density of Raw Material	g/cm^3	ASTM D 792	0.915-0.926
Density of Geomembrane	g/cm^3	ASTM D 792	0.925-0.939
Melt Flow Index	g/10 min	ASTM D 1238 (190°C/2,16 Kg)	< 1,0
Carbon Black Content	%	ASTM D 4218	2,0 - 2,5
Carbon Black Dispersion	-	ASTM D 5596	Note (3)

Durability

Oxidative Induction Time (OIT) Standard OIT High Pressure OIT	min	ASTM D 3895 (200°C) ASTM D 5885	≥ 100 ≥ 400
Oven aging at 85°C HP O.I.T, % retained after 90 days	%	ASTM D 5721 ASTM D 5885	≥ 60
UV Resistance. HP OIT, % retained after 1600 hrs	%	ASTM D 5885	≥ 35

Functional Properties

Tested Property	Unit	Test Method	Value
Low Temperature Brittleness (tª: -40°C)	-	ASTM D 746	No cracks
Water Permeability	m^3/m^2·day	EN 14150	< 1·10^{-6}
Coefficient of Linear Thermal Expansion	1/K	ASTM D 696	2,15·10^{-4}
Water Absorption	%	ASTM D 570 (24h)	≤ 0,2
		ASTM D 570 (6 days)	≤ 1

Strength Characteristics Quality of Final Product

Tested Property	Unit	Test Method	Value					
Thickness	mils	ASTM D 5199	30	40	60	80	100	120
Tolerance	%		-10					
Mechanical Properties								
Tensile strength at Break[1]	lb/in	ASTM D 6693 (Type IV), lo 2 in	125 (108)	171 (148)	256 (222)	342 (296)	428 (371)	513 (445)
Elongation at Break	%		≥ 800					
Tear Resistance	lb	ASTM D 1004	≥ 15	≥ 21	≥ 32	≥ 43	≥ 53	≥ 64
Puncture Resistance	lb	ASTM D 4833	≥ 42	≥ 56	≥ 84	≥ 112	≥ 140	≥ 168
2% Modulus	lb/in	ASTM D 5323	≤ 1800	≤ 2400	≤ 3600	≤ 4800	≤ 6000	≤ 7200
Axi-Symmetric Break Resistance Strain	%	ASTM D 5617	≥ 30					
Dimensional Stability	%	ASTM D 1204 (100°C, 1h)	± 1.5					

PRESENTATION (Standard Sizes)

Parameter	Units	30	40	60	80	100	120
Roll width[4]	ft	19.7					
Roll Length[4]	ft	1,332	999	666	498	399	333
Surface	ft^2	26,240.4	19,680.3	13,120.2	9,810.6	7,860.3	6,560.1

280717

[1] Values indicated are medium. In brackets minimum values.
[2] Certificates belonging to the Environmental and Quality Integrated System of Atarfil.
[3] Carbon black dispersion (only near spherical agglomerates) for 10 different views: 9 in Categories 1 or 2 and 1 in Category 3.
[4] Roll lengths and widths have a tolerance of ±l%.

Headquarters: Ctra. de Córdoba, Km 429 - Complejo El Rey – E-18230 Atarfe – GRANADA – SPAIN – Tel.: +34 958 439 200 – Fax: +34 958 439 128
Middle East: P.O. Box 263 122 - Jebel Ali - DUBAI - U.A.E.
USA Branch: Tel/fax: 2078483431
www.atarfil.com

TEXEL 100P

TECHNICAL DATASHEET

Product	Needle-punched nonwoven, short staple fibers
Composition	Polyester
Main function	Protection

Property	Test Method	Metric	Imperial
Physical			
Weigth (typical)	ASTM D5261	339 g/m²	10 oz/yd²
Thickness	ASTM D5199	2.4 mm	94.5 mils
Mechanical			
Trapezoid Tear	ASTM D4533	170 N	38 lbs
Grab Tensile	ASTM D4632	505 N	114 lbs
Grab Elongation	ASTM D4632	50 %	50 %
CBR Puncture	ASTM D6241	1 355 N	305 lbs
Dimensions			
Width	-	4.57 m	15 ft
Length	-	91.44 m	300 ft

All values are MARV.
Our quality management system is certified by ISO-9001 standard.
Our internal laboratory is certified by the Geosynthetic Accreditation Institute - Laboratory Accreditation Program (GAI-LAP).

According to our fibers suppliers, Polyester in general is considered highly UV resistant and much better than other fibers such as, nylon or polypropylene. Polyester is commonly used for UV exposure such as awnings or boat sails or rope. According once again to one of our fibers suppliers, it is generally known that polyester loses 10% of strength after two years of light exposure.

Please note this statement is only based on polyester fiber, not the needlepunched nonwoven structure which influences the residual tensile strength of the material. If this characteristic is critical, we highly recommend to perform a recognized UV exposure test based on ASTM-D4355 standard to estimate and validate the proposed material resistance to UV exposure.

Revision : 01-13-2016

WESTERN TANK & LINING LTD.

YOUR CONTAINMENT **SPECIALISTS** SINCE **1985**

QUALITY CONTROL MANUAL

P.E. GEOMEMBRANE INSTALLATION
(Geo Textile)
(Draintube)
(Geo Composite)
(Geo Net)
(GCL)
(Petrogard 6)

WESTERN TANK & LINING LTD.
YOUR CONTAINMENT SPECIALISTS SINCE 1985

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INTRODUCTION

This manual details the practices and procedures used by Western Tank and Lining Ltd.'s crews during installation of PE liners to ensure a quality installation and to produce the quality control report. We also included Geotexile, Geonet, Geocomposite, and Draintube manual.

1. SUBGRADE PREPARATION

1.1 Requirements for Soil Subgrade

The Owner, General Contractor, or Earthworks Contractor shall be responsible for preparing and maintaining the subgrade in a condition suitable for installation of the liner unless specifically agreed otherwise. WTL and others install geosynthetic lining materials on earth surfaces prepared for liner installation by others. No liner shall be placed on surfaces not previously found acceptable by the WTL site supervisor. On projects installed by WTL, it is our practice to require written "Subgrade Surface Acceptance" documentation.

Surfaces to be lined shall be smooth and free of all rocks, stones, sticks, roots, sharp objects, or debris of any kind. No stones or other hard objects that will not pass through a 3/8" screen shall be present in the top 4" of the surfaces to be covered. All fill shall consist of well-graded material free of organics, trash, clay balls, sharp stones or any other deleterious material that may cause damage to the liner.

The surface should provide a firm, unyielding foundation for the membrane with no sudden, sharp or abrupt changes or break in grade.

The subgrade shall be compacted in accordance with design specifications but in no event below the minimum required to provide a firm unyielding foundation sufficient to permit the movement of vehicles and welding equipment over the subgrade without causing rutting or other deleterious effects. The subgrade shall have no sudden sharp or abrupt changes in grade, especially at pipes or concrete structures.

Typical preparation sequence involves trimming of the compacted excavation as smooth as possible with heavy equipment, hand raking and rock picking, and rolling of the surface with a smooth drum compactor. Rule of thumb for acceptable surface is "ready to lay sod". Under no circumstances will the integrity of the liner be compromised due to the presence of rocks, lumps, or incomplete subgrade preparation.

(1) **Surface Acceptance:** Upon request, Western Tank and Lining shall provide the Owner/Inspector with a written acceptance of the surface to be lined that day.

1.2 Geotextile Liner Cushion

In the event that suitable soils are not readily available at the construction site, soils containing smooth rocks up to 1-1/2 inches in diameter or angular rocks up to ¾ inches may be utilized if covered with geotextile cushion having a minimum weight of 8 oz/yd^2. The weight of geotextile selected will depend on the actual soil used, thickness of liner, and service life or design considerations, but may be as high as 16 oz/yd^2.

See Appendix A for installation procedures.

1.3 Geonet Drainage Layer

See Appendix B for installation procedures.

2. PLACING COVER SOILS ON TOP OF PE GEOMEMBRANES

Cover soils deployed over synthetic liners should be free of all sharp objects--sharp rocks, and sharp sticks. The stones present in the soil should be rounded and smooth and no larger than 3/4 inch in diameter. Cover materials should be deployed using bulldozers separated from the membrane by at least one foot of cover soil for the smallest size dozers, and at least 18 inches of cover soil separation for the larger size dozers. The spreading operation should begin with placement of a mound of soil such that as the dirt covers the liner, it must ascend up the mound and then down the mound suppressing the formation of wrinkles. The movement of the soil must have this vertical descent to it as the dirt is spread over the membrane, rather than be pushed horizontally across the membrane. This type of action will suppress the formation of wrinkles in the path of the cover soil as it is being spread over the membrane and avoid burying wrinkles in the liner. Alternatively, a front-end loader can be used to place the cover soil out ahead of the path of the dozer to minimize spreading of the dirt and suppress wrinkle formation. If these procedures are followed, there should be no threat of puncture to the membrane due to cover soil operations, and buried wrinkles should be minimized.

In the event that suitable soils are not readily available at the construction site, soils containing smooth rocks up to 1-1/2 inches in diameter or angular rocks up to ¾ inches may be utilized if a cushion geotextile having a minimum weight of 8 oz/yd^2. The weight of geotextile selected will depend on the actual soil used, thickness of liner, and service life or design considerations, but may be as high as 16 oz/yd^2.

The following are recommended procedures for placing of soil cover layers on top of HDPE Geomembrane liners using heavy equipment:

2.1 Liner Temperature

The liner must always be covered during the coolest portion of the day. As HDPE geomembrane is black and has a high coefficient of thermal expansion many "slack wrinkles" will form during sunlight hours. If the membrane is covered when it is warm these slack wrinkles will fold over or the slack will be displaced causing undue stresses on the liner.

2.2 Anchor Trenches

Anchor trenches should only be backfilled after the liner has undergone at least one nighttime contraction cycle after deployment and welding. The backfilling must take place when the membrane temperature is at its lowest - i.e. not at midday with the sun causing solar heating and expansion of the material.

2.3 Covering Sequence

When covering sloped areas, the covering must always proceed from the bottom of the slope to the top of the slope. This will avoid "dragging" the liner down the slope, which will stress the liner, of "sloughing" of the cover soils and heavy equipment.

2.4 Ground Pressure

No vehicles except balloon tire UTV's are allowed directly on the liner. Only low ground pressure equipment can be used near the leading edge of the soil cover. The depth of soil cover required under high ground pressure equipment will depend on the subbase, types of soils, and type of liner protection and must be determined by the project engineer.

2.5 Dozers

Dozers can be used to spread the cover material but cannot be the only method used at the leading edge of the cover material. Pushing with a dozer pushes membrane slack in front of the leading edge into a slack wave which will accumulate causing stresses in the liner. To avoid this an excavator or similar must be used to dump material in front of the leading edge and trap the liner slack before it accumulates.

2.6 Inspection

A responsible person must inspect the liner as the cover material is placed. If damage to the liner is noted it must be marked and cleaned by hand using a plastic shovel for repair.

3. LAYOUT PLAN & RECORD DRAWINGS

3.1 Layout Plan

Wherever possible a proposed layout plan will be prepared before mobilizing to the site. The layout plan will show:

(1) slope lines
(2) seams
(3) panel numbers and dimensions
(4) pipes of other penetration locations

3.2 Record Drawing

As installation progresses the following information will be recorded for the record drawing.

(1) changes to the layout plan's panels, seams and penetrations
(2) roll number for each panel
(3) locations and extrusion #'s of destructive tests, patches, repairs and extrusion beads
(4) seam numbers
(5) the approximate length of main panels

NOTE: The intent of the record drawing is to show the correct number and orientation of panels, seams and details and their approximate location. The locations are not surveyed as would be done for a true "asbuilt" drawing.

4. LINER DEPLOYMENT

Unloading, handling and deployment of the liner is completed using slings and axles without contacting the roll directly with heavy equipment to minimize the potential for damage to the liner.

Panels and seams are oriented parallel to the slope unless approved otherwise by Western Tank and Linings' design department for that particular application. The only vehicles allowed on the liner are low ground pressure ATV's.

As the liner is deployed the following quality control procedures will be performed:

(1) The roll number used is marked on the panel by the rollout crew.

(2) The panel number corresponding to the layout plan is marked on the panel by the rollout or Q.C. crews.

(3) A general visual inspection of the panel laid is performed by the rollout crew. A detailed visual inspection is performed by the Q.C. crew within 24 hrs. of deployment. Any defects in the sheet are circled with a permanent marker. A final visual inspection is performed at the completion of the installation.

(4) Any changes to the layout plan and any sheet defects are recorded on record drawings. Each sheet defect will also receive an extrusion number.

(5) No geomembrane materials shall be deployed if the material temperatures are lower than 0 degrees C (32 degrees F) unless otherwise approved by the Owners Represented. The specified minimum temperature for material deployment may be adjusted by the Owners Representative. Temperature limitations should be defined in the preconstruction meeting. Typically, only the quantity of geomembrane that will be anchored and seamed together in one day should be deployed

5. SEAM WELDING

5.1 Wedge Welding

To the maximum point practical all main seams will be produced using Western Tank and Linings' hot wedge welders. Once a wedge welder has passed a qualification weld (see 6.3) production seaming can proceed with the following quality control procedures performed and recorded on the attached wedge welder seamlog:

(1) The date, welder number, operator initials, welder speed, and sheet temperature will be recorded on the liner next to each seam with a permanent marker by the operator.

(2) The above information is recorded by a Q.C. technician.

(3) The operator cuts one specimen from the end of the weld and performs a "vice-grip peel test" (see 6.1.1) on both weld tracks at the end of each seam. The specimen must pass on both tracks before proceeding to the next seam. The tested specimen is left at the end of the seam for inspection by the Q.C. technician who records the result.

(4) The Q.C. technician cuts one specimen from the end of the seam and performs a tensometer peel test (see 6.1.2) on both tracks within 24 hrs. and records both values.

(5) The Q.C. technician performs the "Air Test" (see 6.2.2) on the completed seam as soon as possible and records the pressures and start and finish times.

(6) Any defects such as burnouts, single seams, etc. are marked on the liner by the operator and recorded and numbered on record drawings for extrusion repair.

(7) No geomembrane material shall be seamed when liner temperatures are less than 0 degrees C (32 degrees F) unless the following conditions are complied with:

1. Seaming of the geomembrane at material temperature below 0 degrees C (32 degrees F) if allowed if the Geomembrane installer can demonstrate to the Owner’s Representative, using pre-qualification test seams, that field seams comply with the project specifications, the safety of the crew is ensured, and the geomembrane material can be fabricated (i.e. pipeboots, penetrations, repairs. etc.) at subfreezing temperatures

2. The Geomembrane Installer shall submit to the Owner Presentative for approval, detailed procedures for seaming.

5.2 Extrusion Welding

Extrusion welding is used for penetration seals, detail welding, patches, butt seam “T” intersections and nip folds, capstrips, seam defects, and sheet defects or damage. Once an extrusion welder/operator combination has passed a qualification weld (see 6.3) extrusion welding can proceed with the following quality control procedures performed and recorded on the extrusion welding log.

(1) Each extrusion weld is given an identification number which is marked on the liner with a permanent marker and recorded on the record drawings. The section of extruding done on a butt seam may be marked using a single identification number from start to finish of that section.
(2) The date, operator and welder number is marked on the liner with a permanent marker by the extrusion crew and recorded by a QC technician.
(3) Each *extrusion weld is leak tested by vacuum testing (see 6.2.4) or in the case of butt seams (see 5.3) air tested or vacuum tested.
***NOTE:** Some extrusion welds cannot be leak tested due to the geometry; i.e. pipe boot sleeves or plate to pipe welds.
(4) Each extrusion weld is "pik tested" (see 6.2.5) to evaluate bond strength.
(5) Each extrusion weld is visually inspected for overgrind, heat distortion, thin bead, etc.
(6) Any welding defects found are marked and recorded for repair and retesting.

5.3 Butt Seams

Butt Seams (also known as "Tie-In Seams") are used to join main sections of liner that have seams oriented in more than one direction. Butt seams require a combination of wedge welding and extrusion welding to be leak free.
In general butt seams are not welded until the main sections of liner have undergone at least one thermal contraction cycle. Often additional slack is "built in" at the butt seams during wedge welding by using more than 6" of overlap. The overlap is measured and trimmed at cool times of the day.

A qualified wedge welder is used to weld the seam which is tested and documented according to 5.1 except that the "Air Test" must be performed after the extrusion welding is complete. A qualified extrusion welder is used to reinforce and seal the wedge weld at the nip folds and the "T" intersections on both tracks. Extrusion testing and documentation is as per 5.2 except that extrusion beads that pass the high pressure test are not vacuum tested. To the maximum point practical all butt seams will be high pressure air tested. If a section of seam is not high pressure tested it is vacuum tested for leaks.

6. WELD TEST PROCEDURES

6.1 Destructive Test Procedures

Destructive tests require cutting "coupons" from a trial weld or production weld or from the parent material for strength testing. If the coupon is cut from a production weld within the finished seam length or installed liner it requires a patch using extrusion welding. Western tank and Linings' philosophy is to minimize coupon cutouts requiring extrusion weld patches by using data from non-destructive testing, especially our "High Pressure Air Test", qualification weld destructive testing, and gathering production seam destructive test data from small coupons that are outside

the finished seam length (i.e. in the anchor trench or at the tie-in seams excess overlap).

6.1.1 Vice Grip Peel Test

Weld specimens cut perpendicular to the weld track(s) approximately 1 inch wide are tested for peel adhesion by placing one flap from each sheet of the weld into two vice grip sheet metal pliers and applying peel stress by levering the backs of the pliers against each other until break occurs. A Film Tear Bond and good visual appearance are the criterion for a pass. A Film Tear Bond indicates good fusion. Visually the break should be ductile with a consistent clean appearance; i.e. no unfused spots.

6.1.2 Tensometer Peel Test

Weld specimens are cut using a coupon cutter with 1" x 8" die. Care must be taken to cut the specimens perpendicular and centred on to the weld tracks. Specimens are placed in a field tensometer in the peel mode with the grips approximately 2 from either side of the weld and the specimen perpendicular to the jaws. Specimens are pulled at 2"/minute until break occurs (for both weld tracks for wedge welds). The peak load in pounds is displayed on the tensometer and recorded for determining acceptance. A Film Tear Bond is also required on all specimens. If some peel separation should occur the % incursion is determined by dividing the area of separation by the total weld area (nominally 2" x 1" = 2 in5) x 100.

NOTE: The peel strength is related to parent material break strength and should not be compared to parent material yield strength.

6.1.3 Tensiometer Tensile Test

Parent material tensile yield strength as well as weld tensile strength (also known as the shear test) and elongation are determined using a tensiometer. Specimens are cut using a coupon cutter with a 1" x 8" die.

The purpose of testing the parent material is to gauge the effects of field testing temperature (strengths will be higher at less than 20°C and lower at higher than 20°C). Parent material specimens are pulled at a speed of 2"/minute and an initial grip separation of 2" with the specimen perpendicular to the jaws. The initial peak load is recorded. The test is terminated after the initial peak load is reached. This test is only performed if the temperature effects on the test results are deemed significant.

When testing weld specimens the specimens must be cut perpendicular to the weld track(s) and placed in the tensometer square to the jaws. Also note that nicks in the cutter die can cause premature breaks. The specimens are marked at 1" outside the weld edge on both sides of the weld for grip placement. Testing speed is 2"/minute. The initial peak load is recorded and the distance the grips travel after the grips first pull tight is monitored. The % elongation is defined as the grip travel/1" x 100 (as almost all the elongation occurs on one side of the weld the initial gauge length is defined as 1" = the distance from the grip to the edge of the weld). The test is terminated after the minimum elongation specified has been achieved.

6.2 Non-destructive Testing

The following tests are performed to evaluate the continuity and bond strength of completed seams and detail welds in a non-destructive manner. The "High Pressure Air Test" and "Pick Test" can become destructive tests only if the weld bond strength is inferior. These tests can detect areas of poor strength that would not be located by other test procedures.

6.2.1 Visual Inspection

Visual inspections are performed by both the welder operators and the QC technicians. Wedge welds are inspected for burnouts, spinouts, single seams, inclusions, etc. Extrusion welds are inspected for overgrind, excessive heat distortion, thin bead, etc. Any welding defects found are marked on the liner and recorded on record drawings for repair and testing.

6.2.2 High Pressure Air Test

Purpose The air test was developed to provide a non destructive test to evaluate the bond strength of double wedge welded seams.

Description The pressurized air channel forms a tube which is then visually inspected. Areas of the seam with partial fusion will show up as a bulge or widening of the air channel, or a weld separation resulting in a complete loss of pressure.

Specification

(1) Pressurize the seam to a minimum of 30 psi

(2) Allow the pressure to stabilize for 5 minutes while performing a visual inspection.

(3) Record the pressure at the beginning and the end of the next 5 minutes. There should be no more than a 10% pressure drop.

Test Procedure

(1) Seal off both ends of the seam.

(2) Connect the WTL pressure gauge assembly to the air channel.

(3) Pressurize the air channel with a compressor to a minimum pressure of 30 psi

(4) Allow the pressure to stabilize in the air channel for 5 minutes. While the seam is pressurized perform a visual inspection of the air channel to look for bulges which would indicate incomplete fusion.

(5) There should be no more that 10% pressure drop for a period of 5 minutes.

(6) If a rapid pressure drop occurs, perform a visual inspection of the seam. If a flaw is detected in the seam, pressure test the seam on either side of the flaw. Record and repair the flaw using extrusion welding and test the extrusion weld using the vacuum test. If the entire weld is suspect, replace the weld.

(7) Record the results of the test on the seam log.

6.2.3 Vacuum Box Soap Test

The vacuum box test is used to check extrusion welds (or wedge welds that cannot be practically tested using the High Pressure Test) for leaks.

Vacuum Test Procedure

(1) Trim off any flaps on the wedge weld and coat the seam with a strong soap solution.
(2) Place the vacuum chamber over the test area and depressurize to 5 inches of mercury.
(3) Observe the weld inside the vacuum chamber. Any leaks will allow atmospheric pressure air from beneath the liner to enter the vacuum chamber. Soap bubbles will form at the leak.
(4) Mark any leaks that are found, repair and retest.
(5) Record the results of the test.

NOTE: Some extrusion welds such as at boots, etc. cannot be vacuum tested due to the geometry involved.

6.2.4 Pick Test

The pick test is used to evaluate the bond strength of extrusion welds. The test is performed by welder operators and QC technicians by prying at the edges of an extrusion weld using a blunt screwdriver. Areas of weakly bonded extrudate can be pried off the parent material. Any flaws are marked and recorded for repair and testing.

6.3 Welder Qualification Seams

Each welding machine for wedge welders, and each welder/operator combination for extrusion welding, produces qualification seams each day before starting production welding. Qualification seams are made using strips of material approximately 300 mm wide and are a minimum of 1 m long for extrusion welding and 3 m long for wedge welding. These seams are destructively tested and the results recorded on the welder qualification data sheets attached.

7. MINIMUM ACCEPTANCE CRITERIA

The following limits are the minimum acceptable for a completed installation.

7.1 Destructive Weld Testing

TEST		MINIMUM ACCEPTANCE CRITERIA				
Thermally Bonded Smooth and Textured High Density Polyethylene (HDPE) Geomembranes						
Vice Grip Peel Test		FTB (on both tracks for wedge welds)				
Material Thickness		30 mils	40 mils	60 mils	80 mils	100 mils
Peel Strength, lb/in	Wedge	45	60	91	121	151
	Extrusion	39	52	78	104	130
Peel Separation (Incursion)		- FTB for all specimens - Avg of 5 must be less than 25% - Single specimen test for production end coupon – less than 10%				
Shear Strength, lb/in (Wedge/Extrude)		57	80	120	160	200
Shear Elongation at break, %		50	50	50	50	50
Thermally Bonded Smooth and Textured Linear Low Density Polyethylene (LLDPE) Geomembranes						
Vice Grip Peel Test		FTB (on both tracks for wedge welds)				
Material Thickness		30 mils	40 mils	60 mils	80 mils	100 mils
Peel Strength, lb/in	Wedge	38	50	75	100	125
	Extrusion	34	44	66	88	114
Peel Separation (Incursion)		- FTB for all specimens - Avg of 5 must be less than 25% - Single specimen test for production end coupon – less than 10%				
Shear Strength, lb/in (Wedge/Extrude)		45	60	90	120	150
Shear Elongation at break, %		50	50	50	50	50

7.2 Non-Destructive Weld Testing

TEST	MINIMUM ACCEPTANCE CRITERIA
Visual Inspection	No unrepaired flaws.
Air Lance	Produce a steam of continuous air along the flap of the weld edge
High Pressure Air Test	No more than 10% pressure drop for 5 minutes at 1.0 PSI/mil thickness/inch of air channel width.
Vacuum Box Test	Produce up to 4 inches of Hg (2psi)
Pick Test	Non unbonded areas.
Each welder will produce a minimum of 1 qualification seam for each day that welder is used for production.	

8. MINIMUM TEST FREQUENCIES

The following test frequencies are the minimum required for a complete installation.

8.1 Wedge Weld Qualification Seams

TEST	FREQUENCY
Vice Grip Peel	2 specimens / qualification tested on both tracks
Tensiometer Peel	5 specimens / qualification tested on both tracks
Weld Tensile (Shear)	2 specimens / qualification

Each welder will produce a minimum of 1 qualification seam for each day that welder is used for production.

8.2 Extrusion Welder / Operator Qualification Seams

TEST	FREQUENCY
Vice Grip Peel	2 specimens / qualification
Tensiometer Peel	5 specimens / qualification
Weld Tensile (Shear)	2 specimens / qualification
Each welder will produce a minimum of 1 qualification seam for each day that welder is used for production.	

8.3 Wedge Weld Production Seams

TEST	FREQUENCY
Vice Grip Peel	1 specimen tested on both tracks / seam (except panel width cross seams). Specimen to be taken from the end of the seam – no repair patch required.
Visual Inspection	Full seam length.
Air Lance	Only used when the seam is welded with a full wedge assembly
High Pressure Air Test	Full length of all seams to the maximum point practical.
Vacuum Test	Only used where High Pressure Testing is impractical.

8.4 Extrusion Weld Seams or Beads

TEST	FREQUENCY
Visual Inspection	Full seam length.
Vacuum Test	Full seam length except for beads previously pressure tested which are not vacuum tested.
Pick Test	1 pick / lineal foot of seam.
High Pressure Air Test	Only applies to butt seam, “T’s”.

9. FAILED TEST PROCEUDRES

If a weld or seam fails one or more of the required tests the following procedures are performed.

TEST	FREQUENCY
Welder Qualification Seam	Adjust welder, reweld, and retest.

(wedge or extrusion)	
Visual Inspection and Vacuum Box Test	Mark liner, record defect, repair and retest. If the defect already has an extrusion number renumber as 47A (initial extrusion #47) for records.
Pick Test	Mark, record and repair as above. If the weld is suspect due to many flaws, cap or replace the weld.
High Pressure Air Test	Retest on either side of the defect. Mark, record and repair as above. If there are more bulges than 1/20' of seam length (average) replace the weld.
Production Wedge Weld Vice Grip Peel Test or Tensiometer Peel Test	If single specimen fails track along the seam and retest using 3 specimens. If 1 (or more) of the 3 specimens fail track along the seam and retest using 5 specimens (or replace the seam). If the 5 specimens test fails the acceptance criteria track to obtain a 5 specimen coupon that passes the acceptance criteria and repair the area to the passing sample or place the seam and retest.

10. PENETRATIONS

Any structures such as pipes, sumps, concrete, etc. that penetrate the liner require mechanical attachment and/or welding are an anchor point and can result in stresses on the liner under some conditions. For stress considerations and possibilities of leakage the number of penetrations should be minimized where practical. In addition, the final liner penetration detail should be considered during design and construction of the earthworks and piping. Please consult Western Tank and Lining during the design phase to optimize the end product. Attention to compaction around pipes or structures is a must to avoid shear or tensile forces on the liner due to subsidence. Western Tank and Lining takes careful consideration of penetration location during panel layout design, panel deployment, and slack incorporation.

10.1 HDPE Pipe

Where possible HDPE piping should be used for pipelines, or for the last section of pipe, penetrating the liner. For all but the highest molecular weight pipe resins (Drisco 8600), geomembrane and pipe resins are compatible for welding. Typical methods include cutting the HDPE pipe flush with the side slope and welding geomembrane or HDPE plate, directly to the pipe.

The resulting weld is more reliable than boots and does not require any steel banding or rubber gaskets. Pump out sumps can also be constructed of HDPE pipe or plate and welded directly to the liner.

10.2 Concrete

Sealing to concrete structures of pipe collars are accomplished with anchor bolts, clamping bar, and rubber gaskets. Clamping to vertical surfaces is not recommended. To ensure a complete seal, using horizontal (or flush with slope) concrete surfaces which are smooth and stringline flat. Rebar should be located away from the anchor bolt line or more than 4 inches below the surface. Concrete pipe collars should include anchor rings and/or waterstops on the pipe. Satisfactory pipe seals for many applications can be constructed using a concrete collar with waterstop and a liner to concrete clamp seal. Some applications involving new concrete are best handled using cast-in HDPE inserts.

10.3 Pipe Boots

Pipe boots can be field or factory fabricated from HDPE geomembrane and sealed to piping or round pilings using stainless steel bands and neoprene gaskets. A 90degree pipe boot is always preferred to a slope angle boot for a pipe entering near the bottom of a reservoir. Pipe boots should be avoided for horizontal pipes penetrating the sideslopes.

10.4 Corrugated Culverts

Corrugated Culverts should be avoided as the only method of sealing is a concrete collar with waterstop, but the waterstop is very difficult to construct.

10.5 Pipe Support Pilings

Pipe Support Pilings should be cylindrical concrete or pipe to facilitate boot seals. Rectangular or "I" beam shapes pose serious sealing problems and should be avoided.

11. SLACK INCORPORATION

Most HDPE liner installations require some slack incorporation due to the materials high coefficient of thermal expansion (approximately 1% / 75°C), solar heating that takes place during construction due to its black colour, and the minimum temperature the liner will see during its service life.

In general, exposed liners will require more slack than buried applications. In all cases slack incorporation is a compromise between too little slack which will result in bridging at corners or toes of slopes, or excessive stresses at fixed points during cold temperatures, and too much slack resulting in slack "wrinkles" that will fold over when covered with soils or fluids, with resultant stresses at the folds. Covered applications should be built to fit the subgrade at the temperature that the liner will be covered at. Exposed applications should be built so that no significant stresses are developed at the minimum service temperature.

The following techniques are used to "size" the liner:

(1) The main sections of liner must be allowed to undergo at least one thermal contraction cycle before the anchor trench is backfilled or the butt seams are welded or liner is covered.
(2) The butt seam(s) overlaps are measured and trimmed at the cool times (early morning or evening) of the day.
(3) If additional slack is required it can be placed at the anchor trench before backfilling or at the butt seams (or seams between fixed points) by using extra overlap.
(4) The project superintendent determines the amount of slack to be incorporated based on field experience, calculations, and the expected service life of the liner.

12. QUALITY CONTROL REPORT

A quality control report is produced after the project is completed. The report contains the following information:

(1) The manufacturing material certifications.
(2) The wedge welder and extrusion welder / operator qualification data sheets.
(3) The wedge welding and extrusion welding seam logs.

(4) The record drawing showing:
   a. approximate location of all panels and seams;
   b. the panel numbers;
   c. the seam numbers;
   d. the roll number used for each panel;
   e. the approximate lengths of main panels;
   f. the approximate location of all penetrations; and
   g. the extrusion weld number and approximate location of all extrusion weld patches, beads, and repairs.

13. STANDARD INSTALLATION WARRANTY

WESTERN TANK & LINING LTD.

12180 Vickers Way
Richmond, B.C., V6V-1H9
PHONE (604) 241-9487
FAX (604) 241-9485

WORKMANSHIP WARRANTY

PURCHASER/USER	
LOCATION OF INSTALLATION	
DESCRIPTION OF INTENDED USE	

WESTERN TANK & LINING LTD. (the "**Installer**") warrants to the party named above as the Purchaser/User ("**Purchaser**") that the tank and/or lining membrane system ("the "Liner System") as installed by the Installer will be free from installation-related defects for normal use in approved applications, on the terms and conditions set forth in this Workmanship Warranty (the "**Warranty**"). This Warranty shall be in effect from the above noted **Acceptance Date** for the above noted **Warranty Period**.

The term "**normal use**" means uses reasonably consistent with the above noted Description of Intended Use, and does not include, among other things, the exposure of the Liner System to harmful chemicals; abuse of the Liner System by machinery, equipment or people; excessive pressures or stresses from any source; subsurface or overburdened soil conditions; and total or differential soil settlements and the effect those settlements may have on the Liner System. The Purchaser acknowledges that the sale of the Liner System is for commercial or industrial use only.

This Warranty does **not** include damages or defects in the Liner System resulting from: (i) acts of God, casualty or catastrophe, including earthquakes, floods, weather, tornadoes, explosion, war, acts of any public authority, or any other cause beyond the Installer's reasonable control; (ii) faulty materials, or any defects in the workmanship, design or manufacturing of the materials comprising the Liner System; (iii) defects arising on account of third party action; (iv) defects arising from improper maintenance, use, repair, replacement or alteration of the Liner System by the Purchaser; (v) subsidence of the land around the Liner System; or (vi) surface defects in workmanship and materials apparent and accepted by the Purchaser at the date of delivery.

Any claim for an alleged breach of this *Warranty* must be made in writing, by registered mail or fax, to the President of the Installer at the address above within thirty (30) days of the Purchaser becoming aware of the alleged defect. If the Purchaser fails to deliver notice as required under this Warranty, the defect and all warranties shall be deemed to have been waived and the Purchaser will have no right of recovery against the Installer. Should defects within the scope of the above Warranty occur, the Installer will, at its option, repair or replace the Liner System or defective portion thereof. The Installer will have the right to inspect and determine the cause of any alleged defect in the Liner System and to take appropriate steps to repair or replace the Liner System if a defect exists for which the Installer is liable under the terms of this Warranty. The Installer will not be required to make such repairs and/or replacements until the Purchaser has ensured that the area surrounding the Liner System is clean, dry, and in an unencumbered condition, including without limitation free from all water, dirt, sludge, residuals, and liquids of any kind.

The Installer's liability under this Warranty shall in no event exceed the lesser of: (i) the replacement cost of the Liner System or defective portion thereof; or (ii) the total amount paid by the Purchaser to the Installer in respect of the Liner System. Further, under no circumstances shall the Installer be liable to the Purchaser or any other party for any special, direct, indirect, or consequential damages arising from any defect in the installation of the Liner System. This Warranty is given in lieu of all other possible warranties by the Installer in respect of the Liner System and by accepting delivery of the Liner System, the Purchaser waives all other such possible warranties, except those specifically given.

THE INSTALLER MAKES NO WARRANTY OF ANY KIND OTHER THAN AS EXPRESSLY SET OUT HEREIN, AND HEREBY DISCLAIMS ALL OTHER WARRANTIES, BOTH EXPRESSED AND IMPLIED, OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THIS WARRANTY IS NOT EFFECTIVE AND THE INSTALLER IS NOT BOUND BY THE TERMS HEREOF UNTIL RECEIPT OF FULL AND FINAL PAYMENT FOR THE LINER SYSTEM FROM THE PURCHASER.

I hereby state I have read and understand the above and foregoing Warranty and agree to such by signing hereunder.

	PURCHASER/USER	WESTERN TANK & LINING LTD.
NAME		
SIGNATURE		
TITLE		
DATE (dd/mm/yy)		

APPENDIX "A"

GEOTEXTILES

Handling and Placement

All geotextiles shall be handled in a manner to ensure they are not damaged. The following special handling requirements shall be adhered to:

- On slopes, the geotextiles shall be secured in the anchor trench and then rolled down the slope when practical. In any event it should be deployed in such a manner as to continually keep the geotextile sheet in sufficient tension to reduce folds and wrinkles.

- In presence of wind, all geotextiles shall be weighted with sandbags or the equivalent.

- Geotextiles shall be cut using an approved cutter. If the material is being cut in place, special care must be taken to protect other geosynthetic materials from damage.

- Care shall be taken not to entrap stones or excessive dust that could damage the geomembrane, or generate clogging of drains or filters.

Seams and Overlaps

Geotextiles may be seamed by thermal bonding or by sewing.

- On slopes steeper than ten (10) horizontal to one (1) vertical, it is recommend that geotextiles be continuously seamed along the entire length of the panel. Geotextiles shall be overlapped approximately four (4") inches prior to seaming.

- On bottoms and slopes shallower than ten (10) horizontal to one (1) vertical, geotextiles can be either seamed, as indicated above or overlapped. If not thermally bonded the geotextile shall be overlapped a minimum of twelve (12") inches prior to seaming.

Repairs

Any holes or tears in the geotextile shall be repaired as follows:

- On Slopes - a patch made from the same geotextile shall be seamed into place.

- Horizontal Areas - a patch made from the same geotextile shall be spot seamed in place with a minimum of twelve (12") inches overlap in all directions.

APPENDIX "B"

GEONET

Handling and Placement

The geonets shall be handled in such a manner as to ensure the geonets are not damaged in any way.

- On slopes, the geonets shall be secured in the anchor trench and then rolled down the slope in such a manner as to continually keep the geonet sheet in tension. If necessary, the geonet shall be positioned by hand after being unrolled to minimize wrinkles. Geonets can be placed in the horizontal direction (i.e. across the slope) in some special locations (i.e. where extra layers are required or where slope is less than 10:1).

- Such locations shall be identified by the Design Engineer in the project drawings.

- Geonets shall not be welded to geomembranes. Geonets shall be cut using approved cutters, i.e. hook blade, scissors, etc. Care should be taken to prevent damage to underlying layers.

- Care must be taken not to entrap dirt in the geonet that could cause clogging of the drainage system, and/or stones that could damage the adjacent geomembrane.

Layering and Tying of Geonet

When several layers of geonets are installed, care should be taken to prevent the strands of one layer from penetrating the channels of the next layer. Adjacent geonets shall be joined according to the following requirements.

- Adjacent rolls shall be overlapped by at least four (4") inches and securely tied.

- Tying can be achieved by plastic fasteners. Tying devices shall be white or yellow for easy inspection. Metallic devices are not allowed.

- Tying shall be five (5') feet to ten (10') feet along the bottom, every five (5') feet along the slope every two (2') feet across the slope and at top of berm and into anchor trench at least with one (1') foot intervals.

- In the corners of the side slopes where overlaps between perpendicular geonet strips are required, an extra layer of geonet shall be unrolled along the slope, on top of the previously installed geonets, from top to bottom of the slope.

- When more than one layer of geonet is installed, overlaps must be staggered and layers tied together.

Repairs

Any holes or tears in the geonet shall be repaired by placing a patch extending two (2') feet beyond edges of the hole or tear. The patch shall be secured to the original geonet by tying every twelve (12") inches. If the hole or tear width across the roll is more than 50% the width of the roll, the damaged area shall be cut out and the two (2) portions of the geonet shall be joined.

APPENDIX "C"

GEOCOMPOSITE

Handling and Placement

All geocomposite shall be handled in a manner to ensure they are not damaged.

- On slopes, the geocomposite can be secured in the anchor trench and then rolled down the slope when practical. The geocomposite shall be deployed in a manner to continually keep the geocomposite sheet in sufficient tension to reduce folds and wrinkles.

- In the presence of high wind, all geocomposite shall be weighted with sandbags or the equivalent.

- Geocomposite shall be cut using an approved cutter. If material is being cut in place, special care should be taken to protect other geosynthetic materials from damage.

- Care should be taken not to entrap stones or excessive dust that could damage the geomembrane, or generate clogging of drains or filters.

Seams and overlaps

- Geocomposite shall be seamed by thermal bonding or by sewing.

- No horizontal seams shall be allowed on side slopes greater than 4H:1V. Owners Represented. The horizontal seams on side slopes greater than 4H:1V can be adjusted by the Owners Representative to utilize material to its entirety.

- Tying of the geonet shall be with plastic fasteners. Tying devices shall be white or yellow for easy inspection. Metallic devices are not allowed.

- Tying shall be every 1.5 m across the cell floor, every 1.5 m along the side slopes and every 750 mm at the top of berms and into anchor trenches. End to end joints on the cell floor shall be overlapped 600 mm. Tying shall be every 0.3 m across the end to end joint. All tying shall be covered with geotextile, sewn or heat bonded.

Repairs

The damage shall be observed, and if smaller than one (1) m by one (1) m, the geocomposite shall be repaired. If the tear or hole is larger, then the roll shall be cut to remove the damaged area, fasteners shall be used to attach the geonet with the geotextile being heat seamed. Minimum overlaps to be as specified.

- If the geonet is undamaged, and the geotextile is damaged, a patch of geotextile shall be placed. The geotextile patch shall be thermally bonded in place with a minimum of 300 mm overlap in all directions.

- If the geonet is damaged, the geonet shall be removed. A section of geonet shall be cut to replace the removed section. The geonet shall be tied to the existing geonet using plastic fasteners placed at least every 150 mm. A geotextile patch shall be placed over the repaired geonet section. The geotextile patch shall be thermally bonded in place with a minimum of 300 mm overlap in all directions.

APPENDIX "D"

GEOSYNTHETIC CLAY LINER (GCL)

Handling and Placement

All rolls GCL shall be handled in a manner to ensure they are not damaged.

- GCL rolls should be delivered to the working area of the site in their original packaging. Immediately prior to deployment, the packaging should be carefully removed without damaging the GCL. The orientation of the GCL should be in accordance with the Engineer's or manufacturer's recommendations.

- Proper equipment, spreader-bar and core-bar assembly and/or a forklift with stinger attachment shall be used during handling and deployment as per manufacturer's recommendations.

- Equipment which could damage the GCL shall not be allowed to travel directly on it. If the installation equipment causes rutting of the sub-grade, the sub-grade must be restored to its originally accepted condition before placement continues.

. The GCL shall be placed so that seams are parallel to the direction of the slope. Seams should be located at least 1 m from the toe and crest of slopes steeper than 4H:1V. The horizontal seams on side slopes greater than 4H:1V can be adjusted by the Owners Representative to utilize material to its entirety.

- Placement shall be from highest elevation to the lowest elevation to facilitate drainage in the event of precipitation unless the Engineer and or the Owners Representative assure that the subgrade is porous and free draining.

- All GCL panels should lie flat on the underlying surface, with minimal wrinkles and no folds, especially at the exposed edges of the panels. Panels shall be placed with non-woven side up.

- Only as much GCL shall be deployed as can be covered with soil, a geomembrane, or a temporary waterproof tarpaulin at the end of the working day.

- The GCL shall be placed in an anchor trench at the top of the slope as per the drawings. The front edge of the trench should be rounded so as to eliminate any sharp corners. Loose soil should be removed from the floor of the trench. The GCL should cover the entire trench floor, but not the rear trench wall.

Field Seams

- The GCL seams are constructed by overlapping their adjacent edges. Care should be taken to ensure that the overlap zone is not contaminated with loose soil or other debris. Supplemental bentonite is required in the overlap zone.

- The minimum dimension of the longitudinal overlap should be 225 mm. End-of-roll overlapped seams should be similarly constructed, but the minimum overlap should measure 600 mm.

- Seams at the ends of the panels should be constructed such that they are shingled in the direction of the grade to prevent the potential for runoff flow to enter the overlap zone.

- Where the GCL product requires bentonite-enhanced seams as recommended by the GCL manufacturer, bentonite-enhanced seams shall be constructed by overlapping adjacent panels as instructed above, exposing the underlying edge and then applying a continuous bead of granular sodium bentonite along a zone defined by the edge of the

underlying panel and the 150 mm line. The bentonite shall be applied at a minimum application rate of 0.4 kg/m. Where bentonite-enhanced seams are not required by the GCL product as recommended by the GCL manufacturer, GCL installer shall receive approval from the Engineer.

- GCL may be seamed by thermal bonding to prevent the movement of material while covering it with a geomembrane, covering it with soil or a temporary waterproof tarpaulin

Detail Work

- The GCL shall be sealed around penetrations and embedded structures embedded in accordance with the drawings.

- Cutting the GCL should be performed using a sharp utility knife. Frequent blade changes are required to avoid damage to the geotextile components of the GCL during the cutting process.

Repair

- If the GCL is damaged (torn, puncture, perforated, etc.) during installation, it may be possible to repair it by cutting a patch to fit over the damaged area. The patch shall be obtained from a new GCL roll or scrape peice and shall be cut to size such that minimum overlap of 300 mm (12 inches) is achieved around all of the damaged area. Dry bentonite or bentonite mastic should be applied around the damaged area prior to placement of the patch. It may be desirable to use an adhesive or heat bonded to affix the patch in place so it is not displaced during cover placement.

- Any solvent or adhesive in contact with the GCL must be approved by the Manufacturer.

APPENDIX "E"

DRAIN TUBE

Handling and Placement

Rolls of Draintube shall be handled in a manner to ensure they are not damaged.

- Draintube Drainage Geocomposite shall not be placed, seamed/joined, or repaired during periods of heavy precipitation, excessively high winds, or in areas of ponded water or excessive moisture.

- Draintube Drainage Geocomposite shall be installed in accordance with manufacturer's recommendations, and as shown on the Drawings and specified herein.

- Draintube Drainage Geocomposite shall be installed in the direction of the slope such that the pipe components are oriented with the intended flow direction (typically perpendicular to the contours) unless otherwise specified by the ENGINEER.

- The Draintube Drainage Geocomposite shall be kept clean prior to and during installation.

- Folds or excessive wrinkling of deployed Draintube Drainage Geocomposite shall be removed to the extent practicable.

- Installs shall exercise care not to entrap stones, excessive dust, or foreign objects in the material.

- Draintube Drainage Geocomposite shall be adequately weighted, using sand bags or equivalent until the subsequent soil or geosynthetic layer is placed. In the presence of wind, the sandbags or the equivalent shall be placed along the leading edge and removed once cover material is placed.

- If the project contains slopes steeper than 5 horizontal to 1 vertical, special care should be taken to use full length rolls from the top of the slope. If the roll length cannot cover entire slope, then the next roll should be situated towards the toe of the slope. The locations of horizontal connections of adjacent panels should be staggered at least 10 feet apart.

- Overlaps shall be singled down the slope and/or in the direction that backfilling will occur.

- If the project includes an anchor trench to secure the Draintube Drainage Geocomposite, then the panels shall be secured in the anchor trench as indicated on the Drawings.

Field Seams

Adjacent sheets of Draintube Drainage Geocomposite shall be overlapped as described below.

- Connections at along the side of the Draintube Drainage Geocomposite roll shall be overlapped 4 inches, and shall be secured using sewn seams, additional overlap, or welds (hot air or flame) [*ENGINEER to select one or more alternatives*].

- Connection at the leading or terminating edge of the Draintube Drainage Geocomposite shall be overlapped such that the upper geotextile layer can be rolled back 12 to 18 inches and the end of the next roll inserted into the opening. Pipes shall be connected either using a snap coupler fitting supplied by the geocomposite manufacturer or by overlapping the pipes by 12 to 18 inches [*ENGINEER to select the alternative*].

Connections to an interceptor drain and/or vacuum pipe shall conform to the Drawings and be at the direction of ENGINEER.

Repair

Prior to covering the deployed Draintube Drainage Geocomposite, each roll shall be inspected for damage.

- Any rips, tears or damaged areas on the geocomposite shall be removed and patched.

- If a section of pipe is damaged during installation, add a piece of undamaged pipe of the same diameter next to the damaged pipe, extending a minimum of 8 inches beyond each end of the damaged section of pipe.

- If the geotextile is ripped or torn, install an undamaged piece of the same material under the hole that extends a minimum of 6 inches beyond the hole in all directions to insure that protection of the geomembrane is maintained.

- If the area to be repaired is more than 50 percent of the width of the panel, then the damaged area shall be cut out and replaced with undamaged material. Damaged geotextile shall replaced by the same type of geotextile.

APPENDIX "F"

PETROGARD VI

Preparation

- Ensure subgrade is compacted and surface finished to not impair installed membrane.
- Subgrade to provide firm, unyielding surface with no sharp changes or abrupt breaks in grade. A smooth drum rolled surface is preferable.
- Ensure surfaces to be lined are smooth, free of foreign and organic material, sharp objects, or debris of any kind.
- If a suitable sub-grade is not available, then a cushion layer of clean sand or non woven geotextile shall be placed prior to liner placement.
- Excavate anchor trench to line, grade, and width indicated on drawings, prior to liner placement. Provide slightly rounded corners in the trench to avoid sharp bends in the geomembrane.
- Prepare mechanical attachments according to ASTM D6497 Standard Guide for Mechanical Attachment of Geomembrane to Penetrations or Structures.
- All concrete surfaces to which the liner will attach shall have “smooth trowel” finish. All the corners should have radius to a minimum 25mm as per the drawing.
- Compaction at pipe penetrations and areas of mechanical attachment will be inspected carefully as these are areas where differential settlement can occur.
- A certificate of subgrade acceptance will be prepared by the liner installation contractor prior to liner installation.

Handling and Placement

- Installation of the geomembrane shall be performed in a logical sequence.
- Place panels according to the drawings, the panel layout, and the label on each panel.
- Sufficient thermal slack shall be incorporated during placement to ensure that harmful stresses do not occur in service.
- Ensure personnel working on geomembrane do not use damaging footwear.
- Protect completed panels from damage; handle carefully to avoid damaging the liner.
- Equipment and methods used to unroll liner panels should not damage the prepared subgrade.
- Ballast used to prevent uplift by wind must not damage the geomembrane. A continuous load is recommended along the edges of panels to eliminate the risk of wind uplift.

Weather Conditions at Time of Installation

- Site welding may proceed at any temperature providing a suitable qualification weld can

be prepared at site conditions using the operator, equipment, and materials intended for the project.

- Installation of membrane in winds above 20 km/h can proceed only if the installer can demonstrate that the liner will not be at risk of damage.

- Do not install membrane during precipitation or in the presence of excessive moisture.

- Do not install in weather conditions that may be detrimental to the function of the membrane.

Qualification

- A qualification seam will be run prior to any field seams.

- A qualification seam is made with separate pieces of geomembrane using the same material and equipment that will be used for production welding.

- Machine conditions, and operator used for welding must be the same as those used for the qualification weld.

- Qualification seam must be tested in shear and peel, and meet the specified requirements for the material.

- A qualification seam must be rerun whenever the operator is changed, the equipment adjusted, or at least every 4 hours.

Seaming

- Cleaning solvents shall not be used unless product is approved by membrane manufacturer.

- Use water and rags for all cleaning. If soap is used for cleaning rinse with clean water and dry before welding.

- Over lap of a seam shall be a minimum of 150mm

- Technician shall record the machine number, date, technician initials and start the time of every wedge weld.

Destructive and Seam Testing

- Field seams will be sampled for testing in a way that does not compromise the installed liner One sample to be tested for every 150m of field seam

- Test samples are to be removed from the ends of seams, from the anchor trench, or other location that does not introduce a defect into the liner.

- Samples to be approximately 100 mm long to permit testing of one shear and two peel specimens (ASTM D6392).

- Test samples shall be taken with in 24hrs after seaming
  - Record date, location and pass/fail description

- Field seams must meet the specified requirements in peel and shear for the material.

- A written record will be maintained for all field seam tests.

All completed field seams will be 100% non-destructively tested using an air lance test (ASTM D4437 method 7.2).

- .

- Destructive Test Failure:
  - Cut out seam and re-weld; or,
  - Retrace welding path to <3 m> <<10 feet>> from location of failed test. Take sample for additional test. If passed - cap strip or extrusion weld between failed location and original failed location.

Repairs

- Inspect seams and non-seam areas for defects, holes, blisters, undispersed raw materials.
- Identify any sign of foreign matter contamination.
- Repair all through-thickness defects.
- Defective Seams: Cap strip or replace.
- Tears: Patch and seal round sharp ends of tears on slope or stressed area prior to patching.
- Repair blisters, large cuts and undispersed raw materials with patch.
- Secure Patches by Hot Air Welding:
  - Hot Air Welding
    - Hand hot air welding is permitted for patching liner.
    - Clean area to be patched.
    - Hand weld the patch with a hot air gun and suitable roller.
- Patches: Round or oval, of same geomembrane. Extend minimum 75 mm beyond the edge of the defect.
- Verification of Repairs: All repairs to be non-destructively tested using
  - Air Lance Test, ASTM D4437 Method 7.2
  - Vacuum Box Test ASTM D5641
- Redo failed repairs and re-test.
- Keep records of all repairs and the results of repair testing.

Cleaning solvents shall not be used unless product is approved by membrane manufacturer.
Use water and rags for all cleaning. If soap is used for cleaning rinse with clean water and dry before welding.

APPENDIX G

OMS MANUAL

Baffinland Iron Mines Corporation

KM 106 STOCKPILE RUNOFF MANAGEMENT MEASURES - OPERATION, MAINTENANCE AND SURVEILLANCE MANUAL

BAF-TS-106KM-OMS-1

Rev 1

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Signature:

DOCUMENT REVISION RECORD

Issue Date MM/DD/YY	Revision	Prepared By	Approved By	Issue Purpose

TABLE OF CONTENTS

1 INTRODUCTION

1.1 PROJECT DESCRIPTION AND LOCATION

The Mary River Project (the Project) is an operating iron ore mine located in the Qikiqtani Region of Nunavut. Baffinland Iron Mines Corporation (Baffinland) is the owner and operator of the Project, which includes the following key infrastructure:

- Mary River Mine Site, including the open pit and associated crushing and load out facilities
- Milne Port, which acts as the main entrance/exit point for the mine
- Northern Transportation Corridor, which is approximately 100 km long and connects the Mary River Mine Site to Milne Port

As part of Baffinland's mining strategy, a long-term stockpile has been developed at KM 106 at the mine site to stockpile run-of-mine material. The location of the stockpile in relation to the Mary River Mine Site infrastructure is shown on Figure 1.1.

The stockpile development includes the construction and operation of Runoff Management Measures (RMMs) to manage surface water flows for the stockpile. The RMMs for the stockpile include Collection/Diversion Berms and a Sedimentation Pond. The general arrangement for the stockpile and RMMs is illustrated on Figure 1.2.

1.2 SCOPE AND OBJECTIVES OF THE MANUAL

This Operations, Maintenance and Surveillance (OMS) Manual provides information on the requirements for operations, monitoring, regular maintenance, routine inspections, and contingency procedures for the RMMs at the KM 106 Stockpile. Knight Piésold Ltd. (KP) assisted with the development of this manual and the provided information is based on the detailed design work and Issued For Construction Drawings for the RMMs (KP, 2019); as well as the as-built drawings to be prepared by Baffinland (Appendix A). The OMS Manual is a living document that will be updated throughout the life of the mine and at closure.

Inspection and surveillance schedules for the RMMs are provided in Appendix B. Inspection templates are provided in Appendix C. These templates are to be utilized to record day-to-day data, as well as to gather and document pertinent information and observations from the routine inspections.

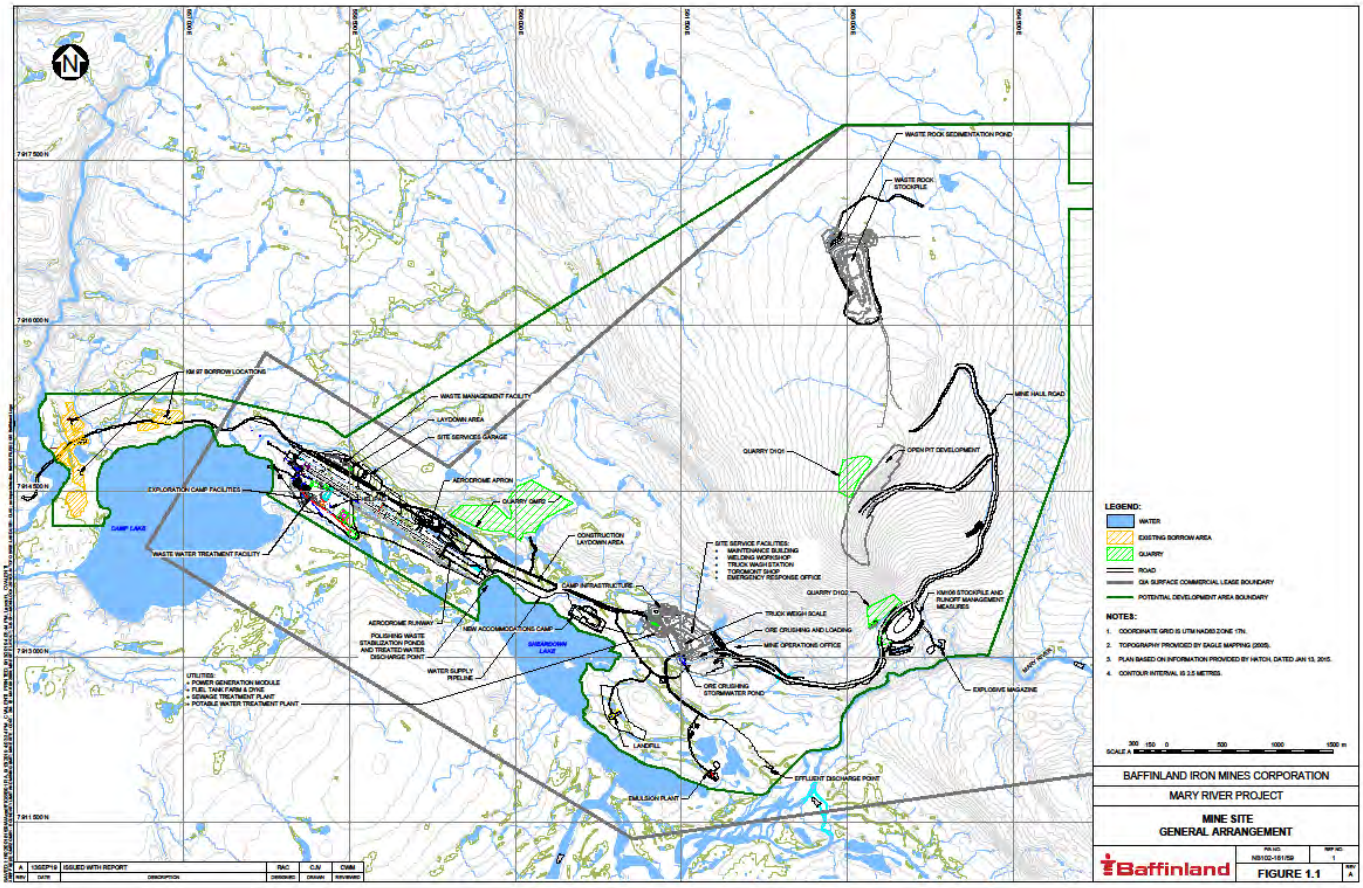


Figure 1.1

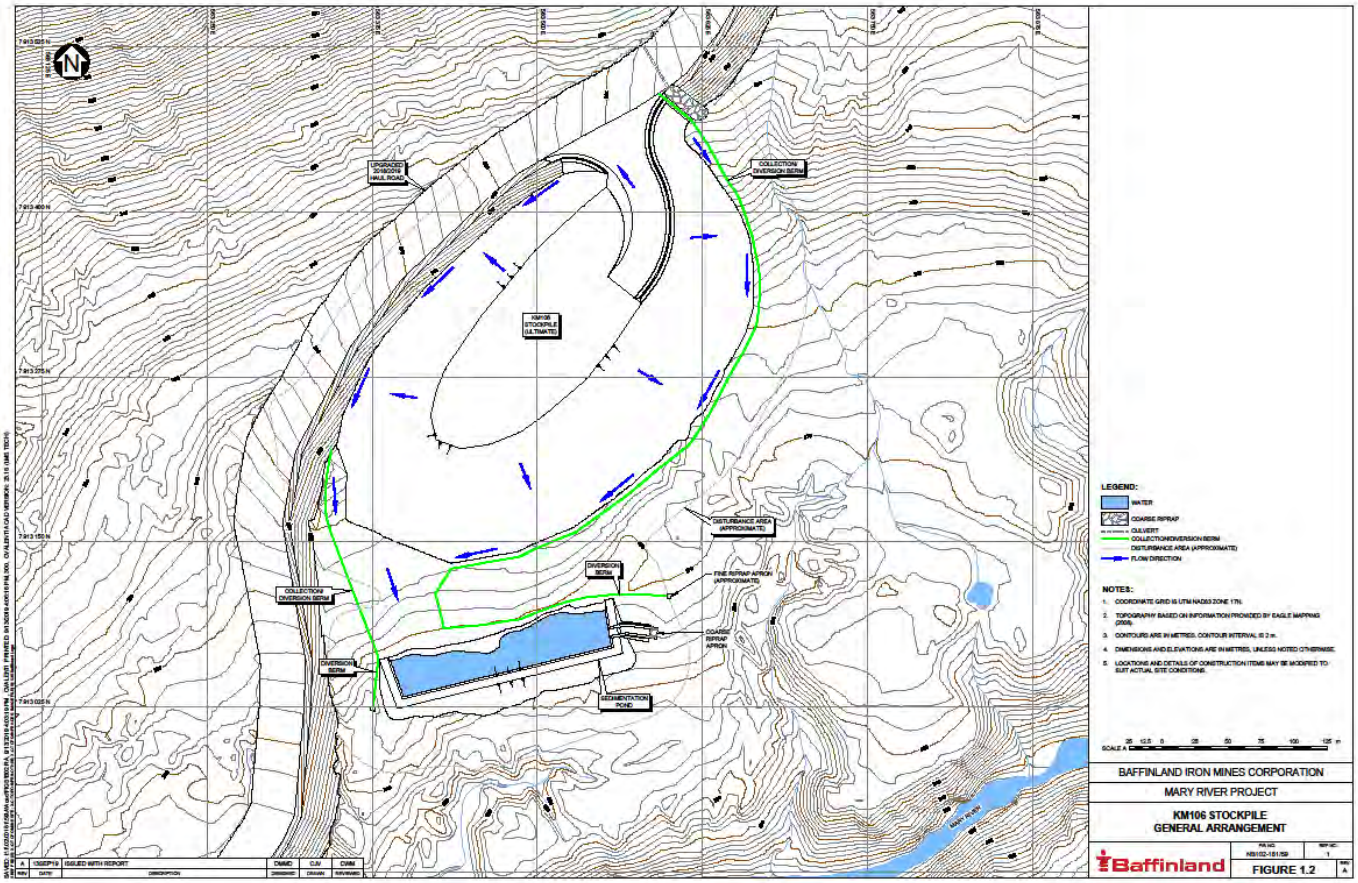


Figure 1.2

1.3 ROLES AND RESPONSIBILITIES

The administrative structure and organizational flowchart for the operation, maintenance and surveillance of the RMMs and related structures is illustrated on Figure 1.3. Baffinland is the Engineer Of Record (EOR) for the KM106 Stockpile RMMs.

Figure 1.3 Organizational Flow Chart

The responsibilities and functions of these key personnel are outlined in Table 1.1.

1.4 COMPETENCY AND TRAINING

All key personnel as identified in Table 1.1 must have a clear understanding of this OMS Manual and their respective roles and responsibilities. It is the role of each specific Manager, supervisor, and designated personnel to ensure this is the case. Specific competency and training requirements are summarized below.

- **Mine Manager -** Fully understand, implement and document the operation, maintenance and surveillance requirements for the RMMs.
- **Managers, Supervisors and Technicians -** Understand the operational and maintenance requirements for the RMMs.

In addition, all site personnel must be made aware of basic RMMs operations so that they can assist in routine monitoring and reporting. It is imperative that anything observed to be outside of normal operating parameters or procedures, as outlined in this Manual, must be reported immediately to the Environmental Manager, Mine Manager, and/or the General Manager.

Table 1.1 Summary of Key Roles in Organizational Flow Chart

Position	Description
Chief Operating Officer	Holds ultimate responsibility for the operation of the Mary River Project and has overall responsibility for the Managers and RMMs.
General Manager	Responsible for overall operations at the Project. Oversees the daily operations of the Project. Provides direction to the Managers and RMMs.
Mine Manager	Responsible for overall operations at the Mine. Oversees the operations of the RMMs.
Engineer of Record	Registered Professional Engineer who is familiar with the design and specifications for the RMMs.
Manager of Capital Projects	Responsible for capital projects related to the construction and operation of the RMMs during construction. Provides direction to the project teams and RMM Technicians during construction.
Environmental Manager	Responsible for overall environmental performance at the Project. Provides direction to the RMM Technicians for environmental monitoring and sampling protocols.
RMM Technicians	Responsible for the daily operation, monitoring and sampling of the RMMs. Technicians will be used from MineOps Technical Services and Environmental Department accordingly.

2 DOCUMENT CONTROL AND REGULATORY REQUIREMENTS

2.1 DOCUMENT CONTROL AND DISTRIBUTION

This OMS Manual is a controlled document. The following is a distribution list of personnel that will be provided with copies of the OMS Manual, and the location of each copy.

- Copy 1 – Mine Managers office
- Copy 2 - Manager of Capital Projects office
- Copy 3 - Environmental Manager's office
- Copy 4 - EORs Office

This OMS Manual will be reviewed as part of periodic inspections for the RMMs that will be carried out by qualified Baffinland personnel or a qualified Engineer that is familiar with the design and operation of the RMMs. The updates will be made to reflect current operating, maintenance and surveillance practices and whenever there are changes to the structure, flow control equipment, operating ranges or conditions.

All reviews and revisions are overseen by the Mine Manager with assistance from the Environmental Manager. The Mine Manager will be responsible for ensuring that each of the documents on the distribution list is kept up to date. This will include removing and archiving out-of-date materials.

2.2 REGULATORY REQUIREMENTS

The design and operating strategies for the RMMs have been developed to meet the requirements of Baffinland's Civil Design Philosophy (Hatch, 2018) as well standards and guidelines recommended by the Mining Association of Canada (MAC, 2019), the Canadian Dam Association (CDA, 2007 and 2013), British Columbia Ministry of Environment (BCMOE, 2015) and the Metal and Diamond Mining Effluent Regulations (MDMER, 2018). Operation of the RMMs includes periodic sediment removal, water management, maintenance, monitoring and surveillance of all components. Operation of the RMMs shall comply with all applicable laws and regulations.

3 RUNOFF MANAGEMENT MEASURES

3.1 GENERAL

The RMMs are mainly designed to achieve the following:

- Collect contact surface runoff from the KM 106 Stockpile using a series of collection berms
- Divert non-contact surface runoff around the site using a series of diversion berms
- Temporarily store collected runoff and sediment in the Sedimentation Pond

The details of the RMMs are presented below.

3.2 COLLECTION/DIVERSION BERMS

Runoff is managed through the operation of the Collection/Diversion Berms, which will divert non-contact water around the site and convey contact water from the site to the Sedimentation Pond. Berms constructed around the perimeter of the stockpile, except where the stockpile is directly adjacent to the existing haul road, collect and convey runoff from the KM106 Stockpile area to the Sedimentation Pond. Additional berms are located between the Sedimentation Pond and undisturbed upstream areas in order to divert runoff from those areas around the pond and to the environment.

The Collection/Diversion Berms are sized to convey runoff from the 1 in 200 year, 24-hour rainfall event by utilizing the space between the berm's upstream slope and the stockpile slope (or the natural ground) as the two sides of a trapezoidal channel, with a base width of approximately 2.5 m. A freeboard depth of 0.3 m is included in the berm sizing to account for minor variations in the berm cross section and grade following construction.

3.3 SEDIMENTATION POND

3.3.1 GENERAL

The Sedimentation Pond provides sediment control for runoff originating from catchment areas within the stockpile footprint. The Sedimentation Pond is also lined with a geosynthetic lining system to prevent the collected runoff from reporting to the environment. The key design criteria for the Sedimentation Pond is provided on Table 3.1.

Table 3.1 Key As-built Design Criteria for Sedimentation Pond

Parameter	Value
Crest Elevation	268.5 m
Minimum Freeboard	0.7 m
Maximum Operating Level	267.2 m
Crest Width	6 m
Berm Slopes	Upstream: 2.5H:1V
	Downstream: 2H:1V
Maximum Sediment Volume	0.5 m in thickness
Maximum Operating Pond Volume	Approx. 4,392 m^3
Spillway Inlet Elevation	267.9 m
Spillway Base Width	5 m
Spillway Side Slopes	3H:1V

Key Sedimentation Pond details are presented below.

3.3.2 DAM CLASSIFICATION

The CDA (2013) guidelines provide a classification system for water retaining dams in Canada. The selection of appropriate design criteria is determined based on the Dam Hazard Classification (DHC) system. The DHC is based on the following criteria:

- Population at Risk
- Loss of Life
- Environmental and Cultural Values
- Infrastructure and Economics

The Sedimentation Pond is classified as LOW DHC structure (KP, 2019) based on the following main site characteristics:

- There is no downstream population at risk
- There is no potential for loss of life
- The potential environmental losses are short term and include erosion and sedimentation of downstream waterways (i.e. the Mary River)
- The potential economic losses are limited. There is no mine site infrastructure downstream of the Sedimentation Pond. Economic loses are likely to be limited to local repairs.

3.3.3 SEDIMENT MANAGEMENT

Operation of the Sedimentation Pond is based on the temporary storage and periodic removal of sediment. Sediment will fill the pond basin until it reaches its ultimate capacity. Removal of sediment shall occur prior to reaching the ultimate capacity of the basin. The periodic removal of sediment is required to maintain temporary water storage requirements. The Sedimentation Pond includes capacity to store a sediment thickness of approximately 0.5 m, based on BCMOE (2015) guidelines. Additional design information is provided in KP (2019).

3.3.4 WATER MANAGEMENT

The water volume in the Sedimentation Pond basin is managed to maximize the available capacity for sediment and stormwater. Surface runoff water is accumulated in the pond basin following freshet and rainfall events to allow the majority of the sediment to settle out, prior to release to the environment. A geosynthetic lining system is also present to prevent runoff from reporting to the environment.

The Sedimentation Pond includes the following measures/structures for water management, based on CDA (2013) and BCMOE (2015) guidelines. Additional design information is provided in KP (2019).

- Temporary storage of runoff collected from the contributing catchment areas resulting from the 1 in 10 year, 24-hour duration rainfall event.
- Safe conveyance of the runoff resulting from the 1 in 200 year, 24-hour duration rainfall event over the Emergency Overflow Spillway.
- 0.3 m of freeboard depth for wave run-up and flow routing during the 1 in 200 year, 24-hour duration rainfall event.
- 40 mil Atarfil linear low density textured geomembrane and Texel 100P non-woven geotextile for seepage protection.

The sedimentation pond should be maintained empty during normal operating conditions. The de-watering measures and procedures to remove runoff collected in the Sedimentation Pond will consist of a pump and discharge line which will discharge to a specified discharge location. A technician will test water quality to ensure it meets the environmental requirements prior to any discharge into the environment.

4 OPERATIONS, MAINTENANCE AND SURVEILLANCE

4.1 GENERAL

Surveillance consists of making regular observations relating to both the condition and performance of the RMMs. The intent of surveillance is to identify hazardous or potentially hazardous conditions. Once a hazardous or potentially hazardous condition has been identified, it is critically important to complete the required maintenance to resolve the issue. It is also important to document the measures completed to rectify the issue.

The following is a partial list of possible concerns to be used as a guide during inspections at the RMMs:

- Evidence of slope instability or movement (cracks, bulging, slumping, settlement, sink holes, permafrost degradation, etc.)
- Evidence of seepage (increased flow, color change, suspended solids, seepage existing on slope, etc.)
- Ripped, damaged or sagging geomembrane
- Evidence of animal burrows
- Scour and/or erosion
- Loss of erosion protection
- Debris accumulation

- Blockage (debris, siltation, vegetation, etc.)
- Deterioration

4.2 SURVEILLANCE SCHEDULE

It is the responsibility of Mine Ops Technical Services Superintendent (or approved equivalent) to complete surveillance and inspections of the RMMs on a regular basis to confirm that the facility is being operated and maintained correctly. The surveillance schedule for the RMMs requires inspections to be carried out daily.

The operation, inspection and surveillance requirements for the RMMs are summarized on Table B1.1 (Appendix B). During the inspections, the inspector must document the inspection using the designated reporting templates (Appendix C).

Any abnormal observations need to be discussed immediately with the Mine Manager and/or General Manager to define appropriate actions. The Mine Manager will ensure that any identified issues are addressed via maintenance measures and that all completed remedial measures are documented and filed.

5 UNUSUAL EVENTS REQUIRING INSPECTIONS

Unusual or significant events at the KM 106 Stockpile should be investigated and characterized to ensure any adverse effects to the RMMs are not expected. Examples of unusual or significant events include, but are not limited to, the following:

- Storms and floods (extreme rainfall, rain on snow event, rapid melting of snow pack, high winds, etc.)
- Extreme earthquake event
- Significant, rapid erosion (any cause) of embankment or channel slopes
- Prolonged power failure
- Fire or explosion
- Human interference by vandalism or accident

Following the occurrence of an unusual or significant event, an inspection would be carried out by a Professional Engineer licensed in Nunavut experienced in dam inspections and/or under the direct supervision of other experienced dam engineers licensed in Nunavut, in addition to both the Environmental Manager (or designate) and the Mine Manager (or designate) and/or General Manager. Any abnormal observations should then be discussed immediately internally to define the appropriate actions.

Unusual event descriptions and recommended action items are summarized in Table B2.1 (Appendix B). Any abnormal observations need to be reviewed with the Environmental Manager, Mine Manager and General Manager to define appropriate actions. The Environmental Manager will ensure that any identified issues are addressed and that all completed remedial measures are documented and filed. The completed report shall be sent to the designated Baffinland representative for review and filing.

6 INDEPENDENT INSPECTIONS

Bi-annual inspections shall be carried out at the Sedimentation Pond. The annual inspection will follow the Dam Safety Inspection (DSI) procedure as presented by CDA (2007). This inspection shall be completed by a 3rd party qualified Nunavut licensed Professional Engineer experienced with dam inspections, who is familiar with the site and the facility design and be accompanied by the Mine Manager (or designate) and the Environmental Manager (or designate). The qualified Engineer will provide a report summarizing the results of the inspection.

Dam Safety Reviews (DSRs) are not required for structures with a DHC category of LOW (CDA, 2007). The consequences of failure should be re-evaluated periodically as they may change based on infrastructure development downstream of the Sedimentation Pond. DSRs would be required if the DHC increases from the current category of LOW.

7 REFERENCES

British Columbia Ministry of Environment (BCMOE), 2015. *Assessing the Design, Size, and Operation of Sediment Ponds Used in Mining.* December. Version 1.0. Technical Guidance 7 - Environmental Management Act. Environmental Protection Division.

Canadian Dam Association (CDA), 2007. *Dam Safety Guidelines*.

Canadian Dam Association (CDA), 2013. *2007 Dam Safety Guidelines*. 2013 Revision.

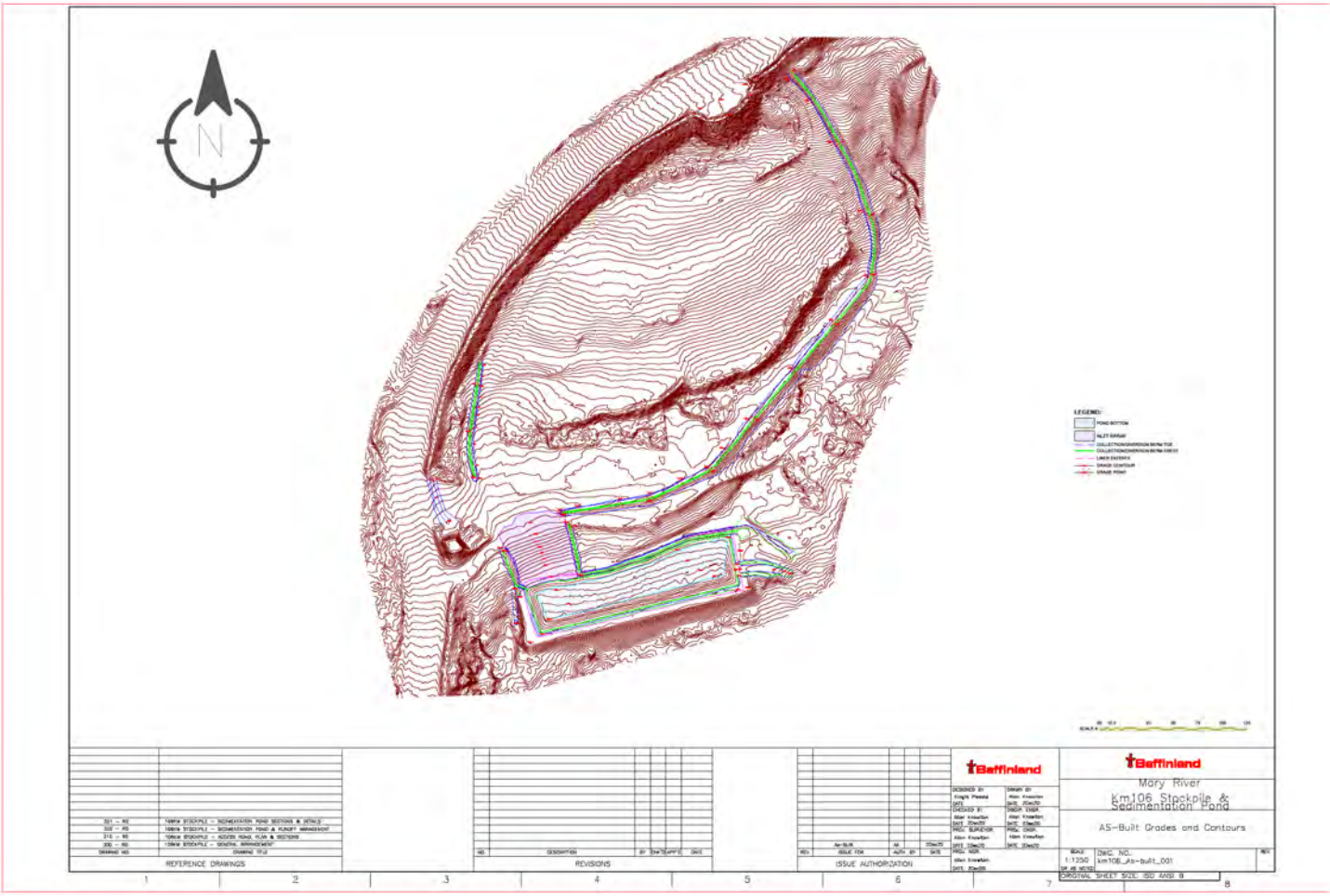
Hatch, 2018. *Civil Design Philosophy*. March 12. Ref. No. H353004-00000-200-210-00001, Rev. 2.

Knight Piésold Ltd. (KP), 2019. Letter to: Allan Knowlton, Baffinland Iron Mines Corporation. Re: *Design Summary for the KM106 Stockpile and Runoff Management Measures*. June 20. North Bay, Ontario. Ref. No. NB19-00443 (NB102-181/57).

Metal and Diamond Mining Effluent Regulations (MDMER), 2018. *SOR/2002-22*.

Mining Association of Canada (MAC), 2019. *Developing an Operation, Maintenance and Surveillance Manual for Tailings and Water Management Facilities.* February. Second Edition.

APPENDIX A



APPENDIX B

Table B1.1

Frequency	Task	Accountability
Daily	Monitor water level in the pond	WTP Operator
	Discharge if MOWL (267.2 masl) is reached. Obtain water samples for lab to verify if water quality meets criteria prior to discharge. Do not discharge if environmental criteria is not met.	WTP Operator & Environment
	Inspect pumping system to ensure it is operational and ready for use	WTP Operator
	Inspect for evidence of seepage (increased flow, color change, suspended solids, seepage existing on slope, etc.)	WTP Operator
Monthly	Inspect for evidence of slope instability or movement (cracks, bulging, slumping, settlement, sink holes, permafrost degradation, etc.)	Tech. Services
	Inspect for evidence of seepage (increased flow, color change, suspended solids, seepage existing on slope, etc.)	Tech. Services
	Inspect for ripped, damaged or sagging geomembrane	Tech. Services
	Inspect for Scour and/or erosion	Tech. Services
	Inspect riprap areas for loss of erosion protection	Tech. Services
	Inspect for debris accumulation and remove if present	Tech. Services
	Inspect spillway, along diversion/catchment berms and pump system for blockage (debris, siltation, vegetation, ROM falling off stockpile, etc.)	Tech. Services
	Inspect berm and swale along access road and magazine access road to ensure water from haul road cannot migrate into facility and water within the facility cannot leave the catchment area	Tech. Services
	Inspect for deterioration of dam berm, diversion berms, access road, and spillway. Inspect for damage to any of these structures.	Tech. Services
Bi-Annually	Inspect sediment accumulation height in pond (0.5 meter capacity). If greater than 0.5m height must remove.	Tech. Services
	Geotechnical Engineering inspection and reporting	Professional Engineer

TABLE B2.1

Unusual Event Description	Action
Seismic Event	Notify Mine Manager, Environmental Manager, and General Manager. Professional Engineer Review required immediately
Unusual Flood Event	Notify Mine Manager, Environmental Manager, and General Manager. Take environmental water samples. If samples are satisfactory for discharge, start draining pond, ensure that pump is keeping up with water inflow. If the pump is not keeping up with water inflow, add another pump until the water level starts drawing down. After event, perform a RMM inspection.
Rainfall event exceeds 1 in 10 year event	Notify Mine Manager. Immediate RMM inspection required. Monitor water level in pond and ensure maximum water level is not exceeded (0.7m freeboard - 269.2 masl). If level exceeds the 269.2 masl, refer to flood event scenario.
Emergency Spillway Overflow	Notify Mine Manager, Environmental Manager, and General Manager. Document and notify authorites. Professional Engineer Review required as soon as possible to review damage/erosion to spillway.
Earth Slide	Notify Mine Manager, Environmental Manager, and General Manager. Professional Engineer Review required immediately.
Seepage becomes turbid	Notify Mine Manager, Environmental Manager, and General Manager. Professional Engineer Review required immediately. Drain pond empty immediately.
Damage to liner	Notify Mine Manager, Environmental Manager. Professional Engineer Review required as soon as possible. Drain pond below damage immediately.
Damage to dam structure	Notify Mine Manager, Environmental Manager, and General Manager. Professional Engineer Review required as soon as possible to review damage to dam.
Pump failure	Notify Mine Manager. Install replacement pump immediately.

APPENDIX C

Inspection Template

Inspection reporting template / check list*

106KM POND / ACCESS ROAD / DIVERSION BERM Stability Monitoring Form

Inspection Date:
Inspection Time:
Inspection By:

SITE CONDITIONS

Current Precipitations:
Precipitations Last 3 Days:
Access Road Condition:
(surface water, saturated from rain. Dry, Snow)
Pond Dam Condition:
(surface water, saturated from rain. Dry, Snow)

Observations at Access Road Entry Level	Comments
Cracking between crest of fill Access Road and original ground	Y/N
Cracking behind crest of original ground	Y/N
Lowering of ground surface at or behind crest of the access road	Y/N
Observations of Fill Accumulation Face	**Comments**
Is water accumulating or flowing on the dump surface?	Y/N
Is there any bulging or erosion in the dump face?	Y/N
Is there any cracking in the access road driving surface?	Y/N
Observations of Km 106 Stockpile Area	**Comments**
Is any water flowing on the mine haul road reporting to the 106 pond area?	Y/N
Observations of Km 106 Stockpile Diversion Berms	**Comments**
Is there any seepage occuring on downstream side of berm?	Y/N
Is there any blockages along upstream side of berm?	Y/N
Is the minimum 1% gradient along upstream side of berm maintained?	Y/N
Is there a loss of riprap erosion protection?	Y/N
Is there evidence of degradation of the diversion berm?	Y/N
Observations of Km 106 Stockpile Dam Berm	**Comments**
Is there any seepage occuring on downstream side of berm?	Y/N
Is there evidence of animal burrows in dam berm?	Y/N
Is there evidence of damage or degradation caused to the dam berm?	Y/N
Is there evidence of instability or movement of the dam berm?	Y/N
Observations of Km 106 Stockpile Spillway	**Comments**
Is there a loss of riprap erosion protection?	Y/N
Is there evidence of damage or degradation of the spillway?	Y/N
Is there evidence of a blockage or accumulation on the spillway?	Y/N
Observations of Km 106 Stockpile Pond	**Comments**
Is there evidence of ripped, damaged, or sagging geomembrane?	Y/N
What is the current height of water in the pond?	m
Is the sediment accumulation greater than 0.5 meters?	Y/N
Is the pumping system functional and ready to operate?	Y/N
Additional comments and Recommendations for Immediate Action	

*Format subject to change