newfoundland labrador hydro

Hydro Place. 500 Columbus Drive.
P.O. Box 12400. St. John's. NL
Canada A1B 4K7
t. 709.737.1400 f. 709.737.1800
www.nlh.nl.ca

December 19, 2022

Board of Commissioners of Public Utilities
Prince Charles Building
120 Torbay Road, P.O. Box 21040
St. John's, NL A1A 5B2

Attention: Cheryl Blundon
Director of Corporate Services & Board Secretary

Re: *Reliability and Resource Adequacy Study Review* – Updated Project Schedule for L'Anse au Diable Grounding Station and Wave Study for Dowden's Point Grounding Station

In its correspondence dated July 25, 2022,[1] Newfoundland and Labrador Hydro ("Hydro") advised the Board of Commissioners of Public Utilities ("Board") that it would provide an updated schedule for the completion of work at the grounding site located in L'Anse au Diable. In the same correspondence, Hydro also advised the Board that as part of the Design Review for the Dowden's Point Grounding Station, a wave study would be completed by the fourth quarter 2022.

A summary of the proposed project schedule is provided in Attachment 1 and includes three appendices:

1) A plan for project execution in 2023 (Appendix A),

2) Major project milestones (Appendix B); and

3) Level of effort (Appendix C).

The results of the Dowden's Point Grounding Site wave study ("Wave Study"), completed by Tiller Engineering Inc. ("TEI"), are provided in Attachment 2. The scope of the Wave Study was to evaluate this breakwater's original design parameters. TEI concluded that based on the documentation provided, the design life of the breakwater was 100-year minimum and was designed to withstand the expected worst-case conditions. In its conclusion, TEI also noted that the risk of wave damage to a rubble mound breakwater is considered less than the similar breakwater in L'Anse au Diable given the sheltered conditions of Dowden's Point in Conception Bay.

Further, TEI concluded that the Dowden's Point breakwater was based on a wave height with a 200-year return and appears it has been factored to account for other height parameters and sea level rise of 1.0 metres or storm surge. TEI considered this a valid design. TEI noted that in the light of the importance of the breakwater in protecting the electrode site, and considering global climate trends, Hydro could consider use of a higher wave factor if there was a desire to increase the long-term reliability for the breakwater structure at Dowden's Point. TEI recommended that Hydro conduct continual inspections and monitoring of the breakwater to validate the current design and construction to determine if a higher wave factor is required. Hydro has reviewed and accepted these recommendations.

[1] "*Reliability and Resource Adequacy Study Review* – Design Review for L'Anse au Diable and Dowden's Point Grounding Stations," Newfoundland and Labrador Hydro, July 25, 2022.

Should you have any questions, please contact the undersigned.

Yours truly,

NEWFOUNDLAND AND LABRADOR HYDRO

Shirley A. Walsh
Senior Legal Counsel, Regulatory
SAW/sk

Encl.

Board of Commissioners of Public Utilities
Jacqui H. Glynn
Maureen Greene, KC
PUB Official Email

Island Industrial Customer Group
Paul L. Coxworthy, Stewart McKelvey
Denis J. Fleming, Cox & Palmer
Dean A. Porter, Poole Althouse

Labrador Interconnected Group
Senwung F. Luk, Olthuis Kleer Townshend LLP
Nicholas E. Kennedy, Olthuis Kleer Townshend LLP

Consumer Advocate
Dennis M. Browne, KC, Browne Fitzgerald Morgan Avis & Wadden
Stephen F. Fitzgerald, Browne Fitzgerald Morgan Avis & Wadden
Sarah G. Fitzgerald, Browne Fitzgerald Morgan Avis & Wadden
Bernice Bailey, Browne Fitzgerald Morgan Avis & Wadden
Bernard M. Coffey, KC

Newfoundland Power Inc.
Dominic J. Foley
Lindsay S.A. Hollett
Regulatory Email

Attachment 1

Breakwater Rehabilitation

L’Anse au Diable

Project Schedule Summary

Breakwater Rehabilitation

L’Anse au Diable

Project Schedule Summary

Project Schedule Summary

The proposed project schedule is attached as Appendix A and provides a plan for project execution in 2023. The plan is contingent on this project starting in January 2023 to allow adequate time for design, tendering, and construction.

Engineering design by an external engineering consultant is planned to start in late February 2023 with issue for tender design drawings and technical specification complete by the end of April 2023.

The construction is to be publicly tendered in early May 2023, with contract award in early June 2023. Key pre-construction activities include:

- The approval of the armour stone source;
- DFO approval of the fish habitat compensation design change; and
- Review and approval of the contractor's safety plan.

Construction site work is to start soon after contractor mobilization to site at the end of June 2023, with anticipated construction completion mid-September 2023. Contractor demobilization is planned for early October 2023, after successful final inspection and site clean up.

Closeout documentation shall include the contractor's as-built drawings and redline markup of the design drawings, which are to be submitted at the end of September 2023 for owner review and acceptance. Standard project closeout activities will then follow, with project completion scheduled for early November.

This will be a challenging project due to construction access restraints and associated risks working near water. Therefore, project construction methodology, which may including rock placement from a barge or vessel, will need to be carefully developed to ensure safe project execution. Collaborative discussions and planning with the construction contractor will be required to lessen potential impacts to the baseline schedule(Appendix A).

Documents outlining major project milestones and level of effort are attached as Appendix B and C, respectively.

Attachment 1, Appendix A

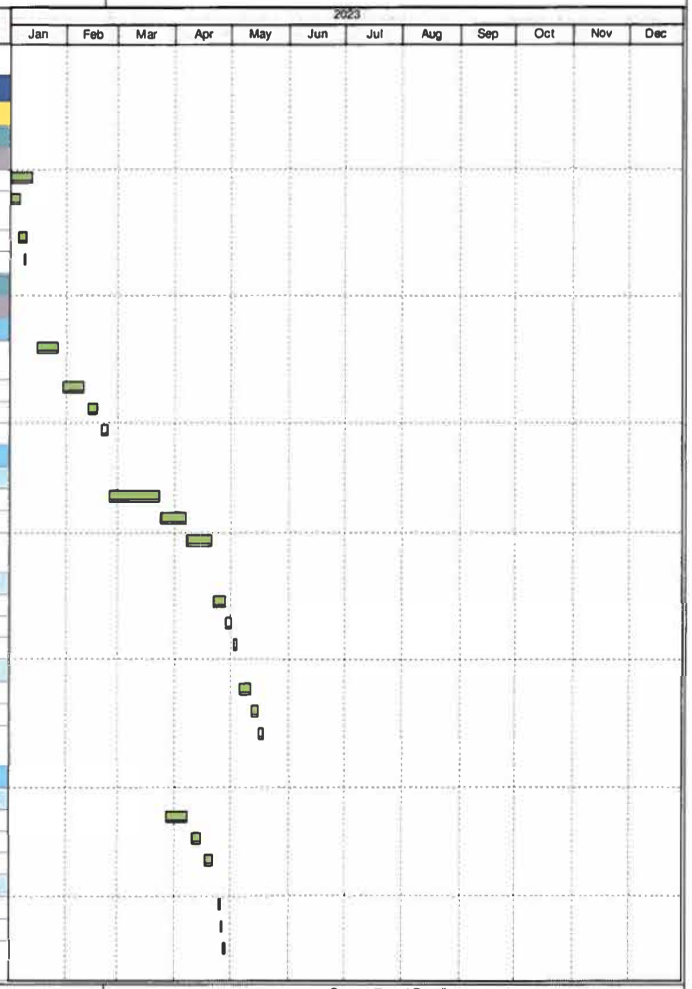
Shoreline Pond Electrode Breakwater Rehabilitation

L’Anse au Diable

Baseline Schedule

L'Anse-au-Diable Shoreline Pond Electrode Breakwater Rehabilitation — **Data date - 01-Jan-23**

Activity ID	Activity Name	Activity % Complete	Start	Finish	At Completion Duration
Total			02-Jan-23	09-Nov-23	223.7
L'Diab			02-Jan-23	09-Nov-23	223.7
L'Anse-au-Diable Shoreline Pond Electrode Breakwater Rehabilitation			02-Jan-23	09-Nov-23	223.7
Project Management			02-Jan-23	13-Jan-23	10.0
Initiation/Startup Activities			02-Jan-23	13-Jan-23	10.0
A1160	Develop Project Scope Statement & Submit for Approval	0%	02-Jan-23	13-Jan-23	10.0
A1100	Capital Budget Proposal (BU Coding & Budget Breakdown/Cash Flow)	0%	02-Jan-23	06-Jan-23	5.0
A1140	Initiate Asset Assignment Form	0%	06-Jan-23	10-Jan-23	2.0
A1180	Set-up Work Orders (PM)	0%	09-Jan-23	09-Jan-23	1.0
Deliverables			16-Jan-23	24-Oct-23	201.7
Engineering			16-Jan-23	18-May-23	89.0
Engineering Consultant RFP (Standing Offer)			16-Jan-23	23-Feb-23	29.0
A3470	Develop Engineering Consultant RFP Documents (Scope of Work)	0%	16-Jan-23	27-Jan-23	10.0
A3480	RFP Period	0%	30-Jan-23	10-Feb-23	10.0
A3490	Review & Award Contract	0%	13-Feb-23	17-Feb-23	5.0
A3500	Issue PO to Consultant for Engineering Deliverables	0%	20-Feb-23	23-Feb-23	4.0
Design			24-Feb-23	18-May-23	60.0
Issued For Review (IFR)			24-Feb-23	20-Apr-23	40.0
A3740	Develop Engineering Design Drawings	0%	24-Feb-23	23-Mar-23	20.0
A3750	Issue Design Drawings for Owner review	0%	24-Mar-23	06-Apr-23	10.0
A3730	Incorporate Owner comments to Engineering Design Drawings	0%	07-Apr-23	20-Apr-23	10.0
Issued For Tender (IFT)			21-Apr-23	04-May-23	10.0
A3760	Revise Design Drawings for Tender	0%	21-Apr-23	27-Apr-23	5.0
A3770	Issue Design Drawings for Owner review	0%	28-Apr-23	01-May-23	2.0
A3780	Incorporate Owner comments to Design Drawings for Tender	0%	02-May-23	04-May-23	3.0
Issued For Construction (IFC)			05-May-23	18-May-23	10.0
A3810	Revise Design Drawings for Construction	0%	05-May-23	11-May-23	5.0
A3820	Issue Design Drawings for Construction to Owner for review	0%	12-May-23	15-May-23	2.0
A3830	Incorporate Owner comments to Design Drawings for Construction	0%	16-May-23	18-May-23	3.0
Technical Specification			27-Mar-23	05-May-23	30.0
Issued For Review (IFR)			27-Mar-23	21-Apr-23	20.0
A3170	Develop Technical Specifications	0%	27-Mar-23*	07-Apr-23	10.0
A4070	Issue Technical Specifications for Owner review	0%	10-Apr-23	14-Apr-23	5.0
A4080	Incorporate Owner comments to Technical Specifications	0%	17-Apr-23	21-Apr-23	5.0
Issued For Tender (IFT)			24-Apr-23	28-Apr-23	5.0
A4090	Revise Technical Specifications for Tender	0%	24-Apr-23	25-Apr-23	2.0
A4100	Issue Technical Specifications for Owner review	0%	26-Apr-23	26-Apr-23	1.0
A3790	Incorporate Owner comments to Technical Specifications for Tender	0%	27-Apr-23	28-Apr-23	2.0

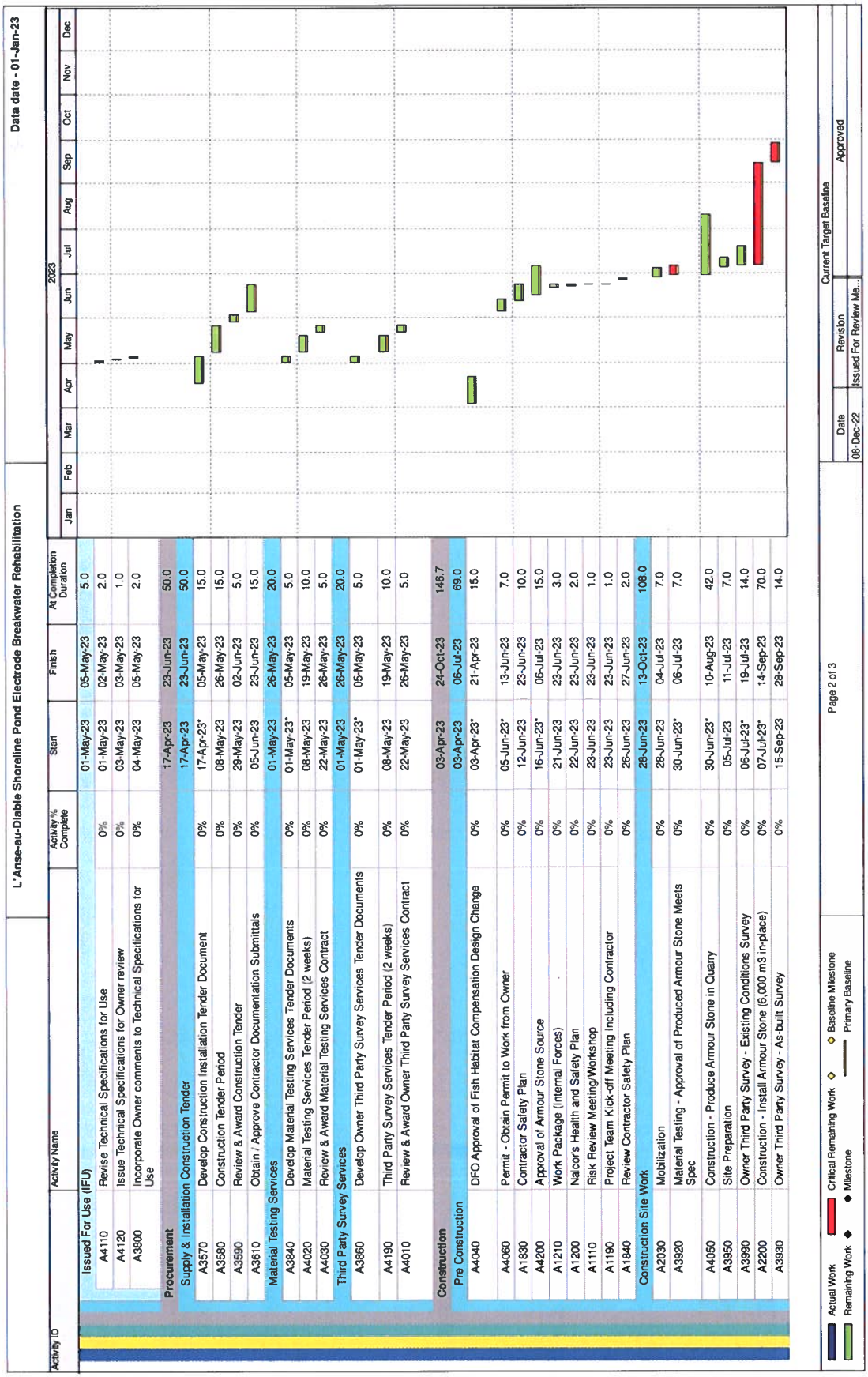


Actual Work · Remaining Work · Critical Remaining Work · Milestone · Baseline Milestone · Primary Baseline

Page 1 of 3

Current Target Baseline

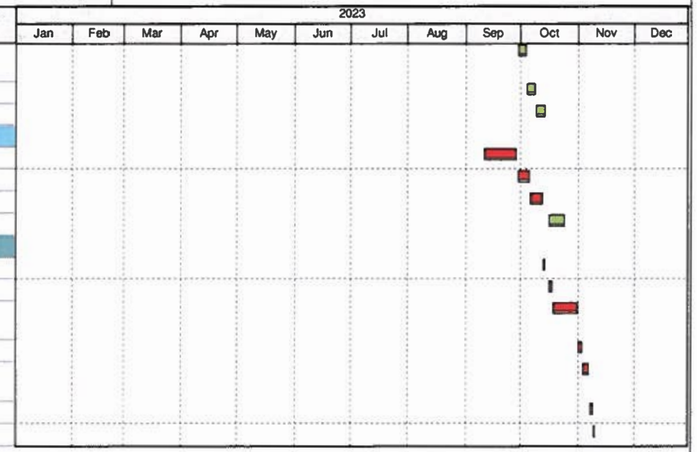
Date	Revision	Approved
06-Dec-22	Issued For Review Me...	


L'Anse-au-Diable Shoreline Pond Electrode Breakwater Rehabilitation
Data date - 01-Jan-23
Activity ID
Activity Name
Activity % Complete
Start
Finish
At Completion Duration
2023
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Issued For Use (IFU) 0% 01-May-23 05-May-23 5.0
A4110 Revise Technical Specifications for Use 0% 01-May-23 02-May-23 2.0
A4120 Issue Technical Specifications for Owner review 0% 03-May-23 03-May-23 1.0
A3800 Incorporate Owner comments to Technical Specifications for Use 0% 04-May-23 05-May-23 2.0
Procurement 17-Apr-23 23-Jun-23 50.0
Supply & Installation Construction Tender 17-Apr-23 23-Jun-23 50.0
A3570 Develop Construction Installation Tender Document 0% 17-Apr-23* 05-May-23 15.0
A3580 Construction Tender Period 0% 08-May-23 26-May-23 15.0
A3590 Review & Award Construction Tender 0% 29-May-23 02-Jun-23 5.0
A3610 Obtain / Approve Contractor Documentation Submittals 0% 05-Jun-23 23-Jun-23 15.0
Material Testing Services 01-May-23 26-May-23 20.0
A3840 Develop Material Testing Services Tender Documents 0% 01-May-23* 05-May-23 5.0
A4020 Material Testing Services Tender Period (2 weeks) 0% 08-May-23 19-May-23 10.0
A4030 Review & Award Material Testing Services Contract 0% 22-May-23 26-May-23 5.0
Third Party Survey Services 01-May-23 26-May-23 20.0
A3860 Develop Owner Third Party Survey Services Tender Documents 0% 01-May-23* 05-May-23 5.0
A4190 Third Party Survey Services Tender Period (2 weeks) 0% 08-May-23 19-May-23 10.0
A4010 Review & Award Owner Third Party Survey Services Contract 0% 22-May-23 26-May-23 5.0
Construction 03-Apr-23 24-Oct-23 146.7
Pre Construction 03-Apr-23 06-Jul-23 69.0
A4040 DFO Approval of Fish Habitat Compensation Design Change 0% 03-Apr-23* 21-Apr-23 15.0
A4060 Permit - Obtain Permit to Work from Owner 0% 05-Jun-23* 13-Jun-23 7.0
A1830 Contractor Safety Plan 0% 12-Jun-23 23-Jun-23 10.0
A4200 Approval of Armour Stone Source 0% 16-Jun-23* 06-Jul-23 15.0
A1210 Work Package (Internal Forces) 0% 21-Jun-23 23-Jun-23 3.0
A1200 Naicor's Health and Safety Plan 0% 22-Jun-23 23-Jun-23 2.0
A1110 Risk Review Meeting/Workshop 0% 23-Jun-23 23-Jun-23 1.0
A1190 Project Team Kick-off Meeting Including Contractor 0% 23-Jun-23 23-Jun-23 1.0
A1840 Review Contractor Safety Plan 0% 26-Jun-23 27-Jun-23 2.0
Construction Site Work 28-Jun-23 13-Oct-23 108.0
A2030 Mobilization 0% 28-Jun-23 04-Jul-23 7.0
A3920 Material Testing - Approval of Produced Armour Stone Meets Spec 0% 30-Jun-23* 06-Jul-23 7.0
A4050 Construction - Produce Armour Stone in Quarry 0% 30-Jun-23* 10-Aug-23 42.0
A3950 Site Preparation 0% 05-Jul-23 11-Jul-23 7.0
A3990 Owner Third Party Survey - Existing Conditions Survey 0% 06-Jul-23* 19-Jul-23 14.0
A2200 Construction - Install Armour Stone (6,000 m3 in-place) 0% 07-Jul-23* 14-Sep-23 70.0
A3930 Owner Third Party Survey - As-built Survey 0% 15-Sep-23 28-Sep-23 14.0
Actual Work
Remaining Work
Critical Remaining Work
Milestone
Baseline Milestone
Primary Baseline
Page 2 of 3
Current Target Baseline
Date
Revision
Approved
08-Dec-22
Issued For Review Me...

L'Anse-au-Diable Shoreline Pond Electrode Breakwater Rehabilitation

Data date - 01-Jan-23

Activity ID	Activity Name	Activity % Complete	Start	Finish	At Completion Duration
A3980	Commissioning - Final Inspection	0%	29-Sep-23	03-Oct-23	5.0
A3970	Site Clean-up	0%	04-Oct-23	08-Oct-23	5.0
A2220	Demobilization	0%	09-Oct-23	13-Oct-23	5.0
As-Builts/Closeout Documentation			11-Sep-23	24-Oct-23	32.0
A3700	Contractor As-built Drawings Submittal	0%	11-Sep-23	28-Sep-23	14.0
A3710	Nalcor to Review Draft As-Builts	0%	29-Sep-23	05-Oct-23	5.0
A3720	Final As-Builts Submitted	0%	06-Oct-23	12-Oct-23	5.0
A3960	Contractor Redline Markup of Design Drawings Submittal	0%	16-Oct-23	24-Oct-23	7.0
Project Closeout Activities			13-Oct-23	09-Nov-23	20.0
A2590	Lessons Learned	0%	13-Oct-23	13-Oct-23	1.0
A2530	Deliverable Sign Off	0%	16-Oct-23	17-Oct-23	2.0
A1890	Final Drawings & Equipment Data Book Updated & Submitted to OPS for Approval	0%	18-Oct-23	31-Oct-23	10.0
A2000	Final Project Assets (add, transfer, retire)	0%	01-Nov-23	02-Nov-23	2.0
A2550	Contract Closeout Forms (HSE and General Evaluation) & Letter of Final Acceptance	0%	03-Nov-23	06-Nov-23	2.0
A2580	Project Completion Certificate	0%	07-Nov-23	08-Nov-23	2.0
A2540	Close Work Orders	0%	09-Nov-23	09-Nov-23	1.0



Actual Work | Critical Remaining Work | Baseline Milestone
Remaining Work | Milestone | Primary Baseline

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Current Target Baseline		
Date	Revision	Approved
08-Dec-22	Issued For Review Me...	

Attachment 1, Appendix B

Shoreline Pond Electrode Breakwater Rehabilitation

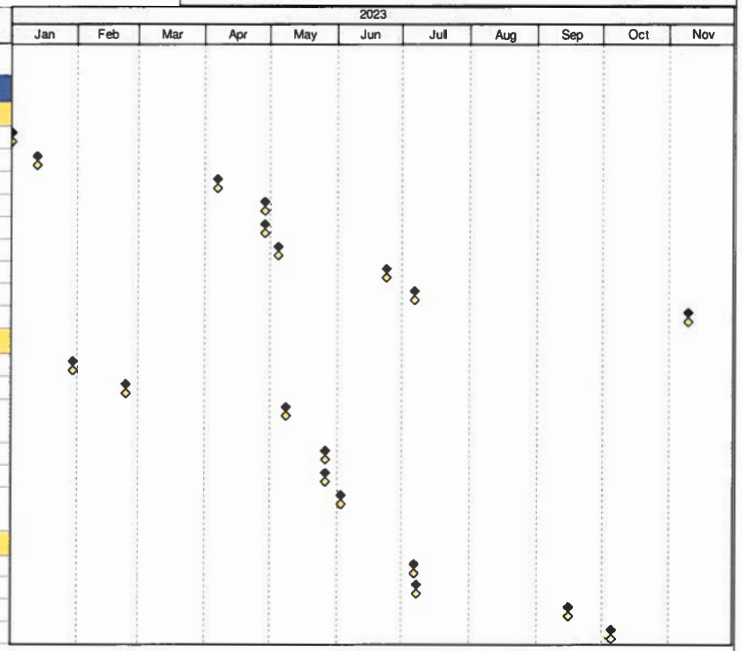
L’Anse au Diable

Major Project Milestones

MAJOR PROJECT MILESTONES

L'Anse-au-Diable Shoreline Pond Electrode Breakwater Rehabilitation

Activity ID	Activity Name	Start	Finish
Total		02-Jan-23	09-Nov-23
L'Diab	L'Anse-au-Diable Shoreline Pond Electrode Breakwater Rehabilitation	02-Jan-23	09-Nov-23
Engineerng & PM Milestones		02-Jan-23	09-Nov-23
A1240	Project Approved	02-Jan-23	
A1220	Scope Statement Signed Off		13-Jan-23
A4170	Engineering Design Drawings Issued For Owner Review		06-Apr-23
A4160	Engineering Specfications Issued For Tender		28-Apr-23
A4180	Engineering Specfications Issued For Owner Review		28-Apr-23
A4150	Engineering Design Drawings Issued For Tender		04-May-23
A2300	Risk Review Completed		23-Jun-23
A2450	Quarry Approved for Armour Stone Supply		06-Jul-23
A1250	Project Closed Out		09-Nov-23
Procurement Milestones		30-Jan-23	02-Jun-23
A2390	RFP Issued for Engineering Services	30-Jan-23	
A2340	PO Issued for Engineering Services		23-Feb-23
A3880	Contract Tender Issued - Supply & Install of Breakwater Rehab.	08-May-23	
A4130	Contract Award - Owner Third Party Survey Services		26-May-23
A4140	Contract Award - Material Testing Service Contract		26-May-23
A3890	Contract Tender Awarded - Supply & Install of Breakwater Rehab		02-Jun-23
Construction Milestones		06-Jul-23	03-Oct-23
A2460	Approval of produced armour stone from quarry meets spec		06-Jul-23
A2350	Construction Started	07-Jul-23	
A2360	Construction Finished		14-Sep-23
A2930	Released for Service		03-Oct-23



◆ Milestone
◇ Baseline Milestone

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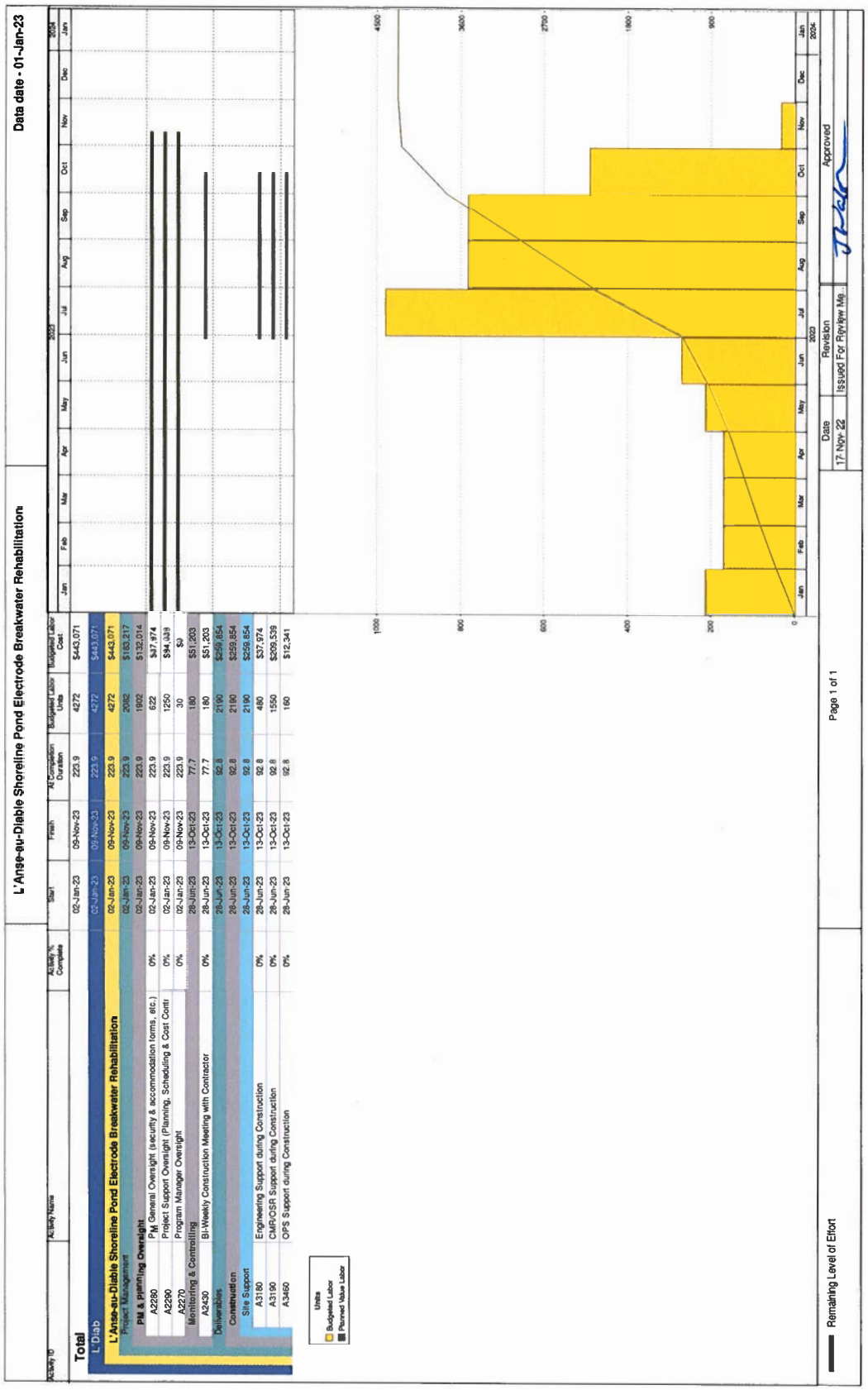
Date	Revision	Approved
08-Dec-22	PSES Schedule Templ...	

Attachment 1, Appendix C

Shoreline Pond Electrode Breakwater Rehabilitation

L’Anse au Diable

Level of Effort


L'Anse-au-Diable Shoreline Pond Electrode Breakwater Rehabilitation
Data date - 01-Jan-23
Activity ID
Activity Name
Activity % Complete
Start
Finish
AT Completion Duration
Budgeted Labor Units
Budgeted Labor Cost
2023
2024
Total
L'Diab
L'Anse-au-Diable Shoreline Pond Electrode Breakwater Rehabilitation
Project Management
PM & planning Oversight
A2280 PM General Oversight (security & accommodation forms, etc.)
A2290 Project Support Oversight (Planning, Scheduling & Cost Contr
A2270 Program Manager Oversight
Monitoring & Controlling
A2430 Bi-Weekly Construction Meeting with Contractor
Deliverables
Construction
Site Support
A3180 Engineering Support during Construction
A3190 CMR/CSR Support during Construction
A3460 OPS Support during Construction
Units
Budgeted Labor
Planned Value Labor
Remaining Level of Effort
Page 1 of 1
Date
Revision
Approved
17-Nov-22
Issued For Review Me...

Attachment 2

Design Check Report

Dowden's Point Breakwater

Dowden's Point Breakwater

Design Check Report

Prepared by:
Tiller Engineering Inc.
PO Box 403
50 Hamlyn Rd. Plaza
St. John's, NL,
Canada, A1E 5X7

Issue and Date:	Status:	Project #:	Issued By:	Checked By:	Approved By:
Dec 11, 2022	R1.2 Reissued	2022-114	RT	RT	RT
Nov 18, 2022	R1.1-Reissued	2022-114	RT	RT	RT
Sept. 16, 2022	R0-Issued for Review	2022-114	RT	JS	RT

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1.0 Introduction

Dowden's Point has been selected as the most suitable site for the island converter station electrode. The site is located on the south shore of Conception Bay, between Seal Cove Pond and Lance Cove Pond. The Dowden's Point breakwater was constructed in 2016 as a protection for shoreline pond electrodes as part of the Lower Churchill Project. The purpose of the breakwater was to protect the electrodes from wave and wind forces which otherwise may damage the electrodes.

2.0 Purpose

Tiller Engineering Inc. (TEI) was engaged by the client to review the project drawings, specifications and related construction documentation and to provide an independent opinion on the basis of design and construction processes associated with the breakwater.

TEI reviewed the documentation and the project drawings and specifications with respect to industry guidelines.

Industry Standards, Guidelines, and data used by TEI in this review included:

i) National Building Code of Canada, 2015
ii) Shore Protection Manual (US Army Corps of Engineers, 1984)

3.0 Abbreviations

The following abbreviations are used throughout the report:

Abbreviations	
TEI	Tiller Engineering Inc.
LCP	Lower Churchill Project
SPM	Shore Protection Manual
MSC	Meteorological Service Of Canada
m	Meters

Table 1 – Abbreviations

4.0 References

[1] MFA-SN-CD-6300-CV-DC-0001-01 - Shoreline Pond Electrodes Civil/Marine Design Criteria

[2] Wave Climate and Extremes at Dowden's Point, Conception Bay, May 2012, 505573-8600-41ER-0001 Rev. 00

[3] Issued for Construction and As Built Project Drawings

[4] Electrode Sites Breakwater Installation Technical Specification ILK-SN-CD-8600-CV-TS-0001-01

[5] Shore Protection Manual – Department of the Army US Corps of Engineers 1984

5.0 Original Design Criteria

The breakwater design is intended to withstand the expected worst case site conditions, including wave action, tidal effects, pack ice and freezing inside the shoreline pond. The area of Dowden's Point has a maritime climate that is somewhat more temperate compared to other parts of the Avalon Peninsula. The average daily temperature is reported as 6.1 C and the total annual precipitation at 1127.2mm on average.

5.1 Wind Speed

The design criteria provided for the breakwater design shows that West and South West winds prevail and outlines monthly maximum wind speeds along with direction and average speed which can be seen below in Table 2.

Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Maximum Hourly Speed (km/h)	120	137	121	93	101	74	67	84	97	103	105	97	137
Maximum Gust Speed (km/h)	167	193	193	159	146	108	107	113	153	153	161	153	193
Direction of Gust	SW	SW	NW	SW	N	NE	SE	SW	S	NW	SW	S	S to SW

Table 2 - Wind Speeds

5.2 Water Current

The currents along the coast are reported to be 1 knot in the east-west direction.

5.3 Water Levels

The following water levels for Dowden's Point are provided:

Low Low Water = 0.2 m
Lowest Low Water = 0.0 m
High High Water = 1.1 m
Highest High Water = 1.3 m

5.4 Wave Height

The following Significant wave height data is provided in the Design Criteria Document:

Return Period (Years)	Extreme Wave Height, Hs (m) Location 1	2	3	4	5	6
1	2.5 ± 0.1	3.1± 0.1	2.7± 0.1	2.8± 0.1	2.6± 0.1	2.5± 0.1
2	2.9 ± 0.1	3.5± 0.1	3.1± 0.1	3.1± 0.1	2.9± 0.1	2.7± 0.1
5	3.2 ± 0.1	3.9 ± 0.2	3.4 ± 0.1	3.4 ± 0.1	3.2 ± 0.1	3.0 ± 0.1
10	3.3 ± 0.2	4.1 ± 0.2	3.6 ± 0.2	3.6 ± 0.2	3.4 ± 0.2	3.2 ± 0.2
25	3.5 ± 0.2	4.4 ± 0.2	3.8 ± 0.2	3.9 ± 0.2	3.6 ± 0.2	3.4 ± 0.2
50	3.7 ± 0.2	4.6 ± 0.3	4.0 ± 0.2	4.0 ± 0.2	3.8 ± 0.2	3.5 ± 0.2
100	3.8 ± 0.3	4.7 ± 0.3	4.1 ± 0.3	4.2 ± 0.3	4.0 ± 0.3	3.7 ± 0.3
200	4.0 ± 0.3	4.9 ± 0.3	4.4 ± 0.3	4.3 ± 0.3	4.1 ± 0.3	3.8 ± 0.3

Table 3 - Significant Wave Heights

From this table, it appears that the Hs (significant wave height) of 4.9m with a return period of 200 years was selected as the Design Wave for the breakwater.

5.5 Design Life

The design life of the breakwater is reported to be 100 years minimum.

5.6 Breakwater Material Properties

The following material properties are reported for the breakwater materials:

Rock fill shall be assumed to have the following properties:

- dry unit weight of 1900 kg/m3
- submerged unit weight of 1100 kg/m3

Armor stone shall be assumed to have the following properties:

- dry unit weight of 2700 kg/m3
- submerged unit weight of 1900 kg/m3
- 35% in place porosity

Core Material

- The gradation of the core material shall provide sufficient permeability to maintain flushing of the shoreline pond.

5.7 Breakwater Design Loads Summary

The following table summarizes original design values used for the breakwater:

Load	**Basis**
Wind Loads	Based on maximum hourly wind speed of 137 km/hr.
Wave Loads	Based on Design wave of 4.9 m
Current Loads	Based on 2 knots

Table 4 – Design Loads Summary

5.8 Breakwater Crest Height

2010 preliminary Dowden's Point Breakwater Designs detail a crest height of 9.50m. It is assumed that this is referenced to chart datum which would equate to 8.75m geodetic. A 2010 cross section is shown below:

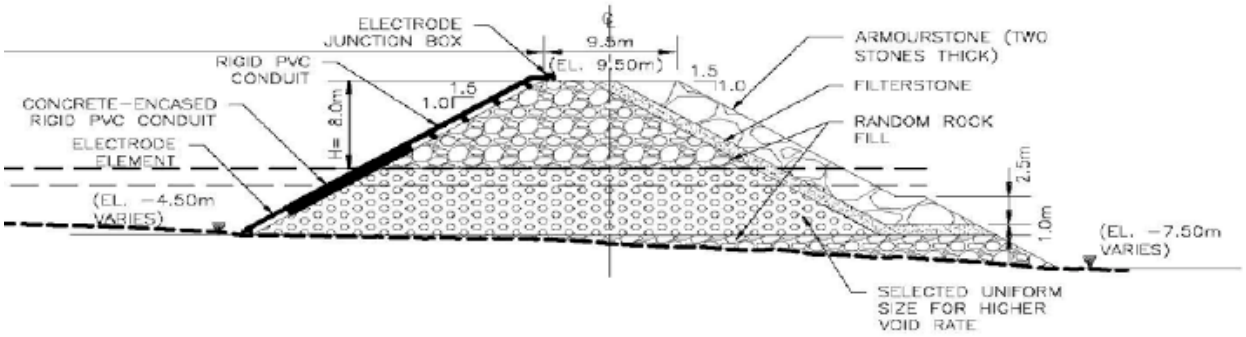


Figure 1 – 2010 Preliminary Breakwater Design

Based on the 2012 Design Criteria, the 2015 Issued for Construction Design defines a 7.55m (geodetic) crest height as can be seen below:

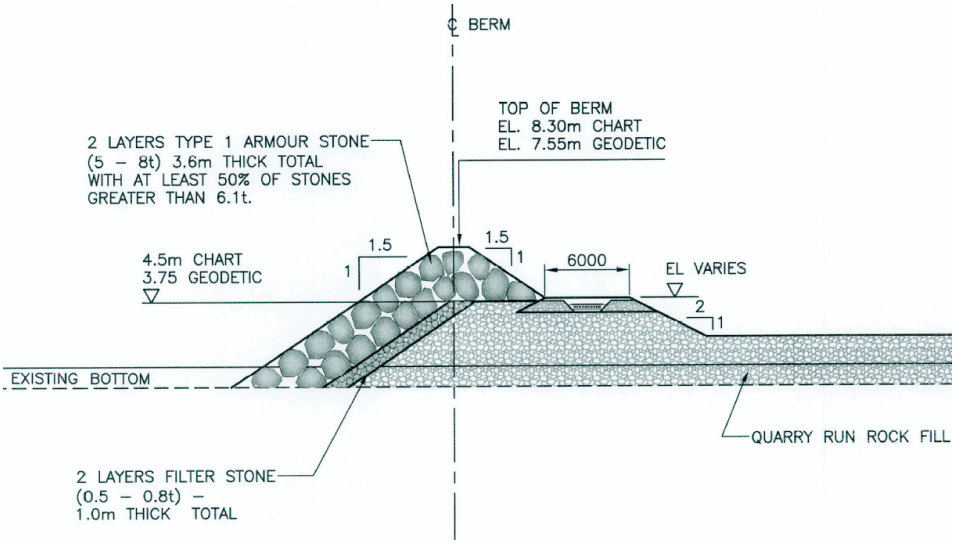


Figure 2 – 2015 Issued for Construction Breakwater Design

6.0 Construction

6.1 Construction Methodology

Construction of a breakwater includes excavation of the sea bed, laying of the core, filter and armor stones. In the case of Dowden's Point the same processes were undertaken with the additional construction of electrode wells to facilitate the Lower Churchill Project (LCP). Core stones are first placed on the seabed in sections and filter and armor stones are sequentially added to protect the core stones from wave action. This procedure continues until the breakwater is complete. Crest width is an important factor to consider as heavy equipment is needed to lay armor stones and the crest must be wide enough for equipment to safely reach all points of the breakwater. Core, filter, armor stone sizes and width layers are all determined through design and the construction requires the breakwater to be built as close as possible to the design to retain the structural resistance against wave action.

6.2 Breakwater Condition

In June 2022, TEI performed a visual inspection of the breakwater. It appears to be in very good condition. The armour stones are well graded with a range of sizes providing a tightly stitched structure with very few occurrences of sizable voids between stones. The slopes are consistent along all faces as are the top elevations and alignments of the toes over the total length of the breakwater. The east and west sides of the breakwater extend well inland over the beach intercepting higher ground. Although the breakwater appears to be in very good condition and unaffected by any wave action to date, there is a local anomaly located at the center of the inside of the north side of the

breakwater at the toe of the slope. Several large (2-3 tonne) armour stones are displaced, previously buried filter fabric is exposed and smaller filter stone is displaced and scattered from its originally constructed location. It does not appear to have been caused by overtopping of the breakwater due to its very localized nature.

6.3 As-Built Elevations

As-Built project documents include a site overview as well as cross sections at various points along the breakwater. Elevations on the design drawings include height for core, filter, and armor stones; as-built elevations are to be as close as possible to these elevations as these elevations are the determined heights for the breakwater to resist wave action.

As-built surveys performed and verified after construction show a consistent crest elevation over the length of the structure of approximately 7.8m geodetic. A sample of the as-built survey results is shown below:

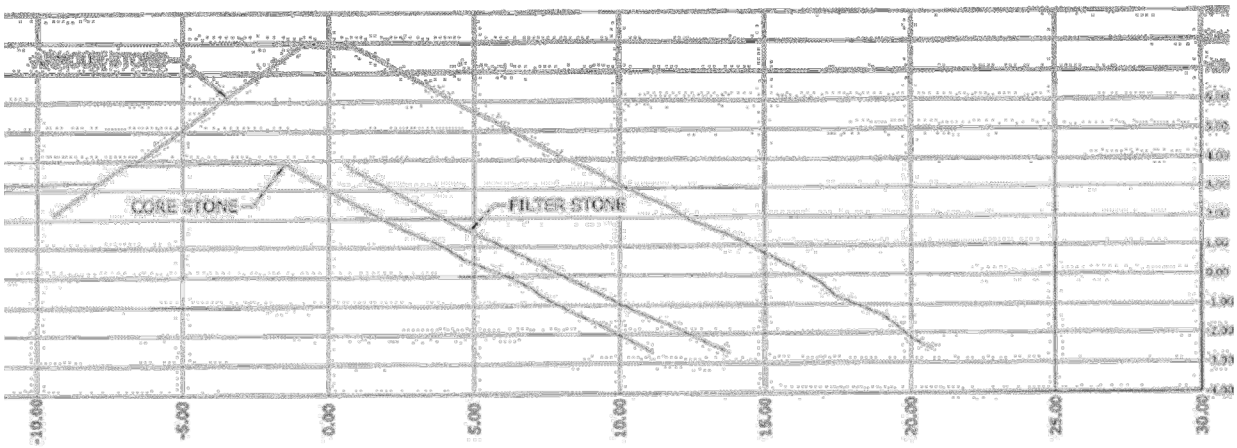


Figure 3 – 2016 As-Built Breakwater Survey

Table 5 below summarizes the design and as-built crest elevations:

Breakwater Crest Elevations (Geodetic)		
Cross Section Station	Design (m)	Actual (m)
0+050	7.55	7.8
0+075	7.55	7.8
0+125	7.55	7.8
0+175	7.55	7.8
0+225	7.55	7.8

Table 5 – Breakwater Crest Elevations

7.0 Conclusions and Recommendations

TEI performed an inspection of Dowden's Point breakwater in June 2022, and the breakwater structure, approximately six (6) years after construction is in very good condition.

Based on the documentation provided, the design life of the breakwater was 100-year minimum and the breakwater for the site was designed to withstand the expected worst-case conditions.

The Design Wave for the breakwater was taken as the 1:200-year Significant Wave Height (H_s). It is stated that a sea level rise of 1.0m will be included in the Design and no discussion of storm surge water levels is included.

Reference [5] Shore Protection Manual – Department of the Army US Corps of Engineers 1984 provide s the following discussion of Significant Wave vs. Design Wave

The wave height usually derived from statistical analysis of synoptic weather charts or other historical data to represent wave conditions in an extreme event is the significant height H_s. H_s may be further defined in approximate relation to other height parameters of the statistical wave height distribution in deep water:

- $H_{1/3}$ or H_s = average of highest 1/3 of all waves
- H_{10} = 1.27 H_s = average of highest 10 percent of all waves
- H_5 = 1.37 H_s = average of highest 5 percent of all waves
- H_1 = 1.67 H_s = average of highest 1 percent of all waves

Damage to rubble-mound structures is usually progressive, and an extended period of destructive wave action is required before a structure ceases to provide protection. It is therefore necessary in selecting a design wave to consider both frequency of occurrence of damaging waves and economics of construction, protection, and maintenance. If there is an increased frequency of waves in excess of the 1:200 year design height, Hs, the resulting effect could be progressive annual damage if left unaddressed. Here, a higher design wave of H_{10} or H_5 may be advisable. Selection of a design height between H_s and$_5$ is based on the following factors:

- Degree of structural damage tolerable and associated maintenance and repair costs (risk analysis and life-cycle costing).
- Availability of construction materials and equipment.
- Reliability of data used to estimate wave conditions.

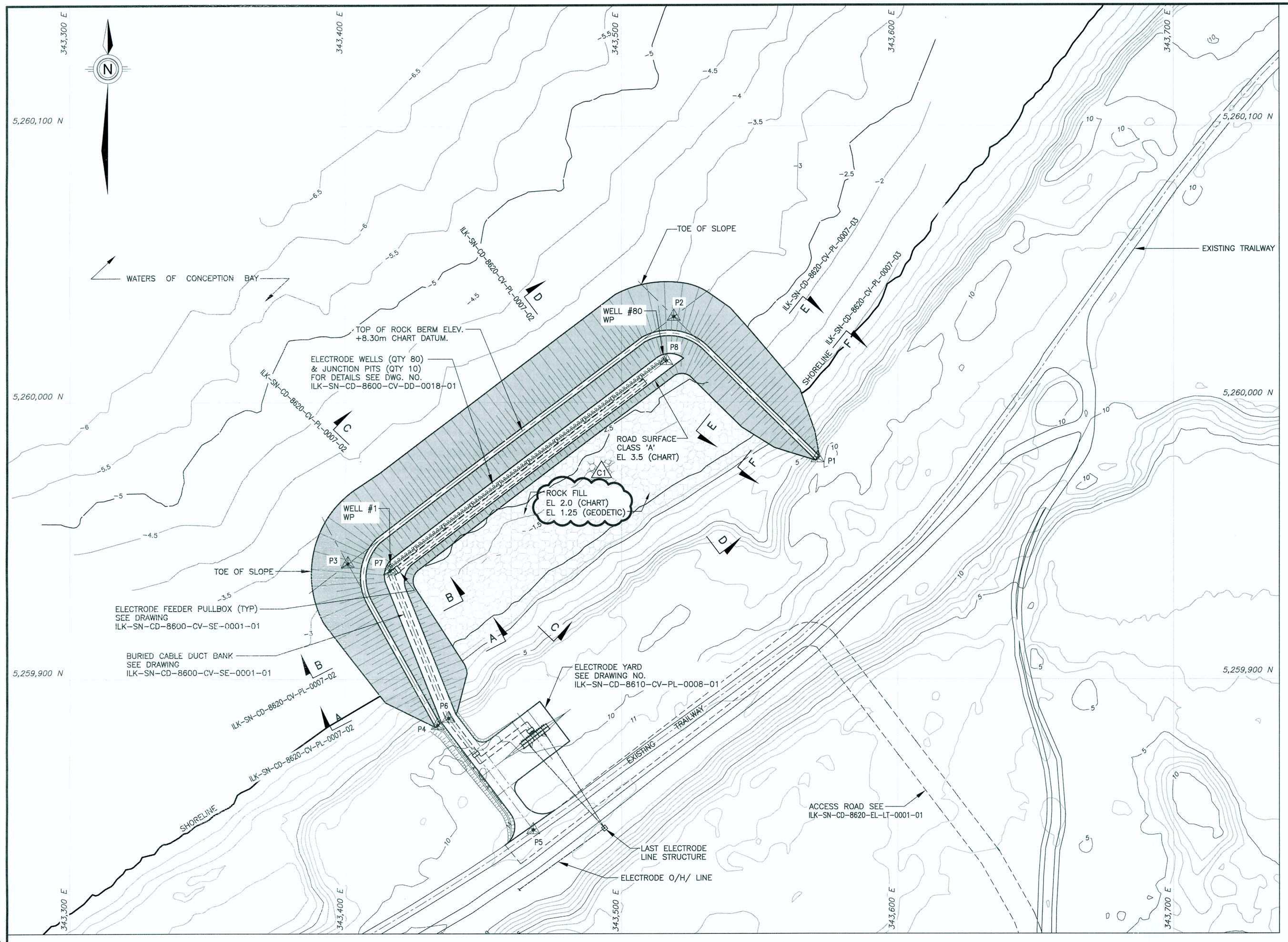
It appears that H_s for Dowden's Point breakwater was based on H_s 200 year return and appears it has been factored to account for other height parameters and sea level rise of 1.0m or storm surge. We consider this a valid design decision.

The risk of a wave damage to a rubble mound breakwater is considered less than the similar breakwater in L'anse Au Diable given the sheltered conditions of Dowden's Point in Conception Bay.

Given the economic importance of this breakwater in protecting the HVDC electrodes, and the global trend of larger and more frequent storms the factor of H_{10}, H_5, or H_1 could be considered if the owner would like to increase the long-term reliability for the breakwater structure at Dowden's Point. We would recommend continual inspection and monitoring of the breakwater to validate the current design and construction and whether the above consideration is required.

Appendix A

Design Drawings



BREAKWATER PLAN
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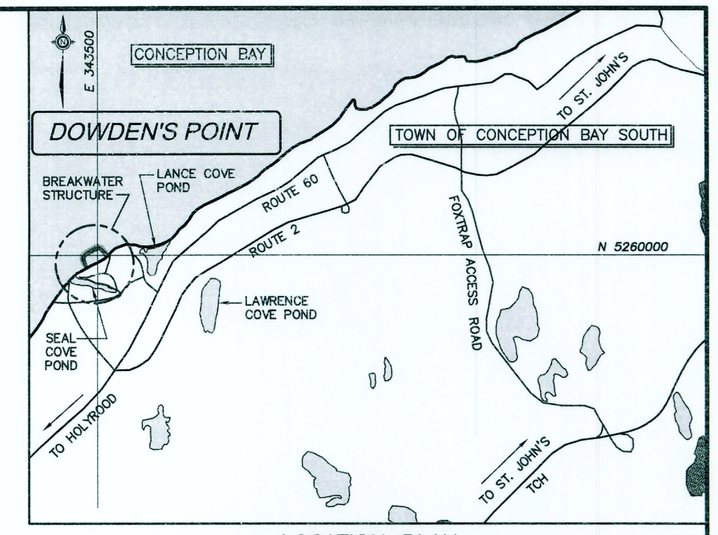

LOCATION PLAN

NOTES:

1. PROJECTION NAD 83 (CSRS) UTM ZONE 22
2. ALL BREAKWATER ELEVATIONS ARE IN CHART DATUM.
3. 0.0m GEODETIC = 0.75m CHART ELEVATION.
4. CHART DATUM ELEVATION REFERENCED FROM CANADIAN HYDROGRAPHIC SERVICE BENCHMARK 02F9150 & 62F9503.

LEGEND:

- TOPOGRAPHIC CONTOUR (GEODETIC)
- BATHYMETRIC CONTOUR (CHART)
- EMBANKMENT SLOPE
- BURIED CABLE DUCT BANKS
- ROCK FILL

LOCATION POINTS

POINT NO.	NORTHING	EASTING
P1	5,259,979.4	343,571.0
P2	5,260,031.1	343,519.0
P3	5,259,941.7	343,400.8
P4	5,259,883.3	343,433.3
P5	5,259,845.4	343,468.0
P6	5,259,885.9	343,437.3
P7	5,259,939.2	343,416.0
P8	5,260,015.0	343,516.3
WELL #1 WP	5,259,941.1	343,416.1
WELL #80 WP	5,260,016.2	343,515.4

C1

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1	B1	16-JAN-2014	ISSUED FOR BID

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ILK-SN-CD-8600-CV-DD-0018-01	ELECTRODE STATION – ELECTRODE WELLS PLANS AND SECTION
ILK-SN-CD-8600-CV-SE-0001-01	ELECTRODE SITES BURIED CABLE DUCT BANKS & PULL BOXES – DETAILS AND SECTIONS
ILK-SN-CD-8620-CV-PL-0008-01	DOWDEN'S POINT ELECTRODE STATION – YARD PLAN – SITE GRADING AND LEVELLING
ILK-SN-CD-8620-CV-PL-0007-03	DOWDEN'S POINT ELECTRODE STATION – BREAKWATER SECTIONS E AND F
ILK-SN-CD-8620-CV-PL-0007-02	DOWDEN'S POINT ELECTRODE STATION – BREAKWATER SECTIONS A, B, C AND D
ILK-SN-CD-8620-EL-LT-0001-01	DOWDEN'S POINT ELECTRODE STATION – GENERAL ARRANGEMENT PLAN

No.	DATE	REVISION	MOD.	VER.	APP.
C1	25-FEB-2015	ROCKFILL EL REVISED, LOCATION POINTS REVISED			
B3	11-JUN-2014	DESIGN OPTIMIZATION – GENERAL REVISION			

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LEAD REVIEWER: Blair McMillan — Date (dd-mmm-yyyy): 27-FEB-2015
NE-LCP MANAGEMENT: N/A — Date (dd-mmm-yyyy):
PROJECT MANAGER: — Date (dd-mmm-yyyy): 2 Mar 2015

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2015-02-27
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CLIENT: nalcor energy — LOWER CHURCHILL PROJECT

DESIGNED: N. GILLIS	APPROVED (Discipline Lead Engineer):
DRAWN: B. MURRAY/CMc	APPROVED (Engineering Manager):
VERIFIED: C. FUDGE	
DATE: 02-OCT-2013	SCALE: AS NOTED

PROJECT: LOWER CHURCHILL PROJECT
TITLE: DOWDEN'S POINT ELECTRODE STATION BREAKWATER PLAN

SLI DOC No.: 505573-8620-41DD-2002-SH1_03
NE DOC No.: ILK-SN-CD-8620-CV-PL-0007-01
Rev.: C1

FORMAT ANSI B (279x432)

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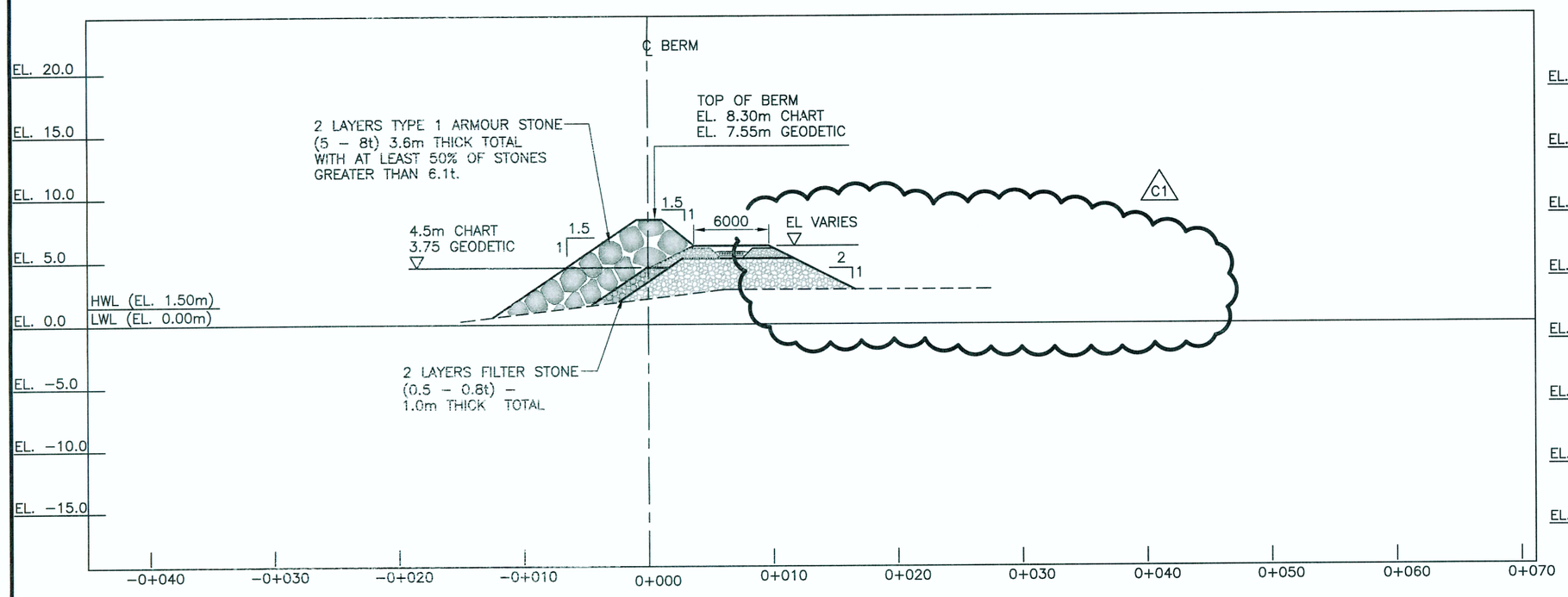

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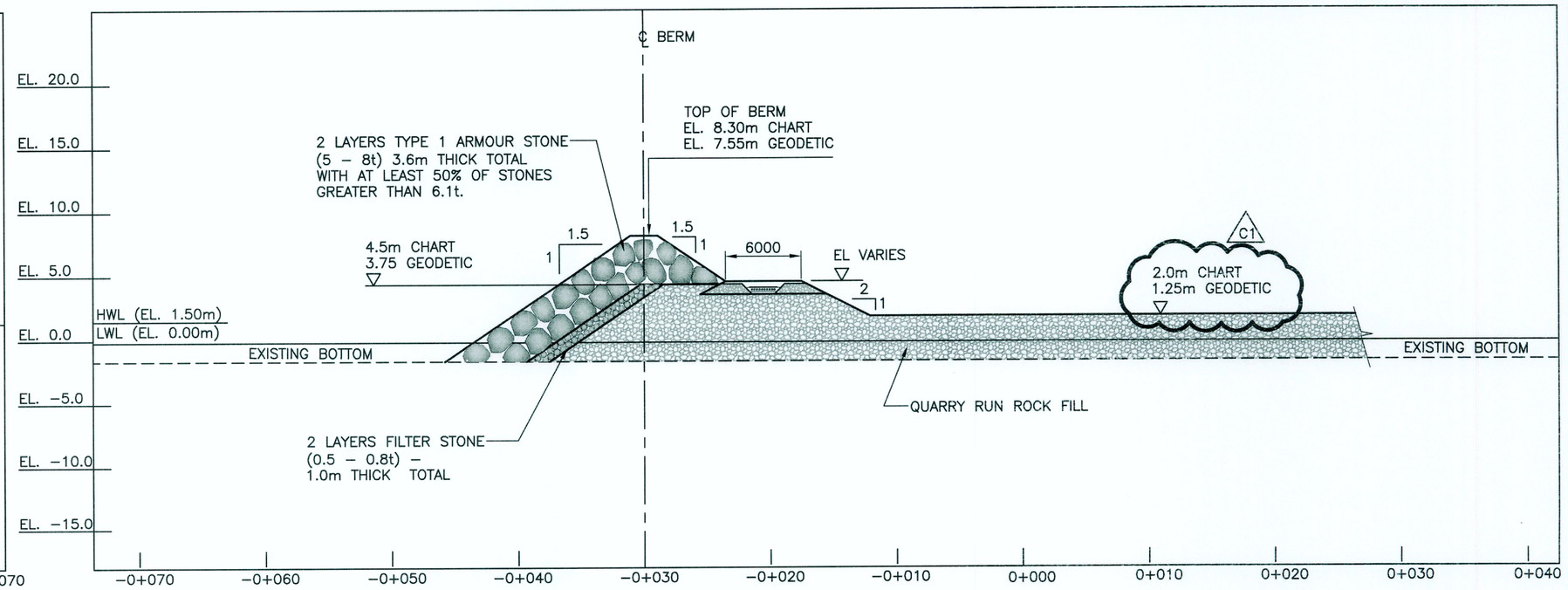

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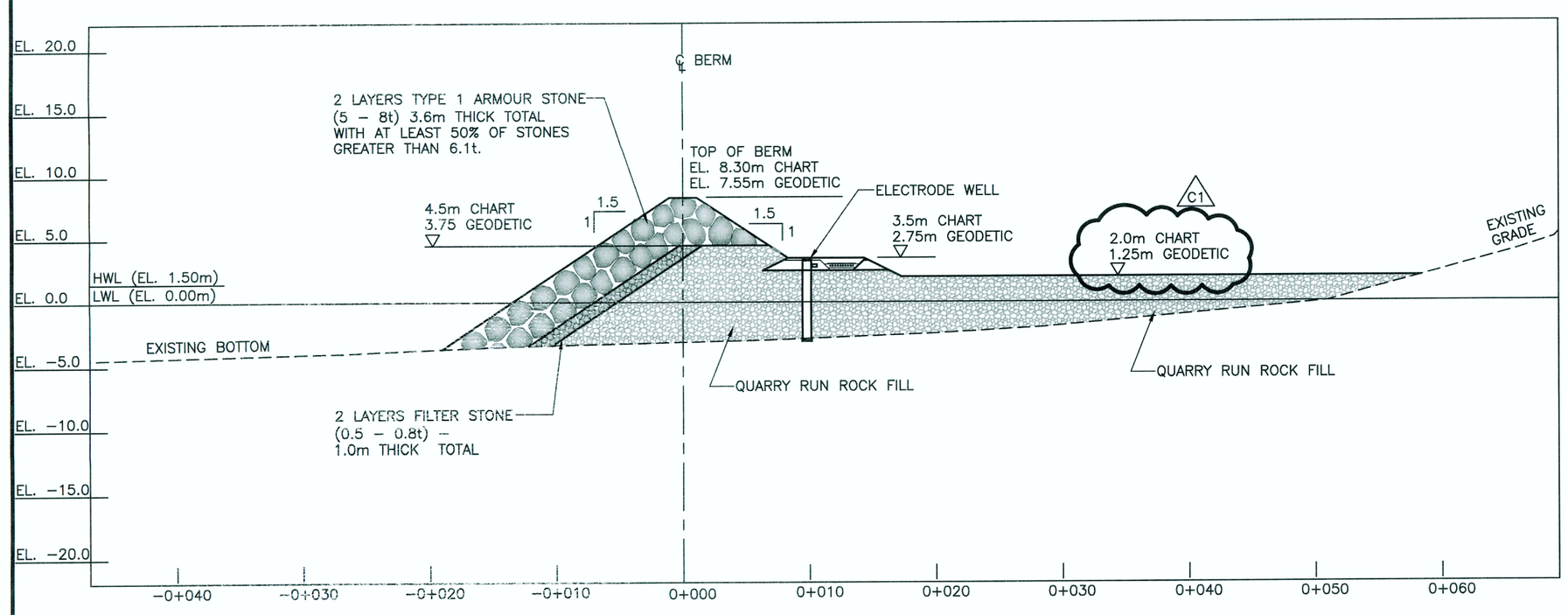

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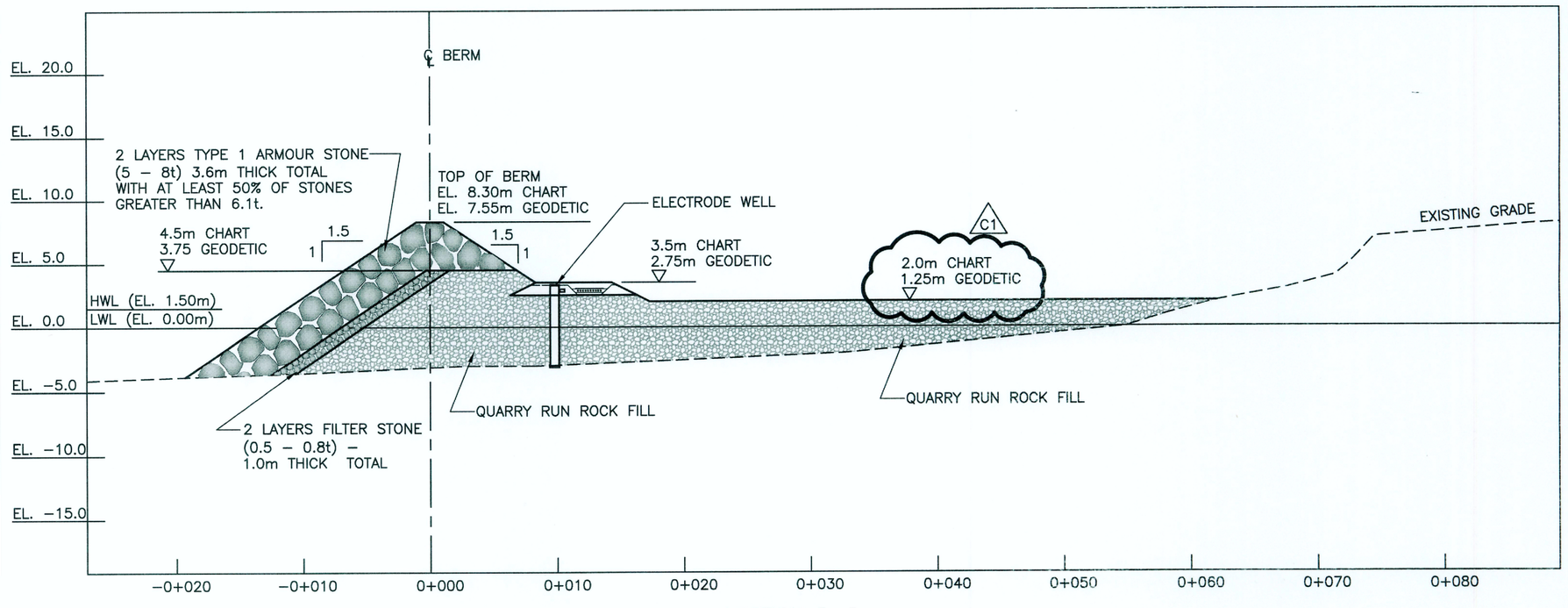

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SCALE: 1:300

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NOTES:

1. PROJECTION NAD 83 (CSRS) UTM ZONE 22
2. ALL BREAKWATER ELEVATIONS ARE IN CHART DATUM.
3. 0.0m GEODETIC = 0.75m CHART ELEVATION.

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ILK–SN–CD–8600–CV–DD–0019–01	ELECTRODE STATION – ELECTRODE WELLS – DETAILS
ILK–SN–CD–8600–CV–SE–0001–01	ELECTRODE SITES BURIED CABLE DUCT BANKS & PULL BOXES – DETAILS AND SECTIONS
ILK–SN–CD–8620–CV–PL–0007–01	DOWDEN'S POINT ELECTRODE STATION – BREAKWATER PLAN

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B2	11-JUNE-2014	DESIGN OPTIMIZATION – GENERAL REVISION			

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PROJECT MANAGER: — Date (dd-mmm-yyyy): 27-FEB-2015

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PEGNL Newfoundland and Labrador
CHRISTOPHER M. FUDGE
SIGNATURE
2015-02-27
DATE
NEWFOUNDLAND & LABRADOR

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DESIGNED N. GILLIS	APPROVED (Discipline Lead Engineer)
DRAWN B. MURRAY / G. LAING	APPROVED (Engineering Manager)
VERIFIED C. FUDGE	
DATE 03-OCT-2013	SCALE AS NOTED

CLIENT: nalcor energy — LOWER CHURCHILL PROJECT

PROJECT: LOWER CHURCHILL PROJECT

TITLE: DOWDEN'S POINT ELECTRODE STATION BREAKWATER SECTIONS A, B, C & D

SLI DOC No. 505573-8620-41DD-2002-SH2_02

NE DOC No. ILK–SN–CD–8620–CV–PL–0007–02

Rev. C1

FORMAT ANSI D (22"x34")

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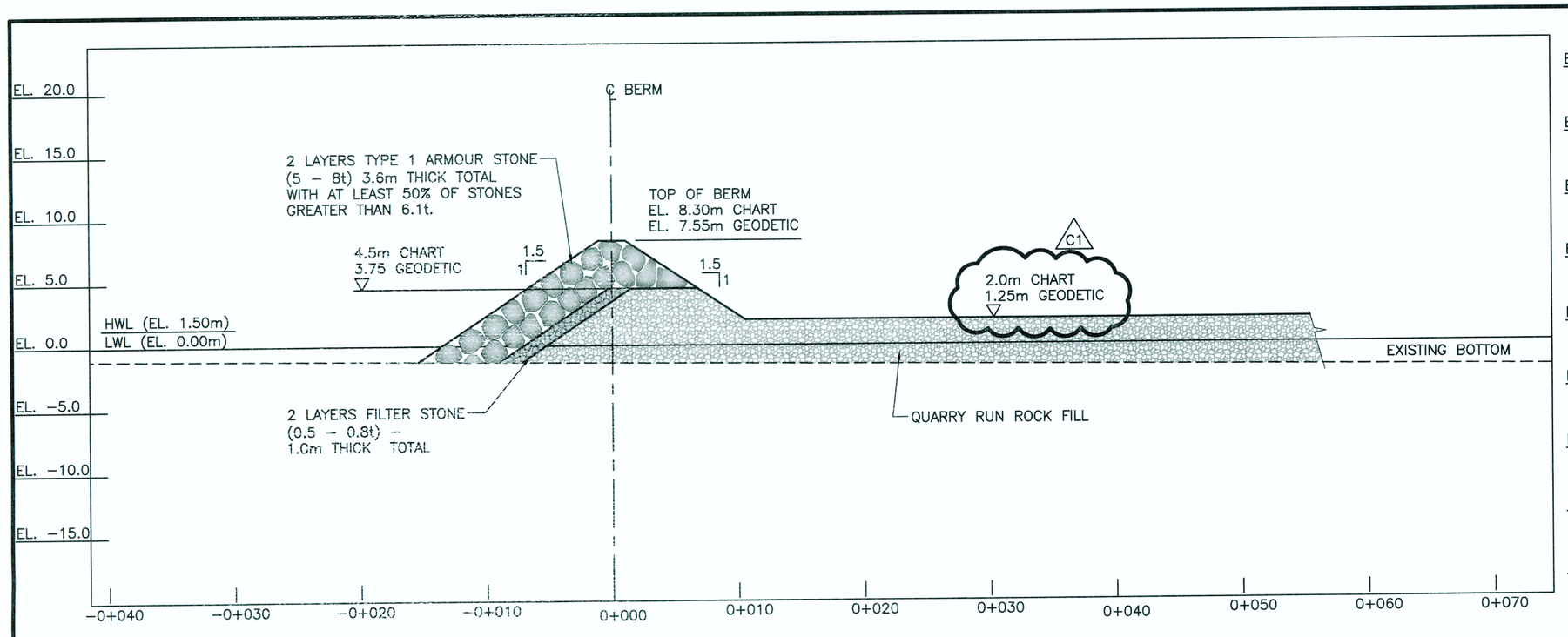
Updated Project Schedule for L'Anse au Diable Grounding Station Reliability and Resource Adequacy Study Review
Dowden's Point Grounding Station, Attachment 2, Page 14 of 15



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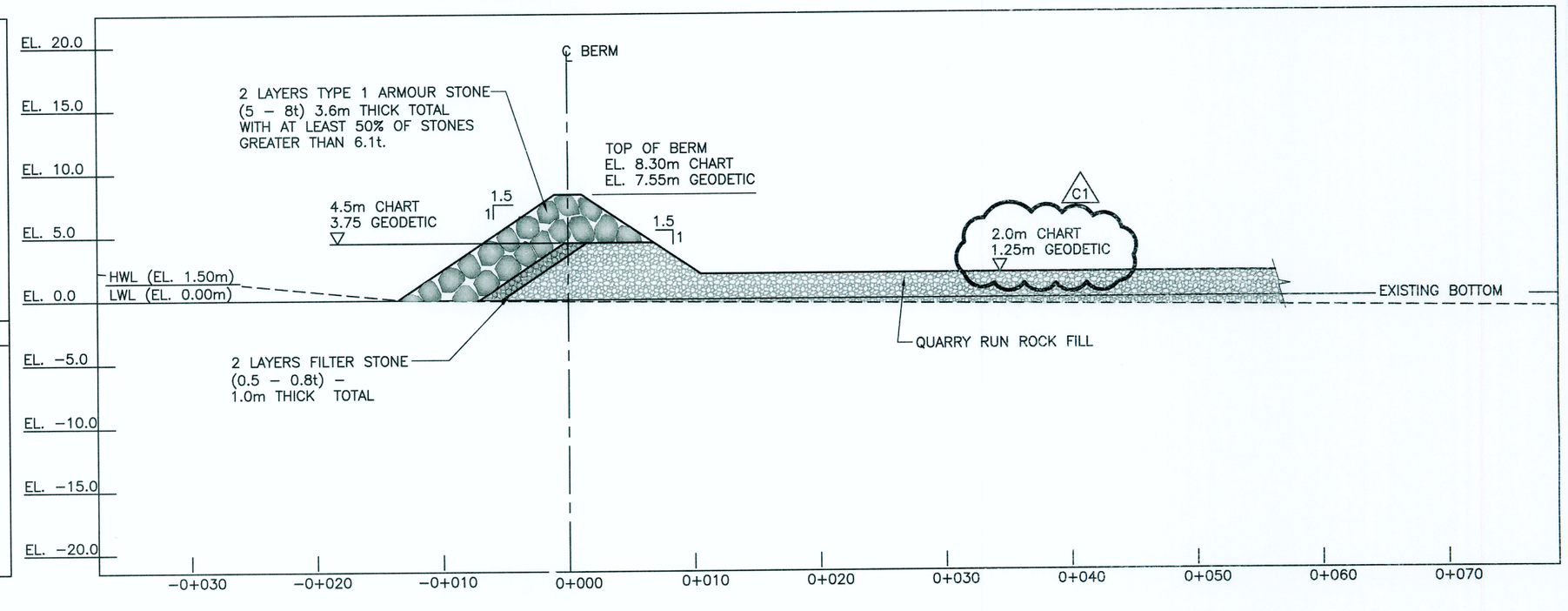

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3. 0.0m GEODETIC = 0.75m CHART ELEVATION.

0 5 10 15m

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ILK–SN–CD–8600–CV–SE–0001–01	ELECTRODE SITES BURIED CABLE DUCT BANKS & PULL BOXES – DETAILS AND SECTIONS
ILK–SN–CD–8620–CV–PL–0007–01	DOWDEN'S POINT ELECTRODE STATION – BREAKWATER PLAN

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C1	25–FEB–2015	ROCK FILL EL REVISED			
B2	11–JUNE–2014	DESIGN OPTIMIZATION – GENERAL REVISION			

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LEAD REVIEWER: Blair McKinnon Date (dd-mmm-yyyy): 27-FEB-2015
NE-LCP MANAGEMENT: N/A Date (dd-mmm-yyyy): —
PROJECT MANAGER: Date (dd-mmm-yyyy): 27 Feb 2015

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CLIENT: nalcor energy — LOWER CHURCHILL PROJECT

DESIGNED: N. GILLIS	APPROVED (Discipline Lead Engineer):
DRAWN: B. MURRAY / C. LAING	APPROVED (Engineering Manager):
VERIFIED: C. FUDGE	
DATE: 03–OCT–2013	SCALE: AS NOTED

PROJECT: LOWER CHURCHILL PROJECT

TITLE: DOWDEN'S POINT ELECTRODE STATION BREAKWATER SECTIONS E & F

SLI DOC No.: 505573–8620–41DD–2002–SH3_02

NE DOC No.: ILK–SN–CD–8620–CV–PL–0007–03

Rev.: C1

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Dowden's Point Grounding Station, Attachment 2, Page 15 of 15