Q. Preamble: Under Section 44 of the Water Resources Act, the Minister of Environment and Conservation has "Safety of Works", oversight duties with regards to Dam Safety. Under section 48 of the Act, all persons wishing to construct a dam must file an application in the form set out in Schedule C, which must contain a "Dam Safety Review Report" and an "Emergency Preparedness Plan".
Has a Schedule C Application, Dam Safety Review Report and Emergency Preparedness Plan been completed with respect to instability and potential catastrophic failure of the North Spur? If so, please provide a copy. If not, why not?

A. An application for a Permit to Alter a Body of Water requires a Schedule C form for each dam constructed pursuant to the application. Applicable Schedule C forms were included in the application filed with the Water Resources Division, Department of Environment and Conservation, Government of Newfoundland and Labrador for the works at Muskrat Falls. The entire package is available at http://muskratfalls.nalcorenergy.com/wp-content/uploads/2013/03/Muskrat-Falls_Update-to-DOEC-Permit_March-2013-Reduced-Size.pdf (attached as GRK-NLH-043 Attachment 1).

A Schedule C form is a description of the dam to be constructed. The statement that the Schedule C form must contain a Dam Safety Review Report and an Emergency Preparedness plan is incorrect. The permit issued by the Water Resources Division for Muskrat Falls and available at http://muskratfalls.nalcorenergy.com/wp-content/uploads/2013/03/Muskrat-Falls_WRD-Permit_Jul2013.pdf (attached as GRK-NLH-043 Attachment 2) requires that a Dam Safety Report be filed within two years of impoundment and that an Emergency Preparedness Plan be filed prior to impoundment.

As a Dam Safety Review (which forms the basis for the report) is based on an inspection of the actual dam, among other things, it cannot be completed until the dam is actually constructed.

Similarly, no hazards associated with the operation of the dam exist prior to impoundment, so the Emergency Preparedness Plan is not required until impoundment takes place.

nalcor energy
LOWER CHURCHILL PROJECT

Hydro Place. 500 Columbus Drive.
P.O. Box 12800. St. John's. NL
Canada A1B 0C9
t. 709.737.1833 or 1.888.576.5454
f. 709.737.1985

March 8, 2013

Department of Environment and Conservation
Water Resources Management Division
PO Box 8700,
St. John's NL A1B 4J6

Attention: Clyde McLean, Manager, Investigations Section

Subject: Update to Department of Environment and Conservation Permit Applications

Dear Mr. McLean:

Attached is the required documentation in application for the infrastructure required for the Muskrat Falls hydroelectric generation facility (activities listed below) for approval under the *Water Resources Act*, SNL 2002 c W-4.01. This application is for Schedule C (Dams), Schedule H (Other Alterations), Schedule E (Pipe Crossing) and Schedule F (Stream Modification).

Bulk Excavation and Associated Civil Works (Package CH0006) is scheduled between November 2012 and October 2013. The work includes but not limited to:

- Grubbing, stripping and excavation of the Switchyard, Powerhouse, Spillway and its related channels;
- Exploitation of borrow areas
- Construction of temporary rockfill cofferdams (Cofferdams No 1, 2, 3 and 4);
- Construction of Riverside RCC Cofferdam;
- Dewatering of the construction sites;
- Construction and maintenance of temporary Sedimentation Ponds No 1 and 2; to comply with criteria for Total Suspended Solids content of construction-altered water before releasing into a natural waterbody.
- Construction of Diversion Channel and Ditches (DOEC permit approval number ALT6480-2012) (permanent and temporary) to prevent the runoff water from adjacent areas from entering into construction zones.

Construction of Intake and Powerhouse, Spillway and Transition Dams (Package CH0007) is scheduled between September 2013 and May 2018. The work includes but is not limited to:

- Exploitation of a sand deposit as source for concrete sand; screening of natural material could be required; Production of concrete coarse aggregates, using rock stockpiled during the excavation at the spillway and powerhouse sites;
- Exploitation of concrete batch plants;
- Construction, maintenance, dust control and snow clearing of temporary roads, access ramps and laydown areas;
- Operation and maintenance of the dewatering systems;
- Exploitation and maintenance of the sedimentation ponds;
- Preparation of the foundation surface of the permanent structures;
- Curtain grouting and consolidation and contact grouting in the foundation of the permanent structures;
- Concreting, including reinforcement, anchors and dowels, of the permanent structures: Spillway, Intake Powerhouse, Transitions Dams and Separation Wall;
- Installation of primary anchors and templates for embedded parts for intake gates and trash racks, stoplogs for the spillway, etc;
- Supply and installation of structural steel and miscellaneous metalwork for the intake, powerhouse, spillway and transition dams;
- Supply and installation of embedded and exposed piping;
- Supply and installation of embedded conduits and accessories for electrical work;
- Supply and installation of materials for architectural works.

North Spur Stabilization Works (Package CH0008) is scheduled between April 2014 and November 2016. The work includes but not limited to:

- Grubbing, stripping and excavation works;
- Exploitation of borrow areas;
- Embankment works upstream, downstream and on the top of the North Spur;
- Construction of slurry cutoff walls;
- Construction of roads;
- Water Management works to comply with criteria for total suspended solids content of construction-altered water that is released into a natural water body.
- Construction of ditches (permanents and temporary) to prevent the runoff water from adjacent areas from entering construction zones.
- The work in the three kettle lakes outlet channel will include:
    - Clearing and grubbing on the slopes,
    - Re-profiling the natural slope to 2.5:1 to stabilize the slope,
    - Hydro seeding the re-graded slope at the end of the work,

- Filling the outlet channel bed by free draining rock fill material to facilitate long term drainage.

Construction of cofferdams in Churchill River and North and South Dams (Package CH0009) is scheduled between May 2015 and November 2016. The work includes but is not limited to:

- Grabbing, stripping and excavation of the North RCC dam, South rockfill dam, cofferdams and tailrace Rock Plug;
- Exploitation of borrow areas
- Construction of temporary rockfill cofferdams (upstream and downstream cofferdams) across the Churchill River;
- Construction of North RCC dam and South rockfill dam
- Construction and removal of intake cofferdam
- Removal of all temporary cofferdams and downstream part of riverside RCC cofferdam;
- Removal of temporary sedimentation ponds;
- Construction of temporary ditches to prevent the runoff water from adjacent areas from entering construction zones.

Please find attached the drawings related to these activities, current schedules of work, site hydrological data, scope of work, design information for sedimentation ponds and the schedules (Schedules C, E, F and H) required for this application.

It is anticipated that this work will take approximately four years to complete.

Please don't hesitate to contact me at (709) 737-4972 or by email at petermadden@nalcorenergy.com, if you have any questions.

Sincerely,

P. Madden

Peter Madden
Environmental Coordinator
Lower Churchill Project, Nalcor Energy

Permit Application Enclosures

Construction of Intake and Powerhouse, Spillway and Transition Dams (Package CH0007)

__ 2 Schedule C – Intake Channel Cofferdam
Gated Spillway
__ Schedule E –Powerhouse Intake
__ Updated Scope of Work
__ Drawing set
__ Estimated schedule of activities

North Spur Stabilization Works (Package CH0008)

__ Schedule F – Stream Modification Three Kettle Lakes
__ Scope of Work
__ Drawing set
__ Estimated schedule of activities

Construction of cofferdams in Churchill River and North and South Dams (Package CH0009)

__ 4 Schedule C – Upstream Cofferdam
Downstream Cofferdam
North RCC Dam
South Rockfill Dam
__ Schedule F – Stream Diversion
__ Package Dictionary
__ Drawing set
__ Estimated schedule of activities

__ Schedule H – Other Alterations (work within 15m of a waterbody) (Applicable to all packages)
__ Surface Water Hydrology Bulk Excavation Works Report
__ Preliminary Water Sampling Plan
__ General Environmental Requirements

Construction Package Schedules

Package	Activity	Date
CH0006	Construction of upstream portion of spillway approach channel and upstream cofferdam groins.	June - Sept-13

Package	Activity	Date
CH0007	Construction start	Sept 2013
CH0007	End of Spillway construction, ready for Churchill River diversion	May 2015
CH0007	Construction Headpond (water level raised to el. 25 m)	Oct. 2015
CH0007	Intake / Powerhouse, ready for impoundment	July 2016
CH0007	Impoundment (water level raised to el. 39.1 m)	May 2017
CH0007	Starting testing first group	Sep 2017
CH0007	All four units ready	May 2018

Package	Activity	Date
CH0008	On-Site Start Date- Required Construction Start	Apr-14
CH0008	Excavation and embankment works on upstream area up to elevation 28.0 m completed	Nov-15
CH0008	Excavation and embankment works on downstream area up to elevation 25.0 m completed	Nov-15
CH0008	Upstream cutoff wall construction completed	Nov-15
CH0008	NW cutoff wall construction completed	Nov-15
CH0008	Excavation and embankment works on upstream area above elevation 28.0 m completed	Nov-16
CH0008	Excavation and embankment works on downstream area above elevation 25.0 m completed	Nov-16

Package	Activity	Date
CH0009	On-Site Start Date- Required Construction Start	May-15
CH0009	Dismantlement of Cofferdams 1 and 2 in the spillway channels	Aug-15
CH0009	Upstream cofferdam construction start	Aug-15
CH0009	Upstream cofferdam construction completed	Oct-15
CH0009	Downstream cofferdam construction start	Oct-15
CH0009	Downstream cofferdam construction completed	Nov-15
CH0009	Construction of the North RCC Dam start	Oct-15
CH0009	Construction of the North RCC Dam completed	Nov-16
CH0009	Dismantlement of Cofferdam 3 in the tailrace channel	Nov-16
CH0009	Excavation of rock plug in the tailrace channel	Nov-16

Government of Newfoundland and Labrador
Department of Environment and Conservation
Water Resources Management Division

Application for Permit to Alter a Body of Water

As required under **Section 48** of the *Water Resources Act*, SNL 2002 c W-4.01

APPLICATION CHECKLIST (The following information must accompany your application):

- G 'Application for Permit to Alter a Body of Water' (this form)
- G Schedules 'A' to 'H' (as appropriate)
- G 'Fee Schedule' and application fee payment (or proof of payment)
- G Location map (1:50,000 scale) and/or UTM coordinates indicating location of project
- G Proof of Land Ownership (for Schedule H)

IF ASSISTANCE IS REQUIRED IN COMPLETING THESE FORMS PLEASE CALL 729-2945 or 729-5713.

YOUR APPLICATION WILL NOT BE PROCESSED AND MAY BE RETURNED IF ANY OF THE ABOVE INFORMATION IS NOT PROVIDED WITH YOUR APPLICATION OR IS NOT COMPLETED IN SUFFICIENT DETAIL.

Please mail completed Application Forms to:

Department of Environment and Conservation
Water Resources Management Division
PO Box 8700, St. John's NL A1B 4J6
Attention: Clyde McLean, Manager, Investigations Section

Applicant Information:

Name/Company/Agency: Nalcor Energy
Contact Person: Peter Madden
Address: Street/PO Box: Hydro Place, 500 Columbus Drive, P.O Box 12800
City/Town: St. John's
Province: NL Postal Code: A1B 0C9
Telephone No.: (709) 737-4972 Fax No.: (709) 737-1985
E-mail Address: PeterMadden@nalcorenergy.com

Owner Information: X Same as above, or

Name/Company/Agency: _____
Contact Person: _____
Address: _____
Street/PO Box: _____
City/Town: _____
Province: _____ Postal Code: _____
Telephone No.: ( ) _____ Fax No.: ( ) _____
E-mail Address: _____

Alteration Type:

Please select the Applicable Type(s) and attach completed Schedule(s) for each:

Type	Check (x)	Required Schedule
Culvert		Schedule A
Bridge		Schedule B
Dam	X	Schedule C
Fording		Schedule D
Pipe Crossing/Water Intake	X	Schedule E
Stream Modification or Diversion	X	Schedule F
Pedestrian/ATV/Snowmobile Bridge		Schedule G
Other works within 15 metres of a body of water ie: Wharf, Boathouse, Infilling, Landscaping, Dredging, Debris Removal, Drainage Works, Settling Ponds, Other Minor Works	X	Schedule H

Project Information:

Project Name: Lower Churchill Project

Water Body Name: Muskrat Falls

Community Name: _____

Area (if outside a community): Muskrat Falls

Is this project located in a Protected Public Water Supply Area? Yes No X

Proposed Start Date: Sept-2013 **Estimated Completion Date**: Nov-2016

Reason(s) for the Project: _ To construct the Muskrat Falls Hydro Generating Station

Date: 03- Oct-2012 **Signature:** S. Hodder

CH0007

Construction of Intake and Powerhouse, Spillway and Transition Dams

Schedule C - Dam

Project Description
(Please complete one Schedule for each dam)

Dam Name: Intake Channel Cofferdam **Project Name**: _Lower Churchill Project_____

Location:
Please mark location on a copy of a topographic map (preferably at 1:50,000 scale) and include with the application:

1:50,000 Topographic Map No: _____

or provide UTM Coordinates:

N ___5901693_____ E ____649168_____ NAD ___83_____ ZONE ____20____

Design

Purpose of Dam:

x Hydroelectric □ Water Supply Intake □ Tailings □ Other _____

Drainage Area Profile:

Drainage Area: ____92,500_____ km^2

Main Channel Length: _____288_____ km

Slope of Drainage Area:_____0.037_____ %

Drainage Area Classification:

Forest: _____%

Barren: _____%

Wetland: _____%

Urban: _____%

Inflow Design Flood:

Return Period: 1: ___20_____ years Max Inflow: __5,990____ m^3/s

Probable Max Flood (PMF): __25,060_____ m^3/s

Description of Estimation:

Please show sample calculation(s) below or attach separate sheets, if required.

_____

_____

_____

_____

_____

_____

_____

Design (Cont'd)

Dam Details: (Please attach detailed drawings and specifications)

Dam Material:

□ Concrete x Earth fill □ Treated Timber □ Untreated Timber □ Other_____

Dam Height:	_____ m	Freeboard:	_____1_____ m
Crest of Dam:	_____26_____ m	Crest of Spillway:	___ N/A _____ m
Sill of Control Gate: (or Sluice Gate)	_____N/A_____ m	Storage Capacity:	____ N/A _____ m
Max Water Elevation:	____25.0_____ m	Min Water Elevation:	_____8_____ m
Normal Operation Elev:	___15.0_____ m	Spillway Capacity:	____ N/A _____ m
Control Gate Capacity:	____N/A_____ m/s	Penstock Capacity:	_____ N/A _____ m/s

Dam Safety

Dam Safety Classification: (as per CDA Guidelines Consequence Category)

□ Very High □ High □ Low □ Very Low

Please attach a Dam Safety Review Report. If not available, please indicate when the report will be completed: _____

Construction (Please attach separate sheets, if required)

Equipment to be used: _____

Proposed dewatering method(s): _____

Briefly describe how erosion control and stabilization will be carried out:
_____See attached General Environmental Requirements_____
_____
_____
_____
_____

Briefly describe how site restoration will be carried out: _____
See attached General Environmental Requirements _____
_____
_____
_____
_____

Technical guidelines, departmental policies and application forms are available at:
www.gov.nl.ca/env/water

Schedule C - Dam

Project Description
(Please complete one Schedule for each dam)

Dam Name: Gated Spillway___ **Project Name**: _Lower Churchill Project_____

Location:
Please mark location on a copy of a topographic map (preferably at 1:50,000 scale) and include with the application:

1:50,000 Topographic Map No: _____

or provide UTM Coordinates:

N ___5901850_____ E ____649097_____ NAD ___83_____ ZONE ___20_____

Design

Purpose of Dam:

x Hydroelectric □ Water Supply Intake □ Tailings □ Other _____

Drainage Area Profile:

Drainage Area: __92,500_____ km^2

Main Channel Length: _____288_____ km

Slope of Drainage Area:____0.037_____ %

Drainage Area Classification:

Forest: _____%

Barren: _____%

Wetland: _____%

Urban: _____%

Inflow Design Flood:

Return Period: 1: __PMF_____ years Max Inflow: __25,060___ m^3/s

Probable Max Flood (PMF): ___25,060___ m^3/s

Description of Estimation:

Please show sample calculation(s) below or attach separate sheets, if required.

While the gated spillway structure is designed to withstand the forces exerted by the PMF flood, it is not designed to pass the associated discharge. During PMF, the gated spillway will work with the North RCC Dam (which is an overflow spillway with a crest at el. 39.3 and length 430m). The routed peak flow of both spillways together is designed to pass the PMF. For flows less than the total capacity of the gated spillway, the gated spillway is the primary spillway.

Design (Cont'd)

Dam Details: (Please attach detailed drawings and specifications)

Dam Material:

x Concrete □ Earth fill □ Treated Timber □ Untreated Timber □ Other_____

Dam Height:	_____ m	Freeboard:	_____0.4_____ m
Crest of Dam:	_____45.5_____ m	Crest of Spillway:	___18.0_____ m
Sill of Control Gate:	_____41.0____ m	Live Storage Capacity:	___$50x10^6$_____ m^3
		Total Storage Capacity:	_$2150x10^6$_ m^3 at PMF

(or Sluice Gate)

Max Water Elevation:	___45.1_____ m	Min Water Elevation:	____38.5_____ m
Normal Operation Elev:	___39.0_____ m	Spillway Capacity:	____14,500_____ m^3/s
Control Gate Capacity:	___2900_____ m^3/s	Penstock Capacity:	_____N/A_____ m/s

Dam Safety

Dam Safety Classification: (as per CDA Guidelines Consequence Category)

□ Very High □ High □ Low □ Very Low

Please attach a Dam Safety Review Report. If not available, please indicate when the report will be completed: _____

Construction (Please attach separate sheets, if required)

Equipment to be used: _____

Proposed dewatering method(s): _____

Briefly describe how erosion control and stabilization will be carried out:
_____See attached General Environmental Requirements_____
_____
_____
_____
_____

Briefly describe how site restoration will be carried out: _____
See attached General Environmental Requirements_____
_____
_____
_____

Technical guidelines, departmental policies and application forms are available at:
www.gov.nl.ca/env/water

Schedule E - Pipe Crossing/Water Intake

Project Description
(Please complete one Schedule for each installation)

Location:

Crossing Name/No: _Churchill River_____

Please mark location on a copy of a topographic map (preferably at 1:50,000 scale) and include with the application:

1:50,000 Topographic Map No: _____

or provide UTM Coordinates:

N __5901693____ E _____649468___ NAD ___83____ ZONE ___20___

Design

Pipe Description:

Pipe Material: □ Ductile Iron □ PVC □ HDPE □ Reinforced Concrete
□ Other _____

Pipe Diameter: _____ mm

Reason for Pipe Crossing/Intake:

□ Sanitary Sewer x Electrical □ Fuel □ Water Supply

□ Other _____

Channel Description at the Proposed Crossing Location:

On the next page, or on separate sheets, please show the crossing/intake details, including:

- Top width of channel
- Bottom width of channel
- Depth of channel
- Shape and slope of embankments
- High water level
- Slope of channel
- Pipe diameter
- Depth of burial below stream bed
- Dimensions of concrete encasement (If required)

Detailed Dimensioned Drawing(s) (or provide on separate sheets)

See attached drawing

Construction

Equipment to be used**:** __Batch plant, crane, trucks, concrete pumps, etc. _____

Proposed dewatering method: __Pumps, sedimentation ponds, ditches, trenches

Briefly describe how erosion control and stabilization will be carried out:

___See Attached General Environmental Specifications

_____

_____

Briefly describe how site restoration will be carried out:

See Attached General Environmental Specifications

_____

_____

_____

Technical guidelines, departmental policies and application forms are available at:
www.gov.nl.ca/env/water

CH0007

CONSTRUCTION OF INTAKE AND POWERHOUSE, SPILLWAY AND TRANSITION DAMS

SCOPE OF WORK SPECIFICATION

Prepared by: _____
Andre Mosser
Package Engineer (Hydro Generation)

Checked by: _____
Stephen Chorny
Lead Civil Engineer (Hydro Generation)

Approved by: _____
Greg Snyder
Engineering Manager

Approved by: _____
Luc Turcotte
Area Manager - Powerhouse

REVISION LIST

Revision						Remarks
N°	By	Verif.	Appr.	Appr.	Date	
05	AM	SC	GS	LT	11-Feb-2013	Issued for Addendum 10
04	AM	SC	GS	LT	30-Nov-2012	Issued for Addendum 3
03	AM	SC	GS	LT	25-Oct-2012	Re-Issued for Addendum 1
02	AM	SC	GS	LT	17-Oct-2012	Issued for Addendum 1
01	FR	SC	GS	LT	12-Sep-2012	Re-issued for Bid
00	FR	HB	GS	LT	20-Aug-2012	Issued for Bid
PA	FR	HB	GS	LT	09-Aug-2012	Issued for internal coordination.

TABLE OF CONTENTS
SCOPE OF WORK

PART 1 GENERAL

1.1 PROJECT DESCRIPTION

1.1.1 The Lower Churchill Project (LCP) located on the Churchill River in the Province of Newfoundland and Labrador, Canada, consists of the Muskrat Falls Generating Station with a capacity of eight hundred and twenty-four megawatts (824 MW) and associated transmission line works.

1.1.2 The project Site for Muskrat Falls is located on the lower reaches of the Churchill River approximately 35 km west of the Town of Happy Valley – Goose Bay. Permanent access to the Site is from the south shore, via a road extension from the existing Trans Labrador Highway. The Muskrat Falls Hydroelectric Development consists of the following main components:

.1 Main access road, including upgrading and construction of over 22 km of new road with several stream crossings;

.2 Approximately 20 km of Site roads to be constructed to reach the main structures, laydown areas, accommodation complex, borrow areas and spoil disposal area;

.3 1,500 person accommodation complex;

.4 Contractor and Company's laydown areas;

.5 Reservoir preparation including some 130 km of forest access road, forest harvesting, and bank stabilization;

.6 Intake, Powerhouse, Spillway, Transition Dams, North RCC Dam and South Dam;

.7 North Spur stabilization works;

.8 Switchyards at Muskrat Falls and Churchill Falls;

2 .9 High voltage AC and DC overhead transmission lines and associated infrastructure; and AC/DC converter stations at Muskrat Falls and Soldiers Pond;

.10 Environmental habitat (fish and terrestrial) protection, remediation and replacement.

1.2 GENERAL DESCRIPTION OF PACKAGE CH0007

1.2.1 The Intake and Powerhouse, Spillway and Transition Dams Package (CH0007) consists generally of the construction of the Intake, Powerhouse, Spillway complete with Upstream and Downstream Permanent Bridges, Downstream Temporary Bridge, South, Centre and North Transition Dams, Separation Wall, concrete lining of Discharge Channel, access road between the Powerhouse and the Spillway, the Underground Piping and Duct Banks between the Powerhouse and the Switchyard and related work as described herein, in the Technical Specification and shown on the Drawings. 2

1.3 LANGUAGE AND UNITS

1.3.1 The language to be used for all nameplates and documentation is English.

1.3.2 The units of measurement shall be the International System of Units (SI).

1.3.3 All instruments graduations and inscriptions shall comply with the SI system.

1.4 CLIMATIC DATA

1.4.1 The Climatological Data is included in Exhibit 11 - Company Supplied Documents.

1.5 HYDROMETEOROLOGICAL DATA

1.5.1 Hydrometeorological data is summarized on Drawing MFA-SN-CD-2000-CV-DD-0003-01, Exhibit 1. 1

PART 2 SCOPE OF WORK

2.1 WORK INCLUDED

2.1.1 The work listed in this Scope of Work Specification includes the supply of all labour, materials and equipment and the execution of all work required to construct all structures and related works as called for in the Technical Specification, as shown on the Drawings and as specified herein.

2 **2.1.2** The term Technical Specification, refers to the document MFA-SN-CD-3300-CV-TS-0001, Exhibit 1.

2.1.3 The Work includes, but is not limited to:

.1 Civil, Geotechnical/Embankment Work

.1 Design, construction, maintenance, relocation, if required, and removal of all temporary construction roads to borrow pits, stockpile and spoil disposal areas, access ramps and work areas and as necessary for the execution of the work as specified in the Contract or as indicated on the Drawings or as required by the Engineer;

.2 Clearing, grubbing and stripping of the borrow areas and their access roads where needed;

5 .3 Maintenance, dust control and snow clearing of all roads (temporary and permanent), access ramps, work areas, as well as the Contractor's and Owner's Laydown Areas and Camp roads (excluding walkways) during the work period;

2 .4 Exploitation of borrow areas and rockfill stockpile areas, including material processing and transportation, and rehabilitation of these Sites at the end of the Work;

3 2 .5 Operation and maintenance of the existing dewatering systems and if required, design, supply, installation, operation and maintenance of additional necessary dewatering systems. This includes coordination with the Engineer for the dewatering layout and its integration with the permanent equipment. This also includes the removal of the dewatering systems at the end of the work;

2 1 .6 Operation and maintenance of sedimentation ponds with associated ditches;

.7 Not used;

.8 Construction of the access road between the powerhouse and the spillway, including its maintenance during the work;

.9 Removal of sand layer, placed for winter protection, on the foundations of transition dams and spillway;

2 .10 Foundation preparation including dental excavation and scaling at the separation wall, south, centre and north transition dams;

.11 Drilling for grouting, drainage, exploration and instrumentation, as indicated on the Drawings or as required by the Engineer;

2 .12 Curtain grouting, consolidation grouting and contact grouting in the powerhouse, intake, south, centre and north transition dams and spillway foundations, including supply and installation of PVC pipe sleeves in concrete and installation and removal of the temporary instrumentation for grouting;

4 .13 Excavation and backfill work for the tile field, underground piping between the Powerhouse and the tile field;

.14 Excavation and backfill work for the electrical duct banks between the Powerhouse and the Switchyard;

.15 Supply and installation of permanent geotechnical instrumentation as shown on the Drawings;

.16 Removal of existing temporary fence around the top of the rock excavations in the structure areas;

2 .17 Supply, installation and grounding of the chain link fences and gates in the powerhouse parking area and in the Contractor's laydown area.

.2 Design, supply, installation and subsequent dismantlement and handover of the temporary downstream bridge over the spillway;

.3 Supply, installation and subsequent removal of temporary lateral support and bracing for piers of the spillway, as shown on the Drawings.

.4 Concrete Work.

1 The Work described in this section includes: supply, transporting, handling, placing, finishing and curing of all concrete (including mix design and testing of the mix design); the design, construction, erection, maintenance and removal of all formwork and falsework; removal of the existing chain link wire mesh from excavated rock surfaces in the structure areas; all as called for the in the Technical Specification, as shown on the Drawings and specified herein.

Intake and Powerhouse

.1 Supply and placing of concrete for the intake and powerhouse substructure, including south and north service bays, gate hoist building, downstream tailrace deck, oil/separator, retaining basins and bases for GSU transformers, retaining walls, slab on grade at the powerhouse entrance and as indicated on the Drawings;

2 1 .2 Supply and placing of secondary concrete for the draft tube liner, stayring and generator pit cover at El. 15.5 m;

.3 Supply and placing of overbreak concrete which is placed between the minimal excavation line and the actual rock surface;

.4 Supply and placing of concrete for duct banks between the powerhouse and the Switchyard;

.5 Supply and placing of backfill concrete in areas where the surface of natural bedrock is located below level shown on the Drawings or as indicated on the Drawings or as required by the Engineer;

1 .6 Supply and placing of grout for base plates, rails and any component supplied and installed by Contractor;

.7 Supply and installation of water stops;

2 .8 Sealing of contraction and control joints, including supply and installation of asphalt impregnated fibre board;

.9 Supply and installation of the bituminous coating at contraction joints;

2 .10 Supply and installation of the prefabricated concrete fire walls at the tailrace deck and between the GSU transformers (above El. 16.80 m);

3 .11 Supply and placing of concrete for the retaining wall at the powerhouse parking area.

Spillway, Separation Wall and Discharge Channel

.1 Supply and placing of concrete for the spillway, including base slab, piers and rollways;

.2 Supply and placing of concrete for the upstream and downstream bridge deck for the spillway;

2 .3 Supply and placing of concrete for the separation wall;

.4 Supply and placing of Phase 1 concrete liner for the discharge channel for the spillway;

2 .5 Supply and placing of Phase 2 and Phase 3 of the concrete lining for the spillway discharge channel to be completed after impoundment if required by Company based on assessment of erosion. Provide optional prices for such activities where indicated in the Schedule of Price Breakdown;

.6 Supply and placing of overbreak concrete which is placed between the minimal excavation line and the actual rock surface;

.7 Supply and placing of concrete for the retaining walls for the access road between the powerhouse and the spillway;

.8 Supply and placing of grout for base plates, rails and any component supplied and installed by Contractor;

1 .9 Supply and placing of water stops;

.10 Supply and installation of the bituminous coating at contraction joints.

Transition Dams and Elevated Deck for Electrical Building

2 .1 Supply and placing of concrete for the centre transition dam, including concrete bases for the elevated deck for electrical building, diesel fuel tank and stairs;

.2 Supply and placing of concrete for the north transition dam including the connection section with the existing RCC cofferdam and concrete base for stairs;

1 .3 Supply and placing of grout for base plates, rails and any component supplied and installed by Contractor;

.4 Supply and placing of water stops;

1 .5 Supply and installation of the bituminous coating at contraction joints;

2 .6 Supply and placing of concrete for the South Transition Dam, including the retaining wall for the South Rockfill Dam.

.5 Reinforcement, Anchors and Dowels

1 .1 Supply, fabrication and placing of reinforcement (reinforcing steel), including supply of all tie wire, spacers and supports, all as shown on the Drawings and indicated in the Technical Specification; includes the preparation of the bar lists and the placement Drawings from the engineering Drawings provided by the Engineer, those documents shall be submitted to the Engineer for approval before any fabrication is done;

.2 Supply and installation of threaded rebars with Couplers;

2 .3 Drilling, grouting, installing and testing rock dowels, all as shown on the Drawings;

1 .4 Drilling of the holes for anchors with epoxy adhesive.

.6 Installation of primary anchors and template supplied by Company's Other Contractors as follows:

1 .1 Installation of primary anchors and template in primary concrete, for the embedded parts for intake bulkhead gates and trash racks;

.2 Installation of primary anchors and template in primary concrete, for the embedded parts for intake- gates;

.3 Installation of primary anchors and template in primary concrete, for the embedded parts for the draft tube stoplogs;

2 1 .4 Installation of primary anchors and embedded parts in primary concrete, for turbine-generator units including the semi spiral case access door;

.5 Installation of primary anchors and template in primary concrete for the embedded parts for the furthest upstream set of stoplogs for the spillway;

.6 Installation of primary anchors and template in primary concrete, for the embedded parts for the second upstream set of stoplogs for the spillway;

2 .7 Installation of primary anchors and on templates and miscellaneous embedded steel in primary concrete, for the embedded parts for spillway gates;

.8 Installation of primary anchors and template in primary concrete, for the embedded parts for downstream stoplogs for the spillway;

1 .9 Installation of liner plates in the sides of piers downstream of the spillway gates;

.10 Installation of concrete anchors, in the primary concrete piers for the spillway gate hoist towers and steel walkways.

.7 Structural Steel and Miscellaneous Metalwork

The Work described in this section includes the supply, fabrication, painting, galvanizing or metallization if required, inspection and testing, connection design, shop Drawings, transportation to the Site and installation of structural steel, miscellaneous metals and embedded parts, etc., all as called in the Technical Specification, as shown on the Drawings and specified herein.

Intake and Powerhouse

2 .1 Supply and installation of the structural steel for the superstructure and mezzanines. The protective coatings shall be as per the Structural Steel Technical Specification, using intumescent painting where required;

.2 Supply and installation of all miscellaneous metals for the powerhouse and the intake, including access and service platforms, hatch and trench covers, stairs, ladders, grating, handrails and guardrails;

.3 Supply and installation of all embedded miscellaneous metals for the powerhouse and the intake (frames, L-shapes, sleeves, anchor bolts etc.);

2 .4 Supply and installation of the runway rails with Gantrex fastening system for the overhead cranes inside the powerhouse and at the draft tube gallery;

.5 Supply and installation of the gantry rails on the intake road deck for the trash cleaning system, including fastening system and accessories;

.6 Supply and installation of support beam at the top of the elevator shaft;

.7 Supply and installation of the monorail supporting beam in the dewatering gallery;

.8 Supply and installation of the connections for the steel superstructure at column lines, to the downstream face of the intake for primary lateral support;

.9 Supply and installation of the building column anchor bolts, including base plates, as well as the supply and installation of double templates for the correct positioning of the anchor bolts;

.10 Supply and installation of all concrete anchorages required for the installation of the miscellaneous metal work;

.11 Supply and installation of stainless steel anchor points at locations to be determined by Company inside the Powerhouse. The stainless steel anchor point assemblies are to consist of a steel host ring, steel attachment/base plate and anchors/bolts or clamps, such that the assemblies can be connected to concrete walls/floors/ceilings or to steel beams/columns;

.12 Supply and installation of metal decking required for the roof and mezzanines;

.13 Supply and installation of the miscellaneous rooms located at the north service bay.

Spillway and Transition Dams

.1 Supply and installation of the steel structure for the upstream and downstream permanent bridges for the spillway including shear studs;

.2 Supply and installation of the steel structure, including metal decking and shear studs for the elevated deck for the spillway electrical building;

.3 Supply and Installation of all miscellaneous metals for the spillway and transition dams, including access and service platforms, hatch and trench covers, stairs, ladders, grating, handrails and guardrails as shown on the Drawings;

.4 Supply and Installation of all embedded miscellaneous metals for the spillway and transition dams (frames, L-shapes, sleeves, anchor bolts etc.) as shown on the Drawings;

.5 Supply and installation of the gantry rails on the centre transition dam road deck and spillway road deck for the trash cleaning system including fastening system and accessories;

.6 Supply and installation of bearing pads for the upstream and downstream permanent bridges and for the elevated deck at the centre transition dam;

.7 Supply and installation of anchor bolts, include the supply and installation of double templates for the correct positioning of the anchor bolts;

.8 Supply and installation of all concrete anchorages required for the installation of miscellaneous metal work;

4 .9 Supply and installation of stainless steel anchor points at locations to be determined by Company at the Spillway. The stainless steel anchor point assemblies are to consist of a steel host ring, steel attachment/base plate and anchors/bolts or clamps, such that the assemblies can be connected to concrete walls/floors/ceilings or to steel beams/columns.

.8 Supply and Installation of Embedded/Exposed Piping and HVAC

.1 Supply and installation of all embedded/exposed piping and various mechanical parts for the intake, powerhouse and centre transition dam, all as shown on the Drawings, including inspection and testing, cleaning, quality assurance and control of piping works;

.2 Supply and installation of valves on the raw water supply piping, the draft tube drain systems and the oil water piping as shown on the Drawings;

.3 Supply and installation of pipe supports and pipe insulation on the building roof drain piping, as shown on the Drawings;

4 .4 Supply and installation of underground buried piping, prefabricated septic tank, prefabricated septic distribution box and septic tile field between the powerhouse and the tile filed;

2 .5 Supply and installation of HVAC louvers, wall sleeves, flashing and framing, as shown on the Drawings.

.9 Electrical Work

.1 Supply and installation of embedded conduits and accessories of size and quantity as indicated and detailed on the Drawings;

2 .2 Supply and installation of the grounding network including aluminothermy (Cadweld) welding at the intake, powerhouse, south, centre and north transition dams and spillway, as detailed on the Drawings;

.3 Connections of grounding conductors to non-electrical equipment including structural and miscellaneous steel, stairs, columns, handrails, guardrails etc. as detailed on the Drawings;

2

.4 Supply and install high bay lighting for the powerhouse generator floor;

.5 Supply and install lighting panels, transformers, disconnect switches, lighting contactors and light switches as indicated on the Drawings;

.6 Supply, install and connect all the wiring required to form a complete and operational lighting system as indicated on the Drawings;

.7 Supply and install power cables for the lighting system from the construction power 600 V switchgear, to the lighting distribution system. The 600 V switchgear is located outside the powerhouse (south-east side of the powerhouse);

4

.8 Construction of concrete slabs for Construction Power Distribution Equipment at Powerhouse Parking Area and Contractor's Laydown Area;

.9 Supply and installation of prefabricated manholes and construction of electrical duct banks between the powerhouse and the switchyard.

.10 Architectural Work and Building Envelope

.1 Supply and installation of the insulated metal wall panels for the powerhouse building;

.2 Supply and installation of the preformed metal siding for the powerhouse building;

.3 Supply and installation of the modified bituminous membrane roofing system;

.4 Supply and installation of the exterior metal insulated doors;

.5 Supply and installation of the windows and aluminum insulated doors;

.6 Supply and installation of the multi-leaf vertical lift metal Insulated door (special main entrance for the powerhouse);

.7 Supply and installation of roof anchors and safety restraints.

.11 Environmental Work

.1 Construction, maintenance and operation of all temporary mitigation measures to comply with Technical Specification Section 01 35 43 - General Environmental Requirements;

.2 Site restoration at completion of work.

2.2 WORK EXCLUDED

2 The following works are excluded from the Work and will be performed by Company's other Contractors:

2.2.1 Excavation of the intake, powerhouse, spillway, intake approach channel and discharge channel, as well as rock excavation in Transition dams and separation wall foundations;

2.2.2 Excavation of the tailrace rock plug;

2.2.3 Construction of the riverside RCC cofferdam;

2.2.4 Construction of North RCC overflow dam;

2.2.5 Construction of South rockfill dam;

1 **2.2.6** Construction and removal of cofferdams;

2.2.7 Removal of the downstream part of the riverside RCC cofferdam;

2.2.8 Construction of the access road to the powerhouse;

2.2.9 Construction and removal of the upstream temporary bridge over the spillway approach channel;

2.2.10 Construction of the concrete pier and abutments for the upstream temporary bridge over the spillway approach channel

2.2.11 Construction and removal of the temporary access ramp to the temporary upstream bridge over the spillway approach channel;

2.2.12 Embankment required for the switchyard and converter station and their access roads;

1 **2.2.13** With the exception of the supply of secondary concrete, supply and installation of intake trash racks, intake bulkhead gates, intake gates and draft tube stoplogs, including the embedded parts and placement of the secondary concrete for the embedded parts for these gates;

2.2.14 With the exception of the supply of the secondary concrete, supply and installation of the spillway upstream stoplogs, downstream stoplogs, and gates; including the embedded parts and the placement of the secondary concrete for the embedded parts for these stoplogs and gates;

2.2.15 Supply and installation of the turbine-generator units;

2 **2.2.16** Supply and installation of the powerhouse elevator;

2.2.17 Supply and installation of the powerhouse main overhead cranes;

2.2.18 Supply and installation of the overhead crane for the draft tube gates;

2.2.19 Supply and installation of the spillway hoist superstructure;

2.2.20 Interior architectural work except as noted;

5 **2.2.21** Maintenance, dust control and snow clearing of walkways;

2.2.22 Supply and installation of the spillway electrical building;

2.2.23 Supply and installation of electrical and mechanical works related to the spillway electrical building;

1 **2.2.24** Decommissioning and backfilling of sedimentation ponds No. 1 and 2;

2.2.25 All other services provided by Company as specified in Exhibit 12: Site Conditions;

2.2.26 Supply and installation of the outdoor 600 V switchgear;

2.2.27 Removal of Construction Power (electrical equipment, concrete slab, grounding and fences);

4 **2.2.28** Excavation and backfill work for the underground buried piping, between the tile field and the converter station;

2.2.29 Supply and installation of underground buried piping, between the tile field and converter station;

2.2.30 Removal of all remaining temporary safety fences outside the structures area.

2.3 WORK PROVIDED TO COMPANY'S OTHER CONTRACTORS

1 **2.3.1** The Contractor shall supply concrete to Company's Other Contractors, including the delivery of concrete from the batch plant to the pour location as well as design and testing of the mix.

PART 3 SPECIAL REQUIREMENTS

3.1 GENERAL

3.1.1 The overall project schedule requires that some of the Work be performed during the winter period. The Contractor shall take all necessary measures for winter concreting, including the use of heated shelters. The Contractor shall design, supply, install and remove temporary shelters.

3.1.2 Where the building envelope is used by the Contractor as shelter for the execution of its work before the remainder of the building is completed, it is the responsibility of the Contractor to supply, install and subsequently remove any temporary bracing, walls and enclosure as may be required.

3.1.3 All temporary works shall be designed by a qualified Professional Engineer registered in the Province of Newfoundland and Labrador. The Professional Engineer shall be approved by the Engineer prior to starting any Work. All designs and Drawings shall be submitted to the Engineer for review and approval before starting of any work.

3.1.4 The Contractor is responsible to supply, install and operate an appropriate heating and ventilation system as well as a lighting system for the duration of the Work. Those systems shall be installed as the Work progresses and as required and shall be transferred to the Company at the completion of the Work.

3.1.5 The Contractor shall supply, install, operate, dismantle and remove from the Site at the end of the Work a temporary construction overhead crane of a capacity to suit the Contractor's needs. The use of this crane by the Contractor will not be exclusive and the crane could be used from time to time by Company's other Contractors. In such case, the Contractor will be entitled to compensation for operating costs. This temporary construction crane will travel on the rails for the powerhouse permanent overhead cranes, and it is intended to limit, as much as possible, the use of the permanent powerhouse overhead crane by the Contractor, which will be principally, but not exclusively, used by the turbine-generator supplier. The use of all overhead cranes in the Powerhouse will be coordinated by the Engineer.

3.1.6 Production of concrete including mobilization, installation, operation and demobilization of the batch plants at the end of concrete supply contract, fabrication of coarse and fine aggregates for concrete production from blasted rock stockpile and from granular borrow areas, the supply and storage of Portland cement, Fly Ash/Blast furnace slag and admixtures.

3.1.7 The Contractor is responsible for all quality control for the fabrication of the concrete at the batch plant. The inspection and the quality control of the concrete at the placement Sites will be performed by a third party retained and paid by the Company. Concrete will

3 be tested in accordance with CAN/CSA A23.1/A23.2-M standards. The Contactor shall provide full cooperation to the Company's other Contractor in charge of the quality control of the concrete for obtaining specimens required for testing. The Contractor shall provide heated shelters for the execution of this work, as approved by the Engineer.

3.1.8 The Contractor is responsible to perform the trial mixes for all classes of concrete specified. Those trial mixes shall be planned appropriately to allow enough time for all testing to be completed and approved by the Engineer prior to any concreting of 2 permanent work. The Contractor shall submit to the Engineer a detailed plan and schedule of all work related to the trial mixes for the approval by the Engineer.

3.1.9 The Contractor shall submit the required documentation to the Engineer for review and approval in accordance with the Technical Specification and Supplier Document Requirement List (SDRL)

1 **3.1.10** Where there are conflicts between or within the Technical Specification and the Drawings, the Technical Specification will have precedence. Where there are conflicts between or within Codes, Standards or Acts, priority shall be given to the more stringent.

3.2 SITE CONDITIONS

3.2.1 This Scope of Work Specification shall be read in conjunction with Exhibit 12 - Site Conditions.

3.3 COMPANY SUPPLIED DOCUMENTS

3.3.1 Company supplied documents are listed in Exhibit 11. The Contractor shall observe all requirements of the Company Supplied Documents.

3.4 SETTING-OUT OR IMPLEMENTATION OF SURVEY POINTS AND LINES

3.4.1 The Contractor shall be responsible for:

2 .1 Surveying required for setting-out the structures and for as-built profile of the excavation and structures;

1 .2 Locate, confirm and protect control points prior to starting Site work. Preserve permanent reference points during construction;

.3 Establish permanent benchmarks on Site, referenced to established bench marks by survey control points. Record locations, with horizontal and vertical data in Project Record documents;

2 .4 The accurate setting-out of the Work in relation to reference points, lines and levels given by the Engineer in writing;

.5 The correctness, subject as above mentioned, of the position, levels, dimensions and alignment of all parts of the Work;

.6 The provision of all necessary instruments, appliances and labour in connection with the foregoing responsibilities;

.7 If, at any time during the execution of the Work, any error appears in the position, levels, dimensions or alignment of any part of the Work, the Contractor, on being required to do so by the Engineer, shall, at its own cost, rectify such error to the satisfaction of the Engineer, unless such error is based on incorrect data supplied in writing by the Engineer, in which case the Engineer shall recommend a change to the work in accordance with Article 14;

.8 The checking of any setting-out or of any line or level by the Engineer shall not in any way relieve the Contractor of its responsibility for the accuracy thereof and the Contractor shall carefully protect and preserve all bench-marks, sight-rails, pegs and other reference points used in setting-out the Work.

3.5 SITE INFORMATION

2 **3.5.1** The Company has made available to the Contractor, Site information (Exhibit 11 – Company Supplied Documents), before the submission by the Contractor of the Proposal. Such data on subsurface conditions have been obtained by or on behalf of the Company from investigations undertaken relevant to the Work but the Contractor shall be responsible for its own interpretation thereof.

3

3.5.2 The Contractor shall be deemed to have inspected and examined the Site and its surroundings, be fully knowledgeable of the information available in connection therewith and to have satisfied itself before submitting its Proposal, as to:

3

.1 The form and nature thereof, including the subsurface conditions;

.2 The hydrological and climatic conditions;

.3 The extent and nature of work and materials necessary for the execution and completion of the Work and the remedying of any defects therein; and

.4 The means of access to the Site and the accommodation it may require, when not provided for (Refer to Exhibit 12 – Site Conditions);

3.5.3 In addition, the Contractor, in general, shall be deemed to have obtained all necessary information, subject as above mentioned, as to risks, contingencies and all other circumstances which may influence or affect its Proposal. 3

3.5.4 The Contractor shall be deemed to have based its Bid on the data made available by the Company and on its own inspection and examination, all as aforementioned.

3.6 SPECIALIST SUBCONTRACTOR

3.6.1 The Contractor may subcontract specialized services, such as design engineering services, but it shall obtain the approval of the Engineer prior to the award of any such subcontract. Such approval shall not relieve the Contractor from any liability or obligation under the Agreement and it shall be responsible for the acts, default and neglects of the SubContractor, its agents, personnel as fully as if they were the acts, defaults and neglect of the Contractor. The Engineer reserves the right to refuse the services of a sub-Contractor proposed by the Contractor. 2

3.6.2 The Contractor shall submit to the Engineer for approval, details on the history of the SubContractor (previous work done in similar conditions, etc), on the personnel the SubContractor intends to use, inclusive of their detailed resumes, membership in professional organizations, their authority to sign and approve Drawings, registration and/or eligibility to register with the Professional Engineers and Geoscientists of Newfoundland and Labrador (PEGNL). All calculations and such like shall be in accordance with Newfoundland and Labrador Regulations. Such approval by the Engineer does not change the full responsibility of the Contractor in the execution of the Work. 2 3

3.6.3 The SubContractor may be requested to undertake its work or part of its work at the Work Site.

3.7 ENVIRONMENTAL REQUIREMENTS

3.7.1 Contractor shall comply with the Technical Specification Section 01 35 43 – General Environmental Requirements (Exhibit 1) and Environmental and Regulatory Compliance Requirements (Exhibit 6). 2

3.7.2 Prior to the start of Site work, the Contractor shall prepare a Work Specific Environmental Protection Plan (C-SEPP) for review and approval by the Engineer. The C-SEPP will detail the environmental protection measures that will be implemented by the Contractor for all components of the Work. The Contractor shall reference the General Environmental Requirements of the Specification, as well as Contract Drawings, as required. The template for preparation of the C-SEPP is attached in Exhibit 11-Company Supplied Documents. 3

3.8 DOCUMENTS

3.8.1 Drawings Provided to the Contractor

.1 The Drawings issued with the Request for Proposal (RFP) are intended to indicate the location, type and scope of work to be carried. They are not to be used for construction. At Effective Date, a schedule of issue of the Approved for Construction (AFC) Drawings will be provided. With those Drawings, the Contractor shall verify on Site all levels and dimensions before starting work and shall notify the Engineer of all differences and/or discrepancies with the Approved for Construction Drawings.

.2 Before the beginning of the Work, the Contractor shall submit for the Engineer's approval, the Drawings required as per the Technical Specification and as provided in the SDRL (Exhibit 4- Supplier Document Requirement List). The Contractor shall submit for review by the Engineer all test certificates, purchase orders, Drawings and all details necessary for the execution of the Work as specified in the Technical Specification.

.3 The turnaround time for Engineer's review of Contractor's drawings is 21 calendar days.

3.8.2 Drawings

.1 The Drawings are included in Exhibit 1 and are listed in the Technical Document List, document number 505573-CH0007-40AL-I-0001.

.2 The Drawings issued with the Request for Proposal are not to be used for Construction.

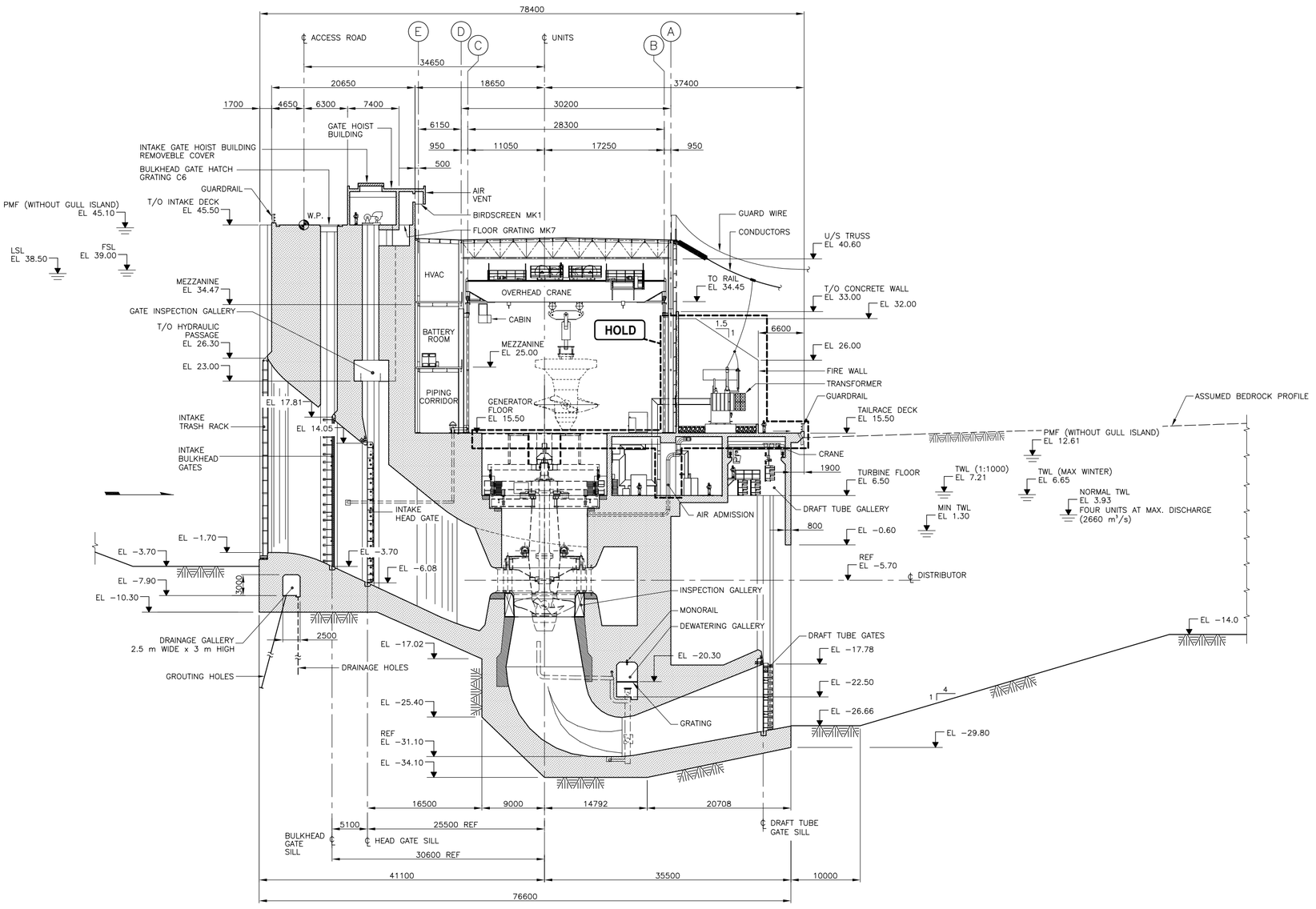
.3 Contractor shall only execute the Work based on Approved for Construction Drawings.

3.8.3 Technical Specification

The Technical Specification related to the Work is provided in Exhibit 1.

NOTE:

1. FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS SEE DWG MFA-SN-CD-3300-CV-LS-0002 (505573-3331-42DD-0100)
2. HOLD ON GENERATOR FLOOR, CONCRETE COLUMNS FROM EL 6.50 m TO 15.50 m AND FIREWALLS. DETAILS TO BE ISSUED IN AN ADDENDUM.



TRANSVERSE SECTION AT CENTRELINE OF UNIT

NOT FOR CONSTRUCTION

0 5000 10000 15000 20000 mm
SCALE 1:250

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
1	B1	31-JUL-2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA-SN-CD-3300-CV-LS-0002 (505573-3331-42DD-0100)	GENERAL NOTES, LEGEND AND ABBREVIATIONS

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.

* * * * * * * * FOR INTERNAL USE ONLY * * * * * * * *

REVIEW CLASS: | EQUIPMENT TAG NUMBER:

REVIEW DOES NOT CONSTITUTE APPROVAL OF DESIGN DETAILS, CALCULATIONS, TEST METHODS OR MATERIAL DEVELOPED AND/OR SELECTED BY THE CONTRACTOR, NOR DOES IT RELIEVE THE CONTRACTOR FROM FULL COMPLIANCE WITH CONTRACTUAL OR OTHER OBLIGATIONS.

- ☐ 1. REVIEWED AND ACCEPTED NO COMMENTS
- ☐ 2. REVIEWED - INCORPORATE COMMENTS, REVISE & RESUBMIT
- ☐ 3. REVIEWED - NOT ACCEPTED
- ☐ 4. INFORMATION ONLY
- ☐ 5. NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy):
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy):
PROJECT MANAGER: Date (dd-mmm-yyyy):

PROFESSIONAL STAMP

SNC·LAVALIN

DESIGNED BY H. BOUZAIENE
DRAWN BY P. PETIT
VERIFIED BY F. RAHMAN
DATE 28-JUN-2011
APPROVED Discipline Lead Engineer H. BOUZAIENE
APPROVED Engineering Manager G. SNYDER
SCALE 1 : 250

CLIENT: nalcor energy
PROJECT: LOWER CHURCHILL PROJECT
TITLE: MUSKRAT FALLS POWERHOUSE GENERAL ARRANGEMENT TRANSVERSE SECTION AT CENTRELINE OF UNIT

File No. 505573-333A-42DD-0002_00
MFA-SN-CD-3300-CV-GA-0006-01 Rev. B1

FORMAT A0 (mm)

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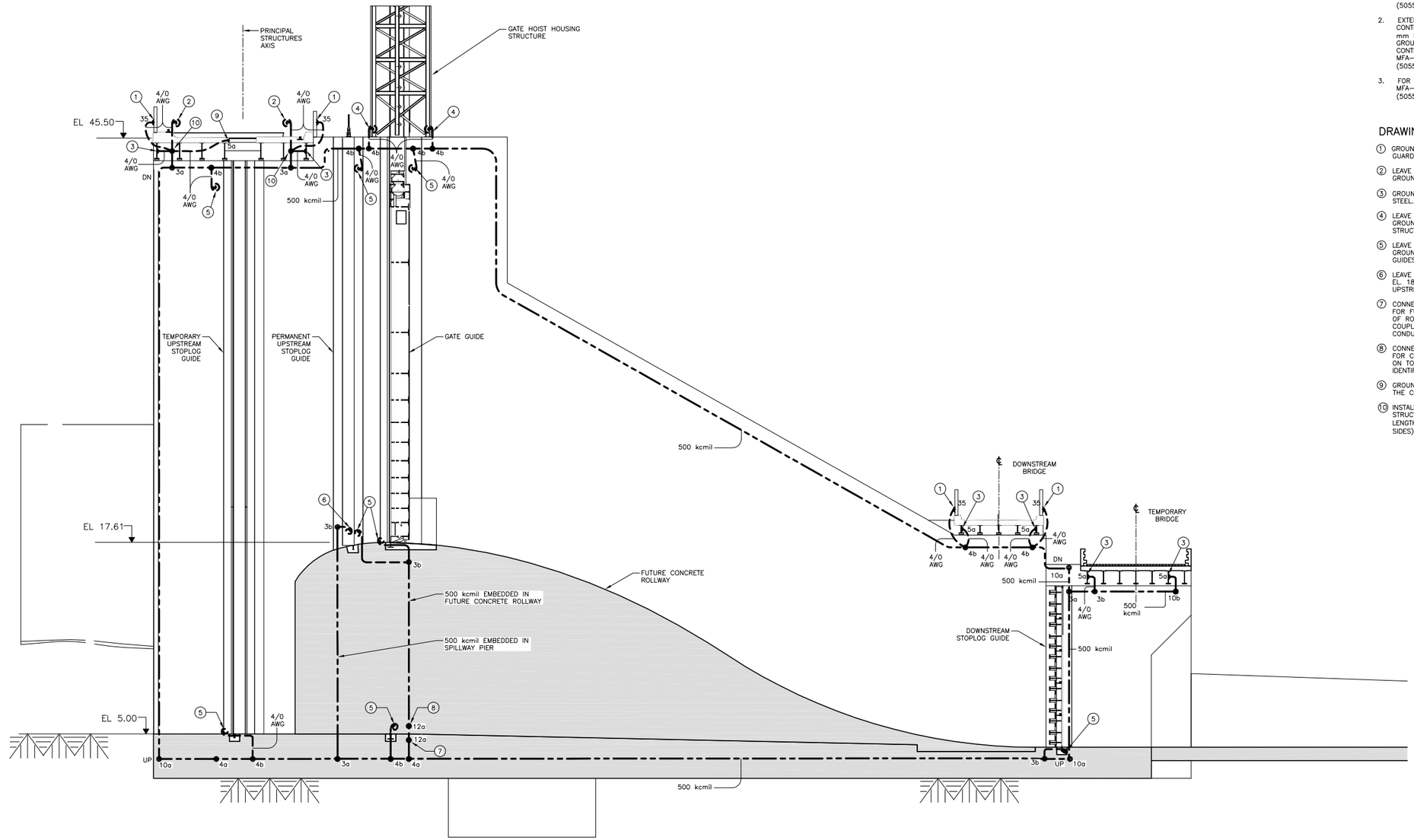

SECTION A–A

MFA–SN–CD–2410–EL–PL–0001–01
(505573–3243–47DD–0013
MFA–SN–CD–2410–EL–PL–0002–01
(505573–3243–47DD–0150)

GENERAL NOTES:

1. EXTEND GROUND CONDUCTORS PAST EACH VERTICAL AND HORIZONTAL CONSTRUCTION JOINT AND LEAVE A COIL OF 1000 mm MIN FOR CONNECTION WITH/TO SUCCESSIVE GROUND CONDUCTORS IN ORDER TO FORM A CONTINUOUS GROUND LOOP. SEE DETAIL 14 ON DWG MFA–SN–CD–3340–EL–DD–0018–01 (505573–3344–47DD–0273).
2. EXTEND GROUND CONDUCTORS PAST EACH POUR CONTRACTION JOINT AND LEAVE A COIL OF 1000 mm MIN FOR CONNECTION WITH/TO SUCCESSIVE GROUND CONDUCTORS IN ORDER TO FORM A CONTINUOUS GROUND LOOP. SEE DETAIL 11 ON DWG MFA–SN–CD–3340–EL–DD–0018–01. (505573–3344–47DD–0273).
3. FOR LEGEND SEE DWG MFA–SN–CD–3340–EL–DD–0018–01 (505573–3344–47DD–0273).

DRAWING NOTES:

1. GROUNDING OF GUARDRAILS. EACH SECTION OF GUARDRAIL SHALL BE GROUNDED.
2. LEAVE A MINIMUM OF 1000 mm LONG PIGTAIL FOR GROUNDING OF TCS RAILS.
3. GROUNDING OF THE ROADWAY/BRIDGE STRUCTURAL STEEL.
4. LEAVE A MINIMUM OF 1000 mm LONG PIGTAIL FOR GROUNDING OF THE GATE HOIST HOUSING STRUCTURAL STEEL.
5. LEAVE A MINIMUM OF 1000 mm LONG PIGTAIL FOR GROUNDING OF THE GATE SILL BEAMS AND GUIDES.
6. LEAVE A MINIMUM OF 1000 mm LONG PIGTAIL AT EL. 18.0 ± FOR GROUNDING OF THE PERMANENT UPSTREAM STOPLOG GUIDES.
7. CONNECT TO REBAR 100 mm BELOW COUPLER, FOR FUTURE GROUNDING OF SILL BEAMS ON TOP OF ROLLWAY. PERMANENTLY IDENTIFY GROUNDED COUPLER FOR FUTURE CONTINUATION OF GROUND CONDUCTOR.
8. CONNECT TO REBAR 100 mm ABOVE COUPLER, FOR CONTINUATION OF GROUNDING TO SILL BEAMS ON TOP OF ROLLWAY. MATCH COUPLER TO IDENTIFIED GROUNDED COUPLER AT EL. 5.00.
9. GROUNDING OF EMBEDDED STEEL CHANNEL FOR THE COVER PLATES.
10. INSTALL 500 kcmil CONDUCTOR IN WEB OF STRUCTURAL SUPPORT STEEL ACROSS THE ENTIRE LENGTH OF THE SPILLWAY ROADWAY/BRIDGE (BOTH SIDES).

NOT FOR CONSTRUCTION

SCALE 1:100

ISSUE REGISTER								No.	REFERENCE DRAWING	No.	REFERENCE DRAWING
								MFA–SN–CD–2410–EL–PL–0002–01 (505573–3243–47DD–0150)	SPILLWAY PLAN AT EL 5.00 EMBEDDED GROUNDING AND CONDUITS		
								MFA–SN–CD–2410–EL–PL–0001–01 (505573–3243–47DD–0113)	SPILLWAY PLAN AT EL 45.50 EMBEDDED GROUNDING AND CONDUITS		
1	B1	31–JUL–2012	ISSUED FOR BID					MFA–SN–CD–3340–EL–DD–0018–01 (505573–3344–47DD–0273)	POWERHOUSE INSTALLATION DETAILS EMBEDDED GROUNDING AND CONDUITS		
ISSU.	REV.	DATE	DISTRIBUTION & STATUS	ISSU.	REV.	DATE	DISTRIBUTION & STATUS	MFA–SN–CD–3340–EL–DD–0003–01 (505573–3344–47DD–0236)	POWERHOUSE INSTALLATION DETAILS SURFACE GROUNDING AND CONDUITS		

No.	DATE	REVISION	MOD.	VER.	APP.

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REVIEW CLASS: EQUIPMENT TAG NUMBER:

REVIEW DOES NOT CONSTITUTE APPROVAL OF DESIGN DETAILS, CALCULATIONS, TEST METHODS OR MATERIAL DEVELOPED AND/OR SELECTED BY THE CONTRACTOR, NOR DOES IT RELIEVE THE CONTRACTOR FROM FULL COMPLIANCE WITH CONTRACTUAL OR OTHER OBLIGATIONS.

- ☐ 1. REVIEWED AND ACCEPTED NO COMMENTS
- ☐ 2. REVIEWED - INCORPORATE COMMENTS, REVISE & RESUBMIT
- ☐ 3. REVIEWED - NOT ACCEPTED
- ☐ 4. INFORMATION ONLY
- ☐ 5. NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy):

NE-LCP MANAGEMENT: Date (dd-mmm-yyyy):

PROJECT MANAGER: Date (dd-mmm-yyyy):

PROFESSIONAL STAMP

SNC·LAVALIN

DESIGNED BY V. JAREMKO — APPROVED Discipline Lead Engineer R. SANLIAN
DRAWN BY G. WALSH — APPROVED Engineering Manager G. SNYDER
VERIFIED BY B. CAMPBELL
DATE 19–MARCH–2012
SCALE 1 : 100

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
SPILLWAY
SECTION A–A
EMBEDDED GROUNDING AND CONDUITS

SU DOC No. 505573–3243–47DD–0151_00
NE DOC No. MFA–SN–CD–2410–EL–SE– 0001–01 Rev. B1

FORMAT A0 (mm)
CH0007–E08

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SITE PLAN

NOTES:

1. ALL COORDINATES ARE REFERENCED TO UTM NAD83, ZONE 20.
2. THE GROUND TOPOGRAPHY CONTOURS ARE BASED ON A SITE-SPECIFIC LIDAR SURVEY COMPLETED IN 2006.
3. THE RIVER BATHYMETRY CONTOURS ARE BASED ON AN AIRBORNE BATHYMETRIC SURVEY COMPLETED IN 1998.
4. THE CONTOUR INTERVAL OF THE GROUND TOPOGRAPHY AND THE RIVER BATHYMETRY IS 2 METRES.
5. ALL ELEVATIONS AND DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.

LEGEND

- TOPOGRAPHIC CONTOUR
- BATHYMETRIC CONTOUR
- DITCH
- DIVERSION CHANNEL
- CULVERT
- NIC — NOT IN CONTRACT

NOT FOR CONSTRUCTION

0 50 100 150 200 250 m
SCALE 1:3000

ISSU.	REV.	DATE	DISTRIBUTION & STATUS	ISSU.	REV.	DATE	DISTRIBUTION & STATUS
1	B1	31-JUL-2012	ISSUED FOR BID				

ISSUE REGISTER

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No.	DATE	REVISION	MOD.	VER.	APP.

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REVIEW CLASS: EQUIPMENT TAG NUMBER:

REVIEW DOES NOT CONSTITUTE APPROVAL OF DESIGN DETAILS, CALCULATIONS, TEST METHODS OR MATERIAL DEVELOPED AND/OR SELECTED BY THE CONTRACTOR, NOR DOES IT RELIEVE THE CONTRACTOR FROM FULL COMPLIANCE WITH CONTRACTUAL OR OTHER OBLIGATIONS.

☐ 1. REVIEWED AND ACCEPTED NO COMMENTS
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☐ 3. REVIEWED - NOT ACCEPTED
☐ 4. INFORMATION ONLY
☐ 5. NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy):
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy):
PROJECT MANAGER: Date (dd-mmm-yyyy):

PROFESSIONAL STAMP

SNC·LAVALIN

DESIGNED BY D. DAMON
DRAWN BY R. MERRI
VERIFIED BY M. TRAVERS
APPROVED Discipline Lead Engineer M. MAEYER
APPROVED Engineering Manager G. SNYDER
DATE 26-AUG-2011
SCALE 1 : 3000

CLIENT nalcor energy

PROJECT LOWER CHURCHILL PROJECT
TITLE MUSKRAT FALLS
INTAKE AND POWERHOUSE,
SPILLWAY AND TRANSITION DAMS
GENERAL LAYOUT
PLAN

SLI DOC No. 505573-3331-41DD-0100_00
NE DOC No. MFA-SN-CD-3000-GT-GA-0001-01 Rev. B1

FORMAT A0 (mm)
PLATE G1

0 1 2 3 4 5 6 7 8 9 10 CENTIMETRES

N 5 910 000
E 640 000
E 650 000
E 660 000
N 5 900 000

T-4B
GR-5
GD-1
GD-11
GD-8
GD-7
GD-5
TD-8
TD-7
TD-7A
TD-6
TD-4

TO CHURCHILL FALLS
TRANS-LABRADOR HIGHWAY ROUTE 500
EXISTING TRANSMISSION LINE
EXISTING NORTH SIDE ACCESS ROAD
PROPOSED LOWER CHURCHILL PROJECT MUSKRAT FALLS SITE
NORTH SPUR
Muskrat Island
FLOW
Brook
COMPANY'S PROPOSED LAYDOWN AREA
SPOIL DISPOSAL AREA
CONTRACTOR'S PROPOSED LAYDOWN AREA
Kenzie River
PROPOSED TOTE ROAD TO GD-11
FULL SUPPLY LEVEL EL. 39.0
PROPOSED ACCOMMODATIONS COMPLEX
PROPOSED PERMANENT SOUTH SIDE ACCESS ROAD

LOCATION PLAN

NOTES:

1. ALL COORDINATES ARE REFERENCED TO UTM NAD83, ZONE 20.
2. THE GROUND TOPOGRAPHY CONTOURS HAVE BEEN OBTAINED FROM A 1:50000 MAP.
3. PRIOR TO BORROW AREA/QUARRY DEVELOPMENT, SITE SPECIFIC PLANS FOR SEDIMENT AND EROSION CONTROL, AND FOR SITE WATER MANAGEMENT, SHALL BE DEVELOPED.

LEGEND:

- GRANULAR DEPOSIT
- TILL DEPOSIT
- QUARRY
- CONTRACTOR'S DESIGNATED BORROW AREA
- FLOOD AREA
- LAYDOWN AREA

NOT FOR CONSTRUCTION

0 500 1000 1500 2000 2500 m
SCALE 1:25000

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
1	B1	31-JUL-2012	ISSUED FOR BID

ISSUE REGISTER

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No.	DATE	REVISION	MOD.	VER.	APP.

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- ☐ 3. REVIEWED - NOT ACCEPTED
- ☐ 4. INFORMATION ONLY
- ☐ 5. NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy):
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy):
PROJECT MANAGER: Date (dd-mmm-yyyy):

PROFESSIONAL STAMP

SNC·LAVALIN

DESIGNED BY A. CEBALLOS — APPROVED Discipline Lead Engineer H. BOUZIANE
DRAWN BY R. MERRI
VERIFIED BY R. LEMOIGNE — APPROVED Engineering Manager
DATE 29-MAY-2012 — SCALE 1 : 25000

CLIENT: nalcor ENERGY
PROJECT: LOWER CHURCHILL PROJECT
TITLE: MUSKRAT FALLS
INTAKE AND POWERHOUSE,
SPILLWAY AND TRANSITION DAMS
BORROW AREAS AND QUARRY
PLAN

SLI DOC No. 505573-3331-41DD-0107_00 | NE DOC No. MFA-SN-CD-3000-GT-PL-0002-01 | Rev. B1

FORMAT A0 (mm) **PLATE G4**

\\SLI300\projects\505573-4L_Drafting\Drawings\Civil\Issued\3331\VER_31-JUL-2012\BOUND\Dan\505573-3331-41DD-0107_00.dwg
2012.09.22/2:35pm

0 1 2 3 4 5 6 7 8 9 10 CENTIMETRES

NOTES:

1. ALL COORDINATES ARE REFERENCED TO UTM NAD83, ZONE 20.
2. THE GROUND TOPOGRAPHY CONTOURS ARE BASED ON A SITE–SPECIFIC LIDAR SURVEY COMPLETED IN 2006.
3. THE RIVER BATHYMETRY CONTOURS ARE BASED ON AN AIRBORNE BATHYMETRIC SURVEY COMPLETED IN 1998.
4. THE CONTOUR INTERVAL OF THE GROUND TOPOGRAPHY AND THE RIVER BATHYMETRY IS 1 METRE.
5. ALL ELEVATIONS AND DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.

LEGEND:

- BENCHMARK
- SHORELINE (JULY–OCTOBER FOR AVERAGE FLOW OF 1830 m^3/s)
- TOPOGRAPHIC CONTOUR
- NATURAL STREAM
- DITCH
- DIVERSION CHANNEL
- ACCESS ROAD
- HYDROLOGICAL STATION
- CULVERT
- ROCK STOCKPILE AREA
- LAYDOWN AREA
- CLEARING LIMITS (BY OTHERS)
- 25 kV LINE
- STOCKPILE AND LAYDOWN BOUNDARIES

NOT FOR CONSTRUCTION

0 100 200 300 400 m
SCALE 1:4000

TABLE 1 – ROCK STOCKPILES (FOR INFORMATION)

AREA	DESCRIPTION	SURFACE (m^2)	MINIMUM VOLUME (m^3)
A	ROCK STOCKPILE (FOR OTHERS)	–	–
C1	RESERVED FOR BATCH PLANT, CRUSHER, CONCRETE AGGREGATES AND CONCRETE LAB	≈ 166 000	
C2	ROCK STOCKPILE FOR CONCRETE COARSE AGGREGATES		440 000
G	ROCK STOCKPILE (FOR OTHERS)	–	–

TABLE 2 – LAYDOWN AREAS (FOR INFORMATION)

AREA	SURFACE (m^2)	PAD EL (m)
B	≈ 37 000	EL 50.00
D	≈ 17 000	VARIABLE
E	≈ 14 000	
F	≈ 14 000	
H	≈ 5 000	

PLAN

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
3	B3	08-MAR-2013	ISSUED FOR ADDENDUM 12
2	B2	15-OCT-2012	ISSUED FOR ADDENDUM 1
1	B1	31-JUL-2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.
B3	08-MAR-2013	GENERAL REVISION	A.E.B.	R.L.	M.M.
B2	15-OCT-2012	CONVERTER STATION ADDED; CLEARING LIMITS MODIFIED			

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☐ 5. NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy):
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy):
PROJECT MANAGER: Date (dd-mmm-yyyy):

PROFESSIONAL STAMP

SNC·LAVALIN

DESIGNED BY: A. CEBALLOS
DRAWN BY: R. MERRI
VERIFIED BY: R. LEMIEUX
DATE: 23-MAY-2012
APPROVED Discipline Lead Engineer: H. BOUZAIENE
APPROVED Engineering Manager: G. SNYDER
SCALE: 1 : 4000

CLIENT: nalcor energy
PROJECT: LOWER CHURCHILL PROJECT
TITLE: MUSKRAT FALLS INTAKE AND POWERHOUSE, SPILLWAY AND TRANSITION DAMS EXISTING CONDITIONS – PLAN

SLI DOC No. 505573-3331-41DD-0108_02
NE DOC No. MFA-SN-CD-3000-GT-PL-0003-01 Rev. B3

FORMAT A0 (mm)
PLATE G6

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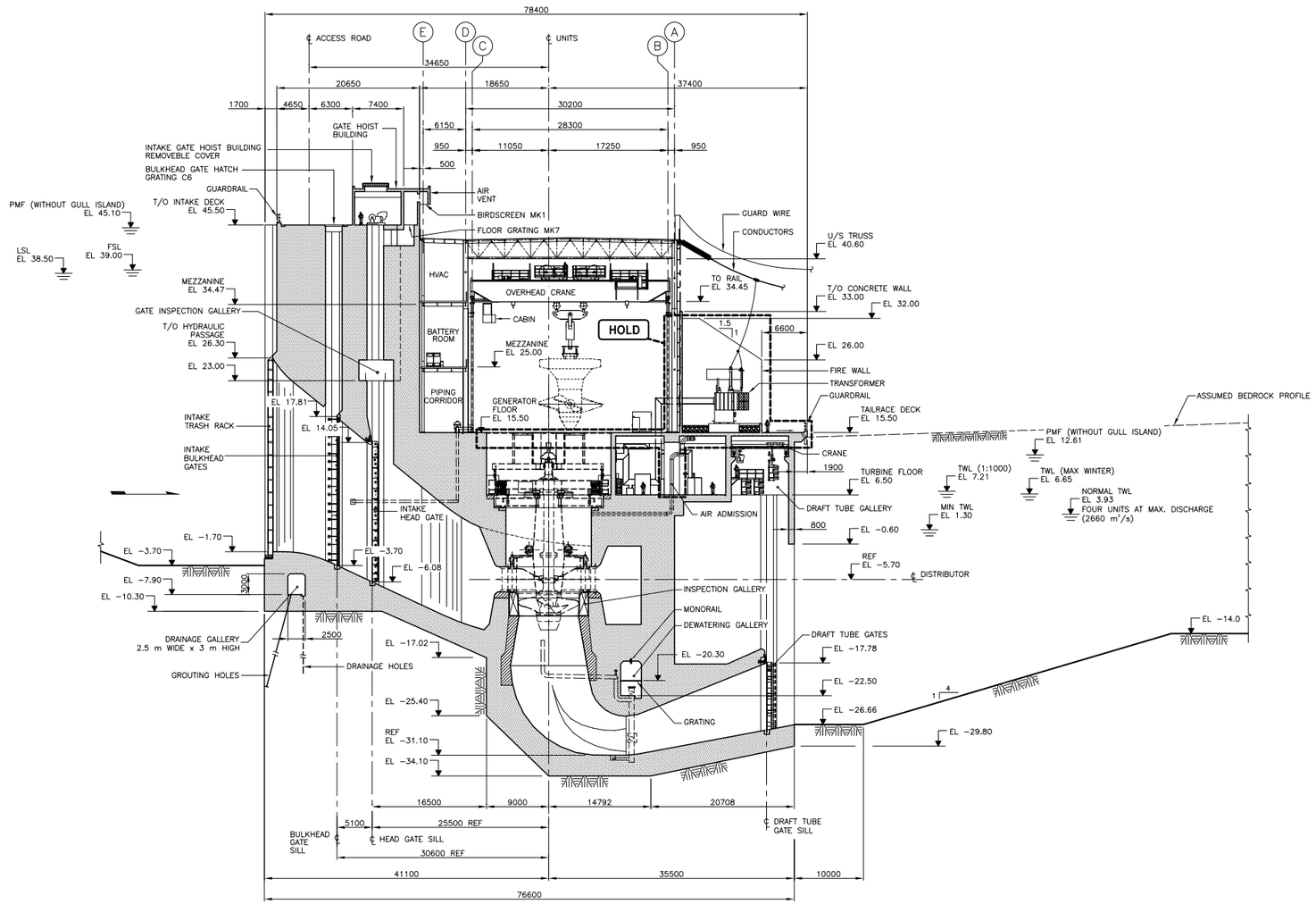
NOTE:

1. FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS SEE DWG MFA-SN-CD-3300-CV-LS-0002 (505573-3331-42DD-0100)



TRANSVERSE SECTION AT CENTRELINE OF UNIT

NOT FOR CONSTRUCTION

0 5000 10000 15000 20000 mm
SCALE 1:250

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	B2	24-SEP-2012	ISSUED FOR ADDENDUM 1
1	B1	31-JUL-2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA-SN-CD-3300-CV-LS-0002 (505573-3331-42DD-0100)	GENERAL NOTES, LEGEND AND ABBREVIATIONS

No.	DATE	REVISION	MOD.	VER.	APP.

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☐ 5. NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy)
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy)
PROJECT MANAGER: Date (dd-mmm-yyyy)

PROFESSIONAL STAMP

SNC·LAVALIN

DESIGNED BY H. BOUZAIENE	APPROVED Discipline Lead Engineer H. BOUZAIENE
DRAWN BY P. PETIT	APPROVED Engineering Manager G. SNYDER
VERIFIED BY F. RAHMAN	
DATE 28-JUN-2011	SCALE 1 : 250

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
POWERHOUSE
GENERAL ARRANGEMENT
TRANSVERSE SECTION AT CENTRELINE OF UNIT

File No. 505573-333A-42DD-0002_01 | MFA-SN-CD-3300-CV-GA-0006-01 | Rev. B2

FORMAT A0 (mm)
PLATE C5

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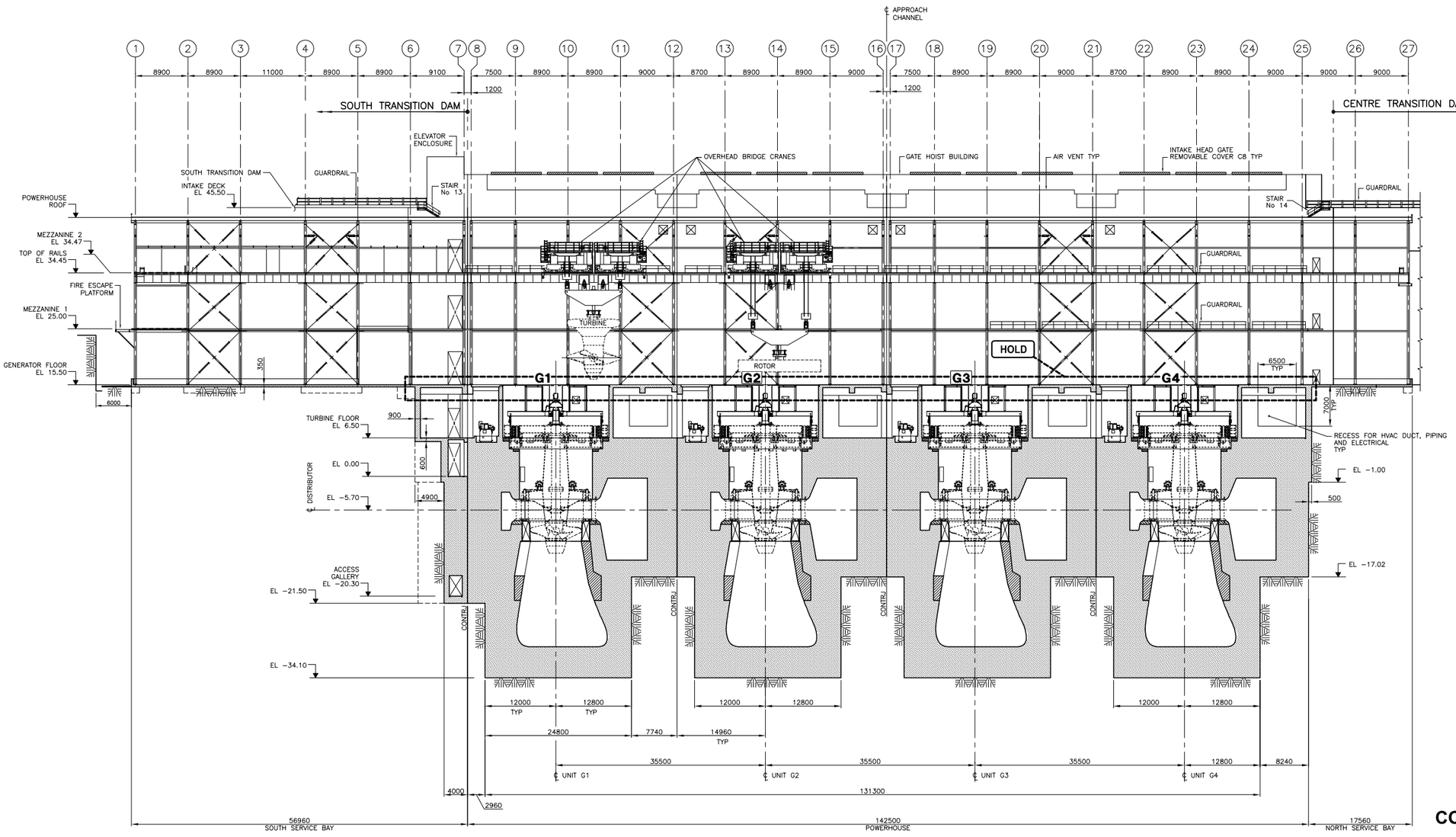
NOTE:

1. FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS SEE DWG MFA-SN-CD-3300-CV-LS-0002 (505573-3331-42DD-0100)



LONGITUDINAL SECTION AT CENTRELINE OF UNITS – LOOKING UPSTREAM

NOT FOR CONSTRUCTION

SCALE 1:250

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	B2	24-SEP-2012	ISSUED FOR ADDENDUM 1
1	B1	31-JUL-2012	ISSUED FOR BID

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No.	DATE	REVISION	MOD.	VER.	APP.

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LEAD REVIEWER: Date (dd-mmm-yyyy)
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy)
PROJECT MANAGER: Date (dd-mmm-yyyy)

PROFESSIONAL STAMP

SNC·LAVALIN

DESIGNED BY H. BOUZIANE	APPROVED Discipline Lead Engineer H. BOUZIANE
DRAWN BY P. PETIT	APPROVED Engineering Manager G. SNYDER
VERIFIED BY F. RAHMAN	
DATE 28-JUN-2011	SCALE 1 : 250

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
POWERHOUSE
GENERAL ARRANGEMENT
LONGITUDINAL SECTION AT CENTRELINE OF UNITS

File No. 505573-333A-42DD-0003_01 | MFA-SN-CD-3300-CV-GA-0007-01 | Rev. B2

FORMAT A0 (mm)

PLATE C6

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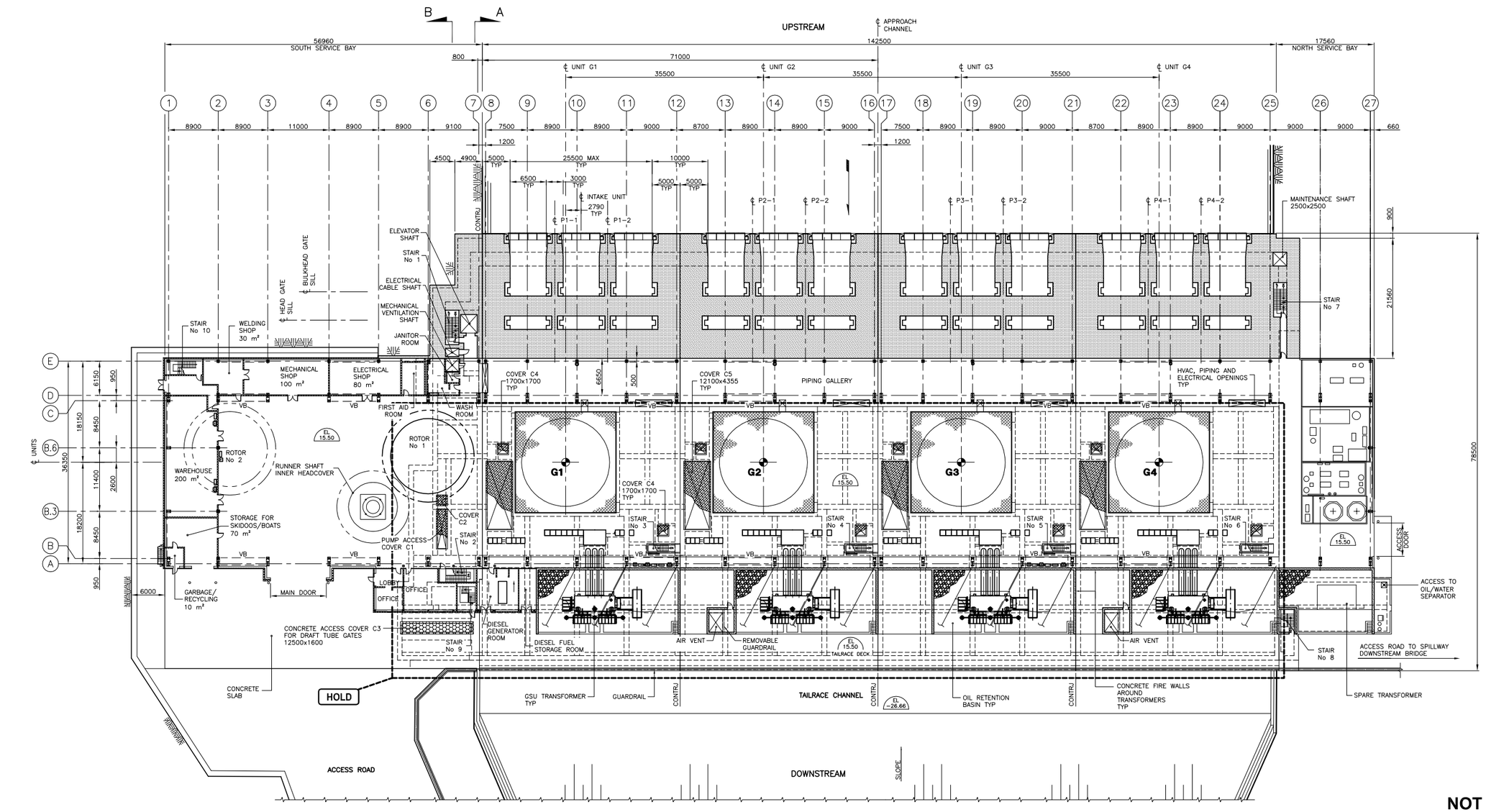
NOTE:

1. FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS SEE DWG MFA-SN-CD-3300-CV-LS-0002 (505573-3331-42DD-0100)



GENERATOR FLOOR PLAN – EL 15.50

NOT FOR CONSTRUCTION

SCALE 1:250

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	B2	24-SEP-2012	ISSUED FOR ADDENDUM 1
1	B1	31-JUL-2012	ISSUED FOR BID

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No.	REFERENCE DRAWING
MFA-SN-CD-3310-CV-GA-0021 (505573-333A-42DD-0017)	GENERAL ARRANGEMENT SECTIONS
MFA-SN-CD-3300-CV-LS-0002 (505573-3331-42DD-0100)	GENERAL NOTES, LEGEND AND ABBREVIATIONS

No.	DATE	REVISION	MOD.	VER.	APP.

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NE-LCP MANAGEMENT: Date (dd-mmm-yyyy)
PROJECT MANAGER: Date (dd-mmm-yyyy)

PROFESSIONAL STAMP

SNC·LAVALIN

DESIGNED BY H. BOUZAIENE	APPROVED Discipline Lead Engineer H. BOUZAIENE
DRAWN BY J.F. ZULUAGA	APPROVED Engineering Manager G. SNYDER
VERIFIED BY F. RAHMAN	
DATE 31-AUG-2011	SCALE 1 : 250

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
POWERHOUSE
GENERAL ARRANGEMENT
GENERATOR FLOOR EL 15.50
PLAN

File No. 505573-333A-42DD-0009_01

MFA-SN-CD-3300-CV-GA-0012-01 Rev. B2

FORMAT A0 (mm)
PLATE C12

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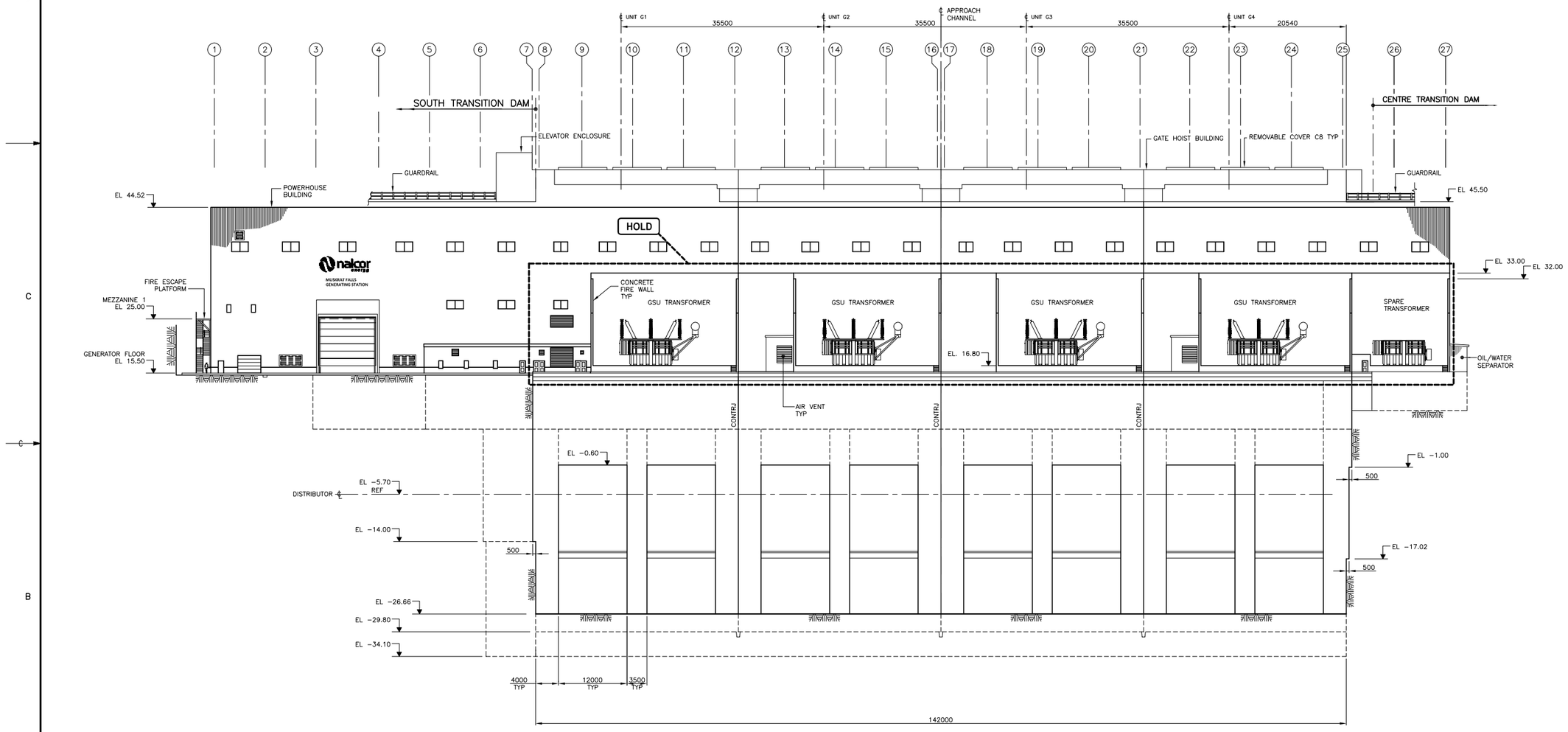
NOTE:

1. FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS SEE DWG MFA-SN-CD-3300-CV-LS-0002 (505573-3331-42DD-0100)



DOWNSTREAM ELEVATION

NOT FOR CONSTRUCTION

0 5000 10000 15000 20000 mm
SCALE 1:250

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	B2	24-SEP-2012	ISSUED FOR ADDENDUM 1
1	B1	31-JUL-2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA-SN-CD-3300-CV-LS-0002 (505573-3331-42DD-0100)	GENERAL NOTES, LEGEND AND ABBREVIATIONS

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.

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- ☐ 3. REVIEWED - NOT ACCEPTED
- ☐ 4. INFORMATION ONLY
- ☐ 5. NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy)
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy)
PROJECT MANAGER: Date (dd-mmm-yyyy)

PROFESSIONAL STAMP

SNC·LAVALIN

DESIGNED BY H. BOUZAIENE	APPROVED Discipline Lead Engineer H. BOUZAIENE
DRAWN BY P. PETIT	APPROVED Engineering Manager G. SNYDER
VERIFIED BY F. RAHMAN	
DATE 28-JUN-2011	SCALE 1 : 250

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
POWERHOUSE
GENERAL ARRANGEMENT
DOWNSTREAM ELEVATION

File No. 505573-333A-42DD-0016_01 | MFA-SN-CD-3300-CV-GA-0019-01 | Rev. B2

FORMAT A2 (mm)

PLATE C19

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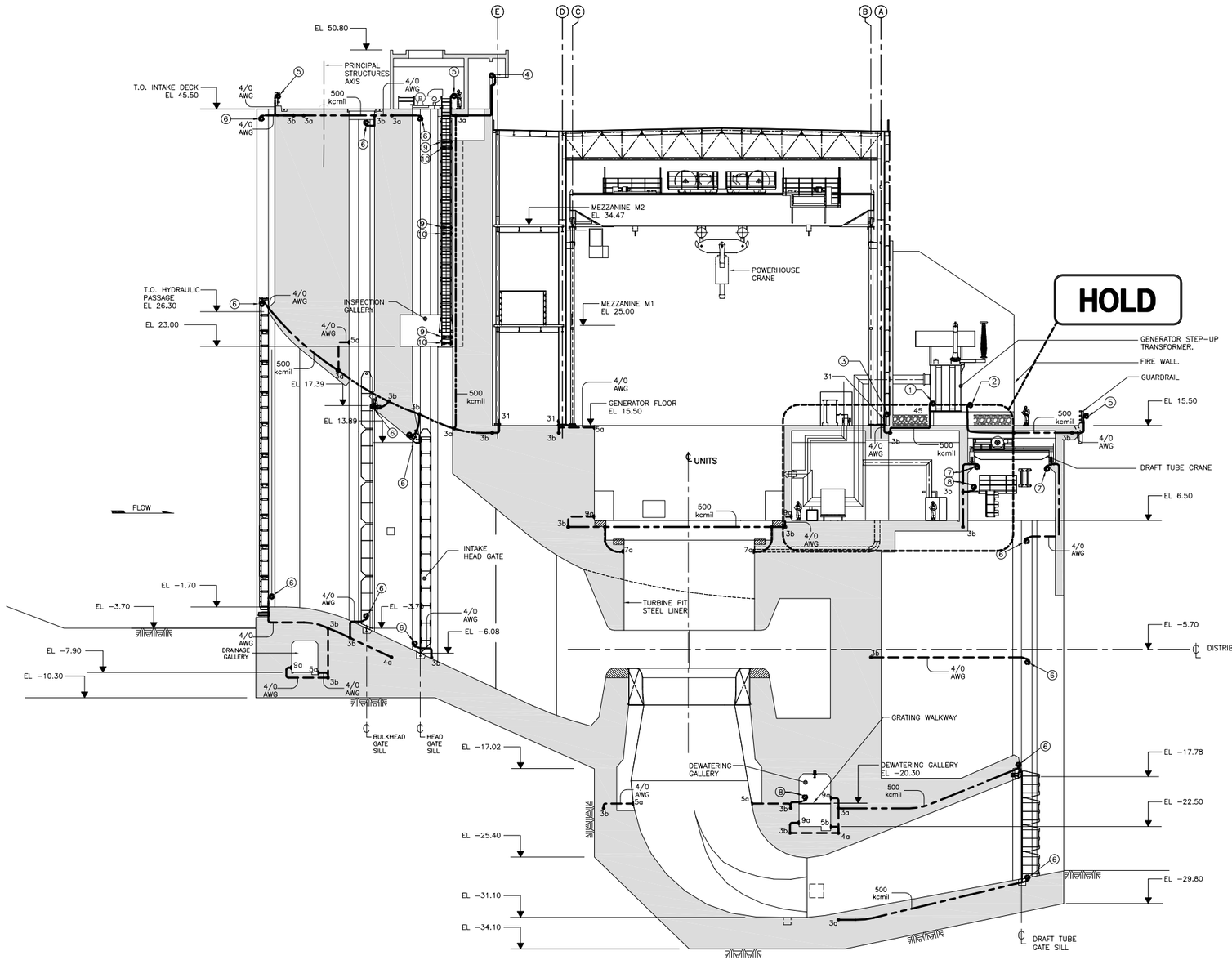

CROSS SECTION AT CENTRELINE OF UNIT

GENERAL NOTES:

1. ALL MAIN GROUNDING EMBEDDED CONDUCTORS SHALL BE 500 kcmil COPPER.
2. ALL CONNECTIONS SHALL BE EXOTHERMIC WELD TYPE.
3. EXTEND GROUND CONDUCTORS PAST EACH VERTICAL AND HORIZONTAL CONSTRUCTION JOINT AND LEAVE A COIL OF 1000 mm MIN FOR CONNECTION WITH/TO SUCCESSIVE GROUND CONDUCTORS IN ORDER TO FORM A CONTINUOUS GROUND LOOP. SEE DETAIL 14 ON DWG MFA-SN-CD-3340-EL-DD-0018-01 (505573-3344-47DD-0273).
4. EXTEND GROUND CONDUCTORS PAST EACH VERTICAL CONTRACTION JOINT AND LEAVE A COIL OF 1000 mm MIN FOR CONNECTION WITH/TO SUCCESSIVE GROUND CONDUCTORS IN ORDER TO FORM A CONTINUOUS GROUND LOOP. SEE DETAIL 11 ON DWG MFA-SN-CD-3340-EL-DD-0018-01. (505573-3344-47DD-0273).
5. FOR LEGEND SEE DWG MFA-SN-CD-3340-EL-DD-0018-01 (505573-3344-47DD-0273)
6. HOLD ON GENERATOR FLOOR, CONCRETE COLUMNS FROM EL 6.5m TO 15.5m AND FIREWALLS. DETAILS TO BE ISSUED IN AN ADDENDUM.

DRAWING NOTES:

(1) LEAVE A MINIMUM OF 1000 mm PIGTAIL FOR GROUNDING OF THE GENERATOR STEP-UP TRANSFORMER.

(2) LEAVE A MINIMUM OF 1000 mm OF 500 kcmil PIGTAIL AT EACH GENERATOR STEP-UP TRANSFORMER FOR THE GROUNDING OF LIGHTNING ARRESTORS, THE TRANSFORMER HO, AND THE ISOLATED PHASE BUS.

(3) LEAVE A MINIMUM OF 1000 mm OF 500 kcmil PIGTAIL FOR GROUNDING OF OVERHEAD GUARD WIRES.

(4) LEAVE A MINIMUM OF 1000 mm LONG PIGTAIL FOR GROUNDING OF STEEL FLY SCREEN AND BIRD SCREEN

(5) LEAVE A MINIMUM OF 1000 mm LONG PIGTAIL FOR GROUNDING OF GUARDRAILS EACH SECTION OF GUARDRAIL SHALL BE GROUNDED.

(6) LEAVE A MINIMUM OF 1000 mm LONG PIGTAIL FOR GROUNDING OF EMBEDDED GATE GUIDES, SILL BEAM AND LINTEL.

(7) LEAVE A MINIMUM OF 1000 mm LONG PIGTAIL FOR GROUNDING OF CRANE RAILS.

(8) LEAVE A MINIMUM OF 1000 mm LONG PIGTAIL FOR GROUNDING OF CATWALK/INSPECTION PLATFORM

(9) GROUNDING OF ACCESS LADDER

(10) GROUNDING OF STEEL PLATFORM

NOT FOR CONSTRUCTION

0 5000 10000 mm
SCALE 1:150

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
1	B1	31-JUL-2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING	No.	REFERENCE DRAWING
MFA-SN-CD-3300-EL-PL-0011-01 (505573-3344-47DD-0282)	POWERHOUSE TURBINE FLOOR UNITS 1 & 2 EL 6.50 EMBEDDED GROUNDING & CONDUITS		
MFA-SN-CD-3300-EL-PL-0010-01 (505573-3344-47DD-0281)	POWERHOUSE DRAINAGE GALLERY PLAN EL -7.90 EMBEDDED GROUNDING & CONDUITS	MFA-SN-CD-3300-EL-PL-0016-01 (505573-3344-47DD-0325)	POWERHOUSE GATE INSPECTION GALLERY PLAN EL 23.00 EMBEDDED GROUNDING & CONDUITS
MFA-SN-CD-3300-EL-PL-0009-01 (505573-3344-47DD-0280)	POWERHOUSE DRAFT TUBE UNITS 1 & 2 EMBEDDED GROUNDING AND CONDUITS	MFA-SN-CD-3300-EL-PL-0007-01 (505573-3344-47DD-0322)	POWERHOUSE DEWATERING GALLERY PLAN EL -22.50 EMBEDDED GROUNDING & CONDUITS
MFA-SN-CD-3300-EL-PL-0008-01 (505573-3344-47DD-0279)	POWERHOUSE DRAFT TUBE UNITS 1 & 2 EMBEDDED GROUNDING AND CONDUITS	MFA-SN-CD-3220-EL-PL-0002-01 (505573-3344-47DD-0287)	POWERHOUSE INTAKE UNITS 1 & 2 PLAN EL -5.20 EMBEDDED GROUNDING & CONDUITS
MFA-SN-CD-3340-EL-DD-0018 (505573-3344-47DD-0273)	POWERHOUSE INSTALLATION DETAILS EMBEDDED GROUNDING AND CONDUITS	MFA-SN-CD-3220-EL-PL-0001-01 (505573-3344-47DD-0285)	POWERHOUSE INTAKE DECK PLAN EL 45.50 EMBEDDED GROUNDING & CONDUITS
MFA-SN-CD-3340-EL-DD-0003 (505573-3344-47DD-0236)	POWERHOUSE INSTALLATION DETAILS SHEET 1 SURFACE GROUNDING	MFA-SN-CD-3300-EL-PL-0003-01 (505573-3344-47DD-0283)	POWERHOUSE GENERATOR FLOOR PLAN TANK AREA UNITS 1 & 2 EL 15.50 EMBEDDED GROUNDING & CONDUITS

No.	DATE	REVISION	MOD.	VER.	APP.

* * * * * * * * * FOR INTERNAL USE ONLY * * * * * * * * *

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☐ 4. INFORMATION ONLY
☐ 5. NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy)

NE-LCP MANAGEMENT: Date (dd-mmm-yyyy)

PROJECT MANAGER: Date (dd-mmm-yyyy)

PROFESSIONAL STAMP

SNC·LAVALIN

DESIGNED BY V. JAREMA — APPROVED Discipline Lead Engineer R. SANJAN
DRAWN BY T. SHEPPARD
VERIFIED BY W. C[illegible] — APPROVED Engineering Manager G. SNYDER
DATE 19-MAR-2012 — SCALE 1:150

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
POWERHOUSE
CROSS SECTION AT CENTRELINE OF UNIT
EMBEDDED GROUNDING AND CONDUITS

File No. 505573-3344-47DD-0274_00 | MFA-SN-CD-3340-EL-SE-0005-01 | Rev. B1

FORMAT A0 (mm)
CH0007-E11

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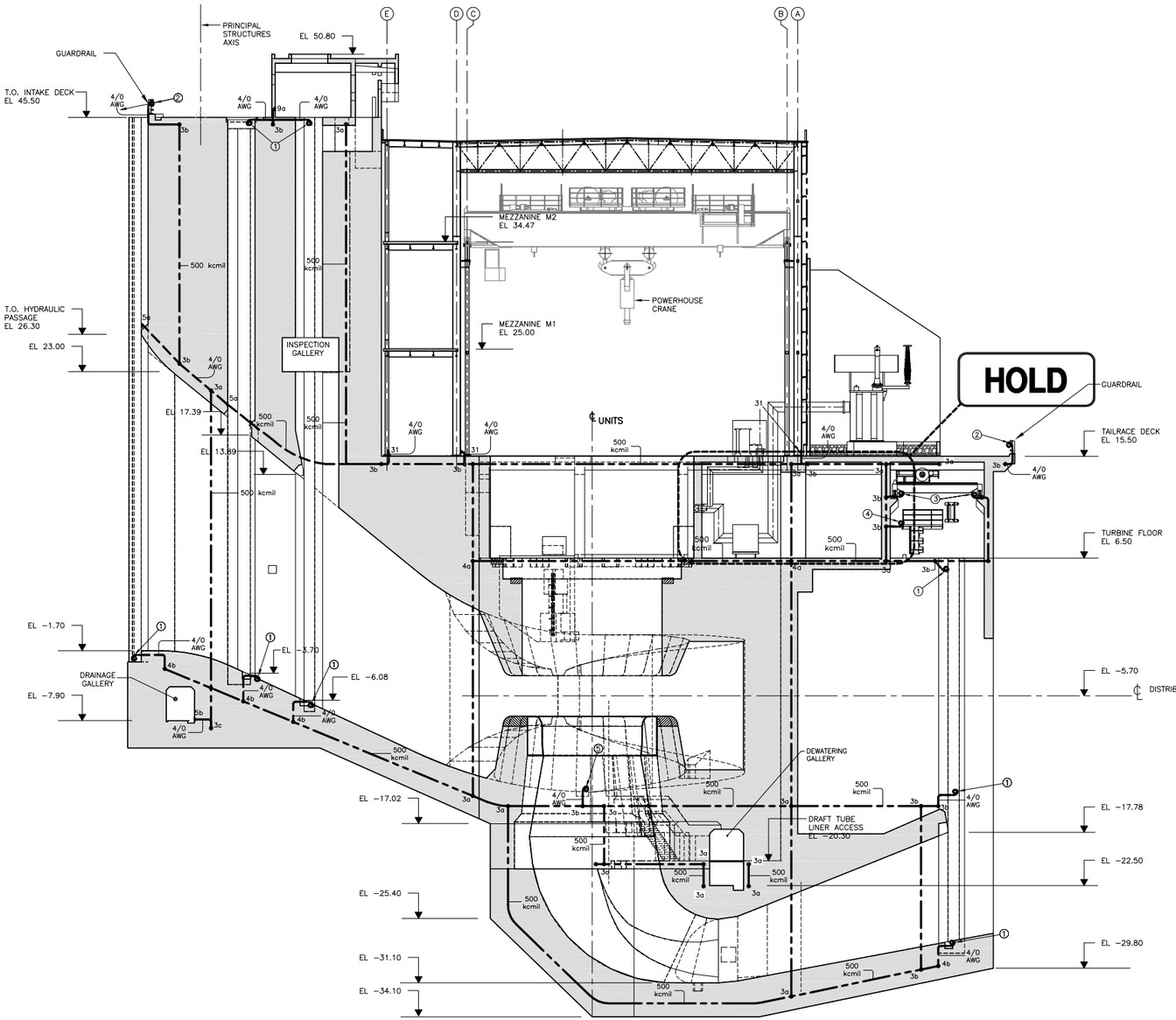

CROSS SECTION BETWEEN UNITS

GENERAL NOTES:

1. ALL MAIN GROUNDING EMBEDDED CONDUCTORS SHALL BE 500 kcmil COPPER.
2. ALL CONNECTIONS SHALL BE EXOTHERMIC WELD TYPE.
3. EXTEND GROUND CONDUCTORS PAST EACH VERTICAL AND HORIZONTAL CONSTRUCTION JOINT AND LEAVE A COIL OF 1000 mm MIN FOR CONNECTION WITH/TO SUCCESSIVE GROUND CONDUCTORS IN ORDER TO FORM A CONTINUOUS GROUND LOOP. SEE DETAIL 14 ON DWG MFA-SN-CD-3340-EL-DD-0018-01 (505573-3344-47DD-0273).
4. EXTEND GROUND CONDUCTORS PAST EACH VERTICAL CONTRACTION JOINT AND LEAVE A COIL OF 1000 mm MIN FOR CONNECTION WITH/TO SUCCESSIVE GROUND CONDUCTORS IN ORDER TO FORM A CONTINUOUS GROUND LOOP. SEE DETAIL 11 ON DWG MFA-SN-CD-3340-EL-DD-0018-01. (505573-3344-47DD-0273).
5. FOR LEGEND SEE DWG MFA-SN-CD-3340-EL-DD-0018-01 (505573-3344-47DD-0273)
6. HOLD ON GENERATOR FLOOR, CONCRETE COLUMNS FROM EL 6.5m TO 15.5m AND FIREWALLS. DETAILS TO BE ISSUED IN AN ADDENDUM.

DRAWING NOTES:

1. LEAVE A MINIMUM OF 1000 mm LONG PIGTAIL FOR GROUNDING OF EMBEDDED GATE GUIDES, SILL BEAM AND LINTEL.
2. LEAVE A MINIMUM OF 1000 mm LONG PIGTAIL FOR GROUNDING OF GUARDRAILS EACH SECTION OF GUARDRAIL SHALL BE GROUNDED.
3. LEAVE A MINIMUM OF 1000 mm LONG PIGTAIL FOR GROUNDING OF CRANE RAILS.
4. LEAVE A MINIMUM OF 1000 mm LONG PIGTAIL FOR GROUNDING OF CATWALK/INSPECTION PLATFORM
5. LEAVE A MINIMUM OF 1000 mm LONG PIGTAIL FOR GROUNDING OF DRAFT TUBE LINER.

NOT FOR CONSTRUCTION

0 5000 10000 mm
SCALE 1:150

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
1	B1	31-JUL-2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING	No.	REFERENCE DRAWING
MFA-SN-CD-3300-EL-PL-0011-01 (505573-3344-47DD-0282)	POWERHOUSE TURBINE FLOOR UNITS 1 & 2 EL 6.50 EMBEDDED GROUNDING & CONDUITS		
MFA-SN-CD-3300-EL-PL-0010-01 (505573-3344-47DD-0281)	POWERHOUSE DRAINAGE GALLERY PLAN EL -7.90 EMBEDDED GROUNDING & CONDUITS	MFA-SN-CD-3300-EL-PL-0016-01 (505573-3344-47DD-0325)	POWERHOUSE GATE INSPECTION GALLERY PLAN EL 23.00 EMBEDDED GROUNDING & CONDUITS
MFA-SN-CD-3300-EL-PL-0009-01 (505573-3344-47DD-0280)	POWERHOUSE DRAFT TUBE UNITS 1 & 2 EMBEDDED GROUNDING AND CONDUITS	MFA-SN-CD-3300-EL-PL-0007-01 (505573-3344-47DD-0322)	POWERHOUSE DEWATERING GALLERY PLAN EL -22.50 EMBEDDED GROUNDING & CONDUITS
MFA-SN-CD-3300-EL-PL-0008-01 (505573-3344-47DD-0279)	POWERHOUSE DRAFT TUBE UNITS 1 & 2 EMBEDDED GROUNDING AND CONDUITS	MFA-SN-CD-3220-EL-PL-0002-01 (505573-3344-47DD-0287)	POWERHOUSE INTAKE UNITS 1 & 2 PLAN EL -5.20 EMBEDDED GROUNDING & CONDUITS
MFA-SN-CD-3340-EL-DD-0018 (505573-3344-47DD-0273)	POWERHOUSE INSTALLATION DETAILS EMBEDDED GROUNDING AND CONDUITS	MFA-SN-CD-3220-EL-PL-0001-01 (505573-3344-47DD-0285)	POWERHOUSE INTAKE DECK PLAN EL 45.50 EMBEDDED GROUNDING & CONDUITS
MFA-SN-CD-3340-EL-DD-0003 (505573-3344-47DD-0236)	POWERHOUSE INSTALLATION DETAILS SHEET 1 SURFACE GROUNDING	MFA-SN-CD-3300-EL-PL-0003-01 (505573-3344-47DD-0283)	POWERHOUSE GENERATOR FLOOR PLAN TANK AREA UNITS 1 & 2 EL 15.50 EMBEDDED GROUNDING & CONDUITS

No.	DATE	REVISION	MOD.	VER.	APP.

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- ☐ 5. NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy)

NE-LCP MANAGEMENT: Date (dd-mmm-yyyy)

PROJECT MANAGER: Date (dd-mmm-yyyy)

PROFESSIONAL STAMP

SNC·LAVALIN

DESIGNED BY V. JAREMA
DRAWN BY T. SHEPPARD
VERIFIED BY W. CAMPBELL
DATE 19-MAR-2012
APPROVED Discipline Lead Engineer R. SANLIAN
APPROVED Engineering Manager G. SNYDER
SCALE 1:150

CLIENT Nalcor Energy

PROJECT LOWER CHURCHILL PROJECT

TITLE MUSKRAT FALLS
POWERHOUSE
CROSS SECTION BETWEEN UNITS
EMBEDDED GROUNDING AND CONDUITS

File No. 505573-3344-47DD-0275_00

MFA-SN-CD-3340-EL-SE-0008-01 Rev. B1

FORMAT A0 (mm) CH0007-E12

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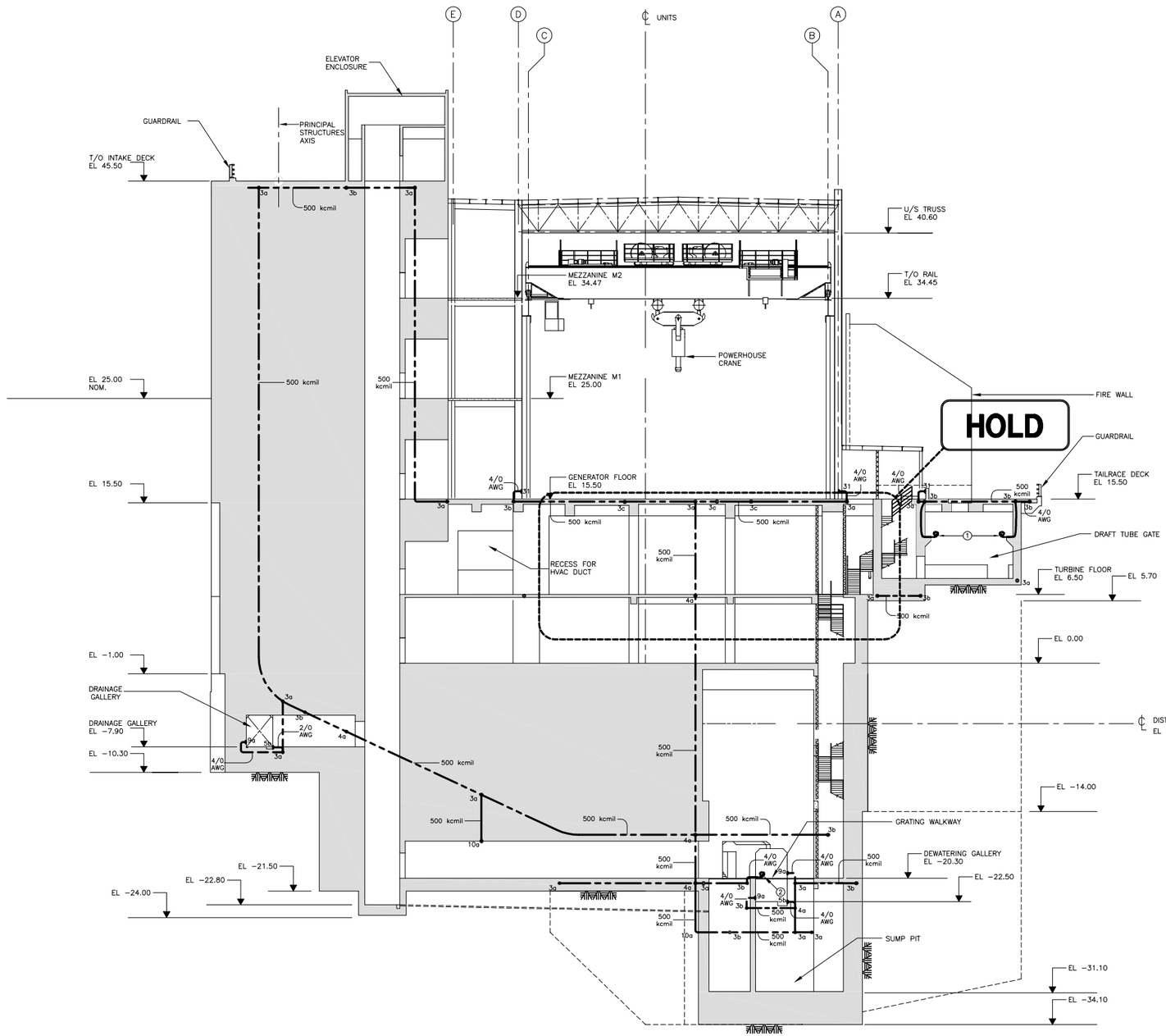

GENERAL NOTES:

1. ALL MAIN GROUNDING EMBEDDED CONDUCTORS SHALL BE 500 kcmil COPPER.
2. ALL CONNECTIONS SHALL BE EXOTHERMIC WELD TYPE.
3. EXTEND GROUND CONDUCTORS PAST EACH VERTICAL AND HORIZONTAL CONSTRUCTION JOINT AND LEAVE A COIL OF 1000 mm MIN FOR CONNECTION WITH/TO SUCCESSIVE GROUND CONDUCTORS IN ORDER TO FORM A CONTINUOUS GROUND LOOP. SEE DETAIL 14 ON DWG MFA-SN-CD-3340-EL-DD-0018-01 (505573-3344-47DD-0273).
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6. HOLD ON GENERATOR FLOOR, CONCRETE COLUMNS FROM EL 6.5m TO 15.5m AND FIREWALLS. DETAILS TO BE ISSUED IN AN ADDENDUM.

DRAWING NOTES:

(1) LEAVE A MINIMUM OF 1000 mm LONG PIGTAIL FOR GROUNDING OF CRANE RAILS.

(2) LEAVE A MINIMUM OF 1000 mm LONG PIGTAIL FOR GROUNDING OF CATWALK/ INSPECTION PLATFORM.

NOT FOR CONSTRUCTION

CROSS SECTION THROUGH SOUTH SERVICE BAY

SCALE 1:150

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
1	B1	31-JUL-2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING	No.	REFERENCE DRAWING
MFA-SN-CD-3300-EL-PL-0004-01 (505573-3344-47DD-0284)	POWERHOUSE GENERATOR FLOOR SERVICE BAY PLAN EL 15.50 EMBEDDED GROUNDING & CONDUITS		
MFA-SN-CD-3300-EL-PL-0010-01 (505573-3344-47DD-0281)	POWERHOUSE DRAINAGE GALLERY PLAN EL −7.90 EMBEDDED GROUNDING & CONDUITS		
MFA-SN-CD-3300-EL-PL-0009-01 (505573-3344-47DD-0280)	POWERHOUSE DRAFT TUBE UNITS 1 & 2 EMBEDDED GROUNDING AND CONDUITS	MFA-SN-CD-3300-EL-PL-0016-01 (505573-3344-47DD-0325)	POWERHOUSE GATE INSPECTION GALLERY PLAN EL 23.00 EMBEDDED GROUNDING & CONDUITS
MFA-SN-CD-3300-EL-PL-0002-01 (505573-3344-47DD-0278)	POWERHOUSE SERVICE BAY PLAN EL. 6.50 EMBEDDED GROUNDING AND CONDUITS	MFA-SN-CD-3300-EL-PL-0007-01 (505573-3344-47DD-0322)	POWERHOUSE DEWATERING GALLERY PLAN EL −22.50 EMBEDDED GROUNDING & CONDUITS
MFA-SN-CD-3340-EL-DD-0018 (505573-3344-47DD-0213)	POWERHOUSE INSTALLATION DETAILS EMBEDDED GROUNDING AND CONDUITS	MFA-SN-CD-3220-EL-PL-0002-01 (505573-3344-47DD-0287)	POWERHOUSE INTAKE UNITS 1 & 2 PLAN EL −5.20 EMBEDDED GROUNDING & CONDUITS
MFA-SN-CD-3340-EL-DD-0003 (505573-3344-47DD-0236)	POWERHOUSE INSTALLATION DETAILS SHEET 1 SURFACE GROUNDING	MFA-SN-CD-3220-EL-PL-0001-01 (505573-3344-47DD-0285)	POWERHOUSE INTAKE DECK PLAN EL 45.50 EMBEDDED GROUNDING & CONDUITS

No.	DATE	REVISION	MOD.	VER.	APP.

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LEAD REVIEWER: Date (dd-m-mm-yyyy)

NE-LCP MANAGEMENT: Date (dd-m-mm-yyyy)

PROJECT MANAGER: Date (dd-m-mm-yyyy)

PROFESSIONAL STAMP

SNC·LAVALIN

DESIGNED BY	V. JAREK
DRAWN BY	T. SHEPPARD
VERIFIED BY	W. CHAN
APPROVED Discipline Lead Engineer	R. SANJAN
APPROVED Engineering Manager	G. SNYDER
DATE	19-MAR-2012
SCALE	1:150

CLIENT: nalcor ENERGY

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
POWERHOUSE
CROSS SECTION THROUGH SOUTH SERVICE BAY
EMBEDDED GROUNDING AND CONDUITS

File No. 505573-3344-47DD-0276_00

MFA-SN-CD-3340-EL-SE-0003-01 Rev. B1

FORMAT A0 (mm)

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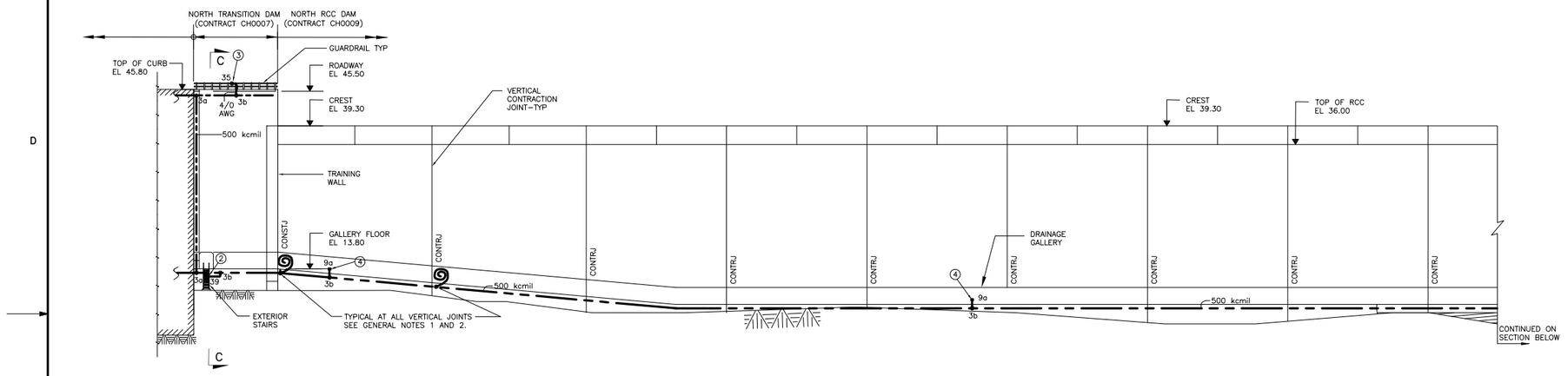
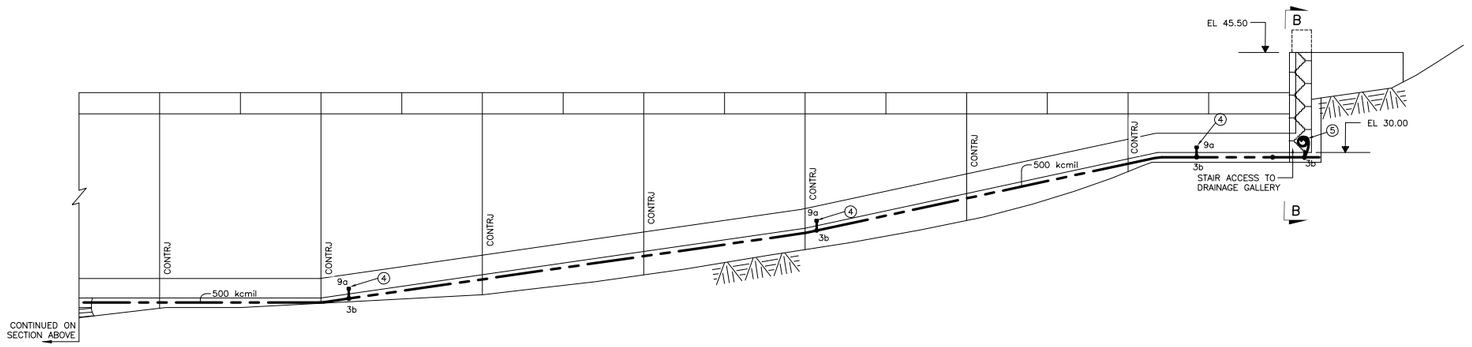
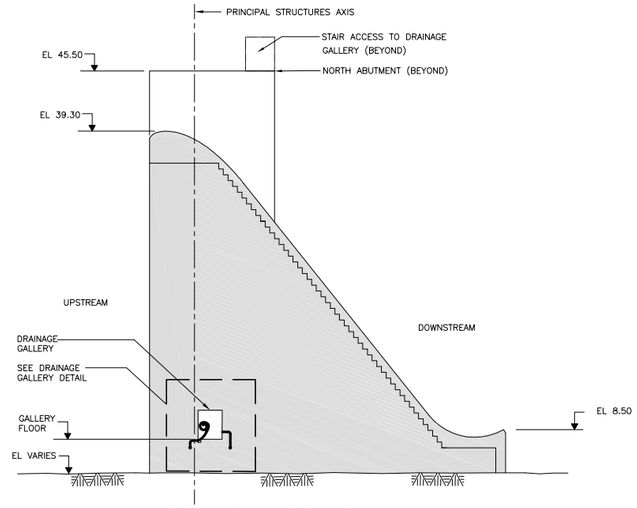


SECTION A–A – NORTH TRANSITION DAM AND NORTH RCC DAM



SECTION A–A – NORTH TRANSITION DAM AND NORTH RCC DAM



SECTION B–B – NORTH RCC DAM
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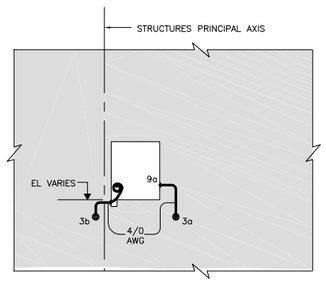

DRAINAGE GALLERY DETAIL
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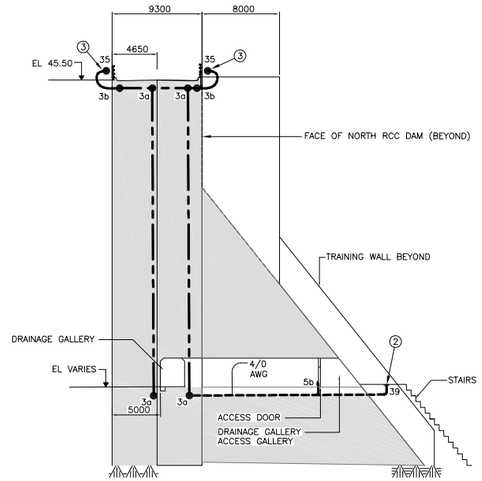
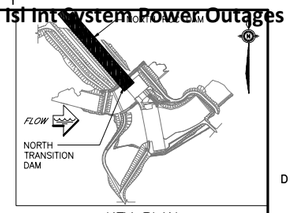


SECTION C–C – NORTH TRANSITION DAM
1:200



KEY PLAN

GENERAL NOTES:

1. EXTEND GROUND CONDUCTORS PAST EACH VERTICAL AND HORIZONTAL CONSTRUCTION JOINT AND LEAVE A COIL OF 1000 mm MIN FOR CONNECTION WITH/TO SUCCESSIVE GROUND CONDUCTORS IN ORDER TO FORM A CONTINUOUS GROUND LOOP. SEE DETAIL 14 ON DWG MFA–SN–CD–3340–EL–DD–0018–01 (505573–3344–47DD–0273).
2. EXTEND GROUND CONDUCTORS PAST EACH VERTICAL CONTRACTION JOINT AND LEAVE A COIL OF 1000 mm MIN FOR CONNECTION WITH/TO SUCCESSIVE GROUND CONDUCTORS IN ORDER TO FORM A CONTINUOUS GROUND LOOP. SEE DETAIL 11 ON DWG MFA–SN–CD–3340–EL–DD–0018–01. (505573–3344–47DD–0273).
3. FOR LEGEND SEE DWG MFA–SN–CD–3340–EL–DD–0018–01 (505573–3344–47DD–0273)

DRAWING NOTES:

1. GROUNDING OF EMBEDDED ANGLE FRAMES FOR GRATING COVERS.
2. GROUNDING OF STEEL STAIRS.
3. GROUNDING OF GUARDRAILS. EACH SECTION OF GUARDRAIL SHALL BE GROUNDED.
4. EMBEDDED COPPER GROUNDING PLATE INSTALLED 2000 mm ABOVE GALLERY FLOOR.
5. LEAVE A MINIMUM OF 1000 mm LONG PIGTAIL FOR GROUNDING OF STEEL STAIRS.

NOT FOR CONSTRUCTION

0 2000 4000 6000 8000 10000 mm
SCALE 1:100
0 5000 10000 15000 mm
SCALE 1:200
0 10000 20000 mm
SCALE 1:300

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
1	B1	31–JUL–2012	ISSUED FOR BID

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA–SN–CD–3340–EL–PL–0001–01 (505573–3344–47DD–0289)	NORTH TRANSITION AND NORTH RCC DAMS PLAN AND DETAILS EMBEDDED GROUNDING AND CONDUITS
MFA–SN–CD–3340–EL–DD–0018–01 (505573–3344–47DD–0273)	POWERHOUSE INSTALLATION DETAILS EMBEDDED GROUNDING AND CONDUITS
MFA–SN–CD–3340–EL–DD–0003–01 (505573–3344–47DD–0236)	POWERHOUSE INSTALLATION DETAILS SURFACE GROUNDING AND CONDUITS

No.	DATE	REVISION	MOD.	VER.	APP.

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LEAD REVIEWER: Date (dd-mmm-yyyy):
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy):
PROJECT MANAGER: Date (dd-mmm-yyyy):

PROFESSIONAL STAMP

SNC·LAVALIN

DESIGNED BY V. JAREMA
DRAWN BY G. WALSH
VERIFIED BY B. CA
DATE 25–MARCH–2012
APPROVED Discipline Lead Engineer R. SANLIAN
APPROVED Engineering Manager G. SNYDER

CLIENT nalcor energy

PROJECT LOWER CHURCHILL PROJECT

TITLE
MUSKRAT FALLS
RCC AND TRANSITION DAMS
NORTH TRANSITION AND NORTH RCC DAMS
SECTIONS AND GALLERY DETAIL
EMBEDDED GROUNDING AND CONDUITS

SLI DOC No. 505573–3344–47DD–0290_00
NE DOC No. MFA–SN–CD–3340–EL–SE– 0002–01
Rev. B1

FORMAT A0 (mm)
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CH0008

North Spur Stabilization Works

Newfoundland Labrador

Government of Newfoundland and Labrador
Department of Environment and Conservation
Water Resources Management Division

Application for Permit to Alter a Body of Water

As required under **Section 48** of the *Water Resources Act*, SNL 2002 c W-4.01

APPLICATION CHECKLIST (The following information must accompany your application):

- G 'Application for Permit to Alter a Body of Water' (this form)
- G Schedules 'A' to 'H' (as appropriate)
- G 'Fee Schedule' and application fee payment (or proof of payment)
- G Location map (1:50,000 scale) and/or UTM coordinates indicating location of project
- G Proof of Land Ownership (for Schedule H)

IF ASSISTANCE IS REQUIRED IN COMPLETING THESE FORMS PLEASE CALL 729-2945 or 729-5713.

YOUR APPLICATION WILL NOT BE PROCESSED AND MAY BE RETURNED IF ANY OF THE ABOVE INFORMATION IS NOT PROVIDED WITH YOUR APPLICATION OR IS NOT COMPLETED IN SUFFICIENT DETAIL.

Please mail completed Application Forms to:

Department of Environment and Conservation
Water Resources Management Division
PO Box 8700, St. John's NL A1B 4J6
Attention: Clyde McLean, Manager, Investigations Section

Applicant Information:

Name/Company/Agency: Nalcor Energy
Contact Person: Peter Madden
Address: Street/PO Box: Hydro Place, 500 Columbus Drive, PO Box 12800
City/Town: St. John's
Province: NL Postal Code: A1B 0C9
Telephone No.: (709) 737-4972 Fax No.: (709) 737-1985
E-mail Address: PeterMadden@nalcorenergy.com

Owner Information: X Same as above, or

Name/Company/Agency: _____
Contact Person: _____
Address: _____
Street/PO Box: _____
City/Town: _____
Province: _____ Postal Code: _____
Telephone No.: ( ) _____ Fax No.: ( ) _____
E-mail Address: _____

Alteration Type:

Please select the Applicable Type(s) and attach completed Schedule(s) for each:

Type	Check (x)	Required Schedule
Culvert	G	Schedule A
Bridge	G	Schedule B
Dam	G	Schedule C
Fording	G	Schedule D
Pipe Crossing/Water Intake	G	Schedule E
Stream Modification or Diversion	X	Schedule F
Pedestrian/ATV/Snowmobile Bridge	G	Schedule G
Other works within 15 metres of a body of water ie: Wharf, Boathouse, Infilling, Landscaping, Dredging, Debris Removal, Drainage Works, Settling Ponds, Other Minor Works	G	Schedule H

Project Information:

Project Name: Lower Churchill Project

Water Body Name: Three Kettle Lakes

Community Name: _____

Area (if outside a community): Muskrat Falls

Is this project located in a Protected Public Water Supply Area? Yes G No X

Proposed Start Date: ___April 2014____ **Estimated Completion Date:** __November 2016__

Note: Exact dates will be determined by the contractor

Reason(s) for the Project:

_____

_____

Date: _____8-Mar-2013_____ **Signature:** _____

Schedule F – Stream Modification or Diversion

Project Description
(Please complete one Schedule for each modification)

Location

Site Name/No: Three Kettle Lakes Area

Please mark location on a copy of a topographic map (preferably at 1:50,000 scale) and include with the application:

1:50,000 Topographic Map No: _____

or provide UTM Coordinates: See attached drawing (Plate 30)

N __5903388.660____ E ___648568.005 ___ NAD ___83____ ZONE ___20_____

Design

Drainage Area Profile:

Drainage Area: _____1.24_____ km^2

Main Channel Length: _____2.15_____ km

Slope of Drainage Area: _____3.9_____ %

Drainage Area Classification:

Forest: _____%

Barren: _____%

Wetland: _____%

Urban: _____%

Hydrologic Details:

Return Period: 1: ___100___ years

Estimation Method: X Rational □ TR55 □ RFFA □ Other _____

Maximum Flow: ____5.86___ m^3/s Design Flow: ____5.86___ m^3/s

Description of Estimation:
Please show calculation(s) below or attach separate sheets, if required.

See attached.

Design (cont'd)

Dimensions: Please provide the following drawings:

(a) Site Layout (b) Cross-sectional View (c) Longitudinal View

For the proposed channel modification these drawings should show:

- Bottom width of channel
- Top width of channel
- Channel depth
- Slope of channel embankments
- Normal water depth
- Low water level
- High water level
- Slope of channel
- Extent of floodplain
- Diameter of rip-rap
- Energy dissipaters

Hydraulic Details:

Maximum Velocity: _____ (m/s) Minimum Velocity: _____ (m/s)

Maximum Flow: 5.86 (m^3/s) Minimum Flow: _____ (m^3/s)

Construction

Equipment to be used**:** Excavator and compactor

Proposed dewatering method: N/A

Briefly describe how erosion control and stabilization will be carried out:

See attached general environmental requirements

Briefly describe how site restoration will be carried out:

See attached general environmental requirements

Peak Discharge for Stream Diversion – Three Kettle Lakes Area

Design Philosophy

In order to compute the peak discharge for the drainage area intersecting the stream diversion for the Three Kettle Lakes Area at the Muskrat Falls site the rational method was used. The idea behind the rational method is that if a rainfall of intensity i begins instantaneously and continues indefinitely, the rate of runoff will increase until the time of concentration t_c, when all of the watershed is contributing to flow at the outlet. The product of rainfall intensity i and watershed area A is the inflow rate for the system, iA, and the ratio of this rate to the rate of peak discharge Q (which occurs at time t_c) is named the runoff coefficient C (0 < C < 1) (1). This is expressed with the rational formula:

$$Q = \frac{1000}{3600} CiA$$

Where:

Q = Peak Discharge (m³/s)
i = Rainfall Intensity (mm/hr)
A = Watershed Area (km²)
C = Runoff coefficient

The duration used for the determination of the design precipitation intensity i is the time of concentration of the watershed.

The assumptions associated with the rational method are:

1. The computed peak rate of runoff at the outlet point is a function of the average rainfall rate during the time of concentration, that is, the peak discharge does not result from a more intense storm of shorter duration, during which only a portion of the watershed is contributing to runoff at the outlet.

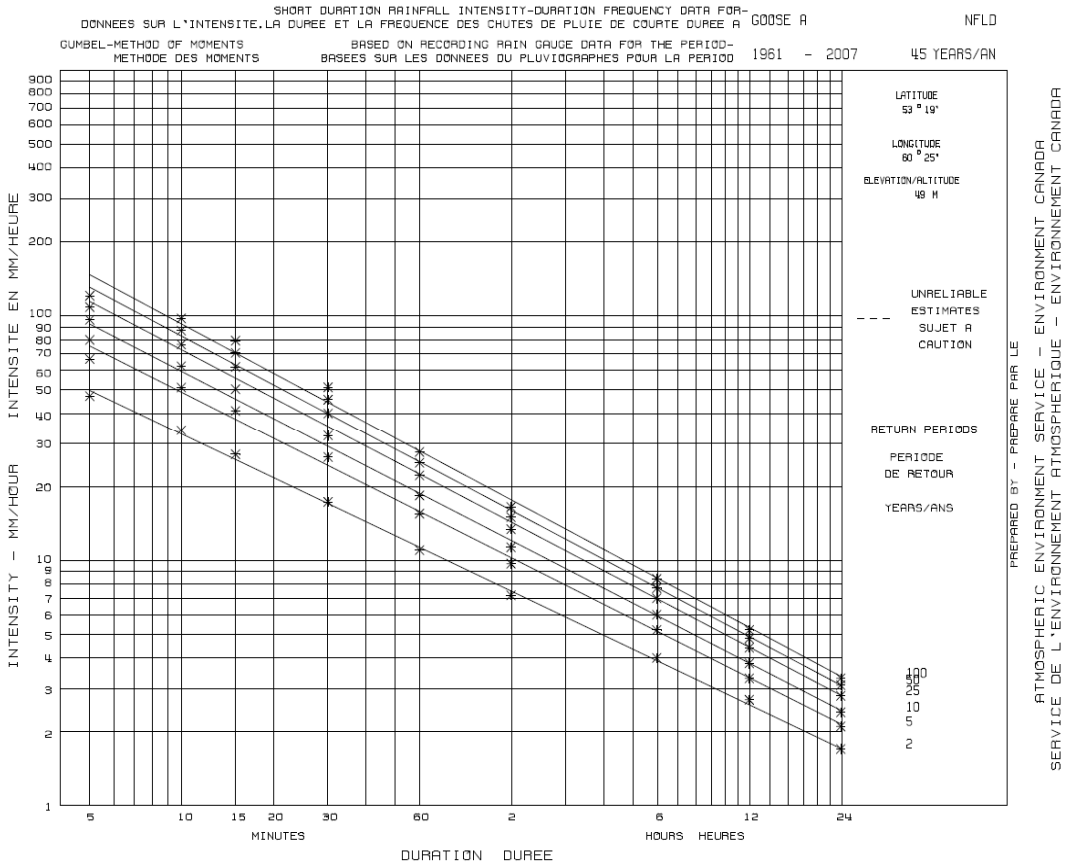
2. The time of concentration employed is the time for the runoff to become established and flow from the most remote part of the drainage area to the outflow of the watershed.

3. Rainfall intensity is constant throughout the storm duration.

IDF Curve

Figure 1 presents the IDF curves at Goose Bay obtained from Environment Canada. The return periods for the calculations was 1:100 yr.

Figure 1: Goose Bay A – Station 8501900
Return Period Rainfall Rates (mm/h)
From Environment Canada (Based on Data from 1961 to 2007)



Duration	2 yr (mm/h)	5 yr (mm/h)	10 yr (mm/h)	25 yr (mm/h)	50 yr (mm/h)	100 y (mm/h)r
5 min	47.1 ± 6.0	66.8 ± 10.1	79.9 ± 13.6	96.4 ± 18.3	108.6 ± 21.9	120.7 ± 25.6
10 min	34.1 ±5.2	51.1 ±8.7	62.4 ±11.8	76.6 ±15.9	87.2 ±19.0	97.7 ±22.1
15 min	27.1 ±4.2	41.0 ±7.1	50.3 ±9.7	62.0 ±13.0	70.7 ±15.6	79.3 ±18.2
30 min	17.3 ±2.8	26.4 ±4.6	32.4 ±6.3	40.0 ±8.4	45.6 ±10.1	51.2 ±11.8
1 h	11.0 ±1.4	15.5 ±2.3	18.4 ±3.1	22.2 ±4.2	25.0 ±5.0	27.7 ±5.8
2 h	7.2 ±0.8	9.7 ±1.3	11.3 ±1.7	13.4 ±2.3	15.0 ±2.8	16.5 ±3.2
6 h	4.0 ±0.4	5.2 ±0.6	6.0 ±0.8	7.0 ±1.1	7.7 ±1.3	8.4 ±1.5
12 h	2.70 ±0.2	3.3 ±0.4	3.8 ±0.5	4.4 ±0.6	4.8 ±0.8	5.2 ±0.9
24 h	1.7 ±0.1	2.1 ±0.2	2.4 ±0.3	2.8 ±0.4	3.1 ±0.5	3.3 ±0.6

Time of Concentration

The time of concentration for a drainage basin is made up of the longest combination of overland flow time plus the accumulated flow time in the stream channels to the outlet of the basin. To estimate the time of concentration for every drainage area the Kirpich's equation was used (2):

$$T_c = 2 \times 0.0192 \times L^{0.77} \times I^{-0.385}$$

Where:

L = length of channel from head water to outlet (m)
I = average watershed slope (m/m)

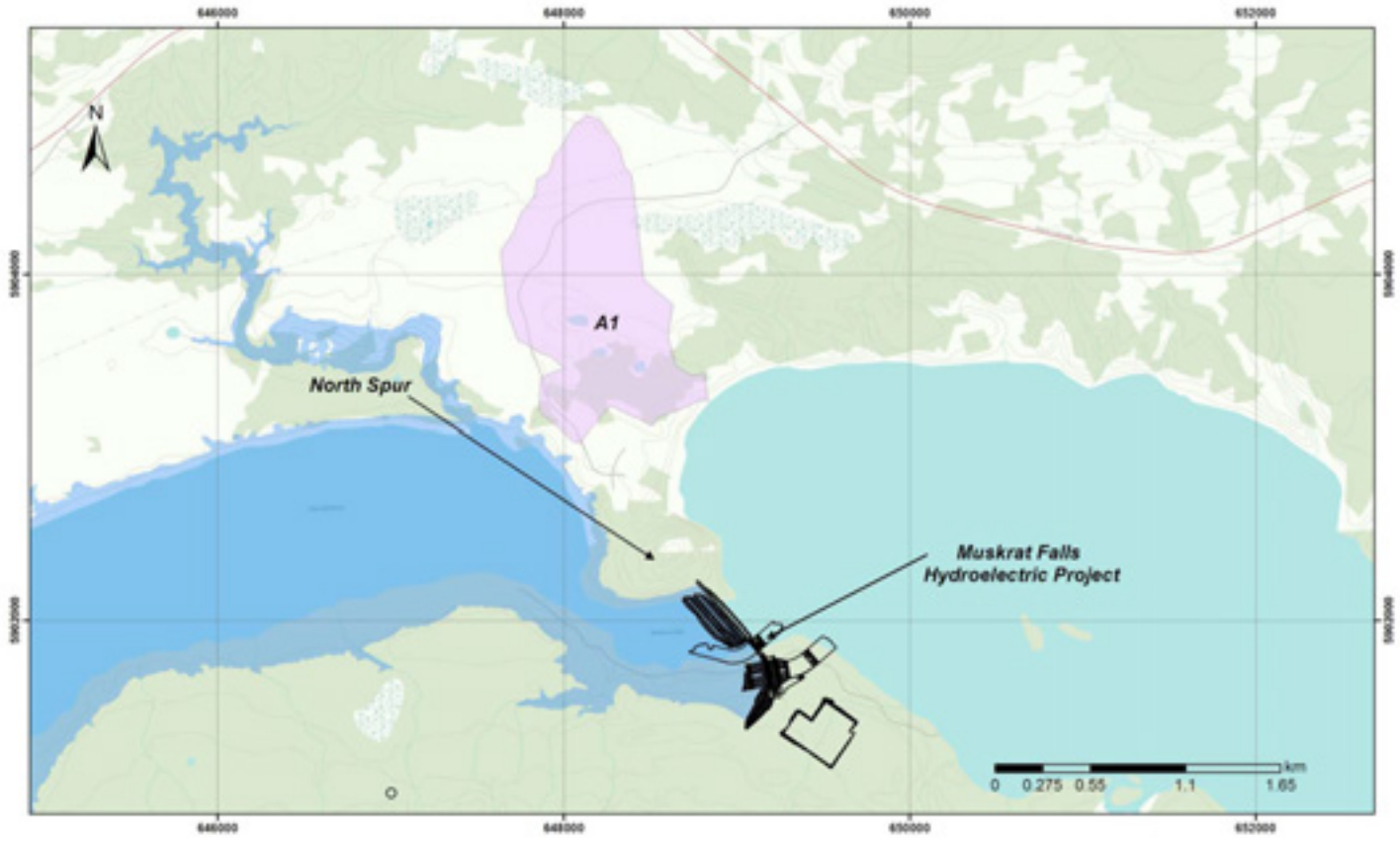
The Runoff Coefficient

The runoff coefficient depends on the percent of imperviousness, slope, and ponding potential of the surface. The runoff coefficient is also dependent on the type and condition of the soil. The infiltration rate decreases as rainfall continues and the soil becomes saturated, and is also influenced by the antecedent moisture conditions of the soil. Other factors influencing the runoff coefficient are rainfall intensity, proximity of the water table, degree of soil compaction, porosity of the subsoil, vegetation, ground slope and depression storage. Table 1 presents the runoff coefficient for forest and woodland areas (1).

Table 1: Runoff coefficients to use in the rational method

		Return Period (years)						
Character of surface		**2**	**5**	**10**	**25**	**50**	**100**	**500**
Undeveloped								
Forest/Woodlands								
Flat	0-2%	0.22	0.25	0.28	0.31	0.35	0.39	0.48
Average	2-7%	0.31	0.34	0.36	0.4	0.43	0.47	0.56
Steep ,over	7%	0.35	0.39	0.41	0.45	0.48	0.52	0.58

Structure: Stream Diversion – Three Kettle Lakes Area	Condition: For Construction
Character of Surface: Undeveloped (Forest/Woodland)	



Sub-Basin	Area (km²)	Avg. Slope (%)	Length (Km)	T_c (hr)	Intensity (mm/hr)	Runoff Coeff.	Return Period (yr)	Q (m³/s)
A1	1.24	3.9	2.15	49.2	36.2	0.47	100	**5.86**

REFERENCES

(1) Chow, Ven te, “Applied Hydrology”, McGraw Hill, Inc. 1988

(2) Kirpich, P.A. “Time of concentration of Small Agricultural Watersheds.” Civil Engineering, 10, no. 6 (June 1940)

(3) Roberson, A. “Hydraulic Engineering.” John Wiley & Sons, Inc. Second Edition ,1998

LOWER CHURCHILL PROJECT

CH0008

NORTH SPUR STABILIZATION WORKS

SCOPE OF WORK SPECIFICATION

Prepared by:

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Geotechnical Specialist

Alvaro Ceballos
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Checked by:

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Approved by:

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Area Manager

REVISION LIST

Revision						Remarks
N°	By	Verif.	Appr.	Appr.	Date	
PA	ND/ AC	RB	GS	KS	30-Apr-2013	Issued for internal coordination.

TABLE OF CONTENTS
SCOPE OF WORK

PART 1 GENERAL

1.1 PROJECT DESCRIPTION

1.1.1 The Lower Churchill Project (LCP), located on the Churchill River in the Province of Newfoundland and Labrador, Canada, consists of the Muskrat Falls Generating Station with a capacity of eight hundred and twenty four megawatts (824 MW) and associated transmission line works.

1.1.2 The project site for Muskrat Falls is located on the lower reaches of the Churchill River approximately 35 km west of the Town of Happy Valley– Goose Bay. Permanent access to the site is from the south shore, via a road extension from the existing Trans-Labrador Highway (Route 510). Permanent access road to the North Spur is from the north shore, via an extension road from the existing Trans-Labrador Highway (Route 500).

1.1.3 The Muskrat Falls Hydroelectric Development consists of the following main components:

.1 Main access road, including upgrading and construction of over 22 km of new road with several stream crossings,

.2 Approximately 20 km of access roads to be constructed to reach the main structures, laydown areas, accommodation complex, borrow areas and spoil disposal areas,

.3 Accommodation complex to accommodate 1,500 persons,

.4 Contractor and Company's laydown areas,

.5 Reservoir preparation including some 130 km of forest access road, forest harvesting, and bank stabilization,

.6 Intake, Powerhouse, Spillway, Transition Dams, North RCC Dam and South Dam,

.7 North Spur stabilization works,

.8 Switchyards at Muskrat Falls and Churchill Falls,

.9 High voltage AC and DC overhead transmission lines and associated infrastructure, and AC/DC converter stations at Muskrat Falls and Soldiers Pond,

.10 Environmental habitat (fish and terrestrial) protection, remediation and replacement.

1.2 GENERAL DESCRIPTION OF PACKAGE CH0008

1.2.1 The North Spur Stabilization Works (Package CH0008) consists of overburden excavations, embankments constructions on both upstream and downstream sides of the Spur, construction of two cut-off walls on the north-west and upstream sides of the Spur, permanent access roads and related works, and instrumentations, as described in this document and Technical Specifications, and as shown on the drawings.

1.3 LANGUAGE AND UNITS

1.3.1 The language to be used for all nameplates and documentations is English.

1.3.2 The units of measurement shall be the International System of Units (SI).

1.3.3 All instruments' graduations and inscriptions shall comply with the SI system.

1.4 CLIMATIC DATA

1.4.1 The Climatological Data is included in Exhibit 11 - Company Supplied Documents.

1.5 HYDROMETEOROLOGICAL DATA

1.5.1 Hydrometeorological data are summarized on Drawing MFA-SN-CD-2000-CV-DD-0003-01, Exhibit 1.

PART 2 SCOPE OF WORK

2.1 WORK INCLUDED

2.1.1 The work listed in this Scope of Work Specification includes the supply of all labour, materials and equipment, and the execution of all work required to construct all structures and related works as required in the Technical Specification, as shown on the drawings and as specified herein.

2.1.2 The term Technical Specification, refers to the document MFA-SN-CD-3300-CV-TS-0001, Exhibit 1.

2.1.3 The Work includes, but is not limited to:

.1 Surveying required for implementing the works before starting,

.2 Surveying required for establishing work advancement during the work, and as-built documents at the end of the work,

.3 Design, construction, maintenance, relocation (if required) and removal of all temporary construction roads to borrow pits and quarries, and stockpile and spoil disposal areas as specified in the Contract, as indicated on the drawings or as required by the Engineer,

.4 Construction and maintenance of the permanent access road to the south limit of the North Spur from Trans-Labrador Highway. Construction of permanent access roads to the upstream and downstream sides of the North Spur as specified in the Contract, as indicated on the drawings or as required by the Engineer,

.5 Design, construction, maintenance, relocation (if required) and removal of all temporary construction roads, access ramps and work areas necessary for the execution of the work as specified in the Contract, as indicated on the drawings or as required by the Engineer,

.6 Maintenance of the temporary access road to the north bank around the rock knoll as specified in the Contract, as indicated on the drawings or as required by the Engineer,

.7 Clearing, grubbing and stripping of borrow areas, quarries and their access roads where needed. Clearing and grubbing of stockpile area, and clearing the spoil disposal area. All as specified in the Contract, as indicated on the drawings or as required by the Engineer,

.8 Clearing and grubbing inside the footprint of all excavations and embankments, as specified in the Contract, as indicated on the drawings or as required by the Engineer,

.9 Maintenance, dust control and snow clearing of all construction roads, access ramps, work areas, as well as the north side laydown area, stockpile area and spoil disposal area during the work period. Construction roads include all roads used by the Contractor for the execution of the Work,

.10 Exploitation of borrow areas and quarries including processing and transportation of materials, and rehabilitation of the sites at the end of the work as specified in the Technical Specifications,

.11 Supply and installation of safety fences around the excavations as specified in the contract and required by the Engineer,

.12 Relocating the construction power and fibre optic lines, during construction of the north-west cut-off wall, as specified in the Contract, as indicated on the drawings or as required by the Engineer,

.13 Relocating the North Spur access road during the excavations for the north-west cut-off wall, as specified in the Contract, as indicated on the drawings or as required by the Engineer,

.14 Construction of the upstream and north-west cut-off walls, and associated platforms, as specified in the Contract, as indicated on the drawings or as required by the Engineer,

.15 Excavations and embankments construction works as specified in the Contract, as indicated on the drawings or as required by the Engineer,

.16 Construction of finger drains on the downstream side of the North Spur, as specified in the Contract, as indicated on the drawings or as required by the Engineer,

.17 Design, supply, installation, operation and removal of all required dewatering systems during the construction period,

.18 Design, construction and maintenance of all surface water control systems as specified in the Contract, as indicated on the drawings or as required by the Engineer,

.19 Installation of relief wells and the collector pipe as specified in the Contract, as indicated on the drawings or as required by the Engineer,

.20 Installation and maintenance of turbidity barriers on the upstream and downstream sides of the North Spur, during excavation and embankment works,

.21 Maintenance and relocation, if required, of the existing portage trail during construction works, as specified in the Contract, as indicated on the drawings or as required by the Engineer,

.22 Construction of the permanent portage trail and boat launch as specified in the Contract, as indicated on the drawings or as required by the Engineer,

.23 Foundation preparation including dental excavation and scaling where embankment of zone 1 material is placed against the bedrock, as specified in the Contract, as indicated on the drawings or as required by the Engineer,

.24 Foundation preparation where the embankment is placed on the in situ soil material, as specified in the Contract, as indicated on the drawings or as required by the Engineer,

.25 Construction of peripheral drain around the rock knoll to drain the surface runoff water towards the upstream and downstream sides of the Spur, as specified in the Contract, as indicated on the drawings or as required by the Engineer,

.26 Supply and installation of the permanent geotechnical instrumentation, and to maintain and operate the instrumentation during the construction works, as specified in the Contract, as shown on the Drawings or as required by the Engineer,

.27 Supply, installation and grounding of the chain link fences and gates for the entrance to the construction area, as specified in the Contract, as shown on the Drawings or as required by the Engineer,

.28 Construction of the log boom platforms and associated access roads on the north bank of the River, as specified in the Contract, as indicated on the drawings or as required by the Engineer,

.29 Construction of the south side impervious blanket, as specified in the Contract, as indicated on the drawings or as required by the Engineer,

.30 Restoring and relocating the existing monument and instrumentation which are located in the vicinity of the excavation or embankment works, as specified in the Contract, as indicated on the drawings or as required by the Engineer,

.31 Construction, maintenance and operation of all temporary mitigation measures to comply with Technical Specification Section 01 35 43 - General Environmental Requirements,

.32 Site restoration at the end of the work, as specified in the Contract, as indicated on the drawings or as required by the Engineer,

.33 Operation and maintenance of the existing pump well system during the construction works. Refurbishment of the pump wells, if required, and as directed and approved by the Engineer,

.34 Supply, installation, operation and maintenance of the telecommunication system to transfer data recorded by the instrumentations (piezometers and pump wells) to the Energy Control Center (ECC) in St. John's, as specified in the Contract, as indicated on the drawings or as required by the Engineer,

2.2 WORK EXCLUDED

The following works are excluded from this contract and will be performed by Company's other Contractors:

2.2.1 Design and construction of the temporary access road to the north bank around the rock knoll,

2.2.2 Construction of the pump well system, control shelter and associated 25 kV power line,

2.2.3 Design and construction of log booms,

2.2.4 Construction of the high Voltage transmission lines and associated infrastructures,

2.2.5 Construction of the temporary (construction) power line,

2.2.6 Reservoir preparation and bank stabilization,

2.2.7 Construction of the 138 Kv/ 25 Kv substation,

2.2.8 All services provided by the Company as specified in Exhibit 12: Site Conditions.

PART 3 SPECIAL REQUIREMENTS

3.1 GENERAL

3.1.1 The Contractor shall conform to all Federal and Provincial safety and security laws and regulations,

3.1.2 The overall project schedule requires some works to be performed during the winter period. The Contractor shall take all necessary measures for works in winter conditions,

3.1.3 Some works are required to be completed before the first impoundment (water level 25 m). These works include the upstream and north-west cut-off walls, the upstream embankment works up to elevation 27 m, the downstream embankment works up to elevation 25 m including instrumentations and relief wells, and the kettle lakes discharge channel improvements,

3.1.4 After completion of the temporary access road to the south side, the rockfill material required for the North Spur stabilization works shall be sourced from the south side stockpile area,

3.1.5 The Contractor shall submit the required documentation to the Engineer for review and approval in accordance with the Technical Specification and the Supplier Document Requirement List (SDRL),

3.1.6 Where there are conflicts between or within the Technical Specification and the Drawings, the Technical Specification will have precedence. Where there are conflicts between or within Codes, Standards or Acts, priority shall be given to the more stringent.

3.2 SITE CONDITIONS

3.2.1 This Scope of Work Specification shall be read in conjunction with Exhibit 12 - Site Conditions.

3.3 COMPANY SUPPLIED DOCUMENTS

3.3.1 Company supplied documents are listed in Exhibit 11. The Contractor shall observe all requirements of the Company Supplied Documents.

3.4 SETTING-OUT OR IMPLEMENTATION OF SURVEY POINTS AND LINES

3.4.1 The Contractor is responsible for:

.1 Surveying required for setting-out and as-built profile of the works,

.2 Locating, confirming and protecting reference points prior to starting site works, and protecting the permanent reference points during construction,

.3 Establishing permanent benchmarks on site referenced to the permanent reference points, and recording the coordinates of the benchmarks in the project record documents,

.4 The accurate setting-out of the Work in relation to reference points, lines and levels given by the Engineer in writing,

.5 The accuracy of the positions, levels, dimensions and alignments of all parts of the Work,

.6 The provision of all necessary instruments, appliances and labour required for the foregoing responsibilities,

.7 If at any time during the execution of the Work, any error appears in the position, levels, dimensions or alignments of any part of the Work, the Contractor, upon being required to do so by the Engineer, shall, at its own cost, rectify such errors to the satisfaction of the Engineer; unless such error is based on incorrect data supplied in writing by the Engineer, in which case the Engineer shall recommend a change to the work in accordance with Article 14,

.8 The checking of any set-out or line or level, by the Engineer, will not, in any way, relieve the Contractor of its responsibility for the accuracy. The Contractor shall carefully protect and preserve all benchmarks, sight-rails, pegs and other reference points used in setting-out the Work.

3.5 SITE INFORMATION

3.5.1 The Company has made available to the Contractor the site information (Exhibit 11 – Company Supplied Documents), before the submission of the Proposal by the Contractor. Such data on subsurface conditions have been obtained by or on behalf of the Company from investigations undertaken relevant to the Work; however the Contractor shall be responsible for its own interpretation thereof.

3.5.2 The Contractor is deemed to have inspected and examined the site and its surroundings, be fully knowledgeable of the related information available and to have satisfied itself before submitting its Proposal, as to:

.1 The form and nature thereof, including the subsurface conditions,

.2 The hydrological and climatic conditions,

.3 The extent and nature of work and materials necessary for the execution and completion of the Work and the remedying of any defects therein, and

.4 The means of access to the Site and the required accommodation, when not provided (Refer to Exhibit 12 – Site Conditions),

3.5.3 In addition, the Contractor, in general, is deemed to have obtained all necessary information, as to risks, contingencies and all other circumstances which may influence or affect its Proposal.

3.5.4 The Contractor is deemed to have based its Bid on the data made available by the Company and on its own inspection and examination, all as aforementioned.

3.6 SPECIALIST SUBCONTRACTOR

3.6.1 The Contractor may subcontract specialized services, such as design engineering services, but it shall obtain the approval of the Engineer prior to the award of any such subcontract. Such approval shall not relieve the Contractor from any liability or obligation under the Agreement and the Contractor will be responsible for the acts, defaults and neglects of the Subcontractor, its agents, and personnel as fully as if they were the acts, defaults and neglects of the Contractor. The Engineer reserves the right to refuse the services of a subcontractor proposed by the Contractor.

3.6.2 The Contractor shall submit to the Engineer for approval, details on the history of the Subcontractor (such as previous works completed in similar conditions), on the personnel the Sub-Contractor intends to use including their detailed resumes, membership in professional organizations, their authority to sign and approve Drawings, registration and/or eligibility to register with the Professional Engineers and Geoscientists of Newfoundland and Labrador (PEGNL). All calculations and such like shall be in accordance with Newfoundland and Labrador Regulations. Such approval by the Engineer does not relive the full responsibility of the Contractor in the execution of the Work.

3.6.3 The Subcontractor may be requested to undertake its work or part of its work at the Work Site.

3.7 ENVIRONMENTAL REQUIREMENTS

3.7.1 The Contractor shall comply with the Technical Specification Section 01 35 43 – "General Environmental Requirements" (Exhibit 1) and Environmental and Regulatory Compliance Requirements (Exhibit 6).

3.7.2 Prior to starting the site work, the Contractor shall prepare a Contract Specific Environmental Protection Plan (C-SEPP) for review and approval by the Engineer. The C-SEPP will detail the environmental protection measures that will be implemented by the Contractor for all components of the Work. The Contractor shall refer to the General Environmental Requirements Technical Specification and the Contract Drawings, as required. The template for preparation of the C-SEPP is attached in Exhibit 11- Company Supplied Documents.

3.8 DOCUMENTS

3.8.1 Drawings provided to the Contractor:

.1 The Drawings issued with the Request for Proposal (RFP) are intended to indicate the location, type and scope of work to be carried out. They are not issued to be used for construction. At effective date, a schedule of issue of the Approved for Construction (AFC) Drawings will be provided. The Contractor shall verify on site all levels and dimensions before starting the works, and shall notify the Engineer of any differences and/or discrepancies with the Approved for Construction Drawings.

.2 Before the beginning of the Work, the Contractor shall submit for the Engineer's approval, the Drawings required as per the Technical Specification and as provided in the SDRL (Exhibit 4- Supplier Document Requirement List). The Contractor shall submit all test certificates, purchase orders, Drawings and all details necessary for the execution of the Work, to the Engineer for review, as specified in the Technical Specification.

.3 The turnaround time for Engineer's review of Contractor's drawings is 21 calendar days.

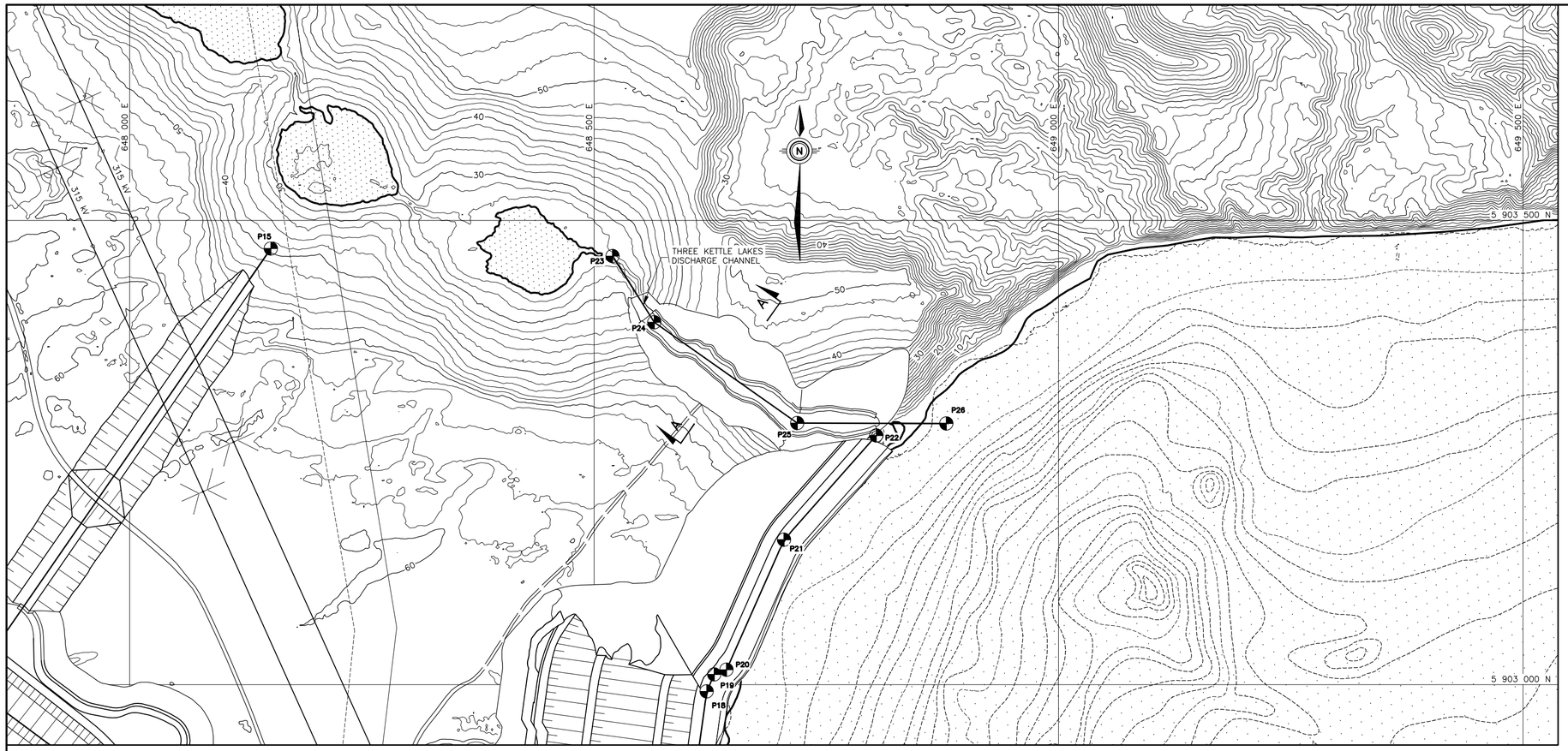
3.8.2 Drawings

.1 The Drawings are included in Exhibit 1 and are listed in the Technical Document List, document number 505573-CH0008-40AL-I-0001.

.2 The Drawings issued with the Request for Proposal are not intended to be used for Construction. The Contractor shall only execute the Work based on Approved for Construction Drawings.

3.8.3 Technical Specification

The Technical Specification related to the Work is provided in Exhibit 1.



NOTES:

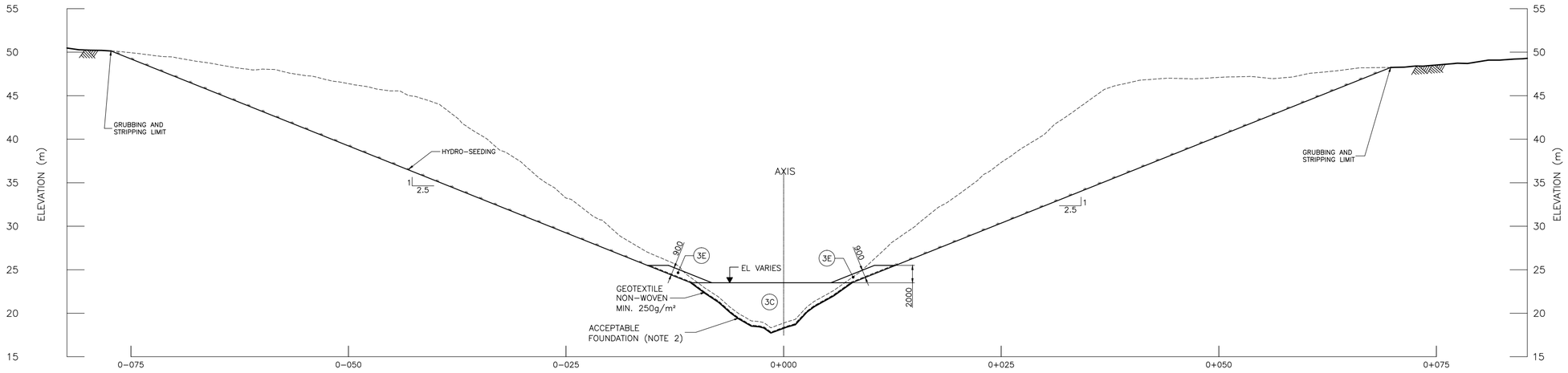
1. ALL COORDINATES ARE REFERENCED TO UTM NAD83, ZONE 20.
2. THE GROUND TOPOGRAPHY CONTOURS ARE BASED ON A SITE–SPECIFIC LIDAR SURVEY COMPLETED IN 2006.
3. THE RIVER BATHYMETRY CONTOURS ARE BASED ON AN AIRBORNE BATHYMETRIC SURVEY COMPLETED IN 1998.
4. THE CONTOUR INTERVAL OF THE GROUND TOPOGRAPHY AND THE RIVER BATHYMETRY IS 2 METRES.
5. ELEVATIONS ARE IN METRES AND DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
6. IN THE DOWNSTREAM AREA THE TRANSITIONS SHALL BE BONE 5.00 m IN BOTH SIDES OF EVERY SECTION LIMITS.

LEGEND

- TOPOGRAPHIC CONTOUR
- BATHYMETRIC CONTOUR
- SHORELINE (JULY–OCTOBER FOR AVERAGE FLOW OF 1.830 m3/s)
- ACCESS ROAD
- HYDROLOGICAL STATION
- CULVERT
- NIC — NOT IN CONTRACT
- BENCHMARK
- LOCATION POINT
- TRANSMISSION TOWER

TABLE 4 (THREE KETTLE LAKES DISCHARGE CHANNEL)

POINT No	COORDINATES	
	EASTING	NORTHING
P23	648519.937	5903461.568
P24	648564.783	5903390.262
P25	648718.686	5903281.720
P26	648879.311	5903281.235



SECTION A–A
1 : 200

NOT FOR CONSTRUCTION

0 5000 10000 15000 mm
SCALE 1:200

0 50 100 150 200 m
SCALE 1:2000

SNC•LAVALIN — nalcor energy

LOWER CHURCHILL PROJECT

NORTH SPUR STABILIZATION

THREE KETTLE LAKES DISCHARGE CHANNEL

PLAN AND SECTION

PLATE 30

G:\505573\4_Drafting\Drawings\Civil\328\SKETCHES\
PLATE 30_THREE KETTLE LAKES DISCHARGE CHANNEL.dwg

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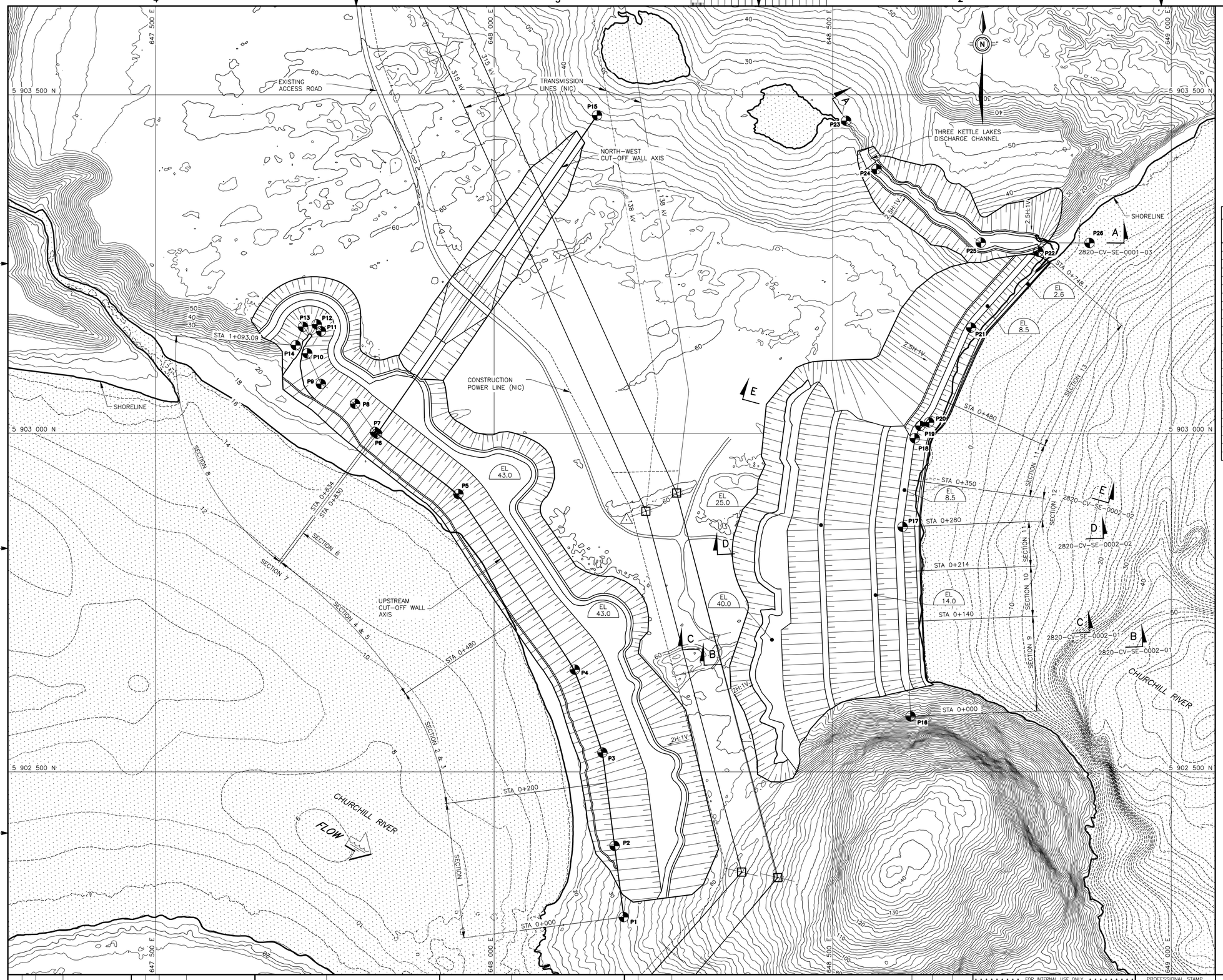

POINTS LOCATION			
POINT No	COORDINATES		
	EASTING	NORTHING	RADIUS
P1	648191.491	5902285.719	–
P2	648177.853	5902390.861	150.00
P3	648159.986	5902528.612	150.00
P4	648119.100	5902651.024	150.00
P5	647947.386	5902910.350	150.00
P6	647827.258	5902999.509	–
P7	647824.046	5903001.893	–
P8	647794.692	5903043.619	–
P9	647744.289	5903072.850	–
P10	647724.225	5903118.179	–
P11	647744.483	5903150.728	–
P12	647737.962	5903160.967	–
P13	647717.796	5903157.341	–
P14	647707.063	5903130.118	–
P15	648152.050	5903469.635	–
P16	648615.000	5902582.219	–
P17	648603.343	5902861.976	100.00
P18	648621.176	5902992.766	100.00
P19	648629.277	5903011.052	–
P20	648642.471	5903016.144	–
P21	648704.449	5903156.029	100.00
P22	648803.788	5903268.419	–
P23	648519.937	5903461.568	
P24	648564.783	5903390.262	
P25	648718.686	5903281.720	
P26	648879.311	5903281.235	

NOTES:

1. ALL COORDINATES ARE REFERENCED TO UTM NAD83, ZONE 20.
2. THE GROUND TOPOGRAPHY CONTOURS ARE BASED ON A SITE-SPECIFIC LIDAR SURVEY COMPLETED IN 2006.
3. THE RIVER BATHYMETRY CONTOURS ARE BASED ON AN AIRBORNE BATHYMETRIC SURVEY COMPLETED IN 1998.
4. THE CONTOUR INTERVAL OF THE GROUND TOPOGRAPHY AND THE RIVER BATHYMETRY IS 2 METRES.
5. ELEVATIONS ARE IN METRES AND DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
6. TRANSITION BETWEEN SECTIONS SHALL BE ADJUSTED ON SITE.
7. THE CONTRACTOR SHALL PREPARE A CONTRACT SPECIFIC ENVIRONMENTAL PROTECTION PLAN WHICH SHALL BE SUBJECT TO THE ENGINEER'S APPROVAL.
8. LOCATION OF CUT-OFF WALLS CAN BE ADJUSTED ON SITE BY THE ENGINEER.
9. THE LIMITS OF THE TYPICAL CROSS-SECTIONS SHOWN IN THE DRAWINGS ARE APPROXIMATE. FINAL LIMITS WILL BE ESTABLISHED ON SITE BY THE ENGINEER.

LEGEND

- TOPOGRAPHIC CONTOUR
- BATHYMETRIC CONTOUR
- SHORELINE (JULY–OCTOBER FOR AVERAGE FLOW OF 1830 m3/s)
- ACCESS ROAD
- HYDROLOGICAL STATION
- CULVERT
- NIC — NOT IN CONTRACT
- BENCHMARK
- LOCATION POINT
- TRANSMISSION TOWER

NOT FOR CONSTRUCTION

0 50 100 150 200 m
SCALE 1:2000

ISSU.	REV.	DATE	DISTRIBUTION & STATUS	ISSU.	REV.	DATE	DISTRIBUTION & STATUS
1	PA	26-FEB-2013	ISSUED FOR INTERNAL REVIEW				

ISSUE REGISTER

No.	REFERENCE DRAWING
MFA-SN-CD-2800-CV-SE-0004-01	NORTH SPUR STABILIZATION WORKS – NORTH-WEST CUT-OFF WALL SECTIONS
MFA-SN-CD-2800-CV-DD-0006-01	NORTH SPUR STABILIZATION WORKS – CUT-OFF WALLS WORK PLATFORM AND CONSTRUCTION STAGES
MFA-SN-CD-2820-CV-SE-0002-01 TO 02	NORTH SPUR STABILIZATION WORKS – FINGER DRAINS – SECTIONS AND DETAILS SHEET 1 OF 2 AND 2 OF 2
MFA-SN-CD-2820-CV-SE-0001-01 TO 03	NORTH SPUR STABILIZATION WORKS – DOWNSTREAM – TYPICAL CROSS-SECTIONS AND DETAIL SHEET 1 OF 3 TO 3 OF 3
MFA-SN-CD-2810-CV-SE-0001-01 TO 04	NORTH SPUR STABILIZATION WORKS – UPSTREAM – TYPICAL CROSS-SECTIONS AND DETAIL SHEET 1 OF 4 TO 4 OF 4

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.

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REVIEW CLASS: | EQUIPMENT TAG NUMBER:

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- ☐ 3. REVIEWED - NOT ACCEPTED
- ☐ 4. INFORMATION ONLY
- ☐ 5. NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy):
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy):
PROJECT MANAGER: Date (dd-mmm-yyyy):

PROFESSIONAL STAMP

SNC·LAVALIN

DESIGNED BY A. CEBALLOS	APPROVED Discipline Lead Engineer R. BOUCHARD
DRAWN BY R. MERRI	APPROVED Engineering Manager G. SNYDER
VERIFIED BY N. DAIYAN	
DATE 29-SEP-2012	SCALE 1 : 2000

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
NORTH SPUR STABILIZATION WORKS
PLAN

File No. 505573-3281-4GDD-0003-PA | MFA-SN-CD-2800-CV-PL-0009-01 | Rev. —

FORMAT A0 (mm)
PLATE G12

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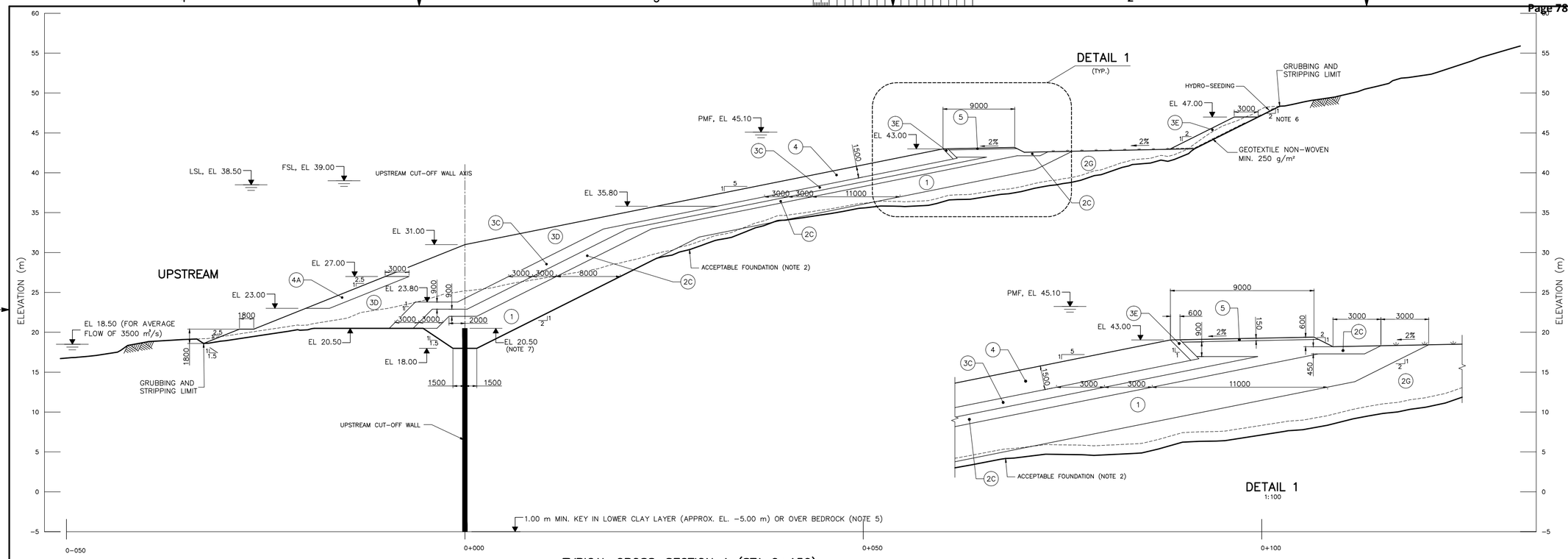
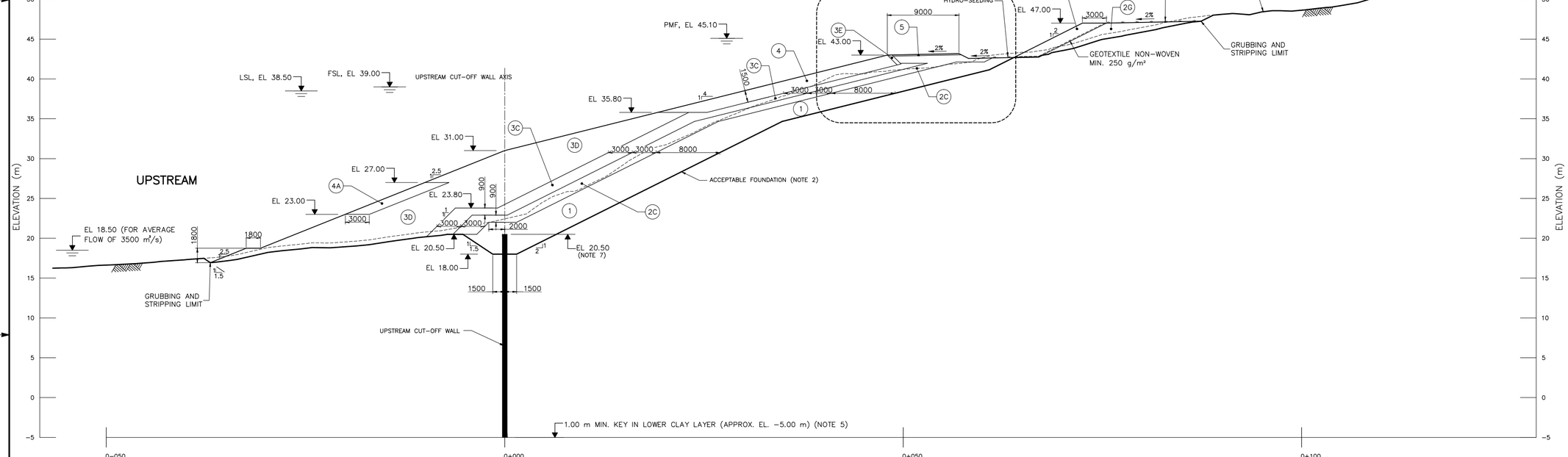


TYPICAL CROSS-SECTION 1 (STA 0+150)
2800-CV-PL-0009-01

DETAIL 1
1:100



TYPICAL CROSS-SECTION 2 (STA 0+300)
2800-CV-PL-0009-01

NOTES:

1. ELEVATIONS ARE IN METRES AND DIMENSIONS ARE IN MILLIMETRES.
2. DEFINED AND APPROVED ON SITE BY ENGINEER.
3. DURING SPREADING AND COMPACTION, THE SURFACE OF ZONE (1) MATERIAL SHALL BE CROWNED OR SLOPED WITH A 5% TRANSVERSE GRADE.
4. DURING SPREADING AND COMPACTION, THE SURFACE OF ZONE (1) MATERIAL SHALL BE GRADED WITH A MINIMUM 2% LONGITUDINAL SLOPE.
5. FINAL KEY ELEVATION IS APPROXIMATIVE AND SHALL BE APPROVED BY THE ENGINEER.
6. ABOVE EL 43.00, REGRADING TO 2H : 1V IS NOT REQUIRED WHEN NATURAL SLOPE IS 1.8H : 1V OR GENTLER.
7. TOP ELEVATION OF THE SLURRY CUT-OFF WALL
8. IF NECESSARY, MATERIAL OF ZONE (3E) SHALL BE PLACED UP TO 1 m ABOVE WATER LEVEL DURING CONSTRUCTION.
9. IN CONTACT WITH THE BEDROCK, THE TILL (ZONE (1) MATERIAL) SHALL BE SCREENED AT 80 mm, AND PLACED IN LAYERS OF 150 mm THICK OVER 10 m LENGTH.

LEGEND:

(1)	COMPACTED TILL, MAX. 150 mm
(2C)	SELECTED COMPACTED GRANULAR, MAX. 300 mm
(2G)	SELECTED FINE TO MEDIUM SAND MAX. FINE CONTENT (0.08 mm) 20%
(3C)	SELECTED COMPACTED ROCKFILL, MAX. 450 mm
(3D)	RANDOM COMPACTED ROCKFILL, MAX. 900 mm
(3E)	SELECTED PLACED ROCKFILL, MAX. 450 mm
(4)	RIPRAP
(4A)	ROCKFILL, 300-900 mm (D50= 600 mm)
(5)	MAINTENANCE GRADE MATERIAL

PMF : PROBABLE MAXIMUM FLOOD
FSL : FULL SUPPLY LEVEL
LSL : LOW SUPPLY LEVEL
MIN. : MINIMUM
MAX. : MAXIMUM
EL. : ELEVATION

NATURAL GROUND
HYDRO-SEEDING
EXISTING NATURAL GROUND
EXCAVATION LIMIT

NOT FOR CONSTRUCTION

0 2000 4000 6000 8000 10000 mm
SCALE 1:100
0 5000 10000 15000 mm
SCALE 1:200

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1	PA	26-FEB-2013	ISSUED FOR INTERNAL REVIEW

ISSUE REGISTER

No.	REFERENCE DRAWING
(MFA-SN-CD-2800-CV-PL-0009-01)	NORTH SPUR STABILIZATION WORKS - PLAN

No.	DATE	REVISION	MOD.	VER.	APP.

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LEAD REVIEWER: Date (dd-mmm-yyyy):
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy):
PROJECT MANAGER: Date (dd-mmm-yyyy):

PROFESSIONAL STAMP

SNC·LAVALIN

DESIGNED BY A. CELARDOS
DRAWN BY R. MERRI
VERIFIED BY N. DAIYAN
DATE 29-SEP-2012
APPROVED Discipline Lead Engineer R. BOUCHARD
APPROVED Engineering Manager G. SNYDER
SCALE NONE

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
NORTH SPUR STABILISATION WORKS - UPSTREAM
TYPICAL CROSS-SECTIONS AND DETAIL
SHEET 1 OF 4

SLI DOC No. 505573-3281-4GDD-0004-SH1-PA
NE DOC No. MFA-SN-CD-2810-CV-SE-0001-01
Rev. -

FORMAT A0 (mm)
PLATE G13

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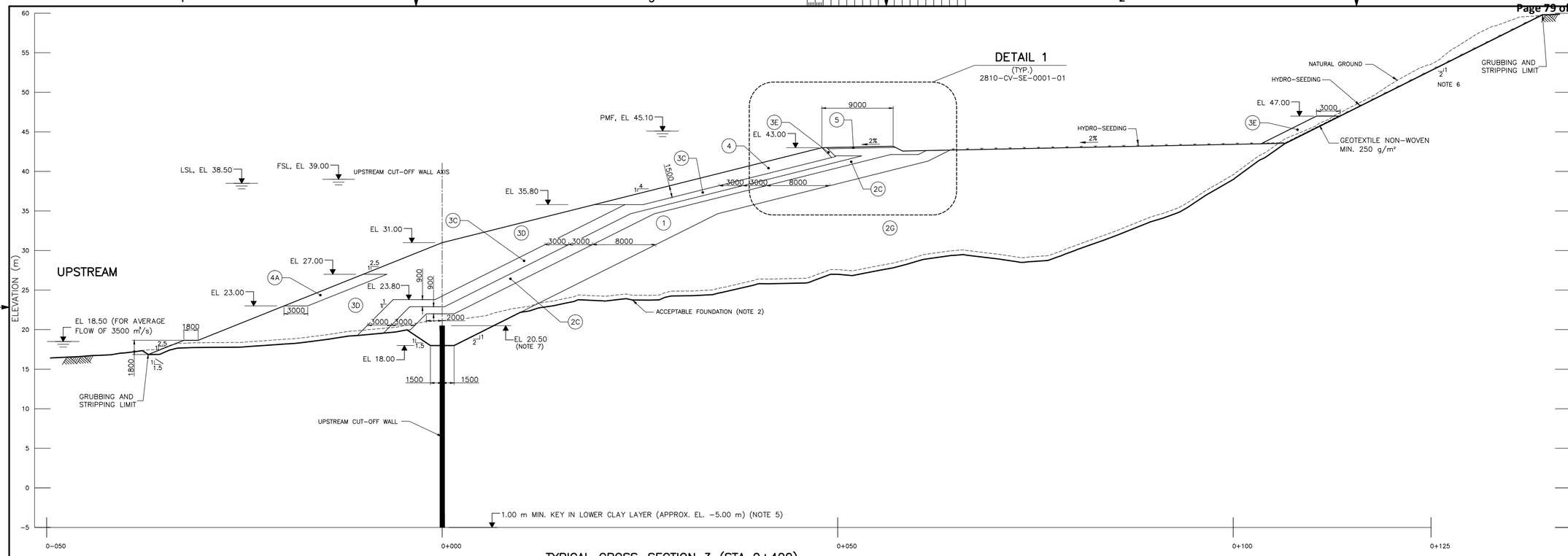
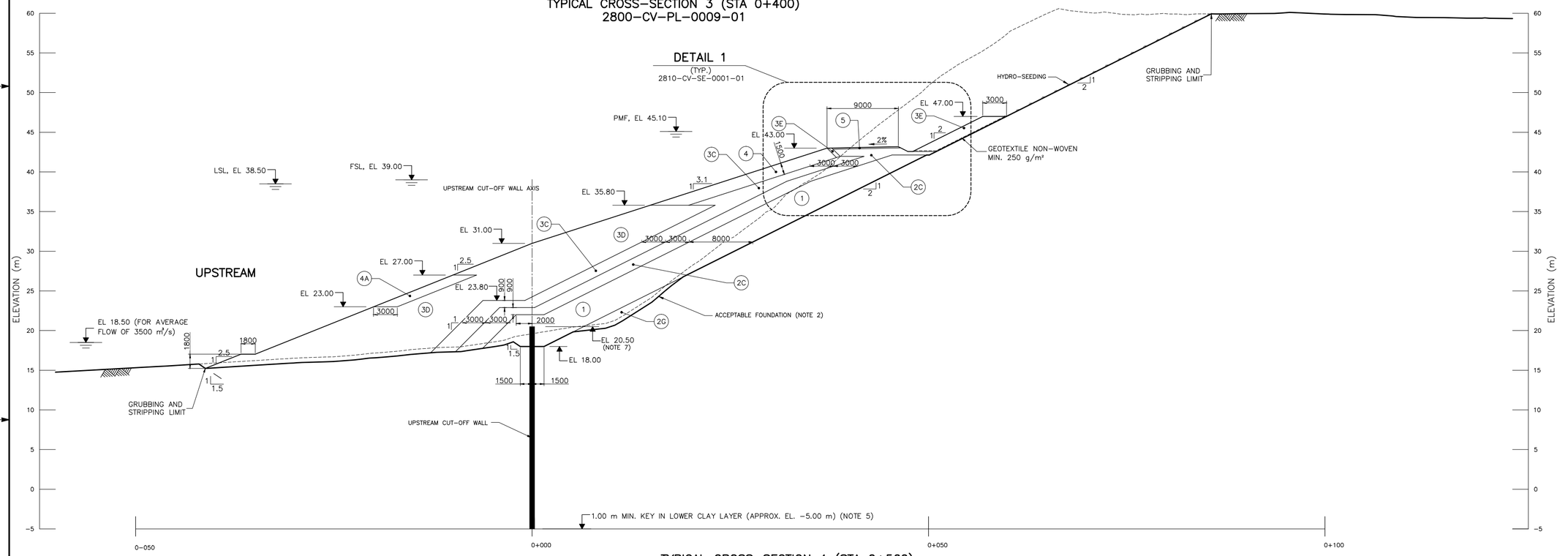


TYPICAL CROSS-SECTION 3 (STA 0+400)
2800-CV-PL-0009-01



TYPICAL CROSS-SECTION 4 (STA 0+560)
2800-CV-PL-0009-01

NOTES:

1. ELEVATIONS ARE IN METRES AND DIMENSIONS ARE IN MILLIMETRES.
2. DEFINED AND APPROVED ON SITE BY ENGINEER.
3. DURING SPREADING AND COMPACTION, THE SURFACE OF ZONE (1) MATERIAL SHALL BE CROWNED OR SLOPED WITH A 5% TRANSVERSE GRADE.
4. DURING SPREADING AND COMPACTION, THE SURFACE OF ZONE (1) MATERIAL SHALL BE GRADED WITH A MINIMUM 2% LONGITUDINAL SLOPE.
5. FINAL KEY ELEVATION IS APPROXIMATIVE AND SHALL BE APPROVED BY THE ENGINEER.
6. ABOVE EL 43.00, REGRADING TO 2H : 1V IS NOT REQUIRED WHEN NATURAL SLOPE IS 1.8H : 1V OR GENTLER.
7. TOP ELEVATION OF THE SLURRY CUT-OFF WALL
8. IF NECESSARY, MATERIAL OF ZONE (3E) SHALL BE PLACED UP TO 1 m ABOVE WATER LEVEL DURING CONSTRUCTION.

LEGEND:

- (1) COMPACTED TILL, MAX. 150 mm
- (2C) SELECTED COMPACTED GRANULAR, MAX. 300 mm
- (2G) SELECTED FINE TO MEDIUM SAND MAX. FINE CONTENT (0.08 mm) 20%
- (3C) SELECTED COMPACTED ROCKFILL, MAX. 450 mm
- (3D) RANDOM COMPACTED ROCKFILL, MAX. 900 mm
- (3E) SELECTED PLACED ROCKFILL, MAX. 450 mm
- (4) RIPRAP
- (4A) ROCKFILL, 300-900 mm (D50= 600 mm)
- (5) MAINTENANCE GRADE MATERIAL

PMF : PROBABLE MAXIMUM FLOOD
FSL : FULL SUPPLY LEVEL
LSL : LOW SUPPLY LEVEL
MIN. : MINIMUM
MAX. : MAXIMUM
EL. : ELEVATION

NATURAL GROUND
HYDRO-SEEDING
EXISTING NATURAL GROUND
EXCAVATION LIMIT

NOT FOR CONSTRUCTION

0 5 10 15 m
SCALE 1:200

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
1	PA	26-FEB-2013	ISSUED FOR INTERNAL REVIEW

ISSUE REGISTER

No.	REFERENCE DRAWING
(MFA-SN-CD-2810-CV-SE-0001-01)	NORTH SPUR STABILIZATION WORKS - UPSTREAM - TYPICAL CROSS-SECTION AND DETAIL SHEET 1 OF 4
(MFA-SN-CD-2800-CV-PL-0009-01)	NORTH SPUR STABILIZATION WORKS - PLAN

No.	DATE	REVISION	MOD.	VER.	APP.

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LEAD REVIEWER: Date (dd-mmm-yyyy):
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy):
PROJECT MANAGER: Date (dd-mmm-yyyy):

PROFESSIONAL STAMP

SNC·LAVALIN

DESIGNED BY A. CEBALLOS
DRAWN BY R. MERRI
VERIFIED BY N. DAIYAN
DATE 29-SEP-2012
APPROVED Discipline Lead Engineer R. BOUCHARD
APPROVED Engineering Manager G. SNYDER
SCALE NONE

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT
TITLE: MUSKRAT FALLS
NORTH SPUR STABILIZATION WORKS - UPSTREAM
TYPICAL CROSS-SECTIONS
SHEET 2 OF 4

SLI DOC No. 505573-3281-4GDD-0004-SH2-PA | NE DOC No. MFA-SN-CD-2810-CV-SE-0001-02 | Rev. -

FORMAT A0 (mm)
PLATE G14

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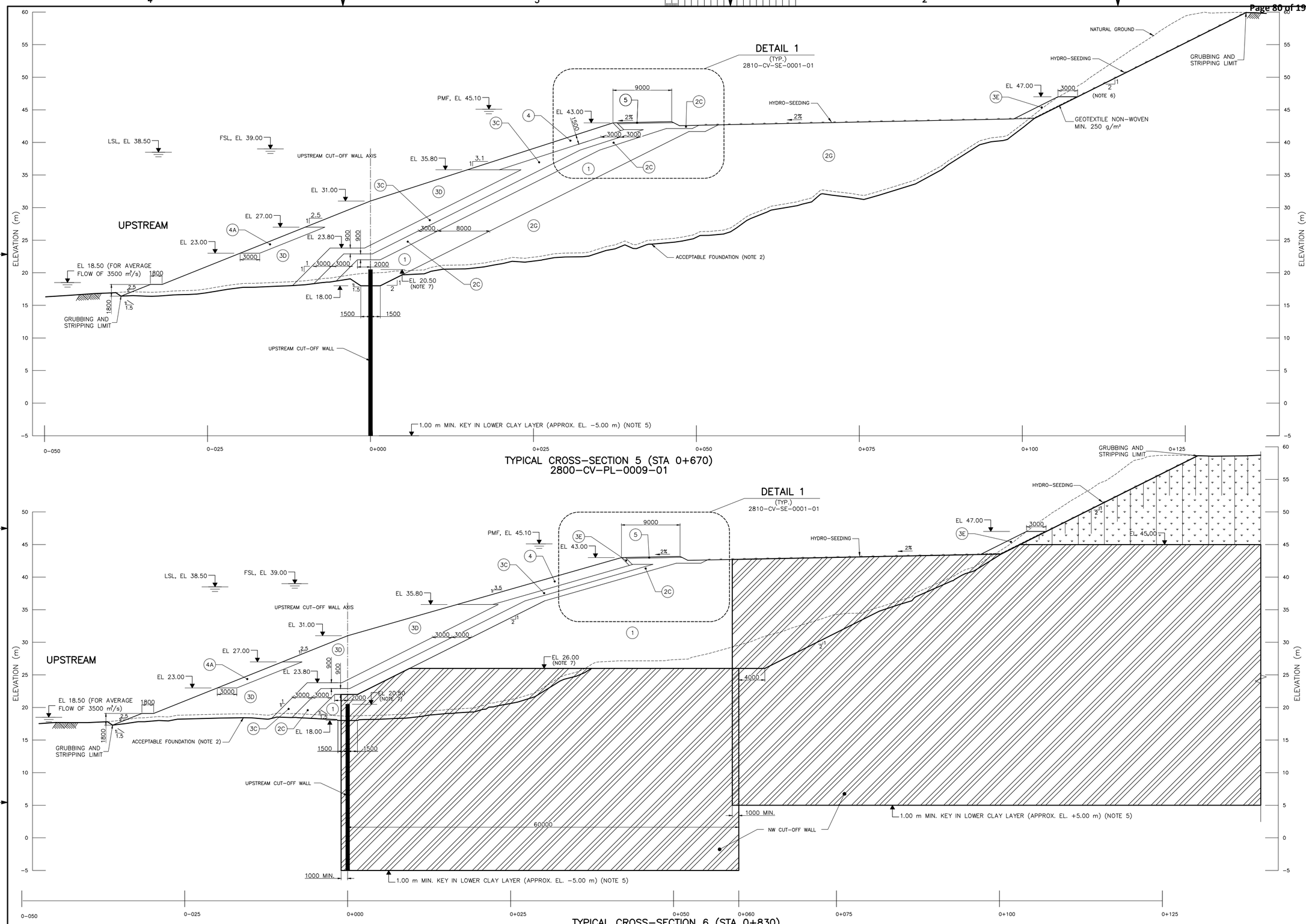

TYPICAL CROSS-SECTION 5 (STA 0+670)
2800-CV-PL-0009-01

TYPICAL CROSS-SECTION 6 (STA 0+830)
2800-CV-PL-0009-01

NOTES:

1. ELEVATIONS ARE IN METRES AND DIMENSIONS ARE IN MILLIMETRES.
2. DEFINED AND APPROVED ON SITE BY ENGINEER.
3. DURING SPREADING AND COMPACTION, THE SURFACE OF ZONE (1) MATERIAL SHALL BE CROWNED OR SLOPED WITH A 5% TRANSVERSE GRADE.
4. DURING SPREADING AND COMPACTION, THE SURFACE OF ZONE (1) MATERIAL SHALL BE GRADED WITH A MINIMUM 2% LONGITUDINAL SLOPE.
5. FINAL KEY ELEVATION IS APPROXIMATIVE AND SHALL BE APPROVED BY THE ENGINEER.
6. ABOVE EL 43.00, REGRADING TO 2H : 1V IS NOT REQUIRED WHEN NATURAL SLOPE IS 1.8H : 1V OR GENTLER.
7. TOP ELEVATION OF THE SLURRY CUT-OFF WALL
8. IF NECESSARY, MATERIAL OF ZONE (3E) SHALL BE PLACED UP TO 1 m ABOVE WATER LEVEL DURING CONSTRUCTION.

LEGEND:

- (1) COMPACTED TILL, MAX. 150 mm
- (2C) SELECTED COMPACTED GRANULAR, MAX. 300 mm
- (2G) SELECTED FINE TO MEDIUM SAND MAX. FINE CONTENT (0.08 mm) 20%
- (3C) SELECTED COMPACTED ROCKFILL, MAX. 450 mm
- (3D) RANDOM COMPACTED ROCKFILL, MAX. 900 mm
- (3E) SELECTED PLACED ROCKFILL, MAX. 450 mm
- (4) RIPRAP
- (4A) ROCKFILL, 300-900 mm (D50= 600 mm)
- (5) MAINTENANCE GRADE MATERIAL

PMF : PROBABLE MAXIMUM FLOOD
FSL : FULL SUPPLY LEVEL
LSL : LOW SUPPLY LEVEL
MIN. : MINIMUM
MAX. : MAXIMUM
EL. : ELEVATION

NATURAL GROUND
HYDRO-SEEDING
EXISTING NATURAL GROUND
EXCAVATION LIMIT
CUT-OFF WALL
HYDRO-SEEDING

NOT FOR CONSTRUCTION

SCALE 1:200

ISSUE REGISTER							
ISSU.	REV.	DATE	DISTRIBUTION & STATUS	ISSU.	REV.	DATE	DISTRIBUTION & STATUS
1	PA	26-FEB-2013	ISSUED FOR INTERNAL REVIEW				

No.	REFERENCE DRAWING
(MFA-SN-CD-2810-CV-SE-0001-01)	NORTH SPUR STABILIZATION WORKS - UPSTREAM - TYPICAL CROSS-SECTION AND DETAIL SHEET 1 OF 4
(MFA-SN-CD-2800-CV-PL-0009-01)	NORTH SPUR STABILIZATION WORKS - PLAN

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.

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LEAD REVIEWER: Date (dd-mmm-yyyy):
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy):
PROJECT MANAGER: Date (dd-mmm-yyyy):

PROFESSIONAL STAMP

SNC·LAVALIN

DESIGNED BY A. CEBALLOS
DRAWN BY R. MERRI
VERIFIED BY N. DAIYAN
DATE 29-SEP-2012
APPROVED Discipline Lead Engineer R. BOUCHARD
APPROVED Engineering Manager G. SNYDER
SCALE NONE

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
NORTH SPUR STABILIZATION WORKS - UPSTREAM
TYPICAL CROSS-SECTIONS
SHEET 3 OF 4

SLI DOC No. 505573-3281-4GDD-0004-SH3-PA
NE DOC No. MFA-SN-CD-2810-CV-SE-0001-03 Rev. -

FORMAT A0 (mm)
PLATE G15

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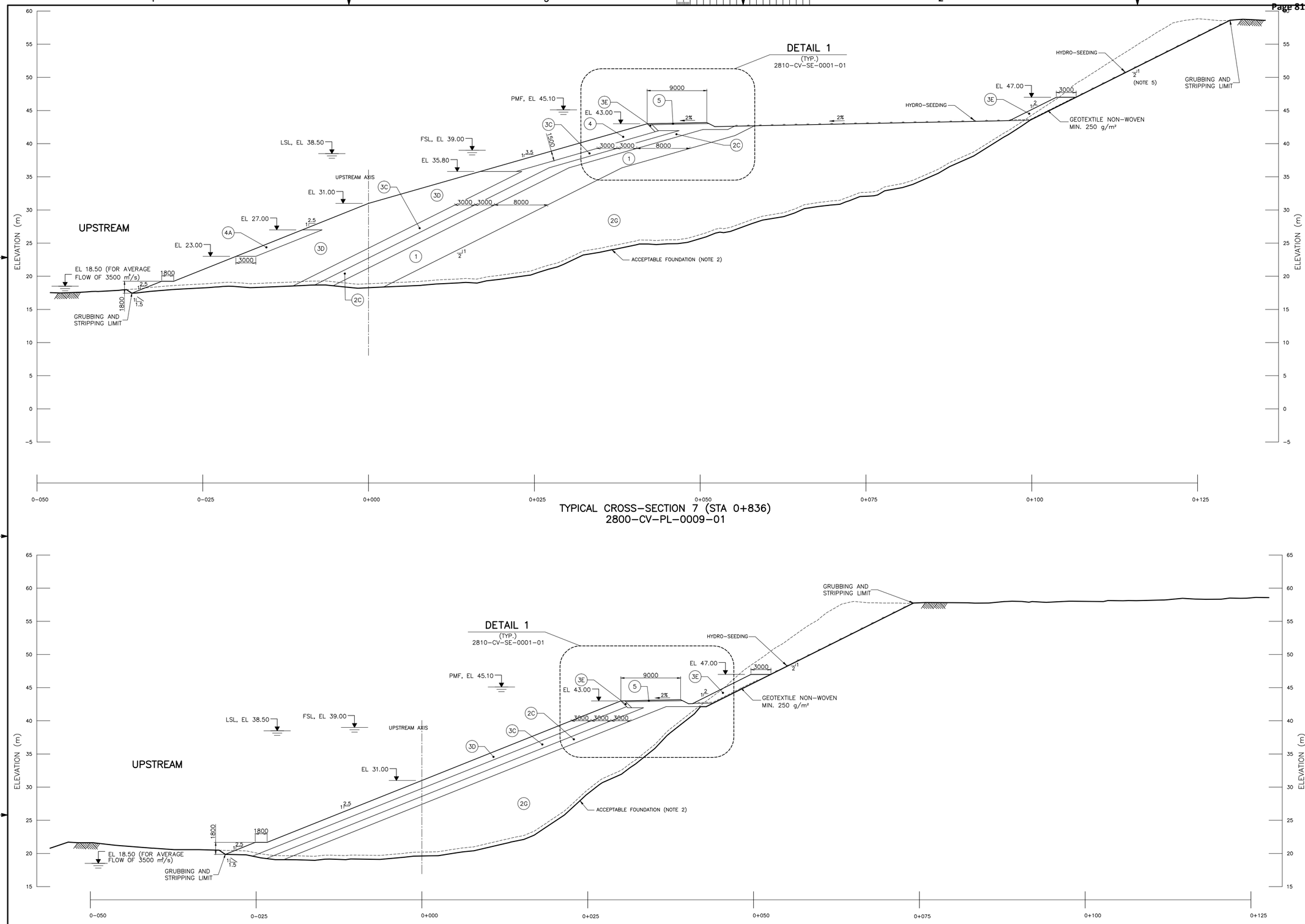

TYPICAL CROSS-SECTION 7 (STA 0+836)
2800-CV-PL-0009-01

TYPICAL CROSS-SECTION 8 (STA 0+943)
2800-CV-PL-0009-01

NOTES:

1. ELEVATIONS ARE IN METRES AND DIMENSIONS ARE IN MILLIMETRES.
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4. DURINGSPREADING AND COMPACTION, THE SURFACE OF ZONE (1) MATERIAL SHALL BE GRADED WITH A MINIMUM 2% LONGITUDINAL SLOPE.
5. ABOVE EL 43.00, REGRADING TO 2H : 1V IS NOT REQUIRED WHEN NATURAL SLOPE IS 1.8H : 1V OR GENTLER.
6. IF NECESSARY, MATERIAL OF ZONE (3E) SHALL BE PLACED UP TO 1 m ABOVE WATER LEVEL DURING CONSTRUCTION.

LEGEND:

- (1) COMPACTED TILL, MAX. 150 mm
- (2C) SELECTED COMPACTED GRANULAR, MAX. 300 mm
- (2G) SELECTED FINE TO MEDIUM SAND MAX. FINE CONTENT (0.08 mm) 20%
- (3C) SELECTED COMPACTED ROCKFILL, MAX. 450 mm
- (3D) RANDOM COMPACTED ROCKFILL, MAX. 900 mm
- (3E) SELECTED PLACED ROCKFILL, MAX. 450 mm
- (4) RIPRAP
- (4A) ROCKFILL, 300-900 mm (D50= 600 mm)
- (5) MAINTENANCE GRADE MATERIAL

PMF : PROBABLE MAXIMUM FLOOD
FSL : FULL SUPPLY LEVEL
LSL : LOW SUPPLY LEVEL
MIN. : MINIMUM
MAX. : MAXIMUM
EL. : ELEVATION

NATURAL GROUND
HYDRO-SEEDING
EXISTING NATURAL GROUND
EXCAVATION LIMIT

NOT FOR CONSTRUCTION

0 5000 10000 15000 mm
SCALE 1:200

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ISSUE REGISTER

No.	REFERENCE DRAWING
(MFA-SN-CD-2810-CV-SE-0001-01)	NORTH SPUR STABILIZATION WORKS - UPSTREAM - TYPICAL CROSS-SECTION AND DETAIL SHEET 1 OF 4
(MFA-SN-CD-2800-CV-PL-0009-01)	NORTH SPUR STABILIZATION WORKS - PLAN

No.	DATE	REVISION	MOD.	VER.	APP.

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LEAD REVIEWER: Date (dd-mmm-yyyy):
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy):
PROJECT MANAGER: Date (dd-mmm-yyyy):

PROFESSIONAL STAMP

SNC·LAVALIN

DESIGNED BY A. CEBALLOS
DRAWN BY R. MERRI
VERIFIED BY N. DAIYAN
DATE 29-SEP-2012
APPROVED Discipline Lead Engineer R. BOUCHARD
APPROVED Engineering Manager G. SNYDER
SCALE NONE

CLIENT: nalcor energy
PROJECT: LOWER CHURCHILL PROJECT
TITLE: MUSKRAT FALLS
NORTH SPUR STABILIZATION WORKS - UPSTREAM
TYPICAL CROSS-SECTIONS
SHEET 4 OF 4

SJ DOC No. 505573-3281-4GDD-0004-SH4-PA
NE DOC No. MFA-SN-CD-2810-CV-SE-0001-04
Rev. -

FORMAT A0 (mm)
PLATE G16

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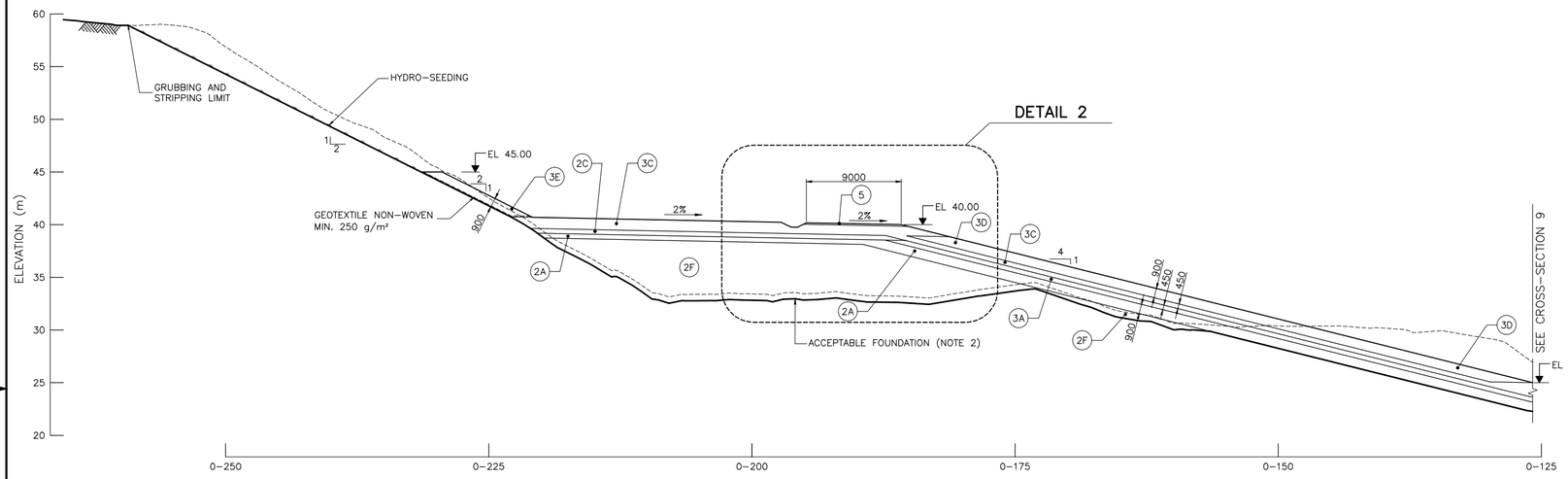
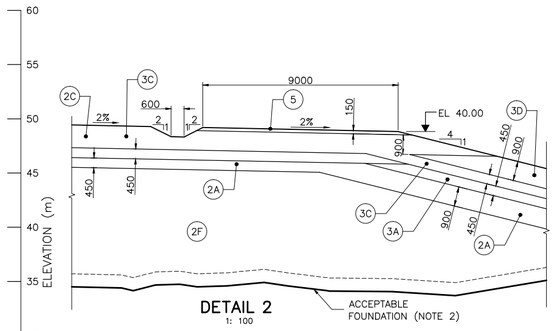


TYPICAL CROSS-SECTION 9 (STA 0+050) – CONT'D
2800-CV-PL-0009-01



NOTES:

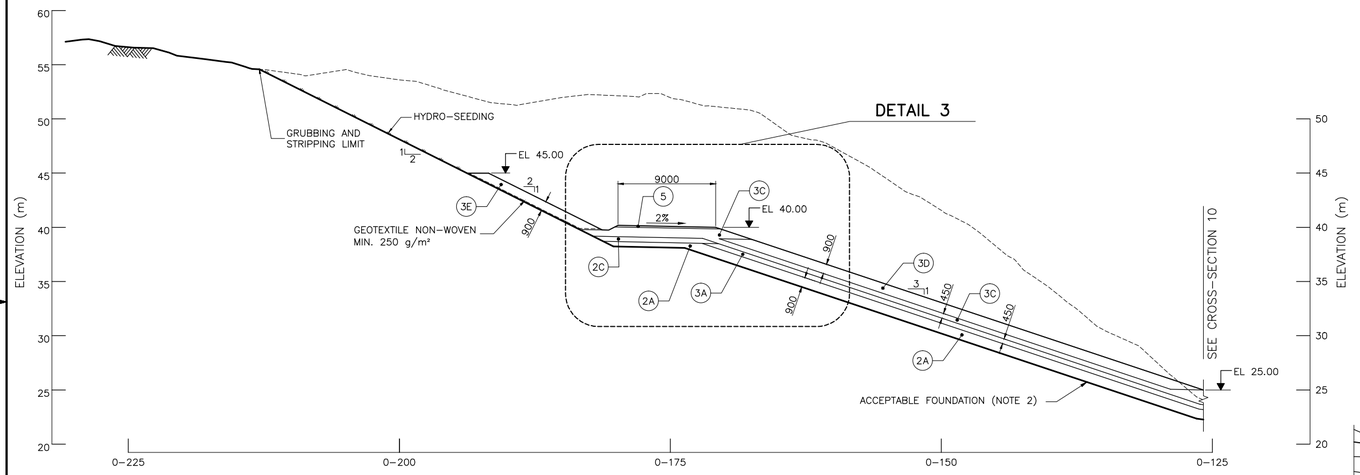
1. ELEVATIONS ARE IN METRES AND DIMENSIONS ARE IN MILLIMETRES.
2. DEFINED AND APPROVED ON SITE BY THE ENGINEER.

LEGEND:

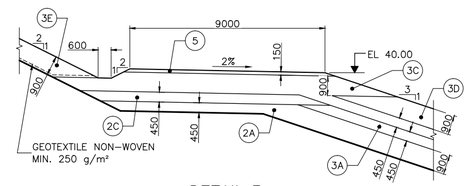
- (2A) SELECTED COMPACTED GRANULAR, MAX. 80 mm
- (2C) SELECTED COMPACTED GRANULAR, MAX. 300 mm
- (2E) SELECTED PLACED GRANULAR, MAX. 150 mm
- (2F) SELECTED FINE TO MEDIUM SAND MAX. FINE CONTENT (0.08 mm) 5%
- (3A) COMPACTED CRUSHED STONE, MAX. 80 mm
- (3C) SELECTED COMPACTED ROCKFILL, MAX. 450 mm
- (3D) RANDOM COMPACTED ROCKFILL, MAX. 900 mm
- (3E) SELECTED PLACED ROCKFILL, MAX. 450 mm
- (4) RIPRAP
- (4B) ROCKFILL, 0-600 mm (D50= 180 mm)
- (5) MAINTENANCE GRADE MATERIAL

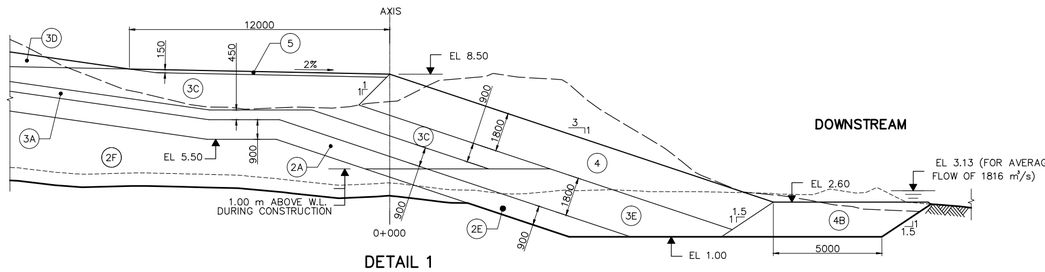
MIN. : MINIMUM
MAX. : MAXIMUM
EL. : ELEVATION
W.L. : WATER LEVEL

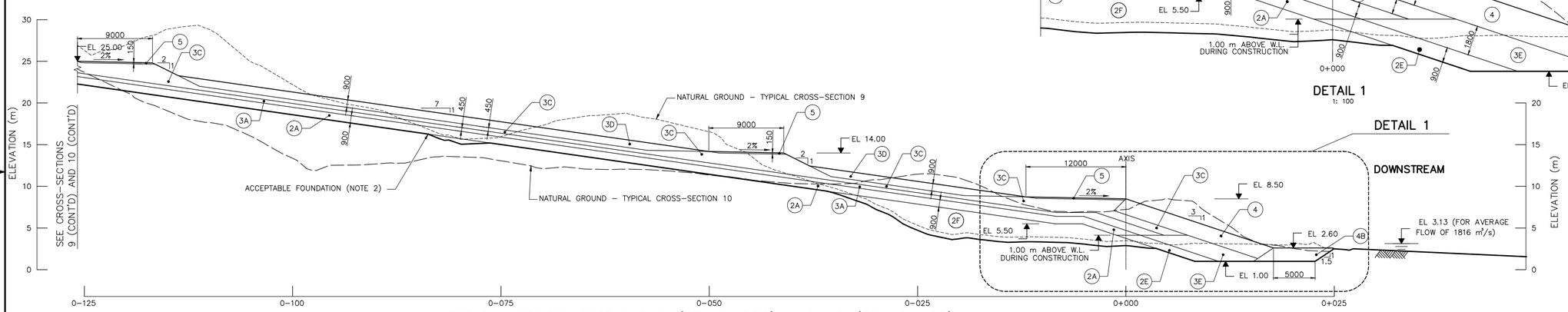
NATURAL GROUND
HYDRO-SEEDING
EXISTING NATURAL GROUND
EXCAVATION LIMIT



TYPICAL CROSS-SECTION 10 (STA 0+180) – CONT'D
2800-CV-PL-0009-01







TYPICAL CROSS-SECTIONS 9 (STA 0+050) AND 10 (STA 0+180)
2800-CV-PL-0009-01

NOT FOR CONSTRUCTION

SCALE 1:100
SCALE 1:200

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
1	PA	26-FEB-2013	ISSUED FOR INTERNAL REVIEW

ISSUE REGISTER

No.	REFERENCE DRAWING
(MFA-SN-CD-2800-CV-PL-0009-01)	NORTH SPUR STABILIZATION WORKS – PLAN

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.

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REVIEW CLASS: EQUIPMENT TAG NUMBER:

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- ☐ 3. REVIEWED - NOT ACCEPTED
- ☐ 4. INFORMATION ONLY
- ☐ 5. NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy):
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy):
PROJECT MANAGER: Date (dd-mmm-yyyy):

PROFESSIONAL STAMP

SNC·LAVALIN

DESIGNED BY A. CEBALLOS	APPROVED Discipline Lead Engineer R. BOUCHARD
DRAWN BY R. MERRI	APPROVED Engineering Manager G. SNYDER
VERIFIED BY N. DAIYAN	SCALE NONE
DATE 29-SEP-2012	

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
NORTH SPUR STABILIZATION WORKS – DOWNSTREAM
TYPICAL CROSS-SECTIONS AND DETAILS
SHEET 1 OF 3

SU DOC No. 505573-3281-4GDD-0006-SH1-PA
NE DOC No. MFA-SN-CD-2820-CV-SE-0001-01
Rev. –

FORMAT A0 (mm)
PLATE G19

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2013.03.01 7:27am

NOTES:

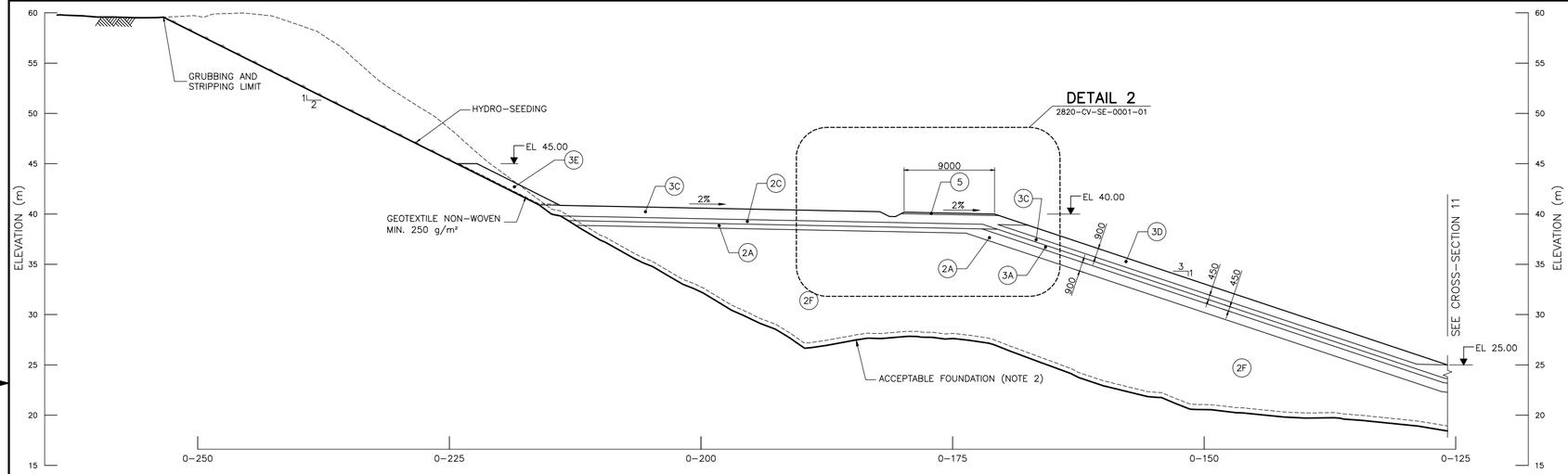
1. ELEVATIONS ARE IN METRES AND DIMENSIONS ARE IN MILLIMETRES.
2. DEFINED AND APPROVED ON SITE BY THE ENGINEER.

LEGEND:

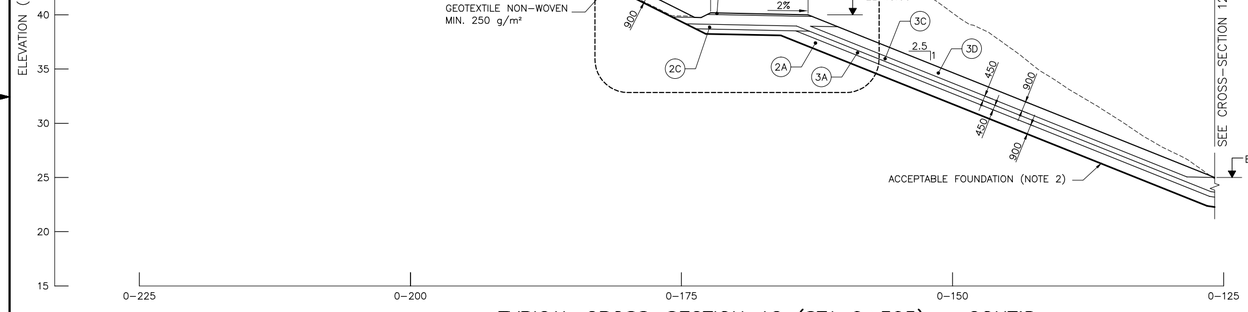
- (2A) SELECTED COMPACTED GRANULAR, MAX. 80 mm
- (2C) SELECTED COMPACTED GRANULAR, MAX. 300 mm
- (2E) SELECTED PLACED GRANULAR, MAX. 150 mm
- (2F) SELECTED FINE TO MEDIUM SAND MAX. FINE CONTENT (0.08 mm) 5%
- (3A) COMPACTED CRUSHED STONE, MAX. 80 mm
- (3C) SELECTED COMPACTED ROCKFILL, MAX. 450 mm
- (3D) RANDOM COMPACTED ROCKFILL, MAX. 900 mm
- (3E) SELECTED PLACED ROCKFILL, MAX. 450 mm
- (4) RIPRAP
- (4B) ROCKFILL, 0–600 mm (D50= 180 mm)
- (5) MAINTENANCE GRADE MATERIAL

MIN. : MINIMUM
MAX. : MAXIMUM
EL. : ELEVATION
W.L. : WATER LEVEL

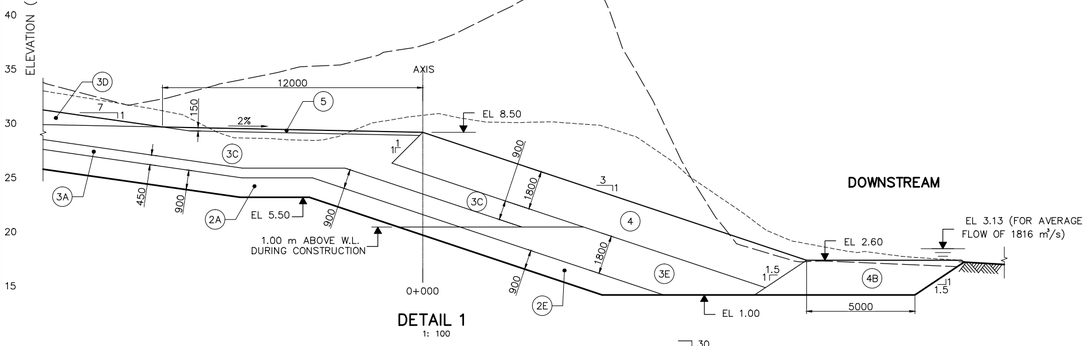
NATURAL GROUND
HYDRO–SEEDING
EXISTING NATURAL GROUND
EXCAVATION LIMIT



TYPICAL CROSS–SECTION 11 (STA 0+230) – CONT'D
2800–CV–PL–0009–01



TYPICAL CROSS–SECTION 12 (STA 0+305) – CONT'D
2800–CV–PL–0009–01



DETAIL 1
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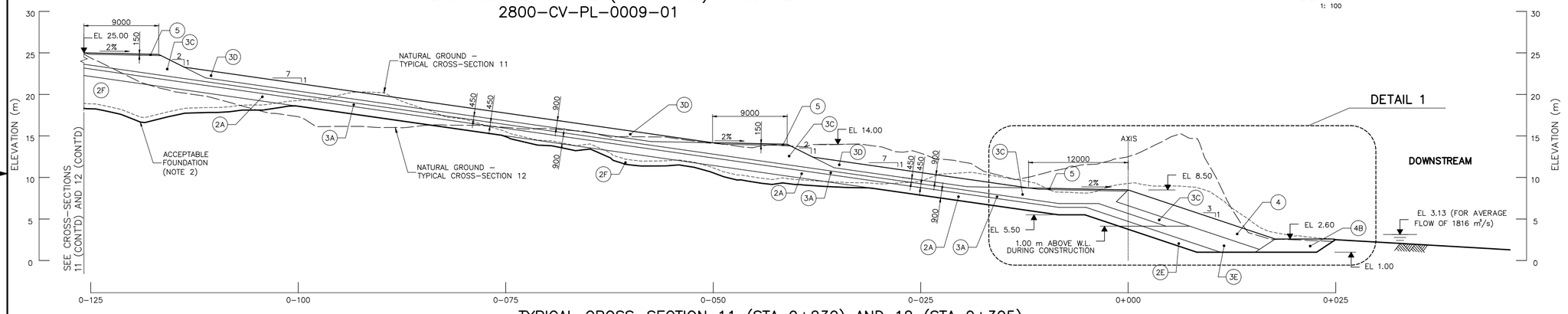

TYPICAL CROSS–SECTION 11 (STA 0+230) AND 12 (STA 0+305)
2800–CV–PL–0009–01

NOT FOR CONSTRUCTION

0 2000 4000 6000 8000 10000 mm
SCALE 1:100

0 5000 10000 15000 mm
SCALE 1:200

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
1	PA	26-FEB-2013	ISSUED FOR INTERNAL REVIEW

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No.	REFERENCE DRAWING
(MFA–SN–CD–2820–CV–PL–0001–01)	DOWNSTREAM – TYPICAL CROSS–SECTIONS AND DETAILS SHEET 1 OF 3
(MFA–SN–CD–2820–CV–PL–0009–01)	NORTH SPUR STABILIZATION WORKS – PLAN

No.	DATE	REVISION	MOD.	VER.	APP.

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- ☐ 4. INFORMATION ONLY
- ☐ 5. NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy):
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy):
PROJECT MANAGER: Date (dd-mmm-yyyy):

PROFESSIONAL STAMP

SNC·LAVALIN

CLIENT: nalcor energy

DESIGNED BY A. CEBALLOS	APPROVED Discipline Lead Engineer R. BOUCHARD
DRAWN BY R. MERRI	APPROVED Engineering Manager G. SNYDER
VERIFIED BY N. DAIYAN	
DATE 29–SEP–2012	SCALE NONE

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
NORTH SPUR STABILIZATION WORKS – DOWNSTREAM
TYPICAL CROSS–SECTIONS AND DETAIL
SHEET 2 OF 3

SLI DOC No. 505573–3281–4GDD–0006–SH2–PA
NE DOC No. MFA–SN–CD–2820–CV–SE–0001–02
Rev. —

FORMAT A0 (cm)
PLATE G20

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2013.03.01/7:28am

PLATE

NOTES:

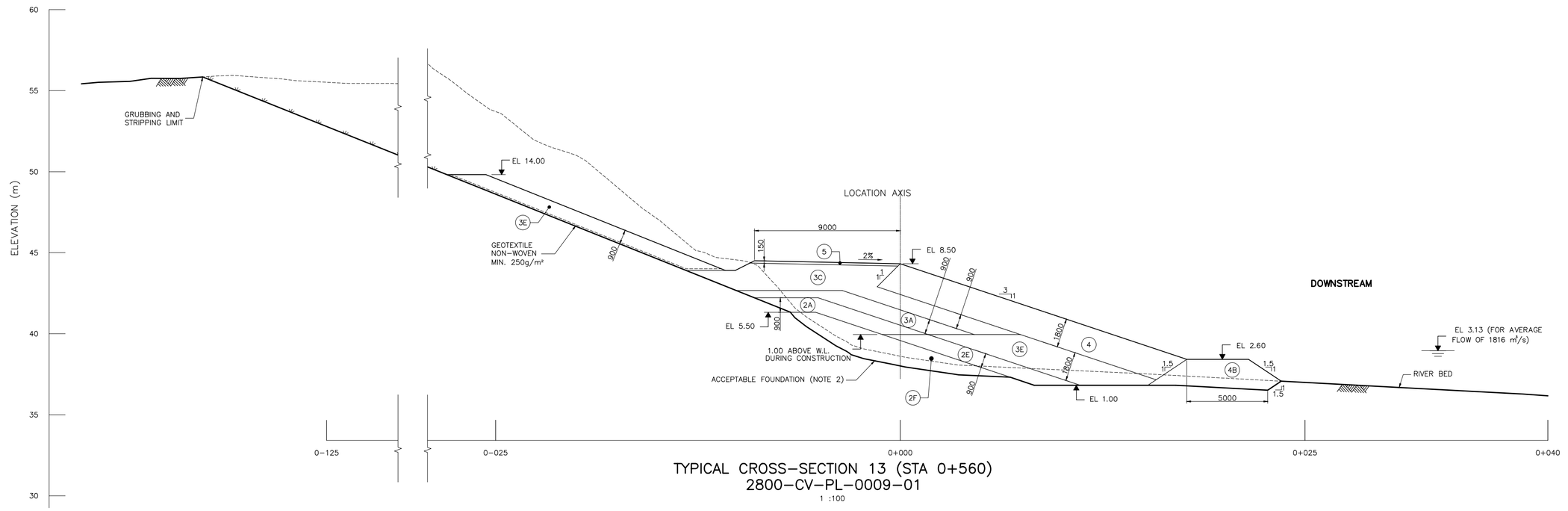
1. ELEVATIONS ARE IN METRES AND DIMENSIONS ARE IN MILLIMETRES.
2. DEFINED AND APPROVED ON SITE BY THE ENGINEER.
3. SLOPES SHALL BE REGRADED AFTER GRUBBING AND STRIPPING AND BEFORE GEOTEXTILE INSTALLATION.

LEGEND:

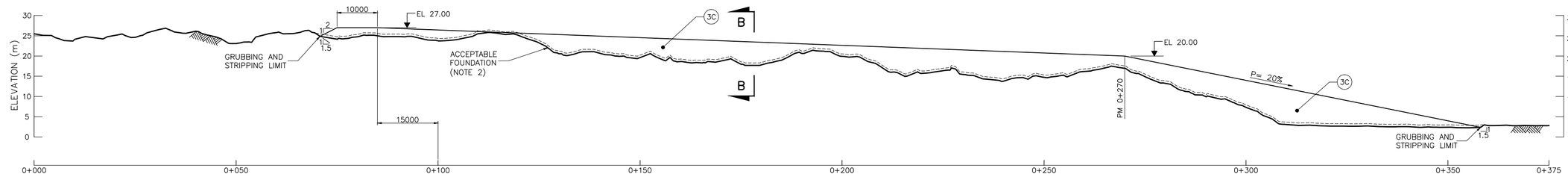
- (2A) SELECTED COMPACTED GRANULAR, MAX. 80 mm
- (2C) SELECTED COMPACTED GRANULAR, MAX. 300 mm
- (2E) SELECTED PLACED GRANULAR, MAX. 150 mm
- (2F) SELECTED FINE TO MEDIUM SAND MAX. FINE CONTENT (0.08 mm) 5%
- (3A) COMPACTED CRUSHED STONE, MAX. 80 mm
- (3C) SELECTED COMPACTED ROCKFILL, MAX. 450 mm
- (3D) RANDOM COMPACTED ROCKFILL, MAX. 900 mm
- (3E) SELECTED PLACED ROCKFILL, MAX. 450 mm
- (4) RIPRAP
- (4B) ROCKFILL, 0–600 mm (D50= 180 mm)
- (5) MAINTENANCE GRADE MATERIAL

MIN. : MINIMUM
MAX. : MAXIMUM
EL. : ELEVATION
W.L. : WATER LEVEL

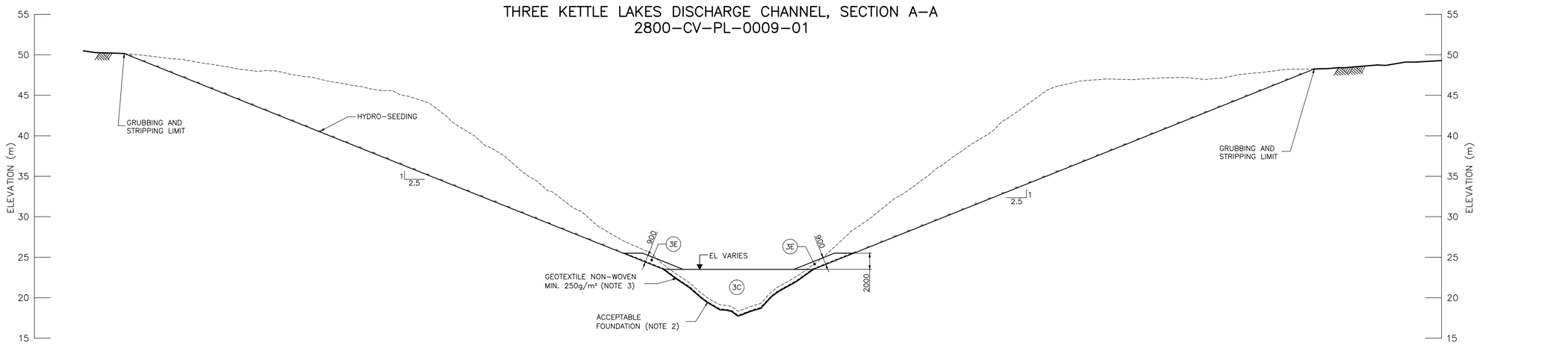
NATURAL GROUND
HYDRO–SEEDING
EXISTING NATURAL GROUND
EXCAVATION LIMIT



TYPICAL CROSS–SECTION 13 (STA 0+560)
2800–CV–PL–0009–01
1 :100



THREE KETTLE LAKES DISCHARGE CHANNEL, SECTION A–A
2800–CV–PL–0009–01



SECTION B–B
1 :200

NOT FOR CONSTRUCTION

SCALE 1:100
SCALE 1:200
SCALE 1:400

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
1	PA	26–FEB–2013	ISSUED FOR INTERNAL REVIEW

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No.	REFERENCE DRAWING
(MFA–SN–CD–2800–CV–PL–0009–01)	NORTH SPUR STABILIZATION WORKS – PLAN

No.	DATE	REVISION	MOD.	VER.	APP.

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☐ 4. INFORMATION ONLY
☐ 5. NOT REVIEWED
LEAD REVIEWER: Date (dd-mmm-yyyy):
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy):
PROJECT MANAGER: Date (dd-mmm-yyyy):

PROFESSIONAL STAMP

SNC·LAVALIN

DESIGNED BY A. CEBALLOS
DRAWN BY R. MERRI
VERIFIED BY N. DAIYAN
DATE 29–SEP–2012
APPROVED Discipline Lead Engineer R. BOUCHARD
APPROVED Engineering Manager G. SNYDER
SCALE NONE

CLIENT: nalcor energy

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
NORTH SPUR STABILIZATION WORKS – DOWNSTREAM
TYPICAL CROSS–SECTIONS AND DETAIL
SHEET 3 OF 3

SLI DOC No. 505573–3281–4GDD–0006–SH3–PA
NE DOC No. MFA–SN–CD–2820–CV–SE–0001–03
Rev. —

FORMAT A0 (cm)
PLATE G21

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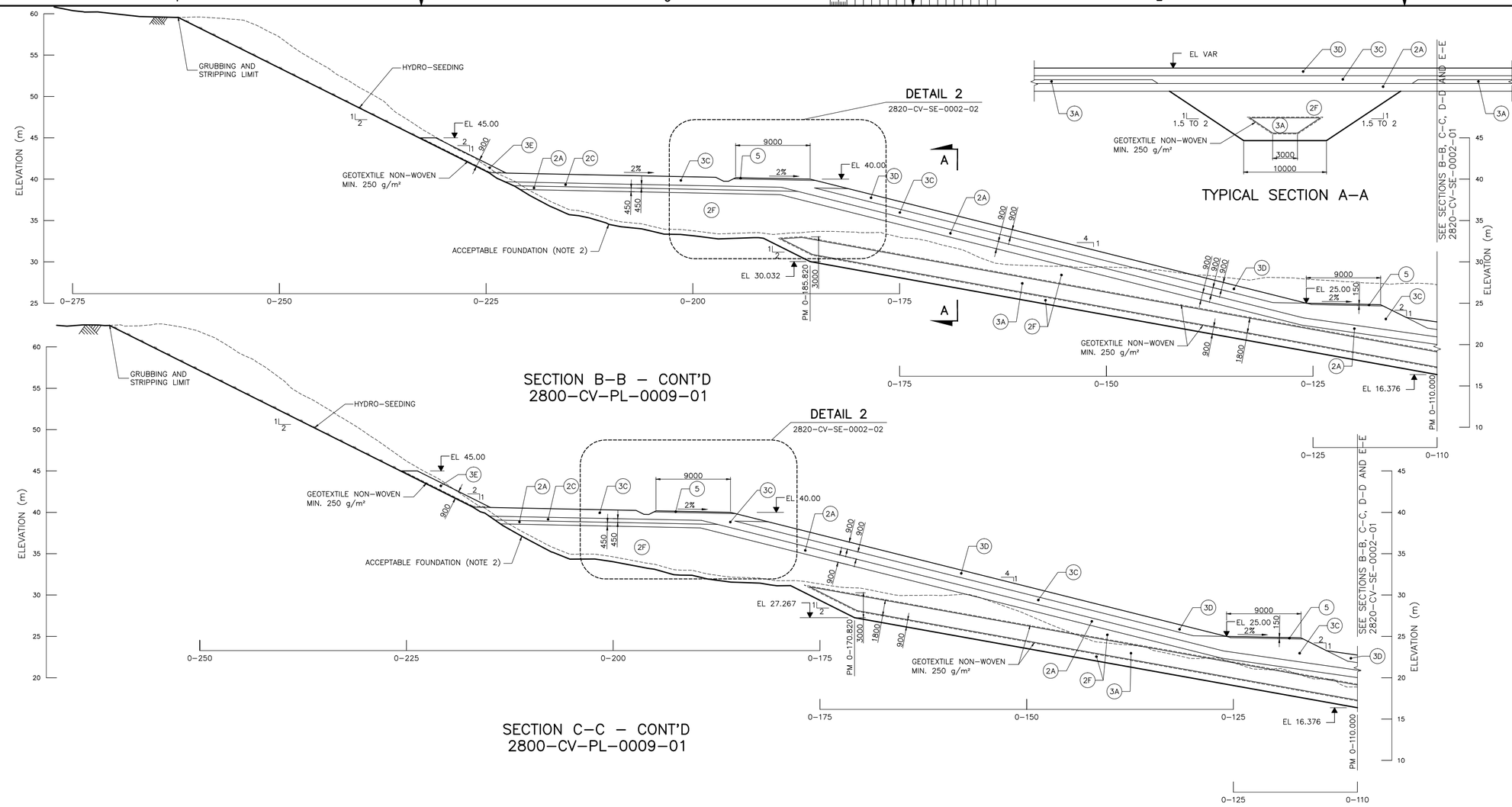
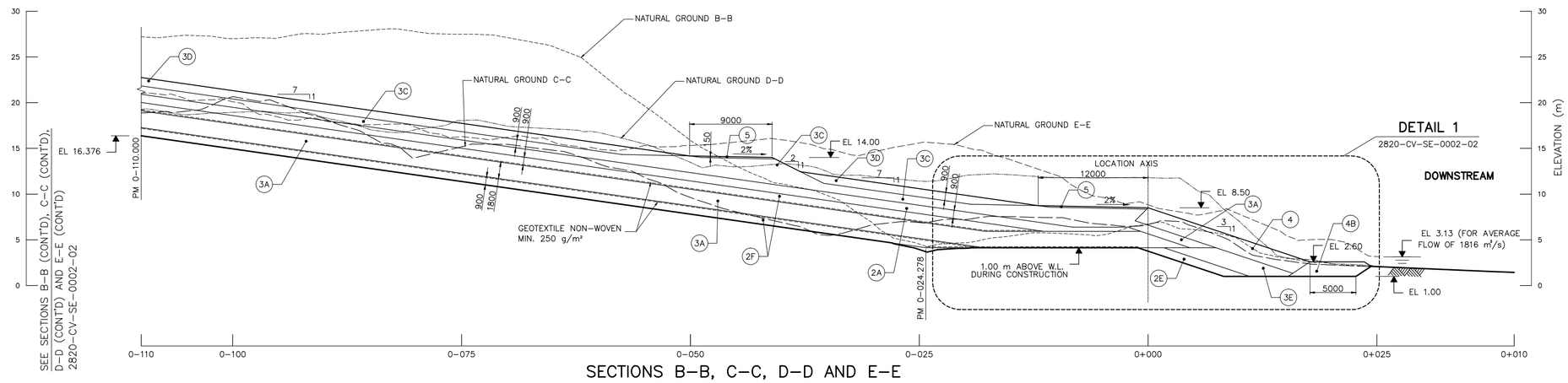


SECTION B–B – CONT'D
2800–CV–PL–0009–01

SECTION C–C – CONT'D
2800–CV–PL–0009–01



SECTIONS B–B, C–C, D–D AND E–E
2800–CV–PL–0009–01

TYPICAL SECTION A–A

NOTES:

1. ELEVATIONS ARE IN METRES AND DIMENSIONS ARE IN MILLIMETRES.
2. DEFINED AND APPROVED ON SITE BY THE ENGINEER.

LEGEND:

- (2A) SELECTED COMPACTED GRANULAR, MAX. 80 mm
- (2C) SELECTED COMPACTED GRANULAR, MAX. 300 mm
- (2E) SELECTED PLACED GRANULAR, MAX. 150 mm
- (2F) SELECTED FINE TO MEDIUM SAND MAX. FINE CONTENT (0.08 mm) 5%
- (3A) COMPACTED CRUSHED STONE, MAX. 80 mm
- (3C) SELECTED COMPACTED ROCKFILL, MAX. 450 mm
- (3D) RANDOM COMPACTED ROCKFILL, MAX. 900 mm
- (3E) SELECTED PLACED ROCKFILL, MAX. 450 mm
- (4) RIPRAP
- (4B) ROCKFILL, 0–600 mm (D50= 180 mm)
- (5) MAINTENANCE GRADE MATERIAL

MIN. : MINIMUM
MAX. : MAXIMUM
EL. : ELEVATION
W.L. : WATER LEVEL

NATURAL GROUND
HYDRO–SEEDING
EXISTING NATURAL GROUND
EXCAVATION LIMIT

NOT FOR CONSTRUCTION

SCALE 1:200

REV.	DATE	DISTRIBUTION & STATUS	REFERENCE DRAWING
1	26-FEB-2013	ISSUED FOR INTERNAL REVIEW	(MFA-SN-CD-2820-CV-SE-0002-02) NORTH SPUR STABILIZATION WORKS – FINGER DRAINS – SECTIONS – SHEET 2 OF 2
PA			(MFA-SN-CD-2800-CV-PL-0009-01) NORTH SPUR STABILIZATION WORKS – PLAN

ISSUE REGISTER

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LEAD REVIEWER: Date (dd-mmm-yyyy):
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy):
PROJECT MANAGER: Date (dd-mmm-yyyy):

PROFESSIONAL STAMP

SNC·LAVALIN

DESIGNED BY A. CEBALLOS
DRAWN BY R. MERRI
VERIFIED BY N. DAIYAN
DATE 29-SEP-2012
APPROVED Discipline Lead Engineer R. BOUCHARD
APPROVED Engineering Manager G. SNYDER
SCALE NONE

CLIENT: nalcor energy
PROJECT: LOWER CHURCHILL PROJECT
TITLE: MUSKRAT FALLS
NORTH SPUR STABILIZATION WORKS
FINGER DRAINS
SECTIONS
SHEET 1 OF 2

SLI DOC No. 505573-3281-4GDD-0007-SH1-PA
NE DOC No. MFA-SN-CD-2820-CV-SE-0002-01
Rev. –

FORMAT A0 (mm)
PLATE G32

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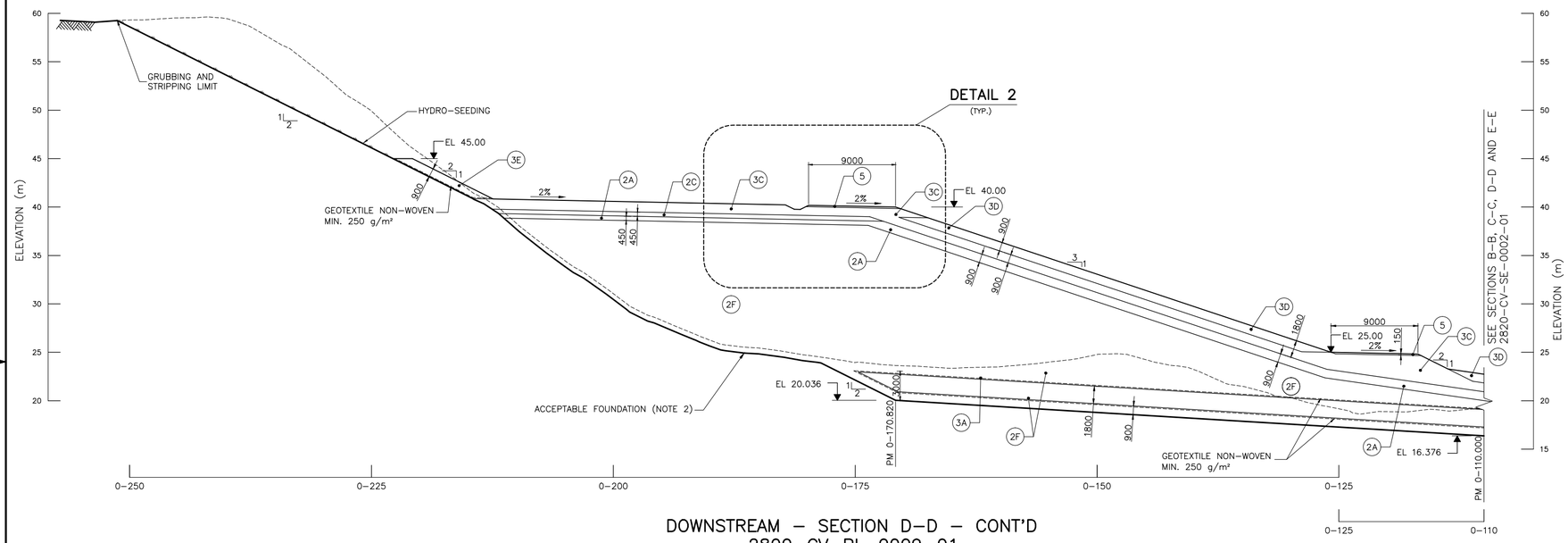
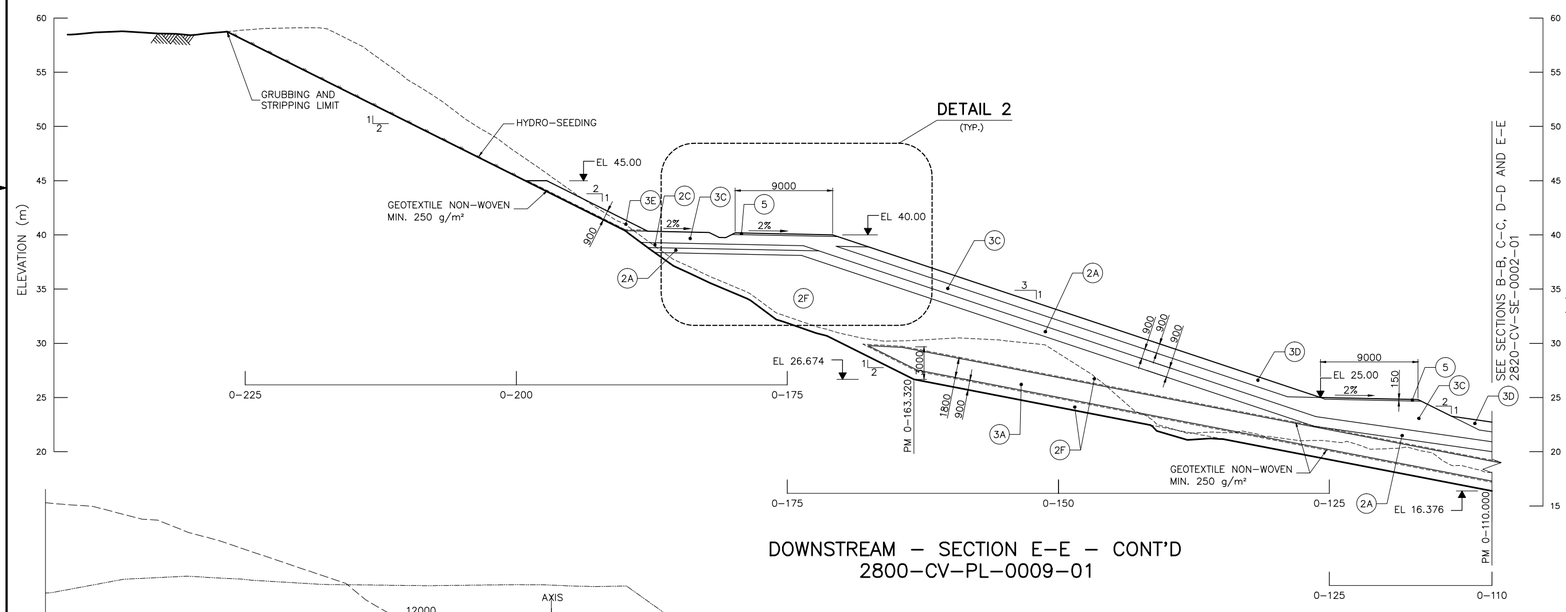
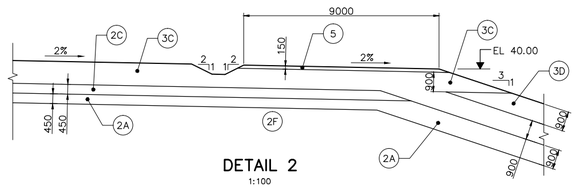
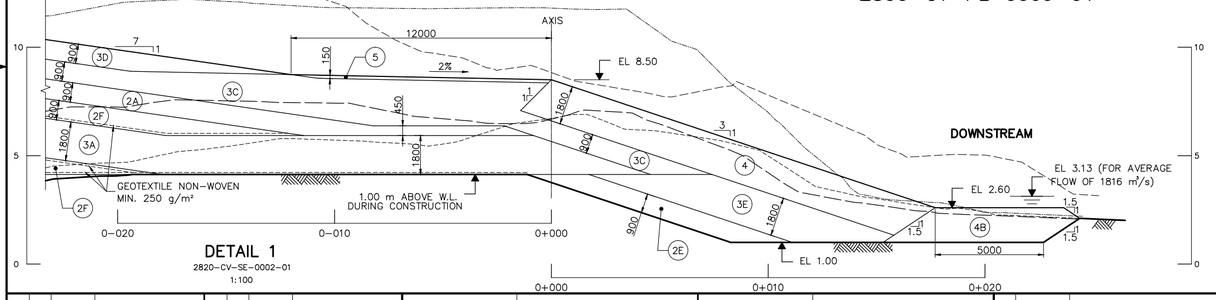


DOWNSTREAM – SECTION D–D – CONT'D
2800–CV–PL–0009–01



DOWNSTREAM – SECTION E–E – CONT'D
2800–CV–PL–0009–01





DETAIL 1
2820–CV–SE–0002–01
1:100

NOTES:

1. ELEVATIONS ARE IN METRES AND DIMENSIONS ARE IN MILLIMETRES.
2. DEFINED AND APPROVED ON SITE BY THE ENGINEER.

LEGEND:

- (2A) SELECTED COMPACTED GRANULAR, MAX. 80 mm
- (2C) SELECTED COMPACTED GRANULAR, MAX. 300 mm
- (2E) SELECTED PLACED GRANULAR, MAX. 150 mm
- (2F) SELECTED FINE TO MEDIUM SAND MAX. FINE CONTENT (0.08 mm) 5%
- (3A) COMPACTED CRUSHED STONE, MAX. 80 mm
- (3C) SELECTED COMPACTED ROCKFILL, MAX. 450 mm
- (3D) RANDOM COMPACTED ROCKFILL, MAX. 900 mm
- (3E) SELECTED PLACED ROCKFILL, MAX. 450 mm
- (4) RIPRAP
- (4B) ROCKFILL, 0–600 mm (D50= 180 mm)
- (5) MAINTENANCE GRADE MATERIAL

MIN. : MINIMUM
MAX. : MAXIMUM
EL. : ELEVATION
W.L. : WATER LEVEL

NATURAL GROUND
HYDRO–SEEDING
EXISTING NATURAL GROUND
EXCAVATION LIMIT

NOT FOR CONSTRUCTION

0 2000 4000 6000 8000 10000 mm
SCALE 1:100
0 5000 10000 15000 mm
SCALE 1:200

SSU.	REV.	DATE	DISTRIBUTION & STATUS
1	PA	26-FEB-2013	ISSUED FOR INTERNAL REVIEW

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MFA-SN-CD-2820-CV-SE-0002-01	NORTH SPUR STABILIZATION WORKS – FINGER DRAINS – SECTIONS – SHEET 1 OF 2
MFA-SN-CD-2800-CV-PL-0009-01	NORTH SPUR STABILIZATION WORKS – PLAN

No.	DATE	REVISION	MOD.	VER.	APP.

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LEAD REVIEWER: Date (dd-mmm-yyyy):
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy):
PROJECT MANAGER: Date (dd-mmm-yyyy):

PROFESSIONAL STAMP

SNC·LAVALIN

DESIGNED BY A. CEBALLOS
DRAWN BY R. MERRI
VERIFIED BY N. DAIYAN
DATE 29-SEP-2012
APPROVED Discipline Lead Engineer R. BOUCHARD
APPROVED Engineering Manager G. SNYDER
SCALE 1:200

CLIENT nalcor energy

PROJECT LOWER CHURCHILL PROJECT

TITLE MUSKRAT FALLS
NORTH SPUR STABILIZATION WORKS
FINGER DRAINS
SECTIONS AND DETAILS
SHEET 2 OF 2

SLI DOC No. 505573-3281-4GDD-0007-SH2-PA | NE DOC No. MFA-SN-CD-2820-CV-SE-0002-02 | Rev. –

FORMAT A0 (mm)
PLATE G33

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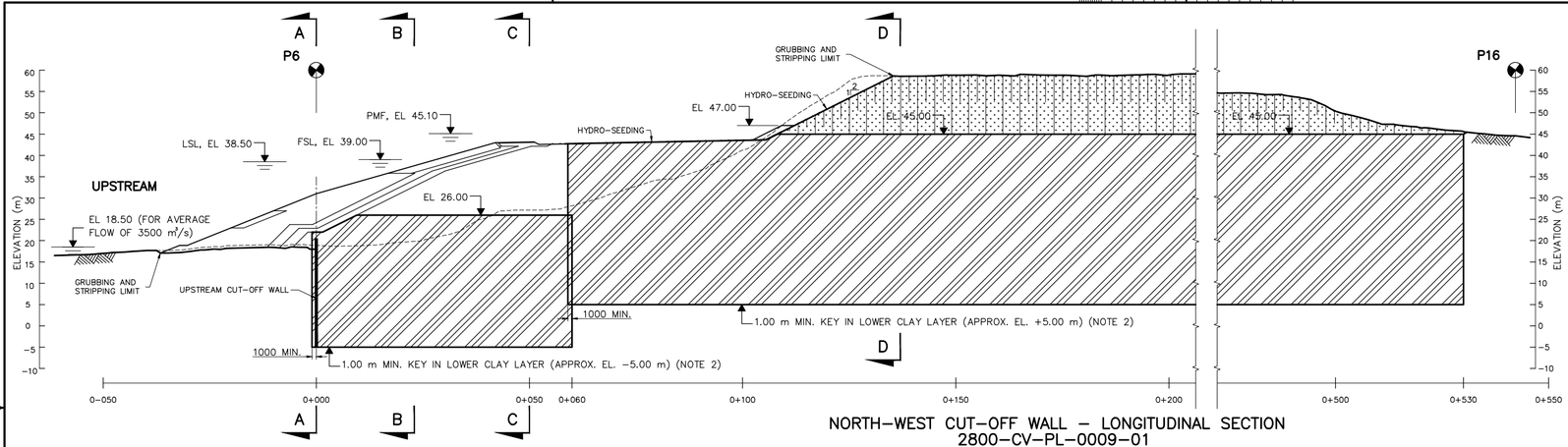
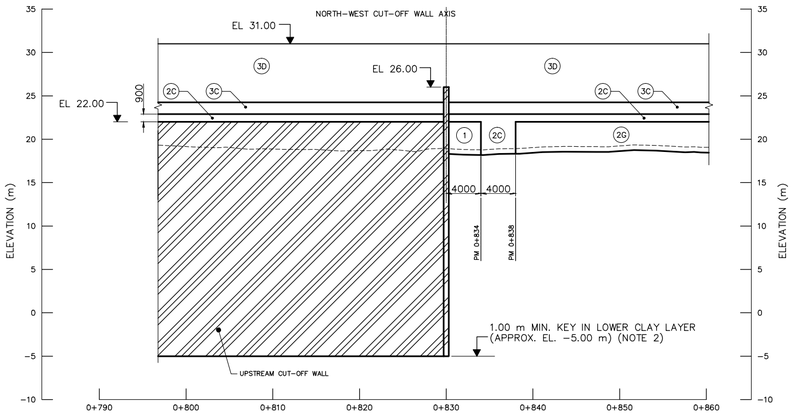
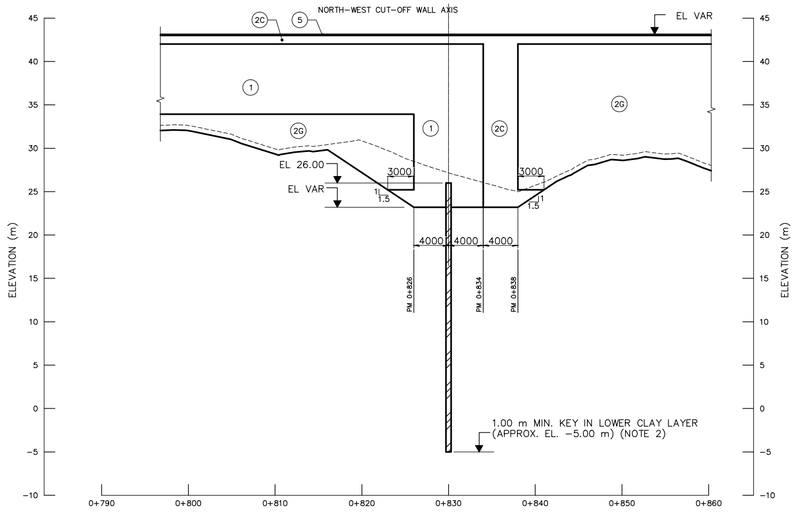


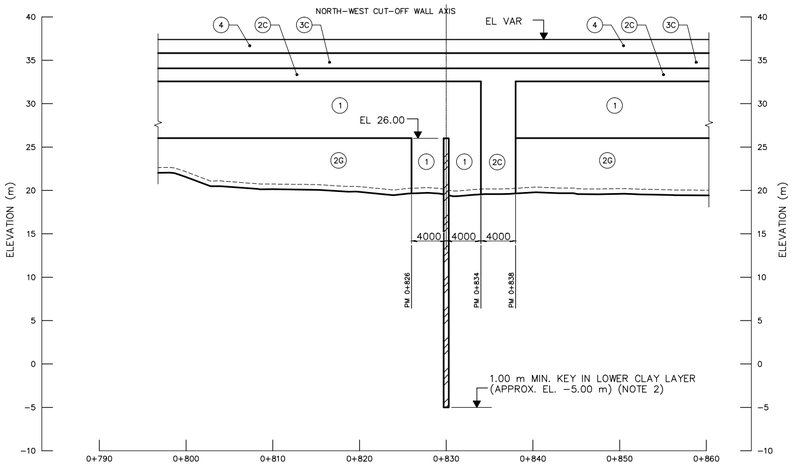
NORTH-WEST CUT-OFF WALL - LONGITUDINAL SECTION
2800-CV-PL-0009-01



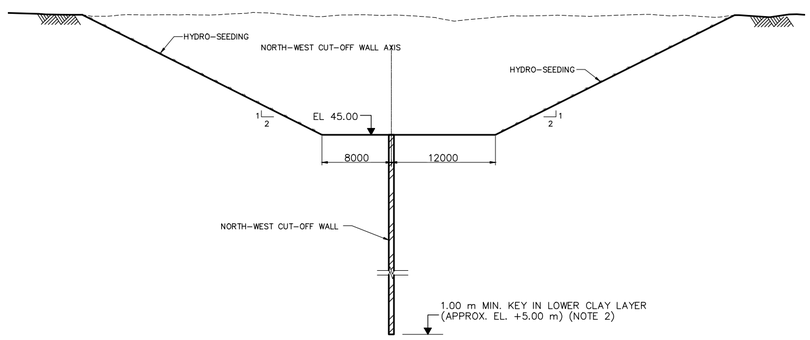
SECTION A-A
1 : 250



SECTION C-C
1 : 250



SECTION B-B
1 : 250



TYPICAL CROSS-SECTION D-D
1 : 250

NOTES:

1. ELEVATIONS ARE IN METRES AND DIMENSIONS ARE IN MILLIMETRES.
2. FINAL KEY ELEVATION IS APPROXIMATIVE AND SHALL BE APPROVED BY THE ENGINEER.

LEGEND:

1	COMPACTED TILL, MAX. 150 mm
2C	SELECTED COMPACTED GRANULAR, MAX. 300 mm
2G	SELECTED FINE TO MEDIUM SAND MAX. FINE CONTENT (0.08 mm) 20%
3C	SELECTED COMPACTED ROCKFILL, MAX. 450 mm
3D	RANDOM COMPACTED ROCKFILL, MAX. 900 mm
3E	SELECTED PLACED ROCKFILL, MAX. 450 mm
4	RIPRAP
4A	ROCKFILL, 300-900 mm (D50= 600 mm)
5	MAINTENANCE GRADE MATERIAL

PMF : PROBABLE MAXIMUM FLOOD
FSL : FULL SUPPLY LEVEL
LSL : LOW SUPPLY LEVEL
MIN. : MINIMUM
MAX. : MAXIMUM
EL. : ELEVATION

NATURAL GROUND
HYDRO-SEEDING
EXISTING NATURAL GROUND
EXCAVATION LIMIT
CUT-OFF WALL
HYDRO-SEEDING

NOT FOR CONSTRUCTION

0 5000 10000 15000 20000 mm
SCALE 1:250
0 10 20 30 40 50 m
SCALE 1:500

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
1	PA	26-FEB-2013	ISSUED FOR INTERNAL REVIEW

ISSUE REGISTER

No.	REFERENCE DRAWING
(MFA-SN-CD-2800-CV-PL-0009-01)	NORTH SPUR STABILIZATION WORKS - PLAN

REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.

REVISION

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☐ 2. REVIEWED - INCORPORATE COMMENTS, REVISE & RESUBMIT
☐ 3. REVIEWED - NOT ACCEPTED
☐ 4. INFORMATION ONLY
☐ 5. NOT REVIEWED
LEAD REVIEWER: Date (dd-mmm-yyyy):
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy):
PROJECT MANAGER: Date (dd-mmm-yyyy):

PROFESSIONAL STAMP

SNC·LAVALIN
DESIGNED BY A. CEBALLOS
DRAWN BY R. MERRI
VERIFIED BY N. DAIYAN
DATE 29-SEP-2012
APPROVED Discipline Lead Engineer R. BOUCHARD
APPROVED Engineering Manager G. SNYDER
SCALE NONE

CLIENT: nalcor energy
PROJECT: LOWER CHURCHILL PROJECT
TITLE: MUSKRAT FALLS
NORTH SPUR STABILIZATION WORKS
NORTH-WEST CUT-OFF WALL
SECTIONS

SLI DOC No. 505573-3281-4GDD-0011-PA
NE DOC No. MFA-SN-CD-2800-CV-SE-0004-01
Rev. —
FORMAT A0 (mm)
PLATE G17

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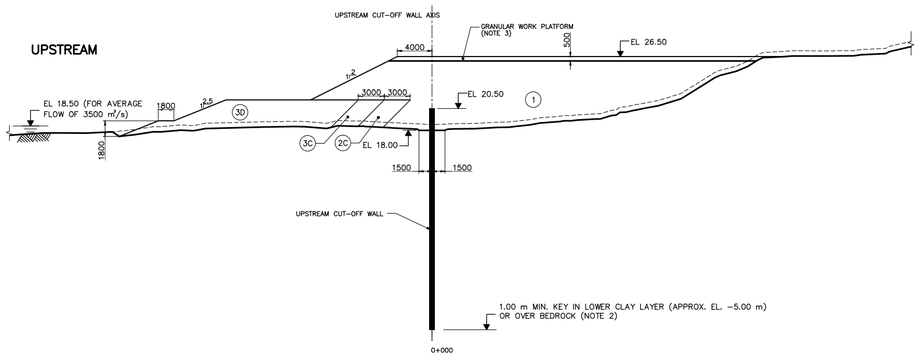
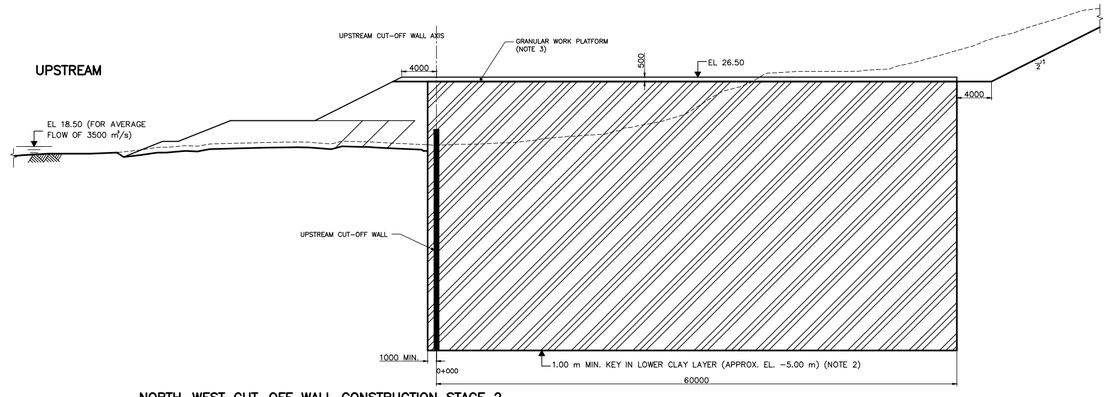
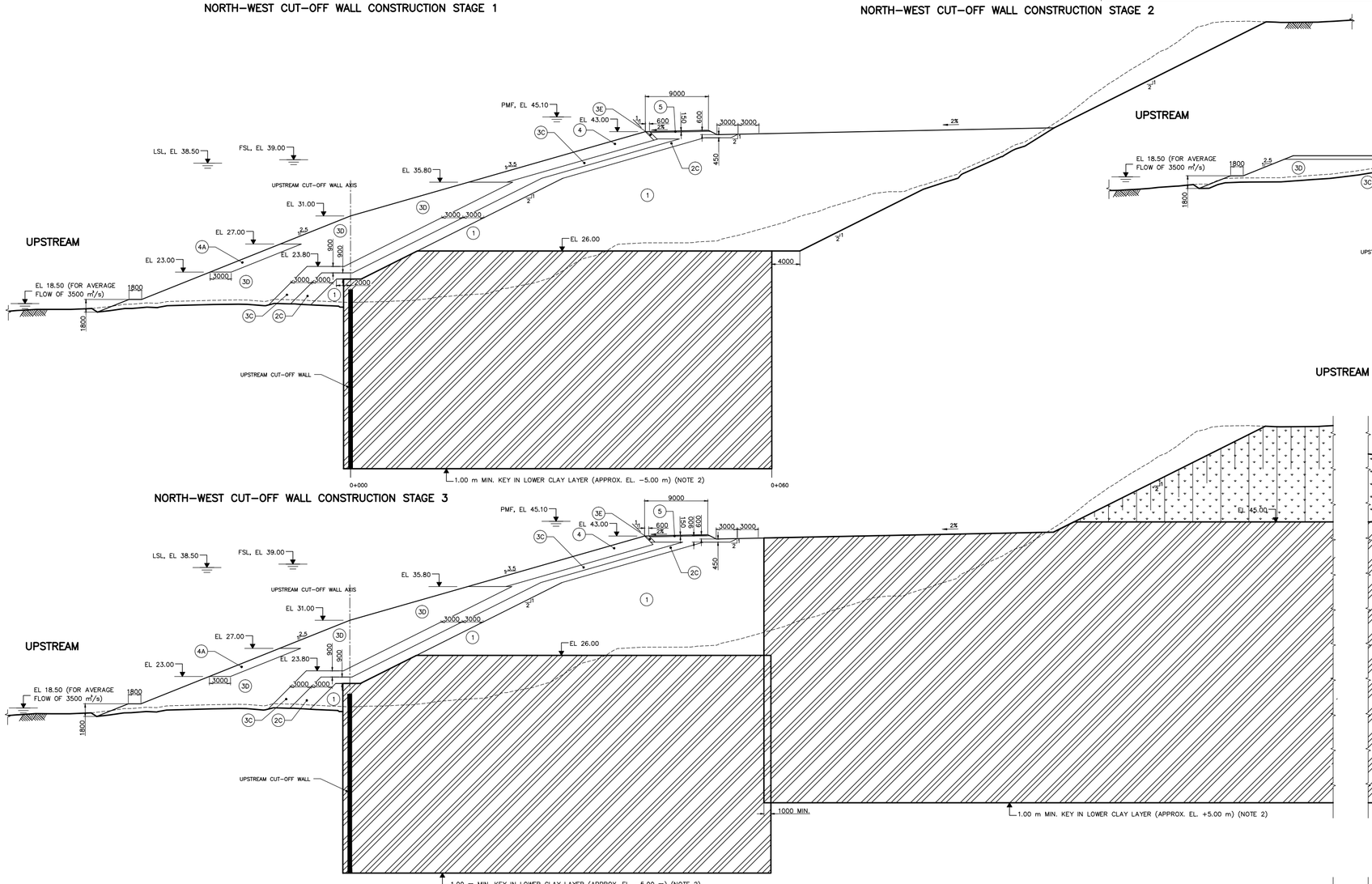


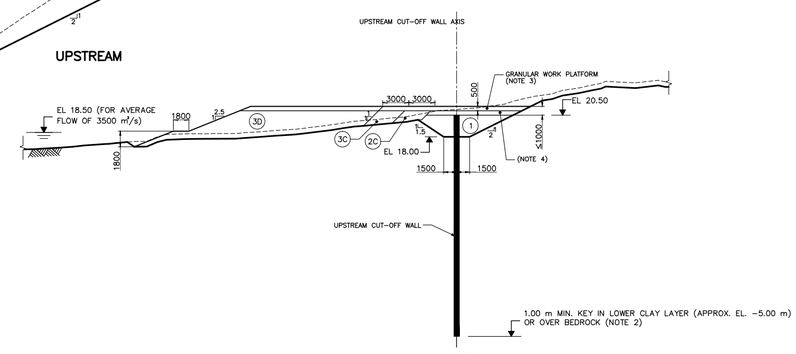
NORTH-WEST CUT-OFF WALL CONSTRUCTION STAGE 1



NORTH-WEST CUT-OFF WALL CONSTRUCTION STAGE 2



NORTH-WEST CUT-OFF WALL CONSTRUCTION STAGE 3



UPSTREAM CUT-OFF WALL – WORK PLATFORM DETAIL

NORTH-WEST CUT-OFF WALL CONSTRUCTION STAGE 4

NOTES:

1. ELEVATIONS ARE IN METRES AND DIMENSIONS ARE IN MILLIMETRES.
2. FINAL KEY ELEVATION IS APPROXIMATIVE AND SHALL BE APPROVED BY THE ENGINEER.
3. TO BE EXCAVATED AFTER CURE OR ENGINEER APPROVAL.
4. THE TOP OF THE CUT-OFF WALL SHALL BE CLEANED AND THE FINAL SURFACE APPROVED BEFORE PLACEMENT OF EMBANKMENT MATERIALS
5. THIS DRAWING PRESENTS ONLY THE MAIN CONSTRUCTION STAGES. THE DETAILS OF THE WORKS ARE INDICATED IN THE TECHNICAL SPECIFICATION, DRAWINGS AND (APPENDIX)

LEGEND:

- (1) COMPACTED TILL, MAX. 150 mm
- (2C) SELECTED COMPACTED GRANULAR, MAX. 300 mm
- (3C) SELECTED COMPACTED ROCKFILL, MAX. 450 mm
- (3D) RANDOM COMPACTED ROCKFILL, MAX. 900 mm
- (3E) SELECTED PLACED ROCKFILL, MAX. 450 mm
- (4) RIPRAP
- (4A) ROCKFILL, 300-900 mm (D50= 600 mm)
- (5) MAINTENANCE GRADE MATERIAL

PMF : PROBABLE MAXIMUM FLOOD
FSL : FULL SUPPLY LEVEL
LSL : LOW SUPPLY LEVEL
MIN. : MINIMUM
MAX. : MAXIMUM
EL. : ELEVATION

NATURAL GROUND
HYDRO-SEEDING
EXISTING NATURAL GROUND
EXCAVATION LIMIT

NOT FOR CONSTRUCTION

0 5000 10000 15000 20000 mm
SCALE 1:250

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
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ISSUE REGISTER

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(MFA-SN-CD-2800-CV-PL-0009-01)	NORTH SPUR STABILIZATION WORKS - PLAN

No.	DATE	REVISION	MOD.	VER.	APP.

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- ☐ 5. NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy):
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy):
PROJECT MANAGER: Date (dd-mmm-yyyy):

PROFESSIONAL STAMP

SNC·LAVALIN

CLIENT: nalcor energy

DESIGNED BY: A. CEBANOS	APPROVED: Discipline Lead Engineer, R. BOUCHARD
DRAWN BY: R. MERRI	APPROVED: Engineering Manager, G. SNYDER
VERIFIED BY: N. DAIYAN	
DATE: 29-SEP-2012	SCALE: NONE

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
NORTH SPUR STABILIZATION WORKS
CUT-OFF WALLS
WORK PLATFORM AND CONSTRUCTION STAGES

SLI DOC No.: 505573-3281-4GDD-0013-PA
NE DOC No.: MFA-SN-CD-2800-CV-DD-0006-01
Rev.: -

FORMAT A0 (mm)
PLATE G18

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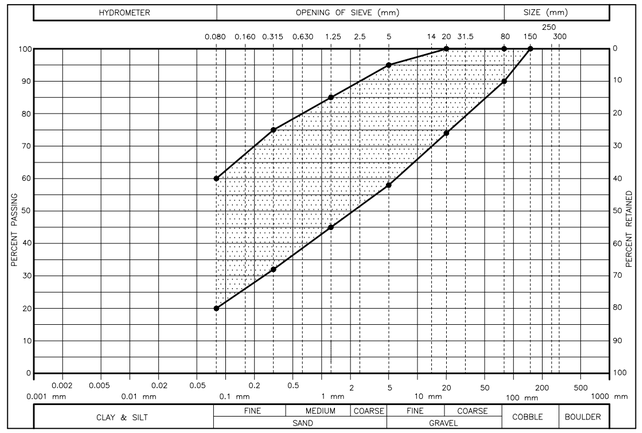
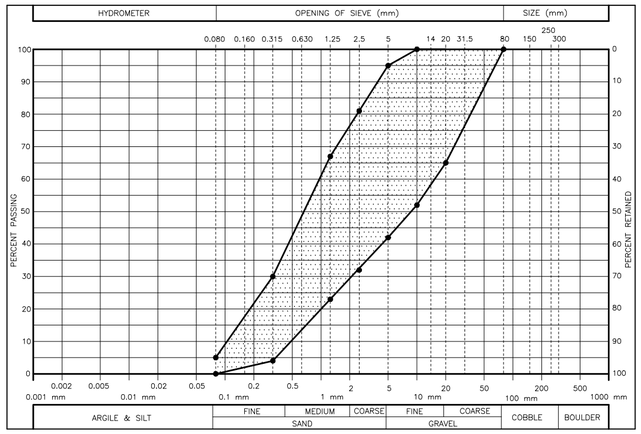
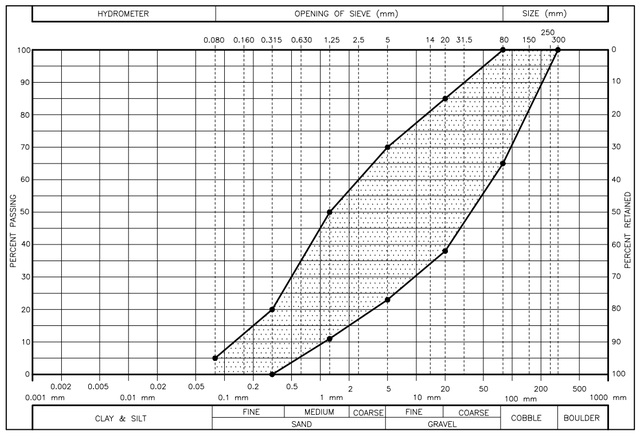


GRAIN SIZE DISTRIBUTION – ZONE (1)



GRAIN SIZE DISTRIBUTION – ZONE (2A)



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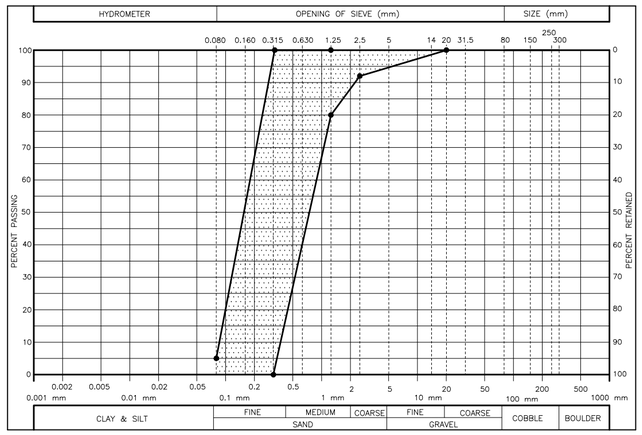
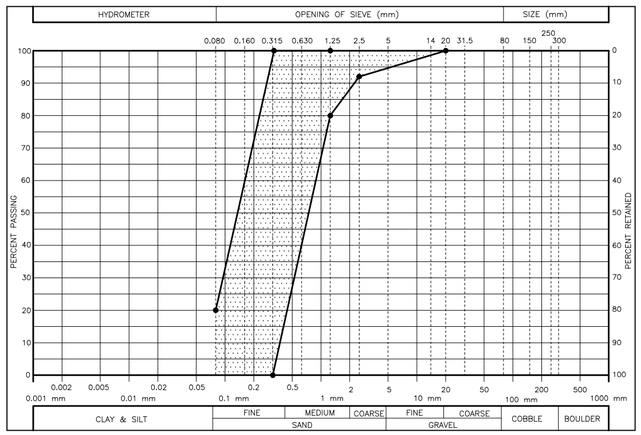
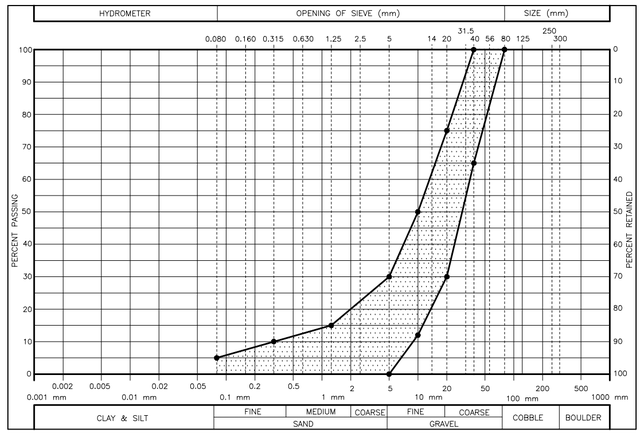


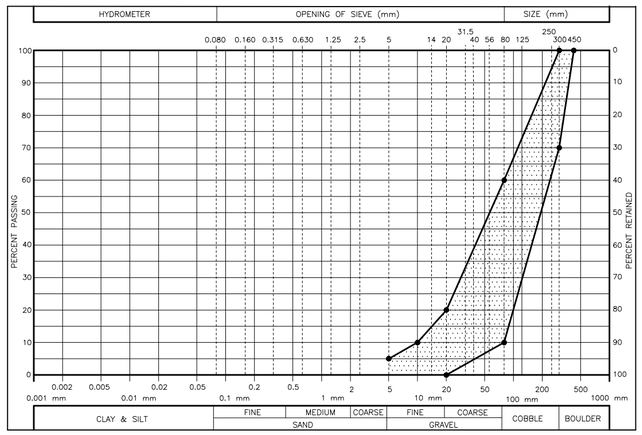
GRAIN SIZE DISTRIBUTION – ZONE (2F)



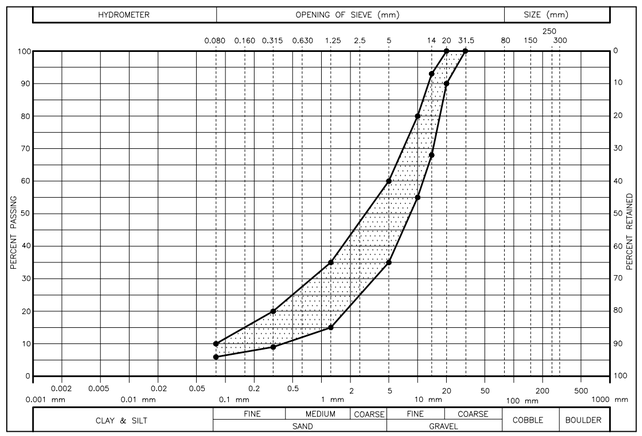
GRAIN SIZE DISTRIBUTION – ZONE (2G)



GRAIN SIZE DISTRIBUTION – ZONE (3A)



GRAIN SIZE DISTRIBUTION – ZONE (3C)



GRAIN SIZE DISTRIBUTION – ZONE (5)

ZONE	TYPE	$D_{MIN.}$	$D_{50\ MIN.}$	$D_{MAX.}$
(3D)	QUARRY ROCK	0	200	900
(4A)	QUARRY ROCK	300	600	900
(4B)	QUARRY ROCK	0	180	600
(4) CLASS 1	RIPRAP	–	–	–
(4) CLASS 2	RIPRAP	–	–	–
(4) CLASS 3	RIPRAP	–	–	–

GRADATION – ROCKFILL ZONES (3D), (4A), (4B) AND RIPRAP ZONE (4) CLASSES 1 TO 3

NOTE:

1. AT CONTACT WITH BEDROCK, THE ZONE (1) MATERIAL SHALL BE SCREENED AT 80 mm.

LEGEND:

(1) COMPACTED TILL, MAX. 150 mm

(2A) SELECTED COMPACTED GRANULAR, MAX. 80 mm

(2C) SELECTED COMPACTED COARSE GRANULAR, MAX. 300 mm

(2E) SELECTED PLACED GRANULAR, MAX. 150 mm

(2F) SELECTED FINE TO MEDIUM SAND MAX. FINE CONTENT (0.08 mm) 5%

(2G) SELECTED FINE TO MEDIUM SAND MAX. FINE CONTENT (0.08 mm) 20%

(3A) COMPACTED CRUSHED STONE, MAX. 80 mm

(3C) SELECTED COMPACTED ROCKFILL, MAX. 450 mm

(3D) RANDOM COMPACTED ROCKFILL, MAX. 900 mm

(3E) SELECTED PLACED ROCKFILL, MAX. 450 mm

(4) RIPRAP

(4A) ROCKFILL, 300–900 mm (D50 = 600 mm)

(4B) ROCKFILL, 0–600 mm (D50 = 180 mm)

(5) MAINTENANCE GRADE MATERIAL

NOT FOR CONSTRUCTION

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ISSUE REGISTER

No.	REFERENCE DRAWING

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.

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NE-LCP MANAGEMENT: Date (dd-mmm-yyyy):
AREA MANAGER: Date (dd-mmm-yyyy):

PROFESSIONAL STAMP

SNC·LAVALIN

DESIGNED BY A. CEBALLOS
DRAWN BY R. MERRI
VERIFIED BY N. DAIYAN
DATE 13-SEPT-2012
APPROVED Discipline Lead Engineer R. BOUCHARD
APPROVED Engineering Manager G. SNYDER
SCALE –

CLIENT nalcor energy

PROJECT LOWER CHURCHILL PROJECT

TITLE MUSKRAT FALLS
NORTH SPUR STABILIZATION WORKS
EMBANKMENT MATERIALS
GRAIN SIZE DISTRIBUTION

File No. 505573-3281-4GDD-0014-PA

MFA-SN-CD-2800-GT-DD-0005-01 Rev. –

FORMAT A0 (mm)

PLATE G11

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2013.03.01/7:25am

CH0009

Construction of cofferdams in Churchill River and North and South Dams

Schedule C - Dam

Project Description
(Please complete one Schedule for each dam)

Dam Name: Upstream Cofferdam **Project Name**: _Lower Churchill Project_____

Location:
Please mark location on a copy of a topographic map (preferably at 1:50,000 scale) and include with the application:

1:50,000 Topographic Map No: _____

or provide UTM Coordinates:

N _5902010_____ E __648855_____ NAD ____83_____ ZONE ___20_____

Design

Purpose of Dam:

x Hydroelectric □ Water Supply Intake □ Tailings □ Other _____

Drainage Area Profile:

Drainage Area: ___92,500_____ km^2

Main Channel Length: _____288_____ km

Slope of Drainage Area:___0.037_____ %

Drainage Area Classification:

Forest: _____%

Barren: _____%

Wetland: _____%

Urban: _____%

Inflow Design Flood:

Return Period: 1: ___20_____ years

Max Inflow: __5,990____ m^3/s

Probable Max Flood (PMF): __25,060____ m^3/s

Description of Estimation:

Please show sample calculation(s) below or attach separate sheets, if required.

_____

_____

_____

_____

_____

_____

_____

Design (Cont'd)

Dam Details: (Please attach detailed drawings and specifications)

Dam Material:

□ Concrete x Earth fill □ Treated Timber □ Untreated Timber □ Other_____

Dam Height:	_____30_____ m	Freeboard:	_____1_____ m
Crest of Dam:	_____26_____ m	Crest of Spillway:	___ N/A _____ m
Sill of Control Gate: (or Sluice Gate)	_____N/A_____ m	Storage Capacity:	____ N/A _____ m
Max Water Elevation:	_____25_____ m	Min Water Elevation:	____8_____ m
Normal Operation Elev:	_____15_____ m	Spillway Capacity:	___ N/A _____ m
Control Gate Capacity:	____ N/A _____ m/s	Penstock Capacity:	___ N/A _____ m/s

Dam Safety

Dam Safety Classification: (as per CDA Guidelines Consequence Category)

□ Very High x High □ Low □ Very Low

Please attach a Dam Safety Review Report. If not available, please indicate when the report will be completed: _____

Construction (Please attach separate sheets, if required)

Equipment to be used: _Bulldozer, Compactor. Backhoe, Truck_____

Proposed dewatering method(s): __N/A_____

Briefly describe how erosion control and stabilization will be carried out:

_____
_____See attached General Environmental Requirements ___ ____
_____
_____
_____

Briefly describe how site restoration will be carried out: _____
____See attached General Environmental Requirements
_____
_____
_____
_____
_____

Technical guidelines, departmental policies and application forms are available at:
www.gov.nl.ca/env/water

Schedule C - Dam

Project Description
(Please complete one Schedule for each dam)

Dam Name: Downstream Cofferdam **Project Name**: _Lower Churchill Project_____

Location:
Please mark location on a copy of a topographic map (preferably at 1:50,000 scale) and include with the application:

1:50,000 Topographic Map No: _____

or provide UTM Coordinates:

N __5902030_____ E ____649030_____ NAD ___83_____ ZONE __20_____

Design

Purpose of Dam:

x Hydroelectric □ Water Supply Intake □ Tailings □ Other _____

Drainage Area Profile:

Drainage Area: _____92,500_____ km^2

Main Channel Length: _____288_____ km

Slope of Drainage Area:____0.037_____ %

Drainage Area Classification:

Forest: _____%

Barren: _____%

Wetland: _____%

Urban: _____%

Inflow Design Flood:

Return Period: 1: ____20_____ years

Max Inflow: __5,990____ m^3/s

Probable Max Flood (PMF): __25,060_____ m^3/s

Description of Estimation:

Please show sample calculation(s) below or attach separate sheets, if required.

_____

_____

_____

_____

_____

_____

_____

Design (Cont'd)

Dam Details: (Please attach detailed drawings and specifications)

Dam Material:

□ Concrete x Earth fill □ Treated Timber □ Untreated Timber □ Other_____

Dam Height:	____5_____ m	Freeboard:	_____1_____ m
Crest of Dam:	_____9_____ m	Crest of Spillway:	_____ N/A _____ m
Sill of Control Gate: (or Sluice Gate)	___N/A_____ m	Storage Capacity:	_____ N/A _____ m
Max Water Elevation:	____8_____ m	Min Water Elevation:	_____2_____ m
Normal Operation Elev:	____6_____ m	Spillway Capacity:	____ N/A _____ m
Control Gate Capacity:	____ N/A ____ m/s	Penstock Capacity:	_____ N/A _____ m/s

Dam Safety

Dam Safety Classification: (as per CDA Guidelines Consequence Category)

□ Very High x High □ Low □ Very Low

Please attach a Dam Safety Review Report. If not available, please indicate when the report will be completed: _____

Construction (Please attach separate sheets, if required)

Equipment to be used: __Bulldozer, Compactor, Backhoe, Trucks__

Proposed dewatering method(s): _____

Briefly describe how erosion control and stabilization will be carried out:

_____

_____See attached General Environmental Requirements ___ ____

_____

_____

_____

Briefly describe how site restoration will be carried out: _____

____See attached General Environmental Requirements

_____

_____

_____

_____

_____

Technical guidelines, departmental policies and application forms are available at:
www.gov.nl.ca/env/water

Schedule C - Dam

Project Description
(Please complete one Schedule for each dam)

Dam Name: North RCC Dam **Project Name**: _Lower Churchill Project_____

Location:
Please mark location on a copy of a topographic map (preferably at 1:50,000 scale) and include with the application:

1:50,000 Topographic Map No: _____

or provide UTM Coordinates:

N ___5902048_____ E ____648930_____ NAD ___83_____ ZONE ___20_____

Design

Purpose of Dam:

x Hydroelectric □ Water Supply Intake □ Tailings □ Other _____

Drainage Area Profile:

Drainage Area: ___92,500_____ km^2

Main Channel Length: _____288_____ km

Slope of Drainage Area:___0.037_____ %

Drainage Area Classification:

Forest: _____%

Barren: _____%

Wetland: _____%

Urban: _____%

Inflow Design Flood:

Return Period: 1: ___PMF_____ years Max Inflow: __25,060____ m^3/s

Probable Max Flood (PMF): __25,060___ m^3/s

Description of Estimation:

Please show sample calculation(s) below or attach separate sheets, if required.

_____

_____

_____

_____

_____

_____

_____

Design (Cont'd)

Dam Details: (Please attach detailed drawings and specifications)

Dam Material:

□ Concrete x Earth fill □ Treated Timber □ Untreated Timber □ Other_____

Dam Height:	_____45_____ m	Freeboard:	_____ N/A ____ m
Crest of Dam:	_____39.3_____ m	Crest of Spillway:	___ 39.3 _____ m
Sill of Control Gate: (or Sluice Gate)	_____N/A_____ m	Storage Capacity:	____ N/A _____ m
Max Water Elevation:	_____45.1_____ m	Min Water Elevation:	____38.5_____ m
Normal Operation Elev:	_____39_____ m	Spillway Capacity:	___ 430 _____ m
Control Gate Capacity:	____ N/A _____ m/s	Penstock Capacity:	___ N/A _____ m/s

Dam Safety

Dam Safety Classification: (as per CDA Guidelines Consequence Category)

x Very High □ High □ Low □ Very Low

Please attach a Dam Safety Review Report. If not available, please indicate when the report will be completed: _____

Construction (Please attach separate sheets, if required)

Equipment to be used: _Bulldozer, Compactor. Backhoe, Truck_____

Proposed dewatering method(s): __N/A_____

Briefly describe how erosion control and stabilization will be carried out:

_____

_____See attached General Environmental Requirements ___ ____

_____

_____

_____

Briefly describe how site restoration will be carried out: _____

____See attached General Environmental Requirements

_____

_____

_____

_____

_____

Technical guidelines, departmental policies and application forms are available at:
www.gov.nl.ca/env/water

Schedule C - Dam

Project Description
(Please complete one Schedule for each dam)

Dam Name: South Rockfill Dam **Project Name**: _Lower Churchill Project_____

Location:
Please mark location on a copy of a topographic map (preferably at 1:50,000 scale) and include with the application:

1:50,000 Topographic Map No: _____

or provide UTM Coordinates:

N ___5901500_____ E ____649130_____ NAD ___83_____ ZONE ___20_____

Design

Purpose of Dam:

x Hydroelectric □ Water Supply Intake □ Tailings □ Other _____

Drainage Area Profile:

Drainage Area: ___92,500_____ km^2

Main Channel Length: _____288_____ km

Slope of Drainage Area:___0.037_____ %

Drainage Area Classification:

Forest: _____%

Barren: _____%

Wetland: _____%

Urban: _____%

Inflow Design Flood:

Return Period: 1: ___PMF_____ years Max Inflow: __25,060____ m^3/s

Probable Max Flood (PMF): __25,060___ m^3/s

Description of Estimation:

Please show sample calculation(s) below or attach separate sheets, if required.

_____

_____

_____

_____

_____

_____

_____

Design (Cont'd)

Dam Details: (Please attach detailed drawings and specifications)

Dam Material:

□ Concrete x Earth fill □ Treated Timber □ Untreated Timber □ Other_____

Dam Height:	_____20_____ m	Freeboard:	_____1.2_____ m
Crest of Dam:	_____46.3_____ m	Crest of Spillway:	___ N/A _____ m
Sill of Control Gate: (or Sluice Gate)	_____N/A_____ m	Storage Capacity:	____ N/A _____ m
Max Water Elevation:	_____45.1_____ m	Min Water Elevation:	____38.5_____ m
Normal Operation Elev:	_____39_____ m	Spillway Capacity:	___ N/A _____ m
Control Gate Capacity:	____ N/A _____ m/s	Penstock Capacity:	___ N/A _____ m/s

Dam Safety

Dam Safety Classification: (as per CDA Guidelines Consequence Category)

x Very High □ High □ Low □ Very Low

Please attach a Dam Safety Review Report. If not available, please indicate when the report will be completed: _____

Construction (Please attach separate sheets, if required)

Equipment to be used: _Bulldozer, Compactor. Backhoe, Truck_____

Proposed dewatering method(s): __N/A_____

Briefly describe how erosion control and stabilization will be carried out:

_____

_____See attached General Environmental Requirements ___ ____

_____

_____

_____

Briefly describe how site restoration will be carried out: _____

____See attached General Environmental Requirements

_____

_____

_____

_____

_____

Technical guidelines, departmental policies and application forms are available at:
www.gov.nl.ca/env/water

Schedule F – Stream Modification or Diversion

Project Description
(Please complete one Schedule for each modification)

Location

Site Name/No: __Churchill River Diversion/Bypass (Gated Spillway)_____

Please mark location on a copy of a topographic map (preferably at 1:50,000 scale) and include with the application:

1:50,000 Topographic Map No: _____

or provide UTM Coordinates:

N ___5901850_____ E ____649097____ NAD ____83____ ZONE ___20_____

Design

Drainage Area Profile:

Drainage Area: ____92,500_____ km^2

Main Channel Length: _____288_____ km

Slope of Drainage Area:_____0.037_____ %

Drainage Area Classification:

Forest: _____%

Barren: _____%

Wetland: _____%

Urban: _____%

Hydrologic Details:

Return Period: 1: _____20_____ years

Estimation Method: □ Rational □ TR55 □ RFFA x Other _Statistical Analysis

Maximum Flow: ___6,220_____ m^3/s

Design Flow: ___5,990___ m^3/s

Description of Estimation:
Please show calculation(s) below or attach separate sheets, if required.

_____

_____See attached_____

_____

_____See attached drawings for gated spillway design, as requested below_____

_____

_____

_____

_____

_____

Design (cont'd)

Dimensions: Please provide the following drawings:

(a) Site Layout (b) Cross-sectional View (c) Longitudinal View

For the proposed channel modification these drawings should show:

- Bottom width of channel
- Top width of channel
- Channel depth
- Slope of channel embankments
- Normal water depth
- Low water level
- High water level
- Slope of channel
- Extent of floodplain
- Diameter of rip-rap
- Energy dissipaters

Hydraulic Details:

Maximum Velocity: _____ (m/s) Minimum Velocity: _____ (m/s)

Maximum Flow: 6,220 (m^3/s) Minimum Flow: 700 (m^3/s)

Construction

Equipment to be used**:** _____

Proposed dewatering method:

____N/A_____

Briefly describe how erosion control and stabilization will be carried out:

_See attached General Environmental

requirements_____

_____

Briefly describe how site restoration will be carried out:

_____ See attached General Environmental requirements

_____

_____

_____

_____

Technical guidelines, departmental policies and application forms are available at:
www.gov.nl.ca/env/water

Schedule F – Stream Modification or Diversion
Churchill River Temporary Diversion Through Gated Spillway

1 INTRODUCTION

During construction of the Muskrat Falls Project, the Churchill River will be diverted through the gated spillway. The gated spillway will also be under construction during diversion. The following highlights how flows in the Churchill River will be managed during its temporary diversion in support of the Schedule F – Stream Modification or Diversion permit.

2 GATED SPILLWAY DESCRIPTION

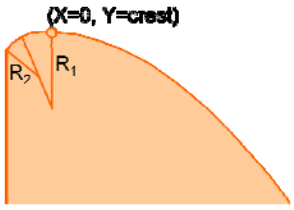
MAIN CHARACTERISTICS OF THE GATED SPILLWAY

The main characteristics of the gated spillway for the Muskrat Falls Project are described as follows:

- Number of bays: 5
- Bay width: 10.5 m
- Invert elevation without rollways: 5.0 m
- Shape of rollways: parabolic
- Crest elevation of rollways: 18.0 m
- Rollway geometry design head, H_{dr}:

  H_{dr} = 0.85 * (FSL 39.0 m – 18.0 m) = 17.85 m
- Geometry downstream of crest (Ref. 4):

  $Y = 18.0 – X^2/(4H_{dr}) = 18.0 – X^2/71.4$
- Geometry upstream of crest with two radii R_1 and R_2 (Ref. 4):



  R_1=11.1 m starts at X=0 m Y=18.0 m

  R_2=4.9 m starts from R_1 at X=-1.716 m ends at Y=15.342 m
- Upstream face: vertical from R_2
- Width of piers: 4.0 m
- Shape of pier noses (Ref. 6): elliptical with rounded edge
- Gate type: vertical surface
- Gate height: 23.0 m
- Approach channel:

Schedule F – Stream Modification or Diversion
Churchill River Temporary Diversion Through Gated Spillway

- o invert elevation: 5.0 m
- o length: about 300 m
- o width: 74.5 m
- o lining: on rock
- o slope: horizontal

- Discharge channel:
  - o invert elevation at end of piers: 4.1 m
  - o length: about 120 m
  - o width: 70.1 m
  - o lining (partial length): concrete
  - o slope: 0.1%

The gated spillway initially will be without rollways with invert at elevation 5.0 m and the vertical gates will control the upstream water level during river diversion. With the progression of the works, the rollways will be constructed in stages and therefore the capacity of the diversion will vary depending on the availability of bays and configuration.

3 GATED SPILLWAY DISCHARGE CAPACITY

During construction, the total capacity of the spillway will vary depending on the number of bays with invert El. 5.0 m, the number with rollways at El. 18.0 m and the number of bays closed. Figure 1 below shows the discharge capacity for one single bay with invert El. 5.0 m, 5 bays with invert El. 5.0 m, one single bay with a rollway at crest El. 18.0 m, 5 bays with rollways at crest El. 18.0 m as well as the capacity of the overflow spillway which will be unavailable during construction.

Schedule F – Stream Modification or Diversion
Churchill River Temporary Diversion Through Gated Spillway

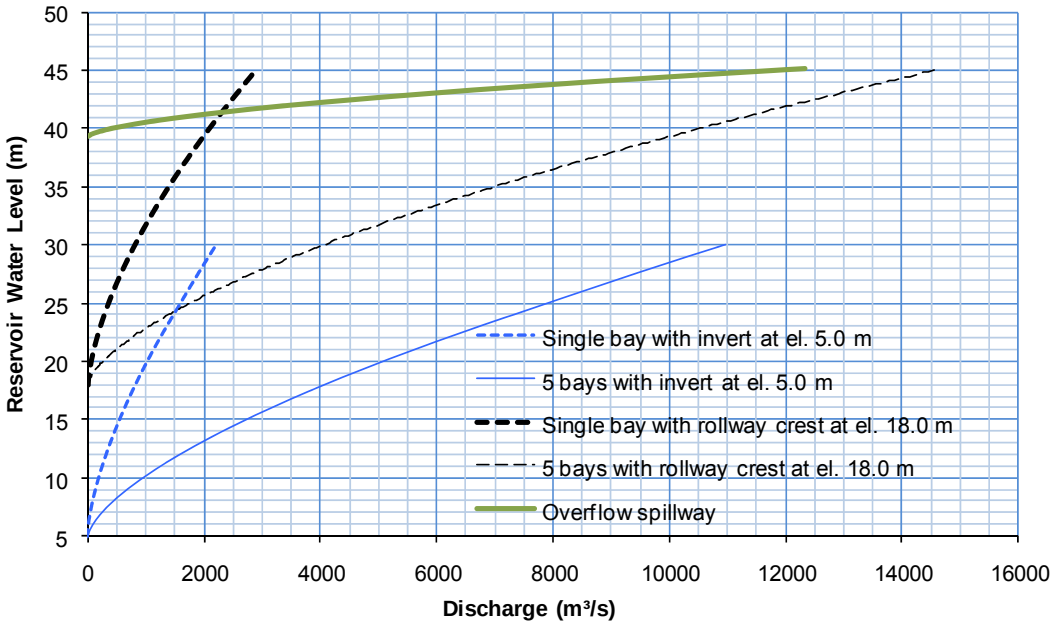


Figure 1: Discharge Capacity of Spillway Structures

4 DISCHARGE CAPACITY DURING CONSTRUCTION

The gated spillway at Muskrat Falls will serve as temporary diversion of the Churchill River during construction of the powerhouse and the north dam. For this purpose, initially the five bays of the spillway will be without rollways and the gates will be closing on an invert with elevation 5.0 m. Throughout the course of the construction phase, the bays will be isolated with stoplogs and the rollways constructed in a sequence driven by hydrology and progress of the works. The project construction design flood is the 1:20 year flood. The implementation schedule of the rollways is illustrated on Figure 2. It shows the available capacity to meet the requirement of routing the construction design flood and also the progress of implementation of the river closure structures. In Year 1, the river will be diverted in summer/fall and that the impoundment to full supply level (FSL) will be achieved in October/November of Year 2 when the north dam and the powerhouse intake will be completed. Therefore, one rollway will be constructed in fall/winter Year 1-Year2 and will be completed before the spring flood of Year 2. During the summer/fall of Year 2, two more rollways will be constructed and will be completed before October of Year 2. The last two bays will be closed with stoplogs to allow impounding the reservoir to FSL 39.0 m and the rollways will be constructed during winter Year 2-Year 3. The gated spillway in this schedule is planned to be completed before the spring flood of Year 3.

The gated spillway capacity for the period of construction of the Muskrat Falls development is presented in Figure 3. The discharge capacity for all periods of construction, as shown on

Schedule F – Stream Modification or Diversion
Churchill River Temporary Diversion Through Gated Spillway

Figure 2, are depicted on the chart along with the construction design inflows corresponding to summer/fall (July to November), winter (December to April) and spring (May to June).

For appreciation of the hydrology that may be expected during construction, the day by day statistics of the historical flows observed just upstream of Muskrat Falls between the 1978 and 2009 are presented on Figure 4. The statistical 1:20 year peak discharge for each period of the year is also shown on the chart.

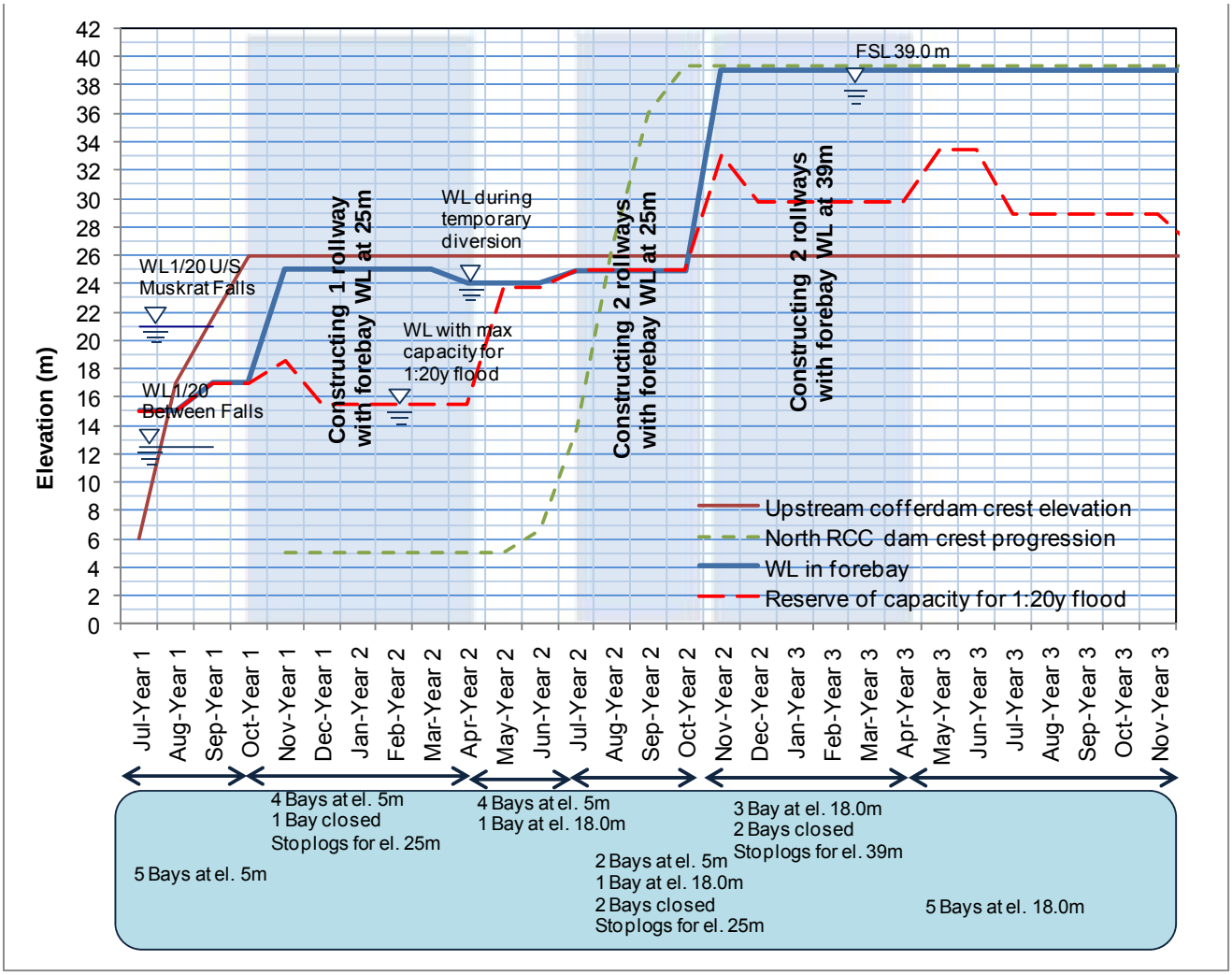


Figure 2: Implementation Schedule for Spillway Rollway Construction

Schedule F – Stream Modification or Diversion
Churchill River Temporary Diversion Through Gated Spillway

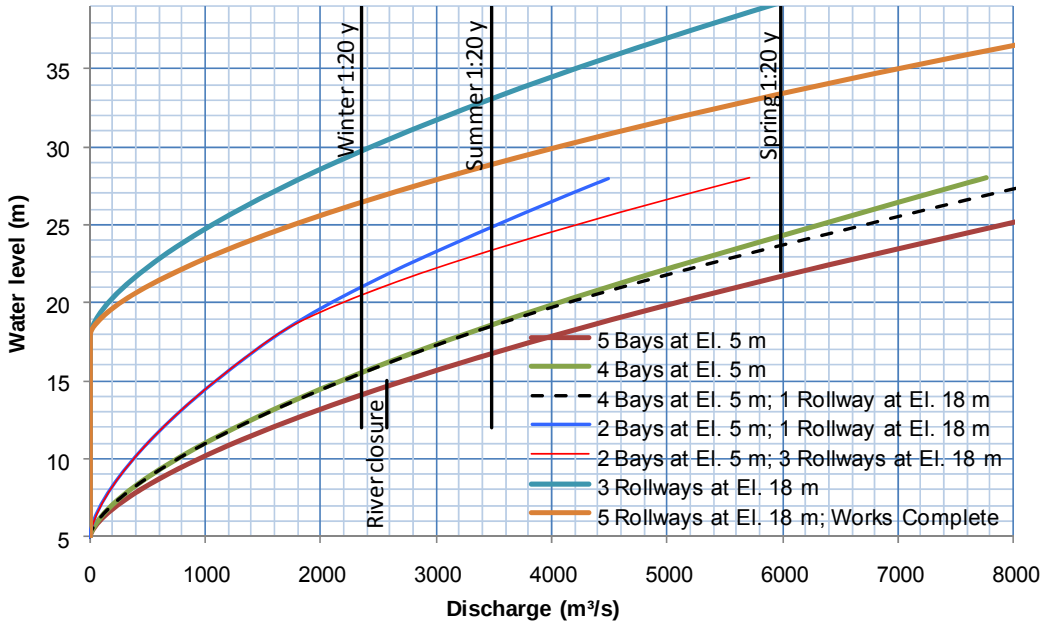


Figure 3: Discharge Capacity of Gated Spillway during Construction

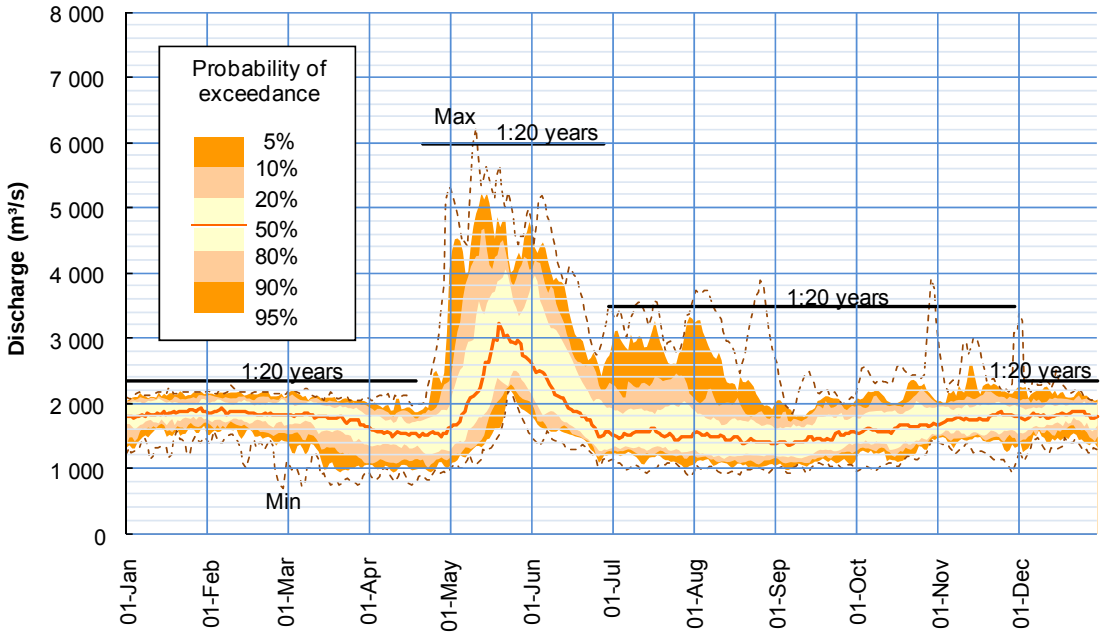


Figure 4: Daily Flows at Muskrat Falls

Project Base Currency: CAD **at the rate of** 1.00000000
Report Currency: CAD **at the rate of** 1.00000000

Package No. : CH0009 **Type** C - Contract
Titles (long) : Construction of North and South Dams **Revision No.** 01
(short) : North and South Dams **Date** 19-Apr-2012
Discipline :

Responsibilities : **Area Manager :** Maeyens, Michel **Engineer :** Dubey, Bhasker
QA / QC : Morrison, Ken **Contract Formation / Buyer :**

Scope of Work

Package CH0009 includes the construction of Rock fill Cofferdams with impervious till core and cutoffs and associated filters and transition zones, and the construction of the South Rockfill Dam and North RCC dam .

Work Included:

- The North Upstream Rockfill Cofferdam, including cutoff, foundation preparation and treatment. Foundation preparation may consist of jet grouting, pending on the results of the site investigations to be undertaken in SM0713
- The North Downstream Cofferdam.
- The North RCC Dam, including excavation, foundation preparation, treatment, drainage, electrical works, mechanical works and instrumentation.
- The South Rockfill Dam including foundation preparation, treatment, drainage, and instrumentation.
- The South Transition Dam (CVC), between the Powerhouse and Rock Fill Dam, including retaining walls..
- This package will include hardware supply for the monitoring of instrumentation consisting of vibrating wire piezometers, opens standpipe piezometers, joint meters, crest monuments, Flow –V-notch type flow meters, seismographs and central unit readout stations.
- Removal of the downstream part (from the Spillway D/S) of the RCC Riverside Cofferdam (built by CH0006)
- Access Road around North Spur from the upstream cofferdam to the North spur
- Temporary Access Roads
- Borrow Areas

Ref: Package CH0007: Construction of Intake and Powerhouse, Spillway and Transition Dams

Ref. Package CH0008: Construction of North Spur Stabilization Works

Ref. Package CH00006: Construction of Bulk Excavation Works and Associated Civil Works.

Work Excluded :

- Tailrace Cofferdam, including foundation preparation and treatment (CH0006)
- Riverside Cofferdam to be constructed (CH0006)
- Powerhouse intake Cofferdam (separation Wall) (CH0007)
- Construction of Bulk Excavation Works and associated Civil Works inclusive of: (CH0006)
    - Powerhouse / Intake Excavation;
    - Tailrace excavation;
    - Spillway excavation;
    - Switchyard and switchyard extension excavation and backfill

- Intake and Powerhouse Construction (CH0007)

Project Base Currency: CAD **at the rate of** 1.00000000
Report Currency: CAD **at the rate of** 1.00000000

Package No. : CH0009 **Type** C - Contract
Titles (long) : Construction of North and South Dams **Revision No.** 01
(short) : North and South Dams **Date** 19-Apr-2012
Discipline :

Responsibilities : **Area Manager :** Maeyens, Michel **Engineer :** Dubey, Bhasker
QA / QC : Morrison, Ken **Contract Formation / Buyer :**

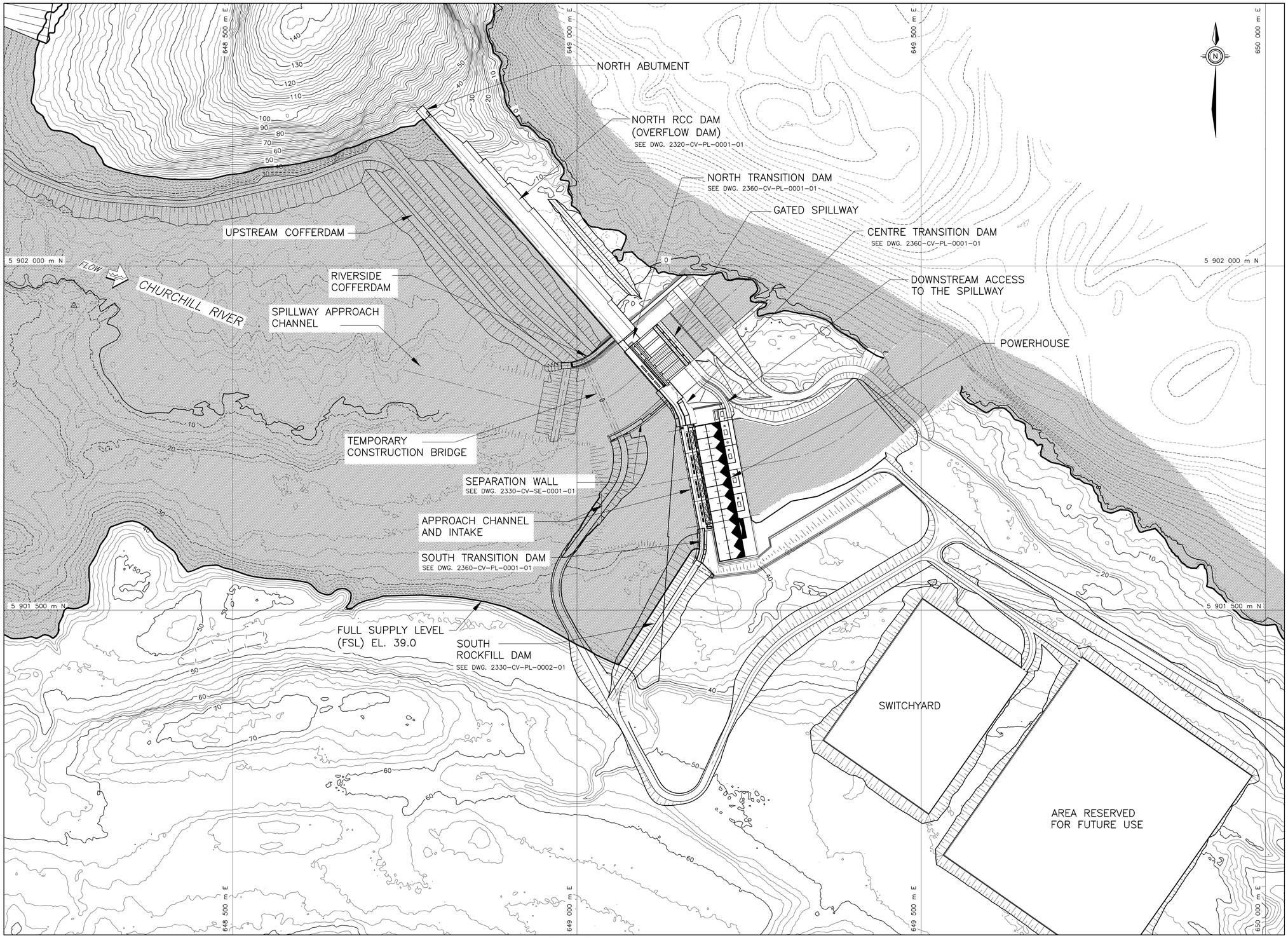
Work Excluded :

- Spillway Structure Construction (CH0007)
- Transition Dams(North and Centre) (CH0007)
- North Spur Improvement (CH0008)
- Construction of access road/cofferdam at upstream end of Intake Approach Channel (CH0007)
- Construction of temporary access bridges (CH0007)

Remark :

- Lump Sum Contract
- NOT a IBA Contract.

User Defined References :



PLAN

NOTES:

1. TOPOGRAPHIC GRID IS BASED ON UTM NAD 83, ZONE 20 SYSTEM.
2. ABOVE WATER CONTOURS ARE BASED ON GEODATA DIGITAL MAPPING 1998.
3. BATHYMETRIC CONTOURS AWAY FROM FALLS AREA ARE ADJUSTED TO THE 1979 CORRECTED DATUM (M.S.L.).

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2360-CV-PL-0001-01	RCC & TRANSITION DAMS SOUTH, CENTRE AND NORTH TRANSITION DAMS
2330-CV-SE-0001-01	RCC & TRANSITION DAMS SEPARATION WALL – PLAN & SECTIONS
2330-CV-PL-0002-01	RCC & TRANSITION DAMS SOUTH ROCKFILL DAM – PLAN & ELEV
2320-CV-PL-0001-01	RCC & TRANSITION DAMS NORTH RCC DAM – PLAN & ELEVATION

No.	DATE	REVISION	MOD.	VER.	APP.

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NE-LCP MANAGEMENT: Date (dd-mmm-yyyy):
AREA MANAGER: Date (dd-mmm-yyyy):

PROFESSIONAL STAMP

SNC·LAVALIN

DESIGNED BY T. SMITH | APPROVED Discipline Lead Engineer
DRAWN BY C. McCARTHY | APPROVED Engineering Manager
VERIFIED BY
DATE 15-OCT-2011 | SCALE 1 : 2000

CLIENT: nalcor energy
PROJECT: LOWER CHURCHILL PROJECT
TITLE: MUSKRAT FALLS
RCC AND TRANSITION DAMS
GENERAL ARRANGEMENT OF WORKS
PLAN

File No. 505573-323A-41DD-0001-PB | MFA-SN-CD-2300-CV-PL-0003-01 | Rev. A1

FORMAT A0 (mm)
PLATE C1

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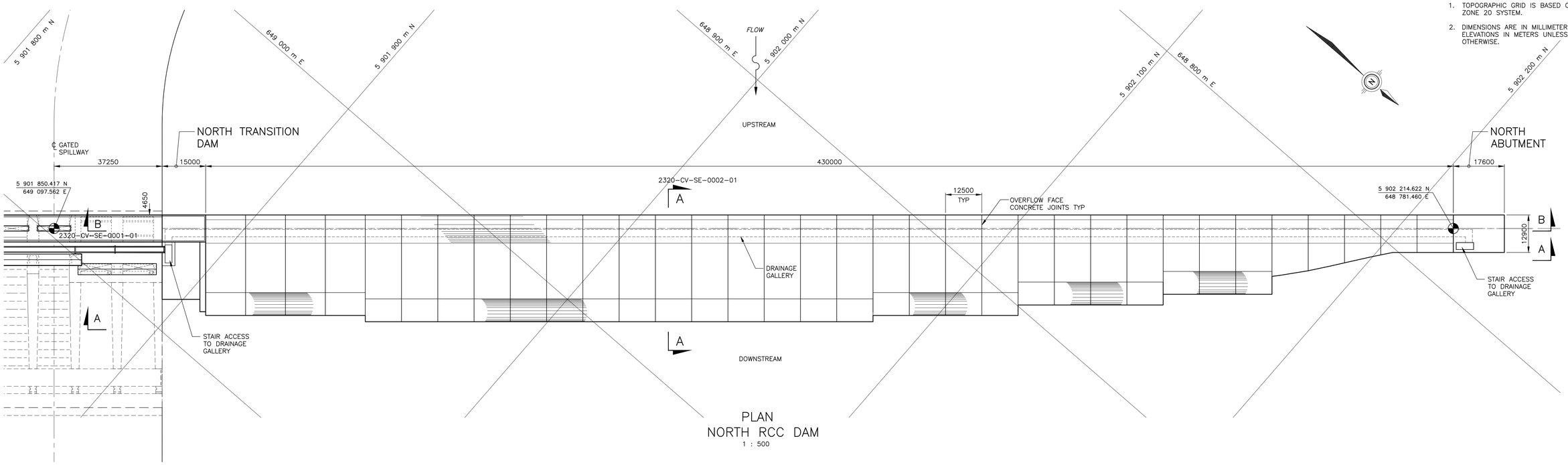
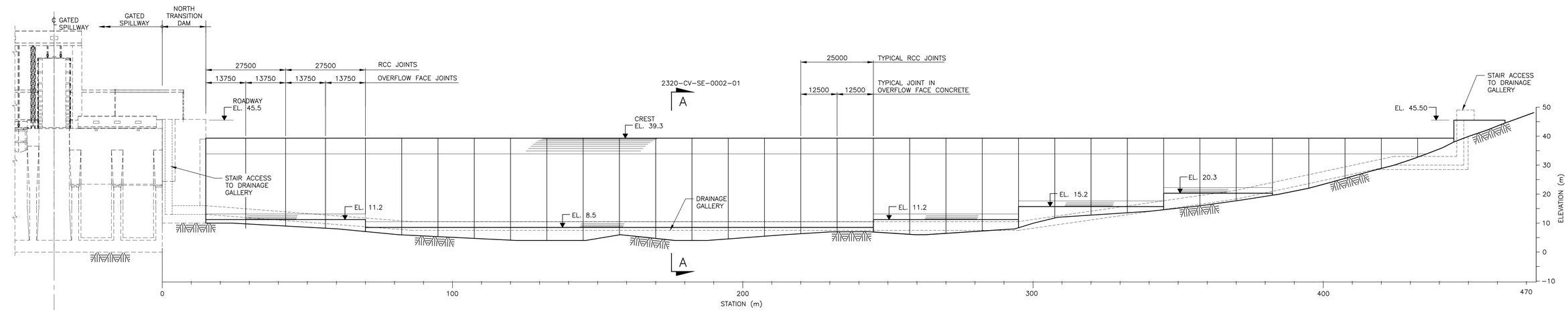
NOTES:

1. TOPOGRAPHIC GRID IS BASED ON UTM NAD 83, ZONE 20 SYSTEM.
2. DIMENSIONS ARE IN MILLIMETERS AND ELEVATIONS IN METERS UNLESS NOTED OTHERWISE.



PLAN
NORTH RCC DAM
1 : 500



ELEVATION A–A
NORTH RCC DAM
(LOOKING UPSTREAM)
1 : 500

PRELIMINARY

1:500 0 5000 15000 25000 mm

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2320-CV-SE-0002-01	RCC AND TRANSITION DAMS NORTH RCC DAM – DETAILS
2320-CV-SE-0001-01	RCC AND TRANSITION DAMS NORTH RCC DAM – SECTIONS
2300-CV-PL-0003-01	RCC AND TRANSITION DAMS GENERAL ARRANGEMENT OF WORKS – PLAN

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NE-LCP MANAGEMENT: Date (dd-mmm-yyyy):
AREA MANAGER: Date (dd-mmm-yyyy):

PROFESSIONAL STAMP

SNC·LAVALIN

CLIENT: nalcor energy

DESIGNED BY G. CASAGRAN	APPROVED Discipline Lead Engineer
DRAWN BY C. McCARTHY	APPROVED Engineering Manager
VERIFIED BY T. SMITH	
DATE 15-OCT-2011	SCALE 1:500

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
RCC AND TRANSITION DAMS
NORTH RCC DAM
PLAN & ELEVATION

File No. 505573-323A-41DD-0002-PB | MFA-SN-CD-2320-CV-PL-0001-01 | Rev. A1

FORMAT A0 (mm)
PLATE C2

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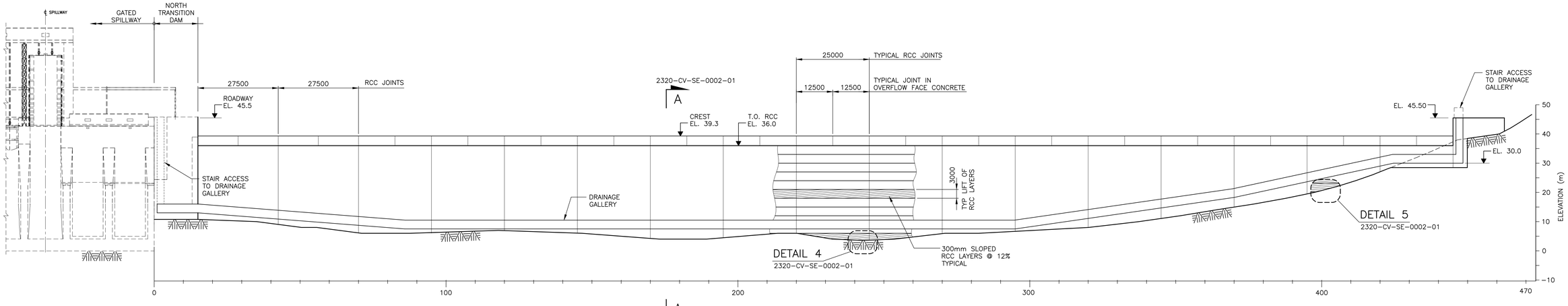
NOTES:

1. TOPOGRAPHIC GRID IS BASED ON UTM NAD 83, ZONE 20 SYSTEM.
2. DIMENSIONS ARE IN MILLIMETERS AND ELEVATIONS IN METERS UNLESS NOTED OTHERWISE.



SECTION B-B
NORTH RCC DAM
2320-CV-PL-0001-01
1 : 500

PRELIMINARY

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2320-CV-PL-0001-01	RCC AND TRANSION DAMS NORTH RCC DAM- PLAN & ELEVATION

No.	DATE	REVISION	MOD.	VER.	APP.

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NE-LCP MANAGEMENT: Date (dd-mmm-yyyy):
AREA MANAGER: Date (dd-mmm-yyyy):

PROFESSIONAL STAMP

SNC·LAVALIN

DESIGNED BY G. CASAGRAN — APPROVED Discipline Lead Engineer
DRAWN BY C. McCARTHY
VERIFIED BY T. SMITH — APPROVED Engineering Manager
DATE 15-NOV-2011 — SCALE 1:500

CLIENT nalcor energy LOWER CHURCHILL PROJECT

PROJECT LOWER CHURCHILL PROJECT

TITLE MUSKRAT FALLS
RCC DAMS AND TRANSITION
NORTH RCC DAM
SECTIONS

File No. 505573-323A-41DD-0003-PB
MFA-SN-CD-2320-CV-SE-0001-01 Rev. A1

FORMAT A0 (mm)
PLATE C3

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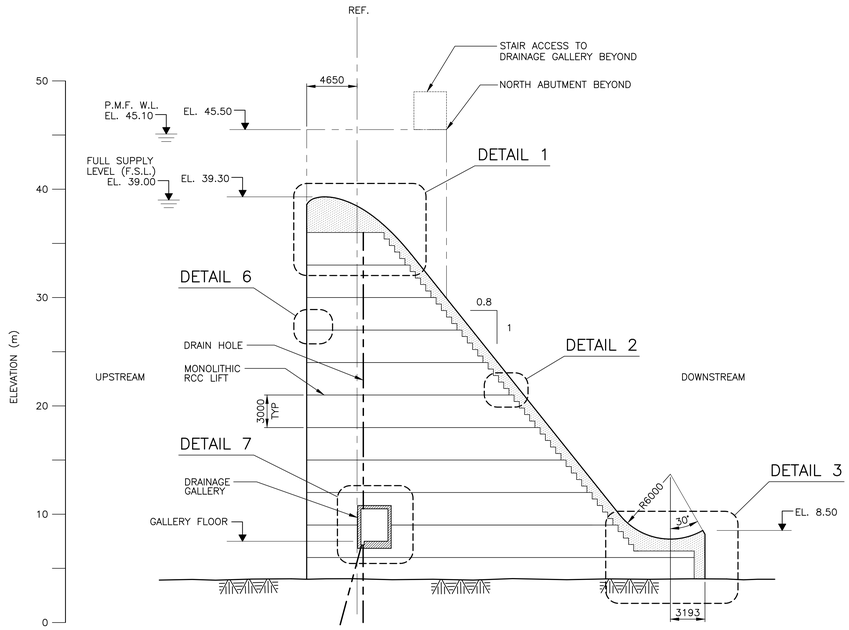
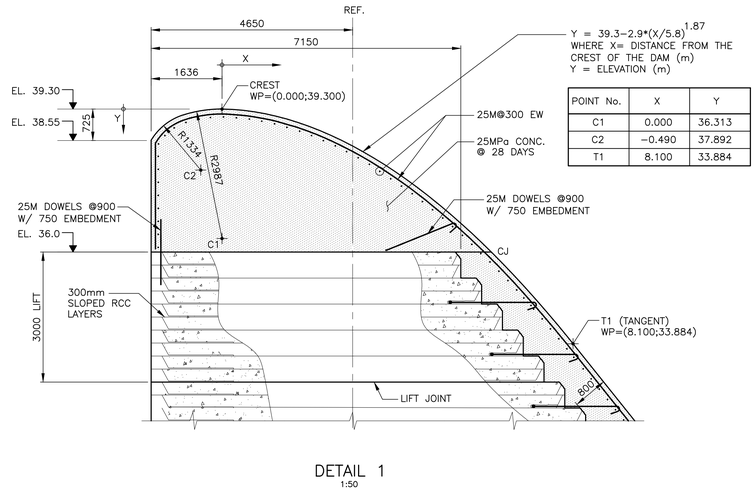


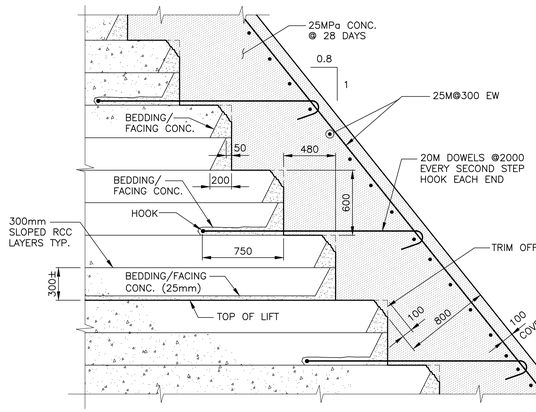
NORTH RCC DAM
SECTION A–A
2320–CV–PL–0001–01
2320–CV–SE–0001–01
1:200



$Y = 39.3 - 2.9*(X/5.8)^{1.87}$
WHERE X= DISTANCE FROM THE CREST OF THE DAM (m)
Y = ELEVATION (m)

POINT No.	X	Y
C1	0.000	36.313
C2	−0.490	37.892
T1	8.100	33.884

DETAIL 1
1:50



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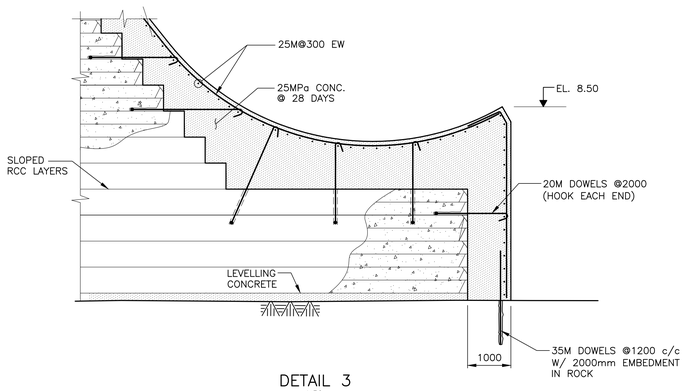

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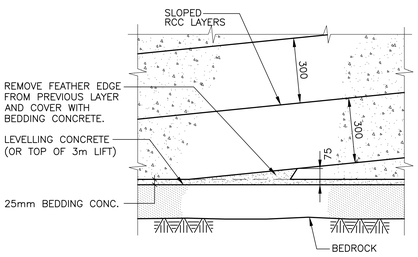

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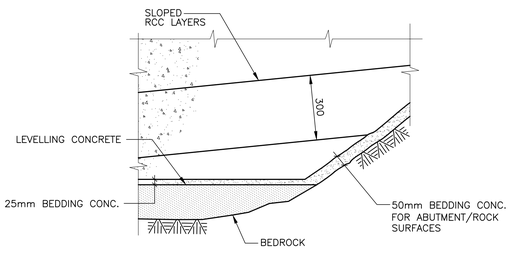

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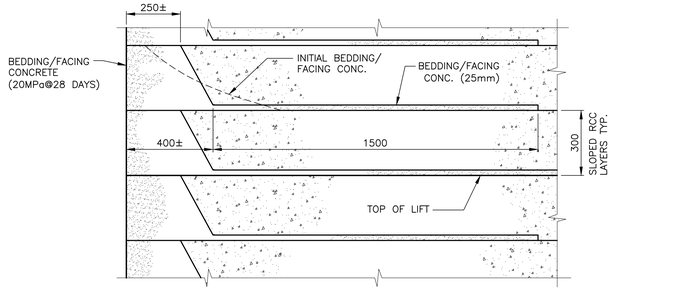

DETAIL 6
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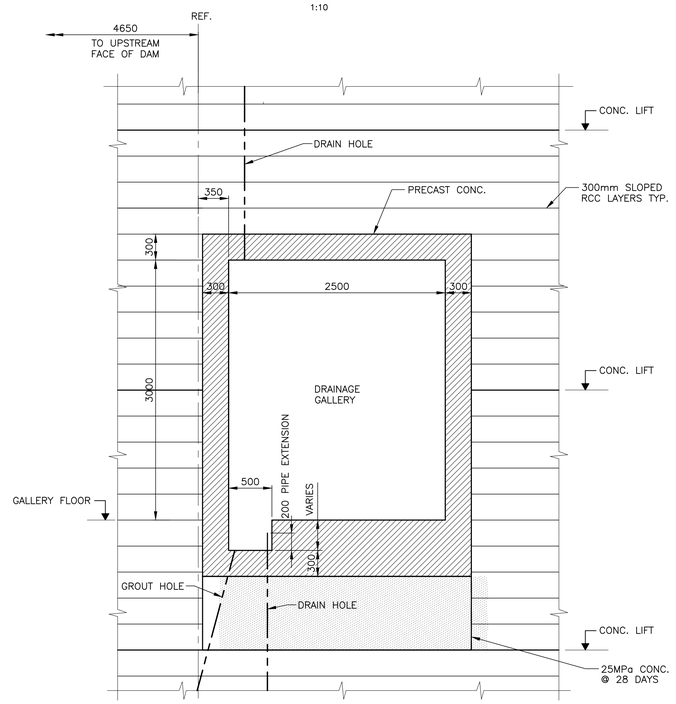

NORTH RCC DAM – DRAINAGE GALLERY
DETAIL 7
1:25

NOTES:

1. DIMENSIONS ARE IN MILLIMETERS AND ELEVATIONS IN METERS UNLESS NOTED OTHERWISE.

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1:10 100 300 500
1:20 200 400 600
1:25 250 750 1250
1:50 500 1500 2500
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2	A1	09–DEC–2011	ISSUED FOR REVIEW

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2320–CV–SE–0001–01	RCC AND TRANSITION DAMS NORTH RCC DAM – SECTIONS
2320–CV–PL–0001–01	RCC AND TRANSITION DAMS NORTH RCC DAM – PLAN & ELEVATION

ISSUE REGISTER

No.	DATE	REVISION	MOD.	VER.	APP.

REVIEW CLASS: EQUIPMENT TAG NUMBER:

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☐ 2.REVIEWED - INCORPORATE COMMENTS, REVISE & RESUBMIT
☐ 3.REVIEWED - NOT ACCEPTED
☐ 4.INFORMATION ONLY
☐ 5.NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy):
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy):
AREA MANAGER: Date (dd-mmm-yyyy):

PROFESSIONAL STAMP

SNC·LAVALIN

DESIGNED BY G. CASAGRAN
DRAWN BY C. McCARTHY
VERIFIED BY T. SMITH
DATE 15–OCT–2011
APPROVED Discipline Lead Engineer
APPROVED Engineering Manager
SCALE AS NOTED

CLIENT nalcor energy

PROJECT LOWER CHURCHILL PROJECT
TITLE MUSKRAT FALLS
RCC DAMS AND TRANSITION
NORTH RCC DAM
DETAILS

File No. 505573–323A–41DD–0004–PB
MFA–SN–CD–2320–CV–SE–0002–01 Rev. A1

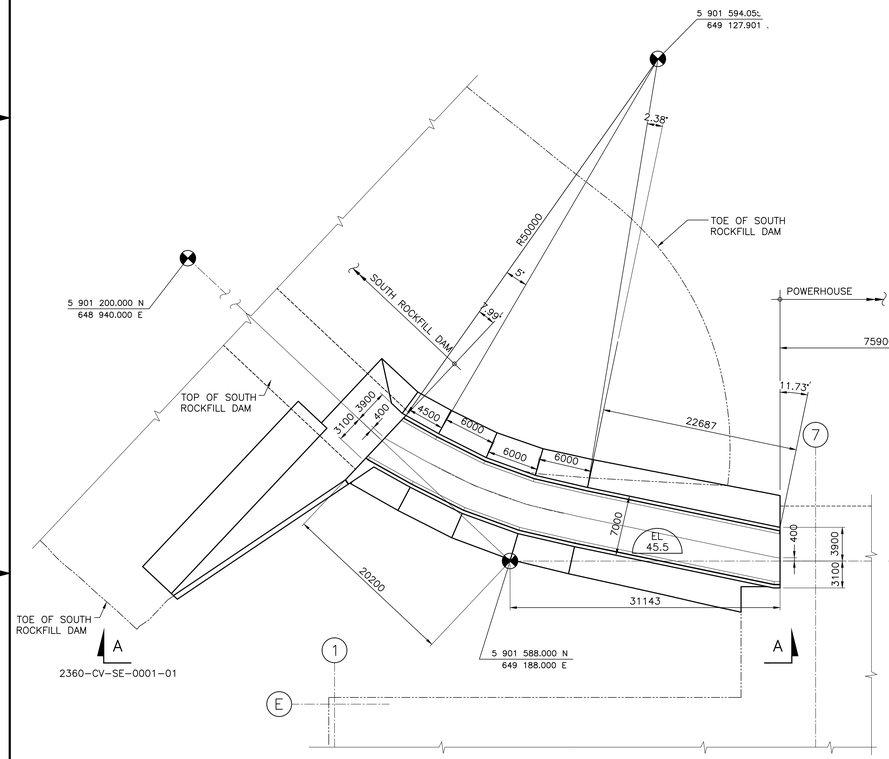
FORMAT A0 (mm)
PLATE C4

G:\505573\4L_Drafting\Drawings\Civil\Issued\323A\FR_40ft_9-DEC-2011\505573-323A-41DD-0004-PB.dwg
2011.12.09/2:40pm

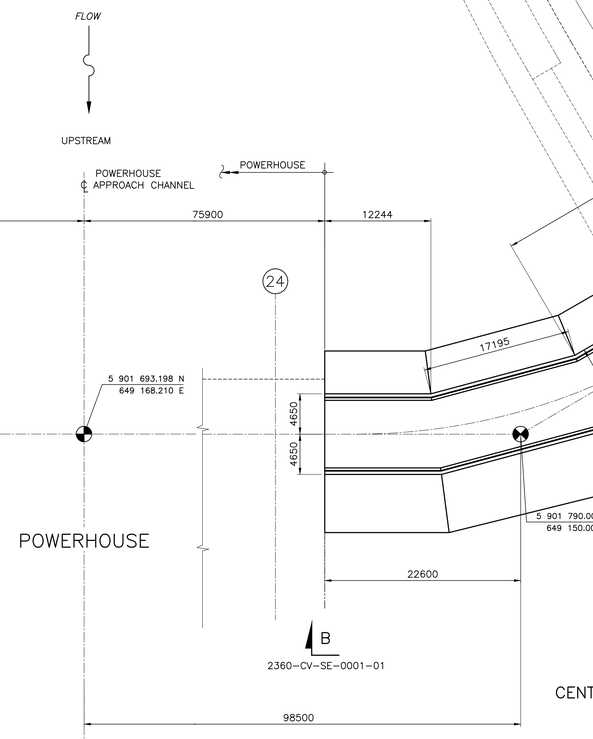
0 1 2 3 4 ℄ 6 7 8 9 10 CENTIMETRES

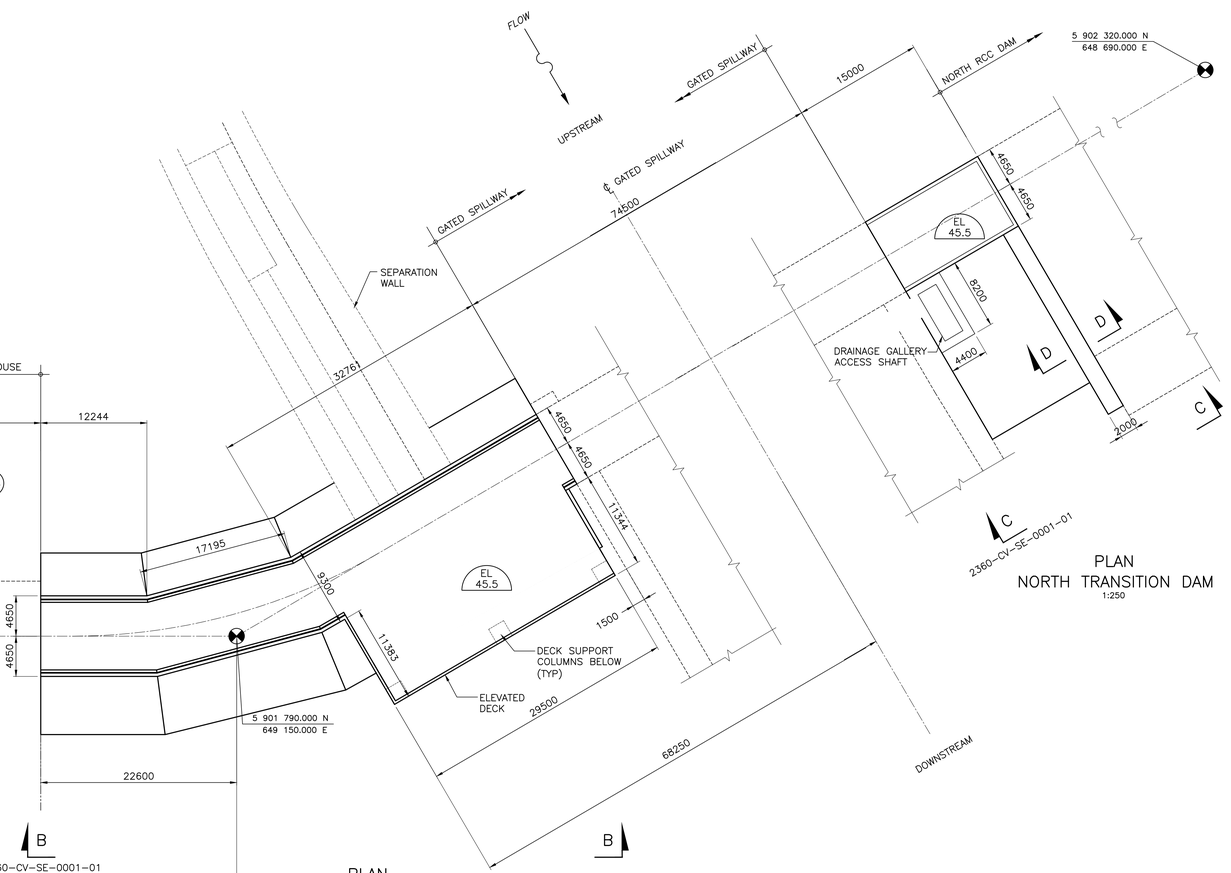
NOTES:

1. TOPOGRAPHIC GRID IS BASED ON UTM NAD 83, ZONE 20 SYSTEM.
2. DIMENSIONS ARE IN MILLIMETERS AND ELEVATIONS IN METERS UNLESS NOTED OTHERWISE.



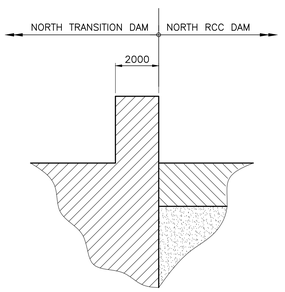
PLAN
SOUTH TRANSITION DAM
1:250





PLAN
CENTRE TRANSITION DAM
1:250

PLAN
NORTH TRANSITION DAM
1:250



SECTION D–D
1:100

PRELIMINARY

PROVINCE OF NEWFOUNDLAND
PERMIT HOLDER
CLASS "A"
This Permit Allows
SNC-LAVALIN Inc.
To practice Professional Engineering in Newfoundland and Labrador. Permit No. as issued by PEGNL ND458 which is valid for the year 2011.

1:100 0 1000 3000 5000 mm
1:250 0 2500 7500 12500 mm

ISSU.	REV.	DATE	DISTRIBUTION & STATUS
2	A1	9-DEC-2011	ISSUED FOR REVIEW

ISSUE REGISTER

No.	REFERENCE DRAWING
2360-CV-SE-0001-01	RCC AND TRANSITION DAMS SOUTH, CENTRE AND NORTH TRANSITION DAMS – SECTIONS AND ELEVATIONS
2300-CV-PL-0003-01	RCC AND TRANSITION DAMS GENERAL ARRANGEMENTS OF WORKS PLAN.

No.	DATE	REVISION	MOD.	VER.	APP.

REVIEW CLASS: | EQUIPMENT TAG NUMBER:

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- ☐ 4.INFORMATION ONLY
- ☐ 5.NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy):
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy):
AREA MANAGER: Date (dd-mmm-yyyy):

PROFESSIONAL STAMP

SNC·LAVALIN

CLIENT: nalcor energy

DESIGNED BY	APPROVED Discipline Lead Engineer
DRAWN BY C. McCARTHY	
VERIFIED BY	APPROVED Engineering Manager
DATE 22-AUG-2011	SCALE AS NOTED

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
RCC AND TRANSITION DAMS
SOUTH, CENTRE AND NORTH TRANSITION DAMS
PLANS

File No. 505573-323A-41DD-0005-PB | MFA-SN-CD-2360-CV-PL-0001-01 | Rev. A1

FORMAT A0 (mm)

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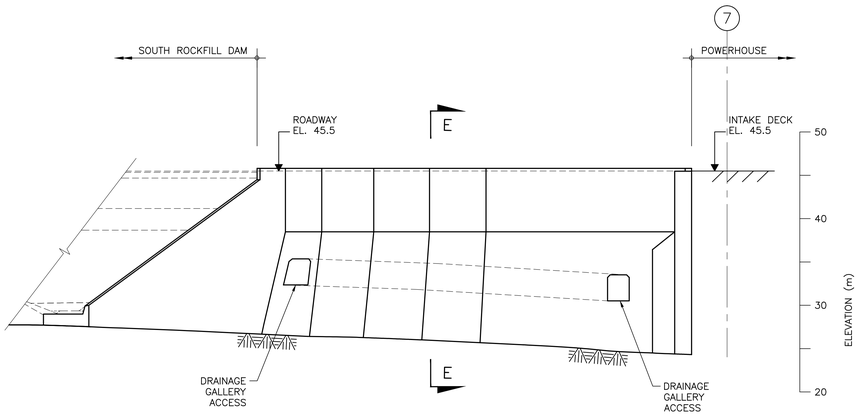
2011.12.09/2:40pm

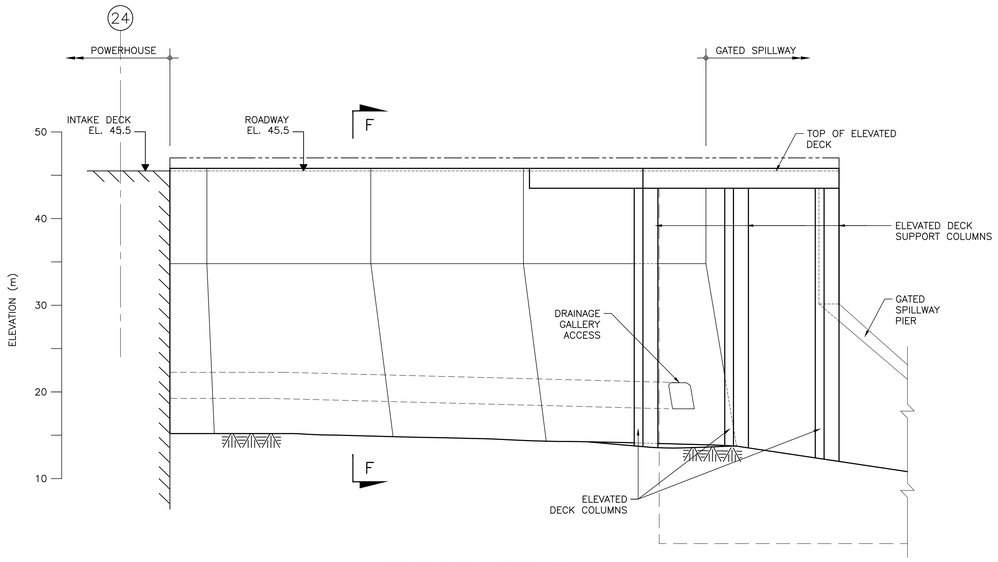
0 1 2 3 4 5 6 7 8 9 10 CENTIMETRES

NOTES:

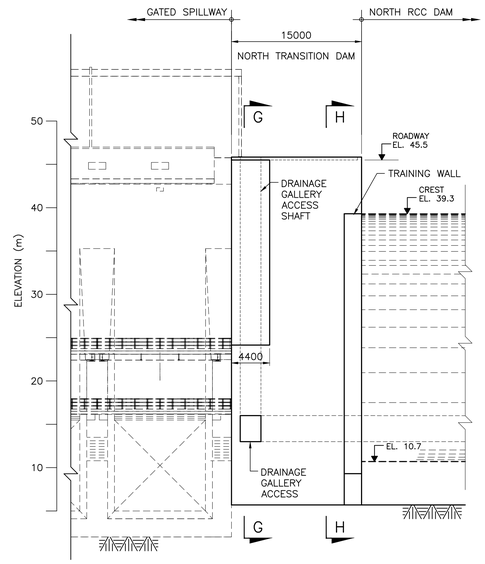
1. DIMENSIONS ARE IN MILLIMETERS AND ELEVATIONS IN METERS UNLESS NOTED OTHERWISE.



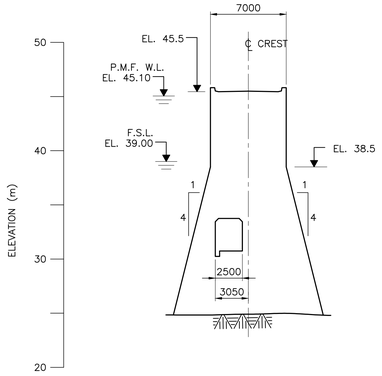
SOUTH TRANSITION DAM
(LOOKING UPSTREAM)
ELEVATION A–A
2360–CV–PL–0001–01
1:250



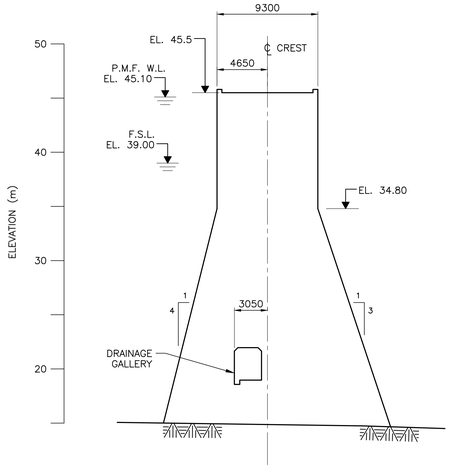
CENTRE TRANSITION DAM
(LOOKING UPSTREAM)
ELEVATION B–B
2360–CV–PL–0001–01
1:250



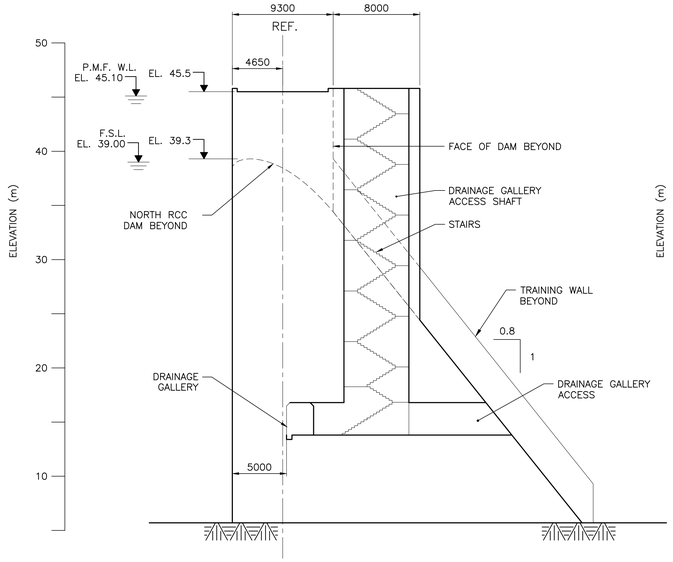
NORTH TRANSITION DAM
(LOOKING UPSTREAM)
ELEVATION C–C
2360–CV–PL–0001–01
1:250



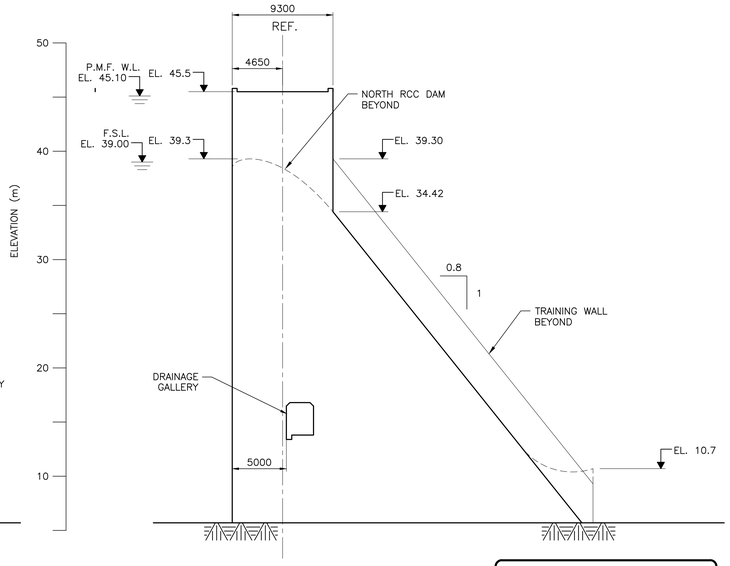
SOUTH TRANSITION DAM
SECTION E–E
1:200



CENTRE TRANSITION DAM
SECTION F–F
1:200



NORTH TRANSITION DAM
SECTION G–G
1:200



NORTH TRANSITION DAM
SECTION H–H
1:200

PRELIMINARY

PROVINCE OF NEWFOUNDLAND
PERMIT HOLDER
CLASS "A"
This Permit Allows

SNC–LAVALIN Inc.

To practice Professional Engineering in Newfoundland and Labrador
Permit No. as issued by PEGNL 10458
which is valid for the year 2011.

1:250 0 2500 7500 12500 mm
1:200 0 2000 6000 10000 mm

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2	A1	09–DEC–2011	ISSUED FOR REVIEW

ISSUE REGISTER

No.	REFERENCE DRAWING
2360–CV–PL–0001–01	RCC AND TRANSMITION DAMS SOUTH, CENTRE AND NORTH TRANSITION DAMS PLANS.

No.	DATE	REVISION	MOD.	VER.	APP.

PROFESSIONAL STAMP

SNC·LAVALIN

CLIENT: nalcor energy

DESIGNED BY: F. GUIBANE	APPROVED: Discipline Lead Engineer
DRAWN BY: C. McCARTHY	APPROVED: Engineering Manager
VERIFIED BY: T. SMITH	
DATE: 22–AUG–2011	SCALE: AS NOTED

PROJECT: LOWER CHURCHILL PROJECT

TITLE: MUSKRAT FALLS
RCC AND TRANSITION DAMS
SOUTH, CENTRE AND NORTH TRANSITION DAMS
SECTIONS AND ELEVATIONS

File No. 505573–323A–41DD–0006–PB

MFA–SN–CD–2360–CV–SE–0001–01 Rev. A1

FORMAT A0 (mm)

PLATE C6

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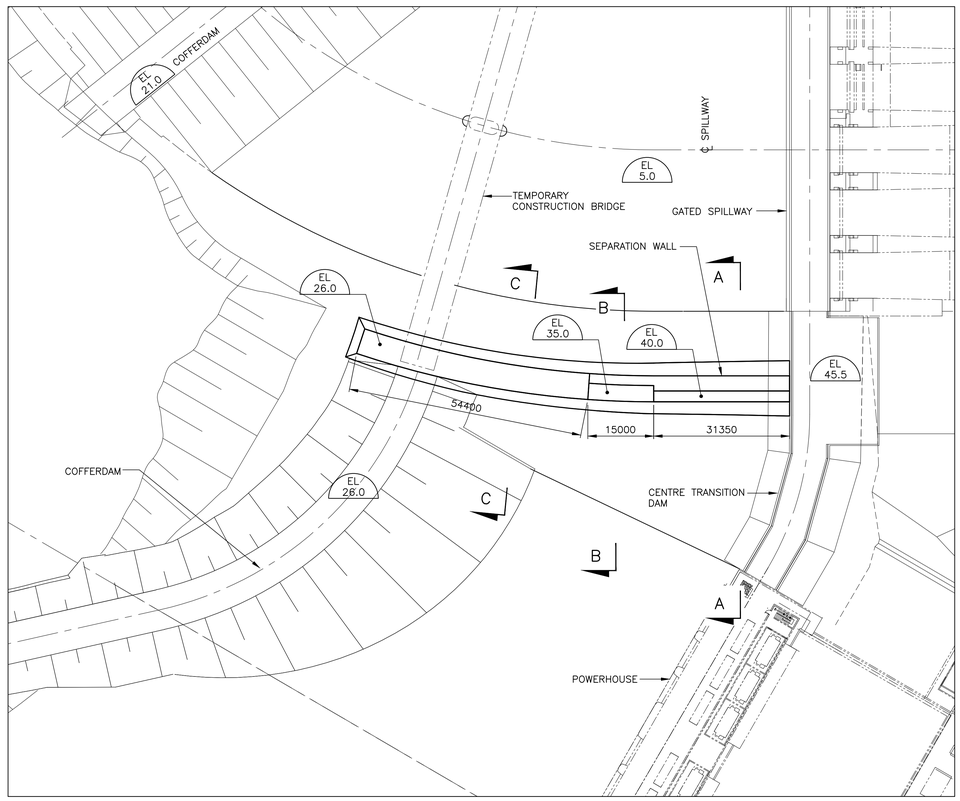
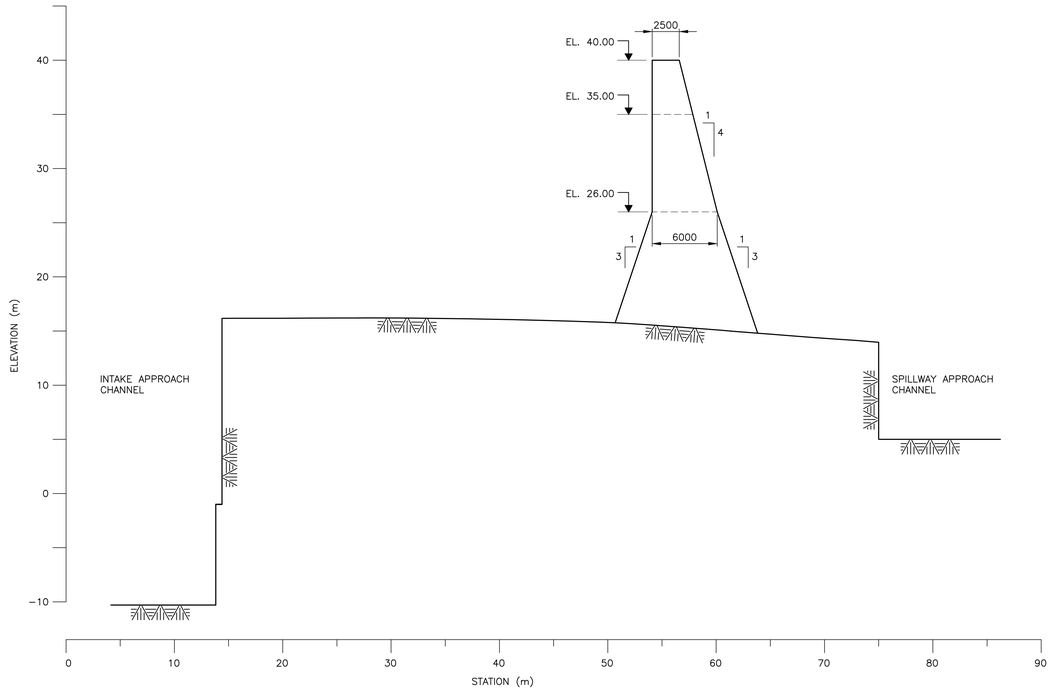


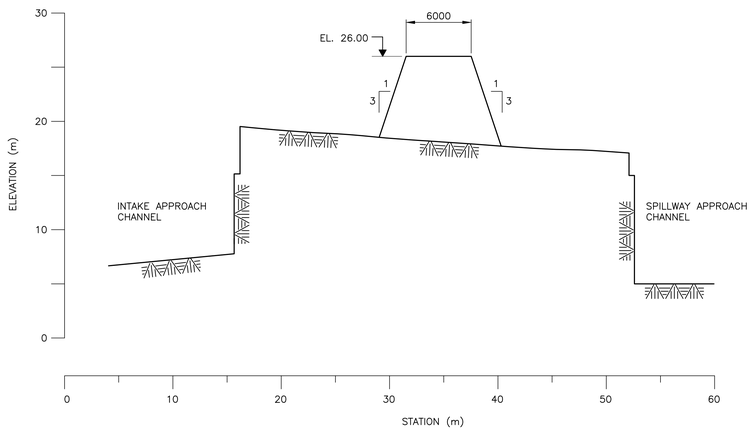
PLAN
SEPARATION WALL
1:500



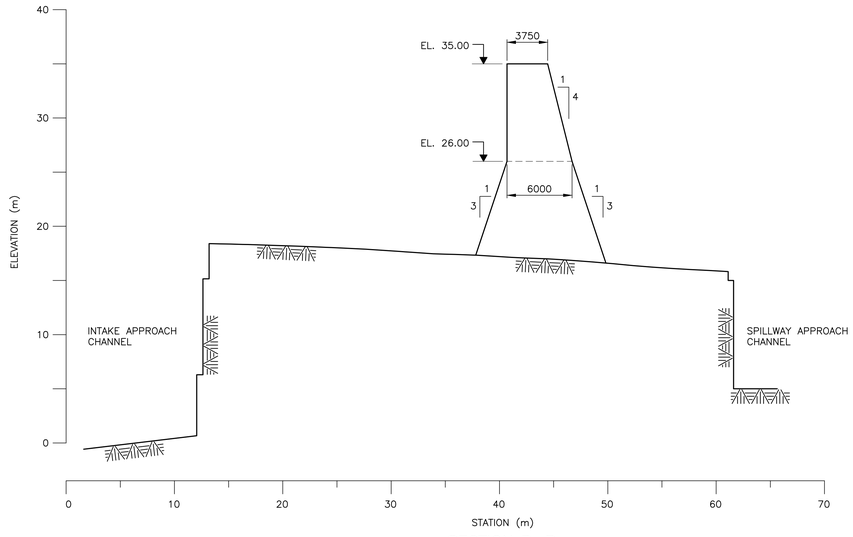
SECTION A–A
1:200

NOTES:

1. DIMENSIONS ARE IN MILLIMETERS AND ELEVATIONS IN METERS UNLESS NOTED OTHERWISE.



SECTION C–C
1:200



SECTION B–B
1:200

PRELIMINARY

1:200 0 2000 6000 10000
1:500 0 5000 15000 25000 mm

PROVINCE OF NEWFOUNDLAND
PERMIT HOLDER
CLASS "A"
This Permit Allows
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To practice Professional Engineering in Newfoundland and Labrador. Permit No. as issued by PEGNL N0458 which is valid for the year 2011.

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2	A1	9-DEC-2011	ISSUED FOR REVIEW

ISSUE REGISTER

No.	REFERENCE DRAWING
2300-CV-PL-0003-01	RCC AND TRANSITION DAMS GENERAL ARRANGEMENT OF WORKS – PLAN

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.

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NE-LCP MANAGEMENT: Date (dd-mmm-yyyy):
AREA MANAGER: Date (dd-mmm-yyyy):

PROFESSIONAL STAMP

SNC·LAVALIN

DESIGNED BY T. SMITH | APPROVED Discipline Lead Engineer
DRAWN BY C. McCARTHY | APPROVED Engineering Manager
VERIFIED BY H. BOUZAIENE
DATE 15-NOV-2011 | SCALE AS NOTED

CLIENT: nalcor energy
PROJECT: LOWER CHURCHILL PROJECT
TITLE: MUSKRAT FALLS
RCC AND TRASITION DAMS
SEPARATION WALL
PLAN & SECTIONS

File No. 505573-323A-41DD-0007-PB
MFA-SN-CD-2330-CV-SE-0001-01 Rev. A1

FORMAT A0 (mm)
PLATE C7

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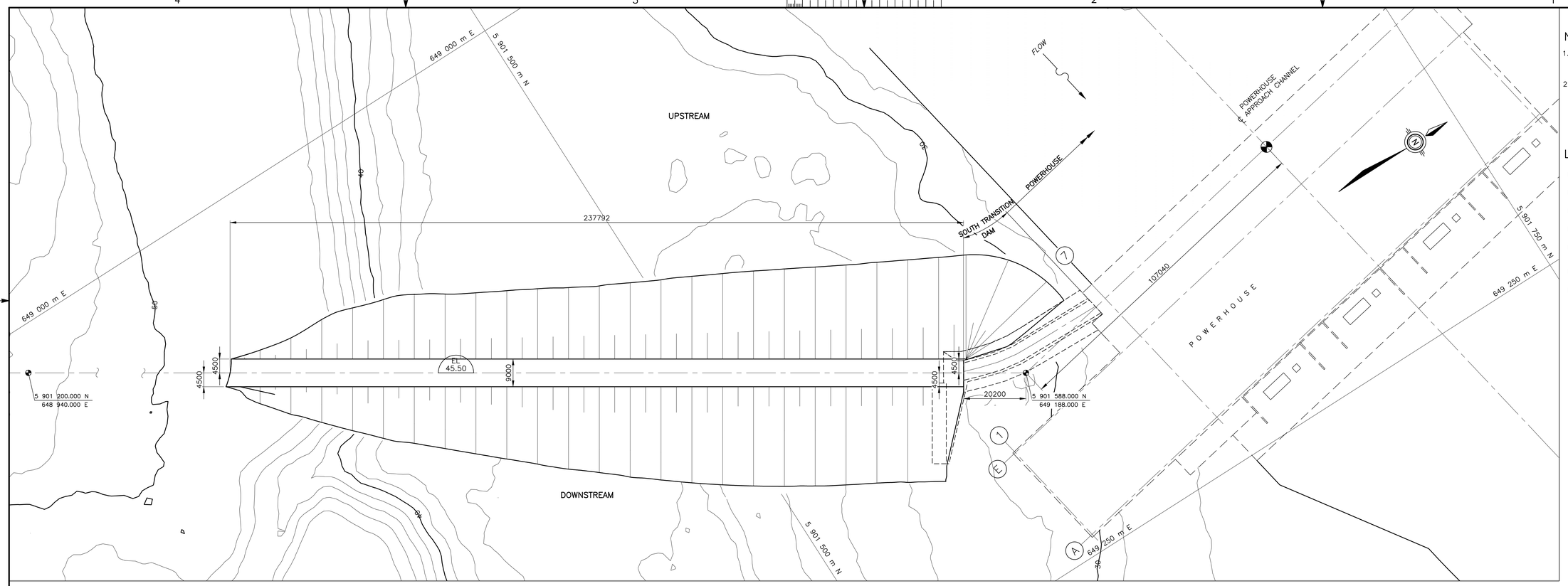


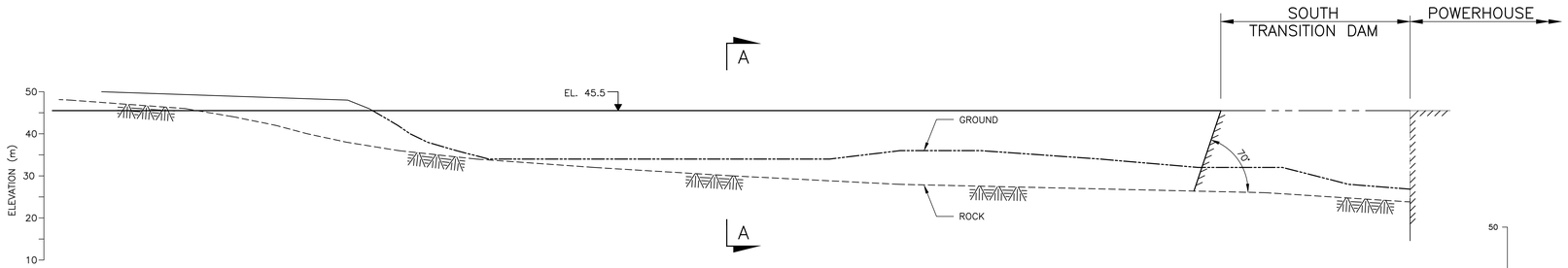
NOTES:

1. ALL DIMENSIONS IN MILLIMETERS AND ELEVATIONS IN METERS UNLESS NOTED OTHERWISE.
2. TOPOGRAPHIC GRID IS BASED ON UTM NAD 83, ZONE 20 SYSTEM

LEGEND:

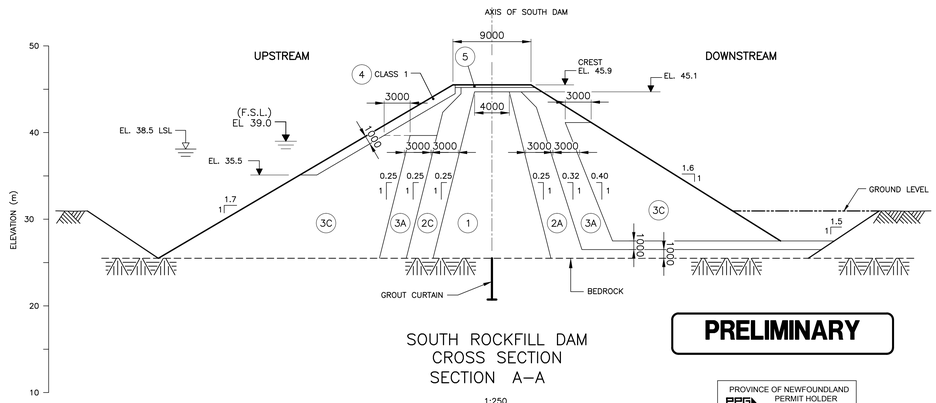
- (1) COMPACTED TILL (MAX. 300mm)
- (2A) COMPACTED GRANULAR (MAX. 80mm)
- (2C) COMPACTED GRANULAR (MAX. 300mm)
- (3A) CRUSHED STONE (MAX. 50 mm)
- (3C) SELECTED OR PROCESSED ROCKFILL (MAX. 450mm)
- (4) CLASS 1 – RIPRAP (400–600mm)
- (5) CRUSHED STONE (MAX. 21.5 mm)

- NATURAL GROUND SURFACE
- OUTLINE ORIGINAL GROUND
- ASSUMED BEDROCK
- LIMIT OF EXCAVATION
- FINISHED GRADE
- SELECTED MATERIALS
- F.S.L. FULL SUPPLY LEVEL
- NATURAL GROUND
- WATER LEVEL



ELEVATION
SOUTH ROCKFILL DAM
(LOOKING UPSTREAM)

1:500



SOUTH ROCKFILL DAM
CROSS SECTION
SECTION A–A

1:250

1:500 0 5 15 25 m
1:250 0 2.5 7.5 12.5 m

PRELIMINARY

PROVINCE OF NEWFOUNDLAND
PERMIT HOLDER
CLASS "A"
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2	A1	09-DEC-2011	ISSUED FOR REVIEW				

ISSUE REGISTER

No.	REFERENCE DRAWING
2300-CV-PL-0003-01	RCC AND TRANSITION DAMS GENERAL ARRANGEMENT OF WORKS PLAN

No.	REFERENCE DRAWING

No.	DATE	REVISION	MOD.	VER.	APP.

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- ☐ 5.NOT REVIEWED

LEAD REVIEWER: Date (dd-mmm-yyyy):
NE-LCP MANAGEMENT: Date (dd-mmm-yyyy):
AREA MANAGER: Date (dd-mmm-yyyy):

PROFESSIONAL STAMP

SNC·LAVALIN

DESIGNED BY A. CEBALLOS
DRAWN BY G. DECARIE
VERIFIED BY R. LEMIEUX
DATE 22-AUG-2011
APPROVED Discipline Lead Engineer
APPROVED Engineering Manager
SCALE AS NOTED

CLIENT: nalcor energy
PROJECT: LOWER CHURCHILL PROJECT
TITLE: MUSKRAT FALLS
RCC AND TRANSITION DAMS
SOUTH ROCKFILL DAM
PLAN, ELEVATION AND SECTION

File No. 505573-323A-4GDD-0001-PB
MFA-SN-CD-2330-CV-PL-0002-01 Rev. A1

FORMAT A0 (mm)
PLATE G1

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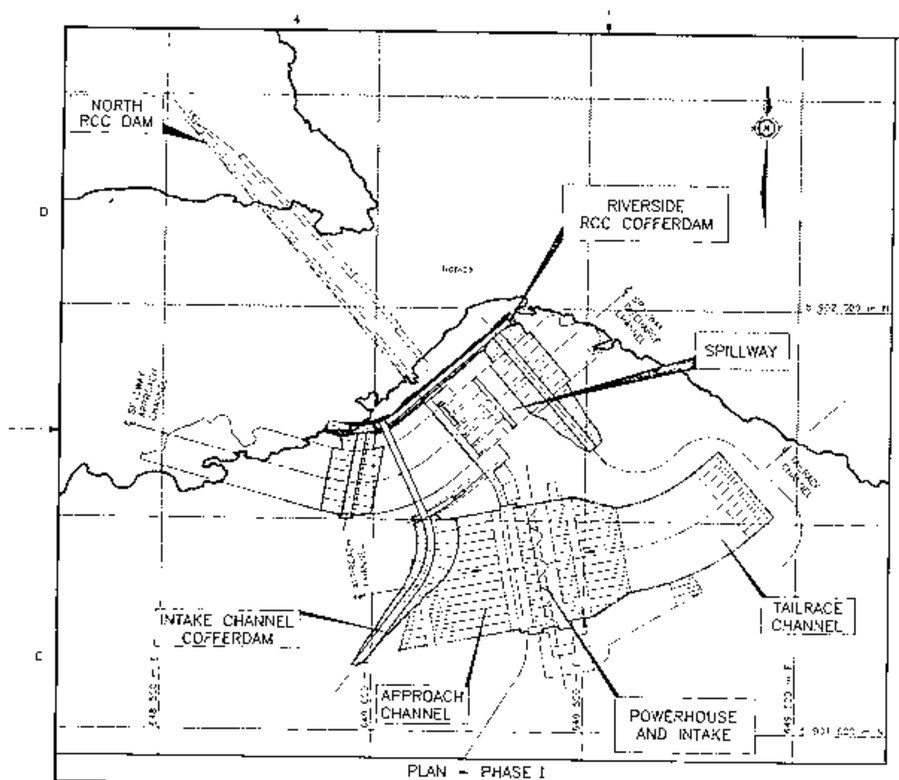
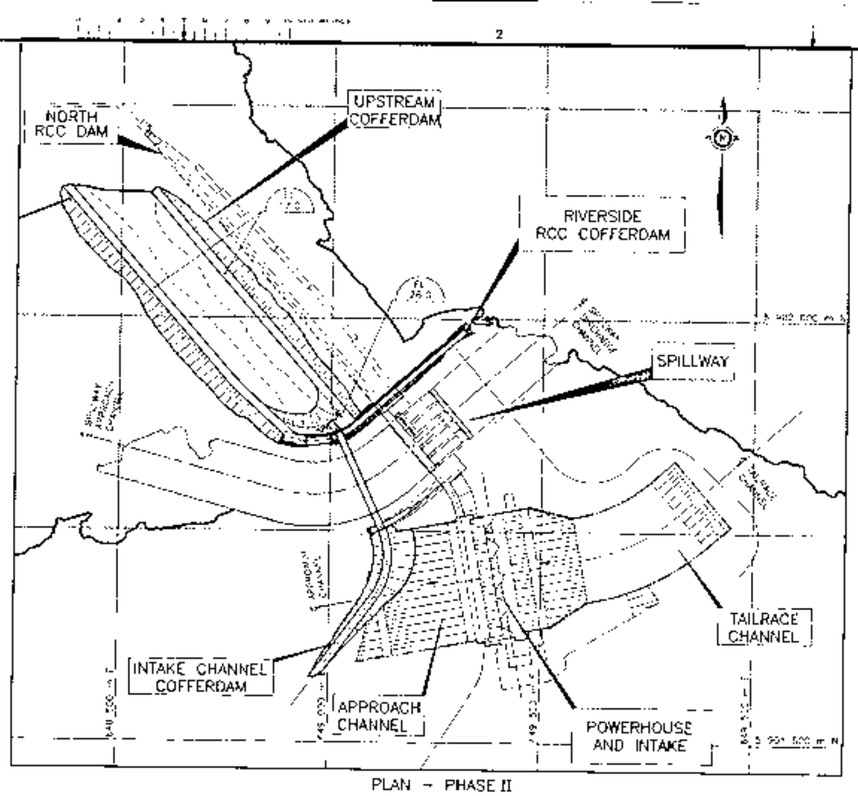
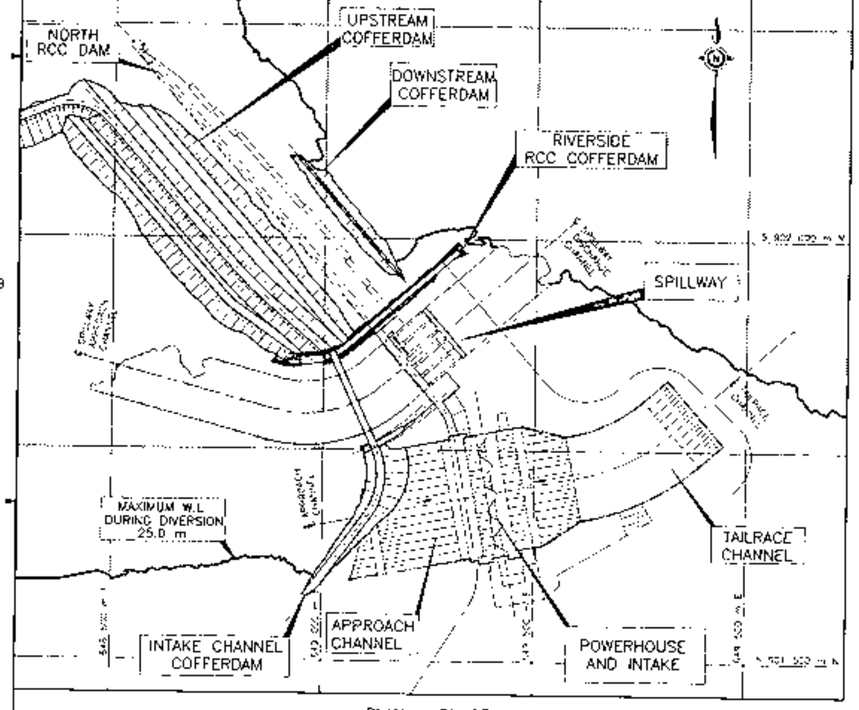
2011.12.09/2:37pm



PLAN – PHASE I



PLAN – PHASE II



PLAN – PHASE III

NOTE :

1. TOPOGRAPHIC GRID IS BASED ON NAD 83, ZONE 20 SYSTEM

PRELIMINARY

SNC-LAVALIN

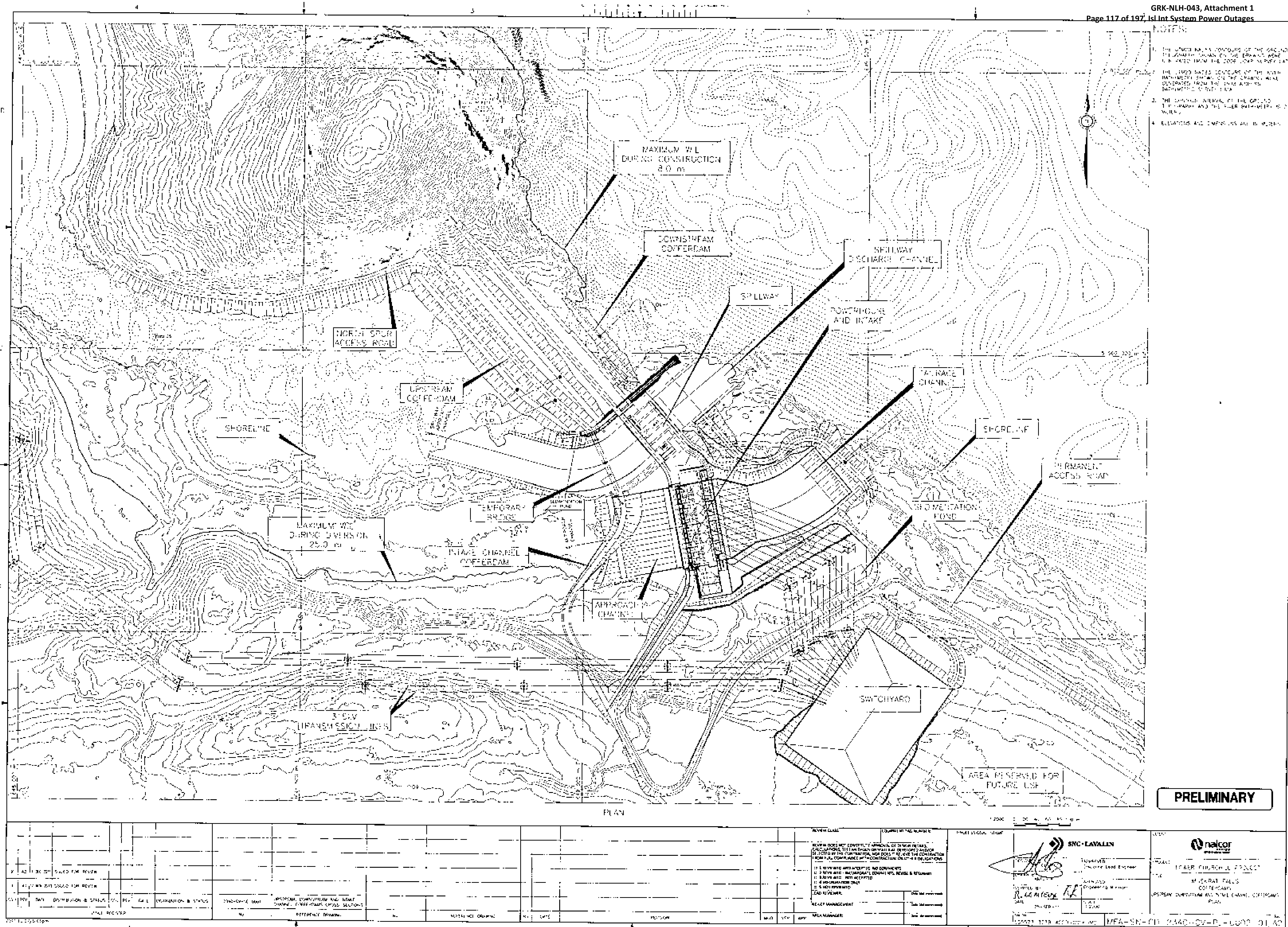
nalcor energy

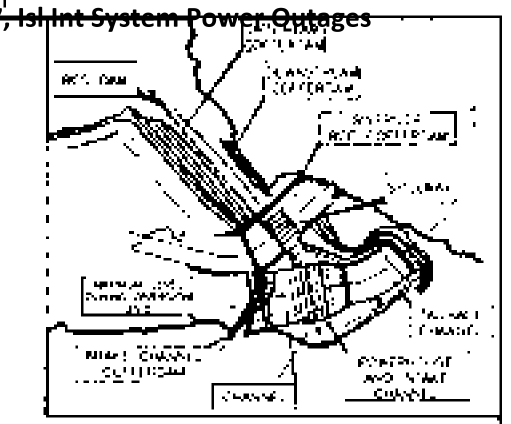
LOWER CHURCHILL PROJECT

MUSKRAT FALLS

DIVERSION STRUCTURE PLAN

MFA-SN-CD-2340-CV-PL-0001-01 A2


NOTES:
4. ELEVATIONS AND DIMENSIONS ARE IN METERS.
MAXIMUM W.L.
DURING CONSTRUCTION
60.0 m
DOWNSTREAM COFFERDAM
SPILLWAY DISCHARGE CHANNEL
SPILLWAY
POWERHOUSE AND INTAKE
NORTH SPUR ACCESS ROAD
UPSTREAM COFFERDAM
TAILRACE CHANNEL
SHORELINE
SHORELINE
PERMANENT ACCESS ROAD
TEMPORARY BRIDGE
SEDIMENTATION POND
MAXIMUM W.L.
DURING DIVERSION
25.0 m
INTAKE CHANNEL COFFERDAM
APPROACH CHANNEL
SWITCHYARD
315kV TRANSMISSION LINES
AREA RESERVED FOR FUTURE USE
PRELIMINARY
PLAN
SNC-LAVALIN
nalcor
LOWER CHURCHILL PROJECT
MUSKRAT FALLS
COFFERDAMS
UPSTREAM, DOWNSTREAM AND INTAKE CHANNEL COFFERDAMS
PLAN
MFA-SN-CD-2440-CV-PL-0002-01



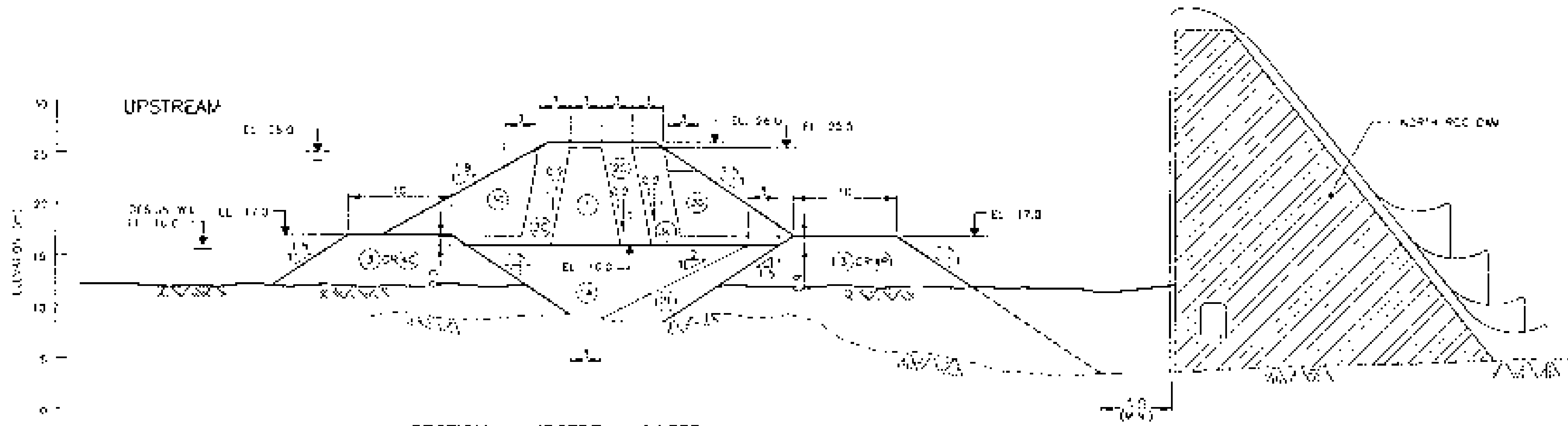
KEY PLAN

NOTE:

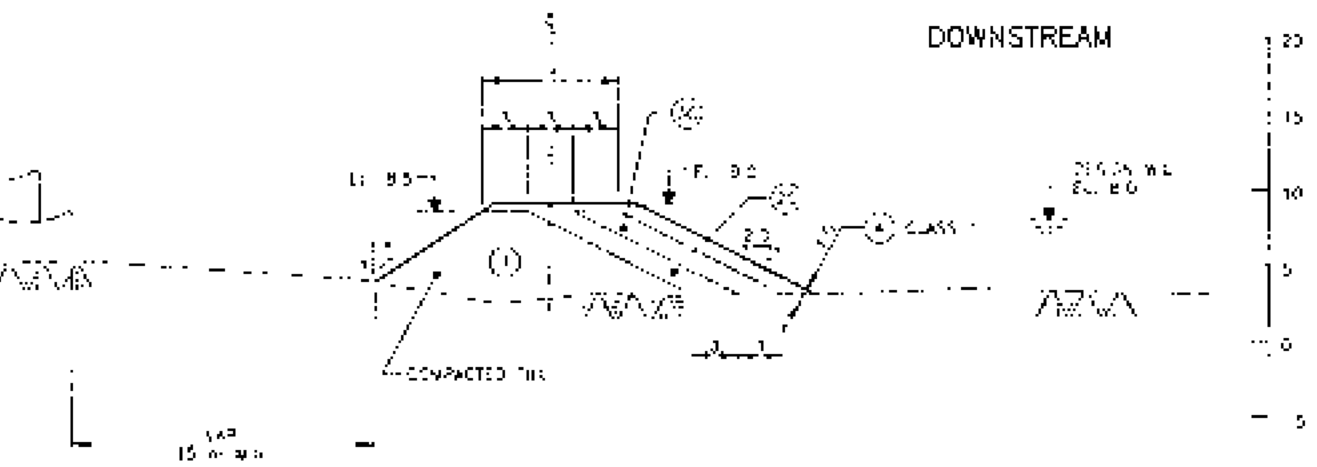
1. ELEVATIONS AND DIMENSIONS ARE IN METRES.

LEGEND:

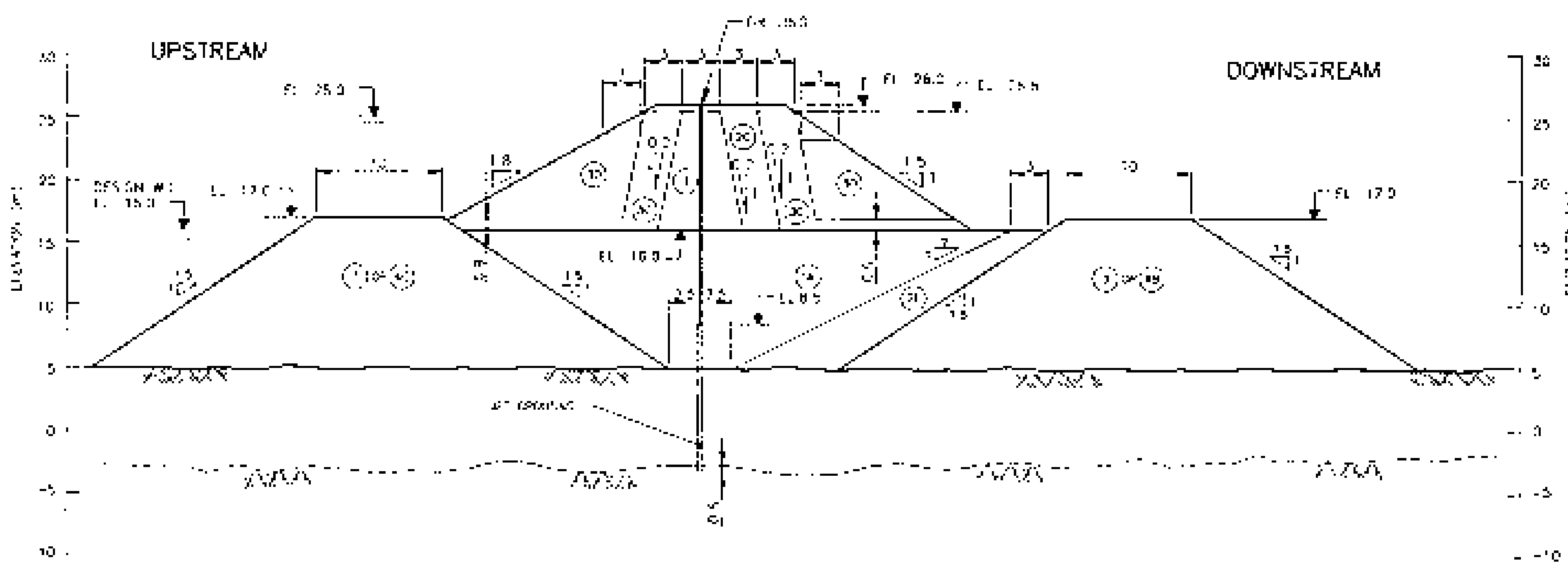
- (1) COMPACTED FILL
- (1A) DUMPED FILL
- (2C) COMPACTED GRANULAR
- (2D) DUMPED GRANULAR
- (3) DUMPED ROCKFILL
- (3C) SELECTED OR PROCESSED COMPACTED ROCKFILL
- (3D) SELECTED OR PROCESSED COMPACTED ROCKFILL
- (4) CLASS 1 RIPRAP
- (4B) DUMPED BOULDERS
- (4C) DUMPED BOULDERS
- ASSUMED BEDROCK
- NATURAL GROUND
- WATER LEVEL
- RCC
- CONVENTIONAL CONCRETE



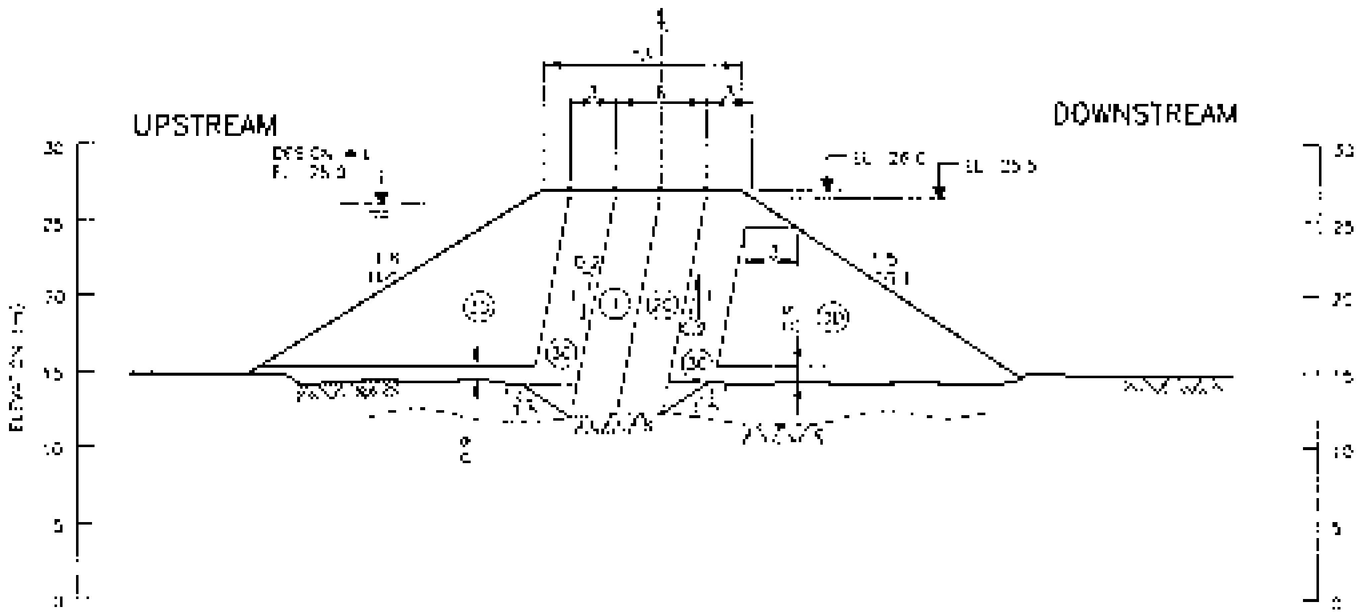
SECTION – UPSTREAM COFFERDAM
BEDROCK AT ELEVATION ≥ 8m



SECTION – DOWNSTREAM COFFERDAM



SECTION –UPSTREAM COFFERDAM
BEDROCK AT ELEVATION < 8m



SECTION – INTAKE CHANNEL COFFERDAM

PRELIMINARY

SNC-LAVALIN

nalcor

LOWER CHURCHILL PROJECT

MUSKRAT FALLS

COFFERDAMS

SCALE 1:250

MFA-SN-CD-2340-CV-SE-0001-01 A2

Package	Activity	Date
CH0009	On-Site Start Date- Required Construction Start	May-15
CH0009	South Rockfill Dam construction start	May-15
CH0009	Dismantlement of Cofferdams 1 and 2 in the spillway channels	Aug-15
CH0009	Upstream cofferdam construction start	Aug-15
CH0009	Upstream cofferdam construction completed	Oct-15
CH0009	Downstream cofferdam construction start	Oct-15
CH0009	Downstream cofferdam construction completed	Nov-15
CH0009	Construction of the North RCC Dam start	Oct-15
CH0009	Construction of the North RCC Dam completed	Nov-16
CH0009	Dismantlement of Cofferdam 3 in the tailrace channel	Nov-16
CH0009	Excavation of rock plug in the tailrace channel	Nov-16

Hydrology Information, Water Sampling Program & General Environmental Requirements

Schedule H - Other works within 15 metres of a body of water

Project Description

Location

Site Name/No: Lower Churchill Project, Muskrat Falls Site

Please mark location on a copy of a topographic map (preferably at 1:50,000 scale) and include with the application:

1:50,000 Topographic Map No: 13C14

or provide UTM Coordinates: See Attached Table

N 5901799 E 648976 NAD 83 ZONE 20

Land Ownership

Do you own the land on which the works are to be located? Yes No X
(If yes, please provide proof of ownership)

If not, who owns the land? Private Ownership Crown Ownership X

If this project is taking place on crown land, please give lease, licence or permit number Reference No: Will provide when available **(Please attach tenure document)**

or contact the Regional Crown Lands Office of the Department of Government Services at 729-0193 (Eastern), 256-1400 (Central), 637-2384 (Western) or 896-2489 (Labrador).

Landowner's Approval (If different from applicant):

Landowner's Name: _____

Address: _____

Postal Code: _____

Telephone: _____

Landowner's Signature: _____

Design

Briefly list the major construction materials to be used:
See attached Scope of Works/Package Dictionary

Design (Cont'd)

Detailed Dimensioned Drawing: Please show overall measurements of works to be constructed in or near any body of water. Include relevant features such as buildings, roads, crossings, shorelines, etc and show grid north.

See attached drawings

Construction

Equipment to be used**:** Construction Equipment (backhoes, bulldozers, etc.)

Proposed dewatering method: See attached scope of work

Briefly describe how erosion control and stabilization will be carried out:

General construction guidelines and environmental guidelines will be followed. See attached General Environmental Requirements

Briefly describe how site restoration will be carried out:

All necessary procedures will be followed to minimize or eliminate environmental impacts. Whenever possible, areas will be restored and/or revegetated. General construction and environmental guidelines will be followed. See attached General Environmental Requirements.

Please note that guidelines, departmental policies and application forms are available at: www.gov.nl.ca/env/water

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Lower Churchill Project

SURFACE WATER HYDROLOGY BULK EXCAVATION WORKS

SLI Document No. 505573-3001-4HER-0010-00

Nalcor Reference No. MFA-SN-CD-2000-CV-RP-0008-01 Rev. B1

Date: 15-Aug-2012

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REVISION LIST

Revision						Remarks
N°	By	Chec	Appr.	Appr.	Date	
00	JP/SW	MT	GS	AH	15-Aug-2012	Issued for final client acceptance.
PB	SW	DD	GS	AH	05-Jul-2012	Issued for client review and comments.
PA	SW	DD	GS	AH	22-Jun-2012	Issued for internal review and comments.

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References

No.	Description
(1)	Chow, Ven te, "Applied Hydrology", McGraw Hill, Inc. 1988
(2)	Kirpich, P.A. "Time of concentration of Small Agricultural Watersheds." Civil Engineering, 10, no. 6 (June 1940)
(3)	Roberson, A. "Hydraulic Engineering." John Wiley & Sons, Inc. Second Edition ,1998
(4)	Fisheries and Oceans, Land Development Guidelines for the Protection of Aquatic Habitat, 1993

1 INTRODUCTION

SNC-Lavalin Inc. has signed an agreement with Nalcor Energy (the Client) to deliver engineering, procurement and construction management services for the Lower Churchill Project (LCP) in Newfoundland and Labrador, Canada.

As part of the LCP, the Muskrat Falls Hydroelectric Development is located on the Churchill River, about 291 km downstream of the Churchill Falls Hydroelectric Development which was developed in the early 1970's. The installed capacity of the project will be 824 MW (4 units of 206 MW each).

This report highlights the computation of design discharge for watersheds within the area of bulk excavation to aid in the design of sedimentation ponds, drainage ditches and diversion channels and ditches. This information will also be used to aid in the permitting process.

2 OBJECTIVE

The objective of this report is to present the methodology used and the results of the hydrology for the area affected by Bulk Excavation Works for the Muskrat Falls Hydroelectric Development.

The information contained in this report is to be used by civil designers to design water control structures such as culverts, drainage ditches, diversion channels and sedimentation ponds.

3 DESIGN PHILOSOPHY

In order to compute the peak discharge for the drainage areas crossing the area for bulk excavation, the rational method was used. The idea behind the rational method is that if a rainfall of intensity (i) begins instantaneously and continues indefinitely, the rate of runoff will increase until the time of concentration, T_c, when all of the watershed is contributing to the flow at the outlet. The product of the rainfall intensity (i) and the watershed area (A) is the inflow rate for the system (iA). The ratio of this rate to the rate of peak discharge (Q, which occurs at time T_c) is named the runoff coefficient C ($0 < C < 1$). This is expressed in the rational formula:

$$Q = 0.28CiA$$

Where: Q Peak Discharge (m^3/s)

i Rainfall Intensity (mm/hr)

A Watershed Area (km^2)

C Runoff coefficient

The duration used for the determination of the design precipitation intensity, i, is the time of concentration of the watershed.

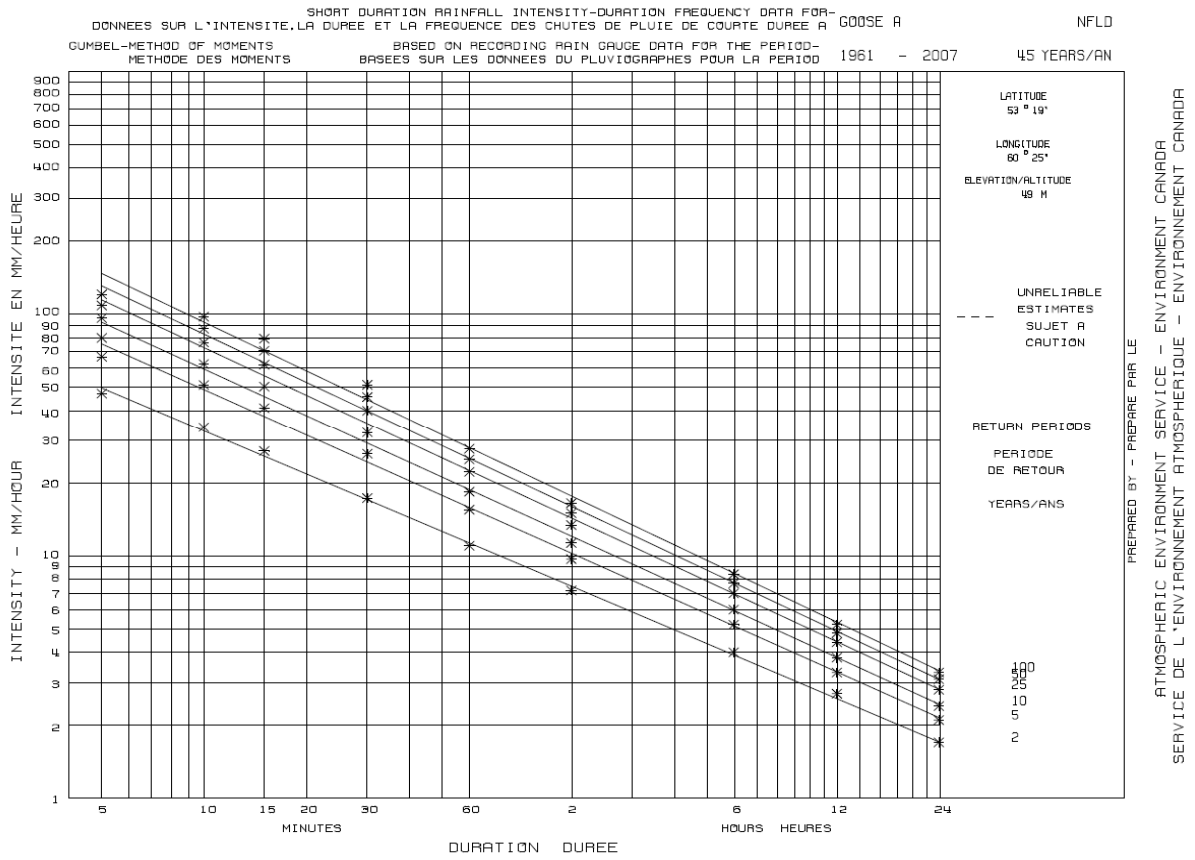
The assumptions associated with the rational method are:

1. The computed peak rate of runoff at the outlet point is a function of the average rainfall rate during the time of concentration, that is, the peak discharge does not result from a more intense storm of shorter duration, during which only a portion of the watershed is contributing to runoff at the outlet.
2. The time of concentration employed is the time for the runoff to become established and flow from the most remote part of the drainage area to the outflow of the watershed.
3. Rainfall intensity is constant throughout the storm duration.

3.1 IDF CURVE

Figure 3-1 presents the IDF curves at Goose Bay obtained from Environment Canada. Design discharges are presented for return periods from 2 to 100 years.

Figure 3-1: Goose Bay A – Station 8501900 - Return Period Rainfall Rates (mm/h) From Environment Canada (Based on Data from 1961 to 2007)



Duration	2 yr (mm/h)	5 yr (mm/h)	10 yr (mm/h)	25 yr (mm/h)	50 yr (mm/h)	100 y (mm/h)r
5 min	47.1 ± 6.0	66.8 ± 10.1	79.9 ± 13.6	96.4 ± 18.3	108.6 ± 21.9	120.7 ± 25.6
10 min	34.1 ± 5.2	51.1 ± 8.7	62.4 ± 11.8	76.6 ± 15.9	87.2 ± 19.0	97.7 ± 22.1
15 min	27.1 ± 4.2	41.0 ± 7.1	50.3 ± 9.7	62.0 ± 13.0	70.7 ± 15.6	79.3 ± 18.2
30 min	17.3 ± 2.8	26.4 ± 4.6	32.4 ± 6.3	40.0 ± 8.4	45.6 ± 10.1	51.2 ± 11.8
1 h	11.0 ± 1.4	15.5 ± 2.3	18.4 ± 3.1	22.2 ± 4.2	25.0 ± 5.0	27.7 ± 5.8
2 h	7.2 ± 0.8	9.7 ± 1.3	11.3 ± 1.7	13.4 ± 2.3	15.0 ± 2.8	16.5 ± 3.2
6 h	4.0 ± 0.4	5.2 ± 0.6	6.0 ± 0.8	7.0 ± 1.1	7.7 ± 1.3	8.4 ± 1.5
12 h	2.70 ± 0.2	3.3 ± 0.4	3.8 ± 0.5	4.4 ± 0.6	4.8 ± 0.8	5.2 ± 0.9
24 h	1.7 ± 0.1	2.1 ± 0.2	2.4 ± 0.3	2.8 ± 0.4	3.1 ± 0.5	3.3 ± 0.6

3.2 TIME OF CONCENTRATION

The time of concentration for a drainage basin is made up of the longest combination of overland flow time plus the accumulated flow time in the stream channels to the outlet of the basin. To estimate the time of concentration for every drainage area, Kirpich's equation was used:

$$T_c = c \times 0.0192 \times L^{0.77} \times I^{-0.385}$$

Where: Tc time of concentration (min)

L length of channel from head water to outlet (m)

I average watershed slope (m/m)

c coefficient

The Kirpich equation is most applicable for natural basins with well-defined channels, bare-earth overland flow, or flow in mowed channels. Rossmiller (1980) gives adjustment factors for other conditions based on literature values. In this case *c* is 2 in order to account for general overland flow.

3.3 RUNOFF COEFFICIENT

The runoff coefficient depends on the percent of imperviousness, slope and ponding potential of the surface. It is also dependent on the type and conditions of the soil. The infiltration rate decreases as rainfall continues, and so it is also influenced by the antecedent moisture conditions of the soil. Other factors influencing the runoff coefficient are rainfall intensity, proximity of the water table, degree of soil compaction, porosity of the subsoil, vegetation, ground slope and depression storage. Table 3-1 presents the runoff coefficient for forest and woodland areas.

Table 3-1: Runoff Coefficients to Use in the Rational Method

		Return Period (years)						
Character of surface		2	5	10	25	50	100	500
Developed								
Poor Conditions (grass cover less than 50 % of the area)								
Flat	0-2%	0.32	0.34	0.37	0.40	0.44	0.47	0.58
Average	2-7%	0.37	0.40	0.43	0.46	0.49	0.53	0.61
Steep, over	7%	0.40	0.43	0.45	0.49	0.52	0.55	0.62
Undeveloped								
Forest/Woodlands								
Flat	0-2%	0.22	0.25	0.28	0.31	0.35	0.39	0.48
Average	2-7%	0.31	0.34	0.36	0.4	0.43	0.47	0.56
Steep, over	7%	0.35	0.39	0.41	0.45	0.48	0.52	0.58

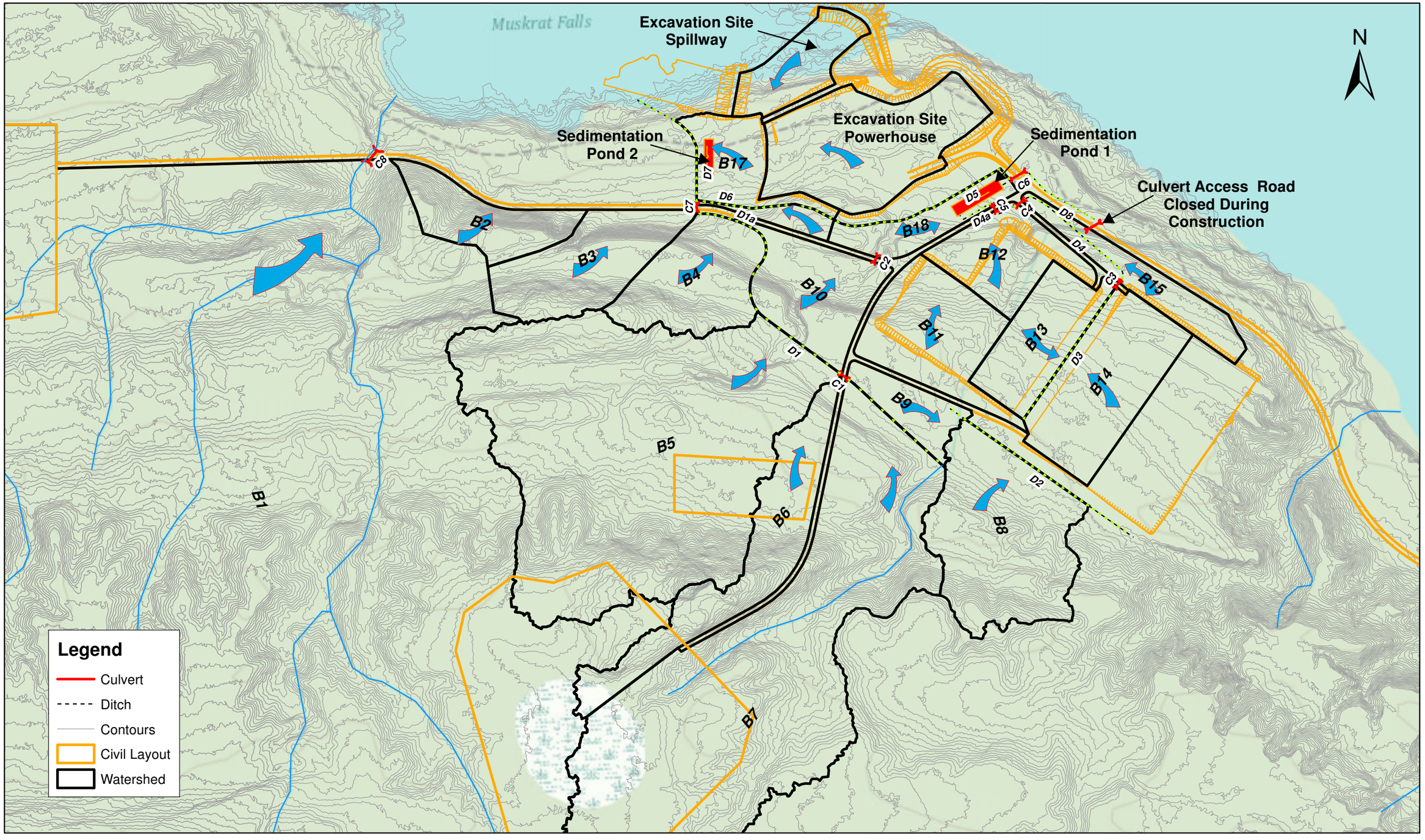
4 RESULTS

Figure A-1 and Figure A-2 in appendix A show the location of the studied watersheds along with the civil structures layout during construction and after construction, respectively. The time of concentration was computed taking into account the slopes shown in Table 4-1. Z_{max} represents the elevation of the upper limit of the basin and Z_{min} represents the elevation of the lower limit of the basin (outlet of the stream). For a given return period the peak discharge of a watershed is generated when the time of concentration coincides with the duration and therefore with the corresponding intensity of the rainfall from the IDF curves. The peak discharges computed for each watershed and hydraulic structure are presented in Appendix B.

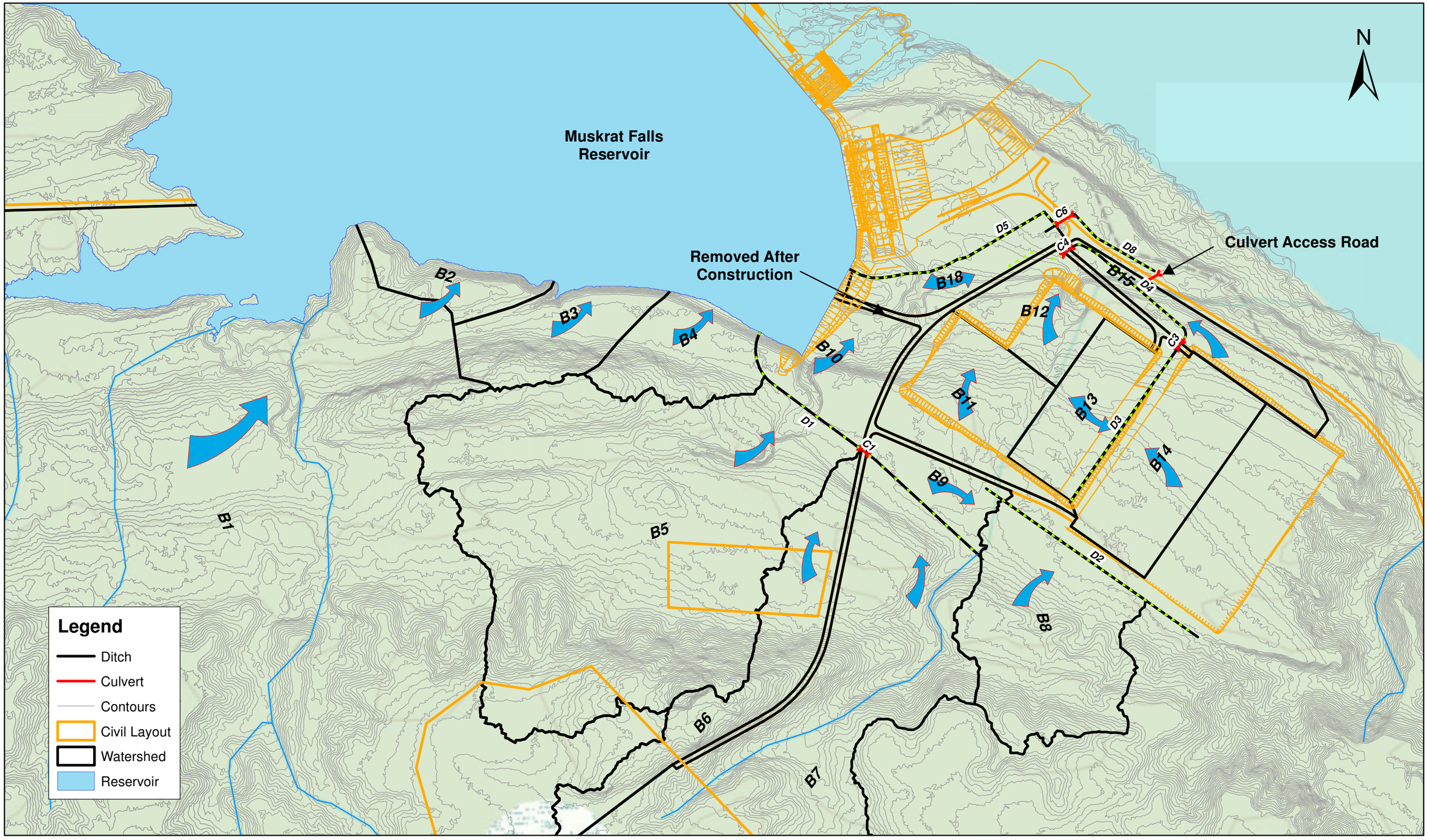
Table 4-1: Drainage Area, Length of Longest Stream and Average Slope

Watershed	Area (km²)	Length of Longest Stream (m)	Z_{max} (m)	Z_{min} (m)	Slope (m/m)
B1	4.281	4452	309	22	0.064
B2	0.036	122	52	28	0.196
B3	0.050	253	70	28	0.166
B4	0.049	298	69	28	0.137
B5	0.302	1162	108	47	0.052
B6	0.065	894	93	50	0.048
B7	0.301	1661	93	50	0.026
B8	0.088	463	78	47	0.067
B9	0.019	243	50	47	0.012
B10	0.045	360	49	31	0.050
B11	0.053	244	-	-	0.015
B12	0.036	185	-	-	0.015
B13	0.038	131	-	-	0.015
B14	0.063	177	-	-	0.015
B15	0.033	551	-	-	0.015
B16	0.008	195	36	27	0.046
B17	0.027	215	28	22	0.028
B18	0.022	338	36	23	0.038

APPENDIX A
FIGURES



SNC·LAVALIN	**WATER MANAGEMENT LAYOUT, SEDIMENTATION PONDS, CULVERTS & DRAINAGE DITCHES - DURING CONSTRUCTION**	**FIGURE A-1**	0 75 150 300 450 m nalcor energy



SNC·LAVALIN	**WATER MANAGEMENT LAYOUT, CULVERTS & DRAINAGE DITCHES AFTER CONSTRUCTION**	**FIGURE A-2**	0 75 150 300 450 m nalcor energy

APPENDIX B
COMPUTED PEAK DISCHARGES FOR BULK EXCAVATION WORKS

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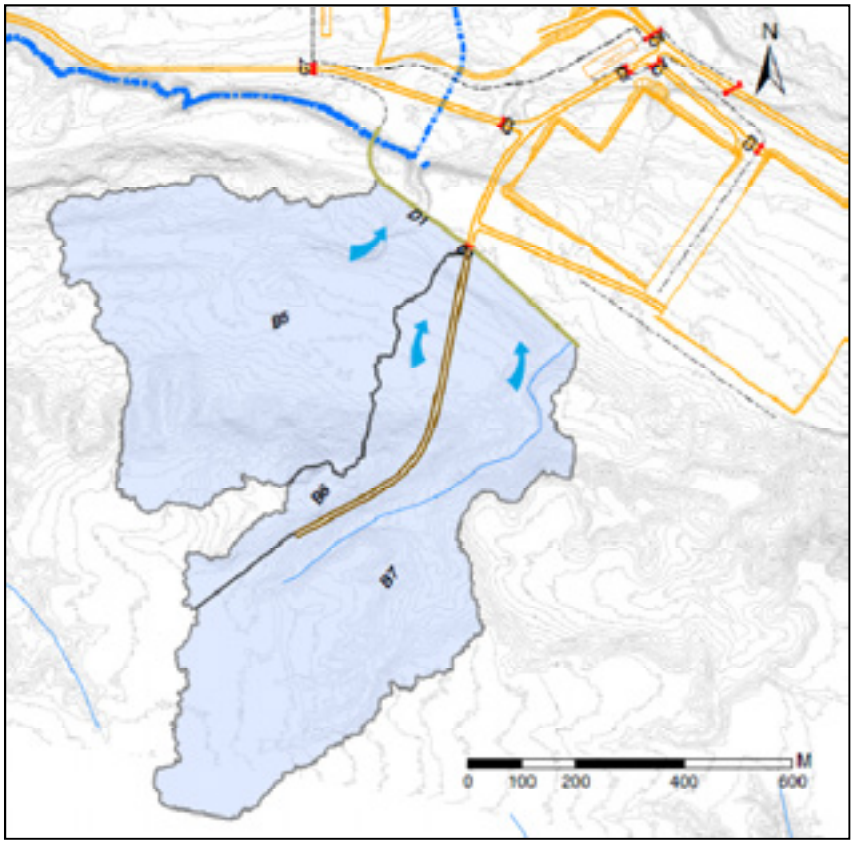
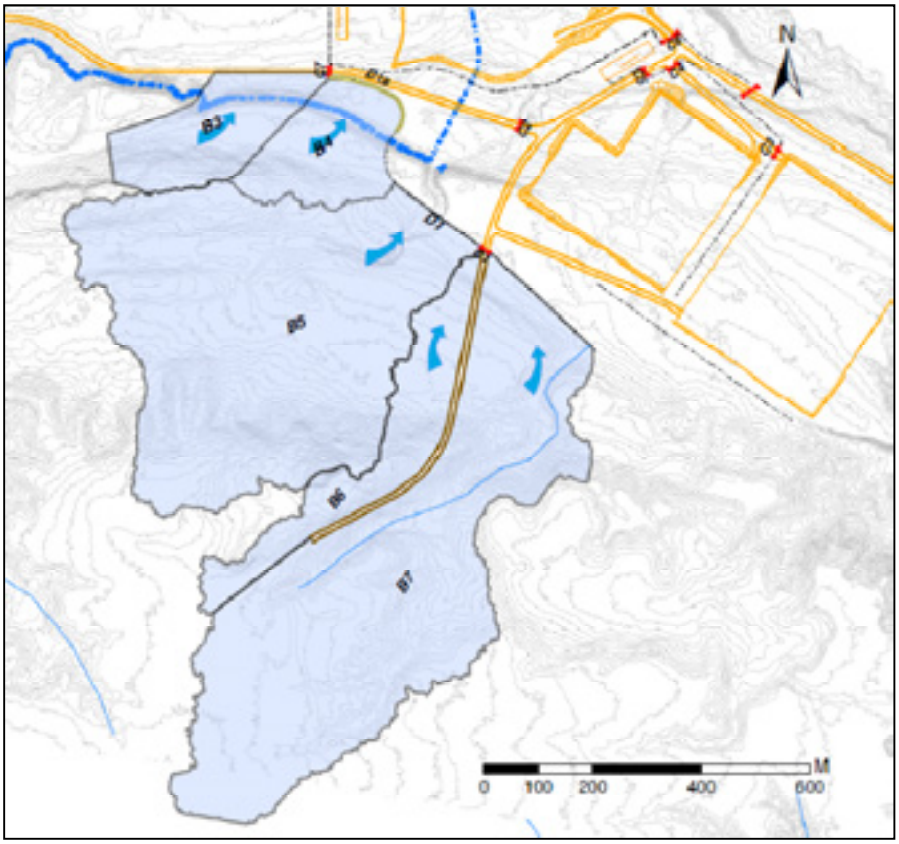
Structures: Ditch (D1) Culvert (C1)	Condition: Permanent
Character of Surface: Undeveloped (Forest/Woodland)	



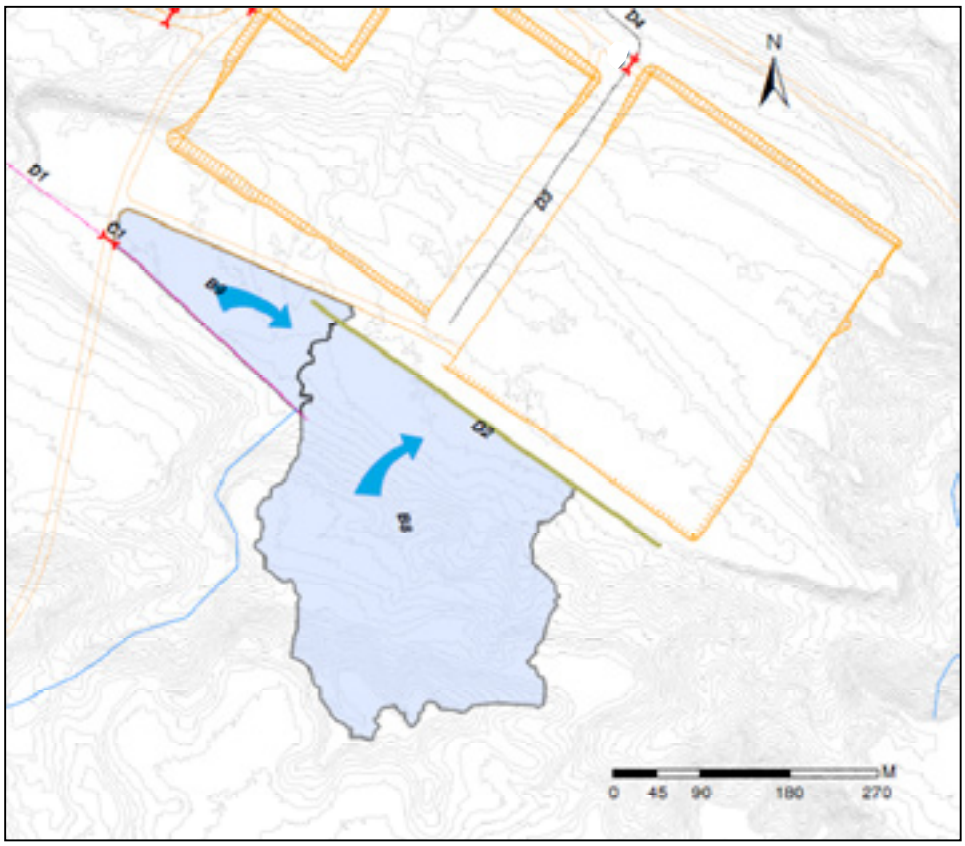
Sub-Basin	Area (km^2)	Avg. Slope (%)	Length (km)	T_c (hr)	Intensity (mm/hr)	Runoff Coeff.	Return Period (yr)	Q (m^3/s)
B5	0.302	5.25	1.16	0.46	56.1	0.47	100	**2.21**
B6	0.065	4.81	0.89	0.39	64.1	0.47	100	**0.54**
B7	0.301	2.59	1.66	0.79	37.6	0.47	100	**1.48**
							TOTAL DISCHARGE DIVERSION CHANNEL (D1)	**4.23**
							TOTAL DISCHARGE CULVERT (C1)	**1.48**
							Theoretical Diameter for C1 (Inlet Control- end projecting)	**1120 mm**

Structures: Ditch (D1a) Culvert (C7)	Condition: For Construction
Character of Surface: Undeveloped (Forest/Woodland)	



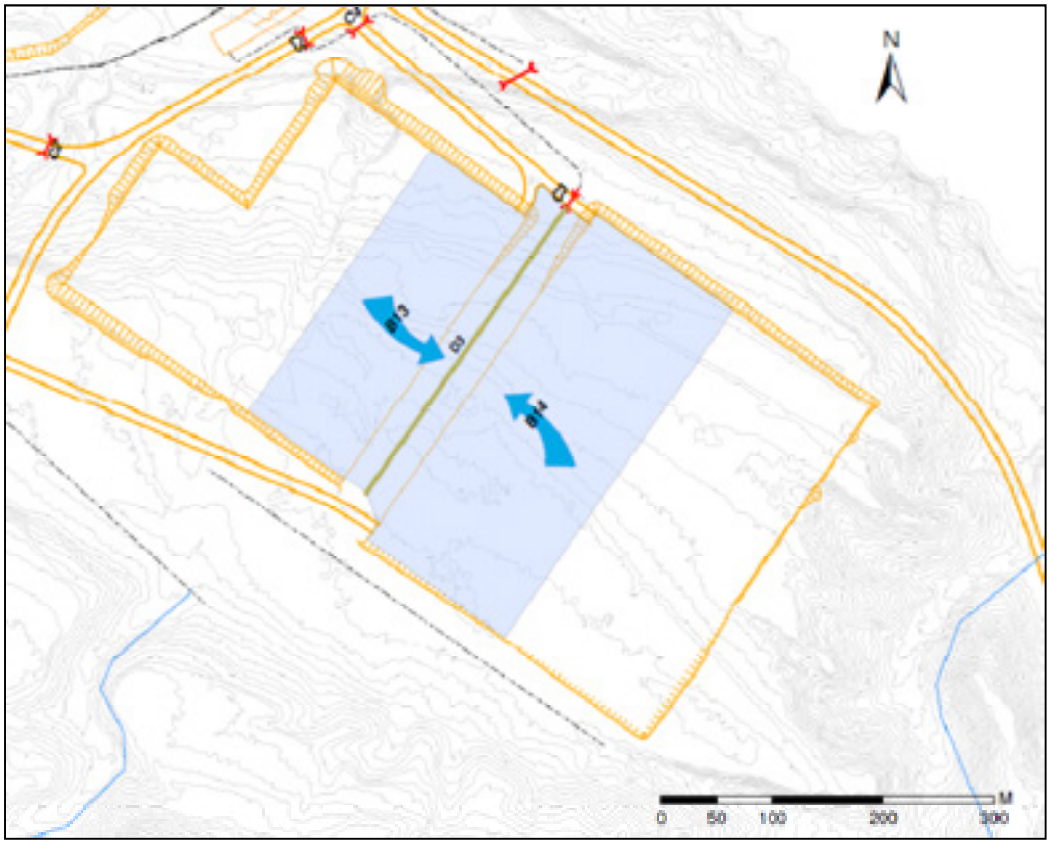
Sub-Basin	Area (km^2)	Avg. Slope (%)	Length (km)	T_c (hr)	Intensity (mm/hr)	Runoff Coeff.	Return Period (yr)	Q (m^3/s)
B3	0.050	16.62	0.25	0.09	90.8	0.44	20	**0.56**
B4	0.049	13.74	0.30	0.11	86.1	0.44	20	**0.51**
B5	0.302	5.25	1.16	0.46	41.8	0.39	20	**1.37**
B6	0.065	4.81	0.89	0.39	47.8	0.39	20	**0.34**
B7	0.301	2.59	1.66	0.79	28.4	0.39	20	**0.93**
TOTAL DISCHARGE DIVERSION CHANNEL (D1a)								**3.15**
TOTAL DISCHARGE CULVERT (C7)								**3.71**
Theoretical Diameter for C7 (Inlet Control- end projecting)								**1524 mm**

Structure: Ditch (D2)	Condition: Permanent
Character of Surface: Undeveloped (Forest/Woodland)	



Sub-Basin	Area (km^2)	Avg. Slope (%)	Length (km)	T_c (hr)	Intensity (mm/hr)	Runoff Coeff.	Return Period (yr)	Q (m^3/s)
B8	0.088	6.69	0.46	0.20	89.3	0.47	100	**1.03**
B9	0.019	1.24	0.24	0.24	81.9	0.39	100	**0.17**
							TOTAL DISCHARGE DITCH (D2)	**1.20**

Structure: Ditch (D3) Culvert (C3)	Condition: Permanent
Character of Surface: Developed (Poor Conditions)	



Sub-Basin	Area (km^2)	Avg. Slope (%)	Length (km)	T_c (hr)	Intensity (mm/hr)	Runoff Coeff.	Return Period (yr)	Q (m^3/s)
B13	0.038	1.50	0.13	0.14	105.7	0.47	100	**0.53**
B14	0.063	1.50	0.18	0.17	96.2	0.47	100	**0.79**
							TOTAL DISCHARGE DITCH (D3)	**1.32**
							TOTAL DISCHARGE CULVERT (C3)	**1.32**
							Theoretical Diameter for C3 (Inlet Control- end projecting)	**1067 mm**

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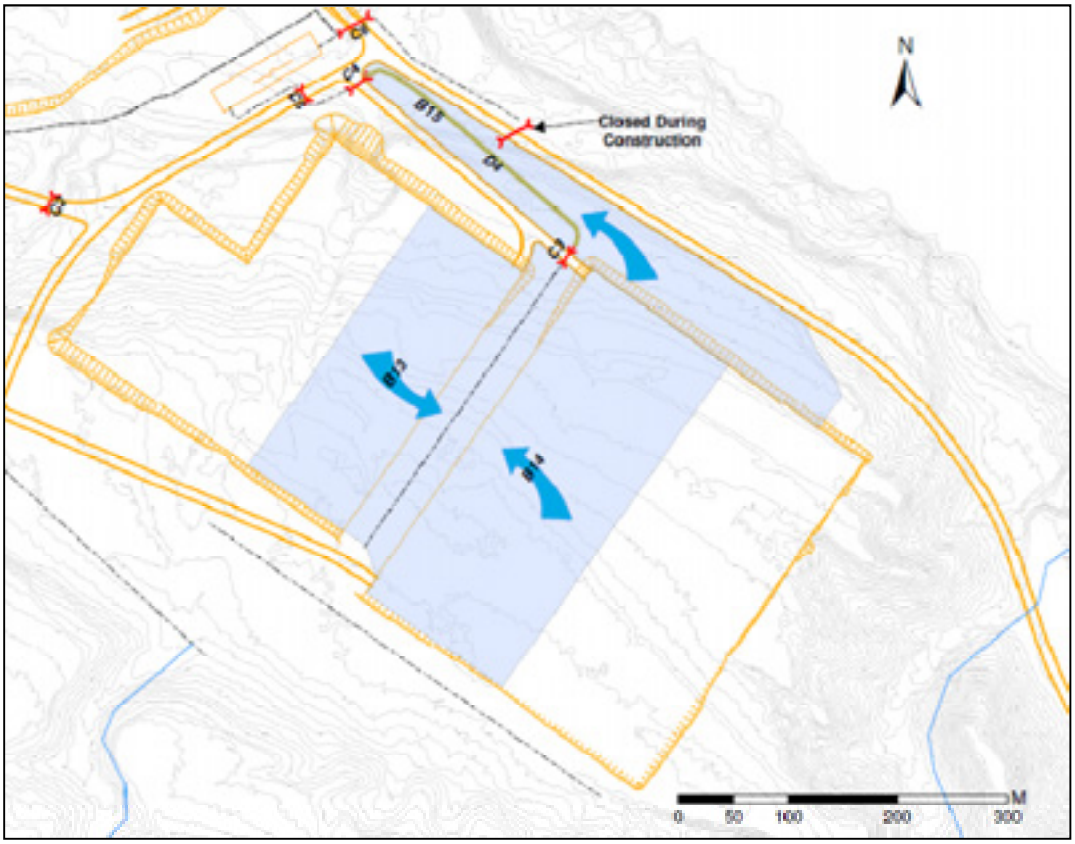
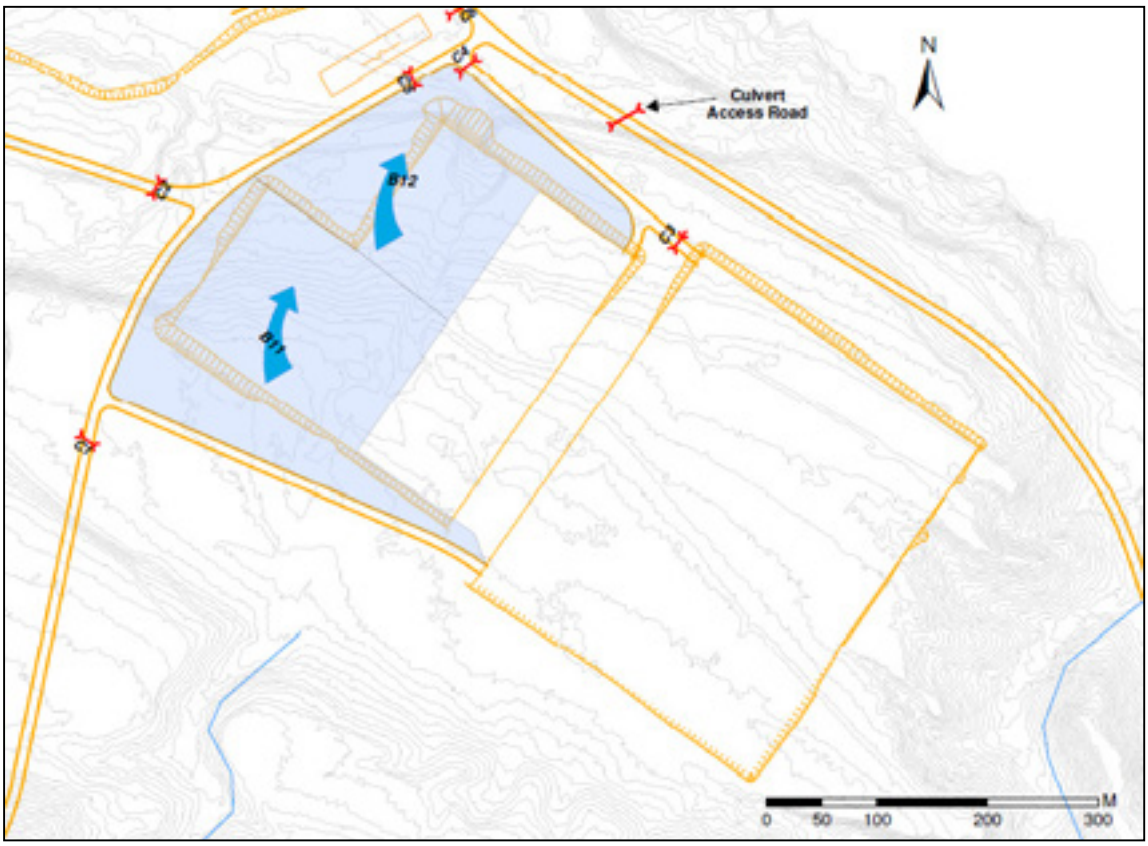
Structure: Ditch (D4) Culvert (C4)	Condition: For Construction
Character of Surface: Developed (Poor Conditions)	



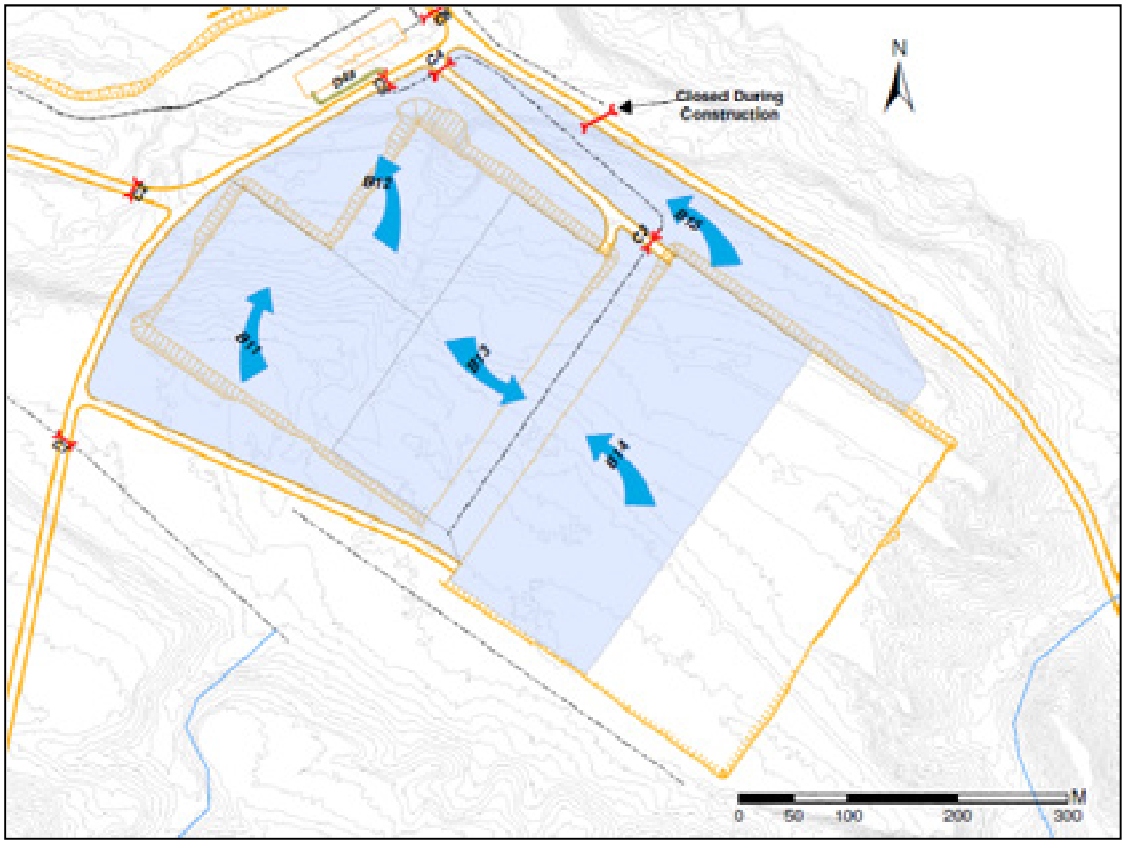
Sub-Basin	Area (km^2)	Avg. Slope (%)	Length (km)	T_c (hr)	Intensity (mm/hr)	Runoff Coeff.	Return Period (yr)	Q (m^3/s)
B13	0.038	1.50	0.13	0.14	79.9	0.39	20	**0.33**
B14	0.063	1.50	0.18	0.17	72.0	0.39	20	**0.49**
B15	0.028	1.50	0.55	0.42	45.3	0.39	20	**0.16**
							TOTAL DISCHARGE DITCH (D4)	**0.98**
							TOTAL DISCHARGE CULVERT (C4)	**0.98**
							Theoretical Diameter for C4 (Inlet Control- end projecting)	**940 mm**

Structure: Culvert (C4)	Condition: Permanent
Character of Surface: Developed (Poor Conditions)	



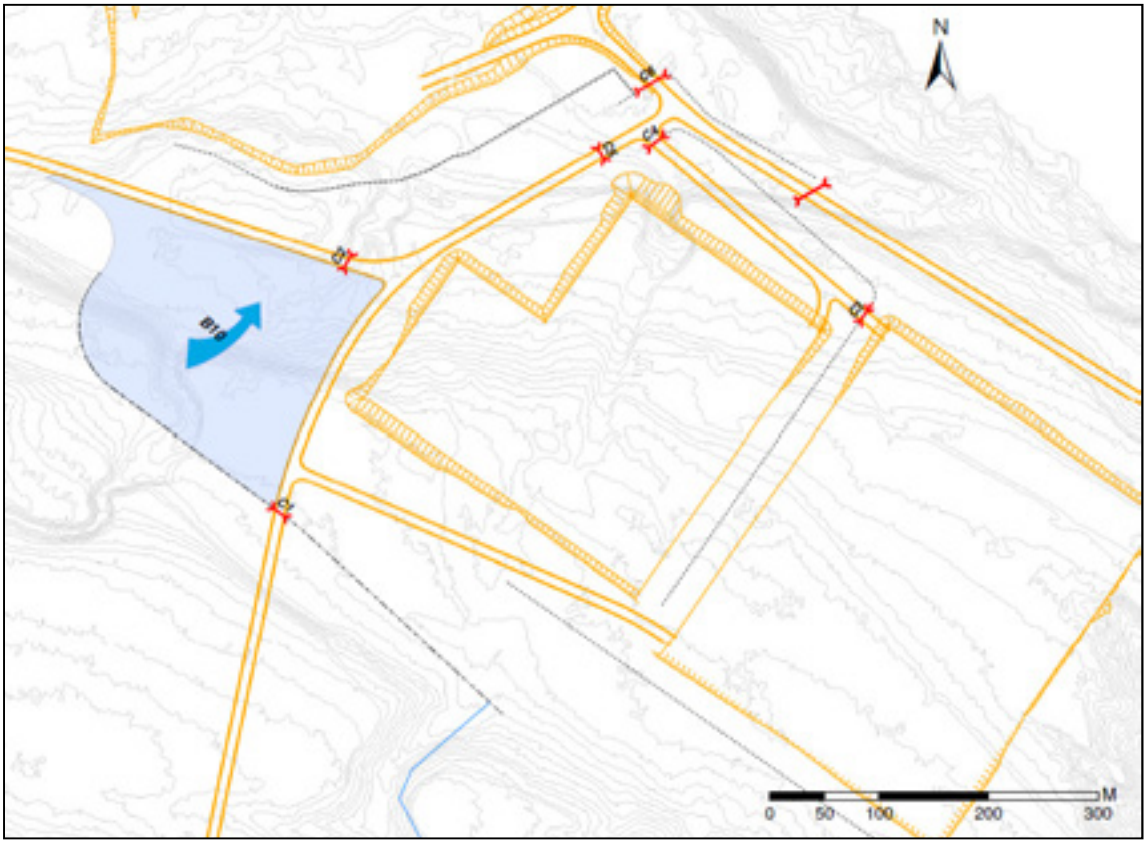
Sub-Basin	Area (km²)	Avg. Slope (%)	Length (km)	T_c (hr)	Intensity (mm/hr)	Runoff Coeff.	Return Period (yr)	Q (m³/s)
B11	0.053	1.50	0.24	0.22	63.9	0.47	100	**0.59**
B12	0.036	1.50	0.18	0.18	71.0	0.47	100	**0.45**
							TOTAL DISCHARGE CULVERT (C4)	**1.04**
							Theoretical Diameter for C4 (Inlet Control- end projecting)	**940 mm**

Structure: Ditch (D4a) Culvert (C5)	Condition: For Construction
Character of Surface: Developed (Poor Conditions)	



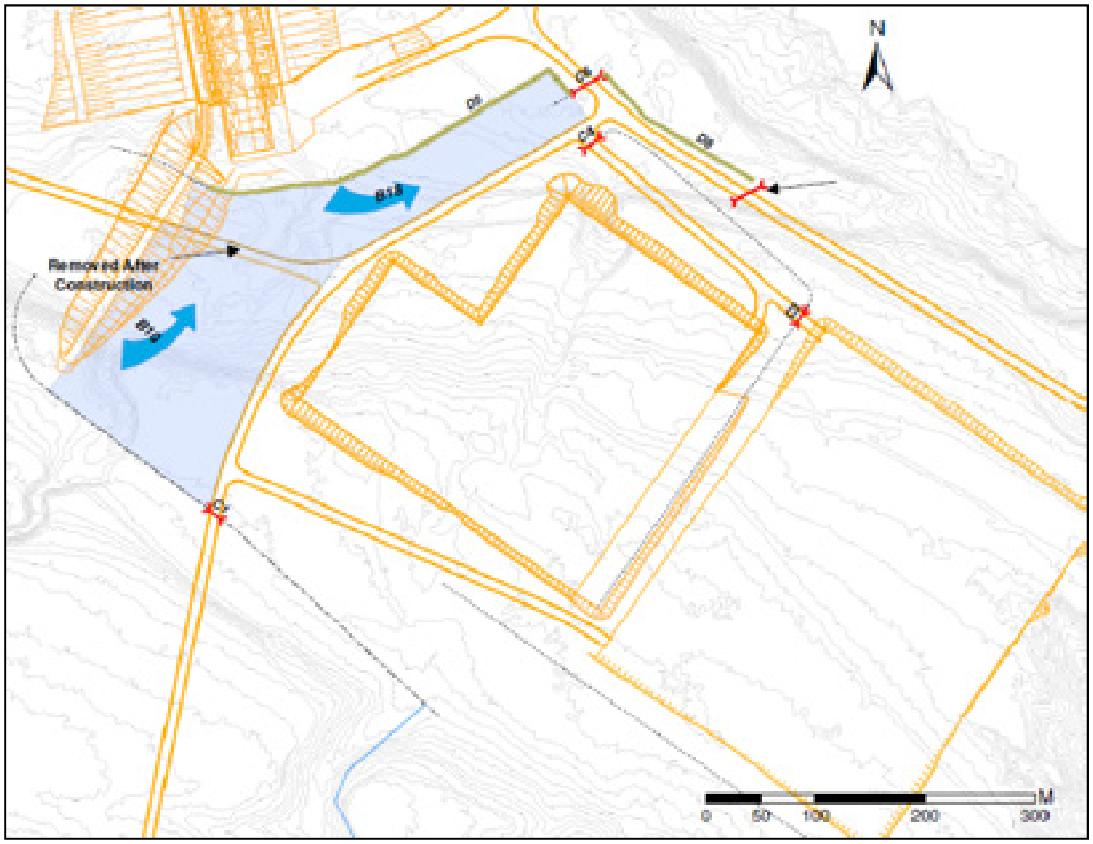
Sub-Basin	Area (km^2)	Avg. Slope (%)	Length (km)	T_c (hr)	Intensity (mm/hr)	Runoff Coeff.	Return Period (yr)	Q (m^3/s)
B11	0.053	1.50	0.24	0.22	63.9	0.39	20	**0.37**
B12	0.036	1.50	0.18	0.18	71.0	0.39	20	**0.28**
B13	0.038	1.50	0.13	0.14	79.9	0.39	20	**0.33**
B14	0.063	1.50	0.18	0.17	72.0	0.39	20	**0.49**
B15	0.033	1.50	0.55	0.42	45.3	0.39	20	**0.16**
							TOTAL DISCHARGE DITCH (4a)	**1.63**
							TOTAL DISCHARGE CULVERT (C5)	**1.63**
							Theoretical Diameter for C5 (Inlet Control- end projecting)	**1143 mm**

Structure: Culverts (C2)	Condition: For Construction
Character of Surface: Developed (Poor Conditions)	



Sub-Basin	Area (km^2)	Avg. Slope (%)	Length (km)	T_c (hr)	Intensity (mm/hr)	Runoff Coeff.	Return Period (yr)	Q (m^3/s)
B10	0.045	5.00	0.36	0.19	69.5	0.39	20	**0.34**
							TOTAL DISCHARGE CULVERT (C2)	**0.34**
							Theoretical Diameter for C2 (Inlet Control- end projecting)	**686 mm**

Structure: Ditch (D5) – (D8) Culverts (C6)	Condition: Permanent
Character of Surface: Developed (Poor Conditions)	



Sub-Basin	Area (km^2)	Avg. Slope (%)	Length (km)	T_c (hr)	Intensity (mm/hr)	Runoff Coeff.	Return Period (yr)	Q (m^3/s)
B10	0.045	5.00	0.36	0.19	69.5	0.47	100	**0.54**
B18	0.022	3.85	0.34	0.20	67.8	0.47	100	**0.26**
							TOTAL DISCHARGE DITCH (D5) - (D8)	**0.80**
							TOTAL DISCHARGE CULVERT (C6)	**0.80**
							Theoretical Diameter for C6 (Inlet Control- end projecting)	**914 mm**

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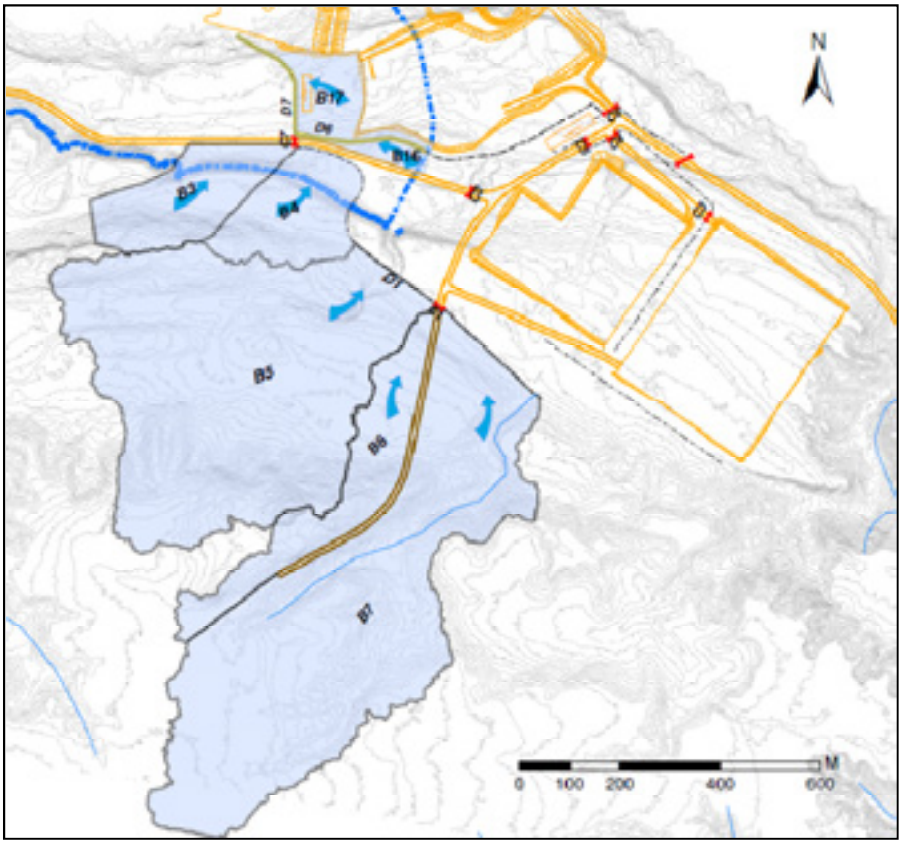
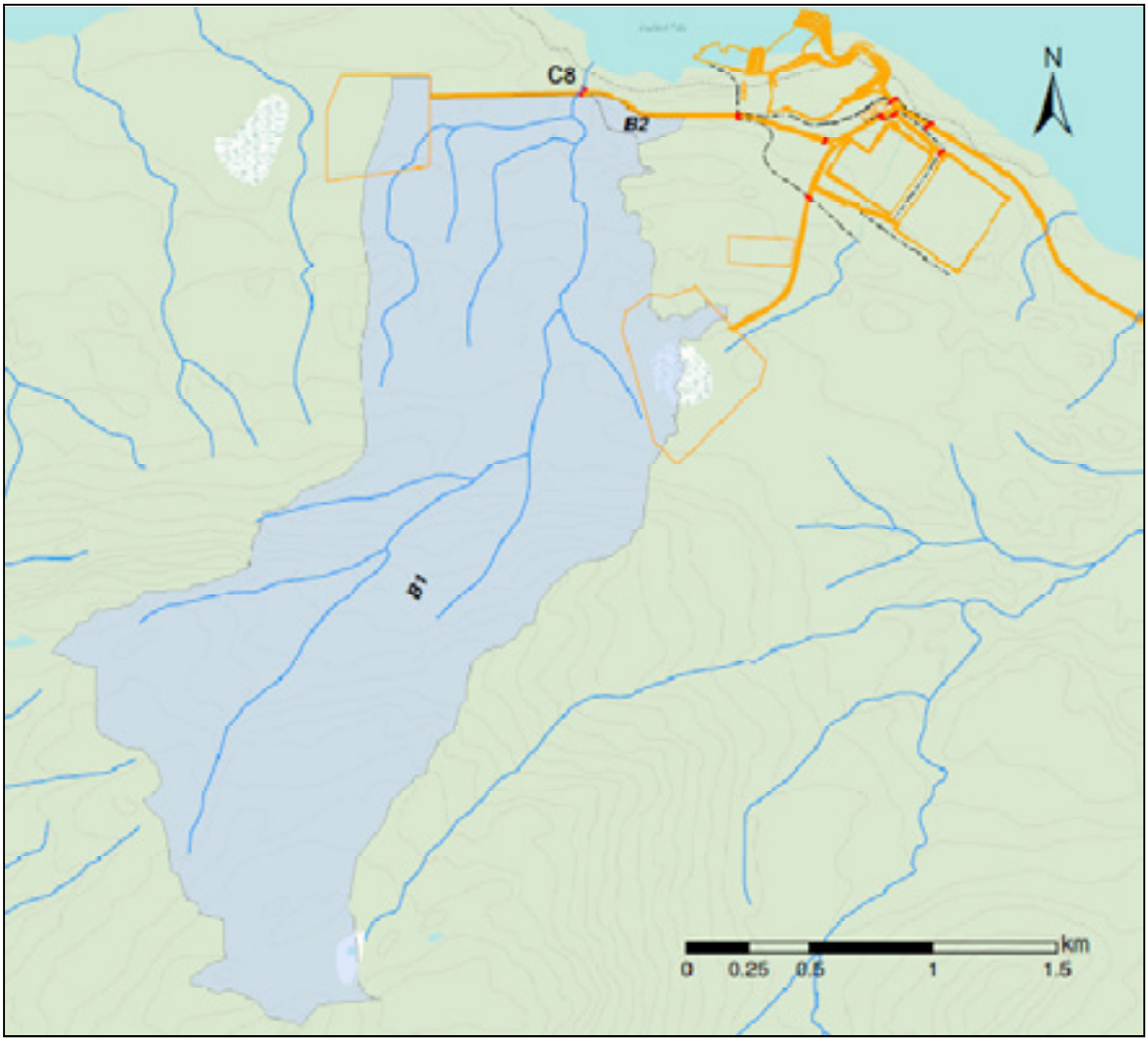
Structure: Ditch (D6) Ditch (D7)	Condition: For Construction
Character of Surface: Undeveloped (Forest/Woodland)	



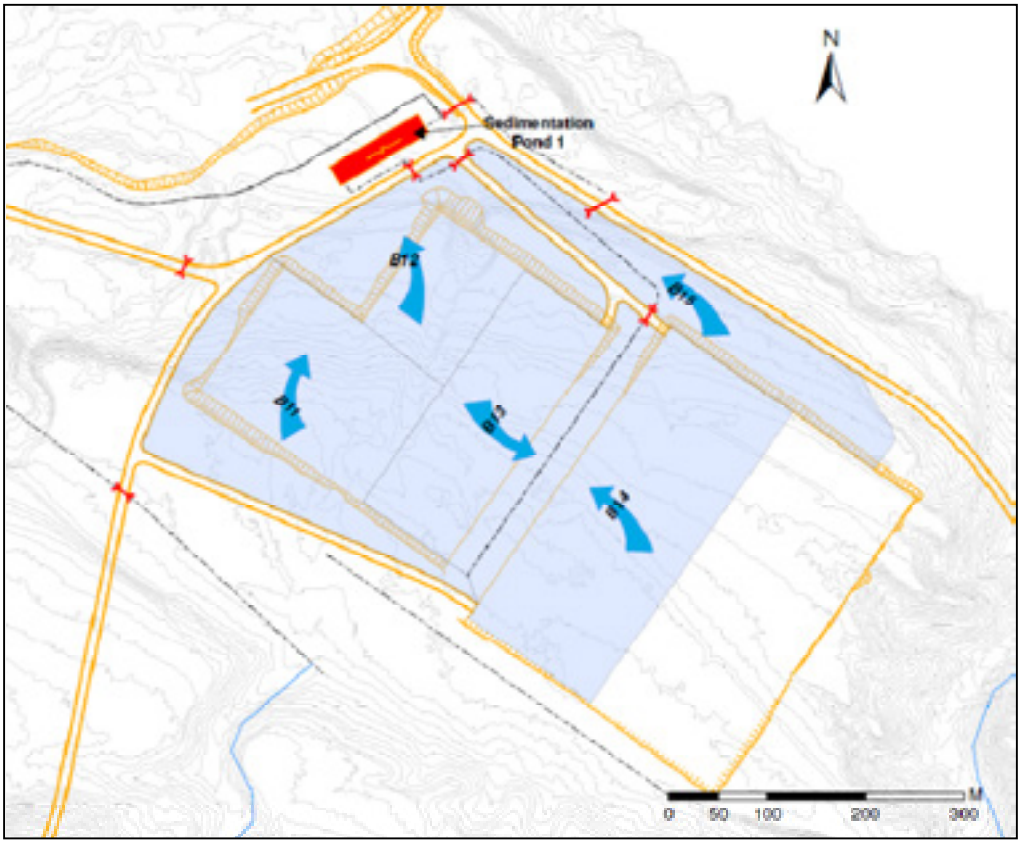
Sub-Basin	Area (km^2)	Avg. Slope (%)	Length (km)	T_c (hr)	Intensity (mm/hr)	Runoff Coeff.	Return Period (yr)	Q (m^3/s)
B3	0.050	16.62	0.25	0.09	90.8	0.44	20	**0.56**
B4	0.049	13.74	0.30	0.11	86.1	0.44	20	**0.51**
B5	0.302	5.25	1.16	0.46	41.8	0.39	20	**1.37**
B6	0.065	4.81	0.89	0.39	47.8	0.39	20	**0.34**
B7	0.301	2.59	1.66	0.79	28.4	0.39	20	**0.93**
B16	0.008	4.63	0.19	0.12	83.7	0.39	20	**0.07**
B17	0.027	2.79	0.22	0.16	75.0	0.39	20	**0.22**
							TOTAL DISCHARGE DITCH (D6)	**0.07**
							TOTAL DISCHARGE DITCH (D7)	**4.00**

Structure: Culvert (C8)	Condition: For Construction
Character of Surface: Undeveloped (Forest/Woodland)	



Sub-Basin	Area (km^2)	Avg. Slope (%)	Length (km)	T_c (hr)	Intensity (mm/hr)	Runoff Coeff.	Return Period (yr)	Q (m^3/s)
B1	4.281	6.50	4.45	1.19	19.7	0.39	20	**9.14**
B2	0.036	19.6	0.12	0.08	92.4	0.44	20	**0.40**
							TOTAL DISCHARGE CULVERT (C8)	**9.54**
							Theoretical Diameter for C8 (Inlet Control- end projecting)	**2400 mm**

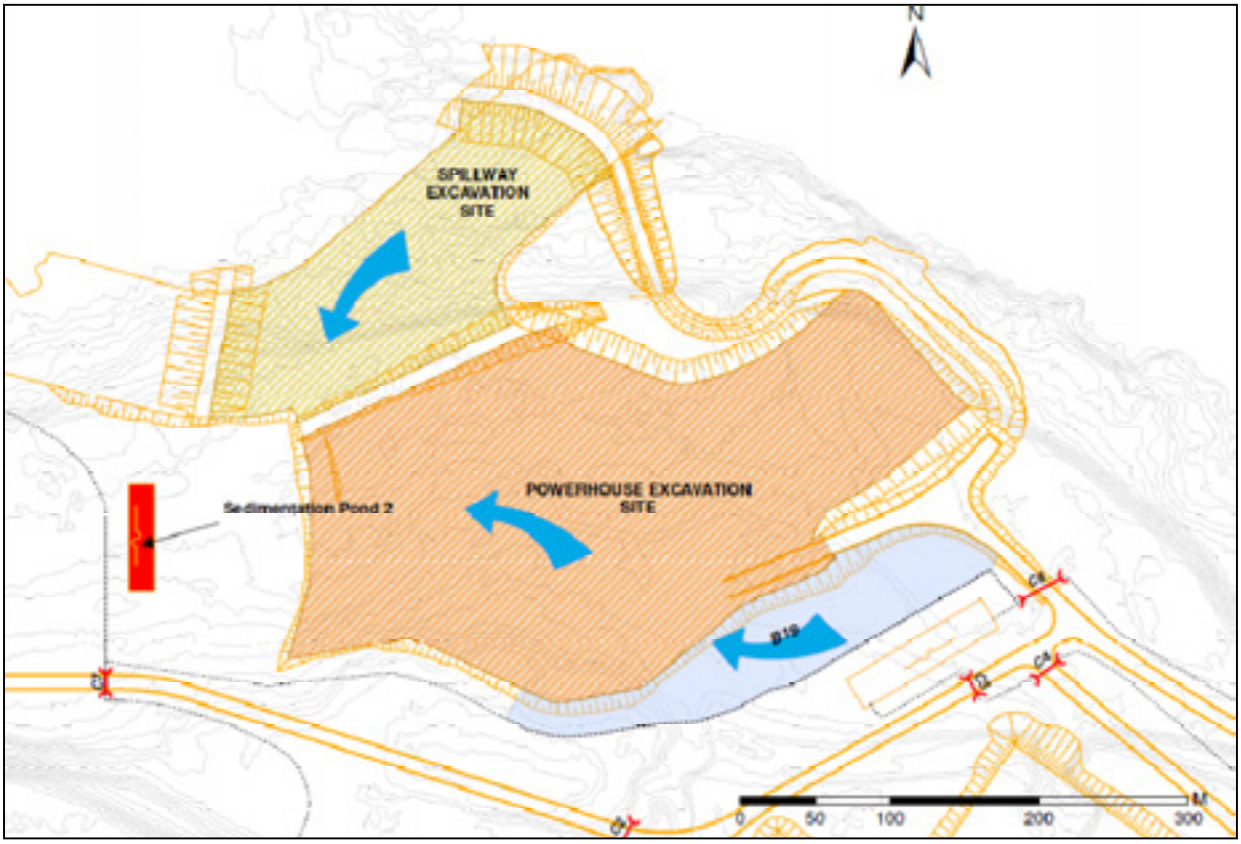
Structure: Sediment Pond 1	Condition: For Construction
Character of Surface: Developed (Poor Conditions)	



Sub-Basin	Area (km²)	Avg. Slope (%)	Length (km)	T_c (hr)	Intensity (mm/hr)	Runoff Coeff.	Return Period (yr)	Q (m³/s)
B11	0.053	1.50	0.24	0.22	44.4	0.34	5	**0.22**
B12	0.036	1.50	0.18	0.18	49.6	0.34	5	**0.28**
B13	0.038	1.50	0.13	0.14	56.6	0.34	5	**0.20**
B14	0.063	1.50	0.18	0.17	50.3	0.34	5	**0.30**
B15	0.033	1.50	0.55	0.42	31.3	0.34	5	**0.10**
							TOTAL DISCHARGE SEDIMENTATION POND 1	**1.1**
TOTAL AREA (m²)		223,000			**1% of the Erodible Area (m²)**[1]			**2,230**

[1] According to the "Land Development Guidelines for the Protection of Aquatic Habitat – Fisheries and Oceans", the design pond area for sediment control ponds has to take as design parameter the 5 year (1:5) storm on runoff flow and design particle or minimum of 1% of the total erodible area.

Structure: Sediment Pond 2	Condition: For Construction
Character of Surface: Developed (Poor Conditions)	



Sub-Basin	Area (km²)	Avg. Slope (%)	Length (km)	T_c (hr)	Intensity (mm/hr)	Runoff Coeff.	Return Period (yr)	Q (m³/s)
B19	0.015	3.41	0.29	0.19	48.7	0.40	5	**0.08**
Exc. PH	0.075	-	-	0.08[2]	66.8	0.34	5	**0.47**
Exc. SP	0.027	-	-	0.08[2]	66.8	0.34	5	**0.17**
TOTAL DISCHARGE SEDIMENTATION POND 2								**0.72**
TOTAL AREA (m²)		116,708		**1% of the Erodible Area (m²)[1]**				**1,167**

[2] The concentration Time is taken as minimum of 5 min because is an excavation site.

Water sampling program

As per the P-WEPP any effluent directed out of the Project site shall be tested for TSS and hydrocarbons (if there are any indications of hydrocarbon contamination, such as a sheen or odour) before being discharged to any watercourse, waterbody or other ecological sensitive area. Effluent discharge shall comply with the provincial *Environmental Control Water and Sewage Regulations, 2003* under the provincial *Water Resources Act.*

Samples shall be collected from the sedimentation pond effluent and analyzed in the event of a sedimentation control measure failure (i.e silt fence breakage) or if maintenance/upgrading is performed on the sedimentation pond.

With respect to maintenance of water quality within receiving waterbodies on and around the site, the *CCME Canadian Water Quality Guidelines for the Protection of Aquatic Life* shall be used. Samples shall be analyzed for Total Suspended Solids (TSS).

Samples shall be collected from the Churchill River and any other potential discharge locations prior to start of construction to obtain baseline information. Additional samples may be required in the case of a heavy rainfall; this will be decided by the on-site environmental monitor.

The awarded contractor is required to provide a sampling program as part of their C-SEPP. Changes may be made to this sampling plan once the C-SEPP has been accepted.

LOWER CHURCHILL PROJECT

TECHNICAL SPECIFICATION

General Environmental Requirements

Prepared by: _____
Michel Wawrzkow
Environmental Coordinator - Hydro

Checked by: _____
Ken Dominie
Environmental Manager

Approved by: _____
Normand Bechard
Project Manager

REVISION LIST

Revision					Remarks
N°	By	Verif.	Appr.	Date	
03	MW	KD	NB	31-May-2012	Issued for client review and acceptance
02	DH	MW	NB	27-Apr-2012	Reformatted to NMS and issued for client acceptance
01	MW	KD	NB	23-Mar-2012	Issued for client acceptance
00	MW	KD	NB	02-Feb-2011	Issued for client review.
PB	RH	KD	NB	15-Dec-2011	Issued for client review.
PA	DH	KD	NB	29-Nov-2011	Issued for internal review and comments

Lower Churchill Project Muskrat Falls Hydroelectric Development	TECHNICAL SPECIFICATION	SECTION: **01 35 43**
	GENERAL ENVIRONMENTAL REQUIREMENTS	
MFA-SN-CD-0000-EV-SP-0001-01		**505573-0000-68RA-I-0015**

TABLE OF CONTENTS
SECTION 01 35 43
GENERAL ENVIRONMENTAL REQUIREMENTS

PART 1 GENERAL

1.1 DESCRIPTION

1.1.1 The intent of the *Environmental Requirements Specification* is to detail the methods and procedures to be implemented during construction activities at the Lower Churchill Project to minimize any potential impacts on the environment.

1.2 CONTRACTOR'S RESPONSIBILITIES - REGULATORY AGENCIES

1.2.1 The Contractor shall refer to Exhibit 6 (Environmental and Regulatory Compliance Requirements).

1.3 CONTRACT-SPECIFIC ENVIRONMENTAL PROTECTION PLAN (C-SEPP)

1.3.1 The Contractor shall refer to Exhibit 6 (Environmental and Regulatory Compliance Requirements) and documents provided in Exhibit 11, specifically the *Project-Wide Environmental Protection Plan* (P-WEPP) and *Contract-Specific Environmental Protection Plan Template*.

1.4 LIST OF ACRONYMS AND ABREVIATIONS

.1	ACA	Ammoniacal Copper Arsenate
.2	ACZA	Ammoniacal Copper Zinc Arsenate
.3	C-SEPP	Contract-Specific Environmental Protection Plan
.4	CAN/CGSB	Canadian General Standards Board
.5	CCA	Chromated Copper Arsenate
.6	CCME	Canadian Council of Ministers of the Environment
.7	CuN	Copper Naphthenate
.8	dB(A)	Decibels in A-Weighted Measurements
.9	DFO	Fisheries and Oceans Canada
.10	DNR	Newfoundland and Labrador Dept. of Natural Resources

.11	DOEC	Newfoundland and Labrador Dept. of Environment and Conservation
.12	ESCP	Erosion and Sedimentation Control Plan
.13	GAP	Storage and Handling of Gasoline and Associated Product Regulations, 2003
.14	HOST	Heating Oil Storage Tank System Regulations
.15	NL	Newfoundland and Labrador
.16	OECD	Organization for Economic Co-operation and Development
.17	PA	Pond Area
.18	PCP	Pentachlorophenol
.19	P-WEPP	Project-Wide Environmental Protection Plan
.20	Qout	Outflow Capacity
.21	Us	Sedimentation Velocity
.22	TSS	Total Suspended Solids
.23	UOC	Used Oil Control Regulations
.24	WHMIS	Workplace Hazardous Materials Information System

PART 2 PRODUCTS

2.1 NOT USED

PART 3 EXECUTION

3.1 ENVIRONMENTAL PROTECTION PROCEDURES

3.1.1 The Contractor shall install all environmental protection procedures illustrated on the Contract Drawings in accordance with the design, installation, maintenance and removal procedures detailed below. The Contractor shall also adhere to these requirements when preparing the C-SEPP. The Contractor shall use the P-WEPP in Exhibit 11 as a guide when preparing the C-SEPP.

3.2 CLEARING OF VEGETATION

3.2.1 The Contractor shall implement the following environmental protection procedures:

.1 All vegetation shall be removed in such a manner that will accommodate salvage of merchantable timber.

.2 Clearing activities shall be limited to only those areas that are required for Project development and site infrastructure; and shall comply with the requirements of all applicable permits, including the commercial cutting permit.

.3 Clearing shall generally take place only within areas identified in the Contract Drawings. However, it is recognized that there will be “incidental” clearing of some areas. The Engineer will monitor this and accept/direct as required.

.4 Clearing areas designated on the Drawings shall be clearly marked at intervals in advance of clearing, as required, to define the limits of the work.

.5 Slash and any other debris shall not be permitted to enter any watercourse; piling of slash shall be above the high water level.

.6 Slash piles shall include a 6.5 m break every 200 m to allow drainage. Slash piles shall be no more than 3 m high.

.7 Trees with a top diameter greater than 9.1 cm, and generally free of rot/defects, shall be removed from the cutting area as directed by the Engineer.

.8 Clearing shall not take place within 20 m of the high water mark (15 m for reservoir preparation areas) of a watercourse unless otherwise designated on the Contract Drawings.

.9 Timber shall be felled inward towards the work area so that standing trees within the immediate work area will not be damaged.

.10 Measures shall be implemented so that workers do not destroy or disturb any features indicative of a cultural or archaeological site. Such sites shall be isolated until the Historic Resources Division of the Newfoundland and Labrador Department of Tourism, Culture and Recreation is notified and clearance to proceed has been received.

.11 Measures associated with an Avifauna Management Plan, as required, shall be implemented.

3.3 GRUBBING AND DISPOSAL OF RELATED DEBRIS

3.3.1 The Contractor shall implement the following environmental protection procedures:

.1 Grubbing activities shall be limited to only those areas that are required for Project development and activities shall comply with the requirements of all applicable permits.

.2 Grubbing of vegetation shall only take place where identified in Contract Drawings.

.3 Grubbing shall only take place within clearly marked intervals staked in advance to define the limits of the work.

.4 Grubbing and any other debris shall not be permitted to enter any watercourse.

.5 Grubbing piles shall be a minimum of five (5) m from free standing timber.

.6 Grubbing shall be done so that, wherever possible, the organic vegetation mat and upper soil horizons will be removed.

.7 Surface water runoff shall be diverted around grubbing activities, where possible.

.8 Where grubbed materials are re-spread or stockpiled; stumps and roots shall be left on the ground surface to maintain soil cohesion, to dissipate energy from runoff, and promote natural revegetation.

.9 Erosion control measures shall be implemented in areas prone to soil loss; these measures may include brush cover, stone rip rap, wire mesh, sedimentation ponds and drainage channels. Appropriate erosion control practices for specific sites shall be developed and outlined in the C-SEPP.

.10 The length of time that grubbed areas are left exposed shall be minimized to prevent unnecessary erosion.

.11 Overburden and topsoil from grubbing activities shall be stored, and stabilized, for the purpose of future site rehabilitation.

.12 Where possible, spoil areas shall be located within the work area.

.13 Spoil areas shall be designed such that all slopes, grades and surface material do not impede wildlife movement through the area.

.14 Spoil areas near watercourses shall be lined with filter fabric screens, such that fines cannot migrate into adjacent waters.

.15 Abandoned borrow areas may be used for spoil disposal.

.16 The spoil material shall be graded to reflect the natural grade. Spoil disposal piles shall be contoured to minimize slope and promote re-vegetation. Spoil piles shall be located as far away from watercourses as practical.

3.4 SITE WATER MANAGEMENT

3.4.1 The Contractor is responsible for storm water and drainage management on its worksite during the period of the Contract. The Contractor shall construct and maintain all storm water and drainage management shown on the Contract Drawings. This includes the collection, pumping, channelling, containment, sediment removal, discharge and any other operation to effectively control storm runoff and prevent erosion and siltation of

adjacent or downstream areas.

3.4.2 The Contractor shall reduce the potential for silt-laden water to enter a watercourse. The approach shall include dewatering and diversion measures to reduce the amount of water entering the work site, handling and treatment of water once present in excavations, and removing the sediment in the water that is released back into the environment. Where site disturbance is required, the Contractor shall implement the control measures illustrated on the Contract Drawings (e.g. ditches, ponds, and erosion and sedimentation control measures).

3.4.3 The volume of runoff entering the work sites shall be minimized by placement of diversion ditches as illustrated on the Contract Drawings. Ditches shall be located to intercept surface water and divert it around the areas of construction.

3.4.4 Ditches shall be located along the lower boundaries of the construction site to intercept and contain silty or muddy surface water. Where required, silt fences, rock check dams, infiltration areas and detention ponds shall be installed to slow the flow of water in the ditches allowing sediment to settle out prior to reaching the sedimentation ponds.

3.5 PROTECTION OF FISH HABITAT AND WATER QUALITY

3.5.1 Federal and Provincial Legislation requires prescribed methods and procedures to be employed when carrying out such work as culvert or bridge installations, watercourse diversions, fording, fill placement at watercourses, and any other work which may alter or impact any watercourse, or the quality of the water therein. These requirements are detailed in Exhibit # 6 – “Environmental Compliance Requirements”.

3.6 CLEARING AND/OR GRUBBING ADJACENT TO WATERCOURSES

3.6.1 The Contractor shall implement the following environmental protection procedures.

.1 Prepare an Erosion and Sedimentation Control Plan, as part of the Contract-Specific Environmental Protection Plan, prior to the start of construction.

.2 Maintain a minimum 20 m buffer zone (15 m for reservoir preparation areas) of undisturbed natural vegetation between the construction area and watercourses.

.3 Construct sediment control devices at the toe of slopes outside the buffer zone, when required, to control runoff from areas of exposed soils towards watercourses.

.4 Inspect silt fences and buffer strips on a daily basis, and more frequently, where conditions dictate (e.g. during and after a significant rainfall event).

.5 Remove any accumulations of silt and dispose in an area where it will not re-enter any watercourse.

.6 Stabilize all areas of exposed erodible soil.

.7 Where slope erosion is a potential concern, and there is less than a 20 m buffer of natural vegetation between the area and natural watercourses, an alternative means of erosion control such as a silt fence shall be established.

.8 Temporary servicing and/or washing of equipment shall not be allowed within 30 m of a watercourse.

.9 The Contractor shall mark limits established by the Engineer for clearing and grubbing adjacent to watercourses. Buffer zones of undisturbed vegetation shall be maintained at watercourse crossings as marked in the field.

.10 A permanent buffer zone shall be maintained on both sides of the construction zone at watercourse crossings, wherein, no disturbance or cutting of vegetation is to take place.

3.7 FORDING OF WATERCOURSES

3.7.1 The use of equipment or machinery in a watercourse is generally not permitted. Should it be necessary for equipment to ford a watercourse, then the approval of the Engineer is required on a site-specific basis.

3.7.2 When fording any watercourse, the Contractor shall comply with Environmental Guidelines for Fording prepared by the DOEC, Water Resources Division. For all fords, a permit shall be obtained from the DOEC and a Letter of Advice shall be obtained from

DFO. The Contractor shall implement the following environmental protection procedures.

.1 Areas of spawning habitat shall be avoided.

.2 Crossings shall be restricted to a single location and crossings shall be at right angles to watercourses, where possible.

.3 Equipment activity within the watercourse shall be reduced by limiting the number of crossings.

.4 Equipment shall be mechanically sound (minimize leaks of oil, gasoline and hydraulic fluids).

.5 Approaches to all watercourse crossings shall be stabilized with erosion resistant materials such as rock or clean gravel.

.6 Materials placed in the watercourse to improve the crossing site shall be clean, non-erodible and non toxic to aquatic life.

.7 Fording shall not decrease the depth of the watercourse to less than 200 mm. Where the existing depth is less than 200 mm, that depth shall be maintained.

.8 Fording activities shall be halted during high flow periods.

3.8 GENERAL PROCEDURES FOR INSTALLING WATERCOURSE CROSSINGS

3.8.1 This Section covers general requirements for installing both temporary and permanent watercourse crossings. Watercourses shall not be crossed where alternative access is possible. Crossings may be unavoidable at some locations to facilitate the construction of site roads and infrastructure, reservoir clearing and transmission line construction.

.1 Work shall be performed in such a way that deleterious substances, including but not limited to material such as sediment, fuel and oil do not enter watercourses.

.2 All structures shall be designed by a Professional Engineer certified to practice in

the province of Newfoundland and Labrador.

3.8.2 Culverts shall be designed in accordance with good engineering and environmental practices, which include, but are not limited to, the following procedures.

.1 Culvert installations in watercourses deemed to be fish habitat shall be designed to allow the passage of fish and to preserve habitat.

.2 Unless otherwise indicated, all work shall take place in dry conditions, either by use of cofferdams or by diverting the watercourse.

.3 Cylindrical culverts shall be counter sunk where necessary to protect fish habitat.

.4 At multiple culvert installations, one culvert shall be set at an elevation lower than the others.

.5 Culvert installations shall be designed so that the natural flow regime of the river is not altered.

.6 Culverts shall not be installed until site specific information such as localized watercourse gradient, fish habitat type and species present has been evaluated.

.7 Riprap shall be used to stabilize culvert outlets and inlets.

.8 Culverts shall be marked to indicate their position under the snow.

.9 Culverts of sufficient length shall be used to extend a short distance beyond the toe of the fill material.

.10 Backfilling material shall be used to support the culvert and limit seepage and subsequent washing out.

.11 Fill and construction debris shall be removed from the culvert area to a location above the peak flow level to prevent its entry into the watercourse.

.12 Construction activity shall be confined to the immediate area of the culvert.

.13 Fill material shall not be removed from watercourse or banks, except when installing a culvert and its removal is necessary for establishing a flat foundation.

.14 The use of heavy equipment shall be restricted in and near watercourses; an excavator shall be used from shore rather than a bulldozer in the watercourse.

.15 As required, cofferdams of non-erodible material shall be used to separate work areas from the watercourse when excavating for culverts and footings.

.16 Cofferdams shall be removed upon completion of construction and the watercourse returned as closely as possible to its original condition.

3.8.3 Construction activities that take place within 15 metres of a watercourse shall implement the following procedures.

.1 The Contractor shall arrange a pre-construction meeting with the Engineer prior to any work being carried out at the proposed crossing site to review environmental protection measures. The Contractor shall include the environmental protection measures as described hereafter.

.2 Work within a channel determined to be fish habitat, is generally prohibited between June 1 and September 30 in Newfoundland and between June 15 and September 15 in Labrador, unless otherwise approved by DFO and accepted by the Engineer.

.3 A cofferdam shall be installed at the low end of the construction zone to collect all site water which is to be disposed of in an accepted manner.

.4 The operation of heavy equipment shall be confined to dry stable areas in order to prevent the generation of mud and silted water.

.5 All flow shall be diverted, or pumped around or through, the work area by a means acceptable to the Engineer. Flow shall be maintained in the watercourse immediately below the site.

.6 The flow diversion system shall have sufficient freeboard to be capable of accommodating rain events; or provision shall be made to safely discharge elevated flows without causing washouts of constructed works, erosion, or siltation in downstream areas.

.7 The discharge location of the pumping or diversion system shall be stabilized to prevent erosion.

.8 Work shall be carried out from the downstream section of the work area and progress upstream.

.9 The Contractor shall ensure that fish are not left stranded in the work area. All stranded fish shall be removed by appropriate means and quickly returned to the watercourse below the construction area to prevent mortalities.

.10 Impermeable cofferdams of non-erodible material, such as sandbags and sheet plastic, shall be constructed at the outlet area of the construction zone to prevent any silted water from entering downstream areas, and to assist in dewatering operations.

.11 Excavations associated with watercourse crossings shall be carried out to the limits marked in the field by the Contractor. All excavations shall be carried out using a tracked excavator which shall operate within the limits of the work area or as directed by the Engineer. Excavated material shall be removed from the site, and stockpiled at an accepted location.

.12 When corrugated steel pipes are installed, impervious material shall be placed under the invert of the pipe and around the haunches of the pipe at the inlet area so as to ensure that all flow is confined within the pipe, particularly during low flow conditions, and not lost into the porous fill zones outside the pipe.

.13 All sections of newly constructed channel, pipe inlets, and outlets shall be adequately stabilized to prevent destabilization, erosion, or scouring of the channel and fill embankments. Rip-rap on road slopes shall be placed concurrently with backfilling operations on the pipe so that inlet and outlet areas are protected immediately from erosion.

3.8.4 Removal and Reinstatement of works in or near a watercourse shall include the following procedures.

.1 Disturbed areas or exposed soils within the high water zone of the watercourse shall be stabilized by such means as placing rip-rap or well staked sodding within 48 hours

of completion of backfilling operations. Other adjacent disturbed areas shall be rehabilitated by sodding or seeding, or as directed by the Engineer.

.2 Upon completion of the work, flow shall be introduced slowly into the new channel or watercourse crossing. Any silted water generated as a result shall be prevented from entering downstream areas of the watercourse, and pumped or treated as required.

.3 Where baffles are required as part of a culvert installation all activities associated with the baffle pipe installation including the diversion of all water flow from the natural watercourse into the baffled pipe, abandonment of any temporary watercourse diversion system and rehabilitation of the surrounding disturbed area shall be carried out efficiently without delay so as to not interfere with fish migration.

3.9 USE OF FRESH CONCRETE IN OR NEAR BODIES OF WATER

3.9.1 The Contractor shall implement the following environmental protection procedures.

.1 The Contractor shall comply with the NL Environmental Code of Practice for Concrete Batch Plant (Ready Mix Plant) Operations and Rock Washing Operations, 1992.

.2 Washwater from the cleaning of mixers, mixer trucks and concrete delivery systems shall be directed to a closed system aggregate rinsing sedimentation pond(s).

.3 In the event that water from the closed sedimentation system is intended for release, it shall first be tested for parameters related to any concrete additives used in the production of concrete (e.g. pH, total suspended solids). It shall also meet the limits specified by DOEC, and shall adhere to those portions of the Fisheries Act (SN1995 F12.1) that relate to fish habitat protection and pollution prevention.

.4 When concrete is placed in or adjacent to, a watercourse, all necessary precautions shall be taken to prevent the concrete from adversely affecting water quality. Whenever possible, fresh concrete shall not come in direct contact with the watercourse.

.5 Standing water shall be removed prior to placing fresh concrete.

.6 Formwork shall be made secure and tight to prevent leakage of fresh concrete into any adjacent waters.

.7 Where tremie concrete is required, the work shall be carried out under the specific directions of the Engineer.

.8 Concrete delivery trucks or chutes shall not be washed within 100 m of any watercourse or watercourse.

.9 All necessary precautions shall be taken when handling related substances such as form coatings and concrete admixtures to prevent any spill or leakage of these substances.

3.10 CONTROL AND TREATMENT OF SILTED WATER

3.10.1 Contractor shall implement the following environmental protection procedures.

.1 Runoff from the construction site shall meet the following criteria for Total Suspended Solids and other contaminates:

.1 The Total Suspended Solids content of construction-altered water that is released into a natural water body shall not exceed 30 milligrams per litre and be in compliance with *"Environmental Control Water and Sewage Regulations, 2003"*.

.2 Limits for other parameters listed in Schedule A of the *Environmental Control Water and Sewage Regulations, 2003 shall also be complied with.*

.3 With respect to maintenance of water quality on and around the site the *"CCME Canadian Water Quality Guidelines for the Protection of Aquatic Life"* shall be used.

.4 The pH level of construction-altered water that is released into a natural water body shall be between 5.5 and 9 pH units and be in compliance with *"Environmental Control Water and Sewage Regulations, 2003".*

.2 Runoff from adjacent areas shall be channelled, piped, diverted, or confined to prevent the water from entering construction zones.

.3 Sedimentation ponds shall be pumped dry, backfilled and compacted. Hand seeding, hydroseeding, and /or sodding of disturbed areas shall be carried out as directed by the Engineer. Additional rehabilitation may be required by the Engineer.

.4 Silted runoff water released or pumped from construction zones may be discharged to an accepted vegetated area where ground absorption will occur, or to an accepted sedimentation pond constructed in accordance with the Contract Drawings, or as directed by the Engineer.

3.10.2 This Section provides guidance on the design, construction and decommissioning of sediment retention ponds (sedimentation ponds). The Contract Drawings may include sedimentation pond details. Any proposed modifications to the Contract Drawings shall be detailed in the C-SEPP and shall be accepted by the Engineer prior to implementation. A properly designed and constructed sedimentation pond is the preferred method of silt removal. The design of the structure shall consider:

.1 The efficiency of the pond is proportional to the settling velocity and the particle size. The outflow of the system shall be designed based on free-draining properties which would normally function through a seepage/filter drainage outlet. The outfall capacity is designed to be equal to, or smaller than, the inflow volume, and to function with the pond configuration to provide sufficient detention time to effect sedimentation of the target particle size.

.2 The pond size will depend upon the size of the disturbed area, amount of runoff (Design Storm) and the target particle size (taken from the soil gradation curve). The outflow capacity is a function of structure and permeability of the filter media. General design criteria are presented below:

.1 design storm shall be the precipitation of the 24 hour rainfall intensity from a 1:20 year storm;

.2 drainage area for each sedimentation pond should not exceed 2 ha;

.3 ponds shall be located in low-lying areas where they will not contribute to high groundwater conditions and where the system can return the water to a watercourse or recharge the water table;

.4 sedimentation ponds shall be accessible by heavy equipment for removal of accumulated silt;

.5 the Contractor may also use other low-lying areas or wetlands for treating lightly silted water or smaller quantities of water;

.6 pond designs should include an overflow discharge in case of flooding. The overflow section should have a minimum width of 1.5 m for every 250 m^2 of pond area;

.7 provide 1 to 2 % elevation drop between inlet and outlet grades;

.8 maintain a minimum pond depth of 1 m. A minimum length to bottom width ratio of 4 :1;

.3 If clay soils are encountered the Contractor shall be prepared to implement mechanical and/or chemical processes (hydrodynamic, filtration, flocculating agents) to help precipitate very fine or colloidal particles for smaller quantities of water.

.4 The level of total suspended solids (TSS) in the released water shall meet the following criteria:

1. The Total Suspended Solids content of construction-altered water that is released into a natural water body shall not exceed 30 milligrams per litre and be in compliance with *"Environmental Control Water and Sewage Regulations, 2003"*.

2. With respect to maintenance of water quality on and around the site the *"CCME Canadian Water Quality Guidelines for the Protection of Aquatic Life"* shall be used.

3. The pH level of construction-altered water that is released into a natural water body shall be between 5.5 and 9 pH units and be in compliance with *"Environmental Control Water and Sewage Regulations, 2003".*

.5 It is recognized that certain site activities (such as the placement of cofferdams in the river) will result in the generation of silt in the water column and that the water containing elevated levels of TSS will be difficult to contain and treat. Such activities were recognized and included in a plume modelling exercise presented in the Environmental Impact Statement.

.6 Sedimentation ponds are to be constructed where required prior to any soil disturbance activity. The sedimentation pond shall be constructed in accordance with the Contract Drawings, or as accepted in the C-SEPP.

.7 The sedimentation ponds shall be cleaned when the storage zone is full. Remove the sediments from the pond when the level is within 700 mm of the discharge elevation.

.8 Removed sediment shall be placed in a confined area where it will not re-suspend.

.9 Retention ponds shall be inspected after each significant rainfall. Both outfall and overflow spillways shall be checked to ensure that they are free draining and not eroding. The embankments shall be inspected to ensure they are structurally sound and not damaged by erosion.

.10 The sedimentation pond should drain completely between rainfall events, if the pond is not draining adequately the pond bottom, and discharge structure, may be clogged and require cleaning.

.11 The Contractor shall remove the sedimentation pond when required to do so by the Engineer.

.5 On removal of the sedimentation pond the site shall be graded and stabilized. Ditch networks shall be cleaned and graded to the required ditch cross Section.

3.11 FILL PLACEMENT AT WATERCOURSES

3.11.1 The Contractor shall implement the following environmental protection procedures.

.1 Only clean rock can be placed in, or near, a watercourse.

.2 Where in the opinion of the Engineer, there is a risk of silt and sediments to create water quality problems, the fill zone shall be isolated from the remainder of the watercourse by such means as a silt curtain, as accepted by the Engineer.

.3 Rock shall be placed into the watercourse so as to create the least amount of disturbance of bottom sediments.

.4 Rock shall be placed along the outer edge of the fill zone to close off and isolate the fill zone from the rest of the watercourse.

.5 Fill placement shall proceed with runs of rock along the inside of the first outer run of fill. Successive runs of rock fill shall be placed in this manner until the zone is filled back to the inner fill limits.

.6 Height of the placed rock fill shall be maintained a minimum of 300 mm above water level during fill operations.

.7 Equipment shall not operate in standing water zones.

.8 Removal of displaced sediments and/or bog materials shall be carried out as directed by the Engineer.

.9 Pumping of water from the fill zone to a designated area may be required to reduce water levels in the fill zone and prevent movement of silted water through the rock fill back into the watercourse.

3.12 EROSION AND SEDIMENTATION CONTROL

3.12.1 The Contractor shall install all required erosion and sedimentation control measures as illustrated on the Contract Drawings. This Section provides additional guidance on erosion control and details on the required design criteria, installation procedures and removal protocols.

3.12.2 The information presented below shall be used by the Contractor during the preparation of Contract Specific Environmental Protection Plans and the development of site-specific Erosion and Sedimentation Control Plans that shall supplement, where

necessary, those measures already detailed on the Contract Drawings.

3.12.3 The Contractor shall, as part of the work, implement erosion and sedimentation control measures where project activities result in a blockage of natural drainage, the diversion of natural drainage, or the exposure of soil or subsoil to potential erosion. General erosion and sedimentation control measures may include the following measures:

.1 Minimize soil disturbance where possible.

.2 Erosion control blankets, grooving, tracking or stepping.

.3 Hydraulic mulch.

.4 Spreading hay over exposed soils.

.5 Spreading a thin layer of brush or slash over disturbed areas.

.6 Drainage collectors across the disturbed area to channel drainage into vegetated areas.

.7 Re-routing disturbed drainage ditches back into the natural course.

.8 Stabilization of exposed soils at drainage locations with appropriate rip-rap.

.9 Check dams to confine mud or slurry at such locations as unsodded ditch lines, catch-ponds and culvert inlets.

.10 Pumping of silted water to sedimentation or designated vegetated areas.

.11 Installing sedimentation ponds of adequate size at run-off locations from exposed areas to contain heavy silt and mud as directed by the Engineer.

3.12.4 Silt fences are intended for reducing the amount of silt present in runoff from exposed areas of soil with grades of less than five (5) percent as a result of construction activities. The Contractor shall install all erosion and sedimentation control measures in accordance with the Contract Drawings and the following procedures.

.1 The silt fence shall consist of a filter fabric fence held in place by posts.

.2 The woven filter fabric shall be of a weight of at least 200 g/m^2.

.3 No single run of silt fence shall exceed 100 m in length.

.4 The drainage area behind the silt fence should not exceed 0.1 ha per 30 metres of fence.

.5 Silt fences should not be installed on a slope, and be located no closer than 1 m from the toe of slope.

.6 Silt fences should not be used when the overland flow exceeds 0.03 m^3/sec.

.7 The fabric shall be ≥ 900 mm wide (i.e. installed height of silt fence fabric shall be ≥ 900 mm).

.8 The fence posts shall be of sufficient length to support the fabric, be sturdy and be of dimensions of at least 50 mm square.

.9 The staples shall be sufficiently sturdy to support the fabric for the required life of the fence.

.10 The silt fence shall be constructed as shown on the Contract Drawings, and placed at the location, or locations, as required by the Engineer.

.11 In areas where stakes cannot be driven into the ground (due to frost, shallow bedrock, very dense/hard soil, and/or numerous cobbles and boulders, etc), sandbags shall be used along the base of the silt fence to secure the fabric and stakes.

.12 At the location required by the Engineer, the Contractor shall excavate a trench in a crescent shape across the projected flow path with ends pointing up slope. The trench shall have a width of approximately 100 mm, and a depth of approximately 100 mm. Where the fence crosses bedrock outcrops along the same contour line the toe of the fence can be supported by sandbags.

.13 The posts shall be secured at 3 m intervals on the immediate down slope side of the trench.

.14 The filter fabric shall be taken from a continuous roll, and cut to the required length. The maximum length the filter fabric shall be stapled to the upstream side of the

stakes, with 200 mm of fabric extending into the trench and spread over the trench bottom.

.15 The trench shall be backfilled and compacted to secure the fabric in the ground. The silt fence shall be properly constructed to ensure continuous protection along its perimeter. Under no circumstances are silt fences to be installed in a watercourse.

.16 The Contractor shall conduct routine inspections of all silt fences and other sediment retention ponds, and unscheduled inspections prior to any anticipated heavy precipitation or runoff event (e.g. snow melt). The Contractor shall maintain the silt fence, until such times as the Engineer requires that the silt fence be removed.

.17 The Contractor shall remove silt and debris, as required, in order that the silt fence continues to perform its function of reducing the amount of silt present in the run-off. Should the fabric become clogged, the Contractor shall replace the fabric with new fabric.

.18 The Contractor shall remove the silt fence, when required to do so by the Engineer. The posts shall be taken out of the ground and the site cleaned up. Waste materials shall be disposed of in an approved waste disposal site with the approval of the owner and/or operator.

3.12.5 Check dam sediment traps are intended for reducing the amount of silt present in runoff from ditches during construction. Check dam sediment traps shall incorporate the following procedures.

.1 The check dam sediment trap shall consist of rock fill with filter fabric on the upstream face held in place with small shot rock.

.2 The filter fabric shall be of a weight of at least 200 g/m^2.

.3 The rock fill shall be clean rock, with rock fragments sized between 100 and 150 mm.

.4 The small shot rock shall be clean rock, with fragments no larger than 120 mm.

.5 When used in series, the top of the downstream check dam should be level with the bottom of the next check dam upstream.

.6 The check dam shall extend beyond the top of the ditch banks and the centerline elevation shall be low enough that flow does not go around the structure.

.7 The check dam sediment trap shall be constructed as shown on the Contract Drawing. The storage area shall be excavated, and the check dam constructed, at the location as required by the Engineer.

.8 The Contractor shall maintain the check dam, until such time as the Engineer requires that the check dam be removed.

.9 The contractor shall perform periodic inspections, and unscheduled inspections prior to, and after, a significant rainfall event (10 mm).

.10 The Contractor shall carry out such silt and debris clean outs as are required, in order that the check dam continues to perform its function of reducing the amount of silt present in the run-off.

.11 The Contractor shall remove the check dam sediment trap, when required to do so by the Engineer.

.12 On removal of the check dam, the fabric shall be disposed of in an approved waste disposal site with the approval of the owner and/or operator. The ditch shall be cleaned and graded to the required ditch cross section.

.12

3.13 STORAGE, HANDLING AND USE OF FUELS AND OTHER HAZARDOUS MATERIALS

3.13.1 The Contractor shall comply with the following procedures related to Storage Tank Registration, Inspection and Removal.

.1 All storage tank systems shall be constructed, installed, and operated in compliance with the Storage and Handling of Gasoline and Associated Products Regulations, 2003 (GAP regulations); the Heating Oil Storage Tank System Regulations, 2003 (HOST Regulations); or the Used Oil Control Regulations.

.2 Contractors shall supply verification of storage tank registration or Certificates of Approval to the Engineer prior to the commencement of work.

.3 Mobile fuel tanks shall comply with the Transportation of Dangerous Goods Regulations, SOR/2008-34 which requires intermediate size containers to comply with the requirements of CAN/CGSB-43.146-2002. Mobile tanks shall be properly secured.

.4 GAP regulation controlled storage tank systems shall be operated as per Section 18 of the Storage and Handling of Gasoline and Associated Products Regulations, 2003. This involves, but is not limited to, gauging or dipping, reconciliation of records and the proper maintenance of reconciliation records for a period of two years. Records shall be maintained for inspection by the Engineer and/or Service NL Inspectors.

.5 The operator of a storage tank system shall, within 30 days of known abandonment, empty the system of all products, remove the tank and associated piping from the ground, remove any contaminated soil, clean the area and restore the site to the satisfaction of the Engineer and in accordance with the criteria of Service NL.

.6 All HOST regulation controlled tanks shall have secondary containment.

3.13.2 The Contractor shall comply with the following Spill Reporting and Cleanup Procedures.

.1 The Contractor and Sub-contractors shall abide by the following measures in the event of a fuel or hazardous material spill:

.1 Make every effort to stop leakage and contain contaminant flow.

.2 Immediately notify the Engineer's On-Site Environmental Monitor of all environmental incidents, including any loss of hazardous or controlled products. Any spill meeting the following criteria shall be reported immediately to the Canadian Coast Guard at 709-772-2083 or 1-800-563-9089:

.1 Any spill on a natural water body (marine or freshwater); or

.2 Any land-based spill:

.1 over 70 litres, or

.2 of any quantity that has the potential (e.g. by migrating through subsurface soil/bedrock/substructures , etc) to enter a natural water body, or

.3 of any quantity that has the potential to impact a privately owned property.

.3 Once the spill is reported, the Engineer will liaise with the Company, as required. The Company will liaise with government agencies where necessary.

.4 Investigate and document in a written report, consistent with the format described in the Emergency Response Plan (which includes a master spill response plan), all releases that require Canadian Coast Guard reporting. This report shall be prepared and submitted to the Engineer. The Engineer will provide the report to the Company for distribution to applicable government agencies, including the Canadian Coast Guard and Service NL. All other releases shall be investigated and documented.

.5 Remove the contaminant from spill site by absorbent, pumping, or whatever method is appropriate and acceptable to the Engineer.

.6 Clean up the affected area in accordance with Service NL requirements, and as directed by the Engineer.

.7 Take all necessary action to ensure the incident does not recur.

.2 The Contractor shall apply the following criteria in reaching decisions on contaminant and clean-up procedures.

1. Minimize danger to persons.
2. Minimize pollution to watercourses and wetlands.
3. Minimize the size of the area affected by a spill.

4. Minimize the degree of disturbance to the area and watercourses during clean-up.

.3 The Contractor shall dispose of any soil contaminated by small leaks of oil or lubricating fluids from equipment in a manner accepted by the Engineer, and in accordance with the criteria of Service NL.

.4 The Contractor shall have on site a suitable quantity of absorbent material which can be accessed quickly and effectively in the event of any hydrocarbon spill.

.5 The Contractor shall advise its staff of the location and application of the absorbent material.

3.13.3 The Contractor and its subcontractors shall implement all necessary precautions to prevent and reduce spillage, misplacement or loss of fuels and other hazardous materials. These precautions shall include, but are not limited to:

.1 Bulk fuel storage (>2000 L) shall be established at least 100 m from any surface water. The storage of smaller quantities of fuel (i.e. 25 L or less) shall be permitted no closer than 15 m of a watercourse at accepted sites.

.2 Water pump use and refuelling may only take place within prescribed buffer zone limits identified in, and in accordance with provisions of, the Project-Wide Environmental Protection Plan.

.3 Handling and fuelling procedures shall also comply with WHMIS, applicable Sections of the *National Fire Code and Fire Prevention Act*, and any additional requirements brought forth by the Newfoundland and Labrador Department of Environment and Conversation (NLDOEC) to limit potential contamination of soil or water.

.4 Used oils shall be collected, stored, transported, and disposed of as per requirements outlined in the *Used Oil Control Regulations (UOC Regulations)*. Companies engaged in collecting, transporting, storing, using, selling, handling, and/or disposing of used oil shall hold a valid certificate of approval issued by Service NL or DOEC. Approvals shall be requested and obtained prior to the handling and disposal of used oils and a copy kept on file. Used oil shall be stored in a used oil storage tank

meeting the requirements outlined in Sections 18 and 21 of the UOC Regulations. Used oil can be stored in 205 L drums as long as the quantity does not exceed 205 L; the drums are clearly marked “used oil”; the drum is 18 gauge steel; the drum has secondary containment; the top of the drum is equipped with a sufficient opening to prevent spillage during filling or emptying; the drum is equipped with venting if it is intended to be vacuumed out and; it complies with CAN/CGSB – 43.150.95 if the drum is to be transported by road.

.5 Fuels and other hazardous materials shall be handled by trained and qualified persons in accordance with the manufacturer’s instructions and government laws and regulations. Operators shall be in attendance for the duration of the refuelling operation.

.6 Fuel caches of helicopter fuels stored in 205 L drums shall be established within the Project area as required. All fuel caches shall be operated as per conditions of approvals from Service NL. All helicopter refuelling shall be done at these locations if remote fuelling is required.

.7 Gasoline for chainsaws and water pumps may be stored in accepted 20 L storage containers.

.8 Regular inspections of hydraulic and fuel systems on machinery shall be performed by Project personnel, and leaks shall be repaired immediately upon detection. Servicing of mobile equipment on land shall not be performed within 50 m of a watercourse.

.9 Any above-ground container, with the exception of those exempted under the *Storage and Handling of Gasoline and Associated Products Regulation, 2003*, shall be provided with secondary containment consisting of:

.1 an impervious mat and an impervious dyke of sufficient height (minimum height 0.6 m) to contain a specified amount of fuel, or

.2 a double walled tank.

.10 Fuel storage areas and non-potable transfer lines shall be clearly marked or barricaded so that they will not be damaged by moving vehicles. The markers shall be visible under all weather conditions and barriers shall be constructed in compliance with the *Storage and Handling of Gasoline and Associated Products Regulations, 2003* and the National Fire Code of Canada (NFC).

.11 The Contractor shall be required to verify personnel qualifications as they pertain to this item and provide written confirmation of same to the Engineer. The Contractor shall supply a copy of the Material Safety Data Sheets (in accordance with the *Workplace Hazardous Materials Information System (WHMIS) Regulations* under the *Occupational Health and Safety Act*) to the Engineer of all hazardous, toxic or dangerous materials or substances which will be used during the course of the Agreement.

3.13.4 The Contractor shall implement the following Equipment Servicing Procedures.

.1 All heavy equipment maintenance shall be carried out using suitable fluid collection equipment and in a manner which ensures all waste material is collected and suitably disposed of.

.2 The Contractor shall ensure that all equipment is mechanically sound to avoid leaks of grease, oil, diesel, gasoline, and hydraulic and transmission fluids.

.3 The Contractor shall ensure that no servicing or washing of heavy equipment occurs adjacent to watercourses and designated wetlands (i.e. within buffer zones defined in the Project-Wide Environmental Protection Plan).

.4 The Contractor shall remove from the work area, and properly dispose of, all waste oil, filters, containers or other such debris at an approved waste disposal site.

3.13.5 Contractors shall at all times maintain in good condition at least one spill kit dedicated to each piece of fuel-powered equipment and absorbent material as required. Each spill kit shall be located on the equipment and stored in a weather-proof container. Each spill kit shall have an absorption capacity of no less than 23 litres. Examples of

acceptable spill kits with various absorption capacities are as follows:

.1 23 Litre Absorption Capacity

.1 One (1) 10-litre bag Oclansorb®, or equivalent accepted by Engineer;

.2 Two (2) 4-mil heavy duty disposal plastic bag 30" * 48";

.3 One (1) spark-resistant hand spade;

.4 Two (2) 100mm * 1200mm Sorb Sox®, or equivalent accepted by Engineer; and

.5 Five (5) sorbent pads 3/8" * 17" * 19".

.2 64 Litre Absorption Capacity

.1 One (1) 13-litre bag Oclansorb®, or accepted equivalent;

.2 Ten (10) sorbent pads 3/8" * 17" * 19", or accepted equivalent;

.3 Two (2) 4-mil yellow heavy duty disposal bag 30" * 48";

.4 One (1) spark-resistant hand spade;

.5 Two (2) 4" * 4' Sorb Sox®, or accepted equivalent; and

.6 Two (2) 4" * 8' Sorb Sox®, or accepted equivalent.

.3 121 litre Absorption Capacity

.1 Twenty five (25) sorbent pads 3/8" * 17" * 19";

.2 Ten (10) 4-mil yellow heavy duty disposal bag, 30" * 48":

.3 One (1) 44-litre bag Oclansorb®, or accepted equivalent;

.4 Eight (8) Sorb Sox® 4" * 4', or accepted equivalent;

.5 Five (5) Sorb Sox® 4" * 8', or accepted equivalent;

.6 Two (2) Spillows® 2" * 17" * 19", or accepted equivalent;

.7 One (1) spark resistant poly-shovel;

.8 One (1) Sorb Sox® Boom 7" * 10', or accepted equivalent; and

.9 One (1) Pair of chemical resistant gloves.

.4 In addition to equipment-dedicated spill kits, the Contractor shall at all times maintain in good condition spill response caches that are: 1) accessible within 15 minutes travel of all work faces, and 2) at all fuel/hazardous materials storage areas. Each cache shall have sufficient absorption capacity for one thousand (1000) litres of fuel or hazardous liquids, and shall contain at a minimum the following:

.1 Forty (40) hazardous material socks 3" * 4';

.2 Twenty four (24) hazardous material socks 3" * 8';

.3 Sixty (60) Sorb Sox® 4" * 4', or accepted equivalent;

.4 Sixteen (16) hazardous material pillows 18" * 18";

.5 Eight (8) 44-litre bag Oclansorb®, or accepted equivalent;

.6 Eight (8) 13-litre bag Oclansorb®, or accepted equivalent;

.7 Four (4) 25-pound Qualisorb Gold #628, or accepted equivalent;

.8 One hundred (100) hazard material pads 3/8" * 17" * 19";

.9 One hundred twenty (120) Hi-Point Pads (3/8" * 17" * 19"), or accepted equivalent;

.10 Four (4) Neoprene drain cover 36" * 36" * 1/8";

.11 Four (4) 1-pound Container Gap Seal plugging compound;

.12 Four (4) spark resistant poly-shovels;

.13 Eight (8) pairs chemical resistant gloves;

.14 Eight (8) pairs splash goggles;

.15 Eight (8) pairs Tyvek coveralls;

.16 Fifty (50) 4-mil yellow heavy duty disposal bags 30" * 48";

.17 Two (2) plastic scoop and brush;

.18 Eight (8) steel hand spades; and

.19 Eight (8) 4-kg. Vytac ACX powder acid neutralizer with colour indicator and instructions (for battery acid spills), or accepted equivalent.

3.14 USE OF HAZARDOUS, TOXIC, OR DANGEROUS MATERIAL

3.14.1 Hazardous, toxic, or dangerous materials that are not approved for use in Canada shall not be used on the Project, in accordance with provisions of the *Canadian Environmental Protection Act, 1999* and its subordinate regulations..

3.14.2 The Contractor shall implement the following procedures when working with hazardous, toxic or dangerous material:

.1 Toxic material shall be stored at least 100 m away from all areas where drainage is directed into any watercourse or wetlands.

.2 Toxic or dangerous substances such as form release agents, fuels, concrete additives (including super-plasticisers), and other such substances, shall be transported, stored, and handled with all necessary precautions so as to prevent any spillage from occurring.

.3 Drip pans shall be used at locations where such liquids are being drawn off in order to contain any minor spills, and as a safety measure for containment of a significant spillage.

.4 Batteries shall be stored in secure dyked areas (with no drains), suitably protected to prevent infiltration of rainwater, snow and meltwater.

.5 Any liquids, including acids, that drain into the dyked area shall be collected, handled and disposed of as a hazardous waste.

.6 All equipment on the Project site shall use only oils/lubricants that classify as “biodegradable” , unless the Contractor justifies in writing to the Engineer’s satisfaction that it is not feasible because of:

.1 technical or performance constraints,

.2 negative impacts on equipment warranties, and/or

.3 unavailability of biodegradable oils and lubricants.

.7 The Contractor shall document the consideration of this issue in its bid documents providing, as a minimum, the following information:

.1 cost differential in using biodegradable and non-biodegradable oils and lubricants; and

.2 life cycle cost differential for equipment maintenance and operation; and

.3 product specifications indicating the product meets the definition of "biodegradable" when tested in accordance with the OECD 301B Ready Biodegradability Test procedure; or

.4 reasons (e.g. technical, market availability, equipment warranty provisions, etc) for not using biodegradable fluids, should that option be proposed.

.8 The Contractor shall implement the following procedures when working with treated wood products.

.1 Creosote shall not be used on the site.

.2 Protected Water Supply Areas

.1 The Contractor shall not use treated wood products in protected water supply areas unless the Contractor can justify its use in writing to the Engineer's satisfaction.

.2 Where written justification for treated wood is presented to the Engineer for acceptance, the treatment options shall be restricted to chromated copper arsenate (CCA), ammonical copper arsenate (ACA), ammoniacal copper zinc arsenate (ACZA), pentachlorophenol (PCP), or copper naphthenate (CuN).

.3 Table 1 below specifies the required buffer zones separating water bodies (within protected water supply areas) from locations where treated wood products, including poles, are to be used.

Table 1: Buffer Zones for placement within a Water Supply Area

Body of Water	Width of Buffer Zone
Pond/Lake	150 m (for pond/lake intake structures)
River	150 m for a distance of 1 km upstream and 100 m downstream of river intake structures
Main River Channel	75 m
Major Tributaries/Lakes/Ponds	50 m
Other bodies of water	30 m

.4 If structures are required within these specified buffer zones, then only untreated wood, steel or concrete shall be used.

.5 If wood poles are required within the buffer zones outlined in Table 1, but untreated wood poles are not practical or feasible, alternative protective measures may be accepted by the Engineer; however, regulatory approval for such alternative measures is required. Specific techniques used to eliminate or minimize environmental disturbance include wrapping the pole using a pole bandage or wrap installed at the ground line. Preservatives are applied to the inside of the bandage and installed on untreated poles. The external backing does not allow any preservative to escape its intended use. Similar untreated bandages can also be used on treated poles to absorb the excess preservative at the ground level. A second option is the installation of the pole in a pipe or culvert to prevent the preservative from leaching into sensitive areas.

.9 The Contractor shall implement the following procedures when using hazardous materials near saltwater and freshwater areas (other than Protected Water Supply Areas).

.1 In areas of low water hardness (i.e., 15-25 mg/L-1 CaCO3), pH 5.5 or less, and elevated background metals levels, or areas where metals-sensitive biota exist, ACA, ACZA and CCA shall not be used.

.2 Pentachlorophenol shall not be used in salt water environments.

.3 For temporary installation of wood structures (i.e. bridge abutments or wood poles) within 15 metres of a water body only untreated timber shall be used.

.4 For permanent installations, non-invasive materials such as concrete or steel shall be used.

.5 If use of untreated wood or alternative materials is not feasible or practical, approval by regulators is required prior to use of CCA, ACA, PCP and CuN.

.6 Protective measures outlined above under Protected Water Supply Areas, such as pole wrapping and pipe installation, may be considered; however, using these alternatives requires preapproval by regulatory agencies.

3.15 WASTE MANAGEMENT

3.15.1 The Contractor shall implement the following Solid Waste Disposal procedures.

.1 The Contractor shall review and comply with the Company provided Waste Management Plan (included in Exhibit # 11 of the Agreement) as required by the P-WEPP. The Waste Management Plan includes methods for waste stream separation, collection, storage, transport and disposal, and associated schedules.

.2 The Contractor is responsible to collect and dispose of all waste produced by its employees and those of its Sub-contractors in a manner accepted by the Engineer, and in accordance with the Newfoundland and Labrador Environmental Protection Act, Waste Management Regulations and Waste Diversion Regulations.

.3 The Contractor shall implement the following waste management related environmental protection procedures:

.1 Disposable wastes shall be stored in a leak proof container and disposed of at an existing approved municipal landfill site with the permission of the owner and/or operator.

.2 Recyclable materials shall be collected separately and provided to an approved recycling facility.

.3 Waste material shall not be deposited in any watercourse.

.4 Waste types shall be separated and appropriate receptacles shall be provided for the collection of recyclable materials including; aluminum, glass, paper, cardboard and plastic.

.5 Construction scrap and debris shall be separated into disposable and salvageable materials.

.6 Waste accumulated on the site prior to disposal shall be confined in animal-resistant containers so that it does not pose an environmental or health hazard or cause conflict with wildlife.

.7 Upon completion of the work, the Contractor shall, at its own expense, and to the satisfaction of the Engineer, dispose of, or remove from, the job site all construction plant, rubbish, unused material, including concrete forms, filter fabric material, sediment fencing, sand bags, and other equipment and materials belonging to it or used under its direction during the performance of the work. The site shall be left in a neat and clean condition.

3.15.2 The Contractor shall implement the following Sanitary Facilities / Sewage Disposal procedures.

.1 The Contractor shall comply with all the requirements of the Health and Community Services Act (SN1997, plus amendments).

.2 The Contractor shall obtain approval, where required, for any water and sewer systems, grey water systems, food dispensing systems and potable water systems to be used at permanent and temporary facilities and remote sites.

.3 Approval shall be obtained from Service NL for all water and sewage systems, except for sewage systems that discharge into the ocean or that are installed by a municipality. In these cases approval shall be obtained from DOEC.

.4 The sanitary facilities shall be used by all Contractor employees and those of Sub-contractors. The Contractor shall transport the waste from these units, using a collection company (whenever possible) licensed by Service NL. Otherwise, transportation and disposal shall be by a means and at a facility or location as approved by Service NL.

3.16 MARSHALLING YARDS AND TEMPORARY WORK CAMPS

3.16.1 Any site proposed for a marshalling yard, or work camp, should be of low value with respect to its potential for other uses when compared to other lands in the area. Abandoned gravel pits, abandoned commercial enterprises, or other previously disturbed areas are preferred locations.

3.16.2 Any site shall be located so as to minimize potential traffic hazards. Incoming and outgoing vehicles should be able to merge safely with other traffic. Prior to the commencement of construction the Contractor shall submit a list of candidate sites, which shall be reviewed and accepted by the Engineer and any other relevant agency.

3.16.3 The Contractor shall implement the following general environmental protection procedures.

.1 The marshalling yards and laydown areas used for equipment and material storage shall be located at least 30 m from any watercourse or designated wetland;

.2 Camp plans shall be reviewed prior to the commencement of construction so that equipment or material storage yards and temporary work camps shall be located at least 30 m from any watercourse or designated wetland.

.3 Buffer zones are to be flagged prior to any disturbance activities.

.4 Natural vegetation is to be left in place where possible.

.5 Drainage from areas of exposed fill is controlled by grade or ditching and directed away from watercourses or to site water control structures.

.6 Surface water is to be directed away from work areas by ditching and runoff from these areas have silt removed by filtration or other suitable treatment.

.7 The requirements for check dams or sediment traps to intercept runoff are to be determined in the field.

.8 Check dams shall be used, as required, to reduce runoff velocity from work areas where there is exposed soil.

.9 Areas to be exposed/disturbed shall be reduced to only what is required. Disturbed areas are to be graded to level grades and compacted. If required, erosion control matting may be required on exposed slopes prone to erosion.

.10 In areas where natural vegetation is to be removed, the vegetation layer shall be stored for possible use as erosion control material on exposed slopes.

3.17 BORROW AREAS AND QUARRIES

3.17.1 The number of borrow pits and quarries opened during construction shall be controlled and existing areas shall be used wherever possible. These areas shall comply with all applicable regulations and guidelines and a permit from the NL Department of Natural Resources (NLDNR) shall be obtained.

3.17.2 The development of borrow areas shall be controlled and shall not be located within 100 m of any watercourse. In exceptional cases, where no suitable alternative exists, sites within the 100 m buffer shall be evaluated on an individual basis and a decision shall be made on seeking permission to use the area, including the identification of additional mitigation measures.

3.17.3 The processing of aggregates, whether in the borrow area or at the Project sites, shall be planned in advanced. There shall be a plan implemented for sediment and run-off control associated with any aggregate washing operations. This may include, but will not be limited to, use of a closed system washing operation or a multiple tiered

sedimentation pond system.

3.17.4 The Contractor shall develop borrow and quarry areas in the following sequence:

.1 removal of organic layer and topsoil and stockpile separate from mineral soil;

.2 excavation of pit;

.3 replacement of unused excavated material;

.4 replacement of topsoil and organic layer; and

.5 grading of the area.

3.17.5 Quarry and borrow areas shall be developed in a controlled manner to reduce potential environmental effects. The Contractor shall implement the following environmental protection procedures to facilitate site rehabilitation.

.1 Development areas, stockpile areas and limits of clearing shall be staked and/or flagged to prevent overextension of the development, thereby minimizing the extent of the operation.

.2 Area to be excavated shall be clear-cut of all vegetation prior to any grubbing, excavation or removal of any material.

.3 All stumps, organic material and topsoil shall be stripped from the area to be excavated and stockpiled at least 5 m from uncleared areas; stockpiled strippings shall be placed a minimum of 10 m away from the area of excavation; separate overburden piles shall be developed for topsoil and underlying overburden.

.4 Sedimentation ponds shall be established and if required, cleaned on a regular basis so that the retention capacity is maintained.

.5 Dust from aggregate storage and handling shall be controlled with water, as required.

.6 Quarries shall be developed with clear closure/rehabilitation objectives for aspects such as cliff face or bench height and the use of available material to reduce slopes, face heights and to rehabilitate the quarry at closure.

.7 Following sloping, the topsoil and any organic material shall be re-spread over the disturbed area to promote natural re-vegetation.

3.18 DUST CONTROL

3.18.1 The Contractor shall ensure that dust does not become a problem for adjacent property owners, construction site personnel, or create a hazard to vehicular traffic.

3.18.2 When required, or as directed by the Engineer, water or an acceptable dust suppressant such as calcium chloride shall be used by the Contractor on haul routes or other locations on the Project to control dust.

3.19 TEMPORARY TRAVEL ROUTES

3.19.1 The Contractor shall restrict linear travel along the right of way by vehicles and equipment to one track or travel route, particularly during the early stages of opening access along the route, unless otherwise accepted by the Engineer.

3.19.2 The Contractor shall maintain the routes free of standing water. Surface drainage shall not be permitted to run along the route which can generate extensive mud and silt, and adversely affect materials to be excavated such as grubbing, unsuitable material, and overburden.

3.19.3 Surface drainage shall be directed off the route at frequent intervals. Where drainage courses are encountered, and frequent crossings are required, temporary pipes (CSP or iron) shall be installed to permit passage of equipment and vehicles in the dry, without causing erosion and siltation.

3.20 PROTECTION OF VEGETATION AND WETLANDS

3.20.1 Drainage is to be maintained in its natural state wherever possible, with provision being made for spring flooding. Where existing drainage patterns cannot be maintained, the Contractor shall install alternate drainage to approximate normal conditions with the acceptance of the Engineer.

3.20.2 The Contractor shall implement the following procedures when working near trees and shrubs.

3.20.3 The Contractor shall implement the following Off Right of Way Travel procedures.

.1 The Contractor shall limit equipment travel to the surveyed right-of-way and existing municipal and provincial roads.

.2 Use of equipment of any type is not permitted outside the clearing limits of the right of way without prior approval. To obtain approval for additional or new travel routes, the Contractor shall notify the Engineer a minimum of five (5) working days in advance of such requirements and not commence work until written acceptance is given by the Engineer.

3.20.4 The Contractor shall implement the following procedures when working near bogs and wetlands.

.1 The Contractor shall avoid bogs and wetlands whenever possible. When such travel is necessary, it shall be carried out in consultation with the Engineer.

.2 Bog excavation shall conform to good construction practices and be carried out in accordance with relevant Sections of the Contract Specifications.

3.21 WILDLIFE PROTECTION

3.21.1 Work activities shall be undertaken in a manner that does not harass wildlife. Harassment is defined as any activity that would disrupt the normal behaviour of an animal. Any incidents that involve harassment of wildlife shall be reported to site management. Investigation of such incidents shall be completed and a report provided.

3.21.2 Only essential vehicular activity, including helicopter flights, will be permitted on the construction sites and access roads. The location of identified sensitive wildlife resources shall be provided in the Contract Drawings (Environmental Constraint Mapping).

3.21.3 The following conditions apply to active raptor nests during the critical stages of the

bird's life, which is normally between May 15 and August 15.

.1 All aircraft must maintain a 300 m vertical and horizontal buffer from known active raptor nests between May 15 to August 15

.2 No clearing shall take place within 800m of an active raptor nest between the months of May 15 to August 15;

.3 For all work activities other than clearing, a 200 m buffer shall be respected for active raptor nests from May 15 to August 15. Within this 200 m buffer zone the following applies, after consultation with the provincial government:

.1 Only essential vehicular activity shall be permitted;

.2 Work shall only be permitted in the presence of the On-Site Environmental Monitor; and

.3 Crews shall cease work if there is a disturbance at a nest until activity at the nest has returned to normal; work shall not commence again until approval from the On-Site Environmental Monitor.

.4 Crews shall not establish a permanent or temporary camp within 800 m of a known raptor nest.

3.21.4 Firearms shall not be permitted on the construction sites, unless authorized for use in control of nuisance animals. A policy of no hunting or fishing shall be in force for all personnel on the Project site.

3.22 NOISE CONTROL

3.22.1 The Contractor shall implement measures wherever possible to reduce potential effects arising from a variety of noise sources.

3.22.2 The Contractor shall regularly inspect exhaust systems on all vehicles and generators to ensure the equipment is in good operating condition.

3.22.3 The Contractor(s) shall also take measures so that workers are not exposed to noise levels above 85 dBA as per Occupational Health and Safety Guidelines.

3.22.4 The Contractor shall ensure that its workers shall wear proper personal protective equipment for hearing protection.

3.23 BLASTING

3.23.1 All blasting shall comply with the appropriate permits and approvals. The handling, transportation, storage and use of explosives and all other hazardous materials shall comply with all applicable laws, regulations, orders of the Newfoundland and Labrador Department of Human Resources, Labour and Employment and the Mining and Energy branches of NLDNR, and the *Dangerous Goods Transportation Act* (RSN1990, Chapter D-1, plus amendments).

3.23.2 The Contractor shall review and incorporate environmental protection measures detailed in the “Guidelines for the Use of Explosives in or Near Canadian Fisheries Waters” (Wright and Hopkey, 1998), which is referenced in the P-WEPP.

3.23.3 Blasting mats shall be used in environmentally sensitive areas.

3.23.4 Explosives shall be used in a manner that will minimize damage or defacement of landscape features, trees and other surrounding objects by controlling through the best methods possible the scatter of blast material beyond the limits of the work site.

3.23.5 Blasting patterns and procedures shall reduce shock or instantaneous peak noise levels.

3.23.6 Time delay blasting cycles shall be used if necessary, to control the scatter of blasted material.

3.23.7 Blasting shall not occur near any fuel storage facilities.

3.23.8 When blasting operations are within 200 m of a watercourse occupied by fish, the operations shall be carried out in accordance with DFO guidelines.

3.23.9 Underwater blasting activities shall require review and authorization from DFO and the

DFO Area Habitat Coordinator shall be notified 24 hours before the start of blasting operations.

3.23.10 The Contractor shall monitor downstream areas after each blast for evidence of fish kills and if any are evident, blasting operations shall cease and DFO shall be contacted.

3.23.11 Blasting underwater shall comply with the required water resources permits from DOEC and a Letter of Advice from DFO.

3.23.12 The contractor shall conduct a visual inspection three (3) hours prior to any blasting near watercourses; the visual reconnaissance shall establish the presence of any waterfowl or aquatic mammals. Blasting may be delayed in such circumstances until wildlife have been allowed to leave the area of their own accord.

3.23.13 The immediate area of the blast site shall be surveyed within one hour prior to a blast and operations shall be curtailed if wildlife (e.g. black bears, water fowl, raptors, etc.) is observed within 500 m. Environmental personnel and On-Site Environmental Monitors shall conduct pre-blast monitoring to see and identify species of concern. Additionally, any individual animal sightings by other personnel shall be reported to the On-Site Environmental Monitor. Blasting may be delayed in such circumstances until wildlife have been allowed to leave the area of their own accord;

3.23.14 Drilling and blasting activities shall be undertaken so that the magnitude of explosions is limited. Blasting plans shall be provided as part of the C-SEPP plans.

3.24 PROTECTION OF HISTORIC RESOURCES

3.24.1 The Contractor shall be aware that the *Historic Resources Act* (1985) requires the protection of archaeological sites and artefacts, and sets forth procedures to be followed in the event that either is found. The Contractor shall be aware of the following Sections of the Act:

.1 Section 10(1) - A person who discovers an archaeological object in, on, or forming part of the land within the province shall report the discovery forthwith to the Minister

stating the nature of the object, the location where it was discovered and the date of the discovery.

.2 Section 10(2) - No person, other than the one to whom a permit has been issued under this Act, who discovers an archaeological object shall move, destroy, damage, deface or obliterate, alter, add to, mark or in any other way interfere with, remove or cause to be removed from the province that object.

.3 Section 11(1) - The property in all archaeological objects found in, on or taken from the land within the province, whether or not these objects are in the possession of Her Majesty is vested in Her Majesty.

3.24.2 Should the Contractor encounter any archaeological remains, such as stone, bone or iron tools, concentrations of bone, fireplaces, house pits and/or foundations, work in the area of the find shall cease immediately. The Contractor shall immediately notify the Engineer, immediately upon discovery of any historic resources. The Engineer shall immediately notify The Company who in turn shall immediately notify the Historic Resources Division.

3.25 ENVIRONMENTAL COMPLIANCE MONITORING

3.25.1 Ongoing monitoring for compliance with regulatory requirements shall be conducted throughout the life of the Project by the Engineer. Dedicated On-Site Environmental Monitors shall be present at the construction sites.

.1 The Contractor shall not unduly restrict or impede the Monitors in the performance of their duties.

.2 The Contractor shall be responsible for environmental performance and reporting, as required by provisions of any permits, authorizations or approvals.

.3 The results of compliance monitoring shall be evaluated as part of the Project's Environmental Management Plan. Compliance instructions shall be issued by the Engineer, as required, ensuring compliance with all regulatory and contractual environmental requirements.

Newfoundland Labrador

Government of Newfoundland and Labrador
Department of Environment and Conservation
Water Resources Management Division

PERMIT TO ALTER A BODY OF WATER

Pursuant to the *Water Resources Act*, SNL 2002 cW-4.01, Section(s) 48

Date: **JULY 10, 2013**

File No: **536-12**
Permit No: **ALT6933-2013**

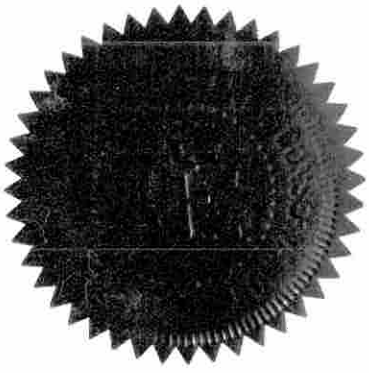
Proponent: **Nalcor Energy**
500 Columbus Drive
P.O. Box 12800
St. John's NL A1B 0C9

Attention: **Peter Madden**

Re: **Lower Churchill Muskrat Falls - Dams, Powerhouse, Spillway and North Spur Stabilization**

Permission is hereby given for : **the construction of Powerhouse and Intake, Spillway and Transition Dams, North RCC Dam, Rockfill Dams, Cofferdams, North Spur stabilization and associated activities outlined in the application received on March 25, 2013 required for the Muskrat Falls hydroelectric generation facility.**

- This permit does not release the proponent from the obligation to obtain appropriate approvals from other concerned provincial, federal and municipal agencies.
- The proponent must obtain the approval of the Crown Lands Division of the Department of Environment and Conservation if the project is being carried out on Crown Land.
- This permit is subject to the terms and conditions indicated in Appendix A (attached).
- It should be noted that prior to any significant changes in the design or installation of the proposed works, or in event of changes in ownership or management of the project, an amendment to this permit must be obtained from the Department of Environment and Conservation under Section 49 of the *Water Resources Act*.
- Failure to comply with the terms and conditions will render this permit null and void, place the proponent and their agent(s) in violation of the *Water Resources Act* and make the proponent responsible for taking any remedial measures as may be prescribed by this Department.



MINISTER

GOVERNMENT OF NEWFOUNDLAND AND LABRADOR
Department of Environment and Conservation

Permit No: ALT6933-2013

APPENDIX A

Terms and Conditions for Environmental Permit

Lower Churchill Muskrat Falls - Dams, Powerhouse, Spillway and North Spur Stabilization

Special Conditions

1. Prior to construction of upstream cofferdam and diversion of Churchill River an Emergency Preparedness Plan (EPP) must be submitted to **Director of Water Resources Management Division (WRMD)**. The proponent must also provide a written notification to the Director of WRMD prior to start of construction of cofferdams within the Churchill River.

2. This permit includes temporary cofferdams to ensure dry working conditions during construction as per application submitted by proponent. Additional temporary cofferdams may be constructed under the authority of this permit to complete the work outlined in the application.

Dam/Reservoir Design

3. The dam(s) and appurtenant structures shall be constructed at the following coordinates:

Name	Datum	Northing (m)	Easting (m)	Zone
Intake Channel Cofferdam	NAD83	5901693	649168	20
Gated Spillway	NAD83	5901850	649097	20
Upstream Cofferdam	NAD83	5902010	648855	20
Downstream Cofferdam	NAD83	5902030	649030	20
North RCC Dam / overflow dam	NAD83	5902048	648930	20
South Rockfill Dam	NAD83	5901500	649130	20

4. The dam(s) must have the following dimensions:

Name	Height of Dam (m)	Height of Spillway (m)	Maximum Water Elevation (m)	Minimum Water Elevation (m)	Minimum Freeboard (m)
Intake Channel Cofferdam	n/a	n/a	25.0	8	1
Gated Spillway	n/a	40	45.1	38.5	n/a
Upstream Cofferdam	30	n/a	25	8	1
Downstream Cofferdam	5	n/a	8	2	1
North RCC Dam	45	39.3	45.1	38.5	n/a
South Rockfill Dam	20	n/a	45.1	38.5	1.2

5. To safely convey peak flows the dam(s) must be designed according to the following hydraulic criteria:

Name	Design Return Period (years)	Minimum Flow Capacity (m^3/s)
Intake Channel Cofferdam	20	5990
Gated Spillway	PMF	25060
Upstream Cofferdam	20	5990
Downstream Cofferdam	20	5990
North RCC Dam	PMF	25060
South Rockfill Dam	PMF	25060

6. Reservoirs must be provided with a spillway of adequate capacity to safely discharge design flows at non-erosive velocities without causing flooding of the reservoir or damage to the spillway or section downstream channel.

7. The range of normal operating water levels in the reservoir shall be between elevations 38.5 metres and 39.0 metres.

Dam Construction

8. Reservoir shorelines with moderately steep slopes or vulnerability to wave induced erosion, must be adequately protected with armour stone, rip-rap, or by other suitable measures.

9. The dam structure must be constructed with a sluice gate of adequate capacity to provide continuous flow to downstream areas and to enable reservoir dewatering for dam or reservoir maintenance.

10. The area to be flooded by the reservoir must be prepared by removing timber, brush, and slash.

11. The transportation of labour and materials to the site must be along existing access roads where possible

12. The dam and spillway must be inspected regularly to identify any indications of structural failure, leaking, erosion or other problem so that immediate action can be taken to rectify the problem.

13. The work must meet the requirements of the Environmental Protection Plan (latest approved version) for the project.

Dam Safety

14. The North RCC Dam and the South Rockfill Dam have been conditionally classified in the VERY HIGH Consequence category based on the 2007 Canadian Dam Association (CDA) guidelines. To meet the CDA's Dam Safety guidelines (Current Edition) for dams of this classification, the owner must:
    - Carry out an annual Dam Safety Inspection and provide the results to this Department,
    - Carry out a Dam Safety Review and submit a Dam Safety Report to this Department within two years of the start of reservoir filling and a maximum of every **five years** after that,
    - Develop within one year of the issuance of this permit, and in consultation with this Department, an Operation, Maintenance and Surveillance (OMS) Manual for the operation and closure phases,
    - Prepare an Emergency Preparedness Plan (EPP) prior to filling reservoir.

Stream Diversion Design

15. The stream diversion(s) must have the following dimensions:

Name	Bottom Width (m)	Depth of Channel (m)	Bank Slope (H:V)	Flow Area (m^2)	Bed Slope (%)
Three Kettle Lakes Area	varies	varies	2.5:1	unknown	varies (~3-20)

16. To safely convey peak flows, the stream diversion(s) must be designed according to the following hydraulic criteria:

Name	Design Return Period (years)	Maximum Flow Capacity (m^3/s)	Maximum Flow Velocity (m/s)
Three Kettle Lakes Area	100	5.86	unknown

17. An approximately 332.5 metre long permanent discharge channel may be excavated to carry the waters of Three Kettle Lakes to the Churchill River.

18. The new channel must provide adequate capacity to safely discharge flood flows at a velocity no greater than that which would occur in the natural channel.

19. A minimum freeboard of 0.5 metres must be provided between the design high water level and the top of the channel bank to prevent overtopping.

Fording

20. Except for single passenger all terrain vehicles, crossings by other vehicles or construction equipment shall be limited to one trip in and one trip out unless temporary structures are constructed to protect the natural stream.

21. Timbers or rocks shall be placed in streams to facilitate crossing or to minimize damage to the channel sections provided the streams are not unnecessarily constricted or backed up.

22. Alteration of the natural minimum streamflow is not permitted in order to preserve aquatic life.

23. Stream banks at fording sites that contain loose or erodible material must be adequately stabilized before crossing to minimize any siltation of streams.

24. Infilling must not cause increased water elevation upstream or increase flow velocity downstream of the site. Reduction of the natural cross sectional area of any watercourse is not permitted.

25. The fording sites must be located at shallow sections of the channels where there are low approach grades, and where the channels consists of stable non-erodible rock or cobbles.

26. Fording shall only be carried out during periods of low water levels.

27. When the fording sites are no longer required, the proponent must dismantle and remove all constructed works and restore the sites to their original condition. All material placed in streams must be completely removed.

28. A complete oil spill clean-up kit must be on site at all times when gasoline or fuel powered equipment is being used or refuelled. The kit must contain the following:
    - One hand operated fuel pump
    - One recovery container such an empty 205 litre drum
    - One shovel
    - One pick ax
    - Five metres of containment boom
    - Five absorbent pads
    - Twenty-five litres of loose absorbent material

General Alterations

29. Any work that must be performed below the high water mark must be carried out during a period of low water levels.

30. Any flowing or standing water must be diverted around work sites so that work is carried out in the dry.

31. Water pumped from excavations or work areas, or any runoff or effluent directed out of work sites, must have silt and turbidity removed by settling ponds, filtration, or other suitable treatment before discharging to a body of water. Effluent discharged into receiving waters must comply with the *Environmental Control Water and Sewage Regulations, 2003.*

32. All operations must be carried out in a manner that prevents damage to land, vegetation, and watercourses, and which prevents pollution of bodies of water.

33. The use of heavy equipment in streams or bodies of water is not permitted. The operation of heavy equipment must be confined to dry stable areas.

34. All vehicles and equipment must be clean and in good repair, free of mud and oil, or other harmful substances that could impair water quality.

35. During the construction of concrete components, formwork must be properly constructed to prevent any fresh concrete from entering a body of water. Dumping of concrete or washing of tools and equipment in any body of water is prohibited.

36. Wood preservatives such as penta, CCA or other such chemicals must not be applied to timber near a body of water. All treated wood or timber must be thoroughly dry before being brought to any work site and installed.

37. Any areas adversely affected by this project must be restored to a state that resembles local natural conditions. Further remedial measures to mitigate environmental impacts on water resources can and will be specified, if considered necessary in the opinion of the Department.

38. The bed, banks and floodplains of watercourses, or other vulnerable areas affected by this project, must be adequately protected from erosion by seeding, sodding or placing of rip-rap.

39. All waste materials resulting from this project must be disposed of at a site approved by the Department of Service NL.

40. Periodic maintenance such as painting, resurfacing, clearing of debris, or minor repairs, must be carried out without causing any physical disruption of any watercourse. Care must be taken to prevent spillage of pollutants into the water.

41. The owners of structures are responsible for any environmental damage resulting from dislodgement caused by wind, wave, ice action, or structural failure.

42. Sediment and erosion control measures must be installed before starting work. All control measures must be inspected regularly and any necessary repairs made if damage is discovered.

43. The attached Completion Report (Appendix B) for Permit No. 6933 must be completed and returned to this Department upon completion of the approved works.

44. This Permit is valid for five years from the date of issue. Work must be completed by that date or the application and approval procedure must be repeated.

45. The location of the work is highlighted on the Location Map for this Permit attached as Appendix C.

46. Pictures must be submitted along with the completion report, showing the project site prior to and after development.

Water Resources EA Commitments

47. The Proponent must establish an index network of climate stations throughout the reach of the project area. These stations may be used to distinguish Project impacts from climate change impacts, assess any Project impacts on the Mud Lake ice bridge and be used for operational purposes. The proposed climate network stations must be submitted to Water Resources Management Division for review and approval.

48. As per OC 2012-061(Lower Churchill Hydroelectric Generation Project Undertaking Order) the Proponent must include in its Environmental Effects Monitoring Plan provisions to undertake groundwater monitoring in Mud Lake. Any proposed monitoring and reporting must be submitted to the Water Resources Management Division for review and approval.

49. As per OC 2012-061 (Lower Churchill Hydroelectric Generation Project Undertaking Order) the Proponent must include in its Environmental Effects Monitoring Plan provisions to undertake ice formation monitoring. Any proposed monitoring and reporting must be submitted to the Water Resources Management Division for review and approval.

50. As per Section 49.2 of the Water Resources Act the minister may amend any terms and conditions outlined in this permit or add new terms and condition by issuing an amendment to this permit.

cc: File Copy for Binder

cc: Manager, Water Investigations Section
Department of Environment and Conservation
Water Resources Management Division
P.O. Box 8700
St. John's NL A1B 4J6

cc: Ms. Michelle Roberge
Section Head, Habitat Planning and Operations
Marine Environment and Habitat Management Division
Department of Fisheries and Oceans
PO Box 5667
St. John's NL A1C 5X1

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Mingan, QC G0G 1V0

cc: Chef Raymond Bellefleur
Conseil de bande des Montagnais d'Unamen Shipu
Carte postale 121
La Romaine QC G0G 1M0

cc: Chef Rodrigues Wapistan
Conseil des Montagnais de Natashquan
78, rue Mashkush
Natashquan QC G0G 2E0

cc: Chef Réal McKenzie
Conseil de la Nation Innu Matimekush-Lac John
172 Pearce Lake
Carte postale 1390
Schefferville, QC G0G 2T0

cc: Chief Isaac Pien
Naskapi Nation of Kawawachikamach
1009 Naskapi Road, P.O. Box 5111
Nuchimiyuschiiy, QC G0G 2Z0

cc: Conseil des Innus de Pakua Shipu
Carte postale 178
Pakua Shipi, QC G0G 2R0

cc: David Andre
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Schefferville QC G0G 2T0

cc: Ken Rock
Innu Takuaikan Uashat mak Mani-Utenam
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265 Boul. Des Montagnais
Uashat, QC G4R 4L9

cc: Larry Innes and Paula Reid
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cc: Marie-Christine Gagnon
BCF LLP

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Montréal, QC H3B 5C9

cc: Morgan Kendall
O'Reilly & Associes
1155 University, Bureau 1007
Montreal QC H3B 3A7

cc: Mr. Brian Harvey
Director, Policy and Planning (A), Aboriginal Affairs Branch
Intergovernmental and Aboriginal Affairs Secretariat

cc: Mr. George Russell Jr.
Environment and Resource Manager
NunatuKavut Community Council
P.O. Box 460, Station C
Happy Valley-Goose Bay
NL A0P 1C0

cc: Mr. John Mameamskum
P.O. Box 5111
Kawawachikamach QC G0G2Z0

cc: Mr. Steve Pellerin
Nalcor Energy
Hydro Place, 500 Columbus Drive
P.O. Box 12800
St. John's, NL A1B 0C9

cc: Mr. Tom Sheldon
Director
Environment Division
Nunatsiavut Government
P.O. Box 70
Nain, NL A0P 1L0

cc: Paul Renzoni
General Advisor, Naskapi Nation of Kawawachikamach
5800 Monkland Avenue
2nd Floor
Montreal QC H4A 1G1

Newfoundland Labrador

Government of Newfoundland and Labrador
Department of Environment and Conservation
Water Resources Management Division

Appendix B - Completion Report

Pursuant to the *Water Resources Act*, SNL 2002 cW-4.01, Section(s) 48

Date: **JULY 10, 2013**

File No: **536-12**
Permit No: **ALT6933-2013**

Proponent: **Nalcor Energy**
500 Columbus Drive
P.O. Box 12800
St. John's NL A1B 0C9

Attention: **Peter Madden**

Re: **Lower Churchill Muskrat Falls - Dams, Powerhouse, Spillway and North Spur Stabilization**

Permission was given for : **the construction of Powerhouse and Intake, Spillway and Transition Dams, North RCC Dam, Rockfill Dams, Cofferdams, North Spur stabilization and associated activities outlined in the application received on March 25, 2013 required for the Muskrat Falls hydroelectric generation facility.**

I (the proponent named above or agent authorized to represent the proponent) do hereby certify that the project described above was completed in accordance with the plans and specifications submitted to the Department of Environment and Conservation and that the work was carried out in strict compliance with the terms and conditions of the Permit issued for this project.

Date: _____ Signature: _____

This completion report must be completed and forwarded to the following address upon completion of the approved work.

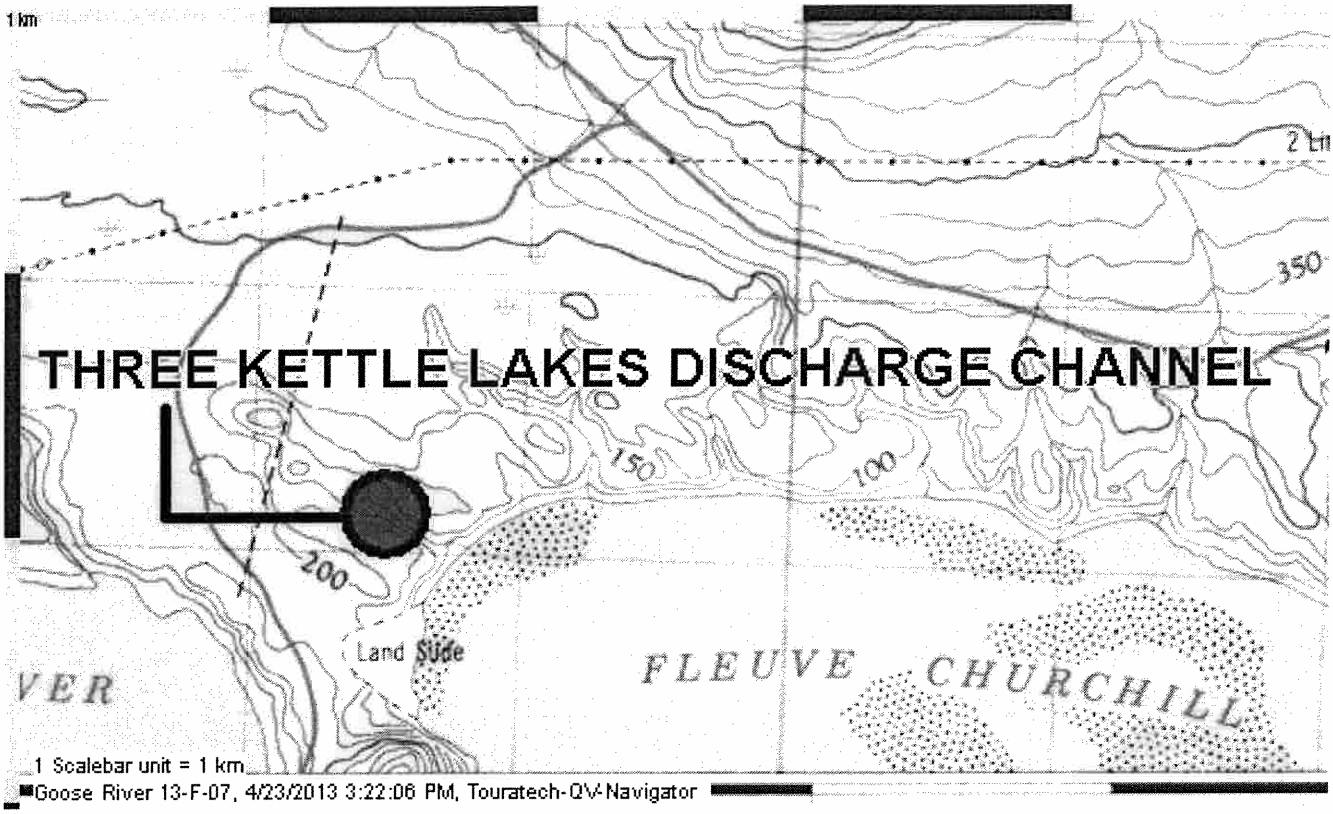
Department of Environment and Conservation
Water Resources Management Division
PO Box 8700
St. John's NL A1B 4J6

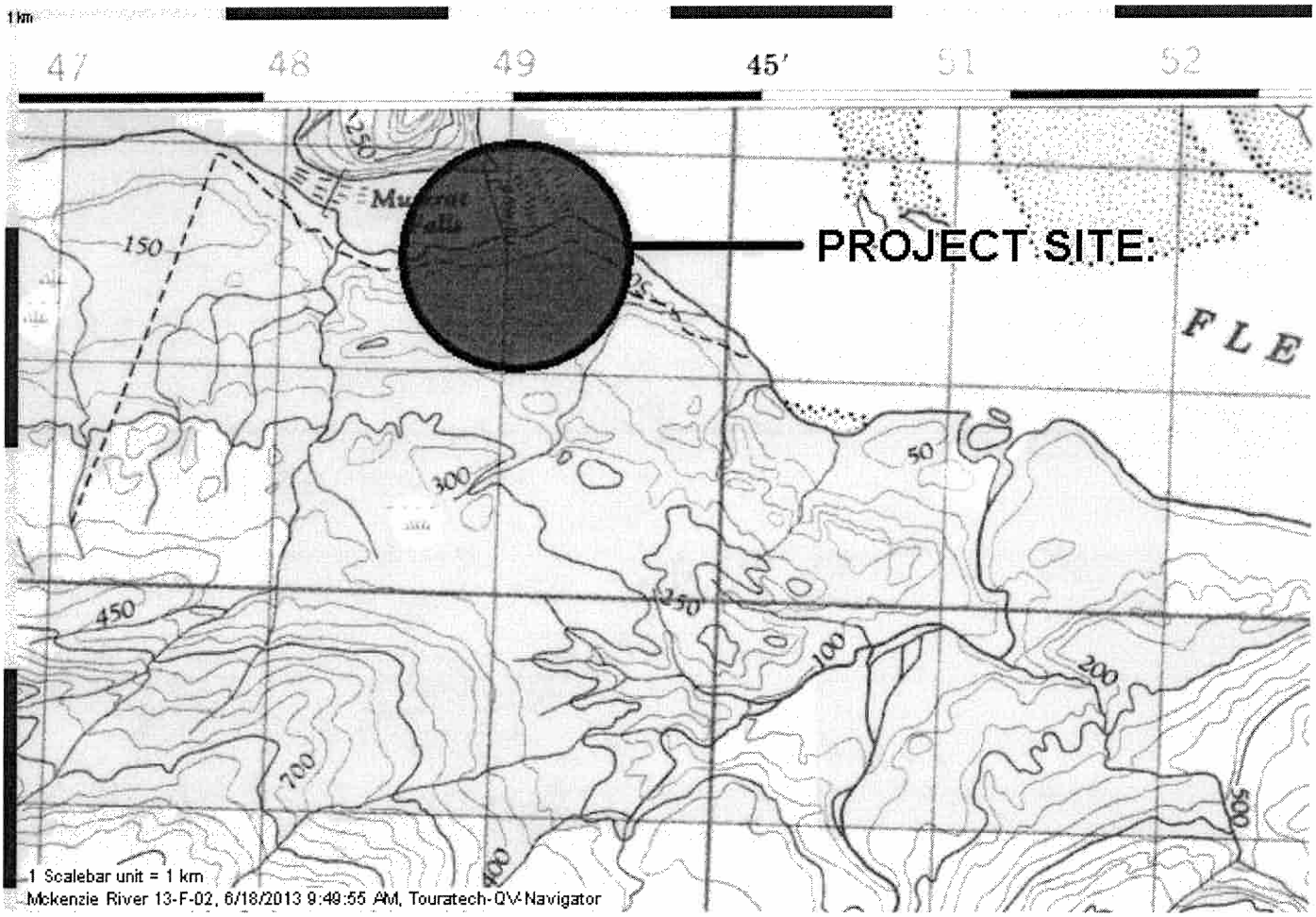
GOVERNMENT OF NEWFOUNDLAND AND LABRADOR
Department of Environment and Conservation

Permit No: ALT6933-2013

APPENDIX C

Location Map for Environmental Permit

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45'
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PROJECT SITE:
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