Peace River Project Water Use Plan

Dunlevy Boat Ramp Feasibility, Design and Costing

Final Report

Reference: GMSWORKS-54

Dunlevy Replacement Boat Ramp Feasibility Study

Moffatt & Nichol

June 28, 2013

DUNLEVY REPLACEMENT BOAT RAMP FEASIBILITY STUDY

June 28, 2013

DUNLEVY REPLACEMENT BOAT RAMP FEASIBILITY STUDY

June 28, 2013

7937 – FINAL

Prepared for:

BC hydro

6911 Southpoint Drive
Burnaby, BC, V3N 4X8

Prepared by:

moffatt & nichol

777 West Broadway, Suite 301
Vancouver, BC
V5Z 4J7

REV	DESCRIPTION	DATE ISSUED	PREPARED BY	REVIEWED BY	APPROVED BY
G	Final Report	June 28, 2013	PH	MN	PH
F	Options 5, 5A, 5B,6, 6A &6B - Draft	May 31, 2013	PH	MN	PH
E	Revised Draft	April 22, 2013	PH		
D	Revised Draft – Option 4	April 4, 2013	PH		PH
C	Revised Draft	March 19, 2013	PH		PH
B	Revised Draft	March 13, 2013	PH	MN	PH
A	Draft	February 27, 2013	PH	MN	PH

Table of Contents

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

1.1 PROJECT BACKGROUND

As part of the Water Use Agreement, BC Hydro (BCH) is obligated to provide physical works on the reservoir that will allow recreational/sports users to access the Peace River and Williston Reservoir throughout the annual water level cycles in the river and reservoirs. The Peace Water Use Plan Consultative Committee (PWUPCC) was tasked with the mandate to determine the requirements and make recommendations for recreational access on the river and reservoir. PWUPCC recommended a package that included operating constraints and physical works for the Peace System that will result in enhanced recreational access to the Williston Reservoir, the Dinosaur Reservoir, and the Peace River below Peace Canyon Dam.

Based on the PWUPCC recommendations, the Comptroller of Water Rights issued the Order to BCH to prepare feasibility studies to improve recreational access to the reservoirs. Subsequently, BCH issued a Request for Proposal (RFP) in March 2009 for a consultant to undertake a feasibility study for access to the Peace River, and the Williston and Dinosaur Reservoirs including improvements to the existing access points on the reservoir.

In June 2009, the Moffatt & Nichol (M&N) project team was engaged by BCH to undertake the feasibility study. The Terms of Reference (TOR) for the feasibility study as provided by BCH required the M&N project team to fulfill the following tasks:

- Perform a reconnaissance survey of the existing boat launch ramp and the best relocation alternative for a replacement boat ramp at Dunlevy on the Peace Reach of the Williston Reservoir. The preferred relocation alternative is to be identified by the project team; and,
- Determine the feasibility of the alternative boat launch ramps and (where relevant) of the upgraded or relocated dock and breakwater based on engineering technical feasibility, archaeological feasibility, and environmental criteria, and also provide recommendations for each site.

In March 2010, Moffatt & Nichol (M&N) submitted a feasibility study final report[1] to fulfill the requirements of the TOR which included a review and recommendation of recreational access for the Dunlevy area on the Williston Reservoir. At that time, two sites were investigated, Dunlevy West located on the west side of the Dunlevy inlet, and the existing Dunlevy boat ramp site located on the east side of the Dunlevy Inlet. A reconnaissance site survey was undertaken for each location by the project team. The feasibility for the sites was reviewed from engineering, environmental and archaeological perspective.

The M&N 2010 feasibility report recommended that the existing Dunlevy site was potentially feasible subject to further geotechnical evaluation for erosion.

[1] Moffatt & Nichol report dated March 5, 2010 titled "GMSWORKS 12/13 – Water License Requirements Peace and Williston Recreational Access Feasibility Study, Reach, and Dinosaur Lake-FINAL REPORT"

Geotechnical investigations were carried out by EXP Services Inc. (EXP); formerly Trow Associates and the results of the investigations were presented in EXP's report[2] dated September 3, 2010. Based on the results of the geotechnical investigations, M&N prepared detailed design and probable construction cost estimates[3] for a new boat launch ramp at the existing Dunlevy site. The proposed new boat launch ramp is orientated in a south–north direction versus an east-west layout for the existing ramp.

Subsequent reviews by BCH recognized the need to consider a range of alternative sites in order to arrive at the optimal site taking into account factors such as constructability, user requirements, ease of access, costs, etc., which included Josef Creek Inlet as a potential site for a replacement ramp as well as an alternative site on the west side of Dunlevy inlet. M&N provided a report[4] on the feasibility level designs and cost estimates for four sites for comparison, namely Existing Dunlevy, Dunlevy West, Josef Creek with access through the Ross property and Josef Creek with access through the Provincial Park property.

Based on the findings in M&N report dated October 23, 2012, BCH confirmed that the existing Dunlevy site was best suited for providing a replacement ramp. However, in a further effort to reduce the capital costs, BCH requested M&N to prepare feasibility designs for the existing east-west boat ramp location to determine if improvements to the existing boat ramp could provide cost reductions for the capital costs over a new north-south boat ramp at the existing Dunlevy site.

Subsequent to Revision E dated April 22, 2013 of this draft report, BC Hydro hosted a boat launch ramp workshop on May 9, 2013 to develop additional options by considering revised operating water levels and other factors. As result, the conceptual layouts for Options 5, 5A, 6 and 6A were conceived in the workshop.

1.2 SCOPE OF WORK

The scope of the work is as follows:

- Prepare and provide conceptual designs for the existing boat ramp location at Dunlevy. This option is identified as the base option case, and consideration should be given for a graveled surface ramp at the current location;
- Prepare and provide tweaks to the design of replacement Dunlevy boat ramp at the existing site to reduce costs; and,
- Prepare cost estimates of construction costs for both options.

[2] EXP (Trow Associates) report dated September 3, 2010 titled "Geotechnical Report – Proposed BC Hydro Boat Launch Ramp, Dunlevy Main Site, Williston Reservoir, BC"

[3] M&N memorandum dated May 18, 2011 titled "Williston Reservoir and Peace River Boat Launch Ramp Cost Estimate."

[4] M&N report dated October 23, 2012, and titled "Dunlevy Replacement Boat Ramp Facility Feasibility Study."

1.3 DATA COLLECTION

Bathymetry surveys of the existing Dunlevy site at the replacement ramp location was done by TerraSond in August 2010. Atek Hydrographic Surveys Ltd also carried out bathymetry surveys in May 2009 for the existing Dunlevy site. These bathymetry surveys were used to prepare base drawings for the feasibility design layouts of the boat launch ramp facility.

A geotechnical investigation was carried out by EXP Services (EXP) in July 2010 for the replacement boat ramp at the Dunlevy site. Two deep drill-holes were done (6m and 14m depth) and two shallow test pits (only 200mm deep). However, the drill-holes (AH1 & AH2) were not located along the alignment of the preferred option (Option 5), so it would be prudent to carry out a more focused field investigation before the next design stage. This is confirmed in Section 2.2.11.

1.4 REPORT ORGANIZATION

Section 2 describes the user requirements and the design basis for the feasibility design of the existing boat ramp replacement. Section 3 describes the features of the layout of the boat ramp feasibility. An opinion of probable construction costs for the feasible designs are presented in Section 4, with conclusions and recommendations in Section 5. Our closing remarks are in Section 6.

Appendix A contains drawings including a project location map, feasible layout plans of the replacement facilities. Appendix B contains the details of the cost estimate.

2. FEASIBILITY DESIGN FOR REPLACEMENT BOAT RAMP AT DUNLEVY

2.1 BC HYDRO USER REQUIREMENTS

BCH user requirements were determined through consultation with local stakeholders who identified their needs in the 2007 Peace Water Use Plan, Committee Report. Subsequent Peace River and Reservoir Access Public meetings were held to verify that the design option had fulfilled the stakeholders' expectations.

BCH notes of the community meetings were presented to the Comptroller of Water Rights to confirm that BC Hydro had fulfilled the requirement of the Peace River Recreational Access component of the Water License. The design criteria for the boat ramp facility were developed from BCH User requirement documents.

2.2 DESIGN CRITERIA

The design criteria document outlines the basis and parameters for the planning and the feasibility designs of the boat launch ramp, riprap protection, parking area, and access road at the existing Dunlevy site. The design criteria comply with BC Hydro Site Specific User Requirements. In the event of a discrepancy, the BC Hydro Site Specific User Requirements will take precedence over the design criteria.

2.2.1 Codes and Standards

The structures will be designed to conform to the most current version of the following codes and standards at the time of the study:

- US Army Corps of Engineers, Coastal Engineering Manual;
- US Army Corps of Engineers, Shore Protection Manual;
- Oregon State Marine Board, Layout and Design Guidelines for Recreational Boat Launching Facilities;
- Layout, Design and Construction Handbook for Small Craft Boat Launching Facilities, California Department of Boating and Waterways, Division of Boating Facilities;
- Layout and Design Guidelines for Marina Berthing Facilities, California Department of Boating and Waterways, Division of Boating Facilities;
- Park Design Guidelines and Data, Province of British Columbia, Ministry of Environment Lands and Parks;
- National Building Code of Canada; and,
- CERIA; CUR; CETMEF; The Rock Manual, The Use of Rock in Hydraulic Engineering, 2nd Edition 2007.

2.2.2 References

- Sodhi, D.S., S.L. Borland and Stanley J.M. (1996), Ice Action on Riprap, Small Scale Tests. CRREL Report 96-12; and,
- White K.D., (2004) Method to Estimate River Ice Thickness based on Meteorological Data. US Army Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire, ERDC/CRREL Technical Note 04-3.

2.2.3 Materials and Testing

Materials and testing will be specified to conform to the most current edition of the relevant standards, where applicable, as published by the following organizations:

- Canadian Standards Association (CSA); and,
- American Society of Testing and Materials (ASTM).

In the event of any discrepancy, CSA shall take precedence over ASTM.

2.2.4 Units of Measurement

Construction drawings and specifications will be in accordance with the International System of Units (SI) metric units. All dimensions shall be in millimeters unless noted otherwise.

2.2.5 Project Datum and Elevations

Horizontal coordinates are in meters to the UTM NAD83 Zone 10 coordinate system. All elevations are referenced to geodetic datum, and are in metres unless noted otherwise.

2.2.6 Design Life

The launching ramp of the proposed facility will be designed for a thirty (30) year service life. This service life assumes that a regular inspection and maintenance program is implemented to repair damage and deterioration which is normal for structures exposed to wave, current and ice forces. The mooring anchors for the floating timber breakwater will be designed for a thirty (30) year service life. Due to regulatory requirements for untreated timber to be used for in water works, the structural timber members for the floating breakwater will have a ten (10) year service life.

2.2.7 Environmental Loads and Effects

Environmental loads are in accordance with the data published in the supplement of the National Building Code of Canada (NBCC). It is assumed that the environmental loads and effects for Mackenzie is applicable to Dunlevy as provided in Table C-2 in Appendix C of the NBCC. The relevant data for Dunlevy are included as below:

(A) RAINFALL

- 15 minutes - 10 mm
- One day - 50 mm
- Annual total - 350 mm

(B) GROUND SNOW

- S_s ground snow load 1 in 50 yr - 5.1 kPa
- S_r associated rain load 1 in 50 yr - 0.2 kPa

(C) WIND PRESSURE

Hourly Wind Pressure:

- 1/10 yr - 0.25 kPa
- 1/50 yr - 0.32 kPa

(D) TEMPERATURE

The maximum and minimum temperature ranges for Mackenzie have been adopted for Dunlevy as shown in Table 1 below.

Table 1: Maximum and Minimum Temperature Range for Dunlevy

January		July 2.5%	
2.5%	1%	Dry	Wet
°C	**° C**	**° C**	**° C**
-34	-38	27	17

(E) CURRENT

The current at the existing Dunlevy site was considered negligible.

(F) ICE

In a design review meeting held at BC Hydro Edmonds offices on December 18, 2012, Klohn Crippen Berger (BC Hydro's review Engineer) proposed that the riprap could be designed based on metocean conditions only due to limited ice information, observational based (empirical) design method and high associated cost of riprap. Any potential movement to the riprap due to ice forces could be repaired under an annual maintenance of the facility. Adopting the approach based on the riprap being designed for metocean conditions will likely have a reduction on the capital cost for the boat ramp facility; however, there could be a potential increase in the annual maintenance cost. Additional costs to repair riprap for ice damage can be included in annual maintenance budget for the facility. For the

purposes of this study, a 1 in 30 year design wave will be used to size the riprap protection as the worse scenario governing the riprap design.

If ice force effects are to be considered on the riprap and taken into account in the design of the scour protection for the boat ramp, it should be noted that there is no data collection for ice formations on the Williston Reservoir and Peace River except for anecdotal information from local fishermen who ice fish in the winter months.

M&N has estimated the ice cover thickness using empirical degree-day relationships and compared it to local knowledge information. Table 2 below summarizes the estimates of ice thickness for the Peace River.

Table 2: Summary of Estimate of Design Ice Thickness

Analysis Method		Estimated Ice Thickness (mm)
Degree-Day Estimate	Min.	605
	Max.	960
Anecdotal	Min.	250
	Max.	340
	Exceptional	610

Factors such as snow cover, wind exposure, currents and site location can significantly influence the ice cover on the reservoir. The extent of field investigations required to quantify these effects is beyond the scope of this project. Previous studies using a design ice thickness of 0.5m resulted in large sized riprap to be used for scour protection.

BC Hydro has agreed that ice forces need not be included in the design criteria for the Dunlevy replacement boat ramp, and the riprap design should be for wave effects only.

2.2.8 Landslides and Tsunamis

The effects of a seismically induced landslide at the preferred site can be assessed in the detailed design development.

The effects of tsunamis have not been evaluated at this time, although the risk is low due to low levels of seismicity. A tsunami risk analysis may not be required as part of the detailed design development.

2.2.9 Marine Criteria

(A) WATER LEVELS

Design elevations for locations on Williston Reservoir are based on water levels provided by BC Hydro and obtained from the Environmental Canada website for the period July 1976 through December 2007. The archived water levels for Williston Reservoir near Lost Cabin Creek and Williston Reservoir at Schooler Creek are quoted relative to an arbitrary datum. M&N converted these measurements to geodetic datum based on reservoir levels reported by BC Hydro for two dates in 2004. These conversions should be considered approximate (accuracy 0.3 m at best). Based on these measurements, Figure 1 shows the annual variability in water level at Williston Reservoir.

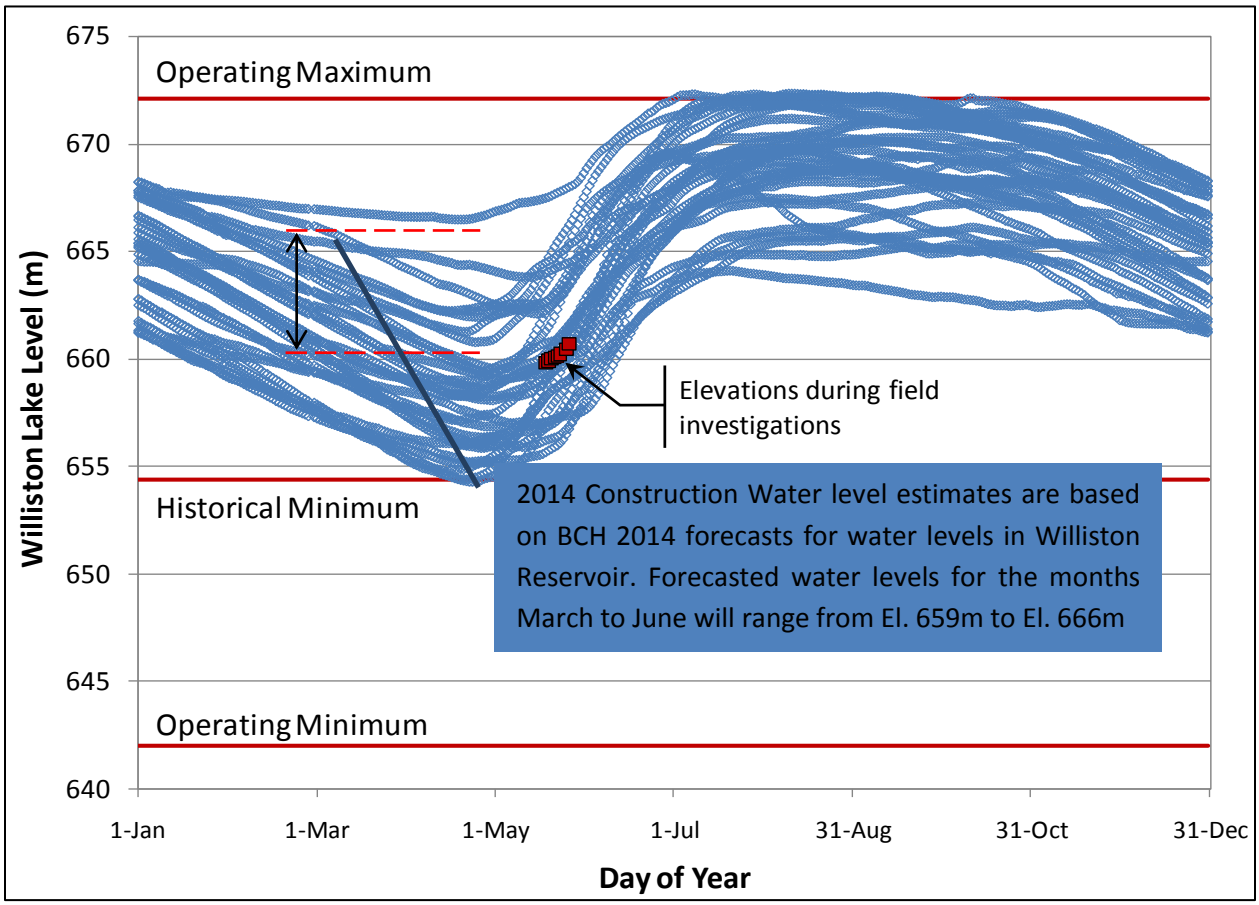


Figure 1: Water Surface Elevations at Williston Reservoir

A striking feature of these water levels is that the operating minimum of El. 642.0 m (2106 ft) has not been approached in the past 30 years. As such, BC Hydro has stated a minimum normal operating level of El. 654.4 m (2147 ft). BC Hydro has also indicated that a gravel surface can be used on the ramp from El. 660m to the design ramp toe El. 653.2 m (see Table 3). A gravel surface on the lower ramp portion at up to 15% slope does not comply with normal design guidelines, but has been adopted for constructability and/or cost reduction reasons as explained in Section 3.3. Table 3 implies that a ramp toe at El. 660m is 1.2m below the design summer minimum water level El. 661.2m. BCH is also

examining the option of building the ramp toe at El. 658m with a design low water level El. 659.2m, i.e. 1.2m above the toe of the ramp .

Based on the historical minimum and maximum pool water levels, the design water levels for sites on the Williston Reservoir are as follows:

Table 3: Water Level Elevations Referenced to Geodetic Datum

Water Level Designation	Elevation with respect to Geodetic Datum (GD) (metres)
Recorded High Water Elevation	672.2
Recorded Low Water Elevation	654.4
Design Low Water Elevation for Summer Boating Season	661.2
Design Low Water Elevation for All Year Boating Season	654.4
NB: The elevation of the toe of the ramp is 1.2m (minimum water depth) below the Design Low Water Elevation.	

Construction Water Levels will be based on forecasted data provided by BC Hydro. The construction methodology and schedule for the replacement boat ramp will be determined in collaboration with BC Hydro, consultant and contractor.

(B) BATHYMETRY AND TOPOGRAPHY

Water depths are based on hydrographic surveys carried out by TerraSond in August 2010 and Atek Hydrographic Surveys in May 2008. Upland contours were generated using LIDAR data provided by BC Hydro. McElhanney was engaged by BCH in May 2013 to provide additional topography survey information for the upland areas. All water depth contours are in metres referenced with respect to geodetic datum.

(C) DESIGN VESSELS

The maximum design vessel is shown in Table 4.

Table 4: Maximum Design Vessel

Vessel Type	Length (metres)	Width (metres)	Max. Draft (metres)
Maximum Power Boat	6.1	2.4	1

(D) WIND

The closest long-term wind data is available from Canada's National Climate Archive at Mackenzie Airport. Data was collected for the directions of concern for wind wave generations at the project site, south through west. This information is shown in occurrences in Tables 5 and 6. The data

was collected as 2-min average wind speed and reported hourly from 1971-2010, recorded at 10 meters above ground.

Table 5 shows the frequency of magnitude by month and shows that extremal wind speeds are observed throughout the year. Table 6 shows the number of occurrences by direction broken into 45 degree increments and shows that the south direction is the dominant wind direction with respect to number of total occurrences as well as number of extreme events. It is also noted that the strongest wind observed over the 39 year record have occurred from the south.

Table 5: Occurrences by Month of Wind Speeds (km/h, west-south)

Month	West-South Wind Speeds in km/h						
	<11	11-21	21-31	31-41	41-51	51-61	>61
1	3601	1879	246	29	8	-	-
2	3698	1810	221	23	1	-	-
3	4950	3037	369	20	-	-	-
4	4875	3548	422	28	-	-	-
5	5259	3939	419	27	3	-	-
6	5247	4290	390	21	-	-	-
7	5015	3940	315	8	1	-	-
8	4867	3140	241	8	-	-	1
9	4501	3015	268	15	1	-	-
10	4436	3207	416	50	4	-	-
11	4041	2161	242	20	2	-	-
12	3936	1863	246	29	5	-	-
Total	**54426**	**35829**	**3795**	**278**	**25**	**0**	**1**

Table 6: Frequency by Direction of Wind Speeds (km/h)

Direction	Wind Speeds in km/h							
	<11	11-21	21-31	31-41	41-51	51-61	>61	Total
S	34061	23988	2620	186	18	-	1	**60874**
SW	7457	5833	604	54	3	-	-	**13951**
W	12908	6008	571	38	4	-	-	**19529**

Extreme Winds

An extreme wind analysis was carried out to evaluate if there was seasonality to event occurrence and the magnitude of statistical extremal wind speeds. The effect of seasonality was determined by examining times of year when water levels will vary and the potential impacts on wave heights on the design of the structure. Water data was provided by BC Hydro and obtained from the Environmental Canada website for the period July 1976 through December 2007. Based on these measurements, Figure 1 shows the annual variability in water level at Williston Reservoir.

From Figure 1 the high-water season was selected as July-October and the low water season as November-June. Based on maximum annual winds speeds, extremal wind speeds were developed for south winds during both low and high water time periods. Extremal wind speeds for both the low and high water seasons are presented in Table 7 along with the yearly extremal wind speeds. Each set of wind speeds was developed using a 2-parameter Gumbel distribution. Table 7 shows that there is a minor difference in the magnitude of extremal wind speeds during the two time periods. This will indicate that portions of the project site which are exposed to the varying water levels of the reservoir will experience similar design wave heights.

Table 7: Extremal wind speeds (South, km/h)

Return Period (yr)	High Water Months (July-Oct) Extremal Wind Speeds (km/hr)	Low Water Months (Nov. –June) Extremal Wind Speeds (km/hr)	All Months Extremal Wind Speeds (km/hr)
2	29	34	35
5	36	39	41
10	40	43	45
25	45	47	50
50	49	51	53
100	53	54	57
200	57	57	60

(E) WAVES

Wind speed analysis using yearly maximums of the south winds were used in developing extremal wind generated waves. Winds from the south represent both the strongest winds and the longest fetch over which waves can generate and is considered the worst case scenario.

The USACE software program CEDAS-ACES was used to predict extreme wind-driven wave heights. The program predicts wave heights and periods based on given wind speeds and fetch distances (the distance over which wind waves are generated). Table 8 gives the extremal wind speed, significant wave height, and peak period at the project site for return periods between 25 and 200 years. These return periods were selected based on the stated design life of 30 years.

Table 8: Summary of Significant Wave Heights for the existing Dunlevy site

Return Period	Wind Speed (km/h)	Significant Wave Height (m)	Peak Period (sec)
25	50	0.46	2.5
50	53	0.5	2.6
100	57	0.55	2.7
200	60	0.61	2.9

(F) WATER AREAS

The general requirements for the boat launch ramp water areas are as follows:

- Minimum water depth of 1.2 m at design low water;
- Minimum bottom width at the ramp will not be less than the combined width of the boat launching ramp, walkway and riprap shoulders or other shore protection immediately adjacent to the launching ramp; and,
- Minimum length of 15 m (50ft) beyond the toe of the ramp at design low water. Area in the front will be clear of navigation obstructions.

2.2.10 Structural Loads

(A) LAUNCHING RAMP DECK LOADS

The launching ramps will be designed to carry the weight of a vehicle with a loaded boat trailer. The design weight of a loaded boat trailer is 4,400 kg and is assumed the maximum for the ramp design. The total weight of some vehicles plus the loaded boat trailer may exceed the above design weight.

2.2.11 Geotechnical Information

Geotechnical investigation at the existing Dunlevy ramp site was performed by EXP and results of the investigations are provided in a report titled “Geotechnical Report, Proposed BC Hydro Boat Launch Ramp, Dunlevy Main Site, Williston Reservoir, BC” dated September 3, 2010. At a boat launch ramp workshop held on May 9, 2013 at BC Hydro Edmonds offices, additional geotechnical investigations were considered to be necessary to define potential risks at the toe of the ramp due to observed sharp changes in the ground profile at the El. 660m.

2.2.12 Functional Criteria

(A) LAUNCHING RAMPS

The existing boat launch ramp is a single lane ramp, 6m wide. As this is a replacement ramp, the same width will be adopted.

- For single lane ramps, a lane width of 6 m (19.7 ft). The boat ramp workshop held on May 9, 2013 mentioned that a 6.0m wide ramp may encourage double launching, with vehicles alongside each other, and that 1 4.5m to 5.0m wide ramp with edge safety curbs may enhanced operational safety. It is recommended that the risks and benefits of designing the ramp narrower than 6.0m should be examined in the next stage of the design, and in a Safety-By-Design Workshop;
- On ramps more than 61 m (200 ft) long and less than 18 m (60 ft) wide, a 18 m (60 ft) minimum diameter turn-around area will be provided every 61 m (200 ft);

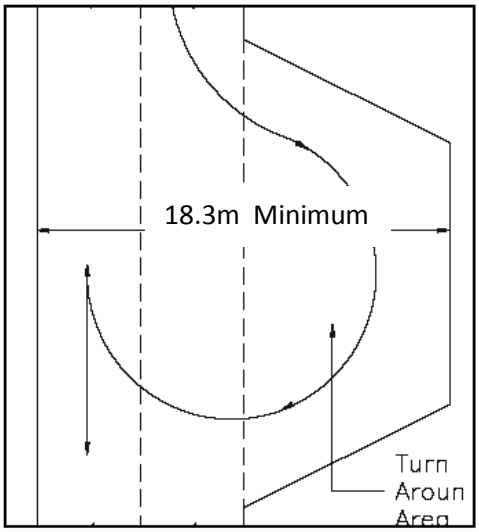


Figure 2: Turn-Around Area

- The head of ramp should be constructed to an elevation not less than 0.6 m (2 ft) above design high water;
- The toe of ramp should be constructed to an elevation not less than 1.2 m (4 ft) below design low water;

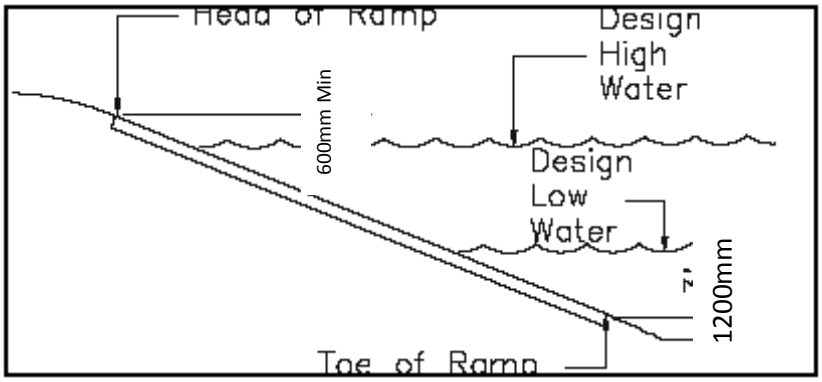


Figure 3: Ramp Head and Toe Details

- Slope of ramp: 12.0% minimum and 15.0% maximum; and,

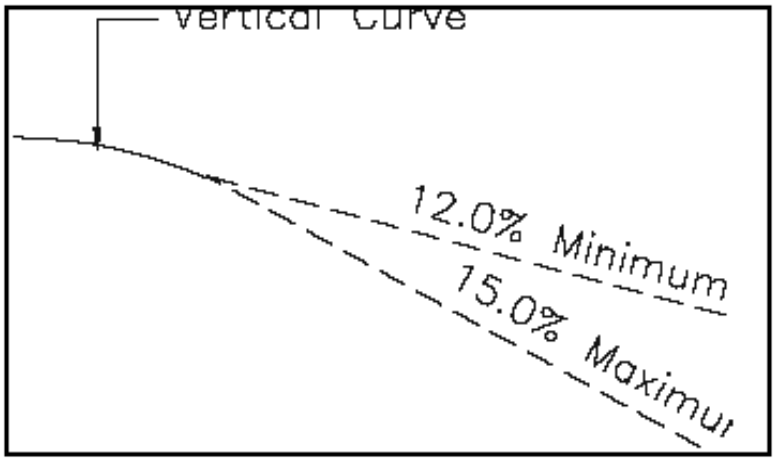


Figure 4: Range of Launching Ramp Slopes

- A vertical curve (4.5 m to 6.0 m) must be constructed at the head of the ramp to provide a smooth transition between the boat launch ramp and the apron.

(B) WALKWAY

1.5 m wide lock-block walkway fitted with timber rubbing strips and mooring cleats along the length of the boat launch ramp was considered but may not be included.

Due to the relative remoteness, large reservoir drawdown, relatively small user group base, no provisions have been made to ensure that the site is fully accessible for all users.

2.2.13 Navigation Aids and Signs

If and as required by Transport Canada, install Canadian Coast Guard specified marine navigation aids. Install required BC Hydro safety signage and warning signs.

2.2.14 Parking Area

The parking area will be sized to accommodate 16 vehicles and trailers and four vehicles which is similar to the capacity of the parking area provided for the improvement works for the existing Dunlevy boat ramp. A minimum 20m diameter turnaround area is required at the top of the ramp. The size of turnarounds will be reviewed and re-confirmed by the project team in the next stage.

2.2.15 Utilities

The launching ramp will NOT be provided with any general utilities such as power, lighting, or water supply.

2.2.16 Washrooms and Garbage Receptacles

Existing washrooms (pit toilets) are available at the existing boat launch facility. Bear proof garbage receptacles are provided in the parking area.

2.2.17 Safety by Design

During the detailed design phase, safety by design workshop will be conducted on the following:

- Reduce the width of the ramp from 6.0m to discourage two vehicles from launching beside each other. A 4.5m to 5.0m with safety edge curbs may enhance operational safety;
- Safety curbs and elevation marker etched into into ramp to provide information on where to launch safely; and,
- Lock block walkway.

3. CONCEPTUAL LAYOUTS OF REPLACEMENT BOAT LAUNCH RAMP

3.1 CONDITION OF EXISTING BOAT LAUNCH RAMP

The existing boat launch ramp has an east-west alignment and is subjected to wind and wave attack from predominantly occurring southerly wind generated waves. Scour protection was not placed along the southern edge of the existing boat ramp. As a result, sections of the existing concrete panels of the boat ramp have been severely eroded from wind generated southerly waves. Currently, concrete traffic barriers have been placed as a temporary barricade preventing public use of the existing boat launch ramp.

3.2 TOPOGRAPHY OF EXISTING BOAT RAMP

Generally, the profile along the centerline of the existing boat ramp is comprised of two main gradients. From the top of the ramp towards the bottom of the ramp, the gradient is approximately 14% (1 in 7.2) between El. 674m to El. 664m. From lake bed contour at El. 664m, the gradient of the shoreline steepens sharply to 53.4% (1 in 1.9) to El. 631m offshore. While the upper portion of the ramp is at the preferred gradient for boat launch operations, the lower section of the ramp is too steep to function as a boat ramp and fill will have to be placed to provide a suitable gradient for a boat ramp.

If the orientation of the replacement ramp is kept in an east-west alignment, large volumes of fill will be required to form the required slope at the lower section in order to form the preferred slope of the ramp. However, if the alignment of the ramp is orientated along the slope of the bank in a south to north orientation, a lesser amount of cut and fill will be needed to achieve the low water elevation toe of the ramp. Protection of embankment upslope and downslope areas with riprap will be required.

3.3 OPTIONS 1 & 1A -REPLACEMENT BOAT LAUNCH RAMP – EAST-WEST ALIGNMENT WITH LOWER SECTION PARALLEL TO LAKE BED SLOPE

BC Hydro has requested that a gravel surface be considered for the lower section of the proposed ramp commencing from El. 660 m to the design toe elevation of the ramp. Gravel-surfaced boat launch ramps are the least expensive and are typically used for temporary facilities. This type of loose surface provides very limited traction and is generally not recommended because of safety, capacity and maintenance issues. However, at the lowest level of the boat ramp, the use is expected to be infrequent. Surface erosion and wear and tear will be dependent on water levels, wave and ice forces acting on the ramp. This area may likely require more frequent maintenance to keep the lower section of the ramp operational.

The existing parking and upper turnaround areas will be retained as shown on Drawing SK1.

Option 1 of the proposed concrete boat launch ramp is 6.0 m wide and is 200 m long with a top of ramp at El. 674.7 m and a toe of ramp at El. 653.2 m, allowing access at all water levels. The layout of the proposed ramp is dogleg shaped with gradient of 14.4%. The upper section of the ramp is orientated in the existing East-West direction with a turnaround at approximately halfway down the ramp. The lower section of the ramp is orientated in North-South direction from the turnaround. A 200 mm high

curb will be placed on the outer perimeter of the turnaround as a barrier to prevent vehicles and trailers from going over the steeper section of the slope.

A lock-block walkway located along the length of the ramp is proposed for accessing launched boats. Erosion prone slopes will be protected with riprap in areas subjected to wave action. Riprap was sized for wind generated waves as a 55kg rock material with a D50[5] size of 275 mm and a layer thickness of 550mm. The underlying filter stone will be 260 mm thick.

The components of the proposed replacement boat ramp are as follows:

- Demolish and remove the existing concrete panels;
- Re-grade and shape ramp alignment as shown on plan layout on Drawing SK 1;
- Incrementally increase the size of upper turnaround at the top of the ramp;
- A 6m wide single lane, an overall 148 m long ramp with 101 lin. m of concrete surface and 47 lin. m of gravel surface;
- A safety curb at the lower turnaround area and elevations marked imprinted into ramp surface to provide a clear understanding as to where it is safe to launch;
- Signage should be provided to show launch parameters and description of elevation markers to users;
- A lock-block walkway access along the length on the ramp (optional);
- A lower turnaround area at the change of alignment of the ramp from south to north;
- Scour protection along the excavated and fill faces along the boat ramp alignment; and,
- Floating log breakwater anchored with chains and concrete anchor blocks along southern side of the ramp.

Operation safety should be discussed further in the next stage in a Safety-By-Design workshop.

As discussed in Section 2, Drawing SK1A shows the typical profile and section through the ramp. The parking and turnaround area will have capacity for parking 16 vehicles and trailers and four vehicles.

To attenuate wave heights in the vicinity of the boat ramp from the predominate southerly wind generated waves, a 85 m long, 3 m wide floating log breakwater will be provided on the southern side of the boat ramp. The floating breakwater will only be effective to attenuate short return period waves such as 1 in 1 year to 1 in 2 year waves which occurs in the normal operating summer conditions and will also attenuate the beam on waves acting on the boats making launching and retrieving operations safer. The mooring anchors for the floating breakwater will be designed for the 1 in 50 year wave forces.

Option 1A is similar to Option 1 but considers a boat ramp slope completely surfaced in concrete.

[5] D50 is defined as the median diameter or the medium value of the particle size distribution, it is the value of the particle diameter at 50% in the cumulative distribution.

3.4 OPTION 2 – REPLACEMENT BOAT LAUNCH RAMP - STRAIGHT - EAST-WEST ALIGNMENT

For comparison purposes, a layout showing a straight east-west alignment of the boat ramp was prepared. As indicated in Section 3.3, a large volume of fill will be required to form the lower section of the boat ramp slope as shown on Drawing SK 2. Scour protection will be designed to resist wind generated wave forces. Riprap was sized as a 55 kg rock material with a D50 size of 275mm and a layer thickness of 550mm. The underlying filter stone will be 260mm thick.

Further geotechnical analysis will be required to determine if the native ground will be capable to support the large weight of fill without causing slope failure.

The main components of the proposed replacement boat ramp are as follows:

- Demolish and remove the existing concrete panels;
- Re-grade and shape ramp alignment as shown on plan layout on Drawing SK 2;
- Incrementally increase the size of upper turnaround at the top of the ramp;
- A 6m wide single lane, an overall 153m long boat ramp with 105 lin. m of concrete surface and 48 lin. m of gravel surface;
- A safety curb at the lower turnaround area and elevations marked imprinted into ramp surface to provide a clear understanding as to where it is safe to launch;
- Signage should be provided to show launch parameters and description of elevation markers to users;
- A lock-block walkway access along the length on the ramp (optional);
- A lower turnaround area at the change of alignment of the ramp from south to north;
- Scour protection along the excavated and fill faces along the boat ramp alignment; and,
- Floating log breakwater anchored with chains and concrete anchor blocks along southern side of the ramp.

Operation safety should be discussed further in the next stage in a Safety-By-Design workshop.

3.5 OPTION 3 – ALTERNATE REPLACEMENT BOAT RAMP - NORTH-SOUTH ALIGNMENT

An alternate boat launch ramp at the existing Dunlevy site in a north-south alignment starting from the north side of the existing parking lot was proposed as shown on Drawing SK 3. The main advantage with this layout is that the ramp is protected from predominant southerly wind and waves by the parking lot headland. The orientation of the boat ramp also facilitates relatively calm conditions for launching and retrieving boats. The main disadvantage is that the ramp has to be formed along steep embankments which will require large areas of cut and fill for placement riprap protection. A concrete surfaced ramp will be provided from the top of the ramp to the turnaround area at El. 660m. A gravel surfaced ramp will be provided from El. 660m to the toe of the ramp at El. 653.2m. Scour protection will be designed to resist wind generated wave forces. Similar to Options 1 and 1A, the riprap was sized as 55 kg rock material with a D50 size of 275mm and a layer thickness of 550mm. The underlying filter stone will be 260mm thick.

The main components of the proposed replacement boat ramp are as follows:

- Demolish and remove the existing concrete panels;
- Re-grade and shape ramp alignment as shown on plan layout on Drawing SK 3;
- Revised parking and upper turnaround area at the top of the ramp;
- A 6m wide single lane, an overall 197m long boat ramp with 152 lin. m of concrete surface and 45 lin. m of gravel surface;
- A lock-block walkway access along the length on the ramp;
- A lower turnaround area; and,
- Scour protection along the excavated and fill faces along the boat ramp alignment.

Option 3A is similar to Option 3 but considers a ramp slope completely surfaced in concrete.

3.6 OPTION 4 – EAST- WEST ALIGNMENT - AT - GRADE GRAVEL RAMP

BCH has requested M&N to describe a conceptual layout for a simple grade and gravel surfaced boat launch ramp option. Also as directed by BCH, Option 4 will be located in the east-west orientation of the existing ramp with finished surfaces matching the existing ground grades, to disregard erosion protection and the provision of a floating log wave attenuator for the ramp. We have assumed that the existing concrete panels will be demolished and replaced with a gravel driving surface.

The gravel surface will only extend 80m from the top of the ramp at El. 674.6m to the end of the ramp at El. 662.0m. Beyond the end of the ramp at El. 662.0m, the existing ground becomes very steep with a gradient of 53.4% (1 in 1.9) down to El. 631.0m offshore. At this steep gradient, the natural terrain is unusable for boat launch operations, therefore no gravel surfacing will be provided beyond El. 662.0m. A 200mm high precast concrete curb will have to be placed at the end of the ramp to provide a physical barrier to prevent trailer wheels from going over the steep section of the slope. The precast concrete curb will be designed to have a buried foundation section, sufficiently to resist overturning forces from a trailer wheel impact.

El. 663.2m is the limiting water elevation for launching boats in this option. Based in the water level variation graph (Figure 1) in the reservoir, the lowest water level range in the reservoir could result in unavailability of the ramp for use up to from the end of November to beginning of July. However, at higher water level ranges, the ramp could potentially have all year access.

The placement of a floating log wave attenuator on the southern side of the ramp provides some protection from waves generated from the predominant south and south west winds. Without the floating attenuator, boaters will be subjected to beam on waves which can cause the boat to the roll and make launching and retrieving difficult. In some extreme weather conditions, a boat could be pushed towards the shoreline possibly endangering the safety of the occupants in the boat and also doing damage to the hull of the vessel.

Drawings for Option 4 have not been prepared since it does not comply with the design criteria and is an option that could not be recommended for a permanent boat ramp facility. A gravel surfaced

ramp has very limited traction and often requires four wheel drive tow vehicle. It requires frequent maintenance to keep it operational and has safety and capacity issues associated with it.

3.7 OPTION 5 – EAST - WEST ALIGNMENT - RAMP TOE AT EL. 660M

The conceptual layout of the boat ramp with a toe El. 660m is shown in Drawing SK 5. The layout of the proposed replacement ramp is shown aligned in the east-west orientation of the original ramp.

The original boat ramp is comprised of two rows concrete panels with gravel infill between panels. The slope is approximately 11% and the toe of the ramp is at approximately El. 668m. The top section of the existing ramp is severely eroded with half the width of the ramp unusable due to erosion damage.

The proposed toe of the replacement ramp is shown at El. 660m. Option 5 shows gradient of 15% with a cast-in place concrete slab with V-grooves as shown in Drawing SK 5. The width of the concrete ramp is 6m wide with 1m wide shoulders on either side of the ramp. The excavated slopes of the replacement ramp are 2H to 1V, and are protected with geotextile, filter stone and riprap. The design operating water levels for Option 5 at low water is El. 661.2m. The design high water is at El. 672.2m.

An 86m long floating log breakwater located on the south side of the ramp is proposed to attenuate the predominant waves from south – south west direction. This breakwater will improve boat launch and retrieval conditions at the site and reduce wave erosion at the ramp.

The proposed turnaround area at the top of the ramp is defined by a turning circle diameter of 20m. The new turnaround area generally fits within the existing turnaround area but at a lower elevation than the existing ground. The elevation of the turnaround is at El. 673.2m and is connected to the existing access road.

The access road connecting the proposed turnaround area at the top of the ramp will need to be re-graded at 10% slope similar to the existing slope. 2H to 1V side slopes along the either side of the access road will be cut to tie in to the original ground elevation of the road. Side slopes beyond high water level will be protected with hydraulic seeding. Navigation markers will be required to identify top of cut slopes along the length of the ramp.

BCH has directed M&N to exclude the lock block walkway from this option. This should be discussed further in a Safety-By-Design Workshop because it has boat safety implications.

3.8 OPTION 5A – EAST - WEST ALIGNMENT - RAMP TOE AT EL. 654M BUILT IN TWO PHASES

Option 5A considers the ramp built in two phases to a final ramp toe El. 654m. Phase I would entail the ramp toe being built to EL. 660m. In Phase II, the ramp toe is extended from El. 660m to El. 654m.

For Phase I Option 5A, the ramp toe is assumed to be built at the intercept point of the existing slopes of where the slope changes steeply which is El. 660m. It is also assumed that the water levels at

the time of construction will facilitate building the entire ramp in the dry. The ramp slope will be built at 15% and will require the new ramp slope to be formed by excavating the existing ground as shown in Drawing SK 5B. The width of the concrete ramp is 6m wide with 1m wide shoulders on either side of the ramp. The excavated slopes of the replacement ramp are 2H to 1V, and are protected with geotextile, filter stone and riprap. Navigation markers will be required to identify top of cut slopes along the length of the ramp.

BCH has directed M&N to exclude the lock block walkway from this option. This should be discussed further in a Safety-By-Design Workshop because it has boat safety implications.

Other Phase I construction activities would also include:

- An 86m long floating timber breakwater located on the south side of the ramp is proposed to attenuate the predominant waves from south – south west direction. This breakwater will improve boat launch and retrieval conditions at the site and reduce wave erosion at the ramp;
- The proposed turnaround area at the top of the ramp is defined by a turning circle diameter of 20m. The new turnaround area generally fits within the existing turnaround area but at a lower elevation and existing ground. The elevation of the turnaround is at El. 673.2m and is connected to the existing access road; and,
- The access road connecting the proposed turnaround area at the top of the ramp will need to be re-graded at 10% slope similar to the existing slope. 2H to 1V side slopes along the either side of the access road will be cut to tie in to the original ground elevation of the road. Side slopes beyond high water level will be protected with hydraulic seeding.

Phase II, Option 5A assumes the water level in the reservoir to be at El. 654m at the time of construction to facilitate building the ramp extension in the dry. The ramp slope extension will be 15% and the design operating low water level for the boating season is El. 655.2m. The ramp extension will require a large volume of imported fill to form the ramp extension as shown in Drawing SK 5A, which is considered to be impractical and costly to be built in the short construction window. Other extension options such as sheet piles, and pile and deck were considered to be too costly and impractical to be constructed due to the height of structure required to form the ramp slope.

3.9 OPTION 5B – EAST - WEST ALIGNMENT - RAMP TOE AT EL. 658M

BC Hydro has requested that a ramp toe at El. 658m be considered as this would reduce the average annual non-accessible days from 6 days for a ramp toe of El. 660m to one day for a ramp toe El. 658m. Option 5B is similar to Option 5 with the ramp toe constructed at El. 658m.

It is assumed that water levels at the time of construction will be low enough to permit construction of the ramp toe without a cofferdam.

3.10 OPTION 5C – EAST - WEST ALIGNMENT - RAMP TOE AT EL. 654M BUILT IN TWO PHASES

Option 5C is similar to Option 5A, with the Phase I ramp toe El. 658m and Phase II ramp toe elevation at El. 654m

It is assumed that water levels at the time of construction for both phases will be low enough to allow construction of the ramp toe without a cofferdam.

3.11 OPTION 6 – EAST-WEST ALIGNMENT - RAMP TOE AT EL. 654M

The conceptual layout for the boat ramp with a toe El. 654m is shown in Drawing SK 6. The layout of the proposed replacement ramp is shown aligned in the east-west orientation of the original ramp.

The proposed toe of the replacement ramp is shown at El. 654m. Option 6 shows gradient of 15% with a cast-in place concrete slab with V-grooves as shown in Drawing SK 6. The width of the concrete ramp is 6m wide with 1m wide shoulders on either side of the ramp. The excavated slopes of the replacement ramp are 2H to 1V, and are protected with geotextile, filter stone and riprap. The extent of the cut slopes for the ramp and turnaround area encroaches more into the existing parking area for Option 6 than Option 5.

The design operating low water levels for the boating season is El. 655.2m. The design high water level is at El. 672.2m.

An 86m long floating timber breakwater located on the south side of the ramp is proposed to attenuate the predominant waves from south – south west direction. This breakwater will improve boat launch and retrieval conditions at the site and reduce wave erosion at the ramp.

The proposed turnaround area at the top of the ramp is defined by a turning circle diameter of 20m. The new turnaround area generally fits within the existing turnaround area but at a lower elevation and existing ground. The elevation of the turnaround is at El. 673.2m and is connected to the existing access road.

The access road connecting the proposed turnaround area at the top of the ramp will need to be re-graded at 10% slope similar to the existing slope. 2H to 1V side slopes along the either side of the access road will be cut to tie in to the original ground elevation of the road. Side slopes beyond high water level will be protected with hydraulic seeding.

Navigation markers will be required to identify top of cut slopes along the length of the ramp.

BCH has directed M&N to exclude the lock block walkway from this option. This should be discussed further in a Safety-By-Design Workshop because it has boat safety implications.

3.12 OPTION 6A – EAST-WEST ALIGNMENT - RAMP TOE AT EL. 654M BUILT IN TWO PHASES

Option 6A considers the ramp built in two phases to a final ramp toe El. 654m. Phase I would entail the ramp toe being built to EL. 660m. In Phase II, the ramp toe is extended from El. 660m to El. 654m.

The conceptual layout for Option 6A assumes the entire ramp is formed by excavating the existing sloping ground as shown on Drawing SK 6A. It is also assumes that the water levels at the time

of construction will facilitate building the entire ramp in the dry. The final ramp toe is set to coincide with the existing ground at El. 654m and is then projected up the slope at 15%. At El. 660m, the Phase I ramp toe elevation commences by excavating the existing ground as shown in Drawing SK 6A. An area approximately 29m long in front of the toe of the ramp will be excavated level to permit future excavation in the existing ground to extend the ramp toe to El. 654m as shown in the profile on Drawing SK 6A. Navigation marker buoys with short tethers will be used in the level area to mark the potential navigation hazard of the area when water levels are too shallow to allow for launching boats. These navigation buoys could be susceptible to propeller damage when the buoys are just submerged. The width of the concrete ramp is 6m wide with 1m wide shoulders on either side of the ramp. The excavated slopes of the replacement ramp are 2H to 1V, and are protected with geotextile, filter stone and riprap.

Navigation markers will be required to identify top of cut slopes along the length of the ramp.

BCH has directed M&N to exclude the lock block walkway from this option. This should be discussed further in a Safety-By-Design Workshop because it has boat safety implications.

Other Phase I construction activities would also include:

- An 86m long floating timber breakwater located on the south side of the ramp is proposed to attenuate the predominant waves from south – south west direction. This breakwater will improve boat launch and retrieval conditions at the site and reduce wave erosion at the ramp;
- The proposed turnaround area at the top of the ramp is defined by a turning circle diameter of 20m. The new turnaround area generally fits within the existing turnaround area but at a lower elevation and existing ground. The elevation of the turnaround is at El. 673.2m and is connected to the existing access road; and,
- The access road connecting the proposed turnaround area at the top of the ramp will need to be re-graded at 10% slope similar to the existing slope. 2H to 1V side slopes along the either side of the access road will be cut to tie in to the original ground elevation of the road. Side slopes beyond high water level will be protected with hydraulic seeding.

Phase II, Option 6A assumes the water level in the reservoir to be at El. 654m at the time of construction to facilitate building the ramp extension without the use of a cofferdam. Additional mobilization and demobilization will be required for Phase II construction.

The ramp slope extension will be 15% and the design operational water level for boating is El. 655.2m. The ramp extension will requires excavation to form the ramp extension as shown in Drawing SK 6A.

3.13 OPTION 6B – EAST-WEST ALIGNMENT - RAMP TOE AT EL. 654M BUILT IN TWO PHASES

Similar to Option 6A, Option 6B considers the ramp built in two phases to a final ramp toe El. 654m. Phase I would entail the ramp toe being built to EL. 658m. In Phase II, the ramp toe is extended from El. 660m to El. 654m.

4. OPINION OF PROBABLE CONSTRUCTION COSTS

The opinion of probable construction costs for the various sites are summarized in the tables below. The cost estimates are considered, order-of-magnitude Class D estimates.

4.1 OPTION 1 – REPLACEMENT BOAT LAUNCH RAMP – EAST-WEST ALIGNMENT WITH LOWER SECTION ALONG SLOPE – CONCRETE/GRAVEL SURFACE

Table 9 provides the estimated construction cost for: a 6.0 m wide single lane boat launch ramp with a concrete/gravel surface, lock-block walkway and scour protection. Detailed breakdown of the costs are provided in Appendix B.

Table 10 shows the estimated annual maintenance cost for the boat ramp facility, including allowances for repairs to the ramp and riprap protection. The annual maintenance cost is based on mobilization and demobilization of equipment, labour and materials to perform maintenance to repair damaged section(s) of riprap and gravel surfaces.

Table 9: Opinion of Probable Construction Cost – Option 1 – Concrete/Gravel Surface

Item No.	Item Description	Item Total
1	Demolition of existing concrete slabs	$8,280
2	General Excavation and off-site disposal	$336,000
3	General Fill	$224,000
4	Granular Base Course for Ramp	$32,500
5	Scour Protection – Filter Stone for 55 kg riprap	$194,454
6	Scour Protection – 550mm thick riprap	$380,120
7	Geotextile	$20,500
8	New Concrete Panels (Cast-in-Place)	$327,151
9	Base Coarse Material – High Fines Granular Surfacing Aggregates (HGSA)	$6,500
10	Lock-block walkway	$207,200
11	Abutment	$15,000
12	Hydraulic Seeding & Organic – Provisional Item	$25,000
13	Floating Log Breakwater including mooring anchors	$361,200
14	Garbage Receptacle	$5,000
15	Allowance for miscellaneous items (signage)	$10,000
	SUB TOTAL	**$2,152,905**
Mobilization and Demobilization (5%)		$107,645
Contingency (25%)		$565,138
	TOTAL	**$2,825,688**

Table 10: Option 1: Estimated Annual Maintenance Cost

Item No.	Item Description	Unit	Quantity	Rate	Total
1	Repair scour protection	Sum	-	-	$15,000
2	Repair gravel surfaces	Sum	-	-	$15,000
				TOTAL	**$30,000**

4.2 OPTION 1A – REPLACEMENT BOAT LAUNCH RAMP – EAST-WEST ALIGNMENT WITH LOWER SECTION ALONG SLOPE – CONCRETE SURFACE

Table 11 provides the estimated construction cost for: a 6.0 m wide single lane boat launch ramp with a concrete/gravel surface, lock-block walkway and scour protection. Detailed breakdown of the costs are provided in Appendix B.

Table 12 shows the estimated annual maintenance cost for the boat ramp facility, including allowances for repairs to the ramp and riprap protection. The annual maintenance cost is based on an assumed amount required for mobilization and demobilization of equipment, labour and materials to perform maintenance to repair section(s) of riprap and gravel surfaces.

Table 11: Opinion of Probable Construction Cost – Option 1A – Concrete Surface

Item No.	Item Description	Item Total
1	Demolition of existing concrete slabs	$8,280
2	General Excavation and off-site disposal	$336,000
3	General Fill	$224,000
4	Granular Base Course for Ramp	$32,500
5	Scour Protection – Filter Stone for 55 kg riprap	$194,454
6	Scour Protection – 550mm thick riprap	$380,120
7	Geotextile	$20,500
8	New Concrete Panels (Cast-in-Place)	$442,616
9	Lock-block walkway	$207,200
10	Abutment	$15,000
11	Hydraulic Seeding & Organic – Provisional Item	$25,000
12	Floating Log Breakwater including mooring anchors	$361,200
13	Garbage Receptacle	$5,000
14	Allowance for miscellaneous items (signage)	$10,000
	SUB TOTAL	**$2,261,870**
Mobilization and Demobilization (5%)		$113,093
Contingency (25%)		$593,741
	TOTAL	**$2,968,704**

Table 12: Option 1A: Estimated Annual Maintenance Cost

Item No.	Item Description	Unit	Quantity	Rate	Total
1	Repair scour protection	Sum	-	-	$15,000
2	Repair gravel surfaces	Sum	-	-	$12,000
				TOTAL	**$27,000**

4.3 OPTION 2 - REPLACEMENT BOAT LAUNCH RAMP – STRAIGHT - EAST-WEST ALIGNMENT

Table 13 provides the estimated construction cost for a 6.0 m wide single lane boat launch ramp with V-grooved concrete surface, lock-block walkway and scour protection.

Table 14 provides the estimated construction and maintenance costs respectively for a 6.0 m wide boat launch ramp facility.

Table 13: Opinion of Probable Construction Cost – Option 2

Item No.	Item Description	Item Total
1	**Demolition of existing concrete slabs**	$8,280
2	**General Excavation and off-site disposal**	$72,000
3	**General Fill**	$2,559,375
4	**Granular Base Course for Ramp**	$25,253
5	**New Concrete (Cast in Place)**	$384,883
6	**Scour Protection – Filter Stone for 55kg Riprap**	$361,951
7	**Scour Protection – 55kg Riprap**	$1,002,456
8	**Geotextile**	$62,531
9	**Base Course Material – 75mm Crushed Base Course**	$5,720
10	**Lock-block Walkway**	$214,200
11	**Abutment**	$15,000
12	**Hydraulic Seeding & Organic Soil – Provisional Item**	$25,000
13	**Floating Log Breakwater including mooring anchors**	$361,200
14	**Garbage Receptacle**	$5,000
15	**Allowance for Miscellaneous Item (Signage)**	$10,000
	SUB TOTAL	**$5,113,849**
Mobilization and Demobilization (5%)		$255,642
Contingency (25%)		$1,342,123
	TOTAL	**$6,710,615**

Table 14: Option 2: Estimated Annual Maintenance Cost

Item No.	Item Description	Unit	Quantity	Rate	Total
1	**Repair scour protection**	sum	-	-	$15,000
2	**Repair gravel surfaces**	sum	-	-	$15,000
				TOTAL	**$30,000**

4.4 OPTION 3 - REPLACEMENT BOAT LAUNCH RAMP – NORTH-SOUTH ALIGNMENT-CONCRETE/GRAVEL SURFACE

Table 15 provides the estimated construction cost for Option 3 which includes a 6.0 m wide single lane boat launch ramp with V-grooved concrete surface extending to El. 660 m, gravel surface extending from El. 660 m to the toe of the ramp, lock-block walkway and scour protection. Table 16 shows the estimated construction and maintenance costs respectively for a 6.0 m wide boat launch ramp facility.

Table 15: Opinion of Probable Construction Cost – Option 3 – Concrete/Gravel Surface

Item No.	Item Description	Item Total
1	General Excavation	$547,350
2	General Fill	$504,000
3	Base Coarse Material - High Fines Granular Surfacing Aggregate (HFSA)	$73,437
4	Base Coarse Material - 75mm Crushed Base Coarse (CBC) Aggregates	$26,455
5	Base Coarse for Ramp (Granular Base)	$30,550
6	New Concrete (cast in place)	$420,293
7	Scour Protection - Filter Stone for 55kg Riprap	$278,424
8	Scour Protection - 55kg Riprap	$744,630
9	Scour Protection - 35kg Riprap	$10,505
10	Geotextile	$38,750
11	Precast Low profile barrier	$17,010
12	Precast median barrier	$4,800
13	Precast concrete curb	$325
14	Lock block Walkway	$229,600
15	French Drain (including outlet protection)	$24,000
16	Hydraulic seeding (including growing medium)	$10,966
17	Turf & root reinforcement mats (Including growing medium and Hydraulic seeding)	$14,850
18	Abutment	$15,000
19	Garbage Receptacle	$5,000
20	Site clearing & removal of debris	$39,480
	SUB TOTAL	**$3,035,424**
Mobilization and Demobilization (5%)		$151,771
Contingency (25%)		$796,799
	TOTAL	**$3,983,994**

Table 16: Option 3: Estimated Annual Maintenance Cost

Item No.	Item Description	Unit	Quantity	Rate	Total
1	Repair scour protection	sum	-	-	$10,000
2	Repair gravel surfaces	sum	-	-	$10,000
				TOTAL	**$20,000**

4.5 OPTION 3A - REPLACEMENT BOAT LAUNCH RAMP – NORTH - SOUTH ALIGNMENT – CONCRETE SURFACE

Table 17 provides the estimated construction cost for Option 3A which includes a 6.0 m wide single lane boat launch ramp with V-grooved concrete surface extending to the toe of the ramp, lock-block walkway and scour protection. Table 18 provides the estimated construction and maintenance costs respectively for a 6.0 m wide boat launch ramp facility.

Table 17: Opinion of Probable Construction Cost – Option 3A – Concrete Surface

Item No.	Item Description	Item Total
1	General Excavation	$547,350
2	General Fill	$504,000
3	Base Coarse Material - High Fines Granular Surfacing Aggregate (HFSA)	$68,172
4	Base Coarse Material - 75mm Crushed Base Coarse (CBC) Aggregates	$26,455
5	Base Coarse for Ramp (Granular Base)	$30,550
6	New Concrete (cast in place)	$524,211
7	Scour Protection - Filter Stone for 55kg Riprap	$278,424
8	Scour Protection - 55kg Riprap	$744,630
9	Scour Protection - 35kg Riprap	$10,505
10	Geotextile	$38,750
11	Precast Low profile barrier	$17,010
12	Precast median barrier	$4,800
13	Precast concrete curb	$325
14	Lock block Walkway	$229,600
15	French Drain (including outlet protection)	$24,000
16	Hydraulic seeding (including growing medium)	$10,966
17	Turf & root reinforcement mats (Including growing medium and Hydraulic seeding)	$14,850
18	Abutment	$15,000
19	Garbage Receptacle	$5,000
20	Site clearing & removal of debris	$39,480
	SUB TOTAL	**$3,134,077**
Mobilization and Demobilization (5%)		$156,704
Contingency (25%)		$822,695
	TOTAL	**$4,113,477**

Table 18: Option 3: Estimated Annual Maintenance Cost

Item No.	Item Description	Unit	Quantity	Rate	Total
1	Repair scour protection	sum	-	-	$10,000
2	Repair gravel surfaces	sum	-	-	$7,000
				TOTAL	**$17,000**

4.6 OPTION 4 - AT- GRADE GRAVEL RAMP

Table 19 provides the estimated construction cost for Option 4 which includes a 6.0 m wide, 80m long single lane boat launch ramp with gravel surface. The cost estimate assumes that the existing concrete panels will be demolished and replaced with a gravel surface. Concrete curbs will be placed at the end of the ramp near the steeply sloped section to prevent trailers from going off the end of the ramp.

Table 19: Option 4: At-Grade Gravel Ramp

Item No.	Item Description	Item Total
1	**Demolition of existing concrete slab**	$8,280
2	**General Excavation and Off-site Disposal**	$9,000
3	**Granular Surfacing for Ramp (Granular Base)**	$22,500
4	**Concrete curbs**	$720
5	**Geotextile**	$4,800
	SUB TOTAL	$45,300
Mobilization and Demobilization (5%)		$5,000
Contingency (25%)		$12,575
	TOTAL	**$62,875**

Table 20 provides an estimate of the maintenance cost associated with a gravel surfaced ramp. The wind data assessment in Section 2, shows that approximately 2-3 extreme events occurs in the summer months and 14 extreme events occur in the winter months over the 39 year period of the wind records. Based on this information, we have assumed that a least one repair in undertaken in the summer months and two are undertaken in the winter months. We have assumed repair of 5m x5m eroded area for each event.

Table 20: Option 4: Estimated Annual Maintenance Cost

Item No.	Item Description	Unit	Quantity	Rate	Total
1	**Repair gravel surfaces**	sum	-	-	$45,000
				TOTAL	**$45,000**

4.7 OPTION 5 – EAST-WEST ALIGNMENT - RAMP TOE AT EL. 660M

Table 21 provides the estimated construction cost for a 6.0 m wide single lane boat launch ramp with a cast-in-place V-grooved concrete surface, scour protection and a floating breakwater and ramp toe elevation of 660m.

Table 21: Opinion of Probable Construction Cost – Option 5- Ramp toe at El. 660m

Item No.	Item Description	Item Total
1	Demolition of existing concrete slabs	$8,280
2	General excavation and off-site disposal – ramp	$154,111
3	Granular base course for ramp	$10,360
4	New Concrete Surface (cast in place)	$204,758
5	Geotextile	$14,000
6	Scour Protection – Filter Stone for 55kg Riprap	$104,598
7	Scour Protection – 55kg Riprap	$241,332
8	General excavation and off-site disposal – turnaround	$45,000
9	Granular base course for turnaround	$7,326
10	HFSA for turnaround	$3,677
11	General excavation and off-site disposal – access road	$178,350
12	Granular base for access road	$8,159
13	HFSA for access road	$4,095
14	Hydraulic Seeding & Organic Soil – Provisional Item	$25,000
15	Floating Log Breakwater including mooring anchors	$361,200
16	Allowance for Miscellaneous Item (Signage)	$15,000
	SUB TOTAL	**$1,385,246**
Mobilization and Demobilization (5%)		$69,262
Contingency (25%)		$363,627
	TOTAL	**$1,818,135**

4.8 OPTION 6 – EAST-WEST ALIGNMENT - RAMP TOE AT EL. 654M

Table 22 provides the estimated construction cost for Option 6 which includes a 6.0 m wide single lane boat launch ramp with a cast-in-place V-grooved concrete surface, scour protection and a floating breakwater and ramp toe at El. 654m.

Table 22: Opinion of Probable Construction Cost – Option 6 – Ramp Toe at El. 654m

Item No.	Item Description	Item Total
1	Demolition of existing concrete slabs	$8,280
2	General excavation and off-site disposal – ramp	$849,798
3	Granular base course for ramp	$14,996
4	New Concrete Surface (cast in place)	$297,130
5	Geotextile	$35,058
6	Scour Protection – Filter Stone for 55kg Riprap	$351,896
7	Scour Protection – 55kg Riprap	$512,320
8	General excavation and off-site disposal – turnaround	$155,100
9	Granular base course for turnaround	$7,326
10	HFSA for turnaround	$3,677
11	General excavation and off-site disposal – access road	$227,700
12	Granular base for access road	$8,159
13	HFSA for access road	$4,095
14	Hydraulic Seeding & Organic Soil – Provisional Item	$35,000
15	Floating Log Breakwater including mooring anchors	$529,200
16	Allowance for Miscellaneous Item (Signage)	$15,000
	SUB TOTAL	**$3,054,735**
Mobilization and Demobilization (5%)		$152,737
Contingency (25%)		$801,868
	TOTAL	**$4,009,340**

OPTION 5A – RAMP TOE AT EL. 654M IN TWO PHASES

Table 23 provides the estimated construction cost for Option 5A for a 6.0 m wide single lane boat launch ramp with a cast-in-place V-grooved concrete surface, scour protection and a floating breakwater and ramp toe elevations of 660m and 654m constructed in two phases.

Table 23: Opinion of Probable Construction Cost – Option 5A- Ramp toe at El. 660m

Item No.	Item Description	Item Total
Option 5A - PHASE I – Ramp Toe El. 660m		
1	Demolition of existing concrete slabs	$8,280
2	General excavation and off-site disposal – ramp	$154,111
3	Granular base course for ramp	$10,360
4	New Concrete Surface (cast in place)	$204,758
5	Geotextile	$14,000
6	Scour Protection – Filter Stone for 55kg Riprap	$104,598
7	Scour Protection – 55kg Riprap	$241,332
8	General excavation and off-site disposal – turnaround	$45,000
9	Granular base course for turnaround	$7,326
10	HFSA for turnaround	$3,677
11	General excavation and off-site disposal – access road	$178,350
12	Granular base for access road	$8,159
13	HFSA for access road	$4,095
14	Hydraulic Seeding & Organic Soil – Provisional Item	$25,000
15	Floating Log Breakwater including mooring anchors	$529,200
16	Allowance for Miscellaneous Item (Signage)	$15,000
	SUB TOTAL	**$1,553,246**
Mobilization and Demobilization (5%)		$77,662
Contingency (25%)		$407,727
	PHASE I TOTAL	**$2,038,635**
Option 5A - PHASE II – Ramp Toe El. 654m		
1	General Fill	$1,540,980
2	Granular base course for ramp	$4,662
3	New Concrete Surface (cast in place)	$92,372
4	Geotextile	$26,601
5	Scour Protection – Filter Stone for 55kg Riprap	$392,297
6	Scour Protection – 55kg Riprap	$233,529
	PHASE II SUB TOTAL	**$2,290,441**
Mobilization and Demobilization (5%)		$114,522
Contingency (25%)		$601,241
	PHASE II TOTAL	**$3,006,204**
	PHASE I & II TOTALS	**$5,044,838**

4.9 OPTION 5B – EAST-WEST ALIGNMENT - RAMP TOE AT EL. 658M

Table 24 provides the estimated construction cost for a 6.0 m wide single lane boat launch ramp with a cast-in-place V-grooved concrete surface, scour protection and a floating breakwater and ramp toe elevation of 660m.

Table 24: Opinion of Probable Construction Cost – Option 5B- Ramp toe at El. 658m

Item No.	Item Description	Item Total
1	Demolition of existing concrete slabs	$8,280
2	General excavation and off-site disposal – ramp	$340,217
3	Granular base course for ramp	$11,888
4	New Concrete Surface (cast in place)	$235,549
5	Geotextile	$18,961
6	Scour Protection – Filter Stone for 55kg Riprap	$125,288
7	Scour Protection – 55kg Riprap	$289,245
8	General excavation and off-site disposal – turnaround	$238,470
9	Granular base course for turnaround	$7,326
10	HFSA for turnaround	$3,677
11	General excavation and off-site disposal – access road	$102,060
12	Granular base for access road	$12,238
13	HFSA for access road	$6,143
14	Hydraulic Seeding & Organic Soil – Provisional Item	$25,000
15	Floating Log Breakwater including mooring anchors	$361,200
16	Allowance for Miscellaneous Item (Signage)	$15,000
	SUB TOTAL	**$1,800,540**
Mobilization and Demobilization (5%)		$90,027
Contingency (25%)		$472,642
	TOTAL	**$2,363,211**

4.10 OPTION 5C – RAMP TOE AT EL. 654M IN TWO PHASES

Table 25 provides the estimated construction cost for Option 5C for a 6.0 m wide single lane boat launch ramp with a cast-in-place V-grooved concrete surface, scour protection and a floating breakwater and ramp toe elevations of 658m and 654m constructed in two phases.

Table 25: Opinion of Probable Construction Cost – Option 5C- Ramp toe at El. 658m

Item No.	Item Description	Item Total
Option 5C - PHASE I – Ramp Toe El. 658m		
1	Demolition of existing concrete slabs	$8,280
2	General excavation and off-site disposal – ramp	$340,217
3	Granular base course for ramp	$11,888
4	New Concrete Surface (cast in place)	$235,549
5	Geotextile	$18,961
6	Scour Protection – Filter Stone for 55kg Riprap	$125,288
7	Scour Protection – 55kg Riprap	$289,245
8	General excavation and off-site disposal – turnaround	$238,470
9	Granular base course for turnaround	$7,326
10	HFSA for turnaround	$3,677
11	General excavation and off-site disposal – access road	$102,060
12	Granular base for access road	$12,238
13	HFSA for access road	$6,143
14	Hydraulic Seeding & Organic Soil – Provisional Item	$25,000
15	Floating Log Breakwater including mooring anchors	$529,200
16	Allowance for Miscellaneous Item (Signage)	$15,000
	SUB TOTAL	**$1,968,540**
Mobilization and Demobilization (5%)		$98,427
Contingency (25%)		$516,742
	PHASE I TOTAL	**$2,583,709**
Option 5C - PHASE II – Ramp Toe El. 654m		
1	General Fill	$1,201,270
2	Granular base course for ramp	$3,108
3	New Concrete Surface (cast in place)	$61,581
4	Geotextile	$28,426
5	Scour Protection – Filter Stone for 55kg Riprap	$207,532
6	Scour Protection – 55kg Riprap	$552,827
	PHASE II SUB TOTAL	**$2,054,744**
Mobilization and Demobilization (5%)		$102,737
Contingency (25%)		$539,370
	PHASE II TOTAL	**$2,696,851**
	PHASE I & II TOTALS	**$5,280,562**

4.11 OPTION 6A – RAMP TOE AT EL. 654M IN TWO PHASES

Table 26 provides the estimated construction cost for a 6.0 m wide single lane boat launch ramp with a cast-in-place V-grooved concrete surface, scour protection and a floating breakwater and ramp toe elevations of 660m and 654m constructed in two phases.

Table 26: Opinion of Probable Construction Cost – Option 6A- Ramp toe at El. 660m

Item No.	Item Description	Item Total
Option 6A - PHASE I – Ramp Toe El. 660m		
1	**Demolition of existing concrete slabs**	$8,280
2	**General excavation and off-site disposal – ramp**	$568,611
3	**Granular base course for ramp**	$10,334
4	**New Concrete Surface (cast in place)**	$204,758
5	**Geotextile**	$34,737
6	**Scour Protection – Filter Stone for 55kg Riprap**	$276,883
7	**Scour Protection – 55kg Riprap**	$639,224
8	**General excavation and off-site disposal – turnaround**	$155,100
9	**Granular base course for turnaround**	$7,326
10	**HFSA for turnaround**	$3,677
11	**General excavation and off-site disposal – access road**	$227,700
12	**Granular base for access road**	$8,159
13	**HFSA for access road**	$4,095
14	**Hydraulic Seeding & Organic Soil – Provisional Item**	$35,000
15	**Floating Log Breakwater including mooring anchors**	$529,200
16	**Allowance for Miscellaneous Item (Signage)**	$20,000
	SUB TOTAL	**$2,733,084**
Mobilization and Demobilization (5%)		$136,654
Contingency (25%)		$717,435
	PHASE I TOTAL	**$3,587,173**
Option 6A - PHASE II – Ramp Toe El. 654m		
1	**General excavation and off-site disposal – ramp**	$281,187
2	**Granular base course for ramp**	$4,662
3	**New Concrete Surface (cast in place)**	$92,372
4	**Geotextile**	$643
5	**Scour Protection – Filter Stone for 55kg Riprap**	$5,127
6	**Scour Protection – 55kg Riprap**	$11,837
	PHASE II SUB TOTAL	**$395,828**
Mobilization and Demobilization (5%)		$19,791
Contingency (25%)		$103,905
	PHASE II TOTAL	**$519,524**
	PHASE I & II TOTALS	**$4,106,699**

4.12 OPTION 6B – RAMP TOE AT EL. 654M IN TWO PHASES

Table 27 provides the estimated construction cost for a 6.0 m wide single lane boat launch ramp with a cast-in-place V-grooved concrete surface, scour protection and a floating breakwater and ramp toe elevations of 658m and 654m constructed in two phases.

Table 27: Opinion of Probable Construction Cost – Option 6B- Ramp toe at El. 658m

Item No.	Item Description	Item Total
Option 6B - PHASE I – Ramp Toe El. 658m		
1	**Demolition of existing concrete slabs**	$8,280
2	**General excavation and off-site disposal – ramp**	$638,889
3	**Granular base course for ramp**	$11,888
4	**New Concrete Surface (cast in place)**	$235,549
5	**Geotextile**	$34,841
6	**Scour Protection – Filter Stone for 55kg Riprap**	$277,725
7	**Scour Protection – 55kg Riprap**	$641,167
8	**General excavation and off-site disposal – turnaround**	$155,100
9	**Granular base course for turnaround**	$7,326
10	**HFSA for turnaround**	$3,677
11	**General excavation and off-site disposal – access road**	$227,700
12	**Granular base for access road**	$8,159
13	**HFSA for access road**	$4,095
14	**Hydraulic Seeding & Organic Soil – Provisional Item**	$35,000
15	**Floating Log Breakwater including mooring anchors**	$529,200
16	**Allowance for Miscellaneous Item (Signage)**	$20,000
	SUB TOTAL	**$2,838,595**
Mobilization and Demobilization (5%)		$141,930
Contingency (25%)		$745,135
	PHASE I TOTAL	**$3,725,656**
Option 6B - PHASE II – Ramp Toe El. 654m		
1	**General excavation and off-site disposal – ramp**	$210,909
2	**Granular base course for ramp**	$3,108
3	**New Concrete Surface (cast in place)**	$61,581
4	**Geotextile**	$436
5	**Scour Protection – Filter Stone for 55kg Riprap**	$3,444
6	**Scour Protection – 55kg Riprap**	$7,952
	PHASE II SUB TOTAL	**$287,431**
Mobilization and Demobilization (5%)		$14,371
Contingency (25%)		$75,450
	PHASE II TOTAL	**$377,252**
	PHASE I & II TOTALS	**$4,102,908**

Annual maintenance costs for Options 5, 5A, 5B, 5C, 6, 6A and 6B would be similar to Option 1A.

4.13 SUMMARY

In reviewing the above cost estimates, it is important to note the following:

- The estimates are concept level only and are not intended to be used to establish a project budget. The estimates are intended to provide an indication of the probable costs to determine which boat launch ramp facility alternative(s) warrant further consideration;
- The estimates are based on Moffatt & Nichol's in-house experience and data for projects of a similar nature;
- The estimates are based upon mid-2012 and 2013 price levels in Canadian dollars;
- The estimates exclude any land purchase, permits, navigation and site signage, archaeological investigation assessment, additional habitat compensation programs, removal and remediation of contaminated materials and other hazardous waste;
- A contingency allowance of 25% was included in the cost estimates to cover unforeseen construction costs at the feasibility stage of this project; and,
- The estimates exclude taxes.

Table 25 below summaries the capital cost estimate and annual maintenance costs rounded to the nearest thousand for the various locations.

Table 28: Summary of Estimates for Capital and Annual Maintenance Costs

Location	Opinion of Probable Construction Cost including Contingencies	Annual Maintenance Cost	Ranking Order Lowest to Highest Construction Cost
Option 1 - Replacement Boat Launch Ramp – East-West Alignment with Lower Section along Slope – Concrete/Gravel Surface	$2,825,688	$30,000	3
Option 1A - Replacement Boat Launch Ramp – East-West Alignment with Lower Section along Slope – Concrete Surface	$2,968,704	$27,000	4
Option 2 - Replacement Boat Launch Ramp – Straight - East-West Alignment	$6,710,615	$30,000	12
Option 3 - Replacement Boat Launch Ramp – North - South Alignment – Concrete/Gravel Surface	$3,983,994	$20,000	5
Option 3A - Replacement Boat Launch Ramp – North - South Alignment – Concrete Surface	$4,113,477	$17,000	9
Option 4 - At-Grade Gravel Ramp	$62,875	$45,000	N/A
Option 5 - Ramp Toe at El. 660m	$1,818,135	$27,000	1
Option 5A – Extend Ramp Toe to El. 654m in Two Phases, Phase I – El. 660m, Phase II – El. 654m	$5,044,838	$27,000	10
Option 5B - Ramp Toe at El.658m	$2,363,211	$27,000	2
Option 5C – Extend Ramp Toe to El. 654m in Two Phases – Phase I – El. 658m, Phase II – El.654m	$5,280,562	$27,000	11
Option 6 – Ramp Toe at El. 660m	$4,009,340	$27,000	6
Option 6A – Extend Ramp Toe to El. 654m in Two Phases – Phase I – El. 660m, Phase II El. 654m	$4,106,699	$27,000	8
Option 6B – Extend Ramp Toe to El. 654m in Two Phases – Phase I –El. 658m, Phase II – El. 654m	$4,102,908	$27,000	7

4.14 LIMITATIONS OF THE COST ESTIMATES

The cost estimates are based on the feasibility level drawings as presented in Appendix A and is considered to be a Class D Estimate. The estimate is based on feasibility level drawings and the design basis in Appendix C of this report as well as the results of all site investigations to date. This estimate should be sufficient to provide the ranking of options.

We wish to emphasize that even with the preparation of an accurate construction budget (e.g. within +/- 20% to 25%) that the costs may vary significantly from this estimate due to fluctuations in materials and labour costs, and to uncertainties including market conditions (i.e., bid competition).

In view of the above uncertainties and the importance of not under-estimating the costs, we have included a contingency amount of 25% on all items. We have attempted to identify the major cost components and have made provisional allowances where possible.

In providing estimates of construction cost, it is recognized that neither the client nor M&N has control over the costs of labour, equipment, or materials, or over contractors' methods of determining prices or bidding. Normal variance in Contractor bid prices can range from 10% to 20%. These feasibility estimates of construction cost are based on M&N's reasonable professional judgment and experience and do not constitute a warranty, expressed or implied, that contractors' bids will not vary from the estimate of feasibility cost prepared by the consultant.

4.15 ASSUMPTIONS AND EXCLUSIONS

In addition to the general limitations discussed above, our cost estimate is based on the following assumptions and exclusions:

Assumptions:

- Water levels at the time when the boat launch ramp will be constructed is at the lowest possible elevation (El.653.0 metres), so that the majority of the ramp is constructed in the dry.
- BC Hydro will determine the extent of the in-waterworks which is dependent on water levels at the time of construction. BC Hydro intends to construct the ramp when dry, whenever possible. Therefore, the quantities may decrease depending on reservoir water levels at the time when construction is undertaken.
- The cost of mobilization/demobilization, which includes insurance and bonding, is estimated to be approximately 5% of the total construction cost. The cost of mobilization also includes general cost to meet basic environmental requirements; such as silt-curtain, dust control and sediments control. This percentage was obtained from recent similar projects including the Roberts Bank Environmental Habitat Compensation Project (RBEHC) and the Deltaport Barge Ramp Construction Project.
- The unit rates for the supply, transport and installation of filter stone, riprap, 25mm HFSA, 75mm CBC were based on quotations for supply and installation from local suppliers in or near Chetwynd, and from a contractor who recently provided estimates for construction for

similar boat ramp facility on the Peace Reach. The travel time between the different quarry sources to the Dunlevy was estimated to be 4hrs for a round trip.

- The unit rate of $385/m2 for Cast-In-Place concrete supply and placement was derived from a March 2013 quotation for the Taylor Boat Ramp project.
- The cost estimate includes a 25% contingency allowance, which we consider to be appropriate for a project at this stage of development. The estimates, including the contingency amount, are considered accurate to +/- 20% given the uncertainties noted above.

Exclusions:

The cost estimate excludes:

- Habitat compensation works (if required);
- Indirect costs for engineering and project management;
- Indirect costs for owner's project management, construction administration, and third party consulting fees; and,
- All applicable taxes, land purchase, permits, and regulatory approvals.

5. CONCLUSIONS

Our general conclusions for the replacement boat ramp options at the existing Dunlevy site are as follows.

5.1 OPTIONS 1 & 1A – EAST-WEST ORIENTATION WITH DOGLEG

It is potentially feasible to construct a replacement boat launch ramp at the existing site in the east-west alignment as shown for Options 1, and 1A. Boat launching operations can be improved by using a floating breakwater on the southern side of the ramp which will attenuate some of the predominant southerly waves. The dogleg shaped ramp alignment requires a curb barrier along the outer edge of the turnaround area to prevent trailers and vehicles from going over the steep embankment. If bank erosion at the south end of the site can be mitigated with placement of scour protection and global bank erosion rates in the Dunlevy inlet are determined not to be critical to this area, then developing a new replacement ramp in current alignment could be feasible.

The advantages of Option 1 and 1A are:

- Covers the full recorded operating range of water levels;
- Utilizes the existing cut slopes of the original boat ramp minimizing earthworks for the upper section of the ramp;
- Existing parking lot not affected by this layout;
- Existing access road that is in good condition;
- Option 1 is the third lowest cost alternative mainly due to the optimal alignment following the existing east-west orientation of the ramp and the lower section of the ramp run parallel with the steep contours of the site. This orientation reduces the fill and cut volumes needed to form the slope of the ramp; and,
- Option 1A is the fourth lowest cost alternative. This option features a ramp slope with a concrete surface.

The disadvantages of Options 1 and 1A are:

- The location is exposed to wave action from the southerly direction. The existing boat ramp has erosion occurring along the ramp;
- Gravel surfaced in the lower section of the boat ramp for Option 1 provides very limited traction and is generally not recommended because of safety, capacity and maintenance issues;
- Requires a floating breakwater to attenuate wave action on the ramp. The floating breakwater provides some shielding from southerly winds;
- Timber material for the floating breakwater will have 10 year design life, and timber members will require replacement every 10-15 years;
- Dogleg shaped ramp will require barriers at the outer edge of the turnaround area to prevent vehicles and trailers from accidentally going the edge of the slope; and,

- May require more maintenance due to exposed location especially the gravel surface in the lower section of the ramp in Option 1.

5.2 OPTION 2- EAST-WEST ORIENTATION WITHOUT DOGLEG

Option 2 is similar to Options 1 and 1A but without a dogleg in the ramp alignment.

The advantages are:

- Covers the full recorded operating range of water levels;
- Existing access road that is in good condition;
- Utilizes the existing cut slopes of the original boat ramp minimizing earthworks for the upper section of the ramp; and,
- Existing parking lot not affected by this layout.

The disadvantages are:

- The location is exposed to wave action from the southerly direction. The existing boat ramp has erosion occurring along the ramp;
- Requires a large volume of fill at the lower section of the ramp to form the required slope for the boat ramp;
- For consideration of the viability of Option 2, further geotechnical analysis will be required to determine if the native ground will be capable to support the large weight of fill without causing slope failure;
- Requires a floating breakwater to attenuate wave action on the ramp. The floating breakwater provides some shielding form the southerly wind;
- Timber material for the floating breakwater will have 10 year design life and timber members will require replacement every 10-15 years; and,
- Option 2 is the highest cost alternative mainly due to the large of fill that will be required to form the require slope for the boat ramp.

5.3 OPTIONS 3 & 3A – NORTH-SOUTH ALIGNMENT

The north-south ramp alignment as shown in Options 3 and 3A provides the best orientation for launching boats as the existing headland will provide a natural shelter from the predominant wind generated southerly waves.

The advantages are:

- Covers the full recorded operating range of water levels;
- Provides the best orientation for safely launching boats; and,
- Sheltered boat launch area will require less maintenance.

The disadvantages are:

- Existing parking lot and access road will be reconfigured by this layout;
- Requires larger volumes of earthworks to construct the ramp;
- Option 3 is the fifth lowest cost alternative as this new north-south alignment will require larger volumes of cut and fill than Option 1 to form the new ramp alignment; and,
- Option 3A is the ninth lowest cost alternative. This option considers the ramp slope made of concrete.

5.4 OPTION 4 – GRAVEL SURFACED RAMP

A gravel surfaced boat ramp in the existing ramp orientation was considered. The ramp is only 80m long and does not have scour protection or a floating breakwater.

The advantages are:

- Existing parking lot and access road remain unchanged; and,
- Least cost alternative.

The disadvantages are:

- Does not comply with the design guidelines or the user requirements;
- Truck and trailer cannot gain sufficient traction on a gravel surface at 15% grade;
- Significant risk of a loaded vehicle and trailer getting stuck on the ramp and creating major ruts in the gravel surface and therefore will be a safety concern for the next user;
- Limited access to the range of water levels in the reservoir;
- Exposed to wind generated waves from the south;
- Gravel surfaced boat launch ramp has very limited traction and has safety and capacity issues with the driving surface; and,
- Requires frequent maintenance to keep the facility operational and has a higher maintenance cost.

This option should not be considered any further due to the safety and non-compliance with design criteria and user requirements.

5.5 OPTION 5 – EAST-WEST ALIGNMENT - RAMP TOE AT EL. 660M

Option 5 is similar in alignment to Options 1&2 with a 15% slope at a lower ground profile than Options 1&2. The ramp is toe constructed at El. 660 m with no further extensions to the ramp.

The advantages are:

- Proposed boat ramp is operational for the majority of the summer boating season;
- Proposed ramp layout fits generally within the footprint of the existing ramp; and,
- Least cost option for the concrete surfaced ramps.

The disadvantages are:

- The location is exposed to wave action from the southerly direction;
- Requires a floating log breakwater to attenuate waves;
- Timber logs for the floating breakwater will have a 10 year design life and timber members will have to be replaced every 10-15 years;
- Navigation markers required to mark top of cut slopes when submerged; and,
- Ramp will be expensive to extend to lower water levels due to the large fill quantities required to form the slope.

5.6 OPTION 5A – EAST-WEST ALIGNMENT - RAMP TOE AT EL. 654M BUILT IN TWO PHASES

Option 5A considers construction of the ramp to the low water elevation in two phases. Phase I involves building the ramp to El. 660m, and Phase II involves extending the ramp to El 654m in another construction season by filling to form the extended ramp slope.

The advantages are:

- Covers the full recorded operating water level range in the reservoir;
- Lowering the ground profile of the ramp reduces the amount of fill required for Phase II construction; and,
- The upper section of the proposed ramp generally fit within the footprint of the existing ramp.

The disadvantages are:

- The location is exposed to wave action from the southerly direction;
- Requires a floating log breakwater to attenuate waves;
- Timber logs for the floating breakwater will have a 10 year design life and timber members will have to be replaced every 10-15 years;
- Additional mobilization and de-mobilization required for phased construction;
- Navigation markers required to mark top of cut slopes when submerged; and,
- Ramp extension requires large volume of fill to form the boat ramp slope.

5.7 OPTION 5B – EAST-WEST ALIGNMENT - RAMP TOE AT EL. 658M

Option 5B is similar in alignment to Option 5 with a 15% slope. The lower ramp toe El. 658m reduces the annual non-accessible use of the ramp from 6 days to 1 day. The ramp is toe constructed at El. 658 m with no further extensions to the ramp.

The advantages are:

- Proposed boat ramp is operational for the majority of the summer boating season;
- Proposed ramp layout fits generally within the footprint of the existing ramp; and,

- Least cost option for the concrete surfaced ramps.

The disadvantages are:

- The location is exposed to wave action from the southerly direction;
- Requires a floating log breakwater to attenuate waves;
- Timber logs for the floating breakwater will have a 10 year design life and timber members will have to be replaced every 10-15 years;
- Navigation markers required to mark top of cut slopes when submerged; and,
- Ramp will be expensive to extend to lower water levels due to the large fill quantities required to form the slope.

5.8 OPTION 5C – EAST-WEST ALIGNMENT - RAMP TOE AT EL. 654M BUILT IN TWO PHASES

Option 5C considers construction of the ramp to the low water elevation in two phases. Phase I involves building the ramp to El. 658m, and Phase II involves extending the ramp to El 654m in another construction season by filling the ground to form the extended ramp slope.

The advantages are:

- Covers the full recorded operating water level range in the reservoir;
- Lowering the ground profile of the ramp reduces the amount of fill required for Phase II construction; and,
- The upper section of the proposed ramp generally fit within the footprint of the existing ramp.

The disadvantages are:

- The location is exposed to wave action from the southerly direction;
- Requires a floating log breakwater to attenuate waves;
- Timber logs for the floating breakwater will have a 10 year design life and timber members will have to be replaced every 10-15 years;
- Additional mobilization and de-mobilization required for phased construction;
- Navigation markers required to mark the approach to the ramp, and the top of cut slopes when submerged; and,
- Ramp extension requires large volume of fill to form the boat ramp slope.

5.9 OPTION 6 – EAST –WEST ALIGNMENT – RAMP TOE AT EL. 654M

Option 6 considers lowering the ground profile of the boat ramp so that proposed ramp is constructed by excavating the existing slope to form the ramp that will be operable over the full water level range.

The advantage is:

- Covers the full recorded operating water level range in the reservoir.

The disadvantages are:

- The location is exposed to wave action from the southerly direction;
- Requires a floating log breakwater to attenuate waves;
- Timber logs for the floating breakwater will have a 10 year design life and timber members will have to be replaced every 10-15 years; and,
- Navigation markers required to mark top of cut slopes when submerged.

5.10 OPTION 6A – EAST- WEST ALIGNMENT - RAMP TOE AT EL 654M BUILT IN TWO PHASES

Option 6A considers lowering the ground profile of the boat ramp so that proposed ramp is constructed by excavating into the existing ground to form the ramp that will be operable over the full water level range but built in two Phases. In Phase I, the ramp toe is constructed to El. 660m and in Phase II the ramp is constructed to El. 654m.

The advantage is:

- Covers the full recorded operating water level range in the reservoir.

The disadvantages are:

- The location is exposed to wave action from the southerly direction;
- Requires a floating log breakwater to attenuate waves;
- Timber logs for the floating breakwater will have a 10 year design life and timber members will have to be replaced every 10-15 years;
- Additional mobilization and de-mobilization required for phased construction; and,
- Navigation markers required to mark top of cut slopes and ramp approach when submerged.

5.11 OPTION 6B – EAST- WEST ALIGNMENT - RAMP TOE AT EL 654M BUILT IN TWO PHASES

Option 6B considers lowering the ground profile of the boat ramp so that proposed ramp is constructed by excavating the boat ramp slope to a toe level of El. 654m. This allows the boat ramp to operate over the full water level range, but is built in two Phases. In Phase I, the ramp toe is constructed to El. 658m and in Phase II the ramp is constructed to El. 654m.

The advantage is:

- Covers the full recorded operating water level range in the reservoir.

The disadvantages are:

- The location is exposed to wave action from the southerly direction;
- Requires a floating log breakwater to attenuate waves;

- Timber logs for the floating breakwater will have a 10 year design life and timber members will have to be replaced every 10-15 years;
- Additional mobilization and de-mobilization required for phased construction; and,
- Navigation markers required to mark top of cut slopes when submerged.

5.12 RISKS

Other risks to be considered when developing this site are:

- For consideration of the viability of Options 2, 5, 5A, 6 and 6A further geotechnical analysis will be required to determine if the native ground will be capable to support the large weight of fill without causing slope failure and bedrock elevations;
- Habitat compensation works may be required;
- Availability of suitable riprap and filter stone materials in the vicinity of the site could reduce costs significantly;
- Excess excavated material will need to be disposed off-site, a suitable site will need to identified;
- Construction methodology will need to be assessed to determine if ramp can be constructed in the low water window given the large volumes of materials that needs to be placed; and,
- Construction of the lower section of the ramp will have to be done in the winter/spring months when the water level in the reservoir is low, however, construction in frozen ground will be difficult or water logged soil in spring may be problematic to construction.

6. RECOMMENDATIONS

Option 5 is the lowest cost concrete surfaced alternative with the ramp toe at El.660m. At this water level range, the proposed boat ramp is operable for the majority of time in the summer months May to October which is the typical boating season on the reservoir. This option is technically feasible, but the east-west orientation of the boat ramp on the southern side of the site is more exposed to wind and waves, providing a floating breakwater on the southern side of the ramp will attenuate waves and improve boater safety. Providing the User requirements are satisfied with May to October operations period only possibly 6 days in the season when the boat launch ramp is not operable, Option 5 is the preferred alternative to be carried forward to preliminary and detailed design.

Option 5B is the second ranked alternative with a ramp toe El. 658m. This option reduces the non-operable period from six days to one day during the summer boating season. The cost for Option 5B is approximately 1.4 times Option 5.

Options 1 and 1A are technically feasible, but are in a more exposed orientation to the predominant wind and wave direction, and are similar to Option 5. These two options are ranked third and fourth respectively and are based on capital cost. These options are approximately one and half times the estimated cost for Option 5. Higher maintenance costs will likely be associated with these options.

Options 6, 6B and 6A are the sixth, seventh, and eighth ranked alternatives respectively. These options are approximately two times the estimated cost of Option 5.

Options 3 and 3A are the fifth and ninth ranked alternatives respectively based on estimated construction costs. However, from a technical and safety operational perspective; Options 3 or 3A are the best options due to the sheltered North-South orientation of the boat launch ramp and associated lower maintenance cost. Options 3 and 3A are approximately double the cost of Option 5.

Options 5A, 5C and 2 are the tenth, eleventh and twelfth ranked alternatives respectively based on estimated construction cost. These options consider ramp extensions that require large volumes of fill to form the lowest ramp toe elevation. These options are not recommended.

Option 4 is least expensive of the alternative, but is not recommended for a permanent boat ramp facility as it does not meet the design criteria and user requirements.

If user requirements can be revised to accept some amount of non-accessible time that the boat ramp can be usable in summer operating period, ramp construction costs can be considerable reduced.

Extension of the ramps to the lowest recorded water level of El. 654m may not be practical as this water level typically occurs during the winter/spring months where areas are frozen and not suitable for boating.

7. CLOSURE

This report has been prepared for the sole benefit of BC Hydro and its agents, and may not be used by any third party without the expressed written consent of Moffatt & Nichol and BC Hydro. Any use of this document by a third party is at the sole risk of such third party. The statements and conclusions presented herein are valid as of the date of publication. Future changes in the conditions affecting the underlying assumptions of this report may alter its findings and the conclusions. Moffatt & Nichol does not undertake to revise and update this report should future events reflect changed conditions.

We trust that this report meets BC Hydro's requirements at this time. Should you have any questions, or if we can be of further assistance, please contact us at any time.

Disclaimer:

Electronic versions (including Microsoft Word formats or Adobe Acrobat PDFs) are provided for reference only, and should not be relied upon as a final work product. Electronic copies are potentially subject to alteration by others beyond Moffatt & Nichol's control, and Moffatt & Nichol assumes no responsibility for damages suffered by any party as a result of decisions made or actions based on any electronic report. Refer to the original, printed and signed version of this document for the official and final Moffatt & Nichol work product.

APPENDIX A

DRAWINGS

NOTES:

1. BASE SURVEY MAP PROVIDED BY ATEK HYDROGRAPHIC SURVEY, DATED MAY 19, 2009.
2. CONTOURS ARE IN METRES TO GEODETIC DATUM.
3. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.
4. CONCRETE SURFACE EXTENTS ARE FROM EL. 674.6 m TO EL. 660 m
5. GRAVEL SURFACE EXTENTS ARE FROM EL. 660 m TO EL. 653.2 m

LEGEND:

- RIPRAP
- GRAVEL
- CONCRETE

DUNLEVY REPLACEMENT BOAT RAMP

SCALE: 1:500

OPTION 1

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

10m 0m 10m 20m
SCALE: 1 : 500

Mark	Description	Date	Dr'n	Appr.
B	DRAFT REPORT	03/08/13	AM	PH
A	DRAFT REPORT	02/27/13	AM/EZ	PH

BC hydro

moffatt & nichol
777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

SEAL

Designed by: PH		Date: FEB 22/13	Rev. B
Dwn by: AM	Ckd by: –	M&N Project No. 7937	
Reviewed by: –		Drawing code:	
Submitted by: – MOFFATT & NICHOL		Dwg Scale: AS SHOWN Plot scale: 1:1 (D SHEET)	

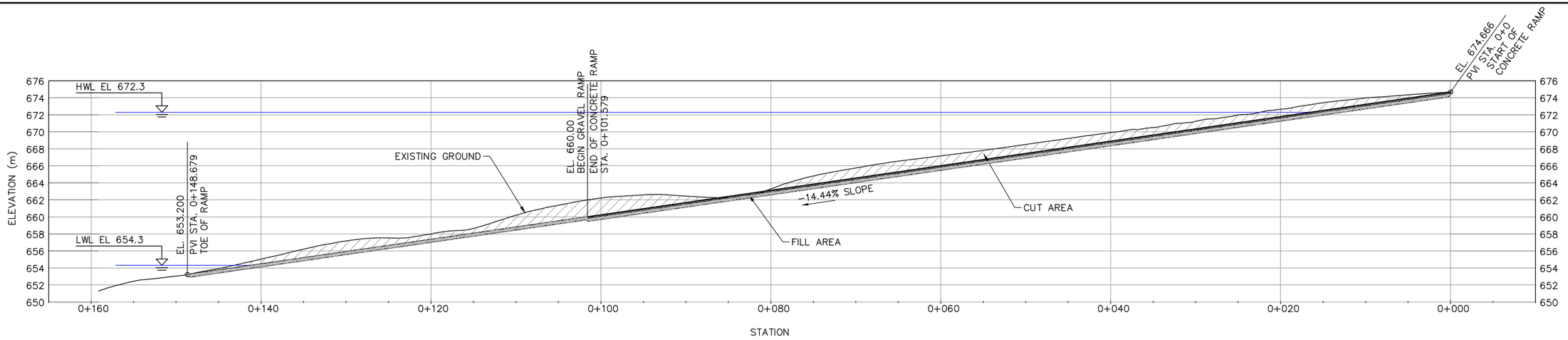
DUNLEVY BOAT LAUNCH RAMP

REPLACEMENT BOAT RAMP
OPTION 1
PLAN

Sheet Reference Number: SK1

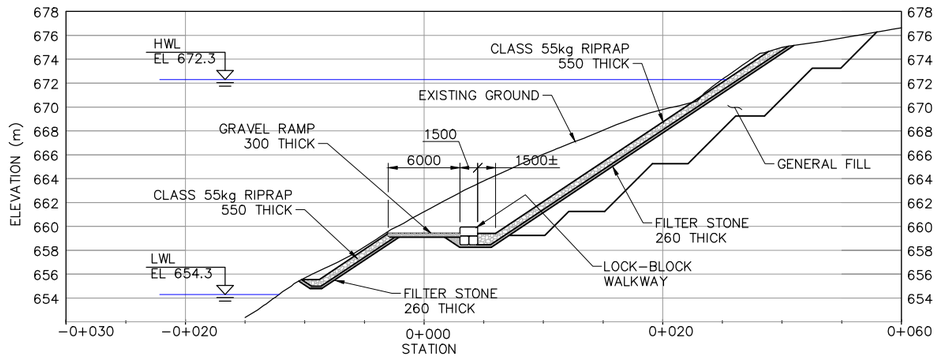
Sheet of

DRAWING SCALES SHOWN BASED ON 22"X34" DRAWING



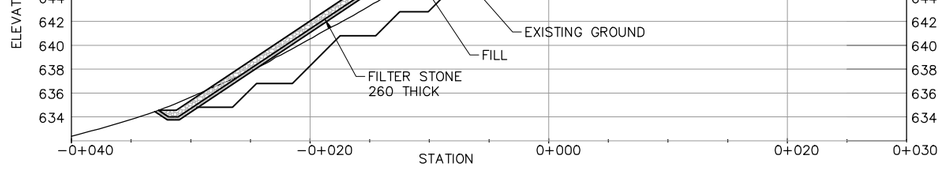
PROFILE ALONG OPTION 1 RAMP CENTERLINE

SCALE: 1:250



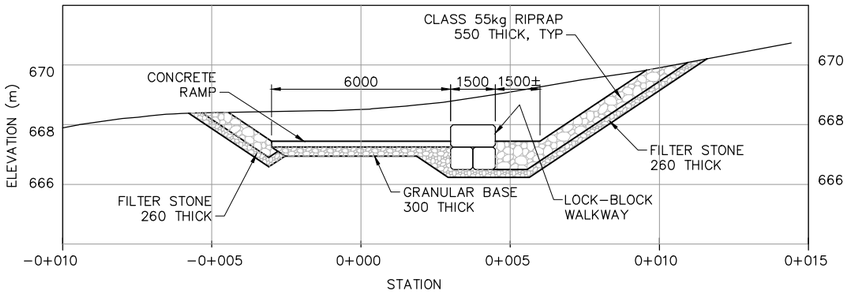
A SK1 **SECTION**

SCALE: 1:250



B SK1 **SECTION**

SCALE: 1:250



C SK1 **SECTION**

SCALE: 1:100

5m 0m 5m 10m

SCALE: 1 : 250

2m 0m 2m 4m

SCALE: 1 : 100

PRELIMINARY

NOT TO BE USED FOR CONSTRUCTION

Mark	Description	Date	Dr'n	Appr
B	DRAFT REPORT	03/08/13	AM	PH
A	DRAFT REPORT	02/27/13	AM/EZ	PH

BC hydro

moffatt & nichol
777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

SEAL

Designed by: PH	Date: FEB 22/13	Rev. B
Dwn by: EZ/AM	Ckd by: –	M&N Project No. 7937
Reviewed by: –		Drawing code:
Submitted by: – MOFFATT & NICHOL		Dwg Scale: AS SHOWN Plot scale: 1:1 (D SHEET)

DUNLEVY BOAT LAUNCH RAMP

REPLACEMENT BOAT RAMP
OPTION 1
SECTIONS

Sheet Reference Number: SK1A

Sheet of

DRAWING SCALES SHOWN BASED ON 22"X34" DRAWING

NOTES:

1. BASE SURVEY MAP PROVIDED BY ATEK HYDROGRAPHIC SURVEY, DATED MAY 19, 2009.
2. CONTOURS ARE IN METRES TO GEODETIC DATUM.
3. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.
4. CONCRETE SURFACE EXTENTS ARE FROM EL. 674.6 m TO EL. 660 m
5. GRAVEL SURFACE EXTENTS ARE FROM EL. 660 m TO EL. 653.2 m

LEGEND:

RIPRAP

GRAVEL

CONCRETE

DUNLEVY REPLACEMENT BOAT RAMP
SCALE: 1:500

OPTION 2

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

10m 0m 10m 20m
SCALE: 1 : 500

Mark	Description	Date	Dr'n	Appr.
A	DRAFT REPORT	03/08/13	AM	PH

BC hydro

moffatt & nichol
777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

SEAL

Designed by: PH		Date: MAR 08/13	Rev. A
Dwn by: AM	Ckd by: –	M&N Project No. 7937	
Reviewed by: –		Drawing code:	
Submitted by: – MOFFATT & NICHOL		Dwg Scale: AS SHOWN Plot scale: 1:1 (D SHEET)	

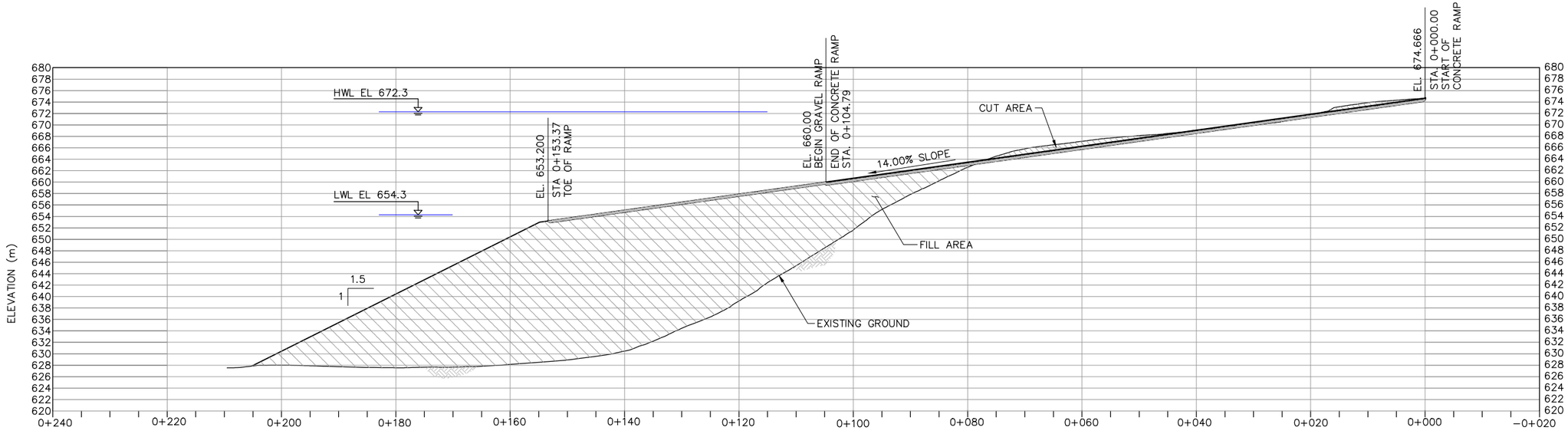
DUNLEVY BOAT LAUNCH RAMP

REPLACEMENT BOAT RAMP
OPTION 2
PLAN

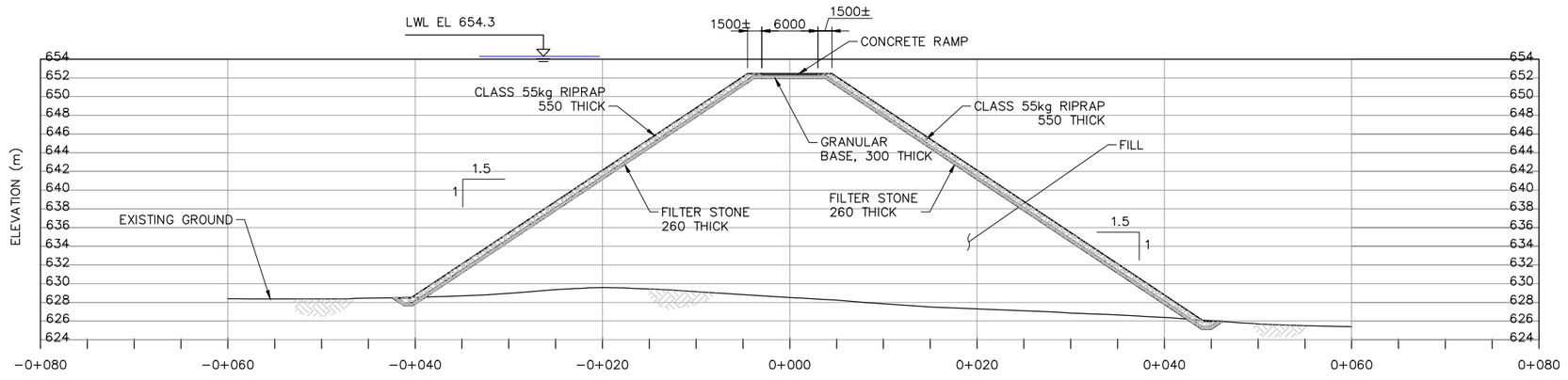
Sheet Reference Number: SK2

Sheet of

DRAWING SCALES SHOWN BASED ON 22"X34" DRAWING



A SK2 **PROFILE ALONG OPTION 2 RAMP CENTERLINE**
SCALE: 1:400



B SK2 **SECTION**
SCALE: 1:300

8m 0m 8m 16m
SCALE: 1 : 400

6m 0m 6m 12m
SCALE: 1 : 300

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

Mark	Description	Date	Dr'n	Appr.
A	DRAFT REPORT	03/08/13	AM	PH

BC hydro

moffatt & nichol
777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

SEAL

Designed by: PH	Date: MAR 08/13	Rev. A
Dwn by: AM	Ckd by: –	M&N Project No. 7937
Reviewed by: –		Drawing code:
Submitted by: – MOFFATT & NICHOL		Dwg Scale: AS SHOWN Plot scale: 1:1 (D SHEET)

DUNLEVY BOAT LAUNCH RAMP

REPLACEMENT BOAT RAMP
OPTION 2
SECTIONS

Sheet Reference Number: SK2A
Sheet of

DRAWING SCALES SHOWN BASED ON 22"X34" DRAWING

NOTES:

1. BASE SURVEY MAP PROVIDED BY ATEK HYDROGRAPHIC SURVEY, DATED MAY 19, 2009.
2. CONTOURS ARE IN METRES TO GEODETIC DATUM.
3. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.
4. CONCRETE SURFACE EXTENTS ARE FROM EL. 682.1 m TO EL. 660 m
5. GRAVEL SURFACE EXTENTS ARE FROM EL. 660 m TO EL. 653.2 m

LEGEND:

- RIPRAP
- GRAVEL
- CONCRETE

15m 0m 15m 30m

SCALE: 1 : 750

DUNLEVY REPLACEMENT BOAT RAMP

SCALE: 1:750

OPTION 3

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

Mark	Description	Date	Dr'n	Appr
A	DRAFT REPORT	03/08/13	AM	PH

BChydro

moffatt & nichol
777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

SEAL

Designed by: PH	Date: MAR 08/13	Rev. A
Dwn by: EZ	Ckd by:	M&N Project No. 7937
Reviewed by:	Drawing code:	
Submitted by: MOFFATT & NICHOL	Dwg Scale: AS SHOWN Plot scale: 1:1 (D SHEET)	

DUNLEVY BOAT LAUNCH RAMP

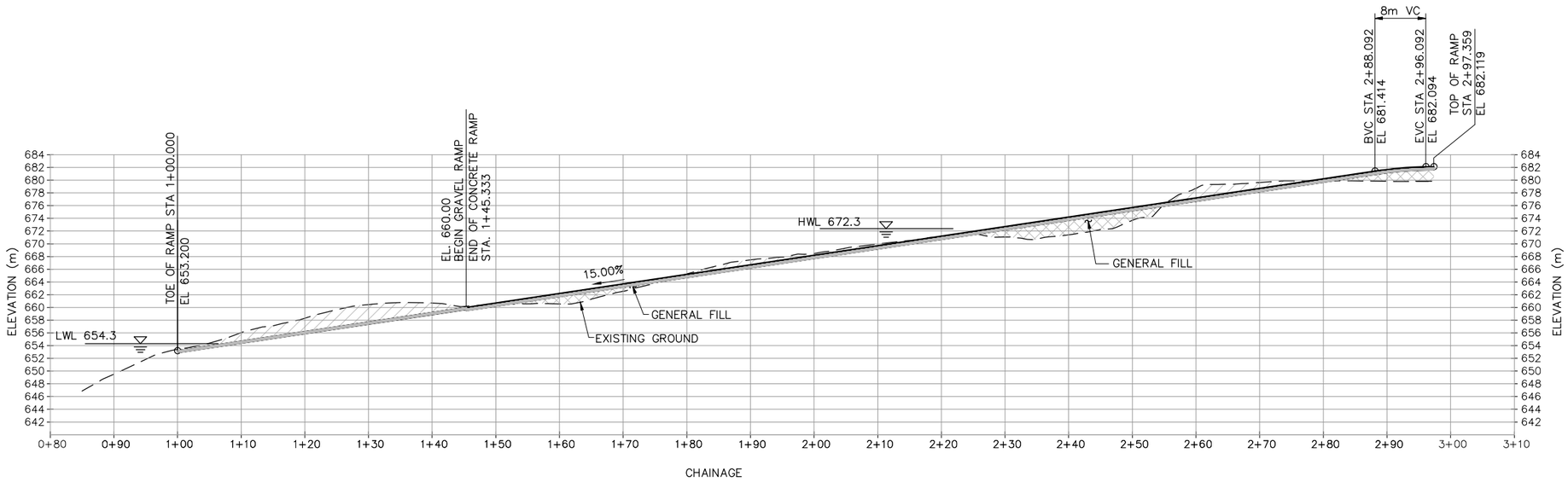
REPLACEMENT BOAT RAMP
OPTION 3
PLAN

Sheet Reference Number: SK3

Sheet of

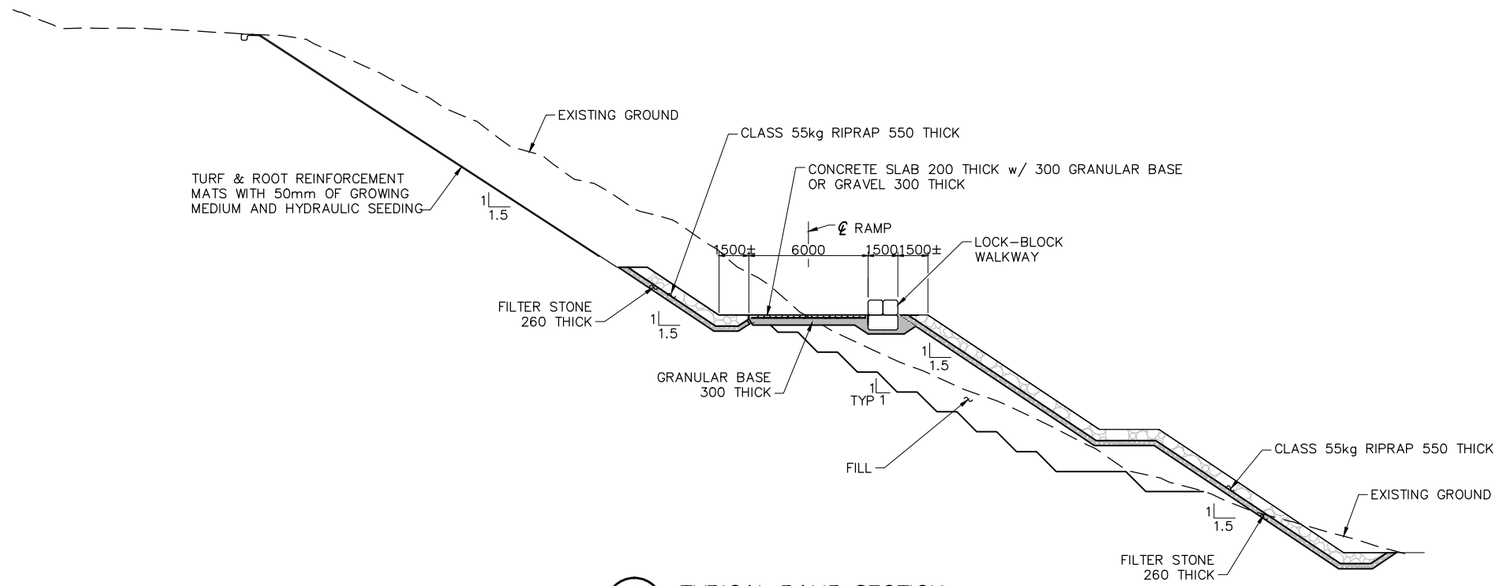
DRAWING SCALES SHOWN BASED ON 22"X34" DRAWING

File: P:\7937 Dunlevy Bt Rmp Dsgn & Construction Site Visits\CADD_Active\793700-SK3; Plotted: 3/14/2013 8:46 AM by MANUZON, ALLEN; Saved: 3/13/2013 11:22 AM by SCARSON



PROFILE ALONG OPTION 3 RAMP CENTERLINE

SCALE: 1:400



A / SK3 TYPICAL RAMP SECTION

SCALE: 1:150

3m 0m 3m 6m

SCALE: 1 : 150

8m 0m 8m 16m

SCALE: 1 : 400

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

Mark	Description	Date	Dr'n	Appr.
A	DRAFT REPORT	03/08/13	AM	PH

BC hydro

moffatt & nichol
777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

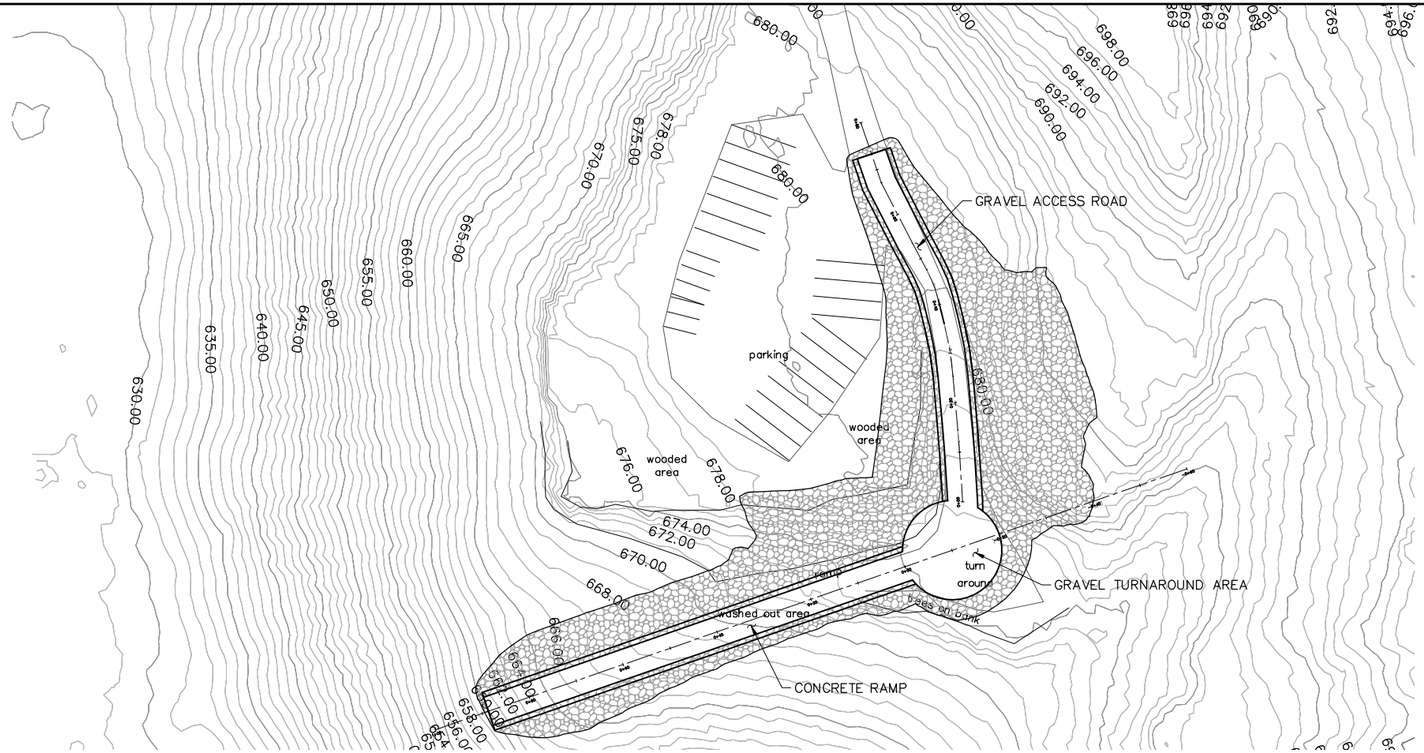
SEAL

Designed by: PH	Date: MAR 08/13	Rev. A
Dwn by: EZ / Ckd by:	M&N Project No. 7937	
Reviewed by:	Drawing code:	
Submitted by: MOFFATT & NICHOL	Dwg Scale: AS SHOWN; Plot scale: 1:1 (D SHEET)	

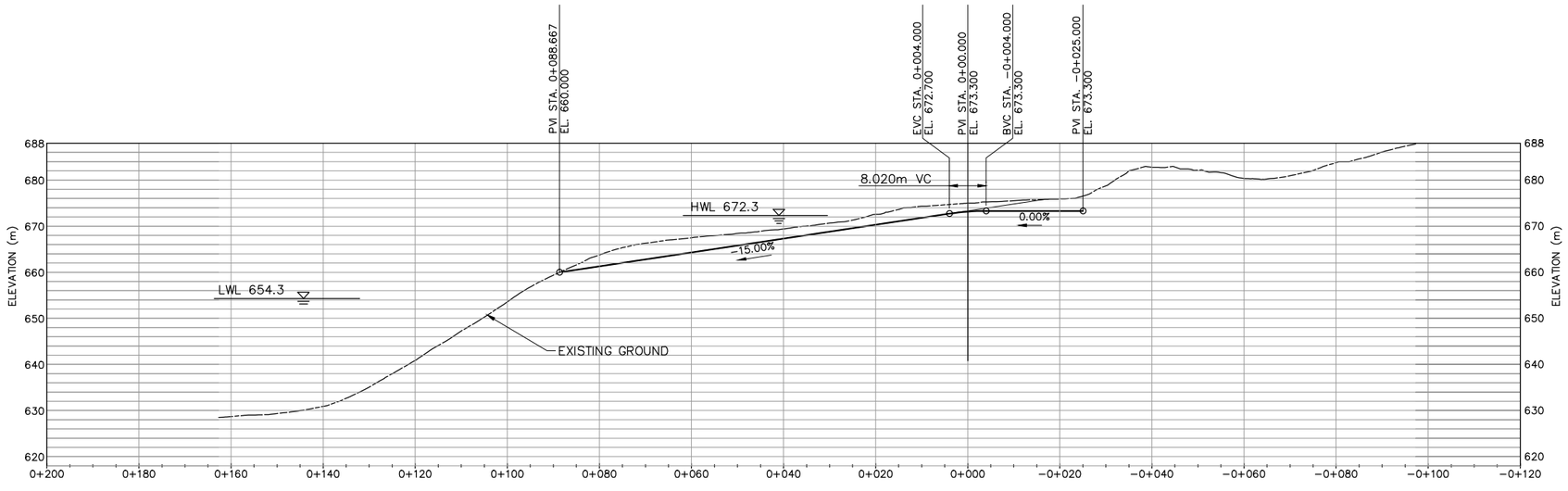
DUNLEVY BOAT LAUNCH RAMP
REPLACEMENT BOAT RAMP
OPTION 3
SECTIONS

Sheet Reference Number: **SK3A**
Sheet of

DRAWING SCALES SHOWN BASED ON 22"X34" DRAWING



A SK5 **PLAN** OPTION 5
SCALE: 1:600
(FLOATING BREAKWATER NOT SHOWN FOR CLARITY)



B SK5 **PROFILE ALONG BOAT RAMP CENTRELINE**
SCALE: 1:600

12m 0m 12m 24m
SCALE: 1 : 600

NOTES:

1. BASE SURVEY MAP PROVIDED BY ATEK HYDROGRAPHIC SURVEY, DATED MAY 19, 2009.
2. CONTOURS ARE IN METRES TO GEODETIC DATUM.
3. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.

Mark	Description	Date	Dr'n	Appr.
A	ISSUED FOR REVIEW	05/24/13	EZ	PH

BC hydro

moffatt & nichol
777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604–707–9004

SEAL

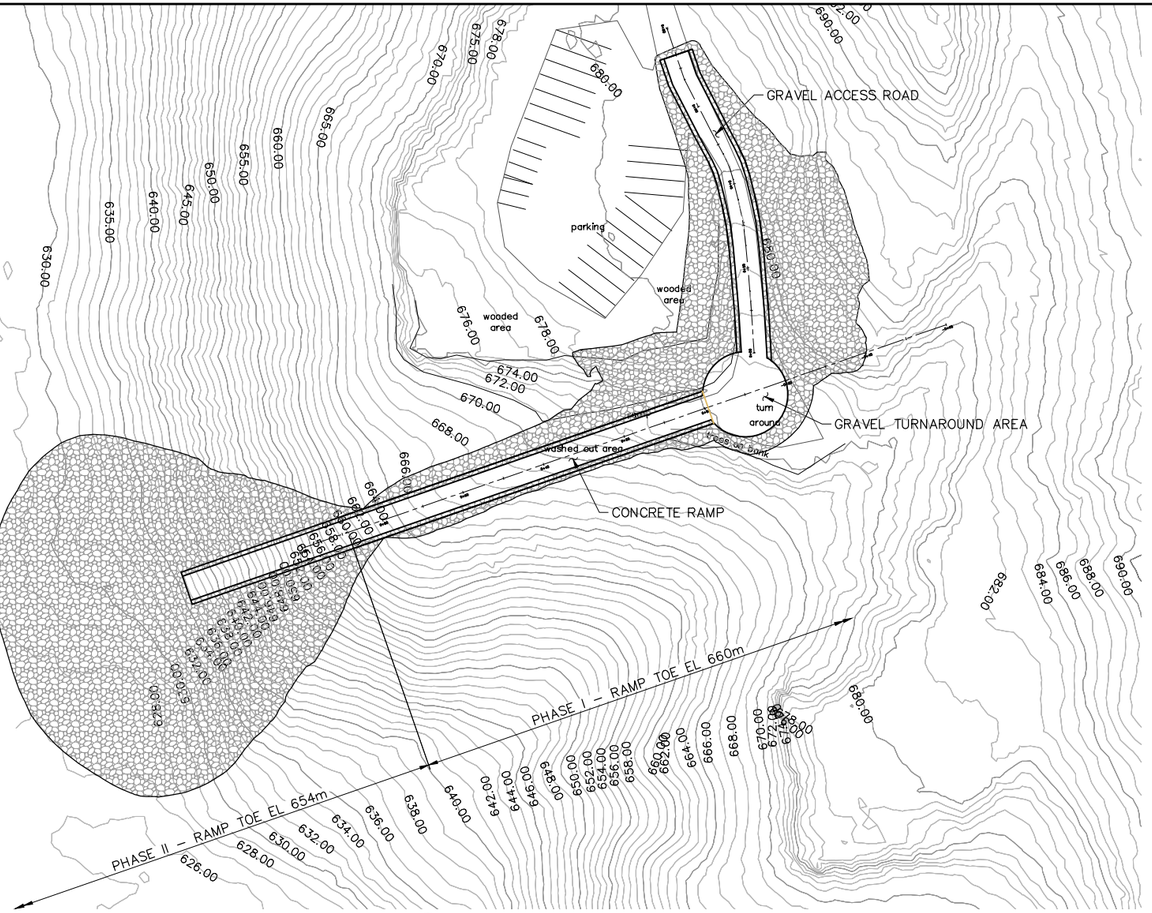
Designed by: PH	Date: MAY 14/13	Rev. A
Dwn by: EZ	Ckd by: –	M&N Project No. 7937
Reviewed by: –		Drawing code:
Submitted by: – MOFFATT & NICHOL		Dwg Scale: AS SHOWN Plot scale: 1:1 (D SHEET)

DUNLEVY BOAT LAUNCH RAMP

REPLACEMENT BOAT RAMP
OPTION 5
PLAN & PROFILE

Sheet Reference Number: SK5
Sheet of

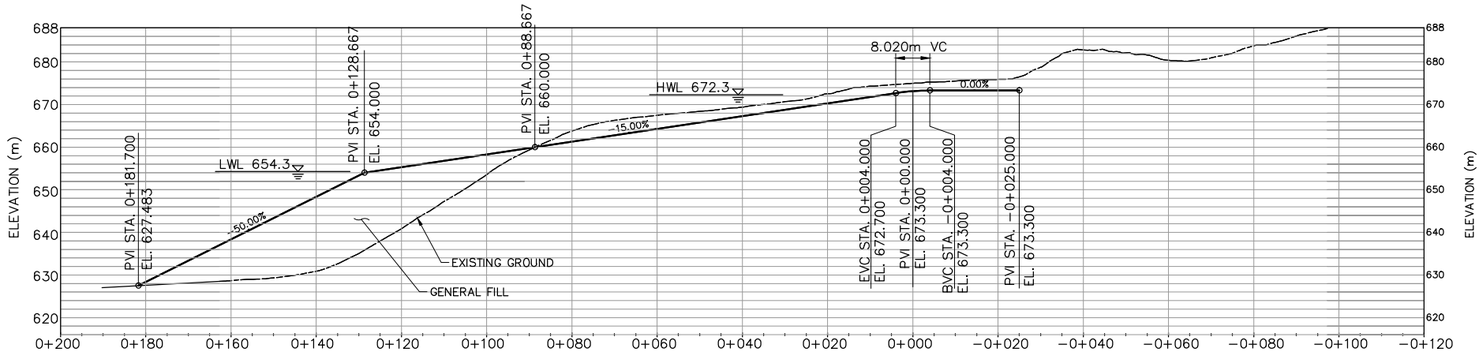
DRAWING SCALES SHOWN BASED ON 22"X34" DRAWING



A SK5A **PLAN** OPTION 5A

SCALE: 1:700

(FLOATING BREAKWATER NOT SHOWN FOR CLARITY)



B SK5A **PROFILE ALONG BOAT RAMP CENTRELINE**

SCALE: 1:700

14m 0m 14m 28m

SCALE: 1 : 600

NOTES:

1. BASE SURVEY MAP PROVIDED BY ATEK HYDROGRAPHIC SURVEY, DATED MAY 19, 2009.
2. CONTOURS ARE IN METRES TO GEODETIC DATUM.
3. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.

Mark	Description	Date	Dr'n	Appr.
A	ISSUED FOR REVIEW	05/24/13	AM	PH

BC hydro

moffatt & nichol
777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

SEAL

Designed by: PH		Date: MAY 22/13	Rev. A
Dwn by: EZ/AM	Ckd by: –	M&N Project No. 7937	
Reviewed by: –		Drawing code:	
Submitted by: – MOFFATT & NICHOL		Dwg Scale: AS SHOWN Plot scale: 1:1 (D SHEET)	

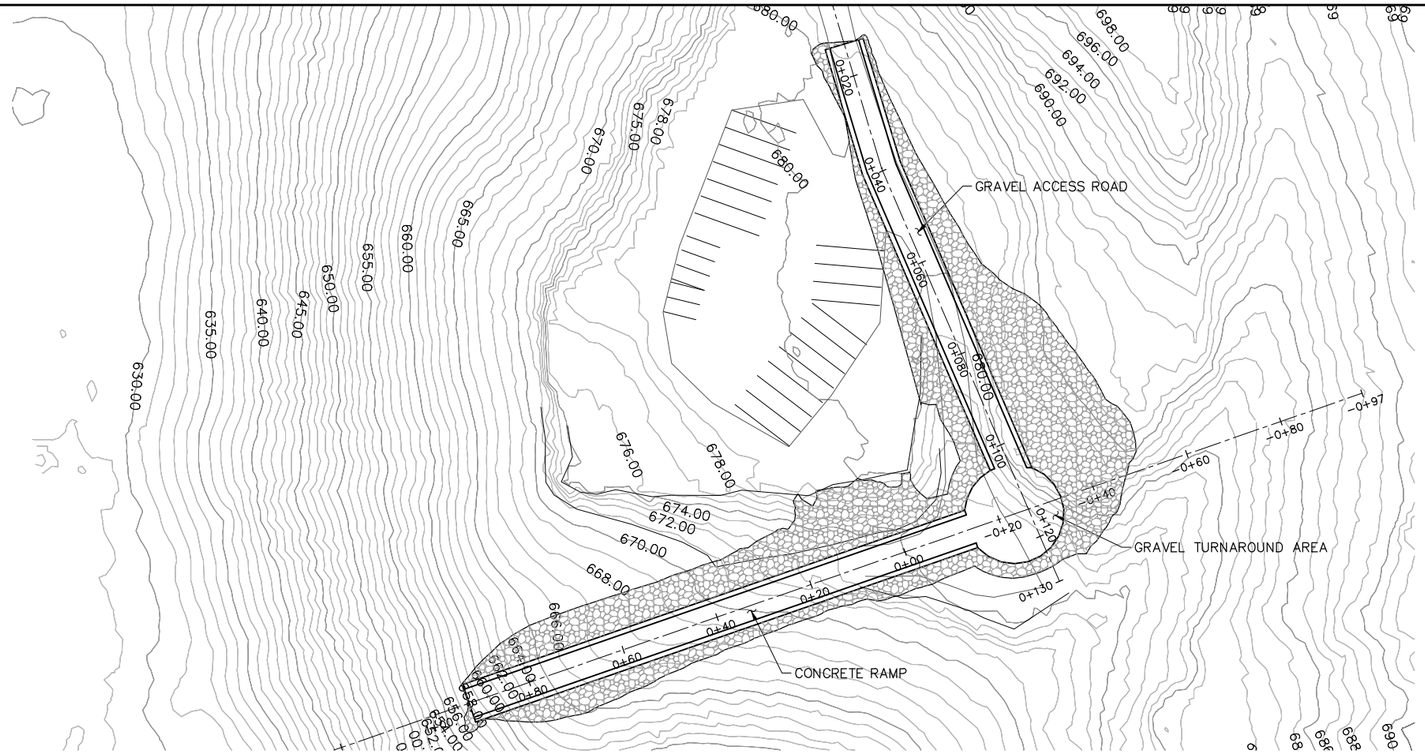
DUNLEVY BOAT LAUNCH RAMP

REPLACEMENT BOAT RAMP
OPTION 5A
PLAN & PROFILE

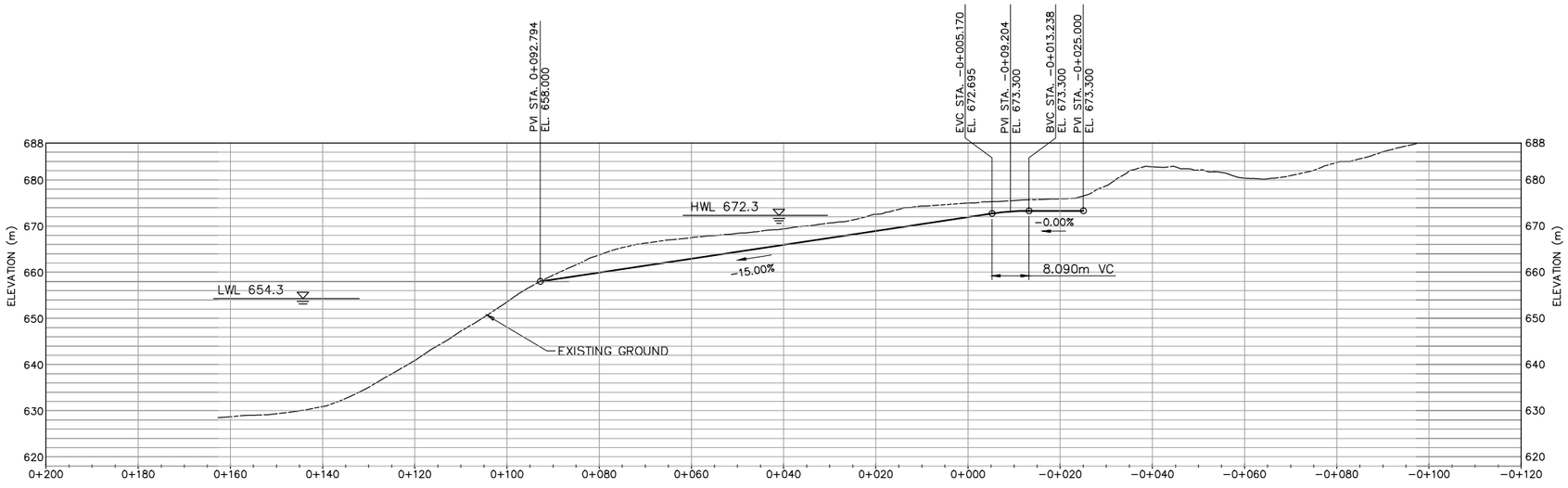
Sheet Reference Number: SK5A

Sheet of

DRAWING SCALES SHOWN BASED ON 22"X34" DRAWING



A SK5B **PLAN** OPTION 5B
SCALE: 1:600
(FLOATING BREAKWATER NOT SHOWN FOR CLARITY)



B SK5B **PROFILE ALONG BOAT RAMP CENTRELINE**
SCALE: 1:600

SCALE: 1 : 600
12m 0m 12m 24m

NOTES:

1. BASE SURVEY MAP PROVIDED BY ATEK HYDROGRAPHIC SURVEY, DATED MAY 19, 2009.
2. CONTOURS ARE IN METRES TO GEODETIC DATUM.
3. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.

Mark	Description	Date	Dr'n	Appr.
A	ISSUED FOR REVIEW	05/28/13	EZ	PH

BC hydro

moffatt & nichol
777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604−707−9004

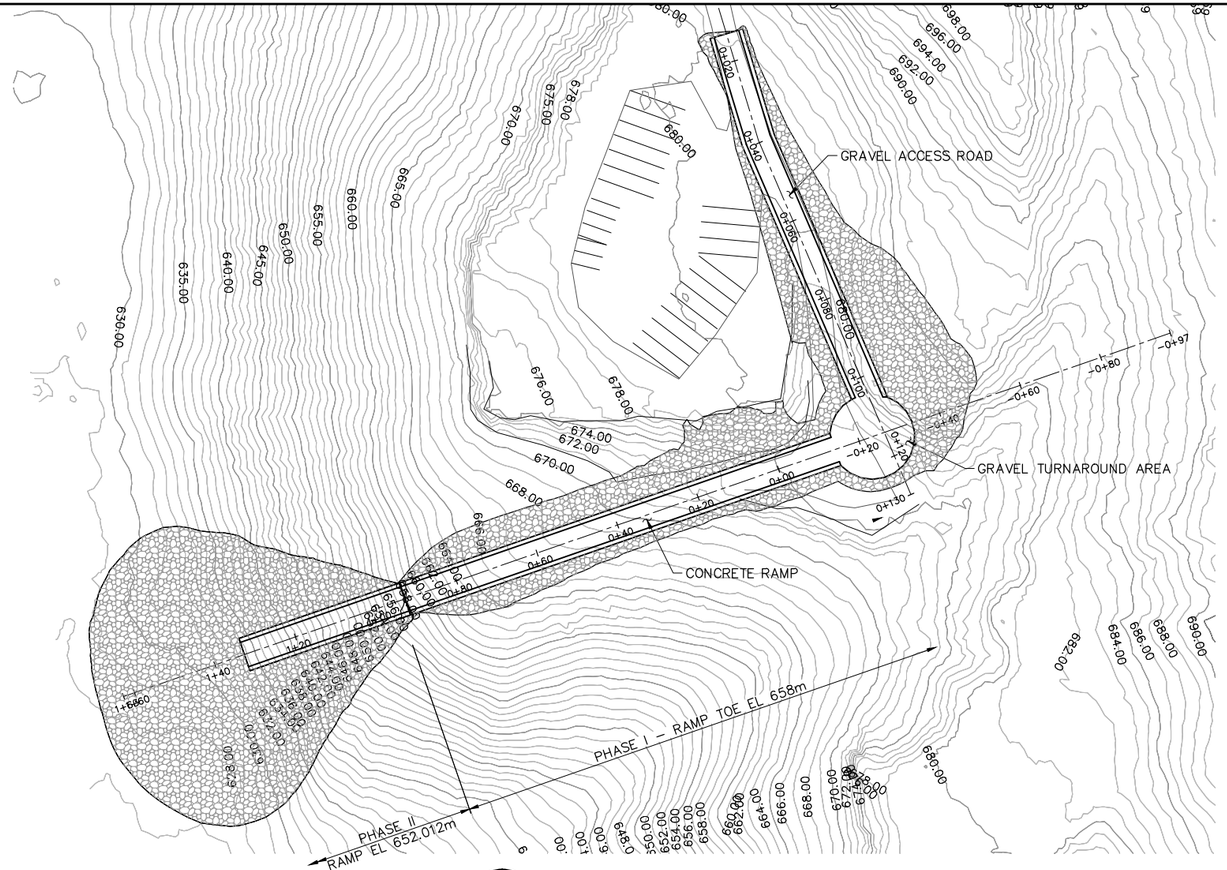
SEAL

Designed by: PH		Date: MAY 28/13	Rev. A
Dwn by: AM	Ckd by: –	M&N Project No. 7937	
Reviewed by: –		Drawing code:	
Submitted by: – MOFFATT & NICHOL		Dwg Scale: AS SHOWN	Plot scale: 1:1 (D SHEET)

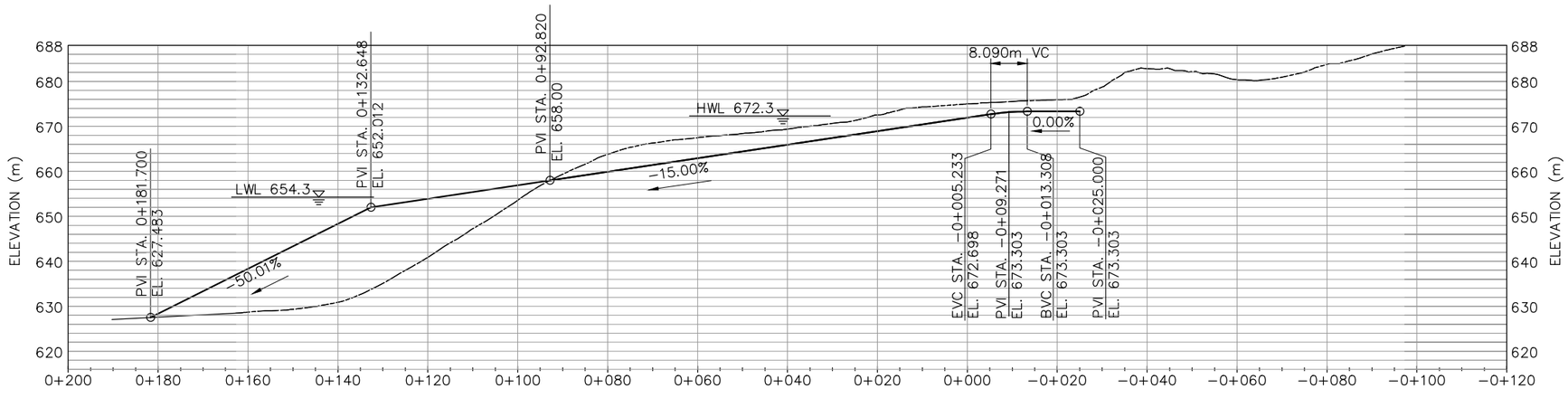
DUNLEVY BOAT LAUNCH RAMP
REPLACEMENT BOAT RAMP
OPTION 5B
PLAN & PROFILE

Sheet Reference Number: SK5B
Sheet of

DRAWING SCALES SHOWN BASED ON 22"X34" DRAWING



A SK5C **PLAN** — OPTION 5C
SCALE: 1:700
(FLOATING BREAKWATER NOT SHOWN FOR CLARITY)



B SK5C **PROFILE ALONG BOAT RAMP CENTRELINE**
SCALE: 1:700

SCALE: 1 : 600

Mark	Description	Date	Dr'n	Appr
A	ISSUED FOR REVIEW	05/28/13	AM	PH

BC hydro

moffatt & nichol
777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

SEAL

Designed by: PH		Date: MAY 28/13	Rev. A
Dwn by: EZ/AM	Ckd by: –	M&N Project No. 7937	
Reviewed by: –		Drawing code:	
Submitted by: – MOFFATT & NICHOL		Dwg Scale: AS SHOWN Plot scale: 1:1 (D SHEET)	

DUNLEVY BOAT LAUNCH RAMP

REPLACEMENT BOAT RAMP
OPTION 5C
PLAN & PROFILE

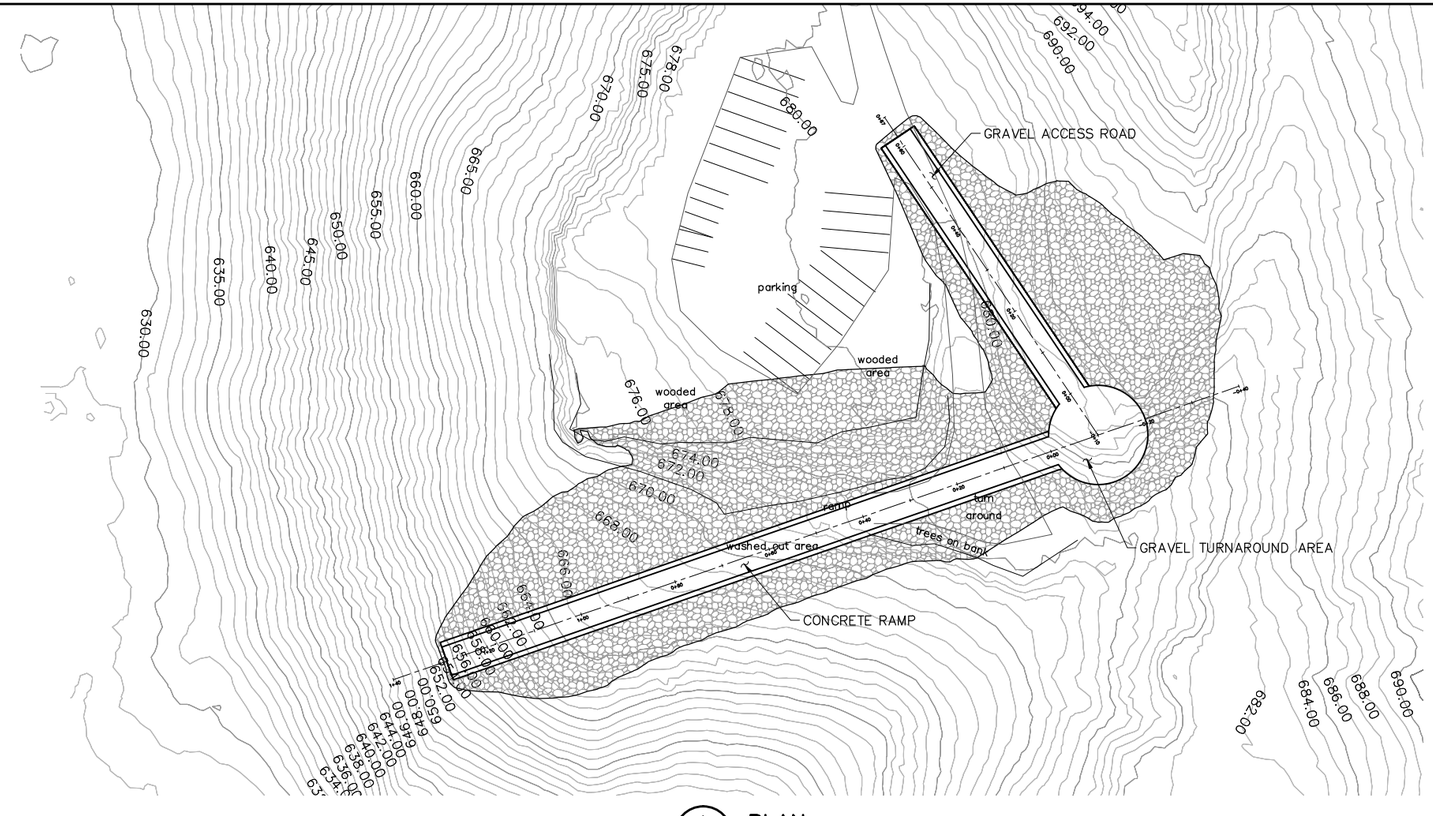
Sheet Reference Number: SK5C

Sheet of

DRAWING SCALES SHOWN BASED ON 22"X34" DRAWING

NOTES:

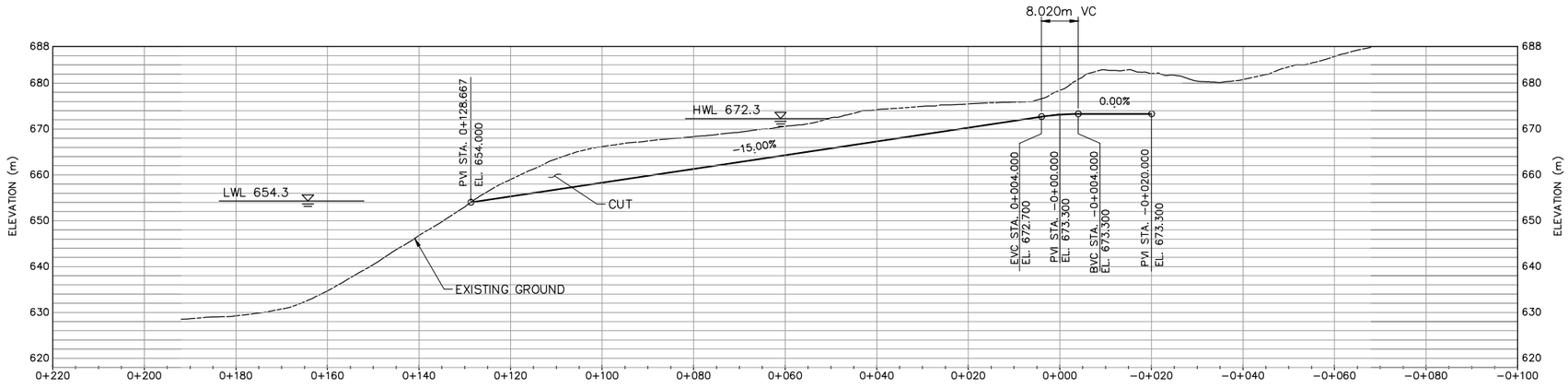
1. BASE SURVEY MAP PROVIDED BY ATEK HYDROGRAPHIC SURVEY, DATED MAY 19, 2009.
2. CONTOURS ARE IN METRES TO GEODETIC DATUM.
3. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.



NOTES:

1. BASE SURVEY MAP PROVIDED BY ATEK HYDROGRAPHIC SURVEY, DATED MAY 19, 2009.
2. CONTOURS ARE IN METRES TO GEODETIC DATUM.
3. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.

A SK6 **PLAN** OPTION 6
SCALE: 1:600
(FLOATING BREAKWATER NOT SHOWN FOR CLARITY)



B SK6 **PROFILE ALONG BOAT RAMP CENTRELINE**
SCALE: 1:600

12m 0m 12m 24m
SCALE: 1 : 600

Mark	Description	Date	Dr'n	Appr
A	ISSUED FOR REVIEW	05/24/13	EZ	PH

BC hydro

moffatt & nichol
777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

SEAL

Designed by: PH	Date: MAY 15/13	Rev. A
Dwn by: EZ / Ckd by: –	M&N Project No. 7937	
Reviewed by: –	Drawing code:	
Submitted by: – MOFFATT & NICHOL	Dwg Scale: AS SHOWN / Plot scale: 1:1 (D SHEET)	

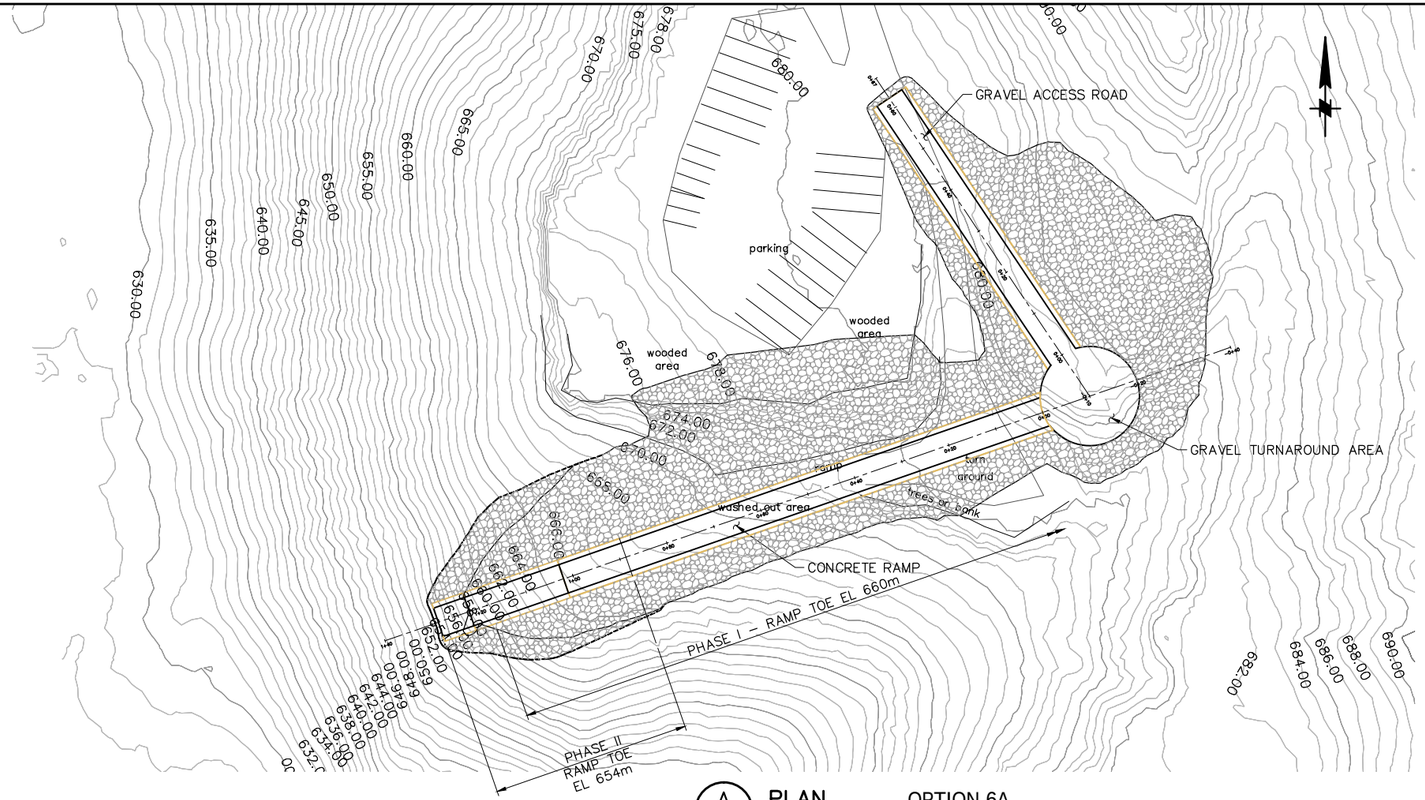
DUNLEVY BOAT LAUNCH RAMP

REPLACEMENT BOAT RAMP
OPTION 6
PLAN & PROFILE

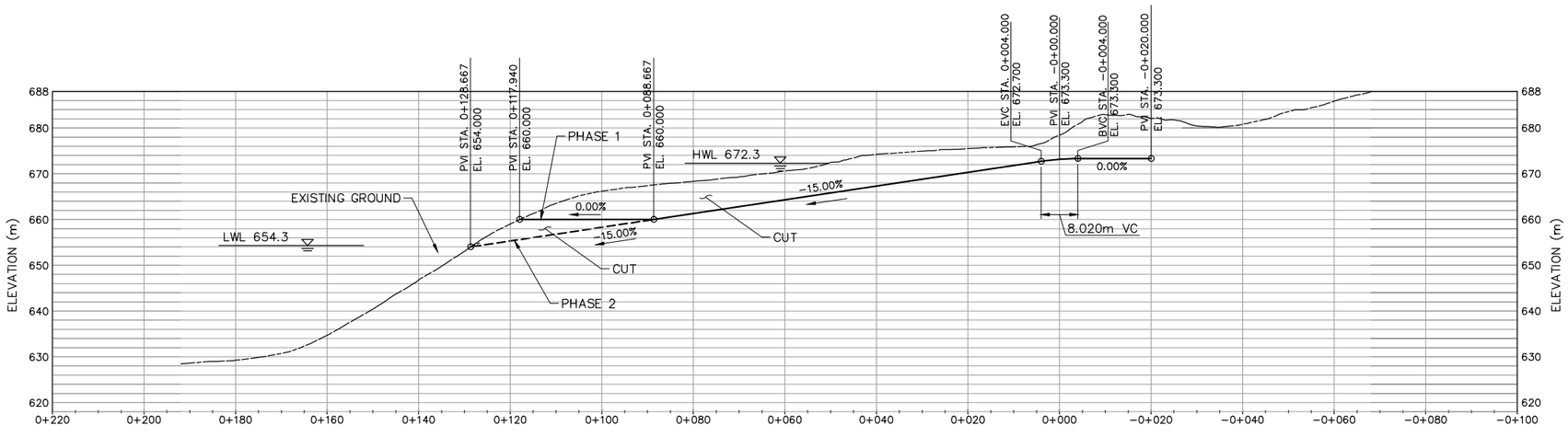
Sheet Reference Number: SK6
Sheet of

DRAWING SCALES SHOWN BASED ON 22"X34" DRAWING

File: P:\7937 Dunlevy Bt Rmp Dsgn & Construction Site Visits\CADD_Active\793700-SK6; Plotted: 5/30/2013 4:19 PM by MANUZON, ALLEN; Saved: 5/30/2013 4:19 PM by MANUZON



A SK6A **PLAN** OPTION 6A
SCALE: 1:600
(FLOATING BREAKWATER NOT SHOWN FOR CLARITY)



B SK6A **PROFILE ALONG BOAT RAMP CENTRELINE**
SCALE: 1:600

12m 0m 12m 24m
SCALE: 1 : 600

NOTES:

1. BASE SURVEY MAP PROVIDED BY ATEK HYDROGRAPHIC SURVEY, DATED MAY 19, 2009.
2. CONTOURS ARE IN METRES TO GEODETIC DATUM.
3. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.

Mark	Description	Date	Dr'n	Appr.
A	ISSUED FOR REVIEW	05/24/13	AM	PH

BC hydro

moffatt & nichol
777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

SEAL

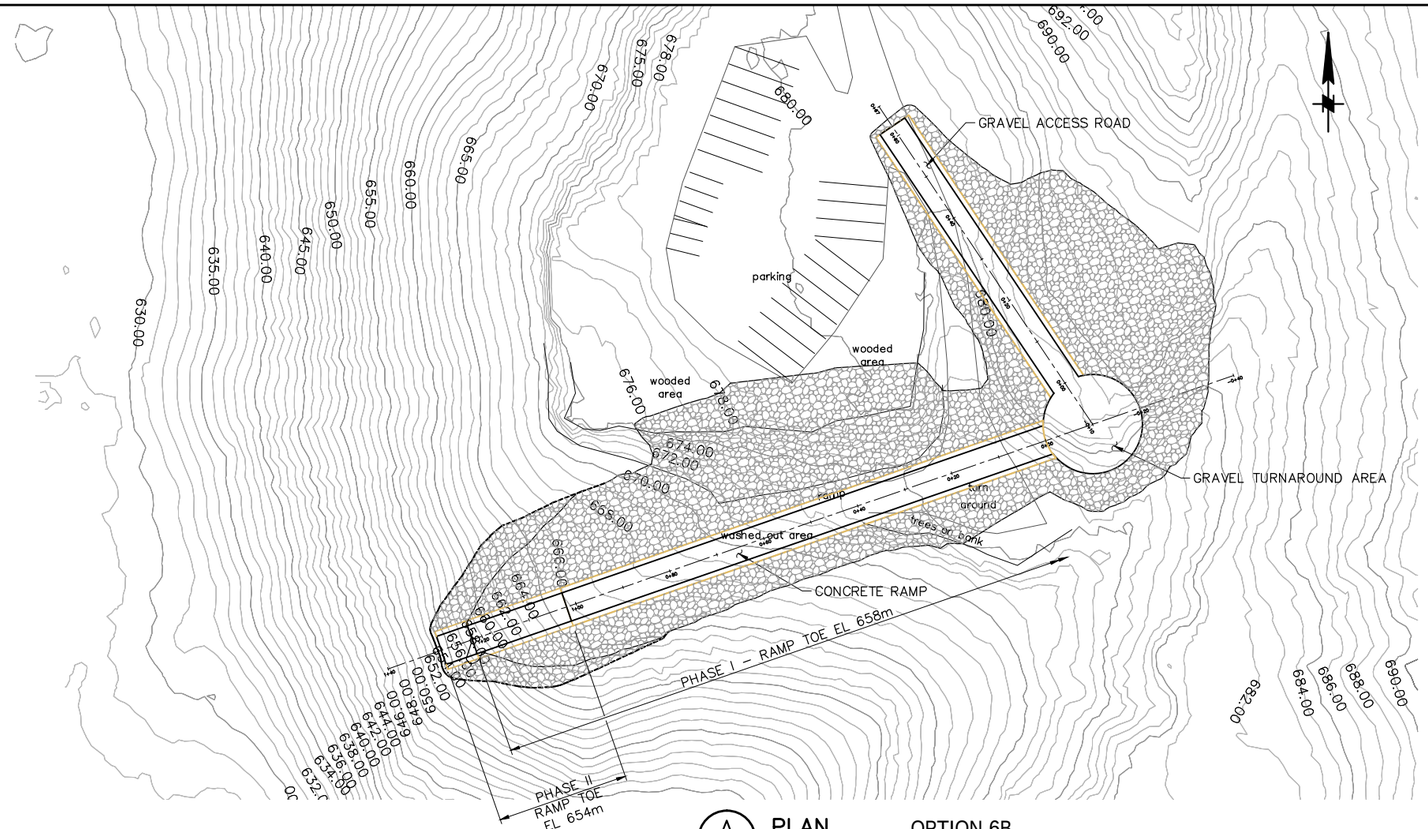
Designed by: PH	Date: MAY 22/13	Rev. A
Dwn by: EZ/AM	Ckd by: –	M&N Project No. 7937
Reviewed by: –		Drawing code:
Submitted by: – MOFFATT & NICHOL		Dwg Scale: AS SHOWN Plot scale: 1:1 (D SHEET)

DUNLEVY BOAT LAUNCH RAMP

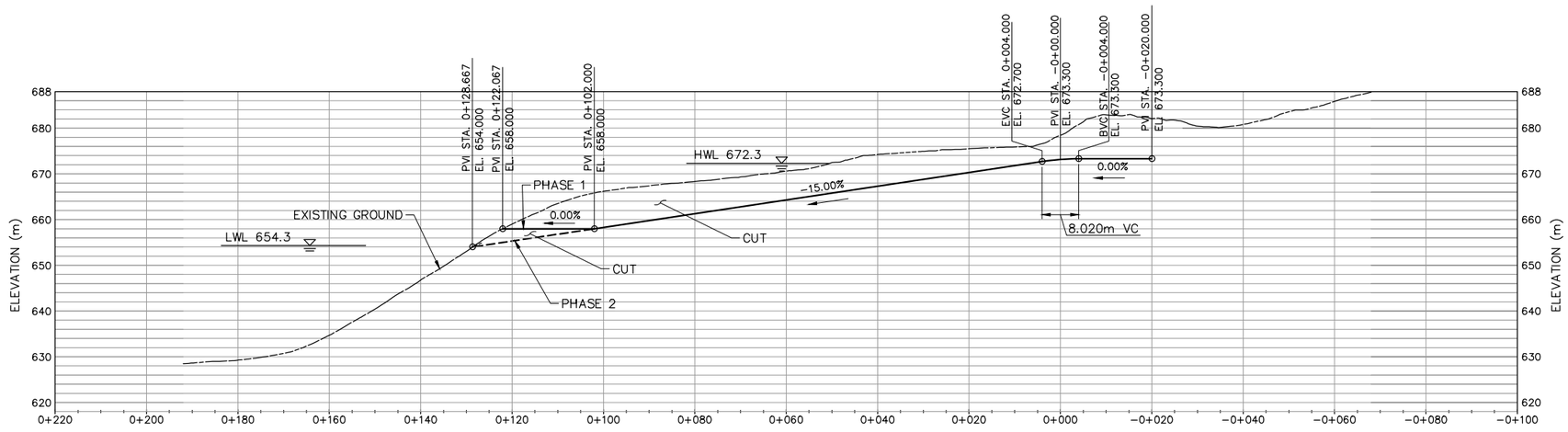
REPLACEMENT BOAT RAMP
OPTION 6A
PLAN

Sheet Reference Number: SK6A
Sheet of

DRAWING SCALES SHOWN BASED ON 22"X34" DRAWING



A SK6B **PLAN** OPTION 6B
SCALE: 1:600
(FLOATING BREAKWATER NOT SHOWN FOR CLARITY)



B SK6B **PROFILE ALONG BOAT RAMP CENTRELINE**
SCALE: 1:600

NOTES:

1. BASE SURVEY MAP PROVIDED BY ATEK HYDROGRAPHIC SURVEY, DATED MAY 19, 2009.
2. CONTOURS ARE IN METRES TO GEODETIC DATUM.
3. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.

12m 0m 12m 24m
SCALE: 1 : 600

Mark	Description	Date	Dr'n	Appr.
A	ISSUED FOR REVIEW	05/28/13	AM	PH

BC hydro

moffatt & nichol
777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

SEAL

Designed by: PH		Date: MAY 28/13	Rev. A
Dwn by: EZ/AM	Ckd by: –	M&N Project No. 7937	
Reviewed by: –		Drawing code:	
Submitted by: – MOFFATT & NICHOL		Dwg Scale: AS SHOWN Plot scale: 1:1 (D SHEET)	

DUNLEVY BOAT LAUNCH RAMP
REPLACEMENT BOAT RAMP
OPTION 6B
PLAN & PROFILE

Sheet Reference Number: SK6B
Sheet of

DRAWING SCALES SHOWN BASED ON 22"X34" DRAWING

APPENDIX B

COST ESTIMATES

Project Name: **DUNLEVY BOAT RAMP - EXISTING**
WILLISTON RESERVOIR BOAT LAUNCH RAMP
Client **BC Hydro**
Project no. **7937**
Drawing References: 7937-SK1-2
Date 19-Mar-13

Table 1 - DUNLEVY Replacement Boat Ramp - Option1 - East-West Alignment with lower section aligned parallel with slope contours - Concrete/Gravel Surface

Item no.	Item Description	Unit	Quantity	Unit Rate	Item Cost	Contingency	Contingency Amount	TOTAL
1	Mobilization and Demobilization (5%)	LS	1	$ 107,645	$ 107,645	25%	$ 26,911	$ 134,557
2	Demolition of existing concrete slab	m^3	60	$ 138	$ 8,280	25%	$ 2,070	$ 10,350
3	General Excavation and Off-site Disposal	m^3	11200	$ 30	$ 336,000	25%	$ 84,000	$ 420,000
4	General Fill	m^3	6400	$ 35	$ 224,000	25%	$ 56,000	$ 280,000
5	Base Coarse for Ramp (Granular Base)	m^3	500	$ 65	$ 32,500	25%	$ 8,125	$ 40,625
6	Scour Protection - Filter Stone for 55kg Riprap	m^3	1385	$ 140	$ 194,454	25%	$ 48,614	$ 243,068
7	Scour Protection - 550mm thick Riprap D50 = 55kg	m^3	2150	$ 177	$ 380,120	25%	$ 95,030	$ 475,150
8	Geotextile	m^2	4100	$ 5	$ 20,500	25%	$ 5,125	$ 25,625
9	New Concrete (cast in place)*	m^2	850	$ 385	$ 327,151	25%	$ 81,788	$ 408,939
10	Base Coarse Material - High Fines Granular Surfacing Aggregate (HFSA)	m3	100	$ 65	$ 6,500	25%	$ 1,625	$ 8,125
11	Supply and Install Lock-Block for Walkway	m	148	$ 1,400	$ 207,200	25%	$ 51,800	$ 259,000
12	Abutment	ea.	1	$ 15,000	$ 15,000	25%	$ 3,750	$ 18,750
13	Hydraulic Seeding & Organic Soil - Provisional Item	LS	1	$ 25,000	$ 25,000	25%	$ 6,250	$ 31,250
14	Floating Log Breakwater including mooring anchors	m	86	$ 4,200	$ 361,200	25%	$ 90,300	$ 451,500
15	Garbage Receptacle	L.S	1	$ 5,000	$ 5,000	25%	$ 1,250	$ 6,250
16	Allowance for Miscellaneous items (Signages, navigation lights etc.)	LS	1	$ 10,000	$ 10,000	25%	$ 2,500	$ 12,500
	Sub-Total				**$ 2,260,550**		**$ 565,138**	**$ 2,825,688**

NOTES

1) Based on a Design Construction Water Level (DCWL) is assumed to be El. 653.0 m, a cofferdam is likely not required to construct the toe of the launch ramp in the dry.

2) The quantities indicated on the Opinion of Probable Cost represent the volume, area, or linear meter for each item as calculated from the neat line limits shown on the drawings without any adjustments for construction tolerances and material settlement.

3) Cost estimate excludes any temporary construction items such as cofferdams, site security, site services, first aid stations & environmental monitoring and annual

* Unit cost references cost estimate prepared by Duz-Cho Construction for BC Hydro, Mackenzie Boat Launch Ramp - Jan 14, 2013

MOFFATT & NICHOL

Project Name: **DUNLEVY BOAT RAMP - EXISTING**
WILLISTON RESERVOIR BOAT LAUNCH RAMP
Client **BC Hydro**
Project no. **7937**
Drawing References: 7937-SK1-2
Date 19-Mar-13

Table 2 - DUNLEVY Replacement Boat Ramp - Option1A - East-West Alignment with lower section aligned parallel with slope contours - Concrete Surface

Item no.	Item Description	Unit	Quantity	Unit Rate	Item Cost	Contingency	Contingency Amount	TOTAL
1	Mobilization and Demobilization (5%)	LS	1	$ 113,093	$ 113,093	25%	$ 28,273	$ 141,367
2	Demolition of existing concrete slab	m^3	60	$ 138	$ 8,280	25%	$ 2,070	$ 10,350
3	General Excavation and Off-site Disposal	m^3	11200	$ 30	$ 336,000	25%	$ 84,000	$ 420,000
4	General Fill	m^3	6400	$ 35	$ 224,000	25%	$ 56,000	$ 280,000
5	Base Coarse for Ramp (Granular Base)	m^3	500	$ 65	$ 32,500	25%	$ 8,125	$ 40,625
6	Scour Protection - Filter Stone for 55kg Riprap	m^3	1385	$ 140	$ 194,454	25%	$ 48,614	$ 243,068
7	Scour Protection - 550mm thick Riprap D50 = 55kg	m^3	2150	$ 177	$ 380,120	25%	$ 95,030	$ 475,150
8	Geotextile	m^2	4100	$ 5	$ 20,500	25%	$ 5,125	$ 25,625
9	New Concrete (cast in place)*	m^2	1150	$ 385	$ 442,616	25%	$ 110,654	$ 553,270
10	Supply and Install Lock-Block for Walkway	m	148	$ 1,400	$ 207,200	25%	$ 51,800	$ 259,000
11	Abutment	ea.	1	$ 15,000	$ 15,000	25%	$ 3,750	$ 18,750
12	Hydraulic Seeding & Organic Soil - Provisional Item	LS	1	$ 25,000	$ 25,000	25%	$ 6,250	$ 31,250
13	Floating Log Breakwater including mooring anchors	m	86	$ 4,200	$ 361,200	25%	$ 90,300	$ 451,500
14	Garbage Receptacle	L.S	1	$ 5,000	$ 5,000	25%	$ 1,250	$ 6,250
15	Allowance for Miscellaneous items (Signages, navigation lights etc.)	LS	1	$ 10,000	$ 10,000	25%	$ 2,500	$ 12,500
	Sub-Total				**$ 2,374,963**		**$ 593,741**	**$ 2,968,704**

$ 2,261,870

NOTES

1) Based on a Design Construction Water Level (DCWL) is assumed to be El. 653.0 m, a cofferdam is likely not required to construct the toe of the launch ramp in the dry.

2) The quantities indicated on the Opinion of Probable Cost represent the volume, area, or linear meter for each item as calculated from the neat line limits shown on the drawings without any adjustments for construction tolerances and material settlement.

3) Cost estimate excludes any temporary construction items such as cofferdams, site security, site services, first aid stations & environmental monitoring and annual

* Unit cost references cost estimate prepared by Duz-Cho Construction for BC Hydro, Mackenzie Boat Launch Ramp - Jan 14, 2013

MOFFATT & NICHOL

Project Name: **DUNLEVY BOAT RAMP**
WILLISTON RESERVOIR BOAT LAUNCH RAMP DESIGN
Client **BC Hydro**
Project no. **7937**
Drawing References: 7937-SK1-2
Date 19-Mar-13

Table 3 - DUNLEVY Replacement Boat Ramp - Option 2 - Straight East-West Alignment

Item no.	Item Description	Unit	Quantity	Unit Rate	Item Cost	Contingency	Contingency Amount	TOTAL
1	Mobilization and Demobilization (5%)	LS	1	$ 255,642	$ 255,642	25%	$ 63,911	$ 319,553
2	Demolition of existing concrete slab	m^3	60	$ 138	$ 8,280	25%	$ 2,070	$ 10,350
3	General Excavation and Off-site Disposal	m^3	2400	$ 30	$ 72,000	25%	$ 18,000	$ 90,000
4	General Fill	m^3	73125	$ 35	$ 2,559,375	25%	$ 639,844	$ 3,199,219
5	Base Coarse for Ramp (Granular Base)	m^3	390	$ 65	$ 25,253	25%	$ 6,313	$ 31,566
6	New Concrete (cast in place)*	m^2	1000	$ 385	$ 384,883	25%	$ 96,221	$ 481,104
7	Scour Protection - Filter Stone for 55kg Riprap	m^3	2578	$ 140	$ 361,951	25%	$ 90,488	$ 452,439
8	Scour Protection - 550mm thick Riprap D50 = 55kg	m^3	5670	$ 177	$ 1,002,456	25%	$ 250,614	$ 1,253,070
9	Geotextile	m^2	12506	$ 5	$ 62,531	25%	$ 15,633	$ 78,164
10	Base Coarse Material - High Fines Granular Surfacing Aggregate (HFSA)	m^3	88	$ 65	$ 5,720	25%	$ 1,430	$ 7,150
11	Supply and Install Lock-Block for Walkway	m	153	$ 1,400	$ 214,200	25%	$ 53,550	$ 267,750
12	Abutment	ea.	1	$ 15,000	$ 15,000	25%	$ 3,750	$ 18,750
13	Hydraulic Seeding & Organic Soil - Provisional Item	LS	1	$ 25,000	$ 25,000	25%	$ 6,250	$ 31,250
14	Floating Log Breakwater including mooring anchors	m	86	$ 4,200	$ 361,200	25%	$ 90,300	$ 451,500
15	Garbage Receptacle	ea.	1	$ 5,000	$ 5,000	25%	$ 1,250	$ 6,250
16	Allowance for Miscellaneous items (Signages, etc.)	LS	1	$ 10,000	$ 10,000	25%	$ 2,500	$ 12,500
	Sub-Total				**$ 5,368,492**		**$ 1,342,123**	**$ 6,710,615**

NOTES

1) Based on a Design Construction Water Level (DCWL) is assumed to be El. 653.0 m, a cofferdam is likely not required to construct the toe of the launch ramp in the dry.

2) The quantities indicated on the Opinion of Probable Cost represent the volume, area, or linear meter for each item as calculated from the neat line limits shown on the drawings without any adjustments for construction tolerances and material settlement.

3) Cost estimate excludes any temporary construction items such as cofferdams, site security, site services, first aid stations & environmental monitoring and annual maintenance costs.

* Unit cost references cost estimate prepared by Duz-Cho Construction for BC Hydro, Mackenzie Boat Launch Ramp - Jan 14, 2013

MOFFATT & NICHOL

Project Name: **Existing DUNLEVY Boat Ramp**
WILLISTON RESERVOIR BOAT LAUNCH RAMP DESIGN-FOR TENDER
Client **BC Hydro**
Project no. **7937**
Drawing References: **Conceptual Design**
Date 19-Mar-13

Table 4 - DUNLEVY Replacement Boat Ramp - Option 3 - North-South Alignment - Concrete/Gravel Surface

Item no.	Item Description	Unit	Quantity	Unit Rate	Item cost	Contingency	Contingency Amount	TOTAL
1	General Excavation	m3	18245	$30	$547,350	25%	$136,838	$684,188
2	General Fill	m3	14400	$35	$504,000	25%	$126,000	$630,000
3	Base Coarse Material - High Fines Granular Surfacing Aggregate (HFSA)	m3	1130	$65	$73,437	25%	$18,359	$91,796
4	Base Coarse Material - 75mm Crushed Base Coarse (CBC) Aggregates	m3	407	$65	$26,455	25%	$6,614	$33,069
5	Base Coarse for Ramp (Granular Base)	m3	470	$65	$30,550	25%	$7,638	$38,188
6	New Concrete (cast in place)	m2	1092	$385	$420,293	25%	$105,073	$525,366
7	Scour Protection - Filter Stone for 55kg Riprap	m3	1989	$140	$278,424	25%	$69,606	$348,030
8	Scour Protection - 55kg Riprap	m3	4207	$177	$744,630	25%	$186,158	$930,788
9	Scour Protection - 35kg Riprap	m3	191	$55	$10,505	25%	$2,626	$13,131
10	Geotextile	m2	7750	$5	$38,750	25%	$9,688	$48,438
11	Precast Low profile barrier	m	162	$105	$17,010	25%	$4,253	$21,263
12	Precast median barrier	m	40	$120	$4,800	25%	$1,200	$6,000
13	Precast concrete curb	Unit	13	$25	$325	25%	$81	$406
14	Lockblock Walkway	m	164	$1,400	$229,600	25%	$57,400	$287,000
15	French Drain (including outlet protection)	m	120	$200	$24,000	25%	$6,000	$30,000
16	Hydraulic seeding (including growing medium)	m2	3655	$3	$10,966	25%	$2,741	$13,707
17	Turf & root reinforcement mats (Including growing medium and Hydraulic seeding)	m2	1500	$10	$14,850	25%	$3,713	$18,563
18	Abutment	Unit	1	$15,000	$15,000	25%	$3,750	$18,750
19	Garbage Receptacle	Unit	1	$5,000	$5,000	25%	$1,250	$6,250
20	Site clearing & removal of debris	m2	13160	$3	$39,480	25%	$9,870	$49,350
	Sub-Total				**$3,035,424**		**$758,856**	**$3,794,280**
	Mobilization and Demolization (5%)	**LS**			**$151,771**	**0.25**	**$37,943**	**$189,714**
TOTAL					**$3,187,195**		**$796,799**	**$3,983,994**

* Note:

1) Based on a Design Construction Water Level (DCWL) is assumed to be El. 653.0 m, a cofferdam is likely not required to construct the toe of the launch ramp in the dry.

2) BC Hydro will determine the extent of the in-waterworks which is dependent on water levels at the time of construction. BC Hydro intends to construct the ramp when dry whenever possible. Therefore, the quantities may decrease according to reservoir water levels at construction time.

3) The quantities indicated on the Opinion of Probable Cost represent the volume, area, or linear meter for each item as calculated from the neat line limits shown on the drawings without any adjustments for construction tolerances and material settlement.

MOFFATT & NICHOL

Project Name: **Existing DUNLEVY Boat Ramp**
WILLISTON RESERVOIR BOAT LAUNCH RAMP DESIGN-FOR TENDER
Client **BC Hydro**
Project no. **7937**
Drawing References: **Conceptual Design**
Date 19-Mar-13

Table 5 - DUNLEVY Replacement Boat Ramp - Option 3A - North-South Alignment - Concrete Surface

Item no.	Item Description	Unit	Quantity	Unit Rate	Item cost	Contingency	Contingency Amount	TOTAL
1	General Excavation	m3	18245	$30	$547,350	25%	$136,838	$684,188
2	General Fill	m3	14400	$35	$504,000	25%	$126,000	$630,000
3	Base Coarse Material - High Fines Granular Surfacing Aggregate (HFSA)	m3	1049	$65	$68,172	25%	$17,043	$85,215
4	Base Coarse Material - 75mm Crushed Base Coarse (CBC) Aggregates	m3	407	$65	$26,455	25%	$6,614	$33,069
5	Base Coarse for Ramp (Granular Base)	m3	470	$65	$30,550	25%	$7,638	$38,188
6	New Concrete (cast in place)	m2	1362	$385	$524,211	25%	$131,053	$655,264
7	Scour Protection - Filter Stone for 55kg Riprap	m3	1989	$140	$278,424	25%	$69,606	$348,030
8	Scour Protection - 55kg Riprap	m3	4207	$177	$744,630	25%	$186,158	$930,788
9	Scour Protection - 35kg Riprap	m3	191	$55	$10,505	25%	$2,626	$13,131
10	Geotextile	m2	7750	$5	$38,750	25%	$9,688	$48,438
11	Precast Low profile barrier	m	162	$105	$17,010	25%	$4,253	$21,263
12	Precast median barrier	m	40	$120	$4,800	25%	$1,200	$6,000
13	Precast concrete curb	Unit	13	$25	$325	25%	$81	$406
14	Lockblock Walkway	m	164	$1,400	$229,600	25%	$57,400	$287,000
15	French Drain (including outlet protection)	m	120	$200	$24,000	25%	$6,000	$30,000
16	Hydraulic seeding (including growing medium)	m2	3655	$3	$10,966	25%	$2,741	$13,707
17	Turf & root reinforcement mats (Including growing medium and Hydraulic seeding)	m2	1500	$10	$14,850	25%	$3,713	$18,563
18	Abutment	Unit	1	$15,000	$15,000	25%	$3,750	$18,750
19	Garbage Receptacle	Unit	1	$5,000	$5,000	25%	$1,250	$6,250
20	Site clearing & removal of debris	m2	13160	$3	$39,480	25%	$9,870	$49,350
	Sub-Total				**$3,134,077**		**$783,519**	**$3,917,597**
	Mobilization and Demolization (5%)	**LS**			**$156,704**	**0.25**	**$39,176**	**$195,880**
TOTAL					**$3,290,781**		**$822,695**	**$4,113,477**

* Note:

1) Based on a Design Construction Water Level (DCWL) is assumed to be El. 653.0 m, a cofferdam is likely not required to construct the toe of the launch ramp in the dry.

2) BC Hydro will determine the extent of the in-waterworks which is dependent on water levels at the time of construction. BC Hydro intends to construct the ramp when dry whenever possible. Therefore, the quantities may decrease according to reservoir water levels at construction time.

3) The quantities indicated on the Opinion of Probable Cost represent the volume, area, or linear meter for each item as calculated from the neat line limits shown on the drawings without any adjustments for construction tolerances and material settlement.

MOFFATT & NICHOL

Project Name: **DUNLEVY BOAT RAMP - EXISTING**
WILLISTON RESERVOIR BOAT LAUNCH RAMP
Client **BC Hydro**

Project no. **7937**
Drawing Referen 7937-SK-2 first 80m of ramp
Date 2-Apr-13

Table 6 -DUNLEVY Replacement Boat Ramp - At-Grade Gravel surfaced Ramp - East-West Alignment

Item no.	Item Description	Unit	Quantity	Unit Rate	Item Cost	Contingency	Contingency Amount	TOTAL
1	Mobilization and Demobilization	LS	1	$ 5,000	$ 5,000	25%	$ 1,250	$ 6,250
2	Demolition of existing concrete slab	m^3	60	$ 138	$ 8,280	25%	$ 2,070	$ 10,350
3	General Excavation and Off-site Disposal	m^3	150	$ 60	$ 9,000	25%	$ 2,250	$ 11,250
4	Granular Surfacing for Ramp (Granular Base)	m^3	150	$ 150	$ 22,500	25%	$ 5,625	$ 28,125
5	Concrete kerb	m	6	$ 120	$ 720	25%	$ 180	$ 900
6	Geotextile	m^2	480	$ 10	$ 4,800	25%	$ 1,200	$ 6,000
	Sub-Total				**$ 50,300**		**$ 12,575**	**$ 62,875**

NOTES

1) Cost estimate excludes any temporary construction items such as cofferdams, site security, site services, first aid stations & environmental monitoring and annual maintenance costs.

2) No Scour protection is provided for this option as requested by BC Hydro.

3) This option does not conform to the design basis for the ramp.

* Unit cost references cost estimate prepared by Duz-Cho Construction for BC Hydro, Mackenzie Boat Launch Ramp - Jan 14, 2013

moffatt & nichol

Project Name: DUNLEVY BOAT RAMP
WILLISTON RESERVOIR BOAT LAUNCH RAMP DESIGN
Client BC Hydro
Project no. 7937
Drawing References: 7937-SK5 (Figure 1)
Date 14-May-13

Table 7 - DUNLEVY Replacement Boat Ramp - Option 5 - Straight East-West Alignment Toe at El. 660m

Item no.	Item Description	Unit	Quantity	Unit Rate	Item Cost	Contingency	Contingency Amount	TOTAL
1	Mobilization and Demobilization (5%)	LS	1	$ 69,262	$ 69,262	25%	$ 17,316	$ 86,578
2	Demolition of existing concrete slab	m^3	60	$ 138	$ 8,280	25%	$ 2,070	$ 10,350
3	General Excavation and Off-site Disposal for ramp	m^3	5137	$ 30	$ 154,111	25%	$ 38,528	$ 192,639
4	Base Coarse for Ramp (Granular Base)	m^3	160	$ 65	$ 10,360	25%	$ 2,590	$ 12,950
5	New Concrete (cast in place)*	m^2	532	$ 385	$ 204,758	25%	$ 51,189	$ 255,947
6	General Excavation and Off-site Disposal for Turnaround	m^3	1500	$ 30	$ 45,000	25%	$ 11,250	$ 56,250
7	Base Course for the turnaround (Granular Base)	m^3	113	$ 65	$ 7,326	25%	$ 1,832	$ 9,158
8	HSFA surfacing for turnaround	m^3	57	$ 65	$ 3,677	25%	$ 919	$ 4,596
9	General Excavation and Off-site Disposal for Access Road	m^3	5945	$ 30	$ 178,350	25%	$ 44,588	$ 222,938
10	Base Course for the access road (Granular Base)	m^3	126	$ 65	$ 8,159	25%	$ 2,040	$ 10,198
11	HSFA surfacing for access road	m^3	63	$ 65	$ 4,095	25%	$ 1,024	$ 5,119
12	Scour Protection - Filter Stone for 55kg Riprap	m^3	745	$ 140	$ 104,598	25%	$ 26,150	$ 130,748
13	Scour Protection - 550mm thick Riprap D50 = 55kg	m^3	1365	$ 177	$ 241,332	25%	$ 60,333	$ 301,665
14	Geotextile	m^2	2800	$ 5	$ 14,000	25%	$ 3,500	$ 17,500
15	Hydraulic Seeding & Organic Soil - Provisional Item	LS	1	$ 25,000	$ 25,000	25%	$ 6,250	$ 31,250
16	Floating Log Breakwater including mooring anchors	m	86	$ 4,200	$ 361,200	25%	$ 90,300	$ 451,500
17	Garbage Receptacle	ea.	1	$ 5,000	$ 5,000	25%	$ 1,250	$ 6,250
18	Allowance for Miscellaneous items (Signages, etc.)	LS	1	$ 10,000	$ 10,000	25%	$ 2,500	$ 12,500
	Sub-Total				**$ 1,454,508**		**$ 363,627**	**$ 1,818,135**

NOTES

1) Based on a Design Construction Water Level (DCWL) is assumed to be El. 660 m, a cofferdam is not likely required to construct the toe of the launch ramp in the dry.

2) The quantities indicated on the Opinion of Probable Cost represent the volume, area, or linear meter for each item as calculated from the neat line limits shown on the drawings without any adjustments for construction tolerances and material settlement.

3) Cost estimate excludes any temporary construction items such as cofferdams, site security, site services, first aid stations & environmental monitoring and annual maintenance costs.

* Unit cost references cost estimate prepared by Duz-Cho Construction for BC Hydro, Mackenzie Boat Launch Ramp - Jan 14, 2013

Project Name: DUNLEVY BOAT RAMP
WILLISTON RESERVOIR BOAT LAUNCH RAMP DESIGN
Client BC Hydro
Project no. 7937
Drawing References: 7937-SK5A (Figure 1)
Date 14-May-13

Table 8 - DUNLEVY Replacement Boat Ramp - Option 5A - Straight East-West Alignment Extend ramp to Toe El.654m

Item no.	Item Description	Unit	Quantity	Unit Rate	Item Cost	Contingency	Contingency Amount	TOTAL
	PHASE I							
1	Mobilization and Demobilization (5%)	LS	1	$ 77,662	$ 77,662	25%	$ 19,416	$ 97,078
2	Demolition of existing concrete slab	m^3	60	$ 138	$ 8,280	25%	$ 2,070	$ 10,350
3	General Excavation and Off-site Disposal for ramp	m^3	5137	$ 30	$ 154,111	25%	$ 38,528	$ 192,639
4	Base Coarse for Ramp (Granular Base)	m^3	160	$ 65	$ 10,360	25%	$ 2,590	$ 12,950
5	New Concrete (cast in place)*	m^2	532	$ 385	$ 204,758	25%	$ 51,189	$ 255,947
6	General Excavation and Off-site Disposal for Turnaround	m^3	1500	$ 30	$ 45,000	25%	$ 11,250	$ 56,250
7	Base Course for the turnaround (Granular Base)	m^3	113	$ 65	$ 7,326	25%	$ 1,832	$ 9,158
8	HSFA surfacing for turnaround	m^3	57	$ 65	$ 3,677	25%	$ 919	$ 4,596
9	General Excavation and Off-site Disposal for Access Road	m^3	5945	$ 30	$ 178,350	25%	$ 44,588	$ 222,938
10	Base Course for the access road (Granular Base)	m^3	126	$ 65	$ 8,159	25%	$ 2,040	$ 10,198
11	HSFA surfacing for access road	m^3	63	$ 65	$ 4,095	25%	$ 1,024	$ 5,119
12	Scour Protection - Filter Stone for 55kg Riprap	m^3	745	$ 140	$ 104,598	25%	$ 26,150	$ 130,748
13	Scour Protection - 550mm thick Riprap D50 = 55kg	m^3	1365	$ 177	$ 241,332	25%	$ 60,333	$ 301,665
14	Geotextile	m^2	2800	$ 5	$ 14,000	25%	$ 3,500	$ 17,500
15	Hydraulic Seeding & Organic Soil - Provisional Item	LS	1	$ 25,000	$ 25,000	25%	$ 6,250	$ 31,250
16	Floating Log Breakwater including mooring anchors	m	126	$ 4,200	$ 529,200	25%	$ 132,300	$ 661,500
17	Garbage Receptacle	ea.	1	$ 5,000	$ 5,000	25%	$ 1,250	$ 6,250
18	Allowance for Miscellaneous items (Signages, etc.)	LS	1	$ 10,000	$ 10,000	25%	$ 2,500	$ 12,500
	Sub-Total				**$ 1,630,908**		**$ 407,727**	**$ 2,038,635**

NOTES

1) Based on a Design Construction Water Level (DCWL) is assumed to be El. 660 m, a cofferdam is not likely required to construct the toe of the launch ramp in the dry.

2) The quantities indicated on the Opinion of Probable Cost represent the volume, area, or linear meter for each item as calculated from the neat line limits shown on the drawings without any adjustments for construction tolerances and material settlement.

3) Cost estimate excludes any temporary construction items such as cofferdams, site security, site services, first aid stations & environmental monitoring and annual maintenance costs.

* Unit cost references cost estimate prepared by Duz-Cho Construction for BC Hydro, Mackenzie Boat Launch Ramp - Jan 14, 2013

Item no.	Item Description	Unit	Quantity	Unit Rate	Item Cost	Contingency	Contingency Amount	TOTAL
	PHASE II							
1	Mobilization and Demobilization (5%)	LS	1	$ 114,522	$ 114,522	25%	$ 28,631	$ 143,153
2	Demolition of existing concrete slab	m^3	0	$ -	$ -	25%	$ -	$ -
3	General Excavation and Off-site Disposal for ramp	m^3	0	$ 30	$ -	25%	$ -	$ -
4	General Fill	m^3	44028	$ 35	$ 1,540,980	25%	$ 385,245	$ 1,926,225
5	Base Coarse for Ramp (Granular Base)	m^3	72	$ 65	$ 4,662	25%	$ 1,166	$ 5,828
6	New Concrete (cast in place)*	m^2	240	$ 385	$ 92,372	25%	$ 23,093	$ 115,465
7	General Excavation and Off-site Disposal for Turnaround	m^3	0	$ 30	$ -	25%	$ -	$ -
8	Base Course for the turnaround (Granular Base)	m^3	0	$ 65	$ -	25%	$ -	$ -
9	HSFA surfacing for turnaround	m^3	0	$ 65	$ -	25%	$ -	$ -
10	General Excavation and Off-site Disposal for Access Road	m^3	0	$ 30	$ -	25%	$ -	$ -
11	Base Course for the access road (Granular Base)	m^3	0	$ 65	$ -	25%	$ -	$ -
12	HSFA surfacing for access road	m^3	0	$ 65	$ -	25%	$ -	$ -
13	Scour Protection - Filter Stone for 55kg Riprap	m^3	2794	$ 140	$ 392,297	25%	$ 98,074	$ 490,371
14	Scour Protection - 550mm thick Riprap D50 = 55kg	m^3	1321	$ 177	$ 233,529	25%	$ 58,382	$ 291,911
15	Geotextile	m^2	5320	$ 5	$ 26,601	25%	$ 6,650	$ 33,252
16	Hydraulic Seeding & Organic Soil - Provisional Item	LS	0	$ 25,000	$ -	25%	$ -	$ -
17	Floating Log Breakwater including mooring anchors	m	0	$ 4,200	$ -	25%	$ -	$ -
18	Garbage Receptacle	ea.	0	$ 5,000	$ -	25%	$ -	$ -
19	Allowance for Miscellaneous items (Signages, etc.)	LS	0	$ 10,000	$ -	25%	$ -	$ -
	Sub-Total Phase II				**$ 2,404,963**		**$ 601,241**	**$ 3,006,203**

moffatt & nichol

Project Name: DUNLEVY BOAT RAMP
WILLISTON RESERVOIR BOAT LAUNCH RAMP DESIGN
Client BC Hydro
Project no. 7937
Drawing References: 7937-SK5B
Date 28-May-13

Table 9 - DUNLEVY Replacement Boat Ramp - Option 5B - Straight East-West Alignment Toe at El. 658m

Item no.	Item Description	Unit	Quantity	Unit Rate	Item Cost	Contingency	Contingency Amount	TOTAL
1	Mobilization and Demobilization (5%)	LS	1	$ 90,027	$ 90,027	25%	$ 22,507	$ 112,534
2	Demolition of existing concrete slab	m^3	60	$ 138	$ 8,280	25%	$ 2,070	$ 10,350
3	General Excavation and Off-site Disposal for ramp	m^3	11341	$ 30	$ 340,217	25%	$ 85,054	$ 425,271
4	Base Coarse for Ramp (Granular Base)	m^3	184	$ 65	$ 11,888	25%	$ 2,972	$ 14,860
5	New Concrete (cast in place)*	m^2	612	$ 385	$ 235,549	25%	$ 58,887	$ 294,436
6	General Excavation and Off-site Disposal for Turnaround	m^3	7949	$ 30	$ 238,470	25%	$ 59,618	$ 298,088
7	Base Course for the turnaround (Granular Base)	m^3	113	$ 65	$ 7,326	25%	$ 1,832	$ 9,158
8	HSFA surfacing for turnaround	m^3	57	$ 65	$ 3,677	25%	$ 919	$ 4,596
9	General Excavation and Off-site Disposal for Access Road	m^3	3402	$ 30	$ 102,060	25%	$ 25,515	$ 127,575
10	Base Course for the access road (Granular Base)	m^3	189	$ 65	$ 12,238	25%	$ 3,059	$ 15,297
11	HSFA surfacing for access road	m^3	95	$ 65	$ 6,143	25%	$ 1,536	$ 7,678
12	Scour Protection - Filter Stone for 55kg Riprap	m^3	892	$ 140	$ 125,288	25%	$ 31,322	$ 156,610
13	Scour Protection - 550mm thick Riprap D50 = 55kg	m^3	1636	$ 177	$ 289,245	25%	$ 72,311	$ 361,556
14	Geotextile	m^2	3792	$ 5	$ 18,961	25%	$ 4,740	$ 23,701
15	Hydraulic Seeding & Organic Soil - Provisional Item	LS	1	$ 25,000	$ 25,000	25%	$ 6,250	$ 31,250
16	Floating Log Breakwater including mooring anchors	m	86	$ 4,200	$ 361,200	25%	$ 90,300	$ 451,500
17	Garbage Receptacle	ea.	1	$ 5,000	$ 5,000	25%	$ 1,250	$ 6,250
18	Allowance for Miscellaneous items (Signages, etc.)	LS	1	$ 10,000	$ 10,000	25%	$ 2,500	$ 12,500
	Sub-Total				**$ 1,890,567**		**$ 472,642**	**$ 2,363,209**

NOTES

1) Based on a Design Construction Water Level (DCWL) is assumed to be El. 658 m, a cofferdam is not likely required to construct the toe of the launch ramp in the dry.

2) The quantities indicated on the Opinion of Probable Cost represent the volume, area, or linear meter for each item as calculated from the neat line limits shown on the drawings without any adjustments for construction tolerances and material settlement.

3) Cost estimate excludes any temporary construction items such as cofferdams, site security, site services, first aid stations & environmental monitoring and annual maintenance costs.

* Unit cost references cost estimate prepared by Duz-Cho Construction for BC Hydro, Mackenzie Boat Launch Ramp - Jan 14, 2013

Project Name: DUNLEVY BOAT RAMP
WILLISTON RESERVOIR BOAT LAUNCH RAMP DESIGN
Client BC Hydro
Project no. 7937
Drawing References: 7937-SK5C
Date 14-May-13

Table 10 - DUNLEVY Replacement Boat Ramp - Option 5C - Straight East-West Alignment Extend ramp to Toe El.654m

Item no.	Item Description	Unit	Quantity	Unit Rate	Item Cost	Contingency	Contingency Amount	TOTAL
	PHASE I							
1	Mobilization and Demobilization (5%)	LS	1	$ 98,427	$ 98,427	25%	$ 24,607	$ 123,034
2	Demolition of existing concrete slab	m^3	60	$ 138	$ 8,280	25%	$ 2,070	$ 10,350
3	General Excavation and Off-site Disposal for ramp	m^3	11341	$ 30	$ 340,217	25%	$ 85,054	$ 425,271
4	Base Coarse for Ramp (Granular Base)	m^3	184	$ 65	$ 11,888	25%	$ 2,972	$ 14,860
5	New Concrete (cast in place)*	m^2	612	$ 385	$ 235,549	25%	$ 58,887	$ 294,436
6	General Excavation and Off-site Disposal for Turnaround	m^3	7949	$ 30	$ 238,470	25%	$ 59,618	$ 298,088
7	Base Course for the turnaround (Granular Base)	m^3	113	$ 65	$ 7,326	25%	$ 1,832	$ 9,158
8	HSFA surfacing for turnaround	m^3	57	$ 65	$ 3,677	25%	$ 919	$ 4,596
9	General Excavation and Off-site Disposal for Access Road	m^3	3402	$ 30	$ 102,060	25%	$ 25,515	$ 127,575
10	Base Course for the access road (Granular Base)	m^3	189	$ 65	$ 12,238	25%	$ 3,059	$ 15,297
11	HSFA surfacing for access road	m^3	95	$ 65	$ 6,143	25%	$ 1,536	$ 7,678
12	Scour Protection - Filter Stone for 55kg Riprap	m^3	892	$ 140	$ 125,288	25%	$ 31,322	$ 156,610
13	Scour Protection - 550mm thick Riprap D50 = 55kg	m^3	1636	$ 177	$ 289,245	25%	$ 72,311	$ 361,556
14	Geotextile	m^2	3792	$ 5	$ 18,961	25%	$ 4,740	$ 23,701
15	Hydraulic Seeding & Organic Soil - Provisional Item	LS	1	$ 25,000	$ 25,000	25%	$ 6,250	$ 31,250
16	Floating Log Breakwater including mooring anchors	m	126	$ 4,200	$ 529,200	25%	$ 132,300	$ 661,500
17	Garbage Receptacle	ea.	1	$ 5,000	$ 5,000	25%	$ 1,250	$ 6,250
18	Allowance for Miscellaneous items (Signages, etc.)	LS	1	$ 10,000	$ 10,000	25%	$ 2,500	$ 12,500
	Sub-Total				**$ 2,066,967**		**$ 516,742**	**$ 2,583,709**

NOTES

1) Based on a Design Construction Water Level (DCWL) is assumed to be El. 658 m, a cofferdam is not likely required to construct the toe of the launch ramp in the dry for Phase I and El. 654m for Phase II.

2) The quantities indicated on the Opinion of Probable Cost represent the volume, area, or linear meter for each item as calculated from the neat line limits shown on the drawings without any adjustments for construction tolerances and material settlement.

3) Cost estimate excludes any temporary construction items such as cofferdams, site security, site services, first aid stations & environmental monitoring and annual maintenance costs.

* Unit cost references cost estimate prepared by Duz-Cho Construction for BC Hydro, Mackenzie Boat Launch Ramp - Jan 14, 2013

Item no.	Item Description	Unit	Quantity	Unit Rate	Item Cost	Contingency	Contingency Amount	TOTAL
	PHASE II							
1	Mobilization and Demobilization (5%)	LS	1	$ 102,737	$ 102,737	25%	$ 25,684	$ 128,422
2	Demolition of existing concrete slab	m^3	0	$ -	$ -	25%	$ -	$ -
3	General Excavation and Off-site Disposal for ramp	m^3	0	$ 30	$ -	25%	$ -	$ -
4	General Fill	m^3	34322	$ 35	$ 1,201,270	25%	$ 300,318	$ 1,501,588
5	Base Coarse for Ramp (Granular Base)	m^3	48	$ 65	$ 3,108	25%	$ 777	$ 3,885
6	New Concrete (cast in place)*	m^2	160	$ 385	$ 61,581	25%	$ 15,395	$ 76,977
7	General Excavation and Off-site Disposal for Turnaround	m^3	0	$ 30	$ -	25%	$ -	$ -
8	Base Course for the turnaround (Granular Base)	m^3	0	$ 65	$ -	25%	$ -	$ -
9	HSFA surfacing for turnaround	m^3	0	$ 65	$ -	25%	$ -	$ -
10	General Excavation and Off-site Disposal for Access Road	m^3	0	$ 30	$ -	25%	$ -	$ -
11	Base Course for the access road (Granular Base)	m^3	0	$ 65	$ -	25%	$ -	$ -
12	HSFA surfacing for access road	m^3	0	$ 65	$ -	25%	$ -	$ -
13	Scour Protection - Filter Stone for 55kg Riprap	m^3	1478	$ 140	$ 207,532	25%	$ 51,883	$ 259,415
14	Scour Protection - 550mm thick Riprap D50 = 55kg	m^3	3127	$ 177	$ 552,827	25%	$ 138,207	$ 691,034
15	Geotextile	m^2	5685	$ 5	$ 28,426	25%	$ 7,106	$ 35,532
16	Hydraulic Seeding & Organic Soil - Provisional Item	LS	0	$ 25,000	$ -	25%	$ -	$ -
17	Floating Log Breakwater including mooring anchors	m	0	$ 4,200	$ -	25%	$ -	$ -
18	Garbage Receptacle	ea.	0	$ 5,000	$ -	25%	$ -	$ -
19	Allowance for Miscellaneous items (Signages, etc.)	LS	0	$ 10,000	$ -	25%	$ -	$ -
	Sub-Total Phase II				**$ 2,157,482**		**$ 539,370**	**$ 2,696,852**

Project Name: DUNLEVY BOAT RAMP
WILLISTON RESERVOIR BOAT LAUNCH RAMP DESIGN
Client BC Hydro
Project no. 7937
Drawing References: 7937-SK6 (Figure 3)
Date 14-May-13

Table 11 - DUNLEVY Replacement Boat Ramp - Option 6 - Straight East-West Alignment Toe at El. 654m

Item no.	Item Description	Unit	Quantity	Unit Rate	Item Cost	Contingency	Contingency Amount	TOTAL
1	Mobilization and Demobilization (5%)	LS	1	$ 152,737	$ 152,737	25%	$ 38,184	$ 190,921
2	Demolition of existing concrete slab	m^3	60	$ 138	$ 8,280	25%	$ 2,070	$ 10,350
3	General Excavation and Off-site Disposal for ramp	m^3	28327	$ 30	$ 849,798	25%	$ 212,450	$ 1,062,248
4	Base Coarse for Ramp (Granular Base)	m^3	232	$ 65	$ 14,996	25%	$ 3,749	$ 18,745
5	New Concrete (cast in place)*	m^2	772	$ 385	$ 297,130	25%	$ 74,282	$ 371,412
6	General Excavation and Off-site Disposal for Turnaround	m^3	5170	$ 30	$ 155,100	25%	$ 38,775	$ 193,875
7	Base Course for the turnaround (Granular Base)	m^3	113	$ 65	$ 7,326	25%	$ 1,832	$ 9,158
8	HSFA surfacing for turnaround	m^3	57	$ 65	$ 3,677	25%	$ 919	$ 4,596
9	General Excavation and Off-site Disposal for Access Road	m^3	7590	$ 30	$ 227,700	25%	$ 56,925	$ 284,625
10	Base Course for the access road (Granular Base)	m^3	126	$ 65	$ 8,159	25%	$ 2,040	$ 10,198
11	HSFA surfacing for access road	m^3	63	$ 65	$ 4,095	25%	$ 1,024	$ 5,119
12	Scour Protection - Filter Stone for 55kg Riprap	m^3	3649	$ 140	$ 512,320	25%	$ 128,080	$ 640,400
13	Scour Protection - 550mm thick Riprap D50 = 55kg	m^3	1990	$ 177	$ 351,896	25%	$ 87,974	$ 439,870
14	Geotextile	m^2	7012	$ 5	$ 35,058	25%	$ 8,765	$ 43,823
15	Hydraulic Seeding & Organic Soil - Provisional Item	LS	1	$ 35,000	$ 35,000	25%	$ 8,750	$ 43,750
16	Floating Log Breakwater including mooring anchors	m	126	$ 4,200	$ 529,200	25%	$ 132,300	$ 661,500
17	Garbage Receptacle	ea.	1	$ 5,000	$ 5,000	25%	$ 1,250	$ 6,250
18	Allowance for Miscellaneous items (Signages, etc.)	LS	1	$ 10,000	$ 10,000	25%	$ 2,500	$ 12,500
	Sub-Total				**$ 3,207,472**		**$ 801,868**	**$ 4,009,340**

NOTES

1) Based on a Design Construction Water Level (DCWL) is assumed to be El. 654 m, If water levels at the time of construction is at El.654m, cofferdam is likely not required to construct the toe of the launch ramp in the dry. It should be noted that this water level does not occur often.

2) The quantities indicated on the Opinion of Probable Cost represent the volume, area, or linear meter for each item as calculated from the neat line limits shown on the drawings without any adjustments for construction tolerances and material settlement.

3) Cost estimate excludes any temporary construction items such as cofferdams, site security, site services, first aid stations & environmental monitoring and annual maintenance costs.

* Unit cost references cost estimate prepared by Duz-Cho Construction for BC Hydro, Mackenzie Boat Launch Ramp - Jan 14, 2013

moffatt & nichol

Project Name: DUNLEVY BOAT RAMP
WILLISTON RESERVOIR BOAT LAUNCH RAMP DESIGN
Client BC Hydro
Project no. 7937
Drawing References: 7937-SK6A
Date 22-May-13

Table 12 - DUNLEVY Replacement Boat Ramp - Option 6A - Straight East-West Alignment Toe at El. 654m

Item no.	Item Description	Unit	Quantity	Unit Rate	Item Cost	Contingency	Contingency Amount	TOTAL
	PHASE I - Toe El.660m							
	Mobilization and Demobilization (5%)	LS	1	$ 136,654	$ 136,654	25%	$ 34,164	$ 170,818
1	Demolition of existing concrete slab	m^3	60	$ 138	$ 8,280	25%	$ 2,070	$ 10,350
2	General Excavation and Off-site Disposal for ramp	m^3	18954	$ 30	$ 568,611	25%	$ 142,153	$ 710,764
3	Base Coarse for Ramp (Granular Base)	m^3	160	$ 65	$ 10,334	25%	$ 2,584	$ 12,918
4	New Concrete (cast in place)*	m^2	532	$ 385	$ 204,758	25%	$ 51,189	$ 255,947
5	General Excavation and Off-site Disposal for Turnaround	m^3	5170	$ 30	$ 155,100	25%	$ 38,775	$ 193,875
6	Base Course for the turnaround (Granular Base)	m^3	113	$ 65	$ 7,326	25%	$ 1,832	$ 9,158
7	HSFA surfacing for turnaround	m^3	57	$ 65	$ 3,677	25%	$ 919	$ 4,596
8	General Excavation and Off-site Disposal for Access Road	m^3	7590	$ 30	$ 227,700	25%	$ 56,925	$ 284,625
9	Base Course for the access road (Granular Base)	m^3	126	$ 65	$ 8,159	25%	$ 2,040	$ 10,198
10	HSFA surfacing for access road	m^3	63	$ 65	$ 4,095	25%	$ 1,024	$ 5,119
11	Scour Protection - Filter Stone for 55kg Riprap	m^3	1972	$ 140	$ 276,883	25%	$ 69,221	$ 346,104
12	Scour Protection - 550mm thick Riprap D50 = 55kg	m^3	3616	$ 177	$ 639,224	25%	$ 159,806	$ 799,031
13	Geotextile	m^2	6947	$ 5	$ 34,737	25%	$ 8,684	$ 43,421
14	Hydraulic Seeding & Organic Soil - Provisional Item	LS	1	$ 35,000	$ 35,000	25%	$ 8,750	$ 43,750
15	Floating Log Breakwater including mooring anchors	m	126	$ 4,200	$ 529,200	25%	$ 132,300	$ 661,500
16	Garbage Receptacle	ea.	1	$ 5,000	$ 5,000	25%	$ 1,250	$ 6,250
17	Allowance for Miscellaneous items (Signages,Marker Buoys etc.)	LS	1	$ 15,000	$ 15,000	25%	$ 3,750	$ 18,750
	Sub-Total				**$ 2,869,739**		**$ 717,435**	**$ 3,587,173**

NOTES

1) Based on a Design Construction Water Level (DCWL) is assumed to be El. 654 m, If water levels at the time of construction is at El.654m, cofferdam is likely not required to construct the toe of the launch ramp in the dry. It should be noted that this water level does not occur often.

2) The quantities indicated on the Opinion of Probable Cost represent the volume, area, or linear meter for each item as calculated from the neat line limits shown on the drawings without any adjustments for construction tolerances and material settlement.

3) Cost estimate excludes any temporary construction items such as cofferdams, site security, site services, first aid stations & environmental monitoring and annual maintenance costs.

* Unit cost references cost estimate prepared by Duz-Cho Construction for BC Hydro, Mackenzie Boat Launch Ramp - Jan 14, 2013

Item no.	Item Description	Unit	Quantity	Unit Rate	Item Cost	Contingency	Contingency Amount	TOTAL
	PHASE II							
	Mobilization and Demobilization (5%)	LS	1	$ 19,791	$ 19,791	25%	$ 4,948	$ 24,739
1	Demolition of existing concrete slab	m^3	0	$ 138	$ -	25%	$ -	$ -
2	General Excavation and Off-site Disposal for ramp	m^3	9373	$ 30	$ 281,187	25%	$ 70,297	$ 351,484
3	Base Coarse for Ramp (Granular Base)	m^3	72	$ 65	$ 4,662	25%	$ 1,166	$ 5,828
4	New Concrete (cast in place)*	m^2	240	$ 385	$ 92,372	25%	$ 23,093	$ 115,465
5	General Excavation and Off-site Disposal for Turnaround	m^3	0	$ 30	$ -	25%	$ -	$ -
6	Base Course for the turnaround (Granular Base)	m^3	0	$ 65	$ -	25%	$ -	$ -
7	HSFA surfacing for turnaround	m^3	0	$ 65	$ -	25%	$ -	$ -
8	General Excavation and Off-site Disposal for Access Road	m^3	0	$ 30	$ -	25%	$ -	$ -
9	Base Course for the access road (Granular Base)	m^3	0	$ 65	$ -	25%	$ -	$ -
10	HSFA surfacing for access road	m^3	0	$ 65	$ -	25%	$ -	$ -
11	Scour Protection - Filter Stone for 55kg Riprap	m^3	18	$ 281	$ 5,127	25%	$ 1,282	$ 6,409
12	Scour Protection - 550mm thick Riprap D50 = 55kg	m^3	33	$ 354	$ 11,837	25%	$ 2,959	$ 14,797
13	Geotextile	m^2	64	$ 10	$ 643	25%	$ 161	$ 804
14	Hydraulic Seeding & Organic Soil - Provisional Item	LS	0	$ 35,000	$ -	25%	$ -	$ -
15	Floating Log Breakwater including mooring anchors	m	0	$ 4,200	$ -	25%	$ -	$ -
16	Garbage Receptacle	ea.	0	$ 5,000	$ -	25%	$ -	$ -
17	Allowance for Miscellaneous items (Signages, etc.)	LS	0	$ 15,000	$ -	25%	$ -	$ -
	Sub-Total				**$ 415,620**		**$ 103,905**	**$ 519,526**

moffatt & nichol

Project Name: DUNLEVY BOAT RAMP
WILLISTON RESERVOIR BOAT LAUNCH RAMP DESIGN
Client BC Hydro
Project no. 7937
Drawing References: 7937-SK6B
Date 22-May-13

Table 13 - DUNLEVY Replacement Boat Ramp - Option 6B - Straight East-West Alignment Toe at El. 654m

Item no.	Item Description	Unit	Quantity	Unit Rate	Item Cost	Contingency	Contingency Amount	TOTAL
	PHASE I - Ramp Toe El.658m							
	Mobilization and Demobilization (5%)	LS	1	$ 141,930	$ 141,930	25%	$ 35,482	$ 177,412
1	Demolition of existing concrete slab	m^3	60	$ 138	$ 8,280	25%	$ 2,070	$ 10,350
2	General Excavation and Off-site Disposal for ramp	m^3	21296	$ 30	$ 638,889	25%	$ 159,722	$ 798,611
3	Base Coarse for Ramp (Granular Base)	m^3	184	$ 65	$ 11,888	25%	$ 2,972	$ 14,860
4	New Concrete (cast in place)*	m^2	612	$ 385	$ 235,549	25%	$ 58,887	$ 294,436
5	General Excavation and Off-site Disposal for Turnaround	m^3	5170	$ 30	$ 155,100	25%	$ 38,775	$ 193,875
6	Base Course for the turnaround (Granular Base)	m^3	113	$ 65	$ 7,326	25%	$ 1,832	$ 9,158
7	HSFA surfacing for turnaround	m^3	57	$ 65	$ 3,677	25%	$ 919	$ 4,596
8	General Excavation and Off-site Disposal for Access Road	m^3	7590	$ 30	$ 227,700	25%	$ 56,925	$ 284,625
9	Base Course for the access road (Granular Base)	m^3	126	$ 65	$ 8,159	25%	$ 2,040	$ 10,198
10	HSFA surfacing for access road	m^3	63	$ 65	$ 4,095	25%	$ 1,024	$ 5,119
11	Scour Protection - Filter Stone for 55kg Riprap	m^3	1978	$ 140	$ 277,725	25%	$ 69,431	$ 347,156
12	Scour Protection - 550mm thick Riprap D50 = 55kg	m^3	3627	$ 177	$ 641,167	25%	$ 160,292	$ 801,459
13	Geotextile	m^2	6968	$ 5	$ 34,841	25%	$ 8,710	$ 43,551
14	Hydraulic Seeding & Organic Soil - Provisional Item	LS	1	$ 35,000	$ 35,000	25%	$ 8,750	$ 43,750
15	Floating Log Breakwater including mooring anchors	m	126	$ 4,200	$ 529,200	25%	$ 132,300	$ 661,500
16	Garbage Receptacle	ea.	1	$ 5,000	$ 5,000	25%	$ 1,250	$ 6,250
17	Allowance for Miscellaneous items (Signages,Marker Buoys etc.)	LS	1	$ 15,000	$ 15,000	25%	$ 3,750	$ 18,750
	Sub-Total				**$ 2,980,525**		**$ 745,131**	**$ 3,725,656**

NOTES

1) Based on a Design Construction Water Level (DCWL) is assumed to be El. 654 m, If water levels at the time of construction is at El.654m, cofferdam is likely not required to construct the toe of the launch ramp in the dry. It should be noted that this water level does not occur often.

2) The quantities indicated on the Opinion of Probable Cost represent the volume, area, or linear meter for each item as calculated from the neat line limits shown on the drawings without any adjustments for construction tolerances and material settlement.

3) Cost estimate excludes any temporary construction items such as cofferdams, site security, site services, first aid stations & environmental monitoring and annual maintenance costs.

* Unit cost references cost estimate prepared by Duz-Cho Construction for BC Hydro, Mackenzie Boat Launch Ramp - Jan 14, 2013

Item no.	Item Description	Unit	Quantity	Unit Rate	Item Cost	Contingency	Contingency Amount	TOTAL
	PHASE II - Ramp Toe extended - El. 654m							
	Mobilization and Demobilization (5%)	LS	1	$ 14,371	$ 14,371	25%	$ 3,593	$ 17,964
1	Demolition of existing concrete slab	m^3	0	$ 138	$ -	25%	$ -	$ -
2	General Excavation and Off-site Disposal for ramp	m^3	7030	$ 30	$ 210,909	25%	$ 52,727	$ 263,636
3	Base Coarse for Ramp (Granular Base)	m^3	48	$ 65	$ 3,108	25%	$ 777	$ 3,885
4	New Concrete (cast in place)*	m^2	160	$ 385	$ 61,581	25%	$ 15,395	$ 76,977
5	General Excavation and Off-site Disposal for Turnaround	m^3	0	$ 30	$ -	25%	$ -	$ -
6	Base Course for the turnaround (Granular Base)	m^3	0	$ 65	$ -	25%	$ -	$ -
7	HSFA surfacing for turnaround	m^3	0	$ 65	$ -	25%	$ -	$ -
8	General Excavation and Off-site Disposal for Access Road	m^3	0	$ 30	$ -	25%	$ -	$ -
9	Base Course for the access road (Granular Base)	m^3	0	$ 65	$ -	25%	$ -	$ -
10	HSFA surfacing for access road	m^3	0	$ 65	$ -	25%	$ -	$ -
11	Scour Protection - Filter Stone for 55kg Riprap	m^3	12	$ 281	$ 3,444	25%	$ 861	$ 4,305
12	Scour Protection - 550mm thick Riprap D50 = 55kg	m^3	22	$ 354	$ 7,952	25%	$ 1,988	$ 9,940
13	Geotextile	m^2	44	$ 10	$ 436	25%	$ 109	$ 545
14	Hydraulic Seeding & Organic Soil - Provisional Item	LS	0	$ 35,000	$ -	25%	$ -	$ -
15	Floating Log Breakwater including mooring anchors	m	0	$ 4,200	$ -	25%	$ -	$ -
16	Garbage Receptacle	ea.	0	$ 5,000	$ -	25%	$ -	$ -
17	Allowance for Miscellaneous items (Signages, etc.)	LS	0	$ 15,000	$ -	25%	$ -	$ -
	Sub-Total				**$ 301,801**		**$ 75,450**	**$ 377,252**