Peace Project Water Use Plan

Dunlevy Boat Ramp Feasibility, Design and Costing

Reference: GMSWORKS-54

Dunlevy Replacement Boat Ramp Feasibility Study

Moffatt & Nichol

October 23, 2012

DUNLEVY REPLACEMENT BOAT RAMP FACILITY FEASIBILITY STUDY

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7820 - 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

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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 would 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.
- 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 as shown in Figure 1. 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.

[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"

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

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. BCH requested M&N to undertake 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.

1.2 SCOPE OF WORK

BCH has selected four potential boat launch ramp sites for feasibility study consideration. These sites are:

- Existing Dunlevy boat ramp site;
- Dunlevy West located on the west side of the Dunlevy inlet;
- Josef Creek with access through the Ross property; and,
- Josef Creek with access through the Provincial Park property.

The locations of these sites are shown on Drawing 7820-001 in Appendix A.

M&N tasks for the assignment are:

- Visit the sites with the BCH project team and conduct a reconnaissance level walkover assessment of the access, geotechnical and constructability conditions;
- Prepare feasible layouts for each of the three sites; and,
- Prepare an opinion of probable construction costs for each site.

[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"

1.3 DATA COLLECTION

BCH provided M&N with bathymetry and LIDAR surveys for the Josef Creek inlet. Bathymetry surveys of the existing Dunlevy site at the replacement ramp location was done by Terra Sond in August 2010. Atek Hydrographic Surveys Ltd carried out bathymetry surveys in May 2009 for the existing Dunlevy site and Dunlevy West. These bathymetry and LIDAR surveys were used as base drawings for the feasibility design layouts of the boat launch ramp facilities.

Geotechnical investigations were undertaken by Exp Services for the existing Dunlevy site in July 2010. The field work consisted of two drilled holes and two hand-dug test pits. The two holes were drilled by an auger to depths 13.7m and 6.1m depths below grade. Dynamic Cone Penetration Tests (DCPT) and grab samples were done for each hole. Moisture content tests were carried out on the grab samples.

Exp prepared a geotechnical investigation report with recommendations for cut slopes, embankment fill, and seismic considerations. The recommended cut slopes and embankment fill were used in the feasibility design of access roads and boat launch ramp layout in this study.

1.4 REPORT ORGANIZATION

The site visit for this study is described in Section 2 below. The feasibility design for four sites are provided in Section 3. 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, site map summarizing opportunities and constraints for each boat launch location, and feasible layout plans of the existing and potential new facilities. Appendix B contains photographs taken during the past and recent site visits.

2. SITE VISIT FINDINGS AT THE BOAT LAUNCH RAMP SITES

2.1 SITE LOCATIONS

The project team consisting of BCH engineering erosion specialist Dr. Martin Lawrence, BCH Environmental Specialist Ms. Cynthia Powell, BCH Property Mr. Damian Dunne, Mr. Kevin Wilson of Ecofor (environment consultant) and Mr. Paul Hoo of M&N participated in the field reconnaissance walkover for the potential boat launch ramp sites at Dunlevy, conducted on July 11-12, 2012. The sites visited were Existing Dunlevy, Dunlevy South West and Josef Creek inlet (with two alternative access options). The Dunlevy West site was investigated in the previous feasibility study but was not visited at the time of July 2012 site visit. For the purposes of this report, it was agreed with Mr. Mark Leng of BC Hydro that a feasible design would not be done for the Dunlevy South West site, however, a description of the observations made during the site visit would be presented in this section of the report.

The location of the sites investigated are shown on the key plan on Drawing No. 7820 - 001 in Appendix A. Drawing No. 7820 - 010 also provides a summary of the constraints and opportunities for each site that are discussed in detail in Sections 2.2 – 2.6. The sites are listed as follows:

- Existing Dunlevy Site;
- Dunlevy West Site;
- Dunlevy South West;
- Josef Creek Option 1 – using the Ross Property Access Road; and,
- Josef Creek Option 2 – using the Provincial Parks Property Access Road.

2.2 DUNLEVY EXISTING SITE

The existing Dunlevy site is located on the north side of the Peace Arm of the Williston Reservoir, and on the east shore of the Dunlevy Inlet in the Butler Ridge Provincial Park. Figure 1 shows an aerial view of Dunlevy Inlet and the sites examined at this inlet (the location of the Torwood Resort, a private development, is also shown as reference). The park is accessible through well-maintained gravel road and has an ample gravel upland parking area (see Photo no.1 in Appendix B). Other facilities at the site include informational signs and pit toilets.

The approach to the existing boat launch ramp is along a gravel road (see Photo no. 2). The gravel approach to the ramp is in good condition. However, the concrete ramp is in very poor condition as a result of active wind-wave (beaching-type) erosion, and has been closed since April 2009[4] (although it appears that some boaters are still using the ramp).

[4]Butler Ridge Provincial Park. BC Parks. Viewed online at <http://www.env.gov.bc.ca/bcparks/explore/parkpgs/ butler_ridge/> on February 25, 2010.

Photos No.3 and 4 taken in 2009 show damage at the upper part of the boat launch ramp. A portion of the ramp has been undercut by wave erosion. Concrete barriers have been placed in the middle section of the ramp to keep boaters from straying towards the edge. Comparison with the photos of the upper section of the ramp taken from the recent site visit showed that undermining with further collapse of concrete ramp panels had occurred.

Although the lower end of the ramp was not visible at the July 2012 site visit, observation notes in the previous site visited in 2009 indicated that the bank has slumped and become over steepened. As shown in Photos No. 5 and 6 taken in 2009, the concrete panels on the surface of the boat launch ramp in this location have shifted downhill as a result of the over steepening of the bank. Photo no. 8 (2012) shows that the concrete panels have suffered further erosion damage since the 2009 site visit.

Relatively rapid erosion is also occurring at the top of the bank above the boat ramp, as shown in Photo no. 7 (2009).

The surface materials at Existing Dunlevy are generally relatively dense with a good mixture of sand and gravel, as shown in Photo no. 9. There are areas of finer substrate, however, as indicated in Photo no. 10. The area most subject to slumping, includes the area directly below the most eroded upper area (Photos No. 3 and 4), have this finer substrate. The exposed southerly fetch is approximately 6.2km and there is no protection from wind-waves that are directly due south. It was noted during the site visit that westerly winds are funneled in a northerly direction up the Dunlevy inlet also creating waves from a south direction (though with a shorter 1.8 km fetch). Consequently, it is considered likely that southerly wind-waves are the prevailing direction of erosion energy and that substantial erosion protection works would be required to improve and maintain this site.

The existing boat launch at the existing Dunlevy site is directly exposed to waves that may be generated by southerly winds in the Peace Arm and within inlet itself: there is a direct line of sight from the boat launch to the south shoreline of the Peace Arm.

Photos nos 11 and 12 taken in 2009 illustrate some of the shoreline erosion taking place at the existing Dunlevy site. Photo 13 taken in July 2012 shows the eroding upper bank above the boat ramp.

The proposed alternative boat launch ramp at the existing Dunlevy site is orientated in a north-south direction with the top of the ramp at the north side of the existing parking area. The north-south alignment of the alternative boat launch ramp is sheltered from the wind and waves from the south. The existing Dunlevy site also has the benefits of a good existing access road and parking area.

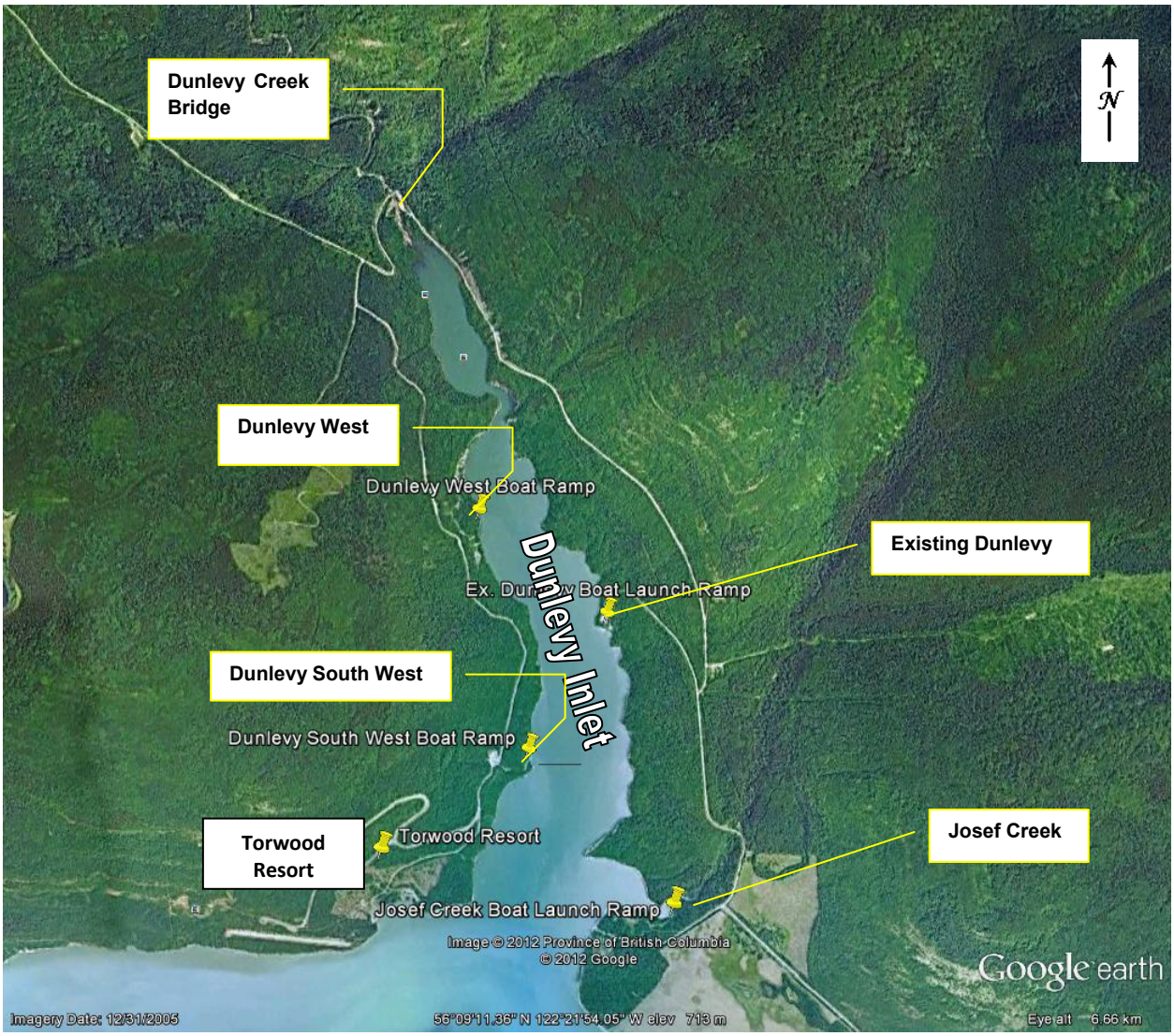

Figure 1: Location Map for Dunlevy sites (*Source: Google Earth*)

2.3 DUNLEVY WEST

The Dunlevy West site was not included in the 2012 site reconnaissance visit, but was previously inspected by M&N project team in May 2009 and described in M&N final report dated March 2010.

In the March 2010 M&N report, it was noted that there was a lack of suitable alternative sites on the east shore of Dunlevy Inlet; however, the M&N project team had identified a potential site on the west shore Dunlevy West for investigation. There is a gravel road that connects the east side of the inlet with the west side. The road is in good condition (including a new bridge over Dunlevy Creek). Although a sign warns that this road is not maintained past the turnoff to the existing site, it is likely that it will continue to be maintained to allow access to the Torwood Resort (Figure 1). However, if operations at the Torwood Resort ceases, the likelihood of continued road maintenance is doubtful. This risk to

determine who maintains the access road would have to be investigated should an alternate boat launch ramp site is located on the west side of the inlet.

The Dunlevy West site was identified as being significantly less susceptible to erosion compared to the majority of Dunlevy Inlet. The site is sheltered from the expected dominant southerly wind generated waves by the general alignment of the shoreline and inlet (see Figure 1). While there is erosion along the upper bank (Photo no. 15), this is much less advanced compared to sites on the west bank of Dunlevy Inlet, as indicated by fact that trees affected by erosion appear to have been dead for some time. The shoreline has a much less steep slope compared to the typical condition on the west bank (Photos No. 16 and 17), which may make low water access easier to achieve. Substrates at the site were generally similar to those at the existing site. The upland area is wooded but appears to have a generally manageable relief (Photo no. 18). Discussions with Dr. Lawrence included concerns that the terrain may actually consist of relic landslides, and that steep scarps and unstable ground would require additional engineering and hence additional costs.

Dunlevy West is a greenfield site that has no existing access road and would need approximately 0.5km of new road construction with cut and fill slopes to the proposed boat launch ramp location.

Users would need to drive approximately 7 km further to reach this site, compared to the existing Dunlevy site.

Land ownership at this site is not certain, although it seems likely to be Crown Land. The Online Cadastre of British Columbia[5] does not show any ownership or ownership type at the site. In contrast, the Online Cadastre does show the private ownership at the Torwood Resort and other areas on the southeast side of Dunlevy Inlet. The iMapBC GIS system[6] shows that most of the west side of Dunlevy Inlet is subject to licenses of occupation for Summer Extensive Use and Winter Extensive Use for commercial recreation. This suggests the land tenure would allow for a new boat launch ramp in the vicinity, but this must be verified. The land ownership must be definitively identified if this site is to be considered further.

2.4 DUNLEVY SOUTH WEST

The project team visited the Dunlevy South West site on July 12, 2012. Located on the west shore of the Dunlevy inlet, the Dunlevy South West is approximately 9 km by the existing gravel road from the existing Dunlevy ramp and is situated between the Dunlevy West site and the Torwood Resort property.

The Dunlevy South West site is also located near the mouth of the Dunlevy inlet and is potentially more exposed to wind generated waves from the south and southeast. Lake bed contours at

[5] Online Cadastre. British Columbia. Viewed online at <http://webmaps.gov.bc.ca/imf5/imf.jsp?site=olc> on September 14, 2012.
[6] iMapBC. Province of British Columbia. Viewed online at <https://webmaps.gov.bc.ca/imfz/imf.jsp?site=imapbc> on September 14, 2012.

this site are similar to the Dunlevy West site. The upland elevations and steepness of the terrain to the lake is also similar to the Dunlevy West site but without the relic landslides.

The existing access road to the lake is very steep with average gradients of approximately 20% to 25%) as shown in Photo no.19 and is not considered suitable route to the boat ramp site. A substantially longer and more costly new access road would be needed to meet the design requirement of 8% maximum grades.

During the site visit, the project team also observed an environmentally sensitive "mineral lick" or salt lick area was located along the existing access road. The area is an active mineral lick as confirmed by a remote camera and by numerous fresh ungulate tracks found in the immediate area (See Ecofor Environment report for details and discussions).

As noted in Section 2.1, feasible design was not developed for this site and is not discussed any further in this report.

2.5 JOSEF CREEK

The Josef Creek site is in a small inlet located on the east shore near the entrance of the Dunlevy Inlet as shown in Figure 1. The proposed boat ramp is sited at the upstream end of the Josef Creek inlet. It is moderately well-sheltered from the wind and waves from the longer south fetch but is somewhat exposed to wind-waves from the relatively shorter westerly fetch. The proposed boat ramp site is located on the Provincial Park property. The mouth of Josef Creek is located just north of the potential boat ramp site. The mouth of the creek widens as it approaches the top of the inlet.

Photos nos 20 and 21 taken in August 2010 show the potential upland parking area and boat launch area at the Josef Creek site. Photo no. 22 shows a near vertical sedimentary type bedrock at the potential boat ramp site. At the time of the August 2010 and July 2012 site visits, the steep drop at lower water levels was not visible as shown in Photo no. 22 taken in May 2012.

There appears to be adequate area above high water level to site a new vehicle and parking area at the top of the ramp.

There are two possible road accesses to the site, one route is via the existing access road through the Ross property and the other is through the Provincial Park lands.

The existing access road through the Ross property appears to be fair to good condition as shown in Photo no.23 but will require improvements such as widening, alignment adjustments, surfacing improvements and drainage. The turning radius of the 180 degree switch back turn at the top of the road is tight and would not allow a single turning maneuver for vehicles and trailers. However, the surrounding area is relatively flat and available for possible turning radius improvements. The slope of the terrain to the potential boat ramp site is approximately 8% and can be easily improved see Photo no. 23.

Access to the Josef Creek site through the Butler Ridge Provincial Parks lands is possible but will require crossing Josef Creek at some location. Crossing the creek at the narrowest location would provide the most economical solution to access the site; however, other parameters such as private property boundaries of the Ross property and steepness of terrain are other considerations. The terrain on the west side of Josef Creek in upper northern section of the Provincial Parks land is relatively flat but closer to the creek, the ground slopes steeply down to the valley where the creek flows. The ground gradually becomes less steep as the creek spreads out in a narrow flood plain at the mouth of the creek.

Trees and shrubs in the park are generally 100mm to 150mm diameter which will make clearing for a new access route easier than areas with larger mature trees see Photo no. 24.

Josef Creek flows under Twelve Mile Road through a 1.8m diameter corrugated steel pipe culvert see Photo No.25. The bed of the creek is fairly steep from the exit of the culvert towards the lake, and the width of the creek is narrow in this section, but it gradually flattens out as it nears the entry into the lake. At full pool, the creek widens out in a narrow flood plain near the potential boat ramp location as seen in Photo no. 26.

3. FEASIBILITY DESIGN OF BOAT LAUNCH RAMP AT THE STUDY LOCATIONS

3.1 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.

Notes of the community meetings were presented the Comptroller of Water Rights to confirm that BC Hydro had fulfilled the requirements 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.

3.2 DESIGN CRITERIA

This design criteria document in Appendix C outlines the basis and parameters for the planning and layout of the feasible designs for the boat launch ramp, riprap protection, parking area, and access road at the existing Dunlevy site, Dunlevy West, and the Josef Creek sites in the Dunlevy area, BC.

4. FEASIBLE LAYOUT OF BOAT LAUNCH RAMPS AND ACCESS

The layout and general features for the feasible design of the boat launch ramps is based on the design criteria as detailed in Appendix C. The main issues for the feasible design of the boat launch ramp include but are not limited to:

- Provision of adequate parking areas and turnarounds;
- Provision of ramp and access roads with suitable slopes; and,
- Other site-specific issues such as slope protection, walkways, and washrooms.

4.1 DUNLEVY EXISTING SITE

The existing boat launch ramp will be decommissioned and a new replacement boat ramp orientated north-south is proposed. This north-south alignment utilizes the protection provided by the existing headland (on which the parking area is located) from the southerly wind waves. The existing parking and turnaround area will be retained and expanded slightly by filling out on the access road south of the parking area as shown on Drawing 7820-30.

The proposed concrete boat launch ramp is 6.0 m wide and overall 200 m long with a top elevation of ramp El. 682.0 m and a toe of ramp El. 653.2 m, allowing access at all water levels. The ramp gradient is 15% and a turnaround at approximately halfway down the ramp is provided for lower water level launches. A lock block walkway ramp located along the length of the ramp is proposed for accessing launched boats. Erosion prone slopes are protected with riprap in areas subjected to wave action, Slopes above full pool elevation will be protected with a combination of riprap and turf and root mats. Decommissioning of the existing ramp will include the addition of riprap and recycled concrete fragments to improve the erosion resistance of the headland at the south end of the parking lot. Drawing 7830-31 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. A precast concrete toilet building is also provided in the parking area.

4.2 DUNLEVY WEST

The main features of the proposed boat launch ramp at Dunlevy West are shown on Drawing No. 7820 - 20 in Appendix A. Because this is a completely new and undeveloped site, there is a great deal of flexibility in the design in selecting the alignment of the boat launch.

The proposed new concrete boat launch ramp is 6.0 m wide and 160 m long with a top elevation of ramp El. 674.0 m and a toe of ramp El. 653.2 m, allowing access at all water levels. A profile through the proposed boat ramp is shown on Drawing 7820-20. The ramp gradient is 15%. The ramp is cast-in-place at elevations above El. 660.0 m and is constructed of precast concrete panels at lower elevations.

A new gravel surfaced combined parking area and turnaround area, 40 m x 50 m at El. 678.0 m, is provided at the head of the ramp. The parking area will accommodate 16 vehicles and trailers. A second turnaround area, approximately 20 m x 20 m, is provided halfway along the ramp.

A new two lane gravel surfaced access road, 8m wide and 600 m long will be provided to access the site from the FSR. The proposed access road will have maximum gradient of 8%.

4.3 JOSEF CREEK – OPTION 1 - ROSS PROPERTY ACCESS ROAD

The layout of the proposed boat launch ramp for Josef Creek is shown on Drawing No. 7820-40. The boat launch ramp is a 6m wide 140m long single lane concrete surfaced ramp with a 20m x 20m turnaround in the middle of the ramp. The lake bed has a steep, near vertical drop-off at El. 660m down to El. 650m as shown on the boat ramp profile on Drawing No. 7820-41. The ramp will require large volumes of granular fill to create the 15% ramp slope at this location as illustrated in the profile. In addition, the fill footprint on the lake bed will be significant from the side slopes of the fill.

The upland parking and turnaround area is approximately 40m x 50m to accommodate 16 vehicles and trailers and four vehicles.

The existing access road includes a sharp 180 degree turn from the upland area and is almost entirely within private property down to the proposed parking and turnaround area. The proposed design includes a larger 180 degree turn with 30m radius to facilitate easier maneuvering to access the boat launch ramp. The access road will be two lanes with an overall width of 8m and a design speed of 50kph.

4.4 JOSEF CREEK – OPTION 2 - PROVINCIAL PARKS PROPERTY ACCESS ROAD

The proposed boat launch ramp, turnaround and parking areas are the same as described in Section 4.3 and shown on Drawing 7820-50.

In this option, the access road through the Provincial Park land is an 8m wide, two lane gravel surfaced road approximately 680m long. The maximum gradient of the road is 8% and design speed of 50kph. It crosses the creek at chainage 0+395m see Drawing 7820-051. The approaches to the proposed bridge have a 30kph speed design speed to facilitate a shorter perpendicular crossing at the creek banks. The centerline of the road alignment on the east bank of the creek was offset from the private property boundary by 6m minimum.

The single span bridge crossing is 30m long and the top of the bridge is at El. 676m.

5. 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.

5.1 DUNLEVY EXISTING SITE

Table 1 provides the estimated construction cost for: a new 6.0 m boat launch ramp with erosion protection.

Table 2 shows the estimated annual maintenance cost for Dunlevy existing, including allowances for repairs to the ramp and riprap protection.

Table 1: Dunlevy Existing: Opinion of Probable Construction Cost

Item No.	Item Description	Item Total
1	General Excavation	$364,900
2	General Fill	$504,000
3	Base Coarse Material – High Fines Granular Surfacing Aggregates (HGSA)	$23,500
4	Base Coarse Material – 75mm Crushed Base Coarse (CBC) Aggregates	$20,350
5	Base Coarse for Ramp (Granular Base)	$23,500
6	New Concrete Slab (Precast)	$63,360
7	New Concrete (Cast in Place)	$264,880
8	Scour Protection – Filter Stone for 250kg Riprap	$360,173
9	Scour Protection – 250kg Riprap	$1,003,787
10	Scour Protection – 35kg Riprap	$24,639
11	Geotextile	$38,750
12	Precast Low Profile Barrier	$17,010
13	Precast Median Barrier	$4,800
14	Precast Concrete Curb	$325
15	Lock Block Walkway	$23,200
16	French Drain (including outlet protection)	$24,000
17	Hydraulic Seeding (including growing medium)	$10,966
18	Turf & Root Reinforcement Mats (including growing medium and hydraulic seeding)	$723,000

Item No.	Item Description	Item Total
19	Abutment	$15,000
20	Washroom	$16,000
21	Site Clearing & Removal of debris	$65,800
	SUB TOTAL	$3,591,939
	Mobilization and Demobilization (10%)	$359,194
	Contingency (25%)	$987,783
	TOTAL	$4,938,917

Table 2: Dunlevy Existing Site: 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

5.2 DUNLEVY WEST

Table 3 provides the estimated construction cost for a new 6.0 m boat launch ramp including erosion protection.

Table 4 provides the estimated construction and maintenance costs respectively for a new 6.0 m wide boat launch ramp, parking and turnaround, and road access at the Dunlevy West.

Table 3: Dunlevy West: Opinion of Probable Construction Cost

Item No.	Item Description	Item Total
1	General Excavation	$1,034,270
2	General Fill	$5,970,045
3	Base Coarse Material – High Fines Granular Surfacing Aggregates (HGSA)	$52,440
4	Base Coarse Material – 75mm Crushed Base Coarse (CBC) Aggregates	$104,880
5	Base Coarse for Ramp (Granular Base)	$14,760
6	New Concrete Slab (Precast)	$31,680
7	New Concrete (Cast in Place)	$234,780

Item No.	Item Description	Item Total
8	Scour Protection – Filter Stone for 250kg Riprap	$95,722
9	Scour Protection – 250kg Riprap	$450,273
10	Scour Protection – 35kg Riprap	$1,792,133
11	Geotextile	$158,735
12	Precast Low Profile Barrier	$9,450
13	Precast Median Barrier	$49,920
14	Precast Concrete Curb	$400
15	Lock Block Walkway	$65,600
16	French Drain (including outlet protection)	$25,000
17	Hydraulic Seeding (including growing medium)	$15,000
18	Turf & Root Reinforcement Mats (including growing medium and hydraulic seeding)	$597,198
19	Abutment	$15,000
20	Washroom	$16,000
21	Site Clearing & Removal of debris	$191,830
	SUB TOTAL	**$10,925,115**
	Mobilization and Demobilization (10%)	$1,092,512
	Contingency (25%)	$3,004,407
	TOTAL	**$15,022,033**

Table 4: Dunlevy West: 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**

5.3 JOSEF CREEK – ROSS PROPERTY ACCESS

Table 5 provides the estimated construction cost for a new 6.0 m boat launch ramp including erosion protection, parking and turnaround area, and access road improvements.

Table 6 provides the estimated construction and maintenance costs respectively for a new 6.0m wide boat launch ramp, parking and turnaround.

Table 5: Josef Creek – Ross Property Access: Opinion of Probable Construction Cost

Item No.	Item Description	Item Total
1	General Excavation	$244,892
2	General Fill	$1,816,031
3	Base Coarse Material – High Fines Granular Surfacing Aggregates (HFSA)	$59,280
4	Base Coarse Material – 75mm Crushed Base Coarse (CBC) Aggregates	$118,560
5	Base Coarse for Ramp (Granular Base)	$12,510
6	New Concrete Slab (Precast)	$31,680
7	New Concrete (Cast in Place)	$163,830
8	Scour Protection – Filter Stone for 250kg Riprap	$557,453
9	Scour Protection – 250kg Riprap	$1,003,787
10	Scour Protection – 35kg Riprap	$176,924
11	Geotextile	$43,130
12	Precast Low Profile Barrier	$9,450
13	Precast Median Barrier	$17,040
14	Precast Concrete Curb	$400
15	Lock Block Walkway	$55,600
16	French Drain (including outlet protection)	$25,000
17	Hydraulic Seeding (including growing medium)	$15,000
18	Turf & Root Reinforcement Mats (including growing medium and hydraulic seeding)	$189,426
19	Abutment	$15,000
20	Washroom	$16,000
21	Site Clearing & Removal of debris	$87,530
	SUB TOTAL	**$4,658,522**
	Mobilization and Demobilization (10%)	$465,852
	Contingency (25%)	$1,281,094
	TOTAL	**$6,405,468**

Table 6: Josef Creek – Ross Property Access: 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**

5.4 JOSEF CREEK – PROVINCIAL PARK ACCESS

Table 7 provides the estimated construction cost for a new 6.0 m boat launch ramp including erosion protection, parking and turnaround area, access road and bridge crossing.

Table 8 provides the estimated construction and maintenance costs respectively for a new 6.0m wide boat launch ramp, parking and turnaround, and bridge.

Table 7: Josef Creek – Provincial Park Access: Opinion of Probable Construction Cost

Item No.	Item Description	Item Total
1	**General Excavation**	$320,634
2	**General Fill**	$2,304,631
3	**Base Coarse Material – High Fines Granular Surfacing Aggregates (HFSA)**	$73,259
4	**Base Coarse Material – 75mm Crushed Base Coarse (CBC) Aggregates**	$146,518
5	**Base Coarse for Ramp (Granular Base)**	$12,510
6	**New Concrete Slab (Precast)**	$31,680
7	**New Concrete (Cast in Place)**	$163,830
8	**Scour Protection – Filter Stone for 250kg Riprap**	$167,236
9	**Scour Protection – 250kg Riprap**	$786,673
10	**Scour Protection – 35kg Riprap**	$589,982
11	**Geotextile**	$81,150
12	**Precast Low Profile Barrier**	$9,450
13	**Precast Median Barrier**	$30,000
14	**Precast Concrete Curb**	$400
15	**Lock Block Walkway**	$55,600
16	**French Drain (including outlet protection)**	$25,000

Item No.	Item Description	Item Total
17	Hydraulic Seeding (including growing medium)	$15,000
18	Turf & Root Reinforcement Mats (including growing medium and hydraulic seeding)	$810,242
19	Abutment	$15,000
20	Washroom	$16,000
21	Site Clearing & Removal of debris	$67,788
22	Access Road Bridge	$1,350,000
	SUB TOTAL	**$7,072,582**
	Mobilization and Demobilization (10%)	$707,258
	Contingency (25%)	$1,944,960
	TOTAL	**$9,724,800**

Table 8: Josef Creek - Provincial Park Access: 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
3	Repair bridge	sum	-	-	$10,000
				Total	**$30,000**

5.5 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 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 9 below summaries the capital cost estimate and annual maintenance costs rounded to the nearest thousand for the various locations.

Table 9: Summary of Estimates for Capital and Annual Maintenance Costs

Location	Opinion of Probable Construction Cost including Contingencies[i]	Annual Maintenance Cost
Dunlevy Existing Site	$ 4,939,000	$20,000
Dunlevy West	$15,023,000	$20,000
Josef Creek – Ross Property Access	$6,406,000	$20,000
Josef Creek – Provincial Park Access	$9,725,000	$30,000

5.6 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 does not constitute a warranty, expressed or implied, that contractors' bids will not vary from the estimate of feasibility cost prepared by the consultant.

5.7 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.654.4 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 10% 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 did a similar project in the Lower Arrow Lakes area. The travel time between the different quarry sources to the Dunlevy was estimated to be 4hrs for a round trip.
- The unit rate of $440/m2 for precast concrete panels was derived from costs obtained from BC Hydro for the supply, storage and transport of the precast panels to the construction site. The installation cost was obtained from a contractor who constructed a boat ramp in the Lower Arrow Lakes area in 2011.
- The unit rate of $215/m2 for Cast-In-Place concrete supply and placement was derived from tender prices for the Roberts Bank East Causeway project, and was compared to unit rates provided by budget prices received from a contractor who constructed a boat ramp in the Lower Arrow Lakes area in 2011.
- 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.

6. CONCLUSIONS AND RECOMMENDATIONS

Our general conclusions and recommendations for the various sites are as follows.

6.1 DUNLEVY EXISTING SITE

It is potentially feasible to reconstruct a new boat launch ramp at the existing site in the proposed new alignment, in which the ramp and turnaround are accessed through the north end of the existing parking area.

The site has existing access road and does not have that additional capital cost when compared with the other green field sites.

If bank erosion at the 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 ramp at this location could be feasible.

Other risks to be considered when developing this site are:

- 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.

6.2 DUNLEVY WEST

The Dunlevy West site is technically feasible to construct, but is the highest cost option because of the large volume of fill required to construct the access road. The road requires a large volume of fill because of the steep terrain to construct the access road to the ramp location.

This site also has similar risks as the Dunlevy existing site as listed above.

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.

6.3 JOSEF CREEK – OPTION 1- ROSS PROPERTY ACCESS ROAD

The Josef Creek – Ross property site is technically feasible and is the second lowest cost option. However, because there is a steep drop-off in the lake bed profile in the inlet, a fill height of approximately 10m is required to form the design ramp slope. The fill embankment footprint on the lake bed will have a significant fisheries impact. Improvement to the access road is minimal in comparison to the access route through the Provincial Park but land purchase is required which is not accounted for in the cost estimate. Habitat compensation works may be required at Josef Creek site.

6.4 JOSEF CREEK – OPTION 2 – PROVINCIAL PARKS PROPERTY ACCESS ROAD

The Josef Creek – Option 2 is the second most expensive option. The ramp issues are similar to Option 1. Constructing the access road through the parks property is feasible including a bridge crossing over Josef Creek. Some potential risks are:-

- Habitat compensation works may be required at Josef Creek;
- Cadastral boundary survey will be required along the adjacent private property to ensure access road does not encroach;
- Availability of riprap, filter stone and fill materials in the vicinity of the site could reduce cost significantly;
- 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; and,
- 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.

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 the undersigned at any time.

Prepared by:	Reviewed by:
MOFFATT & NICHOL	**MOFFATT & NICHOL**
Paul Hoo, P.Eng. Project Manager	Farhad Shushtarian, P.Eng. Sr. Project Manager

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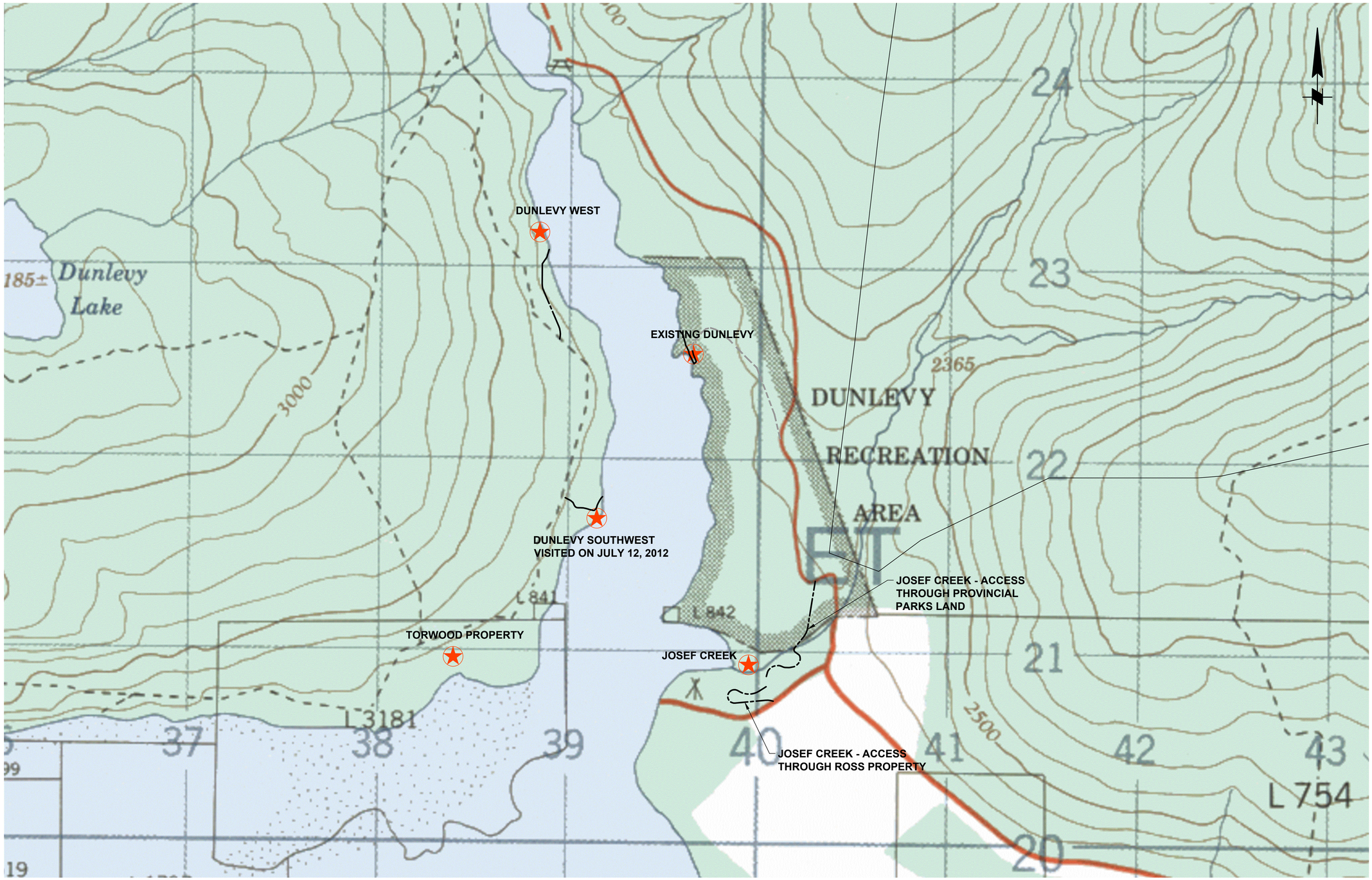
APPENDIX A

DRAWINGS



PLAN
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NOTE:

1. BASEMAP EXTRACTED FROM E-TOPO MAPS.

PRELIMINARY
FOR DISCUSSION PURPOSES

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A	ISSUED FOR REVIEW	AUG.29,12	EZ	PH

BC hydro

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

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Reviewed by:	Drawing code:	
Submitted by: MOFFATT & NICHOL	Dwg Scale: AS SHOWN Plot scale: 1:1 (D SHEET)	

DUNLEVY BOAT RAMP FEASIBILITY

GENERAL LOCATION PLAN

Sheet Reference Number: **001**

Sheet 01 of

DRAWING SCALES SHOWN BASED ON 22"X34" DRAWING

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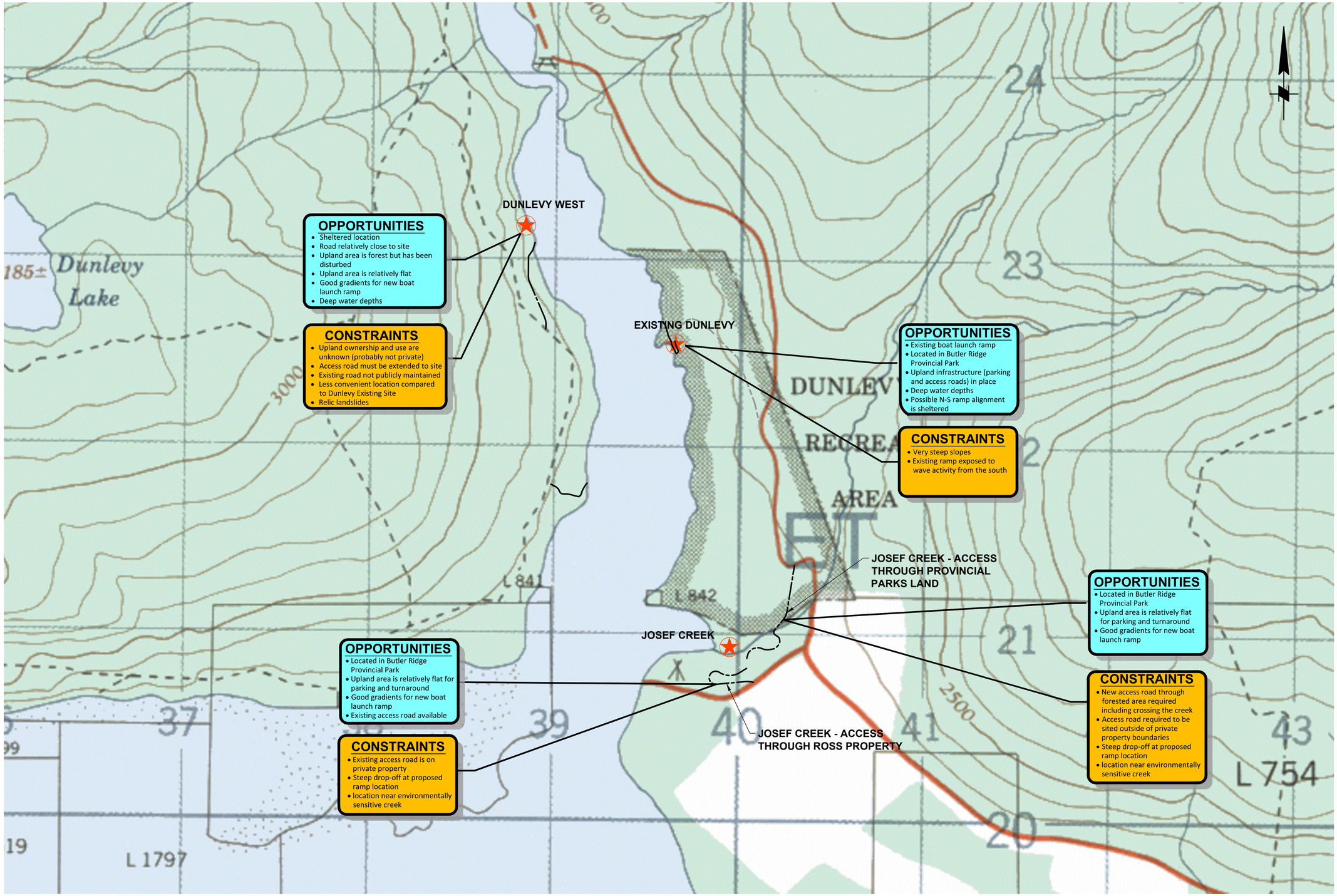

NOTE:

1. BASEMAP EXTRACTED FROM E–TOPO MAPS.

PRELIMINARY
FOR DISCUSSION PURPOSES

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DRAWING SCALES SHOWN BASED ON 22"X34" DRAWING

DUNLEVY BOAT RAMP FEASIBILITY

SITE OPPORTUNITIES & CONSTRAINTS

Sheet Reference Number: **010**

Sheet 02 of

PLAN
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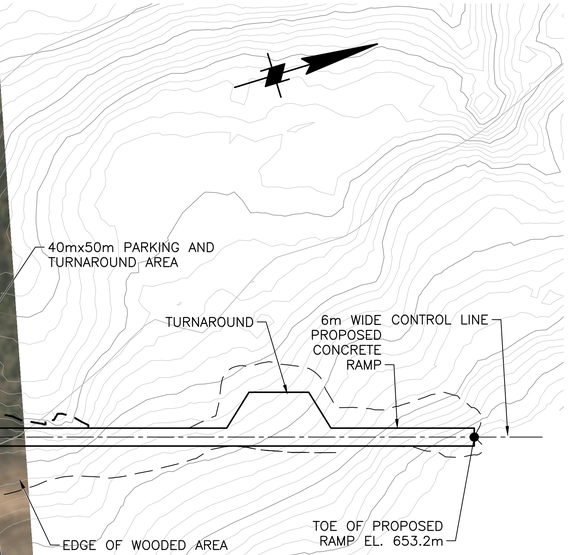

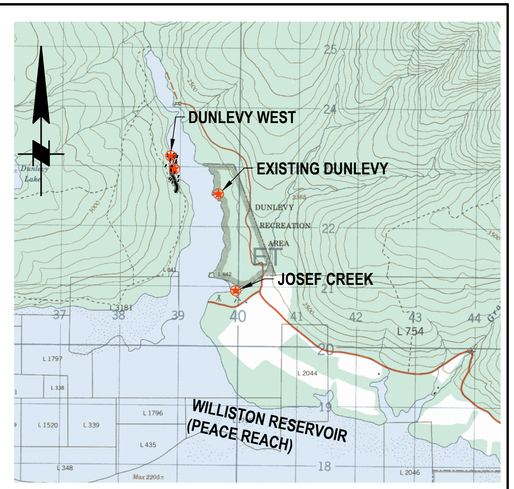

KEY PLAN
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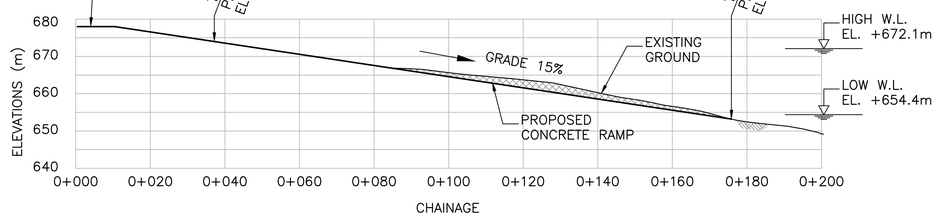

PROFILE ALONG CONTROL LINE
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NOTES:

1. CONTOURS ARE IN METRES TO GEODETIC DATUM AND ARE BASED ON HYDROGRAPHIC SURVEYS CONDUCTED BY ATEK HYDROGRAPHIC SURVEYS LTD. ON MAY 19, 2009.
2. UPLAND CONDITIONS BASED ON AERIAL PHOTOGRAPHY DATED 2006 AND TOPOGRAPHY INFORMATION FROM ETOPO MAPS.
3. CONTOURS ARE DERIVED FROM LIDAR SURVEY PROVIDED BY BCHYDRO, AUG. 10, 2012.

20m 0m 20m 40m
SCALE: 1 : 1000

PRELIMINARY
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C	ROAD OFFSET ADDED	OCT.12,12	EZ	PH
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BCHydro

moffatt & nichol
777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
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Submitted by: MOFFATT & NICHOL		Dwg Scale: AS SHOWN Plot scale: 1:1 (D SHEET)	

DUNLEVY BOAT RAMP FEASIBILITY

DUNLEVY WEST SITE PLAN & PROFILE

Sheet Reference Number: **020**

Sheet 03 of

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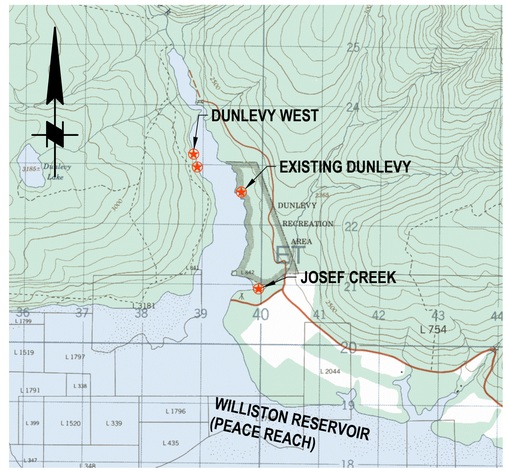

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NOTES:

1. CONTOURS ARE IN METRES TO GEODETIC DATUM AND ARE BASED ON HYDROGRAPHIC SURVEYS CONDUCTED BY ATEK HYDROGRAPHIC SURVEYS LTD. ON MAY 19, 2009.
2. UPLAND CONDITIONS BASED ON AERIAL PHOTOGRAPHY DATED 2006 AND TOPOGRAPHY INFORMATION FROM ETOPO MAPS.
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VANCOUVER, BC, CANADA, V5Z 4J7
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DUNLEVY BOAT RAMP FEASIBILITY

EXISTING DUNLEVY SITE PLAN

Sheet Reference Number: **030**

Sheet 04 of

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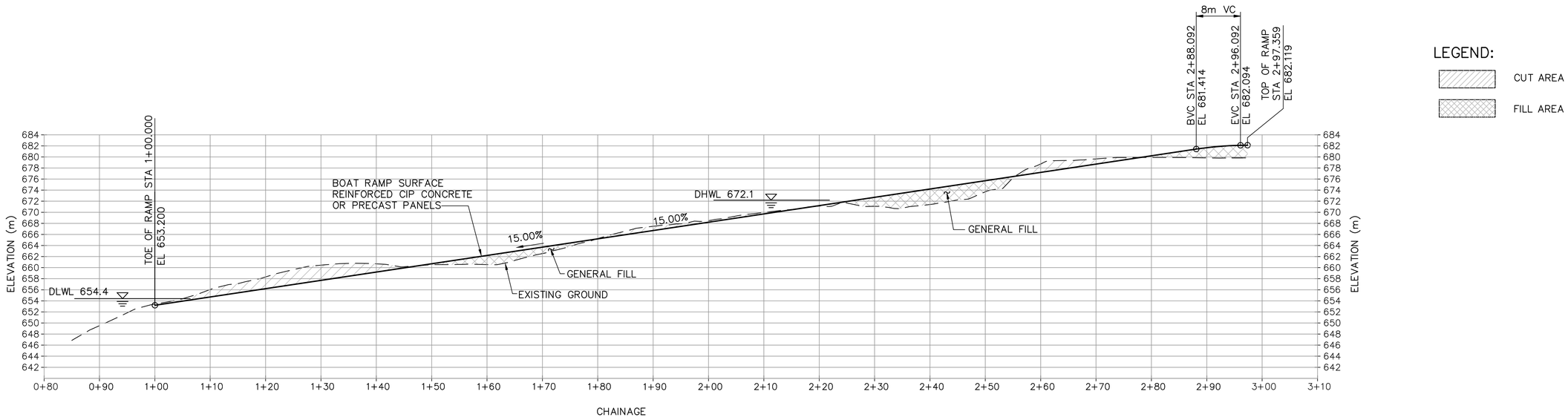


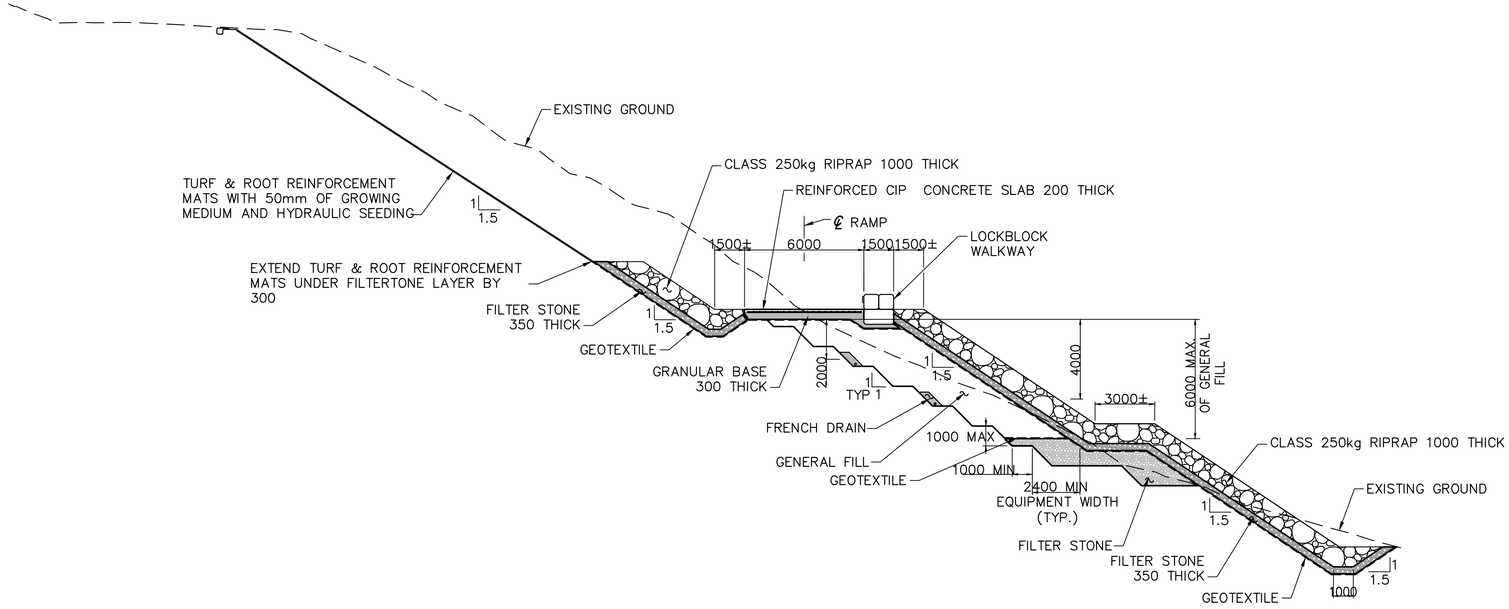
LEGEND:

CUT AREA

FILL AREA

PROFILE ALONG RAMP CONTROL LINE

SCALE: 1:400



TYPICAL RAMP SECTION

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SCALE: 1 : 150

8m 0m 8m 16m

SCALE: 1 : 400

PRELIMINARY
FOR DISCUSSION PURPOSES

Mark	Description	Date	Dr'n	Appr
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DUNLEVY BOAT RAMP FEASIBILITY

EXISTING DUNLEVY SITE
PROFILE & TYPICAL SECTION

Sheet Reference Number: **031**

Sheet 05 of

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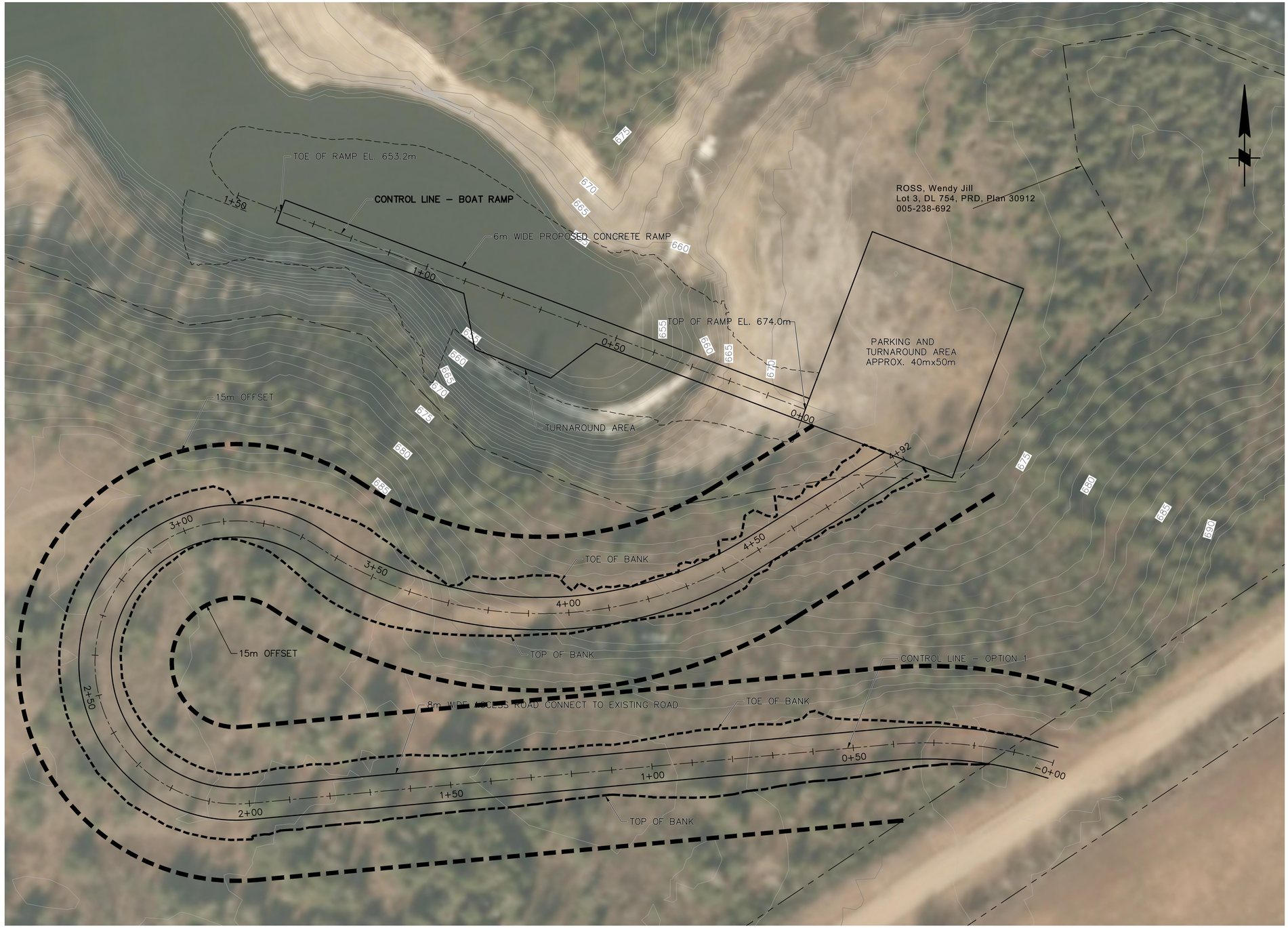

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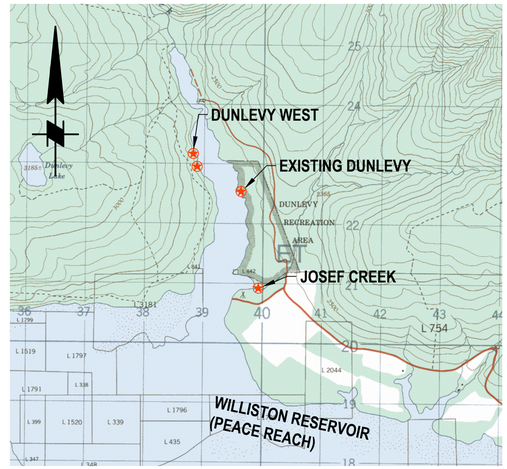

KEY PLAN
SCALE: N.T.S

NOTES:

1. CONTOURS ARE IN METRES TO GEODETIC DATUM AND ARE BASED ON HYDROGRAPHIC SURVEYS CONDUCTED BY ATEK HYDROGRAPHIC SURVEYS LTD. ON MAY 19, 2009.
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10m 0 10m 20m
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PRELIMINARY
FOR DISCUSSION PURPOSES

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C	ROAD OFFSET ADDED	OCT.12,12	EZ	PH
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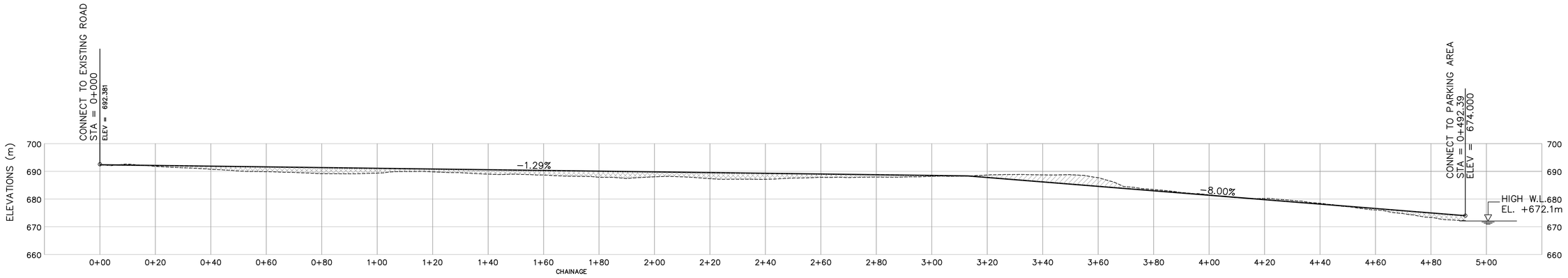
DUNLEVY BOAT RAMP FEASIBILITY

JOSEF CREEK - OPTION 1
ACCESS ROSS PROPERTY

Sheet Reference Number: **040**

Sheet 06 of

DRAWING SCALES SHOWN BASED ON 22"X34" DRAWING



JOSEF CREEK OPTION 1 ACCESS ROAD PROFILE ALONG CONTROL LINE

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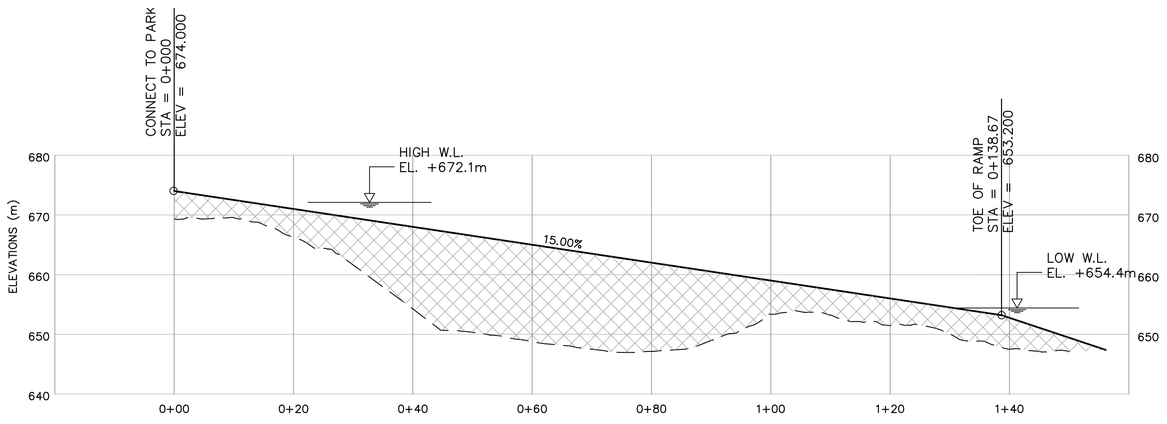

JOSEF CREEK BOAT RAMP PROFILE ALONG CONTROL LINE

SCALE: 1:500

LEGEND:

- CUT AREA
- FILL AREA

15m 0 15m 30m

1:750

10m 0 10m 20m

1:500

PRELIMINARY
FOR DISCUSSION PURPOSES

Mark	Description	Date	Dr'n	Appr
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B	ISSUED FOR DRAFT REPORT	SEP.19,12	EZ	PH
A	ISSUED FOR REVIEW	SEP.04,12	EZ	PH

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Submitted by: MOFFATT & NICHOL		Dwg Scale: AS SHOWN Plot scale: 1:1 (D SHEET)

DUNLEVY BOAT RAMP FEASIBILITY

JOSEF CREEK - OPTION 1
ACCESS ROSS PROPERTY
PROFILE

Sheet Reference Number: **041**

Sheet 07 of

DRAWING SCALES SHOWN BASED ON 22"X34" DRAWING

PLAN
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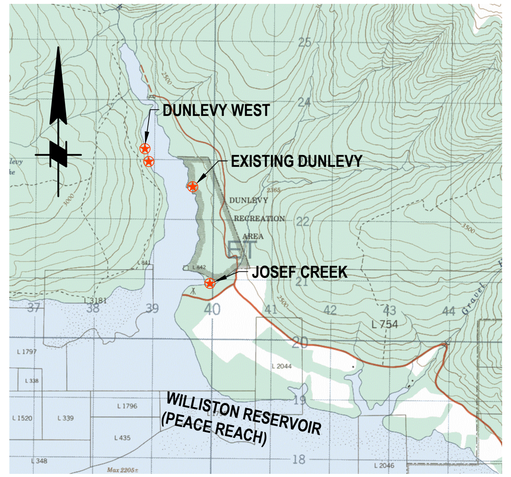


KEY PLAN
SCALE: N.T.S

NOTES:

1. CONTOURS ARE IN METRES TO GEODETIC DATUM AND ARE BASED ON HYDROGRAPHIC SURVEYS CONDUCTED BY ATEK HYDROGRAPHIC SURVEYS LTD. ON MAY 19, 2009.
2. UPLAND CONDITIONS BASED ON AERIAL PHOTOGRAPHY DATED 2006 AND TOPOGRAPHY INFORMATION FROM ETOPO MAPS.
3. CONTOURS ARE DERIVED FROM LIDAR SURVEY PROVIDED BY BCHYDRO.

25m 0 25m 50m
1:1250

PRELIMINARY
FOR DISCUSSION PURPOSES

Mark	Description	Date	Dr'n	Appr.
D	ISSUED FOR FINAL REPORT	OCT.17,12	AM	PH
C	ROAD OFFSET ADDED	OCT.12,12	EZ	PH
B	ISSUED FOR DRAFT REPORT	SEP.19,12	EZ	PH
A	ISSUED FOR REVIEW	SEP.04,12	EZ	PH

BCHydro

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

SEAL

Designed by: PH	Date: AUG.22, 2012	Rev. D
Dwn by: EZ / Ckd by:	M&N Project No. 7820	
Reviewed by:	Drawing code:	
Submitted by: MOFFATT & NICHOL	Dwg Scale: AS SHOWN Plot scale: 1:1 (D SHEET)	

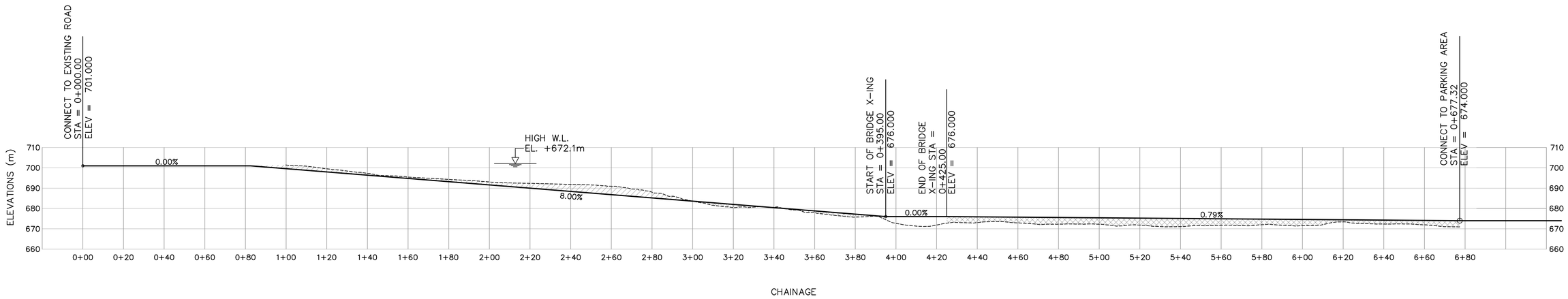
DUNLEVY BOAT RAMP FEASIBILITY

JOSEF CREEK - OPTION 2
ACCESS ON PARKS PROPERTY

Sheet Reference Number: **050**
Sheet 08 of

DRAWING SCALES SHOWN BASED ON 22"X34" DRAWING

File: P:\7820 Dunlevy Boat Ramp Feasibility_Study\CADD_Active\782000-050_Josef_Option-2; Plotted: 10/23/2012 4:43 PM by MANUZON, ALLEN; Saved: 10/17/2012 3:39 PM by AMANUZON



JOSEF CREEK OPTION 2 ACCESS ROAD PROFILE ALONG CONTROL LINE

SCALE: 1:1000

LEGEND:

CUT AREA

FILL AREA

20m 0 20m 40m

1:1000

PRELIMINARY
FOR DISCUSSION PURPOSES

Mark	Description	Date	Dr'n	Appr
C	ISSUED FOR FINAL REPORT	OCT.17,12	AM	PH
B	ISSUED FOR DRAFT REPORT	SEP.19,12	EZ	PH
A	ISSUED FOR REVIEW	SEP.04,12	EZ	PH

BC hydro

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

SEAL

Designed by: PH	Date: SEP.04,2012	Rev. C
Dwn by: EZ / Ckd by:	M&N Project No. 7820	
Reviewed by:	Drawing code:	
Submitted by: MOFFATT & NICHOL	Dwg Scale: AS SHOWN Plot scale: 1:1 (D SHEET)	

DUNLEVY BOAT RAMP FEASIBILITY

JOSEF CREEK - OPTION 2
ACCESS ON PARKS PROPERTY
PROFILE

Sheet Reference Number: **051**

Sheet 09 of

DRAWING SCALES SHOWN BASED ON 22"X34" DRAWING

APPENDIX B

PHOTOGRAPHS

Appendix B:

Photographs Taken on Field Trips to Dunlevy, on May 19, 2009 and July 11-12, 2012

Photo 1: Taken on 5-19-2009 at Existing Dunlevy Site (View of the parking area).

Photo 2: Taken on 7-12-2012 at Existing Dunlevy Site (Approach to the existing boat launch ramp).

Photo 3: Taken on 5-19-2009 at Existing Dunlevy Site (Existing boat launch ramp looking uphill).

Photo 4: Taken on 5-19-2009 at Existing Dunlevy Site (Erosion and undercutting of the upper part of the existing boat launch ramp; concrete barrier has been installed for safety).

Photo 5: Taken on 5-19-2009 at Existing Dunlevy Site (Bank slumping and associated damage of the lower part of the existing boat launch ramp).

Photo 6: Taken on 5-19-2009 at Existing Dunelvy Site (Lower end of the existing boat launch ramp).

Photo 7: Taken on 5-19-2009 at Existing Dunlevy Site (Ongoing erosion at the top of bank adjacent to the existing boat launch ramp).

Photo 8: Taken on 7-12-2012 at Existing Dunlevy Site (Erosion damage to concrete panels at the existing boat launch ramp).

Photo 9: Taken on 5-19-2009 at Existing Dunlevy Site (Typical each deposit over much of the bank).

Photo 10: Taken on 5-19-2009 at Existing Dunlevy Site (In-situ native clayey silt found in parts of the bank at Dunlevy and was present in the vicinity of the areas most subject to slumping).

Photo 11: Taken on 5-19-2009 at Existing Dunlevy Site (Erosion of upper bank at the north side of the existing Dunlevy site and showing the site of the proposed N-S alignment).

Photo 12: Taken on 5-19-2009 at Existing Dunlevy Site (Ongoing wave-driven erosion and slumping at the bottom of bank immediately downstream (south) of the boat launch ramp; similar to erosion at the ramp).

Photo 13: Taken on 7-12-2012 at the Existing Dunlevy Site View from the existing boat ramp of the south side of the shoreline embankment (Upper bank shoreline erosion south of existing Dunlevy compares with Photo No. 11).

Photo 14: Taken on 5-20-2009 of the Dunlevy West Site (Potential alternative site across from the existing Dunlevy boat launch ramp).

Photo 15: Taken on 5-20-2009 of the Dunlevy West Site (Upland portion of the site: erosion is less severe compared to the existing boat launch ramp).

Photo 16: Taken on 5-20-2009 of the Dunlevy West Site (General view of the terrain at this site)

Photo 17: Taken on 5-20-2009 of the Dunlevy West Site (View of the beach near the low water area of the potential alternative sites).

Photo 18: Taken on 5-20-2009 of the Dunlevy West Site (View of the upland area of the potential alternative sites).

Photo 19: Taken on 7-12-2012 of the Dunlevy South West Site (Existing access road is steep. Mineral Lick area located just at the top of slope)

Photo 20: Taken on 8-03-2010 of the Josef Creek Site (View of Josef Creek inlet and potential boat launch site from the likely parking and turnaround area).

Photo 21: Taken on 8-03-2010 of the Josef Creek Site (View of potential boat launch site area).

Photo 22: Taken on 5-17-2012 of the Josef Creek Site (Steep drop-off at potential boat launch site area).

Photo 23: Taken on 8-03-2010 of the Josef Creek Site (View of existing access road at the Josef Creek site).

Photo 24: Taken on 07-12-2012 of the Josef Creek Site (View of potential access route through the provincial parks lands. Note relatively small diameter trees).

Photo 25: Taken on 07-12-2012 of the Josef Creek Site (View of CSP at the Twelve Mile Road crossing over Josef Creek).

Photo 26: Taken on 07-12-2012 of the Josef Creek Site (Upstream View of the mouth of the Josef Creek at full pool).

APPENDIX C

DESIGN BASIS

moffatt & nichol

777 W. Broadway, Suite 301
Vancouver BC, Canada V5Z 4J7

(604) 707-9004 Fax (604) 707-9005
www.moffattnichol.com

MEMORANDUM

To:	**Mark Leng, Project Team Lead, BC Hydro**
Cc.	**Farhad Shushtarian, Senior Project Manager, Moffatt & Nichol**
From:	**Paul Hoo, Project Manager, Moffatt & Nichol**
Date:	**October 23, 2012**
Subject:	**DUNLEVY REPLACEMENT BOAT RAMP FEASIBILITY STUDY- DESIGN CRITERIA**
M&N Job No.:	**Project 7820 – 42**

1. INTRODUCTION

This 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, Dunlevy West, and the Josef Creek sites in the Dunlevy area, BC. 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 document.

2. 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 (1991);
- Layout and Design Guidelines for Marina Berthing Facilities, California Department of Boating and Waterways, Division of Boating Facilities (2005);
- Park Design Guidelines and Data, Province of British Columbia, Ministry of Environment Lands and Parks;
- National Building Code of Canada 2010;
- CAN/CSA – S-6.06, Canadian Highway Bridge Code;
- 2012 Standard Specifications for Highway Construction BCMOT;

- Bridge Standards and Procedures Manual, BCMOT;
- Forest Service Bridge Design and Construction Manual, July 30, 1999;
- Forest Road Engineering Guidebook 2nd edition, June 2002; and,
- CERIA; CUR; CETMEF; The Rock Manual, The Use of Rock in Hydraulic Engineering, 2nd Edition 2007.

2.1. 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.

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).

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.

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.

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.

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:

7.1. Rainfall

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

7.2. 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

7.3. Wind Pressure

Hourly Wind Pressure:

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

7.4. 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

7.5. Current

The current at sites along the Dunlevy Inlet was considered negligible. Based on site observations, the current at the Josef Creek site was considered negligible as well. At high water elevations, the creek flows into a deep widened area near the Josef Creek inlet where the creek flows are considerably slowed before it meets the head on the inlet.

7.6. Ice

Consideration of the ice force effects on the riprap is to be taken into account in the design of the scour protection for the boat ramp. Unfortunately, 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. In addition, BC Hydro does not measure ice formations at WAC Bennett Dam or on the reservoir.

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 river. The extent of field investigations required to quantify these effects is beyond the scope of this project. However, for the design of the scour protection for the Dunlevy boat ramp, a design ice thickness of 0.5m is adopted and is considered conservative.

7.7. Seismic

The seismic accelerations for various probabilities of exceedance for the proposed bridge at the Josef Creek site are as provided by the interpolation of the 2010 National Building Code of Canada seismic hazard values for the site located at Latitude 56.132º N, Longitude 122.3576º W. Table 3 summarizes the Uniform Hazard Response Spectrum for this site.

Table 3: Uniform Hazard Response Spectrum

Site	Performance Level	Probability of Exceedance in 50 Years	Probability of Annual Exceedance	Spectral Response Accelerations* (5% Damping)				PGA**	Return Period in Years
				Sa(0.2)	Sa(0.5)	Sa(1.0)	Sa(2.0)		
Josef Creek	OBE	10%	0.2105%	0.096	0.055	0.026	0.014	0.055	475
	LSE	2%	0.0404%	0.0235	0.134	0.063	0.034	0.120	2,475

*Sa = 5% damped horizontal Spectral Response Accelerations for the periods of 0.2, 0.5, 1.0, and 2.0 seconds

**PGA = horizontal Peak Ground Acceleration

Structural design criteria will be established in accordance with the requirements of the NBCC 2005. The performance criteria for the level of acceptable seismic damage shall be based on the following two seismic events. As new CSA S-6.06 clause 9.9.2 Design 6Q is 1:475 year or 15% in 75 years or 6% in 30 years.

Operating Basis Earthquake (OBE)

The OBE is defined as the seismic event that produces ground motions associated with a 475-year return period. After the OBE event, the ramp facility and bridge should be operable with little or no damage.

Life Safety Earthquake (LSE)

The LSE is a rare and extreme seismic event that produces ground motions associated with a 2,475-year return period. At this level of event, the structure is expected to protect life safety by avoiding major structural collapse and maintaining continuity of personnel egress routes. Structural damage to the facilities is expected, up to and including total economic loss.

7.8. Landslides and Tsunamis

The effects of a seismically induced landslide at the preferred site will be assessed after geotechnical investigations have been completed.

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.

8. MARINE CRITERIA

8.1. Water Levels

Design elevations for locations on Williston Reservoir are based on water levels provided by BC Hydro and obtained from the Environmental Canada web-site 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.

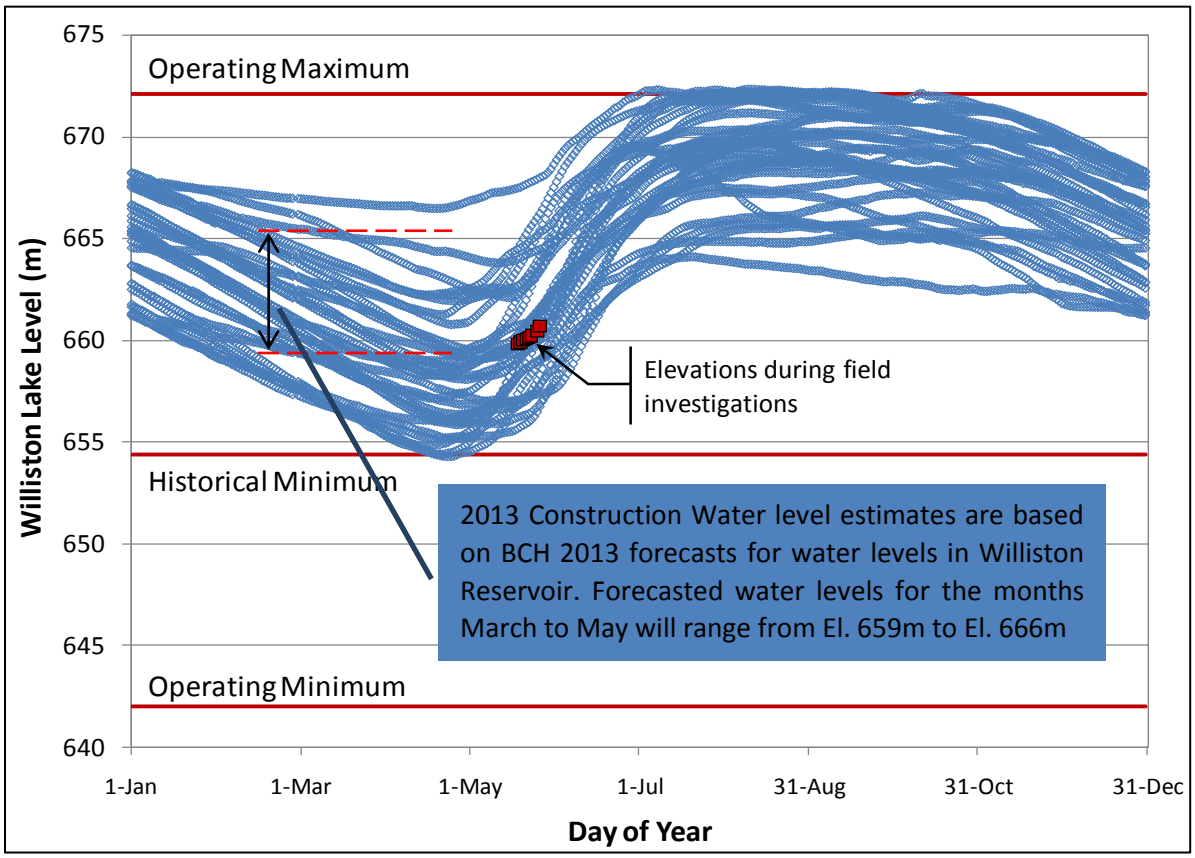


Figure 1: Water Surface Elevations at Williston Reservoir

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).

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

Table 4: Water Level Elevations Referenced to Geodetic Datum

Water Level Designation	Elevation with respect to Geodetic Datum (GD) (metres)
Ramp Design High Water Elevation	672.1
Ramp Design Low Water Elevation	654.4
Elevation of Toe of the Ramp	653.2

NB: The elevation of the toe of the ramp is 1.2m (minimum water depth) below the Ramp 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.

8.2. Bathymetry and Topography

Water depths are based on a hydrographic survey carried out by Atek Hydrographic Surveys on April 5, 2012 and LIDAR data provided by BC Hydro. All water depth contours are in metres referenced with respect to geodetic datum.

8.3. Design Vessels

The maximum design vessel is shown in Table 5.

Table 5: Maximum Design Vessel

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

8.4. Waves

Table 6 summarizes the significant wave heights for the various site locations at Dunlevy and is based on a CEDAS-ACES model. The significant wave height is the average height (trough to crest) of the one-third highest waves for the indicated period.

Table 6: Summary of Significant Wave Heights at site locations along the Dunlevy Inlet

Location	Significant Wave Height, Hs (metres)	Peak Wave Period, Tp (sec)
Josef Creek	0.6	3.0
Dunlevy Existing	0.6	2.9
Dunlevy West	0.3	2.0

8.5. Water Areas

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

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

9. STRUCTURAL LOADS

9.1. 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.

9.2. Design Vehicle Loads for Bridge

The design vehicle for the bridge will be CL-625 truck. Refer to CAN/CSA S-6 Canadian Highway Bridge Code for dimensions and axle loading for the design vehicle.

10. GEOTECHNICAL INFORMATION

Geotechnical investigation at the existing Dunlevy ramp site was performed by Trow Associates Inc. (currently known as exp Services Inc.) 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. The Josef Creek and alternate Dunlevy West sites have not yet had geotechnical investigations carried out. Geotechnical review of the preferred site will be carried out prior to implementation of detailed design work.

11. FUNCTIONAL CRITERIA

11.1. 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 6m (19.7ft);
- 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);

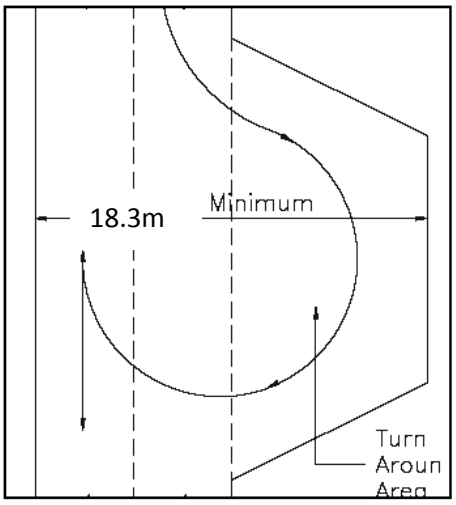


Figure 2: Turn-Around Area

- 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;

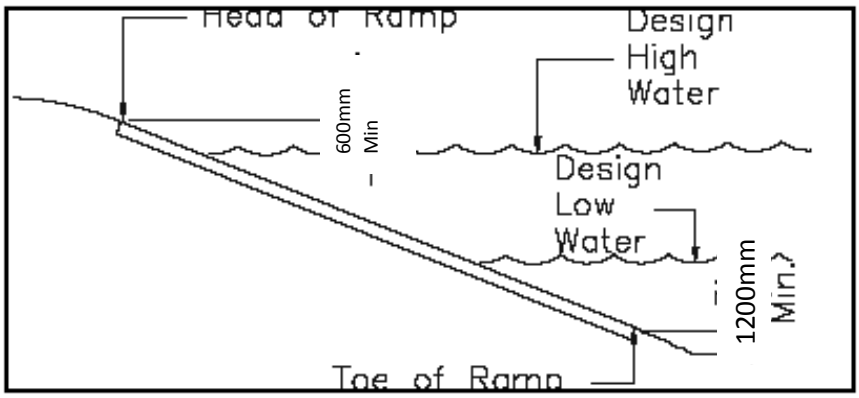


Figure 3: Ramp Head and Toe Details

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

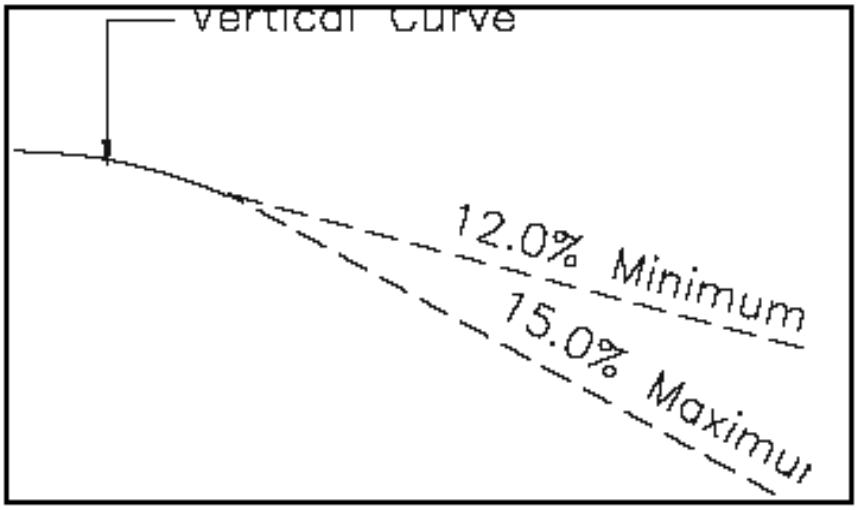


Figure 4: Range of Launching Ramp Slopes

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

11.1.1. Walkway

1.5m wide Lock Block walkway will be provided along the length of the boat launch ramp. The Lock Block walkway will be fitted with timber rubbing strips and mooring cleats.

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.

11.2. 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.

11.3. Parking Area

The parking area for 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.

11.4. Access Road

The stabilized road width will be 8m wide two lane road as recommended in Table 7 below.

Table 7: Road Widths for Access Road

Stabilized Road Width[a]	Description	Turnout Width[b] (m)
9+	2-lane off-highway	none
8	2-lane on-highway	none
6	1-lane off-highway	10
5	1-lane on/off-highway	8 to 10
4	1-lane on/off-highway	8

[a] Where no road surfacing is used, the stabilized road width is the width of the road subgrade. Sufficient room should be left on the low side to accommodate debris.
[b] Turnout width includes stabilized road width.

(Source: Forest Road Engineering Guidebook)

The access road alignment controls will be based on a two-lane, 8m wide stabilized road with a design speed of 50kph as shown in Table 8.

Table 8: Summary of Alignment controls for Access Road

Stabilized Road Width (m)	Design Speed (km/h)	Minimum Stopping Sight Distance[a] (m)	Minimum Passing Sight Distance for 2-Lane Roads (m)	Minimum Radius of Curve (m)	Suggested Maximum Road Gradient[b,c]				
					Favourable		Adverse		Switchbacks
					S	P[d]	S	P[e]	
4	20	40		15	16%	18% for distance <150 m	9%	12% for distance <100 m	8%
5–6	30	65		35	12%	14% for distance <150 m	8%	10% for distance <100 m	8%
	40	95		65					
8+	50	135	340	100	8%	10% for distance <200m	6%	8% for distance <100m	6%
	60	175	420	140					
	70	220	480	190					
	80	270	560	250					

NOTE: These are suggested alignment controls for average conditions on forest roads. Variations can be expected, depending on, for example, site conditions and time of use.

[a] For two-lane and single-lane one-way roads, multiply the minimum stopping sight distance by 0.5.

[b] There are no absolute rules for establishing maximum road gradient. Maximum grades cannot generally be established without an analysis to determine the most economical grade for the site-specific conditions encountered. The maximum grade selected for design purposes may also depend on other factors such as: topography and environmental considerations; the resistance to erosion of the road surface material and the soil in the adjacent drainage ditches; the life expectancy and standard of road; periods of use (seasonal or all-weather use); and road surfacing material as it relates to traction, types of vehicles and traffic, and traffic volume. Apply other grade restrictions in special situations. For example:

- On horizontal curves sharper than 80 m radius, reduce the adverse maximum grade by 0.5% for every 10 m reduction in radius.
- As required at bridge approaches, and at highway and railway crossings.

[c] S – sustained grade; P – short pitch

[d] Design maximum short-pitch favourable grades so that they are followed or preceded by a section of slack grade. The average grade over this segment of the road should be less than the specified sustained maximum.

[e] Design maximum short-pitch adverse grades as momentum grades.

Source: Forest Road Engineering Guidebook

11.5. Bridge

The proposed bridge crossing at the Josef Creek site will be designed to meet the design objectives of safety, cost effectiveness, environmental concerns, and regulatory approvals.

11.5.1. Alignment

Bridge alignment and plan geometry will be based on site conditions, traffic, and user safety sight stopping distance.

11.5.2. Lanes and Approaches

Two lanes will be provided for the proposed bridge. Depending on site conditions, the alignment for the road approaches for the bridge will be vertically and horizontally tangent to the bridge deck for at least ten metres at either end of the bridge. Smooth transitions will be provided to the proposed bridge.

11.5.3. Hydrology and Hydraulics

The design high and low water levels for the bridge are similar for the ramp as listed in Table 4. The bridge will be designed for the 100 year flood event including floating debris without any resulting damage to the structure, approaches, and abutments.

11.6. Utilities

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

11.7. Washrooms and Garbage Receptacles

Washrooms (pit toilets) as specified in the Park Design Guidelines and Data, Province of British Columbia, Ministry of Environment Lands and Parks will be provided at the boat launch facility.

Bear proof garbage receptacles will be provided in the parking area.

We trust that the above meets BC Hydro current needs. If you have any questions or need additional information, please do not hesitate to contact us.

11.8. NavAids

Install BCH safety signage and warning signs. Marine Navigation Aids to be provided if required by Transport Canada.

Prepared by:	Reviewed by:
MOFFATT & NICHOL	**MOFFATT & NICHOL**
[Original signed by: Paul Hoo]	[Original signed by: Farhad Shushtarian]
Paul Hoo, P.Eng.	Farhad Shushtarian, P.Eng.
Project Manager	Senior Project Manager

APPENDIX D

COST ESTIMATES

Project Name: **Existing DUNLEVY Boat Ramp**
WILLISTON RESERVOIR BOAT LAUNCH RAMP DESIGN-FOR TENDER
Client **BC Hydro**
Project no. **7820**
Drawing References: **Conceptual Design**
Date 19-Sep-12

Table 1 - Existing DUNLEVY- Probable Construction Cost

Item no.	Item Description	Unit	Quantity	Unit Rate	Item cost	Contingency	Contingency Amount	TOTAL
1	General Excavation	m3	18245	$20	$364,900	25%	$91,225	$456,125
2	General Fill	m3	14400	$35	$504,000	25%	$126,000	$630,000
3	Base Coarse Material - High Fines Granular Surfacing Aggregate (HFSA)	m3	470	$50	$23,500	25%	$5,875	$29,375
4	Base Coarse Material - 75mm Crushed Base Coarse (CBC) Aggregates	m3	407	$50	$20,350	25%	$5,088	$25,438
5	Base Coarse for Ramp (Granular Base)	m3	470	$50	$23,500	25%	$5,875	$29,375
6	New Concrete Slab (precast)	m2	144	$440	$63,360	25%	$15,840	$79,200
7	New Concrete (cast in place)	m2	1232	$215	$264,880	25%	$66,220	$331,100
8	Scour Protection - Filter Stone for 250kg Riprap	m3	2629	$137	$360,173	25%	$90,043	$450,216
9	Scour Protection - 250kg Riprap	m3	5192	$193	$1,003,787	25%	$250,947	$1,254,733
10	Scour Protection - 35kg Riprap	m3	191	$129	$24,639	25%	$6,160	$30,799
11	Geotextile	m2	7750	$5	$38,750	25%	$9,688	$48,438
12	Precast Low profile barrier	m	162	$105	$17,010	25%	$4,253	$21,263
13	Precast median barrier	m	40	$120	$4,800	25%	$1,200	$6,000
14	Precast concrete curb	Unit	13	$25	$325	25%	$81	$406
15	Lockblock Walkway	m	58	$400	$23,200	25%	$5,800	$29,000
16	French Drain (including outlet protection)	m	120	$200	$24,000	25%	$6,000	$30,000
17	Hydraulic seeding (including growing medium)	m2	3655	$3	$10,966	25%	$2,741	$13,707
18	Turf & root reinforcement mats (Including growing medium and Hydraulic seeding)	m2	1500	$482	$723,000	25%	$180,750	$903,750
19	Abutment	Unit	1	$15,000	$15,000	25%	$3,750	$18,750
20	Washroom	Unit	1	$16,000	$16,000	25%	$4,000	$20,000
21	Site clearing & removal of debris	m2	13160	$5	$65,800	25%	$16,450	$82,250
	Sub-Total				**$3,591,939**		**$897,985**	**$4,489,924**
	Mobilization and Demolization	**LS**			**$359,194**	**0.25**	**$89,798**	**$448,992**
TOTAL					**$3,951,133**		**$987,783**	**$4,938,916**

* Note:

1) The Design Construction Water Level (DCWL) is assumed to be 1.5 metres above the designed elevation of the toe of the ramp.

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.

Project Name: **Dunlevy West Boat Ramp**
WILLISTON RESERVOIR BOAT LAUNCH RAMP DESIGN-FOR TENDER
Client **BC Hydro**
Project no. **7820**
Drawing Reference 7820-
Date 17-Sep-12

Conceptual Design

Table 2 - DUNLEVY WEST- Probable Construction Cost

Item no.	Item Description	Unit	Quantity	Unit Rate	Item cost	Contingency	Contingency Amount	TOTAL
1	General Excavation	m3	51714	$20	$1,034,270	25%	$258,568	$1,292,838
2	General Fill	m3	170573	$35	$5,970,045	25%	$1,492,511	$7,462,556
3	Base Coarse Material - High Fines Granular Surfacing Aggregate (HFSA)	m3	1049	$50	$52,440	25%	$13,110	$65,550
4	Base Coarse Material - 75mm Crushed Base Coarse (CBC) Aggregates	m3	2098	$50	$104,880	25%	$26,220	$131,100
5	Base Coarse for Ramp (Granular Base)	m3	295	$50	$14,760	25%	$3,690	$18,450
6	New Concrete Slab (precast)	m2	72	$440	$31,680	25%	$7,920	$39,600
7	New Concrete (cast in place)	m2	1092	$215	$234,780	25%	$58,695	$293,475
8	Scour Protection - Filter Stone for 250kg Riprap	m3	699	$137	$95,722	25%	$23,930	$119,652
9	Scour Protection - 250kg Riprap	m3	2329	$193	$450,273	25%	$112,568	$562,842
10	Scour Protection - 35kg Riprap	m3	13893	$129	$1,792,133	25%	$448,033	$2,240,166
11	Geotextile	m2	31747	$5	$158,735	25%	$39,684	$198,419
12	Precast Low profile barrier	m	90	$105	$9,450	25%	$2,363	$11,813
13	Precast median barrier	m	416	$120	$49,920	25%	$12,480	$62,400
14	Precast concrete curb	Unit	16	$25	$400	25%	$100	$500
15	Lockblock Walkway	m	164	$400	$65,600	25%	$16,400	$82,000
16	French Drain (including outlet protection)	Sum	1	$25,000	$25,000	25%	$6,250	$31,250
17	Hydraulic seeding (including growing medium)	Sum	1	$15,000	$15,000	25%	$3,750	$18,750
18	Turf & root reinforcement mats (Including growing medium and Hydraulic seeding)	m2	1239	$482	$597,198	25%	$149,300	$746,498
19	Abutment	Unit	1	$15,000	$15,000	25%	$3,750	$18,750
20	Washroom	Unit	1	$16,000	$16,000	25%	$4,000	$20,000
21	Site clearing & removal of debris	m2	38366	$5	$191,830	25%	$47,958	$239,788
	Sub-Total				**$10,925,115**		**$2,731,279**	**$13,656,394**
	Mobilization and Demolization	**LS**			**$1,092,512**	25%	**$273,128**	**$1,365,639**
TOTAL					**$12,017,627**		**$3,004,407**	**$15,022,033**

* Note:

1) The Design Construction Water Level (DCWL) is assumed to be 1.5 metres above the designed elevation of the toe of the ramp.

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.

Project Name: **Josef Creek Boat Ramp - Access Road through Ross Property**
WILLISTON RESERVOIR BOAT LAUNCH RAMP DESIGN-FOR TENDER
Client **BC Hydro**
Project no. **7820**
Drawing References: **Conceptual Design**
Date 17-Sep-12

Table 3- Josef Creek- Access through Ross Property - Probable Construction Cost

Item no.	Item Description	Unit	Quantity	Unit Rate	Item cost	Contingency	Contingency Amount	TOTAL
1	General Excavation	m3	12245	$20	$244,892	25%	$61,223	$306,115
2	General Fill	m3	51887	$35	$1,816,031	25%	$454,008	$2,270,039
3	Base Coarse Material - High Fines Granular Surfacing Aggregate (HFSA)	m3	1186	$50	$59,280	25%	$14,820	$74,100
4	Base Coarse Material - 75mm Crushed Base Coarse (CBC) Aggregates	m3	2371	$50	$118,560	25%	$29,640	$148,200
5	Base Coarse for Ramp (Granular Base)	m3	250	$50	$12,510	25%	$3,128	$15,638
6	New Concrete Slab (precast)	m2	72	$440	$31,680	25%	$7,920	$39,600
7	New Concrete (cast in place)	m2	762	$215	$163,830	25%	$40,958	$204,788
8	Scour Protection - Filter Stone for 250kg Riprap	m3	4069	$137	$557,453	25%	$139,363	$696,816
9	Scour Protection - 250kg Riprap	m3	5192	$193	$1,003,787	25%	$250,947	$1,254,733
10	Scour Protection - 35kg Riprap	m3	1372	$129	$176,924	25%	$44,231	$221,154
11	Geotextile	m2	8626	$5	$43,130	25%	$10,783	$53,913
12	Precast Low profile barrier	m	90	$105	$9,450	25%	$2,363	$11,813
13	Precart median barrier	m	142	$120	$17,040	25%	$4,260	$21,300
14	Precast concrete curb	Unit	16	$25	$400	25%	$100	$500
15	Lockblock Walkway	m	139	$400	$55,600	25%	$13,900	$69,500
16	French Drain (including outlet protection)	Sum	1	$25,000	$25,000	25%	$6,250	$31,250
17	Hydraulic seeding (including growing medium)	Sum	1	$15,000	$15,000	25%	$3,750	$18,750
18	Turf & root reinforcement mats (Including growing medium and Hydraulic seeding)	m2	393	$482	$189,426	25%	$47,357	$236,783
19	Abutment	Unit	1	$15,000	$15,000	25%	$3,750	$18,750
20	Washroom	Unit	1	$16,000	$16,000	25%	$4,000	$20,000
21	Site clearing & removal of debris	m2	17506	$5	$87,530	25%	$21,883	$109,413
	Sub-Total				**$4,658,522**		**$1,164,631**	**$5,823,153**
	Mobilization and Demolization	**LS**			**$465,852**	25%	**$116,463**	**$582,315**
TOTAL					**$5,124,374**		**$1,281,094**	**$6,405,468**

* Note:

1) The Design Construction Water Level (DCWL) is assumed to be 1.5 metres above the designed elevation of the toe of the ramp.

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.

Project Name: **Josef Creek Boat Ramp - Access road through Provincial Park Lands**
WILLISTON RESERVOIR BOAT LAUNCH RAMP DESIGN-FOR TENDER
Client **BC Hydro**
Project no. **7820**
Drawing References: **Conceptual Design**
Date 17-Sep-12

Table 4 - Josef Creek - Access Road through Provincial Property - Probable Construction Cost

Item no.	Item Description	Unit	Quantity	Unit Rate	Item cost	Contingency	Contingency Amount	TOTAL
1	General Excavation	m3	16032	$20	$320,634	25%	$80,159	$400,793
2	General Fill	m3	65847	$35	$2,304,631	25%	$576,158	$2,880,789
3	Base Coarse Material - High Fines Granular Surfacing Aggregate (HFSA)	m3	1465	$50	$73,259	25%	$18,315	$91,574
4	Base Coarse Material - 75mm Crushed Base Coarse (CBC) Aggregates	m3	2930	$50	$146,518	25%	$36,629	$183,147
5	Base Coarse for Ramp (Granular Base)	m3	250	$50	$12,510	25%	$3,128	$15,638
6	New Concrete Slab (precast)	m2	72	$440	$31,680	25%	$7,920	$39,600
7	New Concrete (cast in place)	m2	762	$215	$163,830	25%	$40,958	$204,788
8	Scour Protection - Filter Stone for 250kg Riprap	m3	1221	$137	$167,236	25%	$41,809	$209,045
9	Scour Protection - 250kg Riprap	m3	4069	$193	$786,673	25%	$196,668	$983,342
10	Scour Protection - 35kg Riprap	m3	4574	$129	$589,982	25%	$147,495	$737,477
11	Geotextile	m2	16230	$5	$81,150	25%	$20,288	$101,438
12	Precast Low profile barrier	m	90	$105	$9,450	25%	$2,363	$11,813
13	Precart median barrier	m	250	$120	$30,000	25%	$7,500	$37,500
14	Precast concrete curb	Unit	16	$25	$400	25%	$100	$500
15	Lockblock Walkway	m	139	$400	$55,600	25%	$13,900	$69,500
16	French Drain (including outlet protection)	Sum	1	$25,000	$25,000	25%	$6,250	$31,250
17	Hydraulic seeding (including growing medium)	Sum	1	$15,000	$15,000	25%	$3,750	$18,750
18	Turf & root reinforcement mats (Including growing medium and Hydraulic seeding)	m2	1681	$482	$810,242	25%	$202,561	$1,012,803
19	Abutment	Unit	1	$15,000	$15,000	25%	$3,750	$18,750
20	Washroom	Unit	1	$16,000	$16,000	25%	$4,000	$20,000
21	Site clearing & removal of debris	m2	22596	$3	$67,788	25%	$16,947	$84,734
22	Bridge Crossing	m2	300	$4,500	$1,350,000	25%	$337,500	$1,687,500
	Sub-Total				**$7,072,582**		**$1,768,145**	**$8,840,727**
	Mobilization and Demolization	**LS**			**$707,258**	25%	**$176,815**	**$884,073**
TOTAL					**$7,779,840**		**$1,944,960**	**$9,724,800**

* Note:

1) The Design Construction Water Level (DCWL) is assumed to be 1.5 metres above the designed elevation of the toe of the ramp.

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.