SITE C HYDRO PROJECT

QUARRY DEVELOPMENT PLAN

PORTAGE MOUNTAIN QUARRY

Doc EIS-1A-011

[Final]

Prepared for BC Hydro by

Tetra Tech

November 2012

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(by section)

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1.0 INTRODUCTION AND PURPOSE

If the Site C Clean Energy Project (the Project) proceeds, it would require permanent riprap material for construction of the Highway 29 realignment sections and the Hudson's Hope Berm, and the Project may require riprap material for reservoir protection during filling. A source of this material in close proximity to the Hudson's Hope area is preferred to minimize transportation requirements.

The proposed Portage Mountain Quarry is a potential riprap source that was identified during a reconnaissance of the area near the Gordon M. Shrum Generating facility. The Site C project team reviewed documentation on potential sources and conducted a preliminary geological investigation of sites on Portage Mountain in 2011. Portage Mountain has been identified as the source most likely to produce the quality and quantity of riprap necessary for the proposed work. It is located approximately 14 kilometres from Hudson's Hope and is accessed via Canyon Drive and south on 400 Road as shown in Figure 1.1. The area is situated on Crown land and would require land tenure and permit approvals.

The objective of this plan is to: 1) facilitate environmental assessment approvals; 2) support permitting requirements; and 3) plan for guiding the use of the quarry site during construction and operation.

Williston Reservoir

W.A.C. Bennett Dam

G.M. Shrum Generating Station

12 Mile Rd

Canyon Drive

Beryl Prairie Rd

400 Road

Canyon Drive

Hudson's Hope

29

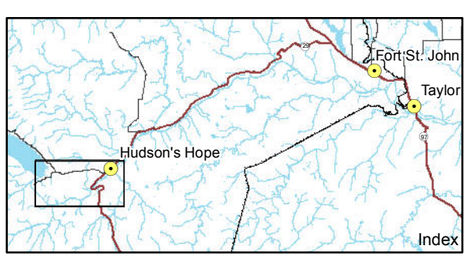
Peace River

Peace Canyon Dam

Dinosaur Reservoir

29

N



Map Notes:
1. Datum: NAD83
2. Projection: UTM Zone 10N
3. Orthophotos created from 1:40,000 photos taken Sept. 10th 2007; 1:15,000 taken Aug 26th 2011; TRIM

Legend

- Portage Mountain Quarry Boundary
- Highway
- Road

1:55,000 0 2.5 km

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Figure 1.1: Key Plan Location of Portage Mountain Quarry

Date	Nov. 22, 2012	DWG NO	1016-C14-B6127-1	R 0

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Construction of the Site C Clean Energy Project is subject to required regulatory approvals including environmental certification

2.0 BACKGROUND

A geological site reconnaissance undertaken in September 2011 (RF Binnie and AMEC 2012) confirmed the presence of thick beds of sedimentary rock at Portage Mountain. The potential quarry site is on a ridge of sandstone which projects out of a side of the mountain, approximately at the 1,000 metre elevation, and runs back into higher ground to the west. The area is treed, with pine and aspen trees with sparse low vegetation.

The rock formation is part of the Cadomin or Gething formation of the Bullhead Group. The outcrops observed were medium to thickly bedded (e.g., with some beds exceeding 3 metres in thickness), consisting of medium to coarse grained, strong to very strong, fresh to slightly weathered sandstone inter-bedded with pebble conglomerate. Talus, in the form of large angular boulders often exceeding 3.5 cubic metres, has developed at the toe of the southern portion of Ridge 3 over a distance of approximately 200 metres. The size of the boulders indicates the durability of the rock.

The sedimentary rock has the potential to produce the size of riprap blocks that would be required for the Highway 29 realignments, Hudson's Hope Berm and for protection during reservoir filling. An investigative drilling program has been completed in Fall 2012 to confirm the suitability of the material for the intended purpose. Laboratory testing will be performed on the material samples obtained during this investigation and will be available in early 2013.

Should the source prove to meet the quality requirements, a test blast may be considered in order to determine block sizes, yield potential, and to help determine costs to aid in preparation for procurement.

3.0 QUARRY MAP RESERVE

Portage Mountain is an undeveloped source. A Section 16 Map Reserve (FNLRO 2012) for geotechnical investigation purposes has been established on those parts of District Lot 276 and the NW ¼ of District Lot 1039, together with that parcel or tract of unsurveyed Crown land in the vicinity of Portage Mountain east, containing approximately 148 hectares as shown in Figure 1.1. Additional provincial Land Act permits would be required to investigate or develop the quarry.

4.0 DEVELOPMENT PLAN BASIS

The development plans for the quarry were based on the following information:

- Approximately 197,000 cubic metres of riprap and riprap bedding would be required for Highway 29 realignment.
- Approximately 172,000 cubic metres of riprap and riprap bedding would be required for the Hudson's Hope berm.
- Approximately 250,000 cubic metres of riprap and riprap bedding would be required for areas along the reservoir requiring protection during the reservoir filling.
- The riprap and bedding materials would be hauled from the quarry as they are produced.
- The estimated yield of useable riprap would be 35% of the total quarried material.
- The riprap bedding material would be taken from the coarser surplus material.
- There is rock interlacing between thin bedded, good quality sandstone to more competent and massive sandstone layers. A test drill program is planned for Fall 2012, drilling to 30 metres below original ground at the southern end of the site to 60 metres at the north end of the proposed site.
- The final pit floor base would be at an elevation of 970 metres, between 12 to 40 metres below original ground.
- The excavation area boundaries would be within the proposed area identified in Figure 4.1 and based on the drill program and laboratory testing confirming the most suitable location.
- The main excavation area would be up to 320 metres long south to north, up to 200 metres wide west to east and up to 16 metres deep near the southern end of the rock escarpment.
- The riprap would be removed from the escarpment face on the east side of the proposed quarry.
- The blasted rock would be collected at the base of the escarpment for sorting and processing at the stockpile locations as shown in Figure 4.1.
- The quarry development design would include a wall slope of 0.25H:1V, and a 5 metre bench for every 10 meters of elevation change.
- Overburden and surplus storage embankments would have a maximum slope of 2H:1V.
- Overburden is at depths ranging from at rock surface in the southern portion and to 2.0 metres in the north portion of the site with an average depth of 0.5 metres
- The overburden would be stored on the west edge of the quarry and the surplus materials would be located near the base of the rock escarpment.

Bulking factors were applied to excavated and quarried volumes. A bulking factor represents the volume increase (expressed as a percent) that a material undergoes when removed from its natural state, and is applied to estimate the total volume of quarried or excavated material. Different materials have different bulking factors based on their ability to reconsolidate once excavated. A bulking factor of 1.2 means that a volume of naturally existing material would undergo an increase of 20 per cent once excavated and placed at its final location. Based on an understanding of similar materials within the province the following bulking factors were applied:

- The Bedrock Bulking Factor would be 1.3.
- The Overburden Bulking Factor would be 1.0.

Ridge 2

Ridge 3

Overburden Storage Area

Main Excavation Area

New Access Road

Escarpment

Existing Road

400 Road

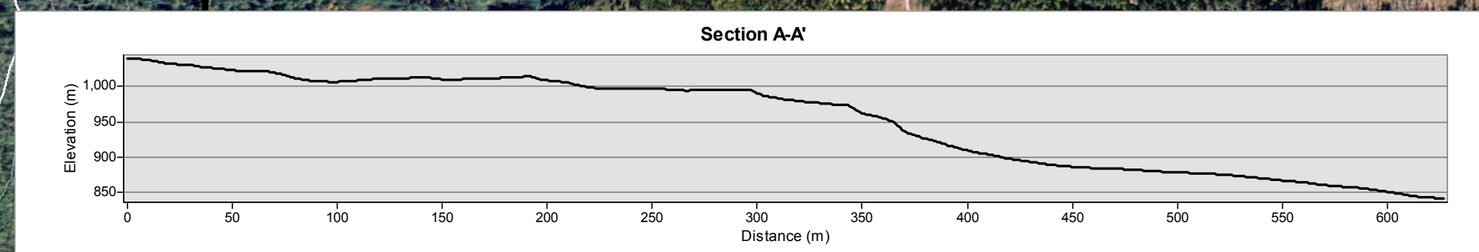
Sorting & Stockpile Area

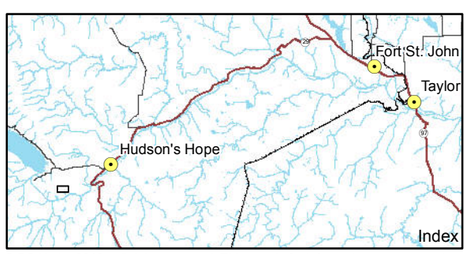
Tote Road

A

A'

N





Map Notes:
1. Datum: NAD83
2. Projection: UTM Zone 10N
3. Orthophotos created from 1:40,000 photos taken Sept. 10th 2007; 1:15,000 taken Aug 26th 2011.

Legend

- Portage Mountain Quarry
- Main Excavation Area
- Overburden Storage Area
- Sorting and Stockpile Area
- Ridge
- Escarpment
- New Access Road
- Tote Road
- Existing Road
- Contour-Major 50m
- Contour-Minor 10m
- Section Profile

1:7,000 0 250 m

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Figure 4.1: Proposed Development Plan of Portage Mountain Quarry

Date	Nov. 22, 2012	DWG NO	1016-C14-B6127-3	R 0

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5.0 PORTAGE MOUNTAIN QUARRY – OPERATIONS

5.1 RIPRAP PRODUCTION

BC Hydro has estimated an approximate 35% yield of usable riprap from the blasting operations. Approximately 619,000 cubic metres of rock would be produced for the required riprap and bedding material. The larger rock would be used for various sizes of riprap and would be sorted prior to the smaller rock being processed through screens. Some of the smaller rock would be used for riprap bedding. Bedding material is a by-product of riprap production and would be obtained from the surplus rock left on site. Screened materials too small for bedding and any other rock material not suitable for use would be considered surplus and would be stored in stockpile at the base of the proposed quarry for future use. The total surplus rock is estimated to have a volume of 463,000 cubic metres.

The surplus material and the remaining intact bedrock would be used during operations, as required, by BC Hydro over the longer term for routine maintenance of Hudson's Hope Berm and the relocated Highway 29 segments. The site would remain an active quarry under the control of BC Hydro for its use.

5.2 PRODUCTION AND SCHEDULING ESTIMATES

In order to produce the amount of riprap material that would be necessary for Highway 29 and Hudson's Hope berm construction purposes and for reservoir protection (as shown in Table ~~6~~5.1), areas for storage of surplus rock and overburden would need to be created within the quarry site. As the quarry site is developed, overburden would be cleared from areas proposed for rock extraction and stockpiled for eventual quarry site reclamation. In addition to the overburden material, a volume of surplus rock would also need to be stored.

An area at the base of the escarpment would be developed to collect, sort and stockpile the riprap and bedding materials. The surplus rock material would be stored in the same stockpile area.

Table 5.1 Portage Mountain Quantities and Production Years

Section	Riprap (m^3)	Bedding (m^3)	Total (m^3)	Year 1 (m^3)	Year 2 (m^3)	Year 3 (m^3)	Year 4 (m^3)	Year 5 (m^3)	Year 6 (m^3)
Cache Creek/Bear Flat	30,465	5,985	36,450	20,000	16,450				
Halfway River	46,950	10,665	57,615			28,808	28,808		
Farrell Creek	10,275	3,090	13,365			6,683	6,683		
Dry Creek	6,345	2,565	8,910				8,910		
Lynx Creek	65,685	14,445	80,130				26,710	26,710	26,710
Hudson's Hope Berm	18,780	153,280	172,060					153,280	18,780

Section	Riprap (m^3)	Bedding (m^3)	Total (m^3)	Year 1 (m^3)	Year 2 (m^3)	Year 3 (m^3)	Year 4 (m^3)	Year 5 (m^3)	Year 6 (m^3)
Reservoir Shoreline areas	200,000	50,000	250,000		50,000	50,000	50,000	50,000	50,000
Total	378,500	240,030	618,530	20,000	66,450	85,490	121,110	229,990	95,490

5.3 QUARRY OPERATIONS DURING CONSTRUCTION

The Province's Aggregate Management Principles (MOEM 2009) have been established to ensure that aggregate activities are undertaken in compliance with health and safety standards and environmental protection requirements. The reference documents are:

- Aggregate Operators Best Management Practices Handbook for British Columbia, 2002, Ministry of Energy and Mines (MOEM 2002)
- Health and Safety: A Practical Guide for Aggregate Operations, 2007, Ministry of Energy, Mines and Petroleum Resources, Mining and Minerals Division (MOEM 2007)

Following is a summary of quarry operation considerations:

- The main excavation area would be the southern portion of the site and the stockpiling would be at the base of the escarpment below the excavation as shown in Figure 4.1.
- The maximum volumes proposed for extraction would be based on the suitability and quality of the materials as they were processed. The materials unsuitable for construction would remain within the site and would be stockpiled for future use.
- The site would contain a trailer office, maintenance and storage areas for fuel and explosives.
- Potable water for the office and service area, and water to be used for dust control would not be a substantial volume and would be brought to the site from an offsite location.
- Extraction requires drilling, blasting and processing, such as screening, prior to riprap being removed from the site. More than one area would be active with room in between sites to maintain equipment manoeuvrability and production rates.
- Blasting materials would be available from commercial material supply companies. Delivery would be by bulk mix and loading pump trucks and properly equipped trucks to deliver the primary explosives. The materials would be delivered prior to loading the holes with the explosives; the equipment would then leave the site. No explosives would be stored on site. Blasting activities would be in accordance with WorksafeBC, the *Mines Act* (BC) the *Explosives Act* (Canada), the Transportation of Dangerous Goods Regulations (Canada) and the *Motor Vehicle Act* (BC).
- Access to the quarry would be required for the rock drills, excavators and bulldozers. The rock materials produced would be pushed to the escarpment quarry bench.

- The equipment required for the operations would be as follows with the number of equipment pieces to be determined at a later stage:
  - Excavators (to pre-sort riprap)
  - Rock Drills
  - Loaders (to move material and process material at the screening and crushing plants, and stockpile)
  - Bulldozers (to push material for stripping stockpiles and loosen blasted materials)
  - Highway legal haul trucks (to transport the material)
  - Water Trucks (to control dust as required)
  - Personnel Site Pick-ups (for onsite mobility)
  - Service vehicle (mechanic, fuel trucks)

5.4 ACCESS

Access to Portage Mountain would utilize an existing forestry road (400 Road). An additional road to the quarry site, approximately 700 metres in length, would need to be constructed. A further 800 metres on-site tote road would be required to reach the quarry location (as shown on Figure 4.1). Access would be closed to the public and/or controlled during the length of the extraction operations.

Truck haul would utilize the roads near the quarry area, 400 Road, Canyon Drive, Highway 29 and some streets in Hudson's Hope (as shown on Figure 4.1).

5.5 SAFETY AN ENVIRONMENTAL MANAGEMENT DURING OPERATIONS

Management measures during quarry operation would include:

- A gate would be installed to control access.
- Berms would be constructed at the top edges of excavations and sorting area to control movement within the quarry.
- Portable toilet facilities would be installed near the project site offices. If trailer type washroom stations were to be used onsite, the grey water created would be disposed of into a suitable tank and then pumped out and trucked to the municipal treatment location.
- The planning and installation of a lighting system, if required, for the safe operation of the site would follow guidelines in the Aggregate Operators Best Management Practices Handbook (MOEM 2002). The goal would be to facilitate safe and secure operations for the extraction, processing and stockpiling locations while minimizing offsite visual nuisance. Lighting would be needed for the quarry property, inside buildings and their entrances, extraction faces, haul roads, stockpiles, equipment, and vehicles. Lighting would be directed downward or shielded by buildings to minimize off-site spill and glare.

The lighting of road junctions and site entrances would be kept to the minimum required for safety purposes.

- Other site management features would include:
  - Sediment control, and oil control separation
  - Fuel would be stored on site
  - Explosives would not be stored on site. Explosives would be prepared on site on an as required basis – blasting caps and charge would be stored at the suppliers off site bunker location.
  - Control of noxious weeds through vegetation cover or seeding where required
  - Maintenance of road surfaces to reduce vibration
  - The provision of a truck wash for noxious weed control
  - Control of equipment generated air emissions and wind generated dust

5.6 SITE RECLAMATION AND FUTURE USE

BC Hydro would continue to operate the Portage Mountain Quarry. Slopes would be stabilized and drainage features would be established to control drainage. Seeding to control noxious weeds would be done on soil slopes and overburden stockpiles.

6.0 REFERENCES

WAC Bennett Dam – Riprap Upgrade Reconnaissance of Potential Riprap Sources, November 2011, BC Hydro (MER No. 2011-088)

FNLRO. 2012. Notice of Establishment of Section 16 Map Reserve, FNLRO – BC Hydro, dated July 18, 2012 – Map Reserve # R128006, file # 8015510

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