Shannon Rasmussen #1
July 18, 2018

No. 180247
Victoria Registry

IN THE SUPREME COURT OF BRITISH COLUMBIA

BETWEEN:

WEST MOBERLY FIRST NATIONS, and ROLAND WILLSON ON HIS OWN BEHALF AND ON BEHALF OF ALL OTHER WEST MOBERLY FIRST NATIONS BENEFICIARIES OF TREATY NO. 8

Plaintiffs

AND:

HER MAJESTY THE QUEEN IN RIGHT OF THE PROVINCE OF BRITISH COLUMBIA, THE ATTORNEY GENERAL OF CANADA, and BRITISH COLUMBIA HYDRO AND POWER AUTHORI

Defendants

AFFIDAVIT #1 OF SHANNON RASMUSSEN

I, Shannon Rasmussen, Legal Assistant, of Victoria, British Columbia, SOLEMNLY AFFIRM AND SAY THAT:

1. I am a legal assistant at Woodward & Company LLP, counsel for the Plaintiffs herein and as such I have personal knowledge of the matters hereinafter deposed to, except where stated to be on information and belief and where so stated, I verily believe the same to be true.

2. E. Harvey Elwin filed an expert report in these proceedings, a complete copy of which is attached to his Affidavit #2, made July 10, 2018, as Exhibit B (the "Expert Report"). The complete copy of the Expert Report contains reference to information identified as confidential by BC Hydro, and which must be redacted from any filed copies to ensure compliance with Court Order.

3. Attached as Exhibit "A" to this my Affidavit is a redacted copy of the Expert Report, which I redacted on instructions from Plaintiffs' counsel to comply with Court Order.

AFFIRMED before me)
at the City of Victoria in the)
Province of British Columbia on)
this 18th day of July, 2018)
)
)
)
A Commissioner for taking Affidavits in)
and for the Province of British Columbia)

Michael B Bendle
Barrister & Solicitor
400 - 1022 Government Street
Victoria BC V8W 1X7

SHANNON RASMUSSEN

This is Exhibit "A" referred to in the Affidavit of Shannon Rasmussen affirmed before me at Victoria, British Columbia this 18th day of July, 2018.

A Commissioner for taking Affidavits within British Columbia

Michael B Bendle
Barrister & Solicitor
200 - 1022 Government Street
Victoria BC V8W 1X7

In the Matter Involving:
West Moberly First Nations, et al

Plaintiffs

And

British Columbia, Canada & BC Hydro

Defendants

Expert Report of PMCM Associates LLC E. Harvey Elwin

Submitted by:
E. Harvey Elwin
PMCM Associates LLC
409 T Avenue
Anacortes, WA 98221

July 6, 2018

Expert Report of E. Harvey Elwin
West Moberly First Nations, et al
v. British Columbia, Canada & BC Hydro

REPORT CONTENTS

EXECUTIVE SUMMARY

The Site C Project is a $10.7 billion major, world-class dam hydroelectric project currently under construction by BC Hydro in northern British Columbia. It is located on the Peace River, 75 km downstream from the William Bennet Dam at a site near Fort St. John, on and among West Moberly First Nations lands provided under Treaty 8 made and concluded in 1899.

This Report, in Part F, provides a review of the current public information available on the Site C Project and the evidence provided to date in the matter involving West Moberly First Nations, et al and British Columbia, Canada & BC Hydro to assess and provide expert opinion on the impact of the Injunction to suspend work in the Critical Areas being sought by First Nations on the Site C Project Milestones and the project construction activities in the Critical Areas.

It then develops and provides a summary level project management schedule for the Critical Area work activities both in and out of the Critical Areas. Next, it uses the project management schedule to assess the effect of Injunctions of 18, 24, 30, and 36 month durations on the Project Milestones and the impact to the work as currently planned and scheduled by BC Hydro in the Critical Areas. From the schedule assessment for each Injunction duration, it identifies the effect on the project milestones and the adjustments that would be required to ensure the milestones would not be impacted and delayed by the Injunction. It further identifies the impacts on the various Critical Area project preconstruction and construction activities and then provides a cost estimate of additional Site C Project costs from the impacts of schedule adjustments required to meet the Project Milestones for each of the four Injunction durations.

In respect of the Injunctions over Critical Areas being sought by West Moberly First Nations, it is my opinion that:

- The current BC Hydro current plan and schedule for the Site C Project work within the Critical Areas can be worked around during an Injunction up to three years in duration, with all currently planned and scheduled work achieved during the Injunction without working in the Critical Areas. The Project Milestones during an Injunction of 18, 24, 30, or 36 months could be met without delay.

- All preconstruction activities could continue as scheduled through the injunction as planned without change other than potentially the delayed award of some contracts. In actuality, the injunctions in a number of cases would give BC Hydro more time to complete the preconstruction work activities.

- An Injunction duration longer than 18 months would require some increasing adjustments to the current planning and schedules to achieve the currently scheduled Project Milestones without delay, but would be completely feasible. Relatively minor schedule adjustments made through use of constructive acceleration and resequencing of work, or, in the case of the three year injunction, the extension of some Highway 29 realignment

completions after start of reservoir filling would allow the Project Milestones to be achieved.

- Achieving the Project Milestones eliminates impact and additional project costs from other project construction activities outside of the Critical Area project components.

- There would be additional Site C Project costs resulting from the impact of Injunctions on some currently BC Hydro planned and scheduled activities and the required adjustments on the BC Hydro planned and scheduled work; however, they would be orders of magnitude less than estimated by BC Hydro in its submitted evidence.

- The estimated Site C Project additional costs from Injunctions of 18, 24, 30, and 36 months would range from about $17 million to $71 million.

The Report, in Part G, after its assessment of the effect of the Injunctions on the current project schedule, identifies the major current construction risks to achieving the current Project Milestones and provides a discussion of what is known from the evidence on the current RCC Buttress delay as a basis for forming an opinion on the likelihood of further delay of another year to the Project. It shows that the RCC Buttress work is in serious trouble and most likely will further delay the Project Milestones.

Finally, in Part H, the Critical Area project management schedule is used to reexamine the effect of another year delay on the Project Milestones. The assessment shows that an additional year delay to the Project Milestones would eliminate the need for most of the constructive acceleration required to meet the Project Milestones without the year delay. It also shows that for the three year Injunction, there would be no need to extend completion of any segment of the Highway 29 after the start of reservoir filling.

PART A: PERSONAL INFORMATION

A-1 Name and Address

1. My name is E. Harvey Elwin. My business address is 409 T Avenue, Anacortes, WA 98221.

A-2 Area of Expertise

2. My area of expertise is the management and delivery of large heavy civil dam, tunnel, canal, pipeline, and hydroelectric capital projects and programs around the world. I have worked as an engineer, construction manager, project manager, and executive manager and project sponsor. I have experience-based expertise in all phases of capital project and program delivery, including planning, financing, permitting, bidding, procurement, design, and construction phases. I have expertise in the functional areas of planning and scheduling, management of design, management of professional services contracts, management of equipment and construction contracts, project cost control, cost estimating, quality management of design and construction, risk assessment/mitigation, and mitigation and resolution of construction-related claims/disputes. I also have expertise in assessing problem areas on troubled water and hydroelectric projects, performing risk assessments, and identifying mitigation measures. I have even taken over project management responsibilities on troubled hydroelectric projects and successfully completed them under difficult conditions.

3. Attached to this Report is summary biography and my detailed C.V. (Appendix A).

PART B: QUALIFICATIONS AND EXPERIENCE

B-1 Qualifications

4. Most of my career has been directly involved with developing, designing, and managing the construction of complex civil infrastructure water dam and hydroelectric projects around the world. I have over forty-five years of progressively responsible experience in the leadership of planning, permitting, engineering, procurement and contracting, and construction management of dams, water projects, hydroelectric powerhouses, canals, tunnels, pipelines, transportation facilities, and other heavy civil interdisciplinary projects.

5. My general experience includes over thirty years as a Project/Senior Project/Program/Operations Manager directly responsible for major roles in implementing

major world-class mega capital projects and programs. These projects/programs include the following:

- $4.8 billion San Francisco Water Improvement Program,
- $27.6 billion Three Gorges Dam in China,
- $4.3 billion Uribante-Caparo Project in Venezuela,
- $1 billion Bakun Hydroelectric Project in Malaysia,
- $1.2 billion San Roque Dam Project in the Philippines,
- $2.25 billion Ghazi Barotha Hydroelectric Project in Pakistan,
- $500 million Maheshwar Hydel Power Project in India,
- $1 billion Raise Mangla Dam Project in Pakistan,
- $500 million Niagara Hydroelectric Expansion Project in New York State,
- $350 million Bradley Lake Hydroelectric Project in Alaska,
- $200 million Wells Hydroelectric Project, and
- $150 million Cowlitz Falls Hydroelectric Project in Washington State.

The above project cost figures are based on local labor, material, and other costs. They are at pricing levels near the time of the project.

6. Presently, I am an Independent Consultant providing professional engineering services internationally to Public Sector Owners, Contractors, and Private Sector Professional Services Consultants for delivery of heavy civil water and power facilities including dams, tunnels, canals, pipelines, pumping plants, hydroelectric plants, treatment plants, and other associated facilities. Services include provision of project management, project startup and implementation, engineering management, construction management, program/project control, disputes resolution, and other professional consulting services as President of PMCM Associates LLC.

7. My specific work experience particularly applicable to this Report assignment includes the following roles, which provide me a solid experience base for review and understanding of the Site C Project evidence which I have reviewed:

   a. **River Flow and Water Surface Levels** - Hydrologist/Hydraulics Engineer for Bechtel Corporation's Hydraulics and Hydrology Group, where I provided specialized hydrologic and hydraulic studies for Bechtel Projects worldwide, including the Manapouri Hydroelectric in New Zealand.

b. **Transmission Lines/Substations** - Project Engineer/Project Manager for design and construction of the Wells Hydroelectric Project 230kV/115kV Transmission lines and switchyard extension, where I managed transmission and switchyard design and construction.

c. **Management of Design/Procurement** - Advisor to CADAFE Manager of Engineering and Procurement where I managed the contracted consultant design phase and the procurement phase for bidding of the Owner-furnished dam and hydroelectric equipment and construction Contracts for the $4.3 billion Uribante-Caparo hydroelectric project in Venezuela.

d. **Cost Estimating** - Learned construction cost estimating in Bechtel Rotation Program – used extensively during career for developing independent cost estimates of construction change orders and claim settlements. Lead resolution of major claims for constructive acceleration and disruption requiring my independent cost estimating and state of art as built scheduling analysis at American Falls Replacement Project, Bradley Lake Hydroelectric Project, and the Cowlitz Falls Hydroelectric Project.

e. **Remote Arctic Construction/Project Suspension** - Construction Manager for the Bradley Lake Hydroelectric Project in Alaska. The project was constructed remotely in an arctic climate. At the time, the project was the largest capital project that the State of Alaska had ever undertaken. The Project included a concrete gravity dam, reservoir clearing, a powerhouse, a 5.6 km tunnel, 30km of 115kv Transmission Line, and 20 km of permanent roads. It set world records for its tunneling rates and was selected the ASCE Regional Project of the Year. The project was suspended a year after start and completion of site infrastructure facilities and construction of the dam, tunnel, and powerhouse delayed by execution of final power sales agreements

f. **River Diversion Delays** - Project Manager and Construction Manager for the Cowlitz Falls Hydroelectric Project, where I took over construction management of a troubled project experiencing a projected year delay to diversion of the river and put the project back on schedule, completing it on time and within the Project Initial Cost Estimate.

g. **Project Quality Assurance Surveillance –** Management of Harza team responsible for oversight of construction quality for the construction of the $1 billion San Roque Dam Project in the Philippines under an EPC contract with Ebasco Services.

h. Achieving Mass Concrete Production – Management of Harza team assisting China Three Gorges Corporation Project construction management team reach planned 400, 000 cubic meters per month concrete production at Three Gorges Dam Project. Project included millions of cubic meters of RCC concrete.

i. **Responsibility For Similar World Class Project** - Chief Resident Engineer then subsequently JV Board of Management representative with management oversight and delivery responsibility for the design and construction of the world-class Ghazi Barotha Hydroelectric Project. The project was completed in 2004 in Pakistan under its $2.25 billion budget and on its original schedule, both established in 1995. If constructed at US

labor rates, the project would have cost well over US $10 billion. It involved more embankment dam fill, excavation, and concrete placed than the Site C Project. The project was one of few world-class mega hydroelectric projects to finish on time and under budget in the last 20 years.

j. **Performance Audits Hydroelectric Project** – Team Leader responsible for management evaluation and audit of the operations of the EPC Contractor responsible for the Main Civil Works for the $1.8 billion troubled 2400 MW Bakun Hydroelectric Project in Malaysia.

k. **Recognized Construction Planning and Scheduling Expertise** - Director of Construction for the San Francisco $4.6 billion Water System Improvement Program (WSIP). The WSIP program won the 2010 National Construction Management Association of America Award for Best Construction Planning of Major Programs. I personally was awarded the 2011 Project Management Institute College of Scheduling "Crystal Award" for the innovative scheduling of the WSIP-integrated P6 schedule and construction management information system (CMIS), which I developed and implemented on the Program.

l. **Highways Construction** - Surveyor and Grade/Bridge Inspector for the Alaska Department of Highways, where I worked as construction surveyor and grade inspector for construction of state highways between Moose Pass and Turnagain Pass; Big Lake and Talkeetna; Kenai and Nikiski, Alaska; and a major bridge over the Kenai River. My projects, such as the American Falls Dam Project and the Bradley Lake Hydroelectric Project, included the construction of highway and permanent roads.

m. **Understanding of Site C Main Civil Work** - As Independent Consultant in 2015-16, I acquired a comprehensive understanding of the Site C Project scope and schedule of the Main Civil Works Contract. I provided project management advisory and risk assessment services on proposed schedule and proposed work plans to the Main Civil Works Contractor at the Site C Project. No PRHP confidential information provided during this work was used in the preparation of this report.

n. **Understanding of Site C Generating Station Work** - As Independent Consultant in 2017, I acquired a comprehensive understanding of the Site C Project and scope of the Generating Station work from the Generating Station Request for Proposal (RFP). I provided advisory services to Bechtel for preparation of its proposal for the Generating Station. No Bechtel confidential information provided during this work was used in the preparation of this report.

B-2 Employment

8. My employment history includes long tenure at two of the world's premier companies that provide management and delivery of large dam and hydroelectric projects worldwide. They are Bechtel Corporation and Harza Engineering Company, the latter of merged with Montgomery Watson to become Montgomery Watson Harza in 2001. My employment

history is summarized in Table 1.

Table 1. Employment History – E. Harvey Elwin

Dates	Company	Position(s) held	Type of Activities Performed
2014-Present	PMCM Associates	Independent Consultant/Owner	Consulting services to several large private and public sector projects delivery of heavy civil water, dam and hydroelectric facilities.
2012-2014	CBI (and Shaw E&I)	Exec. Dir., Program Management/Const. Management Western USA	State and local infrastructure program and construction management
2007-2012	San Francisco Public Utilities Commission	Manager, Const. Management Bureau	Supervision and leadership of construction of all SFPUC's capital projects including the $4.6 billion Water System Improvement Program
2004-2007	San Francisco Public Utilities Commission	Manager, Project Management Bureau	Leadership and delivery of all SFPUC water and wastewater capital projects and the $4.6 billion Water Systems Improvement Program
1999-2004	MWH	VP and Director, Global Energy and Infrastructure	Asia and Worldwide Dam, Canal, hydroelectric project management and construction management
1997 1999	Harza Engr. Company	Chief Resident Engineer	Construction Management of Power Complex Facilities, Ghazi Barotha Hydroelectric Project
1995-1997	O'Brien Krietzberg	VP and Manager of Pacific NW	Construction Management of Projects
1969-1995	Bechtel Corporation	Engineer/Senior Engr. /Project Engr./ Project Mgr./Sr. Proj. Manager	Planning, permitting, design, and construction of dams, hydroelectric And water supply facilities
1967-1969	Water Res Inst Oregon State University	Engineering Research Associate	Managed Hydraulic Laboratory and performed hydrological studies
1964-1967	Alaska State Dept. Highways	Survey Party Chief/ Grade/Bridge Insp.	Highway Const. Surveys and Grade and Bridge Inspection

B-3 Education

9. I graduated with a Bachelor of Science Degree in both Civil Engineering and Mathematics in 1968 from Oregon State University located in Corvallis, Oregon. I graduated with a Master of Science Degree in Civil Engineering from Oregon State University in 1969 with a major in Hydraulics and a minor in Water Resources Engineering.

PART C: TERMS OF ENGAGEMENT

10. I am an independent project management expert retained by Woodward & Company LLP ("Woodward") to provide expert analysis to aid in understanding issues surrounding an injunction of the Site C Clean Energy Project ("the Site C Project" or "the Project") in respect to the estimated costs and scheduling considerations and the evidence of any or all of the defendants, British Columbia (BC) Hydro and Power Authority, British Columbia, and Canada.

11. Attached to this Report is the May 7, 2018 Retainer Letter (Appendix B) from counsel confirming my engagement as an independent expert on this matter.

12. I received from counsel by a separate letter dated June 13, 2018 further supplemental instructions to detail the scope of the independent expert Report I was asked to prepare. These instructions state,

> *"Please review the Affidavit evidence of Brian McGhee, Andrew Watson, Farzard Kossari, Cameron Penfold, Matthew Drown, Charles Young, Alan Le Couteur, James Thomas, Steven de Roy, and Bruce Muir (Affidavit #2, Appendices H-R), additional documents, and available public documents.*
>
> *Based on this information, please:*
>
> 1. *Develop a project management schedule for the construction activities that would be affected by an injunction enjoining construction activities in the "Critical" Areas identified by the Plaintiff's in their Notice of Application filed January 31, 2018.*
>
> 2. *Advise whether an injunction of the following durations would affect either (i) diversion of the Peace River, which BC Hydro says is planned for September 2020, (ii) the start of reservoir filling, which BC Hydro says is planned for September 2023, or (iii) the project in-service date, which BC Hydro says is planned for November 2024 (collectively the "Project Milestones"):*

a) 18 months;
b) 24 months;
c) 30 months;
d) 36 months.

In considering the answer to question 2, please address: (i) the extent to which BC Hydro would have to adjust its existing schedule (if that can be determined) to ensure that each of the Project Milestones are met; and (ii) the feasibility of any such adjustments.

3. *The questions above are based on the assumption that BC Hydro will otherwise meet its planned Project Milestones. Please provide your expert opinion on the likelihood that BC Hydro will instead fail to meet the Project Milestones.*

4. *Please describe how your answer in question 3 affects the scenarios described and opinions reached in response to question 2."*

13. Attached to this Report is the June 13, 2018 Supplemental Instruction Letter (Appendix C) from counsel providing the supplemental instructions addressed in this Report.

14. I certify that:

- I am aware of my duty of independence,
- I have prepared my Report in accordance with the duty of independence, and
- If called to give oral or written testimony, I will give that testimony in conformity with the duty of independence.

15. My duties as an independent expert override any obligation. I believe that the facts stated in this Report are true and that my opinions are correct based on information available to me and from my own industry experience.

16. I have not entered into any arrangements in which the amount or payment of my fees depends on the outcome of this legal Action or the content of my opinions. I have no interest, financial or otherwise, in the outcome of this Action, and I know of no conflict of interest that would preclude me from submitting this Report.

17. I reserve the right to supplement or amend my Report, should counsel request my review of additional materials.

_____
E. Harvey Elwin

PART D: DOCUMENTS REVIEWED

18. Documents relied upon in the preparation of this Report are listed in Appendix D.

PART E: DEVELOPMENT OF PROJECT MANAGEMENT SCHEDULE FOR PLANNED SITE C PROJECT WORK IN CRITICAL AREAS

E-1 The Critical Areas

19. The Critical Areas are the thirteen areas shown on map entitled "Critical Areas identified by West Moberly First Nations" attached to the Notice of Application filed by West Moberly First Nations on January 31, 2018 (Appendix D).

20. The Critical Areas have also been identified and shown on maps in Exhibit D of Affidavit #1 of James Thomas. Mr. Thomas used the maps to identify in his Affidavit #1 (paragraphs 25, 29, 33, 37, 41, 45, 49, 53, 57, 61, and 64) the amount of area within each of the Critical Areas, not including the area of the existing river.

21. The Critical Areas include ten identified and named areas along the Site C Project reservoir extending approximately 83 kilometers (km), from Peace Canyon dam (just west of Hudson's Hope) to the Site C dam in the dam site area. The Critical Areas going upstream from the Site C dam to the Peace Canyon dam are identified as: Upstream of Eagle Island; Buffalo Jump; Bear Flats; Canoe in the Bush (Halfway); Camp with Animal Crossing; Islands with Old Growth Forest; Farrell Creek to The Gates; Lynx Creek; Rocky Mountain Fort Area; and Dreamer Island.

22. Three more Critical Areas are identified along the western end of the Transmission Corridor. These are identified as: Trappers Lake Area; Peace-Moberly Tract (Transmission Corridor); and Sucker Lake.

23. The total area of each of the Critical Areas in hectares (ha) as identified in Mr. Thomas's Affidavit #1 (paragraphs 25, 29, 33, 37, 41, 45, 49, 53, 57, 61, and 64), not including the existing river, is reproduced in Table 2. I have numbered the Critical Areas as references numbers.

Table 2. Size of Critical Areas As Reported by Mr. Thomas

No.	Critical Area Name	Total Area Not Including River (ha)
1	Upstream of Eagle Island	2248.4
2	Buffalo Jump	318.3

3	Bear Flats	1359.4
4	Canoe in the Bush (Halfway)	1350.6
5	Camp 1 with Animal Crossing	594.5
6	Farrell Creek to the Gates	1258.0
7	Lynx Creek	221.9
8	Rocky Mountain Fort	178.8
9	Dreamers Island	53.1
10	Islands with Old Growth Forests	1013.4
11	Peace Moberly Tract (Trans L Corridor)	(
12	Trappers Lake	(8648.0
13	Sucker Lake	(
	Total	17,244.4 ha

24. From Mr. Thomas's numbers in paragraph 20 of his Affidavit #1, I assume that the area of the existing river within the Critical Areas is 18,611 ha – 17,245 ha, or 1366.6 ha.

E-2 Project Components Located In Critical Areas

25. The Site C Project consists of a number of various project components. These have been identified and described in Affidavit #1 of Andrew Watson (paragraphs 17 through 30), and in Exhibit A. Exhibit A of Mr. Watson's Affidavit #1 includes a figure showing the six Project areas and their components entitled, "Building the Site C Clean Energy Project."

26. I have also reviewed the map entitled "Critical Areas Identified by West Moberly First Nations" attached to the Notice of Application filed by West Moberly First Nations on January 31, 2018. In the table below, I have compared it with the Exhibit A in Affidavit #1 of Mr. Watson and have shown in Table 3 whether the Project component overlaps with a Critical Area shown on that map. The Project components that overlap with Critical Areas are shown in italics. I have further assessed them in the following subsections to understand the effects of the Injunctions on the remaining work to be done in the Critical Areas.

Table 3. Project Component Overlap with Critical Areas

Project Area	Project Component	Overlap with Critical Area
1. Roads & Highways	Upgrades to 240,269,271, and Old Fort Roads	No
2. Roads & Highways	*Realignment of Highway 29*	*Partially*
3. Hudson's Hope	*Hudson Hope*	*Partially*

		Shoreline Protection	
4.	*Transmission works*	*Transmission Clearing*	*Partially*
5.	*Transmission works*	*Transmission 500kV Lines*	*Partially*
6.	Transmission works	Peace River SY Ext	No
7.	*Reservoir Area*	*Reservoir Clearing*	*Yes*
8.	Reservoir Area	Public Safety Signs and Beacons U/S and D/S of Dam Site	No
9.	Quarried Materials	Portage Mt Quarry	No
10.	Quarried Materials	West Pine Quarry	No
11.	Quarried Materials	Wuthrich Quarry	No
12.	Quarried Materials	85th Avenue	No
13.	Dam Site	Dam Site Facilities	No

27. In paragraphs 42 and 43 of his Affidavit #1, Mr. Watson confirms overlap of the Critical Areas with the work for the realignment of Highway 29, reservoir clearing, and construction of the Hudson's Hope Shoreline Protection.

28. Affidavit #1 of Matthew Drown, in paragraph 9, confirms overlap of the Critical Areas with the work for the 500 kV Transmission Lines and Transmission Line clearing.

E-3 Highway 29 Realignment Work

29. I have been provided much information on the scope of the Highway 29 Realignment work, its latest status as of May 2018, its work remaining to be completed, and details of the current plan and schedule for completing the remaining work in Affidavit #1 of Farzad Kossari in the BC Hydro Application Response dated May 10, 2018.

30. However, Mr. Kossari does not fully define a clear representation of the remaining work for realignment of Highway 29 that is outside the Critical Areas. In the following subsections, I present a summary of Mr. Kossari's presentation of scope of work, status of work supplemented by other available BC Hydro progress reports, scope of remaining work, and schedule of remaining work for the realignment of Highway 29. I have made some necessary adjustments to Mr. Kossari's schedule for the work to reflect the allocation of work scope to Critical Areas to provide a current schedule of the Highway 29 Realignment work, which identifies in detail work located in and outside of the Critical Areas. I will use the adjustments for subsequent analysis of the effect of the Injunctions on the Highway 29 Realignment work in the Critical Areas. For all segments, I have maintained Mr. Kossari's planned schedule dates for award and completion of highway and bridge construction in my later developed project management schedule.

E-3.1 Scope of Highway 29 Realignment Work

31. Mr. Kossari's Affidavit #1 describes the scope of the Highway 29 Realignment work as consisting of six segments of Highway 29 that need to be realigned due to inundation by the

reservoir or risk of erosion and instability in the area (paragraph 5). He indicates that the total length of highway being realigned is about 30 km of the total length of 87 km from Hudson's Hope to Fort St. John (paragraphs 5 and 23). He breaks the six segments into eight segments or construction work areas and identifies the length of each (paragraphs 7 and 9). He indicates that four of the six original segments involve construction of a bridge, and he provides for each of the four segments the bridge length, the number of piers, and the presence or lack of a causeway (paragraphs 6 and 9). He further identifies the existence or non-existence of overlap of the eight segments with the Critical Areas (paragraph 9) and provides as his Exhibit D a series of maps showing the segments of Highway 29 that need to be realigned, the proposed location of the realigned highway, and the relative location of the Critical Areas.

32. The scope of the Realigned Highway 29 work presented by Mr. Kossari in paragraph 9 of his Affidavit #1 follows in Table 4.

Table 4. Scope of Hwy. 29 Realignment Work Presented by Mr. Kossari

Highway Segment	Overlap with Critical Areas	Length of Segment	Bridge Length/Piers	No. of Landholders Impacted
Cache Crk. East	Yes (Bear Flats)	5.0 to 5.9 km	600m-700m	8 to 9 (all Cache Crk.)
Cache Crk. West	No (adjacent to Bear Flats)	3.8 km	n/a	(included above)
Halfway River	Yes (Canoe in the Bush [Halfway])	3.7 km	1040m 12 piers	None
Farrell Crk. East	Yes (Camp with	6.0 km	n/a	1
Farrell Crk.	Yes ("Farrell Crk. to the Gates")	2.1 km	340m, 1 pier & causeway	2
Dry Creek	Yes ("Farrell Crk. to the Gates")	1.4 km	n/a culvert	None
Lynx Crk. East	Yes ("Farrell Crk. to the Gates")	1.6 km, emb fill	n/a	10 (all Lynx Crk.)
Lynx Crk. West	Yes ("Lynx Crk." & "Farrell Crk. to the Gates")	8.2 km	440m & causeway	(included above)

E-3.2 Status of Highway 29 Realignment Work

33. In his Affidavit #1, Mr. Kossari identifies and describes the steps necessary to construct the realigned segments of Highway 29 (paragraph 11). He reports them as: 1) geotechnical investigations; 2) functional design following geotechnical investigations; 3) property acquisition and other construction prerequisite activities following functional design; 4) detailed design following functional design; 5) procurement using tender package following detailed design and

construction of the highway following procurement; 6) construction of the bridge occurring simultaneously with the construction of the highway; and 7) decommissioning of the old highway and bridges after the new highway is put in service and before inundation.

34. Mr. Kossari, in his Affidavit #1, also provides information on the status of the Highway 29 Realignment work both by references to specific segments and steps of work, as well as provides in Exhibit E to a copy of a schedule for the construction of the Highway 29 Realignment segments (paragraphs 11, 14, and 15). The construction schedule shows a May 9, 2018 status date. Therefore, I believe it represents the current status of the Highway 29 Realignment work, as well as its current plan and schedule.

35. With regard to his references, Mr. Kossari reports, "Geotechnical investigations are ongoing for segments, except for Cache Creek West, for which they are complete, and Halfway River, for which they are largely complete but depending on design, may require further geotechnical work. The ongoing geotechnical work is expected to be complete by October 2018." He further reports, "A functional design is complete for Cache Creek West, and in progress for Halfway River." Additionally he reports, "The tender package is prepared for the Cache Creek West segment, although procurement has not begun. The other segments are still undergoing functional design (step b described above) or geotechnical investigations (step a)" (paragraphs 11 and 20).

36. I have summarized the current status of the eight Highway 29 Realignment segments in Table 5 using the information provided by Mr. Kossari in his Affidavit #1.

Table 5. Status of Highway 29 Realignment Work as of May 9, 2018

Highway Segment	Completed Step	Ongoing Step	Comment
Cache Creek. West	Detailed Design	Procurement	To be completed 7/26/18
Cache Creek. East	n/a	Geotech Inv.	To be completed 10/2018
Halfway River	Geotech Inv	Funct. Design	Proc. to start 11/22/18
Farrell Creek. East	n/a	Geotech Inv.	To be completed 10/2018
Farrell Creek	n/a	Geotech Inv.	To be completed 10/2018
Dry Creek	n/a	Geotech Inv.	To be completed 10/2018
Lynx Creek East	n/a	Geotech Inv.	To be completed 10/2018
Lynx Creek West	n/a	Geotech Inv.	To be completed 10/2018

E-3.3 Scope of Remaining Highway 29 Realignment Work

37. I have assumed that the scope of the remaining Highway 29 Realignment work to be completed by the Site C Project includes completion of the uncompleted preconstruction stage

steps identified by Mr. Kossari in his Affidavit #1 that have not yet been completed, as shown in Table 6, and the construction of the highway segments and bridges, as shown in Table 5.

E-3.4 Remaining Highway 29 Realignment Work in Critical Areas

38. Mr. Kossari has not addressed in his Affidavit #1 the length of segments which are within or outside the Critical Areas. This is significant in that my review of the maps shows that portions of the Highway 29 Realignment work are not in the Critical Areas and could be constructed outside the Critical Areas.

39. In particular, Mr. Kossari does not account for the lengths of the Cache Creek East segment that are outside the Bear Flats Critical Area, even though there is some overlap. The Cache Creek East segment is shown to vary in length from 5.0 km to 5.9 km due to the three possible alignments shown on Map 7 of 7 of his Exhibit D. All of these alternative alignments are shown on the map with lengths of the Cache Creek East segment outside of the Bear Flats Critical Area both to the east and west. They are adjacent to both the Buffalo Jump Critical Area to the east and adjacent to the Bear Flats Critical Area to the west, but they are outside of the Critical Areas. The measured Cache Creek East segment from Map 7 of 7 for the north, middle, and south alternative alignments are 5.7 km, 5.2 km, and 5.1 km respectively. The lengths of the segments in the Critical Area for the north, middle, and south alternative alignments are 1.7 km, 2.0 km, and 2.0 km respectively.

40. Using Mr. Kossari's maps, I have set out in Table 6 the approximated lengths of the new highway segments that are both within and outside of the Critical Areas. For the Cache Creek East segment, I have used the longest most north alternative alignment per instruction from "Woodward." In the table below, I also identify which bridges are inside and outside of the Critical Areas. Table 6 provides the actual scope of the Highway 29 Realignment work by segment that is inside and outside of the Critical Areas.

Table 6. Scope of Highway 29 Realignment Work Inside and Outside of Critical Areas

Highway Segment	Total Length of Segment	Length Outside Critical	Length Inside Critical	Bridge Length/Piers	Bridge in Critical Area
Cache Creek East	5.7 km	4.0 km	1.7 km	600m-700m 9 piers	Yes
Cache Creek West	3.8 km	3.8 km	0 km	n/a	
Halfway River	3.7 km	0 km	3.7 km	1040m 12 piers	Yes
Farrell Creek East	6.0 km	4.0 km	2.0 km	n/a	

Farrell Creek	2.1 km	0 km	2.1 km	340m, 1 pier & causeway	Yes
Dry Creek	1.4 Km	0 km	1.4 km	n/a culvert	
Lynx Creek East	1.6 km, emb fill	0 km	1.6 km	n/a	
Lynx Creek West	8.2 km	4.1 km	4.1 km	440m & causeway	Yes
Total	**30.4*km**	**15.1 km**	**15.3* km**		

*does not include Lynx Creek East 1.6 km which is already in the Lynx Crk West length, nor the 0.9 km additional Cache Creek East length subject to design development

41. The length of the Highway 29 Realignment outside the Critical Areas is about 15.1 km, or 49.7% of the total Highway 29 Realignment length of 30.4 km. The scope of work of the Highway 29 Realignment within the Critical Areas includes 15.3 km of highway and the four bridges.

E-3.5 Current Plan and Schedule For Completing Remaining Highway 29 Realignment Work

42. I have used the current assumptions and plan and schedule for the remaining realignment of the Highway 29 segments which have also been provided by Mr. Kossari in his Affidavit #1. He provides the plan and schedule of the Highway 29 Realignment work by references to completion dates as discussed previously, duration ranges for specific steps of work, and Exhibit E, a copy of the schedule for the future construction of the Highway 29 Realignment segments.

43. With regard to his planning and scheduling duration references, Mr. Kossari reports that functional design is expected to take 6 to 12 months, depending on the complexity of the design and river crossing bridge structures (paragraph 11.b). He also indicates that the detailed design is expected to take 6 to 12 months considering the scope of work and design details, and procurement is expected to take a further 2 to 3 months (paragraph 11.d). He further provides the planned completion date for each segment as shown in Table 7 (paragraph 15).

Table 7. Highway 29 Realignment Segment Completion Dates

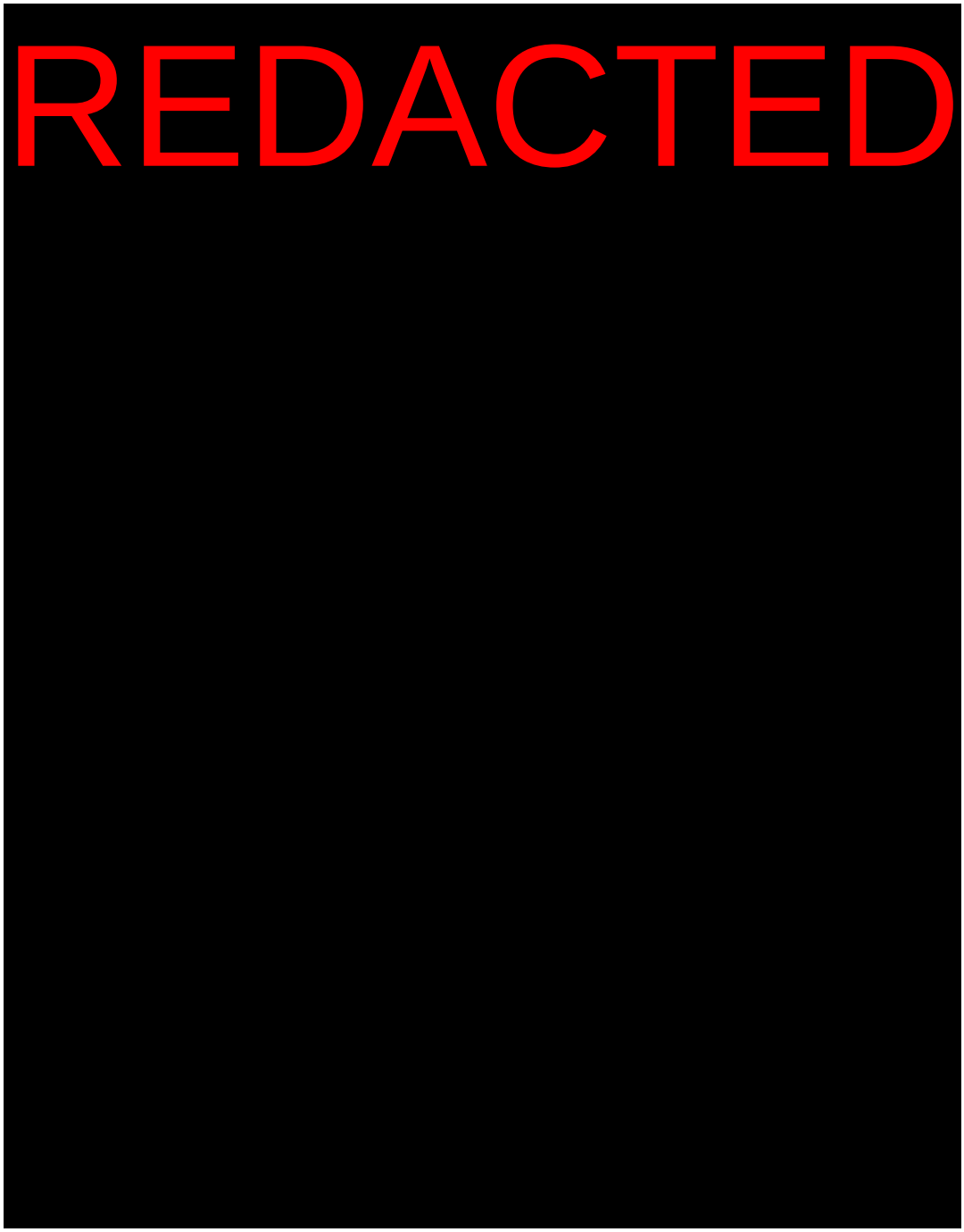
Highway Segment Schedule	**Kossari Paragraph 15**	**Kossari Exh. E**
Cache Creek West	June 2023	June 13, 2023
Cache Creek East	June 2023	July 7, 2023

Halfway River	Nov. 2022	Dec. 17, 2022
Farrell Creek East	April 2023	April 6, 2023
Farrell Creek	April 2023	April 14, 2023
Dry Creek	Oct. 2021	Jan. 13, 2022
Lynx Creek	July 2023	July 8, 2023

44. I have used all the information provided by Mr. Kossari's Affidavit #1 for scheduling; status of steps; activity durations for functional design, detailed design, procurement, and construction; and completion dates to develop a schedule of remaining Highway 29 Realignment work by segment, which shows the prorated durations of the construction work in both the Critical Areas and the non-Critical Areas. I arrived at the duration of the construction within and outside of the Critical Areas by prorating the total construction duration by the ratio of the linear length of work in the respective area to the total linear length of the segment. I have presented the resulting schedule for the remaining Highway 29 Realignment work in Figure 1.

45. After receipt of the Confidential Documents from Woodward and finding that the Site C June PMFB Schedule 2018-06-20 included detailed schedules for the Highway 29 Realignment segments, I checked the PMFB schedule construction start and end dates for each segment and confirmed that they were similar. Where my use of Mr. Kossari's dates were different, I revised Mr. Kossari's dates to reflect the construction schedule for the segment as provided in the PMFB. A validation of the agreement is provided later in the Report in Table 10.

Figure 1. REDACTED



E-4 Hudson's Hope Slope Protection

46. Much information on the scope of the Hudson's Hope Shoreline Protection work, its latest status as of May 2018, the remaining work to be completed, and the BC Hydro current plan and schedule for completing the remaining work in general has been provided in Affadavit #1 of Mr. Kossari in the BC Hydro Application Response dated May 10, 2018 in paragraphs 26 through 30 and its Exhibit G.

47. However, Mr. Kossari does not fully define a clear representation of what remaining work for Hudson's Hope Shoreline Protection is outside the Critical Areas and will not be affected by a Case B scenario Injunction. In the following subsections, I present a summary of Mr. Kossari's presentation of scope of work, status of work, scope of remaining work, and schedule for completing the remaining work for Hudson's Hope Shoreline Protection. In this summary, I make the necessary allocation of work items to work within the Critical Areas to provide a current schedule of the work. This schedule identifies in detail work located within and outside of the Critical Areas that can be used for subsequent analysis of the effect of the Injunctions on the Hudson's Hope work in the Critical Areas.

E-4.1 Scope of Hudson's Hope Slope Protection Work

48. The scope of the Hudson's Hope Slope Protection work is described in Mr. Kossari's Affidavit #1 (paragraph 27). It includes: 1) a 1650 meter (m) berm adjacent to the residential area of Hudson's Hope; 2) 550 m of slope flattening adjacent to land downstream of the residential area; 3) a 450 m berm downstream of the slope flattening work; 4) replacement of components of the municipal water system which will be inoperable when below the reservoir surface elevation; 5) upgrades to various roads (including DA Thomas Road) and trails in Hudson's Hope; and 6) development of a recreation area.

49. Exhibit G of Mr. Kossari's Affidavit #1, which is an information sheet, confirms this scope of work.

E-4.2 Status of Hudson's Hope Slope Protection Work

50. In his Affidavit #1, Mr. Kossari provides the status of the Hudson's Hope Slope Protection work in his Affidavit by references to specific remaining items of work and his Exhibits. In Exhibit E to his Affidavit #1, he provides a copy of a schedule for the construction of the Hudson's Hope Berm (paragraphs 11, 14, and 23). The construction schedule shows a May 9, 2018 status date; therefore, I assume it represents the current status of the work. The construction schedule shows that engineering started in September 2016 and is to be completed on August 18, 2018. Mr. Kossari further indicates that testing is being done at Portage Mountain Quarry to determine if it can be used as a source for riprap material.

E-4.3 Scope of Remaining Hudson's Hope Slope Protection Work

51. The scope of the remaining Hudson's Hope work to be completed by the Site C Project includes completion of engineering, permitting, procurement, and construction of the facilities previously described.

E-4.4 Remaining Hudson's Hope Slope Protection Work in Critical Areas

52. In Exhibit G of his Affidavit #1, Mr. Kossari provides an information sheet and map describing and showing the location of the Hudson's Hope Shore Protection work. Map 1 of 7 of Exhibit D of his Affidavit #1 shows the location of scope items 1, 2, and 3 relative to the West Moberly claimed Critical Area. The 450 m berm in item 3 and the slope flattening work in item 2 are not shown within the Rocky Mountain Fort Area Critical Area. They are outside all Critical Areas. Most of the 1650 m berm in item 1 and items 4, 5, and 6 appear to be in the Rocky Mountain Fort Area Critical Area.

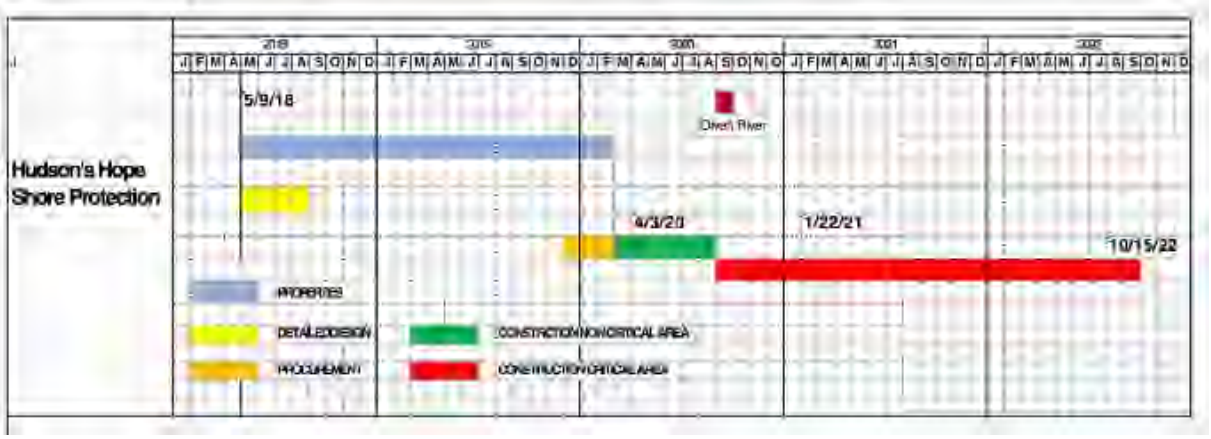
E-4.5 Plan and Schedule of Remaining Hudson's Hope Slope Protection Work

53. I have used the current assumptions, plan, and schedule for completing the remaining work which have also been provided by Mr. Kossari in his Affidavit #1 and his Exhibit E Schedule. In his Affidavit #1, he indicates that Construction of the DA Thomas Road is scheduled to occur in 2020 and that the construction of the Hudson Hope Berm and recreation site will begin in 2020 once the road is complete, and is scheduled to be complete in October 2022. The Exhibit E schedule provided indicates that Hudson's Hope construction completion will be in September 2023, almost a year later than indicated in Affidavit #1. It does not differentiate the work within and outside of the Critical Areas. It shows a 45 month duration for construction, which I believe to be excessive based on the fact that the EIS Construction Schedule shows that the entire construction period should last 16 months, with a start of construction in April 2019 and construction completion by August 2020.

54. For completing the remaining Hudson's Hope work, I have assumed a construction start of February 2020 or the DA Thomas Road, consistent with Mr. Kossari's Exhibit E schedule. I have also assumed that procurement for the berm will take place between January 2020 and October 2020, as indicated in the Exhibit E schedule. The berm and shoreline work would start in October 2020 and continue to October 2022, as indicated by Mr. Kossari. Consistent with the Exhibit F Map 1 of 7, I have assumed that about 40% of the berm work (the slope flattening and the 450 m berm) will be outside of Critical Areas. I have presented the resulting derived schedule for the remaining Hudson's Hope Shore Protection Work in Figure 2.

REDACTED

Figure 2. Hudson's Hope Shore Protection Remaining Work Schedule



E-5 Reservoir Clearing

56. Much information on 1) the scope of the Site C Reservoir clearing work; 2) the latest status of the progress of work as of May 2018; 3) the work remaining to be completed; and 4) the current plan and schedule for completing the remaining work is within the Affidavit #1 of Cameron Penfold and its exhibits.

57. In the following subsections, I reference, summarize, and comment on Mr. Penfold's presentation of scope of work, status of work, scope of remaining work, and schedule of remaining work for the remaining clearing work. Based on Mr. Penfold's information, I have adapted a schedule of the remaining clearing work for further use and analysis in this Report.

E-5.1 Scope of Reservoir Clearing Work

58. The scope of the Site C reservoir clearing work and the guidelines and constraints for implementing the work is summarized in Mr. Penfold's Affidavit #1 and its exhibits. He provides the Site C Vegetation and Clearing and Debris Management Plan ("Clearing Plan") as his Exhibit A. He provides a summary of seasonal limitations on clearing in paragraphs 5 through 10 of his Affidavit #1, which explains why all the clearing is scheduled for the winter season. He confirms in paragraphs 11 and 12 of his Affidavit #1 that 2918 ha of forested land in the reservoir and the adjacent area up to the five-year beach erosion line need to be cleared prior to inundation. He further explains the strategy in paragraphs 12 through 15 of his Affidavit #1.

59. In paragraph 11 of his Affidavit #1, Mr. Penfold reconfirms that 2918 ha are to be cleared for the reservoir. This number is confirmed in the Affidavit #1 Exhibit A "Clearing Plan" in Table 2 on paragraph 17 and in Table 18 on page 48 of 61.

E-5.2 Status of Reservoir Clearing Work

60. In paragraph 11, Mr. Penfold confirms the progress of the reservoir clearing work at the date of May 11, 2018 in his statement, "A small portion of the reservoir has been cleared (approximately 65 hectares in total, comprised of 30 hectares in the Moberly drainage area and approximately 35 hectares on the south back of the area BC Hydro refers as the ("Lower Reservoir")."

61. BC Hydro's Public Quarterly Progress Report No. 10 – October 2017 to December 2017 in Section 1.2-4.2 on page 9 conflicts with Mr. Penfold's Affidavit #1 where it states, "As of December 31, 2017 clearing of Lower Reservoir was substantially complete and remaining clearing will commence February 2018." The Progress Report further states, "As of December 31, 2017 clearing at Moberly River was approximately 45 percent complete."

62. Per Mr. Penfold's Affidavit #1 Exhibit F, the total acreage to be cleared in the Lower River and Moberly is 374 ha. However, the map of the reservoir clearing zones presented in Section 4.2 (Project Scope and Status) in the September 8, 2017 Deloitte Report shows Eastern Reservoir clearing, Lower Reservoir and Moberly River Valley clearing, and Cache Creek clearing all to be completed by Spring 2018.

63. The quantity of completed clearing in Mr. Penfold's Affidavit #1 (65 ha) and clearing to be done in the Lower Reservoir and Mobley Drainage (374 ha) are not consistent with the Progress Quarterly Reports or the Deloitte Report. Therefore, it is not clear what the current status of completed reservoir clearing is.

64. For the purpose of this Report, I will assume Mr. Penfold's May 10, 2018 update of completed clearing reservoir area of 65 ha.

E-5.3 Scope of Remaining Work

65. As stated by Mr. Penfold in his Affidavit #1 (paragraph 11), "The amount of remaining forested land to be cleared in the reservoir is estimated to be 2,853 hectares."

66. In his Exhibit D, Mr. Penfold provides a map showing the various clearing areas of the reservoir and schedule that have been established for permitting and procurement. In Exhibit E, he further provides a detailed resource estimate of staffing and equipment for the various clearing areas and sub areas, along with the quantities and volumes of work and areas of clearing. From this information, I have obtained the remaining clearing work in the respective clearing areas and sub areas, as shown in Table 8.

Table 8. Remaining Reservoir Clearing Quantities By Reservoir Area In Hectares (Penfold Affidavit #1 [Paragraph 11 and Exhibit D])

Area	Total Req'd Clearing	Completed Clearing	Remaining Clearing
Eastern Reservoir	609	-	609
Lower Reservoir/Moberly Drainage	374	65	309
Middle Reservoir	744	-	744
Western Reservoir	1191	-	1191
Total Area	2918	65	2853

E-5.4 Remaining Reservoir Clearing Work in Critical Areas

67. Reservoir clearing acreages in the Critical Areas were only partially addressed in the evidence which I reviewed in Affidavit #1 of Bruce Muir and Affidavit #1 of James Thomas and their respective Exhibits.

68. Mr. Muir's Affidavit #1 Exhibits provide "Clearing Overlay Maps" for each of the 13 Critical Areas showing BC Hydro's "Clearing Plan" layered on top by BC Hydro Clearing Area, i.e. Eastern Reservoir Clearing, Middle Reservoir Clearing, etc. The Affidavit #1, however, does not contain information that quantifies the clearing areas within the Critical Areas. It is evident from the Exhibit maps that each of the thirteen Critical Areas contains reservoir clearing, some being significant portions.

69. Mr. Thomas's Affidavit #1 Exhibit E provides West Moberly claimed Critical Area maps and quantifies the areas of each of the claimed Critical Areas, both including and excluding the existing river. Mr. Thomas's Affidavit #1 provides quantification of areas of land ownership within the Critical Areas. It also provides computation of areas of Project use and areas of use by Project activity or component within the Critical Areas.

70. I have extracted information of the use of each Critical Area by the Project proponents or activity to quantify the area of clearing and reservoir use. Mr. Thomas notes in his Affidavit #1 (paragraph 22, item c) that the clearing he notes in his tables generally relate to land above the reservoir level but within the preliminary impact lines being cleared for debris management purposes. These areas are shown in Table 9. It is expected that combined Reservoir and Clearing number are reflective of the amount of clearing in the various Critical Areas but the Reservoir

and Clearing totals exceed the "Clearing Plan" estimates for reservoir clearing. At this point, I do not have access to enough information to determine the reason.

Table 9. Use of Land within Critical Areas Use by Project Component/Activity (Affidavit #1 of James Thomas)

West Moberly Critical Area	**Reservoir**	**Clearing**	**Tran Line**	**Highway 29**
U/S of Eagle Island	481.6	142.9		
Buffalo Jump		7.1		3.1
Bear Flats	601.4	19.4		20.2
Canoe in the Bush	636.7	11.4		31.3
Camp with Animal Crossing	166.9	5.7		15.0
Islands with Old Growth Forest	730.1	51.8		
Farrell Creek to the Gates	316.1	6.4		78.6
Lynx Creek	61.8	8.7		19.0
Rocky Mt. Fort Area	27.8	7		
Dreamers Island	13.4	0.4		
PMT/Trappers/ Sucker Lake			385.1	
Totals	**3,035.8**	**252.1**	**385.1**	**167.2**

E-5.5 Plan and Schedule of Remaining Reservoir Clearing Work

71. In his Affidavit #1 (paragraph 21), Mr. Penfold indicates that the clearing schedule provides that the reservoir clearing between the dam site and approximately the Halfway River (an

estimated 1,489 ha) is to be cleared before river diversion (scheduled for fall 2020). He indicates that the Halfway River Drainage (an estimated 336 hectares) is also to be cleared after river diversion but before the spring freshet (spring 2020) for a total of 1,825 ha to be cleared before diversion of the river in September 2020.

72. I have not found where Mr. Penfold obtains his 1489 ha figure, or where he obtains his position that clearing to the Halfway River needs to be cleared before river diversion.

73. In paragraphs 4 and 26 of Affidavit #1, Mr. Penfold indicates that the "Clearing Plan" is the current approved version and must be followed ("clearing must be conducted in conformance with…"). The "Clearing Plan" indicates in its General Clearing Schedule, Section 3.2, Table 4 that prior to diversion, only 374 and 609 ha in the reservoir need to be cleared, in year 1 and year 2 respectively. The remaining 744 ha and 1181 ha which make up Mr. Penfold's total reservoir clearing 2818 ha in the "Clearing Plan" are scheduled in year 3 and 4 respectively. They are also listed with an option to be done in year 5 or 6. Furthermore, the paragraph which introduces the table states, "Reservoir clearing shown in Years 3 and 4 could be delayed until Years 5 and 6 of the construction schedule." It is evident, contrary to Mr. Penfold's Affidavit #1, that the "Clearing Plan" only requires 374 ha plus 609 ha to be cleared before river diversion and not 1825 ha.

74. In comparing the 374 ha "Clearing Plan" year 1 reservoir clearing quantity with both Mr. Penfold's Affidavit #1 Exhibit D map of the reservoir clearing areas and his Affidavit #1 Exhibit E schedule and resource estimate (which also identifies the "Clearing Plan" Table 4 clearing areas), I have observed and concluded that the year 1 clearing amount of 374 ha is the reservoir clearing required at the Lower Reservoir Access and Clearing area, as well as the Moberly River Drainage and Clearing area. Comparison of these clearing areas with the Critical Area map locations show that neither the Lower Reservoir nor the Moberly River Drainage areas are within any Critical Area and that the clearing of the 374 ha could proceed at any time without impacting the Critical Areas.

75. In comparing the 609 ha "Clearing Plan" year 2 reservoir clearing quantity with both Mr. Penfold's Affidavit #1 Exhibit D map of the reservoir clearing areas and his Affidavit #1 Exhibit E schedule and resource estimate, I have observed and concluded that the year 2 clearing amount of 609 ha is the reservoir clearing required at the Eastern Reservoir Access and Clearing area. This area of reservoir clearing is shown in Mr. Penfold's Exhibit E to entail four Eastern Reservoir Access and Clearing area sub areas. These include the South Bank; North Bank (Dam to Tea Creek; Wilder Creek to Cache Creek); North Bank (Tea Creek to Wilder Creek); and Cache Creek Drainage. Comparison of these clearing sub areas with the Critical Area map locations shows that only the North Bank Dam to Tea Creek sub-sub area is not within any Critical Areas and could proceed at any time without impacting the Critical Areas.

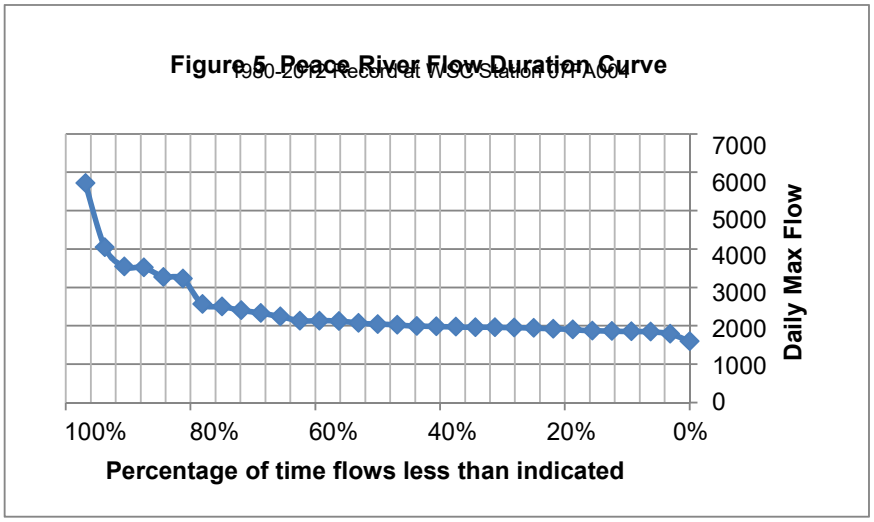
76. Mr. Penfold, in paragraph 23 of his Affidavit #1, describes Diversion Stage 2 (diversion of river into the tunnels) from Diversion Stage 1 (Channelization) and notes that a head pond will be created with the river level rising periodically to 420 m elevation after diversion of the river into the tunnels. In paragraphs 24 and 25 of his Affidavit #1, he raises concern about clearing to

Halfway River before river diversion to avoid debris entering into the river at the higher water levels of the Diversion Stage 2. In paragraph 26, he indicates that all planned clearing below 420 m must be cleared before river diversion in order to meet BC Hydro's commitments under the "Clearing Plan." It is not clear where the 420 m commitment is in the "Clearing Plan." I have reviewed the "Clearing Plan" comprehensively and a 420 m clearing commitment is not evident. It appears that Mr. Penfold's "Clearing Plan" commitment may be in reference to the 609 ha clearing requirement in the Eastern Reservoir Area required in year 2.

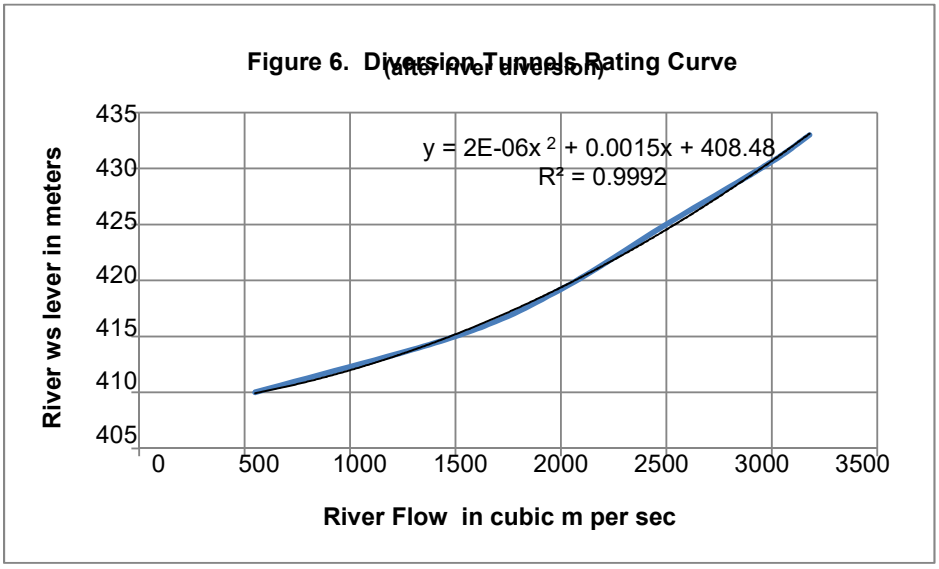
77. Delay of the Eastern Reservoir Area clearing until after river diversion by a halt of work in the Critical Areas will not preclude BC Hydro from clearing below 420 m water level before river diversion. The reason is that the debris and clearing areas below the 420 m water level are outside of any of the Critical Areas, meaning that clearing and debris removal work can continue as planned below 420 m elevation until diversion. In his Affidavit #1, Mr. Steven Deroy reports that the 90th percentile head pond data does not overlap with the Critical Areas on the Critical Areas map. I have been told by Firelight that the 90th percentile head pond water level elevation corresponds to the post river diversion (Diversion Stage 2) condition, which is 420 m.

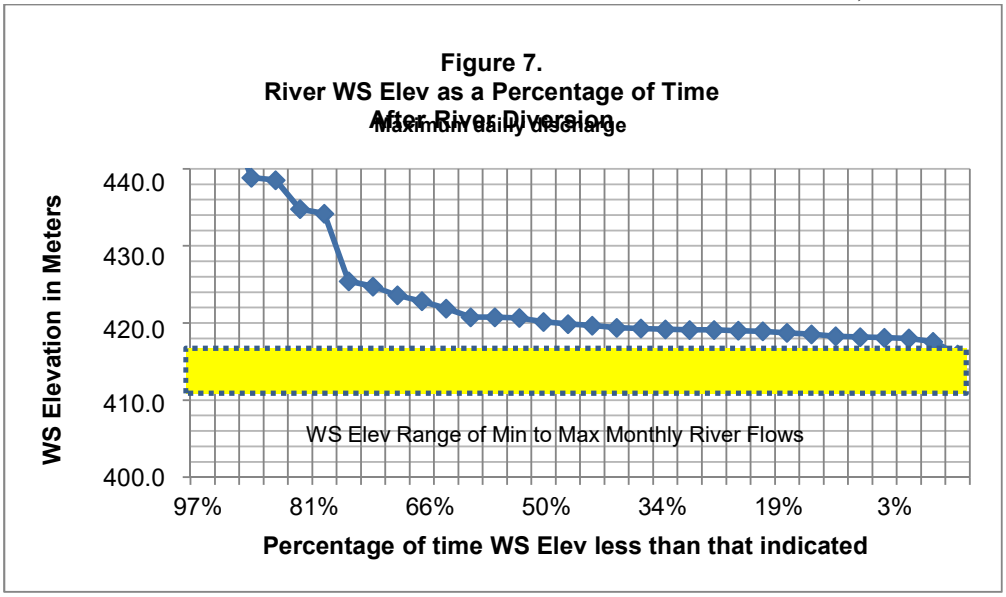
78. Even if clearing in the Eastern Reservoir area in the Critical Areas were halted until after diversion, there would still be significant opportunity access and time before reservoir filling to clear below the 433 m water surface level. After river diversion and as the river is flowing in the tunnels, the 420 m level will correspond to a mean annual flood flow. The head pond elevation after diversion will continue to vary between 409.1 m elevation at lower flows to 419.2 m elevation at mean annual flow (see Site C Clean Energy Project Implementation Design Hydrotechnical Data Report, Revision 2, February 2017). The variation in river levels most of the time will be at lower flows and the location of areas below 420 m outside of the Critical Areas will be a of the time and will allow more time necessary for access for debris removal and clearing up to 433 m after river diversion. The statistical odds of the water level rising to 433 m before the zone is cleared is very small. This should be realized by the fact that the 433 m elevation is the cofferdam design height and they have been designed with a flood return period of more than 10 year, actually closer to about 14 or 15.

79. To support the position that most of the time the water surface elevations will be significantly below 420 m, I have analyzed the variation of the water surface level of the river after diversion of flow into the tunnels using the data from the Hydrotechnical Data Report. I have identified the variation of the river headpond water surface elevation as a function of percentage time exceeded. I have accomplished this by taking the maximum daily flow of the Peace River at the station above Pine River (WSC Station 07FA004) each year for the 1980-2012 record from Dwg 1016-C01-00157 and converting it to a standard flow duration curve. I completed this by doing a frequency analysis of the series distribution of the 32 year flow record to provide the relationship of maximum daily annual flow in each year of record versus percent of time exceeded. The result is shown in Figure 5. This graph shows the statistical percent of time of experiencing the maximum annual flood flow.



80. In order to convert the flows to water surface elevation, I reproduced the rating curve for water surface elevation during river diversion by taking the river flow values versus water surface elevations from Table 9 in the Hydrotechnical Data Report for the Diversion Stage 2 and creating a graphical chart (see Figure 6). Using regression analysis, I derived an equation for the relationship between flow and water surface elevation during diversion. I then used the equation to transform the flow values in Figure 5 to water surface elevations, producing Figure 7, which shows the statistical percentage of time for the period of record that the water surface elevations are less than indicated.





81. To understand the behavior of the river and water surface elevation during river diversion on a monthly and annual basis and how it relates to clearing the zone above to 433 m, I obtained the monthly average river flows for the river over the record from Dwg 1016-C01-00157. From this reference, the monthly average flow for the 1980 to 2012 period of record is about 1240 cubic meters per second; the low monthly flows in June is about 950 cubic meters per second; and the maximum monthly is about 1600 cubic meters per second in December. From Figure 6 and the regression analysis equation, these monthly flows in the river equate to the following elevations in the river:

Average Monthly Flows		**Dam Upstream WS Elevation**
Minimum	950 cubic m/sec	411.7 m
Mean	1240 cubic m/sec	413.4 m
Maximum	1600 cubic m/sec	416.0 m

82. Figure 7 shows that the water surface elevation during diversion will only rise into the zone between 420 m and 433 m infrequently during maximum annual flood and its probability of significantly inundating the 433 m elevation decreases significantly with water surface elevation. It also shows that the majority of the time of the year, even at maximum monthly flows, the water surface level will be below elevation 416 m and working in the 420 m to 433 m zone after river diversion should not be an issue.

83. Firelight has performed calculations of the BC Hydro clearing area requirements both below 420 m and 433 m. Information provided to me from Woodward LLP from Firelight shows the reservoir clearing requirements in the Critical Area below 420 m are essentially nothing – 1.55 ha. The requirements in the Critical Area below 433 m are more substantial at 1084.3 ha. The

latter includes 357 ha in Eagle Island and Upstream; 515 ha in the Bear Flats; 31 ha in Canoe in the Bush; and 181 ha on the Old Growth Island Critical areas.

84. While delaying the clearing activities in Critical Areas below 433 m, or even delaying the Eastern Reservoir Access and Clearing to after river diversion, may be a revision to the "Clearing Plan," it should not be more of a risk and challenge to the Project than doing the Middle Reservoir Access and Clearing work and the Western Reservoir Access and Clearing work as planned post diversion. In addition to the fact that the water surface levels will remain low most of the time, it is because the Project is heavily relying on construction phase waterborne woody debris catchment sites and debris booms to deal with existing debris within the Project footprint that has resulted from natural events, such as floods and variable river flow, as well as unavoidable woody debris created during or up to clearing activities. (See Section 10 of the "Clearing Plan," including Figures 9 and 10.) This is a normal practice for most dam projects located in wooded areas. Additionally, there are two diversion tunnels, which increases reliability for passing missed debris. The tunnel diameters have been increased to 10.8 meters, or 35 feet. They are significantly larger than used on most hydroelectric projects where similar debris problems have existed.

85. In his Exhibit E, Mr. Penfold has provided a current plan and schedule for the remaining reservoir clearing work. I have accepted it to represent BC Hydro's current plan and schedule for the remaining reservoir clearing work as shown in Figure 3.

86. REDACTED

Figure 3. Site C Project Reservoir Clearing Remaining Work Schedule

E-6 Transmission Line Facilities

87. Much information on the scope of the work for the Site C Project two 500 kV transmission lines; latest status of work as of May 2018; work remaining to be completed; and information on the current plan and schedule for completing the remaining work is included in the Affidavit #1 of Matthew Drown in the BC Hydro Application Response dated May 10, 2018. Additional information on status as of May 2018 and information on the current plan and schedule for completing the remaining work of the transmission line has been provided in the Affidavit (not numbered) of Mike Scott.

88. In the following subsections, I reference and summarize Mr. Drown's and Mr. Scott's presentation of scope of work, status of work, scope of remaining work, and schedule of remaining work for the construction and implementation of the two 500 kV transmission lines. I have used Mr. Drown and Mr. Scott's schedule information to develop a schedule of the

remaining Transmission Line work. I have made some assumptions to prorate the transmission line corridor work activity durations by 60% for non-Critical area work and 40% for Critical Area work to reflect the allocation of work scope to Critical Areas in order to provide a current representative schedule of the remaining Transmission Line work, which identifies in detail work located in and out of the Critical Areas.

E-6.1 Scope of 500 kV Transmission Line Work

89. Mr. Drown's Affidavit #1 describes the scope of the 500 kV Transmission Line work as consisting of installation of approximately 75 km of 500 kV lines to be installed from the Site C substation to the Peace Canyon switchyard in an existing right-of-way, which is currently occupied by two 138 kV lines that are to be decommissioned and removed (paragraphs 3 and 4). He indicates that the current 138 kV right-of-way of 45 m will be increased to 120 m (paragraph 3). He describes the scope of the construction as including geotechnical investigations, clearing, construction of access roads, installation of helical or concrete tower foundations, assembly and erection of the towers, and stringing of the conductor lines (paragraph 6).

E-6.2 Status of Work

90. In his Affidavit #1, Mr. Drown provides the status of the 500 kV Transmission Line work through references to specific work activities and phases. In paragraph 6 of his Affidavit #1, he confirms that the geotechnical investigation work is complete. Clearing commenced in early 2017 and continued this past winter season (2017-2019), with approximately 65% of the right-of-way clearing completed and the remaining scheduled for next winter. He indicates in paragraph 7 that BC Hydro entered into a contract with Allteck Line Contractors Inc. ("Allteck") in May 2018 for the construction of both the 500 kV transmission lines to install the foundations for the tower, assemble and erect the towers, string the conductor, and decommission and remove the existing 138 kV lines.

91. The Site C Project BCUC Inquiry Report in Section 4.3 states, "Transmission line access roads were upgraded to facilitate the stat of right-of-way clearing which began in February 2017." It further states, "Approximately 25 kilometers of the 75 km right-of-way was cleared in that period and the remaining clearing will occur in the fall/winter 2017, in time for the start of transmission line construction."

92. The BC Hydro Quarterly Progress Report No. 10 for the period October 2017 to December 2017 states, "Following the government decision on the project in December 2017, a contract for the vegetation clearing and access road construction on the western half of the transmission line right-of-way was awarded to a First Nations contractor."

E-6.3 Scope of Remaining Transmission Line Work

93. The BC Hydro Annual Progress Report No. 2 for the period October 2016 to December 2017 provides a summary of remaining Transmission Line work as of December 2017. It states,

> "Over the next year, the key construction related activities planned for the transmission works include;
>
> - Complete the clearing and access work for the transmission line corridor;
> - Completer the control panel upgrades at Peace Canyon Station, commencement of the Peace Canyon 500 kV gas insulated switchgear expansion work;
> - Award the south bank substation contract in early 2018 and commence work in the spring;
> - Receive delivery of the 500 kV transmission towers;
> - Award the Transmission Line Conductor supply contract; and
> - Award the Transmission Line Construction contract in early 2018 and commence the work in the fall."

E-6.4 Remaining Transmission Line Work in Critical Areas

94. Paragraph 4 of Mr. Drown's Affidavit #1 states that a halt of work in the Critical Areas would prohibit work on approximately 40% of the 500 kV transmission line right-of-way (approximately 29 km of the approximately 75 km), thereby indicating that 40% of the corridor is in the Critical Areas.

95. I have reviewed the map entitled "Critical areas identified by West Moberly First Nations in relation to BC Hydro's proposed clearing areas" in Exhibit R of Bruce Muir's Affidavit #1, which shows the Peace-Moberly Track (Transmission Corridor), Sucker Lake, and Trappers Lake Critical Areas and the transmission line right-of-way. I have taken the length of the transmission line right-of-way in the Critical Areas and find it to measure 28.5 km or 38% of the 75 km Transmission Line.

E-6.5 Plan and Schedule for Remaining Transmission Line Work

96. In paragraph 4 of his Affidavit #1, Mr. Drown indicates that the transmission lines are being built sequentially, and he provides the sequence and dates of work and completion. He indicates that the work will commence with the construction of the first transmission line (5L5) and the Site C Substation schedule, both to be in service in October 2020, allowing for the decommissioning and removal of the 138 kV lines. Once the existing 138 kV lines are removed (currently planned for November 2020 to October 2021), the second transmission line (5L6) can be completed in the portion of the right-of-way currently occupied by the 138 kV lines. The second transmission line is scheduled to be in service in August 2013.

97. Mr. Drown also indicates, in paragraph 6.h of his Affidavit #1, that 24 foundations for the second transmission line that could not be installed prior to removal of the 138 kV transmission lines will be installed after removal, indicating that some of the second line foundation work can proceed before removal of the 138 kV lines.

98. In paragraph 7 and Exhibit A of his unnumbered Affidavit, Mr. Scott indicates that construction will begin in October 2018. In paragraph 13 of his Affidavit, he indicates that under their current work plan, they will commence work in the Critical Areas, which accounts for 40% of their work, in October 2019. He further indicates that if work were stopped in the Critical Area, Allteck could continue work until approximately March 2020.

99. The provided Allteck resource load schedule in Exhibit A of the Mr. Scott's unnumbered Affidavit shows construction of the 500 kV Transmission Lines continuing from October 2018 through March 2022, or a 40 month duration for construction.

100. The Allteck resource schedule shows completion 16 months before Mr. Drown's projected in service date of August 2023. Mr. Drown's projected in-service date of August 2013, from a October 2018 start of construction, represents a 56 month construction duration and contradicts the Allteck resource schedule. Allteck has the construction contract awarded May 1, 2018, and I will assume Mr. Scott's information to take precedence over Mr. Drown's.

101. In addition, in developing the remaining work schedule for the Transmission Line, I will prorate and subdivide the construction durations for the first line, removal of the 138 kV lines, and second line into separate construction activities to reflect durations of work within the Critical Area and outside of the Critical Area using the 40% factor of corridor in the Critical Area.

102. I recognize that the unfinished clearing work needs to be completed before the first transmission line can be installed. Mr. Drown indicates in paragraph 9 of his Affidavit #1 that the majority of the clearing for the portion of the transmission corridor within the Critical Areas still needs to be done. If no clearing within the Critical Areas had been done, it follows that 40% of the corridor clearing would remain. Since Mr. Drown indicates that 35% of the corridor clearing remains to be done, I would assume that the 35% of the remaining clearing is in the Critical Area and that its completion is prerequisite to starting the transmission line work in the Critical Areas.

103. Figure 4 presents the schedules for remaining transmission line work, which I have developed from the information provided by Mr. Drown, Mr. Scott, and the BC Hydro Annual Progress Report. The durations for the construction of the first 500 kV transmission line, the decommissioning of the two 138 kV lines, and the second 500 kV transmission line provided by Mr. Drown have been factored to reflect the shorter 40 month overall duration of the transmission line contract provided by Allteck. The schedule that I originally created for the assessment used Mr. Drown's and the Allteck activities and durations for the first line, but shortened the removal of the 138 kV Lines and the installation of the second line to reflect a compromise with the shorter Allteck construction schedule.

104. After receipt of the Confidential Documents from Woodward and finding that the REDACTED

REDACTED

Figure 4. REDACTED

REDACTED

E-7 Project Management Schedule of Critical Area Work Construction Activities

105. I have prepared a project management schedule of the work and construction activities planned by BC Hydro for Site C Project components and activities which are within or would impact the Critical Areas. The provided schedule, entitled Project Management Schedule of Critical Area Work Construction Activities (PMS), is attached as Appendix J.

E-7.1 Methodology

106. I have incorporated the Site C Project planned and scheduled work activities for the (i) Highway 29 Realignment, (ii) Hudson's Hope Shoreline Protection, (iii) Reservoir Clearing, and (iv) 500 kV Transmission Line project components and activity, as described and provided by

BC Hydro in the evidence into an integrated schedule of the work using Microsoft Project software. I have extracted the work sequences and durations for the planned and scheduled work from the schedules as presented previously in Sections E-3.5, E-4.5, E-5.5, and E-5.6 of this Report. I have incorporated them into a Microsoft Project schedule showing a complete one-page schedule of all remaining work in the Critical Areas.

107. The Site C Project Milestones for river diversion, start of filling the reservoir, and the in-service, with current dates provided to me by Woodward, have been added, and I have incorporated the required logic ties between the work activities and the milestones.

108. The result is a schedule of the Site C Project construction activity in the Critical Areas, as provided by BC Hydro in their submitted evidence. The primary difference between the schedule I've created and the schedule information provided in the BC Hydro evidence is that the construction work activities that take place in the Critical Areas are differentiated from those outside the Critical Areas. For example, where a Highway 29 segment construction is both within a Critical Area and also outside of the Critical Area, the overall activity duration has been prorated by the length of the highway in the Critical Area, and the complete activity has been separated into two separate activities, one in the Critical Area and one outside of the Critical Areas. The construction activities within Critical Areas are shown as red activities; the construction activities outside the Critical Areas are shown as green activities; and preconstruction activities are as blue activities.

E-7.2 Assumptions

109. I made the following assumptions in developing the PMS:

a. The PMS activities, durations, and logic for sequencing the work for the Highway 29 Realignment work segment activities were essentially used as provided by Mr. Farzad Kossari in his Affidavit #1 and exhibits. The completion dates for the geotech work, the procurement, and the construction of each segment were used in the PMS as provided by Mr. Kossari, except modified as needed to reflect the more current Site C June PMFB Schedule 2018-06-20 information received from Woodward as "Confidential Documents."

b. The PMS activities, durations, and logic for sequencing of the work for the Hudson's Hope Shoreline Protection work are also as provided by Mr. Farzad Kossari in his Affidavit #1 and supplemented by the Environmental Impact Statement construction schedule to provide a work breakdown of activities for the Hudson's Hope Slope Protections work, and then used except modified as needed to reflect the more current Site C June PMFB Schedule 2018-06-20 information received from Woodward as "Confidential Documents."

c. The PMS activities, durations, and logic for sequencing of the work for the reservoir clearing work are as provided by Mr. Cameron Penfold in his Affidavit #1 and

exhibits. The start and finish dates for all reservoir clearing areas and sub areas were incorporated into my Report as presented in his Exhibit, and then used except modified as needed to reflect the more current Site C June PMFB Schedule 2018-06-20 information received from Woodward as "Confidential Documents."

d. The activities, durations, and logic for sequencing of the 500 kV Transmission Line work are as provided by Mr. Matthew Drown and have been modified to provide a shorter work duration as provided by Mike Scott of Allteck in his Affidavit and its attached resource schedule, except modified as needed to reflect the more current Allteck contract schedule information received from Woodward as "Confidential Documents."

e. I added activities for energization of each line at the Site C substation as taken from the Environmental Impact Construction Schedule to augment the work sequence.

f. The dates for the Project Milestones were used as provided to me by Woodward in their instruction letter as follows:
   - River Diversion – September 1, 2020
   - Start of Filling Reservoir – September 1, 2023
   - Project In-Service – November 1, 2024

g. I have added an additional milestone, ISD – Unit1 (Target – first power), with a planned date of REDACTED which I selected from the Site C June PMFB Schedule 2018-06-20 information received from Woodward to use as the earliest major Project Milestone in advance of the Project In–Service milestone, which could be impacted by delay to the transmission line work.

h. Finish to Start logic ties were used from the completion of each Project component activity sequences to the Start of Filling Reservoir milestone for all Highway 29 Realignment work segments, Hudson's Hope Slope Protection, and Reservoir Clearing area sub-areas. Highway 29 segments are not totally constrained by the Start of Filling Reservoir milestone as there is a contingency option of completing the work after reservoir filling and accepting the consequences of detouring traffic during completion as identified by Mr. Kossari.

i. Finish to Start Logic ties were used from the completion of the Transmission Line activity sequences to the Project In-Service milestone.

j. Finish to Start logic ties were used from the completion of the reservoir clearing below 90th percentile clearing activities to the River Diversion milestone.

k. Activities in the schedule are not resource leveled and are independent of any work week calendar. They are input as such only to reflect the calendar duration of the activities.

l. The project start date has been set as May 9, 2018 (approximate date of the Affidavits). The PMS schedule shows the planned work from that date. The PMS has not been progressed and therefore represents the evidence understanding of the BC Hydro planning for Critical Area Project Component work as of May 9, 2018.

E-7.3 Validation

110. In Table 10, I provide a comparison of the construction completion dates of the various project component/activities in the Critical Areas Project Management Schedule with the completion dates identified by the Affidavits of Mr. Kossari, Mr. Penfold, Mr. Drown, and Mr. Scott for the completion of the same construction activities. Table 10 serves to provide a verification that the Critical Areas Project Management Schedule sequence of project component activities ends its construction durations on the same approximate completion dates as those reflected by the May 10 submitted evidence provided by BC Hydro through the Affidavits.

Table 10. Project Management Schedule Construction Completion Dates Compared With BC Hydro Planned Construction Completion Dates
(*Affidavits of Kossari, Penfold, Drown, and Scott)*

Project Component/Activity	Project Management Schedule	BC Hydro Affidavits
East Reservoir Clearing	April 30, 2020	April 30, 2020(1)
Lower Reservoir & Moberly Drainage Clearing	April 30, 2020	April 30, 2020 (1)
Middle Reservoir Clearing	April 29, 2020	April 30, 2020 (1)
Western Reservoir Clearing	March 31, 2023	March 31, 2023 (1)
Hwy. 29 – Lynx Creek Segment	July 10, 2023	July 6, 2023 (2)
Hwy. 29 – Dry Creek Segment	February 8, 2022	January 13, 2022 (2)
Hwy. 29 – Farrell Creek	April 7, 2023	April 14, 2023 (2)
Hwy. 29 – Farrell Creek East	April 14, 2023	April 6, 2023 (2)
Hwy. 29 – Halfway River	January 5 , 2023	December 17,2022(2)
Hwy. 29 – Cache Creek East	June 13, 2023	July 7, 2023 (2)
Hwy. 29 – Cache Creek West	October 7, 2020	June 13, 2023 (2)
Hudson's Hope Shore Protection	October 1, 2022	September23, 2023(2)
Transmission Line	March 31, 2022	August 2023 (3) March 2022 (4)

(1) Kossari Affidavit #1 (Exhibit E)
(2) Penfold Affidavit #1 (Exhibit D)
(3) Drown Affidavit #2 (paragraph 4)
(4) Scott Affidavit # 1 (Exhibit A)

REDACTED

Table 11. Project Management Schedule Construction Completion Dates Compared With BC Hydro Planned Construction Completion Dates
(*Site C Project June 2018 PMFB Schedule)*

Project Component/Activity	Project Management Schedule	REDACTED
East Reservoir Clearing	April 30, 2020	
Lower Reservoir & Moberly Drainage Clearing	April 30, 2020	
Middle Reservoir Clearing	April 29, 2022	
Western Reservoir Clearing	March 31, 2023	
Hwy. 29 – Lynx Creek Segment	July 10, 2023	
Hwy. 29 – Dry Creek Segment	February 8, 2022	
Hwy. 29 – Farrell Creek	April 7, 2023	
Hwy. 29 – Farrell Creek East	April 14, 2023	
Hwy. 29 – Halfway River	January 5, 2023	
Hwy. 29 – Cache Creek East	June 13, 2023	
Hwy. 29 – Cache Creek West	October 7, 2020	
Hudson's Hope Shore Protection	October 1,, 2022	
Transmission Line	March 31, 2022	

REDACTED

PART F: ASSESSMENT OF EFFECT OF INJUNCTION DURATION ON BOTH THE PLANNED SITE C PROJECT WORK IN CRITICAL AREAS AND THE "PROJECT MILESTONES"

F-1 Injunctions

112. The Notice of Application for Injunction under the Notice of Civil Claim, filed by the Plaintiffs on January 15, 2018 under its "Part 1: Orders Sought," identifies two possible scenarios for Injunctions (Appendix N).

113. The first scenario in the Notice of Application seeks to enjoin BC Hydro from undertaking any Site C "Construction Activities" except to the extent they are necessary to 1) ensure safety of Site C; 2) mitigate environmental impacts of Site C as constructed on the date of the Order; and 3) preserve and maintain work constructed (Preservation Activities) on the date of the Order in the event the injunction is lifted. It also prevents BC Hydro and Canada from issuing any further approvals or permits authorizing construction activities except for preservation of work constructed. It further requests an expedited trial to commence 18 months from the date of the Order, or as otherwise fixed by the Court.

114. The second scenario in the Notice of Application seeks to enjoin BC Hydro from proceeding with Construction Activities, except for Preservation Activities, and BC Hydro/Canada from proceeding with further approvals except and unless the Construction Activities a) do not flood the reservoir or b) take place within the critical areas identified in Schedule A to the Application, with the exception of the Preservation Activities, and neither BC Hydro nor Canada are not to rely on any costs incurred, activities taken, or intervening events occurring between the date of the Order and final determination of the Plaintiffs claim in addressing relief.

115. For the purposes of this Report, "Injunction" will mean the second scenario or the halting of only Construction Activities which do not flood the reservoir or do not take place within the Critical Areas identified in Schedule A to the Application (Appendix D), with the exception of the Preservation Activities until the indicated duration of the Injunction.

F-2 Methodology

116. To assess the effect of various lengths of Injunction suspension of work on the planned Site C Project work for the Critical Areas and the Project Milestones, I inserted an Injunction activity labeled "Critical Area Suspension" into the PMS developed in the previous section of this Report, creating a slightly modified version of the schedule. The resultant schedule is a baseline schedule version of the PMS for assessment of various durations of injunctions on the Project Milestones, as well as the affected work activities. A copy of the "Injunction Baseline" schedule is attached to this Report in Appendix K.

117. I logically tied the "Critical Area Suspension" activity to all Critical Area work activities by using predecessors with a finish to start logic tie so as the Injunction activity is given a duration, any tied Critical Area work activity is pushed forward and not able to commence until the injunction has ended. The effect is a delay to all planned work activity sequences whose starts are controlled by a Critical Area work activity. All work sequences also have their finish tied to the reservoir filling milestone or, in the case of the Transmission Line work, the in-service milestone by finish to start logic ties. Therefore, work sequences that are pushed out into the future by the injunction, depending on their durations, will affect and delay the milestone to which it is tied. This manifests in the delay to the milestones of all planned work activities in the Critical Areas until the Injunction is over.

118. The Injunction Baseline schedule was updated in separate cases with Injunction durations of 18, 24, 30, and 36 months to produce separate variations of "Injunction Schedules," each showing the effect of the respective injunction duration. A copy of the "Injunction – 18 Months," Injunction - 24 Months," Injunction – 30 Months," and "Injunction – 36 Months" schedules are attached to this Report in Appendix L.

119. I examined the Injunction schedules that resulted in delays to the Project Milestones to identify which activities were on the critical path and delaying the milestones. I then, in separate cases, adjusted the delaying activities and updated the "Injunction Schedule" to confirm the adjustments and ensure that each of the Project Milestones were met. A copy of any of the "Adjusted Injunction Schedules" are attached to this Report in Appendix M.

120. Finally, I identified the adjustments and examined the feasibility of the adjustments.

F-3 Assumptions

121. I incorporated the following assumptions in the Injunction assessments:

a. The Injunction and Critical Area Suspension activity would commence on October 1, 2018 and, in separate assessments, would last 18, 24, 30, and 36 calendar months.
b. The Injunction would only halt, suspend, or delay (prevent from starting) construction work activities which are physically located in the Critical Areas.
c. Construction work activities which are located outside the Critical Areas would continue or proceed as scheduled during an Injunction. Considering the cost of halting work, missing the Project Milestones, and impacting the cost of the total project, the only cost effective option is to continue as much work as possible as close to originally planned with minimal disruption. This entails continuing with the work outside the critical areas to the extent possible and resequencing the scheduling of work in contracts that can proceed, even if it means suspending the Critical Area portions of work or terminating the contracts and re-contracting the work after the work halt is over if it is ever over. In the case of the reservoir clearing, the suspension of work until the injunction is over is prudent cost management. The reason is that if for some reason the Project never restarts, the cost of clearing is saved. In the case of the Highway 29 Realignment segments, if the work is partially done and completed, it will be useable someday to finish the Highway 29 as highway improvement, even if the Project never restarts.
d. Prerequisite preconstruction activities to Critical Area construction activities, such as engineering, permitting, property acquisition, indigenous relations, heritage & archeology, environmental & regulatory, and procurement would continue or proceed during an Injunction.
e. At the end of the Injunction, all suspended and delayed work activities would restart and continue as rescheduled by the Injunction.

f. The Injunction Baseline Schedule does not interconnect the Injunction Critical Area suspension activity with the dam site activities and other Project activities. The reason is that the Critical Area Injunctions will not control or influence other dam site activities unless the Project Milestones are delayed. Only when the Project Milestones are delayed by Injunction-delayed Critical Area work activities, other Project work activities at the dam site or possibly elsewhere will be adversely impacted by the Critical area Injunctions. Otherwise, they only impact the work in the Critical Areas.

F-4 Injunction – 18 Months

F-4.1 Effect of Injunction Duration on "Project Milestones" Before Adjustments

122. **Injunction – 18 months.** Imposing an 18 month Injunction beginning on October 1, 2018 on the project management schedule of Critical Area work construction activities using an 18 month duration for the Critical areas suspension activity shows that an 18 month Injunction does not affect any of the Project Milestones (see Appendix L - the "Injunction 18 Month" schedule).

F-4.2 Effect of Injunction Duration on Planned Site C Work In Critical Areas

123. Simulation of an 18 month Injunction beginning on October 1, 2018 in the Injunction Baseline Schedule by use of an 18 month duration in the Critical Area suspension (schedule activity no. 6) results in most Project component/activity sequences of activities remaining unchanged, continuing as originally scheduled, and not impacted by the 18 month Injunction. Some Project component/activities with work scheduled in Critical Areas during the Injunction period would be delayed until the 18 month Injunction is over. The Injunction Baseline Schedule does not allow the work in the Critical Area planned to start during the Injunction to commence until the Injunction duration is over. I will provide the specific sequences with no impact and those with impact, as well as the extent of the impact, in the next few paragraphs. In general, the 18 month Injunction can be worked around with minor impacts to the BC Hydro planned schedule of work and the Project.

124. Clearing work for all areas below the Diversion Stage 2 90th percentile flood and 420 m elevation in the Eastern Reservoir area would continue as originally scheduled before river diversion and would not be affected, as all the area is below and outside the Critical Areas (Affidavit #1 of Steven DeRoy). All clearing in the Lower Reservoir and Moberly Drainage area would continue as originally scheduled unaffected. All clearing in the Halfway Drainage sub area of the Middle Reservoir area and the Western Reservoir sub areas would continue unaffected and as originally scheduled.

125. Clearing work for all areas above the Diversion Stage 2 90th percentile 420 m elevation in the North and South Bank sub areas of the Eastern Reservoir area would be delayed from January 16, 2019 to April 2, 2020, or about 14.5 months. Clearing work for the Cache Creek Drainage sub area of the Eastern Reservoir areas would be delayed from November 1, 2018 to

April 2, 2020, or about 17 months. Clearing work for the Halfway Debris Boom sub area of the Middle Reservoir area would be delayed from November 1, 2018 to April 2, 2020, or about 17 months. Clearing work for the Cache Creek sub area of the Middle Reservoir area would be delayed from September 1, 2019 to April 2, 2020, or about 7 months. All would be completed almost two years before reservoir filling on September 1, 2023.

126. All preconstruction activity and procurement for Highway 29 Realignment work and Hudson's Hope Shoreline Protection work would continue as originally scheduled and would not be impacted by the Injunction. All construction of the Highway 29 Realignment segments at Lynx Creek, Farrell Creek, Farrell Creek East, Cache Creek East, and Cache Creek West and the Hudson Hope Shoreline Protection work would continue as originally scheduled and would not be impacted.

127. Highway 29 Realignment construction work at the Halfway River segment would be delayed in starting from October 11, 2019 to April 2, 2020, or about 6 months, but would finish before reservoir filling.

128. The transmission line clearing and 5L5 transmission line work in the Critical Area of the construction work would be delayed from August 2, 2019 to April 2, 2020, or about 8 months, and would cause a suspension in the 5L5 work under the transmission line contract. This delay would delay the energizing of the 5L5 line and Site C substation from October 14, 2020 to March 29, 2021, or about 5.5 months. Completion of the 5L6 transmission line would be delayed from March 31, 2022 to September 12, 2022, or about 5.5 months. The line would be completed and energized a year before start of reservoir filling.

129. I have identified the effects of the 18 month Injunction commencing on October 1, 2018 on all Critical Area work and construction activities in the impact heat map labeled, "Effect of Injunction on Critical Work Activity" for the 18 month suspension of work in Critical areas (see Appendix N-1).

F-4.3 Extent To Which BC Hydro Would Have To Adjust Existing Work Schedules To Ensure Project Milestones Are Met and Feasibility of Adjustments

130. No further adjustments are required to the schedule to ensure meeting the milestones.

F-5 Injunction – 24 Months

F-5.1 Effect of Injunction Duration on Project Milestones Before Adjustments

131. Imposing a 24 month Injunction (beginning on October 1, 2018) on the project management schedule of Critical Area work construction activities using an 24 month duration for the Critical areas suspension activity shows that a 24 month Injunction potentially extends the reservoir

filling milestone for about six months, from September 1, 2023 to February 9, 2024. (See Appendix L for the "Injunction – 24 Months" schedule).

F-5.2 Effect of Injunction Duration on Planned Site C Work In Critical Areas

132. Simulation of a 24 month Injunction beginning on October 1, 2018 in the Injunction Baseline Schedule by use of a 24 month duration in the Critical Area suspension (schedule activity no. 5) also results in many Project component/activity sequences of activities remaining unchanged, continuing as originally scheduled, and not impacted by the 24 month Injunction. Some Project component/activities with work scheduled in Critical Areas during the Injunction period would be delayed until the 24 month Injunction is over. The Injunction Baseline Schedule does not allow the work in the Critical Area planned to start during the Injunction to commence until the Injunction duration is over. I have provided the specific sequences with no impact and those with impact, as well as the extent of the impact, in the next few paragraphs. In general, the 24 month Injunction can be worked around with minor impacts to the BC Hydro planned schedule of work and the Project.

133. Clearing work for all areas below the Diversion Stage 2 90th percentile flood and 420 m elevation in the Eastern Reservoir area would continue as originally scheduled before river diversion and would not be affected, as all the area is below and outside the Critical Areas (Firelight). All clearing in the Lower Reservoir and Moberly Drainage area would continue unaffected and as originally scheduled. All clearing in the Western Reservoir sub areas would continue with a one month delay to their original schedules.

134. Clearing work for all areas above the Diversion Stage 2 90th percentile 420 m elevation in the North and South Bank sub areas of the Eastern Reservoir area would be delayed from January 16, 2019 to October 1, 2020, or about 20.5 months. Clearing work for the Cache Creek Drainage sub area of the Eastern Reservoir areas would be delayed from November 1, 2018 to October 1, 2020, or about 23 months. Clearing work for the Halfway Debris Boom sub area of the Middle Reservoir area would be delayed from November 1, 2018 to October 1, 2020, or about 23 months. Clearing work for the Cache Creek sub area of the Middle Reservoir area would be delayed from September 1, 2019 to October 1, 2021, or about 25 months. Clearing work for the Middle Reservoir Halfway Drainage sub area would be delayed from September 2, 2020 to September 1, 2021, or about 12 months. All would be completed at least six months before reservoir filling, which is scheduled for September 1, 2023.

135. All preconstruction activity and procurement for Highway 29 Realignment work and Hudson's Hope Shoreline Protection work would continue as originally scheduled and would not be impacted by the Injunction. All construction of the Highway 29 Realignment segments at Lynx Creek, Dry Creek, Farrell Creek, Farrell Creek East, Cache Creek East, and Cache Creek West and the Hudson Hope Shoreline Protection work would continue as originally scheduled and would not be impacted.

136. Highway 29 Realignment construction work at the Halfway River segment would be delayed in starting from October 11, 2019 to October 1, 2020, or about 12 months. Its completion would

also be delayed from January 5, 2023 to December 28, 2023, or about 12 months. The Halfway River segment without schedule adjustment would also delay making the reservoir filling milestone on September 1, 2023 to December 28, 2023, or about 4 months.

137. The transmission line clearing and 5L5 transmission line work in the Critical Area of the construction work would be delayed from August 2, 2019 to October 1, 2020, or about 14 months, and would cause a suspension of the 5L5 work under the transmission line contract. This delay would delay the energizing of the 5L5 line and Site C substation from October 14, 2020 to September 28, 2021, or about 11.5 months. Completion of the 5L6 transmission line would be delayed from March 31, 2022 to March 13, 2023, or about 11.5 months. The line would be completed and energized before reservoir filling.

138. I have identified the effects of the 24 month Injunction commencing on October 1, 2018 on all Critical Area work and construction activities in the impact heat map labeled, "Effect of Injunction on Critical Area Work Activity" for the 24 month suspension of work in Critical areas (see Appendix N-2).

F-5.3 Extent To Which BC Hydro Would Have To Adjust Existing Work Schedules To Ensure Project Milestones Are Met and Feasibility of Adjustments

139. An adjustment to the work activities controlling the critical path of the activities in the 24 month Injunction schedule delaying the reservoir filling milestone to February 9, 2024 could be made to ensure the start of filling reservoir milestone would be met. The adjustment would require the use of constructive acceleration to shorten the 39 month construction period of the Highway 29 Halfway River construction work to 35 months to make up the four months of delay and to complete the work by September 1, 2023.

140. Constructive acceleration of work is a technique used in managing construction to make up delays to critical path work and/or milestones by increasing the rate of construction efforts by 1) adding more staff and equipment and workers; 2) working additional shifts, such as swing or graveyard; 3) imposing an extended work week by adding one or multiple longer work day(s); or 4) use of occasional overtime on selected work to do more work in less time and effect acceleration of the work. Any of the four means of implementing constructive acceleration can be used individually or in combination to effect the delay recovery.

141. To demonstrate the use of constructive acceleration at Halfway River, assume the planned construction work is scheduled 5 days a week and 8 hours a day. For this example, assume a work force of one man would be required to complete the work at 173 hours per month for 39 months. To save 4 months of schedule, constructive acceleration techniques would be put into place early enough in the 35 month shortened schedule to perform the last 4 months of required effort in the shortened 35 month schedule. Additional effort of 4 x 173 hours, or 692 hours, plus any effort to overcome inefficiencies in production related to the accelerated work, would have to be made up in the 35 month accelerated schedule to accomplish the time savings.

142. I have used constructive acceleration negotiated with contractors effectively as a contract change a number of times in to save time in completing construction and making critical milestones in previous projects. It is a routinely used tool for management of construction to overcome project delays. At the Bradley Lake Hydro Project, I negotiated forward pricing with the contractor and imposed a 10 hours per day for 7 days two-shift operation for the power tunnel work, as well as working for many months over the Thanksgiving, Christmas, and New Year holidays, to make up for months of delay in completing a critical tunnel completion milestone. I also used constructive acceleration at the Cowlitz Falls Hydro Project to complete diversion works in time to make a critical diversion milestone. Missing that milestone would have resulted in a year of project schedule delay.

143. Based on the recent TAB report No. 18, BC Hydro is already using acceleration techniques and schedules with the Main Civil Works contractor to try to meet its modified diversion milestone as well as its Right Bank RCC Buttress schedule.

144. In the previous example, making up four months of schedule during a 35 month accelerated construction schedule would be accomplished by a combination of adding crews, shifts, overtime, or extended work weeks. As a hypothetical example using a work force of one person, it would require performing 4 x 173 or 692 hours of work over the 35 months in addition to the 35 x 173 or 5882 hours of planned work. This is (692 + 5882)/5882, or 17.6% percent more effort during the 35 months than originally planned work effort. Providing 17.6% more effort during the construction period with constructive acceleration techniques should be feasible.

145. It is my opinion that use of constructive acceleration techniques would be feasible to recover 4 months of schedule over a 35 month period and would ensure that the reservoir filling milestone would be met under the 24 month Injunction scenario. Making these adjustments and updating the schedule update to reflect the shorter 35 month accelerated construction activity for Halfway River and the 35.5 month accelerated construction activity for Farrell Creek confirms that meeting the start of reservoir filling milestone would be ensured. See the "Adjusted With Constructive Acceleration" schedule for the 24 month Injunction in Appendix M that shows the effect of the schedule adjustments on the previous Injunction – 24 Months schedule showing the delayed Project Milestones.

146. More effectively and probably with less cost, the Halfway River segment could be bid to a shorter construction schedule either during or after the Injunction and used with a delayed notice to proceed at the end of the Injunction. If the Injunction and suspension of work continued, the contract notice to proceed could be extended or the contract terminated and rebid, saving the construction costs of constructively accelerating work that was already awarded.

F-6 Injunction – 30 Months

F-6.1 Effect of Injunction Duration on Project Milestones Before Adjustments

147. Imposing a 30 month Injunction (beginning on October 1, 2018) on the project management schedule of Critical Area work construction activities using a 30 month duration for the Critical areas suspension activity shows that a 30 month Injunction potentially extends the reservoir filling milestone for about 10 months, from September 1, 2023 to July 26, 2024. The effect of this delay on the project in-service milestone is outside the scope of this assessment, but it is reasonable to expect that the in-service date could be also delayed by late filling of the reservoir if the in-service milestone were not delayed for other reasons.

F-6.2 Effect of Injunction Duration on Planned Site C Work In Critical Areas

148. I simulated a 30 month Injunction beginning on October 1, 2018 in the Injunction Baseline Schedule by use of a 30 month duration in the Critical Area suspension (schedule activity no. 6). This simulation also results in a large number of Project component/activity sequences of activities remaining unchanged, continuing as originally scheduled, and unimpacted by the 30 month Injunction. A number of Project component/activities with work scheduled in Critical Areas during the Injunction period are delayed until the 30 month Injunction is over. Under the Injunction Baseline Schedule, the work in the Critical Area planned to start during the Injunction cannot start until the Injunction duration is over. I have provided the specific sequences with no impact and those with impact, as well as the extent of the impact, in the next few paragraphs. In general, the 30 month injunction can be worked around with some impacts to the BC Hydro planned schedule of work and the Project.

149. Clearing work for all areas below the Diversion Stage 2 90th percentile flood and 420 m elevation in the Eastern Reservoir area would continue as originally scheduled before river diversion and would not be affected, as all the area is below and outside the Critical Areas (Firelight, xx). All clearing in the Lower Reservoir and Moberly Drainage areas would continue unaffected and as originally scheduled. All clearing in the Halfway Drainage sub area of the Middle Reservoir area and the Western Reservoir sub areas would continue with a 10 month delay to their original schedules.

150. Clearing work for all areas above the Diversion Stage 2 90th percentile 420 m elevation in the North and South Bank sub areas of the Eastern Reservoir area would be delayed from January 16, 2019 to March 31, 2021, or about 26.5 months. Clearing work for the Cache Creek Drainage sub area of the Eastern Reservoir areas would be delayed from November 1, 2018 to March 31, 2021, or about 29 months. Clearing work for the Halfway Debris Boom sub area of the Middle Reservoir area would be delayed from November 1, 2018 to March 31, 2021, or about 29 months. Clearing work for the Cache Creek sub area of the Middle Reservoir area would be delayed from September 1, 2019 to March 31, 2021, or about 19 months. All would be completed more than 5 months before reservoir filling on September 1, 2023.

151. All preconstruction activity and procurement for Highway 29 Realignment work and Hudson's Hope Shoreline Protection work would continue as originally scheduled, with the exception of a two month delay in the start of construction to the Hudson's Hope Shoreline Protection work, and not be significantly impacted by the Injunction. Construction of the

Highway 29 Realignment segments at Farrell Creek, Farrell Creek East, Cache Creek East, and Cache Creek West would continue as originally scheduled and would not be impacted.

152. Highway 29 Realignment construction work at the Dry Creek segment construction would be delayed in starting from October 7, 2020 to March 31, 2021, or about 6 months, but would finish before reservoir filling. The Lynx Creek segment construction would be delayed in starting from January 18, 2022 to July 28, 2022, or about 6 months. The Lynx Creek bridge would complete on March 11, 2024, or about 5.5 months after the reservoir started filling. It would potentially delay the reservoir filling milestone and could be consequential to other Project Milestones. The Halfway River segment would also be delayed in starting from October 11, 2019 to March 31, 2021, or about 18 months. Its completion would also be delayed from January 5, 2023 to June 26, 2024, or about 18 months. The Halfway River segment would significantly delay making the reservoir filling milestone from September 1, 2023 to June 26, 2024, or about 10 months. The Cache Creek East segment bridge would also be delayed in starting construction from October 8, 2020 to March 31, 2021, or about 6 months. Its completion would also be delayed 6 months until June 28, 2023, and it would potentially finish after the original reservoir filling Project Milestone by about 3 months. The Cache Creek East segment highway would not be delayed, but the sequence of work would have to proceed with the work outside of the Critical Area first.

153. The Transmission Line clearing and 5L5 transmission line work in the Critical Area of the construction work would be delayed from August 2, 2019 to March 31, 2021, or about 20 months, and would cause a suspension in the 5L5 work under the Transmission Line contract. This delay would also delay the energizing of the 5L5 line and Site C substation from November 6, 2020 to June 29, 2022, or about 20 months. Completion of the 5L6 transmission line would be delayed from November 23, 2022 to July 24, 2024, or about 20 months. The line would be completed and energized before reservoir filling.

154. I have identified the effects of the 30 month Injunction, commencing on October 1, 2018, on all Critical Area work and construction activities. See Appendix N-3

F-6.3 Extent To Which BC Hydro Would Have To Adjust Existing Work Schedules To Ensure Project Milestones Are Met and Feasibility of Adjustments

155. Two adjustments to work activities controlling the critical path delaying the reservoir filling milestone would need to be made to ensure the reservoir filling milestone would be met. The adjustments would require 1) accelerating the construction schedule of the Highway 29 Halfway River construction work for 10 months and 2) accelerating the construction schedule of the Cache Creek bridge construction work for 3 months, to complete the work of both by September 1, 2023. Without further study and further information on the details of the work, I do not know if the reduction of the construction of the Halfway River construction work from 39 to 29 months would be feasible. I believe that the reduction of the construction of the Cache Creek East bridge construction work from 32 months to 29 months would be feasible.

156. Nevertheless, if either application of constructive acceleration techniques or bidding a shorter 29 month construction schedule were not feasible to complete the construction before the start of the reservoir filling milestone, additional schedule adjustments could be made so that the completion of both the Cache Creek East and Halfway River segments would not be prerequisite to the start of filling the reservoir and could be completed after the start of reservoir filling milestone was achieved. Mr. Kossari, in his Affidavit #1 (paragraphs 23, 24, and 25), indicates that deferring completion of highway construction until after the start of reservoir filling would be inconvenient to local traffic, resulting in detours and increased travel time, but he confirms it would be feasible and more favorable than delaying the reservoir filling. The impacts for local traffic would be last as long as the time to complete the highway segments, which would be months. Clearly, this would be preferential to delaying the total project for a year and in all cases would ensure that the start of reservoir filling milestone would not be delayed.

157. Making these adjustments to the schedule and 1) updating the schedule update to reflect the shorter 29 month accelerated construction activity for Halfway River and the 29 month accelerated construction activity for Cache Creek East, or 2) removing the completion of construction of the Halfway River and Cache Creek East segments of the Highway 29 Realignment as a prerequisite to reservoir filling confirms that meeting the start of reservoir filling milestone would be ensured.

F-7 Injunction – 36 Months

F-7.1 Effect of Injunction Duration on Project Milestones Before Adjustments

158. Imposing a 36 month Injunction (beginning on October 1, 2018) on the project management schedule of Critical Area work construction activities using a 36 month duration for the Critical areas suspension activity shows that a 36 month injunction extends the reservoir filling milestone for about 18 months, from September 1, 2023 to February 7, 2025. The effect of this delay on the project in-service milestone is outside the scope of this assessment, but it is certain that the in-service date would also be delayed by late filling of the reservoir if the in-service milestone were not delayed for other reasons.

F-7.2 Effect of Injunction Duration on Planned Site C Work In Critical Areas

159. I simulated a 36 month Injunction beginning on October 1, 2018 in the Injunction Baseline Schedule by use of a 36 month duration in the Critical Area suspension (schedule activity no. 6). This simulation still results in many Project component/activity sequences of activities remaining unchanged, continuing as originally scheduled, and not impacted by the 36 month Injunction. Almost all of these would be preconstruction activities and those construction sequences which do not involve significant work in the Critical Areas. A number of Project component/activities with work scheduled in Critical Areas during the Injunction period would be delayed until the 36 month injunction is over. I have provided the specific sequences with no impact and those with impact, as well as the extent of the impact, in the next few paragraphs

160. Clearing work for all areas below the Diversion Stage 2 90th percentile flood and 420 m elevation in the Eastern Reservoir area would continue as originally scheduled before river diversion and would not be affected, as all the area is below and outside the Critical Areas (Affidavit #1 of Steven DeRoy). All clearing in the Lower Reservoir and Moberly Drainage area would continue unaffected and as originally scheduled. All clearing in the Halfway Drainage sub area of the Middle Reservoir area and the Western Reservoir sub areas would continue with a 13 month delay to their original schedules.

161. Clearing work for all areas above the Diversion Stage 2 90th percentile 420 m elevation in the North and South Bank sub areas of the Eastern Reservoir area would be delayed from January 16, 2019 to October 1, 2021, or about 32.5 months. Clearing work for the Cache Creek Drainage sub area of the Eastern Reservoir areas would be delayed from November 1, 2018 to October 1, 2021, or about 35 months. Clearing work for the Halfway Debris Boom sub area of the Middle Reservoir area would be delayed from November 1, 2018 to October 1, 2021, or about 35 months. Clearing work for Cache Creek sub area of the Middle Reservoir area would be delayed from September 1, 2019 to October 1, 2021, or about 25 months. All clearing would be completed six months before reservoir filling on September 1, 2023.

162. All preconstruction activity and procurement for Highway 29 Realignment work and Hudson's Hope Shoreline Protection work would continue as originally scheduled. Although an 8 month delay in the start of the Hudson's Hope construction would occur, the construction would complete well before start of filling of the reservoir. The construction of the Highway 29 Realignment segments at both Farrell Creek East and Cache Creek West would continue as originally scheduled and would not be impacted by the 36 month Injunction.

163. Highway 29 Realignment construction work at the Lynx Creek segment bridge would be delayed in starting from October 7, 2020 to October 1, 2021, or about 12 months. Completion of construction would be delayed until March 11, 2024, or about six months after the start of reservoir filling. Dry Creek segment construction would be delayed in starting from October 7, 2019 to October 1, 2021, or about 12 months, and would finish before start of reservoir filling. The Farrell Creek segment construction would be delayed in starting from April 17, 2021 to October 1, 2021, or about 6 months. It would complete on October 23, 2023, or about 1 month after the start of reservoir filling The Halfway River segment would be delayed in starting from October 11, 2019 to October 1, 2021, or about 24 months. Its completion would be delayed from January 5, 2023 to December 24, 2024, or about 16 months. The Halfway River segment would significantly delay the start of Reservoir filling milestone from September 1, 2023 to December 24, 2024, or about 16 months. The Cache Creek East segment bridge would also be delayed in starting construction from October 8, 2020 to October 1, 2021, or about 9 months. Its completion would be delayed until June 4, 2024, or 9 months after the original reservoir filling Project Milestone.

164. The Transmission Line clearing and 5L5 transmission line work in the Critical Area of the construction work would be delayed from August 2, 2019 to October 1, 2021, or about 26 months, and would cause a major suspension in the 5L5 work under the Transmission Line

contract. This delay would also delay the energizing of the 5L5 line and Site C substation from October 14, 2020 to September 22, 2022, or about 23.5 months. Completion of the 5L6 transmission line would be delayed from March 31, 2022 to March 12, 2024, or about 23.5 months. The line would be completed and energized before the in-service milestone.

165. I have identified the effects of the 36 month Injunction commencing on October 1, 2018 on all Critical Area work and construction activities in the Critical Areas Project Management Schedule. See Exhibit N-4 of Appendix N.

F-7.3 Extent To Which BC Hydro Would Have To Adjust Existing Work Schedules To Ensure Project Milestones Are Met and Feasibility of Adjustments

166. Four adjustments to work activities controlling the Critical path delaying the reservoir filling milestone would need to be made to ensure the reservoir filling milestone would be met. The adjustments would require 1) accelerating the construction schedule of the Highway 29 Halfway River construction work by about 16 months to be completed by September 1, 2023 rather than December 27, 2024; 2) accelerating the construction schedule of the Farrell Creek construction work by about 11 months, to be completed by September 1, 2023 rather than October 3, 2023; 3) accelerating the construction schedule of the Lynx Creek bridge construction work by about 6 months to be completed by September 1, 2023 rather than March 11, 2024;and 4) accelerating the construction schedule of the Cache Creek East Bear Flat bridge construction work by about 9 months, to be completed September 1, 2023 rather than June 4, 2024. Without further study and further information on the details of the work,

167. Nevertheless, as presented in paragraphs 160 and 161 of this Report, if any application of constructive acceleration techniques were not feasible to complete the construction of the Highway 29 segment before the start of reservoir filling milestone, additional schedule adjustments could be made to remove any prerequisite to starting to fill the reservoir and allow the work to be completed after the start of reservoir filling milestone was achieved (Kossari, paragraphs 23, 24, and 25). Making these adjustments to the schedule confirms that meeting the start of reservoir filling milestone would be ensured.

F-8 Effects of Injunction Duration and Schedule Adjustments on Project Milestones

168. I have summarized the effects of the Injunction schedule updates and Injunction durations with the previously defined adjustments on the three Project Milestones in Table 12.

Table 12. Effect of Injunction Duration on Project Milestones

	Injunction	Project Milestones		
Schedule Run	**Duration**	**Diversion**	**Reservoir Fill**	**In-Service**
Injunction – 18A	18 Months	Sep. 1, 2020	Sep. 1, 2023	Nov. 1, 2024

Injunction – 24A	24 Months	Sep. 1, 2020	Sep. 1, 2023	Nov. 1, 2024
Injunction – 30A	30 Months	Sep. 1, 2020	Sep. 1, 2023	Nov. 1, 2024
Injunction – 36A	36 Months	Sep. 1, 2020	Sep. 1, 2023	Nov. 1, 2024

F-9 Estimated Cost of Effects of Injunctions and Schedule Adjustments Required to Meet the Project Milestones

F-9.1 BC Hydro Estimated Costs of Critical Area Suspensions

169. In his Affidavit #1, Alan Le Couteur presents his estimate of costs to the Site C Project of various injunction suspension scenarios. For the Critical Area suspensions, he presents two scenarios. Scenario C is for a halt to work in areas labeled as Critical on the map attached to the Plaintiffs Notice of Application for a period of two years. Scenario D is the same, but for a period of three years. His estimated costs attributed to the two scenarios are presented in his Exhibit C spreadsheet, which sets out his costs by category. I have reproduced and provided his estimates in Table 13.

170. Mr. Le Couteur in Affidavit #1 states that he spent three months working on his estimate and that it was for the BCUC inquiry. It is not clear what budget information he uses as a basis of his estimate. I expect that it may not reflect the January 2018 adopted $10.7 billion increased budget. It is evident from the Confidential Cost Spreadsheet (provided after Mr. Le Couteur's Affidavit) from the work sheet #3 for environmental information that the Confidential Cost Spreadsheet cost estimate was prepared for the BCUC suspension of 7 years for all Project activities being suspended 7 years. Because of his meddling of costs of all Project activities for his cost category items, Mr. Le Couteur's prorating of all suspended and impacted costs to a two and three year suspension of only Critical Area work activities would not be valid. Furthermore, it makes it impossible to determine what Mr. Couteur's numbers would be for his Scenarios C and D for Injunctions only affecting work activities in Critical areas and not affecting the Project Milestones.

Table 13. Costs Resulting From Suspension Scenarios By Category
(Le Couteur, Exhibit C)

Cost Category	Scenario C Costs to Suspend Critical Areas 2 Years ($M)	Scenario D Costs to Suspend Critical Areas 3 Years ($M)
1. Preservation Costs (Safety, Quality, Environment, Security, Assets)	8.0	9.0

2.	Construction Contracts	64.8	101.8
3.	Permitting Requirements	9.5	19.1
4.	Reinitiate/Acceleration	82.0	82.0
5.	Benefit Agreements	1.9	3.7
6.	Indirects	77.3	132.8
	Subtotal	**243.6**	**348.3**
7.	**Contingency (33%)**	80.4	114.**3**
	Subtotal	**324.0**	**363.2**
8.	Inflation	130.7	268.5
9.	IDC	205.9	381.3
	TOTAL COST	**660.6**	**1113.0**

171. In paragraph 7 of his Affidavit #1, Mr. Le Couteur, for Scenario C (two year suspension of work in Critical areas), makes the assumption that the river diversion, construction of the embankment dam, reservoir filling, and project in-service date would all be shifted out 1 year, delaying the Main Civil Works contractor. Consequently, Mr. Le Couteur's estimated costs would be expected to include many items of costs from Site C project activities other than those suspended in the Critical Areas. If true, his estimated costs would be overstated for any suspension or halt of work in the Critical Areas that does not impact the Project Milestones.

172. In paragraph 32 of his Affidavit #1, Mr. Le Couteur, for Scenario D (three year suspension of work in Critical Areas), also makes the assumption that the river diversion would be delayed a second year and would result in a delay of 2 years to the project in-service date. Therefore, here also Mr. Le Couteur's estimated costs would be expected to include many items of cost from Site C Project activities other than those suspended in the Critical Areas. If true, here also his estimated costs would be overstated for any suspension or halt of work in the Critical Areas that does not impact the Project Milestones.

173. Mr. Le Couteur's Affidavit #1 and Exhibit C do not provide enough information to understand what is in Mr. Couteur's Exhibit C figures. However, review of a provided confidential document, the "Confidential Master Estimate Suspension Injunction.xlsx" spreadsheet ("Confidential Spreadsheet)," provides further information on the cost elements which make up Mr. Le Couteur's figures. REDACTED

174. In the subsequent paragraphs for his various cost categories, I identify in general terms from the "Confidential Spreadsheet" that many of Mr. Le Couteur's cost items used in his cost estimate are not valid cost elements of the Scenario C and D injunction suspensions. I will furthermore demonstrate that they significantly overstate the impact cost of the Critical Area Injunction suspensions of work, and are based on incorrect assumptions regarding the effect of the Injunction work suspensions on both the Project Milestones and the Critical Area work activities as I have previously presented them in Sections F-4, F-5, and F-6 of this Report, as well as in schedules and impact assessment on work areas contained in Appendices L, M, and N. ***These sections of this Report have clearly supported with certainty that none of the 18, 24, 30, and 36 month long Critical Area work Injunction suspensions will delay the Project Milestones of river diversion, reservoir filling, and project in-service dates under any circumstances. They also have demonstrated that most all critical work activities will proceed as currently scheduled with only selected delays and specific work activity suspensions to relatively few work activities occurring in the Critical Areas (Appendix N)***.

175. For cost category number 1, Preservation Costs, the "Confidential Spreadsheet" REDACTED

176. For cost category number 2, Construction Contracts, the "Confidential Spreadsheet" REDACTED All Project Milestones are met with the Critical Area work Injunctions and therefore, any cost element dependent on a Project Milestone delay should not be included in his estimate for Scenario C and D costs.

177. For cost category number 3, Permitting Requirements, the "Confidential Spreadsheet" REDACTED All project milestones are met with the Critical Area work Injunctions and therefore, these cost elements should not be included in his estimate for Scenario C and D costs.

178. For cost category number 4, Reinitiate/Acceleration, the "Confidential Spreadsheet" REDACTED

REDACTED In the Section F-6 narratives for each Injunction and the Critical Area Injunction Heat Maps in Appendix N showing the effects of the Injunctions on Critical Area work activities, it has been confirmed that the effects of the Injunctions of various durations only suspend or delay the start of Critical Area work activities and do not require the need for acceleration, with the exception of some minor Highway 29 Realignment segment construction. No acceleration is required for the clearing, as all clearing work is only started late but finishes before filling the reservoir. No acceleration is required for the transmission line work. It only requires resequencing of work and late start of certain activities. No milestones are delayed, so no dam acceleration originates from the Critical Area Injunctions. Mr. Le Couteur's estimates for cost category 4 are significantly overstated and based on assumptions that are not valid Scenario C and D costs.

179. For cost category number 5, Indirects, the "Confidential Spreadsheet" REDACTED If the Critical Area injunction suspensions do not delay the Project Milestones and all the impacted Critical Area work is completed by the start reservoir of filling, or in the worst case, continues for some months during reservoir filling, Mr. Le Couteur's estimates for cost category 4 are significantly overstated and based on assumptions that are not valid Scenario C and D costs.

180. For cost category number 6, Costs Pursuant to Community Agreements, Mr. Le Couteur's affidavit clearly relates these cost elements to delay of the Project. Since there is no delay to the Project Milestones, Mr. Le Couteur's estimates for cost category are not valid Scenario C and D costs.

181. For cost category number 7, Contingency, the "Confidential Spreadsheet" REDACTED The 2014 Final Investment Decision, Site C Project Budget of $8.775 billion, used a contingency of 14.2% of direct construction costs and indirect costs excluding other and sunk costs (BCUC Final Report, Table 26).

F-9.2 Methodology and Assumptions

182. I have used the identification of specific impacts to the Critical Area project management schedule and Injunction baseline schedule as provided in Appendix N to provide estimated costs to the Project of the impacts of the four Injunction cases on the affected Project components. I

have incorporated some of Mr. Le Couteur's cost elements where I have not determined them to be invalid or significantly overstated. I have also used Mr. Le Couteur's derivation and use of allowances for contingency, inflation, and interest during construction (IDC) and will use them to prepare and present a summary of the cost of each injunction in the same format as the 2014 Final Investment Decision Budget.

183. For cost category number 1, Preservation Activities, I have used Mr. Le Couteur's cost elements from the "Confidential Spreadsheet" REDACTED

184. For cost category number 2, Construction Contracts, I have revisited the Injunction Impact Heat Maps in Appendix N and added a spreadsheet ("Injunction Cost Spreadsheet") with columns (Appendix P) used to develop and gather the additional costs of the scheduled construction work activity caused by three categories of impacts that will increase the cost of the constructed work. The three categories of impacts as shown on the Appendix N Heat Maps and the Appendix L and Appendix M schedules simulating the various injunctions are: 1) the resequencing of the Critical Area and non-Critical Area work where it applies; 2) the delay to the start of Critical Area work until the Injunction is over and, in a few cases, with the longer duration Injunctions; and 3) the use of constructive acceleration to completed the delayed work prior to the milestone that the sequence of work controls. I have used columns 2, 3, and 4 to quantify the direct cost of these impacts for each impact shown on each of the Appendix N Injunction Impact Heat Maps for the 18, 24, 30, and 36 month Injunctions.

185. For cost category number 3, Permitting, I have used Mr. Le Couteur's figures for overall Project permitting costs for all areas, but have prorated them by the direct cost of the Critical Area Project components to the direct cost of all Project components, or the Project direct costs from the FIDB budget. This proration amounts to $411,900,000/$4,468,000,000, or 9.21% of the permitting costs. REDACTED

REDACTED

186. Column 1 of the Appendix P Injunction Cost Spreadsheets is used for the direct construction cost of the project component or activity. REDACTED

Since Column 1 of the Appendix P Injunction Cost Spreadsheets and the Appendix N Heat Map uses the Critical Area project management schedule Project component and activity breakdown and the impacts are identified at that breakdown, I further allocated some of the cost items from the Final Investment Decision Budget cost items. For the reservoir clearing, I made the allocation by prorating the total reservoir clearing budget item by the respective clearing areas of the reservoir clearing areas and sub areas. Where the Highway 29 segments were further broken down into east and west segments and some segments included bridges, I further allocated the Final Investment Decision Budget cost items for the Highway 29 segments by judgement of highway length and bridge length.

187. For the Additional Resequence Work Cost in Column 2 of the Appendix P Injunction Cost Spreadsheets, I assumed the resequencing additional impact cost of any resequenced construction work was 2.5% of the construction contract direct costs of the work. This additional cost is the cost of having to construct the work in the prescribed sequence. It is assumed that the work will be bid this way and that this cost will be mitigated by advance planning and its being bid competitively. This is not a situation where a change of sequencing of the work is being mandated after award and start of construction. As indicated previously, I assume that all preconstruction activities will proceed during the Injunction without impact and that only construction activities will be delayed by the Injunctions. I assume that the various contract packages will be developed and bid as necessary with the work predefined by scope and milestone dates so that the work will be planned and bid to perform non-Critical Area work as planned and Critical Area suspended work after the end of the work suspension. It is assumed and expected that this will mitigate the construction cost of having to work the non-critical work areas first and wait until the end of the Injunction to commence with the critical work to a 2.5% additional cost of the work over what it would cost if the contractor were able to plan and execute it without sequencing where required. Bidding work with use of milestones to work around delayed availability of work areas is common practice as well as resequencing awarded work to work around delay to certain areas and work activities. BC Hydro and the Main Civil Works contractor are currently in the middle of resequencing the RCC Buttress work of the spillway and powerhouse to make its schedule.

188. For the Additional Cost of Injunction Delayed or Suspended Work in Column 3 of the Appendix P Injunction Cost Spreadsheets, the additional cost of the delayed starts of work is assumed to be the escalation of the cost of the direct construction cost at an annual inflation rate of 2%. Column 3 factors in the additional impact cost of delayed work by factoring the direct cost in Column 1 by the amount of delay in months as shown in the Heat Map. My assumption is that the increase in the direct cost of the work due to the delayed start will be the estimated direct cost escalated though the duration of the delay to the work at 2% annually. The additional impact cost uses the escalation percentages for various periods of delay as shown at the bottom of the spreadsheet applied to the direct cost of construction, based on the amount of delay shown in the Heat Map for the Injunction.

189. For the additional cost of constructive acceleration in column 4 of the Appendix P Injunction Cost Spreadsheets, the additional cost of acceleration is assumed to include the added cost of 1) adding equipment and craft during the shortened period; 2) working additional shifts, such as swing or graveyard; 3) imposing an extended work week by adding one or multiple longer work day(s); or 4) use of occasional overtime on selected work to do more work in less time and effect acceleration of the work. The cost of adding small additions of more staff and equipment is assumed be the same as adding the additional equipment and workers during the original extended schedule and would not contribute to additional costs of constructive acceleration. The additional cost of working additional shifts for constructive acceleration of the extended work week would be the cost of additional supervision and shift differentials. The additional cost of an extended work week would be the premium portion of overtime and any loss of efficiency due to the extended work week which would be dependent on the duration of the extended work week. The additional cost of occasional overtime would be the premium portion of the overtime. For the additional cost of constructive acceleration in Column 4, I developed an acceleration cost factor to

be applied to the direct cost of the item by identifying the months of the original planned construction schedule to be made up. I assumed that the hours to be made up in the shortened construction would be made up of a combination of adding equipment and workers and use of occasional overtime. I assumed half of the work hours would be made up by adding equipment and craft over the shortened construction schedule and half would be made up by occasional overtime with associated premium cost at time and one half. I made a hypothetical calculation of shortened schedule original work hours plus made up hours with half at premium time divided by original schedule work hours to get a factor of the added cost of the accelerated effort as percentage of the total original planned work. The constructive acceleration cost factor was separately derived for each specifically required acceleration requirement and original construction schedule duration and is identified at the bottom of each Injunction Cost Spreadsheet. It was applied to the total direct cost of the work item.

190. The additional direct cost of construction due to the injunction impacts to the work activities in the Critical Areas, in Column 5 of the Appendix P Injunction Cost Spreadsheets, is the total of Columns 2, 3, and 4.

191. In the Appendix P Injunction Cost Spreadsheets, I implemented a step by step build-up of additional direct costs of construction column by column to arrive at a bottom line Total Additional Project Cost. The arrived-at cost reflects the additional Project cost incurred by the impact of the Critical Area Injunctions. The build-up across the Appendix P Injunction Cost Spreadsheet is in the format of the Final Investment Decision Budget. Columns 5, 7, 9, and 10 of the spreadsheet provide the indirects, contingency, inflation, and additional interest during construction respectively. I derived the factors assumed and applied in the cost spreadsheet for these additional cost items from the 2014 Final Investment Decision Budget, which is reproduced from the BCUC and shown in Table 14.

Table 14. Final Investment Decision, Site C Project Budget

Element	Estimated Cost ($million)
Direct Construction Costs	$4,468
Indirect Costs:	
BC Hydro Personnel and Consultants	325
Other and Sunk Costs	815
Total Indirect Costs	**$1,130**
Total Construction Cost Without Contingency	**$5,598**
Contingency	679
Total Construction Cost	**$6277**
Inflation	651
Interest During Construction	1,407
Total Project Cost Loaded	**$8,335**

192. For the Indirect Cost amounts put into Column 5 of the Appendix P Injunction Cost Spreadsheets, I obtained the indirect cost rate to be applied to the direct construction cost in Column 4 from the Final Investment Decision Budget in Table 13. I applied the indirect cost rate to direct construction costs in the spreadsheet from the ratio of the FIDB indirect costs to the FIDB direct construction costs, or 1130/4668, or 25%.

193. For the Contingency Cost amounts put into Column 7 of the Appendix P Injunction Cost Spreadsheets, I obtained the contingency rate to be applied to the direct construction costs in Column 4, from the Final Investment Decision Budget in Table 13. I applied the contingency rate factor to direct construction costs in the spreadsheet from the ratio of the FIDB contingency to the FIDB direct construction costs, or 679/4468, or 15.2%.

194. For the Inflation amounts put into Column 9 of the Appendix P Injunction Cost Spreadsheets, I obtained the inflation rate to be applied to the total construction costs with contingency in Column 8 from the Final Investment Decision Budget in Table 13. I obtained the inflation rate factor to be applied to the total construction costs without contingency from calculating the ration of the FIDB inflation to the FIDB total construction cost without contingency, or 1407/6277, or 10.49%.

F-9.3 Estimated Costs of Critical Area Injunctions of 18, 24, 30, and 36 Months

195. I have set forth the estimated costs of the Critical Area Injunctions of 18, 24, 30, and 36 months from impacts on the Critical Area work activities from the Appendix P Injunction Cost Spreadsheet and the proration of the preparation costs from the previous paragraph in Table 15. It summarizes the estimated costs of Critical Area Injunctions as adjusted with constructive acceleration or delayed in the worst case to ensure meeting of the milestones and shows their comparison for the 24 and 36 month cases with Mr. Le Couteur's Critical Area halts for two and three years.

Table 15. Estimated Additional Project Costs of Critical Area Injunctions of Various Durations

Critical Area Injunction	Estimated Additional Project Cost ($M rounded to hundred million)
18 Months	$18.7
24 Months	$33.1
30 Months	$55.4
36 Months	$73.3
BC Hydro –two years	$660.0
BC Hydro- three years	$1110.0

196. I recalculated the estimated additional project costs of each Injunction duration using the revised direct costs of the Project components (Highway 29, reservoir clearing, Hudson's Hope Shore Protection, and Transmission Line) recently received from Woodward as a Confidential Document. The origin and basis of these numbers were not identified and I am uncertain as to what budget or forecast they represent. Nevertheless, I revised and updated a separate version of the original Injunction Cost Spreadsheet cost model for each Injunction duration using this information as direct construction cost of the various components. The resulting estimated additional Project cost for the Injunctions of 18, 24, 30, and 36 months respectively are REDACTED

PART G: EXPERT OPINION ON THE LIKELIHOOD THAT BC HYDRO WILL FAIL TO MEET THE PROJECT MILESTONES

197. To provide an expert opinion on the likelihood that BC Hydro will fail to meet the "Project Milestones," I have reviewed the available information provided by BC Hydro on the status of the Project work to identify what construction activities or issues have been or are delaying planned critical path work and/or has been identified as major risk issue potentially affecting current or future work. In the following sections and paragraphs, I will: 1) identify the major risk issues of the Site C Project to date being realized delaying construction; 2) for one or two of the most problematic risk issues, present the extent to which the risk issue has been realized in the work to date, and 3) provide supporting assessment and evidence that that the risk will continue to delay the Site C Project work and consequently the current Project Milestones. Finally, based on the information presented, I will provide my opinion on the likelihood of further delay to the Project Milestones.

198. The most likely risk issues that could potentially further delay the Project Milestones are those ongoing issues and construction activities that have delayed the river diversion to date, are currently significantly behind schedule and/or are currently still delaying the Project, and/or have a potential to continue to delay the Project and any of its milestones in the future. There may be other risk issues not yet realized because the work has not commenced. Traditionally, there are major risks in dam and hydroelectric projects, especially when they have complex and challenging geology and foundations like the Site C Project. As an example, the grouting work for the earth fill dam and attaining an effective cutoff will have its risks, which will not be realized until it starts.

199. Of particular interest are the issues that are currently delaying the scheduled diversion of the river or delaying turnover of the RCC buttress work areas to the Generating Station Contractor. The reason is that these have been declared by the TAB in January/February 2018 in their Report

No. 18 to both be clearly on the critical path of work. Significant further delays most likely will affect the river diversion milestone and/or other Project Milestones controlled by the powerhouse.

200. I reviewed the Project Quarterly Progress Reports, the Technical Advisory Board Reports, the Leaves To Construct documents, and the most recent June MCW and BC Hydro Progress Reports and updated schedules in the Confidential Documents to identify the significantly delayed construction activities and the important issues recently or currently affecting the Project with potential for further delaying the Project Milestones. These include the following items, which I identify for further discussion:

a. Right Bank RCC Buttress
b. Right Bank Excavation Completion
c. Right Bank Drainage Tunnel Completion
d. Left Bank Excavation and Stabilization Completion
e. Diversion Tunnel Excavation Completion
f. MCW Work Quality and NCRs
g. MCW/GSS Contract Interfaces

201. In the following subsections and paragraphs, I will describe each of these items relative to their associated risks and highlight and provide the evidence from various reviewed documents that indicate and support that they will most likely further delay the Project Milestones. The evidence will be extracted where it exists from the BC Hydro Quarterly, Progress Reports, the BCUC Inquiry Report, the Leaves to Construct, the Technical Advisory Board Meeting Reports, and various Confidential Documents made available to the Plaintiffs.

G-1 Right Bank RCC Buttress

G-1.1 Description of Work

202. The Right Bank Roller Compacted Concrete (RCC) Buttress will be one of the most important features of the Site C Project, both in size and function. It will be a massive concrete structure constructed of almost two million cubic meters (cu m) of concrete along the south (right bank) of the Peace River inside the Stage 1 right bank cofferdam, and in total will extend for approximately 750 m from the upstream side of the core of the earth fill dam to the downstream end of the spillways. It will consist of five sub-structures with five different purposes. It includes:

1. Core buttress – provides the south (right) abutment of the earth fill dam at the core;
2. Dam buttress – provides the south abutment of the downstream shell of the earth fill dam;
3. Powerhouse buttress – provides the foundation for the generating station;
4. Spillway buttress– provides the foundation for the spillways and stilling basin; and
5. Tailrace wall – provides a barrier between the tailrace and toe of the earth fill dam.

203. I have attached to the Report Figures 4.12, 4.13, and 4.14 through 4.21 from the Environmental Impact Statement, which provide a graphic understanding of the Right Bank RCC

Buttress and its sub structures. They include a general arrangement of the project; an artist rendering of the dam, generating station, and spillways; and plans and cross sections of the Right Bank RCC Buttress sub structures (see Appendix Q). Figure 4.16 shows a plan view of the core, dam, powerhouse, and spillway buttresses. Figures 4.17 through Figure 4.20 show the cross sections of the four sub structures and how the powerhouse and spillway structures will sit on top of the RCC Buttresses.

204. I have also attached a copy of the Leave to Construct LTC #06A dated June 2, 2017 for the Buttress, which provides a description of the works and the initial construction implementation plan and schedule (see Appendix R.) In the following paragraphs, I will extract and summarize some significant aspects of this information.

205. The RCC buttress structure is massive. It will be 747 m long and vary in width by as much as 354 m.

206. The RCCX structures will be entirely founded on excavated bedrock surfaces. The bases of the powerhouse and spillway buttress will be at El 345m, more than 35 meters below the existing river level.

207. The design of the buttress will be strongly influenced by the site geological conditions. The geological features in the shale bedrock that have particular influence on the RCC buttress design are the flat-lying low strength bedding planes, steeply-dipping relaxation joints, and cross-cutting shears. Also, the shale bedrock tends to swell and rebound when unloaded with both a short term elastic response and a longer term swelling response. In addition, there are "locked in" in situ stresses in the rock that tend to cause movement when an excavation is opened. The design for the powerhouse, dam, and spillway buttresses include movement joints to accommodate potential movements in the underlying bedrock foundation. An observational method has been adopted for the design of the buttress which depends on rock movement measurements before construction of the buttress starts. Adjustment of the movement joints or additional reinforcement to control cracking is based on the observational method.

208. The total volume of RCC to be placed is more than 1.7 million cu m. The RCC Contract includes weather and temperature restrictions on placing RCC, which require a limited seasonal period when outdoor temperatures are warm enough for RCC placement. Additionally, the configuration of the structures and access to them impose practical limits on placement rates. To limit the time between loading and unloading of the foundation bedrock, the RCC buttress will be constructed in three sections over three years, each with rock excavation during the cold season and RCC placement during the following warmer season as summarized in Table 16 below.

Table 16. Original RCC Buttress Plan and Schedule

Year	Component	Quantity (cu m)	Total (cu m)
2017	Powerhouse buttress	347,000	

	Tailrace Wall	70,500	
	Downstream Spillway Stilling Basin	72,500	
	Tailrace channel	19,000	509,000
2018	Spillway buttress	625,000	
	Spillway walls	102,500	727,600
2019	Dam and Core Buttress	490,000	490,000
		Total	1,726,600

G-1.2 Issue and Risk

209. In April 2018, an Amendment #1 to the Leave To Construct (LTCX) the Right Bank RCC Buttress issued on June 2, 2017 was issued documenting what occurred with the Right Bank RCC Buttress 2017 in its first placement season. It revises a two-stage revised plan for continued future work (see Attachment Q). It confirms that the construction of the right bank drainage tunnel advanced more slowly than originally planned and that the Powerhouse RCC Buttress was only partially completed in 2017. As a result, BC Hydro did not authorize the spillway buttress excavation to proceed during the 2017-18 winter season as originally planned. The Amendment #1 confirms that the issue was discussed with the Technical Advisory Board Meeting No. 18 and that BC Hydro authorized the spillway excavation and powerhouse RCC buttress to be placed in two stages.

210. The Amendment #1 LTC provides the revised RCC placement plan. In the revised plan, the tailrace wall and channel are moved from 2017 to 2018, the spillway RCC placement will be completed over two years in 2018 and 2019, and the dam and core buttresses will be completed in 2020. The revised RCC placement plan is summarized in Table 17.

Table 17. Revised RCC Buttress Plan and Schedule

Year	Component	Quantity (cu m)	Total (cu m)
2017	Powerhouse buttress	106,508	
	Downstream Spillway Stilling Basin	72,500	179,008
2018	Tailrace wall	70,500	
	Tailrace channel	19,000	
	Powerhouse buttress	240,492	

	Spillway buttress	120,000	449,992
2019	Spillway buttress	505,000	
	Spillway walls	102,500	607,600
2020	Dam and Core buttress	490,000	490,000
		Total	**1,726,600**

211. The RCC for the downstream spillway stilling basin was placed in 2017. The revised plan includes excavation of sufficient bedrock in the spring of 2018 to allow placement of the upstream stilling basin RCC in the summer of 2018. The remainder of the excavation for the spillway buttress is to be completed in the winter of 2018-19, with the remainder of the spillway RCC being placed by 2019.

212. The Amendment #1 and Table 17 confirm that for some reason, the MCW Contractor was only able to place 179,008 cu m of RCC during the first of its three planned years of RCC placement. This is only 35% of its planned 2017 placement. Consequently, the MCW Contractor's RCC production and placement rate and ability to complete the work within acceptable schedule became a significant Project risk and issue.

213. If 179,000 cu m of RCC replacement represents the weather restrained seasonal production capacity of the MCW Contractor to place RCC, then the completion of the all the RCC buttresses work would take 1,726,600/179,008 = 9.64, or over nine years. Since the Generating Station Contractor cannot start its work for the powerhouse until the Powerhouse Buttress is completed, they would be delayed by 240,492/179,008 = 1.34, or one and one third years, most likely delaying the powerhouse construction and the project in-service milestone.

214. The previous simplified extrapolations would indicate that at the end of 2017 BC Hydro and the MCW Contractor had to be aware that the Right Bank RCC Buttress work was a major project risk.

215. The 2017 BC Hydro Project Quarterly Progress Reports 8, 9, and 10, with respective cutoff dates of June, September, and December 2017 provide some insight as to what was happening to the RCC production.

216. Quarterly Progress Report No. 8 with a June 2017 cutoff status date indicates that the powerhouse excavation milestone for 2017 was substantially achieved on May 31, 2017 and the Contractor began placement in the stilling basin on June 2017. It indicates, "…however there was a delay and PRHP have proposed means to allow work to be extended into the winter period which mitigates the risk of the handover date for the Generating Station and Spillways."

217. Quarterly Progress Report No. 9 with a September 2017 cutoff status date indicates, "The contractor began placement in the stilling basin on June 4, 2017, however Roller- Compacted-Concrete production in the Stilling Basin and Powerhouse was lower than projected and Peace River Hydro Partners achieved 30 per cent of the Roller-Compacted Concrete placement for 2017. Through the summer 2017, the Contractor's schedule updates and progress reports indicated that the Roller Compacted Concrete production rates could be accelerated in order to meet the 2017 Roller-Compacted Concrete milestones. On August 29, 2017, the Contractor reported that the 2017 Roller- Compacted Concrete milestones would not be met." The report further attributes delays to late procurement of key pieces of equipment and spare parts, equipment failures, Contractor's low rates and supply of aggregates production, Contractor's difficulties in managing high daytime temperatures that limited/prevented Roller-Compacted Concrete placement during the day in the height of summer, and the forecasted low nighttime temperatures that would prevent Roller Compacted Concrete during the night shift from September 2017 onwards. It further states that BC Hydro and PRHP are working together to resequence the Roller-Compacted Concrete excavations and placement in 2018, 2019, and 2020 to mitigate the risk of the handover date for the Generating Station & Spillways.

218. Quarterly Progress Report No. 9 further indicates that BC Hydro is also using a portion of the 12 months of Owner's float to extend the contractual in-service dates for Unit 1 and 6 to provide more schedule duration to complete the generating station and spillways scope of work. If true, and BC Hydro used up its 12 months of float absorbing the diversion delay and extending them, then there is no more available float and these extensions most likely will extend the current in-service milestones which were maintained with the Owner's 12 months of float.

219. Quarterly Project Report No. 10 with a December 2017 cutoff status date indicates, "Despite recovering the schedule delays experienced in 2016 and completing the powerhouse excavation, Peace River Hydro Partners was unable to achieve milestone thresholds in 2017 on the placement of the Roller-Compacted Concrete. Peace River Hydro Partners was only able to complete 30 per cent of the expected placement of Roller Compacted Concrete in 2017 due to various issues experienced throughout the work season. BC Hydro and Peace River Hydro Partners are considering options to mitigate the risk of the handover date for the Generating Station and Spillways."

220. I conclude from the documented RCC placement problems and rates of production achieved by the MCW during its first year that at the end of 2017, the Right Bank RCC Buttress issue became a large risk realized. While it appears that both parties are making efforts to mitigate further delay, the critical information needed to understand this risk as of today is what has happened in 2018 to date.

G-1.3 Assessment of Continuing Delay

221. I reviewed the following confidential documents,

- Picture 36 – RCC Operations placement chart from the PRHP Monthly Schedule and Progress Report for May 2018,
- Unlabeled RCC Placement graph for the tailrace, service bay, and powerhouse as of June 13, 2017,
- Unlabeled sheet from the Main Civil Construction Progress Tracker dated June 13, 2018 showing planned and actual quantities of RCC placed in various locations, and
- RCC Placement Update to TAB, June 8, 2018, Brad Hallett,

which provide updated information on the current status of the Right Bank RCC Buttress, including quantities of RCC placed this year into mid-June (See Appendix S)

222. I have extracted quantities placed through June 13 from these documents and shown them versus those planned for 2018 in Table 18.

Table 18. Status of 2018 RCC Buttress Plan and Schedule
(through June 13, 2018)

Year	Component	Quantity (cu m)	
		Planned	**Actual**
2018	Tailrace wall	70,500	REDACTED
	Tailrace channel	19,000	
	Powerhouse buttress	240,492	REDACTED
	Spillway buttress	120,000	
	Total	**449,992**	REDACTED

REDACTED

REDACTED

226. I did a further analysis of the current placement plan shown in Table 17 to determine how delayed the dam and core blocks would be for various average RCC production rates maintained to complete the plan. REDACTED

With these projected and likely RCC placement delays, independent of the issues with the takeover of the buttresses by the GSS, the dam and core block delays would almost certainly

have a high probability of delaying the dam completion another year beyond the already current diversion delayed milestone for reservoir filling.

227. The planned baseline RCC production is overly optimistic and not realistically achievable as evidenced by the past two seasons of the original three planned. Sustained rates of REDACTED cubic meters a month for concrete production, even for a project the size of the Site C Project, are unusually high. With having to start up from a seasonal shutdown every spring and accomplish these rates of placement with the temperature restrictions and day and night temperatures for the area in combination with the logistics of these placements, the planned baseline is unrealistic. At Three Gorges Dam, our team worked two years to get the Chinese contractor to ramp up and meet its planned peak schedule production of producing and placing 400,000 cubic meters a month. The RCC production planned and required at the Site C Project in the baseline plan identified in the PRHP chart seeks to meet consistently 25% of the peak concrete production and placing capacity achieved at Three Gorges Dam, a project which set world records for concrete volumes and production rates.

228. The only positive aspect about Right Bank RCC Buttress issue is that the full realization of this risk and the certainty of delay will be known for sure in a few months as the summer ends.

G-1.4 Expert Opinion On Likelihood of Failure to Meet Milestones

229. My expert opinion, as supported by the previous referenced evidence and my assessment of the RCC production history of the past year as it related to future schedule requirements, is that there is an extremely high probability and likelihood that the Project Milestones will be delayed by the delay in the remaining RCC Buttress work affecting both the earth fill dam construction and GSS construction work, even if the challenging Left Bank Diversion Facility accelerated plan and schedule succeed and there is no further diversion delay.

G-2 Right Bank Excavation

230. The scope and phasing of the Right Bank bedrock excavation is described by the Leave to Construct LTC #3D dated October 7, 2016 and LTC #3D, Recommendation for Amendment #1 dated November 30, 2016. They indicate that the volume of rock to be excavated in the approach channel and RCC buttress are approximately 8.2 million cu m and 2.3 million cu m respectively. They further indicate that PRHP has sequenced these excavations into six phases, with the first four phases involving sequential excavation of the RCC Buttress to include: Phase 1) powerhouse excavation; Phase 2) spillway excavation; Phase 3) tailrace channel excavation; and Phase 4) dam and core excavation. The Phase 1-4 excavations will extend over an area approximately 750 m by 300 m, and as deep as 35 m below the existing river level.

231. The bedrock excavations and RCC placements for construction of the RCC Buttress are to be completed in a sequential manner. In general, excavation for an individual buttress section is to be carried out during the colder season, and the RCC for the buttress is to be placed during the

following warm season. PRHP's baseline schedule originally indicated that the Phase 1 powerhouse buttress excavation was to occur during 2016-17, the Phase 2 spillway buttress excavation during 2017-18, and the Phase 4 dam and core buttress excavation during 2018-19. The Phase 3 tailrace excavation was to occur during 2017.

232. Per the LTC #3D Amendment #2 dated April 2018, the status of the Right Bank excavation was updated. The LTC indicates that the Phase 1 powerhouse excavation and Phase 3 tailrace excavations were completed as planned during 2016-17, but the powerhouse RCC buttress was only partially completed. Consequently, BC Hydro did not authorize the Phase 3 spillway buttress excavation to proceed during the 2017-18 winter season as originally planned.

233. Both the #3D, Amendment #2 and the TAB Meeting minutes confirmed that the original schedule for excavation and the RCC buttress were revised, with the continued excavation of the spillway buttress to be carried out in two stages. The revised plan includes excavation of sufficient rock in the spring of 2018 to allow placement of the upstream stilling basin RCC in the summer of 2018, with the remainder of the spillway RCC being placed in 2019.

234. The TAB expressed concern about the plan. The October 12-13 TAB Workshop minutes indicated that to complete the RCC placement in the RCC Buttress in the summer of 2018, and to excavate the spillway buttress in winter 2018-19, resulted in a one year delay to the MCW contract milestone. The TAB further indicated that the RCC placement in the spillway buttress is on the critical path, so there is schedule risk and available window in 2018 that needs to be maximized. They were also concerned that if the excavation of the spillway buttress were concurrent with placement of RCC in the powerhouse buttress, there would be a risk to the RCC powerhouse buttress that could stop excavation of placement of RCC for some time.

235. Review of the Confidential Document, MCW BC Hydro RB, LB, Div Progress Report 2018-06-13, shows REDACTED

236. As of June 13, 2018, REDACTED

REDACTED

238. It is my opinion, based on the previous observations and information in Appendix T, that the current progress and status of the work that the Right Bank excavation is seriously behind schedule and currently falling behind further. Since the RCC buttress excavation is in sequence, not only are the powerhouse turnover milestones to the GSS in jeopardy, but there is significant likelihood that the spillway work will be delayed another year, as well as the dam and core blocks, which could put the earth fill dam construction two years behind schedule. It is most likely as a result of the current Right Bank spillway excavation delay and the risk of additional delay that both the powerhouse work and dam construction would be delayed and lead to missing the current Project Milestones another year.

G-3 Right Bank Drainage Tunnel

239. My review of the Technical Advisory Board Workshop minutes of October 12-13 indicates that the excavation of the spillway buttress can only proceed when the Right Bank Drainage Tunnel (RBDT) is completed under the spillway buttress.

240. The RBDT Progress Chart included in the Confidential Document, MCW BC Hydro RB, LB, Div Progress Report 2018-06-13, provides evidence that REDACTED

241. The scope of the RBDT is described in the Leave To Construct LTC #1H dated August 23, 2016. It is approximately 975 m long and to be constructed within the shale bedrock under the RCC buttress. It is a small U-shaped tunnel only 3.7 m wide and 4.3 m high. The tunnel was started in February 2017, but was halted in March due to dust suppression and ventilation systems deficiencies caused by the use of a road header to excavate the tunnel. By October, as confirmed in the Leave To Construct #01H Amendment #1, dated October 11, 2017, only 45 m had been excavated. In October, per the LTC #1H, a change in construction method was requested to go to drill and blast. The target completion date was identified as January 30, 2018.

242. The RBDT Progress Chart shows that as of June 13, 2018, REDACTED

243. It is my opinion that the RBDT should be a straightforward, simple, small tunnel to excavate, and the progress and delays in completing it have been unusual and highly detrimental to the progress and finalization of the design of the Right Bank Buttress. My review of the Technical Board Advisory Reports going back two years indicate that they have expressed the same opinion. It is clear that due to the critical importance of the RBDT to the advancement of RCC buttress

excavation, and the observational method which they have adopted for the design and placement of the RCC buttress, the delay is difficult to understand and clearly a sign of potential problems in moving to the excavation of the two relatively massive diversion tunnels, which the TAB has confirmed in its Report No 18. are on the critical path.

G-4 Left Bank Excavation and Stabilization

244. Review of the Leaves To Construction LTC #01G for Amendments #2 and #3 dated March 9, 2017 and March 31, 2017, respectively, and the TAB reports No. 16, 17, and 18 confirms that the Left Bank excavation initially encountered tension cracks opening up and proceeded with further instrumentation to identifying movement and discovery of former ancient landslides and unstable rock. The conditions required stabilization measures which the progress reports show have delayed the Left Bank progress and added to the quantities of excavation and embankment. The Confidential Document, MCW BC Hydro RB, LB, Div Progress Report 2018-06-13, provides information that REDACTED [redacted] It is my opinion that this situation led to the late start of the diversion facilities and most likely the year delay in the river diversion milestones, and it was evident well before the announcement was made.

245. REDACTED [redacted]
The recent TAB Report No. 18 indicates that there still are concerns with the silver fill and the stability of the continuing excavation. I am not certain with the information that I have had time to review, but it appears that the remaining work still is impacting the access to the diversion inlet and outlet portals for safety concerns.

246. Based on the previous described conditions and status, it is my opinion that there is likelihood of further delays at the Left Bank as work is completed that may still impact the start of the diversion facilities work.

G-5 Diversion Tunnel Facilities

247. My review of the Leaves to Construct LTC #05A, LTC #05A Amendment #1, and LTC #05A Amendment #2 provides a description of the scope of the Diversion Tunnel Facilities. The two diversion tunnels will be approximately 700 m and 792 m long, each with a circular cross section and a finished internal diameter of 10.8 m. The tunnels will be entirely excavated in bedrock with a modified horseshoe shape, and will have an excavated diameter of 12.2 m along most of the tunnel length, increasing to 15 m at the inlet and outlet transitions. At the tunnel portal face, the excavated slope will be about 70 m high. In November 2017, LTC #05A Amendment #2

confirmed a modified design for the diversion tunnel inlet portal involving a benched design which was to take an estimated duration of almost seven months.

248. In report no. 18, the Technical Advisory Board in early February 2018 expressed the following concerns about the diversion facilities and their schedule risks.

a. Inlet Portal – need to manage the "sliver fill" slide and slow progress on the critical path of the slow benching work.

b. Diversion Tunnel – the tunnel productivity being a critical issue compounded by the requirement for cleaning and grouting and regulatory issues regarding silica dust. They identify the dominant factor affecting the goals is the tunnel production, noting that the regulatory bodies have not yet approved the excavation plan.

c. Outlet – risk of slide management.

249. For the diversion tunnel to commence excavation, the diversion tunnel inlet portal must be completed. It is currently scheduled for REDACTED

250. It is my opinion that the largest risk controlling the completion of the diversion tunnel facilities will be the timely completion of tunnel excavation. Based on the subpar performance to date of the Right Bank Drainage Tunnel, I seriously doubt the capability of the Main Civil Works contractor to take on and effectively perform to an accelerated schedule for two major tunnels, each more than seven times the size of the RBDT. The RBDT was a small pilot project compared to the two almost 12. 2 meter diameter tunnels.

251. REDACTED Based on the current schedule, this should be determinable over the next six months. The diversion tunnels need to be completed including linings in thirteen months from October 2018.

G-6 MCW Work Quality and NCRs

252. The BC Hydro Quarterly Project Reports have regularly reported on project quality and counts of Non Conformance Reports ("NCRs") processed by the BC Hydro team. I have observed

that there are always a large number of NCRs generated and being processed. It is also evident that many are not closed rapidly.

253. The number, frequency, and lengths of time to close NCRs are an indicator of the quality of work being put into place on a project. NCRs are generated to document work that is out of compliance and not in accordance with the specifications requirements. They serve as a tracking tool to monitor and correct work quality by the contractors. Normally, an NCR is closed by correction of the non-compliance, which many times leads to rework and correction of defective or unacceptable work. Most times where there are many NCRs that are not being closed quickly on a project, the NCRs are indicative of issues with quality of work, which normally leads to delays to work production. NCRs are also signs of work stoppage or suspensions, which also delay production. In the Technical Advisory Board reports going back two years, there have been comments expressing increasing concern about quality of the Main Civil Contractors work and the amount of attention and staff it is taking the BC Hydro team to attempt to address the issue.

254. In Technical Advisory Board Report No. 18 in Section 4.3, the TAB notes several work stoppages relating to quality and NCRs at the RCC Powerhouse buttress and the Right Bank Drainage Tunnel. They indicate that, "there must be more attention to QC and QA during construction and it must be seriously implemented, tracked and rectified in a timely manner."

255. I have worked with many Technical Advisory Boards and sat on JV Project Management Boards. Boards take interest in issues that potentially become problems affecting the project. They are always careful about identifying problems and usually political on how they address them. They usually try to avoid communication of concern and emphasis on problem areas, particularly when it concerns project problems with management of things like quality, safety, or schedule. The emphasis on quality in the TAB Report No. 18 is unusual. In my opinion, it is the sign of a large performance problem with the MCW contractor meeting the requirements of the specifications and quality of work. In my experience, when this situation occurs it is nearly always accompanied by serious delays in the work due to quality issues involving rework or stoppages of the work until work can be done in accordance with contract requirements.

256. In the Confidential Documents, REDACTED

REDACTED
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258. REDACTED
. If the poor quality of work does not get turned around, it will continue to affect the performance and production of work and raise the likelihood of further delay and that the current Project Milestones will not be met.

G-7 REDACTED

REDACTED

[redacted]

[redacted]

PART H: EFFECT OF DELAYED PROJECT MILESTONES ON INJUNCTION SCENARIOS IN PART F

H-1 Effect of Injunction Duration on Delayed Project Milestones and Project Work Activities

267. I determined the effect of four Injunction durations on the Project Milestones using a year of additional delay of the current milestones and the four Injunction schedule updates. I made these determinations with the Critical Area Project Management Schedule Injunction Baseline using the 18 month, 24 month, 30 month, and 36 month durations assigned to the Critical Area suspension activity. The Injunction schedule updates are attached to this Report in Appendix O.

268. **Injunction – 18 months.** I have shown that an 18 month Injunction does not affect any of the Project Milestones by imposing an 18 month Injunction (beginning on October 1, 2018) on the project management schedule of Critical Area work construction using an 18 month duration for the Critical Areas suspension activity and delaying Project Milestones an additional year from the current 1 year delayed dates.

269. **Injunction – 24 months.** I have shown that a 24 month Injunction does not affect any of the Project Milestones by imposing a 24 month Injunction (beginning on October 1, 2018) on the

project management schedule of Critical Area work construction using an 18 month duration for the Critical Areas suspension activity and delaying Project Milestones an additional year from the current 1 year delayed dates.

270. **Injunction – 30 months.** I have shown that a 30 month Injunction does not affect any of the Project Milestones by imposing a 30 month Injunction (beginning on October 1, 2018) on the project management schedule of Critical Area work construction using an 18 month duration for the Critical Areas suspension activity and delaying Project Milestones an additional year from the current 1 year delayed dates.

271. **Injunction – 36 months.** I have shown that a 24 month Injunction extends the reservoir filling milestone for about 6 months from September 1, 2023 to February 9, 2024, by imposing a 36 month Injunction (beginning on October 1, 2018) on the project management schedule of the Critical Area work construction activities using a 36 month duration for the Critical Areas suspension activity and delaying project milestones an additional year from the current 1 year delayed dates.

272. The start of reservoir filling milestone in the 36 month update is again controlled by the Halfway River construction period finishing 4 months past the start of reservoir filling milestone. As was the situation in the 24 month injunction scenario with the existing Project Milestone dates, an adjustment could be made to the construction activity to reflect constructive acceleration to make up the delay. This adjustment, which I had already shown to be feasible in the 24 month scenario without delayed Project Milestones, would result in assurance of making the delayed start of reservoir filling milestone. The effect of the 36 month injunction on project work activities would be similar to the impacts to Critical Area work activities in the 24 month scenario, and the 36 month injunction, in this case, could be effected and worked around.

273. I have summarized the effects of the schedule updates and Injunction durations on the three Project Milestones in Table 20. Similar constructive acceleration adjustment as previously made for the non-delayed 24 month Injunction scenario would ensure making the Project Milestones in the 36 month delayed one year Injunction scenario.

Table 20. Effect of Injunction Duration on Project Milestones Delayed One Year

Schedule Run	Injunction Duration	Project Milestones		
		Diversion	Reservoir Fill	In-Service
Injunction – 18	18 Months	Sep 1, 2021	Sep 1, 2024	Nov 1, 2025
Injunction – 24	24 Months	Sep 1, 2021	Sep 1, 2024	Nov 1, 2025
Injunction – 30	30 Months	Sep 1, 2021	Sep 1, 2024	Nov 1, 2025
Injunction – 36	36 Months	Sep 1, 2021	Dec 27, 2014	Feb 26, 2026

*Four month delay is recoverable by using constructive acceleration on the Highway 29 Realignment Halfway River segment construction stage.

Appendix A to
Expert Report of E. Harvey Elwin
July 6, 2018

Summary Biography
E. HARVEY ELWIN

Mr. Elwin has over forty years of experience managing the delivery of multi-disciplinary civil infrastructure water supply and hydropower projects internationally and domestically including planning, permitting, design and construction phases. This experience includes over twenty years as a Senior Project/Program/Operations Manager directly responsible for major roles for implementing major world class mega heavy civil water and hydropower capital projects and programs valued over $40 billion. These include the recent award winning and successful $4.6 billion San Francisco Hetch Hetchy Water System Improvement Program; the $30 billion Three Gorges Dam in China; the $4.3 billion Uribante-Caparo Project in Venezuela; and the $2 billion Ghazi Barotha Hydroelectric Project in Pakistan.

Mr. Elwin began his career in 1969 with San Francisco-based Bechtel where he worked for 26 years advancing to increasingly responsible project management positions for the delivery of heavy civil water and hydropower projects and, eventually retiring from Bechtel as a Senior Project Manager. He accepted a vice presidency with O'Brien Kreitzberg in 1995, where he oversaw all Northwest US Region construction management. In 1997, he joined Harza and went to NW Pakistan to manage the world class $2 billion Ghazi Barotha Hydro Project Power Facilities as Chief Resident Engineer. In 1999, he became a Senior Partner and General Partner for Harza Engineering and as Asia Operations Manager managed program and construction management for dam and hydroelectric projects in the Western United States and Asia. From 2001 to 2004 he served as Vice President and in 2003-2004 a Global Director for MWH Energy and Infrastructure where he managed MWH's project management and construction management practice for heavy civil water and hydroelectric projects worldwide with projects and staff working in 20 countries. He served on several Boards of Management overseeing major dam and hydroelectric project delivery and completion from 1999 to 2004. The 1460 MW Ghazi Barotha Hydroelectric project was completed in 2004 on schedule and under its original 2.25 billion US$ budget.

From 2004 to 2012 he consecutively managed and provided leadership for both the Project and Construction Management Bureaus, of the City and County of San Francisco's Public Utilities Commission where he supervised a diverse team of project and construction managers, overseeing delivery of capital programs and

projects for local and regional water systems, primarily the $4.6 billion Water System Improvement Program (WSIP). The WSIP included 86 projects ranging from $3 million to $600 million. They included tunnels, pipelines, pump stations, valve vaults, dams, and treatment plants

Mr. Elwin managed Program Management-Construction Management for the western region of the Commercial, State, and Local Division of the Environmental and Infrastructure Group of Shaw E&I a CBI Company until February 2014 when he retired. He joined Shaw in 2012 to lead Shaw's pursuit of the DWR $14 billion world class Delta Habitat Conservation Conveyance Project.

Currently Mr. Elwin is providing consulting services to large public and private sector infrastructure capital program/projects for delivery of heavy civil, dam, and hydropower water facilities. Services include provision of project management, engineering management, construction management, program/project controls, and claims professional consulting services as an Independent Consultant. Assignments include project management advisory and risk assessment services for implementation of the world class $9 billion Site C Dam/Hydro Project in British Columbia and bidding and tender evaluation assistance for the $1 billion Azad Pattan Hydropower Project in Pakistan.

Mr. Elwin established a reputation for working successfully with clients and consultants to develop expertly integrated large project and program organizational high performing teams. He has worked with diverse international clients with varying degrees of project skills to significantly improve project management standards and effectively execute world-class projects. He is especially known for taking over project management responsibilities on troubled water and hydro power projects, then successfully completing these projects under extremely difficult conditions.

A registered Professional Civil Engineer in Washington, Oregon, Idaho, Alaska and California, Mr. Elwin received two undergraduate degrees, in Civil Engineering and Mathematics, from Oregon State University; and a graduate degree in Civil Engineering, concentration on Hydraulics and Water Resources, from Oregon State University. He is a life member of the American Society Civil Engineers and US Society of Dams. He is a member of Construction Management Association of America (CMAA), Project Management Institute (PMI), and the Society of Sigma X (the scientific research honorary). He won a 2010 national CMAA award for the construction planning of the City of San Francisco $4.6 billion Water System Improvement Infrastructure Program and in 2011 won the Project Management Institute College of Scheduling national "Crystal Award" for Innovative Scheduling for WSIP Construction Program CMIS and P6 control systems. Mayor Ed Lee of San Francisco proclaimed April 30, 2012 as "Harvey Elwin Day in San Francisco" on his retirement from SFPUC for his contributions to SFPUC and the City of San Francisco. He is bilingual, semi- fluent in Spanish.

Resume

E. HARVEY ELWIN, P.E.

409 T Avenue
Anacortes, WA 98221
415 299 2140 (mobile)
Ehelwin@hotmail.com

CURRENT POSITION: Independent Consultant providing professional engineering services internationally to Public Sector Owners, Contractors, and Private Sector Professional Services Consultants for delivery of heavy civil water and power facilities including dams, tunnels, canals, pipelines, pumping plants, hydroelectric plants, treatment plants, and other associated facilities. Services include provision of project management, project startup and implementation, engineering management, construction management, program/project control, disputes resolution, and other professional consulting services as president of PMCM Associates LLC.

Summary:

Most of Mr. Elwin's career has been directly involved with developing, designing, and managing the construction of complex civil infrastructure water dam and hydroelectric projects around the world. He has 46 years of progressively responsible experience in the leadership of planning, permitting, engineering, procurement and contracting, and construction management of dams, water projects, hydroelectric powerhouses, canals, tunnels, pipelines, transportation facilities, and other heavy civil interdisciplinary projects. He is especially known for taking over project management responsibilities on troubled water and hydro power projects, then successfully completing these projects under extremely difficult conditions.

This experience includes over thirty one years as a Project/Senior Project/Program/Operations Manager directly responsible for major roles for implementing major world class mega capital projects and programs.. These projects include the $4.6 billion San Francisco Water Improvement Program, the $27.6 billion Three Gorges Dam in China, the $4.3 billion Uribante-Caparo Project in Venezuela, the $1 billion Bakun Hydroelectric Project in Malaysia, the $1.2 billion San Roque Dam Project in Philippines, the $2 billion Ghazi Barotha Hydroelectric Project in Pakistan, the $500 million Maheshwar Hydel Power Project in India, the $1 billion San Roque Dam in the Philippines, the $1 billion Raise Mangla Dam Project in Pakistan, the $500 million Niagara Hydroelectric Expansion Project in New York State, the $350 million Bradley Lake Hydroelectric Project in Alaska, the $200 million Wells Hydroelectric Project and the $150 million Cowlitz Falls Hydroelectric Project in Washington State.

His experience includes more recently working as an international consultant providing project management and construction advisory services to the $1 billion Azad Pattan Hydropower Project in Pakistan and the $8.75 billion Site C Hydroelectric Project in Canada

Educational and Professional

Bachelor of Science in Civil Engineering, Oregon State University, 1968
Bachelor of Science in Mathematics, Oregon State University, 1968
Master of Science in Civil Engineering (Hydraulics/Water Resources), Oregon State University, 1969
Graduate MBA Courses, Golden Gate University, 1973-74

Professional Societies: Life Member of the American Society of Civil Engineers, Life Member of the United States Society on Dams, Construction Management Association of America, Sigma Xi, Disputes Review Board Foundation, Project Management Institute

Professional Engineer Registrations: Alaska, California, Idaho, and Oregon, Washington

Other: SFPUC O'Shaughnessy Award – May 2005; Construction Management Association of America's 2010 national award for the WSIP Infrastructure Program pre-construction planning and construction approach; Project Management Institute College of Scheduling 2011 Innovation Award for development and implementation of the WSIP Construction Management Information System (CMIS) and Primavera P6 Construction Contract Schedule System. In 2007 he implemented use of Dispute Review Boards on major projects as a City and County of San Francisco policy improving competitive bidding and cost effective implementation of the SFPUC WSIP.

Experience:

Site C Dam and Hydro Project, Canada – Provided advisory services to Bechtel Canada for its Site C Generating Station proposal/ (2017)

Azad Pattan Hydropower Project, Pakistan – Provided services for bidding and evaluation of tenders for $1 billion hydropower development. Provided evaluation of tenders for EPC contract to design and construct the700Mw Azad Patten Hydropower Project focusing on the Contractor's construction planning, schedule, construction methods and equipment, and experience (2016)

Site C Dam and Hydro Project, Canada – Provided project management advisory services to the Dam Contractor for implementation of the $8.75 billion development. Reviewed dam tender documents for Contractor after award of a $1.75 billion dollar dam contract. Provided identification of risks and mitigation strategies on the schedule, organizational plan, and the detailed project implementation plan. Provided recommendations for additional key personnel to implement the contract. (2015-2016)

CBI Environmental and Infrastructure Group - Mr. Elwin managed Program Management/Construction Management for the western US for the Commercial, State, and Local Division of the Environmental and Infrastructure Group of Shaw E&I a CBI Company. He joined Shaw in 2012 and led Shaw's pursuit of the DWR $14 billion world class Delta Habitat Conservation Conveyance Project as well as a number of other State and Local Infrastructure Public Sector PMCM opportunities (2012 – 2014)

San Francisco Public Commission - As Manager of the Construction Management Bureau between 2007 and 2012,, Mr. Elwin was responsible for delivery of water and wastewater capital construction projects for the City and County of San Francisco. This includes the $4.6 billion Water System Improvement Program (WSIP) for which he was WSIP Deputy Director of Construction. Mr. Elwin developed the Construction Management Plan for WSIP and implemented it, including putting in place $235 million of professional Program, Regional, and Project construction management contracts. He managed construction through its peak construction activity to 60% complete. When he retired the WSIP was under budget and on schedule. For the WSIP Program Mr. Elwin developed a state of the art Construction Management Information System (CMIS) based on Primavera Contracts Manager and a state of the art Construction Schedule System based on Primavera P6.The WSIP received the Construction Management Association of Americas 2010 National Award for its construction planning, and the Project Management Institutes 2011 National Crystal Award for its CMIS system and innovation in scheduling.

Between mid 2004 and mid 2007, as Manager of the Project Management Bureau for the Infrastructure Division of the San Francisco Public Utilities Commission, Mr. Elwin was responsible for management of the delivery of the SFPUC capital programs and projects. Programs include the $360 million Proposition A & B Bond Program, the $150 million Five Year Wastewater CIP, and the preconstruction phases of the $4.6 billion Water System Improvement Program (WSIP). The WSIP Program is a major seismic upgrade and rehabilitation of the Hetch Hetchy Regional Water System and Local Water System. The Regional Water System serves 2.5 million people in San Francisco, San Mateo, Santa Clara, and Alameda Counties. The Regional Water System includes 280 miles of transmission pipelines, 60 miles of tunnels, 11 reservoirs, five pumping stations and two treatment plants. These programs include over 200 projects ranging from $100k to $600 million. Projects include pipelines up to 108" in diameter, tunnels, pumping plants, treatment plants, dams, reservoirs, storage tanks, and valve houses. The Local water system which serves the City and County of San Francisco

includes 10 reservoirs and 8 water tanks that store water delivered by the Hetch Hetchy Water and Power Project and the local Bay Area water system; eighteen pump stations and approximately 1,250 miles of pipelines move water throughout the system and deliver it to the City's homes and businesses.

Mr. Elwin was responsible for development and growth and leadership of PMB and its staff; hiring; departmental and project/program capital budgets; and the agency meeting its program/project schedules. Annual capital appropriations were in range of $350 million/fiscal year.

Mr. Elwin provided leadership, management, guidance, and mentoring to forty project managers and several hundred supporting project planning, environmental, engineering, controls, construction, and administrative staff. He oversaw the day-to-day, short-term, and long-term activities of the Project Management Bureau and managed Capital Programs and ensured procedures and policies for staff supervision were followed. He also worked closely with other Infrastructure Bureaus and other SFPCU Organizations to provide teamwork and collaboration in the delivery of SFPUC projects. (2004- 2012)

Bakun Hydroelectric Project, Malaysia - Project Manager and Team Leader responsible for management evaluation and audit of the operations of the EPC Contractor responsible for the Main Civil works for the $1.8 billion 2400 MW Bakun Hydroelectric Project. Purpose of study was to identify problems being experienced with management of construction of the project and recommend solutions to improve construction productivity and recover delay. (2004)

Mill to Bull Creek Tunnel, California - Principal and Project Sponsor of construction management services for the construction of a TBM bored nine-foot diameter 10,000 foot long hydropower and consumptive use water tunnel in the Sierra Nevada foothills. The FERC licensed Project on US Forest Service land included many environmental compliance issues. MWH also provided contract management and supervision of QCIP inspection for rehabilitation of Owner's 1923 powerhouse and diversion dam. (2002 - 2003)

Leaburg and Walterville Hydroelectric Plant Rehabilitation, Oregon - Principal supporting field construction management and supervision for plant upgrades and unit overhauls, including runner replacements and upgrades, generator rewinding, and plant automation. (2002 - 2003)

Lopez Dam Remediation Project, California - Principal supporting field construction management and supervision of remediation and stabilization of the Lopez Dam. Work includes foundation stabilization, downstream buttress, and consolidation grouting. (2001 –2003)

San Roque Multipurpose Project – Project sponsor responsible for performance of on-site oversight of construction and construction quality services for the $1.2 billion, 345 MW project which at the time was one of the largest hydroelectric, irrigation, and flood control projects ever undertaken by a single EPC Contractor. The project included a 200 m high earth and rockfill dam, a gated concrete spillway, a three unit underground powerhouse. (2000 -2004)

Chasma Right Bank Irrigation Project, Pakistan - Chairman of the Joint Venture Board of Management of the Owners Consulting Engineer for the design and construction management of the $250 million canal and irrigation project in western Pakistan. The project included the extension of irrigation to 326,000 acres. Project facilities include a 99-mile concrete lined main canal with capacity to 5000 cfs, major cross drainage structures with capacity from 3,000 to 80,000 cfs, 16 cross-regulators with 35 turn-outs and 20 bridges for the main canal, 400 miles of concrete-lined and earthen distribution canals with structures and 1500 earth and lined watercourses (2002 - 2003)

Mirani Dam Project, Pakistan - MWH Representative on the JV Board of Management for the management for a $150 million EPC irrigation rock fill dam project in Pakistan as the Owners Consulting Engineer. (2002 - 2003)

Raise Mangla Dam Project, Pakistan - MWH Representative on the JV Board of Management for the management of the design and construction management phases for raising Mangla Dam to augment power and water supply as the Owner's Consulting Engineer. Estimated cost is $1 billion US. (2002 - 2003)

Shrinagar Hydropower Project, India - Project Manager for Owners engineer services to Duncan North Hydro Power Company for the implementation of the $405 million Shrinagar Hydroelectric Project in Uttar Pradesh on the Alaknanda River. The project included a 60 m high RCC dam, a 900 m long 13 m diameter tunnel, a 3 km canal, and a 330 MW surface powerhouse with five 66 MW units. As project manager, Mr. Elwin was responsible for services which include review of contractor proposed design, regulatory clearance and financial closure, EPC contract formation and execution, evaluation and optimization of project final design during construction, quality assurance during construction, and construction oversight/surveillance. (2001 – 2002)

Se San 3 Hydropower Project, Viet Nam - Project Sponsor for project management services to Owner for turnkey EPC construction (design and construction) of the Se San 3 Hydropower Project in Vietnam. This $250 million project was being developed by the Government of Vietnam as part of the integrated power system of Vietnam. It is a run of the river project including a 250 MW powerhouse, and RCC dam, spillway, transmission line and associated facilities. As MWH's senior representative for this work, Mr. Elwin was responsible for services by MWH including overall project management, establishing design criteria and basic specifications, drafting EPC contract documents, review and preparation of detailed design, cost/schedule control, quality control, and construction oversight (2001 –2003)

Ghazi Barotha Hydropower Project, Pakistan - As Harza's representative to the Board of Management of Pakistan Hydro Consultants, a Joint Venture involving Harza as the lead, Binnie Black and Veach, Mott MacDonald, NESPAK, and ACE Ltd, Mr. Elwin was responsible for the project and construction management of the $2 billion Ghazi Barotha Hydroelectric Project in northern Pakistan. The PHC Joint Venture had a staff of 500 and was responsible for the design and construction management of the project. The project included a Barrage across the Indus river immediately downstream of Tarbela Dam, a 52 km long 100 meter wide concrete lined power channel, and a 1450 MW powerhouse linked to the power channel through two head ponds and fore-bay covering 540 hectares comprised of 7.5 km of zoned embankment dams up to 80 meters high. The project involved 130 million cubic meters of excavation, 30 million cubic meters of embankment, and 3 million cubic meters of concrete. (1999 – 2003)

Maheshwar Hydel Power Project, India - Project Manager responsible for the pre-construction services for the $523 million Maheshwar Hydroelectric Power Project. Project consisted of a 10 unit 400 MW powerhouse and a 20 bay gated spillway structure involving 1 million cubic meters of concrete. Provided services to the Owner for negotiations and on the revising and updating of contracts with ABB, Siemens, and the Civil Construction Contractor to restart the EPC project on an accelerated schedule. Also managed scheduling and estimating efforts and facilitated contract re-negotiations between the civil, hydro-electrical required for financial close (2000 - 2001)

Three Gorges Project, China - Project Sponsor responsible for performance of advisory services performed by Harza at the Three Gorges Project for quality control and production of concrete. Managed a team of world-class specialists in efforts to assist CTGP and its Construction Contractor increase concrete production and quality. The team assisted CTGP place 5,000,000 cubic meters of concrete in 1999 setting a monthly record of 500,000 cubic meters in November 1999. Team Leader was awarded and received the Friendship Award for outstanding service by Foreign Consultant to the Peoples Republic of China (1999-2000)

Baise Multipurpose Dam Project, Guangxi, China - Project Sponsor for the pre-construction planning and FIDIC contract formation work for the $500 million Biase Multipurpose Project. Project consisted of a large (2 million cubic meters concrete) RCC Dam and a 540 MW underground powerhouse. (1999 –2000).

Ghazi Barotha Hydropower Project, Pakistan - As Chief Resident Engineer was responsible for the construction management of the Power Facilities complex at the $2 billion Ghazi Barotha Hydropower Project in northern Pakistan. The Power complex facilities were constructed by Dong Fang as one of its first international construction projects. Power complex facilities consisted of two head ponds made up of 7.5km of earth fill zoned embankment dam, and a 1440 MW five-unit powerhouse.

Construction required 25 million cubic meters of excavation, 20 million cubic meters of zoned dam embankment, 1 million cubic meters of impervious clay blanket for the head pond reservoir, and 1 million cubic meters of concrete. Project also included a 52-kilometer long by 100-meter wide concrete lined power channel. Duties include all management, quality control, contract administration, construction oversight, client liaison, and budget and schedule control. Managed 150 construction management staff including 10 resident engineers and 3500 contractor staff. (1997-1999).

Cowlitz Falls Hydroelectric Project, Washington, U.S.A. - Project manager for the 70 MW hydroelectric facility. The project included a 45-meter-high concrete gravity dam with four gated and one un-gated spillway bays, an integral powerhouse containing two 35 MW Kaplan turbine units, and two zoned dam embankments all on a vesicular basalt foundation. The spillway and intake contained features to enhance fishery development. In this dual role, was responsible for project management, design engineering, land acquisition, procurement and construction management (including contract administration, claims resolution, project control, environmental compliance, inspection, and startup). After closeout managed team of lawyers, independent claims consultants, and engineering staff in successfully defending and resolving a meditation of $23 million in construction claims to a $3 million settlement. Contractor was represented by its Surety after it defaulted during the construction period and the Surety had to take over work (1992-95).

Bradley Lake Hydroelectric Project, Alaska, U.S.A. - As Project Construction Manager was responsible for construction management services for the $355 million Bradley Lake Hydroelectric Project in a remote location in Alaska. This was the largest capital project undertaken to its date by the State. Responsibilities under his management included construction contract management including constructability reviews of design, contract packaging recommendations, quality assurance/control, field engineering, mitigation of claims and conflicts, settlement of US$50 million in claims, project controls, and startup. Responsibility included setting up first Disputes Review Board used by State. Under his leadership the project was completed US$43 million under the original budget of US$355 million without any claims heard by DRB. Project was selected the Civil Engineering Project of the Year by the northwest region of the American Society of Civil Engineers. The 120 MW project included a 38-meter-high concrete faced rock fill dam, a two-unit powerhouse, a 30-kilometer 115 kV transmission line, a 5.6-kilometer 3,300-mm-diameter concrete/steel-lined tunnel, a barge dock, an airstrip, a construction camp and 20 kilometers of road. The tunnel work established two world records for tunnel boring machines (1986-92).

Niagara Hydroelectric Expansion Project, New York, U.S.A. - Project manager with responsibility for the feasibility engineering and licensing phases of work for a US$650 million, 510 MW powerhouse additions to an existing 1,700 MW hydroelectric power plant at the Robert Moses and Lewiston Generating Plants (1983-85).

Uribante-Caparo Hydroelectric Project, Venezuela - Deputy Manager, reporting to the Venezuelan Manager of Engineering and Manager of Contracts for the US$4 billion hydroelectric project, consisting of 1,280 MW of generating capacity in three major powerhouses; four principal earth fill dams with heights up to 116 meters, and totaling 30 million cubic meters of material; 15,200 meters of tunnels up to 8 meters in diameter; and complete construction support and operational infrastructure in an area previously undeveloped. Responsible for overseeing contracting strategies, bidding, and contract administration for 42 engineering, construction, and major equipment supply contracts, ranging in cost from US$1 million to US$250 million. Also assessed engineering project control needs, developed/implemented engineering management systems, and managed engineering support during construction being performed by three independent designers. (1979-83)

American Falls Dam Project, Idaho, U.S.A. - Construction engineer for the US$80 million, three-unit 99 MW hydroelectric project. Responsible for contract administration, field engineering, and inspections. Project included a dam 30 meters high and 1,200 meters long with a 185-meter long central gravity section between earth fill embankments. After closeout responsible for settlement of US$10 million in claims. Foundation was basalt. (1976-79).

Wells Hydroelectric Project, Washington, U.S.A. - Project engineer responsible for the design of the project's ancillary facilities, including two 115 kV transmission lines and four switchyards (1974-76). Managed the Districts Wells $200 million Bond Funds as Construction Engineer performing all budgeting and accounting functions and certifying all construction expenditures.(1973-76)

Bechtel Construction - San Francisco Home Office, California, U.S.A. - Assistant to the Division Manager of Construction responsible for the administration functions of the Department including the monitoring and management support of ongoing construction and construction management projects (1973-74).

Bechtel Engineering - San Francisco Home Office, California, U.S.A. - Senior Engineer/Engineer performing analysis and design activities for various projects in the areas of water supply and transmission, hydraulic structures, hydrology, and hydroelectric power generation. Developed a number of state-of-art computer simulation models for the evaluation of river, lake, and estuary fluid dynamics and pollution analyses. Performed many feasibility studies of dams and fossil and nuclear plant water supply and cooling systems. Responsible for sizing cooling ponds and systems for eight major nuclear and thermal power plants. (1969-73).

Water Resources Institute - Oregon State University, Oregon, U.S.A. - Engineering Research Associate responsible for the management of the Oregon State University hydraulics laboratory. Projects included silting studies, stratified reservoir currents and selective withdrawal, and ocean outfall and wave force studies (1967-69).

Alaska State Department of Highways/Division of Aviation, Alaska, U.S.A.- Survey party chief, responsible for performing highway and runway construction surveys, (1964-67, summers).

Employment Record :

Dates	Name of Employing Organization	Title of Positions held	Location of Assignments	Types of Activities Performed
2014 – present	PMCM Associates LLC	Independent Consultant/Owner	Pakistan, Canada	Consulting services to several large private and public sector infrastructure capital program/projects for delivery of their heavy civil hydropower, water and dam facilities.
2012 – 2014	CBI (and Shaw E&I)	Manager, Program Management/Construction Management	Western USA	State and local infrastructure program and construction management
2004 – 2012	San Francisco Public Utilities Commission	Manager, Construction Management Bureau (2007-2012)	USA	Supervision and leadership of construction of all SPFUC's capital projects – with capital values from $3 million to $600 million.

Dates	Name of Employing Organization	Title of Positions held	Location of Assignments	Types of Activities Performed
		Manager, Project Management Bureau (2004-2007)		Leadership of delivery of water and wastewater capital projects and improvement programs with capital values from $100k to $500 million.
1997 – 2004	MWH (and Harza Engineering Company)	Vice President and Director, Global Energy and Infrastructure Business (MWH), Senior and General Partner (Harza)	Pakistan, India, Philippines,, China, Malaysia, Vietnam	Worldwide dam, canal, hydroelectric project management and construction management.
1995 - 1996	O'Brien Kreitzberg	Vice President and Manager of North West Region	USA	Construction management projects
1969 – 1995	Bechtel Corporation	Engineer/Senior Engineer/Project Engineer/ Project Manager/Senior Project Manager	USA, Venezuela	Planning, permitting, design and construction of hydroelectric and water supply facilities

Language:

	Speaking	Writing	Reading
English	Excellent	Excellent	Excellent
Spanish	Good	Good	Good

Appendix B to
Expert Report of E. Harvey Elwin
July 6, 2018

ASSISTANT: SARAH MCMILLAN
sarah@woodwardandcompany.com

Our File: 5746

May 7, 2018

Via Email: ehelwin@hotmail.com

PMCM Associates LLC
409 T Avenue
Anacortes, Washington 98222 USA
Attention: E. Harvey Elwin

Dear Mr. Elwin:

Re: Retainer Agreement

We write on behalf of West Moberly First Nations. West Moberly has filed an application for injunctive relief to suspend the construction of some or all activities underway on the Site C hydroelectric project pending an expedited trial of their claim (the "Injunction Application"). Thank you for being available and willing to provide your valuable expertise. We write to retain you for those services in your recognized area of expertise as a project manager and in particular, for your expertise in relation to the planning, permitting, design and construction phases of major hydropower projects.

We request that you conduct research and generate a report or reports in accordance with the Terms of Reference herein.

Terms of Reference

1. Produce a report that responds to the evidence of any or all of the defendants, British Columbia Hydro and Power Authority, British Columbia, and Canada, in respect of the estimated costs and scheduling considerations associated with the relief sought by the Plaintiffs in the Injunction Application. The defendants' evidence

is expected to be filed and served on or about May 10, 2018 and we will further detail the scope of your report shortly thereafter.

2. Make yourself available for cross-examination in respect of your expert report. Such cross-examination is likely to occur in mid- to late-June.

Your expert report should include a summary of your qualifications and experience related to the subject matter of your opinions. Please also provide an up-to-date curriculum vitae. Both your expert report and your curriculum vitae will be produced the court as attachments to an affidavit, which you will need to swear or affirm.

Research

The expert report will be based on the evidence received from the defendants, other relevant information available publicly or to the plaintiffs (in which case it will be provided to you by the plaintiffs), as well as any reference material that you consult with or rely upon within your field of expertise.

Independent and Objective Expert of Integrity, Not Advocate

Ordinarily, evidence of facts is admissible in court proceedings, but evidence of opinions is not. An exception to this rule is made where the opinion tendered is an expert opinion. Expert witnesses who have the court's confidence assist it by drawing inferences from facts, and/or assumed facts, that the court lacks the expertise to draw itself. Thus, the credibility of an expert, and the impact of an expert's opinion, depend upon the expert adopting an objective and dispassionate approach to the formation and presentation of that opinion; by contrast, an expert's credibility and impact will be diminished or eliminated altogether by a partisan and biased approach. Therefore, it is imperative that we as lawyers only submit evidence from experts who independently hold opinions that assist us in advancing the claim being made, as distinct from experts who will strive to find a way to say things that are helpful to our client.

Argument or advocacy that is presented as expert opinion can be, and has been, ruled inadmissible by courts in British Columbia. You must at all time bear in mind that your role is not that of an advocate, but rather to express the independently-formed and impartial expert opinions that you genuinely hold.

It is essential that a person called to give expert evidence be independent and impartial. Such a person is called to assist the court in areas that require expertise. The court must be able to rely on the opinions expressed as those of the expert and no one else. Those opinions cannot be influenced by the demands of counsel retaining the expert nor by the adversarial demands of the relevant litigation.

Accordingly, we and the Court require you to provide the following certification in your report:

> I certify that I am aware of my duty as an expert witness to assist the court and not be an advocate for any party. I further certify that I have made this report in conformity with this duty and will, if called on to give oral or written testimony, give that testimony in conformity with this duty.

You should also be aware that you must avoid giving any opinion that purports to state a legal conclusion. This function is reserved to the Court.

General Report Requirements

The Court requires that you sign and certify your report, and set out the following within it:

1. your name, address and area of expertise;
2. your qualifications and employment and educational experience in your area of expertise;
3. the instructions we provided to you in relation to this litigation (e.g. this letter);
4. the nature of the opinion being sought and the issues in the proceeding to which the opinion relates (e.g. as set out in this letter);
5. your expert opinion respecting those issues;
6. your reasons for your opinion, including
    a. a description of the factual assumptions on which the opinion is based,
    b. a description of any research conducted by you that led you to form the opinion, and
    c. a list of every document, if any, relied on by you in forming the opinion.

You are welcome to review any documents that you consider necessary to form your report. Please keep a list of all documents that you have reviewed as part of this requested work. Please cite the source(s) of information upon which you base your conclusions.

As above, please ensure that all relevant facts, assumptions and definitions that are important to understanding the opinions expressed are set out in your report. You will need to clearly state the facts and assumptions upon which your opinion is based. It may be necessary for you to define your terms and make assumptions in order to form your

opinion. In such case, any definitions that you use and any assumptions that you make should be identified and listed in the report. In addition, we may ask you to make certain assumptions. In such case, please accept those assumptions and list them in your evidence.

Please make it clear in your report if any particular question or issue raised falls outside of your expertise. Also, if you offer an opinion that is not properly researched because you consider that insufficient data is available, then this must be stated with an indication that the opinion is no more than a provisional one. Further, if upon preparing your report you could not assert that the report contained the truth, the whole truth, and nothing but the truth without some qualification, that qualification should be stated in the report.

Please summarize your qualifications to express an expert opinion on the matter(s) you have been asked to address, as set out above. Attach a copy of your most recent C.V. as part of the expert report.

Format

Please write up your expert opinion report in a logical format that clearly sets out the matters you have been asked to address and your responses. You should use heading and sub-heading, if they assist with clarity. Use endnotes, if needed, and provide a full bibliography of sources cited, if any.

Maintenance and Production of Your Files

Your file, including all of your notes, working papers, and correspondence, is privileged and not subject to disclosure, until your written opinion is tendered as evidence in court. At that time, the claim of privilege over the contents of your file is waived and everything that is in it, including this letter, becomes producible for the purposes of cross-examination to counsel on the other side of the litigation. Accordingly, any correspondence or documents of any nature that you create in preparing your opinion may have to be produced and disclosed to that other side at a later date.

It is the practice of some experts to retain any early drafts of their works, and it is the practice of other experts to routinely dispose of such drafts as they are revised. If it is your practice to dispose of any such drafts upon revision, you are entitled to do so. Please retain whatever your normal practice is.

You must therefore maintain in your expert opinion an organized and complete collection of all the papers, notes, calculations, drafts, correspondence, telephone logs, and the like (the “Working Papers”) that are prepared and received in the course of forming your opinion. Moreover, that expert’s file must be provided to us at our request so that, if and

when your expert opinion is tendered as evidence in court, the file is available for production by us to opposing counsel.

We ask that at all times you exercise great care and caution when expressing yourself in writing, even in the most casual and preliminary notes and working papers. Expressions used in preliminary notes and working papers may well lead to lines of cross-examination that could be avoided.

Multiple Authorship

If your expert opinion is tendered as evidence in court, opposing counsel may have a right to cross-examine you. It is essential, therefore, that you personally hold the opinion that has been tendered. This does not mean that parts of the work leading up to the formation and expression of your opinion cannot have been done, under supervision, by others (including subcontractors) to whom partial responsibility for research and other related services has been delegated. However, as the individual who will, eventually, speak to your opinion in court, you must be the person "primarily responsible" for your opinion and therefore be fully conversant with all aspects of its formation and expression. You must, as well, adopt the work of any others (including subcontractors) involved as your own and be able to answer questions about the methodology and conclusions of all persons who played any part in contributing to the development of your opinion. That way, there should be no possibility that opposing counsel will have your expert opinion diminished or ruled inadmissible because:

- the opinion is, in effect, "multiple authored";
- it is not clear which author is responsible for which portions of the opinion; and
- all authors of the opinion have not been produced for cross-examination.

Confidentiality

This matter is confidential. Please do not discuss this matter except with the law offices of Woodward and Company Lawyers LLP, Sage Legal and/or other law firms or persons designated by us in writing. Your primary contact is the writer. Please let the writer know if you have any questions or concerns.

Timetable

You agree to complete and deliver a draft report by or before June 10, 2018, or such other date as may be agreed upon. You agree to complete and deliver a final report by June 15, 2018, or such other date as may be agreed upon.

Payment

We will compensate you at your standard hourly rate of [redacted] per hour. We will repay you for any out-of-pocket expenses you may reasonably incur in relation to this report.

Our normal practice is for retained experts to submit an invoice to us. We will then submit the invoice to our client for review. Typically, it will take some time for our client to process the invoice and release a cheque to us. We, in turn, send the cheque to you. The result is that we typically operate on a 60-day billing cycle.

We trust these arrangements are acceptable to you. To confirm so please return an endorsed copy of this letter forthwith.

Sincerely,
WOODWARD & COMPANY LAWYERS LLP

Sonya Morgan

I hereby agree to the terms and conditions set out above in this retainer agreement:

_____
Name: E. Harvey Elwin

_____
Date

Appendix C to
Expert Report of E. Harvey Elwin
July 6, 2018

WOODWARD & COMPANY
LAWYERS LLP | BARRISTERS & SOLICITORS

REPLY TO: SONYA MORGAN
Victoria Office
email: sonya@woodwardandcompany.com

ASSISTANT: SARAH MCMILLAN
sarah@woodwardandcompany.com

Our File: 5746

June 13, 2018

Via Email: ehelwin@hotmail.com

PMCM Associates LLC
409 T Avenue
Anacortes, Washington 98222 USA
Attention: E. Harvey Elwin

Dear Mr. Elwin:

Re: Supplemental Instructions re: Retainer Agreement

Further to our May 7, 2018 retainer agreement, we write to provide further instructions to detail the scope of the independent expert report we are asking you to prepare.

Please review the Affidavit evidence of Brian McGhee, Andrew Watson, Farzard Kossari, Cameron Penfold, Matthew Drown, Charles Young, Alan Le Couteur, James Thomas, Steven de Roy, and Bruce Muir (Affidavit #2, Exhibits H-R), additional documents provided by BC Hydro in response to the Plaintiffs' request for additional documents, and available public documents.

Based on this information, please:

1. Develop a project management schedule for the construction activities that would be affected by an injunction enjoining construction activities in the Critical Areas identified by the Plaintiffs in their Notice of Application filed January 31, 2018.

2. Advise whether an injunction of the following durations would affect either (i) diversion of the Peace River, which BC Hydro says is planned for September 2020, (ii) the start of reservoir filling, which BC Hydro says is planned for September 2023, or

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200 - 1022 GOVERNMENT STREET
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WHITEHORSE OFFICE:
201 - 3059 3RD AVENUE
WHITEHORSE, YT Y1A 1E2

TEL: 867-633-5940

(iii) the project in-service date, which BC Hydro says is planned for November 2024 (collectively the "Project Milestones"):

a. 18 months;
b. 24 months;
c. 30 months;
d. 36 months.

In considering the answer to question 2, please address: (i) the extent to which BC Hydro would have to adjust its existing schedule (if that can be determined) to ensure that each of Project Milestones are met; and (ii) the feasibility of any such adjustments.

3. The questions above are based on the assumption that BC Hydro will otherwise meet its planned Project Milestones. Please provide your expert opinion on the likelihood that BC Hydro will instead fail to meet the Project Milestones.

4. Please describe how your answer to question 3 affects the scenarios described and opinions reached in response to question 2.

Please complete your report in accordance with the terms of the May 7, 2018 retainer agreement.

Please provide a draft report for questions 1 and 2 by June 18, 2018. We will establish a deadline for the answers to questions 3 and 4 after we determine the full scope of documents to be produced by BC Hydro.

Please do not hesitate to contact me if you have any questions or concerns with respect to these requests.

Sincerely,
WOODWARD & COMPANY LAWYERS LLP

Sonya Morgan

Appendix D to
Expert Report of E. Harvey Elwin
July 6, 2018

To be provided

Appendix D
Documents Relied Upon For Preparation of This Report

Document Reference Number	Category	Document Name
	Public Documents	
1	Public	BC Hydro's *PUBLIC Quarterly Progress Report No. 10* issued March 29, 2018
2	Public	BC Hydro's *PUBLIC Quarterly Progress Report No. 8* issued September 27 , 2017
3	Public	BC Hydro's *PUBLIC Quarterly Progress Report No. 9* issued December 20, 2017
4	Public	BCUC Site C Inquiry Final Report dated November 1, 2017
5	Public	Site C Clean Energy Project – Reservoir Filling Plan, November 2012
6	Public	BC Hydro's *Annual Progress Report No. 2* issued March 29, 2018
7	Public	CV - E. Harvey Elwin
8	Public	Deloitte Site C Construction Review dated September 7, 2017
9	Public	Environmental Impact Statement (EIS), Volume 1, All Figures
10	Public	Environmental Impact Statement (EIS), Volume 2, Section 11, Subsection 11.4
11	Public	Site C Project Budget - April 2018.pdf
12	Public	Summary Bio - E . Harvey Elwin
13	Public	Technical Advisory Board Meeting No 15 Report, April 2016
14	Public	Technical Advisory Board Meeting No 16 Report, December 2016
15	Public	Technical Advisory Board Meeting No 17 Report, June 2017
	Evidence Documents	
16	Evidence	Affidavit #1 of Karen von Muehldorfer and Exhibits, made May 10, 2018
17	Evidence	Affidavit #1 of Matthew Drown and Exhibits, made May 10, 2018
18	Evidence	Notice of Application, January 31, 2017
19	Evidence	Application Response of BC Hydro, made May 10, 2018
20	Evidence	Project Design Hydrotechnical Data Report Revision 2, February 2017
21	Evidence	Advisory Board Meeting No 10 Report, December 2011
22	Evidence	Advisory Board Meeting No 11 Report, August 2012
23	Evidence	Advisory Board Meeting No 7A Report, July 2010
24	Evidence	Advisory Board Meeting No 8 Report, July 2010
25	Evidence	Advisory Board Meeting No 9 Report, June 2011
26	Evidence	Affidavit #1 of Alan Le Couteur and Exhibits, made May 10, 2018
27	Evidence	Affidavit #1 of Andrew Watson and Exhibits, made May 8, 2018
28	Evidence	Affidavit #1 of Brian McGhee and Exhibits, made April 30, 2018
29	Evidence	Affidavit #1 of Bruce Muir and Exhibits, made May 31, 2018
30	Evidence	Affidavit #1 of Cameron Penfold and Exhibits, made April 27, 2018
31	Evidence	Affidavit #1 of Farzad Kossari and Exhibits, made May 9, 2018
32	Evidence	Affidavit #1 of James Thomas and Exhibits, made May 10, 2018
33	Evidence	Affidavit #1 of Mike Scott and Exhibits, made May 10, 2018
34	Evidence	Affidavit #1 of Steven Deroy and Exhibits, made May 10, 2018
35	Evidence	Affidavit #2 of Matthew Drown and Exhibits, made May 11, 2018
36	Evidence	Affidavit #3 of Matthew Drown and Exhibits, made June 6, 2018
37	Evidence	Affidavit (not numbered) of Charles Young and Exhibits, made May 9, 2018
38	Evidence	Application Response of HMQPBC, made May 10, 2018
39	Evidence	LTC # 01G - Left Bank Excavation - Phase 2 - Amendment #2, 3/9/2017
40	Evidence	LTC # 01G - Left Bank Excavation - Phase 2 - Amendment #3, 3/31/2017
41	Evidence	LTC # 01H - Right Bank Drainage Tunnel Underground Work, 8/23/2016
42	Evidence	LTC # 03B - Right Bank Overburden Excavations, 7/28/2016
43	Evidence	LTC # 03C - Stage 1 Diversion Inlet Cofferdam - Amendment #1, 3/9/2017
44	Evidence	LTC # 03C - Stage 1 Diversion Inlet Cofferdam, 9/26/2016
45	Evidence	LTC # 03C Stage 1 Diversion Outlet Cofferdam - Amendment #2, 3/31/2017
46	Evidence	LTC # 03D - Right Bank Bedrock Excavations, Amendment #1, 11/30/2016
47	Evidence	LTC # 05B - Diversion Outlet Works, 6/30/2017
48	Evidence	LTC #01C - Right Bank Drainage Tunnel Portal, 6/23/2016
49	Evidence	LTC #01H - Right Bank Drainage Tunnel Underground Work, Amendment # 1, 10/11/2017
50	Evidence	LTC #03D - Right Bank Bedrock Excavations, 10/7/2016
51	Evidence	LTC #03D - Right Bank Bedrock Excavations, Amendment #2, 4/18/2018
52	Evidence	LTC #03E - Stage 1 Diversion Outlet Cofferdam, 7/4/2017
53	Evidence	LTC #05A - Diversion Linlet Works Portal and Channel , Amendment #1, 9/12/2017
54	Evidence	LTC #05A - Diversion Linlet Works Portal and Channel Including In-River Portion of Channel, 5/15/20

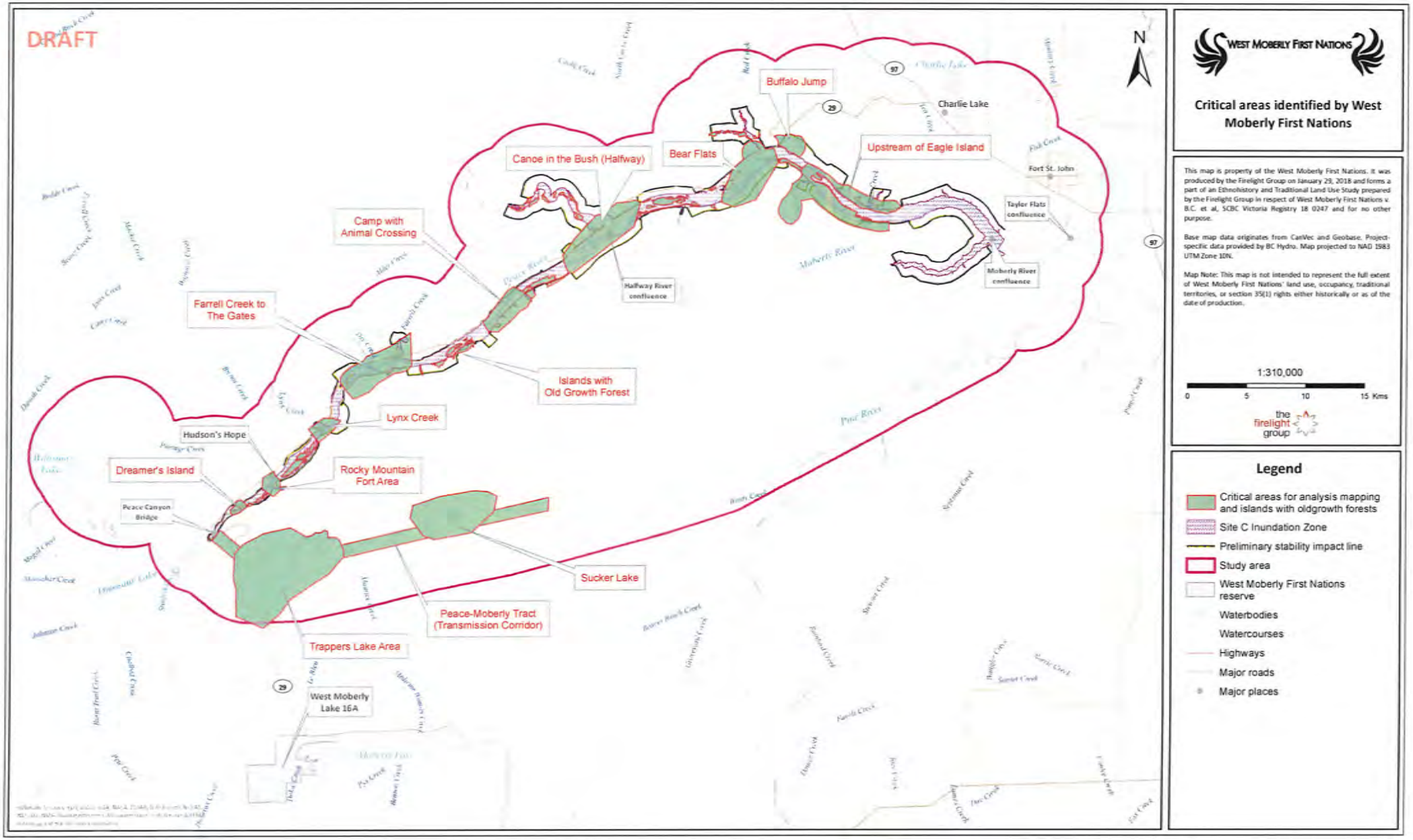
Redacted Document- BCSC No. 180247

Appendix D
Documents Relied Upon For Preparation of This Report

Document Reference Number	Category	Document Name
55	Evidence	LTC #05A - Diversion Linlet Works Portal and Channel, Amendment #2, 11/24/2017
56	Evidence	LTC #05B - Diversion Tunnel Outlet Works, 7/21/2017
57	Evidence	LTC #06A - Powerhouse Roller Compacted Concrete Buttress, 6/2/2017
58	Evidence	LTC #06A - Powerhouse Roller Compacted Concrete Buttress, Amendment #1, 4/18/2018
59	Evidence	LTC# 03F - Stage 1 Diversion Outlet Cofferdam, 6/30/2017
60	Evidence	Reservoir Filling Plan, November 2012
61	Evidence	Site C Vegetation and Clearing and Debris Management Plan
62	Evidence	Technical Advisory Board Meeting No 12 Report, July 2013
63	Evidence	Technical Advisory Board Meeting No 13 Report, March 2014
64	Evidence	Technical Advisory Board Meeting No 14 Report, June 2015
65	Evidence	Technical Advisory Board Meeting No 18 Report, Februay 2018
66	Evidence	UNFILED Affidavit #1 of Lauren Tekano and Exhibits made Junly 6, 2018
	Confidental Documents	
67	Confidential	BC Hydro's BCUC CONFIDENTIAL *Quarterly Progress Report No. 10* issued March 29, 2018
68	Confidential	BC Hydro's BCUC CONFIDENTIAL *Quarterly Progress Report No. 9* issued December 20, 2017
69	Confidential	BC Hydro's BCUC CONFIDENTIAL *Quarterly Progress Report No. 8* issued September 27 , 2017
70	Confidential	BCUC IR 2.9.0 CONFIDENTIAL Attachment 1.pdf
71	Confidential	CONFIDENTIAL Master Estimate Suspension Injunction.xlsv
72	Confidential	Documents Provided to Techical Advisory Board - June 8 Conference Call
73	Confidential	June 2018 PMFB schedule (data date June 1, 2018, printed June 28, 2018).pdf
74	Confidential	MCW BC Hydro RB, LB, Div Progress Report 2018-06-13.pdf
75	Confidential	PRHP Work Program & Schedule Monthly Progress Report - May 2018.pdf
76	Confidential	Retainer Letter - Woodward to Elwin, May 7, 2018
77	Confidential	Site C Project Cost Estimates ($ Expected).pdf
78	Confidential	Site C MCW Contract NCR Tracking Log 2018-06-14.pdf
79	Confidential	Site C MCW Contract NCR Weekly Report 2018-06-14.pdf
80	Confidential	Site C PMB Schedule.pdf
81	Confidential	Supplemental Instruction Letter - Woodward to Elwin, June 13, 2018
82	Confidential	Technical Advisory Board WorkShop - Notes of Meeting, October 12-13,2017
83	Confidential	Transmission Line Construction (FINAL-redacted) Redactions Applied KM.pdf

Appendix D1 to
Expert Report of E. Harvey Elwin
July 6, 2018

To be provided



Appendix J to
Expert Report of E. Harvey Elwin
July 6, 2018

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Appendix K to
Expert Report of E. Harvey Elwin
July 6, 2018

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Appendix L to
Expert Report of E. Harvey Elwin
July 6, 2018

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Appendix M to
Expert Report of E. Harvey Elwin
July 6, 2018

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Appendix N to
Expert Report of E. Harvey Elwin
July 6, 2018

APPENDIX N-1
Effect of Injunction On Critical Area
Work Activities
18 Month Suspension of Work in Critical Areas
October 1, 1018 Start

PROJECT COMPONENT/ACTIVITY	Quantity Length	Delay to Start Preconst Activities	Delay to End of Preconst Activities	Delay to Start of Constr Activites	Delay to End of Const Activities	Const Period Delay (months)	Constr Duration Change	Delay to Project Milestones	Length of Project Milestone Delay	Sequence of Work Dictated
Reservoir Clearing										
Eastern R Clearing Below 420m	0	No	No	No	No	None	No	No	None	**No**
Eastern Res N &S Bank Above 420m	517	No	No	Yes	Yes	14.5	No	No	None	**No**
Eastern R Cache Crk	92	No	No	Yes	Yes	17	No	No	None	**No**
Lower R/Moberly Drainage	374	No	No	No	No	None	No	No	None	**No**
Middle R- Halfway Debris Boom	182	No	No	Yes	Yes	17	No	No	None	**No**
Middle R- Cache Crk to Halfway	226	No	No	Yes	Yes	7	No	No	None	**No**
Middle R - Halfway Drainage	336	No	No	No	No	None	No	No	None	**No**
Western R - Halfway to Lynx South	526	No	No	No	No	None	No	No	None	**No**
Western R - Halfway to Lynx North	316	No	No	No	No	None	No	No	None	**No**
Western R - Lynx to Hudson Hope	349	No	No	No	No	None	No	No	None	**No**
	2918									
Highway 29 - Realignment										
Lynx Creek										
Preconstruction		No change to original plan and schedule								
Highway	8.2 km	No	No	No	No	None	No	No	None	Yes
Bridge		No	No	No	No	None	No	No	None	No
Dry Creek										
Preconstruction		No change to original plan and schedule								
Highway	1.4 km	No	No	No	No	0	No	No	None	No
Farrell Creek										
Preconstruction		No change to original plan and schedule								
Highway	2.1 km	No	No	No	No	None	No	No	None	No
Bridge		No	No	No	No	None	No	No	None	No
Farrel Creek East										
Preconstruction		No change to original plan and schedule								
Highway	6.0 km	No	No	No	No	None	No	No	None	Yes
Halfway River										
Preconstruction		No change to original plan and schedule								
Highway and Bridge	3.7 km	No	No	Yes	Yes	5.7	No	No	None	No
Cache Creek East										
Preconstruction		No change to original plan and schedule								
Highway	5.2 km	No	No	No	No	None	No	No	None	Yes
Bridge		No	No	No	No	None	No	No	None	No
Cache Creek West										
Preconstruction		No change to original plan and schedule								
Highway	3.6 km	No	No	No	No	None	No	No	None	No
Hudsons Hope										
Preconstruction		No change to original plan and schedule								
Construction		No	No	No	No	None	No	No	None	Yes
Transmisssion Line										
Preconstruction		No change to original plan and schedule								
Clearing		No	No	Yes	Yes	5.4	No	No	None	No
Construction		No	No	Yes	Yes	5.4	No	No	None	Yes
Site C Substation										
Preconstructon		No change to original plan and schedule								
Construction		No	No	No	No	None	No	No	None	No

NO IMPACT **IMPACT**

MINOR IMPACT **ADJUSTED WITH CONSTRUCTIVE ACCELERATION**

APPENDIX N-2
Effect of Injunction On Critical
Work Activites
24 Month Suspension of Work In Critical Areas
October 1, 2018 Start

PROJECT COMPONENT/ACTIVITY	Quantity Length	Delay to Start Preconst Activities	Delay to End of Preconst Activities	Delay to Start of Constr Activites	Delay to End of Const Activities	Const Period Delay (months)	Constr Duration Change	Delay to Project Milestones	Length of Project Milestone Delay	Sequence of Work Dictated
Reservoir Clearing										
Eastern R Clearing Below 420m	0	No	No	No	No	None	No	No	None	**No**
Eastern Res N &S Bank Above 420m	517	No	No	Yes	Yes	20.5	No	No	None	**No**
Eastern R Cache Crk	92	No	No	Yes	Yes	23	No	No	None	**No**
Lower R/Moberly Drainage	374	No	No	No	No	None	No	No	None	**No**
Middle R- Halfway Debris Boom	182	No	No	Yes	Yes	23	No	No	None	**No**
Middle R- Cache Crk to Halfway	226	No	No	Yes	Yes	12	No	No	None	**No**
Middle R - Halfway Drainage	336	No	No	No	No	None	No	No	None	**No**
Western R - Halfway to Lynx South	526	No	No	Yes	Yes	1	No	No	None	**No**
Western R - Halfway to Lynx North	316	No	No	Yes	Yes	1	No	No	None	**No**
Western R - Lynx to Hudson Hope	349	No	No	No	No	None	No	No	None	**No**
	2918									
Highway 29 - Realignment										
Lynx Creek										
Preconstruction		No change to original plan and schedule								
Highway	8.2 km	No	No	No	No	None	No	No	None	Yes
Bridge		No	No	No	No	None	No	No	None	No
Dry Creek										
Preconstruction		No change to original plan and schedule								
Highway	1.4 km	No	No	Yes	Yes	11.7	No	No	None	No
Farrell Creek										
Preconstruction		No change to original plan and schedule								
Highway	2.1 km	No	No	No	No	0	No	Yes	None	No
Bridge		No	No	No	No	0	No	Yes	None	No
Farrel Creek East										
Preconstruction		No change to original plan and schedule								
Highway	6.0 km	No	No	No	No	None	No	No	None	Yes
Halfway River										
Preconstruction		No change to original plan and schedule								
Highway and Bridge	3.7 km	No	No	Yes	Yes	11.7	No	Yes	4 mo	No
Cache Creek East										
Preconstruction		No change to original plan and schedule								
Highway	5.2 km	No	No	No	No	None	No	No	None	Yes
Bridge		No	No	No	No	None	No	No	None	No
Cache Creek West										
Preconstruction		No change to original plan and schedule								
Highway	3.6 km	No	No	No	No	None	No	No	None	No
Hudsons Hope										
Preconstruction		No change to original plan and schedule								
Construction		No	No	No	No	None	No	No	None	Yes
Transmisssion Line										
Preconstruction		No change to original plan and schedule								
Clearing		No	No	Yes	Yes	11.3	No	No	None	No
Construction		No	No	Yes	Yes	11.3	No	No	None	Yes
Site C Substation										
Preconstruction		No change to original plan and schedule								
Construction		No	No	No	No	None	No	No	None	No

NO IMPACT — **IMPACT**

MINOR IMPACT — **ADJUSTED WITH CONSTRUCTIVE ACCELERATION**

APPENDIX N-3

Effect of Injunction On Critical Area

Work Activities

30 Month Suspension of Work in Critical Areas

~~October 1, 2018 Start~~

PROJECT COMPONENT/ACTIVITY	Quantity Length	Delay to Start Preconst Activities	Delay to End of Preconst Activities	Delay to Start of Constr Activites	Delay to End of Const Activities	Const Period Delay (months)	Constr Duration Change	Delay to Project Milestones	Length of Project Milestone Delay	Sequence of Work Dictated
Reservoir Clearing										
Eastern R Clearing Below 420m	0	No	No	No	No	None	No	No	None	**No**
Eastern Res N &S Bank Above 420m	517	No	No	Yes	Yes	26.5	No	No	None	**No**
Eastern R Cache Crk	92	No	No	Yes	Yes	29	No	No	None	**No**
Lower R/Moberly Drainage	374	No	No	No	No	None	No	No	None	**No**
Middle R- Halfway Debris Boom	182	No	No	Yes	Yes	29	No	No	None	**No**
Middle R- Cache Crk to Halfway	226	No	No	Yes	Yes	19	No	No	None	**No**
Middle R - Halfway Drainage	336	No	No	Yes	Yes	7	No	No	None	**No**
Western R - Halfway to Lynx South	526	No	No	Yes	Yes	7	No	No	None	**No**
Western R - Halfway to Lynx North	316	No	No	Yes	Yes	7	No	No	None	**No**
Western R - Lynx to Hudson Hope	349	No	No	No	No	None	No	No	None	**No**
	2918									
Highway 29 - Realignment										
Lynx Creek										
Preconstruction		No change to original plan and schedule								
Highway	8.2 km	No	No	Yes	Yes	6	No	No	None	Yes
Bridge		No	No	Yes	Yes	5.8	No	No	None	No
Dry Creek										
Preconstruction		No change to original plan and schedule								
Highway	1.4 km	No	No	Yes	Yes	5.8	No	No	None	No
Farrell Creek										
Preconstruction		No change to original plan and schedule								
Highway	2.1 km	No	No	No	NO	0	No	No	None	No
Bridge		No	No	No	No	0	No	N0	None	No
Farrel Creek East										
Preconstruction		No change to original plan and schedule								
Highway	6.0 km	No	No	No	No	None	No	No	None	Yes
Halfway River										
Preconstruction		No change to original plan and schedule								
Highway and Bridge	3.7 km	No	No	Yes	Yes	17.7	No	Yes	10 Mo	No
Cache Creek East										
Preconstruction		No change to original plan and schedule								
Highway	5.2 km	No	No	No	No	None	No	No	None	Yes
Bridge		No	No	Yes	Yes	5.8	No	Yes	3 Mo	No
Cache Creek West										
Preconstruction		No change to original plan and schedule								
Highway	3.6 km	No	No	No	No	None	No	No	None	No
Hudsons Hope										
Preconstruction		No change to original plan and schedule								
Constructon		No	No	Yes	Yes	2.3	No	No	None	Yes
Transmisssion Line										
Preconstruction										
Clearing		No	No	Yes	Yes	17.4	No	No	None	No
Construction		No	No	Yes	Yes	17.3	No	No	None	Yes
Site C Substation										
Preconstruction		No change to original plan and schedule								
Construction		No	No	No	No	None	No	No	None	No

NO IMPACT **IMPACT**

MINOR IMPACT **ADJUSTED WITH CONSTRUCTIVE ACCELERATION**

APPENDIX N-4
Effect of Injunction On Critical Area
Work Activities
36 Month Suspension of Work in Critical Areas
October 1, 2018 Start

PROJECT COMPONENT/ACTIVITY	Quantity Length	Delay to Start Preconst Activities	Delay to End of Preconst Activities	Delay to Start of Constr Activites	Delay to End of Const Activities	Const Period Delay (months)	Constr Duration Change	Delay to Project Milestones	Length of Project Milestone Delay	Sequence of Work Dictated
Reservoir Clearing										
Eastern R Clearing Below 420m	0	No	No	No	No	None	No	No	None	**No**
Eastern Res N &S Bank Above 420m	517	No	No	Yes	Yes	32.5	No	No	None	**No**
Eastern R Cache Crk	92	No	No	Yes	Yes	35	No	No	None	**No**
Lower R/Moberly Drainage	374	No	No	No	No	None	No	No	None	**No**
Middle R- Halfway Debris Boom	182	No	No	Yes	Yes	35	No	No	None	**No**
Middle R- Cache Crk to Halfway	226	No	No	Yes	Yes	25	No	No	None	**No**
Middle R - Halfway Drainage	336	No	No	Yes	Yes	13	No	No	None	**No**
Western R - Halfway to Lynx South	526	No	No	Yes	Yes	13	No	No	None	**No**
Western R - Halfway to Lynx North	316	No	No	Yes	Yes	13	No	No	None	**No**
Western R - Lynx to Hudson Hope	349	No	No	Yes	Yes	1	No	No	None	**No**
	2918									
Highway 29 - Realignment										
Lynx Creek										
Preconstruction		No change to original plan and schedule								
Highway	8.2 km	No	No	No	No	None	No	No	None	Yes
Bridge		No	No	Yes	Yes	11.8	No	Yes	6.5	No
Dry Creek										
Preconstruction		No change to original plan and schedule								
Highway	1.4 km	No	No	Yes	Yes	12	No	No	None	No
Farrell Creek										
Preconstruction		No change to original plan and schedule								
Highway	2.1 km	No	No	Yes	Yes	5.8	No	Yes	1 Mo	No
Bridge		No	No	Yes	Yes	5.8	No	Yes	1 mo	No
Farrel Creek East										
Preconstruction		No change to original plan and schedule								
Highway	6.0 km	No	No	No	No	None	No	No	None	Yes
Halfway River										
Preconstruction		No change to original plan and schedule								
Highway and Bridge	3.7 km	No	No	Yes	Yes	23.7	No	Yes	16 mo	No
Cache Creek East										
Preconstruction		No change to original plan and schedule								
Highway	5.2 km	No	No	No	No	None	No	No	None	Yes
Bridge		No	No	Yes	Yes	11.8	No	Yes	9 mo	No
Cache Creek West										
Preconstruction		No change to original plan and schedule								
Highway	3.6 km	No	No	No	No	None	No	No	None	No
Hudsons Hope										
Preconstruction		No change to original plan and schedule								
Construction		No	No	Yes	Yes	8.2	No	No	None	Yes
Transmisssion Line										
Preconstruction		No change to original plan and schedule								
Clearing		No	No	Yes	Yes	23.3	No	No	None	No
Construction		No	No	Yes	Yes	23.3	No	No	None	Yes
Site C Substation										
Preconstruction		No change to original plan and schedule								
Construction		No	No	No	No	None	No	No	None	No

NO IMPACT **IMPACT**

MINOR IMPACT **ADJUSTED WITH CONSTRUCTIVE ACCELERATION**

Appendix O to
Expert Report of E. Harvey Elwin
July 6, 2018

REDACTED

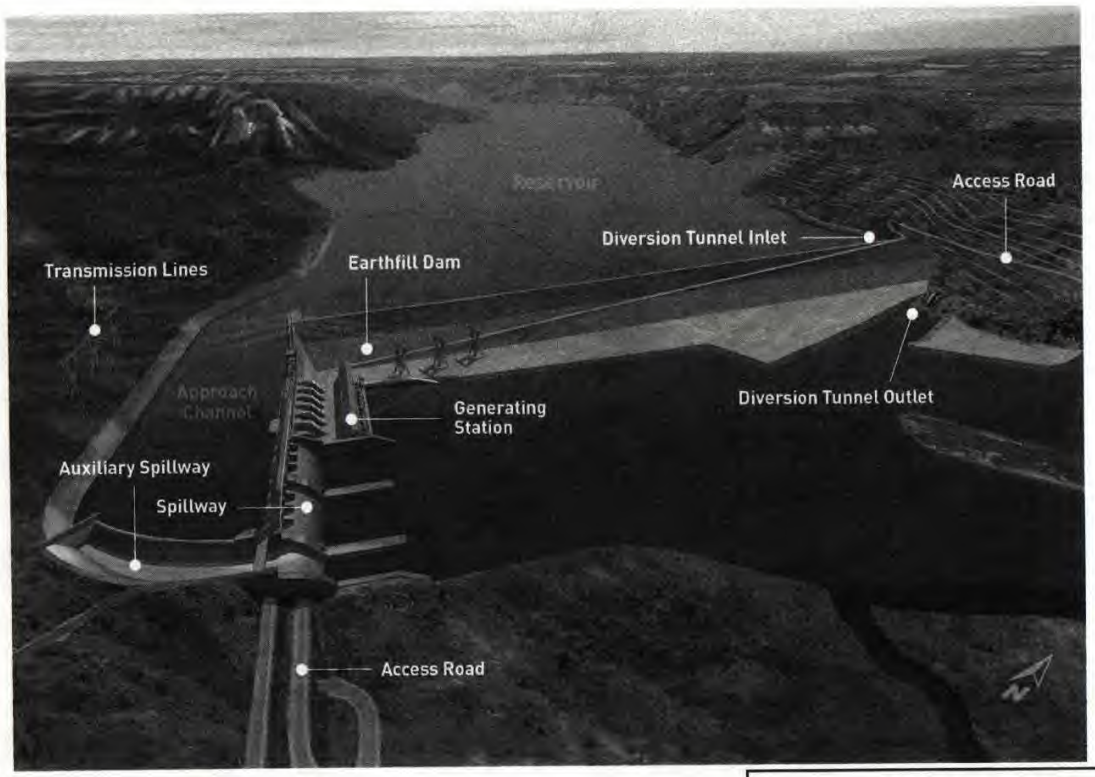
REDACTED

REDACTED

REDACTED

Appendix P to
Expert Report of E. Harvey Elwin
July 6, 2018

Appendix Q to
Expert Report of E. Harvey Elwin
July 6, 2018



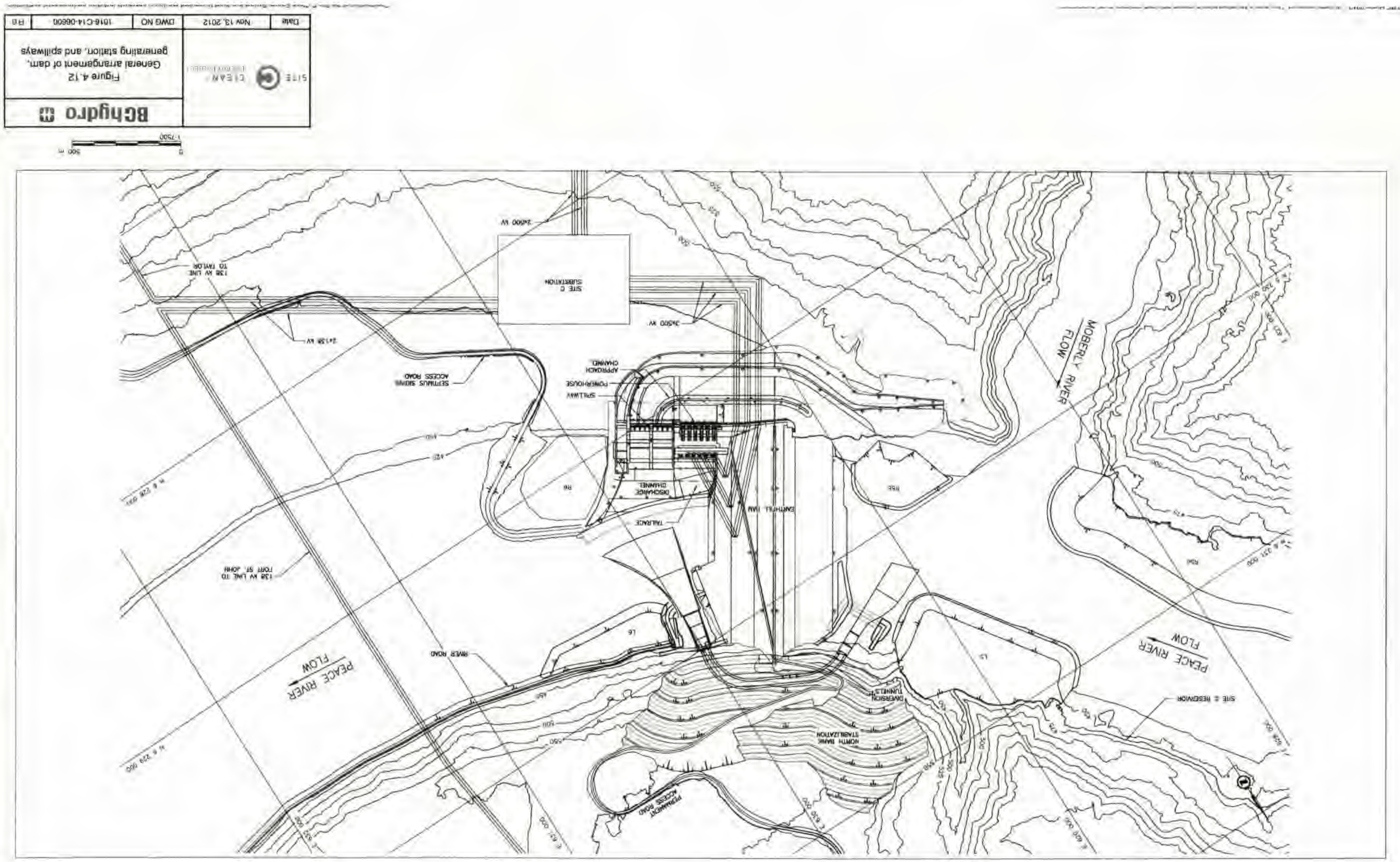
BC hydro

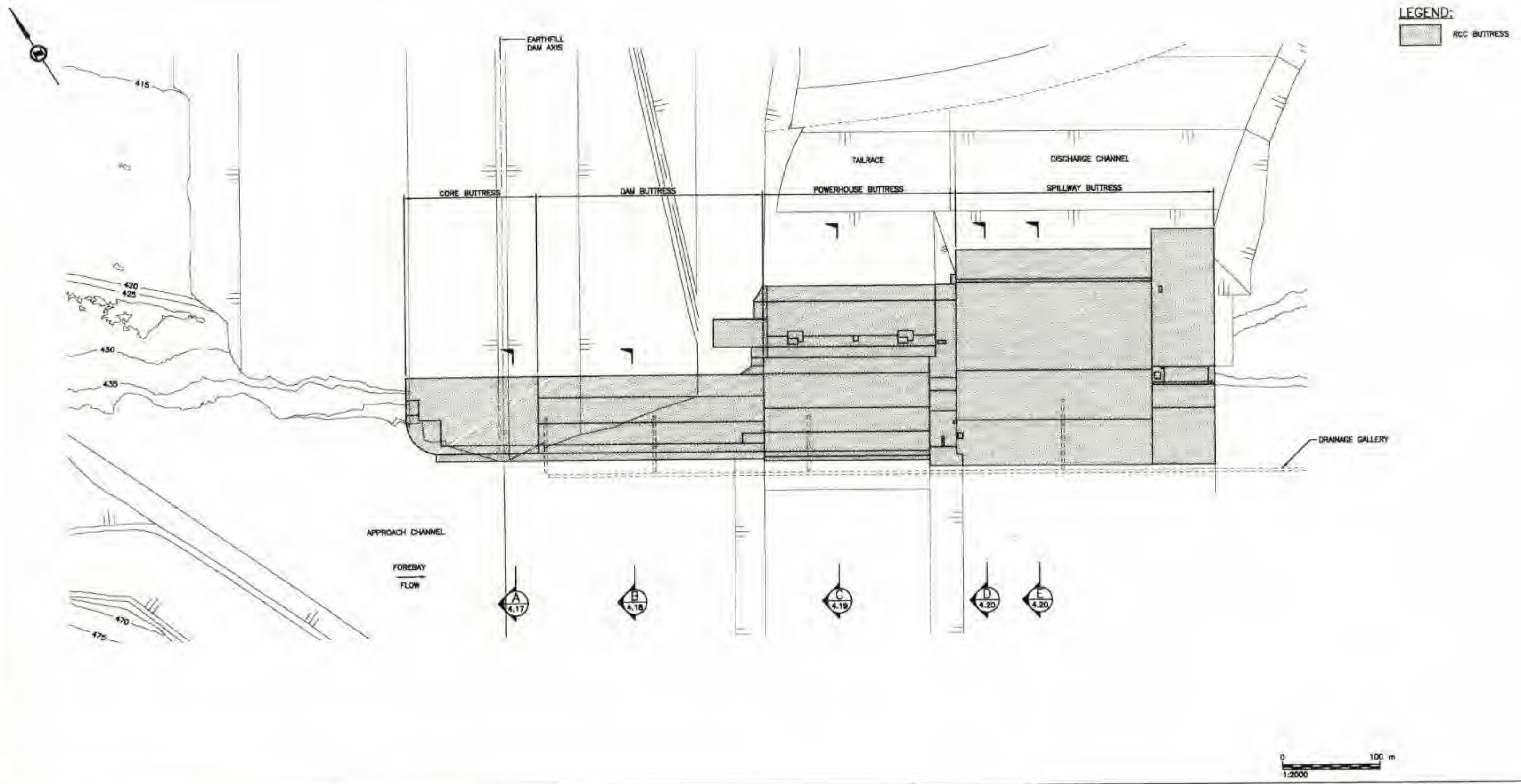
SITE C CLEAN ENERGY PROJECT

Figure 4.13 Artist's rendition of dam, generating station, and spillways

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

Redacted Document- BCSC No. 180247





SCHEMATIC ONLY

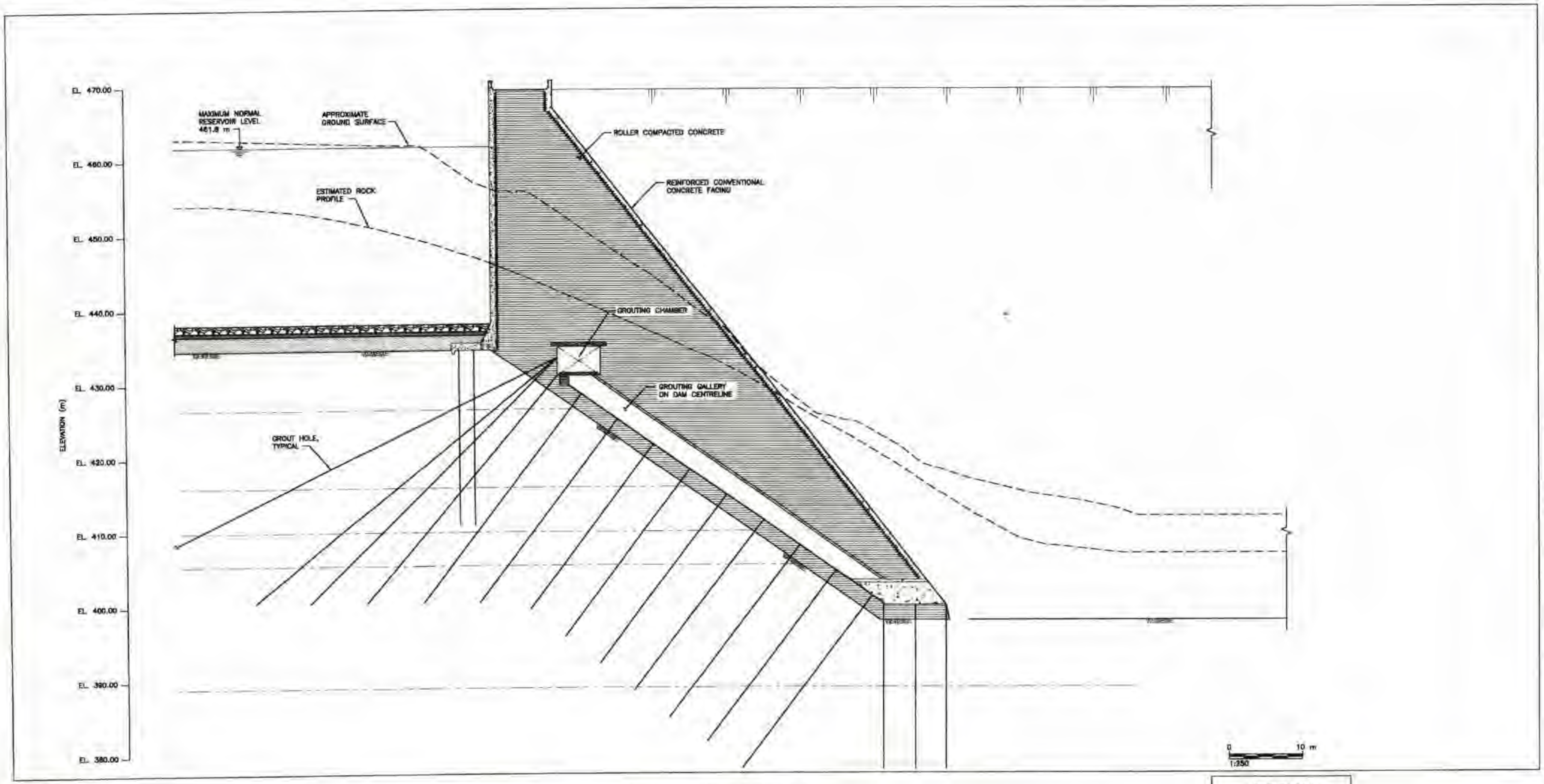
BC hydro

SITE C CLEAN ENERGY PROJECT

Figure 4.16
Plan of roller compacted concrete buttress

Date	Oct 10, 2012	DWG NO	1016-C14-06602	R 0

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



CROSS-SECTION A, SEE FIGURE 4.16

SCHEMATIC ONLY

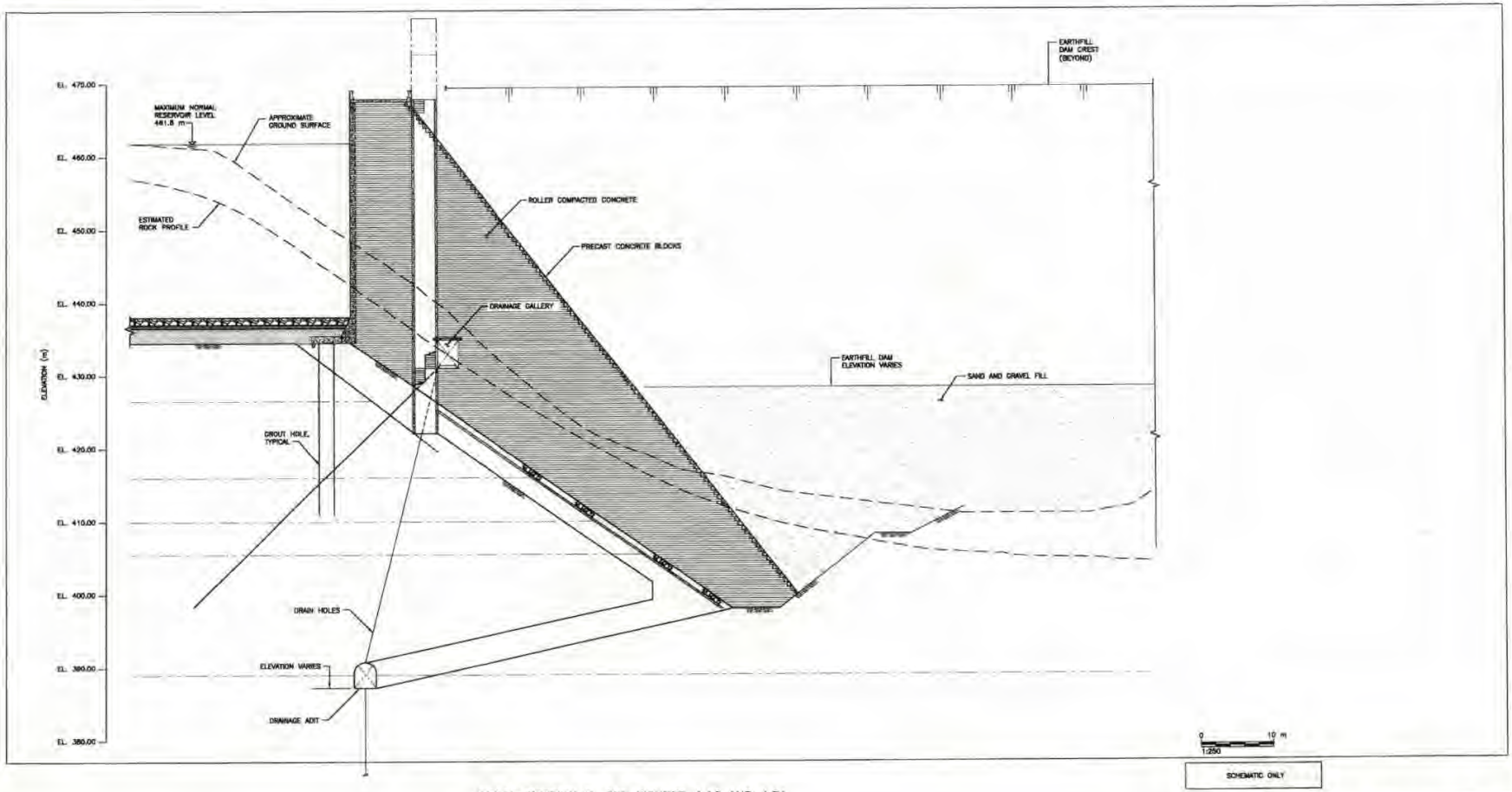
BChydro

SITE C CLEAN

Figure 4.17
Cross-section of core buttress

Date	July 20, 2012	DWG NO	1016-C14-06803	R 0

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



CROSS-SECTION B, SEE FIGURES 4.16 AND 4.21

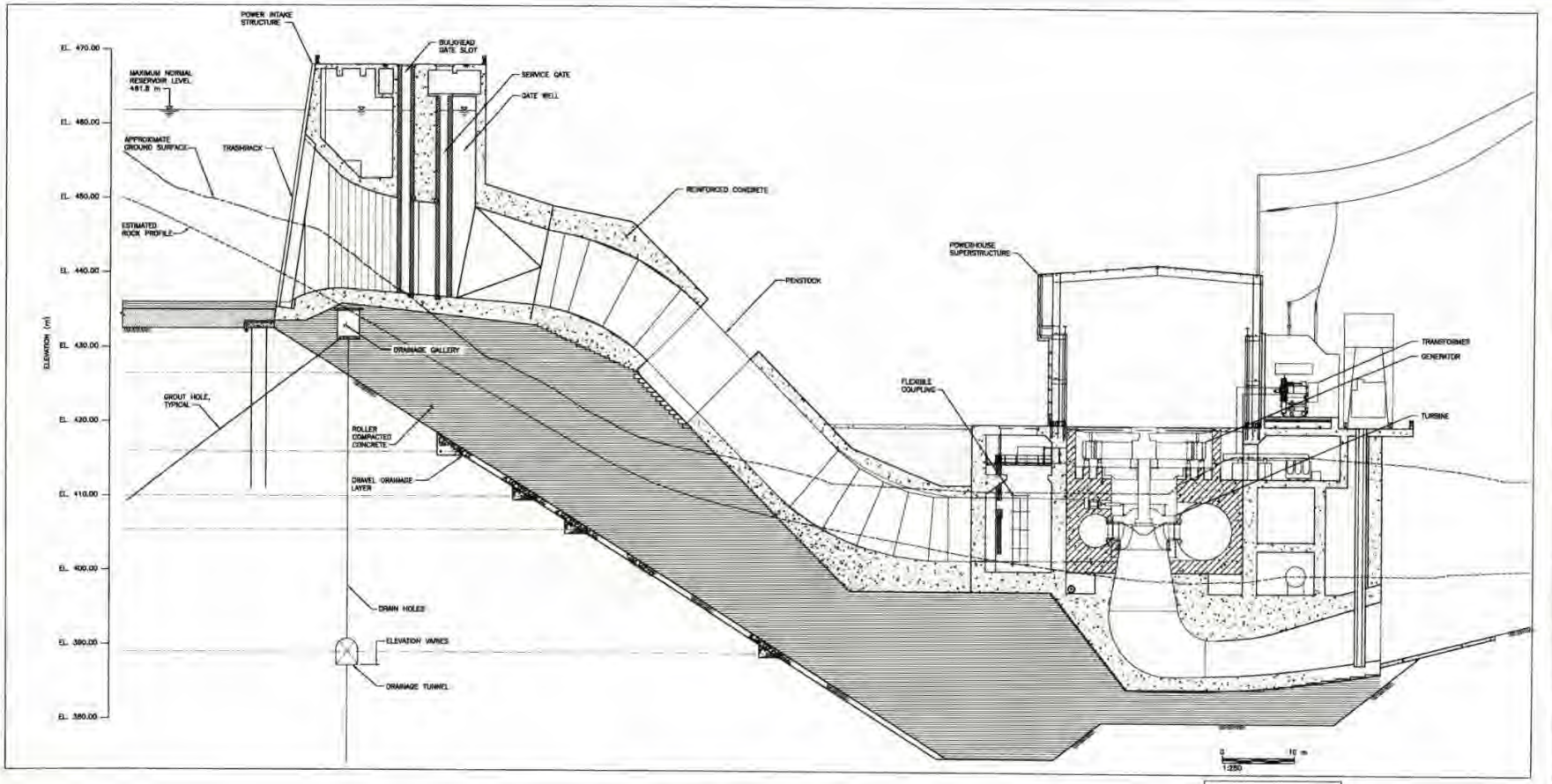
BC hydro

SITE C CLEAN ENERGY PROJECT

Figure 4.18
Cross-section of dam buttress

Date	Oct 10, 2012	DWG NO	1016-C14-06604	R 0

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



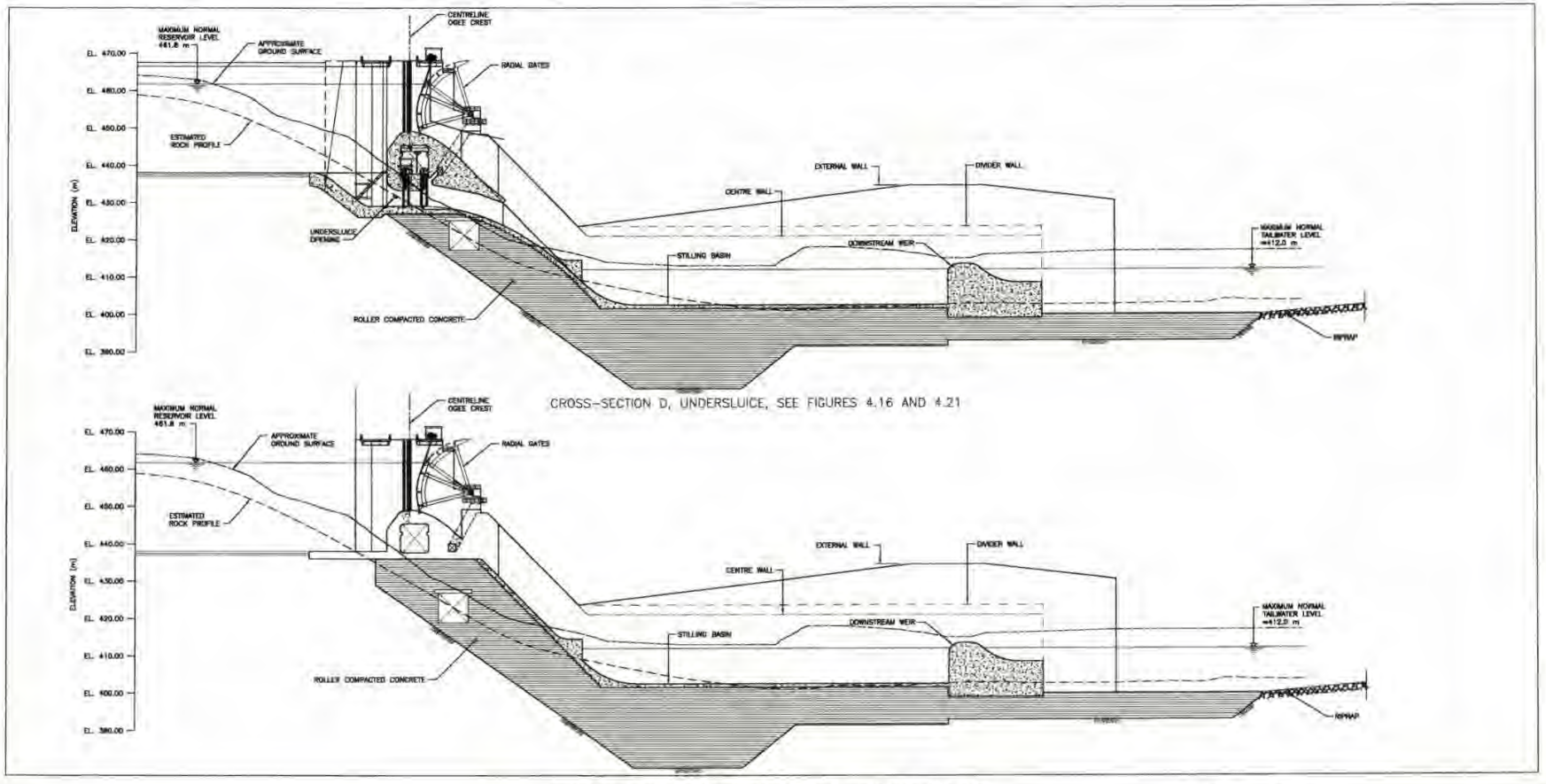
CROSS-SECTION C, SEE FIGURES 4.16 AND 4.21

SCHEMATIC ONLY

BC hydro

Figure 4.19
Cross-section at powerhouse buttress and generating station

Date	Oct 10, 2012	DWG NO	1016-C14-06605	R 0



CROSS-SECTION D, UNDERSLUICE, SEE FIGURES 4.16 AND 4.21

CROSS-SECTION E, NO UNDERSLUICE, SEE FIGURES 4.16 AND 4.21

0 20 m

SCHEMATIC ONLY

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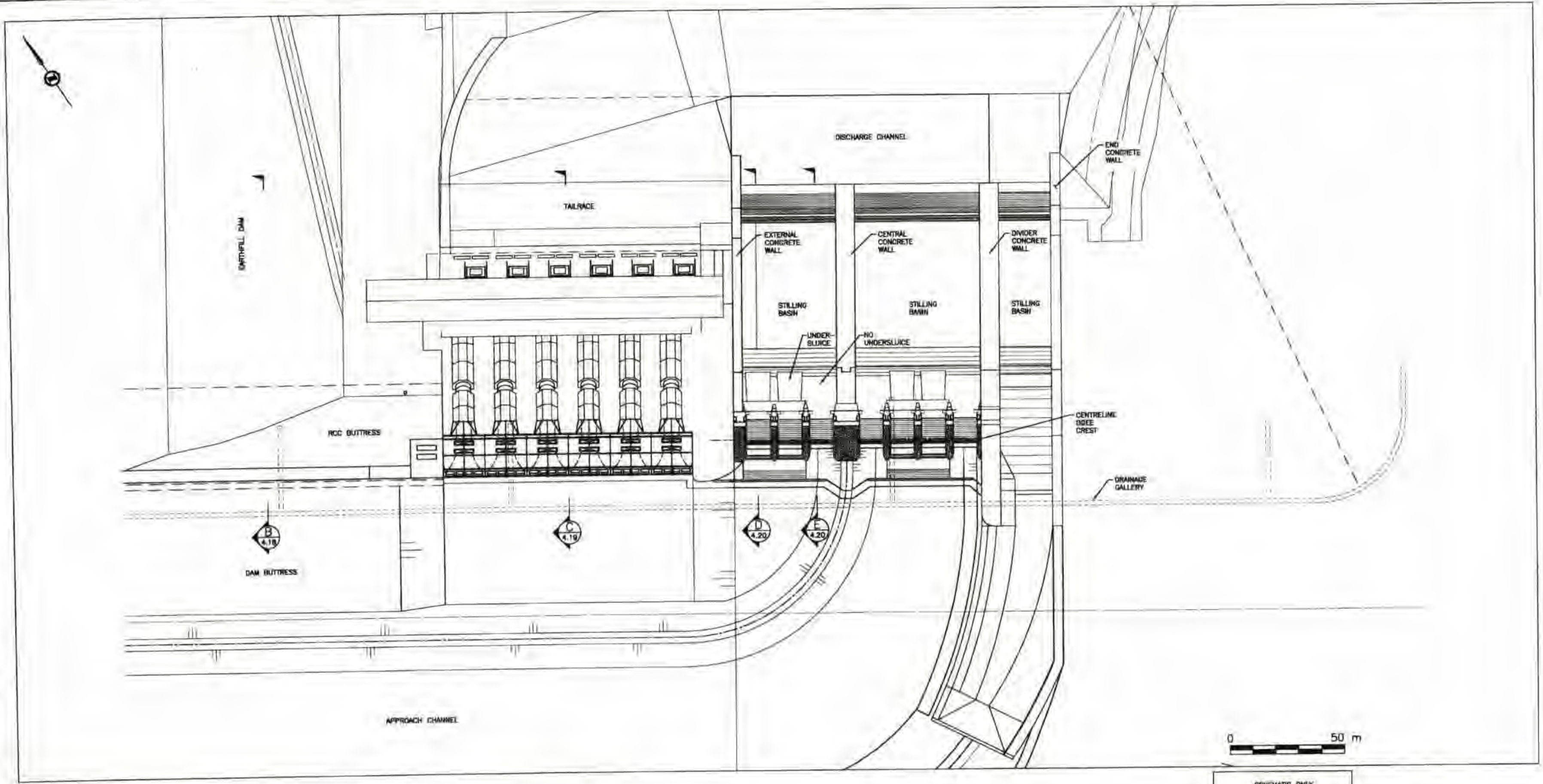
SITE C CLEAN

Figure 4.20
Cross-section of spillway and gated spillway buttress

Date	Oct 10, 2012	DWG NO.	1016-C14-06606	R0

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



SCHEMATIC ONLY

BChydro

Figure 4.21
Powerhouse and spillway plan

Date	Oct 10, 2012	DWG NO	1016-C14-06607	R 0

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

Appendix R to
Expert Report of E. Harvey Elwin
July 6, 2018

T.E. LITTLE CONSULTING INC.

02 June 2017

Bruce O'Neill, P.Eng.
Deputy Comptroller of Water Rights
Ministry of Forests, Lands and Natural Resource Operations
PO Box 9340 Stn. Prov Govt
Victoria, BC, V8W 9M1
Via email: Bruce.ONeill@gov.bc.ca

Dear Mr. O'Neill:

Site C Clean Energy Project - Conditional Water Licences 132990 & 132991
Recommendation for Leave to Construct LTC #06A
Powerhouse Roller Compacted Concrete Buttress

1.0 INTRODUCTION

Conditional Water Licences (CWLs) 132990 and 132991 dated 26 February 2016 authorize construction of works for the storage, diversion and use of water from the Peace River for power purposes at the Site C Clean Energy Project (Site C). Leave to Commence Construction of the works comprising LCC #01 under CWLs 132990 and 132991 was granted to BC Hydro and Power Authority (BC Hydro) on 01 April 2016.

Leave to Commence Construction LCC #06 was granted to BC Hydro, with conditions, on 16 May 2017. The project components included in LCC #06 are the following roller compacted concrete (RCC) structures:

- Core buttress – provides the south (right) abutment of the earthfill dam at the core;
- Dam buttress – provides the south abutment of the downstream shell of the earthfill dam;
- Powerhouse buttress – provides the foundation for the generating station;
- Spillway buttress – provides the foundation for the spillways and stilling basin; and
- Tailrace wall – provides a barrier between the tailrace and the toe of the earthfill dam.

As Independent Engineer (IE) for the Site C project, I have received a submission from BC Hydro requesting permission to commence construction of the powerhouse buttress, tailrace wall and downstream spillway stilling basin. These components are the RCC structures scheduled to be constructed in 2017.

These works are to be constructed by BC Hydro's Main Civil Works contractor, Peace River Hydro Partners (PRHP). For reference, construction of these works is to be authorized under *Leave to Construct LTC #06A*.

The submission received from BC Hydro also includes most of the information that is expected to be required for the remaining RCC structures, but construction of those structures will be authorized under separate LTCs in 2018 and 2019.

2.0 DESCRIPTION OF THE WORKS

The RCC buttress structures will be constructed along the south (right) bank of the Peace River inside the Stage 1 right bank cofferdam, and in total will extend for approximately 747 m from the upstream side of the core of the earthfill dam to the downstream end of the spillways.

In plan, the dam and core buttress sections will have a total width of about 354 m, with a maximum upstream-downstream length of about 62 m. The upper portions of these buttresses will be free-standing sections, extending about 35 m above the approach channel invert to El. 469.4, which is the crest of the future earthfill dam. The south faces of these buttresses will provide containment of the approach channel and the north faces will provide the right abutment for the core and downstream shell of the dam.

In plan, the footprint of the powerhouse buttress will be 162 m wide at its upstream side, with an upstream-downstream length of about 152 m. The powerhouse buttress will support the future power intakes, penstocks and powerhouse, and includes the RCC slab for the service bay, which will be located on its west side.

The tailrace wall, with a maximum width of about 31 m and height ranging from about 15 m to 30 m, will extend about 154 m downstream from the west side of the powerhouse buttress. The wall will provide a barrier between the tailrace and the toe of the earthfill dam to protect against erosion.

The spillway buttress will have a maximum footprint width of about 231 m, with an upstream-downstream length of about 259 m. The spillway buttress will support the future gated spillway headworks, chute, spillway walls, upstream and downstream stilling basins and weir.

Along the toe of the spillway buttress there will be an RCC apron that will protect against foundation scour in the upstream 60 m of the spillway tailrace.

The RCC structures will be entirely founded on excavated bedrock surfaces. The bases of the powerhouse and spillway buttress sections will be at El. 375 m, more than 35 m below existing river level. The dam and core buttress sections will have their bases at El. 398.0 m.

Above its base, the bedrock excavation for the RCC buttresses will slope upwards towards the south at 1.6H:1.0V (powerhouse & spillway buttresses) or 1.45H:1.0V (dam & core buttresses) until it meets the invert of the approach channel excavation. The channel invert will be at El. 432.5 m adjacent to the powerhouse buttress and at El. 434.5 m adjacent to the spillway, dam and core buttresses. The crests of the powerhouse and spillway buttress sections will be at the same elevations as the adjacent approach channel invert.

A drainage gallery will extend longitudinally through all four buttress sections. As the RCC is placed, the gallery will be formed with precast concrete segments, or with removable forms or other acceptable method.

The right bank drainage tunnel, currently under construction, will extend through bedrock below most of the length of the RCC buttress. The tunnel and drain holes to be drilled from it were intended to provide foundation drainage, both in advance of buttress construction and for the long term. The tunnel will also house instrumentation that was intended to serve as a tool to assess the behaviour of the RCC buttress foundation during excavation and later, to monitor long term performance of the buttress. Due to slow progress of the tunnel construction, alternative instruments were installed from surface to monitor the bedrock excavations and surface drains were drilled along the backslope of the RCC buttress excavation to provide interim drainage of the foundation bedrock. The long-term instrumentation and drain holes

will still be installed from the tunnel when it is completed, including drains to be drilled between the tunnel and the RCC buttress drainage gallery.

An access tunnel will be constructed from the right bank drainage tunnel in the downstream direction, and will extend through the powerhouse buttress to connect the tunnel and the future powerhouse. The portion of the access tunnel through the buttress will be constructed in the same manner as the drainage gallery. In the future, a permanent tunnel dewatering system will pump water from the drainage tunnel sump to the powerhouse sump, via this access tunnel.

3.0 LTC #06A SUBMISSION

The following documents have been received from BC Hydro in support of the request for LTC #06A:

1. BC Hydro - *Site C Clean Energy Project Request for LCC6 Component Authorization, Leave to Construct 6A, B and C (LTC6A, LTC6B, and LTC6C) – RCC Buttress Foundation Preparation and RCC Placement*, letter from K. von Muehldorfer to T.E. Little Consulting Inc., 06 May 2017.
2. Peace River Hydro Partners - *Site C Clean Energy Project Main Civil Works, LTC 6 (A, B, & C) Application: Foundation Preparation and RCC Placement*, R2, 04 May 2017.
3. BC Hydro - *Issued for Construction Drawings* (see Appendix A).
4. Klohn Crippen Berger Ltd./SNC Lavalin Inc. – *RCC Powerhouse Buttress – Movement Joints*, Internal memorandum from N. Heidstra to B. Gagne, File 1016.Z.02.014.ENC.01064.MEMO, 04 April 2017.
5. BC Hydro – *Written Direction for Procurement of Optional Work – Observational Case Materials*, letter from T. Watson to L. Brais (PRHP), File ID 1016.Z.05.003.CMO.00835.LTR, 25 April 2017.
6. Klohn Crippen Berger Ltd./SNC Lavalin Inc. - *Right Bank Instrumentation, Expected Deformations and Instrument Readings to Date*, Presentation to Independent Engineer, 24 May 2017.

4.0 REVIEW OF SUBMISSIONS

4.1 Design Details and Construction Drawings

The RCC buttress, in combination with the future overlying intake and spillway structures, will form part of the Site C reservoir-retaining system. As such, the design and analyses of the RCC buttress sections are in accordance with the guiding principles of the Canadian Dam Association (CDA) and are referenced to internationally-recognized design codes, standards and guidelines for dams. The RCC buttress sections are designed as concrete gravity structures and the design analyses were performed for the range of normal, unusual and extreme load cases that are typically evaluated for major concrete dams and hydraulic structures, including seismic, flood, hydrodynamic and thermal loads, post-earthquake condition, extreme uplift conditions, and conditions with one half of the spillway stilling basin dewatered.

As described in the RCC Buttress DBM, the design of the buttress is strongly influenced by the site geological conditions. The geological features in the shale bedrock that have particular influence on the RCC buttress design are the flat-lying low strength bedding planes, steeply-dipping relaxation joints and cross-cutting shears. Much of the outer and upper bedrock underlying the existing right bank terrace has relaxed toward the valley along bedding planes, due to long-term valley formation and unloading processes. Also, the shale bedrock tends to swell and rebound when unloaded, with both a short-term

elastic response and a longer term swelling response. In addition, there are "locked-in" in situ horizontal stresses in the rock that tend to cause movements when an excavation is opened.

The excavation for the RCC buttresses will extend horizontally into the right abutment to a depth that is intended to remove most of the rock with existing relaxation joints, although it is recognized that new joints could be opened as a result of the excavation. Bedding planes BP18, BP25, BP28, BP31 and BP32 occur within the foundation RCC buttress. The bases of the powerhouse and spillway buttress sections will be keyed into rock below BP32 and the bases of the dam and core buttresses will be keyed into or founded on rock below BP28.

The foundation of the core buttress will be grouted in the same manner as the earthfill dam core foundation. Consolidation grouting will be performed over the entire core buttress footprint to reduce the hydraulic conductivity of the upper several metres of bedrock and to ensure the near-surface foundation is uniformly stiff. A grouting gallery will be constructed in the core buttress along the earthfill dam axis. From the gallery, contact grout holes and three rows of 20 m-deep curtain holes will be drilled and grouted along the dam axis to reduce the potential for seepage through the foundation beneath the core buttress.

Except where the RCC will be subsequently covered with compacted earthfill, or where it will not be visually exposed nor exposed to the elements, sloping and vertical outer surfaces of the RCC buttresses will be placed against formwork. Depending on long-term freeze-thaw exposure or what will later be constructed against these outer surfaces, the RCC will have an outer zone of conventionally vibrated concrete (CVC) or a facing of precast concrete blocks. The crests of the core and dam buttresses and the tailrace wall will be capped with a layer of cast-in-place concrete (CIPC) that will be the permanent outer surface. Ultimately, a site access road will be located along the top of the dam and core buttresses. There will be no special treatment of the tailrace wall RCC face that will be in contact with the downstream shell of the earthfill dam.

The RCC buttress will be constructed over a three-year period, starting with the powerhouse buttress in 2017. Construction staging joints consisting of 50 mm of compressible material are to be provided on either side of the powerhouse buttress to allow for differential movements between the adjacent dam and spillway buttresses. These joints will have PVC waterstops at their upstream edges.

Contraction joints will be constructed within all the buttresses to reduce cracking in the RCC. These joints will have PVC waterstops at their upstream edges and will have formed holes in the dam and core buttresses for drainage. The PVC waterstops in the core buttress joints will also continue along the top and downstream face of the buttress.

The design for the powerhouse, dam and spillway buttresses includes movement joints to accommodate potential movements in the underlying bedrock foundation. The joints will include grouting systems and the grouting would be carried out immediately before reservoir filling to allow the maximum time for movements to occur. BC Hydro has the option to delete the movement joints from the design, based on the observational method, which depends on rock movements measured before construction of the buttresses starts. Portions of the outer CVC zones will include reinforcement to control cracking. Similar to the movement joints, additional reinforcement may be installed, based on the observational method.

A decision to delete the movement joints would require advance notice to the contractor to allow time for construction planning. For the powerhouse buttress, RCC placement is scheduled to start shortly after the excavation is completed and the actual time available to observe the response of the rock due to excavation is less than anticipated at the time of design. Based on the recommendation of its designer-of-record (Klohn Crippen Berger/SNC Lavalin) that there is insufficient data to confidently remove the joints, BC Hydro has directed PRHP to proceed with construction of the movement joints for the powerhouse buttress. Decisions on the need for movement joints for other buttresses will be made later when more information is available on the response of the bedrock to excavation.

On 24 May 2017, at the request of the IE, BC Hydro provided a presentation on the expected bedrock deformations at the design stage, and the response to date as measured by instruments in the right bank. At the time, the excavation had advanced below BP28, with BP31 and BP32 not yet daylighted. The recorded bedrock displacements are still being evaluated in detail, but have generally been small and within design estimates. In some locations, measurements show incremental bedrock displacements that coincide with individual blasts, which are interpreted to be the result of local incremental stress relief induced by each 10 m-deep blasting lift. The instrumentation also highlights the importance of foundation drainage, indicated by increased movements at some locations following high rainfall events. Currently, the interim surface drains must be frequently pumped to maintain low piezometric levels in the bedrock foundation.

Drawings have been received for all the RCC buttress structures, including plans, sections and typical details, as listed in Appendix A. The drawings have been sealed by Professional Engineers registered in British Columbia and are Issued for Construction status. It is the IE's opinion that the drawings are consistent with the Site C project general arrangement drawings, the design basis and the conditions of Conditional Water Licences 132990 and 132991. It is also the IE's opinion that incorporating movement joints in the powerhouse RCC buttress is appropriate based on the available information and is consistent with the design basis.

4.2 Construction Implementation Plan and Schedule

The total volume of RCC to be placed is more than 1.7 million m^3. There is a limited seasonal period when outdoor temperatures are warm enough for RCC placement; additionally, the configuration of the structures and access to them impose practical limits on placement rates. To limit the time between unloading and reloading of the foundation bedrock, the RCC buttress will be constructed in three sections over three years, each with rock excavation during the cold season and RCC placement during the following warm season as summarized below.

Year	Component	Quantity (m^3)	Total (m^3)
2017	Powerhouse buttress	347,000	509,000
	Tailrace wall	70,500	
	Downstream spillway stilling basin	72,500	
	Tailrace channel	19,000	
2018	Spillway buttress	625,000	727,600
	Spillway walls	102,600	
2019	Dam & core buttresses	490,000	490,000
Total			**1,726,600**

Final foundation preparation prior to starting RCC placement will include cleaning to remove loose or deteriorated rock and placement of grout, mortar and dental concrete to infill cracks, joints or larger cavities. On prepared horizontal surfaces, construction of the RCC buttress will commence with a CIPC slab on grade, then placement of RCC will proceed in 300 mm-thick horizontal lifts. Against sloping rock faces, a zone of CVC will be placed between the RCC and the rock and compacted/vibrated with the RCC of that lift.

The technical specifications include requirements for installing insulation over exposed RCC surfaces during the first winter after construction of each RCC component.

The IE considers the work plan to be appropriate to the work, and that the sequential stages of excavation and RCC placement are consistent with the design basis. The IE considers that the proposed schedule is reasonable, provided the contractor is well organized and achieves an early start to each season of RCC placement. The IE notes that going into the first season of RCC placement, there is some uncertainty about the degree of final rock surface preparation that will be required prior to RCC placement, which could impact the rate of progress.

4.3 Quality Management

Details of PRHP's quality management program were previously submitted and reviewed with the request for LCC #01. As part of that program, PRHP has developed standard Inspection and Test Plans (ITPs) for specific types of work, which are reviewed by BC Hydro in accordance with the Main Civil Works contract.

The application for LTC #06A lists ITPs for RCC buttress excavation, foundation protection and preparation, and roller compacted concrete, which cover the types of work included in the RCC construction.

The IE notes that the Main Civil Works contract requires numerous contractor submissions related to the RCC construction, including the RCC inspection and test plan, an RCC conveying and hauling plan, an RCC handling and placement plan, and a report on the RCC trial placement. All of these plans and reports are relevant to the construction of RCC structures that will meet the contract technical specifications and quality requirements. BC Hydro has informed the IE that review of the RCC conveying and hauling plan is in progress and will be completed soon, and that BC Hydro has accepted the other plans, either with no further comments or only minor review comments.

4.4 Environmental Protection

The Environmental Protection Plan (EPP) is included in the application document for LTC #06A, and includes descriptions of anticipated work activities and applicable mitigation measures to reduce potential environmental impacts. BC Hydro has accepted the EPP.

The RCC buttress works will be constructed entirely inside the Stage 1 right bank cofferdam, which should allow PAG contact water to be readily collected and managed.

The IE has discussed the work with the IEM and both parties are familiar with the area where the RCC buttress works will be constructed.

The IEM has provided the IE with comments on environmental aspects of the proposed construction in the following letter, a copy of which is attached for reference:

1. EDI Environmental Dynamics Inc. – *Site C Clean Energy Project – Conditional Water License 132990 & 132991 IEM review of the Powerhouse Roller Compacted Concrete Buttress, and relevant component plans in consideration of LTC#6A,* letter to T.E. Little Consulting Inc. dated 02 June 2017.

The IEM has no objections to issuing LTC #06A.

4.5 Dam Safety

Construction of the RCC buttress will take place inside the Stage 1 right bank cofferdam. The *Operations, Maintenance and Surveillance (OMS) Plan* and the *Emergency Response and Preparedness (ERP) Plan* for the Stage 1 cofferdams were previously submitted by BC Hydro with the request for LCC #05 and cover the proposed RCC works. The IE and the FLNRO Dam Safety Officer consider the OMS and ERP Plan contents to be consistent with the requirements of BC Dam Safety Regulation 40/2016.

With its request for LCC #06, BC Hydro provided a copy of a certification letter from the cofferdam designer, Knight Piésold (KP), that *"...certifies that the Stage 1 Right Bank Cofferdam's design is capable of resisting all hydro-static and hydro-dynamic loads that may be exerted onto the structure, and all of its accompanying components"*, and *"KP is of the opinion that the constructed Cofferdam, in general, complies with the design intent, design drawings and specifications, as designed by KP and is ready to be commissioned and be subjected to full hydraulic loading, with the conditions as set-out on the IFC drawings and explicitly noted in Knight Piésold Field Instruction #30 (copy attached to certification letter)"*. The letter and field instruction are sealed by professional engineers registered in British Columbia. During a site visit on 31 May 2017, the IE observed that there was very little visible water in the excavation inside the cofferdam, which indicates that the seepage barrier appears to be effective. Instruments in the cofferdam foundation are also reported to indicate stable piezometric conditions.

4.6 Public Safety

The request for LTC #06A notes that the work will take place entirely on land within the project area, with no public access. In the event of unauthorized personnel accessing the work site, PRHP will follow the mitigation measures outlined in its *Public Safety Management Plan*, which has previously been accepted by BC Hydro.

5.0 RECOMMENDATION FOR LEAVE TO CONSTRUCT LTC#06A

The Independent Engineer hereby recommends to the Deputy Comptroller of Water Rights that BC Hydro can proceed with construction of the powerhouse RCC buttress as described above. As per LCC #06 dated 16 May 2017, this recommendation is copied to BC Hydro and is sufficient for construction of these works to proceed. For reference, this recommendation is referred to as *Leave to Construct LTC #06A*.

Leave to Construct LTC# 06A for construction of the powerhouse RCC buttress is subject to the conditions of LCC #06 which are attached to this letter as Appendix B for reference.

APPENDIX A
LTC #06A – POWERHOUSE RCC BUTTRESS – ISSUED FOR CONSTRUCTION DRAWINGS

General Arrangement and General Details

Drawing No.	Revision	Title
1020-C02-01007	R1	Dam - RCC Buttress General Arrangement Plan
1020-C02-01000	R0	Dam - RCC Buttress RCC and Conventionally Vibrated Concrete Concrete Outline Typical Details
1020-C02-03080	R0	Dam - RCC Buttress Miscellaneous Metalwork

Foundation Protection & Preparation

Drawing No.	Revision	Title
1020-C02-00600	R0	Dam Dam and Other Structures Foundation Preparation Section and Details
1020-C02-00601	R0	Dam Dam and Other Structures Foundation Protection on Rock Section and Details

Powerhouse Buttress

Drawing No.	Revision	Title
1020-C02-01008	R1	Dam - RCC Buttress Powerhouse Buttress Concrete Outline Plan
1020-C02-01011	R1	Dam - RCC Buttress Powerhouse Buttress Concrete Outline Section
1020-C02-01015	R1	Dam - RCC Buttress Powerhouse Buttress - Drainage Gallery Concrete Outline Plan and Section
1020-C02-01017	R1	Dam - RCC Buttress Powerhouse Buttress Precast Concrete Blocks Concrete Outline Plans, Elevations, and Details

Drawing No.	Revision	Title
1020-C02-01018	R0	Dam - RCC Buttress Powerhouse Buttress Precast Concrete Blocks Concrete Outline and Reinforcement Elevations and Section
1020-C02-01024	R1	Dam - RCC Buttress Powerhouse Buttress Movement Joints Concrete Outline Plan, Sections, and Details

Powerhouse Buttress – Tailrace Wall

Drawing No.	Revision	Title
1020-C02-01021	R1	Dam - RCC Buttress Powerhouse Buttress - Tailrace Wall Concrete Outline - Plan
1020-C02-01022	R1	Dam - RCC Buttress Powerhouse Buttress - Tailrace Wall Concrete Outline - Sections

Spillway Buttress

Drawing No.	Revision	Title
1020-C02-01051	R2	Dam - RCC Buttress Spillway Buttress Upstream Concrete Outline Part Plan
1020-C02-01052	R1	Dam - RCC Buttress Spillway Buttress Downstream Concrete Outline Part Plan
1020-C02-01055	R0	Dam - RCC Buttress Spillway Buttress Concrete Outline Section and Details
1020-C02-01056	R0	Dam - RCC Buttress Spillway Buttress Concrete Outline Section and Detail
1020-C02-01059	R2	Dam - RCC Buttress Spillway Buttress Concrete Outline Sections and Detail

Dam and Core Buttresses

Drawing No.	Revision	Title
1020-C02-00650	R0	Dam - RCC Buttress Core Buttress Grouting Plan and Section
1020-C02-00651	R1	Dam - RCC Buttress Core Buttress Grouting Section B
1020-C02-01025	R0	Dam - RCC Buttress Core Buttress Concrete Outline Plan and Section
1020-C02-01026	R0	Dam - RCC Buttress Core Buttress Concrete Outline Sections
1020-C02-01033	R0	Dam - RCC Buttress Core Buttress Concrete Outline Details and Sections
1020-C02-01035	R1	Dam - RCC Buttress Dam Buttress Concrete Outline Plan
1020-C02-01039	R0	Dam - RCC Buttress Dam Buttress Concrete Outline Sections
1020-C02-01046	R0	Dam - RCC Buttress Core and Dam Buttress - Drainage Gallery Concrete Outline Plan, Sections, and Detail
1020-C02-02031	R0	Dam - RCC Buttress Core Buttress Reinforcement Part Plan, Sections, and Detail

Tailrace RCC

Drawing No.	Revision	Title
1020-C22-00400	R1	Tailrace Tailrace Channel Excavation Plan
1020-C22-00401	R1	Tailrace Tailrace Channel Fill Plan
1020-C22-00402	R1	Tailrace Tailrace Channel Excavation and Fill Details Z, Y, X, and W
1020-C22-00403	R1	Tailrace Tailrace Channel Excavation and Fill Sections A, B and Detail V
1020-C22-00404	R1	Tailrace Tailrace Channel Excavation and Fill Sections C and D

APPENDIX B
LCC #06 – CONDITIONS

No.	Condition	Status for LTC #06A
a)	Before the construction of any component of LCC #6 may proceed, the Licensee must: • submit relevant design drawings signed and sealed by a professional engineer registered in the province of British Columbia to Tim Little P. Eng. to review in his capacity as IE, and • receive a copy of a report (the "Recommendation Report") submitted by the IE to the DCWR, which recommends that construction of that component of LCC #6 may proceed. The Recommendation Report is in the form of a letter, referred to as a "Leave to Construct" and is sufficient for construction of that component to proceed.	Completed.
b)	The Licensee may request the DCWR to review any of the IE's Recommendation Reports and make alterations that the DCWR deems appropriate.	If and as required.
c)	If during construction material changes to the works of LCC #6 are proposed, the changes must be authorized through the process described in Section 12 a).	If and as required.
d)	Any revisions to sections of the CEMP that are applicable to the construction of works authorized by the Water Licences, including temporary works in support of constructing the named permanent works, must be reviewed by the IEM and accepted by the Deputy Comptroller of Water Rights	If and as required.

EDI
ENVIRONMENTAL DYNAMICS INC.

301 George Street
Prince George, BC V2L 1R4

June 02, 2017

EDI Project No: 14P0693

T.E. Little Consulting Inc.
13541 – 15A Avenue
Surrey, BC V4A 9A1

Attention: Tim Little, Independent Engineer

RE: Site C Clean Energy Project – Conditional Water License 132990 & 132991 IEM review of the Powerhouse Roller Compacted Concrete Buttress, and relevant component plans in consideration of LTC#6A

Leave to Commence Construction (LCC#6) was issued by the Deputy Comptroller of Water Rights as identified in the Conditional Water Licence (CWL) 132990[1] and 132991[2] for the Powerhouse Roller Compacted Concrete Buttress involving the following key components:

- Core buttress – provides the south (right) abutment of the earthfill dam at the core.
- Dam buttress – provides the south abutment of the downstream shell of the earthfill dam.
- Powerhouse buttress – provides the foundation for the generating station.
- Spillway buttress – provides the foundation for the spillways and stilling basin.
- Tailrace wall – provides a barrier between the tailrace and the toe of the earthfill dam.

While it is the role of the Independent Engineer (IE) to issue the LTCs, the IEMs role is to review Environmental Protection Plans (EPPs) and associated component plans provided by contractors to verify they adequately address the potential environmental impacts in advance of construction.

This letter has been prepared specifically the Powerhouse Roller Compacted Concrete Buttress works pertaining to LTC#6A. It is our understanding that works under this LTC are to include the following:

- Foundation protection measures for the roller compacted concrete (RCC) buttress; and
- Construction of the RCC buttress, including the powerhouse, spillway, and dam and core components.

[1] Conditional Water Licence 132990. Prepared by the Ministry of Forests, Lands and Natural Resource Operations, Office of the Comptroller of Water Rights, Water Management Branch. Dated February 26, 2016.

[2] Conditional Water Licence 132991. Prepared by the Ministry of Forests, Lands and Natural Resource Operations, Office of the Comptroller of Water Rights, Water Management Branch. Dated February 26, 2016.

As the issuance of each LTC requires the IEMs review and recommendation for acceptance to the IE, it is the IEMs understanding that any revisions to the EPP or supporting documents, or changes to scopes of work that could require such revisions, would require review and acceptance by the IEM prior to initiating works, and could be considered a hold point by the IE.

The IEM has reviewed the EPP provided by BC Hydro including cross-referencing with the various applicable project requirements found within the Construction Environmental Management Plan (CEMP), components of BC Hydro supporting documentation/plans, relevant permits/approvals/licences, and related drawings for the works. In addition, the review was conducted in consideration of the Environmental Assessment Certificate (EAC) Schedule B Table of Conditions and Decision Statement issued by the Canadian Environmental Assessment Agency (CEAA) for the Project.

The IEM team has deferred review of relevant safety plans to the Independent Engineer and the Dam Safety Officer.

The following is a summary of plans, permits, and authorizations received and reviewed by the IEM team, which are related to LTC#6A.

BC Hydro Plans/Documents

- *Site C Clean Energy Project Request for LCC6 Component Authorization, Leave to Construct 6A, B and C (LTC6A, LTC6B, and LTC6C) – RCC Buttress Foundation Preparation and RCC Placement*, letter from K. von Muehldorfer to T.E. Little Consulting Inc., dated May 6, 2017.
- *Construction Environmental Management Plan* (Revision 4), dated July 26, 2016.

Contractor Plans (including relevant design drawings)

- Peace River Hydro Partners - *Site C Clean Energy Project Main Civil Works, LTC 6 (A, B, & C) Application: Foundation Preparation and RCC Placement*, R2, dated May 4, 2017.

Relevant Design and Conceptual Drawings

- BC Hydro - *Issued for Construction Drawings,* dated May 30, 2017.

Provincial Permits/Approvals

- *Conditional Water Licence 132990.*
- *Conditional Water Licence 132991.*
- Leave to Commence Construction #6 – *Roller Compacted Concrete Buttress Foundation Preparation and Roller Compacted Concrete Placement*, dated May 16, 2017.

Conclusions and Recommendations

Upon review of the submitted documents for LTC#6A, and based on our understanding of the works proposed in addition to communications and information provided by BC Hydro, we have no objections to issuing LTC#6A for the works associated with the Powerhouse Roller Compacted Concrete Buttress, as described. Ultimately, all works must be compliant with appropriate permits, approvals, authorizations, and conditions as identified within the EAC and CEAA Decision Statement, regulations, and the CEMP.

Yours truly,

EDI Environmental Dynamics Inc.

Kevin Christie, R.P.Bio., P.Biol., P.Ag.
Independent Environmental Monitor, Delegate

cc. Bruce O'Neill, Water Management Branch, Manager of Water Allocation and Utilities Section
Gypsy Fisher, FLNRO Water Management Officer
Richard Penner, FLNRO Water Management Officer
Greg Scarborough, BC Hydro, Manager, Project Environmental Risk Management
Karen von Muehldorfer, BC Hydro Regulatory Manager

T.E. LITTLE CONSULTING INC.

18 April 2018

Bruce O'Neill, P.Eng.
Deputy Comptroller of Water Rights
Ministry of Forests, Lands, Natural Resource Operations and Rural Development
PO Box 9340 Stn. Prov Govt
Victoria, BC, V8W 9M1
Via email: Bruce.ONeill@gov.bc.ca

Dear Mr. O'Neill:

Site C Clean Energy Project - Conditional Water Licences 132990 & 132991
Leave to Construct LTC #03D – Right Bank Bedrock Excavations
Recommendation for Amendment #2

Leave to Construct LTC #06A - Powerhouse Roller Compacted Concrete Buttress
Recommendation for Amendment #1

1.0 INTRODUCTION

Conditional Water Licences (CWLs) 132990 and 132991 authorize the generating system and reservoir works for the Site C Clean Energy Project (Site C). Leave to Commence Construction of the following works comprising LCC #03 was granted to BC Hydro and Power Authority (BC Hydro) by the Engineer under the Water Sustainability Act on 29 June 2016:

- Right bank Stage 1 cofferdam
- Left bank Stage 1 inlet and outlet cofferdams
- Overburden & bedrock excavations for approach channel and structures to be constructed inside right bank Stage 1 cofferdam

Leave to Construct LTC #03D for right bank bedrock excavations was issued on 07 October 2016.

Leave to Commence Construction LCC #06 for construction of the following roller compacted concrete (RCC) structures was granted to BC Hydro on 16 May 2017:

- Core buttress – provides the south (right) abutment of the earthfill dam at the core;
- Dam buttress – provides the south abutment of the downstream shell of the earthfill dam;
- Powerhouse buttress – provides the foundation for the generating station;
- Spillway buttress – provides the foundation for the spillways and stilling basin; and
- Tailrace wall – provides a barrier between the tailrace and the toe of the earthfill dam.

Leave to Construct LTC #06A for construction of the powerhouse RCC buttress was issued on 02 June 2017.

The excavations and construction of the RCC structures are being completed by BC Hydro's Main Civil Works contractor, Peace River Hydro Partners (PRHP).

The shale bedrock at Site C moves vertically and horizontally in response to stress changes caused by excavations. As described in the IE recommendation for LTC03D, bedrock excavations and RCC placements for construction of the RCC buttress will be completed in a sequential manner to minimize potential movements within the buttress foundation. In general, it was intended that excavation for an individual buttress section would be carried out during the colder season and RCC for that buttress would be placed during the following warmer season. PRHP's baseline schedule indicated that Phase 1 (powerhouse buttress excavation) would occur during 2016-17, Phase 2 (spillway buttress excavation) during 2017-18 and Phase 4 (dam and core buttress excavation) during 2018-19. Phase 3 (tailrace excavation) would occur during 2017.

Movements within the bedrock foundation can be influenced by piezometric pressures, and it was intended that the right bank drainage tunnel and drain holes drilled from the tunnel would be completed prior to excavations for the overlying RCC buttress sections. It was also intended that instrumentation to be installed from the tunnel would monitor foundation piezometric pressures and rock movements in response to the surface excavations. The design basis for RCC buttress construction allows for modification of the construction sequence based on the Observational Method, which considers the response of the bedrock foundation as measured by this instrumentation.

Construction of the right bank drainage tunnel advanced more slowly than originally planned. To reduce piezometric pressures in the RCC foundation in advance of the surface excavation for the powerhouse buttress, inclined drain holes were drilled from surface and downhole pumps were installed. Similarly, additional instrumentation was installed from surface to provide monitoring of the foundation behaviour in response to the excavation.

Phases 1 and 3 excavations were completed as planned during 2016-17, but the powerhouse RCC buttress was only partially completed in 2017. Consequently, BC Hydro did not authorize Phase 2 excavation for the spillway buttress to proceed during the 2017-18 winter season as originally planned, but reviewed options with PRHP to revise the construction schedule.

BC Hydro reviewed a proposed revised scheduling approach with its Technical Advisory Board (TAB) at Meeting No. 18 during 29 January to 02 February 2018, which was attended by the IE. Discussions with the TAB included an evaluation of the performance and stability of the right abutment, and an assessment of construction progress rates and technical risks. The TAB was supportive of a revised sequencing of bedrock excavations and RCC placements and stressed the need for proactive measures to minimize piezometric pressures in the right abutment bedrock.

Based on its review, BC Hydro has authorized the spillway buttress excavation and RCC placement to be carried out in two stages. The IE and the IEM have received the following documents related to the revised construction approach:

1. Klohn Crippen Berger Ltd./SNC Lavalin Inc. - *MCW – Spillway Excavation,* Memorandum to BC Hydro, 24 November 2017.
2. BC Hydro – *Design Change Notice No. 216 – Spillway RCC Buttress Slab Thickening*, 22 November 2017.

3. BC Hydro – *Design Change Notice No. 218 – Partial Excavation of Spillway for Upstream Stilling Basin*, 29 November 2017.
4. Klohn Crippen Berger Ltd./SNC Lavalin Inc. - *MCW – Information for Change, Spillway Buttress Phase 1 Excavation, IFC Drawing 1020-C02-00437 R0, IFC Drawing 1020-I02-05013 R0*, Memorandum to BC Hydro, 07 February 2018.
5. Klohn Crippen Berger Ltd./SNC Lavalin Inc. - *MCW – Information for Change, Spillway Buttress Excavation, Issued for Information Drawing 1020-C02-00437 R1C*, Memorandum to BC Hydro, 27 February 2018.
6. BC Hydro - *Issued for Construction Drawings* (see Appendix A).
7. Peace River Hydro Partners - *Site C Clean Energy Project Main Civil Works, Spillway Excavation – Phase 1 Construction Implementation Plan*, R0, 17 March 2018.

The original plan for RCC placements was:

Year	Component	Quantity (m^3)	Total (m^3)
2017	Powerhouse buttress	347,000	509,000
	Tailrace wall	70,500	
	Downstream spillway stilling basin	72,500	
	Tailrace channel	19,000	
2018	Spillway buttress	625,000	727,600
	Spillway walls	102,600	
2019	Dam & core buttresses	490,000	490,000
Total			**1,726,600**

In the revised plan the tailrace wall and channel are moved from 2017 to 2018, spillway RCC placement will be completed over two years in 2018 and 2019 and the dam and core buttresses will be completed in 2020:

Year	Component	Quantity (m^3)	Total (m^3)
2017	Powerhouse buttress	106,508	179,008
	Downstream spillway stilling basin	72,500	
2018	Tailrace wall	70,500	449,992
	Tailrace channel	19,000	
	Powerhouse buttress	240,492	
	Spillway buttress	120,000	
2019	Spillway buttress	505,000	607,600
	Spillway walls	102,600	
2020	Dam & core buttresses	490,000	490,000
Total			**1,726,600**

The RCC for the downstream spillway stilling basin was placed in 2017. The revised plan includes excavation of sufficient bedrock in the spring of 2018 to allow placement of the upstream stilling basin RCC in the summer of 2018. The remainder of the excavation for the spillway buttress is to be completed in the winter of 2018-19, with the remainder of the spillway RCC being placed in 2019.

Construction of the remaining spillway RCC works over two years will introduce a construction joint between the upstream stilling basin and the remainder of the buttress. To provide adequate strength of the slab for extreme design load conditions, the RCC slab has been thickened by 1 m.

To reduce piezometric levels in the spillway foundation, horizontal drain holes will be drilled in fan patterns from several locations on the existing slope prior to the start of excavation. Also prior to excavation, instrumentation will be installed from surface locations to monitor piezometric pressures and rock movements.

Excavation will be by mechanical excavation and drill and blast methods as required by rock conditions. Both methods have been successfully used in the excavation for the powerhouse buttress. BC Hydro's design shows a backslope of 1.6H:1.0V for the first stage of the spillway excavation. PRHP has proposed to excavate this temporary slope with benches to suit its construction equipment and methodology, and BC Hydro has accepted this approach. Except for the local thickening of the upstream stilling basin slab, there is no change to the final excavation lines for the spillway buttress.

There are no changes to the Environmental Protection Plans or Care of Water plans for the bedrock excavations or the RCC placements.

The IE has discussed the revised construction plan with the IEM, and the IEM has no comments on the revised plan.

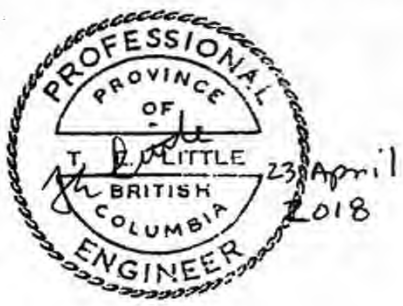
The drawings have been sealed by a Professional Engineer registered in British Columbia and are Issued for Construction status. It is the IE's opinion that the drawings remain consistent with the Site C project general arrangement drawings, the design basis and the conditions of Conditional Water Licences 132990 and 132991. The revised construction approach also satisfies the recommendations of BC Hydro's Technical Advisory Board.

The Independent Engineer hereby recommends to the Deputy Comptroller of Water Rights that BC Hydro can proceed with the revised sequencing of excavations and RCC placements as described above. This recommendation is copied to BC Hydro and is sufficient for construction of these works to proceed. For reference, this recommendation is referred to as:

- *Leave to Construct LTC #03D – Right Bank Bedrock Excavations - Amendment #2*
- *Leave to Construct LTC #06A - Powerhouse Roller Compacted Concrete Buttress - Amendment #1*

The IE proposes that a separate recommendation for Leave to Construct LTC #06B for construction of the spillway RCC buttress will be submitted to the Deputy Comptroller after the excavation for the upstream stilling basin has been completed and BC Hydro has provided information to confirm that conditions are suitable for RCC placement to begin in that area.

Yours truly,



Tim Little, P.Eng.
Independent Engineer, Site C Clean Energy Project

Attachments: Appendix A – Issued for Construction Drawings

c: Karen von Muehldorfer, BCH (Site C Licensee Representative)
Andrew Watson, BCH (Site C Design Engineer & Construction Engineer)
Jason Yarmish, Independent Environmental Monitor
Gypsy Fisher, FLNRO Water Management Officer
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APPENDIX A
LTC #03D AMENDMENT #2 & LTC #06A AMENDMENT #1
ISSUED FOR CONSTRUCTION DRAWINGS

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1020-C02-00437	R1	Dam - RCC Buttress Spillway Buttress Excavation and Drainage - Phase 1 Section C

T.E. LITTLE CONSULTING INC.

18 April 2018

Bruce O'Neill, P.Eng.
Deputy Comptroller of Water Rights
Ministry of Forests, Lands, Natural Resource Operations and Rural Development
PO Box 9340 Stn. Prov Govt
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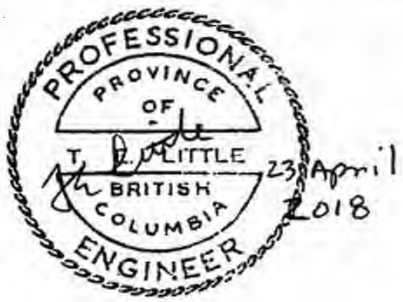

Tim Little, P.Eng.
Independent Engineer, Site C Clean Energy Project

Attachments: Appendix A – Issued for Construction Drawings

c: Karen von Muehldorfer, BCH (Site C Licensee Representative)
Andrew Watson, BCH (Site C Design Engineer & Construction Engineer)
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Appendix S to
Expert Report of E. Harvey Elwin
July 6, 2018

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Appendix T to
Expert Report of E. Harvey Elwin
July 6, 2018

Appendix U to
Expert Report of E. Harvey Elwin
July 6, 2018

Appendix V to
Expert Report of E. Harvey Elwin
July 6, 2018

Appendix W to
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