

September 8, 2017

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Commission Secretary

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BCUC INQUIRY RESPECTING SITE C

A-8

Sent via eFile

Re: British Columbia Hydro and Power Authority – British Columbia Utilities Commission Inquiry Respecting Site C – Project No. 1598922

In accordance with Order G-120-17, in which the British Columbia Utilities Commission (Commission) stated that it has engaged the consulting firm Deloitte LLP to produce independent reports on the questions posed in section 3(b) of the terms of reference in Order in Council (OIC) No. 244, please find attached the following non-confidential Deloitte LLP independent report – Site C Construction Review.

The Commission will consider the information contained in the Deloitte LLP independent report, as well as the information provided by BC Hydro in its August 30, 2017 submission, and the submissions of data and analysis from members of the public, when preparing its preliminary report due September 20, 2017.

Sincerely,

Original signed by:

Patrick Wruck Commission Secretary

Deloitte.



British Columbia Utilities Commission



September 8, 2017

David Morton Chair and Chief Executive Officer British Columbia Utilities Commission 900 Howe Street, Suite 410 Vancouver, BC V6Z 2N3 Deloitte LLP. 2800-1055 Dunsmuir St. Four Bentall Centre Vancouver, BC, V7X 1P4 Canada

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Site C - Construction Review

Dear Mr. Morton,

Deloitte LLP (Deloitte) is pleased to submit this report as part of the British Columbia Utilities Commission (BCUC or the Commission) inquiry with respect to the Site C Clean Energy Project (the Site C Project or the Project). This engagement has been performed in accordance with the consulting services agreement between Deloitte and BCUC, dated August 30, 2017.

The objective of the engagement is to provide an independent review of the Project to assist BCUC answer four questions of the inquiry:

- 1. Is the Project currently on time and within the proposed budget of \$8.335 billion (which excludes the \$440 million project reserve established and held by the Province of British Columbia)?
- 2. What are the costs to ratepayers of suspending the Site C Project, while maintaining the option to resume construction until 2024?
- 3. What are the costs to ratepayers of terminating the Site C Project?
- 4. What, if any, other portfolio of commercially feasible generating projects and demand-side management initiatives could provide similar benefits to ratepayers at similar or lower unit energy cost as the Site C Project?

This report covers Deloitte's assessment related to the first three questions. Our assessment of the fourth question is under a separate cover, entitled Alternative Resource Options and Load Forecast Assessment.

We would like to express our appreciation for the cooperation and assistance provided by BCUC and BC Hydro during this review.

Yours sincerely,

Dehilfe LLP

Deloitte LLP

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1 Executive summary

In December 2014, the BC Hydro and Power Authority (BC Hydro or the Authority) Site C Clean Energy Project (the Site C Project or the Project) received approval from the Government of the Province of British Columbia (the Province) to proceed with construction. Construction of the Project began in July 2015 and was expected to be in service in November 2024. At the time of the Project's approval, BC Hydro estimated its cost at \$8.775 billion, which included a capital-cost estimate of \$8.335 billion, plus a \$440 million project reserve held by the Treasury Board.

The British Columbia Utilities Commission (BCUC or the Commission) has engaged Deloitte LLP (Deloitte) to provide an independent review of the Site C Project as part of its inquiry into the Project. Deloitte has conducted site visits, interviewed senior management and the Project team, and reviewed project documentation and data provided by BC Hydro and BCUC.

The objective of the engagement is to provide an independent review of the Project to assist BCUC answer four questions of the inquiry:

- 1. Is the Project currently on time and within the proposed budget of \$8.335 billion (which excludes the \$440 million project reserve established and held by the province)?
- 2. What are the costs to ratepayers of suspending the Site C Project, while maintaining the option to resume construction until 2024?
- 3. What are the costs to ratepayers of terminating the Site C Project?
- 4. What, if any, other portfolio of commercially feasible generating projects and demand-side management initiatives could provide similar benefits to ratepayers at similar or lower unit energy cost as the Site C Project?

The fourth question is covered under a separate Deloitte report.

1.1 Is the Project currently on time and within the proposed budget?

Currently the Project has two key categories of risks:

- Schedule There is a potential to miss the 2019 Start of River Diversion milestone; and
- Cost There is a potential that the existing cost contingency is insufficient to cover further increases in the Main Civil Works (MCW) contract, uncertainties in major contracts yet to be awarded, increases in interest rates, and geotechnical issues.

At the time of the review, Deloitte received limited information related to the mitigating actions that BC Hydro and Peace River Hydro Partners (PRHP) are contemplating to reduce the risk of missing the Start of River Diversion milestone in 2019, associated with the MCW contract. BC Hydro and PRHP are continuing to assess their options. Deloitte also received limited data on the major contracts yet to be awarded, although we see that the Project has already drawn considerably on its contingency, due to the difference between the initial budget and the actual bid price for MCW. Budgets for major contracts not yet awarded have been supplemented with contingency, as current estimates are greater than budgeted amounts. Based on these unknowns, we have taken a qualitative approach to our scenario analysis.

Considering the specific risks of the Project, and the overall risks encountered by other large global and Canadian projects, Deloitte's assessment indicates that there are three impact scenarios for the outcome of the Site C Project, as illustrated in Table 1 and Table 2.

Table 1: Site C Project scenarios - cost and schedule performance

	Meet Start of River Diversion milestone	Miss Start of River Diversion milestone
Existing cost contingency sufficient to cover further consumption of MCW contingency, uncertainties in other major contracts, increases in interest rates, and geotechnical issues	 One-year schedule contingency maintained, sufficient to cover other potential schedule risks, Final Investment Decision(FID) schedule maintained Cost pressures of additional 0–10% to FID budget 	 Loss of one-year schedule contingency due to continued issues with MCW, loss of ability to absorb other schedule slippage, potential for up to one-year delay Cost pressures of additional 10–20% to FID to reduce schedule impact,
.	Overall impact: Low	including one year of additional Interest During Construction (IDC) and indirect costs
		 Overall impact: Moderate
Existing cost contingency insufficient to cover further consumption of MCW contingency, uncertainties in	 One- year schedule contingency maintained, sufficient to cover other potential schedule risks Cost pressures of additional 10–20% 	 Loss of one-year schedule contingency due to continued issues with MCW, other schedule issues result in >1 year delay
other major contracts yet to be awarded, increases in	to FID to cover shortfall in contingency	 Cost pressures of additional 20–50% to FID to reduce schedule impact,
interest rates, and geotechnical issues	Overall impact: Moderate	including one to two years of additional IDC and indirect costs
		 Overall impact: High

Table 2: Possible impact scenarios (nominal \$ million)

Impact	Schedule Delay to FID Nov 2024 ISD		act to FID \$8.335B)	Final Cost R Complet		-	
		low	high		low	high	
Low	On time	0%	10%	\$	8,335	\$ 9,169	
Moderate	One year delay	10%	20%	\$	9,169	\$ 10,002	
High	More than 1 year delay	20%	50%	\$	10,002	\$ 12,503	

The likelihood of these scenarios will depend on the mitigations that the Project takes to address the risk of missing the Start of River Diversion and the risks of potential further cost increases in MCW or uncertainties of major contracts yet to be awarded.

The Project is facing significant schedule and cost pressures. With respect to the Project schedule, both PRHP and BC Hydro recognize that the 2019 river diversion is at risk. PRHP has submitted project schedules that show PRHP missing this milestone, and BC Hydro has rejected these schedules. BC Hydro is working directly with PRHP on a constructability review, the main purpose of which is to develop a plan to mitigate the potential delay in order to meet the 2019 river diversion. The potential knock-on effects of not achieving the milestone include the loss of a year of schedule contingency.

With respect to the Project costs, the overall contingency amount has increased \$401 million due to a corresponding decrease in the expected Interest During Construction (IDC); furthermore, approximately half of the increase in contingency is currently forecasted to be allocated and absorbed.

The current schedule and budget still include contingency to absorb the schedule and cost risks identified in the Project, and in particular with respect to river diversion. As the Project continues to operate within both the existing schedule and budget (and unallocated contingency), today the Project remains on time and on budget.

In the event that the Start of River Diversion milestone is met in 2019, we believe, based on the known risks, that the Project currently has sufficient schedule contingency to achieve the November 2024 In-Service Date (ISD); however, the overall Project costs are at significant risk, with the potential to use up the balance of the unallocated contingency. We estimate that the costs, even in the event of achieving the 2019 Start of River Diversion milestone, could potentially exceed the \$8.355 billion FID budget in the range of an additional 0-10%.

In the event that the Start of River Diversion milestone is not met in 2019, we believe the impact on the Project would be approximately a year of delay to the November 2024 ISD, and cost increases above the FID budget in the range of 10-20%.

The Site C Project faces major risks including performance issues of contractor(s), unforeseen geotechnical conditions, and cost risks associated with major contracts that have not been awarded yet. These risks could impact the cost and schedule performance of the Project. Given that the Site C Project is in the early stages of construction with over seven years to go before the ISD, these major risks could be mitigated to a certain extent through a variety of methods including, but not limited to, design and schedule innovation and improving relationships with contractors. However, the actual potential impact on the Project's cost and schedule is unpredictable at this stage with the information that Deloitte has reviewed.

1.2 What are the costs to ratepayers of suspending the Site C Project?

As of June 30, 2017, BC Hydro had a total commitment of \$4.5 billion for the Project, including actual costs incurred to date, remaining commitments on awarded contracts, and the future value of post-implementation payments. Based on the current burn rate and the planned schedule, we estimate BC Hydro could incur an additional \$300 million before December 31, 2017, the anticipated decision point to continue, suspend, or terminate the Project.

A decision to suspend the Project (the Suspension Scenario) would change the current scope of work and the associated schedule and budget. It would therefore trigger the close-out of the existing Site C Project and require a new project to be defined. The new project would have its own scope, budget, and schedule, and would require a project setup phase to establish the conceptual design and to perform the associated environmental appraisal, permitting, design for construction, and contracting. Based on the current status of the Project, existing contracts and agreements, and anticipated activities to demobilize, preserve, safeguard, and remobilize the site, we estimate the total incremental cost of the Suspension Scenario to be approximately \$1.4 billion², excluding inflation impacts and incremental interest costs.

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¹ Our estimate includes cost to suspend the Project between 2018 and 2025 only. It does not include potential additional costs (due to design changes, market conditions etc.) which BC Hydro may incur after resuming construction in 2025.

² This is a Class 5 Estimate with an expected accuracy range of -35% and +100% as per the Association for the Advancement of Cost Engineering International (AACE) standards.

Table 3: Summary of cost impact – Suspension Scenario

#	Suspension Scenario	Cost impact (\$ millions)
1	Cost to suspend the Site C Project (cancellation of contracts and agreements, and demobilization)	381
2	Cost to maintain the Site C Project in a state of suspension	510
3	Cost to remobilize the Site C Project to begin construction in 2025	200
	Total	1,091
	Contingency (30%)	327
<u> </u>	Grand total	1,418

1.3 What are the costs to ratepayers of terminating the Site C Project?

As in the Suspension Scenario, a decision to terminate the Project (the Termination Scenario) would change the current scope of work and the associated schedule and budget. This would also, therefore, trigger the close-out of the existing Site C Project and require the definition of a new project. The new project would have its own scope, budget, and schedule, and would require a project setup phase to establish the conceptual design and to perform associated environmental appraisal, permitting, design for construction, and contracting. We estimate the total cost of the Termination Scenario to be approximately \$1.2 billion³, excluding inflation impacts and interest costs.

Table 4: Summary of cost impact – Termination Scenario

#	Termination Scenario	Cost impact (\$ millions)
1	Cost to terminate the Site C Project (cancellation of contracts and agreements, and demobilization)	370
2	Cost impact of site remediation	555
	Total	925
	Contingency (30%)	278
	Grand total	1,203

³ This is a Class 5 Estimate with an expected accuracy range of -35% and +100% as per AACE standards.

2 Glossary

Acronym/Abbreviation	Terminology
AACE	Association for the Advancement of Cost Engineering International
Acciona	Acciona Infrastructure Canada, Inc.
Advisor	Deloitte LLP and affiliated entities
ATCO	ATCO Two River Lodging Group
The Authority	BC Hydro and Power Authority
Baseline	Performance Measurement Baseline, or Project Management Baseline
BC Hydro	BC Hydro and Power Authority
BCUC	British Columbia Utilities Commission
Board	Site C Project Board of Directors
BOQ	Bill Of Quantity
CA	Contract Agreement
CB Agreement	Community Benefits Agreement
CCFA	Consultation and Capacity Funding Agreement
CE	Component Engineering
CEAA	Canadian Environmental Assessment Agency
The Commission	British Columbia Utilities Commission
DD	Detailed Design
Deloitte	Deloitte LLP and affiliated entities
EAC	Estimate At Completion
EAO	Environmental Assessment Office
EIS	Environmental Impact Statement
EM	Environmental Monitor
EPP	Environmental Protection Plan
EVM	Earned Value Methodology
EW	Early Works
FID	Final Investment Decision
FN	First Nations
FN Agreement	Agreement with First Nations
GSS	Generating Station and Spillway
IBA	Impact and Benefits Agreement
IDC	Interest During Construction
ISD	In-Service Date
kV	Kilovolt
LTD	Life To Date
MCW	Main Civil Work
MW	Megawatt
P3	Public-Private Partnership

Acronym/Abbreviation	Terminology
PA	Project Agreement
PAG	Potentially Acid Generating
Petrowest	Petrowest Corporation
PMB	Performance Measurement Baseline, or Project Management Baseline
PMFB	Prior Month Forecast Baseline
PPM	Project and Portfolio Management
PRHP	Peace River Hydro Partners
The Project	Site C Clean Energy Project
The Province	The Government of the Province of British Columbia
RCC	Roller Compacted Concrete
RSEM	Relocated Surplus Excavation Materials
Samsung	Samsung C&T Corporation
SE	System Engineering
TG	Turbines & Generators
TLA	Tripartite Land Agreement
UBC	University of British Columbia
Voith	Voith Hydro Inc.
WA	Worker Accommodation
WBS	Work Breakdown Structure

3 Introduction

3.1 Scope of the review

The British Columbia Utilities Commission (BCUC or the Commission) has initiated an inquiry into the Site C Clean Energy Project (the Site C Project or the Project), as directed by the Government of the Province of British Columbia (the Province) in an Order in Council on August 2, 2017. Specifically, the Commission has been asked the following:

- 1. After the Commission has made an assessment of BC Hydro (the Authority)'s expenditures on the Site C Project to date, is the Commission of the view that the Authority is, respecting the Project, currently on time and within the proposed budget of \$8.335 billion (which excludes the \$440 million project reserve established and held by the province)?
- 2. What are the costs to ratepayers of suspending the Site C Project, while maintaining the option to resume construction until 2024, and what are the potential mechanisms to recover those costs?
- 3. What are the costs to ratepayers of terminating the Site C Project, and what are the potential mechanisms to recover those costs?
- 4. Given the energy objectives set out in the Clean Energy Act, what, if any, other portfolio of commercially feasible generating projects and demand-side management initiatives could provide similar benefits (including firming shaping storage grid reliability and maintenance or reduction of 2016/17 greenhouse gas emission levels) to ratepayers at similar or lower unit energy cost as the Site C Project?

Deloitte LLP (Deloitte)'s Site C Construction Review Report covers the responses to the first three questions. Excluded from our review scope are:

- Estimating any potential costs to ratepayers related to differences in energy prices between Site C unit energy costs and the available alternatives; and
- Considerations of potential mechanisms to recover costs from ratepayers.

A separate report covers our response to the fourth question.

3.2 Approach

Deloitte conducted the assessment in three phases to answer each of the three in-scope questions: information gathering, assessment, and report writing.

3.2.1. Information-gathering phase

For the information-gathering phase, we relied on information provided by BC Hydro related to the Site C Project via documents and interviews. Appendix A summarizes the documents we reviewed and Appendix B tabulates the interviews we conducted. The Deloitte team, which included technical advisors and subject matter advisors, also conducted two visits to tour the construction site and meet with BC Hydro's on-site team to get that team's views on progress to date and remaining work.

Deloitte and BC Hydro have executed a confidentiality agreement (Appendix F), pertaining to the use of the Project documents. According to the agreement, the information provided by BC Hydro contains confidential documents, as determined by BC Hydro, and the release of this information could cause harm to BC Hydro, and thus impact its ability to successfully deliver the Project.

3.2.2. Assessment phase

3.2.2.1 An assessment of whether the Site C Project is on time and budget

Using the information gathered from interviews, document reviews, and site visits, we reviewed the work performed to date, related plans, and work packages. We also reviewed and analyzed the cost, schedule, risks, and contingencies of the Project. As required, we followed up with BC Hydro for clarifications. Deloitte's assessment of whether the Site C Project is on time and budget is discussed in Section 5.8.

3.2.2.2 An assessment of the financial impact of suspending construction

BC Hydro has several existing contracts including construction and engineering contracts and agreements with First Nations (FNs) and local communities. In addition to reviewing the work performed to date, we have also reviewed these existing contracts and extracted pertinent clauses related to payments, termination, mobilization/demobilization, and claims and litigation. The impacts of cancelling existing contracts and FN and community agreements under a Suspension Scenario are discussed in Section 6.2.

Furthermore, based on the information we gathered from documents, interviews, and site visits, we developed the scope of work needed to secure the site in the Suspension Scenario. Based on this scope, we developed a total cost estimate (a Class 5 Estimate according to the Association for the Advancement of Cost Engineering (AACE) standards) for the Suspension Scenario.

3.2.2.3 An assessment of the financial impact of terminating construction

Similar to our assessment of the Suspension Scenario, we reviewed the existing contacts and agreements and developed the scope of work related to a Termination Scenario, including remediation of the site. We relied on BC Hydro's insights for the necessary level of site remediation needed to return the site to an acceptable form. The impacts of cancelling existing contracts and FN and community agreements under a Termination Scenario are discussed in Section 7.2.

We also developed a Class 5 Estimate for the scenario based on the scope of work for remediation activities.

3.2.3. Report-writing phase

To meet the Commission's timelines, we provided a draft report on August 30, 2017, followed by a presentation of our findings to the Commission on the same day. A final report was submitted to BCUC on September 7, 2017.

3.3 About Deloitte

Deloitte LLP is Canada's leading professional services firm, providing a full range of consulting, assurance and advisory, financial advisory, enterprise risk, and tax services to clients in all sectors of the Canadian economy through more than 8,800 people in more than 55 locations across the country. Deloitte has been in business in Canada for over 150 years. During this tenure, our clients have relied on Deloitte and its predecessor organizations for solutions to their ever-changing needs. We are a national and global leader today because we have earned our clients' trust and exceeded their expectations throughout our history. As one of the world's leading professional services firm, Deloitte LLP Canada can, when needed call on our over 57,000 professionals serving 100 countries.

This report was prepared primarily by a team of professionals in our Infrastructure & Capital Projects (I&CP) practice.

3.3.1. Deloitte's Infrastructure & Capital Projects practice

Our I&CP practice consists of industry-trained practitioners with significant and practical experience and advanced degrees in engineering, project management, economics, architecture, business, statistics, law,

finance and accounting. Many are experienced and licensed Engineers, Lawyers and Quantity Surveyors and include team members who have run large projects and large project organizations.

Our professionals have provided advisory services, in a variety of industries including power and utilities, oil and gas, mining, and large public-purpose infrastructure projects.

Our professionals also demonstrate a long track record of working with key federal and provincial government entities, and combine capital project, financial, commercial, and technical backgrounds to provide well-rounded and valuable advice.

An important part of our I&CP practice is our Infrastructure Mergers & Acquisitions (M&A) group which is dedicated to helping investors fund, buy, sell and partner on direct infrastructure investments. Our Infrastructure M&A team consists of over one dozen former investment professionals, corporate development executives, developers, project managers and infrastructure specific transaction specialists with significant experience in Canada and globally. Our Infrastructure M&A team has significant regulated utilities experience including financial advisory, modeling and due diligence. They have a deep understanding of the BC, Alberta and Ontario rate regulation regimes from advising utilities with hydro assets across Canada.

In addition to the I&CP practitioners, for the Site C review Deloitte engaged a group of additional subject matter advisors in the fields of: dam construction, environmental, geotechnical, civil engineering, biology, air quality, permitting, environmental assessment, and project estimating.

Members of the team that conducted the Site C review have experience in performing program, project, and project management organizational assessments, including cost and schedule focused reviews on the following projects:

- Cost and schedule assessment of a \$14.6 billion infrastructure project located in Massachusetts;
- Cost and schedule assessment of a \$4.0+ billion mine project in Madagascar;
- Project management assessment \$2.0+ billion hydro refurbishment project;
- Project management assessment \$2.0+ billion mining project;
- Project execution plan for a multi-billion dollar hydro project in eastern Canada
- Project management, cost, and schedule assessments on multiple proposed and executed nuclear refurbishment projects in Canada with a total value in excess of \$20 billion;
- Project management, cost, and schedule assessments on multiple mining, SAG-D, and pipeline programs and projects located in Alberta's Oil Sands, with a total value in excess of \$40 billion; and
- Program assessment of a multi-billion dollar rapid transit project in western Canada.

3.4 Assumptions and limitations

This report has been prepared pursuant to the following general assumptions and limiting conditions. Additional assumptions and limitations are provided in Appendix E.

- 1. The analyses, advice, recommendations, opinions, or conclusions contained herein are valid only as of the indicated date and only for the indicated purpose.
- 2. The analyses, advice, recommendations, opinions, or conclusions contained herein are for the exclusive use of BCUC for the sole and specific purposes noted herein and may not be used for any other purpose by BCUC or any other party. Furthermore, the analyses, advice, recommendations, opinions, or conclusions are not intended by the author and should not be construed by the reader to be investment advice in any manner whatsoever. The analyses, advice, recommendations, opinions, or conclusions represent the considered opinion of Deloitte LLP (the Advisor) based on information furnished to it by the client, its representatives, and other sources.
- 3. Possession of this report, or a copy thereof, does not carry with it the right of publication or distribution to or use by any third party. Any third party that uses the information contained herein does so at its

- sole risk and agrees to hold the Advisor, its subcontractors, and their respective personnel harmless from any claims resulting from use by any other third party. Access by any third party does not create privity between the Advisor and any third party.
- 4. No item in this report shall be changed by anyone other than the Advisor, and the Advisor shall have no responsibility for unauthorized changes.
- 5. Neither the Advisor nor its personnel, by reason of this engagement, is required to give testimony or to be in attendance in court unless arrangements have been previously made in writing.
- 6. The Advisor conducted interviews with BC Hydro regarding the Project and has assumed that the information gathered in such interviews is accurate and complete.
- 7. Financial information provided to the Advisor in the course of this engagement by BC Hydro has been accepted without any verification as fully and correctly reflecting the business conditions and operating results of the relevant assets, properties, or businesses for the respective periods, except as specifically noted herein. The Advisor has not audited, reviewed, or compiled any financial information provided to it and, accordingly, expresses no audit opinion or any other form of assurance regarding such information.
- 8. If prospective financial information provided by the client or its representatives has been used in this analysis, the Advisor has not examined or compiled the prospective financial information and, therefore, does not express an audit opinion or any other form of assurance on the prospective financial information or the related assumptions. Events and circumstances frequently do not occur as expected and there will usually be differences between prospective financial information and actual results, and those differences may be material.
- 9. The Advisor does not provide assurance on the achievability of any forecasted results contained herein because events and circumstances frequently do not occur as expected, differences between actual and expected results may be material, and achievement of the forecasted results is dependent on actions, plans, and assumptions of management.
- 10. The Advisor believes the information obtained from public sources or furnished to it by other sources is reliable. However, it issues no warranty or other form of assurance regarding the accuracy of such information.
- 11. The Advisor is not an environmental consultant or auditor, and it takes no responsibility for any actual or potential environmental liabilities. Any person entitled to rely on this report wishing to know whether such liabilities exist, or the scope and their effect on the value of any subject asset, property, or business interest, is encouraged to obtain a professional environmental assessment. The Advisor does not conduct or provide environmental assessments and has not performed one in the course of this engagement.

4 Site C Project

4.1 Project description

The Site C Project is the third dam and hydroelectric generating station on the Peace River in northeast BC. It is part of BC Hydro's overall program to invest in and renew BC's electricity system. The Project would provide approximately 1,100 megawatts of capacity and produce about 5,100 gigawatt-hours of energy per year. The Site C Project is the largest project in BC Hydro's history.

The estimated cost of the Project at the time of the Financial Investment Decision (FID) in December 2014 was \$8.775 billion, which included a capital-cost estimate of \$8.335 billion plus a \$440-million project reserve held by the Treasury Board to account for events outside of BC Hydro's control.

4.2 Project scope and status

In summary, the Project includes:

- Site preparation activities
- Construction and commissioning of an earthfill dam, reservoir, hydroelectric generating station, substation, and transmission lines
- Implementation all of the authorized regulatory conditions including all the agreed mitigation and compensation requirements and benefit agreements
- · Acquisition of the properties and rights necessary for construction and operation of all the Project assets
- Negotiation and conclusion of agreements with FN groups that meet goals and interests of the parties, and which fulfill Environmental Assessment process requirements
- Site reclamation, demobilization, and project closure

BC Hydro has divided the construction activities related to the Site C Project into various sub-projects, including Worker Accommodation (WA), Early Works (EW), Main Civil Works (MCW), Highway 29 realignment, Transmission, Turbines and Generators (TG), and Generating Station and Spillways (GSS). In addition, BC Hydro has awarded several other contracts for smaller work, as well as contracts for continued engineering.

Highlights of the scope and current status of the various sub-projects include:

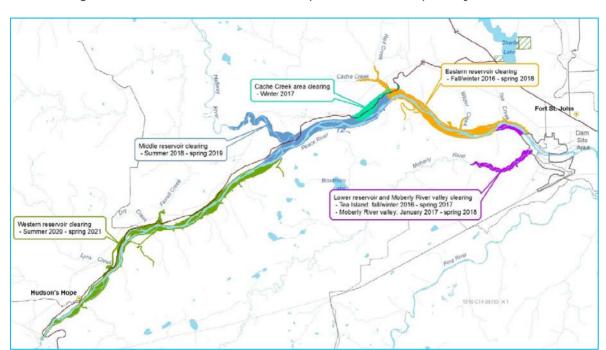
 Worker Accommodation: The WA scope includes the design, construction, partial financing, operation, and maintenance of a temporary worker accommodation camp at the Site C dam site. The camp would house up to 1,600 people.

Status – The construction of the camp was completed by ATCO Two Rivers Lodging Group (ATCO) in October 2016 under a public-private partnership (P3) agreement. Since that date, ATCO has been operating and maintaining the facility.



• **Early Works:** The EW scope covers the preparation of the site and surrounding areas for construction, including clearing, access roads, construction power, and a communication tower.

⁴ Site C Fact Sheet: https://www.bchydro.com/news/press_centre/news_releases/2016/site-c-fact-sheet.html



Status – Site preparation work was completed in late 2016. Most of the EW scope is complete except for some clearing work in the reservoir area, which is planned to be complete by March 2018.

• Main Civil Works: The MCW contract with PRHP comprises the majority of earthworks required to construct the Site C Project. PRHP was established as a general partnership between Acciona Infrastructure Canada Inc. (Acciona), Samsung C&T Corporation (Samsung), and Petrowest Corporation (Petrowest). On August 2017, Acciona and Samsung declared Petrowest to be in default and terminated it from the general partnership. Potential risks related to the termination of Petrowest are included in Section 5.7.1.2.

The MCW contract includes:

- Approximately 32 million cubic metres of excavation for structures
- River diversion works, including construction of two 10.8-metre internal diameter concrete-lined tunnels between 700 and 800 metres in length, and associated cofferdams and intake and outlet structures
- Earthfill dam: a central core zoned earth embankment approximately 1,050 metres long and 60 metres above the present river level
- Roller-compacted concrete buttress: approximately 800 metres in length and a maximum of 70 metres in height
- Ancillary works such as a permanent network of site roads, site drainage, and debris-handling facilities

Status – PRHP mobilized to site in March 2016, and to date has completed planning and project setup activities, and has put in place major elements of the site production equipment such as aggregate processing and concrete production. Ongoing work includes major excavations on the Left and Right Banks of the river and roller-compacted concrete placement on the Right Bank, which began in July 2017. According to BC Hydro's June 2017 monthly report, PRHP has excavated approximately 9.5 million m³ of a total planned excavation of 21 million m³.

In February 2017, a tension crack developed on the Left Bank⁵ excavation during construction of a haul road, requiring the excavation to be stopped. BC Hydro and PRHP have agreed on a plan to stabilize the slope, and PRHP has undertaken these measures. An instrumentation installation and monitoring program was initiated in February 2017 to inform the design of the stabilization measures and monitor the stability and safety of the slope. A second crack occurred in May 2017. BC Hydro and PRHP are developing a mitigation plan to address this issue.

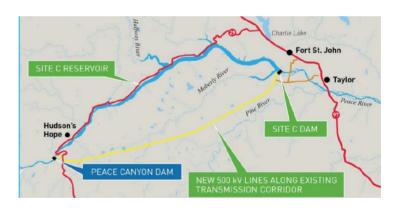
Highway 29: Highway 29 connects
 Hudson's Hope to Fort St. John and runs
 along the north side of the Peace River.
 Approximately 30 kilometres of the
 highway will be realigned to
 accommodate the Site C reservoir.

Status – The tendering process for this sub-project is currently on hold. Design and tender preparation work continue for the Cache Creek-Bear Flat section of highway. Once the temporary hold is removed, the two tender packages will



be issued by the Ministry of Transportation and Infrastructure: (1) for grading and paving and (2) for a new bridge. Design for the grading and paving contract is complete and the Cache Creek Bridge design is substantially complete.

• Transmission: Transmission works include the construction of two new 75-kilometre, 500 kV transmission lines along an existing right-of-way between the Site C Project and the Peace Canyon generating station. A new Site C substation will connect the Site C generating station to the new transmission lines. The Peace Canyon 500-kV gas-insulated switchgear will be expanded to incorporate the new transmission lines and to connect Site C to the BC Hydro transmission system.



Status – Transmission-line access roads were upgraded to facilitate the start of right-of-way clearing, which began in February 2017. Approximately 25 kilometres of the 75-kilometre right-of-way was cleared in that period. The remaining clearing will occur in the fall/winter 2017, in time for the start of transmission-line construction.

• **Turbines and Generators:** The contract with Voith Hydro Inc. (Voith) consists of the design, supply, and installation of six turbines, six generators, and associated equipment.

Status – Voith has recently completed the design for the turbines and generators. It is our understanding that Voith has started procuring materials, but has not yet started fabrication. Voith has also built a temporary facility at the dam site to assemble the steel structures for the turbines and generators.

⁵ For the Site C Project, the terms "Left Bank" and "North Bank" are the same, and this report uses the terms interchangeably. Similarly, the "Right Bank" is the same as the "South Bank."

 Generating Station and Spillways: The GSS component of the Site C Project will be procured through multiple contracts, including the civil works contract, the hydro-mechanical equipment supply contract, the powerhouse bridge crane supply contract, and a completion (balance of plant) contract.



Status - BC Hydro shortlisted

proponent teams for the GSS civil works contract in September 2016, and proponent teams for the GSS hydro-mechanical equipment contract in February 2017. It also issued the RFP for Powerhouse Bridge Crane Supply in Spring 2017. These contracts are scheduled to be awarded in the fall of 2017. The support works for the balance of the plant are at various stages of procurement. As per the direction received from the Province, it appears that BC Hydro will not be issuing the contracts prior to the completion of BCUC's review.

5 On time/on budget?

5.1 Introduction

In December 2014, the Site C Project received approval from the Province to proceed with construction. Construction began in July 2015 and the Project is targeted to be in service in November 2024. At the time of the Project's approval, BC Hydro estimated its cost at \$8.775 billion, which includes escalation, and consists of a capital-cost estimate of \$8.335 billion (including \$795 million in contingency) plus a \$440-million project reserve held by the Treasury Board.

To assist the BCUC answer the question of whether the Project is currently on time and within the proposed budget, Deloitte visited the construction site, interviewed BC Hydro functional and project management team members, and reviewed project documents.

As part of this assessment, Deloitte reviewed the evolution of the Project budget and schedule from the FID in December 2014 to the latest re-forecast Performance Measurement Baseline (PMB or Baseline) in June 2016. We assessed the current state of the major work packages, cost and schedule performance to date, and major risks. Based on this review, we have made a determination about whether the Project is on track for on-time and on-budget completion.

As will be discussed, a critical milestone for the Project is related to the Start of River Diversion currently scheduled for September 2019. If the Start of River Diversion is missed, then the milestone would slip a year, to September 2020 (as explained in Section 5.2.1.2). That slippage would place significant pressure on both the Project's budget and its schedule. Based on our assessment of the current status of the Project, the ability to hit the Start of River Diversion milestone is at considerable risk. Contractor performance and potential claims are negatively impacting the timeline. BC Hydro is actively working with its contractors to develop a mitigation plan to achieve the milestone. Deloitte has not performed an evaluation of the merit or quantum of the contractor claims. Furthermore, as the mitigation plan is still under development, we are unable to comment on the likelihood of success of the plan. Lastly, we do not have information on the potential costs of implementing the mitigation plan.

The Project's current schedule and budget still include contingency to absorb the schedule and cost risks identified on the Project. As the Project continues to operate within both the existing schedule and budget (and unallocated contingency), today the Project remains on time and on budget.

As the status of achieving the Start of River Diversion milestone is unknown, and cannot be easily predicted, Deloitte has developed multiple scenarios that consider the potential effects of achieving or missing the milestone. These low-impact, moderate-impact and high-impact scenarios are summarized in Table 5.

Table 5: Possible impact scenarios (nominal \$ million)

Impact	Schedule Delay to FID Nov 2024 ISD	Cost Impa Budget (act to FID \$8.335B)	Fi	Final Cost Range at Completion		•
		low	high		low		high
Low	On time	0%	10%	\$	8,335	\$	9,169
Moderate	One year delay	10%	20%	\$	9,169	\$	10,002
High	More than 1 year delay	20%	50%	\$	10,002	\$	12,503

Based on Deloitte's assessment of the current project status, including the cost, schedule, and major risks, if the Start of River Diversion milestone is achieved, the Project would likely experience the low-impact scenario. If, however, the September 2019 Start of River Diversion milestone is not achieved and is delayed until September 2020, the Project will likely experience the moderate-impact scenario.

5.2 Provincial final investment decision

Planning and evaluation of the Site C Project began as early as the 1980s,⁶ and it was then put on hold. Planning resumed in 2004 with a review of project feasibility, followed by subsequent phases of consultations, environmental studies, engineering design, and regulatory approvals. A timeline of the multistage evaluation and planning process for the Site C Project is illustrated in Figure 1.⁷

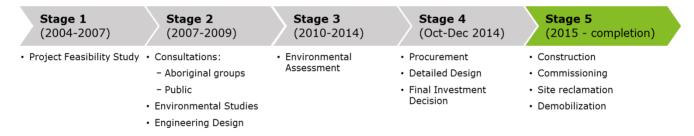


Figure 1: Multi-stage evaluation and planning process for the Site C Project

Stage 4 of the process represents the period during which BC Hydro received the required federal and provincial Environmental Assessment Certificates, and during which it prepared its business case for the FID. The business case provides information for the FID, such as budget and schedule milestones, as well as other key project information. It was first prepared in October 2014 and revised in December 2014.

The provincial FID was received on December 16, 2014. 10

5.2.1. FID schedule

Deloitte reviewed the schedule developed for the approved FID¹¹ and has extracted some key project milestones, as shown in Table 6. These milestones relate to major work packages, as well as to work critical

⁶ http://www.ordersdecisions.bcuc.com/bcuc/decisions/en/112107/1/document.dom

⁷ Appendix H - Cost Management Plan, of the Project Execution Plan

⁸ Site C Implementation Project Plan, dated June 30, 2016

⁹ Business Case for Investment Decision by BC Hydro Board of Directors, dated December 16, 2014

¹⁰ Deloitte relied on other documents that summarize certain cost and schedule information of the FID such as the Basis of Estimate and the Business Case for Site C. Those numbers were consistently reported throughout the documents that we reviewed

¹¹ Site C First Full Funding - Final Investment Decision Baseline.xer

to the timely completion of the Project. According to the FID, completion was projected for November 25, 2024, the in-service date for the sixth turbine generator.

Table 6: Key FID milestones

Milestone	Date	Current Critical Milestone
Early Works		
Commence Dam Site Clearing	1-Aug-15	
Worker Accommodation Operational	1-Mar-16	
Main Civil Works		
Complete all Civil Work for Diversion	28-Feb-20	
Complete Testing of Diversion Gates (Dry)	10-May-19	
Start River Diversion	1-Sep-20	✓
Highway 29 Realignment		
Highway 29 in service	30-Sep-21	
Transmission and Distribution		
5L5 500kV Transmission Line in service	16-Oct-20	
5L6 500kV Transmission Line in service	10-Jul-23	
Site C Substation in service	3-Nov-20	
Turbines and Generators		
Unit 1 in service	8-Dec-23	✓
Unit 6 in service	25-Nov-24	✓

5.2.1.1 FID critical path

Figure 2 shows a summary of the critical path on the FID schedule, including critical milestones related to the Start of River Diversion, which are explained in Section 5.2.1.2. The majority of the Project's critical path relates to the Main Civil Works contract, as it runs through Left Bank diversion tunnels and dam construction prior to commissioning the six turbines.

Although the other milestones noted in Table 6 are key to the overall Project, they are not on the FID schedule's critical path, and therefore are not illustrated in Figure 2.

0 3 8 3 0	3 A 3 O	3 A 3 O 3	1 A J O	3 A 3 C	3 8 3 0	J A J O	3 A 3 O	3 A 3
								_
			Start Riv	ver				
							-	
								_
				Start Ri	Sept. 1, 2020 Start River Diversion	Start River	Start River Diversion Nov. 2:	Start River

Figure 2: December 2014 FID critical path

5.2.1.2 FID schedule contingency

A critical milestone is the Start of River Diversion, as it is both significantly time sensitive and on the critical path. It requires construction of cofferdams, which must be completed outside of the May-through-August period due to the risk of floods, and outside of the winter period due to constructability constraints. In addition, construction of the cofferdams must occur in a period with a high likelihood of controlled low discharges from the upstream W.A.C. Bennett Dam. 12

This schedule restricts the Start of River Diversion to a window between September 1 and October 1 of a given year. If the diversion window is missed, the Start of River Diversion would be rescheduled to the following year, directly impacting schedule contingency and project completion. The Project's FID schedule includes six months of schedule contingency related to critical civil work leading up to river diversion. This contingency is represented by the schedule activity "Waiting for Diversion Window" shown in Figure 2. It is also seen when comparing the milestones for "Complete all Civil Work for Diversion" and "Start River Diversion."

5.2.2. FID budget

According to the approved FID, the capital-cost estimate for the Project is \$8.335 billion. In addition to this cost, the provincial Treasury Board holds a project reserve of \$440 million, for a total authorized project cost of \$8.775 billion, as detailed in Table 7.

¹² BC Hydro response to Deloitte question no. 159

¹³ Special Meeting of the Site C Project Board, dated August 3, 2017

Table 7: FID budget breakdown (nominal \$ million) 14

	FID Budget
Description	Dec 2014
Direct Construction Costs	4,885
Other - Indirect	1,249
Contingency	794
Total Construction & Development Cost	6,928
Interest During Construction (IDC)	1,407
Total Cost	8,335
Treasury Board Reserve	440
Total Cost including Project Reserve	8,775

The FID budget, approved in December 2014, was the result of the preparation and review of multiple estimates that were developed throughout the multi-stage evaluation and planning process beginning in 2007. ¹⁵ In 2010, a Class 3 level ¹⁶ estimate was prepared, which gave a total project cost of \$7.96 billion (excluding project reserve). ¹⁷ Between 2010 and 2014, as design and project definition progressed, the estimate was further refined but the overall project estimate remained at \$7.96 billion. As part of its due diligence, BC Hydro engaged a panel of external consultants ¹⁸ in 2014 to perform further validation of the cost estimate. According to BC Hydro, ¹⁷ this panel concluded that the cost estimate was sufficient for the proposed scope and schedule of the Project.

In December 2014, the provincial FID was approved for the Site C Project. As part of the approval, the Province announced an updated project cost estimate of \$8.335 billion.¹⁹

The contingency amount of \$794 million was developed by BC Hydro's Estimating team using Monte Carlo models²⁰ that assessed the potential cost variability associated with each work package due to the following risks: design uncertainty, labour costs, estimate accuracy, and contractor markup expectations.²¹ The budget was identified as having a P50 value, meaning that the Project had a 50% chance of being over and 50% chance of being under the budgeted value. At FID, the contingency of \$794 million represented 11.5% of the total construction and development costs of \$6.928 billion and 9.5% of the total project costs of \$8.335 billion.

At FID, the Province also established \$440 million for a project reserve, held by the Treasury Board, to account for events outside of BC Hydro's control during the construction period. This reserve was estimated based on the advice provided by external consultants to BC Hydro and the Treasury Board.²²

The project reserve of \$440 million, combined with the contingency of \$794 million, resulted in an overall contingency of \$1,234 million, which represented 14% of the overall total project costs.²³ Based on Deloitte's experience reviewing large complex capital projects, we would expect that the contingency (including project

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¹⁴ Nominal dollar breakdown provided by BC Hydro

¹⁵ Basis of Project Estimate

¹⁶ Following the AACE – Class 3 Estimate accuracy: -10%/+60%

¹⁷ Appendix E – Business Case for Investment Decision by BC hydro Board of Directors of the Project Execution Plan (p.8/40)

¹⁸ The panel consisted of KPMG, Marsh Canada, and a panel of independent contractors

¹⁹ The cost was updated to account for HST and PST changes in addition to an adjusted project completion date of 2024

²⁰ The model was reviewed by a panel of external consultants. Ref footnote 18. Note: Deloitte did not perform an independent assessment of the Monte Carlo model

²¹ Monte Carlo – Direct Cost Estimate memo – Section 1 Chapter 9 - Contingency

²² Basis of Project Estimate, Appendix 2-B

²³ \$1,234 / \$8,775

reserve) would be in the range of 15%–20% of total project costs. The Site C Project's contingency at FID was just below the low end of that range.

5.3 Project performance measurement baseline

The FID provided the approved budget for the Project; however, following FID, BC Hydro prepared its first PMB in December 2015. The PMB is BC Hydro's project baseline. This baseline is the cost and schedule basis used by the Project team to monitor the progress of the Project, and according to the Schedule Management Plan, reflects the current approved work-package scope, cost, and schedule for approved work-package agreements.

The PMB differs from the FID in that the FID is established during the planning stages, at the point of budget approval, or "first full funding" for the implementation phase. Although the FID is not the Project baseline, it is used as a point of reference throughout the Project when tracking schedule and cost.

According to the Schedule Management Plan, the PMB is updated annually, or as required, to account for significant changes to the Project's scope, schedule, and cost, as a result of contract awards, contract changes, contingency allocations, or unforeseen conditions. The PMB was revised in March 2016 and in June 2016. BC The current Project baseline is the June 2016 PMB.

5.3.1. PMB schedule

Deloitte reviewed the June 2016 PMB schedule²⁴ for critical path and key schedule milestones. The PMB schedule shows overall completion of the Project on November 24, 2023, 12 months earlier than the FID completion date of November 25, 2024.

From a review of contemporaneous project documentation, we note that BC Hydro initially intended to complete the Project in November 2023, and that as part of the FID, the Province made a decision to delay the start of construction, directly impacting the Start of River Diversion and resulting in overall completion in 2024. We understand, from discussions with BC Hydro's team, that the schedule activities in the PMB were re-sequenced in order to complete the Project as per the initial target of November 2023. The re-sequencing therefore resulted in an additional contingency to the schedule of 12 months.

A summary of the key PMB schedule milestones compared to the FID schedule milestones is shown in Table 8.

²⁴ Site C June 2016 PMB.xer

²⁵ Appendix K of the Business Case for FID

Table 8: Key PMB milestones compared to FID milestones

Milestone	FID Dec 2014	PMB Jun 2016	PMB Critical Milestone	Diff. (months)
Early Works				
Commence Dam Site Clearing	1-Aug-15	27-Jul-15		-
Worker Accommodation Operational	1-Mar-16	1-Mar-16		-
Main Civil Works				
Complete all Civil Work for Diversion	28-Feb-20	1-Mar-19		-12
Complete Testing of Diversion Gates (Dry)	10-May-19	1-Jun-19		1
Start River Diversion	1-Sep-20	1-Sep-19	✓	-12
Highway 29 Realignment				
Highway 29 in service	30-Sep-21	30-Sep-21		-
Transmission and Distribution				
5L5 500kV Transmission Line in service	16-Oct-20	22-Nov-19		-11
5L6 500kV Transmission Line in service	10-Jul-23	25-Aug-22		-10
Site C Substation in service	3-Nov-20	10-Dec-19		-11
Turbines and Generators				
Unit 1 in service	8-Dec-23	7-Dec-22	✓	-12
Unit 6 in service	25-Nov-24	24-Nov-23	✓	-12

5.3.1.1 PMB critical path

In addition to the change to the overall completion date, the critical path in the PMB was also revised when compared to the original FID schedule. In the FID schedule, the critical path prior to river diversion ran through construction of the diversion tunnels on the Left Bank. The critical path in the PMB is shown as running through the Right Bank roller-compacted concrete (RCC) activity prior to river diversion and construction of the dam.

Although not shown as critical in the PMB, the work related to diversion tunnels remains important due to the sensitivity of the Start of River Diversion. It is represented in Figure 3 as near-critical work, meaning that a major impact to this work could place it on the critical path.

As noted earlier, the FID contained six months of contingency on civil work and tunnel construction required for the Start of River Diversion. This contingency was on the critical path in the FID, meaning that tunnel work could be delayed six months without affecting the Start of River Diversion or impacting the overall Project schedule. As it has been revised and re-sequenced, the PMB now contains only three months of contingency on work required prior to diversion. The PMB shows that, following civil and tunnel work, Testing of Diversion Gates needs to be completed prior to the Start of River Diversion. This, in turn, leaves only three months of contingency to the Start of River Diversion. This contingency is represented in Figure 3 under the activity "Waiting for Diversion Window."

A summary of the critical path for the June 2016 PMB is shown in Figure 3.

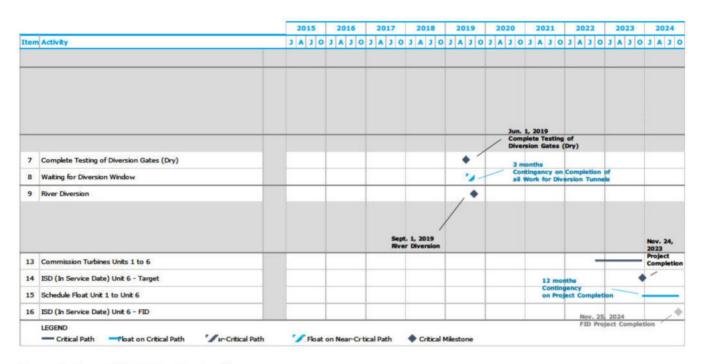


Figure 3: June 2016 PMB critical path

5.3.1.2 PMB schedule contingency

Based on our review of the Project schedules, as well as interviews with the BC Hydro project team, we note that the Project schedule contains a significant amount of contingency. In the PMB, the contingency is incorporated in various locations:

- 12 months of contingency, or "Owner's Float," due to differences in FID and PMB final in-service dates:
 This is contingency on the critical path of the Project, represented by an activity in the Project schedule
 and directly tied to the in-service dates of the turbine generators.
- Three months of contingency on tunnel work prior to River Diversion: This is contingency on tunnel work
 prior to the Start of River Diversion, which is on the critical path of the schedule. It is represented through
 the different milestones incorporated into the schedule.
- Contract contingency: Based on discussions with BC Hydro, we understand that the dates included in the contract documents contain a degree of contingency.
 - contingency on completion of the transmission lines: this contingency is not on the critical path but is related to a major sub-project.
 - contingency on completion of the substation: this contingency is not on the critical path but is related to a major sub-project.
- Calendar contingency: According to the schedule basis,²⁶ the Project schedule contains 14% contingency
 per week for site-based activities, as site-based work is scheduled on a six-day work week in Primavera,
 but is expected to be executed on a seven-day work week. This can result in up to 50 days per year,²⁷ or
 400 days total over the life of the Project. This contingency is dependent on several factors, such as
 continuous work flow, labour agreements, and labour availability.

If the three months of contingency prior to diversion is consumed, and the river diversion date is missed, the Project schedule would consume the additional 12 months of contingency allocated post-diversion as the

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²⁶ Schedule Basis document referred to in the BC Hydro Schedule Management Plan dated April 8, 2015

²⁷ Excludes winter holidays

critical diversion work would have to be rescheduled to the following year. The additional 12 months of contingency introduced in the PMB is therefore dependent on the successful completion of river diversion in 2019. This highlights the criticality of the Start of River Diversion milestone to the overall Project. Meeting or missing this milestone would have a significant impact on the Project's ability to meet its cost and schedule targets.

5.3.2. PMB budget

Deloitte's review of the June 2016 PMB budget in comparison to the FID budget breakdown is summarized in Table 9.

Table 9: FID Budget compared to June 2016 PMB Budget (nominal \$ million) ²	Table 9:	FID B	Budaet	compared t	to June	2016 PN	MB Budaet	(nominal	\$ million)) 28
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Description	FID Budget Dec 2014	PMB Jun 2016	Difference
Direct Construction Costs	4,885	5,133	249
Other - Indirect	1,249	1,410	160
Contingency	794	763	-31
Total Construction & Development Cost	6,928	7,306	378
Interest During Construction (IDC)	1,407	1,029	-378
Total Cost	8,335	8,335	0
Treasury Board Reserve	440	440	0
Total Cost including Project Reserve	8,775	8,775	0

The differences between FID and the PMB are mainly explained by changes to the work breakdown structure (WBS) cost-code mapping for the various direct, indirect, contingency, and IDC costs.

A detailed breakdown of the evolution of budgeted costs throughout the various re-baselines is presented in Appendix C.

5.4 Schedule assessment

The previous sections have set forth the FID (December 2014) schedule and budget approved by the Province and the most recent PMB (June 2016), which the Project is using as its baseline to control, monitor, and report progress. In the following sections the PMB will be compared to the most recent Project updates and reports.

The current state of the Project is assessed with BC Hydro's Cost Report and with the Prior Month Forecast Baseline (PMFB). The PMFB is the monthly schedule update used by BC Hydro to track its work. It includes the latest scope updates, and updates to cost and schedule actuals and forecasts. It incorporates approved contractor schedule updates.

From discussions with BC Hydro's Project Team, we understand that BC Hydro does not currently use Earned Value Methodology (EVM) to monitor, report, and manage the Project, and that as part of its Project and Portfolio Management (PPM) practice, earned value reporting will be implemented toward the end of this year. We note that the use of earned value reporting on other mega-projects is a common practice. If developed and executed properly, it would provide a monthly assessment of the overall health of the Project as well a view into trends.

²⁸ Nominal dollar breakdown provided by BC hydro

5.4.1. Schedule review

The latest PMFB available is dated June 2017. Prior to assessing schedule status from the PMFB, Deloitte performed an integrity check on BC Hydro's FID, PMB, and PMFB schedules for compliance with industry standards for scheduling using the critical-path method.

Based on an integrity check, the schedules appear to have appropriate activity relationships, logic, and WBS. We understand from discussions with BC Hydro's scheduling team that BC Hydro also performs a similar integrity schedule review on a monthly basis for the PMFB and for all contractor schedules submitted.

5.4.2. Schedule summary

Table 10 shows the key schedule milestones extracted from the June 2017 PMFB and compared to the PMB baseline. It can be seen that the Project is currently reporting a delay to Main Civil Works and to Transmission and Distribution milestones.

Table 10: Comparison of planned and actual milestones

	PMB	PMFB		Diff.
Milestone			Critical	
	Jun 2016	Jun 2017		(mths)
Early Works				
Commence Dam Site Clearing	27-Jul-15	27-Jul-15		-
Worker Accommodation Operational	1-Mar-16	29-Feb-16		-
Main Civil Works				
Complete all Civil Work for Diversion	1-Mar-19	22-May-19		3
Complete Testing of Diversion Gates (Dry)	1-Jun-19	1-Sep-19	✓	3
Start River Diversion	1-Sep-19	1-Sep-19	✓	-
Highway 29 Realignment				
Highway 29 in service	30-Sep-21	7-Oct-21		-
Transmission and Distribution				
5L5 500kV Transmission Line in service	22-Nov-19	2-Apr-20		4
5L6 500kV Transmission Line in service	25-Aug-22	15-Dec-22		4
Site C Substation in service	10-Dec-19	7-Apr-20		4
Turbines and Generators				
Unit 1 in service	7-Dec-22	7-Dec-22	✓	-
Unit 6 in service	24-Nov-23	24-Nov-23	✓	-

5.4.3. Status of critical activities

According to the June 2017 PMFB, construction activities began on July 27, 2015, with clearing of the dam site in preparation for mobilization of PRHP in 2016. In August 2015, ATCO mobilized to site and began installation of the camp. The worker accommodation was operational by February 29, 2016.

On March 22, 2016, two months later than planned, ²⁹ PRHP began mobilization to the dam site, and began work on the Right Bank. In July 2016, due to the delay in mobilization, as well as to related delays in contractor submittals, PRHP was reportedly two months behind schedule on the Right Bank drainage tunnel and on critical RCC work at the Right Bank. ³⁰

In response to these delays, it is our understanding that BC Hydro worked with PRHP on constructability reviews to re-sequence activities and recover the schedule, and to settle any claims associated with these

²⁹ According to the June 2016 PMB, mobilization was to begin January 21, 2016

³⁰ Site C Project Board Update – September 2016

delays. As a result of these efforts, the Project was reported to be back on schedule in February 2017³¹ to meet the contract milestones of Complete all Civil Work for Diversion by March 1, 2019, and of Testing of Diversion Gates by June 1, 2019, therefore maintaining the three months contingency on tunnel work ahead of the Start of River Diversion milestone on September 1, 2019.³² This required a draw on contingency funds of approximately . The critical path at this point remained on the Right Bank prior to the Start of River Diversion.

On February 11, 2017, a tension crack 400 metres long occurred on the Left Bank, during earth moving for slope stabilization work. This event resulted in a stop to construction activities on the Left Bank for approximately 10 weeks. Work resumed on April 24, 2017.³³ We understand that PRHP plans to submit a claim to BC Hydro for this delay.

In May 2017, a second tension crack, this one 250 metres long, occurred. Constructability reviews between BC Hydro and PRHP are currently ongoing to address this issue and to attempt to develop a plan to mitigate the impact of the delays incurred. The details of these reviews have not been shared with Deloitte.

As a result of the tension cracks and the stop to work, the Project critical path up to the Start of River Diversion has shifted from the Right Bank to the Left Bank, now moving through excavation and stabilization of the Left Bank prior to construction of the tunnels. According to BC Hydro's June 2017 PMFB, the Project is delayed on Left Bank civil work but is still on track to meet the September 2019 diversion date, as well as the overall target completion date of November 2023. The PMFB, however, does not incorporate PRHP's latest proposed schedule updates as they have been rejected by BC Hydro due to PRHP's failure to comply with contractual requirements and mitigate delays.

During the last constructability review, PRHP submitted an impacted schedule showing completion of work related to diversion tunnels on March 30, 2020. Although this schedule has not been approved by BC Hydro, it shows seven months of delay to the planned Start of River Diversion in September 2019. Deloitte performed a scenario analysis on BC Hydro's June 2017 PMFB schedule update, updating it with the latest estimated completion date for tunnel work required for diversion. The scenario analysis confirms that the Start of River Diversion is at risk of being rescheduled to September 2020, delaying the overall completion of the Project by 12 months to November 25, 2024.

5.4.4. Schedule assessment

BC Hydro's latest schedule update is showing that the Start of River Diversion is still on track for September 1, 2019. It is, however, also showing three months of delay to work required prior to diversion. As we noted in Section 5.3.1.2, the PMB includes three months of schedule contingency on crucial work pre-diversion. The current PMFB is showing that this contingency will be consumed, putting the Start of River Diversion at risk.

In addition, although rejected by BC Hydro, PRHP's latest schedule submission shows an impact of seven months to river diversion, which, if realized, would impact the overall completion date of the Project by one year, consuming the entire 12 months of contingency to completion built into the baseline schedule.

According to minutes from BC Hydro's latest board meeting, BC Hydro expects that a minimum of can be recovered on PRHP's latest project schedule as a result of the constructability reviews. As discussions between BC Hydro and PRHP are still ongoing, the mitigation measures discussed have not been finalized and were not available for review at the time of Deloitte's report. It is our understanding that these measures may include re-sequencing of activities, deferral of activities, acceleration of activities, and early

³¹ This was validated with both BC Hydro's February 2017 PMFB and PRHP's February 2017 schedule update

³² Special Meeting of the Site C Project Board, dated August 3, 2017

³³ Special Meeting of the Site C Project Board, dated August 3, 2017

start of activities initially planned for later periods. It is unknown whether or not contingency funds would be used.

At this date, the success of the Project is dependent on achieving river diversion in September 2019. This is directly related to the potential success or failure of the plan being developed during the constructability reviews between BC Hydro and PRHP. If the Start of River Diversion does not occur in September 2019, it would have a significant impact on the overall cost and schedule of the Project, consuming the 12 months of contingency developed in the PMB and likely drawing additional project contingency funds, as discussed below. The Project would therefore not likely have sufficient remaining schedule contingency to address construction risks going forward, including the other major work packages, such as GSS and Transmission, for which contracts have not yet been awarded.

5.5 Cost and contingency assessment

5.5.1. Documents reviewed

In order to assess the current state of the Project, Deloitte reviewed and considered information from the following documents:

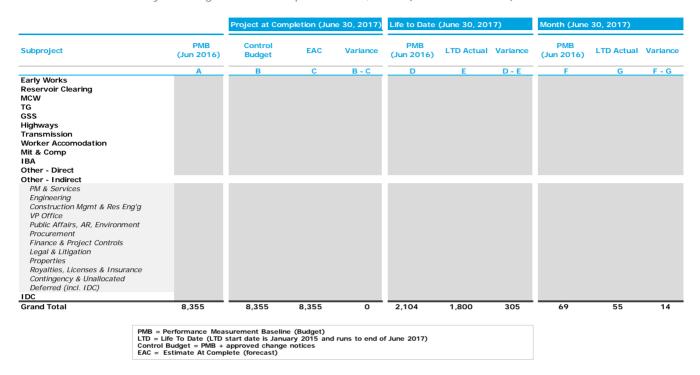
- Site C Cost Report
- Site C Monthly Accountability Reports (which include cost and contingency summaries)
- Site C Board of Directors Minutes, Reports, and Presentations

Deloitte reviewed the cost report and various other cost summaries contained in the Project's monthly accountability reports to confirm that they reconcile. With the exception of minor variances between reports as a result of different reporting cutoff dates, all reports appear to reconcile.

5.5.2. Cost reporting and status

Deloitte was provided with the cost summaries from December 2015 to June 2017. The cost summary presented in the June 2017 Accountability Report is illustrated in Table 11.

Table 11: Cost summary covering actual costs up to June 30, 2017 (nominal \$ million)³⁴



The cost summaries that are included in the monthly accountability reports provide:

- Cost information by sub-project (MCW, GSS, Highway 29, direct costs, indirect costs, etc.)
- "Project at Completion" cost information such as the latest PMB; 35 the Control Budget, which consists of the budget plus approved changes; the forecasted cost at completion or Estimate at Completion (EAC); and the Variance between the EAC and Control Budget
- "Life to Date (LTD)" cost comparison between the PMB and actual cost incurred to date
- Monthly cost comparison between the PMB for the reporting month and the actual cost incurred for that month

Work-package cost analysts perform a monthly review of actual LTD spend and trending information to update the EAC.³⁶ To ensure consistency and accuracy in EAC forecasting, each cost analyst is assigned to specific contracts throughout the duration of the Project. This allows analysts to be knowledgeable of the current progress, risks, and challenges of their assigned contracts.

Table 12 provides details of the percentage spent by sub-project in relation to the Project's EAC as of June 30, 2017.

³⁴ July 2017 Monthly Report

³⁵ The latest PMB is the one that was completed in June 2016

³⁶ According to discussions with BC Hydro

Table 12: LTD Actual vs EAC as of June 30, 2017 (nominal \$ millions)

Subproject	LTD Actual	EAC	LTD / EA
	Α	В	A / B
Early Works			
Reservoir Clearing			
MCW			
TG			
GSS			
Highways			
Transmission			
Worker Accomodation			
Mit & Comp			
IBA			
Other - Direct			
Other - Indirect			
PM & Services			
Engineering			
Construction Mgmt & Res Eng'g			
VP Office			
Public Affairs, AR, Environment			
Procurement			
Finance & Project Controls			
Legal & Litigation			
Properties			
Royalties, Licenses & Insurance			
Contingency & Unallocated			
Deferred (incl. IDC)			
IDC			
Grand Total	1,800	8,335	22%

Based on the cost information presented in the above tables, the Project's current overall EAC remains at \$8.335 billion. The largest contract package, MCW, is budgeted at bu

As of June 30, 2017, the Project had spent \$1.8 billion of \$8.335 billion, representing approximately 22% of EAC. This percentage is based on spent cost only and does not represent actual progress on the site to date. Deloitte has not seen a clear method the Project uses to measure percentage complete. The Project's planned implementation of EVM by December 2017 will allow the Project to better assess the actual versus planned percentage complete.

As shown in Table 11, LTD cost performance of the Project is \$305 million or 14% behind its planned spend as of June 30, 2017. This variance could indicate that less work is being performed compared to the plan (i.e., the Project may be behind schedule). According to BC Hydro³⁷ and Deloitte's assessment, this variance can be explained by:

- 1. Lower-than-planned spend on MCW as a result of delays in starting some activities. As stated previously (Section 5.4.3), the Project is experiencing MCW delays on the Left Bank due to the tension cracks. It is Deloitte's understanding that Left Bank construction activities stopped for approximately 10 weeks starting February 11, 2017; this work is on the critical path.
- 2. Lower-than-planned rates of excavating material at Left and Right Banks, and lower-than-planned placement of concrete.
- 3. Lower-than-planned expenditures for Highways, Transmission, and clearing for the Lower Reservoir to Cache Creek due to delays in work.
- 4. Shifting of spends on Properties purchases, Royalties, and Mitigation & Compensation into future periods.

³⁷ July 2017 Monthly Report, page 75

5. Lowering of actual expenditure to date on Turbines & Generators and different payment start dates between the PMB cash flow and vendor cash flow.

In terms of Project at Completion cost performance, according to Table 11 there are positive and negative variances between the Control Budget and EAC for certain sub-projects. According to BC Hydro³⁸ these variances can be explained by:

Ι.	Savings on certain contracts that were completed or are forecasted to be completed under budget
2.	Savings in IDC (plus plus) on implementation costs as a result of a forecasted drop in
	interest rates assuming an in-service date of the first unit in December 2022. It should be noted that
	every additional month of delay beyond this assumed date results in
3.	Additional costs on certain sub-projects (Reservoir Clearing [], Highways [], and
	Transmission []) due to higher-than-planned expenditure from a) increased quantities as
	scope definition advances and b) higher contract costs than initially estimated
4.	Additional costs for unplanned direct/indirect costs and higher headcount resourcing than planned. This is
	mainly associated with Engineering (variance due to higher Klohn/SNC utilization than
	planned), Construction Management & Resident Engineering (higher due to unplanned costs
	and higher headcount resourcing than planned), Project Management & Services (higher due
	to additional labour resources forecasts), Public Affairs, Aboriginal Relations, and Environment (
	higher due to additional environmental oversight)
	date, the forecasted variances compared to the Control Budget for the various sub-projects sum to a total
	of the Control Budget). Based on these forecasts, the Project would
rec	uire to draw on its contingency an additional in order to maintain the \$8.335 billion Estimate
at (Completion Forecast.

5.5.3. Contingency framework and status

5.5.3.1 Contingency management framework

To ensure additional governance and due diligence, the Project's full contingency is not delegated to management. According to BC Hydro, Site C's management must request approval from the Board of Directors in order to use the portion of the Project contingency required to manage the risks for that period.

The contingency delegated by the Board of Directors to management is allocated to specific work packages, as necessary. Management then "commits" contingency (i.e., commits that it will be spent) through a project change notice in order to fund contract awards that are higher than budgeted and/or go beyond other initial contract commitments. There may remain contingency that has been released by the Board but is "uncommitted" (i.e., may not be spent) by management. This uncommitted contingency is being managed directly by the Project team.

Management updates the allocation of contingency up or down to particular scopes of work, based on contracts awarded to date, work completed, and forecasts of project expenditures through EAC for scopes of work yet to be completed. Any savings identified in project budgets in insurance and IDC are flagged and are formally returned to the unused balance of contingency.

Contingency usage, allocation, and summary reports are provided to the Site C Board of Directors quarterly for their information. Furthermore, prior to making any project reserve request to the Treasury Board, management will review such request with the Board of Directors.

³⁸ July 2017 Monthly Report, page 75

³⁹ BC Hydro response to Deloitte question no. 26

5.5.3.2 Contingency status

The original contingency identified in the FID was \$794 million. Since FID, the Project has projected a 51% increase (\$401 million) in contingency, totalling \$1,195 million. This increase is primarily due to an overall lowering of IDC. The Project currently forecasts using \$1,000 million⁴⁰ of contingency. Therefore, forecasted contingency usage exceeds the value of contingency identified in the FID (\$794 million) and represents 84% of total contingency value (\$1,000 million of \$1,195 million).

In Table 13, we summarize the current contingency status starting from the FID budget of \$794 million to the current contingency forecast of \$1,000 million (as of June 2017), of which \$509 million has been released to management. Of the \$509 million that has been released, \$356 million has been committed (i.e., will be spent) by management. The table also outlines the \$401 million in additional contingency that is either realized or projected through savings in IDC and other unallocated budgets, resulting in an overall contingency of \$1,195 million. In Section 5.2.2, we stated that at FID, Deloitte would have expected total contingency in the range of 15%–20% of the total project cost. The addition of the \$401 million would boost the total contingency to 19%⁴¹ of total project budget, within our expected range.

Table 13: Contingency summary as of June 2017 (nominal \$ million)

Work Description	Budget Contingency	Forecast Contingency	Contingency Released to Management	Contingency Committed by Management	Uncommitted Contingency Held by Management
	Α	В	С	D	C - D
Contingency Budget	794	1,000	509	356	154
Percentage of FID Contingency Budget (\$794)	100%	•	64%	45%	19%
Savings on IDC/Other Unallocated Budget	401	195			0
Total Contingency	1,195	1,195	509	356	154
Percentage of Total Contingency (\$1,195)	100%	100%	43%	30%	13%

We provide additional analysis and observations relating to the budget contingency, forecast contingency, and allocated and committed contingency in the section below.

5.5.3.2.1. Budget contingency

As previously stated, as part of the total project capital-cost estimate of \$8.335 billion, \$794 million (nominal) of contingency was allocated to the Site C Project at FID in December 2014.⁴²

Additional contingency amounts totalling \$251 million have been identified up to March 31, 2017, a result of savings related to IDC and other unallocated budget. A further \$150 million of savings related to forecast IDC savings are anticipated, resulting from expected reductions in the forecasted interest rates for the period from F2018 through to F2025. As a result, the total budget for contingency is expected to increase by \$401 million or 51%, up to \$1,195 million⁴³ total. This is a significant addition of contingency that has mitigated the risk of the budget overruns as detailed further below.

⁴⁰ Contingency reporting package, June 30, 2017

⁴¹ Combining this contingency amount of \$1,195 million with the \$440 million of Project Reserve results in an overall contingency of \$1,635 million, representing 19% of the total \$8,775-million project cost.

⁴² This excludes \$440 million of project reserve, which is being held by the Treasury Board.

⁴³ BC Hydro corporately finances its capital projects, which means that specific borrowing vehicles are not attached to specific projects. Interest costs for the Site C Project are based on corporate-wide internal interest rate charges. The internal finance rate charged to projects changes periodically (but not frequently) in response to market interest conditions. Approximately 18 months ago, in response to very low current interest rates, BC Hydro initiated a hedging program for planned future borrowings including (but not limited to) cost for the Site C Project. This hedging program covered 50% of planned future borrowing.

5.5.3.2.2. Forecast contingency

The Project's current updated contingency forecast is \$1,000 million, representing a 26% increase from the original \$794 million in budget contingency. This \$206 million forecasted increase in contingency is only possible as a result of the \$401 million in realized and forecasted IDC savings, which brings the total allocation to \$1,195 million, as summarized in Table 13 and detailed in Table 14:

Table 14: Difference between FID contingency allocation and current forecast as of June	e 2017	(nominal \$ million)

Work Description	Budget Contingency Allocation	Forecast Contingency Allocation	Difference
	Α	В	A - B
Main Civil Works			
Generating Station and Spillways			
Rights, Taxes and Grants			
Highway 29 Relocation			
Clearing			
Early Civil Works			
Turbines and Generators			
Transmission			
Miscellaneous			
Worker Accommodation			
BC Hydro Construction Management			
Indirect Costs			
Insurance Savings			
Total Contingency Budget	794	1,000	-206
Realized IDC savings/Other Unallocated Budget	251		251
Forecasted IDC savings	150		150
Savings on IDC/Other Unallocated Budget	401	195	206
Total Contingency	1,195	1,195	0

Based on Deloitte's understanding, this 26% increase in forecasted contingency is a result of (i) additional indirects and management costs, (ii) higher contract costs than estimated, and (iii) additional unexpected scope (explained in Section 5.5.2). Such an increase in forecasted contingency within only the second year of an eight-year contract calls into question the accuracy of the Project's initial estimates.

Furthermore, considering that there is a 26% forecasted increase in contingency after approximately 24 months of construction, the current trend is a 1% increase for every month – which could potentially mean a 100% increase in 100 months or eight years of expected construction. While we do not expect this trend to continue, close monitoring on the contingency forecast is required.

Despite this overall increase in forecasted contingency, there are some instances of contingency savings on sub-projects where contracts have been successfully completed under budget. They allow for the contingency savings to be reallocated to other sub-projects, as illustrated in Table 14: Turbines & Generators () and Insurance Savings (). It is also our understanding that some of the smaller contracts have returned money to contingency.

5.5.3.2.3. Allocated and committed contingency

As of June 2017, \$509 million in contingency has been released to management, of which \$356 million has been allocated and committed to work packages through a work-package change notice in order to fund

The Site C Project is exposed to interest rate fluctuations going forward as this central rate charged to project periodically changes. The risk is mitigated by two factors: first, the hedging program will reduce BC Hydro's overall exposure to interest rate changes over the coming years, and two, any interest rate savings are available to fund other aspects of the Project.

contract award and/or contract contingency. This leaves a balance of contingency released to management but uncommitted of \$154 million as illustrated in Figure 4.

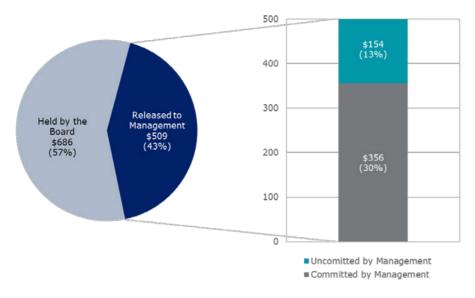


Figure 4: Allocated and committed contingency (nominal \$ million)

The \$356 million of committed contingency represents 30% of the total contingency of \$1,195 million. Had the Project not gained the \$401 million in additional contingency as a result of IDC savings, the total committed contingency of \$356 million would have represented 45% of the FID budget contingency of \$794 million, and this percentage would have been significantly higher than the 22% of total budget spent to date (\$1.8 billion spent on \$8.335 billion). A large portion of the committed contingency is attributable to the as detailed in Column D of Table 15.

Table 15: Detailed contingency breakdown by sub-project (nominal \$ million)

Work Description	Budget Contingency Allocation	Forecast Contingency Allocation	Contingency Released to Management	Contingency Committed by Management	Uncommitted Contingency Held by Management	Total Remaining Contingency	Percentage Commite Contingen
	Α	В	С	D	E = C - D	F = B - D	G = D / E
Main Civil Works							
Generating Station and Spillways							
Rights, Taxes and Grants							
Highway 29 Relocat on							
Clearing							
Early Civil Works							
Turbines and Generators							
Transmiss on							
Miscellaneous							
Worker Accommodat on							
BC Hydro Construct on Management							
Indirect Costs							
Insurance Savings							
Total Contingency Budget	794	1,000	509	356	154	644	36%
Realized IDC savings/Other Unallocated Budget	251					0	
Forecasted IDC savings	150					0	
Savings on IDC/Other Unallocated Budget	401	195	0	0	0	195	0%
Total Contingency	1,195	1,195	509	356	154	839	30%

Based on interviews with BC Hydro, historic contingency usage on other projects occurred at the beginning and at the end of projects. Therefore, a higher commitment or usage of contingency at the beginning of the

Site C Project, as compared to spend (on a percentage basis), is not necessarily unusual. It should, however, be noted that the Site C Project is a series of contracts, and that there are large unawarded contracts for GSS and Transmission. Should these unawarded contracts require similarly large commitments, as has MCW, the contingency budget would be at risk of overruns.

5.5.3.2.4. MCW contingency allocation status

In reviewing the contingency of MCW, and the of the overall budgeted contingency of has already been committed (i.e., will be spent) by management. This is relatively high compared to the

Table 16 shows a historical summary of the contingency allocation for MCW.

Table 16: MCW contingency allocation summary

Index	Work Description	Contingency	Percentage
Α	Budget Contigency Allocation		
В	Contingency Released to Management:		
	Contingency for Contract Award (2016)		
	Contingency for Year 1 (2016) construction		
	Contingency for Year 2 (2017) construction		
	Additional Contingency Request (April 2017) ¹		
	Additional Contingency Request (June 2017) ²		
C=A-B	Contingency Held By Board of Directors		
D	Contingency Committed by Management		
E=B-D	Uncommitted Contingency Held by Management		
F=C+E	Total Remaining Contingency		

Notes:

- (1) Left Bank Tension Crack remdial work and 2016 PRHP Left Bank Claim allocation
- (2) Additional costs related to Tension Crack impacts ,Construction Environmental Management Plans and increased areas for surplus materials relocation/storage

As detailed above, of the total MCW contingency has been allocated (and committed) to cover the additional MCW contract cost, which was higher than initially budgeted. In Years 1 and 2 of construction, the Board released the planned contingency allocation in line with the contingency framework. However, in April and in June 2017, there have been additional contingency allocation requests from management to the Board to cover unforeseen costs, resulting from contractor delays and Left Bank tension crack in the Board has been more than the planned contingency allocations for Years 1 and 2 of construction and contributes to the fact that MCW contingency has been released to date by the Board, as illustrated in Figure 5.

⁴⁴ See Table 11

⁴⁵ Discussed in Section 5.4.3

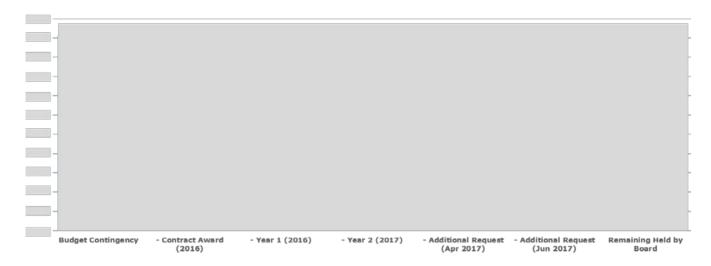


Figure 5: MCW contingency releases from the Site C Project Board of Directors (nominal \$ million)

As of June 2017, as shown in Table 16, only of MCW contingency is left uncommitted, 46 which may not be sufficient for potential future issues, considering that of the MCW budget is yet to be spent and that the Left Bank tension-crack issues are still ongoing and will likely result in additional claims.

5.5.4. Cost and contingency assessment

Contingency usage, allocation, and forecasts are higher than anticipated at this point in the Project. The results of our contingency assessment are as follows:

- As of June 30, 2017, the Project has spent 14%⁴⁸ less than it had planned in the June 2016 PMB, which is indicative of certain delays
- The Project is already forecasting a 26% increase in its total contingency budget after only 24 months of construction
- The Project has committed 45% of its FID budget to date, which reduces our confidence in the accuracy of the other main contract packages that have yet to be awarded
- There remains only MCW contingency, which is a concern considering that PRHP has only completed two years of the scheduled eight years on the Project, and has both submitted claims and suggested that more claims are to come

5.6 Comparison to other large capital projects

5.6.1. Historical time and cost performance of dam projects around the world

In a 2014 article entitled "Should we build more large dams? The actual costs of hydropower megaproject development," 49 authors Ansar et al. of the University of Oxford published a study on the schedule and cost performance of historical dam projects. The study consisted of 245 large dams ("large" defined as greater

⁴⁶ i.e., either not released by the Board, or else released by the Board but uncommitted by Management

⁴⁸ LTD Actual of \$1.8 billion vs. PMB Actual of \$2.1 billion

⁴⁹ Ansar, Atif, Bent Flyvbjerg, Alexander Budzier, and Daniel Lunn, "Should We Build More Large Dams? The Actual Costs of Hydropower Megaproject Development," *Energy Policy*, March, pp. 1-14, DOI: 10.1016/j.enpol.2013.10.069, URL: http://bit.ly/1ekyL7Q

than 15 metres in wall height) built between 1937 and 2007 in 65 countries. ⁵⁰ By comparison, the Site C Project's wall height is 60 metres. Of the 245 large dams, 186 were hydroelectric projects, with the balance being irrigation, flood control, and water supply dams.

The study found that three out of four large-dam construction projects suffered cost overruns. Actual costs were on average 96% higher than estimated costs; the median was 27% above estimated costs. The large difference between average and median values would suggest a number of outliers that skewed the average value. There were no significant differences in cost forecasting errors over time, i.e., cost performance of recent projects was no better than older projects. Larger projects were more prone to outlying cost overruns.

The study also found that eight out of ten large-dam projects suffered schedule overruns. Actual implementation schedules were on average 44% longer than estimated; the median overrun was 27%. Similar to historical cost performance, there were no significant differences in schedule forecasting errors over time. Projects with longer estimated schedules tended to have poorer schedule performance.

The publication of this study elicited responses from hydroelectric industry.⁵¹ For example, the study did not include the names of the projects sampled, so the conclusions could not be independently verified. Deloitte has not attempted to corroborate the conclusions from this study.

5.6.2. Comparison to other recent Canadian hydroelectric and transmission projects

The University of British Columbia (UBC)'s Program on Water Governance published a paper in April 2017 called "Reassessing the Need for Site C." 52 The authors summarized the cost and schedule performances of a number of recent greenfield Canadian hydroelectric and transmission projects as comparisons to the Site C Project.

For the purpose of our review, we updated the data collected by UBC with more recent publicly available data; the result is shown in Table 17. None of these recent hydroelectric and transmission programs have been on budget, with the hydroelectric projects at 55–90% over budget. Based on limited available public data on schedule performance, the Keeyask Project is currently 21 months behind, ⁵³ and the Muskrat Falls Project is at 61% actual completion versus a plan of 63%. ⁵⁴

⁵⁰ The study noted that the total number of dams with wall heights greater than 15 metres is 45,000. The selection of 245 sample dams was based on availability of schedule and cost data.

⁵¹ http://www.waterpowermagazine.com/features/featureoxford-study-on-large-dams-the-right-to-reply-4302108/ and http://www.globalwaterforum.org/2014/06/24/yes-we-should-build-more-large-dams/

⁵² Hendriks, R., Raphals, P. and K. Bakker, "Reassessing the Need for Site C," Program on Water Governance, (Vancouver: University of British Columbia, 2017), https://watergovernance.ca/projects/sitec/

⁵³ Project news release, March 7, 2017, http://keeyask.com/wp-content/uploads/2011/06/03-07-News-Release.pdf

⁵⁴ Muskrat Falls Project Oversight Committee Quarterly Report, Period Ending March 2017, https://www.gov.nl.ca/mfoversight/pdf/report_mar_2017.pdf

Table 17: Cost performance of recent greenfield Canadian hydroelectric and transmission projects

Project	Proponent	Capacity	Total Cost (3)		Cost O	verrun	Status	
			Initial Budget	Actual Cost/ Current Estimate	\$	%		
HYDRO ELECTRIC PROJECTS								
Muskrat Falls ⁽²⁾⁽ⁱ⁾	Nalcor Energy	824 MW	\$2.9 B ⁽¹⁾	\$5.5 B ⁽¹⁾	\$2.6 B	90%	~69% complete	
Wuskwatim ⁽ⁱⁱ⁾	Manitoba Hydro	200 MW	\$0.9 B	\$1.6 B	\$0.7 B	78%	Began operations in 2012	
Keeyask ⁽ⁱⁱⁱ⁾	Manitoba Hydro	695 MW	\$5.6 B	\$8.7 B	\$3.1 B	55%	Under construction	
TRANSMISSION PROJECTS								
Labrador-Island Tranmission Link ^(iv)	Nalcor Energy	350kV, 1050 km	\$2.6 B ⁽¹⁾	\$3.7 B ⁽¹⁾	\$1.1 B	42%	~84% compete	
Bipole III ^(v)	Manitoba Hydro	500 kV, 1384 km	\$2.2 B	\$4.9 - 5 B	\$2.8B	125%	Under construction	
Dawson Creek/Chetwynd Area Transmission Project ^(vi)	BC Hydro	230 kV	\$255 M	\$296 M	\$41 M	16%	Operating	
Interior to Lower Mainland Transmission Line ^(vii)	BC Hydro	500 kV, 247 km	\$602 M	\$743 M	\$141 M	23%	Operating	
Northwest Transmission Line(viii)	BC Hydro	287 kV, 344 kM	\$404 M	\$736 M	\$332 M	82%	Operating	

Notes:

- (1) Excludes interest during construction and cap talized financing costs
- (2) Generat on facility only
- (3) Costs have not been adjusted to nominal basis

Source:

- (i) http://muskratfalls.nalcorenergy.com/wp-content/uploads/2017/08/June-2017-LCP-Monthly-Benef ts-Report-final.pdf
- (ii) https://www.winnipegfreepress.com/opin on/analysis/wuskwatim-under-water----and-sinking-163983306.html
- (iii) http://keeyask.com/wp-content/uploads/2012/05/2011-06-28-keeyask_news_release.pdf http://keeyask.com/wp-content/uploads/2011/06/03-07-News-Release.pdf
- (iv) http://muskratfalls.nalcorenergy.com/wp-content/uploads/2017/08/June-2017-LCP-Monthly-Benef ts-Report-final.pdf
- (V) http://www.cbc.ca/news/canada/mantoba/mantoba-hydro-s-bipole-iii-cost-shoots-up-by-more-than-1b-1.2770793 https://www.hydro.mb.ca/corporate/news_media/news/2016-09-21-no-choice-but-to-move-forward-mantoba-hydro-electric-board.shtml
- (vi) https://www.bchydro.com/news/press_centre/news_releases/2013/dcat-construction-begins.html https://www.bchydro.com/news/press_centre/news_releases/2016/dcat-completion.html
- (vii) https://www.bchydro.com/news/press_centre/news_releases/2015/ilm-completed.html https://www.bchydro.com/content/dam/hydro/medialib/internet/documents/projects/ilm/ILM_BCUC_approves_project.pdf
- (viii) https://www.bchydro.com/content/dam/hydro/medialib/internet/documents/projects/ntl/NTL_NTLProj_BCEAO_Approved_Feb2011.pdf http://www.vancouversun.com/northwest+transmission+line+powered+crit cs+proponents+wa t+lives+promise/10135321/story.html

Please note that Deloitte has not conducted a review of the project management practices and risk profiles of these Canadian hydroelectric and transmission projects to draw specific parallels to the Site C Project. We present the data to illustrate recent trends in capital project performance in the same industry.

5.7 Major risks

Currently the Project has two categories of key risks:

- Schedule There is a potential to miss the 2019 milestone of Start of River Diversion.
- Cost There is a potential that the existing cost contingency is insufficient to cover further increases in MCW contract, uncertainties in major contracts yet to be awarded, increases in interest rates, or geotechnical risks.

In the following section, we outline the bases of these key risks, and provide a scenario analysis on potential project outcomes.

5.7.1. Main Civil Works contractor

Throughout the Project, and according to BC Hydro's accountability reports, PRHP has demonstrated several performance issues, including:

- Two months of delay⁵⁵ in mobilization to the dam site
- Delay in obtaining permits
- Delays in document submittals, according to discussions with BC Hydro
- Slow work progress (excavation, backfill, general earth moving, concrete placement)

The recent termination of Petrowest from the PRHP general partnership, and claims from PRHP against BC Hydro, are additional considerations in the schedule and cost risks.

5.7.1.1 Performance issues and Left Bank delays

A specific example of PRHP's slow progress is its excavation work at the Right and Left Banks. Data from the last nine monthly project reports⁵⁶ indicate that PRHP has consistently excavated lower volumes compared to its own prior-month forecasts, except for April 2017 at the Right Bank. The poor correlation between forecast and actual performance (see Figure 6) raises concerns about PRHP's ability to forecast.

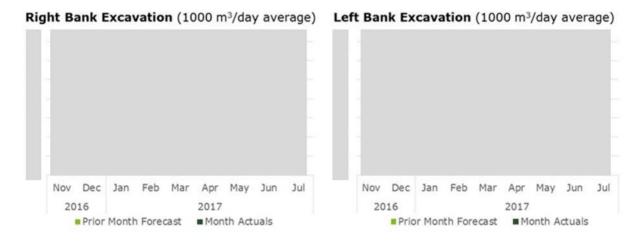


Figure 6: PRHP's excavation output (Right Bank includes approach channel and powerhouse RCC excavations)

The Project is currently experiencing a delay due to tension cracks that occurred on the Left Bank in February and May 2017. As a result, PRHP's latest schedule update indicates that the Start of River Diversion milestone would not be achieved in 2019 as planned. However, to date, BC Hydro has not accepted PRHP's revised schedule submissions. PRHP's poor plan-versus-actual performance appears to support this rejection. Constructability reviews on the issue of Left Bank cracks are currently ongoing between PRHP and BC Hydro, with the goal of developing a mitigation plan to recover the schedule. BC Hydro expects that a minimum of can be recovered as a result of these reviews. BC Hydro has not shared the details of the reviews with Deloitte but we expect they would include re-sequencing of work and acceleration measures, and would likely result in additional unbudgeted costs. Deloitte notes that PRHP's ability to meet the critical milestones poses a major risk to the Project.

⁵⁵ According to the June 2016 PMB, mobilization was to begin January 21, 2016

⁵⁶ BC Hydro "Project Executive Summary Report – PS372" for November 2016 – July 2017. Right Bank daily average performance data prior to November 2016 were not available in the Executive Summary Report.

5.7.1.2 Termination of Petrowest

On August 17, 2017, Acciona, a member of the PRHP general partnership, issued a termination notice to another partner in PRHP, Petrowest, relating to a number of events of insolvency and defaults on the part of Petrowest.⁵⁷ It is BC Hydro's view⁵⁸ that this termination will not have a significant impact on the Project because:

- It is confident that the remaining two members of PRHP have the resources and ability to perform and deliver on the work it has been contracted to provide
- The equipment and labour on site are owned or contracted by PRHP rather than Petrowest
- No additional impacts from Petrowest's receivership are expected related to the MCW contract

While according to BC Hydro this termination will not have "a significant impact," Deloitte is of the view that this termination will create a period of instability that may impact PRHP's ability to meet its planned work schedule in the short to medium term.

5.7.1.3 Claims from PRHP against BC Hydro
PRHP has issued several claims to BC Hydro, the latest of which is dated August 24, 2017, in which PRHP
claims a total of in additional costs as well as an overall delay to its contract of
Previously, PRHP submitted claims of of which BC Hydro has rejected, and
executed as change orders. ⁵⁹ Deloitte has only received an overview of the August 24, 2017, claim,
and not the claims document. An assessment of the claim is beyond the scope of Deloitte's current review;
furthermore, an assessment of this nature would require significant time and resources. As such, Deloitte ha
assumed the potential impacts of the existing claim on the river diversion to be significant.
Upon further review of BC Hydro's MCW Bid Evaluation Report, 60 we found that PRHP's proposal was ranked
second out of four bids for its technical credits, but first for its bid price. PRHP's bid price of
was approximately lower than the bidder with the highest technical proposal, lower than the bidder with the highest technical proposal,
than the average, and lower than the second lowest bid. PRHP may have significantly underbid
the Project, by to to This may explain the claims that PRHP has submitted to the
Project to date to recuperate some of its losses. Deloitte believes that PRHP may continue this trend as long
as it cannot recover its losses.

5.7.2. Interest rates

As discussed in Section 5.5.3.2, the Project has been able to increase its contingency by \$401 million as a result of realized and forecasted IDC savings and unallocated budgets. This is illustrated in Table 18.

⁵⁷ According to BC Hydro's answer to question no. 146

According to BC Hydro's answer to question no. 171

⁵⁹ claim related environmental issues (according to BC Hydro), claim for 2016 Left Bank delay claim (MCW package description provided by BC Hydro), claim settlement for Right Bank delays (MCW Contract Amendment 2).

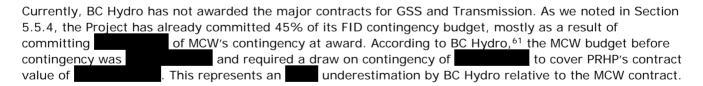
⁶⁰ Site C Clean Energy Project Main Civil Works Request for Proposals Evaluation Report – BC Hydro answer to question no. 80

Table 18: Contingency status as of June 2017 (nominal \$ million)

Work Description	Budget Contingency Allocation	Forecast Contingency Allocation
	Α	В
Main Civil Works		
Generating Station and Spillways		
Rights, Taxes and Grants		
Highway 29 Relocation		
Clearing		
Early Civil Works		
Turbines and Generators		
Transmission		
Miscellaneous		
Worker Accommodation		
BC Hydro Construction Management		
Indirect Costs		
Insurance Savings		
Total Contingency Budget	794	1,000
Realized IDC savings/Other Unallocated Budget	251	
Forecasted IDC savings	150	
Savings on IDC/Other Unallocated Budget	401	195
Total Contingency	1,195	1,195

According to Table 18, the Project has realized \$251 million of these \$401 million in savings, and is forecasting an additional \$150 million based on expected reductions in interest rates for the period from F2018 through to F2025. However, should interest rates increase over this period instead of decreasing, Deloitte notes that the Project would be at risk of potentially losing some contingency that had been anticipated due to potential rate decreases. As of June 2017, the additional contingency from IDC savings represents \$195 million of the remaining unforecasted contingency.

5.7.3. Other major contracts yet to be awarded



The accuracy of the planned MCW contract value compared to its actual value once additional contingency has been included, raises concerns about BC Hydro's ability to accurately estimate large contracts. GSS, the second-largest sub-project, and Transmission, another major sub-project, have yet to be awarded. Should these contracts have similar discrepancies between planned versus actual values, the Project contingency may be insufficient to cover them.

⁶¹ Board briefing – Site C Main Civil Works Contract Award, December 16, 2015, Special Joint Meeting of the Site C Project Board and Board of Directors

5.7.4. Geotechnical risks⁶²

The cost and schedule for the Project can be affected by several geotechnical risks that are characteristic of the site. The risk relates to uncertainties about the geotechnical conditions and the ability of the contractors to execute the design when conditions are exposed.

There can be four areas of geotechnical risks:

- 1. Stability of the overburdened slopes on the Left Bank
- 2. Condition of the rock for excavation of the large diversion tunnels
- 3. Rock conditions for the powerhouse, spillway, and embankment dam abutment on the Right Bank
- 4. Risks related to the embankment dam

Please see Appendix D for additional details on these geotechnical risks.

It appears that the geotechnical risks for the Project have been investigated and that the design and construction methods have been adapted to the conditions. Issues would mainly occur if conditions deviated from the assumptions made as a result of the design investigations. It appears that BC Hydro has made provisions in the Project estimate for the assumed conditions, by establishing appropriate quantities of work, material sources, and design features, and providing advice to contractors about constructability.

A significant part of the possible geotechnical conditions has already been exposed during the Left Bank excavations, cofferdam cutoffs, and the Right Bank excavations for the RCC buttress. The geotechnical risks largely come into play during the MCW contract and the remaining risks would be fully exposed during the activities planned for 2018 and 2019.

5.8 Project scenarios

As noted above, the two key categories of risks fall under schedule, driven by the 2019 milestone of Start of River Diversion, and cost, primarily related to contingency. At the time of Deloitte's review, we have had limited information on the mitigating actions that BC Hydro and PRHP are contemplating to reduce the risk of missing the Start of River Diversion milestone in 2019. BC Hydro and PRHP are continuing to assess their options. We also have had limited data on the major contracts yet to be awarded, although we observe that the Project has already experienced high contingency drawdown due to the difference between budget and actual bid price for MCW. Based on these unknowns, we have taken a qualitative approach to our scenario analysis.

Considering the specific Site C risks, and the overall risks encountered by other large global and Canadian projects, Deloitte believes that there exist three possible impact scenarios for the outcome of the Site C Project, as illustrated in Table 19.

⁶² Heidstra, N., Nunn, J, Watson, A, Dodman, K, Carter, R., and Burmeister, L., "Roller Compacted Concrete Buttress at the Site C Clean Energy Project," *Canadian Dam Association Bulletin* 28, no. 3 (Summer 2017)

Table 19: Site C Project scenarios – cost and schedule performance

	Meet Start of River Diversion milestone	Miss Start of River Diversion milestone
Existing cost contingency sufficient to cover further consumption of MCW contingency, uncertainties in other major contracts, increases in interest rates, and geotechnical issues	 One-year schedule contingency maintained, sufficient to cover other potential schedule risks, FID schedule maintained Cost pressures of additional 0–10% to FID budget Overall impact: Low 	 Loss of one-year schedule contingency due to continued issues with MCW, loss of ability to absorb other schedule slippage, potential for up to one year delay Cost pressures of additional 10–20% to FID to reduce schedule impact, including one year of additional IDC and indirect costs Overall impact: Moderate
Existing cost contingency insufficient to cover further consumption of MCW contingency, uncertainties in other major contracts yet to be awarded, increases in interest rates, and geotechnical issues	 One-year schedule contingency maintained, sufficient to cover other potential schedule risks Cost pressures of additional 10–20% to FID to cover shortfall in contingency Overall impact: Moderate 	 Loss of one-year schedule contingency due to continued issues with MCW, other schedule issues result in >1 year delay Cost pressures of additional 20–50% to FID to reduce schedule impact, including one to two years of additional IDC and indirect costs Overall impact: High

5.8.1. Low-impact scenario

The Project still has one year of schedule contingency and has benefited from additional cost contingency through IDC savings and other unallocated budgets. Though it will be difficult, if the Start of River Diversion milestone in September 2019 can be achieved with minimal impact to the cost contingency, the Project would still have the potential to finish on time and on budget.

However, based on Deloitte's understanding of the ongoing MCW issues (e.g., claims, potential required acceleration on Left Bank tunnel work), achieving the Start of River Diversion milestone in 2019 would most likely result in additional cost pressures on the Project's budget and contingency in the order of an additional 0–10% of the FID budget. The existing project reserve may be sufficient to cover some cost overruns in this scenario.

5.8.2. Moderate-impact scenario

Even if the Project achieved the Start of River Diversion milestone in 2019, other cost pressures such as higher-than-estimated costs in major contracts yet to be awarded may push the cost further to require an additional 10–20% of the FID budget. This would require funding in excess of the \$440 million project reserve.

Should the Project miss the Start of River Diversion in 2019, the existing one year of contingency would be lost, thus eliminating the Project's ability to mitigate any major schedule risks that may occur after river diversion. Moreover, the Project would use its contingency and project reserve to cover additional IDC, indirect costs and likely contractor "extended duration" delay claims. The Project would likely incur additional

costs, in the order of \$382 million⁶³, excluding inflation impacts and potential delay claims. Overall, the Project would likely require an additional 10–20% of the FID budget, which would also exceed the \$440 million in project reserve.

5.8.3. High-impact scenario

In the event that the Project misses the Start of River Diversion milestone in 2019 and continues to experience delays in MCW or other contracts, schedule slippage may exceed one year. In this scenario, the Project would likely require at least \$1 billion in additional funds in excess of the \$440 million in project reserve.

The scenarios are summarized in Table 20.

Table 20: Possible impact scenarios (nominal \$ million)

Impact	Schedule Delay to FID Nov 2024 ISD	Cost Impa Budget (act to FID \$8.335B)	F	inal Cost Comp	-	Spent Res	Proje erve		Addition quired o Res	ver	Project
		low	high		low	high	low	-	nigh	 low		high
Low	On time	0%	10%	\$	8,335	\$ 9,169	\$ -	\$	440	\$ -	\$	394
Moderate	One year delay	10%	20%	\$	9,169	\$ 10,002	\$ 440	\$	440	\$ 394	\$	1,227
High	More than 1 year delay	20%	50%	\$	10,002	\$ 12,503	\$ 440	\$	440	\$ 1,227	\$	3,728

The likelihood of these scenarios will depend on the mitigations that the Project takes to address the risk to the Start of River Diversion, and the risks of potential further cost increases in MCW or uncertainties of major contracts yet to be awarded.

The Site C Project faces major risks including performance issues of the contractor(s), unforeseen geotechnical conditions, and cost risks associated with major contracts that have not been awarded yet. These risks could impact the cost and schedule performance of the Project. Given that the Site C Project is in the early stages of construction with over seven years to go before the ISD, these major risks could be mitigated to a certain extent through a variety of methods including, but not limited to design and schedule innovation and improving relationships with contractors. However, the actual potential impact on the Project's cost and schedule is unpredictable at this stage with the information that Deloitte has reviewed.

⁶³ According to BC Hydro response to Deloitte question no. 26, every month delay on the first unit in-service date will result in \$21 million of additional IDC costs. This equates to \$252 million in additional IDC costs should the schedule be extended for 12 months.

From Appendix K of the business case for FID, the original budget considering a 2023 completion date increased by \$175 million to extend construction to 2024. The \$175 million is composed of \$65 million for increased indirects and \$110 million for IDC and inflation. Based on Deloitte's assessment of the Project's current budget increases for PM & Services, Engineering and Construction Management (almost doubling according to Table 11), it was assessed that an additional year of construction would likely cost \$130 million in indirects.

Thus an additional year of construction would likely cost \$252 million in IDC plus \$130 million for additional indirects, thus totalling \$382 million.

6 Suspension scenario

6.1 Introduction

A decision to suspend the Project (the Suspension Scenario) would have cost implications. Deloitte estimates the total incremental cost⁶⁴ of the Suspension Scenario to be approximately \$1.4 billion⁶⁵, excluding inflation impacts and incremental interest costs. The rest of this section sets forth our assumptions and methodology used for estimating the cost impact.

The ongoing construction of the Site C Project is being executed with a defined scope of work, budget, schedule, permitting basis, design, and contracting strategy. The objective of the Project is clearly defined for completion of a hydropower generating station. The budget and schedule are defined according to the scope of work and the time for completion. Similarly, the permitting, design, and contracting strategy have been implemented to assist in the delivery the Project scope with the goal of falling within the schedule and budget.

A Suspension Scenario would trigger two sets of activities for the Project team:

- · Management of existing contracts and commitments
- Creation of a new project (the Suspension Project)

Regarding the existing contracts and commitments, the Project team would need to decide whether (i) to retain the existing contractors in anticipation of a future restart, or (ii) to terminate contracts and protect the site for future use. In practice, the proposed seven years' suspension of the current Site C Project to restart in 2025 is long enough to warrant termination of the contracts. The commercial conditions in the contracts would change over that period and any restart would be based on costs and conditions available at the future decision date.

The close-out activities would generally be performed in accordance with the conditions for the various contracts that are active at this time. The main contractors would be expected to complete elements of their scope of work selected for continuation to a practical stage of completion. In many cases, this work would be selected to support the scope for site preservation. The contracts would then be terminated and the cost consequences of the termination would be determined. The construction contractors would demobilize from the site. The engineering contractors would finalize work in progress and archive project documents for later retrieval or as the formal project record.

The purpose of creating the new Suspension Project is that it would be significantly different from the current Site C Project. The scope of the works required would be extensive enough to require independent project planning for control of budget and schedule. The objective of the Suspension Project would be to implement site-preservation and maintenance activities. The Suspension Project would be implemented according to a design defined to meet the objective of the new scope of work. A project setup phase would be required to establish the design and to proceed with any associated environmental appraisal, permitting, and planning for construction and contracting. This Suspension Project would be executed with its own scope, budget, and execution schedule.

⁶⁴ Our estimate includes cost to suspend the Project between 2018 and 2025 only. It does not include potential additional costs (due to design changes, market conditions etc.) which BC Hydro may incur after resuming construction in 2025.

⁶⁵ This is a Class 5 Estimate with an expected accuracy range of -35% and +100% as per the AACE standards.

The cancellation and close-out of existing contracts and commitments could proceed in parallel with the planning and scoping of the new Suspension Project.

The key milestones and activities under a Suspension Scenario would comprise the following:

· Issue suspension notice and demobilize from the site

- Suspension notice is issued on December 31, 2017
- Design engineering and site construction start demobilization

· Preserve and safeguard the site

- Existing site constructors complete specific scope of work deemed as required for the suspension scope
- Design engineering is re-engaged to complete the design scope for suspension of the site
- Construction team completes scope to preserve and safeguard the site

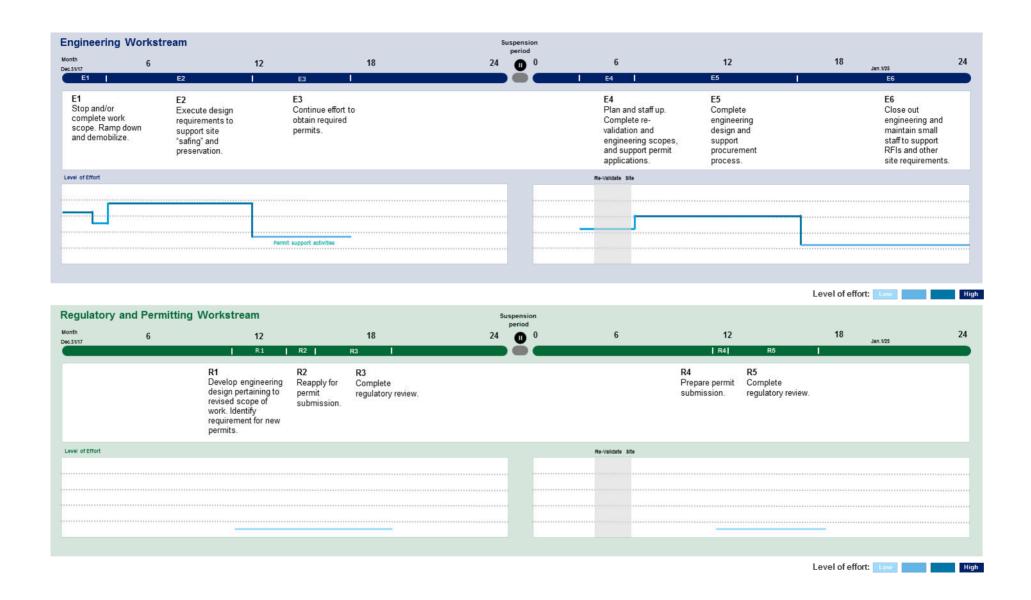
· Maintain the site in suspension

 Core site team maintains the site in a state of suspension until December 31, 2024; this includes, at a minimum, activities such as site monitoring and maintenance, site security, environmental and regulatory monitoring, and reporting

• Remobilize to recommence construction in 2025

- Activities to restart the Project begin, which include, at a minimum, re-engagement of design engineering, contractors, and constructors plus the re-validation of the site to provide a baseline for the "new" project scope
- Teams remobilize to site to support a construction start date of January 1, 2025

Figure 7 illustrates the timeline, sequence of activities, and level of effort required for various activities under a Suspension Scenario.



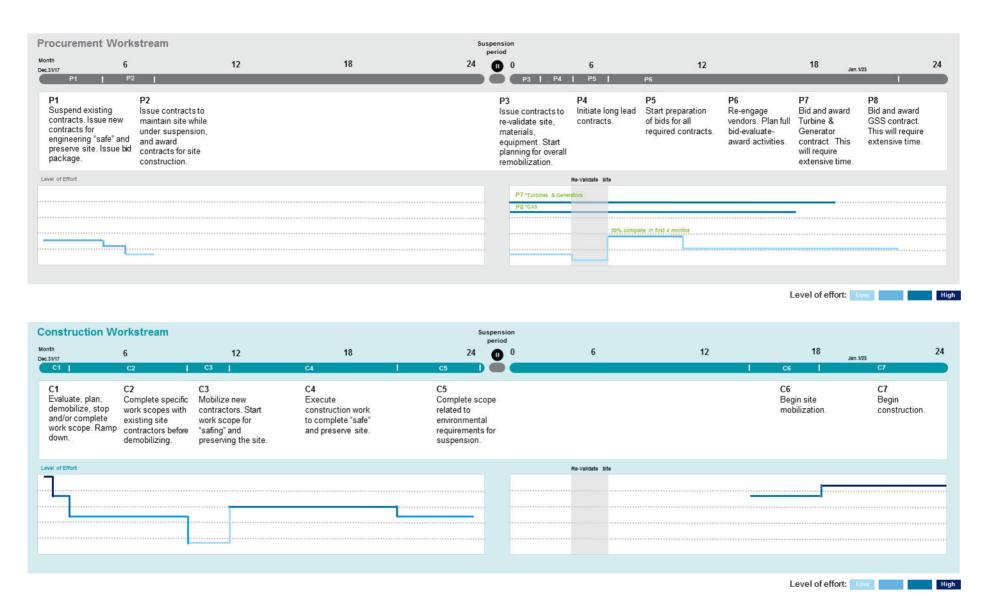


Figure 7 – Timeline, sequence of activities, and level of effort – Suspension Scenario

6.2 Suspend the Site C Project

The following sections discuss the assumed impacts of suspending the Site C Project effective December 31, 2017, while maintaining the option to resume construction until January 1, 2025. Our analysis includes the impacts related to suspending or cancelling all existing contracts and FN-related agreements, demobilizing, performing engineering and construction of the Suspension Project, maintaining the site in a state of suspension until December 31, 2024, and remobilizing to the site to begin construction activities on January 1, 2025.

6.2.1. Management of existing contracts and commitments

Currently there is a total commitment of approximately \$4.5 billion by BC Hydro, including the actual cost incurred to date, remaining commitments on awarded contracts, and the future value of post-implementation payments. It is assumed that additional costs will be incurred for the period from June 30, 2017, to the date when the decision is made on the future of the Project, envisaged to be December 31, 2017. Based on the current burn rate and the planned schedule of the Project, we estimate that BC Hydro would incur approximately an additional \$300 million in costs before December 31, 2017. Furthermore, contract awards currently on hold including GSS, Highway 29, and Transmission would not be awarded during this period.

The contracts reviewed have termination and suspension clauses. In general, these clauses require BC Hydro to pay reasonable and substantiated third-party cancellation charges, contractors' reasonable and substantiated direct costs for demobilization from the contractors' work areas, plus a markup on such direct costs. However, in our experience contractors would likely make claims against BC Hydro which could include, but may not be limited to:

- · Budgeted profit
- · Lack of contribution to home-office overhead
- Staff kept on payroll pending replacement work
- Potential savings that did not materialize (e.g., on equipment purchases or on subcontractors' pricing)
- Currency exchange profits that could have been realized
- Loss of potential savings from escalation (long-term projects have built in escalation in their budgets, and to the extent actual inflation is less than what is carried in the bid, contractors could benefit)
- Unrecovered overhead distributed on Bill of Quantity (BOQ) items that were not executed (reduced recovery)
- Unbalanced BOQ resulting in under-recovery of certain items that could not be performed
- Other claims that resulted during the pre-cancellation phase

We have made assumptions as to the value of the potential claims in our analysis.

Three main contracts make up approximately 61% of the committed value:

- The Main Civil Works (PRHP)
- The Turbines and Generators (Voith)
- Site C Project worker accommodation (ATCO)

The cost impact due to contract cancellations (excluding demobilization costs) in the event of a Suspension Scenario is estimated to be \$331 million.

6.2.1.1 Main Civil Works

PRHP has completed planning and project setup activities for the MCW contract. The major elements of the site production equipment such as aggregate processing and concrete production are now in place and operating. Work done to date has largely been related to opening of the site, developing production facilities, and bulk excavations. The permanent works at the site can be expected to accelerate during the coming

months, barring any disruptions within the contractor consortium. Observations at the site suggest that the contractor should be in a position to increase production rates for key critical-path activities such as the right abutment works, where much of the excavations are well advanced, and for the diversion tunnels.

The nature of the MCW contract precludes any significant value in retention of the contractor under a Suspension Scenario. There appears to be no inherent intellectual property value or other assets that could not be replaced with a similar civil works contractor. We consider the suspension period to be too long to make it desirable to prolong the contract and keep the contractor's equipment on site. In our analysis for the Suspension Scenario, we have assumed that the Project would proceed with the option to terminate the MCW contract.

Termination of the MCW contract would involve an instruction to safely stop work, consolidate/package work, demobilize, and execute the termination payment according to the contract terms. The contract would not provide residual or salvage value beyond a part of the permanent works completed. Any expenditure to date for project planning, submittals, work planning, etc. would be unrecoverable sunk costs. PRHP would likely make some claims against BC Hydro as well.

Note that a decision to suspend the Project would trigger a program of work to stabilize the site for future completion. The scope of work for the stabilization would be defined to preserve the value of the work completed to date. Some elements of the existing MCW contract would continue provided that the work is within the original scope of work and subject to the negotiation between BC Hydro and PRHP. It is anticipated that post-execution of stabilization work, the contract would then be terminated.

The total cost to terminate the MCW contract could include the following as stipulated in the contract:

- All reasonable and substantiated third-party cancellation charges
- The contractor's reasonable and substantiated direct costs for demobilization from the contractor's work areas, plus a markup on such direct costs
- Costs related to potential claims⁶⁶

In addition to the above, BC Hydro would incur costs associated with PRHP's demobilization activities as discussed in Section 6.2.3.

6.2.1.2 Turbines and Generators

The TG contract is for the design, procurement, manufacturing, and installation of generating equipment, including turbines, generators, and associated systems. The contract was awarded to Voith in March 2016.

Voith appears to have completed project-planning activities, which include various project control document submittals required under the contract. Engineering for the equipment packages included in the scope of work is the responsibility of Voith under the design-build contract. Engineering is separated into three phases: System Engineering (SE), Component Engineering (CE), and Detailed Design (DD). Voith is scheduled to substantially complete the CE activities within 2017 for the major components included in the scope of work. CE activities for some minor systems continue into 2018 but they are not required until late in the construction program.

DD activities begin after the CE activities and are scheduled according to the timing required for the start of manufacturing to meet the overall schedule milestones. DD activities in progress during 2017 include the components of the turbines that are required early in the construction program, including embedded parts such as anchorages, draft tubes, draft tube cones, and spiral cases. Components with a long lead time are

⁶⁶ The On time/on budget section addresses some of the potential claims associated with the MCW contract.

also in the DD phase during 2017, including turbine runner, distributor, stator, and rotor. A significant part of the overall DD activity will be under way through 2017 and into 2018.

Voith has completed a manufacturing facility that will be used for assembly of systems at the site. The facility is reported to be operational and will be used for final assembly of the draft tube elbows, spiral cases, and other components. Site warehouses for storage of equipment prior to installation are not yet in place and would be expected to be completed before the deliveries of equipment that must be protected from weather conditions.

Procurement and manufacturing activities have begun for items required early in the construction program. Manufacturing for other elements is scheduled to begin during the latter part of 2017 and 2018. Purchasing of materials and internal procurement arrangements began during 2017. However, the delivery of materials is not scheduled until the beginning of the related manufacturing tasks.

Although there is only limited manufacturing in progress now, the level of activity is scheduled to increase over the last few months of 2017 and the early part of 2018 with the start of major elements of the turbines and generators. The startup of the manufacturing tasks is tied to the time required for completion before delivery to site to meet the overall schedule.

For our analysis, we have assumed that the Suspension Scenario would warrant the termination of the TG contract, as retaining the TG contract would be subject to future negotiations between BC Hydro and Voith to establish a new contract price, which would be difficult to benchmark against the market pricing at the restart date. We understand that BC Hydro and Voith have a longstanding relationship, and we anticipate that this termination would be relatively amicable.

Suspension without retaining the existing TG contractor would be executed in a manner similar to termination. Hence, we assume that the decision by the Project team to stop work would trigger the termination clause of the TG contract. The outcome of this decision would include an instruction to safely stop work, consolidate/package work, demobilize, and execute the termination payment according to the contract terms. It is important to note that except for the site manufacturing facility, the contract would not provide residual or salvage value beyond what would be agreed on as part of a settlement with the contractor. Any expenditure for project planning, component design, and early-stage manufacturing and procurement would be unrecoverable sunk costs.

The total cost to terminate the TG contract could include the following as stipulated in the contract:

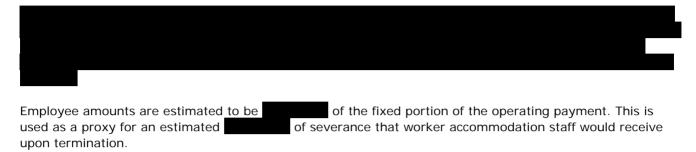
- All third-party cancellation charges
- · Costs on the account of overhead and profit, estimated as a markup on direct costs
- Potential costs related to claims

In addition to the above, BC Hydro will incur costs associated with Voith's demobilization activities as discussed in Section 6.2.3.

6.2.1.3 Worker Accommodation

The WA contract includes the design, construction, partial financing, operation, and maintenance of a temporary worker accommodation camp at the Site C dam site. The camp can house up to 1,600 people. ATCO completed the construction of the camp in October 2016, and is now operating and maintaining the camp.

There are no provisions in the contract for a temporary suspension of the contract obligations. We envision that suspension would be executed in a manner similar to termination. Hence, if the Project suspends the WA contract for convenience, the resulting payment would be determined according to the termination clause stipulated in the contract.



Contract breakage fees are based on lost future profit and the termination amount would be based on a set factor as per the contract. Note that the final amount would be subject to a negotiation and any current performance deductions at the termination date would be set off against this payment.

A Suspension Scenario would warrant ramping down operation of the camp over a two-year period, during which the camp would accommodate workers for the remedial efforts to safeguard and preserve site. Thereafter, the camp would be placed into care and maintenance until construction restarted, assumed to be January 1, 2025. Care and maintenance activities for the camp are assumed to be primarily for mechanical and cleaning services. It is assumed that the Project team would engage a new contractor to operate and maintain the facility according to the revised scope of work after terminating the agreement with ATCO. The costs related to these operation and maintenance activities would be additional costs to BC Hydro in the event of suspension of the Site C Project.

Furthermore, as per the WA contract, ATCO is deemed responsible for decommissioning the facility at the completion of the Site C Project. In a Suspension Scenario, ATCO would no longer be around to complete this work so it would fall to BC Hydro to decommission the facility.

6.2.1.4 Other contracts

All other contracts with the exception of the Security Guard Services contract will be executed in a manner similar to termination in the event of a Suspension Scenario. The Security Guard Services contract is envisaged to be amended for extension of services up to the start date of construction, January 1, 2025.

The cost to terminate the remaining contracts active at time of the suspension/termination decision (December 31, 2017) is included in our estimate in Section 6.5. Contractual obligations, payments, and potential claims as per corresponding agreements have been taken into account in the derivation of the suspension cost.

6.2.2. First Nations and Community Benefits Agreements and archeological impacts

BC Hydro and the Province have entered into numerous agreements with First Nations (FN Agreements) and local municipal governments (Community Benefits Agreements or CB Agreements) to accommodate residual effects of the Site C Project that cannot be mitigated. The purpose of this section is to review the potential incremental financial costs to BC Hydro or the Province that would be incurred through these FN Agreements and CB Agreements by a long-term suspension of the Site C Project. We have estimated the potential cost impact of cancelling FN Agreements and CB Agreements and implementing the Heritage Resources Management Plan. The actual cost impact may vary as it would be subject to the negotiation between BC Hydro and the impacted FNs.

There are five types of FN Agreements: Impact and Benefits Agreements (IBAs), Project Agreements (PAs), Contracting Agreements (CAs), Consultation and Capacity Funding Agreements (CCFAs), and Tripartite Land Agreements (TLAs). Not all FNs signed all types of agreements. Also, some impacted FNs have not signed agreements.

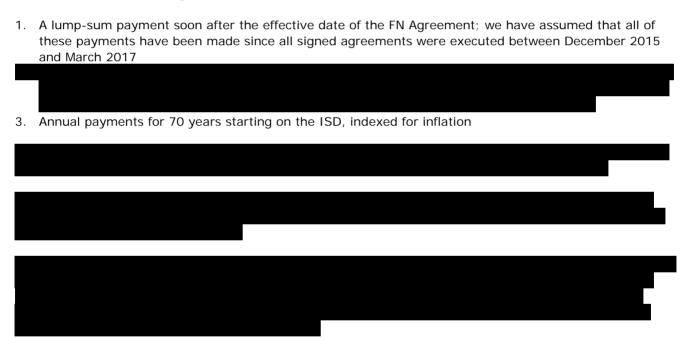
General assumptions and limitations related to our review of FN Agreements are included in Appendix E.

6.2.2.1 Impact and Benefits Agreements and Project Agreements

The IBAs and PAs set out financial compensation, and reference the CAs and TLAs for other benefits. The financial contributions are to be used at the discretion of each FN to address the Project's impacts.

The stated purposes of the IBAs and PAs are to define the accommodation payments to be made to the FNs, to confirm that the FNs have been adequately consulted and accommodated, and to provide legal certainty for BC Hydro. The parties to each IBA and PA are the FN and BC Hydro.

Specified accommodation payments and amounts are different for each FN, but each FN is entitled to receive one or more of the following:



6.2.2.2 Consultation and Capacity Funding Agreements

CCFAs have been signed with the impacted FNs to support their ongoing participation in the consultation activities and approval processes related to or during construction.

The CCFAs are flexible in that the funding amounts can be renegotiated depending on the activities required by the FNs, and can be extended by agreement in writing. Ongoing and incremental consultation activities would be required under a Suspension Scenario to recognize the additional work to preserve the site during suspension and remobilize the Project when construction resumes.

We have estimated low and high incremental costs to extend the CCFA agreements during the suspension period, using the past expenditures and current budget estimates as guides.

6.2.2.3 Tripartite Land Agreements

The intention of the TLAs is to transfer Crown lands to the FNs and implement Land Management Measures to address the permanent loss of lands for traditional purposes resulting from the Project.

The specified purpose of the TLAs is to accommodate the fee simple transfer of a specified amount of Crown land to each FN, and to allow for certain Land Management Measures to be implemented on other specified lands.

In the event that the Site C Project is suspended for an extended period of time, our review has concluded that there would be no financial penalties or additional costs incurred by BC Hydro or the Province under the TLAs. Upon recommencement of the Project, all outstanding obligations would resume without change.

6.2.2.4 Contracting Agreements

The purpose of the CAs is to provide employment, training, and contracting opportunities to the FNs and their members, provide contracting opportunities to FN businesses, and promote economic opportunities.

The agreements include commitments for the FN businesses (as defined and listed in each CA) to be provided with work opportunities on the Site C Project. These work opportunities may include Direct Award, Select Tender, and Set Aside work opportunities.

businesses may be awarded work in excess of the amounts specified in the CAs.



6.2.2.5 Heritage/Archaeology

The heritage resources (archaeology and paleontology) on the site are governed by the BC Heritage Conservation Act, and require permitting for all ground-disturbing activities.

Our discussions with BC Hydro indicated that there likely would be incremental costs to the Project for the implementation of the Heritage Resources Management Plan during the suspension. These costs would involve additional management of identified archaeological assets during the ramp down, and costs to extend the permits that are currently set to expire during the suspension period.

We have applied the Project's estimated incremental cost range for the heritage resource work under a Suspension Scenario.

6.2.2.6 Community Benefits Agreements

We have reviewed the agreements between BC Hydro and five municipal governments (CB Agreements). The general purpose of the CB Agreements is to set out the mitigation procedures that BC Hydro will implement to minimize the impacts on the communities of the Site C construction and operation, and to provide other community benefits to compensate for unmitigated impacts. Not all CB Agreements include provisions for suspension or termination of the Project.

We have estimated the incremental project cost under the Suspension Scenario based our review of the terms of the CB Agreements.

6.2.3. Demobilization

Upon suspension/termination of contractual agreements by BC Hydro, demobilization costs would be incurred as per the stipulated termination clauses of the corresponding contracts. Resulting activities would include, at a minimum, the removal of temporary facilities, equipment, and contractor staff. We have assumed that the worker accommodation would remain on site and functional to support personnel required to maintain the site during the suspension period.

Demobilization of the site would be a two-phase process. The first phase of demobilization would consist of contractors not needed to execute the suspension scope. The second phase would consist of contractors retained to complete specific construction scopes already permitted prior to suspension, in support of the site suspension scope.

The cost impact related to demobilization in the event of a Suspension Scenario is estimated to be \$50 million.

6.3 Preserve and maintain the site in a state of suspension up to 2024

After the formal issuance of project suspension, the site would need to be placed into a safe and preserved state. This would require significant effort by the planning, engineering, regulatory and permitting, and construction groups. After the design engineering and site construction have been completed, the site would then have to be monitored and maintained until the suspension is lifted.

This section defines the required engineering and environmental evaluation and design activities, followed by a description of the requirements needed to support a seven-year suspension of the current Site C Project.

6.3.1. Engineering, permitting, and procurement activities

The cost impact related to procurement, engineering, and permitting activities in the event of a Suspension Scenario is estimated to be \$25 million.

6.3.1.1 Engineering and design

As part of evaluating engineering and environmental requirements to support suspension, we followed a systematic process of identifying and evaluating the activities required to ensure the safe and preserved state of the site. This included geotechnical stability, managing potentially acid-generating (PAG) material, metal leaching, ongoing monitoring activities (including a broad spectrum of issues requiring monitoring, such as air, water, vegetation, and wildlife), and water and soil management. Evaluations were completed to identify the requirements for site re-validation after suspension to support a restart of the construction phase.

Factors requiring consideration before preservation activities can proceed include:

- Structural stability of the existing works: slopes, excavations, etc. need to be made stable and the risk associated with acid generation needs to be managed during suspension
- Impacts from weather and climate events, of which there are three to consider:
 - Suspension would increase the required life span of the temporary infrastructure such as temporary bridges and temporary cofferdams
 - Extending the life span of the Project may affect the climate change calculations (such as flood size and frequency) that the dam infrastructure was designed to withstand

- o The current dam design managed the environmental risk associated with PAG spoil materials by submersing them; by suspending construction for seven years, these PAG materials would not be isolated from oxygen, and metal leaching may result
- Adequacy of environmental controls: total suspended sediments are an ongoing challenge at the active construction site and measures would be required to control erosion during suspension
- Safety of the public and the remaining workforce: the site would be suspended as an Active Construction Site, and would need to be managed as such

Active work areas would have to be put into a safe condition, mitigating risk for the remaining site workers and the public, protecting the environment, and preserving the existing site conditions to enable restart post-suspension. In some cases, investigations would need to be completed to determine the best approach to making the site safe for an extended period of time (e.g., would PAG storage need to be isolated for the duration of suspension, or would managing infiltration and treating runoff be adequate?).

Broadly, these engineering tasks would include grading to increase stability and minimize erosion and sediment runoff, applying clay caps to better isolate the PAG material during suspension, and reinforcing temporary cofferdams. Existing conditions would need to be evaluated and remediation activities prioritized based on risks identified during the assessment, after which the required construction resources would be deployed.

6.3.1.2 Environmental assessment and permitting

Suspension of the Project would constitute a change in how the Project was certified. The scope of work for the Suspension Project should be discussed with the BC Environmental Assessment Office (EAO) and Canadian Environmental Assessment Agency (CEAA) as soon as it is defined. The Suspension Project may require an amendment to the environmental assessment approval, which was issued for the originally proposed Site C Project.

Upon notice of suspension, the primary actions for BC Hydro would be to discuss its plans with BC EAO and CEAA to come to a common understanding of the requirements for ongoing compliance reporting of regulatory conditions, and to develop detailed plans and schedules to re-initiate the construction process for the Suspension Project. Should BC Hydro choose to undertake design changes during the suspension that result in the Project becoming materially different from that defined in the existing certified project description report, then an amendment to the provincial and federal approvals for the Site C Hydro Project may also be required before the restart.

In general, permits are issued for specific conditions that are based on the detailed design of the Project. Modifying project activities of a material nature outside of those described in existing permits would generally be considered non-compliant with the permits. Major changes to projects in general typically require application for new permits. There is, however, a mechanism to seek an extension of permit terms for the existing project scope, although permit extensions tend to be limited in time and would be unlikely to span the duration of the seven-year project suspension.

It is expected that the existing permits for ongoing work would remain in effect until completion of those activities, where no substantial changes to the scope is required to safeguard and preserve the site. For activities that are outside of the scope and schedule of the existing permits, new permit applications would have to be submitted, and permits would need to be received prior to the commencement of those activities.

6.3.1.3 Procurement

In the Suspension Scenario, we anticipate that the Project's procurement team would be responsible for issuing a new bid and award process to contract with new vendors for engineering design and construction work to safeguard and preserve the site, and for the care and maintenance of the site, material, and equipment.

6.3.1.4 Monitoring and maintenance

Monitoring and maintenance of environmental controls would be required through all stages of the Project, including suspension, enabling project activities to be conducted in compliance with the applicable Acts, Regulations, and commitments to the BC EAO and CEA Agency. Monitors would inform the Project if site conditions differed materially from those anticipated under the permit applications and environmental assessments. Corrective actions and preventative measures would be implemented in response to non-conformance. Observations and data would be reported to the Project on a regular schedule.

There would be three entities responsible for monitoring: Contractors' environmental monitors (responsible for construction activities required to safeguard and preserve the site), compliance monitors for ongoing commitments to regulatory authorities, and the Independent Environmental Monitor.

Contractors would be responsible for construction activities, including construction activities to safeguard and preserve the site, and would have to appoint environmental monitors to monitor construction activities with respect to compliance with the applicable Environmental Protection Plans (EPPs), under the direction of a qualified environmental professional.

A Suspension Scenario would warrant retaining an Environmental Monitor (EM) to facilitate compliance with the applicable Acts, Regulations, and commitments to the BC EAO and CEA Agency, regardless of construction activities. The EM would also perform general maintenance of environmental controls (e.g., erosion prevention and sediment controls).

BC Hydro would also retain an Independent Environmental Monitor to conduct independent monitoring inspections, summarize the environmental reports prepared by BC Hydro and its contractors, and report monthly to BC Hydro, the Independent Engineer, the BC EAO, the CEA Agency, the Comptroller of Water Rights, and other regulatory agencies as directed from time to time by BC Hydro.

6.3.2. Site-preservation activities

A program of site construction work would be required for the Suspension Project. We have assumed certain status for the existing work based on the Project's and Contractors' schedules and observations made during our visits to the site. The scope of work for the Suspension Project construction is determined for each element of the Project WBS by assuming the work required on the main construction site at the various work areas in the dam site. The scope of work would include both the elements of the existing construction that would become the permanent project facilities as well as any temporary facilities required for construction that would normally be removed at the end of the construction period.

The cost impact related to site-preservation activities under a Suspension Scenario is estimated to be \$445 million.

The objectives of the site construction work for the Suspension Project would be:

- To ensure the safety of the site during the suspension period
- To mitigate environmental impacts of the site as modified by the construction to date
- To preserve elements of the temporary and permanent works that can be incorporated into the Project after remobilization; the goal of the preservation element is to minimize the cost of additional work that might be required if the Project were remobilized

The majority of the site construction work would be limited to the activities at the various locations where civil construction has been carried out to date. Some elements of the civil construction under the existing Project scope have been completed but a large part of the work is still in progress, especially at the main

dam site area. The following paragraphs outline the physical works that we assume to be required for a Suspension Scenario.

Preservation of the site mainly refers to the work completed to date at the main dam site, which is work being carried out largely by PRHP. The key elements completed to date include excavations on the Left Bank of the river, some of the cofferdams needed to dewater areas for construction, and excavation and placement of concrete at the location for the powerhouse and spillway on the Right Bank of the river.

Note that the existing site has geological risks due to the stability of the overburden and the nature of the bedrock. The original project design intended to manage these risks by sequencing the excavation and replacement of structures with concurrent observations of the existing ground. For the Suspension Project, the left and right abutment stabilization works would mitigate some of the geological risks that would otherwise allow the site conditions to deteriorate to the extent that a project restart would become costlier and involve more construction time.

The following paragraphs summarize the assumed physical site construction works for the Suspension Project, organized according to the elements of works in the Project WBS. Each section includes a table summarizing the work completed to date and additional work required under a Suspension Scenario. Any WBS items that relate to project management, termination or prolongation costs, or similar commercial matters are described in other sections.

6.3.2.1 Offsite road infrastructure - WBS: YM-80004.4.N

The Project includes offsite road works, mainly the Highway 29 realignment, MOTI access roads, other offsite roads, and the development of the Portage Mountain Quarry. The largest part of the work for the offsite infrastructure is associated with the Highway 29 relocation. The site construction works for the Suspension Project would be limited to those that have begun but have not yet been completed.

Current status	Suspension Project
The Highway 29 relocation is a major work package that is planned to be awarded for construction in 2017 with completion scheduled in 2021. The contract includes four main segments of highway construction, along with bridges and associated works. The construction is early in the work program with surveys, investigations, and some vegetation removal having been completed.	For the Suspension Project, the construction works would be limited to those that have begun but have not yet been completed. The road relocation would not be required and the existing contract would be terminated. The site construction works would comprise erosion protection along the excavated alignments, site contouring, and restoration of ground-cover vegetation for erosion control. Safety of the site would involve traffic signage and closure of potential public access points by fencing or other passive road closures.
The offsite roads were developed as part of the MCW contract to provide access to temporary works areas.	The site construction works would include erosion protection similar to the works assumed for Highway 29.
The Portage Mountain Quarry is intended to produce limestone rip rap (i.e., boulders) that will be used for erosion protection on the main dam. It is our understanding that the quarry has not previously been operated to produce rock and the contractor is now mobilizing to the site to start producing rip rap for the Project.	The construction works would comprise erosion control and vegetation of any areas of the quarry site that were disturbed.

6.3.2.2 Reservoir - WBS: YM-80004.4.A

The reservoir section of the WBS involves works related to the reservoir area and has sub-items for removal of trees from the reservoir, construction of debris booms, removal of utilities, and monitoring instrumentation in areas of concern for dam safety.

Several contracts have been let for reservoir clearing, which have involved temporary access and removal of standing trees. Other parts of the scope of work have not yet been contracted or started. The Suspension Project would require that any areas where soil was disturbed during the clearing works be remediated by erosion-control measures and ground-cover revegetation. The objective of the work would be to mitigate soil erosion that could affect the Peace River during the suspension period.

6.3.2.3 Site permanent infrastructure – WBS: YM-80004.4.B

The dam site clearing scope includes removal of vegetation from the dam site where the permanent works such as the dam, spillway, and powerhouse will be located. This part of the work was completed as part of the original EW contract.

Current status	Suspension Project
The dam site infrastructure includes roads on the main dam site that provide access to the main construction areas, to the Septimus Rail siding, and to temporary works areas. The various access roads involved excavation and filling of soil and rock to follow the selected profiles and cross sections. Some road cuts are through acid-generating rock zones. These roads are completed and are now being used for ongoing construction activities at the site.	This infrastructure would still be required if the Project were to remobilize, but erosion protection would be required during the suspension period. The objective would be to control the loss of soil because of surface runoff that could affect water quality in the Peace River. The erosion-control works would involve upgrading site drainage channels, hydro-seeding to establish some ground cover, and adding settlement ponds to intercept any sediment runoff. Ongoing maintenance and monitoring would be required for the settlement ponds and to repair any damage that may occur during the suspension periods as a result of rainfall.
	Where the rock was disturbed during excavations there can be leaching of acids during the deterioration process. Treatment of the exposed cuts would be part of the Suspension Project, and although the final methodology has not been selected, we have assumed soil cover or shotcrete lining.
The historical boreholes and investigation tunnels (adits) are accessible on the site and could represent a public safety hazard.	The Suspension Project would include closure of any historical investigation boreholes or tunnels. We have assumed permanent closure by backfilling.

6.3.2.4 Diversion works - WBS: YM-80004.4.C

The diversion works part of the WBS includes the activities necessary to divert the Peace River during the period when the main embankment dam is being constructed. The diversion involves two large-diameter tunnels through the left (north) abutment of the dam along with cofferdams to control water.

Current status	Suspension Project
The work at the site to date has been limited to construction of cofferdams for the tunnel inlet, the tunnel outlet, and the north end of the embankment dam. The cofferdams are earthfill structures placed on the river alluvium that have a cutoff wall extending through the embankment to the bedrock. The cofferdams have been protected using sandstone rip rap. However, sandstone rip rap is subject to deterioration that causes breakup of the stone sizes.	The value in place for the Project is that the cofferdams would be used for diversion tunnel excavation after remobilization. The objective of the site construction works in the diversion area would be to preserve the value of the work that has been completed to date for the cofferdams and to provide erosion control for the work areas. Protection of the cofferdams would include upgrading and reinforcing the existing rip rap erosion protection along the cofferdam slopes. This erosion protection would be required to prevent scouring of the embankment by the river flow. The existing rip rap is assumed to be reinforced by an additional layer of the sandstone, which should reduce the risk that the protection becomes ineffective within the suspension period.
The existing cofferdams at the site have been designed for a flood return period assuming the original construction period risk exposure.	The suspension period would increase the flood-risk exposure period by seven years. Accordingly, the probability that the cofferdams could be overtopped during the suspension and during the subsequent construction period would increase by roughly a factor of three. This risk would be mitigated by allowing the zones dewatered by the cofferdams to fill with water during the suspension period so that overtopping would be less likely.
Preparation of the rock faces for the diversion tunnel excavation is planned during the fall of 2017 but work has not yet started.	To the extent that any excavation is performed for the tunnel portals by the end of 2017, protection of the excavated surfaces would be required for the Suspension Project. We assume the scope to be application of shotcrete and rock bolting to the excavated bedrock face at the portal to preserve the existing conditions.
The existing schedule shows that excavation of the tunnels will be in progress in 2017.	Excavation would require permanent rock support and shotcrete lining to ensure the stability and safety of the tunnel section during suspension. A closure barricade would likely be required to prevent public access. The barricade could be a solid closure using steel plates and structural members.
A Relocated Surplus Excavated Material (RSEM) site is located at the diversion tunnel area. This site has been used for some spoil deposits during excavations.	The site would be landscaped to improve drainage and revegetated with ground cover for the suspension period. Revegetation would be accomplished by hydroseeding of the ground surface.
PRHP is scheduled to have started procurement for the hydro-mechanical equipment for the diversion tunnels in 2017. This equipment includes gates, stoplogs, hoists, and embedded parts. The manufacturing is not likely to be in progress but some material procurement may have taken place.	We do not anticipate any required construction works related to this equipment beyond those for termination of the existing contracts.

6.3.2.5 Dam - WBS: YM-80004.4.D

The WBS items for the dam include excavations and placement of embankment fill materials to form the dam. The permanent work started to date is limited to (i) placement of cofferdams along the Left and Right Banks of the river that isolate the dam foundation near the abutment ends and (ii) excavation for the Left Bank stabilization work.

Current status

The cofferdams are designed to dewater the foundation of the dam and the abutment areas. The work that will be performed in the cofferdam areas will be excavation to the final excavation level and placement of the various embankment materials. While the cofferdams have been completed, no significant dam construction work is anticipated during the remainder of 2017. Note that most of the fill materials would only be placed during summer weather conditions.

The main value in place for the Project is the excavations to date for the Left Bank stabilization and the cofferdams that will be used for the diversion tunnel and dam construction.

Suspension Project

The site construction work for the Suspension Project would be limited to preserving the cofferdam structures. The work assumed is similar to the scope identified for the inlet and outlet cofferdams and would comprise additional rip rap erosion protection and flooding of the area.

The other major work completed to date is the excavation of the Left Bank, which has been designed to stabilize the original ground slopes. The Left Bank above the bedrock level is overburden material that has experienced landslides and slope creep historically. The Project has been designed to stabilize this material by reducing the slope angle and providing drainage and erosion control. A significant amount of excavation has already been completed and parts of the slope are already in their final configuration. The slope is, therefore, inherently more stable now than it was at the start of construction. Note that similar slopes exist along the Peace River valley in the Project area.

Further large-scale excavation would not be necessary to enhance the overall slope stability as part of the suspension option. However, the excavated slope would need to be remediated by local landscaping to move any temporary slopes, surface water drainage channels for each excavation bench, and revegetation to establish ground cover that can reduce the risk of erosion damage.

We assume that the Project will focus on installing slope instrumentation, including piezometers, inclinometers, and survey monument, to allow the stability of the Left Bank excavation to be monitored during the suspension period. The instrumentation would confirm any movement of the slope material. We have included this element of the scope because of the occurrence of the tension crack during excavation earlier in 2017. The crack is understood to have occurred when the excavation exposed a historical landslide slip surface with low shear strength. Stabilization of the slope would be achieved by the designed reduction in slope angle combined with placement of engineered fill with higher shear strength in selected areas. This work would be carried out when the Project gets remobilized. Monitoring during the suspension period would ensure that a public safety risk does not arise before design and construction interventions can provide for the final long-term stable condition.

The dam works scope also includes RSEM Area L5, which is a large spoil area that has been prepared to deposit PAG rock from the site excavations. This area is located upstream from the proposed dam axis on the north shore of the river. As discussed separately, the spoil material in this area can leach acid when exposed to water and oxygen. As a hydropower project, the spoil areas would be

For the Suspension Project, site construction works would be required to encapsulate the spoil material to mitigate the acid generation. Options to be considered as part of the studies for the Suspension Project would range from full encapsulation using slurry cutoff walls and clay till capping to control of surface water runoff. The site construction works

Current status	Suspension Project
permanently under water where acid release would be inhibited.	would include the scope of work arising from the detailed design.
	Note that rip rap slope protection will be required along the Area L5 dike to prevent erosion damage during floods. The rip rap protection would be to the same design standard as adopted for protection of the cofferdams at the dam site.
The Garbage Creek is a small tributary immediately upstream from the dam axis. This tributary has been filled with spoil material as part of the RSEM L5 area. However, the natural runoff along the creek has been diverted through a temporary pipeline placed in the fill.	We assume that this temporary diversion arrangement would not be sufficient for the suspension period. We assume the site construction works to include construction of a storm-water diversion channel over the top of the Garbage Creek spoil deposit. The objective would be to isolate the storm-water flow from the acid-generating spoil in the main deposit and to prevent erosion that could cause spoil material to flow into the Peace River.

6.3.2.6 Approach and tailrace channel – WBS: YM-80004.4.F

The approach and tailrace channel work items are for excavation of the channels to and from the powerhouse and spillways.

Current status	Suspension Project
We understand that the work achieved to date is about 30% of the volume of excavation for the approach channel and about 40% of the bulk volume for the tailrace channel. None of the permanent works for lining or slope anchoring have been done. The value in place for the Project is the amount of excavation work completed that would be required if the Project were remobilized.	The main issue for this area is that the bedrock exposed would deteriorate and could become a source of acid drainage. The deterioration itself would not be a problem for remobilization of the Project in the future because the excavations have not been completed. However, we assume that the surface runoff from the slopes would be collected and treated to neutralize any acid release.
	The tailrace channel could be flooded to partially cover the exposed rock surface and limit the amount of deterioration.
	The overburden surfaces along the channel would be landscaped to remove locally steep zones and hydroseeded to re-establish a ground cover for erosion protection.

6.3.2.7 RCC buttress - WBS: YM-80004.4.P

The Project design includes a large concrete buttress structure at the right (south) end of the dam. The buttress is provided as a foundation for the powerhouse and spillway structures and as an abutment for the embankment dam fill. The buttress will be constructed using RCC.

We understand that the bedrock at the site is a low strength sedimentary formation that is susceptible to deterioration after exposure. In addition, the bedrock formation is forecast to rebound and expand when the overburden is removed. The purpose of the RCC buttress is to provide structural support for the other structures by directing loads into the foundation bedrock. Placement of the RCC is planned as soon as possible after the excavation of the bedrock to limit the deterioration of the surfaces and the amount of rebound that occurs.

The WBS elements include construction of the RCC buttress in three phases as well as the spoil areas required for disposal of the bedrock from the excavations. A drainage tunnel is planned to lower the piezometric pressures in the bedrock below the powerhouse and spillway.

Current Status	Sugnancian Drainat
Current Status	Suspension Project
The excavation of the powerhouse section of the foundation has been completed and RCC buttress placement is starting in this zone. The excavation for the spillway stilling basin has also been completed and a significant part of the associated RCC has been placed. The powerhouse and stilling basin RCC buttress	We assume that the objective of the site construction works in this area for the Suspension Project would be to preserve the integrity of the excavated surfaces in the bedrock. The RCC buttress placed to the end of 2017 would be of significant value for future remobilization of the Project.
is scheduled to be completed in November of 2017.	We assume the scope of work would include:
The drainage tunnel has started but work has been delayed. Excavation and RCC for the spillway and dam abutment would be carried out during 2018 and 2019.	 Remove locally oversteepened or overhanging rock in the spillway, stilling basin, dam abutment, and tailrace channel areas
	 Apply shotcrete to the finished rock surfaces adjacent to the powerhouse RCC buttress to mitigate possible deterioration
	 Install rock anchors where required to ensure stability of the existing temporary rock face
	 Complete the drainage tunnel, including permanent rock support, lining, and drain holes to reduce natural piezometric pressures and groundwater level at the rock face
	 Backfill the existing investigations adits by grouting
	 Flood the lower part of the excavation to submerge the rock in an effort to mitigate the rate of deterioration
The WBS for the dam works includes RSEM Area R5a and R5b, which are large spoil areas prepared to deposit passive acid-generating rock from the site excavations. This area is located upstream from the proposed dam axis on the south shore of the river.	For the Suspension Project, site construction works would be required to encapsulate the spoil material to mitigate the acid generation. Options to be considered as part of the studies for the Suspension Project would range from full encapsulation using slurry cutoff walls and clay till capping to control of surface water runoff. The site construction works would include the scope of work arising from the detailed design.
RSEM Area L6 is also included in this part of the WBS. This area is located downstream from the tailrace channel and has been filled with overburden material.	Remediation for the suspension period would include revegetation to create a ground cover that would reduce erosion risk.

6.3.2.8 Construction infrastructure facilities - WBS: YM-80004.4.M

Several key parts of the construction infrastructure should be retained as part of the project suspension. These works comprise value in place that could be of use during the construction after remobilization.

Current status	Suspension Project	
Construction infrastructure that has been put in place to date includes: • Worker Accommodation	We assume further site construction would not be required to preserve these facilities although operation and maintenance would be required.	
Temporary Buildings and InfrastructureSite Services	Site construction would be required in the contractor temporary facility areas that have been used for concrete batch plants, aggregate crushing plants, fuel	

Current status	Suspension Project	
Construction PowerConstruction Telecom	storage, and aggregate borrow areas. Site remediation work would be required to landscape these areas and to revegetate to create a ground cover for erosion control. Equipment foundations could remain in place in case they could be used following site remobilization.	
6.3.2.9 Stations – WBS YM-80004.4.S		
Current Status	Suspension Project	
The Site C Substation work to date has been excavations to extract material for use in dike fill and as aggregate for the crushing plants.	For the Suspension Project, we assume, site construction work required in this area would include landscaping, drainage control, sedimentation basins, and revegetation to create a ground cover.	

6.3.2.10 Other work elements

Other elements of the permanent works have not yet started at the site and related construction activities for the suspension period would not required. These include:

- Intake and Penstock YM-80004.4.E
- Spillway Facility YM-80004.4.G
- Powerhouse Structure YM-80004.4.H
- Generating Equipment YM-80004.4.Q
- Ancillary Equipment YM-80004.4.J
- Protection Control and Telecom Systems YM-80004.4.K

6.3.3. Care and maintenance of the site

Once construction work to preserve the site has been completed, the site would be placed into care and maintenance. Services would be required to ensure compliance with regulatory and BC Hydro standards. We assume that these services would be procured, through a bid-award process, and managed until the Project is restarted in January 1, 2025. The services required for care and maintenance would include, at a minimum, security, environmental monitoring, water management and treatment, erosion management, road clearing and maintenance, worker accommodation operation and maintenance, site supervision and ongoing reporting. When the site has been placed into a safe condition, a regular monitoring program would be implemented.

The cost impact related to care and maintenance of the site under a Suspension Scenario is estimated to be \$40 million.

6.4 Remobilizing the Site C Project

The remobilization of the site construction in 2025 would require a number of upfront activities involving personnel from the engineering, regulatory and permitting, and procurement groups, at a minimum. They would lead the planning and vendor engagement activities over an approximate two-year period prior to construction starting in the field. They would also be responsible for leading the site re-validation efforts.

The cost impact related to remobilizing to the site to begin construction in 2025 is estimated to be \$200 million.

6.4.1. Engineering, permitting, procurement, and site mobilization activities

The Suspension Project would need to recommence engineering and permitting activities well in advance of the commencement of construction activities in January 2025. The Suspension Project would also need to undertake procurement activities to remobilize the Site C Project. The procurement activities in advance of the commencement of construction would include, at a minimum:

- Closing out care and maintenance contracts
- Leading the bid-evaluate-award process for early work to prepare the site for construction
- Developing, bidding, and awarding new contracts to support engineering design and construction work
- Initiating the procurement process to support the long lead and critical-path items

We assume that procurement support would be required two years prior to construction start, primarily to ensure procurement of long-term lead items, turbines and generators in particular, to award a contract to complete the remaining MCW activities, and to award the GSS contract.

6.4.2. Re-validating site and materials/equipment

Remobilizing of the Site C Project would require issuance of design and construction contracts for the works, as described in the preceding sub-sections. These contracts for design engineering and construction would be based on the status of the site as of the start of the tender period when the Project remobilizes. There is no assurance that conditions at the site or for the interconnected power system would be identical to the conditions at the time when the Project was suspended. Accordingly, a re-validation exercise would be required, comprising a series of studies to re-establish the baseline conditions to be used for the design and construction following remobilization.

All of the following studies and activities, although they are described in detail and may appear to require extensive resources and time to complete, would only require re-validation against the original conditions and studies. Hence, we have assumed a re-validation duration of two months in the schedule.

The power system, including the transmission grid, power market, and main load centres, would continue to evolve during the suspension period. This may result in a new optimum for the Project connection, depending on the transmission system loading and market areas. Accordingly, a review of the original study would be required to confirm the connection point to the power grid system at the time of the future project on-line date. The study would consider the transmission grid load flow and the need for any transmission-line reinforcement, the location of the key load centres, especially if additional provincial or international interties are developed, and the nature of the market for the power and energy produced by the Project. The latter item could vary depending on whether the Project would serve primarily base load power and energy or would ultimately complement other energy sources, such as wind, solar, or other renewables, interties, or thermal energy.

The installed capacity of the Project might also be reconsidered at a future decision point based on the character of other generating sources available to the provincial power market at that time. The Site C Project as currently planned will generate a mix of power and energy similar to the upstream hydropower projects. However, the optimum mix may change in the future depending on other renewables, climate change sensitivity, or other factors that cannot be accurately predicted at this time.

The civil works contracts for the dam, powerhouse, spillway, and other associated works would need to be defined according to the baseline site conditions at the time of restart, thus key baseline conditions would need to be re-validated. While efforts would be made to preserve the status of the site as of the suspension date, we assume some modification would likely be needed. Accordingly, a series of studies would be required to remobilize the Project. These would include, but not be limited to:

- Detailed topographic surveys to measure the ground surfaces as of the remobilization date; this survey could be undertaken using aerial or satellite based methods, especially given the rapid advances in this area recently
- Bathymetric surveys by soundings or physical measurement to confirm ground levels below water surfaces; this would be especially important for the temporary construction bridge and along the slopes of the cofferdams, which would need to be incorporated in the new project construction work
- Geotechnical investigations to confirm the condition of the site after the suspension period; this work would be important given the likely deterioration of the excavated rock surfaces because of its inherent character, and would include a program of field investigations comprising boreholes and test pits along with associated laboratory studies
- Assessment of the condition of existing structures, which would include any completed dam construction works, the contractor's camp, construction bridge, access roads, water and power utilities, water and sewage treatment plants, and the various temporary buildings that were retained at the site

The above studies would be used to refine the scope of work for the various contracts required to complete the Project after remobilization. Information would be required as input to the tender process, and bidders would be given the opportunity to rehabilitate or to remove and replace existing facilities as needed to achieve the optimum pricing level for the new construction contract bids. The topographic information would be used to revise construction quantity estimates as of the remobilization date. Any changes to the condition of the structures or the characteristics of the bedrock foundations at the site would affect the design for the permanent works, especially the powerhouse and spillway structures.

The above program is indicative only and the work actually required would depend on the conditions at the time of the Project restart, and on the decision framework used to evaluate restart as one of the options available at the time. Additional planning studies, investigations, and design would be carried out immediately following any decision to remobilize the Project and would be required before issuing any construction tenders.

The cost impact related to re-validating the site prior to beginning construction in 2025 is estimated to be \$5 million.

6.5 Cost impact

The estimated cost impact of suspension, including the cost to suspend the Site C Project, the cost to maintain the Project in a state of suspension, and the cost to remobilize the Site C Project to begin construction in January 1, 2025, is summarized in Table 21.

Table 21: Summary of cost impact – Suspension Scenario

#	Suspension Scenario	Cost impact (\$ millions)
1	Cost to suspend the Site C Project	
	Contract cancellations	331
	FNs, community, and archeological impacts	Included above ⁶⁷
	Demobilization	50
2	Cost to maintain the Site C Project in a state of suspension	
	Engineering (site), permitting, and procurement	25
	Site-preservation activities	445
	Care and maintenance	40
3	Cost to remobilize the Site C Project to begin construction in 2025	
	 Engineering (design + site), permitting and procurement, and site mobilization 	195
	Re-validating site	5
	Total	1,091
	Contingency (30%)	327
	Grand total	1,418

Our estimate includes the following assumptions (further assumptions are included in Appendix E).

- Our estimate includes cost to suspend the Project between 2018 and 2025 only. It does not include
 potential additional costs (due to design changes, market conditions etc.) which BC Hydro may incur after
 resuming construction in 2025
- Our estimate does not include incremental interest costs in the event of a suspension
- Our estimate does not include inflation impacts of post-suspension costs to complete the Site C Project

 $^{^{67}}$ The actual cost impact may vary as it is subject to the negotiation between BC Hydro and the impacted FNs and communities.

7 Termination scenario

7.1 Introduction

An alternative to the Suspension Scenario would be to terminate the Project. A decision to terminate the Project (the Termination Scenario) would also have cost implications. Deloitte estimates the total incremental cost of the Termination Scenario to be approximately \$1.2 billion⁶⁸, excluding inflation impacts and interest costs. The rest of this section sets forth our assumptions and the methodology we used for estimating the cost impact.

A Termination Scenario would trigger two sets of activities for the Project team:

- · Management of existing contracts and commitments
- Creation of a new project (the Termination Project)

Regarding the existing contracts and commitments, we assume the close-out activities would be carried out generally in accordance with the conditions for the various contracts that are active at this time. The main contractors would be expected to complete elements of their scope of work relevant for site remediation. The contracts would then be terminated and the cost consequences for the termination would be determined. The engineering contractors would finalize work in progress and archive project documents as the formal project record.

The scope of the work required will be extensive enough to require independent project planning for control of budget and schedule and a Termination Project would be required. The objective of the Termination Project would be to return the site to natural conditions capable of supporting natural vegetation and wildlife. The Termination Project would be implemented according to a design defined to meet the objectives of the new scope of work. A project setup phase would be required to establish the design and to proceed with any associated environmental appraisal, permitting, and planning for construction and contracting. This Termination Project would be executed with its own scope, budget, and execution schedule.

The cancellation and close-out of existing contracts and commitments could proceed in parallel with the planning and scoping of the new Termination Project.

The key milestones and activities of the Termination Scenario would comprise the following:

· Issue termination notice and demobilize from the site

- Termination notice is issued on December 31, 2017
- Design engineering and site construction start demobilization

Return the site to the natural state

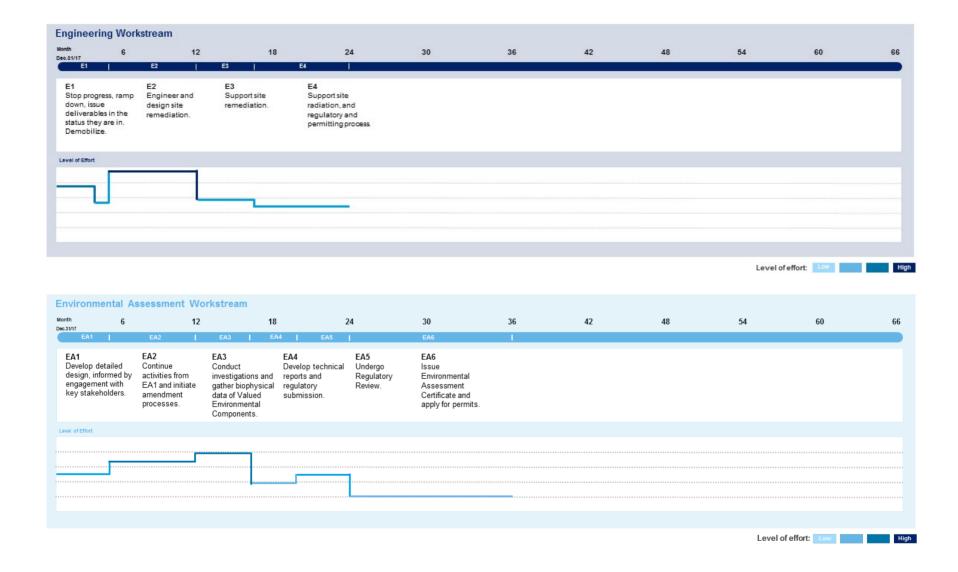
- Design engineering is engaged to complete the design scope to return the site to a natural state that supports long-term wildlife and vegetation
- Construction completes the scope and demobilizes from the site

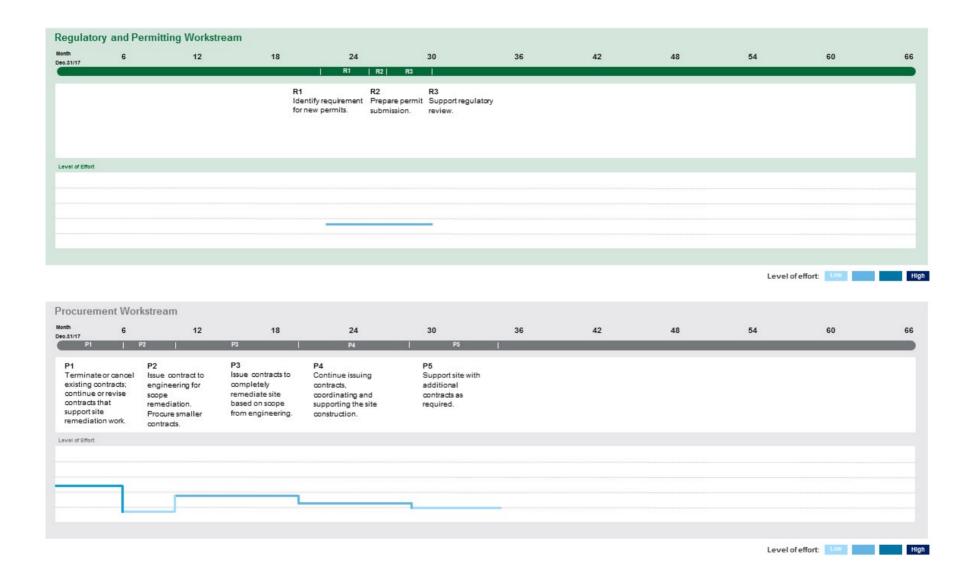
· Monitor and close out liabilities

⁶⁸ This is a Class 5 Estimate with an expected accuracy range of -35% and +100% as per the AACE standards.

 Monitors in place to monitor site: All measured and monitored parameters (water, air, soil, etc.) would have to meet strict levels without deviation for ten consecutive years before the monitoring team could be disbanded

Figure 8 illustrates the timeline, sequence of activities, and level of effort required for various activities under a Termination Scenario.





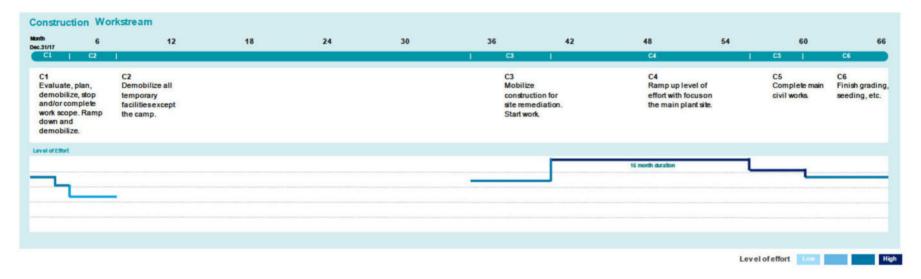


Figure 8 - Timeline, sequence of activities, and level of effort - Termination Scenario

7.2 Terminate the Site C Project

The following sections discuss the impact of terminating the Site C Project, effective January 1, 2018. Our analysis considers the impacts related to terminating all contracts and FN-related agreements, demobilization, and site remediation.

7.2.1. Termination of major contracts

As with the Suspension Scenario, the Termination Scenario would trigger the termination of all active contracts at the time of the terminate decision, December 31, 2017. Please see Section 6.2.1 for additional details.

The cost impact related to termination of contracts under a Termination Scenario is estimated to be \$320 million.

7.2.1.1 Main Civil Works

Refer to Section 6.2.1.1.

7.2.1.2 Turbines and Generators Refer to Section 6.2.1.2.

7.2.1.3 Worker Accommodation Refer to Section 6.2.1.3.

7.2.1.4 Other contracts Refer to Section 6.2.1.4.

7.2.2. First Nations and Community Benefits Agreements, and archeological impacts

The background related to different FN Agreements is outlined in Section 6.2.2.

Termination of the Site C Project would require remediation of the impacted site to some state that may not be exactly the same as the pre-

. However, the true extent of any

remaining long-term impacts would not be known until completion of the remediation plan, which may involve additional consultation and accommodation with impacted FNs.

In a Termination Scenario, two categories of new agreements may be required:

- Agreements with those FNs that have not yet signed agreements, to retroactively provide them with accommodation and compensation they would have been entitled to receive in accordance with their rights and commensurate with the benefits received by the FNs that have signed agreements
- New accommodation agreements with all impacted FNs to address any additional impacts arising from decommissioning and reclaiming the site

We have estimated the potential cost impact of terminating FN Agreements and CB Agreements, and implementation of Heritage Resources Management Plan. The actual cost impact may vary as it would be subject to the negotiation between BC Hydro and the impacted FNs.

7.2.2.1 Impact and Benefits Agreements and Project Agreements

All of the IBAs and PAs we reviewed

There are four FNs acknowledged to be impacted by the Site C Project that have not yet signed accommodation agreements: Prophet River First Nation, West Moberly First Nation, Blueberry River, and Horse Lake First Nation. In the scenario of Site C Project termination, we have assumed these FNs would receive accommodation and compensation payments commensurate with those FNs that have signed agreements. We have estimated low and high amounts of the future lump-sum payments that may be appropriate to the FNs that have not yet signed agreements, based on the payments already made to the signatory FNs, with consideration given to the reported original offers made to those FNs.

In a Termination Scenario, there may be further unmitigated impacts to FNs that persist during the reclamation work, and potentially for the long term, depending on the extent of reclamation relative to the site's original state. We have estimated low and high ends of additional accommodation payments for potential incremental impacts.

7.2.2.2 Consultation and Capacity Funding Agreements

As discussed previously, CCFAs have been signed with the impacted FNs to support their ongoing participation in the consultation activities and approval processes related to or during construction. These activities would be necessary during the remediation, to allow the FNs to participate in the remediation planning and implementation.

We have estimated low and high incremental costs to extend the CCFA agreements during the remediation period, using the past expenditures and current budget estimates as guides.

7.2.2.3 Tripartite Land Agreements

As noted previously, the purpose of the TLAs is to accommodate the fee simple transfer of a specified amount of Crown land to each FN, and to allow for certain Land Management Measures to be implemented on other specified lands. All of the TLAs we reviewed would allow BC Hydro to terminate all land transfers and implementation of Land Management Measures upon abandonment of the Site C Project, without payment of any penalties or other additional costs.

BC Hydro has informed us that no land transfers have been completed to date, and none are anticipated to be completed prior to termination in a Termination Scenario. We have assumed that termination of the Site C Project and subsequent remediation of the site would result in no permanent loss of lands for traditional purposes, so no land transfers would be required.



, there would still be considerable work to remediate the site that could be awarded to FN businesses and would count toward the original obligations.

7.2.2.5 Heritage/archaeology

Based on our discussions with BC Hydro, there would be costs to BC Hydro to manage the site remediation and close off the heritage resources management obligations. Most of these costs would be incurred upon completion of the Project as planned, but would of course occur sooner in the Termination Scenario.

We have applied BC Hydro's estimated cost range to complete the heritage resources work in a Termination Scenario.

7.2.2.6 Community Benefits Agreements

As noted in the Suspension Scenario, the general purpose of the CB Agreements is to set out the mitigation procedures that BC Hydro will implement to minimize the impacts on the communities of the Site C construction and operation, and to provide other community benefits to compensate for unmitigated impacts. Not all CB Agreements include provisions for the termination of the Project.

We have estimated the cost in the Termination Scenario based on our review of the terms of the CB Agreements.

7.2.3. Demobilization

As noted in the Suspension Scenario, upon termination of contractual agreements by BC Hydro, it is assumed that demobilization costs would be incurred as per the stipulated termination clauses of the corresponding contracts. Resulting activities would include, at a minimum, the removal of temporary facilities, equipment, and contractor staff. We have assumed that the WA would remain on site and functional to support personnel required for the Termination Project.

As in the case of the Suspension Scenario, demobilization of the site would be a two-phase process. The first phase of demobilization would consist of contractors not needed to execute the termination scope. The second phase would consist of contractors retained to complete specific construction scopes already permitted prior to termination, in support of the site termination scope.

The cost impact related to demobilization in the event of a Termination Scenario is estimated to be \$50 million.

7.3 Site remediation and reclamation

After the formal issuance of project termination, the site would need to be remediated and reclaimed to return the site to a natural state. We have assumed that there would be no reuse of the site for hydroelectric development, so efforts to preserve existing value would not be necessary. This would require significant effort by the planning, engineering, regulatory and permitting, and construction groups to prevent the release of hazardous materials, stabilize permanent slopes, prevent erosion, control drainage, and redevelop vegetation. After the engineering design and construction of the site for the Termination Project have been completed, the site would then have to be monitored and maintained to ensure all permit and regulatory requirements were met for a minimum of five consecutive years before monitoring of the site could be concluded.

7.3.1. Engineering, permitting, and procurement activities

The cost impact related to procurement, engineering, and permitting activities in the event of a Termination Scenario is estimated to be \$40 million.

7.3.1.1 Engineering and design

As part of evaluating engineering and environmental requirements to support the Termination Project, we followed a systematic process of identifying and evaluating the activities required to restore the site to a safe and natural state. This included evaluating geotechnical stability, facilitating geotechnical stability of

excavation faces, soil piles, etc., managing PAG material exposure in ground and in excavation spoils, and long-term monitoring activities (including a broad spectrum of issues requiring monitoring, such as air, water, vegetation, and wildlife).

Many of the stabilization design activities required as part of project suspension would also be required as part of project termination. Additional factors considered in determining the required degree of site remediation include:

- Time to prepare designs of the ultimate site restoration
- Time to prepare, draft, and submit permit documentation
- Permit processing and approval times
- · Contracting strategy and awards
- Mobilization

Engineering and design work to date has focused on the completed facility and has not considered the measures necessary to return the site to a condition comparable to pre-construction conditions. The design for site closure in the Termination Scenario would need to be developed to support the permit application process. The final design would depend on permit and environmental assessment conditions. Potential factors to be considered would include interim safety and stability issues necessary during the period between cancellations and permit approvals.

The conditions for termination would require evaluation and design to select the most appropriate long-term conditions for the site. In some cases, these long-term conditions would be different than the conditions of an operating dam. For example, PAG material containment, PAG material in the flood plain of the river, and leaving the backwater channel closed would need to be considered in the Termination Scenario. Given our understanding of the regulatory environment, it is possible that these conditions, while acceptable for an operating dam, may not be considered acceptable in a more natural environment, the target long-term conditions in the Termination Scenario.

Much of the Site C Project worksite has been disturbed. Site restoration for the Termination Scenario may involve the import of materials from quarries not yet fully established. Facilities are currently in place for the transport of these materials. However, quarry development, extraction, and subsequent pit closure would be required.

7.3.1.2 Environmental assessment and permitting

The Project area has already been altered in a material way, and thus efforts to reclaim the area would have the potential to interact with many of the components that were considered in the original regulatory applications. It is likely that the scope of the interaction would change relative to what was considered for the Project previously.

Changes to the Project, such as termination after construction has begun, would likely constitute a change in the Project as approved. Termination of the Project may lead to new effect pathways that were not considered during the previous environmental assessment. Such a change to the Project would, therefore, likely require new provincial and federal approvals.

To proceed with termination, the Project would need to be redefined upon issuance of termination. The Termination Project would require detailed design development, informed by engagement with stakeholders including nearby communities, FN groups, and regulatory agencies. Concurrent with design development, the approvals process would need to begin with the BC EAO and CEAA to confirm the scope of the application, as well as timelines and agencies to be involved.

In general, permits are issued for specific conditions that are based on the detailed design of the Project. Modifying project activities of a material nature outside of those described in existing permits would generally be non-compliant with the permits. There is no mechanism to amend existing permits, and thus major changes to projects would typically require application for new permits. Project termination would be considered to be one such major change.

Investigations of valued components defined in the Environmental Impact Statement (EIS) which are likely to interact with the Termination Project design would need to be conducted. These investigations would involve both collecting biophysical data as well as efforts to engage local stakeholders and communities, FN groups, and appropriate regulatory authorities. Gathered data and information would be disseminated by way of technical data reports, and would ultimately inform development of the amendment applications filed with the joint review panel. The scope of the review would be defined by the regulatory authorities, but would be expected to include meetings with regulatory agencies, working group meetings, open houses, and FN engagement activities, as well as responses to Information Requests from the working group and the public. Numerous permit applications would involve FN consultation efforts by agencies, and would thus extend timelines.

7.3.1.3 Procurement

In the Termination Scenario, we anticipate that BC Hydro's procurement team would facilitate the following activities:

- Close out all active contracts
- Manage the bid and award process for new contracts (design and construction) to support remedial work to restore the site to a natural state

7.3.1.4 Monitoring and maintenance

Monitoring and maintenance of environmental controls would be required to support safety and stability of the site for termination, enabling termination activities to be conducted in compliance with the applicable Acts, Regulations, and commitments to the BC EAO and CEA Agency. Monitors would inform BC Hydro if site conditions differed materially from those anticipated under the permit applications and environmental assessments. Corrective actions and preventative measures would be implemented in response to non-conformance. Observations and data would be reported to BC Hydro on a regular schedule. Monitoring and maintenance activities would need to continue after the completion of the site remediation activities as well. The scope and duration of any environmental monitoring would be determined as part of any amendments to the Environmental Assessment.

There would be three entities responsible for monitoring: Contractors' environmental monitors (responsible for construction activities required to safeguard and preserve the site), compliance monitors for ongoing commitments to regulatory authorities, and the Independent Environmental Monitor.

Contractors would be responsible for construction activities, including construction activities to safeguard and preserve the site, and would be required to appoint environmental monitors to monitor construction activities with respect to compliance with the applicable EPPs, under the direction of a qualified environmental professional.

A Termination Scenario would warrant retaining an EM to facilitate compliance with the applicable Acts, Regulations, and commitments to the BC EAO and CEAA, regardless of construction activities. The EM would also perform general maintenance of environmental controls (e.g., erosion prevention and sediment controls).

BC Hydro would also retain an Independent Environmental Monitor to conduct independent monitoring inspections, summarize the environmental reports prepared by BC Hydro and its contractors, and report

monthly to BC Hydro, the Independent Engineer, the BC EAO, the CEA Agency, the Comptroller of Water Rights, and other regulatory agencies as directed from time to time by BC Hydro.

7.3.2. Construction activities for site remediation and reclamation

A program of site construction work would be required to remediate the site to natural conditions in the Termination Scenario. We have assumed certain status of the existing works based on BC Hydro's and contractors' schedules and observations made during our visits to the site. The scope of work for the construction is determined for each element of the Project WBS by assuming the work required on the main construction site at the various work areas remote from the dam site. The scope of work would include changes to both the elements of the existing construction that would have become the permanent project facilities as well as any temporary facilities that were required for construction but would normally be removed at the end of the construction period.

The cost impact related to construction activities for site remediation under a Termination Scenario is estimated to be \$495 million.

The objectives of the site construction work for termination would be:

- To ensure the long-term safety of the site
- · To mitigate environmental impacts on the site caused by the construction to date
- To prevent future impacts to the river environment caused by the work completed to date
- To return the site to a natural state that will facilitate vegetation growth and support local wildlife

The majority of the site construction work for the Termination Scenario would be limited to the activities at the various sites where civil construction has been carried out to date. Some elements of the civil construction have been completed but a large part of the work is still in progress, especially at the main dam site area. The key elements completed to date include excavations on the Left Bank of the river, some of the cofferdams needed to dewater areas for construction, and excavation and placement of concrete at the location for the powerhouse and spillway on the Right Bank of the river.

Note that the existing site has geological risks due to the stability of the overburden and the nature of the bedrock. These conditions would be of lesser concern in the Termination Scenario, and the site construction work would focus on mitigating potential environmental impacts at the site.

The following sections summarize the assumed physical site construction works for the Termination Project, organized according to the elements of works in the Project WBS. Each section includes a table summarizing the work completed to date and additional work required under a Termination Scenario.

7.3.2.1 Offsite road infrastructure – WBS: YM-80004.4.N

The Project includes offsite road works including Highway 29 relocation, MOTI access roads, other offsite roads, and development of the Portage Mountain Quarry. We have assumed the site construction works for the Termination Project would be limited to the works that have commenced but have not yet been completed.

Current status	Termination Project
The Highway 29 relocation is a major work package that is planned to be awarded for construction in 2017 with completion scheduled in 2021. The contract	Highway 29 relocation would not be required in the Termination Project, and the existing contract would be terminated.
includes four main work segments of highway construction along with bridges and associated works. The construction is early in the work program with	Any clearing should be remediated by revegetation and tree planting.

Current status	Termination Project
surveys, investigations, and some vegetation removal having been completed.	
The offsite roads have been developed as part of the MCW contract to provide access to temporary works areas.	The road surfaces would be plowed to break up the gravel wearing course and covered with topsoil. The site construction works would include erosion protection and tree planting similar to the works assumed for Highway 29.
	The site construction works after termination would comprise erosion protection along the excavated alignments, site contouring, restoration of ground-cover vegetation for erosion control, and tree planting. Safety of the site would involve traffic signage and closure of potential public access points by fencing or other passive road closures until tree cover is reestablished.
The Portage Mountain Quarry is intended to produce limestone rip rap (i.e., boulders) that will be used for erosion protection on the main dam. We understand that the quarry has not yet been operated to produce rock and the contractor is now mobilizing to the site to produce rip rap for the Project.	The quarry would be required to produce limestone rip rap for the Termination Project. Rip rap would be extracted as required and the quarry returned to a natural state.
	The site construction works would comprise erosion control and revegetation of any areas of the quarry site that were disturbed.

7.3.2.2 Reservoir - WBS: YM-80004.4.A

The reservoir section involves works related to the reservoir area and has sub-items for removal of trees from the reservoir, debris booms, removal of utilities, and monitoring instrumentation in areas of concern for dam safety.

Current status	Termination Project
Several contracts have been let for reservoir clearing, which have involved temporary access and removal of standing trees. Other parts of the scope of work have not yet been contracted.	The Termination Project would require that any areas where soil was disturbed during the clearing works be remediated by erosion-control measures and ground-cover revegetation.
	Tree planting would be required to re-establish forest cover similar to the trees cleared. The objective of the work would be to mitigate any possible soil erosion that could affect the Peace River and to create a natural habitat to replace the loss caused by the Project.

7.3.2.3 Site permanent infrastructure – WBS: YM-80004.4.B

Site Permanent Infrastructure includes work for the preparation of the dam site, including cleaning and road infrastructure. The dam site clearing of the current Site C Project includes removal of vegetation from the dam site where the permanent works such as the dam, spillways, and powerhouse will be located.

Current status	Termination Project
This part of the work was completed as part of the original EW Contract.	The site roads infrastructure would be removed as part of the Termination Project. The road cross section would be plowed to break up the gravel wearing course

Current status	Termination Project
The dam site infrastructure includes access roads on the main dam site that provide access to the main construction areas, to the Septimus Rail siding, and to temporary works areas. The various access roads involved excavation and filling of soil and rock to follow the selected profiles and cross sections. Some road cuts are through acid-generating rock zones. These roads are completed and are now being used for ongoing construction activities at the site.	and revegetated. Gravel used to prepare the sub-base and base for the roads could be excavated as needed to obtain fill material for other site remediation activities. The objective would be to provide a landscaped ground surface that could sustain vegetation similar to the natural habitat along the roads. The erosion-control work would involve upgrading site drainage channels, hydro-seeding to establish some ground cover, and adding settlement ponds to intercept any sediment runoff. Ongoing maintenance and monitoring would be required for the settlement ponds and to repair any damage that occurred before the vegetation was fully established.
	Where the rock was disturbed during excavations there can be production of acids during the deterioration process. Treatment of the exposed cuts would be part of the Termination Project, and although the final methodology has not been selected, we have assumed the exposed surfaces would be treated by placement of till backfill to bury the rock exposures and recover the natural level of protection.
The historical boreholes and investigation tunnels (adits) are accessible on the site and could represent a public safety hazard.	The Termination Project would include closure of any historical investigation boreholes or tunnels. We have assumed permanent closure by backfilling and

7.3.2.4 Diversion works - WBS: YM-80004.4.C

The diversion works scope includes activities necessary to divert the Peace River during the period when the main embankment dam is being constructed. The diversion involves two large-diameter tunnels through the left (north) abutment of the dam along with cofferdams to control water. For the Termination Project, the objective in the area would be to remove the cofferdam structures and re-establish the natural river flow through the site.

grouting.

Current status	Termination Project
The work at the site to date has been limited to construction of cofferdams for the tunnel inlet, the tunnel outlet, and the north end of the embankment dam. The cofferdams are earthfill structures placed on the river alluvium that have a cutoff wall extending through the embankment to the bedrock.	Cofferdam removal would involve excavation of the embankments and placement of the fill material in locations outside of the natural river channel. Part of the fill might be used to backfill along the base of the bedrock cliff along the site with the remainder being used to fill road cross sections.
Preparation of the rock faces for the diversion tunnel excavation is planned for the fall of 2017 but work has not yet started.	To the extent that any excavation is performed for the tunnel portals by the end of 2017, the tunnels would be backfilled with rock and concrete to re-establish the original cliff face. The portal area would be backfilled to approximate the original ground surface using material excavated from the cofferdams.
An RSEM site is located at the diversion tunnel area. This site has been used for some spoil deposits during excavations.	The site would be landscaped to improve drainage and revegetated with ground cover. Revegetation can be accomplished by hydro-seeding of the ground surface and tree planting as part of the rehabilitation of the access roads.

7.3.2.5 Dam - WBS: YM-80004.4.D

The dam scope of the current Site C Project includes excavations and placement of embankment fill materials to form the dam.

Current status

The permanent work started to date is limited to (i) placement of cofferdams along the Left and Right Banks of the river that isolate the dam foundation near the abutment ends and (ii) excavation for the Left Bank stabilization work.

The cofferdams are designed to dewater the foundation of the dam and the abutment areas. While the cofferdams have been completed, no significant dam construction work is anticipated during the remainder of 2017.

Termination Project

The site construction work following termination would remove the cofferdams and re-establish the natural river bank profile across the dam axis. The work assumed is similar to the scope identified for the inlet and outlet cofferdams.

The other major work completed to date is the excavation of the Left Bank, which has been designed to stabilize the original ground slopes. The Left Bank above the bedrock level is overburden material that has historically experienced landslides and slope creep. The Project design has been defined to stabilize this material by reducing the slope angle and providing drainage and erosion control. A significant amount of excavation has already been completed and parts of the slope are already in their final configuration. The slope is, therefore, inherently more stable now than it was at the start of construction. Note that similar slopes exist along the Peace River valley in the Project area.

Further large-scale excavation would not be necessary to enhance the overall slope stability as part of the Termination Project. However, the excavated slope would need to be remediated by local landscaping to move any temporary slopes, surface water drainage channels for each excavation bench, and revegetation to establish ground cover that can reduce the risk of erosion damage.

We have assumed that this would be addressed by installing slope instrumentation, including piezometers, inclinometers, and survey monument to allow the stability of the Left Bank excavation to be monitored following termination. The instrumentation would confirm any movement of the slope material. We have included this element of the scope because of the occurrence of the tension cracks that occurred during excavation earlier in 2017. This crack is understood to have occurred when the excavation exposed a historical landslide slip surface with low shear strength. Stabilization of the slope would be achieved by the designed reduction in slope angle combined with placement of engineered fill with higher shear strength in selected areas. We assume that monitoring will be put in place to ensure that a public safety risk does not materialize.

The dam works scope also includes RSEM Area L5, which is a large spoil area that was prepared to deposit PAG rock from the site excavations. This area is located upstream from the proposed dam axis on the north shore of the river. As discussed separately, the spoil material in this area can generate acid when exposed to water and oxygen.

The RSEM is located partially in the Peace River floodplain and modification of the bounding dike might be required to eliminate any effect on flood levels upstream from the site.

We assume that the existing sandstone rip rap on the dikes should be removed and replaced by the limestone rip rap to allow for a long-term erosion protection solution. The Portage Mountain Quarry may be a possible source of the limestone.

Site construction works would also be required to encapsulate the spoil material to mitigate the acid generation. Options to be considered as part of the studies for the Termination Project would range from full encapsulation using slurry cutoff walls and clay till capping to control of surface water runoff. The site

Current status	Termination Project
	construction works would include the scope of work arising from the detailed design.
The Garbage Creek is a small tributary immediately upstream from the dam axis. This tributary has been filled with spoil material as part of the RSEM L5 area. However, the natural runoff along the creek has been diverted through a temporary pipeline placed in the fill.	We have assumed the scope would include construction of a storm-water diversion channel over the top of the Garbage Creek spoil deposit. The objective would be to isolate the storm-water flow from the acid-generating spoil in the main deposit and to prevent erosion that could cause spoil material to flow into the Peace River.

7.3.2.6 Approach and tailrace channel – WBS: YM-80004.4.F

The approach and tailrace channel work scope of the current Site C Project includes excavation of the channels to and from the powerhouse and spillways.

Current status Termination Project The work achieved to date is about 30% of the volume of excavation for the approach channel and about 40% Termination Project The main issue for this area is that the bedrock exposed would deteriorate and could become a

of the bulk volume for the tailrace channel. None of the permanent work for lining or slope anchoring has been done.

exposed would deteriorate and could become a source of acid drainage. We assume that the rock slope in the approach channel will be flattened and an impermeable till cap placed to isolate the exposed rock face in the slope and base of the approach channel.

The tailrace channel would be backfilled using material obtained from the cofferdam removal or reclaimed from RSEM Area R 6. The work for the tailrace would be combined with the work scope for the RCC buttress in the following section.

The finished surfaces along the approach and tailrace channels would be landscaped to re-establish vegetation consistent with the area.

7.3.2.7 RCC buttress – WBS: YM-80004.4.P

The current Site C Project design includes a large concrete buttress structure at the right (south) end of the dam. The buttress is provided as a foundation for the powerhouse and spillway structures and as an abutment for the embankment dam fill.

Current status Termination Project

The excavation of the powerhouse section of the foundation has been completed and RCC buttress placement is starting in this zone. The excavation for the spillway stilling basin has also been completed and a significant part of the associated RCC has been placed. The powerhouse and stilling basin RCC buttress is scheduled to be completed in November of 2017.

The drainage tunnel has started but work has been delayed.

We assume that the Termination Project would involve remediation of the work completed in the buttress area. The main considerations would be to improve the long-term aesthetics of the site, to re-establish a natural environment, and to mitigate the effects of acid generation from the exposed bedrock face. No efforts would be made to preserve the value of the works completed to date.

We assume the scope of work would include:

- Backfilling the stilling basin RCC and the tailrace channel to re-establish the natural river bank contour
- Backfilling the valley slope at the RCC buttress excavation to bury any completed concrete works and to cap the exposed bedrock surfaces

Current status	Termination Project
	 Backfilling the drainage tunnel and investigation adits using a combination of rock fill and concrete
	We assume the backfill for the RCC would be designed as an engineered fill with a stable slope extending from the river bank level at the tailrace to the approach channel fill. The backfill would be a combination of impervious till that would be placed next to the excavated rock face and mixed soils available from removal of the cofferdams or reclaimed from the RSEM areas. Topsoil would be spread to the extent available in stockpiles and the surface would be protected by erosion-control works including drainage, settlement ponds, ground-cover vegetation, and native trees.
The WBS for the dam works includes RSEM Areas R5a and R5b, which are large spoil areas prepared to deposit passive acid-generating rock from the site excavations. These areas are located upstream from the proposed dam axis on the south shore of the river. As discussed separately, the spoil material in this area can generate acid when exposed to water and oxygen.	For the termination option, we assume site construction works will be required to encapsulate the spoil material to mitigate the acid generation. Options would need to be considered as part of the studies for termination of the Project but the alternatives would range from full encapsulation using slurry cutoff walls and clay till capping to control of surface water runoff. The dikes enclosing the RSEM would be relocated where necessary to mitigate the effect on Peace River flood levels and armoured using limestone rip rap. The existing sandstone rip rap would be removed. The site construction works would include the scope of work arising from the detailed design.
RSEM Area L6 is also included in this part of the WBS. This area is located downstream from the tailrace channel and has been filled with overburden material.	Remediation for termination would include reclamation of materials from this spoil area for use in the rehabilitation of other parts of the works followed by revegetation to create a ground cover that would reduce erosion risk. Part of the material could be used for the RCC buttress fill.
The original site topography had a large island in the river. The main river channel was on the left side of the island and a smaller channel flowed along the right side. This right side (or back) channel was cut off when the RSEM Area R 6 was filled and the cofferdams were placed.	For the Termination Project, we assume the Project would re-open the channel as part of the site construction works to re-establish any fish habitat in the area. Material extracted from the back channel could be relocated to the RCC buttress fill, the stilling basin fill, and the tailrace channel.

7.3.2.8 Construction infrastructure facilities – WBS: YM-80004.4.M

The main elements of the construction infrastructure for the current Site C Project include:

- Worker Accommodation
- Temporary Buildings and Infrastructure
- Site Services
- Construction Power
- Construction Telecom

Current status	Termination Project
These elements of construction infrastructure are complete and in service.	The worker accommodation and offices for BC Hydro and contractors would be fully removed from the site, along with any foundations and hard stand areas (sidewalks, parking, etc.). The land surfaces would be

Current status	Termination Project
	landscaped and revegetated to recreate the original environmental condition and for erosion control.
	Note that part of the worker accommodation would be required during the site construction works following termination. The schedule for the removal and remediation of the camp would need to be phased according to the demand for site labour.
	Temporary buildings in other parts of the site would be removed from the site, foundations and hard stand areas removed, and the sites remediated to a natural condition and for erosion control.
	Site services for water supply and treatment, power supply, and sewage treatment would be removed and the sites remediated. In the case of water supply, removal would include the pumping station, supply pipeline, and water treatment plant. The sewage treatment plant would be removed by transporting any remaining sewage sludge to offsite disposal facilities. Pond liners would be removed and the pond filled to natural ground level. The facilities for pumping primary treatment plant effluent to the septic leaching field would be removed.

7.3.2.9 Stations – WBS YM-80004.4.S

Current status	Termination Project
The Site C Substation work to date has been excavations to extract material for use in dike fill and as aggregate for the crushing plants.	The site construction works required would include landscaping, drainage control, sedimentation basins, revegetation to create a ground cover, and tree planting.

7.3.2.10 Other work elements

Other elements of the permanent works have not yet started at the site, thus no further activity would be required for the Termination Project. These elements include:

- Intake and Penstock YM-80004.4.E
- Spillway Facility YM-80004.4.G
- Powerhouse Structure YM-80004.4.H
- Generating Equipment YM-80004.4.Q
- Ancillary Equipment YM-80004.4.J
- Protection Control and Telecom Systems YM-80004.4.K

7.4 Cost impact

The estimated cost impact of terminating the Site C Project, including the cost impact of terminating existing contracts and agreements and undertaking remediation activities, is summarized in Table 22.

Table 22: Summary of cost impact – Termination Scenario

#	Termination Scenario	Cost impact (\$ millions)
1	Cost to terminate the Site C Project	
	Contract cancellations	320
	 FNs, community, and archeological impacts 	Included above ⁶⁹
	Demobilization	50
2	Cost impact of site remediation	
	 Engineering (site), permitting, and procurement 	40
	Remediation activities	495
	Ongoing monitoring for 10 years	20
	Total	925
	Contingency (30%)	278
	Grand total	1,203

Our estimate includes the following assumptions (further assumptions are included in Appendix E).

- Our estimate does not include incremental interest costs in the event of a termination
- Our estimate does not include inflation impacts
- The costs related to cancelling FN Agreements in a Termination Scenario replace those payments that the FNs would have received if the Project was completed; this distinction is important when comparing with the Suspend Scenario above, where the FN costs are *in addition to* what the FNs are entitled to get from the Project upon completion and during operation

 $^{^{69}}$ The actual cost impact may vary as it is subject to the negotiation between BC Hydro and the impacted FNs and communities.

8 Appendix A – List of documents reviewed

Category	Topic	Document name
Confidential Documents	1 - Governance-Organization	Appendix A-Contracts On Track-June 2017.pdf
Confidential Documents	1 - Governance-Organization	Appendix B - Schedule Summary - Critical Path - Apr2017.pdf
Confidential Documents	1 - Governance-Organization	Appendix B - Schedule Summary - Critical Path - Feb2017.pdf
Confidential Documents	1 - Governance-Organization	Appendix B - Schedule Summary - Critical Path - Mar2017.pdf
Confidential Documents	1 - Governance-Organization	F2016 Quarterly Progress Report Q2 - September 30, 2015.pdf
Confidential Documents	1 - Governance-Organization	F2016 Quarterly Progress Report Q3 - December 31, 2015.pdf
Confidential Documents	1 - Governance-Organization	F2016 Quarterly Progress Report Q4 - March 31, 2016.pdf
Confidential Documents	1 - Governance-Organization	F2017 Quarterly Progress Report Q1 - June 30, 2016.pdf
Confidential Documents	1 - Governance-Organization	F2017 Quarterly Progress Report Q2 - September 30, 2016.pdf
Confidential Documents	1 - Governance-Organization	F2017 Quarterly Progress Report Q3 - December 31, 2016.pdf
Confidential Documents	1 - Governance-Organization	F2017 Quarterly Progress Report Q4 - March 31, 2017.pdf
Confidential Documents	1 - Governance-Organization	Monthly Report Apr 2017.pdf
Confidential Documents	1 - Governance-Organization	Monthly Report April 2016.pdf
Confidential Documents	1 - Governance-Organization	Monthly Report Aug 2016.pdf
Confidential Documents	1 - Governance-Organization	Monthly Report Dec 2016.pdf
Confidential Documents	1 - Governance-Organization	Monthly Report Feb 2016.pdf
Confidential Documents	1 - Governance-Organization	Monthly Report Feb 2017.pdf
Confidential Documents	1 - Governance-Organization	Monthly Report Jan 2017.pdf
Confidential Documents	1 - Governance-Organization	Monthly Report January 2016.pdf
Confidential Documents	1 - Governance-Organization	Monthly Report Jul 2017.pdf

Category	Topic	Document name
Confidential Documents	1 - Governance-Organization	Monthly Report July 2016.pdf
Confidential Documents	1 - Governance-Organization	Monthly Report Jun 2017.pdf
Confidential Documents	1 - Governance-Organization	Monthly Report June 2016.pdf
Confidential Documents	1 - Governance-Organization	Monthly Report Mar 2016.pdf
Confidential Documents	1 - Governance-Organization	Monthly Report Mar2017.pdf
Confidential Documents	1 - Governance-Organization	Monthly Report May 2016.pdf
Confidential Documents	1 - Governance-Organization	Monthly Report May 2017.pdf
Confidential Documents	1 - Governance-Organization	Monthly Report Nov 2016.pdf
Confidential Documents	1 - Governance-Organization	Monthly Report Oct 2016.pdf
Confidential Documents	1 - Governance-Organization	Monthly Report Sep 2016.pdf
Confidential Documents	1 - Governance-Organization	Site C BoD Material - Apr2017.pdf
Confidential Documents	1 - Governance-Organization	Site C BoD Minutes - Apr2017.pdf
Confidential Documents	1 - Governance-Organization	Site C BoD Minutes - Jul2017.pdf
Confidential Documents	1 - Governance-Organization	Site C BoD Minutes - Jun2017.pdf
Confidential Documents	1 - Governance-Organization	Site C Project Board Minutes - Aug2015.pdf
Confidential Documents	1 - Governance-Organization	Site C Project Board Update - Jun2017.pdf
Confidential Documents	1 - Governance-Organization	Site C Project Board Update - Sept2016.pdf
Confidential Documents	1 - Governance-Organization	Special Meeting of the Site C Project Board - August 3 2017.pdf
Confidential Documents	2 - Change Management	Change Request Log.pdf
Confidential Documents	2 - Change Management	Change Request Log.xlsx
Confidential Documents	3 - Schedule Management	Original Accepted Schedule April 2016 MCW Contract Baseline TR0173 - Primavera File V120_v15.xer
Confidential Documents	3 - Schedule Management	Revised Schedule_April 2017 MCW Update TR5120 - V136_v15.xer
Confidential Documents	3 - Schedule Management	Revised Schedule_Feb 2017 MCW Update TR3907 - V133_v15.xer
Confidential Documents	3 - Schedule Management	SITE C December 2015 PMB.xer

Category	Topic	Document name
Confidential Documents	3 - Schedule Management	Site C First Full Funding - Final Investment Decision Baseline.xer
Confidential Documents	3 - Schedule Management	Site C June 2016 PMB.xer
Confidential Documents	3 - Schedule Management	Site C March 2016 PMB.xer
Confidential Documents	3 - Schedule Management	YM80004-16JUN2017-PMFB-JUN.xer
Confidential Documents	4 - Contractual-Procurement	20110204 CSA Engineering Design Services - Klohn-SNC-signed.pdf
Confidential Documents	4 - Contractual-Procurement	20110325 CSA - RF Binnie Ltd-signed.pdf
Confidential Documents	4 - Contractual-Procurement	20110325 Master CSA - Tetra Tech-signed.pdf
Confidential Documents	4 - Contractual-Procurement	20150427 - Worker Accommodation Overview.pdf
Confidential Documents	4 - Contractual-Procurement	20160204 CO 577509 Project Health Clinic Contract_Redacted.pdf
Confidential Documents	4 - Contractual-Procurement	201707 Contract Status Report - BCUC info.xlsx
Confidential Documents	4 - Contractual-Procurement	97289 MSA_ ERC-NB_Duz Cho_February 6 2017_fully executed.pdf
Confidential Documents	4 - Contractual-Procurement	Clearing Lower Reservoir 4EG Oct 13 2015 Redacted.pdf
Confidential Documents	4 - Contractual-Procurement	CO 97289 Rel 1 NB Duz Cho Feb 10 2017_Redacted.pdf
Confidential Documents	4 - Contractual-Procurement	Duz Cho_MSA_97289_Rls_03_Portage Mnt Quarry_Redacted.pdf
Confidential Documents	4 - Contractual-Procurement	Klohn_SNC_Monthly_Report_20170630.pdf
Confidential Documents	4 - Contractual-Procurement	Main Civil Works Contract.pdf
Confidential Documents	4 - Contractual-Procurement	PRHP_Monthly_Report_20170630.pdf
Confidential Documents	4 - Contractual-Procurement	RFP_5710_Site_C_Lattice_Towers_Contract_Redacted.pdf
Confidential Documents	4 - Contractual-Procurement	Site Prep - SB Clearing CO 87145Paul Paquette_Redacted.pdf
Confidential Documents	4 - Contractual-Procurement	TG Key Contract Terms Summary (January 27, 2016).pdf
Confidential Documents	4 - Contractual-Procurement	Turbine and Generator Contract.pdf
Confidential Documents	4 - Contractual-Procurement	VOITH_Monthly_Reports_20170630.pdf

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Confidential Documents	4 - Contractual-Procurement	VOITH_Monthly_Reports_20170731.pdf
Confidential Documents	4 - Contractual-Procurement	Worker Accommodation - Financial Model 2015-09-22 V4.xlsm
Confidential Documents	4 - Contractual-Procurement	Worker Accomodation Contract.PDF
Confidential Documents	5 - Cost Management	Basis of Project Estimate.pdf
Confidential Documents	5 - Cost Management	Cost Report.xlsx
Confidential Documents	5 - Cost Management	Cost Reports.pdf
Confidential Documents	5 - Cost Management	Project Cashflow Model and Forecast.pdf
Confidential Documents	6 - Risk Management	Project Risk Register.pdf
Confidential Documents	6 - Risk Management	Site C June Project Contingency Reporting Package.pdf
Confidential Documents	7 - First Nations	91207697_v(1)_Halfway River Impact Benefits Agreement EXECUTED.PDF
Confidential Documents	7 - First Nations	91207698_v(1)_Doig River Impact Benefits Agreement EXECUTED (2).pdf
Confidential Documents	7 - First Nations	Doig River Contracting Agreement EXECUTED.pdf
Confidential Documents	7 - First Nations	Doig River TLA EXECUTED.pdf
Confidential Documents	7 - First Nations	Halfway River Contracting Agreement EXECUTED.pdf
Confidential Documents	7 - First Nations	Halfway River TLA EXECUTED.pdf
Confidential Documents	7 - First Nations	MCLE-Contracting Agreement-05Jul2016.pdf
Confidential Documents	7 - First Nations	MCLE-TLA-07Apr2016.pdf
Confidential Documents	7 - First Nations	SFN TLA - Final Signed.pdf
Confidential Documents	7 - First Nations	STC-DFN-Signed Site C Project Agreement-2015Dec14.pdf
Confidential Documents	7 - First Nations	STC-DTFN-IBA-DTFN Site C Project Agreement Signed-JPastion-COReilly-2016.pdf
Confidential Documents	7 - First Nations	STC-MCLE-IBA-Site C Project-Impact and Benefits Agreement- 05Jul2016.pdf
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Confidential Documents	8 - Response to Question	LCCs-LTCs.htm
Confidential Documents	8 - Response to Question	Main Civil Works Quantities with WBS.xlsx
Confidential Documents	8 - Response to Question	MCW Not Redacted.pdf

Category	Topic	Document name
Confidential Documents	8 - Response to Question	Monte Carlo - Direct Cost Estimate Memo - Section 1 Chapter 9 - Contingency.pdf
Confidential Documents	8 - Response to Question	Monte Carlo - Direct Cost Estimate Memo - Section 13 - Contingency Detail.pdf
Confidential Documents	8 - Response to Question	Monte Carlo - MCW Updated Assessment of Contingency - Preferred Proponent - v3.pdf
Confidential Documents	8 - Response to Question	Permits and Authorizations.zip
Confidential Documents	8 - Response to Question	Site C Risk Registers.xlsx
Confidential Documents	8 - Response to Question	TG Not Redacted.pdf
Confidential Documents	8 - Response to Question	WA Not Redacted.pdf
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	5_Year_Beach_Line.dbf
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	5_Year_Beach_Line.prj
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	5_Year_Beach_Line.sbn
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	5_Year_Beach_Line.sbx
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	5_Year_Beach_Line.shp
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	5_Year_Beach_Line.shp.HY221328.7956.7952.sr.lock
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	5_Year_Beach_Line.shx
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	85th_Ave_Industrial_Lands.cpg
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	85th_Ave_Industrial_Lands.dbf
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	85th_Ave_Industrial_Lands.prj

Category	Topic	Document name
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	85th_Ave_Industrial_Lands.sbn
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	85th_Ave_Industrial_Lands.sbx
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	85th_Ave_Industrial_Lands.shp
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	85th_Ave_Industrial_Lands.shp.HY221328.7956.7952.sr.lock
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	85th_Ave_Industrial_Lands.shp.xml
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	85th_Ave_Industrial_Lands.shx
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	Adjacent_Project_Activity_Zone.lyr
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	Dam_Components.cpg
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	Dam_Components.dbf
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	Dam_Components.lyr
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	Dam_Components.prj
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	Dam_Components.sbn
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	Dam_Components.sbx
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	Dam_Components.shp
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	Dam_Components.shp.xml
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	Dam_Components.shx

Category	Topic	Document name
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	Dam_Site_Area.cpg
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	Dam_Site_Area.dbf
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	Dam_Site_Area.lyr
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	Dam_Site_Area.prj
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	Dam_Site_Area.sbn
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	Dam_Site_Area.sbx
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	Dam_Site_Area.shp
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	Dam_Site_Area.shp.xml
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	Dam_Site_Area.shx
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	Dam_Site_Roads.CPG
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	Dam_Site_Roads.dbf
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	Dam_Site_Roads.lyr
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	Dam_Site_Roads.prj
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	Dam_Site_Roads.sbn
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	Dam_Site_Roads.sbx
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	Dam_Site_Roads.shp

Category	Topic	Document name
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	Dam_Site_Roads.shp.xml
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	Dam_Site_Roads.shx
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	North_Bank_Distribution_Line.cpg
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	North_Bank_Distribution_Line.dbf
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	North_Bank_Distribution_Line.prj
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	North_Bank_Distribution_Line.sbn
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	North_Bank_Distribution_Line.sbx
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	North_Bank_Distribution_Line.shp
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	North_Bank_Distribution_Line.shp.xml
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	North_Bank_Distribution_Line.shx
Confidential Documents	8 - Response to Question\125- GIS Shape Files\	Page 6 from 125 Site C Review - Deloitte Questions - August 2017 - Attachment.pdf
Confidential Documents\39 Conceptual Drawings		MCW_General_Arrangment_Drawings_1020-C01-00001_FS_ES_R0.pdf
Confidential Documents\39 Conceptual Drawings		MCW_General_Arrangment_Drawings_1020-C01-00003_FS_ES_R1.pdf
Confidential Documents\39 Conceptual Drawings		MCW_General_Arrangment_Drawings_1020-C01-00005_FS_ES_R0.pdf

Category	Topic	Document name
Confidential Documents\39 Conceptual Drawings		MCW_General_Arrangment_Drawings_1020-C01-00007_FS_ES_R1.pdf
Confidential Documents\Contract Plans		Health Clinic - CP.pdf
Confidential Documents\Contract Plans		MCW - CSR 20140313.pdf
Confidential Documents\Contract Plans		MoTI - CCBF Bridge - CP.pdf
Confidential Documents\Contract Plans		MoTI - CCBF Clear-Grub CSR.pdf
Confidential Documents\Contract Plans		MoTI - CCBF Grade and Pave - CP.pdf
Confidential Documents\Contract Plans		MoTI CP BCO 2017-04-07 (draft) - Appendix 1.pdf
Confidential Documents\Contract Plans		MoTI CP BCO 2017-04-07 (draft) - Appendix 2.pdf
Confidential Documents\Contract Plans		MoTI CP BCO 2017-04-07 (draft) - Appendix 3.pdf
Confidential Documents\Contract Plans		MoTI CP BCO 2017-04-07 (draft).pdf
Confidential Documents\MCW Contract - Changes, Claims		1016.PRH01.ID.O.0002 Schedule Recovery.pdf

Category	Topic	Document name
Confidential Documents\MCW Contract - Changes, Claims		20170808 MCW - Claim for Change Summary.pdf
Confidential Documents\MCW Contract - Changes, Claims		Main Civil Works - First Amending Agreement.pdf
Confidential Documents\MCW Contract - Changes, Claims		MCW Executed Change Orders.pdf
Confidential Documents\MCW Contract - Changes, Claims		MCW package description.pdf
Confidential Documents\MCW Contract - Changes, Claims		SCCEP-PRHP-PM-LTR-000345 Dispute Notice - Left Bank Delay and Disruption.pdf
Confidential Documents\MCW Contract - Changes, Claims		Second Amending Agreement - Main Civil Works Contract (Fully Executed).pdf
Confidential Documents\Project Plan Appendices		Appendix D.pdf
Confidential Documents\Project Plan Appendices		Appendix E.pdf
Confidential Documents\Project Plan Appendices		Appendix F.pdf

Category	Topic	Document name	
Confidential Documents\Project Plan Appendices		Appendix H.pdf	
Confidential Documents\Question_70 _Environmental Monitoring Reports\		BCH Monthly Environmental Monitoring Summary Report Feb 2017.pdf	
Confidential Documents\Question_70 _Environmental Monitoring Reports\		BCH Monthly Environmental Monitoring Summary Report March 2017.pdf	
Public Documents	1 - Governance-Organization	Project Execution Plan.pdf	
Public Documents	1 - Governance-Organization	Statement of Objectives_Delgation Authority Matrix.pdf	
Public Documents	1 - Governance-Organization	Work Breakdown Structure.pdf	
Public Documents	2 - Change Management	Project Change Management Plan.pdf	
Public Documents	3 - Schedule Management	Construction-Schedule-20161007.pdf	
Public Documents	4 - Contractual-Procurement	Main Civil Works Contract.pdf	
Public Documents	4 - Contractual-Procurement	MCW-schedule-7-environmental-obligations.pdf	

9 Appendix B – List of people interviewed

#	Name	Title
1		Finance Manager, Business Services
2		Engineering Division Manager
3		Manager, Business Planning, Scheduling, and Reporting
4		President
5		Manager, Public Affairs and Community Relations
6		Project Manager and Director of Operations
7		Assistant Project Manager, MCW
8		Vice President, and Project Director
9		Director, Finance
10		Assistant Project Manager, Early Works, Accommodation, and Infrastructure
11		Principal Engineer Contracts, Procurement and Market Specialist
12		Manager, Environmental
13		Vice President, Project Delivery
14		Employee Relations Advisor
15		Director, Supply Chain Infrastructure Projects
16		Manager, Aboriginal Relations
17		Design Manager
18		Senior Management, Contract Services Capital Infrastructure Project Delivery
19		Transmission and Distribution Project Manager
20		Assistant Project Manager, GSS and T&G
21		Assistant Project Manager
22		Commercial and Risk Manager
23		Contracts, Document Control and Submittals Manager
24		Vice President, Project Delivery (retired)

10 Appendix C – Evolution of budget

Budget evolution (December 2014 to June 2016) and comparison to FID.

Subprojects	FID Budget Dec 2014	PMB Dec 2015	PMB Mar 2016	PMB Jun 2016
	A	B	C	D
Early Works				
Reservoir Clearing				
MCW				
TG				
GSS				
Highways				
Transmission				
Worker Accomodation				
Mit & Comp				
IBA				
Other - Direct				
Other - Indirect				
PM & Services				
Engineering				
Construction Mgmt & Res Eng'g				
VP Office				
Public Affairs, AR, Environment				
Procurement				
Finance & Project Controls				
Legal & Litigation				
Properties				
Royalties, Licenses & Insurance				
Contingency & Unallocated				
Deferred				
Deferred IDC				
IDC				
Grand Total	8,335	8,335	8,335	8,335

11 Appendix D – Geotechnical risks

The geotechnical risks are discussed further below. Please note that Deloitte has conducted a high-level review based on documents provided by BC Hydro.

11.1 Stability of the overburden slopes in the Left Bank

The Left Bank of the river was identified in the design as requiring stabilization. The proposed works involved excavation of a large amount of overburden material that could be susceptible to landslide. This risk has been validated during the excavations to date, which have resulted in some cracking of the slope due to ground movements. The consequence of the risk is delay in the progress of the works to assess conditions and the possibility of larger quantities of excavation and slope stabilization works. Other overburden excavations on the site are much smaller and do not appear to pose the same level of risk to the Project as the Left Bank.

11.2 Condition of the rock for excavation of the large diversion tunnels

The condition of the rock for excavation of the large diversion tunnels through the left abutment of the dam is another potential geotechnical risk. The geological conditions are reported to be moderately weak silty shale interbedded with thin layers of siltstone, sandstone, and shale. The rock can apparently have near-vertical joints that are infilled with clay and would have weak bedding planes. While rock of this type can be easily excavated by mechanical means, such as the road headers proposed for tunnel excavation, the tunnels would require support and lining. The risk for the Project is whether the proposed construction method for the tunnels would be suitable if there are weaker than anticipated zones that could cause collapse or dislocation of the tunnel. It appears that the tunnels proposed are large at about 10 metres and would require excavation in two phases, one for the top layer and a second phase to remove a bench in the bottom half of the tunnel. The tunnels have not yet started so this risk is still unknown. Potential consequences would be a delay in the progress for tunneling and additional costs for this work element. Any delay in tunneling could affect the milestone date for the Start of River Diversion.

11.3 Rock conditions for the powerhouse, spillway, and embankment dam abutment at the Right Bank

Another potential geotechnical risk is the rock conditions for the powerhouse, spillway, and embankment dam abutment at the Right Bank. The geology is the same as described above for the diversion tunnels. A large concrete buttress is designed to support the surface structures and provide the required factors of safety for sliding and bearing pressures by transferring loads to the continuous rock layers below the river bed level. The bedrock is susceptible to swelling after excavation and the design includes measures to mitigate the risks of rebound and creep of the rock faces. The risk for the Project is whether the construction methods and progress of the construction will be consistent with the design assumptions, which require excavation followed by reloading of the rock to suppress swelling. The other risk in this category is whether the exposed rock layers are consistent with the conditions investigated during design.

The rock foundations have been exposed during the powerhouse excavations. BC Hydro has not identified any concerns about the condition of the bedrock that would suggest a need to adjust the design or construction methods. However, the geologic conditions represent a risk in the event that the Project is suspended because of the likelihood that the condition of the rock would deteriorate with time before the structures can be loaded.

11.4 Embankment dam

The fourth category of risk is the related to the embankment dam. The dam is planned as a zoned earthfill embankment that would use impervious till from a borrow area close to the site and gravel from deposits along the river valley. The risks include (i) the depth of the cutoff required from the foundation level through the river bed alluvium to the bedrock, and (ii) the suitability of the till material for use as impervious fill. The excavation for the dam in the central part of the river cannot be completed until the river diversion is completed.

The depth of the cutoff would not be known until the excavation was completed. However, the cutoffs for the cofferdams along both banks of the river have been completed successfully and BC Hydro did not report any concerns about being able to create a water-tight cutoff. The deepest part of the cutoff would likely be in the central part of the river and some uncertainty would remain until the works commenced.

The suitability of the till material as impervious fill has been investigated in laboratory work. However, the uncertainty pertains to whether the deposit would be suitable for high productivity placement of the large volumes required, especially with respect to consistency of the overall deposit, its moisture content, and the construction methods. The consequences of the dam risks would involve additional time for the construction and potential costs.

12 Appendix E – Assumptions and limitations

12.1 Estimate assumptions

Our cost estimates are Class 5 Estimates with an expected accuracy range of -35% and +100% as per the AACE standards. For the Suspension Scenario, our estimate does not include the incremental interest costs or inflation impacts on the post-suspension costs to complete the Site C Project. For the Termination Scenario, we have not allowed for any interest and inflation costs over the cost associated with termination activities.

12.1.1.Cost basis

- Direct costs are based on the quantities extracted using BC Hydro's GIS files and information gathered during the site visits.
- When available, contractual unit rates were used to establish the cost for the works to be performed.
- The number of personnel on site was based on the manpower loading chart generated for this estimate.
- Project Management costs were based on the BC Hydro Manpower loaded plan.
- Engineering costs for BC Hydro were based on the Manpower loading plan.
- Detailed Engineering manpower and costs were based on the Monthly Reports.
- Escalation or inflation was not included in any of the calculations.
- It was assumed that all original bidders will return for termination scope and for suspension scope with similar components and costs.
- No credit has been taken for sale of land in either scenario.

12.1.2. Schedule basis

- Some of the key dates used for evaluating the execution strategy and resulting costs were based on the following milestones:
 - Notice given (to either suspend or terminate) to contractors on December 31, 2017.
 - Demobilization of equipment and personnel start on January 1, 2018.
- For the Suspension Scenario, a 24-month period has been estimated as the required duration to complete the construction activities required to preserve and safeguard the site.
- For the Suspension Scenario, we have assumed that activities needed to support the engagement of the vendors and contractors, along with project planning, will start 15 months before the start of site mobilization or approximately 20 months before the construction start date, January 1, 2025. This strategy also assumes that four months will allow sufficient time for all critical construction mobilization activities to take place to allow restart of construction for January 1, 2025.
- For the Termination Scenario, we have assumed that approximately 34 months would be required to complete the engineering and procurement activities and obtain the required permits. This would be followed by a three-year construction period to return the site to natural conditions.

12.1.3. General basis

- We have assumed that contractual costs (e.g., unit rates and productivity) from historical work are similar for future work (i.e., costs for indirects or directs from the last two years will remain essentially the same for activities related to the two scenarios being evaluated).
- For the Suspension Scenario, we assumed that specific work scopes currently being performed by PRHP
 will continue to a degree that will support the suspension requirements for preserving and safeguarding
 the site. As well, we assumed that new scopes will have to be engineered, and therefore time will be
 needed to complete the engineering and obtain the permits. The result is additional mobilization and
 demobilization costs.
- For the suspension case, we have assumed that all contracts are suspended per the contractual terms and conditions which has the same intention as termination after a one-to-two-year suspension. No costs have been allocated to continuing work (field construction, fabrication, or engineering) throughout the seven-year suspension period. An example would be continuing engineering for the Turbines and Generators to ensure a fast restart after the seven-year suspension.
- All temporary equipment and facilities are assumed to remain the responsibility and property of the contractors and, therefore, will be demobilized and remobilized as required. The one exception is the camp facilities which have been assumed to remain on-site during the Suspension Scenario.
- Permitting and regulatory for suspension, we assumed that specific existing permits would be applicable in addition to new permits. For termination, we assumed that all permits would be new and that the environmental assessment would be updated.

12.2 FN Agreements

Please note the following limitations and assumptions related to FN Agreements.

12.2.1.Limitations

- This is not a legal review.
- We have not independently verified the status of land transfer obligations set out in the TLAs. 70
- Under the Suspension Scenario, only the costs that are incremental to the base budget have been estimated.
- Under the Termination Scenario, only the costs that will be incurred after the termination date have been estimated.
- The following potential costs are disregarded or not quantified in this section:
 - Impacts of any current or future legal challenges, defaults or breaches of FN Agreements by any parties
 - Dispute resolution costs, if any
 - Incremental overhead costs to administer the agreements during suspension, if any
 - Costs or benefits that are non-financial or seemingly financially immaterial (including but not limited to commemoration/recognition, Land Management Measures, advising FNs of training or employment resources, managing Aboriginal procurement and inclusion/participation provisions, establishment of oversight committees)
 - Market value of lands to be transferred under TLAs
 - Costs to or losses incurred by parties other than BC Hydro or the Province, such as cancelled future benefit payments, job losses, cancelled land transfers, or foregone property taxes
 - Permitting costs to suspend or terminate estimated elsewhere in this report will include costs to engage FNs

12.2.2.Assumptions

 $^{^{70}}$ BC Hydro has reported to us that no land transfers have been completed and that none are expected to be completed prior to the suspension or termination.

Assumptions include:

- · All signed FN Agreements are in good standing
- All conditions required for payment of benefits have been or will be met other than those linked to project milestones that would be affected by suspension of the Project
- Impacted FNs that have not yet signed agreements will be entitled to receive accommodation payments consistent with the significance of impact, consistent with the signatory FNs, under both the Suspension and Termination Scenarios
- Under the Suspension Scenario, all budgeted costs will remain unchanged upon resumption of construction, except as noted herein
- Under the Termination Scenario, all budgeted costs for the items addressed in this section will be terminated, with the exception of the costs estimated herein
- Any change to the assumed to be December 31, 2017, suspension date will not materially impact the findings
- No future obligations to FNs exist except those specified in the FN Agreements
- All accommodation payments due or payable prior to the suspension date have been paid
- Obligations to FNs that remain in effect during project suspension will recommence without change or incremental cost to re-institute, except as addressed elsewhere in this report (i.e., in the cost to remobilize the Project)
- BC Hydro will provide notice of suspension or termination for all FN Agreements immediately, in accordance with the provisions of the FN Agreements
- No land transfers will occur prior to notice of suspension being given

13 Appendix F – Confidentiality agreement

AGREEMENT ON CONFIDENTIALITY PROTOCOL FOR THE SITE C REVIEW between BC HYDRO AND DELOITTE LLP

WHEREAS:

- A. The British Columbia Utilities Commission (Commission) has initiated the Site C Inquiry (Inquiry) pursuant to Terms of Reference issued on August 2, 2017 by the Province of British Columbia.
- B. The Commission retained Déloitte LLP ("Deloitte") to assist in conducting its Inquiry and provide a report to the Commission. Deloitte has, in turn, subcontracted with consultants to assist in its work.
- C. The Parties recognize that the disclosure of BC Hydro's commercially sensitive information could cause harm to BC Hydro, and thus potentially adversely impact BC Hydro's ratepayers.
- D. On August 4, 2017 Deloitte and BC Hydro agreed to the attached interim terms (Interim Terms) regarding protection of commercially sensitive documents and information that BC Hydro provides to Deloitte during the course of the review. The Interim Terms contemplated that the Parties would develop and agree on a more formal protocol for the protection and treatment of commercially sensitive information.
- E. Also on August 4, 2017, BC Hydro provided Deloitte and the Commission with access to a SharePoint site, on which BC Hydro had posted commercially sensitive documents requested by the Commission and Deloitte. BC Hydro has continued to post documents containing commercially sensitive information on the SharePoint site since that time.
- F. The commercially sensitive information includes, but is not limited to, the following categories:
 - Documents and information related to ongoing or potential claims with contractors working on the Project, for which disclosure to the contractor(s) could compromise BC Hydro's position vis-a-vis the contractor(s) and thus harm the interests of BC Hydro and ratepayers;
 - Information that, if disclosed, would compromise BC Hydro's ability to procure materials and services cost-effectively; and
 - (c) Customer information.
- G. The Parties have developed this Agreement Regarding Confidentiality Protocol (Protocol) to ensure that Deloitte can fulfil its mandate from the Commission, while protecting BC Hydro's commercially sensitive information and documents.

THE PARTIES AGREE AS FOLLOWS:

Confidential Documents and Confidential Information

- 1. In this Protocol, Confidential Information means:
 - (a) documents posted on the confidential SharePoint site; and
 - (b) any other information, whether disclosed in writing, orally, or visually, that has been identified by BC Hydro employees, or other representatives, as being commercially sensitive.

Deloitte's Obligation to Maintain Confidentiality Over Confidential Information

- Deloitte shall hold in confidence, and shall not disclose to any person, any Confidential Information except to the extent that
 - the Confidential Information is generally known to the public at the time of disclosure or becomes generally known through no wrongful act on the part of Deloitte;
 - (b) the Confidential Information is in Deloitte's possession at the time of disclosure other than as a result of prior disclosure by BC Hydro or a breach of any legal obligation by Deloitte or a third party;
 - (c) the Confidential Information becomes known to Deloitte through disclosure by sources other than BC Hydro or those having a duty of confidentiality to BC Hydro: or
 - the Commission has determined the Confidential Information should be disclosed publically.

Deloitte will not make any use of the Confidential Information beyond what is required to fulfil its retainer in this Inquiry.

- 3. Notwithstanding section 2, Deloitte may provide Confidential Information to:
 - (a) the Commission; and
 - (b) third parties with whom Deloitte has contracted to perform work on the inquiry, and who have agreed with BC Hydro to abide by terms equivalent to the Interim Agreement, this Protocol or otherwise acceptable to BC Hydro.

In the case of both (a) and (b), Deloitte must advise the recipient that the information is Confidential Information.

4. Notwithstanding Section 2 and 3, Deloitte may disclose Confidential Information if Deloitte is compelled to disclose such Confidential Information by an order of a court of competent jurisdiction or a regulatory body, provided that Deloitte provides prompt notice (to the extent permitted by law) to BC Hydro of any proceedings seeking such an order, so that BC Hydro has the opportunity to make representations to such court or regulatory body regarding the proposed disclosure. If Deloitte is precluded by law from providing the above notice to BC Hydro, and an order is made without notice to BC Hydro, then Deloitte must provide prompt notice of such order to BC Hydro prior to making any disclosure.

5. Deloitte will destroy or return to BC Hydro any written Confidential Information in its possession by December 1, 2017, and provide confirmation of the same to BC Hydro. This Protocol shall apply to all Confidential Information for as long as Deloitte is in possession of Confidential Information. Notwithstanding the foregoing however, Deloitte shall have access to, or maintain copies of, any such Confidential Information as is needed to support its work papers in accordance with applicable professional standards. Such copies will be destroyed promptly following the retention date specified by applicable professional standards.

Inclusion of Confidential Information in Deloitte Report

 Deloitte may, in its own discretion, refer to or include Confidential Information in its report to the Commission. In that event, Deloitte will submit that Confidential Information to the Commission in a confidential appendix to the report or otherwise identify for the Commission where the Confidential Information appears.

Acknowledgement of Commission's Jurisdiction

7. The Parties anticipate that BC Hydro will, upon request by the Commission, provide an explanation to the Commission as to why BC Hydro considers that the commercially sensitive information referenced in the Deloitte Report should remain confidential. Nothing in this Protocol is intended to fetter the Commission's jurisdiction to determine the treatment of Confidential Information for the purposes of the Inquiry.

The Parties agree the above terms, effective August 27, 2017.

Per Fred James

Chief Regulatory Officer

Per THE LLP

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