OLUMBIA

April 1, 2016

File: 7001837

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Vice President & Project Director Site C Clean Energy Project BC Hydro & Power Authority

Dear

Site C Clean Energy Project Re: Conditional Water Licences 132990 and 132991 on Peace River Leave to Commence Construction No. 1

Conditional Water Licences 132990 and 132991 (Water Licences) issued to BC Hydro & Power Authority (BC Hydro), authorize the construction of works for the storage, diversion and use of water from Peace River for power purpose at the Site C Clean Energy Project (Project).

Clause (h) in the Water Licences authorizes the following works:

- 1) an approach channel;
- 2) an intake;
- 3) a dam;
- 4) spillways;
- 5) a reservoir;
- 6) a shoreline protection berm at Hudson's Hope;
- 7) a powerhouse and tailrace;
- 8) an access road; and
- 9) ancillary works associated with operation of the dam and generating station.

Clause (j) in the Water Licences requires that, before commencing construction of the works authorized under clause (h), the licensee must, to the satisfaction of the Comptroller of Water **Rights:**

- 1) retain a professional engineer registered in the province of British Columbia (the "Independent Engineer") who will provide services to the Engineer for the regulation of construction of the works (Attachment A);
- 2) retain a person with professional qualifications (the "Independent Environmental Monitor") who will monitor environmental impacts from the construction of works (Attachment B);

- 3) submit, the following:
 - a. plans that show the general arrangement of the works;
 - b. criteria for the design of the works;
 - c. criteria for the operation of the works;
 - d. a schedule for the construction of the works;
 - e. an environmental management plan (CEMP) for the management and mitigation of construction impacts;
- 4) complete all monitoring, mitigation and compensation projects required for each Leave to Commence Construction, as specified in Schedule A; and
- 5) obtain Leave to Commence Construction (LCC) in writing from the Engineer under the *Water Sustainability Act.*

Clause (j) 4) refers to monitoring, mitigation and compensation projects required to be completed prior to certain construction activities are authorized under LCC, as specified in Schedule A. Schedule A monitoring or mitigation projects that are required to be completed prior to construction of initial right and left bank works, which are included in the LCC 1 - Initial Works request, are the:

- 1) Vegetation Clearing and Debris Management Plan;
- 2) Monitoring plan for downstream flow fluctuations;
- 3) Assessment procedure for evaluating juvenile fish in tributaries;
- 4) Scope of long-term monitoring and follow-up decision criteria for offsets/compensation;
- 5) Kokanee Assessment Plan; and
- 6) Soil Management, Site Restoration and Revegetation Plan.

Upon advice of the Conservation Science Manager, Ministry of Environment, completion of the projects 4) and 5) on the list may be postponed to when pre-diversion left bank works proceeds.

Clause (l) in the Water Licences states that the construction of the said works must not commence until a draft Operation, Maintenance and Surveillance Manual (including a surveillance schedule for first filling) and an Emergency Preparedness Plan have been submitted to the satisfaction of the Dam Safety Officer.

I am the Engineer under the Water Sustainability Act (Engineer) for this Project.

The Independent Engineer advises that the construction activities have been separated into 15 Leave to Commence Construction (LCC) phases:

- LCC 1 Initial Works
- LCC 2 RSEMs
- LCC 3 Right Bank Stage 1 Cofferdam & Excavation
- LCC 4 Reservoir Clearing
- LCC 5 RCC Structures
- LCC 6 Left Bank Stage 1 Cofferdams & Diversion Works
- LCC 7 Powerhouse & Spillway Civil Works
- LCC 8 Stage 2 Cofferdams & Earthfill Dam
- LCC 9 Hydro-Mechanical Works (Gates & Hoists)
- LCC 10 Turbine, Generator & Completion Works

- LCC 11 Reservoir Clearing
- LCC 12 Approach Channel Stage 2
- LCC 13 Reservoir Clearing
- LCC 14 Hudson's Hope Berm
- LCC 15 Diversion Tunnel Conversion & reservoir Filling

Additionally, there will be six Leaves to Commence Operation (LCO), one for each of the six units.

Water Licences clause (j)

In consideration of Water Licences conditions (j), I have reviewed the following submissions:

- Request for Issue of Leave to Commence Construction No. 1 for the Site C Clean Energy Project, dated March 24, 2016, prepared by
- Attachment A Site C Clean Energy Project Scope of Information and Reports by the Independent Engineer, signed by March 9, 2016 and by March 21, 2016.
- Attachment B Site C Clean Energy Project Scope of Information and Reports by the Independent Environmental Monitor, signed by and and by an March 23, 2016 and by on March 24, 2016.
- Site C Clean Energy Project Description of the Project including the General Arrangement drawings of the works and design criteria, dated March 24, 2016, revised March 31, 2016, prepared by BC Hydro & Power Authority;
- *Site C Clean Energy Project Operations Criteria*, dated March 24, 2016, revised March 31, 2016 and submitted by email from **Sector Sector** on March 31, 2016, prepared by BC Hydro & Power Authority;
- Site C Clean Energy Project Construction Schedule, dated March 24, 2016, revised March 30, 2016 and submitted by email from from on March 31, 2016, prepared by BC Hydro & Power Authority;
- *Construction Environmental Management Plan*, dated March 24, 2016, revised March 31, 2016, prepared by BC Hydro & Power Authority;
- Site C Clean Energy Project Project Component Descriptions covered under Leave to Commence Construction #1, dated March 24, 2016, prepared by BC Hydro & Power Authority;
- Site C Clean Energy Project Draft operation, maintenance and surveillance plans and Emergency Preparedness Plan table of Contents, dated March 24, 2016, prepared by BC Hydro & Power Authority;
- Site C Clean Energy Project Status of Schedule A of CWL's C132990 and C132991 for Fisheries Technical Committee, dated March 31, 2016, including follow-up April 1, 2016 email correspondence, prepared by BC Hydro & Power Authority;
- Site C Clean Energy Project Status of Schedule A of CWL's C132990 and C132991 for Vegetation and Wildlife, dated March 31, 2016, prepared by BC Hydro & Power Authority;
- Letter report dated April 1, 2016 from Independent Engineer on the

review of the licensee's March 24, 2016 LCC 1 submission documents, regulatory certificates, permits, licences and supporting reports, criteria for design of the works, criteria for operations of the works, schedule for construction of the works, and construction environmental management plan;

- Letter report dated April 1, 2016 from R.P. Bio., Independent Environmental Monitor on the review of the licensee's March 24, 2016 LCC 1 submission documents, revised March 31, 2016, particularly the construction environmental management plan, and regulatory certificates, the Water Licences, applicable standards and best practices, as well as applicable mitigation, monitoring and safety management plans prepared by BC Hydro; and
- Letter report dated April 1, 2016 from P. Eng., FLNRO Water Management Dam Safety Officer on the review of the licensee's March 24, 2016 LCC 1 submission documents, including the criteria for design of the works, criteria for operations of the works, schedule for construction of the works, LCC 1 project components, water licence schedule A milestone updates, and draft Operation, Maintenance and Surveillance (OMS) Manual and Emergency Preparedness Plan (EPP) table of contents.

Water Licences clause (j) 1), 2)

I have reviewed the credentials of the candidates. I hereby a	ccept	P.Eng., of
as the Independent Engineer (IE), with		P.Eng., as his
alternate, and R.P.Bio., of		as the Independent
Environmental Monitor (IEM), with	, and	as his
delegates.		

Water Licences clause (j) 3)

On April 1, 2016 I received a letter report prepared by **Sector** in his capacity as IE for the Project. In his review of BC Hydro's LCC 1 submission, the IE also reviewed several other relevant project documents, which he notes in his report. I find that the IE's review is thorough and provides sufficient detail to assess the water licence requirements for issuance of Leave to Construct and LCC 1 construction components. I note that the IE considers that conditions for Leave to Commence Construction as defined in the Water Licences have been met, and that he is not aware of any outstanding issues that would adversely affect the interests of licensees, riparian owners and owners of land adjacent to the works. I see that the IE recommends that LCC 1 be issued to the licensee, subject to the following conditions:



Independent Engineer and the Independent Environmental Monitor prior to the issuance of a Leave to Construct.

Water Licences clause (j) 3) e)

On April 1, 2016 I received a letter report prepared by the state of the Site C Clean Energy Project. In his review of BC Hydro's LCC 1 submission, the IEM reviewed the *Construction Environmental Management Plan* (CEMP) against the terms and conditions of the Water Licences, federal decision statement, provincial environmental assessment certificate, applicable standards and best practices identified in the CEMP, as well as applicable mitigation, monitoring and safety management plans prepared by BC Hydro. Although the IEM deems that the CEMP is satisfactory for the issuance of LCC 1, he notes several areas of outstanding concern and IEM expectations, which I have included below.

- The IEM recommends that all hydraulic machinery uses of biodegradable (non-toxic) hydraulic fluids be incorporated into in water work elements of the Project, as identified through the *Standards and Best Practices for Instream Works*.
- An *Acid Rock Drainage Metal Leachate Plan* has been appended to the CEMP, however the IEM believes that additional work is required to provide clarity to contractor as to the management and monitoring requirements for such materials as they are managed on site. [The IEM expects] that this additional information will be provided by BC Hydro prior to any removal and/or relocation of any such material.
- Further to the previous comment, the IEM requests additional details in the CEMP for surface water management within coffer dam areas and/or any other structures on site capable of retaining water. It is expected that this information will be provided prior to construction of any such structures.
- A detailed *Soil Management, Site Restoration and Revegetation Plan* is to be provided for the Project to the satisfaction of the Engineer and the IEM, which provides clarity as to the soil management, site restoration and revegetation requirements for the site. This is to include those requirements to be implemented by the various contractors and direct the preparation of EPPs through the CEMP process (...).
- The CEMP (Section 2.4.1) does not define risk, and BC Hydro has determined that this will be defined by the contractors QEPs.

Should

the IEM not agree with the risk evaluation, [the IEM] may require a re-assessment of risk as might relate (for example) to works around water, sensitive habitats, etc. and subsequent levels of monitoring effort.

• The IEM identified that a 300 m buffer for Bald Eagle nests would be appropriate during the breeding season based on the understanding that many areas would be considered as Undeveloped as defined in the *Guidelines for Raptor Conservation during Urban and Rural Land Development in British Columbia (2013)*. BC Hydro has stated that a 200 m buffer would be appropriate as they consider the area to consist of rural to industrial lands, and that the CEMP does provide that a QEP can make the determination to increase this buffer to 300 m. The IEM requests that this difference of opinion be addressed through the Vegetation and Wildlife Mitigation and Monitoring Technical Committee.

- The IEM recognizes that the CEMP will apply to a broad array of works, and as such the IEM expects sufficient details will be included within the EPPs and supporting plans for the works covered under LCC 1 to provide a clear and concise understanding of the specific mitigation measures to be employed for specific work components. In addition, given the anticipated volume of material expected for each work activity, the IEM must be provided sufficient time to allow for a detailed review of all appropriate documentation, to verify that the plans adequately address potential environmental impacts prior to issuance of any [Leave to Construct (LTC) authorized] by the IE.
- Given both the spatial and temporal nature of this Project, the IEM expects that the CEMP may require further revision, and respects the fact that the CEMP is a living document. Any revisions to the CEMP must be to the satisfaction of the Engineer, as such any changes must be provided in advance to both the IEM and Engineer for their consideration and to the satisfaction of the Engineer before they may be implemented.

I find the CEMP, dated March 24, 2016 and revised March 31, 2016, to be acceptable for the Project, with the exception of section 4.12 Soil Management, Site Restoration and Revegetation, and section 4.14 Acid Rock Drainage and Metal Leachate. Given the role of the Vegetation and Wildlife Monitoring and Mitigation Technical Committee (VWTC) regarding discussions pertaining to the first section and the IEM regarding the second section, I will allow additional time for the licensee to revise these sections in coordination with and to the satisfaction of the VWTC for section 4.12 and the IEM for section 4.14. Accordingly, the revised CEMP section 4.12 Soil Management, Site Restoration and Revegetation is to be submitted prior to the licensee's request for LCC 4 Reservoir Clearing, currently anticipated for July 2, 2016. The revised CEMP section 4.14 Acid Rock Drainage and Metal Leachate is to be submitted prior to the licensee's request for LCC 2 RSEMs, currently anticipated for April 9, 2016.

A total of 195 incidents of hydrocarbon fluid spills occurred on the Site C site between August 8, 2015 and March 23, 2016 during construction of the Project's early works authorized under separate permits. Ten of these incidents were spills directly to water, six of which were hydraulic fluid spills. The Ministry of Water, Land and Air Protection's March 2004 *Standards and Best Practices for Instream Works* includes a section titled *Deleterious Substance Control/Spill Management (Subsections 41 (a) (b) & 42 (1) (d))* which recommends that "all hydraulic machinery entering a steam uses environmentally sensitive hydraulic fluid that are non-toxic to aquatic life and is readily or inherently biodegradable". Furthermore, the Site C IEM supports the implementation of these best practices. I note that section 4.5 Fisheries and Aquatic Habitat Management of the CEMP requires that Environmental Protection Plans (EPPs) to be developed by the

"will address, at a minimum, the following requirements if applicable:

• Consider the use of readily biodegradable hydraulic fluids in equipment working within or above water."

Given the substantial number of hydrocarbon spills on site within the last six months, a stronger requirement is warranted to minimize impact to the aquatic environment. Accordingly, for the construction of works authorized by the Water Licences, including temporary works in support of constructing the named permanent works, all hydraulic equipment and machinery entering or working over a waterbody is required to use environmentally sensitive hydraulic fluids that are non-toxic to aquatic life and is readily or inherently biodegradable.

As mentioned above, the CEMP is a living document that may require revisions from time to time. Any revisions to CEMP sections that are applicable to the construction of works authorized by the Water Licences, including temporary works in support of constructing the named permanent works, are required to be reviewed and accepted by the IEM and the Engineer.

Water Licences clause (j) 4) (Schedule A)

- I have reviewed the Site C Clean Energy Project Vegetation Clearing and Debris Management Plan, dated June 5, 2015, developed by BC Hydro in response to Environmental Assessment Certificate No. 14-02 Condition No. 17. There are outstanding concerns with respect to reservoir clearing during the construction phase and debris management during the operation phase. I note that due to the unexpected recent loss of the forester responsible for the clearing plan, the licensee requires additional time in order to hire new staff and answer our questions. Given that the first LCC request for reservoir clearing is not anticipated until July 2, 2016, I will defer the completion of this Schedule A requirement until the request for LCC 4. In the meantime, I expect that I will be provided with further details on plans for reservoir clearing and debris management, including an in person meeting and presentation on the subject.
- 2) The Monitoring Plan for Downstream Flow Fluctuations focuses on understanding whether changes in flow downstream of the Project would affect sampling conditions and consequently the ability to compare pre- and post- Project fish monitoring data. I understand that the Fisheries and Aquatic Habitat Technical Committee (FAHTC) are in discussions regarding the sufficiency of existing baseline information as well as "baseline" data that will be collected in 2016, 2017 and 2018. I note that Mon-17-Peace River Water Level Fluctuation Monitoring has been added to the Fisheries and Aquatic Habitat Monitoring and Follow-up Program to address this monitoring requirement. I see that the FAHTC has agreed to review the sufficiency of the baseline information following sampling in 2016, 2017 and 2018. If the Committee assessed that the information is not sufficient, I understand that BC Hydro has committed to continue baseline sampling in 2019. To this end, I see that the FAHTC identified a three-step process for the analyses and are currently working on Step 3, which will inform future reviews. Based on the above, and after reviewing additional correspondence from regulatory agency members of the FAHTC, I am satisfied that this Schedule A requirement has been met.
- 3) The assessment procedure for evaluating juvenile fish in tributaries relates to monitoring juvenile fish in tributaries and ensuring that information would be collected for the indicator species: Rainbow Trout, Arctic Grayling and Bull Trout. I understand that the FAHTC reviewed several alternative approaches for monitoring juvenile Bull Trout in the Halfway Watershed, which resulted in the addition of four recommendations included in the document *Halfway Juvenile Assessment Methods*. I note that BC Hydro has committed to monitor juvenile Bull Trout in the Halfway River and that the FAHTC has agreed in principle to the recommended monitoring approach. I see that the FAHTC acknowledges that there is ongoing work needed on the steps to finalize the approach and adapt the program based on learning from sampling in 2016 and subsequent years, and that these steps are anticipated to be reviewed during the FAHTC meeting on April 6,

2016. Furthermore, I note that BC Hydro expects that the approach will be finalized by June 1, 2016 in advance of summer sampling. Based on the above, and after reviewing additional correspondence from regulatory agency members of the FAHTC, I have determined that while this Schedule A requirement has not been fully met, I am satisfied with the progress to date to allow for additional time to complete this project. Accordingly, the assessment approach for evaluating juvenile fish in tributaries is required to be completed and submitted by June 1, 2016.

- 4) Scope of long-term monitoring and follow-up decision criteria for offsets/compensation relates to the geographic extent and species, in particular Walleye and tributaries downstream of the Project. I understand that the FAHTC discussed that monitoring for Walleye occurs directly in the Peace River, where the potential effects of the Project on Walleye would occur, and uses indirect measures for that portion of the Walleye life history that occurs in tributaries. However, opportunities for habitat enhancement for Walleye may be more feasible and effective in tributaries (particularly the Kiskatinaw) than in the mainstream of the Peace River. Consequently, I see that the *Peace River Tributaries Walleye Spawning and Rearing Use Survey* (Task 2e) has been added to Mon-2 Peace River Fish Community Monitoring Program to assess the habitat characteristics of spawning and rearing areas in the Beatton and Kiskatinaw rivers. Based on the above, and after reviewing additional correspondence from regulatory agency members of the FAHTC, I am satisfied that this Schedule A requirement has been met.
- 5) The Kokanee Assessment Plan aims to evaluate the Kokanee status in the reservoir and determine the cause of any deviation from expected outcomes, in particular the understanding of recruitment into the reservoir and entrainment from the reservoir. I note that the FAHTC acknowledged the role of Kokanee in providing forage for other fish in the reservoir such as Bull Trout, and that the FAHTC agreed on the need for the monitoring to be robust to detect population-level changes in Kokanee density in the reservoir, as well as indicate the source of those changes. I understand that although the FAHTC continue to work towards agreement on what such a robust monitoring program would look like, they have made substantial progress on this milestone. I note that several steps have been identified for ongoing work on this project, with a projected completion date of September 30, 2016. Based on the above, and after reviewing additional correspondence from regulatory agency members of the FAHTC, I have determined that while this Schedule A requirement has not been fully met, I am satisfied with the progress to date to allow for additional time to complete this project. Accordingly, the Kokanee Assessment Plan is required to be completed and submitted by September 30, 2016.
- 6) The Soil Management, Site Restoration and Revegetation Plan was submitted as section 4.12 of the CEMP. As mentioned above, this section is not considered acceptable for the Project primarily due to lack of sufficient detail. In response to regulatory agency and IEM review and comments, the licensee has agreed to work with the VWTC to redraft this Plan to the satisfaction of the committee. Accordingly, the revised CEMP section 4.12 Soil Management, Site Restoration and Revegetation is to be submitted prior to the licensee's request for LCC 4 Reservoir Clearing, currently anticipated for July 2, 2016.

Water Licences clause (1)

On April 1, 2016 I received a letter report prepared by the second secon

In his report, DSO also outlined construction information that is not required for DSO review as well as specific construction components for which DSO review is required prior to the IE issuing his LTC. I note that the purview of the DSO review includes general *seepage control measures* such as fractured rock grouting, slurry wall or steel secant pile wall installation for cofferdams, the permanent dam, or other permanent structures. DSO review of the design, construction methodology, and quality control measures is required for the following:

- Diversion tunnel cofferdams
- Permanent dam cofferdams
- Diversion tunnels
- Permanent earthfill dam
- Permanent dam instrumentation installation
- All roller compacted concrete structures
- Approach Channel, Intake, Penstocks and Tailrace
- Spillway
- Low Level Outlets
- Installation of orifices in diversion tunnel
- First fill of the reservoir

I understand that the DSO's review will be at a high level, and that he will communicate directly with the IE to determine the appropriate documents and drawings to be included in his review. Furthermore, I note that addition to the review of historical project information, LCC submissions, selected LTC documents, and communication with the IE, the DSO's review will include observation of selected Technical Advisory Board (TAB) meetings at a minimum frequency of once per year. I see that the DSO proposes to observe the fall 2016 TAB meeting as his first meeting. I also note that the DSO plans to travel to site on a minimum frequency of twice per year or as needed based on consultation with the IE.

The scope of works comprising LCC 1 – Initial Works includes left bank excavation, right bank sidechannel closure dikes, right bank drainage tunnel, Moberly River construction bridge, backfilling of historic drill holes and exploratory adits, and erosion protection as needed. The Independent Engineer advises in his April 1, 2016 letter that the general arrangement and criteria for design and construction of LCC 1 works are acceptable.

Based on the documentation I reviewed and as described above, I find that the Water Licence conditions (j) and (l) have been met. I hereby grant to BC Hydro & Power Authority, the licensee, leave to commence construction of the works comprising LCC 1.

In addition to the above conditions highlighted in **bold text**, this leave to commence construction of works under LCC 1 is subject to the following conditions:

- The Contractor can begin construction of any component of the works only after the relevant design drawings signed and sealed by the design engineer, have been submitted to in his capacity as IE, for review, and permission to begin construction received from the IE. The permission will be in the form of a letter from the IE to the Engineer under the *Water Sustainability Act*, with copies to the Licensee, Design Engineer and the Construction Engineer.
- 2. Construction of works shall be supervised by the Construction Engineer and the Design Engineer.
- 3. Designs and plans for components identified in the April 1, 2016 letter report prepared by in his capacity as DSO require FLNRO Dam Safety Regulator approval prior to the Independent Engineer granting authorization to start construction of those components.
- 4. Weekly progress reports on contract construction shall be submitted by the licensee to the Independent Engineer and the Engineer under the *Water Sustainability Act*.
- 5. Permits, licences, and approvals under enactments other than the *Water Act* or *Water Sustainability Act* for the construction of works may be required in addition to the leave to commence construction, and you should ensure the appropriate authorizations are in place.

I can be contacted at if you have should wish to discuss this leave to commence construction.



Engineer under the Water Sustainability Act





June 29, 2016

File: 7001837

Vice President & Project Director Site C Clean Energy Project BC Hydro & Power Authority 600-1055 Dunsmuir Street Vancouver BC V7X 1V5 Email:

Dear

Re: Site C Clean Energy Project Conditional Water Licences 132990 and 132991 on Peace River Leave to Commence Construction No. 2

Conditional Water Licences 132990 and 132991 (Water Licences) issued to BC Hydro & Power Authority (BC Hydro) authorize the construction of works for the storage, diversion and use of water from Peace River for power purpose at the Site C Clean Energy Project (Project).

Clause (h) in the Water Licences authorizes the following works:

- 1) an approach channel;
- 2) an intake;
- 3) a dam;
- 4) spillways;
- 5) a reservoir;
- 6) a shoreline protection berm at Hudson's Hope;
- 7) a powerhouse and tailrace;
- 8) an access road; and
- 9) ancillary works associated with operation of the dam and generating station.

Clause (j) in the Water Licences requires that, before commencing construction of the works authorized under clause (h), the licensee must, to the satisfaction of the Comptroller of Water Rights:

- retain a professional engineer registered in the province of British Columbia (the "Independent Engineer") who will provide services to the Engineer for the regulation of construction of the works (Attachment A);
- 2) retain a person with professional qualifications (the "Independent Environmental Monitor") who will monitor environmental impacts from the construction of works (Attachment B);
- 3) submit, the following:
 - a. plans that show the general arrangement of the works;
 - b. criteria for the design of the works;
 - c. criteria for the operation of the works;

Water Allocation and Utility Regulation Section

- d. a schedule for the construction of the works;
- e. an environmental management plan (CEMP) for the management and mitigation of construction impacts;
- 4) complete all monitoring, mitigation and compensation projects required for each Leave to Commence Construction, as specified in Schedule A; and
- 5) obtain Leave to Commence Construction (LCC) in writing from the Engineer under the *Water Sustainability Act*.

Clause (l) in the Water Licences states that the construction of the said works must not commence until a draft Operation, Maintenance and Surveillance Manual (including a surveillance schedule for first filling) and an Emergency Preparedness Plan have been submitted to the satisfaction of the Dam Safety Officer.

I am the Engineer under the Water Sustainability Act (Engineer) for this Project.

The Independent Engineer advises that the construction activities have been separated into 15 Leaves to Commence Construction (LCC):

- LCC 1 Initial Works
- LCC 2 RSEMs
- LCC 3 Right Bank Stage 1 Cofferdam & Excavation
- LCC 4 Reservoir Clearing
- LCC 5 RCC Structures
- LCC 6 Left Bank Stage 1 Cofferdams & Diversion Works
- LCC 7 Powerhouse & Spillway Civil Works
- LCC 8 Stage 2 Cofferdams & Earthfill Dam
- LCC 9 Hydro-Mechanical Works (Gates & Hoists)
- LCC 10 Turbine, Generator & Completion Works
- LCC 11 Reservoir Clearing
- LCC 12 Approach Channel Stage 2
- LCC 13 Reservoir Clearing
- LCC 14 Hudson's Hope Berm
- LCC 15 Diversion Tunnel Conversion & Reservoir Filling

Additionally, there will be six Leaves to Commence Operation (LCO), one for each of the six units.

Status of LCCs

• LCC 1 was issued April 1, 2016

Water Licences clause (j) 1), 2)

On April 1 st , 2016 I accepted		as the Independent
Engineer (IE),	as his alternate, and	
	as the Independent Environmental Monitor (IE	M), with
	as his delegates.	

In consideration of Water Licences conditions (j), I have reviewed the following submissions and key documents related to LCC 2:

- Request for Issue of Leave to Commence Construction No. 2 for the Site C Clean Energy Project, dated April 8, 2016, prepared by _____;
- Site C Dam Documentation to Support Application for Leave to Commence Construction 2 (LCC 2), dated April 8, 2016, prepared by BC Hydro & Power Authority;
- Site C Clean Energy Project Request to Include South Bank Initial Access Road Backchannel Crossing in Leave to Commence Construction #2, dated June 14, 2016, prepared by



• Technical Guidance 7 Environmental Management Act – Assessing the Design, Size, and Operation of Sediment Ponds Used in Mining – Version 1.0, dated December 2015, prepared by Ministry of Environment;

http://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrialwaste/mining-smelt-energy/assessing design size and operation of sediment ponds.pdf

• *Technical Guidance 3 Environmental Management Act – Developing a Mining Erosion and Sediment Control Plan – Version 1.0*, dated February 2015, prepared by Ministry of Environment;

http://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/industrial-waste/mining-smelt-energy/erosion_sediment_control_plan_guide.pdf

- British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture Summary Report, dated March 2016, prepared by Ministry of Environment; http://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/waterqualityguidesobjs/approvedwat-qual-guides/final approved wqg summary march 2016.pdf
- Peace River Mainstem Water Quality Assessment and Objectives Technical Appendix, dated November 1987, prepared by Ministry of Environment and Parks; <u>http://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-objectives/wqo tech peace main.pdf</u>
- Ambient Water Quality Objectives for the Peace River Mainstem Overview Report, dated November 2, 1987, prepared by Ministry of Environment and Parks; <u>http://www.env.gov.bc.ca/wat/wq/objectives/peacemain/peace.html</u>
- *Construction Environmental Management Plan*, dated March 24, 2016, revised March 31, 2016 and April 7, 2016, prepared by BC Hydro & Power Authority;
- Site C Clean Energy Project Conditional Water Licence 132990 and 132991 on Peace River Water Quality Management Programme, dated June 24, 2016, prepared by Engineer under the Water Sustainability Act.
- Letter report dated June 27, 2016 from **Engineer**, on the review of the licensee's April 8, 2016 LCC 2 submission documents, including subsequent licensee and contractor materials, as well as regulatory documents;
- Memorandum dated June 29, 2016 from **Construction**, Impact Assessment Biologist with the Ministry of Environment, on the review of the water quality data and reports submitted by the licensee and their consultants, and the review of the Water Quality Management Programme.
- Letter dated May 30, 2016 from Fisheries and Aquatic Lead, Site C Clean Energy Project, BC Hydro, on the status of Schedule A milestone *Assessment procedure for evaluating juvenile fish in tributaries*.
- Email dated June 29, 2016 from Hydroelectric Impacts Biologist, Ministry of Environment, on the status of Schedule A milestone *Assessment procedure for evaluating juvenile fish in tributaries*.

Water Licences clause (j) 3)

On June 27, 2016 I received a letter report prepared by **Example** in his capacity as IE for the Project. In his review of BC Hydro's LCC 2 submission, the IE also reviewed several other relevant project documents, which he notes in his report. I find that the IE's review is thorough and provides sufficient detail to assess the water licence requirements for issuance of LCC 2 construction components. I note that the IE considers that conditions for Leave to Commence Construction as defined in the Water Licences have been met, and that he is not aware of any outstanding issues that would adversely affect the interests of licensees, riparian owners and owners of land adjacent to the works. The IE recommends that LCC 2 be issued to the licensee, subject to the following conditions:

• The IE's issuances of Leaves to Construct (LTCs) for the Relocated Surplus Excavated Materials areas (RSEMs) included in LCC 2 are contingent on BC Hydro providing copies of any additional Issued for Construction (IFC) drawings for each RSEM area and its initial sediment pond, and copies of the contractor's Construction Implementation Plan, Inspection and Test Plan, Care of Water Plan, Safety Plan and Environmental Protection Plan, as applicable to each RSEM area;

- These plans are to incorporate the requirements of the *Water Quality Management Programme*, ordered June 24th, 2016, and be to the satisfaction of the IE and the IEM prior to issuance of a LTC; and,
- BC Hydro shall confirm that all sediment ponds are not large enough to be considered regulated dam structures under the *BC Dam Safety Regulation* (2016).

Furthermore, the IE recommends five LTCs to be issued under LCC 2, one for each of the RSEM areas R5a, R5b, R6, L5 and L6.

Water Licences clause (j) 3) e)

On June 27, 2016 I received a letter report prepared by **Exercise** in his capacity as IEM for the Site C Clean Energy Project. In his review of BC Hydro's LCC 2 submission, the IEM also reviewed several other relevant project documents, which he notes in his report. In his report, the IEM confirms that conditions required by LCC 1 prior to issuance of LCC 2 have been met with the exception of revisions to *Section 4.14 Acid Rock Drainage and Metal Leachate* of the CEMP. Given that the *Water Quality Management Programme* was ordered on June 24, 2016, which the IEM expects will inform the CEMP revision, but may require additional time to complete; the IEM recommends that LCC 2 be issued in advance of the CEMP revision.

The IEM also notes that BC Hydro has confirmed that no end-of-pipe fish screens would be required as the RSEM pond discharge points are anticipated to be above the river's water level. It is expected that this point of consideration will be re-evaluated for each RSEM LTC issued by the IE, depending on the submission details. All sediment pond discharge structures must remain impassable to fish at all times.

The IEM further notes that constructed portions of the RSEMs will be within the wetted perimeter of the Peace River, Garbage Creek and Moberly River, and recommends that BC Hydro provide a list and summary of application status of relevant permits, approvals and authorizations for the works in their LTC applications.

Water Licences clause (j) 4) (Schedule A)

In my letter of April 1, 2016 issuing LCC 1, I directed that the assessment approach for evaluating juvenile fish in tributaries be completed and submitted by June 1, 2016. In his May 30, 2016 letter, submitted on behalf of the Fisheries and Aquatic Habitat Mitigation and Monitoring Technical Committee (FAHTC), describes how the FAHTC has completed this milestone. I see that in March 2016 the FAHTC had agreed in principle on the recommended approach to monitor juvenile Bull Trout in the Halfway River, and that since that time the committee has developed, reviewed and agreed to a specific sampling design. I understand that this sampling design has also been incorporated as an update to *Mon-1b – Site C Reservoir Tributaries Fish Community and Spawning Monitoring Program*, included in the *Fisheries and Aquatic Habitat Monitoring and Follow-up Program*.

Based on the above, and after reviewing additional correspondence from regulatory agency members of the FAHTC, I am satisfied that this Schedule A requirement has been met for juvenile Bull Trout. I have been advised that the FAHTC has further work to do for evaluating juvenile fish in tributaries for Rainbow Trout and Arctic Grayling. I understand that sampling of juvenile Rainbow Trout and

Arctic Grayling is planned for summer 2016, after which appropriate monitoring programs are to be designed for both fish species. Accordingly, the assessment approach for evaluating juvenile Rainbow Trout and Arctic Grayling in tributaries, including the design of their respective monitoring programs, must be completed and submitted by January 31, 2017.

There are no other Schedule A monitoring or mitigation projects that are required to be completed prior to construction of RSEM areas, which are included in the LCC 2 – RSEMs request.

Water Licences clause (1)

On April 1, 2016 I received a letter report prepared by **Exercise**, P.Eng., in his capacity as Dam Safety Officer (DSO) for the Site C Clean Energy Project. In his April 12, 2016 email to the IE, the DSO stated that he did not require review of the RSEM structures as the potential seepage from the ARD is not a dam safety concern. Consequently, the DSO has not provided a letter of review of the LCC 2 submission.

Construction Environmental Management Plan (CEMP)

In my April 1st, 2016 Order issuing LCC 1, I required that *Section 4.14 Acid Rock Drainage and Metal Leachate* of the CEMP be revised, in coordination with and to the satisfaction of the IEM, and submitted prior to the licensee's request for LCC 2. In consideration of the issuance of the *Site C Water Quality Management Programme*, as ordered by my letter of June 24, 2016, revisions to the *Acid Rock Drainage and Metal Leachate Plan*, shall be completed and submitted to the satisfaction of the IEM and the acceptance of the Engineer within 30 days of this Order.

It is acknowledged that the CEMP is a living document that may require revisions from time to time. As a reminder, any revisions to CEMP sections that are applicable to the construction of works authorized by the Water Licences, including temporary works in support of constructing the named permanent works, must be reviewed and accepted by the IEM and the Engineer.

Scope of LCC 2 Works

The scope of works comprising LCC 2 – RSEMs includes five RSEM areas R5a, R5b and R6 located on the right bank of the Peace River and L5 and L6 located on the left bank. Each RSEM area includes a sediment pond that will collect contact water and discharge into the Peace River. These RSEM areas are to be constructed by BC Hydro's Main Civil Works contractor,

I understand that shale and overburden deposits that must be excavated and that are either surplus to or unsuitable as construction materials are to be disposed of in the RSEM areas. I note that materials that are designated as potentially acid generating (PAG) are to be placed only in designated RSEMs that are designed to control and manage potential acid-generation and metal leaching from those materials.

I note that each of the RSEM areas requires a retention (starter) dike, designed by BC Hydro, which will retain the surplus materials to be stored behind the dike. In addition to its starter dike along the Peace River, I see that RSEM R6 will be contained on its west (upstream) side by a section of the Right Bank Stage 1 Cofferdam, and on its east (downstream) side by a section of the South Bank Initial Access Road (SBIAR).



Water Quality Management

It is my understanding that the Project does not require a permit under section 14 of the *Environmental Management Act* to regulate the introduction of waste into the environment. However, the licensee must comply with section 6 (4), which prohibits the introduction of waste into the environment in such a manner or quantity as to cause pollution. Furthermore, section 46 (1) of the *Water Sustainability Act* prohibits the introduction of foreign matter into the aquatic ecosystem or stream. Therefore, the *Site C Water Quality Management Programme* (Programme), as ordered in my letter of June 24, 2016, was developed in collaboration with BC Hydro and their consultants Ministry of Environment,

the Site C Independent Environmental Monitor team as well as the Office of the Comptroller of Water Rights.

In her June 29, 2016 memorandum, (MOE) expects that all water quality parameters of concern, as detailed in the Programme, will meet approved BC water quality guidelines at the edge of the 100 m downstream initial dilution zone (IDZ), with the exception of copper, which is naturally elevated in the Peace River. It was proposed that the predicted copper concentrations will be indistinguishable from background based on a Relative Percent Difference $\leq 20\%$ (MOE). This assessment helped to develop the Programme's site-specific end of pipe discharge limits and establish the criteria used for IDZ boundary concentrations.

notes that there are three main sources of uncertainty in the development of RSEM discharge limits: 1) modeled predictions of water quality at the point of discharge, 2) effectiveness of mitigations that will be used at the RSEMs to help manage water quality at the point of discharge, and 3) limited baseline data to adequately characterize baseline conditions of the Peace River. Overall, MOE agreed with the approach used to develop water quality discharge limits but advocated for robust monitoring at the point of discharge and in the receiving environment, in particular:

- Sediment pond sizing and erosion and sediment control plans should take into consideration *Technical Guidance 7 Environmental Management Act Assessing the Design, Size, and Operation of Sediment Ponds Used in Mining Version 1.0,* dated December 2015, and *Technical Guidance 3 Environmental Management Act Developing a Mining Erosion and Sediment Control Plan Version 1.10,* dated February 2015, both prepared by Ministry of Environment;
- Frequency of toxicity testing during normal operations, if there is a toxicity failure, and when flocculants are used;
- Sampling frequency, and analytical schedule for temporary and permanent sediment ponds discharging into the Peace River;

- Sampling locations, frequency, and analytical schedule for receiving environment monitoring program; and
- Sampling methods and quality assurance and quality control protocols according to *British Columbia Field Sampling Manual*, 2013 edition, prepared by Ministry of Environment (formerly Ministry of Water, Land and Air Protection).

The Programme is applicable to all permanent and temporary water storage/sediment ponds containing water that may be discharged to the aquatic environment and shall be incorporated into the design criteria for such water management structures. Sediment ponds must be designed and operated in accordance with *Technical Guidance 7 Environmental Management Act – Assessing the Design, Size, and Operation of Sediment Ponds Used in Mining – Version 1.0*, dated December 2015, and *Technical Guidance 3 Environmental Management Act – Developing a Mining Erosion and Sediment Control Plan – Version 1.10*, dated February 2015, both prepared by Ministry of Environment.

I understand that all contact water from the construction areas for works authorized by the Water Licences will be directed into sediment ponds located within the RSEM areas. I note that the works already authorized under LCC 1 LTCs 1B and 1C for the upper left bank excavation and the right bank drainage tunnel portal include temporary sediment ponds.

All RSEM sediment ponds must be designed to include any water routed to the ponds from other Project construction areas. Furthermore, all temporary and permanent sediment ponds authorized by the Water Licences, including the ponds mentioned above, are subject to the requirements of the water quality Programme.

It is expected that a low permeability layer will be achieved, as described in section 3.5.7 of

, for the base layer of each of the RSEM areas that will contain PAG material, including the associated sediment ponds as well as the pond walls and/or starter dikes. Furthermore, the same low permeability layer must be installed beneath any other temporary or permanent area on top of which PAG material will be placed. By doing so, seepage of contact water to groundwater or nearby aquatic environment will be minimized.

Based on the documentation I have reviewed and as described above, I find that the Water Licence conditions (j) and (l) have been met. I hereby grant to BC Hydro & Power Authority, the licensee, leave to commence construction of the works comprising LCC 2, subject to the following conditions:

- 1. The Contractor can begin construction of any component of the works only after the relevant design drawings signed and sealed by the Design Engineer, have been submitted to the in his capacity as IE, for review, and permission to begin construction is received from the IE. The permission will be in the form of a letter from the IE to the Engineer under the *Water Sustainability Act*, with copies to the Licensee, Design Engineer and the Construction Engineer;
- 2. Construction of works shall be supervised by the Construction Engineer and the Design Engineer;
- 3. Any revisions to CEMP sections that are applicable to the construction of works authorized by the Water Licences, including temporary works in support of constructing the named permanent works, must be reviewed and accepted by the IEM and the Engineer;

- The assessment approach for evaluating juvenile Rainbow Trout and Arctic Grayling in tributaries, including the design of their respective monitoring programs, must be completed and submitted by January 31, 2017;
- 5. The licensee shall adhere to and implement the *Site C Water Quality Management Programme* as ordered by my letter of June 24, 2016;
- All sediment ponds must be designed and operated in accordance with *Technical Guidance 7* Environmental Management Act – Assessing the Design, Size, and Operation of Sediment Ponds Used in Mining – Version 1.0, dated December 2015, and *Technical Guidance 3 Environmental* Management Act – Developing a Mining Erosion and Sediment Control Plan – Version 1.10, dated February 2015, both prepared by Ministry of Environment;
- All sediment ponds that discharge to the aquatic environment must be designed to include any water routed to the ponds from other Project construction areas;
- 8. All sediment pond discharge structures must be designed to be impassable to fish at all times;
- 9. A low permeability layer must be achieved, as described in section 3.5.7 of

for the base layer of each of the RSEM areas that will contain PAG material, including the associated sediment ponds as well as the pond walls and/or starter dikes. Furthermore, the same low permeability layer must be installed beneath any other temporary or permanent area on top of which PAG material will be placed;

- 10. All sediment ponds must comply with the BC Dam Safety Regulation (2016);
- 11. Weekly progress reports on contract construction shall be submitted by the licensee to the IE and the Engineer;
- 12. Permits, licences, and approvals under enactments other than the *Water Act* or *Water Sustainability Act* for the construction of works may be required in addition to the leave to commence construction, and you should ensure the appropriate authorizations are in place.

I can be contacted at **the second of** if you should wish to discuss this leave to commence construction.

Yours truly,



Engineer under the Water Sustainability Act

pc: Regional Executive Director, Northeast Region , Water Manager, Northeast Region , P.Eng., Independent Engineer Independent Environmental Monitor P.Eng., Dam Safety Officer , Section Head, Omineca – North Area Environmental Assessment Compliance Officer, EAO , Compliance and Enforcement Analyst, CEAA



Email:

July 20, 2016

File: 7001837

Site C C	lean Energy Project
BC Hyd	ro & Power Authority
600 - 10	55 Dunsmuir Street
Vancour	ver BC V7X 1V5

Dear

Site C Clean Energy Project Re: Conditional Water Licences 132990 and 132991 on Peace River Leave to Commence Construction No. 3

Conditional Water Licences 132990 and 132991 (Water Licences) issued to BC Hydro & Power Authority (BC Hydro) authorize the construction of works for the storage, diversion and use of water from Peace River for power purpose at the Site C Clean Energy Project (Project).

Clause (h) in the Water Licences authorizes the following works:

- 1) an approach channel;
- 2) an intake;
- 3) a dam;
- 4) spillways;
- 5) a reservoir;
- 6) a shoreline protection berm at Hudson's Hope;
- 7) a powerhouse and tailrace;
- 8) an access road; and
- 9) ancillary works associated with operation of the dam and generating station.

Clause (j) in the Water Licences requires that, before commencing construction of the works authorized under clause (h), the licensee must, to the satisfaction of the Comptroller of Water Rights:

- 1) retain a professional engineer registered in the province of British Columbia (the "Independent Engineer") who will provide services to the Engineer for the regulation of construction of the works (Attachment A);
- retain a person with professional qualifications (the "Independent Environmental Monitor") who will monitor environmental impacts from the construction of works (Attachment B);

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Location:

Victoria BC V8T 5K7

..../2

- 3) submit, the following:
 - a. plans that show the general arrangement of the works;
 - b. criteria for the design of the works;
 - c. criteria for the operation of the works;
 - d. a schedule for the construction of the works;
 - e. an environmental management plan (CEMP) for the management and mitigation of construction impacts;
- 4) complete all monitoring, mitigation and compensation projects required for each Leave to Commence Construction, as specified in Schedule A; and
- 5) obtain Leave to Commence Construction (LCC) in writing from the Engineer under the *Water Sustainability Act*.

Clause (1) in the Water Licences states that the construction of the said works must not commence until a draft Operation, Maintenance and Surveillance Manual (including a surveillance schedule for first filling) and an Emergency Preparedness Plan have been submitted to the satisfaction of the Dam Safety Officer.

I am the Engineer under the Water Sustainability Act (Engineer) for this Project.

In his April 1, 2016 LCC 1 recommendation letter report, Independent Engineer (IE) advised that the construction activities had been separated into 15 Leaves to Commence Construction (LCC):

- LCC 1 Initial Works
- LCC 2 RSEMs
- LCC 3 Left Bank Stage 1 Diversion Inlet and Outlet Cofferdams, Right Bank Stage 1 Cofferdam & Excavations
- LCC 4 Reservoir Clearing
- LCC 5 RCC Structures
- LCC 6 Left Bank Stage 1 Cofferdams & Diversion Works
- LCC 7 Powerhouse & Spillway Civil Works
- LCC 8 Stage 2 Cofferdams & Earthfill Dam
- LCC 9 Hydro-Mechanical Works (Gates & Hoists)
- LCC 10 Turbine, Generator & Completion Works
- LCC 11 Reservoir Clearing
- LCC 12 Approach Channel Stage 2
- LCC 13 Reservoir Clearing
- LCC 14 Hudson's Hope Berm
- LCC 15 Diversion Tunnel Conversion & Reservoir Filling

Within these 15 LCCs, 66 IE Leave to Commence (LTC) authorizations were identified.

Additionally, there will be six Leaves to Commence Operation (LCO), one for each of the six units.

Recent discussions between the IE, BC Hydro and the Main Civil Works Contractor have highlighted that there have been revisions to the proposed sequencing of construction activities, typical of large construction projects. The IE proposes to consult with BC Hydro and and recommend a revision to the schedule of LCCs and LTCs to incorporate the updated construction plan.

Accordingly, revisions to the schedule of LCCs and LTCs must be completed to the satisfaction of the IE and submitted to the Engineer by September 30, 2016.

Status of LCCs

- LCC 1 was issued April 1, 2016
- LCC 2 was issued June 29, 2016

Water Licences clause (j) 1), 2)



In consideration of Water Licences conditions (j), I have reviewed the following submissions and key documents related to LCC 3:

- Site C Clean Energy Project, CWL 132990 and 132991 on the Peace River Request for Issue of Leave to Commence Construction No. 3 (LCC 3), dated July 6, 2016, prepared by
- Site C Dam Documentation to Support Application for Leave to Commence Construction 3 (LCC 3), dated June 30, 2016, prepared by BC Hydro & Power Authority;



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- Appendix G MCW Contractor Schedule, dated June 30, 2016, prepared by BC Hydro & Power Authority;
- Site C Clean Energy Project Request to Include South Bank Initial Access Road Backchannel Crossing in Leave to Commence Construction #2, dated June 14, 2016, prepared by
- Construction Environmental Management Plan, dated March 24, 2016, revised March 31, 2016 and April 7, 2016, prepared by BC Hydro & Power Authority;
- Letter report dated July 18, 2016 from the Independent Engineer, on the review of the licensee's June 30, 2016 LCC 3 submission documents, including subsequent licensee and contractor materials, as well as regulatory documents;
- Letter report dated July 18, 2016 from Independent Environmental Monitor, on the review of the licensee's June 30, 2016 LCC 3 submission documents, including subsequent licensee and contractor materials, as well as regulatory documents;
- Letter report dated July 15, 2016 from Dam Safety Officer, on the review of the licensee's June 30, 2016 LCC 3 submission documents, including subsequent licensee and contractor materials, as well as regulatory documents;
- Letter dated July 5, 2016 from Manager, Environmental Mitigation, Monitoring and Compliance, Site C Clean Energy Project, BC Hydro, on the status of Schedule A milestone *Review of Program Area 10, determination of any additional plans or program development needed, and time-frame for plan(s) completion*;
- Letter dated July 5, 2016 from Manager, Environmental Mitigation, Monitoring and Compliance, Site C Clean Energy Project, BC Hydro, on the status of Schedule A milestone *Review of Program Area 12, determination of any additional plans or program development needed, and time-frame for plan(s) completion;*
- Letter dated June 20, 2016 from Manager, Environmental Mitigation, Monitoring and Compliance, Site C Clean Energy Project, BC Hydro, on the status of Schedule A milestone *Review of Program Area 13, determination of any additional plans or program development needed, and time-frame for plan(s) completion;*
- Letter dated June 24, 2016 from Manager, Environmental Mitigation, Monitoring and Compliance, Site C Clean Energy Project, BC Hydro, on the status of Schedule A milestone *Review of Program Area 16, determination of any additional plans or program development needed, and time-frame for plan(s) completion;*
- Email dated July 12, 2016 from Wildlife Lead, Site C Clean Energy Project, BC Hydro, on the status of Schedule A milestone *The plan, including detailed methodology, for the annual Waterfowl and Shorebird Monitoring component of the Breeding and Migratory Bird Program area (VWTC Program Area 8)* and milestone *Review of Program Areas 14 and 15, determination of any additional plans or program development needed, and time-frame for plan(s) completion;*
- Email dated July 19, 2016 from Manager, British Columbia Conservation Data Centre, Ministry of Environment, on the status of Pre-Diversion Left and Right Bank Works Schedule A milestones;

- Email dated July 19, 2016 from Unit Head, Species Conservation Science, Ministry of Environment, on the status of Pre-Diversion Left and Right Bank Works Schedule A milestones;
- Email dated July 19, 2016 from Director of Resource Management, Regional Operations Division – North Area, Ministry of Forests, Lands and Natural Resource Operations, on the status of Pre-Diversion Left and Right Bank Works Schedule A milestones; and,
- Letter dated June 28, 2016 from Independent Environmental Monitor, on acceptance of the Site C CEMP, Revision 3, dated April 7, 2016.

Water Licences clause (j) 3)

On July 18, 2016 I received a letter report prepared by **Security** in his capacity as IE for the Project. In his review of BC Hydro's LCC 3 submission, the IE also reviewed several other relevant project documents, which he notes in his report. I find that the IE's review is thorough and provides sufficient detail to assess the water licence requirements for issuance of LCC 3 construction components. I note that the IE considers that conditions for Leave to Commence Construction as defined in the Water Licences have been met, and that he is not aware of any outstanding issues that would adversely affect the interests of licensees, riparian owners and owners of land adjacent to the works.

The IE notes that

The IE reports that

The design flood for the Stage 1

cofferdams has a flow of about 4200 m³/s and a return period of about 90 years. For this flow, water levels at the upstream and downstream ends of the cofferdams would be about El. 414.4 m and 413.0 m, respectively.

Furthermore, the maximum water

level under ice jam conditions, an event that has an annual probability of about 6%, would be about El. 418.1 m and 416.9 m at the upstream and downstream ends of the cofferdams, respectively. In comparison, the design crest levels vary from El. 422.0 m and 418.0 m at the upstream and downstream ends of the cofferdams, respectively, which is higher than the water levels described above.

The IE notes that for the selected seismic design criteria, the annual exceedance probabilities for design seismic ground motions were 1:5000 for the left bank Stage 1 inlet and outlet cofferdams and 1:1000 for the right bank Stage 1 cofferdam.

The IE recommends that LCC 3 be issued to the licensee. Furthermore, the IE recommends four LTCs to be issued under LCC 3 as follows:

- 1. Right bank Stage 1 cofferdam, including the embankment and slurry trench cutoff.
- 2. Overburden excavations for the approach channel and structures to be constructed inside the right bank Stage 1 cofferdam.
- 3. Bedrock excavations for the approach channel and structures to be constructed inside the right bank Stage 1 cofferdam.
- 4. Left bank inlet and outlet cofferdams, including slurry trench cutoffs.

Water Licences clause (j) 3) e)

On July 18, 2016 I received a letter report prepared by the second in his capacity as IEM for the Site C Clean Energy Project. In his review of BC Hydro's LCC 3 submission, the IEM also reviewed several other relevant project documents, which he notes in his report. In his report, the IEM notes that while the right (south) bank side channel isolation has been completed, all fish and amphibian salvages must be completed prior to commencing in water works associated with the Right Bank Stage 1 Cofferdam. The IEM confirms that works associated with the Right Bank Stage 1 Cofferdam. The IEM confirms that works associated with the Right Bank Stage 1 Cofferdam should not require any additional permitting for activities occurring within the previously isolated area. Additional permitting, including a *Fisheries Act* Authorization and *Navigation Protection Act* permit, is required for other instream work components and must be in place prior to commencement of works. The IEM anticipates that this will be addressed through the LTC process.

Water Licences clause (j) 4) (Schedule A)

There are several Schedule A monitoring or mitigation projects associated with the construction of pre-diversion left and right bank works. All of these milestones are under the advisory scope of the Vegetation and Wildlife Technical Committee (VWTC).

Schedule A Pre-Diversion Left Bank Works milestone *The plan, including detailed methodology, for the annual Waterfowl and Shorebird Monitoring component of the Breeding and Migratory Bird Program area (VWTC Program Area 8)*:

In her July 12, 2016 email, **and the provided** an updated regarding annual waterfowl and shorebird monitoring. I understand that the VWTC has yet to discuss Schedule A Program Area 8; however, the committee is scheduled to review the waterfowl monitoring component in August 2016 and the shorebird monitoring component in September 2016.

I have been advised that the Canadian Wildlife Service, Environment and Climate Change Canada is now a member of the VWTC. This agency has a strong interest in this Program Area; therefore, additional time is required to further these discussions. I have also been informed that impacts of reservoir clearing, scheduled to be reviewed and authorized under LCC 4 this fall, would not be critical for these species.

Based on the above, and after reviewing additional correspondence from regulatory agency members of the VWTC, Schedule A milestone *The plan, including detailed methodology, for the annual Waterfowl and Shorebird Monitoring component of the Breeding and Migratory Bird Program area (VWTC Program Area 8)* must be completed and submitted by December 31, 2016.

Schedule A Pre-Diversion Left Bank Works milestone *Review of Program Area 13, determination of* any additional plans or program development needed, and time-frame for plan(s) completion:

In his June 20, 2016 letter written on behalf of the VWTC, **Sector Constitution** provided an update regarding discussions on the mitigation for Lighting Effects. Upon review of the language in the CEMP Section 4.17 *General Wildlife Habitat Protection Measures* and the construction monitoring done by environmental monitors, the VWTC is satisfied that lighting effects will be addressed through these provisions.

Based on the above, and after reviewing additional correspondence from regulatory agency members of the VWTC, I am satisfied that this Schedule A requirement has been met.

Schedule A Pre-Diversion Left Bank Works milestone Review of Program Area 14, determination of any additional plans or program development needed, and time-frame for plan(s) completion:

In her July 12, 2016 email, **Example 1** provided an update regarding Carnivore Den Sites, which included a draft letter, to be signed by **Example 1** and written on behalf of the VWTC, on the topic based on the committee's June 20, 2016 discussions.

I have been advised that while the draft letter has not been officially reviewed and accepted by the VWTC, it was discussed again at the July 15th meeting and the finalized letter is to be sent to committee members for approval shortly.

Based on the above, and after reviewing additional correspondence from regulatory agency members of the VWTC, I am satisfied that sufficient progress has been made on this Schedule A milestone. Accordingly, *Review of Program Area 14, determination of any additional plans or program development needed, and time-frame for plan(s) completion* must be completed and submitted by September 30, 2016.

Schedule A Pre-Diversion Left Bank Works milestone Review of Program Area 15, determination of any additional plans or program development needed, and time-frame for plan(s) completion:

In her July 12, 2016 email, **and the provided** an updated regarding Other Raptors. I understand that the VWTC had yet to review Schedule A Program Area 15 at the time of email; however, the committee was scheduled to discuss this topic at their July 15th

meeting.

I have been advised that Other Raptors were discussed at the July 15th meeting, but further discussions are required. I have been informed that there are implications of reservoir clearing on this suite of species, such as loss of nesting and hosting habitat.

Based on the above, and after reviewing additional correspondence from regulatory agency members of the VWTC, I am satisfied that sufficient progress has been made on this Schedule A milestone. Accordingly, *Review of Program Area 15, determination of any additional plans or program development needed, and time-frame for plan(s) completion* must be completed and submitted prior to issuance of LCC 4 – Reservoir Clearing.

Schedule A Pre-Diversion Right Bank Works milestone *Review of Program Area 10, determination of any additional plans or program development needed, and time-frame for plan(s) completion:*

In his July 5, 2016 letter written on behalf of the VWTC **Sector Conservation** provided an update regarding discussions on the mitigation for Cavity Nesting Species. As a result of these discussions, BC Hydro prepared the *Site C Clean Energy Project Vegetation and Wildlife Mitigation and Monitoring Cavity Nesting Species Summary* document, aimed at incorporating input from and addressing concerns raised by the VWTC. **Sector Project Project Project** outlines that between July and November 2016 BC Hydro plans to develop detailed offsetting programs for cavity nesting songbirds, waterfowl, woodpeckers, raptors and owls. These plans are to be reviewed and discussed by the VWTC late 2016 and early 2017.

I have been advised that Cavity Nesting Species were discussed at the July 15th meeting and that this Program Area requires a significant amount of work for the VWTC members. The mitigation approaches that have been discussed include nest boxes and snag creation via snag planting and fungal inoculation. I have also been informed that snag planting is most efficient and cost effective if done during reservoir clearing activities while the necessary machinery is onsite.

Based on the above, and after reviewing additional correspondence from regulatory agency members of the VWTC, I am satisfied that sufficient progress has been made on this Schedule A milestone. Accordingly, *Review of Program Area 10, determination of any additional plans or program development needed, and time-frame for plan(s) completion* must be completed and submitted prior to issuance of LCC 4.

Schedule A Pre-Diversion Right Bank Works milestone *Review of Program Area 12, determination of any additional plans or program development needed, and time-frame for plan(s) completion:*

In his July 5, 2016 letter written on behalf of the VWTC, **Sector Constitution** provided an update regarding discussions on the mitigation for Sharp-tailed Grouse. Discussions identified the need to expand the language in the CEMP to add specificity to mitigation and monitoring requirements for Sharp-tailed Grouse leks that could be affected by Construction activities. **Sector Construction** notes that the VWTC has yet to agree on the need to monitor the lek after construction if no disturbance is documented during construction monitoring; however, the VWTC is working to resolve this outstanding issue by July 31, 2016. I have been advised that the VWTC is seeking resolution of this issue at the Policy Committee level, in accordance with the committee's Terms of Reference.

Based on the above, and after reviewing additional correspondence from regulatory agency members of the VWTC, I am satisfied that sufficient progress has been made on this Schedule A milestone. Revisions to the CEMP regarding mitigation for Sharp-tailed Grouse as well as resolution of any outstanding issues must be completed and submitted by September 30, 2016.

Schedule A Pre-Diversion Right Bank Works milestone *Review of Program Area 16, determination of any additional plans or program development needed, and time-frame for plan(s) completion*:

In his June 24, 2016 letter written on behalf of the VWTC provided provided an update regarding discussions on the mitigation for Other Species at Risk. During their May and June 2016 meetings, the VWTC determined that it was not possible to complete all Schedule A milestones associated with Pre-Diversion Right Bank Works prior to BC Hydro's submission requesting LCC 3. Rather, the VWTC established a process to provide guidance on monitoring, mitigation and compensation projects for each Schedule A Program Area, including Other Species at Risk, as outlined in the test of test of

Based on the above, and after reviewing additional correspondence from regulatory agency members of the VWTC, Schedule A milestone *Review of Program Area 16, determination of any additional plans or program development needed, and time-frame for plan(s) completion* must be completed and submitted by September 30, 2016.

There are no other Schedule A monitoring or mitigation projects that are required to be completed prior to construction of project components included in the LCC 3 request.

Water Licences clause (1)

On July 15, 2016 I received a letter report prepared by the second secon

Construction Environmental Management Plan (CEMP)

In my April 1st, 2016 Order issuing LCC 1, I required that *Section 4.14 Acid Rock Drainage and Metal Leachate* of the CEMP be revised, in coordination with and to the satisfaction of the IEM, and submitted prior to the licensee's request for LCC 2. In consideration of the issuance of the *Site C Water Quality Management Programme* (Programme), as ordered by my letter of June 24, 2016, my LCC 2 letter dated June 29, 2016, required that revisions to the *Acid Rock Drainage and Metal Leachate Plan*, be completed and submitted to the satisfaction of the IEM and the acceptance of the Engineer by July 29, 2016. BC Hydro is currently working with the Comptroller of Water Rights Office to clarify details of the Programme in advance of directing their contractor and/or tendering a contract for the required monitoring work. Consequently, revisions to the *Acid Rock Drainage and Metal Leachate Plan* are to be completed and submitted to the satisfaction of the IEM and the acceptance of the Engineer by September 30, 2016.

It is acknowledged that the CEMP is a living document that may require revisions from time to time. Any revisions to CEMP sections that are applicable to the construction of works authorized by the Water Licences, including temporary works in support of constructing the named permanent works, must be reviewed and accepted by the IEM and the Engineer. Based on the above, and

letter of June 28, 2016, my email of July 12, 2016 accepted Revision 3 of the CEMP, dated April 7, 2016.

Scope of LCC 3 Works

The scope of works comprising LCC 3 – Left Bank Stage 1 Diversion Inlet and Outlet Cofferdams, Right Bank Stage 1 Cofferdam & Excavations includes construction of the right bank Stage 1 cofferdam and cut-off wall; overburden and bedrock excavations inside the right bank Stage 1 cofferdam for the RCC buttress, spillway, and portions of the tailrace and earthfill dam/core foundation; approach channel overburden and bedrock excavation; and construction of the left bank Stage 1 diversion inlet and outlet cofferdams and cut-off walls. On the right bank, the Stage 1 cofferdam will be mostly parallel to the river and will enclose the area where the roller-compacted concrete (RCC) buttress, the spillway, most of the tailrace and the right side of the earthfill dam will be constructed. Construction of all of these structures will require large excavations in both overburden and bedrock, some of which will extend below river level.

The approach channel will be constructed at a higher elevation on an existing terrace above the river level. The excavation for the RCC buttress will extend into that right bank terrace and into the footprint of the approach channel. Therefore, excavation for the RCC buttress requires that at least a portion of the adjacent excavation for the approach channel be completed at the same time.

On the left bank, two Stage 1 cofferdams will initially be constructed to enclose the areas where the inlet and outlet of the diversion tunnels will be located. Excavations inside these cofferdams, as well as the third left bank Stage 1 cofferdam will be reviewed and authorized under a separate LCC decision(s).

Each of the three Stage 1 cofferdams authorized under LCC 3 will be earthfill embankment dams constructed of granular materials, mostly founded on alluvial river deposits, with some colluvium near the valley sides. Portions of the dam crests will be utilized as construction haul roads. Each cofferdam will have a vertical cement-bentonite slurry cut-off wall extending through the dam and its foundation to sound bedrock. Dewatering systems will be installed inside each cofferdam to collect any seepage that migrates through the slurry cut-off wall or the underlying bedrock; collected water will be directed to Relocated Surplus Excavation Material (RSEM) sediment ponds.



Based on the documentation I have reviewed and as described above, I find that the Water Licence conditions (j) and (l) have been met. I hereby grant to BC Hydro & Power Authority, the licensee, leave to commence construction of the works comprising LCC 3, subject to the following conditions:

The Contractor can begin construction of any component of the LCC 3 works only after the relevant design drawings signed and sealed by the Design Engineer, have been submitted to in his capacity as IE, for review, and permission to begin construction is received from the IE. The permission will be in the form of a letter from the IE to the Engineer under the *Water Sustainability Act*, with copies to the Licensee, Design Engineer and the Construction Engineer;

- 2. Construction of works shall be supervised by the Construction Engineer and the Design Engineer, as per Water Licences clause (k) 1) and 2);
- 3. Any revisions to CEMP sections that are applicable to the construction of works authorized by the Water Licences, including temporary works in support of constructing the named permanent works, must be reviewed by the IEM and accepted by the Engineer;
- 4. Revisions to the *Acid Rock Drainage and Metal Leachate Plan*, Section 4.14 of the CEMP, incorporating the *Site C Water Quality Management Programme*, are be completed and submitted to the satisfaction of the IEM and the acceptance of the Engineer by September 30, 2016;
- 5. <u>Revisions to the schedule of LCCs and LTCs must be completed to the satisfaction of the IE and submitted to the Engineer by September 30, 2016.</u>
- 6. All cofferdams must comply with the BC Dam Safety Regulation (2016);
- 7. The Operation, Maintenance and Surveillance Plan as well as the Emergency Response and Preparedness Plan must be finalized prior to excavation activities within the cofferdams that will result in the dams holding back water;
- 8. Schedule A milestone *The plan, including detailed methodology, for the annual Waterfowl and Shorebird Monitoring component of the Breeding and Migratory Bird Program area (VWTC Program Area 8)* must be completed and submitted by December 31, 2016;
- 9. Schedule A milestone *Review of Program Area 14, determination of any additional plans or program development needed, and time-frame for plan(s) completion* must be completed and submitted by September 30, 2016;
- 10. Schedule A milestone *Review of Program Area 15, determination of any additional plans or program development needed, and time-frame for plan(s) completion* must be completed and submitted prior to issuance of LCC 4 Reservoir Clearing;
- 11. Schedule A Pre-Diversion Right Bank Works milestone Review of Program Area 10, determination of any additional plans or program development needed, and time-frame for plan(s) completion with respect to detailed offsetting programs for cavity nesting songbirds, waterfowl, woodpeckers, raptors and owls must be completed and submitted prior to issuance of LCC 4 – Reservoir Clearing.
- 12. Schedule A Pre-Diversion Right Bank Works milestone *Review of Program Area 12, determination of any additional plans or program development needed, and time-frame for plan(s) completion* with respect to revisions to the CEMP regarding mitigation for Sharp-tailed Grouse as well as resolution of any outstanding issues must be completed and submitted by September 30, 2016;
- 13. Schedule A milestone *Review of Program Area 16, determination of any additional plans or program development needed, and time-frame for plan(s) completion* must be completed and submitted by September 30, 2016;
- 14. Weekly progress reports on contract construction shall be submitted by the licensee to the IE and the Engineer;

15. Permits, licences, and approvals under enactments other than the *Water Act* or *Water Sustainability Act* for the construction of works may be required in addition to the leave to commence construction, and you should ensure the appropriate authorizations are in place.

I can be contacted at **a second** if you should wish to discuss this leave to commence construction.

Yours truly,



Engineer under the Water Sustainability Act

pc:

Regional Executive Director, Northeast Region, FLNRO Water Manager, Northeast Region, FLNRO Independent Engineer Independent Environmental Monitor P.Eng., Dam Safety Officer, FLNRO Section Head, Omineca – North Area. FLNRO Environmental Assessment Compliance Officer, EAO Compliance and Enforcement Analyst, CEAA

Site C Dam

Documentation to Support Application for Leave to Commence Construction 3 (LCC3)

Site C Clean Energy Project

June 30, 2016

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Appendix B Stage 1 Right Bank Cofferdam – Reference Drawings and Technical Specification Section 13 30 00; Diversion Inlet and Outlet Cofferdam – Reference Drawings – Plans and Sections

Appendix C Approach Channel Excavation – Plan

Appendix D RCC Buttress Excavation – Plan

Appendix E Tailrace Channel Excavation – Plan

Appendix F Mid-Stream Island and Bar Excavation – Plan

Appendix G MCW Contractor Schedule

1 INTRODUCTION

The purpose of this submittal is to provide documentation in support of the application for Leave to Commence Construction 3 (LCC3), which covers the following components of the project:

- Stage 1 Right Bank Cofferdam;
- Approach Channel excavation and fill;
- RCC Buttress excavation;
- Tailrace channel excavation and fill; and
- Mid-Stream Island and Bar excavation.

2 DESCRIPTION OF WORK

2.1 Stage 1 Right Bank Cofferdam

The Stage 1 Right Bank Cofferdam will confine the river to the main river channel to allow work to be carried out on the right bank for the RCC Buttresses and tailrace excavations as well as for the right portion of the Earthfill Dam. The upstream part of the Stage 1 Right Bank Cofferdam will be integrated into the Stage 2 Upstream Cofferdam. A plan view of the cofferdam is presented in Appendix A, along with a plan view of the general arrangement of the Stage 1 Cofferdams for reference.

The cofferdam foundation is predominantly sandy gravelly alluvium in the riverbed. The bedrock in the foundation is shale. The abutments consist of silty, clayey colluvium, mixed with the alluvium, overlying shale bedrock.

The cofferdam will be designed by the contractor, based on the reference drawings and specifications presented in Appendix B. The specifications include requirements for the location of the cofferdams, crest elevations, cut-offs as well as erosion protection, and they specify the strength parameters to be used in stability analyses, and minimum factors of safety in stability analyses.



The Contractor's main drawings are included in Appendix B. The Stage 1 Right Bank Cofferdam will be predominantly constructed from compacted granular material.

The criterion used for the design of the riprap is the 1:200 year return period flood event; therefore



Instrumentation will be installed within the cofferdam foundations to monitor the performance of the cofferdam. The installed instrumentation will include piezometers and inclinometers. Survey markers will be installed on the crest of the cofferdam. Monitoring of the instruments will begin shortly after installation and will continue throughout the life of the cofferdam.

2.2 Diversion Inlet and Outlet Cofferdams

The Stage 1 Diversion Inlet and Outlet Cofferdams will partially confine the river at the left bank to facilitate the following works:

- Excavation and support for the inlet and outlet portals,
- Construction of the Diversion Tunnel, the inlet and outlet portal structures, and a portion of the inlet and outlet channels.

The Stage 1 Left Bank Cofferdam will be tied into both Diversion Inlet and Outlet Cofferdams. The eastern portion of the Diversion Inlet Cofferdam will be tied into the dyke for RSEM L5 while the western portion of the Diversion Outlet Cofferdam will be tied into the dyke for RSEM L6. The general arrangement of the Stage 1 Cofferdams in included in Appendix A and the plan views of the Inlet and Outlet cofferdams are presented in Appendix B.

The Stage 1 Inlet and Outlet Cofferdams will be placed partially on colluvium, alluvium and interbedded alluvium and colluvium. The bedrock in the foundation is shale. The abutments consist of silty, clayey colluvium, mixed with the alluvium, overlying shale bedrock.

The cofferdams were designed by the contractor, based on the specifications presented in Appendix B. The specifications include requirements for the location of the cofferdams, crest elevations, cut-offs as well as erosion protection, and they specify the strength parameters to be used in stability analyses, and minimum factors of safety in stability analyses.



Instrumentation will be installed within the cofferdam foundations to monitor the performance of the cofferdams. The installed instrumentation will include piezometers and inclinometers. Survey markers will be installed on the crest of the cofferdam. Monitoring of the instruments will begin shortly after installation and will continue throughout the life of the cofferdams.

2.3 Approach Channel Excavation

The Approach Channel is an excavation in the overburden and bedrock, located on the right bank adjacent to the Earthfill Dam and the RCC Buttress, designed to convey water from the reservoir to the headworks structures.

A plan view of

the Approach Channel excavation is presented in Appendix C.




2.4 RCC Buttress Excavation

The excavation of the RCC Buttress is 750 m long, up to 250 m wide and up to 70 m deep. A plan of the RCC Buttress Excavation is presented in Appendix D.



The geometry of the RCC Buttress excavation is largely determined by the structural requirements of the overlying RCC Buttress, with a few geotechnical requirements: unsupported rock slopes can be no steeper than 1.3H:1V, and supported rock slopes (i.e. with rock bolts and shotcrete) can be no steeper than 0.3H:1V.

2.4.1 Excavation Sequence

The Powerhouse Buttress, located in the center of the overall excavation, is the first buttress to be excavated.



2.5 Tailrace Channel Excavation

The Tailrace channel will convey the flow from the Powerhouse and Spillway to the river. The geometry of the Tailrace channel is governed by hydraulic considerations, as determined from the physical hydraulic model (PHM) and numerical modeling (CFD). The overall Tailrace channel excavation measures approximately 350 m by 550 m. Plans of the Tailrace Channel excavation and protection is presented in Appendix E. The paragraphs below describe, for information, the fill and concrete erosion protection which will be the subject of a separate LCC application.

The Stage 1 Right Bank Cofferdam alignment crosses through the footp	rint of	the
Tairace channel, so the excavation will be divided into three phases.		

3 SCHEDULE

A high level schedule of construction for the components covered in this document is provided in Appendix G.

1020-C17-00725

1020-C17-00734

Appendix B

Stage 1 Right Bank Cofferdam – Reference Drawings and Technical Specification Section 13 30 00

1020-C17-00700

1020-C17-00711

1020-C17-00713

Section 13 30 00 [River Diversion and Cofferdams]

Diversion Inlet and Outlet Cofferdam – Reference Drawings – Plans and Sections

1020-C17-00704

1020-C17-00705

Appendix C – Approach Channel Excavation – Plan

1016-C17-00440

1016-C02-00413

1016-C22-05000

1020-C22-00411

Appendix G – MCW Contractor Schedule

BRITISH COLUMBIA

December 6, 2016

File: 7001837

Vice President & Project Director Site C Clean Energy Project BC Hydro & Power Authority 600 - 1055 Dunsmuir Street Vancouver BC V7X 1V5



Dear

Re: Site C Clean Energy Project Conditional Water Licences 132990 and 132991 on Peace River Leave to Commence Construction No. 4

Conditional Water Licences 132990 and 132991 (Water Licences) issued to BC Hydro & Power Authority (BC Hydro) authorize the construction of works for the storage, diversion and use of water from Peace River for power purpose at the Site C Clean Energy Project (Project).

Clause (h) in the Water Licences authorizes the following works:

- 1) an approach channel;
- 2) an intake;
- 3) a dam;
- 4) spillways;
- 5) a reservoir;
- 6) a shoreline protection berm at Hudson's Hope;
- 7) a powerhouse and tailrace;
- 8) an access road; and
- 9) ancillary works associated with operation of the dam and generating station.

Clause (j) in the Water Licences requires that, before commencing construction of the works authorized under clause (h), the licensee must, to the satisfaction of the Comptroller of Water Rights:

- retain a professional engineer registered in the province of British Columbia (the "Independent Engineer") who will provide services to the Engineer for the regulation of construction of the works (Attachment A);
- 2) retain a person with professional qualifications (the "Independent Environmental Monitor") who will monitor environmental impacts from the construction of works (Attachment B);

- 3) submit, the following:
 - a. plans that show the general arrangement of the works;
 - b. criteria for the design of the works;
 - c. criteria for the operation of the works;
 - d. a schedule for the construction of the works;
 - e. an environmental management plan (CEMP) for the management and mitigation of construction impacts;
- 4) complete all monitoring, mitigation and compensation projects required for each Leave to Commence Construction, as specified in Schedule A; and
- 5) obtain Leave to Commence Construction (LCC) in writing from the Engineer under the *Water Sustainability Act*.

Clause (I) in the Water Licences states that the construction of the said works must not commence until a draft Operation, Maintenance and Surveillance Manual (including a surveillance schedule for first filling) and an Emergency Preparedness Plan have been submitted to the satisfaction of the Dam Safety Officer.

is the Engineer under the *Water Sustainability Act* (Engineer) for this Project. As Deputy Comptroller, I am the statutory decision maker for the Water Licences. Both and I have the authority under the *Water Sustainability Act* to authorize LCCs.

In his April 1, 2016 LCC 1 recommendation letter report, the Independent Engineer (IE) advised that the construction activities had been separated into 15 Leaves to Commence Construction (LCCs):

- LCC 1 Initial Works
- LCC 2 RSEMs
- LCC 3 Left Bank Stage 1 Diversion Inlet and Outlet Cofferdams, Right Bank Stage 1 Cofferdam & Excavations
- LCC 4 Reservoir Clearing
- LCC 5 RCC Structures
- LCC 6 Left Bank Stage 1 Cofferdams & Diversion Works
- LCC 7 Powerhouse & Spillway Civil Works
- LCC 8 Stage 2 Cofferdams & Earthfill Dam
- LCC 9 Hydro-Mechanical Works (Gates & Hoists)
- LCC 10 Turbine, Generator & Completion Works
- LCC 11 Reservoir Clearing
- LCC 12 Approach Channel Stage 2
- LCC 13 Reservoir Clearing
- LCC 14 Hudson's Hope Berm
- LCC 15 Diversion Tunnel Conversion & Reservoir Filling

Within these 15 LCCs, 66 IE Leaves to Commence (LTCs) authorizations were identified. Additionally, there is anticipated to be six Leaves to Commence Operation (LCOs), one for each of the six units. Recent discussions between the IE, BC Hydro and the Main Civil Works Contractor

have highlighted that there have been revisions to the proposed sequencing of construction activities, typical of large construction projects. The IE is currently consulting with BC Hydro and PRHP and will recommend a revised schedule of LCCs and LTCs.

Included in the LCC 3 authorization, dated July 20, 2016, the Engineer requested that revisions to the schedule of LCCs and LTCs be completed to the satisfaction of the IE and submitted to the Engineer by September 30, 2016. I understand that the IE is presently engaged in the review of the proposed revision, and therefore requires additional time. Accordingly, revisions to the schedule of LCCs and LTCs must be completed to the satisfaction of the IE and submitted to the Engineer 31, 2016.

Status of LCCs

- LCC 1 was issued April 1, 2016
- LCC 2 was issued June 29, 2016
- LCC 3 was issued July 20, 2016

Water Licences clause (j) 1), 2)

On April 1, 2016 the Engineer acce	as the
Independent Engineer (IE), with	as his alternate, and
	as the Independent Environmental Monitor (IEM),
with , and	MREM, as delegates.

In consideration of Water Licence condition (j), the Engineer has reviewed the following submissions and key documents related to LCC 4:

- Site C Clean Energy Project, CWL 132990 and 132991 on the Peace River Request for Issue of Leave to Commence Construction No. 4 (LCC 4), dated October 20, 2016, prepared by including:
 - Central and Eastern Reservoir Clearing Drawings, dated October 19, 2016, prepared by BC Hydro;
 - o Land Act Licence of Occupation Application, Eastern Reservoir;
 - Forest Act Occupant Licence to Cut (OLTC #6) Application South Bank Eastern Reservoir;
 - Forest Act Occupant Licence to Cut (OLTC #7) Application North Bank Eastern Reservoir;
 - Site C Clean Energy Project Year 2 Clearing Field Assessment, dated July 19, 2016, prepared by Silvicon Services Inc. for BC Hydro;
 - o Land Act Licence of Occupation Application, east of Cache Creek;
 - o Forest Act Occupant Licence to Cut (OLTC #14) Application east of Cache Creek;
 - Forest Act Section 52 Application Cache Creek;
 - o Vegetation and Debris Management Plan, dated June 5, 2015, prepared by BC Hydro;
 - Vegetation and Debris Management Plan Consideration Table, undated, prepared by BC Hydro;

- Memo RE: Site C Outdoor Recreation Mitigation Planning Update, dated October 18, 2016, prepared by Public Affairs and Community Mitigation Manager, BC Hydro;
- Draft Outdoor Recreation Mitigation Plan, dated July 27, 2016, prepared by BC Hydro;
- Memo RE: Status of Charlie Lake Outfall Impact Mitigation Planning and Implementation, dated October 18, 2016, prepared by Public Affairs and Community Mitigation Manager, BC Hydro;
- Memo RE: Status of Private Land Acquisition in Support of Site C Clearing Requirements, dated September 28, 2016, prepared by Site C
 Properties Manager, BC Hydro; and,
- Several letters prepared by BC Hydro on behalf of the Fish and Aquatic Habitat Technical Committee (FAHTC) and Vegetation and Wildlife Technical Committee (VWTC) providing Water Licence Schedule A Milestone updates.
- Letter report dated November 30, 2016 from the review of the licensee's October 20, 2016 LCC 4 submission documents, including subsequent licensee and contractor materials, as well as regulatory documents;
- Letter report dated November 30, 2016 from Independent Independent Environmental Monitor, on the review of the licensee's October 20, 2016 LCC 4 submission documents, including subsequent licensee and contractor materials, as well as regulatory documents;
- Email dated November 14, 2016 from Dam Safety Officer, regarding the licensee's October 20, 2016 LCC 4 submission;
- Email dated November 18, 2016 from Unit Head, Applied Fisheries Research, Ministry of Environment, on the status of the Kokanee Assessment Plan Schedule A milestone;
- Email dated November 18, 2016 from Senior Fisheries Protection Biologist, Hydro & Flows Unit Ecosystem Management Branch, Fisheries and Oceans Canada, on the status of the Kokanee Assessment Plan Schedule A milestone;
- Email dated November 18, 2016 from Ecosystems Biologist, Regional Operations Division North Area, Ministry of Forests, Lands and Natural Resource Operations, on the status of the Kokanee Assessment Plan Schedule A milestone;
- Email dated November 18, 2016 from Hydroelectric Impacts Biologist, Ecosystems Branch, Ministry of Environment, on the status of the Kokanee Assessment Plan Schedule A milestone;
- Email dated November 18, 2016 from Manager, British Columbia Conservation Data Centre, Ministry of Environment, on the status of Schedule A milestones relevant to reservoir clearing;
- Email dated November 22, 2016 from Unit Head, Species Conservation Science, Ministry of Environment, on the status of Schedule A milestones relevant to reservoir clearing;

- Email dated November 24, 2016 from Senior Environmental Assessment Officer, Canadian Wildlife Service, Government of Canada, on the status of Schedule A milestones relevant to reservoir clearing;
- Email dated November 25, 2016 from Wildlife Biologist, Regional Operations Division North Area, Ministry of Forests, Lands and Natural Resource Operations, on the status of Schedule A milestones relevant to reservoir clearing;
- Email dated November 28, 2016 from Director of Resource Director of Resource Management, Regional Operations Division North Area, Ministry of Forests, Lands and Natural Resource Operations, on the status of Schedule A milestones relevant to reservoir clearing; and,
- Email dated November 29, 2016 from Regulatory Manager, Site C Clean Energy Project, BC Hydro, providing supplementary information to the LCC 4 submission.

Water Licences clause (j) 3)

On November 30, 2016 I received a letter report prepared by the in his capacity as IE for the Project. In his review of BC Hydro's LCC 4 submission, the IE also reviewed several other relevant project documents, which he notes in his report. I find that the IE's review is thorough and provides sufficient detail to assess the water licence requirements for issuance of LCC 4 reservoir clearing components. I note that the IE considers that conditions for Leave to Commence Construction as defined in the Water Licences have been met, and that he is not aware of any outstanding issues that would adversely affect the interests of licensees, riparian owners and owners of land adjacent to the works.

The IE notes that as part of the Site C project Early Works, BC Hydro applied for and received Occupant Licences to Cut and Remove Timber (OLTCs) L50182 and L50813, which covered the north and south banks of the dam site and adjacent upstream areas. Of the OLTC L50813 permitted works, only the area of RSEM R5a has been cleared to date. I understand that the permit will expire on 06 July 2017, and BC Hydro plans to proceed with clearing of the remaining areas during the winter of 2016-17.

The IE also notes that a related aspect of the reservoir clearing works is management of debris from clearing both during the period until the reservoir is filled, and during the operation of the future reservoir. I understand that engineered temporary and permanent debris booms are to be designed and constructed for the Site C project, and that the booms will be authorized by one or more separate LCCs.

The IE recommends that LCC 4 be issued to the licensee. Furthermore, the IE agrees with BC Hydro's request for five LTCs to be issued under LCC 4 as follows:

- 1. LTC 4A: Clearing to occur between December 2016 March 2017
 - North Bank dam site to Tea Creek;
 - North Bank Wilder Creek to Cache Creek; and,
 - South Bank area south of Tea Island.
- 2. LTC 4B: Clearing to occur between February 2017 March 2017
 - North Bank Central reservoir Highway 29 at Cache Creek
- 3. LTC 4C: Clearing to occur between Fall 2017 March 2018
 - North Bank Tea Creek to Wilder Creek

- 4. LTC 4D: Clearing to occur between Fall 2017 March 2018
 - South Bank remaining OLTC #6 area
- 5. LTC4E: Clearing to occur between Fall 2017 March 2018
 - North Bank Cache Creek Drainage Clearing

The IE notes that clearing of Crown lands in the remainder of the central portion and the western portion of the reservoir will be authorized under separate LCCs, currently scheduled for 2018 and 2020, respectively.

The IE further notes that the issuance of each LTC under LCC 4 should be contingent on:

- 1. BC Hydro providing a copy of the relevant vegetation clearing plan signed and sealed by a professional forester registered in the province of British Columbia;
- 2. Each LTC request should identify if any clearing works such as construction of access roads are anticipated to encounter potentially acid-generating (PAG) materials, and if so, what the plan is for their management;
- 3. BC Hydro providing an Environmental Protection Plan (EPP) for reservoir clearing, which is to reference the most recent version of the construction environmental management plan (CEMP; R4 dated 26 July 2016), and which will be submitted with the request for the first LTC under LCC 4; and,
- 4. BC Hydro providing the applicable public safety management plan for the clearing operations with the first LTC request under LCC 4.

I see that it is the opinion of the IE that the criteria for clearing and the clearing strategy are comprehensive, and intended to minimize impacts on the environment and to safely accommodate future public uses of the reservoir.

Water Licences clause (j) 3) e)

On November 30, 2016 I received a letter report prepared by the second in his capacity as IEM for the Site C Clean Energy Project. In his review of BC Hydro's LCC 4 submission, the IEM also reviewed several other relevant project documents, which he notes in his report.

The IEM notes that the EPP, which is to be authored by BC Hydro and to cover all of the clearing activities authorized by LCC 4, will be submitted as part of the LTC submissions. I see that the IEM expects the EPP would be amended or updated as necessary to describe the various clearing contract related works, relevant environmental components and mitigations unique to the various work areas through the LTC process.

Water Licences clause (j) 4) (Schedule A)

There are several Schedule A monitoring or mitigation project areas that may be affected by reservoir clearing activities. Furthermore, there are several requirements that were extended by previous LCCs to either be completed prior to LCC 4 issuance or a specified date. An update of the relevant Schedule A milestones is summarized below.

Schedule A Initial Right & Left Bank Works milestone Vegetation Clearing and Debris Management Plan:

LCC 1 required that this Schedule A milestone regarding the Vegetation Clearing and Debris Management Plan be completed by LCC 4 – Reservoir Clearing, including the provision of additional details on reservoir clearing and debris management and an in-person meeting and presentation on the subject.

LCC 1 noted outstanding concerns with respect to reservoir clearing during the construction phase and debris management during the operation phase. On June 8, 2016 BC Hydro representatives provided my office with an in-person presentation regarding Site C vegetation clearing and debris management. In addition to providing subsequent information, a follow-up call was held on August 16, 2016 with additional BC Hydro representatives including the new project forester as well as the author of the Outdoor recreation and Mitigation Plan.

Based on the above, and after additional correspondence with regulatory agency staff, I have decided that, in broad terms, the Vegetation Clearing and Debris Management Plan reflects an appropriate balance among values and issues including methylmercury, fish and aquatic habitat and nutrients, slope stability, riparian wildlife habitat and water quality. For recreation values around boat launch and other reservoir recreation sites, I am unable to visualise whether the clearing prescriptions presented are site appropriate. In response, rather than requesting clearing prescription changes to the Plan, authorization for the clearing and construction of the three new boat launch/day use sites will require three individual LTC submissions, for the review of this office and the approval of the IE. Each LTC submission package will include at a minimum site specific detailed clearing prescriptions in relation to facility design drawings.

Schedule A Initial Right & Left Bank Works milestone Kokanee Assessment Plan:

LCC 1 required that this Schedule A milestone regarding the Kokanee Assessment Plan be completed and submitted by September 30, 2016. On September 30, 2016 the Engineer received a letter from written on behalf of the FAHTC describing their continued efforts with respect to the Kokanee Assessment Plan, and the resulting outcomes, which include:

- Concurrently monitor Kokanee densities in the Peace Reach of Williston and Site C reservoirs using hydroacoustic and trawl sampling. If this monitoring suggests deviation from predictions in the Environmental Impact Statement (EIS), implement further monitoring; and
- (2) Establishing a series of sequential data interpretation steps for identifying the potential shortcomings in pelagic fish productivity as compared to the EIS predictions as suggested from outcome 1.

I understand that these outcomes and recommendations are summarized in the revised Entrainment Monitoring Program and the Kokanee guidance document, as well as updated sections of the Fisheries and Aquatic Habitat Monitoring and Follow-up Program. I note that the VWTC reviewed the updates and agreed that they would provide a robust assessment plan for Kokanee.

Based on the above, and after reviewing additional correspondence from regulatory agency members of the VWTC, I am satisfied that this Schedule A requirement has been met.

Schedule A Initial Right & Left Bank Works milestone Soil Management, Site Restoration and Revegetation Plan:

LCC 1 noted that the CEMP section lacked sufficient detail and consequently required that revisions to the CEMP section 4.12 Soil Management, Site Restoration and Revegetation be completed and submitted by LCC 4 – Reservoir Clearing.

On June 27, 2016 the Engineer received a letter from the vertice written on behalf of the VWTC regarding this program area. I understand that the VWTC reviewed the Soil Management, Site Restoration and Revegetation Program, and that the plan was revised to incorporate input from and address concerns raised by the committee. I note that BC Hydro has appended the document in its entirety to the CEMP to provide detailed guidance to contractors working in this area.

Based on the above, and after reviewing additional correspondence from regulatory agency members of the VWTC, I am satisfied that this Schedule A requirement has been met.

Schedule A Initial Right & Left Bank Works milestone *Assessment procedure for evaluating juvenile fish in tributaries*:

LCC 2 required that the assessment approach for evaluating juvenile Rainbow Trout and Arctic Grayling in tributaries, including the design of their respective monitoring programs, be completed and submitted by January 31, 2017. I have been advised that this milestone is in progress and on track.

Schedule A Pre-Diversion Left Bank Works milestone *The plan, including detailed methodology, for the annual Waterfowl and Shorebird Monitoring component of the Breeding and Migratory Bird Program area (VWTC Program Area 8)*:

LCC 3 required that this Schedule A milestone regarding Waterfowl and Shorebird Monitoring be completed and submitted by December 31, 2016. BC Hydro has sent the document to the VWTC for review, and has requested responses by November 21, 2016 in order to discuss this program area at the December 9, 2016 VWTC meeting. I have been advised that this milestone is in progress and on track.

I note that MoE has advised the Engineer that clearing activities authorized under LCC 4 are not expected to have significant immediate impact on migratory birds, waterfowl and shorebirds during the clearing period.

Schedule A Pre-Diversion Left Bank Works milestone *Review of Program Area 14, determination of* any additional plans or program development needed, and time-frame for plan(s) completion:

LCC 3 required that this Schedule A milestone regarding Carnivore Den Sites be completed and submitted by September 30, 2016. On August 8, 2016 the Engineer received a letter from

written on behalf of the VWTC describing their review of CEMP Section 4.17 *General Wildlife Habitat Protection Measures*.

I understand that the VWTC requested that the CEMP be modified to require contractors to create an information sheet(s), with photos and descriptions of dens for each species, and that this information sheet must be reviewed during orientations and daily tailboards and provided to machine operators and other workers completing pre-disturbance surveys and ground-disturbing activities. I also note that the VWTC requested that fisher be added to the heading bullet *Active bear, wolf, fox or coyote dens sites*. I see that BC Hydro has agreed to and implemented the above requested CEMP revisions.

I note that MoE has advised the Engineer that there is likely no potential impact from clearing activities authorized under LCC 4 on active fox or coyote den sites, as they are not active at this time of year; however, there may be potential disturbance to bear and/or fisher den sites, which will be active during the clearing period. I understand that the intent is that this concern will be captured during the pre-disturbance surveys and treated appropriately as per the CEMP.

Based on the above, and after reviewing additional correspondence from regulatory agency members of the VWTC, I am satisfied that this Schedule A requirement has been met.

Schedule A Pre-Diversion Left Bank Works milestone *Review of Program Area 15, determination of* any additional plans or program development needed, and time-frame for plan(s) completion:

LCC 3 required that this Schedule A milestone regarding Other Raptors be completed and submitted prior to issuance of LCC 4 – Reservoir Clearing. On November 15, 2016 the Engineer received a letter from Mr. Scarborough written on behalf of the VWTC regarding this program area.

I understand that the VWTC has reviewed the program area Other Raptors, and that committee guidance has been incorporated into the summary. I note that mitigation for Other Raptors is to be delivered through the following three programs:

- Wetland Mitigation Program;
- Mitigation for Non-Wetland Migratory Bird Program; and
- Cavity Nesting Species Mitigation Program.

I note that MoE has advised the Engineer that clearing activities authorized under LCC 4 are expected to result in loss of habitat for these species.

Based on the above, and after reviewing additional correspondence from regulatory agency members of the VWTC, I am satisfied that this Schedule A requirement has been met.

Schedule A Pre-Diversion Right Bank Works milestone *Review of Program Area 10, determination of any additional plans or program development needed, and time-frame for plan(s) completion:*

LCC 3 required that this Schedule A milestone regarding Cavity Nesting Species be completed and submitted prior to issuance of LCC 4 – Reservoir Clearing. On September 27, 2016 the Engineer received a letter from written on behalf of the VWTC describing their ongoing efforts regarding this program area.

I understand that the VWTC has identified the need for development of mitigation programs for cavity nesting songbirds, waterfowl, woodpeckers, raptors and owls, and that the committee is actively working on these plans. I note that the VWTC expected to complete the songbirds and waterfowl mitigation plan October 2016, and the woodpecker, raptors and owls mitigation plan November 2016. I have been advised that BC Hydro has developed the implementation plan to mitigate for cavity nesting species, and that this plan will be reviewed by the VWTC at their next meeting, currently scheduled for December 9, 2016.

I note that MoE has advised the Engineer that clearing activities authorized under LCC 4 are expected to have an impact on cavity nesting species. I understand that the clearing will not disturb or destroy active nests due to timing, with the possible exception of cavity nesting owls; however, there will be extensive loss of habitat for this group of species.

Based on the above, and after reviewing additional correspondence from regulatory agency members of the VWTC, I am satisfied that sufficient progress has been made on this Schedule A milestone. Accordingly, *Review of Program Area 10, determination of any additional plans or program development needed, and time-frame for plan(s) completion* must be completed and submitted by April 30, 2017.

Schedule A Pre-Diversion Right Bank Works milestone *Review of Program Area 12, determination of any additional plans or program development needed, and time-frame for plan(s) completion:*

LCC 3 required that revisions to the CEMP regarding mitigation for Sharp-tailed Grouse as well as resolution of any outstanding issues be completed and submitted by September 30, 2016. I understand that the VWTC was unable to reach consensus on an approach for effective monitoring of construction impacts on the sharp-tailed grouse leks. I note that the issue was elevated to the Fish Hydro Management Committee (FHMC), and that on September 23, 2016 they sent their response advising that in order for monitoring programs to be effective and defensible, they must be able to answer the management questions that they were designed to address. Consequently, the FHMC recommended that the VWTC consider the science as presented by the MOE in implementing its sharp-tailed grouse monitoring program. On November 15, 2016 the Engineer received a letter from

informing my office that BC Hydro has decided to elevate this issue to the BC Hydro Policy Committee for resolution at their next meeting, currently scheduled for February 15, 2017.

I note that MoE has advised the Engineer that clearing activities authorized under LCC 4 are not expected to have significant impact on sharp-tailed grouse.

Based on the above, I expect that the response from the BC Hydro Policy Committee be forwarded to my office, and that revisions to the CEMP regarding mitigation for Sharp-tailed Grouse must be completed and submitted within 30 days of the VWTC receiving the response.

Schedule A Pre-Diversion Right Bank Works milestone *Review of Program Area 16, determination of any additional plans or program development needed, and time-frame for plan(s) completion*:

LCC 3 required that this Schedule A milestone regarding Other Species at Risk be completed and submitted by September 30, 2016. On September 30, 2016 the Engineer received a letter from

written on behalf of the VWTC describing their ongoing efforts regarding the following species groups: Butterflies and Dragonflies; Amphibians; Migratory Birds; and Raptors.

I understand that mitigation and planning requirements differ for each of these groups, and that the VWTC is currently reviewing the third draft "species summary" document. I note that mitigation for these species will be addressed within the following programs:

- Dragonflies wetland mitigation works;
- Amphibians wetland mitigation works and construction management as outlined in the CEMP:V4;
- Migratory birds wetland mitigation works, mitigation for non-wetland migratory birds and construction management as outlined in the CEMP:V4; and,
- Raptors mitigation for Broad-winged Hawk and Short-eared Owl will be addressed within the wetland mitigation program, mitigation for non-wetland migratory birds and construction management as outlined in the CEMP:V4.

I see that the VWTC requested additional mitigation for butterflies, and that it was agreed that this mitigation will be addressed through seeding or planting of food and larval plants known to be used by butterflies. I note that the seeding program will be developed by BC Hydro in consideration of the Soil Management Reclamation and Revegetation Plan, and that the Butterfly Food and Nectaring Plant Seeding Plan has been developed and will be reviewed at the next VWTC meeting on December 9, 2016.

I note that MoE has advised the Engineer that clearing activities authorized under LCC 4 are expected to result in the possible mortality of some amphibian species and changes to their habitat.

I understand that the VWTC has identified that additional work is needed on various aspects of the Vegetation & Wildlife Mitigation and Monitoring – Other Species at Risk Summary, and that the committee intends to address these concerns by April 2017. Based on the above, and after reviewing additional correspondence from regulatory agency members of the VWTC, I am satisfied that sufficient progress has been made on this Schedule A milestone. Accordingly, *Review of Program Area 16, determination of any additional plans or program development needed, and time-frame for plan(s) completion* must be completed and submitted by April 30, 2017.

Although Schedule A does not specifically link project milestones with reservoir clearing activities, there is potential for, and in some cases likelihood of, resulting impacts on the various VWTC program areas. In addition to the above mentioned Schedule A requirements, I understand the status of the remaining program areas to be as follows:

Ungulate Winter Range (VWTC Program Area #1):

FLNRO has developed an approach to be initiated after the Ungulate Winter Range (UWR) exemption decision (Dec 2016) in which the Province will engage with First Nations regarding the management of UWR. There are two components to this approach: 1) Pursuant to existing plans, BCH will manage private land on the North side of the Peace River, adjacent to draft UWR for elk and deer, as elk and deer UWR; and 2) FLNRO will engage with affected First Nations to design and implement a UWR or similar outcome specifically for moose, on the south bank of the Peace. BC Hydro is intending to meet with (FLNRO) regarding this program area. The VWTC is satisfied by this approach.

Wetlands and Riparian Habitat (VWTC Program Area #2):

I have been advised that the VWTC intends to review this program area on January 20, 2017.

I note that MoE has advised the Engineer that clearing activities authorized under LCC 4 are expected to result in wetland habitat loss.

Fisher (VWTC Program Area #3):

The VWTC review of this program area has been deferred until early 2017, including the box and boreal respite program, as program implementation contracts have yet to be finalized. In the meantime, BC Hydro has started to create coarse woody debris piles, which support this program area.

I note that MoE has advised the Engineer that clearing activities authorized under LCC 4 are expected to result in fisher habitat loss.

Bats (VWTC Program Area #4):

BC Hydro is addressing VWTC comments and hopes to revise the summary document in time for the next VWTC meeting on December 9, 2016.

I note that MoE has advised the Engineer that clearing activities authorized under LCC 4 are expected to have little immediate impact on this program area; however, there is expected to be impacts associated with the loss of habitat in the subsequent seasons.

Snakes (VWTC Program Area #5):

The VWTC review of this program area has been deferred until early 2017, as program implementation contracts have yet to be finalized.

I note that MoE has advised the Engineer that clearing activities authorized under LCC 4 are not expected to have significant impact on snakes based on the locations of known snake hibernacula.

Amphibians (VWTC Program Area #6):

BC Hydro has sent the document to the VWTC for review, and has requested responses by November 25, 2016 in order to discuss this program area at the December 9, 2016 VWTC meeting.

I note that MoE has advised the Engineer that clearing activities authorized under LCC 4 are expected to result in the possible mortality of amphibians and changes to their habitat.

Eagles (VWTC Program Area #7):

On October 3, 2016 the Engineer received a letter from the work of written on behalf of the VWTC regarding this program area. I understand that the VWTC reviewed the Bald Eagle Mitigation and Monitoring Program, and that the plan was revised to incorporate input from the committee. I note that the VWTC reviewed eagle species plausibly within the Project Area and concluded that mitigation is not required for Golden Eagle as this species was not documented in the area during baseline surveys and was not identified by BC Hydro, MOE or FLNRO as being adversely affected by the Project.

I note that FLNRO has advised the Engineer that the current Bald Eagle plans adequately mitigate for potential impacts resulting from clearing activities authorized under LCC 4.

Based on the above, and after reviewing additional correspondence from regulatory agency members of the VWTC, I am satisfied that this Schedule A requirement has been met.

Ground Nesting Raptors (VWTC Program Area #9):

On September 26, 2016 wrote a letter to the Engineer on behalf of the VWTC regarding this program area. I understand that the VWTC reviewed the Ground Nesting Raptor Follow-up Monitoring Program, and that the plan was revised to incorporate input from the committee. I note that the revised plan was appended to the letter.

I note that MoE has advised the Engineer that clearing activities authorized under LCC 4 are not expected to have significant impact on ground nesting raptors, and may even provide additional pre-flooding habitat.

Based on the above, and after reviewing additional correspondence from regulatory agency members of the VWTC, I am satisfied that this Schedule A requirement has been met.

Rare Plants (VWTC Program Area #11):

BC Hydro is proposing two programs to manage for rare plants: (1) translocation, including ex situ propagation and planting, and (2) regional surveys for eighteen (18) species. BC Hydro is responding to VWTC comments, which will be reviewed at the December 9, 2016 VWTC meeting. The rare plants program is anticipated to start in 2017, and although rare plants have not been collected prior to the early works clearing in 2015 as well as the planned 2016/2017 clearing activities to be authorized under LCC 4, BC Hydro believes that no plant species have been lost. Rather, they expect to locate any species affected by the clearing activities to date in other areas of the reservoir yet to be cleared.

I note that MoE has advised the Engineer that clearing activities authorized under LCC 4 are expected to result in the loss of some plants. I understand that due to the clearing occurring during winter, including some grubbing activities, it will not be possible to locate rare plant species beyond known locations. Furthermore, I understand that owing to BC Hydro not having a contract in place for the rare plants program, this will be the second project-related clearing event without advance rare plant surveys and collection. These missed opportunities are greatly concerning to this office, and do not reflect responsible stewardship with respect to rare plants.

It is clear that there may be impacts from reservoir clearing, activities authorized under LCC 4 as well as future reservoir clearing LCCs, on the various vegetation and wildlife program areas. Therefore, it is paramount that the relevant mitigation and monitoring programs be initiated as soon as possible in order to minimize these impacts. I understand that BC Hydro and the VWTC hope to have all program area plans developed by April 30, 2017 for initiation in 2017, a target that I strongly support and require be met prior to issuance of any further LCCs related to clearing.

There are no other Schedule A monitoring or mitigation projects that are required to be completed prior to construction of project components or clearing activities included in the LCC 4 request.

Water Licences clause (1)

On November 14, 2016 the Engineer received an email from the second second in his capacity as Dam Safety Officer (DSO) for the Site C Clean Energy Project. The DSO states that he has no dam safety concerns regarding reservoir clearing.

Construction Environmental Management Plan (CEMP)

LCC 3 required that revisions to the CEMP section *Acid Rock Drainage and Metal Leachate Plan* be completed and submitted to the satisfaction of the IEM and the acceptance of the Engineer by September 30, 2016.

With input from MOE, the IEM and the Engineer, BC Hydro revised the *Acid Rock Drainage and Metal Leachate Plan* on July 26, 2016 and the plan was appended in its entirety as Appendix E of Version 4 of the CEMP.

Based on the above, I am satisfied that this LCC 3 requirement has been met.

Scope of LCC 4 Works

The scope of works comprising LCC 4 – Reservoir Clearing – Eastern, includes clearing within the eastern reservoir and Highway 29/Cache Creek portions of the central reservoir that are below the Permit Authorizing the Occupation of Crown Land (PCL) bounds of elevation 466.3 m. I understand that approximately 45% of the Site C reservoir area is forested: comprised of 57% deciduous trees and 43% of coniferous trees. I see that the eastern reservoir clearing area covers the lower 24 km reach of the proposed reservoir. This area includes several islands in the Peace River, as well as riparian areas and several tributary streams on both banks of the river. I understand that the clearing works will be performed under several contracts to be awarded by BC Hydro. I note that some sections of the existing riverbanks are quite steep and include slopes with both exposed bedrock and overburden cover. I have been advised that some vegetation, including merchantable timber, may be left standing in areas that are unsafe to access due to steepness and slope stability concerns.

I note that BC Hydro has applied for two LOOs covering the clearing areas included in LCC 4; one application is for 1,230 hectares in the eastern portion of the reservoir, and the other is for 183 hectares for the 8.5 km long Cache Creek segment of the Highway 29 realignment. A third application covers the proposed location of a temporary road on the south bank that will provide access for clearing that area. I understand that BC Hydro has also applied for two OLTCs that cover the north and south bank areas of the Peace River included in the eastern reservoir. A third OLTC application covers the above-noted south bank temporary road location, which is above the maximum flood level of the proposed reservoir. Each of the OLTC applications includes a timber cruise compilation of timber volumes, overview maps showing areas to be cleared or retained, maps of existing road access, an inventory of required stream crossings, and proposed stream crossing methods. I note that these applications also include a request for exemption from Sections 47, 48, and 49 of the Forest Planning Practice Regulation (FPPR) and that BC Hydro is instead proposing practices outlined in their document Approved Work Practices for Managing Riparian Vegetation. I understand that although the FLNRO statutory decision maker has yet to review the application submissions, the Engineer has been advised that such exemptions are commonly granted for approved activities such as Site C.

I understand that in areas where no reservoir shoreline erosion is predicted, clearing will be to the normal maximum level of El 461.8 m. Elsewhere, clearing will extend up to the elevation where erosion is predicted to occur over the first five years of reservoir operation (5-year beach line). I note that in local areas, the 5-year beach line may be at a higher elevation than the Maximum Flood Level of El. 466.3 m; however, in all cases, clearing could extend to higher elevations if necessitated by access and/or safety considerations. I note that clearing operations are generally scheduled for winter months to minimize impacts on soils and water quality, and to avoid sensitive bird and fish seasons. Where possible, I understand that necessary stream crossings will be via snow fills or ice bridges. Furthermore, I note that in riparian zones along the shoreline of the Peace River and major tributaries, a minimum width of 15 m is to be cleared by hand, although equipment will be allowed to reach into such zones to remove the cut vegetation.

I note that the proposed schedule would provide for reservoir clearing to be completed approximately one year in advance of the scheduled date for reservoir filling. I understand that the eastern area needs to be cleared first to allow for the initial inundation that will occur in 2019 when the second stage cofferdams are completed and the Peace River begins to flow through the diversion tunnels.

I understand that BC Hydro is actively engaged with private land owners in the eastern reservoir area, and that access is required through one owner's land for the 2016/17 winter clearing season. I have been advised that access is required through private property owned by four further landowners for the 2017/18 clearing season. I see that BC Hydro is currently in discussion with all of these landowners affected by the clearing activities authorized by this LCC.

I note that the **second second second**

I see that there are two natural gas lines located within the eastern reservoir clearing area: (1) the

gas line, which is not operational; and (2) the gas line, which is operational. I understand that BC Hydro intends to apply for crossing permits to cross both of these gas lines. In addition, I note that the BC *Oil and Gas Activities Act* and BC *Oil and Gas Commission Regulations* regulate such gas lines and provide protection measures for activities such as crossings, harvest around the pipeline and emergency response notification procedures.

I note that clearing for the Highway 29 realignment at Cache Creek includes the recommended site for a future public boat launch and day use site at the Cache Creek Crossing. BC Hydro advises that the site is on geotechnically stable ground, on BC Hydro owned land, and can accommodate parking and sufficient land for day use facilities. BC Hydro has not identified any environmental concerns for the site related to vegetation or wildlife, and advises that the site was included in the 2016 heritage program with no significant findings. I understand that the Cache Creek reservoir boat launch will be constructed directly adjacent to the replacement Highway 29 Bridge and will include a paved parking area, supporting up to 30 trucks and trailers, leading to a double wide boat launch based on access requirements for a 25 ft long vessel. I note that the recreation site will include day use facilities, including a dock, picnic areas, shoreline areas outhouses and day-use site. To ensure the best site specific recreational experience, a separate LTC submission for the boat launch is required, which should include but not be limited to, detailed boat launch designs and clearing prescriptions stamped by a professional forester registered in the province of British Columbia.

I see that a municipal wastewater effluent pipeline from Charlie Lake discharges from the north bank into the Peace River within the eastern clearing area authorized under LCC 4. I understand that mitigation for the Charlie Lake Outfall, as per EAC Condition No. 47, is one of several items in a draft Community Agreement currently being negotiated between BC Hydro and the

I note that if the agreement is not finalized in time for the work to proceed in advance of the Outfall works being affected by inundation, BC Hydro will approach the to develop a MOU specific to the Outfall. I see that since 2014, both parties have been working closely to investigate the potential Project-related impacts and appropriate mitigating options, and that they are now in the final stage of finalizing the scope, schedule and budget for the investigations and design for the outfall changes. I note that it is still uncertain whether these changes are required to be completed prior to September 2019 when the cofferdams will close the river, consequently raising the river elevation, or if the work can be postponed until 2022 when the reservoir will be filled. I understand that BC Hydro has advised the Engineer that geotechnical investigations are scheduled to take place in the spring of 2017 to assess the stability of the terrain around the outfall, which will inform the development of clearing prescription for this area, if feasible. I note that any clearing of the outfall area will be completed in the 2017/2018 winter clearing season.

Based on the documentation I have reviewed and as described above, I find that the Water Licence conditions (j) and (l) have been met. I hereby grant to BC Hydro & Power Authority, the licensee, leave to commence construction of the works comprising LCC 4, subject to the following conditions:

The Contractor can begin construction of any component of the LCC 4 works only after the
relevant design drawings signed and sealed by the Design Engineer, have been submitted to Tim
Little in his capacity as IE, for review, and permission to begin construction is received from the
IE. The permission will be in the form of a letter from the IE to the Engineer under the Water
Sustainability Act, with copies to the Licensee, Design Engineer and the Construction Engineer;

- 2. Construction of works shall be supervised by the Construction Engineer and the Design Engineer, as per Water Licences clause (k) 1) and 2);
- 3. Any revisions to CEMP sections that are applicable to the construction of works authorized by the Water Licences, including temporary works in support of constructing the named permanent works, must be reviewed by the IEM and accepted by the Engineer;
- 4. Revisions to the schedule of LCCs and LTCs must be completed to the satisfaction of the IE and submitted to the Engineer by December 31, 2016;
- Schedule A Pre-Diversion Right Bank Works milestone Review of Program Area 10, determination of any additional plans or program development needed, and time-frame for plan(s) completion with respect to detailed offsetting programs for cavity nesting songbirds, waterfowl, woodpeckers, raptors and owls must be completed and submitted by April 30, 2017;
- 6. Schedule A Pre-Diversion Right Bank Works milestone *Review of Program Area 12, determination of any additional plans or program development needed, and time-frame for plan(s) completion* with respect to the outstanding monitoring issue, the BC Hydro Policy Committee response must be forwarded to my office, and revisions to the CEMP regarding mitigation for Sharp-tailed Grouse must be completed and submitted within 30 days of the VWTC receiving the response;
- 7. Schedule A milestone *Review of Program Area 16, determination of any additional plans or program development needed, and time-frame for plan(s) completion* must be completed and submitted by April 30, 2017;
- 8. Authorization to construct reservoir boat launch and recreation sites requires separate LTC submissions per site, which are to include detailed facility designs as well as site specific clearing prescription, to be accepted by the Comptroller of Water Rights and approved by the IE;
- 9. All VWTC Schedule A program area plans must be developed and programs initiated prior to the issuance of any further LCCs related to reservoir clearing;
- 10. Weekly progress reports on contract construction shall be submitted by the licensee to the IE, IEM and the Engineer, including water quality monitoring data; and
- 11. Permits, licences, and approvals under enactments other than the Water Act or Water Sustainability Act for the construction of works may be required in addition to the leave to commence construction, and you should ensure the appropriate authorizations are in place. No clearing activities on Crown Land may commence prior to the issuance of relevant Land Act Licence(s) of Occupation, and Forest Act Occupant Licence(s) to Cut, Forest Act Section 52 authorization(s), and Forest and Range Practices Act ungulate winter range exemption(s), where applicable. No clearing activities on Private Land may commence prior to acquiring legal rights to access and/or possess the land.

If you should wish to discuss this leave to commence construction, please contact or myself at	at
Yours truly,	
Deputy Comptroller of Water Rights	
pc: Water Management Officer, WMB, FLNRO Regional Executive Director, Northeast Region, FLNRO Water Manager, Northeast Region, FLNRO Independent Engineer Independent Environmental Monitor Dam Safety Officer, WMB, FLNRO Section Head, Omineca – North Area, FLNRO Environmental Assessment Compliance Officer, EAO Compliance and Enforcement Analyst, CEAA	

File: 7001837



April 25, 2017

Vice President & Project Director Site C Clean Energy Project BC Hydro & Power Authority 333 Dunsmuir Street Vancouver BC V7X 1V5

Dear

Re: Site C Clean Energy Project Conditional Water Licences 132990 and 132991 Leave to Commence Construction #5

British Columbia Hydro and Power Authority (BC Hydro) is the holder of Conditional Water Licences 132990 and 132991 that authorize the construction and operation of the Site C Clean Energy Project (the Project).

Prior to constructing any phase of the Project, BC Hydro must obtain a Leave to Commence Construction (LCC) for that phase. The request for Leave to Commence Construction #5 - Left Bank Stage 1 Cofferdam and Diversion and Drainage Works was received on January 8, 2017.

My decision is to grant Leave to Commence Construction #5. The decision is set out in the attached document.

If you should wish to discuss this Leave to Commence Construction, please contact



Deputy Comptroller of Water Rights

pc's by email:

	Water Management Officer, WMB, FLNRO
	Regional Executive Director, Northeast Region, FLNRO
	Water Manager, Northeast Region, FLNRO
P.I	Eng. Independent Engineer
	Independent Environmental Monitor
	P.Eng. Dam Safety Officer, WMB, FLNRO
	Section Head, Omineca - North Area, FLNRO
E	nvironmental Assessment Compliance Officer, EAO
	Compliance and Enforcement Analyst, CEAA

Water Allocation Section

Mailing Address: PO Box 9340 Stn Prov Govt Victoria BC V8W 9M1 Telephone: 250-952-6790 Facsimile: 250-953-5124

Location: 3rd Floor 395 Waterfront Crescent Victoria BC V8T 5K7



Resource Stewardship Division

BRITISH COLUMBIA

MINISTRY OF FORESTS, LANDS AND NATURAL RESOURCE OPERATIONS

Site C Clean Energy Project

Decision to Issue Leave to Commence Construction #5 Left Bank Stage 1 Cofferdam and Diversion and Drainage Works

Signed: April 25, 2017

by: P. Eng. Deputy Comptroller of Water Rights

Leave to Commence Construction #5

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1. Introduction

1.1 Request and Decision for Leave to Commence Construction

British Columbia Hydro and Power Authority (BC Hydro) is constructing the Site C Clean Energy Project on the Peace River (the "Project") under the authority of the *Water Sustainability Act*. Leave to Commence Construction of Phases 1 to 4 and Phase 7 of the Project have been granted and BC Hydro has requested leave to commence construction of Phase 5.

BC Hydro has also requested leave to commence construction of Phase 6, which is under review.

Phase 5 includes the left bank stage 1 cofferdam for confining the flow of the Peace River to its main channel and two tunnels for diverting the flow of the river during the construction of the earthfill dam. This phase also includes an adit that is to be constructed for relieving the pore water pressure in the left abutment. In-river works are required to improve the flow conditions in the tailrace and downstream river channel.

The request dated January 8, 2017 is from Director of Environment, Aboriginal Relations and Public Affairs and is supported by documents and plans that describe the components of Phase 5. The LCC #5 Submission includes the January 8 request letter along with the supporting information provided by BC Hydro.

This document reviews the Submission and other relevant information, all of which are the basis for the decision to issue Leave to Commence #5 (LCC #5).

The decision with associated conditions is in Section 9.2 – Decision.

1.2 Submission for Leave to Commence Construction

The Submission comprises the documents and plans listed in Appendix A.

2. Decision Maker

The Decision Maker is **Deputy** Deputy Comptroller of Water Rights (the "DCWR") and his authority includes that of an Engineer under the *Water Sustainability Act*.

3. Background

3.1 Water Licences

Conditional Water Licences 132990 and 132991 (the Water Licences) authorize the construction of works for the storage, diversion and use of water from the Peace River for the Project. BC Hydro is the holder of the Water Licences and may be referred to as the Licensee.

The *Water Act* [RSBC 1996] is referenced in the Water Licences. In British Columbia the *Water Sustainability Act* is now the principle law for managing the diversion and use of water resources. The *Water Sustainability Act* came into force on February 29, 2016 and for the purposes of the Water Licences replaced the *Water Act*.

3.2 Works Authorized under the Water Licences

The works authorized in clause h) of the Water Licences includes the following:

- 1) an approach channel;
- 2) an intake;
- 3) a dam;
- 4) spillways;
- 5) a reservoir;
- 6) a shoreline protection berm at Hudson's Hope;
- 7) a powerhouse and tailrace;
- 8) an access road; and
- 9) ancillary works associated with operation of the dam and generating station.

The works are to be located as shown on the plan attached to each Water Licence.

The components of Phase 5 described in the Submission are required for the construction of the dam and tailrace.

3.3 Dam Safety Regulations

Clause i) of the Water Licences states that the dam authorized under clause h) is subject to the Dam Safety Regulations and shall be designed, constructed and maintained, including any alterations, to the satisfaction of a Dam Safety Officer under the *Water Act* (the "Dam Safety Officer") and in accordance with the Canadian Dam Association Guidelines.

The Dam Safety Officer (DSO) for the Site C Clean Energy Project is MSc, P.Eng. Senior Dam Safety Officer, BC Ministry of Forests, Lands and Natural Resource Operations, Water Management Branch.

4. Appointment of Independent Engineer and Independent Environmental Monitor

As required under clause j) 1) and 2) of the Water Licences and in accordance with LCC #1:

- Engineer , with as his alternate, and
 is confirmed as the Independent is confirmed as the
 - Independent Environmental Monitor, with as delegates.

5. Design Engineer and Construction Engineer

The role of the Design Engineer and Construction Engineer as set out in clause k) 1) and 2) of the Water Licences is being fulfilled by P.Eng., who is the Owner's Engineering Manager and is responsible for coordinating both the design and the field review of the works.

6. Phases of Construction

Construction of the Project under the Water Licences has proceeded under the following leaves to commence construction:

- 1. LCC #1 issued April 1, 2016 and authorizes the left bank excavation; right bank side channel closure dikes, right bank drainage tunnel, Moberly River construction bridge, backfilling of historic drill holes and exploratory admits, and erosion protection as needed.
- LCC #2 issued June 29, 2016 and authorizes the construction of five areas for the Relocation
 of Surplus Excavated Material (RSEM). The areas are enclosed by dikes and each has a
 sediment pond for the collection of contact water. The ponds discharge to the Peace River.
 These works
- 3. LCC #3 issued July 20, 2016 and authorizes the construction of the Left Bank Stage 1 Diversion Inlet and Outlet Cofferdams, the Right Bank Stage 1 Cofferdam with cut-off wall, overburden and bedrock excavations inside the right bank cofferdam and approach channel overburden and bedrock excavation.
- 4. LCC #4 issued December 6, 2016 and authorizes clearing of the eastern portion and part of the central portion of the reservoir.
- 5. LCC #7 issued April 20, 2017 and authorizes geotechnical investigations to obtain information for the design of the Hudson's Hope Shoreline Protection Berm and the Halfway River Debris Boom.

The request for LCC #6 was submitted on January 30, 2017 and proposes the construction of a buttress of roller compacted concrete on the right (south) bank. The buttress will support the south wall of the Peace River Valley at Site C and provide an abutment for the earthfill dam and the foundation for the powerhouse and the spillways. The decision on the request is pending.

7. Review of Submission

7.1 Scope of Works

The components of Phase 5 are listed in the Submission as follows:

- Diversion Inlet and Outlet Portal Excavations
- Diversion Inlet and Outlet Cofferdams
- Diversion Inlet and Outlet Channels
- Diversion Tunnel Excavation
- Diversion Tunnel Lining
- Diversion Inlet Structures
- Diversion Outlet Structures
- Left Bank Drainage Tunnel and Adit
- Left Bank Cofferdam and Trench Excavation
- RSEM Area L6 and Related Works in the Peace River

The Submission provides descriptions and plans of the components to be constructed.

7.2 Report by the Independent Engineer (IE)

provides a comprehensive review of Phase 5 in the letter report (the "IE Report") dated March 27, 2017. The IE Report describes the scope of Phase 5 to include the following components:

- 1. Inlet Works Portal and Channel Including In-River Portion of Channel
- 2. Outlet Works Portal and Channel Including In-River Works for the Tailrace and Downstream River Channel
- 3. Stage 1 Left Bank Cofferdam Including Slurry Cut-off Wall & Grouting and Left Bank Earthfill Dam Core Trench Excavation
- 4. Left Bank Drainage Adit Including Portal Works
- 5. Diversion Tunnels Excavation and Rock Support
- 6. Diversion Tunnels Lining and Inlet & Outlet Concrete Structures
- 7. Diversion Tunnel Gates & Electro-Mechanics Installation & Testing

The IE has reviewed the Submission in the context of his mandate as described in Attachment A of the Water Licences. The IE considers that conditions for granting the Submission have been met, subject to the acceptance of the monitoring, mitigation and compensation projects as required under the Water Licences.

The IE clarifies in the his report that LCC #3 already authorized the construction of the inlet and outlet cofferdams and LCC #2 already authorized the construction of all RSEMs.

The IE Report states that part of the requested in-river works related to the *Downstream River Channel* of item 2 above is downstream of the Dam site Boundary and is excluded from LCC #5.

The recommendation of the IE is that the request for LCC#5 be granted and that seven associated Leaves to Construct (LTCs) be established, which is an LTC for each of the components listed above.

I accept the IE Report dated March 27, 2017.

7.3 Description of Works

The construction of the earthfill dam of the Project requires the Peace River to be diverted around the dam site by way of two tunnels. The diversion is completed in two stages.

The first stage is the construction of cofferdams on the left and right banks to confine the river to its main channel. The cofferdams at the inlet and outlet portals of the tunnels stop the river from entering the tunnels while they are under construction. The inlet and outlets of the tunnels will be equipped with gates and ancillary works for controlling the diversion.

The second stage is the removal of a portion of the cofferdams at the inlet and outlet portals, which will divert some flow through the tunnels. The diversion is completed by closing off the river channel with cofferdams upstream and downstream of the dam site. The area between these two cofferdams will be dewatered and portions of the left and right bank cofferdams will be removed to allow construction of the dam. The second stage of the diversion will be authorized in a subsequent LCC.

The construction of the left bank cofferdam and the tunnels is included in LCC #5. The construction of the other cofferdams is included in LCC #3.

The left bank drainage adit with its portal works is intended to relieve pore water pressure in the left abutment bedrock. The construction of the adit is part of LCC #5.

The in-river works for the tailrace and downstream river channel is required to lower the water level in the tailrace to increase power generation and reduce potential stranding of fish when the power generation is ramped down. The portion of the in-river works that is within the dam site boundary is part of LCC #5.

The works of LCC #5 are described in more detail in Appendix C, which is a copy of Section 2 of the IE's Report.

7.4 Amendment of Scope of Works

The components of Phase 5 described in the Submission include:

- the Diversion Inlet and Outlet Cofferdams, and
- RSEM Area L6 and Related Works in the Peace River.

The description in the Submission of the two cofferdams and the RSEM is helpful for understanding the way all the components fit together. However, leave to commence construction of the Diversion Inlet and Outlet Cofferdams, and RSEM Area L6 is provided under LCC #3 and LCC #2 respectively.

The Submission submitted on January 8, 2017 is amended to remove the Diversion Inlet and Outlet Cofferdams, and RSEM Area L6 as components of the works to be constructed under Phase 5.

The "Related Works in the Peace River" described in the Submission is considered to be "in-river excavations" as described in the IE Report. The portion of these works that is within the dam site boundary is part of Phase 5 of the Project.

7.5 Report by the Independent Environmental Monitor

The report of the IEM, dated March 27, 2017 reviews the Submission and includes a description of the components of Phase 7.

The IEM intends to review the information for the construction of each component including the Environmental Protection Plans, associated component plans and design drawings to verify that "they achieve the requirements of relevant permits, approvals authorizations, EAC conditions, the federal Decision Statement and the Construction Environmental Management Plan."

The plans and documents reviewed by the IEM are cited in the IEM's report.

The IEM states that, from his perspective, sufficient information is in place for the issuance of LCC #5.

I accept the IEM's Report dated March 27, 2017.

7.6 Report by Dam Safety Officer (DSO)

February 24, 2017, he accepts the following:

- 1. The consequence classification for the cofferdams as proposed by the Licensee;
- 2. The contents of the Stage 1 Cofferdams Operation, Maintenance and Surveillance Manual dated March 10, 2017 and the Emergency Response and Preparedness Plan dated February 16, 2017.

The DSO is satisfied with the information provided for the design and planned construction methodology for LCC # 5.

8. Environmental Considerations

The Water Licences require the completion of monitoring, mitigation and compensation projects (the "Plans") related to various phases of the Project before construction of the phases may commence. Schedule A attached to the Storage Licence sets out the Plans required for each phase of the Project.

BC Hydro submitted on April 13, 2017, fourteen Plans to satisfy the requirements of the Water Licences related to Schedule A and LCC #6.

A thorough review of the Plans is now underway. On the assurance of BC Hydro that the plans associated with LCC #5 are substantially compliant with the requirements of Schedule A, I have decided to issue LCC #5.

If the review determines that the Plans are not to my satisfaction, I will impose conditions on the LTCs associated with LCC #5.

9. Conclusion

9.1 Documents Considered for Decision

The decision on the Submission considers the *Water Sustainability Act*, the requirements of the Water Licences, the plans and documents listed in Appendix A and the reports by and

9.2 Decision

I hereby grant to BC Hydro & Power Authority leave to commence construction of the works described as:

- 1. Inlet Works Portal and Channel Including In-River Portion of Channel
- 2. Outlet Works Portal and Channel Including In-River Works for Tailrace and Downstream River Channel
- 3. Stage 1 Left Bank Cofferdam Including Slurry Cut-off Wall & Grouting and Left Bank Earthfill Dam Core Trench Excavation
- 4. Left Bank Drainage Adit Including Portal Works
- 5. Diversion Tunnels Excavation and Rock Support
- 6. Diversion Tunnels Lining and Inlet & Outlet Concrete Structures
- 7. Diversion Tunnel Gates & Electro-Mechanics Installation & Testing

This Leave to Commence Construction #5 is subject to the following conditions:

- a) Before the construction of any component of LCC #5 of the Project may proceed, the Licensee must:
 - submit relevant design drawings signed and sealed by a professional engineer registered in the province of British Columbia to to review in his capacity as IE: and
 - receive a copy of a report (the Recommendation Report") submitted by the IE to the DCWR under the Water Sustainability Act, which recommends that construction of that component of LCC #5 may proceed. The Recommendation Report is in the form of a letter and is sufficient for construction of that component to proceed.
- b) In-river works for the tailrace and downstream river channel that are outside the area shaded grey on DWG NO 1016-C14-B6158-22 dated November 8, 2012 (attached in Appendix D) are not authorized for construction under LCC #5.
- c) The licensee may request the DCWR to review any of the IE's Recommendation Reports and make alterations to the Leave to Construct.
- d) If during construction material changes to the works of LCC #5 are proposed, the changes must be authorized through the process described in Section 9.2 a).
- e) Any revisions to sections of the CEMP that are applicable to the construction of works authorized by the Water Licences, including temporary works in support of constructing the named permanent works, must be reviewed by the IEM and accepted by the Deputy Comptroller of Water Rights.



Deputy Comptroller of Water Rights

pil 25/17
Appendix A Information for Decision on Request for LCC #5

Note: Items 1 to 15 are documents included with Submission

- 1. EIS Figure 4.38 Stage 1 River Channelization
- 2. EIS Figure 4.39 Stage 2 River Diversion
- 3. Vegetation Wildlife Technical Committee Program Review Status
- 4. Table 1 Schedule of LCCs, LTCs & LCOs dated January 9, 2017
- 5. Description of Works Left Bank Cofferdam Diversion Tunnels
- 6. Appendix A Inlet and Outlet Excavations
 6.1 Inlet Portal Excavation and Rock Support: DWG No 1020-C17-00402/3/4/5
 6.2 Outlet Portal Excavation and Rock Support: DWG No 1020-C17-00463/4/5/6
- 7. Appendix B Diversion and Cofferdams (Stage 1)
 - 7.1 General Arrangement DWG NO 1020-C17-00704/5
 - 7.2 Dam Safety Instrumentation DWG NO 1020-I17-05023/4
 - 7.3 Appendix 6-2: Technical Specifications River Diversion and Cofferdam
- 8. Appendix C Inlet and Outlet approach
 - 8.1 Inlet Channel Excavation: DWG NO 1020-C17-00409
 - 8.2 Inlet Erosion Protection: DWG NO 1020-C17-00412
 - 8.3 Outlet Channel Excavation: DWG NO 1020-C17-00468
 - 8.4 Outlet Erosion Protection: DWG NO 1020-C17-00471
- 9. Appendix D Diversion tunnel excavation
 - 9.1 General Arrangement Plan DWG NO 1020-C17-000200
 - 9.2 General Arrangement Profiles DWG NO 1020-C17-000202
 - 9.3 Excavation and Rock Support DWG NO 1020-C17-000203/4
 - 9.4 Appendix 6-2: Technical Specifications Underground Excavation
- Appendix E Diversion Tunnel Lining
 10.1 Concrete Outline and reinforcement DWG NO 1020-C17-000214/6
- 11. Appendix F Diversion Tunnel Structures
 - 11.1 Inlet General Arrangement Plan DWG NO 1020-C17-01000/1/2/7
 - 11.2 Outlet General Arrangement Plan DWG NO 1020-C17-01074/6/7
 - 11.3 Inlet Structures General Arrangement Plan DWG NO 1020-M17-01000/1
 - 11.4 Outlet Structures General Arrangement Plan DWG NO 1020-M17-01005/6
 - 11.5 Appendix 6-2: Technical Specifications Diversion Hydromechanical Equipment
 - 11.6 Appendix 6-2: Technical Specifications Diversion Embedded Parts
 - 11.7 Appendix 6-2: Technical Specifications Mechanically Stabilized Earth Walls
- 12. Appendix G Left Bank drainage Adit
 - 12.1 Adit Excavation, Backfill, Drain Holes and Drainage DWG NO 1020-C02-00220/1/4 12.2 Adit Portal Excavation, Backfill, Rock Support – DWG NO 1020-C02-00222/3
 - 12.2 Adit Portal Excavation, Backfill, Rock Support DWG NO 1020-C02-00222/3

- 13. Appendix H Left Bank Cofferdam and Core Trench Excavation
 - 13.1 Cofferdams General Arrangement DWG NO 1020-C17-00700/11
 - 13.2 Cofferdams Dam Safety Instrumentation DWG NO 1020-I17-05021/25
 - 13.3 Dam Earthfill Excavation DWG NO 1020-C02-00403/4/5
- 14. Appendix I
 - 14.1 Relocated Surplus Excavated Materials Left Bank Area L6 DWG NO. 1020-C11-00511
 - 14.2 Relocated Surplus Excavated Materials Left Bank Area L6 DWG NO. 1020-C11-00545
 - 14.3 Appendix 6-2: Technical Specifications Relocated Surplus Excavated Materials and Water Management
 - 14.4 Design Basis Memorandum Excavations and Earthworks Revision 1 December 2014
- 15. Appendix J Foundation Preparation
 - 15.1 Foundation Preparation DWG NO 1020-C02-00600/1
 - 15.2 Appendix 6-2: Technical Specifications Foundation Preparation Revision 3 July 17, 2015
- 16. E-mail dated March 7, 2017, which corrected the drawings that show the Dam Earthfill, Excavation of Appendix 13.
- 17. Report dated March 27, 2017 by Independent Engineer, Recommendation for Leave to Commence Construction LCC #5 Left Bank Stage 1 Cofferdam and Diversion and Drainage Works
- 18. Letter dated March 27, 2017 by Leave to Commence Construction LCC #5 – Independent Environmental Monitor Review
- 19. Letter dated March 27, 2017 by Dam Safety Officer, Acceptance of Stage 1 Cofferdam OMS Manual, Emergency Plan and Failure Consequence Classifications
- 20. DWG NO 1016-C14-B6158-22 dated November 8, 2012, which drawing was prepared by BC Hydro and included in the Environmental Impact Statement as Figure 4.36 Dam Site Area in Section 4 Project Description

Appendix B Description of Works from IE's Report

2.1 General

Diversion of the Peace River, which is required to construct the Site C project, occurs in two stages. In each stage, temporary cofferdams control or direct the river flow and isolate areas that will be dewatered to enable excavations to be carried out and project components to be constructed in dry conditions.

In Stage 1 – River Channelization, the Peace River is confined to its main channel by Stage 1 cofferdams on both sides of the river. On the right (south) bank there is a single Stage 1 cofferdam, currently being constructed under LTC #3A. To date, the cofferdam embankment is completed and the slurry trench cutoff wall is nearing completion. Overburden and bedrock excavations inside this cofferdam for the roller-compacted concrete buttress have been authorized by LTC #3B and LTC #3D.

On the left (north) bank, there will be three Stage 1 cofferdams. The diversion inlet and outlet cofferdams authorized under LCC #3 will isolate the left abutment areas where the upstream and downstream ends of the diversion tunnels will be located. Construction of the inlet and outlet portal works and diversion tunnel works will be carried out in dewatered areas inside the inlet and outlet cofferdams.

The Stage 1 left bank cofferdam included in LCC #5 will be parallel to the river and will connect to the inlet and outlet cofferdams to isolate the area between, where the left side of the earthfill dam will be constructed.

In Stage 2 - River Diversion, portions of the inlet and outlet cofferdams will be removed, the river will be diverted through the two tunnels, and the river channel will be closed off with upstream and downstream Stage 2 cofferdams. The isolated area between those cofferdams will then be dewatered and portions of the Stage 1 right and left bank cofferdams will be removed to allow construction of the earthfill dam. Stage 2 cofferdam construction and removals of Stage 1 cofferdams will be authorized under future LCCs.

The project components included in LCC #5 are shown on Figure 1 and described below.

2.2 Diversion Inlet and Outlet Portal Excavations & Channels





2.3 Diversion tunnels

2.4 Diversion tunnel inlet & outlet portal structures





2.5 Stage 1 left bank cofferdam



2.6 Left bank earthfill dam core trench excavation



2.7 Left bank drainage adit

2.8 In-river excavations for tailrace and downstream river channel

2.9 Excavation methods

Site C Clean Energy Project - Leave to Commence Construction #5







Ministry of Forests, Lands and Natural Water Management Branch **Resource** Operations

Location: 3rd Floor 395 Waterfront Crescent Victoria BC V8T 5K7



Prior to constructing any phase of the Project, BC Hydro must obtain a Leave to Commence Construction (LCC) for that phase. The request for Leave to Commence Construction #6 -Roller Compacted Concrete Buttress Foundation Preparation and Roller Compacted Concrete Placement was received on January 30, 2017.

My decision is to grant Leave to Commence Construction #6. The decision is set out in the

attached document.

I have also provided direction for the completion of mitigation and monitoring plans required for the issuance of LCC #6.

Site C Clean Energy Project Re: Conditional Water Licences 132990 and 132991 Leave to Commence Construction #6

British Columbia Hydro and Power Authority (BC Hydro) is the holder of Conditional Water Licences 132990 and 132991 that authorize the construction and operation of the Site C Clean Energy Project (the Project).

Vice President & Project Director Site C Clean Energy Project BC Hydro & Power Authority

333 Dunsmuir Street Vancouver BC V7X 1V5

Dear

May 16, 2017

File: 7001837





If you should wish to discuss this Leave to Commence Construction, please contact



Attachment

pc's by email:

Water Management Officer, WMB, FLNRO
Regional Executive Director, Northeast Region, FLNRO
, Water Manager, Northeast Region, FLNRO
P.Eng. Independent Engineer
Independent Environmental Monitor
P.Eng. Dam Safety Officer, WMB, FLNRO
Section Head, Omineca - North Area, FLNRO
Environmental Assessment Compliance Officer, EAO
Compliance and Enforcement Analyst, CEAA

BRITISH COLUMBIA

MINISTRY OF FORESTS, LANDS AND NATURAL RESOURCE OPERATIONS



Site C Clean Energy Project

Leave to Commence Construction #6

Roller Compacted Concrete Buttress Foundation Preparation and Roller Compacted Concrete Placement

May 16, 2017

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Leave to Commence Construction #6

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1. Introduction

1.1 Request for and Decision about Leave to Commence Construction #6

British Columbia Hydro and Power Authority (BC Hydro) is constructing the Site C Clean Energy Project on the Peace River (the "Project") under the authority of the *Water Sustainability Act*. Leaves to Commence Construction for Phases 1 to 5 and Phase 7 of the Project have been issued and BC Hydro has requested leave to commence construction of Phase 6.

Phase 6 includes the roller compacted concrete buttress on the right (south) bank. The buttress will support a section of the south wall of the Peace River Valley and provide an abutment for the earthfill dam and the foundation for the powerhouse and the spillways.

The request dated January 30, 2017 is from Director of Environment, Aboriginal Relations and Public Affairs and is supported by documents and plans that describe the components of Phase 6. The Submission for Phase 6 includes the request letter dated January 30, 2017 and the supporting information provided by BC Hydro.

This document reviews the Submission and other relevant information, all of which are the basis for the decision to issue Leave to Commence #6 (LCC #6).

The decision on the Submission and associated conditions is in Section 12.

A condition for granting a leave to commence construction of a particular phase of the Project is that certain environmental monitoring and mitigation projects (the "Plans") must be completed. BC Hydro has submitted information on the status of the Plans required for Phase 6. The completeness of the Plans is discussed Appendix F. Where the Plans are deficient, direction is given Section 11 for the completion of the Plans.

1.2 Submission for Leave to Commence Construction

The Submission comprises the documents and plans listed in Appendix A.

2. Decision Maker

The Decision Maker is P.Eng. Deputy Comptroller of Water Rights (the "DCWR") and his authority includes that of an Engineer under the *Water Sustainability Act*.

3. Background

3.1 Water Licences

The construction of works for the storage, diversion and use of water from the Peace River for the Project is authorized by Conditional Water Licence 132990 and 132991 (the Water Licences). BC Hydro is the holder of the Water Licences and may be referred to as the Licensee.

The *Water Act* [RSBC 1996] is referenced in the Water Licences. In British Columbia the *Water Sustainability Act* is now the principle law for managing the diversion and use of water resources. The *Water Sustainability Act* came into force on February 29, 2016 and for the purposes of the Water Licences replaced the *Water Act*.

3.2 Works Authorized under the Water Licences

The works authorized in clause h) of the Water Licences includes the following:

- 1) an approach channel;
- 2) an intake;
- 3) a dam;
- 4) spillways;
- 5) a reservoir;
- 6) a shoreline protection berm at Hudson's Hope;
- 7) a powerhouse and tailrace;
- 8) an access road; and
- 9) ancillary works associated with operation of the dam and generating station.

The works are to be located as shown on the plan attached to each Water Licence.

The storage licence (C132991) has the following two additional clauses which describe activities that may require works:

- m) The Licensee shall clear the reservoir, including ongoing debris management, in the manner and to the extent as may be directed by the Comptroller of Water Rights after consultation with the provincial forests ministry, and
- n) The Licensee shall provide public access to the reservoir area as may be directed by the Comptroller of Water Rights.

The components of Phase 6 described in the Submission are required for the construction of the dam, spillways, powerhouse and tailrace.

3.3 Dam Safety Regulations

Clause i) of the Water Licences states that the dam authorized under clause h) is subject to the Dam Safety Regulations and shall be designed, constructed and maintained, including any alterations, to the satisfaction of a Dam Safety Officer under the *Water Act* (the "Dam Safety Officer") and in accordance with the Canadian Dam Association Guidelines.

The Dam Safety Officer (DSO) for the Site C Clean Energy Project is MSc, P.Eng. Senior Dam Safety Officer, BC Ministry of Forests, Lands and Natural Resource Operations, Water Management Branch.

4. Appointment of Independent Engineer and Independent Environmental Monitor

As required under clause j) 1) and 2) of the Water Licences and in accordance with LCC #1, I confirm that:

٠		is the Independent Engineer, with
	as his alternate, and	
•		is the Independent
	Environmental Monitor, with	R.P.Bio. and MREM, as
	delegates.	

5. Design Engineer and Construction Engineer

The role of the Design Engineer and Construction Engineer as set out in clause k) 1) and 2) of the Water Licences is fulfilled by P.Eng., who is the Licensee's Owner Engineer Manager.

In a memorandum dated May 5, 2017, P. Eng. describes the role of Owner Engineer Manager or delegate as follows:

- a) Provides Owner Requirements to designers and manages any design approval processes required by BC Hydro
- b) Leads BC Hydro's design
- c) Accepts all the design products and work plans
- d) Accepts all construction field changes
- e) Accepts all integration for the project and leads where necessary Non-Core design integration
- f) Provides oversight on design, integration and field review

6. Phases of Construction

Construction of the Project under the Water Licences has proceeded under the following leaves to commence construction (LCCs):

- 1. LCC #1 issued April 1, 2016 authorizes the left bank excavation; right bank side channel closure dikes, right bank drainage tunnel, Moberly River construction bridge, backfilling of historic drill holes and exploratory admits, and erosion protection as needed.
- LCC #2 issued June 29, 2016 authorizes the construction of five areas for the Relocation of Surplus Excavated Material (RSEM). The areas are enclosed by dikes and each has a sediment pond for the collection of contact water. The ponds discharge to the Peace River.
- LCC #3 issued July 20, 2016 authorizes the construction of the Left Bank Stage 1 Diversion Inlet and Outlet Cofferdams, the Right Bank Stage 1 Cofferdam with cut-off wall, overburden and bedrock excavation inside the right bank cofferdam and approach channel overburden and bedrock excavation.
- 4. LCC #4 issued December 6, 2016 authorizes clearing of the eastern portion and part of the central portion of the reservoir.
- 5. LCC #5 issued on April 25, 2017 authorizes the construction of the left bank Stage 1 cofferdam for confining the flow of the Peace River to its main channel and two tunnels for diverting the flow of the river during the construction of the earthfill dam. This LCC also includes the construction of an adit for relieving the pore water pressure in the left abutment, and in-river works to improve the flow conditions in the tailrace and downstream river channel.
- LCC #7 issued April 20, 2017 authorizes geotechnical investigations to obtain information for the design of the Hudson's Hope Shoreline Protection Berm and the Halfway River Debris Boom.

7. Review of Submission

7.1 Scope of Works

The earthfill dam for the Project will abut onto bedrock on the north bank of the Peace River and onto a constructed buttress of roller compacted concrete (RCC) on the south bank. The RCC buttress will extend from the upstream side of the core of the earthfill dam to the downstream side of the spillways.

The RCC buttress will support the south wall of the Peace River valley at the dam site and provide an abutment for the core (core buttress) and downstream shell of the earthfill dam (dam buttress). Adjacent to the downstream shell is the powerhouse buttress, which supports the generating station and tailrace. Downstream of the powerhouse buttress is the spillway buttress including upper and lower stilling basin and walls for confining the flow.

The toe of the earthfill dam will be protected against erosion from the powerhouse discharge by the tailrace wall. This wall is also built from roller compacted concrete and is included in the powerhouse component of the RCC buttress.

The RCC buttress will be constructed inside the Stage 1 right bank cofferdam.

The submission also discusses the preparation of the foundation, protection of the foundation from degradation, and grouting of the foundation beneath the core buttress to reduce the potential for seepage.

The Submission provides technical specifications and plans for the construction of the four major sections of the roller compacted buttress.

The report by the Independent Engineer is discussed in the next section. The report provides a more detailed description of the RCC buttress. A copy of this description is in Appendix B.

7.2 Report by the Independent Engineer (IE)

P. Eng. provides a comprehensive review of Phase 6 in the letter report (the "IE Report") dated May 3, 2017. The IE Report describes the scope of Phase 6 as comprising four major sections:

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

The staging plan for the RCC buttress is shown in the IE's Report as Figure 1, which is copied into Appendix C. For the purposes of construction and authorizations, the core buttress and the dam buttress are combined as one component.

The IE has reviewed the Submission in the context of his mandate as described in Attachment A of the Water Licences. The IE considers that conditions for granting the Leave to Commence Construction have been met. The role of the IE does not extend to the review of the Plans for Schedule A.

The IE clarifies in his report that the construction of the Stage 1 right bank cofferdam and overburden and bedrock excavations required prior to construction of the RCC buttress were authorized under LCC #03, issued on 20 July 2016. Bedrock excavations for the RCC buttress were authorized by LTC #03D and include the installation of any rock surface preparation and protection measures required under the Main Civil Works contract.

The recommendation of the IE is that the request for LCC#6 be granted with the expectation that there will be three associated Leaves to Construct (LTCs); one for each of the following components:

		Construction Start
LTC	RCC Components	Date
LTC06A	Powerhouse buttress, tailrace wall, downstream stilling basin	15 May 2017
LTC06B	Spillway buttress, upstream stilling basin, spillway walls	April 2018
LTC06C	Dam and core buttresses	April 2019

I accept the IE Report dated May 3, 2017 with the understanding that it does not include a review of the Plans for Schedule A.

7.3 Report by the Independent Environmental Monitor

in a letter report dated May 9, 2017 reviews the Submission and includes a description of the components of Phase 6.

The IEM intends to review the information for the construction of each component including the Environmental Protection Plans, associated component plans and design drawings to verify that "they achieve the requirements of relevant permits, approvals authorizations, EAC conditions, the federal Decision Statement and the Construction Environmental Management Plan."

The plans and documents reviewed by the IEM are cited in the IEM's report.

The IEM states that, from his perspective, sufficient information is in place for the issuance of LCC #6.

I accept the IEM's Report dated May 09, 2017.

7.4 Report by Dam Safety Officer (DSO)

the Dam Safety Officer advises in a letter dated May 4, 2017 he has reviewed following documents:

- 1. Leave to Commence Construction #6 for RCC Buttress Foundation preparation and RCC Placement;
- 3.

- Site C Clean Energy Project – Conditional Water Licences (CWLs) 132990 and 132991 – Recommendation for Leave to Commence Construction LCC #06 – Roller Compacted Concrete (RCC) Buttress Foundation Preparation and RCC Placement

The DSO is satisfied with the information provided for the design and planned construction methodology associated with LCC # 6.

8. Schedule A Plans for LCC #5 and #6

The monitoring, mitigation and compensation projects (the "Plans") to be completed for the Project are set out in Schedule A, which is attached to the Water Licences and included in Appendix D. To address potential ecosystem impacts and ensure that fish and wildlife agency input is addressed, two technical committees (the FAHTC and the VWTC) consisting of provincial and federal agencies and BC Hydro have been formed to provide oversight and guidance to the Licensee in the preparation of many of the Plans described in Schedule A.

Each Plan is attached to a particular phase of the Project, and these Plans must be completed to the satisfaction of the Comptroller of Water Rights before construction of that phase may commence.

BC Hydro submitted a number of Plans required for Schedule A for LCC #5 and #6. These two LCCs are associated with the components named **Pre-Diversion Left Bank Works** and the **Roller Compacted Concrete Buttress** in Schedule A.

The outstanding Plans for LCC #5 are discussed in Section 9 and the Plans associated with LCC #6 are discussed in Section 10.

9. Outstanding Plans Associated with LCC #5

On the assurance of BC Hydro that the Plans associated with LCC #5 were substantially compliant with the requirements of Schedule A, LCC #5 was issued on April 25, 2017. However, LCC # 5 states that if a review of the associated Plans is not to my satisfaction, I will impose conditions on the Leaves to Construct (LTC's) associated with LCC #5.

Subsequent to the issuance of LCC #5 I have reviewed the associated Plans. All but one of the plans are to my satisfaction. I am satisfied that the outstanding issue, which is in regards to the Waterbird Migration Follow-up Monitoring Program, will be resolved shortly, and conditions do not have to be imposed on the LTC's associated with LCC #5.

10. Review of the Schedule A Plans Associated with LCC #6

The Roller Compacted Concrete Buttress component of the Project has one Schedule A requirement related to the fisheries and aquatic habitat and ten requirements related to vegetation and wildlife.

The information submitted by BC Hydro on the status of the Plans required for the issuance of LCC #6 is reviewed in Appendix E.

I find that some of the Plans are complete, others almost complete and some are incomplete. The status of each of the Plans is presented in Appendix F.

Significant progress has been made on the development of the Plans required for the issuance of LCC #6. However, the completion of the Plans is critical for BC Hydro to remain in compliance with clause j) of the water licences.

In the following section I give direction with timelines for the completion of the Plans. In the letter dated April 13, 2017 Re: <u>Status of Program Area Commencement</u>, **Status of Program Areas** states that the Plans for the sixteen Program Areas listed in Schedule A have commenced or will commence in 2017. With this assurance and provided that the outstanding Plans are completed as directed in the following section, the issuance of LCC #6 need not be delayed until the Plans are completed and determined to be satisfactory.

11. Direction to Complete Schedule A Plans

Regarding the Plans for Schedule A, the Licensee is directed as follows:

- a) The Licensee is to complete Plans for the five Program Areas marked as "Almost Complete" in Appendix F by June 23, 2017. Any issues that are not resolved by that time must be fully described from the perspective of the Licensee and the interested agencies.
- b) The Licensee is to complete Plans for the six Program Areas marked as "Incomplete" in Appendix F by June 30, 2017. The Status of any plans that cannot be completed by this date is to be summarized, which is to include a full description of unresolved issues from the perspective of the Licensee and the interested agencies.
- c) Schedule A includes the following requirements for each of the remaining phases of the Project.
 - i. Relevant VWTC mitigation and monitoring programs have commenced as per mitigation and monitoring plans (VWTC Program Areas 1 16).
 - ii. Progress of monitoring and mitigation programs in FAHTC program areas is deemed satisfactory.

The reporting on the completeness and progress of the Plans would benefit significantly from the development of clear, unambiguous templates for reporting out on the Plans.

Therefore, in conjunction with all of the members of the FAHTC and the VWTC, the Licensee is to develop a template for both of the Schedule A requirements described above.

The template is to be submitted to the Comptroller of Water Rights by June 30, 2017. Along with the template the Licensee will submit a separate description of any unresolved issues regarding the template.

d) The Licensee is also to provide by June 30, 2017, a timetable for finishing the Plans required under the remaining four phases of the Project associated with Schedule A commitments. The timetable will target completion of the remaining Schedule A commitments before the associated request for an LCC is submitted. The timetable is to include input from the agencies represented on the FAHTC, VWTC and other Advisory Entities as set out in Schedule A.

12. Decision on Submission

I hereby grant to BC Hydro & Power Authority "Leave to Commence Construction #6 – Roller Compacted Concrete Buttress". This authorizes construction of the following works:

- the core buttress, including the grouting of the buttress foundation,
- the dam buttress,
- · the powerhouse buttress including the tailrace wall, and
- the spillway buttress including the upper and lower stilling basins and spillway walls.

Leave to Commence Construction #6 is subject to the following conditions:

- a) Before the construction of any component of LCC #6 of the Project may proceed, the Licensee must:
 - submit relevant design drawings signed and sealed by a professional engineer registered in the province of British Columbia to as IE; and
 - receive a copy of a report (the Recommendation Report") submitted by the IE to the DCWR, which recommends that construction of that component of LCC #6 may proceed. The Recommendation Report is in the form of a letter, referred to as a "Leave to Construct" and is sufficient for construction of that component to proceed.
- b) The licensee may request the DCWR to review any of the IE's Recommendation Reports and make alterations that the DCWR deems appropriate.
- c) If during construction material changes to the works of LCC #6 are proposed, the changes must be authorized through the process described in Section 12 a).
- d) Any revisions to sections of the CEMP that are applicable to the construction of works authorized by the Water Licences, including temporary works in support of constructing the named permanent works, must be reviewed by the IEM and accepted by the Deputy Comptroller of Water Rights.



May 16, 2017

Date

Deputy Comptroller of Water Rights

Appendix A – Information for Decision on Request for LCC #6

Note: Items 1 to 6 are documents included with Submission

- BC Hydro Re: Site C Clean Energy Project, CWL 132990 and 132991 on the Peace River Request for Leave to Commence Construction 6 for RCC Buttress Foundation Preparation and RCC Placement (LCC6), letter from 30 January 2017.
- 2. BC Hydro Leave to Commence Construction #6, RCC Buttress Foundation Preparation and RCC Placement, Description of Work, prepared by BC Hydro for the Comptroller of Water Rights, Submitted 30 January 2017.
- 3. BC Hydro Plans and Drawings (see Table 1).
- 4. BC Hydro Main Civil Works Technical Specifications:
 - a. Section 03 10 00 R2 Concrete Formwork and Accessories
 - b. Section 03 20 00 R2 Concrete Reinforcement
 - c. Section 03 30 00 R4 Cast-in-Place Concrete
 - d. Section 03 40 00 R3 Concrete, Shotcrete and Roller Compacted Concrete Aggregates
 - e. Section 03 41 00 R2 Precast Concrete
 - f. Section 03 50 00 R4 Roller Compacted Concrete
 - g. Section 03 60 00 R2 Concrete Batch Plant
 - h. Section 03 70 00 R2 Roller Compacted Concrete Batch Plant
 - i. Section 05 12 23 R3 Structural Steel, Miscellaneous Metals and Embedded Parts
 - j. Section 31 40 00 R4 Drilling, Grouting and Drainage
 - k. Section 31 60 00 R3 Foundation Preparation
- 5.
- 6. Drawings for RCC Buttress Foundation preparation and RCC Placement are listed in following tables

Drawing No.RevisionTitle1020-C02-01007R1Dam - RCC Buttress: General Arrangement Plan1020-C02-01000R0Dam - RCC Buttress: RCC and Conventionally Vibrated Concrete
Concrete Outline: Typical Details1020-C02-03080R0Dam - RCC Buttress: Miscellaneous Metalwork

General Arrangement and General Details

Powerhouse Buttress

Drawing No.	Revision	Title
1020 C02 01008	R1	Dam - RCC Buttress: Powerhouse Buttress
1020-002-01008		Concrete Outline: Plan
1020 C02 01011	20-C02-01011 R1	Dam - RCC Buttress: Powerhouse Buttress
1020-002-01011		Concrete Outline: Section
1020 C02 01015	D1	Powerhouse Buttress: Drainage Gallery
1020-002-01015	K1	Concrete Outline: Plan and Section

1020-C02-01017	R0	Dam - RCC Buttress: Powerhouse Buttress - Precast Concrete Blocks
		Concrete Outline: Plans, Elevations, and Details
1020 C02 01018	DΛ	Powerhouse Buttress: Precast Concrete Blocks
1020-C02-01018 K0		Concrete Outline: Reinforcement Elevations and Section
1020 C02 01024	D1	Dam - RCC Buttress: Powerhouse Buttress Movement Joints
1020-C02-01024 KI	KI	Concrete Outline: Plan, Sections, and Details

Powerhouse Buttress – Tailrace Wall

Drawing No.	Revision	Title
1020 C02 01021 D1	D1	Dam - RCC Buttress: Powerhouse Buttress - Tailrace Wall
1020-C02-01021	IUZI KI	Concrete Outline: Plan
1020-C02-01022	D 1	Dam - RCC Buttress: Powerhouse Buttress - Tailrace Wall
	KI	Concrete Outline: Sections

Spillway Buttress

Drawing No.	Revision	Title
1020 002 01051	R2	Dam - RCC Buttress: Spillway Buttress - Upstream
1020-002-01031		Concrete Outline: Part Plan
1020 C02 01052	D 1	Dam - RCC Buttress: Spillway Buttress - Downstream
1020-C02-01032 K	Ki.	Concrete Outline: Part Plan
1020-C02-01055 R	R0	Dam - RCC Buttress: Spillway Buttress
		Concrete Outline: Section and Details
1020 C02 01056	1020-C02-01056 R0	Dam - RCC Buttress: Spillway Buttress
1020-002-01036		Concrete Outline: Section and Detail
1020-C02-01059	DO	Dam - RCC Buttress: Spillway Buttress
	KZ	Concrete Outline: Sections and Detail

Dam and Core Buttress

Drawing No.	Revision	Title
1020 002 00650	R0	Dam - RCC Buttress: Core Buttress Grouting
1020-002-00050		Plan and Section
1020-C02-00651	R1	Dam - RCC Buttress: Core Buttress Grouting
1020.002.00001		Section B
1020-C02-01025	R0	Dam - RCC Buttress: Core Buttress
1020-002-01025		Concrete Outline: Plan and Section
1020-002-01026	R0	Dam - RCC Buttress: Core Buttress
1020-002-01020		Concrete Outline: Sections
1020 C02 01022	R0	Dam - RCC Buttress: Core Buttress
1020-002-01055		Concrete Outline: Details and Sections
1020 C02 01035	R1	Dam - RCC Buttress: Dam Buttress
1020-002-01035		Concrete Outline: Plan
1020 C02 01020	R0	Dam - RCC Buttress: Dam Buttress
1020-002-01039		Concrete Outline: Sections
1020 C02 01046	R0	Dam - RCC Buttress: Core and Dam Buttress - Drainage Gallery
1020-002-01040		Concrete Outline: Plan, Sections, and Detail
1020 C02 02031	R0	Dam - RCC Buttress: Core Buttress - Reinforcement
1020-002-02031		Part Plan, Sections, and Detail

- 7. Report dated May 3, 2017 by Independent Engineer, Recommendation for Leave to Commence Construction LCC #6 Roller Compacted Concrete (RCC) Buttress Foundation and RCC Placement
- 8. Letter dated May 9, 2017 by Leave to Commence Construction LCC #6 – Independent Environmental Monitor Review
- Letter dated May 4, 2017 by Dam Safety Officer Site C Clean Energy Project Conditional Water Licences 132990 and 132991 on Peace River Leave to Commence Construction N0. 6
- 10. Letter dated January 31, 2017 from Fisheries and Aquatic Lead, BC Hydro Re: Status of milestone for evaluating juvenile Rainbow Trout and Arctic Grayling
- 11. Letter dated April 20, 2017 from Fisheries and Aquatic Lead, BC Hydro Re: Status of milestone for evaluating juvenile Rainbow Trout and Arctic Grayling
- 12. Letter dated April 20, 2017 from Fisheries and Aquatic Lead, BC Hydro Re: Status of milestone for progress of monitoring and mitigation programs
- 13. E-mail dated April 13, 2017 from Project Manager, BC Hydro Subject: Program Area 2 Wetlands and Riparian Habitat
- Letter dated April 13, 2017 from Environmental Mitigation, Monitoring and Compliance BC Hydro Re: Status of Program Area 2: Wetlands and Riparian Mitigation Monitoring
- E-mail dated April 13, 2017 from Project Manager, BC Hydro Subject: Program Area 2 Wetlands and Riparian Habitat – Downstream vegetation and nest monitoring program
- 16. Letter dated April 13, 2017 from Environmental Mitigation, Monitoring and Compliance BC Hydro Re: Status of downstream vegetation and nest monitoring program
- 17. E-mail dated April 13, 2017 from Project Manager, BC Hydro Subject: Program Area 3: Fishers
- 18. Letter dated April 13, 2017 from Environmental Mitigation, Monitoring and Compliance BC Hydro Re: Status of Program Area 3: Fisher
- 19. E-mail dated April 13, 2017 from Project Manager, BC Hydro Subject: Program Area 4: Bats
- 20. Letter dated April 13, 2017 from Environmental Mitigation, Monitoring and Compliance BC Hydro Re: Status of Program Area 4: Bats
- 21. Site C Vegetation and Wildlife Bat Mitigation and Monitoring Program Version 1 April 10, 2013
- 22. E-mail dated April 13, 2017 from Project Manager, BC Hydro Subject: Program Area 6: Downstream snake and toad monitoring
- 23. Letter dated April 13, 2017 from Environmental Mitigation, Monitoring and Compliance BC Hydro Re: Status of Program Area 6: Amphibians downstream western toad and garter snake monitoring
- 24. E-mail dated March 24, 2017 from Subject: Site C Schedule A Review of Program Areas (Amphibian monitoring plan i.e. downstream monitoring plan).

25.	Letter dated October 3, 2016 from Environmental Mitigation, Monitoring and Compliance BC Hydro Re: Eagles (Program Area 7)
26.	Site C Vegetation and Wildlife Bald Eagle Mitigation and Monitoring Program (August 2016)
27.	Letter dated March 21, 2017 from Environmental Mitigation, Monitoring and Compliance BC Hydro Re: Status of Program Area 8: Breeding Birds and Migratory Birds: Waterfowl and Shorebirds
28.	E-mail dated April 13, 2017 from Project Manager, BC Hydro – Subject: Program Area 8: Swallows
29.	Letter dated April 13, 2017 from Environmental Mitigation, Monitoring and Compliance BC Hydro Re: Status of Program Area 8: Breeding Birds: Swallows
30.	Site C Vegetation and Wildlife Waterbird Migration Follow-up Monitoring Program V2 April 13, 2013
31.	E-mail dated April 13, 2017 from Project Manager, BC Hydro – Subject: Program Area 8: Common Nighthawk
32.	Letter dated April 13, 2017 from Environmental Mitigation, Monitoring and Compliance BC Hydro Re: Status of Program Area 8: Breeding Birds: Common (Nighthawk)
33.	E-mail dated April 13, 2017 from Project Manager, BC Hydro – Subject: Program Area 8: Woodpeckers
34.	Letter dated April 13, 2017 from Environmental Mitigation, Monitoring and Compliance BC Hydro Re: Status of Program Area 8: Breeding Birds: Woodpeckers
35.	E-mail dated April 13, 2017 from Project Manager, BC Hydro – Subject: Program Area 8: Songbirds
36.	Letter dated April 13, 2017 from Environmental Mitigation, Monitoring and Compliance BC Hydro Re: Status of Program Area 8: Breeding and Migratory Birds: Songbirds
37.	Site C Vegetation and Wildlife Breeding Bird Follow-up Monitoring Program Songbirds (Revised February 2017)
38.	Letter dated September 26, 2016 from Environmental Mitigation, Monitoring and Compliance BC Hydro Re: Ground nesting Raptors (Program Area 9)
39.	E-mail dated April 13, 2017 from Project Manager, BC Hydro – Subject: Program Area 10: Cavity Nesting Species
40.	Letter dated April 13, 2017 from Environmental Mitigation, Monitoring and Compliance BC Hydro Re: Status Program Area 10: Cavity nesting species
41.	Letter dated September 26, 2016 from Environmental Mitigation, Monitoring and Compliance BC Hydro Re: Cavity nesting species
42.	Letter dated July 5, 2016 from Environmental Mitigation, Monitoring and Compliance BC Hydro Re: Cavity nesting species
43.	Site C Vegetation and Wildlife Cavity nesting Species Mitigation and Monitoring Program Version 1, February 2017
44.	E-mail dated April 13, 2017 from Project Manager, BC Hydro – Subject: Program Area 11 Rare Plants – Regional Surveys

- 45. Letter dated April 13, 2017 from Environmental Mitigation, Monitoring and Compliance BC Hydro Re: Status of Program Area 11 Rare Plants – Regional Surveys
- 46. E-mail dated April 13, 2017 from Project Manager, BC Hydro –
 Subject: Program Area 11 Rare plants-translocation
- 47. Letter dated April 13, 2017 from Environmental Mitigation, Monitoring and Compliance BC Hydro Re: Status of Program Area 11 Rare Plants-Translocation
- 48. E-mail dated April 21, 2017 from Project Manager, BC Hydro Subject: Program Area 11 Rare plants-translocation - update
- 49. Letter dated April 21, 2017 from Environmental Mitigation, Monitoring and Compliance BC Hydro Re: Status of Program Area 11 Rare Plants-Translocation
- 50. Site C Vegetation and Wildlife Regional Rare Plant Survey Program Version 1, February 3, 2017
- 51. E-mail dated April 13, 2017 from Project Manager, BC Hydro Subject: Site C: Sharp tailed Grouse Mitigation update for LCC5
- 52. Letter dated March 21, 2017 from Environmental Mitigation, Monitoring and Compliance BC Hydro Re: Sharp-tailed Grouse Mitigation and Monitoring (Program Area 12)
- 53. Letter dated September 30, 2016 from Environmental Mitigation, Monitoring and Compliance BC Hydro Re: Sharp-tailed Grouse Mitigation (Program Area 12)
- 54. Document without header: Fish Hydro Management Committee September 23, 2016 Re: Postconstruction monitoring of Sharp-tailed Grouse leks at Highway 29
- 55. Letter dated August 8, 2016 from Environmental Mitigation, Monitoring and Compliance BC Hydro Re: Carnivore Den sites (Program Area 14)
- 56. Letter dated November 15, 2016 from Environmental Mitigation, Monitoring and Compliance BC Hydro Re: Other Raptors (Program Area 15)
- 57. E-mail dated March 22, 2017 from **Construction** Project Manager, BC Hydro Subject: Site C: Mitigation for Other Species at Risk update for LCC 5
- 58. Letter dated March 21, 2017 from Environmental Mitigation, Monitoring and Compliance BC Hydro Re: Status of Program Area 16: Other Species at Risk
- 59. Letter dated September 26, 2016 from Environmental Mitigation, Monitoring and Compliance BC Hydro Re: Other Species at Risk (Program Area 16)
- 60. Site C Vegetation and Wildlife Mitigation and Monitoring Other Species at Risk Summary Version 1, March 21, 2017
- 61. Site C Plant Seeding Program for Butterfly Larval Food Plants and Adult Nectar Source Plants V1 March 22, 2017
- 62. E-mail dated April 13, 2017 from Project Manager, BC Hydro Subject: VWTC summary of program area review commencement
- 63. Letter dated April 13, 2017 from Environmental Mitigation, Monitoring and Compliance BC Hydro Re: Status of Program Area Commencement
- 64. E-mail dated March 6, 2017 from Project Manager, BC Hydro Subject: Other Species for consideration by the VWTC

- 65. Letter dated September 26, 2016 from Environmental Mitigation, Monitoring and Compliance BC Hydro Re: Furbearers, migratory waterfowl, invertebrates, ungulate calving habitat, mineral licks, bear and carnivore habitats and wildlife downstream of the dam site
- 66. E-mail dated March 8, 2017 to Project Manager, BC Hydro Subject: Other Species for consideration by the VWTC
- 67. E-mail dated March 9, 2017 from Project Manager, BC Hydro Subject: Other Species for consideration by the VWTC
- 68. E-mail dated March 6, 2017 from Project Manager, BC Hydro Subject: Other Species for consideration by the VWTC
- 69. E-mail dated March 15, 2017 from Water Management Branch, FLNRO Subject: Additional Wildlife Species and Habitat for Consideration
- 70. E-mail dated March 27, 2017 from Manager, British Columbia Conservation Data Centre, MoE Re: Additional Wildlife Species and Habitat for Consideration
- 71. E-mail dated March 27, 2017 from Manager Ecosystem Information Centre, MoE Re: Additional Wildlife Species and Habitat for Consideration
- 72. E-mail dated March 28, 2017 from Unit Head, Species Conservation Science, MoE Re: Additional Wildlife Species and Habitat for Consideration
- 73. E-mail dated March 15, 2017 from Water Management Branch, FLNRO Subject: Schedule A Program Areas for LCC #5 and LCC #6
- 74. E-mail dated May 3, 2017 from Manager Ecosystem Information Centre, MoE Subject Re: Schedule A Program Areas for LCC #5 and LCC #6
- 75. E-mail dated May 4, 2017 from Senior Environmental Assessment Officer, Canadian Wildlife Service Subject Re: Schedule A Program Areas for LCC #5 and LCC #6
- 76. E-mail dated May 4, 2017 from Wildlife Biologist, FLNRO Re: Schedule A Program Areas for LCC #5 and LCC #6
- 77. Letter Dated April 1, 2016 signed by Engineer under the *Water* Sustainability Act, which letter is Leave to Commence Construction No.1
- 78. Letter Dated June 29, 2016 signed by Engineer under the *Water* Sustainability Act, which letter is Leave to Commence Construction No.2
- 79. Letter Dated July 20, 2016 signed by Engineer under the *Water* Sustainability Act, which letter is Leave to Commence Construction No.3
- 80. Letter Dated December 6, 2016 signed Deputy Comptroller of Water Rights, which letter is Leave to Commence Construction No.4
- 81. Letter dated April 25, 2017 signed by Deputy Comptroller of Water Rights, which include Leave to Commence Construction No.5

Appendix B – Description of Works from IE's Report

2. DESCRIPTION OF THE WORKS

The arrangement of the LCC components is shown in plan on Figure 1. (Appendix B). The RCC buttress will be constructed along the south (right) bank of the Peace River inside the Stage 1 right bank cofferdam, and will extend for approximately 747 m from the upstream side of the core of the earthfill dam to the downstream end of the spillways. The buttress will be entirely founded on excavated bedrock surfaces, with a maximum height of about 71 m. Above the base, the bedrock excavation will slope upwards towards the south at a1.6H:1.0V (powerhouse and spillway buttresses) or 1.45H:1V (dam &core buttresses) until it meets the invert of the approach channel excavation. The channel invert will be at El 432.5 m adjacent to the powerhouse buttress and El. 434.5 m adjacent to the spillway, dam and core buttresses.

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

The bases of the powerhouse and spillway buttress sections will be at El. 375 m, more than 35 m below existing river level. The crests of these buttress sections will be at the same elevation as the adjacent approach channel invert and will provide the foundation surfaces on which the future generating station and spillway structures will be constructed. The powerhouse buttress will support the power intakes, penstocks and powerhouse, and the spillway buttress will support the spillway piers and gate structures, chute slab, spillway walls, stilling basin and weir.

The dam and core buttress sections will have their base at El. 398.0 m and will extend as free-standing sections up to 35 m above the approach channel invert to El. 469.4, which is the crest of the future earthfill dam. The south faces of these buttresses will contain the approach channel and the north faces will provide the right abutment for the core and downstream shell of the dam. The north face of the core buttress will be angled such that any downstream movement of the abutting earthfill dam would compress the contact. The contact surface of the core buttress will be faced CVC placed against steel forms to achieve a smooth finish.

The tailrace wall, with a height ranging from about 15 m to 30 m, will extend about 154 m downstream from the powerhouse buttress section. The wall will provide a barrier between the tailrace and the toe of the earthfill dam.

A drainage gallery will extend longitudinally through all four buttress sections, and drains will be drilled between the drainage gallery and the right bank drainage tunnel below. The gallery will be formed with precast concrete segments, or with removable forms or other acceptable method.

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

As indicated by the proposed LTCs, the RCC buttress will be constructed over a three-year period, starting with the powerhouse buttress in 2017. Construction staging joints consisting of 50 mm of compressible material are to be provided on either side of the powerhouse buttress to allow for differential movements between the adjacent dam and spillway buttresses.

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

Movement joints may be constructed in the powerhouse, dam and spillway buttresses to accommodate potential movements in the bedrock foundation. Installation of these joints will be determined by the observational method, dependent on measured rock movements before construction of the buttresses.

Portions of the outer CVC zones will include reinforcement to control cracking. Similar to the movement joints, additional reinforcement may be installed, based on the observational method.

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

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

Appendix C – Figure 1 Staging Plan for RCC Buttress



Appendix D – Schedule A of Water Licences

Clause j) 4) in Conditional Water Licence 132990 and Conditional Water Licence 132991 requires a number of monitoring, mitigation and compensation projects to be completed to the satisfaction of the Comptroller of Water Rights before construction of certain works components are authorized to proceed. The monitoring, mitigation and compensation projects are specified in the table below along with the corresponding construction components and agency or committee from which the Comptroller of Water Rights will seek advice.

To address potential ecosystem impacts and ensure that fish and wildlife agency input is addressed, two *ad hoc* technical committees consisting of provincial and federal agencies and BC Hydro have been formed to collaboratively provide oversight and guidance to many of the required programs in the table. The two technical committees are the Fisheries and Aquatic Habitat Mitigation and Monitoring Technical Committee (FAHTC) and the Vegetation and Wildlife Mitigation and Monitoring Technical Committee (VWTC);

The FAHTC will provide guidance on the Fisheries and Aquatic Habitat Management Plan and Fisheries and Aquatic Habitat Monitoring and Follow-up Program.

The VWTC will provide guidance in the following areas:

- 1. Ungulate Winter Range
- 2. Wetlands and Riparian Habitat
- 3. Fishers
- 4. Bats
- 5. Snakes
- 6. Amphibians
- 7. Eagles
- 8. Breeding and Migratory Birds
- 9. Ground Nesting Raptors
- 10. Cavity Nesting Species
- 11. Rare Plants
- 12. Sharp-tailed Grouse
- 13. Lighting Effects
- 14. Carnivore Den Sites
- 15. Other Raptors
- 16. Other Species at Risk (Red and Blue-listed, Committee on the Status of Endangered Wildlife in Canada, *Species-At-Risk Act* Schedule 1)

The VWTC is directed to consider the following wildlife species and habitats, which are not directly mitigated for under the existing 16 program areas: fur-bearers, including beavers, otters and muskrat; migratory waterfowl; invertebrates; ungulate calving habitat; mineral licks; bear and carnivore habitats, including dens and migratory corridors; and, wildlife downstream of the dam site.

The Ministry of Forests, Lands and Natural Resource Operations is referred to in the table as FLNRO; the Ministry of Environment as MoE.

Project Construction Component	Monitoring or Mitigation Projects Completed	Advisory Entity
	Vegetation Clearing and Debris Management Plan	Provincial Forests – FLNRO
	Monitoring plan for downstream flow fluctuations	FAHTC
Initial Right & Left	Assessment procedure for evaluating juvenile fish in tributaries	FAHTC
Bank Works	Scope of long-term monitoring and follow-up decision criteria for offsets/compensation ¹	FAHTC
	Kokanee Assessment Plan ¹	FAHTC
	Soil Management, Site Restoration and Revegetation Plan	VWTC
Shoreline Protection Berm at Hudson's Hope	Initial design, including habitat features, is provided to FAHTC and District of Hudson's Hope for review at least three years before berm construction is to begin	FAHTC
	Final design criteria and preliminary design drawing are agreed to by FAHTC and DHH two years before construction is to begin	FAHTC

¹ Upon advice of the Conservation Science Manager, MoE, completion of the project may be postponed to when pre-diversion left bank works proceeds.

Project Construction Component	Monitoring or Mitigation Projects Completed	Advisory Entity
Pre-Diversion Left Bank Works	The plan, including detailed methodology, for the annual Waterfowl and Shorebird Monitoring component of the Breeding and Migratory Bird Program area (VWTC Program Area 8)	VWTC
	Review of Program Areas 13, 14, and 15, determination of any additional plans or program development needed, and time-frame for plan(s) completion	VWTC
Pre-Diversion Right Bank Works	Review of Program Areas 10, 12, and 16, determination of any additional plans or program development needed, and time-frame for plan(s) completion	VWTC
	Progress of monitoring and mitigation programs in FAHTC program areas is deemed satisfactory	FAHTC
	Wetland function assessment tool. Implementation process for Wetland and Riparian Habitat mitigation and monitoring plan (VWTC Program Area 2)	VWTC
Roller Compacted Concrete Buttress	Plan for implementing and monitoring Fisher mitigation (VWTC Program Area 3)	VWTC
	Bat Mitigation and Monitoring Program Plan (VWTC Program Area 4)	VWTC
	Amphibian Mitigation and Monitoring Plan (VWTC Program Area 6)	VWTC
	Eagle Mitigation and Monitoring Plan (VWTC Program Area 7)	VWTC

Project Construction Component	Monitoring or Mitigation Projects Completed	Advisory Entity
	Plan, including detailed methodology, for the annual Breeding Bird Monitoring component of the Breeding and Migratory Bird Program (VWTC Program Area 8)	VWTC
Roller Compacted Concrete Buttress	Plan, including detailed methodology, for annual Ground Nesting Raptor Program (VWTC Program Area 9)	VWTC
	Rare Plant Mitigation and Monitoring Plan (VWTC Program Area 11)	VWTC
	Reviews of mitigation plans in VWTC Program Areas 10, 12, 13, 14, 15, 16	VWTC
	Relevant VWTC mitigation and monitoring programs have commenced as per mitigation and monitoring plans (VWTC Program Areas $1 - 16$)	VWTC
Earthfill Dam	Progress of monitoring and mitigation programs in FAHTC program areas deemed satisfactory	FAHTC
	Relevant VWTC mitigation and monitoring programs have commenced as per completed mitigation and monitoring plans (VWTC Program Areas 1 – 16)	VWTC
ProjectMonitoring or MitigationConstructionProjects CompletedComponent		Advisory Entity
--	--	---------------------------------
Stage 2 Cofferdams and Diversion	Update of Fisheries and Aquatic Habitat Monitoring and Follow-up Program for monitoring during the diversion stage	FAHTC
	Schedule for reviews of monitoring results, including fish passage management, through the diversion stage is completed.	FAHTC
	Ungulate Winter Range Program Plan (VWTC Program Area 1)	VWTC
	Snake Mitigation and Monitoring Program Plan (VWTC Program Area 5)	VWTC
	Relevant VWTC mitigation and monitoring programs have commenced as per mitigation and monitoring plans (VWTC Program Areas 1 – 16)	VWTC
	 Report on: (1) results of further investigation of potentially contaminated sites that may be inundated or affected by the change in groundwater level; (2) list of sites that require remediation 	MoE
	Methylmercury Monitoring Plan, to be submitted a minimum of three (3) years prior to reservoir filling	Northern Health Authority
Spillway and Generating Station	Relevant VWTC mitigation and monitoring programs have commenced as per mitigation and monitoring plans (VWTC Program Areas $1 - 16$)	VWTC
	 Plan and Schedule for: (1) contaminated site remediation and (2) monitoring of water quality of surface water and potentially affected wells 	MoE

Project Construction Component	Monitoring or Mitigation Projects Completed	Advisory Entity
Diversion Tunnel Conversion and Reservoir Filling	Update of Fisheries and Aquatic Habitat Monitoring and Follow-up Program for monitoring during the operation phase	FAHTC
	Relevant VWTC mitigation and monitoring programs have commenced as per mitigation and monitoring plans (VWTC Program Areas $1 - 16$)	VWTC
	Remediation of contaminated sites and monitoring of surface water quality as well as groundwater quality for existing water well users that may be affected.	MoE

Appendix E – Detailed Review of Schedule A Commitments Associated with LCC #6

Schedule A Plans Associated with LCC #6

The Roller Compacted Buttress component of the Project has one requirement related to the fisheries and aquatic habitat and ten requirements related to vegetation and wildlife. These requirements are discussed in the following sections.

Fisheries and Aquatic Habitat Plans

The FAHTC provides guidance on the Fisheries and Aquatic Habitat Management Plan (the Management Plan) and Fisheries and Aquatic Habitat Monitoring and Follow-up Program (the Follow-up Program). A requirement of Schedule A associated with LCC #6 is for the Licensee to report on the review by the FAHTC on the progress of monitoring and mitigation programs for fisheries and aquatic habitat.

Fisheries and Aquatic Lead, BC Hydro, wrote on April 20, 2017 (Re: Status of Progress of monitoring and mitigation programs) on behalf the FAHTC that the progress of the monitoring and mitigation programs is to the satisfaction of the committee. The activities of the FAHTC include the following:

- 1. Meet regularly to review the Management Plan and Follow-up Program.
- 2. Prepare and reach agreement on: updates to the Kokanee Assessment Plan, monitoring downstream flow fluctuations, and assessment procedure for evaluating the indicator species of Bull Trout and Arctic Grayling in tributaries.
- 3. Review results from the monitoring programs implemented in 2016 and update monitoring programs accordingly.
- 4. Review information and provide guidance on fish passage management.

The fishery agencies have reviewed and support the letter of April 20, 2017.

I am satisfied that the above noted letter dated April 20, 2017 and the response of the fishery agencies fulfills this Schedule A requirement.

Vegetation and Wildlife Plans

Leave to commence construction of the Roller Compacted Concrete Buttress requires the completion of eight of the sixteen Plans that are listed on page 1 of Schedule A, which include the following wildlife species and habitats:

- 1. Wetlands and Riparian Habitat
- 2. Fishers
- 3. Bats
- 4. Amphibians
- 5. Eagles
- 6. Breeding and Migratory Birds Breeding Bird components
- 7. Ground Nesting Raptors
- 8. Rare Plants

The RCC buttress component of the Project also stipulates that the following reviews are to be completed:

- 1. Reviews of mitigation plans in VWTC Program Areas 12, 13, 14, 15 16, which are the Sharptailed Grouse (12), lighting effects (13), Carnivore den sites (14), other Raptors (15) and Other species at risk (16).
- 2. Relevant VWTC mitigation and monitoring programs have commenced as per mitigation and monitoring plans (VWTC Program Areas 1 16).

In addition to the sixteen Plans noted above, the VWTC is also required to provide oversight and guidance on a seven other wildlife species and habitats that are described in the paragraph following the list on page 1 of Schedule A. The seven species and habitats are referred to as the Supplementary List and include the following:

- 1. Furbearers including beavers, otters and muskrat
- 2. Migratory waterfowl
- 3. Invertebrates
- 4. Ungulate calving habitat
- 5. Mineral licks
- 6. Bear and carnivore habitats, including dens and migratory corridors
- 7. Wildlife downstream of the dam site.

These seven wildlife species and habitats are not associated with a particular Project Construction Component of Schedule A.

The VWTC has provided guidance and BC Hydro has provided Plans for review under the RCC buttress component of the Project.

BC Hydro has submitted letters on behalf of the VWTC on each of the Vegetation and Wildlife Plans required for the RCC buttress component of the Project. The letters summarize the status of each of the Plans and these have been reviewed by the federal and provincial agencies that have an interest in the wildlife species and habitat. The table in Appendix E provides a brief description of the status and the comments provided by the agencies on each Plan.

On the basis of the status provided by BC Hydro and the comments of the agencies, each Plan is ranked as Complete, Almost Complete or Incomplete.

Complete Vegetation and Wildlife Plans

The Plans required for Schedule A for the RCC Buttress that are ranked as "Complete" include:

- 1. Cavity Nesting Species Program Area 10
- 2. Other Species at Risk Program Area 16
- 3. Review mitigation plans for Program Areas 10, 12, 13, 14, 15 and 16
- 4. Plans for furbearers, ungulate calving habitat, mineral licks and bear and carnivore habitat of Supplementary List are complete. The migratory waterfowl, invertebrates and wildlife downstream of the dam site are moved to other program areas for development of mitigation and monitoring plans.

I am satisfied that the Plans prepared for Program Areas 10 and 16 and for the wildlife and habitat of furbearers, ungulate calving habitat, mineral licks and bear and carnivore habitat fulfills this part of the Schedule A requirement for the RCC Buttress component of the Project.

Program Areas 13, 14 and 15 were deemed to be satisfactory in LCC #3 and LCC #4.

Program Are 12 - Sharp-tailed Grouse Plan is discussed in sub-section 10.4.

Sharp-tailed Grouse Plan – Program Area 12

Environmental Mitigation, Monitoring and Compliance, BC Hydro, wrote on March 21, 2017 and advised that the VWTC discussed mitigation for Sharp-tailed Grouse as proposed in the CEMP, and identified the need to expand the mitigation and monitoring, which is reflected in the CEMP V4, issued Jul 26, 2016.

The outstanding issue is the need to monitor the Sharp-tailed Grouse leks after construction if monitoring during construction does not document any disturbance. As the VWTC and BC Hydro could not agree, the matter was elevated to the Fish-Hydro Management Committee (FHMC). The FMHC provided advice on the matter in a document dated September 23, 2016. The advice supports the position of the majority of the members of the VWTC. BC Hydro disagrees with the advice of the FHMC, and elevated the matter to the BC Hydro Policy Committee. The February 15, 2017 meeting of this committee was cancelled, and has not been rescheduled.

I am satisfied that the direction provided in the document from the FHMC dated Sep 23, 2017 is the proper resolution of the matter of monitoring the Sharp-tailed Grouse leks.

The Licensee is directed to complete the Sharp-tailed Grouse Plan – Program Area 12 in accordance with the document from the FHMC dated Sep 23, 2017. A draft of the completed Plan is to be provided to the VWTC for review at its meeting in June, 2017. The Licensee is to provide the DCWR with a summary of the position of the VWTC on the Sharp-tailed Grouse Plan – Program Area 1 by June 23, 2017.

If the BC Hydro Policy Committee should decide to review the matter of monitoring the Sharp-tailed Grouse leks, I will consider any information it provides.

Almost Complete Vegetation and Wildlife Plans

The Plans required for Schedule A for the RCC Buttress that are ranked as "Almost Complete" include:

- 1. Fishers Program 3
- 2. Bats Program Area 4
- 3. Breeding and Migratory Birds (Breeding Bird Monitoring Component) Program Area 8
- 4. Breeding and Migratory Birds (Waterfowl and Shorebird Monitoring Component, which is brought forward from LCC #5) Program Area 8
- 5. Rare Plants (Regional Surveys) Program Area 11

The comments provided by the interested agencies indicates that these five Program Areas may be reviewed and completed at the next VWTC meetings tentatively scheduled for May 18, 2017 and June 16, 2017.

The Licensee is to complete Plans for the five Program Areas marked as "Almost Complete" in Appendix E by June 23, 2017. Any issues that are not resolved by that time must be fully described from the perspective of the Licensee and the interested agencies. At that time the DCWR may make a decision on any remaining impasses.

Incomplete Vegetation and Wildlife Plans

The Plans required for Schedule A for the RCC Buttress that are ranked as "Incomplete" include:

- 1. Wetlands and Riparian Habitat Program Area 2
- 2. Amphibians Program Area 6
- 3. Breeding and Migratory Birds (Breeding Bird Monitoring Component): Common Nighthawk – Program Area 8
- 4. Breeding and Migratory Birds (Breeding Bird Monitoring Component): Woodpeckers – Program Area 8
- 5. Rare Plants (Translocation) Program Area 11
- 6. Downstream Vegetation and Nest Monitoring (This is an extension of Program Areas 2, 8 and 11) Program Area 2.1

The Licensee is to complete Plans for the six Program Areas marked as "Incomplete" in Appendix F by June 30, 2017. At the same time, the Licensee is to provide an update on the status of these six Program Areas. For any Plans that are not completed by June 30, 2017, the unresolved issues must be fully described from the perspective of the Licensee and the interested agencies.

The Licensee is also to provide by June 30, 2017 a timetable for finishing all outstanding Plans including the Plans required under the remaining four phases of the Project as described in Schedule A. The timetable is to consider input from the agencies represented on the FAHTC, VWTC and other Advisory Entities as set out in Schedule A.

Tracking Progress

A condition in Schedule A for leave to commence construction of the RCC buttress is as follows: Relevant VWTC mitigation and monitoring programs have commenced as per mitigation and monitoring plans (VWTC Program Areas 1 - 16)

Environmental Mitigation, Monitoring and Compliance wrote on April 13, 2017 (Re: Status of program Area Commencement) that the relevant programs have a) commenced or b) will commence in 2017. A table is provided with four columns showing the number and name of each program area, the date of a letter sent to Comptroller and the Program Implementation date.

The agencies represented on the VWTC commented on the letter as follows:

An important missing piece is a mitigation accounting framework that we have agreed needs to be in place but have yet to see the details.

Schedule A also includes a similar condition for fisheries and aquatic habitat, and requires the following:

Progress of monitoring and mitigation programs in FAHTC program areas is deemed satisfactory

The summary provided in response to this condition is discussed in section 9.1 Fisheries and Aquatic Habitat Plans.

The two conditions discussed above are required before leave to commence construction may be granted for any of the four remaining components of construction for the Project as defined in Schedule A.

I agree with the VWTC that the reporting on the completeness and progress of the Plans would benefit significantly from the development of templates for reporting out on the following Schedule A requirements:

- 1. Relevant VWTC mitigation and monitoring programs have commenced as per mitigation and monitoring plans (VWTC Program Areas 1 16)
- 2. Progress of monitoring and mitigation programs in FAHTC program areas is deemed satisfactory

In conjunction with all of the members of the FAHTC and the VWTC the Licensee is to develop a template for both of the Schedule A requirements described above.

The template is to be submitted to the Comptroller of Water Rights by June 30, 2017. Along with the template the Licensee will submit a separate description of any unresolved issues regarding the template.

Future Schedule A Commitments

A request for LCC #8 has already been submitted, and a request for LCC #9 is expected to follow shortly.

Therefore, the Licensee is also to provide, by June 30, 2017, a timetable for finishing the Plans required under the remaining four phases of the Project associated with Schedule A commitments. The timetable will target completion of the remaining Schedule A commitments before the associated request for an LCC is submitted. The timetable is to include input from the agencies represented on the FAHTC, VWTC and other Advisory Entities as set out in Schedule A.

Appendix F – Completeness of Vegetation and Wildlife Mitigation and Monitoring programs

Program Area No. and Description	Status and Comments	Completeness
Cavity Nesting Species	Apr 13, 2017: advises that the VWTC has reviewed the Cavity Nesting	Complete
Program Area 10	Species Mitigation and Monitoring Program V1, which will be implemented in 2017.	-
	Plan to be reviewed annually.	
	The agencies agree that there are no outstanding issues.	
Other Species at Risk	Mar 21, 2017: advises that VWTC has reviewed and the outstanding issue is	Complete
Program Area 16	mitigation for waterfowl in migration, which is to be resolved under Program Area 8.	
	The agencies agree that there are no outstanding issues.	
Review mitigation plans for: Program	Program areas 10 and 16 are reviewed above.	Complete
Areas 10, 12, 13, 14, 15, 16	Program area 12 is reviewed below.	
	Program areas 13, 14 and 15 were satisfactory under LCC3 and LCC4.	
	No information is provided on ongoing sufficiency.	
	The agencies agree that there are no outstanding issues.	
Other wildlife species and habitat:	Letter dated Sep 26, 2016 from states VWTC has reviewed and concludes	Complete for:
that following is from the paragraph	that additional mitigation and monitoring is not required for:	1. Furbearers
that follows the list of areas on page 1	1. Furbearers including beaver, otter and muskrat.	including beaver,
The WWTC is directed to consider the	2. Ungulate calving habitat.	otter and muskrat.
following wildlife engine and hebitet	3. Milleral licks.	2. Ungulate calving
which are not directly mitigated under	4. Bear and carnivore nabitats including dens and migratory corridors.	habitat.
the existing 16 program grass of	5. Migrotory weterfourly up den Brogram Area 8. Weterhind	3. Mineral licks.
Schedule A	5. Migratory wateriowi, under Program Area 8 - Wateroirds.	4. Bear and
1 Furbearers including beaver offer	7. Data on wildlife downstream of dom site will be collected for	carnivore habitats
and muskrat	a Amphibiana under Drogram Area 6	including dens and
2 Ungulate calving habitat	a. Anipinolais under Program Area 0	migratory
3 Mineral licks	c. Breeding and migratory birds which are under Brearom Area 8	corridors.
4. Bear and carnivore habitats	d. Wetlands and Rinarian Habitat under Program Area 2	For the new states
including dens and migratory	The agencies with an interest in the above are in agreement with the conclusion of BC Hudro	For the remaining
corridors.	The agenetes with an interest in the above are in agreement with the conclusion of DC Hyuto.	species
5. Migratory waterfowl, under		dotormined under
Program Area 8.		the other Program
6. Invertebrates (dragonflies and		Areas
butterflies), under Program Area 16.		ru vas.
7. Wildlife downstream of dam site.		

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Program Area No. and Description	Status and Comments	Completeness
Sharp-tailed Grouse	Mar 21, 2017: advises that the outstanding issue is the need to monitor the	Complete. See
Program Area 12	lek after construction if no disturbance is documented during construction.	Sharp-tail Grouse
	The Fish-Hydro Management Committee (FHMC) agrees with the position of Ministry of	– Program Area !2
	Environment that monitoring should continue after construction.	section in
	Committee for consideration. This committee concelled its matter to the BC Hydro Policy	Appendix E
	set a date for the next meeting	
Program Area 4	Apr 13, 2107: advises that VWTC to provide comments on Version 1 dated	Almost Completer
Bat Mitigation and Monitoring Plan	Apr 10, 2017. VWTC has requested:	Annost Complete:
	1. Additional monitoring at Portage Mountain Quarry.	
	2. Installation of bat boxes at Alwin Holland Park and along the bottom of Tea Creek, which	
	will begin in 2017.	
	Agencies comment is that Plan is ready for implementation after final edits.	
Program Area 8	Apr 13, 2017: advises that the VWTC has reviewed the plan, which will be	Almost Complete
Breeding and Migratory Birds Breeding	implemented in 2017, and there are no outstanding issues.	
Songhirds including Swallows	Swallows are included in Breeding Bird Follow-up Monitoring Program as they are	
Songon us including Swanows	Waterbird Migration program which is amended to include this data collection	
	The agencies commented that a completed draft Plan is to be submitted for review by the	
	VWTC.	
Program Area 8	Mar 21, 2017: advises in the letter that the review of the Waterbird Migration	Almost Complete
Breeding and Migratory Birds	Follow-up Monitoring Program (Mar 21/17) is nearing completion and describes seven issues	
Waterfowl and Shorebird Monitoring	on which the VWTC is in agreement. There are three outstanding issues that need to be	
Component	addressed by Canadian Wildlife Service (CWS).	
	Apr 13, 2017: advises that the program is modified by adding the collection	
	of data on the location and size of swallow colonies. Version 2 of the program is dated Apr	
	13, 2017. The outstanding issues of CWS are not addressed. May 4, 2017: The CWS has advised that it is in discussion with PC Hydro and may be also	
	to resolving the outstanding issues	
Program Area 11	Apr 13, 2017: Advises that the VWTC has reviewed the plan and second and	Almost Complete
Rare Plants: Regional Surveys	final year will be implemented in 2017, and there are no outstanding issues.	Annosi Complete
C V	The agencies advise that while there is agreement on the scope of program, the final version	
	of the Regional Rare Plant Survey Program needs to be reviewed.	
Program Area 3	Apr 13, 2017: advises that review by the VWTC of the Fisher mitigation	Almost Complete:
Fisher Mitigation and Monitoring	plan began in Feb 2017, with installation of coarse woody debris piles at the dam site and	-
Plan	transmission line and installation of den boxes.	
	Comments provided by VWTC to be incorporated into plan for discussion on May 18, 2017.	

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Program Area No. and Description	Status and Comments	Completeness
Program Area 2.1 an extension of	Apr 13, 2017: advises that that Program Areas 2, 8 and 11 require additional	Incomplete
Program Areas 2, 8 and 11	development in the Peace River below the dam site. A component of these three areas is to	
Downstream Vegetation and Nest	document the response to of riparian vegetation, rare plants and bird nests to changes in the	
Monitoring.	developed in 2017 and implemented in 2018, one year before river diversion.	
Program Area 6	Apr 13, 2017: advises that the VWTC began review of this project in Feb,	Incomplete
Amphibian Mitigation and	2017, which is to determine the response of the western toad to changes in water levels	_
Monitoring Plan	downstream of the dam. The VWTC has asked that the determination of western toad	
	presence/absence be changed to abundance. Revisions for discussion at May 18, 2017	
	Amphibians are also addressed under Program Area 16: Other Species at Risk and Drogram	
	Area 2Wetalands and Riparian Habitat.	
Program Area 8	Apr 13, 2017: advises that the VWTC determined that data on the common	Incomplete
Breeding and Migratory Birds	nighthawk is needed. Species-specific surveys discussed at meeting on Apr 7, 2017. Further	meompiete
Breeding Bird Monitoring Component -	discussion required and scheduled for May 18, 2017.	
Common Nighthawk		
Program Area 8	Apr 13, 2017: advises that the VWTC determined that data on woodpeckers	Incomplete
Breeding and Migratory Birds Breeding	is needed. Species-specific surveys discussed at meeting on Apr 7, 2017. Further discussion	,
Bird Monitoring Component -	required and scheduled for May 18, 2017.	
Woodpeckers		
Program Area 11	Apr 13, 2017: advises that that the VWTC is working to address issues with	Incomplete
Rare Flants: Translocation	program scope, which is to be expanded to included collection of materials. The VWTC to	
Program Area 2	Apr. 13, 2017: Apr. 14, 2017: Apr. 1	
Wetlands and Rinarian Habitat	2016 before commenting. Timelines for comments to be determined at May 18, 2017.	Incomplete
Mitigation and Monitoring.	meeting Implementation started in 2014 and is continuing. Plans for five wetland projects	
and the second stage	to be developed in 2017 and one to be constructed	
	This Plan is the largest and most complex of all the Plans required for Schedule A Needs	
	actual implementation to adjust offset targets. Reassessment is required every year until	
	satisfaction with Plan can be determined.	
Relevant VWTC mitigation and	Apr 13, 2017: provides table with date for implementation of each program.	Template
monitoring programs have	This Schedule A requirement is duplicated in each of the remaining project phases.	Required – See
commenced as per mitigation and	The VWTC has agreed that an accounting framework for all the Program Areas needs to be	item d) under
monitoring plans (VWTC Program	put in place. BC Hydro is to provide a draft of the document for review by the VWTC.	Section 11
Areas 1 – 16)	- -	

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BRITISH COLUMBIA

April 20, 2017

File: 7001837

Vice President & Project Director Site C Clean Energy Project BC Hydro & Power Authority 333 Dunsmuir Street Vancouver BC V7X 1V5

Dear

Re: Site C Clean Energy Project Conditional Water Licences 132990 and 132991 on Peace River Leave to Commence Construction # 7

British Columbia Hydro and Power Authority (BC Hydro) is the holder of Conditional Water Licence 132990 and 132991 (the Water Licences) that authorize the construction and operation of the Site C Clean Energy Project (the Project).

Prior to constructing any phase of the Project, BC Hydro must obtain a Leave to Commence Construction (LCC) for the phase. Four LCCs have been granted to BC Hydro. Submissions have been received for LCC #5 and #6 that are under review.

The Submission for Leave to Commence Construction #7 – Geotechnical Investigations for the Hudson's Hope Shoreline Protection Berm and Halfway River Debris Boom was received in this office on March 22, 2017.

My decision is to grant Leave to Commence Construction #7 – Geotechnical Investigations for the Hudson's Hope Shoreline Protection Berm and Halfway River Debris Boom.

The attached document is the decision and has a number of conditions that BC Hydro should review before any construction under LCC #7 is started.

If you should wish to discuss this Leave to Commence Construction, please contact



Ministry of Forests, Lands and Natural Resource Operations

Water Management Branch Water Allocation and Utility

Regulation Section

Mailing Address: PO Box 9340 Stn Prov Govt Victoria BC V8W 9M1 Telephone: 250-952-6790 Facsimile: 250-953-5124 Location: 3rd Floor 395 Waterfront Crescent Victoria BC V8T 5K7





pc:	, Water Management Officer, WMB, FLNRO
	, Regional Executive Director, Northeast Region, FLNRO
	, Water Manager, Northeast Region, FLNRO
	, P.Eng. Independent Engineer
	, Independent Environmental Monitor
	, P.Eng. Dam Safety Officer, WMB, FLNRO
	, Section Head, Omineca – North Area, FLNRO
	, Environmental Assessment Compliance Officer, EAO
	, Compliance and Enforcement Analyst, CEAA

BRITISH COLUMBIA

MINISTRY OF FORESTS, LANDS AND NATURAL RESOURCE OPERATIONS

Site C Clean Energy Project

Decision on Request for Leave to Commence Construction # 7 Geotechnical Investigations for the Hudson's Hope Shoreline Protection Berm and Halfway River Debris Boom

Signed April 20, 2017

by: P. Eng. Deputy Comptroller of Water Rights

Leave to Commence Construction # 7

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1. Introduction

1.1 Request and Decision for Leave to Commence Construction

British Columbia Hydro and Power Authority (BC Hydro) is constructing the Site C Clean Energy project on the Peace River (the "Project") under the authority of the *Water Sustainability Act*. Part of the Project includes the construction of the Hudson's Hope Shoreline Protection Works (the "Protection Works") and the Halfway River Debris Boom (the "Debris Boom"). The design of the Protection Works and the Debris Boom requires information on subsurface conditions at the site of these works. BC Hydro has requested a leave to commence construction that will be used in the design of works whose construction will be authorized as part of a subsequent leave to commence construction.

The request, dated March 9, 2017, is from the provided by Director of Environment, Aboriginal Relations and Public Affairs and is supported by documents and plans that describe the geotechnical investigation. The request, along with the supporting information provided by BC Hydro, is referred to as the Submission.

The Submission is for Leave to Commence Construction No. 7 (LCC #7), which comprises geotechnical investigations for the design of works authorized under Conditional Water Licence 132991.

This document reviews the Submission and other relevant information, all of which is the basis for the decision to issue Leave to Commence #7.

The decision is in Section 7.2 - Decision and the conditions associated with the decision should be reviewed before construction begins.

1.2 Submission for Leave to Commence Construction

The Submission comprises the plans and documents listed in Appendix A.

1.3 Overview of Works of Phase 7

The District of Hudson's Hope (DHH) is located on the reservoir that will be created under the Site C Clean Energy Project. The length of the reservoir will be about 83 kilometres, and Hudson's Hope is about 77 km upstream of the dam site. The shoreline of the reservoir will form the south boundary of the DHH and the works on the shoreline will provide protection against wind-wave induced erosion and increase the stability of the slope.

The Debris Boom will span the main channel and the side channels of the Peace River about 4 km below the mouth of the Halfway River. This debris handling facility will assist with the overall removal of debris upstream of the dam construction site. The debris is generated naturally and from reservoir clearing activities.

The geotechnical investigations comprising wells classed as monitoring wells and geotechnical wells are to obtain stratigraphical information for the design of the Shoreline Protection Berm and Debris Boom. These investigations are Phase 7 of the Project.

2. Decision Maker

The Decision Maker is the advantage of Deputy Comptroller of Water Rights and his authority includes that of an Engineer under the *Water Sustainability Act*.

3. Background

3.1 Water Licences

Conditional Water Licences 132990 and 132991 (the "Water Licences") authorize the construction of works for the diversion and use of water from Peace River and the storage of water in the Site C Reservoir. BC Hydro is the holder of the Water Licences and may be referred to as the Licensee.

The proposed geotechnical investigations relate specifically to Conditional Water Licence 132991 (the "Storage Licence") that authorizes the creation of the Site C Reservoir.

The *Water Act* [RSBC 1996] is referenced in the Water Licences. The *Water Sustainability Act* came into force on February 29, 2016 and for the purposes of these licences replaced the *Water Act*. In British Columbia the *Water Sustainability Act* is now the principle law for managing the diversion and use of water resources.

3.2 Works Authorized under the Storage Licence

The works authorized in clause h) of the Storage Licence includes the following:

- 1) a dam;
- 2) spillways;
- 3) a reservoir;
- 4) a shoreline protection berm at Hudson's Hope; and
- 5) ancillary works associated with operation of the dam and generating station.

The works, except for the ancillary works, are to be located as shown on the plan attached to the Storage Licence.

Clause m) of the Storage Licence states that:

"The licensee shall clear the reservoir, including ongoing debris management, in the manner and to the extent as may be directed by the Comptroller of Water Rights after consultation with the provincial forests ministry."

The geotechnical investigations described in the Submission are considered to be part of item 4) of clause h) a shoreline protection berm at Hudson's Hope of the works authorized under the Storage Licence and part of the debris management required under clause m) of the Storage Licence

3.3 Dam Safety Regulations

Clause i) of the Storage Licence states that the dam authorized under clause h) is subject to the Dam Safety Regulations and shall be designed, constructed and maintained, including any alterations, to the satisfaction of a Dam Safety Officer under the *Water Act* (the "Dam Safety Officer") and in accordance with the Canadian Dam Association Guidelines.

The Dam Safety Officer (DSO) for the Site C Clean Energy Project is Senior Dam Safety Engineer, BC Ministry of Forests, Lands and Natural Resource Operations, Water Management Branch.

3.4 Groundwater Protection Regulation

The *Groundwater Protection Regulation* (GWPR) ensures that any activity related to wells and groundwater is performed in an environmentally safe manner.

The proposed monitoring wells and geotechnical wells, which includes boreholes and test pits, are each a class of wells regulated under the GWPR.

4. Commencement of Construction

4.1 Clause j) of the Storage Licence

This clause states that, before commencing construction of the works authorized under clause h), the Licensee must, to the satisfaction of the Comptroller of Water Rights:

- 1) retain a professional engineer registered in the province of British Columbia (the "Independent Engineer") who will provide services to the Engineer under the *Water Act* for the regulation of construction of the works (Attachment A);
- 2) retain a person with professional qualifications (the "Independent Environmental Monitor") who will monitor environmental impacts from the construction of works (Attachment B);
- 3) submit, the following:
 - a. plans that show the general arrangement of the works;
 - b. criteria for the design of the works;
 - c. criteria for the operation of the works;
 - d. a schedule for the construction of the works;
 - e. an environmental management plan (CEMP) for the management and mitigation of construction impacts;
- 4) complete all monitoring, mitigation and compensation projects required for each Leave to Commence Construction, as specified in Schedule A; and
- 5) obtain Leave to Commence Construction (LCC) in writing from the Engineer.

4.2 Clause k) of the Storage Licence

This clause states that, before undertaking construction of any component of works for which an

LCC is issued under clause j) 5), the Licensee must:

- 1) ensure that the design drawings for the works to be constructed are signed and sealed by a professional engineer registered in the province of British Columbia (the "Design Engineer");
- 2) ensure that a professional engineer registered in the province of British Columbia (the "Construction Engineer") supervises the construction of the works; and
- 3) obtain a letter from the Independent Engineer that the actual construction of that component work may proceed.

4.3 Appointment of Independent Engineer and Independent Environmental Monitor

As required under clause j) 1) and 2) and in accordance with LCC #1:

- is confirmed as the Independent Engineer , with as his alternate, and
 is confirmed as the
- Independent Environmental Monitor, with as his delegates.

4.4 Role of Independent Engineer (IE) and Independent Environmental Monitor (IEM)

The IE provides information and reports under the direction of the Engineer regarding the design and construction of the works.

The IEM is responsible for observing the methods of construction and preparing information reports on the compliance of construction activities with the Construction Environmental Management Plan and Environmental Protection Plans.

The IE and the IEM communicate with each other to coordinate their activities to provide the Engineer with information for the proper regulation of the construction of the works.

4.5 Design Engineer and Construction Engineer

The Licensee has determined that the role of the Design Engineer and Construction Engineer as set out in clause k) 1) and 2) of the Water Licences is fulfilled by **Sector** who is the Owner's Engineering Manager and is responsible for coordinating both the design and the field review of the works.

4.6 Role of Engineer and Independent Engineer

The Storage Licence provides the Engineer under the *Water Sustainability Act* with the specific task of granting Leaves to Commence Construction. The IE has the task of reviewing the design and plans for each phase of the works. When sufficient information is provided by BC Hydro, the IE prepares a report to the Engineer with a recommendation for the issuance of a LCC for a specific phase of the works.

After the LCC is granted for a phase of the works, the IE reviews the information related to the design of each component within the phase in accordance with Attachment A of the Storage Licence. When sufficient information is provided by BC Hydro, the IE prepares a report to the Engineer that recommends that the construction of a particular component of the works may be undertaken. The Licensee, Design Engineer and Construction Engineer are provided a copy of the report, which is sufficient for construction of the component to proceed.

4.7 Schedule for Leave to Commence Construction

The IE submitted a schedule of Leaves to Commence Construction, Leaves to Construct (LTCs) and Leaves to Commence Operation (LCOs), with a letter dated December 27, 2017. Subsequent revisions by the Licensee are incorporated into a schedule effective on February 6, 2017. This schedule is attached to a letter dated February 13, 2017 from the IE.

The schedule submitted by the IE is Table 1 in Appendix B and is accepted as the current schedule of LCCs, LTCs & LCOs for the Project.

The schedule may be revised as required to suit the site conditions and design of the Project.

4.8 Phases of Construction

Construction of the Project under the Water Licences commenced with LCC #1, #2, #3 and #4, which authorize the construction of works as follows:

- 1. LCC #1 issued April 1, 2016 and authorizes the left bank excavation; right bank side channel closure dikes, right bank drainage tunnel, Moberly River construction bridge, backfilling of historic drill holes and exploratory adits, and erosion protection as needed.
- 2. LCC #2 issued June 29, 2016 and authorizes the construction of five areas for the Relocation

of Surplus Excavated Material (RSEM). The areas are enclosed by dikes and each has a sediment pond for the collection of contact water. The ponds discharge to the Peace River.

- 3. LCC #3 issued July 20, 2016 and authorizes the construction of the Left Bank Stage 1 Diversion Inlet and Outlet Cofferdams, the Right Bank Stage 1 Cofferdam with cut-off wall, overburden and bedrock excavations inside the right bank cofferdam and approach channel overburden and bedrock excavation.
- 4. LCC #4 issued December 6, 2016 and authorizes clearing of the eastern portion and part of the central portion of the reservoir.

Submissions are under review for two phases of the Project as follows:

1. The submission for LCC #5 proposes the construction of the Left Bank Stage 1 cofferdams for confining the flow of the Peace River to its main channel and two tunnels for diverting the flow of the river for the construction of the earthfill dam.

A decision on the

submission is pending.

2. The submission for LCC #6 proposes the construction of a buttress of roller compacted concrete on the south bank. The buttress will support the south wall of the Peace River Valley at Site C and provide an abutment for the earthfill dam and the foundation for the powerhouse and the spillways. The decision on the submission is pending.

5. Review of Submission

5.1 Scope of Works

5.1.1 Shoreline Protection Berm

Hudson's Hope is situated on the north shore of the Peace River about six kilometres from the upper end of Site C Reservoir. The proposed shoreline protection comprises a granular berm to protect against erosion and excavation of the embankment to flatten the slope to offset effects of the reservoir on slope stability. The portion of the berm exposed to the reservoir would be armoured with rip rap.



BC Hydro will be entering into agreements with the District of Hudson's Hope and the owners of private land for access for the geotechnical investigations.

5.1.2 Halfway River Debris Boom

Halfway River flows into the Peace River from the north and the confluence of the two rivers is about halfway between Site C Dam and the upper end of Site C Reservoir. The Halfway River Debris Boom facility will be located on Peace River about four km downstream of the mouth of Halfway River.



5.1.3 Schedule for Geotechnical Investigations

5.2 Report by the Independent Engineer

, the IE provides a review of the proposed Phase 7 works in the letter report (the "Report") dated April 13, 2017. The Report describes the proposed geotechnical investigations for the Hudson's Hope Shoreline Protection Berm and the Halfway River Debris Boom.

The IE has reviewed the Submission in the context of Attachment A of the Storage Licence.

The recommendation of the IE is to grant leave to commence construction for the geotechnical investigations as LCC #7 and there should be two Leaves to Construct under LCC #7 as follows:

- 1. LTC07A: Halfway River Debris Boom Geotechnical Investigations
- 2. LTC07B: Hudson's Hope Berm Geotechnical Investigations

I accept the Report dated April 13, 2017 by the IE.

5.3 Report by the Independent Environmental Monitor

The report of the IEM, dated dated April 17, 2017 reviews the proposed geotechnical investigations for the Hudson's Hope Shoreline Protection Berm and the Halfway River Debris Boom.

The IEM has deferred review and comments on the technical and public safety aspects of the geotechnical investigations to the Independent Engineer and the Dam Safety Officer.

The IEM states that the Construction Environmental Management Plan (CEMP) (Revision 4, dated July 26, 2016) prepared by BC Hydro is intended to provide a framework to the contractors in the development of their work specific Environmental Protection Plans (EPPs).

The IEM states that, from his perspective, sufficient information is in place for the issuance of LCC #7. The documents prepared for each LTC will direct the preparation of site specific EPPs for review by the IEM and Independent Engineer. This is in accordance with Attachment B to the Storage Licence.

I accept the Report dated April 17, 2017 by the IEM.

5.4 Report by Dam Safety Officer

The shoreline protection at Hudson's Hope does not meet the definition of a dam in the *Dam Safety Regulation* and the regulation is not applicable to these works.

The debris management works proposed under Phase 7 will contribute to the safe construction of the dam authorized under the Storage Licence, and as such the geotechnical investigations fall under the *Dam Safety Regulation*.

P. Eng. the Dam Safety Officer has reviewed the Submission, and advises that the proposed geotechnical investigations are reasonable for the anchors of the Halfway River Debris Boom.

6. Environmental Considerations

The Storage Licence requires the completion of monitoring, mitigation and compensation projects (the "Plans") related to various phases of the Project before construction of the phases may commence. Schedule A attached to the Storage Licence sets out the Plans required for each phase of the Project.

Schedule A requires an initial design of the Hudson's Hope Berm, including habitat features, to be provided for review by the Fisheries and Aquatic Habitat Technical Committee (FAHTC) and DHH at least three years before construction of the berm is to begin.

The construction of the shore line protection berm is scheduled to **EXAMPLE 1** so the specified time of three years for the review of the initial design by FAHTC and DDH is no longer available. Rather than moving the date for start of construction, the Licensee has requested that time for the preparation of the initial design be reduced to 2.5 years. Both FAHTC and DDH agreed in November 2016 to the shortened time frame.

Schedule A does not make a correlation between the geotechnical investigations of either the berm or the debris boom to the timeframe required for the completion of any of the Plans. Consequently, no

particular monitoring, mitigation and compensation projects need to be completed prior to the commencement of these geotechnical investigations.

Therefore, no more Plans need to be completed prior to a decision on the Submission.

Nonetheless, drilling wells and excavating test pits may have environmental impacts. The Licensee is required to prepare an EPP for the geotechnical investigations for the Hudson's Hope Shoreline Protection Berm and the Halfway River Debris Boom.

The most recent version of the Construction Environmental Management Plan should be referenced in the Environmental Protection Plans. The current version is R4 dated July 26, 2016.

7. Conclusion

7.1 Documents Considered for Decision

The decision on the Submission considers the *Water Sustainability Act*, the requirements of the Storage Licence, the plans and documents listed in Appendix A, the construction schedule in Appendix B, the plans in Appendix C, D and E and the reports by

7.2 Decision

I, hereby, grant to BC Hydro & Power Authority leave to commence construction of the works for the geotechnical investigations (including temporary access roads, geotechnical wells and monitoring wells for the purpose of obtaining stratigraphical information, monitoring, observing measuring and assessing the level of groundwater and determination of subsurface conditions) as follows:

- 1. Hudson Hope Berm Geotechnical Investigations including nine wells, sixteen test pits and temporary access roads in the vicinity of Hudson's Hope, all of which are located approximately as shown on the plan in Appendix E.
- 2. Halfway River Debris Boom Geotechnical Investigations including up to seven wells on islands in the Peace River about 4 km downstream of the mouth of Halfway River and helicopter launching pads, all of which are located approximately as shown on the plans in Appendix D.

This Leave to Commence Construction is subject to the following conditions:

- 1. Before commencing the geotechnical investigations, the Licensee must submit to the Deputy Comptroller of Water Rights, with a copy to the Independent Engineer, a document signed by each private landowner affected by the works authorized under LCC #7 that acknowledges there is an agreement for BC Hydro to access the privately owned land.
- 2. Before commencing any of the geotechnical investigations, the Licensee must:
 - submit relevant plans for the access roads, geotechnical wells, monitoring wells, environmental protection and public safety for each site to to review in his capacity as IE, and
 - receive a copy of a report (the "Recommendation Report") submitted by the IE to the Engineer under the Water Sustainability Act, which report recommends that construction of a component of LCC #7 may proceed. The Recommendation Report is in the form of a letter and is sufficient for construction of that component to proceed.

- 3. Within ten days of the receipt of the Recommendation Report, the Licensee may request the Engineer to make revisions to the Recommendation Report, if it conflicts with the Licensee's plans or site conditions.
- 4. If during construction material changes are made to the manner in which the geotechnical investigations are to be carried out, the changes must be authorized through the process described in Item 2.
- 5. Material changes to the number and location of the geotechnical wells, monitoring wells and access roads are to be submitted to the Engineer for amendment of the plans in Appendix C and E.
- Any revisions to sections of the CEMP that are applicable to the construction of works authorized by the Water Licences, including temporary works in support of constructing the named permanent works, must be reviewed by the IEM and accepted by the Deputy Comptroller of Water Rights;
- 5. Weekly progress reports on construction shall be submitted by the Licensee to the IE, IEM and the Engineer;
- 6. The Licensee must comply with the provisions for wells in the *Water Sustainability Act* and *Groundwater Protection Regulation*.
- 7. When the geotechnical investigations are complete, all ground surface disturbances must be restored as nearly as possible to the original condition.
- 8. Permits, licences, and approvals under enactments other than the *Water Sustainability Act* for the construction of works may be required in addition to the leave to commence construction, and the Licensee should ensure the appropriate authorizations are in place.
- 9. No clearing activities on Crown Land may commence prior to the issuance of relevant Land Act Licence(s) of Occupation, and Forest Act Occupant Licence(s) to Cut, Forest Act Section 52 authorization(s), and Forest and Range Practices Act ungulate winter range exemption(s), where applicable.



Deputy Comptroller of Water Rights

mi 20/

Date

Appendix A – Information Considered in Decision Request for LCC #7 and Supporting Information

List of Plans and Documents in support of Submission for LCC #7

- 1. Cover letter from **Exercise**, Director of Environment, Aboriginal Relations and Public Affairs and dated March 9, 2017.
- 2. Description of Activities and Works for the Hudson's Hope Shoreline Protection Berm Geotechnical Investigations.
- 3. Hudson's Hope Shoreline Protection Investigations DWG NO 1016-C14-07479, March 2, 2017.
- 4. Permit Authorizing the Occupation of Crown Land by flooding and constructing, maintaining and operating works Permit No.: 28283.
- 5. Request dated Feb 16, 2017 under Section 52 of the *Forest Act* for authorization to fall timber along the shoreline of the protection berm.
- 6. Decision from Council of the District of Hudson's Hope to approve change in time frame for submission of initial design.
- 7. E-mail dated Nov 18, 2016 from the on behalf of FAHTC that the change in time frame for submission of initial design still provides sufficient time to review, and response from Water Management Officer.
- 8. Description of Activities and Works for the Halfway River Debris Boom Geotechnical Investigations.
- 9. Two site plans showing drill hole and helicopter staging locations for the Halfway River Debris Boom.
- 10. Site Specific Tenure Licence No. 815767, under *Land Act*, and supporting documents for Halfway River debris boom.
- 11. Occupant Licence to Cut L50574, under *Forest Act*, and supporting documents for Halfway River debris handling facility.
- 12. Schedule for Hudson's Hope Shoreline protection berm and Halfway River debris boom investigations.
- 13. Geotechnical Investigation Workplan Hudson's Hope Shoreline Protection Berm prepared by Dated March 15, 2017.
- 14. E-mail dated April 13, 2017 from **Example**, BC Hydro, that provides a plan showing the ownership of lands in the vicinity of the District of Hudson's Hope and the status of agreements with the owners of privately owned land.
- 15. DWG 1016-C14-08840 Hudson's Hope Shoreline Protection Investigations Geotechnical Plan Ownership Type.

Appendix A (con't)

- 16. Report dated April 13, 2017 by Independent Engineer, for Geotechnical Investigations for Hudson's Hope Shoreline Protection Berm & Halfway River Debris Boom.
- 17. Letter dated April 4, 2017 from **Dam** Safety Officer that reviews the geotechnical investigations for the Halfway River Debris Boom.
- 18. Letter dated April 18, 2017 by Independent Environmental Monitor, for Geotechnical Investigations for Hudson's Hope Shoreline Protection Berm & Halfway River Debris Boom.
- 19. E-mail dated April 6, 2017 from Regulatory Manager, Site C Clean Energy Project which advises that all lands on which wells are proposed are to be included in LCC #7.
- 20. Geotechnical Design Memo dated April 11, 2017 prepared by that describes the proposed work program for the Halfway River Debris Boom.



July 21, 2017

File: 7001837



Vice President & Project Director Site C Clean Energy Project BC Hydro & Power Authority 333 Dunsmuir Street Vancouver BC V7X 1V5

Dear

Re: Site C Clean Energy Project Conditional Water Licences 132990 and 132991 on Peace River Leave to Commence Construction # 8

British Columbia Hydro and Power Authority (BC Hydro) is the holder of Conditional Water Licences 132990 and 132991 (the Water Licences) that authorize the construction and operation of the Site C Clean Energy Project (the Project).

Prior to constructing any phase of the Project, BC Hydro must obtain a Leave to Commence Construction (LCC) for the phase. Seven LCCs have been granted to BC Hydro since April 1, 2016.

The Submission requesting LCC #8 – Earthfill Dam Excavation, Foundation Preparation, Fill Placement and Approach Channel Foundation Preparation and Placement was received in this office on May 10, 2017.

My decision is to grant LCC #8. The attached document is the decision and has a number of conditions that BC Hydro should review before any construction under LCC #8 is started.

.../2

Ministry of Forests, Lands,	Water Management Branch	Mailing Address:	Location:
Natural Resource Operations		PO Box 9340 Stn Prov Govt	3rd Floor 395 Waterfront Crescent
and Rural Development	Water Allocation and Utility	Victoria BC V8W 9M1	Victoria BC V8T 5K7
	Regulation Section	Telephone: 778-698-7344	<u> </u>
Resource Stewardship Division		Facsimile: 250-953-5124	

If you should wish to discuss this Leave to Commence Construction, please contact

Yours truly,



Deputy Comptroller of Water Rights

Attachment



BRITISH COLUMBIA

MINISTRY OF FORESTS, LANDS AND NATURAL RESOURCE OPERATIONS

AND RURAL DEVELOPMENT



Site C Clean Energy Project

Leave to Commence Construction #8

Earthfill Dam Excavation, Foundation Preparation, Fill Placement and Approach Channel Foundation Preparation and Placement

July 20, 2017

Leave to Commence Construction #8

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1. Introduction

1.1 Request for and Decision about Leave to Commence Construction #8

British Columbia Hydro and Power Authority (BC Hydro) is constructing the Site C Clean Energy Project on the Peace River (the "Project") under the authority of the *Water Sustainability Act*.

Leaves to Commence Construction for Phases 1 to 7 of the Project have been issued and BC Hydro has requested leave to commence construction of Phase 8 – Earthfill Dam.

Phase 8 – Earthfill Dam includes excavation and preparation of the foundation and placement of the fill for the dam, preparation and protection of the approach channel foundation and placement of the lining for the approach channel.

The request dated May 8, 2017 is from **Construction**, Director of Environment, Aboriginal Relations and Public Affairs and is supported by documents and plans that describe the extent of the works of Phase 8. The request, along with the supporting information provided by BC Hydro, is referred to as the Submission.

BC Hydro is required to address potential ecosystem impacts before a leave to commence construction may be issued. I have reviewed the requirements associated with Leave to Commence #8 (LCC #8). As discussed in **Section 8 – Environmental Considerations**, I am satisfied the requirements have been met.

This document reviews the Submission and other relevant information, all of which are the basis for the decision to issue LCC #8.

The decision is in **Section 9** – **Decision** and the conditions associated with the decision should be reviewed before construction begins.

1.2 Submission for Leave to Commence Construction

The Submission comprises the documents and plans listed in Appendix A. Other documents considered in my decision are also included in Appendix A.

2. Decision Maker

The Decision Maker is **Decision**, P.Eng. Deputy Comptroller of Water Rights (the "DCWR") and his authority includes that of an Engineer under the *Water Sustainability Act*.

3. Background

3.1 Water Licences

The construction of works for the storage, diversion and use of water from the Peace River for the Project is authorized by Conditional Water Licences 132990 and 132991 (the Water Licences). BC Hydro is the holder of the Water Licences and may be referred to as the Licensee.

The *Water Act* [RSBC 1996] is referenced in the Water Licences. In British Columbia the *Water Sustainability Act* is now the principle law for managing the diversion and use of water resources. The *Water Sustainability Act* came into force on February 29, 2016 and for the purposes of the Water Licences replaced the *Water Act*.
3.2 Works Authorized under the Water Licences

The works authorized in clause h) of the Water Licences includes the following:

- 1) an approach channel;
- 2) an intake;
- 3) a dam;
- 4) spillways;
- 5) a reservoir;
- 6) a shoreline protection berm at Hudson's Hope;
- 7) a powerhouse and tailrace;
- 8) an access road; and
- 9) ancillary works associated with operation of the dam and generating station.

The works are to be located as shown on the plan attached to each Water Licence.

The components of Phase 8 described in the Submission are required for the construction of the approach channel and dam authorized under the Water Licences.

3.3 Dam Safety Regulations

Clause i) of the Water Licences states that the dam authorized under clause h) is subject to the Dam Safety Regulations and shall be designed, constructed and maintained, including any alterations, to the satisfaction of a Dam Safety Officer under the *Water Act* (the "Dam Safety Officer") and in accordance with the Canadian Dam Association Guidelines.

The Dam Safety Officer (DSO) for the Site C Clean Energy Project is **Exercise**, MSc, P.Eng. Senior Dam Safety Officer, BC Ministry of Forests, Lands and Natural Resource Operations and Rural Development, Water Management Branch.

4. Appointment of Independent Engineer and Independent Environmental Monitor

As required under clause j) 1) and 2) of the Water Licences and in accordance with LCC #1:

continues in his designated role as the Independent Engineer, with
, P.Eng. as his alternate, and
. continues in his designated role as the Independent Environmental Monitor, with and , MREM, as delegates.

5. Design Engineer and Construction Engineer

The role of the Design Engineer and Construction Engineer as set out in clause k) 1) and 2) of the Water Licences is fulfilled by P.Eng., the Licensee's Owner Engineer Manager.

In a memorandum dated May 5, 2017, P. Eng. describes the role of Owner Engineer Manager or delegate as follows:

- a) Provides Owner Requirements to designers and manages any design approval processes required by BC Hydro
- b) Leads BC Hydro's design
- c) Accepts all the design products and work plans
- d) Accepts all construction field changes

- e) Accepts all integration for the project and leads where necessary Non-Core design integration
- f) Provides oversight on design, integration and field review

The role of the Owner Engineer Manager or delegate as described above satisfies the requirement of clause k) 1) and 2).

6. Phases of Construction

Construction of the Project under the Water Licences has proceeded under the following leaves to commence construction (LCCs):

- 1. LCC #1 issued April 1, 2016 authorizes the left bank excavation; right bank side channel closure dikes, right bank drainage tunnel, Moberly River construction bridge, backfilling of historic drill holes and exploratory adits, and erosion protection as needed.
- 2. LCC #2 issued June 29, 2016 authorizes the construction of five areas for the Relocation of Surplus Excavated Material (RSEM). The areas are enclosed by dikes and each has a sediment pond for the collection of contact water. The ponds discharge to the Peace River.
- 3. LCC #3 issued July 20, 2016 authorizes the construction of the Left Bank Stage 1 Diversion Inlet and Outlet Cofferdams, the Right Bank Stage 1 Cofferdam with cut-off wall, overburden and bedrock excavation inside the right bank cofferdam and approach channel overburden and bedrock excavation.
- 4. LCC #4 issued December 6, 2016 authorizes clearing of the eastern portion and part of the central portion of the reservoir.
- 5. LCC #5 issued on April 25, 2017 authorizes the construction of the left bank Stage 1 cofferdam for confining the flow of the Peace River to its main channel and two tunnels for diverting the flow of the river during the construction of the earthfill dam. This LCC also includes the construction of an adit for relieving the pore water pressure in the left abutment, and in-river works to improve the flow conditions in the tailrace and downstream river channel.
- 6. LCC #6 issued May 16, 2017 authorizes the roller compacted buttress on the right bank. The buttress will support a section of the south wall of the Peace River and provide an abutment for the earthfill dam and the foundation for the powerhouse and spillways.
- LCC #7 issued April 20, 2017 authorizes geotechnical investigations to obtain information for the design of the Hudson's Hope Shoreline Protection Berm and the Halfway River Debris Boom.

7. Review of Submission

7.1 Scope of Works

The construction of the earthfill dam of the Project requires the Peace River to be diverted around the dam site by way of two tunnels. The diversion is completed in two stages.

The first stage is the construction of cofferdams on the left and right banks to confine the river to its main channel. The cofferdams at the inlet and outlet portals of the tunnels stop the river from entering the tunnels while they are under construction. The inlet and outlets of the tunnels will be equipped with gates and ancillary works for controlling the diversion.

The second stage is the removal of a portion of the cofferdams at the inlet and outlet portals, which will divert some flow through the tunnels. The diversion is completed by closing off the river channel with Stage 2 cofferdams upstream and downstream of the dam site. Parts of the inlet and outlet cofferdams are incorporated into the Stage 2 cofferdams.

The area between the upstream and downstream Stage 2 cofferdams will be dewatered and portions of the left and right bank cofferdams will be removed to allow construction of the dam.

The second stage of the diversion will be authorized in a subsequent LCC.

The construction of the right bank cofferdam and inlet and outlet cofferdams are included in LCC #3. The construction of the left bank cofferdam and the tunnels are included in LCC #5.

The construction of the earthfill dam includes excavation, foundation preparation, foundation protection, grouting and drainage, fill placement and instrumentation.

The work on the approach channel includes foundation preparation and protection, construction of the cut-off wall and channel lining as well as installation of instrumentation.

The Submission provides technical specifications and plans for the construction of the earthfill dam and the work on the approach channel.

The Independent Engineer has submitted a report that includes a more detailed description of the construction of the earthfill dam. A copy of this description is in Appendix B.

7.2 Report by the Independent Engineer (IE)

, P. Eng. provides a comprehensive review of the earthfill dam and approach channel in the letter report (the "IE Report") dated July 19, 2017.

The IE has reviewed the Submission in the context of his mandate as described in Attachment A of the Water Licences. The IE considers that conditions for granting Leave to Commence Construction #8 have been met. The role of the IE does not extend to a review of the Plans for Schedule A.

The recommendation of the IE is that the request for LCC#8 be granted with the expectation that there will be three associated Leaves to Construct (LTCs); one for each of the following components:

LTC	LCC Components	Construction Start Date
LTC #08A	Earthfill Dam Excavation and Foundation Preparation including	November 2017
	Drilling & Grouting	
LTC #08B	Earthfill Dam Fill Placement	November 2018
LTC #08C	Approach Channel Foundation Preparation, Concrete Plinth,	February 2021
	Grouting, Cutoff Wall and Lining	

I accept the IE Report dated July 19, 2017 with the understanding that it does not include a review of the Plans for Schedule A.

7.3 Report by the Independent Environmental Monitor

in a letter report dated July 14, 2017 reviews the Submission and includes a description of the components included in Phase 8 of the construction of the Project.

The IEM intends to review the information for the construction of each component including the Environmental Protection Plans, associated component plans and design drawings to verify that "they achieve the requirements of relevant permits, approvals authorizations, EAC conditions, the federal Decision Statement and the Construction Environmental Management Plan."

The component documents provided in accordance with LCC #8 and reviewed by the IEM will ultimately direct the preparation of the site specific Environmental Protection Plans for review and acceptance by the IEM and IE through the LTC process.

The plans and documents reviewed by the IEM are cited in the IEM's report.

The IEM states that, from his perspective, sufficient information is in place for the issuance of LCC #8.

I accept the IEM's Report dated July 14, 2017 with the understanding that it does not include a review of the Plans for Schedule A.

7.4 Report by Dam Safety Officer (DSO)

, P. Eng. the Dam Safety Officer advises in a letter dated July 18, 2017 that he has reviewed the documents and drawings of the Submission for LCC #8.

The DSO is satisfied with the information provided for the design and planned construction methodology associated with LCC #8.

8. Environmental Considerations

The Water Licences require the completion of monitoring, mitigation and compensation projects (the "Plans") related to various phases of the Project before construction of the phases may commence. Schedule A attached to the Water Licences sets out the Plans required for each phase of the Project.

The Vegetation and Wildlife Technical Committee (VWTC) and the Fisheries and Aquatic Habitat Technical Committee (FAHTC) provide oversite and guidance to the Licensee in the preparation of the Plans that address potential ecosystem impacts of the Project. The technical committees consist of federal and provincial agencies and BC Hydro.

Schedule A, attached to the Water Licences, describes the Plans required to be completed prior to the start of each phase of the Project.

8.1 Vegetation and Wildlife Program

The agencies with an interest in the Schedule A Plans may review the Plans periodically to determine if additional areas need to be considered and that the monitoring and mitigation for each area is proceeding according to the Plans.

For the Earthfill Dam phase of the Project, Schedule A only requires that "*Relevant VWTC mitigation* and monitoring programs have commenced as per mitigation and monitoring plans (VWTC Program Areas 1 - 16)."

The technical assessment report to support the decision to issue the Site C water licences indicates that this condition is attached to the Earthfill Dam component of the Project because "*Regular periodic reviews allow for program flexibility and adaptive management to ensure adequate results to management questions (VWTC Program Areas 1 – 16).*"

Comments from the agencies are as follows:

- 1. While many of the Plans are complete, there are still a number that are outstanding, and the Plans have not progressed enough to determine if revisions or course corrections are necessary.
- 2. A periodic review is important to track the implementation and effectiveness of the Plans. An annual or bi-annual review may be appropriate.

Response to agency comments:

The Licensee has given assurance that all the Plans will be implemented in 2017 and that the outstanding issues will not adversely affect the monitoring projects. The agencies will have an opportunity to review all the Plans again prior to the issuance of the next LCCs. LCC #10 is scheduled to be issued in February 2018 and LCC # 11 in April 2018.

Decision:

I am satisfied that the requirements of the vegetation and wildlife program under Schedule A related to the Earthfill Dam phase of the Project have been met.

8.2 Fisheries and Aquatic Habitat Program

For the Roller Compacted Concrete Buttress and Earthfill Dam phases of the Project, Schedule A only requires that "*Progress of monitoring and mitigation programs in FAHTC program areas deemed satisfactory*."

The technical assessment report to support the decision to issue the Site C water licences indicates that this condition is attached to the Earthfill Dam component of the Project because "*Periodic reviews allow for flexibility and adaptive management, and ensures that the programs meet their goals.*"

Fisheries and Aquatic Lead, BC Hydro, wrote on April 20, 2017 (Re: Status of Progress of monitoring and mitigation programs) on behalf the FAHTC that the progress of the monitoring and mitigation programs is to the satisfaction of the committee. The activities of the FAHTC include the following:

- 1. Meet regularly to review the Management Plan and Follow-up Program.
- 2. Prepare and reach agreement on: updates to the Kokanee Assessment Plan, monitoring downstream flow fluctuations, and assessment procedure for evaluating the indicator species of Bull Trout and Arctic Grayling in tributaries.
- 3. Review results from the monitoring programs implemented in 2016 and update monitoring programs accordingly.
- 4. Review information and provide guidance on fish passage management.

The fishery agencies have reviewed and support the letter of April 20, 2017.

Decision:

I am satisfied that the requirement of the fisheries and aquatic habitat program under Schedule A for the Earthfill Dam phase of the Project has been met.

9. Decision on Submission

I hereby grant to BC Hydro & Power Authority "Leave to Commence Construction #8 – Earthfill Dam. This authorizes construction of the following works:

- 1. Earthfill Dam:
 - a) Excavation
 - b) Foundation Preparation and Foundation Protection
 - c) Grouting and Drainage
 - d) Fill Construction
 - e) Instrumentation
- 2. Approach Channel:
 - a) Foundation Preparation and Foundation Protection
 - b) Concrete Plinth, Grouting and Cutoff Wall
 - c) Lining
 - d) Instrumentation

Leave to Commence Construction #8 is subject to the following conditions:

- a) Before the construction of any component of LCC #8 of the Project may proceed, the Licensee must:
 - submit relevant design drawings signed and sealed by a professional engineer registered in the province of British Columbia to P. Eng. to review in his capacity as IE; and
 - receive a copy of a report (the Recommendation Report") submitted by the IE to the DCWR, which recommends that construction of that component of LCC #8 may proceed. The Recommendation Report is in the form of a letter, referred to as a "Leave to Construct" and is sufficient for construction of that component to proceed.
- b) The licensee may request the DCWR to review any of the IE's Recommendation Reports and make alterations that the DCWR deems appropriate.
- c) If during construction material changes to the works of LCC #8 are proposed, the changes must be authorized through the process described in item a) above.
- d) Any proposed revisions to the CEMP that are applicable to the construction of works authorized by the Water Licences, including temporary works in support of constructing the named permanent works, must be reviewed by the IEM and accepted by the Deputy Comptroller of Water Rights before coming into effect.



Deputy Comptroller of Water Rights

July 21, 2017 Date

Appendix A – Information for Decision on Request for LCC #8

Items 1 to 6 are documents submitted by BC Hydro in its Submission

- BC Hydro Re: Site C Clean Energy Project, CWL 132990 and 132991 on the Peace River Request for Leave to Commence Construction 8 for Earthfill Dam Excavation, Foundation Preparation and Fill Placement & Approach Channel Foundation Preparation and Placement (LCC8), letter from 08 May 2017.
- 2. BC Hydro Leave to Commence Construction #8, Earthfill Dam Excavation, Foundation Preparation and Fill Placement & Approach Channel Foundation Preparation and Protection, Description of Work, prepared by BC Hydro for the Comptroller of Water Rights, Submitted 08 May 2017.
- 3. BC Hydro General Arrangement Drawings (see Table 1).
- 4. BC Hydro Main Civil Works Technical Specifications:
 - a. Section 13 50 00 R3 Instrumentation
 - b. Section 31 12 00 R4 Sources of Materials
 - c. Section 31 23 00 R3 Surface Excavation
 - d. Section 31 32 20 R3 Geomembrane
 - e. Section 31 40 00 R4 Drilling, Grouting and Drainage
 - f. Section 31 60 00 R3 Foundation Preparation
 - g. Section 31 70 00 R4 Fill Construction
 - h. Section 31 75 00 R2 Slurry Cut-Off Wall
 - i. Section 31 80 00 R2 Care of Water

5.

6. Drawings for Earthfill Dam and Approach Channel are listed in following tables:

Earthfill Dam Foundation Excavation

Drawing No.	Revision	Title
1020-C02-00403	R1	Dam – Earthfill; Excavation; Plan and Section A
1020-C02-00404	R0	Dam – Earthfill; Excavation; Sections B, C, and D
1020-C02-00405	R0	Dam – Earthfill; Excavation; Sections E, F, and G

Earthfill Dam Foundation Preparation & Protection

Drawing No.	Revision	Title
1020-C02-00600	R0	Dam; Dam and Other Structures; Foundation Preparation; Section and Details
1020-C02-00601	R 0	Dam; Dam and Other Structures; Foundation Protection on Rock Section and Details

Earthfill Dam Foundation Grouting

Drawing No.	Revision	Title
1020-C02-00603	R0	Dam – Earthfill; Grouting and Drainage; Plan and Section A
1020-C02-00604	R0	Dam – Earthfill; Grouting and Drainage; Sections B and D, and Details X and Y
1020-C02-00605	R0	Dam – Earthfill; Grouting and Drainage; Sections C and E, and Detail Z

Earthfill Dam - Fill

Drawing No.	Revision	Title
1020-C02-00800	R1	Dam – Earthfill; Fill; Plan
1020-C02-00801	R0	Dam – Earthfill; Fill; Sections A, B, and C
1020-C02-00802	R0	Dam – Earthfill; Fill; Sections D, E, F, and G
1020-C02-00803	R0	Dam – Earthfill; Fill; Sections H, J and K
1020-C02-00804	R0	Dam – Earthfill; Fill; Sections L and M, and Detail X
1020-C02-00805	R0	Dam – Earthfill; Fill; Dam Crest Camber Profile and Detail
1020-C02-00806	R0	Dam – Earthfill; Integration of Downstream Cofferdam;
		Plan and Sections
1020-C02-00807	R0	Dam – Earthfill; Boat Ramp - Dam Toe; Plan, Section A and B, and
		Detail Z
1020-C02-00808	R0	Dam – Earthfill; Fill; Details Z, Y, X, V, U, T, S, and R
1020-C02-00809	R0	Dam – Earthfill; Integration of Downstream Cofferdam;
		Sections B, C, and D
1020-C02-00810	R0	Dam; Dam and Other Structures; Gradation and Compaction of Fill
		Materials
1020-C02-00811	R0	Dam; Dam and Other Structures; Gradation of Riprap and Bedding
		Zones
1020-C02-00813	R0	Dam – Earthfill; Test Fill; Impervious Fill Zone 1; Plan, Sections A
		and B, and Detail
1020-C02-00814	R0	Dam – Earthfill; Test Fill; Filter Zone 2A and 2B; Plan, Sections A,
		B, and C
1020-C02-00815	R0	Dam – Earthfill; Fill; Sections N, P, Q, R, and S
1020-C02-00816	R1	Dam – Earthfill; Fill; Sections T, U, V, W, and X
1020-C02-00820	R0	Dam – Earthfill; Helicopter Marshalling Area;
		General Arrangement; Plan
1020-C02-00821	R0	Dam – Earthfill; Helicopter Marshalling Area;
		General Arrangement; Sections A And B, and Details

Earthfill Dam - Instrumentation

Drawing No.	Revision	Title
1020-I02-05000	R0	Dam – Earthfill; Dam Safety Instrumentation; General
		Arrangement Plan
1020 102 05001	R0	Dam – Earthfill; Dam Safety Instrumentation;
1020-102-05001		General Arrangement Details
1020 102 05002	R0	Dam – Earthfill; Dam Safety Instrumentation;
1020-102-05002		General Arrangement Tables
1020-I02-05003	R0	Dam – Earthfill; Dam Safety Instrumentation;
		General Arrangement; Sections A, B, C, D, and E
1020 102 05004	R0	Dam – Earthfill; Dam Safety Instrumentation;
1020-102-03004		Reservoir Level Monitoring; Section D and Details
	R0	Dam – Earthfill; Dam Safety Instrumentation; Piezometer -
1020-I02-05005		Installation
		Plans and Sections
1020-I02-05006	R0	Dam – Earthfill; Dam Safety Instrumentation;
		Instrumentation Installation; Typical Details
	R0	Dam – Earthfill; Dam Safety Instrumentation;
1020-I02-05007		Strong Motion Accelerograph and Temperature Sensing Cable
		Sections

Approach Channel

Drawing No.	Revision	Title
1020-C17-00440	R2	Diversion - Approach Channel; Excavation - Stage 1 and 2; Plans
1020-C17-00441	R1	Diversion - Approach Channel; Liner and Fill; Plans
1020-C17-00442	R2	Diversion - Approach Channel; Auxiliary Spillway; Excavation Plan
1020-C17-00443	R2	Diversion - Approach Channel; Auxiliary Spillway; Excavation and Fill Sections
1020-C17-00444	R0	Diversion - Approach Channel; Grouting Plan
1020-C17-00445	R1	Diversion - Approach Channel; Excavation, Liner, and Fill Sections A, B, and C
1020-C17-00446	R1	Diversion - Approach Channel; Excavation, Liner, and Fill Sections D, E, and F
1020-C17-00447	R1	Diversion - Approach Channel; Excavation, Liner, and Fill Sections and Details
1020-C17-00448	R1	Diversion - Approach Channel; Excavation, Liner, and Fill Sections and Details
1020-C17-00451	R2	Diversion - Approach Channel; Slurry Cut-Off Wall; Plan, Profile, and Sections
1020-C17-00452	R1	Diversion - Approach Channel; Auxiliary Spillway Fill Plan

Approach Channel - Instrumentation

Drawing No.	Revision	Title
1020-I17-05015	R0	Diversion - Approach Channel; Dam Safety Instrumentation
		Plan and Tables
1020-I17-05016	R0	Diversion - Approach Channel; Dam Safety Instrumentation
		Sections A, B, and C
1020-I17-05017	R0	Diversion - Approach Channel; Dam Safety Instrumentation
		Sections D, E, and L

Other Documents considered in decision

- 7. Report dated July 19, 2017 by Independent Engineer, Recommendation for Leave to Commence Construction LCC #8 Earthfill Dam & Approach Channel
- 8. Letter dated July 14, 2017 by **Leave to Commence Construction** LCC #8 – Independent Environmental Monitor Review
- 9. Letter dated July 18, 2017 by Dam Safety Officer Site C Clean Energy Project Conditional Water Licences 132990 and 132991 on Peace River Leave to Commence Construction No. 8
- 10. E-mail from dated July 5, 2017 requesting agencies with an interest in the vegetation and wildlife program and to comment on submissions requested under LCC #8
- 11. E-mail from dated July 7, 2017 with comments on Schedule A requirement for vegetation and wildlife program under LCC #8
- 12. Letter from **dated** April 20, 2017 Status of milestone for Progress of monitoring and mitigation projects for fisheries and aquatic habitat program
- 13. Tracking Sheet FAHTC review status for Comptroller 30 June 2017
- 14. E-mail from dated July 7, 2017 to agencies with an interest in the fisheries and aquatic habitat program requesting comments on Schedule A requirements under LCC #8

Appendix B – **Description of Works from IE's Report**

2.0 DESCRIPTION OF THE WORKS

2.1 Earthfill Dam

The earthfill dam will be a zoned embankment dam with a maximum height of about 60 m above the existing riverbed, a maximum height of about 75 m above the lowest bedrock foundation level, and a crest length of approximately 1050 m. The nominal dam crest level will be El. 469.4 m, which will provide a normal freeboard of 7.6 m above the maximum normal reservoir level El. 461.8 m, and minimum freeboard of 3.1 m above the maximum flood level El. 466.3 m. The crest will be 10 m wide and will have a 2% camber upstream and downstream of its centreline to provide surface runoff and to accommodate any post-construction settlements.

The Stage 2 upstream and downstream cofferdams will be incorporated into the body of the earthfill dam. The top 30 m of the upstream side of the earthfill dam will slope at 2.5H:1.0V, with near-horizontal random fill between the dam and the upstream cofferdam. The downstream side of the dam will slope at 2.5H:1.0V in the top 30 m, and at 6.0H:1.0V below, with horizontal granular fill between the dam and the downstream cofferdam.

The dam will have a central impervious core, with one filter zone on the upstream side and two filters on the downstream side of the core, and with upstream and downstream granular shells. There will be a drainage blanket underneath the downstream shell. The upstream slope of the dam will be protected with riprap down to El. 441.0 m, which is 1.0 m below the minimum reservoir drawdown level. The 2.5H:1.0V slope on the downstream side will be protected against surface erosion with a layer of select coarse granular material.

The core and filter zones will be founded on bedrock, and the shells will be founded on approved existing alluvium. At the left (north) abutment the core and filter zones will abut the shale bedrock, and at the right (south) abutment, these zones will abut the RCC buttress and the downstream toe of the dam will abut the RCC tailrace wall.

Consolidation grouting will be done in the foundation across the width of the core contact, with a singleline grout curtain along the centre of the core contact. At the right abutment, the foundation of the RCC core buttress will be grouted in the same manner.

At the left abutment, foundation drainage will be provided by the left bank drainage adit and drainholes from that adit, as well as a line of drain holes downstream of the core contact. At the right abutment, the right bank drainage tunnel and drainholes from the tunnel will provide foundation drainage of the RCC buttress that will form the dam abutment.

Instruments will be installed to monitor the performance of the dam and its foundation, both during construction and for the post-construction long term. Most of the instruments will be installed along three sections perpendicular to the dam axis and at the dam/abutment interfaces. The instruments will include piezometers, inclinometers, extensometers, settlement cells, surface settlement markers, fibre optic temperature cable, thermistor strings and strong motion accelerometers, which will monitor pore pressures, seepage patterns, settlements, deformations, temperatures and seismic response.

Several ancillary facilities will be incorporated on the dam embankment. On the upstream left side of the dam there will be a facility for handling debris collected from the future reservoir. On the downstream left side of the dam, there will be a boat ramp into the Peace River. On the lower toe of the dam near the powerhouse, there will also be a helicopter marshalling area, consisting of an area 36 m by 36 m in size, with asphalt pavement. This area will provide access to Site C by helicopters for future operations and emergency purposes.



2.2 Approach Channel

The approach channel will be constructed along the natural right bank terrace to convey Peace River flows from the reservoir to the power intakes and spillways. As noted above, bulk excavation for the approach channel is currently in progress. When completed, the channel will be about 200 m wide at its invert, and will be approximately 900 m long from the inlet to the spillways, as measured along its centerline.

The excavation for the approach channel will typically be about 25 to 30 m deep, with a maximum depth of about 35 m. The channel invert and most of the wetted southern side slope will be excavated in bedrock. It is estimated that the bedrock surface along the south side will be up to several metres below the maximum normal reservoir level of El. 461.8 m. This slope will be constructed at 3.0H:1.0V in both bedrock and overburden.

On its north side, upstream of the power intakes, the south faces of the dam and core RCC buttresses will provide containment of the approach channel. The upper portions of these buttresses will be free-standing sections, extending about 35 m above the approach channel invert to El. 469.4 m, which will be the crest level of the earthfill dam.

The approach channel excavation will be shaped to leave a low dividing berm along the centre of the channel, to provide capability for future in-the-dry repairs to the power intakes, spillway headworks, side channel spillway, or approach channel. With the reservoir drawn down below the berm crest at El. 443.5 m, the berm would divide the approaching flow into two channels. One channel on either side of the berm could then be isolated by constructing a cofferdam at the upstream end, allowing the isolated channel to be dewatered. Site C inflows would then be conveyed through the adjacent non-isolated channel while repairs are being carried out.

Several integrated measures will be constructed to minimize seepage from the reservoir. A grout curtain will be constructed to reduce foundation seepage from the reservoir towards the bedrock below the RCC buttress. The grout curtain will extend along the upstream side of the RCC buttress from the east end of the auxiliary spillway intake to the RCC core buttress, and across the base of the approach channel. The top of the grout curtain will be integrated with a concrete plinth to be constructed on the bedrock surface along this alignment.

The approach channel will have an impervious lining to reduce seepage into the underlying bedrock. In high-velocity areas, such as adjacent to the power intakes and spillway headworks, the lining will be castin-place concrete. Elsewhere, the lining will be a layer of compacted glacial till overlain by a bituminous geomembrane. The till layer will cover the invert and side slope to the top of bedrock and will be 1.5 m thick, except for the 50 m nearest the RCC buttress where it will be 2.5 m thick. The bituminous geomembrane will cover the approach channel invert and centre berm, but will not extend up the side slopes. The geomembrane will be connected to waterstops in the concrete plinth, such that the geomembrane and the grout curtain will form a continuous seepage barrier.

In addition, to minimize seepage from the reservoir through the overburden, a slurry cutoff wall will be constructed at the downstream (east) east end of the approach channel. This cutoff wall will extend from the auxiliary spillway for about 680 m across the right bank terrace. The top of the wall will be at the maximum flood level of El. 466.3 m and the base will be to sound bedrock, ranging up to about 14 m deep based on the estimated bedrock surface profile.

The approach channel invert and slopes will be protected from erosion with riprap, except for the local portion that will be lined with cast-in-place concrete. Where the channel is lined with geomembrane, a protective granular filter layer will be placed on the membrane before the riprap bedding and riprap are installed.

Instruments will be installed to monitor the performance of the seepage mitigation measures and the performance of the approach channel side slopes. Piezometers, inclinometers, fibre optic temperature cable, joint meters and survey markers will be installed on four cross sections and along the RCC/approach channel interface. The piezometers will generally be installed in key bedding planes in the bedrock foundation. Another set of piezometers and an inclinometer will be installed downstream of the seepage cutoff wall, in boreholes located east of the auxiliary spillway.

The glacial till for the approach channel lining will be from the 85th Avenue Industrial Lands source that will be used for the earthfill dam. Concrete will be provided by the on-site batch plant.