# Site C Western Toad Management Procedure

This management procedure is applicable only during construction on access roads, the transmission line right-of-way, and areas within 250 m of wetlands. However, in all construction areas impacts to amphibians must be mitigated as described in §4.17 of the Site C CEMP, including through the implementation of barriers, setback buffers, and salvage and relocation, as appropriate and at the direction of a Qualified Environmental Professional.

<u>Core Period: June 01 to August 15</u> – At this time juvenile western toads (**Figures 1, 3, and 4**) disperse from breeding sites (shallow margins of lakes, ponds, or wetlands) into foraging sites (other wetlands, riparian areas along streams, or upland sites). Large numbers of toads might be encountered on roads and at work sites. Juvenile western toad observations ≥10 individuals have occurred within the Project area from June 1 until August 15; the anticipated duration for western toad dispersal is approximately 11 weeks – the “core dispersal period”.

**During the core dispersal period, a Qualified Environmental Professional (QEP) <u>must</u> survey:**

- **all Project Access Roads prior to crews driving to site,**
- **all Project Access Roads prior to the first daily site delivery; and**
- **all daily Work Sites before work commences.**

<u>Caution Periods: April 01 – May 31; August 16 – September 30</u> – Adult western toads (**Figure 2**) and juveniles (**Figure 1**) may occur on Access Roads and at Work Sites during their “breeding period” or “foraging period.”

The breeding window is when adults start to move from hibernation areas to breeding sites (shallow margins of lakes, ponds, or other wetlands). Toads often move at night, when temperatures are cooler, and especially after a rainfall. The breeding window coincides with days where the minimum temperature doesn’t drop below 0°C AND the maximum temperature is above 10°C. In the Project area, the breeding period is April 01 – May 31.

The foraging window is when adults and juveniles move from breeding sites to foraging areas to prepare for hibernation. As with the breeding window, toads tend to be more active at night, especially following a rainfall. Toads can be found foraging year-round, but the key foraging period is August 16 – September 30.

**During the caution period, before any work starts, the contractor <u>must</u> contact the QEP to provide the work location and start date. The contractor’s QEP <u>must</u> conduct an Access Road / Work Site sweep to determine if toads are likely to be present, before work starts. The contractor’s QEP can give an “all clear” window for up to one week after this sweep during the caution period. The contractor’s QEP <u>must</u> be notified to re-assess the area if one week or more has passed since the previous “all clear.”**

<u>Hibernation Period: October 01 – March 31</u> - Western toads are not anticipated to be on work sites or roads.

Figure 1. Juvenile western toads are small and can be difficult to detect if dispersal is limited to a few individuals.

Figure 2. Adult western toad traveling to breeding site.

Figure 3. Sub-adult western toad.

Figure 4. Mass dispersal event of juvenile western toads.

July 21, 2017

# Site C Western Toad Management Procedure

BC Hydro
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This management procedure outlines how BC Hydro and its contractors will remain compliant with EAC conditions 16 and 19 pertaining to western toads, a federally and provincially listed species at risk. It applies only during construction on access roads, transmission line rights-of-way, and off-site areas within 250 m of wetlands. However, all construction activities must mitigate for amphibians as described in §4.17 of the Site C CEMP.

A QEP with western toad survey experience, employed by the contractor, must survey for toads:

- before any work along project access roads during the core dispersal period (June 01 to August 15).
- at work sites within the transmission line right-of-way (towers, roads, laydown, pull-sites, offices, staging areas) and any project-related off-site areas within 250 metres of wetlands.
- along existing project access roads adjacent to wetlands during the caution period (breeding and foraging windows, April 01 – May 31 and August 16 – September 30, respectively).

**On the direction of the contractor's QEP, contractors may be required to alter their schedule.**

**Access Road and Work Site Sweep Methods**

During the core dispersal period, and during the caution periods (April 01 - May 31 and August 16 - September 30), the contractor's QEP must conduct a road and work site sweep prior to heavy traffic use on access roads, and construction activities at transmission towers and transmission access routes. Once the road and work site sweeps have finished, the contractor's QEP will determine if western toads are at risk of direct mortality. If there is determined to be no risk to dispersing toads, work will be allowed to commence.

Road sweeps must be conducted by vehicle travelling at 35-55 km/h (as appropriate given QEP experience and road/weather conditions) with the contractor's QEP in the passenger seat looking for dispersing western toads on the road and road verges. Road sweeps can commence at dawn using headlights on low beam for illumination (see *RISC Standard for Pond Breeding Amphibians*).

Work site and adjacent wetland area sweeps / searches must be conducted on foot by the contractor's QEP using a search pattern (zig-zag, grid or transect) that considers observability, terrain, searcher safety and search area coverage. Maximum survey effort is 1 ha/hour time constrained searches, as per the *RISC Standard for Pond Breeding Amphibians*.

The contractor' QEP will maintain awareness of best management practices for western toads, including the BC *Guidelines for Amphibians during Development* and *BMP - Amphibian and Reptile Salvages* and revisions.

**Toad Sweep Crew Tool Kit**

2 x 30km/h road signs, 20 x 0.5 m stakes, 3 x hammer/mallet, 200 m landscaping fabric (minimum 0.5 m width), 1 x box cutter, 2 x shovel, 5 x pit trap buckets (2 gal, ~9" diameter, ~9" depth), 2 x bucket lids with holes (for translocation), 100 x nitrile gloves (various sizes), 5 x work gloves, 1 L unscented bleach, 4 gallon water.

**Stop Work Procedure**

All road and work site sweeps must be conducted by the contractor's QEP. If dispersing western toads are confirmed within 20 m of access roads or construction, the contractor's QEP must halt traffic and construction activities at the dispersal site and initiate the steps described before work recommences. Qualified personnel under the direction of the contractor's QEP will install temporary barrier fences along the road or around construction at the dispersal site. Barrier fences will be of UV stabilized material, woven or solid to prevent small toads passage, and 0.5 m high and curved or L-shaped at the top (with the fence lip facing away from the road) to prevent toads from climbing over the fence. Barrier fences must be arranged in a wedge or zig-zag pattern to funnel amphibians into traps and must extend 50 to 100 m beyond the last trap at either end of the fence. Trapped toads will be translocated away from the road or work site in buckets to continue dispersal (see "Translocation"). Personnel requirements depend on the size and spatial extent of the dispersal. Speed restrictions of 30 km/h in the area 50 m either side of the dispersal site must be applied and maintained for the duration of the dispersal event. A sweep must confirm dispersing western toads have vacated the area before the contractor's QEP can approve the commencement / re-commencement of construction at the dispersal site, and lift the speed restriction.

**Translocation**

If dispersing western toads are observed on any roads, or at tower construction sites, the contractor's QEP will determine the direction of dispersal. All toads potentially affected by traffic or construction must be captured, translocated, and released by the contractor's QEP; in the direction of dispersal and to a safe area within 200 m (and at least 50 m from) the capture site. Translocated individuals will not be placed in any specific habitat type, but sub-optimal habitats (e.g., drill pads, rock outcrops) will be avoided. During translocations the contractor's QEP must maintain hygiene when handling amphibians, including following established procedures to prevent the spread of amphibian chytrid fungus, as described below. If individuals are translocated >200 m from point of capture, survival monitoring must be completed by the contractor's QEP as per *Wildlife Act* permit FJ16-226024.

If a mass dispersal (>100 individuals during a 24-hour period) requiring relocation of toads (as above) is identified over three consecutive years in the same location, consideration will be given to installing a permanent crossing structure to separate dispersing toads from traffic. Crossings will be appropriately designed culverts or structures achieving separation, and including well-maintained guidance fencing to direct toads into the structure, see *Guidelines for Amphibians during Development* (pg. 23). Such mitigation will be directed by the QEP and BC Hydro's Representative and will be an extra to the contract, to be managed via the contract change process.

**Disinfectant and Hygiene**

Handlers must wear clean, new vinyl or nitrile gloves during salvages, as per BC's *Standard Operating Procedures: Hygiene Protocols for Amphibian Fieldwork*. Gloves must be changed when moving to another translocation site. Buckets used for transferring individuals must be disinfected using a household bleach and water mixture at 32 ml / 1 litre of water (or 3.5 cups bleach to one tall bucket / 25 litre of water).

July 21, 2017

## Western Toad Caution Period
## (April 1 – May 31, August 16 – September 30)

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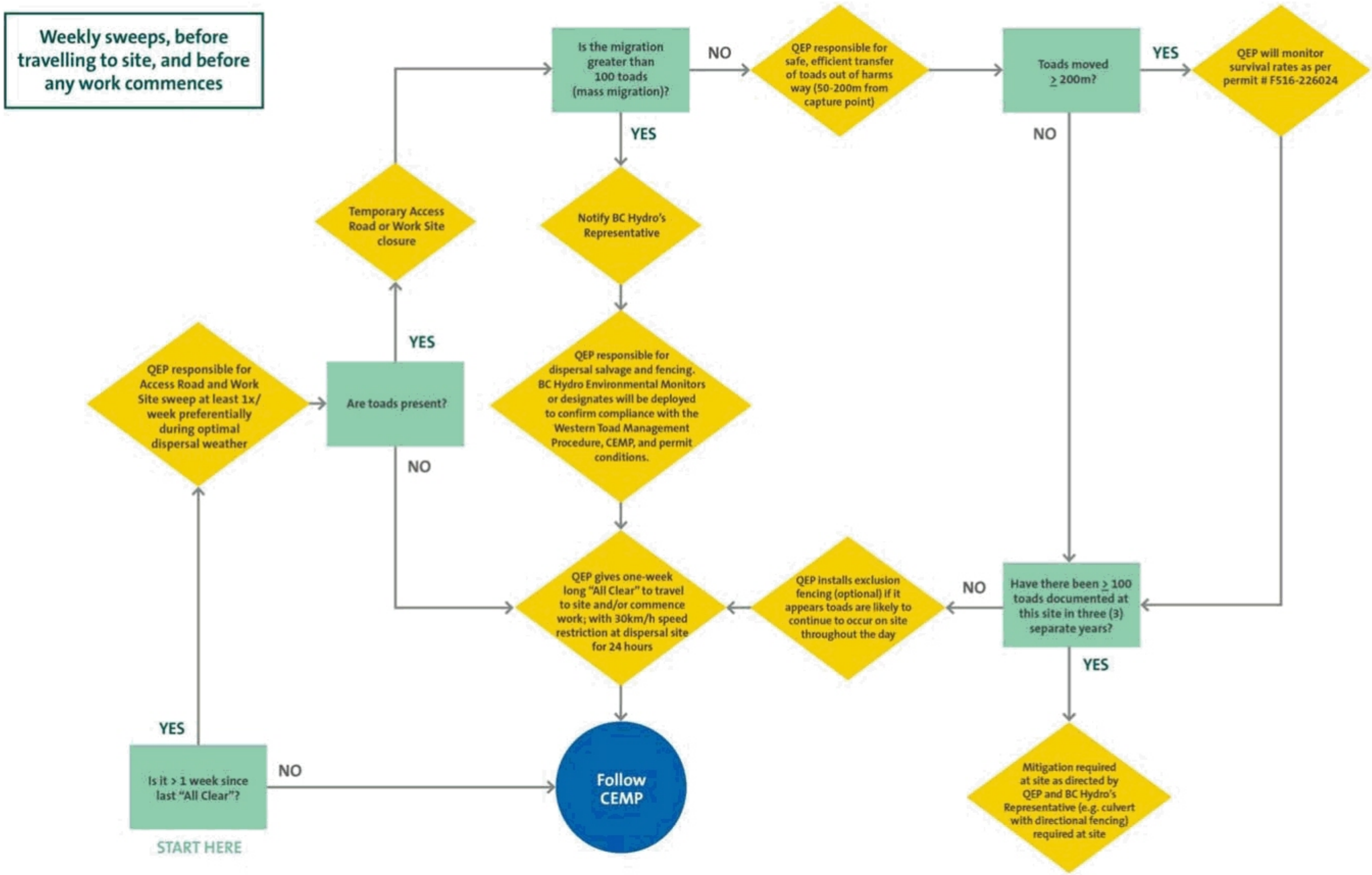
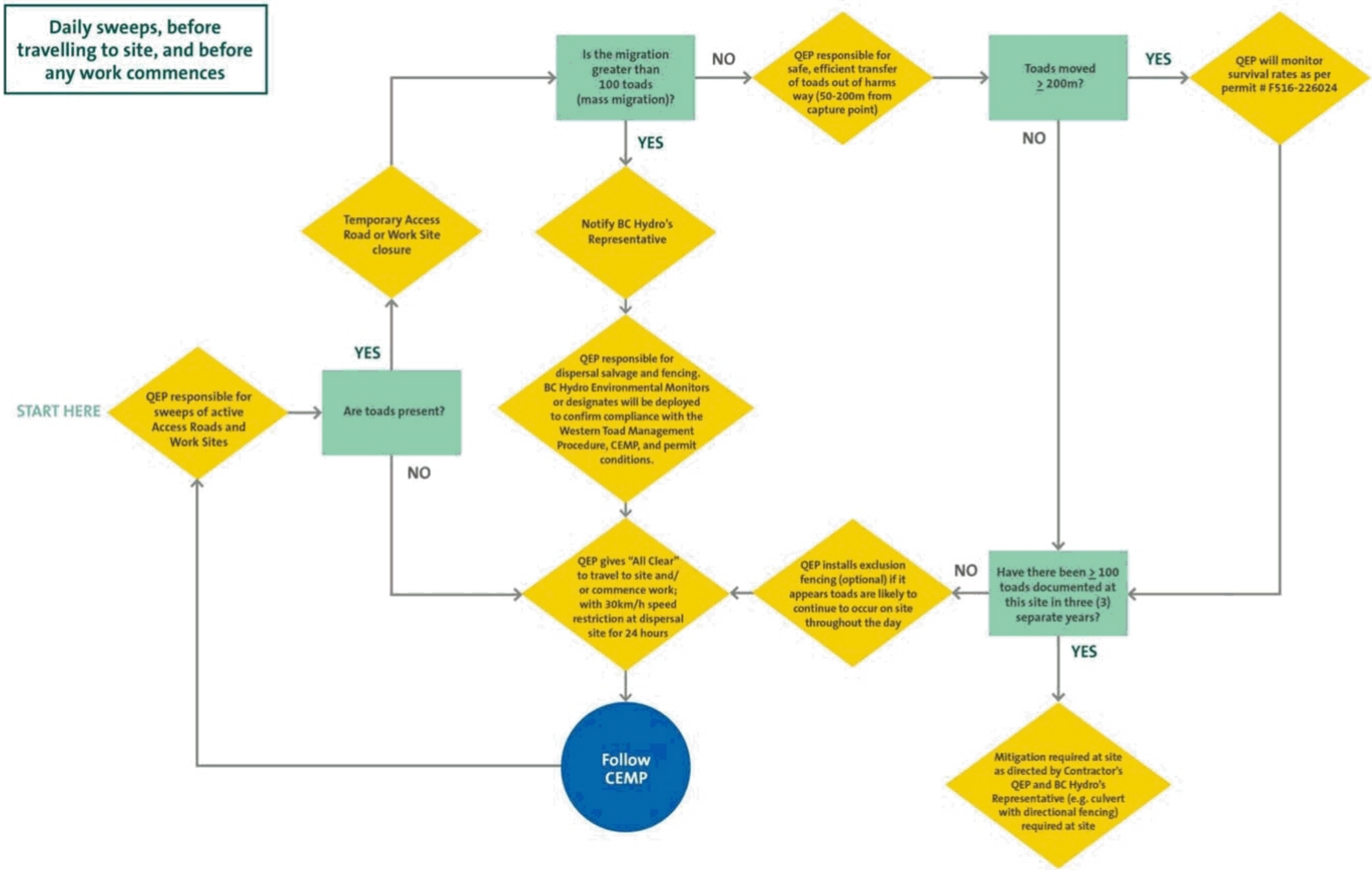



July 21, 2017

## Western Toad Core Dispersal Period (June 1 – August 15)

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July 21, 2017

Page 05 to/à Page 49

Withheld pursuant to/removed as

s.13

**Assessment of Wetland Function for the Site C Clean Energy Project:**

**Key changes made since the December 2016 version of the report**

*This document summarizes the major changes made to the December 2016 report on the wetland function assessment for the BC Hydro Site C Clean Energy Project. These changes were based on feedback received at the January 2017 meeting and comments received in June 2017 on the December 2016 report.*

## Improved description of the wetland function assessment (WFA) model structure.

Input received (MOE): *"Although I have been involved in the review of this tool all along, I have to say that once I get so Step 4 I do struggle to keep things straight in my head as to what is actually going on. It is much easier when you are in the room and having the tool explained to you but as a reader familiar with it I am challenged to keep up on paper. I would suggest that at the beginning of step 4 a paragraph or 2 be added that outlines the overall approach to this section in straightforward language such that one understands what is being outlined and why in the subsequent text and screen shots."*

Changes made: Key components of the ranking process are now defined at the head of Step 4. In addition, a flow chart has been added for clarity, that summarizes the fauna ranking protocol.

Relevant sections: See 'Step 4. Determining Total Loss Given Habitat Affected: Wetland Function Assessment Model Structure and Assumptions', as well as Figure 4 (flow chart).

## Model assumptions brought forward in the document.

Input received (MOE): Multiple reviewers from the MOE suggested the model assumptions should be brought forward in the document.

Changes made: Model assumptions have been brought to the head of the ranking section (Step 4).

Relevant sections: See 'Step 4. Determining Total Loss Given Habitat Affected: Wetland Function Assessment Model Structure and Assumptions.'

## Included interpretation of the sensitivity analysis results.

Input received (ECCC): *"A summary table of the sensitivity analysis in the main body of the Report (the 'total' column at the end of each analysis) and a discussion/interpretation of the values might be considered."*

Changes made: A paragraph interpreting the results of the sensitivity analysis has been added, as well as incorporating the results of the sensitivity analysis into the main body of the text (in addition to Appendix F).

Relevant sections: See the Sensitivity Analysis section and Table 10 in 'Step 4. Determining Total Loss Given Habitat Affected: Wetland Function Assessment Model Structure and Assumptions.'

**Addition of all external review comments received, as an appendix.**

Input received (MOE, ECCC, BC Hydro, NPS): At the January 2017 meeting, all parties agreed to the incorporation of the external review comments and responses, with reviewer names removed, to the wetland function assessment report as an appendix.

Changes made: Feedback received on the November 2015 and December 2016 versions of the report, including reviewer comments, BC Hydro responses and replies to BC Hydro responses (where applicable) have been added.

Relevant sections: Appendix H. External Review of the Wetland Function Assessment Report.

**Additional formatting changes made:**

- Section numbering added
- Incorporation of list of tables and figures into main table of contents
- Changed 'species at risk' to 'fauna species at risk'
- Changed 'rare plants' to 'flora species at risk'
- 'Function' (i.e., function loss) to 'functional' (i.e., functional loss)
- Change in terminology from model steps to model components
- Incorporation of required information from Excel files into report
- Incorporation of scientific names in all locations
- Combined Tables 3 and 4
- Reordering fauna species at risk in model components
- Removal of Table 7
- Removal of capitalization of common names

Page 52 to/à Page 62

Withheld pursuant to/removed as

s.13

# *Continuous Ambient Monitor Audit Certificate*

| | | | |
|---|---|---|---|
| Date: | August 24, 2017 | | |
| Station Name: | Fort St John 85th Avenue | Barometric Pressure: | 699 mmHg |
| Permit #: | N/A | AmbientTemperature: | 11.7 °C |
| M-Code: | MA636 | | |
| Auditors: | Kubotani/Chudak | | |
| Method: | Hybrid Beta-Attenuation | K-Factor: | 0.963 |
| Parameter: | SHARP PM2.5 | | |
| Make/Model: | SHARP5030i | Flowmeter: | **Streamline** |
| Serial #: | CM13331010 | | |

| | | | **Streamline Data** | **Total** | **Main** |
|---|---|---|---|---|---|
| Start Time: | 1231 | **PST** | | m: | 0.4262 |
| Finish Time: | 1323 | **PST** | | b: | -0.4748 |

| | | ( 1 ) | ( 2 ) | ( 3 ) | (Avg) | Actual | Error |
|---|---|---|---|---|---|---|---|
| **Sample Flow:** | | In. H2O | In. H2O | In. H2O | In. H2O | lpm | % |
| | Audit Flow | 4.90 | 4.94 | 4.95 | 4.93 | 16.15 | 3.1% |
| | | lpm | lpm | lpm | lpm | | |
| | Sharp Flow | 16.63 | 16.65 | 16.66 | 16.65 | 16.65 | |

| | | ( 1 ) | ( 2 ) | ( 3 ) | (Avg) | Actual | Diff |
|---|---|---|---|---|---|---|---|
| **Leak Flow:** | | In. H2O | In. H2O | In. H2O | In. H2O | lpm | lpm |
| | Audit Flow | 4.83 | 4.84 | 4.84 | 4.84 | 15.99 | 0.16 |
| | | lpm | lpm | lpm | lpm | | |
| | Sharp Flow | 16.62 | 16.63 | 16.63 | 16.63 | 16.63 | |

| **Temperature:** | **°C** | **Pressure:** | **mmHg** |
|---|---|---|---|
| Ambient Temperature (Audit) | 11.7 | Ambient Pressure (Audit) | 699 |
| Ambient Temperature (SHARP) | 13.3 | Ambient Pressure (SHARP) | 695 |

| **Foil Audit:** | | **Time Verification** | **HHMM** |
|---|---|---|---|
| Audit Kit S/N: 2409 | % Diff. | SHARP Time: | 1238 |
| Audit Span Foil: 1218 | 2.4 | Data Logger Time: | 1237 |
| | | Difference | 1 |

**Audit Criteria:**

| | | |
|---|---|---|
| Sample Flow Error: | 3.1% | **Pass** |
| Temperature Error: | 1.6 | **Pass** |
| Pressure Error: | 4 | **Pass** |
| Leak Test: | 0.16 | **Pass** |
| Nephelomter Zero: | 0.0 | **Pass** |
| Filter Tape Spot: | Good | **Pass** |
| SHARP Time: | 1 | **Pass** |
| Head Condition: | Clean | **Pass** |
| Foil Audit: | 2.4 | **Pass** |
| Logbook | Satisfactory | **Pass** |

**Nephelometer Zero Verification:**

Neph: 0.0

**Filter Tape Spot Check:**

**(Good/Poor)**

Good

**PM/VSCC Inlet Condition:**

**(Clean/Dirty)**

Clean

**Loobook Check:**

**(Staisfactory/Unsatisfactory)**

Satisfactory

**Report:**

**Audit Results:** **Pass**

**Air Audit Programme**

**Knowledge Management Branch**

# *Continuous Ambient Monitor Audit Certificate*

| | | | |
|---|---|---|---|
| Date: | August 24, 2017 | | |
| Station Name: | Fort St John 85th Avenue | Barometric Pressure: | 699 mmHg |
| Permit #: | N/A | AmbientTemperature: | 11.7 °C |
| M-Code: | MA665 | | |
| Auditors: | Kubotani/Chudak | | |
| Method: | Hybrid Beta-Attenuation | K-Factor: | 0.963 |
| Parameter: | SHARP PM10 | | |
| Make/Model: | SHARP5030i | Flowmeter: | **Streamline** |
| Serial #: | CM17071011 | | |

| | | | **Streamline Data** | **Total** | **Main** |
|---|---|---|---|---|---|
| Start Time: | 1207 | **PST** | m: | 0.4262 | |
| Finish Time: | 1300 | **PST** | b: | -0.4748 | |

| | | (1) | (2) | (3) | (Avg) | Actual | Error |
|---|---|---|---|---|---|---|---|
| **Sample Flow:** | | In. H2O | In. H2O | In. H2O | In. H2O | lpm | % |
| | Audit Flow | 5.08 | 5.09 | 5.10 | 5.09 | 16.42 | 1.5% |
| | | lpm | lpm | lpm | lpm | | |
| | Sharp Flow | 16.65 | 16.67 | 16.69 | 16.67 | 16.67 | |

| | | (1) | (2) | (3) | (Avg) | Actual | Diff |
|---|---|---|---|---|---|---|---|
| **Leak Flow:** | | In. H2O | In. H2O | In. H2O | In. H2O | lpm | lpm |
| | Audit Flow | 5.01 | 5.03 | 5.05 | 5.03 | 16.32 | 0.10 |
| | | lpm | lpm | lpm | lpm | | |
| | Sharp Flow | 16.65 | 16.66 | 16.66 | 16.66 | 16.66 | |

| **Temperature:** | **°C** | **Pressure:** | **mmHg** |
|---|---|---|---|
| Ambient Temperature (Audit) | 11.7 | Ambient Pressure (Audit) | 699 |
| Ambient Temperature (SHARP) | 13.6 | Ambient Pressure (SHARP) | 696 |

| **Foil Audit:** | | **Time Verification** | **HHMM** |
|---|---|---|---|
| Audit Kit S/N: 2409 | % Diff. | SHARP Time: | 1209 |
| Audit Span Foil: 1218 | -1.2 | Data Logger Time: | 1209 |
| | | Difference | 0 |

**Audit Criteria:**

| | | |
|---|---|---|
| Sample Flow Error: | 1.5% | **Pass** |
| Temperature Error: | 1.9 | **Pass** |
| Pressure Error: | 3 | **Pass** |
| Leak Test: | 0.10 | **Pass** |
| Nephelomter Zero: | 0.0 | **Pass** |
| Filter Tape Spot: | Good | **Pass** |
| SHARP Time: | 0 | **Pass** |
| Head Condition: | Clean | **Pass** |
| Foil Audit: | -1.2 | **Pass** |
| Logbook | Satisfactory | **Pass** |

**Nephelometer Zero Verification:**

Neph: 0.0

**Filter Tape Spot Check:**

**(Good/Poor)**

Good

**PM/VSCC Inlet Condition:**

**(Clean/Dirty)**

Clean

**Loobook Check:**

**(Staisfactory/Unsatisfactory)**

Satisfactory

**Report:**

**Audit Results:** **Pass**

**Air Audit Programme**

**Knowledge Management Branch**

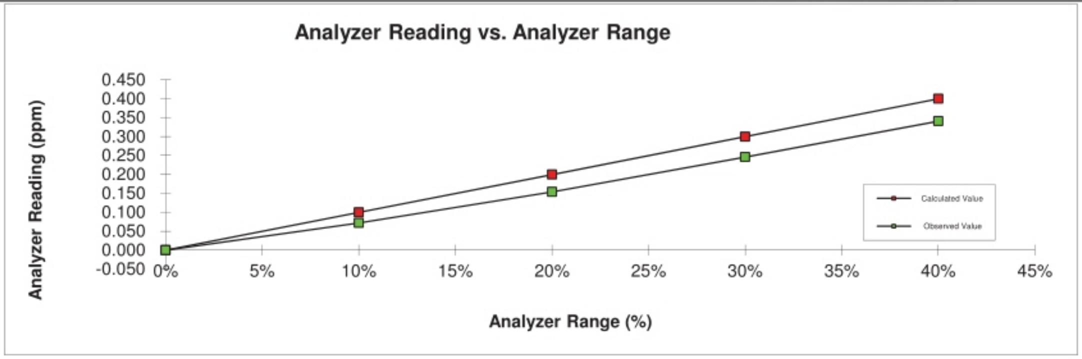
# *Continuous Ambient Monitor Audit Certificate*

| | |
|---|---|
| Date: August 24, 2017 | **Regression Output:** |
| Station Name: Fort St John North Camp | (NO) (NOx) |
| Permit #: N/A | **Intercept:** -0.009 -0.008 |
| M-Code: MA646 | **Slope:** 0.8560 0.8490 |
| Auditors: Kubotani/Chudak | **Correlation Coeff:** 0.9984 0.9985 |
| Method: Chemiluminescence | NOx Coef: 0.986 |
| Parameter: NOx | NOx Bkg: 3.9 |
| Make/Model: TECO 42i | NO Coef: 1.128 |
| Serial #: 1152380009 | NO Bkg: 3.9 |
| Cyl. Number: FF17225 | Dilution Box: Environics 6103 SN#2998 |
| Cyl. Volume: 1750 | |

| | | | Target | (F1) | (F2) | Calculated Value NO | Calculated Value NOx | Observed Value NO | Observed Value NOx | Error NO | Error NOx |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Gas Type: | NO | | 0.000 | 9000 | 0.0 | 0.000 | 0.000 | 0.000 | 0.000 | N/A | N/A |
| Gas Conc: | 50.1 | ppm | 0.100 | 9000 | 18.0 | 0.100 | 0.100 | 0.072 | 0.072 | -28.0% | -28.0% |
| Range(0): | 0.5 | ppm | 0.200 | 9000 | 36.1 | 0.200 | 0.200 | 0.154 | 0.154 | -23.0% | -23.0% |
| Start Time: | 1420 | **PST** | 0.300 | 9000 | 54.2 | 0.300 | 0.300 | 0.246 | 0.243 | -18.0% | -19.0% |
| Finish Time: | 1702 | **PST** | 0.400 | 9000 | 72.4 | 0.400 | 0.400 | 0.341 | 0.339 | -14.7% | -15.2% |
| | | | | | | | | Average Error: | | -20.9% | -21.3% |

**CONVERTER EFFICIENCY**

| | $NO_i$ | $NO_f$ | $NOx_i$ | $NOx_f$ | | |
|---|---|---|---|---|---|---|
| Response | 0.154 | 4.100 | 0.154 | 0.151 | $[(NO_2)_{out}]=$ | -3.946 |
| | | | | | $[(NO_2)_{conv.}]=$ | -3.949 |
| | | | | | Converter Efficiency | 100.1% |




**Report:**

Failed on all points >10% (reading 21% low)
Ran 400 point using their gas (10ppm concentration) NO: 315, NOx: 310
Also ran their calibrator with their gas at 300 point NO: 236, NOx: 234
Used 40% point for converter efficiency check

**Audit Results: Fail**

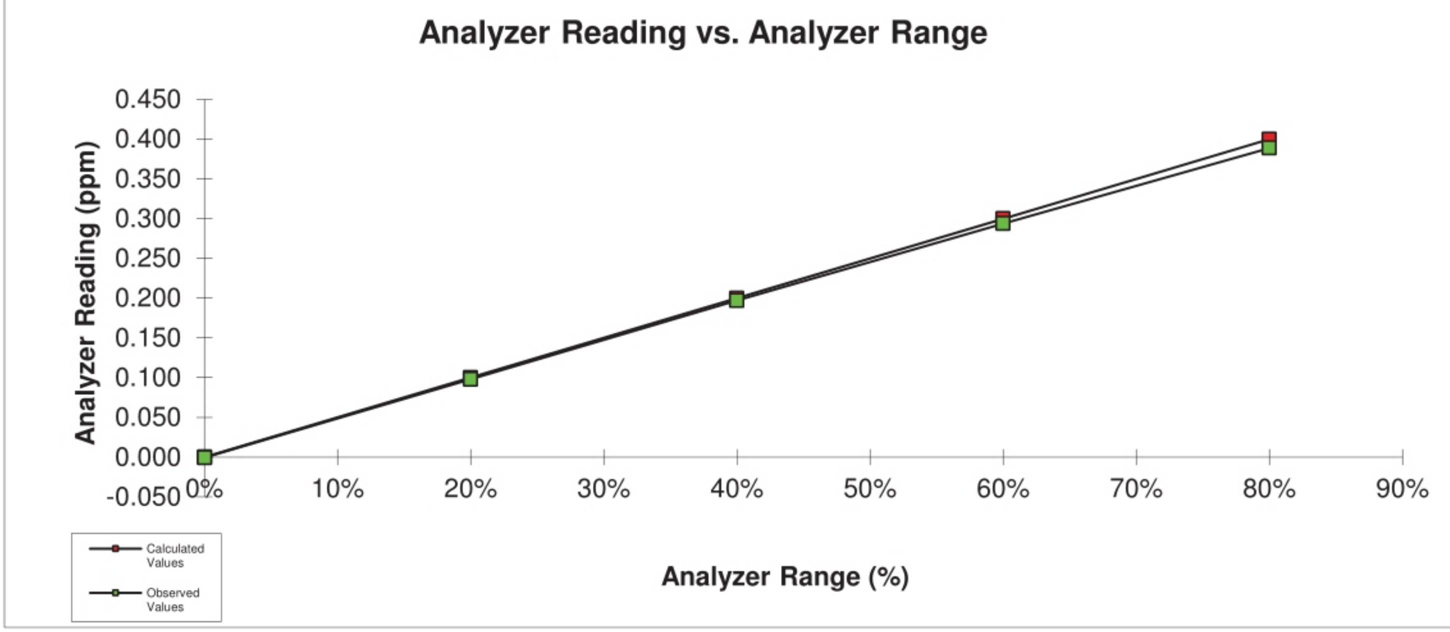
**Air Audit Programme**
**Knowledge Management Branch**

# *Continuous Ambient Monitor Audit Certificate*

| | | | |
|---|---|---|---|
| Date: | August 24, 2017 | **Regression Output:** | |
| Station Name: | Fort St John North Camp | | |
| Permit #: | N/A | **Intercept:** | 0.0004 |
| M-Code: | MA649 | **Slope:** | 0.9752 |
| Auditors: | Kubotani/Chudak | **Correlation Coeff.:** | 1.0000 |
| Method: | U.V. Fluorescence | | |
| Parameter: | SO2 | Bkg: | 14 |
| Make/Model: | TECO 43i | Coef: | 1.018 |
| Serial #: | 1152380010 | | |
| Cylinder Number: | FF21020 | Dilution Box: | Ambient 04 |
| Cylinder Volume: | 1600 | | |

| | | | **Target** | **(F1)** | **(F2)** | **(CV)** | **(OV)** | **Error** |
|---|---|---|---|---|---|---|---|---|
| Gas Type: | SO2 | | | | | | | |
| Gas Conc: | 50.4 | ppm | 0.000 | 5000 | 0.0 | 0.000 | -0.001 | N/A |
| Range(0): | 0.500 | ppm | 0.100 | 5000 | 9.9 | 0.100 | 0.098 | -2.0% |
| Start Time: | 1415 | **PST** | 0.200 | 5000 | 19.9 | 0.200 | 0.197 | -1.5% |
| Finish Time: | 1610 | **PST** | 0.300 | 5000 | 29.9 | 0.300 | 0.294 | -2.0% |
| | | | 0.400 | 5000 | 40.0 | 0.400 | 0.389 | -2.7% |

**Average Error:** -2.1%




**Report:**

**Audit Results: Pass**

Air Audit Programme
Knowledge Managememt Branch

# Continuous Ambient Monitor Audit Certificate

| | |
|---|---|
| Date: | August 24, 2017 |
| Station Name: | Fort St John North Camp |
| Permit #: | N/A |
| M-Code: | MA667 |
| Auditors: | Kubotani/Chudak |
| Method: | Hybrid Beta-Attenuation |
| Parameter: | SHARP PM2.5 |
| Make/Model: | SHARP5030 |
| Serial #: | CM1698 |

| | | |
|---|---|---|
| Barometric Pressure: | 709 | mmHg |
| AmbientTemperature: | 14.0 | °C |
| K-Factor: | 0.969 | |
| Flowmeter: | **Streamline** | |

| | | |
|---|---|---|
| Start Time: | 1520 | **PST** |
| Finish Time: | 1606 | **PST** |

| **Streamline Data** | **Total** | **Main** |
|---|---|---|
| m: | 0.4262 | |
| b: | -0.4748 | |

| **Sample Flow:** | | **( 1 )** | **( 2 )** | **( 3 )** | **(Avg)** | **Actual** | **Error** |
|---|---|---|---|---|---|---|---|
| | | In. H2O | In. H2O | In. H2O | In. H2O | l/hr | % |
| | Audit Flow | 5.20 | 5.24 | 5.25 | 5.23 | 1023.902 | -2.3% |
| | | l/hr | l/hr | l/hr | | | |
| | Sharp Flow | 998.0 | 1000.0 | 1003.0 | 1000.3 | 1000.33 | |

| **Leak Flow:** | | **( 1 )** | **( 2 )** | **( 3 )** | **(Avg)** | **Actual** | **Diff** |
|---|---|---|---|---|---|---|---|
| | | In. H2O | In. H2O | In. H2O | In. H2O | l/hr | l/hr |
| | Audit Flow | 5.20 | 5.22 | 5.22 | 5.21 | 1022.2688 | 1.63 |
| | | l/hr | l/hr | l/hr | | | |
| | Sharp Flow | 1000.0 | 1002.0 | 1005.0 | 1002.3 | 1002.33 | |

| **Temperature:** | **°C** |
|---|---|
| Ambient Temperature (Audit) | 13.8 |
| Ambient Temperature (SHARP) | 14.0 |

| **Pressure:** | **hPa** |
|---|---|
| Ambient Pressure (Audit) | 945 |
| Ambient Pressure (SHARP) | 938 |

**Foil Audit:**

| | | Audit | Read | % Diff. |
|---|---|---|---|---|
| Audit Kit S/N: | 2409 | | | |
| Audit Span Foil: | 1218 | 7151.0 | 7063.0 | -1.2% |

| **Time Verification** | **HHMM** |
|---|---|
| SHARP Time: | 1606 |
| Data Logger Time: | 1606 |
| Difference | 0 |

**Audit Criteria:**

| | | |
|---|---|---|
| Sample Flow Error: | -2.3% | **Pass** |
| Temperature Error: | 0.2 | **Pass** |
| Pressure Error: | 7.0 | **Pass** |
| Leak Test: | 1.63 | **Pass** |
| Nephelomter Zero: | 0.00 | **Pass** |
| Filter Tape Spot: | Good | **Pass** |
| SHARP Time: | 0.0 | **Pass** |
| Battery Check | Good | **Pass** |
| Head Condition: | Clean | **Pass** |
| Foil Audit: | -1.2% | **Pass** |
| Heater: | Good | **Pass** |
| Logbook | Satisfactory | **Pass** |

**Nephelometer Zero Verification:**

Neph: 0.0
Analog: 166.0

**Filter Tape Spot Check:**
**(Good/Poor)**
Good

**Battery Check: (Good/Poor)**
Good

**PM Inlet Condition: (Clean/Dirty)**
Clean

**Heater Check: (Good/Poor)**
Good

**Loobook Check:**
**(Staisfactory/Unsatisfactory)**
Satisfactory

**Report:**

**Audit Results:** **Pass**

**Air Audit Programme**
**Knowledge Management Branch**

# *Continuous Ambient Monitor Audit Certificate*

| | |
|---|---|
| Date: | August 24, 2017 |
| Station Name: | Fort St John North Camp |
| Permit #: | N/A |
| M-Code: | MA647 |
| Auditors: | Kubotani/Chudak |
| Method: | Hybrid Beta-Attenuation |
| Parameter: | SHARP PM10 |
| Make/Model: | SHARP5030 |
| Serial #: | E708 |

| | | |
|---|---|---|
| Barometric Pressure: | 709 | mmHg |
| AmbientTemperature: | 13.8 | °C |
| K-Factor: | 0.969 | |
| Flowmeter: | **Streamline** | |

| | | |
|---|---|---|
| Start Time: | 1502 | **PST** |
| Finish Time: | 1551 | **PST** |

| **Streamline Data** | **Total** | **Main** |
|---|---|---|
| m: | 0.4262 | |
| b: | -0.4748 | |

| **Sample Flow:** | | **( 1 )** | **( 2 )** | **( 3 )** | **(Avg)** | **Actual** | **Error** |
|---|---|---|---|---|---|---|---|
| | | In. H2O | In. H2O | In. H2O | In. H2O | l/hr | % |
| | Audit Flow | 5.15 | 5.18 | 5.18 | 5.17 | 1017.655 | -1.9% |
| | | l/hr | l/hr | l/hr | | | |
| | Sharp Flow | 994.0 | 1000.0 | 1002.0 | 998.7 | 998.67 | |

| **Leak Flow:** | | **( 1 )** | **( 2 )** | **( 3 )** | **(Avg)** | **Actual** | **Diff** |
|---|---|---|---|---|---|---|---|
| | | In. H2O | In. H2O | In. H2O | In. H2O | l/hr | l/hr |
| | Audit Flow | 5.09 | 5.10 | 5.10 | 5.10 | 1010.4081 | 7.25 |
| | | l/hr | l/hr | l/hr | | | |
| | Sharp Flow | 998.0 | 1000.0 | 1003.0 | 1000.3 | 1000.33 | |

| **Temperature:** | **°C** |
|---|---|
| Ambient Temperature (Audit) | 13.8 |
| Ambient Temperature (SHARP) | 15.0 |

| **Pressure:** | **hPa** |
|---|---|
| Ambient Pressure (Audit) | 945 |
| Ambient Pressure (SHARP) | 937 |

**Foil Audit:**

| | | Audit | Read | % Diff. |
|---|---|---|---|---|
| Audit Kit S/N: | 2409 | | | |
| Audit Span Foil: | 1218 | 6969.0 | 6948.0 | -0.3% |

| **Time Verification** | **HHMM** |
|---|---|
| SHARP Time: | 1551 |
| Data Logger Time: | 1551 |
| Difference | 0 |

**Audit Criteria:**

| | | |
|---|---|---|
| Sample Flow Error: | -1.9% | **Pass** |
| Temperature Error: | 1.2 | **Pass** |
| Pressure Error: | 8.3 | **Pass** |
| Leak Test: | 7.25 | **Pass** |
| Nephelomter Zero: | 1.00 | **Pass** |
| Filter Tape Spot: | Good | **Pass** |
| SHARP Time: | 0.0 | **Pass** |
| Battery Check | Good | **Pass** |
| Head Condition: | Clean | **Pass** |
| Foil Audit: | -0.3% | **Pass** |
| Heater: | Good | **Pass** |
| Logbook | Satisfactory | **Pass** |

**Nephelometer Zero Verification:**

Neph: 1.0
Analog: 423.0

**Filter Tape Spot Check:**
**(Good/Poor)**
Good

**Battery Check: (Good/Poor)**
Good

**PM Inlet Condition: (Clean/Dirty)**
Clean

**Heater Check: (Good/Poor)**
Good

**Loobook Check:**
**(Staisfactory/Unsatisfactory)**
Satisfactory

**Report:**

**Audit Results:** **Pass**

**Air Audit Programme**
**Knowledge Management Branch**

# *Continuous Ambient Monitor Audit Certificate*

| | |
|---|---|
| Date: | August 24, 2017 |
| Station Name: | Fort St John Old Fort |
| Permit #: | N/A |
| M-Code: | MA663 |
| Auditors: | Kubotani/Chudak |
| Method: | Hybrid Beta-Attenuation |
| Parameter: | SHARP PM2.5 |
| Make/Model: | SHARP5030 |
| Serial #: | E632 |

| | | |
|---|---|---|
| Barometric Pressure: | 719 | mmHg |
| AmbientTemperature: | 14.7 | °C |
| K-Factor: | 0.980 | |

Flowmeter: **Streamline**

| | | |
|---|---|---|
| Start Time: | 1007 | **PST** |
| Finish Time: | 1038 | **PST** |

| **Streamline Data** | **Total** | **Main** |
|---|---|---|
| m: | 0.4262 | |
| b: | -0.4748 | |

| **Sample Flow:** | | **( 1 )** | **( 2 )** | **( 3 )** | **(Avg)** | **Actual** | **Error** |
|---|---|---|---|---|---|---|---|
| | | In. H2O | In. H2O | In. H2O | In. H2O | l/hr | % |
| | Audit Flow | 5.10 | 5.14 | 5.16 | 5.13 | 1008.537 | -0.8% |
| | | l/hr | l/hr | l/hr | | | |
| | Sharp Flow | 999.0 | 1000.0 | 1002.0 | 1000.3 | 1000.33 | |

| **Leak Flow:** | | **( 1 )** | **( 2 )** | **( 3 )** | **(Avg)** | **Actual** | **Diff** |
|---|---|---|---|---|---|---|---|
| | | In. H2O | In. H2O | In. H2O | In. H2O | l/hr | l/hr |
| | Audit Flow | 5.12 | 5.12 | 5.15 | 5.13 | 1008.2091 | 0.33 |
| | | l/hr | l/hr | l/hr | | | |
| | Sharp Flow | 998.0 | 999.0 | 1001.0 | 999.3 | 999.33 | |

| **Temperature:** | **°C** |
|---|---|
| Ambient Temperature (Audit) | 14.7 |
| Ambient Temperature (SHARP) | 14.0 |

| **Pressure:** | **hPa** |
|---|---|
| Ambient Pressure (Audit) | 959 |
| Ambient Pressure (SHARP) | 957 |

**Foil Audit:**

| | | Audit | Read | % Diff. |
|---|---|---|---|---|
| Audit Kit S/N: | 2409 | | | |
| Audit Span Foil: | 1218 | 7096.0 | 7078.0 | -0.3% |

| **Time Verification** | **HHMM** |
|---|---|
| SHARP Time: | 1037 |
| Data Logger Time: | 1038 |
| Difference | |

**Audit Criteria:**

| | | |
|---|---|---|
| Sample Flow Error: | -0.8% | **Pass** |
| Temperature Error: | 0.7 | **Pass** |
| Pressure Error: | 1.6 | **Pass** |
| Leak Test: | 0.33 | **Pass** |
| Nephelomter Zero: | 3.20 | **Pass** |
| Filter Tape Spot: | Good | **Pass** |
| SHARP Time: | 0.0 | **Pass** |
| Battery Check | Good | **Pass** |
| Head Condition: | Clean | **Pass** |
| Foil Audit: | -0.3% | **Pass** |
| Heater: | Good | **Pass** |
| Logbook | Satisfactory | **Pass** |

**Nephelometer Zero Verification:**

Neph: 3.2
Analog: 209.0

**Filter Tape Spot Check:**
**(Good/Poor)**
Good

**Battery Check: (Good/Poor)**
Good

**PM Inlet Condition: (Clean/Dirty)**
Clean

**Heater Check: (Good/Poor)**
Good

**Loobook Check:**
**(Staisfactory/Unsatisfactory)**
Satisfactory

**Report:**

**Audit Results:** **Pass**

Air Audit Programme
Knowledge Management Branch

# *Continuous Ambient Monitor Audit Certificate*

| | | | |
|---|---|---|---|
| Date: | August 24, 2017 | Barometric Pressure: | 719 mmHg |
| Station Name: | Fort St John Old Fort | AmbientTemperature: | 14.7 °C |
| Permit #: | N/A | | |
| M-Code: | MA633 | | |
| Auditors: | Kubotani/Chudak | | |
| Method: | Hybrid Beta-Attenuation | K-Factor: | 0.980 |
| Parameter: | SHARP PM10 | | |
| Make/Model: | SHARP5030 | Flowmeter: | **Streamline** |
| Serial #: | E063 | | |

| | | | **Streamline Data** | **Total** | **Main** |
|---|---|---|---|---|---|
| Start Time: | 1015 | **PST** | | m: | 0.4262 |
| Finish Time: | 1050 | **PST** | | b: | -0.4748 |

| | | ( 1 ) | ( 2 ) | ( 3 ) | (Avg) | | Actual | Error |
|---|---|---|---|---|---|---|---|---|
| | | In. H2O | In. H2O | In. H2O | In. H2O | | l/hr | % |
| **Sample Flow:** | Audit Flow | 5.26 | 5.29 | 5.31 | 5.29 | | 1023.496 | -2.2% |
| | | l/hr | l/hr | l/hr | | | | |
| | Sharp Flow | 997.0 | 1000.0 | 1006.0 | 1001.0 | | 1001.00 | |

| | | ( 1 ) | ( 2 ) | ( 3 ) | (Avg) | | Actual | Diff |
|---|---|---|---|---|---|---|---|---|
| | | In. H2O | In. H2O | In. H2O | In. H2O | | l/hr | l/hr |
| **Leak Flow:** | Audit Flow | 5.24 | 5.25 | 5.27 | 5.25 | | 1020.2623 | 3.23 |
| | | l/hr | l/hr | l/hr | | | | |
| | Sharp Flow | 998.0 | 999.0 | 1002.0 | 999.7 | | 999.67 | |

| **Temperature:** | **°C** | **Pressure:** | **hPa** |
|---|---|---|---|
| Ambient Temperature (Audit) | 14.7 | Ambient Pressure (Audit) | 959 |
| Ambient Temperature (SHARP) | 12.0 | Ambient Pressure (SHARP) | 956 |

**Foil Audit:**

| | | Audit | Read | % Diff. |
|---|---|---|---|---|
| Audit Kit S/N: | 2409 | | | |
| Audit Span Foil: | 1218 | 7093.0 | 7137.0 | 0.6% |

**Time Verification**

| | HHMM |
|---|---|
| SHARP Time: | 1050 |
| Data Logger Time: | 1050 |
| Difference | |

**Audit Criteria:**

| | | |
|---|---|---|
| Sample Flow Error: | -2.2% | **Pass** |
| Temperature Error: | 2.7 | **Pass** |
| Pressure Error: | 2.6 | **Pass** |
| Leak Test: | 3.23 | **Pass** |
| Nephelomter Zero: | 0.10 | **Pass** |
| Filter Tape Spot: | Good | **Pass** |
| SHARP Time: | 0.0 | **Pass** |
| Battery Check | Good | **Pass** |
| Head Condition: | Clean | **Pass** |
| Foil Audit: | 0.6% | **Pass** |
| Heater: | Good | **Pass** |
| Logbook | Satisfactory | **Pass** |

**Nephelometer Zero Verification:**

Neph: 0.1
Analog: 171.0

**Filter Tape Spot Check: (Good/Poor)**

Good

**Battery Check: (Good/Poor)**

Good

**PM Inlet Condition: (Clean/Dirty)**

Clean

**Heater Check: (Good/Poor)**

Good

**Loobook Check: (Staisfactory/Unsatisfactory)**

Satisfactory

**Report:**

**Audit Results:** **Pass**

Air Audit Programme
Knowledge Management Branch

# *Continuous Ambient Monitor Audit Certificate*

| | |
|---|---|
| Date: | August 24, 2017 |
| Station Name: | Peace Valley Attachie Flats |
| Permit #: | N/A |
| M-Code: | MA646 |
| Auditors: | Kubotani/Chudak |
| Method: | Hybrid Beta-Attenuation |
| Parameter: | SHARP PM2.5 |
| Make/Model: | 5030 |
| Serial #: | E630 |

| | | |
|---|---|---|
| Barometric Pressure: | 711 | mmHg |
| AmbientTemperature: | 12.3 | °C |
| K-Factor: | 0.977 | |

Flowmeter: **Streamline**

| | | |
|---|---|---|
| Start Time: | 802 | **PST** |
| Finish Time: | 833 | **PST** |

| **Streamline Data** | **Total** | **Main** |
|---|---|---|
| m: | 0.4262 | |
| b: | -0.4748 | |

| **Sample Flow:** | | **( 1 )** | **( 2 )** | **( 3 )** | **(Avg)** | **Actual** | **Error** |
|---|---|---|---|---|---|---|---|
| | | In. H2O | In. H2O | In. H2O | In. H2O | l/hr | % |
| | Audit Flow | 5.22 | 5.26 | 5.27 | 5.25 | 1021.376 | -2.2% |
| | | l/hr | l/hr | l/hr | | | |
| | Sharp Flow | 997.0 | 1000.0 | 1001.0 | 999.3 | 999.33 | |

| **Leak Flow:** | | **( 1 )** | **( 2 )** | **( 3 )** | **(Avg)** | **Actual** | **Diff** |
|---|---|---|---|---|---|---|---|
| | | In. H2O | In. H2O | In. H2O | In. H2O | l/hr | l/hr |
| | Audit Flow | 5.22 | 5.23 | 5.25 | 5.23 | 1019.753 | 1.62 |
| | | l/hr | l/hr | l/hr | | | |
| | Sharp Flow | 998.0 | 1000.0 | 1005.0 | 1001.0 | 1001.00 | |

| **Temperature:** | **°C** |
|---|---|
| Ambient Temperature (Audit) | 12.3 |
| Ambient Temperature (SHARP) | 14.0 |

| **Pressure:** | **hPa** |
|---|---|
| Ambient Pressure (Audit) | 948 |
| Ambient Pressure (SHARP) | 946 |

**Foil Audit:**

| Audit Kit S/N: | 2409 | Audit | Read | % Diff. |
|---|---|---|---|---|
| Audit Span Foil: | 1218 | 7075.0 | 6949.0 | -1.8% |

| **Time Verification** | | **HHMM** |
|---|---|---|
| SHARP Time: | 833 | 833 |
| Data Logger Time: | 833 | 833 |
| Difference | | 0 |

**Audit Criteria:**

| | | |
|---|---|---|
| Sample Flow Error: | -2.2% | **Pass** |
| Temperature Error: | 1.7 | **Pass** |
| Pressure Error: | 1.9 | **Pass** |
| Leak Test: | 1.62 | **Pass** |
| Nephelomter Zero: | -0.50 | **Pass** |
| Filter Tape Spot: | 0.00 | **Pass** |
| SHARP Time: | 0.0 | **Pass** |
| Battery Check | 0 | **Pass** |
| Head Condition: | 0 | **Pass** |
| Foil Audit: | -1.8% | **Pass** |
| Heater: | 0 | **Pass** |
| Logbook | 0 | **Pass** |

**Nephelometer Zero Verification:**

Neph: -0.5

Analog: 199.0

**Filter Tape Spot Check:**
**(Good/Poor)**

**Battery Check: (Good/Poor)**

**PM Inlet Condition: (Clean/Dirty)**

**Heater Check: (Good/Poor)**

**Loobook Check:**
**(Staisfactory/Unsatisfactory)**

**Report:**

**Audit Results:** **Pass**

Air Audit Programme
Knowledge Management Branch

# *Continuous Ambient Monitor Audit Certificate*

| | | | |
|---|---|---|---|
| Date: | August 24, 2017 | Barometric Pressure: | 711 mmHg |
| Station Name: | Peace Valley Attachie Flats | AmbientTemperature: | 12.3 °C |
| Permit #: | N/A | | |
| M-Code: | MA632 | | |
| Auditors: | Kubtani/Chudak | | |
| Method: | Hybrid Beta-Attenuation | K-Factor: | 0.977 |
| Parameter: | SHARP PM10 | | |
| Make/Model: | 5030 | Flowmeter: | **Streamline** |
| Serial #: | E630 | | |

| | | | **Streamline Data** | **Total** | **Main** |
|---|---|---|---|---|---|
| Start Time: | 802 | **PST** | m: | 0.4242 | |
| Finish Time: | 900 | **PST** | b: | -0.4748 | |

| | | **( 1 )** In. H2O | **( 2 )** In. H2O | **( 3 )** In. H2O | **(Avg)** In. H2O | **Actual** l/hr | **Error** % |
|---|---|---|---|---|---|---|---|
| **Sample Flow:** | Audit Flow | 5.19 | 5.23 | 5.26 | 5.23 | 1014.318 | -1.4% |
| | | l/hr | l/hr | l/hr | | | |
| | Sharp Flow | 997.0 | 1000.0 | 1002.0 | 999.7 | 999.67 | |

| | | **( 1 )** In. H2O | **( 2 )** In. H2O | **( 3 )** In. H2O | **(Avg)** In. H2O | **Actual** l/hr | **Diff** l/hr |
|---|---|---|---|---|---|---|---|
| **Leak Flow:** | Audit Flow | 5.00 | 5.03 | 5.09 | 5.04 | 996.0324 | 18.29 |
| | | l/hr | l/hr | l/hr | | | |
| | Sharp Flow | 998.0 | 1000.0 | 1003.0 | 1000.3 | 1000.33 | |

| **Temperature:** | **°C** | **Pressure:** | **hPa** |
|---|---|---|---|
| Ambient Temperature (Audit) | 12.3 | Ambient Pressure (Audit) | 948 |
| Ambient Temperature (SHARP) | 15.0 | Ambient Pressure (SHARP) | 946 |

**Foil Audit:**

| | | Audit | Read | % Diff. |
|---|---|---|---|---|
| Audit Kit S/N: | 2409 | | | |
| Audit Span Foil: | 1218 | 6959.0 | 7005.0 | 0.7% |

**Time Verification**

| | **HHMM** |
|---|---|
| SHARP Time: | 852 |
| Data Logger Time: | 852 |
| Difference | 0 |

**Audit Criteria:**

| | | |
|---|---|---|
| Sample Flow Error: | -1.4% | **Pass** |
| Temperature Error: | 2.7 | **Pass** |
| Pressure Error: | 1.9 | **Pass** |
| Leak Test: | 18.29 | **Pass** |
| Nephelomter Zero: | 1.70 | **Pass** |
| Filter Tape Spot: | Good | **Pass** |
| SHARP Time: | 0.0 | **Pass** |
| Battery Check | Good | **Pass** |
| Head Condition: | Clean | **Pass** |
| Foil Audit: | 0.7% | **Pass** |
| Heater: | Good | **Pass** |
| Logbook | Satisfactory | **Pass** |

**Nephelometer Zero Verification:**

Neph: 1.7
Analog: 219.0

**Filter Tape Spot Check: (Good/Poor)**
Good

**Battery Check: (Good/Poor)**
Good

**PM Inlet Condition: (Clean/Dirty)**
Clean

**Heater Check: (Good/Poor)**
Good

**Loobook Check: (Staisfactory/Unsatisfactory)**
Satisfactory

**Report:**

**Audit Results: Pass**

Air Audit Programme
Knowledge Management Branch

| | |
|---|---|
| From: | Frampton, Caelie ENV:EX |
| To: | Heyman, George ENV:EX |
| Subject: | FW: BCUC Site C Inquiry |
| Date: | Wednesday, August 16, 2017 13:19:45 |
| Attachments: | Submission to BCUC--Marc Eliesen.pdf |

**From:** Marc Eliesen s.22
**Sent:** Wednesday, August 16, 2017 11:54 AM
**To:** Frampton, Caelie PREM:EX
**Subject:** BCUC Site C Inquiry

Hi Caelie,

I believe the Minister would be interested in a Report I have just submitted to the BC Utilities Commission regarding it's Inquiry into BC Hydro's Site C Project.

Many thanks.

Marc Eliesen
Former President and CEO of BC Hydro

# An Evaluation of the Need for the Site C Project

Submitted to the British Columbia Utilities Commission's

Inquiry into BC Hydro's Site C Project

Prepared by

Marc Eliesen
former President and CEO of BC Hydro

August 16, 2017

# Table of Contents

# Forward

This report has been prepared for the BC Utilities Commission engaged in an Inquiry into the Site C Dam and Generating Station Project as requested by the Government of British Columbia. The report has been prepared by Mr. Marc Eliesen, former President and CEO of BC Hydro.

The analysis and expert opinion contained in this report was independently prepared by Mr. Eliesen for the benefit of the Commission's deliberations. It is based on Mr. Eliesen's direct experience while at BC Hydro, along with experience accumulated in a career that spans more than 40 years with executive positions in both the public and private energy sector.

In addition to his role as President and CEO of BC Hydro, Mr. Eliesen was Chair and CEO of Ontario Hydro, Chair of Manitoba Hydro and Chair and CEO of the Manitoba Energy Authority, as well as Deputy Minister of Energy in Ontario and Deputy Minister of Energy and Mines in Manitoba.

# 1. Executive Summary

On August 2, 2017, the Government of BC issued Order in Council (OIC) No.44 requesting a review of Site C by the British Columbia Utilities Commission (BCUC).[1] BCUC has been asked to include an evaluation on the economics of the Project and its potential impact on BC Hydro rate payers. It has also been asked to consider how rate payers will be impacted by three options:

(i) completing the Site C project by 2024, as currently planned;

(ii) suspending the Site C project while maintaining the option to resume construction until 2024;

(iii) terminating construction and remediating the site.

BCUC's mandate includes the preparation of a preliminary report by September 20, 2017, and a final report by November 1, 2017. The Minister Responsible for BC Hydro, the Honourable Michelle Mungall, has confirmed that once in receipt of the final report, "Government will consider the advice from the commission along with other environmental and First Nations considerations and make a final decision on the future of Site C."[2]

The final investment decision made in late 2014 to proceed with Site C was a reckless and irresponsible decision made by the former Government of British Columbia and the Board of Directors of BC Hydro. Both the former government and BC Hydro's Board abdicated their fiduciary responsibility to the rate payers and tax payers of this province.

There never was a business case for the start-up of construction of Site C, and there is not a business case to support its continuation or postponement. The Project must be cancelled and the site remediated to minimize the negative impact on BC rate payers and tax payers.

The rationale for this conclusion is based on the following:

1. BC Hydro's load forecast suffers from systemic bias that exaggerates demand and does not incorporate price elasticity of demand that can be expected from higher rates related to BC Hydro's debt burden, deferred accounts, Independent Power Producer (IPP) commitments and Site C.

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[1] Order in Council No. 44, Province of British Columbia August 2, 2017.

[2] Vancouver Sun, Vaughn Palmer: Site C review leaves door open to mothball entire project, August 2, 2017,

2. To the degree that additional electricity supplies may be required, alternatives are available that are more responsive to market conditions and much more cost effective than Site C.

3. BC Hydro rate payers do not need and cannot afford the electricity capacity associated with Site C even if the project is completed on time and on budget.

4. The notion that Site C will be completed on time and on budget is illusionary. The likely scenario is that costs will escalate significantly as has been the experience of Manitoba Hydro with the Keeyask Generating Station (34 percent increase) and Nalcor's Muskrat Falls Generating Station (72 percent increase).

5. It is the author's considered opinion, based on many years of experience at a number of Canadian utilities—including BC Hydro—that the cost of Site C has a high probability of increasing from $9 billion to $12 billion—by more than 30 percent.

If Site C is allowed to be completed there will be a series of devastating high electricity rate increases. The consequences from the rate increases will include:

I) a huge financial burden on BC families and individuals;

II) jobs losses and business failures; and

III) long term financial damage to BC Hydro and the Government of British Columbia.

This report addresses the three options the Government of BC has requested BCUC consider. It provides detailed analysis as to why the only responsible course of action is for the Site C Project to be cancelled, the site remediated, and alternative generating sources pursued in order to meet any future long-term energy demand.

## 2. History

The Site C Hydro Electric Project, with 1100 mega watts (MW) of capacity and 5100 gigawatts (GW) of annual energy produced, is located on the Peace River, near Fort St. John in northeastern British Columbia. It is situated downstream of the WAC Bennett Dam (2916 MW) and the Peace Canyon Dam (736 MW). Site C was initially proposed for development in the early 1980s, however, a review conducted by BCUC determined that BC Hydro failed to adequately demonstrate that Site C was the preferred electricity project.

> "The Commission does not believe that an Energy Project Certificate for Site C should be issued at this time. The evidence does not demonstrate that construction must or should start immediately or that Site C is the only or best feasible source of supply to follow Revelstoke in the system plan. The Commission therefore concludes that an Energy Project Certificate for Site C should not be issued until (l) an acceptable forecast demonstrates that construction must begin immediately in order to avoid supply deficiencies and (2) a comparison of alternative feasible system plans demonstrates, from a social benefit-cost point of view, that Site C is the best project to meet the anticipated supply deficiency."[3]

In 1989, BC Hydro began a review of electricity supply options and revisited the Peace River Site C Project as a possible generating source. The BC Hydro Board concluded that Site C should not be advanced for reasons related to First Nations' rights, economic, social and environmental factors.

The Board was also mindful of the fact that the Revelstoke Generating Station (2,480 MW) became operational in 1984, but would not be required for domestic demand until at least the 1990s. The excess supply of energy it produced was exported through the spot market to US utilities at prices significantly lower than the cost of production.

Accordingly, a public statement that Site C would not be considered for development in the future was issued on November 29, 1993, under my name as CEO of BC Hydro.

In April 2010, the BC government announced it was moving forward with construction of Site C.[4] The final investment decision to proceed was made in December 2014.[5] Site C is in early construction with an in-service date of 2024.

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[3] BCUC, Site C Report, May 3, 1983, page 10.

[4] BC Government, Office of the Premier, Ministry of Energy, Mines and Petroleum Resources, BC Hydro, Press Release, Province Announces Site C Clean Energy Project, April 19, 2010.

[5] BC Government, Office of the Premier, Site C to provide more than 100 years of affordable, reliable clean power, December 16, 2014.

# 3. Site C Project Costs

BCUC's terms of reference for its review specifically requires that the Commission assess Project expenditures to date and whether the Project is on time and on budget:

> "3(b)(i) After the commission has made an assessment of the authority's expenditures on the Site C project to date, is the commission of the view that the authority is, respecting the project, currently on time and within the proposed budget of $8.335 billion (which excludes the $440 million project reserve established and held by the province)?"[6]

Undertaking a fulsome evaluation of the requested assessment of Project costs and construction schedule requires extensive time and resources. The Commission is well aware that under normal due process a review such as this would take 12 - 18 months to complete.

Regrettably the Commission was not requested to review the Site C Project prior to the former government's approval of it. The Commission does not have the historical record of due diligence that would normally accompany a public project of this magnitude to draw on and assist it in responding to the government's request.

Through the Clean Energy Act and a series of OICs in the past decade, the Government of British Columbia has transferred the most important regulatory oversight functions of BC Hydro away from the independence of BCUC. The extent of the limitations on BCUC to fulfill it regulatory obligations are identified in BC Hydro's final argument to the Commission as part of its Revenue Requirements Application 2017 - 2019.[7]

The discussion respecting Project costs and construction schedules that follows in this report is provided to support the Commission in its difficult task under significant time pressure. However, without direct access to various parties involved in the Project or access to detailed information, this report, by necessity focuses on key factors and high level figures. Comments and conclusions are a result of many years of direct experience in the decision making process surrounding major power projects such as Site C.

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[6] OIC No. 44., op cit.

[7] BRITISH COLUMBIA HYDRO AND POWER AUTHORITY FISCAL 2017 – FISCAL 2019 REVENUE REQUIREMENTS APPLICATION, Final Submissions of BC Hydro, May 23, 2017

## 3.1 Trend in Site C Costs

Since the Site C Project was approved, budgeted cost estimates have increased from $6.6 billion to $8.8 billion—an increase of $2.2 billion or by 33.3 percent.

**Table 1**

**Site C Project Budget**

| Year | Budget |
|---|---|
| 2010 | $6.6 billion |
| 2011 | $7.9 billion |
| 2014 | $8.5 billion |
| 2016 | $8.8 billion |

## 3.2 Current Hydro Projects in Canada and Costs

Major hydro infrastructure projects experience staggering construction overruns and implementation delays. This is a world-wide phenomenon. In a series of studies on mega-construction projects, Oxford University researchers have shown that large hydro projects built in 65 countries were, on average, 90 percent higher (in real—inflation adjusted—dollars) than forecast at the time the project was approved.[8]

Although Canadian utilities fared somewhat better in the 1960s to the 1980s, when a number of major hydro projects were taking place in BC, Manitoba, Quebec and Newfoundland and Labrador, more recent experience illustrates that Canadian utility cost over-runs are extensive. In this regard, it is important to note that BC Hydro has not constructed a large hydro project for many decades. The most recent major hydro dam constructed in BC was the Revelstoke dam completed in 1984. The vast majority of people with internal utility expertise in hydro project construction management have retired or no longer work for the company. Consequently there is a lack of professional and management expertise at BC Hydro with respect to large scale construction projects.

[8] Saïd Business School, University of Oxford, New research from Oxford University reveals severe cost and schedule overruns for large hydro-electric dams.

### 3.2.1 Manitoba—Wuskwatim and Keeyask

The first hydro project to be constructed in Manitoba since the Limestone Generating Station twenty-five years ago, was the 200 MW Wuskwatim Dam and Generating Station at Taskingup Falls on Burntwood River near Thompson (about 800 km north of Winnipeg). Project construction costs went from $900 million to $1.37 billion (a 52 percent increase) while the project took six years to build—2 years more than originally scheduled.

The 695 MW Keeyask Generating Station is a partnership between Manitoba Hydro and four northern Manitoba First Nations. Keeyask was originally estimated to cost $6.5 billion with a six year construction schedule for an in-service date of November 2019. Three years into construction it was announced that the budget would increase to $7.8 billion, along with a more than two year completion delay. The most recent projections put project costs at $8.7 billion (an increase of 34 percent over the original estimate) with an in-service date of 2021.

Speaking to the increased cost and delayed completion, Kelvin Shepherd, President and CEO of Manitoba Hydro stated, "Keeyask is a large and very complex project and the updated control budget is a realistic estimate based on what we know today. However, there is always a chance of additional risks materializing that could impact the schedule and costs."[9]

Notwithstanding Manitoba Hydro's construction experience with Wuskwatim, Keeyask costs have risen significantly because of unanticipated geotechnical issues complicating structural work related to the bedrock under the project.

Geotechnical issues relate to the engineering behaviour of earth material and the foundations necessary to support the generating station and the dam. Although significant pre-construction investigative work is undertaken to determine the nature of the geotechnical area, until construction there is no certainty as to what will actually be required. As discussed later in this report, geotechnical requirements are extremely challenging in the context of Site C.

### 3.2.2 Newfoundland and Labrador — Muskrat Falls

The construction of the 824 MW Muskrat Falls Generating Station in Newfoundland and Labrador commenced in 2013 at an estimated cost of $7.4 billion with an in-service date of 2018. The current cost estimate is $12.7 billion (an increase of 72 percent) with in-service delayed to 2020.

Nalcor Hydro (the provincial crown corporation) CEO, Stan Marshall, has described the project as "…a boondoggle. It should have never been built…I don't know what the

9 Manitoba Hydro, Control budget for Keeyask Generating Station revised, March 7, 2017.

motivation was. I don't know what happened and who made the decisions. Unfortunately I have seen a lot of evidence … which suggests to me that intentionally or otherwise, the costs were significantly underestimated."[10]

Among the many reasons for cost over-runs and delays are:

-the original capital cost analysis, estimates and schedule were very aggressive and overly optimistic and did not account for many of the known risks;

-there was, and is, a lack of experience within Nalcor, and among its contractors, with a cold northern climate and with major projects, since Nalcor has not built a major project in decades;

-a major dispute with Astaldi, the Italian company responsible for the construction of the powerhouse, intake and spillway for the Muskrat Falls Station; resolved with an increase from Astaldi's original estimate of $1.26 billion to $1.83 billion.

Nalcor has confirmed that current project costs will result in an astounding increase in domestic residential rates to 23.3 cents per kilowatt hour—almost double current rates.

### 3.2.3 Recent BC Hydro Contract Management

BC Hydro has not built a major generating station since the early 1980s. However, a review of BC Hydro's tendering process and project management in the construction of large transmission lines can provide insight into the current management of large projects.

A. Northwest Transmission Line was constructed to supply electricity to mines and other developments in the northwest part of the province. Its original budget was $395 million, while the project came in at $716 million—81 percent over budget.

B. Interior to Lower Mainland Transmission Project constructed to deliver new generating capacity from upgrades at BC Hydro's Mica and Revelstoke dams. Its original budget was $600 million but came in at $743 million—24 percent over budget.

C. Dawson Creek/Chetwynd Line in the northeast was originally budgeted at $255 million and came in at $296 million—16 percent over budget.

D. Iskut Extension Line primarily to provide electricity to Imperial Metal's Red Chris Mine was originally budgeted at $130 million and came in at $209 million—61 percent over budget.

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[10] CBC News, Labrador's Muskrat Falls price tag now $12.7B: Worse than 1969 Quebec deal, CEO says, June 23, 2017.

The cost over-runs in transmission projects experienced by BC Hydro raise considerable concern regarding the company's due diligence and project management capabilities.

Related to these professional shortcomings, there has been a disturbing development regarding the $1.75 billion civil contract award to Peace River Hydro Partners (PRHP) for the construction of Site C. The joint-venture partners of this group are Alberta based Petrowest Corporation (25 percent), Spain's Acciona Infrastructure (37.5 percent) and Korea's Samsung C&T (37.5 percent).

When the main civil contract for Site C was announced in November 2015, then Premier Christy Clark and BC Hydro, praised Petrowest as a local company in Fort St. John, where Petrowest CEO, Rick Quigley, lived (he was replaced as CEO in May 2017).

Petrowest is an energy and infrastructure service company headquartered in Edmonton, Alberta, operating in northern Alberta and northeastern BC. The company announced on August 13, 2017 that it received notice of termination from Acciona. The notice alleges that Petrowest failed to pay its proportionate share of working capital contributions to the partnership—PRHP.[11] Those funds represent Petrowest's proportionate share of day-to-day operational expense related to Site C work.

The civil contract was awarded to PRHP in November 2015, yet a month later, the media were reporting that Petrowest was "operating on borrowed time from its lenders".[12]

How was Petrowest "qualified" by BC Hydro? Notwithstanding the company's precarious financial situation, how was it that a $1.7 billion contract was not a bankable asset to conventional utility construction lenders?

The BCUC must examine the calibre of due diligence that BC Hydro undertook when it let a $1.7 billion contract to a partnership whose quarter owner became unable to provide promised funds in the amount of $12.5 million.

Petrowest's financial challenges, and its termination from the Project, have negative implications for Site C's cost and construction schedule. The impact of the company's entry into receivership must be examined and factored into the Commission's deliberations.[13]

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[11] Petrowest Corporation, Petrowest announces receipt of PRHP Termination Notice, August 11, 2017, Press Release.

[12] Financial Post, Petrowest Corp. is operating on borrowed time from its lenders as EBITDA cut in half, December 30, 2015.

[13] Press Release, Petrowest announces Demand Notice and Consent to Receivership, August 13, 2017.

# 4. Future Probable Costs

There are strong parallels between the underlying reasons for major cost over-runs and project delays in the hydro projects completed and being built in Manitoba and Newfoundland and Labrador and BC Hydro's construction of Site C. These parallels are:

I) large generating stations have not been constructed for decades;

II) staff experienced in the planning and construction of mega projects have retired or moved on;

III) there is a lack of contractor experience with large hydro projects in northern regions of Canada; and

IV) unexpected geotechnical issues.

BC Hydro's recent experience in the tender and management of large electrical transmission projects does not provide confidence or comfort in Site C Project cost management.

With respect to geotechnical issues in the Peace River region, these are well known. They were a major factor in the failure of the Peace River Bridge downstream from Site C. The Geotechnical Survey Branch of British Columbia concluded in 1991 that, "Valley slopes throughout the region are subject to slope failure and colluviation and the development of these sites should be minimized."[14]

BC Hydro's June 2016 report to BCUC acknowledged numerous issues including unexpected slope failure on the Project's north bank, larger than expected deterioration of shale bedrock exposed during construction, and a phenomenon called rock-exposed swell.[15]

Further, an Ernst Young and BTY Group report commissioned by BC Hydro noted, "Extensive investigation of the site was undertaken during planning of the project, but it is impossible to understand every nuance of the sub-surface conditions of such a large

[14] NR Catto, QUATERNARY GEOLOGY AND LANDFORMS OF THE EASTERN PEACE RnTER REGION, BRITISH COLUMBIA NTS 94A/1,2,7,8, BC Energy Mines and Petroleum Resources, page 17.

[15] BC Hydro, Quarterly Progress Report No. 3 F2016 Fourth Quarter January 2016 to March 2016.

site. As a result, unforeseen problems have arisen, and will continue to arise, requiring innovative engineering responses to contain cost increases."[16]

Unexpectedly, a 400 metre tension crack on the left (north) bank suddenly occurred during construction of the contractors' haul road. It was first observed on February 11, 2017. A two-stage remediation plan has been developed but Hydro acknowledges that addressing the tension crack has impacted schedules and cost. There is no question that BC Hydro and its contractors will encounter many more of these challenges in the geotechnical area, impacting schedule and cost, if construction plans proceed.

Given the discussion above, there is a high probability that the final Site C capital cost will be about $12 billion, well above currently estimated costs of $9 billion.

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[16] Ernst & Young, BTY, BC Hydro Site C Clean Energy Project – Infrastructure risk and cost management report, 13 September 2016, page 23.

# 5. Clean Energy Act

BCUC, as part of its terms of reference, has been asked to provide answers to the following:

> "3(b)(iv) Given the energy objectives set out in the Clean Energy Act, what, if any, other portfolio of commercially feasible generating projects and demand-side management initiatives could provide similar benefits (including firming; shaping; storage; grid reliability; and maintenance or reduction of 2016/17 greenhouse gas emission levels) to ratepayers at similar or lower unit energy cost as the Site C project?"[17]

It is perplexing as to why the scope of the inquiry appears to be limited to the objectives of the Clean Energy Act. When members of the current Government of British Columbia were in opposition they voted against the Act for many valid reasons. Premier Horgan, then energy critic, was at the forefront of resistance to the principles in the Act.

This Act was responsible for the substantial reduction in the regulatory jurisdiction of BCUC. It removed BCUC's authority to approve BC's Long Term Plan and Major Projects (such as Site C), all BC Hydro (POWEREX) export arrangements, the Northwest Transmission Line, the 'so-called' Smart Meter Program and many others.

Without any analysis or evidence, the Act required BC Hydro to undertake electricity supply purchases from IPPs. This has resulted in a costly nightmare that BC Hydro rate payers will pay for, for many years to come.

Related to this inquiry, the Act directed BC Hydro to phase out the existing gas-fired Burrard Thermal Station which has a capacity of roughly 960 MW and 6000 GW hours. There has never been any economic, social or environmental reason as to why this situation was forced onto BC Hydro.

It is useful to note that even if BC Hydro's long term supply requirements forecast were to be accepted as reliable, any predicted shortfall in electricity requirements could be supplied by Burrard Station.

Burrard Station used to be a valuable standby plant available to provide emergency power or peaking power. It was in good working order and well maintained. Foolishly, BC Hydro now pays a private operator in Campbell River $55 million a year to maintain a gas-fired plant on standby. This plant's maximum output is only 275 MW, is not close to Lower Mainland demand, and it does not have Burrard's selective catalytic reduction units to prevent the generation of nitric oxides.

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[17] OIC No. 44., op cit.

It is understood that Burrard Station has been decommissioned, but for relatively low cost, it could be restarted. Any examination of alternative sources of energy supply must include Burrard Station, particularly given the fact that BC Hydro has incurred in its alternatives to Site C generation, a gas-fired station for comparative purposes.

It is strongly recommended that the Commission include in its report to Government BCUC's analysis on the Burrard Thermal Plant in its 2009 publication, "In the Matter of BC Hydro and an Application for approval of the 2008 Long-term Acquisition Plan."[18]

To the degree that there is a need for a large increase in electricity supply in the future —which will be challenged below—another supply alternative excluded as a result of the objectives of the Clean Energy Act, are the electricity benefits owed to British Columbia on our Entitlement Under the Columbia River Treaty.

Over the past number of years, the Entitlement has been approximately 1320 MW of capacity and 4540 GW hours. This amount is currently sold by POWEREX at market value spot prices, primarily to US utilities. If a need arose, BC Hydro could purchase this electricity for use by domestic users which would be considerably cheaper than building costly infrastructure for new electrical supply, such as Site C.

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[18] BCUC, Decision, An Application for Approval of the 2008 Long-term Acquisition Plan, July 27,2009.

# 6. BC Hydro Load Forecast

BCUC has further been directed that:

> "3(c) in making applicable determinations respecting the matters referred to in paragraphs (a) and (b), the commission must use the forecast of peak capacity demand and energy demand submitted in July 2016 as part of the authority's Revenue Requirements Application, and must require the authority to report on
> (i) developments since that forecast was prepared that will impact demand in the short, medium and longer terms, and
> (ii) other factors that could reasonably be expected to influence demand from the expected case toward the high load or the low load case."[19]

It is not clear why BC Hydro's 2016 forecast must be relied upon as the basis for the Commission's evaluation of Site C since that forecast is overly aggressive.

BC Hydro's load forecasting has consistently overestimated electricity demand not only for new generation supplies, but for transmission investments as well. The justification for Site C was based on BC Hydro's Integrated Resource Plan 2012 forecast, which suggested domestic demand would increase by 40 percent over 20 years, which even BC Hydro now admits to be in error.

Overestimation bias is not unique to BC Hydro. The author of this report has been associated with a number of Canadian utilities in the past. Overestimation bias in forecasts of electricity demand is systemic. It is incumbent upon senior utility executives to temper this overestimation bias if a reasoned approach to electricity supply is to be maintained.

Even if it is mandated that BC Hydro's July 2016 forecast be utilized for comparative purposes, sections 3(c)(i) and (ii) provide flexibility to outline factors that "will impact demand in the short, medium and longer terms" and "that could reasonably be expected to influence demand from the expected case toward the high load or the low load case."

BC Hydro's current load forecast suggests not a 40 percent increase in electricity demand as the 2012 forecast suggested, but a 30 percent increase in electricity demand over the 20 year time horizon.

Energy demand in BC has been flat for the past decade, as Graph 1 below illustrates. BC Hydro has not provided any compelling reasons for a reversal in that trend.

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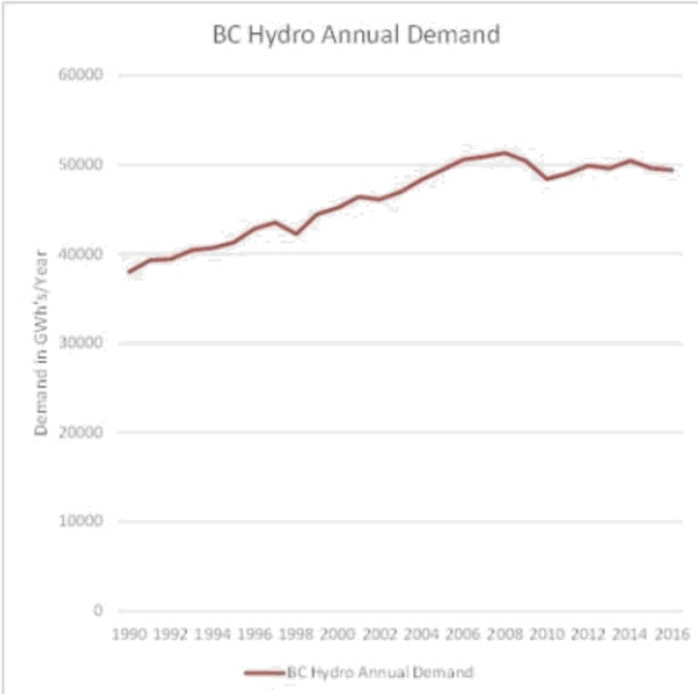
[19] OIC No. 44., op cit.

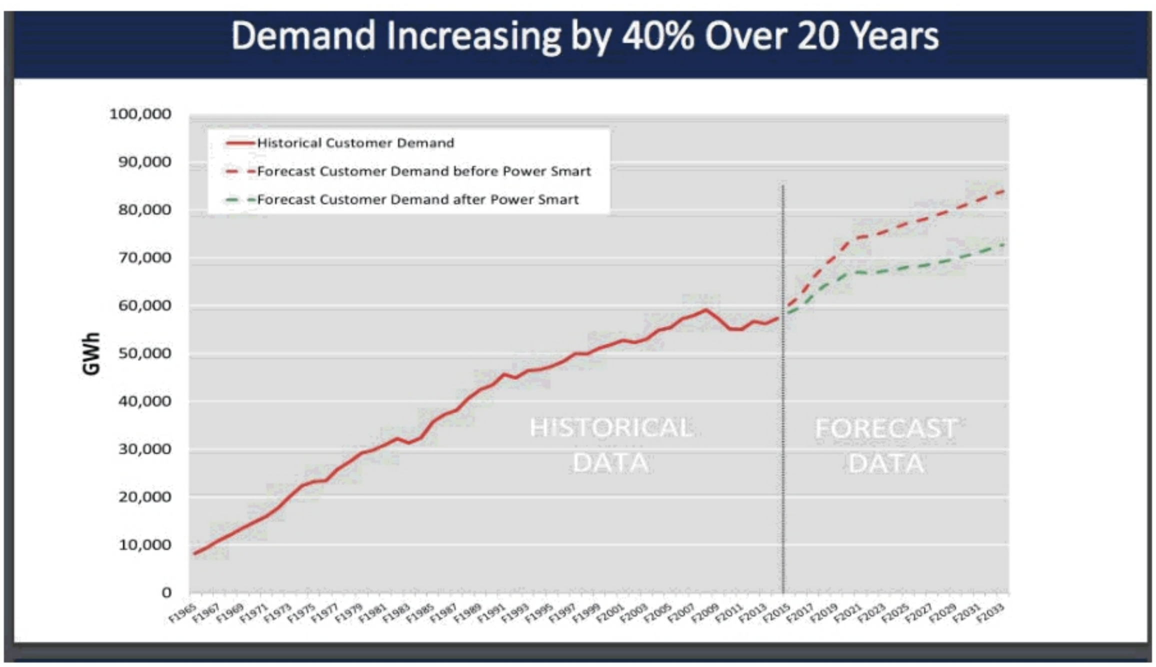
## Graph 1




| Year | GWh | Growth/Yr |
|---|---|---|
| 1990 | 38004 | |
| 1991 | 39314 | 3.4% |
| 1992 | 39429 | 0.3% |
| 1993 | 40455 | 2.6% |
| 1994 | 40706 | 0.6% |
| 1995 | 41311 | 1.5% |
| 1996 | 42834 | 3.7% |
| 1997 | 43543 | 1.7% |
| 1998 | 42254 | -3.0% |
| 1999 | 44468 | 5.2% |
| 2000 | 45203 | 1.7% |
| 2001 | 46402 | 2.7% |
| 2002 | 46129 | -0.6% |
| 2003 | 46960 | 1.8% |
| 2004 | 48326 | 2.9% |
| 2005 | 49450 | 2.3% |
| 2006 | 50602 | 2.3% |
| 2007 | 50908 | 0.6% |
| 2008 | 51339 | 0.8% |
| 2009 | 50429 | -1.8% |
| 2010 | 48424 | -4.0% |
| 2011 | 49013 | 1.2% |
| 2012 | 49922 | 1.9% |
| 2013 | 49595 | -0.7% |
| 2014 | 50460 | 1.7% |
| 2015 | 49631 | -1.6% |
| 2016 | 49421 | -0.4% |

Source:CEC Final Argument Revenue Review 2017 - 2017

## Graph 2




Source: Site C Final Investment Decision Brief, December 16, 2014

It is interesting to compare Graph 1 above, representing actual demand against historical and forecast demand that was presented when former Premier Clark announced on December 16, 2014 that the province had approved the Site C Project (Graph 2 above).

The graph relied upon by the former Premier is designed in such a way as to misrepresent the serious implications of flat demand to the viability of Site C, and ignores the conditions that created it.

For residential demand, BC Hydro continually refers to population growth as the main driver for future electricity need. It is not as if population growth has been zero in the past decade. What has developed is more effective energy efficiency which has reduced overall demand because per capita demand is falling at a greater rate than population growth.

In fact, the success of BC Hydro's Demand Management Programs—its energy conservation programs—have contributed significantly to this overall trend. Regrettably, because BC Hydro is advancing the construction of Site C, the company is scaling down its efforts for demand side management. In the name of "fiscal control", BC Hydro is curtailing scheduled Power Smart Initiatives and have no plans for new conservation efforts after 2021.

This decision is incredibly harmful for BC Hydro ratepayers. The Commission is well aware that energy conservation is the most effective method of "generating electricity by doing with less." Demand side management efforts cost considerably less than energy created through the construction and operation of a project such as Site C.

In its latest load forecast 2016, BC Hydro recognizes that its prior forecasts for industrial and commercial users were overstated, but still failed to adequately adjust for its overestimation bias. BC Hydro's current load forecast exaggerates the industrial need in the pulp and paper, mining and natural gas industries.

With respect to the pulp and paper industry electricity demand is falling not only because of commodity price fluctuations, trade difficulties with the US, and more recently the negative impact on the industry from extensive wild fires, but also because of rising electricity costs. The four CEO's of major forest companies (Canfor, West Fraser, Catalyst and Paper Excellence) recently told the BC government that, "While our industry prides itself on cost-cutting through constant innovation and improvements in efficiency, the magnitude and timing of the increase in B.C. Hydro rates combined with the increase in tax, may result in many of the mills shutting down."[20]

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[20] CCPA, The unintended consequence of massive BC Hydro rate increases, Ben Parfitt, May 22, 2016.

Competitiveness issues in the BC mining industry lead to a conclusion that Hydro rate increases were part of the problem. The BC government responded with a program that allowed companies to elect to defer a portion of their Hydro bills for a five year term.

## 6.1 Deliberate Attempt to Drive Demand

It is one thing to over-exaggerate demand projections and quite another to actively engage in subsidizing industry to generate increased electrical need. There never was a realistic need for Site C. The former government engaged in a series of exercises in an attempt to justify it.

The former BC government subsidized natural gas producers in an attempt to generate electricity demand. It also heavily subsidized the creation of an LNG industry which, as recent announcements and reports show, will not materialize in any meaningful way.

Any future load growth scenario that realistically examines demand by industrial users under current international market conditions and recent policy guidelines—such as the four conditions for operation of a BC LNG project[21]—will expose the 2016 demand forecast as excessively optimistic.

There are a number of actions which the former BC government and BC Hydro have engaged in to promote electricity usage in order to justify Site C that are either unrealistic in their expectations or represent a subsidy to industry that will be borne in rates paid by residential users. These activities include, but are not limited to:

A) **Subsidization of Transmission Lines to Electrify the Natural Gas Industry**—Most natural gas producers rely on natural gas to power compressors, fracking operations and other equipment. A trio of lines have been put forward to substitute electricity for natural gas including the Dawson Creek/Chetwynd Area Transmission Line (completed) and two proposed lines, Peace Region Electricity Supply and ATCO Power Line. Former Minister Bill Bennett exempted both of these yet to be constructed lines from review by BCUC. Subsidization to drive demand increases the burden on other Hydro ratepayers, particularly residential users.

**B) Inventing Industries**—the justification for Site C rested on the notion that an LNG industry would be developed. Notwithstanding that any independent evaluation of the likelihood that an LNG industry would develop would have exposed the promises as little more than wishful thinking, the former BC government continued to rely on the emergence of the industry.

**C) Inventing Customers**—the former BC government claimed that a $1 billion transmission line between BC and Alberta could deliver surplus electricity supply

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[21] Premier John Horgan mandate letter to the Honourable Michelle Mungall Minister of Energy, Mines, and Petroleum Resources, July 18, 2017.

from Site C. Since Alberta can generate electricity cheaply from gas-fired plants there is no merit to such a proposal.

D) **Inventing International Demand**—the former government suggested spot market sale of excess electricity supply to US utilities. The revenue from these markets would be about one-third of the cost of generating the supply from Site C and represents a significant subsidy to foreign users which would be financed on the back of BC rate payers.

In the current market environment, characterized by greater uncertainty and volatility, building a costly hydro station that will take many years to complete is not what BC Hydro should be doing. If BC needs additional supply, technologies that have shorter lead times with a planning framework that can be adjusted to actual demand should be favoured. Additional electricity supply can be generated in smaller increments and closer to markets.

# 7. BC Hydro Financial Issues—Debt, Deferral Accounts and Rates

BC Hydro is under significant financial stress. As a direct result of the former provincial government's political interference in the operations of the utility, and the BC Hydro Board's failure to carry out its fiduciary responsibility to the rate payers of the province, BC Hydro's financial position is an unmitigated disaster.

By systematically eroding BCUC's oversight, the former provincial government ensured that BCUC had little discretion in the assessment of significant utility projects and programs, rate requirements and increases, and thus was unable to perform its public interest function related to BC Hydro's finances.

In addition, in order to finance its budget since 2010, the provincial government forced BC Hydro to borrow $3.1 billion so the crown corporation could pay dividends to the provincial treasury. An additional $852 million in dividend payments is scheduled over the next 3 years.

BC Hydro's debt level has increased from $8.1 billion in 2008 to $20.6 billion for the 2017-2018 fiscal year.[22] The burden this debt load places on future rate payers is significant.

There are additional and more disconcerting issues. BC Hydro has $5.9 billion in deferral accounts[23] and $56.3 billion in obligations related to expensive power purchases under contracts with IPPs.[24]

For many years the former provincial government suppressed BC Hydro rate increases below what was required to meet the utility's financial obligations. The rate increases that will be necessary to accommodate the debt, deferrals, higher IPP prices and dividends, will be borne by future rate payers. The financial burden portended by Site C will be added to this rate payer load.

It is in the context of aggressive rate increases that will be required without Site C (and the negative impact they have on residential, commercial and industrial demand) that the BCUC must conduct its evaluation of future need for electricity.

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22 BC Hydro and Power Authority 2015/16 – 2017/18 Service Plan, page 15.

23 British Columbia Hydro and Power Authority, 2015/16 ANNUAL SERVICE PLAN REPORT, page 26.

24 The 2015/16 Public Accounts and the Auditor General's Findings, February 2017.

Demand growth is overly aggressive in BC Hydro's load plan. Given BC Hydro's debt load, deferral accounting practices, higher prices from IPP sourced energy, and dividend policy, there needs to be an accommodation in the load forecast to recognize, what economists call, the price elasticity of demand. As the relative price of electricity rises, demand falls—consumers demand less electricity because of its cost and, some businesses are forced to close or relocate to other jurisdictions because electricity expense in BC proves too onerous.

BC Hydro is deemed to have the worst financial record among all provincial utilities in Canada. Since Hydro's debt is guaranteed by the provincial government, the province has been warned by credit rating agencies that its current credit rating is at risk. A deterioration of BC's credit rating would mean increased interest expense for both the BC government and BC Hydro.[25]

As a result of BC Hydro's mismanagement by the former provincial government, even in the absence of Site C, hydro rate payers face high and continuous rate increases in the years ahead. This "factor" must be incorporated into the Commission's review of Site C along with the financial burden Site C portends because of its high capital cost and lack of commercial viability once operational.

[25] Moody's, Credit Opinion, British Columbia, Province of Update to Discussion of Key Credit Factors, January 23, 2017

# 8. Options and Conclusions

The analysis in this report identifies that:

1. BC Hydro's load forecast suffers from systemic bias that exaggerates demand and does not incorporate price elasticity of demand that can be expected from higher rates related to BC Hydro's debt burden, deferred accounts, IPP commitments, dividend commitments, and Site C.

2. To the degree that additional electricity supplies may be required, alternatives are available that are more responsive to market conditions and much more cost effective than Site C.

3. BC Hydro rate payers do not need and cannot afford the electricity capacity associated with Site C even if the project comes in on time and on budget.

4. The notion that Site C will be completed on time and on budget is illusionary. The likely scenario is that costs will escalate significantly as has been the experience of Manitoba Hydro with the Keeyask Generating Station (34 percent increase) and Nalcor's Muskrat Falls Generating Station (72 percent increase).

5. It is the author's considered opinion, based on many years of experience at a number of Canadian utilities, including BC Hydro, that the cost of Site C has a high probability of increasing from about $9 billion to $12 billion.

It is important that when BCUC consider whether BC rate payers will be better or worse off if Site C is completed, suspended, or cancelled and the site remediated, that it do so in light of the analysis provided above.

Presumably the Commission will be able to access information from BC Hydro and its consultants as to what amounts have been expended to date, and what irrevocable commitments have been made on contracts where work has not yet commenced. It is standard practice in such major projects for there to be some cost, but certainly less than the value of the original contract.

Former BC Hydro CEO, Jessica MacDonald, publicly stated that about $1.75 billion had been spent to date and that $4 billion (including $1.75 billion) is committed, however, this figure does not likely include cost reductions due to contract cancellations.

Assuming $3 billion is the amount for spent and committed funds, the question is: are rate payers better off by writing off $3 billion or spending an additional likely $9 billion to complete the Project.

BC rate payers do not need a project that would impose an intolerable and unacceptable cost burden for many years to come. The BC government does not need the financial burden that an exacerbation of BC Hydro's financial situation portends. The BC economy does not need the negative macroeconomic consequences of higher electricity rates. It is time to stop the losses from this ill-conceived Project.

The option to moth-ball the project with possible construction resumption by 2024 is not a desirable option. It is not fair to Peace Valley residents and First Nations to impose on them a state of uncertainty for the next six years. Further, from the perspective of the commercial viability of project delay, it must be recognized that there is no likelihood for BC Hydro to negotiate a large-scale firm energy and capacity arrangement in the export market—either to the US or Alberta. There are no transmission lines that could accommodate such an arrangement. Any evaluation of postponing the Project must incorporate the cost of building such lines along with the cost of care and maintenance.

Limestone was Manitoba Hydro's fifth and largest station built on the Nelson River. Construction began in 1976, with the cofferdam completed two years later. At that time, Manitoba Hydro revised its load forecast which indicated there would not be domestic need for the electric power for many years after the station would be constructed. Therefore, it was decided to suspend the construction of Limestone.

The author of this report was Deputy Minister of Energy and then Chair of Manitoba Hydro when construction of Limestone was restarted after being suspended for seven years. This only became possible after a major export contract of 500 MW for 12 years was negotiated between the Manitoba Energy Authority and Northern States Power of Minnesota. The conditions precedent to the success of Limestone do not exist for Site C.

If the Commission requires any further information or wishes to discuss any of the comments and findings provided in this report, the author is available to do so in writing or in person.