

**INFORMATION RESPONSES
LOWER CHURCHILL PROJECT
CEAA REFERENCE NO.07-05-26178**

JOINT REVIEW PANEL

Volume I
IR#s JRP.146 to JRP164

August 2010

INDEX

Volume I

IR Numbers JRP.146 to JRP.164

IR #: JRP.146 Need, Purpose and Rationale for the Project

Attachment A: Supplemental Report on Need, Purpose and Rationale

IR #: JRP.147 Alternatives to the Project

IR #: JRP.148 Reservoir Preparation

IR #: JRP.149 Project Operating Regime (Water Levels)

IR #: JRP.150 Decommissioning

IR #: JRP.151 Aboriginal Consultation and Traditional Land and Resource Use

Attachment 1: Community Consultation Agreement Template

Attachment 2: Community Engagement Agreement Template

Attachment 3: New Dawn Agreement

Attachment 4: Record of Consultation – Nunatukavut

Attachment 5: Record of Consultation – Nunatsiavut Government

Attachment 6: Record of Consultation – Pakua Shipi

Attachment 7: Record of Consultation – Unamen Shipu

Attachment 8: Record of Consultation – Nutashkuan

Attachment 9: Record of Consultation – Ekuanitshit

Attachment 10: Record of Consultation – Uashat Mak Mani-Utenam

Attachment 11: Record of Consultation – Matimekush-Lac John

Attachment 12: Record of Consultation – Naskapi Nation of Kawawachikamach

IR #: JRP.152 Downstream Effects below Muskrat Falls

IR #: JRP.153 Fish Habitat Compensation Strategy

IR #: JRP.154 Ashkui

IR #: JRP.155 Wetlands

Attachment A: Maps IR-JRP.155A, IR-JRP.155B, IR-JRP.155C, and IR-JRP.155D

Attachment B: Table JRP.155.1 Summary of 103 Wetlands Sampled for the Lower Churchill
Hydroelectric Generation Project

- IR #: JRP.156 Mercury Levels in Fish
- IR #: JRP.157 Red Wine Mountain Caribou
- IR #: JRP.158 Rare Plants
- IR #: JRP.159 Fluvial Geomorphology (Large-Scale Mass Movements)
- IR #: JRP.160 Groundwater in Mud Lake Area
- IR #: JRP.161 Economy, Employment and Business

Attachment A: Economy, Employment and Business

- IR #: JRP.162 Dam Break
- IR #: JRP.163 Cumulative Effects
- IR #: JRP.164 Monitoring and Follow-up

IR# JRP.157

Red Wine Mountain Caribou

Requesting Organization – Joint Review Panel**Information Request No.: JRP.157****Subject - Red Wine Mountain Caribou****References:**

EIS Guidelines, Section 3.1 (Study Strategy and Methodology)

Related Comments / Information Requests:

CEAR # 280 (Protected Areas Association of Newfoundland and Labrador)

CEAR # 287 (Grand Riverkeeper Labrador Inc.)

CEAR # 289 (Innu Nation)

CEAR # 291 (Sierra Club Atlantic)

CEAR # 307 (Government of Newfoundland and Labrador – Wildlife Division)

IR # JRP.93

Rationale:

The EIS Guidelines (Section 3.1) state that the Proponent shall explain and justify all methods used in the preparation of the EIS. Several reviewers, including the Government of Newfoundland and Labrador's Wildlife Division (Wildlife Division), raised concerns with respect to the methodology employed in the modelling of caribou habitat and the determination of significance. The Wildlife Division provided extensive commentary on the methodology employed to assess potential impacts to the Red Wine Mountain (RWM) caribou herd and the Proponent should also refer to CEAR # 307 for additional information and rationale.

Information Request JRP.93 requested that the Proponent address deficiencies in the habitat modelling for RWM Caribou to ensure that conclusions about habitat associations remain valid. While this has been done, several reviewers noted that the dataset used for modelling RWM habitat use represents only a fraction of the RWM herd's range and does not represent the entire Assessment area. The Wildlife Division notes that "as a result, the representativeness of both the caribou use information and the landscape are not reflected, and model results may not be applicable when considered at the scale of the population and the range" (CEAR # 307, p. 7). The Wildlife Division also raised both specific and general concerns that the limited habitat data used in the model reduces the power of the model to detect habitat preferences, and to make inferences regarding habitat selection and avoidance at the population level, particularly where little information pertaining to the stability of the model is provided.

The Wildlife Division presented a critical view of the Sorenson *et al.* (2008) reference cited by the Proponent as supporting their view that there will be no significant impacts to the RWM herd as a result of the Project. The Wildlife Division indicated that the paper has been widely criticized for inaccurately estimating the ability of caribou to persist in ranges that are heavily impacted by industrial developments and furthermore states that, "studies indicate that many of the populations considered stable in Sorenson *et al.* (2008) are actually in decline as the study failed to take into account a time lag in the population response to these changes" (CEAR # 307, p. 9).

While the Proponent and reviewers have noted that the main causes of the current decline of the RWM population is likely linked to the mortality of adult animals, reviewers continue to raise concerns that an expanded industrial footprint and associated human activity within the RWM range may further compromise the population and continue to question the actual risks to this population posed by the Project.

In response to JRP.93, the Proponent states that “although there will likely be local disruptions of movement around construction sites, and a potential reduction in crossing the TLH as a result of increased Project traffic, regional movements are expected to be maintained”. However, the Proponent has not provided data on the proximity of winter or calving ranges to existing and proposed roads and the likelihood of road crossings based on the telemetry data provided to support this statement.

Reviewers also raise concerns with respect to the lack of a broader consideration of habitat disturbance which may lead to an increase in the density of primary wolf prey such as moose, which may result in an increase in more efficient and mobile predators such as wolves.

Requesting Organization – Joint Review Panel

Information Request No.: JRP.157

Information Requested:

The Proponent is asked to provide the following technical information with respect to the model:

- a. **The least cost pathway analysis, including an assessment of the use of subjective values rather than likelihood estimates from the Resource Selection Function (RSF);**

Response:

The results of the Least-Cost Pathway (LCP) analysis are not likely to change regardless of whether subjective values or output from the Resource Selection Functions (RSFs) are used in the analysis. The objectives of the LCP analysis were to determine possible crossing locations of woodland caribou along the lower Churchill River, and whether these locations are clumped or widely distributed (Minaskuat Inc. 2009; Nalcor 2009). Landscape friction values used for the LCP analysis were assigned to habitat and slope classes based on the literature (Minaskuat Inc. 2009) and applied professional experience. Actual collar locations prior to and after river crossing, and less than five weeks apart, were used as source and destination points (Minaskuat Inc. 2009; Nalcor 2009). The results of the analysis indicated that caribou cross the river at all times of the year, and that crossing locations are broadly distributed.

Given the availability of telemetry collar location data from the Red Wine Mountain (RWM) Caribou Herd, and its application as the foundation for the original LCP analysis, re-doing the analysis using RSF output would not change the outcome. Indeed, the same conclusions as those found through the LCP analysis can be arrived at, and more succinctly, through use of the telemetry collar data alone. As shown in Table 1, Figure 1, caribou cross the river at all times of the year in both directions and crossing locations are broadly distributed.

Caribou movement across the lower Churchill River is expected to decrease during reservoir clearing, but since clearing activities will not occur in the entire project area simultaneously, and will only occur at select locations at any given time, a variety of crossing locations will remain available, resulting in negligible effects on movement (EIS, Volume IIB, Section 5.14.2.1, p. 5-80). Due to a decrease in water velocity (i.e., due to a reservoir being present, rather than a river), and the related increase in stable ice cover during the winter, the effects of the reservoirs on caribou movement during operation and maintenance are expected to be positive (EIS, Volume IIB, Section 5.11.2.5, p. 5-69).

Table 1 **Number of Crossings of the Lower Churchill River By Red Wine Mountain Caribou within the Forest Inventory Area, by Season, as determined by Class 2 and Class 3 Collar¹ Observations Less Than Five Weeks Apart**

Caribou Collar ID	Number of Crossings		
	Calving	Post-calving	Winter
RW2001001	1 north	0	1 south
RW2001002	2 north	1 north	1 north
RW2001006	1 north, 1 south	1 north	0
RW2002004	1 north	1 north	0
RW2002008	0	1 north	0
RW88001	4 north, 4 south	3 north, 3 south	0
RW94102	1 south	0	0
RW95103	0	1 north, 1 south	0
RW96003	1 south	1 north, 1 south	1 south
RW96007	1 north, 1 south	0	0
RW96013	2 south	0	0
RW96016	0	1 north, 1 south	0
RW96017	2 north	2 north, 1 south	0
RW96026	1 north	0	0
RW96027	1 south	1 north	0
RW96028	0	0	1 north
RW97005	2 north	0	0
RW97010	2 north	1 south	2 north, 3 south
RW97014	0	0	1 north, 2 south
RW97016	0	1 north, 1 south	0

Note:

¹ Collar locations accurate to within 350 m and 150 m, respectively (CLS 2008, website)

References:

Minaskuat Inc. (Minaskuat). 2009. The Lower Churchill Hydroelectric Generation Project Environmental Baseline Report: Caribou (*Rangifer tarandus caribou*). Prepared for the Lower Churchill Hydroelectric Generation Project.

Nalcor Energy (Nalcor). 2009. Volume II Part A: Biophysical Assessment. Lower Churchill Hydroelectric Generation Project Environmental Impact Statement. 368 pp.

Websites Cited:

CLS (Collecte Localisation Satellites). 2008. *Argos User Manual*. Available at:
http://www.argosystem.org/documents/userarea/argos_manual_en.pdf

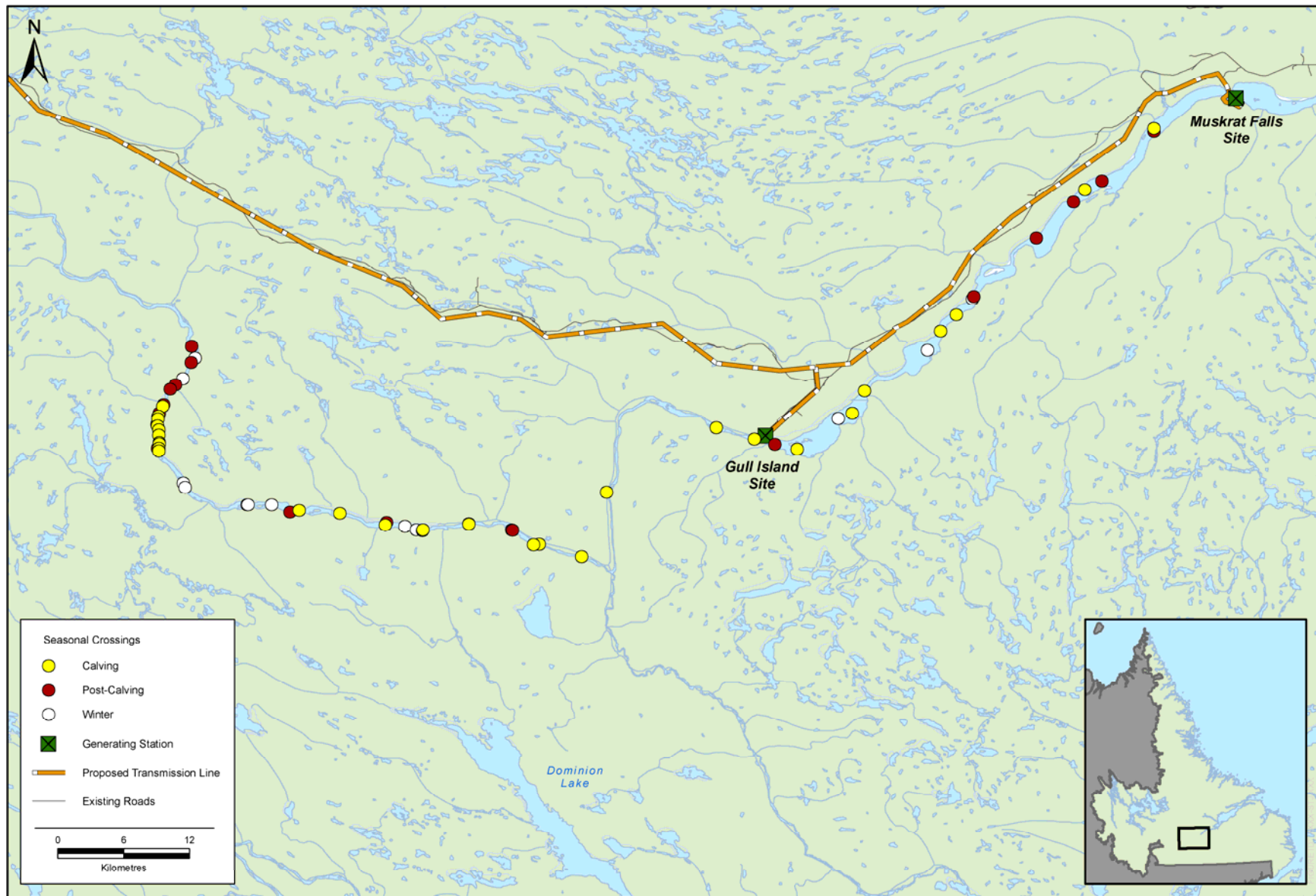


Figure 1 Locations of Red Wine Mountain Caribou Crossing the Lower Churchill River

Requesting Organization – Joint Review Panel**Information Request No.: JRP.157****Information Requested:****The Proponent is asked to provide the following technical information with respect to the model:**

- b. Details regarding how lichen estimates were collected or derived and how this information was incorporated with Forestry Inventory stand types;**

Response:

Percent cover of lichen was estimated visually at 20 m x 20 m (400 m²) Ecological Land Classification (ELC) sample plots during the baseline program (Minaskuat Inc. 2008). The location of these sample plots were then incorporated with locations represented by the classified Forest Inventory (FI) data (Government of Newfoundland and Labrador 2000) to calculate the average percent cover of lichen per FI stand type. Some of the FI cover types were not represented in the ELC data, so in these situations, classes of lichen cover were assigned based on ecological knowledge of the cover types within the FI data extent and applied professional experience.

References:

Government of Newfoundland and Labrador. 2000. Provincial forest inventory. Department of Forest Resources and Agrifoods – Forestry Branch.

Minaskuat Inc. 2008. Project Area Ecological Land Classification. Prepared for the Lower Churchill Hydroelectric Generation Project. Available online at:
http://www.ceaa.gc.ca/050/documents_staticpost/26178/31993/aq-o-05.pdf

Requesting Organization – Joint Review Panel

Information Request No.: JRP.157

Information Requested:

The Proponent is asked to provide the following technical information with respect to the model:

- c. A statement as to whether biomass of lichen was measured and if so, how;

Response:

The amount of lichen per sample plot was measured using estimates of percent cover by species (Minaskuat Inc. 2008). Biomass of lichen was not measured on vegetation sampling sites. Biomass of lichen is not required for the assessment of effects of the Project on caribou because percent cover of lichen is an appropriate indicator of woodland caribou habitat selection (Mayor et al. 2007).

References:

Mayor, S.J., J.A. Schaefer, D.C. Schneider and S.P. Mahoney. 2007. New Approaches to detecting the scale-dependent response to habitat. *Ecology* 88(7): 1634-1640.

Minaskuat Inc. 2008. Project Area Ecological Land Classification. Prepared for the Lower Churchill Hydroelectric Generation Project.

Requesting Organization – Joint Review Panel**Information Request No.: JRP.157****Information Requested:****The Proponent is asked to provide the following technical information with respect to the model:**

- d. A contingency table summarizing kappa coefficients between validation stations (ELC data) and FI stand types, if these were used to validate FI data and modify habitat categories.

Response:

A kappa coefficient is a quantitative tool for measuring the agreement between categories (Cohen 1960). Due to the fact that actual percent lichen cover measures from the Ecological Land Classification (ELC) data were not available for some Forest Inventory (FI) cover types (Government of Newfoundland and Labrador 2000), and were infrequent in others, kappa coefficients cannot be calculated. However, kappa coefficients measuring the association between lichen percent cover and stand types are not necessary for determining the accuracy of the Resource Selection Functions (RSFs) or any other component of the assessment. To evaluate model accuracy, the seasonal RWM caribou Resource Selection Functions (RSF) models were validated using the established, peer-reviewed approach of Boyce et al. (2002). Validation results demonstrated that the seasonal models are strong predictors of the relative probability of caribou habitat selection within the FI data extent (see the response to IR# JRP.93).

The associations between FI cover types and the amount of lichen cover were informed by data collected at ELC sample plots (Minaskuat Inc. 2008). Due to the limited representation of some FI cover types in the ELC data, assigning final levels of lichen cover per FI cover type required application of professional experience. It is important to note that although estimates of lichen cover per FI cover type were used to delineate stand types considered to be important for determining habitat selection by RWM Caribou Herd (Minaskuat Inc. 2009), validation of the RSF model is the indicator of model accuracy. Any weaknesses in the strength of association between lichen availability, FI cover types, and the importance of those cover types to RWM caribou may lower model accuracy, but this would be represented in validation results.

The Boyce et al. (2002) approach of RSF validation involves cross-validation and Spearman-rank correlations to measure the reliability of the models to differentiate between 10 different classes of relative probabilities of habitat selection. As stated in the response to IR# JRP.93, and in Table 2, the calving, post-calving, and winter caribou RSF models all displayed strong, significant Spearman-rank correlations. These correlations indicate that these models are strong predictors of the relative probability of caribou habitat selection across the FI data extent. As these models are strong predictors of caribou habitat selection patterns, they are appropriate for use in predicting likely Project effects to caribou habitat, particularly within the FI area.

Table 2 Spearman-Rank Correlations between Bin and Associated Area-Adjusted Observation Ranks for the Seasonal Caribou RSF Models

Season ¹	Average Spearman-Rank Correlation
calving	0.87
post-calving	0.91
winter	0.94

Note:

¹ Refer to Volume IIA, Section 2.4.4.3

References:

- Boyce, M.S., P.R. Vernier, S.E. Nielsen and F.K.A. Schmiegelow. 2002. Evaluating resource selection functions. *Ecological Modelling* 157: 281-300.
- Cohen, J. 1960. A coefficient of agreement for nominal scales, *Educational and Psychological Measurement* 20(1): 37-46.
- Government of Newfoundland and Labrador. 2000. Provincial forest inventory. Department of Forest Resources and Agrifoods – Forestry Branch.
- Minaskuat Inc. 2009. The Lower Churchill Hydroelectric Generation Project Environmental Baseline Report: Caribou (*Rangifer tarandus caribou*). Prepared for the Lower Churchill Hydroelectric Generation Project.

Requesting Organization – Joint Review Panel**Information Request No.: JRP.157****Information Requested:****The Proponent is asked to provide the following technical information with respect to the model:**

- e. Definitions of qualifying terms used to describe the quality of caribou habitat;

Response:

Estimates of lichen per Forest Inventory (FI) class were derived through a combination of field samples of percent lichen cover and application of professional experience (see the response to IR# JRP.157 1b). These estimates were then expressed as qualifying terms describing the relative availability of lichen in each FI class. As descriptors of relative lichen abundance, definitions of these qualifying terms are only meaningful in relation to each other. Functional definitions of qualifying terms used for describing lichen availability per FI class are:

- High – these land cover classes contain the highest lichen availability within the FI area.
- Moderate – less lichen availability than in high-classed habitats, and more lichen availability than in low-classed habitats.
- Low – much less lichen availability than in high-classed habitats, less lichen availability than in moderate-classed habitats, and more lichen availability than in very low-classed habitats.
- Very low – lichen is present in trace amounts only. Lichen availability is less than in habitats classed low for lichen availability.

Qualifying terms that describe the relative probability of occurrence for woodland caribou from the RWM Caribou Herd include 'primary', 'secondary' and 'tertiary'. For ease of interpretation, 'primary' may be defined as high quality habitat, 'secondary' as moderate quality, and 'tertiary' as low quality habitat (Minaskuat Inc. 2009). However, a more direct interpretation of the model output would define 'primary' habitat as more likely to be selected than 'secondary' or 'tertiary' habitat, and 'tertiary' habitat the least likely to be selected. 'Primary' habitat may also be defined as habitat with the greatest relative probability of being selected by RWM caribou within the FI area.

References:

Minaskuat Inc. 2009. The Lower Churchill Hydroelectric Generation Project Environmental Baseline Report: Caribou (*Rangifer tarandus caribou*). Prepared for the Lower Churchill Hydroelectric Generation Project.

Requesting Organization – Joint Review Panel**Information Request No.: JRP.157****Information Requested:****The Proponent is asked to provide the following technical information with respect to the model:**

- f. An explanation as to why only areas that have burned in the last 30 years are included in the habitat model and the impact this has on predicting available habitat;**

Response:

Areas burned during the last 50 years were used in the habitat model, which is consistent with the ecology of woodland caribou and enhanced the predictive accuracy of the seasonal RWM Caribou Herd Resource Selection Functions (RSFs).

As stated in the responses to IR# JRP.93 and IR# JRP.157(1d), validation results show that the calving, post-calving, and winter caribou RSF models are strong predictors of the relative probability of caribou habitat selection within the extent of the Forest Inventory (FI) data. It is within the FI data extent that all Project infrastructure (e.g., dams, transmission lines) is located, and where the effects of the Project are likely the greatest.

Terrestrial lichen cover begins to peak approximately 40 years following disturbance in coniferous stands in Labrador (Foster 1985). However, caribou in Alaska and Manitoba have been found to avoid burns less than 50 years old (Joly et al. 2003; Joly et al. 2007; Lander 2006; Schaefer and Pruitt 1991). Therefore, the RSF models included areas that were burned in the previous 50 years.

The FI data obtained from the Government of Newfoundland and Labrador had areas classified as burned, wherever burns had been identified from 1960 through to 2000 (Jennings, pers. comm. 2010). Data describing the location of areas burned were provided by the Government of Newfoundland and Labrador to update the FI data with areas burned between 2000 and 2009. When combined, the final version of the FI data used for modeling described the locations of burns that occurred from 1960 through to 2009 (i.e., burns that were up to 50 years old). Using land cover data describing the distribution of burns up to 50 years old is consistent with the ecology of woodland caribou and contributed to the very strong predictive accuracy of the RSF models.

References:

- Foster, D. R. 1985. Vegetation development following fire in *Picea mariana* (black spruce)-*Pleurozium* forests of south-eastern Labrador, Canada. *Journal of Ecology*. 73: 517-534.
- Joly, K., B.W. Dale, W.B. Collins and L.G. Adams. 2003. Winter habitat use by female Caribou in relation to wildlife fires in interior Alaska. *Canadian Journal of Zoology* 81: 1,192-1,201.
- Joly, K. P. Bente and J. Dau. 2007. Response of overwintering caribou to burned habitat in northwest Alaska. *Arctic* 60(4):401-410.
- Lander, C.-A. 2006. Distribution and movements of Woodland Caribou on disturbed landscapes in west-central Manitoba: implications for forestry. Master's thesis. University of Manitoba. Winnipeg, Manitoba.
- Schaefer, J.A. and W.O. Pruitt. 1991. Fire and Woodland Caribou in southeastern Manitoba. *Wildlife Monographs* No 116.

Personal Communications:

Jennings, D. (Computer Systems Analyst, Forest Resources and Agrifoods). 2007. Department of Natural Resources, Government of Newfoundland and Labrador. Telephone conversation with Brock Simons (Golder) on March 26, 2010.

Requesting Organization – Joint Review Panel

Information Request No.: JRP.157

Information Requested:

The Proponent is asked to provide the following technical information with respect to the model:

- g. A table that summarizes all of the variables that were initially input into the model (e.g. distance to water bodies and elevation) and provide the thresholds used for collinearity;

Response:

Numerous variables were considered for inclusion in the seasonal woodland caribou Resource Selection Function (RSF) models that did not appear in the final models, either due to issues with collinearity and multicollinearity, or relatively low explanatory power (Table 3). Univariate correlations between variables were considered to be potentially problematic if the Pearson correlation coefficient describing their strength of relationship was ≥ 0.7 (Tabacknick and Fidell 2001). Multicollinearity was assumed to be present if the Variance Inflation Factors (VIFs) for any variables within a model exceeded a value of 10 (Kutner et al. 2005).

Table 3 Variables Considered for Inclusion in Seasonal Woodland Caribou Resource Selection Functions and Associated Descriptions

Variable ^(a)	Description
dist_burn	Distance to the nearest burned area
dist_cabin	Distance to the nearest cabin
dist_cult	Distance to the nearest cultural feature (i.e., human disturbances such as building and facilities)
dist_cultncabin	Distance to the nearest cultural feature or cabin
dist_cut	Distance to the nearest clearcut
dist_road	Distance to the nearest road
dist_tline	Distance to the nearest transmission line
dist_wpoly	Distance to the nearest river or lake
dist_wline	Distance to the nearest stream
dist_water	Distance to the nearest stream, river or lake
dist_dist	Distance to the nearest natural or human disturbance
slope_per	Percent slope (on a 0-100 scale)
hab_barren	Unvegetated land dominated by rock, soil and/or sand
hab_bsd	Black spruce dominated upland forest habitat of age >40 years
hab_cd	Coniferous dominated upland forest of age >40 years
hab_hyng	Hardwood-dominated stands and young stands
hab_ss	Softwood scrub stand (black-spruce dominated)
hab_bog	Non-treed bog
hab_trebog	Treed bog
hab_allbog	Combined Non-treed and treed bog
hab_wat	Water
hab_burn	Burned area
hab_cut	Logging disturbance ≤ 20 years old
hab_dist	Disturbance (includes linear features, cultural features, natural disturbance, cut-overs)
dist_cult2	A polynomial term describing the squared distance to the nearest cultural feature
dist_cut2	A polynomial term describing the squared distance to the nearest logging disturbance
dist_dist2	A polynomial term describing the squared distance to the nearest human or natural disturbance

Note:

^(a) Model variable names starting with “hab_” represent a percentage (on a 0-100 scale) of a given habitat type within a 350 m radius circle around each location (see the response to IR# JRP.93).

References:

Kutner, M.H., C.J. Nachtsheim, J. Neter and W. Li. 2005. Applied Linear Statistical Models: Fifth Edition. McGraw Hill. Boston, MA. Tabachnick, B.G. and L.S. Fidell. 2001. Using multivariate statistics. Allyn and Bacon. Boston, MA.

Requesting Organization – Joint Review Panel**Information Request No.: JRP.157****Information Requested:**

The Proponent is asked to provide the following technical information with respect to the model:

h. Additional information with respect to the stability of the model;

Response:

The Resource Selection Functions (RSFs) predict the relative probabilities of occurrence of caribou from the RWM Caribou Herd in the calving, post-calving and winter seasons within the extent of the available Forest Inventory (FI) data. The results of model validation demonstrate that these models are stable within the extent of the FI area. To evaluate model accuracy, the seasonal RWM caribou RSF models were validated using the established, peer-reviewed approach of Boyce et al. (2002). This evaluation involves cross-validation and Spearman-rank correlations to measure the reliability of the models for differentiating between 10 different classes of relative probabilities of habitat selection. As stated in response to IR# JRP.93 and reiterated in Table 1 of IR# JRP.157(1d), the calving, post-calving, and winter caribou RSF models all displayed strong, significant Spearman-rank correlations. These validation results show that these models are strong predictors of the relative probability of caribou habitat selection within the FI data extent. As these models are strong predictors of caribou habitat selection patterns, they are appropriate for use in assessing likely Project effects to caribou habitat, particularly within the FI area. It is within the FI area that all Project infrastructure (e.g., dams, transmission lines) is located, and where the effects of the Project are likely the greatest.

The percentage of the telemetry-collared caribou that had ranges that extended into the FI data extent were calving (50 percent), post-calving (38 percent), and winter (44 percent) seasons (Table 4). Of those collared caribou with ranges within the FI area, on average 48 percent (calving season), 53 percent (post-calving season) and 49 percent (winter season) of the total class 2 and 3 collar locations (i.e., accurate to within 350 m and 150 m, respectively; CLS 2008, website) of those animals also fall within the FI area (Table 4, Table 5). Therefore, a substantial proportion of the total collared caribou population is represented within the FI area in each season, along with approximately one-half of the high resolution data from those animals' collars. This strong representation, combined with strong validation results confirming predictive accuracy, provide further support for the stability of the model as a predictive tool for assessing the effects of the Project on RWM caribou within the FI area. It is within the FI area that all Project infrastructure is located, and where the effects of the Project are likely the greatest.

The seasonal RSFs predict that tertiary-classed habitats will be disproportionately affected by inundation within the FI area, and model validation results strongly support this prediction. All Project infrastructure will be located within the FI area. Beyond the FI area, reservoir inundation will directly affect 0.4 percent of each of the calving and post-calving ranges, and 0.3 percent of the winter range of the RWM Caribou Herd (EIS, Volume IIB, Section 5.11.1.4, Table 5-12, p. 5-43). However, peer-reviewed literature, supported by professional experience of the Project experts, strongly suggests that habitat near rivers represents high predation risk for caribou (Rettie and Messier 1998; Stuart-Smith et al. 1997). Therefore, RSF model predictions within the FI area and professional knowledge of the RWM Caribou Herd Range result in the prediction that inundation will have a negligible effect on the availability of primary habitat within the RWM Caribou Herd range. In addition, it is predation and hunting, not the availability of habitat, which are described as the primary limitations on the RWM caribou herd (Bergerud et al. 2008; Schmelzer et al. 2004). Therefore, the Project was assessed as having

no significant effects on the RWM Caribou Herd during construction or operations and maintenance (EIS, Volume II Part B, Section 5.14.1, Table 5-29, p. 5-79).

Table 4 Characteristics of Telemetry Collar Data for Red Wine Mountain Caribou within the Forest Inventory Area, by Season

Season	Percentage of Collared Caribou With Ranges That Penetrate Into the Forest Inventory Area	Average Percentage of Class 2 and 3 Telemetry Collar Points Within the Forest Inventory Area Per Caribou Range Within The Forest Inventory Area
calving	50.0	48.4
post-calving	37.5	53.3
winter	43.8	49.1

Table 5 Percent of Class 2 and 3 Collar Observations within the Forest Inventory Area, by Season

Caribou Collar ID	Collar Observations Within the Forest Inventory Area (%)		
	Calving	Post-calving	Winter
RW2002008	0.0	50.0	0.0
RW2004001	0.0	0.0	50.0
RW2004002	100.0	100.0	50.0
RW330	0.0	0.0	0.0
RW82013	100.0	100.0	0.0
RW86001	0.0	0.0	0.0
RW86002	0.0	0.0	0.0
RW86004	0.0	0.0	0.0
RW86006	15.8	100.0	0.0
RW86007	2.3	0.0	0.0
RW86008	0.0	0.0	0.0
RW86009	0.0	0.0	0.0
RW87002	0.0	0.0	0.0
RW87003	0.0	0.0	0.0
RW87004	0.0	0.0	0.0
RW87008	0.0	0.0	0.0
RW87009	100.0	100.0	0.0
RW88001	4.2	16.0	0.0
RW88003	0.0	0.0	0.0
RW93101	71.4	0.0	20.6
RW93104	0.0	0.0	36.4
RW93106	23.5	0.0	51.1
RW93107	28.6	20.0	0.0
RW93109	70.0	0.0	48.1
RW93111	0.0	0.0	86.4
RW93112	0.0	0.0	100.0
RW93113	55.6	50.0	17.3
RW93114	0.0	0.0	100.0
RW93115	0.0	0.0	52.2
RW93116	50.0	87.5	22.0
RW94101	52.6	0.0	0.0
RW94102	30.4	43.8	31.6
RW94103	28.6	6.7	19.7
RW95103	47.1	13.6	43.5
RW95104	40.0	58.8	0.0
RW95105	0.0	0.0	13.3

Caribou Collar ID	Collar Observations Within the Forest Inventory Area (%)		
	Calving	Post-calving	Winter
RW95106	0.0	0.0	60.6
RW96001	14.3	0.0	0.0
RW96002	80.0	0.0	57.5
RW96026	27.8	4.5	44.1
RW96027	31.6	17.2	100.0
RW97002	100.0	72.4	26.1
RW97003	14.3	62.5	0.0
RW97004	0.0	0.0	0.0
RW97010	0.0	0.0	0.0
RWF041	0.0	0.0	0.0
RWF050	73.3	56.0	0.0
RWF054	0.0	0.0	0.0

References:

Bergerud, C. S.N. Luttich and L. Camps. 2008. The Return of Caribou to Ungava. McGill-Queen's Native and Northern Series, 50. McGill-Queen's University Press, Montreal, QC. 586 pp.

Rettie, W.J. and F. Messier. 1998. Dynamics of woodland caribou populations at the southern limit of their range in Saskatchewan. Canadian Journal of Zoology 76: 251-259.

Schmelzer, I., J. Brazil, T. Chubbs, S. French, B. Hearn, R. Jeffery, L. LeDrew, H. Martin, A. McNeill, R. Nuna, R. Otto, F. Phillips, G. Mitchell, G. Pittman, N. Simon, and G. Yetman. 2004. *Recovery strategy for three Woodland Caribou herds (Rangifer tarandus caribou; Boreal population) in Labrador*. Department of Environment and Conservation, Government of Newfoundland and Labrador, Corner Brook.

Stuart-Smith, A.K., C.J. Bradshaw, S. Boutin, D.M. Hebert and A.B. Rippin. 1997. Woodland caribou relative to landscape patterns in northeastern Alberta. Journal of Wildlife Management 61: 622-633.

Websites Cited:

CLS (Collecte Localisation Satellites). 2008. *Argos User Manual*. Available at:
http://www.argosystem.org/documents/userarea/argos_manual_en.pdf

Requesting Organization – Joint Review Panel**Information Request No.: JRP.157****Information Requested:****The Proponent is asked to provide the following technical information with respect to the model:**

- i. **Mean relocation interval (and its variation) and range of associated buffer sizes used;**

Response:

The temporal and spatial mean relocation intervals (and associated standard deviations) between successive collar location points are shown in Table 6. Similar relocation intervals within each season were grouped, and 95th percentile distances were defined for each interval grouping in SAS (SAS Systems 2002). The ranges of those 95th percentile distance buffers are also shown in Table 6.

Table 6 Relocation Intervals and 95th Percentile Distances for Woodland Caribou Satellite Telemetry Collars

Season ¹	Relocation Interval (days)		Relocation Distance (m)		Range of 95 th Percentile Distance Buffers (m)
	Mean	Standard Deviation	Mean	Standard Deviation	
Calving	4.5	4.8	4,529	6,682	9,367 – 38,150
post-calving	5.8	6.8	5,922	5,681	11,250 – 37,459
Winter	5.0	2.6	2,448	2,559	6,462 - 13,954

Note:

¹ Refer to Volume IIA, Section 2.4.4.3

References:

SAS Systems. 2002. SAS/STAT Release 9.1.3. SAS Institute. Cary, NC.

Requesting Organization – Joint Review Panel**Information Request No.: JRP.157****Information Requested:****The Proponent is asked to provide the following technical information with respect to the model:**

- j. Revised statements pertaining to the scope of the model inference in order to accurately reflect the limitations of the model;

Response:

As stated in the response to IR# JRP.93 and Table 1 of IR# JRP.157(1d), validation results for the calving, post-calving, and winter caribou RSF models show that these models are strong predictors of the relative probability of caribou habitat selection within the FI data extent. As these models are strong predictors of caribou habitat selection patterns, they are appropriate for use in predicting likely Project effects to caribou habitat, particularly within the FI. It is within the FI area that all Project infrastructure (e.g., dams, transmission lines) is located, and where the effects of the Project are likely the greatest. In addition, a substantial proportion of the total collared caribou population is represented within the FI area in each season, along with approximately one-half of the high resolution data from those animals' collars (IR# JRP.157(1h)). This strong representation, combined with strong validation results confirming predictive accuracy, provide additional support for the strength of the model as a tool for predicting the likely effects of the Project on RWM caribou within the FI area.

Within the FI area, tertiary-classed habitats are disproportionately affected by inundation, followed by secondary-classed habitats. This is consistent with the research that shows that habitat near rivers represents high predation risk, and would not be considered primary habitat even if cover and food were available (Rettie and Messier 1998; Stuart-Smith et al. 1997). The primary effect on caribou habitat outside of the FI area will be vegetation clearing along the lower Churchill River, followed by reservoir inundation. Therefore, with or without model inference outside the FI area, it is predicted that inundation will have little effect on the availability of primary habitat within the RWM Caribou Herd range. In addition, it is predation and hunting, rather than the availability of habitat, which are described as the primary limitations on the RWM Caribou Herd (Schmelzer et al. 2004; Bergerud et al. 2008).

For the reasons stated above, the Project was assessed as having no significant effect on the RWM Caribou Herd during construction or operations and maintenance (EIS, Volume II Part B, Section 5.14.1, Table 5-29, p. 5-79).

References:

- Bergerud, C. S.N. Luttich and L. Camps. 2008. The Return of Caribou to Ungava. McGill-Queen's Native and Northern Series, 50. McGill-Queen's University Press, Montreal, QC. 586 pp.
- Rettie, W.J. and F. Messier. 1998. Dynamics of woodland caribou populations at the southern limit of their range in Saskatchewan. Canadian Journal of Zoology 76: 251-259.
- Schmelzer, I., J. Brazil, T. Chubbs, S. French, B. Hearn, R. Jeffery, L. LeDrew, H. Martin, A. McNeill, R. Nuna, R. Otto, F. Phillips, G. Mitchell, G. Pittman, N. Simon, and G. Yetman. 2004. *Recovery strategy for three Woodland Caribou herds (Rangifer tarandus caribou; Boreal population) in Labrador*. Department of Environment and Conservation, Government of Newfoundland and Labrador, Corner Brook.
- Stuart-Smith, A.K., C.J. Bradshaw, S. Boutin, D.M. Hebert and A.B. Rippin. 1997. Woodland caribou relative to landscape patterns in northeastern Alberta. Journal of Wildlife Management 61: 622-633.

Requesting Organization – Joint Review Panel**Information Request No.: JRP.157****Information Requested:****The Proponent is asked to provide the following technical information with respect to the model:**

- k. The thresholds and their metric (e.g. are the maps probability of occupancy, or do they correspond to each of the three separate validation models?) used to define 'primary' 'secondary' and 'tertiary' habitat suitability; and**

Response:

Thresholds were not used to define primary, secondary and tertiary habitat suitability. Instead, habitat suitability classes were defined by splitting the landscape into roughly equal amounts of each within the Forest Inventory (FI) area. This is an appropriate approach for expressing the output of Resource Selection Functions (RSFs) (Johnson et al. 2006). The RSF output maps express the distribution of relative probabilities of woodland caribou occupancy (Manly et al. 2002). Validation models were used to evaluate the predictive accuracy of the seasonal RSF models, but were not used to subdivide the landscape into classes. For ease of interpretation, 'primary' was defined as high quality, 'secondary' as moderate quality, and 'tertiary' as low quality habitat (Minaskuat Inc. 2009). However, a more direct interpretation of the model output would describe 'primary' habitat as more likely to be selected than 'secondary' or 'tertiary' habitat, and 'tertiary' habitat the least likely to be selected.

As the seasonal woodland caribou RSF models were developed using data derived from a used-available sampling scheme, model output is properly expressed using an exponential function and takes the form of relative probabilities of use (Manly et al. 2002). Therefore, output is not constrained between 0 and 1, and is not easily divided into classes by thresholds. However, splitting classes such that they contain roughly equal areas (i.e., quantile splits) is an accepted and objective approach (Johnson et al. 2006). Therefore, 'primary', 'secondary' and 'tertiary' habitat classes were produced by splitting the FI area into roughly equal areas. Quantile habitat classes describing the relative probability of caribou occurrence are effective for showing the spatial distribution of habitat classes, as well as the proportion of Project effects per class.

Validation models were used to evaluate model accuracy through cross-validation, but were not involved in final output classification (see the response to IR# JRP.93 for a detailed description of validation methods). Validation results demonstrated that the calving, post-calving and winter caribou RSF models were reliable in their ability to differentiate between classes of relative probability of use.

References:

- Johnson, C.J., S.E. Nielsen, E.H. Merrill, T.L. McDonald, M.S. Boyce. 2006. Resource selection functions based on use-availability data: theoretical motivation and evaluation methods. *Journal of Wildlife Management* 70(2):347-357.
- Manly, B.F.J., L.L. Macdonald, D.L. Thomas, T.L. McDonald, W.P. Erickson. 2002. *Resource selection by animals*. Kluwer Academic Publishers, Netherlands.
- Minaskuat Inc. 2009. *The Lower Churchill Hydroelectric Generation Project Environmental Baseline Report: Caribou (Rangifer tarandus caribou)*. Prepared for the Lower Churchill Hydroelectric Generation Project.

Requesting Organization – Joint Review Panel

Information Request No.: JRP.157

Information Requested:

The Proponent is asked to provide the following technical information with respect to the model:

- I. A discussion on the observed suitability of secondary and tertiary habitats based on telemetry data.

Response:

The relative suitability of secondary and tertiary habitats is predicted by Resource Selection Function (RSF) output, which was developed and tested with telemetry data. The seasonal woodland caribou RSF models were validated using the Boyce et al. (2002) approach. As described in the response to IR# JRP.93 and IR# JRP.157(1d), validation results showed that the calving, post-calving and winter caribou RSF models were reliable in their ability to differentiate between 10 classes of relative probability of use. Primary-classed habitat has a higher probability of woodland caribou occurrence relative to secondary-classed habitat, which has a higher probability of caribou occurrence relative to tertiary-classed habitat.

To clarify, the observed suitability of each of the primary, secondary, and tertiary habitat classes can be quantified using RSF output, telemetry data and Manly's standardized selection ratio. Manly's standardized selection ratio (Manly et al. 1972, 2002) quantifies apparent habitat preference (primary, secondary and tertiary classes) by estimating the probability that a particular habitat suitability class would be selected if each class were equally available. It does this by comparing the proportion of telemetry locations found in each suitability class to the proportion of the landscape that class represents. A G-test may be used to detect statistically significant differences between observed frequencies of observation per habitat class and frequencies expected by chance (Sokal and Rohlf 1995). Using Manly's selection ratio, primary habitat would have about three to four times the probability of being selected as secondary habitat, assuming equal availability (Table 7). The probability of secondary habitat being selected is about three to six times the probability of tertiary habitat being selected. Apparent selection for habitat classes was statistically significant for all seasons.

Table 7 Manly's Standardized Selection Ratio Results for the Seasonal Woodland Caribou Habitat Suitability Index Model

Season ¹	Habitat Class	Manly's selection ratio	G-Test
Calving	primary	0.78	significant
	secondary	0.19	
	tertiary	0.03	
post-calving	primary	0.67	significant
	secondary	0.25	
	tertiary	0.08	
Winter	primary	0.74	significant
	secondary	0.19	
	tertiary	0.07	

Note:

¹ Refer to Volume IIA, Section 2.4.4.3

References:

- Boyce, M.S., P.R. Vernier, S.E. Nielsen and F.K.A. Schmiegelow. 2002. Evaluating resource selection functions. *Ecological Modelling* 157: 281-300.
- Manly, B.F.J., L.L. Macdonald, D.L. Thomas, T.L. McDonald, W.P. Erickson. 2002. Resource selection by animals. Kluwer Academic Publishers, Netherlands.
- Manly, B.F.J., P. Miller, L.M. Cook. 1972. Analysis of a selective predation experiment. *The American Naturalist* 106(952): 719-735.
- Sokal, R.R. and F.J. Rohlf. 1995. *Biometry*. W.H. Freeman and Company. New York, NY.

Requesting Organization – Joint Review Panel

Information Request No.: JRP.157

Information Requested:

The Proponent is also asked to discuss the following:

- m. How the precautionary principle has been applied to the data gaps resulting from the use of a model that does not cover the entire RWM range or the entire assessment area;

Response:

As indicated in the response to IR# JRP.19, when considering the assumptions, uncertainties, and limitations in the EIS, it is important to understand how the Project was assessed in a careful and precautionary manner in accordance with Section 2.5 of the EIS Guidelines. For the Project and its EIS, a precautionary approach has been applied to be conservative in the assessment of environmental effects and design mitigative measures that will result in residual effects that are likely to be not significant. Discussion of this approach is also provided in Section 9.12 of Volume IA of the EIS.

This precautionary approach included application of the “Precautionary Principle” (i.e., “Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.”). The use of a precautionary approach means that:

- Environmental effects predictions are based on conservative values or modeling inputs and assumptions (at the high end of the scale when predictions result in a range of possibilities) and are used to address uncertainty and propose mitigation that will prevent and reduce adverse effects;
- The lack of scientific certainty regarding the probability of an environmental effect occurring has not been used as a reason to postpone mitigation (i.e., the precautionary principle);
- Mitigation has been proposed for project effects, including those that are not likely to be significant and adverse; and
- Follow-up and monitoring have been proposed.

This has allowed the prediction of likely residual environmental effects (after the application of mitigation measures) to be made with a high level of certainty.

A precautionary approach to the assessment of Project effects was employed by:

- assessing Project effects during construction as if all areas within the Project footprint are affected simultaneously, when in fact that will not be the case; and,
- assessing Project effects on RWM caribou by assuming that all habitat affected by the Project beyond the FI data extent is primary habitat (although it is likely mostly tertiary habitat).

Even though construction will take place over 10 years and the entire Project area will not be affected in any one year, a precautionary approach was taken in the assessment by assuming that the full area that may be affected by construction would be affected simultaneously (EIS, Volume IIB, Section 5.11.1.4, pp. 5-44 to 5-45). In this way, the effects of the Project on sensory disturbance of RWM caribou were assessed in a precautionary manner.

The majority of Project effects in the RWM Caribou Herd range beyond the FI boundary will be due to clearing and inundation associated with the Gull Island Reservoir. Within the FI area, tertiary-classed habitats are disproportionately affected by inundation (see the response to IR# JRP.157(2b) for more detail). This finding is consistent with known caribou ecology, which shows that habitat near rivers represents increased predation risk and is generally avoided (Rettie and Messier 1998; Stuart-Smith et al. 1997). Therefore, it is likely that the majority of habitat affected by inundation of the Gull Island Reservoir outside of the FI area will also be tertiary habitat. The effects of roads required for Project construction beyond the FI boundary will be mitigated by restricted access, and the plans to construct roads in the inundation area and/or follow-up with reclamation as soon as each road is no longer needed (EIS, Volume IIB, Section 5.11.2.5, p. 5-67).

Due to the concentration of tertiary habitat near the lower Churchill River (both according to model predictions and reinforced by knowledge of caribou ecology) and the mitigation of effects associated with access roads, it is likely that the majority of Project effects on primary and secondary habitat are concentrated within the FI area and have been explicitly quantified. However, even if tertiary habitat is not concentrated along the river outside of the FI boundary, the area of the Gull Island Reservoir within the RWM Caribou Herd range outside of the FI area makes up only 0.4 percent, 0.4 percent, and 0.3 percent of the calving, post-calving and winter ranges. Therefore, because the area affected by the Project outside of the FI area is such a small percentage of the RWM Caribou Herd range, if that area was entirely primary-classed habitat there would still be no significant effect of the Project on the RWM Caribou Herd. Furthermore, it is predation and hunting, rather than the availability of habitat, which are described as the primary limitations on the RWM Caribou Herd (Bergerud et al. 2008). Based on the above information, the Project was assessed as having no significant effect on the RWM Caribou Herd during construction or operations and maintenance (EIS, Volume II Part B, Section 5.14.1, Table 5-29, p. 5-79).

Consistent with the precautionary principle, a lack of full scientific certainty was not used as a reason for postponing mitigation, and mitigation to minimize Project effects will be applied, including low speed limits along access roads, the education of Project staff about woodland caribou, zero tolerance for wildlife harassment, restricting access, and reclamation of access roads as soon as they are no longer needed (EIS, Volume IIB, Section IIB, pp. 5-80 to 5-81).

References:

- Bergerud, C. S.N. Luttich and L. Camps. 2008. The Return of Caribou to Ungava. McGill-Queen's Native and Northern Series, 50. McGill-Queen's University Press, Montreal, QC. 586 pp.
- Government of Newfoundland and Labrador. 2000. Provincial forest inventory. Department of Forest Resources and Agrifoods – Forestry Branch.
- Rettie, W.J. and F. Messier. 1998. Dynamics of woodland caribou populations at the southern limit of their range in Saskatchewan. Canadian Journal of Zoology 76: 251-259.
- Stuart-Smith, A.K., C.J. Bradshaw, S. Boutin, D.M. Hebert and A.B. Rippin. 1997. Woodland caribou relative to landscape patterns in northeastern Alberta. Journal of Wildlife Management 61: 622-633.

Requesting Organization – Joint Review Panel**Information Request No.: JRP.157****Information Requested:****The Proponent is also asked to discuss the following:**

- n. The availability of primary habitat within the RWM range after inundation;

Response:

The availability of primary habitat within the RWM Caribou Herd range after inundation will be similar to existing conditions. This is because inundation will affect less than 1 percent of the range of the RWM Caribou Herd, and of this less than 1 percent, very little of it is considered primary habitat. Habitat near rivers represents high predation risk for caribou and would not be considered primary habitat even in the presence of other factors such as cover and food availability (Rettie and Messier 1998; Stuart-Smith et al. 1997).

As reservoir inundation will affect less than 1 percent of the range of the RWM Caribou Herd, the assessment relied, in part, on the FI area. It is within the FI area that all Project infrastructure (e.g., dams, transmission lines) is located, and where the effects of the Project are likely the greatest. Within the FI data extent, primary-classed habitat is only about 2 percent, 1 percent and 9 percent of the habitat affected by inundation in the calving, post-calving and winter seasons, respectively (see Volume IIA, Section 2.4.4.3 for a description of how seasonal ranges are defined). Although there are roughly equal amounts of primary, secondary and tertiary-classed habitats within the FI area (see the response to IR# JRP.157(1k)), tertiary-classed habitats are disproportionately affected by inundation, followed by secondary-classed habitats. This is consistent with the prediction that habitat near rivers represents high predation risk, and would not be considered primary habitat even if cover and food were available (Rettie and Messier 1998; Stuart-Smith et al. 1997).

Using zone of influence buffers around Project components and the extent of the reservoirs, sensory disturbance during construction may result in avoidance or reduced occupancy of up to 12.2 percent of the calving range (4.9 percent increase over baseline), 9.1 percent of the post-calving range (4.4 percent increase) and 14.7 percent of the winter range (8.3 percent increase) (EIS, Volume II Part B, Section 5.11.1.4, p. 5-44). These estimates are conservative because construction activities will not occur throughout the entire Project footprint in any one year. No additional direct habitat loss is expected during operation and maintenance. However, sensory disturbance for the RWM Caribou Herd will continue because of Project activities, albeit reduced. Less than one percent of direct change to habitat is expected within the calving, post-calving and winter ranges of the RWM Caribou Herd during operation and maintenance compared to baseline conditions (EIS, Volume II Part B, Section 5.11.2.5, p. 5-67).

In addition to the above, it is predation and hunting, rather than the availability of habitat, which appear to be the primary limitations on the RWM caribou herd (Bergerud et al. 2008; Schmelzer et al. 2004).

Based on the above information, the Project was assessed as having no significant effect on the RWM Caribou Herd during construction or operations and maintenance (EIS, Volume II Part B, Section 5.14.1, Table 5-29, p. 5-79).

References:

Bergerud, C. S.N. Luttich and L. Camps. 2008. *The Return of Caribou to Ungava*. McGill-Queen's Native and Northern Series, 50. McGill-Queen's University Press, Montreal, QC. 586 pp.

Minaskuat Inc. (Minaskuat). 2009. The Lower Churchill Hydroelectric Generation Project Environmental Baseline Report: Caribou (*Rangifer tarandus caribou*). Prepared for the Lower Churchill Hydroelectric Generation Project.

Rettie, W.J. and F. Messier. 1998. Dynamics of woodland caribou populations at the southern limit of their range in Saskatchewan. Canadian Journal of Zoology 76: 251-259.

Schmelzer, I., J. Brazil, T. Chubbs, S. French, B. Hearn, R. Jeffery, L. LeDrew, H. Martin, A. McNeill, R. Nuna, R. Otto, F. Phillips, G. Mitchell, G. Pittman, N. Simon, and G. Yetman. 2004. *Recovery strategy for three Woodland Caribou herds (Rangifer tarandus caribou; Boreal population) in Labrador*. Department of Environment and Conservation, Government of Newfoundland and Labrador, Corner Brook.

Stuart-Smith, A.K., C.J. Bradshaw, S. Boutin, D.M. Hebert and A.B. Rippin. 1997. Woodland caribou relative to landscape patterns in northeastern Alberta. Journal of Wildlife Management 61: 622-633.

Requesting Organization – Joint Review Panel

Information Request No.: JRP.157

Information Requested:

The Proponent is also asked to discuss the following:

- o. The broader implications of habitat disturbance, particularly predator-prey interactions, with respect to RWM caribou;**

Response:

The broader implications of habitat disturbance, particularly predator-prey interactions, are expected to result in conditions for the RWM Caribou Herd that are similar to those that currently exist. Although clearing activities associated with the Project will create some early succession habitats that may benefit moose, clearing along the lower Churchill River will remove critical winter range that will be detrimental to moose. Therefore, the expectation is that the Project itself will not result in an increase in moose densities, and will not result in any associated increase in predator (i.e., wolf) densities. Therefore, the Project will not result in additional predation pressure on caribou (EIS, Volume IIB, Section 5.14.2.2, p. 5-81).

Increases in the amount of herb and shrub cover due to reservoir and transmission line clearing may support increased densities of ungulates such as moose, which in turn can support higher densities of wolves (Wittmer et al. 2007). However, development of the transmission line right-of-way is not expected to substantially increase forage availability for moose. In addition, the loss of key riparian habitat along the lower Churchill River will be detrimental to moose. Therefore, moose populations along the transmission corridor are not likely to increase measurably, resulting in little or no increase in the local wolf population and subsequent predation on the RWM Caribou Herd (EIS, Section 5.11.2.5, p. 5-69).

References:

Vors, L.S., M.S. Boyce. 2009. Global declines of caribou and reindeer. *Global Change Biology* 15: 2626-2633.

Wittmer, H.U., B.N. McLellan, R. Serrouya and C. Apps. 2007. Changes in landscape composition influence the decline of a threatened woodland caribou population. *Journal of Animal Ecology* 76: 568-579.

Requesting Organization – Joint Review Panel**Information Request No.: JRP.157****Information Requested:****The Proponent is also asked to discuss the following:**

- p. Whether and how the significance determination took into consideration effects of the Project on RWM caribou that may extend beyond the amount of Caribou Habitat within Disturbance Zones of Influence in the Forest Inventory Area (JRP.93, Table 6); and**

Response:

The determination of no significant effect of the Project on caribou from the RWM Caribou Herd during construction or operations and maintenance (EIS, Volume IIB, Section 5.14.1, p. 5-79) took into consideration effects of the Project on habitat, movement, and mortality of RWM caribou throughout their range (i.e., within and beyond disturbance zones of influence in the Forest Inventory (FI) area). The way in which Project effects were taken into consideration was summarized in Section 5.14.1 of Volume IIB of the EIS.

The determination of no significant effect of the Project on RWM caribou during construction or operations was arrived at by predicting that construction will result in increases in disturbed area of 4.9 percent, 4.4 percent, and 8.3 percent for calving, post-calving and winter seasonal ranges, respectively, relative to baseline conditions (EIS, Volume IIB, Section 5.14.2.1, p.5-80). Predation and hunting, rather than the availability of habitat, are the primary limitations on the RWM Caribou Herd (Bergerud et al. 2008; Schmelzer et al. 2004), so these small amounts of habitat disturbance are predicted to have no significant effect on the RWM Caribou Herd. Movement opportunities will be maintained during construction, and predation risk is not expected to increase.

During operation and maintenance, no further direct habitat loss or alteration is anticipated, and sensory disturbance will decrease (EIS, Volume IIB, Section 5.14.2.2, p. 5-81). Habitat availability will be similar to baseline conditions across the seasonal ranges. Movement across the transmission line rights-of-way will not be impeded, and movement across the lower Churchill River will be facilitated by developed shorelines, lower water velocities and more stable ice cover (EIS, Volume IIB, Section 5.14.2.2, p. 5-81).

There is likely to be only negligible changes in predation pressure to RWM caribou, if any. This is because the Project is not likely to increase moose population densities (EIS Section 5.11.2.5, p. 5-67). As a result, wolf density will also not likely increase, thereby resulting in no likely additional predation pressure on caribou (EIS, Volume IIB, Section 5.14.2.2, p. 5-81).

References:

- Bergerud, C. S.N. Luttich and L. Camps. 2008. The Return of Caribou to Ungava. McGill-Queen's Native and Northern Series, 50. McGill-Queen's University Press, Montreal, QC. 586 pp.
- Schmelzer, I., J. Brazil, T. Chubbs, S. French, B. Hearn, R. Jeffery, L. LeDrew, H. Martin, A. McNeill, R. Nuna, R. Otto, F. Phillips, G. Mitchell, G. Pittman, N. Simon, and G. Yetman. 2004. *Recovery strategy for three Woodland Caribou herds (Rangifer tarandus caribou; Boreal population) in Labrador*. Department of Environment and Conservation, Government of Newfoundland and Labrador, Corner Brook.

Requesting Organization – Joint Review Panel

Information Request No.: JRP.157

Information Requested:

The Proponent is also asked to discuss the following:

- q. Further rationale for the “not significant” Project effects determination for RWM Caribou in light of the information requested above.

Response:

The information provided throughout the entire response to IR# JRP.157 reinforces the assessed ‘not significant’ residual environmental effect on RWM caribou. Specifically:

- re-doing the LCP analysis using RSF output would not change the outcome. Indeed, the same conclusions as those found through the LCP analysis can be arrived at, and more succinctly, through use of the telemetry collar data alone, which was done to validate the analysis;
- although lichen cover percentages were used to help form stand types for habitat suitability modeling, model validation is the ultimate measure of predictive accuracy, and the validation demonstrates that the models are accurate and reliable;
- areas burned within the last 50 years were used in the habitat model, which is consistent with the ecology of woodland caribou, and aided in the production of reliable habitat suitability models;
- validation results demonstrate that the calving, post-calving and winter caribou RSF models were reliable in their ability to differentiate between habitat suitability classes;
- assessing Project effects on RWM caribou by assuming that all habitat affected by the Project beyond the FI data extent is primary habitat (although it is likely mostly tertiary habitat). However, regardless of the quality of habitat affected beyond the FI extent, the conclusion of no significant effect on the RWM Caribou Herd would be unchanged;
- based on model predictions within the FI area and known caribou ecology outside the FI area, the availability of primary habitat after inundation will be similar to existing conditions because inundation will affect little primary habitat within the RWM Caribou Herd range;
- the broader implications of habitat disturbance, particularly predator-prey interactions, are expected to result in conditions for RWM caribou that are similar to those that currently exist; and
- the determination of no significant effect of the Project on the RWM Caribou Herd took into consideration effects of the Project on habitat, movement, and mortality of RWM caribou throughout their range.

The Project was assessed as having no significant effect on the RWM Caribou Herd during construction or operations and maintenance (EIS, Volume II Part B, Section 5.14.1, Table 5-29, p. 5-79). Considering the above, the “not significant” Project effects determination for RWM caribou is appropriate.

IR# JRP.158

Rare Plants

Requesting Organization – Joint Review Panel

Information Request No.: JRP.158

Subject - Rare Plants

References:

EIS Guidelines, Section 4.4.4.3 (Terrestrial Environment)

Related Comments / Information Requests:

CEAR # 307 (Government of Newfoundland and Labrador – Wildlife Division)

IR # JRP.42, 103

Rationale:

The EIS Guidelines (Section 4.4.4.3 (j)) state that the Proponent is to describe the composition, distribution and abundance of terrestrial flora, including forest inventories and ecological land classifications. However, the EIS Guidelines (Section 4.4.4.3 (p)) also specify that the Proponent is to describe species of special interest or conservation concern (including their habitat), with an emphasis on rare, vulnerable or threatened species (e.g., species listed in the *Endangered Species Act* or the *Species at Risk Act*). Although no legislatively listed rare species have been found, the Panel has noted the Government of Newfoundland and Labrador's Wildlife Division concerns that impoundment may potentially extirpate regionally rare species from Labrador. The EIS Guidelines direct the Proponent to place an emphasis on rare species listed under legislation, but does not indicate that other species of conservation concern can be excluded from the assessment.

The Government of Newfoundland and Labrador's Wildlife Division provided extensive commentary on this topic and the Proponent should also refer to CEAR # 307 for additional rationale.

Requesting Organization – Joint Review Panel

Information Request No.: JRP.163

Subject - Cumulative Effects

References:

EIS Guidelines, Section 4.5.3 (Cumulative Effects)

EIS, Volume IIB, Section 5.7.1.2 (Disruption of Movement) and Section 5.15 (Cumulative Environmental Effects)

Canadian Environmental Assessment Agency. *Cumulative Effects Assessment Practitioners' Guide*. 1999. Available online at: <http://www.ceaa-acee.gc.ca/default.asp?lang=En&n=43952694-1&toc=hide>.

Canadian Environmental Assessment Agency. *Addressing Cumulative Environment Effects under the Canadian Environmental Assessment*. Operational Policy Statement. 2007. Available online at: <http://www.ceaa-acee.gc.ca/default.asp?lang=En&n=1F77F3C2-1>

Related Comments / Information Requests:

CEAR # 277 (Fisheries and Oceans Canada)

CEAR # 287 (Grand Riverkeeper Labrador Inc.)

CEAR # 289 (Innu Nation)

CEAR # 290 (Innus of Ekuanitshit)

IR # 24S, 44, 97, 97S, 122

Rationale:

With respect to cumulative effects, the EIS Guidelines require the following from the Proponent:

The Proponent shall identify and assess the Project's cumulative environmental effects. Cumulative effects are defined as changes to the environment due to the Project where those overlap, combine or interact with the environmental effects of other existing, past or reasonably foreseeable projects or activities. (...)

The Proponent shall (...) (c) Describe and justify the choice of projects and selected activities for the cumulative effects assessment. These shall include past activities and projects, those being carried out and future projects or activities likely to be carried out; (p. 35)

In its response to JRP.97 (a), the Proponent states that baseline studies included as part of the EIS "provide a comprehensive picture of the existing environment in the CEA Area that has been, in part, influenced by the construction and operation of all past and present projects".

According to the Cumulative Effects Assessment (CEA) Practitioner's Guide (CEAA, 1999), past actions often become, in practice, part of the existing baseline conditions. However, it is important "to ensure that the effects of these actions are recognised". The approach taken by the Proponent does not provide a sufficient understanding of how past projects, activities and events (including but not limited to the Churchill Falls project) have shaped current environmental conditions within the Assessment area

With respect to previous hydroelectric generation projects on the Churchill River, the Proponent lists, in response to JRP.44 (c), the specific environmental effects of the Churchill Falls project that are known to overlap with the lower Churchill River area. However, there is limited discussion in the Proponent's response of the environmental conditions that existed in the Assessment area before any hydroelectric development projects

occurred. In the absence of specific monitoring programs, Innu Nation suggests that the Proponent make use of a variety of other sources of information, such as maps, research observations, Traditional Knowledge and hydrological records (references provided by Innu Nation, CEAR # 289, p. 60-63).

With respect to the choice of projects and activities selected for inclusion in the CEA, reviewers suggested that additional projects or activities should be considered by the Proponent in the CEA:

- Mining of mineral sands (e.g. Grand River Ironsands project);
- Remediation of contamination at the Department of National Defence's facilities in Happy Valley-Goose Bay;
- Construction of additional transmission lines in Labrador in relation to the export of power from the Project (including for transmission access through Quebec);
- Aluminum smelter;
- Uranium mining; and
- Ongoing dumping of raw sewage in the Churchill River.

While the emphasis should be placed on those projects with the greatest certainty of occurring, the Canadian Environmental Assessment Agency's Operational Policy Statement on addressing cumulative effects (2007) mentions that hypothetical projects (i.e. those for which there is considerable uncertainty whether they will ever proceed) may be discussed, at least on a conceptual basis, because they may contribute to future environmental planning.

With respect to the Proponent's CEA for the Terrestrial Environment, the EIS considers three potential effects resulting from the Project on the KIs (i.e. change in habitat, change in health and mortality) (Volume IIB, Section 5.15). Whereas the disruption of movement is not one of the three potential effects considered, it is unclear as to how this was taken into account specifically within the CEA for caribou, as well as for other migratory species. For example, the response to JRP.97 discusses the CEA area for the Red Wine Mountain and George River caribou herds, stating that "due to the threatened status of caribou and its nature as a species that is likely to have a large portion of its population in one geographic area at one time, the Red Wine Mountain (RWM) Caribou Herd's recent range defines the CEA area for caribou. The CEA examines the George River Herd in this CEA area, given the similar habitat relationships when individuals from this herd overwinter there". However, this CEA area does not appear to include migration routes of these herds. In addition, the EIS states that "disturbance resulting in habitat loss may also force Caribou to travel alternate routes" (Volume IIB, Section 5.7.1.2) and suggests that this issue is relevant for the George River herd, but no cumulative effects assessment of disruption of movement is provided. While the Proponent provides a justification for the exclusion of the Lac Joseph caribou herd from the environmental assessment in its response to JRP.122, as noted by the Innus of Ekuanitshit, the Proponent does not appear to have assessed the potential for cumulative impacts on the Lac Joseph Caribou herd or provided a justification as to why this is not necessary, particularly with respect to migration patterns.

Requesting Organization – Joint Review Panel

Information Request No.: JRP.163

Information Requested:

The Proponent is asked to:

- a. describe how past projects, activities and events have affected current ecological and socio-economic conditions. In particular, the Proponent is asked to discuss the environmental conditions that prevailed in the Assessment area prior to hydroelectric developments on the Churchill River.

Response:

In accordance with standard environmental assessment practice, the Lower Churchill Hydroelectric Generation Project's (Project) environmental effects were assessed using the existing environment as the baseline (pre-Project conditions), which captured the environmental and socio-economic effects of previous developments and activities. In particular, features of the biophysical environment (e.g., fish mercury levels, and affected aquatic and terrestrial habitat), as well as the human environment, have been described and included in Chapter 2 of Volumes IIA and III of the Environmental Impact Statement (EIS) as representing baseline conditions for environmental effects assessment (including a consideration of cumulative environmental effects) within the Assessment Areas as defined in the EIS. Therefore, a review of environmental effects from past developments does not add to the baseline condition descriptions presented in the EIS, nor does it result in a need to re-evaluate any of the environmental effects predictions made in the EIS.

The Churchill River is a regulated river, and the effects of this regime on the lower section of the Churchill River have been monitored and are understood. Please refer to parts (b) and (c) in the response to IR# JRP.44 for a detailed description.

The following discussion on how past projects, activities and events have affected current ecological and socio-economic conditions incorporates information pertaining to the lower Churchill River from Lutterman (2007), and other relevant sources (Gillespie and Wetmore 1973; Goudie and Whitman 1987) as were referenced by Innu Nation.

Effect of past hydroelectric developments on current ecological and socio-economic conditions in the Assessment Areas

The three previous hydroelectric developments in the Churchill River watershed are: Menihek Generating Station on Menihek Lake in western Labrador; Twin Falls on the Unknown River; and the Churchill Falls Power Station on the Churchill River. The known effects of the Churchill Falls Power Station on the lower section of the Churchill River were described in Table 4 of IR# JRP.44 for hydrology, fish habitat, fish, avifauna, economy, employment, communities, land and resource use, and climate/air quality. Effects to ice processes, flow regime, water velocity, salt water intrusion, water temperature, bank erosion, fish habitat, fish mortality, fish predatory behavior, methylmercury levels and consumption advisories, annual net revenues from electricity sales, employment, and physical infrastructure have been described in the response to IR# JRP.44. With respect to the other two hydroelectric developments, the response to IR# JRP.44 indicated there is no evidence to suggest that any effect would be perceptible in the lower Churchill River. The following information has been summarized from the response to IR# JRP.44.

The operation of the Menihek Generating Station would be expected to alter the downstream hydrology such that the natural discharge regime has been moderated and some thermal changes would also be likely. Given

the location of the generating station high in the watershed, and up-gradient of the Smallwood Reservoir, it is highly unlikely that any effect from the Menihek Generating Station would be perceptible in the lower Churchill River.

Similar to the Menihek Generating Station, there are no sources to document any environmental effects of the Twin Falls Generating Station on the lower Churchill River. With the closing of the station in 1974 and the permanent opening of the spillway gates, some flow was restored to the Unknown River. Likewise, there is no evidence to suggest that any effect would be perceptible in the lower Churchill River.

The Churchill Falls Power Station has affected the existing aquatic habitat within the lower Churchill River by regulating seasonal flows. The Churchill Falls Power Station regulates the drainage from over 75 percent of the total watershed area, and consequently, this has reduced the natural flow variability of the Churchill River. The current flow through the Churchill Falls powerhouse ranges between approximately 500 and 2000 m³/s, with an average of about 1400 m³/s. All water is discharged back into the Churchill River once passed through the turbines. As a result, compared to natural conditions, flows in the Churchill River are now higher in winter and lower in late spring and summer. As an illustration of downstream flow effects, the highest average monthly flows at Muskrat Falls have decreased (in June) and the lowest average monthly flows (in April) have increased, compared to flows before the Churchill Falls Power Station became operational. This has resulted in a less variable flow regime over the course of the year, both seasonally and monthly. Based on water velocity and water level measurements, made at a series of transects across the lower Churchill River, the existing range in water level fluctuations is estimated at 2.5 m.

This change in flow regime in the lower Churchill River has affected aspects of the aquatic environment within the main stem, including water velocity, and ice processes. The operating regime of the Churchill Falls Power Station has reduced the peak high flows associated with the spring freshet, while adding to the typical low-flow period through mid-winter. Fish populations therefore, experience a lower range of velocities and a more consistent area of habitat as compared to conditions that existed prior to development of the Churchill Falls Power Station.

The portion of the lower Churchill River downstream of the Churchill Falls Power Station tailrace to Winokapau Lake now remains ice-free long into the winter months. Prior to the existing development, an ice cover would form on Winokapau Lake, initiating the progression of the ice cover upstream towards (and perhaps past) the present tailrace location. With the Churchill Falls dam in place, the progression of ice cover development is slower, likely delayed due to the thermal retention of the Smallwood Reservoir. In addition, as the water flows through the power station itself, it is warmed slightly, which also contributes to the maintenance of a small open water area at the tailrace.

The downstream effects of the Churchill Falls Power Station are mostly related to the change in flows and the movement of mercury from the upstream reservoirs to the lower Churchill River. Fish mercury data are available for three locations within the lower Churchill River watershed: Gull Lake; Winokapau Lake; and the estuary. Mercury levels at these sites were influenced by the existing upstream Smallwood Reservoir. Overall, these data suggest that flooding associated with the Smallwood Reservoir, now more than 35 years old, will not contribute measurably to fish mercury levels in the lower Churchill River. Lake whitefish mercury concentrations in Winokapau Lake, downstream from the Smallwood Reservoir, were up to 1.18 µg/g, approximately nine times background regional levels, six years after flooding. A similar trend was observed for lake whitefish downstream from the Robert Bourassa Reservoir in Quebec; Schetagne et al. (2003) concluded that fish passage through turbines stunned or killed fish, allowing downstream whitefish to become piscivorous. This change to piscivory resulted in increased mercury levels in lake whitefish. While Winokapau Lake is 65 km downstream from the

Churchill Falls Power Station, whitefish migration from Winokapau Lake to the Churchill Falls tailrace was demonstrated by radio telemetry studies in 1998 and 1999. These unusual increases in mercury levels in lake whitefish were not observed in Gull Lake (200 km downstream from Churchill Falls), nor for fish that were previously piscivorous in Winokapau Lake, such as northern pike (Nalcor Energy 2009a).

Methylmercury concentrations in Winokapau and Gull Lake of lower trophic level fish species (lake whitefish, brook trout, ouananiche, longnose sucker, white sucker) and higher trophic level species (northern pike, lake trout) have declined over time and are approaching background levels (Nalcor 2009b). Smallwood Reservoir is, therefore, no longer causing increases in fish mercury concentrations.

The diversion of the Churchill River through the Churchill Falls Power Station influenced the environmental parameters that influence riparian vegetation development along the lower portion of the river. For example, prior to the diversion of the Churchill River, the river descended Churchill Falls itself, a large bedrock cliff. There was an almost constant mist within the area, allowing habitat areas to form, called 'spray zones'. Following the diversion, there would have been a reduction in the extent of the spray zone and the habitat associated with it (Lutterman 2007). Reduction or control of extreme seasonal flooding events can also alter floodplain vegetation by limiting disturbance and allowing colonizing plants to strongly establish themselves. Studies have shown that the reduction of flooding events can allow succession of floodplain vegetation, which in turn can lead to a lesser degree of biodiversity (Lutterman 2007; Petts 1984). Lutterman (2007) studied riparian vegetation along the lower Churchill River to evaluate the effects of the Churchill Falls development. The general findings of the study were that the lower Churchill River maintained a diverse riparian vegetation community, and that the only visible effect, based on personal communications, was that the lower zone of riverside beaches had become bare. This was attributed to increased daily fluctuation and low late summer flows (Lutterman 2007).

The processes of shoreline erosion and bed degradation are often accelerated in the reaches downstream of dams as a result of erosion, as the river develops a new equilibrium between material transport and deposition (Northwest Hydraulic Consultants 2008; Petts 1984; Williams and Wolman 1984). For further discussion of the effects of impoundment on sedimentation, please refer to the responses to IR# JRP.149, IR# JRP.152 and IR# JRP.153.

Baseline information was not collected on the sediment loading of the lower Churchill River prior to any of the hydroelectric developments discussed in the previous paragraphs. However, residents of Rigolet and North West River did mention increased shoreline erosion, and noted the loss of banks and trees along the river when the Churchill Falls Power Station was built (Sikumiut 2009). Increased shoreline erosion along the Churchill River was also noted during interviews with elders conducted by Lutterman (2007). Interviewed residents mentioned more exposed shorelines in some areas due to a perceived reduction in water level (Lutterman 2007; Sikumiut 2009). Based on the information obtained from the interviews it is unclear where these effects were located. If the observations were on the lower Churchill River, the phenomenon may have been a result of increased deposition of sediment in downstream reaches due to accelerating beach creation (Collier et al. 1996).

The fish assemblage that currently exists in the Churchill River is generally similar to assemblages observed in other, unregulated, rivers of Labrador. Changes in flow regime associated with previous developments would not have resulted in the elimination of a particular species from the watershed.

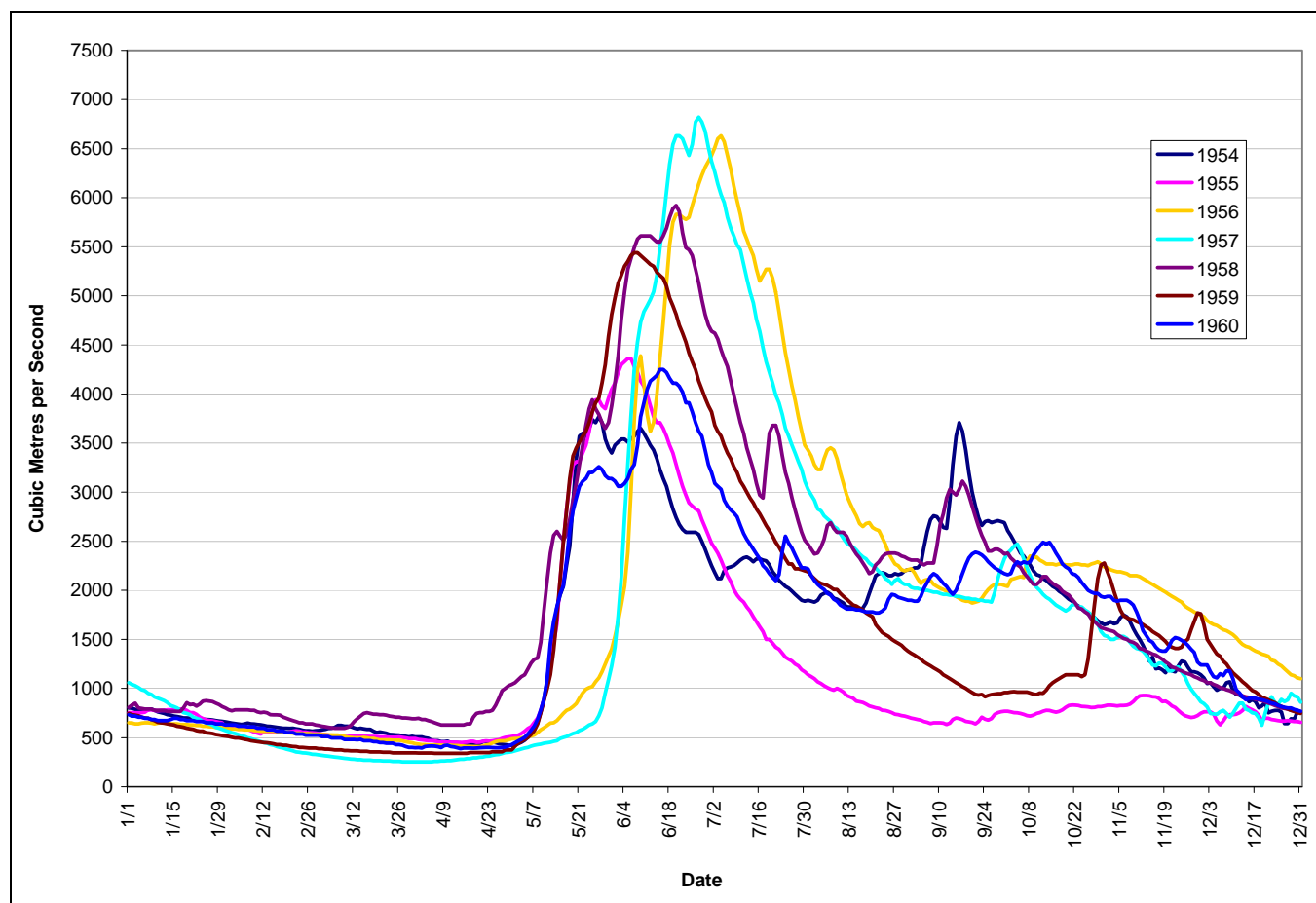
Environmental conditions that prevailed in the Assessment Area prior to hydroelectric developments on the Churchill River

As indicated previously, the Project's environmental effects were assessed using the existing environment as the baseline (pre-Project conditions) in accordance with standard environmental assessment practice. The

environmental and socio-economic effects of previous developments and activities have become part of the baseline environment. However, a review of existing, known sources of data collected prior to the existing hydroelectric developments is provided in this response. All of the existing hydroelectric projects were developed prior to existing environmental assessment legislation, and hence, there are limited baseline data prior to development. The first hydroelectric development on the Churchill River, the Menihek Generating Station, was built in 1954. Environmental conditions that prevailed in the Assessment Area are described, where information is available, but much of the biophysical data starts with the developments.

Aquatic Environment

The hydrologic data available from the Muskrat Falls station prior to any large hydroelectric development on the Churchill River are presented in Figure 1. The figure presents daily flow data from 1954 to 1960 and shows the annual variability associated with an unregulated river. The lower Churchill River became regulated in 1961 with the development of Twin Falls.

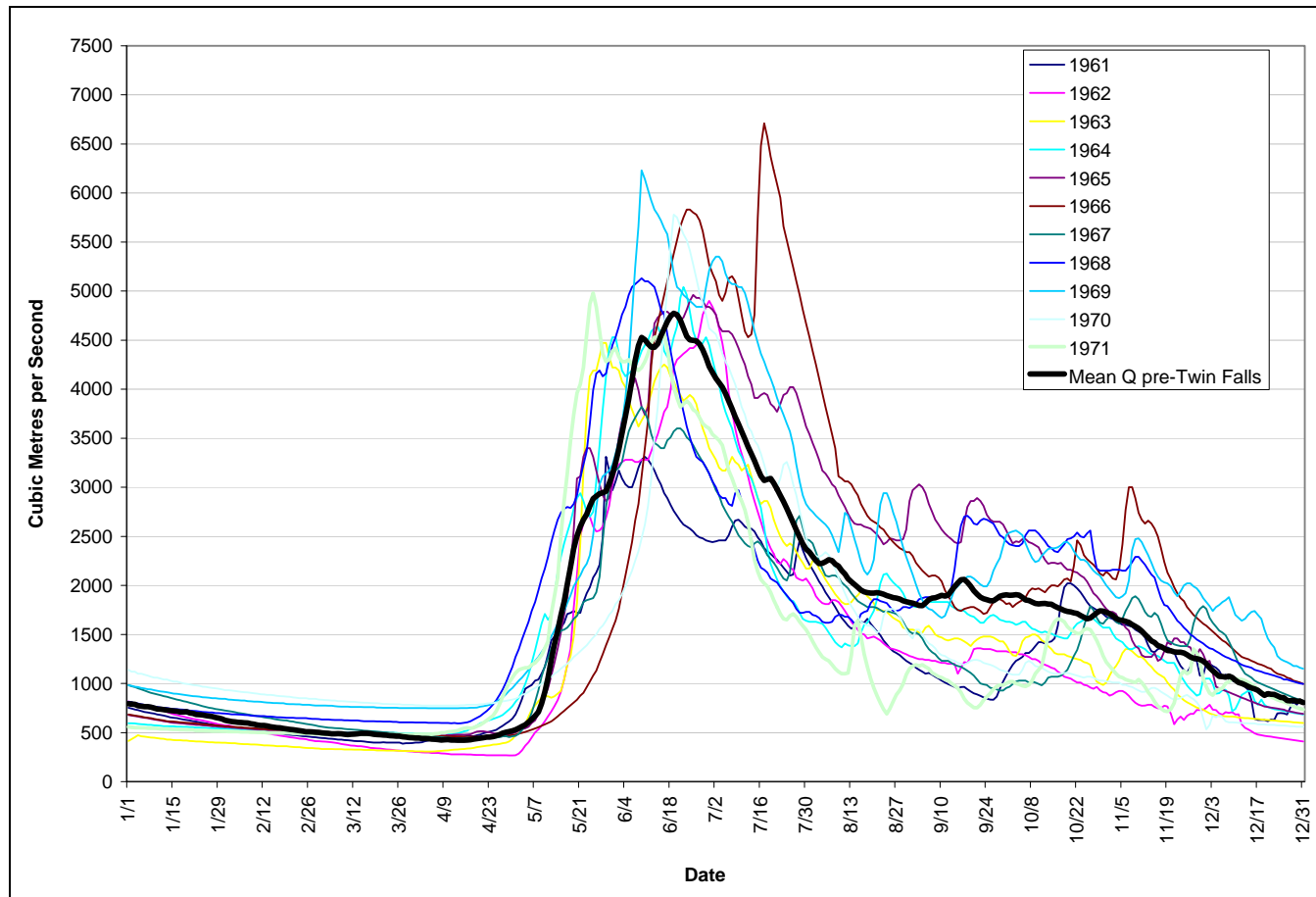


Source: Environment Canada website <http://www.wsc.ec.gc.ca>

Figure 1 Daily discharge (m^3/s) Recorded at Muskrat Falls, 1954 to 1960

Hydrographs, as measured at Muskrat Falls, of the mean daily discharge prior to Twin Falls (1954 to 1960) and the daily discharge from 1961 to 1974 with the operation of the Twin Falls facility are shown in Figure 2. As shown, the facility appears to have had minimal regulation effect on the lower Churchill River. Prior to regulation, the Unknown River supplied approximately 35 percent of the discharge to Muskrat Falls (Lutterman 2007). Following decommissioning of the facility, some flow was restored to the Unknown River as a result of

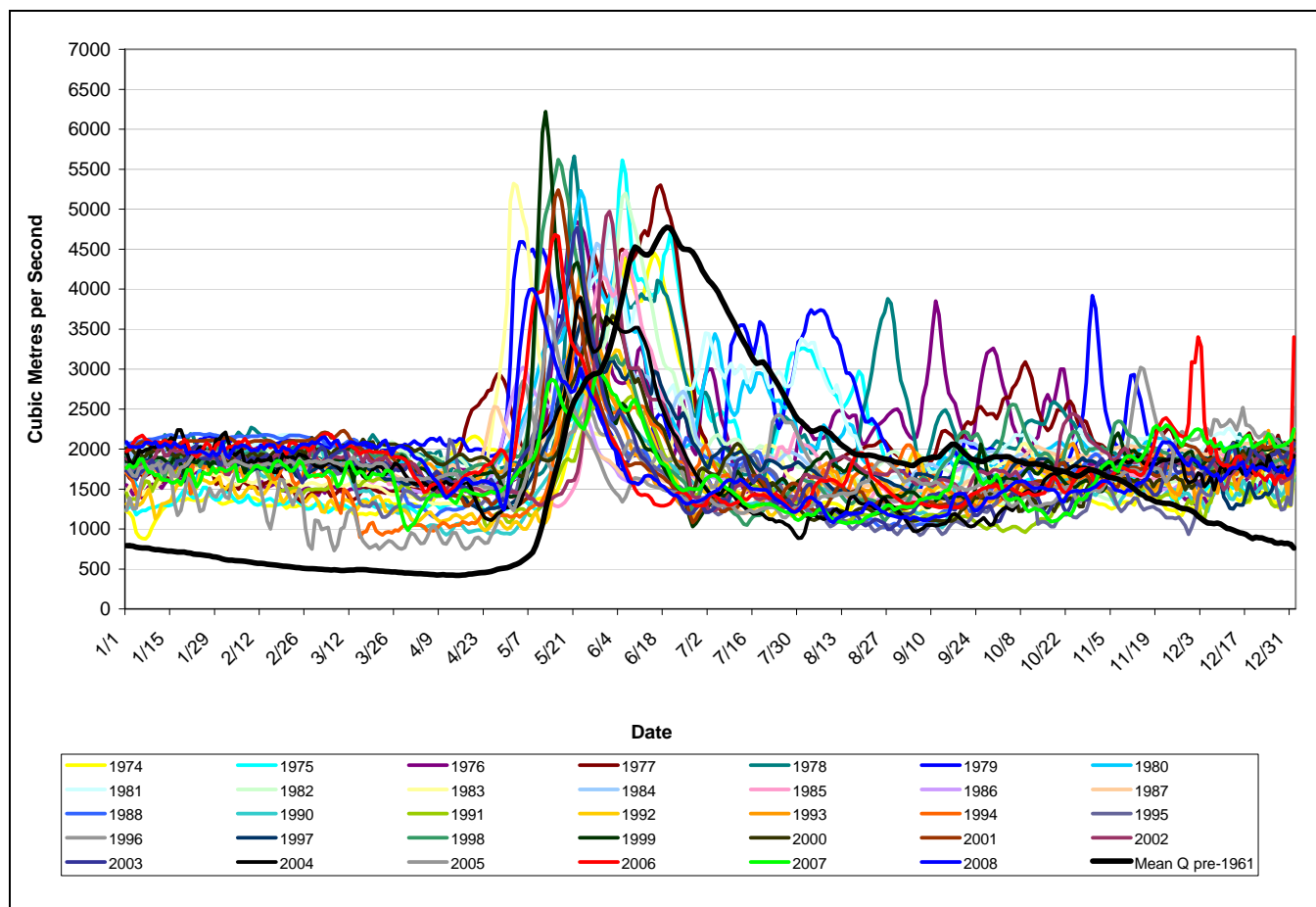
the gates being permanently opened; however, the Ossokmanuan Reservoir was subsequently diverted into the Smallwood Reservoir for use in the Churchill Falls Power Station.



Source: Environment Canada website <http://www.wsc.ec.gc.ca>

Figure 2 Comparison of mean daily flow (m^3/s) pre-Twin Falls development to annual hydrographs post-Twin Falls (1961 to 1971)

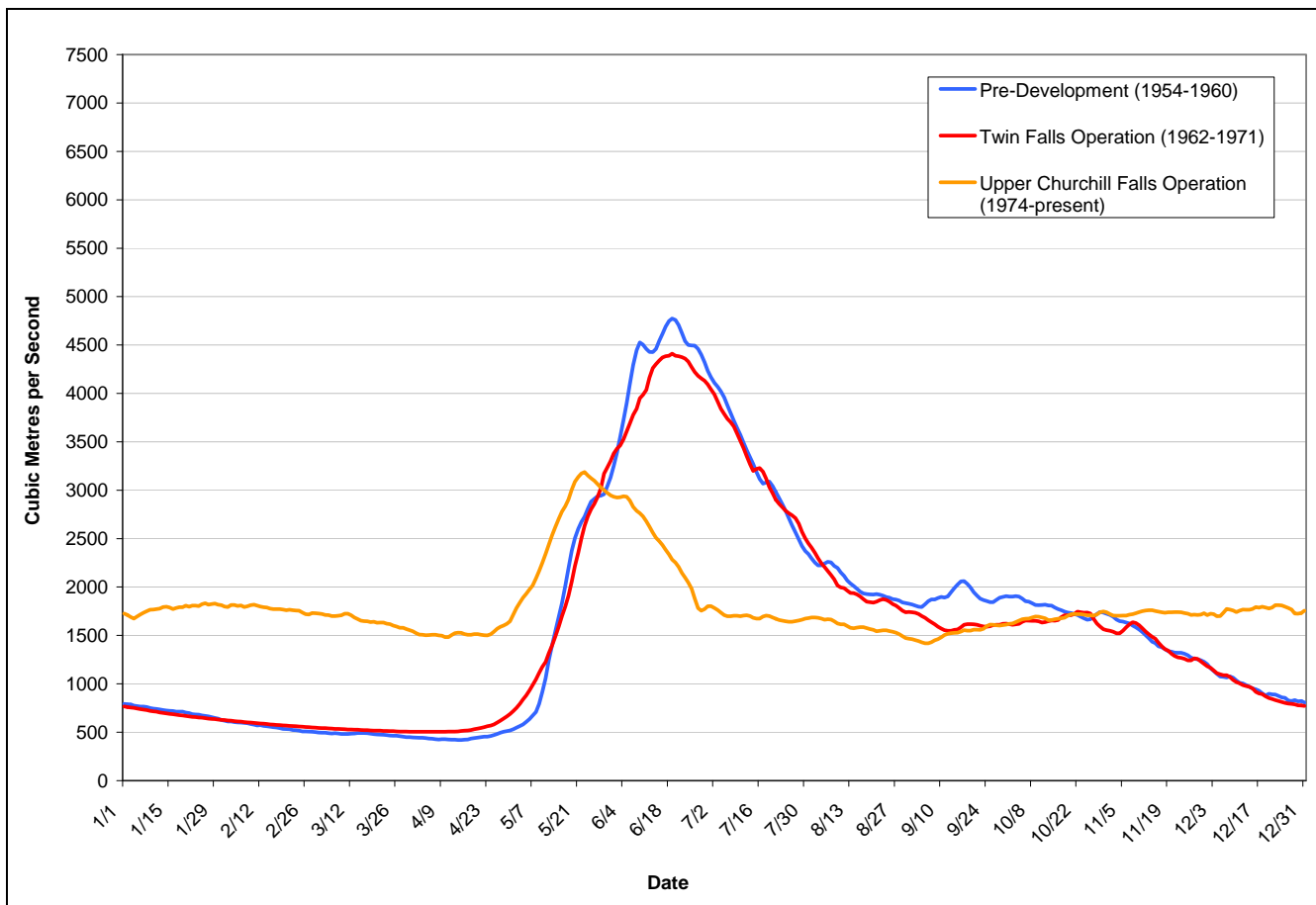
The mean daily discharge of the lower Churchill River, as measured at Muskrat Falls, prior to any major development (1954 to 1960) and the daily discharge during the operation (1974 to present) of the Churchill Falls Power Station are presented in Figure 3. As shown, the Churchill Falls Power Station regulates the lower Churchill River. The winter low flows have nearly tripled, and the spring high flows have been reduced by approximately 30 percent (Bobbitt and Akenhead 1982). In addition, the Churchill River now experiences average flow rates that are approximately 12 percent higher than the natural state (Lutterman 2007) as a result of the diversions.



Source: Environment Canada website <http://www.wsc.ec.gc.ca>

Figure 3: Comparison of Mean Daily Flow (m³/s) pre-Twin Falls Development to Annual Hydrographs Post-Upper Churchill Falls (1974 to 2008)

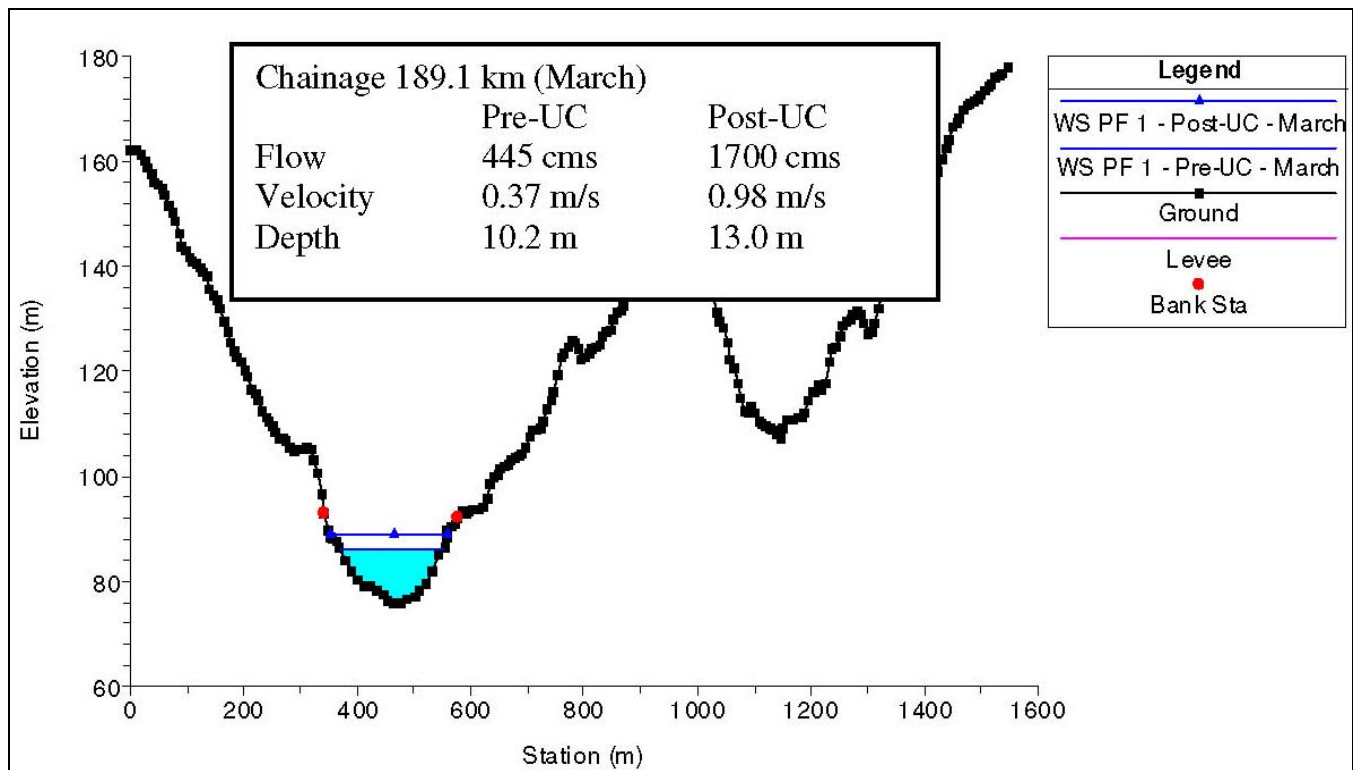
A summary comparison of the degree of regulation is provided in Figure 4. As shown, the Twin Falls development appears to have had little influence on the mean flow regime of the lower Churchill River, while the Churchill Falls Power Station has changed the flow regime of the lower Churchill River since its development in 1974.



Source: Environment Canada website <http://www.wsc.ec.gc.ca>

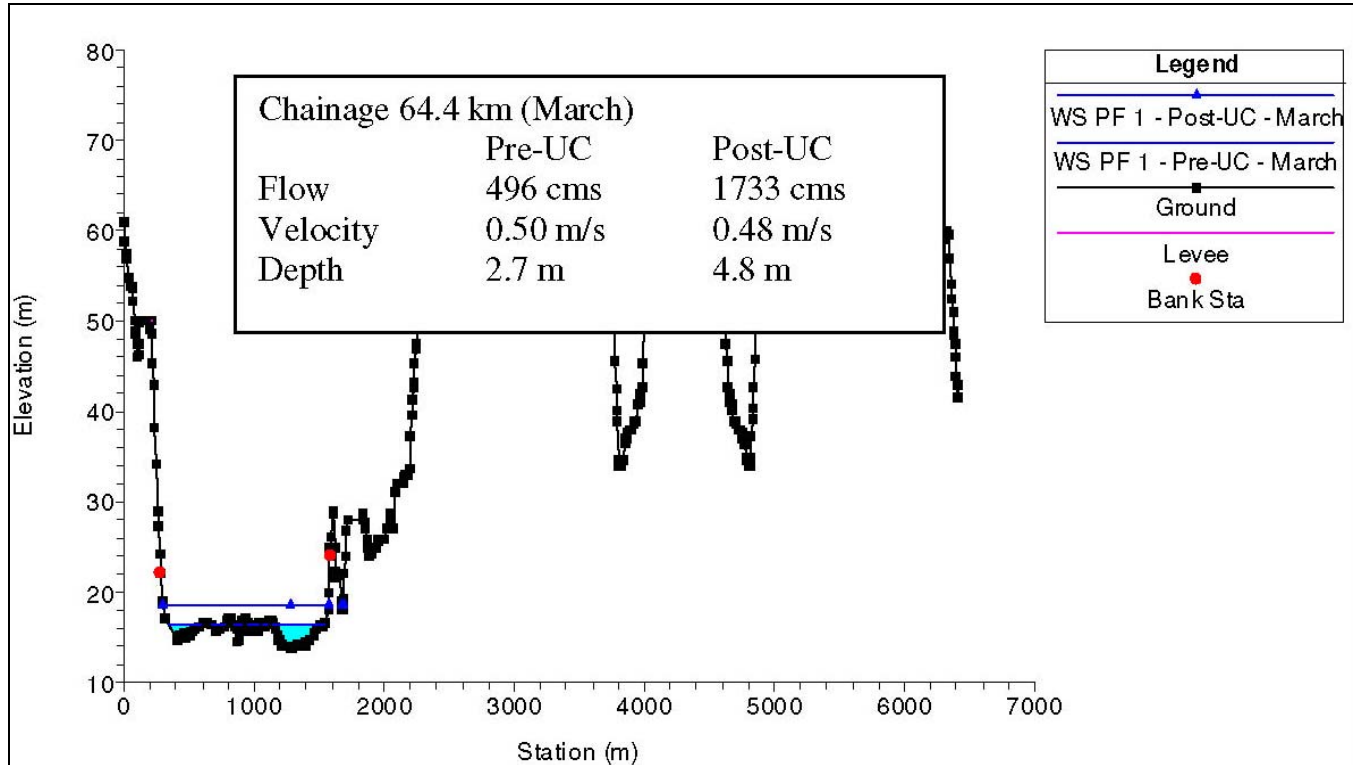
Figure 4 Comparison of Mean Flow Regime (m^3/s) between Pre-development, Twin Falls Operation and Upper Churchill Falls Facility Operation

Flow regulation generally works to diminish annual flow variability. In the case of the lower Churchill River, the Churchill Falls Power Station has increased winter low flows compared to pre-project and has buffered (i.e., reduced) the spring high flows. The ability to store water within the Smallwood Reservoir during heavy precipitation and snowmelt conditions has reduced the frequency and severity of extreme flooding events. Known discharge values were used to model the water levels during spring high flows, and winter low flows for the pre- and post-Churchill Falls periods. Figures 5 through 8 present the relative difference in wetted perimeter relative to pre- and post-development of the Churchill Falls Power Station as generated using Hydrologic Engineering Center – River Analysis System modeling and data from the lower Churchill River.



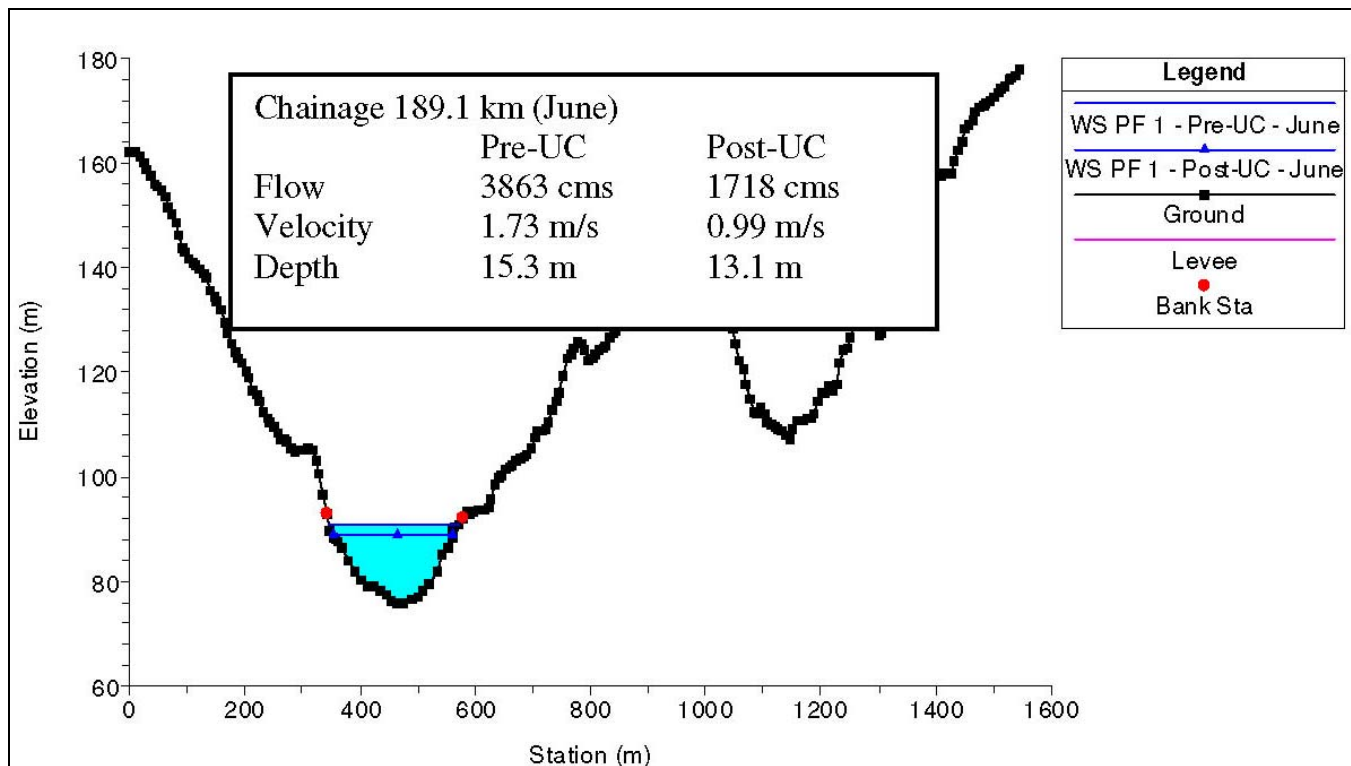
Source: Hatch Ltd. 2008

Figure 5 Cross Section at River Chainage 189.1 (Gull Island Reservoir). Winter Low Flows Downstream of Lake Winokapau Pre- and Post-Churchill Falls Development



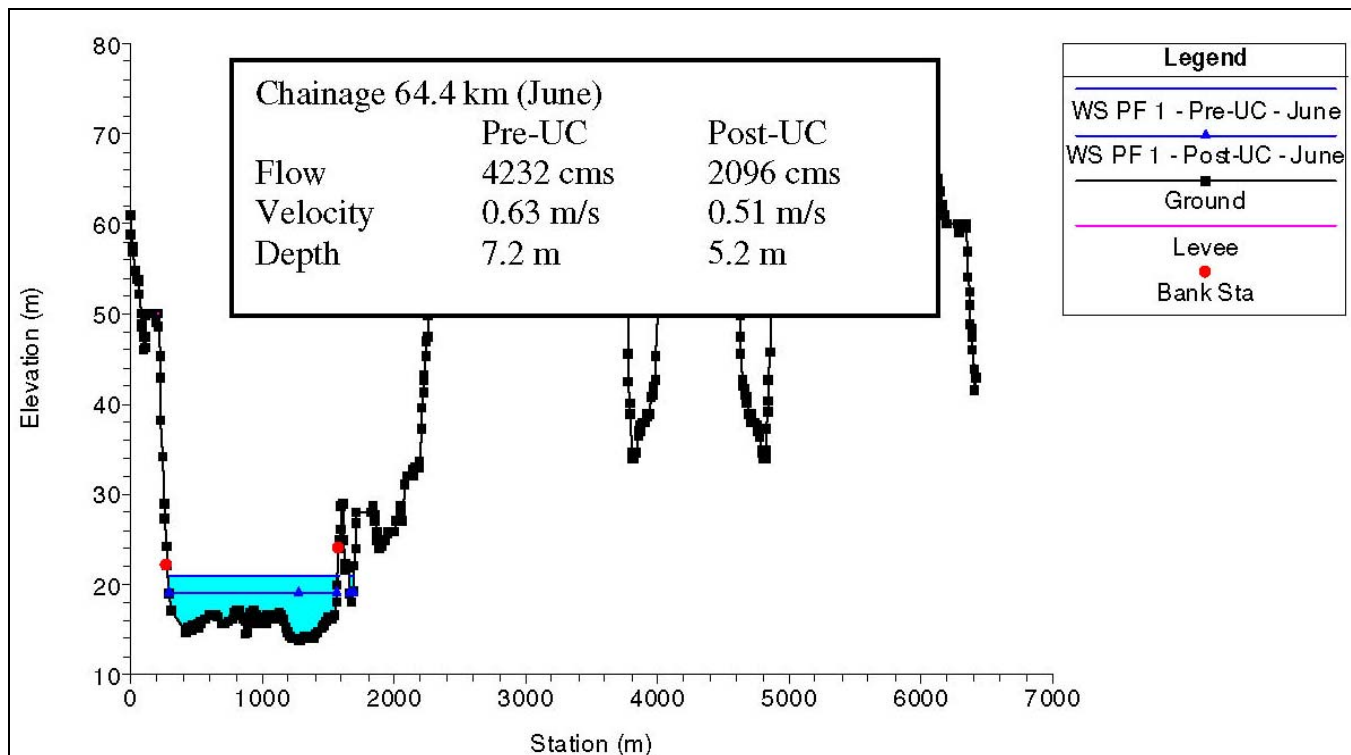
Source: Hatch Ltd. 2008

Figure 6 Cross Section at River Chainage 64.4 (Muskrat Falls Reservoir). Winter Low Flows Upstream of Muskrat Falls Pre- and Post-Churchill Falls Development



Source: Hatch Ltd. 2008

Figure 7 Cross Section at River Chainage 189.1 (Gull Island Reservoir). Summer High Flows Downstream of Lake Winokapau Pre- and Post-Churchill Falls Development



Source: Hatch Ltd. 2008

Figure 8 Cross Section at River Chainage 64.4 (Muskrat Falls Reservoir). Summer High Flows Upstream of Muskrat Falls Pre- and Post-Churchill Falls Development

There was no known baseline sampling of the fish assemblage or methylmercury concentrations in fish or other aquatic organisms within the lower Churchill River prior to the existing hydroelectric developments.

Terrestrial Environment

While much of the terrestrial landscape within the lower Churchill River watershed remains undisturbed by human activity, there are a variety of changes that have occurred in terms of the diversity of species, their abundance and distribution over the last approximately 60 years. Also relevant to this discussion is the difference in the understanding of the terrestrial environment over this period. Prior to hydroelectric development on the Churchill River in the 1950s, western science investigations were few or only just being initiated. Conversely, trapping, hunting and other traditional land use activities were still relatively common compared to today, as was ecological knowledge and awareness. Some examples of these differences are presented below.

Bergerud et al. (2008) describe the start of research on the migratory George River Caribou Herd with the first aerial survey completed in April 1954. At that time, the herd was believed to be recovering from low numbers and was estimated at 4,200 animals. The George River Herd has increased since that time. The range of the George River Caribou Herd during the 1950s and 1960s was north of the lower Churchill River watershed (Bergerud et al. 2008), so the wintering occupation by animals from this herd in the Assessment Area described in the EIS was not documented at that time.

The RWM were once regarded as the core area for the sedentary caribou associated with the RWM Caribou Herd (Brown and Theberge 1985). The herd was estimated at 880 individuals in 1958 (Bergerud 1967). Since that time, the herd has apparently shifted away from the northern part of its range and now extends south of the Churchill River (Schmelzer et al. 2004). The herd declined to about 87 animals in 2003 (Schmelzer et al. 2004).

A review of the range and abundance of sedentary caribou associated with the Lac Joseph Herd by Bergerud et al. (2008) describes the importance of the upland area now occupied by the Smallwood Reservoir for calving. These authors noted a decline in this herd after the creation of this reservoir in 1972.

Following widespread decline in the nineteenth and twentieth centuries from trapping pressure, beaver were reported to have returned to its former range and were more abundant in the Assessment Area beginning in the 1950s (Budgell 1981). Conversely, marten were in decline in the 1950s (Northcott 1961) and porcupine were considered scarce, with no observations reported by Northland Associates Ltd. (1980) during surveys in the lower Churchill River valley. The last confirmed observation of a wolverine in Labrador occurred in 1955 (Fortin et al. 2005).

Waterfowl were probably more abundant in the Assessment Area during the 1950s. Gillespie and Wetmore (1973) completed aerial surveys throughout the Labrador-Ungava Peninsula in 1970, 1971 and 1972. One of their objectives was to establish baseline conditions for waterfowl, to evaluate effects of flooding and loss of habitat associated with the Churchill Falls Power Station project. In comparison with areas further north and east, these authors believed that much of the better waterfowl breeding habitat in southern Labrador was being lost by the formation of the Smallwood Reservoir. Goudie and Whitman (1987) estimated that approximately 1,400 km² of waterfowl habitat was lost in the flooding of the Smallwood Reservoir. In combination with downstream effects such as reduced runoff in several rivers, these authors estimated a possible reduction of 10 percent of waterfowl habitat present in the central Labrador region.

Several wildlife species are new to the lower Churchill River watershed since the 1950s. Moose were not documented in the lower Churchill River watershed until a sighting was reported near Minipi River in 1961

(Mercer and Kitchen 1968). Moose moved into western Labrador by 1949 (Folinsbee 1974) and 12 animals were introduced on the south coast of Labrador by the provincial government in 1953 (Mercer and Kitchen 1968).

There are species of avifauna currently using the habitat within the Churchill River watershed that were not found in the area in the 1950s, or their populations have increased. In comparison with recorded observations in the detailed “Birds of the Labrador Peninsula” (Todd 1963), species such as Ring-necked Duck, Red-tailed Hawk and Mourning Dove were rarely, if ever, observed during the 1950s. Todd (1963) described Osprey as a regular breeder in the lower Churchill River; however, a continent-wide decline occurred thereafter due to the unrestricted use of pesticides at that time (Poole 1989).

Communities

In the 1950s there were four communities in the Assessment Area, including Goose Bay, Happy Valley, North West River, and Mud Lake. Families began moving into Churchill Falls in 1969. Happy Valley and Goose Bay were incorporated as a single community in 1973.

Goose Bay was established in the early 1940s when an Air Force Base was developed “to co-ordinate and supplement the North Atlantic Ferry Command via the Atlantic Bridge” (Plaice 2002) for Canadian, British and American forces. After the Second World War, the base continued to serve as an important refueling location for trans-Atlantic flights, a base for the North American Aerospace Defense Command (NORAD) and as part of the Distant Early Warning (DEW) system and Strategic Air Command during the 1950s. Goose Bay began to expand in the 1950s, largely due to an increased American presence and investment. Between 1951 and 1958, an extensive building program added housing, schools, a hospital, as well as recreational and shopping facilities (Plaice 2002).

The first settlers to the area came from coastal Labrador and the Island of Newfoundland to work on construction of the Goose Bay Air Force Base (now known as 5 Wing Goose Bay). In accordance with the requirement to be at least 8 km from the base, a site was selected in 1942 that was initially referred to as “Refugee Cove”. In 1955, the site was renamed Happy Valley (Encyclopedia of Newfoundland and Labrador 1991). During the 1950s, the main employer in the region was the base and the many spin-off services and industries related to it. In 1951, the Grenfell Mission opened a nursing station in the community, which was replaced by the Paddon Memorial Hospital in 1963.

The Town of North West River is situated on the southeast end of Grand Lake. Prior to construction of the Goose Bay Air Force Base in the 1940s, North West River was the largest community in Hamilton Inlet. Construction of the Goose Bay Air Force Base in the 1940s caused several families to relocate from North West River to that community for work, a pattern that continued throughout the 1950s. The Town of North West River became an incorporated community in 1958.

From the 1950s on, Innu began to settle around North West River and, for many years, the area on the opposite side of the river where they camped was considered part of North West River. However, in 1979 it separated to form its own municipality, which they named Sheshatshiu (Minaskuat 2009).

Mud Lake is situated southeast of Happy Valley-Goose Bay near the mouth of Churchill River on a channel that connects Mud Lake with Hamilton Inlet. Because there is no road access, getting to and from the community requires traveling across the river by boat in summer and over the ice during winter (Minaskuat 2009).

Land and Resource Use

Other than the economic activities described above for the various communities (e.g., wage-employment related to construction and operation of the Goose Bay Air Force Base), the main types of land and resource use

on-going in south-central Labrador in the 1950s were harvesting practices that were deeply rooted in the cultural backgrounds of the area's residents. Included, for example, was fur-trapping and subsistence hunting, fishing and gathering by the various Labrador and Quebec Innu Bands, and by the Settler population residing near Lake Melville and other coastal areas (Brown and Gray 1951; Tanner 1978; Tanner and Armitage 1986; IEDE/Jacques Whitford 2000; Innu Nation 2007). While the non-Aboriginal population and the new-comers to the region employed in the various construction trades were likely involved in some form of recreational and subsistence harvesting (i.e., caribou and bird hunting and fishing), due to the structured work-schedules of employees, it is likely that the nature and extent of these activities in the 1950s was limited.

The Innu of Labrador and Quebec (previously known as Montagnais and Naskapi Indians) are an Amerindian population who refer to this area as Nitassinan (meaning Our Land), which comprises much of the Québec-Labrador peninsula (Mailhot 1997). Traditionally, the Innu were a nomadic people, whose movements throughout the interior and coastal regions corresponded to the seasons and the cycles of the wildlife and other resources they relied upon (Tanner 1978). The Innu harvested a wide range of terrestrial and marine species for food and clothing, as well as several types of plants for food and medical purposes (Rogers and Leacock 1981; Innu Nation 2007).

By the beginning of the twentieth century, the Churchill River and its watersheds were becoming less used by Labrador Innu and more by Settlers from western Lake Melville (JWEL 1998; IEDE/JWEL 2000; JWEL/IELP 2001). Despite this gradual decline in use, archaeological evidence demonstrates that the area continued to be used by Labrador Innu for harvesting, albeit at a reduced rate, into the 1950s and later (IEDE/JWEL 2000). While primary land-use information related to Québec Innu use of the lower Churchill River watershed in the 1950s probably exists (Deschênes 1983), access to it is restricted. Thus, only limited, publicly available data were found for this review and response. Nevertheless, the information at hand indicates that trapping remained part of the economy throughout the 1950s. In the fall of 1950, for example, Innu from Sept-Îles, Mingan and Natashquan were trapping along a route that extended south to north across the lower Churchill River watershed, just west of Winokapau Lake.

Throughout the first half of the twentieth century and into the 1950s, the lower Churchill River and its watershed was an area that was trapped primarily by Settlers from western Lake Melville (JWEL 1998; IEDE/JWEL 2000; JWEL/IELP 2001). In the early 1950s, it was reported that there were at least 40 tilts, used as base-camps, scattered along the Churchill River between Birch Lake and the mouth of the river; as well, there were dozens of over-night cabins situated along the shores of waterbodies contained within the lower Churchill River watershed (Brown and Gray 1951). There were a number of Settler tilts and traplines scattered throughout the lower Churchill River watershed, extending along practically the full length of the river, from an area east of Muskrat Falls, and west to Churchill Falls. Given the extent of trapping known to have taken place in the area at that time and earlier (JWEL 1998; IEDE/JWEL 2000; JWEL/IELP 2001), it is reasonable to assume that the information recorded at the beginning of the 1960s also applied to the previous decade.

Despite a search of sources, no detailed information was located to confirm the nature and extent of any non-Aboriginal land and resource use of the lower Churchill River watershed during the 1950s. However, it is likely that some degree of recreational and subsistence harvesting did occur.

Historic and Archaeological Resources

The lower Churchill River was not surveyed for archaeological resources until 1974 (Tuck 1981). Thus, no detailed archaeological information is available for the lower Churchill River and the watershed prior to hydroelectric development on the river.

Economy, Employment and Business

Employment, economy and business in the region during the 1950s had changed significantly from that which existed during the first half of the century and earlier. As discussed above, prior to construction of the Goose Bay Air Force Base in the 1940s, the economy of the Aboriginal and non-Aboriginal population of south/central Labrador was largely subsistence-based (i.e., hunting and fishing), combined with a system that made available a wide range of food-items and equipment through trade of fish and/or furs. At that time, little cash changed hands (Kennedy 1993). In 1941, for example, it was reported by an American Serviceman that:

“Labrador imports the necessities of living with the exception of what can be obtained by hunting and fishing. Farming is non-existent except for a few small garden patches. Food products, textiles, steel, iron, and machinery all come from outside. The Hudson Bay Company has a virtual monopoly on all trade...” (Them Days 1987a).

However, once construction of the Goose Bay Air Force Base began, people from coastal Labrador and from the Island of Newfoundland, and elsewhere, traveled to Goose Bay for work, a trend that continued into the 1950s. Leonard McNeill, a fisherman from coastal Labrador, reported that he came to North West River in 1950 to look for work. Even though there were “swarms of cod”, as he put it, because the prices were extremely low (\$3.00 a quintal or 112 lbs.), it was not profitable to continue fishing. He also mentioned that furbearing animals were extremely scarce at that time and the prices were low. In 1951, he received employment at Goose Bay with a contracting company and decided to stay, despite the fact that he found the lifestyle of the larger centre unappealing (Them Days 1987b). The pattern of in-migration by workers continued, and by the end of the 1950s, the population of the area had grown to 2,861. In the late 1950's, the Royal Air Force from the United Kingdom began using Goose Bay Air Force Base as a training area for their bombers. Over time, other countries became interested in the advantages of training in the area and made use of the airspace and facilities (http://www.happyvalley-goosebay.com/home/history_of_the_base.htm).

References:

- Bergerud, A.T. 1967. Management of Labrador Caribou. *Journal of Wildlife Management* 31(4):621-642.
- Bergerud, A.T., S.N. Luttich and L. Camps. 2008. The return of caribou to Ungava. McGill-Queen's University Press, McGill-Queen's Native and Northern Series 50.
- Bobbitt, J., and S. Akenhead. 1982. Influence of Controlled Discharge from the Churchill River on the Oceanography of Groswater Bay, Labrador. *Canadian Technical Report of Fisheries and Aquatic Sciences* 1097: iv+43p.
- Brown, A, and R. Gray 1951 Labrador Canoe Adventure. *The National Geographic Magazine*. Vol. C, No. 1, July 1951.
- Brown, W.K and J.B. Theberge. 1985. The calving distribution and calving-area fidelity of a Woodland Caribou herd in central Labrador. *Proceedings of the 2nd North American Caribou Workshop*, McGill Subarctic Research Paper 40: 57-67. McGill University, Montreal, QC.
- Budgell, R. 1981. Lower Churchill Valley Trapping Survey (Draft). Prepared for Lower Churchill Development Corporation, St. John's, NL.
- Collier, M., R.H. Webb, and J.C. Schmidt. 1996. Dams and Rivers: Primer on the downstream effects of dams. U.S. Geological Survey Circular 1126.
- Encyclopedia of Newfoundland and Labrador, Volume Two, (p 797) ISBN 0-9693422-2-5

- Folinsbee, J. 1974. The Moose (*Alces alces*) in the Churchill River Valley, Labrador. Newfoundland Wildlife Service. 11pp.
- Fortin, C., V. Banci, J. Brazil, M. Crête, J. Huot, R. Lafond, P. Paré, J. Schaefer and D. Vandal. 2005. National recovery plan for the wolverine (*Gulo gulo*) [Eastern Population]. National Recovery Plan No. 26. Recovery of Nationally Endangered Wildlife (RENEW). Ottawa, ON. 33pp.
- Gillespie, D.I. and S.P. Wetmore. 1973. Waterfowl surveys in Labrador/Ungava, 1970, 1971, and 1973. In Boyd, H. (ed) Canadian Wildlife Service waterfowl studies in eastern Canada. 1969-73. Canadian Wildlife Service Report Series Number 29. pp.8-18.
- Goudie, R.I. and W.R. Whitman. 1987. Waterfowl populations in Labrador, 1980-82. Pp. 45-60. In: A.J. Erskine (ed.). Waterfowl Breeding Population Surveys, Atlantic Provinces. Canadian Wildlife Service Occasional Paper No. 60.
- Hatch Ltd. 2008. Further clarification and updating of the 2007 Ice Dynamics Report. Report prepared for Newfoundland and Labrador Hydro, St. John's, NL.
- IEDE/JWEL (IED Enterprises in partnership with Jacques Whitford Environment Limited). 2000. Churchill River Power Project 1998 Environmental Studies-Historic Resources Overview Assessment, Labrador Component. (LHP 98-17). Final Report submitted to Labrador Hydro Project, St. John's, NL.
- Innu Nation. 2007. Innu Kaishitshissenitak Mishta-shipu. Innu Environmental Knowledge of the Mishat-shipu (Churchill River) Area of Labrador in Relation to the Proposed Lower Churchill Project. Report of the work of the Innu Traditional Knowledge Committee. Report submitted to Innu Nation by Peter Armitage, Wolverine and Associates Inc., St. John's, NL.
- Internet Website http://www.happyvalley-geesebay.com/home/history_of_the_base.htm
- JWEL/IELP (Jacques Whitford Environment Limited and Innu Environmental Limited Partnership). 2001. Labrador Hydro Project Churchill River Power Project Historic Resources Overview Assessment 1998-2000 Volume 1: Interpretive Summary and Recommendations (LHP 00-17C). Report submitted to Newfoundland and Labrador Hydro, St. John's, NL.
- Kennedy, J. 1993. Recent Developments In Labrador Settler Ethnicity. Paper presented to CAS at York, May 1993. Copy on file at the CNS, MUN, St. John's.
- Lutterman, A.M. 2007. Historical Changes in the Riparian Habitats of Labrador's Churchill River Due to Flow Regulation: the Imperative of Cumulative Effects Assessment. Submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, Dalhousie University, Halifax, NS.
- Mailhot, J. 1997. The people of Sheshatshit: In the land of the Innu. Memorial University: St. John's, NL. Social and Economic Studies, No. 58.
- Mercer, W.E. and D.A. Kitchen. 1968. A preliminary report on the extension of Moose range in the Labrador Peninsula. Pp. 62-81. In: Proceedings of the 5th North American Moose Conference and Workshop. Kenai, AK.
- Nalcor Energy. 2009a. Assessment of the Potential for Increased Mercury Concentrations. Component Study, Environmental Impact Statement for the Lower Churchill Hydroelectric Generation Project. Prepared by R. Harris and D. Hutchinson, Tetra Tech Inc.

- Nalcor Energy. 2009b. Freshwater Fish Mercury Sampling. Component Study, Environmental Impact Statement for the Lower Churchill Hydroelectric Generation Project. Prepared by AMEC Earth and Environmental Limited.
- Northwest Hydraulic Consultants. 2008. Sedimentation and Morphodynamics Study - Final Report. Report prepared for AMEC Earth and Environmental, Edmonton, AB.
- Northcott, T.H. 1961. Progress Report – Labrador Furbearers. Wildlife Division, St. John's, NL. 17pp.
- Northland Associates Ltd. 1980. Lower Churchill Hydroelectric Development Reservoir and Transmission Line – Wildlife Reconnaissance. Prepared for the Lower Churchill Development Corporation, St. John's, NL.
- Petts, G.E. 1984. Impounded Rivers: Perspective for Ecological Management. John Wiley & Sons, Chichester, UK. xviii + 326p.
- Plaice, E. 2002. Touching Base: Land and Lives in Central Labrador. University of New Brunswick, Department of Anthropology, Fredericton, NB.
- Poole, A.F. 1989. Ospreys – A Natural and Unnatural History. Cambridge University Press, New York, NY. 246pp.
- Rogers E. and E. Leacock. 1981. Montagnais-Naskapi. Pp. 169-189. In: J. Helm (ed.). Handbook of North American Indians: Volume 6, Smithsonian Institute, Washington, DC.
- Schmelzer, I., J. Brazil, T. Chubbs, S. French, B. Hearn, R. Jeffery, L. LeDrew, H. Martin, A. McNeill, R. Nuna, R. Otto, F. Phillips, G. Mitchell, G. Pittman, N. Simon and G. Yetman. 2004. Recovery Strategy for Three Woodland Caribou Herds (*Rangifer tarandus* Caribou; Boreal population) in Labrador. Department of Environment and Conservation, Government of Newfoundland and Labrador, Corner Brook.
- Schetagne, R. J. Therien, J. and R. Lalumiere. 2003. Environmental Monitoring of the La Grande Complex: Evolution of Fish Mercury Levels. – Summary Report 1978-2000. Direction Barrages et Environnement, Hydro Québec Production and Groupe conseil Genivar inc. 185 pp. + Appendix.
- Sikumiut Environmental Management Ltd. 2009. Labrador Inuit knowledge of Lake Melville. Report prepared for Nunatsiavut Government, Nain, NL.
- Tanner, A. 1978. Land Use and Occupancy among the Montagnais Indians of North West River. Report on file at Centre for Newfoundland Studies, Memorial University of Newfoundland, St. John's, NL.
- Tanner, A. and P. Armitage. 1986. Environmental Impact Assessment, Ross Bay Junction – Churchill Falls Tote Road: Native Resource Use Study. With Project Consultant, Hardy Associates, St. John's, NL.
- Them Days. 1987a. Report to Washington, D.C. Letter from Elliott Roosevelt, Capt. Air Corps. 21st Recon. Sq. to Adjutant General, War Dept. Washington, D.C., July 6, 1941. Taken from: Them Days, "On The Goose" Vol. 12 No. 4 June 1987, p 15.
- Them Days. 1987b. Taken from article: Along Among Hundreds, in Them Days, "On The Goose", Vol. 12, No. 4, June 1987, pgs 144 to 145.
- Todd, W.E. 1963. Birds of the Labrador Peninsula and Adjacent Areas. University of Toronto Press, Toronto, ON.
- Tuck, J.A. 1981. Final Report: Lower Churchill Development Corporation Muskrat Falls Generating Project Archaeological Report. Report on file, Provincial Archaeology Office, St. John's, NL.

Williams, G.P. and M.G. Wolman. 1984. Downstream effects of dams on alluvial rivers. Geological Survey Professional paper 1286.

Requesting Organization – Joint Review Panel

Information Request No.: JRP.163

Information Requested:

To the extent that information is available to the Proponent, the Proponent is asked to:

- b. justify whether or not the projects or activities suggested by reviewers should be included in the CEA and, if so, whether or not it may influence CEA conclusions. Specifically, the Proponent should consider uranium mining in the CEA. For hypothetical projects, the Proponent should discuss how they may contribute to and influence future environmental planning in the region, to the extent that their impacts may overlap with those of the Project.

Response:

As indicated in the response to IR# JRP.97, the screening process used for the Cumulative Effects Assessment (CEA) in the EIS is appropriate and addresses the requirements in the Guidelines. With respect to the specific list of projects and activities identified by reviewers for inclusion within the CEA, two of these projects or activities, namely the construction of additional transmission lines in Labrador in relation to the export of power from the Project (including the potential for transmission access through Quebec) and the ongoing dumping of raw sewage in the Churchill River, were considered within the EIS as part of the CEA, and are therefore not further discussed in this response (please refer to the EIS, Volume IA, Section 9.9, Table 9-7).

Construction of additional transmissions lines in Labrador in relation to export of power from the Project was included as a project for consideration in the CEA within the EIS for the following Key Indicators: Atmospheric Environment (Volume IIA, Sections 3.11.2 to 3.11.4); Terrestrial Environment (Volume IIB, Section 5.15.2); George River Caribou Herd (Volume IIB, Section 5.15.4.1); Red Wine Mountains Caribou Herd (Volume IIB, Section 5.15.4.2); Moose (Volume IIB, Sections 5.15.3.1 and 5.15.4.2); Black Bear (Volume IIB, Sections 5.15.3.1 and 5.15.4.4); Beaver (Volume IIB, Sections 5.15.3.1 and 5.15.4.6); Porcupine (Sections 5.15.3.1 and 5.15.4.7); Canada Goose (Volume IIB, Sections 5.15.3.1 and 5.15.4.8); Surf Scoter (Volume IIB, Sections 5.15.3.1 and 5.15.4.9); Ruffed Grouse (Volume IIB, Sections 5.15.3.1 and 5.15.4.10); Wetland Sparrows (Volume IIB, Section 5.15.4.12); Harlequin Duck (Volume IIB, Sections 5.15.3.1 and 5.15.4.14); Other Species of Concern (Volume IIB, Sections 5.15.3.1 and 5.15.4.15); Economy (Volume III, Sections 3.5.6 and 3.8.1); Employment (Volume III, Sections 3.6.6 and 3.8.2); Business (Volume III, Sections 3.7.6 and 3.8.3); Physical Infrastructure and Services (Volume III, Sections 4.5.6 and 4.8.1); Social Services and Infrastructure (Volume III, Sections 4.6.6 and 4.8.2); Community Health (Volume III, Sections 4.7.6 and 4.8.3) Land and Resource Use (Volume III, Sections 5.5.7 and 5.6.2.2), and Cultural Heritage Resources (Volume III, Sections 6.5.6 and 6.6). The response to IR# JRP.97f illustrates the proposed route for the Labrador Island Transmission Link (HVdc Transmission Corridor).

Ongoing dumping of raw sewage in the Churchill River was included within the “General Economic and Infrastructural Development in the Upper Lake Melville Area” project, as described in Table 9-7 of Volume IA. This project was included in the CEA within the EIS for the following Key Indicators: Economy (Volume III, Sections 3.5.6 and 3.8.1); Employment (Volume III, Sections 3.6.6 and 3.8.2); Physical Infrastructure and Services (Volume III, Sections 4.5.6 and 4.8.1); Community Health (Volume III, Sections 4.7.6 and 4.8.3); and Land and Resource Use (Volume III, Sections 5.5.7 and 5.6.2.2).

The Cumulative Effects Assessment Practitioners' Guide (CEA Agency 1999) states that “*future actions that are approved within the study area must be considered; officially announced and reasonably foreseeable actions should be considered if they may affect those VECs and there is enough information about them to assess their*

effects.” Hypothetical projects are not required to be assessed because of the greater uncertainty associated with them, and the lack of project details, and therefore the limited usefulness of the assessment. The remainder of the other projects suggested by reviewers (i.e., mining of mineral sands (e.g., Grand River Iron Sands project), aluminum smelter, uranium mining and remediation of contamination at 5 Wing Goose Bay) were therefore not included in the EIS as they were hypothetical at the time that the EIS was prepared, and therefore there would be little value or useful information generated by evaluating those projects. Although hypothetical, these four projects are discussed below to respond to this information request.

With respect to future environmental planning in the region, the referenced hypothetical projects would all be subject to their own individual environmental assessment processes. Environmental assessment is an important tool for environmental planning, providing a process where relevant government agencies can consider project effects in the context of their respective mandates, and identify any mitigation and monitoring that may be required. Because environmental assessment is a planning tool, each project, including the Project, will be subject to terms and conditions applied by these agencies to ensure sustainable development is achieved in the region.

As adequately-detailed information becomes available for these hypothetical projects, agencies responsible for both biophysical and socio-economic planning in the region will determine whether these projects should proceed, and if so, whether these projects create the need for changes or revisions in the current planning regimes. For instance, the Newfoundland and Labrador Wildlife Division will have to consider additional activities or projects when setting harvesting limits for game species in the region. Therefore, provincial and municipal government planning will be more informed by the additional information brought forward in each new application and review process (i.e., such as the potential effects on and requirements for physical, social and economic services and infrastructure). For example, the Project information provided by Nalcor Energy (Nalcor) in the EIS and associated component studies has been provided to government authorities with enough lead time that consideration of the Project can be considered in any regional planning efforts with respect to issues such as infrastructural and service demands. This would also be true of any future large project in the region that would be subject to environmental assessment.

The following provides an explanation of how, if approved and carried out, the referenced hypothetical projects may contribute to and influence future environmental planning in the region, to the extent that their impacts may overlap with those of the Project. Note that none of this discussion alters the conclusions provided in the cumulative effects assessment contained in the EIS.

Mining of Mineral Sands

With respect to mining of mineral sands in the Churchill River watershed, it is important to distinguish between exploration activities and development activities. In 2005, Grand River Ironsands Inc. (formerly Markland Resource Development Inc.) registered a proposal with the Newfoundland and Labrador Department of Environment and Conservation to conduct exploration activities within the lower Churchill River from Muskrat Island to the mouth of the river. They were granted environmental approval to conduct this program in August 2005 with a number of conditions, including that they not use the suction dredging option, that all sampling take place on land and at least 100 m from the river water mark, and that sample size be restricted to 20 cubic metres. Based on publicly available information, the core drilling and bulk sampling occurred in 2005 to 2006 (Grand River Ironsands Inc. 2007). This activity was not included within the CEA for the Project as it was considered a past activity and, assuming the conditions of release were complied with, there would have been no residual effects, and therefore, no cumulative effects.

Mining (versus exploration) of mineral sands within the Churchill River watershed is still considered a hypothetical project for the purposes of CEA (CEA Agency 1999). While it appears that Grand River Ironsands is active in developing investment/funding for this venture and has been engaging local stakeholders in discussions, it is considered a hypothetical project because a mining development project has not yet been registered with any governments and a project description is not publicly available. The concept of the project includes dredging to a depth of 20m 144 km² of the Churchill River bed near Happy Valley-Goose Bay. This dredging would require in-river activities. Sands would be dried and processed through a gravity spiral and a magnetic separator to remove metals before being returned to the river or on land (Grand River Ironsands 2009). The construction and operation of the Project should not prohibit the future exploitation of mineral sand resources should this mining project proceed. If it proceeds, this project could have overlapping socio-economic effects (i.e., cumulative environmental effects on Economy, Employment, and Business, Communities, and Land and Resource Use) and overlapping environmental effects with the aquatic environment (depending on whether approval is received to work in the water). The relevant planning and regulatory authorities may use this information to plan additional requirements (if any) for physical infrastructure and social services, training needs for local and/or regional labour force (depending on labour force requirements), increased levels of enforcement or revised management regimes for fish resources, and appropriate mitigation for loss or alteration of fish habitat (if any).

Remediation Project at 5 Wing Goose Bay

On-going remediation activities have been occurring at 5 Wing Goose Bay since the early 1990s, with the Goose Bay Remediation Project being initiated in 2004. These activities were included in the CEA under the heading of General Economic and Infrastructural Development in the Upper Lake Melville Area which included “miscellaneous civil works on Base” (i.e., 5 Wing Goose Bay) (See the EIS, Volume IA, Table 9-7). Many of these activities have been related to site investigations, testing and monitoring. Larger scale activities have only occurred in a few locations, mainly the Upper Tank Farm and the Stillwater No. 4 Trench (DND 2009). As stated in Table 9-7, Volume IA of the EIS, due to the limited physical nature of this activity, biophysical cumulative environmental effects were not anticipated nor assessed. Potential for cumulative environmental effects with socio-economic VECs was considered in the assessment.

The latest, largest remediation project was not included in the EIS because it was hypothetical at the time of EIS preparation. In July of 2009, following submission of the EIS for the Project, the Government of Canada announced that \$300 million in funding for the remediation project under the Federal Contaminated Sites Action Plan had been approved. An Environmental Screening of the remediation project pursuant to CEAA was submitted in February 2010 (AMEC Earth and Environmental 2010) and the decision has recently been made that the project can proceed with appropriate mitigation in place. While this project was therefore not included within the CEA, Nalcor is confident that the inclusion of this project in the CEA for the Project would not alter any of the effects conclusions, as described below.

The environmental assessment for the remediation project (AMEC 2010) considered the potential for cumulative effects with the Project. While there is no apparent overlap in the physical footprints of the two projects, the environmental assessment (AMEC 2010) identifies the following potential cumulative biophysical environmental effects: short-term/temporary increases in heavy vehicle traffic which could result in increased noise and dust levels and possible effects on fish and fish habitat. An Environmental Management Plan (EMP) will be developed by DND to address these issues, and with mitigation in place the air quality effects from the remediation project are predicted to likely remain within regulatory limits and effects to fish and fish habitat are not likely to be significant (AMEC 2010). Note that based on Nalcor’s review of the environmental assessment for the remediation project, the potential for effects on fish and fish habitat in the Churchill River as a result of

the remediation project appear to be indirect only and localized (i.e., there appears to be no works planned within the Lower Churchill River itself, although there may be some requirement for in-water works in water courses that flow into the Lower Churchill River).

Although not identified in the remediation project environmental assessment (AMEC 2010), there could be some overlap from a socio-economic perspective, as the proposed remediation project would generate employment and business opportunities over the same time period as construction of the Project. Full-scale clean-up activities are scheduled to occur from present to 2020, although the number of local jobs and contracts to be generated from these activities was not explicitly stated in the environmental assessment (AMEC 2010). The relevant planning and regulatory authorities may use information from the environmental assessments of both projects to plan additional requirements (if any) for physical infrastructure and social services, training needs for the local and/or regional labour force (depending on labour force requirements), and appropriate mitigation for controlling air emissions. The ultimate result of this remediation project should be an improvement of environmental quality within and around 5 Wing Goose Bay. In summary, the cumulative effects of the Project in combination with the remediation project at 5 Wing Goose Bay are expected to be not significant and this is consistent with the cumulative effects prediction included within the EIS.

Aluminum Smelter

The aluminum smelter is still considered a hypothetical project, and can be considered an induced project. As stated in the response to IR# JRP.97d, the potential induced development in Labrador that may arise if the Project proceeds is likely to be related to opportunities for residential, commercial/business and industrial development. The likelihood of such induced development cannot be predicted with any certainty. If and when such development may occur is not known. However, any such development that occurs will be subject to applicable government approvals, and require environmental assessment and an evaluation of their cumulative effects, as applicable. If it proceeds, a project like this could have overlapping socio-economic effects (i.e., cumulative environmental effects on Economy, Employment, and Business and Communities) particularly if there were an overlap in construction timeframes. There could also be over-lapping biophysical effects with respect to air quality (depending on nature of operations), terrestrial habitat (depending on location), and aquatic environment (depending on the location and nature of operations). The relevant planning and regulatory authorities may use this information to plan additional requirements (if any) for physical infrastructure and social services, training needs for the local and/or regional labour force (depending on labour force requirements), airshed-based emission limits, increased levels of enforcement or revised management regimes for fish and wildlife resources, and appropriate mitigation for loss or alteration of fish and/or wildlife habitat (if any). As well, any proponent constructing an aluminum smelter in Labrador would require a supply of energy, and therefore a contracting arrangement with Nalcor. Accordingly, there could be an opportunity for Nalcor to work with any developers, where feasible, to optimize socio-economic benefits and reduce adverse environmental effects.

Uranium Mining

If the uranium mine proceeds, it would be located on lands that fall under the jurisdiction of the Nunatsiavut Government. On April 8, 2008, the Nunatsiavut Government implemented a three-year moratorium on uranium mining on Labrador Inuit Lands, but continues to allow uranium exploration. The Nunatsiavut Government will review the moratorium by March 31, 2011.

The mine itself would be located well north of the biophysical cumulative effects assessment areas for the Project, and therefore there are likely no cumulative effects. However, there is potential for overlapping socio-economic effects related to Economy, Employment and Business, and Communities, depending on timing and

labour requirements. The relevant planning and regulatory authorities may use this information to plan additional requirements (if any) for physical infrastructure and social services. Based on publicly available information, mine development could entail construction of a road from North West River to the mine site and then to Postville, which would be located north and east of the biophysical cumulative effects assessment areas for the Project, greatly limiting the potential for any cumulative effects. However, if the project proceeds, there could be an overlap with socio-economic effects with respect to Land and Resource Use, Economy, Employment and Business and Communities. The nature of these effects during mine development would depend on the timing of the mining project in relation to the construction of the Project. The relevant planning and regulatory authorities may use this information to plan additional requirements (if any) for physical infrastructure and social services, increased levels of enforcement or revised management regimes for fish and wildlife resources, and training needs for the local and/or regional labour force (depending on labour force requirements).

Conclusion

With the exception of the two projects that were already assessed in the EIS as part of the CEA, the rationale for not including the remaining projects within the CEA was their hypothetical nature, and/or lack of interactions with the Project (e.g., uranium exploration activities) and/or status as a past activity (e.g., mineral sands exploration activities). With the exception of the remediation project at 5 Wing Goose Bay, there is still insufficient project information available to effectively assess the potential for cumulative environmental effects from any of the remaining hypothetical projects. This is particularly the case with respect to the potential for cumulative biophysical environmental effects where the range of potential effects can vary substantially based on project design including siting of infrastructure and technology selection. Based on the limited information available at this stage, it is not appropriate to include them, and inclusion of these hypothetical projects within the CEA would not alter the results of the cumulative effects assessment for the Project.

References:

- AMEC Earth & Environmental. 2010. Environmental Assessment, 5 Wing Goose Bay, Newfoundland & Labrador. Report Prepared for Defence Construction Canada.
- CEA Agency. 1999. Cumulative Effects Assessment Practitioners Guide. Accessed online at http://www.ceaa.gc.ca/013/0001/0004/index_e.htm
- DND. 2009. Backgrounder: Goose Bay Remediation Project. Accessed online at <http://www.dnd.ca/site/news-nouvelles/news-nouvelles-eng.asp?cat=03&id=2883>
- Grand River Ironsands. 2007. The Ironsands of Labrador. Accessed online at <http://grandriverironsands.com/Grand%20River%20Brochure%20%20-%20May%202007.pdf>
- Grand River Ironsands. 2009. Public Presentation. Accessed online at <http://grandriverironsands.com/Public%20Presentation%20-%20December%202009.pdf>

Requesting Organization – Joint Review Panel**Information Request No.: JRP.163****Information Requested:****The Proponent is also asked to:**

- c. explain and provide rationale for the methodology used in the CEA to assess the impacts to migration patterns as a result of the Project in combination with other projects, activities, or events, given the limited spatial boundaries of the CEA area. The Proponent should be specific with respect to the migration patterns of the Lac Joseph, George River and Red Wine Mountain caribou herds, as well as any other migratory KI that would benefit from such a discussion.

Response:

The spatial boundaries selected for the cumulative effects assessment (CEA) are considered appropriate in capturing all likely cumulative effects on the Terrestrial Environment, including caribou and disruption of movement. The CEA Area used for the caribou herds are larger than the CEA Areas used for the other terrestrial KIs and reflects the full range of the RWM Caribou Herd. The CEA boundaries for migratory KIs provide a balance between capturing cumulative effects and not masking their magnitude (i.e., selecting a CEA Area of appropriate size to properly evaluate effects and not hide the extent of interactions). Inclusion of the full range of the George River Caribou Herd would have encompassed a much larger area and resulted in a broad, generalized and unfocussed assessment. In contrast, the CEA Area selected is of sufficient size to capture potential changes on the landscape including the possible disruption of caribou movements.

With respect to the CEA for the Terrestrial Environment, the EIS considers three potential effects resulting from the Project on the KIs (i.e., change in habitat, change in health and mortality) (Volume IIB, Section 5.15). As stated in Volume IIB, Section 5.7, change in habitat refers to a number of interlinked issues including the alteration or loss of habitat, and habitat fragmentation. These habitat changes can result in displacement of individuals from a migration route or from important habitat, indirect mortality through increased predation, increased intra-specific competition or occupation of lower quality habitat leading to lowered fitness, all of which can have consequences for the abundance of KI populations. For caribou specifically, Volume IIB, Section 5.7.1, discusses three interlinked issues related to change in habitat: habitat loss, disruption of movement and increased predation. Thus while the term 'change in habitat' has been used throughout the assessment for caribou, it also refers to issues related to disruption of movement, such as during migration. This approach was also applied to the CEA to capture issues related to disruption of movement, although the assessment is necessarily at a higher level given the more general information available regarding the effects of other project and activities within the CEA Area.

As indicated in Volume IIA (Section 2.4.1.2) only the George River Caribou Herd is considered a migratory population, whereas the Lac Joseph and RWM Caribou Herds are considered sedentary populations of boreal caribou. Female caribou from sedentary herds do not migrate to common calving grounds but rather disperse at calving (away from other females) (Bergerud et al. 2008). However, caribou from sedentary herds do move seasonally between areas and/or habitats. There is conflicting opinion in the literature (Volume IIB, Section 5.7.1.2) as to whether the existing projects and activities considered under the context of the CEA (e.g., transmission line rights-of-way, roads, forest clearings or military training) may be disrupting movement of caribou. But regardless of whether they have or are influencing the movements of migratory or sedentary boreal caribou, these animals are still moving across or through zones of disturbance associated with these

activities or features. In terms of the migratory George River Herd, these caribou often overwintered in the lower Churchill River watershed in recent years, extending in a southeast direction, south of the Churchill River (Volume IIA, Figure 2-17). Similarly, the sedentary RWM Herd has telemetered caribou that have consistently overlapped with and/or crossed features associated with other projects (Volume IIA, Figure 2-24). As indicated in the response to IR# JRP.122, some telemetered caribou (estimated less than 5 percent of locations) from the Lac Joseph Herd have entered the lower Churchill River watershed (near Churchill Falls) from the west in recent years. The limited amount of overlap between this herd and that of the projects under review in the CEA lead to the conclusion that potential influence on movements are not likely.

The influence of other projects on the movements of other migratory Key Indicators (KI) was also considered in the CEA. Moose for example, which were described in Volume IIA, Section 2.4.5.2 as making seasonal movements in and out of the lower Churchill River valley based on telemetry research by Nalcor (Minaskuat Inc. 2009) and others (Folinsbee 1974; Northland Associates 1980), were described in Volume IIB (Section 5.15.4.3) as influenced by forestry activities and access roads that affected their distribution. Black bear were shown in the telemetry research (Minaskuat Inc. 2009b) to make seasonal movements or migratory patterns that were influenced by human activities such as access to areas of solid waste (e.g., Landfill for the Town of Happy Valley-Goose Bay) or storage of foodstuffs (e.g., construction camps for the upgrade of the Trans-Labrador Highway). Canada Goose breeding in Labrador migrate within the North Atlantic Flyway and winter along the coast (Volume IIB, Section 5.15.4.8). Therefore, effects on the population anywhere in the breeding, moulting, migration, or wintering range for Canada Goose may have implications for the population in the lower Churchill River watershed. Similarly, the Olive-sided Flycatcher which breeds in northeastern Canada as far as the lower Churchill River watershed (Dunn and Alderfer 2007, NatureServe 2007, Internet site), is a species that has been affected by human disturbance. Although loss of breeding habitat is a possible cause for the decline of this species, its preference for fragmented habitat suggests that other factors are involved such as loss or alteration of wintering habitat (Volume IIA, Section 2.4.16.2). In summary, the influence of this Project and others considered within the CEA, will likely be more prominent on seasonal migration movements of species that are resident year-round, compared to those which only breed within the CEA Area.

References:

- Dunn, J.L. and J. Alderfer (Eds). 2007. Field Guide to the Birds of North America. Fifth Edition. National Geographic Society, Washington, D.C.
- Folinsbee, J. 1974. The Moose (*Alces alces*) in the Churchill River Valley, Labrador. Newfoundland Wildlife Service.
- Minaskuat Inc. 2009. The Lower Churchill Hydroelectric Generation Project Environmental Baseline Report: Moose (*Alces alces*) – Final Report. Prepared for Nalcor Energy LCP 535746, St. John's, NL.
- Minaskuat Inc. 2009b. Black Bear (*Ursus americanus*) in the Lower Churchill River Watershed – Final Report. Prepared for Nalcor Energy LCP 535747, St. John's, NL.
- NatureServe. 2007. NatureServe Explorer: An Online Encyclopedia of Life. Version 6.2. NatureServe, Arlington, Virginia. Available at <http://natureserve.org/explorer>.
- Northland Associates. 1980. Lower Churchill Development Studies. Prepared for Lower Churchill Development Corporation, St. John's, NL.