

**Questions for Hydro-Québec on the proposed Romaine Hydro-Electric Mega-Project**  
**Environmental Hearings, Havre St-Pierre, QC, November 2008**

**Résumé de l'étude d'impact sur l'environnement**

In section 4.1.2, the proponent includes a long profile of the Romaine River (Figure 8). What time of year does the current water level depicted in the profile represent?

**General Questions**

Given the current challenges our economy faces, and the current environmental challenges the planet faces due to anthropogenic activities, why not focus our work on reducing consumption and increasing the efficiency of the infrastructure we have already?

Does the Proponent consider it democratic that it has already signed agreements with certain local communities before the results of the BAPE have been released?

**Volume 1**

In section 6.4, the proponent claims that the major hydrologic changes resulting from this project are a change to the natural flow regime, increase in winter baseflow, and dampening for the spring flood. However, this description does not seem completely accurate for this particular project. Why has the proponent not stated that the major hydrologic change is from that of a typical riverine system to a lacustrine system?

In section 9.4.1, the proponent states that it will not be possible to let any water through the 'tronçon court-circuité' of Romaine-4 during the first 75 days of reservoir filling. The total loss of water in the reach for more than 2 months will cause habitat loss that will not recover easily when the ecological flow begins. How does the Proponent propose to compensate for this loss, as it is not included in the tabulation of overall habitat loss?

The Proponent explains in section 9.4.2 that they were unable to measure the bathymetry of lotic zones in the 'tronçon court-circuité' of Romaine-4, and thus did not include these zones in the calculation of wetted area and habitat loss. However, in section 23.6, the proponent claims that 99% of this zone's surface area is composed of lotic zones. How does the proponent verify the accuracy of the habitat loss measurements when they only considered 1% of the reach?

Why hasn't the Proponent figured out a way to maintain ecological flows in the 'tronçon court-circuité' of Romaine-3 during the first 125 day stage of reservoir filling, as described in section 10.4.1?

In section 10.4.1, the Proponent claims it was too difficult to obtain bathymetry measurements of lotic zones of the 'tronçon court-circuité' of Romaine-3. However, in section 10.4, the proponent itself claims that the majority of this reach is lotic. Why has the proponent not developed methods to overcome this barrier?

How is the Proponent going to ensure that flows below KP51.5 remain at  $70\text{m}^3/\text{s}$  during the second phase of filling the reservoir of Romaine-2? There is no explanation in section 11.4.1, nor is there a reference to another section with an explanation.

The ecological flow proposed below Romaine-1, during the filling of Romaine-2, described in section 11.4.1, is  $70\text{m}^3/\text{s}$ . This is only half the ecological flow described in table 12.12 of section 12.4.2.8. What ecological effects does the proponent expect during this period?

During the section phase of the filling of Romaine-2, there will not be any ecological flow. The proponent has calculated in section 11.4.1, that the tributary inputs will be  $70\text{m}^3/\text{s}$  below Romaine-1. What will the proponent do if the tributary flows during are not enough to ensure a discharge of  $70\text{m}^3/\text{s}$ ?

In section 12.4.2.2, the proponent describes future efforts to regulate flow rates in order to maintain the salmon spawning ground at KP 34.5. With an overall reduction in spawning grounds, and an unlikely increase in salmon populations, (as predicted by the Proponent, due to the elimination of northern pike in section 12.4.2.4), does the Proponent expect increased competition to reduce the quality of this spawning ground?

Section 12.4.2.3 describes the winter ecological flow below Romaine-1. How does the proponent expect this flow to affect the other plants and animals living in and around the reach?

In section 12.4.2.1, the proponent identifies six fish species that were taken into account when determining the ecological flow. However, the proponent only discusses spring spawners in section 12.4.2.4. How will the ecological flows during the summer, fall and winter affect these 5 species?

According to the Politique de débits réservés écologique pour la protection du poisson et de ses habitats, the proponent must have a compensation plan if ecological flows harm fish species. However, in section 12.4.2.4, the proponent proposes not to compensate for the loss of northern pike. How does the proponent explain the discrepancy between the regulations and its plan?

Section 12.4.2.6 explains that the proponent does not expect accumulation of fine sediments to be problematic in Salmon spawning beds. Does the proponent have plans to monitor the accumulation of fine sediments and reassess the situation if more fine sediment than expected is accumulating?

Logging, road building and other construction projects result in the availability of more fine sediments in a river system. Did the proponent include these artificial fine sediment inputs when predicting that the salmon spawning beds would not be affected in section 12.4.2.6? If not, why?

In section 19.1.2, the proponent acknowledges that 70% of the banks downstream of Romaine-1 are composed of sand, silt or clay. Did the proponent include the increase in fine sediment load due to tributary incision after damming in its prediction that there wouldn't be sedimentation of salmon spawning beds in section 12.4.2.6? If not, why?

In section 12.4.2.6, the proponent claims that salmon currently clean out the fine sediments from the spawning beds as they lay their eggs. Has the proponent considered the possibility that too much fine sediment accumulation might render the spawning grounds unusable and prevent salmon from being able to clean out the beds?

La section 2.4.4.1, volume 1 de l'ÉIE annonce que la construction du complexe de la Romaine devrait créer ou maintenir un total d'emplois de 33 410 personnes-année. Quelles dispositions seront prises pour assurer que toutes les communautés autochtones aient un accès égal à ces emplois.

Le sommaire, volume 1 mentionne que les postes de départ et les nouvelles lignes feront l'objet d'une autre étude d'impact. Comment est-il possible de présenter une ÉIE complète si ces éléments sont dissociés de la présente ÉIE?

Section 2.4.1.2, volume 1 présente des retombées économiques favorables dues aux exportations d'électricité. Cependant, si, pour la période de 2014 à 2020 les ventes d'énergie ne se feront qu'à l'exportation et que 60% de cette énergie sera vendue durant les périodes de pointe et 40% hors pointe, comment pouvons-nous considérer cela comme des opportunités lucratives d'exportation?

## **Volume 2**

In section 12.4.2, the proponent acknowledges that they are changing the flow regime in the reach below Romaine-1. In section 20.2, the proponent acknowledges that they are changing the sediment regime. However, there is no discussion of expected aggradation or degradation of the reach downstream of Romaine-1. Does the proponent expect either aggradation or degradation, and what are their mitigation plans if it finds evidence that either is occurring?

Why is the flood regime downstream of Romaine-1 different in section 19.2.3 than in 12.4.2.6? The description in 19.2.3 does not include any floods above 1200m<sup>3</sup>/s. Which is the true future regime?

Why hasn't the proponent included a discussion in section 19.2.3 of increased fine sediments downstream of Romaine-1 due to erosion in the tributaries?

### **Volume 3**

On maps 23-11, 23-12, and 23-13, the proponent outlines the regions of the 'tronçons court-circuité' where there will be viable fish habitat. These habitats are small and disconnected. How has the proponent determined that these areas will be suitable for fish survival?

Does the proponent expect the ecological flow from Romaine-4, Romaine-3, and Romaine-2 to connect the habitat patches shown on maps 23-11, 23-12, and 23-13? Why isn't there any discussion of the depth and width of water flowing through the 'tronçons court-circuité'?

In table 23-63 of section 23.2.1, the proponent claims there won't be any surface area losses in the tributaries that feed into the four 'tronçons court-circuité'. However, these tributaries no longer have a meaningful connection to the Romaine. How has the proponent ensured that fish can move freely between these tributaries and the Romaine? If the proponent has not, why is this not described as habitat loss?

The Politique de débits réservés écologiques pour la protection du poisson et de ses habitats states that even when the proponent plans to compensate for habitat loss, "la valeur de débit inférieur au débit réservé écologique ne peut être nulle." However, in section 23.2.1, the proponent states that there won't be any ecological flow in the 'tronçon court-circuité' of Romaine-1. Why is the proponent violating this Government policy?

In volume 3, section P4a of the proponents answers, the proponent claims that it can not be held accountable for the loss of forest habitat that will occur as a result of roads it constructs to reach the intended dam sites. Further on, in volume 3 section P6a, the proponent is willing to take credit for the ecotourism opportunities that will be created as a result of the roads it will construct to the intended dam sites. How does the proponent justify this discrepancy?

### **Volume 4**

Section 26.2.3, volume 4 of the EIA says that the Proponent has not detected the presence of Wolverine or Eastern Wolf (both species have protected status) in the study area. If the presence of these species is verified, what remediation would be taken?

Section 26.1.2.1, volume 4 of the EIA observes that some of the moose populations are higher than expected because of the unique habitat, free of many predators, found at the northern limit of the boreal forest. Has Hydro-Quebec accounted for the changes in

habitat that are going to happen from anthropogenic climate change? And what remediation's might Hydro take to minimize the stresses on the ecosystems?  
Section 26.1.2.1, volume 4 of the EIA states that there is only 0.29 moose for every 10km<sup>2</sup> and 0.37 caribou per 100km<sup>2</sup> in winter. How will summer populations be affected and what are those summer populations? This past summer Alliance Romaine witnessed a significantly higher number of moose and caribou in the study areas than the winter observations. What is the size of the summer populations and how will they be affected?

In Volume 4 of the EIS, Section 26.1.1, in methodologies, the proponent says it studied caribou in the area of the 4 reservoirs and 5km around the periphery. Quebec currently recommends establishing conservation areas of 200km<sup>2</sup> for woodland caribou because that is the smallest range they might occupy (a safe underestimate). How does the proponent justify only looking at a periphery of 5km?

Results published in section 26.2.1.2 of the EIS regarding effects on caribou – an endangered animal in Canada, indicate that the threat the hydroelectric project would have on caribou is medium. How will the construction of the power lines, which were not considered in this study, alter the impact on caribou habitat?

### **Volume 5**

According to section 2.2.2 and 4.2.2 of the guidelines, the environmental impact statement should address the effects on recreation. When asked about how the Romaine would remain a challenging canoe route, the Proponent referred to section 35.2.3 of the EIS, which admits that whitewater sections of the river will be lost. In addressing the issue, the Proponent states that there are 25 other rivers (according to the FQCK) on the North Shore that can satisfy the needs of canoeists. How many of these rivers are already dammed?

### **Volume 7**

Section 17 is a detailed investigation of the current and future water temperature regimes, with the proponent explaining that water temperature is very important for the timing of fish reproduction. Why didn't the proponent investigate the effects of climate change on water temperature in section 49.2?

Can the proponent give some concrete examples to verify the following generalization that Hydro-Québec has been "Engagée dans la protection de l'environnement depuis plus de 30ans?"

In section 49.1.1.2 of the EIS, the proponent recognizes the Boreal Forest as a carbon sink. When responding to questions regarding the loss of this important carbon sink, the proponent states that during a forests life cycle of 100-150 years, the boreal forest emits as much carbon as it absorbs (as a result of tree death, fire, insect infestation, decomposition etc.). How did the proponent measure the life cycle of the forest in this

particular region of Quebec?

**Detailed questions regarding responses to Alliance Romaine's initial concerns:**

**1. Greenhouse Gas (GHG) Emissions**

*Hydro Quebec's response to question P-004; Questions and comments from Environment Canada, CA-163 to CA-165 (in response to P-004)*

**a) Reservoir surface emissions (diffusive and bubbling fluxes) – Methane and CO<sub>2</sub>.**

For example, scientists at the Canadian Government's Freshwater Research Institute have investigated several hydroelectric reservoirs in Northern Canada to produce the first detailed calculations of GHG emissions. At one site it was estimated that annual production of methane was more than 7 grams per square meter of reservoir surface. In another study on flooded peat bog, it was estimated that each year, up to 30 grams of methane and between 450 and 1800 grams of CO<sub>2</sub> were emitted per square meter of reservoir surface.

GHG emissions over the 50 year productive life expectancy of a hydro-electric reservoir were calculated. It was estimated that about two thirds of labile carbon in flooded vegetation and soils would decompose over that period; up to 10% of this carbon would be released as methane with the remainder as CO<sub>2</sub>. Averaged over the 50 year life expectancy, it was estimated that each square metre of a typical reservoir in Northern Canada will emit between 400 and 700 grams GHGs (CO<sub>2</sub> equivalents) per year - the higher figures corresponding to those reservoirs where peat bog dominates. For the 1200 km<sup>2</sup> Cedar lake reservoir in Northern Manitoba, it was estimated that GHG emissions over the 50 years could be similar to a coal-fired power station of equivalent capacity.

In this context, we note that the surface soil layers in the study area of the Romaine complex are almost entirely peat based (high organic matter) and therefore may contribute significantly to annual GHG emissions.

Can the proponent account for the apparent differences in GHG emissions (methane, CO<sub>2</sub>) in the examples they provide for hydro-electric reservoirs in boreal regions of Quebec relative to those in other parts of Northern Canada?

In this regard, has the Proponent made estimates of annual GHG emissions from SM3, since impoundment, which could be used as a reference point for the Romaine? In order to assess the **net** GHG emissions caused by the megaproject, it is necessary to determine emissions from the various ecosystems in the watershed (rivers, lakes, wetlands etc) before and after construction. In this connection, has the proponent assessed GHG emissions from the Romaine watershed prior to construction?

**References:**

1. Pearce F. 1996. Trouble bubbles for hydropower. *New Scientist* (May issue) <http://www.newscientist.com/article/mg15020283.500-trouble-bubbles-for-hydropower--from-china-to-norway-new-hydroelectric-schemes-are-supposed-to-help-cut-emissions-of-greenhouse-gases-but-will-they-if-fred-pearce-it-investigates.html>
2. R.A. Bodaly, et al. "Experimenting with hydroelectric reservoirs." *Environmental Science & Technology* 38 (2004): 347A-352.
3. VL St.Louis, CA Kelly, E Duchemin, JWM Rudd and DM Rosenberg. 2000 "Reservoir surfaces as sources of greenhouse gases to the atmosphere: A global estimate." *BioScience* 50: 766-775.
4. VL St.Louis, AD Partridge, CA Kelly and JWM Rudd. "Mineralization rates of peat from eroding peat islands in reservoirs." *Biogeochemistry* 64 (2003): 97-110.
5. E Duchemin, M Lucotte, VL St.Louis and R Canuel. "Hydroelectric reservoirs as an anthropogenic source of greenhouse gases." *World Resource Review* 14 (2002): 334-353.
6. CA Kelly, JWM Rudd, VL St.Louis and T Moore. "Turning attention to reservoir surfaces, a neglected area in greenhouse studies." *EOS* 75 (1994): 332-333.
7. Rudd, J.W.M., R., Harris, C.A. Kelly and R.E. Hecky. 1993. Are hydroelectric reservoirs significant sources of greenhouse gases? *Ambio* 22(4): 246-248.
8. World Commission on Dams, 2000. Does Hydropower Reduce Greenhouse Gas Emissions? [http://www.dams.org/news\\_events/press357.htm](http://www.dams.org/news_events/press357.htm)

**b) Temporal variation in Reservoir GHG emissions**

does the Proponent plan on doing follow up studies on temporal variation in reservoir GHG (Co2 and methane) emissions? [See also CA- 165

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(Environment Canada's recommendations with regard to accounting for GHG emissions)]

**c) GHG emissions (degassing fluxes) from turbines, spillways and associated structures.**

has the Proponent done any studies on degassing fluxes of methane from reservoirs in Quebec to assess their potential contribution to overall emissions?  
[See also **CA- 165** (Environment Canada's recommendations with regard to accounting for GHG emissions)]

**d) Indirect GHG Emissions**



The United Nations Intergovernmental Panel on Climate Change (IPCC) recommends accounting for direct and indirect GHG emissions attributable to mega projects such as the Romaine complex.

Does the Proponent endorse the recommendations of the IPCC?

**2. Impacts on the productivity of the marine ecosystem - Fisheries, marine birds and mammals (whales) in the zone of the river-mouth and Mingan Archipelago**  
*Questions on Hydro-Quebec's response to P-005 and on Comments by DFO: CA-084 and CA-085*

The Proponent responds to question **P-005** by indicating that simulations (NPZ modelling?) were used to predict that there would be little influence on primary production by the proposed hydrological alterations to the Romaine. According to DFO experts (**CA-085**), NPZ modelling is used to simulate overall phytoplankton production in relation to physical alterations in the environment. We would therefore like to know if the NPZ model used by the Proponent is capable of **1**) predicting qualitative changes in the species composition of phytoplankton populations (i.e. diatoms relative to non-siliceous species) and, **2**) whether significant reductions in riverine silicate inputs were factored into the model?

**References:**

1. Ittekkot et al. 2000. Hydrological alterations and marine biogeochemistry: A silicate issue? *Bioscience* 50:776-782.
2. Treguer et al. 1995. The silica balance in the world ocean: A re-estimate. *Science*. 268:375-379.

**b) Supplementary Question – Primary Production**

We are concerned that significant alterations in river flow regime will not only cause an overall reduction of nutrient inputs (mineral and organic - dissolved and particulate) to the river mouth zone in spring but also lead to a loss of buoyancy flux (caused by reduced freshwater inputs) and the stable layer (stratification) that is essential for high primary productivity in the coastal zone. (See also comment **CA-084** by DFO regarding organic matter inputs)

Has the Proponent considered the impacts of these factors on primary production (particularly the potential loss of buoyancy flux in spring) in the NPZ simulations?

**Reference:**

Rosenburg et al 1997. Large Scale Impacts of Hydro-electric Development. *Environmental Reviews* 5: 27-54.

**c) Secondary productivity and potential impact on Whales.**

**Comment CA-085 by DFO**

We are particularly concerned that the proposed megaproject could have potential impacts on the nine species of Whales (including Rorquals such as the Blue Whale and endangered HumpBack Whale) that frequent the Mingan Archipelago.

In this regard, we refer to comment **CA-085** in which DFO points out that the Proponent's assumption that the megaproject will not affect the zooplankton prey (i.e. **krill**) of Baleen Whales is not valid because the NPZ simulation model can only be used to simulate primary production and cannot be extrapolated to secondary production (zooplankton).

Has the Proponent done alternative follow up studies to assess the impacts of the megaproject on secondary (zooplankton) production and by extension the potential impacts on Whales, Fisheries, animals, and birds? If so, what were the results?

### **3. Impacts on freshwater quality**

We are concerned that the proposed hydrological alterations may cause a significant deterioration in the Romaine's freshwater quality following impoundment.

Research (2) has shown that significant changes in water quality can occur in hydro-electric reservoirs. For example, following impoundment, depletion of oxygen triggers reduction of nitrate, manganese oxides, iron oxides and sulphate. Reduced products of manganese, iron, ammonium and hydrogen sulphide may accumulate in deep water. The reduced compounds are not only toxic to fish and other organisms, but also cause a reduction in the capacity of sediments to retain phosphates. As a result phosphate levels become elevated.

In a Bulletin by Hydro Quebec (1), it was stated that the filling of the nearby River Sainte Marguerite 3 (SM3) Reservoir in about 1998, caused certain metals (unspecified) to become elevated to toxic levels in a down-stream reservoir. This rendered the water unfit to drink. Bottled water was distributed to affected users. Clarke City which drew water from the affected reservoir was connected to a new supply of drinking water in Sept Iles.

Has the Proponent considered measures to mitigate for a potential significant deterioration in freshwater quality following impoundment of the Romaine, similar to that experienced for SM3?

Increased salinity of the drinking water was encountered by the Inuit of Kuujuaq at the mouth of the Koksoak River following impoundment of the Caniapiscau River in 1982 to fill the Caniapiscau Reservoir.

We are concerned that the large scale hydrological alterations proposed for the Romaine could cause a lowering of the water table at the mouth of the river (see Question 4 below), thereby affecting the quality of the drinking water of Havre St Pierre that is currently pumped from ground water.

Does the Proponent have any contingency plans in the event of such an occurrence?

#### **References:**

1. Construction of the Sainte Marguerite Hydro-Electric Development. 1994 -2000. Environmental Highlights. Hydro-Quebec Bulletin.
2. Freidl and Wuest. 2002. Disrupting biogeochemical cycles - Consequences of damming. Aquatic Science 64: 55-65
3. Rosenberg et al.1997 Large-scale impacts of hydroelectric development. Environ Rev. 5: 27-54

#### **4. Biodiversity: Potential impacts on the coastal wetland complex at the mouth of the River Romaine**

The peat / wetland complex at the mouth of the Romaine River has been identified as an area in need protection under Environment Canada's conservation plan to protect the biodiversity of the St. Lawrence. This area is known for its rare biotypes.

We are concerned that sediment deficient water discharged from the Romaine 1 Dam will cause potential erosion of the river bed and lowering of the water table of the peat land complex situated at the mouth of the River Romaine. This in turn could have negative impacts on plant, animal and bird diversity and abundance through loss of habitat. The construction of access roads across this area could also have negative impacts.

Has the proponent considered measures to safeguard the ecological integrity of the wetland complex at the mouth of the Romaine River?

#### **Reference:**

Protecting the biodiversity of the St. Lawrence: Conservation plan. Environment Canada [http://www.qc.ec.gc.ca/faune/biodiv/en/sites/conserv\\_plan.html](http://www.qc.ec.gc.ca/faune/biodiv/en/sites/conserv_plan.html)

#### **5. Reservoir Induced Seismicity (earthquakes)**

Reservoir induced earthquakes occurred after the filling of the Manicougan (Manic 3), Toulnostouc and Sainte Marguerite River (SM3) reservoirs (1). Globally, more than 90 earthquakes have been triggered by the filling of reservoirs. The largest and most damaging earthquake triggered by a reservoir was in 1967 in Koyna, India: the magnitude of the earthquake was a 6.3. Depth of water (> 80 metres) is considered to be the most important factor in reservoir induced earthquakes (2, 3).

In view of the fact that reservoirs proposed for the Romaine exceed 80 metres in depth, what is the probability of the occurrence of an induced earthquake of 6.3 or greater?

Has the proponent made any contingency plans in the event of such an occurrence, particularly with regard to potential effects on the structural integrity of older dams in the region?

#### **References:**

1. Lamontagne, et al. 2006. Reservoir-induced earthquakes at Sainte-Marguerite-3, Quebec, Canada. *Can. J. Earth Sci.* 43: 135–146
2. Baecher and Keeney 1982. Statistical examination of reservoir-induced seismicity. *Bulletin of the Seismological Society of America.* 72: 553-569
3. Earthquakes Caused by Dams: 'Reservoir-Triggered/Induced Seismicity' 2008. <http://www.probeinternational.org/files/dam%20triggeredeearthquakes>