Changes Due to Flow Regulation in the Riparian Habitats of the Churchill River

The Imperative of Meaningful Cumulative Effects Assessment

Presentation to the Lower Churchill Review Panel
Happy Valley-Goose Bay
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Cross-Cutting Issues

- Precautionary Principle
- Cumulative Effects
- Mitigation Measures

Riparian wetland habitats
Environmental Impact Assessment

An opportunity to utilize our collective history and current knowledge to better understand Labrador’s largest river is affected by hydroelectric development.
1. Scoping
1. Scoping

2. Analysis
1. Scoping

2. Analysis

3. Mitigation
1. Scoping
2. Analysis
3. Mitigation
4. Significance
Precautionary Principle

Uncertainty?

TransLabrador Highway
What are some areas of some scientific certainty with regards to environmental effects of these developments?
1. In the EIS there is an inadequate understanding of the degradation of riparian habitats due to changes in hydrological regimes.
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2. The proposed mitigation measures for riparian habitat loss are vague and unrealistic.
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3. The methods used to measure significance are not adequately protective of long-term biodiversity.
1. In the EIS there is an inadequate understanding of the degradation of riparian habitats due to changes in hydrological regimes.

2. The proposed mitigation measures for riparian habitat loss are vague and unrealistic.

3. The methods used to measure significance are not adequately protective of long-term biodiversity.

4. There is an inadequate characterisation of cumulative effects of multiple hydroelectric projects on riparian habitats within the watershed and the region.
Sources of Information

- Research on the effects of dams and impoundments in boreal riparian zones in other regions
- Hydrological data from the Churchill River system
- Historical records of riparian habitats and relevant natural history in the Churchill River watershed
- Local environmental knowledge and perspectives about changes in the river
- Field surveys of riparian vegetation structure and composition along the main stem of the river, in reservoirs and downstream reaches
Knowledge of the river - past and present
Riparian Vegetation Surveys

- substrate types
- distance from mouth
- elevation
- hydrological regime
- channel width
- relative river flow velocity
- average riparian zone width and height
- aspect
- relative slope

vascular plant species richness
% vegetation cover in riparian zone

200 m – long reaches
Wetlands Study

- Nalcor contracted a study of wetlands in the Study Area.
- It provides some useful information and is a good start for a region that has undergone very little previous study.
- But it fails to document all riparian habitats.
- In addition, there are several problems with the interpretation of the data.
According to the data in the wetlands report, of the wetlands identified, the losses would be:

- 100% of marsh/swamp complexes
- 98% of riparian marsh habitat;
- 90% of shallow water swamp complexes
- 95% of shallow water wetlands in the Study Area.
Loss of Riparian Marshes

The report states:

“Approximately 321 ha of the 327 ha (98%) of riparian marsh habitat identified within the study area will be inundated (based on 102 sampled wetlands).

Prior to this study the presence of these wetlands along the lower Churchill River was not documented and so it is likely that the actual presence of this wetland form is more common than currently thought in Labrador.”

- In fact, riparian marsh and swamps are not likely very common in Labrador.
The EIS states that the loss of existing wetlands would be only a small portion (13%) of the wetlands present in the study area. These numbers not accurately represent the loss of the very rich plant communities all along the lower river reaches.

In this calculation they have grouped the very common bogs and relatively common fens of upland Labrador with the much less common fluvial marshes and swamps.
It is well known in the ecological literature that riparian zones of large rivers have greater species richness of vascular plants than those of smaller rivers.

The Churchill River is the largest river in Labrador by an order of magnitude over the next largest river.
“High habitat suitability was typically associated with fens, bogs and marshes. Fens and bogs represent the large majority of wetlands found within the study area, and therefore the loss of habitat for herpetiles is considered to be negligible”.

IR# JRP.155 Revised

The data report 16 sampled riparian marsh and swamp sites that had high herpetile suitability.
2 bog sites, 9 fen sites
Loss of Riparian Wetland Habitat Potential

- Loss of habitats means loss of wildlife potential long into the future for those species that are associated with those habitats.
Wetlands were studied for the EIS, but no ecological value is accorded to linear riparian vegetation complexes in the EIS.

Riparian habitat is formed all along seasonally flooded river and lake shorelines.
Relatively high species richness in the lower river.
Hydrological processes are a primary influence on the fluvial geomorphology of a river and create riparian habitat diversity.

Ushakusk-shipiss
Lower Brook
Delta of a tributary of the Mishta-shipu
Natural Hydrological Regimes in Boreal Rivers

Daily Flow Along Churchill River at Flour Lake 1968-1969
Riparian zones develop a dynamic mosaic of vegetation at various stages of succession.

They provide structural diversity in habitats adjacent to water bodies — important to many species.
Riparian areas provide unique habitats, are generally species rich compared to upland areas, and are always directly affected by changes in the hydrological regime of the river.

(Nilsson, 1992; Naiman and Decamps, 1997; Jansson et al. 2000)
## Monthly Extremes of Daily Discharges above Muskrat Falls
### Pre- and Post-Regulation

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<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
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### Diagram
- **x-axis**: Month
- **y-axis**: m³/s
- **Legend**:
  - Blue: 1954-1972 Max Daily
  - Pink: 1973-2002 Max Daily
  - Yellow: 1954-1972 Min Daily
  - Cyan: 1973-2002 Min Daily
Rich herb forest stands develop in old river valleys subject to periodic extreme floods over the long-term.

Minaik\textsuperscript{u}
White Spruce in the Mishta-shipu valley
Typical Upland vegetation cover
Given what is known about riparian habitats, any river regulation project should have a strong focus on hydrological regimes as a fundamental, landscape-level ecological process.
Primary Effects of River Regulation

- conversion from lotic to lentic environments above dams
- changes in sediment transport, deposition and erosion processes, and nutrient, temperature and moisture regimes below dams;
- alterations in community composition and succession processes due to increased or decreased disturbance

(Naiman et al., 2005).
Effects of River Regulation on Boreal Riparian Vegetation

- Reduction in species richness
- Reduction in vegetation cover
- Decreased structural complexity

(Nilsson, 1986; Naiman and Décamps, 1997; Jansson et al., 2004)
Large hydroelectric facilities were constructed in the upper watershed during the 1960s and 1970s.
What has already been lost?

What will be left?

Cumulative Effects

The late Penote Ben Michel - Former Innu leader
Cumulative Environmental Effects

- The incremental change in the environment that results from an action, when added to other past, present, and foreseeable future actions.

- Cumulative effects are the spatial and temporal accumulation of change in environmental systems.

- Cumulative effects can result from individually minor, but collectively significant actions taking place concurrently, or over a period of time.

(U.S. Council on Environmental Quality, 1978; Ross, 1994; Sears and Yu, 1994)
Cumulative Effects Assessment (CEA)

- Expanded temporal and spatial scope of assessment beyond the immediate footprint of the proposed project

- Definition and understanding of indicators of cumulative environmental change
Regulated hydrological regimes associated with the Menihek and Churchill Falls hydroelectric developments
Daily Flow from the Upper Churchill River for Two Years Pre- and Post Regulation

- 1968-1969 at Flour Lake
- 2000-2001 at Powerhouse Tailraces

Downstream Reaches
Downstream effects of the powerhouse

- Lower peak floods
- Fewer extreme floods
- Lower summer water levels
- Increased bank erosion
- Increased winter ice scour
Increased erosion and ice scouring along banks in the downstream reaches
The upstream end of the island is pushed up and scoured by ice.

Common Wood Sorrel
_Oxalis acetosella_ subsp. _montana_
Monthly Mean Flows above Muskrat Falls during two Periods Pre-and Post-Regulation

Flow m³/s

Month

1954-1961
1990-2002
Summer water levels are lower
Depositional areas with finer substrates provide opportunities for riparian vegetation to become established.

79 species of vascular plants

Tributary delta at upstream end of Winokapau
Flow at the Powerhouse Tailraces and above Muskrat Falls in 2001, and Two Pre-Regulation Years at Muskrat Falls

(Data Sources: Churchill Falls (Labrador Corporation, and Water Survey of Canada).)

![Graph showing flow at the powerhouse tailraces and above Muskrat Falls in 2001, and two pre-regulation years at Muskrat Falls.](image-url)

- Churchill Falls Tailraces 2001
- Above Muskrat Falls 2001
- Above Muskrat Falls 1967
- Above Muskrat Falls 1960
The lower river valley continues to host relatively high species richness, vegetation cover on shores and overall habitat complexity.
Monthly Mean Water Levels in the Smallwood Reservoir for Selected Years

Storage Reservoirs
Smallwood Reservoir – perimeter 3395 km
Total Annual Precipitation at Churchill Falls, Labrador
1969-2006
Lake Michikamau – Smallwood Reservoir
Pre and Post Flooding
Ossokmanuan Reservoir – perimeter 751.9 km
accumulation of woody debris
Development of riparian vegetation is impeded by daily drawdown in the control reservoirs

West Forebay – perimeter 417 km
Daily Forebay Water Levels in 2001
(Data source: Churchill Falls (Labrador) Corporation).
East Forebay
Churchill Falls Control Reservoir

Typically narrow active riparian zone

Few riparian species

Lower vegetation cover and simplified structure
Aesthetic concerns related to shorelines

*It used to be nice country there around Michikamau.... Lots of animals and very beautiful.*

Aniet Nuna, pers. comm., 2005
East Forebay shoreline in sheltered cove
8 species of vascular plants predominantly upland species
- East Forebay
- Dyke in background
- Sheltered area on lee shore
- 16 species
- Former riparian zone
- Minimal draw down
Typical lake and river shoreline habitat in the upper watershed of the Mishta-shipu
- Shoreline of unregulated small lake adjacent to east forebay
- More complex structure
- 22 wetland species
Two new reservoirs – no seasonal flow patterns – daily fluctuations within one meter – little opportunity for diverse riparian habitat to reestablish
A dewatered reach of the Churchill River above the falls
Mishta Paushtuk / Patshetshunau: Before and soon after diversion of the river above the falls
“The whole river and everything connected to it is important ... is essential”

Tshaukuesh Penashue

Mishta-shipu upstream of Lake Winokapau
Watersheds with major regulated reaches in the Québec/Ungava Peninsula region

Rivers with Regulated Reaches
1. Mishta-Shipu/Grand/Churchill
2. Caniapiscau
3. La Grande
4. Eastmain and Opinaca
5. Saint Maurice, Balscan and Mattawin
6. Betsiamites
7. aux Outardes
8. Manicouagan
9. Riviere Sainte Marguerite
10. Riviere Peribonka
Mitigation Measures

- The EIS does not adequately acknowledge the challenges and limitations in any effort to mitigate the effects of major hydrological changes on riparian wetland habitats.

- The potential for re-establishing riparian wetlands in the new reservoirs with the habitat complexity and biodiversity that currently exists is grossly overestimated.
Evidence from other regions where efforts have been made to enhance riparian habitats in reservoirs with similar water level regimes, have not been deemed to be successful.
The mitigation measure proposed in the LCPP EIS for loss of riparian swamp thickets adjacent to water, is to cut trees to create shrub habitat along reservoir shores.

This mitigation has been implemented in the La Grand 1 project in Quebec.

What was found through monitoring is that these areas did provide additional forage for moose and hares, but did not recreate the diversity of vegetation that is present in riparian shrub communities that are developed and maintained through hydrological processes.
A summary of effects of the La Grande Complex in Québec 30 years after construction, states that,

“Altogether, the natural reconstitution of the reservoirs’ riparian vegetation remains limited …”. FORAMEC, 1992a
Patterns of development of riparian vegetation under reservoir conditions associated with La Grande Complex were considered to be predictable enough to estimate losses of comparable habitat for subsequent projects in northwestern Québec.

This is an example from just one region, but we do not have any other examples of good riparian vegetation redevelopment under such altered hydrological conditions.
Great Whale Project

- Quantitative analysis of the changes in riparian habitat was attempted within the context of an environmental assessment for the proposed Grande Baleine or Great Whale project, in a watershed just north of La Grande, flowing into Hudson Bay (Deshaye et al., 1992; FORAMEC, 1992a; Hydro-Québec, 1989; Hydro-Québec, 1993a, 1993b).

- In that exercise, all former shorelines in areas that would be converted to reservoirs were considered to represent a net loss of productive riparian habitat.
The new shorelines were not expected to develop a rich cover of riparian vegetation.

Therefore, the area of riparian habitat predicted to be lost if the Great Whale project were built was quantified by multiplying the length of river course that would be flooded by an estimated average width of the zone of existing riparian vegetation.

A percentage loss of the total riparian habitat was calculated on this basis.
Certainly there is the possibility for future innovation.

However, the reality is that there is a very low level of certainty with regards to the potential level of success of these mitigation measures.

There is a fairly high level of certainty that the measures will have minimal success at best.
Loss of Riparian Habitats in the Lower Churchill

- It is estimated that the perimeter of the Gull Island reservoir would be about 560 km, and that of Muskrat Falls reservoir would be 172 km (Procter and Redfern 1980).

- These areas may develop some minimal riparian vegetation in a narrow zone similar to the Forebay reservoirs, but perhaps with somewhat higher species richness.
Loss of Riparian Habitats in the Lower Churchill

- We could therefore state fairly confidently expect that at least 730 km of relatively diverse riparian shorelines will be lost from the lower reaches of the river.

- The new shorelines will not be expected to develop similar vegetation composition and structure.

- Mitigation measures can only realistically be expected to represent a very small improvements.
Predictable Adverse Changes in Riparian Vegetation due to the Churchill River Projects

- Extensive, cumulative loss of structurally diverse and species rich riparian wetland vegetation complexes in the areas converted to reservoirs
‘Hydroelectricity is green power’

(Graphic: Atlantic Business Weekly, 2001)
We knew that country.
We have been all around that area and visited the falls.
We knew all the rivers around there.

Pien Penashue, pers. comm., 2001