

Nalcor Energy – Lower Churchill Project



Navigation Mitigation and Monitoring Plan

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1 PURPOSE

The purpose of this Navigation Mitigation and Monitoring Plan (NMMP) is to address Project interaction with navigation in the Lower Churchill River at the reservoir area and downstream during construction and operation. This NMMP will:

- identify any impacts to navigation during construction and operation of the Lower Churchill Project (LCP) on the Lower Churchill River near the reservoir and downstream, and determine appropriate mitigation;
- establish a program for monitoring the effectiveness of mitigation measures;
- address any issues during the construction and impoundment periods; and
- identify monitoring and specific adaptive management measures to address any navigational problems downstream of Muskrat Falls.

The NMMP builds on existing information through commitments made in the Environmental Impact Statement (EIS) (Nalcor 2009a) and through the Joint Review Panel (JRP) process, and any navigation-related conditions of permits and licenses for the Project.

The Muskrat Falls Corporation will provide Transport Canada (TC) with draft and finalized copies of this Plan and at all times adhere to its provisions.

2 SCOPE

This plan addresses Muskrat Falls Project interaction with aspects of navigation for construction and operation of the Muskrat Falls Facility and reservoir. This NMMP is prepared in fulfillment of TC and Environmental Assessment (EA) requirements, including JRP Recommendation 8.4.

3 DEFINITIONS

Environmental Assessment: The evaluation of the Project's potential environmental risks and effects before it is carried out and identification of ways to improve project design and implementation to prevent, minimize, mitigate, or compensate for adverse environmental effects and to enhance positive effects. This includes the Environmental Impact Statement (EIS) (Nalcor 2009a), subsequent Information Requests, and statements issued by the LCP during the course of the Environmental Assessment Hearings in 2011.

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Environmental Management: The management of human interactions with the environment (e.g., air, water and land and all species that occupy these habitats including humans).

Environmental Management System: Part of the LCP management system used to develop and implement its environmental policy and manage its environmental aspects.

Environmental Protection Plan: Document outlining the specific mitigation measures, contingency plans and emergency response procedures to be implemented during the construction or operations of the Project.

Environmental Effects Monitoring: Monitoring of overall Project effects to confirm the predictions of the EIS (Nalcor 2009a) and to fulfill commitments.

Environmental Compliance Monitoring: Monitoring of Project activities to confirm compliance with regulatory requirements and commitments.

Integrated Project Delivery Team: The integration of the Nalcor Energy and SNC Lavalin Inc. Environmental and Regulatory Compliance Teams.

4 ABBREVIATIONS AND ACRONYMS

EA – Environmental Assessment

EIS – Environmental Impact Statement

FSL – Full Supply Level (Reservoir; in metres of elevation)

JRP – Joint Review Panel

LCP – Lower Churchill Project

LSL – Low Supply Level (Reservoir; in metres of elevation)

NMMP – Navigation Mitigation and Monitoring Plan

NWPP – Navigable Waters Protection Program

NWPA – *Navigable Waters Protection Act*

TC – Transport Canada

TSS – Total Suspended Solids

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5 REGULATORY COMPLIANCE

The *Navigable Waters Protection Act (NWPA)* is a federal law designed to protect the “public right of navigation”. The Navigable Waters Protection Program (NWPP) of TC is responsible for administering the *NWPA*. Section 5 of the *NWPA* applies to all works that are proposed to be built or placed in, on, over, under, through, or across any navigable water. New works may require an approval under section 5 of the *NWPA* prior to construction or placement. Approvals issued under subsection 5(2) are for works that substantially interfere with navigation and those issued under subsection 5(3) are for works that interfere, other than substantially, with navigation, subject to EA requirements and conditions for the LCP EA process.

To comply with commitments made in the EIS and JRP report, the LCP’s NMMP approach includes consideration of:

- Mitigation objectives – performance objectives in respect of each adverse environmental effect;
- Mitigation – measures planned to achieve the mitigation objectives;
- Metrics and targets – specific, quantifiable, relevant and time constrained;
- Follow-up or Monitoring Programs – how the Project will include follow-up or monitoring surveys to confirm that mitigation strategies are meeting the mitigation objectives; and
- Contingency – plan to be implemented should monitoring reveal that mitigation measures have not been successful.

6 NAVIGABILITY AND IMPACTS

6.1 DETERMINING NAVIGABILITY

THE NWPP of TC uses various tools to assess the navigability of any waterways including (Transport Canada, 2011):

- Conducting site visits to observe physical characteristics of the waterway;
- Determining the level of public access;
- Determining navigation use through consultation;
- Determining historical and/or potential use; and/or
- Reviewing baseline information supplied by the proponent.

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6.2 NAVIGATIONAL ACTIVITIES

The Lower Churchill River and many of its tributaries have been deemed navigable by TC. The majority of boating occurs on the Churchill River between Muskrat Falls and Happy Valley-Goose Bay, and between Churchill Falls and the lower end of Winokapu Lake. The majority of navigation on the river is related to accessing cabins, travel between Mud Lake, recreational use, and subsistence hunting and fishing activities. (Transport Canada, 2011)

Expected navigational use on the lower section of the Churchill River by boat was collected during the preparation of the Land and Resource Use Baseline Report (Minaskuat 2009).

6.2.1 Boating

Boating on the Lower Churchill River occurs from Spring to Fall, consisting primarily of day trips or 3-4 days duration. Boat use for fishing and hunting is concentrated between Muskrat Falls and Goose Bay (downstream of reservoir), while recreational boating occurs along the entire river (canoes) but is concentrated between Muskrat Falls and Goose Bay. Most boats are constructed of aluminum and are either canoes, or equipped with outboard motors. (Joint Review Panel, 2009e)

6.3 IMPACTS TO NAVIGATION

Other impacts to navigation on the Lower Churchill River due to ancillary and associated works include (but not limited to) bridges (temporary or permanent), cofferdams, and diversion channels. TC has determined that the Project will result in substantial navigation interference under Section 5(2) of the *NWPA*, and will thereby require an authorization.

6.3.1 Reservoir

The main components that will require approval under the *NWPA* are the proposed structures for the Muskrat Falls Facility, consisting of a north side concrete dam, a south side earth-filled dam, powerhouse and spillway, and the reservoir. The south section of the dam will be 29m high and 325m long, while the north section will be 32m high and 432m long. The reservoir will be 59km long, inundating approximately 41km² at 39m FSL. This facility operation will result in a significant modification to navigation.

6.3.2 Stick up Zones

To facilitate the determination of volumes associated with the reservoir clearing strategy, three reservoir zones were identified; the ice zone, stick-up zone and flood zone. The ice zone is

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defined as the band or zone along the shoreline on both the north and south banks of the reservoir between 3m above FSL and 3m below low supply level (LSL).

The Stick-up Zone is defined as the area below the ice zone where the base of a tree is below the ice zone; however, the top of a tree is sufficiently high to extend into the ice zone. These trees may be partially submerged when the reservoir is at LSL or may be fully submerged just beneath the surface of the reservoir. Trees in this zone pose a hazard to navigation, and ice formation around these trees when the reservoir is at LSL could result in the trees being uprooted as the reservoir level rises, resulting in safety and navigation issues.

The ice and stick-up zones are also expected to be the main contributors to trash and debris generation, as these zones are subject to wind, wave and other natural erosion processes (such as ice) during reservoir stabilization and operations (Nalcor, 2009b). Debris management will be carried out to control the volume of trash and debris in these zones using log booms. The collection facility will be located upstream of the dam facility.

6.3.3 Loss of North Spur Portage Trail

The existing portage trail around Muskrat Falls is located over the North Spur. The existing trail will be impacted by North Spur stabilization activities. This trail will be replaced after these construction activities are complete.

6.3.4 Loss of Boat Launches

There are 3 boat launches located in the Muskrat Falls reservoir (Nalcor, 2009c). Of these, 2 boat launches will be located in the impoundment zone. The LCP will replace the affected boat launches with new boat launches in a location as close as possible to the existing launches. Stakeholders will be consulted regarding preferred locations and factors such as accessibility, safety and technical constraints when considering re-location (See Section 9, Consultation) (Joint Review Panel, 2009).

6.3.5 Access Impact to Mud Lake

The community of Mud Lake is located on the south side of the Lower Churchill River, without road access to Happy Valley-Goose Bay or the Trans Labrador Highway. Residents of Mud Lake use the Lower Churchill River to navigate to Happy Valley-Goose Bay during the open-water season. The impoundment of the Muskrat Falls reservoir will result in a reduction of downstream flow during the impoundment period; this reduced flow will have a temporary impact on navigation (approx. 10-12 days).

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This reduced flow downstream will affect the residents of Mud Lake by affecting their ability to travel to Happy Valley-Goose Bay. The LCP has committed to consulting the residents of Mud Lake to determine the most effective means of providing alternative transportation during the reservoir impoundment (see Section 9, Consultation).

During winter residents travel to and from Goose Bay on snowmobile via an ice bridge. It is predicted that the Facility will delay the freeze-up of the Lower Churchill River by approximately two weeks, thereby possibly delaying formation of the ice bridge by two weeks (see Section 10.1, Changes to River) (Transport Canada, 2011).

7 MITIGATION OF NAVIGATIONAL IMPACTS

As determined by TC, LCP will cause a substantial interference to navigation. To ensure mitigation of these impacts, LCP will ensure the following measures are established:

- 1) Boat launches which are affected by the inundation of the reservoir will be replaced in locations as close as possible to the original locations;
- 2) Public notices will be delivered by means of radio, community newspaper, project website, Facebook, Twitter, and through town officials, to ensure users of the river are notified at 1-month and 3-week intervals prior to reservoir impoundment. This will occur for the 25m construction headpond (currently scheduled to occur in 2016) and final impoundment to FSL (2017).
- 3) Debris management will be conducted at the log boom during the operation phase to ensure trees, branches etc. are collected to avoid obstructions to navigation and reduce danger to boaters and debris;
- 4) Transportation during impoundment for residents of Mud Lake will be provided by the LCP, if the water levels are not sufficient for travel by boat;
- 5) Clearing of vegetation from the reservoir will be conducted to minimize debris and reduce stick up zones;
- 6) Navigational markers such as floating safety buoys will be installed to guide vessels to upstream portage sites; and
- 7) The Muskrat Falls portage trail will be replaced to ensure navigation is maintained.

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8 COMPLIANCE CONDITIONS

Based on the TC JRP review, It has been determined that the Muskrat Falls Facility will result in a significant interference to navigation on the Lower Churchill River. As a result, TC has developed conditions to mitigate navigational interferences caused by the proposed works.

The following draft *NWPA* conditions have been proposed by TC, and will be implemented by the LCP.

8.1 GENERAL COMPLIANCE CONDITIONS

- The project is to be constructed and installed in accordance with the approved plans. As the proposed work will be completely or partially submerged in a navigable water, LCP is required, once the construction of the work is completed, to provide a Statutory Declaration that the work was built and placed in conformity with the approved plan(s) and site pursuant to the *NWPA*, its regulations and the terms and conditions of the Approval;
- Any cables, equipment or temporary hazards resulting from the construction activities are to be clearly marked so as to be visible to vessels operating in the area;
- Construction material and debris are not permitted to become waterborne. During construction any floating debris must be contained in the immediate area and removed from the water in a timely manner;
- During construction arrangements must be made for the passage of vessels around areas of temporary waterway obstructions;
- Silt Curtains placed in the water must be marked at 40m intervals with 0.4m yellow cautionary buoys;
- All dredge material must be disposed of in a provincially approved manner;
- During construction, arrangements must be made for the passage of vessels around areas of temporary waterway obstructions; and
- As built plans of the Dam and Spillway are to be forwarded to TC Navigable Waters Protection Branch upon completion of the project.

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8.2 PUBLIC SAFETY PLAN

- The Project will be constructed and operated in accordance with the Canadian Dam Associations Technical Bulletin on Public Safety and Security around Dams. The LCP shall develop and provide to TC a copy of the procedures it will implement to address the safety of the boating public that may be impacted by placement of the dam in the area of Muskrat Falls; and
- Audible alerts, Visual Signage and /or Keep out Buoys are to be established and placed as appropriate to notify waterway users both upstream and downstream of the dam of:
 - Changes in flows and reservoir levels;
 - Dangerous Waterway Zones and Warning Waterway Zones;
 - Presence of debris management, containment and safety booms; and
 - Areas for Portages.

8.3 CONSTRUCTION AREAS AND ACTIVITIES

- During construction the proponent must implement measures to ensure the safety of boaters by use of appropriate signage, local communication, and establishment of security perimeters;
- Areas utilizing booms must be clearly identified by signage. The delineated area of the booms must be clearly marked, at a minimum of 20 meter spacing, with cautionary buoys that are to be maintained in a visible upright position above the water surface;
- Yellow flashing lights are to be placed at each end of the booms and at midpoint. These lights are to have a flash characteristic of Fl 0.5 sec; Ecl 3.5 sec;
- Portage areas are to be provided to allow for vessels to bypass areas of total waterway obstruction. Signage is to be utilized to direct boaters to the locations of the portage;
- The boating public is to be made aware in advance of any proposed construction activities that may affect their safe navigation on the river. Such activities include, but are not limited to, blasting operations, installation of temporary cables, and presence of debris, and log containment;
- Debris resulting from construction is not allowed to become waterborne and must be immediately removed from the river; and

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- All temporary works not required for the operation of the dam must be completely removed from the waterway and any area located in the proposed flood zone.

8.4 RESERVOIR PREPARATION

- The reservoir is to be prepared to ensure a zone of clearing of between 3 meters below LSL and 3 meters above FSL;
- Trees, branches and debris are not to be thrown discriminately into the river and must at all times be appropriately contained in a secure manner so as not to create hazards for the boating public; and
- The Churchill River is not to be utilized for log driving. Logs are to be removed from the reservoir clearing area by Heli logging, Fording and trucking. Boaters are to be provided with a safe clear marked navigation route along the river that runs through areas where reservoir clearing is to be performed and where navigation may be impacted by these activities.

8.5 IMPOUNDMENT

- Notice of commencement, duration and period of impoundment of the reservoir is to be given to the public and aboriginal groups prior to reservoir filling;
- Depths in the impoundment area are to be maintained at an elevation of 39 meters above sea level at FSL and 38.5 meters above sea level at LSL. All temporary works, tools, machinery, equipment and anything else that may affect the proposed reservoir depths or cause future hazard to navigation must be removed from the reservoir prior to impoundment;
- Prior to impoundment the LCP is to develop a mitigation plan in conjunction with the Mud Lake Improvement Committee to address any temporary transportation difficulties during reservoir impoundment.

8.6 OPERATION

- The LCP will provide and maintain to the boating public accessible portage areas to allow for passage of vessels around areas of temporary and permanent waterway obstruction. These portage areas are to be clearly defined with signage and markings to allow for safe passage to and around the area of obstruction;

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- The LCP will create and make available to TC and the boating public detailed charting of the reservoir. This charting must show the depths throughout the reservoir and clearly indicate areas where depths are reduced due to the presence of stick up zones;
- Flow and water level gauges will be placed and maintained upstream and downstream of the Dam to record of water flow and levels. Data from these gauges will be made available to TC upon request;
- The area downstream of Muskrat Falls will be monitored by the LCP for changes which may adversely affect the traditional boating route used by the residents of Mud Lake. Should this route become impacted to a degree whereby it significantly impacts the existing passage and safety of these users, the LCP will be required in conjunction with the residents of Mud lake develop measures to mitigate the impact;
- Muskrat Falls Co. will continually monitor the log boom area, advise the public of the areas of potential floating debris and remove it from the log boom in an expedient manner;
- Muskrat Falls Co. will continually monitor areas identified upstream of Muskrat Falls where debris may accumulate, advise the public of the areas of potential floating debris;
- A sweeping technique may be used to avoid the pile up of debris and trash in unwanted areas (recreation and wildlife access points) in the reservoir. A mechanical floating skimmer can be utilized to collect debris from the water surface and haul debris to various shoreline locations.
- Public Notification will be given of any operations that may impact the upstream and downstream users of the waterway;
- During normal operations the water level in the reservoir will be maintained between 38.5 meters above sea level at LSL and 39 meters above sea FSL;
- During normal operation, there will be no measurable effect on flow patterns below Muskrat Falls, in the Goose Bay Estuary or Lake Melville; and
- Upon stabilization of the reservoir and the project completion, Muskrat Falls Co. will provide to TC a detailed geographical plan view of the river showing the locations of the dams and associated structures, portage areas, danger and warning zones, intakes and discharges and all other permanently associated ancillary works.

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8.7 SAFETY MEASURES

A number of measures will be established to ensure the safety of regular and occasional boaters in the vicinity of the Muskrat Falls Facility (Joint Review Panel, 2009).

- Appropriate safety signage will be installed and maintained in the vicinity of the facilities during operation, as recommended via the public safety assessment. The signage will inform both regular and occasional boaters that they are approaching hydroelectric structures and will provide information to aid safe navigation for boats;
- Public advisories will be issued as required;
- The portage route on the north bank around the Muskrat Falls site will be maintained during the operations phase, and
- A floating safety boom will be deployed across the river to guide vessels to the upstream portage access point and to prevent further downstream progress. This boom will be installed yearly during operations as soon as possible after spring breakup and removed in the fall just before freeze up.

In addition, measures such as standard operating procedures, fences and audible warnings and signs are being considered for the dams. Education and awareness campaigns will be implemented as necessary (refer to Section 9, Consultation).

9 CONSULTATION

As per the JRP Report, Recommendation 8.4, the LCP will subject this Navigable Waters Mitigation and Monitoring plan to consultation with river users, as necessary, to address navigation issues on the river, including the reservoir and downstream.

The LCP will host public consultation sessions in Happy Valley-Goose Bay and Mud Lake, to present the draft Lower Churchill Navigation Mitigation and Monitoring Plan to river users. The draft Plan will also be presented at a Community Liaison Committee meeting and Environmental Management Committee meeting.

The draft LCP NMMP Plan will be made publically available on the LCP's website prior to the consultation sessions. An email address and toll free number will be included in the public notice to provide stakeholders an option to send their comments via email or call if they cannot attend the consultation sessions.

Discussions will include:

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- Navigation issues during the construction and impoundment periods;
- Provision of boat launches and portages;
- Identification of areas that need to be cleared before impoundment to create safe shorelines access areas for small boats;
- Management of the stick-up zones, including how and when the LCP would manually remove trees left standing three years after impoundment;
- Management of trash and debris in the reservoir;
- Potential navigational hazards, signage and information, and
- Monitoring and specific adaptive management measures to address any navigational problems downstream from Muskrat Falls.
- Methods of communication with river users during construction, impoundment, and operation

The session will include a feedback form for participants to document comments regarding the Plan. Results from the feedback forms and verbal comments captured during the sessions will be utilized to update the NMMP and advise regarding mitigation measures.

9.1 PUBLIC NOTIFICATION

A public notice will be inserted in the Labradorian, on the project website, Facebook, Twitter, and announced on a local radio station at intervals of 1-month and 3-week prior to the following events:

- 25m elevation construction head pond impoundment
- 39m elevation impoundment to full supply level

This notice will include the predicted length of the 2 reservoir filling periods. A public notice will be inserted in the Labradorian and posted on the project website, Facebook and Twitter 3 weeks prior to NMMP consultation sessions.

Reservoir preparation activities are currently underway, thereby restricting access to certain locations along the lower Churchill River. Public notices are periodically issued regarding these and all other LCP construction activities.

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9.2 ABORIGINAL CONSULTATION

In addition to the consultation with all river users indicated above, the NMMP will be issued to Aboriginal groups as prescribed in the provincial Aboriginal Consultation Guidelines. Any comments provided through this process or indicated at any point in the construction and operation phases of the Project will be considered to reduce impacts to navigation.

The Nalcor-Innu Nation Environmental Management Committee will review the Plan and incorporate comments, as well.

10 ENVIRONMENTAL EFFECTS MONITORING

10.1 CHANGES TO RIVER

The creation of the reservoir will have significant impacts to the current river system of the Lower Churchill River. The changes are described below (Transport Canada, 2011).

10.1.1 *Ice Formation*

The change from a river based system to a reservoir will have an impact on the thermal regime of the Lower Churchill River as it is changed to a deeper, low-velocity reservoir system. The reservoir system will store heat and release warmer water, which results in a time lag and reduction in the variability of water temperatures as currently experienced.

The two primary environmental effects of the Project on the thermal regime will be the introduction of a time lag and a reduction in the variability of water temperatures. The reservoir will form a stable ice cover, however it is predicted that there will be a 2 week lag delay in the cool down period for ice formation on the reservoirs. It is also predicted that the freeze-up period will also be delayed by two weeks while the ice-break up date would occur one week later downstream of the Muskrat Falls facility. This will result in a one-week increase in the open water season downstream of Muskrat Falls.

Downstream of the reservoir, the start of ice progression from Goose Bay to Muskrat Falls is anticipated to be delayed in the post-impoundment scenario by approximately two weeks.

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10.1.2 *Change from River to Reservoir System*

The construction and operation of the dam at Muskrat Falls will change the existing river system into a reservoir system that will be less variable in velocity such as steadies and rapids. Within the reservoir, water velocity will be reduced and a laminar flow will occur over the majority of the created reservoir. None of the existing rapids will exist once the dam is operational. The Muskrat Falls reservoir will be relatively slow moving as compared to its current state.

10.1.3 *Downstream changes*

The Muskrat Falls facility is predicted to intercept Total Suspended Solids (TSS) coming from upstream areas causing the downstream areas to have reduced TSS. The reduction in TSS downstream of Muskrat Falls could lead to increased scour and may induce a shift from the present mildly braided river to a deeper, more consolidated meandering river channel.

The creation of a deeper, more consolidated channel may have navigational impacts on the residents of Mud Lake. There will be reduction of TSS migrating downstream as the reservoir system stabilizes, however, this will likely lead to a new equilibrium of erosion and deposition downstream of the Muskrat Falls facility. A deeper, more consolidated channel will remain navigable but may potentially result in a change in the current navigational patterns.

10.2 EFFECTS MONITORING

To confirm predictions and ensure successful mitigation of the impacts to navigation, monitoring will be conducted. Monitoring will occur through the following programs:

10.2.1 *Ice Survey Program*

An Ice Survey Program will take place in the Lower Churchill River to monitor the formation and break up periods. Information from this survey program will be useful to inform residents and river users of potential hazards and navigational impacts. The Ice Formation Environmental Effects Monitoring Plan contains the details regarding this program and is available on the Project website.

10.2.2 *Aquatic Environmental Effects Monitoring Program*

Following completion of the Muskrat Falls facility, sedimentation and erosion in the reach downstream of Muskrat Falls will be altered. The Aquatic EEMP will focus on the effects downstream of Muskrat Falls, including bottom scour and shoreline erosion. Bathymetric

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mapping will also be used to monitor bottom scour, as well as indicate areas of slumping below Muskrat Falls.

10.2.3 *Stick-up Zones*

Stick-up zones locations will be identified and quantified to determine the potential effects on navigation. An analysis will also be completed to determine the effects of ice on stick-up zones during ice formation.

10.2.4 *Debris Management*

During the inundation of the reservoir, debris such as branches etc. may be disturbed and float to the surface, causing obstructions for boaters. Debris will be estimated and an analysis conducted to determine overall navigational effects. Also, an evaluation of debris management activities and methods, such as specialized marine and land equipment to collect debris, will be conducted.

10.2.5 *Navigation around Facility*

Monitoring will be conducted at the Muskrat Falls facility to confirm that the replaced infrastructure is sufficient for river users.

10.2.6 *Downstream Changes*

Through the Aquatic EEMP as described in Section 9.2.2, parameters such as flow, velocity, sedimentation and erosion will be monitored to determine if the downstream effects of the Muskrat Falls facility will have a significant effect on navigation.

10.3 FOLLOW-UP AND ADAPTIVE MANAGEMENT

10.3.1 *Follow-up*

The Follow-up portion of the Follow-up and Monitoring Report, within the NMMP, will include the collation of all data related to navigational mitigation and monitoring collected

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during the construction period and the first five years of operations. The Follow-up portion of the report will present the pre-construction navigational baseline information, consider the data as a description of the effects collected on navigation impacts during Project construction and operation phases, and discuss the effects observed in relation to the effects predictions made in the EIS (i.e., no significant adverse residual effects on navigation).

10.3.2 Adaptive Management

At this time, contingency plans are not anticipated for navigation near the Muskrat Falls Facility, and any changes to the LCP’s procedures or mitigation plans would be addressed through the Adaptive Management Plan, if and as appropriate. Any changes proposed by the LCP would be based on the findings of the Follow-up and Monitoring Programs.

11 REPORTING & NOTIFICATION

Project site reports to be generated during impoundment activities include:

- Daily Environmental Inspection Report: covers all environmental aspects monitored or noted throughout the day;
- Daily Field Report: to be prepared by the On-Site Environmental Monitor and distributed to the Construction Manager, the Environmental Manager, the Environmental Coordinators, and the Contractor. These reports will describe the work being undertaken by the Contractor, and document incidents of non-conformance with environmental and regulatory requirements;
- Weekly Report: Summary of number and type of inspections conducted, issues, areas for improvement and non compliances.

Residents of Lake Melville, Mud Lake, Happy Valley Goose Bay and surrounding areas will be notified 3 months in advance, along with a follow up reminder one month prior to impoundment.

A detailed report will be generated annually and distributed to TC and other regulatory agencies. The report will cover the environmental effects monitoring and follow up monitoring conducted during impoundment.

Navigation Mitigation and Monitoring Plan		
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12 REFERENCES

Minaskuat. 2009. *Land and Resource Use Baseline Report*.

Nalcor. 2009a *Lower Churchill Hydroelectric Generation Project Environmental Impact Statement – Volume 2A*

Nalcor. 2009b *Reservoir Preparation*. Information request No.148, JRP.

Nalcor. 2009c *Navigation*. Information request No.34, JRP.

Nalcor. 2009d *Navigation (Operation)*. Information request No.36 JRP.

Nalcor. 2009e *Land and Resource Use – Access*. Information request No.72, JRP.

Transport Canada, Technical Analysis of the EIS and Additional Information Documents. February 21, 2011.