Brookfield Power

Ministry of Natural Resources

Ontario

Michipicoten River Water Management Plan

March 2007

Volume 1

ACRES International

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This water management plan has been prepared exclusively for Brookfield Power (BP) and the Ontario Ministry of Natural Resources (MNR). It is based on information gathered by Acres International Limited (Acres), MNR, Laurentian University and Natural Resource Solutions Inc. for this project. This plan contains opinions, conclusions and recommendations made by Acres and its subconsultant using professional judgment and care. Any use of this plan by any other party is done at their own risk and Acres hereby disclaims any responsibility or liability in connection therewith.

The guidance/assistance provided by BP, MNR and the Wawa Area Co-Management Committee is gratefully acknowledged.

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Approval Page

Water Management Plan
for the
Michipicoten River
MNR Wawa, Northeast Region
for the 10-year period April 1, 2007 to March 31, 2017

In submitting this plan, we confirm that this water management plan has been prepared in accordance with Water Management Planning Guidelines for Waterpower, as approved by the Minister of Natural Resources on May 14, 2002.

L. Andrew McPhee — Date: March 27, 2007
Vice-President, Ontario Operations
Brookfield Power
Sault Ste. Marie, Ontario

James McHardy, General Manager — Date: March 27/07
Wawa Production Centre
Brookfield Power, Wawa, Ontario

I concur that this water management plan has been prepared in accordance with Water Management Planning Guidelines for Waterpower, as approved by the Minister of Natural Resources on May 14, 2002, and recommend it be approved for implementation.

Terry Taylor, District Manager, Wawa District — Date: Mar 27/07
Ministry of Natural Resources and
Chair, Steering Committee

Approved by:

For Robert Galloway, Director — Date: March 27/07
Northeast Region
Ministry of Natural Resources

Approval of this plan does not relieve the owner/operators from their responsibility to comply with any applicable legislation or provide authority to flood private or public lands without the consent of the owners of the affected land. Nothing in this water management plan (WMP) precludes the Minister from making further orders under the Lakes and Rivers Improvement Act.

In 1994, MNR finalized its Statement of Environmental Values (SEV) under the Environmental Bill of Rights (EBR). The SEV is a document that describes how the purposes of the EBR are to be considered whenever decisions are made that might significantly affect the environment are made by the Ministry. During the development of this WMP, the Ministry has considered its SEV.

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1 Introduction, Objectives and Plan Organization

1 Introduction, Objectives and Plan Organization

Brookfield Power (BP) operates the following four hydroelectric generating stations (GS) on the Michipicoten River system (see Figures 1.1 and 1.2). Brascan Power Corporation changed its name to Brookfield Power on January 30, 2006. The new Dunford (High Falls) GS became operational in 2003. It replaced the old High Falls GS and was approved on condition that existing water levels and flow limits at High Falls would not change until after the water management plan (WMP) was approved.

Station	Installed Capacity (MW)
Hollingsworth GS	23.2
McPhail GS	12.8
Dunford (High Falls) GS	45.0
Scott GS	22.5
Total	**103.5**

The planning process for this WMP commenced in 1998, prior to the issue of the Ministry of Natural Resources' (MNR) Water Management Planning Guidelines for Waterpower in 2002 (MNR, 2002). Therefore, a Terms of Reference was developed as a guide for this WMP (see Appendix A, Volume 2). The sections of this plan generally reflect the generic Table of Contents found in Appendix B of the Water Management Planning Guidelines.

1.1 Plan Rationale and Purpose

The Ontario Ministry of Natural Resources (MNR) is the government agency responsible for waterpower lease renewals. This plan has been prepared to satisfy a condition of lease renewal as set forth by MNR in a letter dated July 8, 1998. Also, as of December 2000, MNR has the authority to request a WMP under Section 23.1(1) of the Lakes and Rivers Improvement Act. Such an order was received by Brascan Power (now Brookfield Power). WMPs are developed through public, agency and First Nation consultation in an effort to achieve a plan that reflects the interests of all parties involved in the planning process.

The need for WMPs evolved as a result of development occurring in watersheds throughout Ontario during the past century and the recognized need to address the sustainability of resources within these watersheds. While this situation has improved in recent decades as a result of Ontario's environmental assessment process and other similar processes (e.g., MNR's Waterpower Program Guidelines, 1990b), MNR's intention is to have WMPs prepared that reflect a balanced water management strategy for the unique ecosystem and human ecology that is present within each watershed.

The purpose of water management planning is therefore to ensure that consideration is given to all aspects of the existing ecosystem when selecting a preferred water management strategy that encompasses hydroelectric power, flood control, and natural resource management, as well as commercial, recreational, cultural, heritage and First Nation activities.

1.2 Goals and Principles

The goal of water management planning is to contribute to the environmental, social and economic well-being of the people of Ontario through the sustainable development of water power resources and to manage these resources in an ecologically sustainable way for the benefit of present and future generations (MNR, 2002).

Key principles that guide the water management planning process are as follows (MNR, 2002):

- Strive to maximize the net environmental, social and economic benefits derived from the management of water levels and flows.
- Stop any ongoing degradation of a riverine ecosystem resulting from the management of water levels and flows and seek to improve and restore, where possible, riverine ecosystems.
- Use best available information at the time of decision-making in water management planning.
- Conduct a thorough assessment of options for the management of water levels and flows.
- Use an adaptive management approach to planning, resource protection and enhancement.

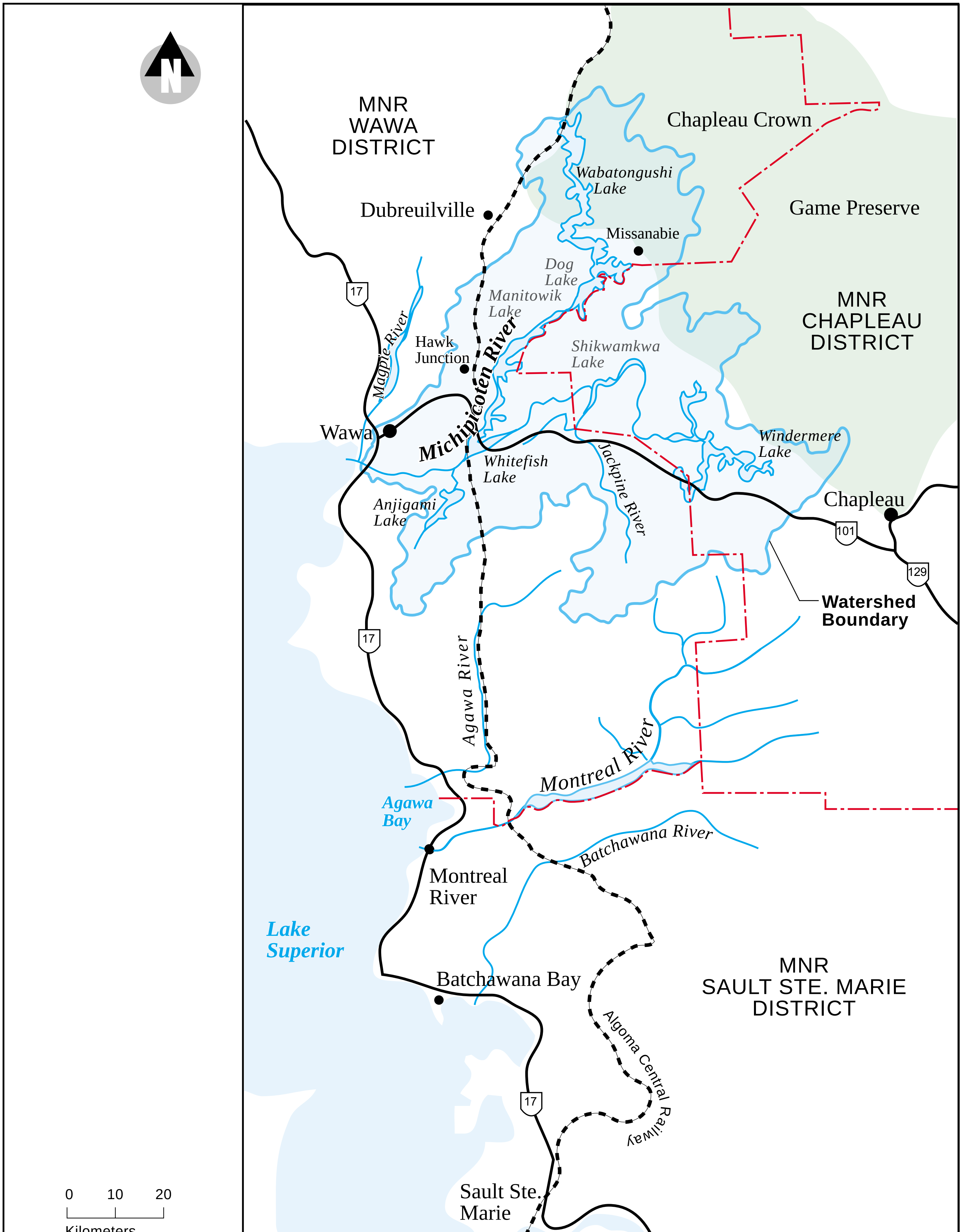

Figure 1.1
Michipicoten River Water Management Plan
Brookfield Power Corporation
Location Map

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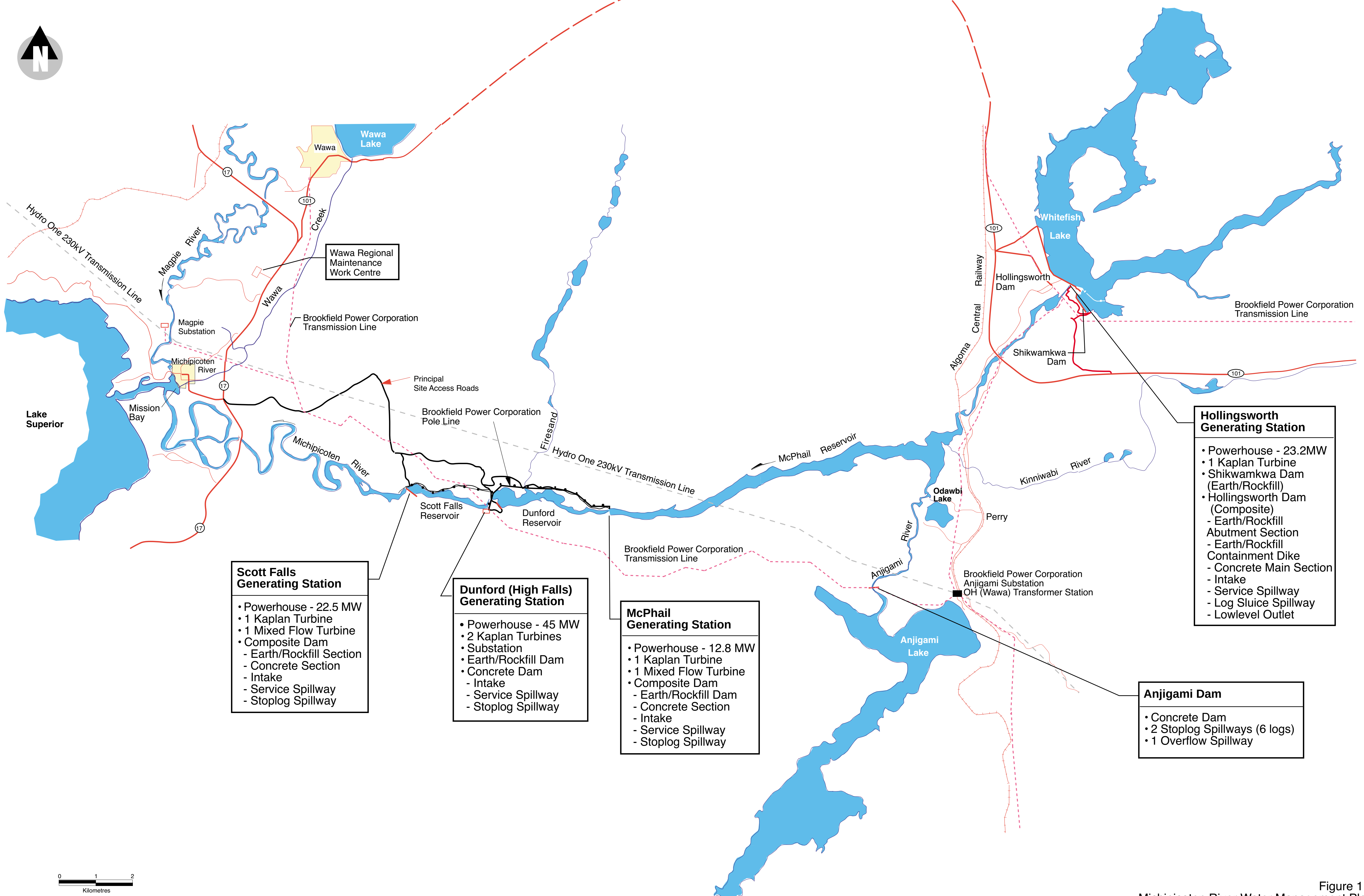

Figure 1.2
Michipicoten River Water Management Plan
Brookfield Power Corporation
Hydro Power Generating Stations on the Michipicoten River System

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- Implement study findings in a timely manner.

- Undertake water management planning without prejudice to the rights of Aboriginal people and treaty rights.

- Implement public participation to ensure accountability and transparency in the planning process.

There are also Aquatic Ecosystem Guidelines (AEGs) within the water management planning process. The key principles that guide the application of the AEGs are as follows (MNR, 2002):

- Use of the ecosystem approach, i.e., the riverine ecosystem will be considered in a holistic manner during water management planning.

- Recognition of the dynamic nature of ecosystems.

- The flow regime as a master variable.

- Arresting any ecosystem decline and seeking to improve and, where possible restore and/or mitigate.

- Documenting baseline environmental conditions at the time that water management planning commences so that changes may be measured against baseline conditions.

- Monitoring to track the success of a change in water management and the use of adaptive management.

1.3 Specific Management Objectives

Specific water management objectives for the Michipicoten River system identified by BP are as follows:

- to optimize power production in an environmentally responsible manner, primarily during peak demand periods

- to provide flood control to minimize significant property damage and to protect human life

- to enable ecological processes to co-exist with hydroelectric operations on the Michipicoten River

- to enable tourism, recreation, and cultural heritage activities to continue to co-exist with hydroelectric operations on the Michipicoten River system.

MNR's specific management objectives for the Michipicoten River system are to balance the environmental, social and economic aspects of the river system, specifically power production, flood control, sport fishing, wildlife viewing and harvesting and tourism/recreational/cultural heritage activities, as well as to maintain ecological integrity of the river system. In recent years, MNR has shifted to a more holistic management regime whereby the entire ecosystem is considered when working toward making changes to create benefits. Specific fish species may still be targeted as indicators of ecosystem health for each reservoir (Table 1.1) and were considered in developing the baseline and effectiveness monitoring described in this WMP.

1.4 Terms of Reference and Plan Organization

The first step in organizing a WMP involved the establishment of a Steering Committee and Planning Team (see Section 1.5). The Planning Team then developed Terms of Reference (Appendix A) outlining the objectives of the plan, Steering Committee and Planning Team members, general planning principles, key environmental and socioeconomic issues, a scope of work for developing the plan, a proposed schedule, a public and First Nation consultation process, and the plan review and approval process. These Terms of Reference were subsequently approved by MNR.

As noted earlier, the planning process for this WMP commenced in 1998, prior to the issue of MNR's Water Management Planning Guidelines for Waterpower in 2002 (MNR, 2002). However, the sections of this plan generally reflect the generic Table of Contents found in Appendix B of the Water Management Planning Guidelines.

Table 1.1
MNR Fisheries Management and Habitat Objectives for the Michipicoten River System

Location	MNR Targeted Fish Species/Habitat	MNR Sportfishing Target Quality	MNR Habitat Target Quality
Upper Reservoirs - Wabatongushi Lake - Dog Lake - Windermere Lake - Anjigami Lake	 Walleye, Northern Pike Walleye, Northern Pike Lake Trout Walleye, Northern Pike Lake Trout Walleye, Northern Pike Lake Trout	 High “ “ “	 High “ “ “
Upper Reservoir Outflows*	Walleye, Northern Pike	High	High
Hollingsworth Reservoir	Walleye, Northern Pike, Lake Trout (Manitowik)	Medium Medium	Adequate Adequate
Hollingsworth Outflow	Walleye, Northern Pike, Brook Trout	Medium	Medium
Lower Reservoirs - McPhail Reservoir - Dunford (High Falls) Reservoir - Scott Reservoir	 Walleye, Northern Pike Walleye, Northern Pike Walleye, Northern Pike	 Medium Viable population Viable Population	 High Medium Medium
McPhail and Dunford (High Falls) Outflows	Walleye	Viable population (see High Falls and Scott Reservoirs)	Medium (emphasis on spring)
Scott Falls outflow to Lake Superior**	Non-native Rainbow Trout, Chinook Salmon, Coho Salmon Native Walleye, Brook Trout, Sturgeon, Lake Trout	Medium Viable population	Medium Medium

Definitions of Habitat Quality

High Quality Habitat: Similar to conditions in an unmanipulated system.
Medium Quality Habitat: Habitat conditions may be moderately different from an unmanipulated system, but provide good habitat for all life stages.
Adequate Quality Habitat: Habitat conditions may be significantly different from an unmanipulated system, but still provide for critical life stages.

* Flows out of the upper reservoirs are adjusted by BP, on an as-required basis, to maintain the agreed upon operating regime for all the reservoirs.

** The objectives for this reach will be supported by BP to the extent possible within the flow regime that is available from hydropower operations and through the provision of a continuous baseflow as outlined in this WMP.

1.5 Steering Committee and Planning Team

The Steering Committee and Planning Team members for this WMP are as listed below. Some members have changed since the original teams were established in 1998, due to retirement, staff moves to other offices, etc.

Steering Committee
Terry Taylor, MNR, Wawa (Chair)
Ian Crawford, MNR, Peterborough
Andy McPhee, Brookfield Power, Sault Ste. Marie
Jim McHardy, Brookfield Power, Wawa.

Planning Team
Kay Ashwood, Hatch Energy (formerly Acres International)
Michelle Miller, MNR, Wawa
Viggo Lundhild, Brookfield Power
Dale Peters, Brookfield Power
Tim Middleton and Bob Wilson, MNR, South Porcupine
Nathan Hanes, MNR, Wawa
Rob Steele, Natural Resource Solutions, Waterloo
John Chiupka, Wawa Area Co-Management Committee
(acting as Public Advisory Committee for this plan)

Advisors to the Planning Team
Sandra Dosser, MNR, South Porcupine
Jennifer Hallett, DFO, Sault Ste. Marie
Tom Kenerknecht, MNR, Wawa
Paul Gamble, MNR, Wawa
Greg Deyne, MNR, South Porcupine
Sue Greenwood, MNR, Upper Great Lakes Management Unit

1.6 Unique Feature of this Water Management Planning Process

For the purposes of this water management planning process, BP's hydroelectric operations on the Montreal and Michipicoten Rivers are presented and evaluated in the model runs (see Sections 8, 9 and 10) as a combined system as they function as part of an integrated unit with the rest of the BP system. The Terms of Reference (Appendix A) specified that an integrated methodology would be used to assess water management strategies for both river systems but that two separate plans would be produced, one for each river system.

2 Agency, Public and First Nation Consultation

2 Agency, Public and First Nation Consultation

2.1 Agency Consultation

The western half of the Michipicoten River watershed is within MNR's Wawa District and the eastern half is within MNR's Chapleau District (see Figure 1.1). Therefore, these were the two key MNR offices involved in providing environmental and socioeconomic baseline information for the WMPs. Also, staff from MNR (Wawa and Peterborough) were on the Steering Committee and staff from MNR (Wawa and South Porcupine) were on the Planning Team. Additional MNR (e.g., Ontario Parks) and Department of Fisheries and Oceans (DFO) support was provided in a review/advisory capacity. Several other federal, provincial and municipal agencies were also contacted inviting input to the WMP process (Appendix B1, Volume 2).

A separate presentation was made to the Township of Michipicoten Council in October 2005 outlining proposed water management plans for both the Michipicoten and Montreal River systems. Communications with the Township are outlined in Appendix B1, Volume 2 of this plan.

2.2 Public Consultation

A Public Consultation Plan was prepared prior to implementation of the water management planning process. This plan is included as part of the Terms of Reference contained in Appendix A.

The purpose of public consultation as a component of the water management planning process was to

- inform stakeholders and other members of the public of the water management planning process
- outline the time frame (schedule) for the water management planning process
- receive stakeholder/public input to the water management planning process with respect to issues and activities in the Michipicoten watershed

- receive stakeholder/public comment on water management strategy options considered and the selected water management strategy proposed for the Michipicoten River

- provide an opportunity for stakeholder/public comment on the draft water management plan produced for the Michipicoten River.

The mechanisms that were used to ensure adequate opportunities for public input to the planning process were as follows:

- Environmental Bill of Rights (EBR) public registry notification (project announcement August 7, 1998)

- Involvement of a Local Citizens' Committee (LCC) (Wawa Area Co-Management Committee) who acted as the Public Advisory Committee (PAC) as there was no requirement for a PAC at the time of planning. They had a representative on the planning team and had opportunities to review and comment on the issues list and various plan components as they were developed, including the Terms of Reference for the plans

- Five meetings with the Wawa Area Co-Management Committee (July 16, 1998, March 16, 2000, April 28, 2001, November 20, 2001, August 23, 2005)

- Contact with other LCC's (Superior Local Citizens Committee, Chapleau Public Advisory Committee, Magpie Forest Co-Management Committee)

- Public Information Centres (PIC) in Wawa, Chapleau and Batchawana Bay

- Public notices on community TV channels in Wawa (English) and Dubreuilville (English and French)

- Newspaper public notices in the Algoma News Review (Wawa), Chapleau Express, Chapleau Sentinel and Sault Star

- Public notices in mail boxes at Dubreuilville and Missanabie Post Offices

- Mailouts to stakeholders

- Newsletter.

In addition, the Wawa Area Co-Management Committee (an LCC) provided a representative to act as a member of the Planning Team.

2.3 Public Information Centres

The first series of Public Information Centres were held in Wawa, Chapleau and Batchawana Bay on August 24, 25 and 26, 1998, respectively. The Information Centre in Batchawana Bay was primarily related to the Montreal River Water Management Plan, while Information Centres in the other communities focused on both the Michipicoten and Montreal River systems. A copy of the public notice, in English and French, is included in Appendix B. Public notices were placed in the following newspapers:

	Date
Sault Star	July 28, 1998
Algoma News Review	July 29, 1998
Chapleau Express	August 2, 1998
Chapleau Sentinel	August 8, 1998

In addition, the notice was presented on Wawa and Dubreuilville TV channels 1 week prior to the information centre. Also, a copy of the notice was inserted into 360 mailboxes in Dubreuilville, 35 mailboxes at Missanabie, and sent to an extensive mailing list of approximately 1000 stakeholders, public interest groups, associations and government agencies.

The purpose of the first series of PICs was to advise stakeholders and the general public of the water management planning process underway for the Michipicoten River and to solicit input on the environmental/ socioeconomic environment within the watersheds and any issues to be addressed. Approximately 30 people attended the Information Centre in Wawa; 8 people attended the Information Centre in Chapleau, and 5 people attended the Information Centre in Batchawana Bay. A summary of the issues raised on the Michipicoten River system is provided in Section 5 - Issues, Data Gaps and Baseline Data Collection.

A second series of PICs were held in Wawa and Batchawana Bay on August 24 and 25, 2005 to

- update stakeholders and the general public on the status of the water management planning process for the Michipicoten River

- receive comments on the draft WMP, including options considered and evaluated

- receive comments on the proposed water management strategy for the Michipicoten River system

Notices of the PICs were placed in the Sault Star (August 15, 2005, Chapleau Newspaper (August 14, 2005) and Algoma News Review (August 17, 2005). A copy of the notice also went to an extensive mailing list of stakeholders, and is included in Appendix B, Volume 2.

Approximately 15 people attended the Information Centre in Wawa, and 12 people attended the Information Centre in Batchawana Bay. When asked whether they were in agreement with the proposed WMP for the Michipicoten River, the following responses were received:

	No. Responding on Comment Form re Michipicoten River	**In Agreement with Plan**		
		Yes	**No**	**Unsure**
Wawa PIC	11	7	2	2
Batchawana Bay PIC	2	2	0	

Comments received at the Information Centre regarding the Michipicoten River WMP are summarized in Table 2.1.

2.4 Contacts with First Nations

Invitations to meet personally with First Nation groups were sent out to the following:

- Michipicoten First Nation
- Batchewana First Nation of Ojibways
- Brunswick House First Nation
- Chapleau Ojibwe First Nation
- Missanabie Cree First Nation
- Chapleau Cree First Nation.

Table 2.1
Summary of Comments Received on the Michipicoten WMP at the PICs on August 24 and 25, 2005

Comment	Response
Extra spring flow below Scott GS for spring spawning fish is great but what about fall spawners (Sturgeon and lake trout)?	There is already a continuous base flow of 17 m^3/s below Scott GS. This will be increased in the spring to 26.3 m^3/s April 15 to June 15. Not all aquatic ecology issues could be addressed in this WMP cycle and current energy demands are also a consideration
I would like to see the historical information for the Michipicoten River mouth (e.g., test pit locations and numbers).	This information has been provided to the Heritage Operations Branch of the Ministry of Culture. Precise locations are not routinely publicly disclosed to preserve the integrity of the heritage sites.
An external body (MNR or local body) should be notified when there are water flow problems.	This WMP outlines a formal reporting procedure to MNR when there are water level or flow problems (see Section 13).
Drastic drop in water levels in October might be detrimental to fall spawning fish.	Water levels do not typically drop drastically in October, and can on occasion rise depending on water availability. Energy demand must also be a consideration.
It is not easy for the general public to understand the massive amounts of information in the binders at the Information Centre.	It is acknowledged that a WMP for a river system with four hydro plants on it can be complex to understand. However, a draft plan summary was prepared and issued to the public which summarized the information in the binders.
Concern at the last bend in the river before marina, and that flow will eventually erode the bank and create a breach, making the marina and Michipicoten mouth no longer usable.	This would also occur with naturally high spring flows. BP would be interested in discussing a monitoring program with the Township of Michipicoten and possibly participating in erosion protection.
Concern that lost hydro power generation will result in increased development on greenfield sites.	This is a likely possibility as renewable energy demand is increasing.
Concern that the options evaluation did not consider the broader provincial generation requirements.	Steering Committee was very aware of this situation which is why all aquatic ecology issues could not be addressed in this WMP.
Glad to see reduced drawdown on Hollingsworth Reservoir but would have liked it reduced more. Concern about high water level in spring – would like it lower to reduce shore damage.	Spring water levels are contingent on inflows from the spring freshet (precipitation and snowmelt.) Maximum existing operating water levels (Section 11) will be maintained to minimize potential for flooding and shore damage.

Great Lakes Power Limited (GLPL) representatives had informal discussions with Chief Sam Stone of the Michipicoten First Nation early in the water management planning process. There was an offer to have a formal meeting with Band members but there was no interest in such a meeting at the time and no issues or concerns raised. As there were no specific First Nation community meetings planned, it is difficult to determine if the appropriate level of aboriginal consultation was completed.

All of the First Nations groups listed above were invited to the PICs held in Wawa, Chapleau and Batchawana Bay early in the planning process (August 1998). A representative of the Chapleau Cree (Fox Lake) attended the Chapleau Information Centre and a representative of the Batchewana First Nation attended the Batchawana Bay Information Centre. Representatives of other First Nations were not in attendance at the Information Centres. However, the Michipicoten First Nation was contacted again following the information centre to see if they had any interest in participating in the planning process. No issues or concerns were registered by First Nations groups.

A First Nation participation plan was developed for the Michipicoten First Nation group and is included in Appendix P. This plan is in draft form as a working document and has not yet been discussed or approved by the Michipicoten First Nation. This participation plan will be used as a starting point for discussion with the Michipicoten First Nation in the next water management planning cycle.

MNR and BP representatives met with the Chief and Elders of Michipicoten First Nation on September 6, 2005 at the draft plan stage, prior to finalization of the WMP to

- inform them of the results of the water management planning process
- determine if they have any concerns or issues (none raised)
- inform them of MNR's ongoing commitment to assist local First Nations with their traditional values database as part of forest management planning and water management planning processes.

For the meeting noted above, a Notice of Aboriginal Community Meeting was posted on August 15, 2005 and a newsletter sent out to community members informing them of the Information Centre (see Appendix P, Volume 2).

MNR met with the Michipicoten First Nation again on January 9, 2006 and briefed the Chief and Band Manager on the status of the Michipicoten WMP review and pending approval by MNR. There were no concerns raised at that time. For additional details on First Nations contacts, see Appendix P.

In addition to the above, MNR will continue efforts to meet with the Missanabie Cree Chief and Council to inform them of the water management planning process, invite comments, and provide the results of the planning process.

2.5 Newsletter

In November 1999, a newsletter (Appendix B) was sent out to all persons who had indicated an interest in being updated on the water management planning process.

The newsletter provided information on the issues identified as a result of the Public Information Centres held in 1998. It also listed BP issues and MNR issues. In addition, the newsletter summarized progress to date and the next steps in the planning process.

The planning process was subsequently delayed due to the time required by the planning team to identify options, option criteria for evaluation, and conduct model runs and the evaluation of results. Additional time was then required to modify the WMP format to more closely meet MNR's WMP guidelines which were issued in 2002. It then took until December 2004 to reach agreement on a preferred water management option. The August 2005 PICs were then held (as described in Section 2.3) to update stakeholders and the general public on progress with the planning process.

2.6 Environmental Bill of Rights

MNR issued an order for Brascan Power (now Brookfield Power) to prepare a WMP under Section 23(1) of the Lakes and Rivers Improvement Act (LRIA). This caused it to be subject to publishing in the EBR registry in accordance with Ontario Regulation 681/94 (EBR Classification of Proposals for Instruments).

The EBR Registry Number for the Michipicoten River WMP initial notice was PB8E2015 and a copy of the EBR notice is provided in Appendix O. The notice was first published in the Environmental Registry on August 7, 1998 at the Invitation to Participate Stage. An instrument information notice for this WMP was also published at the Draft Plan Review Stage on August 8, 2005 (EBR Registry Number XB05E2801).

3 The Michipicoten River System

3 The Michipicoten River System

The headwaters of the Michipicoten River commence just north of Wabatongushi Lake (also known locally as "Wabatong" Lake) and flow southwest toward Lake Superior (see Figure 1.1). There are a number of tributaries, the largest of which are the Shikwamkwa-Windermere Lakes system, the Jackpine River and the Anjigami River. The Magpie River also drains into the Michipicoten River 1 km to the east of Lake Superior but this basin is not considered part of the Michipicoten River system for the purpose of this plan.

The western part of the Michipicoten River system is within MNR's Wawa District and the eastern part is within MNR's Chapleau District (see Figure 1.1).

The following sections provide physical and biological descriptions of the river system, along with a socioeconomic profile. A description of waterpower facilities and water control structures follows in Section 4. The effects of such facilities are generally related to the facility's operations. In the case of the Michipicoten system, the aquatic ecosystem changed over time from a riverine environment to a more lacustrine environment, except for that stretch of river below Scott GS which remains in its natural channel form, but with a change in flows and velocities as a result of hydro generation. Precise effects on the aquatic ecosystem as a result of the presence of hydroelectric facilities on the river system are unknown since no baseline environmental information was collected prior to construction of these facilities in the early to mid-part of the 1900's. Hydroelectric development in the Wawa area provides power to local industry, and commercial, residential and institutional users. Commercial lodges and private camps became established around the upper reservoirs to take advantage of recreational opportunities.

3.1 Physical/Biological Environment

3.1.1 Climate

The Michipicoten River is located in the Canadian Shield area northeast of Lake Superior near the Town of Wawa. The climate of the area is continental and affected by its proximity to Lake Superior. Prevailing winds are out of the southwest, which can cause significant lake-effect precipitation in the area near Lake Superior. This lake effect, however, does not extend very far inland

and only impacts on about 13% of the lower drainage basin. Therefore significant variations in average rainfall occur across the drainage basin.

Average annual precipitation for the entire watershed is estimated at 826 mm, with the lower basin receiving on average 1000 mm and the upper basin approximately 800 mm. The portion of annual precipitation falling as snowfall varies from a rainfall equivalent of 300 mm in the lower basin to about 250 mm in the upper part. Snowfall typically occurs in the winter period from November through to early April. Storms with mixed precipitation including rainfall can occur in all winter months due to storm systems tracking in over the upper Great Lakes. This has some impact on runoff in the basin and can periodically induce early or late winter flood events.

Annual mean temperature over the basin is approximately 4°C. Average monthly temperatures are below freezing from December through to April, with the coldest month being February at -10.5°C and the warmest month July at 13°C. The watershed typically experiences about 1100 degree-days of freezing each year with lake and river freeze-up occurring in early December. In the spring, break-up of river ice cover occurs on average around mid-April, followed by the break-up of ice cover on lakes and reservoirs near the end of the month. On average, about 4100 degree-days above freezing occur on an annual basis.

3.1.2 Hydrology

Watershed Characteristics

The Michipicoten River watershed, as shown in Figure 1.1, encompasses a total drainage area of 5200 km^2. The catchment is part of the Lake Superior Drainage Basin, discharging into the Michipicoten Bay area of eastern Lake Superior through Mission Bay (see Figure 1.2). The watershed is roughly triangular in shape, with the main stem of the river outlet located at the lower, western point. The watershed extends easterly some 100 km and to the north by a similar distance, with runoff flowing generally south and east. The eastern watershed boundary forms part of the major arctic drainage basin divide with neighboring rivers to the east flowing northward into Hudson and James Bay. The western side of the watershed borders primarily on the Magpie River catchment and the small Wawa Lake and Wawa Creek watershed, both of which flow in a southerly direction and discharge into the Mission Bay area where they combine with the Michipicoten river flows before discharging into Lake Superior. The southern limit of the catchment borders the Agawa River and Montreal River catchments which flow into Lake Superior (Figure 1.1).

The watershed is typical of the many rivers of northern Ontario with numerous natural lakes and wetland areas interconnected by short river reaches. The total fall in the watershed is estimated at 275 m from the height of land at the watershed boundary down to Lake Superior level. The generation of hydroelectric power has long been supported on the lower reaches of the river, which has led to the conversion of some of the larger natural lakes in the upper reaches of the catchment into storage lakes with control dams to facilitate the release of water during low runoff periods of the year. Four hydroelectric generating stations are located on the Michipicoten River beginning with Scott GS, Dunford (High Falls) GS, McPhail GS and Hollingsworth GS, as shown in Figure 1.2. The largest storage reservoir in the watershed is located at Hollingsworth GS, which was the original confluence point of the Shikwamkwa River tributary with the Michipicoten River below Whitefish Lake. This development created a primary storage reservoir which joins the Shikwamkwa with Whitefish Lake, which in turn extends upstream and merges with Manitowik Lake (Plate C1, Appendix C). Manitowik Lake was a former storage lake with an outlet dam which was decommissioned in 1959. The Hollingsworth reservoir has a live storage volume of 403 x $10^6 m^3$ and regulates runoff from 83% (4450 km^2) of the total watershed area.

Upstream of the primary storage reservoir at Hollingsworth are three secondary storage lakes comprised of Dog and Wabatongushi Lakes, upstream of the Whitefish/Manitowik arm of the reservoir, and Windermere Lake on the Shikwamkwa River (Plate C1, Appendix C). The total live storage of these three storage lakes is 251 x $10^6 m^3$. A fourth secondary storage lake is located in the southern portion of the watershed at Anjigami Lake (Plate C1, Appendix C) which regulates flow in the Anjigami River tributary. Total live storage in this lake is 24 x $10^6 m^3$ and flow is released into the Michipicoten River downstream of Hollingsworth GS, into the upper end of the McPhail GS reservoir.

Runoff Characteristics

Runoff in the Michipicoten River basin has been recorded since 1920 after the first hydroelectric site was developed at High Falls in 1908. A combination of plant operating data plus streamflow measurement sites set up by the Water Survey of Canada (WSC) has been compiled for inclusion in their national data base of surface water runoff. The earliest data contains a large amount of missing data, especially in the winter months. More reliable and virtually complete daily data is available for the period from 1933 onward. This data provides a very long historical record of the runoff yield of the watershed. However, caution must be exercised in the use of much of this data due to continuing development of various hydroelectric generation sites and storage regulation throughout the watershed, which has altered the distribution of flows throughout the hydrological year. Some of the operational data has been derived on the basis of assumed turbine and generator efficiency, which is used to convert electrical generation into flow and may include some margin of error inherent from this calculation.

3.1.3 Water Balance Budget

Long-term mean annual runoff for the Michipicoten River is 13.43 L/s/km^2, which is equivalent to 424-mm runoff depth over the catchment. Mean annual precipitation for the watershed is estimated at 826 mm. The loss of water in the watershed by evapotranspiration is the difference in these two figures and equals 402 mm, or 49% of annual precipitation. This is typical for this region of the province.

3.1.4 Geology/Mineral Resources

The bedrock of the area is composed of igneous and metamorphic rocks of the Early Precambrian Canadian Shield. The area to the north of a line running approximately from Michipicoten Bay northeast to Dog Lake consists of Early Precambrian metamorphosed volcanic and sedimentary rocks, the Wawa Greenstone Belt. It is within this belt that economic minerals are found (Rupert, 1975). The rest of the region is dominated by intrusive rocks, predominantly granites, gneiss, granodiorites and diorites. There are a number of dikes of Late Precambrian age which intrude into these older rocks.

Economic mineral resources found in the area include iron ore, gold and a few occurrences of lead, zinc and copper-nickel (Rupert, 1975). Gold and diamond explorations are continuously being conducted in the watershed. Aggregate deposits of sand and gravel are present in the floor of the Michipicoten River.

3.1.5 Topography/Soils

The topography is rugged with hills rising steeply to 300 m above the lakes and river. There is a general northeast to southwest alignment of the valleys which has been emphasized by glaciation. Higher elevations are found between Whitefish Lake and the Shikwamkwa River and in the headwaters of the Jackpine River rising to heights of 518 m (1700 ft). The highest area is north of Windermere Lake reaching almost 610 m (2000 ft). The base level is controlled by Lake Superior, at an elevation of 183 m (601 ft).

The soils information is taken primarily from McQuay, 1980. Soils at the mouth of the Michipicoten are characterized by low-lying terraced sand and gravel outwash deposits with good drainage interspersed with sandy alluvial plain deposits with poor drainage. The glaciofluvial deposits are found discontinuously along the river valley to High Falls where they are interspersed once again with alluvial material on the north side of the river. Another occurrence of the same soil types is found north of the McPhail damsite.

East of the McPhail Dam, to the mouth of the Anjigami River, there is mainly steep exposed bedrock interspersed with pockets of ground moraine having good drainage. Glaciofluvial deposits are found again near the mouth of the Anjigami in the form of well drained, low lying, sand and gravel outwash sediments. These deposits surround poorly drained, sandy alluvial plain deposits at the mouth of the Anjigami. The glaciofluvial deposits are found south along the Anjigami to Anjigami Lake, east along the Kinniwabi River and northeast along the Michipicoten to Whitefish Lake. Thicker surficial deposits are located in the southeast part of the watershed (south of Highway 101 and east of Jackpine River) where both sand and gravel glaciofluvial deposits and thicker till deposits are found. There are occasional pockets of organic/peat deposits found throughout the area.

The surficial deposits found throughout the Michipicoten system, other than exposed bedrock, are generally sandy to gravelly and are thus fairly easily eroded. Some areas of erosion susceptibility between High Falls and Highway 101 were noted during field investigations in 1994 and 1997 for the High Falls redevelopment project. These areas of erosion susceptibility are noted on the plates in Appendix D and are generally comprised of a graduated till ranging from gravel to coarse sand.

The higher areas of the watershed have bedrock exposed or near the surface, whereas the valley bottoms, in particular the lower reaches of the Michipicoten River, contain glaciofluvial deposits of sand and gravel.

The southwest portion of the Chapleau Crown Game Preserve is within the Michipicoten watershed (see Figure 1.1). The soils in this area are generally silts and very fine sand or mixed moraine rubble.

3.1.6 Biological Resources

This section is divided into various subsections which describe the biological resources in, or in close proximity to, the Michipicoten River system. It is also important to recognize the various ecological processes that are occurring between organisms and their environment to enable reproductive success and the sustainability of existing resources in their present environment. For example, in an aquatic environment the food chain commences with sun energy being fixed in phytoplankton, which in turn, is consumed by zooplankton. These are, in turn, consumed by benthic invertebrates (benthos) and fish. At the upper end of the food chain many birds and mammals (including humans) consume fish as a part of their diets.

Similarly, individual components of an organism’s life cycle are dependent on a number of variables occurring as part of ecological processes. For example, optimum conditions for fish spawning are dependent on water temperature, flow velocities, water depths and substrate conditions. Littoral zone and wetland habitat are also important as feeding, nursery and resting areas for fish, benthos, waterfowl and aquatic furbearers. The interrelationships between species and their environment are very important when considering resource use on the Michipicoten River. The necessity of making management decisions, despite an incomplete understanding of these interrelationships, is the underlying reason for the adaptive management approach employed in this water management plan.

3.1.6.1 Fisheries

Table 3.1 lists large fish species known to occur in the waters affected by hydro power operations on the Michipicoten River system. Some of these storage reservoirs are also individual management zones in the Wawa District Fisheries Management Plan (see Plate C7, Appendix C, and Appendix H). Others are part of larger management zones (see Plate C7). Additional information is provided below and in MNR lake survey records.

Wabatongushi Lake

MNR's Natural Resource Values Information System (NRVIS) mapping designates this lake as a warm water lake. The lake is primarily a walleye, northern pike, and yellow perch fishery. Coregonids (lake whitefish and cisco) are also present. The lake has a surface area of 38.4 km^2 and is accessible by railway and road from Dubreuilville. Historically, angling pressure has been heavy as indicated by a 1984 creel census which demonstrated that both walleye and northern pike were being harvested at a rate well above their estimated potential yield (MNR, 1989).

Dog Lake

MNR's NRVIS mapping designates Dog Lake (49.7 km^2) as a cold water lake. MNR has designated the lake as a Category B2 lake trout lake (MNR, 1983) which means that the lake is presently managed for lake trout but other management objectives are considered in combination with lake trout management (see Section 4.4). Dog Lake is a walleye, northern pike, lake trout and yellow perch fishery (MNR, 1989). Smallmouth bass and coregonids are also present. A 1981 creel census indicated that all fish species were being harvested below the estimated potential yield of the lake. Review of the latest (1987) creel data available from MNR indicates that the harvest did increase between 1981 and 1987 but had not yet reached the maximum potential yield.

Windermere Lake

Windermere Lake has a surface area of 39.1 km^2. It is designated by MNR Chapleau as a quality fishing zone (MNR, 1989b) since little to no road access

Table 3.1
Known Large Fish Species[1]
on the Michipicoten River System

	Wabatongushi	Dog	Windermere	Hollingsworth Reservoir	Anjigami Lake	Odawbi Lake	McPhail Reservoir	Dunford Reservoir	Scott Falls Reservoir
Walleye	*	*	*	*	*	*	*	*	*
Yellow Perch	*	*		*	*	*	*		
Northern Pike	*	*	*	*	*	*	*	*	*
Lake Whitefish	*	*	*	*		*	*	*	
Cisco	*	*		*	*	*		*	
White Sucker	*	*	*	*	*	*	*	*	*
Long Nose Sucker				*	*		*	*	
Burbot	*	*	*	*	*			*	*
Smallmouth Bass		*	*	*	*	*	*		
Lake Trout		*	*	*	*			*[2]	

[1] This summary of fish species was compiled using the following sources:
a - Unpublished Lake Survey information obtained from MNR Wawa
b - MNR Wawa District Fisheries Management Plan (MNR, 1989)
c - Anecdotal information received from fishermen during public meetings for the Michipicoten River Water Management Plans (held in Wawa and Chapleau, August 24/25, 1998)
d - Information from MNR Wawa District Biologist.

[2] One lake trout was caught in MNR lake survey netting at High Falls Reservoir in the 1980's. This is believed to have been an incidental transfer from the upper (secondary) storage reservoirs. Lake trout is not targeted for management by MNR in Dunford (High Falls) Reservoir.

has resulted in the preservation of a quality fishing experience for the lake (MNR, 1989a). Known fish species present in the lake are walleye, pike and lake trout as well as whitefish, smallmouth bass, whitesucker and burbot. As with Dog Lake, Windermere is a Category B2 lake and is presently managed primarily for lake trout but with consideration allowed for other lake management objectives (MNR, 1983a) (see Section 4.4).

Hollingsworth Reservoir (Whitefish/Manitowik Lake)

Hollingsworth is the main hydroelectric storage reservoir for the Michipicoten River power system operated by BP. It has a surface area of 49.9 km^2. The predominant species in the lake are walleye, pike and lake trout, although coregonids (whitefish and cisco), smallmouth bass and yellow perch are occasionally caught by anglers (MNR, 1989). A 1986 creel survey showed that all species of fish were being harvested below their estimated potential yield (MNR, 1989). The upper portion of this Lake system (Manitowik) is classified as a B2 lake and is presently managed by MNR for lake trout. The Whitefish portion has very few lake trout and is categorized as a Category C lake meaning that it is no longer managed for lake trout even though some residual trout may be present (MNR, 1983).

Anjigami Lake and River

Anjigami Lake has a surface area of 10.6 km^2 and is used as a secondary storage reservoir for the McPhail Reservoir located on the Michipicoten River (Figure 1.2). The lake empties into McPhail Reservoir via the Anjigami River. Fishing for walleye, northern pike and lake trout occurs on Anjigami Lake and one fisherman at the Wawa Public Open House reported “fair” fishing for walleye. Yellow perch and cisco are also known to be present. A 1995 spawning survey (Jerrard, 1995) identified the area at the base of Anjigami Falls (1.5 km downstream of Anjigami Lake) as an important walleye spawning ground.

Odawbi Lake

Riffle habitat occurs along the Odawbi Lake outlet channel that flows into Anjigami River. MNR (Wawa District) indicates that Odawbi Lake is rated as a high potential walleye spawning area.

Michipicoten River
(Downstream of Hollingsworth GS to McPhail Reservoir)

Local residents report catching walleye, northern pike and brook trout in this 4 km stretch of the Michipicoten River. In recent years, reports of brook trout catches have increased in this stretch of the Michipicoten River, and may be related to their relocation from the pond area below Shikwamkwa Dam to the lower Shikwamkwa River during construction of the Shikwamkwa Replacement Dam.

Historically, brook trout have been found more commonly below the Shikwamkwa Dam and in the lower Shikwamkwa River which flows into the Michipicoten River (Figure 1.2). Brook trout have also been observed making use of artificial spawning beds built by BP in 1995 below Shikwamkwa Dam, which were subsequently washed out when a beaver dam broke upstream during heavy rains.

Brook trout habitat areas also occur in the vicinity of Highway 101 bridge. Depending on the amount of flow coming from Hollingsworth GS (Plate C1, Appendix C), wetted area, depth and velocity patterns differ over the substrate in this area. This was demonstrated during 1995 and 1998 experiments carried out by BP (Acres, 1996; NRSI, 1999). MNR is of the opinion that the habitat area in the vicinity of Highway 101 bridge and upstream is important for invertebrate and fish production, although field investigations have not confirmed its importance for fish production.

McPhail Reservoir

McPhail Reservoir has a surface area of 3.16 km^2 and is located between the Algoma Central Railway tracks and McPhail GS (Figure 1.2). A 1995 spawning survey revealed that several tributaries to McPhail Reservoir have the potential to support walleye spawning activities. These tributaries include the Anjigami and Kinniwabi rivers and the outlet channel of Odawbi Lake. For more detail on the habitat features of each of these tributaries, see Jerrard (1995).

Gillnetting undertaken in the reservoir in 1998 as part of the High Falls Redevelopment Project yielded whitefish, walleye, northern pike, white sucker and smallmouth bass.

Dunford (High Falls) Reservoir

This reservoir has a surface area of 0.78 km^2 and is located between McPhail GS and High Falls GS as shown in Figure 1.2. Most of the available information for this reservoir is from 1994/95 field surveys undertaken for the proposed redevelopment of the High Falls GS. A walleye spawning survey identified three locations where spawning occurs or where good potential for spawning exists in the reservoir. These areas are the Firesand River (Site 1), Moon Creek (Site 3) and at the toe of the earthen dam at McPhail Falls (Site 9) as shown on Plate D1, Appendix D. At the toe of the dam, fish may have simply been staging and actually spawning somewhere within the tailrace discharge area. A complete description of the spawning survey results is contained in the Acres (1997a) report.

Attempts at gillnetting during the 1994 fieldwork yielded very low catch per unit efforts [i.e., two fish for 15 hours of fishing with a 61-m (200-ft) gillnet]. This suggests a very limited population of fish in the reservoir which was further substantiated by the few fish observed during a spawning run (i.e., maximum of 10 fish at any one location).

Immediately downstream of the McPhail tailrace, there is a rock pile which may provide limited spawning potential for walleye. This rock pile will be impacted by a planned 0.5-m raise of Dunford (High Falls) reservoir, and a new spawning bed will be created to compensate for this loss (Acres, 1998).

Scott Reservoir

The Scott Reservoir is small in size (0.26 km^2) and is located between High Falls GS and Scott Falls GS as shown in Figure 1.2. Fish populations are believed to be minimal in this reservoir, although no field investigations have been carried out to date.

Immediately downstream of the High Falls tailrace, there is a small rock pile which may be used for walleye spawning and invertebrate production. Since the area was disrupted by construction of the Dunford (High Falls) Redevelopment Project, a new spawning bed was built downstream of the new powerhouse tailrace in 2005 to compensate for reduced flows over this existing rock pile.

Michipicoten River Below Scott Falls

MNR's Wawa District Fisheries Management Plan (MNR, 1989) lists rainbow trout, chinook salmon, and pink salmon as the predominant migratory salmonids making use of this 15 km portion of the river.

Goodier (1982) identified the Michipicoten River as being one of six rivers in eastern Lake Superior with major lake trout spawning runs prior to 1955.

MNR (Wawa District) also advises that coho salmon, lake trout, brown trout, brook trout, walleye, pike, sturgeon, small mouth bass, yellow perch, whitefish, and carp are found in the river. Sea lamprey are also known to use the river below Scott Falls and this section is periodically treated with lampricide.

Moderate spring and fall runs of rainbow trout are known to occur. Runs of chinook salmon peaked in the 1980's, dropped dramatically in the 1990's, and have risen steadily since then. Table 3.2 provides a summary of annual counts of chinook and pink salmon in the lower Michipicoten River.

Table 3.2
Summary of Annual Counts of Chinook and Pink Salmon During Fall Spawning Runs
(Lower Michipicoten River)

Year	Estimated Number of Chinook Salmon	Estimated Number of Pink Salmon
1987	10 000	-
1988	5 000	-
1989	1 200	-
1990	555	-
1991	840	-
1992	536	-
1993	113	-
1994	111	235
1995	104	87
1996	143	46
1998	45	231
1999	424	-
2000	717	355
2001	682	2000+

Source: Adapted from Upper Great Lakes Management Unit – Lake Superior Annual Report 2001 (MNR, 2001).

MNR (Wawa District) advises that pink salmon runs were also high in the 1980’s, particularly in odd-numbered years. An estimated 100 000 came up the river in 1987. Considerable runs continue in both odd and even years.

3.1.6.2 Wildlife

Typical boreal wildlife assemblages are found in the Michipicoten River watershed. Mammals using aquatic habitats include moose, muskrat, otter and mink. Known moose wintering areas are shown on Plate C2, Appendix C.

Several species of ducks and geese use the system during migration and for breeding. A number of other water birds also breed on the system, including common loons, great blue herons, bald eagles and osprey. The bald eagle is listed in Ontario’s Endangered Species Regulations. The Jackpine River is a known stop for migratory birds (MNR, 1983). The locations of known heronries and raptor nesting sites are shown on Plate C2, Appendix C.

Several amphibian species use the aquatic areas of the watershed. There are also a large number of vertebrates that use the riparian areas of the watershed.

The eastern and northern portions of the Michipicoten watershed include part of the Chapleau Crown Game Preserve (CCGP) (see Figure 1.1). The CCGP supports 190 bird species, 50 mammal species, 14 amphibian species and 2 reptile species. The CCGP has high population levels of species such as moose, black bear, beaver, marten and lynx. Two endangered species listed in Ontario’s Endangered Species Regulations (golden eagle and eastern cougar) have been reported in the preserve. In addition, a remnant elk population from a 1933 introduction and a small number of woodland caribou may also exist (MNR, 1990a). A detailed list of invertebrate, insect, fish, reptile, bird and mammal species found in the CCGP is provided in Appendix E.

3.1.6.3 Wetlands

The Michipicoten River watershed is located in the Lower Boreal Wetland Region. Wetlands characteristic of this region include domed bogs, basin bogs, and basin fens. Coniferous swamps containing black spruce or eastern white cedar and hardwood swamps with black ash are also characteristic of this region (National Wetlands Working Group, 1988).

Wetland area in the Dunford (High Falls) and McPhail reservoirs was studied as part of a Project Information Package (PIP) submitted to MNR for potential raises of these reservoirs (Acres, 1997). The PIP document provided relevant information on a portion of the wetland area on the Michipicoten River system. There are approximately 18.7 ha (46.2 acres) of wetlands in the Dunford (High Falls) and McPhail Reservoirs on the lower Michipicoten system and their locations are shown on the air photos in Appendix D (Acres, 1997). Generally, these wetland vegetation communities are comprised of spikerush, meadow, cattail and mixed marshes, thicket swamps, conifer swamps, and a shrub fen (Acres, 1998). All the wetlands in these two reservoirs were assessed and none met the criteria for designation as “provincially significant” under Ontario’s “Wetland Evaluation System, Northern Manual” (MNR, 1993/94). Also, if the reservoir raises were to take place, it is predicted that there may be a shift from shrub (alder) to wetland communities dominated by emergent aquatic vegetation, with a net gain in wetland area due to the increased amount of nearshore, shallow water habitat (Acres, 1997). In any event, the amount of surveyed wetlands in these two reservoirs is very small relative to the amount of wetlands on the entire river system.

The headwaters of the Anjigami River system (NR10) within Lake Superior Provincial Park, and Mirimoki Lake (NR11) are designated nature reserve zones because of their extensive representative wetland communities (see Plate C2). Mirimoki Lake has the largest floating bog apron in the park, one of the few bog associations rich in orchids (MNR, 1995b).

No site-specific information on the wetlands in the rest of the Michipicoten watershed has been documented.

3.1.6.4 Forest Cover

The southern portion of the Michipicoten watershed is located within the Great Lakes-St. Lawrence Mixed Forest Zone. Much of this forest is characterized by mixed stands of black and white spruce, balsam fir, white birch, and trembling aspen. However, some of the southern areas have white pine, yellow birch, red maple and sugar maple.

The northern portion of the watershed is contained within the Southern Boreal Forest zone. This zone has relatively pure stands of jack pine, black spruce, white birch and trembling aspen. There are also mixed stands of white and black spruce, balsam, white birch and trembling aspen (MNR, 1984).

There are a few areas of balsam poplar, black ash and American elm in low-lying areas along the reservoirs. Based on existing information, no known endangered vegetation species have been reported to date. Forest shrub and ground cover is variable, but there is generally thick shrub undergrowth.

3.1.6.5 Provincial Parks and Conservation Reserves

Provincial Parks

Four provincial parks (The Shoals, Potholes and parts of Lake Superior Provincial Park and Michipicoten Post Provincial Park) are located in the Michipicoten watershed (Plate C2, Appendix C). These parks preserve the natural environment and provide recreation and tourism opportunities in the area. A brief description of each provincial park follows.

– Potholes Provincial Nature Reserve Park is located along Highway 101, about 35 km east of Wawa. This park contains a regionally significant geological feature consisting of a complex of glacial potholes in the bed of the Kinniwabi River (MNR, 1996).

– Shoals Provincial Park is a natural environment park located 48 km west of Chapleau, off Highway 101. Camping, canoeing, hiking and fishing are the main recreational activities offered in the park. Within the park boundaries there are 28 different plant communities, ranging from coniferous forests to herbaceous wetlands. Marshes are considered the most significant vegetation community because of their diversity and importance as waterfowl habitat (MNR, 1994). Moose, timber wolf, red fox, lynx, marten, beaver, muskrat and otter are among the mammals that live in the park. Birds spotted each year include osprey, bald eagle, great blue heron, ruffed and spruce grouse and several species of hawk and owl (MNR, 1995a). At the southern end of Little Wawa Lake within Shoals Provincial Park, there is a regionally (and perhaps nationally) significant glacial meltwater delta. Also, there are eskers and sand shoals beneath

Little Wawa Lake and these land forms are the origin of the park's name (MNR, 1994).

– Lake Superior Provincial Park is located on Lake Superior, south of Wawa and north of Sault Ste. Marie. Only a small portion of the park is located within the Michipicoten River watershed (see Plate C2, Appendix C). However, within this small portion there are three nature reserve zones (see Plate C2), i.e., Valentine Lake (NR8), Anjigami River (NR10) and Mirimoki Lake (NR11). Also, this portion of the park is within the park's Interior Wilderness Zone (W2) which has good canoeing and fishing potential (MNR, 1995b).

– Michipicoten Post Provincial Park is located along the Michipicoten River and at the mouth of the river 8 km southwest of Wawa on the shore of Lake Superior. It is a historic park since it contains the ruins of a French fur trading post that operated from the early 1700's until it was abandoned by the Hudson's Bay Company in 1904. This park is ideal for nature viewing and hiking (MNR, 1996).

Conservation Reserves

Two regulated conservation reserves are adjacent to the Michipicoten River system. These are identified below and their locations are shown on Plate C2 (Appendix C).

Unit Code	Name	Area (ha)
C1517	South Michipicoten River – Superior Shoreline	2 223
C1535	Windermere-Goldie Lake Complex	17 203

Conservation reserves complement provincial parks in protecting representative natural areas and special landscapes (MNR, 1999).

In regulated conservation reserves, timber harvesting, mining, and commercial hydroelectric power development will not be allowed (MNR, 1999).

3.2 Social and Economic Environment

3.2.1 Community Profile

Population/Communities

The major population centers in the vicinity of the Michipicoten watershed are Wawa, Dubreuilville and Chapleau (see Figure 1.1). Smaller settlements within the Michipicoten watershed are Hawk Junction, Missanabie and Michipicoten First Nation.

The 1996 population of Michipicoten Township (which includes Wawa) was 4145 (Copp Clark, 1997). It is estimated that outside of the Wawa area there are only a few hundred permanent residents in the entire Michipicoten watershed, although the seasonal tourist population is significant.

English is the most commonly spoken language in the Wawa area although French and First Nations languages (e.g., Ojibway, Cree) are also spoken by some residents.

The town of Chapleau is located just east of the Michipicoten watershed (see Figure 1.1) and has a population of 3000.

Infrastructure

Within the Michipicoten watershed the Trans-Canada Highway (Highway 17) cuts north-south across the westernmost portion of the watershed near the Town of Wawa. Highway 101 transects the south central section of the watershed from east to west. Highways 547 and 651 (off Highway 101) provide access to Hawk Junction and Missanabie, respectively.

Resource access roads such as logging roads are located throughout the Michipicoten watershed providing access to remote areas. The planning and location of these access roads take into account the needs of the mining and forest industries, outdoor recreation opportunities and commercial and industrial transportation uses (MNR, 1983). Abandoned and active access roads are commonly used as hiking, cross-country skiing and snowmobiling trails in the Michipicoten watershed.

Both Canadian Pacific and Wisconsin Central Railways operate rail services east-west and north-south, respectively, across the Michipicoten watershed. Wisconsin Central Railway operates the north-south system known as the Algoma Central Railway.

The area is well serviced by hydro and communication systems, including fiber optics.

Economy

The main industries in the Michipicoten River watershed are hydro power generation, forest industry, mining and tourism. These and other socioeconomic activities are described in the subsections that follow.

The socioeconomic environment associated with the Michipicoten River system is an area that requires further research and information gathering to improve our consideration of socioeconomic factors in future planning efforts.

3.2.2 Hydroelectric Power Generation

Hydroelectric generation on the Michipicoten River began with the construction and commissioning of a single unit station of approximately 5 MW at High Falls in 1908. The demand for electrical power in the eastern Lake Superior region at this time was steadily increasing as forest and mineral resources in the area were being developed. In the Wawa area, mining interests led to the building of various ore processing facilities and the demand for power grew rapidly. Later in the century, Dubreuilville, to the north of Wawa, was developed when a wood milling operation was built to process the timber harvested in the area. This added to the growing power requirements in the vicinity.

The existing hydroelectric facilities on the Michipicoten River are shown in Figure 1.2. In the late 1920's, the High Falls site was redeveloped to maximize available head and a new 2-unit generating station was built with an installed capacity of 16 MW. In 1950 the site facilities were expanded and a third unit of 10 MW was added. In 2003 the Dunford GS, with an installed capacity of 45 MW, replaced the High Falls GS.

During the period 1950 to 1959, the remaining sites on the main stem of the Michipicoten River were developed. This began with Scott Falls, located 2 km downstream of High Falls, which was commissioned in 1952, and added two generating units totaling 17 MW. In 1954 the McPhail site upstream of High Falls was completed adding two units of 5 MW each and finally in 1959 the farthest upstream site at Hollingsworth was built which added a major storage reservoir to the system, along with an installed generating capacity of 22.5 MW in a single unit.

Salient features of the existing generating stations are given in Table 3.3.

Table 3.3
Salient Features of Existing Generating Stations on the Lower Michipicoten River System

Station Name	Installed Unit(s)	Year of Commissioning	Rated Flow* (m^3/s)	Gross Head (m)	Station Operating Capacity (MW)
Hollingsworth GS	1	1959	85	20.7 to 34.4	23.2
McPhail GS	1 and 2	1954	93	13.0 to 14.0	12.8
Dunford (High Falls) GS	1 and 2	2003	93	45.1 to 45.4	45.0
Scott GS	1 and 2	1952	93	23.2 to 23.6	22.5
Total	**-**	**-**	**-**		**103.5**

*Rated station flow at design head.

3.2.3 Forest Industry

The key forest industry companies are Wagner Ontario Forest Management, Dubreuil Forest Products, Clergue Forest Management Inc. (which includes Domtar, Columbia Forest Products, St. Mary’s Paper and Weyerhauser), Weyerhauser OSB, Green Forest Lumber (Weyerhauser), J. E. Martel (Domtar), and McDonald Forest Products.

Portions of the Wawa Forest Management Unit, the Magpie Forest, the Superior Forest and land holdings managed by Wagner all fall within the boundaries of the Michipicoten watershed (see Plate C3, Appendix C).

There are several disturbance areas, cutovers and proposed harvest allocation areas which are shown on Plate C3, Appendix C. A disturbance area is defined as any forested land from which the overstorey has been killed or removed. Overstorey may be killed or removed by clearcutting, wildfire, blowdown, insect attack or natural stand breakup. An area that has been subject to these conditions is considered to be disturbed for a period of 20 years following the event if the area has been prepared for regrowth (MNR, 1997). Cutovers are defined as areas which have not yet been prepared for regrowth.

3.2.4 Mining

In September 1998 there was only one active producing mine in proximity to the Michipicoten River system, i.e., the Edward Gold Mine west of Dog Lake (see Plate C2, Appendix C). Mining of the ore at this location began early in 1997 and is a joint venture between River Gold Mines Ltd. and VenCan Gold Corporation.

Two inactive gold mines south of Dubreuilville (Golden Goose Resources Inc. Magino Mine, and Patricia Mines Inc., Island Gold project) are in “care and maintenance status” but hope to resume production in the future. The Citadel Gold Mine, south of Wawa Lake, is in a similar state of activity.

There is one proposed advanced exploration project in the Michipicoten watershed, i.e., Pele Mountain Resources gold prospect just south of Wabatongushi Lake.

Algoma Steel’s G.W. McLeod Iron Ore Mine north of Wawa Lake ceased production in mid-1998 and is currently in the process of closure.

Aggregate extraction is concentrated just south of the Chapleau Crown Game Preserve and in the southwest portion of the watershed (see Plate C2, Appendix C).

3.2.5 Hunting and Trapping Activities

There are presently 42 registered Bear Management Areas in the Michipicoten River watershed as shown on Plate C4, Appendix C. In Wawa District, bear hunting season runs from August 15 to October 15. Bear hunt outfitters in the watershed rely heavily on non-resident clientele and provide accommodation, transportation and guiding services (MNR, 1983a; MNR, 1992). MNR (Wawa) advises that minimal bear hunting occurs off waterways.

There are also 36 registered trapline areas in the Michipicoten River watershed as shown on Plate C5, Appendix C. Commercial fur trapping activities take place in the area for beaver, marten, mink, otter, coloured fox, muskrat, wolf, lynx and fisher. The main trapping season in the area is from October 15 to December 1. Some beaver trapping is conducted by boat on the Michipicoten system during this period.

Hunting and trapping activities are prohibited in the Chapleau Game Preserve and restricted in some areas of Lake Superior Provincial Park (MNR, 1983).

Moose hunting season in Wawa District runs from the Saturday closest to October 8 to November 15. Some hunting occurs off the waters of the Michipicoten River system. Deer and caribou hunting are not permitted in the watershed due to low populations.

3.2.6 Recreation/Tourism

The primary recreation and tourism activities in the Michipicoten watershed focus on cottaging, sport fishing, hunting, canoeing, hiking, snowmobiling and use of provincial parks and the Chapleau Crown Game Preserve within the watershed. These activities are described in more detail in the subsections that follow. In addition, ecotourism is developing as a new form of recreation in the Michipicoten watershed.

Cottaging/Tourism Lakes

Cottaging is common in the Michipicoten River watershed. Tourist and cottage facilities on hydro storage reservoirs on the Michipicoten River system are shown in Table 3.4. Additional facilities may be present on these lakes but it was the best information available at the time from MNR Wawa and Chapleau Districts, supplemented by additional information received at the public open houses in 1998. Known locations of cottages, commercial outpost camps, and campsites in the Michipicoten watershed are shown on Plate C6, Appendix C.

Table 3.4
Tourist Facilities and Cottages on Reservoirs on the Michipicoten River System

	Number of Tourist Lodges	Number of Outpost Camps	Private Cottages
Wabatongushi Lake	5	-	26
Dog Lake	7	4	31
Whitefish Lake	3	-	73
Manitowik Lake	0	-	34
Anjigami Lake	0	0	77
Windermere Lake	1	5	9
McPhail Reservoir	0	0	5
Dunford (High Falls) Reservoir	0	0	0
Scott Reservoir	0	0	0

Sport Fishing

Sport fishery data for the Wawa District indicates that approximately 85% of sport fishing takes place on open water with the remaining 15% as ice fishing. A large portion of the local fishing pressure occurs on reservoir lakes and regulated river reaches in the Michipicoten watershed. In the 1980's, Wabatongushi Lake had about 13,900 angler-days or about 7% of the District fishing pressure, Dog Lake had about 11,100 angler-days or 5% of District pressure, Hollingsworth Reservoir had about 2,500 angler-days or 1% of District pressure, and the lower Michipicoten River also had an estimated 2,500 angler-days or 1% of District pressure. In addition, Michipicoten Bay had an estimated 6,000 angler-days or about 3% of District pressure (MNR, 1999a).

Hiking/Skiing/Snowmobile Trails

Hiking trails are located in provincial parks and throughout the area. The Voyageur Trail Association constructs and maintains several trails on Crown land, some of which are in the extreme downstream end of the watershed (MNR, 1992).

Winter tourism is also a viable industry in the area. Snowmobile clubs operate trails (see Plate C2, Appendix C) near and between population centers (MNR, 1992). Also, cross-country ski trails are located near Wawa.

Water-Based Recreation

There are four designated canoe routes in the Michipicoten watershed; the Michipicoten River, Shikwamkwa River, Shoals and the Anjigami River (see Plate C2, Appendix C). A portion of the Shikwamkwa to Missanabie canoe route is also located in the watershed (see Plate C2). The designation of a canoe route will not necessarily prevent hydro development on a designated river (MNR, 1992).

Normally, a no-cut buffer of 30 m from the waterway is maintained on the Michipicoten River system to provide canoeists and kayakers with a disturbance-free zone. This buffer may be modified depending on the density of forest cover, slope, and the need to protect other values (which may require a larger buffer).

Use of motor boats, primarily for sport fishing, also occurs throughout the Michipicoten system.

Buck's Marina is a facility of recreational importance at Mission Bay at the confluence of the Michipicoten and Magpie Rivers. There are no other marinas presently existing on the Michipicoten system.

Chapleau Crown Game Preserve

While the primary function of this area is as a game preserve, it has historically attracted tourists interested in outdoor activities such as fishing, canoeing, and wildlife viewing. Also, the Town of Chapleau operates a number of locally popular wildlife tours in the preserve (MNR, 1990a).

Provincial Parks

For information on provincial parks in the Michipicoten watershed, see Section 3.1.6.5.

3.2.7 First Nations

The following First Nations are represented in the Michipicoten watershed:

- Michipicoten First Nation
- Brunswick House First Nation
- Chapleau Ojibway First Nation
- Missanabie Cree First Nation
- Chapleau Cree First Nation.

There is one Indian Reserve located within the boundary of the Michipicoten River watershed, i.e., the Missanabie Indian Reserve (Plate C2, Appendix C) near the settlement of Missanabie. Missanabie Cree First Nation has initiated a treaty land entitlement process which has been recognized by the Ontario government. Much of the land under discussion is within the Michipicoten River watershed, with one parcel directly adjacent to Wabatongushi Lake.

In 1996 the Michipicoten First Nation submitted a claim to the Specific Claims Branch of Indian and Northern Affairs Canada (INAC). This claim alleged unlawful expropriation and inadequate compensation for 4.2 acres of First Nation lands in 1943 by GLPL for a hydro transmission line. The Michipicoten First Nation claimed that these lands had been set aside for First Nations under the terms of the Robinson-Superior Treaty. INAC's status of this claim is listed as "File Closed in 2001".

3.2.8 Heritage Resources

There are 29 known archaeological sites in close proximity to and/or within the Michipicoten River watershed. In the interests of heritage conservation, the specific locations of these sites are confidential but were considered in the planning process. A brief general discussion of known artifacts and archaeological sites in the watershed follows.

Michipicoten River

Archaeological artifacts have been recorded by the Ontario Ministry of Culture (formerly the Ontario Ministry of Citizenship, Culture and Recreation) (OMCCR) along, and in the general vicinity of, the western portion of the Michipicoten River. Artifacts include fire-cracked rock, fragments of burned bones and flint flakes. A Late Woodland (700 to

1600 AD) and Algonkian site with historic goods such as ceramics, lithics (stone tools) and trade goods, has been documented on the north shore of the Michipicoten River in the westernmost portion of the watershed (OMCCR, 1998).

The site of an old village belonging to the Archaic culture (900 to 7000 BC) is also located in the western portion of the watershed on a raised beach above the Michipicoten River. Fire-cracked rock and flint flakes have been found on this large site (OMCCR, 1998).

Michipicoten River Harbour

The mouth and harbour of the Michipicoten River is considered to have high archaeological potential. The harbour has traditionally provided excellent shelter for travelers on Lake Superior. Also, being located at the confluence of the Magpie and Michipicoten rivers, the Michipicoten River harbour provided good physical characteristics for settlement, such as access to the interior and fur trade resources (Algonquin Associates, 1986).

The fur trade commenced around the late 1670's in the area. The Northwest Company's Michipicoten Post (operated by French fur traders) was located on the south shore of the Michipicoten River mouth. The Hudson's Bay Company also occupied a post (Michipicoten House) on the north shore of the river mouth. The main travel route during this time between Lake Superior and Hudson Bay was via the Michipicoten River to the Missanabi and Moose Rivers with established outposts along the river (Algonquin Associates, 1986; MNR, 1984). The mouth of the Michipicoten River has been studied extensively (Algonquin Associates, 1986). Huron-Petun ceramics and lithics of the historic Ojibwa and Late Woodland cultures have been found in the vicinity of this site (OMCCR, 1998). Also, several ceramic, trade good and lithic artifacts from the Late Woodland and Algonkian cultures were recorded at the Michipicoten River Harbour site (OMCCR, 1998).

4 Present Water Management Strategies

4 Present Water Management Strategies

Water management strategies that presently exist for the Michipicoten River system are described in this section and are shown graphically in Figures 4.1 to 4.8 at the end of this section. They encompass power generation, fisheries and aquatic habitat management, flood management, and tourism/recreation considerations. Individual components of present water management strategies are described further below. This information provided the foundation for an analysis of the issues (Section 5) to see how the present water management strategies might be improved upon and integrated into a more ecosystem-based water management strategy. Water levels in Figures 4.1 to 4.8 are shown for typical average, dry and wet hydrology years based on a review of historical records as discussed further in Section 4.3.

4.1 Water Power Operations

4.1.1 Michipicoten River Generating Stations

Water power operations on the Michipicoten River typically respond to power demands which rise each weekday in early morning around 7:00 a.m. and extend through about a 16-h period to 11:00 p.m. This is referred to as the daily on-peak generating demand period. Within this period are a number of brief periods when maximum power demands occur, usually at noon and the supper hour in the early evening. In an 8-h period each weekday, beginning around 11:00 p.m. through to about 7:00 a.m. the next morning and usually over the entire weekend, power generation has historically been reduced to zero or minimum levels when residential and most commercial and industrial demands are light. This is referred to as off-peak generation and in conjunction with on-peak generation, reflects the weekly generation pattern that BP has historically followed to supply load demands in their local demand area.

The traditional off-peak period follows a similar pattern under the new market structure but is not as clearly defined. For example, there are occurrences when market demands are high on weekends and some nights as well.
The overall peak demand is now in the summer rather than winter, so the likelihood of more flow during the summer months is higher.

The four generating stations on the Michipicoten River, as shown in Figure 1.2, are used primarily to supply base energy to the power grid. The reservoir at Hollingsworth GS provides major flow regulation for the river system and generating stations downstream. Releases through the generating station at Hollingsworth combine with local runoff entering the McPhail reservoir downstream, seepage flow from Shikwamkwa dam and releases from the secondary storage dam at Anjigami. The Anjigami release itself is not measured and the entire local inflow component is considered as uncontrolled and is calculated as the difference between total inflow into McPhail and Hollingsworth release. Presently, only limited outlet control at Anjigami can be achieved due to seasonal manual manipulation of stop logs and lake level operational constraints. Hence, the resulting variability in local inflow to McPhail is an important consideration in the operational decision process used to determine the flow releases from Hollingsworth.

The two lower stations at Dunford (High Falls) and Scott essentially run as cascade plants with flow released from McPhail passing through, with very little added inflow from the local catchment area. The only tributary inflow of relevance downstream of McPhail GS is the Firesand River which enters just upstream of Dunford GS. The drainage area of this tributary represents about 2.4% of the total drainage basin, therefore, its contribution is quite small, even during spring runoff periods.

Present water management of the Michipicoten River system is based on a set of operational guidelines which have been developed during many years of operating experience, and periodically adjusted through informal agreements with MNR and cottage/tourist lodge/sportfishing considerations. The latter informal mechanisms were put in place in recent years to create a better balance between hydro operations and recreation and fisheries goals.

Water levels at the four generating stations fluctuate within an established range of levels, which are governed by a combination of legal, voluntary and operational constraints. A definition of typical water level operational limits in the reservoir of a generating station site is given in Figure 4.9 at the end of this section. A summary of current operational constraints, including the range of operational water levels utilized at the four Michipicoten generating sites are summarized in Table 4.1. A description of the basic operation of the four generating stations is presented as follows.

Table 4.1
Operational Constraints at Michipicoten Generating Stations

	Water Level							Flow Release - Powerhouse			
Generating Station	Water Level	Legal Constraint[1] (m)	Voluntary Constraint[2] (m)	(ft)	Operational Constraint[3] (m)	(ft)	Flow	Legal Constraints (m^3/s)	Voluntary Constraints (m^3/s)	Operational Limit (m^3/s)
Hollingsworth GS	Absolute Maximum Level				313.56	1029.0	Maximum			91.7[4]
	Maximum Operating Level	313.33			312.72	1026.0				
	Full Supply Level				312.42	1025.0	Minimum			15.0[4]
	Maximum Drawdown Level		303.28	995.0	298.70	980.0				
	Summer Drawdown Level		309.36	1014.7						
McPhail GS	Absolute Maximum Level				278.13	912.5	Maximum			105[4]
	Maximum Operating Level				277.37	910.0				
	Full Supply Level				276.46	907.0	Minimum			15.0[4]
	Maximum Drawdown Level				274.92	902.0				
Dunford (High Falls) GS	Absolute Maximum Level				263.05	863.0	Maximum			112.5[4]
	Maximum Operating Level				263.04	863.0				
	Full Supply Level				262.28	860.5	Minimum			15.0[4]
	Maximum Drawdown Level				260.00	853.0				
Scott GS	Absolute Maximum Level				217.63	714.0	Maximum			112.5[4]
	Maximum Operating Level				217.32	713.0				
	Full Supply Level				216.87	711.5	Minimum		17.0	17.0
	Maximum Drawdown Level				207.87	682.0				

Note: Metric levels have been calculated from Imperial equivalents based on a conversion factor of 1 m = 3.2808 ft.

[1] As established by LRIA approval (TM-WA-85) for Shikwamkwa Dam (April 7, 2005).

[2] As established by agreement with local MNR office.

[3] As established by design limitations for specific sites.

[4] During on-peak production (07:00 to 23:00). Historically turbine flow has been reduced to 0 overnight and weekends except at Scott.

Hollingsworth GS

Flow releases from Hollingsworth follow a set of rules which, on a weekly basis, are based on the following parameters:

- the current rate of uncontrolled inflow contribution from Anjigami and the local catchment downstream
- the current status of storage in the Hollingsworth reservoir
- current upper catchment inflow in comparison to long-term historical runoff trends to predict future inflow rates.

If the runoff from the upper river basin is high, then the reservoir levels at Hollingsworth will be comparatively high, as the draft rate on storage is low. In this case the optimal release from Hollingsworth would be set equal to the rated turbine flow for the single generating unit at the station. The daily duration and rate of release from Hollingsworth will depend on the rate of local uncontrolled runoff into McPhail GS reservoir. The combined Hollingsworth release and local inflow will not be allowed to exceed the rated flow capacity of the McPhail station units over the 16-h on-peak generation period, as this would cause the reservoir level at McPhail to exceed the full supply level (FSL) and spillage would have to be initiated.

The reservoir at Hollingsworth is normally operated to utilize a high percentage of available live storage over the summer and winter low flow periods, such that at the beginning of the spring freshet, live storage can be replenished back to normal FSL during maximum rates of runoff in the basin. This serves to either eliminate or minimize potential spillage into the lower river system, which would otherwise be lost to generation. During those years in which runoff in the upper basin is exceptionally low, flow releases from Hollingsworth are reduced by the rule curves such that live storage is not over-drafted. Remaining storage is evenly allocated over succeeding weeks on the basis of previous analyses of historical drought sequences, for as long as severe low inflow rates persist.

Present operational guidelines also consider the interests of cottage and camp owners located on the reservoir and limit the amount of drawdown throughout the summer period. This voluntary drawdown limit helps to maintain high water levels as long as possible for ease of boater access to docks and other shoreline areas. On average, the total range of reservoir level fluctuation is less than 10 m throughout the course of the year. Lowest levels are achieved during a 3-wk period at the beginning of April, just prior to the onset of spring freshet inflows which are used to refill the live storage. The actual range of historical water level fluctuations and typical hourly water levels and flow releases are discussed in Section 4.3.

McPhail GS

Operation of the McPhail GS includes some minor reregulation of inflow utilizing, on average, a 0.4-m range of fluctuation in the reservoir. While a greater range of drawdown is possible here, it is not normally utilized as the generating head here is only 14 m and any reduction in this operating head can yield an undesirable drop in power generating efficiency. The actual range of historical water level fluctuations and typical hourly water levels and flow releases are discussed in Section 4.3.

Dunford (High Falls) GS

At High Falls the flow released from McPhail was originally passed through three generating units utilizing a 0.3-m range of head-pond fluctuation, which provided limited reregulating flexibility to inflows. The existing rated flow capacity of the installed units at the old High Falls plant was smaller than that at both McPhail GS upstream and at Scott GS downstream. This necessitated that some flow be passed as spill at High Falls to maintain reservoir level control and supply sufficient inflow to Scott GS. This condition changed after completion of the Dunford (High Falls) Redevelopment project in 2003 and the two units at the new generating station have a rated flow capacity which is compatible with both upstream and downstream stations. The actual range of historical water level fluctuations and typical hourly water levels and flow releases are discussed in Section 4.3.

Scott GS

At Scott GS, generation during the daily on-peak period is matched to incoming flow from upstream. The Scott Reservoir utilizes a slightly larger 0.45-m fluctuation range than High Falls which is used primarily during off-peak generating hours each day and on weekends to maintain a voluntary minimum flow downstream to the lower Michipicoten River of not less than 17 m^3/s. This flow is maintained in part from upstream supply with both High

Falls and McPhail generation reduced to a single unit during off-peak generating periods. The actual range of historical water level fluctuations and typical hourly water levels and flow releases are discussed in Section 4.3.

4.1.2 Michipicoten River Secondary Storage Reservoirs

Conversion of some of the larger natural lakes in the upper catchment into storage lakes with outlet control dams was undertaken progressively since the first hydroelectric development on the Michipicoten River (see Plate C1, Appendix C). The primary objective is to capture spring runoff and store it for later release in the fall and winter months to supplement low natural runoff rates in the basin and enhance power production. A secondary benefit of these storage lakes is to both reduce and attenuate peak flood flows passing downstream to the main stem hydro developments.

With major expansion of the hydroelectric stations through the 1950's, some of the earlier dams were improved or raised to maximize their storage regulation potential. The secondary storage dams are remotely located and consequently, operation and monitoring procedures at them have evolved around infrequent visits. The control dams at the lake outlets are simple in design, utilizing stop logs which can be easily added and removed at key times of the year. The lakes can then be left unattended for long periods of time. Also evolving were other related activities centered around the use of the storage lakes for recreational purposes, including commercial lodges, cottages, camping, fishing and hunting. As the demand for multiple usage of the lakes increased, and more and better access to them became available, cooperative water management strategies became necessary. This included maintenance of sustainable fish spawning and habitat areas and limiting water level fluctuations for cottagers and boaters. When the Hollingsworth development was completed in 1959 and the new primary storage reservoir was created (see Plate C1, Appendix C), the water management demands on the upper storage lakes were partially relaxed because of more efficient storage regulation which could be performed at Hollingsworth. However, the ability to capture, store and control the release of spring runoff in these upper lakes is still essential to the overall water management of the watershed and flood management in particular.

The current water management guidelines for the upper storage lakes still attempt to maximize the capture of spring runoff for storage and reduction of downstream flood flows. The guidelines also still endeavor to retain as much of the storage as possible over the summer and early fall period, with a gradual release of the water over the late fall and winter months, such that all storage is released before the next year's spring freshet, with little or no carry over storage into the next season.

The four secondary storage lakes in the Michipicoten watershed are shown on Plate C1, Appendix C. Three of the storage lakes are located upstream of Hollingsworth reservoir at Dog Lake, Wabatongushi Lake (on the upper Michipicoten) and Windermere Lake on the upper reach of the Shikwamkwa River. The fourth lake is Anjigami which flows into the McPhail GS reservoir downstream of Hollingsworth. Salient details of these storage lakes and control dams are given in Table 4.2.

Spring Stop-Log Replacement

Stop logs at the control dams are replaced each year in late winter or early spring, preferably by May 1, to ensure that lake levels begin to rise throughout the critical fish spawning, incubation and rearing period. This period typically extends from this date through to about mid-June. The date of log replacement is variable and is a function of when spring break-up of the inflowing rivers and streams occurs. On average this occurs about mid-April, and log replacement is usually scheduled 15 days after spring break-up begins, on or about May 1. Historically, spring break-up usually begins after about 30 consecutive degree-days above freezing (0°C) have accumulated. Another rule of thumb used to identify when spring break-up has begun is when the inflow to Hollingsworth reservoir exceeds 68 m^3/s.

The number of stop logs replaced in each structure is based on historical experience to ensure generally rising levels, but maintains sufficient outflow capacity to guard against severe flood runoff filling the lakes too quickly. This situation could make the control dams vulnerable to overtopping, causing damage and possible failure of the structures. Existing guidelines monitor the inflow into Hollingsworth reservoir, as of April 15 and May 1. If the respective inflows are less than or equal to 127 and 210 m^3/s, then stop logs are replaced according to the specifications given in Table 4.3.

Table 4.2 Salient Features of Michipicoten River Secondary Storage Lakes									
Storage Lake	Full Supply Level[1]		Surface Area at FSL	Contributing Drainage Area	Control Dam Minimum Sill Elevation		Live Storage Volume		Remarks
							Available	Presently[2] Utilized	
	(m)	(ft)	(km^2)	(km^2)	(m)	(ft)	(m^3x10^6)	(m^3x10^6)	
Wabatongushi	348.09	1142.0	38.4	608	345.04	1132.0	93.0	77.9	Dam refurbished 1955
Dog	330.41	1084.0	49.7	702	328.46	1077.6	78.2	69.1	Dam refurbished 1955
Windermere	428.25	1405.0	39.1	774	425.60	1396.3	89.5	57.3	New dam constructed 1955
Anjigami	289.56	950.0	10.6	394	285.91	938.0	27.1	18.5	New dam constructed 1955

Note: Metric levels have been calculated from Imperial equivalents based on a conversion factor of 1 m = 3.2808 ft.

1 Full supply levels are governed by legal constraints established by previous water lease agreements.

2 Presently utilized storage volume represents storage between FSL and average low lake level attained with specified fall stop log removal. In some extreme low runoff years removal of additional stop logs will results in greater utilization of available live storage. See definition of live and dead storage in “Glossary and Terms”.

Table 4.3
Spring Impoundment and Stop-Log Replacement Specifications

Storage Lake	Stop Logs In / Bay	Top Log Elevation (m) (ft)	Operating Constraints and Minimum Water Levels (m) (ft)		
			Legal[1]	Voluntary[2]	Operational[3] Target Levels
Wabatongushi	8 - 8	347.08 (1138.7)	Maximum Flood Level 348.09 (1142.0) Stable or rising from May 10 to June 25 Minimum level 347.17 (1139.0)	Water levels stable or rising from May 01 to June 15 Minimum level 347.48 (1140.0) by June 1	347.63 (1140.5) May 15 348.09 (1142.0) May 25
Dog	4 - 4 - 4	329.46 (1080.9)	Maximum Flood Level 330.41 (1084.0)	330.36 (1083.9) by May 25	Voluntary used
Windermere	3 - 5 - 3	426.88 (1400.5)	Maximum Flood Level 428.25 (1405.0)	427.92 (1404.0) by May 25	Voluntary used
Anjigami	6 - 6	287.73 (944.0)	Maximum Flood Level 289.56 (950.0)	287.73 (944.0) by May 16	288.37 (946.1) May 30

Note: Metric levels have been calculated from Imperial equivalents based on a conversion factor of 1 m = 3.2808 ft.

1 As established by previous water levels.
2 Water level target values by voluntary constraints as established by agreement with local MNR office.
3 Water level target values established by current operational practice.

If the respective inflows as of April 15 and May 1 are greater than 127 and 210 m^3/s but do not exceed 142 and 235 m^3/s, then the total number of stop logs to be replaced is reduced by 1 log in 1 bay only, from the Table 4.3 specification.

If the respective inflows as of April 15 and May 1 are greater than 159 and 262 m^3/s, then special flood action regarding the number of logs to be replaced will be determined by the BP System Control Centre (SCC) in Sault Ste. Marie.

Stop-Log Adjustment

Interim stop-log adjustments may become necessary after initial stop-log replacement, depending on the rate at which storage lake levels are building. During the fish spawning and incubation period from about May 1 to June 15, storage lake levels should be stable or rising. If inflow rates fall significantly in the May 1 to June 15 period, then lake outflow, dictated by the stop-log settings of Table 4.3, will be too great and lake levels may fall. In this case, additional stop logs must be added to reduce outflow, but still maintain sufficient outflow capacity at the control dams to ensure safe flood handling.

Periodic stop-log adjustments may also become necessary between June 1 and September 30 to accommodate recreational interests, including boating and camp access, tourism, fishing and hunting. Currently, an attempt is made to hold levels on a voluntary basis, within the range of levels given in Table 4.4.

Early Winter Stop-Log Removal

Stop-log removal is presently planned for completion between mid-October and mid-November to initiate the release of stored water to the lower Michipicoten River before winter freeze-up. Table 4.5 gives the stop-log settings for each storage damsite and reflects the normal number of logs left in each bay after removal has been completed. Minimum target lake levels, after stop-log removal has been completed, are also given in the table. The exact number of logs removed from each damsite varies depending on the current water level status and watershed runoff conditions. Periodically, logs are progressively removed over about a 3 to 4-wk period beginning October 15.

Table 4.4 Desired Range of Lake Levels June 1 to September 30		
Storage Lake	**Minimum Lake Level (m) (ft)**	**Maximum Lake Level (m) (ft)**
Wabatongushi	347.17 (1139.0)[1] 347.48 (1140.0)[2]	347.90 (1141.4)[3]
Dog	329.89 (1082.3)[2]	330.32 (1083.7)[2]
Windermere	427.21 (1401.6)[2]	427.58 (1402.8)[2]
Anjigami	288.04 (945.0)[2]	288.37 (946.1)[2]

Note: Metric levels have been calculated from Imperial equivalents based on a conversion factor of 1 m = 3.2808 ft.

[1] As established by previous water levels.
[2] Water level target values by voluntary constraints as established by agreement with local MNR office.
[3] Water level target values established by current operational practice.

Table 4.5 Early Winter Stop-Log Removal Specifications				
Storage Lake	**Stop Logs Remaining in Each Bay**	**Top Log Elevation (m) (ft)**	**Target Minimum Lake Levels and Dates**	
			(m) (ft)	**(m) (ft)**
Wabatongushi	4 – 4	346.04 (1135.3)	346.56 (1137.0)[1] December 13	346.41 (1136.5)[1] February 15
Dog	2 - 2 - 2	328.97 (1079.3)	329.58 (1081.3)[1] December 13	329.34 (1080.5)[1] February 15
Windermere	0 - 2 - 0	426.12 (1398.0)	426.63 (1399.7)[1] December 8	426.42 (1399.0)[1] February 15
Anjigami	4 - 4	287.13 (942.0)	287.58 (943.5)[1] November 10	287.28 (942.5)[1] February 15

Note: Metric levels have been calculated from Imperial equivalents based on a conversion factor of 1 m = 3.2808 ft.

[1] Water level target value (voluntary constraint as established by agreement with local MNR office).

Lake Level Monitoring

Lake level monitoring is performed approximately once a month, depending on accessibility. During spring freshet more frequent trips are scheduled if necessary to perform additional stop-log manipulations and water levels are always obtained whenever a damsite is visited. Obtaining water level readings over the winter period is performed on an intermittent basis depending on ease of access to the various control dams.

The tabulated minimum and maximum levels given in Tables 4.2 to 4.5 have been established by a combination of legal, voluntary and operational constraints.

4.1.3 Power Tradeoffs for Ecological Benefits

There is an informal agreement with MNR presently in place to provide a continuous minimum baseflow through the Scott GS of 17 m^3/s to benefit the aquatic ecology and habitat downstream. Power production flexibility and revenues are reduced because the water released for minimum flows during the off-peak period would otherwise be stored in the reservoir during the off-peak period for subsequent generation during the on-peak period.

In addition, there are voluntary winter drawdown limits on all the reservoirs [except McPhail, Dunford (High Falls) and Scott Reservoirs] in consideration of the aquatic ecology and associated habitat (see figures in this section).

Also, stop logs in control dams on the secondary storage lakes are replaced each year in late winter or early spring, preferably by May 1, to ensure that lake levels begin to rise throughout the critical fish spawning, incubation and rearing period.

4.1.4 Power Tradeoffs for Social (Tourism/Recreation) Benefits

BP's informal agreement with MNR also makes provision for maintaining stable water levels in Hollingsworth Reservoir and the secondary storage reservoirs to accommodate summer cottaging, boating and fishing activities during the period June 1 to September 30 (see Table 4.4).

4.2 Flood Management

There is a comprehensive flood management plan in place for the Michipicoten River system. It is part of the Emergency Preparedness and Response Plan for Wawa Power comprising facilities on both the Michipicoten and Magpie Rivers. A complete set of flood emergency response procedures for the Michipicoten River system is provided in Appendix I. This information outlines criteria to identify one of four levels of emergency response, depending on the severity of the situation. It also clearly sets out the roles and responsibilities for each level of response, evacuation procedures, communications procedures, and the requirement to maintain a record of all actions taken.

4.3 Existing Flow Regimes and Water Levels

Historical flow in the Michipicoten River has been extensively archived using generating station operational records from two key locations, Hollingsworth GS and High Falls GS. Flow releases from Hollingsworth reflect the regulation of upper basin inflows. These releases combine with local, uncontrolled, inflow from the intermediate drainage basin upstream of McPhail GS and yield total flow to the three downstream cascade generating stations. This combined flow is closely monitored at Dunford (High Falls) GS. Most of the local inflow comes through the Anjigami Lake control structure, however, these inflows are not routinely monitored and are taken as the difference between Hollingsworth release and total flow at High Falls. Detailed hourly operational data has been archived from the SCADA system since late 1995. Typical hourly operating levels and flow releases for the generating stations are presented for two periods of the year in Appendix G. A week in the spring represented by data from May 5 to 11, 1997 is given. In this period, no spill flow was released from Hollingsworth and the level was building, as shown in Figure G1. A fall period is presented in Figure G2 for the period November 2 to 6, 1998. Power flow releases are prevalent through the on-peak hours of the week, with a small release on the weekend. Operations at McPhail for the two weekly periods are given in Figures G3 and G4. In the spring period in Figure G3, spill has been initiated at McPhail to handle inflow from Anjigami and local runoff and is passed downstream through the remaining stations. It is noted that in this spill period, spill is undertaken during the daytime, which allows close monitoring of the spill flows in the river reaches. For more severe spill situations, releases can occur 24 h/d. Figure G4, which is the fall period, shows typical cycling of the McPhail reservoir through the week. Figures G5 and G6 show similar release patterns at High Falls and at Scott in Figures G7 and G8.

A continuous record of average daily flows is available for the 29-yr period from 1970 to 1998. This overall period has been split into a pre-agreement period from 1970 to 1990 and a voluntary agreement period from 1991 to 1998 to better reflect changes in water management in the watershed. The voluntary agreement is still in place. Resulting flow data is presented in Figures G9 and G10 for flow releases below Hollingsworth GS, and Figures G11 and G12 for the lower Michipicoten below Scott (Appendix G). These figures depict the long-term variation in daily average flow, summarized for the 52 weekly periods of the year. This time period was chosen as it corresponds to the normal flow decision period that BP operations staff use when releasing flow from the Hollingsworth reservoir.

The data are in the form of “Box and Whisker” plots which provide the following statistical information on flows, for each week:

- maximum historical flow for the period
- calculated average flow for the period
- minimum historical flow for the period
- 90 percentile flow
- 75 percentile flow
- 25 percentile flow
- 10 percentile flow.

The percentile values reflect a threshold flow magnitude below which the historical flows have occurred over the respective 21-yr and 8-yr monitoring periods. An illustrative example follows, with reference to Figure G9. If the 90% flow for Week 1 is 78 m^3/s, flow releases have been at or below this flow for 90% of the time for all days in Week 1 (viz January 1 to 7). The 75 percentile flow value for Week 1 is 70 m^3/s and the 25 percentile flow value is 55 m^3/s. This means that flow releases from Hollingsworth for the first week of the year typically fall between 55 and 73 m^3/s, 50% of the time (viz 75% to 25%). It is also evident the flow releases for Week 1 exceed the 90 percentile level of 78 m^3/s only 10% of the time, with the maximum recorded flow in Week 1 for the 21-yr period equal to 89 m^3/s. Similar statistical analyses of flows can be made for other weeks of the year.

Water levels in the main storage reservoir at Hollingsworth vary gradually throughout the year, based on the operational guidelines as described in Section 4.1. Water levels in the three downstream cascade stations fluctuate on a daily or sometimes weekly cycle, depending on the time of year and the manipulation of a small amount of live storage within the on-peak and off-peak times of the day. This can be seen in the typical weekly operating plots in Figures G1 to G8.

Historical water levels at key locations in the Michipicoten River are based on long-term operational records. Daily average water levels for the same pre- and post-agreement periods are analyzed on a weekly basis for the primary storage reservoir at Hollingsworth, and are presented in Figures G13 and G14. Water levels for McPhail, Dunford (High Falls) and Scott reservoirs are given in Figures G15-G16, G17-G18 and G19 respectively. The same format as for the flow regime plots has been utilized to depict long-term trends in water level regime at the above locations. Daily average water levels analyzed on a weekly basis over the year are presented in "Box and Whisker" plot format which give maximum, average and minimum historic levels and 90, 75, 25 and 10 percentile threshold levels. Additionally, on these water level regime plots, the normal FSL is indicated for the various reservoirs.

The water level data for Scott GS (Figure G19) covers only a 9-yr period from 1990 to 1998. Prior to 1990, head-pond levels at this station were not routinely recorded as part of long-term operational record-keeping procedures.

Historical water levels in the upper storage reservoirs are recorded on a more intermittent basis, depending on time of year and frequency of visits. Data for the four upper storages are presented in Figures G20 to G23 and are presented in the form of "Box and Whisker" plots on a monthly basis.

Restructuring and deregulation of the Ontario energy market in 2002 has resulted in some changes in how the river systems are operated. However, impacts are considered by BP to be minimal with regard to the representation of the present flow regime and water levels, as presented in this section. This was confirmed through supporting documentation provided by BP to MNR in May 2006, which included an explanation of any anomalies in the data. The key generation planning objective on both river systems remains unchanged and that is to maximize on-peak generation within the limits of operational constraints specific to existing (and future) ecological, legal, social and economic limits, guidelines and initiatives.

In addition to managing the Michipicoten River system for water power operations and flood control, several other management strategies are presently in place as outlined below.

4.4 Fisheries and Aquatic Habitat Management

Broad fisheries management strategies are outlined in MNR's Wawa District Fisheries Management Plan (MNR 1989) MNR's Chapleau District Fisheries Management Plan (MNR, 1989a), Fish Community Objectives for Lake Superior (Horns et al, 2003) and Great Lakes Fishery Commission rehabilitation plans for lake trout, walleye, brook trout and lake sturgeon. Such strategies can be classified under seven general categories.

- harvest assessment through angler surveys, population studies and habitat surveys
- harvest management through regulatory mechanisms and enforcement
- fish community management involving stocking introductions and assessment to increase populations of desired species
- habitat management through regulatory/policy mechanisms, physical improvements to habitat areas, and negotiations with BP regarding flow releases
- use management through catch and release programs, redirection of pressure to under-used species or under-used areas
- fisheries and habitat management (where feasible) for rehabilitation of tributary dependent Lake Superior species
- control of sea lamprey in tributaries.

The Wawa District Fisheries Management Plan (1989 to 2000) has specific management actions for the following individual water bodies within their District; (see Plate C7 and Appendix H):

- Wabatongushi Lake (Zone 5D)
- Dog Lake (Zone 5E)
- Manitowik Lake and Whitefish Lake (Zone 5F)
- Lower Michipicoten River (Zone 5H).

The following broader fisheries management zones are also relevant to the Michipicoten River watershed (see Plate C7) and actions for these zones are included in Appendix H:

- MNR (Wawa) Central Fisheries Management Zone (Zone 1)
- MNR (Wawa) Outlying Fisheries Management (Zone 2)
- MNR (Wawa) Trout Fisheries Management (Zone 3)
- MNR (Chapleau) Quality Fisheries Management Zone
- MNR (Chapleau) Enhanced Fisheries Management Zone
- MNR (Chapleau) Maintenance Fisheries Management Zone.

MNR also employs a variety of other lake-specific fisheries management techniques. These include fish sanctuaries and harvest regulations to protect individual species and size classes of fish. A summary of the current 2005-2006 sanctuary and harvest management practices for the Michipicoten system is provided in Table 4.6. New and more restrictive harvest regulations are expected to be implemented some time in 2007.

Table 4.6
Specific Fisheries Management Strategies[1]
for the Michipicoten River System

Lake/River	Management Strategies
Wabatongushi	Fish sanctuary (March 15 to June 15) “narrows” area of lake and on Dibben Bay, primarily for walleye protection; walleye slot size (34 to 41 cm)
Dog Lake	Fish sanctuaries (March 15 to June 15) - Lochalsh Bay, McMurty Narrows, Bay 57 Narrows, Dog River, McKee Creek, Height of Land Bay (primarily for walleye protection) Lake trout catch limited to 2, only 1 of which can be greater than 40 cm and 1 less than 40 cm Since 1992 a specialized open season for lake trout has been in effect - February 15 to March 15 and the third Saturday in May to September 30 Walleye slot size (36 to 43 cm)
Whitefish-Manitowik	Fish sanctuaries (March 15 to June 15) - Shikwamkwa River, Boisy Creek, Goudreau Creek, Big Stoney Rapids, and Hawk River (primarily for walleye protection)

Table 4.6
Specific Fisheries Management Strategies[1]
for the Michipicoten River System

Lake/River	Management Strategies
Lower Michipicoten River (Scott Falls to Lake Superior)	Since 1992 a fish sanctuary (April 15 to June 15) has been in place on Trout Creek (primarily for rainbow trout protection) Since 1992 a closed season for walleye and sauger (April 14 to June 30) has been in place A combined bag limit of 3 for walleye and sauger is in place year round A bag limit of 2 rainbow trout is in place year round Fish sanctuaries (April 15 to June 15) in all tributaries entering the Michipicoten River within the township of Rabazo (primarily for rainbow trout protection) A minimum flow of 17 m^3/s is maintained by BP downstream of the Scott Falls GS. This was put in place in the late 1980's by BP as a voluntary measure for the protection of migratory salmonid spawning.

[1] Management strategies implemented since the 1989 Fisheries Management Plan were provided by Marcel Pellegrini, MNR Biologist, Wawa District.

Recently management activities have been initiated to restore populations of native species in Lake Superior tributaries. These include walleye, lake trout, brook trout and sturgeon.

4.5 Water Management as a Component of Forest Management Plans

Forest management plans also play a role in water management. In the Michipicoten River watershed, the Superior Forest Management Unit, Wawa Forest Management Unit and Magpie Forest Management Unit Plans are designed to include the preservation, protection and enhancement of aquatic ecosystems. Through the designation of Areas of Concern (AOC) (Appendix F) water resources are protected from the negative impacts of forestry operations in the Michipicoten River watershed. For example, a 30- to 90-m no-cut reserve along the shore has been prescribed to protect the quality of warm and cold water lakes and streams (MNR, 1997) depending on slope (see Appendix F) and MNR (1997b).

Multizoned cutting restrictions are applied in the area surrounding an outpost camp lake or tourism lake. As outlined in the AOCs for the Wawa Crown Management Unit (MNR, 1995), four zones have been established around these lakes. There are no forestry-related operations permitted in Zone 1 which encompasses a 90-m reserve around the lake. Individual trees or small groups may be removed from the 90-m no-cut reserve to 500 m from the lake. A minimum of 50% crown cover must be retained from the 500-m reserve to 1000 m from the lake, which is referred to as Zone 3. In Zone 4, encompassing the area from the 1000-m reserve to 2000 m from the lake, modified cutting is permitted.

There are also large tracts of private land in the Michipicoten watershed under management by Wagner.

4.6 Water Management as a Component of Tourism and Recreation Strategies

As a general management objective, MNR strives to maintain high quality open water recreation, navigation and scenic values.

More specific water management strategies for tourism and recreation industry are outlined in the following documents:

(a) MNR's Wawa District Tourism Strategy (MNR, 1992).

(b) MNR's Forest Management Plans which include timber harvesting restrictions near or adjacent to tourism lakes, outpost camps, canoe routes, etc (see Appendix F).

(c) MNR's Provincial Park Management Plans which include access restrictions near tourism lakes.

(d) MNR's Wawa District Land Use Guidelines (1983) with revisions and MNR Chapleau District Land Use Guidelines (1983a) with revisions, and Crown Land Use Atlas (CLUA).

MNR's tourism management strategy (MNR, 1992) specifically addresses the following activities:

- remote lodge lakes (i.e., Wabatongushi Lake in the Michipicoten watershed)
- outpost camp lakes (see Table 3.4)
- commercial tourism accommodations
- canoe routes
- hiking trails
- cottaging
- bear hunt outfitting
- winter tourism (snowmobiling, cross-country skiing, ice fishing).

A key water management strategy for the tourism industry involves a no-cut buffer zone along waterways and around lakes. This buffer zone varies based on several site-specific conditions (e.g., see Section 3.2.6, Recreation/Tourism).

4.7 Water Management in Provincial Parks and Conservation Reserves

As a general policy, under MNR's Proposed Land Use Strategy (1999), commercial hydroelectric power development will continue to be excluded from all existing and new Provincial Parks and Conservation Reserves.

Provincial parks, including the aquatic resources within these parks, are managed under MNR's park management plans which are specific to each provincial park. Michipicoten Post Provincial Park is of relevance due to its proximity to the Michipicoten River and its influence over the park's environment due to dynamic river channel procedures. A management planning process for this park was initiated in April 2003, and a background information document was released in August 2004.

Shoals Provincial Park which is also within the Michipicoten system, has considerable water resources in and adjacent to its boundaries, but does not have a specific management plan at the present time. Instead, it is governed by an "Interim Management Statement". The key guidelines within this statement pertaining to water and fisheries management are as follows (MNR, 1994):

- a dam partially located within park boundaries between Windermere and Lower Prairie Bee Lakes is operated by MNR to control water levels in the latter lake for recreation and fishing (see Figure 4.10 at the end of this section). The dam was originally constructed in the early 1900's by the Austin-Nicholson Lumber Co. to control water levels for spring log drives.

Upgrading, replacing or abandoning the dam will be addressed during the park management planning process.

- sportfishing (walleye, northern pike, whitefish and yellow perch) is encouraged and sport ice fishing will continue to be permitted.

- commercial fishing (including commercial bait fishing) is not permitted in the park.

- the need for a fisheries study to determine sustainable harvest levels will be examined.

Lake Superior Provincial Park is also of interest since the headwaters of the Anjigami River are within the northern boundary of this park. Fisheries management within the park is mainly directed toward brook trout. Based on a review of the Lake Superior Provincial Park Management Plan, there are no specific water management guidelines for the Anjigami River system or other rivers within the park (MNR, 1995b).

4.8 Heritage Resources

Heritage resources are managed through legislative mechanisms (e.g., Ontario's Heritage Act, Ontario's Environmental Assessment Act and Ontario's Planning Act) as well as government policies and procedures (e.g., Cultural Heritage and Archaeological Policies of the Ontario Provincial Policy Statement, 2005, and MNR's Water Power Site Release and Development Review Procedures (2005), which ensure that heritage resources are considered prior to water resource development. In this way, archaeological and other historic/cultural sites can be avoided or protected. MNR's Provincial Park Management Plans and Forest Management Plans also make provision for the management of heritage resources.

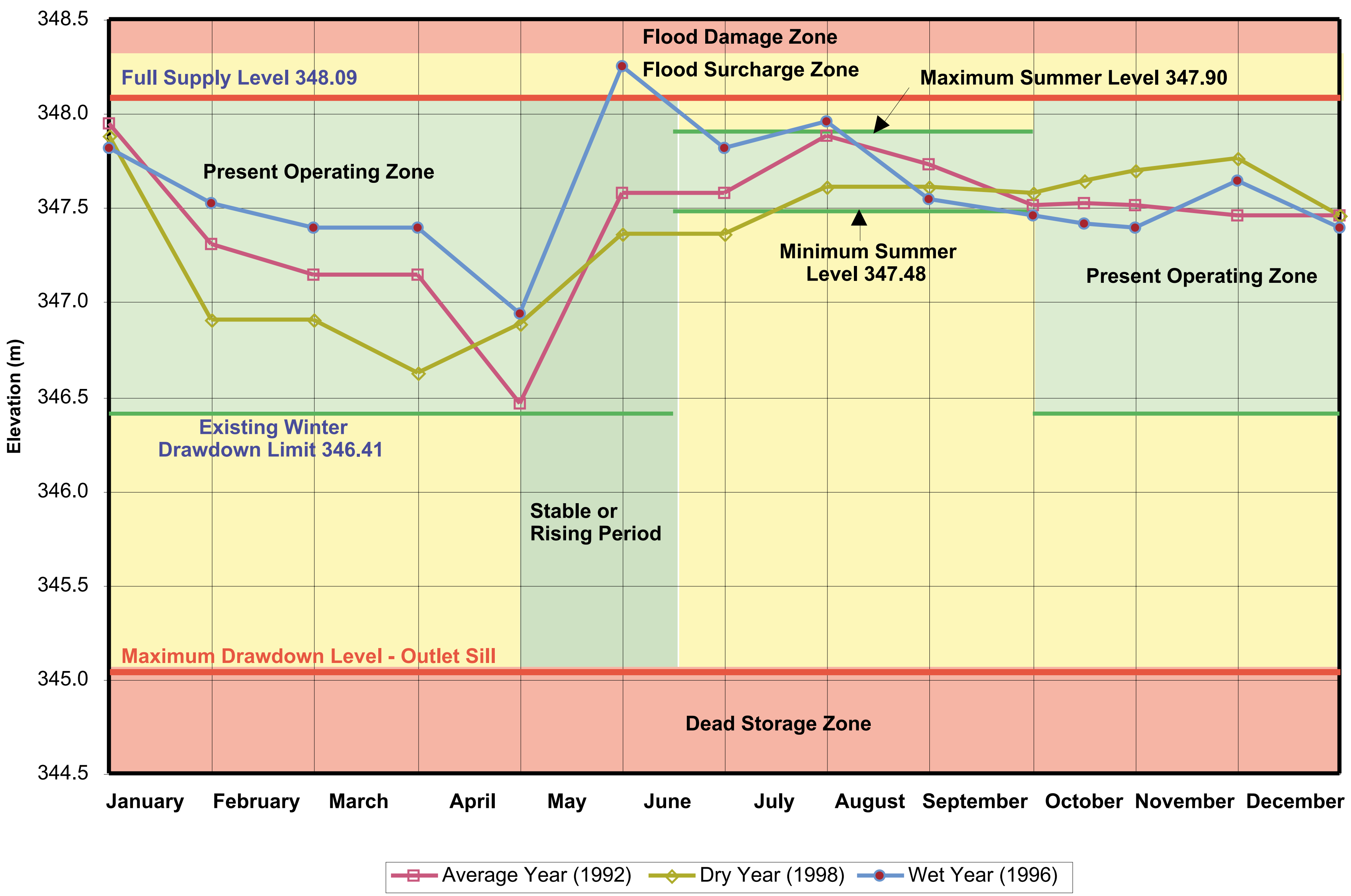

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Figure 4.1
Michipicoten River Water Management Plan
Brookfield Power Corporation

Wabitongushi Lake - Present Operating Levels

ACRES International

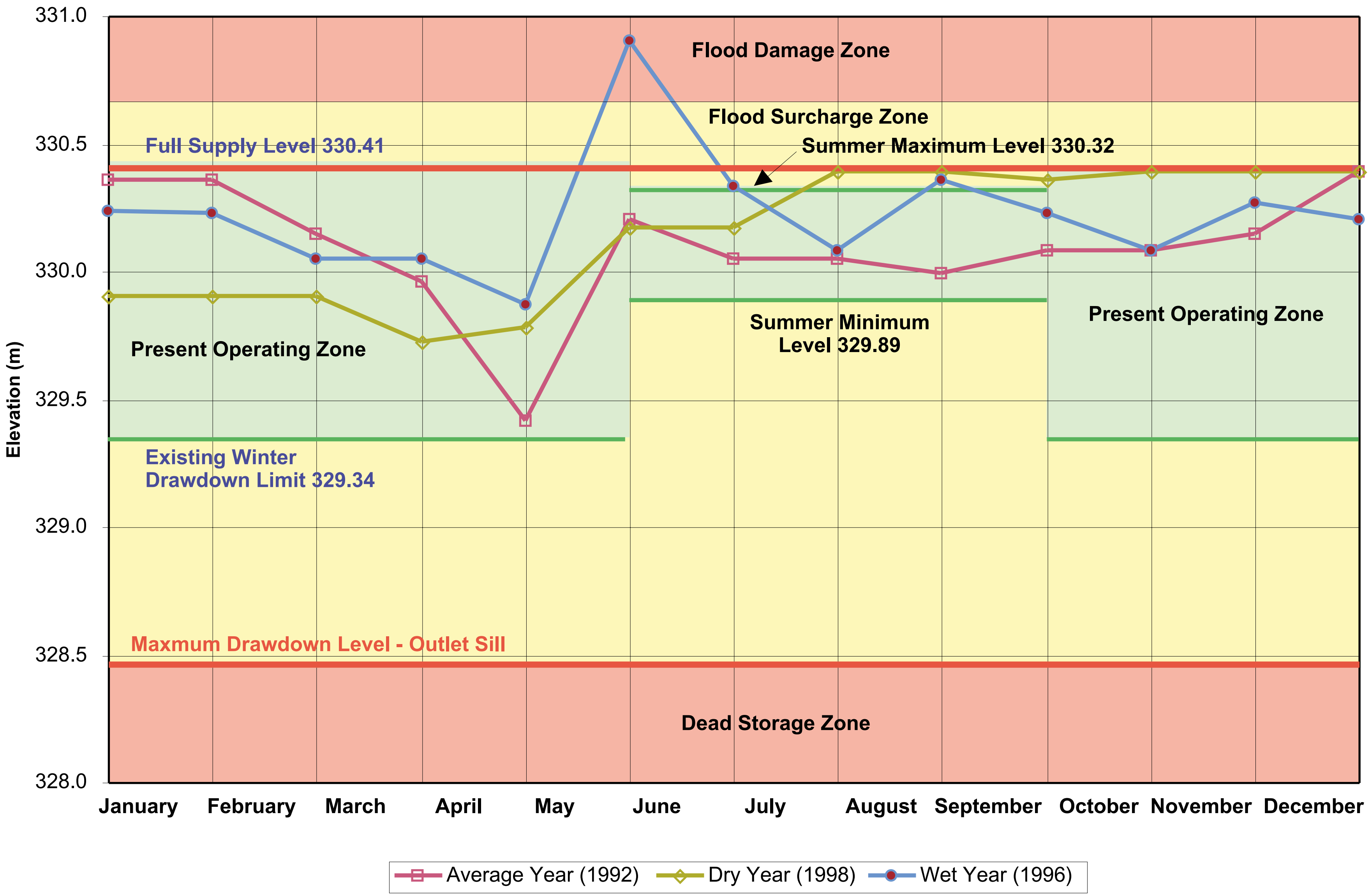

Figure 4.2
Michipicoten River Water Management Plan
Brookfield Power Corporation
Dog Lake - Present Operating Levels

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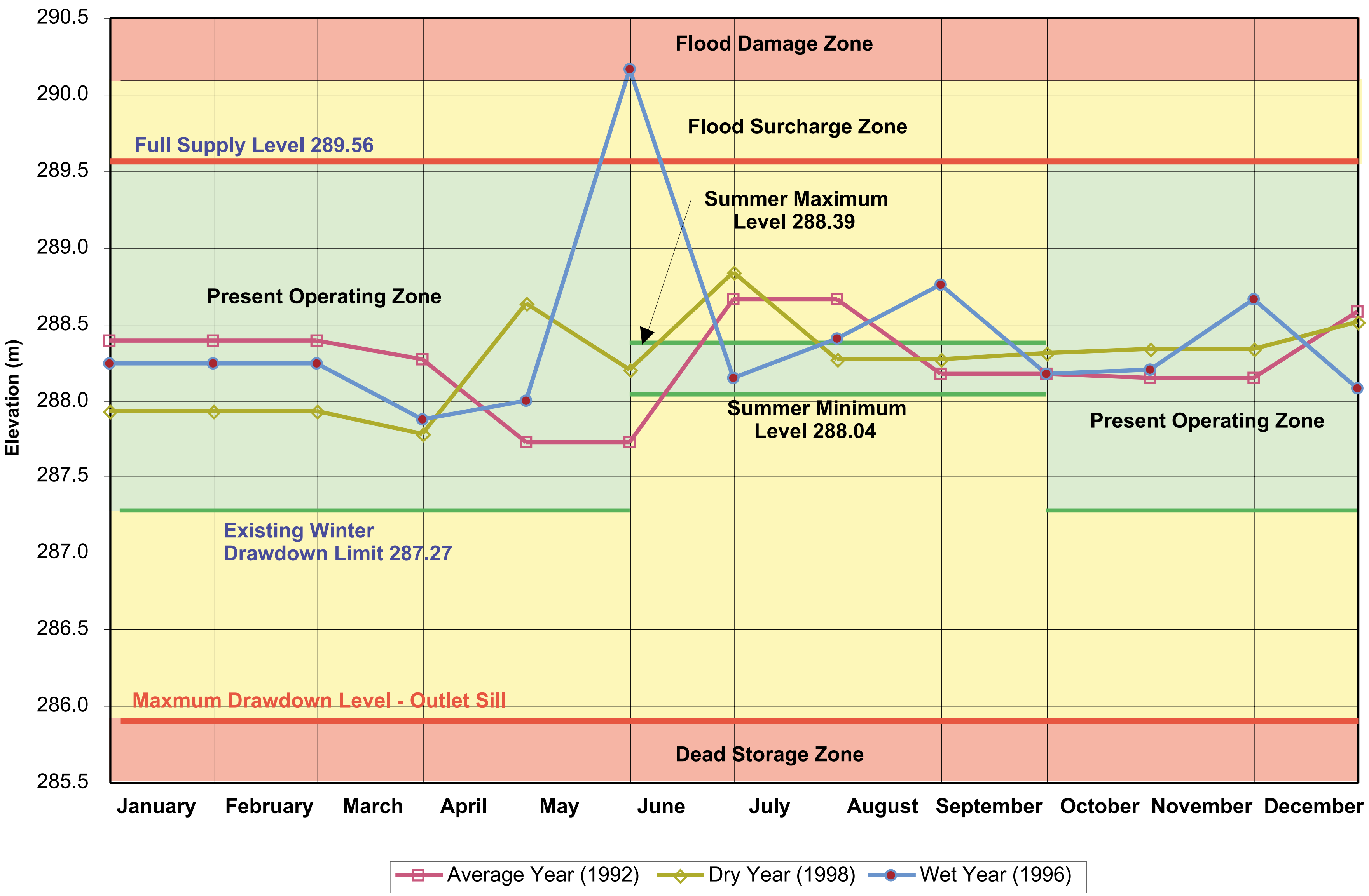

Figure 4.3
Michipicoten River Water Management Plan
Brookfield Power Corporation
Anjigami Lake - Present Operating Levels

ACRES International

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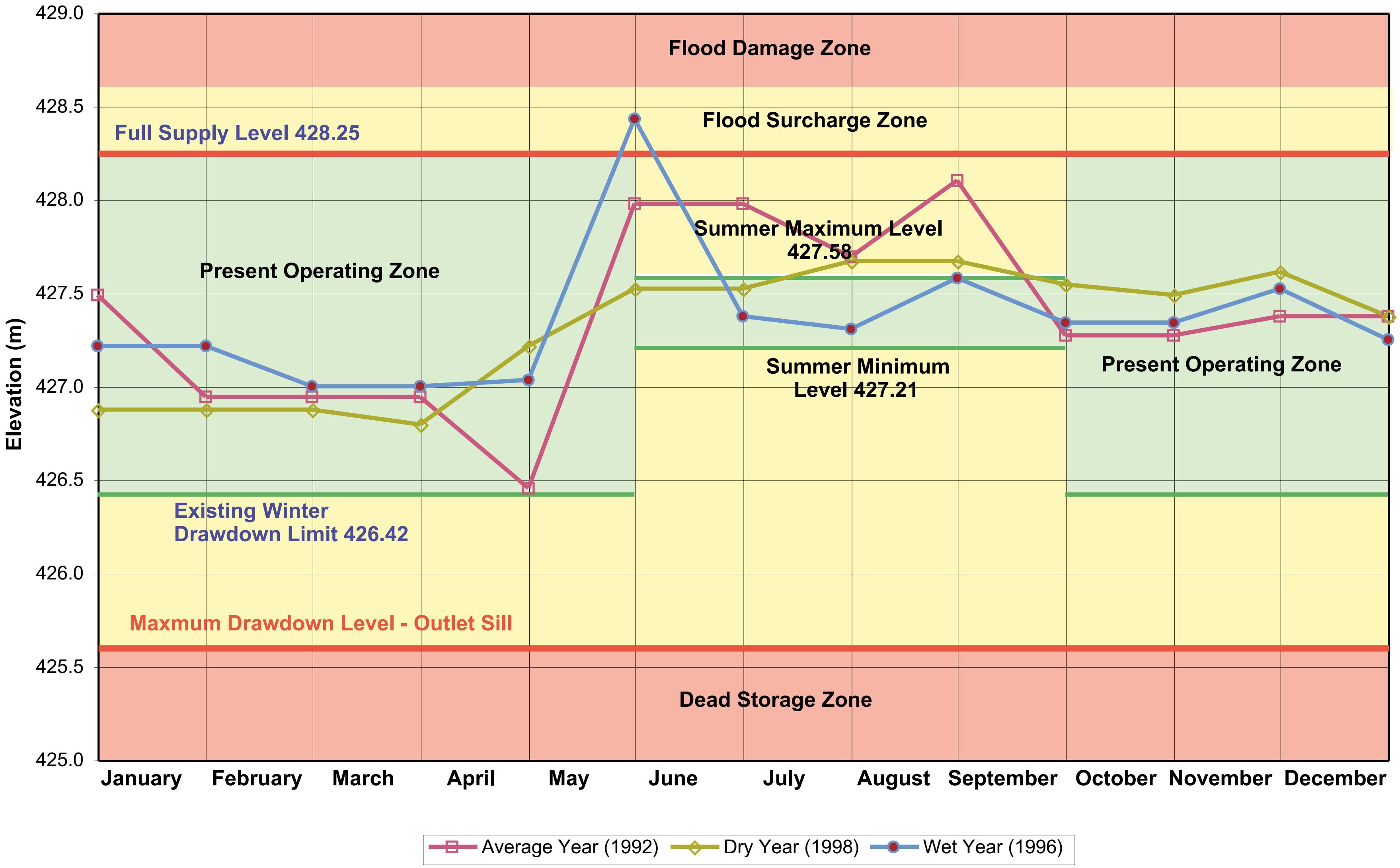

Figure 4.4
Michipicoten River Water Management Plan
Brookfield Power Corporation
Windermere Lake - Present Operating Levels

ACRES International

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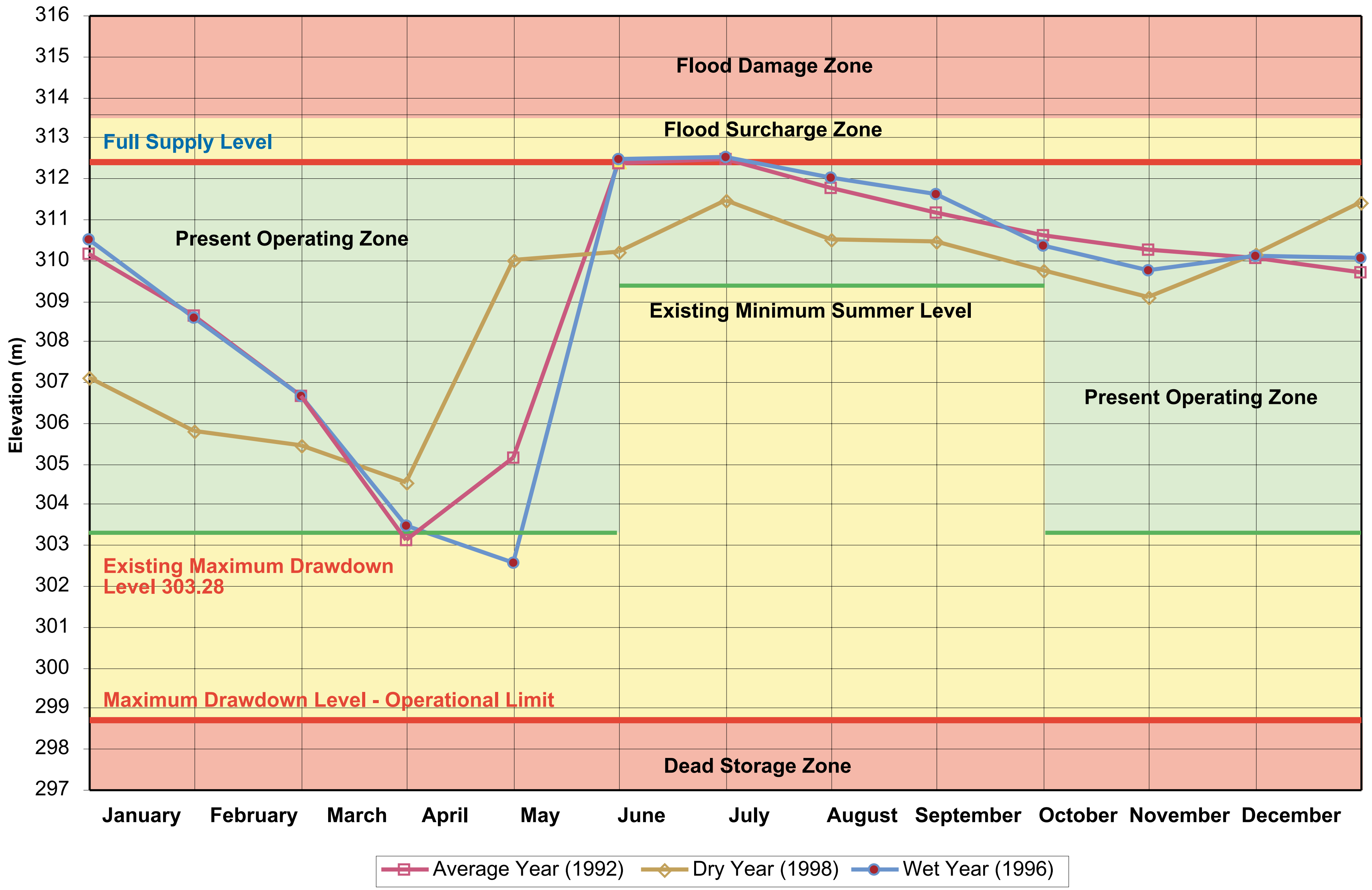

Figure 4.5
Michipicoten River Water Management Plan
Brookfield Power Corporation

Hollingsworth Reservoir - Present Operating Levels

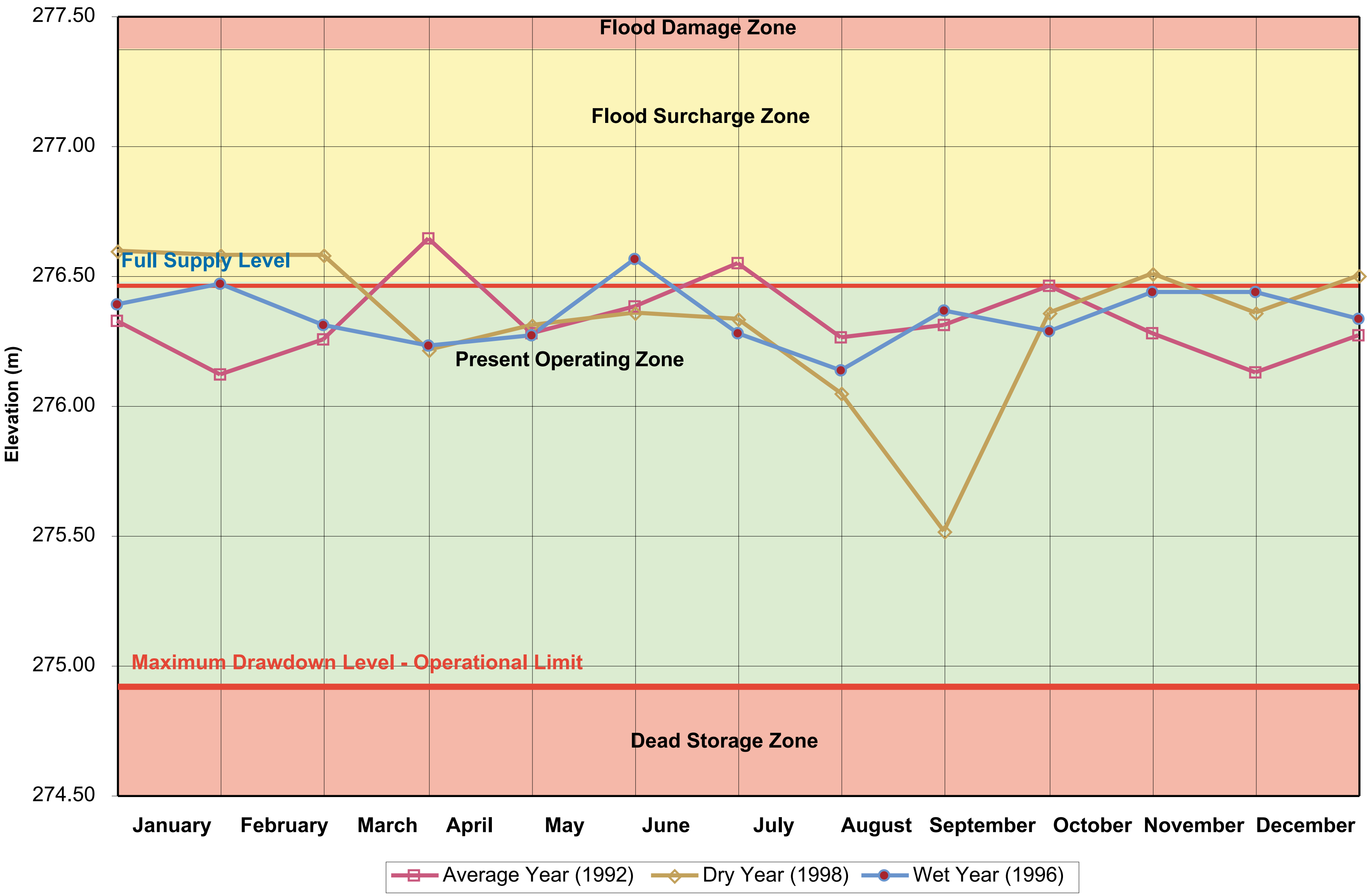

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Figure 4.6
Michipicoten River Water Management Plan
Brookfield Power Corporation
McPhail Reservoir - Present Operating Levels

ACRES International

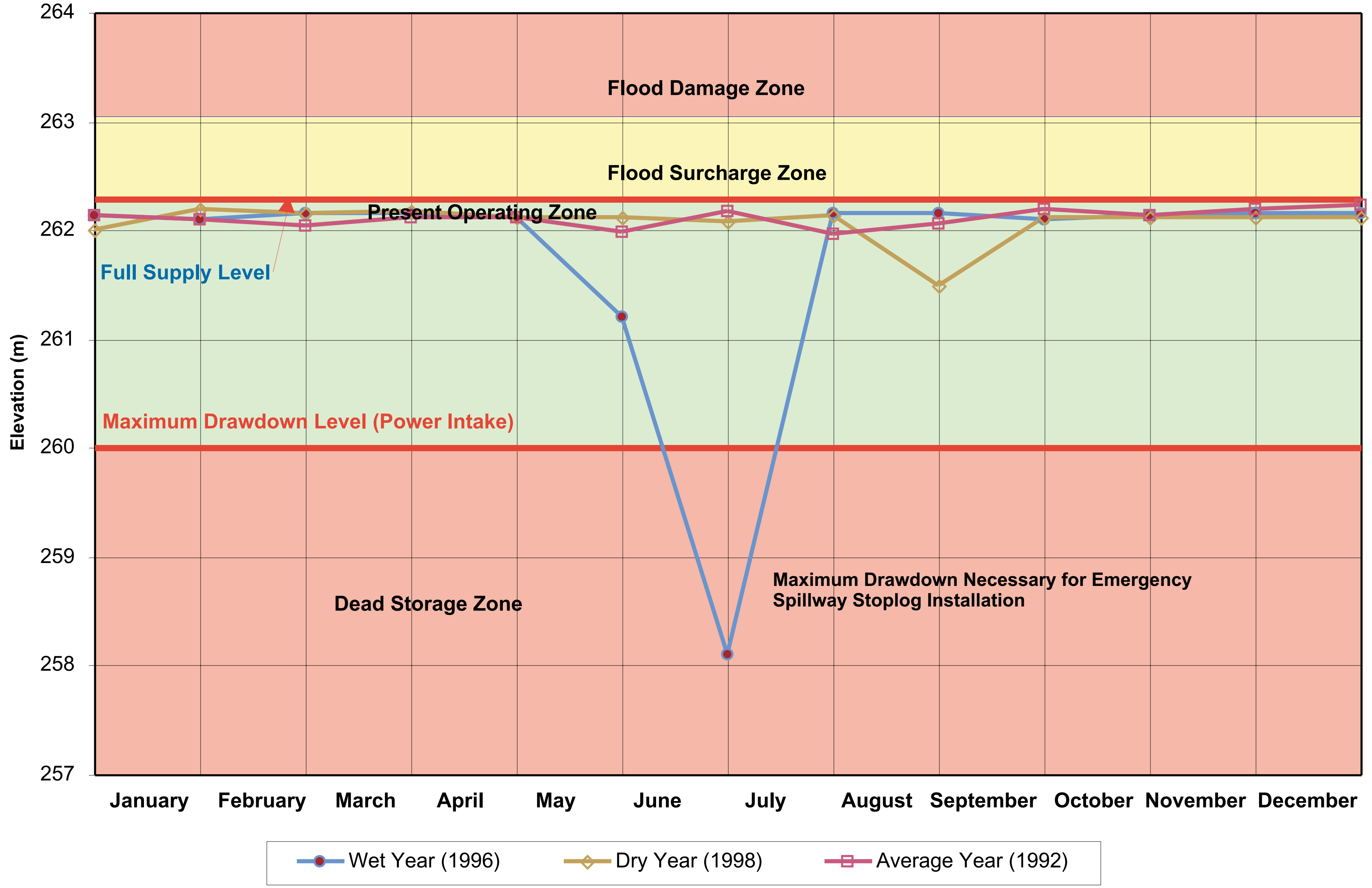

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Figure 4.7
Michipicoten River Water Management Plan
Brookfield Power Corporation

Dunford (High Falls) Reservoir - Present Operating Levels

ACRES International

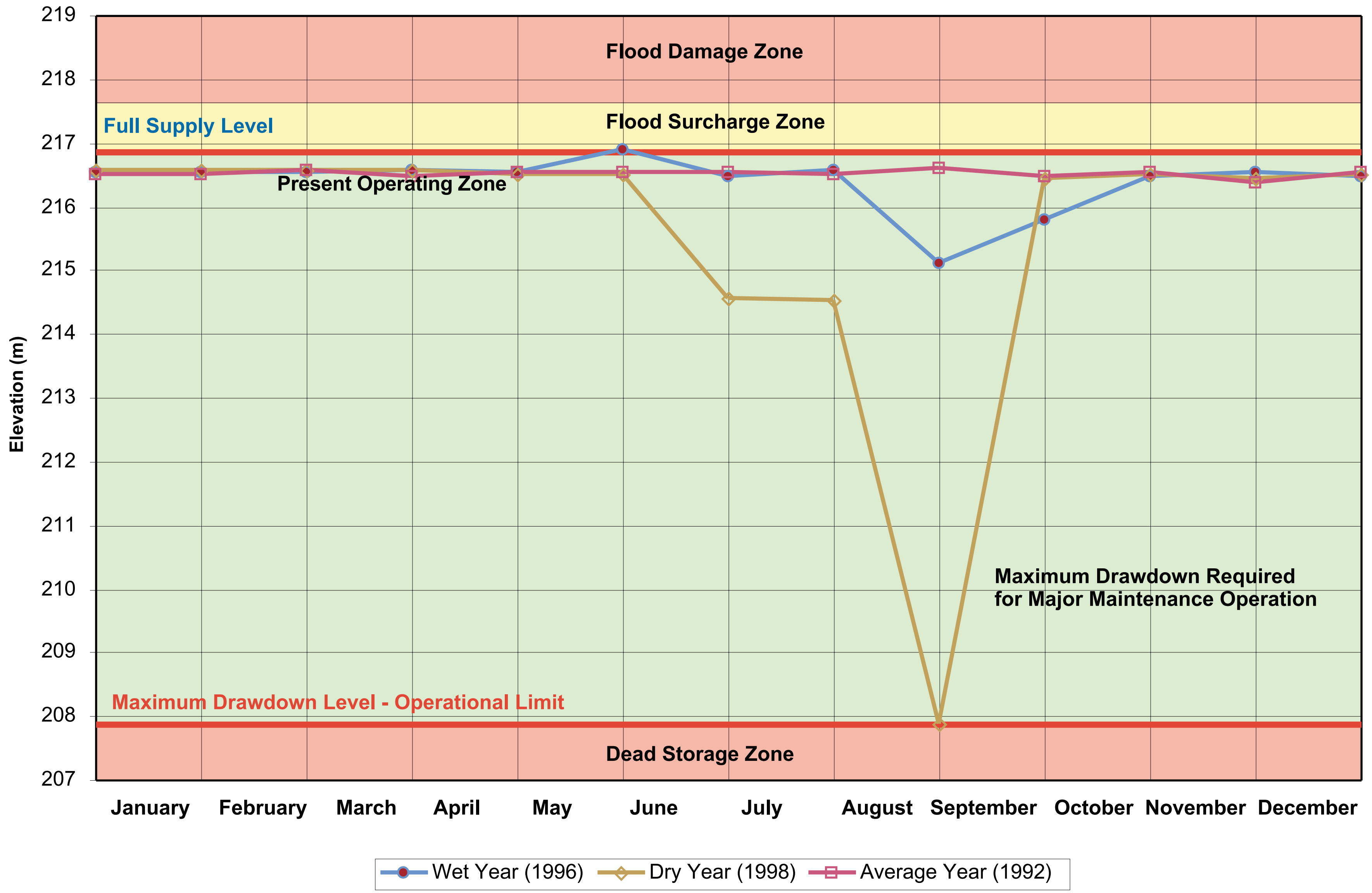

Figure 4.8
Michipicoten River Water Management Plan
Brookfield Power Corporation

Scott Falls Reservoir - Present Operating Levels

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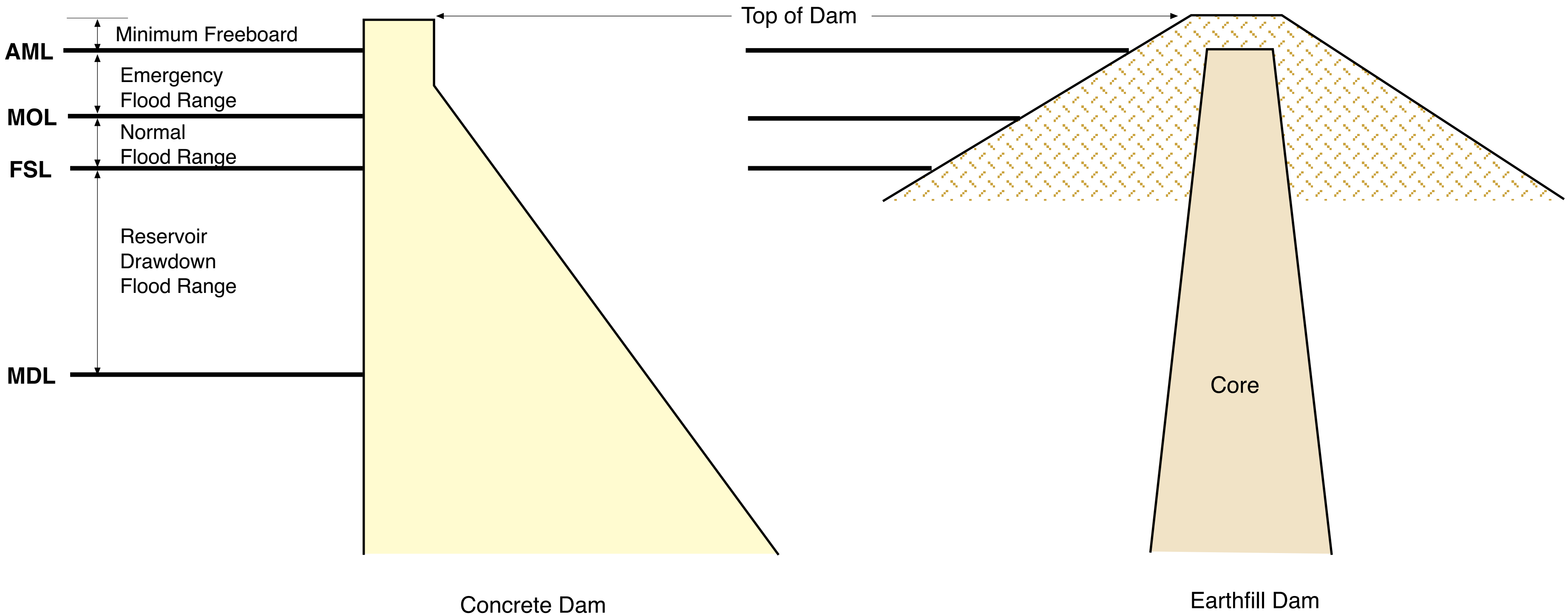

AML - Absolute Maximum Level
MOL - Maximum Operating Level
FSL - Full Supply Level
MDL - Maximum Drawdown Level

Figure 4.9
Michipicoten River Water Management Plan
Brookfield Power Corporation

Definition of Reservoir Operating Levels

ACRES International

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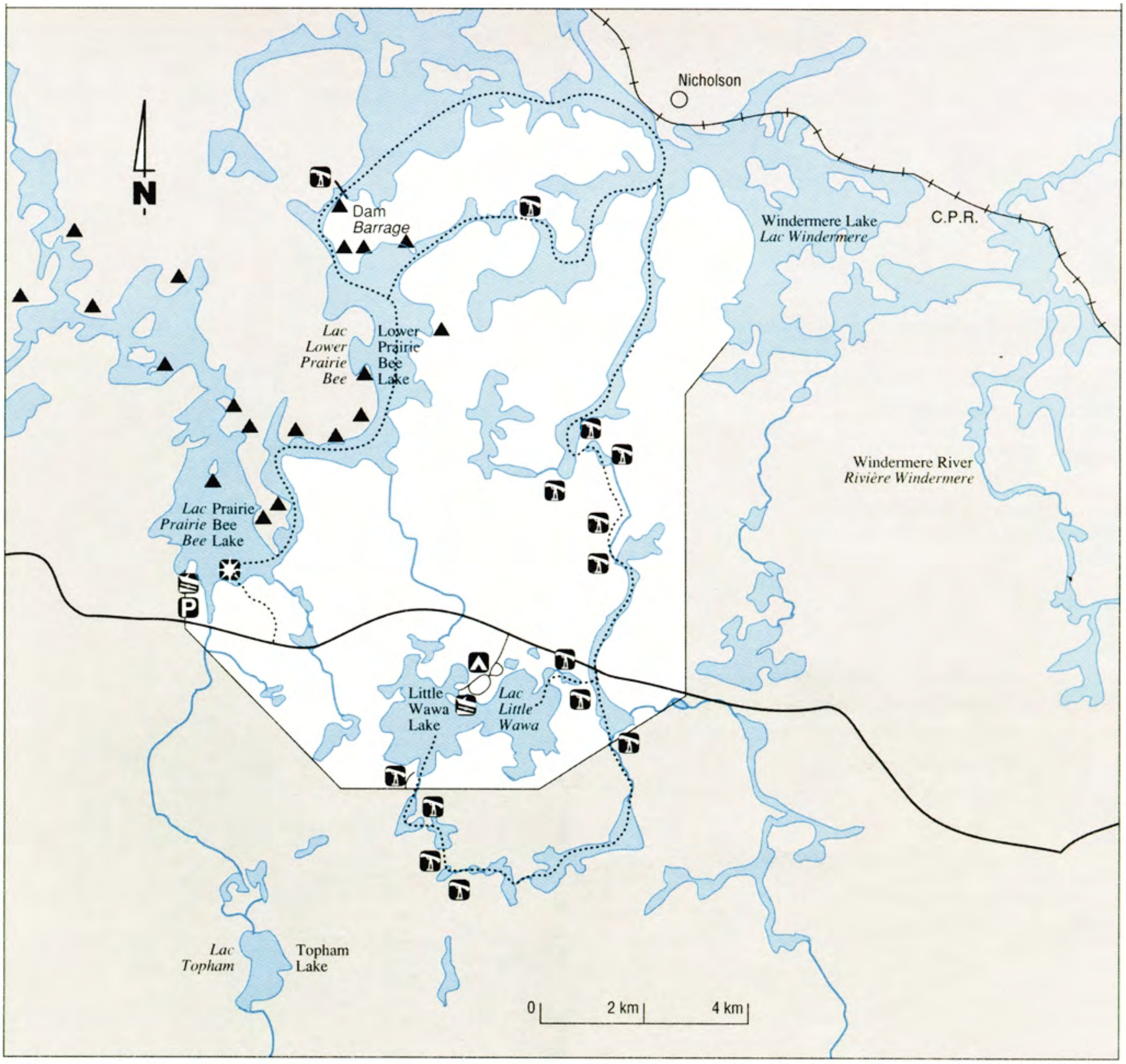


Parking
Stationnement

Day Use
Utilisation de jour

Campground
Terrain de camping

Primitive Campsites
Camping primitif

Boat Launch
Rampe de mise à l'eau

Portage
Portage

Canoe Route
Itinéraire de canotage

Source:
MNR, Chapleau District

P13074_rm_Mar07

Figure 4.10
Michipicoten River Water Management Plan
Brookfield Power Corporation
Shoals Provincial Park

ACRES International

5 Issues, Data Gaps and Baseline Data Collection

5 Issues, Data Gaps and Baseline Data Collection

5.1 Issues

Several economic, environmental and social issues of importance on the Michipicoten River system were identified by stakeholders. These are categorized as follows:

- BP issues
- Public Consultation issues
- MNR issues
- First Nation issues.

Each category of issues is described further in the subsections that follow. Table 11.4, Section 11 describes if and how these issues were resolved for this WMP. It is important to emphasize that the baseline condition for identifying issues and concerns was the ecosystem as it exists today. The Michipicoten River has been developed as a hydro river since 1908.

5.1.1 Brookfield Power Issues

BP has several issues and concerns related to its hydroelectric plant operations on the Michipicoten River.

Economic

- The risk of jeopardizing the economic viability of its hydroelectric operations to accommodate other water demands. This is very important to BP given its investment in hydroelectric power development of the Michipicoten River.

- The risk of losing flexibility of hydroelectric operations in a deregulated market jeopardizing BP's competitive advantage and ability to adapt to evolving market conditions.

- The high cost of preparing a WMP, implementing the WMP, monitoring water management strategies, and amending/revising WMPs.

- BP has a concern that introducing further environmental constraints will result in considerable economic cost to the company.

- Loss of revenues if minimum flows are required below Hollingsworth and Scott Falls GS.

- Management for ecosystem objectives may impact on the economic sustainability of hydropower production on the river.

Socioeconomic

- The risk of adversely affecting hydroelectric power benefits to federal and provincial governments as well as local communities, and industries in the Michipicoten watershed (including tax revenues, water power rentals, employment, hotels, restaurants, contractors, etc).

Operations

- The risk of losing flexibility in operating rule curves to meet other water demands, jeopardizing BP's ability to meet power demands.

- The risk of losing flexibility in varying flow releases (depending on water availability and power demands) to accommodate other water demand.

- The need to improve public and agency understanding of how and why the river is managed for water power operations.

Public Safety/Flood Management

- The potential to affect public safety and emergency response capability, depending on the water management strategy being considered.

- The risk of losing some flood management capability which is an associated secondary benefit of hydroelectric development.

Environmental

- The difficulty of balancing hydroelectric operations with competing water demands (e.g., fisheries, aquatic habitat, recreation, trapping), particularly in terms of timing for power demands versus other ecosystem demands.

5.1.2 Public Issues

During the public consultation process, the following issues were identified.

Environmental

- Concern that fluctuating water levels on Wabatongushi Lake may have an adverse effect on fish spawning activities (identified by one person).

- Concern that changing water levels may have an adverse effect on fish populations (identified by two people).

- Desire for an increase in minimum flows below Scott Falls to improve downstream areas for fish and aquatic habitat (identified by one person).

- The effects of water level fluctuations on loon nesting sites and beaver populations in the Dog/Wabatongushi Lakes area (one person).

- Desire for fish hatchery to enhance fishery and tourism (identified by one person).

- Effects of introducing non-native fisheries. e.g., chinook and pink salmon (identified by one person).

The last two items above are considered outside the scope of the WMP but are included for the purpose of providing complete documentation of the public consultation process.

Social

- Flooding on Dog Lake during the springs of 1980 and 1996 and the effects on the cottage community (identified by one person).

- Alleged damage to outboard motors from the effects of low water levels in the Fifty-Seven Bay area of Dog Lake (mentioned by two cottage owners).

- The effects of Dog Lake drawdowns on the Missinabie water supply (one person).

- Stabilization of water levels throughout the Michipicoten system, including the Windermere Lake area for recreation (cottaging, sport fishing, boating) (identified by three people).

- The interference to navigation caused by sandbars on the Lower Michipicoten River in the vicinity of the marina and at the confluence of the Magpie/Michipicoten rivers (comments made by the public to MNR).

- Observed decline in quality of sport fishing on Wabatongushi Lake (identified by one person).

- Narrow boat access between Manitowik and Whitefish Lake (identified by one commercial resort owner).

- Maintenance of safe access around dams (for portage trails, snowmobile trails) (identified by two people).

Heritage

- Effect of the WMP on Indian pictographs in the Dog Lake area (mentioned by two people).

5.1.3 MNR Issues

MNR has the following issues of concern on the Michipicoten River System. These are presented in more detail in Appendix L.

Upper Reservoirs (Anjigami, Dog, Wabatongushi, and Windermere Lakes)

- Seasonal water levels - effects on aquatic and riparian productivity, and fish spawning.

- Anjigami fluctuations - effects on terrestrial or aquatic ecological communities near the shoreline.

- Effect of Windermere Lake reservoir level changes on confirmed cultural heritage resources and recreation.

- Effect of Anjigami Lake reservoir level changes on recreation.

Upper Reservoir Outflows

- Stop-log manipulations - potential effects on downstream flushing, scouring, flooding, or dewatering.

Hollingsworth Reservoir (Manitowik and Whitefish Lakes)

- Seasonal water levels - effects on aquatic and riparian productivity, and fish spawning.

- Manitowik sunken dam - effects on navigation, drawdowns, and aquatic productivity.

Highway 101 River Reach (Below Hollingsworth GS to Highway 101)

- Flow regime (seasonal and daily) - effects of minimum flow, maximum flow, and fluctuations in flow on fish and invertebrates.

- McPhail Reservoir raising - effects on existing river habitat and aquatic community, including remnant brook trout.

McPhail Falls, High Falls, and Scott Falls Reservoirs

- Maintenance drawdowns - effects on aquatic productivity.

- Daily fluctuations - effects on aquatic productivity.

- Spring high water levels - effects of reduced inundation on terrestrial and aquatic production

- McPhail Reservoir - effects of reservoir raising on aquatic habitat in tributary streams.

Outflow from McPhail and Dunford (High Falls) Reservoirs

- Flow regime (seasonal and daily) - effects of minimum flow, maximum flow, and fluctuations in flow on walleye spawning and invertebrate production.

Lower River Reach (Scott Falls to Lake Superior)

- Flow regime (seasonal and daily) - effects of minimum flow, maximum flow, and fluctuations in flow on invertebrate production and fish species in this reach.

- Overbank flows - effects on channel rejuvenation and ecological processes in the floodplain.

- Navigation - from Scott Falls to Lake Superior during low flows.

- Effect of change in flow on erosion at Michipicoten Post Provincial Park and South Michipicoten River – Superior Shoreline Conservation Reserve.

All Reservoirs

- Mercury - effects of previous flooding on present mercury levels in sport fish.

- Inflowing stream habitat - potential effects of previous flooding on habitat in inflowing streams.

5.1.4 First Nation Issues

Invitations to meet personally with all the First Nations in the Michipicoten and Montreal River watersheds were sent out early in the water management planning process.

The Michipicoten and Missanabie Cree First Nations were invited to the Wawa PIC early in the planning process (August 24, 1998) to receive information on the Michipicoten River water management planning process. BP also extended an invitation to meet personally with First Nations. There was no requirement in the MNR-approved Terms of Reference to have individual First Nation Information Centres separate from the PICs.

No First Nations have expressed any issues to date with the Michipicoten River water management planning process. However, this plan was initiated several years prior to MNR's Water Management Planning Guidelines (2002). Since implementation of Forest Management Planning Guidelines and Water Management Planning Guidelines, MNR is taking a more active role encouraging First Nation participation and is assisting local First Nations in developing a native values database. This will include protection of a First Nation heritage site recently identified at Windermere Lake.

5.1.5 Issues Beyond the Scope of the Water Management Plan

There are some issues on the Michipicoten River system which cannot be addressed because they are caused by factors that are external to the WMP. It is important to identify these other factors because they may need to be addressed through other management strategies independent of this plan, to achieve specific fisheries goals without impacting on the economic viability of BP's operations on the Michipicoten system.

These other factors were identified in the Wawa District Fisheries Management Plan: 1989-2000 (MNR, 1989) and can be summarized as follows:

- Exploitation--fishing pressure on most waters is moderate or high in relation to their productivity. This results in declining fish size and catch rates. Increasing accessibility is a major factor.

- Aquatic Community--predation or competition among fish species can affect the production of sport fish. Problems with introduced species such as sea lamprey and smelt fall in this category.

- Habitat--shoreline development, road construction, and road crossings can cause degradation of important fish habitat such as littoral vegetation and the siltation of spawning areas.

Issues associated with shoreline development, road construction and road crossings for BP’s operations are outside this WMP as they are addressed as part of the environmental permitting process for new water power projects, as well as expansions and maintenance/rehabilitation projects.

5.2 Data Gaps and Baseline Data Collection Program

The key issues identified during planning team sessions, the Public Information Centres and discussions with the Local Citizens’ Committee (Wawa Co-Management Committee) are summarized in Table 5.1.

The key issues were then assessed in terms of baseline data availability and the results are included in Table 5.1. Three areas were identified as having data deficiencies and these are described further in the subsections that follow.

Table 5.1 Summary of Key Issues and Data Gaps in Baseline Information	
Key Issues	**Baseline Data Gap to Address Issue?**
Economic Loss of clean, renewable electricity, power revenues and operational flexibility to accommodate additional environmental and social constraints on waterpower operations	No
Environmental Effects of water levels and flows on aquatic ecology and habitat	Yes
Social Flood management/public safety	No
Summer Water levels for recreation	No
Heritage Water levels to view Indian pictographs (Dog Lake)	Yes – field investigation required
Water management as a potential contributor to exposure of cultural resources on the shoreline of Windermere Lake	Yes – field investigation required

5.2.1 Aquatic Ecology/Aquatic Habitat

In order to obtain a better understanding of the aquatic ecosystem of the Michipicoten River system, the planning team developed a program consisting of first and second priority items as listed in Table 5.2. It was soon recognized that even the list of first priority items in the baseline data collection program outlined in Table 5.2 was too onerous for the limited budgets available and time limits of this water management planning cycle. It was then reduced to the following key first priority baseline field investigations, with responsibilities noted in brackets:

- Fall Walleye Index Netting (FWIN) surveys (MNR/Laurentian University)
- Summer Profundal Index Netting (SPIN) surveys for lake trout (MNR/Laurentian University)
- Nordic Netting Survey on Windermere Lake (MNR/Laurentian University)
- shoreline habitat mapping on McPhail Reservoir (BP/MNR)

- shoreline habitat survey on the Michipicoten River below Hollingsworth GS (BP/MNR)
- shoreline habitat mapping on Wabatongushi Lake (as representative of the upper storage reservoirs on the Michipicoten River system) (BP/MNR)
- wetted habitat survey on the Michipicoten River below Scott GS (MNR)
- fall brook trout spawning survey below Hollingsworth GS (BP)
- radiotelemetry fish tracking (BP/MNR)
- rainbow trout spawning survey below Scott GS (BP)
- spring walleye spawning survey below Hollingsworth GS (BP)
- fish tissue mercury (BP).

The above items are highlighted in Table 5.2, with the remaining data gaps to be assessed, prioritized and filled as appropriate in subsequent WMP cycles.

Each of the above baseline data collection programs is summarized briefly in the subsections that follow. Complete details are provided in a separate baseline monitoring volume of the plan.

The planning team agreed that the aquatic ecology baseline data collection program (and all effects monitoring associated with a change in water management strategy) would be funded through cost sharing between BP and MNR as noted above.

5.2.1.1 Fall Walleye Index Netting Surveys

The main objective of an index netting survey is to assess the relative abundance of a fish stock and provide other biological measures or indicators of the target population's status (MNR, 2002a).

FWIN surveys were carried out by Laurentian University (Cooperative Freshwater Ecology Unit) on the following reservoirs:

- Wabatongushi Lake (south) (1998)
- Wabatongushi Lake (north) (2000)
- Dog Lake (1999)
- Hollingsworth Reservoir (Whitefish Lake) (2000)
- McPhail Reservoir (2000)
- Anjigami Lake (2000).

Table 5.2 Aquatic Baseline Data Collection Program		
Location	**First Priority**	**Second Priority**
Wabatongushi Lake - as representative of the upper storage lakes	**Littoral/Riparian Habitat** Shoreline Cruise: • locate critical habitats • map type and depth range of aquatic plants • map type of riparian wetlands and connectivity to the lake • map bottom type • map aquatic cover – shrubs, debris, rocks etc • map bank erosion. Monitor water level at outlet structure. **Fish Abundance and Population Health** Fall Walleye Index Netting (FWIN) (north end) to complement existing south end data Collect fish tissue samples for mercury analysis. **Forage Base** Walleye Stomach Content Analysis: • during FWIN netting • cooperative effort with lodge owners **Spawning Habitat** Spring walleye spawning surveys of lake shoals and incoming tributaries.	**Small Fish** Small Fish Surveys (seining) to determine critical habitat areas with special reference to species important to walleye diet **Invertebrates** Invertebrate standing crop sampling with special reference to determining critical habitats for invertebrates important to walleye diet **Sport Fishing** Creel Census to assess fishing pressure and harvest **Other** Possible additional monitoring based on experience gained during primary monitoring. **Spawning Habitat** Change in walleye spawning habitat downstream of Wabatongushi Dam due to log manipulation.
Dog Lake	**Fish Abundance and Population Health** Spring Littoral Index Netting (SLIN) or Summer Profundal Index Netting (SPIN) - for lake trout	
Windermere Lake	Nordic netting survey for lake trout	
Anjigami Lake	Fall Walleye Index netting (FWIN) SLIN or SPIN - lake trout Collect fish tissue samples for mercury analysis.	

Highlighted items were the baseline investigations undertaken for this WMP cycle.

Table 5.2 Aquatic Baseline Data Collection Program		
Location	**First Priority**	**Second Priority**
Hollingsworth Reservoir	**Littoral/Riparian Habitat** Shoreline Cruise: • locate critical habitats • map type and depth range of aquatic plants • map type of riparian wetlands and connectivity to the lake • map bottom type • map aquatic cover – shrubs, debris, rocks etc • map bank erosion. Monitor water level at outlet structure. **Fish Abundance and Population Health** Fall Walleye Index Netting (FWIN) (Whitefish) Spring Littoral Index Netting (SLIN) - for lake trout (Manitowik) Collect fish tissue samples for mercury analysis. **Forage Base** Walleye and lake trout Stomach Content Analysis: • during FWIN/SLIN netting • cooperative effort with lodge owners **Spawning Habitat** Spring walleye spawning surveys looking at lake shoals and incoming tributaries	**Small Fish** Small Fish Surveys (seining) to determine critical habitat areas with special reference to species important to walleye diet **Invertebrates** Invertebrate sampling with special reference to determining critical habitats for invertebrates important to walleye diet **Sport Fishing** Creel Census to assess fishing pressure and harvest. **Other** Possible additional monitoring based on experience gained during primary monitoring.

Highlighted items were the baseline investigations undertaken for this WMP cycle.

<table>
<tr><th colspan="3">Table 5.2
Aquatic Baseline Data Collection Program</th></tr>
<tr><th>Location</th><th>First Priority</th><th>Second Priority</th></tr>
<tr><td>McPhail Reservoir</td><td><u>Littoral/Riparian Habitat</u>
Shoreline Cruise:
• locate critical habitats
• map type and depth range of aquatic plants
• map type of riparian wetlands and connectivity to the lake
• map bottom type
• map aquatic cover – shrubs, debris, rocks etc
• map bank erosion.

Monitor water level at outlet structure.

<u>Fish Abundance and Population Health</u>
Fall Walleye Index Netting (FWIN)

Collect fish tissue samples for mercury analyses.

<u>Forage Base</u>
Walleye Stomach Content Analysis:
• during FWIN netting</td><td><u>Small Fish</u>
Small Fish Surveys (seining) to determine critical habitat areas with special reference to species important to walleye diet

<u>Invertebrates</u>
Invertebrate sampling with special reference to determining critical habitats for invertebrates important to walleye diet</td></tr>
<tr><td>Downstream of Hollingsworth GS to Algoma Central Railway</td><td><u>Riparian Habitat</u>
Shoreline Cruise:
• locate critical habitats
• map type and depth range of aquatic plants
• map bottom type
• map aquatic cover – shrubs, debris, rocks, etc
• map bank erosion.

<u>Fish Behavior</u>
Use radiotelemetry and other methods as agreed with MNR to track fish movements.

<u>Fish Abundance and Population Health</u>
Method to be agreed upon with MNR.</td><td><u>Small Fish</u>
Small fish sampling to determine critical habitat areas with special reference to those species important in <u>brook trout</u> diet

<u>Invertebrates</u>
Determination of standing crop with special reference to major habitat groups (i.e. guilds) important in brook trout diet
Drift sampling - look at drift in relation to discharge pattern from Hollingsworth GS

<u>Nursery Habitat</u>
Seining to determine nursery habitats.</td></tr>
</table>

Highlighted items were the baseline investigations undertaken for this WMP cycle.

Table 5.2
Aquatic Baseline Data Collection Program

Location	First Priority	Second Priority
Downstream of Hollingsworth GS to Algoma Central Railway (cont'd)	**Forage Base** Brook Trout stomach content analysis for dietary composition **Fish Habitat** Categorization of available habitat (i.e., by pool, run and riffle) under varying discharges from Hollingsworth GS **Spawning Habitat** Fall brook trout spawning surveys Spring walleye spawning surveys	**Other** Possible additional monitoring based on experience gained during primary monitoring.
River Reach from Scott Falls downstream to confluence with the Magpie River	**Riparian Habitat** Shoreline Cruise: • locate critical habitats • map type and depth range of aquatic plants • map bottom type • map aquatic cover – shrubs, debris, rocks, etc • map bank erosion. **Fish Abundance and Population Health** Method to be agreed upon with MNR. **Forage Base** Rainbow Trout stomach content analysis for dietary composition. **Fish Habitat** Categorization of available habitat features (i.e., by pool, run and riffle) under varying discharges from Scott GS **Spawning Habitat** Spring and Fall Spawning Surveys for Rainbow Trout.	**Small Fish** Small fish sampling (seining) to determine critical habitat areas with special reference to those species important in rainbow trout diet. **Invertebrates** Determination of standing crop with special reference to major habitat groups (i.e. guilds) important in rainbow trout diet. Drift sampling - look at drift in relation to discharge pattern from Hollingsworth GS. **Nursery Habitat** Seining to determine nursery habitats. **Other** Possible additional monitoring experience gained during primary monitoring. Spring surveys for walleye.

Highlighted items were the baseline investigations undertaken for this WMP cycle.

A standardized MNR index gill netting technique was used as a rapid assessment tool for determining walleye abundance and population health. The results are provided in Figures 5.1 to 5.6 at the end of this section.

Generally, relative abundance of walleye is rated as above average for Wabatongushi Lake, and Dog Lake, below average for Whitefish Lake, (Hollingsworth Reservoir) and Anjigami Lake, and poor for McPhail Reservoir. However, other factors also need to be considered such as condition, and fecundity to establish trends over time. Additional summary details for the FWIN program are provided in Volume 3 (Aquatic Ecology Field Protocols and Baseline Data Collection Results) of the WMP.

5.2.1.2 Summer Profundal Index Netting (SPIN) Surveys

SPIN surveys for lake trout were carried out by Laurentian University (Cooperative Freshwater Ecology Unit) on the following reservoirs:

- Hollingsworth Reservoir (Manitowik Lake) (2001)
- Anjigami Lake (2002)
- Dog Lake (2002).

The geometric mean catch per unit effort (CPUE) for these lakes was compared with the CPUE of other lakes in MNR's Northeast Region (SPIN sample size = 123) to determine lake trout relative abundance.

In MNR's Northeast Region, the average lake trout CPUE using Spring Littoral Index Netting (SLIN) or SPIN is 0.40. When compared to MNR's Northeast Region data, Manitowik Lake (geometric CPUE = 0.47) has an above average relative abundance, Dog Lake (geometric mean CPUE = 0.31) has a below average CPUE and Anjigami Lake (geometric mean CPUE = 0.08) has a low relative abundance for lake trout.

The SPIN field protocol and raw data results are included in Volume 3 of this WMP entitled *"Aquatic Ecology Field Protocols and Baseline Data Collection Results"*.

5.2.1.3 NORDIC Netting Survey on Windermere Lake

The NORDIC method of index netting (Appleberg, 2000) was used on Windermere Lake. Details of the monitoring technique and results of the NORDIC netting survey undertaken in 2003 are provided in Volume 3 of the Michipicoten WMP.

Analysis of the NORDIC netting data for lake trout was similar to the SPIN analysis. The geometric mean CPUE was compared to the CPUE of other lakes in the Northeast Region (NORDIC sample size = 122) to determine lake trout relative abundance. NORDIC netting in the Northeast Region has an average lake trout CPUE of 0.35. Windermere Lake (geometric mean CPUE = 0.01) has a very low relative abundance when compared to the Northeast Region data.

5.2.1.4 Shoreline Habitat Mapping on the Michipicoten River below Hollingsworth GS

A shoreline cruise was undertaken in August 2001 on the Michipicoten River below Hollingsworth GS for a 4-km stretch to broadly characterize discrete units of aquatic habitat in the event of a 1-m raise of McPhail Reservoir and a possible continuous baseflow through Hollingsworth GS. The results of the shoreline cruise were mapped by MNR (Wawa) and are provided in Figure 5.7. This map was used to return to this area in August 2002 to collect more detailed site-specific habitat information. Detailed results are provided in Volume 3 of the WMP.

5.2.1.5 Shoreline Habitat Mapping on McPhail Reservoir

Environmental and social impacts associated with a proposed 1 m raise of McPhail Reservoir were outlined in a Project Information Package (PIP) document prepared as part of the Dunford (High Falls) Redevelopment Project (Acres, 1997), including mitigation. Additional environmental studies were subsequently undertaken by Natural Resource Solutions (1999) in the form of a reservoir raising experiment, where McPhail Reservoir was raised in incremental stages to more precisely determine the extent of backwater effects on aquatic ecology habitat.

The above-mentioned PIP document as well as the supplementary 1999 environmental information was reviewed with a view to determining whether any additional baseline environmental information was warranted for the WMP. It was concluded that a shoreline cruise was desirable, which was undertaken in August 2002 to broadly characterize discrete units of aquatic habitat prior to a proposed raise of McPhail Reservoir by 1 m. The results of the shoreline cruise were mapped by MNR (Wawa) and are provided in Figure 5.8. This map was used to return to McPhail Reservoir during the summers of 2003-2004 to collect more detailed site-specific habitat information. Detailed results are provided in Volume 3 of the WMP.

5.2.1.6 Shoreline Habitat Mapping on Wabatongushi Lake

Due to limited time and budgets available for baseline data collection, Wabatongushi Lake was selected by MNR (Wawa) as being representative of the upper storage reservoirs on the Michipicoten River system for shoreline habitat mapping. Air-photo mapping of a portion of the shoreline was undertaken during the summer of 2004. This was to be followed by ground truthing by MNR and BP’s consultant to confirm habitat types during the summer of 2006. However, it was discovered that, over the last 10 years, water levels on Wabatongushi Lake have rarely reached the maximum drawdown level (346.41 m). In fact, in several years, the maximum drawdown has been only 0.51 m below the summer minimum. For this reason, this secondary storage reservoir was not considered representative for baseline investigations.

The Steering Committee was then presented with three options:

1 - Conduct a qualitative investigation on Wabatongushi Lake and compare results with a nearby unregulated lake.

2 - Drop the baseline data collection program on Wabatongushi Lake and determine whether there is another secondary storage reservoir with historical water levels that could represent a baseline condition at existing maximum drawdown level.

3 - Drop baseline field investigations for the secondary storage reservoirs, assuming that there is inherent ecological benefit in reducing the amount of drawdown legally allowed on the secondary storage reservoirs.

The Steering Committee selected Option 3 above with the proviso that the work to date in planning for the shoreline habitat mapping on Wabatongushi Lake be documented. This documentation has been completed and is included in Volume 3 (Aquatic Ecology Field Protocols and Baseline Data Collection Results).

5.2.1.7 Wetted Habitat Survey on the Michipicoten River Below Scott GS

Aerial photographic surveys of the Michipicoten River from Scott GS to Lake Superior were undertaken by MNR in 2000 and 2001. The purpose was to collect baseline data on wetted habitat conditions at various discharges through Scott GS in the event of a change in continuous minimum flows for this WMP. Images were captured using reflected color infrared photography. A camera with a 75-mm lens, used at an altitude of 1372 m (4500 ft) yielded a ground resolution of 0.25 m.

Two flow events were captured, i.e., 65 m^3/s in Year 2000 and 44 m^3/s in 2001, using infrared photography. Efforts to capture additional flows in 2002 and 2003 were unsuccessful due to difficulty in scheduling required flows due to market unpredictability. The land/water boundaries for the data collected were subsequently digitized at a scale of 1:10,000 to compare the wetted habitat between the two flows. The results are summarized below.

Scott Falls to Lake Superior	Main Channel (m^2)	Backwater Areas (m^2)
2000 air photos (65 m^3/s)	1 553 133	213 411
2001 air photos (44 m^3/s)	1 521 998	231 059
Area difference	31 135	352

Some sources of possible inaccuracy were identified during digitizing (as it is dependent on an individual's interpretation and is also affected by shadows (time of year and time of day flights taken).

It was concluded that air photos are only useful for detecting high magnitude changes. For this reason, they were replaced by a ground survey of wetted habitat at flows of 17 and 28 m^3/s in August/September 2004 using a GPS with submeter accuracy. GPS accuracy difficulties were discovered during data analysis and it was agreed that accuracy of the data to a 95% confidence level could only be achieved to +/-2 m. MNR is now in the process of finalizing the report to delineate wetted habitat below Scott GS. While the results will not be available in time for this water management planning cycle, they will be available for the next water management planning cycle.

5.2.1.8 Fall Brook Trout Spawning Survey

Fall brook trout spawning surveys were undertaken on the Michipicoten River below Hollingsworth GS to the Wisconsin Central Railway Bridge from October 9 to 22, 2001. No spawning activity was identified and spawning may be focused in the tributaries (lower Shikwamkwa River and Beaver Creek). More details are provided in Volume 3 (Aquatic Ecology Field Protocols and Baseline Data Collection Results) of the WMP.

5.2.1.9 Radiotelemetry Fish Tracking

A significant effort was made by Natural Resources Solutions Inc. (NRSI) and MNR staff during August, October and November 2001 to capture brook trout downstream of Hollingsworth GS near Highway 101 bridge and rainbow trout downstream of Scott Falls GS for placement of radio tags, to gain information on habitat use. No brook trout were captured, and only two rainbow trout were captured in Trout Creek, and one rainbow in the lower river near Buck’s Marina.

Subsequently, MNR and NRSI staff captured and tagged 21 rainbow trout, but 5 mortalities resulted in 16 live tagged fish. The fish were tracked at various times through the spring, summer and fall of 2002 and 2003.

Due to the high cost and manpower effort associated with radiotagging programs, combined with difficulties tracking, it was concluded that the program was largely unsuccessful and discontinued. More details are provided in Volume 3 (Aquatic Ecology Field Protocols and Baseline Data Collection Results) of the WMP.

5.2.1.10 Rainbow Trout Spawning Surveys

Rainbow trout spawning surveys were undertaken below Scott Falls to Highway 17 from May 11 to May 16, 2001, and from October 3 to October 23, 2001. Water temperatures were monitored to determine the timing of spawning surveys. High flows prevented safe access during the peak spring spawning period. No spawning activity was confirmed in the Michipicoten River during either the spring or fall surveys. However, MNR advises that rainbow trout spawning is known to occur in several areas of the main river channel below Scott GS, including an area behind the big island approximately 1 km downstream of Scott GS and there may be other areas. Trout Creek appears to be an important spawning tributary since rainbow trout were sighted during both the spring and fall of 2001. More details are provided in Volume 3 (Aquatic Ecology Field Protocols and Baseline Data Collection Results) of the WMP.

5.2.1.11 Spring Walleye Spawning Survey

Water temperatures were monitored to determine the timing of walleye spawning surveys between Hollingsworth GS to the Wisconsin/Central Railway Bridge. Many anglers have identified this area as an important stretch for walleye spawning. High flows prevented safe access during the peak spawning period but spawning surveys were undertaken when safe conditions allowed (May 11 to 16, 2001). No spawning activity was identified and it was concluded that the spawning period was already over as walleye were spotted in the plunge pool in a post-spawning condition. More details are provided in Volume 3 (Aquatic Ecology Field Protocols and Baseline Data Collection Results) of the WMP.

Additional walleye spawning surveys were carried out by MNR during the spring of 2005 with low numbers identified at the mouth of Firesand Creek (Dunford Reservoir).

5.2.1.12 Fish Tissue Mercury

The following lakes/reservoirs were sampled in October 2000 for baseline information of fish tissue mercury concentrations in walleye and northern pike:

- Wabatongushi Lake
- Anjigami Lake
- Whitefish Lake (Hollingsworth Reservoir)
- McPhail Reservoir.

The MOE protocol (1989) for mercury in fish tissue was followed for sampling and analysis. Fish were selected from each reservoir on the basis of a representative size range.

The results are provided in Tables 5.3 and 5.4 and were compared to two natural lakes in the Michipicoten River watershed. Samples for the natural lakes were taken from 1977 to 1978 and provided by the Ontario Ministry of the Environment (MOE), Sportfish Contaminant Monitoring Program. Generally, the smaller sized fish had the lowest mercury concentrations.

Northern pike in the regulated lakes (reservoirs) had total mercury concentrations above MOE's restricted consumption guidelines of 0.45 ppm, though this was also the case for Prairie Bee Lake (Table 5.3). Only one large fish (755 mm in length) taken from Anjigami Lake exceeded MOE's total consumption restriction guideline of 1.57 ppm, by 0.09 ppm.

Table 5.3
Mercury Concentrations in Northern Pike of Natural vs Regulated Lake in the Michipicoten River Watershed

	Sample Size (n)	Size Range of Fish Sampled (mm)	Mean Hg Concentration (ppm)	Range of Measured Concentration (ppm)	Fish in Restricted Consumption Category	Fish in Total Restriction Category
Regulated						
Anjigami	10	380 – 794	0.78	0.26 – 1.59	Yes	Yes
McPhail	9	539 – 828	0.65	0.44 – 0.1.19	Yes	No
Wabatongushi	10	364 – 741	0.48	0.28 – 0.89	Yes	No
Natural Lakes						
Como	10	375 – 720	0.23	0.13 – 0.28	No	No
Prairie Bee	10	290 – 645	0.44	0.23 – 0.78	Yes	No

Table 5.4
Mercury Concentrations in Walleye of Natural vs Regulated Lake in the Michipicoten River Watershed

	Sample Size (n)	Size Range of Fish Sampled (mm)	Mean Hg Concentration (ppm)	Range of Measured Concentration (ppm)	Fish in Restricted Consumption Category	Fish in Total Restriction Category
Regulated						
Whitefish	10	194 – 560	0.72	0.197 – 1.579	Yes	Yes
Anjigami	10	286 – 614	0.92	0.423 – 2.61	Yes	Yes
McPhail	9	262 – 454	0.57	0.238 – 1.109	Yes	No
Wabatongushi	10	305 – 640	0.47	0.268 – 0.649	Yes	No
Natural Lakes						
Como	10	200 – 630	0.45	0.15 – 1.02	Yes	No
Prairie Bee	10	250 – 350	0.38	0.27 – 0.53	Yes	No

Environment Canada (2002) Environmental Effects Monitoring (EEM) protocol for the mining sector recommends eight 50-g samples for each size class for meaningful statistical analysis. However, this level of effort is often not practical and difficult to achieve, depending on the success of netting efforts, consideration of fish kills of other species in an effort to obtain adequate samples for targeted species, and budgeted time in the field for netting efforts.

Walleye fish tissue in both the regulated and unregulated lakes/reservoirs had total mercury concentrations above MOE's restricted consumption guideline of 0.45 ppm (Table 5.4). However, only Whitefish and Anjigami Lakes had fish with total mercury concentrations above MOE's total consumption restriction of 1.57 ppm.

Complete details are provided in a report by NRSI (2004) included in Volume 3 of the WMP.

5.2.1.13 Summary Note on Aquatic Ecology/ Habitat Baseline Data Collection Program

Initially, the planning team agreed to conduct an extensive aquatic ecology and aquatic habitat baseline data collection program on the Michipicoten River system to fill data gaps and gain a better understanding of present conditions. However, it became apparent that limited time and budgets for the water management planning process prevented a comprehensive baseline data collection program continuing without a clear focus on priority items.

Therefore, the decision on a preferred water management strategy as described in Section 11 was made based on (a) the options evaluated, and (b) existing baseline information collected to 2004. This baseline information is summarized above in Sections 5.2.1.1 to Section 5.1.1.12 and Section 5.2.2 that follows.

5.2.2 Heritage Data

A field trip to Dog Lake was undertaken by MNR to fill a data gap with respect to desirable water levels to view the Indian pictographs. A maximum water level elevation (330.32 m) on Dog Lake to enable viewing of the pictographs became one of the evaluation criteria for assessing the effects of a change in water management strategy (see Section 7, Table 7.2).

Recent discovery of a First nation heritage site along the shoreline of Windermere Lake has raised a concern by MNR - Ontario Parks that water management may be contributing to exposure of heritage features. For this reason, MNR - Ontario Parks has requested that the issue of water management as a potential contributor to the exposure of cultural heritage resources, particularly in provincial parks, be examined prior to the next WMP cycle.

During the fall of 1998, Wabatongushi Lake (south basin) was sampled according to a standard gillnet method used by Ontario and Quebec. Results from this assessment are summarized in the following presentation.

Below each graphic is a colour-coded interpretation of the biological (IN CAPITAL LETTERS);

A RED flag indicates there is a high risk that the measure is beyond the sustainability level of the resource.

An ORANGE flag specifies a reasonable concern that the measure is close to the sustainability level of the resource.

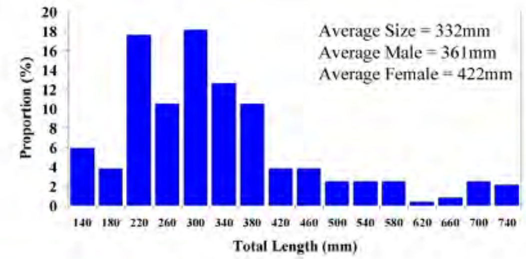
A GREEN flag signifies there is a low risk that the measure is affecting the sustainability of the resource.

How do we diagnose walleye stock status?

We sample using the Ontario standard fall walleye index netting method and measure:

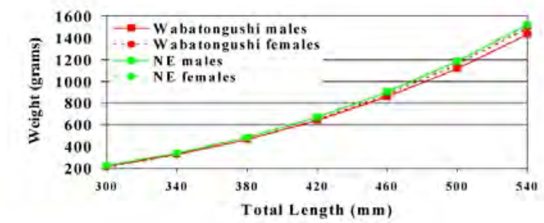
- ✓ Relative Abundance
- ✓ Size Distribution
- ✓ Relative Stock Density
- ✓ Age Distribution and Mortality
- ✓ Growth
- ✓ Condition
- ✓ Sex Ratio by Size
- ✓ Maturity Schedule by Size and Age
- ✓ Reproductive Characteristics

Size Distribution



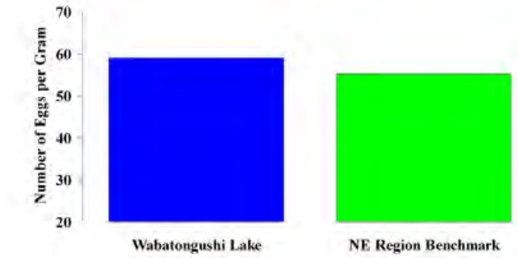
GOOD SIZE RANGE OF FISH.

Condition (Length-Weight)



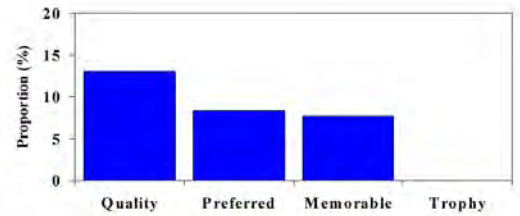
MALE CONDITION IS LOWER THAN NE AVERAGE. FEMALE CONDITION IS SIMILAR TO NE AVERAGE.

Relative Fecundity



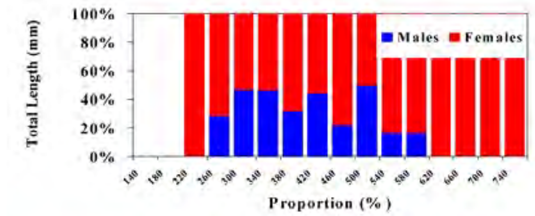
RELATIVE FECUNDITY IS SIMILAR TO NE AVERAGE.

Relative Stock Density



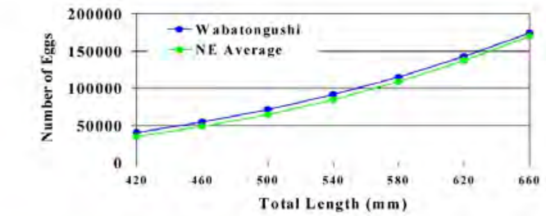
SOME QUALITY, PREFERRED, AND MEMORABLE SIZE FISH AVAILABLE TO THE ANGLERS BUT NO TROPHY SIZE FISH.

Sex Ratio by Size



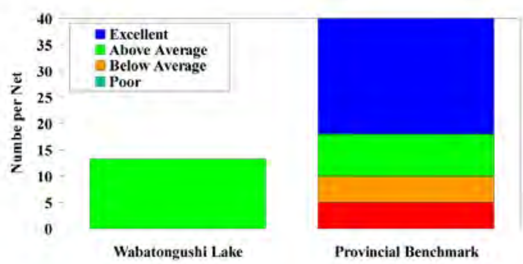
IMBALANCED SEX RATIO. FEW MALES.

Egg Production (Length-Eggs)



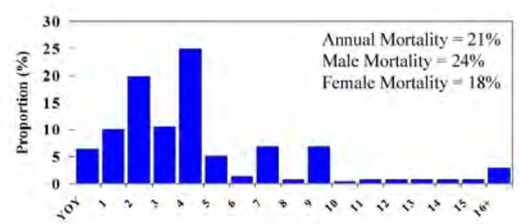
EGG PRODUCTION IS HIGHER THAN NE AVERAGE.

Relative Abundance



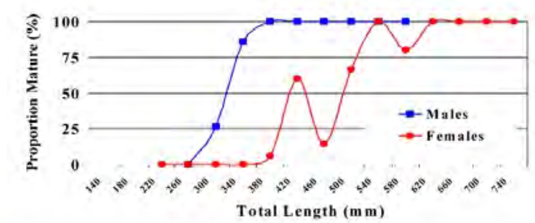
ABUNDANCE IS ABOVE AVERAGE AS EXPECTED (BASED ON CLIMATE AND PRODUCTIVITY).

Age Distribution and Mortality



TWO STRONG YEAR-CLASSES ARE ENTERING THE POPULATION, BUT VERY FEW FISH ARE OLDER THAN AGE 4. MORTALITY IS HIGH.

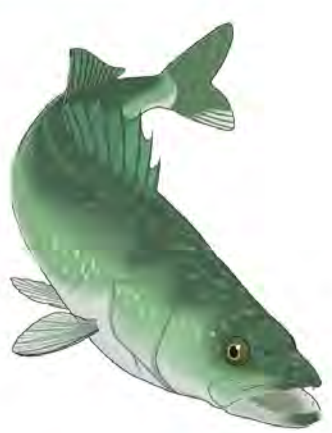
Maturity Schedule by Size



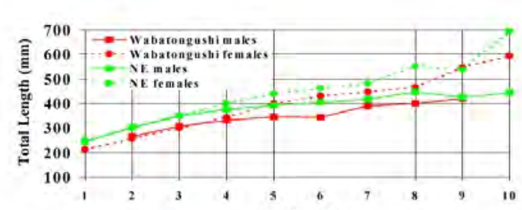
MALES ARE MATURING AT A SMALL SIZE (50% MATURE @ 314mm). FEMALES ARE MATURING SLOWLY (50% MATURE @ 473mm).

Walleye Stock Status Report Card '98

Parameter	Wabatongushi Lake
Relative Abundance	Above average (as expected)
Recruitment	Two strong year-classes
Relative Stock Density	Some large size fish
Age Structure	Few fish older than age 4
Mortality	18% to 24%
Growth	Slower than NE average
Condition	Males in poor condition
Sex Ratio	Imbalanced, few males
Maturity	Females maturing slowly
Fecundity	Similar to NE average

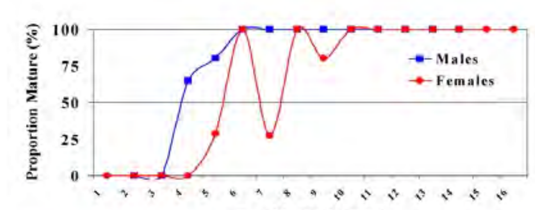


Growth (Length-at-Age)



MALE AND FEMALE GROWTH IS MUCH SLOWER THAN NE AVERAGE.

Maturity Schedule by Age



MALES ARE MATURING NORMALLY (50% MATURE AT 3.8 YEARS) BUT FEMALES ARE MATURING SLOWLY (50% MATURE @ 6.7 YEARS).

Where do we go from here?

✓ Ensuring the sustainability of the Wabatongushi Lake walleye population requires a concerted effort on behalf of all individuals and organizations concerned about this resource. In this new era of fishing, anglers are becoming more aware of the important role they play in helping to manage quality fisheries. The Ministry of Natural Resources needs you to get involved!

For more information, please contact

Marcel Pellegrini
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Highway 101, Box 1160
Wawa, Ontario P0S 1K0
(705) 856-2396

Source: MNR

Figure 5.1
Michipicoten River Water Management Plan
Brookfield Power Corporation
Wabatongushi Lake (South Basin) FWIN Results

ACRES International

P13074_rm_Mar07

During the fall of 2000, Wabatongushi Lake (north basin) was sampled according to a standard gillnet method used by Ontario and Quebec. Results from this assessment are summarized in the following presentation.

Below each graphic is a colour-coded interpretation of the biological (IN CAPITAL LETTERS);

A RED flag indicates there is a high risk that the measure is beyond the sustainability level of the resource.

An ORANGE flag specifies a reasonable concern that the measure is close to the sustainability level of the resource.

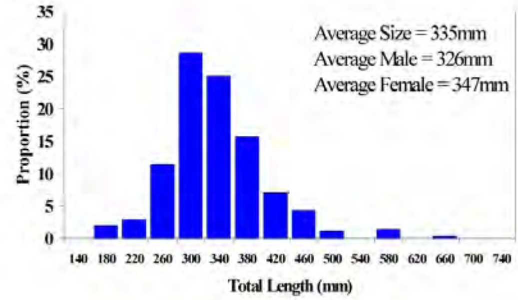
A GREEN flag signifies there is a low risk that the measure is affecting the sustainability of the resource.

How do we diagnose walleye stock status?

We sample using the Ontario standard fall walleye index netting method and measure:

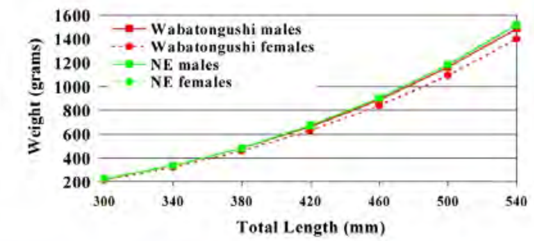
- ✓ Relative Abundance
- ✓ Size Distribution
- ✓ Relative Stock Density
- ✓ Age Distribution and Mortality
- ✓ Growth
- ✓ Condition
- ✓ Sex Ratio by Size
- ✓ Maturity Schedule by Size and Age
- ✓ Reproductive Characteristics

Size Distribution



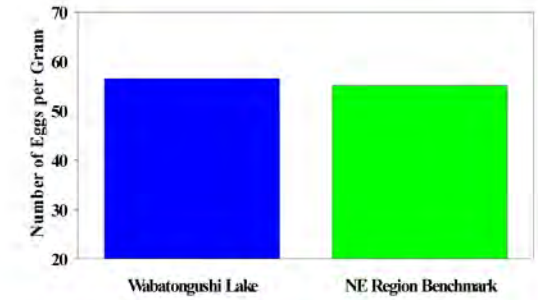
POOR SIZE RANGE OF FISH (FEW FISH ABOVE 460mm).

Condition (Length-Weight)



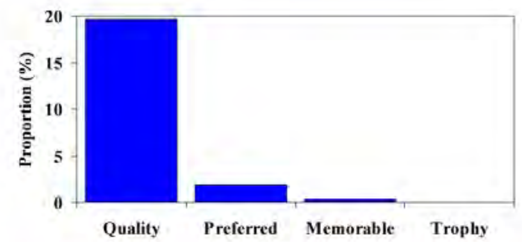
MALE CONDITION IS SIMILAR TO NE AVERAGE. FEMALE CONDITION IS LOWER THAN NE AVERAGE.

Relative Fecundity



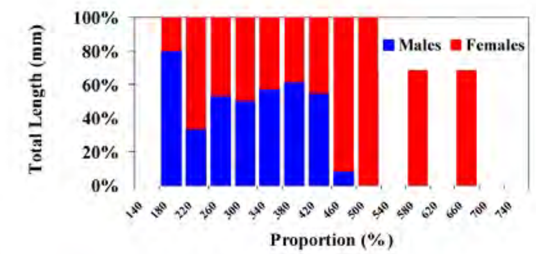
RELATIVE FECUNDITY IS SIMILAR TO NE AVERAGE.

Relative Stock Density



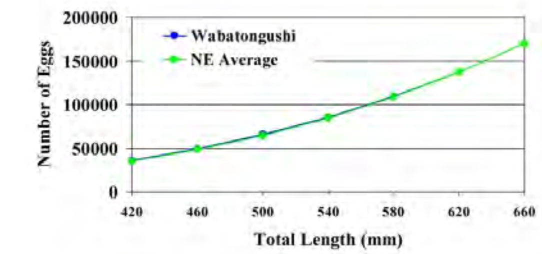
MOSTLY QUALITY SIZE FISH. FEW PREFERRED OR MEMORABLE SIZE FISH AVAILABLE TO THE ANGLERS AND NO TROPHY SIZE FISH.

Sex Ratio by Size



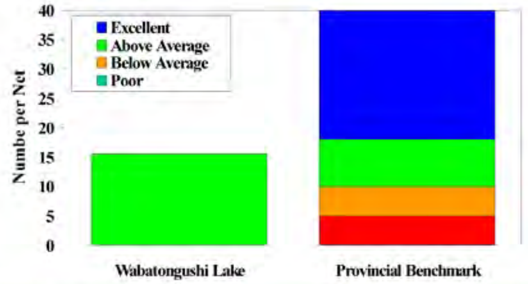
BALANCED SEX RATIO BUT FEW LARGE FEMALES?

Egg Production (Length-Eggs)

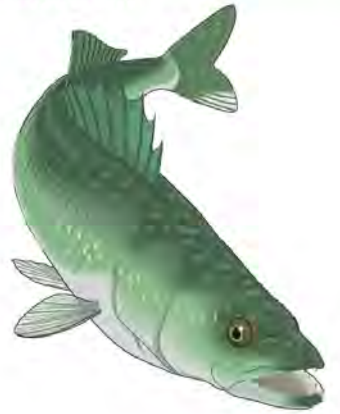


EGG PRODUCTION IS SIMILAR TO NE AVERAGE.

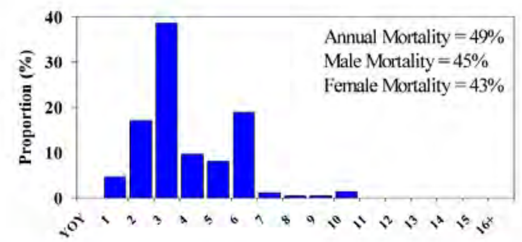
Relative Abundance



ABUNDANCE IS ABOVE AVERAGE AS EXPECTED (BASED ON CLIMATE AND PRODUCTIVITY).

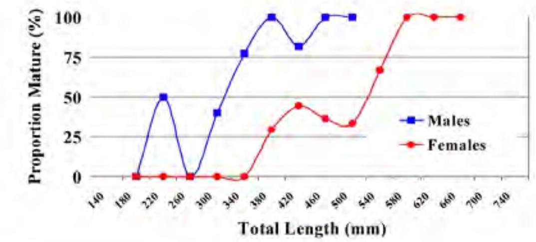


Age Distribution and Mortality



TWO STRONG YEAR-CLASSES ARE ENTERING THE POPULATION, BUT VERY FEW FISH ARE OLDER THAN AGE 6. MORTALITY IS VERY HIGH.

Maturity Schedule by Size

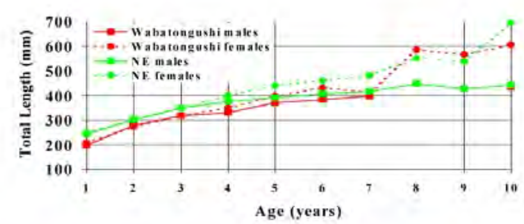


MALES ARE MATURING AT A SMALL SIZE (50% MATURE @ 311mm). FEMALES ARE MATURING SLOWLY (50% MATURE @ 480mm).

Walleye Stock Status Report Card '00

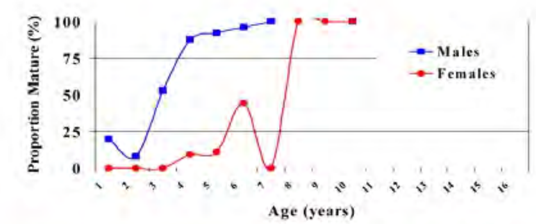
Parameter	Wabatongushi Lake
Relative Abundance	Above average (as expected)
Recruitment	Two strong year-classes
Relative Stock Density	Few large size fish
Age Structure	Few fish older than age 6
Mortality	49% (unsustainable)
Growth	Lower than NE average
Condition	Females in poor condition
Sex Ratio	Balanced
Maturity	Females maturing slowly
Fecundity	Similar to NE average

Growth (Length-at-Age)



MALE AND FEMALE GROWTH IS LOWER THAN NE AVERAGE.

Maturity Schedule by Age



MALES ARE MATURING NORMALLY (50% MATURE AT 3.0 YEARS) BUT FEMALES ARE MATURING SLOWLY (50% MATURE @ 6.4 YEARS).

Where do we go from here?

✓ Ensuring the sustainability of the Wabatongushi Lake walleye population requires a concerted effort on behalf of all individuals and organizations concerned about this resource. In this new era of fishing, anglers are becoming more aware of the important role they play in helping to manage quality fisheries. The Ministry of Natural Resources needs you to get involved!

For more information, please contact

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Highway 101, Box 1160
Wawa, Ontario P0S 1K0
(705) 856-2396 extension 218

Source: MNR

Figure 5.2
Michipicoten River Water Management Plan
Brookfield Power Corporation
Wabatongushi Lake (North Basin) FWIN Results

ACRES International

P13074_rm_Mar07

During the fall of 1999, the walleye population in Dog Lake was sampled according to a standard gillnet method used by Ontario and Quebec. Results from this assessment are summarized in the following presentation.

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A RED flag indicates there is a high risk that the measure is beyond the sustainability level of the resource.

An ORANGE flag specifies a reasonable concern that the measure is close to the sustainability level of the resource.

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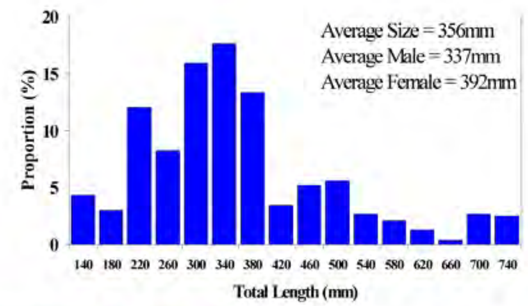
How do we diagnose walleye stock status?

We sample using the Ontario standard fall walleye index netting method and measure:

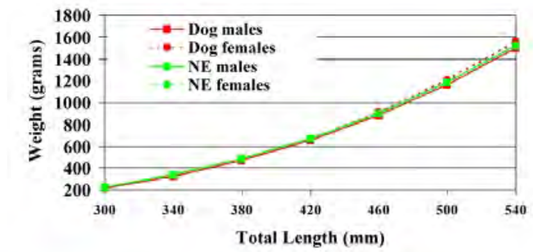
- ✓ Relative Abundance
- ✓ Size Distribution
- ✓ Relative Stock Density
- ✓ Age Distribution and Mortality
- ✓ Growth
- ✓ Condition
- ✓ Sex Ratio by Size
- ✓ Maturity Schedule by Size and Age
- ✓ Reproductive Characteristics

Size Distribution



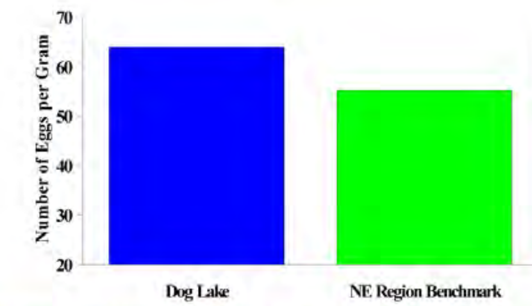
GOOD SIZE RANGE OF FISH.

Condition (Length-Weight)



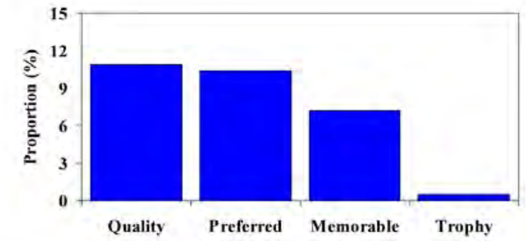
MALE AND FEMALE CONDITION IS SIMILAR TO NE AVERAGE.

Relative Fecundity



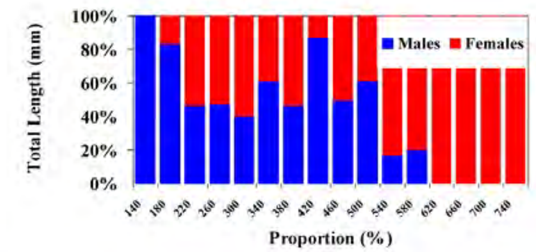
RELATIVE FECUNDITY IS HIGHER THAN NE AVERAGE.

Relative Stock Density



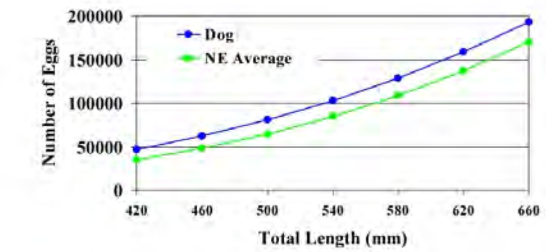
MANY QUALITY, PREFERRED, AND MEMORABLE SIZE FISH. ALSO A FEW TROPHY SIZE FISH AVAILABLE TO ANGLERS.

Sex Ratio by Size



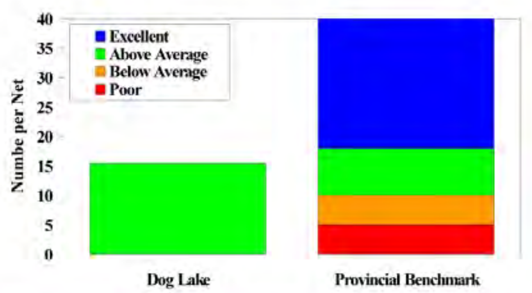
BALANCED SEX RATIO.

Egg Production (Length-Eggs)



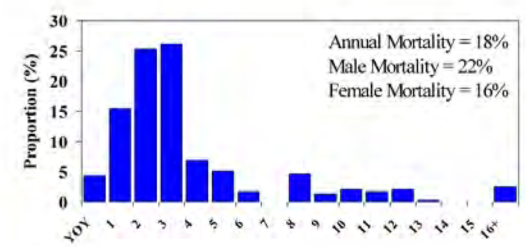
EGG PRODUCTION IS HIGHER THAN NE AVERAGE.

Relative Abundance



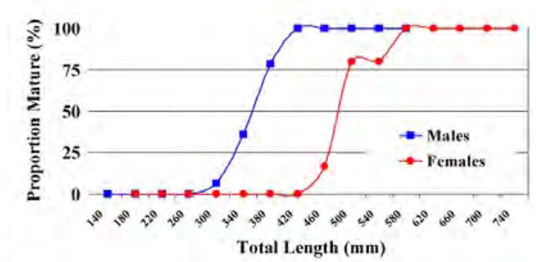
ABUNDANCE IS ABOVE AVERAGE (AS EXPECTED BASED ON CLIMATE AND PRODUCTIVITY).

Age Distribution and Mortality



THREE STRONG YEAR-CLASSES ARE ENTERING THE POPULATION. SOME FISH ARE OLDER THAN AGE 5. MORTALITY IS SUSTAINABLE.

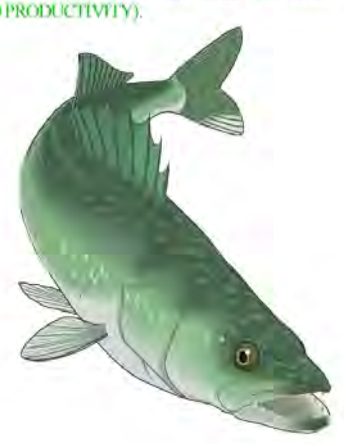
Maturity Schedule by Size



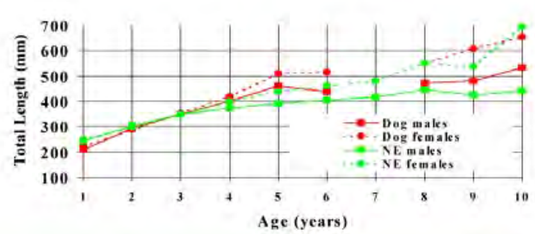
MALES AND FEMALES ARE MATURING NORMALLY. MALES ARE 50% MATURE AT 350mm AND FEMALES ARE 50% MATURE AT 482mm.

Walleye Stock Status Report Card '99

Parameter	Dog Lake
Relative Abundance	Above average (as expected)
Recruitment	Three strong year-classes
Relative Stock Density	Many "good" size fish
Age Structure	Some fish older than age 5
Mortality	18% (sustainable)
Growth	Higher than NE average
Condition	Similar to NE average
Sex Ratio	Balanced
Maturity	Maturing as expected
Fecundity	Higher than NE average

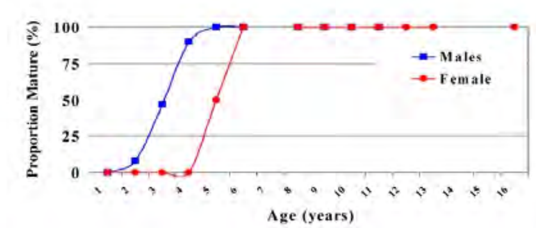


Growth (Length-at-Age)



MALE AND FEMALE GROWTH IS HIGHER THAN NE AVERAGE AFTER AGE 3.

Maturity Schedule by Age



MALES AND FEMALES ARE MATURING NORMALLY. MALES ARE 50% MATURE AT 3.1 YEARS AND FEMALES ARE 50% MATURE AT 5.0 YEARS.

Where do we go from here?

✓ Ensuring the sustainability of the Dog Lake walleye population requires a concerted effort on behalf of all individuals and organizations concerned about this resource. In this new era of fishing, anglers are becoming more aware of the important role they play in helping to manage quality fisheries. The Ministry of Natural Resources needs you to get involved!

For more information, please contact

Marcel Pellegrini
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Highway 101, Box 1160
Wawa, Ontario P0S 1K0
(705) 856-2396 extension 218

Source: MNR

Figure 5.3
Michipicoten River Water Management Plan
Brookfield Power Corporation
Dog Lake FWIN Results

ACRES International

P13074_rm_Mar07

During the fall of 2000, the Whitefish Lake was sampled according to a standard gillnet method used by Ontario and Quebec. Results from this assessment are summarized in the following presentation.

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A GREEN flag signifies there is a low risk that the measure is affecting the sustainability of the resource.

How do we diagnose walleye stock status?

We sample using the Ontario standard fall walleye index netting method and measure:

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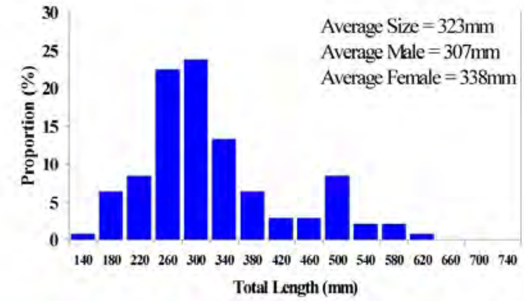
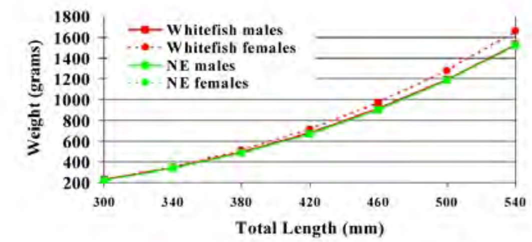
- ✓ Size Distribution
- ✓ Relative Stock Density
- ✓ Age Distribution and Mortality
- ✓ Growth
- ✓ Condition
- ✓ Sex Ratio by Size
- ✓ Maturity Schedule by Size and Age
- ✓ Reproductive Characteristics

Size Distribution



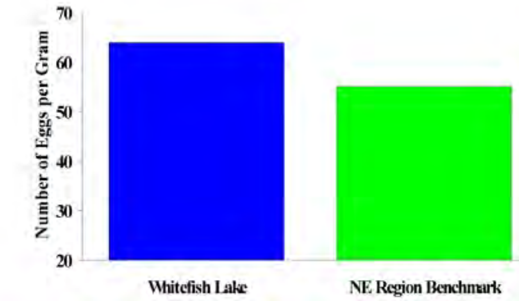
GOOD SIZE RANGE OF FISH.

Condition (Length-Weight)



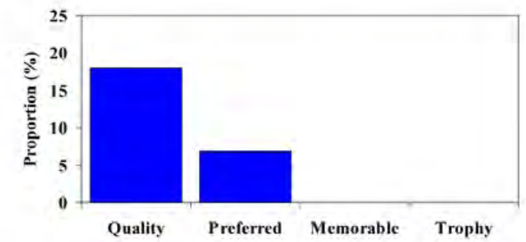
MALE CONDITION IS SIMILAR TO NE AVERAGE. FEMALE CONDITION IS HIGHER THAN NE AVERAGE AFTER 380mm

Relative Fecundity



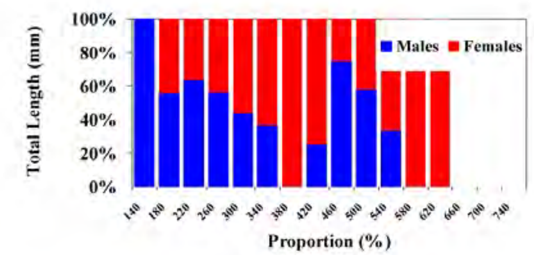
RELATIVE FECUNDITY IS HIGHER THAN NE AVERAGE.

Relative Stock Density



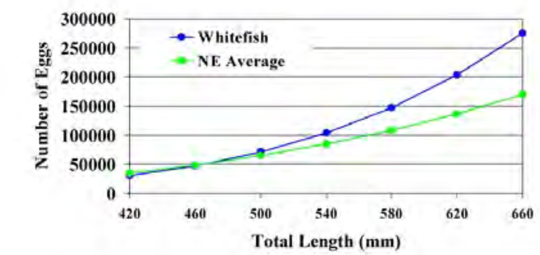
FEW QUALITY OR PREFERRED SIZE FISH. NO MEMORABLE OR TROPHY SIZE FISH.

Sex Ratio by Size



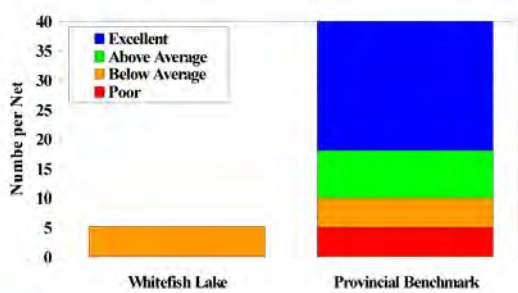
IMBALANCED SEX RATIO. MANY SMALL FEMALES.

Egg Production (Length-Eggs)



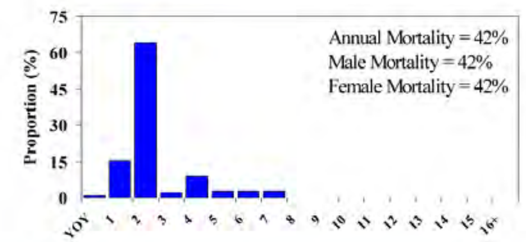
EGG PRODUCTION IS HIGHER THAN NE AVERAGE AFTER 500mm.

Relative Abundance



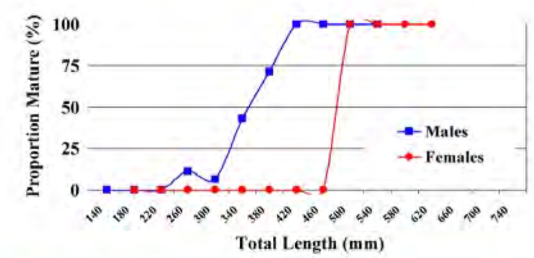
ABUNDANCE LOWER THAN EXPECTED BASED ON CLIMATE AND PRODUCTIVITY.

Age Distribution and Mortality



TWO STRONG YEAR-CLASSES ARE ENTERING THE POPULATION. VERY FEW FISH ARE OLDER THAN AGE23. MORTALITY IS TOO HIGH.

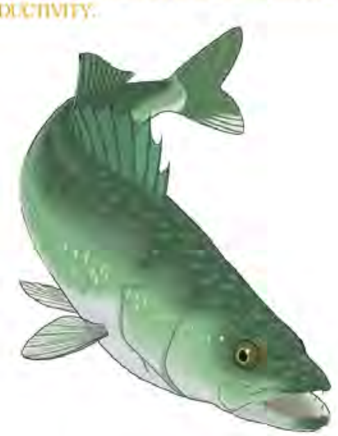
Maturity Schedule by Size



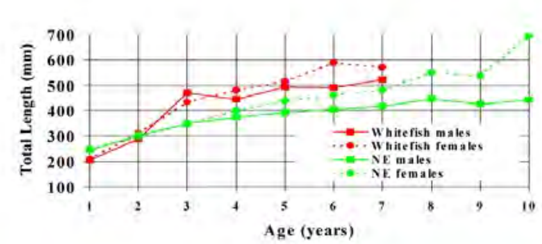
MALES ARE MATURING NORMALLY (50% MATURE AT 345mm). FEMALES ARE MATURING ABRUPTLY AFTER 460mm (50% MATURE AT 476mm).

Walleye Stock Status Report Card '00

Parameter	Whitefish Lake
Relative Abundance	Lower than expected
Recruitment	Two strong year-classes
Relative Stock Density	Few "good" size fish
Age Structure	Few fish older than age 2
Mortality	42% (unsustainable)
Growth	Higher than NE average
Condition	Higher than NE average
Sex Ratio	Imbalanced, few small males
Maturity	Maturing young and abruptly
Fecundity	Higher than NE average

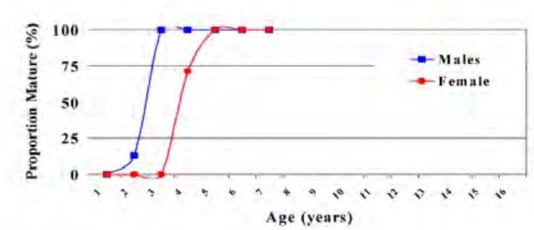


Growth (Length-at-Age)



MALE AND FEMALE GROWTH IS HIGHER THAN NE AVERAGE AFTER AGE 2.

Maturity Schedule by Age



MALES AND FEMALES ARE MATURING YOUNG. MALE ARE 50% MATURE AT 2.3 YEARS AND FEMALES ARE 50% MATURE AT 3.9 YEARS.

Where do we go from here?

✓ Ensuring the sustainability of the Whitefish Lake walleye population requires a concerted effort on behalf of all individuals and organizations concerned about this resource. In this new era of fishing, anglers are becoming more aware of the important role they play in helping to manage quality fisheries. The Ministry of Natural Resources needs you to get involved!

For more information, please contact

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Highway 101, Box 1160
Wawa, Ontario P0S 1K0
(705) 856-2396 extension 218

Source: MNR

Figure 5.4
Michipicoten River Water Management Plan
Brookfield Power Corporation
Whitefish Lake FWIN Results

P13074_rm_Mar07

During the fall of 2000, the McPhail Reservoir was sampled according to a standard gillnet method used by Ontario and Quebec. Results from this assessment are summarized in the following presentation.

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An ORANGE flag specifies a reasonable concern that the measure is close to the sustainability level of the resource.

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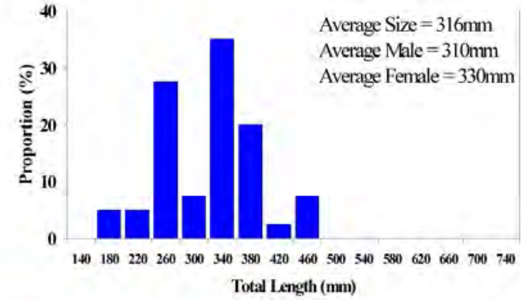
How do we diagnose walleye stock status?

We sample using the Ontario standard fall walleye index netting method and measure:

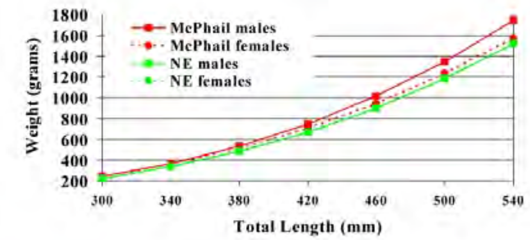
- ✓ Relative Abundance
- ✓ Size Distribution
- ✓ Relative Stock Density
- ✓ Age Distribution and Mortality
- ✓ Growth
- ✓ Condition
- ✓ Sex Ratio by Size
- ✓ Maturity Schedule by Size and Age
- ✓ Reproductive Characteristics

Size Distribution



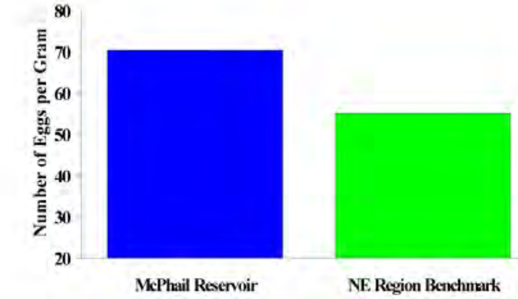
POOR SIZE RANGE OF FISH.

Condition (Length-Weight)



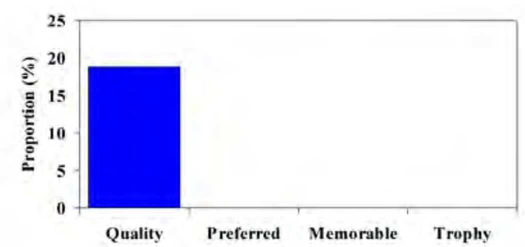
MALE AND FEMALE CONDITION IS HIGHER THAN NE AVERAGE AFTER 380mm.

Relative Fecundity



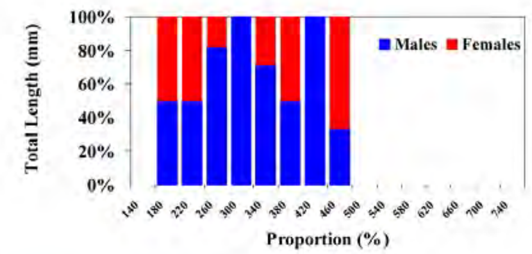
ONE FEMALE SAMPLED.

Relative Stock Density



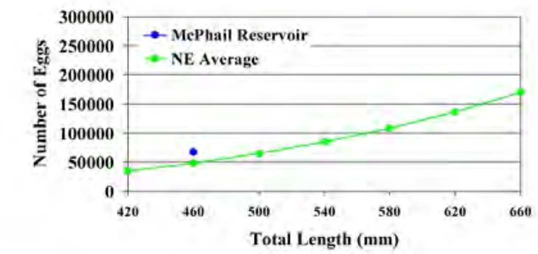
FEW QUALITY SIZE FISH. NO PREFERRED, MEMORABLE OR TROPHY SIZE FISH.

Sex Ratio by Size



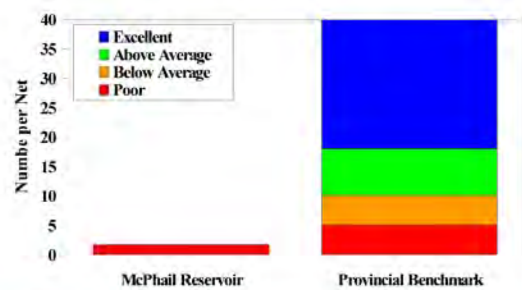
VERY IMBALANCED SEX RATIO. FEW FEMALES.

Egg Production (Length-Eggs)



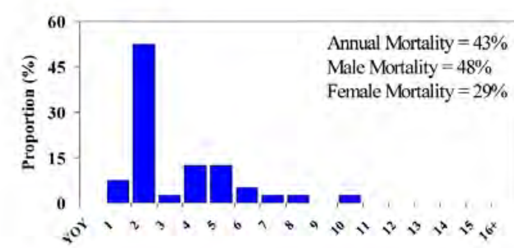
ONE FEMALE SAMPLED.

Relative Abundance



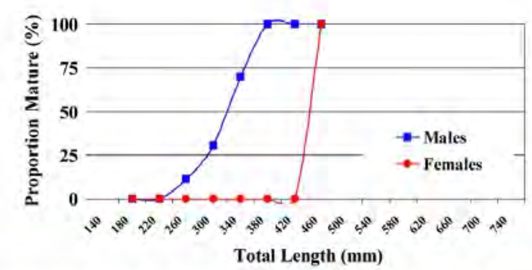
ABUNDANCE IS MUCH LOWER THAN EXPECTED BASED ON CLIMATE AND PRODUCTIVITY.

Age Distribution and Mortality



ONE STRONG YEAR-CLASS IS ENTERING THE POPULATION. VERY FEW FISH ARE OLDER THAN AGE 2. MORTALITY IS TOO HIGH.

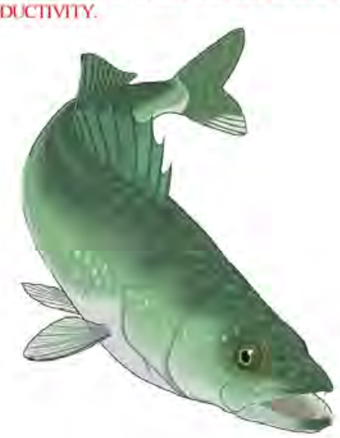
Maturity Schedule by Size



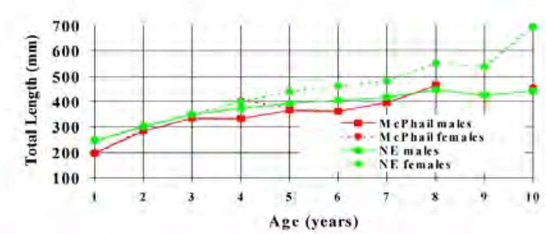
MALES ARE MATURING NORMALLY. ONLY 1 MATURE FEMALE SAMPLED.

Walleye Stock Status Report Card '00

Parameter	McPhail Reservoir
Relative Abundance	Much lower than expected
Recruitment	One strong year-classes
Relative Stock Density	Very few catchable size fish
Age Structure	Few fish older than age 2
Mortality	43% (unsustainable)
Growth	Lower than NE average
Condition	Higher than NE average
Sex Ratio	Imbalanced; few females
Maturity	One mature female sampled
Fecundity	One female sampled

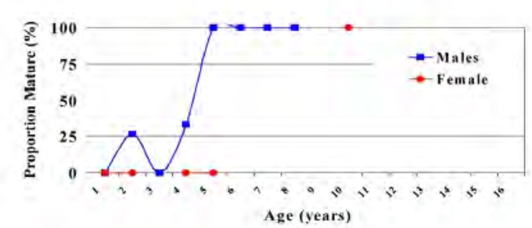


Growth (Length-at-Age)



MALE AND FEMALE GROWTH IS LOWER THAN NE AVERAGE.

Maturity Schedule by Age



MALES ARE MATURING NORMALLY. ONLY 1 AGE 10 MATURE FEMALE SAMPLED.

Where do we go from here?

✓ Ensuring the sustainability of the McPhail Reservoir walleye population requires a concerted effort on behalf of all individuals and organizations concerned about this resource. In this new era of fishing, anglers are becoming more aware of the important role they play in helping to manage quality fisheries. The Ministry of Natural Resources needs you to get involved!

For more information, please contact

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Source: MNR

Figure 5.5
Michipicoten River Water Management Plan
Brookfield Power Corporation
McPhail Reservoir FWIN Results

ACRES International

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During the fall of 2000, the Anjigami Lake was sampled according to a standard gillnet method used by Ontario and Quebec. Results from this assessment are summarized in the following presentation.

Below each graphic is a colour-coded interpretation of the biological (IN CAPITAL LETTERS);

A RED flag indicates there is a high risk that the measure is beyond the sustainability level of the resource.

An ORANGE flag specifies a reasonable concern that the measure is close to the sustainability level of the resource.

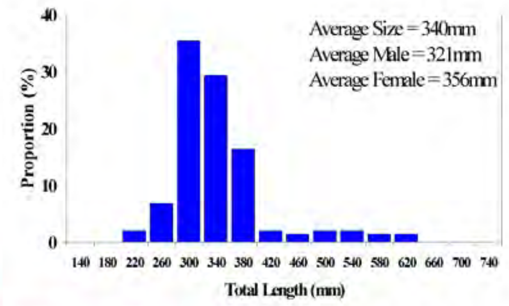
A GREEN flag signifies there is a low risk that the measure is affecting the sustainability of the resource.

How do we diagnose walleye stock status?

We sample using the Ontario standard fall walleye index netting method and measure:

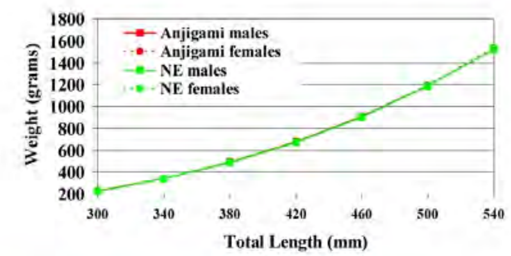
- ✓ Relative Abundance
- ✓ Size Distribution
- ✓ Relative Stock Density
- ✓ Age Distribution and Mortality
- ✓ Growth
- ✓ Condition
- ✓ Sex Ratio by Size
- ✓ Maturity Schedule by Size and Age
- ✓ Reproductive Characteristics

Size Distribution



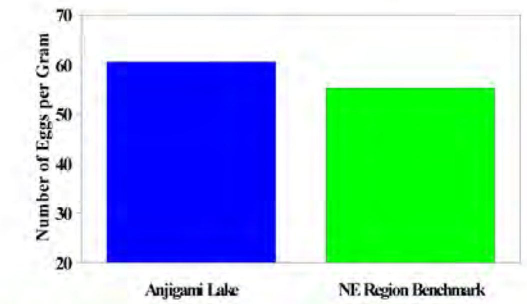
POOR SIZE RANGE OF FISH.

Condition (Length-Weight)



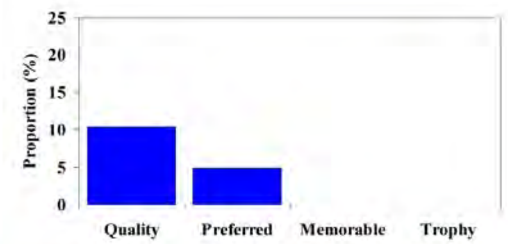
MALE AND FEMALE CONDITION IS SIMILAR TO NE AVERAGE.

Relative Fecundity



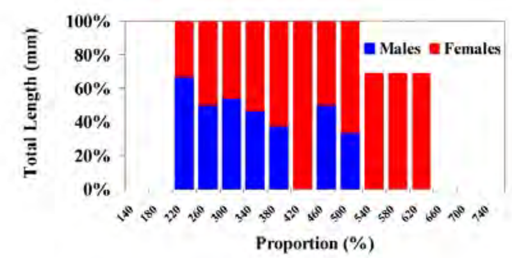
RELATIVE FECUNDITY IS SLIGHTLY HIGHER THAN NE AVERAGE.

Relative Stock Density



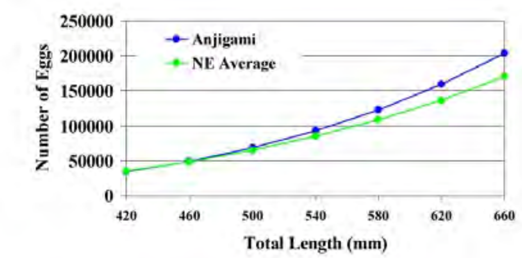
FEW QUALITY OR PREFERRED SIZE FISH. NO MEMORABLE OR TROPHY SIZE FISH.

Sex Ratio by Size



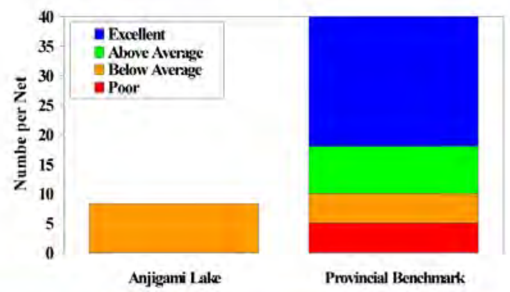
IMBALANCED SEX RATIO. FEW SMALL MALES.

Egg Production (Length-Eggs)



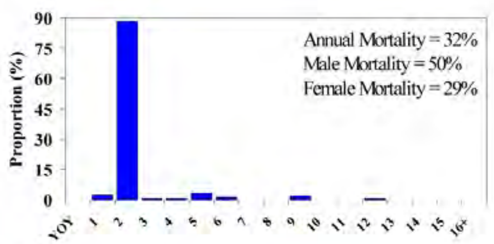
EGG PRODUCTION IS HIGHER THAN NE AVERAGE AFTER 500mm.

Relative Abundance



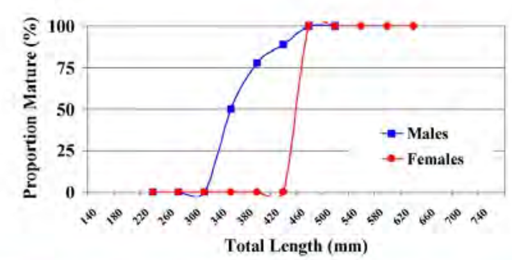
ABUNDANCE IS LOWER THAN EXPECTED BASED ON CLIMATE AND PRODUCTIVITY.

Age Distribution and Mortality



ONE STRONG YEAR-CLASS IS ENTERING THE POPULATION. VERY FEW FISH ARE OLDER THAN AGE 2. MORTALITY IS TOO HIGH.

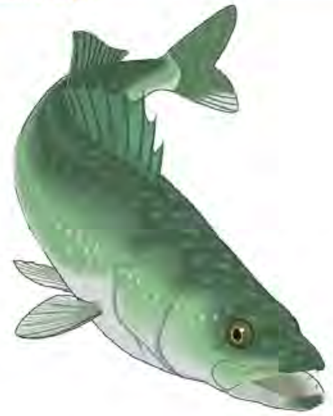
Maturity Schedule by Size



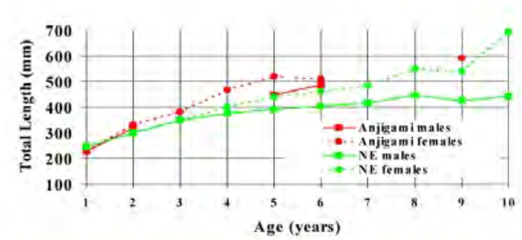
MALES ARE MATURING NORMALLY (50% MATURE AT 341mm). FEMALES MATURING RAPIDLY BETWEEN 420 AND 460mm (50% MATURE AT 440mm).

Walleye Stock Status Report Card '00

Parameter	Anjigami Lake
Relative Abundance	Lower than expected
Recruitment	One strong year-class
Relative Stock Density	Very few catchable size fish
Age Structure	Very few fish older than age 2
Mortality	32% (unsustainable)
Growth	Higher than NE average
Condition	Similar to NE average
Sex Ratio	Imbalanced, few small males
Maturity	Females maturing rapidly
Fecundity	Higher than NE average

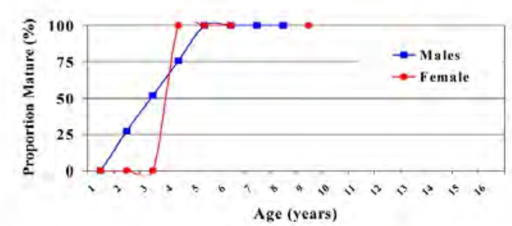


Growth (Length-at-Age)



MALE AND FEMALE GROWTH IS HIGHER THAN NE AVERAGE AFTER AGE 1.

Maturity Schedule by Age



MALES ARE MATURING NORMALLY (50% MATURE AT 2.2 YEARS). FEMALES MATURING RAPIDLY (50% MATURE AT 3.5 YEARS).

Where do we go from here?

✓ Ensuring the sustainability of the Anjigami Lake walleye population requires a concerted effort on behalf of all individuals and organizations concerned about this resource. In this new era of fishing, anglers are becoming more aware of the important role they play in helping to manage quality fisheries. The Ministry of Natural Resources needs you to get involved!

For more information, please contact

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Source: MNR

Figure 5.6
Michipicoten River Water Management Plan
Brookfield Power Corporation
Anjigami Lake FWIN Results

ACRES International

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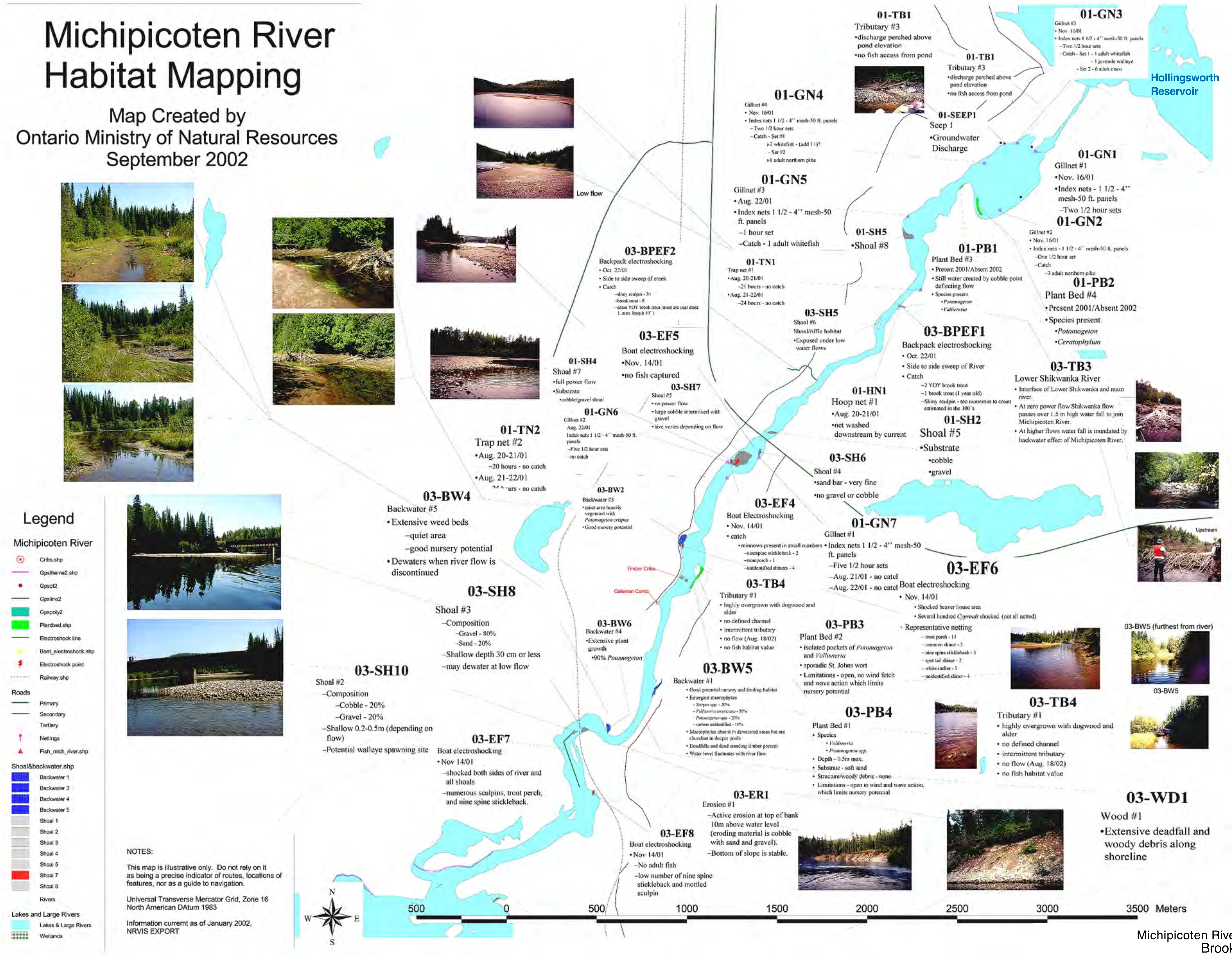

Figure 5.7
Michipicoten River Water Management Plan
Brookfield Power Corporation
Shoreline Habitat Mapping Below Hollingsworth GS

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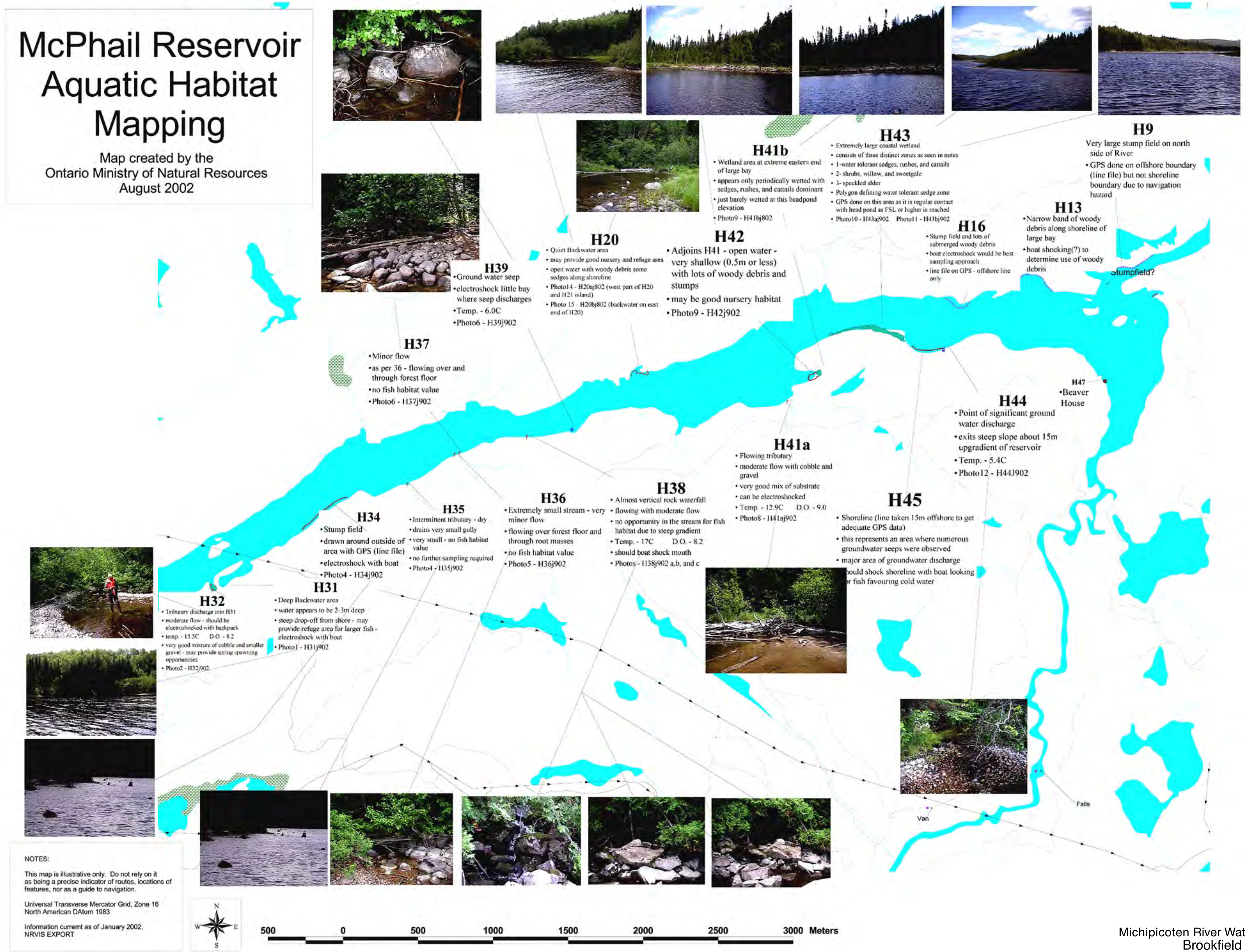

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Figure 5.8
Michipicoten River Water Management Plan
Brookfield Power Corporation
Shoreline Habitat Mapping - McPhail Reservoir

ACRES International

6 Computer Simulation Model to Assess Alternative Water Management Strategies

6 Computer Simulation Model to Assess Alternative Water Management Strategies

It was determined that a computer simulation model would be required that is capable of evaluating alternative water management strategies using economic, operational, ecological and social data inputs.

The first step involved identifying general, technical and cost criteria that would need to be met in order for the computer simulation model to be suitable for evaluating alternative water management strategies.

6.1 Criteria

General Criteria

- The methodology must have the capability of incorporating a balanced ecosystem approach, effectively integrating all pertinent economic, operational, ecological and social criteria.
- The methodology must be readily available and efficient to use.
- The methodology must be compatible with BP's existing information and decision support systems.

Technical Criteria

- The methodology must have the capability of evaluating the operational characteristics of existing hydroelectric developments on the Michipicoten River.
- The methodology must be capable of assessing both the uncontrolled nature of runoff as well as the regulated components of the water resource working in parallel with, and complimentary to, each other.
- The methodology must be capable of evaluating the long-term hydrologic variability inherent in the basin by utilizing historical flow data compiled from BP operational records. This operational data has been reconstituted to reflect a series of natural inflows which can be used to evaluate the operational capabilities of all of the regulated storage in the basin.
- The methodology must be capable of evaluating the implications of seasonal water level fluctuations and storage manipulation options for the large number of regulated storage lakes and reservoirs in the Michipicoten

River system. The options and implications need to be evaluated in terms of the ecological and economic sustainability of resources as well as the sustainability of existing flood control measures.

- The methodology must be capable of incorporating aquatic ecosystem (including fish habitat) requirements.

- The methodology must be capable of incorporating social parameters of concern.

- The methodology must be capable of assessing all competing water demands, considering time dependency requirements throughout the year. Time dependency characteristics of hydropower operations can be quite variable and as small as hourly for meeting electrical load demands. Ecological and social requirements, e.g., fish spawning times, water levels for summer boating and fishing, etc, are also time-dependent.

Cost Criteria

- The model must be capable of analyzing the economic sustainability of the water power resource.

- The methodology must provide a reasonable level of detail in the analysis at reasonable cost. That is, it must not place an unreasonable financial burden on BP resources such that it jeopardizes the economic viability of BP's operations.

6.2 Selection of a Preferred Computer Simulation Model

Synexus Global (an affiliate company of Acres) presently has a very sophisticated and comprehensive Decision Support System (DSS) which is used for hydroelectric system planning. This DSS computer model already incorporates a detailed simulation of most of the required river basin processes in the Michipicoten River.

The addition of the AutoVista historical simulator module provides a very effective tool for assessing alternative water management strategies. The required investment cost to BP is modest in comparison to the substantial investment that would be required to acquire and set up another available computer software package, which would also meet the selection criteria.

The results of an assessment of the ability of the Vista DSS to meet the required criteria, as outlined in Section 6.1, are presented in Table 6.1. This table shows that the Vista DSS meets these criteria and the key benefits of the model are summarized below.

1 - The AutoVista module allows incorporation of the ecosystem approach into water management planning. For example, desired water levels and flows for aquatic ecology can be input to the model and evaluated against desired operational and economic criteria to satisfy hydropower demands. Similarly, flood management and social (recreational) constraint parameters can also be input to the model to complete the ecosystem approach to water management planning (see Section 7, Table 7.2).

2 - The AutoVista model has seamless access to the complete historical operations database of BP which is compiled on a real-time basis by the Vista DSS from continuous SCADA monitoring data.

3 - The AutoVista model can simulate the actual system operation of the generating stations over a long-term, multiyear historical sequence. As part of this simulation, the various storage lakes and reservoirs are managed within user specified water level constraints, corresponding to various planning strategies prescribed over the course of a year.

4 - The performance of the hydroelectric generating stations for the various plan strategies can be compared directly to realistic electrical load demands which are imposed on the model, based on either existing or predicted future system demands.

It was therefore concluded, based on the above analysis, that the Vista DSS was appropriate for assessing alternative water management strategies for the Michipicoten River system. It is important to note that, while the model is used as a tool to aid in decision making, actual operations may vary depending on hydrologic conditions.

Also, while DSS simulations were used for the options evaluation which was carried out prior to deregulation of the energy market, final verification of the economic impacts for the preferred water management strategy required an assessment under current market conditions. It was not practical to use the DSS model for this latter evaluation as it was not configured to perform operational optimization under deregulated energy market conditions. Therefore, the Acres Reservoir Simulation Package (ARSP) was used for this exercise, as agreed with MNR. The results describing the economic impacts on BP's operations for the approved new water management strategy are provided in Section 11 (Table 11.4).

Table 6.1 Evaluation of the Vista DSS Using Selection Criteria													
Model	**General Criteria**			**Technical Criteria**							**Cost Criteria**	**Suitability**
	Ecosystem Approach Possible	Readily Available and Efficient to Use	Compatible with Brookfield's Existing Systems	Comprehensive Hydroelectric Operations Analysis	Analysis of Runoff and Regulated Components	Long-Term Hydrologic Analysis from Brookfield Records	Evaluation of Seasonal Water Level Fluctuations and Storage Manipulation Options	Capable of Incorporating Aquatic Ecosystem Requirements	Incorporates Other Ecological and Social Parameters	Assess Competing Water Demands Considering Time-Dependency Requirements	Provides Reasonable Level of Detail at Reasonable Cost to Brookfield	Overall Suitability Rating
VISTA DSS VISTA Decision Support System for Hydroelectric Generating System Operations and Analysis - Acres International	X	X	X	X	X	X	X	X	X	X	X	Very suitable; incorporates all desired features

Legend:

X - Fully satisfies criteria

7 Criteria for Assessing Alternative Water Management Strategies

7 Criteria for Assessing Alternative Water Management Strategies

7.1 Attributes, Indicators and Criteria

Economic, environmental and social attributes on the Michipicoten River system were identified as listed in Table 7.1. These attributes were then related to the key objectives of the water management planning process (see Section 1 for a complete list of objectives). An approach to meeting the key objectives was then identified for each attribute (Table 7.1). Table 7.2 lists the indicators that were identified for each attribute in order to establish criteria for evaluating the alternative water management strategies. Three criteria ratings were then established to enable comparison with the base case (existing) water management strategy to determine if a potential new water management strategy is better or worse than the base case.

7.1.1 Power Attributes, Indicators and Criteria

For the "power" attribute, two indicators were identified: on-peak power purchases and operational flexibility. On-peak power purchases were used as an indicator (as opposed to off-peak) because these purchases represent the most expensive power, i.e., when demand is the highest. An alternative water management strategy would be considered "neutral" if on-peak power purchases are within 2% of the base case (the approximate margin of error for the model). If there are >2% fewer on-peak power purchases than the base case, this would result in a "positive" rating for the alternative strategy. Conversely, if there were >2% more on-peak power purchases than the base case, this would result in a "negative" rating for the alternative strategy.

Operational flexibility is affected whenever water levels and flows are constrained in the system and these impacts are not necessarily reflected in on-peak power purchases. For this reason, operational flexibility was also used as an indicator to assess effects on the power attribute. Operational flexibility is considered "neutral" if there is no change from the base case. However, if changes are proposed to water levels and flows to enhance ecological conditions, this, in turn, would reduce operational flexibility and cause a "negative" rating. Conversely, the new High Falls Redevelopment

Table 7.1
Attributes and Approach to Meeting Objectives

Attribute	Key Objective	Approach to Meet Objective
Power	To optimize hydroelectric power production and meet owners' return on investment goals, thereby attracting new capital investment	Minimize on-peak generation purchases. Maintain operational flexibility.
Aquatic and riparian ecology and habitat	To provide healthy ecosystems by maintaining and enhancing ecosystem functions	Improve ecological conditions through site-specific habitat improvements or by flow/water level changes.
Flood management	To provide flood management capability thereby minimizing property damage and protecting human life	Minimize risk of exceeding existing maximum reservoir levels or maximum flows in river reaches.
Tourism/recreation	To provide tourism and recreation opportunities	Maintain or improve upon where possible minimum water levels and flows from May 15 to October 15.
Cultural/heritage	To protect natural heritage features and values	Maintain appropriate water levels to prevent submergence of pictographs on Dog Lake and protect other sites as identified (i.e., Windermere Lake and Michipicoten Post P.P.).
Employment benefits	To provide employment security	Provide local opportunities for employment where possible.

Table 7.2 Criteria for Evaluating Alternative Water Management Strategies				
Attribute	**Indicator**	**Criteria for Comparison to Base**		
		+	**=**	**-**
Power	On Peak Generation Purchase Index	>2% less than base	Within 2% of base case	>2% more than base
	Operational Flexibility Index	Enhanced flexibility	Similar to Base	Reduced flexibility
Ecology Aquatic and Riparian Ecology and Habitat (Reservoirs)	Reservoir Minimum Levels (Permanently wetted area)	More than +0.25 m higher	Between 0.25m higher and 0.25 m lower	More than 0.25 m lower
	Reservoir Spring Levels (Conditions for spawning, nutrient cycling and other ecological functions)	FSL begins more than 1 week earlier when peak level reaches 0.1 m of FSL; spring peak level higher than 0.15 m of base case.	FSL begins within 1 week of base when peak level reaches 0.1 m of FSL; spring peak level within 0.15 m of base case.	FSL begins more than 1 week later when peak level reaches 0.1 m of FSL; spring peak level higher than 0.15 m of base case.
Ecology Aquatic and Riparian Ecology and Habitat (River Reaches)*	Minimum Flow (Permanently wetted area)	>20% higher than base case	Within 20%	>20% lower than base case
	Spring Spill Releases (Conditions for spawning, nutrient cycling and other ecological functions)	Start of spill occurs more than 1 week earlier	Start of spill occurs within 1 week of base	No spill release or start of spill more than 1 week later
	Stable flows	> 2 weekends more than base (above ½ peak power flow)	Within 2 weekends of base (above ½ peak power flow)	> 2 weekends less than base (above ½ peak power flow)
	Flow Ramping	Ramping occurs	No ramping	N/A
Social Flood Management	Reservoirs - Maximum Levels above Spring Target Level**	More than 0.15 m lower	Between 0.15 m lower and +0.15 m higher	More than 0.15 m higher
	River Reaches Maximum flows	Maximum flow >20% lower than base case	Maximum flow within 20%	Maximum flow >20% higher than base case
Tourism/Recreation	Minimum Reservoir Levels - May 15 – Oct 15	Higher than 0.15 m	Within 0.15 m	Lower than 0.15 m
	Minimum Flow in River Reaches May 15 - Oct 15	>20% higher	Within 20%	>20% lower
Social Cultural/Heritage	Maximum reservoir level June 1 to Sept 30 – Dog Lake (Pictographs)		330.32 or lower	Above 330.32 m
Social Construction Employment	High Falls Redevelopment and/or McPhail Reservoir Raise	Construction occurs	No construction	

* For the purposes of this plan, a river reach is defined as downstream of a power plant and outside the influence of a downstream reservoir. This definition applies to the river reach below Hollingsworth GS and below Scott GS on the Michipicoten system.

** Spring Target Level is annual reservoir minimum target level set at or below FSL and above which flood management procedures are initiated.

Note: These criteria were used to evaluate each Combination against the base case model, not actual conditions (which may vary from the model according to operator decisions).

project and the proposed McPhail Reservoir raise will improve operational flexibility, resulting in a "positive" rating.

7.1.2 Ecological Attributes, Indicators and Criteria

Aquatic and riparian ecological conditions are reflected by water levels and flows (spatial characteristics) in year to year, seasonal, and daily patterns (temporal characteristics). The quality of ecological conditions is influenced to a large degree by maximum and minimum water levels and flows, and by the fluctuations between them. Three broad indicators for the "aquatic and riparian ecology and habitat" attributes were identified by MNR for evaluation against the base case, i.e.,

- *Minimum water levels and flows for the aquatic and riparian ecology and habitat representing the permanently wetted zone available for long-term aquatic productivity.* Minimum water levels in reservoirs and minimum flows in river reaches were evaluated based on the criteria developed in Table 7.2. The flow criteria in Table 7.2 were used in the absence of natural flow metrics data sheets that subsequently became available following the evaluation (Appendix R). Maximum flows during the normal low flow productivity period in summer and the low flow resting period in winter were also considered as criteria since lower peak flows represent better velocity conditions for aquatic organisms and would be closer to natural conditions. However, since it was difficult to measure this parameter given model limitations, this criterion was dropped from further consideration.

- *Spring conditions for the aquatic and riparian ecology and habitat as defined by water levels and flows.* Aquatic and riparian ecology and habitat were evaluated against the base case on the basis of the start of the FSL and change in the reservoir water levels, and the start of the spring spill through the river reaches (see Table 7.2). This indicates the conditions for spring high water ecological function such as temporary aquatic productivity and fish spawning, wetland function and wildlife reproduction, channel and riparian zone maintenance, and nutrient exchange.

- *Flow fluctuation conditions for the aquatic and riparian ecology and habitat.* Flow ramping or the moderation of changes in flow through a generating station was evaluated simply on the basis of whether it occurred or not. In addition, the number of weeks of stable flow as measured by weekends above one-half the peak power flow were also considered in the evaluation. These indicators are intended to reflect the stability of the aquatic environment which relates to flushing, stranding, and displacement of organisms, although research is presently underway to determine the validity of this assumption with respect to flow ramping.

The above indicators were developed by MNR, Wawa and agreed to by the planning team prior to the availability of MNR's Aquatic Ecosystem Guidelines.

7.1.3 Social Attributes, Indicators and Criteria

Four types of "social" attributes were identified for the Michipicoten system, i.e., flood management, tourism/recreation, cultural/heritage sites (specifically the pictographs on Dog Lake), and construction employment opportunities (see Table 7.2 for the indicators).

For flood management, an increase in the present maximum reservoir level >0.15 m above FSL is considered to adversely affect flood management capability.

For tourism/recreation (sport fishing, boating) the critical period to maintain stable water levels is considered to be May 15 to October 15. With respect to cultural/heritage sites, the objective is to keep water levels on Dog Lake at or below 330.32 m from June 1 to September 30 to protect the pictographs from submergence. The pictographs will begin to get covered at about 330.5 m.

Recreation and tourism employment was also considered as an indicator but it was concluded that it was too difficult to measure (i.e., other external factors, e.g., increase in ecotourism popularity, reduced bear hunt period, etc. would make it difficult to determine what is causing an employment change, if any, that would be directly attributable to a change in water management strategy).

The social criteria did include construction employment opportunities. The indicators were identified as the Dunford (High Falls) Redevelopment Project and/or the McPhail Reservoir raise (see Table 7.2).

7.2 Use of the 'Base Case' as a Neutral Condition for Assessing Preliminary Model Runs and for Evaluation of Alternative Water Management Strategies

Assessment of alternative water management strategies required that baseline conditions be established to provide a reference set of operating conditions in the Michipicoten River system, which could be considered as "neutral" when comparisons were undertaken. The base case water management strategy was fully described in Section 4 and covers a range of water levels and flows that is represented graphically in that section and Appendix K. Before this strategy was adopted as representative of the present "base case" water management conditions, it was reviewed in terms of the historical operational information in Appendix G (Figures G9 to G23). A total of 28 years of historical operation data is available for the Michipicoten River, however, the more recent period from 1991 to 1998 incorporates a number of voluntary operational constraints around which the present system is operated. This period is considered representative of the "base case" water management conditions, not only from an operational context, but also in terms of hydrologic diversity as this period contains years corresponding to long-term historic average, severe wet and dry basin runoff conditions. Typical weekly patterns of reservoir level, generating unit discharge and spill, which is representative of how the generating stations are operated in response to historical system load demands, is presented on an hourly basis in Appendix G. However, it should be remembered that hydraulic models are used as a tool in decision making and that BP operators also use their experience to determine actual operations. That is, BP maintains significant flexibility in adjusting water levels and flows that do not necessarily correspond to model results.

Power purchases by BP, over and above what they can generate themselves to meet the system load demands, are used to assess the economic impact of an alternative water management strategy. Use of historical power purchase data to define "base case" conditions were not utilized because load demands have been growing over time. In addition, a program of unit upgrades and rehabilitation was begun in the mid-1990's and is ongoing at this time. The current DSS model reflects completed changes to generation capacity and efficiency. Representative power purchase reference values for the "neutral" condition, reflecting average, wet and dry hydrologic conditions, were calculated in the DSS model utilizing projected load demand for the 1999-2000 water year (viz May 31, 1999 to May 30, 2000). This load demand period was then fixed for evaluation and comparison with all alternative water management strategies. A water year as opposed to a calendar year was utilized in the model evaluations as a convenient time at which to establish initial water levels in the system. This corresponds to the point in the annual spring freshet period when most reservoirs have typically been filled.

In terms of the effects of the “base case” strategy on the aquatic ecology, these are not well understood, since there is no historic baseline information prior to hydro development on the Michipicoten system against which to assess such effects. Therefore, for the purpose of this water management plan, it was agreed with MNR that the existing environment would be used as the ecological baseline (i.e., a neutral condition) to make a comparison with any changes proposed to the present operations on the system that could benefit the aquatic ecology.

In terms of the effects of the “base case” strategy on social conditions (cottaging, recreational water use, flood management/public safety), private property has better flood protection with the existing regulated system than without regulation. In addition, the base case strategy includes provision for BP to voluntarily maintain stable water levels on the Michipicoten system reservoirs during the summer for cottaging and recreational water use (see Appendix K). This appears to be working well, based on historical operations (see Appendix G), considering some expected deviations during very wet or dry runoff periods, especially in the upper storage lakes under stop log outflow control. The existing social constraints (i.e., for flood management/public safety, and summer recreation) that were incorporated into the base case were therefore assumed to be a “neutral” condition when comparing alternative strategies.

8 Preliminary Model Runs and Comparisons with the ‘Base Case’ (Existing) Water Management Strategy

8 Preliminary Model Runs and Comparisons with the 'Base Case' (Existing) Water Management Strategy

Prior to identifying and evaluating alternative water management strategies, the planning team agreed that some preliminary model runs should be undertaken to obtain a broad understanding of

- the economic, ecological and social implications of two extreme operational scenarios for the Michipicoten and Montreal River systems, i.e., unconstrained and "run of river" (see Section 8.1.1 for an explanation of these terms).
- the economic costs of individual components of possible ecological improvement strategies on the Michipicoten and Montreal River systems in terms of changes to reservoir water levels and flow conditions to improve conditions for the aquatic ecology.
- the economic benefits of the Dunford (High Falls) Redevelopment Project [the ecological and social effects were assessed previously in the Project Information Package prepared for MNR (Wawa) (Acres, 1997) which covered site-specific effects that the computer model does not address].
- the economic benefits of the proposed McPhail Reservoir l m raise [the ecological and social effects were assessed previously (Acres, 1997; Natural Resource Solutions/Acres, 1999) which covered site-specific effects that the computer model does not address].

With regard to the first and second points above, BP's hydroelectric operations on the Michipicoten and Montreal Rivers function as part of an integrated unit with the rest of the BP system and, for the purposes of this water management planning process, were evaluated in the model runs as a combined system. However, it was agreed by the planning team that there would be two separate plans which focus on the individual river systems.

8.1 Preliminary Model Runs

Several model runs initially undertaken are listed in Table 8.1. They are not, by themselves, considered alternative water management strategies and therefore were not subject to the complete evaluation criteria described in Section 7.

Rather, these model runs were simply done to provide BP and MNR with an indication of the economic cost or benefit and the broad ecological and social implications of possible operational and ecological improvements prior to some of them being combined to make up a potential water management strategy.

This preliminary model run information provided the planning team with a basis for developing alternative water management strategies.

8.1.1 The "Extreme" Cases: Unconstrained vs Run-of-River Operations

Two preliminary model runs were undertaken to reflect the opposite ends of the spectrum, i.e., a totally unconstrained system where BP would have total flexibility in operations vs a "run-of-river" situation which would mimic how a river operates under natural conditions.

The economic implications of the two extreme cases were compared with the base case (existing operations) and the results are reflected in the "on-peak power purchase index" in Figure 8.1. Power purchases for the average hydrology scenarios of the base case were set as the reference value, which yields an economic indicator value of 1.0.

As can be seen in Figure 8.1, there would be an economic benefit to BP under average conditions with unconstrained operations compared with the base case. However, BP has already committed to a voluntary ecological baseflow of 17 m^3/s below Scott GS and restrictions on summer water levels for cottagers and sport fishing activities. Also, in a totally unconstrained situation, there would be no provision for flood management/public safety. For these reasons a totally unconstrained water management strategy for the Michipicoten system was dropped from further consideration.

At the other end of the spectrum is the run-of-river scenario, which would be considerably better ecologically than the base case, since water levels and flows would be allowed to fluctuate, based on natural inflows and outflows. However, the economic disbenefits to BP of such a water management strategy are readily apparent in Figure 8.1. Therefore, the run-of-river strategy was also dropped from further consideration.

Table 8.1
Preliminary Model Runs

Michipicoten River	Montreal River
Base	
• Base case (existing operations)	• Base case (existing operations)
Extreme Cases	
• Unconstrained (no ecological or social constraints) • Run-of-river (water levels and flows fluctuate based on natural inflows/outflows)	• Unconstrained (no ecological or social constraints) • Run-of-river (water levels and flows fluctuate based on natural inflows/outflows)
Developments	
• Dunford (High Falls) redevelopment	• Base case
• McPhail Reservoir with 1 m raise	• Base case
Ecological – Michipicoten	
• Scott GS with ramping	• Base case
• Secondary storage reservoirs with reduced winter drawdown	• Base case
• Hollingsworth with a 3 m drawdown	• Base case
• Michipicoten continuous baseflow (Hollingsworth with a 15 m^3/s flow release and 17 m^3/s through downstream GS)	• Base case
• Scott with 28 m^3/s continuous baseflow	• Base case
Ecological – Montreal	
• Base case	• Continuous baseflow of 8 m^3/s through MacKay turbine and spill flow (8 m^3/s) out of other stations
• Base case	• Continuous baseflow 8 m^3/s through MacKay; 13 m^3/s through Gartshore, 17.1 m^3/s through Hogg and 10.1 m^3/s through Andrews
Ecological - Michipicoten/Montreal Systems	
• Continuous baseflow all stations (17 m^3/s except 15 m^3/s from Hollingsworth) (This strategy is also known as “QBase All”)	• Continuous baseflow all stations (17 m^3/s)

8.1.2 The Dunford (High Falls) Redevelopment Project

The old 26-MW High Falls GS is located on the Michipicoten River approximately 15 km east of the mouth of the river at Lake Superior. The old generating station facilities were constructed in 1929/1930 when two of the turbine-generator units were installed. A third unit was installed in 1950. Power facilities at the site were nearing the end of their useful life due to low reliability and the need for repeated repairs. Also, redevelopment at this site created a potential to improve the efficiency of power operations on the Michipicoten system. BP completed construction of the 45-MW Dunford (High Falls) Redevelopment Project in 2002 which involved the following activities:

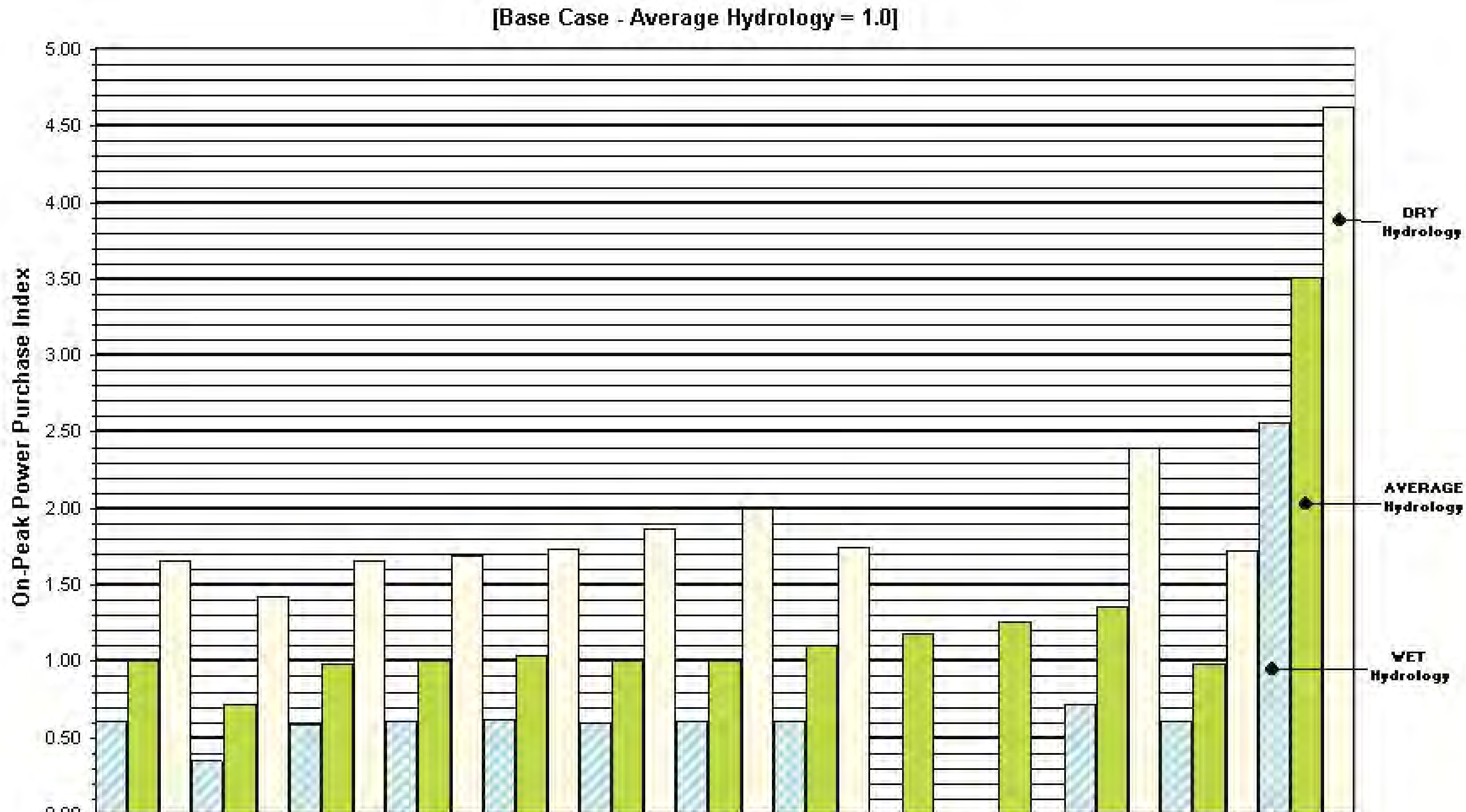
- reconstruction of the existing dam to enhance dam safety and to reduce reliability concerns with the existing dam structure

- replacement of the existing power station on the south shore of the Michipicoten River with a new power station on the north shore opposite the existing station

Raising of the level of Dunford (High Falls) Reservoir by 0.5 m is also part of the redevelopment but will not be undertaken until after approval of the WMP and LRIA approval of this reservoir raise.

An environmental assessment (Project Information Package) of the Dunford (High Falls) Redevelopment Project was undertaken in 1997 (Acres, 1997) which addressed potential environmental and social impacts and mitigation of site-specific impacts associated with this facility in accordance with MNR’s Water Power Program Guidelines (1990).

The relative economic benefit of the Dunford (High Falls) Redevelopment Project, is presented in Figure 8.1 for comparison with the base case. It is readily apparent from this figure that there will be a significant reduction in annual on-peak power purchases with the Dunford (High Falls) Redevelopment Project. However, it is also recognized that the economic benefit achieved by the Dunford (High Falls) Redevelopment Project will be partially offset by the cost of the environmental assessment and monitoring



Hydrology	Base	High Falls Redvp	McPhail FSL+1m	Scott Ramping Up>Dn	Upper Lakes d/d reduced	Hollingsworth 3m d/d	Mich Qbase All Stations 15/17/17/17	Scott Qbase 28	Mont Qbase 8 (turb & spill)	Mont Qbase 8/13/17/10	Mich/Mont Qbase All Stations	Unconstrain Mich & Mont	Run of River Mich & Mont
Wet	0.612	0.354	0.586	0.604	0.621	0.600	0.603	0.604			0.716	0.612	2.556
Average	1.000	0.716	0.978	1.007	1.033	1.004	1.007	1.108	1.178	1.257	1.360	0.986	3.512
Dry	1.659	1.424	1.658	1.687	1.727	1.865	2.003	1.745			2.391	1.722	4.625

Run Scenario

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Figure 8.1
Michipicoten River Water Management Plan
Brookfield Power Corporation

Comparison of Annual On-Peak Power Purchases for Preliminary Model Runs

ACRES International

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program, construction costs, the cost of this water management plan and the costs associated with ecological improvements and monitoring proposed in this plan.

8.1.3 McPhail Reservoir Raise

Another proposed operational change by BP on the Michipicoten River system is to raise McPhail Reservoir by 1 m with the objective of using the available water resources more effectively for power generation. The environmental and social impacts of this change were outlined in the Project Information Package prepared as part of the Dunford (High Falls) Redevelopment Project (Acres, 1997), including proposed mitigation. Additional environmental studies for the proposed McPhail Reservoir raise were subsequently undertaken to better quantify site-specific impacts and mitigation requirements as described in Section 5.2.1.5 of this WMP.

The additional economic benefit of the McPhail Reservoir Raise compared with the base case is presented in Figure 8.1.

8.1.4 Scott Generating Station with Ramping

MNR asked BP to consider a change in the flow rate out of the Scott GS to enhance conditions for the aquatic ecology. Ramping is the term used to describe the rate of change in outflow from a generating station. For this scenario, a flow increase of 60.2% of the previous hour flow rate was chosen, along with a flow decrease of 37.6% of the previous hour flow rate. For the case where flow changes from a minimum of 17 m^3/s to a maximum of 112 m^3/s, the total duration for the above ramping rates would be 4 hours. The economic cost of this potential ecological improvement is provided in Figure 8.1 for various hydrologies for comparison with the base case. The results were used when considering the incorporation of ramping into alternative water management strategies.

8.1.5 Secondary Storage Reservoirs with Reduced Winter Drawdown

MNR proposed modifying the winter drawdown on the secondary storage reservoirs on the Michipicoten system (Wabatongushi Lake, Dog Lake, Windermere Lake and Anjigami Lake) to increase the permanently wetted area for the aquatic ecology and to improve spring aquatic ecology and riparian habitat conditions. This was modeled by limiting the winter drawdown to 0.51 m, taken from the summer minimum drawdown reference level in each of the four storage reservoirs. The relative economic cost of this potential ecological improvement compared with the base case is provided in Figure 8.1. The social impacts (flood management/recreation) of this potential ecological improvement were assessed when it was incorporated into a water management strategy (see Section 10.2.4).

8.1.6 Hollingsworth with 3-m Drawdown

MNR also asked BP to investigate the economic implications of reducing the drawdown on Hollingsworth Reservoir from 9 m to 3 m to increase the permanently wetted area for the aquatic ecology and to improve spring aquatic ecology and riparian habitat conditions. BP was reluctant to consider this possibility since it is their primary reservoir for hydro generation on the Michipicoten River system. However, they did agree to assess it on the basis of economics and flood management. The results of a preliminary model run to determine the economic impacts are graphically displayed in Figure 8.1.

The required flood handling procedures were developed in accordance with the requirements of the Lakes and Rivers Improvement Act (LRIA) and detailed in the letter: “Location Approval and Plans and Specifications Approval for Shikwamkwa Replacement Dam Project, Wawa District LRIA Engineering Approval Number TM-WA-85”, dated April 7, 2005. The pertinent sections of the letter are provided in Appendix N. The procedures deal specifically with the monitoring of end of winter snowpack water equivalent and, should it meet or exceed a set threshold value, could lead to PMF runoff under severe rainfall conditions. Therefore, under these circumstances, filling of Hollingsworth Reservoir must be held at el 306.50 m for a determined length of time to allow the spillway to begin immediate operation. Given that this critical reservoir level is below the 3 m drawdown option limit, this option was no longer considered appropriate as a possible water management strategy.

8.1.7 Michipicoten Continuous Baseflows (Hollingsworth 15 m^3/s; Downstream GS 17 m^3/s)

At the present time there is a low flow on the regulated river system below Hollingsworth GS which BP estimated to be approximately 3 m^3/s (Appendix T). This approximate flow was the sum of three components (i) MNR LRIA culvert software determined the mean annual flood flow rate to be 1.78 m^3/s, (ii) BP determined dam leakage flows of 0.60 m^3/s; and (iii) a visual inspection of groundwater upwelling by BP was estimated to be 0.3 to 0.4 m^3/s. The low flow below Hollingsworth will be measured by MNR, in cooperation with BP over a couple of time periods to determine the average low flow. MNR flow metric sheets for this site indicate a summer (July to September) natural low flow of 16.9 to 24.7 m^3/s, approximated using the monthly Q80 (flow duration) value. MNR asked BP to investigate the economic implications of a continuous baseflow of 15 m^3/s through Hollingsworth GS to improve conditions downstream for the aquatic ecology. The volume of flow was based on the minimum flow that has been passed through the unit for a short time without causing damage to the turbine. Similarly, a continuous baseflow of 17 m^3/s was proposed by MNR for the other generating stations below Hollingsworth since, again, this is the minimum that has been passed through one of the units without causing damage to the turbines. The results are presented in Figure 8.1 for comparison with the base case (which already includes a voluntary minimum continuous flow of 17 m^3/s below Scott GS).

8.1.8 Scott GS with 28 m^3/s Continuous Baseflow

MNR also asked BP to consider the possibility of increasing the voluntary continuous baseflow through Scott GS from 17 m^3/s to 28 m^3/s to provide ecological and recreational (boating/fishing) improvements. The rationale for 28 m^3/s is based on the “New England Aquatic Base Flow” approach established by the U.S. Fish & Wildlife Service (1981). It is the estimated natural median flow for August, which is typically the lowest flow month in the summer. This is the flow most likely to limit aquatic organisms because of diminished living space, dissolved oxygen and food supply, and high water temperatures. The economic impact of increasing the baseflow below Scott GS to 28 m^3/s is provided in Figure 8.1 for comparison with the base case (which already includes provision for a continuous baseflow of 17 m^3/s below Scott GS).

8.1.9 Michipicoten Continuous Baseflows (Hollingsworth 15 m^3/s; Downstream GS 17 m^3/s); Montreal Continuous Baseflows (17 m^3/s)

This scenario involves continuous baseflows throughout both the Michipicoten and Montreal River systems. It is comprised of 15 m^3/s through Hollingsworth GS and 17 m^3/s through McPhail, High Falls and Scott GS. Note that the base case already includes 17 m^3/s through Scott GS. This scenario also includes continuous baseflow of 17 m^3/s through MacKay, Gartshore, Hogg and Andrews GS.

The economic impact of introducing additional ecological baseflows on the Michipicoten and Montreal River systems is provided in Figure 8.1 for comparison with the base case.

8.2 Summary Analysis of Preliminary Model Runs

The purpose of the preliminary model runs was to get a basic understanding of the economic impacts of potential ecological and operational improvements on the Michipicoten system, and to identify any obvious public safety concerns. It was not intended that these preliminary model runs be subjected to the complete evaluation criteria described in Section 7. Rather, it was intended to provide an indication to the planning team of what might be possible in terms of alternative water management strategies and the economic costs to BP of possible operational changes to achieve potential ecological improvements. The planning team achieved this objective and the results of this exercise concluded the following:

- neither of the two extreme cases (i.e., unconstrained and run-of-river operations) is feasible for further consideration as alternative water management strategies for the reasons noted in Section 8.1.1

- the 3-m drawdown restriction on Hollingsworth Reservoir was dropped from further consideration as a possible water management strategy.

MNR requested that all other preliminary model runs, as well as a less severe drawdown on Hollingsworth Reservoir, be carried forward to the next stage for possible inclusion as components in alternative water management strategies.

9 Identification of Alternative Water Management Strategies

9 Identification of Alternative Water Management Strategies

Several alternative water management strategies were developed for evaluation as listed in Table 9.1. Each of these alternatives is described in more detail in the subsections below and all involved some combination of the preliminary model runs undertaken as described in Section 8 of this plan. The goals and principles (Section 1.2), specific management objectives (Section 1.3), and issues and concerns (Section 5) were all considered when reviewing the "base case" (existing) water management strategy to determine potentially better alternative water management strategies.

The alternative water management strategies described below pertain to both the Michipicoten and Montreal River systems. Alternative water management strategies for the two river systems were assessed in conjunction with each other because, due to the integrated nature of the BP's operations on the two rivers, operational changes on one system may impact operational strategies on the other system. This integrated methodology for assessing water management strategies is in accordance with the Terms of Reference for this WMP (Appendix A).

9.1 The "Status Quo" (Base Case) Water Management Strategy

The present water management strategy has been described in Section 4. There would be no changes to operations on the Michipicoten and Montreal River systems with this option. BP does not wish to retain the "Status Quo" option because they recently completed the Dunford (High Falls) Redevelopment Project and are proposing a 0.5-m raise of High Falls Reservoir and a 1-m raise of McPhail Reservoir as an operational strategy to further optimize their hydroelectric operations. MNR does not wish to retain the "Status Quo" option either because they wish to see a more balanced water management plan by improving conditions for the aquatic ecology on the Michipicoten system. For these reasons, the "Status Quo" is not a preferred water management strategy for the Michipicoten system.

Table 9.1 List of Alternative Water Management Strategies for Evaluation	
Michipicoten River	**Montreal River**
• Combination 1 Base case + Dunford (High Falls) Redevelopment Project + McPhail 1 m raise	• Combination 1 Base case
• Combination 2 Base case + Dunford (High Falls) Redevelopment Project + McPhail 1 m raise + Scott Ramping	• Combination 2 Base case
• Combination 3 Base case + McPhail 1 m raise + Scott Ramping	• Combination 3 Base case
• Combination 4 Reduced Drawdown on Hollingsworth and Secondary Storage Reservoirs + minimum flow of 15 m^3/s through Hollingsworth, 28 m^3/s through downstream stations + Scott Ramping	• Combination 4 Base case
• Combination 5 Base Case	• Combination 5 MacKay Reservoir with reduced drawdown (to 10 m) + continuous minimum flows of 8 m^3/s through MacKay, 13 m^3/s through Gartshore, 17.1 m^3/s through Hogg and 10.1 m^3/s through Andrews.
• Combination 6 Combination 4 + Dunford (High Falls) redevelopment	• Combination 6 Base case
• Combination 7 Base Case	• Combination 7 MacKay Reservoir with reduced drawdown (to 12 m) + min. flow of 8 m^3/s through MacKay (April 15 to June 15) and 10.1 m^3/s through Andrews year round.
• Combination 8 (Combined with Montreal Combination 8) Combination 6 + McPhail 1 m raise minus Scott Ramping (see text for details)	• Combination 8 (combined with Michipicoten Combination 8) Combination 7 but with no reduced drawdown on MacKay Reservoir

9.2 Combination 1 – Base Case + Dunford (High Falls) Redevelopment Project + McPhail 1-m Raise

This combination was proposed by BP and is comprised of existing operations on the Michipicoten and Montreal Rivers which include a voluntary minimum ecological baseflow below Scott GS of 17 m^3/s (the base case), plus the Dunford (High Falls) Redevelopment Project (see description in Section 8.1.2), plus a 1-m raise of McPhail Reservoir (see description in Section 8.1.3). If this combination were to be selected, BP indicated that it would consider one or more nonoperational ecological improvements as defined in Section 9.10.

9.3 Combination 2 – Base Case + Dunford (High Falls) Redevelopment Project + McPhail 1-m Raise + Scott Ramping

This combination is similar to Combination 1 but involves a change in flow rate (ramping) out of Scott GS with the objective of improving conditions for the aquatic ecology downstream. For this scenario, a flow increase of 60.2% of the previous hour flow rate was assumed, along with a flow decrease of 37.6% of the previous hour flow rate. This is the same ramping condition that was used in the preliminary model run (see Section 8.1.4).

9.4 Combination 3 – Base Case + McPhail 1-m Raise + Scott Ramping

This combination is similar to Combination 2 but without the Dunford (High Falls) Redevelopment Project.

9.5 Combination 4 – Restricted Drawdown on Hollingsworth and Secondary Storage Reservoirs + Surcharge on Hollingsworth Reservoir + Continuous Baseflows on Michipicoten System + Scott Ramping

Combination 4 was proposed by MNR as a possible strategy for the Michipicoten River system to improve conditions for the aquatic ecology. It assumes the following drawdown limits for Hollingsworth Reservoir.

Season	Water Level (m)
Spring (Apr. 16 to May 31)	Max: 312.57 (0.15 m surcharge above FSL) Min: 304.42 (8 m below FSL; 1.1 m < base case)
Summer (June 1 to Sept. 30)	Max: 312.42 (FSL) Min: 310.42 (2 m below FSL; 1 m < base case)
Fall (Oct. 1 to Dec. 15)	Max: 312.57 (0.15 m surcharge above FSL) Min: 310.42 (2 m below FSL)
Winter (Dec. 16 to Apr. 15)	Max: 312.42 (FSL) Min: 304.42 (8 m below FSL)

The rationale for the winter and spring reduced drawdowns (to 8.0 m) is to provide an additional 1.1 m of permanently wetted depth above the present maximum drawdown of 9.1 m and improve the timing of spring high water levels. A summer minimum level of 310.42 m would provide another 1 m of wetted depth throughout the growing season in dry years and in the latter part of the growing season in average and wet years. This reduced drawdown in summer would also provide better water levels for recreation. A 0.15-m surcharge zone is also proposed in spring and fall to provide for some aquatic habitat function in flooded riparian areas. This surcharge zone is below the 0.3-m freeboard at the top of the spillway gates to prevent unwanted spill.

In addition, for the Combination 4 strategy, the winter drawdown level in all of the upper storage lakes (Wabatongushi, Dog, Windermere and Anjigami Lakes) is reduced to 0.51 m below summer minimum level in each lake (see reference water levels in Table 4.3, Section 4). Also, an adjusted target FSL of 288.8 m was established for Anjigami Lake (0.5 m above average summer water level, but 0.8 m below the maximum in the base case) to reflect a tighter summer operations zone which has occurred in recent years.

Continuous baseflows are also proposed for the Combination 4 strategy as follows:

- 15 m^3/s through Hollingsworth GS
- 28 m^3/s through all other downstream generating stations.

In addition to continuous baseflows, MNR proposed the following ramping rates which would provide a minimum 4-h period to increase turbine discharge from minimum (28 m^3/s) to maximum (112 m^3/s).

Period	Flow	Ramping Rate
All year	28 to 112 m^3/s 112 to 28 m^3/s	+ 41.4%/h - 29.3%/h

9.6 Combination 5 – Michipicoten River: Base Case Montreal River: MacKay Reservoir 10-m Maximum Drawdown + Continuous Baseflows)

Combination 5 is a strategy proposed by MNR for the Montreal River to improve conditions for the aquatic ecology. It is included in the Michipicoten Water Management Plan because an operational change on the Montreal River will affect operations on the Michipicoten River system. The Combination 5 strategy assumes the following reduced drawdowns for MacKay Reservoir.

Season	Water Level (m)
Spring (Apr. 16 to May 31)	Max level 375.06 m (0.15 surcharge above FSL) Min level 364.91 m (10 m below FSL); (5.25 m < base case)
Summer (June 1 to Sept. 30)	Max level 374.91 m FSL Min level 372.91 m (2 m below FSL)
Fall (Oct. 1 to Dec. 15)	Max level 375.06 m (0.15 surcharge above FSL) Min level 372.91 m (2 m below FSL)
Winter (Dec. 16 to Apr. 15)	Max level 374.91 m FSL Min level 364.91 m (10 m below FSL); (5.25 m < base case)

This strategy also assumes a minimum flow of 8 m^3/s through MacKay GS, 13 m^3/s through Gartshore GS, 17.1 m^3/s through Hogg GS and 10.1 m^3/s through Andrews GS at all times.

Also, MNR proposed that a 2 m^3/s flow through the gorge at Andrews GS at all times be included in the Combination 5 strategy. However, the 2 m^3/s flow through the gorge was not modeled because BP did not believe it was practical to do so as Fisheries and Oceans Canada (Fish Habitat Management Branch), in their site assessment of this area, does not consider that the gorge functions as important aquatic habitat due to the steep bedrock conditions through this area.

9.7 Combination 6 – Combination 4 + Dunford (High Falls) Redevelopment Project

Combination 6 combines Combination 4 with the Dunford (High Falls) Redevelopment Project (described previously in Section 8.1.2) and assumes base case (existing) operations on the Montreal River.

9.8 Combination 7 – Michipicoten River: Base Case Montreal River: (MacKay Reservoir 12-m Maximum Drawdown + Seasonal and Continuous Baseflows)

Combination 7 is another strategy proposed by MNR for the Montreal River system to improve conditions for the aquatic ecology compared with the base case. It is a modification of Combination 5 involving a reduction in the extent of aquatic ecology improvements to improve conditions for hydroelectric operations and flood management. As with Combination 5, it is included in the Michipicoten Water Management Plan because an operational change on the Montreal River will affect operations on the Michipicoten River system. The Combination 7 strategy involves the following potential changes to improve ecological conditions compared with the base case:

- Minimum continuous baseflow of 10.1 m^3/s through Andrews GS year round.
- Minimum seasonal baseflow of 8 m^3/s through MacKay GS from April 15 to June 15.
- Maximum drawdown on MacKay Reservoir to 362.91 m (12 m drawdown from FSL; 3.25 m < base case).

MNR’s main objective with this strategy is to improve year round flow conditions at the mouth of the Montreal River for Lake Superior fisheries and recreational use. MNR’s second objective for Combination 7 is to improve spawning conditions for walleye in Gartshore Reservoir, which is the largest of the lower reservoirs on the Montreal system. A third objective is to make some improvement in permanently wetted area in MacKay Reservoir and improve the timing of spring high water levels.

This strategy does not include the proposed Dunford (High Falls) Redevelopment Project or the proposed 1-m raise for McPhail Reservoir. These operational improvements were not included in this strategy so that the economic implications of ecological improvements on the Montreal River could be easily recognized without these developments on the Michipicoten system.

9.9 Combination 8 – A Combined Strategy for the Michipicoten and Montreal Rivers

This strategy proposed by MNR uses a modification of the conditions proposed for Combinations 6 and 7, with the addition of the l-m raise of McPhail Reservoir. Specifically, the conditions imposed for this strategy were as follows:

Michipicoten River

Secondary Storage Reservoirs

- Reduced winter drawdown corresponding to 0.51 m below existing summer minimum level, for all secondary storage reservoirs.
- Anjigami Lake FSL restricted to 288.80 m (from 289.56 m) to better reflect actual operations in recent years, and to make the existing BP/McDonald Forest Products voluntary agreement align more closely with present operations.

Hollingsworth Reservoir

- Spring and fall surcharge of 15 cm above normal FSL of 312.42.
- 1.85-m maximum drawdown level to 310.57 m (from FSL of 312.42 m) over period May 15 to October 25.
- 7.85-m maximum drawdown over rest of year to 304.57 m (from FSL of 312.42).
- Minimum continuous baseflow of 15 m^3/s year round.

McPhail Reservoir

- 1-m raise of McPhail Reservoir (subject to LRIA approval).
- Maximum drawdown of 0.3 m.

Dunford (High Falls) Reservoir

- Redevelopment in place.
- FSL +0.5 m to 262.78 m (subject to LRIA approval).
- Maximum drawdown of 0.3 m.

Scott Reservoir

- Minimum continuous baseflow of 28 m^3/s year round.
- Ramping constraints removed pending results of Magpie study.

Montreal River

MacKay Reservoir

- No change in maximum drawdown constraints.

- Minimum continuous baseflow of 8 m^3/s released from unit in spring period April 15 to June 15 each year.

Andrews Reservoir

- Minimum continuous baseflow of 10.1 m3/s year round.

Other

- Maximum drawdown levels to be upheld by compromising minimum flow release, i.e., if reservoirs are completely drawn down, then the minimum flow would be cutback to prevent level violations. It is anticipated that this action would be particularly required in dry years.

MNR assigned no specific conditions for Gartshore and Hogg Reservoirs. However, BP allows these reservoirs to fluctuate within a specified range (see Appendix G, Volume 2) to manage minimum flows through the turbines.

9.10 Non-Operational Ecological Improvement Strategies

Consideration was given by the planning team to possible nonoperational ecological improvements for the Combination 1 option that could be made on the Michipicoten River system to improve ecological conditions as follows:

- Diking off a bay in Hollingsworth Reservoir (where there are good inflows) to keep water in an embayment to provide additional vegetated littoral zone habitat.

- Planting (or hydroseeding) of terrestrial vegetation along a portion of shoreline at low water to provide structure, cover and nutrients at high water.

- Fish habitat enhancement (e.g., suitable spawning, nursery or adult habitat) in one or more reservoirs, river reaches or tributaries.

- Channel improvements and/or reregulating structures below Scott GS to improve local flow and habitat conditions.

- Fish stocking.

- Addition of nutrients to reservoirs to enhance conditions for the aquatic ecology.

Non-operational ecological improvement strategies are more attractive to BP than operational changes since the former would incur significantly lower costs rather than ongoing operational costs which result in a continuous power tradeoff for potential ecological benefit. MNR prefers operational changes in water levels and flows to improve ecosystem productivity and believes they are generally more effective than non-operational ecological improvement strategies.

10 Evaluation of Alternative Water Management Strategies

10 Evaluation of Alternative Water Management Strategies

10.1 Evaluation Methodology

The economic, ecological and social criteria outlined in Table 7.2 (Section 7), were used to evaluate the alternative water management strategies (i.e., Combinations 1 through 8). Most of the criteria (with the exceptions noted below) were input to the model and the raw data results for all the combination strategies are contained in the foldout sheets in Appendix M. Each alternative water management strategy was compared to the present water management strategy (base case) to determine whether it was better or worse. If a strategy was very similar to (or equal to) the base case, as defined by the criteria in Table 7.2, it was considered “neutral”.

10.1.1 Power Evaluation Methodology

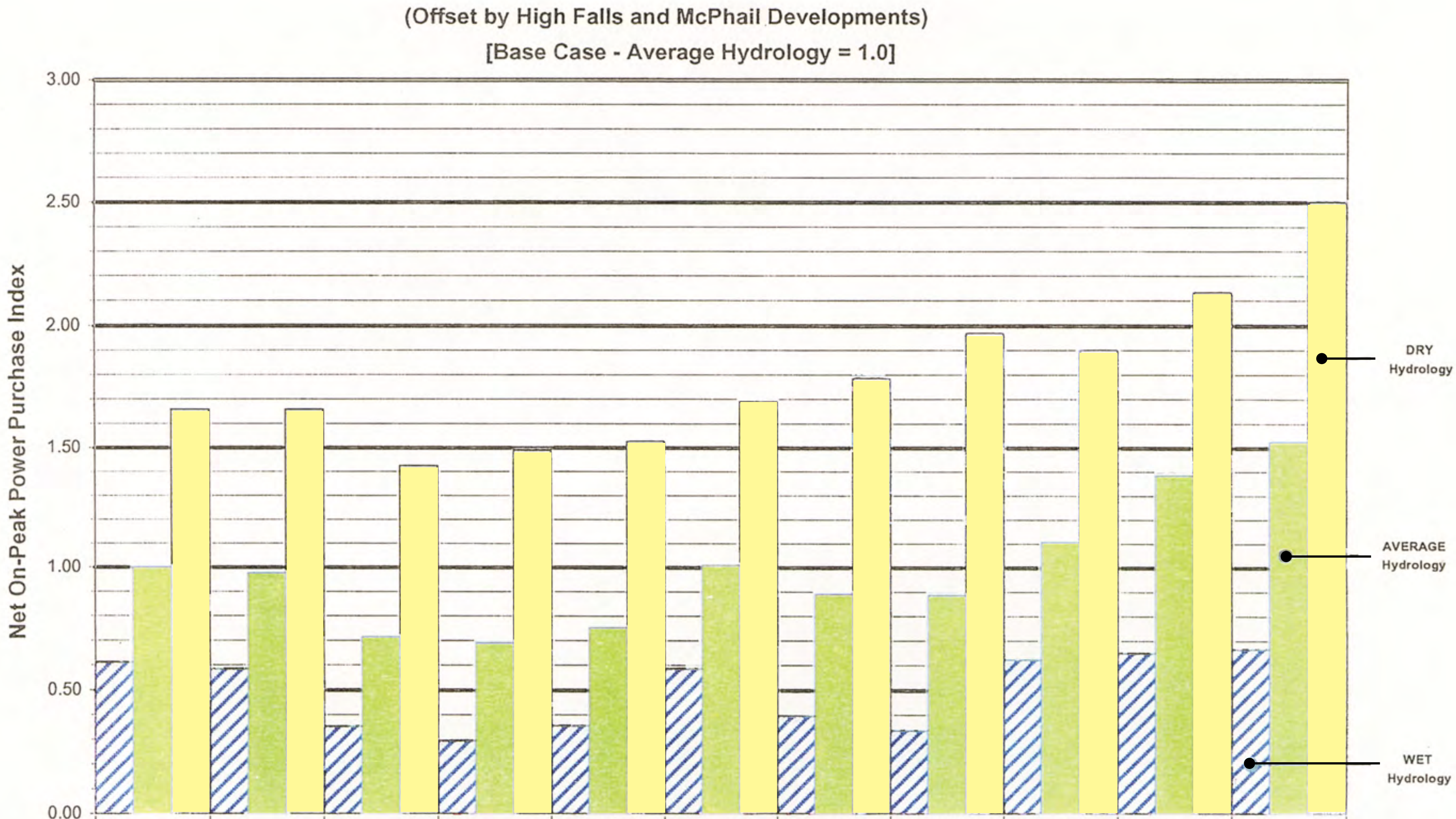
The power evaluation of alternative water management strategies was done on the basis of incremental change in both on-peak generation and operational flexibility compared with the base case.

The direct economic impact of the alternative strategies can be described by the change in on-peak power purchases and the magnitude of the change expressed as an index to a common value taken as the on-peak power purchase for the base case, under average hydrological conditions. Results are presented in Figure 10.1 as net, on-peak power purchase indices for the various water management strategies evaluated. Operational improvements to the system will result in a reduction in on-peak purchases and, conversely, the introduction of ecological improvements will yield increases in on-peak purchases. The Dunford (High Falls) Redevelopment Project and McPhail +1 m FSL raise are two developments which will enhance operation of the system and reduce on-peak power purchases. The individual economic benefits of each of these developments, prior to combining them in Combination 1, are presented in Figure 10.1. Combinations 2, 3, 6 and 8 are comprised of both operational and ecological improvements. Combinations 4, 5 and 7 have ecological improvements but no operational improvements. A comparison of Combinations 2, 3, 6 and 8 with Combinations 4, 5 and 7 reveals how the inclusion of operational enhancements with ecological initiatives can reduce the overall impact on increased on-peak power purchases.

An alternate way of presenting this information is shown in Figure 10.2 in which the benefit/cost index calculated for the various strategies is represented by a positive value for decreased on-peak power purchases. The actual costs of ecological improvements are indicated by the increased purchases below the line. The cost of ecological improvements would be significantly higher if the model did not take advantage of enhanced operational flexibility and hydroelectric generation opportunities elsewhere on the system to compensate for lost generation due to ecological constraints.

Information from Figure 10.1 was used in a methodology to determine a ranking of alternatives based on on-peak generation purchases (Table K11, Appendix K). The ranking results are presented in Section 10.3 (Tables 10.1 and 10.2).

As noted previously in Section 7, operational flexibility is affected whenever water levels and flows are constrained in the system and the impacts are not necessarily reflected in on-peak power purchases. For example, the Dunford (High Falls) Redevelopment and McPhail Reservoir raise significantly improve the operational flexibility in terms of flow releases out of Dunford (High Falls) GS and improve the operational flexibility of McPhail Reservoir. However, this flexibility is then compromised by the addition of ecological constraints (e.g., baseflow, reduced drawdown, etc) at various points throughout the system. The degree of compromise in operational flexibility may not necessarily be reflected to the same degree in on-peak power purchases, depending on whether there is sufficient operational flexibility within the system to minimize the amount of additional on-peak power purchases that may be required. Therefore, it was important to assess operational flexibility independent of on-peak power purchases on the basis of ecological restrictions on water levels in each of the 12 reservoirs and flows through the generating stations compared with the base case. Based on 12 reservoirs and 8 generating stations, there is a maximum of 20 points available to assess operational flexibility for each hydrology. If ramping is included in a strategy, this would reduce operational flexibility and add another possible point for a maximum score of 21 for each hydrology. For



Hydrology	Base	McP +1m	HF rdvp	Comb 1 HFrd & McP+1	Comb 2 HFrdvp MP+1 Scott Ramp	Comb 3 McP+1 Scott Ramp	Comb 6 HFrdvp + Comb 4	Comb 8 HFrMP1 Qmin both Rivers	Comb 4 USHLdd QmScR	Comb 7 Mac12dd Qm8/10	Comb 5 Mackdd Qm8
Wet	0.61	0.59	0.35	0.30	0.36	0.59	0.40	0.34	0.62	0.65	0.67
Average	1.00	0.98	0.72	0.69	0.75	1.01	0.89	0.89	1.11	1.39	1.53
Dry	1.66	1.66	1.42	1.49	1.53	1.69	1.79	1.97	1.90	2.14	2.50

Run Scenario

Fig. 10.1
Michipicoten River Water Management Plan
Brookfield Power Corporation
Comparison of Net Annual On-Peak Power Purchases for Combination Model Runs

ACRES International

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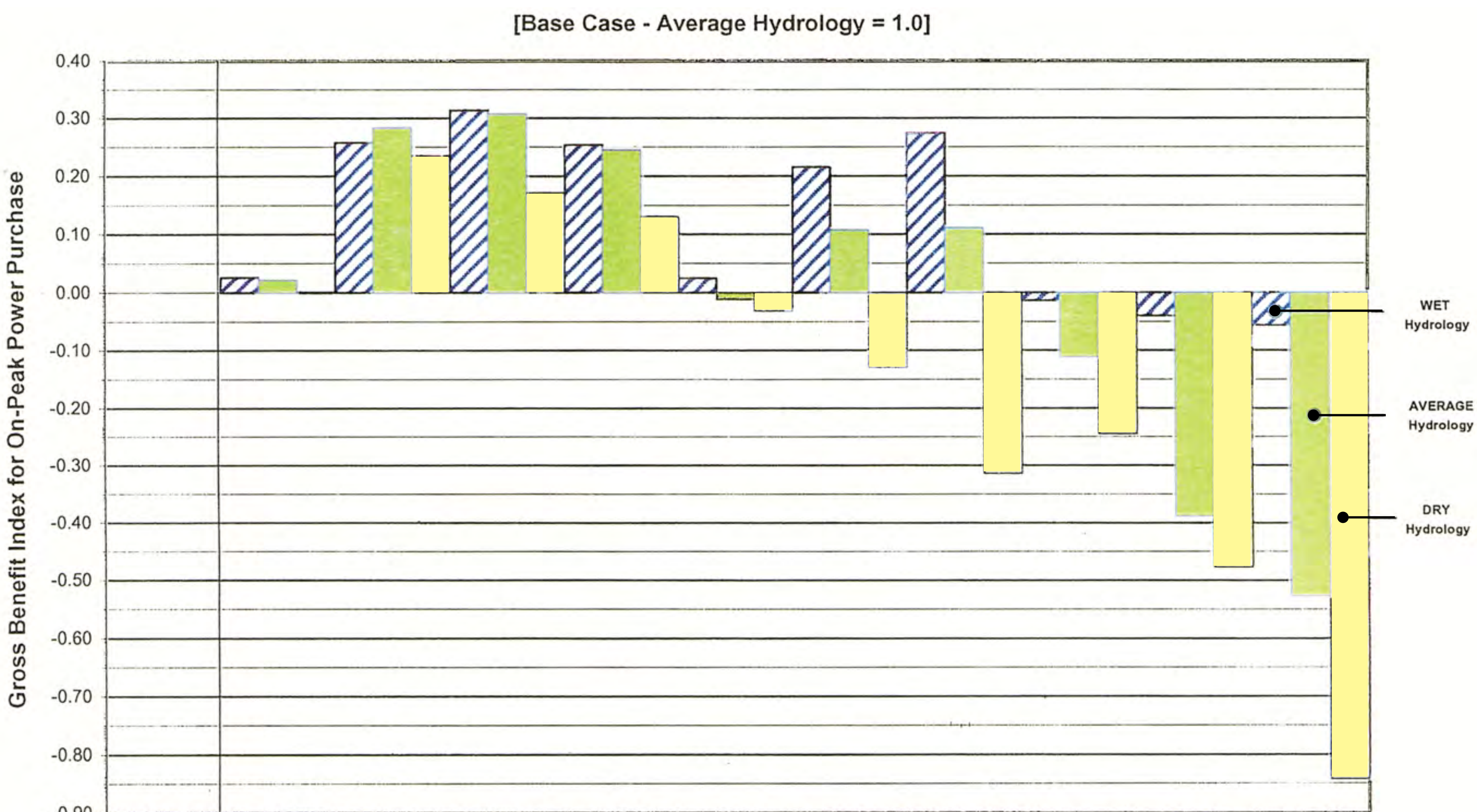

Hydrology	Base	McP +1m	HF rdvp	Comb 1 HFrd & McP+1	Comb 2 HFrdvp MP+1 Scott Ramp	Comb 3 McP+1 Scott Ramp	Comb 6 HFrdvp + Comb 4	Comb 8 HFrMP1 Qmin both Rivers	Comb 4 USHLdd QmScR	Comb 7 Mac12dd Qm8/10	Comb 5 Mackdd Qm8
Wet	0.00	0.03	0.26	0.31	0.25	0.02	0.22	0.27	-0.01	-0.04	-0.06
Average	0.00	0.02	0.28	0.31	0.25	-0.01	0.11	0.11	-0.11	-0.39	-0.53
Dry	0.00	0.00	0.23	0.17	0.13	-0.03	-0.13	-0.31	-0.24	-0.48	-0.84

Run Scenario

Fig. 10.2
Michipicoten River Water Management Plan
Brookfield Power Corporation
Actual Economic Benefit / Cost of Power / Ecological Improvement Strategies

ACRES International

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example, for Combination 1 in Table M-1 (Appendix M), under average hydrology conditions, the operational flexibility in 11 reservoirs and flow releases out of 7 generating stations were determined to be “neutral” or the same as the base case, for a total of 18 points in the “neutral” column. Operational flexibility would be improved in McPhail Reservoir due to raising the water level by 1 m, and flow releases would be improved through Dunford (High Falls) GS, giving a total of 2 points in the “+” column. This exercise was then performed for the dry and wet hydrologies and the results totaled for all hydrologies.

A further breakdown of the operational flexibility evaluation is provided in Table M-10. The overall rating shown in Table M-1 was established by taking the difference between the positive and negative totals. This number was then carried forward to the summary evaluation sheet Table M-9 (Appendix M). The results shown in Table M-9 were then used to produce the rankings described in Section 10.3.

10.1.2 Ecological Evaluation Methodology

The ecological evaluation of alternative water management strategies was carried out using the ecological criteria in Table 7.2 (Section 7). The criteria define how a positive, negative or neutral impact on the aquatic ecosystem is quantified when evaluating a change in reservoir levels and/or flows. These criteria were input to the model and the model outputs (foldout sheets in Appendix M) were reviewed for the 12 reservoirs on the Michipicoten and Montreal systems and three river reaches (i.e., below Hollingsworth GS, below Scott GS, and below Andrews GS). The results were carried forward to the tables in Appendix M (Tables M-1 through M-8).

For example, for Combination 1 (see Table M-1), there was one occurrence under an average hydrology when the reservoir level was better for the aquatic habitat (permanently wetted area) compared with the base case. There was also one occurrence when a reservoir level was worse for the aquatic habitat (permanently wetted area) compared with the base case. The foldout sheets in Appendix M identify which of the reservoirs are specifically affected. The total positive ratings were then subtracted from the total negative ratings for all three hydrologies which resulted in a -1 rating for reservoir minimum levels. This value was then carried forward to the summary evaluation sheet

(Table M-9). A ranking for this indicator was then developed (as shown in Table 10.2, Section 10.3) from the summary evaluation ratings in Table M-9. A similar approach was used to assess changes in reservoir spring levels for aquatic habitat. However, for this indicator, the three lower reservoirs on each river system were considered neutral because they fluctuate on a daily or weekly basis rather than seasonally and generally in a narrower range. Therefore water levels are not recovering from a winter low to a spring high as is the case on the upper reservoirs. In Combination 1 (see Table M-1) under all hydrologies, there were 28 “neutral” occurrences indicating that conditions regarding peak spring water levels in the reservoirs were similar to the base case. There were three “positive” occurrences when the start of FSL in the reservoirs began more than 1 week earlier than the base case, when the peak level reached 0.1 m of FSL. However, there were five “negative” occurrences indicating that conditions were worse than the base case in terms of spring conditions for the aquatic habitat in reservoirs. The total positive ratings (3) were then subtracted from the total negative ratings (5) to produce an overall rating of -2. This number was then carried forward to the summary evaluation sheet (Table M-9).

A similar approach was used to assess aquatic habitat conditions in the river reaches using minimum flows, weeks of stable flow, and the start of spring spill releases as indicators to compare with the base case.

If flow ramping at Scott Falls was included as a component of a combination strategy, it was given a +1 rating for each hydrology (see Table M-9).

10.1.3 Social Evaluation Methodology

The social evaluation was carried out using the social criteria in Table 7.2 (Section 7) to assess the effects in the 12 reservoirs and 3 river reaches for the various combination strategies. The social criteria are based on broad flood management considerations, (i.e., whether the water level rises above the spring target level to create a potential flood risk) whether reservoir levels are suitable for boating and fishing (May 15 to October 15), minimum flows through the river reaches for boating and fishing (May 15 to October 15), and whether the pictographs on Dog Lake would remain above the water line for viewing. Since all of these social factors are related to reservoir levels or flows, they could be input to the model. A positive, neutral or negative rating was noted on the foldout sheets in Appendix M. These results were then tabulated for each combination strategy (Tables M-1 to M-8) in a similar manner to that explained for the ecological evaluation in Section 10.1.2.

For example, for Combination 1, average hydrology, Table M-1 shows that minimum reservoir levels are worse in three reservoirs for tourism/recreation from May 15 to October 15 compared with the base case. However, most of the differences occur in the fall after the peak summer recreation period. There is no change in minimum water levels on nine reservoirs compared with the base case.

Since construction employment opportunities are related to the Dunford (High Falls) Redevelopment Project and the McPhail Reservoir raise (rather than reservoir levels and flows), this social criterion could not be input to the model. Instead, where the Dunford (High Falls) Redevelopment was included in an alternative strategy, it was given a +10 rating (Table M-9), while the McPhail Reservoir raise was given a +1 rating. The difference in ratings reflects the fact that construction employment opportunities are considered to be an order of magnitude greater for the Dunford (High Falls) Redevelopment than the McPhail Reservoir raise.

The overall ratings for all combinations for each attribute and indicator are provided in a summary table (Table M-9). The ratings for each indicator were then ranked for each combination strategy and these rankings are provided in Table 10.2.

10.2 Evaluation Results

The model results for each of the eight alternative water management strategies evaluated are included in the tables in Appendix M. Each strategy was evaluated on the basis of average, dry and wet hydrology conditions. Some highlights from the results of the evaluation are provided in the subsections that follow for each of the combination strategies considered.

Where combination strategies included the Dunford (High Falls) Redevelopment and/or the McPhail Reservoir raise, the increase in water levels on these two reservoirs was considered a neutral condition ecologically. The rationale for this rating was that the existing reservoir perimeter affected by the raise would change from terrestrial to an aquatic environment, and any effects on existing aquatic habitat would be mitigated or compensated by implementing DFO authorization. Normal reservoir management would resume at the new level.

Also, for the purpose of the evaluation on Combinations 4, 6 and 8, which involve ecological conditions that include potential effects to the upper storage reservoirs, the current FSL of 289.55 m on Anjigami Lake was adjusted to 288.8 m to reflect actual operations. This change was not made to the other cases, including the base case, where no change in existing water levels was proposed for the upper storage reservoirs.

10.2.1 Combination 1 – Base Case + Dunford (High Falls) Redevelopment Project + McPhail 1-m Raise

10.2.1.1 Power Considerations

This strategy would incur the least on-peak generation purchases compared with the other alternative strategies, i.e., 24% less than the base case over three hydrologies (see Table 10.1, Section 10.3) due to

- the incorporation of the Dunford (High Falls) Redevelopment project and McPhail Reservoir 1-m raise into this strategy
- the lack of additional ecological conditions compared with the base case and other alternative strategies.

It is also the best in terms of operational flexibility (see Table M-9) since flexibility is enhanced by the increased generating capacity of the Dunford (High Falls) Redevelopment Project and the increase in generating head and incremental reservoir storage of the McPhail Reservoir 1-m raise. Operational flexibility is enhanced by the ability to pass more water through the system on demand, by eliminating the necessity to spill at the original High Falls site. At the same time, operational flexibility is not reduced by ecological improvements that would adversely affect BP’s operations.

10.2.1.2 Ecological Considerations

Reservoirs

In Combination 1 there is a delay in some reservoirs reaching FSL in spring compared with the base case (see Appendix M). However, spring peak water levels under dry conditions would be significantly better (+2.9 m) on Hollingsworth Reservoir. Conversely, Windermere Lake spring water levels would be 1.2 m lower under dry conditions and the spring peak would begin 5 to 6 weeks later on Dog and Windermere Lakes than the base case. Spring reservoir levels are similar to the base case in average and wet hydrology years, although the start of the spring peak is 2 weeks earlier on Dog Lake in the average hydrology.

With regard to changes in permanently wetted area in the reservoirs, under average hydrology Hollingsworth Reservoir would be drawn down 2 m more than the base case to take advantage of the increased generating capacity at High Falls, allowing greater combined generation by the three lower river generating stations. MacKay Reservoir would be drawn down 0.4 m less than the base case as an opportunity to conserve flow is created by the increased generation at the Michipicoten River stations. However, under wet hydrology conditions Hollingsworth Reservoir's minimum water level would be 1.1 m higher than the base, while Anjigami Lake would be 0.8 m lower and MacKay Reservoir would be 0.6 m lower. Under dry conditions, Hollingsworth Reservoir's minimum level would be marginally higher (+0.3 m) compared with the base case, and Scott Falls Reservoir would be marginally lower (-0.3 m).

River Reaches

In terms of spring spill releases through the river reaches under average conditions, there is no change in the timing of the start of spill through the three river reaches (below Hollingsworth, Scott and Andrews). However, there is a 25% reduction in the peak spring flow below Hollingsworth and almost 20% reduction below Scott in an average year. This is related to the deeper drawdown on Hollingsworth. Under dry conditions, there is no spring spill through the three river reaches, which is similar to the base case. Under wet conditions, there is no change in the start of spring spill at Hollingsworth and Scott Falls, while the spring spill occurs 1 week later at the Andrews Station.

Minimum flows through the three river reaches for this strategy remain unchanged from the base case for all hydrologies, i.e., 17 m^3/s minimum flow through Scott GS, and no power flow through Hollingsworth or Andrews GS. However, a low flow does exist on the regulated river system below Hollingsworth GS which is estimated by BP to be approximately 3 m^3/s (see Section 8.1.7).

In terms of stable flows through the river reaches, under average hydrology conditions there were 4 weeks less through Hollingsworth and 6 weeks less through Scott GS compared with the base case, while the reach below Andrews GS experienced two additional weeks of stable flow. Under dry conditions, there was no significant change in the number of weeks of stable flow compared with the base case. Under wet conditions, there were 11 to 13 fewer weeks of stable flow through Hollingsworth and Scott GS compared with the base case. The shorter periods of stable flow are a consequence of the increased generating capacity at High Falls. There was no significant change in weeks of stable flow through Andrews GS compared with the base case.

Combination 1 did not involve ramping of flows through any of the generating stations. For this reason, it was given a neutral rating for ramping (see Table M-9) since conditions were the same as the base case.

10.2.1.3 Social Considerations

Flood Management

There is no effect on flood management capability as conditions are generally the same as the base case for all of the reservoirs under all hydrologies. However, there would be a reduction in maximum flows during an average hydrology through Hollingsworth GS (by 25%) and Scott GS (by 19%). This is due in part to greater over-winter drawdown of the Hollingsworth Reservoir which allows increased capture of spring freshet inflow. The reduction in maximum flow is also a consequence of increased power flows through the lower river stations as a direct benefit of the increased capacity of the Dunford (High Falls) Redevelopment.

Tourism and Recreation

Minimum water levels for tourism and recreation from May 15 to October 15 are generally similar to the base case with the exception of MacKay Reservoir (-0.7 m lower under an average hydrology and 0.4 m higher under a wet hydrology). Both these changes occurred in the fall after the September 15 (base case) summer water level constraint was removed. There were no changes in minimum water levels in the three main river reaches.

Heritage

There would be no change to Dog Lake water levels (compared with the base) that would adversely affect the pictographs.

Construction Employment

Combination 1 received a +11 rating for construction employment opportunities (see Table M-9), since both the Dunford (High Falls) Redevelopment project and McPhail Reservoir raise are included in this strategy.

10.2.1.4 Summary

In summary, Combination 1 ranks highest in power benefits because of the Dunford (High Falls) and McPhail projects. However, it ranks last in the ecological ranking because no ecological improvements in water levels or flows were included in this option. Most ecological indicators scored close to the base case, but there were shorter periods of stable flow. The combination ranks second in the social category (tied with Combinations 1, 5, 6 and 8) because it includes Dunford (High Falls) and McPhail projects and is otherwise similar to the base case.

10.2.2 Combination 2 – Base Case + Dunford (High Falls) Redevelopment Project + McPhail 1-m Raise + Scott Ramping

10.2.2.1 Power Construction

Combination 2 did not fare quite as well as Combination 1 in terms of on-peak generation purchases (see Table 10.1, Section 10.3 and Figure 10.1). It also ranked slightly lower in operational flexibility, due mainly to fewer ecological constraints than most of the other alternative strategies. Operational flexibility is generally improved by the inclusion of the Dunford (High Falls) Redevelopment Project and McPhail Reservoir 1-m raise. However, this improvement in operational flexibility is offset to some degree by the introduction of flow ramping out of Scott GS.

10.2.2.2 Ecological Considerations

Reservoirs

Under an average hydrology, there is no change in spring peak reservoir levels compared with the base case. However, under a wet hydrology, the start of the spring peak is delayed by 3 weeks on Anjigami Lake (see Appendix M), but is 2 weeks earlier on Dog Lake. There is no change in the start of the spring peak for reservoirs on the Montreal system.

Under a dry hydrology, the start of the spring peak is delayed by 2 to 6 weeks on the upper Michipicoten system reservoirs (see Appendix M). Under dry conditions, the spring peak water level would be much better (higher) than base case on Hollingsworth Reservoir (by +3 m), and +0.3 m higher on MacKay Reservoir, but -1 m lower on Wabatongushi Lake and -0.8 m lower on Windermere Lake.

With regard to changes in minimum water levels, under average hydrology Hollingsworth Reservoir would be drawn down 2.4 m more than base case, while Windermere and Anjigami would have reduced drawdowns by 0.5 m. Under the wet hydrology scenario, Anjigami Lake would be drawn down 0.6 m more than base case, however, both Windermere Lake and MacKay Reservoir would benefit ecologically by 0.3 m reductions in drawdown compared with the base case. Under dry conditions minimum water levels would be similar to the base case with the exception of Scott Falls and MacKay where levels would be 0.3 m lower.

River Reaches

Minimum flow through the three river reaches for this strategy remain unchanged from the base case for all hydrologies and the start of the spring spill would occur at the same date for the two cases under average and wet hydrologies (see Appendix M). There is no spill under a dry hydrology which is similar to the base case.

In terms of stable flow, there are 10 fewer weeks of stable flow through Hollingsworth and 12 fewer weeks of stable flow through Scott in a wet year compared with the base case (see Appendix M). The impact decreases to 4 to 6 weeks in an average year and is negligible in a dry year compared with the base case. The shorter periods of stable flow are a consequence of the increased capacity at High Falls.

Combination 2 includes ramping of flows through Scott GS. It was therefore given a +1 rating for ramping compared with the base case (see Table M-9).

10.2.2.3 Social Considerations

Flood Management

Combination 2 creates no adverse effect on flood management in the reservoirs compared with the base case under all hydrology conditions. There would be a benefit in terms of flood management through the three river reaches under an average hydrology with a reduction in maximum flows through Hollingsworth (by 25%), and Scott GS (by 19%).

Tourism and Recreation

A higher minimum water level for tourism and recreation from May 15 to October 15 would occur on Anjigami Lake (+0.2 m) under an average hydrology. However, this benefit would be offset by lower minimum water levels in fall under average conditions on Scott Reservoir (-0.2 m), MacKay Reservoir (-0.8 m) and Andrews Reservoir (-0.3 m). Andrews would also experience lower maximum levels (-0.2 m) in both the dry and wet hydrologies with MacKay Reservoir 0.2 m higher for the wet case. These changes would occur in the fall after the peak summer tourist period.

Heritage

There would be no change to Dog Lake water levels (compared with the base) that would adversely affect viewing of the pictographs.

Construction Equipment

Combination 2 received a +11 rating for construction employment opportunities (see Table M-9) since both the Dunford (High Falls) Redevelopment project and McPhail Reservoir raise are included in this strategy.

10.2.2.4 Summary

In summary, Combination 2 ranks second in the power category, because of the Dunford (High Falls) and McPhail projects (see Table 10.3). However, it is second last in the ecology category after Combination 1, because ramping below Scott Falls was the only ecological improvement included. Most ecological indicators scored close to the base case, but there were lower scores for shorter periods of stable flow and higher scores for ramping. It is second in the social ranking, tied with Combinations 1 and 8 because it includes the High Falls and McPhail projects and is otherwise similar to the base case.

10.2.3 Combination 3 – Base Case + McPhail 1-m Raise + Scott Ramping

This combination is similar to Combination 2 but without the Dunford (High Falls) Redevelopment Project.

10.2.3.1 Power Considerations

Table 10.1 indicates that this strategy was ranked fourth based on on-peak generation purchases and third in terms of operational flexibility. Operational flexibility was not enhanced to the same degree as Combinations 1 or 2 because the Dunford (High Falls) Redevelopment was not included in this strategy.

10.2.3.2 Ecological Considerations

Reservoirs

Under average hydrology the most significant change in wetted perimeter occurs on Hollingsworth Reservoir, where there is an increased drawdown of 1.9 m below the base case. This is due to a change in how the model optimally allocates water in the last month of the winter drawdown period. There are also increased drawdowns on MacKay Reservoir (-0.9 m) and Scott Falls Reservoir (-0.3 m). On the positive side there is increased wetted perimeter under average hydrology due to an increase in water level on Anjigami Lake (+0.8 m). Under dry hydrology, increased water levels occur on Anjigami Lake (+0.4 m), Hollingsworth Reservoir (+0.3 m) and Dog Lake (+0.3 m), resulting in increased wetted perimeter. However, these ecological benefits are offset by a reduced water level under dry conditions on Scott Falls Reservoir (-0.5 m). Under wet hydrology increased water levels occur on Hollingsworth Reservoir (+0.4 m), thereby increasing wetted perimeter. However, this ecological benefit is offset by a reduced water level on MacKay Reservoir (-0.4 m), Anjigami Lake (-0.4 m) and Scott Falls Reservoir (-0.3 m), reducing wetted perimeter on these waterbodies.

Under an average hydrology, Dog Lake and Anjigami Lake reach FSL in the spring 2 weeks earlier compared with the base case. Under a dry hydrology, the spring peak level on MacKay Reservoir is 0.2 m lower than base case. Under a wet hydrology FSL is reached at similar times on all Michipicoten reservoirs except Anjigami which is 3 weeks later. There is no change in timing on the Montreal River reservoirs compared with the base case.

River Reaches

There is no change in minimum flows through the three river reaches (Hollingsworth, Scott and Andrews) compared with the base case. However, there is a 25% reduction in the peak spring flow below Hollingsworth and a 19% reduction below Scott in the average year. Again, this is related to the deeper drawdown on Hollingsworth reservoir. In terms of the timing of spring spill releases, there is no change through the three river reaches under average and wet hydrologies compared with the base case. There is no spring spill release through the three river reaches under a dry hydrology, which is similar to the base case.

The weeks of stable flow in the river reaches improve by 1 to 4 weeks under average and wet hydrologies with Combination 3 compared with the base case (see Appendix M). However, under a dry hydrology, there are only 4 weeks of stable flow through Hollingsworth and Andrews compared with 6 weeks in the base case scenario.

Combination 3 includes ramping of flows through Scott GS. It was therefore given a +1 rating for ramping compared with the base case (see Table M-9).

10.2.3.3 Social Considerations

Flood Management

This strategy creates no adverse effects on flood management of the reservoirs. In fact, there is an improvement in flood management through the river reaches below Hollingsworth and Scott GS, with reduction in maximum flows of 25% and 19%, respectively, under an average hydrology. There is no significant change in maximum flows through these three river reaches under wet and dry hydrologies compared with the base case.

Tourism and Recreation

There is a lower minimum water level for tourism and recreation during the period May 15 to October 15 under average hydrology conditions on Hollingsworth (-0.5 m), Scott (-0.2 m) and Andrews (-0.3 m) Reservoirs. Under dry hydrology conditions there are lower minimum water levels on Hollingsworth (-0.2 m) and Andrews (-0.2 m) reservoirs, but negligible change from the base case for the remaining lakes and most of the reservoirs. MacKay Reservoir conditions improve for tourism and recreation under dry hydrology with a 0.3 m higher minimum water level. Under wet hydrology, there is little change from the base case except for Andrews Reservoir (-0.2 m).

Heritage

Viewing of the Dog Lake pictographs would still be possible with this strategy.

Construction Employment

Combination 3 received a +1 rating for construction employment opportunities (see Table M-9) since the McPhail Reservoir raise is included in this strategy.

10.2.3.4 Summary

In summary, Combination 3 ranked fourth with the McPhail Reservoir raise. It ranked fourth in ecology (ahead of Combinations 1 and 2) due to a higher score for longer periods of stable flow. It ranked fifth in social benefits, primarily because it does not include the (Dunford) High Falls Redevelopment project.

10.2.4 Combination 4 – Reduced Drawdown on Hollingsworth + Reduced Drawdown on Secondary Storage Reservoirs + Continuous Baseflows on Michipicoten System + Scott Ramping

This strategy proposes several changes to water levels and flows with the objective of improving ecological conditions. For example, it includes provision for a maximum 8 m drawdown on Hollingsworth Reservoir from December 16 to May 31 (1.1 m < base case) to provide an additional 1.1 m of permanently wetted depth for the aquatic ecology. It also includes a maximum 2 m drawdown in the summer (June 1 to September 30) which is 1 m less than base case to improve conditions for the aquatic ecology as well as recreational activities. This maximum 2 m drawdown level is also extended into the fall (to December 15). A 0.15 m surcharge above FSL is also proposed in the spring and fall to improve conditions for the aquatic ecology. Base flows proposed by MNR are 15 m^3/s through Hollingsworth GS and 28 m^3/s through all other downstream generating stations.

In addition, for the Combination 4 strategy, the winter drawdown level in all of the upper storage lakes (Wabatongushi, Dog, Windermere and Anjigami Lakes) is reduced to 0.51 m below summer minimum level in each lake (see reference water levels in Table 4.3, Section 4). Also, an adjusted FSL of 288.8 m was established for Anjigami Lake (0.5 m above average summer water level, but 0.8 m below the maximum allowable FSL in the base case) to better represent existing operations.

10.2.4.1 Power Considerations

The lost power revenues resulting from the introduction of ecological benefits is reflected in the significant on-peak power purchases and lost operational flexibility throughout the system (see Table 10.1 and Table M-4) for the Combination 4 strategy. Operational flexibility is compromised considerably due to the large number of ecological conditions built into this strategy.

10.2.4.2 Ecological Considerations

Reservoirs

As would be expected, this strategy did particularly well in terms of increasing the permanently wetted area in the reservoirs with one exception. For the average hydrology, Hollingsworth Reservoir experiences increased drawdown of almost 2 m, even though this strategy called for a reduction in maximum drawdown level on this reservoir. The reason is that this strategy also calls for continuous baseflows through Hollingsworth GS and higher minimum flows in the lower reaches of the Michipicoten system. This results in an ecological tradeoff under average hydrology, i.e., conditions are better ecologically downstream of Hollingsworth but potentially worse in the reservoir itself. There are, however, some ecological improvements in minimum water levels elsewhere on the system with reduced drawdowns on Wabatongushi Lake (+0.7 m) and Anjigami Lake (+0.6 m) under average hydrology. Under dry hydrology conditions, Hollingsworth Reservoir has a reduced drawdown of 1 m, increasing the wetted perimeter for the aquatic ecology. Similar reduced drawdowns occur on Wabatongushi Lake (+0.5 m) and Windermere Lake (+0.3 m) under dry hydrology conditions. Under wet hydrology conditions there are improvements in minimum water levels on Wabatongushi Lake (+0.5 m) and MacKay Reservoir (+0.6 m).

The spring peak level on Wabatongushi Lake is reached 1 to 2 weeks earlier under average and dry hydrologies. Under a wet hydrology, the spring peak occurs 2 weeks earlier on Dog Lake.

River Reaches

Minimum flows through the two Michipicoten river reaches were improved with this strategy as a result of the inclusion of 15 m^3/s through Hollingsworth and an increase to 28 m^3/s through Scott GS, compared with 17 m^3/s through Scott GS that presently occurs with the base case. No minimum flows were proposed on the Montreal system for Combination 4 and, therefore, there is no change compared with the base case.

The start of the spring peak spill through the three river reaches was not affected at Hollingsworth, Scott and Andrews stations under average and wet hydrologies, compared with the base case. However, there is a 19% reduction in the peak spring flow below Hollingsworth and almost 20% reduction below

Scott in the average year which is related to the deeper drawdown on Hollingsworth Reservoir. There is no spring peak spill through the three river reaches under a dry hydrology, which is equivalent to the base case.

The Combination 4 strategy results in 3 to 4 fewer weeks of stable flows through the river reaches below Hollingsworth and Scott Falls GS under dry and wet hydrologies compared with the base case. This is likely related to the requirement for increased minimum flow. However, there is no significant change in weeks of stable flow through the three river reaches under an average hydrology.

Combination 4 includes ramping of flows through Scott GS. It was therefore given a +1 rating for ramping compared with the base case (see Table M-9).

10.2.4.3 Social Considerations

Flood Management

The Combination 4 strategy has no adverse effects on flood management of the reservoirs. In fact, there is an improvement in flood management through the river reaches with reduced maximum flows through Hollingsworth (by 19%), and Scott (by 20%) under average hydrology conditions. There is no change in flood management through the three river reaches (below Hollingsworth, Scott and Andrews GS) under dry and wet hydrologies.

Tourism and Recreation

The continuous baseflows proposed out of Hollingsworth, and Scott GS for this strategy will be beneficial for tourism and recreation, however, there is a 0.8 m reduction in the minimum water level on MacKay Reservoir during the period May 15 to October 15 under average hydrology. Under dry conditions, the beneficial tourism and recreation effect of a 1 m higher minimum water level on Hollingsworth Reservoir during the same period will be offset by lower minimum water levels on Dog Lake (-0.6 m), Anjigami Lake (-0.6 m) and MacKay Reservoir (-0.2 m). Under wet conditions, reservoir levels during the recreation period are generally similar to the base case with the exception of a higher minimum water level on MacKay Reservoir (+0.4 m).

Heritage
Any changes to water levels on Dog Lake resulting from the Combination 4 strategy will not adversely affect the pictographs.

Construction Employment
Combination 4 received a neutral rating for construction employment opportunities (Table M-9) since neither the Dunford (High Falls) Redevelopment nor the McPhail Reservoir Raise is included in this strategy.

10.2.4.4 Summary

In summary, Combination 4 ranks sixth from a power perspective because it does not include the Dunford (High Falls) development or McPhail Reservoir raise and requires more on-peak power purchases than the base case to provide ecological benefits. It was first ecologically because of the large number of improvements on reservoirs and river reaches on the Michipicoten system compared with the base case. However, there are some trade-offs for these improvements. Specifically, the introduction of continuous baseflows out of Hollingsworth GS and throughout the system downstream resulted not only in the reduced drawdown restriction on Hollingsworth Reservoir not being met under average conditions, but required an increased drawdown on this reservoir of almost 2 m to meet baseflow conditions. Also, the periods of stable flow in two main river reaches on the Michipicoten were reduced by 3 to 4 weeks in dry and wet years.

Combination 4 was third based on tourism and recreation criteria, with improvements to water levels and flows compared with most of the other strategies.

10.2.5 Combination 5 – Michipicoten River: Base Case Montreal River: MacKay Reservoir 10 m Maximum Drawdown + Continuous Baseflows

This strategy focused on improving ecological conditions on the Montreal River system. In this regard, MNR proposed a 5.25 m reduction in maximum reservoir drawdown on MacKay Reservoir as well as a summer and fall water level drawdown restriction to 2 m below FSL during the period June 1 to December 15. In addition, this strategy assumes a minimum flow of 8 m^3/s

through MacKay GS, 13 m^3/s through Gartshore GS, 17.1 m^3/s through Hogg GS and 10.1 m^3/s through Andrews GS at all times.

10.2.5.1 Power Considerations

This combination ranks sixth from a hydropower perspective, behind Combinations 1, 2, 3, 6 and 7, primarily because the (Dunford) High Falls and McPhail projects are not included and there are significant on-peak power purchases required to accommodate ecological improvements (see Table M-9).

10.2.5.2 Ecological Considerations

Reservoirs

Under an average hydrology, this strategy resulted in higher minimum reservoir levels on Anjigami Lake (+0.8 m) and Wabatongushi Lake (+0.3 m), thereby increasing the permanently wetted area for the aquatic ecology. However, these ecological improvements were offset by lower minimum water levels in Hollingsworth Reservoir (-3 m) and MacKay Reservoir (-0.8 m), considerably reducing the permanently wetted area in these reservoirs compared with the base case. Under average and wet hydrologies the 5.25 m reduced drawdown requirement for MacKay Reservoir was not achieved due to the need for continuous baseflows. Under a wet hydrology, there is no change in minimum reservoir levels compared with the base case, except for a lower minimum water level (-1 m) on MacKay Reservoir. Under a dry hydrology, there is no change in minimum reservoir levels on the Michipicoten system compared with the base case. As expected, on MacKay Reservoir, the 5.25 m reduced drawdown requirement is achieved. However, not enough storage was available to maintain baseflow on the Montreal system in the late winter and early spring of the dry years.

In terms of achieving maximum reservoir spring water levels under an average hydrology, FSL is reached earlier at Anjigami Lake (by 3 weeks). The higher spring peak water level of 2.6 m at MacKay Reservoir under dry hydrology conditions reflects the specified reduction in maximum drawdown during the year. However, not enough storage was available to maintain baseflow on the Montreal system in the late winter and early spring of the dry year.

River Reaches

The introduction of a continuous baseflow on the Montreal River system for the Combination 5 strategy improves permanently wetted area conditions under average and wet hydrology conditions. However, under a dry hydrology, the ecological baseflow was not maintained in the late winter and early spring period in order to achieve the reduced drawdown (by 5.25 m) in MacKay Reservoir.

Spring peak spill releases generally begin within a week of the base case under average and wet hydrologies in the three river reaches. However, in the average hydrology year, there is a 25% reduction in the peak spring flow below Hollingsworth, 20% below Scott and 14% below Andrews. There was no spill in the dry year.

The Combination 5 strategy results in three more weeks of stable flow in the reach below Scott GS under an average hydrology compared with the base case. There is negligible change in weeks of stable flow through the three river reaches under a dry hydrology. Under a wet hydrology, there are 3 weeks less of stable flow through the Andrews reach compared with the base case.

Combination 5 does not include flow ramping and therefore a neutral rating was provided for this indicator (as shown in Table M-9) since it was the same as the base case condition.

10.2.5.3 Social Considerations

Flood Management

For Combination 5, there is no adverse effect on flood management capability under average hydrology conditions. In fact, there is a reduction in maximum flow releases out of Hollingsworth (25%), Scott GS (20%) and Andrews (14%). Under the dry hydrology scenario, the 2.6-m raise in MacKay Reservoir spring fill level, which reflects the reduced drawdown limits with the Combination 5 strategy, does not create a flood management concern. In the wet year there was a 25% reduction in peak flow at Andrews on the Montreal System which reflects the impact of continuous baseflow releases.

Tourism and Recreation

In terms of recreation, minimum water levels from May 15 to October 15 were higher in MacKay Reservoir by 1.8 m under average and dry hydrologies, and by 0.7 m (wet hydrology) compared with the base case. However, levels were lower in Hollingsworth in the average and dry year. There were also improvements in flow under all three hydrologies below Andrews GS as a result of the introduction of a continuous baseflow.

Heritage

The Combination 5 strategy would have no adverse effect on the viewing of pictographs on Dog Lake.

Construction Employment

Combination 5 received a neutral rating for construction employment opportunities (Table M-9) since neither the (Dunford) High Falls Redevelopment nor the McPhail Reservoir raise is included in this strategy.

10.2.5.4 Summary

In summary, Combination 5 ranks last in power (tied with Combinations 4 and 8) because Dunford (High Falls) Redevelopment and McPhail raise are not included and high on-peak purchases are required to compensate for minimum flows throughout the Montreal system. The combination ranks third ecologically (tied with Combination 7 and behind Combinations 4 and 8). The good ecological showing is based on improvements in MacKay Reservoir and minimum flows below Andrews. However, there were also ecological tradeoffs, i.e., minimum flow was not maintained throughout the dry year, and there were larger drawdowns in both MacKay and Hollingsworth in the average year. Combination 5 ranked first in the social category (tied with Combination 6), based primarily on flood management and recreation in the river sections.

10.2.6 Combination 6 – Combination 4 + Dunford (High Falls) Development

Combination 6 combines Combination 4 with the Dunford (High Falls) Development and assumes base case (existing) operations on the Montreal River.

10.2.6.1 Power Considerations

Combination 6 ranks third in on-peak power purchases with 6% fewer on-peak purchases than the base case [see Table 10.1 and Table M11 (Appendix A)]. This improvement over the base case reflects the (Dunford) High Falls Redevelopment project but is countered by the reductions in available storage and requirements for continuous base flows at all stations and ramping at Scott Falls GS.

Operational flexibility is significantly reduced with this strategy to incorporate ecological improvements (see Table M-9) even with the inclusion of the Dunford (High Falls) Redevelopment Project.

10.2.6.2 Ecological Considerations

Reservoirs

Higher minimum reservoir levels result in a significant improvement to permanently wetted area under average hydrology for Wabatongushi Lake (+0.9 m) and Anjigami Lake (+0.5 m). However, this is offset by an increased drawdown on Hollingsworth Reservoir by almost 2 m because of increased capacity at Dunford (High Falls) and increased minimum flows in the Michipicoten system. Under the dry hydrology there are improvements to permanently wetted area on Wabatongushi Lake (+0.4 m), Windermere Lake (+0.3 m) and Hollingsworth Reservoir (+0.4 m). Under the wet hydrology, permanently wetted area is increased on Wabatongushi Lake (+0.7 m), Windermere Lake (+0.4 m), and MacKay Reservoir (+0.5 m).

In terms of reservoir spring water levels under an average hydrology, the FSL is reached 2 weeks earlier at Wabatongushi and Dog Lakes compared with the base case. Under a dry hydrology, there is a 0.8 m increase in the spring peak water level of Hollingsworth Reservoir, and a 0.4 m increase in the spring peak water level of MacKay Reservoir.

River Reaches

There is significant ecological benefit in terms of continuous baseflows through the Hollingsworth, McPhail, Dunford (High Falls) and Scott generating stations with this strategy. However, there is no baseflow proposed for the Montreal River system with this strategy.

There is no change in the start of spring peak spill releases through the three river reaches under average and wet hydrologies compared with the base case. However, there is a 19% reduction in the peak flow below Hollingsworth and almost 20% reduction below Scott in the average year, due to the deeper downstream on Hollingsworth Reservoir. Under a dry hydrology, there is no spill, similar to the base case.

There are fewer weeks of stable flow through the Michipicoten river reaches with the Combination 6 strategy, i.e., Hollingsworth (-5 weeks) and Scott (-9 weeks) under an average hydrology compared with the base case. This condition is exacerbated under a wet hydrology, i.e., Hollingsworth (-11 weeks) and Scott (-13 weeks). Under a dry hydrology, there are also fewer weeks of stable flow, i.e., Hollingsworth (-4 weeks) and Scott (-4 weeks) compared with the base case. There is no significant change in weeks of stable flow through the Andrews river reach on the Montreal system for any of the hydrologies.

Combination 6 includes ramping of flows through Scott GS. It was therefore given a +1 rating for ramping compared with the base case (see Table M-9).

10.2.6.3 Social Considerations

Flood Management

There is no adverse effect on flood management capability for this strategy. As noted above, there is a reduction in maximum flow of 19% from Hollingsworth, 20% from Scott, but an increase of 5% at Andrews in an average year.

Tourism and Recreation

From a recreational perspective, this strategy ranked second with Combinations 4 and 8. The continuous baseflows proposed out of Hollingsworth, McPhail, Dunford (High Falls) and Scott generating stations for the Combination 6 strategy will be beneficial for tourism and recreation in the river reaches. Under an average hydrology, minimum water levels for recreation were higher (by 0.2 m) on Hollingsworth Reservoir but lower (by 0.7 m) on MacKay Reservoir. Under a dry hydrology, there is a higher minimum water level during the summer months on Hollingsworth Reservoir (+1 m) but this benefit is offset by lower minimum water levels during the summer months on Dog Lake (-0.3 m), Windermere Lake (-0.3 m), and MacKay Reservoir (-0.7 m). Under a wet hydrology, there are tourism and recreation benefits on MacKay Reservoir, with a 0.3 m higher minimum water level during the summer months compared with the base case. All of these changes occurred in the fall outside of the summer peak recreation period.

Minimum flows through the river reaches below Hollingsworth and Scott GS, as proposed for this strategy, would provide tourism and recreation benefits for all hydrologies.

Heritage
The Combination 6 strategy would have no adverse effect on the viewing of pictographs on Dog Lake.

Construction Employment
Combination 6 received a +10 rating for construction employment (see Table M-9) since the Dunford (High Falls) Redevelopment Project is included in this strategy.

10.2.6.4 Summary

In summary, Combination 6 ranks fourth in the power category and did not score well in this category, despite the inclusion of the Dunford (High Falls) Redevelopment, due to the ecological concessions and subsequent loss in operational flexibility and additional on-peak power purchases. It is tied for first in the ecology category along with Combination 4, because of the improvements in minimum levels and spring levels in reservoirs, and minimum flows and ramping in the river reaches of the Michipicoten. However, there were shorter periods of stable flow and lower peak flows in the Michipicoten. Combination 6 ranks first in the social category (tied with Combination 5, with the inclusion of the Dunford (High Falls) Project and improved minimum flow on the river reaches of the Michipicoten.

10.2.7 Combination 7 – Michipicoten River: Base Case Montreal River: MacKay Reservoir 12 m Drawdown + Seasonal and Continuous Baseflows

This strategy involves the following potential changes to improve ecological conditions compared with the base case:

- minimum continuous baseflow of 10.1 m^3/s through Andrews GS year round
- minimum seasonal baseflow of 8 m^3/s through MacKay GS from April 15 to June 15
- maximum drawdown on MacKay Reservoir to 362.91 m (12 m drawdown from FSL; 3.25 m < base case).

10.2.7.1 Power Considerations

Combination 7 is not as favorable as Combinations 1, 2, 3, 4, and 8 in terms of power purchases (see Table 10.1) because it does not include the Dunford (High Falls) Redevelopment or McPhail Reservoir raise and requires minimum flows on the Montreal system. It is also not as favorable as Combinations 1, 2 and 3 in terms of operational flexibility due to the reduced drawdown restriction on MacKay Reservoir and subsequent operational flexibility limitations through downstream generating station flow releases.

10.2.7.2 Ecological Considerations

Reservoirs

With regard to reservoir minimum levels under average hydrology conditions, there are increased drawdowns on Hollingsworth (-1.8 m), Hogg (-0.3 m), and Andrews (-0.7 m) reservoirs due to the drawdown restriction on MacKay Reservoir and to accommodate baseflow requirements on the Montreal River system. There are, however, reduced drawdowns on Wabatongushi Lake (+0.3 m) and Anjigami Lake (+0.5 m). Under dry hydrology conditions, there is a significant increase in permanently wetted area on MacKay Reservoir due to a 3.6 m reduction in drawdown. However, there are increased drawdowns on Hogg (-0.3 m) and Andrews (-0.6 m) reservoirs to accommodate the continuous baseflow requirement of 10.1 m^3/s through Andrews GS. Lower minimums are expected on the lower reservoirs of the Montreal system to provide for the minimum flow out of Andrews GS. Under a wet hydrology, there is a 0.81 m reduction in drawdown on MacKay Reservoir which is offset by an increase in drawdown on Hollingsworth Reservoir (-0.6 m).

In terms of spring conditions for the aquatic ecology under average conditions, there is no significant change in reaching FSL for any of the reservoirs on the Montreal River compared with the base case. On the Michipicoten, FSL is reached 2 weeks earlier at Anjigami Lake. Under dry hydrology the spring peak level is 1.5 m higher on MacKay Reservoir than the base case due to a reduced winter drawdown. Under wet hydrology conditions, spring FSL is reached 1 week earlier on Dog Lake.

River Reaches

The Combination 7 strategy includes minimum flows on the Montreal River system as follows to improve conditions for the aquatic ecology:

- seasonal baseflow of 8 m^3/s through MacKay GS from April 15 to June 15
- continuous baseflow of 10.1 m^3/s through Andrews GS year round.

There is no change in baseflows for the Michipicoten system with this strategy.

There is no change in the start of the spring spill through the three river reaches under average and wet hydrologies. However, there is a 23% reduction in the peak spring flow below Hollingsworth and almost 20% reduction below Scott GS in the average year due to the deeper drawdown on Hollingsworth. Under dry hydrology conditions there is no spill, which is the same as the base case.

There is no significant change in the number of weeks of stable flow with this strategy compared with the base case.

10.2.7.3 Social Considerations

Flood Management

There will be no change in maximum reservoir levels with this strategy under average and wet hydrologies and therefore no effect on flood management capability compared with the base case. However, under dry conditions the maximum reservoir level on MacKay Reservoir will increase by 1.5 m but is still below the spring target level and therefore there is no flood management concern. In an average year, there would be a reduction in maximum flow below Hollingsworth (by 23%) and below Scott (by 20%).

Tourism and Recreation

The primary recreational benefit on the Montreal system is a higher minimum water level on MacKay Reservoir during the period May 15 to October 15. Under average hydrology the minimum water level is improved by +2.4 m; under dry hydrology it is improved by +2.6 m, and under wet hydrology it is improved by +0.8 m. This reflects the reduced drawdown imposed on MacKay Reservoir for this combination strategy. The minimum water level is also improved by 0.2 m on Wabatongushi Lake under a dry hydrology. In addition, tourism and recreation conditions are improved below Andrews GS under all hydrologies due to the continuous baseflow of 10.1 m^3/s out of Andrews GS proposed for this strategy. On the negative side, however, is a lower minimum water level on Hollingsworth Reservoir by -0.5 m under average and dry hydrology conditions. In addition, during dry hydrology, there is a lower minimum water level on Andrews Reservoir (by -0.8 m) and Hogg Reservoir (by -0.5 m) to accommodate the continuous baseflow requirement through Andrews GS. This requirement also causes a lower minimum water level on Andrews Reservoir by -0.2 m under wet hydrology conditions.

Heritage

The Combination 7 strategy would have no adverse effect on the viewing of pictographs on Dog Lake.

Construction Employment

Combination 7 received a neutral rating for construction employment opportunities (Table M-9) since neither the Dunford (High Falls) Redevelopment nor the McPhail Reservoir raise is included in this strategy.

10.2.7.4 Summary

Combination 7 ranks fifth in the power category because it does not include the Dunford (High Falls) Redevelopment or McPhail Reservoir raise and it requires on-peak purchases to the minimum flows below Andrews. It scores third in the ecological category (tied with Combination 5) due to improvements on the Montreal system in minimum flows and spring reservoir levels. However, there are larger drawdowns on Hogg and Andrews reservoirs to incorporate the minimum flow below Andrews. It scores fourth in the social category with improvements in minimum flows for navigation on the lower reach of the Montreal, but no construction employment opportunities.

10.2.8 Combination 8 – A Combined Strategy for the Michipicoten and Montreal Rivers

This strategy proposed by MNR uses a modification of the conditions proposed for Combinations 6 and 7, i.e.,

- without ramping of flows at Scott GS (Michipicoten River)
- with the addition of the 1 m raise of McPhail Reservoir
- without a reduced drawdown on MacKay Reservoir (Montreal River).

The conditions imposed for this strategy are described in detail in Section 9.9.

10.2.8.1 Power Considerations

Combination 8 ranks fourth in terms of on-peak generation purchases (Section 10.3, Table 10.1) but is last in terms of operational flexibility due to the losses incurred to accommodate the ecological improvements proposed for the reservoirs and the baseflows proposed for both the Michipicoten and Montreal River systems.

10.2.8.2 Ecological Considerations

Reservoirs

Under average hydrology, there are higher minimum levels on Wabatongushi Lake (+0.6 m), Anjigami Lake (+0.6 m), and Windermere Lake (+0.3 m), increasing the permanently wetted perimeter on these lakes. However, these ecological benefits are offset by a lower minimum water level on Hollingsworth Reservoir (-1.8 m) and Andrews Reservoir (-0.3 m). Under dry hydrology conditions there is a higher minimum level on Wabatongushi Lake

(+0.4 m), Windermere Lake (+0.3 m), and Hollingsworth Reservoir (+1.3 m). However, these ecological benefits are offset on the Montreal system during dry conditions by increased drawdowns on Gartshore Reservoir (-2.7 m), Hogg Reservoir (-2.4 m), and Andrews Reservoir (-1.6 m), to maintain the continuous baseflow out of Andrews in the late winter. Under wet hydrology conditions, there are higher minimum levels on Wabatongushi Lake (+0.5 m) and Windermere Lake (+0.6 m) but a lower minimum level on Hollingsworth Reservoir (-0.3 m).

In terms of spring conditions for the aquatic ecology under all hydrologies, there are some changes in the timing to reach FSL in some of the reservoirs compared with the base case. Under average conditions, the FSL is reached 1 week earlier on Wabatongushi Lake and Dog Lake. Under dry conditions, there is a +1.2 m increase in the spring peak water level on Hollingsworth Reservoir. Under a wet hydrology, the spring FSL is reached 2 weeks earlier on Dog Lake.

River Reaches

There are presumed ecological benefits in terms of baseflows for both the Michipicoten and Montreal River systems with this strategy compared with the base case. This strategy involves a continuous baseflow of 15 m^3/s through Hollingsworth GS, 28 m^3/s through the downstream stations on the Michipicoten system, a seasonal baseflow of 8 m^3/s through MacKay GS (April 15 to June 15) and 10.1 m^3/s through Andrews GS year round. These conditions could not be met under a dry hydrology at Scott GS (where only 7.5 m^3/s was possible), and no flow was possible through Andrews GS.

There is no change in the start of the spring peak spill through the three river reaches under average and wet hydrologies. However, there is a 19% reduction in the spring peak flow below Hollingsworth GS and almost 20% reduction below Scott GS in the average year. Under dry conditions there is no spill, which is the same as the base case.

There are fewer weeks of stable flow through the river reaches under all hydrologies with this strategy compared with the base case. This is related to the increased capacity at Dunford (High Falls) and the requirement for increased minimum flows. Under average hydrology conditions, there are 8 fewer weeks of stable flow through the river reach below Hollingsworth GS, 9 fewer weeks through the river reach below Scott GS, and 2 fewer weeks in the river reach below Andrews GS. Under a wet hydrology, there are 6 fewer weeks of stable flow through the river reach below Hollingsworth GS, and 10 fewer weeks of stable flow through the river reach below Scott GS, but the weeks of stable flow in the river reach below Andrews GS increase from 14 to 16 weeks compared with the base case. Under a dry hydrology, there are 3 fewer weeks of stable flow through the river reach below Hollingsworth GS, and 3 fewer weeks of stable flow through the river reach below Scott GS, compared with the base case. There would be no change in weeks of stable flow through the river reach below Andrews GS under a dry hydrology, compared with the base case.

10.2.8.3 Social Considerations

Flood Management

There is no adverse effect on flood management capability as there is no change in maximum water levels for the reservoirs on the Michipicoten and Montreal River systems under average and wet hydrologies. Under a dry hydrology there is a +1.2 m increase in maximum water level on Hollingsworth, but it is still below the spring target level and therefore was not considered a flood management concern relative to the base case. Under average conditions the reduction in maximum flow is 19% less than the base case for Hollingsworth and 20% for Scott. There is virtually no change in maximum flow at Andrews on the Montreal system.

Tourism and Recreation

There are tourism/recreation improvements in the river reaches as a result of baseflow provisions throughout the Michipicoten and Montreal systems (see Table 10.2). Under an average hydrology, there are significant improvements in minimum flow releases during the May 15 to October 15 period on both the Michipicoten and Montreal River systems (see foldout sheets in Appendix M). However, these social benefits are offset by lower minimum water levels on Windermere Lake (-0.2 m), MacKay Reservoir (-0.6 m) and Andrews Reservoir (-0.5 m). Under a dry hydrology, there is a higher minimum water level on Hollingsworth Reservoir (+1.1 m). However, this is offset by a decrease in minimum water levels on Dog Lake (-0.5 m), Windermere Lake (-0.2 m), MacKay Reservoir (-0.6 m) and Andrews Reservoir (-0.5 m). Under a wet hydrology, there is a social benefit from a 0.4 m higher minimum water level on MacKay Reservoir during the May 15 to October 15 period, and a 0.2 m higher minimum water level on Hogg Reservoir. All of these changes occurred in the fall outside the peak summer recreation period.

Heritage

The Combination 8 strategy would have no adverse effect on the viewing of pictographs on Dog Lake.

Construction Employment

Combination 8 received a +11 rating for construction employment opportunities (see Table M-9), since both the Dunford (High Falls) Redevelopment project and McPhail Reservoir raise are included in this strategy.

10.2.8.4 Summary

In summary, Combination 8 ranks sixth in terms of on-peak power purchases, and operational flexibility. It ranks second in the ecological category (behind Combinations 4 and 6) because of the variety of ecological improvements on both the Michipicoten and Montreal systems. Note however that in the dry year there are problems maintaining minimum flows in the river reaches and minimum levels in some of the smaller reservoirs. There are also shorter periods of stable flow compared with several of the other strategies. Combination 8 ranks second in the social category (tied with Combinations 1 and 2). It includes both the Dunford (High Falls) and McPhail projects, and has better flows for recreation on the river reaches.

10.3 Ranking of Alternative Water Management Strategies

Table 10.1 provides rankings based on the power, ecological and social analysis. The rankings for power purchases and operational flexibility were established from Tables M-9, M-10 and M-11. From a power perspective, Combination 1 [the Dunford (High Falls) Redevelopment Project and McPhail Reservoir 1 m raise] is best.

The rankings shown in Table 10.1 for the ecological attributes were established on the basis of the overall ecological rating results summarized in Table M-9 (Appendix M) for each combination strategy. The rankings were determined by comparing the overall ecological rating result for each combination strategy relative to each other. The results in Table 10.1 indicate that Combinations 4 and 6 are best from an ecological perspective, although both of these combinations include ecological improvements on the Michipicoten system. Combination 8 ranked second ecologically and includes ecological improvements on both the Michipicoten and Montreal systems.

The rankings shown in Table 10.1 for the social attributes were derived in a similar manner to that described for the ecological attributes above. The results in Table 10.1 indicate that Combinations 5 and 6 are best from a social perspective, followed closely by Combinations 1, 2 and 8.

The next step involved adding the power, ecological and social rankings to develop a final ranking. The results are provided in Table 10.2 and indicate that Combination 6 ranks first. However, this strategy was not considered satisfactory because

- BP had concerns with the lower rating from a power perspective
- MNR had concerns because Combination 6 does not incorporate potential ecological improvements for the Montreal system.

Combinations 1 and 2 placed second overall. BP favored Combination 1 for the obvious economic and operational flexibility advantages, and offered some one-time ecological improvements to improve the overall ecology of the river system (e.g., habitat enhancement). However, MNR planning team members rejected Combinations 1 and 2 as ramping of flows below Scott GS was the only operational change on the Michipicoten River system, and there were no changes to the Montreal River system that would potentially improve conditions for the aquatic ecology and habitat. MNR planning team members favored Combination 8 (which ranked third) because it included provision for potential ecological improvements for both the Michipicoten and Montreal River systems. None of the other combination strategies investigated included provision for potential ecological improvements through operational changes for both the Michipicoten and Montreal River systems. The decision regarding a preferred water management strategy was then left to the Steering Committee since a consensus among planning team members could not be reached.

The Steering Committee subsequently directed the planning team to complete the water management plan for the Combination 8 strategy (Table 10.3). MNR's rationale was that it was the only strategy that included provision for potential ecological improvements through operational changes for both the Michipicoten and Montreal River systems. However, BP did not endorse the plan, particularly in view of

- the economic impact of the Combination 8 strategy on BP's operations
- recent power shortages in the province
- increasing power demand in Ontario
- the Ministry of Energy's focus on encouraging renewable energy (hydro and wind) projects to assist in meeting demand in the near future.

The Steering Committee also considered the above points in their subsequent discussions which focused on which component(s) of Combination 8 might be possible or modified to make them acceptable to both MNR and BP for the Michipicoten River system. Consensus was reached between MNR and BP, resulting in numerous operational changes compared with existing operations on the Michipicoten River system as noted in Table 10.3 and Table 11.1 (Section 11). Many components of Combination 8 were retained or only slightly modified for the Michipicoten system as listed in Table 10.3. The compromise reached by MNR/BP to improve conditions for the aquatic ecology included a 1-m reduced drawdown on Hollingsworth Reservoir, a spring surcharge of 15 cm on Hollingsworth Reservoir, an increase in the spring continuous baseflow out of Scott GS from 17 to 26.3 m^3/s, and a maximum drawdown on the secondary storage reservoirs of 0.51 m below the summer minimum. In addition, the compromise included a new fall drawdown limit on Hollingsworth Reservoir of 1 m below the summer minimum (October 1 to 25) for boat-based hunting activities.

Complete details of the new water management strategy for the Michipicoten River system, as agreed by the Steering Committee, are provided in Section 11.

The tradeoffs incurred by BP and MNR to achieve a new water management strategy were as follows:

- BP Tradeoff
  - BP will incur a loss of approximately 2700 MWh of average annual energy value to accommodate all of the ecological/social improvements agreed to between BP and MNR.

- MNR Tradeoff
  - MNR considered current renewable energy demands in Ontario, and compromised by dropping the requirement for a baseflow from Hollingsworth GS, and agreed to a less restrictive drawdown on Hollingsworth Reservoir than MNR would have desired.

Table 10.1 Ranking of Alternative Water Management Strategies by Indicator (also see Appendix M)									
Attribute	**Indicator**	**Strategy/Ranking Combinations**							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Power	On-peak Generation Purchase	1	2	4	5	7	3	6	4
	Operational flexibility	1	2	3	6	4	5	4	7
Power Summary	Total Ranked Score	2	4	7	11	11	8	10	11
	Rank	**1**	**2**	**3**	**6**	**6**	**4**	**5**	**6**
Ecology Aquatic and Riparian Ecology (Reservoirs)	Reservoirs Minimum Levels (permanently wetted area)	5	5	6	2	4	1	6	3
	Reservoirs Spring Levels (conditions for spawning nutrient cycling and other ecological functions)	5	5	4	1	3	1	2	2
Ecology Aquatic and Riparian Ecology (River Reaches)	Minimum Flow (permanently wetted areas)	4	4	4	1	3	1	2	1
	Spring Spill Releases (conditions for spawning, nutrient cycling)	1	1	1	1	1	1	1	1
	Stable Flows	3	3	1	3	2	4	2	4
	Ramping	2	1	1	1	2	1	2	2
Ecological Summary	**Total Ranked Score**	20	19	17	9	15	9	15	13
	Rank	**6**	**5**	**4**	**1**	**3**	**1**	**3**	**2**
Social Flood	Reservoirs (Maximum levels)	1	1	1	1	1	1	1	1
	River Reaches (Maximum flows)	2	2	2	3	1	3	2	3
Tourism/ Recreation	Reservoir Levels (Minimum) (May 15 - Oct 15)	4	4	5	3	1	2	4	6
	River Reaches (Minimum flows - May 15 - Oct 15)	4	4	4	2	3	2	3	1
Employment Benefits	Construction Employment Opportunities	1	1	3	4	4	2	4	1
Heritage Sites	Pictographs (Dog Lake)	1	1	1	1	1	1	1	1
Social Summary	**Total Ranked Score**	13	13	16	14	11	11	15	13
	Rank	**2**	**2**	**5**	**3**	**1**	**1**	**4**	**2**

Table 10.2
Summary Ranking of Alternative Water Management Strategies by Attribute (Equal Weighting)

Attribute	Combinations							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Power	1	2	3	6	6	4	5	6
Ecology	6	5	4	1	3	1	3	2
Social	2	2	5	3	1	1	4	2
Total	9	9	12	10	10	6	12	10
Rank	**2**	**2**	**4**	**3**	**3**	**1**	**4**	**3**

Table 10.3 Comparison of Combination 8 With Modified Option 8 Agreed to By Steering Committee		
	Combination 8	**Modified Combination 8 Agreed by Steering Committee**
Secondary storage reservoirs	• Reduced winter drawdown corresponding to 0.51 m below existing summer minimum water level	Same as Combination 8
	• Anjigami lake FSL restricted to 288.8 m (from 289.56 m) to better reflect operations in recent years.	Same as Combination 8
Hollingsworth Reservoir	• Spring and fall surcharge of 15 cm above normal FSL of 312.42 m	• Spring surcharge only of 15 cm above normal FSL • Except during dry periods, trending water level upward between May 15 and June 1 if below summer maximum drawdown level noted below, to address fish spawning considerations. • New fall water level constraint involving maximum drawdown level to 309.36 m (October 1 to October 25) for boat-based hunting activities. (NB – Cannot be same drawdown as box below for Sept 30)
	• 1.85-m maximum drawdown level to 310.57 m (from FSL of 312.42 m) from May 15 to October 15	• 2.06-m maximum summer drawdown to 310.36 m (from FSL of 312.42) June 1 to September 30 except in dry periods
	• 7.85-m maximum drawdown over rest of year to 304.57 m (from FSL of 312.42 m)	• Maximum 8.14-m drawdown over rest of year to 304.28 m (from FSL of 312.42 m)
	• Minimum continuous baseflow of 15 m^3/s year round	• No continuous baseflow

Table 10.3
Comparison of Combination 8 With Modified Option 8 Agreed to By Steering Committee

	Combination 8	Modified Combination 8 Agreed by Steering Committee
McPhail Reservoir	• 1 m raise of McPhail Reservoir (subject to LRIA approval)	Same as Combination 8
	• Maximum drawdown of 0.3 m	• Maximum drawdown of 0.5 m
Dunford (High Falls Reservoir)	• Redevelopment in place	Same as Combination 8
	• 0.5-m raise of Dunford Reservoir (subject to LRIA approval)	Same as Combination 8
	• Maximum drawdown of 0.3 m	Same as Combination 8
Scott Reservoir	• Minimum continuous baseflow of 28 m^3/s year round	• Minimum continuous baseflow of 17 m^3/s (as existing), + 26.3 m^3/s (80% exceedance flows) April 15 to June 15 for spring spawning fish)
	• Ramping constraints removal pending results of Magpie study	• No ramping constraints

11 Approved Water Management Strategy and Operating Plans for Waterpower Facilities on the Michipicoten River System

11 Approved Water Management Strategy and Operating Plans for Waterpower Facilities on the Michipicoten River System

11.1 Key Features

The focus of the Steering Committee in developing a new water management strategy was on system operational changes that would

- improve conditions for the aquatic ecology
- enable BP to continue their power operations with a reasonable return on investment
- not adversely affect water levels for recreational users.

The key features of the approved water management strategy for the Michipicoten River system that differ from the previous water management strategy are noted below (also see Table 11.1).

Secondary Storage Reservoirs

- Reduced winter drawdown corresponding to 0.51 m below existing summer minimum level for all secondary storage reservoirs. The rationale for this change is that it would provide additional aquatic habitat with year-round coverage.

- Anjigami Lake FSL restricted to 288.8 m (from 289.56 m) to better reflect actual operations in recent years, and to make the existing BP/McDonald Forest Products voluntary agreement align more closely with present operations

Hollingsworth Reservoir

- Spring surcharge of 15 cm above normal FSL of 312.42 m by May 15 to provide for some aquatic habitat function in flooded riparian areas when natural inflows available.

- Except during dry periods, trending water level upwards between May 15 and June 1 if below summer maximum drawdown level noted below.

- Maximum 2.06-m summer drawdown level to 310.36 m (from FSL of 312.42 m) from June 1 to September 30 except in dry periods. This reduces the present maximum drawdown by 1 m during the summer months which potentially improves conditions for aquatic habitat and recreation.

- Except during dry periods, maximum drawdown level in fall to 309.36 (October 1 to October 25 for boat-based hunting activities).

- Maximum 8.14-m drawdown over rest of year to 304.28 m (from FSL of 312.42 m). This reduces the present maximum drawdown by 1 m which potentially improves conditions for aquatic habitat by ensuring that this 1 m of depth is permanently wetted.

McPhail Reservoir

- 1-m raise of McPhail Reservoir (subject to LRIA approval). Modifications to McPhail GS operations are proposed to improve power production opportunities and to balance the river system flow, given the new Dunford (High Falls) Redevelopment Project.

- Maximum drawdown of 0.5 m to protect the aquatic ecosystem.

Dunford (High Falls) Reservoir

- Power plant redevelopment in place

- 0.5-m raise of reservoir to improve power production opportunities and balance the river system flow (subject to LRIA approval).

- Maximum drawdown of 0.3 m to protect the aquatic ecosystem.

Scott Generating Station

- Minimum continuous baseflow of 17 m^3/s except in dry periods when the flows may be reduced, except as noted below.

- Seasonal baseflow of 26.3 m^3/s (80% exceedance flows) April 15 to June 15. The increased baseflow provides potential for improved aquatic ecology productivity through improved habitat conditions, and also improves conditions for recreational boating.

Where it is not possible to provide both baseflow and maintain water levels in reservoirs, the latter shall take precedence. Relaxation of baseflow will take place in accordance with the dry year criteria specified in Section 13.2 of this WMP.

This approved water management strategy has no effect on established legal flood limits (or dam safety limitations). If this were not the case, it would require LRIA Section 16 approval on EA, and amendments to tenure documents.

11.2 Operating Plans for Each Waterpower Facility

The approved operating plans for each waterpower facility on the Michipicoten River set forth by this plan are contrasted with the previous operating plan in Table 11.1. Where changes in water levels or flows have been approved, they are highlighted in this table. The approved plan requirements are restated in Section 13, Table 13.1 and shown graphically in Figures 13.1 to 13.4. Additional details are provided in Table 11.2.

11.3 How the Approved Water Management Plan Meets the Objectives

The objectives identified in Section 1 of this WMP were considered in developing alternative water management strategies. The water management strategy described in Section 11.1 was then assessed in terms of the specific water management objectives identified in Section 1.3, and the results are presented in Table 11.3.

All of the objectives were achieved at least to some degree.

11.4 How the Approved Water Management Plan Addresses the Issues

Prior to implementing any change in the existing operation strategy for the Michipicoten River system, consideration was given to how the new strategy would address the issues presented in Section 5 by BP, MNR and public stakeholders. The results are summarized in Table 11.4.

This WMP focused on a new water management strategy that would potentially improve conditions for the aquatic ecology while sustaining other multiuse objectives for the river system (i.e., hydropower operations, flood management and recreation/tourism). As such, this plan was not an exercise to determine the environmental effects of existing operations but will use existing operations as a baseline in determining the effects of a new water management strategy.

Table 11.1 Pre-Existing and Approved Water Levels and Flows						
					Flow Release - Powerhouse	
Generating Station	Water Level	Pre-Existing Operating Plan (m)	Approved WMP (m)	Flow	Pre-Existing (m^3/s)	Approved (m^3/s)
Primary Storage Reservoirs						
Hollingsworth	Absolute Maximum Level Maximum Operating Level Full Supply Level Spring Surcharge Summer Minimum Level* Fall Minimum Level (Oct 1 to Oct 25) Maximum Drawdown Level*	313.56 313.33 312.42 - 309.36 - 303.28	313.56 313.33 312.42 312.57 310.36 309.36 304.28	Maximum	91.7	91.7
McPhail**	Absolute Maximum Level Maximum Operating Level Full Supply Level Maximum Drawdown Level*	278.13 277.37 276.46 274.92	278.46 277.80 277.46 276.96	Maximum	105	109
Dunford*** (High Falls)	Absolute Maximum Level Maximum Operating Level Full Supply Level Maximum Drawdown Level*	263.05 263.04 262.28 260.00	263.55 263.50 262.78 262.48	Maximum	112.5	112.5
Scott	Absolute Maximum Level Maximum Operating Level Full Supply Level Maximum Drawdown Level*	217.63 217.32 216.87 207.87	217.63 217.32 216.87 207.87	Maximum Minimum*	112.5 17.0	112.5 17.0 continuous 26.3 April 15 to June 15
Secondary Storage Reservoirs						
Wabatongushi	Absolute Maximum Level Maximum Operating Level Full Supply Level Summer Maximum Level Summer Minimum Level Maximum Drawdown Level*	348.30 348.30 348.09 347.90 347.48 346.41	348.30 348.30 348.09 347.90 347.48 346.97			
Dog	Absolute Maximum Level Maximum Operating Level Full Supply Level Summer Maximum Level Summer Minimum Level Maximum Drawdown Level*	330.70 330.70 330.41 330.32 329.89 329.34	330.70 330.70 330.41 330.32 329.89 329.38			
Windermere	Absolute Maximum Level Maximum Operating Level Full Supply Level Summer Maximum Level Summer Minimum Level Maximum Drawdown Level*	428.70 428.70 428.25 427.58 427.21 426.42	428.70 428.70 428.25 427.58 427.21 426.70			

Table 11.1
Pre-Existing and Approved
Water Levels and Flows

Generating Station	Water Level	Pre-Existing Operating Plan (m)	Approved WMP (m)
Anjigami	Absolute Maximum Level	290.15	290.15
	Maximum Operating Level	290.15	290.15
	Full Supply Level	289.56	288.80
	Summer Maximum Level	288.37	288.37
	Summer Minimum Level	288.04	288.04
	Maximum Drawdown Level*	287.27	287.53

Notes:

(a) Metric levels have been calculated from Imperial equivalents based on a conversion factor of 1m = 3.2808 ft.
(b) Shaded numbers indicate a proposed change in water level/flow from existing conditions.
(c) Stop logs will be adjusted according to inflows to meet seasonal water level targets.

* Except during dry period as defined in Section 13.2.
** New McPhail levels will only apply in the event of LRIA approval of a proposed 1 m raise of the reservoir. If the raise does not proceed for any reason, existing levels remain with the exception of the maximum drawdown level, which becomes 275.96 m (0.5 m below FSL).
*** New Dunford levels only apply in the event of LRIA approval of a proposed 0.5 m raise of the reservoir. If the raise does not proceed for any reason, existing levels remain with the exception of the maximum drawdown level which becomes 261.98 m (0.3 m below FSL).

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Table 11.2
Additional Details - Water Management Plan
Michipicoten River

Generating Station/ Storage Reservoirs	No. of Unit/ No. of Outlet Works[1]	Gross Head (m)	Operating Capacity[2] (MW)	Rated Power Flow[3] (m^3/s)	Normal Operating Range Elevation (m), (Range, m)	Flood Surcharge Zone Elevation (m), (Range, m)	Absolute Range Elevation (m), (Range, m)	Flow Releases – Powerhouse		Operating Constraints Legal Requirements	Operating Constraints Recreation/Tourism, Aquatic Ecology and Cultural/Heritage Commitments (Except in Dry Periods)
								Maximum (m^3/s)	Minimum (m^3/s)		
Hollingsworth GS and reservoir	1	20.7-34.4	17 – 23.2	85	304.28 – 312.42 (8.14) Summer - 310.36 – 312.42 (2.06)	312.42 – 313.33 (0.91)	298.70 – 313.56 (14.86)	91.7	0[4]	Maximum Operating Level as established by water power lease – 313.34 m	**Recreation/Tourism** Maximum fall drawdown to 309.36 (October 1 to October 25) for boat-based hunting activities **Aquatic Ecology** Spring surcharge target of 15 cm above normal FSL by May 15 when inflows available Trending water level upwards between May 15 and June 1 if below summer maximum drawdown level Maximum summer drawdown to 310.36 m (June 1 to September 30) except in dry periods Maximum winter drawdown limit to 304.28 m
McPhail GS and reservoir	2	13.0 -14.0 w/o 1 m raise 14.0 – 15.0 with 1 m raise	2.0 – 12.8 2.0 – 12.8	93 93	275.96 – 276.46 (0.5) 276.96` – 277.46 (0.5)	276.46 – 277.37 (0.91) 277.46 – 278.37 (0.91)	274.92 – 278.13 (3.21) 274.92 – 278.46 (3.54)	109 109			
Dunford (High Falls) GS and reservoir	2	45.1 – 45.4 w/o 0.5 m raise 45.6 – 45.9 with 0.5 m raise	7.0 – 45.0 7.0 – 45.0	93 93	261.98 – 262.28 (0.3) 262.48 – 262.78 (0.3)	262.28 – 263.04 (0.76) 262.78 – 263.54 (0.76)	260.0 – 263.05 (3.05) 260.0 – 263.55 (3.55)	112.5 112.5			
Scott GS and reservoir	2	23.2 – 23.6	3.3 – 22.5	93	216.42 - 216.87 (0.45)[5]	216.87 – 217.32 (0.45)	207.87 – 217.63 (9.76)	112.5	17		**Aquatic Ecology** Minimum continuous base flow of 17 m^3/s through Scott GS. Minimum seasonal base flow of 26.3 m^3/s, April 15 to June 15
Wabatongushi Lake	2				Winter: 346.97 – 348.09 (1.12) Summer: 347.48 – 347.90 (0.42)	348.09 – 348.3 (0.21)	345.04 – 348.3 (0.26)			Maximum Flood Level 348.09 m, stable or rising water levels May 10 to June 25	**Recreation/Tourism** Summer minimum and maximum lake levels 347.48 – 347.90 m for boating, camp access, tourism and fishing (June 1 to September 30) **Aquatic Ecology** Stop logs replaced around May 1 to ensure lake levels stable or rising May 1 to June 15 through fish spawning, incubation and rearing period, (operational target levels are 347.63 m by May 15 and 347.90 m by May 25 when inflows available) Winter minimum level of 346.97 m
Dog Lake	3				Winter: 329.38 – 330.41 (1.03) Summer: 329.89 – 330.32 (0.43)	330.41 – 330.7 (0.29)	328.46 – 330.7 (2.24)			Maximum Flood Level 330.41 m, as established by a Licence of Occupation	**Recreation/Tourism** Summer minimum and maximum lake levels 329.89 – 330.32 m for boating and camp access, tourism, fishing and hunting (June 1 to September 30) **Aquatic Ecology** Water level target of 330.32 m to be reached by May 25 for fish spawning, incubation and rearing period when inflows available Winter minimum level of 329.38 m **Cultural/Heritage** Maximum reservoir level of 330.32 m (June 1 to September 30) to enable observation of pictographs

[1] Outlet works are devices to control the flow of water at intakes, outlets and over control structures
[2] Normal range of generating capacity
[3] Rated station flow at design head
[4] Flow of approximately 3 m^3/s estimated by BP when the unit is shut off at Hollingsworth GS.
[5] Based on historical average weekly water levels.

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Table 11.2 Additional Details - Water Management Plan Michipicoten River											
Generating Station/ Storage Reservoirs	No. of Unit/ No. of Outlet Works[1]	Gross Head (m)	Operating Capacity[2] (MW)	Rated Power Flow[3] (m^3/s)	Normal Operating Range Elevation (m), (Range, m)	Flood Surcharge Zone Elevation (m), (Range, m)	Absolute Range Elevation (m), (Range, m)	Flow Releases – Powerhouse		Operating Constraints Legal Requirements	Operating Constraints Recreation/Tourism, Aquatic Ecology and Cultural/Heritage Commitments (Except in Dry Periods)
								Maximum (m^3/s)	Minimum (m^3/s)		
Windermere Lake	3				Winter: 426.70 – 428.25 (1.55) Summer 427.21 – 427.96 (0.37)	428.25 – 428.70 (0.45)	425.60 – 428.70 (3.10)			Maximum Flood Level 428.25 m, as established by a Licence of Occupation	**Recreation/Tourism** Summer minimum and maximum lake levels 427.21 – 427.58 m for boating, camp access, tourism and fishing (June 1 to September 30) **Aquatic Ecology** Water level target of 427.58 m to be reached by May 31 for fish spawning, incubation and rearing period when inflows available Winter minimum level of 426.70 m
Anjigami Lake	2				Winter: 287.53 – 288.80 (1.27) Summer: 288.04 – 288.37 (0.33)	288.8 – 290.15 (1.35)	285.91 – 290.15 (4.24)			Maximum Flood Level 289.56 m, as established by water power lease agreement	**Recreation/Tourism** Summer minimum and maximum lake levels 288.04 – 288.37 m for boating, camp access, tourism and fishing (June 1 to September 30) **Aquatic Ecology** Water level target of 287.73 m to be reached by May 16 for fish spawning, incubation and rearing period (operational target is 288.37m by May 30) when inflows available Winter minimum level of 287.53 m

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Table 11.3 The Approved Water Management Plan and Achievement of Objectives		
Objective	**Achieved?**	**Comments**
BP Objectives		
Optimize hydro power production in an environmentally responsible manner, primarily during peak demand periods	Partially	Average annual energy losses of 2700 MWh to address additional MNR requests to improve river and reservoir ecology and habitat (compared with base case)
Provide flood control to minimize damage and to protect human life	Yes	Existing high level of flood management sustained
Enable ecological processes to co-exist with hydroelectric operations on the Michipicoten system.	Yes	Further restrictions on reservoir levels and flows to support MNR's ecological management objectives
Enable tourism and recreational activities to continue to co-exist with hydroelectric operations on the Michipicoten system	Yes	Improved recreational navigation conditions on Hollingsworth Reservoir due to increased constraints on water levels; also improved boating conditions downstream of Scott GS due to seasonal baseflow of 26.3 m^3/s from April 15 to June 15
MNR Objectives		
To provide opportunities for the multiple use of the water for - power production - flood control - sport fishing - wildlife viewing and harvesting - tourism, recreation, and cultural heritage activities	Partially	Multiple use of the water resource sustained, with more balanced focus.
MNR/DFO Objective		
Maintain and improve, where possible, conditions for the aquatic ecology on the Michipicoten River system	Partially	Numerous changes to operations (water levels and flow) to improve conditions for the aquatic ecology as defined in Section 11.1.

Table 11.4
How the Approved Water
Management Strategy Addresses the Issues

Stake-holder	Issue	Issue Resolution
BP	**Economic** Risk of jeopardizing economic viability of hydroelectric operations	Economic viability still sustainable
	Risk of losing flexibility of hydroelectric operations in a deregulated market	Some loss of flexibility will be experienced to accommodate MNR's request for ecological improvements
	High cost of water management plan and monitoring	Approximately $1 million for plan preparation and monitoring programs
	Economic impact of new water management plan implementation	Average annual energy losses of 2700 MWh to address additional MNR requests to improve river and reservoir ecology and habitat (compared with base case, which already includes ecological constraints)
	Loss of BP revenues to provide seasonal baseflow of 26.3 m^3/s below Scott GS April 15 to June 15	Included in above
	Management for ecosystem objectives may impact on the economic sustainability of hydropower production on the Michipicoten River	Economic viability of BP's Michipicoten River hydroelectric operations still sustainable, but with significant energy losses as noted above
	Socioeconomic The risk of adversely affecting hydropower benefits to government agencies, local communities, and local industries	Hydropower services sustained except during peak demand periods when additional power purchases will be required
	Operations The risk of losing flexibility in operating rule curves to meet other water demands, jeopardizing BP's ability to meet power demands	Some loss of flexibility will be experienced to accommodate MNR's request for changes in water levels and flows to improve conditions for aquatic ecology and habitat
	The risk of losing flexibility in varying flow releases (depending on water availability and power demands) to accommodate other water demands	BP has already lost some flexibility by providing a voluntary baseflow of 17 m^3/s 24 h/day below Scott Falls. Additional flexibility will be lost to provide seasonal baseflow of 26.3 m^3/s below Scott GS

Table 11.4
How the Approved Water Management Strategy Addresses the Issues

Stake-holder	Issue	Issue Resolution
BP (cont'd)	The need to improve public and agency understanding of how and why the river is managed for water power operations	Improving through ongoing public and agency consultation as part of the water management planning process
	Public Safety/Flood Management The potential to affect public safety and emergency response capability	No change in present high level of public safety and emergency response capability
	The risk of losing some flood management capability	No change in present high level of flood management capability
	Environmental The difficulty of balancing hydroelectric operations with competing water demands	BP will accommodate competing water demands but more on-peak power purchases will be required
Public	**Environmental** Concern that fluctuating water levels on Wabatongushi Lake may have an adverse effect on fish spawning and fish populations	MNR advises that fisheries in the upper (secondary) storage reservoirs are better in recent years, possibly due to MNR management initiatives (fish sanctuary, slot size). New water management plan includes reduced winter drawdown corresponding to 0.51 m below existing summer minimum level
	The effects of water level fluctuations on loon nesting sites and beaver populations in the Dog/Wabatongushi Lakes area.	Reduced winter drawdown corresponding to 0.51 m below existing summer minimum level for all secondary storage reservoirs.
	Desire for an increase in minimum flows below Scott Falls to improve downstream areas for fish and aquatic habitat	Increase in minimum baseflow below Scott GS from 17 to 26.3 m^3/s April 15 to June 15 to provide potential for improved aquatic ecology productivity
	Desire for fish hatchery to enhance fishery and tourism	MNR/DFO have a preference for enhancement of existing natural habitat before considering artificial means of reproduction

Table 11.4
How the Approved Water Management Strategy Addresses the Issues

Stake-holder	Issue	Issue Resolution
Public (cont'd)	Effects of introducing non-native fisheries (e.g., chinook and pink salmon) in lower river	The historical effects of introducing non-native fisheries to the lower Michipicoten River are beyond the scope of the WMP
	Social Flooding on Dog Lake during 1980 and 1996 and the effects on the cottage community	These were natural flood events which were attenuated, at least to some degree, by BP's reservoir operations. Water levels on Dog Lake are lowered during the winter months for water power and to accommodate spring flood conditions
	Alleged damage to outboard motors from the effects of low water levels in the Fifty-Seven Bay area of Dog Lake	During the summer of 1999 GLPL and MNR investigated navigation through this area and found that it is possible if boaters use caution. Boaters must take responsibility for using caution in the Fifty-Seven Bay area
	The effects of Dog Lake drawdowns on wells (school and residential) in the Town of Missanabie	Partially resolved through reduced drawdown on upper storage reservoirs. To be brought forward in next planning cycle.
	Stabilization of water levels throughout the Michipicoten system, including the Windermere Lakes area for recreation (cottaging, sport fishing, boating)	BP maintains summer water levels for recreation in Hollingsworth Reservoir and all secondary storage reservoirs, including Windermere Lake area. Reduced drawdown proposed for Hollingsworth Reservoir (see Section 11.1).
	The interference to navigation caused by sand bars in the lower Michipicoten River in the vicinity of the marina and at the confluence of the Magpie/Michipicoten River.	Township has improved channel for navigation in vicinity of marina. Sandbars are a natural occurrence and beyond scope of WMP.

Table 11.4
How the Approved Water Management Strategy Addresses the Issues

Stake-holder	Issue	Issue Resolution
Public (cont'd)	Observed decline in sport fishing on Wabatongushi Lake	MNR advises that fisheries in the upper (secondary) storage reservoirs are better in recent years, possibly due to MNR management initiatives (fish sanctuary, slot size). New water management plan includes reduced winter drawdown corresponding to 0.51 m below existing summer minimum level.
	Narrow boat access between Manitowik and Whitefish lakes	1-m reduced drawdown will improve access and reduce safety hazard. Marker buoys will be installed by BP in vicinity of stones. Also BP is planning to remove the piers associated with the stop-log gains in 2007 to widen the boat channel. The earthen structures will remain to provide refuge habitat for fisheries.
	Maintenance of safe access around dams (for portage trails, snowmobile trails)	No change in present situation
	Heritage Effect of the water management plan on Indian pictographs in the Dog Lake area	The proposed water management strategy will have no effect on the Indian pictographs since there will be no increase in present water levels on this lake. Pictographs would only be covered if water levels exceed 330.32 m which may occur naturally in a wet year.
MNR	Other heritage sites	Ontario Parks strongly recommends an assessment of the potential effects of water management and along the banks of the lower Michipicoten River (Michipicoten Post PP) before the next WMP.
	The effects of winter drawdowns (secondary storage reservoirs and Hollingsworth Reservoir) on littoral zone productivity and fall spawners	Reduced winter drawdowns are proposed for secondary storage reservoirs and Hollingsworth Reservoir (see Section 11.1) to partially resolve issue.

Table 11.4 How the Approved Water Management Strategy Addresses the Issues		
Stake-holder	**Issue**	**Issue Resolution**
MNR (cont'd)	Mercury levels in all reservoirs	Mercury in fish was monitored during MNR FWIN activities and results are reported in Section 5.2.1.12
	The effects on navigation and fisheries of the submerged dam between Manitowik and Whitefish Lakes (Hollingsworth Reservoir)	1-m reduced drawdown will improve access and reduce safety hazard. Marker buoys will be installed by BP in vicinity of stones. Also BP is planning to remove the piers associated with the stop-log gains in 2007 to widen the boat channel. The earthen structures will remain to provide refuge habitat for fisheries.
	Shikwamkwa Dam (sluiceway) - condition of structure	This is an old timber crib structure that resides on Crown land and is not BP's responsibility. It is beyond the scope of the WMP.
	Maintenance drawdowns on Scott, Dunford (High Falls) and McPhail Reservoirs (timing and effect on fisheries)	BP installed a permanent bulkhead mechanism in front of the dam during construction of the Dunford (High Falls) Redevelopment Project to allow maintenance work to be done without dewatering the entire reservoir. Portable deployable bulkheads are used at other sites. BP will notify MNR prior to maintenance drawdowns and request LRIA approval for any repairs requiring dewatering beyond operational limits set forth in the WMP.
	Daily reservoir fluctuations (range/rate) and effects on littoral zone	No change in present operations. To be brought forward in next WMP.

Table 11.4 How the Approved Water Management Strategy Addresses the Issues		
Stake-holder	**Issue**	**Issue Resolution**
MNR (cont'd)	Effects of Scott, Dunford (High Falls) and McPhail reservoir operations on spawning habitat (inflowing stream, riffle, head-pond raising)	Baseline information on spawning habitat and riffle locations has been collected for Dunford (High Falls) and McPhail Reservoirs in order to assess the effect of (and mitigate) a change in strategy from the status quo. No change in present operations of the Scott Reservoir are proposed.
	Backflooding of riffle habitat upstream of McPhail Reservoir to Hollingsworth GS as a result of the proposed McPhail Reservoir raise	Habitat mitigation/compensation addressed during an environmental assessment for the proposed McPhail Reservoir raise (Acres, 1997) and during subsequent environmental investigations in 1999 in support of DFO and MNR approvals.
	Effect of reservoir level changes (Anjigami and Windermere Lakes) on recreational resources.	Change from voluntary to legal constraint on drawdowns will improve on current situation.
	Effect of water management as a potential contributor to the exposure of cultural heritage resources on Windermere Lake.	MNR Ontario Parks and BP will jointly examine the potential impact to the burial site prior to the next WMP cycle. MNR and BP will meet prior to the end of the second year of the approved WMP to finalize the scope of the study and jointly determine the next steps.
	Effect of changing water levels on erosion within Shoals Provincial Park	MNR and BP will meet prior to the end of the second year of the approved WMP to finalize the scope of the study and jointly determine the next steps.
	The effects of existing flows (minimum/maximum, seasonal/ daily) below Scott Falls on fisheries	Existing minimum baseflow below Scott GS of 17 m^3/s will be maintained. In addition, a seasonal continuous baseflow of 26.3 m^3/s (80% exceedance flow) will be provided from April 15 to June 15 to partially resolve issue.

Table 11.4 How the Approved Water Management Strategy Addresses the Issues		
Stake-holder	**Issue**	**Issue Resolution**
MNR (cont'd)	Lack of baseflow below Hollingsworth GS for the aquatic ecology.	Unresolved in this WMP. To be brought forward in next WMP.
	Effect of flow changes on Michipicoten Post Provincial Park and South Michipicoten – Superior Shoreline Conservation Reserve	The additional spring seasonal continuous baseflow is not anticipated to exacerbate existing erosion processes as higher spring flow volumes are currently (and have historically been) experienced in this stretch of river
	The scouring of fines in the river reach below Scott Falls and the need for replacement material	Not a priority at this time.
	Channelization of the river reach below Scott Falls	Not a priority at this time.
First Nations	Traditional values database (not formally defined by FN as an issue)	MNR will provide ongoing assistance to local FN with their traditional values database as part of forest management planning and water management planning.

12 Effectiveness Monitoring Program

12 Effectiveness Monitoring Program

The Water Management Guidelines for Waterpower indicate that Effectiveness Monitoring (EM) is required to evaluate changes implemented through the WMP process. EM is not only applicable to ecological values, but also to social and economic values. If an operating regime for a waterbody is changed, an EM program is specifically designed to evaluate the introduced change. If no changes are made to a particular operating regime, an EM program is not required for the waterbody regulated or affected by that operating regime.

This EM program has been developed to assess whether operational changes are effective in meeting the ecological and socioeconomic objectives of this WMP. Biological indicators will be used to measure the effectiveness of alterations to water levels. Socioeconomic feedback will be primarily from the public, the proponents, riparian landowners, cottage associations and First Nations (also see Sections 12.2 and 13.6). The results of the EM program will be evaluated on an ongoing basis by a Standing Advisory Committee (SAC) and will be used to justify any adaptive management that may be agreed upon by BP/MNR/DFO during this or subsequent WMP cycles.

12.1 Aquatic Ecology/Habitat

EM for the WMP will be shared by MNR and BP and will focus on the following areas:

Secondary Storage Reservoirs
(EM using one of the reservoirs as the representative lake for Secondary Storage Reservoirs)
Objective: Provide additional aquatic habitat and improved conditions for aquatic ecology through a reduced drawdown limit on secondary storage reservoirs, thereby improving conditions for the aquatic ecology, specifically walleye and lake trout.

Through a review of historical operating ranges on the secondary storage reservoirs, it was determined that they have all been operated mostly within the new legal drawdown limits. For this reason, effectiveness monitoring cannot be practically applied to these reservoirs.

As an alternative, it is recommended that the following activities be undertaken to gather additional baseline information on the secondary storage reservoirs for the next WMP cycle.

- A FWIN survey by Laurentian University/MNR on Anjigami Lake between Years 5 and 10 after plan implementation to compare with the previous baseline FWIN undertaken (Figure 5.6), since this is the secondary storage of most concern regarding the aquatic ecology. This reservoir has a considerably higher concentration of camps compared to other upper reservoirs on the Michipicoten system (see Table 3.4). Fish tissue samples will be taken from walleye and northern pike to compare with previous baseline data collected (see Section 5.2.1.12). In the event that MNR budgets are available, additional index netting surveys will be carried out as follows to compare with previous baseline data:

  - Dog Lake (FWIN and SPIN), or
  - Anjigami Lake (SPIN), and
  - Windermere Lake (NORDIC netting survey).

It is recommended that Laurentian University and MNR (Wawa) address the FWIN sampling design with MNR Regional Biologists prior to conducting FWINs on the Michipicoten system to factor in extraneous factors such as altered fishing pressure.

Hollingsworth Reservoir (1-m reduced drawdown)
Objective: Provide additional aquatic habitat through a 1-m reduced drawdown thereby improving conditions for the aquatic ecology, specifically walleye and lake trout.

- FWIN survey between Years 5 and 10 after plan implementation on Whitefish Lake by Laurentian University/MNR to compare with 2000 baseline data. Fish tissue samples will be taken from walleye and northern pike to compare with baseline data collected (see Section 5.2.1.12).

- SPIN survey between Years 5 and 10 after plan implementation for lake trout on Manitowik Lake by Laurentian University/MNR to compare with 2001 baseline data.

McPhail Reservoir (1-m raise)
Objective: Assess whether a 1-m raise has an adverse effect on existing aquatic ecology and habitat.

- A FWIN survey by Laurentian University/MNR between Years 5 and 10 after plan implementation (and after the reservoir raise) to compare with the baseline FWIN survey undertaken in 2000.

- Shoreline habitat mapping during the summer between Years 5 and 10 after plan implementation (and after the 1-m reservoir raise) for comparison with 2003/2004 baseline data. Field work will be done jointly by BP's consultant and MNR. GIS mapping will be done as agreed between MNR and BP.

In addition to the above monitoring for the WMP, a separate effects monitoring program is outlined in the environmental assessment document (Acres 1997) and DFO authorization for the 1-m raise of McPhail reservoir, including fish tissue mercury monitoring in Years 1 and 5 after reservoir raising to compare with 2000 baseline data. This work will be done by BP's environmental consultant. This work also includes assessing changes to wetlands, walleye spawning habitat and invertebrate production habitat.

Dunford (High Falls) Reservoir (0.5-m Raise)
Objective: Assess whether a 0.5-m raise has an adverse effect on existing aquatic ecology and habitat.

No specific effects monitoring is proposed for this reservoir as part of the WMP, since it is already covered by the effects monitoring program outlined in the environmental assessment document (Acres, 1997) and DFO authorization for the 0.5-m raise of High Falls reservoir. This work will be done by BP's environmental consultant.

Below Scott GS
Objective: Increase minimum flow from 17 m^3/s to 26.3 m^3/s during the period April 15 to June 15.

BP and MNR will jointly monitor the April 15 to June 15 increased flow in the first year of plan implementation to determine whether the duration of the increased flow period is adequate to prevent drying of spawning redds and stranding of alevins. The need for 1 or 2 years of additional monitoring will be determined based on the results of the first year of monitoring.

12.2 Socioeconomic Monitoring

No specific socioeconomic monitoring program is proposed for this WMP. Economic concerns of BP that arise will be expressed at any time to MNR. Social or other concerns may be provided at any time by First Nations, the public, riparian landowners, or cottage associations, or other interested parties, to MNR. All written correspondence will be kept on file by BP and MNR and made available for review by the SAC.

12.3 Science Needs to Determine Ecological Value of Reduced Drawdowns

It was recognized by the planning team that more science is needed to determine the true ecological value of a 1-m reduced drawdown on Hollingsworth Reservoir. A multiyear research experiment (outside the EM program noted above) is needed using a control lake to determine the effects of a 1-m reduced drawdown in the summer and winter months. Discussions will be held by MNR (Wawa) with MNR's Watershed Science Group to determine the possibility of initiating such a reservoir experiment prior to the next WMP cycle. If so, BP would be interested in participating with MNR and other stakeholders in the experiment.

12.4 Windermere Lake Cultural Heritage Site Protection

Shoals Provincial Park Superintendent with input from the Brunswick House First Nation, Zone Ecologist, Regional Engineer, and Ministry of Culture Archaeologist, and support from BP, will commission a study to determine the effect of Windermere Lake water level fluctuations on erosion of an identified burial site (Borden # Clhw-5). This will be achieved through a study design which will examine

- historical water levels relative to approved water levels
- if and/or how the approved water level regime affects the burial site
- other factors associated with erosion on the site, e.g., wind-wave action, and ice.

A report will be submitted containing an analysis of impacts and present options for mitigation to protect the burial site. A "do nothing" approach is one potential recommendation. If a study conclusion recommends relocating human remains and/or artifacts, advice will be sought from Brunswick House First Nation, an archaeologist and/or the Ministry of Culture. Ontario Parks and BP will meet prior to the end of the second year of the approved Water Management Plan (April 2, 2009) to finalize the scope of the study and jointly determine the next steps.

13 Compliance Monitoring and Reporting Programs

13 Compliance Monitoring and Reporting Programs

Subsection 23.1(7) of the LRIA requires that facility operators operate their facilities in accordance with an approved plan. Guiding principles related to assessing compliance with the plans are listed below as outlined by MNR in their WMP guidelines (Appendix J):

- compliance with the law is an obligation borne by everyone
- noncompliance with standards or legislation in the name of economics or convenience is never acceptable
- dam owners and/or operators will self-monitor and report to MNR
- communication is the first step in problem identification and resolution
- while monitoring and enforcement activities will apply to all mandatory components contained in each WMP, industry monitoring and MNR inspection and audit activities will focus on the water flow and levels components specified in the approved WMPs
- compliance and enforcement actions will be administered in a fair and equitable manner
- enforcement action and penalties (to the extent that MNR can recommend to the court) will be applied in a manner that considers conclusions made after a review of the nature of the infraction, the impact or potential impact of the infraction and the historic performance of the owner/operator
- planning is an iterative process and the operating plans may change through adaptive management or as additional information becomes available to support amendments to the WMP
- water levels and flows that are agreed upon in WMPs will be recorded as an absolute number (i.e., water level in meters referred to a geodetic datum, or flow in m^3/s). The self-monitoring and reporting data may reflect the range of operations and may be based on a calculated instead of an absolute number (e.g., an average).

- the owner/operator will maintain the data required to support the self-monitoring and reporting data (e.g., daily average could be supported by hourly or less frequent data).

BP will be responsible for ongoing self-monitoring, and will report to MNR any instances where there is deviation from the mandatory flow and water level components of the WMP. MNR may inspect or perform spot audits to ensure compliance.

A compliance monitoring strategy is presented in the following section for water power operations on the Michipicoten River.

13.1 Mandatory Compliance

Operational requirements placed on Brookfield Power by MNR as outlined in this WMP (Table 13.1) are considered mandatory with the following exceptions in this plan:

- In instances where, due to energy imperatives (e.g., system reliability, demand/supply challenges, etc), the Independent Electricity System Operator (IESO) requests that the operator seek relief from certain provisions of this plan, MNR will consider those requests expeditiously. After consultation with IESO and the Owner, MNR may allow short-term relief from certain provisions. (An IESO/MNR Industry Protocol will be established and documented.)

- In instances of unscheduled facility imperatives (e.g., emergency maintenance, etc), MNR will consider requests from the owner for temporary relief from the plan expeditiously with consideration to the relative priorities of both MNR and the Owner.

- Conditions outlined in this WMP may not apply when managing operations outside of the agreed upon operational rule curves if a low or high water indicator has been met as specified in Section 13.2 of this WMP. As a result, operators will not automatically be out of compliance with this WMP when they operate outside the defined operating range while these indicators exist.

- Mandatory provisions of this Plan will be waived, as appropriate, when the plan holder and MNR are requested to do so by a police agency or other recognized emergency organization.

Table 13.1
Compliance Water Levels and Flows

Reservoir	Water Level	Water Level (m)	Flow Type	Flow Release - Powerhouse Flow (m³/s)
Primary Storage Reservoirs				
Hollingsworth	Absolute Maximum Level Maximum Operating Level Full Supply Level Spring Surcharge Summer Minimum Level* Fall Minimum Level (Oct 1 to Oct 25) Maximum Drawdown Level**	313.56 313.33 312.42 312.57 310.36 309.36 304.28	Maximum	91.7
McPhail (without LRIA approval of 1 m raise)	Absolute Maximum Level Maximum Operating Level Full Supply Level Maximum Drawdown Level	278.13 277.37 276.46 275.96	Maximum	109
McPhail (with LRIA approval of 1 m raise)	Absolute Maximum Level Maximum Operating Level Full Supply Level Maximum Drawdown Level**	278.46 277.80 277.46 276.96	Maximum	109
Dunford (High Falls) (without LRIA approval of 0.5 m raise)	Absolute Maximum Level Maximum Operating Level Full Supply Level Maximum Drawdown Level	263.05 263.04 262.28 261.98	Maximum	112.5
Dunford (High Falls) (with LRIA approval of 0.5 m raise)	Absolute Maximum Level Maximum Operating Level Full Supply Level Maximum Drawdown Level**	263.55 263.50 262.78 262.48	Maximum	112.5
Scott	Absolute Maximum Level Maximum Operating Level Full Supply Level Maximum Drawdown Level**	217.63 217.32 216.87 207.87	Maximum Minimum**	112.5 17.0 continuous 26.3 April 15 to June 15
Secondary Storage Reservoirs				
Wabatongushi	Absolute Maximum Level Maximum Operating Level Full Supply Level Summer Maximum Level* Summer Minimum Level* Maximum Drawdown Level**	348.30 348.30 348.09 347.90 347.48 346.97		
Dog	Absolute Maximum Level Maximum Operating Level Full Supply Level Summer Maximum Level* Summer Minimum Level* Maximum Drawdown Level**	330.70 330.70 330.41 330.32 329.89 329.38		

Table 13.1
Compliance Water Levels and Flows

Reservoir	Water Level	Water Level (m)	Flow Type	Flow Release - Powerhouse: Flow (m^3/s)
Windermere	Absolute Maximum Level	428.70		
	Maximum Operating Level	428.70		
	Full Supply Level	428.25		
	Summer Maximum Level*	427.58		
	Summer Minimum Level*	427.21		
	Maximum Drawdown Level**	426.70		
Anjigami	Absolute Maximum Level	290.15		
	Maximum Operating Level	290.15		
	Full Supply Level	288.80		
	Summer Maximum Level*	288.37		
	Summer Minimum Level*	288.04		
	Maximum Drawdown Level**	287.53		

* June 1 to September 30
** Except during dry period as defined in Section 13.2.

Note:
In certain circumstances such as nights or weekends, it may be necessary to contact the MNR Planning and Information Management Supervisor at home in the event of a situation requiring water levels or flows to go outside the compliance limits stated above. However, MNR acknowledges that BP has no staff at the secondary storage reservoirs except to make periodic checks/ inspections. BP will contact MNR prior to the need to go out of compliance or within 24 hours of a noncompliance situation being observed (as per Section 13.4).

Table 13.2 outlines the methodology that will be used to assess compliance with water levels and flows listed in Table 13.1. Figures 13.1 to 13.8 provide compliance requirements and targets graphically.

Table 13.2
Water Level and Flow Monitoring Methods

Location	Tenure Instrument	Water Level Monitoring Measure	Flow Rate Monitoring Measure
Windermere/ Kathleen Lake	Licence of Occupation 7172	Upstream staff gauge on Windermere Lake read at least monthly in spring, summer, fall and winter (helicopter access)	Calculated based on staff water level gauge readings and stop-log settings
Anjigami Lake	Licence of Occupation 7195	Upstream staff gauge read at least monthly in spring, summer, fall winter (helicopter access)	Calculated based on staff water level gauge readings and stop-log settings
Dog Lake	Licence of Occupation 2528	Upstream staff gauge read at least monthly in spring, summer, fall and winter (helicopter access)	Calculated based on staff water level gauge readings and stop-log settings
Wabatongushi Lake	Licence of Occupation 9312	Staff gauge read at least monthly in spring, summer, fall and winter (helicopter access)	Calculated based on staff water level gauge readings and stop-log settings
Hollingsworth GS	Waterpower Lease Agreement #172	Head-pond pressure transducers linked to SCADA system. Water levels available on hourly basis	Hourly flow rate back-calculated from generator output. Spill flow calculated from Tainter Gate setting.
McPhail GS	Waterpower Lease Agreement #171	Head-pond pressure transducers linked to SCADA system. Water levels available on hourly basis.	Hourly flow rate back-calculated from generator output. Spill flow calculated from Tainter Gate setting.
Dunford GS	Waterpower Lease Agreement #166	Head-pond pressure transducers linked to SCADA system. Water levels available on hourly basis.	Hourly flow rate back-calculated from generator output. Spill flow calculated from Tainter Gate setting.
Scott Falls GS	Waterpower Lease Agreement #170	Head-pond pressure transducers linked to SCADA system. Water levels available on hourly basis.	Hourly flow rate back-calculated from generator output. Spill flow calculated from Tainter Gate setting.

13.2 Deviations from Mandatory Compliance with Natural Variations in Water Supplies

MNR recognizes that weather conditions and their impacts on water supplies are a source of ongoing uncertainty in managing water power facilities and other control structures.

Operators will not be considered out of compliance with their WMP when they operate outside the operating range as a result of a high or low water condition as defined below by MNR (WMP Guidelines, Appendix J).

Low Water Indicators

Facilities with minimum downstream flow and minimum reservoir/head-pond water level requirements are in a low water condition when all of the following indicators are met:

- outflow from the facility is at or below the minimum flow required in Table 13.1 of the WMP

- water level in the head pond/reservoir is at or below the minimum water level stipulated in Table 13.1 of the WMP, and

- the head pond/reservoir water level is decreasing.

Facilities with no minimum downstream flow requirements but having a minimum reservoir/head-pond water level are in a low water condition when all of the following indicators are met:

- outflow from the facility is at the minimum possible
- the head pond/reservoir water level continues to decrease.

High Water Indicators

High water conditions exist at a facility when all the following indicators are met:

- water level in the head pond/reservoir is at or above the maximum operating level stipulated in Table 13.1 of the approved WMP, and

- head pond/reservoir water level is increasing, and

- discharge facilities have been operated to discharge the maximum discharge possible (see Table 13.1) (while minimizing upstream and downstream flood damages).

In instances where BP reports that they can no longer operate within the approved operating range because a low or high water condition has been met, they will

- immediately advise MNR and file an incident report

- comply with any conditions/components contained in the WMP related to these circumstances.

MNR requires owners of facilities that have mandatory water flow and level requirements to convene the Standing Advisory Committee (SAC) which will be established by the Steering Committee. It is recommended that this be done within 1 month of plan approval. One of the SAC's responsibilities will be to assess options once a low water indicator has been met. Assessments will consider the circumstances of the situation against the priorities that were set during the planning process and will make recommendations accordingly. Standing Committees do not have a regulatory role. The role is to provide advice during low water conditions where operations are outside of the approved plan (MNR, 2002).

MNR requires that an official record be maintained of all recommendations made by the SAC to the operator and copied to MNR.

Once a high or low water condition has been met, the Plan will permit the owner/operator to operate outside the operating range while continuing to meet any other requirements of the Plan until the condition described by the indicator ends (i.e., as long as the conditions applies, operations outside of the approved operating range will be in compliance with the Plan).

MNR may request appropriate existing data and information to confirm or assess the high or low water conditions, or may independently verify the situation. MNR has indicated that reports generated as a result of such a review will not constitute non-compliance reports unless the owner/operator is found to be deliberately or negligently operating outside the approved operating range.

13.3 Annual Reporting of Water Levels and Flows

BP will prepare an Annual Compliance Report for the items listed in Table 13.3.

Table 13.3
Annual Reporting Requirements and Rationale

Facility	Data Requirement	Reporting Period	Rationale	Responsibility
Secondary storage reservoirs	Monthly water levels and flows by helicopter visit	Annually or on request by MNR for inspections	Requirement to monitor levels of the storage reservoirs. Flows required to build database for next WMP	BP
Hollingsworth Reservoir/GS	Hourly instantaneous water levels and flows*	Annually or on request by MNR for inspections	Reservoir levels are WMP requirement; flows required to build database for next WMP	BP
McPhail Reservoir/GS	Hourly instantaneous water levels and flows*	Annually or on request by MNR for inspections	Reservoir levels are WMP requirement; flows required to build database for next WMP	BP
Dunford (High Falls) Reservoir	Hourly instantaneous water levels and flows*	Annually or on request by MNR for inspections	Reservoir levels are WMP requirement; flows required to build database for next WMP	BP
Scott Reservoir/GS	Hourly instantaneous water levels and flows*	Annually or on request by MNR for inspections	Reservoir levels are WMP requirement; flows required to build database for next WMP	BP

*For compliance and enforcements, upon request, the power producer will provide hourly instantaneous readings of flows and levels data for the generating stations. Pertinent operation data that are monitored through the SCADA system are archived in the Plant Information (PI) database every hour. Information queries from the PI database will form the basis for data transfer to meet compliance monitoring requirements. For water levels, an instantaneous reading is taken at the end of the hour which, for operation and water management purposes, allows an accurate change in reservoir volume to be determined. No additional readings within the hourly period are archived. For flow data, an hourly average value is calculated based on an integration of numerous readings as they occur over the hourly period and is archived into the PI database.

In accordance with MNR's WMP guidelines, BP agrees to the following with respect to the reporting of information:

- BP will complete an annual report in a form provided by MNR and forward the report to MNR annually by March 31 of the following year

- data required for compliance monitoring and reporting will be recorded and maintained by BP for a period of 1 year beyond the term of the WMP but at no time will the retention period be less than 5 years following it being recorded

- BP will make this existing data available to an MNR inspector or engineer when requested to do so

- when requested by MNR to supply such information BP will do so in the timeframe indicated in the request

- BP will monitor and report on their operations as required in this WMP.

It is recognized that water level measurements may be unavailable from time to time due to equipment failure or environmental conditions. BP will maintain data for their respective facilities and make it available to MNR upon request for audit activities. MNR will maintain data for its facilities at the MNR regional office in the City of Timmins. MNR will undertake a number of compliance activities, such as monitoring of real-time water levels and flows from time to time or occasional audits.

BP will make the data required in this plan, available to an MNR inspector or engineer when requested to do so. In the absence of a specific request contained in the plan, or from time to time by an inspector, BP will supply the data annually.

13.4 Incident Notification and Reporting

BP will notify MNR of all incidents outside the approved operating range. Notification to MNR will be made within 24 hours of the incident being discovered. The owner/operator will explain the nature of the incident, why it happened if known, what is being done to bring operations back into compliance (i.e., any corrective actions required), and how long it will take.

BP will provide any additional information required on a standard form to MNR within 30 days of discovery of the incident. This report will be signed and dated by the owner/operator.

MNR will take into account the nature, severity and the reasons for the non-compliance. BP will be provided with a fair and reasonable opportunity to explain what happened and their actions before any enforcement action is taken. However, repeat violations (even minor examples) will be reviewed with increasing concern by MNR and met with increasingly stronger enforcement measures as per the WMP Compliance Guidelines. Enforcement responses can range from cautionary to severe and the actions to be taken by MNR are listed in Section 13.5 as per the WMP Compliance Guidelines.

When an MNR structure in a WMP is operated such that water levels and flows are outside the approved operating range, MNR will complete and file an incident report following the same timelines as set out for owners. MNR will maintain a copy of all reports on file for at least 5 years from the date of the report. After this period reports will be removed from the file in accordance with the file retention schedule. All reports produced are subject to the Freedom of Information and Protection of Privacy Act and are considered public documents subject to mandatory exemptions in that Act and may be made available to the public upon request.

13.5 Investigation and Enforcement

MNR will, from time to time, carry out compliance inspections of the site as provided for in Section 20 of the LRIA. It is understood that where there is a failure to comply with the mandatory components of an approved WMP; the following actions will be taken by MNR:

- companies that do not operate their waterpower facilities in accordance with their approved WMP will be held accountable

- MNR will determine the response to noncompliance in accordance with legislation and policy

- in instances of noncompliance, MNR will conduct a review. These reviews will take into account a number of factors including weather, the intent of the offender, failure of equipment and unforeseen events

- procedures will be developed to help determine the most appropriate enforcement action (including warnings, orders and laying charges under S.28 of the LRIA) based on a number of factors including the history of the offender and the impact of the offence

- a procedure will be written by MNR to provide guidance in deciding on appropriate recommendations to the courts for penalties.

13.6 Public Involvement and Awareness

Public awareness, public involvement and transparency for compliance monitoring will be achieved primarily through the use of a Standing Advisory Committee (SAC) for the Michipicoten River WMP. The SAC will be established by the Steering Committee prior to disbanding of the Planning Team LCC, and within 1 month of sign-off of the WMP by the MNR's Regional Director. The SAC will be composed of a number of citizens representing a diversity of interests and expertise, some of whom might be members of the existing Planning Team and PAC, or any membership as named by the MNR District Manager.

The SAC will monitor the implementation of the plan and produce an annual status report each year to be distributed to BP, MNR, First Nations and the public. The SAC will review all data collected during monitoring of the plan and provide a communication link with the public to foster and maintain credible relationships. Public complaints about flows and water levels on the Michipicoten River system will be maintained by BP and reviewed annually by the SAC.

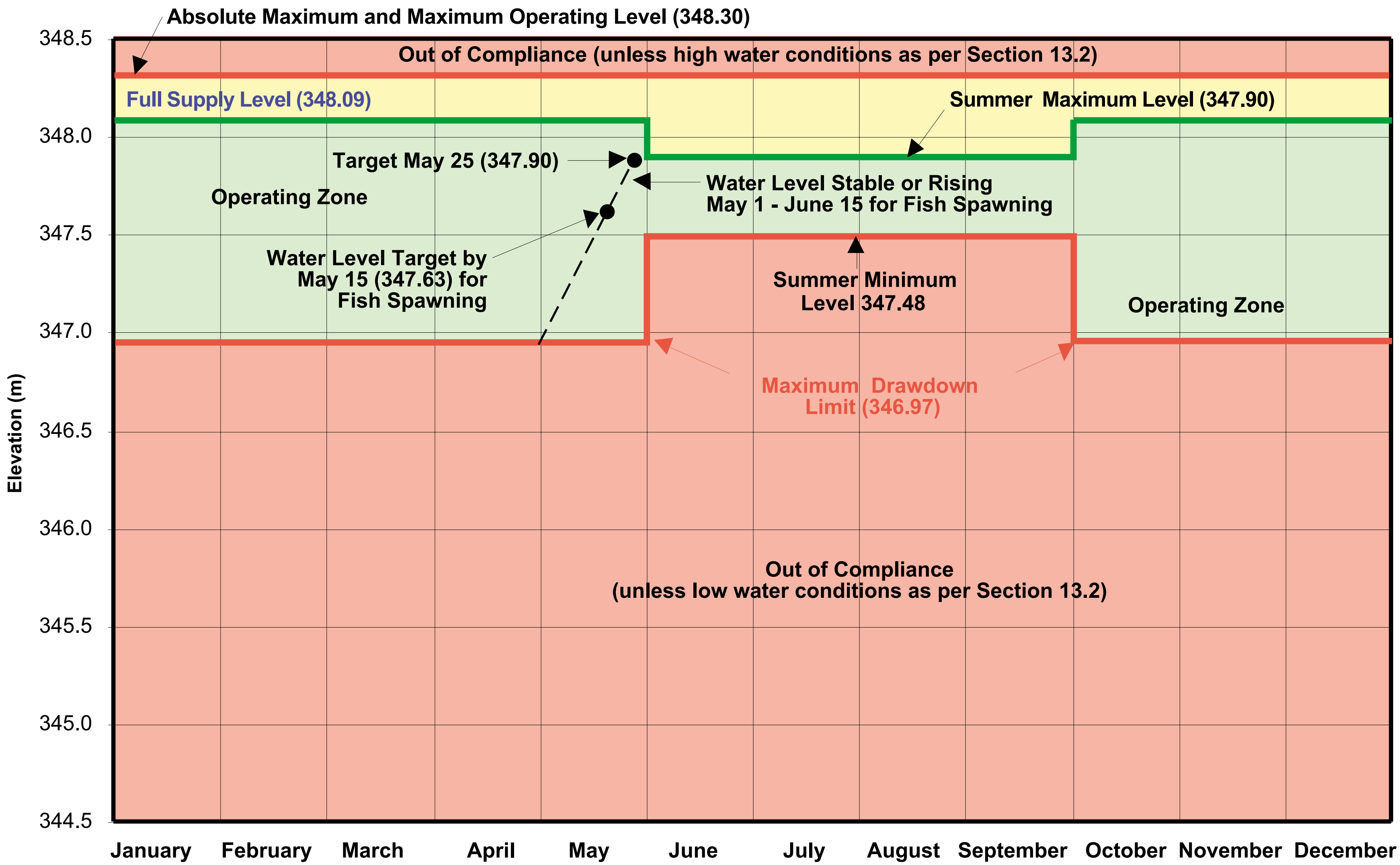

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Figure 13.1
Michipicoten River Water Management Plan
Brookfield Power Corporation

Wabatongushi Lake - Compliance Operating Levels

ACRES International

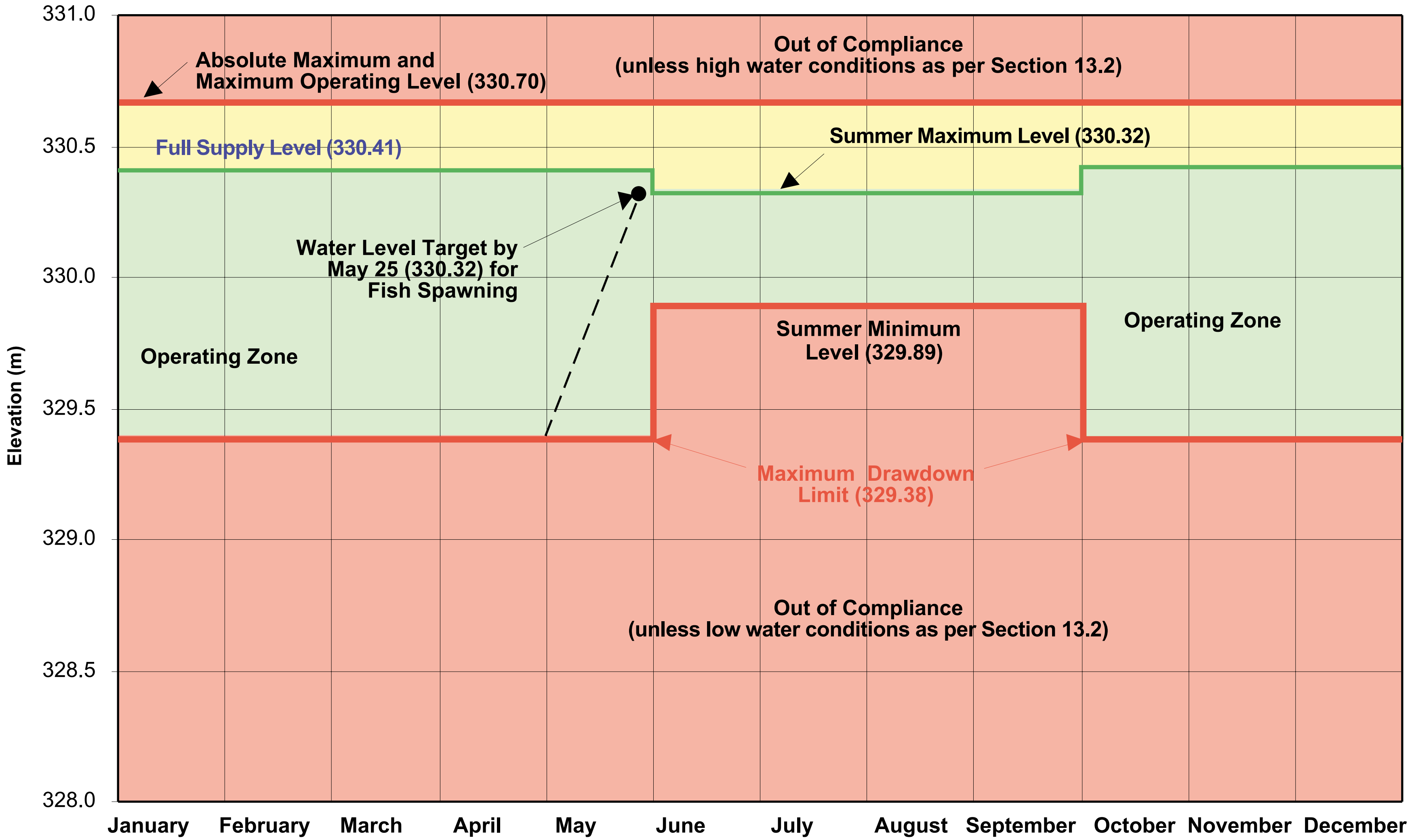

Figure 13.2
Michipicoten River Water Management Plan
Brookfield Power Corporation

Dog Lake - Compliance Operating Levels

ACRES International

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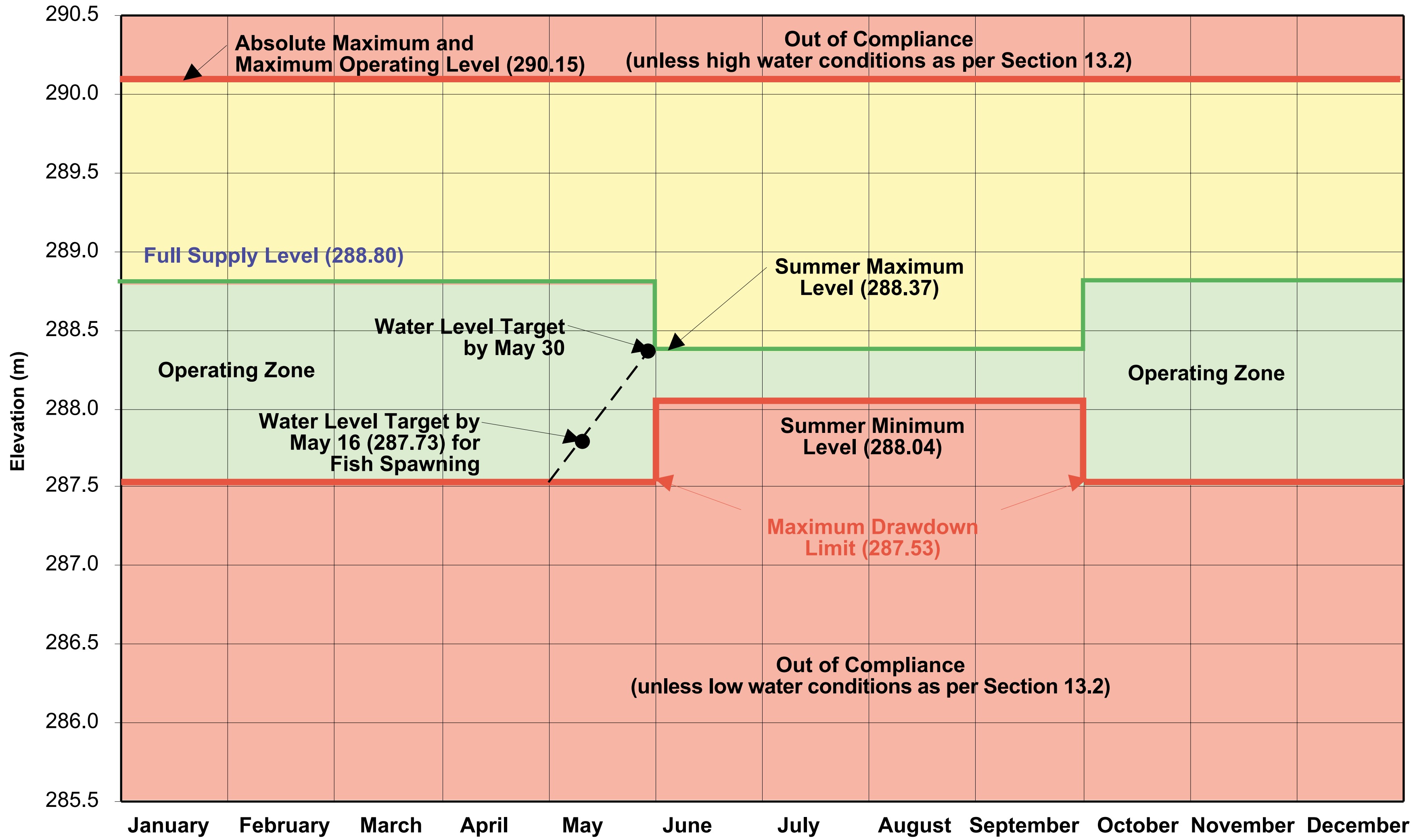

Figure 13.3
Michipicoten River Water Management Plan
Brookfield Power Corporation

Anjigami Lake - Compliance Operating Levels

ACRES International

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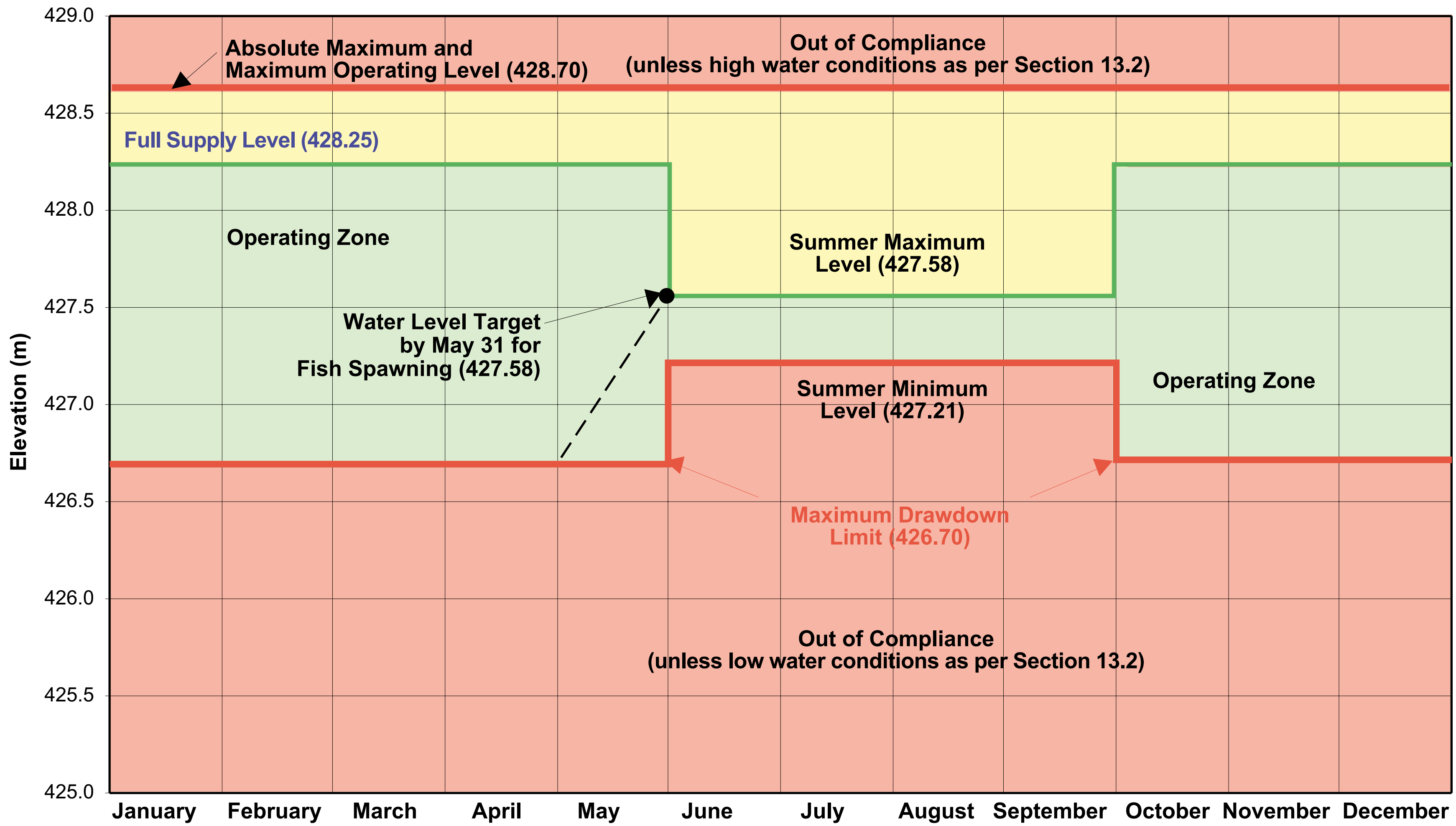

Figure 13.4
Michipicoten River Water Management Plan
Brookfield Power Corporation

Windermere Lake - Compliance Operating Levels

ACRES International

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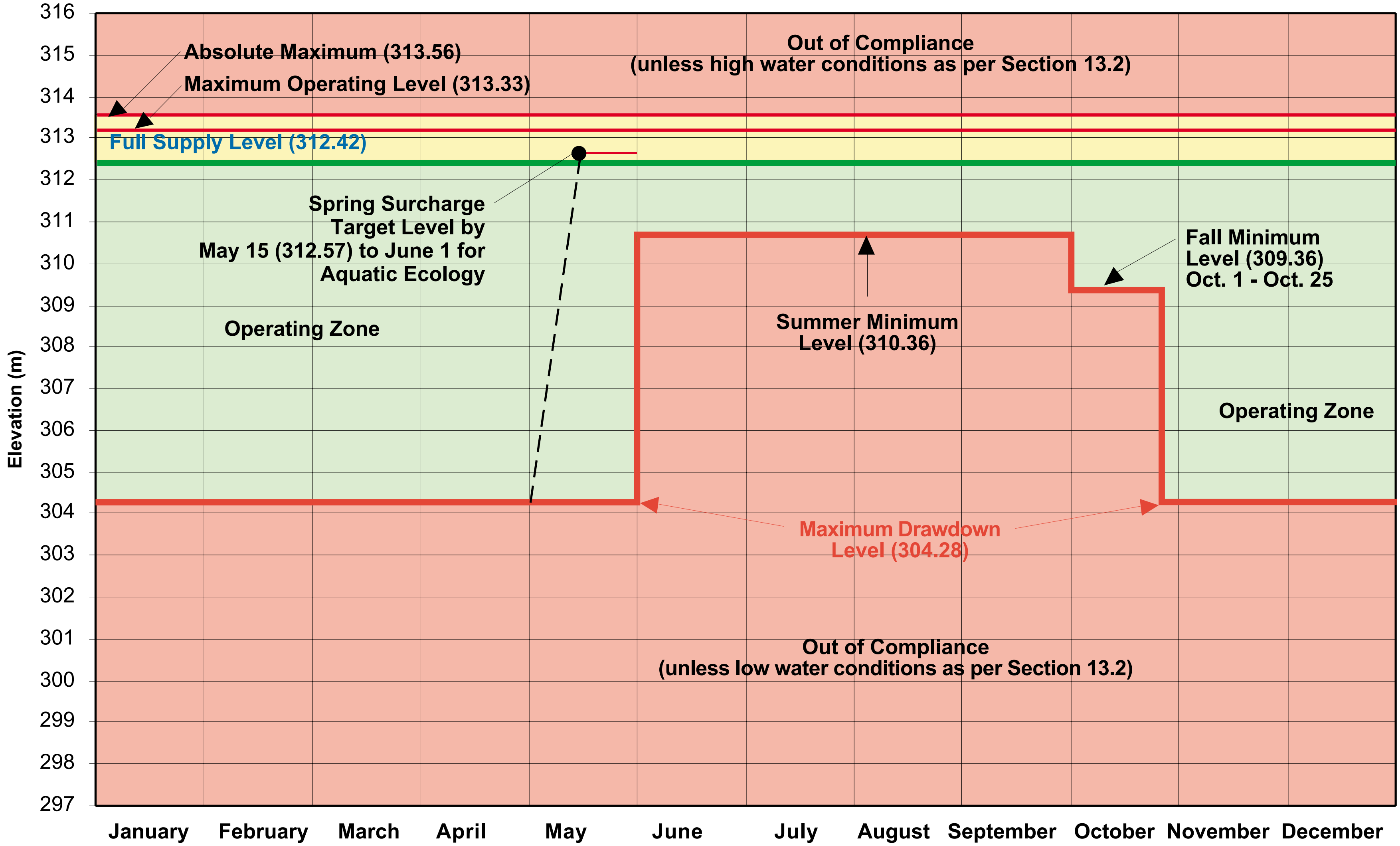

Figure 13.5
Michipicoten River Water Management Plan
Brookfield Power Corporation

Hollingsworth Reservoir - Compliance Operating Levels

ACRES International

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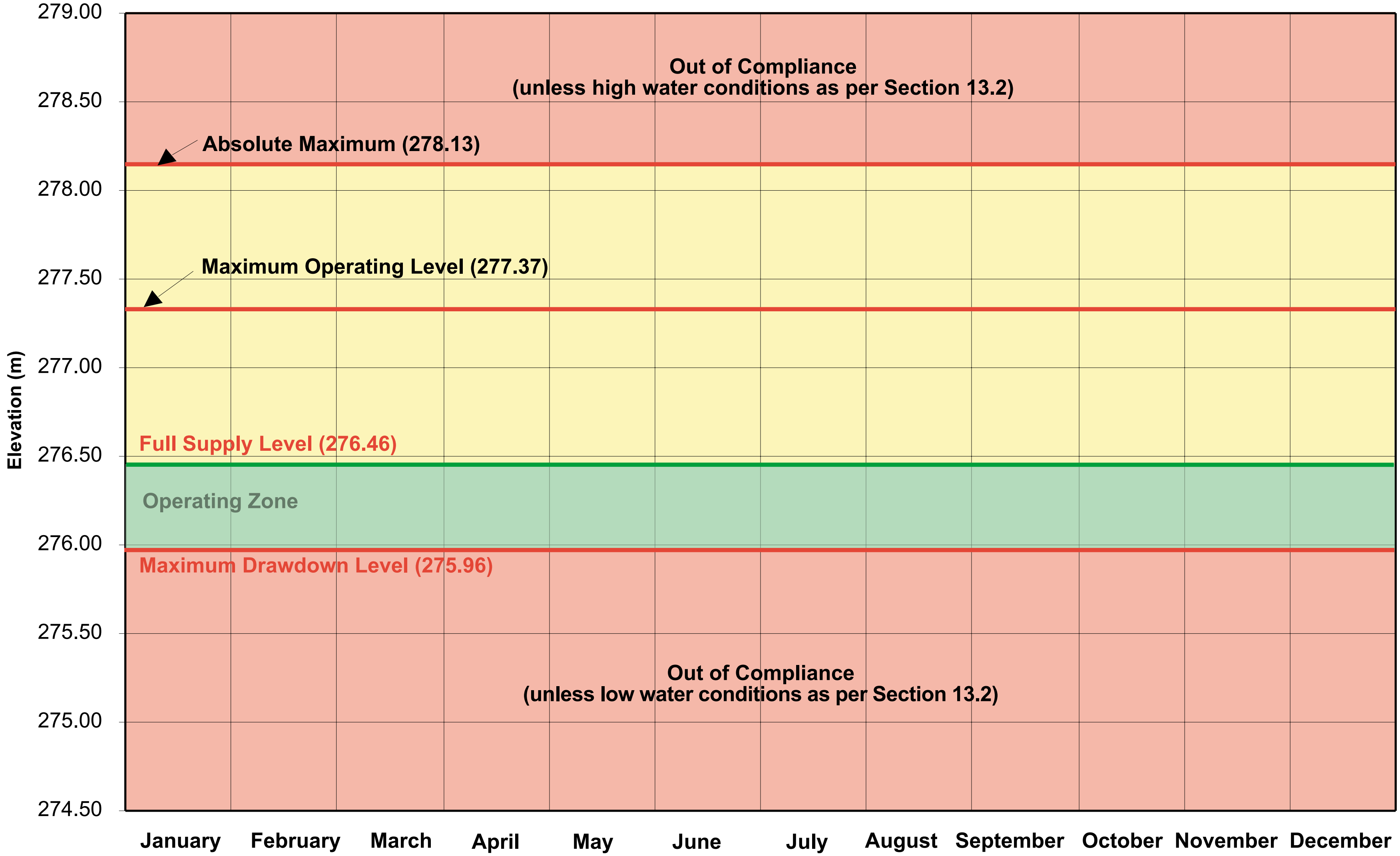

Figure 13.6a
Michipicoten River Water Management Plan
Brookfield Power Corporation

McPhail Reservoir - Compliance Operating Levels **(without LRIA Approval of 1m Raise)**

ACRES International

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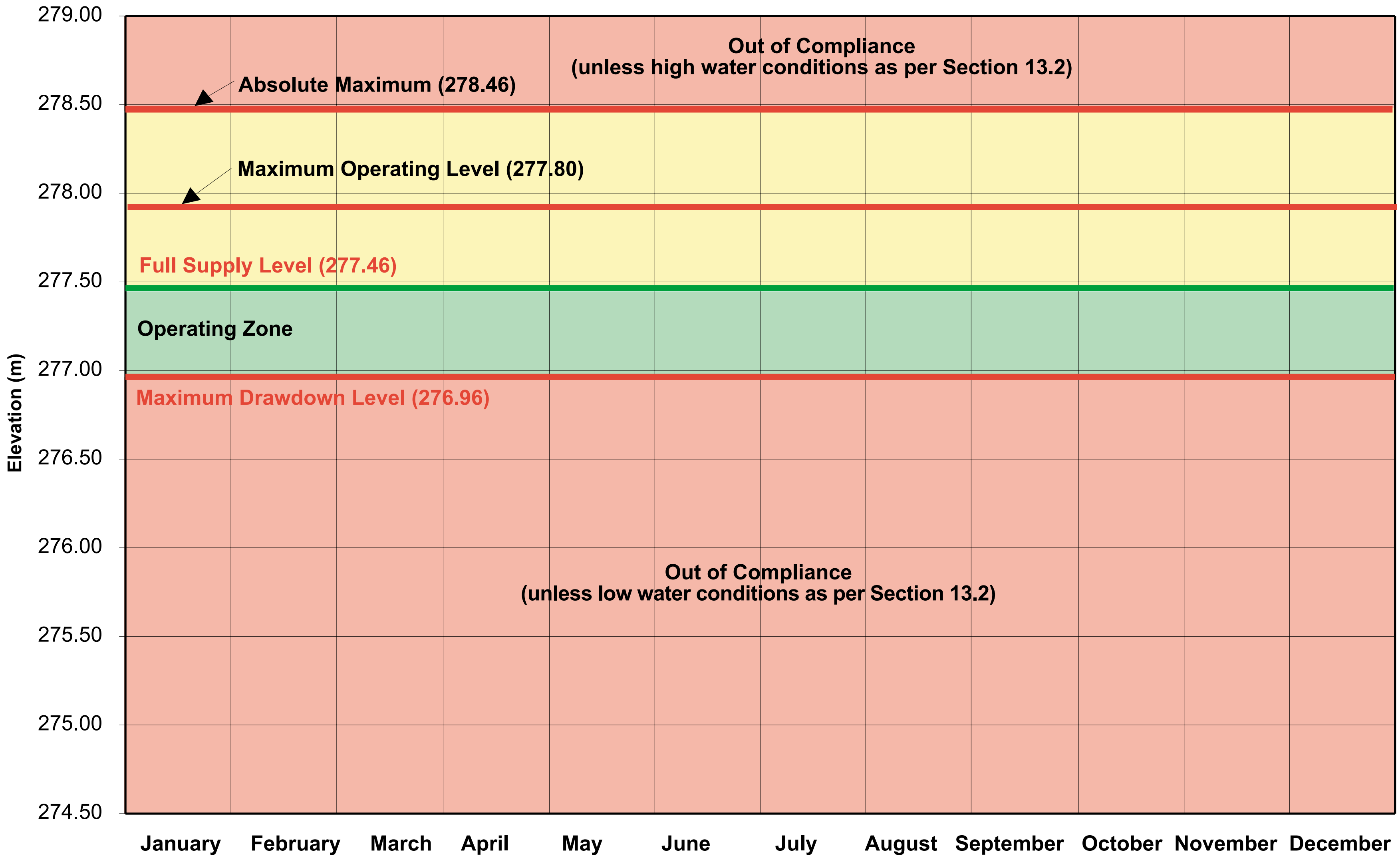

Figure 13.6b
Michipicoten River Water Management Plan
Brookfield Power Corporation

McPhail Reservoir - Compliance Operating Levels **(with LRIA Approval of 1m Raise)**

ACRES International

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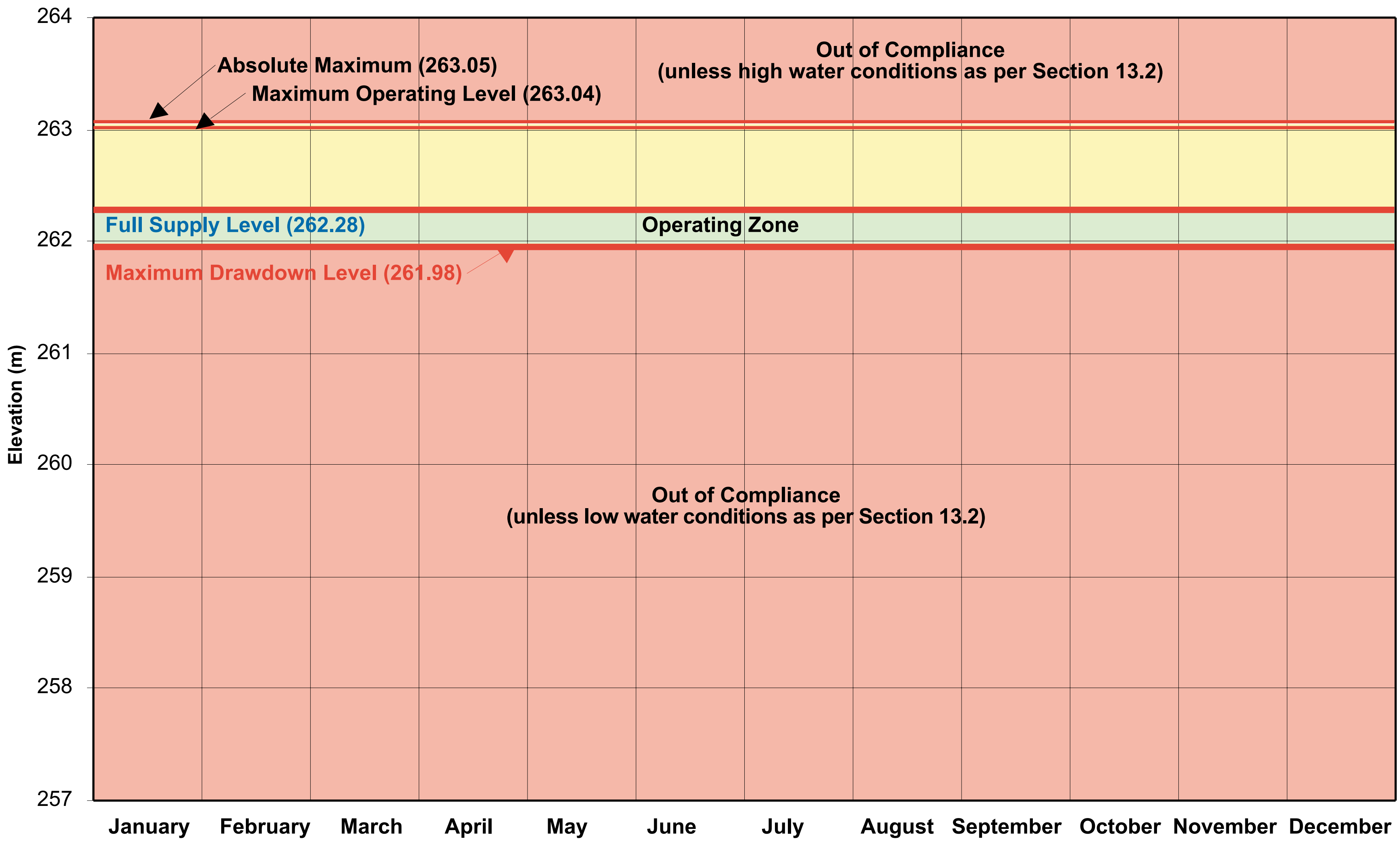

Figure 13.7a
Michipicoten River Water Management Plan
Brookfield Power Corporation

Dunford (High Falls) Reservoir - Compliance Operating Levels (without LRIA Approval of 0.5m Raise)

ACRES International

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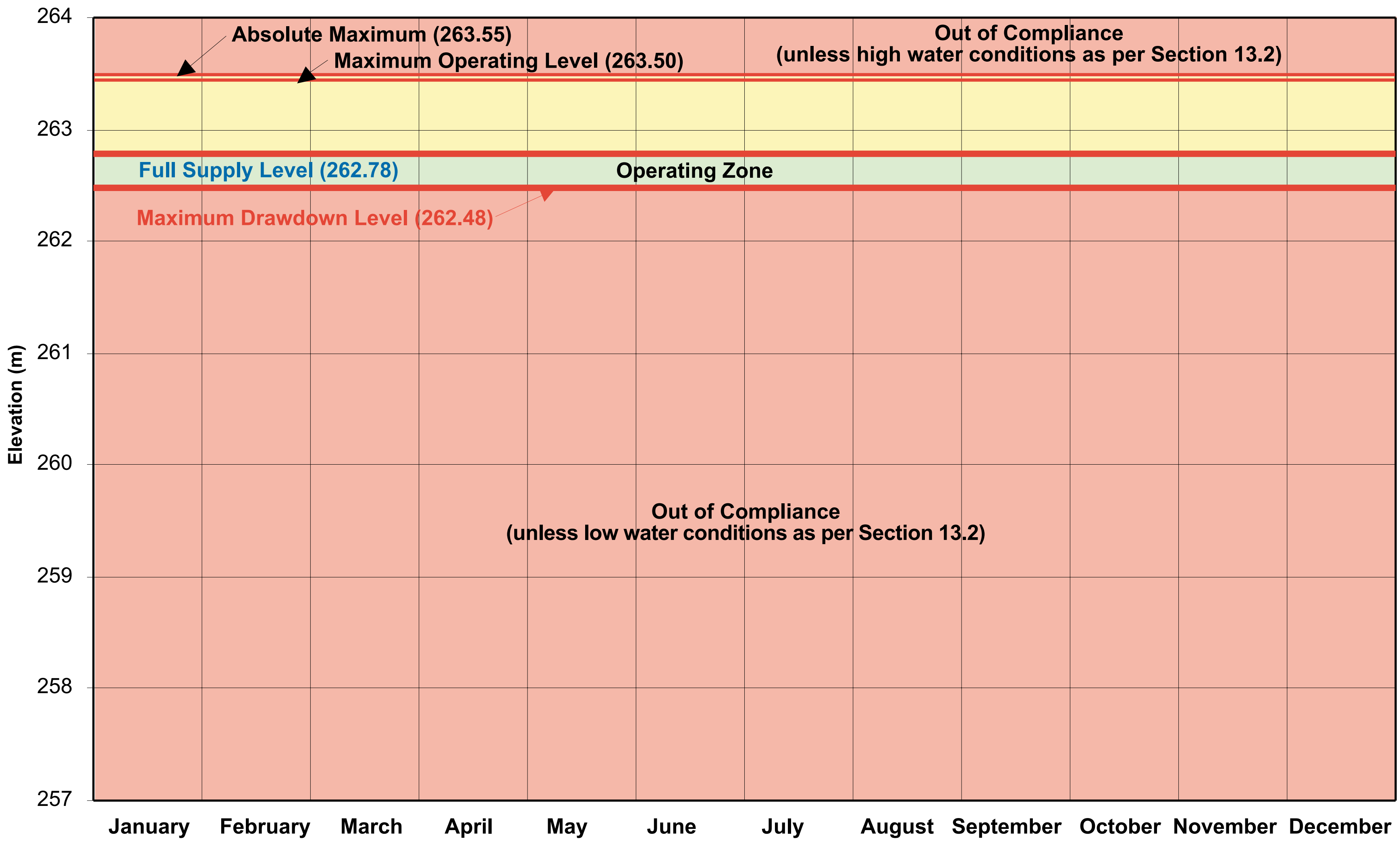

Figure 13.7b
Michipicoten River Water Management Plan
Brookfield Power Corporation

Dunford (High Falls) Reservoir - Compliance Operating Levels (with LRIA Approval of 0.5m Raise)

ACRES International

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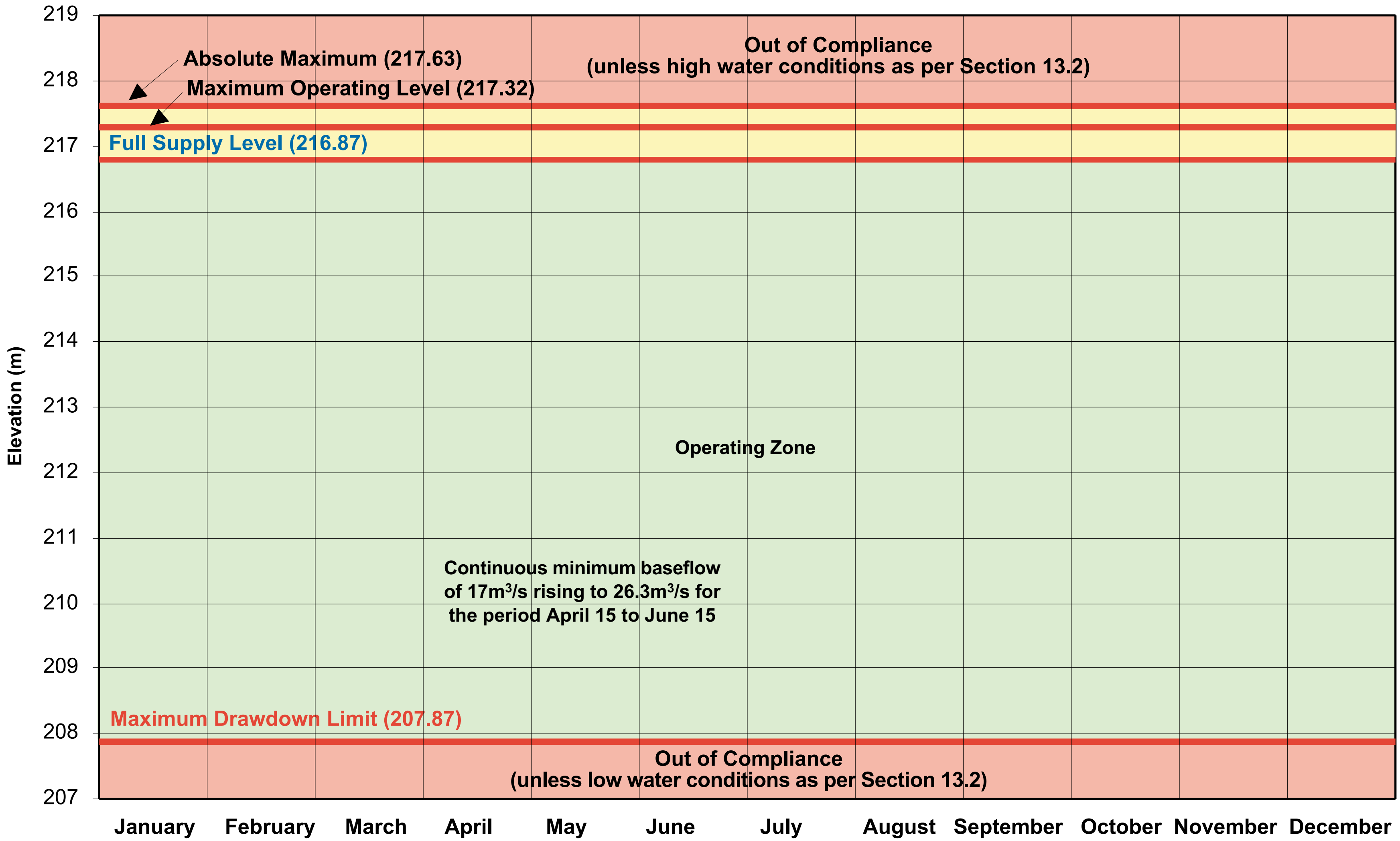

Figure 13.8
Michipicoten River Water Management Plan
Brookfield Power Corporation

Scott Falls Reservoir - Compliance Operating Levels

ACRES International

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14 Provision for Plan Amendments, Plan Reviews, and Plan Renewals

14 Provision for Plan Amendments, Plan Reviews, and Plan Renewals

14.1 Plan Amendments

As noted in the WMP Guidelines (MNR, 2002), prior to the plan review and renewal terms noted below, a plan amendment may be warranted, i.e., if a key issue triggers the review process (e.g., a new dam, new policies, scientific research and/or studies and monitoring for the WMP) that merits considerations of changes to the operating regime. The SAC should review and comment on all new information.

When this information indicates that there is merit in considering changes to the operating regime of one or more waterpower facilities or dams, at the request of the Steering Committee, or following a decision by MNR, then MNR will issue an order to amend the WMP (WMP Guidelines, MNR, 2002).

14.2 Plan Review and Renewal

The WMP will remain in effect for a period of 10 years. It will then be subject to review and renewal as determined by the Steering Committee. The plan review process will be initiated 18 to 24 months prior to the end of the plan term. The result of any periodic review of a WMP may be "renewal unchanged" or it may necessitate an amendment or revision to the plan. In any event, it would be subject to a public comment period prior to renewal.

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List of References

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