Canadian Nuclear Safety Commission | Commission canadienne de sûreté nucléaire

CMD 18-H4.146

File / dossier: 6.01.07
Date: 2018-04-23
Edocs: 5514442

Oral Presentation

Submission from the Saugeen Ojibway Nation

Exposé oral

Mémoire de la Nation Saugeen Ojibway

In the Matter of

Bruce Power Inc. – Bruce A and B Nuclear Generating Station

Request for a ten-year renewal of its Nuclear Power Reactor Operating Licence for the Bruce A and B Nuclear Generating Station

Commission Public Hearing – Part 2

May 28-31, 2018

À l'égard de

Bruce Power Inc. - Centrale nucléaire de Bruce A et Bruce B

Demande de renouvellement, pour une période de dix ans, de son permis d'exploitation d'un réacteur nucléaire de puissance à la centrale nucléaire de Bruce A et Bruce B

Audience publique de la Commission – Partie 2

28-31 mai 2018

Canada

Written Submissions of the Saugeen Ojibway Nation –

Application from Bruce Power Inc. to Renew the Nuclear Power Operating Licence for the Bruce A and B Nuclear Generating Station

---

Commission Public Hearing Part 2: May 30 – 31

TABLE OF CONTENTS

1. OVERVIEW

The Saugeen Ojibway Nation ("SON") are the Indigenous peoples of the Territory they know as the Anishinaabe-aki or Anishinaabekiing. It is the area comprising the modern-day Bruce and Grey region and is the site of the Bruce Power nuclear complex. These are SON's treaty lands and the source of their rights, identity, and cultural and economic survival.

The Bruce Nuclear Generating Station (or "Bruce facility") has been operating in the heart of Anishinaabekiing, or the SON Territory, since the early 1970s and is now, with onsite waste facilities, the world's largest operating nuclear facility. SON has long-standing and serious concerns about how the Bruce facility interacts with and adversely impacts its environment. For decades, SON and its leadership have sought to understand these impacts and find ways of reducing the risks and harms caused to their rights and interests, including to their traditional waters, the source of their proven Aboriginal and treaty right to a commercial fishery.

Bruce Power now seeks authorization to effectively double the lifespan of the facility through a major refurbishment (the "Refurbishment Project"). The Refurbishment Project will extend the duration of impacts for over 50 years, including continued impacts from entrainment and impingement, thermal discharge, ongoing generation of nuclear wastes, and the risk of releases, accidents, and malfunctions. And this will occur in a changing environment and already fragile aquatic ecosystem. Yet Bruce Power maintains in its application that it will cause no significant environmental impacts.

SON strongly disagrees. The current application is critically deficient and cannot support any credible conclusion about the current and future environmental impacts caused by the Bruce facility or its refurbishment. The application is based on incomplete and flawed data and analysis. It provides a wholly inadequate assessment of future impacts, failing to even consider the effects of climate change. In the face of this uncertainty, the application offers no analysis and proposal for viable mitigation measures.

SON submits that the current application and, in particular, the request for authorizations for refurbishment, fail to meet the statutory requirements for approval. Further, the long-standing concerns of SON regarding the adverse effects of the facility and its refurbishment on its rights,

interests, and way of life have not been addressed or properly accommodated. Consequently, the constitutional obligations owed to SON under the duty to consult have not been fulfilled.

SON submits that Bruce Power's request for authorization of its Refurbishment Project should not be granted until necessary and appropriate accommodation measures to protect SON rights and interests are agreed to and implemented.

2. SIGNIFICANCE OF THE REFURBISHMENT FOR FUTURE OF SON

2.1. SON Treaties, Territory, and Rights

2.1.1. SON and Its Territory

SON is comprised of the Chippewas of Nawash Unceded First Nation and the Chippewas of Saugeen First Nation. The SON people are among the Anishinaabek people of the Great Lakes region. They are the Indigenous peoples of the Anishinaabe-aki or Anishinaabekiing, or what is now known as the Bruce and Grey region. These are the treaty lands of SON and the source of their rights and identity as a People, and the basis of their cultural, spiritual, and economic survival.

SON's creation story holds that the SON people originate from an island called Michilimackinac in the strait between Lake Huron and Lake Michigan. SON's identity as an Indigenous people grows out of its relationship and connection to the SON Territory:

> Our identity as an Aboriginal people grows out of our relationship and connection to our territory. Our people have a fundamental and unbroken connection to our Territory… We continue to define ourselves as a people through our connection to our lands.[1]

SON's ancestors used and occupied the Anishinaabe-aki since time immemorial and its people continue to do so today. SON's Territory consists of everything integral to life—the lands, rivers, lake, winds, grass, people, animals, and fish. The Anishinaabe-aki has sustained the SON people physically and spiritually for countless generations and must continue to do so far into the future.

The lands that comprise the SON Territory extend east from Lake Huron to the Nottawasaga River and south from the northern tip of the Saugeen Peninsula (also known as the Bruce Peninsula) to the Maitland River system, eleven miles south of Goderich.[2] The waters that comprise the SON Territory are the waters surrounding these lands and include the lakebed of Lake Huron from the shore to the international boundary with the United States and the lakebed of Georgian Bay to halfway across the Bay. The SON communities occupy large, unceded

---

[1] Affidavit of Randall Kahgee, 15 August 2013, para. 21 ("Randall Kahgee Affidavit"). Attached as Appendix N.

[2] See the Map of the SON Territory, attached as Appendix L.

communal lands (reserves) bordering Lake Huron and Georgian Bay. SON also has exclusive use of a large hunting reserve in the northern part of the Saugeen Peninsula.

2.1.2. SON Treaty Relationship with the Crown

SON has signed numerous treaties with the Crown. These treaties are foundational promises and commitments that created a sacred and enduring relationship between SON and the Crown that exists to this day. These treaties are solemn agreements that allow others to share the use of SON lands while protecting and preserving SON rights to use and rely on those lands for all time and in the ways they always have.

Notable among the treaties and commitments made by the Crown to SON is the Royal Proclamation of 1763. The Proclamation was a promise by the Crown (in the person of King George III) to protect Indigenous lands, including the SON Territory, from encroachment by non-Indigenous settlers. The Proclamation was issued at a time when Indigenous people held the balance of power in the Great Lakes region, and clearly recognized Indigenous ownership of their traditional territory as a pre-existing interest that co-existed with any assertion of Crown "sovereignty."

In 1764, Crown representatives met with more than 1,500 Anishinaabek Chiefs and warriors at Niagara Falls, including the leaders of what would become SON. The Royal Proclamation was explained as a fundamental commitment to treat Indigenous peoples with honour and justice. It was stated that the Crown only required the "eastern corner" of the Great Lakes, and that the Anishinaabek would flourish with the British as their allies. These commitments—called the Treaty of Niagara—were entered into as an agreement between equals and sealed by the delivery of two wampum belts.

After the Treaty of Niagara, SON's ancestors signed a number of other major treaties with the Crown. In these treaties, the Crown recognized SON rights throughout its Territory and set aside large unceded communal lands for its exclusive use and occupation. Of particular significance are Treaties 45½ and 72. Treaty 45½ was signed in 1836 under the threat of ever increasing encroachment by non-Indigenous settlers and the government's professed inability to prevent it. In 1854, Treaty 72 was entered into under similar circumstances of encroachment on SON

Territory by settlers and was again signed in return for the same promises by the Crown to protect SON land and interests.

SON's Aboriginal and treaty rights throughout its Territory have also been recognized in numerous more recent agreements with the Crown. These include a series of negotiated agreements with the Crown in respect of SON commercial fishing rights within its Territory. They also include a 2010 agreement between SON and Ontario's then Ministry of Energy and Infrastructure recognizing the rights of SON in its Territory and setting out a number of protection and accommodation measures relating to energy development initiatives within the SON Territory.[3]

SON's rights have also been recognized in constituting documents for major environmental assessment processes in the SON Territory, including by the Canadian Nuclear Safety Commission ("CNSC" or "Commission") for the review of Ontario Power Generation's Inc.'s ("OPG") proposed deep geologic repository for low and intermediate-level waste (the "DGR Project"),[4] and Bruce Power's earlier proposed application for a new nuclear power plant. SON's rights and place in the Territory are also the basis for historic commitments from OPG and the Nuclear Waste Management Organization ("NWMO") that allow the SON communities to decide the future of nuclear waste management within their Territory.[5]

Further, SON has asserted claims to some lands and lakebeds in the SON Territory in two separate legal actions currently before the courts. The first claim is for a return of certain lands still owned by the Crown within the Saugeen Peninsula that were purportedly surrendered under Treaty 72. The claim is based on the Crown's failed promise in Treaty 45½, and breach of its fiduciary duty to protect SON's lands from encroachment by non-Indigenous settlers.

---

[3] Agreement Between Her Majesty the Queen in Right of Ontario as Represented by the Minister of Energy and Infrastructure and the Saugeen Ojibway Nations, 14 January 2010 ("MEI Agreement").

[4] Agreement to Establish a Joint Review Panel for the Deep Geologic Repository Project by Ontario Power Generating Inc. Within the Municipality of Kincardine, Ontario, announced 26 January 2009.

[5] Letter from Tom Mitchell, President and CEO of Ontario Power Generation, to Chief Arlene Chegahno, Chippewas of Nawash Unceded First Nation, and Chief Randall Kahgee, Saugeen First Nation, 7 August 2013 ("OPG 2013 Commitment Letter"). Letter from Ken Nash, President and CEO of the Nuclear Waste Management Organization, to Chief Greg Nadjiwon, Chippewas of Nawash Unceded First Nation, and Chief Vernon Roote, Chippewas of Saugeen Fist Nation, 30 May 2016 ("NWMO Commitment Letter").

The second claim is for a declaration of SON's Aboriginal title to the lakebeds of Lake Huron and Georgian Bay within the SON Territory. These lakebeds were never identified or negotiated as part of SON's historical Treaties with the Crown and consequently, were not subject to surrender.

2.2. The Central Place of Fishing in SON Culture and Economy

SON and its ancestors have been fishing within the SON Territory, in the waters of Georgian Bay and Lake Huron, for sustenance and as the basis of trade and commerce for hundreds of generations. Fishing is a fundamental aspect of the SON as a people and is integral to the SON culture and to SON belief systems. As explained by former Councillor Paul Jones:

> The fishery and the lands are part of who I am. The lands and waters are inseparable from me as an Annishnabe person. My family and our oral histories have shaped me as an Annishnabe person. My family has conducted ceremonies on the waters and the ice when the water is covered. Our belief is that the waters, trees and lands all have spirits, and that these spirits are interconnected. For example, when our people fish, we share in the catch. Our people watch the harvest. Our children see the fishermen return with their catch and share in the process. We have ceremonies to the creator for the lands and waters of which we are a part. Our feasts celebrate the fishery, and our connections to the waters and the lands that surround it.[6]

The preservation of the SON fishery has been a constant and singular concern for SON, and the SON people have struggled to protect their right to continue fishing as they always had. In the 1993 landmark *R v Jones and Nadjiwon* decision, Justice Fairgrieve recognized and affirmed that right under s.35 of the *Constitution Act, 1982*:

> The Ojibway in that area were involved in a very productive fishery from, as is said, time immemorial. Specifically, the evidence established that they made use of numerous fishing stations on both sides of the peninsula, including the islands immediately offshore from the present Saugeen Ojibway reserves located at Cape Croker on the east side and Saugeen on the west. Their fishing was not prosecuted by individual fishermen merely to feed their own families, but rather was a community-based, collective activity in which the benefits were shared amongst the members of the community generally and directed to the subsistence of the group as a whole. Moreover, the Crown concedes, their fishing operation is accurately described as "commercial" in nature.[7]

---

6 Affidavit of Paul Jones, 15 August 2013, para. 15 ("Paul Jones Affidavit"). Attached as Appendix O.

7 *R v Jones and Nadjiwon,* [1993] 3 C.N.L.R. 182.

Although the courts and the Crown have now come to recognize SON's fishing rights, this recognition was only achieved through years of political and legal struggle. For decades, SON fishers were systematically prevented from exercising their rights and carrying out an economic activity that had sustained SON people for countless generations. In the 1980s, the SON communities were consistently excluded from the waters of their Territory and were prosecuted for even attempting to exercise their rights.[8] In one case, eleven Nawash fishermen including the Nawash Chief and Elders were forced to stand for 45 minutes as the Justice of the Peace lectured them about their fishing activities. The fishermen were portrayed as thieves, greedily taking too many fish, and were subjected to fines totaling $32,000 plus jail time ($200 and 30 days for one fisherman who caught 9 fish). It was such occurrences that ultimately led the Nawash Band Council to make the decision to divert resources out of its very limited programs and services budget to support then Chief Jones and Mr. Nadjiwon in the case which led to the recognition of SON's fishing rights. The cost of defending Chief Jones and Mr. Nadjiwon was almost $500,000.

Since the *R v Jones and Nadjiwon* decision, SON has worked hard to rebuild the fishery. As a direct result of this judicial affirmation of SON's fishing rights, SON has entered into a series of negotiated agreements with the Government of Ontario:

> Our position was simple: while we did not need an agreement to fish, an agreement would stabilize our relationship with the Crown and bring some peace to our communities. It would also help us rebuild our fishery, reversing years of damage.[9]

On June 22, 2000, SON signed its first fishing agreement with Ontario's Ministry of Natural Resources and Forestry ("MNR") and Indian and Northern Affairs Canada. While this agreement provided some measure of protection, it did not create sufficient mechanisms for SON to rebuild their commercial fishery and "restore [the SON] fishery to the centerpiece of [SON] culture."[10]

In April 2011, SON and Ontario began negotiations towards a substantive fishing agreement that would ensure enduring protection of both the SON right to fish and the resource itself. On

---

8 See generally the Paul Jones Affidavit.
9 *Ibid,* para. 61.
10 *Ibid,* para. 105.

August 27, 2011, SON and MNR executed a foundational Framework Agreement to assist the parties in negotiating a long-term substantive fishing agreement, including the recognition of the government to government relationship between Ontario and SON, economic measures to build the SON commercial fishery and restore it to its central place in the SON economy, and various governance and resource management provisions.[11]

On January 24, 2013, SON signed a final substantive Agreement with MNR, incorporating and implementing the commitments and obligations contained in the August 2011 Framework Agreement.[12] Attached here for reference is a map indicating SON fishing zones, including Zone 1 surrounding the Bruce Nuclear site.[13] Importantly, the January 2013 Agreement also contained provisions for SON and Ontario to work collaboratively to rebuild the SON fishery by creating a high value, vertically integrated fishery with the aim of maximizing economic benefit to the SON communities. The significance of these efforts is that:

> [P]roperly implemented over the long term, this economic working group can restore our fishery, undoing the effects of our historical exclusion, and make it a center piece of our economy, as it once was ... Our fishing agreements with Ontario set out the foundation for SON, working with Ontario, to rebuild our fishery from the decades' long history of destruction caused by encroachment by European settlers and government actions. This long process of rebuilding is now beginning. Under the 2013 Agreement, for the first time, we can and will restore the fishery to its rightful place within our economy so that it will no longer be the case that only a few fishermen can survive from fishing, but rather that many SON members will be support[ed] by our fishery, whether through catch, assessment, processing, marketing or distribution.[14]

It must be noted that despite these recent efforts to rebuild the commercial fishery and maximize economic benefit, to the SON people the value of their fishery—even their commercial fishery—cannot be understood in simple economic terms. As former Councillor Jones said:

> … The right for any SON member to go to the water to catch a fish to feed his or her family, or to make a living, is a right that cannot be assigned an economic value. Rather, it is fundamental to who we are as a people ... [t]hese lands and waters are part of our

---

11 *Ibid*, paras. 75-81.
12 *Ibid*, para. 85.
13 See Appendix P.
14 Paul Jones Affidavit, para. 92.

> belief system; they are not just 'rights' which are inalienable to our people. This is engrained in our prayers to the creator in regard to the spirits in the lands and waters.[15]

SON has undertaken enormous efforts politically and legally to protect its rights and the fishery itself. SON has intervened in almost every significant regulatory proceeding respecting industrial projects and plans that stood to affect the waters, fish, or fish habitat of Lake Huron and Georgian Bay.

It is the view of SON that their commercial fishery is the basis of a renewed economy for their people and communities. They have fought many decades to protect their right and the resource. SON has just now created the conditions that will allow them to restore their fishery:

> Our goal is to preserve our ability to live off our fishery, as our people always have. The fight for our inherent aboriginal and treaty rights has come at an enormous cost to our communities. But today, for the first time in our recent history, we believe we are on the road to rebuilding our fishery because of 150 years of work and a newly signed 2013 Substantive Fishing Agreement SON negotiated with the Province of Ontario. We are doing so primarily under the terms of that Agreement, while at the same time another arm of the Ontario government is seeking to bury nuclear waste within hundreds of meters from our waters and important spawning grounds.[16]

2.3. SON's Stewardship Rights and Obligations

SON has asserted and proven Aboriginal and treaty rights throughout its Territory and continues to rely on this Territory for its economic, cultural, and spiritual survival. SON asserts its Aboriginal and treaty rights fundamentally entitle its members to be sustained by the lands, waters, and resources of their Territory, and this includes the right to protect and preserve their Territory to ensure that it will be able to sustain its future generations.[17]

The identity of the SON as a Nation, and the members as Anishinaabek people, is manifestly dependent on their connection to the lands and waters of their Territory. The SON people define themselves by their bond to their ancestral home in the Territory, and by their physical connection to the land, water, flora, and fauna. Former Councillor Jones recounted how his father explained the SON connection to their lands and waters:

---

15 *Ibid*, para. 20.
16 *Ibid*, para. 8.
17 Saugeen Ojibway Nation Statement of Rights and Concerns, 18 June 2008 ("SON Statement of Rights"). Attached as Appendix M.

> My elders told me that our land is sacred to all the Ojibway. Anishinaabek surround the Great Lakes. I heard stories of how the Ojibway used to have their sacred ceremonies on the Bruce Peninsula. When they had their sacred ceremonies they could hear the heartbeat of the earth- the waves at Lake Huron against the Bruce Peninsula.[18]

Former Chief Randall Kahgee of the Saugeen First Nation community deposed, "our people and communities rely on our Territory for our cultural identity—the Saugeen Ojibway people and our culture cannot be separated from this place."[19] Former Chief Kahgee quoted Professor Darlene Johnston, a SON member from the Chippewas of Nawash Unceded First Nation community, who gave expert testimony at the Ipperwash Inquiry. She said: "for the Anishnaabeg, the Great Lakes region is more than geography. It is a spiritual landscape."

SON members, like other Anishinaabek people, identify the land as "Mother Earth." They understand the soil, rocks, air, and water as having life and real agency. As will be shared by Community Elder Miptoon during oral hearings, this is not simply mythology for SON members. The land, as the source of all life-sustaining gifts, deserves the utmost care and respect. Noted SON Elder and author Basil Johnston wrote: "Just as the Anishnabeg saw the sun as a symbol of the fatherhood of man, so they saw in the earth, motherhood. A woman, by a singular act with a man conceives and gives birth to new life. … As a woman deserves honour and love for her gift of life, so does the earth deserve veneration."[20] Potawotami biologist and author Robin Wall Kimmerer, who bridges the gap between Indigenous and Western science, described it this way:

> In the indigenous worldview, a healthy landscape is understood to be whole and generous enough to be able to sustain its partners. It engages land not as a machine but as a community of respected non-human persons to whom we humans have a responsibility. Restoration requires renewing the capacity not only for "ecosystem services" but for "cultural services" as well. Renewal of relationships includes water that you can swim in and not be afraid to touch. Restoring relationship means that when the eagles return, it will be safe for them to eat the fish. People want that for themselves too. Biocultural restoration raises the bar for environmental quality of the reference ecosystem, so that as we care for the land, in can once again care for us.[21]

---

18 Paul Jones Affidavit, para. 3.

19 Randall Kahgee Affidavit, para. 44.

20 Basil Johnston, *Ojibway Heritage* (Toronto, Ontario: McClelland & Stewart, 1976), p. 24 ("*Ojibway Heritage*").

21 Robin W. Kimmerer, *Braiding Sweetgrass* (Minneapolis, Minnesota: Milkweed Editions, 2013), p. 338.

SON asserts that it has a foundational right to act as "stewards" of its lands and waters to ensure that they can continue to sustain their cultural and spiritual survival.[22] As will be shared by Community Elder Miptoon orally, Anishinaabek people owe the land a duty of care and respect in return for its sustaining all humans. The term "stewardship" attempts to capture the profound sense of obligation that Anishinaabek hold *to* the land, and consequently to other community users of the land. Anishinaabek people demonstrate respect for plants, animals, and Mother Earth, not only in ceremony and language, but also by carefully managing the gifts, and not "resources," the land offers. It is for this reason that all those responsible for making decisions about the care of the land, including the Commission, must seek wisdom and carry out their responsibilities with humility.

For centuries, the Anishinaabek people, including the ancestors of SON, exercised their stewardship obligations through established custom and practice. Hunting, fishing, farming, trapping, and sugar production were conducted in areas assigned by the *ogimaa*, the community leader. These areas were assigned to community members in such a way as to avoid overuse of the land and to maintain a peaceful community:

> [H]istorical and anthropological evidence also demonstrate proprietorship over other resources, such as fish and firewood, as well as ricing and sugarbush areas. The proprietorship *ogimaag* inherited was not a fee-simple ownership as Anglo Americans understood land ownership; rather it was a governorship or stewardship of the usufruct resources the band lands provided for residents. The *ogimaag* and councils carefully distributed these resources among families in order to limit conflict both between and within their villages.[23] [underline added]

This tradition of caring for the land, being stewards of its use, continues for SON people to this day, with the individual community Councils and SON Joint Council actively managing land use on the reserves and maintaining and asserting SON's right to act as stewards throughout its Territory.

The Anishinaabek people consider those alive today to have the smallest portion of rights to the Territory. The life span of living members is much shorter than that of combined future

---

22 SON Statement of Rights, para. 8.

23 Cary Miller, *Ogimaag: Anishinaabeg Leadership 1760-1845* (Lincoln, Nebraska: University of Nebraska Press, 2010), p. 94.

generations. Consequently, SON has a profound duty to act as trustees for its future generations. Basil Johnston wrote:

> The unborn are entitled to the largesse of the earth, no less than the living. During his life a man is but a trustee of his portion of the land and must pass on to his children what he inherited from his mother. At death, the dying leave behind a mantle that they occupied, take nothing with them but a memory and a place for others to come. Such is the legacy of man: to come, to live, and to go; to receive in order to pass on.[24]

The rights that SON asserts as fundamental to its continued reliance and identity with its Territory, including the right of stewardship, are recognized and supported by the *United Nations Declarations on the Rights of Indigenous People* ("UNDRIP"). Canada has now fully committed to implementing UNDRIP and ensuring federal laws support and are consistent with its provisions.[25] Of particular relevance:

> Article 25
>
> Indigenous peoples have the right to maintain and strengthen their distinctive spiritual relationship with their traditionally owned or otherwise occupied and used lands, territories, waters and coastal seas and other resources and to uphold their responsibilities to future generations in this regard.[26]

> Article 29
>
> 1. Indigenous peoples have the right to the conservation and protection of the environment and the productive capacity of their lands or territories and resources. States shall establish and implement assistance programmes for indigenous peoples for such conservation and protection, without discrimination.
>
> 2. States shall take effective measures to ensure that no storage or disposal of hazardous materials shall take place in the lands or territories of indigenous peoples without their free, prior and informed consent.
>
> 3. States shall also take effective measures to ensure, as needed, that programmes for monitoring, maintaining and restoring the health of indigenous peoples, as developed and implemented by the peoples affected by such materials, are duly implemented."[27]

---

[24] *Ojibway Heritage*, p. 25.

[25] Canada has, for example, announced its support for Bill C-262, *An Act to ensure that the laws of Canada are in harmony with the United Nations Declaration on the Rights of Indigenous Peoples*, 1st Sess, 42nd Parl, 2016.

[26] UN General Assembly, *United Nations Declaration on the Rights of Indigenous Peoples*: resolution / adopted by the General Assembly, 13 September 2007, art. 25.

[27] *Ibid*, art. 29.

> Article 32
>
> 1. Indigenous peoples have the right to determine and develop priorities and strategies for the development or use of their lands or territories and other resources.
>
> 2. States shall consult and cooperate in good faith with the indigenous peoples concerned through their own representative institutions in order to obtain their free and informed consent prior to the approval of any project affecting their lands or territories and other resources, particularly in connection with the development, utilization or exploitation of mineral, water or other resources.
>
> 3. States shall provide effective mechanisms for just and fair redress for any such activities, and appropriate measures shall be taken to mitigate adverse environmental, economic, social, cultural or spiritual impact.[28]

As will be explained below, the historical, ongoing, and future operations of the nuclear industry within SON Territory have had and will continue to have profound impacts on SON rights, including the right of SON to effectively act as stewards and protectors of its Territory. Without full participation by SON in critical decisions respecting the industry through meaningful consultation and accommodation processes, SON is barred from fulfilling its profound cultural obligations as keepers of the land—a fundamental violation of its rights.

2.4. The History of Nuclear Power in SON Territory

In the 1960s, decisions were made to build a nuclear facility at Douglas Point. Those decisions, which first brought nuclear industrialization to the SON Territory and forever changed it, were made without any consultation or involvement of the SON people whatsoever. SON was also not consulted about subsequent decisions to intensify that development through the construction of the world's largest nuclear facility and the construction of the Western Waste Management Facility that would house all low and intermediate-level nuclear waste from OPG owned reactors, in addition to 40% of Canada's used nuclear fuel.

In an effort to change that history of exclusion, SON has taken every opportunity in recent years to engage with proponents and governments respecting proposals for new projects. SON has pushed in all instances to ensure that proposals and applications are reviewed at the highest possible standards and that potential impacts to the SON Territory and on the constitutionally-

[28] *Ibid*, art. 32.

protected Aboriginal and treaty rights of SON, described above, are fully considered and accommodated.

In 2006, when Bruce Power applied to build four new nuclear reactors at the Bruce site, SON engaged in a lengthy consultation and accommodation process with the federal Crown to ensure that the proposal would be reviewed through a robust process that would focus on the project's potential impacts on SON. That engagement proved successful, and the Joint Review Panel Agreement,[29] which included the CNSC as a party, identified SON specifically as having a unique interest in the Territory and the proposal. It also set out a new mandate—beyond the statutory requirements of the *Canadian Environmental Assessment Act*[30] and the *Nuclear Safety and Control Act*[31] (the "*NSCA*")—requiring the joint review panel to take information in support of ongoing consultation efforts between SON and the Crown.

Around the same time, SON engaged with the CNSC staff on OPG's proposed DGR Project to ensure that it too would be assessed at the highest possible standards, and that the impacts on SON would again form a central component of the review. The project was reviewed through an extensive joint review panel process consisting of 33 hearing days over the course of two years. SON also engaged directly with OPG and in 2013 secured a historic commitment from OPG that it would not proceed with its proposed DGR Project in the SON Territory without the support of the SON communities[32]—a commitment which the Crown recently described as "an example of how reconciliation practices can be implemented on the ground."[33] OPG also committed to addressing legacy issues relating to its nuclear facilities in SON Territory. SON has since been working with OPG collaboratively and constructively under that commitment.

More recently, SON obtained a similar commitment from NWMO that it will not select a site for a deep geological repository for Canada's used nuclear fuel waste, in the SON Territory, without

---

29 Agreement to Establish a Joint Review Panel for the New Nuclear Power Plant Project by Bruce Power Within the Municipality of Kincardine, Ontario Between the Minister of the Environment and the Canadian Nuclear Safety Commission.

30 S.C. 1992, c-37.

31 S.C. 1997, c. 9 ("*NSCA*").

32 OPG 2013 Commitment Letter.

33 Letter from the Honourable Catherine McKenna, Minister of Environment and Climate Change, to Lise Morton, Vice President of the Nuclear Waste Management Division of Ontario Power Generation, 21 August 2017.

the consent of the SON communities.[34] That commitment, again, was secured after many years of hard work and engagement between SON and the NWMO.

SON has also entered into a historic agreement with Ontario, referenced above, respecting the protection of the SON Territory. In 2010, SON and the then Ministry of Energy and Infrastructure in Right of Ontario committed through the "MEI Agreement" to build a new positive relationship to reflect and address SON concerns about existing and future energy-related projects in SON Territory and to allow for the development of future projects in ways that are respectful of, and accommodate, SON rights.[35] That agreement speaks directly to the complex challenges posed by the nuclear industry within SON Territory and commits the Crown in Right of Ontario to participate in consultations towards the resolution of those issues. With respect to nuclear development, the agreement acknowledges that the resolution of issues arising from the historical, current, and future operations of the Bruce site will be complex and will require the participation of multiple parties, including SON, Ontario, Canada, Bruce Power, OPG, and the NWMO. The agreement identifies consultation and accommodation processes as the appropriate mechanism for addressing the future of nuclear projects and facilities in SON Territory.

2.5. SON's Concerns with the Bruce Nuclear Generating Station

In the last twenty years, SON and its leadership have made tremendous efforts to ensure that the ongoing operations of the Bruce facility are protective of the SON Territory, and that the physical, radiological, and chemical impacts of the plant are credibly understood and carefully managed.

A primary concern of SON's has been, and continues to be, the interaction between the facility and the waters of Lake Huron. Each year, the facility's once-through cooling system draws several trillion litres of water from Lake Huron, warming it by as much as 13 C before releasing it back into the environment. That system harms fish through physical disturbances, impingement and entrainment, and thermal effects. The reality of these adverse effects is universally acknowledged. CNSC staff have previously described the impingement and

[34] NWMO Commitment Letter.
[35] MEI Agreement.

entrainment effects of the facility as follows:

> …. the ongoing losses of thousands to tens of thousands of adult and juvenile fish (impingement) and millions to tens of millions of fish eggs and larvae and aquatic benthic invertebrates (entrainment) involvement at least 15 species combined. One of the species impinged in very low numbers in recent years is a SARA species (deep-water sculpin)…[36]

Similarly, a representative of Environment and Climate Change Canada ("ECCC") has described the risks associated with the thermal plume created by nuclear power plants as follows:

> Canada's nuclear power plants utilize once-through cooling technology that relies on a large water body as heat sinks. Once-through cooling is an efficient, low cost method of condensing steam back to liquid in the power generation industry. However, it is becoming apparent that there may be ecological risks associated with the often extensive thermal plumes created by the large volumes of cooling water discharged by nuclear power plants.[37]

SON has participated in numerous proceedings during the last fifteen years and consistently engaged with Crown representatives, regulators, and Bruce Power to advocate for more robust and credible assessments of these impacts.

In 2001, Bruce Power initiated an environmental assessment respecting its intention to restart two of its reactors (Units 3&4). SON was extremely concerned about the manner in which ecological effects on lake whitefish had been ignored in the application, and in particular, those identified through a multi-party research initiative (the WINGS Project). SON filed detailed submissions critiquing the work of Bruce Power and CNSC staff and attended the one-day hearing into the screening report in Ottawa on December 12, 2002. The Commission ultimately decided that the interests and concerns of SON could be addressed through a follow-up monitoring program as a condition of the approval. A Lake Huron Whitefish Follow-up Monitoring Program (the "FUMP") was initiated as a result, which was later incorporated into the FUMP for the Bruce A Refurbishment for Life Extension and Continued Operation Project.

SON and its advisors participated actively in the early part of the implementation of the FUMP,

---

[36] Canadian Nuclear Safety Commission, Technical Rationale for Recommendation to the Department of Fisheries and Oceans that an Application for Authorization is Required by Bruce Power, 10 March 2014.

[37] Duck Kim, "Management of the Effects of Thermal Discharge: Environment and Climate Change Canada's Perspective," Canadian Ecotoxicity Workshop (2017), Presentation Abstract.

but later withdrew from active participation, largely because of a concern that the goals and implementation of the program were no longer able to address the key questions of SON. In particular, SON was concerned that the FUMP would not address key questions respecting the impact of the Bruce facility on the total ecology of Lake Huron, and specifically, questions about populations of Lake Whitefish and the impacts on those various populations.

SON raised these concerns with the Commission when in 2008 Bruce Power sought to refuel and restart two refurbished reactors (Units 1&2). As a result of SON's submissions, the Commission imposed on Bruce Power a requirement that it undertake studies that would satisfactorily answer the questions and concerns of SON. At page 7 of its decision, the Commission wrote: "the Commission directs CNSC staff and Bruce Power to continue to work with the Saugeen Ojibway Nation in order to address the Saugeen Ojibway Nation's concerns regarding the whitefish follow-up monitoring as expeditiously as possible."[38] Following from the Commission's decision, in 2009, SON and Bruce Power negotiated terms and initiated a research program called the "Collaborative Lake Whitefish Research Program." That research program was carried out between 2011 and 2015, but has yielded mixed results. From SON's perspective, the program suffered operational challenges that precluded effective collaboration and resulted in a set of discreet, non-integrated studies, by researchers from different institutions. Further, while some useful new data appear to have been collected, from SON's perspective, and based on the studies that SON had more direct involvement with, the studies have raised more questions than they have answered but suggest useful directions for necessary future research.

Although SON representatives stopped their active participation in the FUMP process in approximately 2007 for the concerns set out above, SON continued to monitor the progress and implementation of the FUMP. In July 2011, Bruce Power distributed to regulatory agencies, SON, and stakeholders a draft of its Entrainment and Impingement Monitoring Plan ("Monitoring Plan"). On October 5, 2011, SON technical experts from the University of Guelph—at the request of SON—reviewed the document and filed a list of 296 concerns with the Monitoring Plan. The concerns addressed many topic areas including, for example,

[38] Canadian Nuclear Safety Commission, Record of Proceedings Including Reasons for Decision in the Matter of Bruce Power Inc. Application to Renew the Power Reactor Operating Licence for the Bruce A Nuclear Generating Station and Approval to Reload Fuel for Bruce A Units 1 and 2, 1 October 2009, p. 7.

deficiencies in sampling design and the definition of key terms, problematic assumptions with respect to population discrimination, and a lack of supporting documentation.

Subsequently, in spring 2012, Bruce Power released a revised draft of the Monitoring Plan and, in a letter sent to SON technical experts, stated that SON input and comments had been incorporated into the revised Monitoring Plan. However, a review of the revised Monitoring Plan by the SON experts revealed no reference to the 296 comments or explanation as to how the comments had been addressed. In a report evaluating the adequacy of Bruce Power's response to each of the 296 comments, SON experts concluded that only 16 of the 296 comments had been dealt with effectively, and stated "[t]he University of Guelph Team remains seriously concerned that the vast majority of their comments (280/296 = 94.6%) were either ignored by Bruce Power, or were responded to in a manner that did not deal effectively with the issues and concerns that were raised."[39] That report was circulated to Bruce Power and CNSC staff.

CNSC staff have acknowledged the concerns articulated in the October 5, 2011 submission and CNSC staff and SON have now begun engagement to develop a process to systematically address the concerns raised in that submission. To date, however, SON's concerns remain unresolved and Bruce Power's impingement and entrainment monitoring efforts continue to suffer from the deficiencies identified by SON. As explained below, until these critical gaps in data and analysis can be filled, SON's position remains that no credible conclusions can be drawn regarding the population-level effects of impingement and entrainment.

SON has also been engaged directly with Bruce Power regarding the thermal effects of the Bruce facility. Current engagement between SON and Bruce Power on thermal effects began with Bruce Power's application to the Ontario Ministry of the Environment and Climate Change ("MOECC") for an amendment to its Thermal Environmental Compliance Approval ("ECA") to increase the temperature limit on Bruce Power's discharge. SON opposed the change on the basis that there was insufficient data to support the conclusion that the change would have no adverse effect on the natural environment. MOECC has not yet granted Bruce Power a

[39] Steve Crawford, Dan Gillis, Robert Hanner, and Andrew Binns, "Saugeen Ojibway Nation-Bruce Power (SON-BP) Collaborative Lake Whitefish Research Program, University of Guelph Team Comments Regarding 'Bruce A Refurbishment for Life Extension and Continued Operations Environmental Assessment Followup Program - Draft Operations Phase Impingement and Entrainment Monitoring Plan,'" 5 October 2011 ("the 296er"). Attached as Appendix G.

permanent amendment. Instead, Bruce Power is operating under a temporary amendment, and has been directed by MOECC to work with SON to resolve any "environmental issues from the ECA application… that may specific impact on [SON's] Aboriginal and treaty rights."[40] SON's engagement with Bruce Power and MOECC is ongoing and SON continues to have unresolved concerns respecting the impacts from Bruce Power's thermal discharge.

2.6. SON's Concerns with the Refurbishment Project

Since SON first learned of the Refurbishment Project, SON has been clear about its deep concerns with the project. From SON's perspective, the Refurbishment Project represents a rebuilding of the facility so that it can operate for another 50 years—essentially, a doubling of the life of the facility. To SON, this represents one of the most significant projects ever proposed in SON Territory and is as significant to SON's future as the initial decision to build the facility in the Territory. It is a multi-billion dollar, multi-year project, that is expect to extend the operating life of the Bruce Nuclear Generating Station until 2064, and will lead to the continued, and potentially increasing, degradation of the environment of the SON Territory for the next fifty years. It will certainly have significant and enduring impacts on the rights and interests of the SON people.

SON has also been clear that the project can only proceed after there has been a full and robust review process to consider its potential impacts on SON rights, and deep consultations with the Crown to ensure necessary accommodation measures are in place. In a meeting on February 27, 2017, between SON and CNSC staff before Bruce Power had submitted its application, SON told CNSC staff that it was deeply concerned that the project could proceed without a full environmental assessment under *Canadian Environmental Assessment Act, 2012*[41] ("*CEAA, 2012*"). SON told CNSC staff that they would need to work together with SON to plan a robust process capable of satisfying SON's concerns if the review was going to proceed under the *NSCA*. In September 1, 2017, without any consultation with SON or follow up to the discussions

[40] Letter from the Ontario Ministry of the Environment and Climate Change to Kathleen Ryan, Territorial Resources Coordinator for the Saugeen Ojibway Nation, 15 July 2016.
[41] S.C. 2012, c. 19, s. 52.

between SON and CNSC staff, CNSC announced dates for a hearing to consider the licence renewal application under the *NSCA* a mere six months after the announcement.

SON held two subsequent meetings with CSNC staff, the first in September and the second in October. In both cases, SON hoped that there could be serious and meaningful discussions about the concerns SON had been raising with respect to the proposed review process and how CNSC, as the Crown, would address those concerns. Instead, during the first meeting, on September 12, 2017, SON was told by CNSC staff that the process had already been determined—that is, SON's representatives were told that "the train had already left the station" and would not be called back. Even though SON was told there was still room to talk about its concerns, SON's representatives left that first meeting feeling that CNSC staff had closed the door to meaningful discussion, and that their strategy moving forward would not be to change the CNSC's process, but to manage SON's concerns. The second meeting, on October 19, 2017, was more productive, but the discussion did not produce any substantive proposals on how SON's concerns could be addressed or how the proposed process could be modified to accommodate them.

On November 14, 2017, SON wrote to the Commission directly to express its concerns that the review process planned would not be capable of satisfying the Crown's constitutional obligations and to request an adjournment of the hearings.[42] Specifically, SON submitted that the process announced by the Commission would not leave SON with sufficient time to engage with the issues raised by the application, for Bruce Power to remedy gaps in its application respecting the assessment of impacts and evaluation of mitigation measures, or for the Crown to address SON's concerns with the project. The Commission denied SON's request and directed SON and CNSC staff to work together to address SON's concerns.[43]

SON has been working with CNSC staff since. That engagement has confirmed what SON suspected—namely, that it would not be possible for the Crown to substantively satisfy SON's concerns in the short time made available prior to the licence renewal and refurbishment

---

[42] Letter from Chief Greg Nadjiwon, Chippewas of Nawash Unceded First Nation, and Chief Lester Anoquot, Chippewas of Saugeen First Nation, to Michael Binder, President and CEO of the Canadian Nuclear Safety Commission, 14 November 2017 ("SON to CNSC November 2017 Letter"). Attached as Appendix H.

[43] Canadian Nuclear Safety Commission, Reasons for Decision in the Matter of Request from the Saugeen Ojibway Nation for Adjournment of the Hearing on the Application to Renew the Bruce A&B Power Reactor Operating Licence, 21 December 2017.

authorization hearings. SON has engaged in discussions with CNSC staff more recently on potential procedural mechanisms that might frame an acceptable path forward by ensuring that there is a clear commitment and plan for addressing SON's concerns. To be clear, these discussions have sought only to define potential procedural safeguards and commitments. No adequate accommodations of SON concerns have yet been provided. This is explained in section 5.2 below.

SON maintains that the current regulatory review process has provided insufficient time for a full and meaningful review of the application by SON, and has provided insufficient time for a meaningful consultation process between SON and the Crown with respect to the licence renewal and Refurbishment Project.

3. LEGISLATIVE AND COMMON LAW REQUIREMENTS FOR APPROVAL

Bruce Power requests, as part of its current licence renewal application, Commission approval to carry out certain activities as part of a major Refurbishment Project of six of its nuclear reactors, which it refers to as its Major Component Replacement project. SON submits that there are both legislative and common law requirements that must be met by the Commission as it considers whether to grant Bruce Power the authorizations it seeks with respect to its proposed Refurbishment Project.

3.1. Legislative Requirements[44]

Section 24(4) of the *NSCA* sets out the Commission's legislative responsibilities in connection with Bruce Power's application. It requires that the Commission ultimately be satisfied that the licensee will "make adequate provision for the protection of the environment:"[45]

> 24(4) No licence shall be issued, renewed, amended or replaced — and no authorization to transfer one given — unless, in the opinion of the Commission, the applicant or, in the case of an application for an authorization to transfer the licence, the transferee
>
> > (a) is qualified to carry on the activity that the licence will authorize the licensee to carry on; and
> >
> > (b) will, in carrying on that activity, make adequate provision for the protection of the environment, the health and safety of persons and the maintenance of national security and measures required to implement international obligations to which Canada has agreed.

Here, prior to granting a renewal of Bruce Power's operating licence, which includes authorization to carry out steps in furtherance of its Refurbishment Project, the Commission must be satisfied that Bruce Power has made adequate provision for the protection of the environment *in relationship to that project*.

---

[44] In letters to the Commission and Minister McKenna on November 14, 2017, SON indicated its profound concern with the review of the refurbishment project under the *NSCA* rather than *CEAA 2012*, noting its more narrow scope of review and fewer procedural safeguards. We must note now that *CEAA 2012* is set to be replaced by the new *Impact Assessment Act*, tabled by the federal government as Bill C-69 in February 2018. Under the proposed legislation, the Refurbishment Project would certainly be reviewed by panel, taking into consideration a broad range of impacts including cultural, economic, and rights impacts on SON. SON would also have increased participation opportunities, including in the design and conduct of the review.

[45] *NSCA*, s. 24(4).

Additional legislative and regulatory requirements pertain to how the requirements of s.24(4) of the *NSCA* must be fulfilled. In particular, REGDOC 2.9.1[46] outlines the regulatory requirements that guide CNSC's fulfillment of its environmental protection obligations. It includes as a "guiding principle" a commitment to "respect the precautionary principle:"

> For each facility or activity that has direct interactions with the environment, the CNSC must determine that the licensee or applicant has made adequate provision for the protection of the environment. The applicant or licensee's licence application shall demonstrate (through performance assessments, monitoring or other assessments) that their environmental protection measures:
>
> …
>
> - respect the precautionary principle, the "polluter pays" principle, and the concepts of pollution prevention, sustainable development and adaptive management

SON submits, and will explain below, that the current application contains serious and material deficiencies that prevent the Commission from concluding, or accepting CNSC staff conclusions, that Bruce Power has made "adequate provisions for the protection of the environment" in relation to its Refurbishment Project. Further, SON submits that regulatory requirements for the CNSC to fulfill its mandate under the *NSCA* in a manner that respects the precautionary principle have not been met, in particular, due to Bruce Power's failure to consider available mitigation measures or provide a mitigation measures plan.

3.2. Common Law Requirements - s.35 Duty to Consult

3.2.1. The Duty to Consult

In addition to legislative requirements that fall on the Commission and CNSC staff under the *NSCA*, there are "super-added" and constitutionally based requirements imposed by the common law on the duty to consult and accommodate. The duty to consult is a well-established principle in Canadian law. The Crown has a duty to consult and, where appropriate, accommodate when the Crown contemplates conduct that might adversely impact potential or established Aboriginal and treaty rights. The level of consultation required must be determined on a case-by-case basis

[46] Canadian Nuclear Safety Commission, REGDOC 2.9.1: *Environmental Protection: Environmental Principles, Assessments and Protection Measures*, s. 2.1 ("REGDOC 2.9.1").

and is proportionate to: (1) "a preliminary assessment of the strength of the case supporting the existence of the right" and (2) "the seriousness of the potentially adverse effect upon the right."[47]

SON's position has been clear since the Refurbishment Project was first announced that the proposal stands to have serious impacts on SON's rights and interests and that the obligations resting on the Crown in this case fall at the highest levels on the spectrum. The Refurbishment Project, which will allow for the continued operation of six nuclear reactors in the heart of the SON Territory, will have serious and lasting impacts on established SON rights and the SON Territory including:

- Cumulative and adverse impacts and stress on the waters and aquatic life in SON Territory over the next four to five decades;
- Continued and increasing nuclear waste generation in the SON Territory;
- Increased duration of risk of accidents and malfunctions posed to SON lands, waters and people;
- Ongoing impacts and risks to SON identity and connection to the land and use of the land for cultural, spiritual, and sustenance purposes;
- Socio-economic impacts relating to the SON commercial fishery and tourism economies; and
- A many decades long delay in the decommissioning of the facility and abatement of ongoing environmental impacts.

SON submits that the strength of SON's Aboriginal and treaty rights assertions, confirmed by both the courts and through multiple agreements with the Crown, and the seriousness of the impacts from the Refurbishment Project, not only trigger a duty to consult, but place that duty on the highest end of the spectrum.

3.2.2. Crown Obligations under the Duty to Consult

SON submits that the significance of the Refurbishment Project, and its potential long-term impacts on SON rights and interests places a significant obligation on the Crown, as represented by the Commission, CNSC staff, and other federal Crown agents, to understand and accommodate SON's concerns with respect to the Refurbishment Project.

---

47 *Haida Nation v British Columbia (Minister of Forests),* 2004 SCC 73, para. 39 ("*Haida*").

SON does not accept CNSC staff conclusions[48] on the scope of the duty owed to SON with respect to the Refurbishment Project and submits CNSC staff have mischaracterized the nature and potential impacts of the Refurbishment Project and fundamentally misunderstood the law with respect to the duty to consult.

In their Commission Member Document, CNSC staff have suggested that because the Bruce Nuclear Generating Station is an existing facility, any duty to consult that exists falls "at the low end of the spectrum."[49] Their conclusion rests on the assertion that the Refurbishment Project represents a "brownfield project" that will introduce no "novel adverse impacts." CNSC staff seek to rely on the *Rio Tinto* decision in which the Supreme Court of Canada held that the duty to consult attaches to "novel adverse impacts" flowing from the specific Crown proposal at issue and not to larger adverse impacts of a project including past and continuing breaches.[50]

In a letter dated March 9, 2018 to CNSC, SON legal counsel explained SON's position that CNSC staff have misunderstood "novel adverse impact" to mean a *new type of impact* rather than a *new impact*, and have consequently, mistakenly applied *Rio Tinto* to Bruce Power's Refurbishment Project:

> The *Rio Tinto* case was concerned with the British Columbia ("BC") Utilities Commission's approval of an energy purchase agreement between Rio Tinto Alcan and the BC Hydro and Power Authority for excess electricity generated from an existing dam project. No physical work or changes to the facility were being proposed. The Commission was asked to consider only whether the energy purchase agreement was in the public interest. It was common ground that the facility would continue to operate and produce electricity at the same rates whether or not the energy purchase agreement was approved.
>
> In the specific facts of the case, the Court found that no new duty to consult was triggered – not on the basis that no decision relating to an existing project can trigger the duty, but rather because the duty to consult relates "to adverse impacts flowing from the specific Crown proposal at issue – not to larger adverse impacts of the project of which it is a part. The subject of the consultation is the impact on the claimed rights of the current decision under consideration." No duty to consult arose in the *Rio Tinto* case because no physical changes at all were being proposed, and Crown approval of the energy purchase

48 CNSC Staff, Commission Member Document on Licence Renewal for Bruce Nuclear Generating Station A and B, 12 February 2018, p. 141-142 ("Commission Member Document").
49 Commission Member Document, p. 138.
50 *Rio Tinto Alcan Inc v Carrier Sekani Tribal Council*, 2010 SCC 43, para. 49.

> agreement would not have any physical impact on the waters and fisheries to which the rights of the First Nations attached.
>
> This stands in stark contrast to Bruce Power's proposed Refurbishment Project and the authorization it seeks in the current application.
>
> …
>
> [The potential impacts of refurbishment] are significant impacts, and impacts that would not exist if refurbishment was not carried out. That these are new, or "novel," impacts cannot be reasonably disputed – these impacts would not exist but for the refurbishment activities. We can only assume that CNSC staff, in their assessment, have misunderstood "novel adverse impacts" to mean "a new type of impact," rather than "a new impact." In fact, the impacts that will be caused by the refurbishment are not materially different than the impacts that would be generated if Bruce Power decided to build new reactors rather than refurbish old ones. When Bruce Power proposed a new build in 2006, it was proposed to be reviewed by a Joint Review Panel under the *Canadian Environmental Assessment Act* and attracted the highest levels of consultation and accommodation obligations...[51]

SON's position is clear—CNSC staff's analysis of the requirements of the duty to consult owed to SON is wrong. Any decisions, or Crown actions guided by the analysis, will be vulnerable to legal challenge as a breach of the duty. It strains credulity to deny that the Refurbishment Project—which will double the lifespan of the world's largest operating nuclear reactor complex and constitute the largest industrial project in Ontario history—would attract anything other than the highest level of consultation obligations.

3.2.3. Obligations on the Commission under the Duty to Consult

It is clear that the Commission, as an agent of the federal Crown both by article and function of its constituting legislation, is subject to the duty to consult.[52] As such, it is required to ensure that the duty is fulfilled in relation to the decisions it makes on the Refurbishment Project.

---

[51] Letter from Alex Monem, Legal Counsel to the Saugeen Ojibway Nation, to Luc Sigouin, Director of the Bruce Regulatory Program Division for the Canadian Nuclear Safety Commission, 9 March 2018 ("March 9 Letter"). Attached as Appendix I.

[52] Under s. 8(2) of the *NSCA*, the Commission is identified as an agent of the Crown. Further, *Clyde River* makes clear that the function of the regulatory body can de facto render it an agent of the Crown "once it is accepted that a regulatory agency exists to exercise executive power as authorized by legislatures, any distinction between its actions and Crown action quickly falls away." *Clyde River (Hamlet) v Petroleum Geo-Services Inc*, 2017 SCC 40, para. 29 ("*Clyde River*").

The Supreme Court of Canada in the recent *Clyde River* case, has clarified the role of regulatory agencies, like the Commission, in relation to the duty to consult.[53] The Court confirmed that ultimate responsibility for ensuring the adequacy of consultation remains with the Crown, but that the Crown may rely on steps undertaken by a regulatory agency to fulfill aspects of the duty to consult. Whether the Crown is capable of relying on a regulatory agency depends on whether the agency's statutory duties and powers enable it to do what the duty requires in the particular circumstances.[54] This includes a determination of whether the agency is capable of providing necessary accommodations.[55]

In *Clyde River*, the Court considered specifically whether the Crown could rely on a National Energy Board ("NEB") process to fulfill the duty to consult, where the NEB was the final decision-making authority. The Court concluded it could. Instrumental in its decision was a consideration of the NEB's procedural powers, and expertise, in implementing consultation processes;[56] the NEB's powers to attach any terms and conditions to authorizations it issues, and to make the authorization contingent on their performance; and most importantly, the NEB's ability to require accommodation by exercising its discretion to deny an authorization or by reserving its decision pending further proceedings.[57] SON submits the exact conditions obtain here in relation to the Commission and its procedural and remedial powers under the *NSCA*.

The Court, in *Clyde River*, further confirmed that a regulatory body with authority to decide questions of law has both the duty and authority to apply the *Constitution Act, 1982*, unless the authority to decide the constitutional issue has been clearly withdrawn—"it follows that they must ensure their decisions comply with s.35 of *the Constitution Act, 1982*."[58]

Finally, the Court in *Clyde River* confirms that the duty must be fulfilled *prior to* a decision being made. Relying on both *Haida* and *Tsilhqot'in*,[59] the Court held that where the regulatory agency is the final decision-maker, "the key question is whether the duty is fulfilled prior to project approval." Where the Crown's duty to consult remains unfulfilled the regulatory agency

---

53 *Ibid.*
54 *Ibid*, para. 30.
55 *Ibid*, para. 30.
56 *Ibid*, para. 34.
57 *Ibid*, para. 32.
58 *Ibid*, para. 36.
59 *Tsilhqot'in Nation v British Columbia*, 2014 SCC 44.

must withhold project approval. And, where the agency fails to do so: "its approval decision should (as we have already said) be quashed on judicial review, since the duty to consult must be fulfilled prior to the action that could adversely affect the right in question."[60]

SON submits that the Commission cannot authorize Bruce Power to carry out activities as part of the Refurbishment Project *unless* the Commission determines that constitutional obligations owed to SON under the duty to consult have been fulfilled and, in particular, that its concerns relating to that project have been properly understood and necessary accommodations have been made.

As will be explained in detail in section 5.2 below, SON has made significant efforts to engage with both CNSC staff and the Bruce Power to explain and attempt to resolve its concerns relating to the Bruce facility and the Refurbishment Project. SON has engaged both the federal and provincial Crowns, as well as OPG and NWMO to ensure its broader concerns relating to the nuclear industry and nuclear wastes are understood and addressed. These matters are subject to ongoing engagement and consultation efforts.

Despite these efforts, no substantive accommodation measures have yet been developed and implemented that would ensure the protection of SON rights and interests in relation to the Refurbishment Project. SON submits that in the absence of such accommodation measures, approval of the Refurbishment Project, or the authorization of activities in furtherance of refurbishment, will represent a failure to discharge the duty owed to SON.

60 *Clyde River*, para. 39.

4. DEFICIENCIES IN BRUCE POWER'S APPLICATION

Bruce Power has produced, in support of its request for renewal of its operating licence and for authorization to proceed with refurbishment activities, two documents assessing the environmental impacts of its operations. SON submits that, collectively, the deficiencies inherent in these two reports materially undermine their reliability as the basis for sound decision-making and cannot support credible conclusions on current and future impacts from the Bruce facility, including impact that might be caused by the Refurbishment Project.

4.1. Critical Deficiencies in Monitoring and Characterization of Impacts

The first of the two documents submitted by Bruce Power, the Environmental Quantitative Risk Assessment ("EQRA" or "ERA"), addresses the interaction between Bruce Power's current operations and the environment. It asserts, like earlier assessments carried out by Bruce Power, that the facility's activities are protective of the environment. But two critical issues undermine the conclusions of the assessment: (1) the report relies heavily on data and analysis that SON has long challenged as unreliable and that are the subject of ongoing processes between SON and CNSC staff, and (2) where the report presents new data, critical information is lacking.

4.1.1. Reliance on Flawed Data and Methodologies

SON has engaged with both Bruce Power and CNSC staff for many years on issues related to the impacts of impingement and entrainment on Lake Huron fish ecology. SON has consistently raised issues regarding the data and analysis on which Bruce Power and CNSC staff rely to draw conclusions respecting the magnitude and significance of impacts on fish populations. SON's concerns are well-documented and relate to a range of issues from deficiencies in sampling design in monitoring programs and assumptions about population discrimination to concerns around the absence of any cumulative effects assessment.[61] SON's concerns—including those respecting the FUMP described in section 2.5—have not been resolved. They are the subject of an ongoing process between SON and CNSC staff, described below.

[61] The 296er. Dr. Scott Findlay, "Workshop Follow-Up Report for Saugeen Ojibway Nation – Canadian Nuclear Safety Commission Science Facilitation Workshop," 19 September 2017 ("Findlay Report"). Attached as Appendix F. Written Submissions of the Saugeen Ojibway Nation on the Application to Renew the Power Reactor Operating Licence for the Bruce Nuclear Generating Stations A and B, 16 March 2015, pp. 12-19.

SON has said that until these issues and gaps are resolved, no credible conclusions respecting the impacts of impingement and entrainment can be drawn. Bruce Power's EQRA, however, continues to heavily on data derived from the same programs SON has consistently challenged to support conclusions respecting impacts of the Bruce facility from entrainment and impingement.[62]

4.1.2. New Information Not Sufficient to Close Gaps

SON submits that even where the EQRA presents new data and analysis—for example, in its discussion of thermal effects—critical information required to make credible conclusions respecting impacts is missing. As explained in a SON staff report on thermal effects:

> The thermal effects information presented in EQRA is broader in scope (than the ECA) and includes consideration of the entire year, as well as the discharge at both Bruce A and Bruce B. However, the information and interpretation of the thermal discharge/plume data are still coarse and the EQRA does not present or discuss thermal modelling.[63]

The new information presented in the EQRA consists of thermal monitoring data from five summer seasons and three winter seasons. In the report, Bruce Power compares that data with thermal criteria or benchmarks for various fish species using the hazard quotient ("HQ") method set out in CSA Standard N288.6-12. Notably, for a number of fish species, the measured temperatures exceed the benchmarks resulting in an HQ of greater than 1 (and in some cases, far greater than 1), which under the CSA Standard, indicates a "potential for direct thermal effects" warranting additional study. But, as SON staff explain, Bruce Power chooses not to carry forward the potential risk for further evaluation:

> On page 225 of the EQRA (Thermal Effects), BP provides a Maximum and Avoidance Hazard Quotient analysis to determine if various fish species and life stages would be impacted by the thermal discharge. The input data for this analysis are temperature benchmarks for select fish species taken from the literature (critical thermal maximums and short-term maximums) and data from multiple temperature monitoring sites in the vicinity of the discharge. The analysis shows that during the egg/incubation life stage,

---

[62] CNSC staff now acknowledge the existence of uncertainties and, in their Environmental Assessment Report, recommend that Bruce Power "provide means by which they can reduce uncertainties to improve quantification during future monitoring," but they continue to conclude that the facility is protective of the environment. CNSC Staff, Environmental Assessment Report for Bruce Power Inc. – Bruce Nuclear Generating Station A and B – PROL 18.00/2020 Licence Renewal, p. 45.

[63] Saugeen Ojibway Nation Environment Office, "Report on Thermal Effects," p. 2 ("SON Thermal Report"). Attached as Appendix D.

> Emerald Shiner (Notropis atherinoides) was in exceedance 66% of the time between July and August. This did not lead BP or CNSC to determine that there was potential for significant effect, even though this was not the only fish species that exceeded the HQ for relatively high percentages of time (multiple species between 30% and 66% of the time).[64]

Instead of assessing the potential risks further, Bruce Power determines that further assessment is not required—in part, by applying criteria[65] it asserts are required to distinguish temperature variations caused by the thermal discharge from natural lake conditions. The use of such criteria to evade further assessment is not contemplated by the HQ method set out in the CSA Standard, and, SON submits, is wholly unjustified. SON notes that ECCC identified the same concern with Bruce Power's failure to carry forward HQ>1 exceedances for further assessment:

> [T]he HQ value of 5.4 (intra) and 7.04-6.87(inter) spawning stage of Yellow Perch seems to indicate more than a trivial potential for causing adverse effects during spawning. However no additional analysis is presented for this. Smallmouth Bass also experienced HQ>1 exceedance during the egg/incubation stage but as with the Yellow Perch spawning stage, no additional analysis was presented.[66]

Only with respect to Lake and Round Whitefish eggs does Bruce Power acknowledge the need for further assessment. Even here, Bruce Power's analysis does not support a credible conclusion of "low risk." Bruce Power's additional assessment consists largely of a summary scientific studies based on laboratory studies that are not necessarily reflective of "the conditions that the thermal plume creates, the aquatic biota, or the conditions present in the receiving environment."[67] Critical information, such as the size of the thermal plume in the winter months or on the nature of the "aquatic fish communities present," that would be required to understand the magnitude of potential impacts is absent:

> Understanding thermal dynamics in the winter months is of high importance in the context of lake whitefish (a high value fish species to the SON). During the winter (Nov – April), all life stages of lake whitefish are present in the vicinity of BNGS. Lake

---

64 *Ibid*, pp. 4-5.

65 Bruce Power makes the argument that only those sites with an HQ of greater than 1 for a percentage of time 25% greater than at the reference site, or with a maximum HQ 50% greater than the reference site require further assessment, but provides no scientifically credible basis for the 50% and 25% criterion used to dismiss the need for further assessment of the potential harm to fish species.

66 Letter from Luc Sigouin, Director of the Bruce Regulatory Program Division for the Canadian Nuclear Safety Commission, to Frank Saunders, Vice President of Nuclear Oversight and Regulatory Affairs for Bruce Power, 3 April 2018, Enclosure D, comment 5.

67 SON Thermal Report, p. 3.

whitefish adults spawn (Nov /Dec), embryos overwinter (Nov – Apr) and larvae hatch (Apr). This means that all life stages of lake whitefish are susceptible to impacts from the thermal discharge and impingement /entrainment, yet these impacts have not been quantified. Michael C. Nichols (Ph.D., CHP – Chesapeake Nuclear Services) provided independent review of the EQRA for SON and has identified specific recommendations that would enhance our understanding of the potential (real) impacts to spawning, overwintering and newly hatched lake whitefish within the vicinity of the site (Appendix B).[68]

Mike Nichols, an independent consultant engaged by SON, has noted the absence of critical information respecting thermal impacts, including:[69]

- No description in the ERA under Cold Weather Conditions of the buoyant plume, the vertical extent of the plume, direction, or distance until it decreases to 4°C.

- No information provided on the direction, vertical and horizontal extent, and variation with time of thermal plumes that may affect temperature differences at specific sites when compared to "ambient" sites 1 and 29.

- No presentation of temperature data by day, week, or month which may indicate variation in the path of the thermal plume over time. No indication of the range temperatures is provided for each site during cold weather conditions. While temperature results for the winter spawning period is evaluated for the entire cold weather season, there is no corresponding monitoring of hatch success and larval development as the Phase III of the objective was eliminated.

- BP infers from the three seasons of temperature monitoring and comparison to laboratory-based studies that there is "no significant risk to survival" for Lake Whitefish eggs. No data are provided regarding the actual spawning times and locations for Lake and Round Whitefish relative to thermal plumes that exist during cold weather conditions (i.e. the known spawning period).

- Table 37 "Delta T Thermal Criteria for Fish Species (°C)" (page 209) limits the scope for considering Delta T to sites 11, 9, 5 for Lake and Round whitefish. The tabulated results indicate the Delta T criteria of 3.7°C is exceeded 30% of the time at site 9B.

- The Risk Assessment HQ are only indications of potential thermal impact and not indications of the presence or absence of Valued Ecosystem Components.

Together, these and other uncertainties seriously undermine the credibility of the report. As the SON staff report explains:

---

68 *Ibid,* p. 3.

69 *Ibid,* Appendix B: pp. 21-22.

> The key point here is that given the nature and number of gaps and uncertainties in our collective knowledge about the thermal impacts of BNGS, the determination by BP and CNSC staff of "low to negligible impact" cannot be made with confidence. In fact, these gaps make it irresponsible to make a determination of "no effect" or "little to no risk".
>
> In engagement with BP, SON has utilized a number of Western Scientific ("WS") experts to examine the impacts of BNGS on the environment. It is not only the SON's own perspectives stemming from a cultural understanding and awareness, but the WS evaluations that have identified these same flaws, gaps and inconsistencies in Bruce Power's monitoring/assessment/data analysis methodologies and interpretations.[70]

Professor Marc Cadotte, speaking to the robustness of the report, similarly questions the EQRA's ability to assess potential environmental impacts, noting broadly that "the report has a general lack of data and analysis, which would normally be required to support conclusions."[71]

4.1.3. SON-CNSC Staff Process to Address Uncertainties and Issues Ongoing

In a facilitated workshop held on May 25, 2017, SON and CNSC staff began an important process to discuss SON's longstanding concerns with the characterization of the impacts of the Bruce facility and to work towards their resolution.

A major focus of the workshop was on impingement and entrainment impacts, but it also touched upon broader and more foundational questions on which SON and CNSC staff have had disagreement over the last fifteen years including: (1) how regulatory decisions should be made in the face of uncertainty and what level of uncertainty should be tolerated, (2) in what circumstances adaptive management can be appropriately operationalized and in what cases reliance on the approach is inappropriate, and (3) how the impact of various stressors acting in concert, as well as cumulative effects, should be assessed.

The discussion and outcomes of the workshop were documented in a comprehensive follow-up report from the facilitator.[72] On cumulative effects, for example, the report summarized the key issue and difference in perspective between SON and CNSC staff as follows:

---

70 SON Thermal Report, p. 5.

71 Dr. Marc W. Cadotte, "External review of Bruce Power environmental risk assessments," 20 April 2018, p. 8 ("Cadotte Report"). Attached as Appendix B. He also notes that the report focusses singularly on individual effects on organismal performance and survival with little consideration of ecological and food web effects, and fails to consider in any credible manner interactive effects among stressors.

72 Findlay Report.

> In its review of the 2012 EIMP, SON raised concerns about population–level cumulative effects over time from BNGS operations, as well about the apparent decision (by BNGS) to consider the significance of cumulative effects as pertaining strictly to the residual effects of entrainment and impingement as a result of BNGS Units 1-4 operations, rather than considering the significance of these effects in light of other BNGS-derived stresses (e.g. thermal pollution) as well as non BNGS-derived effects on identified VECs (e.g. commercial LW fisheries). More generally, SON has concerns that environmental monitoring generally, either as stipulated in EA FUPs or as part of the NSCA regulatory regime, be designed in such a manner as to provide adequate characterization of cumulative effects of BNGS operations.
>
> For its part, CNSC acknowledged the difficulties and associated large uncertainties in CEA, especially at the level of individual projects. Some of these difficulties may be reduced for CEA prosecuted in the context of regional environmental assessments (REAs), which at least provide opportunities for more appropriate spatial and temporal bounding and for the determination of baseline conditions. CNSC noted, however, that REAs will almost certainly impinge upon areas of provincial jurisdiction or authority, and as such, would require cooperation with relevant provincial agencies. CNSC also noted that with respect to cumulative effects of the BNGS, environmental monitoring under the *NSCA* may be a better vehicle than the EIMP, as *FAA* considers only the effects of entrainment and impingement.[73]

The report also included a set of recommendations for a series of additional workshops required to come to resolution on the issues discussed between the parties. Specifically, it identified five issues as requiring additional discussion: (1) the site-specific implementation of CNSC's regulatory decision-making framework for environmental effects of the Bruce facility, (2) the role and application of the scientific method in environmental monitoring, (3) cumulative environment effects assessment of the Bruce facility, (4) operationalizing adaptive management of environmental effects of the Bruce facility, and (5) entrainment and impingement monitoring reliability and the *Fisheries Act* authorization.[74]

On cumulative effects, for example, the facilitator recommended discussions to address the following:[75]

> *Issue 3: Cumulative environmental effect assessment of the BNGS*
>
> During the workshop, the Parties [agreed] that environmental monitoring at the BNGS should provide a better estimate of cumulative effects over time, over space, and over

[73] *Ibid*, p. 10.
[74] *Ibid*, pp. 17-21.
[75] *Ibid*, p. 19.

activities. How such estimates might best be obtained was considered an important issue, but one for which there was insufficient time to thrash out. Further progress on this issue will require the Parties to:

(a) Present their respective views on the appropriate spatiotemporal bounding for adequate cumulative effects assessment of the E&I effects (minimally) as well as other effects (ideally) of the BNGS, as well as the underlying rationale for same;

(b) Specify the set of relevant past, current or potential future activities that should, in their view, be considered in CEA and associated monitoring;

(c) Consider the implications of (a) and (b) to project versus regional environmental assessment. Of particular importance here would be the extent to which CEA for the BNGS could feasibly be prosecuted in the context of project EA, versus requiring regional assessment.

SON and CNSC staff have since met twice and discussions are ongoing. There has not yet been any resolution of the issues that are the subject of discussions between SON and CNSC staff.

The current application provides no new data, analysis, or proposals that could address the issues. SON submits that until these issues—which go to the heart of the credibility of the assessment of the Bruce facility's impacts—are resolved, the SON communities cannot have confidence in the reliability of the assessment of the impacts of the facility on the environment and on SON rights.

4.2. No Credible Assessment of Future Impacts

The second report submitted by Bruce Power in support of its application, and specifically its request for authorization to proceed with refurbishment activities, is the Predictive Environmental Risk Assessment (the "PERA" or "PEA"). The purpose of the report is ostensibly to illustrate how the environment and the health of persons will continue to be protected during future operations. However, the report provides no evidence that could support that conclusion.[76] The PERA submitted by Bruce Power does not follow any coherent or scientifically accepted methodology, includes little data or analysis, and is based on the dubious assumption that environmental conditions are constant.

[76] As SON noted in its November 14, 2017 letter to the Commission, "the materials submitted by Bruce Power have serious gaps in so far as the prediction of future effects." SON to CNSC November 2017 Letter.

4.2.1. The PERA Follows No Scientifically Established Methodology

In a review of Bruce Power's environmental assessment prepared for SON, Professor Marc Cadotte explains that, broadly speaking, environmental assessment is "the scientific process used to identify and evaluate the possible negative effects of human activity on the environment."[77] The precise content and form of an environmental assessment will depend on the context but in all cases "there are norms of best practice that should be employed to ensure that conclusions and recommendations are valid and not subject to alternative interpretations."[78]

Professor Cadotte's review identifies that the PERA fails to follow norms of best practice and, in fact, fails to follow *any* scientifically recognized methodology. Although "[the PERA report] makes clear that the PERA is meant to predict long-term impacts… the PERA does not describe any necessary methodology to make predictions."[79] The approach employed by Bruce Power "does not exist in the environmental science or environmental monitoring literature, and therefore does not represent an accepted practice that has been subject to evaluation by the scientific community."[80] The implications of this are described below.

4.2.2. Bruce Power's Approach Fails to Account for Environmental Changes

The approach employed by Bruce Power in its PERA essentially consists of five steps: (1) defining current conditions and operations, (2) defining future conditions and operations, (3) determining whether environmental interactions associated with future operations are bounded by current conditions, (4) screening only those future environmental interactions that are not bounded by current conditions against criteria considered protective of the environment, and (5) conducting a quantitative assessment where screening criteria are exceeded.[81] In essence, it requires that potential impacts be divided into two categories: those that might be amplified in the future which require assessment, and those that will be the same as or less than current impacts (i.e., "bounded by") and which require no further assessment.

---

77 Cadotte Report, p. 4.
78 *Ibid*, p. 4.
79 *Ibid*, p. 9.
80 *Ibid*, p. 9.
81 Bruce Power, Predictive Environmental Risk Assessment for Continued Operations, June 2017, pp. 3-4 ("PERA").

Applying the approach, Bruce Power makes the wholly unjustified assumption that current operational conditions are "bounding" in most cases, and accordingly, dismisses the need for any further assessment for most categories of impacts. The entire assessment of thermal and impingement and entrainment effects, for example, consists of a summary of the conclusions of the EQRA and a declaration that "current operational conditions are demonstrated to be bounding of future activities."[82] No further analysis or new data, *whatsoever*, are provided.

The problem with Bruce Power's approach is obvious: even if it is assumed that Bruce Power's future operations will resemble current or past operations, those future operations will occur in a different and changing environment. Professor Cadotte explains:

> … as we move further into the future, the uncertainty introduced by interactive, non-linear, or compounding effects will greatly increase. Both the ERA and the PERA look at chemical, radiological, and physical (including warm water effluent) on several focal species. However, these stressors will be occurring under broader environmental changes that are and will continue to occur in the region. Three important broad stressors that are expected to increase into future in this region include: climate change, invasive species, and eutrophication. These broad stressors will result in systematic changes to the abundance of species and the diversity of nearshore environments, and in fact the impacts of climate change on Great Lakes has already been reported.
>
> The proximate stressors resulting from Bruce Power activities will be interacting with the changes imposed by broad stressors. For example, the increasing surface temperatures in the Great Lakes needs to be taken into consideration when evaluating thermal effects on species. Using historical water temperatures will not provide the necessary information to evaluate future impacts. Furthermore, the other two broad stressors will not have effects that are independent of climate change. Exotic invasive species, which may have limited cultural and traditional value to indigenous communities, are more likely to benefit from warming waters and hence the thermal effects introduced by warmed effluent.[83]

Another expert retained by SON, Dr. Phil Byer, elaborates on the PERA's failure to consider the impacts of climate change on the Great Lakes. He explains that climate change will alter the baseline conditions with which future plant operations will interact, and describes climate change as a "critical issue that will have significant effects on the environment:"

> Climate change is expected to continue to occur over the foreseeable future and is widely acknowledged as a critical issue that will have significant effects on the environment. These effects include rising air and water temperatures and changed precipitation patterns

82 PERA, p. 126.
83 Cadotte Report, p. 11.

> and water levels, which in turn affect ecosystems, including fish and fish habitats. A number of studies and reports discuss the effects of climate change on the Great Lakes…Because of the changing climate conditions, potential effects from proposed projects would need to be predicted relative to the new baseline environment created by these changes. [84]

He explains that the need to consider climate change when assessing projects has been widely recognized, and identifies various guidelines and best practices that have been developed to guide such analysis.[85] Speaking specifically to the nuclear context, he notes that past environmental assessments in Canada have included consideration of climate change:

> For example, the Joint Review Panel for OPG's Darlington nuclear power plant EA wrote in its report that "Environment Canada stated that adverse effects in early life stages of round whitefish could arise from temperature exceedances up to the edge of the once-through cooling system diffuser mixing zones, and noted that this effect could become more pronounced if warmer temperatures become more prevalent with climate change." In response, the Panel recommended thermal plume modelling "taking into account possible future climate change effects."[86]

4.2.3. No Real Analysis or Data in the PERA

The failure to consider the changing nature of the environment ultimately renders Bruce Power's predictive effects assessment useless. For most categories of impacts—including those of greatest significance to SON such as thermal effects and impingement and entrainment—the complex and typically data-intensive task of predicting future impacts is reduced to a declarative and qualitative pronouncement that risks will continue to be low or negligible.

The PERA submitted by Bruce Power only superficially resembles an environmental assessment report carried out according to accepted methodology. For the most part, it does not include any of the analysis and data that would generally support an environmental assessment. For example, while the PERA includes a section purportedly on cumulative effects, the brief 3-page section includes none of the analysis required:

> The assessment language leaves the impression that it has undertaken what is called a cumulative impacts assessment (CIA), but it does not fulfil the necessary requirements to qualify as such… The CIA is an established methodology with clear guidelines. The CIA

---

84 Dr. Philip Byer, "Review of Consideration of Climate Change in Bruce Power Predictive Effects Assessment of Aquatic Environment," March 2018, pp. 4-5 ("Byer Report"). Attached as Appendix C.

85 *Ibid,* pp. 5-6.

86 *Ibid,* p. 6.

> requires that the spatial extent be defined and should be large enough to capture important ecosystem processes, like animal movement, and it requires data from longer periods of time to understand the behaviour of the system of interest. Further, the CIA should not assess environmental values individual or in isolation, but in combination, and should include indirect effects. The PERA described in the second report does none of these things.[87]

In each of their reports, Professor Cadotte and Dr. Byer state unequivocally that the PERA cannot be relied upon. Dr. Byer writes:

> Climate change is likely to significantly affect the aquatic environment near the site, and it is that future environment against which the effects of the proposal need to be made. Since the PEA did not consider the effects of future climate change, its results cannot be relied upon.[88]

Similarly, Professor Cadotte concludes that the "PEA's ability to adequately assess potential long-term future environmental impacts is simply not valid and does not conform to best scientific practice" nor does "it meet a minimum threshold of scientific validity."[89]

SON submits that it was necessary for Bruce Power to provide to the Commission a credible and scientifically defensible assessment of future environmental impacts to support its request to proceed with its Refurbishment Project. Bruce Power has manifestly failed to do so. The PERA provided cannot support any credible conclusions about future environmental impacts, and consequently, cannot be relied upon to justify a positive decision on refurbishment.

4.3. Mitigation Measures Not Considered

Given the significant uncertainties respecting the impacts of the Bruce facility, including uncertainties respecting future impacts, SON submits it was incumbent on Bruce Power to provide an analysis of potential mitigation measures that could act to reduce or avoid future harms. Bruce Power has provided no assessment of mitigation measures as part of its application.

Further, CNSC staff did not require Bruce Power to carry out an assessment of viable mitigation measures. This is so despite CNSC's past regulatory actions compelling other proponents to

---

87 Cadotte Report, p. 10.
88 Byer Report, p. 8.
89 Cadotte Report, p. 11.

carry out a BATEA analysis,[90] and SON having specifically raised the concern with CNSC staff.[91]

For reasons explained in section 5.1.2 below, SON submits given the uncertainties regarding the potential impacts of the Refurbishment Project, and the significance of those potential impacts, the CNSC was required by REGDOC 2.9.1 to compel Bruce Power to carry out a mitigation measures assessment.

4.4. Nuclear Waste and Risk Implications Not Considered

The application submitted by Bruce Power does not consider the environmental or rights impacts of the Refurbishment Project caused by increased nuclear waste generation or through increased risk of accident and malfunction. These are significant project impacts that ought to be considered by the Commission.

The Refurbishment Project will create two new sources of radiological waste. First, the refurbishment will generate "refurbishment wastes" through the replacement of major components of the reactors, including steam generators, feeders, and fuel channel assemblies.[92] It will also generate wastes in the form of tools and materials used in refurbishment. Second, by significantly increasing the life span of the reactors, by approximately 200 reactor years, refurbishment will generate a significantly increased "operational waste" stream.

These two waste streams are by definition "novel", as they would not exist but for the refurbishment. Refurbishment wastes include both low-level and highly radioactive intermediate-level nuclear wastes. New operational wastes, again, include both low and intermediate-level nuclear wastes, in addition to used nuclear fuel wastes. All these wastes are planned to be stored at the Western Waste Management Facility, in the SON Territory. Further, the low and intermediate-level wastes are currently planned to be permanently disposed of in OPG's DGR Project within the Bruce site. In terms of volume, the refurbishment waste alone

---

[90] Ontario Power Generation was, for example, required to carry out a BATEA analysis for its Pickering facility to reduce losses through impingement and entrainment. As a result of that analysis, Ontario Power Generating put in place a barrier net.

[91] SON raised the issue with CNSC staff in both the September and October meetings described in section 2.6.

[92] Bruce Power, Bruce Power's 2018 Licence Renewal Briefing: Playing a Role in the Future of Our Communities, p. 24.

would comprise as much as 12% of the total waste in OPG's proposed DGR Project.[93] In terms of activity, refurbishment waste would represent a proportionally greater part of total waste, accounting for 39% of the radioactivity in OPG's proposed DGR Project.[94]

With respect to operational wastes, the increase that will be caused by the refurbishment is on the order of a 20-25% increase in waste volume to be stored at the Western Waste Management Facility relative to the situation that would exist if the project were not approved.[95] The refurbishment will similarly result in significant increases in the amount of used fuel generated and stored in the SON Territory.

The increased lifespan of the refurbished generators will also lead to an increased risk period for serious accidents and discharges of radioactivity into the air and water. Experts retained by SON have determined that the 200 new reactor years of operation created by the Refurbishment Project will lead to a cumulative increased risk of a severe accident and large radioactive release with a probability of approximately 1 in 600.[96] This is not a trivial increase in risk, particularly for SON whose very existence as a people is contingent on its connection with its Territory.

As will be explained in section 5.2.5 below, issues respecting the future of nuclear waste management in the SON Territory, as well as issues of the broader impacts of the nuclear industry historically in the SON Territory are the subject of various engagement and consultation processes between SON, the federal and provincial Crowns, OPG and NWMO. SON submits that the Commission must consider these processes, and their outcomes, in its current and future decisions respecting refurbishment.

---

93 Chesapeake Nuclear Services Inc., "Assessment of Radioactive Waste and Operational Risk Factors Related to Bruce NGS Relicensing and the Major Component Replacement Plan," 12 April 2018, p. 5 ("Chesapeake Report"). Attached as Appendix E.

94 *Ibid*, p. 5.

95 *Ibid*, p. 4. The precise change is dependent on various factors include decisions about life extensions at OPG's Pickering and Darlington stations, whose operational wastes are transported to and stored at the Western Waste Management Facility.

96 *Ibid*, p 6.

5. STATUTORY AND COMMON LAW REQUIREMENTS FOR APPROVAL NOT MET

5.1. Statutory Requirements under NSCA Not Satisfied

5.1.1. Section 24(4) "Adequate Provision for the Protection of the Environment"

Section 24(4) of the *NSCA* requires that prior to granting a renewal of Bruce Power's operating licence, which includes authorization relating to the Refurbishment Project, the Commission must be satisfied that Bruce Power has made adequate provision for the protection of the environment *in relationship to that project*.

CNSC staff indicate that they are satisfied that risks to the environment or human health for the continued operation of Bruce facility, including the Refurbishment Project, are low to negligible. CNSC staff have concluded that, based on the environmental assessment conducted under the *NSCA,* Bruce Power has and will continue to make adequate provisions for the protection of the environment and the health of persons.[97] CNSC staff finally conclude that statutory requirements under s.24(4) of the *NSCA* have been fulfilled.[98]

SON submits that the conclusions of the CNSC staff cannot be accepted. As detailed in section 4 above, the current application contains significant and material deficiencies that make it impossible for the Commission to conclude that Bruce Power has made adequate provisions for the protection of the environment in relation to the Refurbishment Project. These include: (1) a reliance on flawed data and analysis respecting the current impacts of the facility through entrainment and impingement, as well as through thermal effluent; (2) a complete failure to credibly assess combined and cumulative effects of the facility with other stressors; (3) a fundamentally flawed, and ultimately useless, assessment of future impacts; and (4) the related failure to consider, at all, the effects of climate change on the future impacts of the facility.

The current application simply does not provide sufficient data or analysis to support a credible decision on impacts that could be caused by the Refurbishment Project, or what "adequate

---

97 Commission Member Document, p. 101.

98 *Ibid,* p. 13.

provisions" might be required for the protection of the environment for the proposed life extension of the Bruce facility.

5.1.2. REGDOC 2.9.1—the Precautionary Principle

As noted in section 4.3 above, Bruce Power did not provide a mitigation measures assessment as part of the current application. CNSC staff did not require Bruce Power to carry out an assessment of viable mitigation measures.

CNSC staff took the position that an analysis of mitigation measures was not warranted on the basis that: (1) the facility does not pose an unreasonable risk to the environment requiring mitigation, and (2) that if evidence of unreasonable risk arises in the future, mitigation measures can be required then. CNSC staff have since evolved in their positions through discussion with SON, as explained in section 5.2.2 below.

REGDOC 2.9.1 sets out how CNSC must operationalize its environmental protection mandate under the *NSCA*. It requires CNSC to ensure that proponents "respect the precautionary principle."[99] The language of REGDOC 2.9.1 is mandatory, as is the requirement to comply with the precautionary principle. SON submits that the failure of CNSC staff to require Bruce Power to carry out a credible mitigation measures assessment is not consistent with CNSC's regulatory mandate and not consistent with its constitutional obligations to SON, as an agent of the Crown.

In a report prepared for SON, law professor Chris Tollefson explains the recognition and function of the precautionary principle in the Canadian legal and regulatory context. He states unequivocally that "particularly where it is explicitly referred to in statutory or regulatory provisions, the duty to consider and apply the precautionary principles in the interpretation and application of legislative provisions and powers is now clear."[100]

Speaking specifically to the obligations resting on the CNSC, he makes clear that application of the principle requires more than merely paying it "lip service" and in fact requires a careful

---

[99] REGDOC 2.9.1, s. 2.1.

[100] Chris Tollefson, "Implementing the CNSC's Mandate to Ensure Respect for the Precautionary Principle: Bruce Power's Application to Refurbish the Bruce Nuclear Generating Station," 20 April 2018, p. 7 ("Tollefson Report"). Attached as Appendix A.

accounting of the state of scientific uncertainty and of the costs and benefits of various mitigation measures:

> … the CNSC has a statutory duty to protect the environment under its enabling legislation. The nature of this duty is elaborated in REGDOC 2.9.1 which speaks of an obligation to "respect" the precautionary principle. In this regard, the CNSC finds itself in a position akin to that of many federal regulators that increasingly – both by statute and by operation of common law interpretive principles – are tackling the challenge of putting the precautionary principle to work. To do this regulators must do more than simply pay it lip service.
>
> Implementing the precautionary principle in a meaningful manner will not be easy... Doing so will need to take careful account of a variety of factors including the nature of the regulatory setting, the state of scientific knowledge and uncertainty, and the relative costs and benefits of various mitigation measures.[101]

SON submits that, in the face of the significant uncertainties respecting current and future environmental impacts caused by the Bruce facility, and the proposed doubling of its lifespan through refurbishment, the CNSC was required to compel Bruce Power to ensure a credible mitigation measures study was completed and included for Commission consideration as part of the current application. Further, as part of its mandate to regulate through "adaptive management," it was incumbent on the CNSC to provide a clear and detailed assessment of those mitigation measures as well as a plan to implement those measures when and as necessary.

SON submits that, given these various failures, it is impossible to conclude that CNSC has met its statutory obligations, and requirements for approval, under the *NSCA* and REGDOC 2.9.1.

5.2. Section 35 Duty to Consult Obligations Not Fulfilled

As outlined in section 3.2 above, a proposed decision on whether to authorize Bruce Power's Refurbishment Project triggers the duty to consult and places constitutional obligations on the CNSC and Commission. These obligations, at a minimum, require the Commission to ensure that, prior to making any decision that would authorize refurbishment activities, it is satisfied that SON's concerns have been properly understood and addressed through appropriate mitigation measures.

---

101 *Ibid*, p. 14.

5.2.1. SON's Concerns Not Addressed

SON has raised serious concerns about the Bruce facility and the Refurbishment Project over the last many years. These are detailed in sections 2.5 and 2.6 above. SON has said consistently that the Bruce facility interacts in complex and significant ways with the SON Territory and that its operation, and potential refurbishment, will have lasting impacts on the environment of the SON Territory and on SON rights.

It is critical to understand that SON's concerns are not academic, and not raised from the perspective of a regulator, scientist, or concerned citizen. The environmental and risk impacts of the Bruce facility have a direct connection to SON's rights as Indigenous peoples, and their continued ability to rely on their Territory for their economic and cultural survival.

SON's rights are tied to the specific geography of the SON Territory in a spiritual and cultural sense, but also in a legal sense. SON cannot exercise its Aboriginal and treaty rights outside its Territory; they are legally *bound to this place*. This is reflected in the judicial recognition of SON's right to a commercial fishery, and Crown agreements recognizing and implementing those rights in SON's traditional waters, including the waters surrounding the Bruce facility. More significantly still, SON's cultural and spiritual identity is *bound to this place.* As described below, SON's creation stories speak of their origins within this Territory. This is the place they have existed since time immemorial and where their ancestors remain.

It is for this reason that environmental harms and risks of accident or malfunction take on special significance. SON cannot simply leave the SON Territory for another. Other people may be affected by impacts or accidents from the Bruce facility, but for SON it is not a life inconvenience—it is an existential threat. Without their Territory to sustain them, and to ground their identity, spirituality, and culture, the SON as a people would cease to exist. Former Chief Randall Kahgee previously attested to this grim truth in an affidavit to this Commission:

> [If] we were ever required to leave our Territory, if our lands and waters could no longer sustain us, it would be the end of us as a people. We have no other place to go. And if our people start to fear developments in the Territory, if we become anxious about the safety of our lands and waters, if we develop a dread of accident in the future - a deep

> and fundamental connection will be severed. It will be a deadly blow to our cultural existence.[102]

SON submits that it is required, as an integral aspect of the duty to consult, that the CNSC and the Commission understand and address the concerns raised by SON in relation to the Bruce facility and Refurbishment Project not only as environmental issues or as regulatory matters, but in the context of their relationship to and effect on SON Aboriginal and treaty rights.

As explained in detail above in section 2, the concerns that SON has raised are the subject of various ongoing consultation and engagement process with both federal and provincial Crown representatives, as well as proponents, including OPG, NWMO, and Bruce Power. Some of these processes are at the very earliest stages. In other cases, including discussions with CNSC staff relating to the current application, discussions have begun to identify possible measures for addressing concerns.

The duty to consult, however, is not just a talking process. It is not a process intended to give a First Nation "an opportunity to blow off steam" before the Crown proceeds to do what it intended to do all along.[103] Consultation, rather, is a process that must be carried out in good faith and with the intention of substantially addressing the concerns of the Indigenous peoples whose lands are at issue.[104] As the Supreme Court of Canada said in *Haida*:

> The effect of good faith consultation may be to reveal a duty to accommodate. Where a strong *prima facie* case exists for the claim, and the consequences of the government's proposed decision may adversely affect it in a significant way, addressing the Aboriginal concerns may require taking steps to avoid irreparable harm or to minimize the effects of infringement, pending final resolution of the underlying claim.[105]

SON submits that obligations imposed on the CNSC, and Commission, by the duty to consult require more than compliance with statutory obligations and cannot be fulfilled simply through reliance on existing and ongoing consultation processes. SON submits that <u>accommodations</u> are required to protect SON rights and interests in the face of the potential harms from the Refurbishment Project.

---

102 Randall Kahgee Affidavit, para. 46.
103 *Mikisew Cree First Nation v Canada (Minister of Canadian Heritage)*, 2005 SCC 69, para. 54.
104 *Delgamuukw v British Columbia*, [1997] 3 SCR 1010, para. 168. *Haida*, para. 42.
105 *Haida*, para. 47.

SON further submits that these accommodations are required now—before approval of the Refurbishment Project. CNSC staff have urged reliance on future processes and behaviors in order to ensure the protection of the environment. They do so explicitly when they conclude that Bruce Power has *and will continue to* make adequate provisions for the protection of the environment. CNSC also ask SON to trust and rely on the future actions of CNSC staff, by proposing that ongoing review of Bruce Power's environmental performance and compliance be reviewed by staff through internal processes,[106] and ongoing environmental protection measures be addressed by CNSC's "adaptive management" approach.

For SON, however, these future undefined behaviors are cold comfort. And, courts have been clear that the duty to consult, properly understood and implemented, does not tolerate "wait and see" approaches. Accommodations are required before decisions are made that stand to adversely impact the Aboriginal or treaty rights of a First Nation.[107]

For this reason, SON submits, the Commission should not grant Bruce Power's request for authorization of refurbishment activities as part of this licence renewal application and until such time as appropriate accommodation measures are agreed to and implemented. These are described below.

5.2.2. Accommodation Measures Necessary to Satisfy the Duty

SON has been engaged in a decades-long effort to understand the risks and harms caused by the Bruce facility and to seek resolutions that would minimize those impacts. Recently, and in the shadow of the current licence renewal application, SON has met with CNSC staff to expedite consultation efforts on these matters and to seek an approach to developing and implementing necessary accommodation measures.

In a letter dated March 9, 2018, sent by legal counsel on behalf of SON to Mr. Luc Sigouin, Director of the Bruce Regulatory Program Division for CNSC, SON set out its understanding of

106 Commission Member Document, p. 133

107 *Gitxaala Nation v Canada*, 2016 FCA 187, para. 283. See also, *Haida*, para. 67; and *Clyde River*, para. 39.

accommodation measures that would be required prior to any authorization of refurbishment activities.[108] From that letter:

> In meetings and through correspondence, SON has identified what it believes to be some of the accommodation measures that require discussion between SON and CNSC staff:
>
> 1. Processes that draw on both western science and the knowledge of the SON communities to close information gaps and uncertainties in the characterization of the impacts of the facility
>
> 2. Measures to enhance the confidence of the SON communities in Bruce Power's monitoring activities, including SON direct participation where possible
>
> 3. A mitigation strategy and plan that is consistent with recognition of and respect for SON's rights and values as well as the precautionary principle (e.g., to address entrainment and impingement and thermal impacts of the facility)
>
> 4. Developing a common understanding and strategy on how future and connected regulatory measures will be carried out (e.g. how the *Fisheries Act* authorization process will be integrated with the current licencing process, how future Environmental Compliance Approval applications respecting discharge temperature will be harmonized, etc.)

In a subsequent meeting on March 20, 2018, SON and CNSC staff discussed in general terms proposals for measures to address SON's concerns, and in a letter from Mr. Sigouin, dated April 6, 2018, CNSC staff set out proposals relating to: (1) developing a mutually agreeable study and analysis program (to reduce uncertainties relating to the Bruce facility's impacts on the environment); (2) monitoring program enhancements with SON participation; and (3) a study of available mitigation measures.[109] In that letter, Mr. Sigouin asked for feedback to allow both SON and CNSC staff to make submissions to the Commission in respect to any agreed to proposals.

In a letter dated April 16, 2018, from Kathleen Ryan, Bruce Power Coordinator at the SON Environment Office, SON responded indicating its general agreement with the approach being proposed by CNSC staff, but seeking clarification on each of the specific proposed measures

---

108 March 9 Letter.

109 Letter from Luc Sigouin, Director of the Bruce Regulatory Program Division for the Canadian Nuclear Safety Commission, to Kathleen Ryan, Bruce Power Coordinator for the Saugeen Ojibway Nation, 6 April 2018. Attached as Appendix J ("April 6 CNSC Letter").

aimed at addressing SON concerns.[110] CNSC staff provided further clarification through subsequent correspondence on April 20, 2018.

The recent discussions between SON and CNSC staff have been constructive, and SON believes good progress has been made towards agreement on interim accommodations and protection measures. SON understands that CNSC staff recommendations will largely be in alignment with what is proposed below.

5.2.3. Plan to Understand and Reduce Uncertainties

CNSC staff have understood and acknowledged SON's interest in working with CNSC staff to develop a mutually agreeable study and analysis program based on sound scientific principles as well as SON knowledge to reduce uncertainties and generate a credible and reliable understanding of the potential impacts of the facility on the environment and fish populations. CNSC staff have proposed to SON that CNSC staff and SON work together in relation to the development and implementation of study programs for (1) Thermal Effluent and (2) Impingement and Entrainment, that will be part of Bruce Power's licence requirements.[111]

SON submits that this approach is generally acceptable, but with the following clarifications regarding SON – CNSC staff engagement on the development and implementation of these study and monitoring programs. SON has a strong interest in participating in the design of the programs to ensure their scientific credibility, as well as their credibility to the SON communities through the inclusion of SON knowledge. This includes the implementation of the study program (specifically, data collection methodologies and practices), the establishment of evaluation criteria, and the analysis and interpretation of the data. SON understands from recent correspondence that CNSC staff will propose the establishment of a steering committee comprised of CNSC staff and SON representatives to develop the study objectives, receive updates on SON – Bruce Power collaboration on data collection, establish evaluation criteria, and review analyses of the data. SON recognizes the value in this proposal and believes that a

[110] Letter from Kathleen Ryan, Bruce Power Coordinator for the Saugeen Ojibway Nation, to Luc Sigouin, Director of the Bruce Regulatory Program Division for the Canadian Nuclear Safety Commission, 16 April 2018. Attached as Appendix K.

[111] April 6 CNSC Letter, p. 2.

body with this function will be critical to ensuring the objectives of this accommodation measure are met.

As a related matter, SON has repeatedly raised the concern that monitoring program enhancements are required and should include SON participation, to allow for the collection of reliable data and to increase SON community confidence in monitoring.

CNSC staff has acknowledged this concern and proposed that CNSC and SON work together in the development and implementation of CNSC's Independent Environmental Monitoring Program ("IEMP").

However, the thrust of SON's concerns respecting monitoring has been in respect to the credibility of monitoring activities carried out by Bruce Power under licence requirements and, in particular, in relation to the monitoring of thermal effluent and entrainment and impingement. As explained above, SON is seeking to be involved in the design of the monitoring program in relation to these study areas to ensure they are both scientifically and methodologically sound, but also that they are seen as credible and reliable by the SON Communities. We anticipate that this will require the development of new measures to verify compliance with the monitoring program, and should include direct SON involvement in verification.

SON understands from recent correspondence that CNSC staff consider monitoring program implementation to be a matter requiring direct dialogue between SON and Bruce Power. SON acknowledges CNSC staff's offer of support in encouraging such dialogue and remains committed to direct engagement with Bruce Power. SON, however, submits that CNSC staff participation, as well as Commission oversight, will be critical to ensuring productive discussions and agreement between SON and Bruce Power in this regard.

5.2.4. Development of a Mitigation Plan

SON has repeatedly raised the need for a protective and precautionary approach to the management of the Bruce facility, in keeping not only with the requirements of federal legislation and western science, but also SON values, knowledge, and stewardship. The duty to

consult requires that the statutory obligation to comply with the precautionary approach be sensitive to and informed by SON values.[112]

SON submits that a credible and proactive mitigation measures plan must be developed and implemented now. This is the only way to ensure the protection of the environment and SON rights and interests in the face of the significant uncertainties about the environmental impacts of the facility now and into the distant future.

This has been the subject of consultations with CNSC staff, and they have understood SON's position to be a request for a study of available mitigation measures which takes into account not only a cost-benefit assessment, but also precautionary principles and SON values. From recent correspondence, CNSC staff appear to have also understood SON's position that a study of available mitigation measures is only a first step. Also required is agreement on how to assess the outcomes of the study, and the development of an implementation plan for viable and necessary mitigation measures where the analysis and monitoring require it. Here, it is imperative that the "cost-benefit" analysis of mitigation measures be done in a way that reflects SON values, in particular, the value of adverse impacts avoided to the health of the environment and SON's ability to continue to rely on that environment for its cultural, spiritual, and economic well-being.[113]

SON submits that this goes beyond good faith efforts to incorporate Traditional Knowledge. This is a requirement of the duty to consult. If the Crown seeks to rely on the regulatory processes under the *NSCA* to ensure the protection of SON Aboriginal and treaty rights, that process, including the development and implementation of mitigation measures, must take into

---

112 Tollefson identifies that the application of the precautionary principle here will require special considerations given the potential impacts on SON Aboriginal and treaty rights, noting CNSC will need to "apply the principle in a manner that recognizes and respects Indigenous knowledge and rights including those rights that are protected under s. 35 of the *Constitution Act, 1982*." Tollefson Report, p. 14.

113 As Tollefson writes: "It is important in this cost-benefit analysis to avoid the tendency, associated with traditional cost benefit analyses, to 'squeeze out qualitative soft values in favour of quantifiable values'. This admonition… arises from a concern that traditional economics struggles to properly understand and price non-market based values. For this proportionality test to engender public trust, it must therefore strive to capture and reflect these values in a way is seen as inclusive, robust and legitimate. This challenge takes on added importance in the current instance where the nature of the potential harm being confronted by the SON people goes beyond simply the value of the sustenance and commercial fishery that might be affected and embraces more amorphous, yet closely related, cultural and spiritual impacts." *Ibid*.

account the nature of the rights to be protected, *from the perspective of the rights-holders themselves*.

CNSC staff have proposed that a licence condition be established requiring Bruce Power to conduct an assessment of feasible mitigation measures for thermal effluent and impingement and entrainment. And, that CNSC staff and SON work together to review the assessment so that SON values can be considered.

SON submits that in addition to this, agreement must be reached on other related matters, to ensure the development and implementation of a robust *mitigations plan*, as distinct from a *mitigations study*. These include agreement on: (1) how SON will participate in establishing criteria or expectations for the mitigation measures study; (2) the process by which SON and CNSC staff will carry out an assessment of mitigation measures identified in the study in a manner that reflects SON values and is protective of SON rights and interests; and, (3) how the outcomes of this assessment will be implemented through ongoing regulatory activities—including trigger points for future action, and necessary systems and operations planning to ensure mitigation measures can be implemented in a timely way if necessary. These aspects of a mitigation measures plan could be developed through ongoing, and Commission mandated, work between SON and CNSC staff, possibly through the proposed steering committee structure.

Lastly, any licence condition requiring Bruce Power to carry out a mitigation study must anticipate and be able to accommodate the work undertaken towards a mitigation measures plan between SON and CNSC staff.

5.2.5. Ensuring Consistency with Other Consultation and Accommodation Processes

As described in section 2.4 above, SON has been actively and centrally involved in understanding and attempting to mitigate the impacts of the nuclear industry in its Territory for many decades. SON has invested countless hours and dollars in pursuit of these objectives, and fundamentally views this as both a right and obligation—to exercise stewardship over its Territory to ensure its health and integrity as the basis for its rights, way of life, and future.

The Refurbishment Project, and the authorizations Bruce Power is now seeking, intersect with a number of other consultation and engagement processes that SON is currently engaged in. For this reason, it is critical that the Commission understand the context in which its decisions will be made to ensure consistency with those other processes.

i. Other Regulatory Processes

The Refurbishment Project, including licence conditions that may be imposed, have the potential to overlap, or interact, with other ongoing regulatory process. This includes the processes relating to authorizations required by Bruce Power under s.35 of *the Fisheries Act*[114] and ECA applications respecting cooling water discharge temperatures under the jurisdiction of the provincial MOECC.

Respecting the *Fisheries Act* authorization, CNSC staff have indicated that the authorization is independent but related to the current application. While each piece of legislation must be complied with independently, they are complementary.

SON remains quite concerned about the interaction between these two processes and submits that clear harmonization is required. In the 2015 Bruce Power licence renewal application, SON made submissions raising concern that the Department of Fisheries and Oceans ("DFO") regulatory guidance documents were not being followed in the review of Bruce Power's *Fisheries Act* authorization application.[115] SON emphasized SON's interest in the avoidance and mitigation of the Bruce facility's harm and raised concerns with CNSC's decision to forego any consideration of mitigation measures and to proceed directly to the consideration of off-sets without justification or rationale to support the decision.

CNSC staff have identified that DFO has raised similar concerns—that the current off-set measures proposed by Bruce Power aimed at habitat creation will not effectively off-set losses from entrainment and impingement.

A more fundamental concern is that the accommodation measures SON is calling for in the context of the current application all relate directly to decisions that will need to be made to

114 R.S.C., 1985, c. F-14.
115 Canadian Nuclear Safety Commission, Public Hearing Transcript, 14 April 2015, pp. 78-79.

determine whether, and under what conditions, a *Fisheries Act* authorization should be granted. This includes those relating to a new study program to ensure credible data on losses through entrainment and impingement, changes to baseline conditions through a study program on thermal effluent, improved and enhanced monitoring to ensure integrity and confidence in data, and the development of a mitigation measures plan that could limit avoidable harms.

Without careful harmonization of these regulatory processes, there is a real risk of inconsistent regulatory decisions. For example, SON submits that until such time as uncertainties related to Bruce facility impacts are reduced and a credible mitigations plan implemented, no *Fisheries Act* authorization should be closed and no "off-set" program should be understood as accounting for impacts. Similarly, future Commission regulatory decisions respecting thermal effluent in the context of Bruce Power's Refurbishment Project, including the need for mitigation measures, must take into account the ongoing work and consultation between SON and MOECC.

SON submits that clarity is required on how these various interacting regulatory processes will be harmonized, not only for the understanding of SON and its communities, but also to ensure regulatory consistency. Further, harmonization issues should form part of future reports to regulatory authorities and in a forum that allows for SON participation through review and submissions.

ii. Other Consultation and Engagement Processes

SON is directly engaged with both proponents and Crown representatives on other matters directly related to the Refurbishment Project. Significantly, SON is engaged with: (1) OPG to address nuclear waste management issues within the SON Territory under commitments relating to the proposed DGR Project, and relating to the Western Waste Management Facility;[116] (2) NWMO to address issues relating to used nuclear fuel waste management within SON Territory;[117] and (3) OPG on the resolution of legacy issues relating to the history of the nuclear

[116] OPG 2013 Commitment Letter. Letter from Lise Morton Vice President of the Nuclear Waste Management Division of Ontario Power Generation, to Chief Lester Anoquot, Chippewas of Saugeen First Nation, and Chief Greg Nadjiwon, Chippewas of Nawash Unceded First Nation, 29 March 2017.

[117] NWMO Commitment Letter.

industry in SON Territory.[118] In each case, SON is also engaged in, or will need to establish, direct and related consultation process with relevant Crown representatives.[119]

As explained in section 4.4 above, decisions relating to the Refurbishment Project have significant impact on volumes and nature of nuclear wastes, and will effectively double the risk from accident and malfunction faced by SON and its communities. These are all matters that are, or could be, the subject of the consultation and engagement processes described above. The outcomes of those processes, including necessary accommodations, could have a significant effect on future refurbishment plans and activities. Likewise, decisions respecting refurbishment must not have the effect of precluding available and appropriate accommodations measures being discussed in other processes.

SON submits that care must be taken to ensure future regulatory processes and decisions in relation to refurbishment activities do not compromise ongoing consultation and engagement processes on related matters; and, that these regulatory processes must be responsive to any outcomes or accommodations that flow from consultation processes.

5.2.6. Involvement and Oversight by the Commission

CNSC staff have recommended that much of the compliance work related to new and ongoing environmental assessment related activities could be reviewed at the staff level, and reported on through the Regulatory Oversight Report for Canadian Nuclear Power Plants. Further, CNSC staff have said that where warranted, CNSC staff could provide progress updates to the Commission during Commission meetings, at the request of CNSC staff.

SON submits that the Commission ought to retain direct and active oversight of the development, implementation, and compliance review of the accommodation measures described above through an annual reporting process that provides SON with a meaningful opportunity to

---

118 OPG 2013 Commitment Letter.

119 SON and Ontario have developed a framework for engagement on these and other matters through the MEI Agreement discussed in section 2.4 above. SON has also committed to ongoing and regular engagement with Minister McKenna respecting OPG's Proposed DGR Project and the SON Community Process to determine support for the project. Further, CNSC staff have agreed to work with SON to identify additional federal or provincial agencies involved in decisions related to nuclear matters at the Bruce site, April 6 CNSC Letter, p. 4.

participate, including review of reports and opportunity to make submissions, and that the Commission be prepared to order corrective action through licence conditions and amendments.

SON has no objection in principle to using the Regulatory Oversight Report for Canadian Nuclear Power Plants as the mechanism for Commission oversight but requires assurance that this forum will provide SON with the opportunity for full participation.

As has been explained, the CNSC, including the Commission, must discharge its statutory mandate in a manner consistent with, and in fulfillment of, s.35 constitutional obligations to SON. This requires that regulatory processes be capable of addressing SON concerns, and where necessary, providing accommodations. SON submits that this requires that reporting, review and assessment, compliance review, and remedial action all take place in a forum that allows for full SON participation before the Commission.

6. SUMMARY OF SON POSITIONS

SON respectfully submits that the Commission should not authorize refurbishment activities as part of Bruce Power's current licence renewal application, and should not authorize those activities until such time as appropriate accommodation measures are agreed to, implemented, and approved by the Commission.

Those accommodation measures, described more fully in section 5.2.2 above, are:

1) SON participation—potentially through the establishment of a SON – CNSC staff steering committee—in the development of study and monitoring programs for thermal effluent and impingement/entrainment that will draw on both sound scientific principles and SON knowledge and be included as a licence condition

2) SON participation in the implementation of study and monitoring programs refered to above, including through direct SON participation in data collection

3) SON participation in the development of criteria for the conduct of a mitigation measures study for thermal effluent and entrainment/impingement that will be included as a licence condition

4) A direction to CNSC to work with SON on an agreement for a mitigations plan, which will include i) how SON will participate in establishing criteria and expectations for the mitigation measures study; ii) the process by which SON and CNSC staff will assess the mitigation measures identified, taking into account SON values; and iii) how the outcomes of the study and assessment will be implemented, including how recommendations will be made to the Commission

5) A direction to CNSC staff to work with SON to reach agreement on how regulatory decision-making on the refurbishment can be harmonized with other regulatory processes (e.g., the *Fisheries Act* authorization, the MOECC ECA amendment application, etc.) and consultation or engagement processes (e.g., on the DGR Project), including how recommendations will made to the Commission, where appropriate

6) Direct and active oversight by the Commission of the development and implementation of the above accommodation measures, including ensuring that reviews are conducted in a forum that allows for full SON participation through review and submissions

Saugeen Ojibway Nation Written Submissions
re Bruce Power Licence Renewal and Refurbishment Project

Appendices

TABLE OF CONTENTS

Saugeen Ojibway Nation Written Submissions
re Bruce Power Licence Renewal and Refurbishment Project

Appendices

TABLE OF CONTENTS

Appendix A

IMPLEMENTING THE CNSC'S MANDATE TO ENSURE RESPECT FOR THE PRECAUTIONARY PRINCIPLE:

BRUCE POWER'S APPLICATION TO REFURBISH THE BRUCE NUCLEAR GENERATING STATION

A REPORT BY

PROFESSOR CHRIS TOLLEFSON

ON BEHALF OF

THE SAUGEEN OJIBWAY NATION

APRIL 20, 2018

Table of Contents

I. INTRODUCTION

I have been retained by the Saugeen Ojibway Nation ("SON") to provide a report in connection with the forthcoming review of an application by Bruce Power seeking authority from the Canadian Nuclear Safety Commission ("CNSC") to refurbish the Bruce Nuclear Generating Station ("Bruce NGS") as part of a pending operating licence review process. The purpose of this report is to provide advice on how the CNSC can carry out this licence review in a manner consistent with its regulatory duty to ensure that the prospective licencee "has made adequate provision for the protection of the environment" including ensuring "…respect [for] the precautionary principle".

This report is in six parts. Part II sets out the background facts relevant to this licence review including information about the Bruce NGS refurbishment initiative and ongoing concerns of the SON about facility operations and impacts. Part III sets out the policy framework within which this review process will proceed including the requirement that the applicant demonstrate that it has taken adequate steps to protect the environment and respect the precautionary principle. Part IV considers the growing role played by the precautionary principle in judicial and quasi-judicial decision-making. Among other things it considers Canadian and Commonwealth caselaw interpreting and operationalizing the principle. Drawing on this discussion in Part V, the report offers a framework for the CNSC to undertake an assessment of Bruce NGS's licence application in a manner that implements the CNSC's stated commitment to respect the precautionary principle. Finally, in Part VI, I offer some concluding observations.

II. BACKGROUND FACTS

The SON are the Indigenous peoples of the Grey and Bruce region. The Bruce NGS as well as adjacent support and nuclear waste management facilities lie within the SON's Traditional Territory. SON and its members have Aboriginal and Treaty rights throughout the SON Territory and continue to rely on their Territory today as they have for countless generations. Those rights include a proven Treaty right to a commercial fishery in the waters of Lake Huron and Georgian Bay.

The Bruce NGS is the largest operating nuclear generating station in the world and interacts in complex ways with the environment of the SON traditional Territory. Chief among SON's concerns is the impact of the facility—and specifically, its once-through cooling system—on the fish of Lake Huron. Bruce Power asserts, and has long asserted, that its operations have low to no impact on the environment, and CNSC staff have acceded to that position in the absence of conclusive evidence of greater impact. From SON's perspective, however, Bruce Power's assertions about the state of the science concerning the environmental effects of Bruce NGS do not justify regulatory inaction. SON maintains that the impacts caused by the withdrawal and warming of several trillion litres of water annually from Lake Huron are not well understood and there is a real risk that Bruce Power's operations will over time have serious and irreversible effects on the fish on which the SON communities rely.

Although there have been discussions over the last 15 years between Bruce Power, SON, and CNSC staff to address concerns SON has raised respecting the facility's impacts and conclusions drawn respecting those impacts, significant uncertainties in the data and analysis remain unresolved.[1] The

[1] Some of the uncertainties that SON has raised over the years include: a poor understanding of the magnitude of impingement and entrainment impacts given deficiencies in monitoring design, gaps in the understanding of fish

SON communities fear that the continued operation of the Bruce NGS, particularly in the context of a changing environment, will have enduring impacts on Lake Huron and its aquatic life. SON community members observe that the waters of Lake Huron have already changed significantly and the fish on which they have relied for countless generations are not as abundant as they once were. There is great concern in the SON communities that if the Bruce NGS's impacts continue unabated, there may come a time when important fish populations will collapse and an integral part of who the SON are will be lost.[2]

On June 30, 2017, Bruce Power submitted to the CNSC a licence renewal application confirming its intention to proceed with the refurbishment of six of the Bruce NGS's nuclear reactors and seeking approval from the CNSC to do so. The refurbishment of each reactor will allow it to operate for an additional 30 to 35 years; without the refurbishment, each of the six reactors would reach the end of its operational life in the next ten to fifteen years.

On September 1, 2017, the CNSC announced the process through which Bruce Power's licence renewal application including the refurbishment will be reviewed. According to the announcement, the application will be considered through three days of hearings under the *Nuclear Safety and Control Act* between March and May 2018.

The refurbishment initiative being advanced by Bruce Power is one of the most significant projects ever proposed in SON Territory. It represents a multi-billion dollar multi-year project that is expected to extend the operating life of the Bruce NGS until 2064. If authorized, the refurbishment will allow Bruce NGS to continue to operate for the next fifty years. As such, the SON claim it will have significant and enduring impacts on the rights and interests of their people and on the lands, waters, plants, fish, and animals within their Territory.

Currently, Bruce NGS extracts several trillion litres of water annually from Lake Huron, from a location where the SON have an established and exclusive Aboriginal and Treaty right to a commercial fishery. Over the last twenty years, the SON has consistently registered concerns in various regulatory processes that the facility's impacts have never been the subject of a comprehensive and careful assessment, and are poorly understood. The facility's cooling water system is known to interact with the aquatic environment of Lake Huron and to have impingement and entrainment impacts as well as thermal effects on fish and fish habitat. However, there remain gaps in the scientific knowledge as to the magnitude of these various effects, their interaction with each other, and their potential to interact with other stressors on Lake Huron. Addressing these

---

populations in Lake Huron that make it impossible to make credible assertions respecting population-level impacts, the absence of a winter thermal plume model to characterize the geographic extent of thermal effects during the sensitive spawning window of important fish species, a lack of data and research on the implications of thermal impacts during embryo development on post-hatch survival, and the absence of any credible combined or cumulative effects assessment.

[2] "Fishing is engrained in who we are as a people; it is integral to our culture and our belief systems… The fishery and the lands are part of who I am. The lands and waters are inseparable from me as an Annishnabe person. My family and our oral histories have shaped me as an Annishnabe person. My family has conducted ceremonies on the waters and the ice when the water is covered. Our belief is that the waters, trees and lands all have spirits, and that these spirits are interconnected. For example, when our people fish, we share in the catch. Our people watch the harvest. Our children see the fishermen return with their catch and share in the process. We have ceremonies to the [C]reator for the lands and waters of which we are a part. Our feast celebrates the fishery, and our connections to the waters and the lands that surround it." Affidavit of Paul Jones, August 15, 2013, Submitted to the Joint Review Panel in the Environmental Assessment of Ontario Power Generation's Proposed Deep Geologic Repository for Low and Intermediate Level Waste.

gaps is the focus of an ongoing process between SON and CNSC staff. This process began in May 2017 and remains at very initial stage.

With respect to impingement and entrainment effects, SON has raised concerns with the methodology used by Bruce Power to monitor and characterize impacts. CNSC acknowledges that there are issues with Bruce Power's methodology and has asked Bruce Power to more work to describe/address these issues in the future. However, based on currently available science and information, CNSC staff are of the view that these effects do not pose "an unreasonable risk to fish populations and …the aquatic environment around the Bruce site".[3]

With respect to thermal effects, CNSC staff determined that Bruce Power has provided adequate information concerning the thermal assessment to confirm that thermal effects in the aquatic environment surrounding the Bruce site are not likely to pose an unreasonable risk to the environment. SON disputes this conclusion and argues that mitigation measures, not simply continued monitoring and adapative management, should be implemented. To date, while Bruce Power and CNSC staff have apparently acknowledged there are mitigation measures that could reduce thermal effects, their position is that it would be premature to implement such measures. Both in respect of thermal effects and more generally, it is my understanding that the reasons offered in support of this position include:

1) the cost implications associated with implementing mitigation measures;
2) the operational challenges associated with implementing such measures; and
3) the potential that such measures can be implemented later if and when evidence of significant impacts are identified.[4]

A particular source of uncertainty are the cumulative effects of Bruce NGS's impacts over time when considered in combination with environmental changes anticipated in this area due to increasing development and other environmental stressors including climate change. The environment is changing and is expected to continue to change in the coming decades. For instance, water temperatures in Lake Huron are rising, and these temperature increases could serve to amplify the thermal effects of Bruce NGS's water system, but it is uncertain precisely how these

[3] Canadian Nuclear Safety Commission, *Environmental Assessment Report: Bruce Power Inc. – Bruce Nuclear Generating Station A and B – PROL 18.00/2020 Licence Renewal*, dated February 2018, page 45 in Appendix G of CNSC Staff submissions to Commission Public Hearing, dated 12 February 2018, e-Doc 5454349.

[4] For example, during the environmental assessment of the proposed restart of Units 3 and 4 of the Bruce A Nuclear Generation Station in 2002, Environment Canada recommended that Bruce Power "should use the best available technology to lower discharge as much as is feasible, reduce plume size and work towards complying with the CWQG temperature guidelines for protection of freshwater aquatic life." Canadian Nuclear Safety Commission, Screening Report on Environmental Assessment of the Proposed Restart of Units 3 and 4 of Bruce A Nuclear Generating Station, October 2002, Appendix 2, Comment 6.2. Bruce Power subsequently evaluated and identified potential beneficial technologies but asserted that their implementation was not warranted. See, for example, Canadian Nuclear Safety Commission, Environmental Assessment of the Bruce A Refurbishment for Life Extension and Continued Operations Project, Bruce A Nuclear Generation Station, March 2006, Appendix 2, Comment 10-EC. Since then, Bruce Power's position has been that the implementation of mitigation measures is not yet warranted, a view that CNSC staff appear to share. See, for example, Letter from F. Saunders, Vice President of Nuclear Oversight and Regulatory Affairs (Bruce Power), to K. Lafreniere, Director of the Bruce Regulatory Program Division (CNSC), 17 April 2014; and Letter from K. Lafreniere, Director of the Bruce Regulatory Program Division (CNSC), to F. Saunders, Vice President of Nuclear Oversight and Regulatory Affairs (Bruce Power), 6 February 2014. See also p. 53 of CNSC staff's Environmental Assessment Report for the licence renewal where the CNSC acknowledges that climate change may change the extent of the facility's impacts on aquatic biota in the future, but that the "cyclical nature of th[e CNSC's environmental protection framework allows for the CNSC to assess and mitigate risks that may arise."

impacts will evolve.

Aside from cumulative effects, the SON are also concerned with project-related risks and uncertainties associated with routine operations as well as those arising from potential accidents and malfunctions. The SON claim that these risks should be weighed mindful of the potentially irreversible consequences to the SON and their territory. The SON people assert that they have a unique relationship with the Territory; it is the source of their identity as Anishnabek peoples, as well as of their Aboriginal and treaty rights. As such, harm caused to the lands and waters of their Territory are seen as an existential threat that would be visited upon the SON in an acute and unique manner, imperilling their future as a people and infringing their constitutionally guaranteed Treaty rights.

III. THE APPLICABLE REGULATORY FRAMEWORK

This application is being reviewed pursuant to *Nuclear Safety and Control Act*, S.C. 1997, c. 9. The statutory task of the CNSC is spelled out in subsection 24(4) as follows:

> **Conditions for issuance, etc.**
>
> (4) No licence shall be issued, renewed, amended or replaced — and no authorization to transfer one given — unless, in the opinion of the Commission, the applicant or, in the case of an application for an authorization to transfer the licence, the transferee
>
> (a) is qualified to carry on the activity that the licence will authorize the licensee to carry on; and
>
> (b) will, in carrying on that activity, make adequate provision for the protection of the environment, the health and safety of persons and the maintenance of national security and measures required to implement international obligations to which Canada has agreed.

The duty of the CNSC to protect the environment is elaborated upon in REGDOC 2.9.1. It sets outs a number of "guiding principles for protection of the environment" including the precautionary principle:

> For each facility or activity that has direct interactions with the environment, the CNSC must determine that the licensee or applicant has made adequate provision for the protection of the environment. The applicant or licensee's licence application shall demonstrate (through performance assessments, monitoring or other assessments) that their environmental protection measures:
>
> - are commensurate with the level of risk associated with the activity
> - recognize that uncertainty exists in science and account for this uncertainty:
>   - by keeping all releases to the environment as low as reasonably achievable (ALARA), social and economic factors being taken into account for nuclear substances
>   - through the application of the best available technology and techniques economically achievable (BATEA) for hazardous substances

- respect the precautionary principle, the "polluter pays" principle**,** and the concepts of pollution prevention, sustainable development and adaptive management
- are assessed against performance indicators and targets that are based on sound science

The precautionary principle is defined in REGDOC 2.9.1 as follows:

> **precautionary principle** *(principe de la prudence)*
>
> The principle that where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation. (Source: *Federal Sustainable Development Act*, *Canadian Environmental Protection Act, 1999 (preamble)*)
>
> **Note 1:** In other words, the absence of complete scientific evidence to take precautions does not mean that precautions should not be taken – especially when there is a possibility of irreversible damage.
>
> **Note 2:** The "precautionary principle" is discussed in additional detail in *A Framework for the Application of Precaution in Science-based Decision Making about Risk*.

IV. ROLE & NATURE OF THE PRECAUTIONARY PRINCIPLE IN JUDICIAL AND QUASI-JUDICIAL DECISION-MAKING

A. Role and Prevalence of the Precautionary Principle in Canadian Law

The origins and implications of the precautionary principle are the subject of a considerable and growing scholarly literature.[5] Derivative of the maxim "better safe than sorry", at its core the principle seeks to formalize precaution as a regulatory obligation in the face of environmental threats and scientific uncertainty. In the domain of international law, the principle began to emerge in the early 1980s most notably in the *World Charter for Nature* (1982). Since that time, it has become a central feature of close to one hundred international agreements and has been incorporated into scores of domestic environmental and public health laws worldwide.

There are several different formulations of the precautionary principle. The most widely-cited version of the precautionary principle is found in Principle 15 of the *Rio Declaration on Environment and Development* (1992):

---

[5] See generally David Freestone & Ellen Hey, eds, *The Precautionary Principle and International Law* (The Hague: Kluwer Law International, 1996); Arie Trouwborst, *Evolution and Status of the Precautionary Principle in International Law* (The Hague: Kluwer Law International, 2002); Harold Hohmann, *Precautionary Legal Duties and Principles of Modern International Environmental Law* (London: Graham & Trotman, 1994); Ronnie Harding & Elizabeth Fisher, *Perspectives on the Precautionary Principle* (Sydney: Federation Press, 1999); Simon Marr, *The Precautionary Principle in the Law of the Sea* (The Hague: Kluwer Law, 2003); Joakim Zander, *The Application of the Precautionary Principle in Practice: Comparative Dimensions* (Cambridge: Cambridge Univ Press, 2010); Jocelyn Stacey, "Preventive Justice, the Precautionary Principle and the Rule of Law" (2016) in Tamara Tulich et al, *Regulating Preventive Justice* (New York: Routledge, 2016) 23. What follows draws upon C. Tollefson, "A Precautionary Tale: The Trials and Tribulations of the Precautionary Principle" in A. Ingelson (ed) *Environment in the Courtroom* (University of Calgary Press, forthcoming).

> "Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."[6]

It is this version of the precautionary principle that is embodied in REGDOC 2.9.1, a version of the principle that, as signatory to the *Rio Declaration*, Canada has agreed to implement.

The precautionary principle has come to play a key role in the interpretation of laws and regulations designed to protect the environment and public health. While the Supreme Court of Canada has led the way in the recognizing the importance of the principle in modern-day environmental decision-making, other courts have likewise made significant contributions to a growing caselaw that affirms the central role that law mandates this principle to assume.[7]

A good illustration of the application of the principle arose recently in *Taseko Mines v. Canada*, 2017 FC 1099. In this case, a review panel conducting an environmental assessment under *CEAA, 2012* applied the principle in deciding to recommend rejection of a mining project proposed for north-central British Columbia. It was accepted that under *CEAA, 2012* the panel was obliged to apply the precautionary principle. The proponent argued, however, that the panel could do so by recommending an adaptive management approach to project-related risks. In light of the nature of the these risks, the panel disagreed. On judicial review, the Federal Court sided with the panel noting that these were not circumstances in which the requirements of the precautionary principle could be met through "vague assurances" by the proponent to implement adaptive management. According to the Court:

> Indeed, acceptance of vague adaptive management schemes in circumstances such as these would, in my view, tend to call into question the value of the entire review panel process – if all such decisions could be left to a later stage, then the review panel process would simply be for the sake of appearances.[8]

By far the most common way that the principle finds its way before domestic courts and tribunals is through its implicit or explicit adoption in domestic statutes. A growing number of jurisdictions have enacted legislation that explicitly incorporates the precautionary principle either as a substantive decisional criterion or in preambular language. In Canada, the principle is now affirmed in most our federal environmental laws including the *Species at Risk Act* (*SARA*), the *Oceans Act*, the *Canadian Environmental Protection Act* (*CEPA*), the *Canadian Environmental Assessment Act* (*CEAA*) and the *Pest Control Products Act* (*PCPA*). The principle is also specifically referenced in recently tabled amendments to the *Fisheries Act* (Bill C-69, s. 2.5) and in the new *Impact Assessment Act* [Bill C-68, ss. 6(1)(d) and ss. 6(2)].

Currently the principle appears in the preambles to *CEPA*, *SARA* and the *Oceans Act*, in the purposes section of *CEAA* (s. 4) and as a mandatory strategic management principle under the *Oceans Act* (s. 30). It is also expressed as a relevant consideration in the exercise of administrative

---

[6] The United Nations Conference on Environment and Development, *Rio Declaration on Environment and Development*, Principle 15.

[7] *114957 Canada Ltee (Spraytech) v. Hudson (Town of)*, 2001 SCC 40 ("*Spraytech*"); *Castonguay Blasting Ltd. v Ontario (Environment)*, 2013 SCC 52 ("*Castonguay*"); *Morton v. Minister of Fisheries and Oceans*, 2015 FC 575 ("*Morton*"); *Wier v. British Columbia (Environmental Appeal Board)*, 2003 BCSC 1441 ("*Wier*"); *Taseko Mines v Canada*, 2017 FC 1099 ("*Taseko*").

[8] *Taseko*, *ibid.* at para 124.

duties vested in the Government of Canada and its agencies under *CEPA* and *CEAA*.[9] Moreover, in several instances, as set out below, the principle operates as a substantive decisional criterion:

- When conducting various assessments of potentially toxic substances, federal Ministers shall "apply … the precautionary principle": section 76.1, *CEPA*.
- In preparing a recovery strategy, action plan or management plan the competent minister shall "consider the principle that, if there are threats of serious or irreversible damage to the listed wildlife species, cost effective measures to prevent the reduction or loss of the species should not be postponed for lack of full scientific certainty": section 38, *SARA*.
- When conducting a re-evaluation or special review of a registered pesticide product, the Minister must take the precautionary principle "into account" when deciding whether "a situation … endangers human health or safety or the environment": see subsections 20(1) and (2), *PCPA*.

Particularly where it is explicitly referred to in statutory or regulatory provisions, the duty to consider and apply the precautionary principle in the interpretation and application of legislative provisions and powers is now clear.[10] However, precisely what it means to apply the precautionary principle, in particular *when* it applies and *how* it applies is still something with which the caselaw is still grappling. A key difficulty to date has been to chart a middle ground between interpretations of the principle that would render it completely innocuous (i.e. simply exhorting caution) and interpretations that would unreasonably thwart economic development by prohibiting decisions in the face of uncertainty.

To operationalize the precautionary principle so that it can offer decision-makers a viable procedural means to take risk into account in a manner that is consistent with established administrative law principles, a host of important questions about the meaning and implications of the principle must be addressed. These include:

- *when should the principle apply?* In other words, should it apply generically or only when certain threshold requirements relating to environmental damage and scientific uncertainty are met?
- *how should it apply?* Who should bear the burden of proof, should the burden shift at some juncture, what form of evidence should be considered, and what standard(s) of proof should apply?
- *what remedial consequences should flow from its application?* To what extent and how should an adjudicative body prescribe measures necessary to achieve compliance with the principle?

B. Operationalizing the Precautionary Principle

Of late, leadership in operationalizing the precautionary principle has been supplied by courts in Australia and New Zealand. In these jurisdictions, following the lead of a landmark decision of the New South Wales Land and Environment Court, courts and tribunals with *de novo* jurisdiction are

[9] See *CEPA*, s. 2 and *CEAA*, s. 4(2).
[10] *Spraytech, supra* note 7; *Castonguay, supra* note 7; *Morton, supra* note 7; *Wier, supra* note 7.

now equipped with a tool that not provides guidance as to *when* the principle applies but also *how* it applies.[11]

This growing iterative body of jurisprudence is helping, to paraphrase a recent decision on the precautionary principle of our Federal Court, to define the "legal contours" of the principle and what duties it imposes on statutory decision-makers. A key focus of this jurisprudence concerns the relationship between the precautionary principle and adaptive management.[12]

What these cases underscore is that in instances where the precautionary principle is triggered this does not mean the activity or development at issue is halted or prohibited.[13] Nor does it imply a "zero-risk" based precautionary standard.[14] Rather, the principle dictates that a contextual analysis of the measures aimed at reducing risk and managing uncertainty be undertaken. In appropriate cases, adaptive management can be one of the "measures" employed to this end.[15]

1. The Telstra Decision

The leading Commonwealth decision on the application of the precautionary principle is *Telstra*. *Telstra* is a landmark decision that provides guidance as to whether and how the precautionary principle applies in the context of regulatory decision-making and judicial review. The *Telstra* analysis proceeds in three discrete stages: (1) deciding whether the principle applies; (2) if so, reversing the onus of proof; and (3) identifying the appropriate governmental response.

The *first stage* of the *Telstra* test is aimed at determining whether the precautionary principle is engaged. At this stage, the onus lies with the applicant to establish two conditions: that the activity in issue potentially poses a "serious *or* irreversible threat of environmental damage" *and* "scientific uncertainty as to the environmental damage."[16] Once *both* of these conditions are shown to apply, the precautionary principle is engaged.

The first arm of this stage of the test involves consideration of whether the apprehended environmental damage is *"serious or irreversible"*. This is a question of fact. Assessment of this question requires "scientific evidence". This means that evidence relied on must be based on scientific knowledge, grounded in scientific methods or procedures, or supported by expert testimony.[17] The decision emphasizes, however, that assessment of whether a "serious or irreversible threat" exists should not be restricted to expert evidence but rather should take into account "the views of relevant stakeholders and rightholders": in the words of the court, "different judgments, values and cultural perceptions of risk, threat and required action play a role in the assessment process".[18]

---

[11] *Telstra Corporation Ltd. v. Hornsby Shire Council*, [2006] NSWLEC 133 ("*Telstra*"); *Environment East Gippsland Inc v VicForests*, [2010] VSC 335 (*"Gippsland*"); *Sustain our Sounds Inc. v. The New Zealand King Salmon Co Ltd.*, [2014] NZSC 40 ("*SOS*").

[12] *Morton*, *supra* note 7, see especially para. 43; *Telstra*, *ibid*; *Gippsland*, *ibid*; *SOS*, *ibid.*

[13] See *Telstra*, *supra* note 11 at paras. 179-181.

[14] *Ibid.* at paras. 157-178.

[15] *Ibid.* at paras. 163-65.

[16] *Ibid* at para. 128.

[17] *Ibid.* at para. 135-36.

[18] *Ibid.* at para. 132.

In considering the question of whether the threat is "serious or irreversible", *Telstra* suggests that a variety of factors might be relevant including:[19]

(a) the spatial scale of the threat (e.g. local, regional, statewide, national, international);
(b) the magnitude of possible impacts, on both natural and human systems;
(c) the perceived value of the threatened environment;
(d) the temporal scale of possible impacts, in terms of both the timing and the longevity (or persistence) of the impacts;
(e) the complexity and connectivity of the possible impacts;
(f) the manageability of possible impacts, having regard to the availability of means and the acceptability of means;
(g) the level of public concern, and the rationality of and scientific or other evidentiary basis for the public concern; and
(h) the reversibility of the possible impacts and, if reversible, the time frame for reversing the impacts, and the difficulty and expense of reversing the impacts.

While *Telstra* does not elaborate what level or quantum of proof must be adduced to establish the existence of the threat, a subsequent Supreme Court of Victoria decision has described it as a risk that "though remote may nevertheless be real and not fanciful or far-fetched."[20]

To satisfy the test set out in first stage of *Telstra*, an applicant must *also* establish that there is "*a lack of full scientific certainty*" as to the nature and scope of the relevant environmental damage. This is also a question of fact. Among the factors that *Telstra* identifies as relevant to its determination are:

(a) the sufficiency of the evidence that there might be serious or irreversible environmental harm caused by the development plan, programme or project;
(b) the level of uncertainty, including the kind of uncertainty (such as technical, methodological or epistemological uncertainty); and
(c) the potential to reduce uncertainty having regard to what is possible in principle, economically and within a reasonable time frame.

In *Telstra*, the court discusses at some length the requisite degree of uncertainty required to trigger the application of the principle. The court rejects the notion that "this threshold is crossed whenever there a lack of 'full' scientific certainty" suggesting that this would render the condition "meaningless".[21] The question the court then asks is "how much scientific uncertainty need there be as to the threat of environmental damage before the second condition precedent to trigger application of the precautionary principle is fulfilled?"[22]

Ultimately, *Telstra* adopts a threshold test of "reasonable scientific plausibility". This test is satisfied when: [23]

> ...empirical scientific data (as opposed to simple hypothesis, speculation or intuition) make it reasonable to envisage a scenario, even if it does not enjoy unanimous scientific support. When is there "reasonable scientific plausibility"? When risk begins to represent a minimum

[19] *Ibid.* at para. 131.
[20] See *Gippslands*, *supra* note 11 at para. 191.
[21] *Telstra*, *supra* note 11 at para. 142.
[22] *Ibid.* at para. 145.
[23] *Ibid.* at para. 148.

> degree of certainty, supported by repeated experience. But a purely theoretical risk may also satisfy this condition, as soon as it becomes scientifically credible: that is, it arises from a hypothesis formulated with methodological rigour and wins the support of part of the scientific community, albeit a minority.

In the *Gippsland* decision, the Supreme Court of Victoria analyzed the relevant evidence on the basis of what it terms a "substantial uncertainty" test.[24]

The *second stage* of the test in *Telstra* commences upon applicant establishing that each of the two preconditions set out above are present. At this juncture, the precautionary principle is triggered, and the burden of proof shifts to the proponent to show that the alleged threat does not exist or is negligible. In the words of *Telstra*: [25]

> If each of the two conditions precedent or thresholds are satisfied…the precautionary principle will be activated. At this point, there is a shifting of the evidentiary burden of proof. A decision-maker must assume that that the threat of serious or irreversible environmental damage is no longer uncertain but is a reality. The burden of showing that this threat does not in fact exist or is negligible effectively reverts to the proponent of the economic or other development plan, programme, or project.

Telstra describes the rationale for this burden shift as being "preventative anticipation: to act before scientific certainty of cause and effect is established."

> …it may be too late or too difficult and costly to change a course of action once it is proven to be harmful. The preference is to prevent environmental damage, rather than remediate it. The benefit of the doubt is given to environmental protection when there is scientific uncertainty. To avoid environmental harm, it is better to err on the side of caution.[26]

Telstra emphasizes that this burden shift "operates in relation to only one input of the decision-making process – the question of environmental damage". If the proponent fails to discharge its burden, this does not mean that its "…project must be refused. It simply means that, in making the final decision, the decision-maker must assume there will be serious or irreversible environmental damage".[27] According to *Telstra*, the precautionary principle does not require "...decision-makers to give the assumed factor (the serious or irreversible environmental damage) overriding weight compared to the other factors required to be considered, such as social and economic factors, when deciding how to proceed".[28]

The *third stage* of the Telstra test allows for preventative steps to be taken "without having to wait until the reality and seriousness of the threats become fully known".[29] At the same time, *Telstra* emphasizes that the principle should not be used to avoid all risks[30] or preclude the carrying out of a project until "full scientific certainty is attained".[31] The type and level of precautionary measures

---

[24] *Gippslands*, *supra* note 11 at para. 197.
[25] *Telstra*, *supra* note 11 at para. 150. See also discussion in *Telstra* at paras 150-155; and *Gippsland*, *supra* note 11 at paras. 199-201.
[26] *Telstra*, *supra* note 11 at para. 151.
[27] *Ibid.* at para. 154.
[28] *Ibid.* at para. 154.
[29] *Ibid.* at para. 156.
[30] *Ibid.* at para. 157.
[31] *Ibid.* at para. 179.

that will be appropriate will depend on the combined effect of the degree of seriousness and irreversibility of the event occurring, and the seriousness of the consequences should it occur.[32]

Telstra urges that "some margin for error" be retained until all the consequences of the decision to proceed with the project are known. One way it suggests this can occur is through an adaptive management plan.[33]

A key part of the determination of what precautionary measures might be appropriate is the concept of "proportionality". The measures adopted must be proportionate to the potential threats and reflect a "risk weighted" analysis of consequences and costs of various options.[34] This will require some form of cost-benefit analysis to be undertaken that avoids the tendency, associated with traditional cost benefit analyses, to "squeeze out soft values in favour of quantifiable values".[35]

The *Telstra* case arose as a *de novo* appeal.[36] The appellant was a telecom company (Telstra) that had been refused permission by a local council to install a cell phone tower in a suburb of Sydney on the basis of a variety of concerns including the effects of exposure to electromagnetic energy (EME). The respondent council rejected Telstra's application even though the levels of EME to be released from the proposed facility were well within a recently approved national EME standard ("Australian Standard RPS3").

At the appeal, the respondent adduced no expert evidence as to the potential for adverse effects associated with exposures predicted to result from the cell phone tower. Nonetheless, it asserted that the precautionary principle should apply to justify its rejection of Telstra's application. Preston C.J. disagreed. In the circumstances, and particularly because the predicted EME levels were well within a nationally established peer reviewed safety standard, Preston C.J. concluded that the respondent had failed to demonstrate that the proposal posed a threat of serious or irreversible harm and accordingly that the precautionary principle did not apply. A key factor supporting this conclusion was that a precautionary approach had already been adopted in the standard setting process and in the terms of Australian Standard RPS3.

2. *Elaborations on and refinements of the Telstra approach*

The *Telstra* case has been frequently followed and approved in Australia and New Zealand and been elaborated by various superior courts. In several cases these elaborations have considered the role of adaptive management and the relationship between adaptive management and the precautionary principle.

Three subsequent decisions deserve scrutiny, all of which focus considerable attention on the relationship between the precautionary principle and adaptive management, a topic that is only dealt with in passing by *Telstra*.

---

[32] *Ibid.* at para. 161.
[33] *Ibid.* at para. 162-165.
[34] *Ibid.* at para. 167, 171, 172.
[35] *Ibid.* at para. 173.
[36] This type of "*de novo*" appeal allows the parties to re-argue the matter appeal from afresh without restrictions on the legal arguments they may make, nor on the evidence they may adduce. In this sense, it is very much akin a "first instance" determination of the type the CNSC will make on this application.

Telstra was followed and applied by the NSW Land and Environment Court in a 2013 decision in a *de novo* merits-based review of a permit amendment application for an existing coal mine seeking to modernize its operations.[37] The Panel held that the proposed expansion triggered the precautionary principle, applying the *Telstra* test, due to impacts on the aquifer and proposed discharges to a nearby river. The burden of proof thus shifted to the proponent to show that these harms could be reduced or eliminated. The proponent sought to rely on an adaptive management plan. The Panel was not persuaded that the adaptive management plan was adequate *inter alia* because "there remained significant uncertainties and undefined parameters due to a lack of baseline data on the groundwater and river water quality issues". As such, the Panel held that the adaptive management plan did not conform with the minimum requirements for an adaptive management plan as set out in *Newcastle v Hunter Valley Speleological Society v Upper Hunter Shire.* ("*Newcastle*"). [38]

Like *Telstra*, *Newcastle* was authored by the Chief Judge of the NSW Land and Environment Court. In *Newcastle*, Preston C.J. takes the opportunity of elaborating how adaptive management aligns with the analysis of the precautionary principle he offers in *Telstra.*

Newcastle involved a project that presented a risk of harm to certain cave dwelling species. Preston C.J. heard the appeal from the granting of a development permit on a *de novo* basis. In his view, the circumstances of the case engaged the precautionary principle, however, the threats in question were satisfactorily addressed through the proposed adaptive management plan. In his words,[39]

> In the circumstances of this case, I consider that the appropriate and proportionate response to the threat of environmental damage to biota within the limestone is to implement a step-wise or adaptive management approach. This would involve imposition of conditions of consent requiring monitoring linked to adaptive management.

Preston C.J. went on, however, to underscore that the legal test as to what constitutes "adaptive management" is a rigorous one.

> Adaptive management is a concept which is frequently invoked but less often implemented in practice. Adaptive management is not a "suck it and see", trial and error approach to management, but it is an iterative approach involving explicit testing of the achievement of defined goals. Through feedback to the management process, the management procedures are changed in steps until monitoring shows that the desired outcome is obtained. The monitoring program has to be designed so that there is statistical confidence in the outcome. In adaptive management the goal to be achieved is set, so there is no uncertainty as to the outcome and conditions requiring adaptive management do not lack certainty, but rather they establish a regime which would permit changes, within defined parameters, to the way the outcome is achieved.[40]

The relationship between adaptive management and the precautionary principle has also been recently discussed in a 2014 decision of the New Zealand Supreme Court. In this decision, the NZSC reverses the order of the inquiry. It first asks the question, before considering whether the precautionary principle applies, whether an adaptive management regime can even be considered "as

---

[37] *Southern Highlands Coal Action Group v. Minister for Planning and Infrastructure*, [2013] NSWLEC 1032 ("*Southern Highlands*").
[38] *Newcastle v. Hunter Valley Speleological Society v. Upper Hunter Shire*, [2010] NSWLEC 48 ("*Newcastle*").
[39] *Ibid.* at para. 183.
[40] *Ibid.* at para. 184.

a means of reducing uncertainty and adequately managing any remaining risk".[41] To determine this "overall question", the NZSC identifies four key factors: [42]

(a) there will be good baseline information about the receiving environment;
(b) the conditions provide for effective monitoring of adverse effects using appropriate indicators;
(c) thresholds are set to trigger remedial action before the effects become overly damaging; and
(d) effects that might arise can be remedied before they become irreversible.

The final decision deserving of mention is a judgment of the Supreme Court of Victoria (Common Law Division). *Environment East Gippsland Inc. v VicForests* ("*Gippsland*") is a lengthy and careful consideration and application of *Telstra* in the context of logging activity by the defendant company that the applicant conservation group claimed would adversely impact the critical habitat of various endangered species. In the end, Osborn J. elaborates on the 3 stage test set out in *Telstra*. *Gippsland* proposes that the *Telstra* test be applied as follows:[43]

(a) is there a real threat of serious or irreversible damage to the environment?
(b) is it attended by a lack of full scientific certainty (in the sense of material uncertainty)?
(c) if yes to (a) and (b), has [the Proponent] demonstrated the threat is negligible?
(d) is the threat able to be addressed by adaptive management?
(e) is the measure alleged to be required proportionate to the threat in issue?"

Under Osborn J's five step test steps (a) and (b) correspond to stage one of *Telstra*; step (c) corresponds to stage two of *Telstra*; and steps (d) and (e) roughly correspond to the third stage of *Telstra*.

In particular, the "proportionate measure" element of the *Gippsland* draws heavily on paras. 166 to 181 of *Telstra* and affirms a recognition of the need to ensure that measures taken in response to the principle "should not go beyond what is appropriate and and necessary to achieve the objective in question", and that such measures be assessed in terms of their practicality, costs and benefits.[44]

Applying this "*Gippsland*" test, Osborn J. offered the following conclusions:[45]

- That the proposed logging presented a *real threat of serious or irreversible damage* to the environment (i.e. these two species) including their "threatened" status and relevant expert evidence;
- That this damage was attended by *a lack of full scientific certainty* including evidence with respect to very significant uncertainties relating to their respective distribution, biology and conservation;
- The defendant has not demonstrated that the threat is negligible insofar as it led "no evidence from an expert with specialist qualifications relating to the biology and conservation of frogs";

[41] *SOS*, *supra* note 11 at para. 125.
[42] *Ibid.* at para. 133.
[43] *Gippsland*, *supra* note 11 at para. 212.
[44] *Ibid.* at para. 207-209.
[45] *Ibid.* at para. 506.

- The threat can be addressed through adaptive management, including "management measures, which would significantly better inform a further judgment as to the relevant conservation values of the Brown Mountain….[reducing]…uncertainty with limited cost and within a reasonable timeframe"; and
- The "measures proposed are proportionate to the threat in issue. They are limited operations. Further, they are capable of definition and …controlling supervision… In addition there is no satisfactory evidence that postponement of timber harvesting…would cause VicForests significant economic damage"

V. APPLYING THE PRECAUTIONARY PRINCIPLE TO BRUCE POWER'S REFURBISHMENT APPLICATION

As described in Part III, the CNSC has a statutory duty to protect the environment under its enabling legislation. The nature of this duty is elaborated in REGDOC 2.9.1 which speaks of an obligation to "respect" the precautionary principle. In this regard, the CNSC finds itself in a position akin to that of many federal regulators that increasingly—both by statute and by operation of common law interpretive principles—are tackling the challenge of putting the precautionary principle to work. To do this regulators must do more than simply pay it lip service.

Implementing the precautionary principle in a meaningful manner will not be easy, particularly in these early days. Doing so will need to take careful account of a variety of factors including the nature of the regulatory setting, the state of scientific knowledge and uncertainty, and the relative costs and benefits of various mitigation measures. In the Canadian context, an added challenge will be to understand and apply the principle in a manner that recognizes and respects Indigenous knowledge and rights including those rights that are protected under s. 35 of the *Constitution Act, 1982*.

In ensuring that its review of Bruce Power's application is conducted in a manner that is consistent with the precautionary principle, the CNSC can draw much helpful guidance from pioneering work in this area that has been done in other Commonwealth jurisdictions that augments the judicial direction Canadian courts have offered to date. In my opinion, the most practical and balanced approach is one emerges from the *Telstra* line of cases which has recently been encapsulated as follows by the Supreme Court of the State of Victoria in *Gippsland*. This five-step *Gippsland* test, as set out and discussed in Part IV, asks these five questions:

Step One: Is there a real threat of serious or irreversible damage to the environment?

Step Two: If so, is this threat attended by a lack of full scientific certainty?

Step Three: If the answers to questions 1 and 2 is affirmative, has the Proponent demonstrated the threat is negligible?

Step Four: Is the threat capable of being addressed by adaptive management?

Step Five: Is the measure(s) alleged to be required proportionate to the threat in issue?

In balance of this Part, I offer some thoughts on how the CNSC might employ the *Gippsland* test in its review of Bruce Power's current application.

Step One: Is there a real threat of serious or irreversible damage to the environment?

In Step One of its assessment, the CNSC should consider whether the evidence before it supports a conclusion that the proposed project poses a threat to the environment that is "real" *and* one that could potentially cause "serious or irreversible damage" to the environment. There mandates two distinct inquiries: one focussed on the quantifying the probability of the risk to the environment, and another that addresses the nature of the damage (consequences) associated with that risk.

In a sense, this formulation parallels the well-known theorem that posits that **risk = probability x consequences**.

The caselaw offers some helpful guidance as for the *probability* arm of the inquiry (whether the risk poses a "real threat"). In *Gippsland*, Osborn J. emphasizes the quantum of proof will be satisfied if the risk "though remote may nevertheless be real and not fanciful or far-fetched".[46] Moreover, according to *Telstra*, the evidence must also have a scientific basis.[47]

In the Background Facts, the project-related environmental risks associated with *routine operations* of Bruce NGS facility that are identified by the SON as arising from the project fall into two categories: 1) impingment and entrainment effects; and 2) thermal effects. My understanding is that it is common ground as between the Parties that Bruce NGS's extraction of several trillion litres of water from Lake Huron and its subsequent release back into the lake has adverse impingement, entrainment and thermal effects. The uncertainty, and the disagreement between the parties, concerns the nature and magnitude of those effects.

In assessing whether the risk is "real" (rises to level of probability that is "not fanciful or far-fetched"), it is important for the CNSC to bear in mind that it must consider this question alive to the potential that these adverse effects will interact with each other and with other stressors that Lake Huron will face over the fifty year life-time of this project. Lake warming and climate change must be part of this *cumulative effects* analysis. Additionally, in addressing the question of whether the risks identified by the SON are a "real threat", it is important for the CNSC to factor into its analysis the potential for malfunctions and accidents at the facility not associated with routine operations.

At this stage of inquiry, a risk should not be discounted as failing to meet the test of being "real" simply because of a lack of conclusive scientific evidence. It must be borne in mind that scientific certainty is a highly exacting standard. To postpone remedial action to await this standard being met is inconsistent with the principle. Indeed, in some instances, the remedial action being sought under the auspices of the principle may be an order that credible studies be done to assist in filling scientific knowledge gaps.

It is also important for the CNSC to be mindful of the various types of evidence that it might consider in relation to this first arm of the test. Thus, while *Telstra* opines that to meet this arm of the test there must be some scientific evidence suggestive that the risk is real, this does not preclude consideration of other supporting evidence that might otherwise be overlooked or discounted. This is of particular importance in the present case insofar as the SON possess highly relevant Indigenous knowledge on issues such as how the Lake Huron environment has changed over time.

---

[46] *Ibid.* at para. 191.

[47] *Telstra*, *supra* note 11 at para. 134.

The second arm of the test considers whether the impacts associated with threat posed is "serious or irreversible". It is to be noted that the party arguing the principle applies need only prove that the impacts are serious or irreversible, not necessarily both. Are the consequences of this threat presented by renewing Bruce NGS's licence for another fifty years without requiring modification of its cooling system serious *or* irreversible? As set out above, *Telstra* provides a list of factors to consider for serious or irreversible environmental damage. These factors include

> (a) the **spatial scale** of the threat (e.g. local, regional, statewide, national, international);
> (b) the **magnitude of possible impacts**, on both natural and human systems;
> (c) the **perceived value of the threatened environment**;
> (d) the **temporal scale of possible impacts**, in terms of both the timing and the longevity (or persistence) of the impacts;
> (e) the **complexity and connectivity** of the possible impacts;
> (f) the **manageability of possible impacts**, having regard to the availability of means and the acceptability of means;
> (g) the **level of public concern**, and the rationality of and scientific or other evidentiary basis for the public concern; and
> (h) the **reversibility of the possible impacts** and, if reversible, the time frame for reversing the impacts, and the difficulty and expense of reversing the impacts. (emphasis added)

In this instance, the SON would likely argue that most, if not all, of these factors support a conclusion that the threat here is "serious" or "irreversible". The evidentiary basis for this position includes what is at stake here is a constitutionally protected treaty right to fish, a right that could irrevocably be extinquished within the whole of their territory; a prospect that has created great anxiety and concern within the SON nation. In particular, SON would likely argue that whenever a project poses a real threat (irreversible or otherwise) to a constitutionally recognized Treaty right, the regulator must treat that threat as "serious". It would, of course, be open to Bruce Power to argue that threat posed by allowing the project to proceed is neither serious or irreversible. It could argue, for example, that the CNSC should not concern itself, in applying the precautionary principle, with potential impacts on Treaty rights as the principle is calibrated to take account of *environmental* effects. The counter to that argument would be that, as is often argued in the environmental assessment context, regulators must consider both adverse environmental effects in their own right as well as how those adverse effects impact the exercise of rights guaranteed under s. 35 of the *Constitution Act, 1982*.

Step Two: If so, is this threat attended by a lack of full scientific certainty?

It must be emphasized that the precautionary principle does *not* apply where there is full scientific certainty, nor does it apply where the evidence of risk does not rise to a minimum degree of certainty.[48] The level of scientific certainty capable of sustaining the principle must therefore fall between these two points on the certainty-uncertainty spectrum. Moreover, the posited risk may be entirely theoretical and unproven as long as it has credibility within at least some part of the scientific community.[49]

---

[48] *Ibid.* at para. 142.
[49] *Ibid.* at para. 148; see also *Morton*, *supra* note 7.

Accordingly, at this stage of the analysis, the CNSC must ask whether in relation to the environmental effects identified in stage one, there is "reasonable scientific plausibility" to the concerns raised by SON. In particular, is there reasonable scientific plausibility to SON's concerns about project-related adverse effects of impingement and entrainment, and of thermal warming on fish and fish habitat in Lake Huron and, ultimately, on their Treaty protected fishery?[50]

Telstra suggests three factors to consider in the assessment of the degree of scientific uncertainty:[51]

- the sufficiency of the evidence that there might be serious or irreversible environmental harm caused by the development plan, programme or project;
- the level of uncertainty, including the kind of uncertainty (such as technical, methodological or epistemological uncertainty); and
- the potential to reduce uncertainty having regard to what is possible in principle, economically and within a reasonable time frame.

I do not have a great deal of information upon which to review the present facts and circumstances in relation to this stage of the inquiry. The parties do seem to agree that the available science suggests both in terms of impingement and entrainment effects, and of thermal effects, that the project will have potentially adverse environmental effects.

There also seems to be agreement that there are gaps in the scientific knowledge surrounding these nature and extent of these effects. It would appear that this scientific uncertainty is compounded by the uncertainties associated with predicting the interaction between this project and other natural and human factors that will influence the fate and condition of Lake Huron over the fifty year lifetime of the project.

Where the parties appear to differ concerns what should be done in the face of this scientific uncertainty. It would appear that Bruce Power and CNSC favour a wait and see approach that involves ongoing monitoring, whereas SON favours more an approach that would require proactive action in the form of mitigation measures.

If the CNSC concludes on the basis of this test that there is at least some "reasonable scientific plausibility" to the concerns that SON has raised about the environmental effects impingment, entrainment and thermal warming, it would then turn move to the third step in the framework.

Step Three: If the answers to questions 1 and 2 is affirmative, has the Proponent demonstrated the threat is negligible?

At this stage of the inquiry, if the CNSC concludes that SON has met the evidentiary requirements of Steps One and Two, the onus then shifts to Bruce Power to demonstrate on the whole of the evidence in the record that the environmental threats identified by SON are negligible.

I understand from the facts provided that the CNSC has concerns about the methodology used by Bruce Power to monitor and characterize impingement and entrainment effects but does not consider that these concerns are of a sufficient magnitude to alter its conclusion that the project is not likely to cause unreasonable risk to the environment. Moreover, I also understand that at this

[50] *Telstra*, *supra* note 11 at para. 148.
[51] *Ibid.* at para. 141.

stage CNSC has concluded that the project is "not likely to pose an unreasonable risk to the environment". I have not been provided with any other details as to the rationale or methodology employed by CNSC to reach these conclusions.

If the CNSC were to implement the framework proposed here, at this stage it would call upon the Proponent to submit into the record evidence it relies on to suggest that the Project's impacts in terms of impingement, entrainment and thermal effects are negligible. The CNSC would then give SON and other parties an opportunity to question this evidence and lead their own evidence. Bruce Power would likewise have an opportunity to question and respond to evidence led by other parties.

While this would likely closely resemble the hearing process the CNSC would typically employ to identify and assess adverse environmental effects, it would have two differences. First, the ultimate question to be addressed would be framed differently. The key question on which the CNSC would have to be persuaded would not be whether it considers the relevant risk or threat to be likely to occur *and* unreasonable. Rather the question would be whether the CNSC is satisfied that the threat of risk is negligible. Secondly, unlike in most environmental assessment hearings, the applicant/proponent here would have the burden of persuading the CNSC on a balance of probabilities that the risk/threat was negligible. If it were to succeed in establishing that, it would be unnecessary to take further steps to implement the precautionary principle. On the other hand, if Bruce Power were to fail to persuade the CNSC at this stage that the risk/threat is negligible, the inquiry would then move to Step Four.

Step Four: Is the threat capable of being addressed by adaptive management?

The fourth stage of the test requires consideration of whether the threat is able to be addressed by adaptive management. A key threshold question that must be addressed is whether there is an "adequate evidential foundation to have reasonable assurance that the adaptive management approach will achieve its goals of sufficiently reducing uncertainty and adequately managing any remaining risk."[52]

Typically proponents, when faced with the prospect of complying with the precautionary principle, will argue in favour of an adaptive management approach. From a regulatory perspective, such an approach often entails adjourning making difficult scientific determinations about risk until more scientific studies can be done and further data is gathered. Such an approach is not necessarily inconsistent the precautionary principle. However, it is the job of regulators, and subsequently courts, to decide if in the circumstances adaptive management and the precautionary principle are compatible.

As noted earlier, in a recent decision, the Federal Court has grappled with precisely this issue. In *Taseko v. Canada*, the proponent argued for an adaptive management approach that the court described as a proposal "that environmental risks and mitigation measures could be dealt with during further stages of development".[53] Other parties involved in the EA process considered this an inadequate approach that was inconsistent with the government's obligation to apply the precautionary principle. The Federal Court agreed holding that, in this instance, it was reasonable to conclude that the proponent's adaptive management plan was inconsistent with the precautionary principle.

---

[52] *SOS*, *supra* note 11 at para. 125.
[53] *Taseko*, *supra* note 7 at para. 121.

Courts in other jurisdictions have likewise affirmed the need to closely scrutinize claims that adaptive management regimes can satisfy the requirements of the precautionary principle: see, for instance, the reasons Preston C.J. in *Newcastle* where he opines that when relied on in this manner adaptive management regimes must be held to a high standard of rigour in terms of design and operation.[54] Also useful are the four factors relied on by the NZSC in *Sustain our Sounds* that are indicia of rigorous and effective adaptive management regime:[55]

- there will be good baseline information about the receiving environment;
- the conditions provide for effective monitoring of adverse effects using appropriate indicators;
- thresholds are set to trigger remedial action before the effects become overly damaging; and
- effects that might arise can be remedied before they become irreversible

In the current instance, at this juncture the available facts relevant to this step in the analysis are sparse. The facts disclose that Bruce Power has committed to monitoring, at least in respect of thermal effects. Beyond that, the parameters of its adaptive management plan are largely unknown. In particular, it is unclear whether there is reliable evidence to conclude the plan meets any of the four prerequisites to "rigorous and effective adaptive management" set out in the *Sustain our Sounds* are met.

Step Five: Is the measure(s) alleged to be required proportionate to the threat in issue?

Under the *Telstra/Gippsland* test, the final stage of the inquiry focuses on the *proportionality* of the proposed response to the threat that has been identified.[56] It is important at this stage to ensure that the responsive measures are carefully calibrated to the nature of the threat. The precautionary principle does *not* require that potential serious or irreversible harm be avoided at any cost. Rather the measures it requires must be practical, and strike a "balance…between the cost burden of the measures and the benefit derived from them".[57]

It is important in this cost-benefit analysis to avoid the tendency, associated with traditional cost benefit analyses, to "squeeze out qualitative soft values in favour of quantifiable values".[58] This admonition from *Telstra* arises from a concern that traditional economics struggles to properly understand and price non-market based values. For this proportionality test to engender public trust, it must therefore strive to capture and reflect these values in a way that is seen as inclusive, robust and legitimate. This challenge takes on added importance in the current instance where the nature of the potential harm being confronted by the SON people goes beyond simply the value of the sustenance and commercial fishery that might be affected and embraces more amorphous, yet closely related, cultural and spiritual impacts.

Offering specific views as to how the CNSC might embark on this final stage of the test to the current case is challenging given the limited facts that have been provided. What the facts do

[54] *Newcastle*, *supra* note 38 at para. 0.
[55] *SOS*, *supra* note 11 at para. 133.
[56] *Telstra*, *supra* note 11 at paras. 166-178; *Gippsland*, *supra* note 11 at paras. 207-212.
[57] *Gippsland*, *supra* note 11 at para. 208; see also *Telstra*, *supra* note 11 at para. 177.
[58] *Telstra*, *supra* note 11 at para. 174.

disclose is that Bruce Power and/or CNSC apparently do not support immediate implementation of mitigation measures in part because of cost considerations. The facts do not, however, disclose what the cost and/or relative efficacy of such mitigation measures would be. The rigourous proportionality analysis mandated here would require the parties to this review to tender for the CNSC evidence on a range of matters including:

- the various *potential mitigation measures* that could be employed to reduce or eliminate identified adverse environment effects (including cumulative effects) associated with the project over its lifespan including impingement, entrainment and thermal warming;
- the *predicted efficacy* of these respective measures in terms of 1) limiting adverse environmental effects, 2) sustaining viable fish populations and fish habitat, and 3) minimizing infringement of SON's treaty rights;
- the *predicted cost* of these respective measures in terms of 1) limiting adverse environmental effects, 2) sustaining viable fish populations and fish habitat, and 3) minimizing infringement of SON's treaty rights;
- the *predicted benefits* associated with these respective measures in terms of limiting adverse environmental effects, 2) sustaining viable fish populations and fish habitat, and 3) minizing infringement of SON's treaty rights; and
- the *costs and benefits of delaying implementation of such measures* including the potential that delay could risk irreversible consequences for fish species that are critical to the SON and to their treaty rights.

Based on this and other evidence, it would the CNSC's task to determine which, if any, mitigation measures proposed by the SON or other parties are proportionate to the threat it has identified and can be justified on a robust cost-benefit analysis that takes proper account of risks of the project for the SON's Aboriginal and treaty rights and way of life.

VI. CONCLUSION

Bruce Power's refurbishment application provides the CNSC with an opportunity to clarify and elaborate upon the nature of its critical role in protecting the environment. There can be no question that environmental protection is a central feature of the CNSC's mandate and operating mission. As such, the task ahead for the CNSC is to clarify and elaborate *how* it will fulfil this role. In some instances, I would contend, the CNSC must employ a methodology that puts the precautionary principle to work. For reasons set out in this Report, this is one of those cases.

In recognizing that imperative and in accepting that challenge, the CNSC has discretion as to the precise methodology it employs. It is, of course, the master of its own procedures. Ultimately, however, it will be judged on the adequacy of that methodology. In confronting the need to develop a methodology that lends proper respect for the precautionary principle, the CNSC is not alone. This challenge is one with which regulators and courts are grappling worldwide. In my opinion, in crafting a made-in-Canada approach that is balanced, rigourous and capable of instilling public trust, the CNSC can greatly benefit from the experience of other jurisdictions, notably the recent work of Commonwealth courts reviewed in this Report.

CHRIS TOLLEFSON is a Professor of Law at the University of Victoria and founding executive director of the Pacific Centre for Environmental Law and Litigation (CELL). Professor Tollefson combines teaching and research on environmental issues with counsel work for various public interest environmental clients. This counsel work has included appearances before all levels of court, including the Supreme Court of Canada, and various environmental regulatory boards and tribunals. He was counsel to BC Nature and Nature Canada during the Enbridge Northern Gateway and Kinder Morgan Trans Mountain pipeline hearing processes. He is co-author (with Dr. Meinhard Doelle) of a leading environmental law textbook and has written on a range of topics including the precautionary principle, environmental assessment, Indigenous rights and forest certification. He has also advised provincial and federal governments on various issues including contaminated sites, environmental management and certification, and international trade. He is a former President of Ecojustice and founding executive director of the UVic Environmental Law Centre. In 2014 he was the recipient of Nature Canada's Conservation Partner Award for his work leading their legal team during the Northern Gateway pipeline hearings.

Appendix B

External review of Bruce Power environmental risk assessments

Prepared by:

Marc W. Cadotte

TD Professor of Urban Forest Conservation and Biology
Department of Biological Sciences
University of Toronto -Scarborough
and
Department of Ecology and Evolutionary Biology
University of Toronto

Executive Editor, Journal of Applied Ecology

Date: April 20th, 2018

TABLE OF CONTENTS

PREAMBLE

Two environmental impact assessments were sent to me for review on behalf of the Saugeen Ojibway Nation. The first assessment is titled: “Bruce Power Environmental Quantitative Risk Assessment” dated Oct 18, 2017 (hereafter referred to as ERA). The second assessment is titled: “Predictive Environmental Risk Assessment for Bruce Power Continued Operations including Major Component Replacement” dated June 29, 2017 (hereafter referred to PERA). I was asked to assess these reports in terms of their scientific validity and their ability to adequately determine environmental impacts. My report does not determine whether the proposed activities outlined in these two assessments will have adverse environmental impacts, as that would require the collection of pertinent data and analysis. My report only addresses the robustness of the two assessments and whether they should be considered sufficient to approve infrastructure expansion and other activities that could have environmental impacts.

EXECUTIVE SUMMARY

Bruce Power submitted two risk assessments to support ongoing and expanding activities. The two reports relied upon an environmental risk assessment (ERA) and a predictive environmental risk assessment (PERA). Best practice for risk assessments is based upon sound science and routine evaluation and improvement in the scientific literature. The methodology employed in both the ERA and PERA do not meet the minimum scientific thresholds needed to make sound decisions about environmental impacts. While I do not judge whether the proposed activities will result in negative environmental impacts, I do not think that the two reports provide the necessary evidence to support the conclusion of a general absence of environmental impacts.

INTRODUCTION

Environmental risk or impact assessments (hereafter ERA) are often a robust way to assess the potential impacts of human activity on environmental health[1], and further frequently required by regulatory agencies for development approval processes. ERAs require objective assessment of proposed development activities and the likely impacts on environmental variables of interest. ERAs are performed by a number of organizations, for a variety of purposes, and can vary in who performs the ERA, ranging from utilizing dedicated staff within the organization to contracting with an external consulting service. ERAs can vary from assessment of impacts on a minimum set of environmental variables dictated by agency policy to providing best-practice recommendations that include a multitude of environmental variables.

Regardless of the exact nature of the ERA, there are norms of best practice that should be employed to ensure that conclusions and recommendations are valid and not subject to alternative interpretations. As with any scientific endeavour, ERAs rely on key assumptions when making predictions about future events and require robust data to support inferences. Broadly, ERA is defined as the scientific process used to identify and evaluate the possible negative effects of human activity on the environment. ERAs most frequently focus on living organisms and ecosystem health. ERAs should clearly define the environmental values being considered, and would normally include organismal health, animal population sizes, stability over time, functioning of an ecosystem (e.g., carbon sequestration), biodiversity, and benefits to humans (e.g., fishing). There are variants on ERAs from those that focus on a single or subset of environmental values, but increasingly state-of-the-art ERAs are seen as those that attempt to understand and predict the long-term cumulative effects of multiple stressors on a wide

[1] "Environmental health" is used here as a generic term that encapsulates different measures of environmental and resource variables and their consistency. For example, population size of target species, biodiversity, or CO_2 sequestration could all be employed as measures of environmental health.

variety of environmental values[2,3]. This approach is usually referred to as 'cumulative impacts assessment' (CIA) and has become the benchmark for some agencies[4].

This report reviews two ERAs prepared for Bruce Power and planned infrastructure upgrades and expansion. The two reports are:

BRUCE POWER ENVIRONMENTAL QUANTITATIVE RISK ASSESSMENT – dated October 2017

And

PREDICTIVE ENVIRONMENTAL RISK ASSESSMENT FOR BRUCE POWER CONTINUED OPERATIONS INCLUDING MAJOR COMPONENT REPLACEMENT – dated June 2017

In the text below, these two ERAs will be reviewed sequentially.

ASSESSMENT OF REPORT #1: *BRUCE POWER ENVIRONMENTAL QUANTITATIVE RISK ASSESSMENT*

Broadly, this ERA focusses on the following effects:

1- Chemicals of potential concern (COPC) and their effects on human health directly and on various species that are believed to inhabit the region.
2- Radiological effluents and their effects on human health directly and on various species that are believed to inhabit the region.
3- Physical stressor effects on species, including thermal changes, impacts on water flow and physical impingement.

---

[2] MacDonald, L. H. 2000. Evaluating and managing cumulative effects: process and constraints. Environmental Management **26**:299-315.
[3] Baxter, W., W. A. Ross, and H. Spaling. 2001. Improving the practice of cumulative effects assessment in Canada. Impact assessment and project appraisal **19**:253-262.
[4] EPA. 1999. Consideration Of Cumulative Impacts In EPA Review of NEPA Documents. U.S. Environmental Protection Agency, Office of Federal Activities (2252A)

Overall the report includes a large number of assumptions about the types of species present and the pathways of contact. For example, the report often has incomplete information on specific species and so makes assumptions about their susceptibility to stressors. Further, there is a general and surprising lack of data presented. The report makes important inferences and conclusions often without providing supporting evidence, and the majority of inference relies on estimates of chemical and thermal tolerances selected from literature. Generally, there is a dearth of analyses that would normally be required to support or refute assertions. As an example, the assessment of thermal limits does not contain biological data and so is difficult to determine ecological consequences of predicted changes in temperature. Even when data is alluded to, none of it is ecological -meaning that data to assess thermal effects on predation rates, reproduction, competition among species, and disease infection and transmission rates were not assessed.

Related to data quality is a couple of subtle, but important points. Much of the data on the direct effects of stressors comes from estimates from the literature. There are two main limitations with this approach. First of all, the context-dependency of organisms to stressors is assumed to be unimportant. That is, local site conditions, species differences, and climate are assumed to not influence organismal response to the stressor of interest. The second issue is that the report uses point estimates, that is, single numeric values. Undoubtedly, the literature would have reported variation or uncertainty around these values, and the report does not assess uncertainty which would undoubtedly affect the hazard Quotient calculations and other inferences. This would be an especially important issue if the report had included variation in climate or exposure events, thus compounding sources of variation.

Further on the topic of data, a robust assessment should include the collection of data prior to, or independent of development activities to provide benchmark values for environmental variables that impacts can be assessed against. The report does not indicate that preliminary data was collected in order to provide sufficient benchmarks. Proper ERAs require sampling to estimate diversity and species abundances, as well as spatial locations (e.g., aggregations, spawning grounds, etc.). The report suffers from insufficient data to examine how habitat use corresponds to existing environmental conditions and how alterations to environmental variables might influence this habitat use. For the assessment of

COPCs for example, little information or assessment is provided of COPC release rates and temporal fluctuations, and further how seasonality and yearly variation in rainfall or snow accumulation can influence exposure to COPCs of species with differing life histories and occupying different trophic levels. The report essentially assumes a constant supply rate and constant bio-availability, which is very unlikely to be true.

Importantly, the ERA focusses solely on direct health effects of stressors on species (and here I ignore the parts of the report focussed on human health impacts, I am reviewing the environmental impact only) -that is whether or not Bruce Power activities result in direct mortality or some other adverse health effect. The report explicitly excludes indirect effects. For example, "the scientific literature focuses on behavioural adaptations to elevated noise levels (e.g., avoidance) rather than health effects. As a result, noise effects to wildlife were not quantitatively assessed" (p. 11). Sub-lethal and indirect effects, such as on behavior, immune responses, growth rates, and so on have been shown to have important consequences for ecological processes[5,6]. It could be argued that most environmental impacts from human activities on other species are sub-lethal, but the consequences are nonetheless profound, evidenced by declining populations of most wildlife species in Canada[7].

The report singularly focusses on individual effects on organismal performance and survival, with little consideration of ecological and food web effects from, for example, shifts in behaviour, phenology, competitive hierarchies, and so on. Organisms and species are not entities operating in isolation from one another, and alterations in one species or trophic level can have cascading effects through an ecosystem. Further, different stressors will have interactive and synergistic effects that might result in compounding effects on ecosystems. This is well understood in the ecological and ecotoxicological literatures, with concluding statements such as "*Of more general importance is our finding that the consequences of stressors are often unpredictable on the basis of knowledge of single effects; if*

---

[5] Rohr, J. R., and K. A. McCoy. 2010. A qualitative meta-analysis reveals consistent effects of atrazine on freshwater fish and amphibians. Environmental health perspectives **118**:20.

[6] Fleeger, J. W., K. R. Carman, and R. M. Nisbet. 2003. Indirect effects of contaminants in aquatic ecosystems. Science of The Total Environment **317**:207-233.

[7] WWF. 2017. Living Planet Report Canada: A National Look at Wildlife Loss. World Wildlife Fund Canada.

managers only consider the effects of individual stressors, their assessment of risk may be higher or lower than reality"[8].

Summary of review of report #1

In summary, the ERA's ability to adequately assess potential environmental impacts is questionable. The major reasons I say this are:

1- The report has a general lack of data and data analysis, which would normally be required to support conclusions.

2- The report does not assess important sub-lethal and indirect effects on organisms, which can result in important ecological changes to the distribution and abundance of species and alter their interactions.

3- No consideration of interactive effects among stressors. For example, chemical exposure and seasonality or variation in precipitation.

4- The report assumes constant supply rates and organismal uptake. It is reasonable to assume that contaminant build up and release over time with rainfall or thaw events.

ASSESSMENT OF REPORT #2: *PREDICTIVE ENVIRONMENTAL RISK ASSESSMENT FOR BRUCE POWER CONTINUED OPERATIONS INCLUDING MAJOR COMPONENT REPLACEMENT*

This second report moves beyond the basic ERA presented in report #1 and presents what they refer to as a predictive environmental risk assessment (PERA). The PERA in report #2 was performed with a specific goal, as stated in the report: "*The purpose of the ERA and Predictive Effects Assessment is to demonstrate that Bruce Power has made adequate provision for the protection of the environment*" (p. 4). Thus, given that the PERA is an important component of the overall assessment, it is worth critically examining this approach. At this point it is worth pointing out the fact that Report #2's goal is to demonstrate that Bruce Power protects the environment, rather than to objectively assess the impacts of Bruce Power's activities. Importantly, the report actually states that this is not an assessment per se, but rather "was conducted to characterize and illustrate how the environment and the health of

[8] Townsend, C. R., S. S. Uhlmann, and C. D. Matthaei. 2008. Individual and combined responses of stream ecosystems to multiple stressors. Journal of Applied Ecology **45**:1810-1819.

persons will continue to be protected during ongoing future operations" (p. 4). This statement makes clear that the *a priori* assumption is that future operations will not negatively impact the environment. The report states that the PERA was performed in accordance with standardized practice based on governmental guidelines[9]. The report makes clear that the PERA is meant to predict long-term impacts (or lack thereof) of the stressors identified in the ERA. However, the PERA does not describe any of the necessary methodology to make predictions, nor does it actually define what is meant by 'prediction'. The claim that a particular analysis will provide prediction is actually a substantial claim that requires a robust analyses and estimation of degree of confidence in predictions.

In a detailed search of the environmental monitoring literature, I was unable to find any methodology or assessment framework referred to as a 'predictive environmental risk assessment'. As far as I can determine from internet and article searches, PERA is a phrase created by consultants working with Ontario Power Generation (OPG), or OPG directly. This methodology does not exist in the environmental science or environmental monitoring literature, and therefore does not represent an accepted practice that has been subject to evaluation by the scientific community. The lack of scientific review does draw into question to validity and robustness of the approach.

Further. I would posit that the report misconstrues what 'prediction' means in environmental science. Making environmental or ecological predictions is a very complex and data intensive exercise. Environmental scientists or ecologists might wish to predict the future value of a state variable, or more likely they wish to estimate the probability or likelihood of the persistence of an environmental value above a threshold or the probabilistic upper or lower bounds of these values. To do this, a predictive analysis would require complex statistical models and computer simulations of the influence of a) environmental variables (which themselves need to be modelled), b) the endogenous dynamics of the environmental value (e.g., population growth models or stage-based matrix projection models to simulation population growth), and c) influences of exogenous pressures (e.g., anthropogenic effects) which should be modelled under different scenarios. These types of models are becoming

[9] CNSC. 2017. REGDOC-2.9.1 Environmental Principles, Assessments and Protection Measures.

commonplace to inform management and policy[10], and if done properly can provide managers a basis for informed actions.

The assessment language leaves the impression that it has undertaken what is called a cumulative impacts assessment (CIA)[11], but it does not fulfil the necessary requirements to qualify as such. As stated in the introduction, the CIA is a recognized methodology (see footnotes 2-4). The CIA is an established methodology with clear guidelines[12]. The CIA requires that the spatial extent be defined and should be large enough to capture important ecosystem processes, like animal movement, and it requires data from longer periods of time to understand the behaviour of the system of interest. Further, the CIA should not assess environmental values individual or in isolation, but in combination, and should include indirect effects. The PERA described in the second report does none of these things.

Many of the same criticisms that were presented for the first report are identical for the second report. There is a lack of data, inadequate analyses, lack of indirect effects, and no assessment of species interactions. It is worth expanding on one of these here in the context of predicting future impacts, namely, the lack of interaction amongst stressors. This is important because as we move further into the future, the uncertainty introduced by interactive, non-linear, or compounding effects will greatly increase. Both the ERA and the PERA look at chemical, radiological, and physical (including warm water effluent) on several focal species. However, these stressors will be occurring under broader environmental changes that are and will continue to occur in the region. Three important broad stressors that are expected to increase into future in this region include: climate change, invasive species, and eutrophication. These broad stressors will result in systematic changes to the abundance

---

[10] Albert, C. H., B. Rayfield, M. Dumitru, and A. Gonzalez. 2017. Applying network theory to prioritize multispecies habitat networks that are robust to climate and land-use change. Conservation Biology **31**:1383-1396.

[11] Also referred to as cumulative effects assessment

[12] Hegmann, G., C. Cocklin, R. Creasey, S. Dupuis, A. Kennedy,, and W. R. L. Kingsley, H. Spaling and D. Stalker. 1999. Cumulative Effects Assessment Practitioners Guide. Canadian Environmental Assessment Agency. Also see the updated "Assessing Cumulative Environmental Effects Under the Canadian Risk Assessment" (https://www.canada.ca/en/environmental-assessment-agency/news/media-room/media-room-2015/assessing-cumulative-environmental-effects-under-canadian-environmental-assessment-act-2012.html)

of species and the diversity of nearshore environments, and in fact the impacts of climate change on Great Lakes has already been reported[13,14].

The proximate stressors resulting from Bruce Power activities will be interacting with the changes imposed by broad stressors. For example, the increasing surface temperatures in the Great Lakes needs to be taken into consideration when evaluating thermal effects on species. Using historical water temperatures will not provide the necessary information to evaluate future impacts. Furthermore, the other two broad stressors will not have effects that are independent of climate change. Exotic invasive species, which may have limited cultural and traditional value to indigenous communities, are more likely to benefit from warming waters and hence the thermal effects introduced by warmed effluent.

Despite the probable scenarios outlined above, the reality is that we cannot really determine the likely effects of various stressors without adequate data and statistical analyses. The report includes neither the data nor analyses necessary to support the conclusions. Thus, I find that the PERA does not meet a minimum threshold of scientific validity.

Summary of review of report #2

In summary, the PERA's ability to adequately assess potential long-term future environmental impacts is simply not valid and does not conform to best scientific practice. There is evidence that the analysis was performed to support the *a priori* conclusion that the proposed activities will not impact the environment. The major reasons I say this are:

1- The report has a general lack of data and data analysis, which would normally be required to support conclusions.

[13] O'Beirne, M., J. Werne, R. Hecky, T. Johnson, S. Katsev, and E. Reavie. 2017. Anthropogenic climate change has altered primary productivity in Lake Superior. Nature Communications **8**:15713.
[14] Bartolai, A. M., L. He, A. E. Hurst, L. Mortsch, R. Paehlke, and D. Scavia. 2015. Climate change as a driver of change in the Great Lakes St. Lawrence River basin. Journal of Great Lakes Research **41**:45-58.

2- The report does not assess important sub-lethal and indirect effects on organisms, which can result in important ecological changes to the distribution and abundance of species and alter their interactions.

3- The report does not consider interactive effects among stressors, and especially with other long-term stressors like climate change and exotic species invasion.

4- The report does not reply on the analyses and modelling approaches required to make informed predictions and does not provide confidence intervals (i.e., upper and lower bounds) of the likely impacts of stressors.

Biological Sciences
UNIVERSITY OF TORONTO
SCARBOROUGH

CURRICULUM VITAE: MARC WILLIAM CADOTTE

Biological Sciences
University of Toronto-Scarborough
Scarborough, ON
M1C 1A4
(416)208-5105

BIOGRAPHICAL SKETCH

Prof. Marc Cadotte holds the endowed TD Professor of Urban Forest Conservation and Biology chair at the University of Toronto-Scarborough. He is also the Executive Editor of the Journal of Applied Ecology. He researches the links between biodiversity and ecosystem function, how to predict and control invasive species, and how environmental change influences the delivery of ecosystem services. He has published more than 130 articles and has pioneered biodiversity measures that quantify species differences. Along with Jonathan Davies, Prof. Cadotte is the author of the recently published book: Phylogenies in Ecology, published by Princeton University Press. Prof. Cadotte is listed on Web of Science's top 1% most cited scientists in environmental science. He has supervised more than 75 student research projects.

DEGREES

PhD. 2006 University of Tennessee, USA
M.Sc. 2001 University of Windsor, Canada
B.Sc. 1998 University of Windsor, Canada

EMPLOYMENT/POSITIONS

2017 – current: Acting Vice-Principal Research, University of Toronto Scarborough
2017 – current: Professor; Dept. of Biological Sciences, University of Toronto Scarborough, Dept. of Ecology & Evolutionary Biology, University of Toronto
2017 – current: Dean's Advisory Board, University of Hong Kong
2014 – current: Executive Editor, *Journal of Applied Ecology*
2011 – Present: Scientific Advisory Committee, Canadian Institute of Ecology and Evolution.
2014 - 2017: Associate Professor; Dept. of Biological Sciences, University of Toronto Scarborough, Dept. of Ecology & Evolutionary Biology, University of Toronto 2014-2019: TD Professor of Urban Forest Conservation and Biology, University of Toronto Scarborough
2016-2017: Member of Indigenous working group drafting UTSC's response to the Truth and Reconciliation Commission.
2016-2017: Associate Chair for Research and Graduate Affairs. Department of Biological Sciences, University of Toronto Scarborough

2015-2016: Visiting Professor, Sun Yat-sen University, Guangzhou, China
2009-2014: Assistant Professor; Dept. of Biological Sciences, University of Toronto Scarborough, Dept. of Ecology & Evolutionary Biology, University of Toronto
2009-2014: Senior Editor, *Journal of Applied Ecology*
2009 - 2013: Associate editor, *Biological Invasions*
2006-2009: Postdoctoral researcher, University of California, Santa Barbara

HONOURS
2017: Named as a highly cited researcher by Clarivate/Web of Science for being in the top 1% of the most cited works in the fields of environment and ecology.
2014-2019: Recipient of the endowed, term-limited TD Professor of Urban Forest Conservation and Biology chair
2014-2018: Early Career Fellow, the Ecological Society of America
2014-2017: Early Researcher Award, Ontario Ministry of Research and Innovation
2015: University of Toronto Scarborough Research Recognition Award
2013: Selected to give the Helen Battle lecture at the University of Western Ontario
2012: Selected as the annual speaker by the graduate students in the Curriculum for the Environment and Ecology, University of North Carolina –Chapel Hill
2010: Selected as the annual speaker by the graduate students in the Department of Zoology, Oregon State University
2003: Professional Promise Citation, University of Tennessee
2002: Governor General's Gold Medal for Excellence, awarded by the University of Windsor

RESEARCH FUNDING
2016 - 2021 ($37,000/year): NSERC Discovery grant; Title: Biodiversity and the delivery of ecosystem services in novel landscapes
2014 - 2017 ($100,000): Ontario Ministry of Research and Innovation, Early Researcher Award. Title: The role of species in maintaining ecosystem function in urban landscapes.
2011 - 2016 ($32,000/year): NSERC Discovery grant; Title: Community assembly and ecosystem processes in the light of evolutionary history: the formation and function of plant communities
2013 - 2014 (€35,000): iDiv –German Integrative Biodiversity Centre; Title: (S-Phy) Synthesizing phylogenetic measures for ecology and conservation. PI: Marc Cadotte & Dan Rosauer
2010 ($87,283): Canada Foundation for Innovation; Title: Community assembly and ecosystem processes in the light of evolutionary history
2010 ($87,283): Ontario Research Initiative; Title: Community assembly and ecosystem processes in the light of evolutionary history

INVITED LECTURES
More than 100 invited lectures and keynote addresses around the world since 2009.

STUDENT SUPERVISION
Undergrads > 50; MSc = 7; PhD = 14; Postdoctoral fellows = 7

SCHOLARLY AND PROFESSIONAL WORK
More than 130 articles published in many of the top academic journals in biology, environmental science, ecology and evolution. *Total citations according to Google as of April 2, 2018: 7427; H-index: 40.*

Supervised co-authors are indicated by: [U]Undergraduate; [G]Graduate; [P]Postdoctoral scholars and [†]Corresponding author. **My author position is always ordered according to contribution** (i.e., I do not use the last position as a senior one).

Books

1. **Cadotte**, M. W. In prep. A Place for Green Space.
2. **Cadotte**, M. W. and T. J. Davies. 2016. Phylogenies in Ecology: A Guide to Concepts and Methods. Princeton University Press.
3. Keller, R. P., M. W. **Cadotte** & G. Sandiford (Editors). 2014. Invasive species in a globalized world. University of Chicago Press
4. **Cadotte**, M.W., S. M. McMahon and T. Fukami (Editors). 2006 Conceptual ecology and invasion biology: reciprocal approaches to nature. Springer, Dordrecht, The Netherlands.

SELECTED PUBLICATIONS FROM THE PAST THREE YEARS

1. Rohr[†], J. R., E. Bernhardt, M. W. **Cadotte**, and W. H. Clements. 2018. The ecology and economics of restoration: When, what, where, and how to restore ecosystems. Ecology and Society, in press
2. **Cadotte**[†], M. W., S. Campbell, S. Li[G], D. Sodhi[G], and N. Mandrak. 2018. Pre-adaption and naturalization of non-native species: Darwin's two fundamental insights into species invasion. Annual Review of Plant Biology, 69: .
3. Livingstone[G,†], S. W., M. W. **Cadotte** & M. E. Isaac. 2018. Ecological engagement determines ecosystem service valuation: A case study from Rouge National Urban Park in Toronto, Canada. Ecosystem Services 30: 86-97.
4. Li[G], L., M. W. **Cadotte**[†], C. Martinez-Garza, M. de la Pena, and G. Du. 2018. The influence of transplanted seedlings on phylogenetic, functional and taxonomic diversity during early tropical forest restoration. Journal of Applied Ecology 55:986-996.
5. **Cadotte**[†], M.W., T.J. Davies and P. R. Peres-Neto. 2017. Why phylogenies do not always predict ecological differences. Ecological Monographs, 87: 535-551.
6. MacIvor[†,P] J.S., A.N. Roberto[U], D.S. Sodhi[G], and M. W. **Cadotte.** 2017. Honey bees as the dominant pollinator of native milkweed in invaded habitats. Ecology and Evolution, *7*(20), 8456-846.
7. **Cadotte**[†], M. W., S.L.E. Yasui[G], S. W. Livingstone[G], and J. S. MacIvor[P]. 2017. Are urban systems beneficial, detrimental, or indifferent for biological invasion? Biological Invasions 19: 3489-3503.
8. **Cadotte**[†], M. W., S. W. Livingstone[G], S.L.E. Yasui[G], R. Dinnage[G], J.T. Li, R. G. Marushia[P], J. Santangelo[U] and W. Shu. 2017. Explaining ecosystem multifunction with evolutionary models. Ecology 98: 3175-3187.
9. **Cadotte[†],** M. W. and C. M. Tucker[G]. 2017. Should environmental filtering be abandoned? Trends in Ecology and Evolution 32: 429-437.
10. Violle[†], C., W. Thuiller, N. Mouquet, F. Munoz, N. J. B. Kraft, M. W. **Cadotte,** S. W. Livingstone[G], and D. Mouillot. 2017. Functional rarity: the ecology of outliers. Trends in Ecology and Evolution 32: 356-367.
11. **Cadotte**, M. W. 2017. Functional traits explain ecosystem function through opposing mechanisms. Ecology Letters 20: 989-996.
12. Gianuca[†], A. T., S. A. J. Declerck, M. W. **Cadotte**, C. Souffreau, T, De Bie and L. De Meester. 2017. Integrating single α- and β-niche traits with phylogenetic information reveals contrasting assembly processes in freshwater zooplankton. Ecography 40: 742-752.
13. Si[P†], X., M. W. **Cadotte**, D. Zeng, A. Baselga, Y. Wu, Y. Zhao, J. Li, S. Wang, and P. Ding. 2017. Functional and phylogenetic structure of island bird communities. Journal of Animal Ecology 86: 532-542.
14. Bassler[†], C. M. W. **Cadotte**, B. Beudert, C. Heibl, M. Blaschke, J. H. Bradtka, S. Werth and J. Muller. 2016. Contrasting patterns of lichen functional diversity and species richness across an elevation gradient. Ecography 39: 689-698.
15. MacIvor[P†], J. S. M. W. **Cadotte**, S. Livingstone[G], J. Lundholm, and S. L. Yasui[G]. 2016. Phylogenetic ecology

and the greening of cities. Journal of Applied Ecology 53: 1470-1476.

16. Li[G], S., M. W. **Cadotte**, S. J. Meiners, Z. Pu, T. Fukami, L. Jiang[†]. 2016. Convergence and divergence in a long-term old-field succession: the importance of spatial scale and species abundance. Ecology Letters. 19: 1101-1109.

17. Harpole[†], W. S., L. L. Sullivan, E. M. Lind, J. Firn, P. B. Adler, E. T. Borer, J. Chase, P. A. Fay, Y. Hautier, H. Hillebrand, A. S. MacDougall, E. W. Seabloom, R. Williams, J. D. Bakker, M. W. **Cadotte**, E. J. Chaneton, C. Chu, E. E. Cleland, C. D'Antonio, K. F. Davies, D. S. Gruner, N. Hagenah, K. Kirkman, J. M. H. Knops, K. J. La Pierre, R. L. McCulley, J. L. Moore, J. W. Morgan, S. M. Prober, A. C. Risch, M. Schuetz, C. J. Stevens, and P. D. Wragg. 2016. A Global test of the niche dimension hypothesis for plant species diversity. Nature. 537:93-96.

18. Tucker[G†], C.M., M. W. **Cadotte**, S. B. Carvalho, T. J. Davies, S. Ferrier, S. A. Fritz, R. Grenyer, M. R. Helmus, L. S. Jin[G], A. O. Mooers, S. Pavoine, O. Purschke, D. W. Redding, D. F. Rosauer, M. Winter, F. Mazel. 2016. Unifying phylogenetic metrics for conservation, community ecology and macroecology. Biological Reviews 19: 845-854.

19. **Cadotte[†],** M. W., C. A. Arnillas[G], S. W. Livingstone[G] & S. L. E. Yasui[G]. 2015. Predicting communities from functional traits. Trends in Ecology and Evolution 30: 510-511.

20. Rohr[†], J., A. Farag, M. W. **Cadotte**, W. Clements, J. Smith, C. Ulrich, R. Woods. 2015. Transforming ecosystems: When, where, and how to restore contaminated sites. Integrated Environmental Assessment and Management 12: 273-283.

21. Li[G], S., M. W. **Cadotte**[†], S. J. Meiners, Z. Hua, H. Shu, J. Li, W. Shu. 2015. The effects of phylogenetic relatedness on invasion success and impact: deconstructing Darwin's naturalization conundrum. Ecology Letters 18: 1285.

22. **Cadotte**, M. W. 2015. Phylogenetic diversity and productivity: gauging interpretations from experiments that do not manipulate phylogenetic diversity. Functional Ecology 29: 1603-1606.

23. Pearse[†], W. D., M. W. **Cadotte**, J. Cavender-Bares, Anthony R. Ives, C. M. Tucker, S. C. Walker, and M. R. Helmus. 2015. pez: Phylogenetics for the Environmental Sciences. Bioinformatics btv277.

24. **Cadotte**, M.W. 2015. Topology is more important than branch lengths for phylogenetic diversity-ecosystem function relationships. Functional Ecology 29: 718-723.

Appendix C

Review of Consideration of Climate Change in Bruce Power Predictive Effects Assessment of Aquatic Environment

April 9, 2018

Philip H. Byer, Ph.D.
Professor Emeritus
Dept. of Civil Engineering and Centre for Environment
University of Toronto

Purpose and Scope of the Report

This report is a review of the methodology, predictions, and conclusions in the Predictive Effects Assessment (PEA), June 2017, submitted by Bruce Power to the Canadian Nuclear Safety Commission (CNSC), with a focus on the consideration of climate change in the assessment of the effects on the aquatic environment. This does not include a review of the regulations or CSA standards on which the PEA methodology is based, or on how the PEA followed those regulations and standards.

PEA Approach and Conclusions

Effects of proposed activities on the environment will depend on the future state of the environment without those activities (the *baseline* conditions) together with how the proposed activities affect that future state. The purpose of the predictive effects assessment[1] is to identify potential changes to the baseline environment resulting from the future activities, where the baseline environment is characterized in the Environmental Risk Assessment (ERA) that was submitted to the CNSC in 2017. These effects are predicted over the life of the activities, which is to at least 2053.[2] The PEA is essentially a predictive ERA that is prepared "to demonstrate consideration of environmental protection during future site activities," and provide "sufficient information to the CNSC to support their preparation of an EA under the NSCA…."[3]

The PEA uses a 2-tiered approach that assumes that current activities and conditions are protective of the environment. Tier 1 assesses whether the interactions associated with the future activities are "bounded by" current operational conditions, i.e. whether future activities would result in potential environmental emissions that are the same as or less than current ones. Where this is the case, it is viewed that the environment will continue to be protected. Where the interactions associated with future activities are not bounded by current conditions, i.e. future activities are expected to result in potential emissions that are greater than current ones, further screening is carried out against criteria for the protection of the environment. Where the screening values are predicted to be exceeded, a Tier 2 assessment

[1] PEA, page 3
[2] The PEA, pages 3, 12, and 24 state the timeline is assumed to extend through 2053. It also states (page 13) that the Life-Extension Program will extend the operating life through to 2064. Whether the predictions are meant to be to 2053 or 2064 does not affect the comments and conclusions in this report.
[3] PEA, page 14

(quantitative risk assessment) is carried out.

The Tier 1 assessment for the aquatic environment concluded that "as the current operational conditions are demonstrated to be bounding of future activities, including MCR activities, the baseline ERA is, therefore, shown to be bounding of the proposed activities."[4] No Tier 2 assessment was therefore carried out.

The baseline conditions assumed in the PEA are taken from the 2017 ERA, which uses data available for 2012 to 2016. This ERA is used as "a point of comparison for future activities, including MCR activities, to determine if the existing ERA bounds future activities."[5] As stated in the PEA, "Where applicable, the baseline values identified in the ERA are referenced in the identification of potential interactions and are combined or compared as appropriate with the estimated predicted changes resulting from future site activities, including MCR activities, to evaluate risk. The baseline values are combined with the estimated predicted changes resulting from the proposed future site activities, including MCR activities, to obtain the total environmental condition for the predictive effects assessment."[6] Key areas of interest in the ERA continue to include thermal emissions and impacts, and impingement and entrainment of fish.[7]

The PEA of the Aquatic Environment (Species and Habitat)[8] follows the approach described above. The effects of future site systems, structures and activities on sediments, thermal discharges and impingement and entrainment, and their effects on species and habitat were considered. For example, construction activities are identified as having "effects potentially increasing relative to current operational conditions" due to runoff with silt and sediments, and measures (barriers) would be taken to protect fish habitat. Essentially all other future site activities including ongoing operations of the Bruce A and Bruce B stations, with their cooling water systems, are identified as "no change to effects from or similar to current operational conditions".[9]

Since the current operational conditions were considered to be "bounding of predicted changes, as a result of future activities" for water quality (including temperature and near shore circulation) and hydrology, geology and soil quantity and quality, and groundwater quality and flow, "changes predicted in these environmental components are not considered as potentially effecting aquatic receptors."[10] The Tier 1 Screening concludes that "no future site activities were found to have a likely measureable change on aquatic habitat or aquatic biota."[11] As such, no further (Tier 2) assessment was carried out.

[4] PEA, page 5
[5] PEA, page 27
[6] PEA, page 28
[7] PEA, page 153
[8] PEA, Section 4.6
[9] PEA, Section 4.6, Table 4-17
[10] PEA, page 126
[11] PEA, page 126

Approach and Conclusions of the 2017 ERA[12]

Since current site activities were considered "bounding of" (similar to) future site activities, the effects of future site activities were assumed to be, or similar to, those presented in the 2017 baseline ERA, which concluded that there are no or acceptable risks to the aquatic environment from normal operations. The focus of this review is the consideration of climate change in the PEA. Climate directly affects water temperature and levels, which relate directly to the baseline ERA for physical stressors: thermal effects, impingement and entrainment and gas bubble trauma effect of discharge. These stressors are summarized as follows:

> *Thermal effects*: The effects of thermal effluent from the site were assessed in the ERA using average and maximum temperature data from 2012-2016 lake and stream monitoring data, compared with fish thermal criteria for the effects of increased water temperatures. It concluded that "thermal effluent causes little to no risk to fish."[13]
>
> *Impingement and entrainment*: "The magnitude of impingement and entrainment depends on the volume and velocity of water withdrawn at the intake" in the lake.[14] These intakes are located 550 to 880 m offshore and depths of 11 to 15 m. Impingement is also affected by local currents, bottom contours and the fish community. The report states that "adequate provisions have been made for the protection of fish" and that "the company has conducted several environmental assessments and is conducting ongoing monitoring that continues to support this conclusion."[15]
>
> *Gas bubble trauma*: Gas bubble trauma to fish relates to the level of dissolved gas, and can be affected by discharge current velocity, area of the thermal plume and depth. For example, fish can tolerate increased dissolved gas saturation at greater depths. Following monitoring, the ERA concluded that "there was a low potential for gas bubble trauma to occur"[16] and upon further monitoring "no evidence of gas bubble trauma was found in any fish collected."[17]

The ERA's conclusion was that "risks to aquatic populations due to physical stressors were considered to be negligible. Specifically, the assessment considered the thermal effects of the cooling-water discharge, as well as effects of entrainment and impingement on local aquatic populations."[18]

---

[12] This summary is based on the explanation given in the Predictive Effects Assessment, Section 4.6.1.
[13] PEA, page 119
[14] PEA, page 120
[15] PEA, page 121
[16] PEA, page 124
[17] PEA, page 125
[18] PEA, page 117

Climate Change

Climate change is expected to continue to occur over the foreseeable future and is widely acknowledged as a critical issue that will have significant effects on the environment. These effects include rising air and water temperatures and changed precipitation patterns and water levels, which in turn affect ecosystems, including fish and fish habitats. A number of studies and reports discuss the effects of climate change on the Great Lakes. Three recent examples are:

- A study[19] for Ontario Power Generation of lake surface temperatures (LST) in the Great Lakes. The main objective of this report was to provide an overview of how climate change could impact the temperature of Lake Ontario water, which is used as cooling water at the Pickering and Darlington nuclear power stations and then returned to the environment at higher temperatures. The report states (pg. 6): "Climate change is expected to induce multiple changes to the Great Lakes hydrological and thermal regimes. Apart from increases of air temperature, apprehended changes include: a decrease in lake ice cover, an increase in lake evaporation and longer periods of summer lake stratification…. The changes mentioned above favor a decrease in the Great Lake water levels." The report also presents results from other studies that projected long term increases in temperature of surface water and deep water.

- A study[20] that predicted increases in surface water temperatures (SWT) due to climate change for each of the Great Lakes for the periods 2011-2040, 2041-2070 and 2071-2100. The maximum SWT in Lake Huron was predicted to increase 2.1 to 2.4 degrees C in 2041-2070 compared with the base case in 1971-2000. The study also predicted that in 2041-2070, there would be over 30 fewer days with SWT in Lake Huron with less than 4 degrees C and over 30 more days with SWT greater than 4 degrees C. There are uncertainties in the specific numbers. However, as noted in the study (pg. 7) "The estimated potential increases in surface water temperatures in this study could have important effects on the fisheries and ecosystems of the Great Lakes."

- A study[21] of the effects of increased water temperatures due to climate change on habitat in Lake Superior. It states (pg. 1) that "Climate change is expected to alter species distributions and habitat suitability across the globe. Understanding these shifting distributions is critical for adaptive resource management. The role of temperature in fish habitat and energetics is well established and can be used to

[19] Irambona, C., Music, B., Huard, D. and Frigon, A. 2017. *Lake Ontario Water Temperature in a Changing Climate*. [Report presented to Ontario Power Generation]. Montreal: Ouranos.

[20] Trumpickas, J., Shuter, B.J. and Minns, C.K. 2008. *Potential Changes in Future Surface Water Temperatures in the Ontario Great Lakes as a Result of Climate Change*, Research Information Note Number 7, Applied Research and Development Branch, Ontario Ministry of Natural Resources.

[21] Cline, T.J., Bennington, V. and Kitchell, J.F. 2013. *Climate Change Expands the Spatial Extent and Duration of Preferred Thermal Habitat for Lake Superior Fishes*. PLoS ONE 8(4): e62279.

evaluate climate change effects on habitat distributions and food web interactions. Lake Superior water temperatures are rising rapidly in response to climate change and this is likely influencing species distributions and interactions."

Because of the changing climate conditions, potential effects from proposed projects would need to be predicted relative to the new baseline environment created by these changes.[22] This has been recognized in sets of guidelines and best practices for addressing future climate change when assessing proposed projects, such as under environmental assessment (EA) requirements. These include documents from the International Association for Impact Assessment (IAIA, 2012)[23], Institute of Environmental Management and Assessment (IEMA, 2015)[24], and Ontario Centre for Climate Impacts and Adaptation Resources and Risk Sciences International (OCCIAR/RSI, 2014).[25] The best practices include:

- *Scoping* (identifying) the environmental components (ECs), e.g. water, fish, etc. that might be affected by climate change.
- Predicting the state of those ECs as affected by climate change, i.e. the future *baseline* conditions of those ECs as the effects of climate change might unfold;
- *Predicting effects*, i.e. how the proposal is expected to change the state of the ECs relative to the new baselines;
- Describing the *methodologies* used and the *uncertainties* and degrees of confidence in the results*;*
- Assessing the importance (*significance*) of those changes; and
- Identifying how the project could be changed to *mitigate those effects*.

The following are some of the best practices presented in the three documents:

- IAIA (2012) states that: "A changed climate and local weather affects the baseline environment against which impacts are assessed. Therefore, for those elements of the environment that are potentially affected by the proposal, the impact assessment (IA) should identify how the baseline environment will be affected by climate change, and assess impacts against this changed baseline. At least three climate change scenarios should be addressed: minimum change, intermediate change and maximum change.

[22] As noted in the PEA (Section 5.6), the CSA standard states that the periodic, e.g. 5-year, reviews and updating of the ERA should include, among other things new or previously unrecognized environmental issues that have been revealed by the Environmental Monitoring Program. While the EMP itself might not reveal climate change as a new environmental issue, it is well known that climate change is a significant issue.

[23] Byer, P., Cestti, R., Croal, P., Fisher, W., Hazell, S., Kolho, A. and Kørnøv, L. 2012. *Climate Change in Impact Assessment International Best Practice Principles*. Special Publication Series Number 8. International Association for Impact Assessment, Fargo, N.D., USA.

[24] Institute of Environmental Management and Assessment. 2015. *IEMA Environmental Impact Assessment Guide to Climate Change Resilience and Adaptation.* Lincoln, UK.

[25] Rodgers, C., Eng, S., Sparling, E., Douglas, A., Byer, P. and Auld, H. 2014. *Assessing the Treatment of Climate Change Impacts and Adaptation in Project-level EAs in the Canadian Mining Sector* Report to Climate Change Impacts and Adaptation Division, Natural Resources Canada.

Programs and reports on how to estimate climate parameters for these scenarios are available and should be consulted…. For proposals where the effects of climate change on the baseline environment are a minor issue, refining the baseline may require only the intermediate climate change to be evaluated. Alternatively, where climate change is an important issue relative to the proposal, all three scenarios should be considered."

- IEMA (2015) outlines the steps as: "identifying the emerging baseline, taking account of the influence of climate change; identifying the potential impacts from the scheme during construction, operation and decommissioning; assessing the sensitivity of baseline receptors to climate change; assessing the scale of impact of the project in combination with climate change; assessing the significance of the combined impact; identifying mitigation measures and, where these do not result in acceptable impacts, redefine the design and reassess the significance until the project achieves the minimum acceptable requirements; and developing a climate change adaptation plan."

- OCCIAR/RSI (2014) states two of the key steps as: 1. *Redefining baseline conditions*: For each environmental component that could be moderately-to-highly impacted by climate change, the EA should project the future baseline conditions of the component as they may be affected by climate change for each phase of the project. 2. *Project impacts:* For each type of project impact requiring further climate change analysis for each phase of the project, the EA should assess the impact relative to the redefined baseline condition with climate change.

Current practices are not typically at the level of best practices. However, climate change has been addressed in planning infrastructure projects including nuclear power plants. For example, the Joint Review Panel for OPG's Darlington nuclear power plant EA wrote in its report[26] that "Environment Canada stated that adverse effects in early life stages of round whitefish could arise from temperature exceedances up to the edge of the once-through cooling system diffuser mixing zones, and noted that this effect could become more pronounced if warmer temperatures become more prevalent with climate change."[27] In response, the Panel recommended thermal plume modelling "taking into account possible future climate change effects."[28]

Adequacy of the PEA

The purpose and basic steps used in the Bruce PEA are essentially the same as in an EA. In addition, the PEA states that "The purpose of this report is to provide sufficient information to the CNSC to support their preparation of an EA for these future site activities under the NSCA…."[29] Although it is known that climate change may have important effects on Lake

[26] Joint Review Panel Environmental Assessment Report, Darlington New Nuclear Power Plant Project (August 2011)
[27] Joint Review Panel Report, page 81
[28] Joint Review Panel Recommendation #34, page 83
[29] PEA, page 12

Huron, the effects on the aquatic environment predicted in the PEA are based on recent data in the 2017 ERA, and did not make any predictions that accounted for *future* climate change. Instead, the baselines used are current or recent conditions. While this data should include effects of climate change that have already occurred, significant future changes are still expected over the life of the project, but are not addressed. In fact, there is no mention of climate change in the PEA, and the only mention of climate change in the ERA is that the Saugeen Ojibway Nation (SON) had expressed interests in, among other issues, the effects of future lake water levels and climate change.[30]

There are potentially significant implications from not considering future climate change in the predictions of the physical stressors:

> *Thermal effects*: The effects of thermal effluent from the site were assessed in the ERA using average and maximum temperature data from 2012-2016 lake and stream monitoring data, compared with fish thermal criteria for the effects of increased water temperatures. It concluded that "thermal effluent causes little to no risk to fish." However, with expected increases in lake water temperatures due to climate change, the additional heat from the effluent would cause the lake water temperature to be higher than was assumed when coming to that conclusion. In essence, the effect of increased lake temperatures due to climate change combined with the increase from the plant effluent could cause the temperature of the water to exceed fish thermal criteria, which would indicate effects on fish.
>
> *Impingement and entrainment*: Climate change will likely affect lake levels and local currents, and could affect the fish community in the vicinity of the intakes. Each of these may in turn affect the impingement and entrainment of fish. However, none of these issues were addressed in the predictive assessment of impingement and entrainment.
>
> *Gas bubble trauma*: The potential for gas bubble trauma is affected by factors such as currents, depth and fish population. It is not the purpose here to assess this possibility, but rather to identify that the PEA did not address how climate change may affect these factors or gas bubble trauma.

There is significant uncertainty about the precise nature (e.g. degree and timing) of future climate change. These uncertainties complicate the prediction of future effects, and as set out in best practices, the uncertainties and their implications for confidence in the predictions should be explained. The PEA[31] acknowledges that there are uncertainties with regard to future site activities and therefore in the effects predictions. It also states that where there are these uncertainties, a potential worst case, i.e. "upper bounding" scenario, is used to provide a conservative assessment "to capture the range of potential future effects." Similarly, a conservative (precautionary) approach should be used when considering future climate change.

[30] ERA, October 2017, page 32
[31] PEA, pages 24 and 30

Conclusion

Climate change is likely to significantly affect the aquatic environment near the site, and it is that future environment against which the effects of the proposal need to be made. Since the PEA did not consider the effects of future climate change, its results cannot be relied upon.

April 2018

Dr. Philip H. Byer

Dr. Philip Byer is Professor Emeritus in the Department of Civil Engineering and the School for Environment at the University of Toronto. He joined the University of Toronto in 1975 after completing his undergraduate and graduate degrees in engineering from the Massachusetts Institute of Technology, and continued to work at the University until his retirement in 2011. His teaching, research and professional work have been in the areas of environmental impact and risk assessment, project evaluation, and municipal waste management.

Over the past 18 years, his research has focused on improving the consideration of climate change in infrastructure planning through impact assessment. This has included two research projects funded by the Canadian Environmental Assessment Agency and several refereed publications, one of which won the prize for best paper in *Impact Assessment and Project Appraisal* in 2007. He was also the principal author of the International Association for Impact Assessment's document *Climate Change in Impact Assessment International Best Practice Principles*, and co-author of reports with best practices prepared for Natural Resources Canada and CEAA.

In addition to his university work, Dr. Byer has been a member of various advisory committees for governments and the private sector. He was a member of a 3-person Federal Review Panel for the EA of a proposed mine in Northern Ontario from 2011-2014. From 1986-1995, he was Chair of the Ontario Environmental Assessment Advisory Committee, which carried out public consultations and advised the Minister of the Environment on controversial public and private sector projects, and policy and legislative changes.

As a consultant, Dr. Byer has provided advice on various infrastructure projects. He was the technical advisor on risk assessment to the federal panel that reviewed the environmental assessment of the Confederation Bridge project, as well as an advisor on the environmental impacts of an innovative renewable energy proposal and a major water diversion project.

Appendix D

Saugeen Ojibway Nation Environment Office

Prepared By: Kathleen Ryan, Bruce Power Coordinator, SON Environment Office

BSc. Environmental Science: Specializing in Indigenous Environmental Science
MSc. Integrative Biology - Aquatic Ecology: Thesis - Larval Lake Whitefish Ecology in Lake Huron

---

Introduction

The interaction between Bruce Power's ("BP") Bruce Nuclear Generating Station ("BNGS") and the environment has been of concern and issue to the Saugeen Ojibway Nation ("SON") since its inception. Thermal effects and impingement and entrainment represent major areas of concern related to what is referred to in Bruce Power's Application for the Renewal of a Power Reactor Operating Licence ("Relicencing Application") Environmental Quantitative Risk Assessment ("EQRA") as "Physical Stressors". The context of these concerns is based on the Aboriginal and Treaty rights held by the SON and the stewardship responsibilities of the SON as caretakers of the lands and waters of their Territory.

It is important to recognize that the People of the SON carry a special relationship with the Water, and with all beings that inhabit the Water. This relationship is based on cultural ways of knowing, understanding and living in this world in a good way; this relationship has existed since the beginning, since time beyond memory. SON relates with Water as that which brings and sustains life, both to the People and to all of Creation. It is this relationship that makes it vital to the SON to uphold their responsibilities of caring for and protecting the Water.

It is with this recognition of the importance of Water to the SON People that an understanding of the importance of these issues to SON, as well as SON's own perceptions and evaluations of "risk" and "impact" become apparent. It is important to recognize that SON's valuation and perception of risk, and determination of the level of impact that is acceptable are not the same as BP or the Canadian Nuclear Safety Commission ("CNSC"). While BP and/or CNSC's ways of understanding might determine that the risks or the impacts are "not significant", SON's understandings lead to a different determination

The following report outlines key issues with BP's interaction with the Lake Huron environment through thermal effects, including an overview of SON's engagement with BP, CNSC and other regulators regarding these issues. The report below is not intended to itemize or to disposition technical issues arising from the 2016 Relicencing Application.

Thermal Effects of Bruce Nuclear Generating Station

BNGS operates a once-through cooling system, using water from Lake Huron. Once the water taken in for cooling (up to 32 billion l/day) has circulated, it is discharged from Bruce A and Bruce B as high-volumes of decreased quality, increased temperature water. Once released, the discharge creates a mass of water that is significantly different in temperature from the receiving

environment (up to 11.1°C difference in the summer and 13.0°C difference in the winter). Due to the volume of water released and the difference in temperature from the receiving environment, the discharge creates a "thermal plume".

SON has been engaged with BP regarding the thermal discharge since 2010. Engagement between SON and BP on thermal discharge began with BP's application for an amendment to their Thermal Environmental Compliance Approval (ECA) through the Ministry of Environment and Climate Change (MOECC). The amendment was to increase the discharge temperature limit from 32.2°C to 35°C (the maximum limit was revised in 2013 to 34.5°C). Since receiving the Relicencing Application in 2016, SON has been reviewing information regarding the thermal discharge in the context of EQRA.

In the first case of the Thermal ECA, the scope is limited in both time and space. The Thermal ECA regulation is limited to a 3-month window (June 15 - September 30) and to Bruce A thermal discharge only. When considered in isolation (Bruce A - Bruce B – Summer -Winter), very little insight is available that would provide an understanding of the behavior and potential impacts of the thermal plumes and their interaction with the aquatic environment. Recently (early 2018) BP provided some predictive modelling for the Bruce A thermal plume, for the summer months. However, the potential impacts on fish were not even theoretically considered for the ECA (e.g., as they were in the EQRA via HQ analysis). Instead, BP used metrics of creel and smallmouth bass nesting surveys to determine impacts, both of which are inappropriate for this type of assessment, or at least does not provide enough information to make an impact assessment. BP also did not consider any climate change scenarios to accompany the proposed limit increase to 34.5°C.

While BP's evaluation of the thermal discharge for the Thermal ECA has evolved over the course of the past five (5) years through scrutiny from the SON and MOECC, there are still many outstanding uncertainties. The disposition table regarding SON and BP's engagement on the Thermal ECA are appended to this report (Appendix A). Overall, SON maintains that the proposed increase to 34.5°C is not warranted based on the limited information available and the nature of the remaining uncertainties.

BP has submitted its final application to the MOECC as a 10-year temporary amendment to the Thermal ECA operational flexibility. The application is now proceeding through the provincial regulatory process. MOECC has yet to make a decision regarding the proposed amendment.

Environmental Qualitative Risk Assessment(EQRA)

BP presents information on thermal effects in the Relicencing Application EQRA as "Physical Stressors". SON has conveyed some of the key concerns around the thermal effects with CNSC and BP in the context of the EQRA.

The thermal effects information presented in the EQRA is broader in scope (than the ECA) and includes consideration of the entire year, as well as the discharge at both Bruce A and Bruce B. However, the information and interpretation of the thermal discharge/plume data are still coarse and the EQRA does not present or discuss thermal modelling.

In the EQRA, BP reports on scientific studies that investigate the effects of thermal change on early life stage lake and round whitefish. However, the majority of these findings are based on laboratory research and literature that are not necessarily reflective of the conditions that the thermal plume creates, nor the aquatic biota or conditions present in the receiving environment.

Understanding thermal dynamics in the winter months is of high importance in the context of lake whitefish (a high value fish species to the SON). During the winter (Nov – April), all life stages of lake whitefish are present in the vicinity of BNGS. Lake whitefish adults spawn (Nov / Dec), embryos overwinter (Nov – Apr) and larvae hatch (Apr). This means that all life stages of lake whitefish are susceptible to impacts from the thermal discharge and impingement / entrainment, yet these impacts have not been quantified. Michael C. Nichols (Ph.D., CHP – Chesapeake Nuclear Services) provided independent review of the EQRA for SON and has identified specific recommendations that would enhance our understanding of the potential (real) impacts to spawning, overwintering and newly hatched lake whitefish within the vicinity of the site (Appendix B).

The EQRA presents fish thermal criteria and analysis via a Hazard Quotient approach. This report does not provide a detailed technical assessment of this approach, however, Environment Climate Change Canada ("ECCC") provided detailed comments regarding the suitability of BP's approach to the Hazard Quotient Analysis in their review of the EQRA. Moreover, ECCC has made many additional comments on the EQRA that raise concerns about the methodologies used and justifications made by BP to characterize thermal impacts/risks. There are many comments in this regard where there is outstanding disagreement between ECCC and BP.

BP statement on page 221 of the EQRA regarding thermal effects summarizes the key issues with the approach taken and conclusions derived from this approach:

> "Data collected from five summers (2011, 2012, 2014, 2015, 2016) and three winter (2012/2013, 2014/2015, 2015/2016) season were compiled and considered in the recent assessment. Results showed that the thermal plume causes little to no risk to the aquatic community present, it also demonstrates that fish are not avoiding the area affected by the thermal plume. Monitoring data included in the assessment included that collected via data loggers deployed within the surrounding environment (Figure 17) as well as permanent temperature monitors in each discharge channel to measure effluent temperature, which is regulated by MOECC"

There are three key issues with this statement and the data that supports this statement:

1. None of the data presented describes the "aquatic community present" (which is apparently unaffected).

2. Data that would demonstrate that fish are not avoiding the area are specific to Smallmouth Bass and Creel Surveys, which, alone, are not appropriate metrics for this evaluation (See: Appendix A).

3. The assessment is based purely on theoretical information, and not reflective of actual conditions or actual effects detected in the environment or aquatic biota (receptors).

4. No data regarding the number of "die-offs" or fish mortality events are reported here or incorporated into the assessment (we know there are gizzard shad mortality events that occur at the plant as a result of thermal shock). A high percentage of impingement numbers are gizzard shad. This is presented in the impingement/entrainment section, but no connection is made between gizzard shad impingement rates and thermal shock.

The discussion that follows is specific to the uncertainties and gaps in our collective understanding of thermal effects.

Uncertainties and Gaps in our Understanding of Thermal Effects

On thermal effects, it is difficult to derive cause-effect evidence regarding the impact of the thermal plume on aquatic life. It is important to state here that lack of evidence does not mean lack of impact. From the scientific literature, it is well-known that temperature has an important relationship with fish ecology, physiology and behavior and fish are often grouped by their thermal guilds (cool-water, warm-water and cold-water species).

Impacts of the thermal plume on fish and aquatic biota are difficult to detect, especially in this particular receiving environment (dynamic and complex). The only real detectable impact (and the only "type" of impact that seems to be considered when evaluating thermal effects) is fish mortality in high enough numbers to be considered a "die-off" (note: there is no information provided in the EQRA to indicate the frequency of die-offs, fish runs, or smaller mortality events that are captured through impingement monitoring that could have resulted from thermal shock). The problem with this measurement of impact ("die-off" / large mortality event) is that there are several factors that limit capturing the actual impact. The effects of a change in thermal conditions varies across fish species, and the degree of that affect (behavior to mortality) depends on a number of factors. The effects could manifest as a behavioral and/or physiological response and can occur in short duration or as a chronic effect. Detection of a "die-off" also excludes detection of mortality events that occur to small-bodied fish species, early life stage fishes or smaller magnitude mortality events. None of these types of impacts are characterized or considered by BP.

A simple example:

On page 225 of the EQRA (Thermal Effects), BP provides a Maximum and Avoidance Hazard Quotient analysis to determine if various fish species and life stages would be impacted by the thermal discharge. The input data for this analysis are temperature benchmarks for select fish species taken from the literature (critical thermal maximums and short-term maximums) and data from multiple temperature monitoring sites in the vicinity of the discharge. The analysis shows that during the egg/incubation life stage, Emerald Shiner (*Notropis atherinoides*) was in exceedance 66% of the time between July and August. This did not lead BP or CNSC to

determine that there was potential for significant effect, even though this was not the only fish species that exceeded the HQ for relatively high percentages of time (multiple species between 30% and 66% of the time).

My observations are as follows:

- The impacts of the thermal plume on fish species such as the emerald shiner (or other Cyprinidae) are discrete, in that, if 500 fishes the (maximum) size of an adult's index finger were to die from a thermal event, there would be no way of capturing that occurrence. Detection would be depleted through predation by other fishes, birds and by the dispersion ability of the hydrodynamics/conditions of the environment (wind, waves, currents). This scenario would be the same across many small-bodied fishes and early life-stages of all fish species. Detection is also limited for capturing low density fish kills (e.g., 10-20 large-bodied fish die).

- The only time thermal effects on fish are detectable is when a thermal change causes a a large-scale mortality event and hundreds of large fish are impacted (via a thermal shock response). In this instance, due to the volume of fish, and depending on the prevailing winds and currents, dead fish would be washed close enough to shore to be detected on land, or would be readily visible to fishermen in the area (provided someone reports the event to the proper authorities).

- The factors above (notwithstanding many other uncertainties) leave significant gaps in our understanding of thermal impacts on fish and aquatic biota. It also demonstrates a bias towards considering and understanding large-bodied and recreationally valued fish species. We also know that other aquatic organisms such as phyto and zooplankton as well as micro and macro invertebrates are sensitive to thermal changes, yet there are no thermal impact scenarios that include these organisms.

The key point here is that given the nature and number of gaps and uncertainties in our collective knowledge about the thermal impacts of BNGS, the determination by BP and CNSC staff of "low to negligible impact" cannot be made with confidence. In fact, these gaps make it irresponsible to make a determination of "no effect" or "little to no risk".

In engagement with BP, SON has utilized a number of Western Scientific ("WS") experts to examine the impacts of BNGS on the environment. It is not only the SON's own perspectives stemming from a cultural understanding and awareness, but the WS evaluations that have identified these same flaws, gaps and inconsistencies in Bruce Power's monitoring/assessment/data analysis methodologies and interpretations.

It has become clear over the many years of engagement on this issue, that neither BP nor SON understand the impact BNGS is having on the ecology of Lake Huron (even at a local scale). SON wants to understand these impacts better. SON wants to be a key part of the development of new and novel ways of understanding the thermal plume, and how thermal plume interacts with the waters and aquatic biota of Lake Huron. SON wants to have an active role in monitoring,

assessing and interpreting the data that are generated by future investigations. SON does not believe that the impact or risk assessment and conclusions being drawn by both BP and CNSC regarding thermal effects are accurate, or supported by the available information (or lack thereof).

Conclusions

Through the engagement with both BP and CNSC, SON has invested substantial time, effort and resources to ensure that Aboriginal and treaty rights of the SON People and the environment of the Territory are protected. For many years, SON has made every reasonable attempt to ensure that more is done, and that SON's concern and voice is heard. SON has met BP and CNSC with our Western Science experts and have participated in every regulatory process possible. Still, there is no improvement, no meaningful incorporation of the concerns and issues SON has brought to the table, and no reasonable attempts made to improve BP or CNSC's programs and processes in response. SON's concerns and voice have been largely ignored.

It has become clear over the many years of engagement on this issue, that neither Bruce Power nor SON understand the impact that BNGS is having on the ecology of Lake Huron (even at a local scale). SON wants to understand these impacts better. SON wants to be a key part of the design and implementation of more robust programs to assess I/E impacts and to understand the interaction between I/E and the ecology of Lake Huron. SON wants to have an active role in monitoring, assessing and interpreting the data that are generated by future investigations. SON does not believe that the impact assessment and conclusions being drawn by both BP and CNSC regarding I/E are accurate, or supported by the available information.

APPENDICES

Appendix A – Thermal ECA Disposition Table

DISPOSITION TABLE
Saugeen Ojibway Nation's (SON) Preliminary Technical Comments on the "Thermal ECA Application: Appendix A – Technical Summary Report for 2013-2015 Monitoring" as prepared by Bruce Power for the Ministry of Environment and Climate Change (MOECC) *[Last Update: October 09 2017 – SON EO]*

Based on the preliminary comments made by SON's technical staff on the Bruce Power's (BP) Thermal ECA Application to the Ministry of Environment and Climate Change (MOECC), the following have been identified as high-level preliminary issues/concerns for SON:

- Unclear whether there is sufficient justification or evidence for the proposed thermal discharge maximum of 34.5**°C.**
- Lack of justification/data to support the conclusion of "no adverse effect on the natural environment".
- Lack of connection between fish data (creel surveys and bass nesting success) and potential ecological impacts of the thermal plume and conclusion of "no adverse effects".

Specific text and/or methodologies that require further clarification or justification are outlined in detail below.

Please note that the comments provided in this table are meant to be preliminary and high-level. These comments are not meant to identify the full scope of SON's issues/concerns regarding Bruce Power's Thermal ECA Application, only to begin a technical discussion around the application.

#	Page Reference	Relevant ECA Application Text	SON Comment	Bruce Power Response	SON Notes/Questions on BP Responses	Status
1	**7**	"Environment Canada monitors temperatures in Lake Huron during the ice free season, with two locations (45008, 45003) having long term data sets (1981 to present). Buoy 45008 is in central Lake Huron due west of the Site and buoy 45003 is in northern Lake Huron where the basin is deeper (see Figure 2.1.4)."	This is referring to surface water temperatures. The Bruce A intake is at 10 m depth and 470 m offshore. Bruce B intake is 14 m deep and 830m offshore. It is not clear at what water depth these are calculated for.	Buoy 45008 is located 0.6 m below the water line. Buoy 45003 is located 1 m below the water line. This data was obtained from the NOAA website and used for long term trending of summer (July-Sept) lake water temperatures. The purpose for using this data was to show that there is a general natural rising temperature trend observed since 1981 to present.	Satisfactory Explanation	R
2	**15**	"Intake temperatures continue to be affected by long range natural variations and have	This statement is unclear. What is meant by "long range" natural variations?	This statement is referring to the fluctuating lake conditions (i.e. temperature, water level, ice	Satisfactory Explanation	R

		been observed to be increasing."		cover) presented in Figures 2.1.5, 2.1.6, 2.2.1 etc. that reflect the natural changes occurring since the 1970's to 2015.		
3	**15**	"If the maximal daily average change in temperature from the intake to effluent (delta T of 11.1°C) was applied to the intake temperature, then the potential number of days of the daily average temperature being above 32.2°C is shown in Table 3-1 below."	It is not clear whether the theoretical case is appropriate given the data collected	The theoretical case was established based on the rationale that the effluent temperatures are directly related to lake/intake temperatures and delta T values. Since the construction of the plant in the late 1970's, the delta T value has remained consistent and within the limit of 11.1°C, due to equipment capabilities and plant design. Since this value remains relatively constant, we chose to use the maximum value allowed. Therefore, a simple approach is to track and tabulate the number of days each year with a 24 hour intake temperature average over 21.1°C. By adding 11.1°C to this value, it can be assumed that the effluent temperature above the limit of 32.2°C would be obtained. This projection assumes the plant is in full (4 unit), uninterrupted operation, achieving typical MW output, with all CCW pumps in use. This theoretical case allows	It is understood how the Tmax was calculated using the delta T and that the 34.5 degree limit was established using the observed increase in Lake Huron water temperatures at the Bruce Power and in the literature. What is not clear is the environmental/ecological risks associated with the Tmax and how these risks were considered in the calculation. **Bruce Power Response:** The existing delta T limit was used as a maximal case and added to the potential lake temperature increases to devise a flexibility limit that is reflective of operational needs in light of long term temperature changes observed in the lake. The flexibility limit is a 2.3°C increase over the existing Tmax and this was selected to allow only a small margin. This increase was applied to Smallmouth Bass and Lake Whitefish temperature thresholds for the immediate vicinity of the effluent and was found to be within the range of these thresholds. If the flexibility limit was not within these thresholds, then the value of the flexibility limit would have been revisited.	**NR**

				Bruce Power to estimate the risk of exceeding effluent temperature limits under normal maximum operations, and highlight the need for a modification of the current ECA limits due to changing lake conditions. The intake temperatures are monitored continually and 24 hour averages are calculated. Eleven years of data was analyzed and summarized in Tables 3.1 and 3.2 to show in a particular year the number of days where the average intake temperatures were high and of potential concern for exceeding the limit. This theoretical case uses the measured temperature data from the lake and applies the working operational limits regulated by the MOECC. It is a reasonable estimate to provide an understanding of the potential range of thermal limits. This was also discussed in the 2013 submission on page 19 of		

				the Technical Summary Report.		
4		Table 3-1	This table isn't intuitive and relies on the reader to trust that Bruce Power has done the correct analysis.	Table 3-1 attempts to summarize eleven years of continuous temperature monitoring in the intake channel of Bruce A. It tabulates the number of days with intake temperatures that have the potential (≥21.1°C) to surpass the 32.2°C effluent limit each year, as well as the consecutive number of days that this occurred. It compares those values to the number of days that the effluent temperature *actually* exceeded the limit during that time frame, and demonstrating that Bruce Power uses all means possible to avoid discharging thermal emissions to the lake.	Satisfactory Explanation	R
5	**16**	Table 3-1	Are these the numbers used to justify the 15 consecutive and 30 aggregate days?	The number of consecutive (15) and aggregate (30) days were chosen based on the data shown in Table 3-1. Over the past eleven years, the numbers of aggregate days above the current limit in a single year ranges between 3 and 33 days. The number of consecutive days ranges between 2 and 19 days. In order to set the number of	It is understood that the number of days at 30 aggregate and 15 consecutive will be conservative numbers in order to ensure the ECA, if permanent, will cover the maximum potential days during the ECA window. However, the number of days should again make correlation to the temperature benchmarks for fish species and some measure of potential impacts, for example the MaxHQ values BP has used in it's Relicensing ERA submission. For example,	**NR**

				aggregate days and consecutive days to account for natural increases in lake temperature, the 15 consecutive days and 30 aggregate days were chosen by rounding down (33 to 30 for aggregate days, 19 to 15 for consecutive days). This represents the upper range of days potentially affected as shown by collected data to date. This was also discussed in the 2013 submission on page 19 of the Technical Summary Report.	provide an example scenario where the Tmax was reached for 15 consecutive days and use that temperature to calculate or determine a measure of potential impact for several fish species. This would give some indication of the potential impacts. **Bruce Power Response:** The details of the thermal effects portion of the Environmental Risk Assessment, which quantified risk from thermal effluents on 16 local fish species for 5 different life stages by comparing measured lake temperatures within or near the thermal plume to fish benchmarks, where available, demonstrated that the risk to local fish populations from thermal effluent is low. This includes the period of the ECA Window and the known fish species and life stages in the local area at that time. The Smallmouth Bass adult when guarding the nest and the egg/larval development occurs over more than 15 days and there is no effect on their development or cohort production as known from observations. Life stages of other species tend to not be resident in the local area continuously for 15 to 30 days and thus would not be subjected to this temperature range on a continuous basis. The derivation of the 15 continuous and 30 aggregate days limits the duration of potential exposure to warmer temperatures. Consideration was given to just an overall increase (all year round), then only for the summer months (3	

					months) and now only for up to 30 days (1 month). This approach has greatly narrowed the duration. In conjunction with the request for a marginal increase (2.3°C) based on lake temperature regimes, this results in a decreased exposure and duration which minimizes risk.	
6	**16**	"Table 3-1 is a summary of recent years where daily average effluent limits exceeded the ECA temperature effluent maximum of 32.2°C. Over the past 11 years, Bruce Power has taken measures to either: 1) remain within the limit by de-rating units, 2) obtain emergent Section 61 Directives, or 3) obtain a temporary amendment to allow a proactive approach."	It is not clear why these mitigation measures won't be sufficient in the future to mitigate high temperatures Bruce A may experience.	The current measures used to mitigate temperature exceedances (i.e. de-rating, Section 61 permissions) are not ideal working practices or acceptable long term solutions for operating a nuclear facility. The process of de-rating units to reduce heat generation and avoid exceeding regulatory limits requires a decrease in reactor power, which is accomplished at Bruce A using the Reactor Regulating System (RRS). This method can achieve small amounts of Megawatt output reduction over a short period of time. However, these derates are dependent on the reactor condition and are not very effective at lowering effluent temperatures quickly; thus in order to achieve the necessary changes in temperature, a unit must be shut down. When this	Satisfactory Explanation	R

				happens, it takes 48 hours before the unit can be returned to the grid, and during periods of high energy consumption this restricts Bruce Power's ability to supply power to the province. More information regarding derates was provided in the 2013 ECA Application Supplemental Documentation #00001. A Section 61 directive from the MOECC allows Bruce Power to temporarily exceed Tmax under very specific circumstances, such as high energy consumption periods. Obtaining a Section 61 involves an application and approval process that is not conducive to sudden increases in lake temperatures. Often, this results in the necessity to derate in order to keep within the regulatory limit. Additionally, the MOECC has indicated that they do not want to continually grant Section 61 approvals as this reactionary method is meant for emergency purposes and is not a suitable long term solution. The Operational Flexibility		

				conditions requested would allow for safe plant operations and adequate environmental monitoring. A permanent amendment is a practical solution.		
7	**17**	Table 3-2: Annual summary of the number of days, maximum values of daily average temperatures and derates or directives in place	Why 20°**C** and not 21.1°**C** ? Similarly not 32.2°**C**?	Any intake temperature above 20.0°C and any discharge temperature above 30.0°C is monitored closely for potential exceedance of Tmax. The process to reduce temperature by derating a unit is a lengthy and involved; therefore when lake temperatures approach these thresholds, temperatures are very carefully monitored to ensure safe and well-planned alterations to reactor power. Thus when intake temperatures approaching 20°C and outfall temperatures approaching 30°C are evident, this would result in engaging of steps to prepare for a unit shutdown.	Satisfactory Explanation	R
8	**17**	Table 3-2: Annual summary of the number of days, maximum values of daily average temperatures and derates or directives in place	While it may be understandable that a derate is costly, but it is difficult to understand if seven (7) derates are significant. For example is one (1) derate to	There are two situational categories for derating units; 1) non-IESO derates which include routine tests, non-IESO emergency conditions and thermal limitations, and 2) IESO	Provide the costs and risk associated with derates. Specifically, that which would result from seven (7) derates in one year. **Bruce Power Response:** The issue with derates is not about cost, but about	**NR**

			many or three (3), and is seven (7) highly significant?	mandated derates which include Surplus Baseload Generation (SBG) and transmission constraints. Derating a unit and powering down a reactor to keep within temperature limits fall under category (1) and are what is tabulated in Table 3-2. These situations limit Bruce Power from supplying continuous power to the grid and are preferably avoided. Requiring seven derates in one year to work around high lake temperatures is highlighting the need for a modification of the current regulatory limits.	being able to supply electricity to the grid on demand. Derates can only help with the temperature situation to a certain degree, after which, the reactor simply has to be shut down. Once shut down, it takes a number of days for the unit to get back on line and during this time it cannot supply the Province with electricity during potentially peak consumption periods. The degree to which the lake has warmed naturally and the annual variations observed, far outweigh the ability of derates to help the situation. A long term solution in needed to address the changing conditions so that Bruce Power can reliably supply power to the grid while adequately monitoring and caring for the environment. This can be done with a long term amendment to the ECA. The preplanning and budgeting that accompanies long term commitments allows for suitable monitoring of the environment.	
9	**17**	Table 3-2: Annual summary of the number of days, maximum values of daily average temperatures and derates or directives in place	Also, a derate can also occur if there is too much electricity on the grid at one time. Bruce Power can then use a CSDV (Condenser Steam Discharge Valve) to reduce output by 12MW/minute BUT this derate will increase Tmax. It is not clear if these are indicated here or not?	IESO mandated derates are not included in Table 3-2. Our analysis has shown that derates due to SBG and line constraints do not have a strong influence on effluent temperatures in the summer months relative to the increasing trend in lake temperatures. The majority of SBG derates are required during the spring and fall based on decreased market demand. There may be one or two instances a	Satisfactory Explanation	R

				year during the summer months that derates due to SBG and line constraints would minimally contribute to higher effluent temperatures. If a situation arises where the Tmax limit is at risk of being reached, there are established IESO protocols to either stay within the temperature limits or ask the MOECC for a temporary provision depending on the alert level. More information about IESO and non-IESO derates is provided in the 2013 ECA Application Answer to Questions 1 and 2 and Supplemental Documentation #00001. In general, Table 3-2 is demonstrating the increasing need for a more permanent solution to the rising lake temperatures that will allow Bruce Power to supply continuous, reliable electricity to the province during peak energy consumption periods. A permanent amendment to Operational Flexibility during the ECA window is a viable option.		

10	**19**	"The average daily temperature difference between effluent and intake (the delta T) is approximately 9.5°C in the summer months, with the winter months seeing more variation as the recirculation gate is opened to allow warmer effluent water to recirculate back into the forebay to prevent frazil ice formation (Figure 3.2)."	This is important given the previous figure uses the maximum allowable Delta T temperature 11.1°**C** rather than their averages.	The delta T value of 11.1°C is used because that is the maximum allowable value (an ECA limit) and a conservative estimate when determining the potential for exceeding the maximum temperature limit. It is based on equipment capabilities and plant design. Operations since construction in the late 1970's have shown that this value has remained consistent and kept within this limit. Figure 3.1 presents the raw effluent temperature data over an eleven year period, along with the temperatures with the maximum deltaT value added to illustrate the potential for exceeding the current Tmax of 32.2°C.	Satisfactory Explanation	R
11	**19**	"The average daily temperature difference between effluent and intake (the delta T) is approximately 9.5°C in the summer months, with the winter months seeing more variation as the recirculation gate is opened to allow warmer effluent water to recirculate back into the forebay to prevent frazil ice formation (Figure	This is why they have a higher delta T in the winter months.	The higher delta T limit (13°C) in the winter months is to allow for recirculation to prevent frazil ice formation in the forebay.	Satisfactory Explanation	R

		3.2)."				
12	**19,20**	"In summary, recent history since 2005 has demonstrated the need for some kind of flexibility or variance from existing approvals. These have taken the form of Section 61 directives or temporary ECA amendments for a limited timeframe. Bruce Power continues to make all operational efforts to minimize thermal emissions to the lake but naturally changing conditions has highlighted a need over the last 10 years. The best regulatory instrument provided to date has been the recent three-year temporary operational flexibility. Although the operational flexibility was not invoked from 2012 to 2015 inclusive because of generally cooler summers during this time frame, there remains a potential to need the flexibility. Thus a permanent amendment to the daily average maximum temperature effluent limit is being requested in the form of	This may be true, but does it justify the increase to 34.5°**C** or the number of days? I'm not sure it does given the data presented, and the monitoring efforts over the past three years Again, it is not conclusive that this temperature increase is justified based on the data collected Unclear as to what this variance measure is.	This application is a long term plan that includes operations during years with warmer than average summer temperatures, such as those observed in 2010, 2012 and 2015. The value of 34.5°C was chosen based on projected Tmax values for the years of 2008 through 2012. There is potential for this value to be reached in a particularly warm summer, as observed in 2010. The current limit is 32.2°C and the long term trend in the lake temperature (over the past ~30yrs) has been an increase of 2.1-2.2°C; the addition of 2.2°C to 32.2°C results in 34.5 request. The maximum effluent temperature of 35°C was requested to accommodate for some future margin (0.5 degrees) for the 2013 ECA temporary amendment and it was decided by the MOECC that 34.5°C would be granted in the 2013 ECA temporary amendment.	Re: "The value of 35°C was compared to previous EA predictions to see if significant adverse impact would result or if the predictions would still hold true." How did BP "see if significant adverse impacts would result" and what were the predictions? See comment #5. **Bruce Power Response:** In our last meeting, we had discussed that using the term "significant adverse impact" which is EA language would not be appropriate to characterize the risk characterized in this Thermal ECA discussion.	**NR**

		an operational flexibility. Note that this is Industry Best Practice as the United States Environmental Protection Agency (US EPA) employs this type of variance to their operational limits."		The value of 35°C was compared to previous EA predictions to see if significant adverse impact would result or if the predictions would still hold true. Two specific species were looked at (lake whitefish and smallmouth bass) as was done in the previous EA. In the case of lake whitefish, the sensitive life stages were not within the ECA window being requested. In the case of smallmouth bass, the temperature increase was still within the temperature criteria for the sensitive life stages. This was also discussed in the 2013 submission in Section 8 of the Technical Summary Report. The requested number of aggregate (30) and consecutive (15) days is reasonable for years with warmer than average lake temperatures during the specific 107 day time frame. These values came from monitoring the number of average intake temperature values over a period of 11 years (2005 to 2015) as	

				described in a previous question, and also in the 2013 ECA Application, Supplemental Document #00002.Bruce Power is looking to obtain a modification, or variance, to the current temperature limit of 32.2°C to reflect increases in lake water temperature.		
13	**20**	"Bass nesting: bass nesting was monitored in the discharge channels and Baie du Dore from the start of the season through to dispersal of fry in 2013, 2014 and 2015. In addition, this monitoring has been conducted annually since 2009. Creel Survey: anglers were surveyed at the Baie du Dore and Inverhuron Provincial Park boat launches following a standardized MNR protocol to understand what species were being sought and harvested. Participating anglers allowed fish lengths, weights and scale samples to be collected. Surveys were conducted in 2013, 2014 and 2015. In addition, this monitoring has	It has been pointed out by the SON Science and Fisheries Assessment Teams that it isn't clear how these two components contribute to evaluating the 'effect' of temperatures.	Bass nesting and Creel surveys are not used to observe the effect of temperature directly, but instead as an indicator of a potential changes near the Bruce Power site. Smallmouth Bass are a focus of interest because they are known to live in the areas with the highest temperatures (i.e. Bruce A discharge channel, Baie du Dore) during their most vulnerable and immobile stage of life (i.e. larvae, fry). Monitoring their population, including their habitat and reproductive behavior, provides information on the overall health of the species. Therefore, tracking their success is a reasonable approach for obtaining information on the	While the nesting surveys of SMB do represent a measure of potential impact on a resident fish species and one that is exposed directly to the thermal discharge for many consecutive days across multiple life stages, this cannot be the key indicator of impacts to aquatic organisms as a whole. **Bruce Power Response:** At the time, SMB was simply used as an example of where the proposed Tmax was within temperature thresholds for this species during this time period. In the future, as part of our other required regulatory processes, we will establish links with the thermal portion of the ERA and view this to be a routine process that gets updated every 5 years. This allows us to re-visit assumptions in a routine manner.	**NR**

		been conducted annually since 2009."		effect of temperature on the local environment and natural changes in the local environment. In addition, Creel surveys are a common tool in gaining information about fish populations and fish health. Anglers provide details on numbers, size and types of species present in the lake specifically near Bruce Power. This data contributes to understanding the local fish presence and relative abundance in a given year. As previously described in the February 2013 ECA Application many other species have been considered for effects due to short term increases in temperature and it was concluded that there is no serious harm.		
14	**23**	"Smallmouth Bass nest monitoring begins in mid-April and continues through mid-July depending on the presence of bass nests in a given year. Nesting surveys have occurred annually since 2009 and	This is not evidence of 'no effect' of high temps for two reasons: 1. these high temps were not observed, and 2. high temps were not observed for any prescribed or specific length of time.	Smallmouth Bass consistently nest in the warm waters of Bruce Power's discharge channels and the most sensitive life stages are present in the early portions of the ECA window. Nesting fry are present constantly for a	SMB would experience some element of acclimation to these conditions. It would be beneficial to extend this type of survey to Baie du Dore (bass nesting surveys) and provide these results in tandem with those of the discharge channel. This could indicate potential impacts of thermal change in an area where fish are not	**NR**

		surveys were also conducted in the past. The proportion of nests with successful risen fry was high in 2014 and 2015, with more unsuccessful nests in 2013 (Figure 4.1). This greater proportion in 2013 was also seen in nearby reference areas and is indicative of low water levels in the spring of this year compared to other years. Nests are observed in consistent geographic locations over time, likely with the selection of a given area determined by water depth/velocity. There have been no changes observed in the areal extent of nest locations over time (Figure 4.2). Locations of unsuccessful nests are shallower waters and/or may be disturbed by boat traffic utilizing the shelter of the dock."		range of 2 weeks (if started early in July) to 2 months (if started earlier in the year) and thus are constantly exposed to the environmental conditions at the discharge locations for this length of time. Exposure to higher temperatures is not constant given that nesting typically ends in July. After this time, they become mobile and can swim away from any undesirable conditions. Similarly, all other fish species would not be constant residents in the discharge channels for extended (i.e. 15 days) periods of time. The nesting studies demonstrate that a fish species, in a vulnerable phase of life, in a region of higher than ambient water temperatures are successful during conditions present during normal operations of Bruce Power.	experiencing a warmer condition nearly constantly and are more exposed to natural fluctuations in temperature and condition. **Bruce Power Response:** Smallmouth bass nesting surveys are carried out each year at the Bruce A and Bruce B discharges as well as in Baie du Doré. The results are reported annually in the EMP report. Baie du Doré is consistently used by spawning Smallmouth Bass and has shown to be a successful habitat. Temperature fluctuations (delta T) were considered in the thermal portion of the ERA. In general, fish were found to not avoid the local area. For warm water fish, critical thermal maximum values were not exceeded. As previously discussed, further work was done for understanding the risk to whitefish eggs, however this occurs during the winter months and not during the ECA window.	
15	**25**	"There has been no decline in the number of recreational anglers at local boat launches, indicative that local fishing remains an enjoyable activity.	Again it isn't clear how these surveys relate to evaluating 'effect' of the thermal plume?	The Creel survey shows that in the local near shore area, with the presence of the thermal plume, there has been little change in the fishing activities	Creel surveys may demonstrate that there has not been a measureable change in the presence of recreational fish (predatory, large bodied fish) or in the number of anglers within the vicinity of the discharge. However, presence of fish does not	**NR**

		The estimated effort, measured in rod hours, by species and year shows the most sought species remained consistent from year to year (Chinook Salmon, Walleye, Smallmouth Bass and Lake Trout) as shown in Table 5-1. Estimated catch was variable by year, with the most sought species also having the highest catch (Table 5-2). Estimates are calculated using OMNRF software. There is no indication of changes in the recreational fishery, monitored via the creel surveys, over time."		over the period studied, suggesting that there has been minimal impact on the fish population (including type of fish, numbers of fish, general health of the fish caught).	equate to absence of impact. These data are not synonymous with measuring impacts on the local "fish population" or on fish health. Thermal impacts to fish are not necessarily visible, especially to a recreational fisherperson reporting their catch. **Bruce Power Response:** At the time, creel surveys were simply used to show changes to fish populations and make any interpretation whether or not populations are affected by operations, which they are not. Changes are influenced by natural and cyclical factors in the lake. Since then, as part of our other required regulatory processes, we have established links with the thermal portion of the ERA and view this to be a routine process that gets updated every 5 years. This allows us to re-visit assumptions in a routine manner.	
16	**27**	"When the MOECC approval was being considered in 2013, a number of questions were initially answered with the intent to refine the answers after the three year period upon completion of the thermal model refinements and recalibration. This summary application only covers thermal modelling results for two of the three ECA windows of the 2013 through 2015 period as,	ADCP data is not necessarily temperature data. There was less precision regarding the thermal characteristics of the plume during these 'high' temperature periods. The model doesn't tell you what effect these temperatures have on the environment.	ADCPs reside on the lake bottom and each has a temperature sensor attached. This data was retrieved with the plan to use the information to augment the data from 2012. The 2012 data was used to provide three years to the model (2012, 2014, 2015). In the summer of 2012, 2 units were operational at Bruce A and all units were operational at Bruce B. Data collection continued in	Satisfactory Explanation	R

		due to unforeseen weather complications; insufficient field data was retrieved for 2013 to establish the boundary conditions required to operate the model. Instead, a preliminary examination of a portion of the commensurate 2012 period has been undertaken, but not yet finalized. Moving forward, the plan is to augment hydrodynamic data gaps in the 2012 ECA window, with information collected at a nearby hydrodynamic monitoring location. While this approach creates limitations from a data interpretation perspective, it will allow the mechanics of plume movement under low lake levels (as observed prior to 2014) to be examined. Moreover, it will also include an examination of plume effects during a period of higher lake temperatures than observed throughout the 2013 to 2015 period."		2016 and is planned for 2017. The thermal plume model does not provide information on the effect of temperature on the neighboring environment, but it does provide information on the geographic extent and timing of plume movement within the lake. It is able to model water temperatures within a model boundary, which captures the change in temperature, to within 1°C difference from ambient. The measured temperatures, and potentially the modeled temperatures, may then be used to compare to thermal benchmark values by fish species.		
17	**30**	Table A-1:	The 2013 data is missing.	The data for 2013 was not	Satisfactory Explanation	R

				included in Table A-1 because insufficient field data was obtained for this year due to lost or damaged equipment from extreme weather conditions. To establish boundary conditions and three years of data, the data collected in 2012 are being examined, but the results have not yet been finalized. Moving forward, data from 2016, and possibly 2017, will be added to the model to provide 4-5 years of analysis.		
18	**30**	Table A-2:	I think it is important to note that for these years, Tmax and Delta T were not reached. Temperature averages were close but again, does this warrant a permanent increase to 34.5**°C**.	Table A-2 summarizes the actual temperatures and current velocities measured near site during 2014 and 2015. It shows that the effluent temperatures are approaching the regulatory limit, while the deltaT value has not approached its allowable limit. This is highlighting a continual risk each year for temperature exceedances. Furthermore, the Tmax value of 34.5°C is based on a scenario with full 4 unit operation with all CCW pumps running and typical MW reactor output each day. It is based on continued	The challenge here is that 'risk' has not been quantified. Please provide the costs (and other operational risks) associated with temperature exceedances. **Bruce Power Response:** Again, the avoidance of non-compliance of the ECA Tmax limit is not associated with cost, but instead the ability to operate a predictable (and therefore safe) and environmentally responsible facility. The preplanning and budgeting that accompanies long term commitments allows for suitable monitoring of the environment.	**NR**

				operation into the future, accounting for increasing lake temperatures and previous ECA temporary limits.		
19	**31**	Figure A-1:	These are the same snapshots BP provided in a briefing to SON in early 2015. Why only these snapshots and not others?	Other scenarios and cross-sections are possible, but these snapshots were chosen as a representative of the thermal plume during the predominant conditions of the lake.	Satisfactory Explanation	R
20	**33**	"B. Vertical mixing of the plume Estimates of the areal surface extent of the Bruce A thermal plume show 2015 predictions were of a smaller extent compared to 2014 (Table B-1). Estimates are made by comparing the predicted hourly water temperatures under full operational conditions (maximum flow and delta T up to 32.2°C) to non-operational conditions (no discharge). Areal plume extents are areas that contain a plume that is specified as an increase over the ambient temperature 75% (quartile) or 95% (maximum) of the time."	Could this be a factor of higher water-levels and better plume diffusion? While this may be the null hypothesis, is it realistic to compare to non-operational no discharge conditions? My sense is no, but that if you are using a theoretical case for a permanent increase you should predict maximum outputs, and compare with actual data values, using the no discharge as a control scenario. In this way, you would present worst-case scenario, actual operational data, and no discharge and then compare.	Higher water levels occurred in 2015 and record lows occurred in the winter of 2012/2103. A report with 3 years of data (2012, 2014, 2015) will provide the extent of the plume in these three years. In 2015, the vertically mixed extent was the smallest of the three and 2012 extents were the largest, which may be attributable in part to the lower lake levels coupled with lower current speeds during the 2012 ECA window. A dynamic water level will be used in the future for simulations of the 2017 data. The estimates of the areal surface extents of the plume have been made based on comparison between the model	Satisfactory Explanation	R

				results for Non-Operational conditions (no flow or temperature discharge) to the results of Measured Operational conditions (max T 32.2°C). Adding the theoretical case of Full Operational conditions (max flow and 34.5°C maximum temperature) is in the process of being completed now that there are 3 years of data and a verified model.		
21	**34**	Figure B-2:	The model, I believe, assumes that Baie du Dore is isolated and also does not provide an estimate of shoreline temperatures (orange line in each figure)	For the most recent ECA amendment, the mesh used in the RMA10 Model was refined in Baie du Dore to further model the thermal plume in this region. It was determined that Baie du Dore remains essentially thermally independent from Bruce A. The orange line in Figures B.1, B.2, B.3 are the high water line, and vary from one year to the next depending on lake water levels. The model boundary along the shoreline starts at a depth of 0.5 m, wherever this occurs.	More information is required regarding the temperature relationship between Bruce A and Baie du Dore. It is difficult to believe that BDD is thermally independent from Bruce A. I would like to see more detailed information (with or without the plume model) related to temperature logger data about that relationship. **Bruce Power Response:** For the most recent modeling studies spatial resolution was increased in BDD and the bathymetry was updated to better represent the rock shoals and connecting channel between BDD and the rest of the lake. Provisions for inflows from Stream C into BDD were also included to better capture hydraulic and thermal inputs to the bay. Modelling predictions have indicated that the effects of CCW discharges are limited outside	**NR**

					BDD owing to the presence of the large sill, which increases the physical separation between the bay and other areas of the lake, particularly as lake levels decrease. In addition, atmospheric effects within BDD were found to be much more influential on water temperature variations than thermal plume interactions, a consequence of the shallow nature and physical separation from the open water body. Even further, it was found that water temperatures within BDD exhibit a more pronounced response to diurnal variations in air temperature and solar radiation than elsewhere in the model domain. Simulations showed that regardless of surface water elevation or operational status, the increase in temperature in BDD due to the Bruce A discharge was minimal (<0.5°C).	
22	**36**	E. Plume interactions with intakes (cross connection)	Why are these senarios the only ones presented?	These scenarios were specified by the MOECC.	Satisfactory Explanation	R
23	**37**	F. Ability of the model to capture/predict upwelling and downwelling events	Both up and down-welling events are natural events that can negatively impact local biota. However, these impacts can be exaggerated by the the Bruce A & B thermal plumes. event.	The conclusions of this study show that the model provides a reasonable estimate in reproducing the location and magnitude of both an upwelling and downwelling event. It is shown that during these events there is thorough mixing due to the turbulent nature of the water body, and thus no exaggeration of impacts by the thermal plumes is measureable.	Satisfactory Explanation	R

24	**38**	"A location well above the thermocline will not have a downwelling event. Two downwelling events were observed at the Bruce B intake location in 2014 and the model represented the temperature increase well but did not accurately recreate the decrease in water temperature at the end of the event, however this is less relevant to this work as only temperature increases would result in higher effluent temperatures. In 2015, three minor downwelling events were reasonably well matched between observed and predicted at most locations."	A better statistical treatment of the upwelling and down-welling events should be applied. Especially if the model has difficulty predicting them. This is touched on in the first paragraph, but I think it would be a good exercise to expand the understanding of what the impact is on Bruce Power operations.	The upwelling events, where colder water at depth is brought to the surface, do not impact Bruce Power's ability to generate power, as the intake water would be cooler. In regards to downwelling events, it was determined that these events usually occur outside the flexibility window in early spring, and would not likely affect the Bruce A intake temperatures. Consequently, no further studies are required.	Satisfactory Explanation	R
25	**38**	"In general, downwelling events only affect the Bruce A intake during the spring (April to June) and only result in very small temperature increases at the intakes (typically no greater than5°C). Because of this limitation in timing and magnitude, and although downwelling events appear to occur relatively frequently, the highest resultant intake	These (downwelling) events could be more important than upwelling events, given that these events have the ability to cause the thermal plume to not diffuse properly and may increase the likelihood that the plume will interact with the plant intakes. This may be true, but the effects on local biota may be	Results from the model were evaluated for 3 years to better understand the occurrence of downwelling events. It is understood that this type of water movement brings warmer surface water to the bottom and thus it is important to understand their timing and duration. The cross connection between the plume and the intakes was addressed on page 36 and it was	Satisfactory Explanation	R

		temperatures during downwelling events rarely exceed 15°C. As a result, downwelling events are not expected to result in exceedances of maximum temperature criteria exceedances."	significant. This is especially given that upwelling events may induce 'cold shock' in animals acclimated to thermal plume temperatures. It is unclear what the effects a significant drop in temperature from 34.5°**C** would be on local biota.	found that the Bruce B intake was not affected by the plume and that the Bruce A intake was marginally affected (0.6°C 11% of the time under full operational conditions with maximum flow and temperature). There is no evidence that the downwelling events prevent the thermal plume from diffusing as normal. Cold shock is not evident during the summer months (i.e. the ECA window). This is seen as a natural phenomenon in late winter/early spring and is not caused by changes in discharge temperatures. The plant operates consistently and the lake conditions are generally well mixed during this time. Cold shock occurs when surface temperatures swing as the result of air temperature changes from below to above freezing. There is no evidence of significant drops in temperature from the measured data.		
26	**39**	I. Determine whether hourly changes in plume behaviour are suitably represented at higher time scales such as daily	This may be important for SON interests in Lake Whitefish spawning habitat.	Temperature is measured at Loscombe Bank as it is the shallowest habitat in a close geographic range to the Bruce A	Satisfactory Explanation	R

		averages, with a focus on days when the daily average effluent temperature is greater than 30°C. The effect of temporal resolution of results on the representation of plume behaviour was examined by comparing hourly versus daily-averaged results on Loscombe Bank (Location 31-1 which is 1 m off the bottom) on days when the daily average effluent temperature exceeded 30°C. In 2014, these conditions occurred between September 3 and September 7. Table I-1 provides a summary of the daily average temperatures and daily variation of hourly values for the period where the daily average effluent temperature exceeds 30°C. The measured and predicted hourly temperatures on Loscombe Bank are within 0.5 to 1.5°C of the daily. This suggests that the daily variation predicted by the model is consistent with the observed variation."		discharge. This data is for the summer period and ECA window of interest.		

27	**40**	Table I-1: Summary of hourly variation for periods where the daily average effluent temperature was greater than 30oC in 2015	I am not sure this demonstrates the daily average is the best representation of this data.	Table I-1 summarizes the hourly temperature measurements taken over a 24 hour period as a daily average for the Bruce A discharge channel and Loscombe Bank. The small ranges observed each day suggest that there was little change in temperature over the course of 24 hours. There was no indication of a dramatic change in temperature at this time. The thermal plume model uses the measured temperature data to predict average daily temperatures, which are also presented in Table I-1. The predicted daily temperatures are consistent with the actual values observed in Loscombe Bay. The fact that there are small temperature ranges each day and that the model replicates measured lake temperatures, indicates that hourly changes in plume behavior are adequately represented in daily averages, particularly during days with daily average effluent	Satisfactory Explanation	R

				temperatures greater than 30°C as shown.		
28	**40**	"Over the past three years, the monitoring for the temporary ECA amendment has shown no adverse effect on the natural environment."	I strongly disagree with this statement. This statement is especially concerning given that there is not a clear connection between the thermal plume modeling and the effects of these temperatures to the collected biological surveillance dataa. It still isn't clear, from this summary, what effects we might expect and how your measurements contribute to evaluating effect.	Bruce Power has been monitoring its impact on the nearby environment since the construction of the plant in the 1970's. The last three years have not shown any major differences to the previous decades. Over the years, a lot of work has gone into measuring and analyzing temperature data, sampling and studying fish populations and constructing a model to better understand the thermal plume. These activities will continue to be done while the nuclear facility is in operation. The thermal plume model has provided a prediction of the size and extent of the plume and the water temperatures inside the plume under various conditions. This provides information on what temperatures are present in local habitat areas and also the degree of mixing and dissipation of the temperature. There has not been any evidence from the model, or with continuous temperature monitoring, that	Other than intake water, water level and ice cover data, there is no site-specific information in the Thermal ECA application related to other types of monitoring data (e.g., aquatic biota) or comparisons to environmental conditions from 1970-present. If there are comparable data that would draw some correlation between the thermal effluent/thermal regime in the vicinity of BP and impact (or lack of impact) to aquatic biota, this should be provided for review. **Bruce Power Response:** This information has been assessed pre and post operations for Bruce A and Bruce B in the 1970's and 1980's and again for ecological and environmental assessments and the conclusions have demonstrated that there are no long term impacts. This is a large body of work over a long time frame and thus a comprehensive review is not easily available at this time. As discussed in the literature, changes in fish communities in Lake Huron are driven by long term ecological change – see Riley [ED] (2013). The State of Lake Huron Report discusses multiple fish species and communities and highlights the profound ecological changes over the last 100 years driven by invasive species, low nutrient levels, mussels, the decline of *Diporeia* – all of which have	**NR**

				there are any warmer areas within or near the plume that local biota would encounter. The species that spends time in the thermal plume area at its most delicate life stage is the Smallmouth Bass, and nesting studies of this species has shown minimal change over the last three years. The creel studies in the area have also shown minimal change over the last 3 years. These results suggest that normal operations have minimal effect on the natural environment.	resulted in declines to fish biomass. Mussel density continues to increase, alewife abundance remains low, cladophora has proliferated, phragmites is highly present on shorelines and the offshore demersal fish community remains in a state of flux. All of these ecological changes affect the fish community such that it is difficult to compare data from the 1970s to present. Riley, S.C. [ED.]. 2013. The state of Lake Huron in 2010. Great Lakes Fish. Comm. Spec. Pub. 13-01.	
29	**40**	"The Operational Flexibility permitted in 2013 to 2015 was not exercised as intake water temperatures were cooler than those seen in 2010 due to natural lake conditions. However, it is predicted that Operational Flexibility will be required in the future and therefore Bruce Power is seeking a permanent amendment for long term thermal effluent Operational Flexibility to establish proactive measures for continued protection of the	Again, a better statistical treatment of the operations temperature data, downwelling events, and Tmax data should be undertaken to understand the basis for the theoretical case for the amendment permanence.	The theoretical case is based on the number of days in a given year that have intake temperatures ≥21.1°C and are at risk of exceeding the maximum effluent temperature limit of 32.2°C. High temperatures observed are provided in Table 3-2 and summarize eleven years of continuous temperature monitoring at the intakes. Tracking these high risk days is a simple method for demonstrating the challenges that Bruce Power is facing in regards to thermal restrictions to	Satisfactory Explanation.	R

		natural environment. As noted previously, the US EPA employs this type of variance to their operational limits. As stated in the introduction, this summary report forms the basis of the application to start the MOECC approval process."		operation. In regards to downwelling events, it has been shown that abrupt temperature changes due to downwelling events do not significantly impact the period within the ECA window and do not require further examination.		
30	**40**	"This is highly preferred to requesting emergency relief on a reactive basis as it allows long term understanding and trending which is required to fully capture the nature of a dynamic system such as the immediate waters of Lake Huron."	I agree, but also stress the importance of using the collected data appropriate to make a reasonable case to base a permanent ECA amendment on.	Bruce Power is looking for a long term solution that addresses the trend of increasing lake temperatures. The intake temperature data measured over the last eleven years shows an increased risk of exceeding effluent temperature limits during the ECA window timeframe. The temperature and current data collected near the site has been used in the thermal plume model and has provided a good understanding of the geographic extent of the plume and the temperatures present within it. The Smallmouth Bass nesting studies and Creel Surveys in the areas potentially impacted by the plume (discharge channels, Baie du Dore) have not changed in the last three years.	This may signal a larger discussion about the thermal inputs into the lake and whether the discussion should revisit the potential of alterative cooling methodologies or technologies, rather than simply raising the Tmax in response. It is also important to recall that Bruce B is also subject to these raising temperatures, despite the fact that it is not limited in its Tmax. It will be important to raise this with the MOECC. BP should share its Bruce B data with SON. Are there comparable temperature logging/monitoring at Bruce B? **Bruce Power Response:** Once Bruce A obtains an appropriate temporary or long term amendment, the same can be applied to Bruce B. The Bruce B intake, effluent and delta T temperatures from 2005 to 2016 have been provided to SON (17NOV2017).	**NR**

				A permanent amendment to the operational flexibility conditions during the ECA window would allow Bruce Power to adequately monitor and plan into the future.	The lake temperature monitoring program has deployed loggers (25-38) annually, since 2011 and earlier, in the nearshore region outside of the Bruce A and Bruce B generating stations. The logger locations and measured temperatures have been communicated in a variety of places, including the EMP and ERA.	
31	**40**	"Although it is recognized that it may take time to progress through this process, Bruce Power requests an approval prior to the 2016 time window (starting June 15th 2016) be considered. This request is for the same number of days and temperature limits as the 2013 – 2015 ECA temporary amendment for Operational flexibility (see Table 7-1, repeat of Table 1-1)."	I would agree than an appropriate measure is required for the 2016 ECA window.	A temporary extension has been granted for two years (2016 & 2017 ECA time windows).	Satisfactory explanation	R
32	**41**	"Bass and creel surveys may be discontinued in future years as these longer term monitoring programs (7 consecutive years currently) have demonstrated	I disagree with discontinuing biological monitoring. A more appropriate biological monitoring program is required. This would require using better	The statement does not state that there will be no biological monitoring, rather that it may change from the current monitoring of bass and creel	The statement: "It has been demonstrated that there has been no change in the bass nesting studies and the creel surveys over the last number of years, which suggests that there may be no need to continue them. If and when a change occurs a	**NR**

		that there is no effect of thermal effluent and short term (up to 30 days) gradual increases in temperature are not predicted to warrant more extensive local studies."	biological data collection methodologies and statistical treatments of the data.	surveys. There is a need for an ongoing biological monitoring program that is commensurate with the potential risk and captures potential impact on aquatic biota. It has been demonstrated that there has been no change in the bass nesting studies and creel surveys over the last number of years, which suggests that there may be no need to continue them. If and when a change occurs, a reassessment will be undertaken at that time including appropriate monitoring.	reassessment will be undertaken…including appropriate monitoring". How will any change be captured if the monitoring program is discontinued? It is important to continue to build a consistent and long-term data series of replicated data in order to make meaningful correlations. While it may not be the only measure that should be used to assess temperature, the bass nest monitoring program should be extended to BDD and be continued indefinitely. **Bruce Power Response:** Bass nest monitoring has been done in BDD and the Bruce A and Bruce B discharge channels for a number of years and the results have been reported annually in the EMP report. As per our Environment monitoring program design, field monitoring is re-evaluated on a routine basis and modified as needed. As stated, ongoing monitoring commensurate with risk will continue. At this time, there are no plans to discontinue bass nest monitoring.	

33	**N/A**	N/A	What effect will the aggregate 30 days (with 15 consecutive days max) have on the environment? What would happen if the increase was 15 days, a 1 day break, and then 15 days again? How are they determining the impact on the ecosystem? What evidence supports these values? Looking at the data in Table 3-1, they clearly haven't used the average or the median to come up with these values. Further, the actual number of days that fell into the range of 32.2°**C** to 34.5°**C** maxed out at 6 days aggregate, and 5 days consecutive. I don't see any justification for the 15 and 30 day values.	The number of aggregate and consecutive days comes from predicting the number of days of potentially high effluent temperatures based on temperatures measured at the intake channel during the ECA window. In a single year there is potential to exceed 32.2°C for 33 days, for 19 consecutive days (2012). The 30 aggregate and 15 consecutive days chosen are a conservative estimate that would allow Bruce A to operate at full power (4 units) during a warm summer year. In general, the model results demonstrate that the plume becomes well mixed in the open water body of the lake, with temperatures dissipating quickly away from the channel.	Would these number change based on the seven (7) years of data collected? **Bruce Power Response:** In 2017, there were 19 days with the potential to go above 32.2°C, with 15 days of those being consecutive. Of the last seven years (2011 - 2017), the number of days with the potential to exceed the Tmax has ranged from 5 to 33, and the number of consecutive days from 4 to 19. The number of aggregate (30) and consecutive (15) days requested in the long term amendment of the ECA would remain the same.	**NR**

34	**N/A**	N/A	Is the model for the ice coverage statistically significant? Looks like the slope coefficient's confidence interval covers zero. That is, I'm not sure if the 7% loss in coverage between 1972/73 and 2014/15 is significant or not.	The figure to show annual ice coverage (Figure 2.2.1) is taken from Environment Canada, including the regression lines showing the average, median and trend. It is not meant to be a statistical analysis.	Satisfactory Explanation.	R
35	**N/A**	N/A	How did lake temperatures compare between 1998 and 2003 to now? Ice coverage had dropped significantly in this period. If the temps were the same, how did they respond to the deltas then?	Between 1998 and 2003 the annual ice coverage had dropped, but the lake temperatures were generally lower than they are now and did not cause concern at the intakes. It wasn't until 2005 and beyond that the lake temperatures became a more frequent challenge to maintain discharge temperatures within the ECA limit. In regards to specific lake temperatures at this time, the average water temperature for July, August, September (JAS) of the years between 1998 and 2003, taken from Environment Canada's Buoy 45008 in the middle of Lake Huron, is 16.9°C. The average lake temperature for JAS of 2015 is 15.5°C. The average delta T	Satisfactory Explanation	R

				value for JAS of 2015 is 8.24°C (annual 9.14°C). The delta T values have remained within the 11.1°C limit since plant construction in the late 1970's. Figure 3.2 shows the seasonal variability of the delta T over the last eleven years and demonstrates that the values remain consistent regardless of changes to water level and ice coverage.		
36	**N/A**	N/A	While there is obvious trends in the data that were analyzed, the use of linear regression seems a bit odd (in several cases) - given that the data are correlated. That is, one could expect the average water level in 2014 to be highly correlated to the water level in 2015. I don't necessarily think that we'll see much of a difference in the result (linear regression is rather robust), but better methods could and should be used (specifically - time series analysis, or a mixed method that allows for the correlations to be captured). The use of improved methods would likely improve the standard error	The trendline in the water levels shown in Figure 2.3.3 was used to show overall long term trends in general, for discussion purposes only. A statistical analysis is not necessary. Within the current model water levels are taken into account via three years of measured data during record low and average water levels. A dynamic water level will be used in a future model for simulations in 2017.	Satisfactory Explanation	R

			estimates, resulting in hopefully stronger conclusions.			
37	**N/A**	N/A	What evidence supports the 32.2**°C** or 34.5°C value? How did they come up with these values?	The current effluent temperature limit of 32.2°C was set in the late 1970's when Bruce Power was constructed. It is assumed that the value was derived from lake trend data at that time and condenser design capability. In the late 1970's, the maximum lake temperature was 70°F (21.1°C). Added to this is the maximum designed condenser capability of 20°F (11.1°C), reaching a maximum output temperature of 32.2°C. The requested effluent temperature limit of 34.5°C was obtained from the projected maximum effluent temperatures observed in past years (2008 to 2012). The projected effluent temperatures	Satisfactory Explanation	R

				based on intake temperatures plus deltaT of 11.1°C, range from 33.2°C (2008) to 34.5°C (2010). With the trend towards increasing lake temperatures, Bruce Power, in discussions with the MOECC, have chosen 34.5°C as the limit, in order to continue operations into the future. See answer to 19,20 above.		
38	**N/A**	N/A	Is there a model that combines info relating ice cover, water level, water temps, etc. to daily average intake temp and daily average effluent temp?	The current model includes water level, water temperatures, and intake and effluent temperatures. Ice cover cannot be modeled as it is too dynamic and this time frame is not relevant to the flexibility time window. The effect of high annual ice cover would be cooler lake conditions in the spring. This would be incorporated into the model time frame used here of June 15 to Sept 30 which uses water temperatures from the lake.	Satisfactory Explanation	R
39	**N/A**	N/A	They indicate that in 2005 they exceeded the 32.2°**C** value, and include a statement "visual observations of discharge channel" - what does this mean?	A requirement of Section 61 directive provided at that time was to perform surveillance monitoring. Observations of the discharge channels were made from shore and in boats to	Satisfactory Explanation	R

				identify any adverse impacts due to short term increases in effluent temperatures.		
40	**N/A**	N/A	What is the probability that they will actually see temperatures exceed 32.2°**C**. And in duration that warrants the 30 day and 15 day limits?	It has been demonstrated in Table 3-1 and Table 3-2 that there is potential for exceeding effluent temperatures of 32.2°C for the number of aggregate and consecutive days requested. Over the course of eleven years, measures have been necessary to mitigate these temperature exceedances, and a longer term plan that considers the trend of increasing lake temperatures is required.	Satisfactory Explanation	R
41	**N/A**	N/A	Model - I am glad to see that it has been updated and improved. Can this be used to simulate future years? That is, could this be used to estimate the probability of future events where the discharge temperature exceeds 32.2°**C**? I'm imagining that the ambient lake temperature can be updated based on existing climate predictions. This might give us a better sense of the challenge that BP is facing with discharge temperatures - and how the thermal plume might change	Yes, it is possible to use the model to run predictive scenarios for future years. Climate prediction scenarios have been discussed but not implemented as the first step of devising a robust model is now just being finalized.	Incorporating climate prediction scenarios into the modelling is very important in the consideration of future thermal impacts, and in what ways Tmax may need to change (increase) in the next 20 years. Climate prediction scenarios must be part of the modelling, and the results must be shared with SON as part of thermal discussions with SON. **Bruce Power Response:** Climate change prediction scenarios are in early stages of development globally. Bruce Power is engaged in understanding the outputs from climate predictions and considering how they may affect future operations and the local environment. This information will be shared with SON as part of our ongoing thermal discussions as the work	**NR**

			with increasing ambient temperatures. It could also be used to see what happens in the case of 15 consecutive days to surrounding water temps - because this may have an influence on the ecosystem. In short - the model seems quite robust, and I think it could be used to fully investigate various scenarios that can support management decisions (both for BP and the SON).		evolves. Collingsworth et al (2017) looks at climate change as a long-term stressor for fish in the Great Lakes. Fish could experience prolonged periods of optimal growth but may also be subject to eutrophication and invasive species (with a focus on Lake Ontario and Erie). In light of climate change considerations, Bruce Power is agreeable to a long term (10 year) temporary ECA with a 5 year review such that climate change information can be incorporated to revisit the requested flexibility parameters. Collingsworth, P.D. et al (2017). Climate change as a long-term stressor for the fisheries of the Laurentian Great Lakes of North America. Rev Fish Biol Fisheries 27:363-391.	
42	**N/A**	N/A	Over the past three years, the monitoring for the temporary ECA amendment has shown no adverse effect on the natural environment" - This is an odd statement. There is no way to test that there is no adverse effect because they didn't implement the amendment.	During 2013-2015 the temporary amendment was in place however the daily average temperatures did not require the flexibility. It is true that the monitoring over the past three years has shown no adverse effect on the natural environment during current operations. It is also true that there is a need to increase the regulatory limit in order to continue normal operations during the ECA window as a result of increasing lake temperatures.	Satisfactory Explanation	R
43	**N/A**	N/A	"It is predicted that operational	Looking at trends in the natural	Satisfactory Explanation	R

			flexibility will be required in the future" - how is this predicted? Predicted using some sort of scientific method? I didn't see that in the report. That is, they've summarized a lot of data, but I didn't see how those data were used to predict a future that REQUIRES operational flexibility.	variations of lake conditions, lake temperatures are increasing and are predicted to continue in the future. This will result in an increase of intake temperatures and correspondingly, increases in effluent temperatures. Tracking the number of days with high intake temperatures for each year has illustrated a trend towards higher risk and highlighted a need for a modification of the effluent temperature limit. In order to continue to operate in a safe and responsible manner, with proper pre-planning and environmental monitoring, the temperature limits and time periods described by Operational Flexibility is necessary.		

DISPOSITION TABLE
Saugeen Ojibway Nation's (SON) Preliminary Technical Comments on the "Thermal ECA Application: Appendix A – Technical Summary Report for 2013-2015 Monitoring" as prepared by Bruce Power for the Ministry of Environment and Climate Change (MOECC) *[Last Update: October 09 2017 – SON EO]*

Based on the preliminary comments made by SON's technical staff on the Bruce Power's (BP) Thermal ECA Application to the Ministry of Environment and Climate Change (MOECC), the following have been identified as high-level preliminary issues/concerns for SON:

- Unclear whether there is sufficient justification or evidence for the proposed thermal discharge maximum of 34.5**°C.**
- Lack of justification/data to support the conclusion of "no adverse effect on the natural environment".
- Lack of connection between fish data (creel surveys and bass nesting success) and potential ecological impacts of the thermal plume and conclusion of "no adverse effects".

Specific text and/or methodologies that require further clarification or justification are outlined in detail below.

Please note that the comments provided in this table are meant to be preliminary and high-level. These comments are not meant to identify the full scope of SON's issues/concerns regarding Bruce Power's Thermal ECA Application, only to begin a technical discussion around the application.

#	Page Reference	Relevant ECA Application Text	SON Comment	Bruce Power Response	SON Notes/Questions on BP Responses	Status
1	**7**	"Environment Canada monitors temperatures in Lake Huron during the ice free season, with two locations (45008, 45003) having long term data sets (1981 to present). Buoy 45008 is in central Lake Huron due west of the Site and buoy 45003 is in northern Lake Huron where the basin is deeper (see Figure 2.1.4)."	This is referring to surface water temperatures. The Bruce A intake is at 10 m depth and 470 m offshore. Bruce B intake is 14 m deep and 830m offshore. It is not clear at what water depth these are calculated for.	Buoy 45008 is located 0.6 m below the water line. Buoy 45003 is located 1 m below the water line. This data was obtained from the NOAA website and used for long term trending of summer (July-Sept) lake water temperatures. The purpose for using this data was to show that there is a general natural rising temperature trend observed since 1981 to present.	Satisfactory Explanation	R
2	**15**	"Intake temperatures continue to be affected by long range natural variations and have	This statement is unclear. What is meant by "long range" natural variations?	This statement is referring to the fluctuating lake conditions (i.e. temperature, water level, ice	Satisfactory Explanation	R

		been observed to be increasing."		cover) presented in Figures 2.1.5, 2.1.6, 2.2.1 etc. that reflect the natural changes occurring since the 1970's to 2015.		
3	**15**	"If the maximal daily average change in temperature from the intake to effluent (delta T of 11.1°C) was applied to the intake temperature, then the potential number of days of the daily average temperature being above 32.2°C is shown in Table 3-1 below."	It is not clear whether the theoretical case is appropriate given the data collected	The theoretical case was established based on the rationale that the effluent temperatures are directly related to lake/intake temperatures and delta T values. Since the construction of the plant in the late 1970's, the delta T value has remained consistent and within the limit of 11.1°C, due to equipment capabilities and plant design. Since this value remains relatively constant, we chose to use the maximum value allowed. Therefore, a simple approach is to track and tabulate the number of days each year with a 24 hour intake temperature average over 21.1°C. By adding 11.1°C to this value, it can be assumed that the effluent temperature above the limit of 32.2°C would be obtained. This projection assumes the plant is in full (4 unit), uninterrupted operation, achieving typical MW output, with all CCW pumps in use. This theoretical case allows	It is understood how the Tmax was calculated using the delta T and that the 34.5 degree limit was established using the observed increase in Lake Huron water temperatures at the Bruce Power and in the literature. What is not clear is the environmental/ecological risks associated with the Tmax and how these risks were considered in the calculation. **Bruce Power Response:** The existing delta T limit was used as a maximal case and added to the potential lake temperature increases to devise a flexibility limit that is reflective of operational needs in light of long term temperature changes observed in the lake. The flexibility limit is a 2.3°C increase over the existing Tmax and this was selected to allow only a small margin. This increase was applied to Smallmouth Bass and Lake Whitefish temperature thresholds for the immediate vicinity of the effluent and was found to be within the range of these thresholds. If the flexibility limit was not within these thresholds, then the value of the flexibility limit would have been revisited.	**NR**

				Bruce Power to estimate the risk of exceeding effluent temperature limits under normal maximum operations, and highlight the need for a modification of the current ECA limits due to changing lake conditions. The intake temperatures are monitored continually and 24 hour averages are calculated. Eleven years of data was analyzed and summarized in Tables 3.1 and 3.2 to show in a particular year the number of days where the average intake temperatures were high and of potential concern for exceeding the limit. This theoretical case uses the measured temperature data from the lake and applies the working operational limits regulated by the MOECC. It is a reasonable estimate to provide an understanding of the potential range of thermal limits. This was also discussed in the 2013 submission on page 19 of		

				the Technical Summary Report.		
4		Table 3-1	This table isn't intuitive and relies on the reader to trust that Bruce Power has done the correct analysis.	Table 3-1 attempts to summarize eleven years of continuous temperature monitoring in the intake channel of Bruce A. It tabulates the number of days with intake temperatures that have the potential (≥21.1°C) to surpass the 32.2°C effluent limit each year, as well as the consecutive number of days that this occurred. It compares those values to the number of days that the effluent temperature *actually* exceeded the limit during that time frame, and demonstrating that Bruce Power uses all means possible to avoid discharging thermal emissions to the lake.	Satisfactory Explanation	R
5	**16**	Table 3-1	Are these the numbers used to justify the 15 consecutive and 30 aggregate days?	The number of consecutive (15) and aggregate (30) days were chosen based on the data shown in Table 3-1. Over the past eleven years, the numbers of aggregate days above the current limit in a single year ranges between 3 and 33 days. The number of consecutive days ranges between 2 and 19 days. In order to set the number of	It is understood that the number of days at 30 aggregate and 15 consecutive will be conservative numbers in order to ensure the ECA, if permanent, will cover the maximum potential days during the ECA window. However, the number of days should again make correlation to the temperature benchmarks for fish species and some measure of potential impacts, for example the MaxHQ values BP has used in it's Relicensing ERA submission. For example,	**NR**

				aggregate days and consecutive days to account for natural increases in lake temperature, the 15 consecutive days and 30 aggregate days were chosen by rounding down (33 to 30 for aggregate days, 19 to 15 for consecutive days). This represents the upper range of days potentially affected as shown by collected data to date. This was also discussed in the 2013 submission on page 19 of the Technical Summary Report.	provide an example scenario where the Tmax was reached for 15 consecutive days and use that temperature to calculate or determine a measure of potential impact for several fish species. This would give some indication of the potential impacts. **Bruce Power Response:** The details of the thermal effects portion of the Environmental Risk Assessment, which quantified risk from thermal effluents on 16 local fish species for 5 different life stages by comparing measured lake temperatures within or near the thermal plume to fish benchmarks, where available, demonstrated that the risk to local fish populations from thermal effluent is low. This includes the period of the ECA Window and the known fish species and life stages in the local area at that time. The Smallmouth Bass adult when guarding the nest and the egg/larval development occurs over more than 15 days and there is no effect on their development or cohort production as known from observations. Life stages of other species tend to not be resident in the local area continuously for 15 to 30 days and thus would not be subjected to this temperature range on a continuous basis. The derivation of the 15 continuous and 30 aggregate days limits the duration of potential exposure to warmer temperatures. Consideration was given to just an overall increase (all year round), then only for the summer months (3	

					months) and now only for up to 30 days (1 month). This approach has greatly narrowed the duration. In conjunction with the request for a marginal increase (2.3°C) based on lake temperature regimes, this results in a decreased exposure and duration which minimizes risk.	
6	**16**	"Table 3-1 is a summary of recent years where daily average effluent limits exceeded the ECA temperature effluent maximum of 32.2°C. Over the past 11 years, Bruce Power has taken measures to either: 1) remain within the limit by de-rating units, 2) obtain emergent Section 61 Directives, or 3) obtain a temporary amendment to allow a proactive approach."	It is not clear why these mitigation measures won't be sufficient in the future to mitigate high temperatures Bruce A may experience.	The current measures used to mitigate temperature exceedances (i.e. de-rating, Section 61 permissions) are not ideal working practices or acceptable long term solutions for operating a nuclear facility. The process of de-rating units to reduce heat generation and avoid exceeding regulatory limits requires a decrease in reactor power, which is accomplished at Bruce A using the Reactor Regulating System (RRS). This method can achieve small amounts of Megawatt output reduction over a short period of time. However, these derates are dependent on the reactor condition and are not very effective at lowering effluent temperatures quickly; thus in order to achieve the necessary changes in temperature, a unit must be shut down. When this	Satisfactory Explanation	R

				happens, it takes 48 hours before the unit can be returned to the grid, and during periods of high energy consumption this restricts Bruce Power's ability to supply power to the province. More information regarding derates was provided in the 2013 ECA Application Supplemental Documentation #00001. A Section 61 directive from the MOECC allows Bruce Power to temporarily exceed Tmax under very specific circumstances, such as high energy consumption periods. Obtaining a Section 61 involves an application and approval process that is not conducive to sudden increases in lake temperatures. Often, this results in the necessity to derate in order to keep within the regulatory limit. Additionally, the MOECC has indicated that they do not want to continually grant Section 61 approvals as this reactionary method is meant for emergency purposes and is not a suitable long term solution. The Operational Flexibility		

				conditions requested would allow for safe plant operations and adequate environmental monitoring. A permanent amendment is a practical solution.		
7	**17**	Table 3-2: Annual summary of the number of days, maximum values of daily average temperatures and derates or directives in place	Why 20°**C** and not 21.1°**C** ? Similarly not 32.2°**C**?	Any intake temperature above 20.0°C and any discharge temperature above 30.0°C is monitored closely for potential exceedance of Tmax. The process to reduce temperature by derating a unit is a lengthy and involved; therefore when lake temperatures approach these thresholds, temperatures are very carefully monitored to ensure safe and well-planned alterations to reactor power. Thus when intake temperatures approaching 20°C and outfall temperatures approaching 30°C are evident, this would result in engaging of steps to prepare for a unit shutdown.	Satisfactory Explanation	R
8	**17**	Table 3-2: Annual summary of the number of days, maximum values of daily average temperatures and derates or directives in place	While it may be understandable that a derate is costly, but it is difficult to understand if seven (7) derates are significant. For example is one (1) derate to	There are two situational categories for derating units; 1) non-IESO derates which include routine tests, non-IESO emergency conditions and thermal limitations, and 2) IESO	Provide the costs and risk associated with derates. Specifically, that which would result from seven (7) derates in one year. **Bruce Power Response:** The issue with derates is not about cost, but about	**NR**

			many or three (3), and is seven (7) highly significant?	mandated derates which include Surplus Baseload Generation (SBG) and transmission constraints. Derating a unit and powering down a reactor to keep within temperature limits fall under category (1) and are what is tabulated in Table 3-2. These situations limit Bruce Power from supplying continuous power to the grid and are preferably avoided. Requiring seven derates in one year to work around high lake temperatures is highlighting the need for a modification of the current regulatory limits.	being able to supply electricity to the grid on demand. Derates can only help with the temperature situation to a certain degree, after which, the reactor simply has to be shut down. Once shut down, it takes a number of days for the unit to get back on line and during this time it cannot supply the Province with electricity during potentially peak consumption periods. The degree to which the lake has warmed naturally and the annual variations observed, far outweigh the ability of derates to help the situation. A long term solution in needed to address the changing conditions so that Bruce Power can reliably supply power to the grid while adequately monitoring and caring for the environment. This can be done with a long term amendment to the ECA. The preplanning and budgeting that accompanies long term commitments allows for suitable monitoring of the environment.	
9	**17**	Table 3-2: Annual summary of the number of days, maximum values of daily average temperatures and derates or directives in place	Also, a derate can also occur if there is too much electricity on the grid at one time. Bruce Power can then use a CSDV (Condenser Steam Discharge Valve) to reduce output by 12MW/minute BUT this derate will increase Tmax. It is not clear if these are indicated here or not?	IESO mandated derates are not included in Table 3-2. Our analysis has shown that derates due to SBG and line constraints do not have a strong influence on effluent temperatures in the summer months relative to the increasing trend in lake temperatures. The majority of SBG derates are required during the spring and fall based on decreased market demand. There may be one or two instances a	Satisfactory Explanation	R

				year during the summer months that derates due to SBG and line constraints would minimally contribute to higher effluent temperatures. If a situation arises where the Tmax limit is at risk of being reached, there are established IESO protocols to either stay within the temperature limits or ask the MOECC for a temporary provision depending on the alert level. More information about IESO and non-IESO derates is provided in the 2013 ECA Application Answer to Questions 1 and 2 and Supplemental Documentation #00001. In general, Table 3-2 is demonstrating the increasing need for a more permanent solution to the rising lake temperatures that will allow Bruce Power to supply continuous, reliable electricity to the province during peak energy consumption periods. A permanent amendment to Operational Flexibility during the ECA window is a viable option.		

10	**19**	"The average daily temperature difference between effluent and intake (the delta T) is approximately 9.5°C in the summer months, with the winter months seeing more variation as the recirculation gate is opened to allow warmer effluent water to recirculate back into the forebay to prevent frazil ice formation (Figure 3.2)."	This is important given the previous figure uses the maximum allowable Delta T temperature 11.1°**C** rather than their averages.	The delta T value of 11.1°C is used because that is the maximum allowable value (an ECA limit) and a conservative estimate when determining the potential for exceeding the maximum temperature limit. It is based on equipment capabilities and plant design. Operations since construction in the late 1970's have shown that this value has remained consistent and kept within this limit. Figure 3.1 presents the raw effluent temperature data over an eleven year period, along with the temperatures with the maximum deltaT value added to illustrate the potential for exceeding the current Tmax of 32.2°C.	Satisfactory Explanation	R
11	**19**	"The average daily temperature difference between effluent and intake (the delta T) is approximately 9.5°C in the summer months, with the winter months seeing more variation as the recirculation gate is opened to allow warmer effluent water to recirculate back into the forebay to prevent frazil ice formation (Figure	This is why they have a higher delta T in the winter months.	The higher delta T limit (13°C) in the winter months is to allow for recirculation to prevent frazil ice formation in the forebay.	Satisfactory Explanation	R

		3.2)."				
12	**19,20**	"In summary, recent history since 2005 has demonstrated the need for some kind of flexibility or variance from existing approvals. These have taken the form of Section 61 directives or temporary ECA amendments for a limited timeframe. Bruce Power continues to make all operational efforts to minimize thermal emissions to the lake but naturally changing conditions has highlighted a need over the last 10 years. The best regulatory instrument provided to date has been the recent three-year temporary operational flexibility. Although the operational flexibility was not invoked from 2012 to 2015 inclusive because of generally cooler summers during this time frame, there remains a potential to need the flexibility. Thus a permanent amendment to the daily average maximum temperature effluent limit is being requested in the form of	This may be true, but does it justify the increase to 34.5°**C** or the number of days? I'm not sure it does given the data presented, and the monitoring efforts over the past three years Again, it is not conclusive that this temperature increase is justified based on the data collected Unclear as to what this variance measure is.	This application is a long term plan that includes operations during years with warmer than average summer temperatures, such as those observed in 2010, 2012 and 2015. The value of 34.5°C was chosen based on projected Tmax values for the years of 2008 through 2012. There is potential for this value to be reached in a particularly warm summer, as observed in 2010. The current limit is 32.2°C and the long term trend in the lake temperature (over the past ~30yrs) has been an increase of 2.1-2.2°C; the addition of 2.2°C to 32.2°C results in 34.5 request. The maximum effluent temperature of 35°C was requested to accommodate for some future margin (0.5 degrees) for the 2013 ECA temporary amendment and it was decided by the MOECC that 34.5°C would be granted in the 2013 ECA temporary amendment.	Re: "The value of 35°C was compared to previous EA predictions to see if significant adverse impact would result or if the predictions would still hold true." How did BP "see if significant adverse impacts would result" and what were the predictions? See comment #5. **Bruce Power Response:** In our last meeting, we had discussed that using the term "significant adverse impact" which is EA language would not be appropriate to characterize the risk characterized in this Thermal ECA discussion.	**NR**

		an operational flexibility. Note that this is Industry Best Practice as the United States Environmental Protection Agency (US EPA) employs this type of variance to their operational limits."		The value of 35°C was compared to previous EA predictions to see if significant adverse impact would result or if the predictions would still hold true. Two specific species were looked at (lake whitefish and smallmouth bass) as was done in the previous EA. In the case of lake whitefish, the sensitive life stages were not within the ECA window being requested. In the case of smallmouth bass, the temperature increase was still within the temperature criteria for the sensitive life stages. This was also discussed in the 2013 submission in Section 8 of the Technical Summary Report. The requested number of aggregate (30) and consecutive (15) days is reasonable for years with warmer than average lake temperatures during the specific 107 day time frame. These values came from monitoring the number of average intake temperature values over a period of 11 years (2005 to 2015) as	

				described in a previous question, and also in the 2013 ECA Application, Supplemental Document #00002.Bruce Power is looking to obtain a modification, or variance, to the current temperature limit of 32.2°C to reflect increases in lake water temperature.		
13	**20**	"Bass nesting: bass nesting was monitored in the discharge channels and Baie du Dore from the start of the season through to dispersal of fry in 2013, 2014 and 2015. In addition, this monitoring has been conducted annually since 2009. Creel Survey: anglers were surveyed at the Baie du Dore and Inverhuron Provincial Park boat launches following a standardized MNR protocol to understand what species were being sought and harvested. Participating anglers allowed fish lengths, weights and scale samples to be collected. Surveys were conducted in 2013, 2014 and 2015. In addition, this monitoring has	It has been pointed out by the SON Science and Fisheries Assessment Teams that it isn't clear how these two components contribute to evaluating the 'effect' of temperatures.	Bass nesting and Creel surveys are not used to observe the effect of temperature directly, but instead as an indicator of a potential changes near the Bruce Power site. Smallmouth Bass are a focus of interest because they are known to live in the areas with the highest temperatures (i.e. Bruce A discharge channel, Baie du Dore) during their most vulnerable and immobile stage of life (i.e. larvae, fry). Monitoring their population, including their habitat and reproductive behavior, provides information on the overall health of the species. Therefore, tracking their success is a reasonable approach for obtaining information on the	While the nesting surveys of SMB do represent a measure of potential impact on a resident fish species and one that is exposed directly to the thermal discharge for many consecutive days across multiple life stages, this cannot be the key indicator of impacts to aquatic organisms as a whole. **Bruce Power Response:** At the time, SMB was simply used as an example of where the proposed Tmax was within temperature thresholds for this species during this time period. In the future, as part of our other required regulatory processes, we will establish links with the thermal portion of the ERA and view this to be a routine process that gets updated every 5 years. This allows us to re-visit assumptions in a routine manner.	**NR**

		been conducted annually since 2009."		effect of temperature on the local environment and natural changes in the local environment. In addition, Creel surveys are a common tool in gaining information about fish populations and fish health. Anglers provide details on numbers, size and types of species present in the lake specifically near Bruce Power. This data contributes to understanding the local fish presence and relative abundance in a given year. As previously described in the February 2013 ECA Application many other species have been considered for effects due to short term increases in temperature and it was concluded that there is no serious harm.		
14	**23**	"Smallmouth Bass nest monitoring begins in mid-April and continues through mid-July depending on the presence of bass nests in a given year. Nesting surveys have occurred annually since 2009 and	This is not evidence of 'no effect' of high temps for two reasons: 1. these high temps were not observed, and 2. high temps were not observed for any prescribed or specific length of time.	Smallmouth Bass consistently nest in the warm waters of Bruce Power's discharge channels and the most sensitive life stages are present in the early portions of the ECA window. Nesting fry are present constantly for a	SMB would experience some element of acclimation to these conditions. It would be beneficial to extend this type of survey to Baie du Dore (bass nesting surveys) and provide these results in tandem with those of the discharge channel. This could indicate potential impacts of thermal change in an area where fish are not	**NR**

		surveys were also conducted in the past. The proportion of nests with successful risen fry was high in 2014 and 2015, with more unsuccessful nests in 2013 (Figure 4.1). This greater proportion in 2013 was also seen in nearby reference areas and is indicative of low water levels in the spring of this year compared to other years. Nests are observed in consistent geographic locations over time, likely with the selection of a given area determined by water depth/velocity. There have been no changes observed in the areal extent of nest locations over time (Figure 4.2). Locations of unsuccessful nests are shallower waters and/or may be disturbed by boat traffic utilizing the shelter of the dock."		range of 2 weeks (if started early in July) to 2 months (if started earlier in the year) and thus are constantly exposed to the environmental conditions at the discharge locations for this length of time. Exposure to higher temperatures is not constant given that nesting typically ends in July. After this time, they become mobile and can swim away from any undesirable conditions. Similarly, all other fish species would not be constant residents in the discharge channels for extended (i.e. 15 days) periods of time. The nesting studies demonstrate that a fish species, in a vulnerable phase of life, in a region of higher than ambient water temperatures are successful during conditions present during normal operations of Bruce Power.	experiencing a warmer condition nearly constantly and are more exposed to natural fluctuations in temperature and condition. **Bruce Power Response:** Smallmouth bass nesting surveys are carried out each year at the Bruce A and Bruce B discharges as well as in Baie du Doré. The results are reported annually in the EMP report. Baie du Doré is consistently used by spawning Smallmouth Bass and has shown to be a successful habitat. Temperature fluctuations (delta T) were considered in the thermal portion of the ERA. In general, fish were found to not avoid the local area. For warm water fish, critical thermal maximum values were not exceeded. As previously discussed, further work was done for understanding the risk to whitefish eggs, however this occurs during the winter months and not during the ECA window.	
15	**25**	"There has been no decline in the number of recreational anglers at local boat launches, indicative that local fishing remains an enjoyable activity.	Again it isn't clear how these surveys relate to evaluating 'effect' of the thermal plume?	The Creel survey shows that in the local near shore area, with the presence of the thermal plume, there has been little change in the fishing activities	Creel surveys may demonstrate that there has not been a measureable change in the presence of recreational fish (predatory, large bodied fish) or in the number of anglers within the vicinity of the discharge. However, presence of fish does not	**NR**

		The estimated effort, measured in rod hours, by species and year shows the most sought species remained consistent from year to year (Chinook Salmon, Walleye, Smallmouth Bass and Lake Trout) as shown in Table 5-1. Estimated catch was variable by year, with the most sought species also having the highest catch (Table 5-2). Estimates are calculated using OMNRF software. There is no indication of changes in the recreational fishery, monitored via the creel surveys, over time."		over the period studied, suggesting that there has been minimal impact on the fish population (including type of fish, numbers of fish, general health of the fish caught).	equate to absence of impact. These data are not synonymous with measuring impacts on the local "fish population" or on fish health. Thermal impacts to fish are not necessarily visible, especially to a recreational fisherperson reporting their catch. **Bruce Power Response:** At the time, creel surveys were simply used to show changes to fish populations and make any interpretation whether or not populations are affected by operations, which they are not. Changes are influenced by natural and cyclical factors in the lake. Since then, as part of our other required regulatory processes, we have established links with the thermal portion of the ERA and view this to be a routine process that gets updated every 5 years. This allows us to re-visit assumptions in a routine manner.	
16	**27**	"When the MOECC approval was being considered in 2013, a number of questions were initially answered with the intent to refine the answers after the three year period upon completion of the thermal model refinements and recalibration. This summary application only covers thermal modelling results for two of the three ECA windows of the 2013 through 2015 period as,	ADCP data is not necessarily temperature data. There was less precision regarding the thermal characteristics of the plume during these 'high' temperature periods. The model doesn't tell you what effect these temperatures have on the environment.	ADCPs reside on the lake bottom and each has a temperature sensor attached. This data was retrieved with the plan to use the information to augment the data from 2012. The 2012 data was used to provide three years to the model (2012, 2014, 2015). In the summer of 2012, 2 units were operational at Bruce A and all units were operational at Bruce B. Data collection continued in	Satisfactory Explanation	R

		due to unforeseen weather complications; insufficient field data was retrieved for 2013 to establish the boundary conditions required to operate the model. Instead, a preliminary examination of a portion of the commensurate 2012 period has been undertaken, but not yet finalized. Moving forward, the plan is to augment hydrodynamic data gaps in the 2012 ECA window, with information collected at a nearby hydrodynamic monitoring location. While this approach creates limitations from a data interpretation perspective, it will allow the mechanics of plume movement under low lake levels (as observed prior to 2014) to be examined. Moreover, it will also include an examination of plume effects during a period of higher lake temperatures than observed throughout the 2013 to 2015 period."		2016 and is planned for 2017. The thermal plume model does not provide information on the effect of temperature on the neighboring environment, but it does provide information on the geographic extent and timing of plume movement within the lake. It is able to model water temperatures within a model boundary, which captures the change in temperature, to within 1°C difference from ambient. The measured temperatures, and potentially the modeled temperatures, may then be used to compare to thermal benchmark values by fish species.		
17	**30**	Table A-1:	The 2013 data is missing.	The data for 2013 was not	Satisfactory Explanation	R

				included in Table A-1 because insufficient field data was obtained for this year due to lost or damaged equipment from extreme weather conditions. To establish boundary conditions and three years of data, the data collected in 2012 are being examined, but the results have not yet been finalized. Moving forward, data from 2016, and possibly 2017, will be added to the model to provide 4-5 years of analysis.		
18	**30**	Table A-2:	I think it is important to note that for these years, Tmax and Delta T were not reached. Temperature averages were close but again, does this warrant a permanent increase to 34.5**°C**.	Table A-2 summarizes the actual temperatures and current velocities measured near site during 2014 and 2015. It shows that the effluent temperatures are approaching the regulatory limit, while the deltaT value has not approached its allowable limit. This is highlighting a continual risk each year for temperature exceedances. Furthermore, the Tmax value of 34.5°C is based on a scenario with full 4 unit operation with all CCW pumps running and typical MW reactor output each day. It is based on continued	The challenge here is that 'risk' has not been quantified. Please provide the costs (and other operational risks) associated with temperature exceedances. **Bruce Power Response:** Again, the avoidance of non-compliance of the ECA Tmax limit is not associated with cost, but instead the ability to operate a predictable (and therefore safe) and environmentally responsible facility. The preplanning and budgeting that accompanies long term commitments allows for suitable monitoring of the environment.	**NR**

				operation into the future, accounting for increasing lake temperatures and previous ECA temporary limits.		
19	**31**	Figure A-1:	These are the same snapshots BP provided in a briefing to SON in early 2015. Why only these snapshots and not others?	Other scenarios and cross-sections are possible, but these snapshots were chosen as a representative of the thermal plume during the predominant conditions of the lake.	Satisfactory Explanation	R
20	**33**	"B. Vertical mixing of the plume Estimates of the areal surface extent of the Bruce A thermal plume show 2015 predictions were of a smaller extent compared to 2014 (Table B-1). Estimates are made by comparing the predicted hourly water temperatures under full operational conditions (maximum flow and delta T up to 32.2°C) to non-operational conditions (no discharge). Areal plume extents are areas that contain a plume that is specified as an increase over the ambient temperature 75% (quartile) or 95% (maximum) of the time."	Could this be a factor of higher water-levels and better plume diffusion? While this may be the null hypothesis, is it realistic to compare to non-operational no discharge conditions? My sense is no, but that if you are using a theoretical case for a permanent increase you should predict maximum outputs, and compare with actual data values, using the no discharge as a control scenario. In this way, you would present worst-case scenario, actual operational data, and no discharge and then compare.	Higher water levels occurred in 2015 and record lows occurred in the winter of 2012/2103. A report with 3 years of data (2012, 2014, 2015) will provide the extent of the plume in these three years. In 2015, the vertically mixed extent was the smallest of the three and 2012 extents were the largest, which may be attributable in part to the lower lake levels coupled with lower current speeds during the 2012 ECA window. A dynamic water level will be used in the future for simulations of the 2017 data. The estimates of the areal surface extents of the plume have been made based on comparison between the model	Satisfactory Explanation	R

				results for Non-Operational conditions (no flow or temperature discharge) to the results of Measured Operational conditions (max T 32.2°C). Adding the theoretical case of Full Operational conditions (max flow and 34.5°C maximum temperature) is in the process of being completed now that there are 3 years of data and a verified model.		
21	**34**	Figure B-2:	The model, I believe, assumes that Baie du Dore is isolated and also does not provide an estimate of shoreline temperatures (orange line in each figure)	For the most recent ECA amendment, the mesh used in the RMA10 Model was refined in Baie du Dore to further model the thermal plume in this region. It was determined that Baie du Dore remains essentially thermally independent from Bruce A. The orange line in Figures B.1, B.2, B.3 are the high water line, and vary from one year to the next depending on lake water levels. The model boundary along the shoreline starts at a depth of 0.5 m, wherever this occurs.	More information is required regarding the temperature relationship between Bruce A and Baie du Dore. It is difficult to believe that BDD is thermally independent from Bruce A. I would like to see more detailed information (with or without the plume model) related to temperature logger data about that relationship. **Bruce Power Response:** For the most recent modeling studies spatial resolution was increased in BDD and the bathymetry was updated to better represent the rock shoals and connecting channel between BDD and the rest of the lake. Provisions for inflows from Stream C into BDD were also included to better capture hydraulic and thermal inputs to the bay. Modelling predictions have indicated that the effects of CCW discharges are limited outside	**NR**

					BDD owing to the presence of the large sill, which increases the physical separation between the bay and other areas of the lake, particularly as lake levels decrease. In addition, atmospheric effects within BDD were found to be much more influential on water temperature variations than thermal plume interactions, a consequence of the shallow nature and physical separation from the open water body. Even further, it was found that water temperatures within BDD exhibit a more pronounced response to diurnal variations in air temperature and solar radiation than elsewhere in the model domain. Simulations showed that regardless of surface water elevation or operational status, the increase in temperature in BDD due to the Bruce A discharge was minimal (<0.5°C).	
22	**36**	E. Plume interactions with intakes (cross connection)	Why are these senarios the only ones presented?	These scenarios were specified by the MOECC.	Satisfactory Explanation	R
23	**37**	F. Ability of the model to capture/predict upwelling and downwelling events	Both up and down-welling events are natural events that can negatively impact local biota. However, these impacts can be exaggerated by the the Bruce A & B thermal plumes. event.	The conclusions of this study show that the model provides a reasonable estimate in reproducing the location and magnitude of both an upwelling and downwelling event. It is shown that during these events there is thorough mixing due to the turbulent nature of the water body, and thus no exaggeration of impacts by the thermal plumes is measureable.	Satisfactory Explanation	R

24	**38**	"A location well above the thermocline will not have a downwelling event. Two downwelling events were observed at the Bruce B intake location in 2014 and the model represented the temperature increase well but did not accurately recreate the decrease in water temperature at the end of the event, however this is less relevant to this work as only temperature increases would result in higher effluent temperatures. In 2015, three minor downwelling events were reasonably well matched between observed and predicted at most locations."	A better statistical treatment of the upwelling and down-welling events should be applied. Especially if the model has difficulty predicting them. This is touched on in the first paragraph, but I think it would be a good exercise to expand the understanding of what the impact is on Bruce Power operations.	The upwelling events, where colder water at depth is brought to the surface, do not impact Bruce Power's ability to generate power, as the intake water would be cooler. In regards to downwelling events, it was determined that these events usually occur outside the flexibility window in early spring, and would not likely affect the Bruce A intake temperatures. Consequently, no further studies are required.	Satisfactory Explanation	R
25	**38**	"In general, downwelling events only affect the Bruce A intake during the spring (April to June) and only result in very small temperature increases at the intakes (typically no greater than5°C). Because of this limitation in timing and magnitude, and although downwelling events appear to occur relatively frequently, the highest resultant intake	These (downwelling) events could be more important than upwelling events, given that these events have the ability to cause the thermal plume to not diffuse properly and may increase the likelihood that the plume will interact with the plant intakes. This may be true, but the effects on local biota may be	Results from the model were evaluated for 3 years to better understand the occurrence of downwelling events. It is understood that this type of water movement brings warmer surface water to the bottom and thus it is important to understand their timing and duration. The cross connection between the plume and the intakes was addressed on page 36 and it was	Satisfactory Explanation	R

		temperatures during downwelling events rarely exceed 15°C. As a result, downwelling events are not expected to result in exceedances of maximum temperature criteria exceedances."	significant. This is especially given that upwelling events may induce 'cold shock' in animals acclimated to thermal plume temperatures. It is unclear what the effects a significant drop in temperature from 34.5°**C** would be on local biota.	found that the Bruce B intake was not affected by the plume and that the Bruce A intake was marginally affected (0.6°C 11% of the time under full operational conditions with maximum flow and temperature). There is no evidence that the downwelling events prevent the thermal plume from diffusing as normal. Cold shock is not evident during the summer months (i.e. the ECA window). This is seen as a natural phenomenon in late winter/early spring and is not caused by changes in discharge temperatures. The plant operates consistently and the lake conditions are generally well mixed during this time. Cold shock occurs when surface temperatures swing as the result of air temperature changes from below to above freezing. There is no evidence of significant drops in temperature from the measured data.		
26	**39**	I. Determine whether hourly changes in plume behaviour are suitably represented at higher time scales such as daily	This may be important for SON interests in Lake Whitefish spawning habitat.	Temperature is measured at Loscombe Bank as it is the shallowest habitat in a close geographic range to the Bruce A	Satisfactory Explanation	R

		averages, with a focus on days when the daily average effluent temperature is greater than 30°C. The effect of temporal resolution of results on the representation of plume behaviour was examined by comparing hourly versus daily-averaged results on Loscombe Bank (Location 31-1 which is 1 m off the bottom) on days when the daily average effluent temperature exceeded 30°C. In 2014, these conditions occurred between September 3 and September 7. Table I-1 provides a summary of the daily average temperatures and daily variation of hourly values for the period where the daily average effluent temperature exceeds 30°C. The measured and predicted hourly temperatures on Loscombe Bank are within 0.5 to 1.5°C of the daily. This suggests that the daily variation predicted by the model is consistent with the observed variation."		discharge. This data is for the summer period and ECA window of interest.		

27	**40**	Table I-1: Summary of hourly variation for periods where the daily average effluent temperature was greater than 30oC in 2015	I am not sure this demonstrates the daily average is the best representation of this data.	Table I-1 summarizes the hourly temperature measurements taken over a 24 hour period as a daily average for the Bruce A discharge channel and Loscombe Bank. The small ranges observed each day suggest that there was little change in temperature over the course of 24 hours. There was no indication of a dramatic change in temperature at this time. The thermal plume model uses the measured temperature data to predict average daily temperatures, which are also presented in Table I-1. The predicted daily temperatures are consistent with the actual values observed in Loscombe Bay. The fact that there are small temperature ranges each day and that the model replicates measured lake temperatures, indicates that hourly changes in plume behavior are adequately represented in daily averages, particularly during days with daily average effluent	Satisfactory Explanation	R

				temperatures greater than 30°C as shown.		
28	**40**	"Over the past three years, the monitoring for the temporary ECA amendment has shown no adverse effect on the natural environment."	I strongly disagree with this statement. This statement is especially concerning given that there is not a clear connection between the thermal plume modeling and the effects of these temperatures to the collected biological surveillance dataa. It still isn't clear, from this summary, what effects we might expect and how your measurements contribute to evaluating effect.	Bruce Power has been monitoring its impact on the nearby environment since the construction of the plant in the 1970's. The last three years have not shown any major differences to the previous decades. Over the years, a lot of work has gone into measuring and analyzing temperature data, sampling and studying fish populations and constructing a model to better understand the thermal plume. These activities will continue to be done while the nuclear facility is in operation. The thermal plume model has provided a prediction of the size and extent of the plume and the water temperatures inside the plume under various conditions. This provides information on what temperatures are present in local habitat areas and also the degree of mixing and dissipation of the temperature. There has not been any evidence from the model, or with continuous temperature monitoring, that	Other than intake water, water level and ice cover data, there is no site-specific information in the Thermal ECA application related to other types of monitoring data (e.g., aquatic biota) or comparisons to environmental conditions from 1970-present. If there are comparable data that would draw some correlation between the thermal effluent/thermal regime in the vicinity of BP and impact (or lack of impact) to aquatic biota, this should be provided for review. **Bruce Power Response:** This information has been assessed pre and post operations for Bruce A and Bruce B in the 1970's and 1980's and again for ecological and environmental assessments and the conclusions have demonstrated that there are no long term impacts. This is a large body of work over a long time frame and thus a comprehensive review is not easily available at this time. As discussed in the literature, changes in fish communities in Lake Huron are driven by long term ecological change – see Riley [ED] (2013). The State of Lake Huron Report discusses multiple fish species and communities and highlights the profound ecological changes over the last 100 years driven by invasive species, low nutrient levels, mussels, the decline of *Diporeia* – all of which have	**NR**

				there are any warmer areas within or near the plume that local biota would encounter. The species that spends time in the thermal plume area at its most delicate life stage is the Smallmouth Bass, and nesting studies of this species has shown minimal change over the last three years. The creel studies in the area have also shown minimal change over the last 3 years. These results suggest that normal operations have minimal effect on the natural environment.	resulted in declines to fish biomass. Mussel density continues to increase, alewife abundance remains low, cladophora has proliferated, phragmites is highly present on shorelines and the offshore demersal fish community remains in a state of flux. All of these ecological changes affect the fish community such that it is difficult to compare data from the 1970s to present. Riley, S.C. [ED.]. 2013. The state of Lake Huron in 2010. Great Lakes Fish. Comm. Spec. Pub. 13-01.	
29	**40**	"The Operational Flexibility permitted in 2013 to 2015 was not exercised as intake water temperatures were cooler than those seen in 2010 due to natural lake conditions. However, it is predicted that Operational Flexibility will be required in the future and therefore Bruce Power is seeking a permanent amendment for long term thermal effluent Operational Flexibility to establish proactive measures for continued protection of the	Again, a better statistical treatment of the operations temperature data, downwelling events, and Tmax data should be undertaken to understand the basis for the theoretical case for the amendment permanence.	The theoretical case is based on the number of days in a given year that have intake temperatures ≥21.1°C and are at risk of exceeding the maximum effluent temperature limit of 32.2°C. High temperatures observed are provided in Table 3-2 and summarize eleven years of continuous temperature monitoring at the intakes. Tracking these high risk days is a simple method for demonstrating the challenges that Bruce Power is facing in regards to thermal restrictions to	Satisfactory Explanation.	R

		natural environment. As noted previously, the US EPA employs this type of variance to their operational limits. As stated in the introduction, this summary report forms the basis of the application to start the MOECC approval process."		operation. In regards to downwelling events, it has been shown that abrupt temperature changes due to downwelling events do not significantly impact the period within the ECA window and do not require further examination.		
30	**40**	"This is highly preferred to requesting emergency relief on a reactive basis as it allows long term understanding and trending which is required to fully capture the nature of a dynamic system such as the immediate waters of Lake Huron."	I agree, but also stress the importance of using the collected data appropriate to make a reasonable case to base a permanent ECA amendment on.	Bruce Power is looking for a long term solution that addresses the trend of increasing lake temperatures. The intake temperature data measured over the last eleven years shows an increased risk of exceeding effluent temperature limits during the ECA window timeframe. The temperature and current data collected near the site has been used in the thermal plume model and has provided a good understanding of the geographic extent of the plume and the temperatures present within it. The Smallmouth Bass nesting studies and Creel Surveys in the areas potentially impacted by the plume (discharge channels, Baie du Dore) have not changed in the last three years.	This may signal a larger discussion about the thermal inputs into the lake and whether the discussion should revisit the potential of alterative cooling methodologies or technologies, rather than simply raising the Tmax in response. It is also important to recall that Bruce B is also subject to these raising temperatures, despite the fact that it is not limited in its Tmax. It will be important to raise this with the MOECC. BP should share its Bruce B data with SON. Are there comparable temperature logging/monitoring at Bruce B? **Bruce Power Response:** Once Bruce A obtains an appropriate temporary or long term amendment, the same can be applied to Bruce B. The Bruce B intake, effluent and delta T temperatures from 2005 to 2016 have been provided to SON (17NOV2017).	**NR**

				A permanent amendment to the operational flexibility conditions during the ECA window would allow Bruce Power to adequately monitor and plan into the future.	The lake temperature monitoring program has deployed loggers (25-38) annually, since 2011 and earlier, in the nearshore region outside of the Bruce A and Bruce B generating stations. The logger locations and measured temperatures have been communicated in a variety of places, including the EMP and ERA.	
31	**40**	"Although it is recognized that it may take time to progress through this process, Bruce Power requests an approval prior to the 2016 time window (starting June 15th 2016) be considered. This request is for the same number of days and temperature limits as the 2013 – 2015 ECA temporary amendment for Operational flexibility (see Table 7-1, repeat of Table 1-1)."	I would agree than an appropriate measure is required for the 2016 ECA window.	A temporary extension has been granted for two years (2016 & 2017 ECA time windows).	Satisfactory explanation	R
32	**41**	"Bass and creel surveys may be discontinued in future years as these longer term monitoring programs (7 consecutive years currently) have demonstrated	I disagree with discontinuing biological monitoring. A more appropriate biological monitoring program is required. This would require using better	The statement does not state that there will be no biological monitoring, rather that it may change from the current monitoring of bass and creel	The statement: "It has been demonstrated that there has been no change in the bass nesting studies and the creel surveys over the last number of years, which suggests that there may be no need to continue them. If and when a change occurs a	**NR**

		that there is no effect of thermal effluent and short term (up to 30 days) gradual increases in temperature are not predicted to warrant more extensive local studies."	biological data collection methodologies and statistical treatments of the data.	surveys. There is a need for an ongoing biological monitoring program that is commensurate with the potential risk and captures potential impact on aquatic biota. It has been demonstrated that there has been no change in the bass nesting studies and creel surveys over the last number of years, which suggests that there may be no need to continue them. If and when a change occurs, a reassessment will be undertaken at that time including appropriate monitoring.	reassessment will be undertaken…including appropriate monitoring". How will any change be captured if the monitoring program is discontinued? It is important to continue to build a consistent and long-term data series of replicated data in order to make meaningful correlations. While it may not be the only measure that should be used to assess temperature, the bass nest monitoring program should be extended to BDD and be continued indefinitely. **Bruce Power Response:** Bass nest monitoring has been done in BDD and the Bruce A and Bruce B discharge channels for a number of years and the results have been reported annually in the EMP report. As per our Environment monitoring program design, field monitoring is re-evaluated on a routine basis and modified as needed. As stated, ongoing monitoring commensurate with risk will continue. At this time, there are no plans to discontinue bass nest monitoring.	

33	**N/A**	N/A	What effect will the aggregate 30 days (with 15 consecutive days max) have on the environment? What would happen if the increase was 15 days, a 1 day break, and then 15 days again? How are they determining the impact on the ecosystem? What evidence supports these values? Looking at the data in Table 3-1, they clearly haven't used the average or the median to come up with these values. Further, the actual number of days that fell into the range of 32.2°**C** to 34.5°**C** maxed out at 6 days aggregate, and 5 days consecutive. I don't see any justification for the 15 and 30 day values.	The number of aggregate and consecutive days comes from predicting the number of days of potentially high effluent temperatures based on temperatures measured at the intake channel during the ECA window. In a single year there is potential to exceed 32.2°C for 33 days, for 19 consecutive days (2012). The 30 aggregate and 15 consecutive days chosen are a conservative estimate that would allow Bruce A to operate at full power (4 units) during a warm summer year. In general, the model results demonstrate that the plume becomes well mixed in the open water body of the lake, with temperatures dissipating quickly away from the channel.	Would these number change based on the seven (7) years of data collected? **Bruce Power Response:** In 2017, there were 19 days with the potential to go above 32.2°C, with 15 days of those being consecutive. Of the last seven years (2011 - 2017), the number of days with the potential to exceed the Tmax has ranged from 5 to 33, and the number of consecutive days from 4 to 19. The number of aggregate (30) and consecutive (15) days requested in the long term amendment of the ECA would remain the same.	**NR**

34	**N/A**	N/A	Is the model for the ice coverage statistically significant? Looks like the slope coefficient's confidence interval covers zero. That is, I'm not sure if the 7% loss in coverage between 1972/73 and 2014/15 is significant or not.	The figure to show annual ice coverage (Figure 2.2.1) is taken from Environment Canada, including the regression lines showing the average, median and trend. It is not meant to be a statistical analysis.	Satisfactory Explanation.	R
35	**N/A**	N/A	How did lake temperatures compare between 1998 and 2003 to now? Ice coverage had dropped significantly in this period. If the temps were the same, how did they respond to the deltas then?	Between 1998 and 2003 the annual ice coverage had dropped, but the lake temperatures were generally lower than they are now and did not cause concern at the intakes. It wasn't until 2005 and beyond that the lake temperatures became a more frequent challenge to maintain discharge temperatures within the ECA limit. In regards to specific lake temperatures at this time, the average water temperature for July, August, September (JAS) of the years between 1998 and 2003, taken from Environment Canada's Buoy 45008 in the middle of Lake Huron, is 16.9°C. The average lake temperature for JAS of 2015 is 15.5°C. The average delta T	Satisfactory Explanation	R

				value for JAS of 2015 is 8.24°C (annual 9.14°C). The delta T values have remained within the 11.1°C limit since plant construction in the late 1970's. Figure 3.2 shows the seasonal variability of the delta T over the last eleven years and demonstrates that the values remain consistent regardless of changes to water level and ice coverage.		
36	**N/A**	N/A	While there is obvious trends in the data that were analyzed, the use of linear regression seems a bit odd (in several cases) - given that the data are correlated. That is, one could expect the average water level in 2014 to be highly correlated to the water level in 2015. I don't necessarily think that we'll see much of a difference in the result (linear regression is rather robust), but better methods could and should be used (specifically - time series analysis, or a mixed method that allows for the correlations to be captured). The use of improved methods would likely improve the standard error	The trendline in the water levels shown in Figure 2.3.3 was used to show overall long term trends in general, for discussion purposes only. A statistical analysis is not necessary. Within the current model water levels are taken into account via three years of measured data during record low and average water levels. A dynamic water level will be used in a future model for simulations in 2017.	Satisfactory Explanation	R

			estimates, resulting in hopefully stronger conclusions.			
37	**N/A**	N/A	What evidence supports the 32.2**°C** or 34.5°C value? How did they come up with these values?	The current effluent temperature limit of 32.2°C was set in the late 1970's when Bruce Power was constructed. It is assumed that the value was derived from lake trend data at that time and condenser design capability. In the late 1970's, the maximum lake temperature was 70°F (21.1°C). Added to this is the maximum designed condenser capability of 20°F (11.1°C), reaching a maximum output temperature of 32.2°C. The requested effluent temperature limit of 34.5°C was obtained from the projected maximum effluent temperatures observed in past years (2008 to 2012). The projected effluent temperatures	Satisfactory Explanation	R

				based on intake temperatures plus deltaT of 11.1°C, range from 33.2°C (2008) to 34.5°C (2010). With the trend towards increasing lake temperatures, Bruce Power, in discussions with the MOECC, have chosen 34.5°C as the limit, in order to continue operations into the future. See answer to 19,20 above.		
38	**N/A**	N/A	Is there a model that combines info relating ice cover, water level, water temps, etc. to daily average intake temp and daily average effluent temp?	The current model includes water level, water temperatures, and intake and effluent temperatures. Ice cover cannot be modeled as it is too dynamic and this time frame is not relevant to the flexibility time window. The effect of high annual ice cover would be cooler lake conditions in the spring. This would be incorporated into the model time frame used here of June 15 to Sept 30 which uses water temperatures from the lake.	Satisfactory Explanation	R
39	**N/A**	N/A	They indicate that in 2005 they exceeded the 32.2°**C** value, and include a statement "visual observations of discharge channel" - what does this mean?	A requirement of Section 61 directive provided at that time was to perform surveillance monitoring. Observations of the discharge channels were made from shore and in boats to	Satisfactory Explanation	R

				identify any adverse impacts due to short term increases in effluent temperatures.		
40	**N/A**	N/A	What is the probability that they will actually see temperatures exceed 32.2°**C**. And in duration that warrants the 30 day and 15 day limits?	It has been demonstrated in Table 3-1 and Table 3-2 that there is potential for exceeding effluent temperatures of 32.2°C for the number of aggregate and consecutive days requested. Over the course of eleven years, measures have been necessary to mitigate these temperature exceedances, and a longer term plan that considers the trend of increasing lake temperatures is required.	Satisfactory Explanation	R
41	**N/A**	N/A	Model - I am glad to see that it has been updated and improved. Can this be used to simulate future years? That is, could this be used to estimate the probability of future events where the discharge temperature exceeds 32.2°**C**? I'm imagining that the ambient lake temperature can be updated based on existing climate predictions. This might give us a better sense of the challenge that BP is facing with discharge temperatures - and how the thermal plume might change	Yes, it is possible to use the model to run predictive scenarios for future years. Climate prediction scenarios have been discussed but not implemented as the first step of devising a robust model is now just being finalized.	Incorporating climate prediction scenarios into the modelling is very important in the consideration of future thermal impacts, and in what ways Tmax may need to change (increase) in the next 20 years. Climate prediction scenarios must be part of the modelling, and the results must be shared with SON as part of thermal discussions with SON. **Bruce Power Response:** Climate change prediction scenarios are in early stages of development globally. Bruce Power is engaged in understanding the outputs from climate predictions and considering how they may affect future operations and the local environment. This information will be shared with SON as part of our ongoing thermal discussions as the work	**NR**

			with increasing ambient temperatures. It could also be used to see what happens in the case of 15 consecutive days to surrounding water temps - because this may have an influence on the ecosystem. In short - the model seems quite robust, and I think it could be used to fully investigate various scenarios that can support management decisions (both for BP and the SON).		evolves. Collingsworth et al (2017) looks at climate change as a long-term stressor for fish in the Great Lakes. Fish could experience prolonged periods of optimal growth but may also be subject to eutrophication and invasive species (with a focus on Lake Ontario and Erie). In light of climate change considerations, Bruce Power is agreeable to a long term (10 year) temporary ECA with a 5 year review such that climate change information can be incorporated to revisit the requested flexibility parameters. Collingsworth, P.D. et al (2017). Climate change as a long-term stressor for the fisheries of the Laurentian Great Lakes of North America. Rev Fish Biol Fisheries 27:363-391.	
42	**N/A**	N/A	Over the past three years, the monitoring for the temporary ECA amendment has shown no adverse effect on the natural environment" - This is an odd statement. There is no way to test that there is no adverse effect because they didn't implement the amendment.	During 2013-2015 the temporary amendment was in place however the daily average temperatures did not require the flexibility. It is true that the monitoring over the past three years has shown no adverse effect on the natural environment during current operations. It is also true that there is a need to increase the regulatory limit in order to continue normal operations during the ECA window as a result of increasing lake temperatures.	Satisfactory Explanation	R
43	**N/A**	N/A	"It is predicted that operational	Looking at trends in the natural	Satisfactory Explanation	R

			flexibility will be required in the future" - how is this predicted? Predicted using some sort of scientific method? I didn't see that in the report. That is, they've summarized a lot of data, but I didn't see how those data were used to predict a future that REQUIRES operational flexibility.	variations of lake conditions, lake temperatures are increasing and are predicted to continue in the future. This will result in an increase of intake temperatures and correspondingly, increases in effluent temperatures. Tracking the number of days with high intake temperatures for each year has illustrated a trend towards higher risk and highlighted a need for a modification of the effluent temperature limit. In order to continue to operate in a safe and responsible manner, with proper pre-planning and environmental monitoring, the temperature limits and time periods described by Operational Flexibility is necessary.		

Appendix B – Dr. Michael Nichols, Chesapeake Nuclear Services – ERA Review

Review of Ecological Impacts for the Bruce Power Major Component Replacement

Prepared for Saugeen Ojibway Nation

Prepared by: Michael Nichols, PhD, CHP

4/11/2018

Contents

ACRONYMS

BP	Bruce Power
EcoRA	Ecological Risk Assessment
EMP	Environmental Monitoring Program Report
ERA	Environmental Quantitative Risk Assessment
FMP	Follow Up Monitoring Program Report
HHRA	Human Health Risk Assessment
SON	Saugeen – Ojibway Nation
PQRA	Preliminary Quantitative Risk Assessment

INTRODUCTION

The interaction between Bruce Nuclear Generation Station and the environment has been of concern and issue to Saugeen – Ojibway Nation (SON) for many years. The context of these concerns is based on the Aboriginal and Treaty rights held by the SON and the stewardship responsibilities of the SON as caretakers of the lands and waters of their Territory.

A review of information provided by Bruce Power for the Repowering Project Environmental Risk Assessment for Continuing Operations and Major Component Replacement [11] has been performed for the Saugeen – Ojibway Nation. This review is an independent evaluation of the information provided in the Environmental Quantitative Risk Assessment (ERA) [11] and supporting reports. The review focused on key environmental issues and concerns, developing questions and hypotheses for protecting the environment and First Nation interests as part of Canada's Environmental Assessment decision-making.

The review of BP Environmental Impacts of proposed Major Component Replacement described in the Bruce Power Environmental Quantitative Risk Assessment (June 2017) and referenced documents includes the following topics:

1. Physical Stressors – Section 5 Ecological Risk Assessment for Chemicals and Physical Stressors
    a. Section 5.4.3: Thermal Effects.
2. Section 7, Radiological Ecological Risk Assessment.
    a. Appendix F. Release Rates from the Bruce Power Site (applicable to Appendix J)
    b. Appendix H. Exposure Point Concentrations for the HHRA (applicable to Appendix J).
    c. Appendix J. Radiation Dose to Non-Human Biota
3. Appendix K. Possible Future Drinking Water Standards for Tritium.
4. Appendix L. Response to CNSC comments on January 2015 PQRA [11]

The review is provided in four sections corresponding to the outline above. Observations and recommendations are provided at the end of each section.

The technical review of the Environmental Risk Assessment for adequacy addresses the following topics:

1. The technical description of input data and models for the impact of physical stressors and estimating radiation dose to biota.
2. The assumptions and calculations used to predict effects.
3. Consistency between the ERA and CSA 288.6-12 Environmental Risk Assessments [19].

The evaluation of physical stressors includes reviewing the objectives, methods, and results as presented in the ERA and supporting documents as well as consistency with CSA N288.6-12, Environmental Risk Assessments [19].

The evaluation of the exposure pathways includes examination of the applicability and reasonableness of methods, assumptions, and calculations as presented in the ERA with the guidance found in CSA 288.4-10, Environmental Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills [17]; CSA N288.5-11, Effluent Monitoring Programs [18]; and CSA N288.6-12, Environmental Risk Assessments [19].

1. PHYSICAL STRESSORS

1.1. BACKGROUND

The interaction between Bruce Nuclear Generation Station and the environment has been of concern and issue to SON for many years. Thermal effects is a major area of concern related to what is referred to in the ERA as “Physical Stressors”. The context of these concerns is based on the Aboriginal and Treaty rights held by the SON and the stewardship responsibilities of the SON as caretakers of the lands and waters of their Territory.

The review of the physical stressors includes evaluation of temperature effects from once through cooling discharges. The review is based on information provided by Bruce Power in the Environmental Quantitative Risk Assessment [11] and supporting documents.

The Environmental Quantitative Risk Assessment was prepared as part of the approval process for the planned Major Component Replacement project for Bruce A and Bruce B Nuclear Power Plant facilities described elsewhere. The facilities are Class I Nuclear Facilities operated under license from the CNSC.

1.2. DESCRIPTION OF FACILITIES

Bruce Power describes the power generation facilities in ERA Section 2.1, Engineered Site Facilities. The site consists of two sets of four reactors each, Bruce A Generating Station and the Bruce B Generating Station with total gross electrical production of 7,276 MWe.

The cooling system is described in Section 2.1 as “*Each of the generating stations contains intake and outflow channels to collect cooling water for circulation through the generating stations followed by discharge into Lake Huron. Most of the water that is withdrawn passes once through the Condenser Cooling Water (CCW) system, and the remainder is used for service water to maintain pressure and provide water for small components. Water is drawn from Lake Huron through a deep-water intake equipped with a velocity cap to minimize currents and fish impingement. Water passes to the forebay via a tunnel that runs underneath the lake bed. Intake water passes through bar screens and travelling screens to remove large and small debris, respectively. Water passes through the condenser and is discharged to Lake Huron via the CCW duct and discharge channel. This process is the same for Bruce A and Bruce B which have separate intake structures. At Bruce A, the reinforced CCW duct extends from Unit 4 in the east to the outfall structure, which is the start of the discharge channel that reports into Lake Huron. Similarly, at Bruce B, the reinforced CCW discharge duct extends from Unit 8 in the northeast to the outfall structure, at the start of the discharge channel into Lake Huron. Both discharge channels are bounded by concrete and rock groynes*.” (see Figure 1).

The nominal pumping rate for the CCW is 88 m^3/s for two units and 175 m^3/s for four units in operation [5]. Water is withdrawn from deep water intakes designed with a velocity cap and located 500 meters west of the intake forebay and 12 m underwater. This is also described as being connected 800m offshore through an intake tunnel (page 8-3, reference 1).

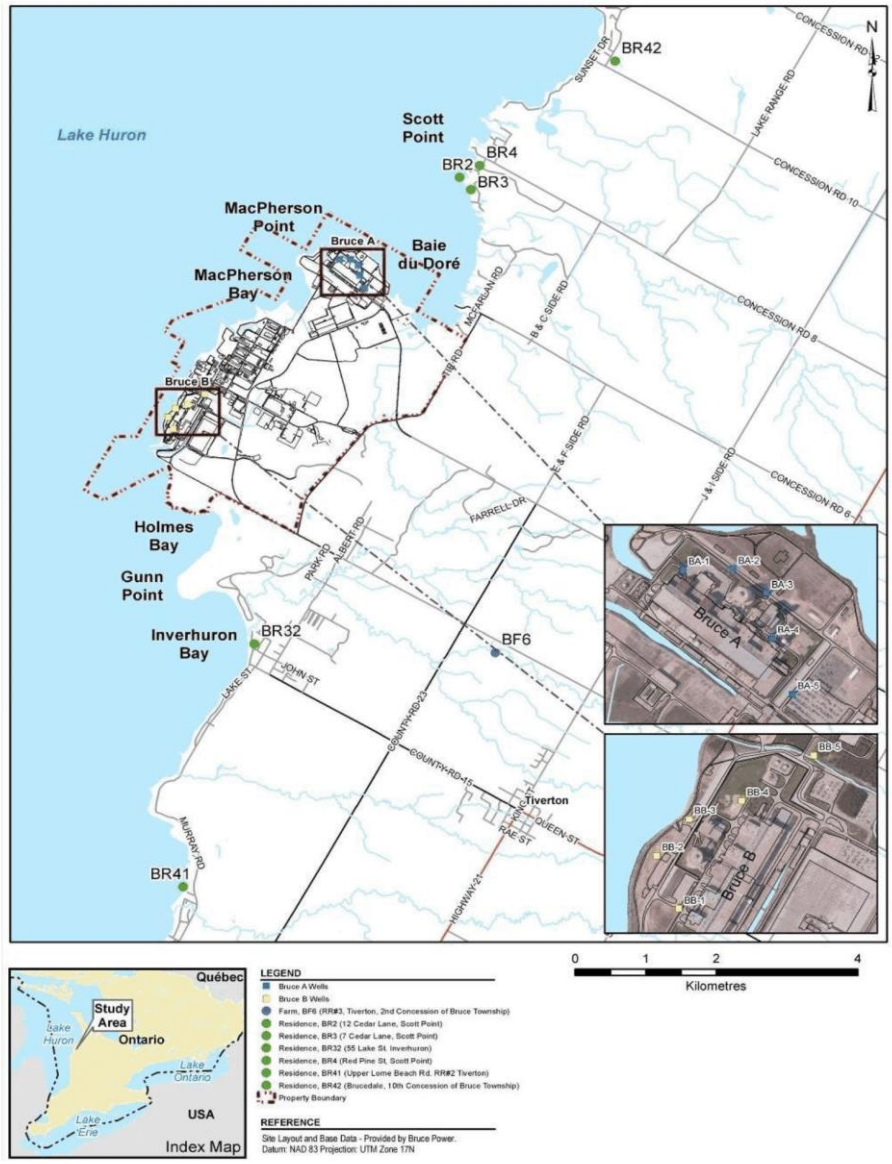


Figure 15
Locations of shallow and multi-level wells

Figure 1. Bruce A and B. From Bruce A Refurbishment for Life Extension and Continued Operations Environmental Assessment Annual Follow-up Monitoring Report.

1.3. THERMAL EFFECTS

The thermal effects addressed by BP include:

- evaluation of temperature increases in the winter that may affect winter spawning fish;
- extent of the thermal impact from once through cooling; and
- operational impacts of thermal limits during the summer.

Thermal effects have been monitored throughout the life of the facility. A review was performed covering information found in three reports: 1) the Bruce Power Environmental Quantitative Risk Assessment [11], which for further details refers to the 2) BP 2016 Environmental Monitoring Report [10] and 3) BP Bruce A Refurbishment for Life Extension and Continued Operations Environmental Annual Follow-Up Monitoring Program Report [5]. The following summary is provided in the order of the publication of these reports.

1.3.1. BRUCE A FOLLOW-UP MONITORING PROGRAM STUDIES

The “Bruce A Refurbishment for Life Extension and Continued Operations Environmental Assessment Annual Follow-up Monitoring Program Report” [6] summarizes the results for the first calendar year of operations following refurbishment of Bruce A units 1 and 2.

The EA Study Report for Refurbishment of Bruce A units identified increases in winter water temperatures at Loscombe Bank a potential impact. Two elements of the 2008 work plan are of interest regarding thermal effects, Element 3.8 “Increase in water temperature at Loscombe Bank” and Element 3.9 “Change in water temperature at substrate”. The objective of Element 3.8 is verifying the hypothesis that no adverse effect of on Lake Whitefish hatching and development would result from thermal discharges during the winter. The objective of Element 3.9 is to verify the EA Study Report prediction of negligible temperature increase (at the substrate for key locations at which whitefish spawning and development might occur).

1.3.1.1. ELEMENT 3.8 THERMAL PLUME

Element 3.8 included two phases. Phase I consisted of review of the importance of local habitat to Lake Whitefish spawning success; and Phase II compared predicted (believed to be

measured) temperatures to a threshold using the MWAT[1] criteria. The report indicates that a proposed Phase III on "monitoring hatching success and larval development" was removed following discussion with CNSC and EC in December 2011 (page 107 [6] with the reason being substrate temperatures were to be compared to updated threshold values as part of Work Plan Element 3.9. Bruce Power indicated in discussion of Work Plan Element 3.1 that potential Lake Whitefish spawning habitat comprised roughly 72% of the area potential affected by the Bruce A thermal plume with depths between 2m and 6m [6].

BP evaluated measured substrate temperatures for five scenarios over the measurement periods December 1, 2012 through April 30, 2013 and November 15, 2012 through April 30, 2013. The scenarios (parameters) included hourly mean temperature; daily mean temperature; weekly 7-day average temperature; chronic temperature increases over the median ambient temperature; and semi-chronic temperature increase assessed as the difference between the median site temperature and the median ambient temperature. Temperature thresholds were specified in the Follow-Up Monitoring Report Table 45 [6] for each scenario, which have been summarized below in Table 1. Additionally, Table 1 shows the alternative temperature thresholds that were adopted following a EA Stakeholder workshop, considered to be more protective for round whitefish and used for evaluation of temperature data.

Table 1. Temperature Benchmark Values for Bruce A Refurbishment Thermal Monitoring

Scenario	Temperature Threshold	Alternative Temperature Threshold
Hourly mean	≥ 10 °C	≥ 9 °C
Daily mean	≥ 8 °C	≥ 7 °C
Weekly (7 day rolling) mean	≥ 7 °C	≥ 6 °C
Chronic temperature increase (all of development)	≥ ambient + 4°C	≥ ambient + 3°
Semi-chronic temperature increase (25% of development).	≥ ambient + 6°C	≥ ambient + 5°

[1] MWAT – maximum weekly average temperature

Scores were assigned in each time period under a given scenario and where the threshold value was exceeded and results summarized in the Follow-Up Monitoring Report Table 46 [6].

BP indicates the median temperature from sites 1 (20m), 4 (15m), 7(15m), 15 (15m), 20 (5m), 28 (10m), and 29 (20m) are considered ambient temperatures (see Figure 2. Bruce Power Thermal Monitoring Sites.). (Note: Value in parenthesis represent depth of measurement.) Depths are from Follow-Up Monitoring Report Figure 31 [6]. Sites were chosen to represent "ambient" temperature based on minimum variation from the median temperature for the winter intervals (page 125).

Figure 2. Bruce Power Thermal Monitoring Sites.

While this element of the Bruce A Refurbishment Follow-Up monitoring report refers to Thermal Plume, no description is provided regarding the extent of thermal plumes under winter conditions. Environment Canada, in "Guidance Document: Environmental Effects Assessment of

Freshwater Thermal Discharge" [21], provides the following description of thermal modeling for the Bruce site (page 39) under Cold Weather Conditions (CWC):

> *CWC occur when ambient lake water temperature is less than 4°C, i.e., during the winter. Under CWC, the thermal plume would be buoyant in the vicinity of the outlet channel. When the buoyant plume temperature decreases to 4°C, the plume could sink during calm winter days and under ice cover conditions. Under CWC, plumes associated with Bruce A also appeared to be predominantly alongshore to the northeast. The sinking plumes to the northeast extended along the lake bottom more than 10 km from the discharge channel and up to 3 km offshore. An offshore plume might extend along the lake bottom up to 8 km offshore from the discharge channel. Sinking plumes can extend more than five times farther offshore from the station as compared to the surface plumes.*

It is noted that the farthest north ambient monitoring station 1 is approximately 13 km from the Bruce A site and approximately 3.5 km offshore. Ambient monitoring stations 4 and 7 are approximately 6.7 km and 3.4 km from the Bruce A site, respectively.

Nearshore flows are described in the 2005 Bruce A Refurbishment for Life Extension and Continued Operations Project EA Study Report [1] and presented graphically in Figure 2. The near-shore currents are predominately bi-directional and parallel to shore. The average lake current speed is 9 cm/s to 11 cm/s, depending on the location of measurement. Current direction and speed are seasonal, with stable and slow speeds in the spring, variable speeds occurring with summer stratification, higher current speeds in the fall, and then significantly lower speeds during the winter.

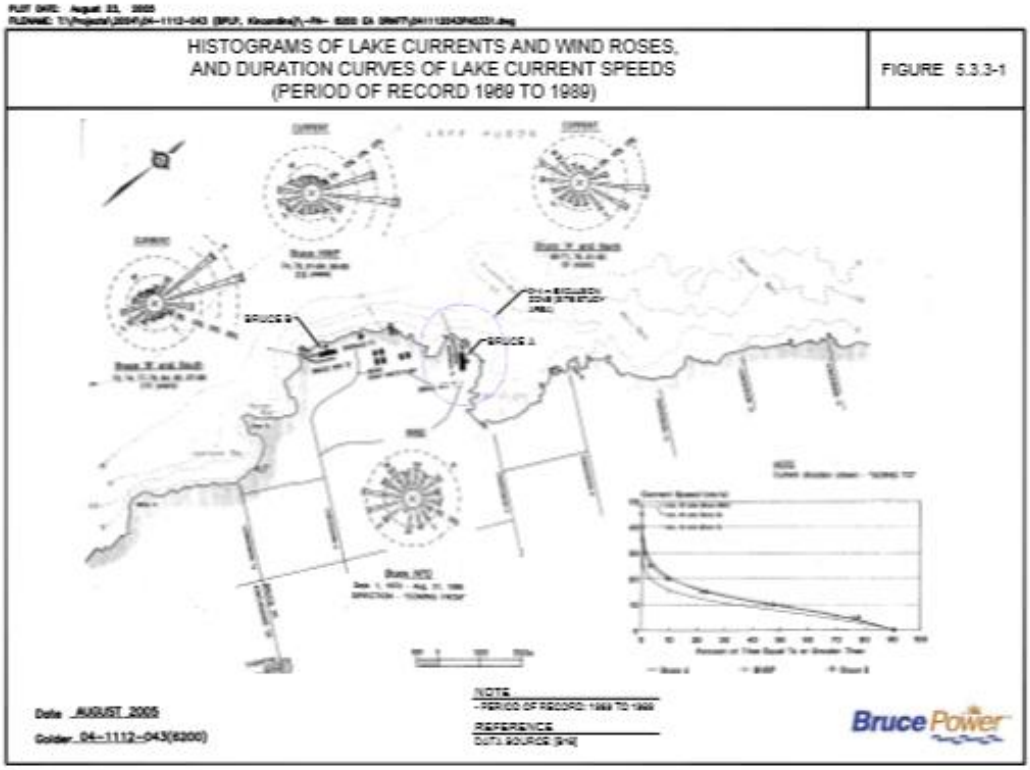


Figure 3. Lake Currents Bruce Power site.

1.3.2. 2016 ENVIRONMENTAL MONITORING REPORT

The BP 2016 Environmental Monitoring Report discusses temperature monitoring, including a summary of results from 2012 to 2015. According to the report, Lake Whitefish spawning is understood to occur from late November to late April.

1.3.2.1. SUBSTRATE TEMPERATURE EVALUATION

Three periods of winter monitoring are summarized including 2012/2013, 2014/2015, and 2015/2016.

Bruce Power indicates: "… modeling of the plume with only bottom temperatures is not possible." (Page 177). This position somewhat conflicts with the findings of Environment Canada, which summarizes modeling efforts from 2005 indicating some understanding of thermal plumes under cold weather conditions [21].

BP provided a Site-Wise comparison of mean and median substrate temperatures for the period December 1 through April 30 in Table 65 (page 179), including the temperature difference (ΔT) from the ambient reference temperature. Derivation of ambient temperature is

described in the 2013 EA FUP, discussed in this report in section 2.1.1 [3]. No indication of the range temperatures is provided for each site. Sites presented in Table 65 include 1, 7, 8, 15, 17, 18, 19, 21, 24, 28, 29, 32, and 33 (see Figure 2. Bruce Power Thermal Monitoring Sites.). BP indicates Site 1 shows the least variation from the yearly ambient temperature and is considered the average temperature of the lake for the winter season. Sites 17, 18, 33 are in Baie du Doré and are shallow. These sites show the greatest ΔT compared to the yearly ambient temperatures. The remaining nine sites show ΔT differences for the mean of less than 1 degree C.

BP summarizes the results of temperature studies on Whitefish (Section 5.5.6.2, pages 180-181) as the basis for threshold temperatures found in 2016 EMP report Table 66, including the alternate thresholds 1°C lower for each thermal category, added to be protective of round whitefish (Table 1). These threshold temperatures are carried forward from the 2013 FUP [5]. Note that the categories (or scenarios) are evaluated as the percentage of time periods (hours, days, weeks) in the development period exceeding the specified threshold. It is assumed that development days are the number of days included in the estimated spawning season from late November to late April, but this is not specified.

1.3.2.2. AMBIENT AND MEASURED TEMPERATURES

Bruce Power indicates in the 2016 EMP section 6.4.6 “Monitoring” [10] that lake temperatures were measured from surface to bottom with a rope and anchor system and suspended data loggers every 5 meter. The number of sites has varied from 38 (2015) to 25 (2016) with five sites with only bottom monitors in 2016 (assumed to be 1 m of the bottom). Two current meters were deployed, one off Gunn Point, and a second off Douglas Point. No information is provided regarding the current meter deployment or results during periods of temperature monitoring.

Ambient temperatures are determined as the median temperature of selected sites with minimum variation. For the period December 1 to April 30, the hourly means did not exceed the 9°C threshold. As the winter season temperatures varied from 2012 through 2015, ambient temperatures did exceed the daily mean threshold of 7 °C for 9% of the time during 2012/2013 and 8% of the time in 2015/2016.

BP evaluated near bottom water temperatures for three winter seasons, 2012/2013, 2014/2015, and 2015/2016. The results show variations across years, with the 2014/2015 period having the lowest temperatures and few or no sites exceeding the criteria. It is noted that as the scenario time intervals increase (hourly, daily, and weekly), the threshold values decrease (9 °C, 8°C, and 7°C, respectively). For all three periods, the sites most frequently

exceeding the delta T criteria (defined as per cent of time during the expected spawning season the temperature exceeded the criteria) are located within Baie du Doré at sites 17, 18, and 19 (see Figure 2). The frequency of exceeding these thresholds is compared to temperature effects on white fish survival and hatching time evaluated in laboratory studies, particularly by Griffiths [22, 23].

BP also considered the frequency with which sites differed from the reference ambient temperature, evaluating a ΔT of +3°C temperature increase for the entire spawning season, and a ΔT of +5°C temperature increase for 25% of the development period. Baie du Doré sites 17, 18, 19 exceeded the ΔT of +5°C criteria for 42 to 45% of the development period. Site 8 exceeded this criterion 25% of the time period in 2012/2013, but not in 2014 or 2015/2016.

BP infers from the three seasons of temperature monitoring and comparison to laboratory-based studies that there is “no significant risk to survival” for Lake Whitefish eggs. No data are provided regarding the actual spawning times and locations for Lake and Round Whitefish.

1.3.2.3. ENVIRONMENTAL COMPLIANCE APPROVAL

Bruce Power discusses the thermal effects of Condenser Cooling Water discharges for Bruce A and Bruce B facilities in 2016 EMP Section 6.4.2 [10]. BP obtained a conditional Environmental Compliance Approval (ECA) for the Bruce A CCW discharge to allow effluent temperatures between June 15 and September 30 (2013 – 2015) to exceed 32.2°C limit up to 34.5°C for no more than 30 aggregate days and no more than 15 consecutive days for each event. The ECA delta temperature limit of 11.1°C for the period between April 15 and December 14 remained unchanged.

BP shows in 2016 EMP Figure 70 monthly intake temperatures for Bruce A for the periods 1977-1979, 2006-2010, and 2011-2015. The figure shows during the ECA period an increase in mean temperatures from 1977-1979 measurements, and an increase in the range of minimum and maximum monthly averages for the 2006-2010 and 2011-2015 periods compared to those measured in 1977. The figure also shows that the monthly mean temperatures are decreasing in the period October through December, reaching average temperatures of less than 7.5 °C in December for the later time periods. Mean monthly temperatures are typically less than 2.5 °C from January through March and begin increasing in April.

Results from monitoring by Environment and Climate Change Canada at buoy 45008 in Lake Huron for the average water temperatures for July, August, and September (annual mean of the three months) are provided in 2016 EMP Figure 75. The temperatures are increasing but show variation from year to year. BP indicates the temperatures have increased approximately 2.3 °C over 34 years based on the slope of the fitted line. Note, the rate of change per year in

the average water temperature is slightly greater when considering the linear regression equation. No discussion of the annual variation in temperatures is provided or estimates of the probability that rising intake temperatures will result in thermal discharges exceeding 32.2°C in future years.

1.3.2.4. THERMAL PLUME MODELING

Bruce Power began modeling thermal discharges prior to plant construction (section 6.4.7, [10]). The model has been periodically updated and results provided to MOECC.

Bruce Power provides in Table 75 a summary of Bruce A discharge temperatures along with measured temperatures at Site 31 (1 m from the bottom) and predicted temperatures. The temperatures are provided as Daily Averages ± Daily Range °C. It is assumed the daily range is the difference between the daily maximum and the daily minimum. The source of the daily range for predicted temperatures is not known. The data presented are for September 2014 and July, August, and September 2015 when daily discharge temperatures exceed 30 °C.

There are several points that remain to be clarified. The Measured Location, Site 31-1, is 1 meter of above the bottom at site 31, Loscombe Bank. There is no indication as to the depth of the monitoring point for the Bruce A Discharge, but one assumes it is thoroughly mixed at the point of measurement. BP indicates the tabulated results for measured and predicted hourly temperatures at Loscombe Bank "are typically within 1.5°C of the daily average" and goes on to indicate that two days in 2015 had predicted variations greater than 2 °C (July 30 and 31). If the data discussed are presented in Table 75, it should be noted 15 of 28 paired comparisons show differences greater than 2 °C between the Measured Location 31-1 values and the Predicted values provided. A Student's t-test of paired comparisons (Difference = Measured – Predicted) finds that the measured daily average is significantly different from the predicted daily average.

Table 2. Paired T-test for differences between measured and predicted temperatures.

Average Difference	2.28
S_{diff}	1.47
N	28
T_{diff}	8.19
Probability	8.5E-09

Where $T_{diff} = \frac{\bar{d}}{S_{diff}/\sqrt{n}}$. (page 312, reference [24]) and probability is the Type I error rate for a two-sided t-distribution with N-1 degrees of freedom.

The paired t-test suggests the predicted temperatures systematically underestimate the daily average temperature at Location 31-1.

1.3.2.5. THERMAL FLUME INVESTIGATION (PAGE 243).

Bruce Power indicates in 2016 EMP Section 9.2.1 Thermal Study (2016-2020) that a flume study is being initiated to examine the hypothesis that the cobble substrate may serve to insulate or buffer fluctuations in water temperatures. Initial results suggest that monitors placed in various depths of cobble respond more slowly to increased temperature spikes and reached lower peak temperatures. Studies with embryos were not completed due to complications from a fungal buildup during the study.

1.3.3. ENVIRONMENTAL QUANTITATIVE RISK ASSESSMENT

Bruce Power developed an Environmental Quantitative Risk Assessment [11] incorporating information from previous Environmental Risk Assessments and information found in annual Environmental Monitoring Reports. The ERA references guidance in CSA 288.6-12 "Environmental Risk Assessments at Class I Nuclear Facilities and Uranium Mines and Mills." [19]

Bruce Power identifies in ERA Table 21 (page 126) the following Valued Ecosystem Components grouped by environmental guild: Cold water fishes, including Chinook Salmon, Lake Trout, Rainbow Trout, Lake Whitefish, and Round Whitefish; Cool water fishes, including Emerald Shiner, Gizzard Shad, Smallmouth Bss, Walleye, White Sucker, and Yellow Perch; and Warm water fishes, including Brown Bullhead, Channel Catfish, Common Carp, Freshwater Drum, and White Bass.

1.3.3.1. ERA HAZARD QUOTIENTS

CSA N288.6-12 defines Hazard Quotient (HQ) as "a numerical representation of the potential for effects due to exposure to a non-carcinogenic (threshold acting) contaminant or stressor. To calculate an HQ, some estimated exposure value (EV) is divided by a Toxicity Reference Value (TRV) or (Benchmark Value) BV in the same units."

CSA N288.6-12 discusses in Clause 7.4.4 "Thermal benchmarks" temperature benchmarks for direct thermal effects on growth, survival, and reproduction of aquatic biota. The guidance offers:

- Maximum weekly average temperatures (MWATs) as a benchmark to assess thermal conditions for fish growth;
- Maximum temperature for embryos (MTE) as a benchmark to assess thermal conditions during the period of spawning and embryonic development;
- ΔT to assess advancement of hatching based on spawning temperatures and degree-days required for development
- UIL to assess the potential for thermal incapacitation for elevated water temperatures.

Bruce Power specifies in ERA section 5.4.1.3 (page 212) four HQs evaluating the potential for thermal effects in the form $HQ = EV/BV$. These are summarized here in Table 3. Thermal HQs for Bruce Power Environmental Quantitative Risk Assessment.

Critical Thermal Maximum (CTM) is used as the Benchmark Value when data are available, otherwise the Short-term Maximum (ST_{max}) is used for maximum thermal limits. The CTM is defined in the BP ERA as the point above which the organism loses its ability to escape from conditions that ultimately lead to mortality. The ST_{max} is defined as "..*the temperature above which lethal, critical or similar effects occur, regardless of acclimation time*."

The avoidance criteria, specified as Tupper, is specified by species and life stage, defined as the temperature at which avoidance or other effects become apparent. The Benchmark Value is expressed as the difference between T_{upper} and the preferred temperature T_{pref}.

Temperature fluctuations were evaluated against two criteria: daily temperature fluctuations within a site, Delta-T_{intra}; and the difference between daily average for a site and a north or south reference site (Sites 1 and 29, respectively), Delta-T_{inter}. Earlier reports described these reference sites as the source of "ambient" temperatures.

Criteria included tabulating the percent of time the HQs exceeded 1. An exceedance of the HQ greater than 25% of the difference between the logger site and the lowest reference site was flagged for assessment. The maximum HQ for each site was compared to the HQ value at each reference site for the same period. Further assessment was made when the maximum HQ was 50% greater at the logger site than at the reference site [page 224].

Table 3. Thermal HQs for Bruce Power Environmental Quantitative Risk Assessment.

Hazard Quotient (HQ)	Exposure Value (EV)	Benchmark Value (BV)	Notes
Maximum Thermal Limits	T_{max} = maximum hourly temperature (°C).	CTM = critical thermal maximum (°C). When not available, Short-Term Maximum is used.	Compared to HQs calculated at reference sites 1 and 29
Avoidance Thermal Limits	$T_{avg} - T_{pref}$ = difference between the daily average temperature and the preferred temperature (°C).	$T_{upper} - T_{pref}$ = difference between the upper avoidance temperature and the preferred temperature (°C).	Compared to HQs calculated at reference sites 1 and 29
Delta T (intra)	$T_{range}=T_{max} - T_{min}$ daily range in measured temperature (°C).	ΔTbenchmark = change in temperature benchmark (°C).	Applicable to non-motile life stages including eggs; varies by species
Delta T (inter)	$T_{avg(site)} - T_{avg(reference)}$ difference in the daily average temperature at a site from the daily average at the reference sites(°C).	ΔTbenchmark = change in temperature benchmark (°C).	Applicable to fish swimming in the vicinity of the site; varies by species.

Bruce Power provides in Table 37 Delta T criteria for Lake Whitefish and Round Whitefish egg/incubation (3.7°C), Smallmouth Bass egg/incubation and adult stages (5°C); walleye adult stage (4°C), and Yellow Perch Spawning (2°C), growth/YOY/Juvenile (6°C), and adult stage (10°C).

Results for thermal maximum and avoidance HQs are summarized by BP in Table 41 "Summary of Thermal Maximum HQ and Avoidance HQ results where HQ>1."[11]. The sites (see Figure 2)

exceeding the $HQ_{thermalmax}$ criteria include 18B, 20B, 9B, BB, and BA, where BB is Bruce B; BA is Bruce A and measurements at sites 9, 18 and 20 are for measurements 1 meter from the bottom . Site 20 is east of the Bruce A discharge, and site 9 is north east of the Bruce A discharge. It should be noted that Site 20 was included in the list of sites where "ambient" temperatures were determined in the Bruce A Follow-Up Monitoring Report [5]. It is also of interest that Table 41 indicates site 9B exceeds the HQ for Thermal Maximum (of 9°C for Lake Whitefish Larvae) 33% of the monitored time during March through May. Site 9B also exceeds the HQ for Thermal Maximum (of 6.3°C for Round Whitefish Incubation) 39% of the monitored time December through March. This suggests site 9B temperatures are in the range from 6.3°C to 13°C (Thermal Max HQ * Benchmark Value) for 39% of the monitored period.

BP reached the following conclusions [page 224] "*A summary of the avoidance HQ results where HQ>1 is shown in Table 41. The avoidance HQs were very close to 1 (for most species the HQ was below 1), indicating that existing temperatures are not causing fish to avoid the area*." It should be noted the HQs provide an estimate of risk relative to the Benchmark Values and no data are provided regarding the use of these sites by fish.

Bruce Power summarizes temperature variation within sites as well as between sites and "ambient" sites in Table 42 "Summary of the Delta T HQ Results where HQ > 1." The sites exceed the Delta T criteria include 9B, 11B, 18B, 20B, 26S (walleye and yellow perch), BB, and BA. The tabulated results indicate the Delta T criteria of 3.7°C is exceeded 30% of the time at site 9B

Bruce Power indicates that results for the Delta T (intra) exceeded the benchmark at some time during the year for all species. The nearshore sites (limited to sites 5, 9, 11 according to Table 37) showed a range of variation and this variation will be further evaluated. The daily range between a site and the reference ("ambient" bottom temperatures) also exceed the Delta T (inter) criteria at some time during the year. Bruce Power indicates "*Further review demonstrates that exceedances are mostly due to the sites being at different depths (20 m versus 5 m), as comparisons to other shallow sites do not show great variation.*" However, there is no information provided on the water current direction, vertical and horizontal extent, and variation with time that may affect temperature differences at specific sites when compared to ambient sites 1 and 29.

Bruce Power concludes "*The assessment considered the potential effect of thermal discharges on fish species. The thermal assessment considered conservative benchmarks and multiple years of data collection. Considering the resulting hazard quotients, it is concluded that thermal effluent causes little to no risk to fish. Further analyses done on whitefish to incorporate updated benchmarks from recent research also supported the finding of little to no risk. The results of the Detailed Quantitative Risk Assessment (DQRA) show that the average and maximum temperature values for all three winters were less than or equal to the 8°C benchmark*

for being protective for Round Whitefish, except in Baie du Doré; however, suitable spawning cobble is limited I n Baie du Doré. Maximum temperatures at all sites were higher in the first and last time windows (December and April), likely due to natural fall and spring lake turnover."

1.3.4. SUMMARY EVALUATION OF REPORTS AND FINDINGS - THERMAL

The following observations are provided regarding the thermal effects assessment provided in the ERA and supporting documents.

Temperature Data Presentation

1. The "ambient" temperatures are derived from measurements 1 m from the bottom for seven sites, five of which are at depths between 15 and 20 meters. The definition of ambient temperature is not clear and differs between the ERA [11] and the 2013 Bruce A Follow-Up Monitoring Report [3]. The issue of definition of ambient temperature was also raised by CNSC in review of the PQRA (See Section 5 Review of CNSC Comments, Comment 14).
2. There is no description in the ERA under Cold Weather Conditions of the buoyant plume, the vertical extent of the plume, direction, or distance until it decreases to 4°C.
3. There is no information provided on the direction, vertical and horizontal extent, and variation with time of thermal plumes that may affect temperature differences at specific sites when compared to "ambient" sites 1 and 29.
4. There is no description or indication as to the depth of the temperature monitoring point for the Bruce A Discharge
5. The predictive tool used to estimate temperatures presented in Table 75 of the 2016 Environmental Monitoring Report [10] for location 31-1 is not described (nor is it accurate).
6. There is no presentation of temperature data by day, week, or month which may indicate variation in the path of the thermal plume over time. No indication of the range temperatures is provided for each site during cold weather conditions.

Risk Evaluation

1. While temperature results for the winter spawning period is evaluated for the entire cold weather season, there is no corresponding monitoring of hatch success and larval development as the Phase III of the objective was eliminated [5].
2. BP infers from the three seasons of temperature monitoring and comparison to laboratory-based studies that there is "no significant risk to survival" for Lake Whitefish eggs. No data are provided regarding the actual spawning times and locations for Lake

and Round Whitefish relative to thermal plumes that exist during cold weather conditions (i.e. the known spawning period).

3. Table 37 “Delta T Thermal Criteria for Fish Species (°C)” (page 209) limits the scope for considering Delta T to sites 11, 9, 5 for Lake and Round whitefish.
   The tabulated results indicate the Delta T criteria of 3.7°C is exceeded 30% of the time at site 9B.
4. The Risk Assessment HQ are only indications of potential thermal impact and not indications of the presence or absence of Valued Ecosystem Components.

Environmental Compliance Approval – Thermal

1. No discussion of the annual variation in temperatures is included in the consideration for an ECA in terms of uncertainty of future predictions.

Based on the technical review and the observations above, the following recommendations are offered to clearly support the Ecological Quantitative Risk Assessment for Bruce Power’s proposed Major Component Replacement project.

1. Provide a description of the thermal plume for both cold weather conditions and warm weather conditions. Describe thermal plume modeling and verification
2. Consider whether the “ambient” temperature used to estimate temperature variations is actually a “reference” temperature for measurements made 1 m from the lake bottom and reserve “ambient” temperature for measurements in Lake Huron un-influenced by thermal discharges from the Bruce Facilities.
3. Allow access to temperature measurement data or presentation of the data in a format that allows review of daily, weekly, and monthly trends.
4. Develop the uncertainty of future temperature predictions with regards to frequency of occurrence in considering the application for a thermal ECA.
5. Implement periodic surveys during winter spawning periods of fish density in the region of Loscombe Shoals (by hydro-acoustic technology when conditions permit these observations).
6. Measure larval hatch success in thermally affected areas and compare these with control locations.
7. Conduct periodic surveys during summer fishing periods of fish density in the historic fishing regions.

2. RADIOLOGICAL ECOLOGICAL RISK ASSESSMENT

The review of the radiological ecological risk assessment includes consideration of release rates from the Bruce Power Site, basis for estimates of concentrations in the environment, and assumptions made in estimating the radiation dose to biota.

2.1. RELEASE RATES FROM THE BRUCE POWER SITE

Radioactive effluents released to the environment are described in section 6.1.2 of the Bruce Power Environmental Quantitative Risk Assessment [11]. Release rates may be used to calculate activity concentrations in the environment (section 7.2.5.2.1 of CSA 288.6 [19]). The following summarizes the basis for Bruce Power's assessment of release rates.

Radioactive effluents occur from operations at:

- Bruce A Nuclear Generating Station;
- Bruce B Nuclear Generating Station;
- Central Maintenance and Laundry Facility (CMLF);
- OPG Western Waste Management Facility (WWMF); and
- CNL (formerly AECL) Douglas Point Waste Management Facility (DPWMF).

The releases are monitored: "*In order to establish average and upper range exposure concentration data, this assessment examines the airborne and waterborne effluents from all facilities on the Site, from 2012 to 2016 inclusive. Therefore, the average exposure assessment is based on the average annual release from the Site of each radionuclide category listed below; the upper range exposure assessment is based on the maximum annual release from the Site of each radionuclide category listed below.*"

BP indicates in the ERA "*From 2009 to late 2012, Bruce A Units 1 and 2 were being refurbished and therefore only 6 of the 8 Bruce Power reactors were in operation. Bruce A Units 1 and 2 resumed operations in October of 2012. As discussed in the previous ERA, the radiological effluent during and after refurbishment remained relatively constant. Therefore, it is assumed that the effluents from the Site during the next five years (2017 to 2021 inclusive), when Major Component Replacement for Bruce B Unit 6 will commence, will be similar to the effluents over the past five years (2012 to 2016 inclusive). The airborne release categories presented in the figures below and that are used throughout the radiological risk assessment are the ones reported by Bruce Power in their annual Environmental Monitoring Program Reports [157,158,159,160,161], namely:*

- *Tritium oxide as water vapour (HTO);*
- *Noble gases;*
- *Carbon-14;*
- *Mixed fission product iodines;*
- *Gross alpha particulates; and*
- *Gross beta/gamma particulates.*

The waterborne radionuclide groups are reported as follows:

- *Tritium oxide as water vapour (HTO);*
- *Carbon-14;*
- *Gross alpha; and*
- *Gross beta/gamma."*

Bruce Power summarizes annual gaseous and liquid effluent releases in Environmental Monitoring Program Reports for 2012 through 2016 [references 2,3,4,9, and 10, respectively]. The total site releases are summarized here for releases to the atmosphere in Table 4 and releases to the aquatic environment in Table 5 from the Annual Environmental Monitoring Reports. Note Bruce Power provides an updated summary of data from 2012 through 2016 in ERA Appendix F "Release Rates from the Bruce Power Site". The average and maximum release activity for the period 2012-2016 are provided from ERA Table F-6 and Table F-7, respectively, for comparison in Table 5.

Table 4.Annual gaseous emission Bruce Power Site 2012-2016 as reported in annual Environmental Monitoring Reports, compared with ERA Average and Maximum from Appendix F [11].

Airborne	Total Bq/yr					ERA Table F-6	ERA Table F-7
Year	2012	2013	2014	2015	2016	Average	Maximum
Tritium Oxide	7.87E+14	8.52E+14	1.17E+15	1.08E+15	1.16E+15	1.05E+15	1.34E+15
Noble Gas	7.18E+13	7.03E+13	1.06E+14	1.09E+14	1.09E+14	9.32E+13	1.21E+14
^{131}I	2.60E+08	<1.15E08	4.34E+08	<9.20E+07	4.57E+06	1.98E+08	4.36E+08
Particulate Gross Beta	2.55E+07	NR	NR	NR	NR		
Particulate Gamma	5.57E+05	<2.78E07	1.90E+07	2.74E+07	1.45E+06	1.85E+07	3.05E+07
Particulate Gross Alpha	<1.08E06	<3.63E12	3.06E+06	3.70E+06	4.31E+03	1.96E+06	3.87E+-6
^{14}C	3.46E+12	3.63E+12	2.90E+12	<4.31E+12	2.83E+12	3.43E+12	4.42E+12

NR – not reported

Inconsistencies in presenting results were noted in annual Environmental Monitoring Reports when annual estimates by facility include positive values and upper limits (reported as < value). For example, ^{14}C estimated activity in 2015 include the following3.15E+12 (Bruce A), 1.16E+12 (Bruce B), 1.41E+09 (WWMF), < 4.49E+08 (CNL), with a total of < 4.31E12 Bq/yr, the sum of values from Bruce A and Bruce B. The total should be 4.31E+12 Bq/yr. The issue of confusion created by data sets with censored values was also raised previously by CNSC in review of the PQRA (see Section 5 Response to CNSC Comments, Comment 18).

Table 5. Annual Liquid effluent releases Bruce Power Site 2012-2016, with selected gamma emitted radionuclides. Gross Beta and Gross Alpha results are not summarized. NR = not reported.

Water	Total Bq					ERA Table F-6	ERA Table F-7
Year	2012	2013	2014	2015	2016	Average	Maximum
Tritium Oxide	1.28E+15	6.15E+14	8.36E+14	8.92E+14	7.44E+14	8.73E+14	1.38E+15
^{14}C	8.28E+09	5.90E+09	1.34E+10	1.47E+10	3.42E+09	9.95E+-09	1.57E+10
Gross Beta/Gamma	3.97E+09	4.01E+09	3.01E+09	2.45E+09	2.42E+09	3.56E+09	5.51E+09
^{60}Co	9.72E+08	1.07E+09	5.00E+08	NR	NR	-	-
^{137}Cs	6.49E+07	2.94E+07	3.27E+07	NR	NR	-	-
Gross Alpha						5.75E+06	2.00E+07

Changes in reporting were also noted in liquid effluent releases with reports for 2012, 2013, and 2014 including activity estimates by radionuclide (cobalt-60 (^{60}Co) and cesium-137 (^{137}Cs) are included here) and only summary estimates of gross Beta/Gamma are provided in 2015 and 2016.

2.2. ESTIMATES OF CONCENTRATIONS IN THE ENVIRONMENT

The evaluation of dose to biota is based in part on measurements of radionuclide concentrations in the environment and reported in annual Environmental Monitoring Reports. These measurements include radionuclide measurements provided by Bruce Power and provincial background radionuclide measurements provided by OPG. In addition, gamma dose measurements by thermoluminscent dosimeters are provided by OPG [10] and included in annual reports. The basis for estimates of concentrations in the environment are reviewed and discussed, including sampling media and locations; laboratory performance testing; reporting of results; and estimates of exposure concentrations.

2.2.1. SAMPLING MEDIA AND LOCATIONS

Sampling media include Air, Water, Precipitation, Aquatic Samples (fish, sediment, sand), and Terrestrial Samples (animal feed, eggs, beef, pork, poultry, deer, fruit, berries, milk, root vegetables, non-root vegetables, honey, grain, and soil). Samples are analyzed for tritium, carbon-14, I-131, Beta (presumably gross beta measurement of air particulates and water), and Gamma emitters. Sampling sites are categorized into Near (on or outside the facility perimeter), Area Near (less than 20 km from the facility), Area Far (locations further than 20km but potentially influenced by facility releases), and Provincial Background. When used in public dose calculations, activity concentrations are adjusted by subtracting background activity concentrations where appropriate [10].Sampling sites are depicted in Appendix E of the 2016 Environmental Monitoring Report (see Figure 4. Bruce Power monitoring locations.).

APPENDIX E: SAMPLING SITE LOCATIONS

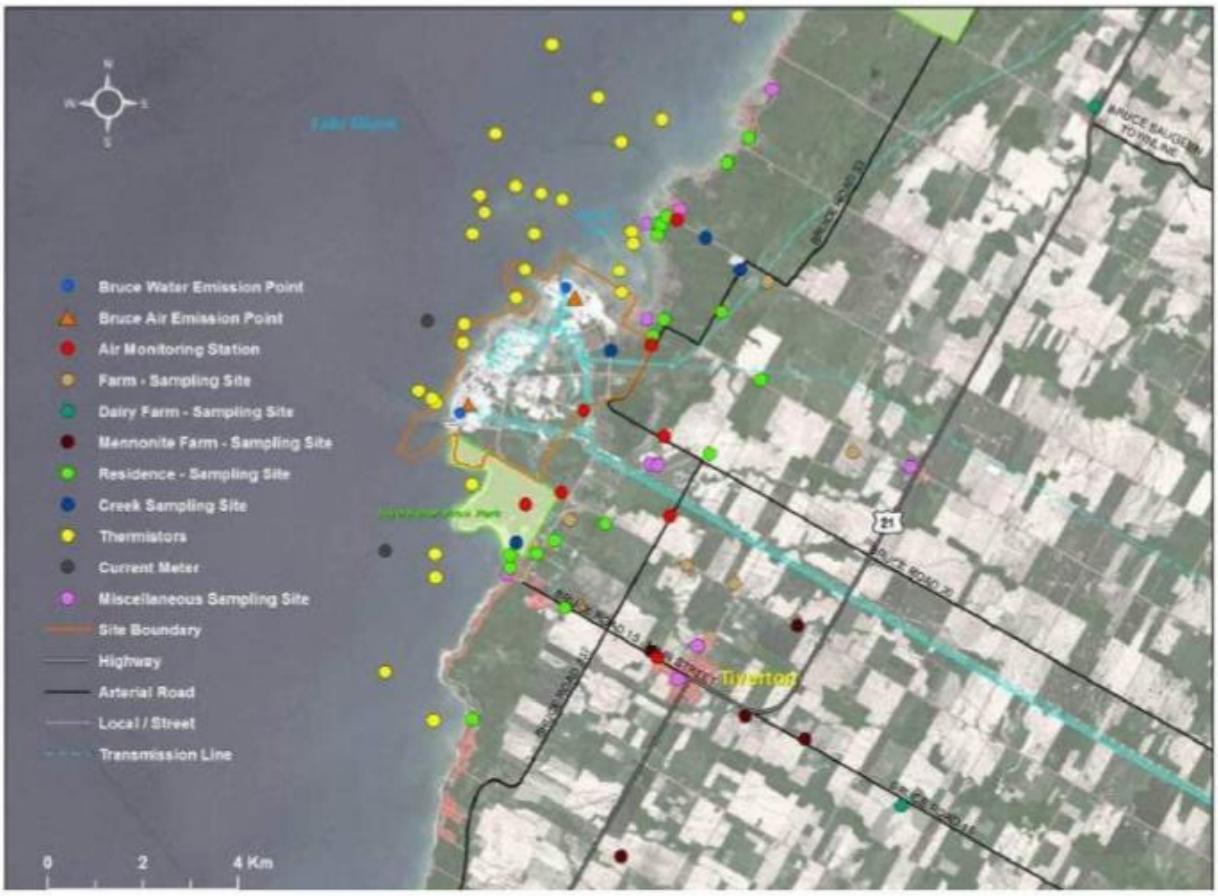


Figure 4. Bruce Power monitoring locations.

2.2.2. RESULTS OF ENVIRONMENTAL MONITORING DATA

The evaluation of dose to biota is based in part on measurements of radionuclide concentrations in the environment. These measurements include radionuclide measurements provided by Bruce Power and provincial background radionuclide measurements provided by OPG.

Bruce Power provides annual average activity by location each year in annual Environmental Monitoring Program Reports [e.g. 2, 3, 4, 9, 10]. Results are presented for the current year in tables and compared to historic results for the previous nine years graphically. The results presented in the 2016 EMP were reviewed as representative of the current reporting effort.

A summary of environmental monitoring for air, precipitation, water, and milk is provided in Table 7. The summary includes the media, analytes, brief description of the methods, and

frequency referenced to the appropriate table in the 2016 Environmental Monitoring Program Report.

Common to the 2016 EMP Tables 29-33 referenced, annual averages activity concentrations are present without information regarding the variability in results (e.g. 95% confidence intervals for annual average values) or discussion of the measurement and sampling uncertainty. CSA 288.4 section 9.3.3 provides guidance regarding uncertainty in measurement and sampling. Section 9.3.3.3 indicates the uncertainties associated with environmental measurements should be discussed.

Also apparent in 2016 EMP Table 33 "2016 Annual Average Concentration Tritium, ^{131}I, ^{14}C" are different strategies for averaging data groups with censored (less than) values. These differences in part appear to be programmatic. For example, Tritium activity concentrations which include less than values, annual averages use the detection limit value for averaging. Provincial Background samples with data including less than values use one half the detection limit for estimating averages.

A summary of Environmental Monitoring measurements of soil, sediment, fish, and agricultural products is provided in Table 8. Bruce Power provides in Table 34 "2016 Soil and Sediment Data" results for annual sediment samples including ± 2σ estimates for ^{40}K and ^{137}Cs. The definition of the uncertainty estimate should be provided. It is also apparent in this table when analytes are less than the detection limit, the average is set at the greatest detection limit value in the set. Similar averaging of censored (less than) values occurs in for measurements in fish presented in 2016 EMP Tables 36, 37, and 38. A variant of this is the treatment of data for ^{137}Cs in Lake Huron Benthic samples (2016 EMP Table 38) where the eight measurements including one value <0.11 is averaged to arrive at an average value of <0.51 Bq ^{137}Cs/kg. Averaging the seven measured values results in 0.57 ± 0.59 (average ± 95% CI).

For example, the presentation of ^{137}Cs data in the 2016 EMP Table 38 "*2016, Annual Provincial Fish Data*," illustrates the difficulties with BP's data presentation when data sets include less than values, as for White Sucker. Bruce Power summarizes the set of eight values in Table 9 as having average value <0.51 Bq ^{137}Cs/kg fw. If the set of data is averaged assuming the single censored value could be 0.11 Bq ^{137}Cs/kg fw (MDL), the resulting estimate is 0.51 ± 0.30 Bq ^{137}Cs/kg fw (average ± 1 S).

Table 6. Average White Sucker tissue concentration.

White Sucker	^{137}Cs Bq/kg fw
A	0.22
B	0.14
C	0.91
D	0.72
E	0.87
F	0.55
G	0.59
H	< 0.11
Average	0.51
Std. Dev.	0.30

Bruce Power samples animal and agricultural products including deer meat when available, honey, poultry, eggs, grains (beans and corn), animal feed, fruit (apples), leafy vegetables. Average annual activity concentrations are provided for Tritium and Carbon-14 in Tables 39, 40, and 41. There is an indication in the title to Table 39 the ± 2σ data are "± Standard Error when presented. It is not specified whether the σ estimates are total expanded uncertainties or counting uncertainties.

It is noted in CSA 288.4 "Environmental Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills" the Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP) [27] is a suitable source of guidance for radiological sampling and measurements. MARLAP, section 16.6 Reporting Results, offers the following recommendation "MARLAP recommends that the reported value of a measurement result:(1) be reported directly as obtained, with appropriate units, even if negative, (2) be expressed in an appropriate number of significant figures, and (3) include an unambiguous statement of uncertainty." [27].

Bruce Power notes in 2016 EMP Section 3.1.2.2 “Historical Radiological Waterborne Effluent Results” “*It should be noted that the methodology employed for reporting Minimum Detection Levels (MDLs) were not consistent from year to year*” (Page 33 [10]). BP describes their use of MDL in ERA Section 6.2.4 Exposure Point Concentrations as “the minimum level that can be detected with a 95% false/negative confidence and a 5% false/positive confidence” [159]. Reference [159] is “Bruce Power. 2012. Annual Summary & Assessment of Environmental Radiological Data for 2011. B-REP-07000-00004 R000. April, 2012.” The description of MDL or detection limits is not consistent with the definition found in Annex D of CSA N288.4-10 17.

Inconsistent use of detection limits and problems with data presentation were previously identified in CNSC review of the PQRA (Section 5 Review of CNSC Comments, Comment 18). It is noted CSA 288.4 section 8.3.4 indicates “The treatment of results that are less than the critical level for the measurement shall be defined and documented. It is recommended Bruce Power consider Annex D of CSA 288.4 which provides a description of critical levels and detection limits consistent with ISO 11929 and IUPAC recommendations.

For comparison, the annual EMP includes background sample results reported by OPG. OPG provides a description in 2012 Results of Radiological Environmental Monitoring Programs [26] of radionuclide concentrations measurements for environmental samples including a definition for Critical Level (Lc) and Detection Limit (Ld) consistent with CSA 288.4 Appendix D. OPG describes reporting analytical data as follows:

> *“When reporting the analytical data in Appendix D tables, the following protocols were used:*
> - *If the measured value is lower than the Ld of the analytical method but higher than the Lc, the measured value is reported and is in bold type.*
> - *If the measured value is less than the Lc, then “< Lc” is reported (for Appendix D Table D3, it is reported as Lc in italics).*
> - *When averages or other calculations are performed, they are calculated using the measured values even if they are below the Lc.*
> - *Gamma spectrometer results are reported as “< Ld” when their measured values are below the Ld.*

This reporting scheme is also consistent with recommendations found in MARLAP, section 16.6 Reporting Results [27].

Table 7. Summary of Environmental Monitoring measurements of air, precipitation, and water.

Media	Analyte	Description	Frequency	Units	2016 EMP
Air	Tritium	Active Sampler, Molecular Sieve	Monthly	Annual Average Bq/m3	Table 29
Air	Carbon-14	Passive samplers, soda lime pellets	Quarterly	Annual Average Bq ^{14}C/kg Carbon	Table 30
Precipitation	Tritium	Sample buckets	Monthly	Annual Average Bq/L	Table 31
Precipitation, Dust Fallout	Gross Beta	Sample buckets	Monthly	Annual Average Bq/m^2/month	Table 31
Water, Municipal	Tritium, Gross Beta	Composited sample, collected twice per day	Weekly composite	Annual Average Bq/L	Table 32
Water. Residential Wells	Tritium, Gross Beta for selected wells	No description of sampling. Reports averages for indicator, near, and near area groups	Shallow wells – bimonthly Deep wells semiannually	Annual Average Bq/L	Table 32
Water, Lakes and Streams	Tritium, Gross Beta	No description	Bi-monthly when free of ice	Annual Average Bq/L	Table 32
Milk	Tritium, ,	Average of replicate samples of monthly composite	Monthly composite	Annual Average Bq/L	Table 33
Milk	^{14}C	Average of two counts of a monthly composite sample	Monthly composite	Average Bq ^{14}C/kg Carbon	Table 33
Milk	^{131}I	Single composite sample of all locations	Weekly	Annual Average Bq/L	Table 33

Table 8. Summary of Environmental Monitoring measurements of milk, soil, sediment, and fish.

Media	Analyte	Description	Frequency	Units	2016 EMP
Soil	Gamma Spectrometry (^{40}K, ^{60}Co, ^{134}Cs, ^{137}Cs)	Dried, sieved, packaged	Not specified	Annual Average Bq/Kg dry weight	Table 34
Sediment	Gamma Spectrometry (^{40}K, ^{60}Co, ^{134}Cs, ^{137}Cs)	Dried, sieved, packaged	Annually	Annual Average Bq/Kg dry weight	Table 34
Fish	Gamma Spectrometry (^{40}K, ^{60}Co, ^{134}Cs, ^{137}Cs), ^{14}C. Tritium Oxide, Organically Bound Tritium	Benthic (White Sucker) and Pelagic (Lake whitefish or Lake Trout)	Annual, Seasonal – Benthic in the spring, Pelagic in the fall	Annual Average Bq/Kg	Tables 36, 37, 38
Agricultural Products	Tritium	Average of two subsamples	Not specified, assumed to be seasonal	Annual Average Bq/L or Bq/Kg	Tables 39, 40, 41
	^{14}C	Average of two counts of a single sample	Not specified, assumed to be seasonal	Annual Bq ^{14}C/kg-C	Tables 39, 40, 41
	Gamma Spectrometry (^{40}K, ^{60}Co, ^{134}Cs, ^{137}Cs),	Single count of a single sample	Not specified.	No data presented	No data presented

2.2.3. LABORATORY PERFORMANCE TESTING

Bruce Power provides results on the accuracy and precision of measurements from participating in inter-laboratory comparisons in the annual EMP reports. Performance testing includes participation in routine inter-laboratory measurements with Eckert and Ziegler Analytics, Inc. Both OPG and BP-HPL include measurement of tritium in water, gross beta in water, gamma emitting radionuclides in water, gamma emitting radionuclides in milk and soil. In addition, BP-HPL participates in inter-comparison measurements of Iodine-131 in iodine cartridges, gamma emitting radionuclides in filters, and Iodine-131 in milk. OPG also participates in environmental gamma dose measurements with National Research Council of Canada.

The results of inter-laboratory performance testing are provided in annual Radiological Environmental Monitoring Reports for 2012 through 2016. The evaluation considered the acceptance criteria for results and reviewed performance testing results for each year.

BP adopted internal test limits as follows:

$(V_L+1\sigma_L)/V_T \geq 0.75$ and $(V_L-1\sigma_L)/V_T \leq 1.2$

Where V_L is the BP-HPL value

σ_L is the BP-HPL standard deviation

V_T is the Eckert & Ziegler known value.

Dividing by V_T, this criterion is equivalent to a ratio of measured activity divided by known activity +/- the standard error normalized to the known value. The standard deviation σ_L for a single measurement is not defined by BP in the REMP reports reviewed.

OPG applies the following performance test limits

-25% < Relative Difference < +50%

Relative Precision < 40%

and notes: “These test limits are adapted from the in vitro accuracy specifications of the CNSC’s Regulatory Standard S-106 Revision 1, Technical and Quality Assurance Requirements for Dosimetry Services.” [26]. It is noted the referenced standard applies to a “licensed dosimetry service”, not analytical radiochemistry measurements.

Performance Testing Results were reviewed for BP EMP reports from 2012 through 2016 and are acceptable based on the criteria adopted. It is recommended the uncertainty of measurements (standard deviation) be defined and provided by media and analyte, consistent with CSA 288.4 section 9.3.3.

2.3. RADIATION DOSE TO NON-HUMAN BIOTA

Bruce Power describes the assumptions for estimating the dose to biota (Ecological Risk Assessment) in Section 7 of the Environmental Quantitative Risk Assessment [11]. The Ecological Risk Assessment references the recommendations found in CSA N288.6-12 [19]. Bruce Power estimates doses for reference organisms at two locations, terrestrial biota residing on the Site at the southeast section of the WWMF property boundary and aquatic biota residing in the Baie du Doré. Bruce Power lists biota found on the site and corresponding representative radiological receptors in ERA Table 55, "Representative EcoRA Receptors." The biology of the listed biota is described in ERA Section 5.1.1. [19]. Bruce Power indicates deer, pelagic fish, and benthic fish are included as representative receptors since there are radionuclide concentration data available from environmental monitoring during the period 2012-2016.

2.3.1. REFERENCE BENCHMARKS FOR DOSE TO BIOTA

Bruce Power follows guidance from UNSCEAR for reference benchmarks for radiological effects assessment, including:

- Chronic dose rates less than 100 µGy/hr to the most highly exposed individual individuals would be unlikely to have significant effects on most terrestrial communities.
- Maximum dose rates of 400 µGy/hr to any individual in aquatic populations would be unlikely to have any detrimental effect at the population level. [28].

2.3.2. LOCATIONS FOR ESTIMATING DOSE TO BIOTA

Bruce Power selected the southeast section of the WWMF as the location for estimating dose to terrestrial biota as this site has the greatest measured carbon-14 concentration. However, in specific cases, the internal concentrations are from measurements at other locations, e.g. deer meat. Bruce Power selected Baie du Doré as the location for estimating dose to aquatic biota as this site has the greatest concentrations of tritium and gamma emitting radionuclides.

2.3.3. RADIONUCLIDES SELECTED

ERA Section 7.1.3 describes the radionuclides selected for assessment. For dose to terrestrial biota, these radionuclides include tritium (H-3), carbon-14 (C-14), cobalt-60 (Co-60), plutonium-239 (Pu-239), radiodines (in particular I-131), and noble gasses. For aquatic biota, these radionuclides include tritiated water (HTO), organically bound tritium (OBT), carbon-14, cesium-137 (Cs-137), and curium-244 (Cm-244).

With regards to the basis for selecting radionuclides for dose to biota, Bruce Power indicates "*For the exposure to terrestrial biota, Co-60 was chosen as the radionuclide representative of all beta/gamma-emitting radionuclides in the terrestrial environment. Among Co-60, Cs-134 and Cs-137, Co-60 has the highest external dose coefficient and therefore leads to the highest dose among common gamma-emitters emitted from Site operations. In contrast to the HHRA where Cs-137 was selected since it was the only gamma-emitter measured to be present at levels above background in soil outside the Site boundary, Co-60 was selected for the EcoRA since there is no data within the Site boundary to confirm that it is not present above background.*

BP did not provide a clear rationale why Cs-137 was not included in the assessment of dose to terrestrial biota, given measured concentrations in soil discussed below. Cs-137 was also considered in the HHRA, were Cs-137 in soil is the largest dose contributor to external exposure, 33% of the estimated dose to a person (infant) at BF3 (Figure 35) [11].

Bruce Power also indicates: "*For the exposure to aquatic biota, Cs-137 was chosen as the radionuclide representative of all beta/gamma-emitting radionuclides in the aquatic environment. Among Co-60, Cs-134 and Cs-137, only Cs-137 has been measured above detection limits in sediment and fish samples in and around the Site as part of the Environmental Monitoring Program (EMP).*" *[11].*

As noted in 2.1, Release Rates, Bruce Power uses the monitoring data for the period 2012 through 2016. Data prior to 2012 and effluent releases reported for the period 2012-2016, however, do not support assumption Co-60 will not be present in the aquatic environment.

In addition, CSA 288.6-12 Section 7.2.5.3.3 indicates "*Certain COPCs may be carried forward into the EcoRA for reasons of public perception, even if screening benchmarks are not exceeded. For example, the most important radionuclides may be carried forward to demonstrate acceptable risk based on expressed public concern rather than exceedance of screening criteria.* ***Note****: The most important radionuclides can vary among facilities, but for nuclear power plants generally include tritium, C-14, noble gases, and conservative examples of gamma-emitting particulates (e.g. Cs-137 and Co-60). The latter may be assumed for assessment purposes to be main sources of gross-gamma as measured, if site measurements have not been radionuclide specific.*"

The basis of exposure point concentrations in the ERA do not provide bounding estimates of radionuclides expected in effluents and may not adequately address public concerns. CSA 288.6-12 Section 7.2.5.2.5 suggests: "*When screening concentrations of contaminants are calculated from release rates, the modeling should be conservative, using upper-bound release rates and nearest exposure points. For liquid effluents, these might be end of pipe concentrations. "*

2.3.3.1. TERRESTRIAL

Bruce Power states: "*C-14 in air will be the maximum measured annual average value from 2012 to 2016. The maximum annual average concentration of C-14 in air was 5.35 kBq/kg-C, which corresponds to a background-corrected concentration of 1.08 Bq/m^3 [229]*." [11]. Review of the 2016 Environmental Monitoring Program Report Table 30, "2016 Annual Average ^{14}C in Air from Passive Samplers," shows an average concentration at B3 of 248 Bq ^{14}C/kg C). No information is provided in the 2016 Environmental Monitoring Program Report regarding the range of measured values or the statistical distribution. Figure 27, "Annual Average ^{14}C in Air Concentrations at Bruce Power and Provincial Locations Over Time," includes annual averages for "Indicator" for 2007 through 2016. It is unclear how these monitoring data support BP's assumptions for the maximum measured annual average value of 5.35 kBq ^{14}C /kg-C value.

Bruce Power further states: "Using the IMPACT model, the concentration of C-14 in air at location B#3 in 2016 is 0.03 Bq/m^3, which is approximately 36 times lower than the measured value. Since the primary goal of the PQRA is to assess exposure based on measured concentrations, the exposure point concentration of C-14 in air will be the maximum measured annual average value from 2012 to 2016. It is noted that CSA 288.6 Section 7.3.3 "Exposure frequency, duration, and averaging" indicates for immobile receptors (e.g. terrestrial plants and soil invertebrates) "the maximum or 95th percentile concentration (modelled or measured) should be used as the exposure point concentration." In keeping with CSA guidance, for mobile receptors (e.g. birds, mammals, fish) an upper confidence limit on the arithmetic mean concentration should be used as the exposure point concentration [19]. With a limited data set of five years for annual averages, inconsistencies in reporting censored values, and lack of information on the annual range of concentrations, it is not clear that bounding concentrations for future emissions have been established.

Bruce Power estimates the concentration of tritium oxide (HTO) in air by multiplying the tritium releases by a dilution factor derived from the ratio of annual carbon-14 concentration at the Western Waste Management Facility (WWMF) and the annual carbon-14 release from the site. As the predominant source of tritium is Bruce A and Bruce B, the calculation on page 285 indicating $A_{HTO,WWMF}$ is the release rate of tritium from the WWMF in 2016(Bq/s) is likely incorrect [11]. It is noted that the tritium oxide concentrations estimate is based on 2016 measurements, representing a single year.

Bruce Power States: "*Since concentrations in deer tissue are measured from roadkill samples, the maximum concentrations from 2012 to 2016 were used directly in the assessment of internal dose to deer*" [11]. It is noted in reviewing annual Environmental Monitoring Reports for 2012-2016 the analytical results for deer have been provided for three samples, one each

from 2012, 2013, and 2015. Results for gamma emitters (^{60}Co,^{134}Cs, ^{137}Cs) are only reported in 2012 and 2013. It also remains a concern with ^{137}Cs from facility releases reported in soil but calculations for the dose rate to deer is based on ^{60}Co (Table J-1 Calculations used to determine the dose rate to deer, [11]).

The IMPACT model was used to determine the following remaining exposure point concentrations in the terrestrial environment based on emissions from the Site during 2016:

- Co-60 in soil (Bq/kg);
- I (mfp) in soil (Bq/kg);
- Pu-239 in soil (Bq/kg); and
- Noble gases in air (Bq/m3).

2.3.3.2. AQUATIC

As noted in review of Release Rates, Bruce Power uses the monitoring data for the period 2012 through 2016. Prior data as well as specific effluent releases reported for the period 2012-2016, however, do not support specific assumptions made regarding gamma emitting radionuclides released to the aquatic environment.

For example, Bruce Power reports in [5] *"^{134}Cs and ^{60}Co are present in the environment mainly due to nuclear reactor operations*." referencing Figure 5 "Mean annual concentration (standard errors) of ^{60}Co (Bq/kg) in sediment (2007-2012)". Bruce Power also reports in the 2012 REMP report annual waterborne releases of Radioactive effluents in Table 8 "Annual Waterborne (Aqueous) Radioactive Effluent Results for 2012" including Co-60, Cr-51, Cs-137, and Sr-90 released from Bruce B [2]. Co-60 is reported in effluent releases to water from the site for 2012 (9.72E08 Bq), 2013 (1.07E09 Bq), and 2014 (5.00E08 Bq) [2, 3, 4]. There does not appear to be sufficient justification for excluding Co-60 from the dose assessment to biota in the aquatic environment.

Furthermore, the statement: "The waterborne concentrations in the Baie du Doré are higher than those measured at the discharge outlets of Bruce A and Bruce B because of its peculiar hydrological and geological properties," merits further explanation. Tritiated water (HTO) should have maximum concentration at the discharge and be diluted as it disperses. While higher sediment concentrations may be expected, a concentrating mechanism for waterborne activity levels seems illogical.

Bruce Power estimates the dose rate to aquatic biota based on the concentrations of radionuclides in surface water (Lake Huron) and sediment in the Baie du Doré based on measurements from the Environmental Monitoring Program. These measurements include:

- HTO in surface water and fish (Bq/L);
- OBT in fish (Bq/L);
- C-14 in fish (Bq/kg-C);
- Co-60 in fish and sediment (Bq/kg) – all measurements were below detection limits;
- Cs-134 in fish and sediment (Bq/kg) – all measurements were below detection limits; and
- Cs-137 in fish and sediment (Bq/kg).

Bruce Power indicates in the ERA: "*Since the measured concentrations of Co-60 and Cs-134 in fish and sediment were below detection limits, they were assumed to be zero for the purpose of the ecological risk assessment.*" Earlier results reported by BP for the period 2007 through 2012 indicate both Co-60 and Cs-134 have been measurable in sediment samples. It is not appropriate to assume these concentrations are zero if activation products are produced and expected to be discharged in liquid effluent in the future, particularly when there are measurable concentrations reported for past activities of similar nature. See also the discussion of the use of detection limits by BP with reference to CSA 288.4-10 clauses 8.3.4 and 9.2.5. It is also noted that CSA 288.6 Section 7.3.3 "Exposure frequency, duration, and averaging" indicates for immobile receptors "the maximum or 95th percentile concentration (modelled or measured) should be used as the exposure point concentration."[19]

Bruce Power selected Cm-244 as representative of alpha emitters and estimated the concentration in sediment at Baie du Doré by modelling. Since concentrations in fish tissue are measured for both pelagic and benthic fish, these concentrations are used directly in the assessment of internal dose to fish.

It is noted in reviewing the ERA Table J-7, *Calculations used to determine the dose to pelagic fish,* the ^{137}Cs tissue concentration C_t is indicated as 0.0 Bq/kg. This is inconsistent with data reported in Bruce Power's annual Environmental Monitoring Reports. In the 2016 Environment Monitoring Report Table 36, *2016 Annual Near - Field Fish Data,* entries for Baie du Doré Pelagic fish (Lake Trout) average 0.58 ± 0.49 Bq ^{137}Cs/kg (average ± 95%CL, n=8). In Table 38, *2016 Annual Provincial Fish Data,* Lake Huron (US) Pelagic (round white fish) results are 0.33 ± 0.67 Bq ^{137}Cs/kg (average ± 95%CL, n=8, <MDL values (3) entered as MDL).

It is also noted in reviewing the ERA Table J-8, *Calculations used to determine the dose to benthic fish,* the ^{137}Cs tissue concentration C_t is indicated as 0.12 Bq/kg fw. This value appears to be inconsistent with results found in BP annual Environmental Monitoring Reports. In the

2016 Environment Monitoring Report Table 36, *2016 Annual Near - Field Fish Data,* entries for Baie du Doré Benthic fish (Sucker) average 0.22 ± 0.09 Bq ^{137}Cs/kg fw (average ± 95%CL, n=8). In Table 38, *2016 Annual Provincial Fish Data,* Lake Huron (US) Benthic (White Sucker) results are 0.51 ± 0.63 Bq ^{137}Cs/kg fw (average ± 95%CL, n=8, <MDL values (1) entered as MDL). Without a more detailed evaluation of these data and differences in the observed average concentration of ^{137}Cs in near-field benthic fish concentration and the provincial background concentration, the rationale for the assumed value of 0.12 Bq/kg fw in Table J-8 is not clear.

2.3.4. DOSE TO BIOTA

Bruce Power described the radiation dose calculations in ERA Section 7.2.5 Exposure Equations and Exposure Doses. Doses to biota were estimated for reference organisms nominally residing in the aquatic environment at Baie du Doré and reference organisms residing in the terrestrial environment designated as the southwest corner of the WWMF. Bruce Power provided the equations used in estimating dose as well as the input data in Appendix J" Radiation Dose to Non-Human Biota".

The estimated dose to biota were verified by entering the tabulated values in an Excel spreadsheet and calculating internal dose and external dose for deer (large mammal), bird, and benthic fish following the equations presented in Section 7.2.5.

It was found in verifying the calculations for deer with values from Table J-1 the soil surface concentrations (C_{ss} Bq m^{-2}) are not provided. However, dose conversion factors are found in Table J-1 for soil surface ($DC_{ext,ss}$) in units µGy per Bq/kg soil surface and per weight ($DC_{ext,s}$) in units of µGy per Bq/kg in soil. The basis for estimating the external gamma dose to terrestrial biota from radionuclides deposited on the soil surface is not clear.

Different approaches are implemented by Bruce Power in estimating internal dose from tritium concentration in tissues for terrestrial organisms. For deer, the tissue concentration of tritium (C_t = 219 Bq / kg fw) is from measurements. The number of deer samples reported in the annual Environmental Monitoring Reports is limited, and their location when sampled unknown (see Section 2.3.3.1 of this report). For all other terrestrial reference organisms (red fox, bird, amphibian, tree and soil invertebrate), the tissue concentration of tritium is estimated from the measured concentration in air, resulting in a greater tissue concentration (C_t = 8.45E05 Bq / kg fw). Bruce Power also estimated internal dose for deer from C-14 with measured tissue concentrations. Bruce Power acknowledges that using measured tissue concentrations from deer meat results in a lower dose estimate to deer.

Independent verification of dose to terrestrial biota result in total dose rates on the order of 2 µGy per hour for terrestrial biota and 3E-04 µGy per hour for aquatic biota. These dose rates are a small fraction of the UNSCEAR guidance

- Chronic dose rates less than 100 µGy/hr to the most highly exposed individual individuals would be unlikely to have significant effects on most terrestrial communities.
- Maximum dose rates of 400 µGy/hr to any individual in aquatic populations would be unlikely to have any detrimental effect at the population level. [28].

The presentation of radiological dose to biota could be improved by

- Addition of Cs-137 in dose estimates for terrestrial biota
- Addition of Co-60 in dose estimates for aquatic biota
- Estimates of H-3 and C-14 tissue concentrations should be consistent across reference organisms and estimated should be the maximum (or upper 95% CL) for the reference sites.
- Data presented in Appendix J Radiation Dose to Non-Human Biota should be consistent with the description of dose calculations found in ERA Section 7.2.5 Exposure Equations and Exposure Doses.

2.3.5. SUMMARY EVALUATION OF REPORTS AND FINDINGS – RADIOLOGICAL ECOLOGICAL RISK ASSESSMENT

The following observations are provided regarding the Radiological Ecological Risk Assessment provided in the ERA and supporting documents.

Release Rates from the Bruce Power Site

1. Inconsistencies were noted in the presentation results in annual Environmental Monitoring Reports when annual estimates by facility include positive values and less than detection limit values (censored data).
2. Averaging of results is inconsistent, particularly when data sets includes censored values, or they originate from different programs.

Estimates of Concentrations in the Environment

1. The results in annual Environmental Monitoring Reports are often reported without uncertainties for measurements, or when uncertainties are provided they are not defined.
2. Averaging of results is inconsistent, particularly when data sets include censored values.
3. It is noted in comments and reports that the use of detection limits is not consistent from year to year, and as noted in this review the definition and use varies between BP and OPG. The definition provided by BP does not appear to be consistent with CSA 288.4 Anne D. The inconsistency in definition and presentation of data was also noted in CNSCs comments regarding the PQRA (Section 5, Comment 18).
4. The number of samples analyzed seems particularly limited for deer and the location of these samples may result in an underestimate of bounding concentrations specifically for tritium and carbon-14.
5. Interlaboratory comparison results are comprehensive and meet the acceptance criteria provided. The analytical uncertainty used by BP in inter-comparisons should be defined and specified.

Radiation Dose to Non-Human Biota

1. There are inconsistences between the radionuclides evaluated in the Human Health Risk Assessment and the Ecological Risk Assessment, specifically the omission of ^{137}Cs from the dose to terrestrial biota and ^{60}Co from the dose to aquatic biota. The dose contributions to biota are expected to be small but providing a complete assessment would improve understanding of dose from potential food pathways of interest to local communities.

2. The method of calculating internal doses to terrestrial biota from ^{3}H and ^{14}C are inconsistent, with the internal dose to deer based on a small sample set likely not collected at the point of interest. The internal dose from ^{3}H and ^{14}C for other reference organisms are estimated from concentrations measured in air and application of concentration ratios.

Based on the technical review and the observations above, the following recommendations are offered to clearly support the Ecological Quantitative Risk Assessment for Bruce Power's proposed Major Component Replacement project.

1. Provide uncertainties for measurements including performance testing as specified in ISO 17025-2005 section 5.4.6 and CSA 288.4-10 section 9.3.3. [17]
2. Provide a defined basis for review and acceptance of performance testing results consistent with CSA 288.4-10 section 10.4.3.
3. The BP Environmental Management Program should adopt methods found in CSA 288.4 Appendix D [17] regarding the assessment of detection limits and MARLAP [27] regarding reporting of results.
4. Resolve differences in reporting radiological measurements for provincial and site collected samples consistent with CSA 288.4 Section 8.3.4 and Annex D.
5. Provide bounding estimates for radionuclide concentrations in the environment whether determined by modeling or measurement consistent with CSA 288.6-12 Section 7.3.3 [19].

3. POSSIBLE FUTURE DRINKING WATERSTANDARDS FOR TRITIUM

Bruce Power reviews the current Ontario Provincial drinking water standard of 7,000 Bq tritium per Liter and the request to consider a lower standard of 100 Bq/L in Appendix K: "Possible Future Drinking Water Standards for Tritium". The context of the request to consider a 100 Bq/L standard for tritium by Ontario Drinking Water Advisory Council is provided in CNSC *Standards and Guidelines for Tritium in Drinking Water: Part of the Tritium Studies Project* [15].

The CNSC regulates potential releases of tritium to the environment and requires monitoring of effluents for this purpose following CSA standards [16, 18].

Bruce Power notes in Appendix K that privately owned deep wells are monitored twice a year, with most samples having concentrations less than the detection limit of 6 Bq H-3 / liter. One deep well, B37 Mackenzie, Inverhorn, yielded samples with the following average annual tritium concentrations for the period 2009 to 2013. Sampling of this well was discontinued at the request of the well owner.

Table 9. Tritium concentration at BR37 (from [11])

Year	Concentration (H-3 Bq/liter)
2009	22.8
2010	24
2011	25.4
2012	18.7
2013	10.9
Average	20.4

Bruce Power indicates "*The tritium concentrations at this particular deep well are below the current drinking water standard (7000 Bq/L), and based on the trend, it is assumed that the tritium concentration in the BR37 deep well is less than the ODWAC possible drinking water standard of 20 Bq/L.*" It should be noted that tritium decays with a half-life of 12.3 years, so the change due to radioactive decay alone should be approximately a 5 per cent decrease per year assuming no further input. The fluctuations from year to year probably reflect dilution from groundwater flows and inputs which vary annually.

CNSC Standards and Guidelines for Tritium in Drinking Water [15] provides the basis for the current requirement for H-3 concentration in drinking water. The current standard is based on setting a reference dose limit (RDL) one tenth the annual dose limit for a member of the public, or RDL of 0.1 mSv. Following international practice, the Guidance Level (GL) is determined from the following relationship.

$$GL = \frac{RDL}{DCF \times q}$$

Where

RDL = 1/10th of 1 mSv or 1 x 10^{-4} Sv /year

DCF = dose conversion factor, 1.8 × 10-11 Sv/Bq (ICRP)

q = ingestion rate of 2 liter per day or 730 liters per year

The GL for tritium would therefore be calculated as 7,610 Bq/L, which is rounded down to 7,000 Bq/L, the drinking water standard adopted by the Province of Ontario.

Reviewing the derivation of the current guidance level for drinking water, *7000 Bq/L*, there is no risk-based justification for a lower drinking water standard. The history and basis for the current standards are well described by CNSC in *Standards and Guidelines for Tritium in Drinking Water* [15].

4. RESPONSE TO CNSC COMMENTS

Bruce Power provided responses to the CNSC review comments on the draft Environmental Risk Assessment in Appendix L of the ERA [11].

The CNSC comments and a summary of the Bruce Power response is provided below in Table 10. Summary of CNSC comments on January 2015 PQRA. The comments and responses are reviewed in the context of SON's previously expressed concerns and further questions or comments are provided here. BP appears to have addressed CNSC comments numbered 1, 2,4, 6, 7, 8, 10, 11, 12, 19, 21, and 22 as noted in Table 8 of this report.

***CNSC Comment 3**. BP should further clarify the basis for selecting Cs-137 as the representative radionuclide for beta and gamma emitters and provide the rationale for not including alpha emitters in the exposure point concentration and dose assessment.*

Bruce Power addressed the comment from CNSC by including representative radionuclides for gross alpha emissions in the revised ERA. BP indicates Cs-137 is used in the Human Health Risk Assessment "primarily because measurements of Cs-137 in soil in the vicinity of the site are above detection limits and are higher than provincial background locations".

However, it is noted that Co-60 is used as a basis for assessment of dose to terrestrial biota in the ERA. Their remains a concern with the basis for specifying gamma emitters for assessing dose from atmospheric and aquatic releases. In Section 7.1.3 Selection of Radiological Contaminants (for the Ecological Risk Assessment), BP includes Co-60 for terrestrial biota and Cs-137 for aquatic biota. BP suggests that Co-60 is appropriate as "*Co-60 has the highest external dose coefficient and therefore leads to the highest dose among common gamma emitters emitted from Site operations*". The dose depends upon both the quantity released and present in the environment and the dose conversion factor. The selection of Co-60 also ignores the data presented in the 2016 Environmental Monitoring Report Table 34 [10] presenting Cs-137 activity in soil for the 'near area' (average 3.4 ± 4.1 Bq ^{137}Cs / kg dry weight, n=7 average ± 95%CL).

In addition, BP bases future projected radionuclide releases on facility emissions from the period 2012 through 2016. The BP Follow-Up Monitoring Report 2012 [2], for example, presents annual average values of ^{60}Co ranging from approximately 0.5 to 2.2 Bq/Kg in Figure 5 "Mean annual concentration (standard errors) of ^{60}Co (Bq/Kg) in Sediment in sediment (2007-2012)". Presumably these activity concentrations are from past releases with the activity decaying over the subsequent years. It is not clear why future projections do not consider the

possibility that these events may recur, resulting in release of Co-60 and other activation products to the aquatic environment.

RECOMMENDATIONS: The following identify comments requiring resolution to fully support BP's responses and positions:

- As Cs-137 is measured in soils from deposition (see 2016 Environmental Monitoring Report [10]), it should be included in estimates of dose to terrestrial biota.
- There should be a common basis for selecting radionuclides in the Human Health Risk Assessment and the Ecological Risk Assessment, given the Ecological Pathways will include ingestion pathways of interest to Indigenous People?
- The Human Health Risk Assessment and the Ecological Risk Assessment should have a consistent basis regarding effluent releases and quantities and include a reasonable range of estimated releases based on industry and facility experience.

CNSC Comment 5*. BP should confirm as appropriate (e.g., existing information, consultation with provincial authorities) any aquatic habitat that could be affected by the operation of BP and include the entire identified aquatic habitat in the ERA (with reference to the north and south railway ditch).*

BP indicates additional information is provided in Section 2.2.6.1 of the ERA and assessment of Stream C in the ERA captures the upstream contribution of the South Railway Ditch.

RECOMMENDATION: The suggestion of consultation should include First Nations with current interests regarding potential terrestrial and aquatic impacts.

CNSC Comment 14. *BP should clarify whether the selected temperature sites are affected by the thermal plume in the PQRA. (referring to determining ambient temperatures).*

BP indicates that discussion with CNSC and EC on the selection of ambient sites have been ongoing since 2015. BP indicates selecting sites with minimum variation yields sites between Bruce A and Bruce B. BP selected sites 1 and 20 as representative of ambient conditions and indicates the sites are "beyond the known limits of the thermal plume extent known from modeling summer months (June-September)".

ISSUE: The extent of the thermal plume is not presented in the ERA and the potential impact on Lake Whitefish spawning success remains unclear. Specific questions and comments are provided in Section 1.3.4 of this review.

CNSC Comment 15. *BP should provide further detailed analysis of thermal risk quotients and support for the conclusion of low risk to Lake Whitefish population success.*

BP references 2015 ERA section 5.4.3.1 and Table 40 in the same document [11]. BP describes the two approaches as modelled (Approach 1) and measured data (Approach 2), with the modelled data showing HQ values greater than 1 in an area with low numbers of spawning fish and measured temperatures with frequency less than the 25% criteria set by Griffith (1979).

ISSUE: There remains a concern that the extent of the thermal plume is not presented in the ERA and the potential impact on Lake Whitefish spawning success remains unclear. Specific questions and comments are provided on Section 1.3.4 of this review.

CNSC Comment 15. *BP should clarify whether Aboriginal receptor groups and sensitive populations such as pregnant or nursing mothers were considered during the receptor selection process. BP should clarify whether any issues related to the receptor selection were raised by the public, and if so, how these have been taken into account. BP should clarify whether receptors with distinct site access have been considered during the receptor selection process.*

In engagement with First Nations and Métis, BP should initiate a dialogue on their specific interests in terms of monitoring and risk assessment for their specific lifestyles for incorporation in future risk assessments.

BP indicates that “subsistence farm resident”, a revised designation, is representative of Mennonite farmers and other residents who depend on locally grown foodstuff.

BP has added a new receptor “hunter/fisherman” representative of an individual consuming higher quantities of fish and wild game, including Indigenous People. BP indicates a commitment to survey individuals regarding the amount and source location of fish and wild game, and to sample and analyze foodstuff for radioactivity. BP discusses the dose to hunter/fisherman receptor in ERA Sections 4.8.1 and 6.2.5 [11].

It is noted in reviewing annual Environmental Monitoring Reports for 2012-2016 that analytical results for deer have been provided for three samples, one each from 2012, 2013, and 2015. Results for gamma emitters (^{60}Co,^{134}Cs, ^{137}Cs) are only reported in 2012 and 2013.

ISSUE: It remains a concern with ^{137}Cs from facility releases reported in soil but calculations for the dose rate to deer is based on ^{60}Co (Table J-1 Calculations used to determine the dose rate to deer, [11]).

The following long comment has been divided into sections indicated by “a” through “c”.

CNSC Comment 18 a. *CNSC staff expect BP to address concerns about radionuclides other than those formally assessed in this ERA with a detailed response. The response should summarize/update the effluent data on releases of alpha emitters and the key contributing radionuclides from CANDU reactors (for routine operations, as well as any process or refurbishment upsets).*

BP indicates alpha emitters have been included in the revised ERA for the Human Health Risk Assessment and Ecological Risk Assessment.

b. *These data should be discussed in the context of aging management. This information should then be used to explain the framework for how these issues have been addressed and are being routinely monitored by the environmental management system (EMS). The response should also include a retrospective summary of the already-reported data on alpha emitters in liquid effluents to clarify the contributions of various radionuclides to gross alpha, with explanations of anomalies in annual reports, and confusing issues perhaps related to summation of values below limits of detection. Any environmental verification/testing of the presence of radionuclides reported as being present in effluents should also be summarized, or a simple statement provided that no work has been done to investigate this.*

BP indicates recognition of the issue with summing weekly and monthly effluent monitoring data with non-detect values

c. *Lastly, CNSC staff request copies of key supporting references (or reference to when these were sent to the CNSC so that they can be found in our records). In particular, COG-03- 3046 should be provided including any related studies on alpha emitters expected in CANDU operations (e.g. any summary data collected by other operators locally or internationally), along with the presumed chain of controlled documents (laboratory analytical procedures, and effluent and environmental monitoring procedures) that support the logic of how alpha emitters are addressed in the BP EMS.*

BP indicates documents may be obtained following normal document retrieval protocols prescribed by COG.

ISSUE: It is noted the CNSC staff also requested information on key contributing radionuclides from CANDU reactors (for routine operations, as well as any process or refurbishment upsets). Gamma emitting nuclides that may be in local foodstuffs including ^{60}Co,^{134}Cs, ^{137}Cs should be reported in the annual Environmental Monitoring Report and the key contributing radionuclides from CANDU reactors should be documented in the ERA**.**

CNSC Comment 20. *BP should identify any monitoring needs to fill data gaps encountered, validate the modelling results, and verify the major assumptions etc., so as to reduce uncertainty in future human and ecological assessments.*

BP indicates they will follow internal procedures for assessment, corrective action, and process improvement.

ISSUE: There may be an opportunity for First Nations to provide input on identify monitoring needs, data gaps, and modelling verification specifically related to management, use, and harvesting of natural resources including:

- Sampling and analysis of foods including deer, fish, …
- Thermal plume models under cold weather conditions
- Thermal plume modeling and verification
- Presence and density of Lake Whitefish during spawning and harvest seasons.

CNSC Comment 21. *BP should summarize deer data and doses predicted by the ERICA tool. Compare modelled and observed levels of radionuclides in biota for any relevant radiological monitoring data for the terrestrial environment.*

ISSUE: It is noted in reviewing annual Environmental Monitoring Reports for 2012-2016 that analytical results for deer have been provided for three samples, one each from 2012, 2013, and 2015. Results for gamma emitters (^{60}Co,^{134}Cs, ^{137}Cs) are only reported in 2012 and 2013. It remains a concern with ^{137}Cs from facility releases reported in soil but calculations for the dose rate to deer is based on ^{60}Co (Table J-1 Calculations used to determine the dose rate to deer, [11]).

CNSC Comment 23. *BP should clarify and revise as appropriate (exposure doses for biota summarized in ERA Table 56).*

BP indicates the section of the ERA has been updated including calculations and text.

ISSUE: It is noted in reviewing the 2016 Environment Monitoring Report Table J-7 *Calculations used to determine the dose to pelagic fish* the ^{137}Cs tissue concentration C_t is indicated as 0.0 Bq/kg. In the 2016 Environment Monitoring Report Table 36 *2016 Annual Near - Field Fish Data* entries for Baie du Doré Pelagic fish (Lake Trout) average 0.58 ± 0.49 Bq ^{137}Cs/kg (average ± 95%CL, n=8). In Table 38 *2016 Annual Provincial Fish Data* Lake Huron (US) Pelagic (round white fish) results are 0.33 ± 0.67 Bq ^{137}Cs/kg (average ± 95%CL, n=8, <MDL values (3) entered as MDL).

There are apparent differences in results provided in annual Environmental Monitoring Reports and values used in the Ecological Risk Assessment dose calculations.

CNSC Comment 24. *BP should provide an explanation for how the total emissions for Particulate-Gross Beta and Particulate-Gross Alpha were determined in Table 1 of the Screening Level Environmental Risk Assessment. If applicable, provide a revised version of Table 1 of the Screening Level Environmental Risk Assessment with corrected emissions for these radionuclides. If the emission data was used in other areas of the Screening Level Environmental Risk Assessment, corrections should be accounted for.*

BP has revised the ERA, assuming all emissions reported as less than values are equal to the detection limit, and summed emissions for all facilities. The Screening Level Risk Assessment has not been updated.

ISSUE: It is noted in Section 2.2.2 systematic deficiencies in presenting measurement data including definition of detection limit and handling of censored data (less than values). CNSC in comment 18, regarding effluent measurements, requests BP to address “confusing issues perhaps related to summation of values below limits of detection.”

RECOMMENDATION: It is recommended the BP Environmental Management Program adopt methods found in CSA 288.4 Appendix D [17] regarding the assessment of detection limits and MARLAP [27] regarding reporting of results.

Table 10. Summary of CNSC comments on January 2015 PQRA.

Comment	CNSC Comment	Resolution	Assessment
1	*BP should include discussion of uncertainties in routes of exposure to morpholine other than dermal that may potentially occur such as inadvertent oral exposure, consumption of fish and wildlife, etc.*	BP references discussion in section 4.1.4 of the Baseline ERA	ACCEPTABLE
2	*BP should include discussion of derivation of TRVs for morpholine using approach such as QSAR/QSPR in the assessment.*	BP indicates it considered the Quantitative Structure-Activity Relationship or Quantitative Structure-Property Relationship but decided the Health Canada "safe dose" for morpholine used in apple coatings was an appropriate and supported standard.	ACCEPTABLE
3	*BP should further clarify the basis for selecting Cs-137 as the representative radionuclide for beta and gamma emitters and provide the rationale for not including alpha emitters in the exposure point concentration and dose assessment.*	BP included representative radionuclides for gross alpha emissions in the revised ERA. BP indicates Cs-137 is used "primarily because measurements of Cs-137 in soil in the vicinity of the site are above detection limits and are higher than provincial background locations".	ISSUE OR RECOOMENDATION

4	*BP should provide the management system components of the ERA program to confirm compliance with the standard.*	BP references the "Environmental Risk Assessment -Aspect/Impact" procedure DPT ENV-00016 and outlines elements of the review and verification of the ERA	ACCEPTABLE
5	*BP should confirm as appropriate (e.g., existing information, consultation with provincial authorities) any aquatic habitat that could be affected by the operation of BP and include the entire identified aquatic habitat in the ERA (with reference to the north and south railway ditch).*	BP indicates additional information is provided in Section 2.2.6.1 of the ERA and assessment of Stream C in the ERA captures the upstream contribution of the South Railway Ditch.	ISSUE OR RECOOMENDATION
6	*BP should provide the rationale for not including alpha emitters in the exposure point concentration and dose assessment. If such information exists, either from environmental samples or effluent release data, they should be considered in the ERA, or the effect of not including them should be discussed.* *Table 53 includes a list of factors convert the units of measured quantities into units used by IMPACT. The basis for these conversions should be provided.*	BP indicates that alpha emitters are now included for airborne and waterborne releases; conversion factors for IMPACT inputs are now included in Appendix H; and dose by exposure pathway have been included in Appendix I. These changes are verified for the ERA [11].	ACCEPTABLE

	Page 376 of 394 should be added to the ERA document, and the breakdown of dose by exposure pathway should be provided in Appendix I.		
7	*BP should provide an explanation for why the atmospheric chemical contaminants screened into the Screening Level Environmental Risk Assessment were not carried forward to the PQRA for further assessment.*	BP indicates new information became available with the publication of an EDSM (2011) report after the SLRA. An updated EDSM (2015) and information was incorporated in the Baseline ERA.	ACCEPTABLE
8	*BP should consider installing boreholes as necessary to fill any information gaps needed to complete the risk assessment.*	BP references the discussion in ERA Section 2.3.1 and indicates where groundwater water quality data are not available, indirect evidence indicates groundwater was not present.	ACCEPTABLE
9	*BP should provide an explanation as to why the sediment samples were not collected from the Bruce B discharge channel and therefore potential contaminants in the sediments were not screened for in the ERA.*	BP indicates the substrate in the Bruce B discharge channel is bedrock lined with Amourstone. Offshore sediment samples were sampled in 2016 and the information incorporated in the updated ERA. These changes are verified for the ERA [11].	ACCEPTABLE
10	*BP should include and assess, as a receptor, a senior member of the public in the risk assessment.*	BP indicates senior citizens are included in the adult age group and clarification was added to the baseline ERA. The ERA indicates adults include individuals from 16 to 70 years old (ERA Section 6.1.1.1 [11].	ACCEPTABLE

11	*BP should provide a justification for the exclusion of morpholine from the suite of chemicals analyze in drinking water supplies, and clarify whether morpholine concentrations were measured at the water treatment plants which supply drinking water and, if so, was it considered in the drinking water assessment?*	BP indicates morpholine has not been detected at drinking water facilities. BP also points out drinking water testing is regulated by the Safe Drinking Water Act, under which BP is neither responsible or licensed for testing.	ACCEPTABLE
12	*Round whitefish should be used as a VEC species and be included in the ecological risk assessment for potential thermal impacts to fish.*	BP references Section ERA 5.1.1 of the ERA, noting Round Whitefish are included as a receptor for the thermal risk assessment.	ACCEPTABLE
13	*BP should provide further details on how the thermal effects criteria were derived in approach1 and approach 2 and explain why the thermal sensitivity blocks and EC recommended thermal effect values were not considered in the derivation of thermal thresholds.*	BP indicates the thermal criteria selected for the ERA are conservative and consistent with the thermal blocks (for acute, semi-chronic, and chronic effects).	ACCEPTABLE
14	*BP should clarify whether the selected temperature sites are affected by the thermal*	BP indicates that discussion with CNSC and EC on the selection of ambient sites have been ongoing since 2015. BP indicates selecting sites with minimum variation yields sites between	ISSUE OR RECOOMENDATION

	plume in the PQRA. (referring to determining ambient temperatures)	Bruce A and Bruce B. BP selected sites 1 and 20 as representative of ambient conditions and indicates the sites are "beyond the known limits of the thermal plume extent known from modeling summer months (June-September)".	
15	*BP should provide further detailed analysis of thermal risk quotients and support for the conclusion of low risk to Lake Whitefish population success.*	BP references 2015 ERA section 5.4.3.1 and Table 40 in the same document [11]. BP describes the two approaches as modelled (Approach 1) and measured data (Approach 2), with the modelled data showing HQ values greater than 1 in an area with low numbers of spawning fish and measured temperatures with frequency less than the 25% criteria set by Griffith (1979).	ISSUE OR RECOOMENDATION
16	*BP should provide the occupancy times used in the dose calculation for all receptor groups.*	BP indicates the occupancy factor is 20% for all receptors, slightly greater than the 15% obtained through the 2016 Site Specific Survey. Review of the ERA finds the 20% occupancy factor referenced to CSAN288.1-14 in ERA Section 6.2.2. [11].	ACCEPTABLE
17	*BP should clarify whether Aboriginal receptor groups and sensitive populations such as pregnant or nursing mothers were considered during the receptor selection process. BP should clarify whether any issues related to the receptor selection were raised by the*	BP indicates that "subsistence farm resident", a revised designation, is representative of Mennonite farmers and other residents who depend on locally grown foodstuff. BP has added a new receptor "hunter/fisherman" representative of an	ISSUE OR RECOOMENDATION

	public, and if so, how these have been taken into account. BP should clarify whether receptors with distinct site access have been considered during the receptor selection process. *In engagement with First Nations and Métis, BP should initiate a dialogue on their specific interests in terms of monitoring and risk assessment for their specific lifestyles for incorporation in future risk assessments.*	individual consuming higher quantities of fish and wild game, including Indigenous People. BP indicates a commitment to survey individuals regarding the amount and source location of fish and wild game, and to sample and analyze foodstuff for radioactivity. BP discusses the dose to hunter/fisherman receptor in ERA Sections 4.8.1 and 6.2.5 [11].	
18	*CNSC staff expect BP to address concerns about radionuclides other than those formally assessed in this ERA with a detailed response. The response should summarize/update the effluent data on releases of alpha emitters and the key contributing radionuclides from CANDU reactors (for routine operations, as well as any process or refurbishment upsets).* *These data should be discussed in the context of aging management. This information should then be used to explain the framework for how these issues have been addressed and are being routinely monitored by the environmental management system (EMS).*	BP indicates alpha emitters have been included in the revised ERA for the Human Health Risk Assessment and Ecological Risk Assessment. BP indicates recognition of the issue with summing weekly and monthly effluent monitoring data with non-detect values.	ISSUE OR RECOOMENDATION

	The response should also include a retrospective summary of the already-reported data on alpha emitters in liquid effluents to clarify the contributions of various radionuclides to gross alpha, with explanations of anomalies in annual reports, and confusing issues perhaps related to summation of values below limits of detection. Any environmental verification/testing of the presence of radionuclides reported as being present in effluents should also be summarized, or a simple statement provided that no work has been done to investigate this. *Lastly, CNSC staff request copies of key supporting references (or reference to when these were sent to the CNSC so that they can be found in our records). In particular, COG-03- 3046 should be provided including any related studies on alpha emitters expected in CANDU operations (e.g. any summary data collected by other operators locally or internationally), along with the presumed chain of controlled documents (laboratory analytical procedures, and effluent and environmental monitoring procedures) that*		

	support the logic of how alpha emitters are addressed in the BP EMS.		
19	*BP should provide a copy of the 2011 diet survey report to the CNSC.*	BP indicates the results of the 2016 Site Specific Survey were incorporated in the radiological HHRA	ACCEPTABLE
20	*BP should identify any monitoring needs to fill data gaps encountered, validate the modelling results, and verify the major assumptions etc., so as to reduce uncertainty in future human and ecological assessments.*	BP indicates they will follow internal procedures for assessment, corrective action, and process improvement	ISSUE OR RECOOMENDATION
21	*BP should summarize deer data and doses predicted by the ERICA tool. Compare modelled and observed levels of radionuclides in biota for any relevant radiological monitoring data for the terrestrial environment.*	BP has added deer as a representative terrestrial biota in the Ecological Risk Assessment.	ISSUE OR RECOOMENDATION
22	*BP should explain why OBT is not discussed in the ERA, and summarize what is known about OBT in various food chain pathways in the aquatic environment at Baie du Dore and discuss knowledge gaps and the need for sampling and or risk assessment for OBT (and*	BP describes adding Organically Bound Tritium as a contaminant for benthic and pelagic fish in the Ecological Risk Assessment. BP notes the analytical methods and calibration materials are lacking for measurement of OBT in environmental samples.	ACCEPTABLE

	other radionuclides) in this critical habitat near the Bruce A discharge.		
23	*BP should clarify and revise as appropriate (exposure doses for biota summarized in ERA Table 56).*	BP indicates the section of the ERA has been updated including calculations and text.	ISSUE OR RECOOMENDATION
24	*BP should provide an explanation for how the total emissions for Particulate-Gross Beta and Particulate-Gross Alpha were determined in Table 1 of the Screening Level Environmental Risk Assessment. If applicable, provide a revised version of Table 1 of the Screening Level Environmental Risk Assessment with corrected emissions for these radionuclides. If the emission data was used in other areas of the Screening Level Environmental Risk Assessment, corrections should be accounted for.*	BP has revised the ERA, assuming all emissions reported as less than values are equal to the detection limit, and summed emissions for all facilities. The Screening Level Risk Assessment has not been updated.	ISSUE OR RECOOMENDATION

5. REFERENCES

1. Bruce Power, 2005. Environmental Assessment Study Report, Volume 1: Main Report. Environmental Assessment of Bruce A Refurbishment for Life Extension and Continued Operations Project. December 2015.
2. Bruce Power, 2013. 2012 Environmental Monitoring Program Report. B-REP-07000-00005 R00. April 26, 2013.
3. Bruce Power, 2014. 2013 Environmental Monitoring Program Report. B-REP-07000-00006 R00. June 06, 2014.
4. Bruce Power, 2015. 2014 Environmental Monitoring Program Report. B-REP-07000-00007 R00. April 29, 2015.
5. Bruce Power, 2013. Bruce A Refurbishment for Life Extension and Continued Operations Environmental Assessment Annual Follow-up Monitoring Program Report. NK21-REP-07722.07-001. Rev 0, October 2013.
6. Bruce Power, 2014. Bruce A Refurbishment for Life Extension and Continued Operations Environmental Assessment Annual Follow-up Monitoring Program Report. NK21-REP-07722.07-002. Rev 0, October 2014
7. Bruce Power, 2015. Bruce A Refurbishment for Life Extension and Continued Operations Environmental Assessment Annual Follow-up Monitoring Program Report, 2015. NK21-REP-07722.07-003. Rev 0, October 2015.
8. Bruce Power, 2016. Bruce A Refurbishment for Life Extension and Continued Operations Environmental Assessment Annual Follow-up Monitoring Program Report, 2015. NK21-REP-07722.07-004. Rev 0, November 2016.
9. Bruce Power, 2016. 2015 Environmental Monitoring Program Report. B-REP-07000-00008 R00. May 1, 2016.
10. Bruce Power, 2017. 2016 Environmental Monitoring Program Report. B-REP-07000-00009 R00. May 1, 2017.
11. Bruce Power, 2017. Bruce Power Environmental Quantitative Risk Assessment. B-REP-03443-29Jun2017-01.
12. Bruce Power, 2017. Predictive Environmental Risk Assessment for Bruce Power Continued Operations including Major Component Replacement. B-REP-03443-29Jun2017-2. Revision 0.
13. CNSC, 2006. Technical and Quality Assurance Requirements for Dosimetry Services. Regulatory Standard S-1006 Revision 1. May 2006. Canadian Nuclear Safety Commission.

14. CNSC, 2017. Environmental Protection: Environmental Principles, Assessments and Protection Measures. Regulatory Document REGDOC-2.9.1. version 1.1 Canadian Nuclear Safety Commission,
15. CNSC, 2008. Standards and Guidelines for Tritium in Drinking Water: Part of the Tritium Studies Project. INFO-0766. Canadian Nuclear Safety Commission.
16. CSA N288.1-14. Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities. Updated Nov 2017.
17. CSA N288.4-10 Environmental Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills. Reaffirmed 2015.
18. CSA N288.5-11 Effluent Monitoring Programs at Class I nuclear facilities and uranium mines and mills. Reaffirmed 2016.
19. CSA N288.6-12 Environmental Risk Assessments at Class I nuclear facilities and uranium mines and mills. Reaffirmed 2017
20. CSA N288.7-15 Groundwater Protection
21. Environment Canada, 2014. Guidance Document: Environmental Effects Assessment of Freshwater Thermal Discharge. En14-102/2013E-PDF. April 2014.
22. Griffiths, J.S. 1979.Potential Effects of Unstable Thermal Discharges on Incubation of Lake Whitish Eggs. OHRD 79 521 K.
23. Griffiths, J.S. 1980 Potential effects of unstable thermal discharges on incubation of round whitefish eggs. Ontario Hydro Research Division Report Number 80-140-K.
24. Hines, W. W. and D C Montgomery.1990. Probability and Statistics in Engineering and Management Science. 3rd edition. John Wiley and Sons, New York.
25. IAEA, 2005. Environmental and source monitoring for purposes of radiation protection. RS-G-1.8. International Atomic Energy Agency, Vienna, Austria.
26. OPG, 2013. 2012 Results of Radiological Environmental Monitoring Programs. N-REP-03481-10011. April 16, 2013. Ontario Power Generation.
27. USNRC, 2004. Multi-Agency Radiological Laboratory Analytical Protocols Manual. NUREG 01576. U. S> Nuclear Regulatory Commission.
28. UNSCEAR, 2011. Sources and Effects of Ionizing Radiation: United Nations Scientific Committee on the Effects of Atomic Radiation. UNSCEAR Report to the General Assembly with Scientific Annexes. Volume II Scientific Annexes C, D and E. United Nations, New York, 2011
29. Willert, C., and Hart, D. 2010. Administrative Limits for Tritium Concentrations Found in Non-Potable Groundwater. OP-09-3054. April 2010.
30. Wismer, D.A. and A. E. Christie. 1987.Temperature Relationships of Great Lakes Fishes: A Data Compilation. Great Lakes Fish. Comm. Spec. Pub. 87-3. 165p.
31. Nuclear Safety and Control Act (SC 197, c9)

Curriculum Vitae

Michael C. Nichols Ph.D., CHP
146 Vidal Blvd
Decatur, Georgia
Telephone: 404-819-5118
Email: mcnichols@analyticaluncertainty.com

Health Physics and Environmental Assessments

Distinguishing Qualifications

- Technical experience with radiological effluents and environmental monitoring programs for nuclear power plants.
- Strong negotiating skills including experience working with federal and state agencies addressing environmental concerns and protected species.
- International experience with capacity building and working with international regulatory authorities.

Professional History

Health Physics and Environmental Consulting

Technical reviewer for sections of the Thyspunt Site Safety Report, South Africa.

- Reviewed "Evaluation of External Events" including supporting information provided by Environmental Impact Assessments.
- Assessed the methodology for the protection of non-human species
- Assess estimates of maximum radionuclide concentrations that may be expected in flora and fauna from site releases to the atmosphere and marine environments.
- Reviewed the dose screening assessment for non-human species with ERICA
- Assessed the radiological environmental monitoring plan.

Manager, Environmental Laboratory, July 2012 to February 2016, Abu Dhabi, United Arab Emirates.

- Developed project scope and plan for FANR Environmental Laboratory.
- Finalized contract and implementation of Nuclear Monitoring Center hardware and software installation resulting in activation of the Federal Authority for Nuclear Regulation (FANR) gamma dose monitoring network.

- Managed implementation of soil sampling and environmental dose rate measurements across the United Arab Emirates (UAE) to estimate the terrestrial and cosmic contributions to the ionizing radiation background.
- Identified stakeholders and competent authorities in the UAE for establishing the baseline radiological background and with potential for supporting emergency assessments. Implemented bi-annual Environmental Monitoring workshops coordinate with UAE authorities and universities as well as the IAEA.
- Developed project scope, work plan, and contract with RISKAUDIT for design and development of a Radiological Response Vehicle or Mobile Laboratory.
- Reviewed and approved building design for FANR Secondary Standards Dosimetry Laboratory as well as established a contract for design support.

Health Physics Consulting, November 2008 to July 2012

- Primary reviewer for Nuclear Environmental Impact Assessment of the proposed Brakah Nuclear Power Plant, Abu Dhabi, United Arab Emirates.
    - Evaluated Sections of the Preliminary Safety Analysis Report (PSAR) including groundwater movement, atmospheric dispersion, marine dispersion, and dose to individuals and populations.
    - Verified calculations for dose projections provided in the PSAR.
    - Reviewed the Nuclear Environmental Impact Assessment for consistency with the PSAR, including the proposed radiological environmental monitoring program.
- Provided training and workshops for BASF Corporation, US Food and Drug Administration/Federal Emergency Response Networks Laboratories, Westinghouse and, the Georgia Institute of Technology.
- Evaluated and updated Southern Nuclear's Groundwater Protection Initiative for monitoring and corrective actions for tritium in groundwater at three nuclear power sites.

Environmental Manager, Georgia Power Company, March 1992 to November 2008

- Managed four analytical laboratory sections providing Radiochemistry, Dosimetry, Fuel, and Chemistry analytical services supporting nuclear, fossil, and hydro generation as well as transmission, distribution, and corporate organizations.
- Managed Environmental Field Services section supporting nuclear and hydro license renewal, transmission routing, facility site selection, radiological environmental monitoring, aquatic plant management, and water quality monitoring.

- Coordinated support of NEPA assessments for hydroelectric license applications, and nuclear plant license renewal.
- Responsible for 30 employees and operating budget of $3.8 million per year.
- Analytical programs meet the requirements of ISO 17025:" General Requirements for the Competence of Calibration and Testing Laboratories" and accreditation is maintained with the National Voluntary Laboratory Accreditation Program (Dosimetry) and the National Environmental Laboratory Accreditation Conference (Chemistry).

Licensing Supervisor, Air and Water, Georgia Power, Feb 1991 to Feb 1992.

Health Physics and Chemistry Operations Supervisor, Georgia Power, June 1985 to Feb.1991.

Environmental Section Supervisor, Georgia Power, August 1983 to June 1985.

Staff Biologist, Georgia Power, 1978 to 1983.

Assistant Project Director, Institute of Ecology, University of Georgia, 1977 to 1978.

Professional Certification and Education

Comprehensive Certification, American Board of Health Physics through 2021

Ph.D., Radiological Engineering, Georgia Institute of Technology, 2009

M.S. Health Physics, Georgia Institute of Technology, 1985

M.S. Zoology, University of Georgia, 1978

A.B. Biology, University of Michigan, 1973

Appendix E

Assessment of Radioactive Waste and Operational Risk Factors Related to Bruce NGS Relicensing and the Major Component Replacement Plan

April 12, 2018

Prepared by: Chesapeake Nuclear Services, Inc.
Richard Ferch, PhD
Duane M. DeMore, Certified Health Physicist
J. Stewart Bland, Certified Health Physicist

Major Component Replacements

Bruce Power's application for licence renewal for the Bruce NGS includes a request to proceed with the Major Component Replacement (MCR) plan (also referred to as refurbishment). Chesapeake Nuclear Services was asked by the Saugeen Ojibway Nation to examine some aspects of this refurbishment and provide an independent assessment of the impacts. Specific aspects examined by Chesapeake Nuclear staff included:

- timelines (expected ends of lifetime for the Bruce units with and without MCR);
- waste implications (increase in lifetime waste accumulation as a result of performing MCR); and
- impacts on risk due to the longer duration of operation after MCR.

In a major industrial system such as the Bruce power reactors, various system components have a defined operational lifetime, during which there remains a high degree of confidence in the component's reliable functionality. Certain components, in particular those readily accessible and typically smaller, can be replaced during operations and without significant impact (cost or time). However, there are some major components that not only require replacement to ensure operational reliability and safety but whose replacement is sufficiently expensive and time-consuming that a major economic decision has to be made by Bruce Power on whether to refurbish or not. In the case of CANDU nuclear power reactors, the components that are usually considered to fall into this latter category include the fuel channels (including pressure tubes), steam generators (steam generator tubes), and feeder piping. A major outage will be required, involving many months to years where the reactor remains shutdown. The MCR plan's major focus is replacement of all of these in six of the Bruce reactors (Units 3-8). Units 1 and 2 have previously been refurbished and do not come under the MCR.

Of these major components, the fuel channels are expected to reach their end of service lifetimes first. The other major component lifetimes are expected to be longer than those of the fuel channels, but in order to ensure that they do not become the life-limiting major components in turn, they will be replaced during the MCR as well.

The capability to replace fuel channels, including pressure tubes, was built in to the original CANDU reactor design. It was envisaged that replacement of pressure tubes, either individually or *en masse*, might be needed during the lifetime of the plant. Initially, it was not known just how long the pressure tubes would last. It was thought that they might have to be replaced after 15-20 years, i.e., at least once during the nominal 40-year design life of the reactor. As a result of lessons learned from operation and from events such as the pressure tube failure at Pickering A Unit 2 in 1983, various changes have been made to fuel channel design, and to operating and maintenance procedures, which have resulted in significantly longer operating lifetimes for the pressure tubes compared to the original design.

The phenomenon that is considered most threatening to pressure tube lifetime is embrittlement due to hydrogen absorption. At present, the Bruce reactors have a licence condition limiting them to 247,000 Effective Full Power Hours (EFPH) of operation, based on modelling of hydrogen uptake and fracture toughness of pressure tubes. That is around 30 years of on-power operation. CNSC staff is recommending that this limit be changed to 300,000 EFPH, conditional on staff approval of new fracture toughness models to be submitted by Bruce Power by January 2020.

If the reactors are refurbished, their lifetimes would be extended by up to 300,000 EFPH of renewed operation (unless something other than pressure tubes ends up limiting the lifetime). The 300,000 EFPH is around 35 years (depending on whether there are outages for other reasons, which could extend the dates). Units 1 and 2 have been refurbished relatively recently, and their expected end of life date as previously published is around 2043. This date was very likely based on the 247,000 EFPH criterion. If the 300,000 EFPH criterion is applied to Units 1 and 2 as well, that could add an additional 6-7 more years of operation, i.e. out to about 2050, give or take a few years.

Based on Table 16 on page 81 of the CNSC staff submission and the MCR schedule in Table 5 on page 18, and assuming no unexpected extended shutdowns that might extend the dates, our estimates for the approximate end of lifetime for the Bruce reactors is illustrated below. (Note: dates without refurbishment for Units 3-8 are plus or minus a year or so; dates following refurbishment are more speculative.)

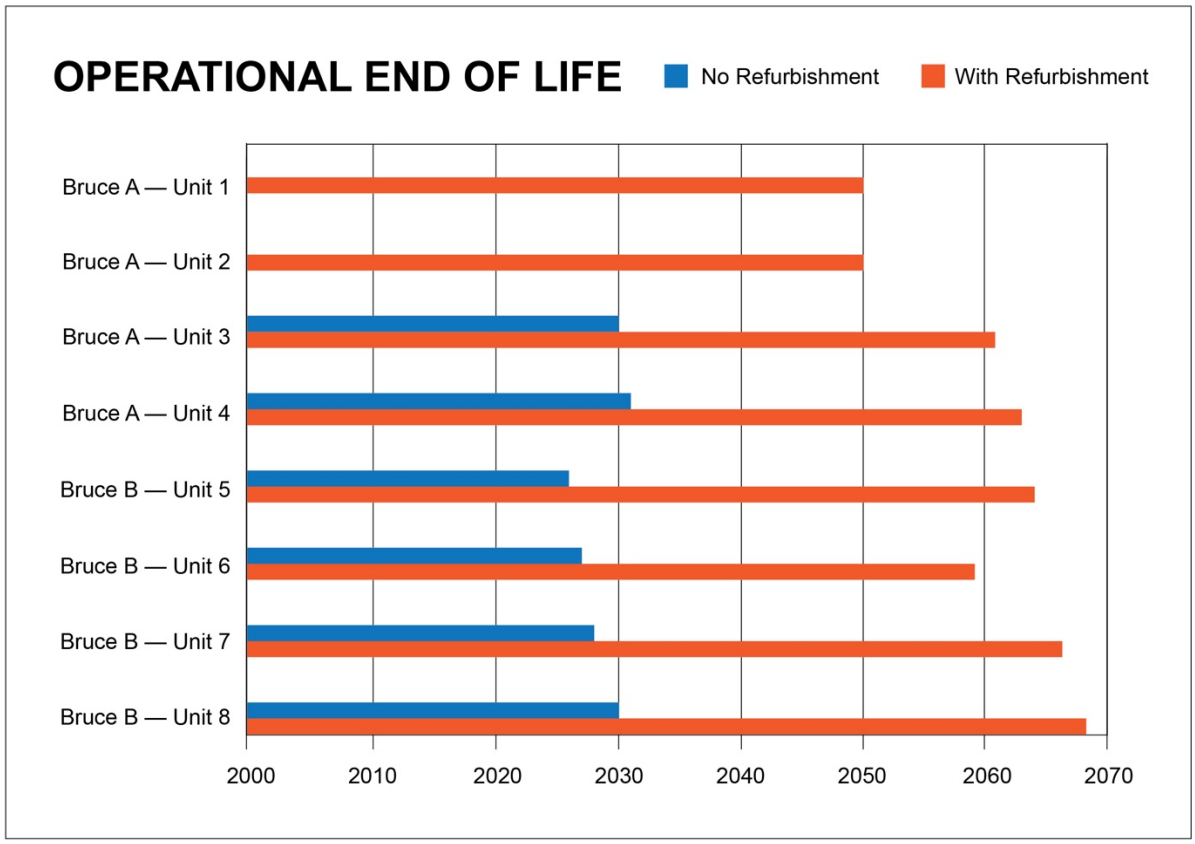


Figure 1: Estimated end-of-life for Bruce A and B reactors with and without MCR

Unit	Operational End of Life – no Refurbishment	Operational End of Life – with Refurbishment
Bruce A, Unit 1	completed	2050
Bruce A, Unit 2	completed	2050
Bruce A, Unit 3	2030	2061
Bruce A, Unit 4	2031	2063
Bruce B, Unit 5	2026	2064
Bruce B, Unit 6	2027	2059
Bruce B, Unit 7	2028	2066
Bruce B, Unit 8	2030	2068

Table 1: Estimated end-of-life for Bruce A and B reactors with and without MCR

Increased Radioactive Waste - Operational

The MCR would have implications on the amount of waste generated and stored at OPG's Western Waste Management Facility (WWMF), both as a result of waste arising during the MCR (notably the old components that are to be removed and replaced, all of which become radioactive waste upon removal from the reactors), and as a result of the increased operational lifetime. To a crude first approximation, if the operational lifetime of the reactors is approximately doubled, that would produce around twice the amount of operational waste from the refurbished reactors. In terms of the overall inventory of waste to be stored at WWMF, the increase is on the order of a 20-25% increase in waste volume relative to the situation that would exist if the MCR at Bruce were not approved (when expressed as a fraction, this also depends on other factors such as decisions about life extensions at OPG's Pickering and Darlington stations, whose operational wastes are transported to and stored at the WWMF).

Increased Radioactive Waste - Refurbishment

The refurbishment itself will generate additional radioactive waste, since it represents a doubling of the lifetime waste inventory production of the major radioactive components that are to be replaced during the MCR. According to the Bruce A Refurbishment Environmental Assessment Study Report, Volume 1, the refurbishment of the four Bruce A units will generate the following waste volumes:

	Volume for Four Refurbishments (m^3)	Assumed Volume for Six Refurbishments (m^3)
Nuclear System Refurbishment	3676	5514
Miscellaneous LLW	4000	6000
Steam Generators	1824	2736
TOTAL	**9500**	**14250**

Table 2: Estimated MCR waste volumes

The Nuclear System Refurbishment waste includes pressure tubes, calandria tubes, inserts, end fittings and shield plugs. If six refurbishments proceed as planned, the increase in waste volume

directly from these refurbishments is approximately 14,250 m^3. According to OPG's assessment[1], the total volume of waste in the DGR could exceed 100,000 m^3.

From a radioactivity perspective, refurbishment activities will generate intermediate level radioactive waste that contains more radioactivity than most operational radioactive waste. In this report, OPG assumes that all reactors (except those at Pickering A) will undergo refurbishment, resulting in a total of 16 refurbishments (4 each from Bruce A, Bruce B, Pickering B and Darlington). Each refurbishment will generate an estimated 7.0 E+14 Bq of radioactive waste, or 4.2E+15 Bq for six refurbishments. This is roughly equivalent to the total activity of radioactive waste expected to be generated for operational activities, 6.6E+15 Bq.

The refurbishment activities will have a significant impact on the total radioactivity of waste that could be generated during these plant lifetimes. As shown in Table 3 below, refurbishment waste will make up an estimated 39% of the waste by radioactivity over the new lifetimes of the units. This increase in radioactivity is a more significant impact than the increase in radioactive waste volumes.

	Volume		Activity	
	(m^3)	percent	(Bq)	percent
MCR Refurbishment Waste	1.4E+04	12%	4.2E+15	39%
Operational Waste	1.0E+05	88%	6.6E+15	61%
Total	1.2E+05		1.1E+16	

Table 3: Estimated waste volumes and activities

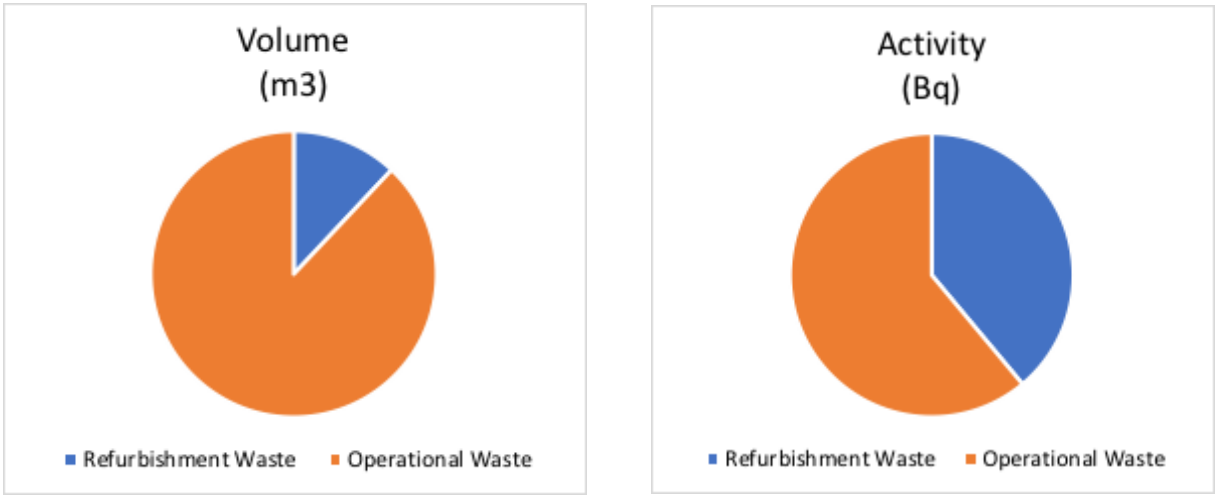


Figure 2: Estimated relative volume and activity of radioactive waste for MCR versus routine operations

[1] Report No.: 00216-REP-03902-00003-R003, Reference Low and Intermediate Level Waste Inventory for the Deep Geologic Repository, Ontario Power Generation, Inc., December 2010.

Risks

The refurbishment will add approximately 300,000 EFPH to the lifetime of each reactor. Multiplied by six reactors, this adds up to a little over 200 reactor-years of additional operation, which is not very different from what has been experienced already. The increased operating life also carries with it the continuing risk of a severe accident and release of significant radioactivity to the environment, which could lead to wide area contaminations of lands surrounding the Bruce site.

Probabilistic Risk Assessments (PRAs) represent very detailed evaluation of a plant's specific design, including its primary and back-up safety systems, and potential system failure rates. This evaluation is used for estimating probabilities of system and component failures, leading to accident conditions with potential for release of radioactivity to the environment. For the Bruce A and B relicensing, CNSC provided an assessment of the probabilities of Severe Core Damage Frequency (SCDF) and Large Release Fraction (LRF) for both Bruce A and Bruce B, as summarized in Table 5, below.[2]

The PRAs for Bruce A and B provided engineering estimates of the probability for the occurrence of a severe accident and release of significant radioactivity to the environment, which could lead to wide area contaminations of lands surrounding the Bruce site. These probabilities are expressed as frequency per reactor year of operation. The increase in operating life represents a corresponding increase in overall risks. Using the CNSC's numbers for a severe accident frequency with a large release fraction, 200 additional reactor-years of operation correlates to a cumulative increased risk of 0.0016, or approximately 1 in 600 probability of a severe accident and release of significant radioactivity to the environment. This increased risk is illustrated in Figure 3, below.

[2] A License Renewal, Bruce Power Inc., Bruce A and B Nuclear Generating Stations, Commission Public Hearing Part 1, Scheduled for 5 February 2015, submitted by CNSC Staff (e-Doc 4601363 (PDF)

	Frequency of Occurrence per Unit	CNSC's Regulatory Safety Goal
Level 1 PRA – Severe Core Damage Frequency (SCDF)		
Bruce A SCDF	3.2E-05 (approx. probability of 1 in 30,000 per year)	1E-04
Bruce B SCDF	2.5E-05 (approx. probability of 1 in 40,000 per year)	1E-04
Level 2 PRA – Large Release Frequency (LRF)		
Bruce A LRF	8.4E-06 (approx. probability of 1 in 120,000 per year)	1E-05
Bruce B LRF	1.9E-06 (approx. probability of 1 in 500,000 per year)	1E-05

Table 4: Bruce A and B Safety Goals

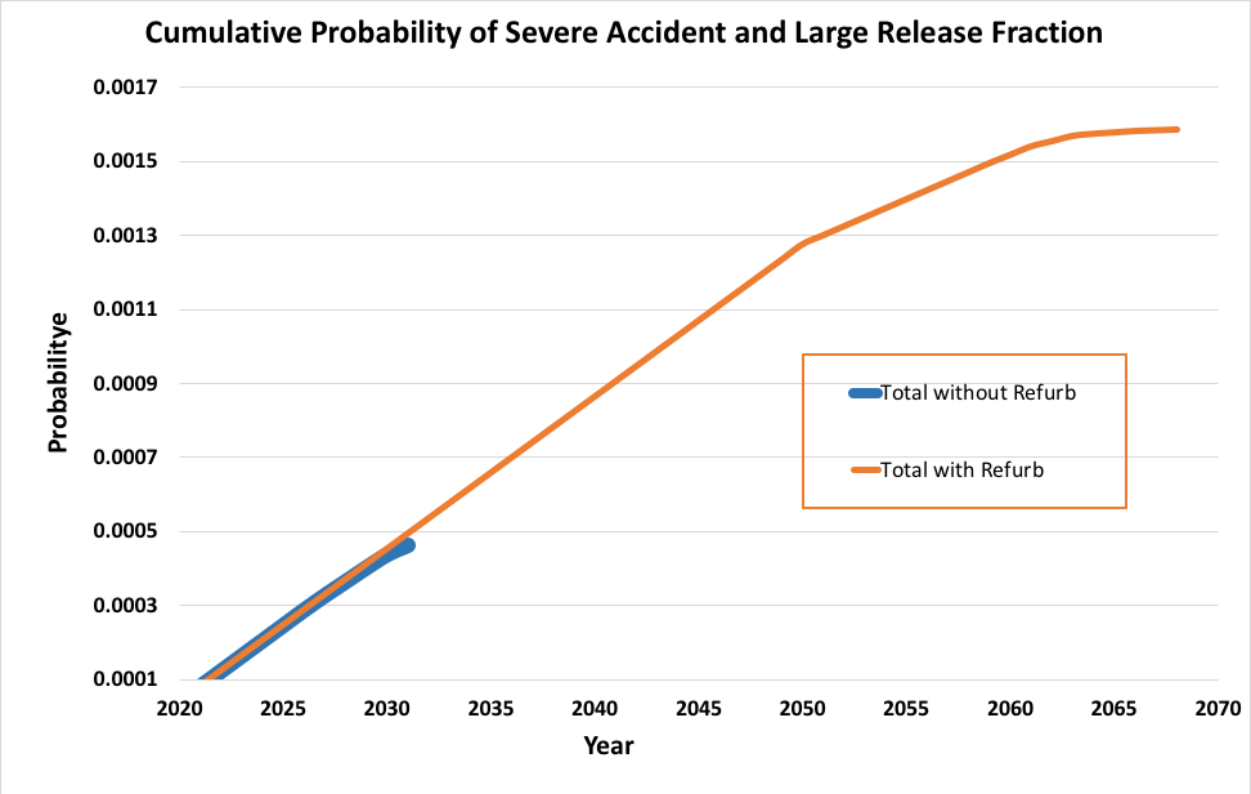


Figure 3: Cumulative probability of severe accident and large release fraction

There is an existing requirement in place for a Periodic Safety Review (PSR) of the Bruce NGS. The purpose of this review, as stated by CNSC staff, is "the determination of reasonable and practical modifications that should be made to the plant or operational programs in order to enhance the safety of the facility to a level approaching that of a modern NPP and to allow for long-term operation." Major products of the PSR study include a Global Assessment Report and Integrated Implementation Plan (IIP). As described on pages 22-24 of the CNSC staff report, the IIP work includes several safety-related upgrades, including in addition to the major components covered by the MCR:

- system upgrades to address Fukushima related action items such as:
    - providing an external water make-up source to the heat transport and moderator system
    - installation of containment filtered venting system to maintain containment integrity and filter radioactive releases
- completion of the new neutronics trip feasibility study
- upgrades to the emergency power generators
- replacement of the maintenance cooling heat exchangers
- upgrades to the fire protection system
- modifications to address heat transport vibrations

The requirement to address the IIP work is separate from approval for the MCR, but, as addressed by the CNSC, it is expected that a number of the items on this list will be carried out during the extended unit outages required for the MCR.

In addition to the Periodic Safety Review requirement, there is also an existing requirement on Bruce Power to develop a policy on safety-related enhancements identified through the Probabilistic Safety Assessment (PSA) process (see the CNSC staff document, pages 151-152). This policy, together with a whole-site PSA methodology, is to be submitted during 2018. While this commitment is independent of the MCR project, the policy would be in effect during and after the MCR project, with the goal of ensuring that the risk per reactor year continues to be controlled.

The annual risk on a per unit basis may be considered acceptable (i.e., within CNSC's regulatory standards); however, when examined collectively for eight (8) units at a single site, each with its extended operating life as afforded by the MCR, the cumulative risks to the current and future generations is not trivial. A decision to proceed with the MCR represents a substantial increase in the total accumulated risk to the SON community. The integrated, cumulative risk should not be dismissed as merely acceptable, being within the CNSC standards, without a structured regulatory review and approval process for the on-going Global Assessment Report and Integrated Implementation Plan, which should also include formal SON engagement.

Curricula Vitae

Richard Ferch is an Associate with Chesapeake Nuclear Services, providing support to the Saugeen Ojibway Nation on nuclear safety and nuclear waste issues. Dr. Ferch was educated at the University of Waterloo and Cornell University and holds a Ph.D. in Applied Mathematics from Cornell. Previous employers include the Cornell University Laboratory for Plasma Studies, AECL's Whiteshell Nuclear Research Establishment, and the Atomic Energy Control Board/Canadian Nuclear Safety Commission, where he served in a variety of positions at the staff, section head and Director levels between 1980 and 2006, including several years as Director of Waste Management and Decommissioning Division. Following his retirement from the CNSC in 2006, he has consulted in the field of nuclear waste and decommissioning safety. In addition to Chesapeake Nuclear Services, his other clients have included the IAEA, the NEA and NWMO.

Duane M. DeMore is a Health Physicist, Certified by the American Board of Health Physics. He received a BS degree in Engineering Physics (Radiological Health) and a ME degree in Radiological Health Engineering, both from the University of Michigan. As a Principal Consultant with Chesapeake Nuclear Services, Mr. DeMore provides radiation protection services to the nuclear industry and government, both within the US and internationally. His operational experience includes ten years in various technical and managerial positions with two nuclear utilities, providing technical, operational and programmatic radiation protection services. In addition, he provided internal dosimetry analyses and dose assessments in support of Department of Energy facilities. Areas of specific expertise include technical radiation protection programs, bioassay and internal dose assessments, radioactive material and dose controls, radioactive waste characterization and classification. Mr. DeMore is also registered by the National Registry of Radiation Protection Technologists (NRRPT).

J. Stewart Bland is a Health Physicist, Certified by the American Board of Health Physics, with over 35 years of experience in radiation safety and environmental assessment. He has a MS degree in Nuclear Safety and a BS in Physics from Georgia Institute of Technology. He has performed radiation safety assessments, environmental transport analysis, environmental impact assessments, and emergency planning covering nuclear power plants, uranium recovery facilities, and radioactive waste disposal sites. Mr. Bland has served as a consultant to the US NRC, US DOE, and internationally to the United Arab Emiratis and the Republic of South Africa’s National Nuclear Regulator for independent safety reviews for new nuclear plants.

Appendix F

FINAL POST-WORKSHOP REPORT September 19, 2017

WORKSHOP FOLLOW-UP REPORT FOR SAUGEEN OJIBWAY NATION – CANADIAN NUCLEAR SAFETY COMMISSION SCIENCE FACILITATION WORKSHOP[1]

C. Scott Findlay,

Department of Biology, Institute of Environment, and Institute for Science, Society and Policy
University of Ottawa

I. BACKGROUND

On May 25th, 2017, I facilitated a discussion between the Saugeen Ojibway Nation (SON), and the Canadian Nuclear Safety Commission (CNSC) as part of an overall consultation in relation to the *Fisheries Act* Authorization ("FAA") required by the Bruce Nuclear Generating Station (BNGS) under the terms of a 2013 Memorandum of Understanding (MOU) between the CNSC and the Department of Fisheries and Oceans (DFO). Pursuant to the MOU, the CNSC undertakes to (a) review license applications for potential impacts to fish and fish habitat; (b) make recommendations for inclusion in any application measures to avoid, mitigate or offset fish or fish habitat impacts, as well as appropriate monitoring and reporting requirements.

The meeting was intended to address SON's long-standing concerns about the effects of the BNGS on the aquatic ecosystems of Lake Huron generally, and specifically those species (lake whitefish (*Coregonus clupeaformis);* deepwater sculpin (*Myoxocephalus thompsonii*) and spottail shiner (*Notropis hudsonius*) identified as Valued Ecosystem Components (VECs) in Bruce Power's 2005 environmental assessment of the refurbishment for life extension and continued operations of BNGS Units 1-4. At that time, the CNSC concluded that life extension activities and the continued operations of the Bruce A facility were not likely to cause significant adverse environmental effects, taking into account identified mitigation measures.

Subsequently, SON's ongoing concerns about entrainment and impingement (E&I) effects were articulated in their comments on the draft Bruce Power's draft Entrainment and Impingement Monitoring Plan (EIMP) in June 2011 and subsequent responses to the revised (final) EIMP in August 2012.

Here I summarize the workshop discussion. Specifically, I describe (a) the issues about which there was some agreement between the Parties (SON[2] and

[1] I am grateful to Jeff Stephenson, Canadian Nuclear Safety Commission, and Dr. Stephen Crawford, University of Guelph, for providing constructive comments on an earlier draft of this report.

[2] Here and subsequently, "SON" is considered to be the Saugeen and Nawash Councils, their representatives and constituencies, members of the Saugeen and

CNSC); (b) issues that are still unresolved; and (c) recommendations about ways by which, I believe, progress might be made on the still unresolved (or only partially resolved) issues.

II. PRIORITY ISSUES[3]

Priority 1.1: Open and transparent communication/dissemination of scientific and technical results and documentation of key elements of decision-making[4].

The issue(s): SON's concerns include (a) obtaining E&I monitoring results and associated scientific and technological information in a timely manner from the proponent (Bruce Power, BP); (b) obtaining feedback from CNSC regarding their (SON's) concerns about the initial and final EIMP generally, and specifically the extent to which these concerns matched those of CNSC and what CNSC had requested of the proponent to address these concerns. More generally, SON/UG was concerned that the revised EIMP was approved, despite SON's concerns and in the absence of feedback from CNSC about their concerns. CNSC noted that (a) it had requested that BP address SON concerns in its (BP's) disposition; (b) that CNSC's evaluation of SON's initial concerns, BP's response, SON's subsequent response and BP's final disposition indicated that there was nothing that was, in CNSC's view, a "show stopper"; (c) there was a need to put an EIMP in place; and (d) that in its (CNSC's) view, remaining outstanding concerns could be addressed through an adaptive management process post- EIMP implementation.

Facilitator comments on the issue: Trust and transparency are critical to good relationships. According to the SON, the failure to ensure that all E&I- relevant scientific and technical (S&T) information acquired by the proponent was made available to them in a timely fashion, and the failure to incorporate E&I relevant information produced by SON/UG in both the draft (2011) and final (2012) EIMP has eroded SON's trust both in BNGS and the CNSC. It has also given rise both to concerns about the "weight" attached to SON science and technology (S&T) input and, more generally (and perhaps more importantly), SON community skepticism

---

Nawash governments, and the University of Guelph scientific advisory team led by Dr. Stephen Crawford.

[3] The numbering of priority issue in this report roughly follows that described in Findlay, C.S. 2017. *Background needs assessment and meeting plan for Saugeen-Ojbway Nation – Canadian Nuclear Safety Commission science facilitation workshop*. Final pre-workshop report, May 22, 2017 (but see footnote 4)

[4] This priority issue combines priority issues 1 ("Timely and open communication and dissemination of results by all stakeholders") and 2 ("Documentation of key elements in the regulatory decision process") from the pre-workshop report cited in footnote 3. Throughout this document, an issue that was not explicitly identified prior to the workshop but was raised during the discussion, or were originally identified as separate issues but are combined here, is given a decimal number designation, e.g. "1.1".

about the science on which regulatory decisions concerning the BNGS are based. For its part, CNSC agrees that notwithstanding considerable efforts to communicate with SON on S&T (and other) issues, communication could be improved by both Parties.

Resolution: CNSC is well aware of, and takes seriously, its responsibility to ensure adequate communication between (a) the proponent and SON; and (b) SON and itself, flowing from its duty to consult and engage indigenous communities pursuant to (among other provisions) s. 35 of the *Constitution Act*, s, 9(b) of the *NSCA*, and s. 3(1.1) of the *General Nuclear Safety and Control Regulations*.

CNSC will, therefore, make best efforts to:

(i) ensure that SON has a complete list of the relevant documents (including standards, guidelines, technical guidance documents, operational policy statements and regulatory documents) and associated rationale for all regulatory decisions that are based in part upon estimates of the E&I (and possibly other) effects of the BNGS. It will, furthermore, ensure that SON is made aware of existing consultations for new (proposed) or revised regulatory documents;
(ii) establish a regular forum for discussions with SON concerning (a) S&T-related issues at the BNGS, including current or proposed regulatory documents, standards, and guidelines; (b) *implementation of current/proposed regulatory frameworks in the BNGS context* (for more on this, see Priority 1.2 and section III below);
(iii) provide copies of all relevant correspondence between BP and CNSC pertaining to E&I effects monitoring and BNGS impacts[5]; and
(iv) provide a summary of SON-CNSC discussions and any associated resolutions in the annual report of the Commission.

Facilitator comments on resolution. Measures (i)-(iv) go some way to directly resolving Priority Issue 1.1(b). However, they do not directly address 1.1(a). One suggestion is that CNSC request that BNGS (a) maintain an updated registry of all research and research projects[6] (including all those commissioned by the proponent) relevant to the environmental effects of the BNGS; and (b) transmit any relevant research products to SON within 30 days of publication, unless there are compelling reasons for doing otherwise[7].

[5] As pointed out by the CNSC, their correspondence with the proponent is voluminous. As such, resolution 1.1(ii) will apply to that correspondence that, in the view of CNSC, pertains directly to the environmental effects generally, and E&I effects specifically, of the BNGS.

[6] Such a registry might, for example, include a brief annotated description of the research as well as research projects when available.

[7] For instance, data or information that might legitimately protected from disclosure under the *Access to Information Act* or the *Privacy Act*. In such cases, it would seem

Priority 1.2 **Implementation of CNSC policies, regulatory guidelines and standards with respect to the potential environmental effects of the BNGS**

The issue(s): The discussion around Priority issue 1.1 led to discussions about the extent to which current and potential future standards and guidelines (S&G) confers sufficient environmental protections. For its part, CNSC pointed out that whatever guidelines and standards are employed, all authorization and licensing decisions are based on site-specific implementation. CNSC also pointed out that all changes to regulatory frameworks include a review period whereby the public is invited to comment on proposed S&G, and that it (CNSC) will be following this process in the development of a new E&I guidance document, forthcoming within the next few months.

Facilitator comment on the issue: In environmental assessment (EA), the initial scoping phase is critical for determining stakeholder trust and confidence, and the credibility of any ensuing regulatory decision. In the same manner, stakeholder[8] confidence in regulatory decision-making depends upon perceptions of the extent to which the implementation of existing standards and guidelines are sufficiently protective of the values they hold.

Resolution: As noted in Issue 1.1 (iii) above, CNSC will engage SON in a discussion concerning:

(a) the standards, guidelines, technical guidance documents, and operational policy statements (current or contemplated) in regulatory decision-making concerning E&I monitoring and assessment, authorizations and licensing, especially those (such as a forthcoming CSA entrainment and impingement guideline) that CNSC is considering incorporating into its regulatory document suite;
(b) local (i.e. site-specific) operationalization and implementation of the regulatory framework.

The goal of this discussion would be to reach agreement on a local operationalization and implementation that addresses SON's concerns about

---

reasonable that the licensee should request that the research products, data or information in question be protected, pursuant to s. 12(1) of the *Canadian Nuclear Safety Commission Rules of Procedure,* and that a copy of this request as well as CNSC's decision be transmitted to the SON.

[8] Here and throughout, I use the term "stakeholder" to mean individuals or institutions with a vested interest in a regulatory decision. I am grateful to Councilor Paul Jones for pointing out that in any stakeholder process, indigenous communities have a special status flowing from rights recognized and enshrined in *s*. 35 of the *Constitution Act* (1982).

environmental protections and respects CNSC's legal responsibilities, conforms to the principles laid out in CNSC REGDOC-2.9.1, *Environmental Protection: Environmental Principles, Assessments and Protection Measures*[9], and is sensitive to the logistical and other constraints and under which CNSC and its staff labour.

Facilitator comments on the resolution: Recommendations concerning the implementation of these measures may be found in Section III of this report.

Priority Issue 2: Hypotheses and predictions

The issue(s): In August 2009, the CNSC accepted the proposed monitoring program associated with the follow-up plan (FUP) to the 2005 Environmental Assessment Study Report (EASR) of the Bruce A refurbishment for life extension and continued operations. This approval was conditional on the proponent's "commitment to continue with separate forums with SON to resolve technical and design details as they arise[10]".

The 2005 EASR included a number of predictions, including:

(1) that the effects of restarting Bruce Units 1 and 2 on rainbow smelt and alewives would be minimal, with no identified residual adverse effects;
(2) that while a measurable (though minimal) increase in entrainment and impingement of lake whitefish (LW), deepwater sculpin (DWS) and spottail shiner (STS) was likely, the residual adverse effects were considered minor and not significant[11].

The 2008 follow-up program (FUP) was designed to "validate the EA findings of no significant entrainment or impingement effects to the aquatic biota as a result of the Project[12]" The 2012 EIMP had, apparently, similar goals[13].

SON's concerns with the 2012 EIMP reflect (1) the lack of a clear translation of the prediction of no significant (minor) adverse effects into specific hypotheses concerned explicitly with mensurable indicators[14]; (2) a clear statement of the

---

[9] http://www.nuclearsafety.gc.ca/eng/acts-and-regulations/regulatory-documents/history/regdoc2-9-1.cfm (accessed June 1, 2017)
[10] Golder and Associates (2012), *p*. 2.
[11] *Ibid*. *pp*. 9-11; see especially Tables 2 and 3.
[12] *Ibid*. *p*. 13.
[13] For example, "Additional Operations Phase related to lake whitefish will involve entrainment monitoring, as proposed in the 2008 Work Plan to validate the EA Study Report predictions pertaining to lake whitefish entrainment" (Golder Associates 2012, *p*. 16)
[14] Here, "indicators" are defined as variables of which empirical measurements or estimates can be made. In the 2012 EIMP, these are referred to as "variables" – see Golder Associates (2012), s. 4.5.2, *pp*. 35-36.

threshold value of these indicators below which the effect is considered "not significant" (i.e. minor); and (3) clear demonstration that the sampling design, protocols and methods; statistical methods; and choice of appropriate referents is sufficient not only to detect effects other than "minor" with reasonable likelihood, but also to permit reasonable inferences that such effects are attributable to BNGS operations and not other factors.

While agreeing that the scientific method involves the formulation of hypotheses, the generation of associated predictions in the context of a particular study, and the evaluation of hypotheses through a comparison of observed and predicted patterns, CNSC noted: (a) that the relevant hypotheses and associated predictions may well depend on the regulatory objective(s)[15]; and (b) a monitoring program designed to test the same general hypothesis (e.g. the hypothesis of no significant adverse effects) may have different local (i.e. site-specific) implementations. The CNSC also noted that in evaluating the proposed EIMP, staff looked to the Electrical Power Research Institute (EPRI) guidance that has been developed to establish best practices for compliance with Phase II rules of §316(b) of the U.S. Clean Water Act[16]. In CNSC's view, BP's EIMP was consistent with this guidance.

Facilitator comment on the issue: All (scientific) evidence-informed regulatory decisions are based in part upon scientific hypotheses that, on the basis of adduced evidence, are taken to be – at least provisionally - true. For example, CNSC's approval of the original FUP was based, at least in part, on its provisional acceptance of the 2005 EASR finding of no significant (minor) adverse E&I effects. In the context of an FUP, these "findings" represent scientific hypotheses which the FUP is

[15] For example, licensing and authorization under s. 24(4) of the *Canadian Nuclear Safety and Control Act* (NSCA) requires that the licensee will make adequate provision to protect the environment. As regards monitoring, "The licensee shall ensure that the results of the environmental monitoring are *used to confirm that the effects on the environment are within the licensing predictions* and adequate provisions are in place to protect the environment." (CNSC RegDoc -2.9.1 v. 1.1, *p*. 24). Under the NSCA, environmental protection is evaluated by CNSC with respect to population-level effects on species considered to be valued ecosystem components. By contrast, authorization under *s*. 35(2)(b) of the *Fisheries Act* requires proponents undertake measures to offset *serious harm* to a commercial or aboriginal fishery. In this case, monitoring is designed to evaluate the success of the offsetting measures (i.e. whether the predicted offsetting effects are indeed realized - Department of Fisheries and Oceans (2013), *Fisheries Productivity Investment Policy: A Proponent's Guide to Offsetting*, p. 18). Although in both authorization contexts, monitoring is designed – at least in part – to test hypotheses, the *relevant* hypotheses depend on the regulatory context.

[16] These guidance documents are available at: https://www.epri.com/#/pages/product/000000000001008470/ and https://www.epri.com/#/pages/product/000000000001011278/

– at least in part - designed to test. Evaluation of these hypotheses necessarily requires that predictions be explicitly specified in terms of those indicators that are the focus of the monitoring program. In other words, given some indicator *X* (e.g. estimated LW adult mortality arising from entrainment and impingement), the monitoring plan must specify, *a priori*, the range of possible outcomes (values of *X*) that are consistent – versus inconsistent – with the hypothesis being evaluated[17].

A crucial question then arises concerning the nature of the monitoring program designed to test the relevant hypotheses[18]. In principle, an effects monitoring program should have (a) a high probability of detecting an effect as large or larger than the predicted effect, given that true effect *is larger* than that predicted; and (b) a low probability of detecting an artefactual effect as large or larger than the predicted effect, given that the true effect is *smaller* than that predicted[19]. But precisely how high or low? Or, put another way: what design

[17] I note here that the it is not simply the relevant hypotheses that depend on the regulatory decision(s) that is/are to be informed by them: so too may the required *precision* of the hypothesis and associated predictions. In the case of a *Fisheries Act* Authorization (FAA), a relevant hypothesis might, for example, generate a prediction about annual LW entrainment and impingement mortality expressed as total adult equivalents. In this instance, the prediction is a *point estimate*. Such an estimate is required because under the *Fisheries Act s*. 35(2)(b), residual adult LW loss must be offset, and measures required to offset an annual loss of, say, 300 adults may be very different than those required to offset a loss of 3000 (or 30) adults.

By contrast, if the hypothesis is one of no significant adverse effects, then testing this hypothesis requires specifying, *a priori*, the range of adult LW losses that would be considered "non-significant" (e.g. 0 - 400) versus significant (e.g. > 400). In this case, the hypothesis generates a predicted *range of estimates*, not a point estimate. Clearly, a predicted *range* has considerably less precision than a predicted *point* estimate. I note that according to CNSC RegDoc -2.9.1 v. 1.1, the former appears to be the type of prediction that is the focus of environmental monitoring under the *NSCA*, for example, "The licensee shall ensure that the results of the environmental monitoring are used to confirm that the effects on the environment are *within the licensing predictions…")* (NSCA, p. 24)

[18] *Any* follow-up monitoring plan concerned with the effects of some undertaking is based on one or more scientific hypotheses. Often the hypotheses are implied, not explicit. But they are there nonetheless. For example, the EPRI guidance documents cited in footnote 16 were developed to assist licensees with compliance with the Phase II rule of §316(b) of the U.S. Clean Water Act that requires an 80-95% reduction in impingement mortality relative to the calculated baseline. Thus, any associated monitoring program is designed to test (to some standard of proof left unspecified, or at least not explicitly specified in the EPRI documents) the hypothesis that indeed impingement mortality has been reduced by at least 80%.

[19] For example, the biological hypothesis of no significant adverse effect implies that the true effect *E* is *no larger* than some threshold *L** that defines the upper limit of a "non-significant" effect. The corresponding statistical null hypothesis is then that

criteria must a monitoring program satisfy such that the regulator is confident enough in the results to make a determination (e.g. that the licensee is/is not abiding by the terms of the license, that indeed there are no significant adverse effects, etc.[20]?

---

the true effect *E* is *greater* than *L**. Consequently, evidence consistent with the biological hypothesis is that which leads to *rejection* of the null, i.e. an estimated effect that lies sufficiently below the threshold *L** to result in rejection of the null, leading to the inference that indeed, the effect is non-significant.

Here there are two possible errors: (I) a true null might be rejected (i.e. in this case, on the basis of monitoring results, the (true) null that $E > L^*$ is rejected, leading to an erroneous inference of non-significant effects); or (II) a false null might be accepted, that is, on the basis of the monitoring results, the (false) null that $E > L^*$ is accepted, leading to an erroneous inference of significant effects. These two errors are negatively related: monitoring programs designed to reduce Type I error will necessarily increase Type II error, and *vice versa*. As such, it has been argued (cogently, in my view) that the determination of appropriate error thresholds requires the calculation of an "optimal" type I error rate that is based on the relative costs of the two types of errors (see, for example, Mudge J.F. et al. (2012) *Setting an optimal α that minimizes errors in null hypothesis significance tests*. PLoS ONE 7(2): e32734. https://doi.org/10.1371/journal.pone.0032734)

[20] During my initial workshop remarks, I suggested to participants they distinguish two sorts of claims: "is" claims, claims about the way the world is, or was, or will be; and "ought" claims, claims about the way the world ought to be. In 1737, the Scottish philosopher David Hume noted that (a) there is a universal tendency to conflate these two types of claims; and (b) that there is no logical connection between them (that is, one cannot logically derive an "ought" claim from an "is" claim).

The question of the threshold quality of a monitoring program required for regulatory decision-making depends on a (usually implicit) evidentiary standard (the so-called "standard of proof" (SoP)). For example, how strong does the evidence need to be of the truth of the hypothesis that adult LW E&I mortality does *not* exceed some value *X* before a regulatory decision (e.g. FA authorization) should be made that is based, at least in part, on the presumption that the hypothesis *is* true?

What constitutes an appropriate SoP is an archetypal question of the "ought" variety. If the regulator considers a lower SoP (say, something akin to the "balance of probabilities" standard employed in the civil law) appropriate, then the required quality of the monitoring program is reduced because it need not be capable of delivering strong evidence that the hypothesis (say, of non-significant adverse effects) is true. By contrast, if the regulator considers a higher standard of proof (say, something akin to the "beyond reasonable doubt" standard employed in the criminal law) appropriate, the required quality of the monitoring program increases because strong evidence of the truth of the hypothesis is required for the regulator to render a decision based on the presumption that, in fact, it *is* true.

Resolution. The Parties agree that any monitoring program (E&I or otherwise) that is, at least in part, designed to support evidence-informed regulatory decision-making must explicitly specify *a priori* (a) the hypotheses that are to be tested and (b) the associated predictions in terms of mensurable indicators. The Parties also agree that depending on both the regulatory decision(s) monitoring is supposed to inform (i.e. the regulatory decision context), hypotheses, the associated predictions and the requirements of the monitoring program itself may vary. Finally, the Parties agree that the requirements of a monitoring program depend on the hypotheses under consideration, the regulatory decision context *and* the standard of proof required for decision-making.

Facilitator comment on the resolution: The above notwithstanding, the workshop discussion on this issue suggests to me that the Parties may well differ with respect (a) the most relevant/important/appropriate hypotheses to be tested in the context of specific monitoring programs (e.g. monitoring under the *NSCA*, monitoring to support a FAA, follow-up monitoring associated with an environmental assessment, etc.); (b) the required attributes of environmental monitoring programs designed to test these hypotheses[21]. Differences of opinion with respect to (b) imply in turn that the Parties may differ with respect to perceived differences in the relative "costs" of Type I and II errors and/or the required standard of proof required to justify an inference (e.g. an inference of non-significant adverse effects[22].

I am persuaded here that a necessary condition for further progress in resolving this (and related) issues is that the Parties consider and explicitly specify: (a) what is, in their view, the most important/relevant/appropriate biological (and associated statistical) hypotheses that monitoring programs should be designed to test; (b) the costs of type I and II errors with respect to the hypotheses specified in (a); (c) the standard of proof (SoP) that is, in the eyes of each Party[23], appropriate to

---

[21] These attributes determine whether a candidate monitoring program is "fit for purpose". Clear, a monitoring program that has high fitness with respect to the testing of hypothesis A need not be fit for testing hypothesis B.

[22] See footnote 20. What constitutes an appropriate SoP, or indeed, an appropriate hypothesis to test in the first place, are questions of (mostly) the "ought" variety. There is no science in the world that can determine, for example, what an appropriate SoP for hypothesis-testing ought to be.

[23] I note here that although CNSC RegDoc-2.9.1 v.1.1 says nothing about standards of proof *per se*, it does state explicitly that in discharging its statutory duty to ensure the environment is adequately protected, the CNSC shall ensure that the protection measures implemented by licensees/applicants "respect the precautionary approach" (p. 6).

There is a large literature on how precisely the precautionary approach should be operationalized in decision-making, but at least one such operationalization holds that (a) the presumption should be that environmental effects of most undertakings (e.g. the operation of nuclear generating stations) are ecologically significant, and (b) that the standard of proof required to overcome this presumption is high (see, for example, Findlay, C.S. and Chalifour, N. 2013. Science

the testing of such hypotheses – and the rationale for same; and (d) the attributes of the associated monitoring plan sufficient for it to be considered "fit for purpose", given the hypotheses in question and the specified SoP.

Priority Issue 3: Cumulative effects assessment (CEA)

The issue. Under *CEAA* (2012, *s*. 19(1)(a)), environmental assessments must consider any cumulative environmental effects that are likely to result from the project in combination with the environmental effects of other physical activities that have been or will be carried out. Cumulative effects have three distinct, but not independent, dimensions: (a) cumulative effects over space; (b) cumulative effects over time; and (c) cumulative effects over activities.

In its review of the 2012 EIMP, SON raised concerns about population–level cumulative effects over time from BNGS operations, as well about the apparent decision (by BNGS) to consider the significance of cumulative effects as pertaining strictly to the residual effects of entrainment and impingement as a result of BNGS Units 1-4 operations, rather than considering the significance of these effects in light of other BNGS-derived stresses (e.g. thermal pollution) as well as non BNGS-derived effects on identified VECs (e.g. commercial LW fisheries). More generally, SON has concerns that environmental monitoring generally, either as stipulated in EA FUPs or as part of the NSCA regulatory regime, be designed in such a manner as to provide adequate characterization of cumulative effects of BNGS operations.

For its part, CNSC acknowledged the difficulties and associated large uncertainties in CEA, especially at the level of individual projects. Some of these difficulties may be reduced for CEA prosecuted in the context of regional environmental assessments (REAs), which at least provide opportunities for more appropriate spatial and temporal bounding and for the determination of baseline conditions. CNSC noted, however, that REAs will almost certainly impinge upon areas of provincial jurisdiction or authority, and as such, would require cooperation

---

and the scientific method. Ch. 2 in *Science Manual for Judges*, National Judicial Institute, pp. 137-139. , available at https://www.nji-inm.ca/index.cfm/publications/ (accessed June 2, 2017)). Such an operationalization suggests that, in the case of E&I monitoring under the NSCA, the CNSC should take as an initial hypothesis that indeed, the environment is *not* being adequately protected, and furthermore require a high standard of proof for the overturning of this presumption. This not only requires specification of the effect level L* above which constitutes inadequate protection, but also the design of a monitoring plan that has a high probability of detecting true effects of magnitude L < L*. I note in passing that such an implementation incentivizes proponents to develop and implement robust and stringent plans, because only such plans can provide the evidence required to exceed the (high) SoP and overturn the presumption. Other operationalizations of the precautionary approach are, of course, possible.

with relevant provincial agencies[24]. CNSC also noted that with respect to cumulative effects of the BNGS, environmental monitoring under the *NSCA* may be a better vehicle than the EIMP, as *FAA* considers only the effects of entrainment and impingement.

Facilitator comment on the issue. There is, arguably, no element of environmental assessment that is more poorly operationalized and prosecuted than CEA. Not only is it difficult to do, it's difficult even to *characterize* it in the first instance. It has been argued (cogently, in my view) that however well-intentioned, high-quality CEA cannot be done in the context of project EAs. This common perspective among EA stakeholders has, in part, contributed to the recent recommendation that federal impact assessment legislation require regional EAs where cumulative impacts may occur or already occur on federal lands or where there are potential cumulative impacts to matters of federal interest[25].

Resolution: The Parties agree that environmental monitoring at the BNGS, whether specifically focused on E&I effects or on environmental effects more generally (as would be the case, presumably, under the *NSCA* and implemented via CNSC RegDoc - 2.9.1 v1.1), should provide a better estimate and understanding of cumulative effects over time, over space, and over activities. The Parties furthermore agree that it is both appropriate and salutary to discuss the issue of what constitutes an appropriate CEA of the environmental effects of the BNGS. CNSC agrees that licensee monitoring may provide information that may be useful in CEA, but points out that such monitoring programs are based on Regulatory Document N288.4-10[26], the provisions of which do not explicitly address cumulative effects.

Still outstanding are two issues: (1) by what process should this consultation occur? (2) in the absence of same, what does CNSC do in the mean time generally, and more specifically with respect to the upcoming FAA?

Facilitator comment on the resolution. I am persuaded that further progress on this issue requires that the Parties explicitly consider and discuss together: (a) their respective views on the appropriate spatiotemporal bounding for adequate cumulative effects assessment of the entrainment and impingement effects

---

[24] The potential advantages to both provincial and federal governments of a systematic and comprehensive REA regime underlies a report by the Canadian Council of Ministers for the Environment (CCME): see CCME (2009) *Regional Strategic Environmental Assessment in Canada: Principles and Guidance*. Canadian Council of Ministers of the Environment, Winnipeg, MB (http://www.ccme.ca/files/Resources/enviro_assessment/rsea_principles_guidance_e.pdf , accessed June 1, 2017)

[25] Final Report of the Expert Panel for the Review of Environmental Assessment Processes (2017), *Building Common Ground*, *p*. 6.

[26] N288.4-10 (R2015), *Environmental monitoring programs at Class I nuclear facilities and uranium mines and mills* (Canadian Standards Association, 2010)

(minimally) as well as other effects (ideally) of the BNGS; (b) the set of relevant past, current or potential future activities that should be considered in future CEA and associated monitoring; and (c) their rationales/justification for (a) and (b). Such a discussion will, at the very least, identify specific areas of agreement/disagreement between the Parties and, in cases of disagreement, hopefully identify whether it arises principally from differing views about the existing scientific evidence (i.e. "is" claims, e.g. whether indeed there is a local, semi-isolated LW population) or differences in the importance attached to specific values (i.e. "ought" claims, e.g. that in establishing baseline conditions for CEA, bounding in time should take into account indigenous knowledge concerning historical whitefish abundance and factors determining changes therein).

With respect to the second question raised above – namely the upcoming FAA – see Priority Issue 5.1 below.

Priority Issue 4: Definition and operational characterization of and "significant" (or "minor") effects, as well as effects and monitoring thresholds.

The issue(s): As noted above, monitoring plans that are, at least in part, designed to test hypotheses about effects must make explicit the range of monitoring results that are (a) consistent, versus (b) inconsistent with the hypotheses in question. In the case of a prediction of, say, no significant adverse effects, this means specifying, *a priori*, a maximum effect threshold L* that distinguishes "significant" from "non-significant" effects. Without such a specification, the hypothesis cannot be tested.

The same issue arises in the context of monitoring thresholds. For example, the 2012 EIMP states that "Operations Phase data will be used to determine whether proposed effects and monitoring thresholds have been met, and will further aid in recommending if additional, longer term or periodic entrainment and impingement monitoring should be undertaken[27]."

As noted in the 2012 EIMP, effects thresholds for LW and DWS "had not been identified nor agreed upon with stakeholders and agencies[28]." Similarly, the EIMP does not include a threshold for E&I monitoring, though it does indicate that monitoring would be discontinued after two years should E&I effects estimates "fall below the agreed upon threshold (to be determined) for effect."[29].

SON's concerns here fall into two classes. First, there is the general concern that establishment of effects thresholds is, in many instances, crucial to monitoring plan design and implementation. For example, if the prediction is no significant effect, then the quality (as defined in Priority Issue 2 above) of a given monitoring plan design depends on what the threshold for significance L* *is determined to be*. So one cannot evaluate the quality of a proposed plan unless L* is specified. Yet as noted above, L* was not – and apparently still has not been –determined.

---

[27] Golder Associates (2012), *p*. 2.
[28] *Ibid*., *p*. 37.
[29] *Ibid.*, *p*. 40.

Second, there is the issue of whether the outcome measure for which an effect threshold L* is determined is appropriate. In the case of LW, the 2012 EIMP identifies this outcome measure as the proportion of equivalent adult lake whitefish E&I mortality relative to the proposed MNR lake whitefish quota in QMA 4-4 for the applicable monitoring year."[30]. SON has grave concerns about the use of this outcome measure for the determination of effects thresholds; similar concerns were voiced about the threshold of effect for STS being based on a comparison with existing long-term source water fish assessment data or established through the performance of annual index sampling in nearby "source" waters.

For its part, CNSC was of the view that, though effects thresholds were not set in the 2012 EIMP, it was nonetheless reasonable that determination of these thresholds would be done post-implementation through an "adaptive management" process[31]. On the issue of appropriateness of outcome measures, CNSC indicated that with respect to LW, it (CNSC) relied upon advice and recommendations from the Ontario Ministry of Natural Resources and Forests (OMNRF)[32].

Facilitator comment on the issue. Effects and monitoring thresholds are critical elements of an environmental monitoring program, with implications not only to the design and implementation, but to appropriate adaptive management based on monitoring results as well as regulatory decision-making. This fact was recognized in the 2012 EIMP, as noted above.

Resolution: Both Parties agree that the determination of effects and monitoring thresholds is crucial to environmental monitoring. Nonetheless, there would appear to be at least some differences of opinion concerning: (a) the appropriateness of thresholds that were identified in the 2012 EIMP; (b) the basis, method and associated rationale for the selection of these thresholds initially; and (c) the extent to which adaptive management methods could, and indeed should, be employed to adjust thresholds in the context of future environmental assessment and/or environmental monitoring.

Facilitator comment on the issue: Recommendations on how these apparent disagreements might be at least clarified, and hopefully resolved, can be may be found in section III of the report below (see especially Section III, Issue 2).

---

[30] *Ibid*., *p*. 37.

[31] Or, in other words, the failure to explicitly identify effects and monitoring thresholds in the EIMP was not a "showstopper", given the commitment to determine thresholds post –implementation via ongoing consultation with stakeholders and relevant government agencies.

[32] At the workshop, Dr. Steve Crawford reported that as a consequence of ongoing differences of opinion between the SON and OMNRF concerning a number of fisheries-related issues, there is now a joint SON-OMNRF forum involving an independent science facilitator that will, hopefully, help resolve some of these concerns.

Priority Issue 4.1: Adaptive management

The issue. Priority Issue 4 prompted animated discussion among participants about the concept of adaptive management, specifically with respect to its definition and operationalization and appropriate implementation, both in the context of E&I monitoring and environmental effects monitoring more generally. Both Parties agree that any definition/operationalization and implementation, at least in the context of environmental monitoring, should provide a means by which information accrued from systematic and rigorous monitoring is used (1) to evaluate the success (or lack thereof) of current mitigation measures and, where indicated, support the development of additional mitigation measures or offsets; (2) to modify elements of the monitoring program itself; and (3) appropriately in regulatory decision-making. Where the Parties apparently disagree is with respect to (a) what adaptive management *means*, and what it *implies*, at least in the context of environmental monitoring, and possibly more generally.

Facilitator comment on the issue: At the workshop, I noted that notwithstanding potentially different views on what adaptive management *means* in the context of environmental monitoring (and regulatory decision-making based on the results thereof) one needs to be clear, at the outset: (a) what elements of a monitoring program it is *both reasonable and appropriate to adaptively manage*; and (b) for those elements that are determined to be subject to adaptive management, *how* they will be adaptively managed.

The failure of proponents to explicitly consider (a) and (b) at both the design and implementation stages of environmental monitoring programs has, in part, led to the pervasive tendency of both proponents *and* regulators to regard adaptive management as the default method for dealing with all manner of scientific uncertainty[33]. For example, the recent review of the federal environmental assessment process notes that adaptive management is poorly operationalized in the federal EA process, a problem that often leads to its inappropriate use by proponents as a means of avoiding mitigation[34].

---

[33] For a comprehensive and lucid treatment of this and related issues, see the January 2, 2017 submission, by M. Olszynski and A. Kwasniak to the federal EA review panel, available at: http://eareview-examenee.ca/wp-content/uploads/uploaded_files/EA_Review_MONITORING_PAPEROlszynskiKwasniak.pdf (accessed June 5, 2017). CNSC also pointed out that deferring the threshold issue allowed monitoring to proceed without delay. While delays in monitoring certainly have attendant benefits, these benefits need to be balanced against the costs (e.g. insufficiently robust and powerful sampling designs) of implementation without first addressing the issue.

[34] Final Report of the Expert Panel for the Review of Environmental Assessment Processes (2017), *Building Common Ground*, *p*. 42.

Yet adaptive management *is* an important approach for dealing with scientific uncertainty. *CEAA* (2002, *s*. 38(5)) noted that "…results of follow-up programs may be used for implementing adaptive management measures or for improving the quality of future environmental assessments" and indeed, provided a corresponding operational policy statement[35], no such provision exist in CEAA (2012)[36]. Although the *NSCA* itself makes no reference to adaptive management, RegDoc -2.9.1 explicitly cites adaptive management as a core underlying principle of environmental protection, particularly as concerns the identification and "implementation of new or modified mitigation measures over the life of a project to address unanticipated environmental effects." [37] (RegDoc 2-9.1, *p*. 56)

Resolution: The Parties agree that it would be both useful and salutary to convene a forum in which they attempt to arrive at a consensual (a) definition and meaning of adaptive management in the context of environmental monitoring (and regulatory decision-making based in part on the results thereof); (b) determination of *what* elements of environmental monitoring programs (E&I and/or otherwise) for the BNGS should be adaptively managed; and (c) determination of *how* these components/elements should be adaptively managed.

Priority Issue 5.1: Quality of the 2012 EIMP, the reliability of E&I estimates derived therefrom, and implications to the *Fisheries Act* Authorization application by the proponent.

The issue(s): The final pre-workshop report included a broad range of additional issues, ranging from entrainment and impingement operational definition and characterization (Priority issue 6) to E&I mortality estimation (Priority issue 12), that, from SON's perspective, have undermined the ability of the EIMP to generate appropriate and accurate estimates of the E&I effects of the refurbishment for life extension and continued operations of BNGS Units 1-4. SON is especially concerned that - these issues notwithstanding - the proponent's FAA application is apparently based on estimates from the 2013 and 2014 EIMP results and associated inferences,

[35] Canadian Environmental Assessment Agency (2009) *Adaptive Management Measures under the Canadian Environmental Assessment Act*. Report 978-1-100-12062-1 ISBN: En106-83/2009E, available at: http://www.ceaa.gc.ca/Content/5/0/1/50139251-2FE4-4873-B6A1-A190C103333D/Adaptive_Management_Measures_under_the_CEAA.pdf (accessed June 4, 2017).

[36] Nonetheless, both proponents and regulators continue to rely on adaptive management in FUPs under CEAA (2012) – see M. Olszynski and A. Kwasniak (2017) in footnote 26, *p*. 5.

[37] Presumably such "unanticipated effects" come to light through on-going environmental monitoring. Additional or new mitigation measures would also be indicated if monitoring identified effects *greater* than those under which licenses or authorizations were granted.

in particular, an estimate of annual E&I LW adult equivalent mortality of 397 fish. From SON's perspective, the issues it identified with the (implemented) 2012 EIMP render any such estimate unreliable. In light of this unreliability and CNSC's commitment to the precautionary principle in decision-making, SON believes that there is, at present, insufficient evidence to support a FAA recommendation by CNSC under the terms of the 2013 DFO/CNSC MOU. As such, SON believes that consideration of FAA should be deferred until such time as the implications of the (what it considers) important shortcomings and limitations of the 2012 EIMP to E&I effects estimates are thoroughly explored.

For its part, CNSC pointed out that:

(a) there is a real interest, on both the part of government and the public, in swiftly bringing existing nuclear facilities into compliance with the provisions specified in the 2013 CNSC/DFO MOU pursuant to the *Fisheries Act* amendments of 2012;

(b) notwithstanding the fact that E&I effects based on the 2012 EIMP may be underestimated, these effects would be considered "serious harm" under the *Fisheries Act*, and therefore must be offset if authorized. Deferring authorization means delaying offsetting, with potential consequences to population dynamics of DWS, STS and (especially) LW;

(c) In principle at least, CNSC could require the uncertainty arising from potential unreliability of E&I effects estimates (and in particular, their underestimation) based on 2012 EIMP results to be addressed in the proponent's FAA application.

Facilitator comment on the issue: There are at least two unanswered but potentially important questions the Parties might wish to consider here:

(1) the shortcomings and limitations of the 2012 EIMP identified by the SON have resulted in how large an underestimate of the true E&I effects? I note that implementation of CNSC's suggestion (c) above requires that this question be answered, at least at some level;

(2) what are the implications to CNSC's discharging its regulatory responsibilities with respect to BNGS if it proceeds with a FAA, notwithstanding SON's concerns? Doing so would seem to imply that the 2012 EIMP, as implemented, was "good enough"; does this not constrain CNSC's ability to require future changes of the proponent ("It was good enough in 2012! So why are you asking making us change it now? If you didn't think it was good enough then, why did you approve it?")[38]

[38] CNSC has pointed out that while there may be some concern about precedent, , in exercising due diligence it is fully empowered – indeed required – to consider the implications to operations, monitoring etc. should new information and data indicate that previous conclusions, and decisions arising therefrom, must be reconsidered. I am grateful to Jeff Stephenson for making this point.

Resolution: The Parties agree that: (a) CNSC will investigate the possibility of delaying the FAA application process; (b) SON will support any request for delay or deferral. In the interim, the Parties agree to a forum that would consider, among other things:

(1) the degree to which estimates of E&I effects might plausibly have been – and perhaps continue to be - underestimated, in light of identified shortcomings/limitations of the EIMP, as well as the implications of any such estimates to the FAA process[39].
(2) SON's concerns with provincial fisheries quotas, and the potential implications of same to E&I monitoring and Fisheries Act authorizations.
(3) the issue of the threshold adequacy and reliability of E&I monitoring data (and inferences therefrom) specifically, as well as *NSCA*- related environmental monitoring data more generally, required to support regulatory decision-making; and
(4) the state of existing knowledge, both western scientific and indigenous, on E&I effects, and how this ought to properly be reflected in future BNGS (and potentially other nuclear generating facilities) environmental assessments, monitoring plans, and regulatory decision-making.

III. CONCLUSIONS AND RECOMMENDATIONS

The May 25th workshop made some progress on a number of SON/CNSC concerns. Perhaps more importantly, there was genuine interest expressed by both Parties in continued discussion to at least clarify - and hopefully resolve - outstanding issues. It was proposed that such discussions might best take place in the context of sessions that would focus on a comparatively narrow range of issues. There was a strong feeling by both Parties that issue-specific sessions would allow not only for focused discussion but would allow session organizers to identify particular required areas of expertise and solicit input or participation from relevant institutions and/or experts (e.g. fisheries scientists from DFO or OMNRF)

To this end, SON/CNSC might wish to consider the following focus topics:

Issue 1: Site-specific implementation of CNSC regulatory decision-making framework for environmental effects of the BNGS

This session would focus on the site-specific application, operationalization and implementation of the existing CNSC regulatory and decision-making framework

[39] The issue of the extent to which estimates of annual mortality are likely to be underestimated is critical to Fisheries Act authorization. The FAA allows for the stipulation of enhanced offsets to account for the risk of overestimation. Estimation of the required enhancement therefore requires an estimate of the extent to which annual mortality is likely to have been underestimated.

with respect to the environmental effects of the BNGS, with particular focus on the current and contemplated future suite of regulatory documents, standards, and guidelines Such a session might, for example, include:

(a) A presentation by CNSC on the set of policies, guidelines and regulatory documents that are currently, or likely will be, employed in future decision-making; the "tests"[40] that such guidelines, policies or standards give rise to; and how CNSC goes about determining the extent to which an authorization or license application satisfies these tests; and the weight ascribed to these tests in decision-making.
(b) Presentations by CNSC on what site-specific factors are considered with respect to the local (i.e. BNGS) application or implementation of the general decision-making framework described in (a), and the weight ascribed to such factors.
(c) An open discussion between the Parties that would focus on (i) the extent to which the current or contemplated regulatory framework and associated regulatory tests is sufficiently protective of identified environmental values; (ii) what modifications to existing tests, or what additional tests, would be required to ensure sufficiently rigorous and comprehensive environmental protections at the BNGS site; and (iii) the extent to which these potential modifications satisfy other important operational and administrative criteria, e.g. respect CNSC's legal responsibilities, conforms to the principles laid out in CNSC REGDOC-2.9.1, *Environmental Protection: Environmental Principles, Assessments and Protection Measures*, and are sensitive to the logistical and other constraints under which CNSC and its staff labour.

Issue 2: The role and application of the scientific method in environmental monitoring.

As noted in Priority Issue 2 above, the Parties agree that any monitoring program designed to support evidence-informed regulatory decision-making must specify the hypotheses that are to be tested, as well as the associated predictions. This session would attempt to come to an agreement between the Parties concerning:

(a) the set of ecological or biological hypotheses that should be the focus of environmental monitoring in general (as might be carried out, e.g. under the NSCA) or E&I monitoring specifically at the BNGS, as well as the

[40] I use "regulatory test" here in its broadest sense. Clearly, one such class of tests is those that might be employed to evaluate compliance (e.g. with the terms of a license or authorization). Another might evaluate the extent to which a proposed environmental monitoring plan is of sufficient quality so as to satisfy suggested standards of proof as articulated in, e.g. policy guidelines. Such tests are generally required at a greater resolution ("granularity") than standard regulatory compliance tests.

associated statistical null hypotheses (where relevant) and ecological/biological/statistical predictions[41].

(b) the appropriate burdens and standard of proof for the testing of the hypotheses given in (a) - and the associated rationales;
(c) criteria for determination of both effects thresholds and monitoring thresholds, and application of these criteria to determine appropriate thresholds;
(d) the threshold adequacy and reliability of environmental monitoring results (whether from E&I specifically, or from more general environmental monitoring) that is/ought to be required to support regulatory decision-making, *given* (a) - (c); and
(e) the implications of (a)-(d) to the EIMP currently in force. That is, if, for example, the Parties come to agreement on the issue of an appropriate standard of proof, the implications of this standard should be operationalized by means of prescriptive recommendations for revision of the current EIMP.

Issue 3: Cumulative environmental effects assessment of the BNGS

During the workshop, the Parties that environmental monitoring at the BNGS should provide a better estimate of cumulative effects over time, over space, and over activities. How such estimates might best be obtained was considered an important issue, but one for which there was insufficient time to thrash out. Further progress on this issue will require the Parties to:

(a) Present their respective views on the appropriate spatiotemporal bounding for adequate cumulative effects assessment of the E&I effects (minimally) as well as other effects (ideally) of the BNGS, as well as the underlying rationale for same;
(b) Specify the set of relevant past, current or potential future activities that should, in their view, be considered in CEA and associated monitoring[42];
(c) Consider the implications of (a) and (b) to project versus regional environmental assessment. Of particular importance here would be the extent to which CEA for the BNGS could feasibly be prosecuted in the context of project EA, versus requiring regional assessment.

[41] This discussion would also require the characterization and operationalization of "significant adverse effects", as well as a determination of thresholds for both effects and monitoring (see Priority Issue 4, *p*. 12)

[42] I note here that in many CEA contexts, indigenous knowledge plays a particularly important role. Consequently, resolution of this issue will, I suspect, require consideration of the role of indigenous knowledge generally, and more specifically, the weight given to such knowledge (where available) in the determination of operational parameters of CEA, especially spatiotemporal bounding and the determination of both baseline and threshold effects.

Issue 4: Operationalizing adaptive management of BNGS environmental effects

The workshop discussion on this topic has given rise to my suspicion that, while both Parties view adaptive management as a key strategy for environmental protection, they differ in (a) its definition and characterization; and (b) the operational implications of different definitions/characterizations in the context of environmental monitoring and evidence-informed regulatory decision-making. This in turn suggests that considerable progress might be made in a forum in which the Parties discuss, and attempt to reach agreement on:

(a) the meaning and characterization of adaptive management in the context of environmental monitoring and regulatory decision-making based in part on the results thereof[43];
(b) *which* elements of environmental monitoring programs (E&I and/or otherwise) for the BNGS should be adaptively managed; and *how* these components/elements should be adaptively managed.

Issue 5: E&I monitoring reliability and Fisheries Act authorization[44]

The pre-workshop report identified a range of concerns with the 2012 EIMP, from entrainment and impingement operational definition and characterization to E&I mortality estimation. In SON's view, these shortcomings and limitations have undermined the ability of the EIMP to generate accurate estimates of the E&I effects of the BNGS. Yet these estimates are being employed by the proponent in its application for authorization under the *Fisheries Act*.

In an attempt to come to resolution on this issue, I propose a technical session that would focus on a number of specific questions:

(a) the degree to which estimates of E&I mortality of VECs might plausibly have been – and perhaps continue to be - underestimated, in light of shortcomings/limitations of the EIMP as identified by SON;
(b) what threshold adequacy and reliability of E&I mortality estimates is required to support an Fisheries Act authorization in the first instance;

[43] The possibility arises that the most appropriate (or rather, useful) meaning and characterization of adaptive management in the context of environmental monitoring may depend on the regulatory issue at hand. For example, adaptive management of E&I monitoring to support *Fisheries Act* authorization may take a different form than that required for license authorization under the *Canadian Nuclear Safety Act.*

[44] In its review of an earlier version of this document, CNSC indicated that of the 5 suggested workshops, this one was top priority.

(c) if the results of E&I monitoring since 2012 are considered to satisfy the threshold reliability specified in (b), what should the regulator request of the proponent as part of the FAA, given (a)?
(d) if the results of E&I monitoring since 2012 are considered to not satisfy the threshold reliability specified in (b), what are the implications to the FAA process? In particular, what size of enhanced offset might be appropriate to compensate for potential underestimation of LW annual adult mortality?

ACKNOWLEDGEMENTS

I thank all the workshop participants for their contributions to the discussion, and for conducting themselves in a thoroughly professional manner that respected the workshop "terms of engagement". I particularly thank Jeff Stevenson (CNSC) and Steve Crawford (University of Guelph) for their exemplary efforts in the workshop lead-up (including answering many questions the answers to which I ought to have known without asking), Jeff for making available his workshop notes, and Steve for his clear and lucid presentation of SON's concerns during the workshop proper. Finally, I thank both CNSC and SON for the opportunity to both participate in the discussion and - or so it pleases me to believe - assist them in coming to some resolution on several of the outstanding issues.

APPENDIX A: MAY 25TH WORKSHOP ATTENDEES

Canadian Nuclear Safety Commission

Barbara Dowsley, Environmental Risk Assessment Specialist, ERAD
Caroline Ducros, Director, EAD
Kevin Ji, Environmental Risk Assessment Specialist, ERAD
Ken Lun, Regulatory Program Officer, BRPD
Andrew McAllister, Director, ERAD
Kim Noble, Team Leader – Aboriginal Consultation and Participant Funding, PAIRD
Mike Rinker, Director General, DERPA
Jeff Stevenson, Power Reactor Site Inspector, BRPD
Josue Wamegni, Environmental Program Specialist, ECLSD
[45]

[45] BRPD – Bruce Regulatory Program Division; DERPA – Directorate of Environmental and Radiation Protection Assessment; ERAD – Environmental Risk Assessment Division; EAD – Environmental Assessment Division; PAIRD – Policy, Aboriginal and International Relations Division.

Saugeen-Ojibway Nation

Randall Kahgee, Legal Counsel, Saugeen Ojibway Nation
Joselyn Keeshig, Manager, Saugeen Ojibway Nation Environment Office
Paul Jones, Nawash Council
Kathy Jones, Nawash Council
Cheryl Johnston, Nawash Council
Alex Monem, Legal Counsel, Saugeen Ojibway Nation
Sara Rohani, Legal Counsel, Saugeen Ojibway Nation
Randy Roote, Saugeen Council
Cheree Urscheler, Saugeen Council

University of Guelph

Clayton Coppaway
Dr. Steve Crawford
Juliana Van Adrichem

Saugeen Ojibway Nation-Bruce Power (SON-BP) Collaborative Lake Whitefish Research Program

University of Guelph Team Analysis of Bruce Power Responses to University of Guelph Team Comments on "BRUCE A REFURBISHMENT FOR LIFE EXTENSION AND CONTINUED OPERATIONS ENVIRONMENTAL ASSESSMENT FOLLOWUP PROGRAM Draft Operations Phase Impingement and Entrainment Monitoring Plan" (Golder Associates, July 2011)

07 August 2012

Dr. Stephen Crawford
SON-UofG Faculty Partnership/Department of Integrative Biology, University of Guelph

Dr. Daniel Gillis
SON-UofG Faculty Partnership/School of Computing Science, University of Guelph

Dr. Robert Hanner
Department of Integrative Biology, University of Guelph

Dr. Andrew Binns
Department of Integrative Biology, University of Guelph

SON-BP Collaborative Lake Whitefish Research Program

University of Guelph Team Analysis of Bruce Power Responses to University of Guelph Team Comments on "BRUCE A REFURBISHMENT FOR LIFE EXTENSION AND CONTINUED OPERATIONS ENVIRONMENTAL ASSESSMENT FOLLOWUP PROGRAM Draft Operations Phase Impingement and Entrainment Monitoring Plan" (Golder Associates, July 2011)

Purpose of this document

In July 2011 Bruce Power distributed to Federal/Provincial regulatory agencies, the Saugeen Ojibway Nation, and stakeholders a draft of its Entrainment/Impingement Monitoring Plan:

> Golder Associates. 2011a. Bruce A Refurbishment for Life Extension and Continued Operations Environmental Assessment Followup Program: Draft Operations Phase Impingement and Entrainment Monitoring Plan. Report 11-111151-0243 Submitted to Bruce Power, Tiverton, Ontario. 28+pp.

On 05 October 2011 the University of Guelph Team of the Saugeen Ojibway Nation-Bruce Power (SON-BP) Collaborative Lake Whitefish Research Program responded to a request from the Saugeen Ojibway Nation and sent Bruce Power a technical document with scientific and technical comments regarding the draft E/I Monitoring Plan:

> Crawford, S., Gillis, D., Hanner, R., and Binns, A. 2011a. Saugeen Ojibway Nation-Bruce Power (SON-BP) Collaborative Lake Whitefish Research Program, University of Guelph Team Comments Regarding "Bruce A Refurbishment for Life Extension and Continued Operations Environmental Assessment Followup Program - Draft Operations Phase Impingement and Entrainment Monitoring Plan" (Golder Associates, July 2011). SON-BP Collaborative Lake Whitefish Research Program, University of Guelph, Guelph, Ontario, Canada. 85pp.

In March 2012, Bruce Power released a revised draft of the Entrainment/Impingement Monitoring Plan:

> Golder Associates. 2012a. Bruce A Refurbishment for Life Extension and Continued Operations Environmental Assessment Followup Program: Operations Phase Impingement and Entrainment Monitoring Plan. Report 11-111151-0243 Submitted to Bruce Power, Tiverton, Ontario. 48+pp.

The University of Guelph Team received a letter from Bruce Power dated 16 May 2012, thanking them for their input on the draft E/I Monitoring Plan, stating “The monitoring plan has been revised following the workshop and submission of written comments. Your comments have been incorporated and helped to improve the Impingement and Entrainment Monitoring Plan.” Unfortunately, a search of the revised draft of the Entrainment/Impingement Monitoring Plan made no reference to the University of Guelph Team’s comments, and it was not clear to what extent Bruce Power had actually responded to those comments in the revised plan.

The purpose of this document is to provide an assessment of the revised March 2012 Bruce Power E/I Monitoring Plan, with specific reference to the comments previously provided to Bruce Power by the University of Guelph Team. For ease of reference, this document uses the same format as the University of Guelph document that had been provided to Bruce Power. Specifically, we re-present our original coded comments that were previously provided to Bruce Power, and evaluate the degree to which Bruce Power has responded to the issues raised in those scientific/technical comments. The original UG comment is followed by identification of 'BP Response' in response to the UG comment, and in the cases where there were Response, a 'UG Team Evaluation of the Bruce Power Response.’

For the n=296 comments provided by the University of Guelph Team on the draft E/I Monitoring Plan, we evaluated the responses by Bruce Power in three general categories:

Response Satisfactory = 16/296 (5.4%)

Response Unsatisfactory = 103/296 (34.8%)

No Response = 177/296 (59.8%)

The University of Guelph Team remains seriously concerned that the vast majority of their comments (280/296 = 94.6%) were either ignored by Bruce Power, or were responded to in a manner that did not deal effectively with the issues and concerns that were raised.

General Comments:

UG-001	There is no reference in the draft E/I Monitoring Plan to the WINGS Project that was undertaken by Nawash-OPG-BP at the University of Guelph, specifically to scope the theory and available knowledge regarding the effects of nuclear generating stations generally and the BNGS specifically on fish populations generally, and the whitefish populations of Lake Huron specifically. Entrainment and impingement feature prominently in the WINGS reports, and these should be reviewed and incorporated in the draft E/I Monitoring Plan where appropriate
	BP Response: None
UG-002	There is no reference in the document to the Saugeen Ojibway Nation-Bruce Power Collaborative Whitefish Research Program generally, or the University of Guelph research program with specific research projects for Bruce Power on (a) Lake Huron whitefish population discrimination, (b) BNGS whitefish entrainment, and (c) whitefish population modeling to integrate BNGS entrainment mortality with other natural human-nonBNGS and BNGS sources of mortality. Given the high degree of overlap between the SON-BP Collaborative Research Program and the draft E/I Monitoring Plan, there should be a much higher level of coordination and integration between these two initiatives.
	BP Response: None.
UG-003	The report identifies several statistical methods that might be used. These are not described in detail. It is suggested that the data are clearly tested to indicate that they satisfy the necessary assumptions of the models. Further, in the case of a Generalized Linear Model, a log link has been suggested. This is the canonical link for the Poisson distribution (for example). This is a good candidate model for count data (which could be offset by the population at risk, if need be). However, in the case of zero-inflated data, a zero-inflated Poisson (ZIP) model, or Negative-Binomial model might prove beneficial. Other Generalized Linear Models should be investigated. Further, based on the sampling design, a Mixed Model might prove beneficial.
	BP Response: Minor updates to text were made to now read (italics emphasis on text differing from draft report): "*Where sufficient data exists to allow for defensible statistical analysis*, options that will be considered for comparing annual estimates of entrainment and impingement pre- and post-Operations Phase will include the non-parametric Mann-Whitney U-test, the Generalized Linear Model with a log link, or an Analysis of Covariance (ANCOVA) with month and flow as possible covariates." [p. 35] **UG Team Evaluation of Bruce Power Response:** Unsatisfactory.

	The updated text suggests that analyses will be performed after consideration of the data. However, it is necessary for evaluation that the methods to be used are clearly stated, including any and all assumptions. The Mann-Whitney U-test will test the hypothesis that one sample has (on average) larger values than another. It assumes the observations within each sample are independent of the other. Depending on the data being studied, this assumption may not be valid.
UG-004	While a number of methods have been proposed for the analysis of the data collected in the Follow-Up monitoring program (pre and post Operations Phase), it is unclear how the results will be synthesized and communicated in order to answer the questions set forth in the document. That is, the purpose of the analyses were to 1) "determine if the environmental and cumulative effects of the project are as predicted in the EA study report.", and 2) "confirm whether the mitigation measures are effective or if additional or modified mitigation measures are required to confirm the prediction of no significant residual impacts." Referring to point 1), there is no mention of cumulative effects anywhere in the document. How are these being addressed/tested? How do the data and analyses address this important issue? Referring to point 2), the mitigation measures are not described. Have data been collected pre and post mitigation measure to determine if the measures are sufficient/effective?
	BP Response: Added discussion on residual adverse entrainment and impingement effects in Section 2.0 ("Overview of EA Study Report Findings"). Specifically stating: "Evaluation of the residual adverse entrainment and impingement effects was based on the criteria outlined in the EA Study Report [Bruce Power 2005]. Assessments for residual adverse entrainment and impingement effects are summarized in Table 2 and Table 3, respectively. The results of these assessments predicted that entrainment and impingement effects to the Aquatic Environment would result in minor adverse effects (not significant)." [p. 9] Expanded upon Section 4.62 ("Endpoints for Follow-Up Monitoring") to include: "Entrainment and impingement will be assessed both as individual effects and cumulative effects. Following an initial two years of Operations Phase entrainment and impingement sampling, data will be analyzed to determine if the annual entrainment and impingement impacts fall below the agreed upon thresholds for effect. If so, entrainment and impingement sampling will cease. If not, Bruce Power will consult with and provide agencies and stakeholders with options for future sampling and/or possible additional mitigation measures and feasibility." [p. 40]

	Added Section 2.0 (“Overview of EA Study Report Findings”) which mentions that: “no feasible mitigation measures for impingement and entrainment by modifying the CCW flow volume were identified in the EA Study Report.” [p. 8] **UG Team Evaluation of BP Response:** Unsatisfactory. Cumulative effects have not been adequately addressed within the document despite the goal to “determine if the environmental and cumulative effects of the project are as predicted”. What is meant by “Entrainment and impingement will be assessed both as individual effects and cumulative effects”? This statement seems to suggest that “cumulative” refers to an aggregation of individuals, and not for example, the cumulative effect that a constant perturbation might have over time on a population. A perturbation on its own might seem inconsequential, but in the face of constant perturbations, a small force becomes of great concern (think *death by a thousand* cuts). Cumulative effects are not the same as population level effects.

1. Background and Facility Information

"*Bruce Power plans to return Bruce A Units 1 and 2 to service from their temporary lay-up in the first quarter of 2012 and the fourth quarter of 2011, respectively. Operation of the condenser cooling water system and operation of the Service Water Supply systems are expected to increase the intake of cooling water from 88 m3/s with only Units 3 and 4 in operation to 175 m3/s following the restart of Units 1 and 2. This increase is expected to double the velocity of water entering the intake structures, potentially affecting impingement and entrainment rates [Bruce Power 2008]. See Section 1.2 for the definition of impingement and entrainment.*" (p.1)

UG-005	The velocity and flow of water through the system are important factors that determine risk of entrainment/impingement, residency in the forebay, probability of being samples, probability of being impinged, and mortality at the level of individual organisms. It is important for the E/I Monitoring Plan to have a good quantitative description of water flow regimes, how these regimes vary across different states of pump activity, and how the regimes affect the performance of E/I sampling. It does not appear that the draft E/I Monitoring Plan takes these important variables explicitly into account in an appropriate manner.
	BP Response: Section 4.2 (“Source Water Sampling Plan”) adds: “For the purpose of this Plan, the area of influence representing increased intake water velocities will be determined using a Hydraulic Zone of Influence (HZI) analysis. The general area where larvae may encounter the predicted Bruce A station intake will be sampled; however they may come into contact with the intake and

	their origin is a complex question." [p. 21] "For the purposes of this study, the HZI represents the instantaneous three-dimensional water volume, the margins of which represent the spatial threshold within which larval fishes have a higher probability to be drawn into the Bruce A station intake rather than escape into the lake. The HZI is estimated by established hydraulic models in a spreadsheet format. The size and shape of the HZI are highly variable, dependent upon prevailing wind direction and velocity, as well as other environmental and operational factors such as water currents, seiche, and the Bruce A station cooling water intake flow. The HZI will be estimated using environmental data from each sampling date and the results included in applicable Operations Phase monitoring reports." [p. 20] **UG Team Evaluation of BP Response:** Unsatisfactory. Further details on the spreadsheet format hydraulic models that are proposed are required. Are there references to support the use of the Hydraulic Zone of Influence methodology? How is the model going to be calibrated, validated and verified? How will the model take into consideration swimming abilities of non-larval fish? No details on evaluating the hydrodynamics in the forebay or the variation of the hydrodynamic patterns in the forebay associated with changing operating capacities of the pumps are provided.
UG-006	It should be noted that Andrew Binns (UofG Post-Doctoral Fellow, SON-BP Collaborative Whitefish Research Program) has been assigned responsibility to develop and undertake hydrodynamic mapping of the waters adjacent to the BNGS to quantitatively identify and describe entrainment and impingement risk zones, and the forebay waters to test assumptions about representivity of sampling locations. The spatio-temporal definition of these risk and flow zones is essential for the E/I plan, but they are not included in this plan.
	BP Response: Section 4.2 ("Source Water Sampling Plan") has added: "The size and shape of the HZI are highly variable, dependent upon prevailing wind direction and velocity, as well as other environmental and operational factors such as water currents, seiche, and the Bruce A station cooling water intake flow. The HZI will be estimated using environmental data from each sampling date and the results included in applicable Operations Phase monitoring reports." [p.21] **UG Team Evaluation of BP Response:** Unsatisfactory. Further details on the collection of environmental data (parameters sampled, sampling frequency and magnitude) are required. The

	parameters presented in Section 4.3.2.6 (Water Quality) on p. 29 are not sufficient to accomplish this goal.

"*The EA Study Report for the Refurbishment for Life Extension and Continued Operations of the Bruce A Nuclear Generating Station (the Project) included a preliminary plan for the design and implementation of the Follow-up Program [Bruce Power 2005]. The primary purposes of the Follow-up Program are two-fold. First the Follow-up Program will assist in determining if the environmental and cumulative effects of the Project are as predicted in the EA Study Report. Second the Follow-up Program will confirm whether the mitigation measures are effective or if additional or modified mitigation measures are required to confirm the prediction of no significant residual impacts. The Follow-up Program includes both the Refurbishment Phase (2007-2011) and Operations Phase (starting in 2012) of the Project.*" (p.1)

UG-007	Reference of "cumulative effects" in this context means that the E/I Monitoring Plan must explicitly consider three different meanings of "cumulative": (a) the accumulation of entrainment effects over time on the affected population, (b) the accumulation of impingement effects over time on the affected population, and (c) the accumulation of entrainment and impingement and other sources of population mortality (e.g. natural, BNGS thermal, BNGS contaminants, fisheries).
	BP Response: Expanded upon Section 4.62 ("Endpoints for Follow-Up Monitoring") to include: "Entrainment and impingement will be assessed both as individual effects and cumulative effects. Following an initial two years of Operations Phase entrainment and impingement sampling, data will be analyzed to determine if the annual entrainment and impingement impacts fall below the agreed upon thresholds for effect. If so, entrainment and impingement sampling will cease. If not, Bruce Power will consult with and provide agencies and stakeholders with options for future sampling and/or possible additional mitigation measures and feasibility." [p. 40] **UG Team Evaluation of BP Response:** Unsatisfactory. It is unclear if the phrase "cumulative effects" is understood. This statement suggests that cumulative effects refers to the aggregation of individuals. See comment UG-004.
UG-008	The plan needs to explicitly re-state the predictions of the EA Study Report.
	BP Response: Added Section 2.0 ("Overview of EA Study Report Findings"), describing the findings (and predictions) of the EA Study Report and stating: "The results of these assessments predicted that entrainment and impingement effects to the Aquatic Environment would result in minor adverse effects (not significant)." [p. 9]

	See also the additions of Tables 2 and 3 on p. 10 and p. 11, respectively, which describe assessments for residual adverse entrainment and impingement effects on Valued Ecosystem Component (VEC) species (based on findings of EA Study Report). **UG Team Evaluation of BP Response:** Satisfactory
UG-009	Use of the word "confirm" is problematic in this context, since it carries the meaning of 'prove to be true'. A neutral scientific wording would read something like: "*Second the Follow-up Program will [~~confirm~~] determine whether the mitigation measures are effective or if additional or modified mitigation measures are required to [~~confirm~~] test the prediction of no significant residual impacts*."
	BP Response: No removal of the word “confirm” from the sentence. Sentence was altered to now read (italics emphasis added to highlight altered part of sentence): “Second, the Follow-up Program will confirm whether the mitigation measures as provided in the EA are effective, *or if these cannot be confirmed*, recommend what additional or modified mitigation measures are proposed to maintain the original predictions of no significant residual impacts.” [p. 1] **UG Team Evaluation of BP Response:** Unsatisfactory. If the predictions of no significant effects are proven false, then the EA must reflect that the activities are resulting in significant effects. Once the extent of these significant effects has been determined, then proposed mitigation can be evaluated to determine the extent to which the effects can be reduced. Reference to "maintain the original predicitions" is very awkward and misleading. If mitigation can not reduce the effects below a significant level, then the activity must be terminated.
UG-010	Reference is made to "significant residual effects," yet neither the concepts of "significance" nor "residual effects" are defined.
	BP Response: Neither concepts of “significance” nor “residual effects” are defined in this section. “Residual effects” is defined in newly added Section 2.6 (“Residual adverse effects”) as “Residual effects include those effects that will be present after mitigation options are considered.” [p. 8] Added Section 2.6.3 “Significance of residual adverse effects”, stating “The results of these assessments predicted that entrainment and impingement effects to the Aquatic Environment would result in minor adverse effects (not significant).” [p. 9]

	No additional statistical definition of “significance” is discussed in the report. **UG Team Evaluation of BP Response:** Unsatisfactory. It does not appear that “significance” has been defined. The definition of significance, both from a biological and a statistical point of view should be highlighted. If significance is based on a quantification of some parameter, that should be stated. If significance is based on committee, the method by which the committee determines significance should be completely transparent, accountable, and reproducible.

"*Bruce Power submitted an initial Follow-up Program work plan to the Canadian Nuclear Safety Commission (CNSC), the Responsible Authority, in September 2007. Taking into account comments provided on the initial work plan, a revised Follow-up Program work plan was submitted to the CNSC for review in December 2008 (the 2008 Work Plan) [Bruce Power 2008]. The monitoring programs included in the 2008 Work Plan were accepted by the CNSC on August 24, 2009, based on Bruce Power’s commitment to the continuation of separate forums to resolve technical and design details where and as they arise. This strategy is consistent with the adaptive management approach that was outlined in the 2008 Work Plan [Bruce Power 2008]. Sections 8.1, 8.3, and 8.4 of the 2008 Work Plan include monitoring plans for impingement and entrainment during the Operations Phase to validate predicted effects on Valued Ecosystem Components (VECs), specifically lake whitefish (Coregonus clupeaformis), deepwater sculpin (Myoxocephalus thompsonii) and spottail shiner (Notropis hudsonius), due to the predicted increases in the intake flow rate associated with the restart of Bruce A Units 1 and 2.*" (p.1)

UG-011	It is important to stress "*Bruce Power's commitment to the continuation of separate forums to resolve technical and design details where and as they arise.*" The plan should explicitly identify the SON-BP Collaborative Whitefish Research Program at UofG/McMaster as an important component of this commitment, especially as it relates specifically to the evaluation of BNGS entrainment and impingement effects on one of the identified VEC (lake whitefish).
	BP Response: None.
UG-012	Use of the word "validate" is problematic in this context, since it also carries the meaning of 'prove to be true.' A neutral scientific wording would read something like: "*to [~~validate~~] test predicted effects on Valued Ecosystem Components.*"
	BP Response: This part of the paragraph is removed from this section in the updated document. **UG Team Evaluation of BP Response:** Unsatisfactory. Given the obvious and important relationship of the SON-BP Collaborative

	Whitefish Research Program at UofG/McMaster, the relationship of these research programs to the E/I Monitoring Program remains essential.

"*Entrainment monitoring plans in the 2008 Work Plan focused on the VEC species of lake whitefish and deepwater sculpin. The monitoring plan for lake whitefish involved a phased approach, with the objective of each phase presented as a key question (see Section 8.1 of the 2008 Work Plan) [Bruce Power 2008]. Based on studies through to 2008, and additional studies to date, genetically distinct populations of lake whitefish have not been identified. A study in 2009 (the 2009 Lake Whitefish Monitoring Program) was carried out to determine the importance of the shoals near the Bruce Power site to the spawning success of lake whitefish [Golder Associates 2010]. The 2009 Lake Whitefish Monitoring Program quantified potential whitefish spawning habitat within the area potentially affected by Bruce Power operations [Bruce Power 2005] and outside the potentially affected area. Gillnetting, conducted in 2009 and 2010 to document the presence and spawning condition of whitefish, showed that whitefish in spawning condition were present in the vicinity of the Bruce Power site, however the relative abundance of whitefish, based on catch per unit effort, was highly variable between sampling locations. However, despite observed areas of suitably sized spawning substrates and of ripe female whitefish captured at the eight sampling locations by gillnetting immediately preceding spawning, egg collection efforts in 2009 using air lift suction devices resulted in no lake whitefish eggs being collected.*" (p.1)

UG-013	The objectives of each phase of the whitefish monitoring plan presented as a key question (see Section 8.1 of the 2008 Work Plan in Bruce Power 2008) need to be explicitly re-stated in this document, so the reader can evaluate the appropriateness of the objectives.
	BP Response: Added Section 3.0 ("Overview of the 2008 Work Plan") in the March 2012 document. Section describes the tasks involved in the three programs, including "Entrainment of Lake Whitefish" (Section 3.1), "Deepwater Sculpin Population Review (Section 3.2), and "Impingement of Spottail Shiner and Lake Whitefish" (Section 3.3) [p. 13, 14]. **UG Team Evaluation of BP Response:** Satisfactory.
UG-014	"*Based on studies through to 2008, and additional studies to date, genetically distinct populations of lake whitefish have not been identified.*" This statement is misleading and inappropriate - for several reasons. First, the document does not provide references to the 'studies' being cited. Second, there have been no genetic studies yet undertaken that were designed in a manner that would have allowed the determination of 'genetic distinction' among lake whitefish populations affected by BNGS. Third, the absence of evidence must not be confused with evidence of absence.
	BP Response: Bruce Power and Golder references were added

	and the sentence now reads: "Based on studies through 2008 [Bruce Power 2008], and additional studies to date [Golder Associates 2010], genetically distinct populations of lake whitefish have not been identified in the vicinity of the Bruce Power site." [p. 15]. The sentence has been moved as is now in Section 4.0 ("Operations Phase Impingement and Entrainment Monitoring Plan"). **UG Team Evaluation of BP Response:** Unsatisfactory. Bruce Power has still confused the absence of evidence, with evidence of absence. Population discrimination remains a key uncertainty for the E/I Monitoring Plan, and this is one of the reasons why SON and BP agreed to sponsor research by the UG Team to help resolve this issue. Reference to the SON Collaborative Whitefish Research Program, and especially the UG research is essential in this regard.
UG-015	It is not clear which studies "through 2008" are being referenced. The conclusions of the 2009 study are not explained with respect to the importance of the shoals, or to quantifying habitat within and outside the effected area.
	BP Response: See comment assessment for UG-014 for updated references included with this statement in the 2012 document. The following addition (new text in italics) was made with regard to potential lake whitefish spawning habitat in the potentially affected area in Section 4.0 ("Operations Phase Impingement and Entrainment Monitoring Plan"): "A 2009 Lake Whitefish Monitoring Program was carried out to determine the importance of the shoals near the Bruce Power site to the spawning success of lake whitefish [Golder Associates 2010]. The 2009 Lake Whitefish Monitoring Program quantified potential whitefish spawning habitat within the area potentially affected by Bruce Power operations [Bruce Power 2005]1 and outside the potentially affected area. *The potentially affected area was defined as the area encompassing the aerial extent of the 2oC thermal plume in winter conditions emanating from the Bruce A station. The thermal plume area stretches approximately 5 km southwest of Bruce B (to McCrae Point) and 6 km northeast of Bruce A (to north of Scott Point, including Loscombe and Welsh banks). The unaffected area selected extended from approximately 2 km southwest of McCrae Point and approximately 3 km northeast of Welsh Bank and includes Scougall Bank. The results of Phase 1 of the Program found approximately 9.22 km2 of potential lake whitefish spawning habitat (defined as boulder and cobble substrates) in the potentially affected area, and approximately 5.77 km2 of potential lake whitefish spawning habitat in the unaffected*

	area (combining the southern and northern unaffected areas). Potential lake whitefish spawning habitat represents approximately 69% of the potentially affected area." [p. 15] **UG Team Evaluation of BP Response:** Unsatisfactory. BP continues to withhold the cited data/reports from the UG Team, despite repeated requests. Without this information, it is not possible to determine if the characterization and quantification of habitat is appropriate.
UG-016	Spatio-temporal population structure of lake whitefish is a key uncertainty for the draft E/I Monitoring Plan. It should be explicitly noted that this same key uncertainty was explicitly recognized by the SON-BP Collaborative Whitefish Research Program, and was assigned as a PhD research project (Clayton Coppaway) for the UofG Team. The E/I Monitoring Plan should explicitly incorporate the research and analyses being conducted by the SON-BP Research Program.
	BP Response: None.
UG-017	"*A study in 2009 (the 2009 Lake Whitefish Monitoring Program) was carried out to determine the importance of the shoals near the Bruce Power site to the spawning success of lake whitefish [Golder Associates 2010].*" The UofG Team has repeatedly requested BP to provide "all relevant data/documentation associated with the historic and ongoing assessments related to the Bruce Power facility/region for (a) entrainment, (b) impingement, and (c) lake whitefish ecology." Despite previous requests for relevant documentation, the UofG Team has not been provided with the data/documentation that have been produced for the ongoing EA and Follow-Up Monitoring Programs. The 2009 Golder study on the importance of lake whitefish spawning shoals is an example of the type of existing evidence that the UofG Team has requested, but has not been provided with.
	BP Response: None.
UG-018	Reference is made to a Golder assessment of the lake whitefish spawning shoals, however there is no linkage between the results of this assessment and the E/I Monitoring Plan.
	BP Response: None.
UG-019	Reference is made to "the potentially affected area" however there is no explanation to where this area is located, or how the area of affect was determined.
	BP Response: See UG-015. **UG Team Evaluation of BP Response:** Unsatisfactory. See UG-015.
UG-020	It should be noted that Andrew Binns (UofG Post-Doctoral Fellow, SON-BP Collaborative Whitefish Research Program) has been

	assigned responsibility to develop and undertake hydrodynamic mapping of the waters adjacent to the BNGS to quantitatively identify and describe entrainment and impingement risk zones. The spatio-temporal definition of these risk zones is essential for the E/I plan, but they are not included in this plan.
	BP Response: See UG-006. **UG Team Evaluation of BP Response:** Unsatisfactory. Further details on how the proposed Hydraulic Zone of Influence (HZI) analysis will take into consideration variation of hydrodynamic conditions in the near shore Lake Huron waters due to various driving mechanisms in the lake are required. How will the results of the hydraulic model be calibrated, verified and validated? What equipment will be used to measure the "environmental data" from each sampling date?
UG-021	Despite previous requests for relevant documentation, the UofG Team has not been provided with the data/documentation associated with Bruce Power's whitefish gillnetting assessment program, as had been requested.
	BP Response: None.
UG-022	It is not clear what conclusion, if any, is being drawn from the reported variability of CPUE for spawning condition lake whitefish, with regard to the E/I Monitoring Plan.
	BP Response: Text was altered to include: "Gillnetting, conducted in 2009, 2010, and 2011 to document the occurrence, relative abundance and reproductive condition of whitefish, showed that whitefish in spawning condition were present in the vicinity of the Bruce Power site. The abundance of whitefish, based on catch per unit effort, was highly variable between sampling locations with Area 1 (Scougall Bank) and Area 8 (McRae Point) generally having the highest abundance of lake whitefish. The numbers of ripe female lake whitefish increased in mid-November and declined by the end of the November. Spent female lake whitefish were found in low abundance (n<=5) across the sites," [p.15] **UG Team Evaluation of BP Response**: Unsatisfactory. BP continues to withhold the cited data/reports from the UG Team, despite repeated requests. Without this information, it is not possible to evaluate the characterization and conclusions made about CPUE and spawning condition.
UG-023	Despite previous requests for relevant documentation, the UofG Team has not been provided with the data/documentation associated with Bruce Power's whitefish egg air lift assessment program, as had been requested.
	BP Response: None.

UG-024	The lack of lake whitefish eggs collected during Bruce Power's air lift assessment program could have resulted from a wide variety of biological and sampling design factors. It is not clear what conclusion, if any, is being drawn from the lack of collected eggs, with regard to the E/I Monitoring Plan.
	BP Response: The following addition (italics to denote added text) was made to the text in Section 4.0 ("Operations Phase Impingement and Entrainment Monitoring Plans"): "Further, despite observed areas of suitably sized spawning substrates and of ripe female whitefish captured at the eight sampling locations by gillnetting immediately preceding spawning, egg collection efforts in 2009 using air lift suction devices resulted in no lake whitefish eggs being collected. *A total 579 m2, or approximately 0.6 ha of substrate was assessed over five field days. Airlift sampling duration, timing and location selection, was impeded by weather throughout the period coinciding with the presence of ripe female lake whitefish. It was expected that, should egg sampling be repeated in the future, that the same weather related issues would hamper egg collection efforts. Given the large area of potential spawning habitat that exists within the study area, the small area that can realistically be sampled in any given year and the effort that may be required to confirm actual spawning locations, the only practical way of estimating habitat use was to use the presence and numbers of spawning adults as a surrogate for spawning activity and egg deposition. It was recommended that airlift sampling effort not be repeated in the future as a method to measure egg deposition near the Bruce Power site [Golder 2010].*" [p. 16] **UG Team Evaluation of BP Response:** Unsatisfactory. BP continues to withhold the cited data/reports from the UG Team, despite repeated requests. It is not clear how the the failure of airlift sampling relates to the E/I Monitoring Plan.
UG-025	It is not clear what the variability in catch-per-unit effort was attributed to and there is no indication of how much effort was given to collecting eggs, or if this is an acceptable methodology.
	BP Response: None.

"*Based on the results of the 2009 study, a scope of work and timeline for a 2011/2012 Bruce Power funded University of Regina whitefish genetics study is currently in development. Additionally, entrainment monitoring during the Operations Phase is recommended, consistent with the 2008 work plan, to validate the EA predictions pertaining to lake whitefish entrainment. This document, "Operations Phase*

Impingement and Entrainment Monitoring Plan", proposes a monitoring investigation to effectively measure entrainment of lake whitefish during the Operations Phase." (p.2)

UG-026	"*Based on the results of the 2009 study, a scope of work and timeline for a 2011/2012 Bruce Power funded University of Regina whitefish genetics study is currently in development.*" Despite previous requests for relevant documentation, the UofG Team has not been provided with the 2009 study. The UofG Team was also very surprised to learn that BP has already funded a Regina study on whitefish genetics; neither BP nor the McMaster/Regina team have provided any information on this funded study. This arrangement is especially problematic given that the SON-BP Collaborative Research Program had previously identified the UofG Team as responsible for the population discrimination, including genetics, mark-recapture and other analyses.
	BP Response: None.
UG-027	"*Additionally, entrainment monitoring during the Operations Phase is recommended, consistent with the 2008 work plan, to validate the EA predictions pertaining to lake whitefish entrainment.*" The UofG Team sees entrainment monitoring as essential to the E/I Monitoring Plan, rather than simply 'recommended.'
	BP Response: Paragraph is moved to Section 4.0 (Operations Phase Impingement and Entrainment Monitoring Plan) to write: "Additional Operations Phase studies related to lake whitefish will involve entrainment monitoring, as proposed in the 2008 Work Plan, to validate the EA Study Report predictions pertaining to lake whitefish entrainment." [p. 16] **UG Team Evaluation of BP Response**: Unsatisfactory. The revision makes no sense.
UG-028	Use of the word "validate" is problematic in this context, since it also carries the meaning of 'prove to be true.' A neutral scientific wording would read something like: *"... to [~~validate~~] test the EA predictions pertaining to lake whitefish entrainment.*"
	BP Response: None.
UG-029	"*This document ... proposes a monitoring investigation to effectively measure entrainment of lake whitefish during the Operations Phase.*" Reference to 'effectiveness' of the entrainment monitoring plan does not appear in the 'Goal and Objectives' of this document, but is an important factor and should be explicitly stated there.
	BP Response: Additional text has been added to Section 1.3 (Study Goal and Objectives): "The assessment of the proposed objectives of impingement and entrainment monitoring during the Operations Phase will be carried out until identified endpoints are achieved. Further details on these

	proposed objectives and endpoints are discussed in Sections 4.3 (Entrainment) and 4.4 (Impingement). Where meaningful, the results of Operations Phase sampling will be compared to data collected prior to the Operations Phase. The Operations Phase data will be used to determine if proposed thresholds for effect and monitoring endpoints have been met and will further aid in recommending if additional, longer term or periodic impingement and entrainment monitoring should be undertaken." [p. 2] **UG Team Evaluation of BP Response**: Unsatisfactory. The issues of "effectively measure entrainment" remains an important outstanding issue.

"*Operations Phase impingement monitoring plans in the 2008 Work Plan focused on two of the VEC species, namely spottail shiner and lake whitefish. This document "Operations Phase Impingement and Entrainment Sampling Plan" proposed modifications to the impingement monitoring protocols outlined in the 2008 Work Plan to improve the consistency in data collection and reporting to aid in determining appropriate impingement effects thresholds and endpoints. Impingement data from 2004-2010 have shown that VEC species impingement has been low (≤90 spottail shiner, ≤1 deepwater sculpin, and ≤10 lake whitefish annually). However, Operations Phase monitoring is recommended because additional impingement relative to only having two units in operation would be assumed with the restart of Units 1 and 2 and the associated increase in flow volume.*" (p.2)

UG-030	"*This document "Operations Phase Impingement and Entrainment Sampling Plan" proposed modifications to the impingement monitoring protocols outlined in the 2008 Work Plan to improve the consistency in data collection and reporting to aid in determining appropriate impingement effects thresholds and endpoints.*" Despite previous requests for relevant documentation, the UofG Team has not been provided with the 2008 Work Plan.
	BP Response: None. Note: this part of the text has been moved to Section 4.0 (Operations Phase Impingement and Entrainment Monitoring Plan) starting on p. 15.
UG-031	The document needs to explicitly identify the specific issues previously identified regarding consistency of impingement data collection and reporting, in order for the reader to evaluate if the draft E/I Monitoring Plan is appropriate.
	BP Response: None.
UG-032	It seems reasonable to suspect that specific issues were also previously identified regarding consistency of entrainment data collection and reporting, however no comment is made in this regard.
	BP Response: None.
UG-033	The document needs to explicitly identify the specific issues

	previously identified regarding consistency of entrainment data collection and reporting, in order for the reader to evaluate if the draft E/I Monitoring Plan is appropriate.
	BP Response: None.
UG-034	"*Impingement data from 2004-2010 have shown that VEC species impingement has been low (≤90 spottail shiner, ≤1 deepwater sculpin, and ≤10 lake whitefish annually).*" Despite previous requests for relevant documentation, the UofG Team has not been provided with the historical time series for entrainment or impingement data.
	BP Response: None.
UG-035	"*However, Operations Phase monitoring is recommended because additional impingement relative to only having two units in operation would be assumed with the restart of Units 1 and 2 and the associated increase in flow volume.*" The UofG Team sees impingement monitoring as essential to the E/I Monitoring Plan, rather than simply 'recommended.'
	BP Response: None.

1.1 Cooling Water Intake

"*The Bruce A station cooling water intake structure is located in Lake Huron, approximately 800 m off shore [Bruce Power 2008]. The cooling water intake structure has a circular concrete cap that is approximately 12 m in diameter and is supported by angled steel legs. Water drawn into the cooling water intake structure is conveyed to the plant via a submerged intake tunnel and a concrete-lined forebay. Water is pumped from the concretelined forebay into four pumphouses, one for each of the four Bruce A station units. Each pumphouse contains traveling screens to prevent large debris and fish from entering the circulating water system. These traveling screens are typically set on an automatic wash cycle that cleans the screens every 12 hours.*" (p.2)

UG-036	The UofG Team has previously been advised that there is an additional system pump that is not associated with the pumphouses and travelling screens. A complete model of all potentially operating pumps, across various levels of individual pump activity, is required for an effective hydrodynamic model of entrainment/impingement risk regions in the waters adjacent to BNGS, and for an effective hydrodynamic model of forebay water flow and entrainment/impingement.
	BP Response: Text has been updated as follows: "Water is pumped from the forebay into four pumphouses, one for each of the four Bruce A station units. The volume of water pumped and flow rates vary and are proportional to the number of condenser cooling water (CCW) pumps and/or the number of units in service at the Bruce A station." [p. 1]

	UG Team Evaluation of BP Response: Unsatisfactory. There is no information in the Plan addressing how the entrainment/impingement sampling program will take into account the various hydraulic conditions present in the forebay due to the variation in operating capacities of the pumps. How will the various operating conditions affect the hydrodynamics in the forebay? How will these hydrodynamics affect the patterns of distribution and abundance of fish in the forebay? How can the hypothesis that the forebay waters are well-mixed be verified for all pump operating conditions? There is no mention of the fifth pump (maintenance pump) in the revised Plan.
UG-037	Previous experience by the SON biologists who participated in BP entrainment/impingement sampling showed that the timing of travelling screen washes was not appropriately recorded, for a variety of reasons: (a) pressure differential and operator over-ride of scheduled washes, (b) lack of records for operator over-ride washes, (c) lack of independent records for screen washes, and (d) unscheduled transfer of collection bins to the waste landfill. SON biologists had previously requested that screen washes be more rigorously recorded, however there was no further information provided by BP in this regard. If the historical time series for screen wash sampling does not take into account of the complete screen was activity, then the data associated with these assessments will be difficult if not impossible to interpret.
	BP Response: None.

1.2 Definitions of Impingement and Entrainment

"*Impingement will be defined as the process by which organisms which are generally larger than or equal to either the Bruce A (Units 1-4) cooling water pump intake screens or the cooling water travelling screens are held against the screens by the through-flow. Entrainment will be defined as the process by which organisms that are generally smaller than either the Bruce A (Units 1-4) pump intake screens or cooling water traveling screens are drawn through the screens by the through-flow.*" (p.3)

UG-038	No references are provided for these definitions. It is important that the definitions of entrainment and impingement in the E/I monitoring plan be consistent with definitions used for previous assessments at the BNGS, and that any major distinctions with other definitions be explicitly identified.
	BP Response: Note: this section of the text has been moved to Section 1.4 (Definitions of Impingement and Entrainment) starting on p. 3. The following text is added to the definition of impingement: “For reference, the USEPA defines impingement as the entrapment

	of all life stages of fish and shellfish on the outer part of an intake structure or against a screening device during periods of intake water withdrawal [USEPA 2002]. Further, the USEPA defines impingement mortality as the death of fish or shellfish due to impingement (as defined above) [USEPA 2002]. Using USEPA guidance, impingement mortality does not need to occur immediately; impingement may cause harm to the organism, which results in mortality several hours after the impingement event. For purposes of the proposed Section 316(b) Rule, impingement is defined as organisms collected or retained by the traveling screens." [p. 3] The following text is added to the definition of entrainment: "For reference, the USEPA defines entrainment as the incorporation of all life stages of fish and shellfish with intake water flow entering and passing through a cooling water intake structure and into a cooling system. Entrainment mortality is defined as the death of fish or shellfish due to entrainment, which also includes the death of those fish and shellfish due to fine mesh screens or other technologies used to exclude the organisms from entrainment (USEPA 2002). For purposes of the proposed Section 316(b) Rule, entrainment is defined as organisms passing through the traveling screens." [p. 3] **UG Team Evaluation of BP Response:** Unsatisfactory. The qualifier 'For reference' does not mean that the stated definitions have been adopted for this E/I Monitoring Plan. As approved under terms of the SON-BP Collaborative Whitefish Research Program, the UG Team has critically analysed the theoretical and practical problems with defining these terms, and the result of that analysis needs to be recognized and incorporated into this E/I Monitoring Plan.
UG-039	"*Impingement will be defined as the process by which organisms which are generally larger than or equal to either the Bruce A (Units 1-4) cooling water pump intake screens or the cooling water travelling screens are held against the screens by the through-flow.*" This definition is too vague for operationalization, specifically: the size condition "generally larger" and "larger than or equal to" and "either ... intake screens or travelling screens"
	BP Response: Definition of impingement is slightly altered to read: "For the purposes of this Plan, impingement is defined as the process of organisms within the intake cooling water flow being held against the travelling screens. The typical size of these organisms is larger than or equal to the specific Bruce A Unit (1-4) cooling water pump intake screen or cooling water travelling screen through which

	the cooling water is being carried." [p. 3] **UG Team Evaluation of BP Response:** Unsatisfactory. This plan does not account for organisms that encounter the travelling screens, yet are not held against them in a manner that leads to the current screen flush sampling.
UG-040	This definition of 'impingement' states that an essential condition is that the organism is "held against the screens by through-flow." This condition does not include the organisms which are carried into the forebay environment and die without having their (recognizable) bodies held against the travelling screens (and potentially be carried up into the screenhouse and flushed with a screen wash). The definition of 'impingement' for the E/I Monitoring plan needs to be much more explicit and rigorous than the definition provided.
	BP Response: None.
UG-041	"*Entrainment will be defined as the process by which organisms that are generally smaller than either the Bruce A (Units 1-4) pump intake screens or cooling water traveling screens are drawn through the screens by the through-flow.*" This definition is too vague for operationalization, specifically: the size condition "generally smaller" and "smaller than" and "either ... intake screens or travelling screens"
	BP Response: Definition slightly altered to read: "For the purposes of this Plan, entrainment is defined as the process by which organisms within the intake cooling water flow are drawn through the Bruce A station intake travelling screens. The typical size of the organisms are generally smaller than the specific Bruce A Unit (1-4) cooling water pump intake screen or cooling water travelling screen through which the cooling water and the organism is being carried." [p. 3] **UG Team Evaluation of BP Response:** Unsatisfactory. The qualifier "generally smaller" has no meaning in this context. This definition does not account for organisms that encounter the travelling screens, yet are not held against them in a manner that leads to the current screen flush sampling. This definition does not account for larger (i.e. juvenile, adult) fish that entrained into the forebay, but do not encounter the screens.
UG-042	It should be noted that Lauren Overdyk (UofG Grad Student, Whitefish Entrainment Research Project, SON-BP Collaborative Whitefish Research Program), has undertaken a comprehensive review and evaluation of various definitions for entrainment that have been proposed/employed in the primary and technical literature. This review/evaluation should be considered when developing operational definitions of entrainment/impingement for

	the E/I Monitoring Plan.
	BP Response: None.

1.3 Study Goal and Objectives

"*The Operations Phase impingement and entrainment monitoring will be performed because previous studies to estimate potential Operations Phase impingement and entrainment impacts to lake whitefish through source water and spawning habitat assessments were not definitive. As with previous studies, the goal of this study will be to evaluate if the effects predictions set forth in the 2005 EA, specific to impingement and entrainment, are valid. Appendix A includes a timeline for the Project, including the milestones related to the acceptance of the EA Study Report for the Project, progression of the Follow-up Program Work Plan, and workshops focused on developing aspects of the 2008 Work Plan. The effects prediction directly associated with impingement and entrainment included in the EA is as follows: 2005 EA prediction : Impingement and entrainment at the Bruce A station due to operation of the condenser cooling water system will have no significant adverse effect on the three VEC species (lake whitefish, spottail shiner, and deepwater sculpin).*" (p.3)

UG-043	"*The Operations Phase impingement and entrainment monitoring will be performed because previous studies to estimate potential Operations Phase impingement and entrainment impacts to lake whitefish through source water and spawning habitat assessments were not definitive.*" It is not clear what is meant by "definitive" estimates of entrainment and impingement, nor how it was determined that the unreferenced previous studies failed to provide such "definitive" estimates. It is not clear what the relationship is between the unreferenced "source water and spawning habitat assessments" and the estimates of entrainment and impingement.
	BP Response: This sentence has been removed from Section 1.3 (Study Goal and Objectives). The opening paragraph of this section now reads: "The goal of Operations Phase impingement and entrainment monitoring is to evaluate the validity of the effects predictions set forth in the EA Study Report [Bruce Power 2005], specific to impingement and entrainment. As noted, Section 2 of this Operations Phase Impingement and Entrainment Monitoring Plan (the Plan) provides a review of the Aquatic Environment component of the EA Study Report for the Project with a focus on impingement and entrainment. The effects predictions specific to impingement and entrainment from the EA Study Report are provided in Section 2.6.3." [p. 2] **UG Team Evaluation of BP Response:** Satisfactory.

UG-044	"*As with previous studies, the goal of this study will be to evaluate if the effects predictions set forth in the 2005 EA, specific to impingement and entrainment, are valid.*" Reference to "previous studies" and "effects predictions set forth in the 2005 EA" are not clear; these need to be explicitly identified. If the unreferenced previous studies failed to evaluate the unreferenced effects predictions, then it is not clear how it will be demonstrated that the current E/I Monitoring will avoid the same failures.
	BP Response: Section 2.0 (Overview of EA Study Report Findings) has been added to the Plan. **UG Team Evaluation of BP Response:** Satisfactory to include new Section 2.0. Unsatisfactory conclusions drawn from 'Overview of EA Study Report Findings.'
UG-045	Use of the word "valid" is problematic in this context, since the term means that a prediction is 'logically possible' - the reference should identify the states of prediction (i.e. true/false) that need to be determined through a test of the prediction. It is unlikely that Goal of the E/I Monitoring Plan is to evaluate if the predictions are 'valid,' but rather to develop a program that will generate the data necessary to determine if the predictions are true. This may seem like semantics, but it is vital that the Goal of the E/I Monitoring Plan be explicitly stated with accuracy and precision.
	BP Response: Wording slightly changed: "The goal of Operations Phase impingement and entrainment monitoring is to evaluate the validity of the effects predictions set forth in the EA Study Report [Bruce Power 2005],..." [p. 2] **UG Team Evaluation of BP Response:** Satisfactory.
UG-046	"*Appendix A includes a timeline for the Project, including the milestones related to the acceptance of the EA Study Report for the Project, progression of the Follow-up Program Work Plan, and workshops focused on developing aspects of the 2008 Work Plan.*" It is not clear why the deliverable for this report (i.e. activities, timeline, milestones) presented in Appendix A is incorporated within the statement of Goal and Objectives.
	BP Response: There is no longer any reference to Appendix A in Section 1.3 and Appendix A has been removed from the Plan. **UG Team Evaluation of BP Response:** Satisfactory.

"*The effects prediction directly associated with impingement and entrainment included in the EA is as follows: 2005 EA prediction : Impingement and entrainment at the Bruce A station due to operation of the condenser cooling water system will have no significant*

adverse effect on the three VEC species (lake whitefish, spottail shiner, and deepwater sculpin)." (p.3)

UG-047	This statement explicitly identifies plural "effects predictions" rather than the single prediction provided in the Goal statement. It is not clear if there are multiple predictions to be tested, and if so what the specific predictions are.
	BP Response: Sentence now reads: "The effects predictions specific to impingement and entrainment from the EA Study Report are provided in Section 2.6.3." [p. 2] In Section 2.6.3 it now reads: "The results of these assessments predicted that entrainment and impingement effects to the Aquatic Environment would result in minor adverse effects (not significant)." [p. 9] **UG Team Evaluation of BP Response:** Unsatisfactory. It is still not clear what is meant by the phrase "minor". Is this a biological or statistical "minor"?
UG-048	2005 EA prediction: "*Impingement and entrainment at the Bruce A station due to operation of the condenser cooling water system will have no significant adverse effect on the three VEC species (lake whitefish, spottail shiner, and deepwater sculpin).*" It is not clear that this is actually the prediction as stated in 2005 EA. It is necessary to quote directly from the EA report to ensure that no interpretation errors have occurred.
	BP Response: See UG-047 (no direct quote from 2005 EA). **UG Team Evaluation of BP Response:** Unsatisfactory. This does not appear to have been addressed. Further, the term "significant" appears without being adequately defined.
UG-049	Reference to the terms "entrainment" and "impingement" are clearly essential for determining the appropriate tests of this prediction. As indicated above, the definitions provided in this document and not sufficiently explicit and rigorous for the E/I Monitoring Plan.
	BP Response: See UG-038-042. **UG Team Evaluation of BP Response:** Unsatisfactory. See UG-038-042.
UG-050	Reference to the term "*significant adverse effect on the ... species*" is problematic for several reasons. First, there is no indication what is meant by 'significant' in this context. Second, the term "adverse" is undefined, and can lead to ambiguity in the identification and measurement of effects. Third, it is unlikely that the EA prediction is actually made at the level of the selected species, but rather at some other biologically-meaningful level that is appropriate to the EA - most likely at the level of biological population. These terms are essential to the interpretation and design of the E/I Monitoring

	Plan.
	BP Response: Wording for “significant adverse effect” has changed to “residual adverse effects”. Section 2.6.3 now reads: “Evaluation of the residual adverse entrainment and impingement effects was based on the criteria outlined in the EA Study Report [Bruce Power 2005].” [p. 9] See UG-047. Wording has changed to “…minor adverse effects (not significant).” [p. 9] No definition of the term “significant” is provided. No definition of the term “adverse” is provided. See UG-047. Instead of citing the three VEC species (lake whitefish, spottail shiner, and deepwater sculpin), wording has changed to put the effects to the “Aquatic Environment.” [p. 9] **UG Team Evaluation of BP Response:** Unsatisfactory. This issues has not been adequately addressed. It is still unclear what “significant” and “adverse” mean.

"*Therefore, the proposed objectives of this Study are to assess, during the Operations Phase (until identified endpoints are achieved) the following:*

- *Entrainment of deepwater sculpin at the Bruce A station exceeds a threshold for effect (to be agreed to) based on MNR/USGS trawling data and the presence of deepwater sculpin eggs and larvae in source water larval tows.*
- *Impingement and entrainment of lake whitefish at the Bruce A station exceeds a threshold for effect (to be agreed to), established as the proportion of adult annual lake whitefish entrainment losses relative to the MNR proposed quota of lake whitefish in MNR quota management area (QMA) 4-4 in which the Bruce Power site resides.*
- *Impingement of lake whitefish within the 2005 EA local study area exceeds test threshold for effect values of 0.50%, 20%, 50%, and 100%, based on the assumption that 0.50%, 20%, 50% and 100% of impinged lake whitefish are from a population which is distinct within the EA local study area.*
- *Impingement of spottail shiner at the Bruce A station relative to a threshold for effect (to be agreed to) based on a comparison to existing long-term source water fish assessment data or established through the performance of annual index sampling in nearby source waters.*" (p.3)

UG-051	The proposed entrainment and impingement objectives do not explicitly refer to determination of "significant adverse effects" as stated in the asserted 2005 EA prediction. As a result, it is possible that the objectives could be satisfied without achieving the stated Goal.
	BP Response: None.
UG-052	Reference is made to 'identified endpoints' however there is no explanation of what these are, or how they came to be determined.
	BP Response: None.

UG-053	"*Impingement and entrainment of lake whitefish at the Bruce A station exceeds a threshold for effect (to be agreed to), established as the proportion of equivalent adult annual lake whitefish entrainment losses relative to the MNR proposed quota of lake whitefish in MNR quota management area (QMA) 4-4 in which the Bruce Power site resides.*" Reference is made to "threshold[s] for effects" however there is no explanation of what these are, or how they came to be or will be determined.
	BP Response: None.
UG-054	"*threshold of effect ... established as the proportion of equivalent adult annual lake whitefish entrainment losses relative to the MNR proposed quota of lake whitefish in MNR quota management area (QMA) 4-4 in which the Bruce Power site resides.*" The proposed measure of effect is problematic, for several reasons. First, according to the statement, both entrainment and impingement effects will be measured as "equivalent adult annual lake whitefish entrainment losses" - this is illogical for the impingement effects. Second, the term "losses" is not defined; depending on whether this is interpreted as mortality or some other form of effect will have important implications for the design of the E/I Monitoring Plan. Third, it is not clear why the conversion of entrainment or impingement mortality to "equivalent adult ... losses" is appropriate, or feasible to employ. Fourth, the selection of MNR quota management areas is highly inappropriate as a unit of biological organization of lake whitefish in Lake Huron - especially given the facts that this zone was created primarily as an administrative zone for management of commercial fishing licenses for multiple species, has little or no support as representing a natural biological unit of lake whitefish. Fifth, given the inappropriateness of the MNR quota management area as biological unit to evaluate "adverse effects" on lake whitefish, it is even more inappropriate to assume that an undefined "quota" (presumably a MNR commercial fishery TAC=total allowable catch) would provide some meaningful representation of abundance for the lake whitefish population(s) supporting commercial harvests in the MNR quota management area.
	BP Response: Sentence has been changed to read (italics emphasis added to highlight change): **“**Impingement and entrainment of lake whitefish at the Bruce A station relative to a yet to be agreed to threshold for effect, established in this Plan as the proportion of equivalent adult lake whitefish *entrainment and impingement mortality estimates compared regionally* to the MNR quota of lake whitefish in MNR Quota Management Area (QMA) 4-4 and *compared locally to test populations values representing the percentage* of QMA 4-4 *distinct to the EA Local Study Area boundaries*.” [p. 2[

	UG Team Evaluation of BP Response: Unsatisfactory. BP is still skirting the issue rather than acknowledging it as a key uncertainty.
UG-055	How is the proposed quota determined? What is the probability that the quota itself, if met, might have a negative impact on the population? This seems to assume that the quota, as established, will have no negative impact. It isn't clear how "the proportion of equivalent adult annual lake whitefish entrainment losses relative to the MNR proposed quota of lake whitefish in MNR quota management area (QMA) 4-4" will provide the necessary information to assess whether impingement and entrainment of lake whitefish exceeds a threshold for effect.
	BP Response: None.
UG-056	Generally speaking the QMAs are geopolitical in nature. That is, they do not necessarily reflect biology or behaviour of the fish population(s) within the QMA. As such, the results of any analyses that artificially separate fish in this way could compromise the ability to adequately test any scientific/statistical hypotheses. The management units could be included in any model (for example, as a random effect) to account for any unobserved geopolitical differences in harvest. While the entrainment and impingement data to be analyzed will be obtained completely within the boundaries of a region, the quota described above should be based on estimates obtained from a model that is not restricted to regional data only (unless it can be shown that the fish never leave the region at any time in their history; that is, the region represents an isolated body of water with geographically locked individuals).
	BP Response: See UG-054. **UG Team Evaluation of BP Response:** Unsatisfactory. See UG-054.
UG-057	It should be noted that Michael Chegahno (UofG Grad Student, Whitefish Population Modelling Research Project, SON-BP Collaborative Whitefish Research Program, is currently undertaking a comprehensive review of the options and selection factors for the representation and evaluation of population-level effects for fishes, with a specific focus on assessment of cumulative effects associated with power plants. This review/evaluation should be considered when developing operational definitions of lake whitefish populations for the E/I Monitoring Plan.
	BP Response: None.
UG-058	It should be noted that Clayton Coppaway (UofG Grad Student, Whitefish Population Discrimination Research Project, SON-BP Collaborative Whitefish Research Program, is currently undertaking a comprehensive review of all available information regarding population spatio-temporal distribution of lake whitefish in Lake

	Huron. This review/evaluation should be considered when developing operational definitions of lake whitefish populations for the E/I Monitoring Plan.
	BP Response: None.
UG-059	"*Impingement of lake whitefish within the 2005 EA local study area exceeds test threshold for effect values of 0.50%, 20%, 50%, and 100%, based on the assumption that 0.50%, 20%, 50% and 100% of impinged lake whitefish are from a population which is distinct within the EA local study area.*" Reference is made to "the 2005 EA local study area" however there is no specification of what this area is, and whether this area is appropriate for use in the E/I Monitoring Plan.
	BP Response: This bullet point has been removed from this section. **UG Team Evaluation of BP Response:** Satisfactory.
UG-060	Reference is made to evaluation of whether the adult equivalent impingement estimates exceeds some (undefined) "threshold for effect" at four pre-selected levels, however there is no specification of what this area is, and whether this area is appropriate for use in the E/I Monitoring Plan.
	BP Response: See UG-059. **UG Team Evaluation of BP Response:** Satisfactory.
UG-061	"*the assumption that ... impinged lake whitefish are from a population which is distinct within the EA local study area.*" This assumption is inappropriate for the E/I Monitoring Plan for several reasons. First, depending on definition of the (undefined) "EA local study area," it is highly unlikely that this will be the same as MNR quota management area 4-4, thus leading to a major inconsistency in measurements and interpretation of effects. Second, there is no evidence upon which to attribute or assume the population origin of the impingement lake whitefish, especially the specific condition that impinged fish are from an (undefined) local population rather than existing hypotheses about larger or migratory populations of lake whitefish in Lake Huron. Third, this assumption is contrary to previous statements in this document about the importance of identifying "distinct populations" in order to properly evaluate whether the Bruce A Restart is having "significant adverse effect on the ... species."
	BP Response: See UG-054. **UG Team Evaluation of BP Response:** Unsatisfactory. See UG-054.

"*Further details on these proposed objectives are discussed in their respective sections below. The results of this sampling will be compared to data collected pre-Operations Phase. These analyses will be performed for the assessment of potential changes in impingement and entrainment impacts from those during the pre-Operations Phase. This data will be used in conjunction with proposed thresholds for effect and endpoints of follow-up monitoring to aid in determining the path forward for Bruce Power following this study, in relation to impingement and entrainment monitoring.*" (p.4)

UG-062	"*Further details on these proposed objectives are discussed in their respective sections below.*" It is appropriate that details regarding the objectives should be presented in the following subsections. However, as discussed above, the objectives present a wide variety of assumptions and presumptions which have not been supported – some of which are very questionable.
	BP Response: Paragraph was altered to now read: "The assessment of the proposed objectives of impingement and entrainment monitoring during the Operations Phase will be carried out until identified endpoints are achieved. Further details on these proposed objectives and endpoints are discussed in Sections 4.3 (Entrainment) and 4.4 (Impingement). Where meaningful, the results of Operations Phase sampling will be compared to data collected prior to the Operations Phase. The Operations Phase data will be used to determine if proposed thresholds for effect and monitoring endpoints have been met and will further aid in recommending if additional, longer term or periodic impingement and entrainment monitoring should be undertaken." [p. 2] **UG Team Evaluation of BP Response:** Unsatisfactory. The assumptions and presumptions remain outstanding.
UG-063	"*These analyses will be performed for the assessment of potential changes in impingement and entrainment impacts from those during the pre-Operations Phase.*" It is not clear that the "pre-Operations Phase" and "Operations Phase" E/I assessments have been undertaken in a manner that will allow for statistical comparison; this is an important factor that must be considered in the E/I Monitoring Plan.
	BP Response: Sentence has been changed to read: "Where meaningful, the results of Operations Phase sampling will be compared to data collected prior to the Operations Phase." [p. 2] **UG Team Evaluation of BP Response:** Unsatisfactory. While the text has been revised to consider the comparability of the data (pre and post operations phase), any future monitoring must be developed with appropriate statistical expertise so that data pre and post are comparable.
UG-064	"*This data will be used in conjunction with proposed thresholds for effect and endpoints of follow-up monitoring to aid in determining*

	the path forward for Bruce Power following this study, in relation to impingement and entrainment monitoring." These (rather than this) data – presumably both the E/I pre-Operations and Operations Phases – may or may not be comparable to the undefined "thresholds for effect and endpoints." It would be unwise to assume that such a comparison will be possible until (a) the "thresholds for effect and endpoints" have been appropriately defined, and (b) statistical evaluation of the data sets concludes that such a comparison is possible.
	BP Response: Sentence has been changed to now read: "The Operations Phase data will be used to determine if proposed thresholds for effect and monitoring endpoints have been met and will further aid in recommending if additional, longer term or periodic impingement and entrainment monitoring should be undertaken." [p. 2] **UG Team Evaluation of BP Response:** Unsatisfactory. The thresholds for effect should be clearly identified, including all assumptions made to develop the effect. It is advisable to consider the effect of evaluation the sensitivity of outcomes given changes to the threshold levels.
UG-065	*"… to aid in determining the path forward for Bruce Power following this study.*" It is not clear what this statement means. There should be some clear and explicit understanding of BP's actions that would result from the contingency of possible outcomes from this study.
	BP Response: Sentence has been reworded to read: **"…**will further aid in recommending if additional, longer term or periodic impingement and entrainment monitoring should be undertaken." [p. 2] **UG Team Evaluation of BP Response:** Unsatisfactory. This statement is still unclear.

2.0 Study Approach

2.1 Adoption of specific USEPA Section 316(b) Methods

"*The proposed study approach will assess potential residual effects of impingement and entrainment on three EA VEC fish species, namely lake whitefish, spottail shiner, and deepwater sculpin, comparing species and life stages of fish impinged or entrained to their relative densities in source waters. This document proposes to adopt certain approaches and methodologies that are used when undertaking similar impingement and entrainment studies in the United States regulated under Section 316(b) of the United States Environmental Protection Agency (USEPA) Clean Water Act (CWA) (hereafter referred to as USEPA Section 316(b)).*" (p.5)

UG-066	"*The proposed study approach will assess potential residual effects of impingement and entrainment on three EA VEC fish species …*" It is not clear what is meant by "residual effects."
	BP Response: This section has been moved to Section 4.1 (Adoption of Specific USEPA Section 316(b) Methods) on p. 17. Residual effects were discussed in Section 2.6.3 (Significance of Residual Adverse Effects) on p. 9. Also refer to Tables 2 and 3 on pages 10 and 11, respectively, for significance of residual adverse entrainment and impingement effects. **UG Team Evaluation of BP Response:** Unsatisfactory. The concept of residual effects has been defined. Significance, significant, and adverse have not. It is important to note that residual has a different interpretation from a statistical point of view, and as such definitions of terms that overlap the biological and statistical world need to be clearly defined.
UG-067	*"… comparing species and life stages of fish impinged or entrained to their relative densities in source waters.*" This is awkwardly worded, and needs to be explicit about the comparison of life-history-specific relative abundance in source water estimates and entrainment/impingement estimates. It is at this point that the E/I Monitoring Plan's problems with defining "entrainment" and "impingement" could have major consequences.
	BP Response: None.
UG-068	"*This document proposes to adopt certain approaches and methodologies that are used when undertaking similar impingement and entrainment studies in the United States regulated under Section 316(b) of the United States Environmental Protection Agency (USEPA) Clean Water Act (CWA).*" The UofG Team strongly supports use of USEPA Section 316(b) in the development of this E/I Monitoring Plan. It is not clear which of the "certain approaches and methodologies" will be adopted from USEPA 316(b), and which will not be adopted. The document should explicitly identify these adoptions, and rationale for the "approaches and methodologies" that were not adopted.
	BP Response: None.

"*Similar analyses of the potential impacts of impingement and entrainment by power plant intakes on fish populations within the Great Lakes has and continues to be performed in the United States. In 2001, the United States Environmental Protection Agency (USEPA) promulgated Phase 1 (Phase 1 Rule) of the USEPA Section 316(b). Section 316(b) of the CWA addresses cooling water intake structures in U.S. jurisdictional waters, including those found at power plants, and requires that their location, design, construction and capacity reflect the best technology available for minimizing adverse environmental impacts. As part of the Phase 1 Rule, the USEPA set*

forth guidelines for performing source water baseline biological characterizations (Federal Register vol.66, no.243, page 65316)." (p.5)

UG-069	"*Similar analyses of the potential impacts of impingement and entrainment by power plant intakes on fish populations within the Great Lakes has and continues to be performed in the United States.*" The document should provide references to identify which Great Lakes power plants have been conducting "similar analyses of the potential impacts of impingement and entrainment by power plant intakes on fish populations."
	BP Response: None.
UG-070	"*… the USEPA set forth guidelines for performing source water baseline biological characterizations (Federal Register vol.66, no.243, page 65316)."* The E/I Monitoring Plan needs to explicitly identify the USEPA 316(b) "National Pollutant Discharge Elimination System: Regulations Addressing Cooling Water Intake Structures for New Facilities; Final Rule" requirements for information to "*characterize the biological community in the vicinity of the cooling water intake structure as well as the operation of the cooling water intake structures.*" (p.65316) "*This supporting information must include existing data (if available), which may be supplemented with new field studies if the applicant so chooses. The applicant must submit the following specific data:* 1. *a list of the data that are not available and efforts made to identify sources of the data* 2. *if available, a list of species (or relevant taxa) in the vicinity of the cooling water intake structure, and identification of the species and life stages that would be most susceptible to impingement and entrainment (including both nekton and meroplankton) (Species identified should include the range of species in the system including the forage base);* 3. *if available, identification and evaluation of the primary period of reproduction, larval recruitment, and period of peak meroplankton abundance for relevant taxa;* 4. *if available, information sufficient to provide data representative of the seasonal and daily biological activity in the vicinity of the cooling water intake structure;* 5. *if available, identification of all threatened or endangered species that might be susceptible to impingement and entrainment at your cooling water intake structures* 6. *documentation of any public participation or consultation with Federal or State agencies undertaken in collecting the data* 7. *if the above data are supplemented with data collected in actual field studies, a description of all methods and quality assurance procedures for data collection, sampling, and analysis, including a description of the study area; identification of the biological assemblages to be sampled or evaluated (both nekton and*

	meroplankton); and data collection, sampling, and analysis methods. *The sampling or data analysis methods used must be appropriate for a quantitative survey and based on a consideration of methods used in other biological studies performed within the same source waterbody. The study area should include, at a minimum, the area of influence of the cooling water intake structure.*" (p.65316) The E/I Monitoring Plan should make specific reference to the data identified above (existing data and proposed sampling data) for each of the selected VEC species.
	BP Response: None.
UG-071	It is important to note that the USEPA 316(b) section on "Source Water Baseline Biological Characterization Data" makes strong reference to the quality and quantity of the data collection and analyses that will be conducted on these data. The E/I Monitoring Plan will need to be much more explicit in it's treatment of these important statistical considerations.
	BP Response: Text has been changed to read (italics emphasis added to highlight change): "The PFM is *used to express impingement and entrainment mortality as biomass*, and may be used in conjunction with a trophic transfer model (TTM) to *further estimate equivalent adult biomass of piscivorous (fish eating) species based upon the impinged/entrained biomass of forage fish species*. Because the focus of this study is restricted to lake whitefish, deepwater sculpin and spottail shiner, none routinely prey on the others, *and because the endpoints/thresholds for this study are anticipated to be based upon numbers of individuals rather than biomass*, neither the PFM or TTM will be utilized." [p. 17] **UG Team Evaluation of BP Response:** Unsatisfactory. The quality and quantity of the data collection and analyses remain key uncertainties.
UG-072	It is also important to realize that the two previous sections of the same USEPA 316(b) document makes explicit reference to the requirement for "Source Water Physical Data" that are "*needed to characterize the facility and evaluate the type of waterbody and species affected by the cooling water intake structure*" and "Cooling Water Intake Structure Data" that are needed "*characterize the cooling water intake structure and evaluate the potential for impingement and entrainment of aquatic organisms. Information on the design of the intake structure and its location in the water column will allow the permit writer to evaluate which species or life stages would potentially be subject to impingement and entrainment.*" (p.65316):

	With specific reference to "Source Water Physical Data": 1. "*a narrative description and scale drawings showing the physical configuration of all source waterbodies used by the facility, including areal dimensions, depths, salinity and temperature regimes, and other documentation;* 2. *an identification and characterization of the source waterbody's hydrological and geomorphological features, as well as the methods used to conduct any physical studies to determine the intake's zone of influence and the results of such studies; and* 3. *locational maps.*" (p.65316) With specific reference to "Cooling Water Intake Structure Data": "*A diagram of the facility's water balance would be used to identify the proportion of intake water used for cooling, make-up, and process water. The water balance diagram also provides a picture of the total flow in and out of the facility, allowing the permit writer to evaluate compliance with the Track I flow reduction requirements (if applicable). Specific data on the intake structure include* 1. *a narrative description of the configuration of each of your cooling water intake structures and where it is located in the waterbody and in the water column;* 2. *latitude and longitude in degrees, minutes, and seconds for each of your cooling water intake structures;* 3. *a narrative description of the operation of each of your cooling water intake structures, including design intake flows, daily hours of operation, number of days of the year in operation, and seasonal changes, if applicable;* 4. *a flow distribution and water balance diagram that includes all sources of water to the facility, recirculating flows, and discharges;* 5. *engineering drawings of the cooling water intake structure.*" (p.65316) As discussed above, the UofG Research Program has a strong emphasis on the collection and analyses of hydrodynamic data to support the kinds of requirements for information about water flow and entrainment/impingement risks for fishes, including the three identified VEC species. The E/I Monitoring Plan will need to be much more explicit in it's treatment of these hydrodynamic analyses.
	BP Response: The following sentence was added to the end of the second paragraph: "Section 4.2 of this work plan provides details on proposed source water sampling." [p. 17] New text in Section 4.2 includes:

	"Figure 3 shows the proposed locations for sampling of source waters in the vicinity of the Bruce Power site. The figure is illustrative and the direction of travel from the consistent start point will vary across weeks of sampling based on wind direction, weather and wave conditions at the time of survey which will affect the direction of travel. To collect suspended eggs and larval fish, larval tows will be performed at the sampling stations placed in the vicinity of the Bruce A station intake using a 1.0 m by 2.0 m neuston net with a 500 µm mesh. For the purpose of this Plan, the area of influence representing increased intake water velocities will be determined using a Hydraulic Zone of Influence (HZI) analysis. The general area where larvae may encounter the predicted Bruce A station intake will be sampled; however they may come into contact with the intake and their origin is a complex question. For the purposes of this study, the HZI represents the instantaneous three-dimensional water volume, the margins of which represent the spatial threshold within which larval fishes have a higher probability to be drawn into the Bruce A station intake rather than escape into the lake. The HZI is estimated by established hydraulic models in a spreadsheet format. The size and shape of the HZI are highly variable, dependent upon prevailing wind direction and velocity, as well as other environmental and operational factors such as water currents, seiche, and the Bruce A station cooling water intake flow. The HZI will be estimated using environmental data from each sampling date and the results included in applicable Operations Phase monitoring reports." [p. 21] **UG Team Evaluation of BP Response:** Unsatisfactory. There are no details describing how the variation in operating conditions of the pumps in the forebay will affect the proposed Hydraulic Zone of Influence (HZI) analysis. Further details on the cooling water intake structure and how it interacts with the nearshore Lake Huron environment is also required.

"*In USEPA 316(b) studies, the equivalent number of adults that are impinged or entrained are calculated using a suite of established models utilized by the USEPA during development of the Section 316(b) Rule (USEPA 2002). These include the Equivalent Adult Model (EAM), the Production Foregone Model (PFM) and the Foregone Fishery Yield Model (FFYM). The PFM is used in conjunction with a trophic transfer model (TTM) to estimate equivalent adults of piscivorous (fish eating) species. Because the focus of this study is restricted to lake whitefish, deepwater sculpin and spottail shiner, and none routinely prey on the others, the PFM/TTM will not be utilized. The FFYM will be used only for lake whitefish, as it is the only recreationally or*

commercially caught species. The EAM will be used for lake whitefish, deepwater sculpin and spottail shiner." (p.5)

UG-073	"*In USEPA 316(b) studies, the equivalent number of adults that are impinged or entrained are calculated using a suite of established models utilized by the USEPA during development of the Section 316(b) Rule (USEPA 2002).*" The UofG Team strongly endorses the USEPA (2002) ""Case Study Analysis for the Proposed Section 316(b) Phase II Existing Facilities Rule" because of the rigorous scientific and quantitative approach to evaluating cumulative effects of mortality associated with power plants, including entrainment and impingement mortality. The conceptual approach adopted by USEPA in this regard is very similar to the approach adopted by the UofG Research Program, especially with regard to life-history population modeling and quality the partitioning of mortality (see Background of this document and Section A5-2.3 in USEPA (2002).
	BP Response: None.
UG-074	The UofG Team supports the use of the Equivalent Adult Model (EAM) and Foregone Fishery Yield Model (FFYM) for lake whitefish, as described by the USEPA (2002) case study document, however it is important to note that many of the required data/parameters for these models may not be readily available. In these cases, the E/I Monitoring Plan will need to explicitly describe and justify decisions about how to deal with important missing information.
	BP Response: None.
UG-075	"*The PFM is used in conjunction with a trophic transfer model (TTM) to estimate equivalent adults of piscivorous (fish eating) species. Because the focus of this study is restricted to lake whitefish, deepwater sculpin and spottail shiner, and none routinely prey on the others, the PFM/TTM will not be utilized*." The UofG Team has serious concerns regarding the decision not to use Production Foregone Model (PFM) and trophic transfer model (TTM) in the E/I Monitoring Plan, for several reasons. First, the author has incorrectly suggested that PFM is limited to piscivorous (fish eating) species – when in fact the USEPA document makes no such constraint "*The foregone production of forage species (those species not harvested for recreational or commercial fisheries) is used to estimate the subsequent reduction in harvested species yield that results from a decrease in the food supply*" (USEPA 2002, p.A5-6). Second, lake whitefish are known to be piscivorous (fish eating) and there is no evidence that the lake whitefish in the area of affect are not relying on other fish as prey. Third, the PFM/TTM methods are not constrained to whether the three selected VEC species feed on each other, but rather that they feed on prey (non-fish or fish) that have biologically significant entrainment/impingement risk exposure. Taken as whole, it is clear to the UofG Team that the PFM/TTM remains a potentially important

	tool for assessing effects of entrainment and impingement, and must be reconsidered in a much more rigorous manner for the E/I Monitoring Plan.
	BP Response: Text has been altered to include further justification for not including PFM/TTM to read: "The PFM is used to express impingement and entrainment mortality as biomass, and may be used in conjunction with a trophic transfer model (TTM) to further estimate equivalent adult biomass of piscivorous (fish eating) species based upon the impinged/entrained biomass of forage fish species. Because the focus of this study is restricted to lake whitefish, deepwater sculpin and spottail shiner, none routinely prey on the others, and because the endpoints/thresholds for this study are anticipated to be based upon numbers of individuals rather than biomass, neither the PFM or TTM will be utilized." [p. 17] **UG Team Evaluation of BP Response:** Unsatisfactory. The PFM/TTM remains a potentially important tool for assessing effects of entrainment and impingement, and must be reconsidered in a much more rigorous manner for the E/I Monitoring Plan.

"*For the study, the effects of impingement and entrainment will be assessed by comparing the number of equivalent adult fish killed as a result of impingement or entrainment at the Bruce A station to an estimate of adult fish of the same species found in the source water. When practicable, a comparison will be made between Bruce A station impingement and entrainment data by life stage to similar life stage estimates or indices of source water fish populations.*" (p.5)

UG-076	"*For the study, the effects of impingement and entrainment will be assessed by comparing the number of equivalent adult fish killed as a result of impingement or entrainment at the Bruce A station to an estimate of adult fish of the same species found in the source water."* It is very unclear what is meant by "*an estimate of adult fish of the same species found in the source water*." The "source water" is undefined with regard to spatial distribution of the lake whitefish population(s) being affected. Previously, the document referred to the assumption that MNR quota management area 4-4 as the corresponding representation of the whitefish population distribution. Aside from serious flaws in this assumption (see above), the "source water" region and MNR quota management area are very different from each other. The E/I Monitoring Program will need to seriously reconsider this factor in assessment of entrainment and impingement effects.
	BP Response: Sentence has been altered to read (italics emphasis added): "Effects of impingement and entrainment will be assessed by

	comparing the modelled number of equivalent adult fish mortalities as a result of impingement or entrainment at the Bruce A station to estimates of adult fish of the same species found in source waters *in the vicinity of the Bruce Power site, based on agency reports and data*." [p. 18] **UG Team Evaluation of BP Response:** Unsatisfactory. The concept "in the vicinity" is still an undefined area.
UG-077	"*When practicable, a comparison will be made between Bruce A station impingement and entrainment data by life stage to similar life stage estimates or indices of source water fish populations.*" It is not clear what this sentence means with regard to the sampling program and analyses. What is meant by "practicable"? What is the distinction between "life stage estimates" and "indices"?
	BP Response: None.
UG-078	What exactly is being defined as a "source water fish population?" Is the author assuming that the lake whitefish in waters adjacent to BNGS are structured as a localized population with spatial distribution corresponding to the (undefined) "source water"? It seems that the E/I Monitoring Plan is becoming mired down with a host of different and very poorly defined meanings of the term "population."
	BP Response: See UG-076. **UG Team Evaluation of BP Response:** Unsatisfactory. See UG-076.

2.1.1 Equivalent Adult Model (EAM)

"*The EAM is used to express impingement and entrainment losses as the equivalent number of individuals at some other life stage or year class (i.e. an age cohort); referred to in the EAM as the age of equivalency (age x).*
This method provides a means of converting losses of fish eggs, fish larvae and other early life stages into units of individual fish at the selected age of equivalency and provides a standard metric for assessing mortality due to impingement and entrainment and to an extent comparing losses between years, and between different facilities [USEPA 2002]. The use of age-1 as an age of equivalency is consistent with the methodology presented by the
USEPA, though the USEPA does note that the age of equivalency can be any life stage of interest. The target age of equivalency value for each of the species will be discussed with the responsible fisheries management agencies and Bruce Power and may be refined prior to undertaking analysis based on that consultation." (p.6)

UG-079	The UofG Team supports the use of EAM as proposed/described by USEPA.
	BP Response: None.

UG-080	"*The target age of equivalency value for each of the species will be discussed with the responsible fisheries management agencies and Bruce Power and may be refined prior to undertaking analysis based on that consultation.*" It is not clear what is meant by this sentence, but there are a couple of important issues that emerge. First, it is not clear what is meant by "responsible fisheries management agencies," although it must be stressed that the Saungeen Ojibway Nation actively manages its own fisheries in its traditional waters of Lake Huron – which includes the BNGS site; thus SON must be consulted on this and all issues related to the effects of the BNGS on Lake Huron lake whitefish. Second, the "target age of equivalency" for lake whitefish should be determined prior to the E/I Monitoring Plan.
	BP Response: This sentence has been removed from the Plan. **UG Team Evaluation of BP Response:** Unsatisfactory. The requirement for consultation with SON and Federal/Provincial fisheries management agencies can not simply be ignored.

"*In order to better relate the impinged and entrained fishes to the available populations in Lake Huron, the age of equivalency proposed for lake whitefish is age-4, the age at which the species has been documented by MNR to first enter the commercial fishery. The age of equivalency proposed for lake whitefish is age-4. Age-4 was selected as it is the youngest age cohort reported as being harvested commercially in Canadian Waters of the Lake Huron main basin in MNR Quota Management Area 4-4 in the MNR report Lake Huron Commercial Fishing Summary for 2010 [MNR 2011]. The sampled gill net catch for QMA 4-4, as reported in Cottrill et al. [2010], consisted of nine age classes ranging from age four to 12 years, with ages seven, eight, and nine dominating. For reference purposes, and subject to availability from MNR, size at age will use data reported in annual quota allocation reports of the Upper Great Lakes Management Unit with size at age comparisons with Bruce Power data made where aging has been conducted.*" (p.6)

UG-081	"*In order to better relate the impinged and entrained fishes to the available populations in Lake Huron, the age of equivalency proposed for lake whitefish is age-4, the age at which the species has been documented by MNR to first enter the commercial fishery. The age of equivalency proposed for lake whitefish is age-4. Age-4 was selected as it is the youngest age cohort reported as being harvested commercially in Canadian Waters of the Lake Huron main basin in MNR Quota Management Area 4-4 in the MNR report Lake Huron Commercial Fishing Summary for 2010 [MNR 2011].*" It is not clear what is meant by "available populations in Lake Huron." As a point of correction, MNR data actually show that lake whitefish in Lake Huron typically begin to enter the commercial fishery at the age of 3 years, rather than 4 years. However, the use of age-4 for

	equivalency is appropriate as a representation of fish that would be fully recruited to the fishery.
	BP Response: This sentence has been altered to read: "In order to better relate the impinged and entrained fishes to the available populations in Lake Huron, the age of equivalency proposed for lake whitefish is age-4. Age-4 is proposed as it is the youngest age cohort reported in the Lake Huron Commercial Fishing Summary for 2010 [MNR 2011] to have been harvested commercially in Canadian Waters of the Lake Huron main basin in MNR QMA 4-4." [p. 18] **UG Team Evaluation of BP Response:** Satisfactory.
UG-082	"*For reference purposes, and subject to availability from MNR, size at age will use data reported in annual quota allocation reports of the Upper Great Lakes Management Unit with size at age comparisons with Bruce Power data made where aging has been conducted.*" SON has previously identified serious concerns regarding the MNR age determination for lake whitefish in Lake Huron, and these issues should be reconciled before using age data from the Upper Great Lakes Management Unit. SON currently deploys the only active commercial fishery in the waters adjacent to the BNGS, and arrangements should be made with the SON Fisheries Assessment Unit regarding assessment of biological samples – as has been the practice between BP and SON for some time. While the age structure comparisons are not discouraged, this seems to assume that the individual whitefish near Bruce Power Generating Station (BPGS) belong to the same population of whitefish that have been studied by the UGLMU. Again, a sensitivity analysis should be conducted to determine how the size at age values might change the estimates of the Foregone Fishery Yield Model (FFYM). Furthermore, size-at-age estimates are likely to involve substantial uncertainty. How are these uncertainties being addressed?
	BP Response: The sentence has been altered to read: "For reference purposes, and subject to availability from MNR, *models will use* the most up to date size-at-age data reported in annual quota allocation reports of the Upper Great Lakes Management Unit. *If deemed necessary*, comparisons with Bruce Power size-at-age data will be made where such data exist." [p. 18] **UG Team Evaluation of BP Response:** Unsatisfactory. The key uncertainty for this issue has been ignored. What models are being referred to? BP is once again ignoring the fact that the UG Team has been tasked under terms of the SON-BP Collaborative Whitefish Research Program to develop mathematical models of the late whitefish population(s) and associated fisheries. In addition,

	how will it be determined if a comparison is *deemed necessary?* Uncertainties in the age estimates has not been addressed.
UG-083	It is recommended that a sensitivity analysis be performed to determine how the EAM outcomes might change if the age of equivalency is different than age-4.
	BP Response: None.

"*The EAM requires life-stage-specific impingement and entrainment counts and life-stage-specific mortality rates from the life stage at which impingement/entrainment took place to the life stage of equivalency. The cumulative survival rate from age at impingement/entrainment until the age of equivalency is the product of all stage-specific survival rates to the age of equivalency [USEPA 2002]. … The components of Equation 1 represent survival rates during the different life stages between life stage **j** , when a fish is impinged or entrained, and age x, the age of equivalency. Survival through the stage at which impingement/entrainment occurs, **j** , is treated as a special case because the amount of time spent in that stage before impingement/entrainment is unknown and therefore the known stage-specific survival rate, **Sj** , does not apply. The term **Sj** describes the survival rate through the entire length of time that a fish is in stage **j** . Therefore, to find the expected survival rate from the day that a fish was impinged/entrained until the time that it would have passed into the subsequent stage, an adjustment to **Sj** is required. The adjusted rate **S*j** describes the effective survival rate for the group of fish impinged/entrained at stage **j** , considering the fact that the individual fishes were impinged/entrained at various specific ages within stage **j** [USEPA 2002].*" (p.6)

UG-084	How are uncertainties associated with impingement and entrainment counts handled? Similarly, how are the uncertainties associated with stage-specific mortality rates addressed?
	BP Response: None.
UG-085	The EAM appears to be a discrete model, lacking statistical assumptions. Are the impingement and entrainment counts assumed to follow a particular distribution?
	BP Response: None.
UG-086	The EAM does not appear to consider or explicitly incorporate uncertainty regarding the estimates of the cumulative survival rate.
	BP Response: None.
UG-087	The EAM aggregates the data at the annual level. Are there risks associated with aggregating (i.e., Simpson's Paradox)? How might these be addressed? Aggregation could mask patterns, or completely change the direction of a relationship.
	BP Response: None.
UG-088	Larvae are expected during certain seasons. Does it make sense to estimate AEX at the annual level? Perhaps the AEX should be modified to account for seasonal age-x equivalents, with subsequent season specific estimates of mortality and counts of individuals killed.

	BP Response: None.
UG-089	The literature has suggested that "Instead of an adult-equivalent (forward projection) approach, the impact assessments should use an egg-equivalent (fecundity or hindcasting) approach, in which total entrainment losses of ichthyoplankton are related to losses of egg production at the population level" – Exponent 2005, pg viii & ix
	BP Response: None.
UG-090	Are other methods of analyses being considered?
	BP Response: None.

2.1.2 Foregone Fishery Yield Model (FFYM)

"*The FFYM is used to estimate the future fishery loss due to the impingement and entrainment of recreationally and commercially caught fishes. For this Study, only primary fishery losses based upon the direct impingement and entrainment of lake whitefish will be considered. Secondary fishery yield losses, which use sport fish equivalents that have been converted from forage fish biomass, will not be considered because forage fish represent very little of the lake whitefish diet.*
The results of the FFYM may be considered as the portion of the lake whitefish equivalent adults (calculated using the EAM) that would have been caught commercially or recreationally had they not been impinged or entrained." (p.7)

UG-091	"*For this Study, only primary fishery losses based upon the direct impingement and entrainment of lake whitefish will be considered. Secondary fishery yield losses, which use sport fish equivalents that have been converted from forage fish biomass, will not be considered because forage fish represent very little of the lake whitefish diet*." There are several serious problems with this statement. First, the focus should not be on "fishery losses" but rather on population losses=population mortality, of which fishery mortality must be combined in a cumulative manner with natural mortality, entrainment mortality, impingement mortality, thermal mortality, contaminant mortality, etc. Second, the so-called "secondary … yield losses" are incorrectly associated with "sport fish equivalents" when there is no such need or justification. Third, as discussed above, the UofG Team has serious concerns regarding the decision not to use Production Foregone Model (PFM) and trophic transfer model (TTM) in the E/I Monitoring Plan. Fourth, the claim that "forage fish represent very little of the lake whitefish diet" has not been investigated for the affected population(s). Fifth, as discussed above, the PFM/TTM methods are not constrained to whether the three selected VEC species feed on each other, but rather that they feed on prey (non-fish or fish) that have biologically significant entrainment/impingement risk exposure. Taken as whole, it is clear to the UofG Team that the PFM/TTM remains a potentially important tool for assessing effects of entrainment and

	impingement, and must be reconsidered in a much more rigorous manner for the E/I Monitoring Plan.
	BP Response: References have been added to the final sentence in this excerpt: "Secondary fishery yield losses, which use sport fish equivalents that have been converted from forage fish biomass, will not be considered because forage fish represent very little of the lake whitefish diet [Pothoven et al. 2001; McNickle et al. 2006]." [p. 19] **UG Team Evaluation of BP Response:** Unsatisfactory. Other than the addition of a couple of references, the key uncertainties and concerns of this issue have not been addressed.
UG-092	Since the FFYM incorporates the results of the EAM, there is a risk of further compounding the effects due to ignoring uncertainty. The EAM is not a point estimate (as the components used to calculate the EAM are themselves subject to variability), and as such will introduce further variability to the estimates of Y. A full study of all uncertainties should be included in this particular research. That is, incorporation of uncertainties of yearly survival, total stage specific mortality, age-x equivalents, average weights at age, etc., are necessary to fully understand the potential foregone yield due to impingement and entrainment. The FFYM should be investigated on alternate time scales (i.e., monthly, seasonally) to determine if there are significant effects that are masked by aggregating the data at an annual level. The results could indicate month, or season specific opportunities to reduce entrainment and impingement.
	BP Response: The following addition was made to this section: "When parameterizing both the EAM and FFYM, preference will be given to life-history data for each of the VEC species resulting from studies in the area of Lake Huron in the vicinity of the Bruce Power site. In the event that life-history data is available from multiple sources, priority for sources will be given as follows: 1) Management Agencies (e.g. MNR, DFO, USGS); 2) Peer-reviewed literature; 3) Gray literature; and 4) Unpublished data from academic or professional studies, industry, and personal communications. Priority is given to the MNR data due to their legal mandate in managing freshwater fish populations in Ontario and as one regulatory stakeholder that will be reviewing the results of the Follow-up Program. To further aid data selection for model parameters, sensitivity analyses may be run on the FFYM to provide a comparison of size-at-age values and the associated model outputs. This may identify those data values most suited for use in future analyses. Results of sensitivity analyses will be summarized

	in applicable future reports on Operations Phase monitoring." [p. 20] **UG Team Evaluation of BP Response:** Unsatisfactory. The use of sensitivity analyses is encouraged. However, the use of data should not be determined based on *legal mandate* or *stakeholder review*. It should be based on data quality, data availability, etc.
UG-093	The FFYM (and the AEX) lump impingement and entrainment into one model. It might be beneficial to study the effects of impingment and entrainment separately, especially if there is a monthly or seasonally specific risk.
	BP Response: None.
UG-094	While not explicitly described, at what levels will AEX and Y be considered significant, or detrimental to the population of whitefish? Furthermore, how are significant effects going to be measured? What are they going to be compared against?
	BP Response: None.
UG-095	The AEX and FFYM do not consider potential covariates to explain survival rates, etc. Furthermore, spatial and temporal correlations are ignored.
	BP Response: None.
UG-096	How are instantaneous fishing and total mortality derived? Are these stage specific? Do they vary by year/season/etc.?
	BP Response: See UG-092. **UG Team Evaluation of BP Response:** Unsatisfactory. See UG-092.

3.0 Source Water Sampling Plan

"*Sampling of source waters for lake whitefish eggs has most recently been performed in the vicinity of the Bruce Power site in 2007 and 2009 using larval trawl gears and air lift collection devices, respectively.*" (p.8)

UG-097	Despite previous requests for relevant documentation, the UofG Team has not been provided with the data/documentation associated with Bruce Power's 2007 and 2009 egg/embryo/larval sampling, as had been requested.
	BP Response: None. The section has been moved to Section 4.2 (Source Water Sampling Plan) starting on p. 20.
UG-098	It should be noted that, given the importance of lake whitefish early life history in this environmental assessment, the term 'eggs' refers to female (unfertilized) gametes, while the term 'embryo' refers to post-activation/fertilization, 'free embryo' refers to post-hatching but pre-feeding, 'larva' refers to post-feeding but pre-definitive morphology, 'juvenile' refers to post-definitive morphology but pre-sexual maturity, 'adult' refers to post-sexual maturity. In this sense,

	the air lift sampling was targeting eggs and or embryos, while trawl sampling was targeting free-embryos and/or larvae.
	BP Response: None.
UG-099	How were these data collected? Were they collected in the same manner as described below, or do the additional source water sampling compliment the findings of the original work? If so, how are the findings going to be incorporated into the study?
	BP Response: None.

"*Additional source water sampling targeting lake whitefish, spottail shiner and deepwater sculpin, but recording all species and life stages captured, will be performed in the vicinity of the Bruce A station intake to assist in the estimation of impingement and entrainment following the USEPA Section 316(b) protocol. Figure 2 shows the proposed locations for sampling of source waters in the vicinity of the Bruce Power site. To collect suspended egg and larval fish (targeting primarily lake whitefish) sampling will be performed using a neuston net with a 300 µm mesh. Sampling for source water larval density will take place in the vicinity of the plant intake using a neuston net with 300 µm mesh. Sampling will proceed at a rate of once per week for ten consecutive weeks, encompassing the period where lake whitefish and deepwater sculpin larval entrainment were highest (April through mid-June).*" (p.8)

UG-100	"*Additional source water sampling targeting lake whitefish, spottail shiner and deepwater sculpin, but recording all species and life stages captured, will be performed in the vicinity of the Bruce A station intake to assist in the estimation of impingement and entrainment following the USEPA Section 316(b) protocol.*" This sentence is not clear – "additional source water sampling" in addition to what? How will the target sampling strategy differ across target species? What specific aspects of the USEPA 316(b) protocol are being referred to in this sense?
	BP Response: This sentence has been altered to now read: "During the Operations Phase, source water sampling to detect larval lake whitefish, larval spottail shiner and larval deepwater sculpin (but recording all species and life stages captured during the period of source water sampling), will be performed in the vicinity of the Bruce A station intake to determine relative abundance of egg and larval stages of these species and provide context for the estimation of entrainment using the USEPA models previously described." [p. 20-21] **UG Team Evaluation of BP Response:** Unsatisfactory. How will the target sampling strategy differ across target species? What specific aspects of the USEPA 316(b) protocol are being referred to in this sense?
UG-101	"*Figure 2 shows the proposed locations for sampling of source waters in the vicinity of the Bruce Power site.*" Figure 2 shows a

	purple line drawn around the BNGS entitled “EA Study Report Local Study Area Boundary.” Is this supposed to define some operational are for use in the E/I Monitoring Plan? If so, how was it determined to be an appropriate area for this plan?
	BP Response: This sentence has been changed to now read: “Figure 3 shows the proposed locations for sampling of source waters in the vicinity of the Bruce Power site. The figure is illustrative and the direction of travel from the consistent start point will vary across weeks of sampling based on wind direction, weather and wave conditions at the time of survey which will affect the direction of travel.” [p. 21] **UG Team Evaluation of BP Response:** Unsatisfactory. The appropriateness of the study area has not been justified. No further justification on EA Study Report Local Study Area Boundary is provided.
UG-102	Figure 2 shows four green lines entitled “Proposed Source Water Sampling Locations.” There is no justification provided for either the number or the location of these four sampling locations. It is inclear if they are intended to provide adequate targeting for the different VEC fish species.
	BP Response: None.
UG-103	“*To collect suspended egg and larval fish (targeting primarily lake whitefish) sampling will be performed using a neuston net with a 300 µm mesh. Sampling for source water larval density will take place in the vicinity of the plant intake using a neuston net with 300 µm mesh.*” Does “vicinity of the plant intake” refer to the four sampling locations identified in Figure 2, or some other sampling that is not described by the identified locations?
	BP Response: The sentence has been changed to now read: “To collect suspended eggs and larval fish, larval tows will be performed at the sampling stations placed in the vicinity of the Bruce A station intake using a 1.0 m by 2.0 m neuston net with a 500 µm mesh.” [p. 21] **UG Team Evaluation of BP Response:** Unsatisfactory. The concept of "in the vicinity of the plant intake" remains undefined.
UG-104	“*Sampling will proceed at a rate of once per week for ten consecutive weeks, encompassing the period where lake whitefish and deepwater sculpin larval entrainment were highest (April through mid-June)*” It is not clear how this sampling frequency came to be determined: What data were analysed? How do we know that the temporal bounds of the sampling season are appropriate? How do we know that the sampling frequency is appropriate?
	BP Response: This sentence has been altered to now read: “Larval fish sampling will proceed at a rate of once per week for ten

	consecutive weeks, encompassing the period from April through mid-June where lake whitefish and deepwater sculpin larval entrainment has been highest in historic entrainment samples and where larval life stages of development would most likely occur based on species life history." [p. 21] **UG Team Evaluation of BP Response:** Unsatisfactory. It is still unclear how the sampling rate was determined, or whether it is appropriate.
UG-105	How were the proposed locations for sampling source waters in the vicinity of the Bruce Power site selected? Are these locations representative of the entire offshore location? How will the results from the sampling be extrapolated over the entire offshore location?
	BP Response: None.
UG-106	How was the sampling frequency selected? Does sampling once per week effectively capture the temporal variability of the patterns of distribution and abundance of the targeted species? Should sampling be conducted at a higher frequency for critical periods (i.e., for hatching times, early stages of life, etc.)? Will the influence of lake circulation and hydrodynamics on patterns of distribution and abundance of larval fish be considered when analyzing the results from the sampling program? How will the results from the sampling be extrapolated statistically over the entire water column (with depth) and the overall offshore location? How will these results be related to assess probability of entrainment in BNGS?
	BP Response: With regards to influence of lake circulation and hydrodynamics on patterns of distribution and abundance of larval fish, the following text has been added: "For the purpose of this Plan, the area of influence representing increased intake water velocities will be determined using a Hydraulic Zone of Influence (HZI) analysis. The general area where larvae may encounter the predicted Bruce A station intake will be sampled; however they may come into contact with the intake and their origin is a complex question. For the purposes of this study, the HZI represents the instantaneous three-dimensional water volume, the margins of which represent the spatial threshold within which larval fishes have a higher probability to be drawn into the Bruce A station intake rather than escape into the lake. The HZI is estimated by established hydraulic models in a spreadsheet format. The size and shape of the HZI are highly variable, dependent upon prevailing wind direction and velocity, as well as other environmental and operational factors such as water

	currents, seiche, and the Bruce A station cooling water intake flow. The HZI will be estimated using environmental data from each sampling date and the results included in applicable Operations Phase monitoring reports." [p. 21] **UG Team Evaluation of BP Response:** Unsatisfactory. References are required to support this methodology. How will the hydrodynamics of the source water be sampled to calibrate/validate/verify the spreadsheet model? What governing equations are included in the spreadsheet model? How will the results from the Hydraulic Zone of Influence (HZI) analysis be incorporated with the source water larval sampling? Further details on this aspect of the Monitoring Plan are required.

"*During each weekly larval and egg sampling event, eight samples will be collected along a series of four transects. Sampling will be performed during daylight and night-time hours, with one day and one night sample collected along each of the four transects. Based on the above, the total number of samples is 80. During daytime and night-time sampling, two of the four samples will be collected at the surface, and two will be collected at mid-depths. To the extent possible under the prevailing wind and wave conditions, samples will be taken perpendicular to shore. Each tow will last for approximately 15 minutes and a calibrated flow meter attached to the neuston net mouth will be used to record the meter revolutions per minute and calculate the volume of water sampled. To reduce potential biases associated with boat propeller wash, the boat RPM's, net distance from the vessel, and ground distance covered will be standardized, to the extent possible. The tow will also be conducted in a broad arc rather than a straight line such that the tow net will remain outside of the boat propeller wash area. The following information will be recorded for each tow*" (p.8)

UG-107	"*During each weekly larval and egg sampling event, eight samples will be collected along a series of four transects. Sampling will be performed during daylight and night-time hours, with one day and one night sample collected along each of the four transects. Based on the above, the total number of samples is 80. During daytime and night-time sampling, two of the four samples will be collected at the surface, and two will be collected at mid-depths.*" How do we know that eight samples per transect is appropriate? What is the basis for day and night sampling? What will be the timing of the day and night samples, and why will that be appropriate? Why are both surface and sub-surface samples being collected? What is mid-depth, why is only one sub-surface stratum being sampled, and how do we know that this design is appropriate?
	BP Response: Text has been altered (italics emphasis added) to now read: "During each weekly larval fish and egg sampling event, *ten* samples will be collected along a series of *five* transects. Sampling

	will be performed during daylight and night-time hours *occurring either from 2-3 hours before and after dawn, or two to three hours before and after dusk*. One day and one night sample will be collected along each of the *five* transects. Based on level of sampling effort, the *total number of samples will be 100*. *All tows will be completed at or within 3 m of the surface*." [p. 21] **UG Team Evaluation of BP Response:** Unsatisfactory. The increase from eight to ten transects does not satisfy the questions raised in the comment. The appropriateness of this number is still unjustified.
UG-108	"*To the extent possible under the prevailing wind and wave conditions, samples will be taken perpendicular to shore.*" Why are shore-perpendicular samples preferred to shore-parallel or wind-oriented samples?
	BP Response: Text has been altered to now read (italics emphasis added): "To the extent possible under the prevailing wind and wave conditions, samples will be taken *roughly* perpendicular to shore *to incorporate sampling over multiple lake depths*." [p. 21] **UG Team Evaluation of BP Response:** Unsatisfactory. It still remains unclear as to why shore-perpendicular samples are preferred. Furthermore, it is unclear why shore-perpendicular samples allow for the incorporation of sampling over multiple lake depths.
UG-109	"*The tow will also be conducted in a broad arc rather than a straight line such that the tow net will remain outside of the boat propeller wash area.*" If the tows are intended to be curved, then why are the 'transects' depicted on Figure 2 as straight lines?
	BP Response: See UG-102. **UG Team Evaluation of BP Response:** Unsatisfactory. See UG-102.
UG-110	Has a power analysis been performed to determine if this adequately provides the statistical power required to answer the specific hypotheses of the experiment?
	BP Response: None.
UG-111	Are the transects sufficient to estimate impingement and entrainment in the vicinity of Bruce A station intake? The identified transects do not completely surround the water intake. Are there considerations for larvae being carried to the intake in a manner that bypasses that proposed transects? What type of statistical analyses will be used to estimate the distribution and abundance of larvae? Will spatial and temporal correlations be considered?
	BP Response: None.

UG-112	"*During each weekly larval and egg sampling event, eight samples will be collected along a series of four transects. Sampling will be performed during daylight and night-time hours, with one day and one night sample collected along each of the four transects.*" What time of day will the day and night sampling be conducted? How will the results from the day and night sampling be extrapolated over the entire day? How does the vertical distribution of larval fish vary during the day? Will the sampling program be able to capture this variation?
	BP Response: Text has been altered to now read (italics emphasis added): "During each weekly larval fish and egg sampling event, ten samples will be collected along a series of five transects. Sampling will be performed during daylight and night-time hours *occurring either from 2-3 hours before and after dawn, or two to three hours before and after dusk*. One day and one night sample will be collected along each of the five transects." [p. 21] **UG Team Evaluation of BP Response:** Unsatisfactory. See UG-107.
UG-113	"*During daytime and night-time sampling, two of the four samples will be collected at the surface, and two will be collected at mid-depths.*" How were the sampling depths (surface and mid-depth locations) selected? Are these representative of the entire water column? How will the results from the two points be extrapolated for the entire water column? What statistical measures, if any, will be applied?
	BP Response: Sentence has been reworded to read: "All tows will be completed at or within 3 m of the surface." [p. 21] **UG Team Evaluation of BP Response:** Unsatisfactory. The uncertainties and concerns raised remain outstanding.

4.0 Entrainment

"*As noted above, entrainment is defined as the process by which organisms that are generally smaller than either the Bruce A (Units 1-4) pump intake screens or cooling water traveling screens are drawn through the screens by the through-flow. The entrainment component of this follow up monitoring study will consist of:*

- *Entrainment monitoring for all organisms that are too small to be impinged on the Bruce A (Units 1-4) pump intakes and traveling screens and are carried through the screens; and*
- *Completion of EAM (deepwater sculpin, lake whitefish) and FFYM (lake whitefish) modeling.*" (p.9)

UG-114	As discussed above, the UofG Team has identified serious problems with the proposed definition of entrainment.
	BP Response: Section is now located in Section 4.3 (Entrainment) starting on p. 22. The definition is appears slightly re-worded in the Plan as follows: "As described in Section 1.4, entrainment is defined as the process by which organisms that are generally smaller than either the Bruce A (Units 1-4) cooling water pump intake screens or the cooling water traveling screens are drawn through the screens by the intake cooling water flow." [p. 22] **UG Team Evaluation of BP Response:** Unsatisfactory. Outstanding concerns remain with the definition. See UG 038-041.
UG-115	As discussed above, not all entrained organisms will pass through the travelling screens.
	BP Response: See UG-114. **UG Team Evaluation of BP Response:** Unsatisfactory. See UG-114.
UG-116	As discussed above, EAM and FFYM are appropriate for lake whitefish assessment.
	BP Response: None.
UG-117	As discussed above, it is clear to the UofG Team that the PFM/TTM remains a potentially important tool for assessing effects of entrainment and impingement, and must be reconsidered in a much more rigorous manner for the E/I Monitoring Plan.
	BP Response: None.

4.1 Entrainment Monitoring Objectives

"*As shown in Appendix B, Table 8.1.1-1 from the 2008 Work Plan indicates that the Operations Phase monitoring objective for Element 3.1 is to determine the relative abundance of lake whitefish eggs and larvae present that are susceptible to entrainment, and to confirm the EA finding of no significant adverse effects to larval lake whitefish due to entrainment from the condenser cooling water system operation during the Operations Phase.*" (p.9)

UG-118	"*As shown in Appendix B, Table 8.1.1-1 from the 2008 Work Plan indicates that the Operations Phase monitoring objective for Element 3.1 is to determine the relative abundance of lake whitefish eggs and larvae present that are susceptible to entrainment, and to confirm the EA finding of no significant adverse effects to larval lake whitefish due to entrainment from the condenser cooling water system operation during the Operations Phase*." As discussed above, the E/I Monitoring plan should use proper terminology when referring to target life-history stages of the target species (eggs,

	embryos, free-embryos, larvae, juveniles, adults).
	BP Response: This section has been removed – largely incorporated into Section 1.3 (Study Goal and Objectives). **UG Team Evaluation of BP Response:** Satisfactory. (but see concerns on Study Goal and Objectives)
UG-119	It is very important to note that "susceptible to entrainment" necessarily involves an understanding of hydrodynamic flow and characterization of entrainment risk zones associated with the water intake. This feature seems to be absent from the E/I Monitoring Plan, but is a major focus of the UofG Research Program
	BP Response: See UG-106. **UG Team Evaluation of BP Response:** Unsatisfactory. See UG-106.
UG-120	Use of the word "confirm" is problematic in this context, since it also carries the meaning of 'prove to be true.' A neutral scientific wording would read something like: "… to [confirm] test the EA [finding] prediction of no significant adverse effects to larval lake whitefish due to entrainment from the condenser cooling water system operation during the Operations Phase."
	BP Response: None.

4.2 Review of Historical Data

"*Entrainment sampling has previously been performed at both the Bruce A and Bruce B stations. Entrainment sampling has been performed at the Bruce A station in 1977, 1985-86, and again in 2004. When feasible, the most recent data (2004) will be used to provide historic context relating to sampling techniques and schedules, and to the extent possible to compare with new sample results to be obtained as part of this program. Although multiple years of entrainment data has been compiled, a review of the data as part of this work plan indicates that monitoring activities (i.e., frequency, level of detail, etc.) have varied between years, which is anticipated to limit the ability to draw comparisons between previous years of sampling and subsequently predict future entrainment trends at the Bruce A station. The limitations of historical data will be further explored as part of the proposed study. Following the more rigorous Operations Phase monitoring, statistical comparisons of pre- and post-Operations Phase monitoring to earlier historical data may be possible. However, due to the variability in historical monitoring, some data may be of limited utility, multiple years of data may need to be pooled, and the analyses may have limited statistical power to detect differences between some pre- and post-Operations Phase variables.*" (p.9)

UG-121	"*Entrainment sampling has previously been performed at both the Bruce A and Bruce B stations. Entrainment sampling has been performed at the Bruce A station in 1977, 1985-86, and again in 2004*." Despite previous requests for relevant documentation, the

	UofG Team has not been provided with the data/documentation associated with Bruce Power's 1977, 1985-86, 2004 entrainment sampling, as had been requested.
	BP Response: References were added to this sentence. It now reads: "Entrainment sampling has previously been performed at both the Bruce A and Bruce B stations. Entrainment sampling has been performed at the Bruce A station in 1977, 1985-86, and again in 2004 [Dunstall 1978; McKinley 1988; Bruce Power 2005]." [p. 22] **UG Team Evaluation of BP Response:** Unsatisfactory. Other than the addition of a few references, the issues and concerns remain outstanding. BP continues to withhold the requested data/information.
UG-122	"*When feasible, the most recent data (2004) will be used to provide historic context relating to sampling techniques and schedules, and to the extent possible to compare with new sample results to be obtained as part of this program.*" How do we know that the most recent data are most appropriate for representing a historical context relating to sampling techniques and schedule?
	BP Response: None.
UG-123	"*Although multiple years of entrainment data has been compiled, a review of the data as part of this work plan indicates that monitoring activities (i.e., frequency, level of detail, etc.) have varied between years, which is anticipated to limit the ability to draw comparisons between previous years of sampling and subsequently predict future entrainment trends at the Bruce A station.*" This is not a sentence. On one hand, it states that a review of the data is part of the proposed workplan, and other the other hand conclusions are already drawn from the review. If the historical time series of entrainment data will not allow rigorous restrospective and prospective analyses, is it necessary for a new sampling design that will allow for comparison of results across years? How will we know if this is needed, and what conditions such a sampling design will need to satisfy?
	BP Response: None.
UG-124	"*The limitations of historical data will be further explored as part of the proposed study. Following the more rigorous Operations Phase monitoring, statistical comparisons of pre- and post-Operations Phase monitoring to earlier historical data may be possible. However, due to the variability in historical monitoring, some data may be of limited utility, multiple years of data may need to be pooled, and the analyses may have limited statistical power to detect differences between some pre- and post-Operations Phase variables.*" This seems to be a rehash of the previous (unclear) statement – the bottom line seems to be that statistical analyses will

	be attempted but are not likely to be informative. As discussed above, should the E/I Monitoring Plan ensure the creation of a meaningful sampling design leading to a useful entrainment time series?
	BP Response: The last two sentences have been reworded to now read: "However, due to the variability in historical monitoring, some data may be of limited utility, and certain data may need to be pooled or omitted. As a result, certain analyses may have a limited statistical power to detect differences between some pre- and post-Operations Phase variables." [p. 23] **UG Team Evaluation of BP Response:** Unsatisfactory. Notwithstanding the caveats about poor historical data, the statistical analyses will be attempted but are not likely to be informative.
UG-125	Variation in monitoring will have an impact on the ability to compare previous studies to the existing project. Further, comparisons need to be balanced against the possibility that the population of whitefish has changed since the original studies were performed. How are the limitations of historical data going to be addressed in the study?
	BP Response: None.
UG-126	What statistical comparisons will be made? What assumptions are required to perform the necessary statistical analyses? Are these comparisons going to consider one variable at a time (i.e., are they univariate analyses)? Will appropriate Time Series methods be used? While pooling may be necessary, is there any concern that trends may be affected by Simpson's Paradox? How will the results be interpreted and communicated if the statistical power is limited?
	BP Response: None.

4.3 Entrainment Sampling

"*Entrainment sampling will identify and quantify the ichthyoplankton (i.e., eggs and larvae) in the intake water that have passed through the intake screening systems and are entrained through the cooling water system during normal plant operations. To the extent possible entrainment sampling will be conducted using methods adopted from the 2004 study [Bruce Power 2005b]. This includes conducting sampling at the upstream end of the forebay using a pump-in-net design*." (p.9)

UG-127	As discussed above, the E/I plan should use appropriate life-history terminology (i.e. eggs, embryos, free-embryos, larvae, juveniles, adults) for the entrainment sampling program
	BP Response: None.
UG-128	"*ichthyoplankton … in the intake water that have passed through the intake screening systems and are entrained through the cooling*

	water system during normal plant operations." As discussed above, this does not account for the ichthyoplankton that is entrained but does not pass through the cooling water system.
	BP Response: The sentence has been re-worded as follows: "Entrainment sampling will identify and quantify the ichthyoplankton (i.e., eggs and larvae) in the intake water that has passed through the intake into the forebay and that is assumed will be swept downstream through the traveling screens and entrained through the cooling water system during normal plant operations." [p. 23] **UG Team Evaluation of BP Response:** Unsatisfactory. The proposed sampling will not account for entrained juveniles/adults that are entrained into the forebay, yet not imping on the screens.
UG-129	"*To the extent possible entrainment sampling will be conducted using methods adopted from the 2004 study [Bruce Power 2005b]. This includes conducting sampling at the upstream end of the forebay using a pump-in-net design.*" As discussed above, the UofG has serious concerns regarding the appropriateness of previous entrainment sampling protocols, especially the assumptions regarding representivity of the sampling location
	BP Response: This sentence has been re-worded to now read (italics emphasis added): "To the extent possible, entrainment sampling will be conducted using sampling methods adopted from studies in 2004 [Bruce Power 2005b]; *however, two methods are currently under evaluation to ensure that they meet Bruce Power sampling and health and safety requirements (see Section 4.3.2.1.1). Entrainment sampling gear size, number of nets, and sampling duration may be modified as a result of field sampling data and ability to capture the coefficient of variation. The two sampling methods under consideration are:* - *Pump-in-net design, similar to 2004 entrainment sampling but at a different location within the forebay ; and* - *Plankton/bongo net tow.*" [p. 23] **UG Team Evaluation of BP Response:** Unsatisfactory. The concerns regarding the appropriateness of previous entrainment sampling protocols, especially the assumptions regarding representivity of the sampling location, remain outstanding. It is unclear if the new sampling methods have been statistically vetted. It is also unclear if the old protocols are comparable to current or newly developed standards.
UG-130	Despite previous requests for relevant documentation, the UofG Team has not been provided with the data/documentation associated with Bruce Power's 2004 entrainment sampling, as had been requested.

	BP Response: None.
UG-131	The UofG Team has serious concerns regarding the representivity of spatial sampling of entrainment in the forebay. To our knowledge there have never been any hydrodynamic assessments of water flow in the forebays to determine in there are regions of hyper- or hypo-representivity of entrainment, with which to evaluate the assumption that upstream end of the forebay is a well-mixed and appropriate location for sampling. It should be noted that hydrodynamic assessment of the forebays is a major component of the UofG Research Program.
	BP Response: None.
UG-132	It should be noted that Andrew Binns (UofG Post-Doctoral Fellow, SON-BP Collaborative Whitefish Research Program) has been assigned responsibility to develop and undertake hydrodynamic mapping of the BNGS forebays to quantitatively identify and describe water flow patterns that must be taken into account when selecting representative forebay sampling location(s). The spatio-temporal definition of these representative sampling locations needs to be considered in the E/I plan.
	BP Response: None.

4.3.1 Entrainment Field Sampling Design

4.3.1.1 Collection Method

"*In the 2004 entrainment study [Bruce Power 2005b], entrainment sampling was conducted at the upstream end of the forebay, using a pump-in-net design, and withdrew water from one point in the water column (approximately 3 m below water surface). During Operations Phase entrainment sampling, samples will be collected in the same location, using a pump-in-net design similar to 2004. Figure 3 shows the location of the Bruce A station intake entrainment sampling point. Sampling at the upstream end of the forebay will help ensure that samples are representative of the actual larval fish composition in the forebay due to mixing of the cooling water between the intake and the forebay. Cooling water enters the forebay from an underground intake channel via a vertical riser, causing turbulent upwelling. Because of the intake channel design and large water volumes, cooling waters are well-mixed thereby negating the need for stratified sampling techniques.*" (p.10)

UG-133	As discussed above, the UofG Team has serious concerns regarding the representivity of spatial sampling of entrainment in the forebay – and specifically the assumption that "*samples are representative of the actual larval fish composition in the forebay due to mixing of the cooling water between the intake and the forebay.*"
	BP Response: Note: Section 4.3.2.1.1 (Collection Method) is now split into two sub-sections dealing with "pump-in-net" and

	"plankton/bongo net", respectively. Text has been re-worded to now read: "In the 2004 entrainment study [Bruce Power 2005b], entrainment sampling was conducted at the upstream end of the forebay, using a pump-in-net design, with water withdrawn by pump from approximately 3 m below water surface. *During Operations Phase entrainment sampling, pump-in-net samples will be collected from an engineered catwalk located approximately 250 meters from the upstream end of the forebay*. Figure 4 shows the location of the Bruce A station intake entrainment sampling point. *The engineered catwalk was originally constructed as a survey point to obtain water temperature data from the intake forebay. Samples collected at the engineered catwalk location will be assumed to be representative of the larval fish composition in the forebay due to mixing of the cooling water between the intake tunnel outlet and the forebay*. Cooling water enters the forebay from an underground intake tunnel via a vertical riser, causing turbulent upwelling. Because of the intake channel design and large water volumes, cooling waters are well-mixed and velocities are predicted to exceed the swimming capability of larval fish. Therefore, vertically stratified sampling techniques are not proposed. *Sampling at the end of the forebay in the vicinity of the vertical riser, as conducted in 2004, is not currently planned as a health and safety risk analysis completed by Golder and Bruce Power indicated that sampling from the catwalk is the safer option*." [p. 23] **UG Team Evaluation of BP Response:** Unsatisfactory. The concerns regarding representivity of spatial sampling of entrainment in the forebay remain outstanding.
UG-134	"*Because of the intake channel design and large water volumes, cooling waters are well-mixed thereby negating the need for stratified sampling techniques.*" This assumption is critical to the representivity of entrainment sampling, and must be tested before relying on it as a truth.
	BP Response: None.
UG-135	"…*a pump-in-net design, and withdrew water from one point in the water column (approximately 3 m below water surface).*" Crawford (UofG) served as an SON participant in the 2004 entrainment study, and has first-hand knowledge that the pump intake was moving vigorously near the upper waters of the forebay, and was not consistently sampling "approximately 3 m below water surface."
	BP Response: None.
UG-136	Sampling in one location may not be representative. Furthermore, assuming that sampling in one location is representative, sampling at 3m below the surface only should be reconsidered. Samples

	taken at the surface, and at multiple levels below the surface are recommended. The existing structure will only inform the study as to the expected entrainment associated with larvae that pass through the water column at 3m below the surface.
	BP Response: None.
UG-137	The assumption that the cooling waters are well-mixed should be verified. If this is already known, what statistical methods were used to verify/support this statement?
	BP Response: None.
UG-138	"*In the 2004 entrainment study [Bruce Power 2005b], entrainment sampling was conducted at the upstream end of the forebay, using a pump-in-net design, and withdrew water from one point in the water column (approximately 3 m below water surface).*" How was the location of sampling (upstream end of the forebay) selected for the 2004 study? How come only one location in the water column will be sampled? How do the hydrodynamics in the forebay affect the vertical distribution of larval fish? If there is hydrodynamic influence on distribution of fish larvae with depth, how will this one sampling point be extrapolated for the entire water column?
	BP Response: None.
UG-139	"*Cooling water enters the forebay from an underground intake channel via a vertical riser, causing turbulent upwelling. Because of the intake channel design and large water volumes, cooling waters are well-mixed thereby negating the need for stratified sampling techniques.*" Are the cooling waters throughout the entire intake forebay well-mixed? How has this been confirmed through hydrodynamic sampling or modeling? Does the mixing of the cooling water infer that the distribution of larval fish with depth is relatively uniform? Are there any "dead zones" in the forebay where fish with sufficient swimming ability could persist? Do the hydrodynamic patterns in the forebay vary depending on the number of pumps operating and their pumping rates?
	BP Response: None.
UG-140	"*Volume of circulating water or flow rate (based on the number of circulating water pumps in operation, and the pumping rates);*" Is it possible to gain more accurate assessment of the flow dynamics in the forebay through conducting measurements of velocity fields (i.e., with use of an acoustic Doppler current profiler)? Are there any other factors besides the number of pumps in operation and pumping rates that could affect the hydrodynamic patterns in the forebay? How could these be accounted for in sampling design? If the pump operating conditions are variable then this needs to be accounted for in sampling design in order to conduct entrainment sampling for the diverse hydrodynamic regimes in the forebay (i.e., conduct sampling for all different pump operating conditions/combinations).

	BP Response: None.
UG-141	"*Air temperature and weather conditions at the beginning, mid-point, and end of the 24-hour sampling period;*" How are air temperatures and weather conditions being recorded? Is it possible to obtain a recording of the weather conditions throughout the entire duration of the 24-hour sampling period to gain greater accuracy for daily variation of these conditions?
	BP Response: None. This point has been moved to Section 4.3.2.6 (Water Quality) on p. 29.
UG-142	"*Water temperature, wave height, wind direction, and wind speed for a period of 2 days prior to and during a sampling event.*" The proposed source for water temperature, wave height, wind direction and wind speed (i.e., at a buoy located in the middle of Lake Huron) is not likely representative of the conditions in the region directly offshore of the Bruce Power nuclear generating station Hydrodynamic and meteorological data at the site should be obtained in order to accurately quantify conditions at the site and relate those conditions to observed patterns of distribution and abundance of larval and adult fish Deploying appropriate instrumentation in the region directly offshore of the facility will more accurately evaluate these conditions and produce more meaningful results
	BP Response: This point has been moved to Section 4.3.2.6 (Water Quality) on p. 29. The sentence has been changed as follows: "Water temperature, wave height, wind direction, and wind speed for a period of *3 days* prior to and during the sampling event;" [p. 29] Source for weather and wind data has been re-worded as being from: "Weather and wind data will be obtained from online sources (e.g., Environment Canada and WindFinder). Water quality data will be used during data analysis to determine if patterns exist between the measured abiotic parameters and impingement, entrainment, or source water data." [p. 29] There is no longer a link to the buoy located in the middle of Lake Huron. **UG Team Evaluation of BP Response:** Unsatisfactory. The geographic location of the data from the "online sources" remains unclear. Where are these data located geographically? Is Are the data representative of the conditions at site?

4.3.1.2 Temporal Scales

"*Entrainment sampling will be assessed on three temporal scales - annual, seasonal, and diel. The inherent variability in fish presence (whether natural or induced by intake velocities, intake screen size, fish swimming capabilities or other factors), and distribution at each of these levels may drive variability in entrainment rates.*" (p.11)

UG-143	As discussed above, the USEPA 316(b) document makes explicit reference to the requirement for "Source Water Physical Data" that are "*needed to characterize the facility and evaluate the type of waterbody and species affected by the cooling water intake structure*" and "Cooling Water Intake Structure Data" that are needed "*characterize the cooling water intake structure and evaluate the potential for impingement and entrainment of aquatic organisms. Information on the design of the intake structure and its location in the water column will allow the permit writer to evaluate which species or life stages would potentially be subject to impingement and entrainment.*"
	BP Response: None.
UG-144	As discussed above, the UofG Research Program has a strong emphasis on the collection and analyses of hydrodynamic data to support the kinds of requirements for information about water flow and entrainment/impingement risks for fishes, including the three identified VEC species. The E/I Monitoring Plan will need to be much more explicit in it's treatment of these hydrodynamic analyses.
	BP Response: None.
UG-145	Assessing the data at multiple scales is highly recommended. It is suggested that relevant Time Series methods be used to determine/account for any autocorrelation, and to potentially determine annual, seasonal, diel level patterns. Further, the data might best indicate the temporal scale that is most appropriate, and this may include other scales. A full temporal analysis is recommended. It is also recommended that temporal analysis incorporate variables to account for fish presence variability. This should include main effects, and tests for interactions between variables (i.e., simple effects).
	BP Response: None.

"*It is assumed that larval fish populations will fluctuate on an annual basis due to a number of biotic and abiotic factors, including adult year-class variations, weather patterns and lake-wide water movement, and changes to habitat or the fish community composition (e.g., new invasive species, increases/decreases in predators). These inter-annual fluctuations can lead to large differences in annual entrainment at a given plant intake; therefore, it is important to have more than one year of baseline data to better estimate baseline annual entrainment. As such, an initial two years of entrainment monitoring is recommended following the start of the Operations Phase. If entrainment of lake whitefish larvae is greater than the threshold effect following two*

years of monitoring, and in consultation with agencies and stakeholders, entrainment monitoring could continue for additional years until an index of population size/entrainment impacts are established." (p.11)

UG-146	"*It is assumed that larval fish populations will fluctuate on an annual basis due to a number of biotic and abiotic factors, including adult year-class variations, weather patterns and lake-wide water movement, and changes to habitat or the fish community composition (e.g., new invasive species, increases/decreases in predators). These inter-annual fluctuations can lead to large differences in annual entrainment at a given plant intake*" While these seem to be reasonable hypotheses, the E/I plan should provide references in support.
	BP Response: None.
UG-147	"*therefore, it is important to have more than one year of baseline data to better estimate baseline annual entrainment.*" The length of baseline time series needs to be considered by more rigorous statistical methods that consider variation of the data and the intended use of the time series. A much higher level of rigour is required on this issue.
	BP Response: This sentence was altered slightly (removing the word baseline) to read: "therefore, it is important to have more than one year of data to better estimate annual entrainment." [p. 26] **UG Team Evaluation of BP Response:** Unsatisfactory. The length of baseline time series needs to be considered by more rigorous statistical methods that consider variation of the data and the intended use of the time series. A much higher level of rigour is required on this issue.
UG-148	"*an initial two years of entrainment monitoring is recommended following the start of the Operations Phase. If entrainment of lake whitefish larvae is greater than the threshold effect following two years of monitoring, and in consultation with agencies and stakeholders, entrainment monitoring could continue for additional years until an index of population size/entrainment impacts are established.*" How do we know that an initial two years is sufficiently long to establish a baseline upon which to make sampling design decisions? As discussed above, there are serious concerns with the undefined "threshold effect." As discussed above, there are important issues for determining who (i.e. SON) will be consulted for these kinds of in-program design decisions. It is not clear what is meant by "an index of population size/entrainment impacts" or why this index would be an appropriate measure of entrainment effect. How will we know how many additional years of sampling would be appropriate to achieve the objective?
	BP Response: None.

UG-149	"*It is assumed that larval fish populations will fluctuate on an annual basis due to a number of biotic and abiotic factors, including adult year-class variations, weather patterns and lake-wide water movement, and changes to habitat or the fish community composition (e.g., new invasive species, increases/decreases in predators).*" In order to be able to be able to predict what impact future hydrodynamic/water circulation patterns in the lake (i.e., such as those brought about by climate change) will have on patterns of distribution and abundance of fish it is necessary to directly relate fish sampling results with accurate hydrodynamic measurements in the direct region. Application of a computational model (such as ELCOM-CAEDYM for the offshore hydrodynamics or FLOW-3D for forebay hydrodynamics) would allow for more accurate assessment of variation of hydrodynamic pattern, such as variation due to variability in wind-induced currents, storm surge or seiche events and thermal (density-driven) flows (such as the influence of the thermal discharge plume on nearshore lake movement). Different climatic scenarios could be simulated from the application of such a model, allowing for extrapolation to future weather and hydrodynamic conditions.
	BP Response: None.

"*Seasonal variability is a very important factor for entrainment studies, with fish life-history typically accounting for the majority of seasonal variability. Most fish species spawn in the late fall/winter months (e.g., lake whitefish) or in the spring. For fall and winter spawners larval fish emerge primarily in the spring to early summer months. However, some fishes are capable of spawning year-round. According to Becker [1983], lake whitefish spawns from October to December in the Great Lakes, with larvae emerging in March or early April and deepwater sculpin likely spawn year-round in the Great Lakes. Limited historic entrainment data from Bruce A and Bruce B stations for both species indicates that deepwater sculpin eggs and larvae are entrained primarily from early April to early June [King 1992], and lake whitefish larvae appear most susceptible to entrainment in May and early June. These findings are consistent with a literature review on deepwater sculpin biology in the Great Lakes that was completed as part of the Bruce A Refurbishment for Life Extension and Continued Operations Environmental Assessment Follow-up Program [Bruce Power 2010]. Based upon these historic entrainment results and the life history of lake whitefish and deepwater sculpin, entrainment sampling is recommended throughout the year, with increased frequency in the spring and early summer when lake whitefish and deepwater sculpin are most likely to be present in the vicinity of the Bruce A station intake structure.*" (p.11)

UG-150	"*According to Becker [1983], lake whitefish spawns from October to December in the Great Lakes, with larvae emerging in March or early April and deepwater sculpin likely spawn year-round in the Great Lakes.*" There is a much more literature regarding life-history and ecology of lake whitefish (including for Lake Huron) that should be considered in this regard. As discussed above, the E/I Monitoring

	Plan should make much more extensive use of the OPG-Nawash-BP WINGS Project which has already compiled and interpreted most of this literature: Holmes, J.A., Noakes, D.L.G., Crawford, S.S., and Wismer, D.A. 2002. Lake whitefish and round whitefish biology: a review of ecological factors important to growth, survival, and reproduction, Report prepared in support of Whitefish Interactions with Nuclear Generating Stations (WINGS) for Ontario Power Generation - Nuclear, Chippewas of Nawash First Nation and Bruce Power. Axelrod Institute of Ichthyology, University of Guelph, Guelph, Ontario, Canada., Guelph, ON.
	BP Response: None.
UG-151	It should be noted that Clayton Coppaway and Lauren Overdyk (UofG Grad Student, Whitefish Population Discrimination and Entrainment Research Projects respectively, SON-BP Collaborative Whitefish Research Program), are undertaking comprehensive reviews of lake whitefish life-history and ecology, specifically associated with BNGS entrainment and impingement. These review/evaluation should be considered when developing operational definitions of entrainment/impingement for the E/I Monitoring Plan.
	BP Response: None.
UG-152	"*Limited historic entrainment data from Bruce A and Bruce B stations for both species indicates that ... lake whitefish larvae appear most susceptible to entrainment in May and early June.*" It is important to cite specifically which limited data were analysed to reach this conclusion. Despite previous requests for relevant documentation, the UofG Team has not been provided with the data/documentation associated with the historical Bruce A and Bruce B entrainment sampling, as had been requested.
	BP Response: None.
UG-153	"*Based upon these historic entrainment results and the life history of lake whitefish and deepwater sculpin, entrainment sampling is recommended throughout the year, with increased frequency in the spring and early summer when lake whitefish and deepwater sculpin are most likely to be present in the vicinity of the Bruce A station intake structure.*" This aspects of the entrainment sampling design needs to be based on a more rigorous consideration of existing information regarding lake whitefish life history and previous entrainment sampling (no matter how limited) at the BNGS. How will we know how much "increased frequency" of sampling in spring and early summer will be appropriate?
	BP Response: None.

"*Diel, meaning daily, variability in larval fish populations may be due to the distribution of food resources, water temperatures, and weather/water movement patterns. Two important factors to consider are diel vertical migration (DVM) and larval drift. DVM describes the process where many larval fishes and zooplankton (an important larval fish food source) will migrate to different depths throughout the day, with larval fish often found near the surface at night and lower in the water column during the day [Hensler and Jude 2007]. Larval drift refers to larval fish movement in flowing water. As observed by Winnell and Jude [1991], larval drift is often greater at night than during the day as well. These studies show that larval fish movement within the water column varies throughout the day in all types of systems and therefore, entrainment sampling both during the day and at night is recommended to provide the best estimate of entrainment.*" (p.11)

UG-154	"*Diel, meaning daily, variability in larval fish populations may be due to the distribution of food resources, water temperatures, and weather/water movement patterns. Two important factors to consider are diel vertical migration (DVM) and larval drift. DVM describes the process where many larval fishes and zooplankton (an important larval fish food source) will migrate to different depths throughout the day, with larval fish often found near the surface at night and lower in the water column during the day [Hensler and Jude 2007].*" It is inappropriate to use ther term 'populations' with regard to larval fish, since this represents only one developmental component of a biological population in question. How do we know that DVM is an important factor in lake whitefish larval ecology (Hensler and Jude is a paper on round goby ecology)? As discussed above, a more rigorous treatment of the literature, including the WINGS reviews and current UofG reviews, is required.
	BP Response: The word "populations" was removed from the first sentence. The sentence now reads: "Diel, meaning daily, variability in larval fish may be due to the distribution of food resources, water temperatures, and weather/water movement patterns." [p. 27] No response with regard to importance of DVM in lake whitefish larval ecology, or mention of WINGS and/or current UofG reviews. **UG Team Evaluation of BP Response:** Unsatisfactory. Simply removing the word 'populations' has done nothing to address the issues and concerns that remain outstanding on this issue.
UG-155	"*Larval drift refers to larval fish movement in flowing water. As observed by Winnell and Jude [1991], larval drift is often greater at night than during the day as well. These studies show that larval fish movement within the water column varies throughout the day in all types of systems and therefore, entrainment sampling both during the day and at night is recommended to provide the best estimate of entrainment.*" The Winnell and Jude (1991) study was performed in a large river (St. Marys) and did not capture larvae for lake whitefish

	(or any of the other VEC species for BNGS). How do we know that lake whitefish larvae exhibit larval drift or "movement in the water column" (diel or otherwise)? How do we know that it is important to sample during both day and night? Once again, a much more rigorous treatment of the literature is required.
	BP Response: None.
UG-156	"*Diel, meaning daily, variability in larval fish populations may be due to the distribution of food resources, water temperatures, and weather/water movement patterns.*" How will the influence of weather/water movement patterns be related to results from the larval fish sampling? In order to gain inference about the influence of daily variation in hydrodynamics/water patterns on patterns of distribution and abundance of fish it is imperative to have direct sampling of hydrodynamics concurrent with entrainment sampling, or a numerical model of the hydrodynamics in the forebay, to be able to understand how hydrodynamics would vary due to water movement, weather conditions, number of pumps in operation, pumping rate, etc.
	BP Response: None.
UG-157	"*Two important factors to consider are diel vertical migration (DVM) and larval drift. DVM describes the process where many larval fishes and zooplankton (an important larval fish food source) will migrate to different depths throughout the day, with larval fish often found near the surface at night and lower in the water column during the day [Hensler and Jude 2007]. Larval drift refers to larval fish movement in flowing water. As observed by Winnell and Jude [1991], larval drift is often greater at night than during the day as well. These studies show that larval fish movement within the water column varies throughout the day in all types of systems and therefore, entrainment sampling both during the day and at night is recommended to provide the best estimate of entrainment.*" How will BP gain a better understanding of the diel vertical migration and larval drift in order to extrapolate sampling results for the entire water column as well as for horizontal dispersal? Application of a coupled hydrodynamic-ecological numerical model (such as ELCOM-CAEDYM) would assist in gaining a better understanding of the relationship between hydrodynamics and biological behaviour of the fish in order to produce more accurate extrapolations for the entire water column.
	BP Response: None.

4.3.1.3 Detectability and Sampling Frequency

"*Neither lake whitefish nor deepwater sculpin were present in Bruce A station entrainment samples in 2001 or 2004. However, deepwater sculpin has been present in*

entrainment samples at the Bruce A station historically (i.e., 1977 and 1985/86) and both species were present during an entrainment study conducted in 1989 at the Bruce B station [King 1992]. Six lake whitefish larvae were also captured during entrainment sampling at the Bruce B station in 2001 [Patrick et al. 2002]. Following these studies, and in review of the 2008 Work Plan, the
CNSC inquired about the likelihood of detecting deepwater sculpin and lake whitefish in entrainment samples if they are truly present in the Bruce A station intake. Because lake whitefish and deepwater sculpin larval densities are not currently known for Lake Huron in the vicinity of the Bruce Power site, an evaluation of several possible scenarios to determine the estimated amount of sampling needed to detect larvae of these species at various assumed densities are provided below." (p.12)

UG-158	"*Neither lake whitefish nor deepwater sculpin were present in Bruce A station entrainment samples in 2001 or 2004. However, deepwater sculpin has been present in entrainment samples at the Bruce A station historically (i.e., 1977 and 1985/86) and both species were present during an entrainment study conducted in 1989 at the Bruce B station [King 1992]. Six lake whitefish larvae were also captured during entrainment sampling at the Bruce B station in 2001 [Patrick et al. 2002].*" Despite previous requests for relevant documentation, the UofG Team has not been provided with the data/documentation associated with the 1977, 1985/86, 1989, 2001, 2004 Bruce entrainment data, as had been requested.
	BP Response: None.
UG-159	As discussed above, the lack of lake whitefish larvae in previous entrainment samples may be associated with lack of representivity in the sampling design/effort. A comprehensive review of these previous sampling programs is required before making any conclusions about future entrainment sampling designs.
	BP Response: None.
UG-160	"*Following these studies, and in review of the 2008 Work Plan, the CNSC inquired about the likelihood of detecting deepwater sculpin and lake whitefish in entrainment samples if they are truly present in the Bruce A station intake. Because lake whitefish and deepwater sculpin larval densities are not currently known for Lake Huron in the vicinity of the Bruce Power site, an evaluation of several possible scenarios to determine the estimated amount of sampling needed to detect larvae of these species at various assumed densities are provided below.*" The CNSC inquiry is based on the same sampling design issues that the UofG Team has expressed. It is important to incorporate a statistically-defensible sampling program for larvae in source waters, and this in turn requires hydrodynamic modelling of entrainment risk regions - as discussed above and as incorporated into the UofG Research Program.
	BP Response: None.
UG-161	"*an evaluation of several possible scenarios to determine the estimated amount of sampling needed to detect larvae of these*

	species at various assumed densities are provided below." The UofG Team is highly skeptical of any such 'scenarios' that are based on the results of previous entrainment sampling programs that are in turn highly questionable.
	BP Response: None.

"*In 2004, an estimated 3,120 m3 of the Bruce A station intake water was sampled during entrainment studies, resulting in the collection of 12 larval fish [Golder Associates 2005]. Overall, this is a larval density of 3.8x10-3 fish per m3. No deepwater sculpin or lake whitefish larvae were collected. During the 1988/89 Bruce B station larval fish entrainment studies, deepwater sculpin larvae were present from early April to early June and one lone lake whitefish larvae was present in early June [King 1992]. Lake whitefish entrained at the Bruce B station in 2001 were also present primarily in early June [Patrick et al. 2002]. If the amount of water sampled during this time period (early April to early June) in 2004 is used, the capture of a single lake whitefish or deepwater sculpin would have given an estimated density of 7.6x10-4 larvae per m3 (1 fish per 1,320 m3 of water). Because no lake whitefish or deepwater sculpin larvae were actually captured in 2004, it is assumed that the actual lake whitefish and deepwater sculpin larval density was less than 7.6x10-4 larvae per m3 . Table 1 shows four possible larval densities and the estimated sampling effort necessary to capture one lake whitefish or deepwater sculpin larvae in the entrainment sample given each density.*" (p.12)

UG-162	Despite previous requests for relevant documentation, the UofG Team has not been provided with the data/documentation associated with the 1988/89, 2001, 2004 Bruce entrainment data, as had been requested.
	BP Response: None.
UG-163	The UofG Team is highly skeptical of the accuracy and precisions of these estimated entrainment larval densities, and the assumptions used in the calculation of water volume required to be sampled per individual larva. A much more rigourous review and analysis of previous entrainment sampling programs would be required before any such projections could be considered.
	BP Response: None.
UG-164	"*In 2004, an estimated 3,120 m3 of the Bruce A station intake water was sampled during entrainment studies, resulting in the collection of 12 larval fish [Golder Associates 2005]. Overall, this is a larval density of 3.8x10-3 fish per m3."* How were these data collected? How does 3,120 m3 compare to the total intake? That is, were the samples representative? Given that previous sampling occurred at one point in the water column, how might the estimated time requirements (highlighted in Table 1) change? Since the data collection method described involves one point in space, over several time periods, the data that are collected will not be representative of the entire water column. The data will be

	longitudinal in nature, with inherent autocorrelation structures; how are these to be addressed? Further, should the sampling method be updated to include multiple points in the water column, a spatial and temporal structure will exist. How might this spatial and temporal structure be addressed?
	BP Response: None.
UG-165	"*Because no lake whitefish or deepwater sculpin larvae were actually captured in 2004, it is assumed that the actual lake whitefish and deepwater sculpin larval density was less than 7.6x10-4 larvae per m3."* This may not be valid. The observed result might be a case where sampling occurred when larvae were not present, but other non-sampled times could have had a much greater density than this.
	BP Response: None.

"*Based on the estimated number of days to catch one larval lake whitefish or deepwater sculpin shown in Table 1, and in order to ensure that adequate sampling is completed during peak entrainment periods, the entrainment*
sampling frequency is proposed to be stratified as follows:

- *January to mid-March: bi-weekly (5 sample occasions, n=20)*
  - *Possible entrainment of eggs or early-emerging larvae*
- *mid-March through June: twice-weekly (30 sample occasions, n=120)*
  - *Primary period of spawning and larval emergence*
- *July through August: weekly (9 sample occasions, n=36)*
  - *Possible late-emerging larvae and post-larvae*
- *September: monthly (1 sample occasions, n=4)*
  - *Few/no egg/larval entrainment anticipated*
- *mid-October through December: bi-weekly (6 sample occasions, n=24)*
  - *Lake Whitefish spawning period, possible egg entrainment*" (p.12)

UG-166	As discussed above, this approach to sample design is extraordinarily weak, due to (a) high dependence on questionable sampling effort projections, (b) arbitrary stratification of sampling periods, and (c) arbitrary allocation of sampling effort per sampling period. A much more rigourous approach is required to develop a biologically- and statistically-defensible entrainment sampling program.
	BP Response: None.

"*Based on the proposed stratification of entrainment sampling above, a total of 51 entrainment sampling events per year are recommended during the first two years of entrainment sampling. This number of entrainment sampling events (8-hours/day) is expected to produce at least one larval lake whitefish and deepwater sculpin, assuming an actual source water larval density equal to or greater than 8.2x10-5 lake whitefish or deepwater sculpin larvae/m3 (1 fish per 12,200 m3 of water). One entrainment*

sampling event refers to a 24-hour period where four entrainment samples will be collected (at a rate of 2 hours per sample for a total of 8 hours of sampling per day). If additional entrainment monitoring will be required beyond the first two years (e.g., if entrainment impacts are greater than the determined effect threshold), the number of annual entrainment sampling events may be modified based upon the results of the first two years. The proposed sampling events will provide a more comprehensive picture of larval entrainment throughout the year, with increased sampling occurring during portions of the year where historic entrainment has occurred and decreased sampling during portions of the year when little to no egg or larval entrainment is expected. For documentation purposes, it is important to sample even in periods where no entrainment is anticipated." (p.13)

UG-167	As discussed above, this approach to sample design is extraordinarily weak, due to (a) high dependence on questionable sampling effort projections, (b) arbitrary stratification of sampling periods, and (c) arbitrary allocation of sampling effort per sampling period. A much more rigourous approach is required to develop a biologically- and statistically-defensible entrainment sampling program.
	BP Response: None.
UG-168	"*If additional entrainment monitoring will be required beyond the first two years (e.g., if entrainment impacts are greater than the determined effect threshold), the number of annual entrainment sampling events may be modified based upon the results of the first two years.*" As discussed above, the E/I Monitoring Plan needs to be much more explicit about the process whereby the duration of entrainment sampling is determined and/or extended.
	BP Response: None.
UG-169	"*The proposed sampling events will provide a more comprehensive picture of larval entrainment throughout the year, with increased sampling occurring during portions of the year where historic entrainment has occurred and decreased sampling during portions of the year when little to no egg or larval entrainment is expected.*" This sentence does not make much sense. Simply because the proposed sampling effort is greater (presumably compared to historical entrainment sampling programs), does not mean that the proposed sampling effort is sufficient to satisfy the program objective(s). Decreasing sampling effort based on 'expectations' based on questionable previous sampling efforts is not appropriate.
	BP Response: None.
UG-170	"*For documentation purposes, it is important to sample even in periods where no entrainment is anticipated.*" This statement suggest that there has been a fundamental misunderstanding of statistical sampling design in the E/I Monitoring Plan. The distribution of sampling effort is much more important than simply satisfying the need for 'documentation.' A much more rigourous approach is required to develop a biologically- and statistically-

	defensible entrainment sampling program.
	BP Response: None.

4.3.1.4 Sampling Intensity

"*Sampling intensity refers to the amount of sampling to be performed during each sampling event. Four entrainment samples are scheduled to be collected during each 24-hour period (i.e., each sampling event) at 0400, 1000, 1600, and 2000, evenly spaced during the day to provide two samples during daytime and two samples during night-time hours. Pumping for two hours during each sample collection is proposed. Sampling effort may depend on the amount of extraneous material being pumped into the collection net and where the sampling period must be decreased then the period of pumping and volume pumped will be determined.*" (p.13)

UG-171	How does the author figure that the daily sampling times (0400, 1000, 1600, 2000) are "evenly spaced" when self-evidently they are not evenly spaced? How do we know that four samples per day - and these specific times of day - are appropriate for the entrainment sampling program? How do we know that 2 hours of pumping is appropriate for each sample?
	BP Response: The sentence has been slightly altered to include the word "relatively", now reading (italics added to emphasize change): "our entrainment samples are scheduled to be collected during each 24-hour period (i.e., each sampling event) at approximately 0400, 1000, 1600, and 2000, *and relatively* evenly spaced during the day to provide two samples during daytime and two samples during night-time hours." [p. 29] **UG Team Evaluation of BP Response:** Unsatisfactory. The BP Response address the scheduling portion of the comment. However, it is still unclear whether or not this level of sampling is appropriate.
UG-172	"*Sampling effort may depend on the amount of extraneous material being pumped into the collection net and where the sampling period must be decreased then the period of pumping and volume pumped will be determined.*" This is not a sentence. What is meant by "extraneous material?" Why does the amount of "extraneous material" require decrease in sampling effort (time?).
	BP Response: Sentence has been altered slightly to include the two sampling methods, now reading: "Sampling effort may depend on the amount of extraneous material being pumped into *or filtered through* the collection net and where the sampling period must be decreased then the period of *collection and volume sampled* will be determined." [p. 29]

	UG Team Evaluation of BP Response: Unsatisfactory. The issues and concerns regarding sampling effort remain outstanding.

4.3.1.5 Sampling Magnitude

"*Sampling magnitude refers to the total volume of intake water that is sampled during each event. In the previous 2004 entrainment study [Bruce Power 2005b], approximately 50 – 160 m3 of water was sampled during each of the 26 sampling events. During Operations Phase entrainment sampling, it is anticipated that 250 – 450 m3 of water will be collected during each sampling event.*" (p.13)

UG-173	How do we know that 250 – 450 m3 of water collected during each sampling event will be appropriate to satisfy the entrainment sampling objective?
	BP Response: None. This section has now been moved to Section 4.3.2.5 (Sampling Magnitude) on p. 29.
UG-174	Sampling magnitude is a function of several variables, including weather conditions, water flow, etc. Since this value will vary throughout the sampling efforts, it should be recorded as a potential covariate, and used to standardize the findings.
	BP Response: None.

4.3.1.6 Water Quality

"*During entrainment and source water sampling events, general water quality measurements will be collected at the sampling location. The parameters to be surveyed will consist of water temperature, dissolved oxygen, pH, water transparency, and conductivity. Air temperature and weather conditions will be recorded concurrently with water quality data. Water quality data will be used during data analysis to determine if patterns exist between the measured abiotic parameters and impingement, entrainment, or source water data.*" (p.13)

UG-175	Are there *a priori* hypotheses about cause-effect relationships between abiotic factors (water quality, environmental conditions) in the source water or forebay, and entrainment and/or impingement of fishes? What patterns would be predicted? How would the existence of patterns affect the E/I Monitoring Plan or its conclusions?
	BP Response: None. This section has been moved to Section 4.3.2.6 (Water Quality) on p. 29.

4.3.1.7 Entrainment Survival Studies

"*Entrainment survival studies will allow for the determination of the proportion of larval fish that:*

- *Are dead prior to being drawn into the Bruce A station cooling water system; and*
- *Return to the lake alive after passing through the Bruce A station cooling water system.*

Survival studies will be performed during the first entrainment sampling period of each sampling event. Due to the potential challenge of collecting adequate larval fish from both the forebay and the discharge during a given event, survival studies will be attempted during likely peak entrainment periods with the goal of completing at least three successful survival studies for fish from the discharge channel and from the intake forebay at the locations shown on Figure 3. If possible, VEC species (i.e., lake whitefish and deepwater sculpin) larvae will be used in the entrainment survival studies. However, if VEC species larvae are not present in the samples, all fish larvae collected in the sample nets will be utilized. A survival study will be determined successful if at least five larval fish are collected for observation. A minimum of three successful survival studies is desired to provide adequate data for statistical analysis of entrainment survival." (p.14)

UG-176	How do we know that the first entrainment sampling period of each sampling event (is the 0400 sample?) is the most appropriate sample for survival studies?
	BP Response: Entrainment survival studies have been replaced by live/dead determinations. This now forms Section 4.3.2.1.3 (Live/Dead Determinations) on p. 25. "For entrainment sampling in 2012, live/dead determinations will replace entrainment survival studies that were originally proposed at the discharge due to the possibility that all larval fish and eggs entering the forebay do not survive their trip through the intake structure. If results from live/dead determinations reveal that a portion of the entrained larvae/eggs are still alive/viable upon reaching the intake forebay, the inclusion of entrainment survival studies at the discharge, after passing through the plant, will be re-evaluated for 2013." [p. 25] **UG Team Evaluation of BP Response:** Unsatisfactory. It is unclear what is meant by a live/dead determination. The scheduling and sampling of mortality assessments remains a major uncertainty.
UG-177	"*Due to the potential challenge of collecting adequate larval fish from both the forebay and the discharge during a given event, survival studies will be attempted during likely peak entrainment periods with the goal of completing at least three successful survival studies for fish from the discharge channel and from the intake forebay at the locations shown on Figure 3*." This sentence does not make sense, and is problematic for several reasons. First, the "potential challenge" of sampling the forebay and discharge should be taken into account with the workplan, rather that artificially constraining the sampling design. Second, as discussed above, how do we know when "peak entrainment periods" are really likely to be? Third, how do we know that three "survival studies" will be

	appropriate to satisfy the objective? Fourth, both the forebay and discharge "sampling points" shown in Figure 3 are at the most extreme upstream positions possible. How do we know that these are the most appropriate sampling locations?
	BP Response: See UG-176. Details on live/dead determinations are given by: "Live/dead determinations will be completed on all larval fish and eggs captured during entrainment sampling. Live/dead determinations will be performed on fish/eggs captured from either of the entrainment sampling methods (i.e., pump-in-net and plankton/bongo net)." [p. 25] **UG Team Evaluation of BP Response:** Unsatisfactory. See UG-176.
UG-178	Andrew Binns (UofG Post-Doctoral Fellow, SON-BP Collaborative Whitefish Research Program) has been assigned responsibility to develop and undertake hydrodynamic mapping of the BNGS forebays and discharge channels to quantitatively identify and describe water flow patterns that must be taken into account when selecting representative forebay and discharge sampling location(s). The spatio-temporal definition of these representative sampling locations needs to be considered in the E/I plan.
	BP Response: None.

"*Larval fish will be collected for survival studies using a 300 µm mesh plankton net deployed in the upstream end of the intake forebay for approximately 10 minutes at a time, if possible. If flow rates prohibit the use of a plankton net in the upstream end of the forebay, alternate locations within the forebay or alternate collection methods will be pursued (e.g., pump-in-net). Following each 10 minute interval, the contents of the net will be washed into the cod end using source water. The contents of the cod end will be poured into a clean glass container to determine the presence of larval fish. If no fish are collected following five consecutive 10-minute deployments, the forebay entrainment survival study may be discontinued until the next sampling period or event. This decision will be made in the field based upon the expected likelihood of collecting sufficient larvae during that event, and the amount of time available for performing additional sampling. If larval fish of any species are collected, they will be transferred to a small glass aquarium for observation, and a determination will be made as to whether the larval fish are dead or alive. If dead larval fish are collected, long-dead (Fish was dead prior to encountering the cooling system. Body may be soft with obvious decomposition, eyes glazed over, and gills lacking red color) determinations will be made to determine if larval fish mortality occurred in the Bruce A station intake or previously in Lake Huron. Larval fish have high natural mortality rates relative to other life phases, and a portion of the entrained larvae may have died prior to becoming entrained in the Bruce A station cooling water intake system. During normal entrainment sampling events, long-dead determinations will not be made due to the specialized*

staffing and equipment needs required. If live larval fish are collected, up to five live larval fish will be placed in each observation aquarium. The aquaria will be placed in a larger, opaque container that will serve as a water bath, with source water continuously flowing through it to maintain the source water temperature in the aquaria. When observations are not being made, an opaque lid will cover the aquaria." (p.14)

UG-179	"*Larval fish will be collected for survival studies using a 300 µm mesh plankton net deployed in the upstream end of the intake forebay for approximately 10 minutes at a time, if possible. If flow rates prohibit the use of a plankton net in the upstream end of the forebay, alternate locations within the forebay or alternate collection methods will be pursued (e.g., pump-in-net).*" The issue of whether plankton nets can be effectively deployed in the forebay/disharge needs to be identified as a separate key uncertainty, in conjunction with the forebay/discharge hydrodynamic mapping requirements discussed above. The E/I plan must provide a more explicit and justified explanation of whether and how "alternate" sites would be "pursued" and what the consequences would be for relating the survival studies back to the regular entrainment samples. In this regard, the design of the survival study sampling design must be rigourously reconsidered.
	BP Response: See UG-176. **UG Team Evaluation of BP Response:** Unsatisfactory. See UG-176.
UG-180	How do we know that the proposed sampling protocol (location, time, processing) are appropriate for collecting live fish larvae in good condition (rather than killing them and confusing this source of mortality with pre-sampling mortality)?
	BP Response: See UG-176. **UG Team Evaluation of BP Response:** Unsatisfactory. See UG-176.
UG-181	"*If no fish are collected following five consecutive 10-minute deployments, the forebay entrainment survival study may be discontinued until the next sampling period or event. This decision will be made in the field based upon the expected likelihood of collecting sufficient larvae during that event, and the amount of time available for performing additional sampling.*" This decision-making process is highly questionable, for several reasons. First, how do we know that five deployments as described is appropriate? Second, how is the "expected likelihood of collecting sufficient larvae during that event" a valid factor in deciding whether sampling should continue? Third, what does "sufficient larvae" mean, and how is this value determined? Fourth, the time allocation for sampling should be incorporated into the workplan, and not allowed to be such a major factor in determining whether additional

	sampling is required.
	BP Response: See UG-176. **UG Team Evaluation of BP Response:** Unsatisfactory. See UG-176 and UG-177.
UG-182	"*If larval fish of any species are collected, they will be transferred to a small glass aquarium for observation, and a determination will be made as to whether the larval fish are dead or alive. If larval fish of any species are collected, they will be transferred to a small glass aquarium for observation, and a determination will be made as to whether the larval fish are dead or alive.*" How do we know that observations in the field will provide a reliable method for determining presence/absence, enumeration and evaluation (live/dead) of the samples?
	BP Response: See UG-176. **UG Team Evaluation of BP Response:** Unsatisfactory. See UG-176 and UG-177.
UG-183	"*If dead larval fish are collected, long-dead (Fish was dead prior to encountering the cooling system. Body may be soft with obvious decomposition, eyes glazed over, and gills lacking red color) determinations will be made to determine if larval fish mortality occurred in the Bruce A station intake or previously in Lake Huron.*" This evaluation protocol is highly questionable, for several reasons. First, the term "long-dead (Fish was dead prior to encountering the cooling system)" is highly misleading, and vulnerable to gross misinterpretation. Second, how does the protocol distinguish between recently "long-dead" fish and fish that were killed as a result of forebay entrainment? Third, the assignment of "long-dead" status is based on body conditions that "may be" observed, thus posing unacceptable risks of misapplication. Fourth, how do we know that the sampling method does not itself transform larvae with "obvious decomposition" into unrecognizable mash. Fifth, how do we know that the proposed morphological indicators apply to the fish species being targeted.
	BP Response: See UG-176. **UG Team Evaluation of BP Response:** Unsatisfactory. See UG-176.
UG-184	"*Larval fish have high natural mortality rates relative to other life phases, and a portion of the entrained larvae may have died prior to becoming entrained in the Bruce A station cooling water intake system. During normal entrainment sampling events, long-dead determinations will not be made due to the specialized staffing and equipment needs required.*" How do we know that the survival study samples will be representative of the "normal entrainment sampling

	events" to the extent that pre-forebay and forebay mortality rates can be applied?
	BP Response: See UG-176. **UG Team Evaluation of BP Response:** Unsatisfactory. See UG-176.
UG-185	"*If live larval fish are collected, up to five live larval fish will be placed in each observation aquarium. The aquaria will be placed in a larger, opaque container that will serve as a water bath, with source water continuously flowing through it to maintain the source water temperature in the aquaria. When observations are not being made, an opaque lid will cover the aquaria.*" How do we know that "up to five larval" fish will serve as a representative subsample? How do we know that the observation aquaria, opaque water bath and water flow regime will serve as an effective environment for holding live fish and making survival observations?
	BP Response: See UG-176. **UG Team Evaluation of BP Response:** Unsatisfactory. See UG-176 and UG-177.
UG-186	Throughout this protocol, only larvae were described – how does this protocol apply to eggs and embryos?
	BP Response: See UG-176. "Live/dead determinations will be completed on *all larval fish and eggs* captured during entrainment sampling. Live/dead determinations will be performed on *fish/eggs* captured from either of the entrainment sampling methods (i.e., pump-in-net and plankton/bongo net)." [p. 25] **UG Team Evaluation of BP Response:** Unsatisfactory. See UG-176.

"*The fish should then be observed again at approximately 1-2 hour intervals throughout the remainder of the sampling event. During each observation, the above items should be recorded. Fish held for more than 12 hours in the aquaria will be provided with wild-caught zooplankton for food. Due to the need for a continuous supply of source water for the water bath and the possible effects of stress associated with transporting the larvae, it is likely not feasible to continue the larval survival studies beyond the completion of each sampling event.*
Throughout the larval survival study, condition will be described using one of the three following general categories, with additional notes taken to describe why the fish was classified as such:

- *Alive and Apparently Healthy (AAH) – fish appears normal, is swimming upright and apparently without hindrance, is active.*

- *Alive but Stressed (AS) – Fish is alive, but not acting normal. This may mean an unusual swimming pattern, spending a lot of time on the bottom - inactive.*
- *Recently Dead (RD) – Fish is dead, no response upon being prodded, no opercular movement, may have begun turning opaque.*" (p.15)

UG-187	"*The fish should then be observed again at approximately 1-2 hour intervals throughout the remainder of the sampling event.*" This statement reveals a bias against longer survival observations for samples that are taken later in the sampling event.
	BP Response: See UG-176. **UG Team Evaluation of BP Response:** Unsatisfactory. See UG-176 and UG-177.
UG-188	"*During each observation, the above items should be recorded.*" This sentence is very poorly worded; it is not clear what survival observations are meant by "the above items."
	BP Response: See UG-176. **UG Team Evaluation of BP Response:** Unsatisfactory. See UG-176.
UG-189	"*Fish held for more than 12 hours in the aquaria will be provided with wild-caught zooplankton for food.*" This aspect of the protocol is highly questionable, for several reasons. First, what is the objective for artificially providing a food supply to the fish? Second, what is the consequence of not adding a food supply? How do we know that 12 hours is an appropriate time to begin feeding the fish? How do we know that wild-caught zooplankton (captured during undefined sampling) would actually represent a viable food source for the fish? How do we know that the fish will eat the food provided? How do we know that food provision does not increase mortality?
	BP Response: See UG-176. **UG Team Evaluation of BP Response:** Unsatisfactory. See UG-176.
UG-190	"*Due to the need for a continuous supply of source water for the water bath and the possible effects of stress associated with transporting the larvae, it is likely not feasible to continue the larval survival studies beyond the completion of each sampling event.*" This statement is problematic, for several reasons. First, if the survival study needs to occur and be continued beyond the completion of a sampling event, then this requirement should be satisfied in the workplan; 'feasibility' of continuing the study is not determined by pre-set entrainment sampling duration. The supply of continuous water supply should not constrain or determine the feasibility of continuing survival observations. Second, how do we know that stress of transportation is a major factor in mortality for

	the sampled fish? Third, if stress of transportation is a potential factor of mortality, how does the study account for the stress of sampling in the first place?
	BP Response: See UG-176. **UG Team Evaluation of BP Response:** Unsatisfactory. See UG-176.
UG-191	"*Throughout the larval survival study, condition will be described using one of the three following general categories, with additional notes taken to describe why the fish was classified as such:* • *Alive and Apparently Healthy (AAH) – fish appears normal, is swimming upright and apparently without hindrance, is active.* • *Alive but Stressed (AS) – Fish is alive, but not acting normal. This may mean an unusual swimming pattern, spending a lot of time on the bottom - inactive.* • *Recently Dead (RD) – Fish is dead, no response upon being prodded, no opercular movement, may have begun turning opaque.*" Is this one of the observations that was referenced in the mis-worded statement "During each observation, the above items should be recorded"? How do we know that the categories are appropriate for evaluating survival condition of the sampled fish? what does "appears normal" mean, and how do we know that what "appears normal" is appropriate for the survival study? Where did the classification of these categories derive from, and how do we know it is appropriate for the sampled species?
	BP Response: See UG-176. These same classifications are also used in the new live/dead determinations. They remain largely unchanged (except for the addition of the Long Dead category) form the draft report with no further clarification of "appears normal" and no reference for the derivation of these categories. Text now reads: "If fish/eggs are determined to be alive, they will be classified as either: - Alive and Apparently Healthy (AAH): Fish/egg appears normal, is swimming upright and apparently without hindrance, is active, has no apparent damage; or - Alive but Stressed (AS): Fish/egg is alive, but not acting normal. This may mean an unusual swimming pattern, spending a lot of time on the bottom – inactive, potentially with signs of physical damage. Likewise, if fish/eggs are determined to be dead, they will be classified as either: - Recently Dead (RD): Fish/egg is dead, no response upon being prodded, no opercular movement or heartbeat, may have begun

	turning opaque; or - Long Dead (LD): Fish/egg is dead, tissues are soft and degraded, fins are degraded, body is opaque, signs of mold are present on the fish/egg." [p. 25-26] **UG Team Evaluation of BP Response:** Unsatisfactory. The concerns regarding assessment of condition remain outstanding.

"*Upon completion of sample collection in the forebay, the same activities will be performed at the discharge sampling point.*" (p.16)

UG-192	How do we know that non-concurrent (i.e. sequential) forebay and discharge sampling will not have an important effect on the comparison of samples and survival estimates?
	BP Response: See UG-176. **UG Team Evaluation of BP Response:** Unsatisfactory. See UG-176 and UG-177.

4.3.1.8 Identification and Enumeration

"*All entrainment samples will be analyzed in a larval fish laboratory by an ichthyologist experienced in larval fish identification and enumeration. For all species except lake whitefish and deepwater sculpin, fish eggs and larvae will be removed from the samples, identified to the lowest taxon possible and counted. For lake whitefish and deepwater sculpin only, larvae will be categorized into prolarvae (yolk-sac larvae) and postlarvae (post yolk-sac larvae). Total length (TL) for up to 30 larvae per life stage will be measured to the nearest 0.1 mm in each sample. Subsampling of larval fish is not anticipated based on historic entrainment sampling results. However, if individuals of a species are present in quantities greater than 1,000 in a single sample, subsampling will be performed. In this case, all individuals of this species would be evenly spread throughout a divided Petri dish. Fish in one quarter of the Petri dish will be counted and the amount will be multiplied by four to determine the total number of that species present in the sample. After each sample has been analyzed, all larvae in that sample will be preserved and retained for future reference.*" (p.16)

UG-193	"*All entrainment samples will be analyzed in a larval fish laboratory by an ichthyologist experienced in larval fish identification and enumeration. For all species except lake whitefish and deepwater sculpin, fish eggs and larvae will be removed from the samples, identified to the lowest taxon possible and counted. For lake whitefish and deepwater sculpin only, larvae will be categorized into prolarvae (yolk-sac larvae) and postlarvae (post yolk-sac larvae).*" This aspect of the entrainment sampling is highly problematic, for several reasons. First, it is implied that the identification of larval fish

	is conducted completely on the basis of visual observations – despite the enormous challenges associated with larval fish species identification in this manner. Even with an "experienced ichthyologist" how do we know that the species identification is reliable – especially in terms of distinguishing lake whitefish from other coregonids? Second, how will eggs and embryos within egg envelopes be identified? Third, what is the importance of distinguishing between larvae with remaining yolk and those with without yolk; and how do we know that the visual observations of yolk presence would be reliable? Fourth, how will the observer distinguish between free-embryos (pre-feeding) and larvae (post-feeding)?
	BP Response: This section is now located in Section 4.3.2.7 (Identification and Enumeration) on p. 30. Text has been altered slightly, now reading: "All entrainment samples will be analyzed in a larval fish laboratory by a qualified individual experienced in larval fish identification and enumeration. For all species fish eggs and larvae will be removed from the samples, identified to the lowest taxon possible and counted. Lake and round3 whitefish and deepwater sculpin larvae will be further categorized into prolarvae (yolk-sac larvae) and postlarvae (post yolk-sac larvae) and the total length (TL) for up to 30 lake whitefish, round whitefish and deepwater sculpin larvae per life stage per sample will be measured to the nearest 0.1 mm. Additionally, up to 30 of each observed sport and commercially targeted species, excluding baitfish, will be measured." [p. 30] **UG Team Evaluation of BP Response:** Unsatisfactory. The issues and concerns regarding the entrainment sampling methods remain outstanding.
UG-194	It should be noted that Lauren Overdyk (UofG Grad Student, Whitefish Entrainment Research Project, SON-BP Collaborative Whitefish Research Program) is developing an innovative method for evaluating the effectiveness of high throughput genetic barcoding for larval fish species identification, in comparison to conventional genetic and visual methods of species identification. This research project should be considered when developing entrainment larval fish species identification protocols for the E/I Monitoring Plan.
	BP Response: None.
UG-195	"*Total length (TL) for up to 30 larvae per life stage will be measured to the nearest 0.1 mm in each sample.*" How do we know that "30 larvae per life stage" is representative for the developmental subsample?
	BP Response: The following sentence was added with regards to measurements of sport and commercially targeted species:

	"Additionally, up to 30 of each observed sport and commercially targeted species, excluding baitfish, will be measured." [p. 30] **UG Team Evaluation of BP Response:** Unsatisfactory. The additional samples do nothing to address the representivity of developmental subsamples.
UG-196	"*After each sample has been analyzed, all larvae in that sample will be preserved and retained for future reference.*" How do we know that the samples will be preserved in a manner that would allow subsequent (e.g. genetic) analyses?
	BP Response: None.

4.4 Data Compilation and Statistical Analyses

4.4.1 Statistical Analyses

"***Where possible, based upon the completeness and reliability of historical entrainment data, statistical analyses are proposed for comparing the multiple entrainment variables listed below prior to and during the Operations Phase****. **Additional variables** will **be considered as necessary**. Analysis options that will be considered for comparing annual estimates of entrainment pre- and post-Operations Phase will include the non-parametric Mann-Whitney U-test, the Generalized Linear Model with a log link, or an Analysis of Covariance (ANCOVA) with month and flow as possible covariates. Data may be log-transformed as needed to meet the normality assumption and bootstrapping procedures may be performed to accommodate for insufficient sample sizes. An alpha level of 0.10 is proposed to be used during statistical analyses.*" (p.16)

UG-197	As discussed above, the UofG Team is seriously concerned about the appropriateness of historical entrainment data for statistical analyses.
	BP Response: This section has been moved to Section 4.5 (Data Compilation and Statistical Analyses – Pre-Operations Phase Versus Operations Phase) and Section 4.5.1 (Statistical Analyses) on p. 34. This paragraph has been expanded to now read (italics added to emphasis additional text): "Where possible, based upon the completeness and reliability of historical entrainment and impingement data, statistical analyses are proposed for comparing the multiple entrainment and impingement variables listed in Section 4.5.2 prior to and during the Operations Phase. Additional variables may be considered *where sufficient and reliable historic data or information collected as part of this program is available. Due to the variability in sampling methods of certain historic data, and in consideration of the time elapsed from a fish population perspective (i.e. many of these fish would have succumbed by this time), more recent data collected as part of*

	this Plan is anticipated to be of greater utility than historic information. Where sufficient data exists to allow for defensible statistical analysis, options that will be considered for comparing annual estimates of entrainment and impingement pre- and post-Operations Phase will include the non-parametric Mann-Whitney U-test, the Generalized Linear Model with a log link, or an Analysis of Covariance (ANCOVA) with month and flow as possible covariates. Data may be log-transformed as needed to meet the normality assumption and bootstrapping procedures may be performed to accommodate for insufficient sample sizes of historic data. An alpha level of 0.10 will be used during statistical analyses. *Statistical techniques described here should be considered as initial approaches. Consistent with an adaptive management approach and the possibility of identifying new factors to be considered as a result of Operations Phase monitoring, additional statistical analysis or inclusion of additional covariates may be considered and included in reporting, at the discretion of Bruce Power and in consideration of consultation with regulatory agencies and stakeholders.*" [p. 34-35] With regards to appropriateness of historical entrainment data, the text has been updated to read: **"**Due to the variability in sampling methods of certain historic data, and in consideration of the time elapsed from a fish population perspective (i.e. many of these fish would have succumbed by this time), more recent data collected as part of this Plan is anticipated to be of greater utility than historic information." [p. 34-35] **UG Team Evaluation of BP Response:** Satisfactory. The revisions reflect a consideration of data quality and utility, and the statistical basis. However, the selection of data should be explicitly defined, including full justification for its use or non-use.
UG-198	The list of possible statistical analyses is fine. However, given the temporal and potentially spatial correlations that might exist in the data, appropriate time series or spatial analyses should be investigated.
	BP Response: See UG-197. Additional text has been added to this paragraph: "Statistical techniques described here should be considered as initial approaches. Consistent with an adaptive management approach and the possibility of identifying new factors to be considered as a result of Operations Phase monitoring, additional statistical analysis or inclusion of additional covariates may be considered and included in reporting, at the discretion of Bruce Power and in consideration of consultation with regulatory agencies and stakeholders." [p. 35]

	UG Team Evaluation of BP Response: Unsatisfactory. Initial approaches or preliminary studies should be considered very carefully. That is, the results from such studies can be highly questionable given uncertainties in the data, inappropriate methods, violated assumptions, etc. This is not to discourage any initial approach – so long as the results are used to inform more appropriate analyses. Decisions should be made using the best methods for analysis. This could help to eliminate such issues as ecological fallacy, atomistic fallacy, and Simpson's paradox.
UG-199	A Generalized Linear Model (GLM) with log link (which could include Poisson regression) should identify an offset variable, thus providing estimates of relative risk. The model should also incorporate spatial and temporal correlations.
	BP Response: None.
UG-200	A GLM with logit link (i.e., Logistic regression) is also recommended. The model could identify the probability of observing a 'success' (i.e., presence of whitefish larvae in a sample) to a 'failure' (i.e., presence of other fish larvae in a sample). Again, the model should incorporate spatial and temporal correlations.
	BP Response: None.

"*Throughout the study, it is recognized that uncertainty may be added to the data at many levels, such as through collection techniques and comparison between multiple methods, plant intake flow measurement, subsampling procedures, differing historic sampling regimes, human error/oversight, and many others, including a host of natural biotic and abiotic factors. When possible, this uncertainty has been accounted for by increasing sample sizes and frequencies, producing and/or following existing standard operating procedures (SOPs) during sampling, providing QA/QC to limit/eliminate data collection, entry, processing, and analysis errors, and aggregating historical data for analysis to limit the effects of single year or single event anomalies which may have resulted from additional short-term sampling effort rather than true changes in fish abundance.*" (p.16)

UG-201	"*Throughout the study, it is recognized that uncertainty may be added to the data at many levels ...*" This part of the sentence does not make sense. Uncertainty (in different forms) is an inherent component of any sample data - it does not have to be "added."
	BP Response: This sentence has been changed to read: "Throughout the monitoring and reporting as part of this Plan, it is recognized that uncertainty exists within the data due to such factors as variability in subsampling procedures, varying historic sampling regimes, human error/oversight, natural biotic and abiotic factors." [p. 35] **UG Team Evaluation of BP Response:** Satisfactory. The comment

	has been adequately addressed.

4.4.2 Variables

"*Upon completion of the lake whitefish and deepwater sculpin entrainment field sampling program in this work plan, it is anticipated that the following variables will be calculated: daily, monthly, and annual lake whitefish and deepwater sculpin egg and larval densities within the forebay; daily, monthly, and annual lake whitefish and deepwater sculpin egg and larval densities within the source water in the vicinity of the plant intake, daily plant intake flow, and annual entrainment expressed as total larval fish/fish eggs, and as total equivalent adults (age-1 fish). Plant entrainment rates expressed as number of fish per million litres of intake flow (no. fish/L) will also be calculated. Additional variables will be calculated as needed.*" (p.17)

UG-202	It should be noted that the discharge sampling is used only to contribute samples for the proposed survival study. How do we know that the larval densities estimated for the forebay entrainment samples would correspond to the larval densities estimated for the discharge entrainment samples? What would it mean for the E/I Monitoring Plan if there were major discrepancies in these different larval density estimates?
	BP Response: None.
UG-203	There needs to be some explicit description of how these variables are going to be used to determine potential significance of BNGS on Lake Huron lake whitefish population(s).
	BP Response: None.
UG-204	"*daily, monthly, and annual lake whitefish and deepwater sculpin egg and larval densities within the source water in the vicinity of the plant intake*" As discussed above, these estimated densities need to be interpreted within the context of a hydrodynamic model of entrainment risk regions for the (undefined) "vicinity of the plant intake."
	BP Response: None. (the "vicinity of the plant intake" has simply been changed to "in the vicinity of the Bruce A station intake")
UG-205	"*annual entrainment expressed as total larval fish/fish eggs, and as total equivalent adults (age-1 fish).*" This statement is factually incorrect with regard to age equivalency for lake whitefish (i.e. not age-1 years).
	BP Response: This sentence has been altered to include age-4 fish. It reads as follows: "Daily Bruce A station intake flow and annual entrainment expressed as total larval fish/fish eggs, and as total equivalent adults (age-1 or age-4 fish)." [p. 35] **UG Team Evaluation of BP Response:** Satisfactory.
UG-206	"*Plant entrainment rates expressed as number of fish per million*

	litres of intake flow (no. fish/L) will also be calculated." As discussed above, the UofG Team is seriously concerned about the appropriateness of assumptions and data collection for estimation of fish entrainment estimates.
	BP Response: None.
UG-207	It is recommended that all point estimates be accompanied by either 95% confidence intervals, or in the case of Bayesian analysis, 95% credible intervals.
	BP Response: None.
UG-208	"*Additional variables will be calculated as needed.*" This statement does not mean anything.
	BP Response: None.

4.4.3 Hypotheses

"*The following hypotheses for each of the variables listed above will be tested:*

- *H0 : There is no difference in each of the variables prior to and during the Operations Phase.*
- *H1 : There is a significant difference in each of the variables prior to and during the Operations Phase.*" (p.17)

UG-209	These hypotheses are satisfactory if the variables are being considered independently. However, if that is the case, a problem with multiple testing arises. How is this being addressed?
	BP Response: This section has been moved to Section 4.5.3 (Hypotheses) on p. 36. The text has been altered to now read: "Before/after statistical analyses will be completed where sufficient and reliable historical data exists. The following hypotheses for each of the entrainment and impingement variables listed above will be tested to compare historic (pre) and current Operations Phase data, where possible:" [p. 36] Besides the addition of "where possible" there are No response. **UG Team Evaluation of BP Response:** Unsatisfactory. The issue of multiple testing still exists.
UG-210	Testing the differences between daily and monthly values should necessitate the use of time series analyses. This should be made explicit.
	BP Response: None.
UG-211	At what level are the hypotheses being tested to determine 'significance'? What are the risks of Type II error?
	BP Response: None.

4.5 Entrainment Effect Tests and Endpoints for Follow-up Monitoring

4.5.1 Entrainment Effect Tests

"*Specific quantifiable effects thresholds due to entrainment of lake whitefish or deepwater sculpin have not been identified nor agreed to with agencies and stakeholders and there is no specific regulatory guidance specific to Ontario that is available for determining entrainment thresholds. The effect test that was stated for Element 3.1 (lake whitefish) in the 2008 Work Plan proposed that entrainment be compared with a threshold for effect to regional abundance with regional referring to the regional study boundaries provided in the 2005 EA. Per the CNSC's comments on the 2008 Work Plan, the threshold for effect was to also be applied to the local population of lake whitefish. Though it requires verification, it is presumed that CNSC's interpretation of local is related to a distinct local population of lake whitefish. The terms regional and local have in some cases been a source of confusion as these terms may relate to a spatial boundary (i.e., a local study area, fish within a certain jurisdictional or management boundary) an ecological boundary (e.g., fish that inhabit a certain regional or local ecosystem with boundaries defined using natural features), fish "stocks" that have been captured within a certain management unit boundary (e.g., MNR quota management areas), or finally, genetically identified fish stocks or populations which have an affinity to any of the aforementioned spatial, ecological or management unit boundaries. For the purpose of this study, the boundaries and approaches for describing regional and local have been revised, as identified below, and are to be discussed and agreed to by Bruce Power, regulatory agencies and stakeholders in terms of how they may be applied to any proposed thresholds.*" (p.17)

UG-212	"*Specific quantifiable effects thresholds due to entrainment of lake whitefish or deepwater sculpin have not been identified nor agreed to with agencies and stakeholders and there is no specific regulatory guidance specific to Ontario that is available for determining entrainment thresholds.*" As discussed above, the E/I Monitoring Plan cannot achieve its stated Goal until such time as an appropriate entrainment effect threshold has been explicitly defined. Until such time as this threshold has been established, the E/I Monitoring Plan should not be finalized or approved.
	BP Response: None. This section has been moved to Section 4.6 (Effect Tests and Endpoints for Follow-up Monitoring) and 4.6.1 (Effects Tests) on p. 36-37.
UG-213	Beyond thresholds, an identification of a risk map should be investigated. For example, if the proportion of equivalent adult annual lake whitefish entrainment losses relative to some abundance estimate were set at 5%, this does not suggest that anything less than 5% is low risk, and anything about 5% is high risk. How does 5.1% compare to 7%, or 20%, for example.
	BP Response: None.
UG-214	"*The effect test that was stated for Element 3.1 (lake whitefish) in the 2008 Work Plan proposed that entrainment be compared with a threshold for effect to regional abundance with regional referring to*

	the regional study boundaries provided in the 2005 EA." The concept of "regional abundance" is not appropriate for evaluating entrainment effects unless the "region" refers to spatial distribution of the lake whitefish population(s) in Lake Huron that are receiving the entrainment effects, especially mortality.
	BP Response: None.
UG-215	"*Per the CNSC's comments on the 2008 Work Plan, the threshold for effect was to also be applied to the local population of lake whitefish. Though it requires verification, it is presumed that CNSC's interpretation of local is related to a distinct local population of lake whitefish.*" This statement is problematic for several reasons. First, an entrainment effect threshold makes sense only with application to a biological population – there is no "also" alternative application. Second, CNSC's comments should be explicitly re-stated to minimize misinterpretation of those comments. Third, "verification" of the CNSC's comments should have been undertaken before this draft of the E/I Monitoring Plan, rather than being "presumed" or presented as an uncertainty. Fourth, it would be inappropriate to "presume" that lake whitefish in waters adjacent to BNGS structured as a "distinct local population."
	BP Response: None.
UG-216	As discussed above, it is clear that the spatio-temporal population structure of lake whitefish is a key uncertainty for the draft E/I Plan. It should be explicitly noted that this same key uncertainty was explicitly recognized by the SON-BP Collaborative Whitefish Research Program, and was assigned as a PhD research project (Clayton Coppaway) for the UofG Team. The E/I Monitoring Plan should explicitly incorporate the research and analyses being conducted by the SON-BP Research Program.
	BP Response: None.
UG-217	"*The terms regional and local have in some cases been a source of confusion as these terms may relate to a spatial boundary (i.e., a local study area, fish within a certain jurisdictional or management boundary) an ecological boundary (e.g., fish that inhabit a certain regional or local ecosystem with boundaries defined using natural features), fish "stocks" that have been captured within a certain management unit boundary (e.g., MNR quota management areas), or finally, genetically identified fish stocks or populations which have an affinity to any of the aforementioned spatial, ecological or management unit boundaries.*" It is true that there has been widespread uncertainty about the meaning of terms and concepts associated with population discrimination, especially as they relate to the need for population-level risk assessment for the BNGS. It should be noted that Clayton Coppaway (UofG Grad Student, Whitefish Population Discrimination Research Project, SON-BP Collaborative Whitefish Research Program), is currently undertaking

	comprehensive reviews of: (a) operational definitions of 'population' which emphasis on fishes, and (b) all available information regarding population spatio-temporal distribution of lake whitefish in Lake Huron. These reviews/evaluations should be considered when developing operational definitions of lake whitefish populations for the E/I Monitoring Plan.
	BP Response: None.
UG-218	"*For the purpose of this study, the boundaries and approaches for describing regional and local have been revised, as identified below, and are to be discussed and agreed to by Bruce Power, regulatory agencies and stakeholders in terms of how they may be applied to any proposed thresholds.*" As discussed above, the proposed boundaries for the lake whitefish population(s) receiving BNGS entrainment effects, should based on rigorous consideration of population biology and the available information for lake whitefish populations in Lake Huron. Discussions between BP, regulatory agencies, SON and other interested parties should occur only after this rigorous consideration has been completed and presented in a manner that is meaningful for the E/I Monitoring Plan.
	BP Response: None.

4.5.1.1 Lake Whitefish - Within QMA 4-4

"*The term regional as it pertains to entrainment estimates is not proposed for use going forward. The proposed boundary for describing entrainment that is proposed is the MNR boundary for QMA 4-4 which is a fisheries management unit boundary that resides entirely within Canadian waters of Lake Huron within the main basin. This QMA 4-4 boundary is proposed as it is within a defined and established management boundary for Lake Huron commercial fisheries in Ontario and provides a means against which lake whitefish data and EAM/FFYM and future direct, indirect or non-use benefits can be calculated and compared. Though a threshold for effect has not been determined or agreed to, it is proposed for the purpose of this study (pending further consultation) that the threshold for effect is established as a proportion of equivalent adult annual lake whitefish entrainment losses relative to the MNR proposed quota of lake whitefish in QMA 4-4. It is assumed that the regulatory agencies that determine the commercial catch quota understand the population dynamics of the regional lake whitefish population and have developed a rigorous estimate of acceptable annual catch. It is also assumed, based on information provided by the MNR [MNR 2011], that this commercial catch quota takes into account the natural mortality and recreational fishing mortality rates of lake whitefish. As such, it is assumed that an annual equivalent adult entrainment greater than an agreed-upon percentage of the lake whitefish regional commercial catch quota for QMA 4-4 for the current monitoring year will represent an effect on the population which inhabits QMA 4-4 and is subject to exploitation by the commercial fishery. For the purpose of this analysis it will be assumed that all potential genetic populations that may reside in QMA 4-4 have an equal chance of occurring*

within the waters subject to the intake influence and therefore possess an equal chance of being entrained and/or impinged. The percentage of the lake whitefish regional commercial catch quota for QMA 4-4 that will represent an effect on the population that inhabits QMA 4-4 for the current monitoring year will be decided based on further consultation with agencies and stakeholders." (p.18)

UG-219	"*The term regional as it pertains to entrainment estimates is not proposed for use going forward.*" This sentence does not make any sense, going forward or backward. The term "regional" is not related to "entrainment estimates" but rather to the hypothesis that lake whitefish population(s) are structured with a spatial distribution at the "regional" (local < regional < basin) scale.
	BP Response: This section has now moved to Section 4.6.1.1 (Lake Whitefish – Within QMA 4-4 (Entrainment and Impingement) starting on p. 37. The sentence was altered slightly to now read: "The term regional as it pertains to entrainment and impingement estimates is not to be used going forward." [p. 37] **UG Team Evaluation of BP Response:** Unsatisfactory. The issues and concerns regarding spatial context of entrainment sampling and analyses remain outstanding.
UG-220	"*The proposed boundary for describing entrainment that is proposed is the MNR boundary for QMA 4-4 which is a fisheries management unit boundary that resides entirely within Canadian waters of Lake Huron within the main basin. This QMA 4-4 boundary is proposed as it is within a defined and established management boundary for Lake Huron commercial fisheries in Ontario and provides a means against which lake whitefish data and EAM/FFYM and future direct, indirect or non-use benefits can be calculated and compared.*" This statement is highly problematic, for several reasons. First, the boundary in question is not a "boundary for describing entrainment," but rather a boundary for describing the spatial distribution of the population that receives the effects of entrainment. Second, as discussed in detail above, the MNR quota management area 4-4 is highly inappropriate as a boundary for describing the spatial distribution of the population that receives the effects of BNGS entrainment. Third, whatever population(s) are explicitly hypothesized as receiving entrainment effects from the BNGS, data for the lake whitefish in the associated population boundaries will be organized for population modeling (EAM/FFYM as well as PFM/TTM) and any "future direct, indirect or non-use benefits" (whatever these might be).
	BP Response: None.
UG-221	"*Though a threshold for effect has not been determined or agreed to, it is proposed for the purpose of this study (pending further consultation) that the threshold for effect is established as a proportion of equivalent adult annual lake whitefish entrainment*

	losses relative to the MNR proposed quota of lake whitefish in QMA 4-4." As discussed in detail above, it is highly inappropriate to use MNR commercial fisheries quotas as a meaningful metric of lake whitefish population abundance.
	BP Response: None.
UG-222	"*It is assumed that the regulatory agencies that determine the commercial catch quota understand the population dynamics of the regional lake whitefish population and have developed a rigorous estimate of acceptable annual catch.*" The first assumption is highly questionable, especially given the administrative origin of the boundaries for MNR quota management area 4-4. The second assumption rests on the first assumption, and is irrelevant when the MNR quota decision-making process is taken into account.
	BP Response: None.
UG-223	"*It is also assumed, based on information provided by the MNR [MNR 2011], that this commercial catch quota takes into account the natural mortality and recreational fishing mortality rates of lake whitefish.*" This assumption is irrelevant when the MNR quota decision-making process is taken into account.
	BP Response: None.
UG-224	"*As such, it is assumed that an annual equivalent adult entrainment greater than an agreed-upon percentage of the lake whitefish regional commercial catch quota for QMA 4-4 for the current monitoring year will represent an effect on the population which inhabits QMA 4-4 and is subject to exploitation by the commercial fishery.*" As discussed in detail above, this assumption is based on numerous errors in logic and is highly inappropriate for the E/I Monitoring Plan.
	BP Response: None.
UG-225	"*For the purpose of this analysis it will be assumed that all potential genetic populations that may reside in QMA 4-4 have an equal chance of occurring within the waters subject to the intake influence and therefore possess an equal chance of being entrained and/or impinged.*" As discussed in detail above, this assumption is based on numerous errors in logic and is highly inappropriate for the E/I Monitoring Plan.
	BP Response: None.
UG-226	"*The percentage of the lake whitefish regional commercial catch quota for QMA 4-4 that will represent an effect on the population that inhabits QMA 4-4 for the current monitoring year will be decided based on further consultation with agencies and stakeholders.*" As discussed in detail above, this assumption is based on numerous errors in logic and is highly inappropriate for the E/I Monitoring Plan.
	BP Response: None.
UG-227	It should be noted that Michael Chegahno (UofG Grad Student, Whitefish Population Modelling Research Project, SON-BP

	Collaborative Whitefish Research Program), has been assigned the responsibility of developing a biologically- and mathematically/statistically-defensible population model and decision-support system for understanding the population dynamics of Lake Huron lake whitefish population(s) and the cumulative effect of mortality associated with the BNGS (entrainment, impingement, thermal, contaminant, etc.) and the commercial fishery. This research project should be considered when developing the sampling design and analyses of data for the E/I Monitoring Plan.
	BP Response: None.

4.5.1.2 Lake Whitefish - Within the EA Local Study Area

"*Local effects at the level of genetically distinct populations can not be determined until such time that genetically distinct populations are identified and the actual proportion of these populations within a broader populations grouping can be discerned. Genetically distinct populations will be determined based upon the results of DNA studies (see Section 1) to confirm the presence of and determine the size and contribution of distinct, populations relative to the total captured for DNA analysis within a specific area. To contribute to this or future genetics studies, lake whitefish eggs and larvae collected during entrainment sampling will be preserved for possible DNA analysis to determine which population or stock they may belong to. Prior to or in lieu of completion of the DNA studies, and subject to further consultation with fishery agencies, the following scenarios will be assumed:*

- *0.5% of entrained lake whitefish are from a population which is distinct within the EA local study area;*
- *20% of entrained lake whitefish are from a population which is distinct within the EA local study area (as shown on Figure 2);*
- *50% of entrained lake whitefish are from a population which is distinct within the EA local study area; and*
- *100% of entrained lake whitefish are from a population which is distinct within the EA local study area.*

Based upon these four scenarios the number entrained in each of the four above scenarios will be converted into estimates of equivalent adults at age-4. The equivalent adult estimates will then be compared to historic gill net sampling results taken from nearby sites within the EA local study area (Figure 2) and the EA Regional study area (see Figure 2.3.3-1 of the Aquatic Environment Technical Support Document [Bruce Power 2005b]). Until the results of the DNA studies are published, and an understanding of the movements of individual stocks of these species is better understood, forming a more reliable estimate of an entrainment effect to a population that is distinct within the local study area will continue to be limited. A benefit of the EAM model is that the results are scalable for comparison to estimated populations sizes from spatial areas deemed appropriate by fisheries managers." (p.18)

UG-228	"*Local effects at the level of genetically distinct populations can not be determined until such time that genetically distinct populations*

	are identified and the actual proportion of these populations within a broader populations grouping can be discerned. Genetically distinct populations will be determined based upon the results of DNA studies (see Section 1) to confirm the presence of and determine the size and contribution of distinct, populations relative to the total captured for DNA analysis within a specific area." This statement is highly problematic, for several reasons. First, as discussed above, the phrase "local effects at the level of genetically distinct populations" is misguided – the term "local" refers to one hypothesized scale of population discrimination, not the effects. Second, as discussed above, it is highly unlikely population discrimination research will identify "genetically distinct" populations; it is much more likely that multiple sources of available information about lake whitefish population distribution will be combined to identify meaningful population scenarios for use in the E/I Monitoring Plan. Third, BP needs to reconcile the "DNA studies (see Section 1)" and the Population Discrimination Research Project that was assigned to UofG under the SON-BP Collaborative Whitefish Research Program. Fourth, the final sentence is illogical and seems to misunderstand the biological insight that can be provided by genetic analyses.
	BP Response: None.
UG-229	"*To contribute to this or future genetics studies, lake whitefish eggs and larvae collected during entrainment sampling will be preserved for possible DNA analysis to determine which population or stock they may belong to.*" This provision is reasonable, however it will require careful selection of the preservative conditions for the samples.
	BP Response: None.
UG-230	"*Prior to or in lieu of completion of the DNA studies, and subject to further consultation with fishery agencies, the following scenarios will be assumed:* • *0.5% of entrained lake whitefish are from a population which is distinct within the EA local study area;* • *20% of entrained lake whitefish are from a population which is distinct within the EA local study area (as shown on Figure 2);* • *50% of entrained lake whitefish are from a population which is distinct within the EA local study area; and* • *100% of entrained lake whitefish are from a population which is distinct within the EA local study area.*" This statement is highly problematic, for several reasons. First, how do we know that the "EA local study area" (presumably that depicted in Figure 2) is an appropriate spatial boundary for this evaluation? Second, it is unclear why these "scenarios" should be assumed "prior to or in lieu of" population discrimination; this seems

	highly arbitrary and illogical. Third, how do we know that the pre-specified population percentages (0.5%, 20%, 50%, 100%) provide a reasonable representation of the actual representations.
	BP Response: None.
UG-231	"*Based upon these four scenarios the number entrained in each of the four above scenarios will be converted into estimates of equivalent adults at age-4. The equivalent adult estimates will then be compared to historic gill net sampling results taken from nearby sites within the EA local study area (Figure 2) and the EA Regional study area (see Figure 2.3.3-1 of the Aquatic Environment Technical Support Document [Bruce Power 2005b]).*" This statement is highly problematic, for several reasons. First, as discussed in detail above, the UofG Team is seriously concerned about the appropriateness of assumptions and data collection for estimation of fish entrainment estimates. Second, as discussed in detail above, the UofG Team is seriously concerned about the appropriateness of assumptions and data collection for estimation of lake whitefish abundance in the "local EA study area" based on historic gill net sampling. Third, despite previous requests for relevant documentation, the UofG Team has not been provided with the data/documentation associated with Bruce Power's historic whitefish gillnetting assessment program, as had been requested.
	BP Response: The second sentence from this excerpt has been removed from the Plan. **UG Team Evaluation of BP Response:** Unsatisfactory. The minor editorial change does not address the outstanding issues and concerns.
UG-232	"*Until the results of the DNA studies are published, and an understanding of the movements of individual stocks of these species is better understood, forming a more reliable estimate of an entrainment effect to a population that is distinct within the local study area will continue to be limited. A benefit of the EAM model is that the results are scalable for comparison to estimated populations sizes from spatial areas deemed appropriate by fisheries managers.*" This statement is highly problematic, for several reasons. First, it seems that the author has confused "movement of individual stocks" (whatever those are), with movement of individuals within a population. Second, DNA studies are unlikely to provide much "understanding of the movements" of individuals with a whitefish population; this is the type of insight that is more likely derived from mark-recapture and fishery (dependent/independent) assessments – all of which are included in the UofG Research Program. Third, the author repeats the illogical mistake of assuming "a population that is distinct within the local study area." Fourth, based on the inappropriateness of MNR quota

	management area 4-4 as a representation of a lake whitefish population distribution in Lake Huron, it would be unwise to reply on what fisheries managers "deem appropriate" for population discrimination.
	BP Response: The last sentence was altered slightly to read: "A benefit of the EAM is that the results can be compared against any population estimate from any spatial area for the same period of time, in the event that new information specific to the population of interest becomes available." [p. 39] **UG Team Evaluation of BP Response:** Unsatisfactory. The issues and concerns regarding population-level analyses remain outstanding.

4.5.2 Entrainment Endpoints for Follow-up Monitoring

"*The endpoint of follow-up for Element 3.1 (Lake Whitefish) is proposed to be the point where entrainment numbers fall below the agreed upon threshold (to be determined) for effect to regional abundance with all four units in operation. Following the initial two years of entrainment sampling, data will be analyzed to determine if the annual entrainment impacts fall below the agreed upon thresholds for effect. If so, entrainment sampling will cease at this point. If not, Bruce Power will consult with and provide agencies and stakeholders with their opinion on options for future sampling and possible additional mitigation measures. The thresholds for effect to the QMA 4-4 lake whitefish population and the lake whitefish from a population which is distinct within the EA local study area (based on the 0.50, 20, 50 and 100 % test values) will each be analyzed separately; proxies for determining populations within the local study area may be derived from sampling data though the ongoing genetics studies will likely be the ultimate determinant of whether or not local populations exist. If Bruce power falls below the threshold for effect to one of these effect tests, but not the others, Bruce Power will provide recommendations for adjustments/alterations to the current monitoring plan to address only impacts to the respective populations being studied. The endpoint of follow-up for Element 3.3 (Deepwater Sculpin) has been established as the point where the species is not present in entrainment sampling, whether or not the species is present in source water sampling,. This zero entrainment target value for deepwater sculpin may be increased though further agency consultation where a refined but increased value can be agreed upon as having a residual effect that is insignificant to the species relative to mortality that may be induced by other factors, whether individually or cumulatively based on current knowledge.*" (p.19)

UG-233	"*The endpoint of follow-up for Element 3.1 (Lake Whitefish) is proposed to be the point where entrainment numbers fall below the agreed upon threshold (to be determined) for effect to regional abundance with all four units in operation.*" This statement is problematic, for several reasons. First, it is not clear why the term "endpoint" is required if it is effectively synonymous with the

	(undefined) threshold that must not be exceeded. Second, the phrase "effect to regional abundance" makes no sense when not related to the concept of "population abundance." Third, it seems inconsistent to refer explicitly to "regional" population abundance for the threshold, yet refer explicitly to "EA local study area" for the scenarios (see above). Fourth, the phrase "with all four units in operation" is illogical; the threshold would be in effect regardless of the number of units in operation (it is simply most likely that the threshold would be exceeded with the maximum number of units operating).
	BP Response: This section is now located in Section 4.6.2 (Endpoints for Follow-up Monitoring) on p. 40. The sentence has been altered to now read: "The endpoint of follow-up for Element 3.1 (Entrainment of Lake Whitefish) and Element 3.4 (Impingement of Lake Whitefish) is proposed to be the point where entrainment and impingement of age-4 lake whitefish fall below the agreed upon threshold (to be determined) for effect, which will be represented by a percentage of the lake whitefish regional commercial catch quota for QMA 4-4." [p. 40] **UG Team Evaluation of BP Response:** Unsatisfactory. The editorial change does not address the outstanding issues and concerns regarding population-level thresholds.
UG-234	"*Following the initial two years of entrainment sampling, data will be analyzed to determine if the annual entrainment impacts fall below the agreed upon thresholds for effect. If so, entrainment sampling will cease at this point. If not, Bruce Power will consult with and provide agencies and stakeholders with their opinion on options for future sampling and possible additional mitigation measures.*" This statement is highly problematic, for several reasons. First, as discussed in detail above, the UofG Team is seriously concerned about the appropriateness of assumptions and data collection for estimation of fish entrainment estimates. Second, as discussed in detail above, the threshold must be explicitly defined and approved before the E/I Monitoring Plan is approved. Third, how do we know that two years of sampling is appropriate for this evaluation? Fourth, how do we know that entrainment thresholds are not likely to be exceeded after the second year of sampling?
	BP Response: None.
UG-235	"*The thresholds for effect to the QMA 4-4 lake whitefish population and the lake whitefish from a population which is distinct within the EA local study area (based on the 0.50, 20, 50 and 100 % test values) will each be analyzed separately; proxies for determining populations within the local study area may be derived from sampling data though the ongoing genetics studies will likely be the*

	ultimate determinant of whether or not local populations exist." As discussed in detail above, the entire approach to representing lake whitefish populations in the proposal (quota management area boundary, "genetic distinctness", "EA local study area", percentage association to "EA local study area") taken as a whole is highly inappropriate for the E/I Monitoring Plan. Aside from the fact that BP has not advised the UofG Team that it has made undefined plans for "genetic studies" in addition to the SON-BP Collaborative Whitefish Research Program, it is highly unlikely that "the ongoing genetics studies will likely be the ultimate determinant of whether or not local populations exist."
	BP Response: None.
UG-236	"*If Bruce power falls below the threshold for effect to one of these effect tests, but not the others, Bruce Power will provide recommendations for adjustments/alterations to the current monitoring plan to address only impacts to the respective populations being studied.*" This statement makes no sense – grammatically or logically.
	BP Response: The sentence was re-worded as follows: "If entrainment and impingement numbers fall below the threshold for effect to one of these effect tests, but not the others, Bruce Power will provide recommendations for adjustments/alterations to this Plan to address only impacts to the respective populations being studied." [p. 40] **UG Team Evaluation of BP Response:** Unsatisfactory. The statement remains illogical.
UG-237	Since patterns of larval fish entrainment may fluctuate on temporal scales beyond the proposed 2 year sampling period of this project, it is not advised to cease entrainment sampling. To the contrary, sampling should continue to ensure that entrainment is not significantly affecting the lake whitefish population(s). That is, it should not be assumed that the aquatic ecosystem is static. Cumulative effects, climate change, etc., all may have an influence on the relative effect of BNGS. Further, since population abundance estimates can change from year to year, the relative impact of BNGS might also change. As such, entrainment sampling should be an ongoing program which serves to determine potential future significant effects, as well as to inform or highlight potential future problems.
	BP Response: None.

5.0 Impingement

"*As noted above, impingement is defined as the process by which organisms which are generally larger than or equal to either the Bruce A (Units 1-4) cooling water pump intake screens or the cooling water travelling screens are held against the screens by the through-flow. The impingement component of this follow-up monitoring study will consist of:*

- *Impingement monitoring to identify the species, quantity and sizes of fish impinged on the Bruce A (Units 1-4) pump intakes and travelling screens during normal plant operations; and*
- *Completion of EAM (spottail shiner and lake whitefish) and FFYM (lake whitefish) modeling.*

Impingement sampling will monitor and calculate if there is a statistically significant change in impingement quantities and rates coincident with the Operations Phase, and the biological relevance of the impingement on the target VEC species. As with past impingement studies, collected data will be used to identify temporal trends in impingement. To the extent that prior methods were successful and repeatable it is proposed that impingement sampling methods follow prior sampling protocols, previously developed by Bruce Power, to maximize the likelihood that past studies and the proposed Operations Phase impingement sampling can be statistically compared. As outlined in the established Bruce Power impingement protocols, sampling is proposed to occur three times per week per unit [Howes 2004a; Howes 2004b]. All impinged fishes, with a primary focus on lake whitefish and spottail shiner as these are the impingement target species, will be identified and recorded during this study. As necessary, ongoing efforts will be made to improve monitoring protocols and guidelines on impingement procedures and fish collection/identification techniques." (p.20)

UG-238	"*As noted above, impingement is defined as the process by which organisms which are generally larger than or equal to either the Bruce A (Units 1-4) cooling water pump intake screens or the cooling water travelling screens are held against the screens by the through-flow.*" As discussed above, the UofG Team has identified serious problems with the proposed definition of impingement. It is important to note the distinction between the juvenile/adult forebay entrainment and the juvenile/adult forebay impingement = the portion of those adults that become impinged on the travelling screens and flushed into a sample bin.
	BP Response: This section has been moved to Section 4.4 (Impingement) starting on p. 30. The definition of impingement has been reworded as follows: "As described in Section 1.4, impingement is defined as the process by which organisms that are generally larger than or equal to the Bruce A (Units 1-4) cooling water pump intake screen mesh are held against the screens by the intake cooling water flow." [p. 30] **UG Team Evaluation of BP Response:** Unsatisfactory. See UG-038-041.
UG-239	"*The impingement component of this follow-up monitoring study will consist of: Impingement monitoring to identify the species, quantity*

	and sizes of fish impinged on the Bruce A (Units 1-4) pump intakes and travelling screens during normal plant operations." The UofG Team has serious concerns that assessment of travelling screens grossly underestimates the juvenile/adult forebay entrainment of lake whitefish.
	BP Response: The sentence has been re-worded to remove "travelling screens" as follows: "Impingement monitoring to identify the species, quantity and sizes of fish impinged on the Bruce A (Units 1- 4) pump intake screens during normal Bruce A station operations; and," [p. 30] **UG Team Evaluation of BP Response:** Unsatisfactory. Editorial change of the term "travelling screen" does not address the outstanding concerns regarding assessment of impingement.
UG-240	"*Impingement sampling will monitor and calculate if there is a statistically significant change in impingement quantities and rates coincident with the Operations Phase, and the biological relevance of the impingement on the target VEC species.*" If juvenile/adult forebay entrainment assessments during both Pre-Operations and Operations Phases are indeed grossly underestimated by juvenile/adult forebay impingement samples, the between-Phase differences in impingement samples would be largely irrelevant.
	BP Response: The sentence has been re-worded to read: "Impingement sampling will provide a pathway to monitor direct impacts to VEC species." [p. 30] **UG Team Evaluation of BP Response:** Unsatisfactory. The updated change does not identify how "impingement sampling will provide a pathway". Concerns regarding juvenile/adult forebay entrainment assessments remain outstanding.
UG-241	"*As with past impingement studies, collected data will be used to identify temporal trends in impingement. To the extent that prior methods were successful and repeatable it is proposed that impingement sampling methods follow prior sampling protocols, previously developed by Bruce Power, to maximize the likelihood that past studies and the proposed Operations Phase impingement sampling can be statistically compared.*" How do we know that methodology employed in past impingement studies is appropriate for estimating juvenile/adult forebay entrainment? The issue of statistical comparison is secondary to the establishment of reliable methodology for accurate and precise estimates of juvenile/adult forebay entrainment.
	BP Response: None.
UG-242	"*As outlined in the established Bruce Power impingement protocols, sampling is proposed to occur three times per week per unit [Howes 2004a; Howes 2004b]. All impinged fishes, with a primary focus on*

	lake whitefish and spottail shiner as these are the impingement target species, will be identified and recorded during this study. As necessary, ongoing efforts will be made to improve monitoring protocols and guidelines on impingement procedures and fish collection/identification techniques." How do we know that impingement sampling three times per week per unit is appropriate for the E/I Monitoring Plan? What specifically are the deficiencies that need to be improved in the existing "monitoring protocols and guidelines on impingement procedures and fish collection/identification techniques"? How will we know when these improvements are sufficient for the E/I Monitoring Plan?
	BP Response: None.

5.1 Impingement Monitoring Objectives

"*Table 8.4.1-1 of the 2008 Work Plan (Appendix B) indicates that the Operations Phase monitoring objective for Element 3.4, lake whitefish and spottail shiner impingement, is to determine the relative abundance of lake whitefish and spottail shiner juveniles and adults susceptible to impingement, and to confirm the EA finding of no significant adverse effects to lake whitefish and spottail shiner due to impingement from condenser cooling water system operation during the Operations Phase. As described for entrainment, the presence or absence of lake whitefish and spottail shiner early life stages (eggs and larvae) in ambient waters will be assessed during the source water sampling proposed in Section 3. For juvenile and adult life stages the presence and abundance of these species will be obtained from USGS/MNR trawl data, where available, coupled with any relevant (previous or future) fishery work that is occurring as part of other Bruce Power programs. This may be complemented by data from MNR index netting, the commercial fishery and/or the recreational fishery, to the extent available and applicable.*" (p.20)

UG-243	"*Table 8.4.1-1 of the 2008 Work Plan (Appendix B) indicates that the Operations Phase monitoring objective for Element 3.4, lake whitefish and spottail shiner impingement, is to determine the relative abundance of lake whitefish and spottail shiner juveniles and adults susceptible to impingement, and to confirm the EA finding of no significant adverse effects to lake whitefish and spottail shiner due to impingement from condenser cooling water system operation during the Operations Phase.*" There are several key aspects of this statement that require attention. First, the focus on determining "relative abundance" of juveniles/adults that are "susceptible to impingement" requires clarification. Second, the term "relative abundance" means a correlate index rather than an absolute estimate of the number of individuals - this is inconsistent with the approach proposed for entrainment assessment and the objective of the E/I Monitoring Plan. Third, the term "susceptible to impingement" could refer to the number of juveniles/adults in the

	entrainment risk regions surrounding the water intake, or it could refer to the number of juveniles/adults already in the impingement risk regions in the forebay. These terms of reference must be more rigorously defined in the E.I Monitoring Plan.
	BP Response: This section has been removed – largely incorporated into Section 1.3 (Study Goal and Objectives). **UG Team Evaluation of BP Response:** Satisfactory. But see concerns regarding Study Goal and Objectives.
UG-244	Use of the word "confirm" is problematic in this context, since it carries the meaning of 'prove to be true'. A neutral scientific wording would read something like: *"... to [confirm] test the EA [finding] prediction of no significant adverse effects to lake whitefish and spottail shiner due to impingement from condenser cooling water system operation during the Operations Phase.*"
	BP Response: See UG-243. Wording has changed to now read (italics emphasis added): "The goal of Operations Phase impingement and entrainment monitoring is to *evaluate the validity* of the effects predictions set forth in the EA Study Report [Bruce Power 2005], specific to impingement and entrainment." [p. 2] **UG Team Evaluation of BP Response:** Satisfactory.
UG-245	"*As described for entrainment, the presence or absence of lake whitefish and spottail shiner early life stages (eggs and larvae) in ambient waters will be assessed during the source water sampling proposed in Section 3.*" This statement does not belong in this section.
	BP Response: See UG-243. **UG Team Evaluation of BP Response:** Unsatisfactory. See UG-243.
UG-246	"*For juvenile and adult life stages the presence and abundance of these species will be obtained from USGS/MNR trawl data, where available, coupled with any relevant (previous or future) fishery work that is occurring as part of other Bruce Power programs. This may be complemented by data from MNR index netting, the commercial fishery and/or the recreational fishery, to the extent available and applicable.*" These statements are so sweeping and conditional as to mean nothing at all. A much more rigorous approach is required to define explicitly how the abundance of juvenile/adult abundance in source water will be undertake - with an explanation of why the proposed methodology is appropriate for the E/I Monitoring Plan.
	BP Response: See UG-243. **UG Team Evaluation of BP Response:** Unsatisfactory. See UG-

	243.

5.2 Review of Historical Data

"*Impingement sampling has previously been performed at both the Bruce A and Bruce B stations. Impingement samples have been collected at the Bruce A station during sampling programs from 1977-1981, and 2004- present. When feasible, recent historic data (2004 to the present) will be used to provide historic context relating to sampling techniques and schedules, and to the extent possible to compare with new sample results to be obtained as part of this program. Although multiple years worth of impingement data have been compiled, a preliminary review as part of this work plan indicates that monitoring activities (i.e., frequency, level of detail, etc.) have varied between years, which is anticipated to limit the ability to draw comparisons between previous years of sampling and subsequently predict future impingement and entrainment trends at the Bruce A station. The limitations of historical data will be further explored as part of the proposed study.*" (p.20)

UG-247	Despite previous requests for relevant documentation, the UofG Team has not been provided with the data/documentation associated with Bruce Power's 1977-1981, 2004-present impingement assessment program, as had been requested.
	BP Response: None. This section has been moved to Section 4.4.1 (Review of Historical Data) on p. 31.
UG-248	As discussed above, the UofG Team has serious that assessment of travelling screens grossly underestimates the juvenile/adult forebay entrainment of lake whitefish. How do we know that the impingement assessment methodology will satisfy the needs of the E/I Monitoring Plan?
	BP Response: None.
UG-249	While this section deals explicitly with impingement data, the questions/comments are the same as those described for the section on entrainment data. Specifically, how are the findings going to be compared, and to what extent will the results of the comparison inform the proposed study?
	BP Response: None.
UG-250	Will comparisons be balanced against the possibility that the population of whitefish has changed since the original studies were performed? How are the limitations of historical data going to be addressed in the study? What statistical comparisons will be made? What assumptions are required to perform the necessary statistical analyses? Are these comparisons univariate? Will appropriate Time Series, Spatial or Spatio-temporal methods be used? Has Simpson's Paradox been considered? How will the results be interpreted and communicated if the statistical power is limited?
	BP Response: None.
UG-251	It should be noted that Lauren Overdyk (UofG Grad Student,

	Whitefish Entrainment Research Project, SON-BP Collaborative Whitefish Research Program) is undertaking a comprehensive review of the historical BNGS impingement assessment methodologies and data, with the purpose of evaluating the value of these data in future assessment of impingement and juvenile/adult forebay entrainment. This research project should be considered when developing juvenile/adult forebay entrainment assessment protocols for the E/I Monitoring Plan.
	BP Response: None.

5.3 Impingement Sampling

"*Impingement sampling will identify and quantify the adult and juvenile fishes in the intake water that are captured on the intake screening systems. Impingement sampling will be conducted using existing Bruce Power impingement protocols.*" (p.21)

UG-252	As discussed above, the UofG Team has serious that assessment of travelling screens grossly underestimates the juvenile/adult forebay entrainment of lake whitefish. How do we know that the "existing Bruce Power impingement protocols" will satisfy the needs of the E/I Monitoring Plan?
	BP Response: Paragraph has been altered slightly to now read (italics added to emphasize new text): "Impingement sampling will identify and quantify the adult and juvenile fishes in the intake cooling water that are captured on the pump intake screens. Impingement sampling will be conducted using existing Bruce Power impingement protocols [Howes 2004a; Howes 2004b]. *Protocols are currently being revised and developed, as needed.*" [p. 31] **UG Team Evaluation of BP Response:** Unsatisfactory. The editorial changes do not address the outstanding issues and concerns regarding juvenile/adult forebay entrainment sampling.

5.3.1 Impingement Field Sampling Design

5.3.1.1 Collection Method

"*Impinged fish will be collected for a 24-hour period at each of the Bruce A station pumphouses (Units 1-4). Figure 3 shows the location of each Bruce A station pumphouse which contain the travelling screens. Prior to each 24-hour impingement sampling event, the travelling screens will be rinsed to remove debris and organic material. Following the 24-hour impingement sampling event, the screens will again be rinsed and the impinged material will be washed into a collection apparatus. Holes in the collection apparatus will be equal in size to the mesh size of the travelling screens*

so that no impinged matter will be lost. Placement of the collection apparatuses will vary based upon the current layout of the Unit 1-4 sluiceways and collection bins. The travelling screens are currently set to operate based upon differential pressure, as well as on a timer. If a large amount of impinged material is collected during a sampling event, the travelling screens may need to be washed during the 24-hour period. If this occurs, all collected impingement sampling material will be combined at the end of the 24-hour sampling period to represent one sampling event. Following each travelling screen wash, the contents of the collection apparatus will be removed and all fish will be identified to the lowest practicable taxonomic level, sorted, and enumerated, as described in the existing Bruce Power impingement sampling protocol [Howes 2004a]. Additional information will be collected for impinged whitefish, including identification as lake or round whitefish, measuring and weighing the fish, and checking for the presence of a tag. Spottail shiner will also be weighed and measured. Should a large impingement event occur such that sub-sampling becomes necessary, the sub-sampling will proceed following the techniques described below in Section 2.3.6." (p.21)

UG-253	"*Impinged fish will be collected for a 24-hour period at each of the Bruce A station pumphouses (Units 1-4). ... Prior to each 24-hour impingement sampling event, the travelling screens will be rinsed to remove debris and organic material. Following the 24-hour impingement sampling event, the screens will again be rinsed and the impinged material will be washed into a collection apparatus. ... "The travelling screens are currently set to operate based upon differential pressure, as well as on a timer. If a large amount of impinged material is collected during a sampling event, the travelling screens may need to be washed during the 24-hour period. If this occurs, all collected impingement sampling material will be combined at the end of the 24-hour sampling period to represent one sampling event.*" As discussed in detail above, previous BNGS impingement assessment did not record or take into account pressure differential or operator over-ride screen washes and unscheduled bin transfers to the onsite landfill, thus reducing or eliminating the utility of the impingement assessment data. How do we know that these problems will not continue in the E/I Monitoring Plan?
	BP Response: The following text has been added to the paragraph (italics added to emphasize new text): "The pump intake screens are currently set to operate based upon differential pressure, as well as on a timer. *It is noted that the bins which receive fish vary somewhat between the units, with Unit 3 and 4 having more recently upgraded collection methods installed. For this reason, all data will be cross referenced to the specific collection apparatus / bin from which it is obtained*. If a large amount of impinged material is collected during a sampling event, the pump intake screens may need to be washed during the 24-hour period. If this occurs, all collected impingement sampling material will be

	combined at the end of the 24-hour sampling period to represent one sampling event. *The duration between screen rinses and sampling events will be recorded to the extent this is feasible with existing technology already installed*." [p. 31] **UG Team Evaluation of BP Response:** Unsatisfactory. Recording of screen rinses should not be constrained by technology that has already been installed.
UG-254	"*Following each travelling screen wash, the contents of the collection apparatus will be removed and all fish will be identified to the lowest practicable taxonomic level, sorted, and enumerated, as described in the existing Bruce Power impingement sampling protocol [Howes 2004a].*" How do we know that the (undefined) existing BP impingement sampling protocol will satisfy the needs of the E/I Monitoring Plan?
	BP Response: The following text was added after this sentence: "In addition to these parameters, protocols will be revised to include the collection of weights and lengths for all individuals of a fish species up to a total of 50 (per species) during a 24- hour impingement sampling event. New protocols will include a "priority assessment list" documenting the species of greatest importance to weigh and measure in the event that sufficient time/resources are not available to assess all fishes during a given event." [p. 31-32] **UG Team Evaluation of BP Response:** Unsatisfactory. The new protocols need to be explained and justified in this proposal, especially the sampling design and the undefined "priority assessment list."
UG-255	"*Should a large impingement event occur such that sub-sampling becomes necessary, the sub-sampling will proceed following the techniques described below in Section 2.3.6.*" This sentence does not make any sense - there is no section 2.3.6.
	BP Response: The cross-reference has been revised and the sentence now reads: "Should a large impingement event occur such that sub-sampling becomes necessary, the sub-sampling will proceed following the techniques described below in Section 4.4.2.5." [p. 32] **UG Team Evaluation of BP Response:** Unsatisfactory. The sub-sampling described in Section 4.4.2.5 is ill-defined and not justified statistically.

5.3.1.2 Temporal Scales

"*The duration of sampling must be addressed on three temporal levels:*

- *Annual;*
- *Seasonal; and*
- *Diel.*

The inherent variability in fish activity and regional/local population dynamics at each of these levels may drive variability in impingement rates.

Fish populations fluctuate on an annual basis due to a number of factors, including year-class strength, weather patterns, spawning cycles, commercial and sport harvest rates, and disease. This variability in fish populations may also be reflected in annual impingement results. Because of inter-annual variation in composition and abundance of the fish community, it is important to have multiple years of data. As such, two years of impingement monitoring is recommended following the start of the Operations Phase.

As with annual variability, fish communities also exhibit seasonal fluctuations in abundance and composition. Seasonal fluctuations may be caused by spawning cycles, changes in water temperature, distribution of food resources, or a combination of these and other interrelated factors. Based upon historic impingement results from the Bruce Power site and the life histories of lake whitefish and spottail shiner, impingement sampling throughout the year is recommended to better quantify the seasonal variability in impingement rates.

Diel variability refers to changes in fish populations within a one-day period. Diel variability may result from factors such as normal behavioural movements related to photoperiod, changes in the temperature of surface waters during the day and night, or changes in the distribution of food resources. In order to account for diel variability, it is recommended that a composite 24-hour sample is collected during each impingement sampling event." (p.22)

UG-256	"*Fish populations fluctuate on an annual basis due to a number of factors, including year-class strength, weather patterns, spawning cycles, commercial and sport harvest rates, and disease. This variability in fish populations may also be reflected in annual impingement results. Because of inter-annual variation in composition and abundance of the fish community, it is important to have multiple years of data. As such, two years of impingement monitoring is recommended following the start of the Operations Phase.*" This statement is problematic, for several reasons. First, it underscores the importance of understanding the dynamics of a biological population, although the E/I Monitoring Plan utilizes artificial representations (i.e. MNR quota management area 4-4, "EA local study area") which are highly unlikely to correspond to the population structure of lake whitefish in Lake Huron. Second, the E/I Monitoring Plan has already recognized that the previous impingement data sets are unlikely to be useful as part of an integrated time series for statistical analyses. How do we know that the impingement assessment for the E/I Monitoring Plan will not suffer the same fate? Third, why is the focus shifter from distribution and abundance of fish populations to "composition and abundance of the fish community"? Fourth, how do we know that two years is

	an appropriate period of time ("multiple years") for Operations Phase impingement monitoring to be able to satisfy the objectives of the E/I Monitoring Plan?
	BP Response: None.
UG-257	"*As with annual variability, fish communities also exhibit seasonal fluctuations in abundance and composition. Seasonal fluctuations may be caused by spawning cycles, changes in water temperature, distribution of food resources, or a combination of these and other interrelated factors. Based upon historic impingement results from the Bruce Power site and the life histories of lake whitefish and spottail shiner, impingement sampling throughout the year is recommended to better quantify the seasonal variability in impingement rates.*" This statement is problematic, for several reasons. First, the reference to abundance and composition of "fish communities" is once again inappropriate in this population assessment context. Second, how do we know that previous impingement assessments support sampling throughout the year? Third, how do we know that seasonal variability in impingement rates need to be better quantified?
	BP Response: None.
UG-258	"*In order to account for diel variability, it is recommended that a composite 24-hour sample is collected during each impingement sampling event.*" This sentence does not make sense. How can a "composite 24-hour sample" provide any meaningful insight into diel (day-night) impingement variability?
	BP Response: None.
UG-259	Assessing the data at multiple scales is highly recommended. It is suggested that relevant Time Series methods be used to determine/account for any autocorrelation, and to potentially determine annual, seasonal, diel level patterns. Further, the data might best indicate the temporal scale that is most appropriate, and this may include other scales. A full temporal analysis is recommended. It is also recommended that temporal analysis incorporate variables to account for fish presence variability. This should include main effects, and tests for interactions between variables (i.e., simple effects).
	BP Response: None.

5.3.1.3 Sampling Frequency

"*In developing the impingement sampling methods proposed within this plan, a preliminary sampling frequency analysis was completed to determine whether changes in impingement rates following the start of the Operations Phase 2 would be statistically detectable at various scales. Since all intake water for the Bruce A station cooling system will be drawn from the same forebay, it is desirable to determine if potential*

impingement changes due to the re-start of Units 1 and 2 are related to the predicted increase in intake flow." (p.22)

UG-260	The first sentence in this statement is very cryptic. How do we know that the (undefined) "preliminary sampling frequency analysis" was appropriate for the (poorly defined) objective of the analysis. The second sentence does not make any sense.
	BP Response: None. This section is now located in 4.4.2.3 (Sampling Frequency) starting on p. 33).

"*An analysis of past impingement and flow data from 2005 to present was completed and used an Analysis of Covariance (ANCOVA) test to calculate the relationship between plant intake flow and recorded impingement levels, with month as the covariate. Due to the large number of sampling events where fish were not impinged, or impinged fish were not recorded, the impingement data was grouped by month for this analysis. A comparison of plant flow to total impingement for all species combined was analyzed, and for lake whitefish and spottail shiner impingement individually. In each case, plant flow was found to have no statistically significant relationship to impingement (α = 0.10). Based on this result, there is therefore no ability to predict future impingement following the start of the Operations Phase based on prior impingement and flow data.*

Since no relationship to flow was detectable, we assumed an overall increase in numerical impingement of 25% following the start of the Operations Phase and equal variances during the Refurbishment Phase and the Operations Phase. Utilizing the 2005 and 2006 datasets as representative impingement sampling years (years with the most complete datasets), it is possible to estimate the number of sampling events necessary to detect a statistical difference in impingement by using a power analysis." (p.22)

UG-261	It is not clear if the data satisfy the assumptions of ANCOVA. For example, the text seems to indicate that the data were zero-inflated, which would suggest the possibility of non-normality.
	BP Response: None.
UG-262	How were the data grouped by month? If aggregation occurs, are there subsequent analyses to test for issues associated with Simpson's Paradox?
	BP Response: None.
UG-263	Do the data grouped by month, which seemingly suffer from zero-inflated data, satisfy the homoscedastic requirement of the ANCOVA?
	BP Response: None.
UG-264	ANCOVA assumes a linear relationship between outcome (impingement level) and the explanatory covariate flow. Is this valid? Do the residuals support this?
	BP Response: None.
UG-265	"*Since no relationship to flow was detectable, we assumed an overall increase in numerical impingement of 25% following the start*

	of the Operations Phase and equal variances during the Refurbishment Phase and the Operations Phase." Were the analyses repeated using other increases in overall numerical impingement? Were decreases considered? How were the increases applied? Were they applied to the monthly impingement results, or were the analyses conducted using the aggregated yearly data?
	BP Response: None.
UG-266	Are other sampling methods available that might provide the same power for a smaller increase in impingement? That is, the report suggests that the proposed sampling method would only identify a statistically significant difference if the total impingement increases by more than 160% of the 2005 levels.
	BP Response: None.
UG-267	While it is not obvious, it seems that the power study was conducted using annual data. It may prove beneficial to consider this on a monthly or seasonal scale, so as to address differences in fish movement and behaviour throughout the year. This would likely inform the sampling strategy – increasing sampling when and where necessary. How was the 25% value determined?
	BP Response: None.

"*Based on these assumptions and an average of the 2005 and 2006 datasets, impingement sampling would need to occur approximately 1,013 times per year (or 784 and 1,241 times per year, respectively based on 2005 and 2006 datasets) to detect a statistical difference (at a power of 0.80) between the Refurbishment Phase and Operations Phase. This level of impingement monitoring is not possible with 24-hour impingement sampling events. If impingement were to increase by 50% following the start of the Operations Phase, approximately 254 sampling events per year (or 197 and 311 times per year, respectively based on 2005 and 2006 datasets) would be required. Alternatively, if impingement were to increase by 100%, an estimated 45 sampling events per year (or 35 and 55 times per year, respectively based on 2005 and 2006 datasets) would be required. These results utilize total fish impingement, which includes both VEC (lake whitefish and spottail shiner) as well as non-VEC species. There was not sufficient data to do these analyses for individual VEC species alone.*

Following established Bruce Power protocols, assuming sampling three times per week (or 156 times per year), is proposed to allow a determination of significant difference in total annual impingement pre- and post- Operations Phase if impingement increases by more than approximately 160% from 2005 levels." (p.23)

UG-268	As discussed in detail above, the UofG Team has serious concerns about the utility of data from previous BNGS impingement sampling programs to serve as a basis for determining future sampling designs. How do we know that averaging of the 2005/2006 datasets is a reasonable option for design of the E/I Monitoring Plan? Taken as a whole, the UofG Team is highly skeptical about the rationale,

	assumptions and calculations used in the E/I Monitoring plan to propose impingement sampling effort.
	BP Response: The following sentences were added to the last paragraph: "However, the intent of this Plan is not to provide a before-and-after study. These analyses will be completed if possible, but the intent of this Plan is to provide a rigorous estimate of annual impingement (and entrainment) during the Operations Phase." [p. 34] **UG Team Evaluation of BP Response:** Unsatisfactory. The goals of the plan should be clearly stated. Each hypothesis should be clearly stated. Each statistical method used to test the hypotheses should be clearly stated (including assumptions). If the plan is not to provide a before-and-after study, what is the goal? Do the methods in the document support the hypotheses created to satisfy the goals?

5.3.1.4 Sampling Intensity

"*Sampling intensity refers to the amount of sampling to be performed during each sampling event. Impingement sampling will include one 24-hour sample collected from the intake screens during each event.*" (p.23)

UG-269	As discussed in detail above, the UofG Team has serious concerns regarding the timing and recording of screen washes and bin sampling, as well as inaccurate statements in the E/I Monitoring Plan about the ability to account for diel variability in a 24-hour composite sample.
	BP Response: None. This section has been moved to Section 4.4.2.4 (Sampling Intensity) on p. 34.
UG-270	Sampling intensity should attempt to maximize the power of the analysis. For that reason, it is suggested that more than 3 sampling events occur per week per each of the intakes.
	BP Response: None.
UG-271	Since the operation of one intake may influence impingement at other intakes (as it is assumed the water dynamics might change), specific details describing the flow of intake at each of the intake sites should be identified (even for those that are not in operation) and incorporated into any statistical analyses.
	BP Response: None.

5.3.1.5 Sampling Magnitude

"*Sampling magnitude refers to the amount of impinged material sampled relative to the total plant impingement during a sampling event. Sampling magnitude during*

Operations Phase impingement sampling will follow existing Bruce Power impingement protocols, which require sampling all impinged fishes from all of the units at the Bruce A station. The only exception to impingement sampling at all four units at the Bruce A station will be during periods where a given unit is not in operation [Howes 2004a]. Such occurrences will be clearly noted in a sample log.

Sampling magnitude also refers to subsampling. Subsampling for non-VEC species will be performed only if greater than 50 individuals of that species were collected during a 24-hour impingement sampling event. In this case, a representative sample of 50 individuals of the species will be counted and weighed as a group, and the remaining individuals will be weighed in one or more groups. All data will be recorded so that numerical count estimates can be established from the measured weights.

In the case of VEC species (i.e., lake whitefish and spottail shiner), the same subsampling techniques will be carried out, with the exception being that the first 50 fish of a given VEC species will be individually weighed and measured prior to batch-weighing the remaining individuals." (p.23)

UG-272	"*Sampling magnitude refers to the amount of impinged material sampled relative to the total plant impingement during a sampling event. Sampling magnitude during Operations Phase impingement sampling will follow existing Bruce Power impingement protocols, which require sampling all impinged fishes from all of the units at the Bruce A station. The only exception to impingement sampling at all four units at the Bruce A station will be during periods where a given unit is not in operation [Howes 2004a]. Such occurrences will be clearly noted in a sample log.*" There are several issues in this statement that require comment. First, while not explicitly explained, it is implied that "total plant impingement" refers to all juvenile/adult forebay entrainment; "impinged material sampled" means the portion of juvenile/adult forebay entrainment that comes into contact with the travelling screens and is transported into the pumphouse, washed off the screens, and flushed into a collection bin that is assessed. Second, as discussed in detail above, the UofG Team has serious that assessment of travelling screens grossly underestimates the juvenile/adult forebay entrainment of lake whitefish. How do we know that the "existing Bruce Power impingement protocols" will satisfy the needs of the E/I Monitoring Plan?
	BP Response: None.

5.4 Data Compilation and Statistical Analyses

5.4.1 Statistical Analyses

"*Where possible, based upon the completeness and reliability of historical impingement data, statistical analyses will be used to compare multiple impingement variables listed below prior to and during the Operations Phase. Additional variables will be considered*

as necessary. Analysis options that will be considered for comparing annual estimates of entrainment pre- and post-Operations Phase will include the non-parametric Mann-Whitney U-test, the Generalized Linear Model with a log link, or an Analysis of Covariance (ANCOVA) with month and flow as possible covariates. Data may be log-transformed as needed to meet the normality assumption and bootstrapping procedures may be performed to accommodate for insufficient sample sizes. An alpha level of 0.10 is proposed to be used for statistical analyses. Statistical techniques described here should be considered as likely initial approaches. Consistent with an adaptive management approach and the possibility of identifying new factors to be considered as a result of the study, additional statistical analysis or inclusion of additional covariates may be considered and included in reporting, at the discretion of Bruce Power and in consideration of consultation with applicable agencies." (p.24)

UG-273	"*Where possible, based upon the completeness and reliability of historical impingement data, statistical analyses will be used to compare multiple impingement variables listed below prior to and during the Operations Phase.*" The E/I Monitoring Plan has already recognized that the previous impingement data sets are unlikely to be useful as part of an integrated time series for statistical analyses.
	BP Response: This section was moved and is now in Section 4.5.1 (Statistical Analyses) starting on p. 34. The following sentence was added: "Due to the variability in sampling methods of certain historic data, and in consideration of the time elapsed from a fish population perspective (i.e. many of these fish would have succumbed by this time), more recent data collected as part of this Plan is anticipated to be of greater utility than historic information." [p. 34-35] **UG Team Evaluation of BP Response:** Unsatisfactory. While it seems logical that more recent data would be more useful to the analyses, the reference to "time elapsed from a fish population perspective" does not make sense.
UG-274	"*Additional variables will be considered as necessary.*" This sentence does not mean anything.
	BP Response: The sentence was changed to now read: "Additional variables may be considered where sufficient and reliable historic data or information collected as part of this program is available." [p. 34] **UG Team Evaluation of BP Response:** Unsatisfactory. The statement still means very little. The use of the phrase "may be" does not suggest that anything will be done.
UG-275	A Mann-Whitney U-test assumes independent data. The independence assumption may be in question given temporal and spatial correlations that might exist in the data. The assumptions should be explicitly tested to verify the use of this statistical method.
	BP Response: None.

UG-276	Generalized Linear Models are recommended. Other links might include the logit, for logistic type regression. Additionally, spatial and temporal correlations should be considered, as well as the introduction of explanatory covariates. Finally, mixed models should be investigated (to accommodate sub-sampling).
	BP Response: None.
UG-277	Log-transforming the data does not necessarily address autocorrelation or other correlations inherent to Time Series data. Generalized Linear Models are more appropriate.
	BP Response: None.
UG-278	"*Consistent with an adaptive management approach and the possibility of identifying new factors to be considered as a result of the study, additional statistical analysis or inclusion of additional covariates may be considered and included in reporting, at the discretion of Bruce Power and in consideration of consultation with applicable agencies.*" This statement is problematic, for several reasons. First, "adaptive management" is about reducing uncertainty (learning) about key uncertainties by taking a scientific approach to strategically deploying management options. "The possibility of identifying new factors to be considered" should not be considered a directly related to "adaptive management." Second, there is little of value in the broad and undefined reference to "additional statistical analysis or inclusion of additional covariates" that "may be considered."
	BP Response: None.

"*It is recognized that uncertainty may be added to the data at many levels throughout the study, such as through plant intake flow measurement, subsampling procedures, differing historic sampling regimes, human error/oversight, and many others, including a host of natural biotic and abiotic factors. When possible, this uncertainty has been accounted for by increasing sample sizes and frequencies, producing and/or following existing standard operating procedures (SOPs) during sampling, providing QA/QC to limit/eliminate data collection, entry, processing, and analysis errors, and aggregating historical data for analysis to limit the effects of single year or single event anomalies which may have resulted from additional short-term sampling effort rather than true changes in fish abundance.*" (p.24)

UG-279	"*It is recognized that uncertainty may be added to the data at many levels throughout the study ...*" This part of the sentence does not make sense. Uncertainty (in different forms) is an inherent component of any sample data - it does not have to be "added."
	BP Response: The sentence has been changed to now read: "Throughout the monitoring and reporting as part of this Plan, it is recognized that uncertainty exists within the data due to such factors as variability in subsampling procedures, varying historic sampling regimes, human error/oversight, natural biotic and abiotic

	factors." [p. 35] **UG Team Evaluation of BP Response:** Satisfactory.
UG-280	Aggregating historical data for analysis to limit the effects of single year or single event anomalies is not recommended. Models should be developed that will account for these fluctuations without affecting the overall ability of the model to determine differences year over year (or month over month, etc.). Mixed models are suggested, as anomalies can be captured in a random effect. That is, year specific (for example) anomalies can be captured while still retaining the ability to estimate *population-averaged* effects (here the term population refers to a statistical population, and not a biological one).
	BP Response: None.

5.4.2 Variables

"*Upon completion of the impingement field sampling program in this work plan, it is anticipated that the following variables will be calculated: daily, monthly, and annual lake whitefish and spottail shiner juvenile and adult densities within the cooling water; daily plant intake flow, and annual impingement expressed as total juvenile/adult fish, and as total age-X equivalents. Plant impingement rates expressed as number of fish per million litres of intake flow (# fish/L) will also be calculated. Additional variables will be calculated as needed.*" (p.24)

UG-281	A quick comparison to the entrainment sampling design reveals a fundamental difference - and weakness - in the impingement sampling design for the E/I Monitoring Plan. There is no effort devoted to the estimation of abundance of juvenile/adult fish in the source water, for direct comparison to the abundance of juvenile/adult fish that are entrained in the forebay (regardless of whether they were sampled in the impingement assessment. The E/I Monitoring Plan must seriously reconsider these major omissions in its sampling design.
	BP Response: This section has moved to Section 4.5.2 (Variables) starting on p. 35. The following sentence was added addressing this point: "Daily, monthly, and annual lake whitefish and deepwater sculpin egg and larval densities within the source water in the vicinity of the Bruce A station intake;" [p. 35] Note: in this section there are several instances where the term "entrainment" is incorrectly used instead of "impingement". **UG Team Evaluation of BP Response:** Unsatisfactory. The numerous concerns and issues related to entrainment sampling design remain outstanding.

UG-282	It is important to note that there is no reference to "fish impinged or entrained to their relative densities in source waters," or "relative densities in source waters" or "relative abundance of lake whitefish and spottail shiner juveniles and adults susceptible to impingement." The E/I Monitoring Plan focuses on absolute estimates of abundance/densities in both source water and BNGS system water.
	BP Response: See UG-281. **UG Team Evaluation of BP Response:** Unsatisfactory. See UG-281.
UG-283	The list of variables is satisfactory, however, there needs to be some explicit description of how these variables are going to be used to determine potential significance of BNGS on Lake Huron lake whitefish populations.
	BP Response: The text in this section has been expanded as follows: "Following the completion of the impingement and entrainment field sampling program outlined in this Plan, it is anticipated that the following variables will be calculated: Daily, monthly, and annual lake whitefish and deepwater sculpin egg and larval densities within the forebay; Daily, monthly, and annual lake whitefish and deepwater sculpin egg and larval densities within the source water in the vicinity of the Bruce A station intake; Daily, monthly, and annual lake whitefish and deepwater sculpin egg and larval live/dead ratios within the forebay; and Daily Bruce A station intake flow and annual entrainment expressed as total larval fish/fish eggs, and as total equivalent adults (age-1 or age-4 fish). Plant entrainment rates expressed as number of fish per million litres of Bruce A station cooling water intake flow (no. fish/ML) will also be calculated. Additional variables will be calculated as needed. Upon completion of the impingement field sampling program in this Plan, it is anticipated that the following variables will be calculated: Daily, monthly, and annual lake whitefish and spottail shiner juvenile and adult densities within the Bruce A station forebay; Daily Bruce A station intake flow and annual impingement expressed as total juvenile/adult fish, and as total age-4 (lake whitefish) or adult (spottail shiner) equivalents. Plant impingement rates expressed as number of fish per million litres of Bruce A station intake cooling water flow (# fish/ML) will also be calculated. Additional variables will be calculated as needed." [p. 35-36] **UG Team Evaluation of BP Response:** Unsatisfactory. Despite the

	elaboration, there is still no explicit description of how these variables are going to be used to determine potential significance of BPGS on Lake Huron lake whitefish populations.
UG-284	It is recommended that all point estimates be accompanied by either 95% confidence intervals, or in the case of Bayesian analysis, 95% credible intervals.
	BP Response: None.

5.4.3 Hypotheses

"*The following hypotheses will be tested for each of the variables listed above:*

- *Ho : There is no difference in each of the variables prior to and during the Operations Phase.*
- *H1 : There is a significant difference in each of the variables prior to and during the Operations Phase.*" (p.24)

UG-285	The hypotheses are satisfactory if the variables are being considered independently. However, if that is the case, a problem with multiple testing arises. How is this being addressed?
	BP Response: This section has moved to Section 4.5.3 (Hypotheses) on p. 36. Text has been altered to read (italics emphasis added): "*Before/after statistical analyses will be completed where sufficient and reliable historical data exists*. The following hypotheses for each *of the entrainment and impingement* variables listed above will be tested *to compare historic (pre) and current Operations Phase data, where possible*:" [p. 36] **UG Team Evaluation of BP Response:** Unsatisfactory. The multiple comparison issue still exists.
UG-286	Testing the differences between daily and monthly values should necessitate the use of time series analyses. This should be made explicit.
	BP Response: None.
UG-287	At what level are the hypotheses being tested to determine 'significance'? What are the risks of Type II error?
	BP Response: None.

5.5 Effect Tests and Endpoints of Follow-up Monitoring

"*Results of the statistical analyses are expected to aid assessment of impingement impacts following the expected change in intake flow associated with the Operations Phase. Actual Operations Phase impacts will be assessed by contextualizing the impacts on the local and regional fish populations and comparing them to existing metrics, as described below.*" (p.24)

UG-288	The first sentence does not appear to be meaningful. The second sentence mistakenly presumes that there are both "local" and "regional" fish populations that will receive effects of juvenile/adult forebay entrainment. The second sentence also seems to contradict the previous statement that "the term regional as it pertains to impingement estimates is not proposed for use going forward."
	BP Response: This section is now located in Section 4.6 (Effects Tests and Endpoints for Follow-up Monitoring) on p. 36. This section has been expanded and altered. Approximate corresponding text now reads: **"**Results of the pre-Operations versus Operations Phase statistical analyses described in Section 4.5 will be used to differentiate statistically significant changes in entrainment and impingement rates. These analyses will allow for a comparison of entrainment and impingement rates with a maximum of two units (pre-Operations and historic data) versus four units (Operations Phase) in operation at the Bruce A station" [p. 36] **UG Team Evaluation of BP Response:** Unsatisfactory. Despite eliminating the confusing terminology regarding "local" and "regional" effects, the statistical basis for the proposed tests is not presented or justified.
UG-289	Thresholds should be determined in advance. As described in the comments pertaining to impingement, the identification of a risk map should be considered.
	BP Response: Text in this section has been changed to now read: "The effects tests and endpoints predictions will rely on the collective information obtained through the EAM and FFYM, coupled with Operations and Pre-Operations phase impingement and entrainment monitoring, including source water sampling. The EAM/FFYM analysis and pre-Operations versus Operations Phase analysis are mutually exclusive. Results of the pre-Operations versus Operations Phase statistical analyses described in Section 4.5 will be used to differentiate statistically significant changes in entrainment and impingement rates. These analyses will allow for a comparison of entrainment and impingement rates with a maximum of two units (pre-Operations and historic data) versus four units (Operations Phase) in operation at the Bruce A station. Analysis of entrainment and impingement rates over time, will determine if the increase in the number of units in operation has resulted in a significant statistical increase in impingement rates for the target VEC species and will yield an improved understanding of the factors which influence impingement and entrainment. If there is no statistically significant difference in the analyzed variables between the pre-Operations and Operations Phase then the determination of endpoints will rely

	solely on Operations Phase data. If statistical differences are observed (reject null hypothesis) then the possible reasons why, and the effect on the population using EAM and FFYM will be further investigated for both the pre-Operations and Operations phase, for that specific variable. Operations Phase effects at a population level will be assessed regardless of pre-Operations and Operations Phase comparisons and will relate the observed Operations Phase impingement and entrainment rates to the proportional reduction in the population for that species within the MNR QMA 4-4 management unit and within the EA Local Study Area boundaries using test values which relate to the assumed proportion of the QMA 4-4 population within the EA Local Study Area. The effect tests and endpoints are discussed in Section 4.6.1 and 4.6.2, respectively." [p. 36] **UG Team Evaluation of BP Response:** Unsatisfactory. It is recommended that instead of proceeding as described in the following sentence: "If there is no statistically significant difference in the analyzed variables between the pre-Operations and Operations Phase then the determination of endpoints will rely solely on Operations Phase data." the data should be pooled in the event of no statistical significance. Further, how exactly are the endpoints determined? How are the thresholds determined? While the updated plan is far more explicit, it seems that some of the initial questions are still unanswered/unaddressed. Finally. How is a reduction proportion calculated? This assumes that the population is known, and that only one population exists.

5.5.1 Impingement Effect Tests

"*Similar to entrainment, specific quantifiable effects thresholds due to impingement of lake whitefish and spottail shiner have not been identified nor agreed to with agencies and stakeholders and there is no specific regulatory guidance specific to Ontario that is available for determining impingement thresholds.*

The effect test that was stated for Element 3.4 in the 2008 Work Plan (Appendix B) proposed that estimated impingement be compared with a threshold for effect to regional abundance. Per the CNSC's comments on the 2008 Work Plan, the threshold for effect was also to be applied to the presumed local population of lake whitefish. It has been previously described in this work plan that confusion regarding the terms regional and local may have occurred in the past. For the purpose of the impingement monitoring the boundaries and approaches for describing

regional and local have been revised to be consistent with that described in the entrainment section and are to be discussed and agreed to by Bruce Power, regulatory agencies and stakeholders in terms of how they may be applied to any proposed thresholds." (p.25)

UG-290	"*Similar to entrainment, specific quantifiable effects thresholds due to impingement of lake whitefish and spottail shiner have not been identified nor agreed to with agencies and stakeholders and there is no specific regulatory guidance specific to Ontario that is available for determining impingement thresholds.*" As discussed above, the E/I Monitoring Plan cannot achieve its stated Goal until such time as an appropriate impingement effect threshold has been explicitly defined. Until such time as this threshold has been established, the E/I Monitoring Plan should not be finalized or approved.
	BP Response: None.
UG-291	"*The effect test that was stated for Element 3.4 in the 2008 Work Plan (Appendix B) proposed that estimated impingement be compared with a threshold for effect to regional abundance. Per the CNSC's comments on the 2008 Work Plan, the threshold for effect was also to be applied to the presumed local population of lake whitefish. It has been previously described in this work plan that confusion regarding the terms regional and local may have occurred in the past. For the purpose of the impingement monitoring the boundaries and approaches for describing regional and local have been revised to be consistent with that described in the entrainment section and are to be discussed and agreed to by Bruce Power, regulatory agencies and stakeholders in terms of how they may be applied to any proposed thresholds.*" This statement is problematic for several reasons. First, as discussed above, "regional abundance" does not mean anything unless it is directly associated with the abundance of a "regional population" - and this is a presumption that neither CNSC nor BP should make. Second, an impingement effect threshold makes sense only with application to a biological population – there is no "also" alternative application. Third, CNSC's comments should be explicitly re-stated to minimize misinterpretation of those comments. Fourth, as discussed above, there are serious problems with the proposed revision of "the boundaries and approaches for describing regional and local" populations in the context of both entrainment and impingement assessment.
	BP Response: The following sentence was added: "Though it requires verification, it is presumed that CNSC's interpretation of local is related to a distinct local population of lake whitefish. The terms regional and local have in some cases been a source of confusion as these terms may relate to a spatial boundary (i.e., a Local Study Area, fish within a certain jurisdictional or management boundary) an ecological boundary (e.g., fish that

	inhabit a certain regional or local ecosystem with boundaries defined using natural features), fish "stocks" that have been captured within a certain management unit boundary (e.g., MNR quota management areas), or finally, genetically identified fish stocks or populations which have an affinity to any of the aforementioned spatial, ecological or management unit boundaries. For the purpose of this Plan, the boundaries and approaches for describing regional and local have been revised, as identified below, in terms of how they may be applied to any proposed thresholds." [p. 37] **UG Team Evaluation of BP Response:** Unsatisfactory. The CNSC's interpretation of population discrimination must be considered prior to proposal of this E/I Monitoring Plan. As discussed above, under terms of the SON-BP Collaborative Whitefish Research Program, the UG Team is tasked with the key uncertainity of population discrimination; this work must be incorporated into the E/I Monitoring Plan. The "boundaries and approaches for describing regional and local" in this plan remain suspect in both theory and evisence.
UG-292	Since patterns of whitefish impingement may fluctuate on temporal scales beyond the proposed 2 year sampling period of this project, it is not advised to cease impingement sampling. The reasons for this follow the same as those that are described for the entrainment follow-up monitoring program.
	BP Response: None.

5.5.1.1 Lake Whitefish – Within QMA 4-4

"*The term regional as it pertains to impingement estimates is not proposed for use going forward. The proposed boundary for describing impingement that is proposed is the MNR boundary for QMA 4-4 which is a fisheries management unit boundary that resides entirely within Canadian waters of Lake Huron within the main basin. This QMA 4-4 boundary is proposed as it is within a defined and established management boundary for Lake Huron commercial fisheries in Ontario and provides a means against which lake whitefish data and EAM/FFYM and future direct, indirect or non-use benefits can be calculated and compared.*" (p.25)

UG-293	This statement has been copied/pasted verbatim from Section 4.5.1.1, and is highly problematic for exactly the same reasons as discussed for that section.
	BP Response: UG-291. **UG Team Evaluation of BP Response:** Unsatisfactory. See UG-291.

"*Though a threshold for effect has not been determined or agreed to, it is proposed for the purpose of this study (pending further consultation) that the threshold for effect is established as the proportion of equivalent adult annual lake whitefish impingement losses relative to the MNR proposed quota of lake whitefish in QMA 4-4. It is assumed that the regulatory agencies that determine the commercial catch quota understand the population dynamics of the regional lake whitefish population and have developed a rigorous estimate of acceptable annual take. Other assumptions regarding the reliability of the MNR data will be consistent with that defined for entrainment. For the purpose of this analysis it will be assumed that all potential genetic populations that may reside in QMA 4-4 have an equal chance of occurring within the waters subject to the intake influence and therefore possess and equal chance of impingement. The percentage of the lake whitefish regional commercial catch quota for QMA 4-4 that will represent an effect on the population that inhabits QMA 4-4 for the current monitoring year will be decided based on further consultation with agencies and stakeholders.*" (p.25)

UG-294	This statement has been largely copied/pasted from Section 4.5.1.1, and is highly problematic for exactly the same reasons as discussed for that section.
	BP Response: See UG-291. **UG Team Evaluation of BP Response:** Unsatisfactory. See UG-291.

5.5.1.3 Lake Whitefish – Within the EA Local Study Area

"*For lake whitefish, local effects at the level of genetically distinct populations can not be determined until such time that genetically distinct populations are identified and the actual proportion of these populations within a broader populations grouping can be discerned. Genetically distinct populations will be determined based upon the results of ongoing DNA studies to confirm the presence of and determine the size and contribution of distinct, populations relative to the total captured for DNA analysis within a specific area. To contribute to genetics studies, lake whitefish eggs and larvae collected during impingement sampling will be preserved for possible DNA analysis to determine which population or stock they may belong to. Prior to or in lieu of completion of the DNA studies, the following scenarios will be assumed:*

- *0.5% of impinged lake whitefish are from a population which is distinct within the EA local study area;*
- *20% of impinged lake whitefish are from a population which is distinct within the EA local study area;*
- *50% of impinged lake whitefish are from a population which is distinct within the EA local study area;*
- *100% of impinged lake whitefish are from a population which is distinct within the EA local study area.*

Based upon these four scenarios, the number impinged in each of the four above scenarios will be converted into estimates of equivalent adults at age four. The

equivalent adult estimates will then be compared to historic gill net sampling results taken from nearby sites within the EA local study area (Figure 2) and the EA Regional study area (see Figure 2.3.3-1 of the Aquatic Environment Technical Support Document [Bruce Power 2005b]). As noted previously, until the results of the DNA studies are published, it is assumed that the best estimate of a local population will come from the annual gill net sampling program." (p.26)

UG-295	This statement has been largely copied/pasted from Section 4.5.1.2, and is highly problematic for exactly the same reasons as discussed for that section.
	BP Response: See UG-291. **UG Team Evaluation of BP Response:** Satisfactory. See UG-291.

5.5.2 Impingement Endpoints for Follow-up Monitoring

"*The endpoint of follow-up for Element 3.4 (Lake Whitefish) is proposed to be the point where impingement numbers fall below the agreed upon threshold for effect (to be determined) to regional abundance with all four units in operation. Following the initial two years of impingement sampling, data will be analyzed to determine if the annual impingement impacts fall below the agreed upon thresholds for effect. If so, impingement sampling will cease at this point. If not, Bruce Power will consult with and provide agencies and stakeholders with their opinion on options for future sampling, and possible additional mitigation measures. The thresholds for effect to the QMA 4-4 lake whitefish population and lake whitefish from a population which is distinct within the EA local study area, will each be analyzed separately. If Bruce Power falls below the threshold for effect to one of these effect tests, but not the others, Bruce Power will provide recommendations for adjustments/alterations to the current monitoring plan to address only impacts to the respective species being studied.*" (p.26)

UG-296	This statement has been largely copied/pasted from Section 4.5.2, and is highly problematic for exactly the same reasons as discussed for that section.
	BP Response: See UG-291. **UG Team Evaluation of BP Response:** Unsatisfactory. See UG-291.

CHIEFS AND COUNCILS
SAUGEEN OJIBWAY NATION

Chippewas of Saugeen, RR 1, Southampton ON N0H 2L0 519-797-2781
Chippewas of Nawash, 135 Lakeshore Blvd, Neyaashiinigmiing ON N0H 2T0 519-534-1689

November 14, 2017

Mr. Michael Binder
President and Chief Executive Officer
Canadian Nuclear Safety Commission
P.O. Box 1046, Station B
280 Slater Street
Ottawa, ON K1P 5S9

Dear Mr. Binder:

Re: Review of Bruce Power's Proposed Refurbishment Project

We write with respect to Bruce Power's proposed refurbishment and our concerns with the timelines and process planned for the review of the project.

Saugeen Ojibway Nation ("SON") considers the refurbishment to be a deeply significant proposal with serious implications for our Territory and people. Bruce Power is requesting from the Canadian Nuclear Safety Commission ("CNSC" or "Commission") approval to double the operating life of six of the Bruce facility's reactors – extending the operations phase alone by more than 30 years. That facility has been a major source of concern for our people since its inception. It interacts with our lands and waters in a negative and complex way and poses an ever-present risk to our Territory and way of life.

The initial development of the facility in the 1960s and 1970s occurred without any consultation with SON and without any real environmental assessment or planning. The decision to allow the facility to continue to operate in our Territory for decades to come cannot be made in the same way. Before this project can proceed, there must be a meaningful assessment of its potential impacts on SON and our Territory, rights, and interests. Critically, there must also be an opportunity for deep engagement between SON and the Crown so that we can understand the harms and risks the project poses, how they might be mitigated, and what accommodations might be required to make the project acceptable to our people.

For the reasons set out in this letter, we ask that the Commission adjourn the hearing dates planned for March and May 2018 to consider Bruce Power's relicensing application including the refurbishment.

From our perspective, the short timeframes announced by the Commission do not leave our First Nation with sufficient time to engage with the issues raised by the application or the materials supporting it. Further, it is our position that the review process currently proposed under the *Nuclear Safety and Control Act* is demonstrably inadequate and unacceptable to SON. As we explain below, the process will almost certainly fail to meaningfully address our concerns with the project, and consequently, to discharge the Crown's

constitutional obligations to SON with respect to the project. SON is working with CNSC staff to determine whether the review process under the CNSC's legislation can be adjusted to provide for an appropriate and satisfactory review, but we do not believe that our concerns in this regard can be resolved in time to allow for the hearings to proceed as planned.

Further information to support and explain SON's concerns and our request is provided in the attachment (enclosed here).

Miigwech,

Chief Greg Nadjiwon
Chippewas of Nawash Unceded First Nation

Chief Lester Anoquot
Chippewas of Saugeen First Nation

ATTACHMENT

Background

i. Nuclear Development in SON Territory

When the initial decision was being made to bring nuclear development to Douglas Point, the SON people were not consulted. Nor were our people consulted when subsequent decisions were being made to intensify that development and to construct within our Territory the largest operating nuclear facility in the world. Against this backdrop, SON has undertaken enormous efforts politically and legally in the last twenty years to ensure that our rights and interests are meaningfully considered when new decisions are being made with respect to the facility. We have actively engaged with government and proponents respecting nuclear issues, and have participated in every significant regulatory proceeding respecting nuclear projects and plans that stand to affect our Territory, our proven Aboriginal and treaty rights, and way of life.

In 1997, when an environmental assessment was being carried out for a used fuel dry storage facility at the Bruce site, SON intervened on matters relating to the interaction of the facility with Lake Huron and the safety of the project. In the years since, we have participated in several proceedings respecting the Bruce site, making submissions on different issues that stand to impact SON rights and, in particular, on the ongoing interaction of the Bruce facility with the fish and fish habitat of Lake Huron.

In 2006, when Bruce Power applied to build four new nuclear reactors at the Bruce site, SON engaged in a lengthy consultation and accommodation process with the federal Crown to ensure that the proposal would be reviewed at the highest possible standards and that the review would focus on the project's potential impacts on SON. That engagement proved successful, and the Joint Review Panel Agreement developed identified SON specifically as having a unique interest in the Territory and the proposal. It also set out a new mandate for the panel to support ongoing consultation efforts between SON and the Crown.

Around the same time, SON engaged with the CNSC on Ontario Power Generation Inc. ("OPG")'s proposal to build a deep geological repository for low and intermediate-level waste (the "DGR Project") to ensure that it too would be assessed at the highest possible standards, and that the impacts on SON would again form a central component of the review. The project was, as you know, ultimately reviewed through an extensive Joint Review Panel process consisting of 33 hearing days over the course of two years. And, through direct engagement between SON and OPG, OPG made a historic commitment in 2013 that it would not proceed with its proposed DGR Project without the support of our communities – a commitment which the Crown recently described as "an example of how reconciliation practices can be implemented on the ground."[1]

ii. The Proposed Refurbishment

The refurbishment proposal now put forward by Bruce Power stands out—together with OPG's proposed DGR Project and Bruce Power's earlier application to build four new reactors at the Bruce site—as among the most significant projects ever proposed in our Territory. It represents a multi-billion dollar multi-year project that is expected to extend the operating life of the Bruce Nuclear Generating Station until 2064. If allowed, the refurbishment will enable the Bruce facility to continue to operate and interact with the lands, waters, plants, fish, and animals of our Territory for the next fifty years. It will have significant and enduring impacts on the rights and interests of our people.

[1] Letter from the Honourable Catherine McKenna, Minister of Environment and Climate Change, to Ms. Lise Morton, Vice President at Ontario Power Generation Inc., 21 August 2017.

Each year, Bruce Power's facility draws close to 12 trillion litres of water from Lake Huron, from the very place where our people have an established and exclusive Aboriginal and Treaty right to a commercial fishery. As SON has consistently indicated in almost every regulatory proceeding in the last twenty years respecting the site, the impacts caused by the facility have never been the subject of a comprehensive and careful assessment, and they are not well understood. Even less is known of how the facility's impacts will evolve in the future as the environment changes under the pressure of increasing development and broader environmental trends. Further, the presence of a nuclear generating station inevitably brings risks with it – not only those linked with routine operations, but also those arising from potential accidents and malfunctions. The risks in this regard are not unique to SON but their significance is. The SON people have a unique relationship with the Territory; it is the source of our identity as Anishnabek peoples, as well as of our Aboriginal and treaty rights. Harm caused to the lands and waters of our Territory will be felt most acutely by us and put our future as a people at risk.

SON's Concerns with the Proposed Review Process

On September 1, 2017, the CNSC announced the process through which Bruce Power's licence renewal application including the refurbishment will be reviewed. According to the announcement, the application will be considered through three days of hearings under the *Nuclear Safety and Control Act* between March and May 2018. For the reasons set out below, we believe that the process as currently planned is not capable of fulfilling the Crown's constitutional obligations to SON with respect to this project.[2]

i. Concerns with Timing

The CNSC's announcement on September 1, 2017 left the SON communities with seven months to prepare for the commencement of the hearings before the CNSC. In SON's view, it left us with too little time to accomplish all that is required.

As noted above, before Bruce Power can extend the operating life of its reactors by 30 to 35 years, the SON communities must have assurance that adequate provision will be made for the safety of our people and our Territories. For SON leadership to provide this kind of assurance to our communities, our advisors and experts must have an opportunity to carefully review Bruce Power's application to ensure that there are no factors that would, in their view, limit the safety of the plant. The seven-month period provided to the public to review the roughly 10,000 pages of materials submitted by Bruce Power—including the 8,000 pages relating to Bruce Power's Periodic Safety Review—is not enough. We have serious concerns that if the review process proceeds as planned, we will not have sufficient opportunity for their review, and that SON leadership will not be able to provide our communities with the required assurance that our Territory and their rights will be safeguarded.

Further, the issues raised by Bruce Power's application are complex and they cannot be adequately addressed or considered through a rushed process. The current impacts of the Bruce facility on the SON Territory are not well understood. The facility's cooling water system is known to interact with the aquatic environment of Lake Huron and to have physical, thermal, and impingement and entrainment impacts on its fish. However, serious gaps persist in our understanding of the magnitude of each of those effects, their interaction with each other, and their potential to act cumulatively with other stressors on Lake Huron. Addressing these gaps is the focus of an ongoing process between SON and CNSC staff. That process only began in May 2017 and there has not yet been any resolution on how to resolve the uncertainties associated with our understanding of the current impacts of the Bruce facility.

---

[2] Courts have been clear that the Crown can rely on regulatory processes to satisfy its consultation obligations but only "if in substance an appropriate level of consultation is provided." *Beckman v. Little Salmon/Carmacks First Nation*, 2010 SCC 53, at para. 39.

Added to the existing uncertainty is the fact that the environment is changing and is expected to continue to change in the coming decades. While we know that the rising lake temperature will amplify the thermal effects of Bruce Power's cooling water system, it is difficult to predict precisely how the impacts will evolve.[3] Of course, SON does not expect all gaps and uncertainties to be resolved before a decision is made. However, we expect that a real effort will be made to bring together all existing knowledge—both scientific and Indigenous—of the past and present impacts of the facility and to predict how those impacts will evolve in the future. Without this, there can be no basis on which to judge what the potential impacts on SON's rights will be or what accommodation measures are required. Again, we believe strongly that there will not be sufficient time to do this, particularly in light of the fact that—as discussed below—the materials submitted by Bruce Power have serious gaps in so far as the prediction of future effects[4] and consideration of mitigation measures are concerned.

The DGR Project was, as described above, considered through a lengthy process that included 33 days of hearings over the course of two years. A final decision on the project has not yet been made. In contrast, three hearing dates have been planned for Bruce Power's application in March and May 2018, and a decision is expected soon after. We cannot accept the assertion that a good and justifiable decision on a project of this magnitude—which will generate impacts and risks at least as significant as those posed by the DGR project—can be made within 9 months. If this process proceeds as a planned, it will meet only the needs of industry and will inevitably leave other requirements—including the Crown's constitutional obligations—unfulfilled.

ii. Concerns with the Nature of the Process

In the past, Bruce Power's proposed refurbishment project would have required, at a minimum, a screening-level environmental assessment under Canada's then *Canadian Environmental Assessment Act*. However, because of changes made to environmental assessment legislation in 2012, Bruce Power's proposed refurbishment no longer automatically triggers a stand-alone environmental assessment. Rather, under the current plans for the review of the refurbishment, the CNSC will consider the project as part of its decision to renew Bruce Power's operating licence. From our perspective, this raises potentially serious issues.

Under an environmental assessment pursuant to the old *Canadian Environmental Assessment Act* or the current *Canadian Environmental Assessment Act, 2012*, before Bruce Power would have been allowed to proceed with the refurbishment, Bruce Power would have been required to determine the environmental effects of its proposal, to assess the significance of those effects, and to discuss, among other factors, potential mitigation measures and alternative means of carrying out its proposal. This analysis and review would have been required prior to approval, and ahead of authorization of any steps towards implementing the project. We understand these same requirements do not apply as part of the currently proposed review process. Environmental assessment under the *Nuclear Safety and Control Act* is not, at its core, a planning mechanism like environmental assessment under the *Canadian Environmental Assessment Act, 2012* or its predecessor; rather it is a process of ongoing verification that "adequate provision for the protection of the environment has been made."

The implications of this distinction can be best illustrated by way of an example. In a meeting held on October 19, 2017 between CNSC staff and SON, our team raised what SON considers to be two glaring shortcomings in

[3] Bruce Power has already sought approval to discharge water at a higher temperature because of increasing intake water temperatures caused by the warming of the lake. The temperature of the lake is expected to continue to rise.

[4] It is worth noting here that if Bruce Power had provided a more fulsome discussion of the anticipated future environmental effects of its activities, additional engagement and analysis between SON and the Crown would be required. As the Supreme Court of Canada held in *Clyde River (Hamlet) v. Petroleum Geo‑Services Inc.,* 2017 SCC 40, while the two are often connected, "the consultative inquiry is not properly into environmental effects per se. Rather, it inquires into the impact on the right."

the materials submitted by Bruce Power: 1) the fact that Bruce Power has done no work to predict of how the impacts of its facility will evolve as the environment changes,[5] and 2) the absence of any discussion of new environmental mitigation measures. In our view, these gaps must be remedied before the project can be approved. We understand that CNSC staff, however, do not see these as critical deficiencies. Because the *Nuclear Safety and Control Act* establishes a framework for ongoing environmental assessment and verification, they are satisfied that the CNSC will have the authority to require the implementation of mitigation measures in the future if and when the facility's impacts are shown to be unacceptable. From this perspective, future impacts and uncertainties need not be addressed. Nor is there a need for any agreement to be reached now on what actions will be taken in the future if troubling trends do emerge.

From the perspective of SON, this kind of "rolling" approach to environmental assessment that the *Nuclear Safety and Control Act* purportedly establishes—or, at a minimum, allows for—is unacceptable. If the CNSC's review process is to be relied upon by the Crown in satisfaction of its constitutional obligations, then it must be capable of satisfying SON's concerns regarding the potential impacts of the project before a decision is made. The need for "consultation… to be complete prior to making the decision at issue" is a point on which the courts have been clear.[6] An assurance that there will be opportunities after the fact to satisfy and accommodate our concerns is not enough. This does not accord with our understanding of good environmental stewardship and decision-making and will give our communities no comfort that the best decisions are being taken for the protection of their rights and future.

Consultation obligations aside, there are other compelling reasons to require that discussions around environmental protection and the need for mitigation measures occur before Bruce Power has been granted approval. Environmental assessment occurs at the outset of a project because it is during the planning stages that a proponent is most willing and able to adjust its project. Further, the kind of "wait and see" approach to environmental assessment, which leaves the consideration of mitigation measures to a later time when effects can be conclusively demonstrated, is fundamentally inconsistent with the precautionary principle. It fails to recognize the fragility of the ecosystem and requires our Territory to bear the risks and costs of scientific uncertainty.

Proposed Resolution

In February 2017, long before Bruce Power submitted its application, our representatives explained to CNSC staff that the refurbishment represents a deeply significant project for SON and expressed our concern with the review for the project proceeding under the *Nuclear Safety and Control Act* alone. Those concerns were never resolved and we were disappointed when the CNSC set hearing dates to consider the application in early 2018. We do not know whether CNSC staff failed to raise with the Commission Secretariat our apprehensions or if they were simply ignored.

Since the announcement of the hearing dates on September 1, 2017, SON has met twice with CNSC staff. In the first of those meetings, it was SON's hope that there would be a meaningful discussion about the concerns SON had been raising for many months and how the CNSC, as the Crown, would address them. SON also hoped to be able to discuss the challenges associated with the short timeframes announced by the CNSC, and that CNSC staff would work to adjust the process. That did not happen. Instead, what SON heard from CNSC staff was that the process had already been determined—that is, our representatives were told that "the

---

[5] In the forward-looking part of its environmental risk assessment, the "predictive effects assessment," Bruce Power simply assumes that its impacts on aquatic life will remain constant and that there is no need for further assessment of those impacts.

[6] *Gitxaala Nation v. Canada,* 2016 FCA 187, at para. 283. See also, *Haida Nation v. British Columbia (Minister of Forests),* 2004 SCC 73, at para. 67; and *Clyde River (Hamlet) v. Petroleum Geo‑Services Inc.,* 2017 SCC 40, at para. 39.

train had already left the station" and would not be called back. Even though SON was told there was still room to talk about our concerns, our representatives left that meeting feeling that CNSC staff had closed the door to meaningful discussion, and that their strategy moving forward would not be to change the CNSC's process, but to manage our concerns.

SON's second meeting with CNSC staff, held on October 19, 2017, was more productive. Our representatives discussed with CNSC staff the CNSC's proposed review in more detail and, again, explained the nature of our concerns with that process. However, the discussion did not produce any substantive proposals on how our concerns could be addressed or how the proposed process could be modified to accommodate them. We remain of the view that the current process will not be capable of meaningfully addressing our concerns, and consequently, discharging the Crown's constitutional obligations.

The courts have been clear that in consultation, "the common thread on the Crown's part must be the 'intention of substantially addressing [Aboriginal] concerns as they are raised,"[7] and that the "controlling question in all situations is what is required to maintain the honour of the Crown and to effect reconciliation between the Crown and the Aboriginal peoples with respect to the interests at stake."[8] They have also held that "consultation is meaningless when it excludes from the outset any form of accommodation."[9] The short timelines announced and the discussions SON has had with CNSC staff to date on the nature of reviews under the *Nuclear Safety and Control Act* suggest to us that the proposed process will not result in any form of accommodation, will not substantially address our concerns, and will do nothing to effect reconciliation with respect to the interests at stake.

SON intends to continue to meet with CNSC staff to determine whether the current process might be adjusted to include more meaningful engagement. However, in light of what appear to us to be potentially fundamental limitations in environmental assessment processes under the *Nuclear Safety and Control Act*, we are initiating concurrent discussions with the Minister of Environment and Climate Change on whether the refurbishment requires designation under the *Canadian Environmental Assessment Act, 2012*.

While SON works with CNSC staff and the Minister of Environment and Climate Change, we ask that the Commission adjourn the hearings planned for March and May 2018. We feel strongly that it would be in the interests of all parties to ensure adequate time to allow meaningful consultations to take place, including the development of an acceptable review process. The Commission's Rules of Procedure provide the Commission with broad authority to adjourn proceedings where the Commission sees fit. We understand that this authority has been exercised in numerous instances in the past where, for example, the Commission has felt that more time is required for meaningful public participation or for the Commission to have before it the information it requires to make a sound decision. The Federal Court of Appeal has recently reminded us that "the importance and constitutional significance of the duty to consult provides ample reason"[10] in appropriate circumstances to extend timelines. We trust that the Commission will give this due consideration, particularly in light of the commitments Canada has made to reconciliation, to renewing the nation-to-nation relationship, and to assessing projects in new ways that further these objectives.

We believe we have made important strides in establishing a collaborative and productive relationship with the CNSC and are hopeful this can continue here. We thank you for your consideration.

---

7 *Haida Nation v. British Columbia (Minister of Forests),* 2004 SCC 73, at para. 42.

8 *Ibid*, at para. 45.

9 *Mikisew Cree First Nation v. Canada (Minister of Canadian Heritage)*, 2005 SCC 69, at para. 54.

10 *Gitxaala Nation v. Canada,* 2016 FCA 187, at para 251.

PAPE SALTER TEILLET LLP BARRISTERS AND SOLICITORS

March 9, 2018

Luc Sigouin
Director, Bruce Regulatory Program Division
Canadian Nuclear Safety Commission
280 Slater Street
Ottawa, ON K1P 5S9

Dear Mr. Sigouin:

Re: SON-CNSC Staff Engagement on Bruce Power's Licence Renewal Application

I write on behalf of the Saugeen Ojibway Nation ("SON") to provide further information on SON's proposal to discuss potential procedural accommodations respecting Bruce Power's proposed refurbishment project, as committed to during the February 20, 2018 call between SON and CNSC staff. I also write to address comments made in the Commission Member Document (the "CMD") dated February 12, 2018[1] and repeated in your recent letter dated February 26, 2018[2] respecting the legal context in which our discussions will take place.

As will be explained below, we believe that CNSC staff haven fallen into error in assessing the nature and magnitude of the constitutional obligations resting on the Crown with respect to the current licence application. SON will speak to this issue in its intervention before the Commission, however, we believe it is also critical to address it in advance of our next meeting. SON has serious concern that if CNSC staff continue to take the position that the constitutional obligations resting on the Crown fall at "the low end of the spectrum," that discussions between SON and CNSC staff will not be effective or meaningful. Specifically, SON's concern is that CNSC staff will not come to the next meeting willing to consider necessary and appropriate accommodations to protect SON rights and interests. This concern was heightened by CNSC staff comments made during the last call indicating that while CNSC staff are prepared to meet with SON to discuss SON's proposal respecting procedural accommodations, CNSC staff's

---

[1] CNSC Staff, Commission Member Document Respecting the Commission Public Hearing for the Licence Renewal Application by Bruce Power Inc. for Bruce Nuclear Generating Stations A and B, 12 February 2018, CMD 18-H4 ("CNSC CMD").

[2] Letter from L. Sigouin, Director of the Bruce Regulatory Program Division (CNSC), to K. Ryan, Bruce Power Coordinator (SON Environment Office), 26 February 2018.

formal positions and recommendations were set out in the CMD. We took this to mean that CNSC staff's final position has already been determined.

Positions Taken by CNSC Staff

Your February 26, 2018 letter refers to certain conclusions reached in the CMD. It states: "As you will note in our CMD, CNSC staff has concluded that, based on the information to date, none of the activities covered under the proposed licence will have impacts on treaty or aboriginal rights." We understand the letter to refer to the following section of the CMD:

> *Impacts on Aboriginal and Treaty Rights*
>
> SON asserted to the CNSC that they were not part of the original decision to construct a nuclear facility within their traditional territory. Therefore, an approval by the Commission for a licence for continued operations of Bruce A and B would have an adverse impact on their Aboriginal and treaty rights. In addition, SON considers the MCR to be a significant proposal with serious implications for their territory and people.
>
> The Supreme Court of Canada's decision, in *Rio Tinto Alcan Inc. v. Carrier Sekani Tribal Council, 2010, SCC 43* [53], states of the duty to consult, "the question is whether there is a claim or right that potentially may be adversely impacted by the current government conduct or decision in question. Prior and continuing breaches, including prior failures to consult, will only trigger a duty to consult if the present decision has the potential of causing a novel adverse impact on a present claim or existing right."
>
> CNSC staff determined that the licence renewal and MCR will not expand the footprint of the Bruce site, and therefore, have not been persuaded that the proposed activities could cause novel adverse impacts to rights in the area. However, CNSC staff and Bruce Power will continue to meet with the SON to share information and to ascertain if there are any new concerns.
>
> Further, the decision to undertake the MCR activities to extend the life of the Bruce A and B rests with the Province of Ontario, and was made in 2013. According to the mandate of the CNSC provided by the NSCA, a decision by the Commission on the current licence application must be based upon whether the MCR project can be undertaken safely, not whether MCR should be pursued or not. The Commission is also responsible for ensuring that its decisions uphold the honour of the Crown.[3]

We believe that CNSC staff have erred in their analysis, both in concluding that the refurbishment project will not give rise to "novel adverse impacts," and in arguing that the

---

[3] CNSC CMD, at p. 142.

constitutional obligations resting on the Commission are diminished because the decision to proceed with the refurbishment was made by the Province of Ontario.

Application of the **Rio Tinto** *Case*

The analysis in the CMD drawing a parallel between the application considered in the *Rio Tinto* case[4] and that being considered in the current Bruce Power licence application, including the authorization of refurbishment activities, fundamentally misconstrues the facts of both applications. This has led CNSC staff to mistakenly conclude that consultation obligations owed to SON in the context of Bruce Power's refurbishment project fall at the "low end of the spectrum."[5]

The *Rio Tinto* case was concerned with the British Columbia ("BC") Utilities Commission's approval of an energy purchase agreement between Rio Tinto Alcan and the BC Hydro and Power Authority for excess electricity generated from an existing dam project. No physical work or changes to the facility were being proposed. The Commission was asked to consider only whether the energy purchase agreement was in the public interest. It was common ground that the facility would continue to operate and produce electricity at the same rates whether or not the energy purchase agreement was approved.[6]

In the specific facts of the case, the Court found that no new duty to consult was triggered – not on the basis that no decision relating to an existing project can trigger the duty, but rather because the duty to consult relates "to adverse impacts flowing from the specific Crown proposal at issue – not to larger adverse impacts of the project of which it is a part. The subject of the consultation is the impact on the claimed rights of the *current* decision under consideration."[7] No duty to consult arose in the *Rio Tinto* case because no physical changes at all were being proposed, and Crown approval of the energy purchase agreement would not have any physical impact on the waters and fisheries to which the rights of the First Nations attached.

This stands in stark contrast to Bruce Power's proposed refurbishment project and the authorization it seeks in the current application. Bruce Power proposes to rebuild six of its eight reactors, doubling the life span of those reactors. Without this work, and the Commission's approval, six of the Bruce Power reactors will go off-line within 15 years. Consequently, the

---

4 *Rio Tinto Alcan Inc. v. Carrier Sekani Tribal Council*, 2010 SCC 43 ("*Rio Tinto*").

5 CNSC CMD, at p. 138.

6 There was "uncontradicted evidence that if Rio Tinto Alcan could not sell its excess electricity to BC Hydro it would sell it elsewhere." With or without the approval of the energy purchase agreement, Rio Tinto Alcan would continue to "produce electricity at the same rates" and operate in a manner that would optimize its power generation under the terms of its existing water licence. *Rio Tinto*, at paras. 86 & 92.

7 *Rio Tinto*, at para. 53.

facility would have a dramatically reduced adverse impact on the environment and SON rights. Instead, Bruce Power's actions will cause the continuation of adverse impacts for 40 or more years. These impacts may, in fact, increase in severity because of their accumulation and because of a changing environment. Unlike *Rio Tinto*, what the Commission proposes to approve here is not an administrative change, but a massive multi-billion dollar industrial project that will cause tangible, significant and new <u>future</u> harms to SON Territory, rights and interests, including:

- Cumulative adverse impacts and stress on the waters and aquatic life in SON Territory through entrainment and impingement, thermal discharge, and radiological releases over the next four to five decades;
- Continued and increasing nuclear waste generation in the SON Territory;
- Increased duration of risk of accidents and malfunctions posed to SON lands, waters and people;
- Socio-economic impacts relating to the SON commercial fishery and tourism economies;
- Ongoing impacts and risks to SON identity and connection to the land and use of the land for cultural, spiritual and sustenance purposes; and
- A many decades long delay in the decommissioning of the facility and abatement of ongoing environmental impacts.

These are significant impacts, and impacts that would not exist if refurbishment was not carried out. That these are new, or "novel," impacts cannot be reasonably disputed – these impacts would not exist but for the refurbishment activities. We can only assume that CNSC staff, in their assessment, have misunderstood "novel adverse impacts" to mean "a new type of impact," rather than "a new impact." In fact, the impacts that will be caused by the refurbishment are not materially different than the impacts that would be generated if Bruce Power decided to build new reactors rather than refurbish old ones. When Bruce Power proposed a new build in 2006, it was proposed to be reviewed by a Joint Review Panel under the *Canadian Environmental Assessment Act* and attracted the highest levels of consultation and accommodation obligations.

Further, the federal Crown has already acknowledged that the refurbishment of Bruce Power nuclear reactors has the potential to cause new adverse environmental effects. When Bruce Power proposed refurbishment activities in 2004, an environmental assessment was carried out precisely to assess those effects.[8] It is inconceivable, and clearly not in keeping with the honour of the Crown, that CNSC staff now take the position that the refurbishment of six reactors does

---

[8] See the Record of Proceedings, Including Reasons for Decision in the Matter of Bruce Power Inc. Environmental Assessment Screening Report for Refurbishment for Life Extension and Continued Operations of the Bruce A Nuclear Generating Station, 19 May 2006.

not have the potential to adversely affect the environment, and consequently, SON rights and interests.[9]

The Role of Ontario in the Refurbishment

CNSC staff's position in the CMD leaves the impression that its consultation obligations are somehow diminished because the decision to proceed with refurbishment was made by the Province of Ontario ("Ontario"). As CNSC staff note, Ontario made a policy decision to proceed with the refurbishment of the remaining six units. SON is not, however, asking the Commission to evaluate Ontario's policy decision and to determine from a policy perspective "whether MCR should be pursued or not." Rather, SON is asking CNSC staff as regulators, and the Commission as decision-maker, to exercise their authority for the refurbishment project in a manner consistent with their respective mandates to protect the environment in a responsible and precautionary manner, and to fulfill constitutional obligations to SON to ensure its Aboriginal and treaty rights are not adversely affected, in the review and implementation of Ontario policy decisions and Bruce Power business plans.

Necessary Procedural Accommodations

SON's position has been clear and consistent from the outset that the refurbishment project stands to have significant impacts on SON's rights and interests and that it cannot proceed in the absence of meaningful consultation and accommodation. Further, that given the many uncertainties in existing data and analysis respecting adverse effects and the inherent difficulty in predicting the evolution of these effects far into the future, precautionary measures are required now in order to protect the environment and SON's rights and interests.

In meetings and through correspondence, SON has identified what it believes to be some of the accommodation measures that require discussion between SON and CNSC staff:

1. Processes that draw on both western science and the knowledge of the SON communities to close information gaps and uncertainties in the characterization of the impacts of the facility

---

[9] That refurbishment projects do not trigger stand-alone environmental assessments under *CEAA 2012* does not change the fact that refurbishment projects cause environmental effects. Nor does it change the constitutional obligations resting on the Crown in relation to those impacts. Courts have held that the Crown cannot evade its consultation obligations by pointing to defective or deficient statutory regimes. *Ross River Dena Council v. Government of Yukon*, 2012 YKCA 14. Even in cases where the statutory regime leaves no opportunity for consultation—a situation different from the present one where the Commission retains discretion in its decision-making and broad authority that would allow it to accommodate SON's rights—courts have said the Crown is not absolved of its obligations.

2. Measures to enhance the confidence of the SON communities in Bruce Power's monitoring activities, including SON direct participation where possible
3. A mitigation strategy and plan that is consistent with recognition of and respect for SON's rights and values as well as the precautionary principle (e.g., to address entrainment and impingement and thermal impacts of the facility)
4. Developing a common understanding and strategy on how future and connected regulatory measures will be carried out (e.g. how the *Fisheries Act* authorization process will be integrated with the current licencing process, how future Environmental Compliance Approval applications respecting discharge temperature will be harmonized, etc.)

In your letter, you ask for clarification on why SON feels regulatory action is required and why addressing concerns through existing processes is not sufficient. While we are not clear on what is meant by "existing processes," SON has previously indicated its position that the refurbishment proposal is a major project that stands to have significant and enduring impacts on the SON Territory and on SON rights. As SON explained in its November 24, 2017 letter to the Commission, if this review process is to be relied upon by the Crown in satisfaction of its constitutional obligations, then it must be capable of satisfying SON's concerns regarding the potential impacts of the project <u>before</u> a decision is made:

> The need for "consultation… to be complete prior to making the decision at issue" is a point on which the courts have been clear.[10] An assurance that there will be opportunities after the fact to satisfy and accommodate our concerns is not enough. This does not accord with our understanding of good environmental stewardship and decision-making and will give our communities no comfort that the best decisions are being taken for the protection of their rights and future.
>
> Consultation obligations aside, there are other compelling reasons to require that discussions around environmental protection and the need for mitigation measures occur before Bruce Power has been granted approval. Environmental assessment occurs at the outset of a project because it is during the planning stages that a proponent is most willing and able to adjust its project. Further, the kind of "wait and see" approach to environmental assessment, which leaves the consideration of mitigation measures to a later time when effects can be conclusively demonstrated, is fundamentally inconsistent

---

[10] Gitxaala Nation v. Canada, 2016 FCA 187, at para. 283. See also, *Haida Nation v. British Columbia (Minister of Forests)*, 2004 SCC 73, at para. 67; and *Clyde River (Hamlet) v. Petroleum Geo-Services Inc.*, 2017 SCC 40, at para. 39.

> with the precautionary principle. It fails to recognize the fragility of the ecosystem and requires our Territory to bear the risks and costs of scientific uncertainty.[11]

SON understands the difficult position that CNSC staff are in given the short time remaining before the hearings. It is for this reason that SON has taken the position that the current regulatory process, including its rushed timeframe, is inadequate and not capable of meeting the requirements of a meaningful consultation and accommodation process between SON and the federal Crown. However, SON has been willing to continue to work with CNSC staff on an expedited basis with the hope that CNSC staff will be willing to arrive at reasonable and necessary accommodations. This is why SON has proposed "procedural accommodations" that would allow aspects of the licence renewal decision to be made while holding some or all decisions relating to the refurbishment to such time as SON and CNSC staff have reached satisfactory outcomes on the issues identified above. As discussed on our call, a similar staged approach to decision-making was agreed to during the licence renewal hearings for the Western Waste Management Facility. From SON's perspective, it may provide a mutually acceptable path forward here as well.

We look forward to our next meeting and remain hopeful that CNSC will approach this meeting with a real intent to arrive at mutually acceptable outcomes.

Yours sincerely,

For Alex Monem
Pape Salter Teillet LLP

Cc: Mike Rinker, Director General, Environmental and Radiation Protection and Assessment, CNSC

Clare Cattrysse, Director Policy, Aboriginal and International Relations Division, CNSC

Michael James, Senior Counsel, CNSC

---

[11] Letter from Chief Greg Nadjiwon, Chippewas of Nawash Unceded First Nation, and Chief Lester Anoquot, Chippewas of Saugeen First Nation, to Michael Binder, President of the Nuclear Safety Commission, 14 November 2017.

Appendix J

Canadian Nuclear Safety Commission
Commission canadienne de sûreté nucléaire

Directorate of Power Reactor Regulation

April 6, 2018

e-Doc 5492751
File 4.01.02

Ms. Kathleen Ryan
Coordinator, Environment Office
Saugeen Ojibway Nation
25 Maadookii Subdivision
Neyaashiinigmiing, ON
N0H 2T0

Subject: SON-CNSC Staff Engagement on Bruce Power's Licence Renewal Application

Dear Ms. Ryan:

As documented in our Commission Member Document (CMD) [1] and Environmental Assessment Report [2], CNSC staff concluded that Bruce Power has made and will continue to adequately provide for the protection of the environment. However, CNSC staff also recognize that Saugeen Ojibway Nation (SON) has long-standing concerns related to the potential environmental impacts of the facilities. For some of these concerns, there is a difference between SON and CNSC staff views on the level of impact on the environment and it is still recommended that SON raise these items with the Commission for their consideration in their decision on the upcoming licence renewal. While CNSC staff have sufficient information to conclude that adequate provision is made, there are areas of uncertainty which would benefit from additional monitoring and/or assessment. We believe that this is an area of agreement with SON, particularly around reducing uncertainties to impacts to fish, and CNSC staff remains committed to working with SON.

Following your letter of March 16, 2018 [3] and the path forward that was discussed on March 20th, CNSC staff would like to elaborate on the proposals that were generally agreed to at the meeting to address SON concerns regarding potential environmental impacts related to the Bruce Nuclear Generating Stations, specifically in the following areas:

1. Developing a mutually agreeable study and analysis program
2. Monitoring program enhancements with SON participation
3. A study of available mitigation measures

CNSC staff request SON to determine if the path forward is acceptable, and provide feedback as soon as possible to allow SON to make an intervention by April 16th and for CNSC staff to make the recommendations to the Commission in a supplemental Commission Member Document (CMD). The path forward builds upon the possible approaches suggested by SON in your March 16th letter [3].

Developing a Mutually Agreeable Study and Analysis Program

SON has expressed the desire to work with CNSC staff on developing a mutually agreeable study and analysis program based on sound scientific principles as well as SON knowledge to reduce uncertainties and generate a credible and reliable understanding of the potential impacts of the NPP on the environment, and more specifically, on local fish populations. It was further clarified that SON would like to be involved in both the development of the study design and the review of the results of the studies when completed. CNSC staff agree with the SON desire for greater understanding and believe that together the SON and CNSC could develop a study program, which could focus on the following topics previously identified by the SON:

i. Thermal Effluent – CNSC staff have concluded that future monitoring is required to reduce the uncertainties surrounding the impact of the thermal plume. The main focus area is on the need to develop a winter thermal plume model. Current efforts to create such a model have been challenging based on the ability of the temperature data loggers to survive the winter conditions on Lake Huron. Environment and Climate Change Canada (ECCC) has indicated to CNSC staff that new technology may be available which may increase the success of the data collection. CNSC staff plan to arrange a workshop with ECCC and Bruce Power to discuss future thermal monitoring. Going forward, CNSC staff would request that SON be included in these discussions which would begin in summer 2018.

ii. Impingement and Entrainment – as part of the *Fisheries Act* Authorization application, Bruce Power is expected to propose an impingement and entrainment (I&E) monitoring plan to reduce the uncertainties in the data collected. Going forward, CNSC staff will request SON to review Bruce Power's proposed I&E plan to ensure that SON concerns are addressed to the extent practicable. CNSC staff believe this is also in line with your letter providing feedback on Bruce Power's offsetting plan for the *Fisheries Act* Authorization [5]

In addition, when the study reports become available, CNSC staff will request SON to review the results and to provide any feedback to ensure that SON's concerns are properly dispositioned. CNSC staff propose to recommend that the Commission endorse SON participation these studies by directing CNSC staff to work with the SON on these items.

Progress updates will be provided to the Commission annually through the Regulatory Oversight Report for Canadian Nuclear Power Plants.

SON Participation in Monitoring Programs

SON has stated that monitoring program enhancements should be considered with SON participation that allow collection of reliable data and increase SON community confidence in the monitoring. CNSC staff would appreciate having SON involvement in the CNSC Independent Environmental Monitoring Program (IEMP).

The next sampling campaign around the Bruce site is in 2019. Sample planning is scheduled to begin in the fall of 2018 and CNSC staff will reach out to the SON for input into the plan. CNSC staff would like to understand if there are any special foodstuffs or other environmental aspects of significance to the SON that could be included in the program. In addition, CNSC staff would also appreciate SON assistance in gathering the samples to be monitored.

The IEMP is an on-going program. CNSC staff propose to recommend that the Commission endorse SON participation in the monitoring program by directing CNSC staff to work with the SON on the planning and sampling for the IEMP.

Study of Available Mitigation Measures

SON have requested that a study of available mitigation measures be performed, which takes into account not only cost-benefit assessment, but also precautionary principles and SON values. As discussed at the recent meeting, CNSC staff is not recommending mitigation measures because we do not believe there are any unreasonable risks requiring mitigation. As noted above, CNSC staff have concluded that Bruce Power has and will continue to make adequate provision for the protection of the environment. However, CNSC staff recognize the value in conducting a review of mitigation measures in case the level of risk changes in the future, due to either changing environmental conditions or new science becoming available. As a life-cycle regulator, the CNSC has the ability to require design modifications in the future if warranted.

As the operator of the facilities, Bruce Power has conducted similar reviews in the past, such as those provided to SON on March 9th, 2018 [6] and is best positioned to conduct updates to these assessments. As such, CNSC staff propose to include a requirement in Bruce Power's proposed Licence Conditions Handbook which would require them to conduct an assessment of feasible mitigation measures for thermal effluent and impingement/entrainment. CNSC staff believe this review should be conducted by December 31, 2019. Following the submission of this assessment, CNSC staff would work with SON on the review of the assessment such that SON values can be considered. Updates on the results of this review would be provided to the Commission in the Regulatory Oversight Report for Canadian Nuclear Power Plants. This is also expected to address the similar comment provided in your March 30th letter providing feedback on Bruce Power's offsetting plan for the *Fisheries Act* authorization [5].

Additional Measures to Collaborate with SON

In addition to the measures suggested by SON in your March 16th letter [1], CNSC staff would like to build upon our long-standing relationship by continuing to build trust in the oversight of the Bruce site. As such, the following additional proposals are being suggested.

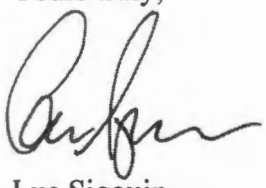
1. CNSC staff would like to go to SON communities in order to present findings, hear concerns and be available to answer questions that community members may have. As suggested by SON, CNSC staff would like to work with the SON Environment Office to determine the best method to implement this proposal.

2. In response to concerns regarding impingement data, CNSC staff conducted an inspection of the impingement monitoring program [4] and the results have been shared with the SON on March 15th. Going forward, CNSC staff plan to repeat this inspection annually and share the results of this inspection with SON, along with other environmental inspections.
3. CNSC staff also commits to continuing to work with SON to identify responsible federal, provincial or municipal agencies involved in decisions related to nuclear matters at the Bruce site, such as the Ontario Ministry of Energy for energy policy decisions or the Nuclear Waste Management Organization for long-term disposal for Canada's spent fuel.
4. CNSC staff would also like to explore methods of coordinating routine meetings with Crown agencies involved in oversight and/ or decision making on nuclear matters in SON territory.

CNSC staff believes that the above reflect the discussions held with SON leadership and will not only contribute to addressing concerns currently raised by SON, but also enable methods of dealing with additional concerns that may arise in the future. Again, feedback on these proposals is requested in order to be able ensure that SONs intervention and CNSC staff's supplemental CMD are aligned.

If you have any questions about this matter, please contact the Crown Consultation Coordinator, Jeff Stevenson at (519) 361-3797 or jeff.stevenson@canada.ca.

Yours truly,



Luc Sigouin
Director
Bruce Regulatory Program Division

c.c.: Chief Greg Nadjiwon, Chippewas of Nawash Unceded First Nation
Chief Lester Anoquot, Saugeen First Nation
A. Monem, Pape Salter Teillet LLP
M. Rinker, J. Stevenson, C. Cattrysse - CNSC

References:

1. CMD 18-H4, Submission from CNSC Staff on Application by Bruce Power for Renewal, February 12, 2018, e-Doc 5454349
2. Environmental Assessment Report, Bruce Power Inc. – Bruce Nuclear Generating Stations A and B – Licence Renewal, February 2018, e-Doc 5401045
3. SON Letter, A. Monem to L. Sigouin, "SON-CNSC Staff Engagement on Bruce Power's Licence Renewal Application", March 16, 2018, e-Doc 5489981

4. CNSC Letter, L. Sigouin to F. Saunders, "New Action Item 2018-07-12672: CNSC Type II Inspection Report: BRPD-AB-2018-003 – Fish Impingement Monitoring Inspection", March 15, 2018, e-Doc 5464726
5. SON Letter, K. Ryan to L. Sigouin, "Bruce Power's Fisheries Act Authorization Application: Comments on the Draft Offsetting Plan.", March 30, 2018, e-Doc 5495275
6. CNSC E-mail, J. Stevenson to K. Ryan, "RE: Information Request", March 9, 2018, e-Doc 5478349

CHIEFS AND COUNCILS
SAUGEEN OJIBWAY NATION

Chippewas of Saugeen, RR 1, Southampton ON N0H 2L0 519-797-2781
Chippewas of Nawash, 135 Lakeshore Blvd, Neyaashiinigmiing ON N0H 2T0 519-534-1689

SENT VIA EMAIL

April 16, 2018

Mr. Luc Sigouin
Regulatory Program Director
Bruce Regulatory Program Division
Canadian Nuclear Safety Commission
280 Slater St.
Ottawa ON K1P S59

Re: SON-CNSC Staff Engagement on Bruce Power's Licence Renewal Application and Refurbishment Project

Dear Mr. Sigouin,

Thank you for your letter of April 6, 2018 where you summarize the recent engagement between CNSC Staff and representatives of the Saugeen Ojibway Nation ("SON") on Bruce Power's Licence Renewal application, which includes specific authorizations for activities relating to reactor refurbishment ("Application"). In your letter, you also set out some proposed measures to address SON concerns relating to the Application.

As you correctly note in your letter, SON disagrees with CNSC Staff conclusions set out in your February 12, 2018 Commission Member Document ("CMD") that "Bruce Power has made and will continue to adequately provide for the protection of the environment." Our position remains unchanged – there are significant uncertainties respecting the nature and scale of adverse environmental effects caused by the Bruce Power facility and how those effects will change over time, and the data and analysis in the current Application cannot support credible decisions on whether refurbishment activities should be authorized. It is for this reason that we have taken the position that no refurbishment activities should be authorized unless accommodation measures are agreed to and implemented to protect the SON territory and SON Rights and interests.

From SON's perspective, the recent meetings we have had with CNSC Staff have been productive and suggest, as you say in your letter, a useful path forward between us. We agree with your characterization of the main areas of activity that must be addressed: (1) developing a mutually agreeable study and analysis program; (2) monitoring enhancements with SON participation; and (3) a study of available mitigation measures. While we appreciate your efforts in articulating an approach to addressing these matters, from our perspective some important questions remain.

Developing a Mutually Agreeable Study and Analysis Program

You have correctly identified SON's interest in working with CNSC Staff to develop a mutually agreeable study and analysis program based on sound scientific principles as well as SON knowledge to reduce uncertainties and generate a credible and reliable understanding of the potential impacts of the facility on the environment and fish populations.

In this respect, we understand from your letter that you are proposing that CNSC Staff and SON work together in relation to the development and implementation of study programs for (1) Thermal Effluent and (2) Impingement and Entrainment that will be part of Bruce Power's licence requirements. We agree with the general approach, but require some clarification on how SON and CNSC Staff would engage in the development and implementation of these programs. In particular, SON has a strong interest in participating in the design of the programs, their implementation (data collection), the establishment of evaluation criteria, and the analysis and interpretation of the data. This level of involvement by SON will ensure that the methodologies are credible and anchored by sound scientific principles and SON knowledge.

We also feel it is necessary to establish robust reporting requirements and compliance measures to ensure that the study programs are being properly implemented, and that SON have the opportunity to participate in the (early) review of those reports. You have suggested in your letter that progress updates will be provided to the Commission annually through the Regulatory Oversight Report for Canadian Nuclear Power Plants. While we have no objection to this in principle, we do have concern that this forum may not provide SON with sufficient opportunity for active participation through meaningful review/analysis and to provide our own submissions on the topic if necessary. We want to ensure that this process is inclusive of SON and will provide the Commission with sufficient opportunity to take corrective action, if required.

SON Participation in Monitoring Programs

As you state in your letter, SON believes that monitoring program enhancements should be developed with SON participation that allow for the collection of reliable data that will increase SON community confidence in monitoring.

Your letter focuses on the participation of SON in the development and implementation of CNSC's Independent Environmental Monitoring Program ("IEMP"), and SON welcomes the opportunity to collaborate with CNSC Staff on this program. However, our concerns with the credibility of monitoring have been in relation to activities carried out by Bruce Power under licence requirements, and especially in relation to the monitoring of thermal effluent and entrainment and impingement. As discussed above, SON is seeking to be involved in the design of the monitoring program in relation to these study areas to ensure they are both scientifically and methodologically sound, but also that they are seen as credible and reliable by the SON Communities. We anticipate that this will require the development of new measures to verify compliance with the monitoring program, and should include direct SON involvement in verification.

Study of Available Mitigation Measures

You state in your letter that SON is requesting a study of available mitigation measures which takes into account not only a cost-benefit assessment, but also precautionary principles and SON values.

To clarify, our position is that a credible <u>mitigation measures plan</u> is required now given the significant uncertainties regarding the impacts of the Bruce facility and how those impacts might change in the future. While a study of available mitigation measures is a necessary first step, we believe agreement is required on

how to assess the study and how to obtain a commitment that would ensure implementation of those viable mitigation mechanisms identified through the assessment. Here, it is imperative that the "cost-benefit" analysis of mitigation measures be done in a way that reflects SON values, in particular, the value of adverse impacts avoided to the health of the environment and SON's ability to continue to rely on that environment for its cultural, spiritual and economic well-being. This is required as part of a precautionary approach to fulfilling regulatory mandates, but also because of the interaction between adverse environmental impacts and SON Aboriginal and treaty rights affected by those impacts.

In your letter you propose to establish a licence condition requiring Bruce Power to conduct an assessment of feasible mitigation measures for thermal effluent and impingement/entrainment. Further, you propose that CNSC Staff and SON work together to review the assessment so that SON values can be considered. While we agree with the general approach, we again require some clarification to understand how SON and CNSC Staff will engage on this matter. In particular, we believe clarity is required on: (1) how SON will participate in establishing criteria or expectations for the mitigation measures study; (2) the process by which SON and CNSC Staff will carry out an assessment of mitigation measures identified in the study in a manner that reflects SON values and is protective of SON Rights and interests; and (3) how the outcomes of this assessment will be implemented through ongoing regulatory activities. We believe that CNSC Staff and SON must continue to work together to address these questions and to develop an effective mitigation measures plan, and that any licence condition related to the conduct of a mitigation study be sufficiently flexible to accommodate the outcomes of the study.

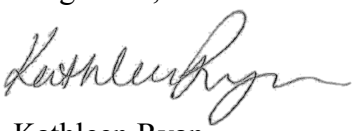
You have proposed that updates on the results of the mitigations measures review would be provided to the Commission in the Regulatory Oversight Report for Canadian Nuclear Power Plants. Again, while we have no objection in principle, SON believes that the Commission must retain oversight of this process to ensure compliance, and that SON must have an effective forum to participate through review and submissions. Further, we believe reports to the Commission must include both Bruce Power's activities relating to the study of mitigation measures as you describe in your letter, but also a report on CNSC Staff and SON activities relating to other aspects of the mitigation measures plan as described above.

Additional Measures to Collaborate with SON

Finally, in your April 6 letter, you propose additional measures to collaborate with SON to continue to build our relationship and trust in the oversight of the Bruce facility. We appreciate your suggestions and will continue to work with you to define and implement the activities you propose.

In conclusion, we believe that our recent meetings have been productive and the measures you have proposed in your April 6 letter are a basis for the development of necessary and appropriate mechanisms to address SON's concerns. We look forward to continuing to work with you to address the outstanding questions we have raised here with the goal of developing a common understanding on the path forward.

Miigwetch,



Kathleen Ryan
Coordinator
Saugeen Ojibway Nation Environment Office

Appendix L

Ojibway Names

Neyaashiinigaamiing = Cape Croker

Kookookoo-Miinis = Owl Island now Hay Island

Paagwaumgwut /Paagwaumquit =Shallow Lake

Saugdawong = Place of the River's Mouth nowSouthampton

Giigonke Piinsaugen = Fishing Islands

Chi-sintub'dik = Big boulder turning over now Tobermory

Sintub'dik = Little Tub now Cape Hurd

Chi-Mookmaunkiing= Land of the Big Knives now United States of America

Saukiing Neyashiing = now Bruce Peninsula

Nitaage-kamiing = Hunting Grounds

Manidoomiinising/Odawa-miinising= Manitoulin Island

Waaboozhoo-Miinis = Rabbit Island

Notchi-mawaniing = Hunter's Point

Naamewikwedong = Sturgeon Bay now Colpy's Bay

Chi-wikwedong = Big Bay now Owen Sound Bay

This is Exhibit ...4..... referred to in the affidavit of ...Randall Kahsee.....
sworn before me, this ....15th.....
day of ....August..... 20..D.....
.....
A COMMISSIONER FOR TAKING AFFIDAVITS

Appendix M

CHIEFS AND COUNCILS
SAUGEEN OJIBWAY NATION

Statement of Rights and Concerns

(June 18, 2008)

Purpose and Scope

1. We are the Saugeen Ojibway Nations, consisting of the Chippewas of Saugeen First Nation and the Chippewas of Nawash Unceded First Nation. Our ancestors have lived in this part of the Great Lakes region since time immemorial, and we will continue to live here long after others have gone. Our territory, the Anishinaabe-aki, defines and sustains us as Aboriginal people, and must continue to do so for countless generations to come.

2. We present this Statement as an expression of our rights and concerns with respect to projects that others have planned for our territory. Those projects would provide electrical energy and benefits to others, but threaten significant harm to our People and our future. We are deeply concerned about proposals for more nuclear reactors, an underground repository for nuclear wastes, hundreds of windmills and new transmission lines, all within in our territory.

3. The concerns we express in this Statement must be acknowledged by governments and the proponents of these projects. The issues we raise must be resolved through effective consultations and accommodation agreements with the Crown before SON could consent to these projects going ahead in our territory.

4. This Statement of Rights and Concerns is an evolving document, intended to provide a basis for consultations. It does not exhaustively define our rights and territory, or the ultimate positions SON may take with respect to the projects.

The Saugeen Ojibway Nations and our Territory

5. We are the Anishnabek people of the Great Lakes region. Our creation story tells us that our People originate here, from an island called Michilimackinac in the strait between Lake Huron and Lake Michigan. The grave sites of our ancestors are here, and still now, our dead are brought back to this land to be buried. Our identity as an Aboriginal people grows out of our relationship and connection to our territory.

6. Our ancestors used and occupied the Anishinaabe-aki historically, and we continue to do so today. Our territory consists of everything integral to life - the lands, rivers, lake, winds, grass, people, animals and fish. The Anishinaabe-aki has sustained our People physically and spiritually for countless generations, and must continue to do so far into the future.

7. Our territory extends east from what we now call Lake Huron to the Nottawasaga River and south from the tip of the Bruce Peninsula to the Maitland River system, 11 miles south of Goderich. Our Traditional waters around these lands include the lakebed of Lake Huron from the shore to the international boundary with the United States and the lakebed of Georgian Bay to the halfway point.

8. We use and occupy the Anishinaabe-aki now as our ancestors did, in a variety of ways and for many purposes, including hunting, fishing and gathering for sustenance, healing, cultural and trade purposes. It is the source of our identity as Aboriginal peoples, and the base for our cultural activities and spiritual ceremonies. We rely on its resources to support ourselves economically. We continue to exercise governance functions and stewardship, in order to protect the territory and ensure its ongoing ability to sustain our People.

9. Within our territory, the Saugeen Ojibway Nations occupy large, unceded Communal lands bordering Lake Huron and Georgian Bay, resulting from our Treaties with the Crown. We enjoy exclusive use and occupation of those lands, and they are critical to sustaining our future in many ways. They house our residential communities and

places of high cultural and spiritual importance. They are grounds for our subsistence fishing, as well as for our hunting and our gathering. They are the base for many current and future economic opportunities, including a commercial fishery and valuable recreational properties.

10. SON also enjoy the exclusive use of a large hunting reserve in the northern part of the Saugeen Peninsula.

SON Treaties with the Crown

11. SON continue to have and exercise Aboriginal and Treaty rights throughout our territory. Our Aboriginal and Treaty rights reflect our unique historical, cultural and spiritual relationship to the territory and our special relationship with the Crown.

12. Our relationship with the Crown is based on our Treaties, which are solemn agreements between our People and the Governments of the time to share access to the land and preserve peace, and protect our way of life as Aboriginal people within our territory.

13. The Royal Proclamation of 1763 constituted a promise by the British government to protect Aboriginal lands, including our territory, from encroachment by non-Aboriginal settlers. The Proclamation was issued at a time when Aboriginal people held the balance of power in the Great Lakes region, and was a recognition of Aboriginal ownership of our territory as a pre-existing interest that co-existed with any assertion of Crown “Sovereignty”.

14. In 1764, Crown representatives met with more than 1,500 of our Anishnabek Chiefs and Warriors at Niagara Falls. Here, the Royal Proclamation was explained as a fundamental commitment to treat Aboriginal peoples with honour and justice. It was explained that the Crown would only require the “eastern corner” of the Great Lakes, and that the Anishnabek would flourish with the British as their allies. After days of meetings, the first Treaty between our People and the Crown was entered into as an

agreement between equals and for mutual benefit. The Treaty of Niagara was sealed by the delivery of two wampum belts, and became sacred and inviolable.

15. After the Treaty of Niagara, SON ancestors signed other Treaties with the Crown respecting our territory. Two major Treaties signed in 1836 and 1854 recognize our rights throughout our territory and set aside large unceded communal lands for our exclusive use and occupation.

16. Treaty 45½ was signed in 1836 under the threat of ever increasing encroachment by non-Aboriginal settlers and the Government's professed inability to prevent it. SON ancestors agreed to a surrender of 1.5 million acres of our lands south of the Saugeen Peninsula, in return for, among other things, a promise by the Crown that it would protect the Saugeen Peninsula and surrounding islands and fisheries from further encroachment.

17. In 1854, Treaty 72 was signed under similar circumstances and with the same promises by the Crown. By Treaty 72, the majority of land on the Saugeen Peninsula was surrendered with the exception of our Communal lands.

18. By signing Treaties, our ancestors never intended to become subjects of the Crown, or to surrender their authority over the land. Our Treaties were not intended to, and did not, sever our connection to our territory, or give up our right to be sustained by our lands, waters and resources.

19. Despite the context of duress under which we signed our Treaties, or the Crown's continuing failure to honour the promises and obligations they contain, our Treaties fundamentally recognize our special relationship with the Crown and our Aboriginal and Treaty rights throughout our territory.

20. We agree with the essential conclusions of the Royal Commission on Aboriginal Peoples that our Treaties with the Crown were entered into as agreements between nations, and that treaty making was an exercise of the governing and diplomatic

powers of the nations involved, intended to recognize and respect one another and to make commitments to a joint future.

21. Our Treaties create enduring relationships between SON and the Crown. Their words, and the understandings on which they were based, are recognized and affirmed by Canada's Constitution and continue to have the full force of law in Ontario and Canada.

22. The rights recognized in our Treaties are not frozen or predetermined, but evolve to allow us to exercise our essential rights and practice our way of life as Aboriginal Peoples in a modern context.

SON Aboriginal and Treaty Rights

23. We assert that our Aboriginal and Treaty rights fundamentally entitle us to be sustained as Aboriginal Peoples by the lands, waters and resources of our territory, and to protect our territory to ensure that it will be able to sustain us far into the future.

24. SON asserts that, at a minimum, our Aboriginal and Treaty rights include the following:
    a. The right to continue to be a distinct people living within our territory.
    b. The right to maintain our culture, language and way of life.
    c. The right to be sustained by our lands, waters and resources.
    d. The right to the exclusive use and occupation of our Communal lands.
    e. The right to continued use of all of our territory.
    f. The right to harvest for sustenance, cultural, and livelihood purposes.
    g. The right to be meaningfully involved in decisions that will affect our territory so that we can protect our way of life for many generations to come.
    h. The right to be the stewards of our territory.

25. SON rights specifically include valuable commercial fishing rights in Lake Huron and Georgian Bay. These rights were recognized and confirmed in *R. v. Jones and Nadjiwan*. Our commercial fishing rights are an interest of growing economic and social importance in light of the increasing settlement in the region.

26. Further, SON has asserted claims to some lands and lakebeds in our territory, in two separate legal actions currently before the Courts. The first claim is for a return of certain lands still owned by the Crown within the Saugeen Peninsula, that were surrendered under Treaty 72. The claim is based on the Crown's failed promise in Treaty 45½, and breach of its fiduciary duty to protect our lands from encroachment by non-Aboriginal settlers.

27. The second claim is for a declaration of our Aboriginal title to the lakebeds of Lake Huron and Georgian Bay within our territory. These lakebeds were never identified or negotiated as part of our historical Treaties with the Crown, and consequently, were not subject to surrender.

The Impact of Industrial-scale Energy Production in our Territory

28. In the past 50 years, our territory has been exploited by others for industrial-scale energy production. The Bruce nuclear complex consists of 8 nuclear reactors producing over 6000 MW of power, making it among the largest nuclear facilities in the world. The Western Waste Management Facility within the Bruce site houses an ever growing amount of fuel wastes, and non-fuel nuclear wastes collected from other regions in Ontario. Large scale wind farms have already been constructed in our territory, and much more wind generation potential has been identified. Transmission facilities, including the existing Bruce to Milton 500 kV line, transect the territory. These were authorized and developed without our consent, participation, or consultation.

29. There are still many unresolved issues and grievances resulting from that history of energy development, that should be addressed before further developments are considered.

30. However, our territory has now been targeted for a dramatic increase in energy production. The projects others have proposed for our territory include:

    a. Refurbishment of existing nuclear reactors at the Bruce complex extending operation for 30 years.
    b. Construction of 4 additional, higher output reactors, at the Bruce Complex.
    c. Construction of Canada's first Deep Geological Repository for low and intermediate level nuclear wastes.
    d. Construction of a new 500 kV double circuit transmission line from the Bruce Complex to Milton, cutting 80 kilometres through our lands
    e. Development of over 2000 MW of wind generation throughout our lands through the installation of hundreds of wind mills.
    f. The construction of new collector and enabler transmission lines to service generation, including a 230 kV line running the entire length of the Saugeen Peninsula.

31. SON has a significant and unique interest in all of these proposed projects, as their construction, operation and possible malfunction would affect our Aboriginal and Treaty rights, and threaten serious consequences for our People and our territory. These projects would fundamentally change our relationship to our territory, and threaten the ability of the territory to sustain us as Aboriginal people.

32. For SON, all of the proposed projects are interrelated and must be considered together. These projects would have cumulative effects on our territory and our rights. Such potential impacts can only be determined through a comprehensive approach.

33. SON also has specific concern respecting the projects.

34. The proposals respecting development at the Bruce complex would continue and significantly increase nuclear energy production in our territory. The proposal calls for the use of new higher output reactors of unproven design. If completed, it will be the largest nuclear generation facility in the world. The waste storage facilities at the site will continue to house high level fuel wastes that will accumulate at an accelerated rate, and for which no long term storage solution is planned. The Bruce complex will also be the site for Canada's first underground repository for low and intermediate nuclear wastes.

35. The Bruce complex is directly on Lake Huron and in an area of significant environmental, cultural, spiritual and economic important for SON. The construction, operation and potential malfunction of these facilities threaten significant, widespread and irreversible harm to the lake and surrounding land areas.

36. Throughout our history, and continuing today, we have used these places to harvest animals, plants and medicines. Our sustenance fishing and our commercial fishery depend on the health of Lake Huron. We have culturally and spiritually significant areas in the vicinity of the proposed project, including the gravesites of our ancestors.

37. The proposed transmission facilities required to support increased generation capabilities at the Bruce complex would cut approximately 80 kilometres through our territory, crossing many rivers leading to Lake Huron. The line will transect and impinge on bird and animal migration routes that are connected to our many hunting grounds.

38. A large number of wind farms have been proposed for sites throughout our territory, as identified in Ontario's Integrated Power Supply Plan. Two large wind farms, constituting more than 400 MW of generation, are targeted for the northern part of the peninsula near our hunting reserve. The transmission lines required to service these generators would run through the heart of our territory, and along our communal lands that house our residential communities.

39. Although these projects, would individually and cumulatively affect our Aboriginal and Treaty rights in profound ways, we have not been consulted, impacts have not been properly studied, and no accommodations have been developed.

40. These developments would also threaten our Communal lands. We currently use and rely on our lands at Saugeen and Nawash as valuable recreational properties. The potential of our lands for tourism, recreation and service industries is central to the development of healthy economies for our communities. However, this potential is jeopardized by much of the proposed industrial-scale energy production.

41. SON is concerned that the nuclear projects will exacerbate an existing nuclear waste problem for which there is no solution, and that the problem will fall to our future generations. These projects will continue to be a threat to the health and safety of our territory and our People for many hundreds of generations. They will require an unprecedented level of management, monitoring and regulation far into the future. We are deeply troubled that the very long term safety of these projects would depend critically on the stability and continued independence of regulatory institutions which have recently been subjected to political interference.

Consultation and Accommodation

42. The recent history of our territory has been that major developments are planned and carried out in a way that exploits our land and resources, subject our people to significant risks without our consent, and interfere with our rights and relationship to our territory. Further, we have been completely excluded from the economic benefits derived from our lands and resources. We have consistently been asked to bear the costs and risks of major developments and energy production without an equitable sharing in their benefits. The projects now planned for our territory continue this history of inequity.

43. SON will only consider projects in our territory acceptable if we have confidence that projects can be carried out in a way that:

(1) does not subject our territory or our People to undue risks or harms;
(2) contributes to the long term sustainability of the territory by improving the environmental, social, cultural and economic well-being of our People and the region; and
(3) ensures that they will be managed, monitored and regulated effectively and with our appropriate participation.

44. SON was not consulted when the first wave of major energy developments where planned and implemented in our territory over the last 50 years. We were merely expected to accept the plans of others, and the consequences they had on our rights and our lands. We should not be considered a willing host community for those existing energy-related projects in our territory. We cannot accept another such wave of development, before meaningful consultations have taken place and appropriate accommodation measures are agreed to.

Appendix N

AFFIDAVIT OF RANDALL KAHGEE

I, **RANDALL KAHGEE**, Chief of the Chippewas of Saugeen First Nation, in the Province of Ontario, MAKE OATH AND SAY:

1. My name is Randall Kahgee, I am a member of the Chippewas of Saugeen First Nation in Ontario. I live on the communal lands of Saugeen, known as Saugeen First Nation Reserve #29. I am the elected Chief of Saugeen and have been for over 6 years. I also sit as the Chief for Saugeen in a Joint Council with the Chippewas of Nawash Unceded First Nation. Together the two First Nations act as the Saugeen Ojibway Nations ("SON"). In my capacity as Chief of Saugeen and as a member of the Joint Council of SON, I have personal knowledge of the matters to which I hereinafter depose, except where stated to be on information and belief, and to these last said matters, I verily believe them to be true.

2. I first became aware of OPG's proposed deep geologic repository for low and intermediate level nuclear wastes (the "DGR Project" or the "Project") in approximately 2003. At the time, I was acting as legal counsel to SON on a variety of matters. The DGR Project is proposed to be built at the current Bruce Nuclear Site which is located in the heart of SON Traditional Territory.[1]

3. I have been involved in all aspects of SON's involvement with the DGR Project since that time, including many internal technical meetings with SON leadership, legal counsel and technical advisors, community meetings at both Saugeen and Nawash, meetings with provincial and federal government representatives, and meetings with

---

[1] Appended hereto as Exhibit "A".

Ontario Power Generation ("OPG") and the Nuclear Waste Management Organization ("NWMO").

4. I have also made submissions relating to the DGR Project, and related projects, at various regulatory proceedings, including at the Joint Panel Review hearings on the OPG's application to build new reactors at its Darlington facility, the Bruce Nuclear Generation Station restart application review and hearings relating to Bruce Power's proposal to transport and recycle decommissioned steam generators.

5. Over this time I have heard and communicated one key message – the DGR Project has the potential to cause tremendous harm to SON's Rights, interests and way of life and this Project cannot go ahead unless these risks are fully assessed and our people understand and accept them. The Project will change our Territory and our peoples' future forever and it is inconceivable that the DGR Project could go ahead without the acceptance and support of our people.

The Saugeen Ojibway Nation are the People of this Place

6. The Saugeen Ojibway Nations and our ancestors are the Anishnabek people of the Great Lakes region. Our creation story tells us that our People originate here, from an island called Michilimackinac in the strait between Lake Huron and Lake Michigan.

7. We have lived and relied on our Traditional Territory (the Anishinaabe-aki) since time immemorial. SON Traditional Territory extends east from what we now call Lake Huron to the Nottawasaga River and south from the tip of the Bruce Peninsula (or "Saugeen Peninsula") to the Maitland River system, 11 miles south of Goderich. Our Traditional waters around these lands include the lakebed of Lake Huron from the shore to the international boundary with the United States and the lakebed of

Georgian Bay to the halfway point. Our Territory has been recognized by governments and proponents in various agreements and otherwise.[2]

8. The grave sites of our ancestors can be found throughout our Territory. Still today, our dead are brought back to this land to be buried. Our ancestors are buried on the very site on which the DGR Project is planned to be built. We refer to this site as "Jiibegmegoong". The site was disturbed in the 1950's and remains were removed. These remains were returned to the burial site in 1998 and agreements have been reached between SON and Bruce Power to allow our members to visit the site for ceremonial purposes.

9. Within our territory, the Saugeen Ojibway Nations occupy large, unceded reserves (which we refer to as our communal lands) bordering Lake Huron and Georgian Bay, resulting from our Treaties with the Crown. We enjoy exclusive use and occupation of those lands, and they are critical to sustaining our future. They house our residential communities and places of high cultural and spiritual importance. They are an important ground for our subsistence fishing, as well as for our hunting and our gathering. They are the base for many current and future economic opportunities, including a commercial fishery and valuable recreational properties.

10. SON also enjoy the exclusive use of a large hunting reserve in the northern part of the Saugeen Peninsula.

The Treaties

11. SON continue to have and exercise Aboriginal and Treaty rights throughout our Territory. Our Aboriginal and Treaty rights reflect our unique historical, cultural and

---

[2] Our Territorial map has been attached to agreements with Ontario Power Generation Inc., Bruce Power Inc., the Ministry of Energy and Infrastructure on behalf of the Government of Ontario, and others. Our map hangs on the wall of the visitor's centre at the Bruce Nuclear facility.

spiritual relationship to the territory and our special relationship with the Crown. Over the years, our people have signed many treaties with the Crown[3].

12. Our relationship with the Crown is based on our Treaties, which are solemn agreements between our people and the governments of the time to share access to the land and preserve peace, and protect our way of life as Aboriginal people within our Territory.

13. The Royal Proclamation of 1763 constituted a promise by the Crown to protect Aboriginal lands, including our territory, from encroachment by non-Aboriginal settlers. The Proclamation was issued at a time when Aboriginal people held the balance of power in the Great Lakes region, and was a recognition of Aboriginal ownership of our territory as a pre-existing interest that co-existed with any assertion of Crown "Sovereignty".

14. In 1764, Crown representatives met with more than 1,500 of our Anishnabek Chiefs and Warriors, including SON representatives, at Niagara Falls. Here, the Royal Proclamation was explained as a fundamental commitment to treat Aboriginal peoples with honour and justice. It was explained that the Crown would only require the "eastern corner" of the Great Lakes, and that the Anishnabek would flourish with the British as their allies. After days of meetings, the first Treaty between our People and the Crown was entered into as an agreement between equals and for mutual benefit. The Treaty of Niagara was sealed by the delivery of two wampum belts, and became sacred and inviolable.

15. After the Treaty of Niagara, SON ancestors signed other Treaties with the Crown respecting our Territory. Two major Treaties signed in 1836 and 1854 recognize our rights throughout our Territory and set aside our large unceded communal lands for our exclusive use and occupation.

---

[3] A compendium of which is appended hereto as Exhibit "B". Also, the history of our early treaties was neatly summarized by Justice Linden in his Report of the Ipperwash Inquiry, 2007, vol. 1

16. Treaty 45½ was signed in 1836 under the threat of ever increasing encroachment by non-Aboriginal settlers and the Government's professed inability to prevent it. SON ancestors agreed to a surrender of 1.5 million acres of our lands south of the Saugeen Peninsula, in return for, among other things, a promise by the Crown that it would protect the Saugeen Peninsula and surrounding islands and fisheries from further encroachment.

17. In 1854, Treaty 72 was signed under similar circumstances and with the same promises by the Crown. By Treaty 72, the majority of land on the Saugeen Peninsula was surrendered with the exception of our Communal lands.

18. By signing Treaties, our ancestors never intended to become subjects of the Crown, or to surrender their authority over the land. Our Treaties were not intended to, and did not, sever our connection to our Territory, or give up our right to be sustained by our lands, waters and resources.

19. Despite the context of duress under which we signed our Treaties, or the Crown's continuing failure to honour the promises and obligations they contain, our Treaties fundamentally recognize our special relationship with the Crown and our Aboriginal and Treaty rights throughout our territory.

20. Our Treaties create enduring relationships between SON and the Crown. Their words, and the understandings on which they were based, are recognized and affirmed by Canada's Constitution and continue to have the full force of law in Ontario and Canada, and their importance has been recognized in international law.

Historical and Continued Use of the Territory

21. Our identity as an Aboriginal people grows out of our relationship and connection to our Territory. Our people have a fundamental and unbroken connection to our

Territory, and we continue to depend on our lands for our survival economically, culturally and spiritually. We continue to define ourselves as a people through our connection to our lands.

22. Our people have occupied and relied on our Territory for their physical, cultural and spiritual survival since time immemorial. Our place on the land and in our waters was recognized by the Crown through our many treaties. This has been recognized by OPG in their work relating to the DGR Project, and affirmed and documented in their environmental impact statement (the "EIS").[4] Our place on the land has been recognized and affirmed in many agreements with governments and proponents, including the agreement to constitute the Joint Review Panel for the current review.[5]

23. Our constant use and reliance on our Territory for our livelihood and our cultural and spiritual survival is well documented. It was explicitly recognized in the historic legal case of *R. v. Jones and Nadjiwon*:

> The undisputed historical evidence led by the defence here has established that for centuries prior to the arrival of European settlers, the Saugeen Ojibway had occupied a vast area of what is now southwestern Ontario, encompassing all of what was known as the Saugeen, now the Bruce Peninsula, and including the area south of Georgian Bay and extending west to the eastern shore of Lake Huron. The Ojibway in that area were involved in a very productive fishery from, as is said, time immemorial. Specifically, the evidence established that they made use of numerous fishing stations on both sides of the peninsula, including the islands immediately offshore from the present Saugeen Ojibway reserves located at Cape Croker on the east side and Saugeen on the west. Their fishing was not prosecuted by individual fishermen merely to feed their own families, but rather was a community-based, collective activity in which the benefits were shared amongst the members of the community generally and directed to the subsistence of the group as a whole. Moreover, the Crown concedes, their fishing operation is accurately described as "commercial" in nature. Not only did the native groups trade among themselves, but after the arrival of the Europeans, fish was bartered with the fur traders for what became essential items. The trade developed further with the growing population of

---

4 OPG Environmental Impact Statement, March 2011, section 6.9.3

5 Appended hereto as Exhibits "C", "D" and "E".

> settlers and became an essential source of the band's "sustenance". The continuity of the exercise of the right from the very distant past to the present was established.[6]

24. Our ancestors used and occupied the Anishinaabe-aki historically, and we continue to do so today. Our territory consists of everything integral to life - the lands, rivers, lake, winds, grass, people, animals and fish. The Anishinaabe-aki has sustained our People physically and spiritually for countless generations, and must continue to do so far into the future.

25. Our Elders have recently given their account of our history on the land in testimony that will support our legal claims to assert title and aboriginal rights within our Territory. Over many days, our Elders recounted an oral history of our historical and ongoing use of and reliance on the Territory, as well as the place names by which we know our lands and waters[7].

26. We use and occupy the Anishinaabe-aki now as our ancestors did, in a variety of ways and for many purposes, including hunting, fishing and gathering for sustenance, healing, cultural and trade purposes. It is the source of our identity as Aboriginal people, and the base for our cultural activities and spiritual ceremonies. We rely on its resources to support ourselves economically. We continue to exercise governance functions and stewardship, in order to protect the Territory and ensure its ongoing ability to sustain our people.

27. Despite the constant encroachment of our lands by industry and European and other settlers over the last many centuries, our people have fought to maintain our connection to the land and our culture and our traditional practices. We have fought

---

[6] *R.* v. *Jones and Nadjiwon* (1993) O.R. (3d) 421 (Ont. Prov. Ct.) See also: Report of the Royal Commission on Aboriginal Peoples: Restructuring the Relationship Volume vol. 2 at p 462

[7] Appended hereto as Exhibit "F": Keeshig Direct (Tab 2) at 51; Keeshig Cross (Tab 1) 225; 493-494; 495-97; Ted Johnston Cross (Tab 3) at 19; 153-167; Shawbedees Direct (Tab 5) at 47-48; Shawbedees Cross (Tab 4) at 47-48; 76; 262-263; 363; Nadjiwon Direct (Tab 8), at 45-46; Nadjiwon Cross (Tab 7), at 443-445; Ross Johnston Direct (Tab 9) at 63-64.

for the protection and space so that we can preserve our Territory and culture and so that we can strengthen our traditional practices and allow our future generations to continue those.

28. Still today, our communities rely on our Territory for our economic survival. Our people have always been a fishing peoples. This history is well documented and culminated in the recognition of our Treaty right to a commercial fishery in *R. v. Jones and Nadjiwon*.[8]

29. Our people have continuously relied on the waters of Lake Huron and Georgian Bay to make a living. Although government action has sometimes pushed our commercial and sustenance fishing to the brink of collapse, we have persevered.[9]

30. Councillor Paul Jones, of the Nawash Unceded First Nation, has told the long story of our SON fishery in an affidavit. I will not repeat his story, but I will say that our people have fought as hard as any peoples in the history of this country to have our rights recognized and protected, and to protect the resource so that it will be able to sustain us far into the future. It is with great pride that our people can say we have saved our fishery and can now hope to restore it to its central place in our lives.

31. As part of our ongoing efforts to protect the Territory and protect our peoples right to use and rely on the Territory as they always have, we have entered into protection

---

[8] *Supra*

[9] Appended hereto as Exhibit "F", Tab 5: Recently, an SON Elder described our decades long fight for rights, and specifically, our right to a commercial fishery as: "And we would like the same thing [self-government], but one of these days that door - we keep knocking on that door and it's going to fall down. The hinges ain't going to take it. We've been pounding on that door for 150 years or more. We may have given up some of our land but we never gave it all up. A lot of us right across the country have never given it all up, and yet laws are made for us to lose more and more. And I think it's about time that both governments gives us the respect that we deserve, if you expect some of us to respect your way of thinking. Remember - we did not know Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday. We did not know two feet, six inches, a meter in those days. We kept what our people thought they needed to survive. And the lake and the fisheries are our survival. Resources, they've been depleted, but not by my people, but by other people. And we're only asking for our fair share."

agreements with the government of Ontario. In 2010, SON and the Ministry of Energy and Infrastructure in Right of the Ontario entered into an agreement that created mechanisms to protect SON rights and interests from impacts caused by new energy projects (the "MEI Agreement").

32. The MEI Agreement also commits SON and Ontario to carry out a landmark study to map and understand SON historical, ongoing and future uses of its Territory. Such an initiative has never been carried out, and the results will constitute both a repository of our history and use of land, as well as a road map for the Territory and our future within it.

33. Under the terms of the MEI Agreement, the study – called the Natural and Cultural Values Study (or "NCVS") – will include in its scope the historical, current and future aspects of SON uses of land, water and resources within the area for spiritual and cultural purposes; SON harvesting for both traditional and sustenance purposes, and commercial purposes; and other economic purposes consistent with SON's historical reliance on the territory to support its culture.[10]

34. Importantly, the results of the NCVS will be used as the basis for ongoing consultation efforts between SON and government respecting future energy development initiatives. It will also be the basis for SON engagement with planners and energy developers and will help inform decisions respecting future projects within the area. Prior to any decisions respecting certain critical energy development initiatives (e.g. major transmission projects on the Saugeen Peninsula or off-shore renewable energy development) SON and Ontario have agreed to enter into a consultation process that would, among other things, consider the results of the NCVS.[11]

---

10 MEI Agreement, section 24 (appended hereto as Exhibit "C").

11 MEI Agreement, sections 25, 28, 30 and 31 (appended hereto as Exhibit "C").

35. SON and Ontario have engaged researchers from the University of Guelph to carry out preliminary scoping work for the study. A draft proposal is now before the parties. Ontario and SON are still in discussions about securing the appropriate funding, which Ontario has committed to doing under the terms of our Agreement.[12] We expect that once these administrative issues are finalized, our Study will begin.

36. Until this study is completed, and we have a systematic and complete survey of the historical, current and future uses by SON of the Territory, it is impossible to gauge the breadth of impacts a project like the DGR Project could have on SON Rights and interests. It is deeply troubling that Ontario would allow its major energy development corporation to proceed with plans as significant as the DGR Project, with significant potential to impact our rights and interests and use of land far into the future, before this collaborative study has been completed or even before preliminary results have been achieved. It is my belief that this is inconsistent with the legal commitments of our Agreement.

37. Over the course of the last several years, SON has undertaken extensive research to document our historical occupation of our Territory, and our historical and ongoing uses of the Territory. This work will be presented in a series of reports, that will be the first systematic documentation of many of the uses of and relationship to the Territory by our people. We expect that these reports will be completed soon, and could be used to support ongoing engagement between SON, governments and proponents to understand the potential risks and harms of proposed projects and initiatives, like the DGR Project.[13]

38. Since the time of *R. v. Jones and Nadjiwon*, we have negotiated a number of agreements with the Government of Ontario to recognize our rights to the fishery in these waters and protect the fishery for our continued use[14].

---

12 MEI Agreement, s. 27 (appended hereto as Exhibit "C").

13 This work has been undertaken in support of title claims currently before the courts.

14 These are documented in the Affidavit of Paul Jones, August 15, 2013 (appended hereto as

39. In January 2013, we signed a substantive agreement with Ontario that not only protects the fishery, but puts mechanisms in place to help SON rebuild its fishery and return it to its central place in our economy and culture. The history that led to this agreement, as well as the terms of the agreement and the efforts that SON and Ontario have committed to, and begun, to rebuild the SON fishery are recounted in the affidavit of Paul Jones[15].

40. Our communities also rely on our Territory as the basis of our tourism and recreational economy. Both Saugeen and Nawash have thriving tourism economies which only stand to become more important with time.

41. Nawash has approximately 500 cottages for lease along the shore of the Georgian Bay, which can rent for as much as $1,000 per week during peak season. Nawash also operates the Cape Croker Indian Park camping grounds. Park rates range from roughly $40 per night for campsites and $65 for cabins. Last year, the Park accommodated more than 5,000 overnight campers. Last year, from all tourism sources Nawash generated roughly $1-million in personal income.

42. Saugeen communal lands contain the vast majority of what is referred to as Sauble Beach, one of the premier beach locations and tourism attractions in Ontario. This area draws hundreds of thousands of visitors each year, from which our community derives significant benefit. Saugeen intends to increase the value of these resources to our people and economy in the future, and to ensure that this is done in a way that is integrated into the vision of our communities.

43. Saugeen also has a large number of recreational properties that it leases to seasonal residents. Currently, Saugeen has over 1,200 leases that bring in significant revenue to our community that we rely on to provide capacity and services for our people.

Exhibit "G".

[15] *Supra*

The revenues from our leasing business represent over 30% of Saugeen's annual budget, in addition to over $30-million in private income. Any threat to this would be catastrophic for our community.

44. Most significantly, however, our people and communities rely on our Territory for our cultural identity – the Saugeen Ojibway people and our culture cannot be separated from this place. Professor Darlene Johnston, a Nawash member, gave extensive testimony at the Ipperwash Inquiry into the killing of Dudley George. During her testimony she spoke of the connection between our people and the land. Justice Linden summarizes her testimony:

> Professor Johnston explained the connection between totemic identity and the soul that remains with the body. The Aboriginal people in the Great Lakes area have a totemic or clan system that is patrilineal. Children are born into the clan or dodaim of their father. The Anishnabek belong to clans such as the Beaver, Crane, and Caribou. They believe the derive from animals. In Aboriginal culture, there is an "interconnection...between people and animals" and "the land". The dodaim or totemic identity is inscribed on the grave posts rather than the personal name of the deceased.[16]

45. Professor Johnston concluded her testimony simply with: "for the Anishnaabeg, the Great Lakes region is more than geography. It is a spiritual landscape."[17]

46. I have spent my whole life listening to my Elders. I have spent many many hours listening to my community as their Chief and I know this – if we were every required to leave our Territory, if our lands and water could no longer sustain us, it would be the end of us as a people. We have no other place to go. And if our people start to fear developments in the Territory, if we become anxious about the safety of our lands and waters, if we develop a dread of accident in the future – a deep and fundamental connection will be severed. It will be a deadly blow to our cultural existence.

---

16 Linden, Report of the Ipperwash Inquiry, 2007, Volume 1, at p.24

17 *Ibid.*

Protecting our Territory and Our Rights, Interests and Way of Life

47. It is for this basic reason that SON leadership has taken such extraordinary steps, since before the time of treaty until the present day, to protect our Territory, and our Rights and interests within our Territory. We have made clear what our Rights and obligations are within our Territory and we have committed enormous resources and time to ensuring that those are respected.

48. The rights recognized in our Treaties are not frozen or predetermined. They evolve to allow us to exercise our essential rights and practice our way of life as Aboriginal Peoples in a modern context.

49. Fundamentally, our Aboriginal and Treaty rights entitle us to be sustained as Aboriginal Peoples by the lands, waters and resources of our territory, and to protect our territory to ensure that it will be able to sustain us far into the future. These Rights include a right to autonomy, self determine our own future within our Territory.

50. SON asserts that, at a minimum, our Aboriginal and Treaty rights include the following:

a) The right to continue to be a distinct people living within our territory.
b) The right to maintain our culture, language and way of life.
c) The right to be sustained by our lands, waters and resources.
d) The right to the exclusive use and occupation of our Communal lands.
e) The right to continued use of all of our territory.
f) The right to harvest for sustenance, cultural, and livelihood purposes.
g) The right to be meaningfully involved in decisions that will affect our territory so that we can protect our way of life for many generations to come.
h) The right to be the stewards of our territory.

51. SON rights include valuable commercial fishing rights in Lake Huron and Georgian Bay. These rights were recognized and confirmed in *R. v. Jones and Nadjiwan*. As described above, and in the affidavit of Paul Jones, our commercial fishing rights are of a central and growing importance to us culturally, as well as economically.

52. We have entered into other agreements with Ontario that recognize and protect our rights within the Territory from risks posed by development, including nuclear. In 2007 we learned of a proposal by Hydro One Networks Inc. ("Hydro One") to develop a new transmission line along the Bruce to Milton corridor, which connects our Territory to the demand centres to the south. The line was designed to enable the continued and expanded nuclear generation at the Bruce Nuclear facility, as well as expanded power generation from many renewable energy projects throughout our Territory. At the same time in 2007, the Ontario Power Authority issued its 20 year plan for energy supply and demand for Ontario – the Integrated Power Supply Plan (the "IPSP").

53. The IPSP set out a dramatic plan for increased industrialization of our Territory for electrical energy generation purposes. An expansion of nuclear generation, over 1400 MWs of wind energy, off-shore wind development off our shores and adjacent to our most fertile fishing grounds, and a new transmission line running up the Saugeen Peninsula from Owen Sound to the Tobemory.

54. SON appeared before the Ontario Energy Board on both the review of Hydro One's Bruce to Milton transmission line application and OPA's IPSP review. In both applications we made the basic submissions that none of these projects should proceed until the impacts on SON Rights and interests are fully understood, and appropriate accommodations are reached. We argued that this could only be achieved through an full consultation and accomodation process between SON and the Crown – here, the Government of Ontario.

55. This led to two years of negotiations between SON and the Ministry of Energy and Infrastructure on behalf of Ontario, with the hope of arriving at an accommodation agreement that would ensure the protection of our Territory and our Rights . In January, 2010, we entered into an historic agreement which, we believe, has gone a significant way towards achieving the goal of protecting our place on the land in the face of future energy development.

56. The MEI Agreement contains many protections, including creating expectations that energy developers will engage with SON to ensure proposed projects are developed in a way that respects and protects of SON Rights and interests. The agreement specifically addresses key concerns relating to transmission infrastructure development on the Saugeen Peninsula and future development of off-shore energy projects in SON traditional waters.

57. The agreement also addresses the special challenges posed by nuclear developments in our Territory. Specifically, the agreement addresses decisions regarding nuclear developments within the Territory and recognizes that these must be addressed and that Ontario and others must come to the table with SON to resolve them. The agreement states that:

> 33. SON has expressed concern about the history, current operations and future of the Bruce Nuclear site. The Parties agree that the resolution of these issues is complex and will require the participation of multiple parties, including SON, Ontario, Canada, Bruce Power, Ontario Power Generation and the Nuclear Waste Management Organization based on their respective authorities and roles.
>
> 34. The Parties recognize that a consultation and accomodation process is the appropriate mechanism for addressing the future of nuclear projects and facilities in Anishnaabekiing and that the process may include consideration of concerns relating to existing projects.
>
> 35. The Minister agrees to be a party to a consultation and accommodation process established between SON, Canada and other federal agencies around the future of nuclear projects and facilities in Anishnaabekiing,

focused on those matters for which Ontario has jurisdiction, responsibilities or a role in decision-making.

58. I believe the current decisions being made in connection with the DGR Project, and more broadly, strategic level decisions about nuclear waste management issues within our Territory, are precisely the matters that are contemplated in our agreement with Ontario. I believe that all responsible parties, including the governments of Canada and Ontario, OPG and NWMO must deal with us honourably under law and our agreement to resolve these matters, and that these decisions must not be made without our deep and central involvement.

The DGR Project and the Nuclear Waste Problem in our Territory

59. We have known about and had deep concerns about the nuclear wastes problems in our Territory for many many years. It has been a consistent worry to our people, and in the last few years, our people have become increasingly worried that decisions are being made without our involvement – a continuation of terrible history of our peoples exclusion from decisions that have fundamentally changed our Territory.

60. In the 1960's, decisions were made to build a nuclear facility at Douglas Point. This was a project by Ontario Hydro, of which Ontario Power Generation is a successor. Those decisions, which first brought nuclear industrialization to our Territory and changed it forever, were made without any consultation or involvement of our people whatsoever. It is from these early decisions that our current nuclear waste problems originate.

61. These problems were compounded immeasurably be another decision made without any involvement or consultation with our people – the decision to develop the Western Waste Management Facility (the "WWMF") at the Bruce Nuclear site in 1974. The WWMF is the central repository for all the low and intermediate level nuclear waste from OPG owned reactors in Ontario. These wastes are transported by truck through our Territory for processing and storage at the facility. It is because of the decision to create the

WWMF that we are now faced with current scope of nuclear waste issues, and the current proposal to build the DGR Project.

62. In addition to this, we have accumulating high level nuclear wastes – spent nuclear fuel – from over 50 years of operation of the Bruce Nuclear reactors. We are told that the accumulated used nuclear fuel from this facility represents 40% of all the used nuclear fuel in Canada.

63. It is without question that the nuclear waste problem facing our people is the most serious in all of Canada and, very likely, all of the world. We are the First People of this Territory and the only people who will remain here forever, and yet we were totally excluded from all decisions that led to these problems. We will not tolerate our continued exclusion from such decisions.

64. OPG now proposes to build the DGR Project which has the potential to increasing harms to our Rights and Territory and will impose on us permanent risks. The Project will ensure the continued and increased importation of nuclear wastes into our Territory for many decades, it will dispose of these wastes permanently in our Territory, affecting our people for all remaining generations. It poses risks to our people, Rights and interests that have not been properly studied or understood.

65. Our people have been deeply troubled by the clear and unacknowledged connection between OPG's DGR Project and NWMO's plans to build a DGR for all of Canada's used fuel – there is overwhelming evidence that the development of the DGR Project at the Bruce Nuclear site will lead to the development of the used fuel repository within the same site our elsewhere within our Territory.

66. We have raised our concerns consistently with OPG representatives, as well as representatives from the governments of Canada and Ontario, and NWMO. The EIS submitted by OPG confirms our constant questions in this regard.[18]

67. We have sought assurances from OPG and NWMO that there was no connection between these projects, and that the used fuel repository would not be put in our Territory over our peoples' objections. OPG and NWMO have refused to provide these assurances.[19]

68. SON has even made submissions to this Panel, asking that the connection between these two projects be considered in the course of this environmental assessment. We made submissions setting out the significant evidence that siting of a used fuel repository in our Territory, and within the Study Area, was reasonably likely and increased by the potential development of the DGR Project. We made subsequent submissions demonstrating the growing evidence of such a connection. However, this Panel has refused to consider the used fuel repository as part of the cumulative effects assessment in this review, and accepts OPG's position that the used-fuel repository could not be developed at the Bruce Nuclear site because Kincardine has not entered into the now closed siting process. The Panel has accepted this without receiving any assurances from NWMO that this is, in fact, the case.[20]

69. Our communities have met many many of times over the last decade to talk about the nuclear waste problems facing our territory and our people. Our people understand that the we as a people bear responsibility to be part of determining a solution for these problems and are willing to accept this responsibility as part of our role as stewards of our lands and waters.

---

18 For example, see OPG's Deep Geologic Repository Project, Environmental Impact Statement, March 2011, page 2-18.

19 Appended hereto as Exhibit "H".

20 *Ibid.*

70. But our people have been clear from the very start – we must be included in the decision making concerning the future of our territory and no major project dealing with nuclear waste management could go ahead without our involvement and support. Our people cannot be left on the outside – we must be at the table for all decisions that will affect our people and Territory in fundamental ways.

71. SON has taken this position consistently in meetings with proponents and governments and in regulatory proceedings. On behalf of SON, I delivered this basic message to the Commission during the Joint Panel Review of OPG's proposal to build new nuclear reactors at the Darlington site, as well as at CNSC proceedings respecting Bruce Power's application to refuel and restart two refurbished reactors, the public hearing into whether the DGR Project would go to a Panel review, and the hearing into Bruce Power's proposal to ship and recycle used steam generators.[21]

72. Our position remains the same to this day – there can be no project that will so dramatically shape the future of our peoples' future like the DGR without the involvement and support of the SON people.

73. OPG has now recognized this. On August 7, 2013, the President of Ontario Power Generation, Mr. Tom Mitchell, sent a letter to the SON Chiefs stating that OPG will not move forward with the construction of the DGR Project until the SON community is supportive of the Project.[22]

74. The commitment made in this letter is the result of many, many years of discussion between SON and OPG regarding the DGR Project and its central significance for SON Rights and Territory. We are very pleased that OPG has recognized the proper role of SON as decision-makers within our Territory and we are hopeful that the relationship between OPG and SON will continue to grow in a positive way.

---

[21] See for example SON submissions in hearings respecting OPG's Darlington NNPP environmental assessment, appended hereto as Exhibit "I".

[22] Appended hereto as Exhibit "J".

75. It is only through this commitment and the implementation of a process that will allow our people to understand the DGR Project fully, including all its potential risks and how it fits into a broader picture of nuclear waste management issues, that the SON communities could ever decide whether they were supportive of the Project, and whether the Project can fit into our view of the future.

76. However, as welcome and hopeful as this development has been, we are still struggling. NWMO has not given us similar assurances respecting the potential development of its HLW DGR in our Territory. Contrary to its own adaptive phased management policy, as well as the foundational work of the Seaborn Panel, NWMO has not given us any assurance that it would seek our support for its HLW DGR project, or that it would not build such a project in our Territory over our communities objections.

The Risks and Harms to SON Rights and Interests from the DGR Project

77. Our experts have told us, and our people understand, that there is a great deal of uncertainty surrounding the safety of the DGR Project and the harms and risks it poses to our people, Rights and Territory. We understand that there are many unanswered questions about impacts that could occur during construction and operation of the facility, as well as the long-term safety of the Project over the thousands of years it is required to operate safely and properly. We know that OPG has failed to ask questions relating to potential stigma effects from the Project and the

devastating impacts these could have on our commercial fishery and tourism economies.

78. Perhaps more importantly, our people still have questions and concerns about how the DGR Project fits into the overall plan for dealing with all of nuclear issues facing our Territory, including the issue of the spent nuclear fuel.

79. OPG has planned its Project to dispose of nuclear waste in our Territory forever. It will create permanent harms and risks for our Territory and people. It will forever change our Territory and become part of the stories of our land, our cosmology. But it is not a positive story.

80. Until just recently, our people have not been asked whether and under what circumstances we could accept such risks. We have been excluded from decision making for the future of our territory and people, though we are being asked to shoulder the risk for all time.

81. We hope that this has now changed. We believe that OPG's commitment to us that it will not move ahead with the construction of the DGR Project until the SON communities are supportive is the only way in which the DGR Project could ever be built.

SWORN BEFORE ME at the)
City of Toronto, in the)
Province of Ontario)
this 15th day of August, 2013)
)

Commissioner for Taking Affidavits

LSUC # 60974J

CHIEF RANDALL KAHGEE

Appendix O

AFFIDAVIT OF PAUL JONES

I, Paul Jones, of the Saugeen Ojibway Nation, **MAKE OATH AND SAY**:

1. I am a member of the Saugeen Ojibway Nation, which is comprised of the Chippewas of Nawash Unceded First Nation and the Saugeen First Nation, known collectively as "the SON" or "SON".

2. This affidavit sets out, for the Joint Review Panel ("the Panel"), the history of our people regarding our fishery including: our connection to it; our historic exclusion from it; its reclamation; and our efforts to preserve and protect, for current and future generations, both our fishery and the lands and waters upon which it depends.

3. The words of my father Fred Jones, a SON Elder who served in World War II, explain our connection to the lands and waters:[1]

> My elders told me that our land is sacred to all the Ojibway. Aishinaabek surround the Great Lakes. I heard stories of how the Ojibway used to have their sacred ceremonies on the Bruce Peninsula. When they had their sacred ceremonies they could hear the heartbeat of the earth – the wave at Lake Huron against the Bruce Peninsula.

4. This affidavit starts with a simple premise: our people have, since the arrival of the European, been under constant threat and encroachment. Our rights, and our connection to the lands and waters, have been ignored to the detriment of our people and our culture. We have been confronted with racism and violence because of our connection to the lands and waters.

5. Fishing is engrained in who we are as a people; it is integral to our culture and our belief systems. Because of its central place to SON, we have fought at every turn to protect the lands and waters that support our fishery. And we have had to fight against many threats. We fought against the encroachment of white settlers, who displaced our people to the detriment of our lands, our waters and who we are as a people. When the land was needed for agriculture by non-SON communities, our people were displaced. When our lands and waters were encroached upon by settlers, we were told that, despite the promises made by Canada, it was unable to intervene. When we protested our exclusion from the fishery, Canada and Ontario ignored us.

---

[1] Personal Correspondence with Fred Jones, as cited in "Under Siege: How the People of the Chippewas of Nawash Unceded first Nation Asserted Their Rights and Claims and Dealt with the Backlash" Submissions to the Ipperwash Inquiry (December 2005) at p. 8. ["Ipperwash Submissions"] [Exhibit "A" of this Affidavit].

When we were successful in reclaiming our rights in 1993 in the landmark decision of *R. v. Jones and Nadjiwon*, we faced a backlash of racism and violence.

6. In many respects, and despite many actions of the government, including legislated exclusion of SON from our Traditional waters, which has eroded our commercial fishery over decades, we have persisted. We have fought for our rights. We have made huge efforts to protect the resource and, over the last two decades, we have successfully negotiated three successive fishing agreements with the Ontario government to protect and preserve our fishery, and to provide for a mechanism for the implementation and exercise of our rights.[2] We have also negotiated three other, separate agreements, which speak to and are designed to protect our rights. I discuss those agreements below at Section III "SON's Other Efforts To Protect the Fishery."

7. We are now beginning the daunting task, after 150 years of exclusion from our traditional waters, of rebuilding our commercial fishery to restore its place at the center of our economy and culture.

8. Our goal is to preserve our ability to live off our fishery, as our people always have. The fight for our inherent aboriginal and treaty rights has come at an enormous cost to our communities. But today, for the first time in our recent history, we believe we are on the road to rebuilding

---

[2] A copy of the 2013 Substantive Commercial Fishing Agreement is annexed hereto as Exhibit "B". The 2000 and 2005 agreements, by their terms, are confidential.

our fishery because of 150 years of work and a newly signed 2013 Substantive Fishing Agreement that SON negotiated with the Province of Ontario. We are rebuilding our fishery primarily under the terms of that Agreement, while at the same time another arm of the Ontario government is seeking to bury nuclear waste within hundreds of meters from our waters and important spawning grounds.

9. Ontario Power Generation's ("OPG") Deep Geological Repository project ("the DGR") poses a significant new threat to our people, our lands, our waters and who we are as a people. It seeks to use the shore of our Traditional waters for a different purpose: not for agriculture, not for the benefit of non-native fishers, but rather to bury Canada's nuclear waste. The consequences of this Project are not known and, we are told, in many cases not even considered.

10. However, we believe, and have reason to believe, that the DGR could strike a fatal blow to our fishery. Burying nuclear waste at the shore of Lake Huron will stigmatize our fishery, will increase development within our territory, and will ultimately increase stressors on the waters of Lake Huron to the detriment of our commercial fishery and our connection to the lands and waters. Should the Panel approve OPG's plan, and the DGR is built, the decision will be irreversible and will change our territory forever.

11. I would ask that the Panel pay close attention to the history of our people and the documents that are attached to this affidavit. In particular, I would ask that you pay particular attention to the 2013 Substantive Fishing Agreement signed by MNR and SON, attached to this affidavit as Exhibit "B". The DGR, either by its stigma or by its construction and implementation, has the

potential to undo all of the commitments and obligations set out in this agreement by fundamentally undermining the aboriginal and Treaty rights of our people.

I. MY BACK GROUND

12. I am Annishnabec and a member of SON. I was born in 1955, and was raised in and have lived on Cape Croker (Nawash) for most of my life. Cape Croker has always been my home. I served in the Canadian Forces from 1973-1975. My service included a tour in Cyprus on a Peace Keeping mission in 1975.

13. After my time in the Canadian Forces, I became involved in fishing because I saw that my people were under constant threat of charges and exclusion from the fishery for simply exercising our rights.

14. I was elected as a band councilor in 1991 and have served on Nawash Band Council ever since. I am now the longest sitting councilor at Cape. During my time on council I have attended virtually every meeting, both with governments and our people, on issues that affect or touch upon our fishery. Those meetings total well in excess of 300 over the years.

15. As is set out below, I have always fought and advocated for the rights of SON – in particular those rights that relate to the fishery, and the lands and waters that support it. I have always considered it my obligation to protect our cultural values and connection to the fishery. The fishery and the lands are part of who I am. The lands and waters are inseparable from me as an Annishnabe person. My family and our oral histories have shaped me as an Annishnabe person. My family has conducted ceremonies on the waters and the ice when the water is covered. Our belief is that the waters, trees and lands all have spirits, and that these spirits are interconnected.

For example, when our people fish, we share in the catch. Our people watch the harvest. Our children see the fishermen return with their catch and share in the process. We have ceremonies to the creator for the lands and waters of which we are a part. Our feasts celebrate the fishery, and our connections to the waters and the lands that surround it.

II. THE HISTORY OF THE SAUGEEN OJIBWAY FISHERY

16. I have read OPG's description of our fishery. That description tells a stark and sad story – of a small and diminishing fishery. Maybe it is even intended to imply that this fishery is not worth protecting, or that its loss could be compensated easily. It is a typical attempt to understand and quantify a fundamental part of our culture in terms of western science and economy.

17. OPG's understanding of our fishery is impoverished. It fails to describe or understand the central role of our fishery in our culture and our economy. It fails to lay out the historical context that explains the current state of our fishery. It fails to tell the story of the hardships and constant struggles our people have faced to protect our right to fish. And it fails tell the story of the victories we have won in the courts and at the negotiating table, and the new future we have committed to with Ontario to restore our fishery to its central place in our culture and economy.

18. In this affidavit, I will tell the story of the SON fishery, and why the right for any SON member to go to the water to catch a fish to feed his or her family, or to make a living, is a right that cannot be assigned an economic value. Rather, it is fundamental to who we are as a people. That our fishery has survived the many threats made to it, and is now once again growing, is an incredible testament to the strength of our people and the role of the fishery in our lives and

culture. As the late Chief Akiwenzie said "it was only through sheer perseverance" that our right to fish has been recognized and protected for our future generations.

1. From Time Immemorial

19. Our people – the Ojibway (Chippewa) or Annishnabe – have fished, hunted and gathered within our Traditional Territory from time immemorial.[3] A copy of our Traditional Territory map is annexed hereto as Exhibit "C".

20. My father has taught me that we have a right to live on and survive off of the land. Since the arrival of the European, our people have been under threat of being separated from our lands and waters. These lands and waters are part of our belief system; they are not just "rights" which are inalienable to our people. This is engrained in our prayers to the creator in regard to the spirits in the lands and waters.

21. The anthropological evidence of the central importance of the fishery to our economy and culture is undisputed. It was well explained in the historic legal case of *R. v. Jones and Nadjiwon*

---

[3] C. E. Cleland, "The Inland Shore Fishery of the North Great Lakes: Its Development and Importance in Pre-history" (1982) 47(4) American Antiquity 761; N. Ferris, Continuity within Change: Settlement Subsistence Strategies and Artifact Patters of the Southwestern Ontario Ojibwa A. D. 1780-1861 (M. A. Thesis, York University, 1989).

(discussed more in detail below). In referring to the anthropological evidence, Justice Fairgrieve observed:[4]

> The undisputed historical evidence led by the defence here has established that for centuries prior to the arrival of European settlers, the Saugeen Ojibway had occupied a vast area of what is now southwestern Ontario, encompassing all of what was known as the Saugeen, now the Bruce Peninsula, and including the area south of Georgian Bay and extending west to the eastern shore of Lake Huron. **The Ojibway in that area were involved in a very productive fishery from, as is said, time immemorial. Specifically, the evidence established that they made use of numerous fishing stations on both sides of the peninsula, including the islands immediately offshore from the present Saugeen Ojibway reserves located at Cape Croker on the east side and Saugeen on the west. Their fishing was not prosecuted by individual fishermen merely to feed their own families, but rather was a community-based, collective activity in which the benefits were shared amongst the members of the community generally and directed to the subsistence of the group as a whole. Moreover, the Crown concedes, their fishing operation is accurately described as "commercial" in nature. Not only did the native groups trade among themselves, but after the arrival of the Europeans, fish was bartered with the fur traders for what became essential items.** The trade developed further with the growing population of settlers and became an essential source of the band's "sustenance". The continuity of the exercise of the right from the very distant past to the present was established.

2. Early Encroachment by Europeans and the Promises Made

22. For our ancestors and our Chiefs, the preservation of our fishery has always been a constant and singular concern. Commencing in the mid 1830s, the Province of Upper Canada sought the surrender of the Saugeen Territory. Even at this early stage, our people could see the growing threat to our use and reliance on the fishery posed by European encroachment. It was this

---

[4] *R. v. Jones and Nadjiwon* (1993), 14 O.R. (3d) 421 (Ont. Prov. Ct.) at p. 14 of version attached to this affidavit [Exhibit "D" of this Affidavit]. See also Royal Commission on Aboriginal Peoples, "Report of the Royal Commission on Aboriginal Peoples: Restructuring the Relationship" vol. 2 at p. 462.

encroachment and the long series of Crown actions and inactions in response that was the beginning of erosion of our rights and our fishery, notwithstanding promises to the contrary.

23. In 1836, as part of a broader process of assimilation policy, Lieutenant Governor Sir Francis Bond Head devised a plan to relocate our people to Manitoulin Island.[5] The treaty negotiations, our ancestors were told, were to ensure that our people would be "fortified against Encroachment of the Whites."[6]

24. Our people resisted these efforts. Chief Metigowob explained to us that, during the treaty negotiations, when they were asked to relocate to Manitoulin Island, the Saugeen Chiefs had informed Bond Head that our ancestors preferred to remain on the Saugeen peninsula as "there were many fish in that place."[7] Chief Metigwob told us that Bond Head responded as follows:[8]

> The Sahgeeng owned all the islands in the vicinity of that neck or point of land, he was about to reserve from them and that he would remove all the white people who were in the habit of fishing on their grounds.

25. Our people understood that the purpose of the treaty was to recognize and protect our right to continue fishing as we always had: not only for sustenance but to share, barter and trade. This is what we would now characterize as a commercial fishery. Historians who have studied this part

---

[5] This issue is explored in great detail by Professor John Burrows in his P.HD thesis "Negotiating the Law: Traditions & Treaties on Manitoulin Island" [Exhibit "E" of this Affidavit]. See also M. Walters, *Aboriginal Rights, Magna Carta and Exclusive Rights to Fisheries in the Waters of Upper Canada,* (1998) 23 Queen's Law Journal 301 at para. 6 [Exhibit "F" of this Affidavit].

[6] Walters, *ibid.* at para. 6.

[7] "Statement of Metigwob, one of the Sahgeeng Chiefs, made in a General Council held at the River St. Clair on the 13th September 1836 respecting the surrender of the Sahgeeng Territory to the British Government." Six Nations Land Research Office, cat. No. 836-9-13-1.

[8] See Walters, *supra* note 5 at para. 12.

of our history have come to the same conclusion. Professor Mark Walters of Queen's University, Faculty of Law, explains:[9]

> Thus, Bond Head's oral statements about the Saugeen reserve were consistent with what he had written in relation to the Manitoulin reserve: native fishing rights were exclusive and non-native encroachment would be prevented. The significance of this promise arises from the larger context within which it was made. In the years preceding the treaty, non-native use of the Saugeen fisheries had increased and some confusion had arisen about the terms under which a non-native commercial fishing company operated from the fishing islands: the company had obtained both a licence of occupation from the Lieutenant Governor in council and a lease from the Saugeen chiefs in 1834 for use of islands. In light of this, treaty recognition of their exclusive rights to the islands and fisheries was important to the Saugeen chiefs. Furthermore, in the 1836 treaty no provision was made for payment for the surrender of the Saugeen territory. It may therefore be argued that the Crown's consideration was, in part, its promise -- conveyed orally by Bond Head -- to protect exclusive Saugeen possession of unsurrendered Ojibway fisheries. In short, very strong reasons exist to conclude that the 1836 treaty recognized exclusive rights of fishing.

3. Broken Promises & Exclusion

26. Many of the promises made to our people by the Crown at the time of the treaty were broken, including the promise that our fishing rights would be protected from encroachment. Our people could not tolerate this and took action early on. As Professor Walters notes:[10]

> In an effort to protect their territories, the Saugeen Ojibway sought further written confirmation of their rights, and in 1847 the imperial Crown issued a proclamation in the form of letters patent under the great seal of the province of Canada defining the Saugeen territory and confirming Ojibway title to it. This 1847 deed defined the boundaries of the Saugeen territory as:
>
> > all that tract of land lying on the shore of Lake Huron, and which is butted and bounded or otherwise known as follows: commencing at the mouth of the River Saugeen, thence . . . [a southern boundary line along the base of

---

[9] *Ibid.* at para. 13.
[10] *Ibid.* at para. 14 [citations omitted].

> the Saugeen peninsula is described], bounded on the east, north, and west by Lake Huron, including any islands in Lake Huron within seven miles of that part of the main land comprised within the hereinbefore described tract of land

27. The Deed went on to declare that the Saugeen Ojibway:[11]

> ...forever shall possess and enjoy" the tract and its "rents, issues, and profits....without any hinderance whatever on our part, or on the part of our heirs and successors, or of our or their servants or officers.

28. Professor Walters and Justice Fairgrieve in *R. v. Jones and Nadjiwon*,[12] a landmark decision that I discuss in more detail below, both conclude what the SON has always known and maintained: reserves on the shores of Lake Huron, as well as the fishing islands and the lake bed under the waters, remained unceded. Indeed, the anthropologic evidence establishes that our people lived on the water as much as we lived on the land. However, despite treaty and letters patent, our exclusive fishing rights were disregarded and Ontario began leasing our lands and waters without our consent.[13] These represent specific actions by the Government of Ontario that would have the effect of eroding our rights and fishery.

29. In *Jones and Nadjiwon*, Justice Fairgrieve stated:[14]

> During the 1830s, the Saugeen continued to enter into arrangements directly with third parties for the leasing of their fishing islands by directors of the Huron Fishing Company, which were then affirmed by licences of occupation by the Crown. No licences of occupation were issued to confirm the arrangement in 1845 that the Saugeen chiefs made with one Cayley, whose name figured prominently in the documents from that period. Mr. Lytwyn, an historical

---

[11] *Ibid.* at para. 15 citing Declaration by Her Majesty in favor of the Ojibway Indians respecting certain lands on Lake Huron (29 June 1847) NAC RG68, vol. LIBER AG. SPECIAL GRANTS 1841-1854, C-4158.
[12] *Supra* note 4.
[13] Walters, *supra* note 5 at para. 16.
[14] *Jones and Nadjiwon*, *supra* note 4 at p. 16.

> geographer called by the defence, gave his opinion that the colonial government could issue such licences in respect of Crown lands, but could not do so in relation to the Saugeen's fisheries because they had not been surrendered.

30. The historical evidence supports the conclusion that, from the aboriginal perspective, the 1836 treaty had confirmed their exclusive right to their traditional fisheries in the area. When the Chief Superintendent of Indian Affairs visited the settlement the next year, he wrote:[15]

> The fishing is bountifully supplied and has attracted the notice of white people who annoy the Indians by encroaching on what they consider their exclusive right and on which they rely much for provisions.

31. The historical evidence also confirms the most basic and fundamental understanding of our people – that the 1836 treaty confirms and recognizes our exclusive right to the fisheries in our Traditional waters.[16]

4. Legislated Exclusion

32. Irrespective of the validity of the 1836 Treaty, one thing is certain: the promise that our fishing rights would be protected from encroachment was broken. As Professor Walters notes:[17]

> Notwithstanding the 1836 treaty, non-native use of Saugeen fisheries increased. A commission of inquiry on Indian affairs in 1844 observed in relation to the Saugeen fisheries that the "fishing is very productive, and has attracted the notice of the white people, who annoy the Indians by encroaching on what they consider their exclusive right…"

33. In 1857, ten years before confederation, the provincial legislature enacted the first statute regulating fishing in Upper Canada. No mention was made of our rights. Since confederation,

---

[15] As quoted by Justice Fairgrieve in *Jones and Nadjiwon, ibid.* at p. 16.
[16] *Jones and Nadjiwon, ibid.* at p. 16.
[17] Walters, *supra* note 5 at para. 16, citing Canada, Legislative Assembly of Canada, Report on the Affairs of the Indians in Canada (22 January 1844) in Journals of the Legislative Assembly of Canada (1845), Appendix EEE, s. 2, II.15 at 43.

Canada has enacted successive fisheries legislation. None of this legislation mentions our rights and, as history demonstrates, the legislation was in fact used to exclude our people from the fishery to the benefit of others.

34. The effect of this legislative history upon our people was profound. In *Jones and Nadjiwon*, Justice Fairgreive noted:[18]

> What the evidence disclosed was a relentless, incremental restriction and regulation of the admitted aboriginal right, despite continuing protests, petitions, objections and resistance by the defendants' band. Much of the conflict appeared to have its source in the apparently inadvertent failure of the first Fishery Act to make any special provision for the treatment of native fisheries or existing treaty rights. The evidence documented as well a protracted intragovernmental policy clash between Fisheries and Indian Affairs. The former generally prevailed, and the fisheries came under increasingly stricter controls.

35. The legislation and enforcement efforts of Ontario (MNR) had real impact on our people. SON elder Donald Keeshig is quoted as saying:[19]

> I've been threated over hunting and fishing. The Conservation Officers and RCMP were always after us. There was no work here when I was young. You couldn't rely on fishing, because we weren't allowed to go very far from our reserve to fish. If we went beyond the "lines" set up by the MNR, they were ready to charge us and take our equipment from us. I remember our grandfathers used to sleep on the shore to watch over their seining nets. The MNR said it was against the law to use a seine net on our reserve. I always felt the MNR and the RCMP were our enemies…they were always after us.

---

[18] *Jones and Nadjiwon, supra* note 4 at p. 18.

[19] Ipperwash Submisssions, *supra* note 1 at p. 34. The chronology of the assertion and protection of our rights is set out at pp. 38-45 [Exhibit "A" to this Affidavit].

36. Elder Keeshig, like many SON members, relied on fishing to make a living and to provide for his family. His ability to continue to do so was constantly under threat by the collective effect of the many government actions that separated our people from our fishery.

5. Reclaiming the Right: R. v. Jones and Nadjiwon

37. I have made much reference to the *Jones and Nadjiwon* decision for its summary of the SON's history. However, it is also important for the Panel to understand the circumstances that led the Chippewas of Nawash Unceded First Nation to challenge the MNR licensing system and the reasons for why *Jones and Nadjiwon* was decided as it was.

38. Prior to becoming a Nawash Band Councilor, I was part of the community-based movement to challenge our exclusion from the fishery. For years, our people were denied access to the fishery by a government that sought to protect the interests of recreational fishermen and the commercial interests of non-SON members. For example, while Ontario was setting quotas and putting in regulatory restrictions on SON members, it was issuing lucrative commercial licenses to non-native commercial fishermen.

39. Despite these efforts at excluding our people, we continued to fish as our people had done from time immemorial. As a result of our actions, criminal and regulatory charges were frequently laid against our people. Sometimes the charges were resolved or withdrawn. In some instances, our people were imprisoned. This cycle continued for decades.

40. By the end of the 1980s, our communities' frustration was palpable. We were facing exclusion from our waters and we were being prosecuted when we exercised our rights. For example, on October 13, 1989, Ross Forgrave, a Wiarton Justice of the Peace forced eleven Nawash fishermen, of the them the Chief of the First Nation, some of them elderly, to stand for 45 minutes as he lectured them about fishing over MNR quota. He portrayed them as thieves, greedily taking too many fish. He imposed fines totaling $ 32,000.00 plus jail time ($200 and 30 days for one fisherman, who caught 9 fish).

41. I recall being in court when the presiding Justice called our people "rapers and pillagers" for simply seeking to survive from our traditional territory and waters. To make matters worse, the quota allocated by MNR was not enough to feed members of our community, let alone support a commercial fishery, as was promised to us. I kept telling Joint Council, our governmental structure where the Chiefs of Nawash and Saugeen, as well as elected councilors, sit, that we had to fight for more fish and not accept the quota being imposed by MNR.

42. Eventually, the community had enough. A group of fisherman approached Joint Council urging that, rather than being under the constant threat of charge and imprisonment, we resolve our rights once and for all. We knew we would have to fight for our rights in a Canadian court. Although it was a long process to change the thought process of our people regarding the Canadian court system – which was considered simply an extension of our exclusion from our traditional waters – eventually there was community support for fighting to resolve our rights once and for all in a Canadian court.

A. The Charges against Howard Jones and Francis Nadjiwon: Settling Our Rights

43. The opportunity to do so arose in 1989, five years after the passage of Section 35 of the *Constitution Act*, 1982, when Chief Howard Jones and Francis Nadjiwon were charged with fishing without a license and the sale of lake trout in excess of that which was allocated to SON.

44. Upon learning of these charges, our Band Council made the brave and difficult decision to divert resources out of our community to assist Chief Howard Jones and Mr. Nadjiwon in their defence. The cost of the defending Chief Jones and Francis Nadjiwon was almost $500,000.00. Unfortunately, the Band Council could not afford to spend money to defend the fishery without diverting funds from health, education and infrastructure. The funds were diverted and, rather than go those areas, they were spent on litigation.

45. The trial was heard in Orangeville. I attended every day of it. Many fishermen and community members were also present.

46. I remember that on the eve of trial, Ontario made an offer to settle the matter. The offer was a marginal increase in the allocated quota. However, to our community, a marginal increase in quota was not the issue. We needed to have our rights to a fishery recognized and our people needed to be free to exercise those rights on a priority basis over all other considerations, save for conservation. The Band Council had already expended hundreds of thousands of dollars and the community had made it clear: we have an aboriginal and treaty right to a commercial fishery and those rights, if they were to be protected, needed to be affirmed under section 35 of the *Constitution Act*. The Government's offer was rejected and the trial proceeded

47. The trial was significant moment in the history of our people. It lasted some ten days and was based on thousands of hours of historical research. Both expert and community members testimony was given. It was as full a review of the history of our fishery as had ever been done.

48. On April 26, 1993, Mr. Justice Fairgrieve issued his decision recognizing what the SON community and our people always knew: we had both an aboriginal and treaty right to commercially fish within our traditional territory and that we had been excluded from our fishery for the benefit of others.[20]

49. In reaching his decision, Justice Fairgreive reviewed the extensive evidence presented at trial and emphasized the place our fishery held at the center of our economy and culture. He concluded that government actions which failed to recognize this reality were unconstitutional. His Honour stated:[21]

> When the lake trout quota was allocated in 1984, the evidence suggests that despite the fact that the band was the only commercial licence-holder covering an entire community, and despite the fact that the band's fishery was the only one in the area dependent on lake trout for its livelihood, the band was simply given an incidental quota, not a production quota, in the same way and of a similar magnitude as other individual commercial licence-holders. The evidence does not support a finding that any special regard was given to the nature of the band's fishery operation, quite apart from the question of any constitutional priority over other users.
>
> .....
>
> What should be stated, however, is that a high-handed and adversarial stance on the part of the Ministry will neither meet the constitutional requirements with which, one would expect, it would consider itself duty-bound to comply, nor will it provide an

---

[20] See *Jones and Nadjiwon*, *supra* note 4 [Exhibit "D" to this Affidavit].
[21] *Ibid.* at pp. 26-27.

> enforceable regulatory scheme capable of achieving the conservation goals which it seeks. It is self-evident, I think, that s. 35(1) of the Constitution Act, 1982, particularly after the judgment of the Supreme Court of Canada in Sparrow, dictated that a new approach be taken by the government to ensure that its policies discharge the obligations assumed by its constitutional agreement. I do not think it was ever suggested that there would necessarily be no adjustments required or no costs attached.
>
> .....
>
> As a practical matter, the court cannot compel good faith or recognition of changed constitutional realities. All that can be done here is to state the conclusion that the quota restrictions do not meet current constitutional standards and are, accordingly, unenforceable against the defendants. The imposition of a prohibition against the purchase of lake trout from band members pending negotiations and a new arrangement which recognizes the priority of their aboriginal and treaty rights would, in my view, also be unconstitutional. It would also fail to reflect the high standard of honourable dealing which the public expects its government to take in respect of the rights of aboriginal people.
>
> Howard Jones and Francis Nadjiwon are found not guilty, and the charges are dismissed.

50. We won the case. Howard Jones and Francis Nadjiwon were found not guilty and SON's rights were recognized and affirmed under s. 35 of the *Constitution Act, 1982*. Ontario did not appeal the decision. It would, however, take SON another 7 years to come to conclude our first fishing agreement with Government to provide for a mechanism by which these rights could just begin to be implemented.

B. The Backlash to *Jones and Nadjiwon*: Violence and Racism

51. The legal victory was an instrumental step in putting an end to over 150 years of exclusion of our people from our fishery. However, the backlash from the non-SON public was swift and strong:[22]

- In the summer of 1995 a Nawash fishermen's boat was sabotaged and defaced with graffiti that read: "splake thief."

- Later in the summer, another fishermen, who had lost 2,000 yards of nets to someone who had them lifted them or cut free, reported his losses to the OPP. No one was apprehended. He was on the verge of bankruptcy but *he* was charged by the OPP for booby-trapping his nets in an effort to protect them.

- On August 5, 1995, about 75-100 angry anglers from the Grey-Bruce area marched on Yolanda Jones, a Nawash Band member who was selling fish at the Owen Sound open market with her daughters. The sportsmen and recreational fishermen were, at the time, protesting against our fishing in Owen Sound. The protest was led by Grey MPP Bill Murdoch and Parliamentary Assistant to MNR Minister Chris Hodgson. A scuffle broke out and Nawash supporters linked arms to bar the sportsmen from attacking the stall. One of the protestors threw a plastic bag with a rotting salmon onto the fish onto Yolanda's stall.

52. These are but a few of the many examples of the violence our people faced after Jones and Nadjiwon was decided. I lived these times, when our community members faced overt acts racism and violence. A complete description of the violence we faced is available in our submissions to Mr. Justice Linden in the Ipperwash Inquiry, which are excerpted in Exhibit "A" of this affidavit.

---

[22] The backlash from the decision are fully detailed in SON's Ipperwash Submissions, *supra note* 1 at pp. 40-45 [Exhibit "A" to this Affidavit].

6. Protecting our People and our Rights: Negotiations with the Crown for a Fishing Agreement

53. While our people faced racism and violence following *Jones and Nadjiwon*, we also faced another obstacle: negotiating a fair and honourable agreement with the Crown that would provide a mechanism for the implementation of our rights, protect the resource and begin to reverse the effects of our fishery's historical decimation.

54. Over the last twenty years, I have attended hundreds of meetings to arrive at such an agreement. Indeed, looking back over the years, it is difficult to convey how difficult these negotiations were. We travelled far, we met with government officials, we wrote letters and we consulted with our people. We fought to obtain data to assess the fishery in Lake Huron, and we retained staff biologists in partnership with the University of Guelph to ensure that the fishery would be protected based on sound science. Most importantly, we sought to establish that which was promised: an exclusive commercial fishery of which we were the primary stewards.

A. The Initial Years After *Jones and Nadjiwon*

55. Following *Jones and Nadjiwon*, we continued to seek a peaceful solution to the acrimonious relationship between SON, the government and public by tabling a comprehensive strategy to develop public support, assess the impact of the stocking of non-indigenous species in our waters, and develop a co-management agreement with Ontario.

56. On August 15, 1995, MNR Minister Chris Hodgson met with SON. The Minister advised that the new government (elected in June 1995) was not interested in negotiating and concluding a co-management agreement and discussions came to an end. A new license was inevitable.

57. On June 24, 1996, Ontario issued an Aboriginal Communal fishing license to SON. It was rejected and our people continued to fish, once again exposing themselves to charges, and the seizure of their nets, fish and boats.

58. Sure enough, on June 24, 1997, MNR issued new charges against two SON fishermen. SON was forced back into court to expend resources to challenge the licenses, notwithstanding Justice Fairgreive's findings in *Jones and Nadjiwon.*

B. Initial Negotiations and the 2000 Agreement

59. SON continued to try to negotiate an agreement with Ontario while, at the same time, defending the new charges under the 1996 fishing license.

60. On July 30, 1997, SON secured a commitment from both the Federal and Provincial Governments to negotiate. The Honourable Mr. Justice Stephen Hunter acted as mediator in those discussions. This was a very difficult time. Charges were still pending against two SON fishermen. Our people questioned how we could negotiate with the very government that charged our fishermen and had imprisoned them in the past.

61. Our position was simple: while we did not need an agreement to fish, an agreement would stabilize our relationship with the Crown and bring some peace to our communities. It would also help us rebuild our fishery, reversing years of damage.

62. I personally attended, along with Chief Akiwenzie and other councilors from 1997-2000, well over two hundred meetings. During this three year period, the promise of *Jones and Nadjiwon* seemed to be slipping from our grasp. Nevertheless, through sheer determination and perseverance, we held on to the hope that we could conclude an agreement that would protect our people on the land and on the waters, and implement the right that was won in *Jones and Nadjiwon*.

63. On June 22, 2000, over 7 years after *Jones and Nadjiwon* was decided, SON signed our first agreement with MNR and Indian Northern Affairs Canada. While the agreement is confidential, it had the following key components:

- It more broadly defined the waters for SON fishing within our traditional territory, allowing for a broader SON commercial fishery than what had been allocated under the previous licensing scheme employed by MNR;

- It ensured that the fishery would be protected by the application of sound science to the setting of safe harvest limits in which SON was an active participant, and not a "stake-holder," in determining the quota that was allocated;

- It provided for a mechanism by which SON could better assess the fishery by providing for the exchange of data between SON and MNR, and by securing a funding mechanism for this exchange of data.

64. From SON's perspective, the protection of the resource was the continuing and primary obligation of the parties under the agreement. The secondary obligation under the agreement was to ensure that our people would benefit from the commercial fishery on a priority basis.

65. Although this agreement was an important first step, it was just a beginning. The 2000 agreement did not go far enough in protecting our rights and the resource and it did not provide the basis for us to rebuild our commercial fishery. To attain this, our people had to fight again, and endure more cost, insult and attack.

66. This SON experience was captured by Mr. Justice Linden, Commissioner of the Ipperwash Inquiry, in his final report:[23]

> Both before and after Jones and Nadjiwon the Saugeen Ojibway Nation approached the province to try to reach a co-management agreement concerning the commercial fishery in the waters around the Bruce Peninsula. In 1994, Ontario agreed to discuss co-management.
>
> Despite the concerted efforts of the Saugeen Ojibway Nation to educate the public about their treaty and Aboriginal rights, the summer and early fall of 1995 was marked by protests, violence, and vocal opposition from some members of the non-Aboriginal community to the commercial fishing rights of the Saugeen Ojibway Nation. The protests and violence included a march by nearly 100 people on an Aboriginal woman who was selling fish in the Owen Sound market. Aboriginal fishing boats and nets were vandalized, a First Nation-owned fishing tug was burned, and several members of the Saugeen Objibway Nation were assaulted in Owen Sound.

---

[23] Report of the Ipperwash Inquiry, vol. 2 at 118-19, online: <http://www.attorneygeneral.jus.gov.on.ca/inquiries/ipperwash/report/vol_2/pdf/E_Vol_2_Full.pdf.>

> In August of 1995, the new provincial government informed the Saugeen Ojibway Nation that it would not continue with the co-management discussions. Later, the government tried to unilaterally impose a new regulatory scheme under The Aboriginal Communal Fishing Licence Regulations, which the Saugeen Ojibway Nation resisted. The MNR continued to lay charges against Saugeen Ojibway Nation fishers for not adhering to the communal licenses.
>
> In 1997, the federal government appointed a judge to mediate the dispute between MNR and the Saugeen Ojibway Nation. In June 2000, seven years after the Jones and Nadjiwon decision recognized the Saugeen Ojibway right to fish commercially, the provincial and federal governments and the Saugeen Ojibway Nation signed the first Fishery Agreement to manage the commercial fishery in Lake Huron and Georgian Bay around the Bruce Peninsula. In July 2005, the Agreement was renewed for a further five years, including a protocol for how the parties will work together to ensure compliance and to exchange information about the commercial fishery.
>
> A First Nation should not have to experience what the Saugeen Ojibway Nation went through to reach a co-operative management agreement with Ontario. I recommend that the provincial government continue to work with First Nations and Aboriginal organizations in Ontario to develop co-management arrangements and resource-sharing initiatives.

67. The 2000 agreement was for a term of 5 years. It was the first step in repairing a badly damaged relationship and its main purpose was to create a peaceful environment in which SON could begin to implement its vision of our fishery and overcome 150 years of exclusion from it. In many ways, the 2000 agreement was both and end and a beginning: it ended the violence of the past, and it began to define SON's vision of the fishery for our people and the generations to come.

68. However, the 2000 agreement was not without compromise. In the interests of moving towards a better relationship with Ontario (with the ultimate goal of securing our rights for our people), SON agreed to refrain from exercising our rights within Owen Sound and Colpoys Bays ("our Bays" or "the Bays"), a contentious issue that I will return to further in this affidavit.

C. Negotiations Continue: The 2005 Agreement

69. Two years before the 2000 agreement was set to expire, SON and MNR began negotiating the next agreement. After lengthy negotiations, a second agreement was concluded on July 12, 2005. The 2005 agreement provided further stability and peace within our traditional territory, and increased the amount of safe harvest limits within our waters. It also confirmed and recognized an SON exclusive commercial fishery in the waters surrounding the Bruce Peninsula.

70. While the violence of the past subsided over the life of the 2000 and 2005 agreements, our fishermen continued to be excluded from our Bays and the agreement provided little in the way of economic development opportunities so that our people could earn a moderate livelihood. As the end of the 2005 agreement approached, SON Joint Counsel provided a renewed mandate to the SON negotiating team to remedy these deficiencies in a new, substantive, agreement that would provide a mechanism to implement the right for both the present and future generations.

71. In preparation for the re-negotiation of a new agreement, SON set out some fundamental principles that would guide its position:

- SON would exercise its aboriginal and treaty rights throughout its Traditional waters, including in Owen Sound and Colpoy Bays;
- The issue of the stocking of exotic species which are predators of the indigenous species we catch would be studied and addressed;
- Our people would derive greater economic benefit from the waters in order to sustain our connection to them and to invest in and protect our fishery and its historical place in our economy and culture;

- The agreement would be based on a Government-to-Government relationship based on mutual trust and respect;

- The agreement would contain binding commitments and obligations on both Government and SON to ensure that our fishery would regain its central importance to our economy and culture.

D. Renegotiation – The Initial Discussions: May 2010 – November 2010

72. In anticipation of the expiry of the 2005 agreement, SON and MNR agreed to extend the 2005 agreement to December 31, 2010 to allow for negotiations of a new agreement to commence. When the 2005 agreement expired on December 31 2009, it was extended by a Memorandum of Understanding to allow for negotiations of a new fishing agreement that would embody a new relationship with Ontario but also implement SON's vision for its fishery for generations to come.

73. The initial discussions were mediated by Professor Michael Coyle. While initial progress seemed positive, the talks broke down in November of 2010.

74. After the breakdown, SON had discussions with the very highest levels of the government of Ontario, including the Minister of Aboriginal Affairs, The Honourable Chris Bentley, and the Minister of Natural Resources, the Honourable Linda Jeffrey. During the meeting with Minister Jeffrey, she and our Chiefs made a renewed commitment to re-commence the negotiations with a new mandate. A Deputy Minister was given the lead on the negotiations and the Honourable Frank Iacobucci, a retired Supreme Court of Canada Justice, was retained to facilitate the renewed discussions.

E. The Framework Agreement Recognizing the Right and a Mechanism for Implementation

75. Following SON's meeting with Minister Jeffry, negotiations with MNR re-commenced in April 2011. They continued through to August 2011.

76. On August 27, 2011, SON and MNR executed a foundational Framework Agreement to assist the parties in negotiating a long-term substantive fishing agreement. A copy of the Framework Agreement is annexed hereto as Exhibit "G". I ask that The Panel review this document closely, paying particular attention to the mutual commitments and obligations relating to the SON fishery.

77. The Framework Agreement was a milestone in setting forward the vision for the SON fishery and our relationship with Ontario for generations to come. It contains several important principles:

- The agreement is based on a Government to Government relationship in which SON decision makers would sit directly with MNR decision makers;
- It created a Governance Committee comprised of SON and Ontario leadership to implement the objectives, commitments and responsibilities set out in the framework agreement; and
- It made commitments to deal with specific key issues including:
    i. Mutual economic benefits;
    ii. Capacity for SON to allow for reconciliation to continue;
    iii. The mutual setting of safe harvest limits based on sound science and not the unilateral allocation of quota under a licensing regime;
    iv. A commitment to study and address the impacts of MNR stocking programs in the waters of Lake Huron;

v. The sustainability of the fishery and the waters that support it; and

vi. The engagement of the Federal Crown.

78. The Framework Agreement committed the parties (SON and MNR) to a number of principles to guide the conclusion of a long term substantive fishing agreement. These principles include:

- A new relationship with a willingness to build a more positive and better future for the parties;
- Mutual respect created through a willingness to act in good faith and in a manner respectful of each other;
- Mutual participation in implementing mechanisms that achieve further participation by both parties in decisions about commercial fishing in the waters.

79. The Framework Agreement also contained important mutual commitments, paramount of which was the protection, conservation and sustainability of the resource.

80. Mutual trust and respect was to be established through meaningful negotiating processes, and through goals and principles that would be included in a long term agreement including:

- mutual economic benefits for the parties;
- capacity for SON;
- the setting of safe harvest limits (TAC); and
- SON fishing in Owen Sound and Colpoys Bays.

81. These commitments, obligations, responsibilities and principles set the stage for SON and MNR to negotiate a new agreement – one that built upon past agreements but would move far beyond them in order to provide for a better future for our people.

F. Negotiation of and Execution of the Long Term Substantive Fishing Agreement

82. After signing the Framework Agreement, SON and MNR re-commenced the negotiations to conclude a lasting and flexible substantive fishing agreement. These negotiations began in September of 2011. Over 50 meetings were held and, by June 2012, the parties had come to an agreement that was recommended for approval by SON leadership and the Ontario Government (referred to in the remainder of my affidavit as either "the 2013 Agreement", or "the Substantive Fishing Agreement" or "the Agreement").

83. On January 24, 2013, the Agreement was signed by The Honourable Minister Gravelle on behalf of Her Majesty The Queen in the Right of Ontario (MNR) and by Chief Randall Kahgee on behalf of the Saugeen First Nation. On February 21, 2013, the Agreement was signed by Chief Scott Lee on behalf of the Chippewas of Nawash First Nation.

84. The changes in the 2013 Agreement – notably that SON fisherman could now exercise their treaty and aboriginal rights to fish throughout our Traditional waters, including the Bays of Georgian Bay – became effective on April 26, 2013. As noted above, the 2013 Agreement is set out at as Exhibit "B" to my affidavit.

7. THE 2013 SUBSTANTIVE FISHING AGREEMENT – A VISION FOR A BETTER FUTURE

85. The Substantive Fishing Agreement is 40 pages in length. It incorporates and implements the commitments and obligations contained in the August 2011 Framework Agreement. It contains Schedules relating to:

- Incorporation of the Framework Agreement (Schedule "A")

- The waters covered by the agreement (Schedule "B");
- Fishing within the waters (Schedule "C");
- Total allowable catch and data exchange (Schedule "D");
- A compliance protocol for SON and non-aboriginal fishers (Schedule "E");
- Terms of reference for:
    - The Capacity and Economic Development Working Group
    - Expert facilitation for TAC Determination Working Group
    - Expert Facilitation Regarding Fish Stocking Working Group

A. The Contents and Purpose of the Agreement: Restoring the Commercial Fishery

86. The 2013 Agreement re-affirms the binding goals, principles, objectives and commitments contained in the Framework Agreement, the primary concern of which is the sustainability of the resource. Within the waters defined under the Agreement, SON has maintained an exclusive commercial fishery.

87. There are several key components to the 2013 Agreement:

(i) **Purpose**: The purpose of the agreement is to implement the commitments made by the parties in the Framework Agreement, which is based on a Government-to-Government structure.

(ii) **Scope**: Its scope is intended to provide for the sustainability of fish, the support of the SON commercial fishery and safety on the waters for all;

(iii) **The Waters**: The waters that are the subject matter of the 2013 Agreement surround the Bruce Peninsula, to the international border on the West Side and to Meaford on the South East Side. A copy of the map defining the waters is contained at page 23 of the

2013 Agreement. As the panel will see the proposed DGR sits in the middle of the waters defined by the agreement and within SON Traditional Territory.

(iv) **Governance Committee:** The Governance Committee oversees implementation of the agreement and ensures that the mutual commitments and obligations under it are kept and implemented. One mechanism through which this is accomplished is by the establishment of working groups with terms of reference.

(v) **Total Allowable Catch:** "TAC" is to be set based on sound science by consensus decision making of the Governance Committee based on a consideration of the biological status of the fish populations in Lake Huron prior to the establishment of TAC.

88. Below, I will address the work being done under the 2013 Agreement, and then I will discuss the aftermath and community backlash that came from its negotiation and execution.

B. The Work Being Done Pursuant to the 2013 Agreement

i. The Capacity and Economic Development Working Group

89. On July 5, 2011, the Governance Committee established the Capacity and Economic Development Working Group by terms of reference. The purpose of this working group, a collaborative effort between SON and Ontario, is to develop detailed proposals for a business development plan so that SON can derive greater economic benefits from the fishery through a vertically integrated fishery. This will be done through a Request for Proposal that will include identification of the following:

i. Equipment requirements of SON;

ii. Cold storage needs;

iii. Processing of fish;

iv. Marketing of fish;

v. Distribution of fish to the market;

vi. Enhancement of revenue for SON processed fish;

vii. Employment and training;

viii. Costs necessary to address the capacity needs of SON in an economically viable and self-sustaining commercial fishery.

90. In addition, the terms of reference required identification of the necessary agencies (governmental and non-governmental) to support and implement the terms of reference, and the necessary capital required for implementation of the business plan by the Governance Committee.

91. Two points need to be made about these terms of reference.

92. First, properly implemented over the long term, this economic working group can restore our fishery, undoing the effects of our historical exclusion, and make it a center piece of our economy, as it once was. Indeed, the historical decimation of our fishery continues to be felt today (and is reported by Ontario Power Generation ("OPG") in its Environmental Impact Statement, in terms of the current size of our fishery) and is reflected in the overall health of our on-reserve economies. Our fishing agreements with Ontario set out the foundation for SON, working with Ontario, to rebuild our fishery from the decades' long history of destruction caused by encroachment by European settlers and government actions. This long process of rebuilding is now beginning. Under the 2013 Agreement, for the first time, we can and will restore the fishery to its rightful place within our economy so that it will no longer be the case that only a few fishermen can survive from fishing, but rather that many SON members will be supported by our fishery, whether through catch, assessment, processing, marketing or distribution.

93. Second, it takes time to build and establish a fishery. The non-aboriginal fishery had 150 years to mature into a self-sustaining commercial fishery. SON did not enjoy that same advantage. We were excluded from our fishery. We are only now, under the 2013 Agreement, beginning to take the steps necessary to overcome the effects of this exclusion. As with the non-aboriginal fishery, this takes time, commitment and capital.

94. The Capacity and Economic Development Working Group has begun its work to develop detailed proposals for a business development plan aimed at building a strong, economical and vertically integrated fishery. As it stands, our fishermen mostly sell their catch "in round" – that is, without any processing or value added. This is the lowest value form of a fishery. The goal of the working group is to build up our fishery so that it can be the basis of a real economy and our people can make a real living from the fishery.

95. The Working Group has established an Request for Proposal for the development of the key components of new and vertically integrated fishery including: equipment needs for cold storage and processing; marketing; distribution; revenue enhancement models for processed fish; employment and training; and the development of business models to address capacity needs of SON to build an economically viable and self-sustaining commercial fishery.

96. We have already begun the work necessary to rebuild and modernize our commercial fishery. This has started from the bottom up. We began with the fishermen in both Saugeen and Nawash. We have held numerous "Community Fishing Meetings" in both Saugeen and Nawash, we have passed Joint Council motions to establish Foundation Principles for Territorial Economic

Development, and we have established a SON fishery committee and hired local youth to assist the committee in its work.

97. Efforts have already begun to acquire necessary equipment, from fishing nets purchased directly from Chinese and Taiwanese suppliers to new boats. We have begun work to price and plan for the construction of new fish processing plants, and we have and conducted research and modeling into the power, transportation and logistics needed to support this. We have considered business models that divide our fishery into four components: (1) whole fish, (2) smoked fish, (3) surimi (processed fish cake) and (4) vacuum packed. Our fishing committee has led planning on an inter-ministerial conference to bring all parties to the 2013 Agreement together in a broader forum to discuss issues related to business and economic development which could inform the development of an integrated SON commercial fishery vision and plan. We have taken advantage of programs such as the Business Retention & Expansion Program offered by the Ontario Ministry of Agriculture, Food, and Rural Affairs, and we have begun work to develop SON-specific marketing materials and strategies.

98. There are already concrete examples of how our efforts are starting to pay off. I will relay a personal example. Over the last year, I have built and made significant investments in a fish smoking facility at Cape Croker. I built a commercial grade smoke house, and purchased an industrial grade smoker and packaging equipment. In the last six months, I have been catching fish, or purchasing fish from our local fishermen, to smoke and sell. I am already processing and selling significant amounts of my smoked fish to local Nawash business people who resell it in their retail shops. In the short time I have been in operation, my business has grown tremendously and there is every indication that it will continue to do so.

99. I fear that the mere possibility of the DGR poses a threat to these positive developments, and to the efforts of SON and government to rebuild our commercial fishery. There is a danger that government, our people and others will not make the investment of time, effort and capital that has been committed to under the Agreement, and is necessary to rebuild our fishery. I worry that nobody will be willing to make these investments if they fear there will be no market at the end of the day for "fish from the nuclear waste dump." They will all see it as a bad investment, a waste of money. I fear that all our efforts will be wasted and our fishery will die out, rather than be rejuvenated.

ii. The TAC Working Group and Data Exchange

100. Other aspects of the agreement establish mechanisms that ensure that the resources will be protected and maintained so that it will continue to be able to support the SON fishery far into the future.

101. Of central importance to our people is the sustainability of the lands and waters that support our fishery. At one time, we were "allocated" a quota without consultation or regard to either our history, our aboriginal right or our treaty relationship with the Crown.

102. The TAC working group provides the mechanism by which safe harvest limits can be set through the establishment, by consensus of the Governance Committee, of total allowable catch in any given year. SON and MNR have differed over the process by which safe harvest limits can be set after annual harvest data is exchanged. Accordingly, the process is now facilitated to ensure that the best science is applied to the setting of safe harvest limits for consideration by the

Governance Committee. This is a crucial element of the Agreement as it assists our people in ensuring the sustainability of the resource.

103. Complementing the TAC working group is Schedule D of the Agreement, which provides for the process by which data will be exchanged for the purposes of establishing TAC. This includes a detailed protocol relating to commercial harvests within Lake Huron, index netting data and recreational harvest. In addition, Schedule D requires TAC to be determined based on key uncertainties, including the status of biological fish populations and their distribution in the waters. In this regard especially the DGR creates enormous uncertainty for TAC: What effect will construction have on the waters? On habitat? On aquifers during construction? On increased urbanization and the resulting increase in effluent and pollution? How is SON to address these uncertainties in setting safe harvest limits if the DGR is built?

iii. Fish Stocking Working Group

104. Over the objection of SON, Ontario has and continues to stock non-indigenous fish in our traditional waters. The purpose of this stocking is to support the non-native recreational fishery. The reason that SON has objected to the stocking of these species (such as salmon) is that they are not only predators of our preferred species (lake whitefish) but they consume many of the nutrients that lake whitefish require for their natural reproduction. In short, the stocking of non-indigenous species, in SON's view, has an adverse impact on the waters that sustain our fishery. The Fish Stocking Working Group, for the first time in history, will examine and address long standing SON concerns with respect to these stocking programs.

C. Public Reaction to the Substantive Fishing Agreement

105. The 2013 Substantive Fishing Agreement is the first one that has been made public. Properly implemented, it will restore our fishery to the center piece of our culture by protecting, by ensuring more SON members will participate in it and ultimately ensure that our connection to the waters for generations to come will be preserved. In the face of this agreement however, and its public release, we have faced yet another hurdle: another backlash to SON's exercise of its aboriginal and treaty rights.

i. The Aftermath of the 2013 Agreement

106. As I noted above, the 2013 Agreement was the first agreement to be made public: it was released on March 12, 2013. Public reaction was immediate. There was outcry and outrage over the Agreement in the local media, and by both federal and provincial politicians. On March 13, 2013, the Owen Sound Sun Times reported that Member of Parliament Larry Miller and Member of Provincial Parliament Bill Walker were "angered" by the agreement. After having reviewed the contents of the Agreement, MP Miller said he was "deeply disappointed" about aspects of the agreement that will "no doubt kill local sport fishing in [the] bays." MP Miller and MPP Walker were also upset about the funds provided under the agreement, stating that SON members were being paid to fish.[24] This public characterization is misguided; the money is for the assessment and sustainability of the fishery based on sound science.

---

[24] "SON Gets Funding to Fish" Bayshore Broadcasting (March 13, 2013). A collection of the articles I reference in this paragraph and below are attached to this affidavit as Exhibit "H". "SON Gets Funding to Fish" is contained therein as Tab 1.

107. Online comments on the Owen Sound Sun Times website expressed outrage about MNR entering into agreements with SON in secret and jeopardizing sports fishing.[25] To make matters worse, MP Miller and MPP Walker issued a joint press release referring to the Agreement as an "insult."[26] They did not reference our treaty and aboriginal rights to fish within our Traditional Territory, nor did they discuss the history of exclusion of SON from the fishery. I heard that MP Miller reported that he heard from people who suggested violence in response to the agreement. Members of the public hosted meetings to express their "concern" over the agreement, organized protests and called for the agreement to be re-opened.[27]

108. As in 1993, we had concerns about the safety of our community members. Some of our members experienced backlash from the agreement – they were taunted at the docks and our children were taunted at school. We put the police, who are playing a role in ensuring that the implementation of the Agreement goes smoothly, on alert to protect our people and fishermen.

---

[25] See the comments at the end of the article by Denis Langlois, "Miller Calls Fishing Agreement a Mess" Owen Sound Sun Times (March 14, 2013) and by Scott Dun, "Miller, Walker Condemn Payments to SON" Owen Sound Sun Times (March 14, 2013) [Exhibit "H" Tab 2]

[26] MPP bill Walker and MP Larry Miller, "Sports Fishers sold out by Ministry of Natural Resources: Response from MPP Walker and MP Miller" (March 12, 2013) [Exhibit "H" Tab 3]

[27] See "Important Announcement: Concerned Anglers to Host Session on Commercial Fishing Agreement" (April 20, 2013) ["Concerned Anglers Announcement"]; Dennis Langlois, "Small Turnout at Commercial Fishing Protest" Owen Sound Sun Times (April 26, 2013); Denis Langlois "Sports Anglers Want Fishing Agreement Reopened" Owen Sound Sun Times (April 27, 2013) [Exhibit "H" at Tab 4].

109. In response to the backlash from the agreement, Chief Kahgee and Chief Lee issued a press release defending our people and our rights. In that press release, the Chiefs wrote about our rights, the 2013 Agreement and its importance.[28]

110. Minister of Natural Resources David Orazietti also publically responded through a letter the editor sent to the Owen Sound Sun Times dated April 9, 2013, a copy of which is attached as Tab 6 of Exhibit "H".[29] Minister Orazietti confirmed what the SON has always known: that we have a treaty right to fish on the waters and that we were not obligated to enter into this agreement with MNR in order to exercise that right.

111. Despite the overwhelming negative public reaction by elected officials and the recreational fishing organizations, there were some non-SON individuals who spoke out in favour of the Agreement. Josh Choronzey of the Owen Sound Sun Times published an article commenting on the situation, which included a brief review of SON's rights and the history of the negotiations. Online, some commentators reminded critics that we had a proven right to fish – a right established by treaties and affirmed by Canadian Courts only 20 years prior.[30] Schools invited our Chiefs to educate teachers about SON's history and the agreement so that they could teach children in their classes about us and our rights.

---

[28] Taking the High Road: The SON/MNR Fishing Agreement" (April 9, 2013) [Exhibit "H" Tab 5 to this Affidavit]
[29] David Orazietti, Minister of Natural Resources "Letters to the Editor – Both Commercial and Recreational Fisheries Can Exist" (April 9, 2013) [Exhibit "H" Tab 6].
[30] Josh Chronzey, "Some Context for Native Fishing Agreement" (March 14, 2013) Owen Sound Sun Times. online at <http://www.owensoundsuntimes.com/>. [Exhibit "H" Tab 7 to this Affidavit].

112. On April 22, 2013, Chief Kahgee, Chief Lee and Minister Orazietti participated in a ceremonial signing of the Agreement – reaffirming SON and MNR's commitments to the principles contained within it. A copy of their signatures in reaffirmation of the 2013 Agreement is attached to this affidavit as Exhibit "I". After the ceremony, Minister Orazietti repeated his already publically expressed opinion that SON did not need to enter into the agreement because of our treaty and aboriginal right to fish in our traditional territory.[31] Chief Lee commented on the importance of Minister Orazietti's statements about SON rights, stating that "We've never heard that kind of commitment, those kinds of acknowledgement of our rights."[32]

113. On that same day, a "peaceful protest" against the agreement was organized by non-native recreational fishers. In addition, some recreational fishing groups organized a "town hall style, non-confrontational information meeting"[33] for the following day, where calls were made for MNR to reopen the agreement.[34] Most recently, the Mayor of Georgian Bluffs has written to Minister Orazietti asking that the agreement be re-opened and amended.

114. The public outcry over the 2013 agreement was reminiscent of public reaction in 1993 to *Jones and Nadjiwon*. General threats of violence were made, although thankfully no one was injured or attacked. However, there are signs that we have moved forward. Non-SON individuals have stepped up in defence of our rights. Some members of the public have taken steps to learn about

---

[31] Scott Dunn, "Minister, SON chiefs say fish deal a new chapter" Owen Sound Sun Times (April 22, 2013) [Exhibit "H", Tab 8].
[32] *Ibid.*
[33] Concerned Anglers Announcement, *supra* note 27 [Exhibit "H" Tab 4].
[34] Langlois "Sports Anglers Want Fishing Agreement Reopened, *supra* note 27 [Exhibit "H" Tab 4].

our history. Ontario has also publicly, for the first time, acknowledged our aboriginal and treaty rights in our traditional territory, confirming we are not required to enter into any agreement about the commercial fishery but rather are obligated to protect it.[35]

8. Summary – SON's Fight to Protect Its Fishery

115. Since the time of contact, and the beginning of the encroachment of settlers and industry on our lands and waters, our fishery has been under attack. Most recently, we have been criticized by elected officials for exercising our rights. We have had to make great efforts to protect our fishery, and who we are, from being wiped out entirely. Now we are facing the difficult task of rebuilding our fishery. We had hoped, and put our efforts into our Agreement with Ontario so that it could be the foundation of our effort to finally rebuild our fishery and restore it to its central place in our economy and culture. For example, we have created a business development office to work with Ontario and other agencies to create a vertically integrated fishery.

116. These efforts are ongoing and, properly implemented, will bring to fruition the obligations and commitments contained in the 2013 Substantive Fishing Agreement. At the very time that SON secures an agreement that would properly protect our waters and the fishery, however, another arm of government seeks to undo it all by building, transporting and burying nuclear waste several hundred meters from the shores of Lake Huron though the construction of a project that

[35] See Minister Orazietti's comment that SON, who has "unfettered" rights, "voluntarily" negotiated with Ontario out of concern for the long-term sustainability of the fishing resource: Denis Langlois, "Minister Praises SON For Negotiating Fishing Agreement" Owen Sound Sun Times (April 18, 2013) [Exhibit "H" Tab 9].

is unprecedented in Canadian history. SON should not have to endure further encroachment or attacks on our rights and our territory. Those days have long since passed. The 2013 Agreement is an important milestone agreement whose very implementation is now threatened by the DGR.

III. SON'S OTHER EFFORTS TO PROTECT THE FISHERY

117. What I have described above is our decades' long fight to have our rights recognized and build a new foundation for our fishery through negotiated agreements.

118. However, SON has fought to protect our rights and fishery on other fronts. Over the last fifteen years, SON has made tremendous effort, spent millions of dollars and devoted countless hours to protect the waters, fish and fish habitat in Lake Huron and Georgian Bay, through legal action, participation in numerous regulatory proceedings and sponsorship of scientific research initiatives. I will briefly describe these efforts in the paragraphs that follow.

119. In January 2013, community members noticed a shore well being constructed that was harmful to fish habitat. SON obtained an injunction to prevent the harm that was occurring. We then entered into negotiations with the Conservation Authority to create a better relationship to ensure that the resource was protected. We have attempted, as part of this effort, to engage the Department of Fisheries and Oceans ("DFO") in order to better protect fish habitat in our traditional waters. Most recently, SON has sent a letter to DFO Minister Shea expressing concern about SON's relationship with DFO and our attempts to reach a relationship agreement with DFO. Our struggle and difficulties to engage with DFO are set out in a letter recently sent by our Chiefs. It is annexed as Exhibit "J". As of the date of the swearing of this affidavit, we have not received a response from the Minister.

120. SON has been consistently and actively involved in the regulatory review of many different industrial developments in our Traditional Territory that could threaten our fishery. We have pushed for scientific and environmental study of the resource, in order that good and precautionary decisions can be made to allow only responsible developments and to mitigate any dangers that those developments might pose.

1. The Bruce Nuclear Site and Bruce Power Inc.

121. Many of these efforts have focused on the operations of Bruce Power and developments at the Bruce Nuclear Site – the site on which OPG now proposes to build its DGR Project. This area is particularly important to the SON fishery because it is close to and influences critical fish spawning areas within Lake Huron.

122. Over the last many years, SON has had a central role in the review of proposed developments and initiatives relating to Bruce Power, including:

    a. In 1997, an environmental assessment was carried out for a used fuel dry storage facility at the Bruce Nuclear site. SON went to the hearings and challenged the science and conclusions of OPG and others respecting the interaction of the facility with Lake Huron and the aquatic environment. As a result of our voice, a new research program was initiated to look at the question of Whitefish interaction with Nuclear Generating

Stations. This study was called "WINGS". Its history is described in a Final Report by Holes & Noakes, in 2002:[36]

> During the Bruce Nuclear Used Fuel Dry Storage Environmental Assessment (BUFDS EA) revew process in 1997, representatives of the Chippewas of Nawash First Nation expressed concern about the monitoring of lake whitefish in Lake Huron as part of the overall Bruce Nuclear environmental monitoring program conducted by Ontario Power Generation (OPG 1990). These concerns predate the BUFDS EA process and derive partly from the fact that the single largest component of the Nawash commercial fishery to which they have an established Treaty right (Walters 1988), the harvest of lake whitefish, is from the eastern Main Basin of Lake Huron, where Bruce Nuclear Power Development (BNPD) is located (OPG 1990)....The health of the ecosystem and the whitefish population(s) it supports in the vicininty of the BNPD are of fundamental importance to the health and economic viability of the Nawash community (OPG 1990) and other users of fisheries resources in Lake Huron.
>
> In response to these long-standing concerns about the effects of the BNPD on the fishing industry and the Lake Huron ecosystem near the Bruce Peninsula, a 3-year collaborative effort to jointly review the available scientific information on the ecology and population dynamics of both lake whitefish and round whitefish in Lake Huron was initiated in 1999. The project was conducted by the University of Guelph with field support from the Chippewas of Nawash and is funded by OPG and since 2001 Bruce Power (BP), which leased the Bruce A and B generating facilities from OPG.

b. In 2002, Bruce Power initiated an environmental assessment respecting its intention to restart two of its reactors (Units 3 and 4) after their refurbishment. In reviewing the application and review documents by CNSC, SON was extremely concerned about the manner in which ecological effects on lake whitefish and the results of the WINGS Project were being ignored. SON filed detailed submissions critiquing the work of Bruce Power and CNSC, and attended the one-day hearing into the screening report in Ottawa

---

36

on December 12, 2002. At those hearings, Nawash Chief, the late Ralph Akiwenzie, along with our biologist Dr Steve Crawford, made the case that the science behind the application was lacking and did not address SON concerns. Ultimately, the Commission made the decision that the application would not go to a fuller review and that the interests and concerns of SON could be addressed through a follow-up monitoring program as a condition of the approval. The Lake Huron Whitefish Follow-up Monitoring Program was initiated, and for a time, SON and its researchers were deeply involved in its work. However, as time went on, it became apparent that the direction research was going would not answer the key questions that SON had about the impact of the Bruce Nuclear facility on the total ecology of Lake Huron, and specifically, questions about populations of lake whitefish and the impacts on those various populations.

c. In 2006, Bruce Power began its application to build four new nuclear reactors at the Bruce Nuclear Complex. SON engaged in a lengthy consultation and accommodation process with the federal Crown, represented by the Canadian Nuclear Safety Commission (the "CNSC") to ensure that the project would be reviewed to the highest possible standards under Canadian law, and that the review would focus on the potential impacts of the project on SON Rights, interests, and way of life. The Joint Panel Review Agreement for that project identified SON specifically as having a unique interest in the territory and the project.[37] It went further to set out a new mandate for the panel to

[37] A copy of the JRP Agreement on the New Nuclear Power Plant Application is annexed hereto as Exhibit "K".

consider and take evidence on the potential impacts of the project on SON Rights and interests to support ongoing consultation efforts between SON and the Crown. The Agreement is attached here as "K". During the environmental assessment of the project, SON engaged experts both external and from within our community, as well as academic reviewers and legal support to review Bruce Power's application. SON representatives continued to meet with the CNSC to participate in a collaborative review of the application, all with the goal of identifying potential impacts on SON rights and the fishery. The project to build the four new reactors was subsequently abandoned by Bruce Power.

d. In 2008, Bruce Power was required to seek a licence for the refueling and restarting of two refurbished reactors. Again, SON made detailed submissions at the CNSC hearings emphasizing, in part, that the ongoing impacts of the facility on the fish and fish habitat of Lake Huron. In particular, SON pointed out its repeated complaint, first made in response to the inadequate follow up monitoring program described above, that the work that Bruce Power was doing in monitoring its entrainment and impingement effects were meaningless without an understanding of the nature of the whitefish populations in Lake Huron. As a result of our submissions, the CNSC imposed on Bruce Power a requirement that it undertake studies that would satisfactorily answer the questions and concerns of SON.

123. Following from the decision of the CNSC panel, SON engaged directly with Bruce Power to negotiate the terms of an agreement to carry out a collaborative study to answer five key

questions respecting the impacts of the facility on the Lake Huron Whitefish, and in particular set out a first of its kind course of study on understanding populations of the Lake Whitefish in Lake Huron so that impacts from contaminants, radiation, thermal changes, and entrainment and impingement could finally be understood. An agreement was concluded in May 2011. The study is referred to as the Collaborative Lake Whitefish Research Program and is being led by SON and Bruce Power with the University of Guelph and McMaster University.

2. The Integrated Power Supply Plan and the "MEI Agreement"

124. In 2007, the Ontario Power Authority proposed a new energy plan for Ontario referred to as the Integrated Power Supply Plan (the "IPSP"). Included in that plan were proposed developments that would have tremendous adverse impacts on SON's rights and interests, including direct impacts on our fishery. Most importantly, the IPSP called for the continued and potentially increased reliance on nuclear power at the Bruce Nuclear Site, as well as the development of offshore wind development in the waters off the coast of Lake Huron and within SON Traditional waters.

125. The IPSP had identified our Traditional waters, and the coast of our Traditional lands adjacent to those waters as the best possible sites for the development of onshore and offshore wind. These areas surrounded our historical fishing islands and were situated very close to important lake whitefish spawning grounds.

126. Because of potential for adverse impacts caused by such developments, SON became deeply involved in the Ontario Energy Board review of the IPSP. Again, SON was forced to devote

significant time and resources to understand and challenge government plans that threatened our fishery. Again, we were required to engage lawyers and external experts, as well as devote countless hours of the time of our Councilors and Chiefs to take up the reviewing and challenging the plan.

127. In late 2008, in an effort to negotiate an agreement on how the developments called for in the IPSP would be reviewed, approved and developed, SON engaged the government of Ontario, represented by the Ministry of Energy and Infrastructure, in negotiations to conclude an accommodation agreement. Negotiations were conducted over seven months in the summer and fall of 2009. An agreement was signed between SON and MEI in January, 2010 (the "MEI Agreement").

128. The MEI Agreement sets out many provisions for the protection of SON Territory and calls for engagement between SON and Ontario on energy related planning and development decisions.

129. The MEI Agreement specifically refers to the off-shore wind development and states that no decisions that would permit the development of off-shore wind until an extensive consultation process with SON was undertaken. It states that:

> Prior to any government decision which would permit renewable energy development in SON Traditional waters, the Parties agree to establish a consultation process to address the matter, including consideration of: the findings of the Natural and Cultural Values study as they might be relevant to a proposed Project in SON Traditional waters; a determination of adverse effects or impacts

on SON Rights; and Special measures to mitigate adverse effects or impacts on SON Rights.[38]

130. Shortly after the signing of the Agreement, the Government of Ontario announced a moratorium on the development of off-shore wind.

131. The MEI Agreement also specifically addresses decisions regarding nuclear developments within the Territory and recognizes that these must be addressed and that Ontario and others must come to the table with SON to resolve them. It states:

> 33. SON has expressed concern about the history, current operations and future of the Bruce Nuclear site. The Parties agree that the resolution of these issues is complex and will require the participation of multiple parties, including SON, Ontario, Canada, Bruce Power, Ontario Power Generation and the Nuclear Waste Management Organization based on their respective authorities and roles.
>
> 34. The Parties recognize that a consultation and accomodation process is the appropriate mechanism for addressing the future of nuclear projects and facilities in Anishnaabekiing and that the process may include consideration of concerns relating to existing projects.
>
> 35. The Minister agrees to be a party to a consultation and accommodation process established between SON, Canada and other federal agencies around the future of nuclear projects and facilities in Anishnaabekiing, focused on those matters for which Ontario has jurisdiction, responsibilities or a role in decision-making.[39]

132. From our perspective, the current decisions being made by the governments of Canada and Ontario, as well as OPG and NWMO, are all the kinds of decisions contemplated by the MEI Agreement. The actions now being considered with respect to the DGR Project fall squarely within our agreement, and must be dealt with as agreed and in an honourable manner. This is

---

[38] MEI Agreement, section 31.
[39] MEI Agreement, supra.

especially so given the huge potential impacts of the DGR Project on our fishery and rights. This has not yet occurred, and all of these parties are proceeding to make decisions without our involvement and without any proper process or accommodation of our rights, interests and culture.

THE DGR AND THE THREAT TO THE SON FISHERY

133. All of the efforts I have described above were done to ensure that the waters, fish and fish habitat that we have relied on for our livelihood since time immemorial would continue to be able to sustain us. For our people, it has been one long fight against the constant encroachment and industrialization of our lands and waters, and the devastating effect this has had on the resource and our people's ability to exercise our rights to fish.

134. As I have explained, since time of contact and the beginning of the encroachment of settlers and industry on our lands and waters, our fishery has been under attack. We have had to make great efforts to protect it from being wiped-out entirely. Now we are facing the difficult task of rebuilding our fishery, but we are always on the back foot. We had hoped and put our efforts into our 2013 Substantive Fishing Agreement with Ontario so that it could be the foundation of our effort to finally rebuild our fishery and restore it to its central place in our economy and culture. We have invested in efforts to protect the resource through legal action, involvement in regulatory review and scientific research. And we have trusted in our MEI Agreement with Ontario to set out key protections against energy related industrial developments that could endanger the resource.

135. But now we have a new and potentially devastating project to contend with: OPG's DGR Project. We have heard that this project, if approved, poses many different kinds of threats to our fishery. The impacts of the DGR will be permanent, impacting our people and the fishery forever. And all of this is being done by a corporation of the Ontario Government—the same government that has entered into many agreements with us to help us protect our fishery.

136. Since we learned of OPG's plans to build the DGR at the Bruce Power site within our Territory, we have been trying to understand the project, and the threats it could pose to our rights, interests and way of life.

137. We have had many meetings of our leadership, communities and experts to try to understand what dangers it may pose. We have engaged world-class nuclear experts with deep experience in the development and regulation of nuclear projects, including nuclear waste repositories. These experts have reviewed all the information provided by OPG in their environmental impact statement and all of its support documents. Our experts and our team have visited the Bruce Nuclear Site to see the specific site proposed for the DGR. We have had many workshops with our experts, leadership, and community members to try to understand the Project.

138. We do not yet know all the dangers this project proposes, and we do not believe that OPG or NWMO or anybody else does either. But we do know that there are critical concerns that have not been fully addressed by OPG, and some that have not even been considered by OPG in any meaningful way.

139. Our experts have told us that the DGR Project is a "first of its kind" project, and because of this it is untested and many unknowns remain. Only a few underground repositories for nuclear waste have been built around the world. Even fewer have been used to store the "intermediate level" nuclear wastes that OPG has planned to place in the DGR Project. We are also told that no repository has been put into the kind of rock formation found under the Bruce Nuclear site. We have heard that of the few repositories that have been developed, some, like the ASSE II in Germany, are experiencing significant and dangerous problems. And all are so new that we do not know what kinds of problems might develop.

140. We also understand that OPG does not yet understand all the impacts that the construction and operation of the DGR Project could have on the fish and fish habitat. There are unanswered questions about run-off from the rock pile that will be created from the excavated rock and how this could affect the waters around the facility. There is poor understanding of the effect of the extensive blasting that will be required to build the facility and what impact this might have on fish. OPG has not considered at all the impacts on fish populations, nor do they have the ability to do so. As I explained above, SON is only now undertaking research that could lead to answers on these kinds of questions. Finally, OPG has not fully explained how it will gather information about the site to confirm its assumptions about the rock and its predictions on how the likely the risk of dangerous failures and leaks.

141. All of these shortcomings have caused our people significant stress, anxiety and fear – we simply do not know what the dangers of this project are. We are being asked to trust OPG and its science, and take on all the risk that they are right that the DGR Project will not cause significant impacts to our environment, fishery and, ultimately, our way of life.

142. An issue of great concern to us is that OPG has completely ignored a critical impact that the DGR **will** have on our Rights and our fishery. That is, that the DGR will cause a "stigma" that has the potential to devastate a local food economy, like our commercial fishery.

143. Stigma has been explained to us as a negative emotional judgment that forms about a place or thing and changes peoples' behaviour. Stigma is quite often developed around nuclear facilities and, in particular, around nuclear waste projects, partly because these projects are difficult to understand and partly because media like to exaggerate any nuclear incident, no matter how small. We understand that it is extremely difficult, often impossible, to eliminate a stigma once it's created.

144. As I understand this, even if there is no accident or malfunction at the DGR Project, the consequences of building a DGR at the Bruce Site could be devastating to our fishery. The mere existence of such a facility is enough. Even worse, any time a nuclear accident happens anywhere in the world, people will become more afraid of the DGR. The stigma will grow and our fishery will suffer even more, and there is nothing that OPG or Bruce Power could do about it. We are told that food economies are particularly sensitive to stigma and that there are examples from around the world where food economies have been seriously harmed, and even devastated, because of stigma.

145. We are told that two DGR projects planned for other places in the world (Yucca Mountain, Nevada, US and Cumbria County, UK) were ultimately rejected because of the potential for stigma to kill local economies. We are told that these other projects happened recently and that there is a very large amount of research available about these projects, but that OPG did not

consider any of this information in its submissions about the DGR. We do not understand how so much relevant information could be ignored by the very people who are asking for our trust and confidence.

146. We are also told that OPG did not even mention the protests and hearings that occurred when it tried to ship contaminated steam generators through the Great Lakes in 2010. I was at these hearings and remember how many people said they were afraid and that the risks were too great. We also understand that the amount of radioactive material in each generator was very small, especially compared to how much waste OPG wants to store in the DGR. We don't understand how OPG could say there is no risk of stigma from the DGR and nuclear waste after seeing the public reaction to the steam generators.

147. We are also troubled by what our experts tell us about OPG's analysis of stigma. Our experts tell us that OPG made many errors in its analysis and yet somehow still concluded the risk of stigma was minimal. We understand that OPG asked questions that were biased and surveyed very few people. We understand that OPG tried to measure potential stigma by surveying people who already live in the area, even though these people have an economic interest in the DGR Project and so are obviously biased.

148. We also understand that OPG made no effort to disclose or discuss any of the limitations of its analysis of stigma. Our experts tell us that OPG's conclusion of minimal stigma is different from what has happened at virtually all other nuclear waste projects, but that OPG does not even mention this fact. Instead, OPG did a very poor analysis of stigma and just concluded that the risk of stigma would be minimal.

149. These problems are compounded because of another nuclear waste management plan to build a DGR for all of Canada's spent nuclear fuel waste. This is a project being carried out by the NWMO. There is growing evidence that the spent nuclear fuel repository is likely to be developed at or near the Bruce Nuclear site.[40] Already all of the 5 local municipalities around the Bruce Nuclear Site, all within the SON Traditional territory, have engaged with NWMO to become the hosts for a new DGR for all of Canada's used nuclear fuel.

150. Our people do not believe that these two plans are unrelated. Rather, our people believe that OPG's DGR plan is only the beginning – a project to test the area for the used fuel DGR and to get local people comfortable with the idea.

151. We have sought assurances from government and NWMO and OPG that the spent fuel DGR would not be developed within SON Territory over our objections, but we have been rejected.

152. We have been told that this plan is not certain, and that nothing has yet been decided. But we have been given no assurances at all that we would have a say in this.

153. We also know that the possibility that another DGR for spent fuel will be built in our Territory, and the media attention and confusion surrounding the two projects together will only add to the potential stigma, as people will continue to be confused about what is going into the "nuclear waste dump" in our territory and likely assume the worst.

---

[40] Much of this evidence is detailed in various SON correspondence and submissions annexed hereto as Exhibit "L".

IV. THE CONTINUING HISTORY OF BROKEN PROMISES

154. There are many ways in which the DGR Project threatens our commercial fishery, which, as I have explained, is the way our people have made a living since time immemorial. It has the potential to deal a fatal blow to our fishery and our aboriginal and Treaty rights. These questions have not yet been adequately understood or even studied by OPG.

155. From the perspective of our people, government and their corporations are once again taking unilateral action that will further damage or even kill our fishery. It is a continuation of the long and terrible history that we have been fighting against since the time of settlement. It could undermine all of the efforts that we have made in the last many decades to protect and reestablish our fishery and return it to a central place within our culture and economy.

156. These actions by the Ontario government's corporation could also undermine the agreements that SON and Ontario have made together. Ontario and SON have concluded four separate agreements that speak to and are designed to protect our rights, including those in the fishery, and to include us in decision making on projects that could negatively impact those rights. A

course of action that again allows OPG to make unilateral decisions about the future of our Territory and our rights is not only a broken promise but a broken legal commitment.

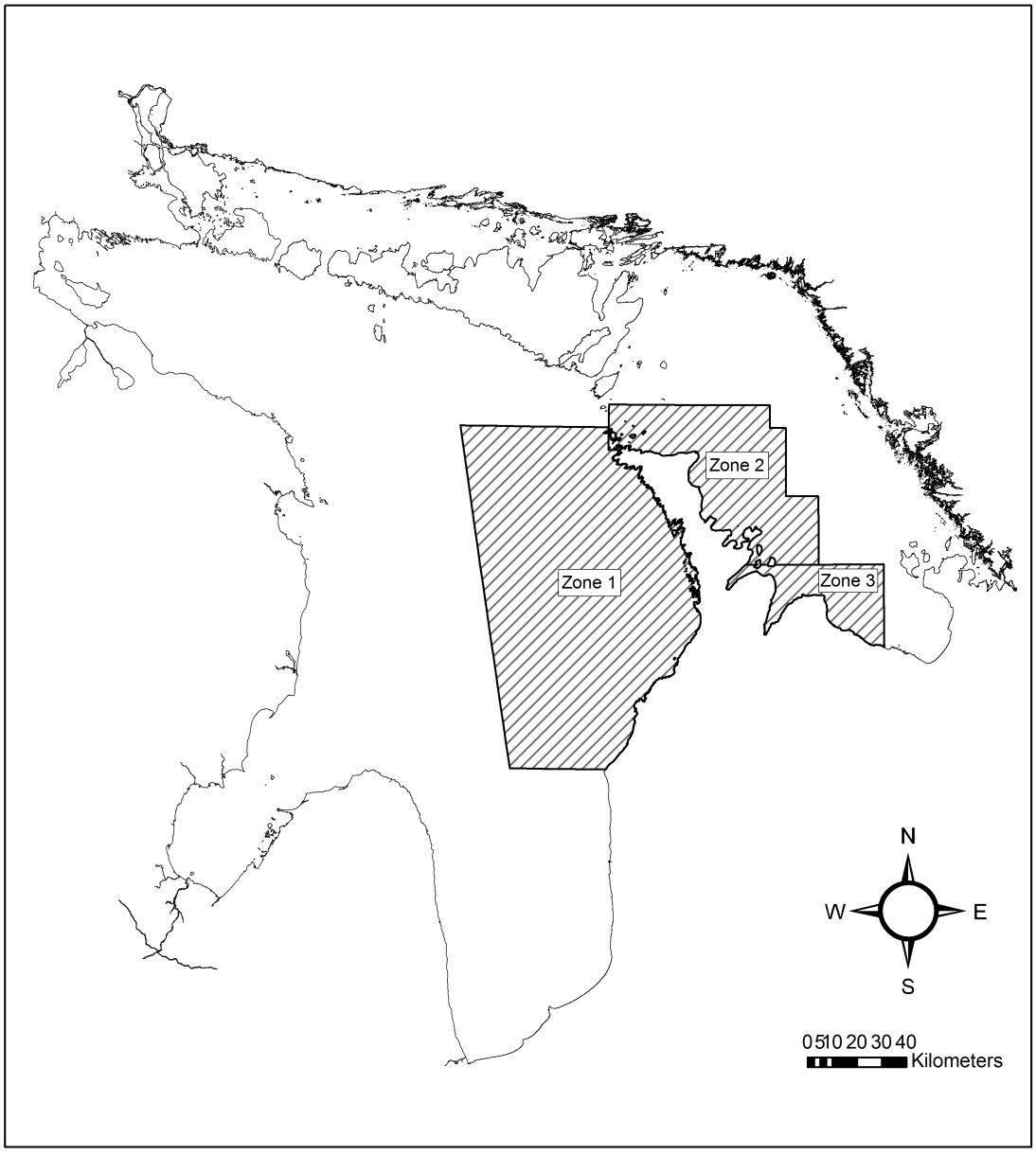
157. No decision should be made that would allow OPG to proceed with its DGR Project in a way that goes against our rights and agreements. This would not be fair, legal or honourable. The only proper way forward to protect SON Rights, interests and way of life is for Ontario and OPG to reconsider the plan for the DGR Project, understand all the dangers posed to SON rights and interests, and include SON in the ultimate decisions these critical decisions.

SWORN BEFORE ME at the)
City of Toronto, in the)
Province of Ontario)
this 15th day of August, 2013)
)

Commissioner for Taking Affidavits
LSUC # 60974J

PAUL JONES

Appendix P



Zone 1 is described as follows: Inside a line beginning at the intersection of the water's edge on the eastern shoreline of Lake Huron (Main Basin) and the parallel of latitude 44°05'N; thence northerly along the western shoreline of mainland Bruce County to its intersection with the parallel of latitude 45°15'N; thence west along that parallel of latitude to its intersection with the line of longitude 81°45'W; thence north along that line of longitude to its intersection with the parallel of latitude 45°20'N; thence west along that parallel of latitude to its intersection with the International Boundary between Canada and the United States of America; thence southerly along that International Boundary to its intersection with the line of latitude 44°05'N; thence east along that parallel of latitude to the place of beginning.