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File: 00216-00531 P
CD#: 00216-CORR-00531-00225
Project ID: 10-60004

Dr. Stella Swanson
Chair, Joint Review Panel
Deep Geologic Repository Project

c/o Canadian Nuclear Safety Commission
280 Slater Street
Ottawa, Ontario
K1P 5S9

Dear Dr. Swanson:

Deep Geologic Repository Project for Low and Intermediate Level Waste – Submission of Response to Information Request EIS-12-510

The purpose of this letter is to provide OPG's response to Information Request (IR) EIS-12-510 from IR Package #12 (Reference 1). The response further clarifies the significance assessments presented in the Environmental Impact Statement and presents a detailed narrative to explain how the significance of each residual adverse effect on the biophysical environment was determined.

The Attachment contains the response to the Information Request.

An updated Tracking Table showing how this submission links to various sections in the documents submitted on April 14, 2011 (References 2 and 3), will be provided by April 4, 2014, as committed in Reference 4.

If you have questions on the above, please contact Mr. Allan Webster, Director, Nuclear Regulatory Affairs, at (905) 623-6670, ext. 3326.

Sincerely,

Laurie Swami
Vice President, Nuclear Services
Ontario Power Generation

Attach.

cc. Dr. J. Archibald – Joint Review Panel c/o CNSC (Ottawa)
Dr. G. Muecke – Joint Review Panel c/o CNSC (Ottawa)
P. Elder – CNSC (Ottawa)
D. Wilson – NWMO (Toronto)

References:

1. JRP letter from Dr. Stella Swanson to Laurie Swami, “Information Request Package #12 from the Joint Review Panel”, November 8, 2013, CD# 00216-CORR-00531-00215.

2. OPG letter from Albert Sweetnam to JRP Chair, “Submission of Information in Support of OPG’s Licence Application for a Deep Geologic Repository for Low and Intermediate Level Waste”, April 14, 2011, CD# 00216-CORR-00531-00090.

3. OPG letter from Albert Sweetnam to JRP Chair, “Submission of an Environmental Impact Statement for a Deep Geologic Repository for Low and Intermediate Level Waste”, April 14, 2011, CD# 00216-CORR-00531-00091.

4. OPG letter from Laurie Swami to Dr. Stella Swanson, “Deep Geologic Repository Project for Low and Intermediate Level Waste – Acknowledgment of Information Request (IR) Package #12”, December 4, 2013, CD# 00216-CORR-00531-00216.

ATTACHMENT

Attachment to OPG letter, Ms. Laurie Swami to Dr. Stella Swanson, "Deep Geologic Repository Project for Low and Intermediate Level Waste – Submission of Response to Information Request EIS-12-510"

March 28, 2014

CD#: 00216-CORR-00531-00225

OPG Response to Information Request EIS-12-510 from Joint Review Panel

OPG Response to Information Request EIS-12-510 from Joint Review Panel

IR#	EIS Guidelines Section	Information Request and Response
EIS 12-510	• Section 11.3 Significance of Residual Effects • Section 2.6 Study Strategy and Methodology	***Information Request:*** ***Significance Determination for Residual Adverse Effects*** *Provide a detailed narrative to explain how the significance of each residual adverse effect on the biophysical environment (Geology, Hydrogeology and Surface Water, Terrestrial Environment, Aquatic Environment, Radiological Conditions, Air Quality, Noise and Vibrations) and on Aboriginal Interests was determined. Provide a separate narrative for each residual adverse effect.* *The narrative must explain the logic behind the significance determinations and is to use context-based reasoning. Arbitrary category limits for criteria such as magnitude are not required. Rather, the context for the predicted measurable change should be explained in sufficient detail that the reader may understand the relative significance of that change in terms of the magnitude, geographic extent, timing and duration, frequency and degree of irreversibility criteria. If the social/ecological context of the adverse effect was also assessed, the rationale for this criterion must be explained. Defensibility is to be provided by references to the literature (peer-reviewed and "grey" literature). Sufficient information must be provided to allow a third party reviewer to understand how the conclusion was reached.* *The narratives provided in the Socio-Economic Assessment are sufficiently clear and do not require further elaboration.* ***Context:*** *In Dr. Duinker's hearing submission (PMD 13-P1.175), he expresses concerns about the lack of transparency of the decision trees and the apparent arbitrariness in professional judgement used to determine significance (pages 5-7 of the PMD). The determination of significance of adverse impacts is fundamental to the environmental assessment. Therefore, the rationale for the determination of significance must be credible, defensible, clear, reliable, and appropriate.* *Narrative Requirements:* • *Clear explanation of the "measurable change" leading to identification of adverse effect in terms of comparison pre and post-impact, and the assumed measurement error. Would the change be detectable using standard monitoring methods? Have similar changes occurred in the study area and would these changes be described as "measurable"?* • *Avoidance of arbitrary low/medium/high categorization in favour of narrative reasoning that is well supported by literature citations and examples from comparable projects. For example, the context for magnitude may include references to the toxicological literature, risk quotients, or population and community monitoring and modelling from comparable projects which have similar effects on the biophysical environment or upon Aboriginal interests.*

IR#	EIS Guidelines Section	Information Request and Response
		• *Avoidance of the "may not be significant" determination. Instead, explain the level of confidence in each of the significance conclusions. The level of confidence must be explained in terms of the precautionary principle; i.e. the application of risk avoidance, adaptive management and preparation for surprise requirements associated with each significance determination. For example, if the assessment team judges that the consequences of being wrong about the significance of a particular effect are such that explicit monitoring, contingency planning, or further risk reduction measures are required, then these measures must be described in association with the significance result.*
		OPG Response: Attachment A presents a detailed narrative explaining how the significance of each residual adverse effect on the biophysical environment was determined in the Environmental Impact Statement (EIS) (OPG 2011). The narrative provides an explanation of the logic used in the significance assessments and further clarifies the significance assessments presented in Sections 7.2.3, 7.3.3, 7.4.3, 7.5.3, 7.6.3, 7.7.3, 7.8.3, and 7.9.3 of the Environmental Impact Statement (OPG 2011). For components of the environment for which no residual adverse effects were identified (i.e., radiation and radioactivity, geology, and surface water quality), information on what would have been required for identification of a significant adverse effect and a discussion of the potential effects of the DGR Project are provided for completeness. The response includes an explanation of "measurable change" leading to the identification of adverse effects for each residual adverse effect. **Reference:** OPG. 2011. OPG's Deep Geologic Repository for Low and Intermediate Level Waste - Environmental Impact Statement. Ontario Power Generation report 00216-REP-07701-00001-R000. Toronto, Canada. (CEAA Registry Doc# 298)

ATTACHMENT A

NARRATIVE EXPLAINING SIGNIFICANCE ASSESSMENTS FOR OPG’S DEEP GEOLOGICAL REPOSITORY PROJECT FOR LOW & INTERMEDIATE LEVEL WASTE

ABSTRACT

The Environmental Impact Statement (EIS) for the Deep Geologic Repository (DGR) Project identified residual adverse effects for air quality, noise, hydrology, the aquatic and terrestrial environments, and Aboriginal interests. Reasoned argument narratives that describe the significance assessments for each identified residual adverse effect are provided in this response. Both the EIS and the enclosed reasoned argument narratives reach the same conclusion, that the DGR Project will not result in any significant adverse environmental effects.

The *Canadian Environmental Assessment Act* contains no legislative direction on what constitutes a significant adverse environmental effect. Section 11.3 of the EIS Guidelines (CEAA and CNSC 2009) required that each residual adverse effect be considered in the categories of the magnitude of the effect, the geographic extent of the effect, the timing and duration of conditions causing the effect, the frequency of the effect, the degree to which the effect is reversible, the social and ecological context, and the probability of occurrence.

In this response, for each residual adverse effect, a hypothesis statement was formulated identifying the conditions that would make a residual adverse effect significant. Following the reasoned narrative, the effect was then judged against these hypotheses. The evidentiary basis for the detailed narratives are contained in the EIS and summarized in this response.

Table A-1 summarizes the residual adverse effects identified, the hypothesis statement, and the overall determination of significance.

Table A-1: Summary of Residual Adverse Effects and Their Significance

Residual Adverse Effect	Hypothesis	Significance Assessment
Hydrology – Section 2		
Reduction in surface water quantity and flow in the existing North Railway Ditch prior to the confluence with Stream C (31%)	For an effect on an existing engineered channel (e.g., a ditch) to be assessed as a significant adverse effect*, a decrease in flow must be sufficient to alter the capacity of the engineered channel through excessive sediment deposition.*	Not significant. The current flow in the North Railway Ditch is already low and the decrease is not expected to increase the amount of sediment deposition such that it will affect the design capacity enough to cause flooding. Additionally, the sediment deposition can be readily addressed through maintenance.
Increase in surface water quantity and flow in the existing drainage ditch at Interconnecting Road (114% during the site preparation and construction phase and 61% during the operations phase)	For an effect on an existing engineered channel (e.g., a ditch) to be assessed as a significant adverse effect, *an increase in flow must exceed the design capacity of the channel sufficiently to cause flooding and/or erosion.*	Not significant. While the predicted increase in flow has the potential to exceed the existing design capacity of the ditch, the flow capacity will be assessed and the ditch re-sized during the final design process, if necessary, to ensure that increases in flow will not cause flooding and/or erosion.
Terrestrial Environment – Section 3		
Loss of eastern white cedar caused by the removal of 8.9 ha of mixed woods	For the loss of eastern white cedar in the Local Study Area to be considered a significant adverse effect, one or more of the following would be required: • *the sustainability and productivity of the local population of eastern white cedar would be compromised;* • *woodland attributes (e.g., edge-area ratio, stand size, shape and age), species or ecological functions that are unique in the Local Study Area would be affected;* • *habitat connectivity and movement within the ecosystem would be disrupted; and/or* • *sustainability in the Local Study Area of other species that have dependence on the specific areas affected (or dependence on the Local Study Area communities containing the VEC) would be*	Not significant. The removal of 8.9 ha of mixed woods is not large enough to affect the sustainability or productivity of eastern white cedar in the Local Study Area and is reversible with time following closure of the DGR Project. The three small, fragmented stands of mixed woods that will be removed are comprised of regenerating common species with no notable age or size characteristics, do not support any sensitive species or provide unique ecological functions that would be lost, and adjacent woodland populations and communities will not be compromised. The loss of the three mixed wood stands will have no measurable effect on regional connectivity or biophysical processes, and will not cause or contribute to fragmentation in the Local Study Area.

Residual Adverse Effect	Hypothesis	Significance Assessment
	compromised by the loss (i.e., they have an obligate dependence).	There are no sensitive wildlife species or wildlife habitat use patterns that could be compromised by the loss.
Aquatic Environment – Section 4		
Removal of burrowing crayfish habitat present in the North Railway Ditch, other drainage ditches and ephemerally wet low areas during site preparation activities	For an effect on aquatic VECs to be considered a significant adverse effect, one or more of the following would be required: • *habitat that is critical to the sustainability and productivity of the aquatic VECs is removed and there is no suitable habitat found elsewhere in the Site Study Area;* • *removal and/or alteration of habitat causes changes to the ecological function of the aquatic community or the aquatic habitat in the Site Study Area; and/or* • *aquatic habitat connectivity and movement of aquatic VECs within the Site Study Area is disrupted.*	Not significant. The area of aquatic habitat loss is not large enough to affect the sustainability or productivity of the local populations of affected aquatic VECs in the Site Study Area. The habitat loss is not expected to cause changes to the ecological function of the aquatic community or the aquatic habitat in the Site Study Area. The habitat loss is not expected to affect watercourse habitat connectivity or disrupt flow movement or migration within the study areas.
Alteration of aquatic habitat for redbelly dace, creek chub, burrowing crayfish, variable leaf pondweed and benthic invertebrates in the South Railway Ditch caused by construction of the rail bed crossing	For an effect on aquatic VECs to be considered a significant adverse effect, one or more of the following would be required: • *habitat that is critical to the sustainability and productivity of the aquatic VECs is removed and there is no suitable habitat found elsewhere in the Site Study Area;* • *removal and/or alteration of habitat causes changes to the ecological function of the aquatic community or the aquatic habitat in the Site Study Area; and/or* • *aquatic habitat connectivity and movement of aquatic VECs within the Site Study Area is disrupted.*	Not significant. The affected habitat is of marginal (non-critical) quality for the aquatic VECs when compared to the quality and availability of habitat elsewhere in the Site and Local Study Area. The habitat alteration is not expected to cause changes to the ecological function of the aquatic community or the aquatic habitat in the Site Study Area. The habitat alteration is not expected to affect watercourse habitat connectivity or disrupt flow movement or migration within the study areas.
Air Quality – Section 5		
Increase in calculated maximum ambient concentrations of 1-hour NO_2, 24-hour NO_2, annual NO_2, 1-hour CO, 24-hour	To have a significant effect on the air quality VEC, *the DGR Project would need to result in ambient air concentrations beyond the Site Study Area that exceed relevant established ambient air quality criteria more than 10% of the time*.	**Site Preparation and Construction and Decommissioning Phases:** Not significant. The predicted maximum ambient concentrations of SO_2, NO_2 and CO do not exceed the relevant ambient air quality criteria beyond the Site Study Area (i.e., the Bruce nuclear site fenceline). The maximum 24-hour ambient

Residual Adverse Effect	Hypothesis	Significance Assessment
CO, 24-hour SPM, annual SPM, 24-hour PM_{10} and 24-hour $PM_{2.5}$		concentrations of $PM_{2.5}$, PM_{10} and SPM were predicted to exceed relevant criteria less than 0.5% of the time, in a relatively small area immediately adjacent to, but beyond, the Site Study Area. **Operations Phase:** Not significant. None of the predicted maximum ambient concentrations exceed the relevant ambient air quality criteria.
Noise – Section 6		
Increase in noise levels at four residences near receptor R2 (Baie du Doré) during the quietest hour.	For a noise effect to be considered a significant adverse effect, *the change in ambient noise would need to be disturbing (i.e., >10 dB change in the quietest hour)*.	Not Significant. Noise effects would not be perceived as disturbing as the predicted change in ambient noise levels at the four residences near Baie du Doré is 5 dB or less. Adverse effects were predicted only during the site preparation and construction and decommissioning phases and only in areas immediately adjacent to the Site Study Area, a short distance into the Local Study Area.
Aboriginal Interests – Section 7		
Diminishment of the quality or value of activities undertaken by Aboriginal peoples at the Jiibegmegoong burial site located within the Bruce	For an effect on Aboriginal heritage resources, specifically the Jiibegmegoong burial site, to be considered a significant adverse effect, *the Project would need to prevent or interfere with the performance of ceremonies at, or observation of, the burial site.*	Not significant. The DGR Project is not anticipated to further restrict access to the burial site for ceremonial purposes or prevent or interfere with ceremonies at the burial site. While the waste rock pile and other Project-related structures will be visible at the burial site, they are not expected to prevent or interfere with ceremonial activities. In addition, indirect effects from noise and dust are expected primarily during the site preparation and construction and decommissioning phases of the project, and would be reversible with time
Radiation and Radioactivity – Section 8		
No residual adverse effects on radiation and radioactivity identified	For a significant adverse effect of radiation and radioactivity to occur, *the DGR Project would need to cause radiological releases that result in doses to human or non-human biota in excess of the relevant Canadian Nuclear Safety Commission (CNSC) regulatory requirements.*	As all predicted doses are less than established dose criteria, no residual adverse effects as a result of radiological releases from the DGR Project were predicted to occur, and no significance assessment was performed.

Residual Adverse Effect	Hypothesis	Significance Assessment
Near-surface Geology and Hydrogeology – Section 9		
No residual adverse effects on near-surface geology and hydrogeology identified	For an effect to near-surface groundwater to be considered a significant adverse effect, the following would be required: • *migration of contaminants of potential concern in excess of established criteria and/or guidelines relevant to human or ecological health, on a frequent and/or continuous basis; or* • *alteration of the shallow groundwater flow regime to an extent that it would alter sensitive or critical habitats on a frequent and/or continuous basis.*	The Project will not have an effect on the overall site groundwater regime or sensitive ecological features located near the site, therefore, OPG concluded that there would be no measurable change to the near-surface geology and hydrogeology that would result in an adverse environmental effect, and thus no residual adverse effects were identified and no significance assessment was performed.
Surface Water Quality – Section 10		
No residual adverse effects on surface water quality identified	For an effect to surface water quality to be considered a significant adverse effect, the following would be required: • *releases of indicator compounds at concentrations in excess of the relevant Provincial Water Quality Objectives or Canadian Environmental Quality Guidelines protective of human or ecological health in receiving waters; or* • *alteration of the surface water quality regime to an extent that it would adversely affect sensitive or critical habitats on a long-term or continuous basis.*	The project design and the commitments made by OPG provide for water treatment where required to meet applicable criteria (OPG 2012, EIS 04 130). The parameters that may need treatment are well understood, common in industrial environments and are easily managed with common treatment technologies. Ensuring that the discharge criteria are met prevents adverse effects on surface water quality. Therefore, OPG concluded that the DGR Project will not result in residual adverse effects to surface water quality and no significance assessment was performed.

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1. BACKGROUND

The response to this Information Request presents the narrative describing the assessment of significance for the residual adverse effects identified through the environmental assessment (EA) for OPG's Deep Geologic Repository (DGR) Project for Low and Intermediate Level Waste and presented in the DGR Project Environmental Impact Statement (EIS) (OPG 2011).

The Information Request asked for a detailed narrative to explain how the significance of each residual adverse effect on the biophysical environment, and on Aboriginal interests, was determined. The EIS identified residual adverse effects for air quality, noise, hydrology, the aquatic and terrestrial environments, and Aboriginal interests. Reasoned argument narratives that support the significance assessments presented in the EIS for each identified residual adverse effect are provided in this response. Although no residual adverse effects were identified for radiation and radioactivity, shallow groundwater and surface water quality, an overview is provided in Sections 8, 9 and 10 respectively to respond to additional direction from the JRP (JRP 2013). For context and completeness, information on what would have been required for identification of a significant adverse effect and a discussion of the potential effects of the DGR Project are provided.

The *Canadian Environmental Assessment Act* contains no legislative direction on what constitutes a **significant** adverse environmental effect. OPG assessed significance for each predicted residual adverse effect according to the categories set out in Section 11.3 of the EIS Guidelines (CEAA and CNSC 2009), including the magnitude of the effect, the geographic extent of the effect, the timing and duration of conditions causing the effect, the frequency of the effect, the degree to which the effect is reversible, the social and ecological context, and the probability of occurrence. In general terms, in the context of existing guidance (FEARO 1994), an adverse effect may be considered significant if it is major or catastrophic, widespread, long-term and/or frequent, or irreversible. Conversely, adverse effects that are inconsequential or minor, localized, infrequent or of short duration, or reversible, may be considered not significant.

A number of methods have been developed to determine significance – technical, collaborative, and reasoned argument (Lawrence 2005). All of the methods incorporate an element of professional judgement (Sippe 1999). Another common feature of the assessment methods is the use of Valued Ecosystem Components (VECs) to represent important ecological features, or features important to stakeholders, consistent with common EA practice (Beanlands and Duinker 1983, CEAA and CNSC 2009). The evidentiary bases for the following detailed narratives are contained in the EIS and corresponding Technical Support Documents (TSDs), and are summarized and cited where appropriate throughout this response. Additional support for the reasoned judgements is taken from available scientific literature, applicable government standards and guidelines and past EAs, including the results of follow-up monitoring programs confirming the conclusions reached in those EAs.

The remainder of this response is organized by environmental component. Each of Sections 2 through 7 begins with a hypothesis statement that states the conditions that would make a residual adverse effect significant, summarizes the significance assessment. Each section outlines the overall approach to the assessment, describes the existing conditions and the potential residual adverse effects, presents a reasoned argument narrative that assesses the significance of the residual adverse effects against the hypothesis statement and discusses OPG's confidence in the conclusions. Sections 8, 9 and 10 each present a brief overview of the assessment for those components where no residual adverse effects were predicted.

1.1 References

Beanlands G.E. and P.N. Duinker. 1983. An Ecological Framework for Environmental Impact Assessment in Canada. Institute for Resource and Environmental Studies, Dalhousie University and Federal Environmental Assessment Review Office. Hull, Canada.

Canadian Environmental Assessment Agency and Canadian Nuclear Safety Commission (CEAA and CNSC). 2009. Guidelines for the Preparation of the Environmental Impact Statement for the Deep Geologic Repository for Low- and Intermediate-Level Radioactive Wastes. Ottawa, Canada. (CEAA Registry Doc# 150).

Federal Environmental Assessment Review Office (FEARO). 1994. A Reference Guide for the Canadian Environmental Assessment Act – Determining Whether a Project is Likely to Cause Significant Adverse Effects. Federal Environmental Assessment Review Office. Hull, Canada.

Joint Review Panel (JRP). 2013. Chair, Deep Geologic Repository Joint Review Panel Letter, S. Swanson to L. Swami, "Ontario Power Generation (OPG) Scope of Work and Proposed Response Dates for Information Request (IR) Package #12", December 6, 2013. (CEAA Registry Doc# 1767).

Lawrence, D. 2005. Significance Criteria and Determination in Sustainability-Based Environmental Impact Assessment. Final Report. Prepared for the Mackenzie Gas Project Joint Review Panel.

Ontario Power Generation (OPG). 2011. OPG's Deep Geologic Repository for Low and Intermediate Level Waste – Environmental Impact Statement. OPG Report 00216-REP-07701-00001 R000. Toronto, Canada. (CEAA Registry Doc #298).

Sippe, R. 1999. Criteria and Standards for Assessing Significant Impact. In J. Petts (ed). Handbook of Environmental Impact Assessment. Blackwell Science. Malden, USA. p. 74-92.

2. HYDROLOGY

This section provides a detailed narrative that explains the significance assessment for surface water quantity and flow (i.e., hydrology). Based on the literature reviewed, and taking into consideration experience from other projects, OPG's hypothesis was that, for an effect on a natural stream to be assessed as a significant adverse effect, *a change to the magnitude of high flow events must be sufficient to alter the geomorphological conditions of the stream, or to alter habitat for sensitive aquatic species on a long-term or continuous basis*. For an effect on an existing engineered channel (e.g., a ditch) to be assessed as a significant adverse effect, *an increase in flow must exceed the design capacity of the channel sufficiently to cause flooding and/or erosion, or a decrease in flow must be sufficient to alter the capacity of the engineered channel through excessive sediment deposition.* Additional information explaining the reasoning behind this hypothesis, including the literature reviewed, is presented in Section 2.1.

The detailed assessment of the potential effects presented in the Hydrology and Surface Water Quality TSD (Golder 2011a, Sections 6, 7, and 8) identified three residual adverse effects of the DGR Project on the hydrology of existing engineered channels. None of those effects were assessed to be significant. No residual adverse effects on the hydrology of natural streams were identified.

2.1 Approach to Assessment

Surface water quantity and flow was chosen as a VEC because surface water features of ecological importance and stakeholder interest (Golder 2011a, Section 4) are present in the Local Study Area.

Changes to surface water quantity and flow in a natural stream can change the rate at which geomorphology, which is the natural process of gradual change to a stream, occurs. Changes to surface water quantity and flow can also alter the channel shape, depth and velocity, which are all components of habitat for aquatic species in rivers and streams (Leopold et al 1964). The "bankfull" flow conditions of a stream are the conditions that are responsible for the bulk of shaping the channels and establishing their location (Leopold et al 1964), the frequency of which can be altered by changing flow in the natural stream. Seasonal flow variations reflect a time period that is consistent with changes to habitat and hydrologic conditions, and maintaining typical seasonal flows will maintain the habitats in and around natural streams (Golder 2011a, Section 4). Changes in the rate of geomorphology or changes that affect habitat for sensitive aquatic species could trigger the need for an authorization under the *Fisheries Act* (Government of Canada 2013) and were therefore classified as being significant effects.

Increases in surface water quantity and flow in an existing engineered channel have the potential to exceed the original design capacity during storm events. If such an increase were to occur, it is possible that flooding and erosion could occur at downstream structures (e.g., culverts) resulting in potential damage and a safety hazard. If surface water quantity and flow were to decrease in an existing engineered channel, it is possible that excessive sediment deposition could occur because the velocities required to prevent sedimentation are not maintained. Excessive sediment deposition would ultimately reduce the capacity of the engineered channel such that flooding could occur under higher flows. Such changes were considered to be significant adverse effects. Engineered channels are typically designed and maintained to have sufficient capacity and resist erosion during storm events (e.g., 25-year return flow) to prevent erosion and/or flooding.

For both natural streams and engineered ditches, the changes in flow were calculated as being directly proportional to the change in drainage area (i.e., it is assumed that there is a linear correlation to the contributing drainage area). The assumption that runoff flow is directly proportional to drainage area is the basis for the Rational Method, which is the most common method to estimate runoff for small urban and rural watersheds (Viessman 1989), and has been used in North America since 1889 (Kuichling 1889). Annual average flow was estimated at the DGR Project site by pro-rating long-term data from other local gauged watersheds.

For the purposes of the assessment, any predicted change in flow as a result of the DGR Project was considered to be a measurable change. For changes in flow to be considered adverse, the change would need to be sufficiently large to be accurately detected using standard stream flow measurement techniques. For streams within the study area, a change of ±15% in stream flow was sufficient to be accurately measured, and thus considered an adverse effect (Golder 2011a, Appendix C).

2.2 Existing Conditions

Figure 2-1 shows the location of the existing surface water features in the Site Study Area. The figure illustrates the natural feature (i.e., Stream C) potentially affected, as well as the various man-made ditches, including the drainage ditch at Interconnecting Road and the North Railway Ditch that extend beyond the DGR Project site.

The Site Study Area is primarily drained by a network of constructed ditches and drains that have been divided into several drainage areas, as shown on Figure 2-2. The DGR Project site is largely located within the MacPherson Bay South Drainage Area, and its runoff drains into MacPherson Bay via the drainage ditch at Interconnecting Road. The remaining portion of the DGR Project site is currently drained by the North Railway Ditch and Stream C, which eventually discharge to Baie du Doré. The DGR Project site is isolated from receiving flows from other parts of the Bruce nuclear site by the existing ditch system (OPG 2012a, EIS-07-299). The only drainage areas receiving flows from the DGR Project Area are the MacPherson Bay South and Stream C catchments.

Stream C is a former tributary of the Little Sauble River that was diverted to Baie du Doré during the initial development of the Bruce nuclear site. The stream enters the Site Study Area via a culvert under Tie Road and transects the southeast corner of the Project Area. The existing drainage area of Stream C is 1,042.4 ha with an average annual flow of 144.6 L/s (Golder 2011a, Table 5.4.3-2). The existing 2-year return (bankfull) flow for Stream C is estimated to be 2,090 L/s (OPG 2000).

The North Railway Ditch (Figure 2-1) flows eastward towards Stream C adjacent to the abandoned rail bed and South Railway Ditch. The North Railway Ditch is similar in size to the South Railway Ditch, which has a wetted channel width of 3 m and top of the bank width of 5 m (OPG 2005). The North Railway Ditch is a straight channel filled with thick stands of cattails. The ditch drains 26.1 ha but is often dry, only conveying water after large rainfall events and during the spring snow melt. The average annual flow of the North Railway Ditch is 3.6 L/s.

The drainage ditch at Interconnecting Road drains a portion (41.3 ha) of the MacPherson Bay South Drainage Area. The ditch is approximately 1.5 m deep near Interconnecting Road and the depth gradually increases as it nears MacPherson Bay. Further upstream, the ditch is barely distinguishable from the surrounding terrain. Most of the ditch bottom is either grass lined (swale) or filled with cattails. The section immediately downstream of Interconnecting Road has been lined with cobbles to reduce erosion during large rainfall events. This ditch conveys an average flow of 5.7 L/s under Interconnecting Road via three culverts that were observed to be partially

Drainage Ditch at Interconnecting Road blocked with sediment and aquatic plants during a site visit in 2007.

The marsh located in the northeast portion of the Project Area is likely the result of precipitation being retained in a shallow depression. There are no inflows to the marsh other than surface runoff from a small catchment of approximately 3 ha. The only outflow of the marsh is intermittent discharge over a sill located in the northwestern area. It is expected that marsh drainage only occurs when the water levels in the marsh exceed the sill elevation. This outfall connects to the drainage ditch at Interconnecting Road.

2.3 Description of Potential Effects

The project was determined to affect the surface water quantity and flow VEC as a result of the drainage area diversion from the Stream C watershed to MacPherson Bay (approximately 8 ha, shown as a hatched area on Figure 2-2), increasing the flow to the existing drainage ditch at Interconnecting Road. Flow in the North Railway Ditch and Stream C will decrease as a result of the diversion. A further increase in the average annual flow to the drainage ditch at Interconnecting Road is predicted to occur as a result of shaft excavation and sump pumping during construction and operations. The predicted changes in flow were calculated by pro-rating flows with change in drainage area and adding discharges from shaft excavation and sump pumping (see Table 2-1). There will be no changes in flow in the South Railway Ditch from the DGR Project.

Table 2-1: Predicted Flow Change from Drainage Diversion and Sump Pumping

Surface Water Feature	Existing Average Annual Flow (L/s)	Change in Flow from Drainage (L/s)	Change in Flow from Pumping (L/s)	Total Predicted Flow (L/s)	Total Change in Flow (%)	Adverse
Stream C at point of discharge from the Bruce nuclear site	144.6	–1.2	0	143.4	-0.8	No
North Railway Ditch at Stream C	3.6	–1.1	0	2.5	-31	Yes
Drainage Ditch at Interconnecting Road	5.7	+1.2	+5.3 [a]	12.2 [a]	+114 [a]	Yes [a]
			+2.3 [b]	9.2 [b]	+61 [b]	Yes [b]

Source: From Table 8.2.3-1 in the Hydrology and Surface Water Quality TSD (Golder 2011a)
Notes: [a] During site preparation and construction; [b] During operations

The decrease in the drainage area of Stream C is calculated to be 0.8%, decreasing the average annual flow to 143.4 L/s. This predicted change is not considered to be adverse as it is less than ±15%.

A decrease in flow in the North Railway Ditch of 31% is predicted as a result of the drainage diversion. As this change is greater than ±15%, it is considered to be an adverse effect.

When the effect of shaft dewatering is combined with the change in flow from drainage diversion, a 114% increase in flow in the existing drainage ditch at Interconnecting Road is predicted to occur during the site preparation and construction phase, and a 61% increase in flow is predicted to occur during the operations phase (see Table 2-2). As these changes are both greater than ±15%, they are considered to be adverse effects.

The potential for the DGR Project to affect the surface water quantity and flow VEC also considered indirect effects through changes to groundwater flow (Golder 2011a, Section 7.2.2). It was predicted that changes in groundwater levels would not be measureable at any of the surface water features, as the estimated zone of influence during dewatering to support shaft construction will not approach any surface water features (OPG 2012b, EIS-03-55; OPG 2012a, EIS-07-298). As discussed in Section 9, there are no adverse effects on surface water quantity and flow as a result of changes to near-surface groundwater.

Since the drainage diversion that redirects flows from the Stream C catchment towards the drainage ditch at Interconnecting Road does not include the local catchments surrounding the northeast marsh, no effects on the surface water quantity in the marsh (inflow) are anticipated as a result of the project (OPG 2013a, EIS-09-413; OPG 2013b, EIS-10-491). There are no aspects of the DGR Project that will encroach on the marsh, nor are there any discharges to the marsh. As described in Section 9 of this response, weathered/fractured tills that could increase vertical connectivity to groundwater are not expected at the site; however, OPG would line the stormwater management pond should such conditions be encountered (OPG 2011, Section 4.4.1.5). This would prevent increased infiltration and decrease in available water in the northeast marsh. Therefore, no adverse effects on hydrology in the marsh were identified.

The North Railway Ditch also provides marginal/secondary habitat for burrowing crayfish that do not rely on open water. As described in Section 4, the aquatic environment assessment determined that the decrease in flow in the North Railway Ditch is not expected to adversely affect the habitat for burrowing crayfish in the Site Study Area (Golder 2011b, Section 7.5.2.1).

In summary, adverse effects to surface water quantity and flow of the existing drainage ditch at Interconnecting Road and North Railway Ditch were predicted to occur during all project phases. Several mitigation measures to avoid or minimize surface water quantity and flow effects were included in the design of the project.

- The project footprint and stormwater management system (drainage ditches and stormwater management pond) were designed to minimize changes in drainage areas, specifically the potential of the project to divert flows to and from Stream C.
- The project includes lining of the shafts to reduce the quantity of water pumped to the stormwater management pond. Lining of the shafts and underground operation as a dry facility will minimize the flow increase predicted in the drainage ditch at Interconnecting Road.

In addition, any increased sediment deposition caused by the decrease in flow predicted in the North Railway Ditch can be readily addressed through ongoing maintenance practices, although no credit was taken in the assessment for such maintenance.

Because the likely adverse effects predicted in the drainage ditch at Interconnecting Road and the North Railway Ditch remain after consideration of mitigation measures, they were classified as residual adverse effects.

2.4 Significance of the Residual Adverse Effects

Based on the categories set out in the EIS Guidelines, the residual adverse effects of the DGR Project on the surface water quantity and flow VEC can be described as follows:

- **Magnitude**: Changes in flows are predicted as follows:
    - A 31% decrease in the flow in the North Railway Ditch.
    - A 114% increase in the flow in the existing drainage ditch at Interconnecting Road during site preparation and construction.

    - A 61% increase in the flow in the existing drainage ditch at Interconnecting Road during operations.
- **Geographic Extent**: The effects are restricted to the Site Study Area, which comprises only a small portion of the local watershed area. The effects do not extend into Stream C or Lake Huron beyond the point of discharge.
- **Timing and Duration**: The changes in flow are predicted to occur throughout all project phases.
- **Frequency**: Effects of the above magnitude will occur during high flow events caused by storms and snowmelt runoff.
- **Reversibility**: The changes in flow can be reversed. Following decommissioning, water will no longer be pumped from the repository; however, at this time the flow diversion is expected to remain in place.
- **Probability**: The changes in flows will occur should the project proceed.
- **Context**: There were no adverse effects predicted in Stream C (a natural stream); adverse effects are only predicted in engineered ditches.

The North Railway Ditch is often dry, only conveying water after large rainfall events and during the spring snow melt. The predicted 31% decrease in annual average flow (from 3.6 L/s to 2.5 L/s) has the potential to result in some increase in sediment deposition over time in the North Railway Ditch. This increase in the rate of sediment deposition would not be sufficient to rapidly alter the capacity enough to cause flooding. Although no credit was taken in the assessment for maintenance, excessive sedimentation will be addressed through ongoing maintenance practices, if necessary.

The increase in flow predicted in the drainage ditch at Interconnecting Road is considered an adverse effect that could exceed the carrying capacity of the present ditch. Although not part of the project design assessed in the EIS, OPG has committed (OPG 2013a) to undertake a detailed design study to evaluate whether the design capacity of the drainage ditch at Interconnecting Road could be exceeded. The ditch will be modified in accordance with accepted practices (e.g., Ministry of Transportation drainage management manual [MTO 1997]), and undergo regular maintenance if current ditch conditions cannot convey the predicted flows (e.g., control of unwanted vegetation) (OPG 2013a). With design modifications, if necessary, the increased flow will not result in flooding or erosion. Therefore, with the OPG commitment to mitigative actions, the effects of increased flows in the drainage ditch at Interconnecting Road are considered to be not significant.

Several past and existing projects/activities and one reasonably foreseeable project (Bruce B refurbishment, continued operations, decommissioning and safe storage) were identified as having potential to act cumulatively with the DGR Project on hydrology. None of these projects or activities were predicted to affect surface water quantity and flow in the drainage ditch at Interconnecting Road or the North Railway Ditch. The DGR Project will not act cumulatively with other projects/activities to affect surface water quantity and flow.

Consideration was also given to whether the effects assessment conclusions on surface water quantity and flow are sensitive to changes in climate conditions (OPG 2011, Section 7.14). Since changes in current flows are proportional to drainage area, changes in future flows, regardless of changing climatic conditions would also be proportional. Therefore, it was concluded that changing climate would not alter the predicted adverse effects of the project. While future climate conditions may result in storm events that exceed the current design capacities, such changes in climate are expected to be gradual. This provides time to modify the engineered drainage features such that they will continue to serve their design purpose.

In summary,

- Residual adverse effects were only predicted for two existing engineered channels, the North Railway Ditch and the drainage ditch at Interconnecting Road. No residual adverse effects were predicted for any natural streams.
- For the North Railway Ditch, the predicted adverse effect was assessed against a hypothesis that, in order to be significant, *a decrease in flow must be sufficient to alter the capacity of the channel through excessive sediment deposition*. The current flow in the North Railway Ditch is already low and the decrease is not expected to increase the rate of sediment deposition such that it will rapidly alter the capacity enough to cause flooding. Excessive sediment deposition can be readily addressed through maintenance.
- For the drainage ditch at Interconnecting Road, the predicted adverse effects were assessed against a hypothesis that, in order to be significant, *increases in flow must exceed the design capacity of the channel sufficiently to cause flooding and/or erosion*. While predicted increases in flow have the potential to exceed the existing design capacity of the ditch, the flow capacity will be assessed and the ditch re-sized during the final design process, if necessary, to ensure that increases in flow will not cause flooding and/or erosion.

Therefore, OPG concluded that the residual adverse effects of the DGR Project on hydrology (i.e., surface water quantity and flow) are not significant.

2.5 Confidence

OPG has a high degree of confidence in the conclusion that the changes in flows predicted to occur as a result of the DGR Project are not significant. The significance conclusion is founded on well-established methods for determining the potential change to surface water flow arising from the changes to the site topography that are planned to occur.

The predicted increases in flow are conservatively estimated in accordance with the precautionary principle. The estimated flows from dewatering during excavation and sump pumping during operation are the maximum flows used to size the pumps. The actual flows are expected to be lower, resulting in a smaller increase of flow in the drainage ditch at Interconnecting Road.

From a hydrological perspective, change of flow for surface water features in small drainage areas can be reasonably estimated by pro-rating the existing flow by the anticipated change in drainage area (Viessman 1989, Kuichling 1889). This method has some inherent uncertainty, mostly attributed to the drainage areas calculated for the existing and future cases. However, the margin of error can be calculated to confirm prediction confidence. A potential error on the order of ±2 m × [perimeter] can be assumed when delineating drainage areas (OPG 2012c, EIS-05-190). Consequently, the drainage areas (existing and future) contributing flow to the North Railway Ditch at Stream C would have errors of ±0.78 ha. Based on these uncertainties, the existing drainage area could range from 17.1 to 18.7 ha and the change in drainage area between existing and future conditions could range from 6.6 to 9.8 ha. These values would imply that the decrease in drainage area is expected to be between 25% and 38%. The significance conclusion for the North Railway Ditch would remain the same (i.e., not significant). The corresponding range in predicted decrease in flow in Stream C is expected to be between 0.6% and 0.9% which would also not change the conclusions reached.

2.6 References

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OPG. 2013a. OPG Letter, A. Webster to S. Swanson, "Deep Geologic Repository Project for Low and Intermediate Level Waste – Submission of Commitments Report", CD# 00216-CORR-00531-00197, July 19, 2013. (CEAA Registry Doc# 1238)

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2.7 Figures

Figures are provided on the following pages.

Figure 2-1: Key Surface Water Features of the Bruce Nuclear Site

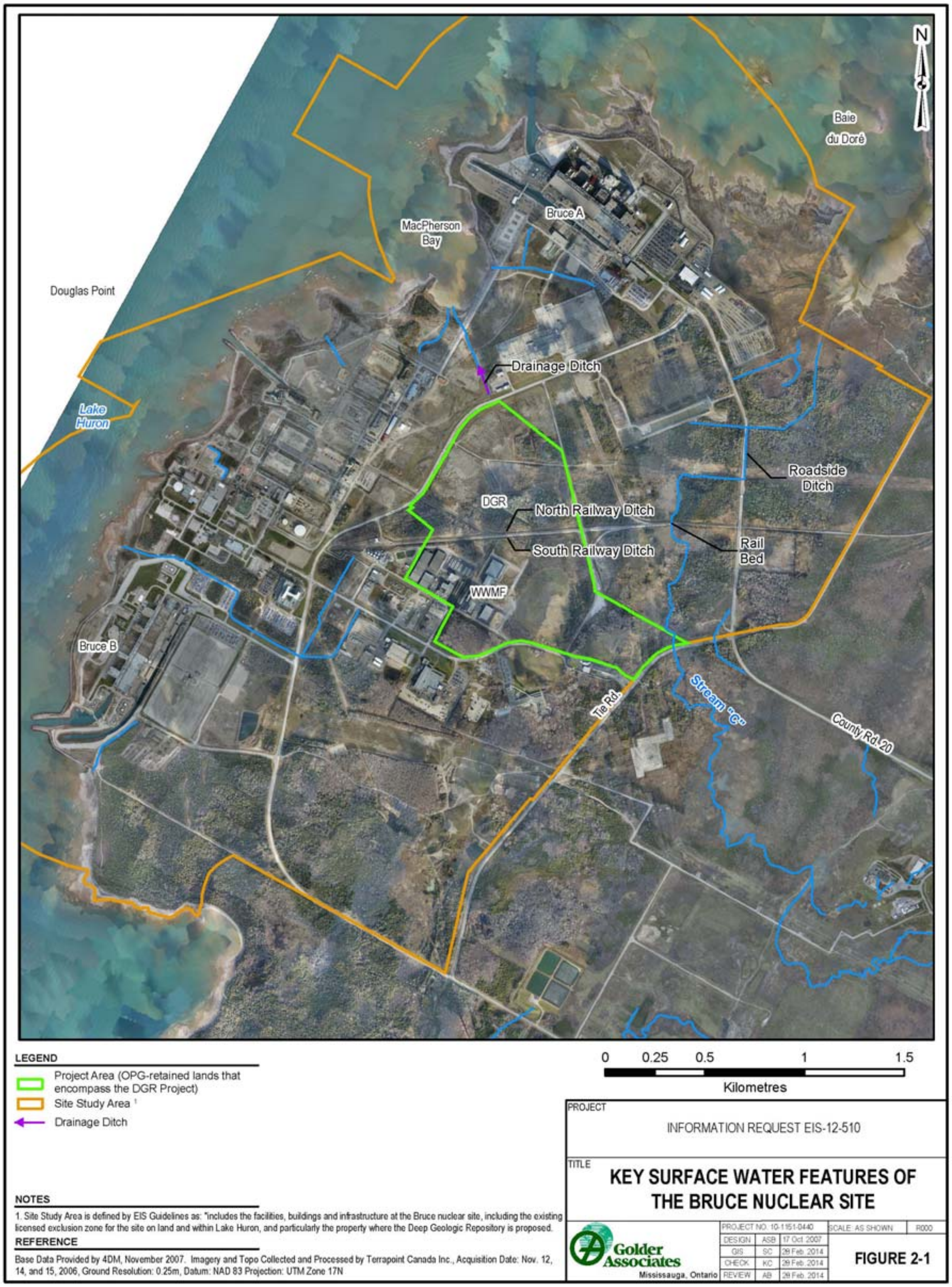
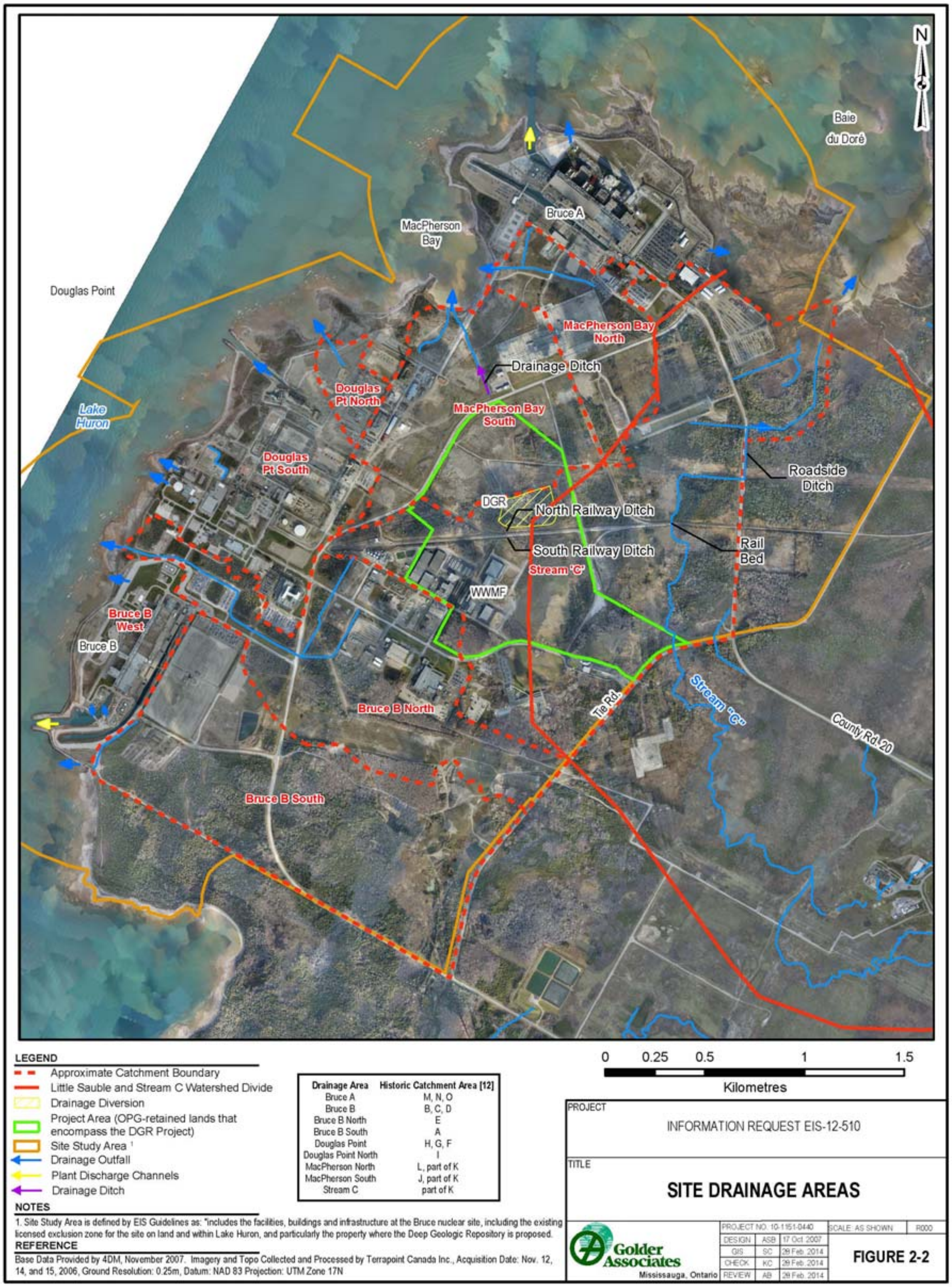


Figure 2-2: Site Drainage Areas



3. TERRESTRIAL ENVIRONMENT

This section provides a detailed narrative that explains the significance assessment for the terrestrial environment, specifically a loss of eastern white cedar. Based on the literature reviewed and taking into consideration experience from other projects, OPG's hypothesis was that, for the loss of eastern white cedar in the Local Study Area to be considered a significant adverse effect, one or more of the following would be required:

- *the sustainability and productivity of the local population of eastern white cedar would be compromised;*
- *woodland attributes (e.g., edge-area ratio, stand size, shape and age), species or ecological functions that are unique in the Local Study Area would be affected;*
- *habitat connectivity and movement within the ecosystem would be disrupted; and/or*
- *sustainability in the Local Study Area of other species that have dependence on the specific areas affected (or dependence on the Local Study Area communities containing the VEC) would be compromised by the loss (i.e., they have an obligate dependence).*

The reasoning behind the above hypothesis, including the literature reviewed, is presented below in Sections 3.1, 3.3 and 3.4.

The detailed assessment of potential effects presented in the Terrestrial Environment TSD (Golder 2011) identified only one residual adverse effect of the DGR Project on the terrestrial environment VECs; the removal of mixed wood forest containing eastern white cedar. This effect was assessed to be not significant.

3.1 Approach to Assessment

A detailed assessment of the potential effects was presented in the Terrestrial Environment TSD (Golder 2011, Sections 6, 7 and 8). Eastern white cedar was one of thirteen VECs identified for the terrestrial environment. These VECs were chosen using factors such as presence and abundance in the study areas, ecological importance, expressions of stakeholder interest, and past precedents in other EAs conducted on the Bruce nuclear site (Golder 2011). These VECs also represent indicators of ecosystem functions or important receptors in the ecosystem, which may be affected by the project.

Consideration of ecological context is important in determining the nature of any effect on the terrestrial environment. One purpose of the effects assessment is to establish the effects of the project on the maintenance of self-sustaining and ecologically functional populations and communities. Self-sustaining plant populations (and communities) can be considered as healthy, robust populations capable of withstanding environmental change and accommodating random population processes (Reed et al. 2003). The potential effects of the DGR Project on the eastern white cedar VEC were examined both from the perspective of sustainability of the individual populations of eastern white cedar, and within the context of other woodlands in the larger system as it relates to habitat diversity, connectivity and wildlife habitat utilization. For example, eastern white cedar dominated woodlands are preferred by white-tailed deer for shelter in the winter.

Consideration of ecological resiliency, or the capacity of the system to absorb disturbance and reorganize and retain the same structure, function and feedback responses (Holling 1973, Gunderson 2000), is also important in determining the nature of any effect on the terrestrial environment. Population resilience can be considered to share similar features as ecological resilience. This is because adaptability influences the ability of the population to absorb or recover from change. Eastern white cedar in the Regional Study Area is generally resilient and tolerant of a broad range of environmental conditions including changing climate and anthropogenic disturbance in the Regional Study Area, partially because it is in the middle of its range (Farrar 1995; McKenney et al. 2007). It is also a hardy species that expanded northward very rapidly after the last glacial period, is known to rapidly take over burned alvar habitats or barrens in the Great Lakes ecosystem (Riley 2013), and recovers quickly after disturbances on relatively shallow soil over limestone bedrock.

There are few absolute effects thresholds for plants and animal species available in literature or established guidelines, and biological parameters are typically subject to large amounts of natural variation. Consequently, the classification of effects for terrestrial VECs is based on quantitative and qualitative analyses, relevant information from the scientific literature on life history characteristics and known effects thresholds, experience from previous EAs and monitoring programs, and professional judgement. For the purposes of the EIS, an effect was considered to be a measurable change if it could be quantified through air photo overlays of the footprint of the project on Ecological Land Classification (ELC) community mapping boundaries.

3.2 Existing Conditions

To understand the importance of changes in the abundance and distribution of plant populations and communities, and their ability to remain self-sustaining, the local terrestrial ecological features need to be put into context with the landscape ecosystem.

Eastern white cedar is a prominent component of conifer and mixed woods throughout the Regional Study Area (and generally throughout southern Ontario) and contributes to a number of ecological functions in the surrounding landscape. For example, it provides a large portion of the tree canopy cover in conifer and mixed woods in all of the forest stands that are present in the immediate vicinity of the DGR Project, as well as in many of the forest stands on Douglas Point, in Kincardine Township[1], major stretches of the Lake Huron Shoreline and in the area occupied by Bruce and Grey Counties (S.L. Ross Environmental Research et al. 1990). It has a broad ecological amplitude, occurring on both dry and wet sites and on organic and mineral soils, particularly shallow soils over carbonate bedrock (Farrar 1995).

The Local Study Area, shown on Figure 3-1, represents the scale where regional ecological processes interact with the natural features and wildlife using the Bruce nuclear site. With the exception of Douglas Point (including the Bruce nuclear site and Inverhuron Provincial Park), which extends into Lake Huron on a peninsula, the Local Study Area is dominated by two major landscape elements. The first includes the Lake Huron shoreline and adjacent relatively contiguous terrestrial corridor comprised of forests (which are dominated by eastern white cedar), wetlands and valley features. The terrestrial corridor varies in width, from less than 0.5 km (particularly south of the Bruce nuclear site) up to approximately 1 to 2 km in and around the Douglas Point Peninsula, and up to approximately 4 km in the vicinity of MacGregor Point Provincial Park to the north. The remainder of the Local Study Area (approximately 75% to 80%) comprises open farmland, interspersed with infrastructure corridors (transmission and road), rural settlement areas and isolated patches of forest cover associated primarily with stream corridors.

The Site Study Area, shown on Figure 3-2, corresponds to the Bruce nuclear site and its exclusion zone. From an ecological perspective, this area contains the extent of potential direct effects from the project on the terrestrial environment. The Site Study Area is characterized as a fragmented and disturbed landscape, dominated by industrial facilities associated with the Bruce nuclear site, with barrens, regenerating wooded areas (which include eastern white cedar) and wetland patches. The habitat composition of the Project Area (OPG-retained land within the centre of the Bruce nuclear site, also shown on Figure 3-2) is similar except it is less diverse and does not include the Lake Huron shoreline.

[1] Kincardine Township amalgamated with the Town of Kincardine and Township of Bruce in 1999.

The wooded areas in the DGR Project Site, (the footprint of all facilities associated with the project within the Project Area), comprise three small separate stands (total area of 8.9 ha) of regenerated mixed woods, dominated by common, resilient species such as eastern white cedar, balsam poplar, white birch and trembling aspen. The understory is dominated by choke cherry and dogwood. Each stand is less than 4 ha in area, within which eastern white cedar is co-dominant. These stands are not a part of the Lake Huron Fringe Deer Yard, which is located to the southeast of the Project Area, and they are also peripheral to a Natural Heritage System identified for the surrounding area (North-South Environmental and Dougan and Associates 2009). No plant species of conservation concern have been identified within the DGR Project site (Golder 2011, Section 5.4.1).

Mixed Wood Forest Containing Eastern White Cedar in the Project Area

3.3 Description of Potential Effects

The assessment concluded that clearing of the DGR Project site during site preparation is likely to cause an adverse effect to the eastern white cedar VEC (Golder 2011, Sections 6, 7, 8). Likely adverse effects on the eastern white cedar VEC were assessed through changes to the indicators and measures, including the area of vegetation communities and the presence, distribution and abundance of plant species. Multiple pathways of effect, based on project infrastructure and activities, were evaluated to determine which have the potential to adversely affect the eastern white cedar VEC (Golder 2011, Sections 6, 7, 8).

The project will affect eastern white cedar through direct removal of 8.9 ha of mixed woods, which include eastern white cedar. The 8.9 ha of mixed woods to be removed represents the only woodland affected by the DGR Project. This loss was considered to be a measurable change as it is readily quantifiable and detectable. The 8.9 ha represents 77.4% of the 11.5 ha of mixed wood in the total DGR footprint, 11.3% of mixed wood in the Site Study Area, and much less than 1% of the woodland in the Local Study Area. Even though the area of mixed wood forests removed (8.9 ha) was relatively small in the context of the Site Study Area, this was considered a potential adverse effect because the removal could potentially interrupt local wildlife habitat use patterns.

The Local Study Area represents the geographic scale at which the functions of sustainability, continuity, wildlife movement and abundance of the mixed woods containing the eastern white cedar population can be interpreted. For instance, one of the broadest scale ecological functions of eastern white cedar in mixed woodlands is the provision of movement corridors for larger, wider ranging wildlife species. The Local Study Area was selected as the appropriate scale to consider major elements of the woodland corridor along the Lake Huron shoreline because, if interrupted, it would have measurable effects on larger wildlife such as white-tailed deer. This scale is also important for maintenance of plant and wildlife species diversity and for local populations of smaller wildlife that require linked home ranges for genetic viability. Residual adverse effects at this scale are considered to influence woodland ecosystem sustainability throughout the region.

Although not extensive, there is some support in literature for a loss of 10% of plant populations as the threshold of measurability at a local scale, such as the Local Study Area for the DGR Project

(Krebs 1972, Cohen cited in Munkittrick et al. 2009). The project represents a loss of much less than 1% of the forest cover (containing eastern white cedar) in the approximately 21,700-ha Local Study Area. The implications of this loss on population sustainability, and other ecological functions such as wildlife habitat provision, are likely to be marginal. However, as it is a loss of forest habitat, and because subtle changes in ecological functions may be difficult to detect (Osenberg et al. 1994), the loss was conservatively considered to be an adverse effect.

In addition to the loss of eastern white cedar during site preparation and construction, the potential for the DGR Project to affect other eastern white cedar through changes to air quality, groundwater, surface water and soil quality, individually and in combination, was also assessed. These changes are not considered likely to cause any additional or combined loss in the quantity or quality of eastern white cedar in the Local Study Area, and therefore, will not have an adverse effect on the remaining eastern white cedar (Golder 2011, Sections 7.2.2 and 8.2.2.2, OPG 2013).

The only identified adverse effect on the eastern white cedar VEC was the direct removal of 8.9 ha of mixed wood forest. Several suitable mitigation measures to minimize the loss of both species and habitat associated with the mixed woods clearing were considered. Opportunities to retain tree cover will be investigated where possible. Where retention is not possible, exclusionary fencing to prevent additional loss of or effect on specimens and habitat during construction will be installed surrounding the DGR Project site within the Project Area. These mitigation measures, however, do not avoid the loss of 8.9 ha of mixed woods on the project site, resulting in a residual adverse effect on the eastern white cedar VEC.

Rehabilitation after decommissioning of the DGR Project may include both active and passive naturalization of the Project Area to provide additional suitable habitat, similar to that currently provided by the eastern white cedar. OPG chose to consider rehabilitation of the project site as a characteristic of reversibility in the significance assessment instead of as a mitigation measure.

3.4 Significance of the Residual Adverse Effects

Based on the categories set out in the EIS Guidelines, the residual adverse effects of the DGR Project on eastern white cedar can be described as follows:

- **Magnitude**: The predicted loss of mixed wood forest containing eastern white cedar is estimated to be 8.9 ha.
- **Geographic Extent**: The extent of the mixed wood forest containing eastern white cedar to be lost is measured in terms of area. In terms of location and condition, it is isolated and fragmented inside a large industrial complex (limited to the Site Study Area).
- **Timing, Duration and Frequency**: The effect will begin immediately and fully at commencement of project construction and remain in full effect until rehabilitation following project closure. Thus, the effect is continuous from the beginning of the site preparation and construction phase through to the end of the operations phase.
- **Reversibility**: Upon completion of the project, rehabilitation plans include re-establishment of high-quality mixed wood habitats containing large portions of eastern white cedar on the site.
- **Probability**: The effect is certain to occur if the project proceeds as planned.
- **Context**: Within the ecologically meaningful context of all the woodland in the Local Study Area, the mixed woods to be lost represent much less than 1% of the total woodland.

The removal of 8.9 ha of mixed woods is not large enough that the population of eastern white cedar in the Local Study Area would no longer remain sustainable and productive. As noted in Section 3.3, for an effect at the scale of the Local Study Area, some literature supports a 10% reduction as being the smallest level of loss that would be considered to have a measurable effect on plant populations

(Krebs 1972, Cohen cited in Munkittrick et al. 2009). Based on additional literature, losses of vegetation communities (e.g., mixed wood forest) of greater than 20% to 30% are high in magnitude and could be significant effects (Suter et al. 1995, Lande 1987, Flather and Bevers 2002) and may influence long term stability, sustainability and productivity of the ecosystem. The magnitude of the predicted residual adverse effect from the DGR Project, the loss of 11% of the mixed woods ecotype in the 1,034 ha Site Study Area, which amounts to less than 1% of the forest cover in the approximately 21,700 ha Local Study Area, would not affect plant population sustainability and productivity.

For the DGR Project, the extent of the loss is restricted to the Project Area, which is a small portion of the Site Study Area. While the loss of the mixed wood forest in that location extends for the duration of the DGR Project, eastern white cedar is a resilient species and the communities in the Site Study Area have been sustained through a number of human related disturbances followed by regeneration in idle or newly created landscape elements. Relatively few individual specimens (less than 100 in a stand) of eastern white cedar are required for minimum population viability and genetic conservation (Lemieux 2010). This suggests that the effect of removing 8.9 ha of mixed woods in the Project Area will not affect the sustainability of the eastern white cedar in the Local Study Area as there is sufficient area of mixed woods remaining and the effect will be reversible with time.

Support for the conclusions on sustainability and productivity may be found in the planning framework used in Ontario. For most industrial and residential land use approvals in southern Ontario, woodlands are assessed through municipal and provincial criteria in environmental impact studies. Ontario's Provincial Policy Statement (PPS) and the Natural Heritage Reference Manual, which guides its implementation, deals with the identification of significant woodlands, and encroachments or disturbances to significant woodlands (OMNR 2010). The potential for woodlands to be considered significant is related to minimum size criteria based on the amount of forest cover in a given region or watershed (e.g., if the woodland is about 15% to 30% of the land cover in a region, woodlands 20 ha or larger could be considered for significance). If potentially significant, a certain level of removal or encroachment may still be allowed, subject to an environmental impact analysis that considers specific ecological attributes of the woodland, the surrounding area and other values such as wildlife use. Using this framework, the mixed woods to be removed as a result of the DGR Project would not be considered significant, nor would any of its related attributes constrain the proposed land use (i.e., the woodlots affected are not part of a >20 ha woodlot).

The affected area does not contain unique features, species or ecological functions within the Local Study Area. In Nova Scotia, where eastern white cedar is rare, conservation priority is placed on large contiguous stands as opposed to more numerous but smaller stands (Lemieux 2010). In Ontario, where eastern white cedar is common, unique woodland attributes such as edge-area ratio, stand size, shape, age, species and connectivity are important in determining the significance of a loss or disturbance, as well as the sensitivity of a population (OMNR 2010, Noss 1995, Diamond and May 1981). At the DGR Project site, the wooded area lost comprises immature regenerating mixed woods that contain no unique or significant tree species. At the Site, Local and Regional Study Area scales, these three stands of mixed woods are small, young, isolated, and contribute no genetic or movement corridor functions north-south along the shoreline forest communities, nor between the shoreline and inland areas (the three patches that will be lost are shown in brown on Figure 3-1). The affected areas are marginal to the core of the natural heritage system, which are already affected by adjacent anthropogenic activities, their utilization by wildlife is low and their functional contribution to the system is small. The largest and least fragmented forests in the Site Study Area are located approximately 1 to 2 km south of the Project Area, contiguous with Inverhuron Provincial Park (EC 2013, and as shown on Figure 3-2). The stands to be removed are already fragments from the larger system. The removal therefore does not contribute to additional fragmentation, including any cumulative fragmentation effects, which are known to affect population viability (Aguilar et al. 2006).

The affected area is not positioned in the landscape such that its loss may affect habitat connectivity and disrupt flow and movement within the ecosystem. No species are dependent on the affected areas such that their sustainability in the Local Study Area could be compromised by the loss (i.e., they have no obligate dependence). Although eastern white cedar can be an important species for some birds and as winter refuge for white-tailed deer, it does not provide preferred habitat to many wildlife species relative to other tree species (Martin et al. 1951). There are no expected negative effects to area sensitive breeding bird species or migratory bird species of conservation concern resulting from the loss of the mixed woods (EC 2013). Neither the white-tailed deer nor wild turkey VECs have habitat limitations or strong dependencies on the 8.9 ha of mixed woods at this location that would make its loss more significant or consequential. The three isolated stands of mixed woods to be removed contain no forest interior habitat and provide no critical links in regional woodland corridors for wildlife.

In addition, no cumulative effects on eastern white cedar as a result of other projects, past, existing or future were identified. The effects assessment inherently gives consideration to effects of other regional land uses or sources of stress on eastern white cedar, given that projected losses of regional forest cover would raise greater concern with respect to the loss of the stands in the Project Area. No such future land uses were identified at a scale that cumulatively would compromise the sustainability of eastern white cedar (i.e., there are no likely cumulative effects on the eastern white cedar VEC).

The assessment also considered whether the conclusions about the terrestrial environment are sensitive to changes in climate conditions (OPG 2011, Section 7.14). It was concluded that the future environment effect by climate change will not influence the conclusions of the assessment.

In summary:

- The only predicted residual adverse effect of the DGR Project on the terrestrial environment was a loss of eastern white cedar caused by the removal of 8.9 ha of mixed woods.
- The predicted adverse effect was assessed against a hypothesis that, in order to be significant, one or more of the following would be required:
    - *The sustainability and productivity of the local population of eastern white cedar would be compromised.* The removal of 8.9 ha of mixed woods is not large enough to affect the sustainability or productivity of eastern white cedar in the Local Study Area and is reversible with time following closure of the DGR Project.
    - W*oodland attributes (e.g., edge-area ratio, stand size, shape and age), species or ecological functions that are unique in the Local Study Area would be affected.* The three small, fragmented stands of mixed woods that will be removed are comprised of regenerating common species with no notable age or size characteristics, do not support any sensitive species or provide unique ecological functions that would be lost, and adjacent woodland populations and communities will not be compromised.
    - *Habitat connectivity and movement within the ecosystem would be disrupted.* In combination with the local abundance of mixed woods, and the poor habitat connectivity of the stands on the project site, the loss of the three mixed wood stands will have no measurable effect on regional connectivity or biophysical processes such as nutrient and energy pathways, and will not cause or contribute to fragmentation in the Local Study Area.

- *Sustainability in the Local Study Area of other species that have dependence on the specific areas affected (or dependence on the Local Study Area communities containing the VEC) would be compromised by the loss (i.e., they have an obligate dependence).* There are no sensitive wildlife species or wildlife habitat use patterns that could be compromised by the loss.

Therefore, OPG concluded that the residual adverse effect of the DGR Project on the terrestrial environment is not significant.

3.5 Confidence

OPG has a high degree of confidence in the conclusion that the removal of 8.9 ha of mixed wood forest at the DGR Project Area is not significant. The significance conclusion is founded on the precautionary principle. A conservative approach was used to identify measurable effects, which were assessed in an ecosystem context. The mixed wood forest containing eastern white cedar would generally be assessed at the Local Study Area scale for broader considerations of population viability and effects on other ecological functions. Relative changes (percent loss) typically applied at the Local Study Area scale were applied at the Project Area scale, which effectively lowered the thresholds for further analysis. This provided an additional level of conservatism in the analysis.

As noted above, the literature generally indicates that losses of receptor vegetation communities of greater than 20% to 30% are high magnitude and/or potentially significant effects (Suter et al. 1995; Lande 1987; Flather and Bevers 2002). Recent EAs, such as the New Prosperity Gold-Copper mine in British Columbia, used sustainability based thresholds with similar magnitudes at the regional scale for significance of forest losses (e.g., a 10-20% reduction in the availability of non-pine old forest in the Regional Study Area was considered to be of a moderate magnitude [Taseko Mines Limited 2012]). There is a high degree of confidence that the removal of 3% of the forest cover in the Site Study Area (or 1% of the forest cover in the Local Study Area), particularly in light of the isolated location of the stands of mixed woods to be removed, is not significant.

The potential risks associated with unforeseen ecological events in the future are also low because if broader blocks of mixed woods are suddenly lost, the stands in the Project Area will not play a significant role in sustaining or rehabilitating ecological functions.

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3.7 Figures

Figures are provided on the following pages.

Figure 3-1: Local Study Area for the Terrestrial Environment

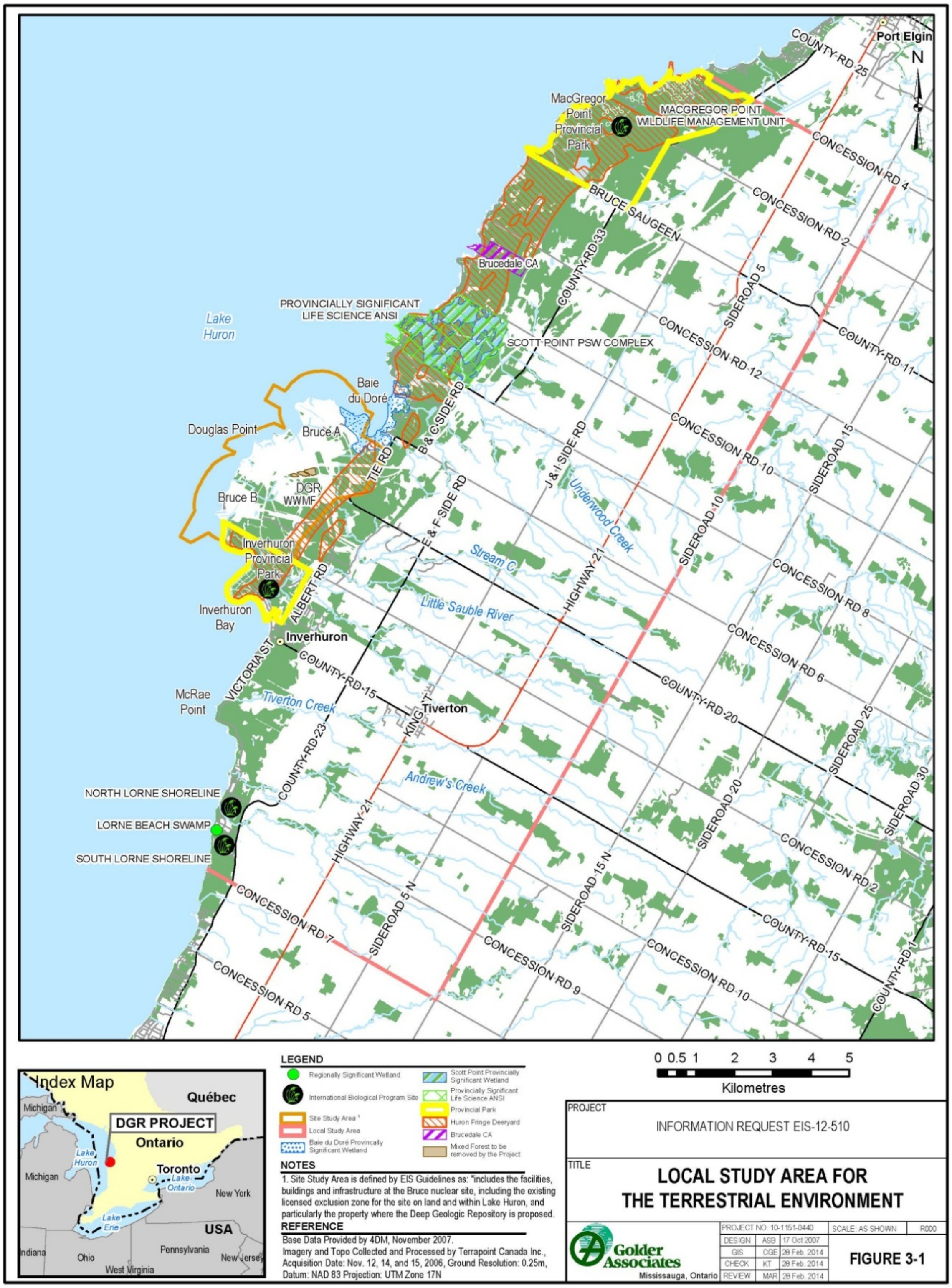


Figure 3-2: Vegetation Communities

4. AQUATIC ENVIRONMENT

This section provides a detailed narrative that explains the significance assessment for the aquatic environment. Based on the literature reviewed and taking into consideration experience from other projects, OPG's hypothesis was that, for an effect on aquatic VECs to be considered a significant adverse effect, one or more of the following would be required:

- *habitat that is critical to the sustainability and productivity of the aquatic VECs is removed and there is no suitable habitat found elsewhere in the Site Study Area;*
- *removal and/or alteration of habitat causes changes to the ecological function of the aquatic community or the aquatic habitat in the Site Study Area; and/or*
- *aquatic habitat connectivity and movement of aquatic VECs within the Site Study Area is disrupted.*

The basis for the above hypothesis, including literature reviewed, is provided below in Sections 4.1, 4.3 and 4.4.

The detailed assessment of the potential effects presented in the Aquatic Environment TSD (Golder 2011a) identified two residual adverse effects of the DGR Project on the aquatic environment. Neither of those effects was assessed to be significant.

4.1 Approach to Assessment

A detailed assessment of the potential effects was presented in the Aquatic Environment TSD (Golder 2011a, Sections 6, 7 and 8). Nine aquatic VECs were chosen using factors such as presence and abundance in the study areas, ecological importance, expressions of stakeholder interest, and past precedents in other environmental assessments conducted on the Bruce nuclear site (Golder 2011a). These VECs also represent indicators of ecosystem functions or important receptors in the ecosystem, which may be affected by the project. The effects on the identified VECs can also be used to describe the effects to other species that share habitat, behaviours and trophic characteristics with the VECs.

Any removal and/or alteration of aquatic habitat, regardless of the size of the area affected, was considered to be both a measurable change and an adverse effect to the VECs inhabiting that habitat. Five of the aquatic VECs are predicted to be affected by the DGR Project through the removal and/or alteration of aquatic habitat: burrowing crayfish, redbelly dace, creek chub, benthic invertebrates and variable leaf pondweed.

Consideration of ecological context is important in determining the nature of any effect on the aquatic environment. One purpose of the effects assessment is to establish the effects of the project on the maintenance of self-sustaining and ecologically functional populations and communities. Self-sustaining populations (and communities) can be considered as healthy, robust populations capable of withstanding environmental change and accommodating random population processes (Reed et al. 2003). The potential effects of the DGR Project on the aquatic VECs were examined both from the perspective of sustainability of the individual populations, and within the context of other aquatic communities in the larger system relating to habitat diversity, connectivity and aquatic habitat utilization. For example, production (e.g., nutrients, benthic invertebrates) from the warm water aquatic community in the South Railway Ditch can be washed downstream and contribute to the foraging opportunities for aquatic species in Stream C.

Consideration of ecological resiliency, or the capacity of the system to absorb disturbance and reorganize and retain the same structure, function and feedback responses (Holling 1973, Gunderson 2000), is also important in determining the nature of any effect on the aquatic environment. Population resilience can be considered to share similar features as ecological resilience. This is because adaptability influences the ability of the population to absorb or recover from change. For example, the South Railway Ditch is a man-made intermittent drainage feature. It supports a resilient aquatic community that is relatively tolerant to a broad range of environmental conditions, including habitats that are anthropogenic in nature. The aquatic habitat in the South Railway Ditch is likely to have the potential to recover more quickly than sensitive aquatic habitats (e.g., permanent coldwater trout streams) after a disturbance. These aquatic VECs, with the exception of burrowing crayfish, are common and widespread throughout the Regional Study Area and beyond, and occur in a wide range of habitat types.

Fisheries and Oceans Canada (DFO) applies the Risk Management Framework (DFO n.d.) to decision-making under the habitat protection provisions of the *Fisheries Act*. This approach uses pathways of effect in relation to the sensitivity of the fish habitat being affected. In a similar way, the approach in this assessment used the scale of residual adverse effects in relation to the sensitivity of the aquatic habitats being affected.

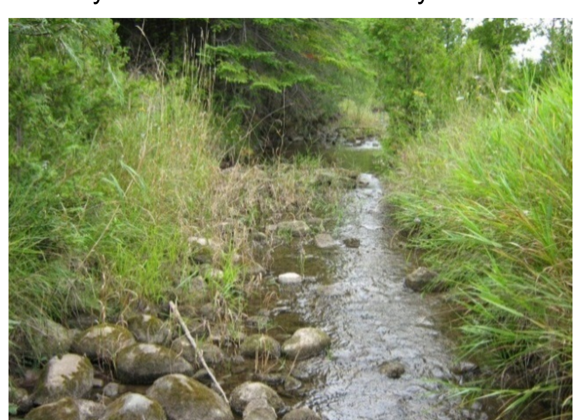
Other than acute toxicological thresholds, there are few absolute effects thresholds for aquatic species available in literature or established guidelines, and biological parameters are typically subject to large amounts of natural variation. There is interest in identifying disturbance thresholds for establishing regulatory criteria for aquatic systems on the part of stream ecologists, watershed managers and policy makers (Wang et.al. 2007). It is anticipated that disturbance thresholds being developed will correspond to meaningful changes in ecosystem function or aquatic communities (Brenden et.al. 2008). The classification of effects on aquatic VECs for the DGR Project is based on quantitative and qualitative analyses supported by relevant information from the scientific literature on life history characteristics, taking into consideration experience from other projects and professional judgement.

4.2 Existing Conditions

The DGR Project is predicted to affect redbelly dace, creek chub and variable leaf pondweed VECs in the South Railway Ditch, and burrowing crayfish and benthic invertebrates in both the South Railway Ditch and other aquatic habitats in the Project Area. These VECs are common and widespread in the Local Study Area and are more fully discussed in the Aquatic Environment TSD (Golder 2011a, Section 5).

To understand the importance of changes in the abundance and distribution of aquatic communities and their ability to remain self-sustainable, as well as the ecological function of the communities the various aquatic habitats support, the aquatic habitat present in surface water features potentially affected by the DGR Project need to be put into context.

The Local Study Area, shown on Figure 4-1, corresponds to the Stream C and Underwood Creek watersheds for the on-land (non-lake) portion. The Local Study Area also extends approximately 2 km offshore into Lake Huron, from MacGregor Point Provincial Park in the north and approaches McRae Point in the south. The watercourses and lake habitats in this study area have been historically influenced by land uses in watersheds comprised of open farmland, interspersed with infrastructure corridors (transmission and road), rural settlement areas and the Bruce nuclear site.


Stream C in the Site Study Area

The Site Study Area, shown on Figure 4-2, corresponds to the Bruce nuclear site and the nearshore waters of Lake Huron (small embayment immediately south of Bruce A known as MacPherson

Bay), which receive the surface water runoff from catchment areas draining water from portions of the Project Area.

The Site Study Area also includes the lower section of the Stream C watershed, which drains the remainder of the Project Area. Effects at the Site Study Area level are focused on the individual species and habitats within the Bruce nuclear site and the potential receiving waterbodies (e.g., on-site ditches, Stream C). The land use in the Site Study Area is dominated by industrial facilities associated with the Bruce nuclear site, characterized as a fragmented and disturbed landscape, as well as a portion of Inverhuron Provincial Park to the south and Baie du Doré to the north.

The surface water features potentially affected by the DGR Project consist of the South and North Railway Ditches, the northeast wetland, other ephemeral aquatic features, including drainage ditches along roadways and the railway spur, and the portion of Stream C downstream of the abandoned rail bed.

Burrowing crayfish habitat (i.e., moist clay soils) occurs in all of the surface water features potentially affected by the DGR Project, and throughout the Site Study Area (Golder 2007).

Redbelly dace, creek chub, variable leaf pondweed and benthic invertebrates use aquatic habitat in the South Railway Ditch and Stream C and are common and widespread in the study areas and throughout Ontario. The South Railway Ditch is choked with cattails and the banks are covered with a mix of grasses, trees and shrubs. Stream C is described fully in the Aquatic Environment TSD (Golder 2011a, Section 5.3.2.2).

4.3 Description of Potential Effects

The only identified adverse effect on the aquatic VECs in the South Railway Ditch results from the construction of the rail bed crossing for waste transfer from the Western Waste Management Facility to the DGR Project site. Construction of the rail bed crossing will cause a change in habitat in a localized area of the South Railway Ditch. The crossing consists of the placement of a culvert in-stream, which will cover a small area of in-stream habitat. Appropriate in-design features (e.g., embedded culvert for fish passage), specific mitigation measures (e.g., management of surface water runoff) and best management practices (e.g., erosion and sediment control) both during and after construction were assessed as having a mitigating effect on the habitat alteration. However, these measures do not avoid the alteration of aquatic habitat in the South Railway Ditch, resulting in a residual adverse effect on the aquatic VECs using this habitat.

South Railway Ditch

Similarly, site preparation and decommissioning activities are identified as resulting in an adverse effect on burrowing crayfish habitat in other aquatic habitats on the DGR Project Site, specifically the North Railway Ditch, other drainage ditches and ephemerally wet low areas. The footprint of the project avoids most of the identified crayfish habitat in the Project Area, including protection of the marsh in the northeast portion of the Project Area. The construction of the crossing over the abandoned rail bed and other surface infrastructure will result in the loss of a small portion of burrowing crayfish habitat in the North Railway Ditch, as well as other ditches in the western portion of the Project Area. Rehabilitation after decommissioning of the DGR Project may include both active and passive naturalization of the Project Area to provide additional suitable habitat, similar to that currently provided on the site. Rehabilitation of the project site was considered as a characteristic of reversibility in the significance assessment instead of as a mitigation measure.

Measurable changes predicted for surface water quantity and flow, surface water quality (see Sections 2 and 10, and Golder 2011b, Section 7.3), are not likely to create any additional or combined effects on the aquatic VECs (Golder 2011a, Section 7.3.2.2 and 7.5.2.1). Vibration effects from blasting during shaft sinking and underground development are predicted to be less than thresholds established for protecting aquatic life (Wright and Hopky 1998) and are not likely to create any additional or combined effects on the aquatic VECs (Golder 2011a, Section 7.2.2.1).

4.4 Significance of the Residual Adverse Effects

In accordance with the categories set out in the EIS Guidelines, the residual adverse effects of the Project on the aquatic VECs can be described as follows:

- **Magnitude**: A loss/alteration of <1% of non-critical habitat in the Project Area.
- **Geographic Extent**: The extent of the habitat loss/alteration effect is localized and limited to the Project Area.
- **Timing and Duration**: The burrowing crayfish habitat loss will begin immediately at the commencement of site preparation and remain in full effect until rehabilitation begins. The habitat alteration caused by the rail bed crossing will begin during the construction phase and remain throughout operations. The rail bed crossing and the ditches would re-naturalize following operations (during decommissioning).
- **Frequency**: The habitat loss and alteration is continuous through the duration of the site preparation and construction, operations and decommissioning phases of the project.
- **Reversibility**: The loss and alteration of habitat was conservatively assumed to not be reversible with time.
- **Probability**: The loss/alteration of aquatic habitat will occur should the project proceed.
- **Context**: The habitat affected is common, non-critical habitat. The effect occurs within man-made, regularly disturbed aquatic features and does not extend into the more sensitive natural watercourses such as Stream C.

Removal of Burrowing Crayfish Habitat – The ecological function, sustainability and productivity of the burrowing crayfish population in the Site Study Area will be unaffected. The habitats to be removed are common in the Site Study Area and are small in proportion to available similar type habitats. Less than 1% of the available burrowing crayfish habitat identified during the baseline studies in the Project Area will be disturbed, and the proportion is smaller with respect to other available, suitable habitat throughout the Site Study Area. In addition, the type of habitat to be removed is anthropogenic, consisting of a small area of disturbed ditch bed and other disturbed seasonally wet depressions. Other burrowing crayfish habitat associated with stream margins and wetland features in the Project and Site Study Areas will not be disturbed through the DGR Project works and activities. There is suitable habitat for the burrowing crayfish in anthropogenically disturbed areas throughout the Site Study Area and the Project footprint will not interrupt any movement corridors or critical habitat connections for burrowing crayfish. For these reasons, it was concluded that the loss of aquatic habitat used by burrowing crayfish was not significant.

Alteration of Aquatic Habitat in the South Railway Ditch – While the South Railway Ditch provides habitat for fish, it is considered habitat of marginal quality (i.e., non-critical) when compared to the quality of habitat elsewhere in the Site and Local Study Areas, for instance the fish habitat in Stream C. The affected VECs are resilient species and the aquatic communities in the Site Study Area have previously been sustained through a number of human-related disturbances. The affected area does not contain unique features, species or ecological functions within the study areas. Therefore, the habitat alteration will not affect the sustainability and productivity of these habitats or the populations of aquatic species that rely on them. The affected aquatic habitat is at the upstream end of the South Railway Ditch. Therefore, the loss is not expected to affect habitat connectivity and disrupt flow or migration within the watershed. For these reasons, it was concluded that the alteration of aquatic habitat was not significant.

The existing conditions and effects assessment capture the cumulative effects of past and existing projects. There were no future projects or activities identified in the Site Study Area or Local Study Area that could contribute to cumulative effects on the VECs concurrent with the effects of the DGR Project. Additionally, the VECs are widespread and tolerant. Therefore the VECs resilience to change indicates that there are few other stressors on these species populations that could compromise their sustainability.

Consideration was also given to whether the effects assessment conclusions on the aquatic environment are sensitive to changes in climate conditions (OPG 2011, Section 7.14). It was concluded that the future environment affected by climate change will not influence the conclusions of the assessment for the aquatic VECs in the South Railway Ditch and burrowing crayfish and benthic invertebrates in the South Railway Ditch and other aquatic habitats.

In summary,

- The only predicted residual adverse effects of the DGR Project on the aquatic environment were the removal of burrowing crayfish habitat present in the North Railway Ditch, other drainage ditches and ephemerally wet low areas during site preparation activities, and the alteration of aquatic habitat for redbelly dace, creek chub, burrowing crayfish, variable leaf pondweed and benthic invertebrates in the South Railway Ditch caused by construction of the rail bed crossing.
- The predicted adverse effects were assessed against a hypothesis that, in order to be significant, one or more of the following would be required:
    - *Habitat that is critical to the sustainability and productivity of the aquatic VECs is removed and there is no suitable habitat found elsewhere in the Site Study Area.* The area of aquatic habitat loss is not large enough to affect the sustainability or productivity of the local populations of affected aquatic VECs in the Site Study Area. The affected habitat is of marginal (non-critical) quality for the aquatic VECs when compared to the quality and there is available habitat elsewhere in the Site and Local Study Area.
    - *Removal and/or alteration of habitat causes changes to the ecological function of the aquatic community or the aquatic habitat in the Site Study Area.* The habitat loss or alteration is not expected to cause changes to the ecological function of the aquatic community or the aquatic habitat in the Site Study Area.
    - *Aquatic habitat connectivity and movement of aquatic VECs within the Site Study Area would be disrupted.* The habitat loss or alteration is not expected to affect watercourse habitat connectivity or disrupt flow movement or migration within the study areas.

Therefore, OPG concluded that the residual adverse effects of the DGR Project on the aquatic environment are not significant.

4.5 Confidence

OPG has a high degree of confidence in the conclusion that the removal of a small proportion of aquatic habitat within the Project Area is not significant to the affected aquatic VECs. The significance conclusion is founded on the precautionary principle. A conservative approach was used to identify measurable effects, which were assessed in a watershed context (Project Area and Site Study Area).

4.6 References

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4.7 Figures

Figures are provided on the following pages.

Figure 4-1: Local Study Area for the Aquatic Environment

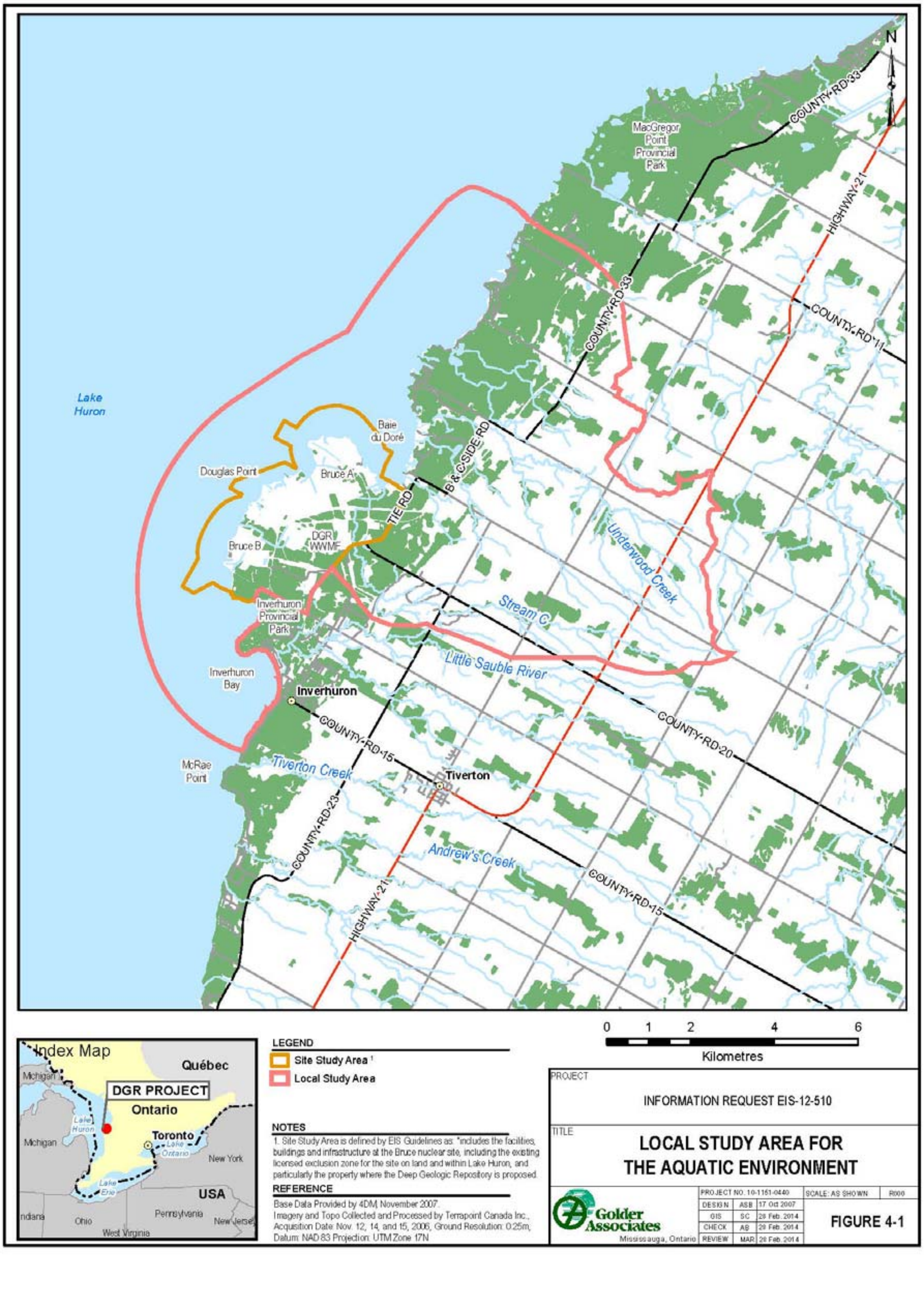
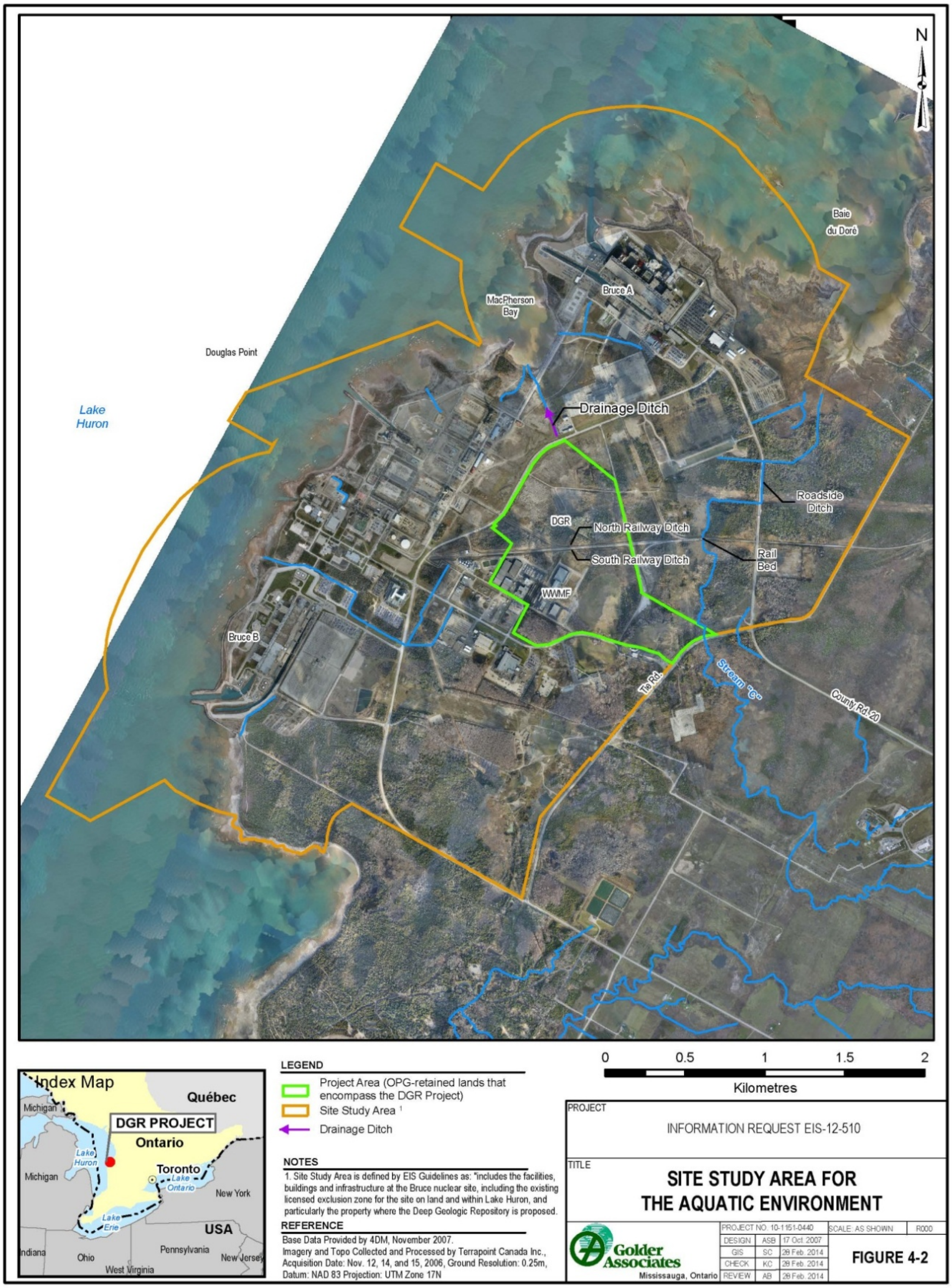


Figure 4-2: Site Study Area for the Aquatic Environment



5. AIR QUALITY

This section provides a detailed narrative that explains the significance assessment for air quality. Based on the literature reviewed and experience from other projects, OPG's hypothesis was that, to have a significant effect on the air quality VEC*, the DGR Project would need to result in ambient air concentrations beyond the Site Study Area that exceed relevant established ambient air quality criteria more than 10% of the time*.

The detailed assessment of the potential effects presented in the Atmospheric Environment TSD (Golder 2011) identified residual adverse effects of the DGR Project on air quality during the site preparation and construction phase, the operations phase, and the decommissioning phase. None of those effects were assessed to be significant.

5.1 Approach to Assessment

The effects assessment focussed on the following indicator compounds selected to represent compounds that will be emitted from the project in measurable amounts, have established ambient criteria, and are commonly used for describing air quality in Ontario:

- nitrogen dioxide (NO_2);
- sulphur dioxide (SO_2);
- carbon monoxide (CO);
- suspended particulate matter (SPM);
- airborne particles with nominal aerodynamic diameters smaller than 10 micrometres (µm) in diameter (PM_{10}); and
- airborne particles with nominal aerodynamic diameters smaller than 2.5 µm in diameter ($PM_{2.5}$).

Table 5-1 provides a listing of the ambient air quality criteria used in the assessment.

When establishing ambient air quality criteria in Canada, thresholds are set at levels that inherently provide a level of protection. Criteria are usually set below "no-effects" or "lowest-observed-adverse effects" levels. For example, the "acceptable" national ambient air quality objectives for exposures to carbon monoxide (CO) (i.e., 15,000 µg/m³ for 8-hour exposures; 35,000 µg/m³ for 1-hour exposures) were set at levels that would result in COHb (Carboxyhemoglobin) levels in adults less than 2%, or below the 2.5% COHb level identified as a conservative "no-effect level" (CEPA/FPAC 1994). Similarly, the "acceptable" national ambient air quality objectives for exposures to nitrogen dioxide (NO_2) (i.e., 100 µg/m³ for annual exposures; 400 µg/m³ for 1-hour exposures) were set to levels that were less than the respective "lowest observed adverse effects levels (LOAEL) of 940 µg/m³ and 156 µg/m³ (FPAC 1987). In some cases, such as SPM, the ambient air quality criteria are established for aesthetic reasons (MOE 2012a) rather than ecological or health thresholds. Therefore, occasionally exceeding the criteria values are not likely to result in significant adverse effects. . Furthermore, the Canada-Wide Standards development process has included acceptable frequency for exceeding the criteria value while still achieving the standard. For fine particulate matter ($PM_{2.5}$) the 24-hour Canada-Wide Standard is based on the 98th percentile, and for 8-hour ozone (O_3) the Canada-Wide Standard is based on the fourth highest daily value (CCME 2000). The fourth highest daily value is approximately equal to the 98^{th} percentile.

Table 5-1: Ambient Air Quality Criteria Used in the Assessment of Effects on Air Quality

Indicators	Air Quality Criteria for Indicators ($\mu g/m^3$) (Golder 2011)[a]	AAQC 2012 ($\mu g/m^3$) (MOE 2012a)	MOE Standards[b] ($\mu g/m^3$) (MOE 2012b)
1-hour NO_2	400	400	400
24-hour NO_2	200	200	200
Annual NO_2	100	—	—
1-hour SO_2	900	690	690
24-hour SO_2	300	275	275
Annual SO_2	60	55	—
1-hour CO	35,000	36,200	—
8-hour CO	15,000	15,700	—
24-hour SPM	120	120	120
Annual SPM	70	60[c]	—
24-hour PM_{10}	50	50	—
24-hour $PM_{2.5}$	30	30 25[d]	—

Notes:

[a] As detailed in Tables 4.2.1-1 and 11.1.1-1 of the Atmospheric Environment TSD (Golder 2011)

[b] The applicability of O.Reg. 419/05 standards are discussed in the responses to IR EIS-01-09 (OPG 2012b), EIS-01-09a (OPG 2012c), EIS-04-138 (OPG 2012a) and EIS-08-321 (OPG 2013).

[c] Geometric mean

[d] The 25 $\mu g/m^3$ MOE guidelines listed in the Information Request only appears as a footnote to the AAQC table (MOE 2012a). The actual AAQC listed for $PM_{2.5}$ is 30 $\mu g/m^3$. The value of 25 $\mu g/m^3$ is recommended as a target for $PM_{2.5}$ resulting from a single facility.

Maximum ambient concentrations for comparison to the above criteria were predicted using a numeric dispersion model, specifically AERMOD, which is recommended for use in Ontario (MOE 2005). The model also provides information regarding the frequency of predicted values. This model was discussed and described in Technical Information Session #2 (OPG 2012d).

To ensure a conservative assessment, maximum existing ambient concentrations of the indicator compounds were predicted for the existing sources in the Local Study Area and combined with background concentrations derived from monitoring data.

All DGR Project activities for which the emissions of indicator compounds could be quantified were classified as having the potential to cause a measurable change to the air quality VEC. Maximum ambient concentrations resulting from the DGR Project were then predicted by combining background air quality, existing sources and project emissions. An adverse effect was identified in cases where the predicted maximum ambient concentrations including DGR Project emissions increased relative to the existing ambient concentrations. The emissions used in the modelling included the mitigation incorporated into the design of the project; therefore, all predicted adverse effects were also classified as residual adverse effects.

In addition to the emissions of indicator compounds, the project is expected to result in emissions of several other compounds in relatively small amounts. The ambient concentrations of all of these compounds were predicted at human receptor locations, and the results assessed as an integral part of the human health assessment (OPG 2011, Appendix C). Although predicted ambient acrolein concentrations at the off-site human receptor locations were less than ambient Ontario criteria (OPG 2012c, IR-05-223), the resulting inhalation of acrolein by local residents during the site preparation and construction phase was identified as a residual adverse effect to human health because the predicted concentrations were above health screening criteria. However, based on the results of a human health risk assessment, the resulting health risks to local residents were considered low (OPG 2011, Section 7.11). Changes in air quality were not predicted to result in adverse health effects during the operations phase. Therefore, no significant adverse effects were predicted on human health (OPG 2011, Section 7.11) as a result of changes in air quality.

5.2 Existing Conditions

Existing air quality conditions in the Local Study Area were predicted using a combination of dispersion modelling of the existing local sources and background air quality derived from air quality monitoring stations in the Regional Study Area. Existing conditions were predicted in a conservative manner.

The contribution to ambient air quality from existing sources at the Bruce nuclear site (including the incinerator at the Western Waste Management Facility) was modelled using on-site local meteorological data and conservative selection of emissions. The emissions were conservatively based on the maximum permitted emissions from all of the facilities at the Bruce nuclear site, as well as the emissions for actual vehicle traffic activity levels for those sources that do not require permits. The resulting predictions are conservative because actual emission levels at the Bruce nuclear site are considerably lower than the permitted maximum values. The resulting maximum predicted concentrations were combined with background concentrations derived from the air quality measurements taken in the Regional Study Area. The existing conditions modelled in this manner are shown in the second column on Tables 5-2 and 5-3.

The background air quality established from air monitoring data collected within the Regional Study Area represents the combined effect of emissions from sources near each of the monitoring stations, as well as the effect of the emissions transported into the region. Based on feedback from regulators (CEAA and CNSC 2009), guidance in other Canadian jurisdictions (AENV 2009) and expert judgement, the 90th percentile of the available monitoring data was considered an appropriate estimate of background air quality for combination with modelled existing sources. The use of the 90th percentile of the available monitoring data continues to be identified as appropriate for establishing background air quality in more recent guidance documents (AESRD 2013). Where data were available, concentrations measured at the nearest regional station (Tiverton) were used. In those cases where data from Tiverton were unavailable, background air quality was based on the next closest regional station in London, Ontario, or was calculated based on the available data.

Generally the monitoring data show that the existing air quality in Tiverton is good; the maximum measured concentrations for the gaseous indicators (i.e., NO_2, SO_2 and CO) are well below established criteria (Golder 2011, Section 5, Appendix E). Monitoring data for Tiverton shows that fine particulate ($PM_{2.5}$) currently exceeds the 30 µg/m³ criteria about 1.0% of the time. Monitoring data from the other communities in the Regional Study Area (i.e., Kitchener, London and Sarnia) report 24-hour $PM_{2.5}$ values higher than those in Tiverton, with maximums ranging between 45.6 and 75.5 µg/m³ (Golder 2011, Section 5, Appendix E), and the frequencies above 30 µg/m³ ranging between 2.2% and 4.7% of the time.

Ambient PM_{10} and SPM concentrations were not available in Tiverton, so values were derived based on available particulate monitoring (Golder 2011, Appendix E8). By applying the derived relationships between available $PM_{2.5}$, PM_{10} and SPM monitoring, it was concluded that there have been periods at Tiverton and the other regional monitoring stations when the maximum 24-hour PM_{10} and SPM concentrations would have exceeded the ambient criteria values of 50 and 120 µg/m³, respectively.

5.3 Description of Potential Effects

Air quality effects of the project were predicted using a dispersion model. The modelling included the conservatively determined existing conditions (described previously), and conservative project emissions that assumed all equipment were operating at their full capacity. The project emissions included all activities at the site, such as traffic, construction equipment exhaust, and fugitive dust.

The resulting calculated maximum ambient concentrations were then compared to the existing maximum ambient concentrations to determine if the emissions from the project were likely to result in an increase in the maximum concentration at, or beyond, the boundary of the Bruce nuclear site.

During the site preparation and construction phase, residual adverse effects were identified for nine of the air quality indicator compounds. Specifically, the calculated maximum ambient concentrations of 1-hour NO_2, 24-hour NO_2, annual NO_2, 1-hour CO, 24-hour CO, 24-hour SPM, annual SPM, 24-hour PM_{10} and 24-hour $PM_{2.5}$ during the site preparation and construction phase were higher than the maximum existing concentrations as shown in Table 5-2 (Golder 2011, Section 8.2.5). The concentrations of 24-hour SPM, 24-hour PM_{10} and 24-hour $PM_{2.5}$ were predicted to exceed the relevant criteria on nine of the 1,826 days modelled (i.e., <0.5% of the time).

Table 5-2: Predicted Residual Adverse Effect, Site Preparation and Construction Phase

Indicator Compound	Maximum Existing Concentration (µg/m³) in Local Study Area [a]	Maximum Site Preparation and Construction Phase Concentration (µg/m³) in Local Study Area [b]	Increase Over Existing Concentration (µg/m³) in Local Study Area [c]	Likely Adverse Effect?
1-hour NO_2	110.4	321.7	+211.3	adverse effect
24-hour NO_2	26.5	141.2	+114.7	adverse effect
Annual NO_2	6.8	18.5	+11.7	adverse effect
1-hour SO_2	318.9	318.9	0	no adverse effect
24-hour SO_2	51.3	51.3	0	no adverse effect
Annual SO_2	5.0	5.0	0	no adverse effect
1-hour CO	1,580.6	2,504.2	+923.6	adverse effect
8-hour CO	1,201.8	1,595.7	+393.9	adverse effect
24-hour SPM	71.0	276.9	+205.9	adverse effect
Annual SPM	25.1	30.7	+5.6	adverse effect
24-hour PM_{10}	26.0	75.3	+49.3	adverse effect
24-hour $PM_{2.5}$	15.4	45.7	+30.3	adverse effect

Notes:

[a] From Table 5.4.2-3 (Golder 2011). [b] From Table 8.2.3-4 (Golder 2011).

[c] The increases over existing concentrations are calculated as the difference between the calculated maximum site preparation and construction phase concentrations and the maximum existing concentrations. These maximums may not occur at the same location.

During the operations phase, residual adverse effects were identified for eight air quality indicator compounds. Specifically, the predicted maximum ambient concentrations of 1-hour NO_2, 24-hour NO_2, annual NO_2, 1-hour CO, 24-hour CO, 24-hour SPM, 24-hour PM_{10} and 24-hour $PM_{2.5}$ were higher than the existing maximum concentrations as shown in Table 5-3 (Golder 2011, Section 8.2.5). None of the predicted maximum concentrations exceed the relevant ambient air criteria.

Table 5-3: Predicted Residual Adverse Effect, Operations Phase

Indicator Compound	Maximum Existing Concentration (μg/m³) in Local Study Area [a]	Maximum Operations Phase Concentration (μg/m³) in Local Study Area [b]	Increase Over Existing Concentration (μg/m³) in Local Study Area	Likely Adverse Effect?
1-hour NO_2	110.4	151.6	+41.2	adverse effect
24-hour NO_2	26.5	67.8	+41.3	adverse effect
Annual NO_2	6.8	7.6	+0.8	adverse effect
1-hour SO_2	318.9	318.9	0	no adverse effect
24-hour SO_2	51.3	51.3	0	no adverse effect
Annual SO_2	5.0	5.0	0	no adverse effect
1-hour CO	1,580.6	1,597.8	+17.2	adverse effect
8-hour CO	1,201.8	1,202.3	+0.5	adverse effect
24-hour SPM	71.0	71.5	+0.5	adverse effect
Annual SPM	25.1	25.1	0	no adverse effect
24-hour PM_{10}	26.0	26.9	+0.9	adverse effect
24-hour $PM_{2.5}$	15.4	15.9	+0.5	adverse effect

Notes:

[a] From Table 5.4.2-3 (Golder 2011).

[b] From Table 8.2.3-5 (Golder 2011).

[c] The increases over existing concentrations are calculated as the difference between the calculated maximum site preparation and construction phase concentrations and the maximum existing concentrations. These maximums may not occur at the same location.

The residual adverse effects for the decommissioning phase were determined to be similar to, or less than, those during the site preparation and construction phase (Golder 2011, Section 8.2.3.2).

5.4 Significance of the Residual Adverse Effects

The following narrative deals with the significance of the predicted residual adverse effects by project phase.

Site Preparation and Construction Phase – In accordance with the categories set out in the EIS Guidelines, the residual adverse effect of the DGR Project on air quality during the site preparation and construction phase can be described as follows:

- **Magnitude**: The maximum ambient concentrations beyond the Site Study Area will increase for nine of the indicators. The maximum ambient concentrations exceed relevant ambient criteria for 24-hour SPM, 24-hour PM_{10} and 24-hour $PM_{2.5}$.
- **Geographic Extent**: The extent of areas where concentrations were predicted to exceed relevant criteria is limited to an area adjacent to, but beyond, the Site Study Area (i.e., the fenceline of the Bruce nuclear site).
- **Timing and Duration**: The effects are assumed to occur throughout the site preparation and construction phase.
- **Frequency**: Predicted concentrations above ambient criteria will occur infrequently throughout the site preparation and construction phase (<0.5% of the time).
- **Reversibility**: The effect on air quality will be immediately reversible when the activities that cause the emissions cease.
- **Probability**: The predicted effects on air quality during the site preparation and construction phase are expected to occur if the Project proceeds.
- **Context**: The existing air quality measured in the region is generally good, with concentrations of gaseous indicators compounds meeting all relevant ambient criteria and particulate matter (SPM, PM_{10} and $PM_{2.5}$) concentrations infrequently exceeding ambient criteria.

For assessing the effects on ambient air quality, there are absolute effects thresholds established as regulatory criteria. Regulatory ambient air criteria established in Canada were developed to ensure adequate protection for the environment and those living in it. Of the predicted residual adverse effects arising during site preparation and construction, only the maximum 24-hour SPM, 24-hour PM_{10} and 24-hour $PM_{2.5}$ increased to the point of exceeding the relevant regulatory criteria values (Golder 2011, Section 11.2.1). Elevated levels of airborne particulates (i.e., $PM_{2.5}$, PM_{10} and SPM) are not uncommon near construction sites, and can occur in many areas where human activities occur. Elevated ambient concentrations of airborne particulates (i.e., concentrations above the relevant criteria) have also been monitored at stations in the region.

Although the air quality assessment predicted that the maximum 24-hour $PM_{2.5}$, 24-hour PM_{10} and 24-hour SPM concentrations could exceed the relevant criteria during the site preparation and construction phase, such predictions were restricted to areas immediately adjacent to, but beyond, the fenceline of the Bruce nuclear site. Ambient air criteria are developed to apply at locations where a member of the public could be exposed (i.e., the criteria would apply at, or beyond, the fenceline of the property). The authors of the Canada-Wide Standards acknowledge that achievement of the standards were to be based on “community-oriented locations” (CCME 2000), with an emphasis on areas “where people live, work and play” (CCME 2000). None of the predicted maximum concentrations at human receptors exceed relevant ambient air quality criteria (Golder 2011, Appendix J).

As ambient air quality criteria in Canada are established at levels that are conservatively safe (see Section 5.1), occasionally exceeding the criteria values is not likely to result in significant adverse effects. This is consistent with the recently developed Canada-Wide Standards for ambient air that incorporate an allowable frequency above the criteria values. Occasional values in excess of the relevant ambient air quality criteria are also observed at the ambient monitoring stations in the Regional Study Area. These data show that, for fine particulate matter ($PM_{2.5}$), the monitoring data for Tiverton exceeds the 30 $\mu g/m^3$ Canada-Wide Standard criteria about 1.0% of the time, for Kitchener about 2.2% of the time, for Sarnia about 4.7% of the time and for London about 2.3% of the time. Similarly, the ambient monitoring in the Regional Study Area shows the reading from 65 parts per billion (ppb) Canada-Wide Standard criteria is exceeded 5.4% of the time in Tiverton, 4.8% of the time in Kitchener, 5.3% of the time in Sarnia and 5.0% of the time in London. For an effect to be considered significant, the frequency of exceeding the relevant ambient air quality criteria was selected as 10%. This frequency is based on professional judgement and past environmental assessments, and is an incremental contribution comparable to the current situation observed in the region. Ambient 24-hour SPM, 24-hour PM_{10} and 24 hour $PM_{2.5}$ concentrations above the relevant ambient air quality criteria were predicted to occur <0.5% of the time (Golder 2011, Section 11.2.1), which is much less than the 10% threshold.

The conservative nature of the assessment in combination with the short duration of the periods during which the criteria could be exceeded, and the point of impingement being limited to the area immediately adjacent to, but beyond, the fenceline of the Bruce nuclear site, is the basis for concluding that the residual adverse effects during site preparation and construction are not significant.

Operations Phase – In accordance with the categories set out in the EIS Guidelines, the residual adverse effect of the DGR Project on air quality during the operations can be described as follows:

- **Magnitude**: None of the predicted maximum ambient concentrations exceed relevant ambient criteria.
- **Geographic Extent**: None of the predicted ambient concentrations exceed relevant ambient criteria beyond the Site Study Area.
- **Timing and Duration**: The effects are assumed to occur throughout the operations phase.
- **Frequency**: None of the predicted ambient concentrations exceed relevant ambient criteria beyond the Site Study Area.
- **Reversibility**: The effect on air quality will be immediately reversible when the activities that cause the emissions cease.
- **Probability**: The predicted effects on air quality during the operations phase are expected to occur should the Project proceed.
- **Context**: The existing air quality measured in the region is generally good, with concentrations of gaseous indicators compounds meeting all relevant ambient criteria and particulate matter (SPM, PM_{10} and $PM_{2.5}$) concentrations infrequently exceeding ambient criteria.

Of the predicted residual adverse effects modelled to occur during operations, none exceed the relevant regulatory criteria values beyond the Site Study Area (Golder 2011, Section 11.3.1). Therefore, it was concluded that the residual adverse effects during operations were not significant.

Decommissioning Phase – The residual adverse effects for the decommissioning phase were determined to be similar to, or less than, those during the site preparation and construction phase. For the reasons presented above, it was concluded that the effects of the DGR Project on air quality during the decommissioning phase are not significant.

No additional cumulative residual adverse effects on the air quality VEC as a result of other projects were identified. The worst case existing air quality used for the assessment inherently included the effect of other existing project emissions. There were no future projects identified that would result in cumulative air quality effects that were greater than the effects predicted as part of the assessment.

Consideration was also given to whether the effects assessment conclusions for air are sensitive to changes in climate conditions (OPG 2011, Section 7.14). It was concluded that the changing climate will not affect any of the conclusions related to the air quality predictions. Therefore, the conclusion that the predicted effects to air quality are not significant remains valid.

In summary,

- Residual adverse effects of the DGR Project on air quality were identified during the site preparation and construction phase, the operations phase, and the decommissioning phase.
- The predicted adverse effects were assessed against a hypothesis that, to have a significant effect on the air quality VEC, *the DGR Project would need to result in ambient air concentrations beyond the Site Study Area that exceed relevant established ambient air quality criteria more than 10% of the time*.
- During site preparation and construction, and decommissioning, the predicted ambient concentrations of SO_2, NO_2 and CO do not exceed the relevant ambient air quality criteria beyond the Site Study Area. The maximum predicted 24-hour ambient concentrations of $PM_{2.5}$, PM_{10} and SPM were predicted to exceed relevant criteria less than 0.5% of the time, in a relatively small area immediately adjacent to, but beyond, the Site Study Area.
- None of the predicted indicator concentrations during the operations phase exceed the relevant ambient air quality criteria beyond the Site Study Area.

Therefore, OPG concluded that the residual adverse effects on air quality are not significant.

5.5 Confidence

OPG has a high degree of confidence in the conclusion that the changes in air quality resulting from the proposed activities associated with the DGR Project are not significant. As described in this section, the significance conclusion is founded on a conservative approach to predicting existing local air quality and to predicting the effect on local conditions of emissions from the DGR Project. Established and accepted air modelling systems were used for the assessment in combination with available air quality measurements for the area and available meteorological data from the site.

5.6 References

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6. NOISE

This section provides a detailed narrative that explains the significance assessment for noise. Based on the literature reviewed and taking into consideration experience from other projects, OPG's hypothesis was that, for a noise effect to be considered a significant adverse effect, *the change in ambient noise would need to be disturbing (i.e., >10 dB change in the quietest hour)*.

The detailed assessment of the potential noise effects presented in the Atmospheric Environment TSD (Golder 2011a, Sections 6, 7, and 8) identified one residual adverse effect of the DGR Project. The effect was assessed to be not significant.

6.1 Approach to Assessment

A detailed assessment of noise was presented in the Atmospheric Environment TSD (Golder 2011a, Sections 6, 7 and 8). Change in noise was assessed as a potential cause of nuisance beyond the Site Study Area and was identified as being important to stakeholders and regulators.

The noise effects VEC was assessed using the lowest 1-hour L_{eq}, or quietest hour which may be affected by the Project. The use of the 1-hour L_{eq} incorporates both level and dose. It follows the approach used in Ontario by the Ministry of the Environment (MOE) (MOE 1995, 2013) and more broadly by Health Canada (HC 2005) and the World Health Organization (WHO 1999), although the approach used in the DGR Project was more conservative. The DGR assessment used the lowest 1-hour L_{eq} rather than longer term average L_{eq} metrics. As a result, any predicted change in noise levels associated with the DGR Project would be greater following the approach used in the EIS (OPG 2011), and have a higher probability of being identified as an adverse effect. The assessment also conservatively assumed that noise from site activities is continuous for the duration of the site preparation and construction and decommissioning phases, even though construction type activities are not continuous in nature. The predictions did not apply equipment duty cycle (i.e., the actual amount of time the equipment will operate), which would result in lower noise predictions. All equipment or activities for which noise emissions can be quantified were considered likely to cause a measurable effect and were included as part of the noise predictions.

A change in ambient noise level of <3 dB is the generally accepted threshold for perceptibility of changes in noise levels in the environment (Hansen 2001). Changes in ambient noise levels >3 dB and ≤6 dB are considered to be noticeable, while changes that are >6 dB and ≤10 dB are considered to be readily noticeable (Hansen 2001). A change in ambient noise level of >10 dB is considered disturbing (Hansen 2001; Beranek 1988; Bies. and Hansen 2009). These thresholds can also be described as follows:

- 3 dB change in ambient noise levels means that noise from the DGR Project is equal to the existing levels at receptor locations (a doubling of the sound power);
- 6 dB change in ambient noise levels is a doubling of the sound pressure level received at receptor locations; and
- 10 dB change in ambient noise levels is perceived by humans as being twice as loud (Hansen 2001) at receptor locations.

Of the above thresholds, a 3 dB change in ambient noise levels as a result of the DGR Project was selected as the threshold above which an adverse effect was identified.

Noise predictions were also carried out, as un-weighted noise levels (i.e., dB_{Lin}) for an assessment of noise effects on wildlife. Noise levels in dB_{Lin} were considered to be more appropriate for evaluating effects on ecological receptors than A-weighted levels (dBA), which are used in describing human response to noise. The un-weighted noise levels represent the actual acoustic energy in the atmosphere, and are considered to be an unbiased representation of how ecological receptors react to noise levels in the environment. The assessment of effects of noise on wildlife was carried out in the Terrestrial Environment TSD (Golder 2011b). The DGR Project noise levels were assessed as not resulting in any residual adverse effect on terrestrial ecology.

Predicted changes in noise levels at nearby residences were evaluated for their potential to affect the use and enjoyment of private property socio-economic environment VEC. The Socio-economic assessment (AECOM 2011a) determined this effect to be not significant. Similarly, changes in noise levels were expected at the on-site burial ground, the effects of which were included in the assessment of Aboriginal Interests (AECOM 2011b) and determined to be not significant (see also Section 7 of this response).

6.2 Existing Conditions

To understand how the potential change in noise levels associated with the DGR Project will be perceived by humans, the existing noise levels were quantified using extended periods of noise monitoring. A field study was conducted to help characterize existing noise levels. The noise monitoring locations are shown in Figure 6-1. The monitored results at each location are summarized in Table 6-1.

Table 6-1: Existing Noise Levels at Off-Site Noise Monitoring Locations

Location	Minimum 1-hour L_{eq} (dBA)
R1 – Albert Street	36
R2 – Baie du Doré	37
R3 – Inverhuron Provincial Park	35

6.3 Description of Potential Effects

Noise emissions associated with the DGR Project were modelled in combination with the background noise levels. Adverse noise effects were considered likely if the modelled ambient noise levels (i.e., existing plus project) were 3 dB or more above the lowest 1-hour L_{eq} at the receptor locations. For the purpose of the noise assessment, it was assumed that activities associated with all phases of the DGR Project would occur 24-hours per day.

The only identified residual adverse effect was a 5 dB increase in noise levels at receptor R2 during the site preparation and construction phase. Table 6-2 summarizes the results of the predicted changes to the noise levels at all three receptor locations.

Table 6-2: Site Preparation and Construction Phase Adverse Effects in the Local Study Area

Receptor	Predicted Project Noise Levels (dBA)	Predicted Ambient Noise Level [a] (dBA)	Lowest 1-Hour L_{eq} (dBA)	Project-related Change Relative to Lowest 1-Hour L_{eq} (dB)	Likely Adverse Effect?
R1 – Albert Street	33	38	36	+2	No
R2 – Baie du Doré	40	42	37	+5	Yes
R3 – Inverhuron Provincial Park	32	37	35	+2	No

Note:
[a] Ambient noise levels include the combined effect of noise from the DGR Project and existing noise levels.

No adverse effects were identified during the operations phase of the DGR Project. The emissions during the decommissioning phase are bounded by the emissions from the site preparation and construction phase and therefore, the potential adverse effects are similar to those predicted for that phase, as presented in Table 6-2.

6.4 Significance of the Residual Adverse Effect

In accordance with the categories set out in the EIS Guidelines, the residual adverse effect of the DGR Project on noise can be described as follows:

- **Magnitude**: The maximum predicted increase in noise level is 5 dB at a receptor location during the quietest hour (primarily during late night/early morning hours).
- **Geographic Extent**: The effect extends only a short distance (approximately 400 m) beyond the Site Study Area.
- **Timing, Duration and Frequency**: The effect will occur only during the site preparation and construction and decommissioning phases of the DGR Project, and is predicted to occur primarily during late night/early morning hours, on a daily basis.
- **Reversibility**: The effect will be reversible immediately upon completion of the site preparation and construction and decommissioning phases.
- **Probability**: The increase is expected to occur should the Project proceed.
- **Context**: The existing area is adjacent to an established industrial site. Existing noise levels are consistent with typical rural environments, with noise from the operations at the Bruce nuclear site audible at some locations.

Although compliance with Ontario noise level limits is not required for construction type activities (MOE 1995; 2013), they were assessed as part of the EA (Golder 2011a). As identified in MOE guideline publication NPC-232 (MOE 1995), recently replaced by NPC-300 (MOE 2013), noise associated with the operations of a facility (i.e., not including existing noise levels) must not exceed the greater of the exclusionary limits or the existing quietest 1-hour L_{eq}. For the DGR Project, this limit is 40 dBA, as all of the existing quietest 1-hour L_{eq} values are less than 40 dBA (see Table 6-2). Furthermore, the conservative nature of the assessment and predictions provides confidence that noise emissions from the DGR Project will meet Health Canada and World Health Organization guidelines.

For construction noise at receptors with durations of more than one year (i.e., long-term) and where noise levels are in the range of 45 to 75 dBA, Health Canada advises that health impact endpoints be evaluated on the change in the percentage of the population (at a specific receptor location) who become highly annoyed (%HA). Health Canada suggests that mitigation be proposed if the predicted change in %HA at a specific receptor is greater than 6.5% between project and baseline noise environments, or when the baseline-plus-project-related noise is in excess of 75 dBA (HC 2005). For the DGR Project, the percentage of the population that will be highly annoyed is less than 6.5 %, and the specific impact or impulse noise indicator (HCII) is less than 75 dBA at all receptor locations.

Noise levels associated with the DGR Project inside dwellings are predicted to be below the 30 dBA level recommended by the World Health Organization to minimize sleep disturbance (WHO 1999).

The only residual adverse effect on noise levels occurs during the site preparation and construction phase and decommissioning phase, and is limited to the residences in the vicinity of Baie du Doré. No cumulative residual effects on the noise levels VEC as a result of future projects were identified. The noise assessment inherently gives consideration to the cumulative effects of existing projects and their influence on the noise levels at all receptor locations given that the monitored noise levels include all emissions present at the time of the monitoring campaign.

Consideration was also given to whether the effects assessment conclusions on noise levels are sensitive to changes in climate conditions (OPG 2011, Section 7.14). It was concluded that the changing climate will not affect noise levels.

In summary,

- The only predicted residual adverse effect of the DGR Project on noise was a predicted increase in noise level at four residences near receptor R2 (Baie du Doré) during the quietest hour during site preparation and construction and decommissioning phases.
- The predicted adverse effect was assessed against a hypothesis that, *for a noise effect to be considered a significant adverse effect, the change in ambient noise would need to be disturbing (i.e., >10 dB change in the quietest hour)*.
- Noise effects would not be perceived as disturbing as the predicted change in ambient noise levels in the quietest hour at four residences near Baie du Doré is 5 dB or less. Adverse effects were predicted only during the site preparation and construction and decommissioning phases and only in areas immediately adjacent to the Bruce nuclear site, a short distance into the Local Study Area.
- In addition, although not required for construction activities, noise levels would comply with MOE guidelines, and the effect is immediately reversible upon completion of the site preparation and construction phase of the DGR Project.

Therefore, OPG concluded that the residual adverse effects of the DGR Project on noise levels are not significant.

6.5 Confidence

OPG has a high degree of confidence in the conclusion that the increase in noise level of 5 dB at receptor R2 is not significant. The significance conclusion is founded on the precautionary principle. A conservative approach was used to identify measurable effects based on comparison to the quietest 1-hour L_{eq} rather than longer term averages. In addition, the following factors provide further support for the conclusion:

- conservative bounding assumptions with respect to emissions and activities were incorporated into the prediction model (i.e., continuous at the highest level of activity and highest noise emissions); and
- limited noise attenuating factors were used in the prediction model.

The DGR Project will comply with relevant MOE criteria, and Health Canada and World Health Organization standards and guidelines. In addition, the DGR Project will meet the requirements of the Municipality of Kincardine Noise Bylaw.

6.6 References

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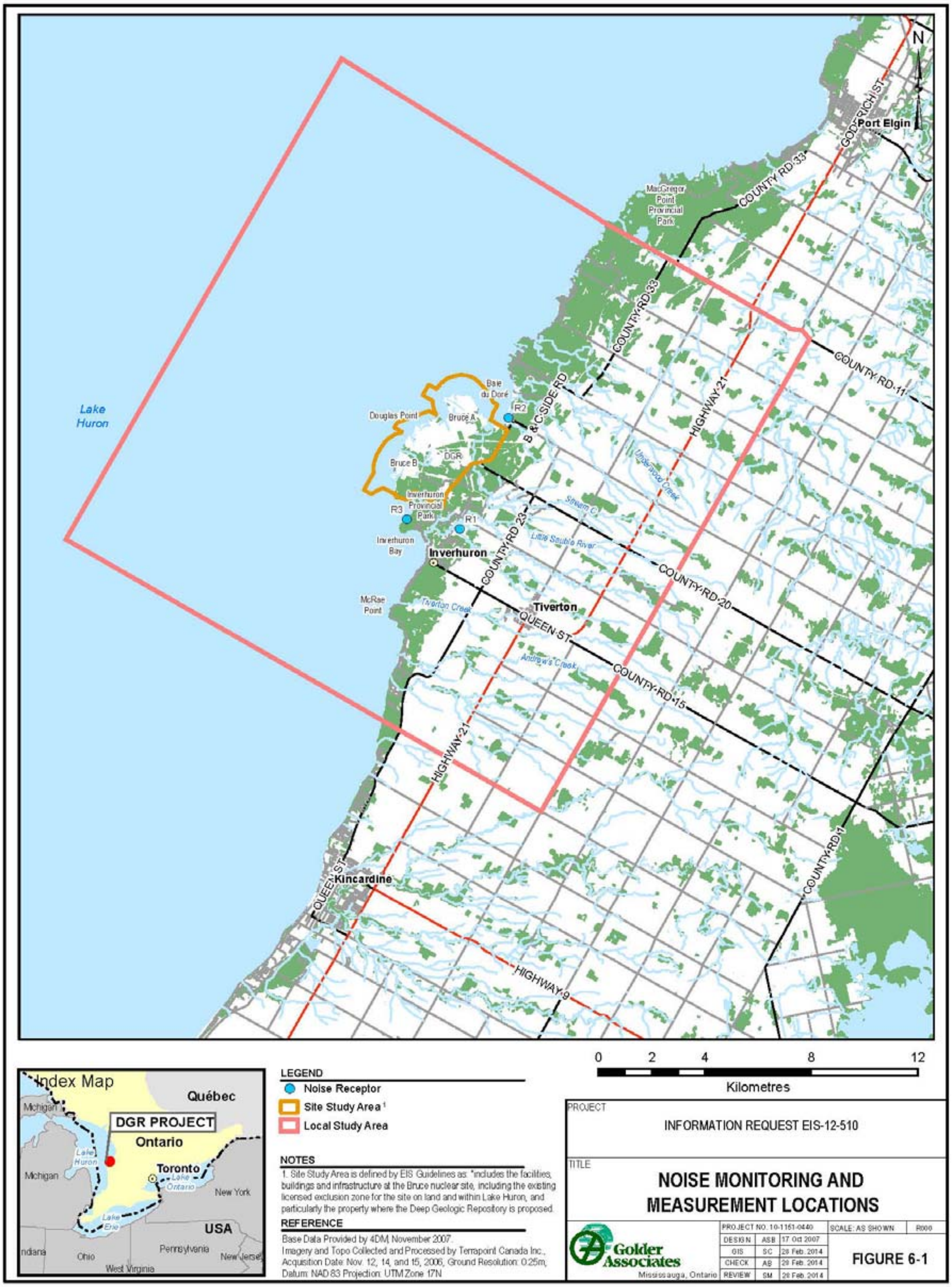
6.7 Figures

Figures are provided on the following pages.

Figure 6-1: Noise Monitoring and Measurement Locations



7. ABORIGINAL INTERESTS

This section provides a detailed narrative that explains the significance assessment for Aboriginal interests. Based on experience from other projects at the Bruce nuclear site, OPG's hypothesis was that an effect of the DGR Project on Aboriginal heritage resources, specifically the Jiibegmegoong burial site, would only be considered a significant adverse effect if *it prevents or interferes with the performance of ceremonies at, or observation of, the burial site*. The reasoning behind this hypothesis is presented below.

The detailed assessment of the potential effects presented in the Aboriginal Interests TSD (AECOM 2011) identified one residual adverse effect of the DGR Project on the Aboriginal heritage resources VEC. The effect was assessed to be not significant.

7.1 Approach to Assessment

A detailed assessment of the potential effects of the DGR Project on Aboriginal interests was presented in the Aboriginal Interests TSD (AECOM 2011, Sections 6, 7 and 8). The assessment concluded that the Aboriginal heritage resources VEC (including the use of the burial site) was the only VEC predicted to have a residual adverse effect as a result of the DGR Project.

The project was assessed to determine whether there was a potential for it to have a measurable change to the Aboriginal heritage resources VEC, and whether that measurable change would be considered adverse. The assessment identified no potential direct effects of the DGR Project on any Aboriginal heritage resources. However, changes to the environment that might indirectly affect potential use and access to the Jiibegmegoong burial site (e.g., the on-going presence of the DGR Project and disruption from changes in noise and dust levels) were identified as both measurable and adverse.

7.2 Existing Conditions

To understand the importance of changes in Aboriginal heritage resources, it was necessary to determine the existing conditions with respect to this VEC. Traditional information from Aboriginal communities was not available during preparation of the EIS. Archaeological investigations have been completed in and around the Bruce nuclear site since the 1950s (Fitzgerald 2009; Golder 2013). Stage 1 and 2 Archaeological Assessments identified and confirmed two registered archaeological sites, Upper Mackenzie and Dickie Lake, within the confines of the Site Study Area (Fitzgerald 2009). Four culturally-sensitive areas (A, B, C and D) have been identified within the Site Study Area (Figure 7-1), three of which were related to Aboriginal interests (i.e., A, B and C) (Fitzgerald 2009). Culturally-sensitive area A is composed of a section of the sandy Nipissing Great Lakes shoreline complex and the abutting Main Lake Algonquin lakebed. The Late Archaic period Jiibegmegoong burial site is located within Area A. The remainder of the Bruce nuclear site, including the footprint for the DGR Project, was considered to be clear of further Aboriginal-related archaeological concerns.

The burial site is located within the Bruce nuclear site more than one kilometre from the DGR Project site. OPG controls access to the burial site and Aboriginal people request site access from OPG in advance when planning to visit the burial ground. OPG has a protocol in place to ensure that access is granted each time it is requested. In the past, visits have been infrequent (International Reporting Inc. 2013).

7.3 Description of Potential Effects

The assessment considered direct and indirect effects on the Jiibegmegoong burial site during all project phases. In 1998, OPG and the Saugeen Ojibway Nation (SON) established a protocol for SON to access the Bruce nuclear site to conduct ceremonies and monitoring at the Jiibegmegoong burial site. The access of the SON to this burial site will be unchanged. The burial site itself will not be physically altered by the DGR Project; however indirect effects have the potential to diminish the quality and value of Aboriginal ceremonial activities at the burial site. The visibility of the DGR structures may diminish the quality or value of activities undertaken by Aboriginal peoples at the burial site. This effect will occur during the site preparation and construction and operations phases. All surface facilities will be removed during the decommissioning phase, but the waste rock pile will remain. Therefore, an adverse effect on Aboriginal heritage resources was identified as a result of the visual presence of the DGR Project during all phases.

The activities and traffic during the site preparation and construction phase of the DGR Project are predicted to cause increased dust and noise levels at the burial site (Sections 5 and 6 of this response). The quality or value of activities undertaken by Aboriginal peoples at the burial site will be diminished because noise and dust from an industrial source are not considered compatible with the intended function of a burial ground; a place where human remains of Aboriginal ancestors have been respectfully and ceremonially laid. Therefore, an adverse effect on Aboriginal heritage resources was identified.

Mitigation measures have been incorporated into the design of the DGR Project to reduce the visual effect (e.g., berm and/or trees). In-design mitigation measures to reduce air quality and noise effects are described in the Atmospheric Environment TSD (Golder 2011, Sections 8.2.2, 8.2.4, 8.3.2, 8.3.4). OPG would have advance notice of visits to the burial site and has committed to take reasonable measures to mitigate effects while visits to the site are occurring (International Reporting Inc. 2013).

The changed aesthetics, including visual presence of DGR structures, and increased dust and noise, are expected to have a residual adverse effect on the Aboriginal heritage resource VEC.

7.4 Significance of the Residual Adverse Effect

In accordance with the categories set out in the EIS Guidelines, the residual adverse effect of the DGR Project on Aboriginal heritage resources, specifically the burial site, can be described as follows:

- **Magnitude**: No physical disturbances to Aboriginal heritage resources; however, there will be changes to the aesthetics, namely visual presence, dust and noise at the Jiibegmegoong burial site.
- **Geographic Extent**: The effect is limited to the burial site within the Site Study Area.
- **Timing and Duration**: The visual effect of structures associated with the DGR will occur during all phases. The indirect effects of noise and dust will occur during the site preparation and construction phase and decommissioning phase.
- **Frequency**: At any time the burial site is visited or used for ceremonial purposes.
- **Reversibility**: Noise and dust effects are immediately reversible when the activity ceases. The waste rock pile will remain in place.
- **Probability**: It is assumed that Aboriginal people will visit the burial site and that the predicted effect would occur.

There are no absolute effects thresholds to use when evaluating effects that diminish the quality or value of activities undertaken by Aboriginal peoples at Aboriginal heritage resources. Therefore, the results were based on the professional judgement of the experts who performed the assessment.

In summary,

- The only predicted residual adverse effect of the DGR Project on Aboriginal interests was the diminishment of the quality or value of activities undertaken by Aboriginal peoples at the Jiibegmegoong burial site located within the Bruce nuclear site.
- The predicted adverse effect was assessed against a hypothesis that an effect of the DGR Project on Aboriginal heritage resources, specifically the Jiibegmegoong burial site, would only be considered a significant adverse effect *if it prevents or interferes with the performance of ceremonies at, or observation of, the burial site.*
- The DGR Project is not anticipated to further restrict access to the burial site for ceremonial purposes. OPG has a protocol in place to accommodate access requests and to ensure safe access is granted. This practice is expected to continue. Therefore, the DGR Project is not expected to prevent or interfere with ceremonies at the burial site.
- The waste rock pile and other Project-related structures that will be visible at the burial site will not change the existing industrial character of the Bruce nuclear site. Therefore, they are not expected to prevent or interfere with ceremonial activities.
- In addition, indirect effects from noise and dust are primarily during the site preparation and construction and decommissioning phases of the project, and would be reversible with time.

Therefore, OPG concluded that the residual adverse effect of the DGR Project on Aboriginal interests is not significant.

7.5 Confidence

OPG is confident that the DGR Project will not change access to the burial site, as the burial site is located one kilometer from the project, and will not result in physical changes to Aboriginal heritage resources.

OPG's confidence in the conclusion that the indirect effects from noise and dust on the quality and value of activities at the burial site will not be significant is based on OPG being aware of the timing of these activities through providing access to the site. It is also based on the ability to manage noise and dust emissions through readily available mitigation measures during Aboriginal ceremonies. Further, the visual impacts of the DGR Project will be mitigated through constructing berms or planting trees on the DGR Project Site.

7.6 References

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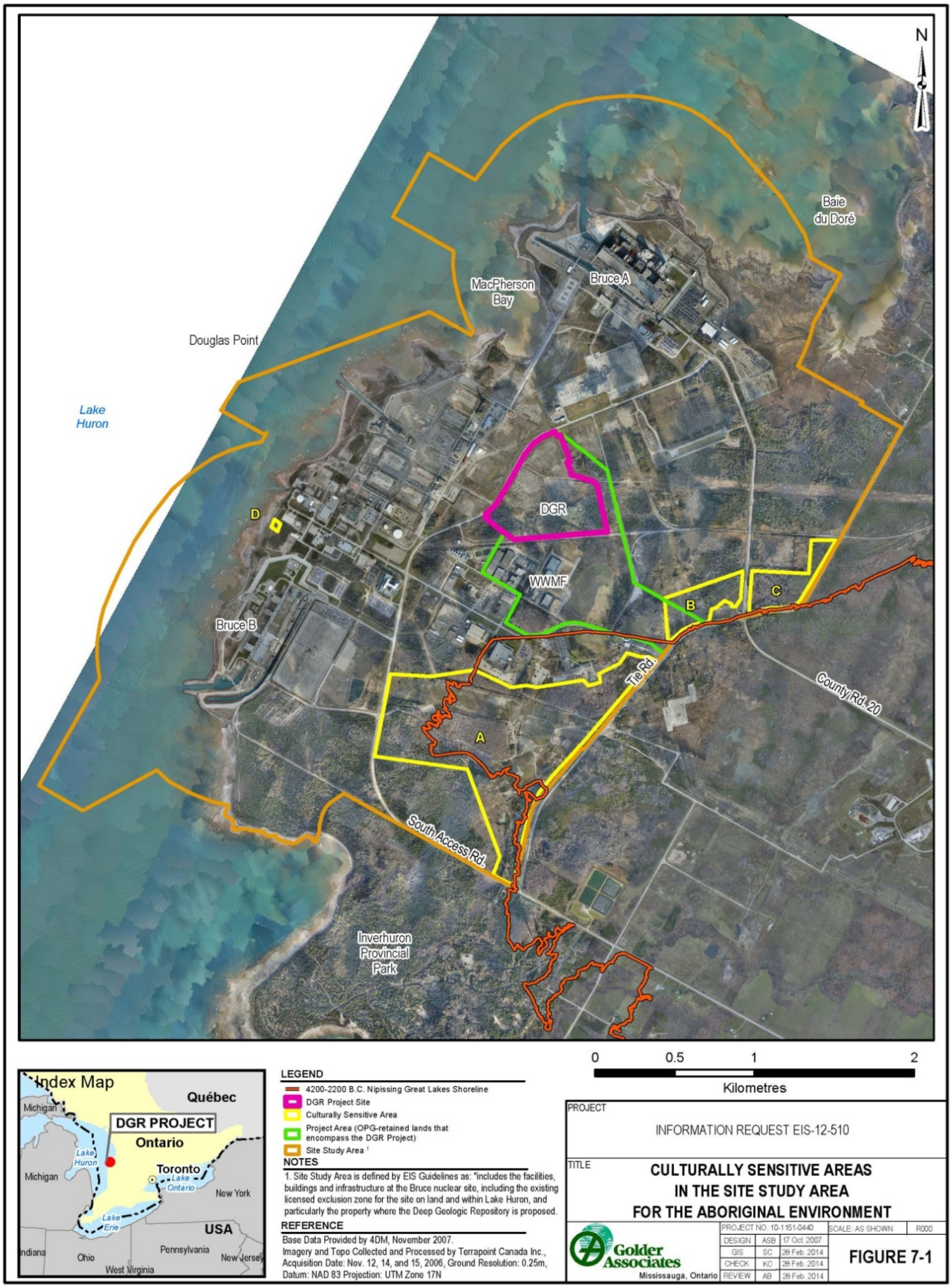
7.7 Figures

Figures are provided on the following pages.

Figure 7-1: Culturally Sensitive Areas in the Site Study Area for the Aboriginal Environment



8. RADIATION AND RADIOACTIVITY

OPG's hypothesis was that, for a significant adverse effect of radiation and radioactivity to occur, *the DGR Project would need to cause radiological releases that result in doses to human or non-human biota in excess of the relevant Canadian Nuclear Safety Commission (CNSC) regulatory requirements*.

A comprehensive assessment of radiological effects was completed using a systematic risk assessment approach (AMEC NSS 2011; OPG 2011) and predicted that there will be no residual adverse effects as a result of the DGR Project. Since no residual adverse effects were identified, a significance assessment was not completed.

Potential effects on humans included Nuclear Energy Workers (NEWs), who are expected to receive radiation doses as a result of the DGR Project, non-NEWs and members of the public including Aboriginal peoples. Non-human biota VECs were identified to capture potential effects on different trophic levels, and hence different exposure pathways.

The existing ionizing radiation and radioactivity conditions were established through a compilation and review of existing information for existing doses to humans and the results of modelling for existing doses to non-human biota. This included consideration of annual reports summarizing radiological data for the other facilities on the Bruce nuclear site, including Bruce A, Bruce B, the WWMF (Bruce Power 2002, 2003, 2004, 2005a, 2006, 2007, 2008, 2009, 2010), and previous EAs conducted on the site (OPG 2005, Bruce Power 2005b).

For the purposes of the radiation and radioactivity assessment, likely effects on humans were compared with regulatory limits for NEWs, non-NEWs and members of the public. The CNSC sets the regulatory limits on the annual dose to members of the public and to workers to ensure that the probability of occurrence of effects is acceptably low (Canada Gazette 1998). For non-human biota VECs, screening dose criteria, which are usually expressed as the Estimated No Effect dose-rate Values (ENEVs), were used to determine whether project-related changes are likely to be adverse. These benchmarks are consistent with the lowest values in various studies (NWMO 2009) and represent chronic dose rates that were observed not to produce any adverse effects upon populations of biota (CNSC 2002).

Predictive modelling was used to calculate the dose to humans as described in the Radiation and Radioactivity TSD (AMEC NSS 2011). All doses to NEWs are expected to be much lower than OPG's occupational dose target of 10 mSv/a for workers, which are lower than the CNSC regulatory limits. The predicted project-related dose is also expected to be less than that received by existing NEWs at the Bruce nuclear site. For non-NEWs, the project-related external dose rate is well below the compliance dose limit of 0.5 µSv/h (AMEC NSS 2011). Doses to members of the public were calculated using conservative methods focused on the (potentially) most exposed receptor groups, consistent with CSA Standard N288.1 (CSA 2008) and the existing Bruce Nuclear Site Radiological Environmental Monitoring Program (REMP). Doses to members of the public due to emissions from the DGR Project are predicted to be less than 1 µSv/a, which is well below the regulatory limit for members of the public of 1000 µSv/a (1 mSv/a).

The approach used to calculate the dose to non-human biota (adapted from that used in [OPG 2009]) calculated dose to non-human biota from internally deposited radioactivity and external radiation using dose coefficients, transfer factors and occupancy factors for each radionuclide in each type of organism for various environments (AMEC NSS 2011). The assessment concluded that doses to non-human biota were much less than dose criteria established to be protective by CNSC (Canada Gazette 1998) and other Canadian agencies (Environment Canada and Health Canada 2003).

As all predicted doses are less than established dose criteria, no residual adverse effects as a result of radiological releases from the DGR Project were predicted to occur, and no significance assessment was performed.

There is a high degree of confidence in the conclusions of the Radiation and Radioactivity TSD (AMEC NSS 2011), owing to the conservatism built into the assessment using a bounding assessment approach. Furthermore, the calculation of doses to humans and non-human biota in this study involved postulating scenarios leading to the highest possible doses, and then comparison with stringent regulatory and literature dose criteria for the assessment of consequences.

8.1 References

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9. NEAR-SURFACE GEOLOGY AND HYDROGEOLOGY

Based on experience from other projects, OPG's hypothesis was that, for an effect to near-surface groundwater to be considered a significant adverse effect, the following would be required:

- *migration of contaminants of potential concern in excess of established criteria and/or guidelines relevant to human or ecological health, on a frequent and/or continuous basis; or*
- *alteration of the shallow groundwater flow regime to an extent that it would alter sensitive or critical habitats on a frequent and/or continuous basis*.

A comprehensive assessment of potential effects to near-surface geology and hydrogeology was completed (OPG 2011; Golder 2011a) and predicted that there will be no residual adverse effects as a result of the DGR Project. Since no residual adverse effects were identified, a significance assessment was not completed.

The existing conditions of the four VECs pertaining to near-surface groundwater were determined through field measurement and reference to available information. The DGR Project is situated on the east shore of Lake Huron on the Douglas Point promontory, a bedrock-controlled feature with nearly flat-lying dolostone bedrock outcropping along the shoreline. Douglas Point extends westward 2.5 to 3.0 km into Lake Huron over a distance of approximately 5 km between Inverhuron Bay to the southwest and Baie du Doré to the north.

Key characteristics of the groundwater regime within the Site Study Area include:

- The near-surface groundwater system is isolated from the deep saline groundwater system in which the proposed DGR would reside (Golder 2011a).
- There are no potable groundwater supply wells between the Project Area and Lake Huron (Golder 2011a).
- The Project Area is underlain by a dense, low permeability ($K \sim 10^{-10}$ m/s) silt till aquitard (10 to 20 m thick) (OPG 2012a, EIS-03-56).
- Overall, groundwater migration directly beneath the Site Study Area is oriented vertically downward within the till aquitard. Groundwater discharge from the till aquitard enters an underlying confined permeable ($K \sim 10^{-6}$ m/s) carbonate aquifer in which groundwater migration is horizontal to Lake Huron (Golder 2011a).

Within the Site Study Area there are some sensitive ecological features, namely the marsh located in the northeastern portion of the Project Area. The groundwater beneath the Project Area does not result in any recharge to these sensitive surface habitats (OPG 2013, EIS-09-473). Measures will be implemented to mitigate the risk of adversely affecting these sensitive ecological areas, such as sustaining a buffer of 30 m between the DGR Project infrastructure and the northeast marsh.

The DGR Project will introduce changes to the quantity and quality of the recharge to the groundwater that occurs from precipitation. The DGR Project includes a stormwater management system which will collect runoff from surface drainage and the rock waste management area for water quality monitoring and eventual discharge to Lake Huron via the drainage ditch at Interconnecting Road. The stormwater management pond and the waste rock management areas are underlain by a dense, low permeability ($\sim 10^{-10}$ m/s) glacial till aquitard with a very low potential for infiltration (OPG 2012a, EIS-03-56). This glacial till aquitard limits infiltration from the stormwater management pond into the underlying shallow groundwater.

The occurrence of fractures within the glacial till aquitard is not expected to influence recharge or solute transport rates to the underlying confined carbonate aquifer in which lateral off-site migration could occur (Golder 2012). Evidence includes the minimum thickness of the native glacial till unit (~10 m) and minor occurrence of an upper weathered till horizon (~2 m) based on observation. Although weathered/fractured tills are not expected, OPG has an allowance for the lining of the stormwater management pond and the waste rock management area as a mitigative measure should such conditions or intervening till deposits be encountered during site preparation construction (International Reporting Inc. 2013).

A quantity of leachate from the waste rock management area will ultimately enter the shallow groundwater regime below the site. The chemical characteristics of the leachate combined with leachate generating capacity will not lead to an effect on the groundwater quality, in part, due to the natural attenuation at the glacial till underlying bedrock interface.

This glacial till aquitard under the Project Area also prevents measurable drainage of water from surface water bodies (e.g., the northeast marsh) into the subsurface, which is confirmed by the continued presence of the water body long after rainfall events. Operational dewatering during construction of the shafts is not expected to have any measurable effect on the groundwater regime beneath the northeast marsh. The zone of influence of the dewatering is temporary and would extend only tens of metres (Sykes 2012a, 2012b) such that it will not have an effect on the overall site groundwater regime or sensitive ecological features located near the site, such as the wetland areas which are approximately 500 m away from the two DGR shafts.

Northeast Marsh within the Project Area

During shaft construction dewatering may temporarily influence groundwater flow paths and downgradient tritium plume migration in the confined carbonate aquifer. Natural attenuation assures that concentrations of tritium in groundwater downgradient of the WWMF and in the vicinity of the shafts will remain well below Ontario Drinking Water Standards (Golder 2011a). The tritium plume does not intersect ecologically sensitive areas, is not predicted to be mobilized to any of these areas, and poses no risk to human or ecological health.

Therefore, OPG concluded that there would be no measurable change to the near-surface geology and hydrogeology that would result in an adverse environmental effect, and thus no residual adverse effects were identified and no significance assessment was performed.

There is a high degree of confidence in the conclusions of the Geology TSD (Golder 2011a), owing to the extent of site-specific and historic local scale investigations completed (e.g., as documented in Golder 2011a, 2011b, 2012; NWMO 2011; OPG 2012b, EIS-04-101; OPG 2012c, EIS-05-185). Substantive groundwater and geological data collected for several decades was available due to historic and on-going routine groundwater monitoring programs.

9.1 References

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10. SURFACE WATER QUALITY

Based on experience from other projects, OPG's hypothesis was that, for an effect to surface water quality to be considered a significant adverse effect, the following would be required:

- *releases of indicator compounds at concentrations in excess of the relevant Provincial Water Quality Objectives or Canadian Environmental Quality Guidelines protective of human or ecological health in receiving waters; or*
- *alteration of the surface water quality regime to an extent that it would adversely affect sensitive or critical habitats on a long-term or continuous basis.*

A comprehensive assessment of potential effects to surface water quality was completed (OPG 2011; Golder 2011) and determined that there will be no residual adverse effects as a result of the DGR Project. Since no residual adverse were identified, a significance assessment was not completed.

The project was assessed to determine whether there was a potential to have a measurable change relative to baseline conditions. A change is considered measureable if any water quality parameters are predicted to be beyond the background variability of the receiving water body. Water quality modelling was conducted based on the understanding of the quality of the flows into the stormwater management pond (SWMP) to determine the predicted concentrations of indicator compounds. The results were compared to the following water quality criteria to determine the need for mitigation:

- Ontario Ministry of the Environment and Energy (MOEE) Provincial Water Quality Objectives (PWQOs) (MOEE 1994); and/or
- Canadian Council of Ministers of the Environment (CCME) Canadian Environmental Quality Guidelines (CEQG) for recreational water quality and aesthetics, as well as for the protection of aquatic life (CCME 1999).

All releases and surface runoff from the DGR Project will be captured in the perimeter drainage system and conveyed to the SWMP. Water from the SWMP will be discharged via a controlled outlet to the existing drainage ditch along the Interconnecting Road, which is frequently dry and not characterized by the Saugeen Valley Conservation Authority as providing fish habitat. There will be no releases from the DGR Project to either the North or South Railway Ditches, or Stream C (to which they drain).

The drainage ditch at Interconnecting Road drains towards MacPherson Bay in Lake Huron, ultimately the receiving waterbody for the proposed releases from the DGR Project. Water quality sampling results for nearshore samples collected in MacPherson Bay in 2007 and 2009, as well as in previous studies (Ontario Hydro 1973, Ontario Hydro Nuclear 1984, Bruce Power 2001), are provided in Table 6.3.5-1 of the EIS (OPG 2011), and were generally within the appropriate range of water quality guidelines. OPG undertook additional monthly water quality sampling over three seasons in MacPherson Bay from September 2011 to December 2012, which specifically included analysis of nitrates, nitrites and ammonia and a number of other parameters. Results were provided as part of OPG's response to Information Request EIS-08-387 (OPG 2013b) and were similar to previous sampling campaigns.

The SWMP will collect water from underground (process water and groundwater inflows), general site runoff, and leachate from the waste rock management area (WRMA). The SWMP will be designed to retain runoff during storm events, and control the total suspended solids concentrations in effluent discharges (MOE 2003). In between storm events, the SWMP will be used to control total suspended solids concentrations primarily from underground sources. During construction, a temporary settling pond will be used to settle out any excess solids in water pumped from underground before discharge into the ditch system leading to the SWMP. The temporary settling pond would be decommissioned at the end of construction.

The site drainage system has also been designed to avoid any measurable effect on wetland habitat. In addition to a commitment to maintain a 30-m setback from adjacent wetlands, the construction and operation of the SWMP will not change water levels or discharge water to adjacent wetlands, including the northeast marsh. The site drainage system design will not allow for water to overtop ditches or the SWMP to the adjacent wetland and will safely convey the peak outflow rate from a 24-hour, 100-year rainfall event (OPG 2012, EIS-04-130). Runoff from the waste rock piles will be directed to the perimeter ditches through grading, preventing runoff from the waste rock piles reaching the wetland.

Ultimately the quality of the water in the SWMP will depend on the quality of inflows to the pond, including both groundwater pumped to surface and stormwater runoff. Water quality modelling (OPG 2013a, EIS-08-394) identified salinity (as measured by total dissolved solids) from underground seepage and nitrogen compounds from blasting residues from waste rock pile runoff as the two water quality issues that may require additional mitigation. Both of these are readily managed using existing treatment technologies.

The final water quality criteria for the effluent from the SWMP will be developed as part of the Ontario Environmental Compliance Approval (ECA) process. The limits will be established taking into consideration the PWQOs, the acute toxicity thresholds for sensitive species that are present in the receiving environment, and the existing water quality in the receiving water at MacPherson Bay. The regulatory process will not allow the release of effluent from the SWMP that is acutely toxic to aquatic receptors.

A review of water quality predictions by Environment Canada and the CNSC determined that the proposed discharge criteria (NWMO 2011) would result in compliance with section 36(3) of the *Fisheries Act* and not be deleterious to aquatic communities in McPherson Bay (CNSC 2013). They also recommended that, before discharge from the SWMP is authorized, OPG conduct chemical characterization and acute and chronic toxicity tests of the effluent to provide further assurance of compliance with section 36(3) of the *Fisheries Act* (CNSC 2013).

It is expected that, if mitigation is required, it could include some type of treatment for one or more parameters for the final effluent to meet the applicable criteria. The project design and the commitments made by OPG provide for water treatment where required to meet applicable criteria (OPG 2012, EIS-04-130). The parameters that may need treatment are well understood, common in industrial environments and are easily managed with common treatment technologies. Ensuring that the discharge criteria are met prevents adverse effects on surface water quality. Therefore, OPG concluded that the DGR Project will not result in residual adverse effects to surface water quality and no significance assessment was performed.

OPG has a high degree of confidence in the conclusion because a conservative approach was used to identify and assess potential effects. Predictive modelling of the stormwater management system was conducted using standard mass-balance calculations. The input parameters are conservative to allow for a robust design with the expected performance of the system to be better than that modelled. Confidence in the determination that there will be no residual adverse effects to surface water quality comes from demonstrating that the discharge from the SWMP can meet the regulatory criteria (determined through the ECA and other regulatory processes) and will not be deleterious. OPG has a good understanding of the baseline conditions and is able to monitor and control inflows into the stormwater management system. The contaminants of concern are well understood and can be treated using commonly available and effective technologies.

Consideration was also given to whether the effects assessment conclusion for surface water quality is sensitive to changes in climate conditions (OPG 2011, Section 7.14). Climate changes that could potentially affect stream flow could indirectly affect water quality. Since the assessment concluded that climate change would not alter the conclusions of the hydrology assessment on surface water quantity and flow, no changes to the conclusions of the surface water quality assessment are predicted.

10.1 References

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