NOVA SCOTIA

Comment Index

Highway 102 Aerotech Connector Road Project

Publication date: September 10, 2019

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Public

Number	Source	Date Received
1	Anonymous	September 20, 2019
2	Anonymous	September 24, 2019
3	Anonymous	October 10, 2019

From:
To: Mageste da Silva, Renata
Cc:
Subject: RE: Highway 102 Aerotech Connector Road Project Environmental Assessment Registration
Date: October 3, 2019 3:39:25 PM

Hi Renata,
The Air Quality Unit has no comments on this environmental assessment.
Regards,
Sharon

From: Mageste da Silva, Renata <Renata.MagestedaSilva@novascotia.ca>
Sent: October 3, 2019 8:46 AM
Cc: Environment Assessment Web Account <EA@novascotia.ca>
Subject: RE: Highway 102 Aerotech Connector Road Project Environmental Assessment Registration
Importance: High

Good morning everyone,

This is a reminder that if you have not already submitted comments to the EA Branch, comments on the Registration Document for the Highway 102 Aerotech Connector Road Project must be provided by **October 10, 2019**, to be considered in this environmental assessment. **Comments are requested to be provided via e-mail if possible and if you have no comments, please indicate this in writing**. Again, attached is a memo template for providing your comments for use if you wish.
Kind regards,
Renata

From:
To: Mageste da Silva, Renata
Subject: RE: Highway 102 Aerotech Connector Road Project Environmental Assessment Registration
Date: October 4, 2019 2:33:40 PM

Resource Management Unit – no comments.

From: Mageste da Silva, Renata <Renata.MagestedaSilva@novascotia.ca>
Sent: October 3, 2019 8:46 AM
To:
Cc: Environment Assessment Web Account <EA@novascotia.ca>
Subject: RE: Highway 102 Aerotech Connector Road Project Environmental Assessment Registration
Importance: High

Good morning everyone,

This is a reminder that if you have not already submitted comments to the EA Branch, comments on the Registration Document for the Highway 102 Aerotech Connector Road Project must be provided by **October 10, 2019**, to be considered in this environmental assessment. **Comments are requested to be provided via e-mail if possible and if you have no comments, please indicate this in writing**. Again, attached is a memo template for providing your comments for use if you wish.

Kind regards,
Renata

Canadian Environmental Assessment Agency | Agence canadienne d'évaluation environnementale

Suite 200
1801 Hollis Street
Halifax, NS B3J 3N4

Bureau 200
1801 rue Hollis
Halifax, NE B3J 3N4

Date: October 7 2019

To: Renata Mageste da Silva, Environmental Assessment Officer

From: Trevor Ford, Environmental Assessment Officer, Impact Assessment Agency of Canada

Subject: Highway 102 Aerotech Connector Road Project

The federal environmental assessment process is set out in the *Impact Assessment Act* (IAA). The *Physical Activities Regulations* (the Regulations) under IAA set out a list of physical activities considered to be "designated projects." For designated projects listed in the Regulations, the proponent must provide the Agency with an Initial Description of a Designated Project that includes information prescribed by applicable regulations (*Information and Management of Time Limits Regulations*)..

The relevant entries in the Regulations for this type of project are:

> The construction, operation, decommissioning and abandonment of a new:
> all-season public highway that requires a total of 75 km or more of new right of way.

Based on the information submitted to the Province of Nova Scotia on the proposed Highway 102 Aerotech Connector Road Project, it does not appear to be described in the Regulations. Under such circumstances the proponent would not be required to submit an Initial Description of a Designated Project to the Agency. However, the proponent is advised to review the Regulations and contact the Agency if, in their view, the Regulations may apply to the proposed project.

The proponent is advised that under section 9(1) of the IAA, the Minister may, on request or on his or her own initiative, by order, designate a physical activity that is not prescribed by regulations made under paragraph 109(b) if, in his or her opinion, either the carrying out of that physical activity may cause adverse effects within federal jurisdiction or adverse direct or incidental effects, or public concerns related to those effects warrant the designation. Should the Agency receive a request for a project to be designated, the Agency would contact the proponent with further information.

The proposed project may be subject to sections 82-91 of IAA. Section 82 requires that, for any project occurring on federal lands, the federal authority responsible for administering those lands or for exercising any power to enable the project to proceed must make a determination regarding the significance of environmental effects of the project. The Agency is not involved in this process; it is the responsibility of the federal authority to make and document this determination.

The proponent is encouraged to contact the Agency at (902) 426-0564 if it has additional information that may be relevant to the Agency or if it has any questions or concerns related to the above matters.

Trevor Ford
Environmental Assessment Officer
Impact Assessment Agency of Canada
Trevor.Ford@canada.ca

60 Research Drive
Suite A
Bible Hill, Nova Scotia
B6L 2R2

NOVA SCOTIA

Agriculture

Date: 2019-10-07

To: Renata Mageste da Silva, Environmental Assessment Officer

From: Executive Director, Policy and Corporate Services
Nova Scotia Department of Agriculture

Subject: Highway 102 Aerotech Connector Road Project Environmental Assessment

Thank you for the opportunity to review the Highway 102 Aerotech Connector Road Project Environmental Registration Project documents.

Given that internal review has not identified any existing agricultural properties within a five-kilometer radius of the project and soil classification in the vicinity of the proposed project indicates limited potential for agricultural activities, the Nova Scotia Department of Agriculture has no immediate concerns with this proposal.

60 Research Drive
Suite A
Bible Hill, Nova Scotia
B6L 2R2

NOVA SCOTIA

Fisheries and Aquaculture

Date: 2019-10-07

To: Renata Mageste da Silva, Environmental Assessment Officer

From: Executive Director, Policy and Corporate Services
Nova Scotia Department of Fisheries and Aquaculture

Subject: Highway 102 Aerotech Connector Road Project Environmental Assessment

Thank you for the opportunity to review the Highway 102 Aerotech Connector Road Project Environmental Registration documents.

The Nova Scotia Department of Fisheries and Aquaculture has no immediate concerns with the proposal.

NOVA SCOTIA
Department of Municipal Affairs and Housing

Maritime Centre, Floor 14 North
1505 Barrington Street
PO Box 216
Halifax, NS B3J 2M4

Date: October 8, 2019

To: Renata Mageste da Silva, Environmental Assessment Officer, NSE

From: Gordon Smith, Provincial Director of Planning

Subject: **HIGHWAY 102 AEROTECH CONNECTOR ROAD PROJECT**

As requested, the Department of Municipal Affairs and Housing has reviewed the Environmental Assessment Registration Documents for the proposed Highway 102 Aerotech Connector Road Project. From the perspective of our Departmental mandate, we have no comments to submit regarding this review.

Although we have found nothing of concern respecting the Department's areas of mandate, we would like to remind the proponent to ensure they have undertaken adequate consultation with the Municipality in order to confirm conditions for compliance with municipal planning policies and by-law provisions.

Thank you for the opportunity to review the Registration Document for the above-noted project. Should you require additional information, please feel free to contact either Alan Howell, Senior Planner (902-483-3746 / Alan.Howell@novascotia.ca) or me (902-424-7918 / Gordon.Smith@novascotia.ca).

Yours truly,

Gordon Smith
Provincial Director of Planning

c: Alan Howell, Senior Planner, DMAH

1894 Barrington Street
PO Box 442
Halifax, Nova Scotia
Canada B3J 2P8

NOVA SCOTIA

Environment

Date: October 9, 2019

To: Water Management Unit Manager, Water Management Unit

From: Senior Surface Water Quality Specialist, Water Management Unit

Subject: Connector Road between Highway 102 Aerotech Interchange (Exit 5A) and Trunk 2 at Wellington Environmental Assessment – Review Comments & Recommendations

Scope of Review

As Senior Surface Water Quality Specialist with the Nova Scotia Environment Sustainability and Applied Science Division, the following Connector Road between Highway 102 Aerotech Interchange (Exit 5A) and Trunk 2 at Wellington Environmental Assessment (EA) review focuses on the following subjects:

- Surface water quality & its management
- General surface and groundwater resources & their management

The following review considers whether the environmental concerns associated with the above subjects and the proposed mitigation measures have been adequately addressed in the Environmental Assessment. The recommendations provided below are meant to supplement the actions outlined in the EA submission documents.

While general comments on fish and fish habitat, wetlands, surface water quantity, and groundwater quality and quantity may be included below, applicable technical specialists should be consulted for specific review and comment.

Reviewed Documents

The following document was the basis for this EA review:

Wood. 2019. *Environmental Assessment Connector Road between Highway 102 Aerotech Interchange (Exit 5A) and Trunk 2 at Wellington.* Environmental Assessment Registration. Nova Scotia Department of Transportation and Infrastructure Renewal. TV184002

Comments

General

- Section 6.1.4 is a review of other undertakings in the area of the proposed Project and assessment of potential combined environmental effects. The proposed Goffs Quarry expansion that is located downstream of WC01, WC03, WC04 and WC05 on unnamed tributaries of Holland Brook is not mentioned. At

the time the Aerotech Connector EA was submitted Goffs Quarry was not an approved project and undergoing a Department of Environment EA review.

Surface Water Quality

- The Project site is located within the Fletchers Lake watershed, Grand Lake watershed and Shubenacadie River watershed, which are all municipal drinking water supplies. Fletchers Lake supplies the Collins Park treatment system. Grand Lake supplies the communities of Enfield, Elmsdale and Lantz. The Shubenacadie River supplies the Bowmont treatment system. There is no assessment on potential impacts to these drinking water supplies from the Project activities.
    - Table 2.4.1 lists herbicide use as a potential vegetation maintenance activity and that it will not be allowed within 60 m of a protected water supply. As the entire project area is within the watershed areas for three drinking water supplies, the 60 m buffer distance could potentially be interpreted to apply and prevent the use of herbicides within the Project area.
- Section 2.2.3 includes the following statement “Surface water from the highway will be collected in drainage ditches running alongside the highway shoulders. There will be no direct connection of surface water runoff into existing watercourses.” There is no description on how surface water runoff will be managed from the Project area to prevent direct connection with existing watercourses. Based on the design details presented in the EA submission, surface water runoff from highway surfaces draining via ditches would be expected to drain directly into watercourses with little to no treatment. There is no discussion on whether this would be considered a direct connection or not. It could be interpreted that no direct connection would involve some level of treatment of surface water runoff prior to discharge into a watercourse.
- Section 5.1.2.1 identifies that the majority of the Project is to be constructed within the Halifax geology group of sulphide bearing rock, which has the potential to be acid generating and metal leaching. Appendix A provides a general acid rock management approach that will be applied to the Project, including high-level pre-and post-construction monitoring and mitigation measures. Example projects, including one managed by NS Transportation and Infrastructure Renewal are discussed at a high-level with respect to mitigation measures. The management approach does not include baseline assessment to identify potential extents of the acid generating rock within the Project area or assessment of preliminary feasibility of the proposed mitigation measures in comparison to site specific conditions (e.g., existing groundwater elevations, soil characteristics [depth, type]).
- Table 5.1.1 presents *in-situ* water quality parameter results measured using a multi-parameter probe from September 4 to 7, 2018. The results indicate relatively low pH values (<6.5) in the monitored watercourses.
- No surface water quality samples were collected during the baseline study and submitted for physical and/or chemical analysis (e.g., general chemistry, metals, nutrients, total suspended solids, herbicides, hydrocarbons) at an accredited laboratory.
- Section 6.1.3.1 indicates that herbicides will be potentially used following the Proponent’s Integrated Roadside Vegetation Maintenance program guidance document. The section also indicates that pesticides will not be used, although

herbicides are a type of pesticide.
- Table 7.2.1 indicates that monitoring of surface water environments will be implemented assess environmental protection plan measures and as part of permitting/approval requirements. No details on what types of monitoring would be implemented are included (e.g., water quality parameters, flows).

Surface Water Quantity
- Section 6.4.3.3 indicates that a Nova Scotia Environment Water Approval will be obtained for watercourse crossings. There is no specific 'water approval' issued by Nova Scotia Environment. Instead a watercourse alteration notification or approval would be sought by the Proponent from the Department.
- There is no discussion of potential changes to watershed drainage areas due to the construction of the highway. It would be expected that the Project works would change localized surface water runoff patterns and increase or decrease local surface water feature drainage areas.
- Ponds 1 and 3 (Figure 5.1.4) are located within the proposed highway right-of-way. There is no assessment within the EA submission on the potential alterations to these ponds, including whether there would removal/infilling. These activities would result in a loss of watercourse within the Project area.

Recommendations

The following recommendations could be potentially developed as conditions in support of potential approvals for the Project:

Operational Issues/Other Permitting Processes

General
- The site-specific EPP should be provided to the Nova Scotia Department of Environment for review and comment prior to commencement of the Project.

Surface Water Quality
- As acid rock drainage and metal leaching are expected to occur due to Project activities and local geology, the proposed development of a management and monitoring plan in consultation with the Department of Environment should be completed. Detailed design of site-specific mitigation measures should be developed by a qualified professional engineer licensed to practice in the Province of Nova Scotia and submitted to the Department of Environment for review and approval.
- The potential use of herbicides within the Project area for vegetation management should be confirmed with the Proponent and their integrated vegetation management plan with respect to the separation distance from protected drinking water supplies.
- The surface water monitoring committed to be undertaken for this Project in the Registration Document (Table 7.2.1) during the construction phase should be developed into a monitoring plan and submitted to the Department of Environment for review and comment prior to implementation. Activities related to monitoring parameters and frequency, interpretation of monitoring results (e.g., action criteria), and actions and mitigation measures that will be implemented if criteria are exceeded. As part of the monitoring program plan methods, details on the establishment of water quality sample sites and sampling frequency should

be indicated and associated analysis requirements included, particularly for the Project identified contaminants of concern (e.g., sediment, acid rock drainage, metals, salt, herbicides, hydrocarbons). Pre- and post-construction monitoring plans with respect to acid rock drainage and metal leaching should be included as part of the overall surface water monitoring plan.

- The Proponent's salt management plan should be submitted to the Nova Scotia Department of Environment for review and comment prior to commencement of the Project.
- Prior to commencement of the Project, the Proponent should submit an erosion and sediment control plan, developed by a qualified professional engineer or geoscientist licensed to practice in the Province of Nova Scotia, to the Department of Environment for review and approval.
- The Proponent proposes to have no direct connection of surface water runoff from the highway area to existing watercourses (Section 2.2.3), this approach would be expected to require mitigation measures to treat surface water runoff for potential contaminants of concern (e.g., hydrocarbons, suspended solids) prior to discharge into a watercourse. Development of mitigation measures as part of this no direct connection approach should be completed by a qualified professional engineer licensed to practice in the Province of Nova Scotia and submitted to the Department of Environment for review and approval.

Surface Water Quantity

- Prior to commencement of the project, planned alterations, associated realignment and mitigation measures with respect to Ponds 1 and 3 should be submitted for review and acceptance by the Department of Environment as part of watercourse alteration approval applications.
- A project operational phase drainage plan presenting changes to local surface water runoff drainage patterns, including changes in drainage areas from pre- and post-construction conditions, should be submitted for review and acceptance by the Department of Environment. The plan should be developed to minimize changes to local watershed drainage areas to the extent feasible for the post-construction condition.

Mageste da Silva, Renata

From: Delaney, Leanda <Leanda.Delaney@dfo-mpo.gc.ca>
Sent: October 9, 2019 11:33 AM
To: Mageste da Silva, Renata
Subject: DRAFT_ RE: *** For Review *** 19-EA-421 HWY 102 Aerotech Connector Road Project Exit 5A and Trunk 2- EA

HI Renata, should the EA be granted conditional approval, DFO will be requesting additional information be provided through the Nova Scotia of Environment Watercourse Alteration Approval process to determine if the project will result in the harmful alteration, destruction or disruption to fish and fish habitat and require an authorization under the *Fisheries Act*. If there is any additional information you require from me at this time, you can contact me at the coordinates below.

Kind regards, Leanda

Leanda Delaney, *M.Sc.*
Senior Biologist, Regulatory Review Unit
Fish and Fish Habitat Protection Program
Fisheries and Oceans Canada
Bedford Institute of Oceanography
1 Challenger Dr., P.O. Box 1006
Station B410, Dartmouth, NS
B2Y 4A2

Mageste da Silva, Renata

From: Finnigan, Jean-Charles
Sent: October 10, 2019 9:07 AM
To: Mageste da Silva, Renata
Subject: RE: Highway 102 Aerotech Connector Road Project Environmental Assessment Registration

Hi Renata,

No comments from me. Sorry for the delay

Thanks

JC

From: Mageste da Silva, Renata <Renata.MagestedaSilva@novascotia.ca>
Sent: Thursday, October 10, 2019 9:03 AM
To: Assessment Registration

Good morning everyone,

This is a friendly reminder that comments on the above noted project are due today **(October 10, 2019).** Comments are requested to be provided via e-mail if possible and if you have no comments, please indicate this in writing.

Thank you very much,

Renata

Mageste da Silva, Renata

From: Hearn, Scott
Sent: October 10, 2019 10:12 AM
To: Mageste da Silva, Renata
Cc: MacPherson, George E
Subject: RE: Highway 102 Aerotech Connector Road Project Environmental Assessment Registration

Hi Renata,

The Mineral Management Division at DEM has no comments to make on this.

Thank you,

Scott Hearn, P.Eng
Manager, Mineral Development and Policy
Geoscience and Mines Branch
Nova Scotia Department of Energy and Mines
1701 Hollis Street
2nd Floor Founders Square
PO Box 698
Halifax, NS
B3J 2T9

NOVA SCOTIA

Environment

Barrington Place
1903 Barrington Street
Suite 2085
Halifax, Nova Scotia
Canada B3J 2P8

Date: October 10, 2019

To: Renata Mageste da Silva, Environmental Assessment Officer

From: Wetland Specialist, Water Management Unit

Subject: Highway 102 Aerotech Connector Road Project

The Water Management Unit has reviewed the proposed Highway 102 Aerotech Connector Road Environmental Assessment Registration Document and offer the following comments and recommendations with respect to the impact on wetlands:

- Impact to wetlands includes a predicted loss of 6.13 ha of wetland habitat as a result of construction activities of the project. There is also potential for indirect changes to wetland functions and services as a result of ongoing use and maintenance activities, including changes to hydrology patterns, reduction in water quality and a loss of biodiversity, relating to on-going use and maintenance activities.

- Section 1.5 of the EARD briefly discusses alternatives to the proposed connector route to minimize effects to natural feature, and references wetlands in particular; however, no alternate alignments are provided. It is anticipated that alternate alignments would also present similar impacts to wetlands but without details, it is difficult to evaluate the route chosen.

- Section 2.2.3 of the EARD indicates that surface water drainage from the highway will be collected in drainage ditches running along side highway shoulders and will not be directly connected to divert surface water runoff into existing watercourses. It is unclear of how this runoff will be stored and ultimately discharged or if this is incorporated into the management of water relating to ARD disposal. It is also not clear if wetlands within the ROW will be also not be directly connected to the highway ditches.

- The project will undoubtedly encounter acid generating rock associated with the Meguma terrane; however, no preliminary geotechnical assessment has been provided to illustrate extent anticipated within the study area and suitability of the

proposed mitigation measures presented within the referenced management plan with respect to local site conditions.

- Wetlands within study area appear to support Species at Risk and/or Species of Conservation Interest across the study area. The suitability of the inventory assessments should be confirmed. The proponent should work closely with Lands and Forestry to develop wildlife management plans that should apply to all NSE approvals.

- The EARD eludes to the use of herbicides associated with NS TIR's Integrated Roadside Vegetation Maintenance program; however, Section 6.5.2.1 suggests that herbicides will not be used, and Section 6.6.3.3 indicates herbicides can be used but pesticides cannot be used. It is unclear if this statement is in relation to management of alien and invasive species or general ROW maintenance. The potential use of herbicides associated with the project should be confirmed, including the clarification on protective setbacks associated with drinking water supplies, watercourses and wetlands.

- Table 7.2.1 includes proposed mitigations for wetlands and states: "Implementation of sufficiently sized drainage structures. (not sure what this means, in TIR terms a structure is a bridge or culvert larger than 3 m diameter or width)". It is unclear if this clause is intended to address; however, mitigation for ensuring flow of water (diffuse) to wetlands bisected by the proposed project should be provided.

- Surface water quality/quantity monitoring should be considered in conjunction with routine watercourse monitoring, site specific watercourse alterations and/or potential changes to flow within the impacted watersheds.

- Groundwater monitoring should be considered in conjunction with routine monitoring of groundwater resource and groundwater dependent ecosystems as a part of the proposed ARD management plan.

- Site specific management plans proposed by the Proponent, including EPP, sediment and erosion control and ARG management should be provided to NSE and accepted prior to any construction activities.

- Prior to any wetland alterations, the proponent must obtain Wetland Alteration Approval for any wetlands altered by the proposed development. The application should include site specific design, relevant updates to flora/fauna inventory updates and discussion of resulting changes to wetland area/function association with the approval application.

- A part of the wetland alteration approval application, the proponent must develop a wetland monitoring plan, which should include the following:

    - How baseline conditions will be documented before construction (and grubbing) begins. This should include indicators of hydrology, water quality parameters and vegetation community.
    - How changes in hydrology of the partially impacted wetlands will be monitored and proposed performance indicators.
    - How changes in the vegetation community of the partially in filled wetlands will be monitored, especially regarding the proportions of wetland specific plants, and invasive species and proposed performance indicators.
    - How changes in water quality of the impacted wetlands will be monitored and proposed performance indicators.

- Prior to any wetland alterations, the proponent must develop a Wetland Compensation Plan, with a preference for on-the-ground wetland restoration within the affected watersheds that provide hydrologic, water quality support and/or stream flow functions, if available, followed by on-the-ground wetland restoration opportunities elsewhere in the province.

NOVA SCOTIA

Environment

Barrington Place
1903 Barrington Street
Suite 2085
Halifax, Nova Scotia
Canada B3J 2P8

Date: October 9, 2019

To: Renata Mageste da Silva, Environmental Assessment Officer

From: Environmental Health

Subject: Connector Road between Highway 102 Aerotech Interchange (Exit 5A) and Trunk 2 at Wellington

Scope of review:

The focus of this Environmental Assessment review from the NSE Sustainability and Applied Science Division's Regional Environmental Health Consultant is potential impacts on human health. In general, the scope of this review includes the assessment of the potential for the proposed undertaking/project to adversely affect human health in all phases of the project. Any recommendations provided below are meant to supplement the actions that are outlined in the EA submission documents.

Documents reviewed:

The documents outlined below formed the basis for this EA review, and is referred to as the 'EA submission' through the rest of this memorandum:

- Environmental Assessment Registration Document – Nova Scotia Department of Transportation and Infrastructure Renewal, Connector Road between Highway 102 Aerotech Interchange (Exit 5A) and Trunk 2 at Wellington. Including Appendices A - I. Report Prepared by Wood Environment & Infrastructure Solutions a Division of Wood Canada Limited. Registered on Sept 10, 2019, and accessed from https://novascotia.ca/nse/ea/Highway.102.Aerotech.Connector.Road.Project/

Comments re: Connector Road EA document:

Metal Leaching and Acid Rock Drainage

The Environmental Assessment (EA) at multiple stages documents that there will be an expectation that the project will encounter sulfide bearing rock with a high potential to generate acid drainage when exposed to water and oxygen.

The EA documents that potential adverse effects related to acid rock drainage (ARD) will be mitigated by implementing a comprehensive ARD Management Plan, that has not yet been developed. The EA documents explain the need for a detailed metal leaching and ARD plan however the specifics of this plan are not detailed in the EA document.

Groundwater resources including residential wells are considered by the assessment to be valued environmental components (VEC). The EA notes that there are 149 wells within the assessment area.

It is recommended that the in depth ARD management plan is submitted and approved prior to commencement of the project. From an environmental health prospective it would be imperative to ensure that the ARD management plan would consider the water quality (bacteriological and physical) of the wells within the assessment area. The ARD management plan should consider the need for baseline data for the drinking water wells within the assessment area.

NOVA SCOTIA

Environment

Barrington Place
1903 Barrington Street
Suite 2085
Halifax, Nova Scotia
Canada B3J 2P8

Date: October 10, 2019

To: Renata Mageste da Silva, Environmental Assessment Officer

From: Coordinator Special Places, Culture and Heritage Development

Subject: Highway 102 Aerotech Connector Road Project

Staff of the Department of Communities, Culture and Heritage has reviewed the EA document for the Aerotech Connector project and have provided the following comments:

Archaeology

Staff reviewed the Registration Document and have no archaeological concerns. The findings and recommendations from the ARIA (A2018NS051) were included in the body of the Assessment document.

Botany

Staff reviewed the Registration Document and provided the following comments:

On page 57 – Blue Felt Lichen is technically a species of concern, not a species at risk (it is provincially classified as "vulnerable", and federally classified as "species of concern").

On page 58 – minor correction: *Coccocarpia palmicola* is ranked by the ACCDC as S3S4, not as S2S3.

On page 101 - While there may be little guidance on methods for reporting GHG impacts from the provincial or federal government, this project is expected to replace 50.75 ha (page 120) of forests and wetlands with a road corridor. According to Nova Scotia Environment, calculating the area of lost natural habitats associated with a development is an important part of reporting on GHG impacts, because forests and wetlands are typically GHG sinks, whereas road corridors are not https://novascotia.ca/nse/ea/docs/Development.Climate.Change.Guide.pdf. See the report "National Inventory Report 1990–2017: Greenhouse Gas Sources and Sinks in Canada" for reiteration of this point. It would be relatively easy for a carbon accounting expert to use estimates of the total volume of merchantable timber in this area, using the provincial forest inventory layer, to project the impacts of losing this volume of natural forest.

As with other developments, any that are likely to destroy or disturb species of conservation concern present opportunities for the Nova Scotia Museum's collections unit to obtain new specimens that support scientific and conservation research. Because this site is so close, with sufficient notice (i.e., 1-2

weeks) the Curator of Botany would be available to collect the lichen species of concern from the sites before they are destroyed.

Paleontology

Staff have reviewed the Registration Document, including the proposed area and the information about geology. Staff did not have any additional concerns related to the bedrock or surficial geology in the area. The risks of encountering significant fossil material appears to be very low.

Zoology

No CCH staff were currently available to review the sections relating to zoology.

NOVA SCOTIA
ABORIGINAL AFFAIRS

PO Box 1617
Halifax, NS
B3J 2Y3

P: 902.424.7409
E: oaa@novascotia.ca

Date: October 10, 2019

To: Renata Mageste da Silva, Environmental Assessment Officer

From: Gillian Fielding, Aboriginal Consultation Advisor

Subject: Highway 102 Aerotech Connector Road

It has been noted that Mi'kmaq use was reported within the Study Area. The Mi'kmaq Ecological Knowledge Study (MEKS), completed by Membertou Geomatics Solutions, illustrates that bass and trout were/are the most reported fishing activity by the informants in the Study Area. The Shubenacadie Grand Lake has also been identified as an important water system to the Mi'kmaq in the area as there are many historical activities tied to it. Although the potential effects of the proposed project could be minimal, it is recommended that the proponent engages in discussions with the Assembly of Nova Scotia Mi'kmaq Chiefs, Sipekn'katik First Nation, and Millbrook First Nation to address mitigation measures for potential impacts on traditional and current use activities within the project area.

NOVA SCOTIA

5151 Terminal Rd.
PO Box 442
Halifax, NS
B3J 2P8

Tel: (902) 424-3600
Fax: (902) 424-0503

MEMORANDUM

DATE: **October 10, 2019**

TO: **Renate Mageste da Silva,**

FROM: **Peter Labor, Director of Protected Areas and Ecosystems**

SUBJECT: **Highway 102 Aerotech Connector Road Project Environmental Assessment**

The Protected Areas and Ecosystems Branch have reviewed the Environmental Assessment application for the Highway 102 Aeroteck Connector Project.

Protected Areas Comments:

- The 102 Aerotek Connector comes close (3 KM) to two Nature Reserves, Bennary Lake and Rawdon River Nature Reserves.
- There is concern about maintaining wildlife movement between the two nature reserves, and within this landscape in general. The Environmental Assessment report does address the impact on animal movement within this area and identifies the need to:
    - Construct and maintain under path (tunnel) sufficiently large to function as wildlife crossing for larger wildlife (e.g., deer).and
    - Ensure culverts at water crossings are sufficiently large to function as wildlife crossing for smaller wildlife.
- We are supportive of this approach, and would welcome the opportunity to work with proponent, Lands and Forestry, and others with respect ensuring the effectiveness of the proposed connectivity elements.

Lands and Forestry

M E M O R A N D U M

TO: Renata Mageste da Silva, NS Department of Environment

FROM: Department of Lands and Forestry

DATE: October 10, 2019

RE: Highway 102 Aerotech Interchange (Exit 5A) and Trunk 2 at Wellington

The Department of Lands and Forestry (herein the Department) provides the following comments on the above project:

Crown Lands:

This project is not on Crown lands and would not require any approvals/authorities from Land Administration.

Wildlife, Wildlife Habitat and Surveys:

The following comments are provided with respect to wildlife, wildlife habitat, surveys, and mitigations as provided within the EA:

1. The proposed footprint disrupts wetlands, including habitat of uncommon lichens. Wetlands 16, 25, 27, and 34 support rare or uncommon lichens and are expected be partially infilled. Although the field assessment of wetlands was comprehensive, the proponent has not adequately addressed the impact of the proposed activity on wetlands. **The Department recommends that the proponent be required to work with staff at the Department of Lands and Forestry to minimize the impact to wetlands and water crossings.**

2. **The proponent will provide the Department's Wildlife Division with shapefiles for all wetlands and geolocations for all Species at Risk (SAR), Nova Scotia Endangered Species Act (NSESA), and S1, S2, and S3 species found through survey work**.

3. **Field Survey Requirements:**
    - **Raptor nest search.** Incidental capture of raptors occurred during survey work for other species, and a number of raptor species were listed as either possible or probable breeding from Maritime Breeding Bird Atlas information available for this area. However, no information has been

provided on raptor nest surveys within the project area. **The Department recommends surveys be conducted for the project Right of Way (ROW) to determine if any raptor nests are within the project footprint. If raptor nests are discovered during this course of work, mitigations may be required**.

- **Nighttime point count surveys.** There are gaps in the field surveys with respect to nighttime surveys (Figure 5.2.4). **The Department recommends that nighttime point count surveys be conducted in those areas where survey gaps have been identified.**

- **Bat acoustic surveys.** It is unclear why there is a difference in both timing and duration for surveys at stations 1 and 2 vs. 3 and 4. **The Department requires further information on the methodology used, and clarification as to why monitoring was restricted in stations 1 and 2** so that it can make a firm determination about the status of the bat population in the western portion of the monitored area. Once clarification has been received, the Department will determine if this information is adequate. If it is not, resurveys may be required.

4. **A mitigation and monitoring plan were not provided with respect to this EA.** Given the project scope, duration, and that multiple species of conservation concern were identified within or near the ROW, t**he Department recommends that a mitigation plan be created that protects wildlife during the planning and construction phase and monitors impacts on wildlife after construction. This plan must be developed in consultation with appropriate staff at the Department of Lands and Forestry.** The following components are highlighted as items of concern to address within the mitigation plan.

Mitigation and Monitoring Plan Requirements:

a) **Blue Felt Lichen.** This species was identified from two separate wetlands within the project ROW. Blue Felt Lichen has been identified as a species at risk, assessed as Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and listed as Special Concern under Schedule 1 of SARA. It is currently managed by the province with clear guidance under the At-Risk-Lichens-Special Management Practices for any Crown Land activities, such as forestry and mineral exploration. **No mitigations have been provided under this EA for this species. The proponent is required to create a mitigation plan for this species with respect to this undertaking. The plan should be developed in consultation with appropriate staff within the Department of Lands and Forestry**.

b) Bats. Three bat species are considered at risk in Nova Scotia, listed under both the NS ESA and SARA Schedule 1 as Endangered. Given the survey

information provided suggests a strong possibility that bats occur in the area and may be encountered during the course of work. **The Department recommends that a mitigation plan for this species be completed.**

c) **Monarch.** Monarch was identified through desktop review of Maritime Butterfly Atlas data as occurring in the area. **The Department does not recommend the use of herbicides within the project area as this could impact the quantity of milkweed which the monarch relies on to host their eggs and larvae.**

d) **Snapping Turtle.** Although not discovered during the course of survey work, suitable habitat for the species exists within the ROW. **The Department recommends that a mitigation plan be developed if Snapping Turtles or nests are discovered during the course of work. A mitigation plan should also include efforts to minimize the risk of creating artificial nesting habitat, which can act as ecological sinks for the species.**

e) **Species at Risk Birds.** Canada Warbler (NS ESA Threatened, SARA Schedule 1 Threatened), Common Nighthawk (NS ESA Threatened, SARA Schedule 1 Threatened), and Eastern Wood-pewee (NS ESA Vulnerable, SARA Schedule 1 Special Concern) were all discovered during field surveys for this project. **No mitigations were provided under this EA with respect to these species. The Department requires that a mitigation plan specifically addressing these species be developed in consultation with appropriate staff from both the Nova Scotia Department of Lands and Forestry and Environment and Climate Change Canada.**

f) **Migratory birds.** A number of migratory birds were identified through survey work as part of the EA submission. **The Department requires that a mitigation plan be created to address the potential to harm or disturb migratory birds, as well as the destruction of nests (active or inactive). This plan should be developed in consultation with appropriate staff from both the Department of Lands and Forestry and Environment and Climate Change Canada**.

g) **Invasive species.** Although there were a few comments concerning invasive species within the EA, overall, this report was lacking a comprehensive plan to address both mitigation and monitoring. **The Department requires a mitigation and monitoring plan for invasive species be created in consultation with appropriate staff from the Department of Lands and Forestry.**

5. **Wildlife Crossing:**
   a) Information provided with respect to this EA has was not sufficient to determine if there is a requirement to have wildlife crossings for this undertaking. **In the absence of survey information to the contrary, the**

Department requires that a wildlife crossing plan be created. **The Wildlife Crossing plan should be developed in consultation with appropriate staff from the Department of Lands and Forestry.**

b) **Location.** Currently available information provided under this is EA is insufficient to determine the location, number, and type(s) of mammal crossing required. No information has been provided to indicate where an appropriate large-mammal crossing should exist along the proposed highway interchange. **The Department recommends that the proponent conduct pellet count field surveys and other targeted mammal surveys to provide further information on both location and density of large mammals in the area.**

c) **Type.** Studies have proven that wildlife avoid multi-use crossing structures. A multi-use structure is not recommended. If, however, a multi-use structure is the only available or logical option, the design must be of a type that would allow for separation of both human and wildlife use.

d) **Fencing.** Fencing is recommended as it has been proven to direct wildlife towards crossing structures and away from highways, increasing crossing use and reducing wildlife-vehicle collisions.

e) **Watercourse crossing.** Watercourse crossing should be of a type and design to maximize the diversity and number of small mammals that would utilize the structure.

f) **Monitoring.** The Department recommends that Transportation Infrastructure Renewal conduct long-term monitoring of wildlife crossings after completion of the structure to assess species diversity and usage. This will help inform the decision-making process on structure design, placement, and usage on future projects moving forward.

NOVA SCOTIA

Environment

Barrington Place
1903 Barrington Street
Suite 2085
Halifax, Nova Scotia
Canada B3J 2P8

Date: October 10, 2019

To: Renata Mageste da Silva, Environmental Assessment Officer

From: NSE Inspection Compliance and Enforcement (ICE) Division

Subject: Environmental Assessment for Proposed NSTIR Connector Road Between Highway 102 Aerotech Interchange (Exit 5A) and Trunk 2 at Wellington

Nova Scotia Environment's (NSE) Inspection, Compliance and Enforcement (ICE) Division has reviewed the following document in relation to a proposed controlled access minor arterial connector road designed to link Highway 102 at Exit 5A and Trunk 2 in Wellington:

- Environmental Assessment, Connector Road Between Highway 102 Aerotech Interchange (Exit 5A) and Trunk 2 at Wellington; prepared by Wood Canada Limited for Nova Scotia Department of Transportation and Infrastructure Renewal (TIR); dated August 2019.

It is NSE's understanding the intended goal of the proposed project is to alleviate traffic congestion in the Fall River area while also improving the connectivity of the highway network between Highway 102 and Trunk 2.

NSE's role in land development is legislated pursuant to the *Environment Act*, regulations and associated policies, guidelines, and standards, which can be obtained from the Regional or District offices of NSE, or by accessing the following Department links:

Environment Act: http://nslegislature.ca/legc/statutes/environment.pdf

Regulations: https://novascotia.ca/just/regulations/rxaa-l.htm#env

ICE Division (Central Region, Bedford) would like to offer the following comments related to our anticipated areas of involvement in the proposed project:

1. Erosion and Sedimentation

Under Section 67 of the *Environment Act* it is an offence to release or permit the release into the environment of a substance in an amount, concentration or level or at a rate of release that causes or may cause an adverse effect. Sediment is one such material. Erosion and sedimentation controls must be in place before construction begins if the construction will in any way impact watercourses, wetlands, or water resources or create an adverse effect to the surrounding environment.

Erosion and sedimentation control measures are the responsibility of the proponent. Plans and methods of control of point source incidents of water pollution must be implemented before construction work begins by adopting the following basic design principles recommended by the Department:

a) Fit the activity to the topography of the soils
b) Minimize the disturbed area and duration of exposure
c) Stabilize disturbed areas immediately
d) Retain or accommodate runoff
e) Retain sediment
f) Do not encroach upon water resources

It is recommended to follow the "*Erosion and Sediment Control Handbook for Construction Sites*", located at the following link:

https://novascotia.ca/nse/surface.water/docs/ErosionSedimentControlHandbook.Construction.pdf

The proponent should prepare a site-specific soil erosion and sediment control plan (ESCP) for NSE's review prior to commencing any disturbance of soils. The ESCP should be prepared by an experienced professional engineer.

2. Watercourses and Wetlands

It is our understanding the proposed Connector Road will cross a total of 10 watercourses and 18 wetlands. Under Section 5(A-F) of the *Activities Designation Regulations (ADRs)* made pursuant to the Environment Act, it is an offence to alter any watercourse, wetland, or water resource without receiving prior written approval or notification where applicable from NSE.

The ADRs can be found at the link below or by contacting a local NSE office:

https://novascotia.ca/just/regulations/regs/envactiv.htm

Alterations may include, but are not limited to, culvert installation, bridge construction, wharf construction, waterline installation, etc. A 'watercourse' includes the bank and bed of every river, stream, lake, creek, pond, spring, or other natural body of water, whether it contains water or not (including all groundwater). Watercourses may also potentially include fish habitat requiring Department of Fisheries and Oceans (DFO) Canada approval, in addition to the above-mentioned approval. Extreme care must be taken when construction work begins, following the conditions of the approval explicitly.

The Department has always required an approval for the alteration of wetlands. The *Nova Scotia Wetland Conservation Policy* expands upon the requirements for wetland alteration and the requirements for compensation. This policy may be found at the following link or by contacting a local NSE office.

http://www.novascotia.ca/nse/wetland/conservation.policy.asp

It is the responsibility of the proponent to ensure the project area is assessed for wetlands and watercourses, and applications submitted for proposed alterations. Wetlands must be assessed by a person(s) qualified in the identification of hydrophytic vegetation, hydrology and hydric soils. All three parameters must be assessed to determine the presence of and delineate wetland boundaries. The wetland assessment should take place in the early stages of design to ensure the incorporation of wetlands in the layout. Note that if applicable, any alterations that disrupt a total of 2 hectares (ha) or more of any wetland or wetland complex is an undertaking which must undergo an Environmental Assessment (EA), as per the *Environmental Assessment Regulations (EA Regulations)*.

3. Sulphide Bearing Materials

If disposal, reuse or storage of Sulphide Bearing Materials (SBMs), as defined under the *Sulphide Bearing Material Disposal Regulations*, is required during development, approvals may be required from the Department. Additional information on the *Sulphide Bearing Material Disposal Regulations* may be found at the link below or by contacting a local NSE office:

https://novascotia.ca/just/regulations/regs/env5795.htm

For this proposed development, it is anticipated that SBMs will be disturbed and therefore, full design and specifications for acid rock drainage (ARD) mitigation will be required. The ARD management and monitoring plans for the handling and disposal of SBMs shall be prepared by an experienced professional engineer.

4. Surface Water, Groundwater and Domestic Wells

If construction activities could potentially impact water resources in the area, including adjoining properties that rely on on-site services such as groundwater wells (e.g. registered public drinking water supplies and/or private residences) baseline conditions should be evaluated to develop an appropriate monitoring program prior to development. This work should be completed by a qualified professional.

5. Blasting

If applicable, a pre-blast survey should be completed prior to the commencement of blasting activities to evaluate potential negative impacts to adjoining structures, watercourses or wildlife. In addition, a blast monitoring program should be designed for structures within 800 metres of the blasting zone. This work should be completed by a qualified professional.

6. Borrow Pits and Quarries

As with many road construction activities, borrow pits and small quarries are often developed adjacent to the road construction sites to obtain materials for construction. If applicable, these potential locations should be clearly identified and ensure the potential impact of the activity on ecological receptors is evaluated.

7. Noise and Dust

Development activities that generate significant noise and dust should evaluate baseline conditions and develop noise and dust monitoring plans prior to commencement of activities. This work should be completed by a qualified professional.

8. Site Contamination

It is recommended that developers conduct *Freedom of Information and Protection of Privacy (FOIPOP)* searches through the two available application processes, FOIPOP and the *Environmental Registry*. Site remediation may have been undertaken in the past that now requires site re-assessment based on development zoning. Additional information on Information Access and Privacy is available at:

https://novascotia.ca/nse/dept/info.asp

The *Contaminated Sites Regulations* clarify the procedures around contaminated sites and ensure cleanups are consistent province-wide. Impacts to soils, groundwater, sediment and/or surface water that may be encountered include, but are not limited to, petroleum hydrocarbons, metals, polyaromatic hydrocarbons, glycol, volatile organic compounds (e.g. perchloroethylene), pesticides, etc. The Department has developed various Ministerial Protocols, guidelines, forms and checklists to assist in the assessment, remediation and/or management of these issues.

Additional information on the contaminated sites process is available at:

Contaminated Sites Regulations:
https://novascotia.ca/just/regulations/regs/envcontsite.htm

Ministerial Protocols, Guidelines, Forms and Checklists:
http://novascotia.ca/nse/contaminatedsites/protocols.asp

9. Management of Salt and Potential Vehicle Fluid Runoff

Given the proximity of adjacent watercourses and wetlands, management of runoff water containing salts and vehicle fluids is a potential concern. The proponent should provide a management plan designed by a qualified professional.

10. Contingency Planning

The proponent should develop contingency plans to handle complaints and/or address any unanticipated issues that may arise from site activities, including potential issues that could have a negative impact on adjoining properties (e.g., damage from blasting, well issues, increases in ambient noise levels, damage to installed protective measures due to rare weather events such as hurricanes, etc.)

11. Application Forms

Specific activities noted in the *Activities Designation Regulations* may require submission of application forms when applying for approval from the Department. The list of activities requiring approval are available from the regional offices throughout the province or via the NSE website. Application processing fees may be required for the activity. Fees are subject to change and as a result, it is advised the proponent contact a local NSE office to determine current fees.

In addition to the above-noted comments, specific dates should be provided for any information requested / required, or at a minimum, the requirement that all information be provided to NSE for review and comment by a specified date (i.e., 6 months prior to the commencement of construction) in order to ensure the terms and conditions of any approvals issued in relation to this proposed project will be enforceable.

Should you have any additional questions or concerns, then please do not hesitate to contact the NSE ICE Division, Central Region, Bedford Office at (902) 424-7773.

Yours truly,

NSE ICE DIVISION, CENTRAL REGION (BEDFORD)

From: Mitchell, David A
To: Mageste da Silva, Renata
Subject: Re: Highway 102 Aerotech Connector Road Project Environmental Assessment Registration
Date: October 10, 2019 6:35:08 PM

Hi Renata,

The Department of Business has reviewed the Highway 102 Aerotech Connector Road EA Registration Document.

Base on this review DOB feels this project is consistent with DOB's mandate and have no comments to provide.

Sincerely,

David Mitchell

Sent from my iPhone

On Oct 10, 2019, at 9:03 AM, Mageste da Silva, Renata <Renata.MagestedaSilva@novascotia.ca> wrote:

> Good morning everyone,
>
> This is a friendly reminder that comments on the above noted project are due today **(October 10, 2019).** Comments are requested to be provided via e-mail if possible and if you have no comments, please indicate this in writing.
>
> Thank you very much,
>
> Renata

NOVA SCOTIA

Sustainability and Applied Science

PO Box 442
Halifax NS
B3J 2P8

Tel: (902)-424-3600
Fax: (902)-424-6925

MEMORANDUM

To: **Paul Currie, Manager, Industrial Management Unit**

From: **Hydrologist, Industrial Management Unit, Sustainability and Applied Science Division**

Date: **October 9, 2019**

Subject: **Highway 102 EA Review Comments**

Scope of review:

The scope of this Environmental Assessment review from the NSE Sustainability and Applied Science Division Hydrologist is to assess the potential environmental impacts and proposed mitigations of the proposed undertaking on surface water quantity and management. While comments may also include considerations for impacts on general surface water quality, groundwater, freshwater fish habitat, and wetlands, appropriate technical specialists for these areas should be consulted for specific review and comment.

Documents reviewed:

The documents outlined below formed the basis for this EA review, and is referred to as the 'the submission' through the rest of this memorandum:

- Environmental Assessment – Connector Road between Highway 102 Aerotech Interchange (Exit 5A) and Trunk 2 at Wellington – Environmental Assessment Registration. Report Prepared by wood.. Dated August, 2019, and accessed from https://www.novascotia.ca/nse/ea/Highway.102.Aerotech.Connector.Road.Project/

Comments and recommendations re: the submission:

Surface water quantity:

- It is outlined that a new section of connector road of approximately 5 km length will be constructed as part of the works, between Fall River and Highway 102.

- It is reported in the submission that "The proposed Connector Road crosses ten watercourses requiring culverts or structures. Requisite hydraulic designs considering both current and future conditions will be carried out for all water crossings. Prior to any in-stream work, approval pursuant to the NS Designated Activities Regulations will be obtained, and, where applicable, authorization by Fisheries and Oceans Canada (DFO) pursuant to the Fisheries Act.' (pg 10).
    - Potential for permanent alterations to flow patterns as a result of the proposed works
    - The submission does not include details surrounding any assessment or consideration of the potential impacts of this on water quantity
- It is unclear whether the 'Standard Cross Section Minor Arterial Type (C) (D)' figure is reflective of the cross section to be installed, as it is stated that the subgrade for a four lane highway will be constructed as part of the proposed works.
- It is reported that "An active transportation trail will be constructed with an approximate 10-m offset from the proposed Connector Road within the ROW. The 4 m-wide trail (3 m hard surface plus 0.5 m gravel shoulders) will be running in parallel to the north side of the Connector Road and will be separated from the road by a ditch and a guardrail system in the gravel shoulder of the highway" (pg 11).
    - What is the approach to watercourse crossings with this information in mind? It is not clear in the submission if or how this may impact watercourse crossings – particularly the existence of a ditch between the active transportation trail and the planned road. Would the intent be to have similarly sized structures for both the active transportation trail and connector road for watercourse crossings?
- The submission highlights that 'Culverts designed to address potential climate change impacts on stream flow (implementation of the 1:100-year storm event design).
- It is reported that "Surface water from the highway will be collected in drainage ditches running alongside the highway shoulders. There will be no direct connection of surface water runoff into existing watercourses" (pg. 10).
    - It is unclear what 'direct connection' in this statement refers to. It could be inferred from this statement that drainage ditch flow will be conveyed through some form of treatment prior to discharging to existing watercourses, but again this is unclear.
- It is reported that "A total of 15 watercourses and two water bodies were identified within the Project study area based on available mapping and field observations (Figure 5.1.4).
    - Figure 5.1.4 outlines three water bodies (Ponds 1, 2, and 3).
- It is outlined earlier in the submission that there were 10 watercourses that require culverts or structures – it is not clear in the submission where these planned crossings will occur. It has been inferred that any water bodies or watercourses with 'n/a' in the 'Habitat at crossing' column of Table 5.2.8 in the submission are to be removed as a result of the proposed works, but following this approach gives 11 potential crossings, and not the 10 stated in the submission. Based on information provided in Figure 5.1.4 and the above:
    - Ponds 1 and 3 look to be directly impacted as a result of the proposed road alignment, with Pond 2 potentially being indirectly impacted through alterations of WL1. Both Ponds 1 and 2 were identified as potential fish habitat in the submission, and Pond 3 was not assessed. There is no mention of these potential impacts in the submission, or impacts to connected watercourses (i.e., WC01, WC02, WC15)

    - WC02, which is identified as marginal fish habitat and feeds WC01 and Pond 2, does not appear to be planned to have a crossing and it is unclear what is the plan for this watercourse
- In Table 4.1.1., 'permanent stream diversion' is listed as a 'Project component and activity'. It is unclear in the submission where any permanent stream diversions are planned to take place.
- The development of the proposed road will alter local drainage patterns. Alteration of surface water flow patterns is not highlighted in the description of potential environmental effects in the Surface Water Quality VEC entry throughout the submission, and there is no assessment or consideration of this within submission text.
    - What are the potential impacts associated with these changes, and how will they be mitigated? Will there be cross-drain culverts every so many metres between the watercourse crossings, as is typical with many roadworks?
- It is not clear in the document how much permanent loss to fish and fish habitat will occur as a result of the proposed works
    - As documented above, it is unclear where the planned watercourse crossings will be
    - According to figure 5.1.4 and elsewhere in the submission, there are several wetlands interspersed with the watercourses that cross the Proposed R.O.W. of the Connector Road. Partial infilling of several wetlands is highlighted, with mitigations to alterations to drainage resulting from this activity outlined as "Maintain surface water paths through culvert placement and appropriate structure sizing" (pg. 129).

Conclusions & Recommendations:

Please see below for a summary of issues and recommendations:

Planning/Design Issues:

-

Operational Issues/Other Permitting Processes

- Prior to commencement of the project, it is recommended that the applicant provides details for review and acceptance by NSE surrounding the approach to mitigate potential impacts to:
    - Local drainage patterns resulting from the proposed works;
    - The 'permanent stream diversions' highlighted but not specifically outlined in the submission; and
    - Ponds 1 and 3 and other watercourses identified in the submission that will not have culverts or structures.
- A detailed sediment and erosion control plan for the overall project is to be developed by a qualified professional and is required to be submitted as part of any industrial approval application for NSE review and approval prior to construction activities, including clearing, grubbing, and stripping, take place.
- Any necessary approvals for the watercourse alterations associated with the proposed works must be obtained prior to project commencement, and applications must include:

- Details associated with the loss of fish and fish habitat associated with the proposed works, including consideration for any partial infilling of associated wetlands for review by NSE and DFO;
- Details associated with potential interaction between structures that may be in place for both the active transportation trail and connector road; and
- Details surrounding plans for drainage ditch flow treatment prior to entering any watercourse

Mageste da Silva, Renata

From: Richardson-Prager, Lance (HC/SC) <lance.richardson-prager@canada.ca>
Sent: October 11, 2019 11:04 AM
To: Mageste da Silva, Renata
Cc: O'Leary, Rick (HC/SC); Rumbolt, Sara (HC/SC)
Subject: Highway 102 Aerotech Connector Road Project Environmental Assessment
Attachments: 27-15-1488_Enviro-Guidance-noise_EN-FINAL-low.pdf; 27-15-1488_Enviro-Guidance-air_EN-FINAL-low.pdf; enviro guidance drinking water -2017-eng.pdf

Dear Renata:

Thank-you for your e-mail dated September 3, 2019, requesting Health Canada's review of the Highway 102 Aerotech Connector Road Project Environmental Assessment (EA) Registration document with respect to human health. Health Canada has reviewed the document, but will not be submitting a formal comment letter for this project.

If the proponent is looking for additional Health Guidance on noise, drinking water and air quality please see the attached Health Canada guidance documents attached.

Lance

Health Canada Santé Canada

Your health and safety… our priority. *Votre santé et votre sécurité… notre priorité.*

Guidance for Evaluating
Human Health Impacts
in Environmental Assessment:

AIR QUALITY

Canada

Health Canada is the federal department responsible for helping the people of Canada maintain and improve their health. We assess the safety of drugs and many consumer products, help improve the safety of food, and provide information to Canadians to help them make healthy decisions. We provide health services to First Nations people and to Inuit communities. We work with the provinces to ensure our health care system serves the needs of Canadians.

Également disponible en français sous le titre :
Conseils pour l'évaluation des impacts sur la santé humaine dans le cadre des évaluations environnementales : Qualité de l'air

To obtain additional information, please contact:

Health Canada
Address Locator 0900C2
Ottawa, ON K1A 0K9
Tel.: 613-957-2991
Toll free: 1-866-225-0709
Fax: 613-941-5366
TTY: 1-800-465-7735
Email: publications@hc-sc.gc.ca

This publication can be made available in alternative formats upon request.

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TABLE OF CONTENTS

This document may be cited as follows:

Health Canada. 2016. *Guidance for Evaluating Human Health Impacts in Environmental Assessment: Air Quality*. Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.

Any questions or comments on this document may be directed to:
Environmental Assessment Program, Ottawa, Ontario K1A 0K9
Email: ead@hc-sc.gc.ca

1 ACRONYMS

ACRONYM	MEANING
AQMS	Air Quality Management System
CWS	Canada-wide Standards
CAAQS	Canadian Ambient Air Quality Standards
CCME	Canadian Council of Ministers of the Environment
CEA	cumulative effects assessment
CEAA 2012	*Canadian Environmental Assessment Act*, 2012
CEPA 1999	*Canadian Environmental Protection Act*, 1999
CI	continuous improvement
CO	carbon monoxide
CO_2	carbon dioxide
COPC(s)	contaminant(s) of potential concern
EA	environmental assessment
EIS	environmental impact statement
HHRA	human health risk sssessment
IARC	International Agency for Research on Cancer
KCAC	keeping clean areas clean
LSA	local study area
$\mu g/m^3$	micrograms per cubic metre
µm	micrometres
mg/m^3	milligrams per cubic metre
MW	molecular weight
NAAQOs	National Ambient Air Quality Objectives
NH_3	ammonia
N_2O	nitrous oxide
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
PAHs	polycyclic aromatic hydrocarbons (e.g. benzo[a]pyrene)
ppb	parts per billion
ppm	parts per million
$PM_{2.5}$	particulate matter less than 2.5 µm in diameter
PM_{10}	particulate matter less than 10 µm in diameter
RA	responsible authority
RfC	reference concentration
RSA	regional study area
SO_2	sulphur dioxide
TOR	terms of reference
TSP	total suspended particulates
VOCs	volatile organic compounds (e.g. benzene, toluene, xylene)
US EPA	United States Environmental Protection Agency
UFP	ultrafine particles
WHO	World Health Organization

2 PURPOSE OF THIS DOCUMENT

This document provides generic guidance on predicting health risks of air quality in federal environmental assessments (EAs) of proposed major resource and infrastructure projects (such as mines, dams, pipelines and other projects). It presents the principles, current practices and basic information Health Canada looks for when it reviews the environmental impact statements (EIS) or other reports submitted by project proponents as part of the EA process.

It was prepared for the benefit of proponents and their consultants and to support an efficient and transparent project review process. The foundational information described here should be supplemented appropriately with additional information relevant to specific projects.

The guidance was also prepared for responsible authorities and stakeholders to the EA process to communicate our normal areas of engagement and our priorities within these areas to help ensure that sufficient evidence is available to support sound decisions. As part of its review, Health Canada may suggest that a responsible authority (RA), review panel or others collect information not specifically described here in order to assess the health effects of specific projects. As the guidance provided here is generic and designed to support EA under multiple jurisdictions, the scope of our review will also necessarily be amended according to specific jurisdictional requirements.

Health Canada updates guidance documents periodically and, in the interest of continuous improvement, accepts comments and corrections at the following address: ead@hc-sc.gc.ca

Please verify that you are reading the most recent version available by consulting:
www.canada.ca/en/services/health/publications/healthy-living.html#a2.5

3 INTRODUCTION AND CONTEXT

Health Canada provides expertise to assist RAs, review panels and/or other jurisdictions leading environmental assessments to determine whether there are potential health risks associated with proposed projects and how to prevent, reduce or mitigate them.

Health Canada brings to bear its expertise in health risks associated with air quality, water quality, radiation, noise and country foods when it reviews and provides comments on information submitted by proponents in support of proposed projects. Health Canada also provides guidance to help stakeholders, including responsible authorities, review panels and affected communities, better understand how to conduct health assessments for proposed major resource projects.

This document concerns the assessment of health risks associated with air quality. It contains information on the division of roles and responsibilities for issues related to air quality at various levels of government in Canada; health effects associated with air quality; indicators of these effects; and, steps in Health Canada's preferred approach to assessing air quality-related health effects.

Appendix A contains a checklist that can be used to verify that the main components of an air quality assessment are complete and to show where this information can be found within an EA document.

Appendix B lists online sources of national and provincial air quality standards, data and general information.

Appendix C lists the Canadian Ambient Air Quality Standards (CAAQS) and National Ambient Air Quality Objectives (NAAQOs) for various ambient air contaminants, current as of the date of publication of this document. Definitions and equations for converting units are provided at the end of this appendix.

4 ROLES AND RESPONSIBILITIES WITH RESPECT TO AIR QUALITY

In Canada, the protection and improvement of ambient air quality is a shared responsibility. The most current and up-to-date criteria and guidelines should be used for any comparisons made in environmental assessments. Health Canada encourages readers to consult with provincial, territorial and municipal authorities, as appropriate, to determine or verify which standards exist for specific regions. Refer to Appendix B for a list of online resources for national and provincial air quality standards, data and general information (current as of the publication date of this guidance document).

The Clean Air Regulatory Agenda is a federal initiative, led by Environment and Climate Change Canada, aimed at improving air quality and protecting human health through reduced emissions of outdoor and indoor air pollutants and greenhouse gases. Health Canada's key role is to provide guidance through health risk assessments and research to ensure risk management actions effectively reduce the health impacts of air pollution. The air quality research, monitoring and modelling activities of Environment and Climate Change Canada and Health Canada aim to quantify priority air pollutants and determine trends, in order to predict air quality in both the near term and long term. The research builds knowledge on atmospheric processes and emissions measurements related to industrial and non-industrial sectors, thereby helping to relate air pollutant emissions to exposure and environmental impacts and in turn, informing the review of environmental assessments (EAs).

4.1. HEALTH CANADA

Health Canada's primary role with respect to air pollution is to identify hazards posed to the Canadian population and to collaborate with others, often Environment and Climate Change Canada, to reduce the identified risks. Health Canada's scientists conduct, evaluate and remain current on domestic and international scientific research on the effects of air quality on human health.

Health Canada's review of air quality assessments for EA processes is project-specific. Health Canada's expertise in this context focuses on assessing the risks to human health resulting from exposure to air contaminants—using health-based evaluation tools, guidelines and toxicological reference values. Health Canada reviews the baseline conditions described (i.e. air quality in the existing environment) and the predicted project-related air pollutant concentrations for different assessment scenarios at locations where human receptors may be affected. Health Canada can comment on whether the assessment of effects of air quality on human health undertaken by the proponent was scientifically valid, and may request further information or rationale. Health Canada may make available additional information or knowledge when predicted air quality changes have the potential to affect human health. Health Canada may also comment on the adequacy of mitigation measures proposed to reduce project-related changes and/or health impacts. The responsible authority, review panel or other jurisdiction conducting the assessment will ultimately determine how the information or knowledge provided by Health Canada will be used in the EA process.

Health Canada does not possess the expertise to verify air quality modelling results and assumes that the assessment has used correct, accepted and/or validated methods. Health Canada relies on the expertise of Environment and Climate Change Canada in the areas of emissions, dispersion and atmospheric modelling. Health Canada may also seek Environment and Climate Change Canada's advice on the adequacy of an EA's ambient air quality predictions. If Environment and Climate Change Canada notes errors and/or gaps in the modelling of air quality, revisions may be requested by the responsible authority to address the errors. If the revised results differ from the originally submitted results, Health Canada suggests that the report be resubmitted to Health Canada for review.

Health Canada does not possess expertise on:

- modelling emissions and deposition; and
- assessing or evaluating of the potential effects of odour.

Environment and Climate Change Canada possesses expertise in areas such as emissions modelling and environmental fate and may share information with Health Canada to inform the evaluation of environmental assessments.

4.2. PROVINCES AND TERRITORIES

In general, provinces/territories are responsible for controlling pollution emissions, including air pollutants, from industry and business operations. The provinces manage air pollutant emissions through regulations and their approach to granting (or issuing) permits that describe the allowable levels of emissions of various pollutants from a given facility, including emissions from associated mobile sources. Provinces may also adopt ambient air quality standards or objectives (see Appendix B), which are used to inform their processes for issuing pollution emission permits (e.g. using air quality modelling to predict how ambient air quality in a neighbouring community will be impacted by a facility's emissions and how the predicted pollution levels compare to the air quality standard) and other air quality management actions. In 2012, the Canadian Council of Ministers of the Environment (CCME), with the exception of Quebec, agreed to begin implementing the new Air Quality Management System (AQMS), which includes the new ambient air quality standards as a key component. Those conducting assessments are encouraged to seek information as early as possible as to which provincial, territorial and/or municipal legislation and regulations concerning ambient air quality may apply to the project.

4.3. AIR QUALITY STANDARDS AND GUIDELINES

The *Canadian Environmental Protection Act*, 1999 (CEPA 1999) is the principal federal legislative tool governing environmental contaminants. It is administered jointly by Environment and Climate Change Canada and Health Canada. CEPA 1999 enables the Minister of the Environment and the Minister of Health to regulate substances and allows the federal government to assess air pollutants and provide targets that can be used in setting goals for reducing health risks from contaminants of potential concern (COPCs). The federal government also has the authority to address air pollution caused by the transboundary flow of air pollutants (e.g. across the Canada-U.S. border) and to identify key air pollutants as toxic substances under CEPA 1999.

Under the auspices of the CCME, Health Canada and Environment and Climate Change Canada have been working with provincial/territorial governments and non-governmental stakeholders on the development of a new AQMS—a comprehensive and national approach to improving air quality in Canada. A key element of the AQMS is new health-based CAAQS, which set the bar for air quality management across the country. In May 2013, the federal government established new CAAQS for fine particulate matter ($PM_{2.5}$) and ozone, using the authority of CEPA (Canada Gazette Part I, May 25, 2013). These new CAAQS, which are to be achieved by 2015 and 2020, are more stringent than the previous Canada-wide Standards (CWS), which they replace.

Like the CWS, the CAAQS are based on the principles of keeping clean areas clean (KCAC) and continuous improvement (CI) (CCME 2000, 2007 and 2012). Provinces and territories will use the CAAQS in air quality management decision-making aimed at improving poor outdoor air quality and maintaining good outdoor air quality. At the time of publication of this guidance document, additional CAAQS for nitrogen dioxide (NO_2) and sulphur dioxide (SO_2) were under development and will replace the former National Ambient Air Quality Standards (NAAQOs) for these pollutants.

Consult the CCME's website for up-to-date information on the AQMS and CAAQS: **www.ccme.ca**

5 COMMON AMBIENT AIR POLLUTANTS

5.1. AMBIENT AIR QUALITY AND HEALTH

There is consensus among international and national organizations (e.g. the World Health Organization (WHO), Health Canada, the United States Environmental Protection Agency (US EPA), the European Union and the International Agency for Research on Cancer (IARC)) that air pollution has significant human health impacts. Causal associations have linked poor air quality to respiratory and cardiovascular illnesses, hospitalizations and mortality. The reaction of an individual to air pollutants depends on the type of pollutant to which a person is exposed, the degree of exposure and the individual's health status and genetics. Harmful health outcomes attributable to air pollution can range from respiratory symptoms to premature death—encompassing acute irritation and respiratory problems, the development or worsening of existing respiratory and/or cardiovascular diseases, and cancer. These effects can result in higher medication use, increased visits to doctors or emergency rooms and more hospital admissions. Epidemiological studies that make use of administrative databases that track information such as mortality, hospital admissions and emergency room visits have been used to characterize population risk; these studies are now a common tool in assessing the health implications of air quality changes related to environmental pollutants. Based on such studies, there is a growing awareness that increasing concentrations of air pollutants in many parts of Canada are associated with morbidity (incidence of disease) and mortality (Judek et al., 2004). The WHO's Global Burden of Disease Study recognizes outdoor air pollution in the form of fine particles as one of the top-ten global health risk factors (Lim et al., 2012), while IARC has recently identified air pollution as a whole, as well as component particles ($PM_{2.5}$ and PM_{10}), as causes of cancer (2013).

5.2. PARTICULATE MATTER

The general term "particulate matter" (PM) can be defined as particles (solid or liquid, or a mixture of both) less than 100 micrometres (µm) in diameter. Particles of 10 µm or less in diameter are referred to as **PM_{10}**. Particles of 2.5 µm or less in diameter are referred to as **$PM_{2.5}$** or **fine PM**. Particles intermediate in size (i.e., $PM_{10-2.5}$) are generally known as the coarse fraction of PM_{10}. All three size designations (PM_{10}, $PM_{10-2.5}$ and $PM_{2.5}$) have been demonstrated to affect various aspects of human health, with the respiratory and cardiovascular systems being the major targets. The fine (smaller) particles pose a greater risk to human health, as they can be inhaled deeply into the lungs, are chemically reactive and have complex characteristics. Despite the overlap between each of these size fractions (i.e. the PM_{10} size fraction includes the $PM_{2.5}$ size fraction), there is also variation in the deposition patterns within the lungs because of differences in the physical and chemical composition, as well as the sources of the particles (WHO 2003). Particulate matter can be primary or secondary in nature; primary particles are emitted directly from a source, while secondary particles arise from the chemical reaction of precursors in the atmosphere.

The WHO *Air Quality Guidelines* (2006) provide exposure-response relationships describing the relationship between ambient PM and various health endpoints. These guidelines do not propose a specific guideline value for PM, as a threshold could not be identified below which no adverse effects on health occur. Recent scientific evidence also indicates that there is no apparent lower threshold for the effects of PM on human health. Scientific evidence shows that fine particles ($PM_{2.5}$) are strongly associated with mortality and other human health endpoints, such as hospitalization for cardio-pulmonary disease (WHO 2003). The new CAAQS for PM also recognize that there is no population health threshold for human health effects; therefore, any increase in exposure will result in an incremental population risk (Environment and Climate Change Canada and Health Canada, 2012; CCME, 2000). In other words, PM_{10} and $PM_{2.5}$ are considered to be non-threshold substances, meaning that health effects may occur at any level of exposure. Health Canada has concluded that the risk associated with fine particles, particularly $PM_{2.5}$, is higher than the health risks associated with coarse PM or total suspended particulates (TSP).

Ultrafine particles (UFPs) refer to very small, usually reactive particles with a diameter smaller than 0.1 µm that achieve widespread deposition within the respiratory tract. Therefore, by definition, $PM_{2.5}$ (and PM_{10}) includes ultrafine particles (UFPs). The results of recent studies on UFPs are not entirely consistent, and the scientific literature in this field continues to evolve. Therefore, Health Canada does not currently make specific conclusions on the potential health effects of UFPs. Rather, Health Canada encourages the inclusion of an assessment of $PM_{2.5}$ and a discussion of the predicted levels in relation to human health in all air quality assessments.

5.3. SECONDARY POLLUTANTS

Secondary pollutants such as ground-level ozone and secondary $PM_{2.5}$ are formed in the atmosphere through the reaction of gaseous precursors; in the case of ozone, the presence of sunlight is required for these reactions to occur. Project-related emissions may contribute to secondary pollutants formation. Including predicted concentrations of secondary pollutants from project-related emissions in an air quality assessment provides a more comprehensive estimate of project-related effects; a qualitative discussion of precursors and secondary pollutant formation (especially ozone and secondary $PM_{2.5}$) is helpful in the absence of a quantitative assessment. Secondary pollutants may be important elements of an air quality assessment, especially when the secondary pollutant precursors (e.g. nitrogen oxides (NO_x), ammonia (NH_3), sulphur dioxide (SO_2), volatile organic compounds (VOCs)) are emitted from project activities. PM and ozone precursor pollutants need to be managed—both in terms of mitigating their own associated health risks and with regard to their contribution to the formation of secondary pollutants. As examples, ground-level ozone is formed from reactions involving NO_x and VOCs, and $PM_{2.5}$ is formed from complex reactions involving NO_x and VOCs and SO_2, as well as other substances. Ground-level ozone is a constituent of photochemical smog and is linked to serious health impacts, including chronic bronchitis, asthma, increased medical and hospital visits, and premature deaths (Environment and Climate Change Canada and Health Canada, 2012; WHO, 2003). Ozone, along with PM, should be treated as having no safe level; that is, on a population basis, there is no threshold below which no adverse effects on health may occur (Environment and Climate Change Canada and Health Canada, 2012).

5.4. OTHER AMBIENT AIR POLLUTANTS

The use of equipment such as engines and generators, as well as other industrial processes, may lead to increased levels of PM and fuel combustion by-products (e.g. PM, NO_x, SO_2, carbon monoxide (CO), polycyclic aromatic hydrocarbons (PAHs), VOCs, metals). NO_x can impair lung function and irritate the respiratory system and are especially problematic for people who already suffer from asthma, bronchitis or other respiratory disease. Similarly, SO_2 at relatively high levels of exposure can cause breathing problems in people with asthma, and there is some evidence that exposure to elevated levels may increase hospital admissions and premature deaths. Exposure to CO may increase hospital admissions for cardiac diseases and, at high levels, CO exposure can cause mortality.

PAHs are relatively non-volatile compounds of low solubility in water. These compounds are mostly adsorbed to particulate matter, on which they are transported. Some PAHs are known to be carcinogenic (e.g. benzo[a]pyrene) (Government of Canada, 1994), as are some volatile organic compounds (VOCs), such as acetaldehyde, formaldehyde, benzene and 1,3-butadiene.

Road transportation (including fuel combustion, tire friction on road pavement and brake usage) is a source of many air pollutants. Equipment used in large development projects can be a significant source of diesel engine exhaust, which is a mix of gases and particles, including criteria air pollutants and air toxics that may damage the lungs and potentially cause cancer. In addition to PM and fuel combustion by-products, traffic-related pollutants include 1,3-butadiene, benzene, formaldehyde, acetaldehyde and acrolein.

Additional air pollutants of concern include hydrogen sulphide (H_2S), toxic metals (e.g. cadmium, lead, mercury, manganese, arsenic and nickel), polychlorinated biphenyls (PCBs), dioxins and other persistent organic compounds.

6 CONDUCTING AN AIR QUALITY ASSESSMENT FOR AN ENVIRONMENTAL ASSESSMENT

Section 6 provides general information about the assessment of project-related changes in ambient air quality in EAs and the potential impacts of these changes on human health. In general, an assessment begins by characterizing the project study area and identifying the people who may be impacted by changes to the environment due to the project. This includes considering the manner of exposure (e.g. inhalation). Next, the possible COPCs are identified and characterized. The existing environment is described, and the emissions and COPCs generated from the project activities are predicted using scenarios and modelling software. The predicted COPC concentrations should be analyzed in relation to appropriate air quality standards (e.g. CAAQS). After estimating the changes in air quality, the assessment should examine and consider the risks to human health due to these changes. Mitigation measures may be recommended to reduce the potential changes to air quality. Measuring COPC levels during the project may assist with implementing or modifying mitigation measures.

6.1. DEFINE SPATIAL AND TEMPORAL BOUNDARIES

"Regardless of whether direct measurement or environmental modelling is used, both spatial and temporal variability need to be characterized. Spatial definition of the site is particularly important for the application of any microenvironment analysis. Temporal definition of the site is needed to address changes in chemical concentrations over time." (Health Canada, 2010)

Spatial boundaries identify and define the area(s) to be considered in the air quality assessment, including local and regional boundaries. The spatial boundaries of air quality effects are project-specific. Depending upon the amount and types of emissions, a project may affect air quality over a larger or smaller area. Often, a local study area (LSA) and a larger regional study area (RSA) are delineated for the assessment. Maps, diagrams and figures should be used to illustrate the boundaries and distances to project site(s). It is good practice to consider adjacent land use if the ecosystem is sensitive; if the land is or will be used for residential purposes; or if on-site contamination is migrating off-site and potentially impacting adjoining properties (Health Canada, 2010). This step of defining boundaries may be conducted in conjunction with the receptor identification step.

It is good practice to focus a discussion of potential human health impacts on locations where people could be most affected, such as those nearest to the emission sources or those who may be exposed to the highest concentrations of COPCs. The latter point is particularly important if there is high variability in air quality within the spatial boundary identified. However, care must be taken to identify those area(s) where there are people who may experience less exposure—but who are at potential greater risk as a result of higher sensitivity. Identification of these areas may be conducted in conjunction with the receptor identification step (Health Canada, 2010). Note that Health Canada is generally interested in all exposures. Medium- and long-range transport is usually evaluated to the extent that it is bounded by the LSA and RSA. Health Canada encourages the evaluation and discussion of long-range transport, if it is important for a particular project.

Temporal boundaries address the timing and lifespan of the potential impacts of the project, and may be described based on the various project phases (i.e. construction, operation, modification, decommissioning and abandonment). It is good practice to clearly determine the most appropriate temporal scales and descriptions of air quality data (e.g. seasonal or annual variation, 24-hour maximum and averaging times, such as 8-hour, 1-hour, etc.)—particularly when the EA will include a comparison of measured or predicted values for air pollutants to existing standards or guidelines. To enable the evaluation of the impacts of project-related air quality changes on human health over time, it is important that the temporal scales provided in both the modelling predictions and health effects assessment are consistent.

To better characterize the types of exposure experienced by humans near the project site(s), it is good practice to differentiate between acute and chronic exposures when describing potential air quality impacts on humans.

6.2. IDENTIFY AND CHARACTERIZE HUMAN RECEPTORS

The identification and description of all existing and reasonably foreseeable human receptors that may be affected by project-related air emissions are necessary for an assessment of potential air quality impacts on human health. It is a good practice to select the most sensitive or exposed individuals in determining these potential impacts. Some individuals are more susceptible to contamination exposure due to the following:

- Physiology (e.g. newborns, children, pregnant or breastfeeding women and elderly people);
- Health status (e.g. immune-compromised persons, and persons suffering from heart disease, respiratory conditions or allergies);
- Behaviour (e.g. amount of time spent outdoors); and
- Lifestyle (e.g. smoking, Body Mass Index (BMI) and exercise status).

It is important to clearly describe the location and distance from the project site(s) of all potential human receptors (permanent, seasonal or temporary)—taking into consideration the different types of land uses (e.g. residential, recreational, industrial, etc.); and identifying all sensitive people (e.g. in schools, hospitals, retirement complexes or assisted care homes). Note that the types of residents and visitors in a particular area will depend on land use, and may include members of the general public and/or members of specific population subgroups (Indigenous peoples, campers, hunters, etc.).

To identify the people that may be affected by project-induced air quality changes, it is useful to provide a map illustrating through isopleths (contour lines showing constant concentration levels) or other means, the predicted pollutant concentrations for those COPCs approaching or exceeding appropriate guidelines and/or standards, overlaid with the receptor locations in the LSA and RSA. Consider that the dispersion of substances into air can affect receptors that are either in close proximity or at considerable distances to the source. If any humans or residences are omitted from the air quality assessment, provide an evidence-based rationale for the exclusion.

Note that occupational exposure and health issues are typically under provincial or territorial jurisdiction.

6.3. DESCRIBE EXPOSURE PATHWAYS

Exposure to air pollutants, such as particulate matter, gaseous chemicals or chemicals adsorbed to particulate matter, occurs primarily via inhalation, which is the main pathway considered in an air quality assessment.

Another potential exposure pathway is the consumption of vegetation, dairy products, meat or game meat from crops or animals that have been exposed to elevated concentrations of airborne contaminants through air deposition to produce, fodder and grazing crops. Health Canada possesses the expertise to review the predicted human health impacts of this mode of contamination, but does not have the ability to verify modelling results that are predictive of this exposure pathway (as discussed in Section 4.1.). It is good practice to employ prediction models obtained from published or other sources that have received peer or regulatory endorsement. Modelling results may indicate that over time, the chemical concentration of contaminants in environmental media may increase (e.g. accumulation over time in soils, bioaccumulation and bio-concentration) due to emissions of airborne contaminants.

6.4. IDENTIFY CONTAMINANTS OF POTENTIAL CONCERN

COPCs are chemicals whose concentration(s) may become elevated in ambient air as a result of project-related activities, and which have the potential for adverse health impacts based on documented scientific evidence or suspected causal relationships.

The COPCs to be characterized for a project EA are often detailed in the project-specific terms of reference (TOR) or EIS Guidelines. It is good practice to include an inventory of all emissions and potential COPCs resulting from the proposed project in an air quality assessment. All sources should be considered, including project-related processes, on-site vehicle usage and fugitive emissions. All phases of the proposed project should also be considered (e.g. construction, operation, modification, decommissioning and abandonment). The inventory should include the following (as applicable):

- Criteria Air Contaminants, (i.e. sulphur oxides, NO_x, particulate matter including total PM, PM_{10}, and $PM_{2.5}$, CO, NH_3, ground-level ozone, and secondary PM);
- Volatile Organic Compounds (VOCs);
- Air pollutants on the *List of Toxic Substances* in *Schedule 1* of CEPA 1999;
- Diesel PM; and
- Other contaminants as appropriate (e.g. heavy metals and PAHs).

As discussed in Section 5, it is widely accepted that PM_{10} and $PM_{2.5}$ are considered non-threshold substances, meaning that health effects may occur at any level of exposure. Health Canada holds the view that there is more risk associated with exposure to very fine particles, particularly $PM_{2.5}$. IARC recently classified particulate matter as carcinogenic to humans (2013). Health Canada suggests that when assessing the potential health effects of PM, there is acknowledgement that there is no threshold below which there is no adverse health effect.

Various sources can help identify COPCs that may be emitted from development projects. These sources include the following: EIS reports, risk assessments, air modelling studies or monitoring data for other similar projects; Environment and Climate Change Canada's National Pollutant Release Inventory; the US EPA; and the Agency for Toxic Substances and Disease Registry.

6.5. ASSESSMENT SCENARIOS AND OTHER CONSIDERATIONS

As good practice, an air quality assessment includes information on baseline conditions and predicted increases in airborne concentrations of COPCs associated with the project, along with appropriate comparisons to applicable standards and guidelines, and discussions of potential impacts and risk to human health due to the predicted changes in air quality.

6.5.1 Assessment Scenarios

Health Canada encourages the inclusion of four assessment scenarios in the air quality assessment, namely: *i) baseline; ii) project alone; iii) baseline plus project; and iv) cumulative or future development,* as appropriate. These scenarios are described below. Additional "development or application" cases or scenarios may be assessed for comparative purposes. Assessment scenarios for v) *decommissioning or abandonment* phases may also be relevant.

i) Baseline Conditions (Pre-project or Base Case Scenario)

The existing baseline levels of air pollutants must be adequately described in order to establish the extent of possible air quality changes related to future project activities (and thus, the subsequent potential impacts on human health). Baseline conditions are the current levels of air pollutants in the RSA, including existing sources, and are usually reported in concentrations, with units of micrograms per cubic metre ($\mu g/m^3$). Comparing predicted COPC concentrations for the project activities to this type of baseline provides information on the sole impact of the project, and the project contributions to the airshed;[1] it does not, however, consider the predicted contributions of already-approved developments in the area.

In some EAs, baseline conditions are reported as concentrations of air pollutants from baseline plus approved but not-yet-built developments. These baseline conditions have higher COPC concentrations than a baseline that excludes approved developments. Comparing predicted COPC concentrations for the project activities to this type of baseline does not present as clear a picture of the contributions of the proposed project alone; it may also contain additional uncertainties associated with the predicted emissions of the approved developments. However, the use of this baseline in the application/development scenario will yield predictions that are higher than the contributions of the project alone, and this may result in additional mitigation measures or more intensively applied mitigation measures to reduce the impacts of the project. It is a good practice to clearly describe if the baseline conditions include—or exclude—approved but not-yet-built facilities or developments.

1 "An airshed is generally described as an area where the movement of air (and, therefore, air pollutants) can be hindered by local geographical features such as mountains, and by weather conditions." Source: B.C. Air Quality (main page) **www.bcairquality.ca/airsheds/bc-airsheds.html**

In areas where industrial activity is prevalent, the baseline concentrations of contaminants may be elevated compared to surrounding undisturbed or less-developed areas. In these cases, discuss the effect of these higher baseline concentrations of contaminants in the context of project activities during the construction, operation or decommissioning phases.

When describing the existing environment, it may be useful to use actual data available from air quality monitoring networks or stations, including regional or air zone air quality monitoring programs, and monitoring initiated by the proponent or other companies in the project area. Note that Environment and Climate Change Canada collects air quality measurements across Canada through monitoring networks and emissions reporting, although there may be limitations to the applicability of the data (e.g. the distance from the project site to monitors may be substantial). Ambient air quality data for specific monitoring stations can be requested from Environment and Climate Change Canada (see Table B1 in Appendix B) and may also be available from provincial authorities.

For particulate matter ($PM_{2.5}$), Health Canada considers 1.8 µg/m^3 to be the average background (or baseline) level of $PM_{2.5}$ in Canada (Judek *et al*, 2004). When there are no site-specific values or measurements, it may be appropriate for the air quality assessment to apply this value as the average background level of $PM_{2.5}$. As previously discussed in Section 5.2, there is no recognized threshold for the health effects of $PM_{2.5}$.

ii) Project Alone Scenario

Even if the predicted effects of a proposed project may be low, there will be some impacts. Therefore, it is a good practice to report the anticipated project emissions in a "project alone" scenario (i.e. not added to the baseline concentrations). The project-alone scenario provides a clear description of the project's contribution to regional air quality. These data may be predicted using air quality and atmospheric dispersion modelling software—or estimated using measurements obtained from other project operations of a similar type and scale.

It is important to report the emissions from the project alone, as in the following situations:

- in urban or near-urban areas;
- in those regions subject to continuing development; and
- when the assessment includes application scenarios that comprise existing and future facilities.

When discussing predicted concentrations for this scenario, also consider the importance of the values for each project phase, e.g. what percentage of the project is construction versus operation? For example, a construction phase may last 1–2 years, producing types of emissions that would not be released during the project's operation phase.

iii) Baseline + Project Scenario (Application or Development Case)

It is a good practice to report the development case as the combination of the baseline conditions and the predicted concentrations of COPCs associated with the project (i.e. the project alone scenario). This scenario is key to the determination of air quality impacts of a project, as it estimates the potential future air quality conditions that would exist if the project is approved and proceeds.

iv) Cumulative or Future Development Scenario(s) (Baseline + Project + Future Projects)

Cumulative effects are the environmental effects of the proposed project in combination with effects from existing and reasonably foreseeable future projects within the same area of influence. An assessment of cumulative effects is required under CEAA 2012 (refer to Section 7 of this document).

Cumulative effects for air quality may be assessed as one scenario, often called the cumulative or future development scenario. Typically, this scenario includes the baseline conditions and predicted changes in COPCs from the project—plus the predicted contributions of COPCs from facilities that are approved but not yet operating, and/or other proposed or likely developments within the study area. The EA may also assess additional future development or application case scenarios for comparative purposes, and to provide additional information on potential future ambient air quality. To model predicted changes in air quality, emissions data from existing projects can be combined with predicted emissions from reasonably foreseeable future projects (estimated from industry averages).

When considering a cumulative effects assessment (CEA) for air quality, note that the evaluation of multiple sources of a COPC from the project (for example, diesel PM from generators and truck-traffic emissions) is considered to be the project-specific scenario and does not constitute a CEA.

v) Project Decommissioning or Abandonment Scenario

If applicable to the project, consider and discuss anticipated changes in air quality due to decommissioning or abandonment of the project facilities in the air quality assessment. The COPCs to consider will depend on the specific post-project activities undertaken—but are likely to resemble those generated in the construction phase. Identify the duration of decommissioning activities, and the measures that may be incorporated to monitor and control PM and other emissions generated from heavy machinery during demolition. Special consideration is advised when decommissioning or abandonment activities of contaminated soils introduce additional COPCs to ambient air. If applicable, it is good practice to provide information related to monitoring and mitigation measures during the decommissioning phase to ensure acceptable air quality is maintained.

6.5.2 Considerations

It is good practice for the air quality assessment to consider the following points for all scenarios:

- Include a map clearly showing the study area(s) and receptor locations. For COPCs with concentrations predicted to approach or exceed guidelines and/or standards, include maps illustrating the predicted concentrations and the location of the human receptors.
- Provide an evidence-based rationale for the omission of any COPCs from the assessment. (Note that the absence of an applicable screening guideline is not a sound rationale for excluding a COPC from further assessment.)
- Provide the predicted or estimated COPC concentrations for the maximally exposed population, for the most sensitive receptors and at the point of maximum impingement.[2]

2 A point of impingement is a technical term used in dispersion modelling of air pollutants - it is the pollutant concentration measured when the plume from a source reaches the ground or a building. Maximum point of impingement concentrations are the maximum level projected by the air quality model. Point of impingement concentrations are used in provincial regulations of industrial sources (rather than top-of-stack levels).

- Report data in concentrations (µg/m^3) (see equations for converting units at the end of Appendix C) that are determined or predicted for time periods corresponding to the applicable health-based standards, guidelines or objectives (e.g. 30- minute, 8-hour, 24- hour and annual intervals). Health-based reference concentrations[3] (RfCs) for COPCs will provide guidance on the appropriate averaging times for COPC concentrations (e.g. if there is a 1-hour RfC, then 1-hour averaging of concentrations should be reported and compared).
- It is necessary to consider both **acute (short-term) exposures and chronic (annual/long-term) exposures** for some COPCs. Annual average concentrations for COPCs with chronic health effects should be provided. For COPCs capable of causing toxic effects following short-term exposures (i.e. chemicals to which short-term exposure may result in human health effects), average daily maximum values may not provide adequate information to address potential health risks. Consider SO_2, where short-term exposures such as 1-hour or in some cases 8-hours, are more important than long-term exposures in terms of toxicity and health effects.
- To enable a comparison of predicted data to health-based standards and guidelines, report contaminant concentrations in µg/m^3, rather than reporting only the emission rates, such as tonnes/year.
- Include predictions of particulate matter in the assessment, including $PM_{2.5}$. When benchmarking predicted air quality levels against the CAAQS or other standards, it is important to consider not just the numerical target of the standard—but also the averaging time period and the statistical form (for the CAAQS, see Table C1 in Appendix C). For $PM_{2.5}$, there are two CAAQS aimed at reducing the health effects of short-term and long-term exposure. The CAAQS are not a "pollute-up-to" level and population health effects occur at levels below the CAAQS. Jurisdictions are urged to take remedial and preventive actions to reduce anthropogenic emissions to the extent practicable to protect against significant air quality deterioration—as there are no recognized thresholds for the health effects of $PM_{2.5}$ and ozone.
- Ozone itself is rarely emitted from project activities, although its precursors often are. The effect of a proposed project on ground-level ozone levels should not be dismissed because the predicted change will be "very small." Ideally, the project's contribution to regional formation of ground-level of ozone will be modelled and included in assessments. If not, provide a discussion of the regional environment, for example, a description of ozone formation, and the regional emissions and conditions that influence its formation. Compare the predicted ozone levels against the CAAQS. As with $PM_{2.5}$, health effects of ozone exposure occur at all levels.
- Discuss the emission of precursors to urban smog and ground-level ozone (NO_2, SO_2, VOCs, etc.). If secondary pollutants (e.g. ground-level ozone and secondarily-formed PM) are not being considered in an air quality assessment, include a thorough, evidence-based rationale for their exclusion. If a quantitative assessment is not possible, it is useful to include a qualitative assessment that analyzes the likely directional impact—based on precursor emissions and the local air quality regime.

3 **Reference Concentration:** An estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious non-cancer health effects during a lifetime (US EPA).

6.6. DETERMINE IMPACTS OF CHANGES TO AIR QUALITY

Compare predicted concentrations for each assessment scenario to appropriate and relevant human health-based air quality guidelines and standards. If predicted concentrations or levels of COPCs and particulate matter remain well below the CAAQS or applicable criteria or guidelines, then generally no further assessment is necessary. However, it is important to identify and comment on the project's overall contribution of pollutants to the local airshed, regardless of whether the predicted values are well below the standards or criteria. Keep in mind that CAAQS for $PM_{2.5}$ and ozone are not to be considered as thresholds or limits of pollution.

Where the predicted COPC concentrations approach or exceed air quality guidelines and standards, the environmental assessment should include a discussion of the potential impacts of these exceedances on human health. In some cases, it may be prudent to proceed to a further level of assessment—using a detailed quantitative human health risk assessment (HHRA).

It is a good practice to conduct a quantitative HHRA in the following situations:

- The assessment predicts that COPC values exceed applicable guideline or standards.
- The project contributes to local air pollutant levels (e.g. the project is the dominant source of pollutant "X" in the area).
- The project contribution leads to a significant deterioration in air quality compared to current levels.
- The project is proposed for a region that is already experiencing environmental pressures from other development projects.

Note that in some cases, contaminants bound to PM may pose unacceptable risk to human health at low levels of PM concentrations—making further assessment necessary to determine if an unacceptable risk may occur.

A detailed quantitative HHRA generally yields more refined conclusions of risk, especially for complex projects with various activities. An HHRA considers the hazards and risks of multiple COPCs, toxicities and exposure pathways, including country foods. In keeping with the precautionary principle, a quantitative HHRA should assess COPCs that are known or suspected carcinogens as carcinogens (i.e. where there may be limited information on carcinogenicity in humans, but strong evidence based on animal studies). IARC provides information and classification on the carcinogenic risks of various substances.

6.7. MITIGATION

Mitigation aims to eliminate, reduce or control adverse environmental effects related to a project. Health Canada prefers that all projects attempt to minimize air emissions to the greatest extent possible, regardless of any upper limits referenced in the applicable criteria, guidelines or standards.

Health Canada views mitigation of negative impacts to air quality as important, especially in the following situations:

- The project contribution leads to a significant deterioration in air quality over existing levels.
- Exceedances or near-exceedances of air quality objectives and guidelines are anticipated.
- The project "load" or contribution to the local airshed is a large proportion of the criteria or guideline value.
- The project is proposed for a region that is already experiencing environmental pressures from other development projects.
- Potential human health impacts are predicted.

Health Canada encourages the use of all available mitigation measures that are technically and economically feasible to limit negative impacts to air quality. The best management activities outlined in *Best Practices for the Reduction of Air Emissions from Construction and Demolition Activities* (Cheminfo, 2005) can be implemented to mitigate air quality effects during the site preparation and construction phase.

Health Canada prefers that mitigation measures also be used in instances when project-related human health impacts are considered minor (in keeping with the CAAQS principles of KCAC and CI). If a low-cost mitigation measure exists and its ability to reduce harmful air emissions is well established, Health Canada encourages the implementation of the measure. It is good practice to describe in the EA documentation the mitigation measures to be employed to address any exceedances or near-exceedances of guidelines. If possible, include details of modelling studies, monitoring or past experience with a mitigation strategy to outline the anticipated effectiveness of a specific measure. If substantial baseline air quality contamination exists at or near the project site(s), the potential for air quality contamination introduced by project-related activities may necessitate consideration of additional mitigation measures.

An Air Quality Management Plan, often part of an environmental management plan for a project, may form the basis for mitigation measures; ideally, this plan addresses the management of all potentially harmful emissions from project-related activities. Such a plan may be implemented during the various project phases, to ensure that potentially harmful air pollutants and possible adverse human health impacts are minimized. Air quality management plans often include measures to limit the frequency and duration of people's exposure to COPCs, airborne dust and $PM_{2.5}$ during all phases of the project.

Upon request from a responsible authority, review panel or other jurisdiction conducting an EA, Health Canada may review an air quality management plan and provide information or knowledge on the effectiveness of any proposed mitigation measures.

6.8. MONITORING

For some projects, air quality monitoring may be advisable to determine the accuracy of predictions; to help verify whether standards are being met; and to assist with implementing or modifying mitigation measures. The extent of monitoring will depend on the project activities, predicted health effects and predictions of COPCs approaching unacceptable concentrations. Monitoring activities may be part of a follow-up program as defined in CEAA 2012.

Health Canada encourages the monitoring of air contaminants when exceedances or near-exceedances of air quality criteria, standards and/or guidance values are predicted or reported—or if the project is predicted to contribute significantly to the elevation of COPC levels above baseline concentrations. Monitoring is also advisable if there is a high degree of uncertainty regarding the project's effects on air quality.

The following questions may assist in determining if monitoring is appropriate:

- Is there significant public concern about the possibility of changes in air quality?
- Is there uncertainty about one or more predicted emissions/COPCs as a result of project activities (e.g. due to difficult modelling issues)?
- Is there potential for novel contaminants to be released, emitted, mobilized or modified as a result of project activities?
- Are new technologies, substances and/or monitoring techniques being used for project activities?
- Have any exceedances been predicted for COPCs in any of the assessment scenarios?
- Are there especially sensitive receptors nearby (e.g. children or seniors)?

Health Canada may make available information or knowledge regarding monitoring plans upon request by a responsible authority, review panel or other jurisdiction conducting an EA. In regards to monitoring activities, Health Canada prefers that a representative number of samples be collected, during different seasons, at locations where potential receptors may be affected. Upon request, Health Canada may also make available information or knowledge on the siting of monitoring stations for regions with an appreciable human presence (e.g. permanent residences, seasonal or temporary residences).

7 ASSESSMENT OF CUMULATIVE EFFECTS

Under CEAA 2012, subsection 19(1), an environmental assessment must consider "the environmental effects … and any cumulative environmental effects that are likely to result from the … designated project in combination with other physical activities that have been or will be carried out."

Considerations for a cumulative effects scenario in an air quality assessment are discussed in Section 6.5 of this document. If the cumulative effects assessment identifies changes to ambient air quality that exceed project-only effects, Health Canada encourages that further monitoring and/or mitigation measures be considered.

For guidance on assessing cumulative effects, consult the Canadian Environmental Assessment Agency's website for up-to-date guidance materials: **www.ceaa.gc.ca**

8 FOLLOW-UP PROGRAMS

Under CEAA 2012, a "follow-up program" means a program for:

a) verifying the accuracy of the environmental assessment of a designated project; and

b) determining the effectiveness of any mitigation measures.

It may be appropriate to consider a follow-up program for air quality if one of the following applies (note: this is not a comprehensive list):

- There is uncertainty about the modelling of contaminant(s) emissions;
- There is uncertainty whether proposed mitigation measures will be effective (e.g. the use of novel technologies or complex systems); or
- The project is located near large population centres, therefore posing a greater potential for exposure and health effects.

For further and up-to-date information on follow-up programs, contact the Canadian Environmental Assessment Agency, Canadian Nuclear Safety Commission, or National Energy Board, as appropriate.

9 REFERENCES

Canada Gazette Part I, August 12, 1989. Volume 123, Number 32. Available online at: **www.collectionscanada.gc.ca/databases/canada-gazette/093/001060-119.01-e.php?document_id_nbr=930&f=p&PHPSESSID=jgn2j8sr2s3ad07pkh7ljsj3m1**

Canada Gazette Part I. May 25, 2013. Objectives for Ambient PM2.5 and Ozone [Canadian Ambient Air Quality Standards (CAAQS) for PM2.5 and Ozone]. Volume 147, Number 21. pp 1243-1246.

Canadian Council of Ministers of the Environment (CCME). 2000. *Canada-wide Standards for Particulate Matter and Ozone*. Available online at: **www.ccme.ca/en/resources/air/pm_ozone.html**

CCME. 2007. Guidance Document on Continuous Improvement (CI) and Keeping-Clean-Areas-Clean (KCAC). Canada-wide Standards for Particulate Matter and Ozone. Available online at: **www.ccme.ca/en/resources/air/pm_ozone.html**

CCME. 2012. Canadian Ambient Air Quality Standards (CAAQS) for Fine Particulate Matter (PM2.5) and Ozone. Available online at: **www.ccme.ca/en/resources/air/pm_ozone.html**

Canadian Environmental Assessment Act. S.C. 2012, c. 19, s. 52. 2012. Available online at: **laws-lois.justice.gc.ca/eng/acts/C-15.21/index.html**

Canadian Environmental Protection Act. S.C. 1999, c. 33. 1999. Available online at: **laws-lois.justice.gc.ca/eng/acts/C-15.31/index.html**

Cheminfo Services Inc. 2005. *Best Practices for the Reduction of Air Emissions From Construction and Demolition Activities.* Prepared for Environment Canada by Cheminfo Services Inc. March 2005.

Environment Canada and Health Canada. 2012. *Canadian Smog Science Assessment: Highlights and Key Messages*. Available online at: **www.ec.gc.ca/Publications/default.asp?lang=En&xml=AD024B6B-A18B-408D-ACA2-59B1B4E04863**

Government of Canada, Environment Canada and Health Canada. 1994. *Canadian Environmental Protection Act*. Priority Substances List Assessment Report: Polycyclic Aromatic Hydrocarbons. Available online at: **www.hc-sc.gc.ca/ewh-semt/pubs/contaminants/psl1-lsp1/hydrocarb_aromat_polycycl/index-eng.php**

Health Canada. 2010. *Federal Contaminated Site Risk Assessment in Canada, Part V: Guidance on Human Health Detailed Quantitative Risk Assessment for Chemicals* ($DQRA_{CHEM}$). Contaminated Sites Division, Safe Environments Directorate, Health Canada, Ottawa.

International Agency for Research on Cancer (IARC). 2013. IARC monographs on the evaluation of carcinogenic risks to humans. Volume 109. Outdoor air pollution. Lyon: International Agency for Research on Cancer.

Judek, S., Jessiman, B., Stieb, D. and Vet, R. 2004. *Estimated Number of Excess Deaths in Canada Due To Air Pollution*. Health Canada and Environment Canada.

Lim et al. 2012. *A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010*: a systematic analysis for the Global Burden of Disease Study 2010. Lancet 2012; 380: 2224–60.

World Health Organization (WHO). 2003. *Health aspects of air pollution with particulate matter, ozone, and nitrogen dioxide*. Report on a WHO Working Group. Bonn, Germany 13-15 January 2003. Copenhagen: World Health Organization. Available online at: **www.euro.who.int/__data/assets/pdf_file/0005/112199/E79097.pdf**

World Health Organization (WHO). 2006. *WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide; global update 2005*. Summary of risk assessment. Geneva, Switzerland: World Health Organization. Available online at: **www.who.int/phe/health_topics/outdoorair/outdoorair_aqg/en/index.html**

APPENDIX AI **AIR QUALITY IN EA CHECKLIST**

This checklist can be used to verify that the main components of an air quality assessment have been completed. It is helpful to include this checklist with the EIS or application, to indicate where the components of the air quality assessment are located in the document. This is especially helpful if the components are located in more than one section of the document.

OVERALL		
✓	***Item***	
	1. Background concentrations of air pollutants and predicted values of Contaminants of Potential Concern (COPCs) are presented in concentrations (i.e. reported in µg/m^3), not only as emission rates, to enable comparisons to human health-based guidelines.	
	2. All phases of the project activities are considered in the assessment (construction, operation, etc.).	
	3. Assumptions are clearly stated and justified (modelling of worst-case scenarios, etc.).	
DESCRIPTION OF BOUNDARIES, COPCS, ETC.		
✓	***Item***	***Section in EA***
	4. Spatial and temporal boundaries are clearly reported.	
	5. Potential human receptors, with particular attention to Indigenous peoples, are identified and characterized. Distances from the project site(s) to all potential human receptors within the area affected by the project are delineated (using maps if applicable), and different land uses are identified (residential, recreational, Indigenous, etc.).	
	6. All possible COPC emissions as result of project activities are identified.	
	7. Any COPCs not carried forward to assessment are identified and accompanied by a scientific rationale.	
SCENARIOS FOR THE ASSESSMENT		
✓	***Item***	***Section in EA***
	8. The assessment scenarios are clearly described and assumptions are stated, and include i) baseline, ii) project alone, iii) baseline plus project, iv) cumulative or future development, and v) decommissioning or abandonment.	
	9. Predictions are accompanied by map(s) showing the estimated COPC concentrations and the location of human receptors.	
	10. The assessment discusses the project's contribution to the local airshed and considers the importance of the project phases (e.g. the portion of the project that consists of construction activities).	
	11. The assessment includes a discussion of ground-level ozone levels, and any project emissions that are precursors to formation of ozone and urban smog in the area affected by the project.	
	12. Predicted exceedances of health-based reference concentrations are identified and their significance is discussed.	

MITIGATION MEASURES, MONITORING ACTIVITIES AND FOLLOW-UP PLANS		
✓	***Item***	***Section in EA***
	13. The mitigation measures to be employed are described in sufficient detail, including any criteria for the implementation of mitigation.	
	14. The assessment includes a discussion of how the Canadian Ambient Air Quality Standards (CAAQS) principles of Keeping Clean Areas Clean and Continuous Improvement will be taken into account in designing mitigation measures, monitoring and follow-up activities.	
	15. The details or a description of monitoring activities (i.e. frequency and duration of monitoring activities, COPCs to be monitored) are provided.	
	16. A description of the air quality portion of the follow-up program is provided, if available.	

APPENDIX B1 NATIONAL AND PROVINCIAL AIR QUALITY: ONLINE RESOURCES

Table B1. Nationally focused ambient air quality resources and information available online (Current as of the publication date of this guidance document)

SOURCE	RESOURCE	URL
Environment and Climate Change Canada	Backgrounder: Clean Air Regulatory Agenda	**www.ec.gc.ca/default.asp?lang=En&n=56D4043B-1&news=295B1964-9737-4F80-B064-B3088D9910BE**
Government of Canada	Health; Environmental Health; Air Quality	**www.healthycanadians.gc.ca/health-sante/environment-environnement/outdoor-air-exterieur/index-eng.php**
Canadian Council of Ministers of the Environment (CCME)	Our Work: Air (Main page)	**www.ccme.ca/ourwork/air.html**
CCME	Air Quality Management System (*includes link to CAAQS levels*)	**www.ccme.ca/ourwork/air.html?category_id=146**
Health Canada	Air Quality (Main page)	**www.healthycanadians.gc.ca/healthy-living-vie-saine/environment-environnement/air/index-eng.php**
Environment and Climate Change Canada	Air Quality (Main page)	**www.ec.gc.ca/air-sc-r**
Environment and Climate Change Canada	Air Quality Science and Research (includes link to *"Access air quality data"*)	**www.ec.gc.ca/air-sc-r**
Environment and Climate Change Canada	Air Quality (Main page)	**www.ec.gc.ca/rs-mn**
Environment and Climate Change Canada	The National Air Pollution Surveillance Network (NAPS)	**www.ec.gc.ca/rnspa-naps**
Environment and Climate Change Canada and Health Canada	Air Quality Health Index	**www.airhealth.ca**
Environment and Climate Change Canada and Health Canada, 2012	Canadian Smog Science Assessment: Highlights and Key Messages.	**www.ec.gc.ca/Publications/default.asp?lang=En&xml=AD024B6B-A18B-408D-ACA2-59B1B4E04863**

Table B2. Select provincial ambient air quality resources, guidelines, objectives and standards available online (Current as of the publication date of this guidance document)

PROVINCE	RESOURCE	DATE	URL
British Columbia	British Columbia Air Quality Objectives and Standards	January 18, 2016	**www.bcairquality.ca/reports/pdfs/aqotable.pdf**
	B.C. Air Quality (main page)		**www.bcairquality.ca/**
Alberta	Alberta Ambient Air Quality Objectives	March 2016	**aep.alberta.ca/air/legislation/ambient-air-quality-objectives/default.aspx**
	Alberta Air (main page)		**esrd.alberta.ca/air/default.aspx**
	Clean Air Strategic Alliance (main page)		**casahome.org**
Saskatchewan	Saskatchewan Ambient Air Quality Standards	1996	**www.environment.gov.sk.ca/adx/aspx/adxGetMedia.aspx?DocID=6b1f40c1-7d4a-499b-a366-e5ffa76324d5**
	Saskatchewan Environment, Programs and Services: Air (main page)		**www.environment.gov.sk.ca/Default.aspx?DN=23774f60-0917-47ed-ba54-3a40d99e23c0**
Manitoba	Objectives and Guidelines for Various Air Pollutants: Ambient Air Quality Criteria	July 2005	**www.gov.mb.ca/conservation/envprograms/airquality/aq-criteria/ambientair_e.html**
	Manitoba Conservation: Air Quality Management (main page)		**www.gov.mb.ca/conservation/envprograms/airquality/index.html**
Ontario	Ontario's Ambient Air Quality Criteria (Sorted by Contaminant Name)	April 2012	**www.airqualityontario.com/downloads/AmbientAirQualityCriteria.pdf**
	Air Quality Ontario (main page)		**www.airqualityontario.com**
Quebec	Les normes et critères québécois de qualité de l'atmosphère (version 4)	2014	**www.mddep.gouv.qc.ca/air/criteres/Normes-criteres-qc-qualite-atmosphere.pdf**
	Normes et critères de qualité de l'atmosphère (main page)		**www.mddep.gouv.qc.ca/air/criteres/index.htm**
New Brunswick	New Brunswick Air Quality Objectives	March 2002	**www2.gnb.ca/content/dam/gnb/Departments/env/pdf/Air-Lair/OrderEstablishingObjectives.pdf**
	New Brunswick Environment—Air Quality (main page)		**www2.gnb.ca/content/gnb/en/departments/elg/environment/content/air_quality.html**

Nova Scotia	Air Quality Regulations	2014	**www.novascotia.ca/just/regulations/regs/envairqt.htm**
	Nova Scotia Environment—Air (main page)		**www.novascotia.ca/nse/air**
Prince Edward Island	Air Quality Regulations	2004	**www.gov.pe.ca/law/regulations/pdf/E&09-02.pdf**
	PEI Environment—Air (main page)		**www.gov.pe.ca/environment/air**
Newfoundland and Labrador	Air Pollution Control Regulations, 2004	2004	**www.assembly.nl.ca/legislation/sr/regulations/rc040039.htm**

APPENDIX C1 CANADIAN AMBIENT AIR QUALITY STANDARDS (CAAQS) AND NATIONAL AMBIENT AIR QUALITY OBJECTIVES (NAAQOs)

The values listed in the tables below are valid as of the date of publication of this document. In addition, you will find information and equations for converting units. Check the appropriate source(s) (i.e. CCME, provincial authorities, etc.) for the most up-to-date and current criteria, standards, and/or objectives. Consult the CCME website for the latest updates and information on the implementation of the Air Quality Management System, including the Canadian Ambient Air Quality Standards (CAAQS).

CAAQS for fine particulate matter and ground-level ozone are listed in Table C1. The CAAQS were established under CEPA in 2013 and replace the Canada-wide Standards for $PM_{2.5}$ and ozone (2000). The CAAQS are both more stringent (i.e. lower) and more comprehensive with the addition of a new long-term standard for $PM_{2.5}$.

National Ambient Air Quality Objectives (NAAQOs) are listed in Table C2. However, these NAAQOs are in the process of being reviewed and updated. CAAQS are currently under development for nitrogen dioxide and sulphur dioxide, with the intent to replace the existing NAAQOs for these pollutants.

Table C1. CAAQS for $PM_{2.5}$ and ozone (CCME, 2012)

POLLUTANT	AVERAGING TIME	STANDARDS (numerical values)		METRIC
		2015	2020	
$PM_{2.5}$	24-hour (calendar day)	28 µg/m^3	27 µg/m^3	The 3-year average of the annual 98th percentile of the daily 24-hour average concentrations
$PM_{2.5}$	annual (calendar year)	10.0 µg/m^3	8.8 µg/m^3	The 3-year average of the annual average concentrations.
Ozone	8-hour	63 ppb	62 ppb	The 3-year average of the annual 4th-highest daily maximum 8-hour average concentrations.

Table C2. National Ambient Air Quality Objectives for Canada (NAAQOs) (Canada Gazette Part I, August 12, 1989)

POLLUTANT	YEAR	AVERAGING TIME	MAXIMUM DESIRABLE LEVEL	MAXIMUM ACCEPTABLE LEVEL	MAXIMUM TOLERABLE LEVEL
Carbon Monoxide (CO)	1996	8 hours	5 ppm	13 ppm	17 ppm
		1 hour	13 ppm	31 ppm	–
Nitrogen Dioxide (NO_2)	1989	Annual	32 ppb	53 ppb	–
		24 hours	–	106 ppb	160 ppb
		1 hour	–	213 ppb	532 ppb
Sulphur Dioxide (SO_2)	1989	Annual	11 ppb	23 ppb	–
		24 hours	57 ppb	115 ppb	306 ppb
		1 hour	172 ppb	334 ppb	–
Total Suspended Particulates (TSP)	1989	Annual	60 µg/m^3	70 µg/m^3	–
		24 hours	–	120 µg/m^3	400 µg/m^3

Definitions and Equations for Converting Units (mg/m^3 to parts per million)

Milligrams per cubic metre (mg/m^3): milligrams of gaseous pollutant per cubic metre of ambient air.

Parts per million (ppm): one part per million (by volume) is equal to a volume of a given gas mixed in a million volumes of air.

Parts per billion (ppb): one part per billion (by volume) is equal to a volume of a given gas mixed in a billion volumes of air.

Convert concentrations in **ppm to mg/m^3** using the following general equation:

$$Y_{mg/m^3} = (X_{ppm})\ (MW)\ /\ 24.45$$

Convert concentrations in **mg/m^3** to ppm using the following general equation:

$$X_{ppm} = (Y_{mg/m^3})\ (24.45)\ /\ (MW)$$

Where:

$\mathbf{Y_{mg/m^3}}$ is the concentration of an element or compound expressed in units of mg/m^3

$\mathbf{X_{ppm}}$ is the concentration of an element or compound expressed in units of ppm

24.45 is a constant (unitless) representing the volume (litres) of a mole (gram molecular weight) of a gas or vapour when the pressure is at 1 atmosphere and the temperature is 25 °C

MW is the molecular weight of the gaseous pollutant (element or compound) expressed in units of grams/mole. The molecular weight of an element (atomic weight) can be found in the periodic table of elements. The molecular weight of a compound is the sum of the atomic weights of each element comprising the compound.

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Guidance for Evaluating
Human Health Impacts
in Environmental Assessment:

NOISE

Canada

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Également disponible en français sous le titre :
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TABLES

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1 ACRONYMS

ACRONYM	MEANING
%HA	percent highly annoyed
%HSD	percent highly sleep disturbed
ANSI	American National Standards Institute
CEAA 2012	*Canadian Environmental Assessment Act*, 2012
CSA	Canadian Standards Association
CTA	Canadian Transportation Agency
dB	decibel
dBA	A-weighted decibels
dBZ	Z-weighted decibels
EA	environmental assessment
EIS	environmental impact statement
ERCB (EUB)	Energy Resources Conservation Board, Alberta (formerly Energy and Utilities Board)
FA	federal authority
Hz	hertz
ISO	International Organization for Standardization
Ld	daytime sound level
Ldn	day-night sound level
Leq	equivalent continuous sound level
Ln	night-time sound level
LAeq	A-weighted equivalent continuous sound level
LAmax	maximum A-weighted sound level
LSA	local study area
MNL	mitigation noise level
NIHL	noise-induced hearing loss
RA	responsible authority
REDA	*Radiation Emitting Devices Act*
RSA	regional study area
SEL	sound exposure level
WHO	World Health Organization
US EPA	United States Environmental Protection Agency

2 PURPOSE OF THIS DOCUMENT

This document provides generic guidance on predicting health risks related to levels and/or types of sound predicted in federal environmental assessments (EAs) of proposed major resource and infrastructure projects (such as mines, dams, pipelines and other projects). It presents the principles, current practices and basic information Health Canada looks for when it reviews the environmental impact statement (EIS) or other reports submitted by project proponents as part of the EA process.

It was prepared for the benefit of proponents and their consultants and to support an efficient and transparent project review process. The foundational information described here should be supplemented appropriately with additional information relevant to specific projects.

The guidance was also prepared for responsible authorities (RAs) and stakeholders to the EA process to communicate our normal areas of engagement and our priorities within these areas to help ensure that sufficient evidence is available to support sound decisions.

As part of its review, Health Canada may suggest that an RA, review panel or others collect information not specifically described here in order to assess the health effects of specific projects. As the guidance provided here is generic and designed to support EA under multiple jurisdictions, the scope of our review will also necessarily be amended according to specific jurisdictional requirements.

Health Canada updates guidance documents periodically and, in the interest of continuous improvement, accepts comments and corrections at the following address: ead@hc-sc.gc.ca

Please verify that you are reading the most recent version available by consulting:
www.canada.ca/en/services/health/publications/healthy-living.html#a2.5

3 INTRODUCTION AND CONTEXT

Health Canada provides expertise to assist RAs, review panels and/or other jurisdictions leading environmental assessments to determine whether there are potential health risks associated with proposed projects and how to prevent, reduce or mitigate them.

Health Canada brings to bear its expertise in health risks associated with air quality, water quality, radiation, noise and country foods when it reviews and provides comments on information submitted by proponents in support of proposed projects. Health Canada also provides guidance to help stakeholders, including responsible authorities, review panels and affected communities, better understand how to conduct health assessments for proposed major resource projects.

This document concerns the assessment of health risks associated with noise. It contains information on the division of roles and responsibilities for issues related to noise at various levels of government in Canada, health effects associated with noise, indicators of these effects, and steps in Health Canada's preferred approach to assessing noise-related health effects.

Appendix A contains a Glossary that defines the technical terms used throughout.

Appendix B contains a checklist of noise impacts that can be used to verify that the essential components of a noise-related health assessment are completed.

Appendices C through H contain additional technical and supplementary information related to noise assessment in EAs.

4 ROLES AND RESPONSIBILITIES WITH RESPECT TO NOISE

In Canada, noise is managed by different levels of government. Federal examples include Transport Canada (aircraft noise), the Canadian Transportation Agency (rail noise), and Employment and Social Development Canada (specifically the Labour Program: occupational noise in workplaces under federal jurisdiction). Health Canada has a regulatory role via the *Radiation Emitting Devices Act* (REDA), which controls the sale of devices that create an unnecessary noise hazard or do not comply with regulatory standards. Outside of these specific federal mandates, noise may be regulated directly through provincial and territorial legislation and guidelines, or through municipal by-laws, which may apply broadly or only to specific project types or sectors. Few or many different criteria may be used to establish noise guidelines, which may include, but not be limited to, noise impacts on sleep, hearing and high annoyance.

In the context of environmental assessments, one of Health Canada's roles concerning noise exposure is to review acoustical assessments for scientific validity and potential risks to human health from project-related changes in environmental noise. This role is fulfilled via leadership in science, research, participation in national and international bodies that develop standards (Canadian Standards Association (CSA) and the International Organization for Standardization [ISO]) and participation in the development of guidelines (World Health Organization [WHO]) for noise and human health.

Health Canada's scientists conduct, evaluate and remain current on domestic and international scientific research pertaining to the human health impacts of noise. Their expertise regarding the potential human health effects of noise is made available to responsible authorities conducting assessments of projects subject to EA legislation. The responsibility for determining the significance of these effects rests with the RAs, review panels or other jurisdictions conducting assessments.

Health Canada does not enforce noise thresholds or standards, but can make available information and knowledge acquired from Canadian and international sources regarding the potential adverse human health effects of noise—based on the type of community (e.g. urban, suburban or quiet rural areas). When noise levels have the potential to induce adverse human health effects, Health Canada may make available information or knowledge on mitigation measures. When mitigation measures are to be implemented, appropriate mitigation strategies based on all applicable guidelines should be considered. Health Canada encourages proponents to consult with other government authorities to determine which enforceable standards for noise exist for specific regions.

4.1 HEALTH CANADA'S APPROACH TO NOISE ASSESSMENTS IN ENVIRONMENTAL ASSESSMENTS

Noise is a somewhat special type of change to the environment, as it is an energy added to the air in the form of acoustical waves. Below the exposure threshold of biological damage to the ear, noise can also cause potential health impacts, such as sleep disturbance and/or cause long-term high annoyance, an indicator of potential health impacts. These impacts depend on the interference of the noise with what one is trying to do (e.g. sleep, concentrate or communicate) and the expectation of peace and quiet during such activities (e.g. in a quiet rural area or during Indigenous spiritual ceremonies).

Human response to noise varies among individuals and according to the specific situation. Response to noise can be characterized using different methodologies and endpoints, and may be affected by several factors. These factors include how noise moves from source to receptor, how it is measured, and what behavioural/physiological and/or psychological changes it evokes in humans.

A particular standard or guideline may not cover all possible considerations or the inherent variability in noise characterization. Several approaches to assessing noise impacts exist, and these various approaches often rely on different noise guidelines and/or regulations that may not be easily reconciled. For example, a guideline may be established to protect against hearing loss, but consideration of additional human health endpoints, such as sleep disturbance, may also be warranted. Some guidelines and/or regulations are based on limiting absolute noise levels, whereas others emphasize the relative change in the noise environment.

This document provides general information on Health Canada's preferred methodology for various human health endpoints used to determine these potential impacts. The prediction of potential impacts is necessary to understand the nature, extent and severity of human health effects that may occur due to noise generated during various stages of a proposed project. These calculations also serve to evaluate the feasibility of the project proponent's planned mitigation measures in reducing human health effects and whether a specific mitigation measure is expected to achieve the desired result. Health Canada reviews the methodology and calculations provided in the noise assessment, as well as the subsequent discussion of potential noise-related impacts on health, for accuracy and completeness. This information may be complementary to the applicable regulations, EIS guidelines or requirements of other jurisdictions.

Depending upon the nature of the project, the responsible authority, review panel or other jurisdiction conducting the EA may want to consider the assessment of noise impacts (specifically, sleep disturbance) on off-duty workers residing in or near the project area. Note that occupational exposure is typically under provincial or territorial jurisdiction, and Health Canada does not review this information in the context of EAs. Also, Health Canada does not possess information or knowledge on the impacts of noise on wildlife or ecosystems.

5 IMPACTS ASSOCIATED WITH NOISE

In reviewing an EA, Health Canada emphasizes only those endpoints that have demonstrated a reasonable causal relationship between noise exposure and adverse human health effects. In the context of an environmental assessment, the associations that have been reported between noise exposure and hearing loss, sleep disturbance, interference with communication, noise complaints and a high level of annoyance are particularly relevant (WHO 1999, 2011). The information and knowledge that Health Canada makes available is based on the following: the modelled changes between the existing and predicted daytime and night-time sound levels (for construction, operation and decommissioning activities); predicted noise-level changes at specific receptor locations (see Appendix G) where people are or will be present; the characteristics of the noise (e.g. impulsive or tonal); and/or the type of community (e.g. urban, suburban or quiet rural area).

5.1 NOISE-INDUCED HEARING LOSS

There is no known risk of permanent hearing loss associated with sound levels below 70 A-weighted decibels (dBA), regardless of the exposure duration. However, as sound levels increase, the duration of daily exposure becomes an important risk factor for hearing loss. The time period before damage occurs shortens as the average sound level increases (WHO 1999; Health Canada 2012).

Hearing loss impacts are not typically considered in EAs because project-related sound levels rarely reach these high levels at the locations of impacted receptors. However, noise-induced hearing loss (NIHL) may be a concern when project activities such as blasting, pile driving and jack hammering are expected. When considering impulsive noise, Health Canada suggests following the WHO recommendation to avoid hearing loss resulting from impulsive noise exposure and that peak sound pressures not exceed 140 Z-weighted decibels (dBZ) for adults and 120 dBZ for children (WHO, 1999).

5.2 NOISE-INDUCED SLEEP DISTURBANCE

Sleep disturbance encompasses the following: difficulty falling asleep; awakenings; curtailed sleep duration; alterations of sleep stages or depth; and increased body movements during sleep. The effects of sleep disturbance have been shown to include, but are not limited to: increased fatigue; irritability; and decreased concentration and performance. These effects are generally experienced in the days subsequent to significant disturbances in sleep. Ongoing disturbed sleep has been reported to be linked to a wide variety of health effects, including, but not limited to cardiovascular effects, mental health and accidents (WHO 2009; Zaharna and Guilleminault 2010).

The guidelines and recommendations of the WHO (1999, 2009) regarding sleep disturbance should be considered in the EA. In particular, WHO guideline levels should not be exceeded for quiet rural areas and susceptible populations, such as those in hospitals, or convalescent or senior homes. For estimating the likelihood of sleep disturbance on any given night, the WHO's *Guidelines for Community Noise* (1999) report a threshold for sleep disturbance as being an indoor sound level of no more than 30 dBA LAeq for continuous noise, during the sleep period. For individual noise events, the WHO has stated: "*For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dBA LAmax more than 10–15 times per night....*" Health Canada recognizes that in many cases, people will want to keep windows at least partially open, depending on the season. Unless specified otherwise, it is assumed by Health Canada that an outdoor-to-indoor transmission loss with windows at least partially open is 15 dBA (United States Environmental Protection Agency [US EPA] 1974; WHO 1999). Fully closed windows are assumed to reduce outdoor sound levels by approximately 27 dBA (US EPA 1974).

More recently, the WHO has published night-time noise guidelines that are intended to protect the public, including the most vulnerable groups, from adverse health effects associated with sleep disturbance due to night-time noise. The recommended annual average is 40 dBA Ln outdoors (WHO 2009). As this is an annual average, there may be times when the sound level is above and below 40 dBA; however, there should be no long-term impact on health if the annual average does not exceed 40 dBA.

Consistent with the view expressed above, when care facilities, including hospitals, nursing homes, daycare centres and homes for the elderly, are identified as receptors that could be impacted by project-related noise, it is a good practice to consult with these facilities to determine whether certain sensitivities to sleep disturbance exist during the day. Should any such sensitivities be noted, the threshold level for sleep disturbance specified in the WHO's Guidelines (1999, 2009) may be used to assess the severity of potential impacts on these receptors. Where there is interest in estimating the prevalence of sleep disturbance—expressed as the percentage self-reported highly sleep disturbed (%HSD)—Miedema and Vos (2007) have published dose-response relationships for estimating %HSD by road, rail and aircraft noise.

5.3 INTERFERENCE WITH SPEECH COMPREHENSION

To maintain good speech comprehension, the recommended sound levels vary, depending on whether the noise from project activities is measured (or estimated) indoors or outdoors. For good speech comprehension, speech levels should exceed that of background noise by 15 dB. The same difference is also desirable for music or television listening. Normal indoor speaking levels are typically 55 to 58 dBA (Levitt and Webster 1991), which is in line with the US EPA 1974 recommendation that indoor background noise levels should not exceed 40 dBA to achieve 100% sentence intelligibility. According to the WHO (1999), speech in relaxed conversation is 100% intelligible in background noise levels of about 35 dBA, and can be understood fairly well in background levels of 45 dBA. Therefore, Health Canada holds the view that background noise levels (i.e. noise due to project activities as measured indoors) be maintained below 40 dBA to sustain adequate speech comprehension.

People generally tend to speak in a louder voice when outdoors, where the separation between speakers is typically larger than indoors. In outdoor environments where distances of up to two metres exist between speakers, US EPA 1974 suggests that 95% sentence intelligibility is acceptable, and recommends a background noise level of 55 dBA outdoors (i.e. 60 dBA with a 5-dBA margin of safety). To sustain good outdoor speech comprehension, background outdoor noise levels for continuous noise should be kept below 55 dBA.

When a school is identified as a potentially impacted receptor, it is suggested that the EA address the special sensitivity of this type of receptor to daytime noise. The WHO recommends an ideal background noise level of 35 dBA in the classroom (WHO 1999). This level is the threshold below which no impacts are expected. This recommendation is based especially on speech interference, but also on the impacts of disturbing message communication and the extraction of information (e.g. speech comprehension and reading), and annoyance.

5.4 INDICATORS OF POTENTIAL HUMAN HEALTH EFFECTS

Health Canada holds the view that certain community reactions to project-related noise represent potential indicators of adverse health; that is, if the noise is experienced over a long period of time, it could potentially increase one's risk of developing health effects. In the context of noise exposure, two of the most common community reactions are complaints and annoyance.

5.4.1 Noise Complaints

Many municipal policies concerning noise are based on the resolution of complaints. Noise-related complaints can be an indicator of human health effects and are used, in US EPA 1974, to help identify sound levels that would protect public health and well-being. Summarizing the US EPA document, Michaud *et al.* (2008) state that a "no reaction" response corresponded to a normalized outdoor day-night sound level (Ldn) of 55 dBA for the intruding noise. They also state that sporadic complaints can occur in communities when this noise level exceeds 55 dBA or widespread complaints, at a level exceeding 58 dBA. Michaud *et al.* (2008) discussed the divergence between "sporadic complaints" and "widespread complaints," when the normalized Ldn of the intruding noise (i.e. project noise) reached 62 dBA. Based on this work, Health Canada uses a normalized Ldn of 62 dBA when it considers effects related to widespread complaints. When project sound levels are greater than a normalized 75 dBA Ldn level, complaints can be expected to include strong appeals to authorities to stop noise. Reliance on noise complaints may only provide a partial indication of a noise problem (Michaud *et al.* 2008) and when possible, the estimated magnitude of complaints should be supplemented with other measures, such as the calculated change in the percentage of highly annoyed (%HA) in an average community and/or estimated impacts on sleep.

5.4.2 Long-term High Annoyance

Annoyance can be described as the effect of noise that most people are aware of. The consideration of community annoyance due to noise is useful; the %HA can be thought of as an aggregate indicator of assorted noise effects, present to varying degrees, which are creating a negative effect on the community and which may not be measurable when considered as separate negative effects.

High annoyance has been widely used as one way to estimate a community response to noise levels. High annoyance is an endpoint that is not directly measured but has been synthesized from self-reported annoyance in numerous large, community-based surveys. Although individual reaction varies greatly, the reported change in %HA among an average community in reaction to certain sound levels provides usable exposure-response relationships (Michaud *et al.*, 2008). Thus, the calculated %HA provides information on how an average community responds to a noise level. Health Canada uses the change in %HA as an appropriate indicator of noise-induced human health effects from exposure to project operational noise (see Section 6.3.2) and to long-term construction noise (see Section 6.3.1) exposure.

There have been more than 50 years of social and socio-acoustic research that either directly or indirectly studied the impact of noise on community annoyance. These studies have consistently shown that an increase in noise level is associated with an increase in the percentage of the community indicating that they are highly annoyed. The relationship between noise levels and high annoyance is stronger than any other self-reported measure, including complaints. Canadian research on road-traffic noise also shows that respondents highly annoyed by traffic noise are significantly more likely to perceive their annoyance as having a negative impact on their health (Michaud *et al.* 2008).

To assess the impacts of noise from projects using this indicator, the project-related change in the sound environment and the related increase in %HA are evaluated. Using the dose-response relationship between noise levels and annoyance, as per ISO 1996-1:2003, one can calculate the percentage of a typical community that would report being "highly annoyed," expressed as %HA. The %HA increases exponentially as sound levels increase. Due to the non-linear nature of the relationship between noise and %HA, there can be a substantial increase in the %HA, with relatively small changes in the noise environment—in situations where the initial baseline noise level is high. In other words, the higher the initial noise level, the more the annoyance will increase when there is an increase from the baseline noise level. In general, this dose-response relationship may be a useful tool in characterizing and quantifying average community response to noise levels and changes in noise levels.

Health Canada prefers the use of the dose-response relationship only for long-term noise exposure considerations in EAs, and holds the view that %HA be calculated only for receptors exposed to long-term project noise (more than one year). It is important to emphasize that these annoyance responses are not applicable to a particular individual or group, but represent an average community. Appendix F presents the methodology for obtaining variables used in the equations to calculate %HA. Health Canada prefers that the increase in %HA per representative receptor (i.e. a group of residences in similar geographic proximity to the noise source) be evaluated and not the average increase in %HA for all receptors—which could underestimate the project-related impact on community annoyance.

Noise mitigation measures should be considered when a change in the calculated %HA at any given receptor location exceeds 6.5%. The ISO method does not characterize the nature of the increase in terms of severity of impact. However, the U.S. Federal Transit Administration describes a long-term increase of more than 6.5%HA as representing a severe project-related noise impact (Hanson *et al.* 2006). This increase is based in part on the historical acceptability in the U.S. of no more than a 5-dBA increase in Ldn in an urban residential environment (not immediately adjacent to heavily travelled roads and industrial areas). Further justification for using an increase of 6.5%HA as a criterion for a severe noise-related impact may be found in Michaud *et al.*, 2008, and Hanson *et al.*, 2006. ISO 1996-1:2003 notes that research has shown that there is a greater expectation for, and value placed on, "peace and quiet" in quiet rural areas, which may be equivalent to up to 10 dB in noise. Unless specified otherwise in an EA, this expectation is assumed by Health Canada to be equivalent to an adjustment of 10 dB (ISO 1996-1:2003).

Note that the change in %HA is only one potential indicator of noise-related human health effects and that all possible human health endpoints may be considered in an assessment. In situations where baseline noise levels exceed an Ldn of 77 dBA , and project noise levels alone exceed an Ldn of 75 dBA, it may be too difficult to meet the WHO guidelines for sleep disturbance and vulnerable populations (see Section 5.2). It may also be too difficult to reduce these environmental noise levels to meet the levels suggested in Section 5.3, regarding adequate speech comprehension indoors for residents. Therefore, Health Canada holds the view that mitigation of project noise be applied if it exceeds an Ldn of 75 dBA, even if the change in %HA does not exceed 6.5%. For example, if project noise alone exceeds an Ldn of 75 dBA, it may be that the levels noted in Sections 5.2 and 5.3 are not achievable in typical residences, even in situations where the highest level of outdoor-to-indoor transmission loss is achieved. In situations like this, project noise should be cautiously mitigated to a level below an Ldn of 75 dBA, which includes a consideration of uncertainty in predictions.

6 AN APPROACH FOR ASSESSING THE HEALTH IMPACTS OF NOISE

The approach preferred by Health Canada for noise assessment involves obtaining the best possible characterization of the acoustical exposure that may impact potential noise receptors. This description includes sound level and duration, and noise characteristics, such as whether the noise is tonal, impulsive, highly impulsive, etc. (see Appendix B).

To obtain the highest-quality data in acoustical studies, acoustical assessments should be completed by professional and properly trained consultants, using equipment and methods that are recognized as the industry standard for acoustical measurements. Occasionally, limitations may exist in the technology and expertise available for some projects. Whenever uncertainty exists in the selection of appropriate monitoring equipment or in the application of standard techniques for noise characterization in EAs, government authorities are encouraged to consult Health Canada for assistance or additional guidance.

The main steps in assessing the potential health impacts of changes in noise associated with a project are the following:

- Identify people (receptors) who may be affected by the project-related noise;
- Determine the existing (baseline) noise levels at representative receptors, by measurement or estimation;
- Predict project-related changes in noise levels for each phase of the project (construction, operation and decommissioning) and describe the sound characteristics;
- Compare predicted noise levels to relevant guidelines and/or standards;
- Identify and discuss the potential human health impacts associated with predicted changes in noise levels;
- Consider mitigation measures, their implementation, and any residual effects, after the measures are implemented;
- Consider community consultation and prepare a complaints-resolution plan; and
- Consider the need for monitoring of noise levels.

6.1 IDENTIFICATION OF HUMAN RECEPTORS IN PROJECT AREAS

It is important to identify and describe all existing and reasonably foreseeable human receptors in the area that may be influenced by project-related noise—including a description of how the receptors were identified (e.g. recent land use maps, verification in person). The characterization of potential receptors typically includes the distance(s) to the project's local study area (LSA) and regional study area (RSA) for each receptor, and map(s) illustrating modelled noise levels from the project at receptor locations in the study area. While sound levels at one receptor site are typically averaged over time, it is not appropriate to assess noise impacts using the average increase in sound levels across receptor locations because sound level ranges, and therefore noise impacts, may be different at different locations.

Health Canada prefers that noise assessments identify and describe any particular receptors that may have a heightened sensitivity to noise exposure (e.g. Indigenous Peoples, schools, child care centres, hospitals). Specifically note in the EA documentation if receptors with heightened sensitivity are not present in the study area. A list of commonly encountered receptors and related characteristics is provided in Appendix G.

When identifying receptor sites at which noise impacts will be assessed, it is a good practice to consider and note the following:

- how the sites are representative of potentially impacted receptors;
- any receptors who have rented dwellings or land; and
- any receptors who live outside Canada that may be impacted by a project, where applicable.

If any local receptors that may be influenced by project noise are not being assessed in the EA, provide a rationale for this exclusion. If no human receptors are (or will be) present in the local or regional study area during the construction, operation or decommissioning phases of the project, no further assessment with respect to noise is necessary.

It is important to identify and describe any receptors in rural areas that could be considered to have a greater expectation of "peace and quiet" (i.e. quiet rural areas). Health Canada considers a "quiet rural area" to be a rural area with Ldn due to human-made sounds to be below 45 dBA. For areas with the most stringent permissible noise levels, provincial regulatory criteria may also be used to define "quiet rural areas," provided these areas are adequately described.

Due to the expected heightened sensitivity to noise, baseline levels in quiet rural areas are adjusted by adding 10 dB (ISO 1996-1:2003, ANSI, 2005). This 10 dB adjustment also applies to the predicted project noise levels for all phases of the project (i.e. construction, operation and decommissioning) in determining percent highly annoyed (%HA). The effect of this +10 dB adjustment in quiet rural areas is to produce a greater change in %HA than would occur with unadjusted noise levels. The exponential relationship between %HA and noise levels, as discussed in Section 5.4.2, produces increasingly larger changes in %HA for equal increases in project noise, compared to the baseline level.

An example follows:
If the initial baseline noise level is 45 dBA and the project-related noise level is 55 dBA, the unadjusted change in %HA would be 3.01 (using equations in Appendix F). When the +10 dB adjustment to both baseline and project-related noise is applied in a quiet rural area, the baseline rating level used to calculate the %HA becomes 55 dBA and the project-related noise rating level becomes 65 dBA in the calculation of %HA. At these rating levels, the resulting change in %HA is 9.79. Therefore, a 10-dBA project-related noise increase from a baseline of 45 dBA in a quiet rural area will result in exceeding the suggested mitigation level of 6.5%, while a 10-dBA increase in project-related noise from a baseline of 45 dBA in a more urbanized area would not exceed this level.

6.2 ASSESSMENT OF BASELINE NOISE

Baseline noise levels that are determined by measurement or estimation can be applied to noise impact assessments for all project phases (construction, operation and decommissioning). Health Canada prefers that measured or valid estimated baseline noise levels for both daytime (Ld) and night-time (Ln) at all representative receptor locations be assessed and reported in the EA. It is a good practice to clearly indicate whether sound levels are measured or estimated, and to identify the exact location of the baseline measurement (e.g. outdoors at the building facade, or on the lower level, upper level, property line, etc.).

6.2.1 Measuring Baseline Noise

When baseline measurement is conducted, Health Canada prefers that the measurement be completed in accordance with ISO 1996-2:2007 at each representative receptor, and that the reports include the dates and hours used to characterize these measurements. Sounds that are not generated by human activity (e.g. ocean, wind and animal noises) should not be included in determining a baseline sound level. Wind and rain can also create false signals in the microphone used to measure sound levels. As a result, sound is not measured in the presence of precipitation or when wind speeds exceed 14 km/hr, unless an appropriate wind screen is used.

To minimize uncertainty of the validity of measured baseline-sound-level data, Health Canada suggests that the EA report provides the following information:

- the number of hours or days used for measurement, and a rationale for why the reported sound levels can be considered representative;
- an estimate of seasonal differences and any differences between the weekend and weekday baseline noise levels;
- where applicable, any differences due to weather conditions;
- all noise sources that contribute significantly to the baseline, by type (e.g. traffic, aircraft, trains, industrial); and
- a characterization of each noise type described in the assessment using descriptors such as continuous, intermittent, regular impulsive, highly impulsive, high-energy impulsive, and continuous tonal and intermittent tonal.

6.2.2 Estimating Baseline Noise

Although the standard approach for baseline sound determinations is direct measurement, there may be situations where baseline measurement data are not available. In such cases alternative approaches to estimating baseline levels exist. One conservative (i.e. most protective) approach is to consider a reasonable worst-case scenario and assume Ldn baselines of 35 dBA for rural areas and 45 dBA for urban/suburban areas. However, defaulting to these lower baseline sound levels may result in greater values obtained for change in %HA when calculating noise effects for construction lasting more than one year or for operational noise. Note that the estimate of an Ldn of 45 dBA for urban/suburban areas does not consider the inherent variability in baseline noise estimates based on population density, proximity to busy roads or adjacent industrial activity.

The use of alternative approaches to estimating baseline noise may yield higher baseline estimates than the reasonable worst-case scenario described above. To adequately review the reliability of such estimates, Health Canada prefers that sufficient supporting rationale is provided in the EA, particularly where the accuracy of the selected estimation approach decreases (see below).

Other approaches to estimating baseline noise in order of decreasing accuracy may include the following:

- predictions based on computer models whose inputs, algorithms and outputs are based on accepted standards;
- manual calculation procedures based on well-accepted models or standards;
- the use of known baseline levels from areas with very similar acoustical environments (e.g. very similar types of baseline noise sources, distances from sources to receptors, meteorological conditions, shielding, etc.); and/or
- approximate values from Table 6.1 (see below).

Table 6.1 describes the estimation of baseline noise levels, based on a qualitative description of community characteristics and an average census-based population density (ERCB Directive 038, 2007). If this method (based on US EPA 1974 and ERCB 2007) is used in a noise assessment, provide a rationale to support the validity of its use.

Table 6.1: Estimation of Baseline Noise Levels Using Qualitative Descriptions and Population Densities of Average Types of Communities

Community Type (Qualitative Description)	Average Census Tract Population Density, Number of People Per Square km	Estimated Baseline Sound Level[1], Ldn (dBA)
Quiet rural dwelling units more than 500 m from heavily travelled roads and/or rail lines and not subject to frequent aircraft flyovers	28	≤45[2]
Quiet suburban residential remote from large cities, industrial activity and trucking	249	48–52
Normal suburban residential not located near industrial activity	791	53–57
Urban residential not immediately adjacent to heavily travelled roads and industrial areas	2493	58–62
Noisy urban residential near relatively busy roads or industrial areas	7913	63–67
Very noisy urban residential	24,925	68–72

1. Note that a range of values is provided and that selection of the appropriate estimated value would typically be based on the precautionary principle in the absence of adequate justification for a higher baseline. All day-night sound level (Ldn) values, except those of the quiet rural area community type, are based on the US EPA levels document (US EPA 1974).

2. The quiet rural area (Ln = 35 dBA) estimated baseline noise level and population density were obtained from ERCB Directive 038 (revised Feb 16, 2007). The difference between Ld and Ln was obtained from ERCB and US EPA, and was approximated as 10 dBA. As such, quiet rural areas are considered to be less than or equal to 45 dBA Ldn.

6.3 ASSESSMENT OF PROJECT-RELATED NOISE

It is a good practice to document the criteria used to review the human health impacts of project-related noise and to characterize the potential for change in the sound environment due to any project activity, including construction, operation and decommissioning. In the noise assessment, it is important to compare predicted noise levels during construction and operation to the baseline noise levels at each representative receptor, as this will clearly demonstrate the predicted changes in noise levels experienced by each receptor. Health Canada suggests that the type of measurements used and the uncertainty associated with any sound-level monitoring, modelling or estimates be provided for all reported data.

It is important to consider that human health effects related to noise may be evaluated by a variety of endpoints and indicators, as discussed in Section 5. Health Canada holds the view that the evaluation of each potential noise-induced human health effect by one method alone is not necessarily representative of all possible human health effects related to noise exposure. For example, when using %HA as an indicator in a noise impact assessment, the change in %HA of receptors exposed to long-term noise may not exceed 6.5%, but these receptors may experience sleep disturbances due to an exceedance of the WHO indoor sleep-disturbance threshold limits discussed in Section 5.2. When changes in the sound environment have been characterized, Health Canada suggests that a discussion of the severity of these changes and how they impact human health be included in the noise assessment. Such an evaluation would typically describe all appropriate endpoints or indicators used to address potential impacts on human health, as described in this guidance. Alternative approaches to this evaluation may be acceptable, provided they are supported by adequate scientific justification.

In some cases, a less extensive assessment may be warranted. If noise levels at all receptors are not expected to approach the US EPA's mitigation noise levels (see Section 6.4.2) or to result in a change in %HA exceeding 6.5%, as discussed in Section 5.4.2, Health Canada suggests that a scientifically sound rationale be provided in the EA—to confirm that noise levels will be well below the level where human health effects may occur (see Section 5) and that this rationale has been provided in place of a complete noise impact assessment.

The results and conclusions of the noise assessment should be clearly documented in the EA. Health Canada suggests that the conclusion include a discussion of whether mitigation measures and/or follow-up monitoring is warranted.

The following sections discuss the assessment of project-related construction noise of short-and long-term durations, as well as project operational noise.

6.3.1 Assessing Construction Noise

Noise from construction activities has the potential to negatively impact nearby receptors and is often the loudest source of project-related noise. Predicted construction noise levels for both daytime (Ld) and night-time (Ln) at all representative receptor locations should be reported in the EA. To permit a proper comparison of noise levels, the units, averaging times and other measurement parameters (including the uncertainty associated with any of the measurements) should be the same as those used in establishing the baseline.

The method for determining effects related to construction noise depends on the duration of the construction activities as follows:

i. Short-Term Construction Noise Exposure (< 1 year)

Health Canada suggests using the US EPA (1974) methodology that provides mitigation noise levels (MNLs) and associated adjustments for community types, to determine if adverse effects are likely and if mitigation is suggested. This methodology is discussed in Section 6.4.2, **Mitigating Short-Term Construction Noise Exposure (<1 year)**. Consideration should also be given to potential impacts on sleep, where adverse impacts are reported to begin when sound levels inside bedrooms exceed 30 dBA for continuous noise sources and 45 dBA LAmax for discrete noise events (WHO 1999). With an estimated 15 dBA outdoor-to-indoor transmission loss, the equivalent outdoor levels should be 45 dBA and 60 dBA, respectively.

ii. Long-Term Construction Noise Exposure (≥ 1 year)

Health Canada suggests that construction noise lasting longer than 1 year be assessed as operational noise. This approach allows for an evaluation of the change in %HA at each receptor, in accordance with ISO 1996-1:2003. Appendix F describes the methodology and equations related to calculating the change in %HA for projects. The appropriate adjustments (see Appendix E) may be applied to the A-weighted calculated or measured noise levels. This method of assessing construction noise is essentially identical to that of assessing operational noise, as discussed in Section 6.3.2 below. Also, potential impacts on sleep should be considered when construction activities may occur at night-time (as noted above in short-term construction).

There may be insufficient information concerning construction activities to permit an assessment of their potential impacts at the EA stage. Conservative assumptions based on similar projects and/or planned activities are often used in estimating noise levels and calculating impacts due to construction. An example of this estimation technique is to assume that all equipment is operating simultaneously for a 12-hour period, even though actual impacts are expected to be lower. In these cases, Health Canada suggests providing as much information as possible on construction activities, schedules, equipment use and any assumptions used, in addition to an explanation of why a more detailed assessment is not possible.

It is a good practice to include a description of construction noise as it relates to exposure duration, rather than construction activity duration. The difference in these perspectives becomes apparent when considering the impacts of construction noise related to road projects. As a road project progresses, noise exposure continually varies from receptor to receptor as the geographic location of the construction equipment changes.

6.3.2 Assessing Project Operational Noise

Predicted operational noise levels for both daytime (Ld) and night-time (Ln) at all representative receptor locations should be reported in the EA. To permit a proper comparison of noise levels, the units, averaging times and other measurement parameters (including the uncertainty associated with any of the measurements) should be the same as those used in establishing the baseline.

As discussed previously, the determination of %HA is a widely accepted indicator of the human health effects of long-term noise exposure. Similar to comments in Section 6.3.1 ii above, the assessment of project operational noise may include an evaluation of the change in %HA at each receptor site, in accordance with ISO 1996-1:2003. Appendix F describes the methodology and equations related to calculating the change in %HA for projects. The appropriate adjustments (see Appendix E) may be applied to the A-weighted calculated or measured noise levels. If noise from project operations may occur at night-time, the assessment of operational noise should also consider potential impacts on sleep.

Modelling sound levels (using appropriate software) is one method that is commonly used to estimate present or future operational sound levels. In the assessment, clearly identify the model(s) used and justify their suitability. Specific models may be selected on a site-by-site basis. Health Canada prefers that any assumptions used be conservative (i.e. reasonable worst-case scenario) and be adequately described in the assessment.

If project-related noise levels are provided without being added to the baseline sound levels, this must be clearly indicated. In assessing impacts on human health, the baseline and project noise are added together, as their sum represents what noise effects the receptors will actually experience. Other changes in the sound environment may also be characterized. If project-related operational noise includes audible tonal or impulsive noise (including regular impulsive, highly impulsive and high-energy impulsive types of noise [ISO 1996-1:2003] [e.g. blasting]), appropriate adjustments as presented in Appendix E can be made. Refer to ISO 1996-2:2007 for additional guidance on describing or measuring tonal and impulsive noise. These adjustments apply only when the noise under consideration is audible at receptor sites. In situations where more than one source characteristic adjustment is applicable (e.g. impulsive or tonal), only the higher of the adjustments is used. However, all time-of-day adjustments and the quiet rural area adjustment are to be added to the highest of the applicable source adjustments.

6.4 MITIGATION

Noise management and noise monitoring plans, including complaint resolution plans, are often incorporated as part of the EA's Environmental Management Plan. When health effects from project-related noise are possible, Health Canada prefers that a noise management plan detailing the actions that will be taken to minimize human health impacts due to project noise (mitigation measures) be developed and included in the EA. Special consideration should be given to mitigation measures for construction noise that occurs at night, in order to minimize impacts on sleep (i.e. avoiding tonal or impulsive noise sources at night).

Due to the inherent uncertainty in both predicted and/or measured project noise, additional information should be provided to demonstrate that exceedances of the MNL or a 6.5% change in %HA are unlikely. Proposals for specific mitigation measures to limit noise at receptors where this uncertainty exists should be provided in the EA.

Health Canada prefers that any noise mitigation measures proposed for the project be described in sufficient detail to permit Health Canada to adequately review the measures' impacts on achieving noise reduction. When describing possible mitigation or other noise management measures, identify the conditions or circumstances under which various mitigation measures will be applied or implemented.

As it is more effective to use source controls, Health Canada prefers that mitigation measures be applied to the source rather than the receptor site, where this is technically feasible. It should be noted that some estimates discussed in Section 5.2 (e.g. noise attenuation by closed windows or enclosed balconies) may not achieve the desired level of noise reduction, due to variability in construction techniques. While fully-closed windows are assumed to typically reduce outdoor sound levels by 27 dBA (US EPA 1974), the type of enclosures that surround the windows or the presence of ventilation ducts may result in an outdoor-to-indoor noise transmission loss that is lower than 27 dBA.

6.4.1 Community Consultation

Developing a community consultation plan can be helpful when projects propose noisy work occurring outside of normal working hours or extended work that produces high levels of noise (such as rock hammering or pile driving). The consultation process may assist in establishing feasible mitigation measures by targeting receptors that have the greatest potential for human health-related effects resulting from noise disturbance. Previous experience in assessing community reaction to noise impacts following community consultation has demonstrated that in these cases, a community is more likely to be understanding and accepting of noise, and more likely to make appropriate adjustments to limit noise exposure. This has been noted particularly when the information provided during the consultation process is accurate and does not attempt to understate the likely noise level, and when commitments made by the proponent to limit noise during specific hours are respected.

The EA should specify whether community consultation with respect to noise has occurred, and whether any human health concerns have been expressed by potentially impacted receptors.

The comments or recommendations received during the consultation process may provide an indication of which project elements are likely to trigger the greatest level of opposition, particularly where noise issues are identified. Informing the public about project plans early in the process is encouraged, as this may provide additional options for mitigation measures, or at the very least, provide the opportunity to discuss the mitigation measures under consideration. It is a good practice to undertake community consultation prior to the creation of work schedules (e.g. continuous versus specific construction times) and to discuss the preferred means of informing the public of the time and duration of noisy activities. When construction delays or other problems result in extended construction schedules, Health Canada suggests that a plan for community consultation be implemented and that this consultation process be described in the EA, where applicable. When a project proponent deems it to be manageable, it may be preferable to consult with residents individually.

When the community receives information about expected changes in sound levels through a consultation process, and feels that concerns with respect to noise may be addressed and resolved, the incidence of noise-related complaints is frequently reduced. Health Canada suggests that this approach be considered in managing both minor and major public concerns related to project-related noise. For more information, refer to ERCB Directive 38 (2007). For information specific to rail projects, refer to the Canadian Transportation Agency's *Guidelines for the Resolution of Complaints Over Railway Noise and Vibration* (2008).

6.4.2 Mitigating Short-Term Construction Noise Exposure (<1 year)

Health Canada often suggests mitigation measures to the authority conducting the EA, when the predicted construction noise level (construction lasting less than one year) exceeds the suggested mitigation noise level (MNL). To avoid widespread complaints regarding construction noise at receptor sites, where the exposure duration is less than one year at any given representative receptor site, the basic suggested MNL is 47 dBA (US EPA 1974). This value has been derived from the data presented in Figure D-7 and Table D-7 in US EPA 1974. The basic MNL is applicable for receptors in quiet suburban or rural areas, assuming that all of the construction noise is tonal and/or impulsive.

In order to determine whether mitigation is advisable, consider the following:

1. Use the data in Table 6.1 to characterize the community type based on average census tract population densities and community qualitative descriptions. Validating the community type may be accomplished by monitoring or calculating baseline noise levels.
2. Use the data in Table 6.2 to identify the applicable correction factors for the relevant community type and additional corrections (e.g. construction duration, presence of tonal or impulsive noise, and whether windows are open), and then calculate the suggested construction noise (less than one year) MNL.
3. If the predicted construction noise levels exceed the suggested MNL for construction phase (less than one year), the authority conducting the EA should consider noise mitigation measures.

Table 6.2: Calculating Suggested Mitigation Noise Level (MNL) for Construction Noise (Based on US EPA 1974)

Suggested Basic MNL 47 dBA Ldn* ***Suggested MNL for various scenarios***		
Community Description	***Applied Correction Factors***	***Suggested MNL***
Quiet suburban or rural	+0 dB	47 dBA Ldn
Normal suburban	+5 dB	52 dBA Ldn
Urban residential	+10 dB	57 dBA Ldn
Noisy urban	+15 dB	62 dBA Ldn
Very noisy urban	+20 dB	67 dBA Ldn
Additional Corrections If applicable, add any or all of the following corrections:		
Construction duration less than two months	+10 dB	
Winter (or windows always closed)	+5 dB	
Negligible tonal or impulsive noise§	+5 dB	

* Due to backup alarms, slamming tailgates, etc., construction noise normally contains both tonal and impulsive components. For the suggested basic MNL, the reasonable worst-case scenario is used and all of the construction noise is assumed to be due to tonal and/or impulsive noise.

§ When the contribution from tonal and/or impulsive noise may be negligible, +5 dB may be added to the suggested basic MNL. Health Canada prefers that a rationale be provided if this adjustment is applied.

Table 6.3 presents an example of how to establish a mitigation noise level (MNL). The final MNL is obtained through the application of several possible correction factors, as shown in Table 6.3. Calculated MNLs for other construction projects may vary, depending on the applicable correction factors specific to the project type, season and location.

Table 6.3: An Example of Applying Corrections to Establish a Suggested MNL for a Project in a Very Noisy Urban Community

Description	Applied Correction	Suggested MNL
Basic MNL	0 dB	47 (dBA) Ldn
Project occurs in a very noisy urban community	+20 (dB) Ldn	67 (dBA) Ldn
Construction duration is less than two months	+10 (dB) Ldn	77 (dBA) Ldn
Noise contains negligible tonal or impulsive noise	+5 (dB) Ldn	82 (dBA) Ldn
Project occurs during winter or in proximity to residences where windows cannot be opened	+5 (dB) Ldn	87 (dBA) Ldn
Final MNL		87 (dBA) Ldn

Widespread complaints tend to occur when the suggested MNLs in Table 6.2 are exceeded (US EPA 1974). Therefore, Health Canada suggests the use of quieter technology or other mitigation measures, rather than lengthening construction duration (e.g. lowering the noise by having fewer pieces of equipment running at a time, thereby extending construction duration) to achieve a reduction in human health-related noise impacts.

Some examples of quiet technology and procedures are the following:

- vibratory pile driving or boring, instead of impulsive pile driving; and
- ambient-sensitive backup alarms, signal workers, machinery turning circles, and side loading/unloading trucks to reduce the impact of backup alarms.

If acceptable levels cannot be obtained with quieter technology, community consultation (as discussed in Section 6.4.1) is preferred, in order to seek consensus on construction operations (e.g. no activity during night-time or weekend hours). Some commonly applied construction noise mitigation measures and considerations for noise reduction are described in Appendix H.

6.4.3 Mitigating Long-Term Construction Noise (≥ 1 year)

Health Canada suggests that mitigation be implemented when noise levels during long-term construction result in a greater than 6.5% increase in %HA. If the change in %HA exceeds 6.5%, even when implementing quieter technology and construction methods as described in Appendix H, community consultation is important to establish mutually agreeable work schedules and is an acceptable means of informing the public of the time and duration of noisy activities.

Communication with potentially impacted residents is especially important when construction must occur outside daytime hours. Residents' concerns about blasting or other noisy activities can often be addressed through community consultation. Some flexibility among impacted residents may exist regarding construction noise levels, if demonstrable mitigation measures are used. Community consultation can be useful to determine whether the ability to avoid long periods of construction would result in greater community acceptance.

In addition to the consultative process, it is a good practice to consider technically and economically feasible mitigation measures (see Appendix H), in an attempt to reduce noise levels to levels that keep the change in %HA below 6.5% and protect against sleep impacts. In some cases, monitoring and working with the impacted community may address community reactions.

6.4.4 Mitigating Blasting Noise

Noise due to blasting has unique characteristics. Therefore, Health Canada holds the view that for blasting during short-term construction (< 1 year), limits on the number of blasts should be implemented irrespective of other noise levels due to background sources or construction activities. Noise effects due to blasting can be assessed in several ways. One approach for blasting exposures lasting less than one year is to use the US EPA 1974 criterion for sonic booms. The rationale for this approach stems from the findings of Schomer *et al.* (1997), whose research indicates that blasts and sonic booms create similar levels of annoyance for equal peaks.

According to US EPA (1974), little or no public annoyance is expected to result from any number of daytime sonic booms per day, if their measured or predicted peak value is below 125-10 log N dB. In this case, dB is interpreted as meaning Z-weighting (dBZ). Health Canada prefers that the US EPA's sonic boom criterion be used as a blasting MNL for blasting that lasts less than one year.

Table 6.4 presents an example of the assessment technique of establishing an MNL based on a representative number of blasts.

Table 6.4: Mitigation Noise Levels Related to Number of Blasts

Number of Daytime Blasts (N)	Blasting MNL (125-10 log N) (dBZ)
10	115
25	111
50	108
100	105

Health Canada suggests following the recommendations in ISO 1996-1:2003, as described in Appendix E and Appendix F of this guidance document, for blasting of duration of more than one year (≥ 1 year),

6.4.5 Mitigating Operational Noise

As with long-term construction noise, Health Canada considers high annoyance with noise generated during a project's operational phase to be an indicator of human health effects. If the change in %HA exceeds 6.5% or the suggested target values noted in Section 6.3.2 for project operational noise, Health Canada suggests that possible mitigation measures target the source, the propagation from source to receptor site and/or the receptor site itself. These measures include, but are not limited to the following:

- reducing noise output, such as using quieter machinery where technically and economically feasible;
- implementing physical barriers, including noise walls, berms (artificial ridges or embankments) and windows with high soundproofing; and
- in some cases, changing project design (e.g. changing the proposed placement of an access road).

In general, implementing mitigation measures that further reduce noise impacts is encouraged.

6.5 ASSESSMENT OF RESIDUAL IMPACTS

An assessment of the residual impacts of a project may include discussion of potential noise impacts arising from the project, after all proposed mitigation and management measures have been applied. It is a good practice for this discussion to include characterizing final sound levels at representative receptor locations—in the same manner as is done in establishing the baseline and predicted sound levels—in addition to discussing the potential impacts that may be expected due to these changes.

Mitigating adverse noise effects can at times be technically challenging and costly. The severity of potential impacts on human health caused by noise is only one of many factors that may be considered in making an overall noise assessment of the project. When mitigation measures are judged to be not technically or economically feasible, a detailed discussion justifying the exclusion of these measures may be helpful in addressing potential concerns with respect to residual impacts of project-related noise. In such cases, the community consultation process discussed in Section 6.4.1 may offer alternative options for limiting complaints arising from excessive noise.

6.6 SOUND LEVEL MONITORING

The periodic monitoring of sound levels at representative receptor locations can be used to verify predictions made during the EA process. This monitoring is particularly important when predicted noise levels approach the level where adverse human health effects are considered likely and mitigation measures become necessary. If the uncertainty related to predicted sound levels is large and the resulting impacts are more severe than expected, monitoring is considered particularly useful. It is also helpful to describe in the EA any commitments to evaluate the need for additional mitigation measures, if actual project-related noise levels are higher than predicted or if community reaction is stronger than expected.

If post-project monitoring is not being undertaken when predicted noise levels are close to the suggested mitigation-measure levels, Health Canada holds the view that the EA documentation should include a rationale explaining why monitoring is not considered appropriate.

7 ASSESSMENT OF CUMULATIVE EFFECTS

If the proposed project is in a region where there are other proposed or ongoing development projects that may contribute to noise levels, an assessment of cumulative effects is an important consideration. In attempting to predict sound levels from the project when contributions from other sources are possible, Health Canada suggests that these sources be included in the modelling to establish potential cumulative effects.

In selecting a baseline for a cumulative effects assessment, the pre-project baseline is the most appropriate comparison for noise-related human health impacts, as this comparison is predictive of the absolute change in the noise environment, when all project and additional noise sources are considered.

For guidance on assessing cumulative effects, consult the Canadian Environmental Assessment Agency's website for up-to-date guidance materials: **www.ceaa.gc.ca**

8 FOLLOW-UP PROGRAMS

Under CEAA 2012, a "follow-up program" means a program to:

a. Verify the accuracy of the environmental assessment of a designated project; and

b. Determine the effectiveness of any mitigation measures.

It may be appropriate to consider a follow-up program for noise if there is uncertainty about (not a comprehensive list):

- Modelling of project construction and/or operational noise; and/or
- Whether proposed mitigation measures (e.g. the use of novel technologies or materials) will be effective.

For further and up-to-date information on follow-up programs, contact the Canadian Environmental Assessment Agency, Canadian Nuclear Safety Commission or National Energy Board, as appropriate.

9 REFERENCES

American National Standards Institute (ANSI). 1995. *Criteria for Evaluating Room Noise* (ANSI S12.2-1995 (R1999)). Standards Secretariat Acoustical Society of America.

American National Standards Institute (ANSI). 2005. *Quantities and Procedures for Description and Measurement of Environmental Sound Part 4: Noise Assessment and Prediction of Long-Term Community Response* (ANSI S12.9-2005/Part 4). Standards Secretariat Acoustical Society of America.

Canadian Environmental Assessment Act. S.C. 2012, c. 19, s. 52. 2012. Available online at: **laws-lois.justice.gc.ca/PDF/C-15.21.pdf**

Canadian Transportation Agency. (2008). *Guidelines for the Resolution of Complaints Over Railway Noise and Vibration*. Available online at: **www.otc-cta.gc.ca/eng/rail-complaints**

Energy Resources Conservation Board (ERCB), Alberta. Feb. 16, 2007. Directive 038: Noise Control. Available online at: **www.aer.ca/rules-and-regulations/directives**

Note: *Effective June 17, 2013, the ERCB has been succeeded by the Alberta Energy Regulator (AER). No changes have been made to Directive 038 by the AER, and the Directive continues to contain references to the ERCB. When a new edition of the Directive is issued, the ERCB references will be revised. The Directive may also contain references to the former Energy Utilities Board (EUB), which had been realigned to the ERCB on January 1, 2008.*

Hansen C *et al.*(2006) Transit Noise and Vibration Impact Assessment. FTA-VA-90-1003-06 May: 1–274.

Health Canada 2012. It's Your Health: Noise-Induced Hearing Loss. Available online at: **www.hc-sc.gc.ca/hl-vs/alt_formats/pdf/iyh-vsv/environ/hearing_loss-perte_audition-eng.pdf**

International Organization for Standardization (ISO). 2003. *ISO 1996-1:2003 Acoustics – Description, measurement and assessment of environmental noise – Part 1: Basic quantities and assessment procedures*. **www.iso.org/iso/catalogue_detail?csnumber=28633**

International Organization for Standardization (ISO). 2007. *ISO 1996-2:2007 Acoustics – Description, measurement and assessment of environmental noise – Part 2: Determination of environmental noise levels*. **www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=41860**

Levitt, H. and Webster, J. C. 1991. Effects of Noise and Reverberation on Speech. In Harris, C.M. *Handbook of Acoustical Measurements and Noise Control, Third Edition* (Chapter 16). New York, New York: McGraw-Hill.

Michaud, D. S., Bly, S. H. P. and Keith, S. E. 2008. Using a change in percentage highly annoyed with noise as a potential health effect measure for projects under the *Canadian Environmental Assessment Act. Canadian Acoustics. 36*, 13–30.

Miedema, HM and Vos, H. (2004). Associations between self-reported sleep disturbance and environmental noise based on reanalysis of pooled data from 24 studies. Behav Sleep Med 5(1):1–20.

Radiation Emitting Devices Act. R.S.C., 1985, c. R-1. 1985. Available online at: **laws-lois.justice.gc.ca/eng/acts/R-1**

Schomer, P. D. and Averbuch, A. 1989. Indoor Human Response to Blast Sounds that Generate Noise. *Journal of the Acoustical Society of America*. 86(2), 665–671.

Schomer, P.D. and Neathammer, R. D. 1987. The Role of Helicopter Noise-Induced Vibration and Rattle in Human Response. *Journal of the Acoustical Society of America*. 81(4), 966–976.

Schomer, P .D., Sias, J. W. and Maglieri, D. 1997. A Comparative Study of Human Response, Indoors, to Blast Noise and Sonic Booms. *Noise Control Engineering Journal*. 45(4), 169–182.

United States Environmental Protection Agency (US EPA). 1974. *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety* (Report No. 550/9-74-004).

United States Federal Transit Administration. 2006. Hanson, C.E., Towers, D.A. and L.D. Meister. *Transit Noise and Vibration Impact Assessment* (Report No. FTA-VA-90-1003-06). Prepared by Harris, Miller, Miller and Hanson Inc. Burlington, Massachusetts. Available online at: **www.transit.dot.gov/regulations-and-guidance/environmental-programs/noise-and-vibration**

World Health Organization (WHO). 1999. *Guidelines for Community Noise*. Berglund, B., Lindvall, T. and Schwela, D.H (Eds.). Available online at: **www.who.int/docstore/peh/noise/guidelines2.html**

World Health Organization (WHO). 2009. *Night Noise Guidelines for Europe*. Hurtley, C. (Ed). Available online at: **www.euro.who.int/en/health-topics/environment-and-health/noise/publications/2009/night-noise-guidelines-for-europe**

World Health Organization (WHO). 2011. *Burden of disease from environmental noise. Quantification of healthy life years lost in Europe*. Theakston, F. (Ed). Available online at: **www.who.int/quantifying_ehimpacts/publications/e94888/en**

Zaharna M, Guilleminault C. Sleep, noise and health: Review. Noise Health 2010;12(47):64–9.

APPENDIX AI **GLOSSARY**

TERM	DEFINITION
Acoustics	The interdisciplinary science that deals with the study of sound, ultrasound and infrasound (all mechanical waves in gases, liquids and solids).
Ambient sensitive backup alarms	Alarms that warn workers that a vehicle is backing up. These alarms increase or decrease in volume based on background noise levels to maintain a readily noticeable tone to workers, while reducing community noise annoyance. The alarms work best on small equipment such as backhoes and trucks. Note: The Construction Safety Association of Ontario notes that alarms offer the greatest benefit when traffic is limited to only one or two vehicles. The warning effect of the alarm is greatly reduced when it becomes part of the background noise on-site.
Annoyance	A state, or adverse reaction, that may be referred to as being annoyed, disturbed, bothered, (or dissatisfied). *Noise annoyance:* A degree of annoyance measured by a subject's response to an annoyance questionnaire as part of a social survey on noise and annoyance. *High annoyance:* A degree of noise annoyance with a minimum cut-off of 71–73 on a scale of 0 to 100 (7–10 if the ISO-recommended scale of 0–10 is used) or the top two categories (very or extremely) of an adjectival scale. (ISO/TS 15666:2003[1])
Average community	A community that would yield the same reaction to noise as that obtained from social surveys on noise in a large number of communities around the world (Michaud *et al*. 2008).
Berm	An artificial ridge or embankment used to shield receptors from intruding noise.
Community	An agglomeration of residents whose reaction to noise is being measured. (For the complaint assessment method using US EPA 1974 only, see the Michaud *et al.* 2008, and US EPA 1974 references). *Very noisy urban residential community:* day-night sound level (Ldn) typical range 68–72 dBA, average 70 dBA; no qualitative characterization. *Noisy urban residential community:* Ldn typical range 63–67 dBA, average 65 dBA; qualitative characterization: near relatively busy roads or industrial areas. *Urban residential community:* Ldn typical range 58–62 dBA, average 60 dBA; qualitative characterization: not immediately adjacent to heavily travelled roads and industrial areas. *Normal suburban community:* Ldn typical range 53–57 dBA, average 55 dBA; qualitative characterization: not located near industrial activity. *Quiet suburban or rural community:* Ldn typical range 48–52 dBA, average 50 dBA; qualitative characterization: remote from large cities, industrial activity and trucking.

1 ISO (2003). ISO/TS 15666:2003 Acoustics – Assessment of noise annoyance of social and socio-acoustic surveys. **www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=28630**

TERM	DEFINITION
Decibel	A logarithmic unit of measurement that expresses the magnitude of a physical quantity (pressure, power or intensity) relative to a specified or implied reference level. Since it expresses a ratio of two quantities with the same unit, it is a dimensionless unit. The decibel is useful for acoustics and confers a number of advantages, such as the ability to conveniently represent very large or small numbers, and a logarithmic scaling that roughly corresponds to the human perception of sound. The decibel symbol is often qualified with a suffix, which indicates which reference quantity or frequency weighting function has been used. An example of this is dBA and is discussed in Appendix D.
Environmental noise	Also called community noise, refers to non-occupational noise. The main sources of community noise include road, rail and air traffic, industries, construction and public work. In the context of this document, environmental noise refers almost always, if not entirely, to the above. In a more general context, the term may also refer to neighbourhood noise and indoor sources; primarily ventilation systems, home appliances and neighbours (e.g. in apartments). (Adapted from WHO 1999.)
Equivalent continuous sound level Leq (t)	A sound level obtained from energy averaging over a specified time interval (t). This level is obtained using an integrating averaging sound level meter, which determines the mean of the square of the sound pressure over a specified time interval (t), and expresses the result in decibels. *Day-night sound level (Ldn, also referred to as DNL):* An equivalent continuous sound level taken over 24 hours, with the night-time (10 p.m. to 7 a.m.) contributions adjusted by +10 dB. (This is a type of rating level because of the night-time adjustments.) The night-time adjustment (or addition of 10 dB to the night-time period) is used to account for the expected increased annoyance due to noise-induced sleep disturbance and the increased residential population at night relative to daytime, by a factor of 2–3. US EPA 1974 suggests that in quiet areas, the night-time levels naturally drop by about 10 dB and this level of adjustment has been used with success in the U.S. *Daytime sound level (Ld):* An equivalent continuous sound level taken over 15 hours from 7 a.m. to 10 p.m. (In some jurisdictions, the start of daytime hours can be as early as 6 a.m. and the end of daytime hours can be as late as 11 p.m.) *Night-time sound level (Ln):* An equivalent continuous sound level taken over 9 hours from 10 p.m. to 7 a.m. (In some jurisdictions, the start of night can be as late as 11 p.m. As well, in some jurisdictions, the end of night can be as early as 6 a.m.) *Day-night rating level ($L_R$dn):* A day-night sound level to which an adjustment has been added. *Daytime rating level (L_Rd):* A daytime sound level to which an adjustment has been added. *Night-time rating level (L_Rn):* A night-time sound level to which an adjustment has been added. *LAeq (t):* An A-weighted equivalent continuous sound level in the denoted time interval. *LAeq (24):* An A-weighted equivalent continuous sound level for a specified 24-hour time interval. *LAeq (1):* An A-weighted equivalent continuous sound level for a specified 1-hour time interval.

TERM	DEFINITION
Frequency weighting	A relative value applied to the spectrum of a sound in each defined frequency interval. *A-weighting (dBA):* A weighting of the frequencies in a sound that approximates the response of the human ear to frequencies in moderately loud sounds (sound pressure levels in the range of 45-65 dBA). *C-weighting (dBC):* A weighting of the frequencies in a sound that approximates the response of the human ear to frequencies in very loud sounds. It emphasizes the low frequencies of a sound much more than the A-weighting. *G-weighting (dBG):* A frequency weighting used for infrasound measurements. It is defined in ISO 7196 as 0 dB at 10 Hz. Between 1 and 20 Hz (the highest weighted frequency), the weighting approximates a straight line with a slope of 12 dB/octave. *Z-weighting (dBZ):* A frequency weighting defined in International Electrotechnical Commission (IEC) 61672-1:2002 with 0 dB weighting from 10 Hz to 20 kHz, within tolerances defined in the standard.
Infrasound	Like **Sound** but with frequency content below 20 Hz.
Maximum A-weighted sound level (LAmax)	The maximum value of the sound pressure level during a noise event, measured with a sound level meter using a Fast Time Weighting. This level can be applied to pass-by noise from transportation noise sources and impulsive noise events.

TERM	DEFINITION
Noise	Unwanted sound. *Low-frequency noise:* Noise with frequency content in the range of 20-200 Hz. Where it produces a 16, 31.5 or 63 Hz octave band sound-pressure level of more than 65, 65 or 70 dBZ, respectively, low frequency noise can be associated with the introduction of noticeable vibrations and rattles in some structures (e.g. as from a nearby idling locomotive). *Tonal noise:* Noise containing prominent (audible) tones such as backup alarms on trucks. Here "tones" refers to tonal sound, defined in ISO 19961:2003 as sound characterized by a single frequency component or narrow-band components that emerge audibly, **at the receptor position**, from the total sound. If the audibility is in dispute, ISO 1996-2:2007 contains a (rather complex) method for analyzing a spectrum to determine audible tonality. *High-energy impulsive noise:* Impulsive noise from any high-energy impulsive sound source, including any explosive source in which the equivalent mass of TNT (trinitrotoluene) exceeds 50 g, or sources with comparable characteristics and degrees of intrusiveness. Internationally agreed upon examples are listed in ISO 1996-1:2003 and include sonic booms, blasting, quarry and mining explosions, demolition or industrial processes that use high explosives, explosive industrial circuit breakers and military ordnance (e.g. armour, artillery, mortar fire, bombs, and the explosive ignition of rockets and missiles). *Highly impulsive noise:* Impulsive noise from any noise source with highly impulsive characteristics and a high degree of intrusiveness. Internationally agreed upon examples of sources are listed in ISO 1996-1:2003 and include impact pile driving, small arms firing, hammering on metal or wood, nail guns, drop-hammering, drop forging, punch pressing, pneumatic hammering, pavement breaking, or metal impacts in rail-yard shunting operations. *Regular impulsive noise:* Impulsive noise from sources that are neither highly impulsive nor high-energy impulsive. Internationally agreed upon examples of these sources are listed in ISO 1996-1:2003 and include slamming car doors and truck tailgates.
Normalized Ldn	A calculated day-night sound level that is used to determine the potential for widespread complaints. The normalized Ldn is obtained from the measured value and the addition of various corrections in dB (US EPA 1974).
Octave band	A section (band) of a sound spectrum where the ratio of the maximum to minimum frequency in the band is 2. Nominal centre frequencies (in Hz) of noise octave bands have been standardized as 16, 31.5, 63, 125, 250, 500, 1000, 2000, 4000, 8000, and 16000.
Sentence intelligibility	The ability to recognize key words in a sentence using full concentration in a laboratory setting. Due to redundancy in normal conversation, all words in the sentence may not have been understood.
Signal workers or Signallers	People who signal to a vehicle operator to ensure his or her awareness of other people. Signallers also warn workers that vehicles are backing up.

TERM	DEFINITION
Sleep disturbance	Any of: (i) interfering with falling asleep, (ii) shortening sleep stage duration, (iii) lessening perceived quality of sleep, (iv) awakening people from sleep, or (v) increasing body movements (motility) during sleep. *Awakenings:* A transient or indeterminate end of sleep. Awakenings can be measured: (i) behaviourally, by a subject pushing a button upon finding that they are aware of awakening, (ii) when a certain threshold of body movement (motility threshold) is exceeded from a previous low level of body movement (sleep), and (iii) by an objectively defined change in brain wave pattern measured by an electroencephalograph (EEG) (Michaud *et al.* 2008). *Percent awakenings due to noise:* Awakenings attributed to noise events divided by the total number of awakenings multiplied by 100 (normally the totals are taken for all subjects in the study). *Sleep stage:* a stage of sleep with a well-defined brain wave pattern measured with an EEG. There are 5 stages of sleep. Sleep stage is also related to muscle activity and eye movements.
Sound exposure level (SEL)	The 1-second equivalent continuous sound level that would be measured if the total energy in a noise event occurred during that one second. This level can be applied to pass-bys of transportation noise sources and impulsive noise events. Note: The equivalent continuous sound level for an extended time period that contains a number of noise events can be obtained by energy averaging the SEL values over the time period.
Time weighting	*Fast weighting:* A time constant of 0.125 second in a sound-level meter used to smooth the square of the measured sound pressure prior to the expression of the sound pressure level in decibels. *Slow weighting:* A time constant of 1 second used to smooth the square of the measured sound pressure prior to the expression of the sound pressure level in decibels.
Transmission loss	In environmental noise, the ratio of the sound energy striking a wall (e.g. the outside of a residence) relative to the transmitted sound energy (e.g. into a living room or bedroom), expressed in decibels.
Vibratory pile driving or boring	A pile driving system that does not rely on an impact hammer but on a rapidly vibrating hammer that transfers its vibrational energy to the pile to drive it in.
Wind screen	A screen, commonly a porous sphere or an egg-shaped structure of open cell foam, to protect a microphone's protective grid from turbulence produced by the passage of wind. For a given wind speed, the lower the frequency of noise to be reduced, the larger the windscreen that is needed.

APPENDIX B1 **NOISE IMPACTS IN EA CHECKLIST**

This checklist is beneficial in verifying that the main components of a noise impact assessment are completed. It is useful to include this checklist as an index in an environmental assessment (EA) to identify the locations of the key components of a noise impact assessment, especially if the information is found in multiple sections of the EA documentation.

OVERALL (THROUGHOUT THE EA)				
✓	***Item***			
	1. In addition to the construction phase, are all other project phases, including operation, decommissioning and abandonment, included in the EA?			
	2. When modelling techniques are used to estimate present (baseline) or future (construction and operational) sound levels, are these techniques and any assumptions documented and appropriately justified?			
	3. Is information provided that describes any tonal, regularly impulsive, highly impulsive or high-energy impulsive noise that is audible at receptors during the construction, operation and decommissioning project phases?			
	4. Does the EA avoid statements relating to the perceptibility or whether changes in noise are noticeable based solely on decibel levels?			
RECEPTOR IDENTIFICATION AND CHARACTERIZATION				
✓	***Item***			***Section in EA***
	5. Are all currently impacted receptors (including Indigenous Peoples) and potential reasonably foreseeable future receptors, clearly identified?			
	6. Is information on all noise-sensitive receptors in the area (including any foreseeable future receptors) and on distances of receptors from the project, included?			
	7. Are maps identifying receptor locations relative to the project site, including noise contour diagrams, provided?			
	8. Is justification provided for any excluded receptors (if applicable)?			
	9. Are receptors identified in "quiet rural areas" assigned a +10 dB adjustment (if applicable)?			
	10. Is a description provided of any community consultation that may have occurred concerning noise impacts, including any human health concerns expressed by potential receptors?			
IMPACTS ASSOCIATED WITH NOISE				
✓	***Item***			***Section in EA***
	11. Does the outdoor annual average for night-time (Ln) exceed 40 dBA?	☐ No	☐ Yes	
	12. Do indoor night-time sound levels (or sound levels when nearby receptors are expected to be sleeping) exceed 30 dBA Leq from continuous noise sources at any representative receptors?	☐ No	☐ Yes	
	13. Are more than 10–15 night-time individual noise events above 45 dBA LAmax indoors predicted at any representative receptor?	☐ No	☐ Yes	
	14. Is an evaluation of the severity of residual impacts (post-mitigation) on sleep disturbance included?			
	15. Is any interference with daytime speech comprehension (indoor sound levels greater than or equal to 40 dBA or outdoor sound levels greater than 55 dBA) predicted?	☐ No	☐ Yes	
	16. Is an evaluation of the severity of residual impacts (post-mitigation) on speech comprehension provided in the EA?			

ASSESSMENT OF BASELINE NOISE LEVELS		
✓	***Item***	***Section in EA***
	17. Are measured or valid estimates of baseline noise levels provided, including any uncertainties for both daytime (Ld) and night-time (Ln) at receptors?	
	18. When measured baseline noise levels are provided, are the hours during which the measurements were obtained and the exact locations of the measurements provided?	
	19. Is a rationale provided explaining why the baseline is considered representative, including the days, weather conditions and any seasonal variations when monitoring occurred?	
	20. Are all noise sources that contribute to the baseline identified (see Appendix E including a description of the specific noise character(s), and appropriate adjustments made?	
	21. When baseline noise is estimated, are the estimation method and a rationale for using this method provided?	
	22. Is a calculation of baseline percent highly annoyed (%HA) at receptors provided?	
ASSESSMENT OF CONSTRUCTION NOISE LEVELS		
✓	***Item***	***Section in EA***
	23. Are valid estimates (predictions) of construction noise levels provided for both daytime (Ld) and night-time (Ln) at receptors, including any uncertainties?	
	24. Are the duration of construction activities impacting each receptor and the method of noise assessment (based on the construction duration) provided?	
	25. Are construction noise-related impacts and a noise management plan (if applicable) included?	
	26. Are construction noise levels estimated or modelled for each receptor, and are appropriate adjustments identified? (See Appendix E)	
	27. When construction noise levels are expected to approach a suggested mitigation noise level (MNL), are mitigation measures and a noise management plan provided?	
	28. If an assessment of construction noise impacts is not conducted because the noise levels are predicted to be below the level for widespread complaints at all receptors, is a rationale provided?	
	29. When construction noise is expected to last longer than 1 year at any given receptor, is an evaluation of the change in %HA (from baseline) at these receptors provided? Are all applicable adjustments identified in estimating %HA?	
MITIGATION MEASURES		
✓	***Item***	***Section in EA***
	30. Are predicted future (operation) daytime (Ld) and night-time (Ln) sound levels provided for all receptors, using the same parameters that were used to establish the baseline (e.g. units and averaging times)? Are appropriate adjustments identified? (See Appendix E)	
	31. Is an evaluation of the change in %HA (from baseline) at each receptor provided for operational noise?	
	32. Are the results and conclusions of the operational noise assessment clearly documented?	

SSS				
✓	***Item***			***Section in EA***
	33. If applicable, is a discussion of whether mitigation measures or follow-up monitoring are warranted included?			
	34. When noise is expected to approach suggested mitigation levels either during project construction or operations, is a discussion of planned or conditional mitigation measures included?			
	35. Is a residual impacts assessment discussing noise impacts following mitigation included?			
	36. When low-frequency noise is emitted, is information describing impacts of any anticipated effects (e.g. rattling) and related mitigation measures included?			
	37. After all of the noise mitigation measures are applied, does the calculated change in %HA (from baseline) at any of the representative receptors exceed 6.5%?	☐ No	☐ Yes	
	38. Is information provided on how the noise-related complaints will be addressed, including a description of a complaint resolution process?			
ASSESSMENT OF CUMULATIVE EFFECTS				
✓	***Item***			***Section in EA***
	39. When other ongoing or reasonably foreseeable future projects in the region may contribute to noise levels, is a cumulative effects assessment included?			

APPENDIX C| **NOISE CHARACTERISTICS**

C.1 TONAL AND IMPULSIVE NOISE

Tonal (e.g. backup alarms on trucks) and impulsive noise (e.g. hammering on metal) are often perceived as annoying and may have a high potential to disturb receptors (US EPA 1974, ISO 1996-1:2003, ANSI 2005, WHO 1999). Therefore, providing information on tonal, regular impulsive, highly impulsive or high-energy impulsive project noise that is audible at receptors is suggested. This characterization of noise is also important in selecting the appropriate corrections and adjustments in the calculation of noise impacts for construction and operational noise.

As described in ISO 1996-1:2003, regular impulsive noise is sometimes characterized as intrusive but not as intrusive as highly impulsive noise. Examples of regular impulsive noise include the slamming of car doors, outdoor ball games, such as football, soccer or basketball, and church bells. Very fast pass-bys of low-flying military aircraft may also fall under this category.

Impulsive noise sources that have a high degree of intrusiveness may be characterized as either highly impulsive (defined in ISO 1996-1:2003) or high-energy impulsive, as described in ISO 1996-1:2003. For details on these noise types, see Appendix A.

ISO 1996-1:2003 recommends making a +5 dB adjustment to tonal and regular impulsive noise sources and a +12 dB adjustment to highly impulsive noise sources. The expected contribution of project noise and details on how tonality and impulsiveness were accounted for are important elements of the noise assessment. See Appendix F for more information.

C.2 LOW-FREQUENCY NOISE

Noise occurring at frequencies below 100 to 200 Hertz (Hz) is generally defined as low-frequency noise. Low-frequency noise is commonly not well perceived by the human ear but may induce vibrations in buildings that may be perceptible or cause a “rattle” in these environments. Research indicates that annoyance related to noise is greater when low-frequency noise is present (ISO 1996-1:2003) and one of the main reasons is the annoyance caused by rattles (Schomer and Neathammer 1987; Schomer and Averbuch 1989). As sound environments are usually characterized using A-weighted decibel levels (dBA) that reflect the frequencies most audible to the human ear, the impacts of low-frequency noise may need to be assessed separately.

Guidance for low-frequency sound (or infrasound) in the 16-63 Hz octave bands stems from the ANSI standard on environmental sound regarding noise assessment and the related prediction of long-term community response (ANSI 2005). Where standards or acceptable procedures for the measurement of these frequencies exist, it is suggested that the EA include a description of the potential impacts and any mitigation measures concerning the effects of these frequencies.

The ANSI standard concerns essentially continuous sounds with strong low-frequency content. To prevent rattles from low-frequency noise and the associated annoyance from this effect, ANSI indicates that the (energy) sum of the sound levels in the 16-, 31.5- and 63-Hz octave bands be less than 70 dBZ. If this 70-dBZ "rattle criterion" is exceeded, Health Canada may suggest the implementation of feasible mitigation measures. ANSI 2005 indicates that there is evidence that noise-induced rattles are very annoying, and this annoyance may be independent of the number or duration of events.

Additionally, ANSI 2005 provides a more sophisticated mathematical procedure for assessing %HA when low-frequency noise is present. Health Canada prefers using this procedure when the C-weighted Ldn exceeds the A-weighted Ldn by more than 10 dB. This is further outlined in Appendix D of ANSI 2005.

C.3 PERCEPTIBILITY

The typical threshold for an increase in sound level that is considered to be "barely perceptible" by the human ear in a controlled laboratory setting varies from 1 to 5 dBA, depending on the sound pressure level and frequency of the sound. In community noise applications, a 5-dBA reduction in highway noise by a barrier is accepted as the minimum that will be clearly noticeable. These findings cannot be broadly generalized in the context of assessing community noise impacts.

Changes to the characteristics of the sound from baseline (e.g. a change in frequency, changes in sound modulation, increased impulsiveness, or a shift in noise from the daytime to being more at night) may be perceived and may cause noise to be more noticeable, even if the absolute equivalent continuous sound level (in dBA) is not substantially increased. Consult ANSI S12.9-2005/Part 4, clause A.1.3 for further information.

It is important to consider that people respond to sound characteristics that do not necessarily appreciably increase the sound level. Therefore, in the context of an EA, it is suggested that statements relating to perceptibility or whether changes in noise are noticeable based solely on decibel levels be avoided, as these statements may be misleading.

APPENDIX DI **INTRODUCTION TO NOISE**

SOUND AND NOISE

Sound is defined as mechanical vibrations travelling through the air or other media.

Noise is most simply defined as unwanted sound.

Sound is measured using a calibrated microphone to determine the rapid cyclical changes in pressure (force per unit area) of the sound wave from the normal atmospheric pressure of about 101,000 pascals (Pa). As the human ear is sensitive to sound waves over a very wide range of maximum changes in sound pressure, for convenience, this range is compressed by using a logarithmic scale, and the resulting sound unit used is called a "decibel" (dB). A logarithmic scale is non-linear; as one moves up the scale, the same change in decibels represents a larger and larger increase in sound pressure. This means that decibels cannot be added or averaged in the same way as other linear measurements such as distance or weight.

D.1 SOUND PERCEPTION

Perception of sound is not related to sound level in decibels in a linear manner. For example, a 10-dB increase is the median change in sound level at 1 kHz, which is perceived as being twice as loud. A typically cited threshold for an increase in sound level that is often stated as being "barely perceptible" by the human ear varies from 3 to 5 dB (see Appendix B). This threshold is often used in EAs, which may state that residual sound increases lower than this threshold will not be perceptible; however, a difficulty with this approach is that humans also perceive and respond to changes in sound characteristics other than loudness. Examples of these characteristics include frequency, sound modulation, impulsiveness and tonality, which are described in Appendix A.

D.2 WEIGHTING

People do not perceive all sound frequencies equally, and as such, decibel levels are modified (weighted) according to the frequencies present in the sound. The modified levels are termed "A-weighted" and are reported as dBA rather than dB. The A-weighting reduces the contribution from low and high frequencies to capture the mid-frequency range to which the average human ear is most sensitive. Note that low-frequency noise is de-emphasized by A-weighting as its impacts are not perceived as well by the human ear. However, these low frequencies are factors that can induce rattles and vibrations that can be heard and felt. There are other ways to weight decibels, such as C-, G- and Z-weighting. C-weighting is applicable in the EA context to assess the %HA from exposure to frequent blasting (a high-energy impulsive noise) or, potentially, other project noise sources in which low-frequency noise dominates.

D.3 ADDING DECIBELS

Sounds often need to be added together to determine sound (or adjusted sound) levels (expressed in decibels) for use in EAs. The known/measured/predicted values characterizing the sound are also normally expressed as sound levels in decibels. To add sounds, the starting sound levels Li are changed to mean square sound pressures, $10^{0.1Li}$ which are added, and then the sum is changed back to decibels. Some rapid estimations are particularly useful, e.g. if sounds with 2 equal sound levels are added, the final value will be very nearly 3 dB greater than the starting values.

D.4 AVERAGING DECIBELS

In calculating an average sound level over a certain time period, the measured sound pressure at each time is squared and then averaged over time (mean square sound pressure). The mean square sound pressure is then converted to decibels. Occasional loud sound events (e.g. a bird landing on a microphone) may inappropriately influence an average. Events unrelated to the assessment are, after being identified, commonly excluded from the calculation of average sound pressure level.

D.5 MEASUREMENTS ASSOCIATED WITH SOUND LEVELS REPORTED IN EAS

In the context of noise impact assessment, sound levels are typically reported in average decibel level over a defined time period. In some cases, a specific time weighting is also applied to the average, most commonly as a penalty for night-time sound levels before averaging, to account for the additional potential for disturbance during these hours. The measurement used to describe the sound level indicates the duration and time of day of the sound, and whether any weighting was applied. The following describes the **A-weighted metrics** most commonly presented in EAs:

Ldn (also termed DNL): indicates that the sound was averaged over 24 hours with 10 dBA added to night-time sound levels. The standard night-time hours for this measurement are 10:00 p.m. to 7:00 a.m. Tables 6.2 and 6.3 show Ldn used in the calculation of suggested Mitigation Noise Levels for construction noise exposure less than 1 year.

Ld: average daytime level (standard hours 7 a.m. to 10 p.m. although this varies between 6 a.m. and 11 p.m. in some jurisdictions, such as Ontario).

Ln: average night-time level (10:00 p.m. to 7:00 a.m.).

Leq (24): indicates that the sound was averaged over 24 hours without any adjustment applied.

Leq (1): indicates that the sound was averaged over 1 hour.

Leq (1 hour max): indicates that the average sound level of the worst hour (as measured by a provincial inspector) in a 24-hour period is being reported.

APPENDIX EI **SOUND SOURCES AND SOUND CHARACTER**

Appendix F Determination of Percent Highly Annoyed (%HA), lists equations that show how to obtain %HA values from daytime and night-time rating levels. The rating levels can be estimated from the application of adjustments to the applicable daytime (Ld) and night-time (Ln) sound levels for the noise environments with and without the project. The Ld and Ln are obtained by an appropriate combination of predictions and measurements.

The values of the daytime rating levels $L_R d_i$ and the night-time rating levels $L_R n_i$ for any applicable noise source are obtained by applying adjustments to the sound levels that are energy-averaged to obtain Ld and Ln for the given (i-th) noise source. Adjustments may pertain to a particular type of source or to a particular character of the noise from a source or to the receiver characteristics.

When adjustments to project or baseline noise are necessary, Health Canada prefers that adjustments be made by following ISO 1996-1:2003. Details of how to apply adjustments are given in Section 6 of ISO 1996-1:2003, in particular for situations where noise sources of specific character are audible and either distinguishable from noise from other sources, or indistinguishable from noise from other sources. Furthermore, this section of the ISO standard indicates how to determine the rating level from combined sources.

With respect to receptor characteristics, an adjustment is made for a "quiet rural area," where a noise receptor (or group of receptors) has a greater expectation for and value placed on "peace and quiet". ISO notes that a +10 dB adjustment should be applied in this situation. In the absence of further information, Health Canada will assume that receptors with a LAeq (7 a.m.–10 p.m.) of 45 dBA or less and a LAeq (10 p.m.–7 a.m.) of 35 dBA or less are in a quiet rural area, and warrant a +10 dB adjustment in the calculation of the change in %HA.

For **air traffic** sources of noise, Health Canada prefers that a +5 dB adjustment be applied.

For **rail traffic**, Health Canada prefers that either a -5 dB (note this is a negative adjustment) or 0 dB adjustment be applied, as applicable. The -5 dB rail traffic adjustment is not applicable to long diesel trains, or to trains operating at speeds in excess of 250 km/hr. These specific adjustments fall within the ranges given in ISO 1996-1:2003.

Road traffic noise and industrial-type noise (including construction noise for the purposes of this guidance) have a 0 dB adjustment, as specified in the ISO standard. The 0 dB adjustment for industry/construction noise applies to only two types of sound levels: (i) from noise sources which are not audibly tonal at the receptor and (ii) from non-impulsive sources.

Certain **other noise sources**, as per ISO 1996-1:2003, are considered regular impulsive (+5 dB adjustment), highly impulsive (+12 dB adjustment) or high energy impulsive. (The rating level is based on the C-weighted sound level and can be obtained from Appendix B of ISO 1996-1:2003.) Tonal sound is also addressed in the ISO standard. Health Canada prefers that a +5 dB adjustment be applied to noise which is audibly tonal at the receptor. This value falls within the range specified in the standard.

As per ISO 1996-1:2003, if more than one adjustment applies for the source type or character of a given **single sound source**, only the largest adjustment is applied. However, time period adjustments are always added to the otherwise adjusted levels. Also, the adjustment for receiver characteristics in a quiet rural area is added to any other adjustments.

ISO 1996-1:2003 also explicitly states that adjustments for tonal character should only be applied when the "sound is audibly tonal at the receiver location". The standard also indicates that adjustments for impulsive source character should only be applied to "impulsive sound sources that are audible at the receiver location." The subtle distinction made in ISO 1996-1:2003 between audibly tonal versus audible sources may only be relevant in consideration of high energy impulsive noise. At long distances, high energy impulsive artillery fire can change from an impulse to a rumble without substantially affecting the magnitude of the required adjustment. For more common sources, a source is still impulsive even if it loses the high frequencies at long distances (e.g. ISO 1996-1:2003 identifies the predominantly low-frequency car door slam as regular impulsive).

E.1 EXAMPLES

Aircraft noise: Although an aircraft can create prominent tones during aircraft noise events, which would normally get a +5 dB adjustment, the adjustment for the air traffic type is also +5 dB. Therefore all the air traffic noise receives a +5 dB adjustment.

Shunting of rail cars: The **sound sources** which are identified as highly impulsive in ISO 1996-1:2003 are the "metal impacts in rail-yard shunting operations." Thus, only the sound level during the time that the metal impacts are audible should receive the +12 dB adjustment; not the rest of the noise associated with the shunting activity. The noise due to the engine and motion of the rail cars during shunting is separate from the impact noise and is thus a separate component with a 0 dB adjustment.

Rail wheel squeal: There are times at the receptor when the noise from the train is audibly tonal, due to wheel squeal, and the +5 dB adjustment applies. However, for that portion of time where the sound is no longer audibly tonal at the receptor, the noise from the train receives either 0 or -5 dB adjustment for source type.

APPENDIX F1 DETERMINATION OF PERCENT HIGHLY ANNOYED (%HA)

INTRODUCTION

Appendix F presents the methodology and equations for calculating (the change in) percent highly annoyed (%HA): using Ld and Ln to calculate rating levels L_Rd and L_Rn; and using rating levels in the equations below to determine %HA. These calculations are applicable to projects where the construction phase ≥ 1 year's duration, and for projects in the operational phase.

Note: Rating levels are an intermediate step in the calculations of %HA, but are generally not reported in an EA. Health Canada prefers the reporting of various details about Ld, Ln and the adjustments applied.

Refer to Section 5.4 for a discussion about complaints and %HA, and consult Appendix A for definitions.

CALCULATION OF BASELINE, CONSTRUCTION ≥ 1 YEAR DURATION, AND OPERATION DAYTIME (7 A.M.–10 P.M.) AND NIGHT-TIME (10 P.M.–7 A.M.) RATING LEVELS

Energy summation of applicable daytime rating levels will result in a daytime rating level which can be used to calculate %HA.

Daytime rating level

$$(L_R d) = 10 \log_{10} [\sum_i 10^{(0.1 L_R d_i)}] \qquad \text{(F1)}$$

For a quiet rural area, the daytime rating level

$$(L_R d) = 10 + 10 \log_{10} [\sum_i 10^{(0.1 L_R d_i)}] \qquad (F1_{\text{quiet rural area}})$$

Where $L_R d_i$ = any applicable daytime rating level and a quiet rural area is considered an area where a noise receptor (or group of receptors) has a greater expectation for and value placed on "peace and quiet". In the absence of further information, Health Canada will assume that receptors with a LAeq[2] (7 a.m.–10 p.m.) of 45 dBA or less and a LAeq (10 p.m.–7 a.m.) of 35 dBA or less are in a quiet rural area and warrant a +10 dB adjustment.

The same calculation (using Equations F1 or $F1_{\text{quiet rural area}}$) is also applicable to determine the night-time rating level (L_Rn) needed to calculate %HA.

2 LAeq is an A-weighted equivalent of continuous sound level in the denoted time period.

CALCULATION OF %HA

The rating level used to calculate %HA is the day-night rating level ($L_R$dn). In general, to calculate the relevant change in %HA values due to the project noise, $L_R$dn values are needed for baseline, construction ≥ 1 year, and operation. The energy summation of baseline and construction $L_R$dn values ($L_R dn_{(\text{baseline and construction})}$) is needed for the construction phase. The energy summation of baseline and operation $L_R$dn values ($L_R dn_{(\text{baseline and operation})}$) is needed for the operation phase. $L_R$dn is a 24-hour energy averaged rating level in which the contribution from the night-time rating level is artificially increased by 10 dB and is calculated using Equation E2.

$$L_R dn = 10 \log_{10} [((15 \times 10^{(0.1 \times L_R d)}) + (9 \times 10^{(0.1 \times (L_R n + 10))}) / 24] \quad \text{(F2)}$$

$$L_R dn_{(\text{baseline and construction})} = 10 \log_{10} (10^{(0.1 \times \text{construction } L_R dn)} + 10^{(0.1 \times \text{baseline } L_R dn)}) \quad \text{(F3a)}$$

$$L_R dn_{(\text{baseline and operation})} = 10 \log_{10} (10^{(0.1 \times \text{operation } L_R dn)} + 10^{(0.1 \times \text{baseline } L_R dn)}) \quad \text{(F3b)}$$

The %HA is calculated using Equation F4:

$$\%HA = 100 / [1 + e^{(10.4 - 0.132^* L_R dn)}] \quad \text{(F4)}$$

The %HA (baseline), %HA (baseline and construction), %HA (construction), %HA (baseline and operation) and %HA (operation) can be obtained by substituting the appropriate $L_R$dn into Equation F4.

The **change in %HA for project construction** is calculated by subtracting %HA (baseline) from %HA (baseline and construction).

The **change in %HA for project operation** is calculated by subtracting %HA (baseline) from %HA (baseline and operation).

Table F.1 is a worked example showing the project noise levels (i.e. construction phase [≥ 1 year] or during the operational phase) that would result in a change of 6.5%HA from the baseline to project scenario. Use this table as a reference to check calculations carried out for a specific project. This table presents rating levels, but note that rating levels are not commonly reported in an EA as they are an intermediate step in calculating %HA (see above).

The table ranges from a baseline of 20 dB (i.e. quiet rural area) up to a project level of 75 dB.

Table F.1: Worked example showing baseline and project rating levels associated with a 6.5% increase in %HA due to a project's noise.

			Change in %HA between baseline and project equals 6.5%	
$L_R$dn baseline (dB)	$L_R$dn project (dB)	total $L_R$dn (dB)	%HA baseline (%)	%HA project (%)
< 20	58.6	58.6	0.0	6.5
35	58.9	59.0	0.3	6.8
42	59.4	59.5	0.8	7.3
46	59.9	60.1	1.3	7.8
48	60.2	60.5	1.7	8.2
50	60.6	61.0	2.2	8.7
52	61.1	61.6	2.8	9.3
53	61.3	61.9	3.2	9.7
55	61.9	62.7	4.1	10.6
56	62.2	63.1	4.7	11.2
57	62.5	63.6	5.3	11.8
58	62.8	64.1	6.0	12.5
59	63.2	64.6	6.8	13.3
60	63.6	65.2	7.7	14.2
61	64.0	65.8	8.7	15.2
62	64.5	66.4	9.8	16.3
63	64.9	67.1	11.1	17.6
64	65.4	67.8	12.4	18.9
65	65.9	68.5	13.9	20.4
66	66.5	69.2	15.6	22.1
67	67.0	70.0	17.4	23.9
68	67.6	70.8	19.4	25.9
69	68.3	71.7	21.6	28.1
70	68.9	72.5	23.9	30.4
71	69.6	73.4	26.3	32.8
72	70.3	74.3	29.0	35.5
73	71.1	75.2	31.8	38.3
74	71.9	76.1	34.7	41.2
75	72.8	77.0	37.8	44.3
76	73.7	78.0	40.9	47.4
77	74.6	79.0	44.1	50.6

APPENDIX GI IDENTIFICATION AND CHARACTERIZATION OF SOME COMMON RECEPTOR LOCATIONS

RECEPTOR LOCATION	CHARACTERIZATION	COMMENTS/ CONSIDERATIONS
Commercial premises	Retail stores, offices, research facilities and laboratories	Noise effects during business hours
Daycare centres	Highly sensitive receptors (children)	Noise effects considered during occupied periods
Entertainment establishments	Film and television studios, theatres, restaurants, etc.	Noise effects during periods of operation
Hospitals	Highly sensitive receptors (sick people)	Noise effects over a 24-hour period
Industrial premises	Factories and other industrial plants	Potential for additive noise in cumulative effects assessment
Places of worship and cemeteries	Churches, mosques, synagogues, temples, locations where Indigenous Peoples' cultural or religious ceremonies occur, etc.	Noise effects during religious services, meetings or processions
Recreation areas: *Active*	Parks and sports grounds	Noise effects considered during occupied periods
Recreation areas: *Passive*	Outdoor grounds used for hunting, fishing, teaching, etc.; includes locations where Indigenous Peoples may hunt, fish or gather country foods	Noise effects considered during activity periods
Residences: *Permanent*	Urban, suburban and rural locations containing houses, mobile homes and/or multilevel dwellings	Noise effects over a 24-hour period with particular emphasis on night-time noise levels
Residences: *Seasonal*	Cottages, campgrounds and RV parks; includes Indigenous hunting and fishing cabins, and seasonal camping places	Noise effects considered during occupied periods
Schools	Education facilities from pre-school to universities; highly sensitive receptors	Noise effects during regular hours of operation, which may include evenings and the possibility of schools being used during summer
Seniors' residences	Highly sensitive receptors (elderly)	Consideration of noise effects over a 24-hour period with particular emphasis on night-time noise levels
Workers' living quarters[3]	Locations may be on or off the project site	Mitigation measures in the design of temporary living quarters for workers to limit noise

3 Occupational exposure and health issues are typically under provincial or territorial jurisdiction, and Health Canada does not review this information in the context of EAs.

APPENDIX HI COMMONLY APPLIED CONSTRUCTION NOISE MITIGATION MEASURES AND CONSIDERATIONS FOR NOISE REDUCTION

The measures below have been adapted from the New South Wales Interim Construction Noise Guideline (July 2009), Department of Environment and Climate Change, New South Wales, Australia. Available at: **www.epa.nsw.gov.au/noise/constructnoise.htm**

GENERAL MITIGATION MEASURES

- Regularly train workers and contractors to use equipment in ways that minimize noise.
- Ensure that site managers periodically check the site, nearby residences and other sensitive receptors for noise problems so that solutions can be quickly applied.
- Include in tenders, employment contracts, subcontractor agreements and work method statements, clauses that assure the minimization of noise and compliance with directions from management to minimize noise.
- Avoid the use of radios and stereos outdoors and the overuse of public address systems where neighbours can be affected.
- Avoid shouting, and minimize talking loudly and slamming vehicle doors.
- Keep truck drivers informed of designated vehicle routes, parking locations, acceptable delivery hours and other relevant practices (e.g. minimizing the use of engine brakes and periods of engine idling).

NIGHT-TIME MITIGATION MEASURES

- Avoid the use of equipment that generates impulsive noise.
- Minimize the need for reversing alarms.
- Avoid dropping materials from a height.
- Avoid metal-to-metal contact on equipment.
- If possible, schedule truck movements to avoid residential streets.
- Avoid clustering of equipment near residences and other sensitive receptors.
- Ensure that periods of respite are provided in the case of unavoidable maximum noise level events.

CONSULTATION AND NOTIFICATION

- The community is more likely to be understanding and accepting of project noise if related information is provided and is frank, and does not attempt to understate the likely noise level, and if commitments are respected.

NOTIFICATION BEFORE AND DURING CONSTRUCTION

- Provide advance notification to people concerning construction duration, defining activities that are expected to be noisy and their expected duration, what noise mitigation measures are being applied, and when noise respite periods will occur.
- For night-time work, receptors may be informed in two stages: two weeks prior to construction and then two days before commencement.
- Provide information to neighbours before and during construction through media such as letterbox drops, meetings or individual consultation. In some areas, the need to provide notification in languages other than English may be considered. A website may also be established for the project.
- Use a site information board at the front of the site with contact details, hours of operation and regular information updates.
- Facilitate contact with people to ensure that everyone can see that the site manager understands potential issues, that a planned approach is in place, and that there is an ongoing commitment to minimize noise.

WORK SITE AND EQUIPMENT

- In terms of both cost and results, controlling noise at the source is one of the most effective methods of minimizing the noise impacts from any construction activities.

QUIETER METHODS

- Examine and implement, where feasible and reasonable, alternatives to rock-breaking work methods, such as hydraulic splitters for rock and concrete, hydraulic jaw crushers, chemical rock and concrete splitting, and controlled blasting, such as penetrating cone fracture.
- Consider alternatives to diesel and gasoline engines and pneumatic units, such as hydraulic or electric-controlled units, where feasible and reasonable. When there is no electricity supply, consider using an electrical generator located away from residences.
- Examine and implement, where feasible and reasonable, alternatives to transporting excavated material from underground tunnelling off-site at night-time. (e.g. stockpile material in an acoustically treated shed during the night and load out the following day).

QUIETER EQUIPMENT

- Examine different types of machines that perform the same function and compare the noise level data to select the least noisy machine (e.g. rubber-wheeled tractors can be less noisy than steel-tracked tractors).
- Pneumatic equipment is traditionally a problem. Consider selecting super-silenced compressors, silenced jackhammers and damped bits, where possible.
- When renting (or purchasing) equipment, select quieter pieces of machinery and construction equipment, where feasible and reasonable. As well, select the most effective mufflers, enclosures and low-noise tool bits and blades. Always seek the manufacturer's advice before making modifications to any equipment to reduce noise.
- Reduce throttle settings and turn off equipment when it is not being used.
- Examine and consider implementing, where feasible and reasonable, the option of reducing noise from metal chutes and bins by placing damping material in the bin.

EQUIPMENT MAINTENANCE

- Regularly inspect and maintain equipment to ensure that it is in good working order, including the condition of mufflers.
- For machines with enclosures, verify that doors and door seals are in good working order and that the doors close properly against the seals.
- Return any leased equipment that is causing noise that is not typical for the equipment. The increased noise may indicate the need for repair.
- Ensure that air lines on pneumatic equipment do not leak.

SITE MITIGATION MEASURES

- Barriers and acoustic sheds are most suited to long-term fixed works, as in these cases, the associated cost is typically outweighed by the overall time savings.

WORK SITE LOCATION

- Place as much distance as possible between the machinery or equipment, and residences and other sensitive receptors.
- Restrict areas in which mobile equipment can operate, so that they are away from residences and other sensitive receptors at particular times.
- Locate site vehicle entrances away from residences and other sensitive receptors.
- Carry out noisy fabrication work at another site (e.g. within enclosed factory premises) and then transport products to the project site.

ALTERNATIVES TO REVERSING ALARMS

- Avoid the use of reversing alarms by designing the site layout to avoid reversing, such as by including drive-through for parking and deliveries.
- When applicable legislation permits, consider less annoying alternatives to the typical "beeper" alarms. Examples include smart alarms that are adjustable in volume depending on the ambient level of noise, and multi-frequency alarms that emit noise over a wide range of frequencies.

MAXIMIZE SHIELDING

- Re-use existing structures rather than demolishing and reconstructing.
- Use full enclosures, such as large sheds, with good seals fitted to doors to control noise from night-time work.
- Use temporary site buildings and material stockpiles as noise barriers.
- Schedule the construction of permanent walls so that they can be used as noise barriers as early as possible.
- Use natural landform as a noise barrier. Place fixed equipment in cuttings or behind earth berms.
- Take note of large reflecting surfaces on- and off-site that might increase noise levels, and avoid placing noise-producing equipment in locations where reflected noise will increase noise exposure or reduce the effectiveness of mitigation measures.

PROVIDE RESPITE PERIODS

- Consult with schools to ensure that noise-generating construction works in the vicinity are not scheduled to occur during examination periods, unless other acceptable arrangements (such as relocation) can be made.
- When night work near residences cannot be feasibly or reasonably avoided, restrict the number of nights per week and/or per calendar month that the work is undertaken.

WORK SCHEDULING

- Schedule noisy work during periods when people are least affected.

SCHEDULE ACTIVITIES TO MINIMIZE NOISE IMPACTS

- Organize work to be undertaken during the recommended standard hours, where possible.
- If the construction site is in the vicinity of a sports venue, consider scheduling work to avoid times when there are special events.

- When work outside the recommended standard hours is planned, avoid scheduling it on Sundays or public holidays.
- Schedule work when neighbours are not present (e.g. outside business hours or on weekends, when commercial neighbours, college students and school students may not be present).
- Schedule noisy activities around times of high background noise (i.e. when local road traffic or other local noise sources are active) where possible, to provide masking or to reduce the amount that the construction noise intrudes above the background noise.

DELIVERIES AND ACCESS

- Nominate an off-site truck parking area away from residences for trucks arriving prior to gates opening and schedule deliveries only during specified periods.
- Optimize the number of vehicle trips to and from the site. Movements can be organized to amalgamate loads rather than using a number of vehicles with smaller loads.
- Designate access routes to the site through consultation with potentially noise-affected residences and other sensitive receptors, and inform drivers of nominated vehicle routes.
- Provide on-site parking for staff and on-site truck waiting areas away from residences and other sensitive receptors. Truck waiting areas may require walls or other barriers to minimize noise.

NOISE TRANSMISSION PATH

- Physical methods to reduce the transmission of noise between construction locations and residences or other sensitive receptors are generally suited to construction projects in which there is long-term noise exposure.
- Reduce the line-of-sight noise transmission to residences and other sensitive receptors using temporary noise barriers.
- Temporary noise barriers can be constructed from boarding (plywood boards, panels of steel sheeting or compressed fibre cement board) with no gaps between the panels at the site boundary. Stockpiles and shipping containers can be effective noise barriers.
- Erect temporary noise barriers before work commences to reduce noise from construction as soon as possible.
- Where high-rise dwellings adjoin the construction site, the height of a barrier may not be sufficient to effectively shield the upper levels of the residential building from construction noise. Find out if this is a consideration for the project and examine alternative mitigation measures, where needed.

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Your health and safety… our priority. *Votre santé et votre sécurité… notre priorité.*

Guidance for Evaluating
Human Health Impacts
in Environmental Assessment:

DRINKING AND RECREATIONAL WATER QUALITY

Canada

Health Canada is the federal department responsible for helping the people of Canada maintain and improve their health. We assess the safety of drugs and many consumer products, help improve the safety of food, and provide information to Canadians to help them make healthy decisions. We provide health services to First Nations people and to Inuit communities. We work with the provinces to ensure our health care system serves the needs of Canadians.

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1 ACRONYMS

ACRONYM	MEANING
CEAA 2012	*Canadian Environmental Assessment Act*, 2012
DOC	dissolved organic carbon
DWTP	drinking water treatment plant
EA	environmental assessment
E. coli	*Escherichia coli*
EIS	environmental impact statement
GCDWQ	*Guidelines for Canadian Drinking Water Quality*
GCRWQ	*Guidelines for Canadian Recreational Water Quality*
HHRA	human health risk assessment
TDS	total dissolved solids
TOC	total organic carbon
VOCs	volatile organic compounds
RA	responsible authority

2 PURPOSE OF THIS DOCUMENT

This document provides generic guidance on predicting health risks of water quality in federal environmental assessments (EAs) of proposed major resource and infrastructure projects (such as mines, dams, pipelines and other projects). It presents the principles, current practices and basic information Health Canada looks for when it reviews environmental impact statement (EIS) or other reports submitted by project proponents as part of the EA process.

It was prepared for the benefit of proponents and their consultants and to support an efficient and transparent project review process. The foundational information described here should be supplemented appropriately with additional information relevant to specific projects.

The guidance was also prepared for responsible authorities and stakeholders to the EA process to communicate our normal areas of engagement and our priorities within these areas to help ensure that sufficient evidence is available to support sound decisions. As part of its review, Health Canada may suggest that a responsible authority (RA), review panel or others collect information not specifically described here in order to assess the health effects of specific projects. As the guidance provided here is generic and designed to support EA under multiple jurisdictions, the scope of our review will also necessarily be amended according to specific jurisdictional requirements.

Health Canada updates guidance documents periodically and, in the interest of continuous improvement, accepts comments and corrections at the following address: ead@hc-sc.gc.ca

Please verify that you are reading the most recent version available by consulting: **www.healthycanadians.gc.ca/publications/department-ministere/hc-sc/environmental-assessment-evaluation-environnementale/index-eng.php**

3 INTRODUCTION AND CONTEXT

Health Canada provides expertise to assist RAs, review panels and/or other jurisdictions leading environmental assessments to determine whether there are potential health risks associated with proposed projects and how to prevent, reduce or mitigate them.

Health Canada brings to bear its expertise in health risks associated with air quality, water quality, radiation, noise and country foods when it reviews and provides comments on information submitted by proponents in support of proposed projects. Health Canada also provides guidance to help stakeholders, including responsible authorities, review panels and affected communities, better understand how to conduct health assessments for proposed major resource projects.

This document concerns the assessment of health risks associated with water quality. It contains information on Health Canada's role with respect to drinking and recreational water quality; steps in Health Canada's preferred approach to human health risk assessment (HHRA) and assessing water quality-related health effects; and assessing cumulative effects.

Appendix A contains a checklist that can be used to verfiy that the main components of a water quality assessment are complete and to show where this information can be found within an EA document.

4 HEALTH CANADA'S ROLE WITH RESPECT TO DRINKING AND RECREATIONAL WATER QUALITY

In Canada, the responsibility for the safety and quality of drinking and recreational waters is shared between federal and provincial/territorial levels of government. The primary responsibility, including for regulations, generally rests with the provinces and territories. Health Canada provides scientific leadership by developing the *Guidelines for Canadian Drinking Water Quality* (GCDWQ) and the *Guidelines for Canadian Recreational Water Quality* (GCRWQ), in partnership with the provinces and territories. These guidelines are used as the basis for provincial/territorial drinking and recreational water quality requirements. For the most recent listing of these guidelines, refer to Health Canada's publication at: **www.healthcanada.gc.ca/waterquality**

Provincial and territorial standards may differ from the GCDWQ, depending on local considerations and needs. Upon request, Health Canada may provide scientific and technical advice to a federal department. This advice may be in the context of an environmental assessment (in this case, advice may also be provided to a province for projects substituted under *Canadian Environmental Assessment Act*, 2012 [CEAA, 2012], or to a territory) or general advice on emergency response to a spill—and could include the development of drinking water guidance values.

Drinking water guidance values are developed upon request to provide a level that is considered to be safe for exposure to a specific chemical contaminant in drinking water, under specific conditions. They are generally developed for contaminants for which no GCDWQ are available.These guidance values are developed for use within the department or government that has made the request, and are based on the limited scientific information available at the time of the request, and not on a thorough research of all existing studies. They are not subject to a review at the level of the GCDWQ, which undergo internal/external peer review and public consultation before being approved by the Federal-Provincial-Territorial Committees on Drinking Water and on Health and the Environment. Drinking water guidance values apply to water intended for human consumption, and do not replace or supersede existing guidelines or regulations.

For more information, refer to Health Canada's publication entitled *Water Talk—Drinking Water Quality in Canada* at: **www.hc-sc.gc.ca/ewh-semt/alt_formats/hecs-sesc/pdf/pubs/water-eau/drink-potab-eng.pdf**

5 HEALTH CANADA'S APPROACH TO HUMAN HEALTH RISK ASSESSMENT

One of the key tools that Health Canada promotes for evaluating the potential health impacts of project-related exposure to contaminants is called a "human health risk assessment" (HHRA). An HHRA can help identify whether there are potential human health risks associated with a proposed project.

Three components must be present for a "risk" to exist: 1. a hazard (for example, a chemical or a radionuclide) 2. a receptor (individuals or communities) and 3. an exposure pathway (a means by which people are exposed to the contaminant).

Within an environmental assessment, an HHRA is defined as the process used to estimate the probability of adverse health effects for people who may be exposed to contaminants through different routes/pathways (ingestion, inhalation and/or dermal contact) in specific environmental media (air, foods, soil, water and/or sediment).

An HHRA provides qualitative and/or quantitative estimates of the likelihood of adverse effects to human health, depending on the available information. These estimates are based on the inherent characteristics of the contaminants, as well as factors specific to the project being assessed—such as the characteristics of the exposed population and the media through which the exposure would take place.

Although conducting an HHRA is not always a requirement of an EA and is dependent on the potential effects of particular project, it can provide increased support for the conclusions of an EA. The findings of an HHRA are particularly useful for determining the significance of a potential effect, and for establishing appropriate mitigation measures, follow-up programs, and plans for monitoring, remediation and/or risk management.

With respect to water quality, an HHRA can be used to assess the risk of potential contamination of drinking or recreational water by taking into consideration the levels of contaminants in the water sources and the exposure of humans to these contaminants. By combining these two factors, one can estimate the potential effects of the intake of contaminants on human health. However, a complete HHRA may not always be necessary in an EA focused solely on water quality—for example, when the project's predicted impacts meet applicable guidelines and standards (such as the GCDWQ, GCRWQ or provincial standards)—given that extensive HHRAs have been already performed to establish these guidelines and standards.

In other cases where multiple pathways of exposure are being evaluated, exposure to contaminants in drinking and recreational water should be included in a multi-media HHRA.

6 ADDRESSING THE POTENTIAL CONTAMINATION OF DRINKING AND RECREATIONAL WATER IN ENVIRONMENTAL ASSESSMENTS

A water quality assessment is typically performed as part of an EA. If the EA demonstrates that a project will not result in any exceedances of applicable water quality guidelines or standards at the point of human consumption or exposure, it is reasonable to conclude that negative impacts on human health are not expected from exposure to drinking or recreational water.

If groundwater is consumed directly without treatment, then its water quality parameters could be compared to applicable drinking water limits. When water is treated before consumption, the water quality assessment for the project should examine whether the technology and capacity of the existing drinking water treatment plant (DWTP) are sufficient to ensure that the treated water will be of adequate quality.

It is not necessary for source water to meet guidelines or standards before treatment; however, this does NOT mean that source water can be contaminated up to the limits set by the guideline or standard. Health Canada holds the view that the assessment should demonstrate the steps to be taken to minimize the impacts of contamination on the quality of source water.

Water quality assessments should consider water quality parameters that are specific to the project, as well as common parameters that could have an impact on drinking water treatment. These common parameters include the following: total dissolved solids (TDS), turbidity, pH, temperature, ammonia, total organic carbon (TOC) and dissolved organic carbon (DOC). Surface water should never be consumed without treatment; this also applies to groundwater under the direct influence of surface water (in cases such as seepage of surface water through well casing or fractured rock)—which should be considered to be surface water for water quality purposes.

If a facility may be affected by a project and rendered unable to treat water to meet the applicable drinking water guidelines or standards, this fact should be considered in the water quality assessment, particularly because upgrading an existing DWTP may take several years.

6.1 ASSESSING POTENTIAL IMPACTS ON DRINKING WATER QUALITY

Assessing the potential impacts of projects on drinking water quality often involves simply comparing predicted concentrations of substances and parameters to the most recent version of the *Guidelines for Canadian Drinking Water Quality* (GCDWQ), published by Health Canada on behalf of the Federal-Provincial-Territorial Committee on Drinking Water. However, when the predicted concentrations approach or exceed the values suggested in the GCDWQ, it is advisable to include drinking water as a pathway in the HHRA conducted for the project.

Health Canada does not establish rules under the CEAA 2012 concerning the format and presentation of data and results when assessing potential impacts on drinking water quality. However, inclusion of the following components is suggested:

1. Identification of sources used for drinking water (locations and proximities to the proposed project);
2. Determination of potential changes to source and well water quality;
3. Determination of impacts of changes in water quality;
4. Mitigation;
5. Assessment of residual risk;
6. Monitoring (if required); and
7. References.

It is Health Canada's preference that only qualified professionals with suitable experience assess potential effects on drinking water quality.

6.1.1 Identification of sources used for drinking water

The water quality assessment should identify and describe all sources of drinking water in the area that may experience a change as a result of the project. Such sources may include source water intakes for DWTPs; sources that are consumed directly (for example, private wells). It is useful to include a statement indicating that all drinking water sources have been listed in the assessment.

The potential spread of contamination through the local watershed should be taken into consideration, when deciding which drinking water sources may experience a change as a result of the project. If a DWTP is present in the project's area of influence, Health Canada suggests that the water quality assessment identify the treatment technologies used in the facility (for example, chlorination, filtration, ozonation) and provide information from the facility (if available) on intake and treated water monitoring. If no sources of drinking water exist in the project area, either public or private, then no assessment with respect to drinking water would be suggested.

6.1.2 Determination of potential changes to source and well water quality

Any potential project-related changes in the quality of drinking water sources should be determined (including the risk of spills or accidents) and quantified to the greatest extent possible in the assessment. Health Canada also suggests provision of basic information on the local watershed; the geographical/hydrological influence of the project on drinking water supplies; and potential human exposure pathways.

Modelling may be used to estimate contaminant levels in water after the project proceeds—through the phases of construction, operation and/or decommissioning, as appropriate. Ideally, the estimates should be based on models recommended by Environment Canada, Natural Resources Canada and/or the United States Environmental Protection Agency, and the water quality assessment should document the models used.

If a potential impact on water quality has been identified, Health Canada would prefer that the water quality assessment include a comprehensive list of potential contaminants and their physicochemical properties. To properly identify these contaminants, the assessment should consider the following types of factors: the nature of the project; the effluents, materials and chemicals present; excavation and construction methods; potential flooding; rerouting of waterways; landscape changes; and waste management.

Health Canada would also prefer that the assessment take into account naturally occurring sources of contamination in the project area (for example, substances found in soils and/or water), as well as contamination from previous industrial activities, which could be mobilized by the project activities. Examples of potential contaminants are metals, pesticides, pathogens, hydrocarbons and volatile organic compounds (VOCs).

A change in physical characteristics, as well as in levels of ammonia or bromide, can affect water treatment. If no water quality changes are expected to occur in the source water of nearby DWTPs or in untreated well water, a statement with proper justification indicating this fact should be included.

6.1.3 Determination of impacts of changes in water quality

If any changes to source or well water quality are predicted, Health Canada prefers that the water quality assessment include discussion of the potential impacts of these changes. In the case of untreated well water or any other untreated drinking water source, the predicted water quality should be compared to the GCDWQ or to the applicable provincial or territorial standards.

The potential risk to human health caused by contaminants for which no Canadian human-health-based guidelines or standards exist needs to be assessed on a case-by-case basis. If there are potential guidelines or standard exceedances, Health Canada suggests that the assessment discuss monitoring and mitigation.

If source water is to be treated, Health Canada prefers that the assessment include discussion of the type of treatment used and/or the capacity of the facility, and whether the facility will be able to address the predicted or possible changes in water quality. If the facility is provincially or territorially regulated, it is advisable to consult with the appropriate authorities and/or facility operators to confirm the expected adequacy of the facility.

6.1.4 Monitoring and mitigation

If the assessment determines that a project poses a risk of a change to the environment or an effect of a change to the environment on a drinking water source—and where that effect cannot be eliminated by existing treatment plants—the assessment should describe the measures to be taken to manage this risk. In addition, Health Canada encourages development of plans for mitigation measures that further reduce small impacts. It is suggested that all recommendations, including any projected mitigation and monitoring plans, be listed and described.

Monitoring

The periodic monitoring of drinking water parameters can be used to verify water quality predictions. If there is uncertainty as to whether water quality will meet applicable guidelines or standards—either due to predicted concentrations being near guideline or standard concentrations or high uncertainty in predicted values—Health Canada suggests that a commitment be made to undertake a monitoring program.

In general, Health Canada prefers that monitoring of drinking water quality be done in accordance with provincial and territorial regulations. The following factors may be of assistance in planning monitoring studies:

- Information on contaminants typically of concern related to similar development projects and similar sites;
- Discussion with local residents;
- Consultation with local health and/or environmental health officials; and
- Previous studies conducted in the project area.

Health Canada does not have specific expertise in development of site-specific sampling plans; however, if it receives a request under Section 20 of CEAA 2012, it may make available information and knowledge to guide the conducting of human health risk assessments (HHRAs) after monitoring data is obtained.

Health Canada prefers that historic drinking water quality data (baseline conditions prior to any project activities in the affected watershed) be collected before the project begins. These data can then be compared to predicted changes in water quality due to project activities, as well as to water quality data collected after the project is underway. Baseline data may be obtained from DWTPs and from nearby wells that may be influenced by the project.

If no monitoring is to be undertaken, Health Canada prefers that the water quality assessment include a justification for this decision.

Mitigation

If an environmental effect on drinking water sources is either predicted or possible, the water quality assessment should include a mitigation plan. Possible mitigation measures include the following:

- Measures to reduce predicted changes in water quality;
- Improved treatment technology or capacity in DWTPs;
- Implementation of water treatment where it was previously absent; and
- Provision of an alternative drinking water source.

If a DWTP's source water quality could be affected by a project, Health Canada prefers that the owners/operators of the facility be notified, and that the assessment include information on this notification and how it will be done. Health Canada also prefers that private well owners affected by a project be notified of potential changes in their water quality.

Health Canada prefers clarifying whether any monitoring, mitigation or other risk management measures will be undertaken conditionally or unconditionally. If the measures are conditional, Health Canada prefers that the water quality assessment clearly describe the conditions under which the measures will be implemented.

6.1.5 Assessment of residual risk

A water quality assessment should discuss potential impacts on drinking water quality after all proposed mitigation and management measures have been applied. This discussion should include human health risks in cases of accidents or spills and in cases where water quality at any stage of the project is found to be different than predicted. If there is a possibility of exposure to contamination in drinking water that is above applicable guidelines or standards, Health Canada prefers that the risk to the health of nearby residents be estimated using methods appropriate for the contaminant in question.

It is very important that the GCDWQ related to *Escherichia coli* (*E. coli*) not be exceeded. *E. coli* is used as an indicator of faecal contamination, which means that disease-causing microorganisms may also be present. People may become sick very soon after being exposed to faecally contaminated water. Other guidelines, many of them for chemicals, are based on the best available science and give a good indication of human health effects that might be seen if levels exceed the GCDWQ over the lifetime of a project.

Some guidelines are aesthetic and exceeding them would not present a human health risk. In other cases, guidelines are risk-managed (due to limitations in analytical methods or treatment technologies) and some risks to human health may be present even below GCDWQ levels. An example is the case of arsenic where the concentration in drinking water representing an "essentially negligible" risk of internal organ cancers is 0.3 µg/L, however, current residential scale drinking water treatment technologies are only certified to reduce arsenic levels to 10 µg/L (the current GCDWQ); the guideline also recommends that every effort should be made to reduce arsenic levels in drinking water to as low as reasonably achievable. More information on the assessment of risk associated with short-term guideline exceedances can be found in the GCDWQ technical documents at: **www.healthcanada.gc.ca/waterquality**

Health Canada prefers that a rationale be provided in the water quality assessment as to why certain expected risks are found to be acceptable.

6.2 ASSESSING POTENTIAL IMPACTS ON RECREATIONAL WATER QUALITY

For the purposes of this guidance document, recreational waters are any natural fresh, marine or estuarine bodies of water, including artificial lakes and quarries, used by people for leisure. As described in The GCRWQ, a recreational water activity can be considered as any activity involving intentional or incidental immersion in natural waters and can be further categorized as:

- *Primary contact:* Activities in which the whole body or the face and trunk are frequently immersed or the face is frequently wetted by spray, and where it is likely that some water will be swallowed (such as swimming, surfing, waterskiing, white-water canoeing/rafting/kayaking, windsurfing and subsurface diving); or
- *Secondary contact:* Activities in which only the limbs are regularly wetted and in which greater contact (including swallowing water) is unusual (for example, rowing, sailing, canoe touring and fishing).

If project activities could affect recreational waters such that waters might not meet the recreational water quality guidelines of the appropriate jurisdictional authority (provincial/territorial or federal), Health Canada prefers that a water quality assessment be undertaken. Such an assessment would be similar to what is described in this document for drinking water and it is advisable to include information from consultations with the authorities responsible for the recreational water in question.

The GCRWQ do not include guidelines for specific chemical parameters. In the case of chemical contamination, Health Canada prefers that the potential risk to human health be assessed on a case-by-case basis.

Considerations specific to the risk assessment of recreational water quality include the following:

- Potential human exposure pathways include ingestion, inhalation and direct contact with the skin and mucous membranes. Health Canada prefers that the water quality assessments include a description of the types of activities practiced on or in the waters, to identify potential exposure pathways.
- Natural recreational waters are not subject to treatment. Similar to the case of untreated source water quality, mitigation of the impact of a project on recreational water quality and related predicted changes (including possible spills and accidents) would involve developing plans to implement measures to reduce this impact and monitor recovery in the water quality.

If recreational water quality could be subjected to an environmental effect due to a project, Health Canada prefers that the appropriate authorities be notified and recreational users be informed.

7 ASSESSMENT OF CUMULATIVE EFFECTS

Under CEAA 2012, subsection 19(1), an environmental assessment must consider "the environmental effects … and any cumulative environmental effects that are likely to result from the … designated project in combination with other physical activities that have been or will be carried out."

In the case of drinking and recreational water quality, Health Canada suggests that an assessment of cumulative effects, if required, include the following:

- Changes in levels of contaminants in drinking and recreational water resulting from all past, present or known future projects and activities (in other words, changes in exposure); and
- Whether future projects could result in new access to recreational and drinking water sources that may be contaminated and that were previously inaccessible (for example, a new road or bridge providing access to water, or modified water flow as a result of a project making previously un-navigable watercourses navigable).

If the cumulative effects assessment identifies water quality effects that exceed project-only effects, Health Canada suggests that further monitoring and/or mitigation measures be considered.

For guidance on assessing cumulative effects, consult the Canadian Environmental Assessment Agency's website for up-to-date guidance materials: **www.ceaa.gc.ca**

8 FOLLOW-UP PROGRAMS

Under CEAA 2012, a "follow-up program" means a program for:

a) verifying the accuracy of the environmental assessment of a designated project; and

b) determining the effectiveness of any mitigation measures.

It may be appropriate to consider a follow-up program for water quality (drinking and recreational) if one of the following applies (note: this is not a comprehensive list):

- There is uncertainty about the modelling of contaminant emission, release, mobilization, deposition or modification in the environment, and uptake into groundwater or surface water sources;
- There is uncertainty about the capacity of the DWTP to respond adequately to changes in source water quality;
- There is a possibility that a novel substance may be introduced into water bodies as a result of project activities;
- There is uncertainty whether proposed mitigation measures will be effective (e.g. the use of novel technologies or complex systems); or
- There is a possibility that water sources may be contaminated unexpectedly (for example, by a sudden release of untreated effluent).

For more information on follow-up programs, contact the Canadian Environmental Assessment Agency, Canadian Nuclear Safety Commission, or National Energy Board, as appropriate.

9 REFERENCES

9.1 CANADIAN WATER QUALITY GUIDELINES

Health Canada. 2012a. *Guidelines for Canadian Drinking Water Quality—Summary Table*. Ottawa, Ontario. Health Canada. Available online at: **www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/sum_guide-res_recom/index-eng.php**

Health Canada. 2012b. *Guidelines for Canadian Recreational Water Quality*. Ottawa, Ontario. Health Canada.

Health Canada reports and publications on water quality in relation to radiological, chemical/physical, bacteriological and microbiological parameters can be found at the following link: **www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/index-eng.php**

9.2 ENVIRONMENTAL ASSESSMENTS

Canadian Environmental Assessment Act. S.C. 2012, c. 19, s. 52. 2012. Available online at: **laws-lois.justice.gc.ca/eng/acts/C-15.21/index.html**

9.3 WORLD HEALTH ORGANIZATION GUIDELINES

WHO. 2011. *Guidelines for Drinking-water Quality. Fourth Edition. Volume 1, Recommendations*. Geneva, Switzerland.

WHO. 2003. *Guidelines for Safe Recreational Water Environments. Volume 1, Coastal and Fresh Waters*. Geneva, Switzerland.

9.4 HUMAN HEALTH RISK ASSESSMENT GUIDANCE

Health Canada. 2010. *Federal Contaminated Site Risk Assessment in Canada, Part I: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA)*, Version 2.0 (revised 2012). Contaminated Sites Division, Safe Environments Directorate, Ottawa.

APPENDIX AI **WATER QUALITY IN EA CHECKLIST**

This checklist can be used to verify that the main components of a water assessment have been completed. It is helpful to include this checklist with the EIS or application, to show where the components of the water quality assessment are located in the document. This is especially helpful if the components are located in more than one section of the document.

OVERALL (throughout the EA)	
✓	***Item***
	1. Worked examples are included for calculations, if a quantitative risk assessment was completed.
	2. Units are clearly stated and consistent (or conversion calculations are included as appropriate).
	3. Assumptions are clearly stated and justified (modelling of worst-case scenarios, etc.).
	4. Principles of minimizing impacts are considered (e.g. not polluting up to guidelines). This concept includes identifying mitigation measures to minimize increases in concentrations of contaminants as a result of project activities.
	5. All Indigenous receptors are clearly identified and their potentially increased exposure to sources of water contamination is characterized

DRINKING WATER SOURCES		
✓	***Item***	***Section in EA***
	6. All sources used for drinking water are identified in the EA study areas (project, local and regional) including: • Source water intakes for DWTP(s) and/or sources from which water is consumed directly (e.g. wells) and their distance from the project; • Whether all sources of drinking water have been identified; • The responsibility/jurisdiction for DWTP(s) in the EA study area (municipal/provincial/territorial/federal).	
	7. Information is included on whether there are predicted or measured changes to source water quality due to project activities (includes spills and accidents, where relevant). If yes, the following is included:	
	a. A comprehensive list (including quantitative information) of potential organic, inorganic and microbial contaminants, as well as their physical characteristics.	
	b. A comparison of predicted or measured changes in individual parameters to appropriate guidelines or standards.	
	c. A conclusion with respect to the ability of DWTP(s) to address the predicted or measured changes in water quality.	
	d. Information on how managers of DWTP(s) will be informed of any predicted or measured changes in source water quality.	
	e. If the province or territory is responsible for managing the DWTP(s), confirmation from the appropriate authority of changes to the drinking water treatment protocol associated with predicted or measured changes to source water parameters.	

PRIVATE WELLS		
✓	***Item***	***Section in EA***
	8. Information is included on whether there are any private wells in the EA study area. If so, a discussion is included on whether any changes to the quality of the well water are likely due to project activities (including spills and accidents).	
	9. If changes to well water quality are predicted or measured as a result of project activities, the following is included:	
	a. A comprehensive list (including quantitative information) of predicted organic, inorganic and microbial contaminants, as well as their physical characteristics.	
	b. A comparison of individual parameters to appropriate guidelines or standards—for both the baseline case and predicted future concentrations during project construction, operation and decommissioning, and in the event of accidents/malfunctions (as applicable).	
	c. Details on how well owners will be notified of potential changes in water quality.	

RECREATIONAL WATER QUALITY		
✓	***Item***	***Section in EA***
	10. All water bodies that are currently being used or may be used in the future for recreational purposes—and which may be affected by project activities—are identified, and a characterization of recreational activities in affected water bodies (swimming, canoeing, fishing, etc.) is included.	
	11. Information is included on whether there are predicted or measured changes to recreational water quality due to project activities (includes spills and accidents, where relevant). If so, the following is included:	
	a. A comprehensive list (including quantitative information) of predicted or measured microbial, organic, and inorganic contaminants, as well as their physical characteristics.	
	b. A comparison of predicted or measured changes in individual parameters to appropriate guidelines or standards (provincial/territorial standards or the GCRWQ, which also apply on federal lands and First Nation reserves south of the 60th parallel).	
	c. As the GCRWQ do not include guidelines for specific chemical parameters, in the case of chemical contamination, a comparison of predicted changes in individual parameters to appropriate guidelines or standards, as determined in consultation with the responsible authorities.	

NEED FOR AN HHRA		
✓	***Item***	***Section in EA***
	12. Are there predicted exceedances of any provincial or territorial standards or federal guidelines after the application of mitigation measures? If so, it is suggested that an HHRA for the drinking or recreational water pathway be completed for contaminants.	

NOVA SCOTIA
Environment

Barrington Tower
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PO Box 442
Halifax, Nova Scotia
Canada B3J 2P8

Date: October 11, 2019

To: Environmental Assessment Officer
Cc: Acting Manager, Water Management Unit, Sustainability and Applied Science Division

From: Senior Hydrogeologist, Sustainability and Applied Science Division

Subject: Environmental Assessment Review of Highway 102 Aerotech Connector Road Project

Reviews for EA's from the Sustainability and Applied Science Division Senior Hydrogeologist focus on the potential for the proposed undertaking/project to adversely affect groundwater resources, including general groundwater quality, local water wells/water supply and groundwater discharge to surface water.

The proposed Project involves the construction, maintenance and post-construction monitoring of a 5-kilometer (km) Connector Road from Highway 102 Aerotech Interchange (Exit 5A) to Trunk 2 in Wellington near Sunnylea Road.

Comments:

1. The proposed site is situated at its closest, about 1 km southwest of Bennery Lake Protected Water Area (PWA). However, the PWA is in a different sub-watershed and there are likely no impacts to it resulting from the proposed Project.

2. The proposed site is located within the broad municipal drinking water watershed for the Shubenacadie River, which supplies several municipal surface water sources.

3. This area of Halifax Regional Municipality (Fall River) has some limited services by Halifax Water from the municipal Collins Park water supply source, supplying over 80 homes. These are located at closest about 500 metres south of the project centre line. All other homes closer to the vicinity of the proposed connector route are supplied by on-site drilled wells.

4. The nearest Registered Public Drinking Water Supplies utilizing groundwater wells (a variety store and a restaurant) are located (according to NSE records) about 600-700 metres south of the proposed project centre line.

5. Using the Department of Energy and Mines online Groundwater Atlas, the reviewer found approximately 150 water supply wells located at individual residences within

500 metres of the proposed project connector road centre line. This is a significant number of water supplies. These are primarily at the western extent of the proposed project connector. Of these, many are within 100-150 metres of the project connector road centre line. It may also be noted that groundwater flow in the area is likely to the southwest (towards Lake Fletcher) and thus groundwater quality impacts could affect an additional number of residential wells in this area also.

It is noted that the proponent's maps show a "Local Study Area" zone outline of 300 metres distance from the project centre line, whereas the text describes water wells and other features within 500 metres of the project centre line.

It has been noted previously that the Well Logs Database Records and any mapping based on these records need to be considered in terms of locational errors/accuracy of the original data. In addition, the Well Logs Database does not contain a complete listing of every water supply well in the province and some areas may contain water supply wells not reported. Field truthing and field surveys for water supply well locations is necessary. This is particularly important given the discrepancies in the registration document concerning the number of water supply wells potentially affected.

6. It should be noted that the area around Fall River has experienced several issues related to adverse groundwater conditions. Some of these relate to inadequate groundwater yields for residences or residential development and others to groundwater quality (e.g. presence of naturally occurring Arsenic).

7. The proponent does note that the area is potentially affected by Acidic Rock Drainage and Metal Leaching due to exposure of potential acidic rock during construction. While a number of surface mitigation measures are proposed, the possible effects on groundwater due to infiltration are critical to groundwater well supplies. Appendix A - Acid Rock Management and Section 6 ML/ARD Management for the Connector Road (p. 11 of the Appendix) provide some details of possible actions, but more site testing and planning will be necessary.

<u>Discussion</u>

From a groundwater perspective some of the greatest concerns for the proposed project are related to the maintenance of groundwater conditions for the high number of residences that rely on individual, on-site water wells for water supply.

While the proponent's report describes some of the general potential issues (Table 6.1.1. Residual Effects – Groundwater Resources p. 99) they conclude that potential effects from the project are "Minimal" and "not significant" due to:

- Construction blasting and vibrations;
- Water level reductions; and
- Well contamination due to acid rock drainage, road salting and herbicide use,

However, there are a number of areas for which more information would be necessary to verify this conclusion. Additional baseline work is required in order to gather and

monitor groundwater conditions before, during and after operations to be prepared for mitigation measures, should they be necessary. The areas for additional work thus include:

- long-term water quality protection and mitigation measures concerning groundwater conditions resulting from winter road maintenance road salting, potential acid rock drainage effects and herbicide use
- Better information concerning the potential locations for blasting and construction vibrations and the potential effects to drilled wells in close proximity to the proposed connector route.
- Baseline information for residential water wells
- A water well supply contingency and mitigation plan

Recommendations

The following recommendations are suggested for proposed Highway 102 Aerotech Connector Road Project.

Planning/Design Issues

- No planning/design issues are specifically noted. However, this type of urban development project does have the potential for significantly affecting a large number of residential homeowners relying on groundwater wells for water supply in the specific Lake Fletcher/Wellington area. There are currently no practical water supply alternatives for this area. Some of the project planning relies on implementation of studies and precautionary measures as the proposed project proceeds. The importance of adequate and proactive best management practices should be emphasized in order to achieve long-term protection of groundwater supplies in this area.

Operational Issues/Other Permitting Processes

- More detailed description of long-term water quality protection and mitigation measures concerning groundwater conditions resulting from winter road maintenance road salting, potential acid rock drainage effects and herbicide use in such close proximity to numerous wells. Management plans mentioned for these (Road Salt Management Plan in TIR's EPP Section 3.18 and TIR Integrated Roadside Vegetation Maintenance program (IRVM)) were not provided. The summaries shown in Table 2.4.1 Operations Activities (p. 19) would seem to suggest that both road salt and herbicide use in the proposed connector route would be largely restricted due to environmental concerns (however the effects of adverse water quality on groundwater well water supplies are not noted in the table). The TIR management/maintenance plans should be provided to Nova Scotia Environment for review with respect to appropriate environmental protection measures.

- Better information concerning the potential locations for blasting and construction vibrations and the potential effects to drilled wells in close proximity. Project construction effects contingency plans should be provided for scenarios where effects to wells are described as "Non-reversible" (Table 6.1.1, p. 99).

- Baseline information for water wells within 500 metres of the proposed project centre line primarily to the north, south and west. Baseline information should include water well construction details, water quality assessment and water quantity assessment. Groundwater residential well monitoring plans should include monitoring pre-, during and post-construction (e.g. 5 years).

- A water well supply contingency and mitigation plan should be prepared to be able to address the long-term needs of individual residences in the community for water supply, that could be negatively affected as a result of the project.

Other Observations

Although this area is not too far from Halifax Water serviced areas, the reviewer is not aware of any municipal plans to extend potable water services in this area.

NOVA SCOTIA
Environment

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Canada B3J 2P8

Date: October 10, 2019

To: Renata Mageste da Silva, Environmental Assessment Officer

From: Climate Change Unit

Subject: Highway 102 Aerotech Connector Road Project

Climate Change Mitigation

The proponent provided little information on the potential for the actual greenhouse gas emissions. There were no estimates for potential CO_2, N_2O and CH_4 emission from the operation of onsite trucking, mobile equipment and utility vehicles. It is expected that the emissions associated with construction of the Highway 102 Aerotech Connector Road Project will be low and will be captured by the reports of fuel supplier emitters under the Nova Scotia Greenhouse Gas Quantification Reporting Verification regulations.

The proponent has committed to mitigative measures for greenhouse gas emissions. These include no idling of machinery and vehicles, and proper maintenance of equipment and has referred to TIR's EPP (Section 2.6.2) as guidance for its strategy.

Climate Change Adaptation

While the proponent has noted that climate change will have no significant adverse effects on the project and mitigation measures have been outlined, the proponent should consider reviewing the Nova Scotia Environment's *Guide to Considering Climate Change in Environmental Assessment in Nova Scotia* for additional guidance. The guide is available at https://novascotia.ca/nse/ea/docs/EA.Climate.Change.Guide.pdf

From:	Wade, Suzanne (EC)
To:	Mageste da Silva, Renata
Cc:	Wade, Suzanne (EC); Knaga, Paul (EC); Hingston, Michael (EC); Wilhelm, Sabina (EC)
Subject:	RE: Highway 102 Aerotech Connector Road Project, NS - EA Registration (EAS# 2019-083)
Date:	October 16, 2019 1:21:22 PM
Attachments:	Canadian Wildlife Service 2017 Birds and Oil - CWS Response Plan Guidance.pdf

Hi Renata,

Environment and Climate Change Canada (ECCC) have reviewed the registration document (dated August 2019) for the Highway 102 Aerotech Connector Road Project and we offer the following comments:

Wildlife Comments

- The current project footprint contains breeding habitat for shorebird species. ECCC-CWS (Canadian Wildlife Service) recommends avoidance mitigations for construction activities (including vegetation clearing) to be done outside the breeding season should prevent the destruction of active nests. Additionally, Killdeer may nest in newly cleared areas and care should be taken to identify any nesting pairs and nests in the construction area from April to June and avoid disturbing established nests until chicks have fledged. Guidance is provided below.
- ECCC-CWS is unclear on the routing options and selection of the current route; it is difficult to determine why the current route is the overall preferred option. This is important to determine because of the high level of existing disturbance and fragmentation in the area already. Cumulative effects is not addressed in any significant way.
- ECCC-CWS recommends updating the description of relevant legislation description for MBCA: it applies to all migratory birds, including game birds.
- ECCC-CWS requests that elevations are included with contours in the figures.
- ECCC-CWS requires that compensation for the loss of wetland functions to be addressed by a Wetland Mitigation Plan, that will be approved by the Canadian Wildlife Service
- ECCC-CWS requests the scientific name for Blue Felt Lichen's be updated to Pectenia plumbea (it was changed recently).
- ECCC-CWS recommends the proponent use lichenologists for any future surveys from a list that NSL&F is compiling of lichenologists experienced in identifying rare cyanolichens.
- There is a record of Blue Felt Lichen in the local study area (to the NE) that isn't mentioned. ECCC-CWS requests that this observation, and any Blue Felt Lichen occurrences that are not removed, have the at-risk lichen SMP buffer applied to it.
- Even though the at-risk lichen SMP recommends a 100 m buffer around lichens, ECCC-CWS warns that this buffer might not be enough to ensure the survival of lichen occurrences. ECCC-CWS requests that any Blue Felt Lichen occurrences that are not removed should be monitored.
- ECCC-CWS requests that if Blue Felt Lichens occurrences are going to be removed that the proponent works with the province / Lichen recovery team to collect the Blue Felt Lichen in support of other activities. There has been some work transplanting cyanolichens and the province would know if there are opportunities to use these Blue Felt Lichen occurrences.
- ECCC-CWS requests additional detail on how the point count locations were selected for the

bird surveys. The proponent indicated that all habitats were captured by the bird point count surveys. Which habitats, specifically are they referencing? Are they referring to those delineated in Figure 5.2.1?

- ECCC-CWS requests the proponent to examine Canada Warbler habitat in further detail. The swamp habitat (Figure 5.2.3) described highlights alder and wild raisin as primary species along with semi-closed canopy of trees is prime Canada Warbler habitat. There is 24 ha of this habitat within the project area.
- ECCC-CWS reminds the proponent that their interaction in Table 6.8.1 - "Destruction of active migratory bird nests during vegetation clearing" is a contravention of the federal MBCA. The only acceptable mitigation for this interaction is avoidance – there are no acceptable minimization techniques.

Standard Guidance

Migratory Birds

Migratory birds, their eggs, nests, and young are protected under the Migratory Birds Convention Act (MBCA). Migratory birds protected by the MBCA generally include all seabirds (except cormorants and pelicans), all waterfowl, all shorebirds, and most landbirds (birds with principally terrestrial life cycles). The list of species protected by the MBCA can be found at https://www.canada.ca/en/environment-climate-change/services/migratory-birds-legal-protection/convention-act.html. Bird species not listed may be protected under other legislation. The MBCA protects these migratory birds, their nests and eggs anywhere they are found in Canada, including ocean waters, and prohibits the dumping of substances harmful to birds in waters or areas frequented by them. Bird species not listed may be protected under other legislation.

Under Section 5.1 of the MBCA describes prohibitions related to depositing substances harmful to migratory birds:

- "5.1 (1) No person or vessel shall deposit a substance that is harmful to migratory birds, or permit such a substance to be deposited, in waters or an area frequented by migratory birds or in a place from which the substance may enter such waters or such an area.

- (2) No person or vessel shall deposit a substance or permit a substance to be deposited in any place if the substance, in combination with one or more substances, results in a substance – in waters or an area frequented by migratory birds or in a place from which it may enter such waters or such an area - that is harmful to migratory birds."

Under Sections 5 and 6 of the Migratory Birds Regulations (MBR) describes hunting and taking of migratory birds:

- 5 (1) No person shall hunt a migratory bird except under authority of a permit therefor.
    - hunt means chase, pursue, worry, follow after or on the trail of, lie in wait for, or attempt in any manner to capture, kill, injure or harass a migratory bird, whether or not the migratory bird is captured, killed or injured;

- 6 Subject to subsection 5(9), no person shall
    - disturb, destroy or take a nest, egg, nest shelter, eider duck shelter or duck box of a migratory bird, or
    - have in his possession a live migratory bird, or a carcass, skin, nest or egg of a migratory bird except under authority of a permit therefor.

It is the responsibility of the proponent to ensure that activities are managed so as to ensure compliance with the MBCA and associated regulations.

Vegetation Clearing

Clearing vegetation may cause disturbance to migratory birds, and may inadvertently cause the destruction of their nests and eggs. Many species use trees, as well as brush, deadfalls and other low-lying vegetation for nesting, feeding, shelter and cover. This would apply to songbirds throughout the region, as well as waterfowl in wetland areas. Disturbance of this nature would be most critical during the breeding period. The breeding season for most birds within the region is generally between April 15th and August 15th, however some species protected under the MBCA do nest outside of this time period. Please see the webpage "Nesting Periods" (Website: https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/general-nesting-periods/nesting-periods.html) and the Bird Nesting Calendar Query Tool (Rousseu and Drolet 2015 https://www.birdscanada.org/volunteer/pnw/rnest) for more specific information concerning the breeding times of migratory birds.

Recommendations:

- The proponent should avoid certain activities, such as clearing, grubbing and vegetation removal during the regional nesting period for migratory birds.
- Active nests can be discovered during project activities outside of the regional nesting period. To reduce the risk of impacting nests or birds caring for pre-fledged chicks at those times, ECCC-CWS recommends implementation of measures such as the establishment of vegetated buffer zones around nests, and minimization of activities, in the immediate area until nesting is complete and chicks have naturally migrated from the area. It is incumbent on the proponent to identify the best approach, based on the circumstances, to complying with the MBCA.
- The proponent should be cognizant that while most migratory bird species construct nests in trees (sometimes in tree cavities) and shrubs, mitigations should be appropriate for migratory birds with different strategies, including on the ground and long cliffs. Additionally, migratory birds may place nests in human-influenced landscapes or infrastructure (e.g. hay fields, exposed quarry or mine dig faces, overburden piles, slash piles, impounded water, and structures like buildings or bridges).
- The proponent should develop and implement a management plan that includes

appropriate preventative measures to minimize the risk of impacts on migratory birds (Please see 'Avoiding harm to migratory birds: guidelines to reduce risk to migratory birds' at https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/reduce-risk-migratory-birds.html). For beneficial management practices regarding how to avoid the incidental take of migratory birds nests and eggs, please refer to the Avoidance Guidelines (Website: https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/guidelines.html). The management plan should include processes to follow should an active nest be found at any time of the year.

- Once a site's vegetation has been cleared, and if the proponent needs to conduct vegetation maintenance (e.g. trimming, mowing, danger tree removal, weed removal), the proponent is advised to conduct vegetation maintenance activities in a manner to avoid incidental take of birds and nests.

Nest Surveys

Migratory bird nests can be found in a variety of habitats and locations. Depending on the species, nests may be found at many heights in trees, in tree cavities, in shrubs, on the ground (including in hayfields, crops and pastures), on cliffs, and in burrows. Nest sites are often hidden and adult birds avoid approaching their nests in a manner that would attract predators to their eggs or young. Moreover, the amount and complexity of habitat to be searched often limits the success of surveys intended to locate all active nests. The nests of a few species are easier to locate, particularly those in isolated trees, on human-made structures and/or in colonies. In most cases, nest search techniques are not recommended because, in most habitats, the ability to detect nests remains very low while the risk of disturbing active nests is high. Flushing nesting birds increases the risk of predation of the eggs or young, or may cause the adults to abandon the nest or the eggs. Therefore, except when the nests searched are known to be easy to locate without disturbing them, active nest searches are generally not recommended; they have a low probability of locating all nests, and are likely to cause disturbance to nesting birds. In many circumstances, incidental take is likely to still occur during industrial or other activities even when active nest searches are conducted prior to these activities.

To determine the likelihood that migratory birds, their nests or eggs are present in a particular location, use a scientifically sound approach that considers the available bird habitats, which migratory bird species are likely to be encountered in such habitats, and the time periods when they would likely be present. This will help you plan work activities to avoid having an impact on nesting birds. Nest search techniques are not recommended because, in most habitats, the ability to detect nests remains very low while the risk of disturbing active nests is high. Flushing nesting birds increases the risk of predation of the eggs or young, or may cause the adults to abandon the nest or the eggs. Therefore, except when the nests searched are known to be easy to locate without disturbing them, active nest searches are generally not recommended; they have a low probability of locating all nests, and are likely to cause disturbance to nesting birds. In many circumstances, incidental take is likely to still occur during industrial or other activities even when active nest searches are conducted prior to these activities.

Recommendations:

- In some cases proponents may be able to carry out nest searches successfully, if:
    - They are conducted by skilled and experienced observers using appropriate methodology
    - They are searching simple habitats (often in man-made settings) with only a few likely nesting spots or a small community of migratory birds. Examples include:
        - An urban park consisting mostly of lawns with a few isolated trees;
        - A vacant lot with few possible nest sites;
        - A previously cleared area where there is a lag between clearing and construction activities (and where ground nesters may have been attracted to nest in cleared areas or in stockpiles of soil, for instance); or
        - A structure such as a bridge, a beacon, a tower or a building (often chosen as a nesting spot by robins, swallows, phoebes, Common Nighthawks, gulls and others).

- Proponents may use nest searches when looking for:
    - Conspicuous nest structures (such as nests of Great Blue Herons, Bank Swallows, Chimney Swifts);
    - Cavity nesters in snags (such as woodpeckers, goldeneyes, nuthatches); or
    - Colonial-breeding species that can often be located from a distance (such as a colony of terns or gulls).

- If the proponent is required to further investigate and determine the presence of breeding birds, they should consider conducting an area search for evidence of nesting (e.g., presence of birds in breeding habitat through observation of singing birds, alarm calls, distraction displays) using non-intrusive search methods to prevent disturbance to migratory birds. In the case of songbirds, for example, “point counts” (a technique to locate singing territorial males) may provide a good indication of the presence of nests of these birds in an area. Please contact Environment and Climate Change Canada’s Canadian Wildlife Service office in your region for further technical information about investigation methods for non-song bird species (notably, waterfowl, waterbirds and shorebirds).

Contaminant Spills, Leaks, and Releases

Under the federal Migratory Bird Regulations, "no person shall deposit or permit to be deposited oil, oil wastes or any other substance harmful to migratory birds in any waters or any area frequented by migratory birds." Contaminant leaks and spills may directly or indirectly cause incidental take if released into areas frequented by migratory birds. Biodegradable alternatives to petroleum-based chainsaw bar oil and hydraulic fluid for heavy machinery are commonly available from major manufacturers. Such biodegradable fluids should be considered for use in place of petroleum products whenever possible, as a standard for best practices Provisions for wildlife response activities should be identified in the Oil Spill Prevention and Response Plan to ensure that pollution incidents affecting Wildlife are effectively and consistently mitigated. The document "Birds and Oil – CWS Response Plan Guidance" is attached and is provided to offer guidance on the development of wildlife response activities.

Recommendations:

- The proponent must ensure that all precautions are taken by the contractors to prevent fuel leaks from equipment, and that a contingency plan in case of oil spills is prepared.
- The proponent should ensure that contractors are aware that under the MBR, "no person shall deposit or permit to be deposited oil, oil wastes or any other substance harmful to migratory birds in any waters or any area frequented by migratory birds."
- The proponent should ensure that fueling and servicing of equipment does not take place within 30 meters of environmentally sensitive areas, including shorelines and wetlands.
- During site remediation, the proponent should ensure that no contaminated soils are permitted to enter any waterbodies frequented by migratory birds. If there is any noticeable change in numbers of any migratory bird species at the project site, EC-CWS should be contacted for further advice.
- The proponent should prepare, and implement, a Spill Prevention and Response Plan, which includes:
    - Mitigation measures to deter migratory birds from coming into contact with contaminants.
    - Mitigation measures to be undertaken if migratory birds and/or sensitive habitat becomes contaminated.
    - The type and extent of monitoring that would be conducted in relation to various spill events.

Noise Disturbance

Anthropogenic noise produced by construction and human activity can have multiple impacts on birds, including causing stress responses, avoidance of certain important habitats, changes in foraging behavior and reproductive success, and interference with songs, calls, and communication. Activities that introduce loud and/or random noise into habitats with previously no to little levels of anthropogenic noise are particularly disruptive.

Recommendations:

- The proponent should develop mitigations for programs that introduce very loud and random noise disturbance (e.g. blasting programs) during the migratory bird breeding season for their region.
- The proponent should, where possible, prioritize construction works in areas away from natural vegetation while working during the migratory bird breeding season. Conducting loud construction works adjacent to natural vegetation should completed outside the migratory bird breeding season.
- The proponent should keep all construction equipment and vehicles in good working order and loud machinery should be muffled if possible.

Invasive Species

Measures to diminish the risk of introducing invasive species should be developed and implemented during all project phases.

Recommendations:

- Proponents should clean and inspect construction equipment prior to transport to ensure that no vegetative matter is attached to the machinery (e.g., use of pressure water hose to clean vehicles prior to transport).
- Proponents should regularly inspect equipment prior to, during and immediately following construction in areas found to support Purple Loosestrife to ensure that vegetative matter is no transported from one construction area to another.
- Proponents should prepare a weed management strategy that would describe when and how invasive plant species will be prevented from establishing on their site/lease.

Killdeer

Killdeer (Charadrius vociferous) are attracted to open gravel habitats, and can place nests in human-built or human-modified environments such as parking lots, cleared areas, and gravel pits.

Recommendations:

- The proponent should ensure that project staff are aware of the potential of killdeer nests in active industrial or development areas.

- If a nest is suspected or discovered, the proponent should conduct no activities around the nest that might cause the nest to be destroyed or abandoned. Activities should be suspended until the chicks have fledged and left the area.

Species at Risk

Federally listed species at risk protected under the Species at Risk Act (SARA). The list of species protected by the SARA can be found at https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html. Under S79. (1) of the SARA, "every person who is required by or under an Act of Parliament to ensure that an assessment of the environmental effects of a project is conducted, and every authority who makes a determination under paragraph 67(a) or (b) of the Canadian Environmental Assessment Act, 2012 in relation to a project, must, without delay, notify the competent minister or ministers in writing of the project if it is likely to affect a listed wildlife species or its critical habitat."
The person must also identify adverse effects of the project on listed species and their critical habitat. If the project is then implemented, the person must ensure that measures are taken to avoid or lessen adverse effects and that effects are monitored. Mitigation measures must be consistent with recovery strategies and action plans for the species.

Under Section 32 of the SARA describes general prohibitions related to the killing, harming, etc. of listed wildlife species:

- 32 (1) No person shall kill, harm, harass, capture or take an individual of a wildlife species that is listed as an extirpated species, an endangered species or a threatened species.

- 32 (2) No person shall possess, collect, buy, sell or trade an individual of a wildlife species that is listed as an extirpated species, an endangered species or a threatened species, or any part or derivative of such an individual.

- 32 (3) For the purposes of subsection (2), any animal, plant or thing that is represented to be an individual, or a part or derivative of an individual, of a wildlife species that is listed as an extirpated species, an endangered species or a threatened species is deemed, in the absence of evidence to the contrary, to be such an individual or a part or derivative of such an individual.

Under Section 33 of the SARA describes general prohibitions related to the damage or destruction of residences of listed wildlife species:

- 33 No person shall damage or destroy the residence of one or more individuals

of a wildlife species that is listed as an endangered species or a threatened species, or that is listed as an extirpated species if a recovery strategy has recommended the reintroduction of the species into the wild in Canada.

It is the responsibility of the proponent to ensure that activities are managed so as to ensure compliance with the SARA and associated regulations.

Presence of Species at Risk and Residences

The following species at risk may occur within the study area: Snapping Turtle, Little Brown Myotis, Northern Myotis, Canada Warbler, Common Nighthawk, Olive-sided Flycatcher, Eastern Wood Pewee, Bobolink, Rusty Blackbird, Barn Swallow, Bank Swallow. The confirmed presence of the species will require mitigations.

Bank Swallow

Bank Swallows (Riparia riparia) are listed as Threatened under Schedule 1 in the SARA . They are small insectivorous and highly social birds and tend to breed in a wide variety of natural habitats, but also at artificial sites with vertical banks (e.g. aggregate pits, road cuts, and stock piles of soil). They tend to breed in colonies ranging from several pairs to a few thousand. In Canada, the Bank Swallow and its nests and eggs are protected under the MBCA. Additionally, under the SARA, Bank Swallows have one type of residence: the occupied burrow. Therefore, any activity that damages or destroys the functions of an occupied burrow would constitute damage or destruction of the residence. These activities include, but are not limited to:

- damaging or destroying the burrow;
- blocking access to the burrow;
- changing the slope of the vertical face used for nesting;
- adding, moving or removing material from the vertical face causing the burrow to collapse or to be filled; or
- any other activity that would destroy the function of the burrow.

The presence of a nesting colony should be confirmed from the bottom of the vertical face, or otherwise in front of the face, as the occurrence and size of the colony can be easily overlooked from the top of the bank above the colony. The presence of a residence can be identified by one or more Bank Swallows entering or leaving a burrow, or the presence of young at the burrow entrance. The occupancy of a burrow can be confirmed from a single observation described above.

Recommendations:

- The proponent should be aware of the risk of nesting bank swallows in their project footprint, and should educate site workers about this risk, and what constitutes a contravention of the SARA and the MBCA.
- The proponent should manage site activities to reduce the risk of bank swallows initiating a colony within their project footprint.

- The proponent is required to understand what constitutes an active bank swallow residence.

- The proponent must protect bank swallow colonies that establish within their project footprint until such a time the colony is no longer active.

Barn Swallow

Barn Swallows (Hirundo rustica) are listed as Threatened under Schedule 1 in the SARA. It is a medium-sized songbird and is closely associated with human rural settlements and human-built infrastructure. The Barn Swallow is social throughout the year, but may nest individually or in groups. Nests are placed in small, loose colonies that usually contain no more than about 10 pairs. Nests are built largely of mud pellets. Regional surveys in the Maritimes show significant population declines over the long term. In Canada, the Barn Swallow and its nests and eggs are protected under the MBCA. Additionally, under the SARA, Barn Swallows have one type of residence: the nest. Any activity that damages or destroys the functions of the nest would constitute damage or destruction of the residence. These activities include, but are not limited to, moving, damaging or destroying the nest; blocking access to the nest; disturbing the nest; or any other activity that would damage or destroy the functions of the nest. Under SARA, the nest, occupied or not, is considered a residence from May 1st or the date when adults are first seen building or occupying the nest, whichever is earlier, to August 31st or the date when a bird is last seen at the nest, whichever is later.

Recommendations:

- The proponent, and their employees, should be aware of the risk of nesting barn swallows in their project footprint, and should educate site workers about this risk, and what constitutes a contravention of the SARA and the MBCA.

- The proponent is required to understand what constitutes an occupied barn swallow residence.

- The proponent must protect barn swallow nests within their project footprint until such a time the residence is no longer active.

Common Nighthawk

Common Nighthawks (Chordeiles minor) are a Schedule 1 listed Threatened species under the SARA, and its nests and eggs are protected under the MBCA. Common Nighthawks may choose nest sites in open areas (e.g. gravel or sand) or cleared areas (e.g. forest harvest blocks, recent cleared land, and recent burns) in a wide range of habitats and a variety of substrates. Common Nighthawks may establish nest sites in newly cleared habitats, such as lands cleared for industrial development.

Recommendations:

- The proponent should ensure cleared areas do not have any Common Nighthawk nests

- The proponent will have to ensure any Common Nighthawk nests that are established in the project area are protected and that the young are able to fledge.

Little Brown Myotis, Northern Myotis, Tri-colored Bat

Little Brown Myotis (Myotis lucifugus), Northern Myotis (Myotis septentrionalis), and Tri-colored Bat (Perimyotis subflavus) are small, insectivorous bats that are listed as Endangered on Schedule 1 of the SARA. A partial identification of critical habitat has been published in the federal recovery strategy. Outside of the listed critical habitat, other habitat features such as maternity roosts are important to the maintenance and recovery of the species.

Recommendations:

- Though unlikely, if active maternity roosts are encountered within the project area, they should be identified, buffered, and avoided until roosting has been completed.
- Little Brown Myotis may use buildings and other anthropogenic structures to roost (particularly for maternity roosting). Though unlikely, the proponent should avoid causing any direct mortalities to these bats, as well as not block off access of nursing females to their pups or trap bats inside structures.

Wetlands

ECCC-CWS recommends that the project proponent follow the mitigation options outlined in the Federal Policy on Wetland Conservation (FPWC). The FPWC was introduced "to promote the conservation of Canada's wetlands to sustain their ecological and socio-economic functions, now and in the future". The policy recognizes the importance of wetlands to the environment, the economy and human health, and promotes a goal of No Net Loss of Wetland Function as a result of the Government of Canada exercising a duty, function, or power in areas of Canada where wetland loss has reached critical levels. In support of this goal, the FPWC and related implementation guidance identify the importance of planning, siting and designing a project in a manner that accommodates a consideration of mitigation options in a hierarchical sequence – avoidance, minimization, and as a last resort, conservation allowances (i.e. compensation). A copy of the FPWC can be found at: http://publications.gc.ca/pub?id=9.686114&sl=0.

Recommendations:

- Developments on wetlands should be avoided.
- If a proponent does plan to develop in the vicinity of wetlands, a minimum vegetation buffer zone of 30 meters should be maintained around existing wetland areas.
- The proponent should ensure that the hydrological function of the wetland is maintained.
- The proponent should direct runoff from development away from wetlands.

- The proponent should use of a 30 meter buffer from the high water mark of any water body (1:100 year Flood Zone) in order to maintain movement corridors for migratory birds. Please see https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/reduce-risk-migratory-birds.html for further information concerning buffer zones.

Cumulative Effects

Cumulative effects are changes to the environment that are caused by an action in combination with other past, present and future human actions. ECCC-CWS needs to be informed in order to make appropriate consideration of effects due to projects.

Project Footprint

Recommendations:

- The proponent should provide ECCC-CWS a GIS file of the project boundaries and study area so that the project can be mapped.

If you have any questions, please let me know.

Suzanne Wade

Environmental Assessment Analyst, Environmental Stewardship Branch
Environment and Climate Change Canada/Government of Canada
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Environnement et Changement climatique Canada / Gouvernement du Canada
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Birds and Oil - CWS Response Plan Guidance

In all circumstances where a polluter is identified the burden of cleanup and response lies with the polluter. However, responsibility for government overview of a response to an oil spill depends on the source of the spill. The identified **lead agency** has responsibility to monitor an oil spill response and to take control if an appropriate response is not undertaken by a polluter or their agent.

Lead agency responsibilities lie with:

- **Environment and Climate Change Canada**
  - For spills and incidents on federal lands and from federal vessels.
  - Potentially for land-based incidents in waters frequented by fish.
  - May take lead if environment is not being protected by other leads, Cabinet Directive 1973.
- **Canadian Coast Guard**
  - For spills from ships.
  - All spills of unknown sources in marine environment.
- **Provincial Department of Environment**
  - For spills from land-based sources.
- **Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) and Canada-Nova Scotia Offshore Petroleum Board (C-NSOPB)**
  - For spills related to offshore oil and gas exploration and production.
- **Transport Canada**
  - To investigate ship source and mystery spills in the marine environment.

The Canadian Wildlife Service of Environment and Climate Change Canada (ECCC-CWS) has the responsibility for licensing activities which involve the handling or disturbance of birds, and of providing advice and often direction to other agencies, responders and the polluter during oil spill incidents.

1. Hazing[1]

Purpose: Prevent birds from coming in contact with oil

Options:

- Hazing by helicopter.
- Hazing by a fast response cutter (FRC) or other watercraft.
- Release of scare devices (e.g. Breco Buoys, Phoenix Wailer).
- Use of hazing sound makers: propane cannons, whizzers, bangers, pyrotechnic devices etc.

Scare devices have a limited range of influence and likely are not a viable option with a large slick. Use of Breco Buoys and Phoenix Wailers can be used but we consider them to be largely ineffective in the situation of a large slick. Logistically, helicopter hazing would be

[1] There are several scare techniques which may be effective and do not require a permit, however a permit under the Migratory Bird Regulations **is required** for the use of aircraft or firearms (defined as capable of emitting at projectile at more than 495 feet per second). Propane cannons, blank pistols or pyrotechnical pistols firing crackers shells with **less than 495fps are legal without a permit**. Most scare tactics are relatively short lived in terms of effectiveness as birds acclimatize to the disturbance so scare techniques should be alternated to be effective.

difficult unless it was possible for a helicopter to remain on a platform offshore overnight. Hazing by FRC or other vessels would be ideal.

Short-term focused hazing by the most expedient means should be attempted to move the birds away from the slick, if logistical conditions permit. Vessels at the site should have the ability to use sound makers (propane canons, pyrotechnic devices) to disperse birds in local areas. Such equipment should be deployed immediately to these ships with trained personnel to operate them. The vessels on site should be tasked to actively search and monitor for congregations of birds which could be vulnerable to oiling. If such groups are found then attempts should be made to disperse the birds away from the oil.

2. Disperse oil

Purpose: Prevent birds from contacting oil by getting oil off the surface of the water as soon as possible.

Options:

- Dispersants.
- Mechanical dispersal with FRCs or other vessels.
- Natural dispersal by environmental conditions.

For small spills, mechanical dispersal would be the preferred method.

3. Bird Collection[2]

Purpose: Implement a humane response to oiled birds as required by Environment and Climate Change Canada's National Policy on Oiled Birds and Oiled Species at Risk.

Options:

- The only option would be a ship-based effort to detect and collect dead and live oiled birds, both within the slick and adjacent to it.

All vessels in or near the slick should understand the need to collect birds. All vessels should have dip-nets, large plastic collecting bags to hold dead birds, and cloth bags or cardboard boxes in which to hold live oiled birds. Efforts should be made to retrieve live oiled birds to ensure they are dealt with humanely.

4. Wildlife monitoring

Purpose: Determine potential impact of spill.

Options:

- Ship-based surveys for oiled and unoiled wildlife.
- Aerial surveys for oiled and unoiled wildlife. Will require structured surveys (e.g. strip or transect surveys of spill area).
- Placement of ECCC-CWS staff on vessels and aircraft.

[2] Only those individuals authorized to do so (nominee on an existing federal permit issued under the Migratory Bird Regulations) can be involved with the collection of migratory birds.

Dedicated ship-based bird surveys should be initiated immediately. Ideally arrangements should be made to have a ECCC-CWS observer on vessels or flights. In addition trained seabird observers need to be placed on all vessels monitoring a slick. This should continue until the slick is dispersed.

5. Beached Bird Surveys

Purpose: Determine impact of spill on wildlife and retrieve any live oiled wildlife on beaches.

Options:

- Conduct daily beached bird surveys during the incident and until one week after slick has been removed or dissipated.

ECCC-CWS or other government officials (CCG, Enforcement Officers) will oversee the collection of dead and live oiled birds[3] as instructed in ECCC-CWS' protocol for collecting birds during an oil spill response. This would only be required in circumstances where a large number of birds are potentially oiled or if the spill occurs in a sensitive area.

6. Drift Blocks

Purpose: Drift blocks may be deployed in slick to provide an estimate of bird mortality.

Options:

- Release from vessel.
- Release from aircraft.

The deployment of drift blocks would only be expected if there was a large spill and blocks should be released as soon as possible after a spill (ECCC-CWS should be consulted to determine protocol for drift block deployment and tracking). The polluter or their agent would be expected to ensure drift blocks are tracked and collected as appropriate.

7. Live oiled bird response[3]

Purpose: Implement a humane response to oiled birds as required by Environment and Climate Change Canada's National Policy On Oiled Birds And Oiled Species at Risk.

Options:

- Rehabilitation.
- Euthanization.

ECCC-CWS will be consulted to determine the appropriate response and treatment strategies which may include cleaning and rehabilitation or euthanization. ECCC-CWS policy specifically requires that species at risk or other species of concern be rehabilitated.

[3] Only those individuals authorized to do so (nominee on an existing federal permit issued under the Migratory Bird Regulations) can be involved with the collection of migratory birds.

From: @easthants.ca
To: Environment Assessment Web Account
Subject: Proposed Project Comments
Date: September 20, 2019 9:02:50 AM

Project: highway.102.aerotech.connector.road.project Comments: Good day, I am writing to you as the Environmental Engineering Technician for the Municipality of East Hants, on behalf of our Source Water Protection Advisory Committee EHSWPAC. We ask that you please take our drinking water source, the Grand Lake Watershed, into consideration during your Environmental Assessment. The EHSWPAC wants to stress the need for watershed protection, following proper Nova Scotia Environment protocols regarding acid rock drainage, and sedimentation during construction. Thank you very much for listening to our concerns, The East Hants Source Water Protection Advisory Committee. Name: Email: @easthants.ca

Native Council of Nova Scotia

The Self-Governing Authority for Mi'kmaq/Aboriginal Peoples residing Off-Reserve in Nova Scotia throughout traditional Mi'kmaq Territory

"Going Forward to a Better Future"

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www.ncns.ca

Aboriginal/Treaty Rights Negotiations Facilitating Directorate

NCNS Citizenship Information Office

Education & Student Services

Rural & Native Housing Group

Aboriginal Peoples Training & Employment Commission (APTEC)

Netukulimkewe'l Commission

Wenjikwom Housing Commission

Social Assistance Recipient Support for Employment & Training (SARSET)

Micmac Language Program

Native Social Counselling Agency

Child Help Initiative Program (CHIP)

E'pit Nuji Ilmuet Program (Prenatal)

Aboriginal Homelessness Program

Parenting Journey Program

Youth Outreach Program

Mi'Kma'ki Environments Resource Developments Secretariat (MERDS)

September 24, 2019

Mr. Peter Fleming
Environmental Analyst
Environmental Services
NS Transportation and Infrastructure Renewal
1672 Granville Street
PO Box 186
Halifax, Nova Scotia
B3J 2N2

RE: Environmental Assessment of Connector Road between Highway 102 Aerotech Interchange (Exit 5A) and Trunk 2 at Wellington

Dear Mr. Fleming,

The Native Council of Nova Scotia was organized in 1974 and represents the interests, needs and rights of Off-Reserve Status and Non-Status Section 91(24) Indians/Mi'kmaq/Aboriginal Peoples continuing on our Traditional Ancestral Homelands throughout Nova Scotia as Heirs to Treaty Rights, Beneficiaries of Aboriginal Rights, with Interests to Other Rights, including Land Claim Rights.

The Native Council of Nova Scotia Community of Off-Reserve Status and Non-Status Indians/Mi'kmaq/Aboriginal Peoples supports projects, works, activities and undertakings which do not significantly alter, destroy, impact, or affect the sustainable natural life ecosystems, or natural eco-scapes formed as hills, mountains, wetlands, meadows, woodlands, shores, beaches, coasts, brooks, streams, rivers, lakes, bays, inland waters, and the near-shore, mid-shore and off-shore waters, to list but a few, with their multitude of in-situ biodiversity.

Our NCNS Community has continued to access and use natural life within those ecosystems and eco-scapes where the equitable sharing of benefits arising from projects and undertakings serve a beneficial purpose towards progress in general and demonstrate the sustainable use of the natural wealth of Mother Earth, with respect for the Constitutional Treaty Rights, Aboriginal Rights, and Other Rights of the Native Council of Nova Scotia Community continuing throughout our Traditional Ancestral Homeland in that part of Mi'kma'ki now known as Nova Scotia.

We are disappointed that a provincial department, whom we have consulted with on multiple occasions, has neglected to include the Native Council of Nova Scotia in their

"Consultation of the Mi'kmaq of Nova Scotia". We assert that as heirs of treaty rights and beneficiaries of Aboriginal rights there is an obligation to consult with our community just as there is an obligation to consult with the *Indian Act* bands. Nonetheless, this letter contains the views, comments and concerns of the NCNS, shared through the channel of public stakeholders.

Bat Survey

Why were survey points one and two only deployed for such short periods? Survey points three and four recorded a number of sequences and it seems that the bats are not just "potentially" present, but certainly present at least for short periods. If bats are present and feeding in this area, destruction of these wetlands may remove a food source and prove detrimental to the wellbeing of one or more endangered bat species.

Wetlands

The written description of wetland degradation appears accurate, but it doesn't seem to align with the categorization of impacts. Looking at the residual effects table, one would think that these wetlands are going to be carefully picked up and placed outside of the project area, with no evidence of the change. It's disingenuous. The infilled area, according to your own numbers, is 6.13 hectares. This is just under the size of the single largest wetland in the local study area. The wetland areas that are partially infilled will not necessarily rebound to their pre-disturbance state. Wetlands adjacent to those wetlands may bear an adverse impact. Your own description states that "a significant adverse effect from the Project on wetlands is defined as an effect that is likely to cause a permanent net loss of flora and wetland function as established during the wetland evaluation." Reducing wetland area by ~17%, changing hydrology, removing vegetation and potentially introducing sediment and nutrients will certainly cause a permanent net loss of flora and wetland function, regardless of mitigation measures. Compensating by restoring a salt marsh 45 kilometers away does not change this fact. Justifying this removal by claiming that there is "similar habitat and priority plants in the region" is not a sound argument, and neither is claiming that the area is "affected by past/adjacent human activity". This is habitat that, by your own account and the Mi'kmaq Ecological Study provided, appears to be healthy. This is habitat that may contain endangered species such as *myotis* and the snapping turtle. This is how habitat loss is allowed to happen. It's chipped away a few hectares at a time, until one day there is no longer similar habitat in the region. If it is decided that this project should proceed, the proponent should at least be honest when taking an account of the ecological cost.

Recommendations

In TIR's public consultation "wildlife and wetland disturbance" was one of the most prominent concerns. We believe these concerns are well founded. We recommend an alternate location, if possible, that avoids this wetland region. We also recommend a more localized offset project, that directly benefits habitat in the immediate region. We would also like to invite the proponent to our Truro Heights Office to discuss the project and share with them the background of the Native Council of Nova Scotia and the Maritime Aboriginal Peoples Council, as well as the history of the Off-Reserve Indigenous Community in Nova Scotia. To arrange such a meeting please contact me at

Going Forward To
A Better Future

Habitat Impact Assessment Manager
Maritime Aboriginal Peoples Council

DJ:mb

Cc: Chief and President, NCNS
Commissioner, Netukulimkewe'l Commission
NCNS BOD
Director of Intergovernmental Affairs, MAPC
Director, IKANAWTIKET
Aquatic Resources Manager, MAARS
Project Manager, Wood Environment and Infrastructure Solutions

October 10, 2019

Honourable Gordon Wilson
Minister of Environment
Nova Scotia Environment
PO Box 442
Halifax, NS B3J 2P8

Re: Aerotech Connector through Collin's Park Public Drinking Water Supply Area.

Dear Minister Wilson:

On behalf of the **Collin's Park Watershed Advisory Committee** (Committee), please accept this letter with respect to the Nova Scotia Department of Transportation and Infrastructure Renewal **Highway 102 Aerotech Connector Road Project Environmental Assessment** (EA).

The Committee would like you to be aware that the Aerotech Connector Road Project (Connector Road) is within the Intake Protection Zone of the **Collin's Park drinking water supply watershed area** (see Map attached), which is Halifax Water's drinking water supply source for 83 service connections in the Collin's Park subdivision and the Wellington community.

As stated in A Drinking Water Strategy for Nova Scotia, the first step in the barrier approach to protecting source water supplies is to keep clean water clean to "prevent contaminants from entering drinking water sources in the first place". To this end, this letter itemizes three potential negative impacts the Committee is concerned the Connector Road may impose on the surface water quality of the source water supply – Lake Fletcher – as a consequence of its development and subsequent use, and questions how the Connector Road was determined to alleviate traffic congestion in Fall River, as follows:

1. As stated in the EA Appendix A: Acid Rock Management document: "Due to the characteristics of the geological environment along the Connector Road corridor it is expected that sulphide-bearing rock material will be encountered during the cut and fill activities. In accordance with the Nova Scotia *Sulphide Bearing Material Disposal Regulations* this will require the development and approval of an ML/ARD Management Plan." (p. 11)

The Committee wants to be assured that the implementation of a comprehensive Metal Leaching and Acid Rock Drainage (ML/ARD) Management Plan will be sufficiently and effectively applied; as outlined in the EA Appendix A: Acid Rock Management document.

2. As stated in the EA Registration document, "[u]navoidable impacts on wetlands and watercourses will be minimized based on best management practices, and compensation and offset measures, where required". (p. iii)

The Committee would prefer that the impacts on wetlands and watercourses be avoided considering the EA Appendix B: Wetland Assessment states that:

   a. "All wetlands scored Moderate to High in benefit [in the Hydrologic Group Wetland Score], largely because of their high position in the watershed, and their proximity to an urban area (Wellington and the airport). In these circumstances, water storage is valuable, as it prevents flooding to the urban zones." (p. 21);

   b. "Wetlands 10 and 12 scored High/High for the Water Purification Group, demonstrating they are effective at intercepting, retaining, and filtering suspended sediments, particulates, and organic matter due to their lack of outlet. Their proximity to residential areas explains why they have a higher benefit score compared to those that scored High/Moderate [of which there were 13 wetlands...]" (p. 22); and

c. "Throughout all the wetlands assessed in the Study Area, functional analysis indicates, in general, **that Nitrate Removal & Retention** and Pollinator Habitat are the most significant functions provided by the wetlands within the Study Area." (Summary section p. 27).

It is important to note that **Nitrates are a significant risk** with respect to drinking water quality.

However, in the event of wetland disturbance, the Committee feels that any wetland compensation be used in the immediate area to replace what is lost.

3. The DRAFT Collin's Park Source Water Protection Plan (SWPP) (available upon request), supported by the Committee, indicates that land use activities (see attached Map of Land Use & Landownership), which increase the risk of spills, erosion and sedimentation, vehicular accidents and fire, are among the highest risk factors to the water supply area.

   The SWPP also indicates where the water supply area watershed (see Map of Collin's Park Intake Protection Zone attached) is most at risk, within which the proposed Connector Road is proposed.

   The Committee recommends that the SWPP be considered and adhered to.

4. Finally, as stated in the EA Registration document on p. 4: "The proposed Connector Road … was determined to be the overall preferred alternative that effectively addresses existing congestion problems and minimizes adverse environmental effects."

This is the most important consideration in making the decision on the route and thus the environmental impacts. However, the proponent does not provide any information on the other alternatives, nor the factors ranked in making this the preferred option. Consequently, it is impossible to judge if it is the best solution.

The Committee wishes to know how building this Connector Road was determined to alleviate congestion problems and what were the other alternatives considered. Only then can comment be provided pertaining to it being the best alternative that warrants adverse environmental effects.

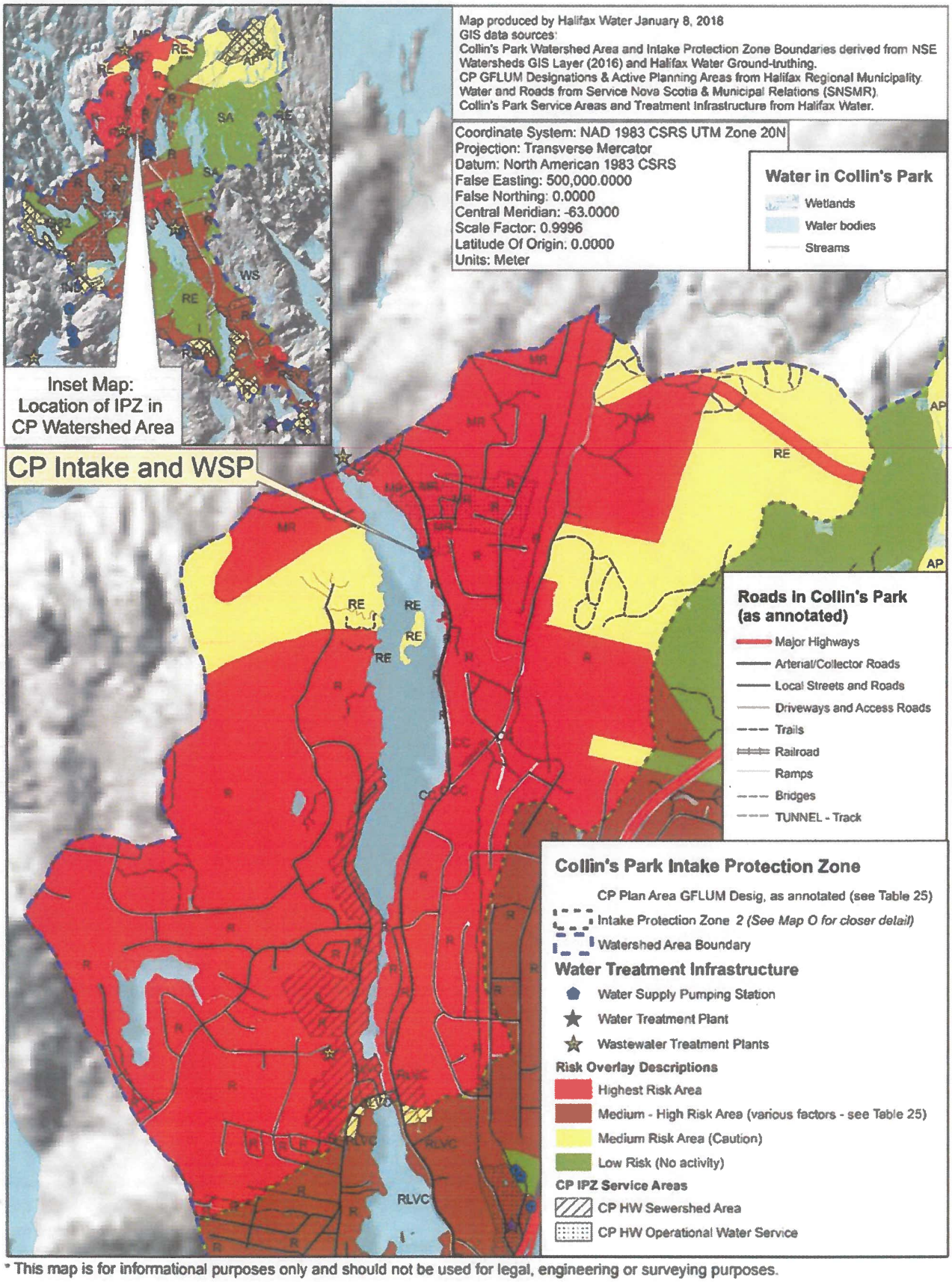
Thank you for considering the Committee's comments, recommendations and questions. We look forward to your response to our letter and to the EA submission. If you have any questions or concerns, please contact Halifax Water at barryg@halifaxwater.ca.

Sincerely,

Chair, CPWAC

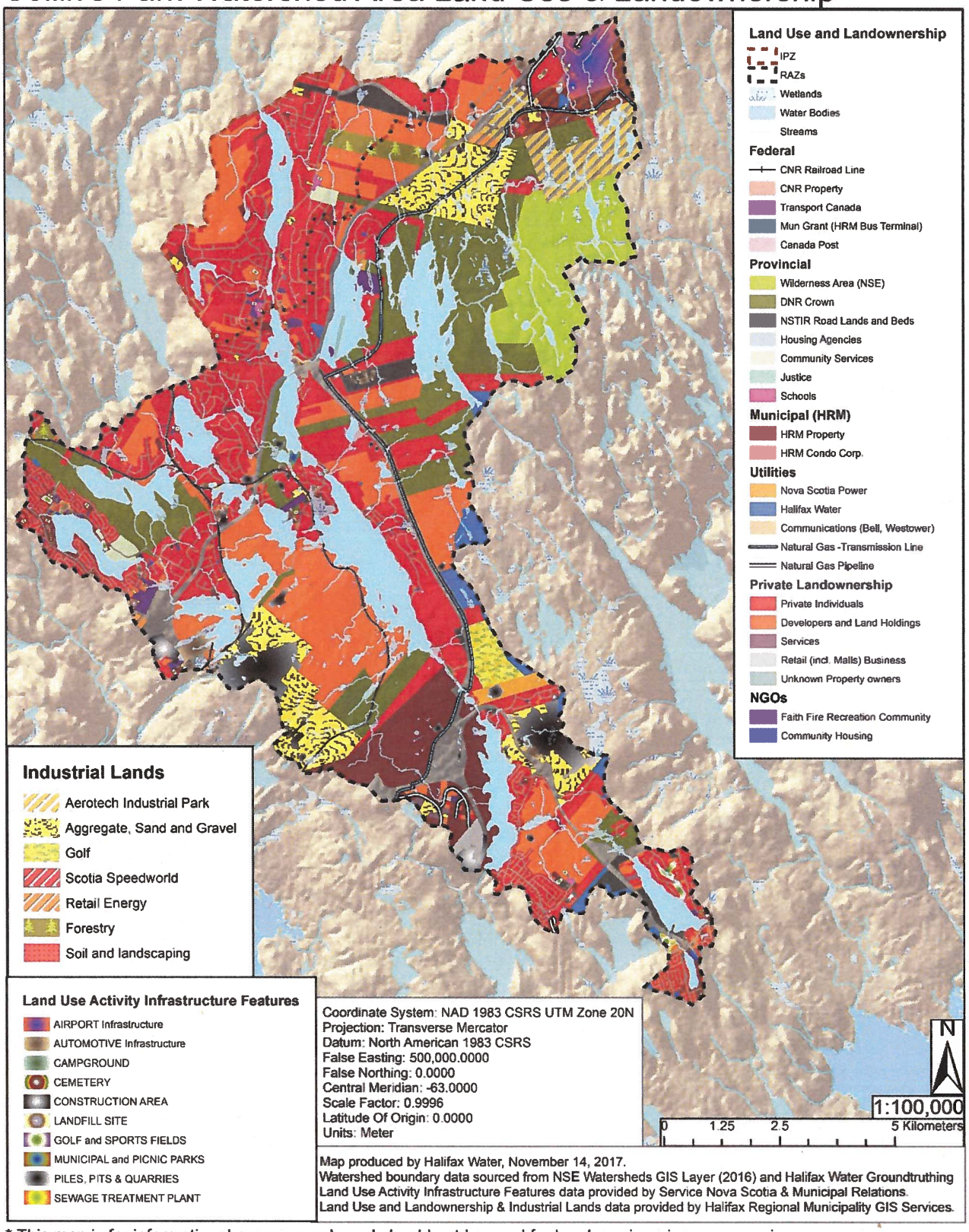
c. Environmental Assessment Branch, Nova Scotia Environment

Collin's Park Intake Protection Zone (IPZ)



* This map is for informational purposes only and should not be used for legal, engineering or surveying purposes.

Collin's Park Watershed Area Land Use & Landownership



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