Keeyask Generation Project

Environmental Impact Statement

Supporting Volume

Physical Environment

Keeyask Hydropower Limited Partnership

June 2012

KEEYASK GENERATION PROJECT

PHYSICAL ENVIRONMENT SUPPORTING VOLUME

AIR QUALITY AND NOISE

June 2012

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3.0 AIR QUALITY AND NOISE

3.1 INTRODUCTION

This section of the Physical Environment Supporting Volume focuses on the potential **effects** of the **Project** on air quality and noise. The Project will be located in a remotely accessible, sparsely populated area. The Project is expected to introduce localized changes to air quality and noise that have the potential to affect local wildlife and resource harvesters. These issues are addressed in this section through a description of the current environmental setting of the local air quality and noise **environment**, and then a characterization of the anticipated noise and air quality effects through **construction** and operation of the Project. The effects on wildlife and resource users are discussed in the Terrestrial Supporting Volume (TE SV) and the Socio-economic Environment, Resource Use and Heritage Resources Supporting Volume (SE SV). This section describes information sources used and the approach and methodology for the particular assessment, and draws conclusions as to Project effects and, where applicable, the proposed **mitigation** and **monitoring** requirements.

The guidelines for preparation of the **Environmental Impact Statement (EIS)** for the Keeyask Project with respect to air quality and noise are summarized in the Keeyask Generation Project EIS: Response to Federal Guidelines document.

3.2 APPROACH AND METHODOLOGY

3.2.1 Overview to Approach

3.2.1.1 Air Quality

Air quality in Manitoba is rated by Environment Canada as "generally good," with the exception of local issues relating to industrial sources or vehicle emissions (Krawchuk and Snitowski 2008).

The approach to considering potential effects of the Project on local air quality consisted of a baseline description of the local air environment, identification of potential pathways of Project construction and operation activities on local air quality, and analysis of the nature and **magnitude** of the potential changes to local air quality. The analysis was based largely on the use of available information, and review of construction and operation practices involving similar facilities. This qualitative approach is necessary due to the absence of site-specific ambient air quality data and is considered adequate to address potential effects of the Project.

In terms of air quality, data from the closest regional monitoring locations in Thompson and Flin Flon was assessed in conjunction with data on wind speed and direction. Potential air pollutants arising from construction and operation activities are expected to include sulphur dioxide (SO_2), carbon monoxide (CO), nitrogen oxides (NOx), volatile **organic** compounds (VOCs), and total suspended particulate matter (PM, PM10, PM2.5).

Construction will involve the use of heavy machinery and construction activities with the potential to generate temporary, localized changes to air quality. Construction activities will generate emissions of particulate matter (PM and dusts), **greenhouse gases** (**GHGs**), nitrogen oxides (NO_x), sulphur dioxide (SO_2) and carbon monoxide (CO). Emissions during the Project construction period will be mainly associated with diesel and gasoline engines in construction equipment, land clearing, ground excavation, drilling and blasting, earth moving operations and construction of the **Generating station (GS)** as well as supporting **infrastructure**.

Air **pollution** estimates for construction equipment are based upon emission factors sourced in EPA AP-42 5th Edition, Section 3.3 "Gasoline and Diesel Industrial Engines."

In the absence of year-to-year summary of heavy vehicle or equipment types used in the Keeyask construction fleet, a total Project atmospheric loading was estimated using available data, including:

- Heating input value of gasoline.
- Heating input value of diesel.
- Density of fuel.
- Construction activity fuel requirement estimates.
- Emission factors from EPA AP-42 (Section 3.3, Table 3.3-1).

This data allows conversion of the estimated total volume of fuel required in construction to a fuel mass, which then allows conversion of the total consumed fuel to a total fuel heat input value expressed as million British thermal units. The total fuel input value is then applied to the EPA AP-42 emission factor data to yield a total mass emitted for each pollutant of interest, namely NO_x, CO, SO_2 and PM_{10}, over the entire construction period.

Dispersion **modelling** of emissions caused by the construction fleet is not feasible because vehicle fleet deployment specifics including vehicle equipment usage, the breakdown of construction vehicle deployment by year of construction, and vehicle specific fuel consumption data are not available at this early stage of the construction planning process. In the absence of modelling, the total Project and annual emission loadings estimates caused by **Project activities** may be examined in the context of the location and timing of the construction activity, and then in comparison with emissions generated by other sectors of ongoing, commonly accepted activities in Manitoba.

The nature of emissions resulting from Keeyask construction activities is such that the sources will be mobile within the construction zone, stationary for short periods of time and will be intermittent, as not all vehicles in the construction fleet will be simultaneously in operation.

3.2.1.2 Noise

Noise is defined as "unwanted sound" (EPA 550/9074-004). Due to the enormous range of sound pressures to which the human ear is sensitive, the raw sound pressure measurement is converted to the decibel scale for purposes of description and analysis. Noise levels are measured in decibel units (dB), generally using a weighting that accounts for human sensitivity to different frequencies, known as the

A scale (dBA). To place decibel units in perspective, the noise level generated by normal conversation is equivalent to about 70 dB.

The decibel is a logarithmic unit, similar to the scale used to measure earthquakes, so when decibels increase in numerical value by a small amount, the noise level that this number represents does not increase by a linear relationship, it increases exponentially. For example, 73 dB is twice as loud as 70 dB. The range of normal human hearing is typically 0 dB to 120 dB.

Most environmental sounds can be described by measures that consider the frequency of the sounds, the overall sound pressure levels, and the variation of these levels with time. Due to the fact that sound pressures that human listeners can detect is highly variable, these levels are measured on a logarithmic scale in units of decibels. Due to this logarithmic scale measurement of sound pressure levels, sound levels cannot be added or averaged arithmetically. In addition, as sound levels of most noises are highly variable with time, and when sound pressure levels are calculated, the instantaneous pressure fluctuations must be integrated over some time period.

This assessment of noise considered activities associated with construction and operation of the Project. Consequently, noise data used in this discussion is sourced from previous studies on typical construction noise levels for specific equipment and construction activities, measured outdoor noise levels associated with a range of urban and rural environments, and individual noise exposure patterns. The sources relied upon for noise data include the U.S. Occupational Safety and Health Administration, and the U.S. EPA's Office of Noise Abatement and Control.

3.2.2 Data and Information Sources

3.2.2.1 Air Quality

The information sources included historical ambient air quality monitoring data from Manitoba Conservation in the general region, and experience from the construction and operation of similar facilities.

Manitoba Conservation, a department of the Government of Manitoba, maintains an ambient air quality-monitoring program for specific locations within the Province of Manitoba. In addition to the Province's set of air quality monitoring stations, a few additional stations have also been established under *The Environment Act* requirements specific to companies with operations in Manitoba. The provincial network of ambient air monitoring stations has been in place since 1968. Manitoba Conservation's Air Quality Division issues annual reports for Manitoba's monitored ambient air quality and the most recent report issued (at the time of this study) covers the years 2003 to 2005 inclusively. Manitoba Conservation's air quality monitoring program includes only dedicated monitors in permanent stations, and these stations fall into the categories of either General/Urban Air Quality or Industrial (source specific) monitoring. Manitoba's monitoring network includes only urban centres such as Winnipeg, Brandon, Thompson and Flin Flon. There are no ambient air quality monitors in remote and/or rural locations.

Environment Canada operates an air quality monitoring station at Flin Flon, Manitoba, where data is gathered on sulphur dioxide, carbon monoxide, nitrous oxide, ozone, particulate matter and volatile organic carbons. Vale conducts regular monitoring of sulphur dioxide and wind speed/direction at nine sites in Thompson and posts results on an internet site.

3.2.2.2 Noise

No noise monitoring data exists for the construction site and surrounding lands adjacent to the proposed Project.

The information sources included in this assessment of noise included data obtained from literature representing typical noise levels in urban and rural environments, and also noise level databases compiled for heavy construction equipment and power tools. The source for these data includes the U.S. EPA's Office of Noise Abatement & Control (USEPA 1978).

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3.2.3 Study Area

The air quality and noise **study area** (the study area) reflects the potential effects of the Project on air quality and noise during construction and operations. The study area for air quality considered regional air quality, in general, from Thompson to Gillam (see Map 1.2-1 in Section 1.0, Introduction). The **local study area** for air quality and noise includes the general **footprint** of the principal generating station structures and **reservoir**, as well as access roads and other supporting infrastructure (see Map 1.2-2 in Section 1.0, Introduction).

3.2.4 Assumptions

It is assumed that the local study area will not undergo development beyond that proposed for completion and operation of the Project as the Project site is not intended or considered for additional industrial or residential development beyond the **scope** of development detailed in the Project Description. Upon completion of the construction phase, the operation of the Project will take place within an environment that can be categorized as relatively undisturbed **boreal** forest.

3.3 ENVIRONMENTAL SETTING

3.3.1 Existing Environment: Air Quality

The Project site is consistent with remote, rural, non-industrialised land, typically considered to be of good to excellent air quality and in compliance with all Manitoba's Ambient Air Quality Guidelines.

The Project is located in the boreal forest region of northern Manitoba, approximately 30 **km** southwest of the Town of Gillam and approximately 180 km northeast of the City of Thompson. There are no publicly available studies describing baseline air quality conditions for the Project site. There are no ambient air quality data monitored for Gillam. An air quality monitoring station is operated at

Thompson; however, air quality data for Thompson can be influenced by the emissions resulting from the operation of one of the largest point source emitters in the province, the Vale smelter. Due to the absence of industrial development in the vicinity of the Project site, it is expected that use of air-quality data for an industrial **community** such as Thompson would not be appropriate for assessing a greenfield future Project site.

The Gillam Airport station (Section 2.3.1.3) indicates winter winds prevail from the west, fall winds prevail from the west/northwest, and spring and summer winds prevail from the northeast. Prevailing winds recorded at the Thompson climate station indicate that emissions originating from Thompson would migrate eastward during most months of the year except for during the period of March through June, when prevailing winds are from the north east. It is not expected that the study area would be subject to **deposition** from industrial facilities in Thompson. The Vale smelter complies with Manitoba regulations regarding air emissions. According to the last Manitoba Conservation State of the Environment Report (1997), Thompson has experienced few episodes of degraded air quality in recent years. Precipitation quality, with respect to acid rain, has remained within acceptable limits in the Boreal Shield. It is not expected that the Study area would be subject to degradation from industrial emissions from Thompson. Existing air quality in Manitoba is considered by Manitoba Conservation to be good in general Krawchuk and Snitowski 2008),and therefore, it is reasonable to believe that air quality at the Project site is good to excellent. The existing air quality at the proposed project site is consistent with remote, rural, non-industrialized land, typically considered to be of good to excellent quality and in compliance with all Manitoba's Ambient Air Quality Guidelines.

As there is no industrial development within the Project site and there are no Pre-project substantive emissions sources in the Project vicinity, the Project site's air quality is influenced primarily by long-range transport of airborne pollutants. Consequently, air quality at the Project site is considered to be representative of remote, relatively isolated and essentially pristine (no urban/rural community development) lands. The existing ambient air **concentrations** of sulphur dioxide (SO_2), carbon monoxide (CO), nitrogen oxides (NO_x) and particulate matter (PM) are expected to be low at the Project site.

Ice fog forms when a cold, dry air mass passes over relatively warmer water. Water evaporates from the water's surface but condenses back into tiny suspended droplets as the cold air becomes saturated. If the air temperature is cold enough, the suspended droplets may freeze to form ice fog. This phenomenon occurs every fall and winter along the open water areas of the Nelson River, but once an ice cover forms, the formation of ice fog will stop. In the areas along the river that stay open for most of the winter, such as upstream of Birthday Rapids and through Gull Rapids, ice fog will continue to form as long as there is open water.

3.3.2 Existing Environment: Noise

Site specific measurements of ambient noise levels within the study area are not available. The Project study area is absent of residential, commercial and industrial development, therefore it is expected that the ambient noise profile would be consistent with isolated, remote northern geographic areas in an undeveloped rural wilderness **landscape**. Consequently, noise data applied in the consideration of noise effects relies upon data obtained from available literature.

Table 3.3-1 lists examples of outdoor sound levels in dB measured at various locations. It should be noted that these sound levels are not regulatory goals, rather they are levels defined by scientific consensus from compiled data sources.

The Local Study Area lacks concentrated urban development and does not contain existing industrial facilities. Anthropogenic sources of noise are expected to be sparsely distributed and intermittent in their occurrence. Anthropogenic noise generated in the area consists of intermittent road traffic near Provincial Road 280, noise from intermittent use of personal transport vehicles on trails (such as snowmobiles and **ATV**s). In addition to intermittent anthropogenic sources of noise known to occur within the Project site, natural sources of noise include localized noise from the water flow within Gull Rapids. Local trappers have stated that the sound of the **rapids** can be heard as far away as 18 km on a quiet evening. Noises associated with developed rural and urban communities are not present at the Project site, as the nearest community, Gillam, is located at a linear distance of approximately 30 km from the Project. The closest community by road access is Split Lake, at a road distance of approximately 74 km from the Project site. Minimal amounts of noise, primarily associated with intermittent ATV/ snowmobile traffic on trails, are expected to exist associated with a number of trap lines in the area, which are used by several families who have cabins in the general area. The acoustic ambient pre-Project environment is expected to experience a noise profile in the range above that found in a natural undeveloped setting but well below that experienced in an agricultural cropland setting. This would place the expected outdoor average sound levels in the range of 35 dB to 45 dB.

Table 3.3-1: Outdoor Sound Levels Measured at Various Locations

Outdoor Location	Average Outdoor Sound Levels (dB)
Apartment next to freeway	88
1 km from touchdown at major airport	82
Downtown with some construction activity	79
Urban high-density apartment	77
Urban row housing on major avenue	68
Old urban residential area	59
Wooded residential	51
Agricultural cropland	44
Rural residential	39
Wilderness ambient	35

Source: Protective Noise Levels: Condensed Version of EPA Levels Document EPA 550/9-79-100

3.3.3 Future Conditions/Trends

3.3.3.1 Local Air Quality

No change to the local air quality is anticipated in a future environment without the Project.

3.3.3.2 Local Noise

Future sound levels expected in the study area environment without the Project would be expected to remain in the current average outdoor day-night range of 35 dB to 45 dB. This would include sounds generated by **flow** of water near watercourses, as well as intermittent small vehicle traffic from personal transport vehicles associated with trapping and other traditional activities.

3.4 PROJECT EFFECTS, MITIGATION AND MONITORING

3.4.1 Construction Period

Construction will take place over approximately an 8.5-year period.

3.4.1.1 Air Quality Effects During Construction

The Project is expected to generate temporary emissions as a result of construction tasks and activities. These include:

1. Upgrading roads and building access roads.
2. Transport traffic involving highway/road shipment of equipment, materials and personnel to support construction activities on-site.
3. Site clearing activities.
4. Construction of Keeyask Dam and Generation facilities.

3.4.1.1.1 Building Access Roads

The Project is expected to generate temporary emissions as a result of construction tasks and activities. The construction of access roads, is expected to cause measurable, but small quantities of exhaust gases and dusts, resulting in air-contaminant loadings to the local air shed. A large portion of these emissions (NO_x, SO_2, CO and PM) will derive from internal combustion gasoline and diesel engines.

The north access road construction is assessed as part of the **KIP** process, while other access roads are considered as part of the Keeyask Project.

Roadwork activities will be short term, linear and localized, and are considered to be relatively low in magnitude.

3.4.1.1.2 Emissions from Highway/Road Transport of Equipment, Materials and Personnel

A breakdown of average daily total traffic flow, stated in terms of total trips, is provided in detail in Section 3.3.3 of the Project Description Supporting Volume. Two scenarios were considered: one assuming 85% of freight is shipped by rail and a second assuming 15% of freight is shipped by rail. The 15% freight shipped by rail scenario was used to generate more conservative emissions estimates due to the fact that this scenario requires additional surface truck shipments/trips along **PTH** 6 to Thompson, which results in higher emissions.

Table 3.4-1 presents a breakdown of Project-related transport traffic by road section for routes servicing the Keeyask site. Values reported for maximum daily trips represent the highest estimate of maximum daily trips predicted over all eight years of Keeyask construction.

Table 3.4-1: Equipment, Materials and Personnel Road Transport: Trip Summary Estimates

Road Section	Description	Trip/Section Linear Distance (km)	Peak Max. Daily Trips (one-way)	Reported Trip Estimates (total driven km)
1	PTH 6 to Thompson	742	50	37,100
2	PR 391-PR 280	10	94	940
3	PR 391-PR 280 Nelson House	65	94	6,110
4	PR 280-PR 391 to Split Lake Junction	124	132	16,368
5	Split Lake Junction to Keeyask Junction	48	132	6,336
6	PR 280 Keeyask Junction to PR 280	84	44	3,696

Heavy-duty commercial vehicles: truck greater than 4.5 tonnes
City fuel consumption = 38.71 l/100 km

Estimates for maximum atmospheric annual loadings caused by transport of equipment, personnel and materials were developed using multiple data sources and assumptions, including:

- Access road route traffic count estimates as provided and summer peak daily trip values.
- Conservatively assuming all vehicular traffic to be "heavy-duty commercial vehicles/trucks" (HDCV) greater than 4.5 tonnes.
- Conservatively applying city fuel efficiency rates for the HDCV vehicle class, as opposed to higher highway driving fuel efficiencies as reported by Transport Canada (Transport Canada 2011).

Table 3.4-2 presents a listing of highest possible daily total peak emissions resulting from Keeyask road transport of equipment, materials and personnel compared to total average daily emissions reported for road transportation sector activities for the entire Province of Manitoba for 2009, the most recent year reported in National Pollutant Release Inventory (NPRI) data (NPRI 2009).

It is expected that due to the inherent conservatism in the Keeyask road transport emission loading estimate (maximum peak daily trips, conservative fuel efficiency ratings, etc.) that actual transport emissions for Keeyask will be smaller than the reported estimates. The maximum potential daily loading due to Keeyask road transport for each reported air contaminant is small in comparison to daily emission loadings derived from total emissions reported to NPRI (2009) for all road transport activities in Manitoba).

Based on the results of these comparisons, it is unlikely that air contaminant emissions from the transport of materials and personnel towards construction of the Keeyask Project will result in frequent exceedances of the ambient air quality objectives and guidelines in the assessment area.

Table 3.4-2: Equipment, Materials and Personnel Road Transport: Emission Estimates

Air Contaminant	Maximum Peak Daily Emissions (tonnes/day)	Average Daily Emissions for MB Road Transport Sector (tonnes/day)
NO_x	2.0	124
CO	0.4	577
SO_x	0.1	0.75
PM_{10}	0.1	7.2

3.4.1.1.3 Site Clearing Activities

One of the first construction activities for the Project will be the clearing of vegetation from various work areas. Clearing activities will begin in 2014 and are expected to continue to varying degrees until the end of construction in 2022. Clearing in the future reservoir area constitutes the largest clearing activity in the Keeyask Project. Initial reservoir clearing will take place before **flooding**, with clearing of trees, snags and shrubs taller than 1.5 m and also woody **debris** on the ground longer than 1.5 m and wider than 15 cm (JKDA, Schedule 11-1). Reservoir clearing will take place using construction machinery and hand tools.

The material cleared from the reservoir has been determined to have no substantial commercial value (see Terrestrial Environment Supporting Volume). Therefore, it will be offered to parties that may be interested in using the material as firewood. Due to the lack of access to, and remoteness of, the study area, it is expected that most cleared material will not be taken as firewood, and therefore will be burned to prevent hazards and **impacts** associated with floating woody debris within the reservoir. The burning will take place in winter and in accordance with relevant permits. The Keeyask GS **Environmental Protection Plan** (**EnvPP**) will outline details such as acceptable conditions for burning (*i.e.,* wind direction is not toward adjacent communities), as well as fire-prevention measures. GHG emissions associated with burning are considered in the Climate section (Section 2.4.2.1) of the PE SV.

Approximately 6 **km^2** of the reservoir is planned to be cleared by hand, and 34 km^2 will undergo machine clearing. Woody debris that is not salvaged will be piled (in the case of hand clearing) or windrowed (in the case of machine clearing) and burned. The clearing is expected to be done over the final three years of construction. Burning of windrows may take place one year after cutting and piling/windrowing, to allow the material to dry out to achieve a more efficient and cleaner burn. Manually piled trees and shrubs may be burned earlier as burn regulations permit.

Table 3.4-3 presents total Keeyask site clearing, emissions (over a 6-year site clearing program) and annual average emission loadings resulting from Keeyask site clearing work. Emission estimate calculations were based upon the estimated fuel requirements for clearing activities (McNeil *pers. comm.* 2010) and EPA AP-42 emission factor data. These values are presented for comparison beside a listing of total annual emissions resulting from road transportation activities for the entire Province of Manitoba for 2009, the most recent year reported by NPRI (2009 National, Provincial and Territorial Emissions Summaries for Key Air Pollutants, including information on subsectors – January 2011).

Comparing the estimated annual Project emissions generated by Keeyask Project site clearing activities with total emissions generated by the Manitoba Road Transport sector in Manitoba for 2009, the predicted estimated emissions from clearing operations are substantially less than emissions associated with road transport activity reported in Manitoba for the year 2009.

For additional context, a comparison of emissions loadings resulting from emissions generated by the operation of all diesel buses within the City of Winnipeg can be applied. Winnipeg Bus Diesel Use estimates are reported in the report "GHG Emissions Baseline for the City of Winnipeg, 2007, Centre for Sustainable Transport, University of Winnipeg." using the reported value of 43,441,161 litres of diesel consumed by buses operating within Winnipeg for the year 2006. EPA AP-42 emission factors can be applied to generate estimates of atmospheric loading resulting from diesel bus use within Winnipeg, allowing comparison with estimates for Keeyask emissions due to site clearing (Table 3.4-3).

Table 3.4-3 indicates the highest estimated total clearing effort emissions to be approximately 9% of those estimated to result from the collective operation of all diesel fuel buses operating in Winnipeg in 2006. On the basis of annual emissions generated for each pollutant listed in Table 3.4-3, Keeyask site annual emissions from site clearing represent less than 2% of the annual emission loading from diesel bus operations in the City of Winnipeg for NO_x, CO, SO_2 and PM.

Table 3.4-3: Emission Estimates for Keeyask Site Clearing Compared to Emission Estimates for Winnipeg Bus Diesel Use (2006)

Air Contaminant	Total Project Clearing Emissions (6 years) (tonnes)	Annual Clearing Emissions (tonnes/year)	Total 2009 Emissions for MB Road Transport[1] (tonnes)	Total 2006 Emissions: Bus Diesel Use in Winnipeg (tonnes/year)
NO_x	275	46	45,101	3,146
CO	59	10	210,498	678
SO_x	18	3	273	207
PM_{10}	19	3	2,638	221

1. Includes heavy-duty diesel vehicles, heavy-duty gasoline trucks, light-duty diesel trucks, light-duty gasoline trucks, light-duty gasoline vehicles and off-road diesel consumption.

3.4.1.1.4 Construction of Keeyask Dam and Generation Facilities

Construction of the Keeyask Generation Project is planned to take eight years to complete. Final construction equipment fleet deployment figures will not be available until after contractor selection has occurred. In order to estimate overall emissions associated with this stage of construction, United States Environmental Protection Agency (USEPA) emission factors were applied to overall fuel requirement estimates prepared for all construction activities occurring under the "Construct Keeyask Dam and Generation Facilities" task. Fuel requirement estimates were reported in the life cycle assessment prepared by the Pembina Institute for Manitoba Hydro (The Pembina Institute, 2012).

When considering Keeyask GS construction activities, estimates were calculated using the fuel requirements reported by the Pembina Institute for activities specific to construction of the Project and EPA AP-42 emission factor data. Table 3.4-4 presents a comparison of the estimates of total Project construction emissions over the 8.5-year construction period, an equivalent annual construction activity emissions loading and total emissions within the Province of Manitoba for the road transport sector as reported in NPRI (2009). Total construction emissions over eight years of construction to build the Keeyask dam and GS facilities are substantially less than emissions to atmosphere resulting from a single year of road transport traffic in Manitoba. Annual emissions associated with **dam** and facility construction are estimated to be highest for NO_x at 382 tonnes per year; however, this is still less than 1% of the annual NO_x loading estimate for road transport within the entire province.

Table 3.4-4: Emission Estimates for Keeyask Dam and Generation Facilities Construction Compared to Emission Estimates for Winnipeg Bus Diesel Use (2006)

Air Contaminant	Total Keeyask Dam and Generation Facilities Construction (8 years) (tonnes)	Annual Keeyask Construction Emissions (tonnes/year)	Total 2009 Emissions for MB Road Transport[1] (tonnes)	Total 2006 Emissions: Bus Diesel Use in Winnipeg (tonnes/year)
NO_x	3,056	382	45,101	3,146
CO	658	82	210,498	678
SO_x	210	25	273	207
PM_{10}	215	27	2,638	221

1. Includes heavy-duty diesel vehicles, heavy-duty gasoline trucks, light-duty diesel trucks, light-duty gasoline trucks, light-duty gasoline vehicles and off-road diesel consumption.

For additional context, Table 3.4-4 also compares the Keeyask Project construction emissions to emissions predicted to result from the collective operation of all diesel fuel buses running in Winnipeg in 2006. On the basis of annual total emission loadings for each pollutant listed in Table 3.4-4, the maximum total annual emissions resulting from construction of the Project represents about 12% of the annual emissions loading generated by diesel bus operating in the City of Winnipeg in a single year.

Note that in addition to the emissions from the operation of equipment, additional atmospheric emissions of VOCs will result from stored fuels and refuelling activities. These emissions are generally intermittent in nature and are minor relative emissions from combustion of these fuels.

3.4.1.2 Summary of Air Quality Effects During Construction

Based on the emission estimates for Keeyask site clearing and construction of the intermittent **durations** and non-stationary nature of construction equipment deployment, and comparisons with commonly accepted emissions such as those resulting from operation of diesel buses within the City of Winnipeg within a given year, it is unlikely that air contaminant emissions from the construction of the Keeyask Project will result in frequent exceedances of the ambient air quality objectives and guidelines for Manitoba in the assessment area.

Dust emissions will vary during the construction period and will be influenced by the level of construction activity, the specific operations and the local weather conditions. The nature of construction is that it consists of a series of different activities and operations, each with its own associated dust emissions. Steps to mitigate the generation of dusts associated with construction include wet suppression.. Acceptable dust-control measures will be used on the roadway, as necessary, to limit the amount of airborne dust. The EnvPP will stipulate appropriate dust control measures to be implemented during the Keeyask construction phase.

Emissions during construction are continuous, **adverse** and will cease after construction is complete. It is unlikely that emissions will be detectable beyond the Local Study Area.

3.4.1.3 Local Noise Effects During Construction

During the construction period, the Keeyask Project will involve six consecutive years of active construction within the study area. Construction activity will cause elevated noise levels within the immediate construction site, with sound propagating away from the origin of the noise and attenuating with distance back to normal ambient noise levels for the local study area. This increased noise level will be short term and limited to the duration of construction, and would be similar to other activities involving large machinery and traffic, including earthmoving operations and large-scale agricultural activities. The majority of construction noise will be generated by sources including earthmoving equipment, materials handling equipment and **concrete/aggregate** processing operations and clearing operations.

Site preparation will involve the operation of relatively light equipment (trucks, chainsaws, etc.) and heavy equipment such as bulldozers, backhoes and large trucks. After the reservoir clearing, there will be haul trucks entering and leaving the site from **borrow areas**. As the **cofferdams** are constructed, blasting, usually during the winter period, will occur at the **quarry sites** and within the approach and discharge channels for the **powerhouse** and **spillway**. Noise levels will be elevated at the site and along the access roads. Blasting will be minimized to the maximum extent feasible from May 15 to June 30, to reduce effects on calving caribou females and their young. Blasting will also be restricted during the bird breeding season (April 1 to July 31) to the extent practicable. Potential effects of noise related to resource use are discussed in the Socio-Economic Environment, Resource Use and Heritage Resources Supporting Volume. Figure 3.4-1 presents a table listing typical construction equipment and their corresponding noise loads. Figure 3.4-2 lists common indoor and outdoor noise sources, which are experienced.

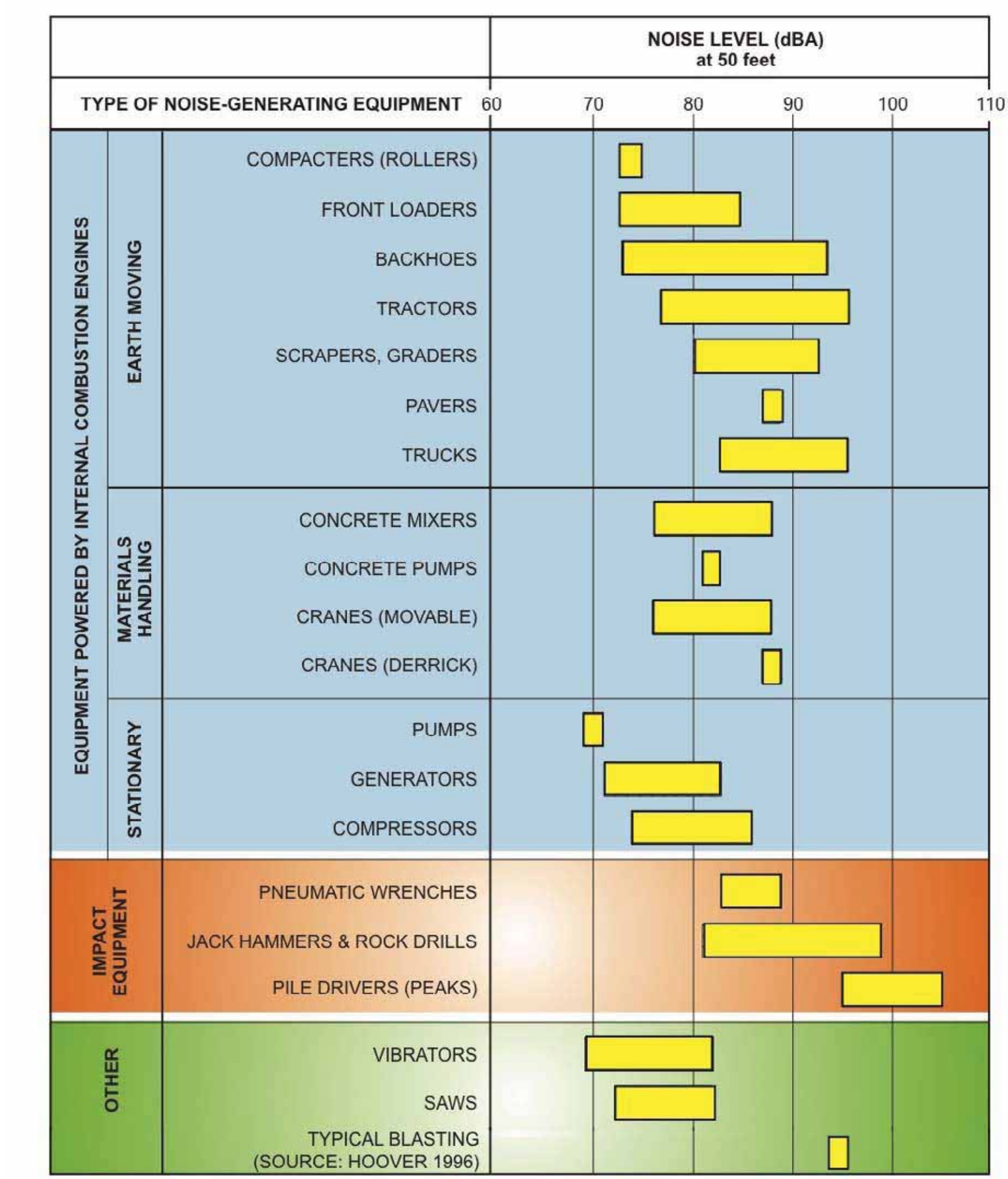
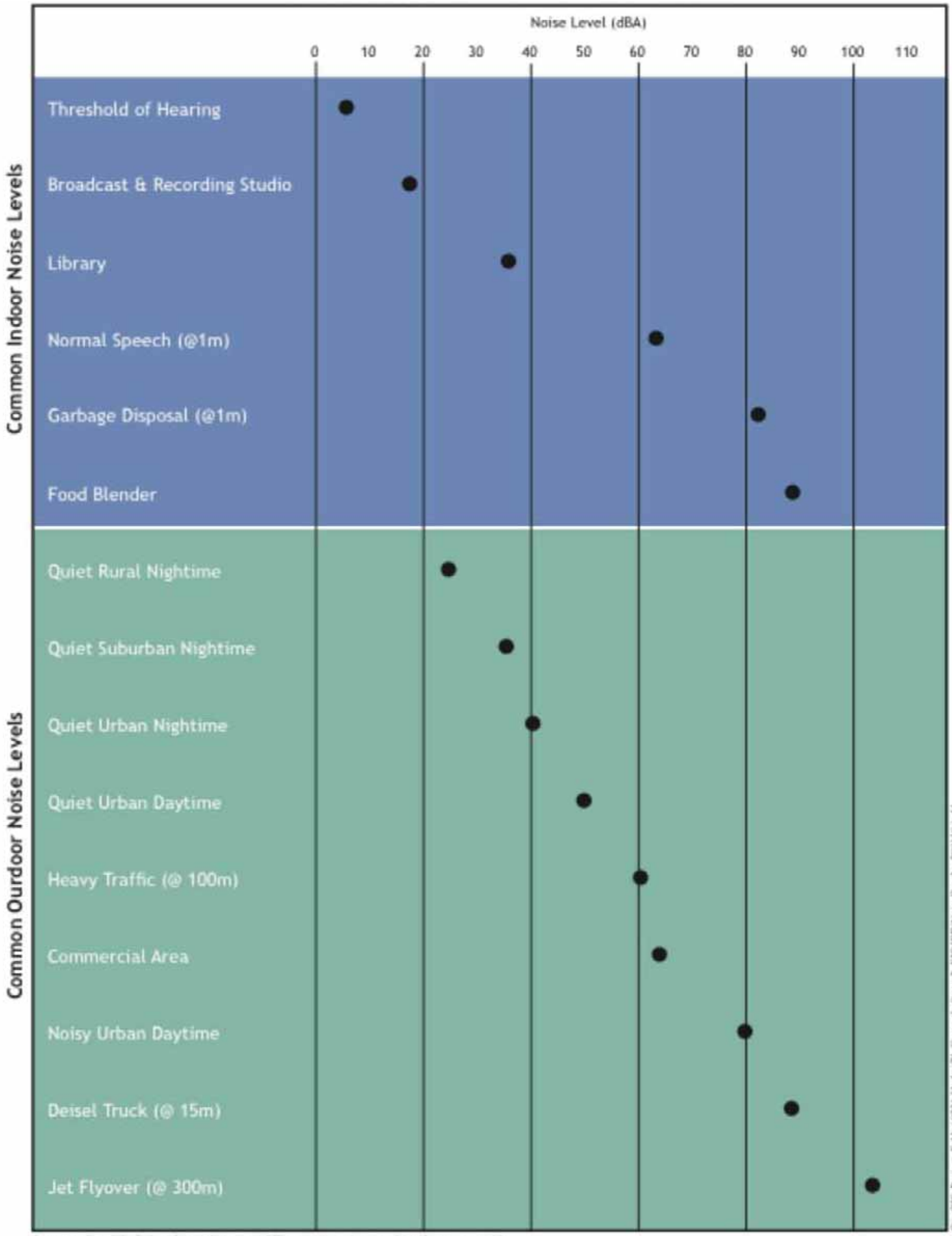


Figure 3.4-1: Construction Equipment Noise Levels



Source: British Columbia Ministry of Transportation and Highways, 1992

Figure 3.4-2: Common Indoor and Outdoor Noise Levels daily in modern developed settings. Noise exposure to workers is governed by the Manitoba Hearing Conservation Noise Regulation under the Workplace, Safety and Health Act.

In situations where construction sites are situated in close proximity to residential communities or other urban, suburban and rural developments, construction noise can exist at levels, which may cause nuisance, and/or health issues for persons exposed at these receptors. For the Keeyask Project, there are no communities or other private residences in the Project construction site vicinity, resulting in no chronic construction noise exposure to off-site human receptors. Consequently, there are no human health impacts related to construction noise anticipated for off-site human receptors.

The worker's **camp** area is located about 2 km from the main project construction site (*i.e.,* the powerhouse). Noise levels from the construction site are not expected to affect workers in the construction camp environment. Related experience from the Wuskwatim GS (currently under construction) indicates that while the Wuskwatim camp is located closer (1.5 km distance) to the construction site, no noise-related issues have been reported by workers residing in the worker's camp (Markowsky *pers. comm.* 2009). Known trapper's cabins are located further away than the worker's camp and construction noise levels are not expected to affect the use of these buildings.

Workers on-site will be expected to wear hearing protection and other Personal Protection Equipment (PPE) consistent with best practice on large scale construction sites utilizing heavy construction machinery. The elevated noise levels associated with construction will be localized, short term in nature, and will cease upon completion of the construction phase.

Health Canada's Draft Guidance for Evaluating Human Health Impacts in **Environmental Assessment (EA)**: Noise, January 2011, provides a suggested approach for assessing the health impacts of noise. The Health Canada approach begins with identification of human receptors in Project areas, and offers guidance in identifying and describing whether receptors may experience a heightened sensitivity to noise exposure (such "heightened sensitivity" receptors include schools, hospitals, child-care centres, etc.). For the Keeyask GS Project, there are no permanently occupied dwellings or facilities within the Project site, and no heightened sensitivity receptors present within the study area. Health Canada states that "if no human receptors are 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."

Human receptors comprised of off-duty construction workers residing in worker camps may be impacted by Project construction noise; however, Health Canada's concern for this construction noise exposure relates to concerns of sleep disturbance. Keeyask GS construction activities will be based upon a 24 hour work day (two 12 hour shifts), but off-duty workers residing in work camps are not expected to experience construction noise levels sufficient to create sleep disturbance due to the distance of the camp from areas of construction activity.

Construction noise levels are considered to be moderate, short term, localized and continuous during the construction period.

3.4.2 Operating Period

3.4.2.1 Local Air Quality

There are very few air emissions associated with the operation of the powerhouse/generating station during the operational life of the project. There are minor levels of emissions associated with activities such as operating backup **generators**, and transport of operators by vehicles to and from the GS site. It is expected that 46 operations jobs will be created, 37 of which would be on site at Keeyask and another nine based in Gillam (SE SV). The volume of traffic resulting from operations (*e.g.,* commuting) is considered minor. In general, impacts to air quality associated with Keeyask operations will be minimal and will be managed by adherence to applicable regulations, guidelines, codes of practice and the Keeyask GS EnvPP developed for the facility. This includes maintaining emergency preparedness plans, and maintaining vehicles and other equipment in good working order; compliance with federal emissions and efficiency standards (EC 2007); and control emissions of dust, combustion gases and GHG by posted speed limits, use of dust control as needed and promotion of a no idling policy.

With the Keeyask Project in place, the ice cover upstream of the station will form earlier, resulting in fewer days of open water and therefore fewer days of ice fog formation. There may still be areas between Birthday Rapids and Split Lake that stay open for much of the winter, resulting in similar ice-fog forming days. Currently Gull Rapids remains open and ice fog can occur all winter. During Project operation about 800 m of water downstream of the powerhouse will be ice free and may create ice fog all year. The open water area below the powerhouse will be much smaller than the existing open water through Gull Rapids and will correspondingly produce less ice fog overall. Beyond the immediate downstream area of the station the water surface will be ice covered as would occur without the Project so there would be very little change in ice fog formation downstream of this area.

During operations, the effects on air quality are considered to be small, localized and continuous.

3.4.2.2 Local Noise

A **hydroelectric generating station** is, by design, a low-impact facility in terms of the impact of its operations on the local noise environment. The majority of noise is generated by operations taking place inside principal structures and is mitigated by the containment of these operations within the **concrete** powerhouse. The **turbines** and generators are submerged beneath several meters of water and are considered low-noise in their operations.

The most audible noise generated by the powerhouse is expected to occur during high flow conditions when water is flowing over the spillway. Noise created by water flowing through the powerhouse **tailrace** and water flowing over the spillway is expected to exceed noise generated by the powerhouse machinery.

Estimates of noise levels associated with water flowing through the powerhouse tailrace and over the spillway depend upon many factors, including the rate of flow for the water, the height of the waterfall, and the distance of the noise receptor (listener) to the point of water flow at the GS. It is expected that noise generated from this passage of flow would be in the range of 75 dBA to 80 dBA within 3 m of the points of flow; however this noise would consist of a constant, non-fluctuating sound of a waterfall and would attenuate rapidly with distance from the point of flow. Most of the time, when there is no flow over the spillway, the noise in the area will be reduced from the present due to absence of the noise from the existing rapids. Some **KCN** community **members** have stated that the sound from Gull Rapids is considered to be a soothing noise. The operation of the Project will reduce the sound of flowing water.

A warning siren will sound when the spillway is used to alert potential downstream users of the waterway of changing conditions. This is episodic in nature and short term.

Blasting activities will cease once the construction phase is complete, and no blasting is associated with the operations phase of the Project.

The effects of the Project operations on the local noise environment are expected to be minor, limited to close proximity to the GS, and long term in nature.

3.4.3 Mitigation

3.4.3.1 Local Air Quality

Mitigation measures will include promoting a no idling policy, regular vehicle/equipment maintenance, limiting traffic to construction vehicles/equipment, and application of acceptable dust control measures as required. Measures that mitigate air quality effects include conditions in the Access Management Plan and the Keeyask GS EnvPP.

3.4.3.2 Noise

Mitigation measures include providing notice of blasting events and limiting blasting during periods that are sensitive for calving (May 15 to June 30) and bird breeding (April 1 to July 31), as noted in the PD SV (Section 2.5). The Keeyask GS EnvPP will also have relevant conditions related to blasting and drilling restrictions.

3.4.4 Summary of Residual Effects

Table 3.4-5 summarizes air and noise effects associated with the Project.

Potential impacts to air quality during the construction phase of the Project are expected to mainly be associated with emissions from the burning of cleared reservoir vegetation, construction vehicles including releases of carbon dioxide and with dust effects from vehicular **movement** along any permanent or temporary roadways. Effects on local air quality during construction are unavoidable, adverse, moderate in magnitude, of short duration and localized. Dust emissions will be controlled by good construction practices. Potential effects on local air quality during operations are expected to be minor.

The measurable effects from dust and combustion gases will be localized to the specific area where the activities take place during construction.

The effects of the Project on the local noise environment relate chiefly to the construction activities. There will be localized continuous noise at the site during construction. These effects are considered adverse, moderate in magnitude, short term and will cease at the end of construction. During operations, the effects are expected to be minor and long term in nature.

If complaints are received during construction regarding noise or dust and other related air quality issues these will be handled on-site on a case by case basis and corrective action taken as necessary.

Table 3.4-5: Summary of Air Quality and Noise Residual Effects

PHYSICAL ENVIRONMENT AIR QUALITY AND NOISE EFFECTS	Magnitude	Extent	Duration	Frequency
Potential impacts to air quality during the construction phase of the Project are expected to mainly be associated with emissions from the controlled burning of vegetation from reservoir clearing, emissions from construction vehicles and with dust effects from vehicular movement along roadways. Dust emissions will be controlled by good construction practices.	Moderate	Medium	Short term	Continuous
Increased atmospheric emissions from fuel storage tank facility and minor releases of volatile organic carbons that are unavoidable during fuelling.	Small	Small	Short term	Intermittent
During the construction phase noise will be generated by heavy machinery working along the principle structures, borrow areas, and access roads. Blasting will be restricted during certain times of year to reduce effects during calving and bird breeding periods. Warning sirens will sound prior to blasting.	Moderate	Medium	Short term	Intermittent
During the operating phase a warning siren will sound when the spillway is used to alert potential downstream users of the waterway of changing conditions.	Small	Small	Short term	Infrequent

PHYSICAL ENVIRONMENT AIR QUALITY AND NOISE EFFECTS	Magnitude	Extent	Duration	Frequency
The turbines and generators are submerged beneath several meters of water and are considered to generate low noise levels when operating.	Small	Small	Long term	Continuous

3.4.5 Interactions with Future Projects

This section will consider the interactions of the Project effects with reasonably foreseen and relevant future projects and activities and their effects.

There are several foreseeable projects in the area, including the following:

- Proposed Bipole III Transmission Project.
- Proposed Keeyask Construction Power and Generation Outlet Transmission Lines.
- Potential Conawapa Generation Project.

A brief description of these projects is provided in the Keeyask Generation Project: Response to EIS Guidelines document (Chapter 7).

There is expected to be temporal overlap with Project construction and work on the construction power transmission and transmission outlet lines. Construction activities associated with the **transmission lines** do not involve substantive air quality and noise effects. Further, for the most part, construction activities of the transmission line are spatially separated from the generation station construction site so little overlap is expected.

There is temporal overlap of operations with the **Construction power** and outlet lines, and with the Conawapa Project; the spatial separation is sufficient that there will be no substantive overlap with respect to noise.

3.4.6 Environmental Monitoring and Follow Up

Project effects on noise and air quality are considered to be generally minimal during the operations phase of the GS. Project effects on noise and air quality related to construction are considered to be moderate in magnitude and medium in their spatial extent from construction sites, and therefore, confined to localized areas within the study area. Consequently, noise and air monitoring programs are not planned for the Project.

3.5 REFERENCES

City of Winnipeg. 2007. Greenhouse Gas Emissions Baseline for the City of Winnipeg. Centre for Sustainable Transportation, University of Winnipeg.

Environment Canada. National Pollutant Release Inventory (NPRI) at www.ec.gc.c/inrp-npri.

Health Canada. 2011. Guidance for Evaluating Human Health Impacts in Environmental Assessment: Noise.

Krawchuk, B.P. and Snitowski, A. 2008. Manitoba Ambient Air Quality: Annual Reports for 2003, 2004 and 2005. Report No. 2008-1 [online]. Available from http://www.gov.mb.ca/conservation/pollutionprevention/airquality/pdf/2003_05_ambient_air_quality_annual_report.pdf [accessed February 17, 2012].

Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety. EPA/ONAC 550/9-74-004.

Joint Keeyask Development Agreement. May 29, 2009. Manitoba Hydro.

Manitoba Conservation. 1997. Department Annual Reports: State of the Environment. Moving Towards Sustainable Development Reporting.

Manitoba's Ambient Air Quality Guidelines. Objectives and Guidelines for Various Air Pollutants: Ambient Air Quality Criteria. Accessed at: www.gov.mb.ca/conservation/pollutionprevention/airquality/aq-criteria/ambientair_e.html. Updated 2005.

NRPI. 2009. National, Provincial and Territorial Emissions Summaries for Key Air Pollutants. Accessed at: www.ec.gc.ca/inrp-npri/.

The Pembina Institute. 2012. A Life Cycle Assessment of Greenhouse Gases and Select Criteria Air Contaminants. A report prepared for Manitoba Hydro (document number GN 9.5.5).

Transport Canada. 2011. Urban Transportation Emission Calculator – Fuel Efficiency by Vehicle Class. Accessed at: www.tc.gc.ca.

United States Environmental Protection Agency (USEPA) AP42: Compilation of Air Pollutant Emission Factors.

USEPA Office of Noise Abatement and Control. 1978. Protective Noise Levels: Condensed Version of EPA Levels Document EPA 550/9-79-100.

Personal Communication:

Markowsky, John. 2009. Resident Manager, Wuskwatim Construction Department, Manitoba Hydro. Conversation with George Rempel, Stantec. December 2009.

McNeil, Greg. 2010. Energy Policy Officer, Energy Policy & Emission Trading Dept., Manitoba Hydro. Email to Roger Rempel. Stantec. September 24, 2010.

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