8 NOISE

8.1 SCOPE OF ASSESSMENT

8.1.1 Terms of Reference

This is the noise component

This section consists of the noise component of the environmental assessment (EA) of the De Beers Canada Mining Inc. (De Beers) Snap Lake Diamond Project.

Noise is included in the Terms of Reference

The noise component provides the information required by the Snap Lake Diamond Project EA Terms of Reference issued by the Mackenzie Valley Environmental Impact Review Board (MVEIRB). Section 2.7.7 of the Terms of Reference requires that De Beers "Assess the impact of the proposed development on the environment resulting from changes to ambient noise levels, and the effect of these changes on humans and wildlife." Because of the remote location of the site, there are no communities or residences located near the site. Thus, noise from the project will not affect communities or residential areas. However, there are tourist facilities (*i.e.*, outfitter camps and commercial lodges) in the region that could potentially be affected by noise associated with the development. In addition, there is concern regarding the effects of facility and traffic noise on wildlife.

8.1.2 Component Description and Organization

Environmental noise will be produced during construction, operation, and closure of the facility

The Snap Lake Diamond Project will produce environmental noise during construction, operation, and closure of the facility. Environmental noise will affect the area around the project site, and also a corridor along the winter access road that will be used to supply material to the site during both construction and operation phases of the project.

Section 8 includes the approach and methods, the baseline, the impact assessment, and conclusions

The scope of assessment (Section 8.1) describes the Terms of Reference, the assessment approach, the study area, and the assessment methods. Section 8.2 summarizes baseline noise conditions. Section 8.3 identifies the major sources that will contribute to the environmental noise resulting from the Snap Lake Diamond Project, provides predicted sound levels for the noise produced, assesses the impact of project construction and operation activities on noise levels, and classifies this impact. Conclusions are provided in Section 8.4. The effects on wildlife are addressed in Wildlife (Section 10.4).

8.1.3 Assessment Approach

8.1.3.1 Key Issues and Key Questions

The primary issue is the effect of noise on wildlife

The primary environmental issue related to noise is impact on wildlife and on the human uses of natural resources including traditional land use and tourist facilities in the region. Based on their traditional knowledge, Aboriginal people have expressed concerns about noise and vibrations. Noise from mine site activities, especially as it relates to wildlife movement, was identified as an issue by the Yellowknives Dene Elders (Weledeh Yellowknives Dene 1997). The North Slave Métis Alliance (no date) considered that noise could drive caribou away initially, but after this initial reaction, the caribou might be attracted to the noise source. It was also thought that their reaction might be different depending on the source, decibel level, frequency, and duration of the noise.

There are two key questions

The noise issues have been consolidated in the following two key questions:

Key Question N-1: What impacts will construction of the Snap Lake Diamond Project have on environmental noise?

Key Question N-2: What impacts will operation of the Snap Lake Diamond Project have on environmental noise?

8.1.3.2 Assessment Cases

The baseline, application, and cumulative effects assessment cases are considered

In order to evaluate the potential impact of the Snap Lake Diamond Project on the ambient noise near the project, the following three assessment cases have been identified:

- the **baseline** case representing conditions prior to development;
- the **application** case representing the noise impact of the Snap Lake Diamond Project by itself; and,
- the **cumulative effects assessment** (CEA) case representing the combined effects of the Snap Lake Diamond Project and other projects in the region that overlap in time and space. The CEA case is addressed in Section 12.5.

The application case includes construction, operation, closure, and post-closure

The application case includes four phases of the project: construction, operation, closure, and post-closure. The process of closure will be progressive, beginning during operations. For example, progressive reclamation of the north pile and progressive back-filling of the mine will occur as the operation phase proceeds. The final closure step is, in a sense, the reverse of construction as the infrastructure is removed from the site. The assessment did not consider closure in detail since a similar type of noise would be generated during construction. Since predictions were made for the noisiest phases of construction, they would also represent the worst case for closure. No residual noise is anticipated in the post-closure phase other than the aircraft noise associated with infrequent visits to the site for long-term monitoring that may be required. Since aircraft noise is assessed for operations, noise was not assessed for post-closure.

8.1.3.3 Temporal Considerations

Construction will last three years beginning in 2003 and the project will continue until closure in 2028

Assuming that permits for construction and operation have been received during the first quarter of 2003, a limited pre-construction work program will begin in 2003. Full construction will begin in early 2004 and be completed by the end of 2005. The production phase will be approximately 21 years from 2006 to 2026, although pre-production mining from underground development will occur from 2003 to 2005. Reclamation and monitoring of the effectiveness of reclamation techniques will occur during the operation phase. The site closure activities will be carried out primarily in 2027, with limited final clean-up and the continuation of effectiveness monitoring in 2028. The total elapsed duration of the project is 26 years. The proposed schedule for the Snap Lake Diamond Project is provided in more detail in Section 3.2.

8.1.4 Study Area

The study areas must include areas affected by site and traffic noise

The study areas for the De Beers Snap Lake Diamond Project were selected by evaluating the region around the site that is expected to be affected by facility and traffic noise. Noise from these sources will affect the study areas by means of airborne sound propagation. Outdoor sound propagation is affected by a number of sound attenuation mechanisms, whereby the cumulative effect of these mechanisms is a reduction in sound levels with increasing distance from the source. At large distances, the sound level of noise from site and traffic sources will ultimately become less than the existing ambient (*i.e.*, background) noise.

Local and regional study areas for noise were established

There are two study areas for noise. The local study area (LSA) for noise is equal to the project footprint plus an additional 1.5 km. This distance has been used since it corresponds to the distance at which a target sound level should be achieved (see also Section 8.1.5.2). The regional study area (RSA) is the same as the RSA for wildlife. It equals the area within a circle with a 31 km radius from the centre of the site. Sound impacts from traffic on the winter access road and air traffic will occur within the RSA. The RSA and LSA are shown in Figures 8.1-1 and 8.1-2.

Three tourist sites are located near the regional study area boundary

Three tourist sites are also located within or adjacent to the RSA boundary. These facilities are lodges and camps identified in Table 8.1-1 and in Figure 8.1-1. In Table 8.1-1, the distance of each tourist site from the Snap Lake site and from the winter access road is shown.

Table 8.1-1 Tourist Site Locations

Tourist Site	Distance from Snap Lake Site [a]	Distance from Winter Access Road
Mackay Lake Lodge	30 km	30.8 km
Warburton Bay Lodge	33 km	9 km
Lac du Roche Camp	31.9 km	26.2 km [b]

[a] Location is taken from the centre of the site.

[b] Distance shown is the distance to the esker access road, which is closer than the winter access road.

The Mackay Lake Lodge is located 3 km from the Tibbitt-Contwoyto winter road

It should be noted that the distance between the winter access road and the Mackay Lake Lodge appearing in Table 8.1-1 refers to the closest segment of the winter access road (*i.e.*, the winter road serving the Snap Lake Diamond Project). The existing Tibbitt-Contwoyto winter road passes within 3 km of the Mackay Lake Lodge. The Snap Lake Diamond Project would be part of a cumulative effect on the Tibbitt-Contwoyto winter road, which is addressed in Section 12.

Figure 8.1-1 Regional Study Area for Noise Assessment

Figure 8.1-2 Local Study Area for Noise Assessment

8.1.5 Methods

8.1.5.1 Environmental Noise Descriptors

Environmental noise varies constantly

Environmental noise is typically not steady and continuous in nature but constantly varies over time. For environmental noise in the vicinity of an industrial facility, there is usually a steady background sound level that exists due to noise from the facility that is slowly varying because of changes in atmospheric and/or ground cover conditions, as well as changes in facility operating conditions. Along with the facility noise, there may also be periodic, short-term, higher level noise, typically associated with transportation sources in the vicinity of the site. Other sources of noise that are associated with the surrounding area may also occur.

The L_{eq} is the steady continuous sound that has the same energy as the fluctuating sound that actually occurs

To account for the time-varying nature of environmental noise, a single number known as the equivalent continuous sound level (L_{eq}) is used. This number quantifies sound that varies over time, such as that commonly occurring in outdoor environments. It is generally accepted and used for environmental noise measurements and criteria by acoustical experts (Beranek and Ver 1992) and government agencies (CMHC 1981; Environment Canada 1989; Nova Scotia Department of the Environment 1989; MOE 1978; Manitoba Department of Environment 1988; EUB 1999). The L_{eq} is the average sound level (based on acoustical energy) of time-varying noise occurring over a specific time period. Time periods commonly used for L_{eq} measurements and criteria are the day time (07:00 to 22:00 hrs), night time (22:00 to 07:00 hrs) and 24 hours. Shorter time periods of one hour or less may also be used.

Different time periods such as 5-minute, 1-hour, and 24-hour periods may be used depending on the type of noise

Day time, night time, and 24-hour time periods are typically used by government agencies (MOE 1978; Manitoba Department of Environment 1988; Environment Saskatchewan 1975; EUB 1999; CMHC 1981) for noise assessments in rural or urban areas that may also be affected by community and/or transportation noise sources. In these areas, ambient sound levels are typically greater during the day as a result of increased community and/or transportation activity. During the night, ambient sound levels are typically lower as a result of reduced activity. For a remote area such as the Snap Lake site, there would likely be little difference between ambient noise during day and night. Consequently, the 1-hour and 24-hour L_{eq} time periods are considered to be more appropriate descriptors for assessing the impact of noise from the Snap Lake Diamond Project. Moreover, the environmental noise effects of intermittent noise sources such as road and air traffic accessing the site, are typically quantified in terms of L_{eq} values for periods of 1 hour or 24 hours. For the case of short-term, high sound level sources, such as aircraft landing and taking off, 5-minute L_{eq} values may be used to estimate the maximum sound levels produced.

A-weighted sound levels account for human hearing ability

L_{eq} values for environmental noise are normally based on A-weighted sound levels expressed in units of decibels (dBA). The A-weighting accounts for the frequency content of the sound and assesses it with a frequency response similar to that of the human ear. Thus measurements and criteria for environmental noise are normally quantified in units of dBA L_{eq}.

Wildlife hearing includes a broader range of frequencies

Although A-weighted sound levels are commonly used in impact assessments, animal hearing differs from human hearing. The hearing range of birds is greater than humans (Bommer and Bruce 1996), although their lowest hearing threshold may be similar to humans and at a similar frequency. Domestic animals (*e.g.*, cattle and sheep) have hearing ranges similar to humans (Ames 1974); however, other mammal species may have lower hearing thresholds at high frequencies (Bommer and Bruce 1996).

Little is known about wildlife hearing

Although scientific literature describing the response of wildlife to noise is available, literature on the hearing (range of frequencies, hearing thresholds) of wildlife species is very limited.

8.1.5.2 Noise Impact Criteria

The Alberta Energy and Utilities Board is the only regulatory body that provides guidelines specifically for developments in remote locations

There are presently no environmental noise regulations or guidelines directly applicable to noise impact from the Snap Lake Diamond Project. Several jurisdictions in Canada, such as Nova Scotia (Nova Scotia Department of Environment 1989), Ontario (MOE 1978), Manitoba (Manitoba Department of the Environment 1988), Saskatchewan (Environment Saskatchewan 1975) and Alberta (EUB 1999), do have environmental noise regulations or guidelines; however, these documents are generally oriented towards the impact of environmental noise on permanent or seasonal dwellings. They are not generally applicable to environmental noise in remote locations, such as the proposed Snap Lake Diamond Project. One exception to this is the Alberta Energy and Utilities Board (EUB) Interim Noise Control Directive ID 99-8, which includes a guideline to prevent uncontrolled noise generation in remote locations in the province of Alberta. This guideline recommends that new facilities planned for remote areas should be designed to meet a target sound level of 40 dBA L_{eq} at a distance of 1.5 km from the site.

Noise at the site will include both continuous noise from equipment operation and short-term noise from vehicles and aircraft

As indicated in Section 8.1.5.1, the L_{eq} value is an average sound level that takes into account the variation of environmental noise over time. Noise variations are due to different types of noise sources and outdoor sound propagation conditions. Noise produced by sources associated with the Snap Lake site can be subdivided into two main types. These include steady, continuous noise, typically associated with the continuous operation of stationary equipment (*e.g.*, diesel generators, mine fans, and aggregate crushing equipment). This type of noise would be expected to emanate from most sources located on the site. The second type is short-term, intermittent noise, typically associated with the effects of vehicles on the winter access road and the esker access road, as well as air traffic accessing the site. Table 8.1-2 identifies typical sound levels associated with common sources of these two types of noise (Harris 1979).

Table 8.1-2 Typical Sound Levels of Common Noises

Description	Type of Noise	Sound Level (dBA)
Rural area – background noise	continuous	30 -35
Small town residential – background noise	continuous	35 - 40
Snowmobile at 15 m	intermittent	75 (peak)
Snowmobile at 1 km	intermittent	50 (peak)
Truck at 15 m	intermittent	85 (peak)
Truck at 1 km	intermittent	60 (peak)

Sound levels (dBA) in Table 8.1-2 can be compared to the human perception of sound

The values in Table 8.1-2 may be compared with the predicted sound level values for noise from facility construction and operation, in order to obtain a subjective impression of the noise impact of the facility. When comparing sound level values, the following general rule may be used:

- a difference in sound level of less than 3 dBA is barely perceptible to the human ear;
- a difference of 5 dBA is noticeable;
- a difference of 10 dBA corresponds to a halving or doubling in perceived loudness; and,
- a 20 dBA difference corresponds to a four-fold difference in perceived loudness.

8.1.5.3 Sound Attenuation

Various sound attenuation mechanisms affect outdoor sound propagation

Outdoor sound propagation between a noise source and a receptor (*i.e.*, a person listening) is affected by several sound attenuation mechanisms. These include the following:

- distance dissipation: sound naturally decreases with increasing distance from the source;
- ground attenuation: sound is absorbed by the ground that it passes over;
- atmospheric absorption: sound is absorbed by the atmosphere it passes through;
- barrier attenuation: sound can be blocked by physical barriers (*e.g.*, buildings or hills);
- sound is affected by wind conditions (*i.e.*, a distant noise source will be louder under downwind conditions than it will be under calm conditions. Conversely, a distant source will be quieter under upwind conditions than it will be under calm conditions); and,
- sound is affected by temperature conditions in the atmosphere (*i.e.*, a distant noise source will be louder under atmospheric inversion conditions than it will be under neutral atmospheric conditions).

Temperature and relative humidity affect sound

Temperature and relative humidity have effects on some of the variables mentioned; however, they do not have specific sound propagation mechanisms associated with them.

To be conservative, this assessment assumed low ground attenuation values

Ground cover conditions in the study area may include boggy soil (high ground attenuation values) and exposed rock and open water (low ground attenuation values). Winter ground cover conditions may range from soft, fresh snow (high ground attenuation values) to hard or crusty snow (low ground attenuation values). To be conservative, this noise assessment assumed that low ground attenuation values associated with exposed rock, open water, and hard or crusty snow would be most typical for the study area. This corresponds to the ground cover condition associated with the worst case for facility and traffic noise.

Sound levels differ when a location is upwind or downwind from the facility, but this effect cancels out when winds shift direction over time

The effects of wind gradients on outdoor sound propagation can cause variations in sound levels at a distance from an operating facility. Under upwind conditions, the wind will cause greater than normal outdoor sound attenuation to occur. This would result in lower sound levels upwind of the facility than would normally occur under calm conditions. However, under downwind conditions, the opposite effect will occur, resulting in higher than normal sound levels. Crosswinds do not have these effects and result in sound levels that are essentially the same as those for calm conditions. If the effects of downwind and upwind sound propagation are averaged over the long term, there would typically be as many times that facility noise would get louder due to downwind conditions as it would get quieter due to upwind conditions. Averaged over time, the expectation is that the sound propagation effects for downwind and upwind conditions would cancel each other, resulting in a net sound propagation effect equivalent to calm conditions.

8.1.5.4 Sound Levels Predictions

8.1.5.4.1 Construction Noise

Construction noise predictions were calculated for the noisiest conditions in the construction period

Sound level predictions of construction noise were calculated using a general prediction method for determining noise emissions from industrial construction sites (Teplitzky and Wood 1978). Predictions were done to calculate site emissions during the noisiest phases of the construction period and are representative of maximum noise from the site during the construction phase. Construction noise results are presented in the form of predicted sound level values at various distances from the mine site.

Construction noise predictions have been used for closure

Removal of site infrastructure during closure involves activities similar to construction. However, some of the noisiest construction activities such as pile driving would not occur at closure. Since noise at closure is likely to be equal to, or less than, construction noise, predictions of construction noise have been used for both phases.

8.1.5.4.2 Operation Noise

Operation noise predictions were calculated by computer modelling using procedures developed for industrial facilities

Sound level predictions of noise emissions for operation of the facility were calculated using the SoundPLAN Outdoor Noise Prediction computer program. SoundPLAN is one of the most sophisticated computer noise prediction programs currently available in the world. The calculation procedures used by the program are from international research and standards specific to industrial noise and outdoor sound propagation (CONCAWE 1981; Danish Acoustical Laboratory 1982; ISO 1992). The calculation procedure for the Snap Lake Diamond Project used the acoustical formula specified in CONCAWE (1981). This procedure was selected for the sound level predictions because it is specifically applicable to the environmental noise effects of industrial facilities like the Snap Lake Diamond Project.

The computer model predicted noise from key sources

The computer model calculated predicted sound levels of facility related noise throughout the LSA and RSA. The model included the effects of noise emissions from stationary and mobile equipment at the mine site, as well as the effects of road and air traffic.

Attenuation and dissipation of outdoor sound were included in the predictions

The following outdoor sound propagation effects were included in the computer model calculation of predicted sound levels:

- distance dissipation;
- ground attenuation;
- atmospheric absorption; and,
- barrier attenuation.

Winter weather conditions were used

Weather parameters and ground attenuation values typical of early or late winter weather conditions were used in the computer model, since these would be the most commonly occurring weather conditions in the region.

Noise contour maps are provided

The computer model results for operation noise are presented in two formats. These include predicted sound level values at various distances from the mine site, and noise contour maps which identify isopleths, or regions of equal sound level, in the study area surrounding the Snap Lake Diamond Project.

8.1.5.5 Impact Classification Method

The residual impacts are classified by using specific criteria

The following impact assessment criteria are listed in Section 2.5.4 of the final Terms of Reference (MVEIRB 2001):

- magnitude;
- geographic extent;
- timing:
- duration;
- frequency;
- irreversibility of impacts;
- ecological resilience; and,
- probability of occurrence and confidence level.

Classification terms are defined

The classification used in this report generally follows the above list; however, there are some changes and additions. The following impact classification terms are used in this EA:

- **Direction** describes an impact or effect as being neutral or negative. The direction reflects the change, if any, from baseline.
- **Magnitude** is a measure of the intensity or severity of an impact. It is a measure of the degree of change in a measurement or analysis endpoint (*e.g.*, an increase in dBA).
- **Geographic extent** refers to the geographic location where the impact is predicted to occur. A local geographic extent is assigned if the effect is restricted to the LSA. A regional geographical extent is assigned if the effect extends beyond the LSA into some part of the RSA.
- **Frequency** refers to how often an effect will occur.
- **Duration** is defined as the length of time that an impact will occur. Duration and timing have been combined within the definition of duration used in this EA. Duration is defined by the timing of the phases of the project.
- **Irreversibility** is an indicator of the potential for recovery from the impact. Irreversibility is classified as reversible in the short-term, reversible in the long-term, or irreversible.
- **Ecological resilience** is usually defined as the rate of ecosystem recovery following a disturbance or the capacity of an ecosystem to absorb disturbances. Ecological resilience is not applicable to this section since resilience applies to components of the ecosystem such as wildlife. Ecological resilience to noise will be addressed in Wildlife (Section 10.4) and the Scope of Assessment for Terrestrial Resources (Section 10.1).
- **Probability of occurrence** is the likelihood that the environmental consequence indicated in the impact prediction will occur if the project goes ahead.
- **Level of confidence** is directly related to the degree of certainty in the impact prediction.
- **Environmental consequence** is the overall effect on the environment when the magnitude, geographic extent, duration, and irreversibility of the project's impact are considered together.

Terms are defined in Table 8.1-3

The criteria described above are ranked for each section of Noise. Definitions for the ranking of criteria (except environmental consequence) are provided in Table 8.1-3.

Table 8.1-3 Definitions of Impact Criteria for Noise

Direction	Magnitude	Geographic Extent	Duration	Reversibility	Frequency
Neutral: no change compared to ambient sound levels; **Negative**: an increase in noise.	**Negligible**: ≤ background noise (20 dBA L_{eq}); **Low**: > background noise, and ≤ 40 dBA L_{eq} at 1.5 km (continuous or intermittent sources); **Moderate**: > 40 dBA L_{eq} at 1.5 km (continuous or intermittent sources), ≤ 50 dBA L_{eq} at 1.5 km (continuous sources 24 hour average sound level), and ≤ 60 dBA L_{eq} at 1.5 km (intermittent sources 1 hour average sound level); **High**: > 50 dBA L_{eq} at 1.5 km (continuous sources 24 hour average sound level), > 60 dBA L_{eq} at 1.5 km (intermittent sources 1 hour average sound level).	**Local**: effect is restricted to the LSA (*e.g.*, mine footprint plus 1.5 km); **Regional**: effect extends beyond the LSA into the RSA; **Beyond Regional**: effect extends beyond the RSA.	**Short-term**: 3 years; includes pre-construction and construction phases; **Medium-term**: 26 years; includes operation phase; **Long-term**: more than 26 years (*i.e.*, after closure).	**Reversible (short-term)**: effects can be reversed at closure of the project; **Reversible (long-term)**: effects can be reversed in +100 years; **Irreversible**: effects cannot be reversed.	**Low:** occurs once; **Moderate:** occurs intermittently; **High**: occurs continuously.

The primary choices made in developing this method to predict environmental consequence were to keep the process simple and transparent

Environmental consequence provides an overall assessment of the residual effects based on a ranking system that incorporates four criteria that represent the most important aspects of the impact. Combining the criteria shown in the residual impact classification into a single answer to the key question involves choices. The choices that have been made in this EA include the following:

- the method is transparent;
- the results will be shown as a bar graph (Figure 8.1-3) and as words in the residual impact classification table;
- the criteria will be added to form the bars of the graph;
- the criteria will be given equal weight except for the following:
  - only one criterion related to time will be used to prevent time from being over-weighted;
  - irreversible and magnitude will be slightly over-weighted due to the greater severity of the consequence of an irreversible impact of high magnitude.

Figure 8.1-3 Generic Environmental Consequence

Numbers have been used only to determine relative positions in the bar graph

The words (*e.g.*, negligible, low, moderate, high) used to rank the criteria (*e.g.*, magnitude) have been assigned numbers to create the bar graph, but the numbers have no meaning other than to ensure that ranks are shown in the correct relative position to each other. The numbers used are shown in Table 8.1-4. Environmental consequence is only determined for residual impacts that are negative in direction.

Table 8.1-4 Generic Residual Impact Classification

Magnitude	Geographic Extent	Duration	Reversibility
Negligible (0)	local (0)	short-term (0)	reversible (short-term) (0)
Low (5)	regional (5)	medium-term (5)	reversible (long-term) (5)
Moderate (10)	beyond regional (10)	long-term (10)	irreversible (15)
High (15)			

Environmental consequence is ranked as negligible, low, moderate, or high

The environmental consequence will be determined by adding the numbers and comparing the sum to the scale determined on the following basis:

- negligible = ≤ 5;
- low = > 5 to ≤ 20;
- moderate = > 20 to ≤ 30; and,
- high = > 30.

The ranking of environmental consequence was based on professional judgement

The relative positions of negligible, low, moderate, and high, are illustrated on a generic graph (Figure 8.1-3). The position of the lines determining the consequence scale is based on professional judgement. For example, an impact that was of moderate magnitude, regional extent, medium-term duration, and irreversible was deemed to be a high environmental consequence. If the same impact was reversible in the long-term, it was deemed to be a moderate environmental consequence. If it was reversible in the short-term, it was deemed to be a low environmental consequence. Professional judgement was used *a priori* to determine the method for ranking consequences. The determination of environmental consequence for each residual noise impact followed this method and was not modified within individual key questions.

Methods provide a standardized comparison of environmental consequences throughout the EA

The true environmental consequence would occur over a continuum rather than four categories. Because other professionals may have other opinions on the dividing line between low and moderate, or moderate and high, the method used here has been kept as simple and transparent as possible, while still providing a standardized comparison of the consequence of the project across all parts of the EA. This method of determining environmental consequence will be used to summarize noise and all other residual impacts in the EA.

8.2 BASELINE

8.2.1 Introduction

Ambient sound levels in the area are low

The region around the Snap Lake Diamond Project is remote and ambient sound levels in the area would typically be low. Noise sources contributing to the ambient sound levels would be the effects of wind, wildlife, periodic aircraft fly-overs, truck traffic on the Tibbitt-Contwoyto winter road, and possible nearby hunting and fishing activities.

8.2.2 Ambient Noise Survey

Existing ambient sound levels were measured in July, 2001

An ambient noise monitoring survey was conducted in the Snap Lake vicinity on July 11- 12, 2001 to measure existing ambient sound levels. The noise survey was conducted at a remote site located approximately 6 km west of the mine portal. Noise from the advanced exploration facilities was not audible at the monitoring site.

Continuous sound levels were measured for 19 hours

The noise survey measured continuous one-minute L_{eq} sound levels for a period of 19 hours, from 10:00 p.m. (22:00) on July 11 to 5:00 p.m. (17:00) on July 12. The survey was not manned. The monitoring site was accessed by helicopter to setup and retrieve the sound measurement instrumentation. The microphone was elevated to a height of about 1.2 metres above the ground for the survey.

8.2.3 Ambient Sound Levels

Valid data are available for 12 hours

Valid noise data were collected for the first 12 hours of the survey period. The noise data record indicated that the monitoring site was disturbed at approximately 10:30 am on July 12, probably by wind gusts, which caused the microphone tripod to fall over.

Day time and night time sound levels were calculated

One-hour L_{eq} sound level values were calculated from the valid noise data and are presented in Table 8.2-1. The last two rows in Table 8.2-1 show the day time and night time sound level values, which have been calculated for the partial day time interval (07:00 to 10:00) and the complete night time interval (22:00 to 07:00).

Table 8.2-1 Monitored Hourly Average Sound Levels and Wind Speed, July 11-12, 2001

Start Time (Hour)	Measured Sound Level (dBA L_{eq})	Average Wind Speed (km/h)
22:00	28.1	16.0
23:00	23.2	16.4
0:00	30.8	12.2
1:00	32.2	15.8
2:00	40.1	17.4
3:00	35.2	24.2
4:00	35.4	22.4
5:00	39.2	21.7
6:00	35.9	24.6
7:00	33.6	22.7
8:00	25.3	19.8
9:00	24.9	14.0
3 hour day time L_{eq}	29.9	
9 hour night time L_{eq}	35.6	

The main source of noise was the wind

The main noise source affecting the ambient sound levels appears to have been the effects of wind. This is supported by the wind speed data presented in Table 8.2-1, which was collected at the Snap Lake weather station during the survey period. The weather station is located at the Snap Lake airstrip approximately 5 km east of the monitoring site.

Higher wind speeds are correlated with higher sound levels

A comparison of the monitored hourly L_{eq} values with the hourly average wind speeds (Table 8.2-1) indicates that the higher hourly sound level values approximately correlate with higher hourly wind speeds. The wind measurements were taken approximately 5 km from the monitoring site and wind conditions were likely similar at the two locations, but were probably not exactly matched. This correlation of sound level and wind speed suggests that the effects of wind were the main source of ambient noise during the survey.

The hourly sound level under light winds in summer was 23 dBA L_{eq}

The minimum hourly sound level measured during the survey was approximately 23 dBA L_{eq}. This value is considered to be representative of existing ambient sound levels in the area during the summer under calm or light wind conditions. Similar or potentially lower ambient sound levels would occur in the winter during calm conditions. A noise survey conducted at a remote location in the northern part of Saskatchewan in February, 1996 measured a night time ambient sound level of 15 dBA L_{eq} during calm conditions (HFP Acoustical Consultants 1996).

This level is close to the threshold of human hearing

These lower sound levels are close to the threshold of human hearing. However, ambient sound levels would not always be this low, as the effects of wind and other noise sources would tend to increase ambient noise to higher sound levels as shown in Table 8.2-1.

8.3 IMPACT ASSESSMENT

8.3.1 Introduction

What impacts will construction and operation have on environmental noise?

The key questions concerning environmental noise issues related to the Snap Lake Diamond Project are as follows:

Key Question N-1: What impacts will construction of the Snap Lake Diamond Project have on environmental noise?

Key Question N-2: What impacts will operation of the Snap Lake Diamond Project have on environmental noise?

The assessment approach involves a series of steps for both construction and operation

The two key questions are addressed by the following methodology.

Construction:

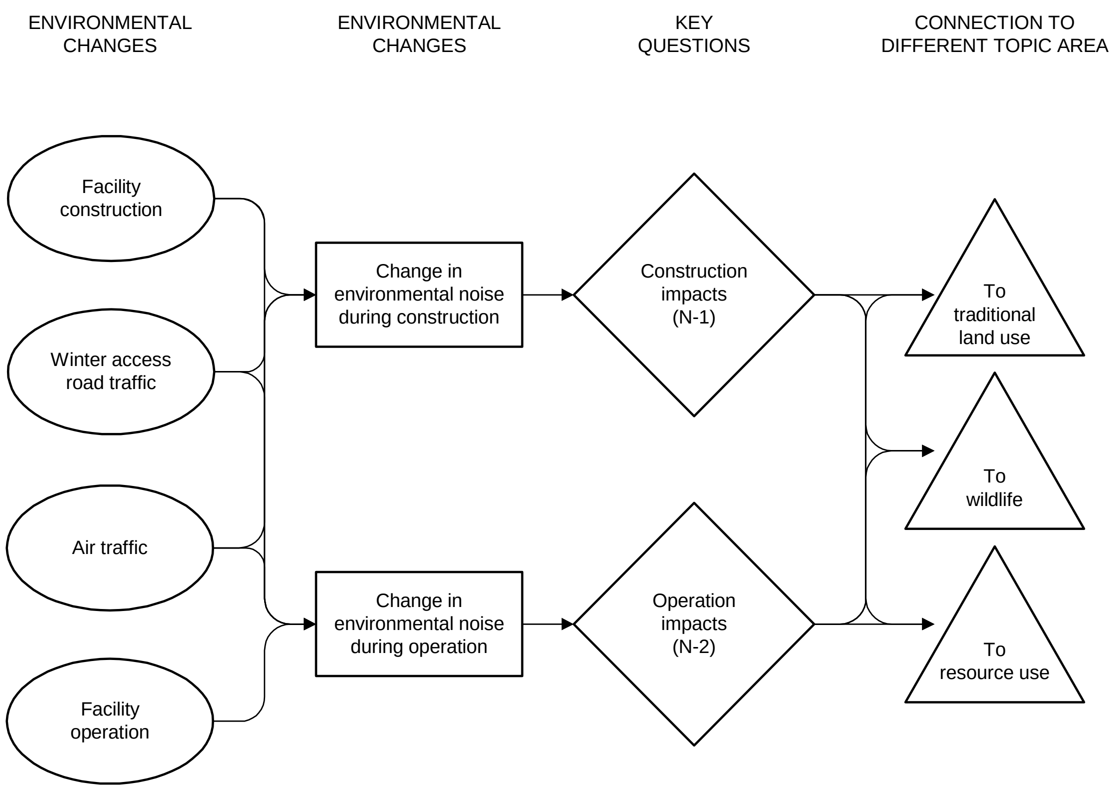
- identifying linkages between construction noise and potentially affected communities, tourist facilities and wildlife, and determining if the linkages are valid;
- identifying noise sources;
- predicting sound levels produced by construction activities and identifying the extent of areas affected by construction noise;
- comparing construction noise with existing ambient noise and with predicted sound levels produced during facility operation; and,
- classifying the residual impact of construction noise.

Operation:

- identifying linkages between operation noise and potentially affected communities, tourist facilities and wildlife, and determining if the linkages are valid;
- identifying operation noise sources and mitigation measures;
- identifying periodic or intermittent noise sources that will cause noticeable short-term changes in noise associated with site operation;
- predicting sound levels produced by operation activities and identifying the extent of affected areas;
- comparing operation noise with existing ambient noise and the environmental noise guideline for noise from industrial facilities; and,
- classifying the residual impact of operation noise.

Linkages between construction and operation noise and potentially affected communities, tourist facilities (resource use) and wildlife are illustrated in Figure 8.3-1.

Figure 8.3-1 Linkage Diagram for Environmental Noise



8.3.2 Key Question N-1: What Impacts Will Construction of the Snap Lake Diamond Project Have on Environmental Noise?

8.3.2.1 Linkage Analysis

Noise will be produced in the vicinity of the mine site and winter access road

Construction activities related to the Snap Lake Diamond Project will produce noise in the vicinity of the project as a result of on-site construction activity, and will produce noise along the winter roads associated with construction traffic using winter roads. The impacts of environmental noise produced by construction activities are normally assessed with respect to potential effects on communities and, for remote site locations, with respect to potential effects on tourist sites and on wildlife.

Linkage between construction noise and communities is invalid

There are no communities in the vicinity of either the project site or the winter access road that can be potentially affected by noise from construction activities. Therefore the linkage between construction noise impact and communities is not valid.

The linkage between construction noise and effects on wildlife and tourist sites is valid

There are three tourist sites (*i.e.*, lodges and camps) near the RSA boundary; the Mackay Lake Lodge is within the RSA. This region is also wildlife habitat. Tourist sites and wildlife in these areas could potentially be affected by both construction noise produced at the site and construction traffic noise on the winter road. Therefore, the linkage between construction noise impact and the tourist sites and wildlife is valid.

8.3.2.2 Impact Analysis

Continuous and intermittent noise will occur during construction

Environmental noise associated with construction of the Snap Lake Diamond Project will consist of more or less continuous noise produced by construction activities at the project site, as well as intermittent noise produced by winter access road traffic and air traffic periodically accessing the mine site. Intermittent noise will also be produced by traffic on the esker access road. To be conservative, the winter access road, which has more traffic, was used in the analysis.

8.3.2.2.1 Construction Site

Construction noise emissions from the site will occur during different phases

It is expected that construction of the mine facility will take approximately two years after an initial pre-construction year. During this period, construction activities will proceed through a number of phases. Each construction phase will have associated with it both generic and phase-specific noise sources. Construction noise emissions from the project site will occur during the following phases:

- pre-construction work program;
- excavation and road construction (including quarrying and aggregate crushing);
- concrete pouring;
- steel erection and building construction;
- mechanical;
- clean-up; and,
- commissioning.

Maximum noise emissions from the construction site are expected to occur during the excavation and steel erection phases.

Typical equipment construction noises provided

In Table 8.3-1, a list of construction equipment noise sources typically found at industrial construction sites is provided (May 1978). Also shown in the table are typical maximum A-weighted sound levels for each noise source.

Construction site noise will be less than 40 dBA L_{eq} at 1.5 km from the site decreasing to ambient sound at 6 km

Sound level predictions of construction noise were calculated for various distances from the mine site and correspond to the predicted noise during the excavation and steel erection phases (Teplitzky and Wood 1978). The noise produced during these phases is approximately the same as, and is representative of, the worst case for noise from the site during the construction period. Predicted sound levels for construction noise at various distances from the mine site are summarized in Table 8.3-2. Construction site noise will be less than 40 dBA Leq at 1.5 km from the site. As a result of the natural attenuation of outdoor sound with distance, continuous noise from the site will be close to, or less than, ambient sound levels at distances of 6 km or more from the site.

Average construction site noise will not be heard at tourist sites

All three lodges and camps in or near the RSA are well beyond 9 km from the site. The predicted average sound levels for these locations are well below ambient sound levels and construction site noise would not be audible.

Table 8.3-1 Typical Maximum Construction Equipment Sound Levels at 15 Metres

Noise Source	Sound Level (dBA)
Earth Moving	
Crawler tractors, dozers	81-85
Front end loaders	81-86
Graders	79-83
Earth haulers	88-90
Dump trucks	88
Material Handling	
Mobile cranes	83
Concrete mixers (truck)	85
Concrete pumps	82
Impact Equipment	
Pile drivers (conventional)	101
Jackhammers	88
Pneumatic tools	86
Auxiliary Equipment	
Pumps	76
Generators	78
Compressors	87
Paging systems	80-92
Warning horns	98-102
Other Equipment	
Saws	78
Vibrators	76

Table 8.3-2 Predicted Average Sound Levels for Construction Site Noise at Various Distances from the Site

Distance from Site (km)	Predicted Sound Level (dBA L_{eq})
1.5	35.7
3	26.9
6	17.9
9	8.9

Levels in Table 8.3-2 increase by up to 2 dBA in summer

The predicted values appearing in Table 8.3-2 are for the contribution of noise from the construction site only; they do not include the effects of local ambient noise. The predicted values are for typical early or late winter weather and ground cover conditions. Incremental increases in these values by up to 2 dBA are predicted for mid-summer weather conditions.

Construction is compared to operation

Average values for continuous noise emanating from the site during construction are predicted to be approximately 2 dBA less than continuous noise produced by the site during operation.

8.3.2.2.2 Construction Traffic

Construction traffic includes trucks and airplanes

Construction traffic accessing the site will include the following:

- winter road traffic (trucks); and,
- air traffic.

Construction traffic noise sources will be the same as traffic noise sources during operation

Construction traffic noise sources (*i.e.*, trucks and aircraft) will be essentially the same as transportation noise sources that occur during the operation phase of the project. Noise emission data for these sources are identified in Section 8.3.3.3, which addresses traffic noise sources during the operation phase.

Noise from construction truck traffic will be audible for 6 km

Noise from construction traffic using the winter road will result in short-term higher sound levels occurring on an intermittent basis. Noise produced by traffic will normally be audible within a 6 km wide corridor along the winter road route.

Average sound levels from the winter access road would not be heard at the tourist lodges

The Warburton Bay Lodge is the closest lodge to the winter access road; it is located 9 km from the winter access road. At this location the predicted average sound level is 8.9 dBA L_{eq}, which would not be audible. The other two tourist sites are farther away (Table 8.1-1). The Lac du Roche Camp is the closest tourist site to the esker access road and would not be affected. The Mackay Lake Lodge and the Warburton Bay Lodge are both within 6 km of the Tibbitt-Contwoyto winter road, and truck traffic is expected to be audible at both these locations during the winter road season. The impact of the Tibbitt-Contwoyto winter road is a cumulative impact addressed in Section 12.

Maximum construction road traffic noise will be the same as regular traffic noise during operation

The winter access road season for construction traffic will last for approximately 11 weeks during the winter of each year of construction. The maximum winter access road traffic during the construction period will be approximately the same as the regular winter access road traffic occurring during the operation phase. Consequently, the maximum noise from winter access road traffic during the construction phase will be approximately the same as traffic noise during the operation phase. Predicted sound levels for winter road traffic accessing the Snap Lake mine site during the operation phase are provided in Table 8.3-5 of Section 8.3.3.3.2 of this report.

Daily flights to the site are expected

Noise from periodic air traffic accessing the site will affect the LSA and extend into the RSA. The noise produced will be intermittent but regular, since air traffic will essentially consist of daily return flights to the site.

Sound levels produced by air traffic during construction and operation will be similar, but there will be more flights during construction

The volume of air traffic during the construction phase will be greater than regular air traffic during the operation phase (approximately four return flights per week). Consequently, air traffic noise during construction will be more frequent than during operation, although the sound levels produced by air traffic will be same. Predicted sound levels for air traffic during the operation phase are provided in Section 8.3.3.3.3 of this report.

Air traffic noise at the tourist sites is addressed in Section 8.3.3.3.3

The noise of air traffic at the three tourist sites during construction will be similar to that during operation. However, the frequency of noise effects will be greater because of the daily arrival and departure of aircraft during the construction period. Air traffic noise impact at the tourist sites during operation is addressed in Section 8.3.3.3.3 of this report.

8.3.2.3 Impact Classification

The magnitude of impact will generally be low, although large aircraft will intermittently cause a moderate impact

The direction of the construction noise impact will be negative. The magnitude of noise impact from the site will generally be low, although moderate noise impact from the site will occur intermittently as a result of aircraft using the site airstrip. The magnitude of noise impact along the winter road route will be low at distances beyond 1.5 km from the roadway.

Geographic extent, timing, duration, and reversibility are described

The extent of the noise impact will mainly be local, although air traffic noise impact will extend approximately 5 km beyond the RSA. Therefore, air traffic noise will be beyond regional in extent. Truck traffic noise impact will be regional in extent. The noise impact for the construction phase is predicted to occur during 2004 and 2005; similar types of noise will occur during decommissioning in 2026 to 2028. As the impacts at closure are expected to be less than the construction phase, they are not classified separately. The duration of the impact will be short-term, extending until the commissioning phase of the project. The impact is reversible in the short-term because noise contributions from construction activities and construction traffic will cease after the project is commissioned. However, noise impact associated with the operation phase of the project will merge with the diminishing construction noise effects at that time.

Frequency of construction noise varies

Noise impact from construction activities at the site will be continuous. The frequency of noise impact from air traffic will be medium, occurring for brief periods on a regular basis (daily). The frequency of the construction traffic noise impact will also be medium, occurring for approximately 11 weeks during the winter months of the construction period.

Table 8.3-3 Classification of Residual Impacts of Noise during the Construction Phase

Source	Direction	Magnitude	Geographic Extent	Duration	Reversibility	Frequency	Environmental Consequence
Mine site	negative	low	local	short-term	reversible (short-term)	high	negligible
Road traffic	negative	low	regional	short-term	reversible (short-term)	moderate	low
Air traffic	negative	moderate	beyond regional	short-term	reversible (short-term)	moderate	low

Probability of occurrence and confidence level are high

The probability of the impacts occurring is high. The confidence level in the predictions for the noisiest phases of construction are high because the impact predictions are based on published noise data and prediction methods for similar industrial facilities. There is a medium probability that noise will be less than that predicted, during other periods of the construction phase.

8.3.3 Key Question N-2: What Impacts Will Operation of the Snap Lake Diamond Project Have on Environmental Noise?

8.3.3.1 Linkage Analysis

The operation phase will produce noise from on-site equipment and traffic

The operation phase of the Snap Lake Diamond Project will produce noise in the LSA and RSA from operation of on-site stationary and mobile equipment, and as a result of air traffic periodically accessing the site airstrip. There will also be noise produced along the winter access road and the esker access road associated with truck traffic providing material to the site during the winter road season. The impacts of environmental noise produced by operation of an industrial facility are normally assessed with respect to potential effects on communities and, for remote site locations, potential effects on tourist sites and on wildlife.

Linkage between noise and communities is invalid

There are no communities in the vicinity of the project site, the winter access road, or the esker access road that can be potentially affected by noise from operation activities. Therefore, the linkage between operation noise impact and communities is not valid.

The linkage between mine site operation noise and effects on wildlife is valid

There are three tourist sites (*i.e.*, lodges and camps) near the outer boundary of the RSA. This region is also wildlife habitat. Both the tourist sites and wildlife in these areas could potentially be affected by noise emissions from on-site equipment, from air traffic accessing the site, and from truck traffic noise emissions on the winter roads. Therefore, the linkage between operation noise impact and the tourist sites and wildlife is valid.

8.3.3.2 Mitigation

Noise mitigation will be required for the power plant

Based upon noise data for the major sources at the site and the results of preliminary noise model calculations, the power plant has been identified as a major source of noise that will require noise mitigation. The power plant will consist of five 4,400 kw diesel generator units. The power requirements for the mine site require operation of only three of these units at the same time. The diesel generator units would normally be fitted with standard engine exhaust silencers to reduce exhaust noise to non-hazardous levels in areas close to the power plant. The preliminary noise model results indicate that additional attenuation of engine exhaust noise will be required to control environmental noise emissions. This will be achieved by fitting the units with high-performance engine exhaust silencers.

8.3.3.3 Impact Analysis

Continuous and intermittent noise will occur during operation

Environmental noise associated with the Snap Lake Diamond Project will consist of continuous noise produced by stationary and mobile equipment located on the mine site, as well as intermittent noise produced by winter road traffic and air traffic periodically accessing the mine site. Intermittent noise will also be produced by traffic on the esker access road. To be conservative, the winter access road, which has more traffic, was used in the analysis.

8.3.3.3.1 Active Mine Site

Above ground, outdoor equipment will contribute to environmental noise emissions from the site

The Snap Lake site will consist of plant and camp facilities necessary to operate the mine facility. Many equipment noise sources at the site will be located inside buildings or underground, and will not contribute substantially to environmental noise emissions from the site. However, the following is a list of major sources that are expected to contribute to environmental noise in the vicinity of the site:

- power plant;
- mine ventilation fans;
- aggregate crushing equipment (above ground); and,
- mobile equipment (above ground).

Noise predictions were based on a survey of equipment on site during the advanced exploration program, and in-house and published data

As part of the impact assessment, a noise survey of the existing equipment used in the advanced exploration program was conducted. This survey included measurements of power generation equipment, kimberlite-crushing equipment, the mine ventilation fan, and several pieces of mobile equipment. Information regarding plant equipment to be installed at the fully operational mine site was provided by AMEC. Noise emissions for the above ground aggregate crushing equipment, and above ground mobile equipment were based upon the noise survey results for the same or similar equipment used in the advanced exploration program. Noise emission data for the power plant equipment was obtained from the diesel generator vendor. Noise emission data for the mine ventilation fans were derived from published noise data for equipment similar in type, size, horsepower, and capacity (Harris 1979).

The main sources of continuous noise are the power plant and the aggregate crushing

Noise produced by the site will include the combined affects of noise from the power plant, mine ventilation fans, above-ground aggregate crushing equipment, and above-ground mobile equipment. Sound level, location, and activity data for each of these sources were entered into the computer model, which then calculated predicted sound levels for normal operation of the site. The main sources of continuous noise at the site will be the power plant and aggregate crushing equipment.

Continuous noise from the site will be less than 40 dBA L_{eq} at 1.5 km

Predictions of average sound levels for site noise at various distances from the mine site are summarized in Table 8.3-4. Since the mine site will operate on a 24-hour basis, the sound levels identified in Table 8.3-4 are the expected average noise continuously produced by the site.

Table 8.3-4 Predicted Average Sound Levels for Mine Site Operation at Various Distances from the Site

Distance from Site (km)	Predicted Sound Level (dBA L_{eq})
1.5	37.6
3	28.9
6	19.4
9	13.0

Figures show the predicted sound levels during operation

Figures 8.3-2 and 8.3-3 present the predicted sound levels in the form of contour maps of site noise for the RSA and LSA, respectively. In the RSA (Figure 8.3-2), the extent of the effects of continuous noise from the site is indicated by the areas having a sound level of 20 dBA or greater. In the areas where the predicted sound level is less than 20 dBA, noise from the site will not be audible above existing ambient noise.

Noise from site operation will meet the Alberta Energy and Utilities Board Noise Control Directive guideline for industrial facilities in remote locations

Average values for continuous noise emanating from the site are predicted to be less than 40 dBA L_{eq} at a distance of 1.5 km from the site. This sound level is similar to the level of continuous background noise that would occur in a small town residential area. Although the continuous noise produced by the site at this distance will be greater than pre-existing ambient sound levels during calm conditions, the predicted sound level does meet the guideline criteria of the Alberta EUB Noise Control Directive for industrial facilities in remote locations. As a result of the natural attenuation of outdoor sound with distance, continuous noise from the site will be close to or less than ambient sound levels at distances of about 6 km from the site.

Continuous noise will not be heard at tourist sites

As indicated by the results in Table 8.3-4 and Figure 8.3-2, average noise from the site will not be audible at any of the three lodges and camps located close to the perimeter of the RSA.

8.3.3.3.2 Traffic

Noise from road and air traffic will be intermittent

Noise from road and air traffic accessing the mine site will also contribute to environmental noise in the study area, in addition to the steady noise produced by mine site operation. Noise from road and air traffic will be intermittent, rather than steady and continuous, and will be in the form of short periods of higher level sound associated with truck pass-bys and aircraft landing and take-off.

Traffic noise sources will include truck and air traffic

Road traffic will consist of truck traffic using the winter roads. The Snap Lake truck traffic will use the existing Tibbitt-Contwoyto winter road from Yellowknife to a junction northwest of the mine site. This segment of the winter road will also be used by truck traffic to other facilities. The winter access road from the junction to Snap Lake will be used only by trucks accessing the Snap Lake mine site.

Figure 8.3-2 Predicted Sound Levels in the RSA from Facility Operation

Figure 8.3-3 Predicted Sound Levels in the LSA from Facility Operation

A wide range of aircraft will be used

Air traffic accessing the site will include of a wide variety of aircraft, ranging from small (*e.g.*, Twin Otter) to large (*e.g.*, Boeing 737 and C-130 Hercules). Hercules air traffic would occur regularly during construction and occasionally during operation. However, smaller turboprop aircraft (*e.g.*, Hawker-Sidley 748, ATR 42-300) will likely be used for most flights to the site during operations.

Published noise data were used for truck and air traffic

Noise emissions for truck traffic using the winter road were based upon published noise data (Harris 1979). Noise emissions for small and large aircraft accessing the site airstrip were based upon HFP Acoustical Consultants in-house measurement data and published data for landing and take-off of these types of aircraft (Harris 1991).

Winter Road Traffic

The noise of one truck and the 24-hour sound levels were determined

The winter road season will occur annually for approximately 11 weeks; during this time truck traffic will occur regularly, travelling to and from the mine site. The estimated number of return trips to the site during each season is 2800. This would be approximately equivalent to three trucks per hour to and from the site during the season. This information was used to predict maximum sound levels associated with individual truck pass-by noise, as well as 24-hour L_{eq} sound levels for truck traffic noise. Predicted sound levels for the Snap Lake traffic at various distances from the winter road route are provided in Table 8.3-5.

Table 8.3-5 Predicted Sound Levels for Truck Traffic at Various Distances from the Winter Road

Distance from Road (km)	Predicted Sound Level (dBA)	
	Maximum	24 hr L_{eq}
0.75	64.3	28.1
1.5	55.1	18.9
3	44.4	8.4

Noise from trucks on the winter access road will occur three times per hour

Noise from periodic truck traffic on the winter access road will result in short-term higher sound levels occurring on an intermittent basis. Noise produced by truck traffic will mainly affect a corridor area along the winter access road. Truck pass-bys, which are estimated at about three trucks per hour, may be audible during calm conditions at distances of approximately 10 km from the roadway. However, no increase in average ambient noise is predicted for distances greater than 1.5 km from the roadway. The subjective effect of the truck traffic would be similar to snowmobile pass-by noise at slightly closer distances.

Table 8.3-5 applies only to truck traffic

The values appearing in Table 8.3-5 are for the contributions of truck traffic noise only. They do not include the effects of noise from the mine site, or the local ambient sound environment.

A noise contour map shows the combined effects of winter road traffic and site operation

In Figure 8.3-4, the combined effects of noise contributions from winter road traffic and continuous noise from the site are presented in the form of a noise contour map. This figure is representative of the average noise produced in the study area over a 24-hour period during the winter road season, exclusive of the effects of air traffic. The predicted sound levels in the figure also include the effects of existing truck traffic using the Tibbitt-Contwoyto winter road. As indicated in the contour map, predicted sound levels are greatest at locations close to the site and the winter road, although the overall noise contribution of the winter road is less than that of the site. In the areas where predicted sound levels are less than 20 dBA L_{eq}, average sound levels will be less than existing ambient sound levels. For these areas, continuous noise from the site would not be audible, although noise from truck pass-bys would be audible up to approximately 10 km from the winter road.

Truck traffic noise from the winter access road will be audible at tourist site

Truck traffic noise will be audible at the Mackay Lake Lodge and the Warburton Bay Lodge. These lodges are both within 3 km of the Tibbitt-Contwoyto winter road, although only the Warburton Bay Lodge will be affected by noise from truck traffic on the winter access road to the Snap Lake site. Truck pass-by noise will normally be audible at both locations, although average noise associated with the truck traffic will be close to existing ambient sound levels. Truck traffic noise will not be audible at the Lac du Roche Camp.

Air Traffic

Five-minute and one-hour L_{eq} dBA sound levels were predicted for aircraft arrival and departure

Air traffic accessing the site will normally consist of a variety of aircraft ranging from small (Twin Otter or similar) to large (Boeing 737, C-130 Hercules or similar). Aircraft are expected to make approximately four return trips to the site per week. Most of these aircraft (*e.g.*, ATR 42-300, Hawker-Sidley 748) will usually be smaller than the Hercules; sound levels are expected to be less than the levels shown for large aircraft. The maximum noise produced by aircraft occurs during take-off. Predictions of five minute L_{eq} sound levels for aircraft take-off were calculated to estimate the maximum short-term noise produced by the largest aircraft accessing the site. Average sound levels produced by the largest aircraft would be greatest under circumstances when aircraft arrival and departure occurs within a short interval. Predictions of one hour L_{eq} sound levels for aircraft arrival and departure within a one hour interval were calculated to estimate the worst case effects of air traffic noise. Predicted sound levels for air traffic noise, at various distances from the site airstrip and perpendicular to the flight path, are provided in Table 8.3-6.

Figure 8.3-4 Predicted Sound Levels in the RSA from Facility Operation and Winter Road Traffic

Table 8.3-6 Predicted Sound Levels for Air Traffic at Various Distances from the Airstrip

Distance from Airstrip (km)	Predicted Sound Level (dBA)			
	Small Aircraft		Large Aircraft	
	5 min L_{eq}	1 hr L_{eq}	5 min L_{eq}	1 hr L_{eq}
1.5	56.7	46.1	67.1	56.4
3	49.9	39.3	59.9	49.2
6	42.0	31.5	51.2	40.5
9	36.5	26.1	45.2	34.5

Table 8.3-6 includes only air traffic

The values appearing in Table 8.3-6 are for the contributions of air traffic noise only. They do not include the effects of noise from the mine site, winter road traffic, or the local ambient sound environment.

Noise from air traffic will occur four times per week when five minute sound levels may reach a maximum of 67 dBA

The noise produced by small aircraft will be approximately 10 dBA less than that produced by the large aircraft. Short-term (five minute) sound levels within the RSA under calm conditions could increase to 67 dBA at 1.5 km from the airstrip for brief periods as a result of air traffic. Maximum noise associated with the site would be produced when aircraft arrival and departure occur within a short interval or when more than one arrival and departure per day occur.

Aircraft take-off is compared to a snowmobile

The short-term noise produced during take-off at a distance of approximately 3 km from the airstrip would be similar in sound level to a snowmobile pass-by noise at a distance of 1 km.

A noise contour map shows the combined effect of air traffic and site operation

The combined effects of intermittent air traffic noise and continuous noise from the site are presented in two contour maps. Figure 8.3-5 shows predicted one hour L_{eq} sound levels for landing and take-off of a small aircraft at the mine site. This figure shows the average noise produced in the LSA and RSA by small aircraft traffic. It assumes arrival and departure within the one hour interval and is representative of much of the air traffic at the mine site. A corresponding noise contour map showing predicted sound levels for landing and take-off of a large aircraft at the mine site is presented in Figure 8.3-6. The predicted sound levels presented in Table 8.3-6 and in Figures 8.3-5 and 8.3-6 indicate the expected range of noise produced by air traffic at the mine site. Typical air traffic would be expected to produce noise within this range.

Figure 8.3-5 Predicted Sound Levels in the RSA from Facility Operation and Small Aircraft Landing and Take-off

Figure 8.3-6 Predicted Sound Levels in the RSA from Facility Operation and Large Aircraft Landing and Take-off

The 24-hour L_{eq} sound levels are predicted for large and small aircraft

The 24-hour L_{eq} sound levels were calculated for the combined effects of noise from the site and air traffic noise. The predicted sound level at 1.5 km from the site for one arrival and departure over one 24-hour period for a small aircraft is 39 to 40 dBA L_{eq}. The predicted sound level at 1.5 km from the site for one arrival and departure over one 24-hour period for a large aircraft is approximately 44 dBA L_{eq}.

Although average noise will be near or below ambient noise at the tourist sites, individual fly-overs will be heard

Average noise produced by large aircraft accessing the mine site will be close to existing ambient sound levels at the Warburton Bay Lodge and the Lac du Roche Camp. Average noise produced by small aircraft will be less than existing ambient noise at these locations. Average noise produced by large and small aircraft will be less than existing ambient noise at the Mackay Lake Lodge. The short-term sound of large aircraft taking off from the site will be barely audible at the tourist sites. However, aircraft fly-over noise will normally be audible at all three locations, particularly for short intervals when the aircraft are at their closest proximity to each location.

8.3.3.3.3 Mine Site and Traffic

The worst case combines noise from site operation, winter road traffic, and air traffic for large aircraft

Figure 8.3-7 shows predicted one hour L_{eq} sound levels for the worst case scenario for noise in the RSA. In this figure, the combined effects of continuous noise from the site, winter road traffic, and arrival and departure of a large aircraft are presented. As in the two previous air traffic noise contour figures, the effects of intermittent air traffic are the dominant noise produced in the study area. This combination will seldom occur. For most of the year, there will be no winter road traffic, and aircraft making scheduled trips to Snap Lake will be smaller than the large aircraft used in the prediction.

Average noise during the worst case will be close to ambient at tourist sites

With respect to noise impact at the three lodges and camps in the RSA, the dominant noise source affecting the Mackay Lake Lodge and the Warburton Bay Lodge is winter road traffic. The dominant source of noise affecting the Lac du Roche Camp is air traffic noise. However, Figure 8.3-7 indicates that the average noise produced at each location for this worst case scenario will be close to existing ambient sound levels.

8.3.3.4 Impact Classification

The magnitude of noise impact will be low, except for large aircraft which cause a moderate impact

The direction of the operation noise impact will be negative (Table 8.3-7). The magnitude of noise impact from the site will generally be low, although a moderate noise impact from the site will occur intermittently when larger aircraft use the site airstrip. The magnitude of noise impact on the winter road will be low at distances beyond 1.5 km from the roadway.

Figure 8.3-7 Predicted Sound Levels for Facility Operation, Winter Road Traffic and Large Aircraft Landing and Take-off

Table 8.3-7 Classification of Residual Impacts of Noise during the Operation Phase

Source	Direction	Magnitude	Geographic Extent	Duration	Reversibility	Frequency	Environmental Consequence
Mine site	negative	low	local	medium-term	reversible (short-term)	high	low
Road traffic	negative	low	regional	medium-term	reversible (short-term)	moderate	low
Air traffic	negative	moderate	beyond regional	medium-term	reversible (short-term)	moderate	moderate

Geographic extent, duration and reversibility described

The extent of the noise impact will mainly be local, although air traffic noise impact will be beyond regional since it extends approximately 5 km beyond the RSA boundary when a large aircraft takes off. Truck traffic noise impact will be regional in extent. The duration of the impact will be medium-term, extending throughout the operational life of the project. The timing will be 2006 to 2026. The impact is reversible in the short-term because the site and traffic noise contributions will cease after the Snap Lake Diamond Project is decommissioned.

Frequency of operations noise varies

Noise impact from stationary and mobile equipment at the site will be continuous. The frequency of noise impact from air traffic will be medium, intermittently occurring for brief periods on a regular basis. The frequency of the truck traffic noise impact will also be medium, occurring annually during the winter months for approximately 11 weeks, although during that period the impact will be frequent.

Probability of occurrence and confidence level are high

Both the probability of occurrence and the confidence level are high because the impact prediction is based on published noise data and actual noise measurements. Moreover, the computer noise model for the facility used published calculation procedures developed for the purpose of predicting noise from industrial facilities.

8.4 CONCLUSIONS

8.4.1 Construction Noise Impact

On-site construction and traffic will produce noise

Construction activities related to the Snap Lake Diamond Project will produce noise in the vicinity of the site as a result of on-site construction activity and air traffic. Noise will be produced along the winter access road associated with construction traffic using the winter road.

Wildlife and tourist sites may be affected by the noise; therefore, there is a link between the project and these effects

There are no communities in the vicinity of either the project site or the winter access road that can be potentially affected by noise from construction activities. However, there are three tourist sites (lodges and camps) near the RSA boundary. Two of these sites are within 6 km of the Tibbitt-Contwoyto winter road. The area around the project site and along the winter access road is also wildlife habitat. The tourist sites and the wildlife in these areas could potentially be affected by environmental noise associated with construction of the facility. Therefore, there is a link between the project and these effects. This is discussed further in Resource Use (Section 6.4).

The Snap Lake Diamond Project will produce continuous and intermittent noise

Environmental noise associated with construction of the Snap Lake Diamond Project will consist of more or less continuous noise produced by construction activities at the project site, as well as intermittent noise produced by winter road traffic and air traffic periodically accessing the mine site.

Construction will produce less noise than project operation

Average sound levels of construction noise are predicted to be marginally less than the noise produced by the site during operation. Construction site noise will be less than 40 dBA L_{eq} at 1.5 km from the site and will decrease to ambient sound levels at 6 km from the site.

Construction traffic will produce the same amount of noise as traffic when the mine is operating

Construction traffic will result in the occurrence of intermittent, short-term vehicle pass-by noise along the winter access road. The average noise produced by construction traffic accessing the Snap Lake site will be approximately the same as traffic noise during the operation phase, because traffic volumes are expected to be approximately the same during both phases.

Air traffic will be greater in the construction phase

Noise from periodic air traffic accessing the site will affect the LSA and RSA, and will extend 5 km beyond the RSA. The noise produced will be intermittent but regular, since air traffic during construction will normally consist of daily return flights to the site. The noise impact of air traffic during the construction phase will be greater than that for air traffic during the operation phase, since air traffic volumes will be less during operation.

People at the tourist sites will not hear site noise, but will hear winter road and/or air traffic periodically

Continuous noise from the Snap Lake construction site will not be audible at any of the three tourist sites. Winter road truck traffic will be audible at the Mackay Lake Lodge and the Warburton Bay Lodge, although only the latter will be affected by Snap Lake truck traffic on the winter access road. Mackay Lake Lodge will be affected only by traffic on the Tibbitt-Contwoyto winter road. Winter road traffic will not be audible at the Lac du Roche Camp. Air traffic noise will be audible at all three tourist sites, particularly for short intervals when the aircraft are at their closest proximity to each location.

Environmental consequence is negligible to low

The overall environmental consequence of the residual impact of construction noise at the Snap Lake Diamond Project is predicted to be negligible to low. The classification is shown in Figure 8.4-1.

8.4.2 Operation Noise Impact

Project operation will produce on-site and traffic noise

The Snap Lake Diamond Project will produce noise as a result of operation of on-site stationary and mobile equipment, and as a result of air traffic periodically accessing the site airstrip. There will also be noise produced along the winter access road associated with truck traffic providing material to the site. Noise from these sources may potentially affect tourist sites and wildlife.

Continuous noise from site operations meets the guidelines and decreases to ambient levels at about 6 km

Average sound level values for continuous noise emanating from the site are predicted to be less than 40 dBA L_{eq} at a distance of 1.5 km from the site. The continuous noise produced by the site at this distance will typically be greater than the pre-existing ambient sound levels. However, the predicted sound level does meet the guideline of the Alberta EUB noise control directive for industrial facilities in remote locations. As a result of the attenuation of outdoor sound with distance, continuous noise from the site will be close to or less than ambient sound levels at distances of about 6 km from the site.

Truck traffic may be audible for up to 10 km from the winter access road

Noise produced by trucks passing by a location along the winter access road may be audible during calm conditions at distances of approximately 10 km from the roadway. However, no increase in average ambient noise is predicted for distances greater than 1.5 km from the roadway. The subjective effect of the truck traffic would be similar to snowmobile pass-by noise at slightly closer distances.

Maximum noise at the site is associated with aircraft arrivals and departures

Noise from periodic air traffic accessing the site will affect the LSA and extend into the RSA. The noise produced will be intermittent but regular, since air traffic will include approximately four return flights to the site per week. The highest short-term sound levels will occur during aircraft take-off, although the noise produced by small aircraft will be approximately 10 dBA less than that produced by the large aircraft. Maximum noise associated with the site would be produced when aircraft arrival and departure occur within a short interval or when more than one arrival and departure per day occur.

Figure 8.4-1 Classification of Residual Impact of Noise during Construction

People at the tourist sites will not hear continuous noise from the site, but they will hear road and/or air traffic periodically

Continuous noise from the Snap Lake mine site will not be audible at any of the three tourist sites. Winter road truck traffic will be audible at the Mackay Lake Lodge and the Warburton Bay Lodge, although only the latter will be affected by Snap Lake truck traffic using the winter access road. Mackay Lake Lodge will be affected by traffic on the Tibbitt-Contwoyto winter road, but Snap Lake truck traffic will not be audible at this location. Winter road traffic will not be audible at the Lac du Roche Camp. Air traffic noise will be audible at all three tourist sites, particularly for short intervals when the aircraft are at their closest proximity to each location. Although aircraft noise will be periodically audible, the average noise produced by air traffic at each of the three sites will be close to existing ambient sound levels.

The environmental consequence is low

The overall environmental consequence of the residual impact of Snap lake Diamond Project operation is predicted to be low. The classification is shown in Figure 8.4-2.

Figure 8.4-2 Classification of Residual Impact of Noise during Operation

8.5 REFERENCES

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8.6 UNITS, ACRONYMS, AND GLOSSARY

UNITS

dBA	A-weighted decibel level
hr	hour
km	kilometre
kw	kilowatt
min	minute

ACRONYMS

CEA	cumulative effects assessment
De Beers	De Beers Canada Mining Inc.
EA	environmental assessment
EUB	Alberta Energy and Utility Board
L_{eq}	single number descriptor known as equivalent continuous sound level
LSA	local study area
MVEIRB	Mackenzie Valley Environmental Impact Review Board
RSA	regional study area

GLOSSARY

ambient	the pre-existing sound environment of a location, prior to the introduction of, or in absence of noise from a specific source which also affects the sound environment of that location
application case	represents the impact of the Snap Lake Diamond Project by itself

atmospheric absorption	the effect of sound absorption by the atmosphere between source and receiver
attenuation	a reduction in sound level that occurs with sound propagation over distance by means of physical dissipation or absorption mechanisms, or a reduction in sound level that occurs by means of noise control measures applied to a sound source
A-weighted sound level	a measurement of overall sound pressure level which accounts for the frequency content of the measured sound and assesses it with a frequency response similar to that of the human ear
barrier attenuation	a noise shielding effect caused by intervening buildings, landforms, etc. between source and receiver
baseline case	represents conditions prior to development
cumulative effects assessment case	represents the combined effects of the Snap Lake Diamond Project and other projects in the region that overlap in time and space
direction	describes an impact or effect as being neutral or negative; the direction usually reflects the change from baseline
distance dissipation	the geometrical dissipation of sound with respect to distance
duration	the length of time that an impact will occur; duration and timing have been combined within the definition of duration used in this EA; duration is defined by the timing of the phases of the project.
ecological resilience	the rate of ecosystem recovery following a disturbance or the capacity of an ecosystem to absorb disturbances
equivalent continuous sound level or L_{eq}	A single number descriptor commonly used for environmental noise measurements and criteria. It is used to quantify sound which constantly varies over time, such as that commonly occurring in outdoor environments. It is defined as the steady, continuous sound level over the measured time period that has the same acoustic energy as the actual fluctuating sound levels that occurred during the same time period. Measurement periods commonly used for L_{eq} measurements and criteria are the daytime (07:00 - 22:00 hrs) and night time (22:00 - 07:00 hrs) periods.
facility noise	environmental noise in the vicinity of industrial buildings, where there is usually a steady background sound level that is slowly varying
frequency	how often an effect will occur

geographic extent	The geographic location where the impact is predicted to occur. A local geographic extent is assigned if the effect is restricted to the LSA. A regional geographical extent is assigned if the effect extends beyond the LSA into some part of the RSA.
ground attenuation	the effect of sound absorption by the ground as sound passes over various types of open terrain
increase in sound level	The perceived increase in loudness of a sound does not correspond directly to numerical increases in dBA values. Typically, an increase of less than 3 dBA is barely noticeable, an increase of 5 dBA is noticeable, an increase of 10 dBA is perceived as a doubling in apparent loudness, and an increase of 20 dBA is perceived as a four-fold increase in apparent loudness.
irreversibility	an indicator of the potential for recovery from the impact. The irreversibility category is classified as reversible in the short-term, reversible in the long-term, or irreversible.
isopleth	region of equal sound level.
level of confidence	directly related to the degree of certainty in the impact prediction.
magnitude	a measure of the intensity or severity of an impact; a measure of the degree of change in a measurement or analysis endpoint
probability of occurrence	the likelihood that the environmental consequence indicated in the impact prediction will occur if the project goes ahead
wind gradient	enhances sound propagation in downwind directions and attenuates sound propagation in upwind directions