

**SECTION 5.0 – NOISE  
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## 5.0 NOISE

### 5.1 Introduction

In Alberta, energy facility noise emissions are regulated by the Energy Resources Conservation Board (ERCB) through Directive 38: *Noise Control* (ERCB 2007). New or modified facilities that contain continuous noise sources require a Noise Impact Assessment (NIA). This section of the application details the NIA undertaken for the proposed BlackGold Expansion Project.

### 5.2 Study Area

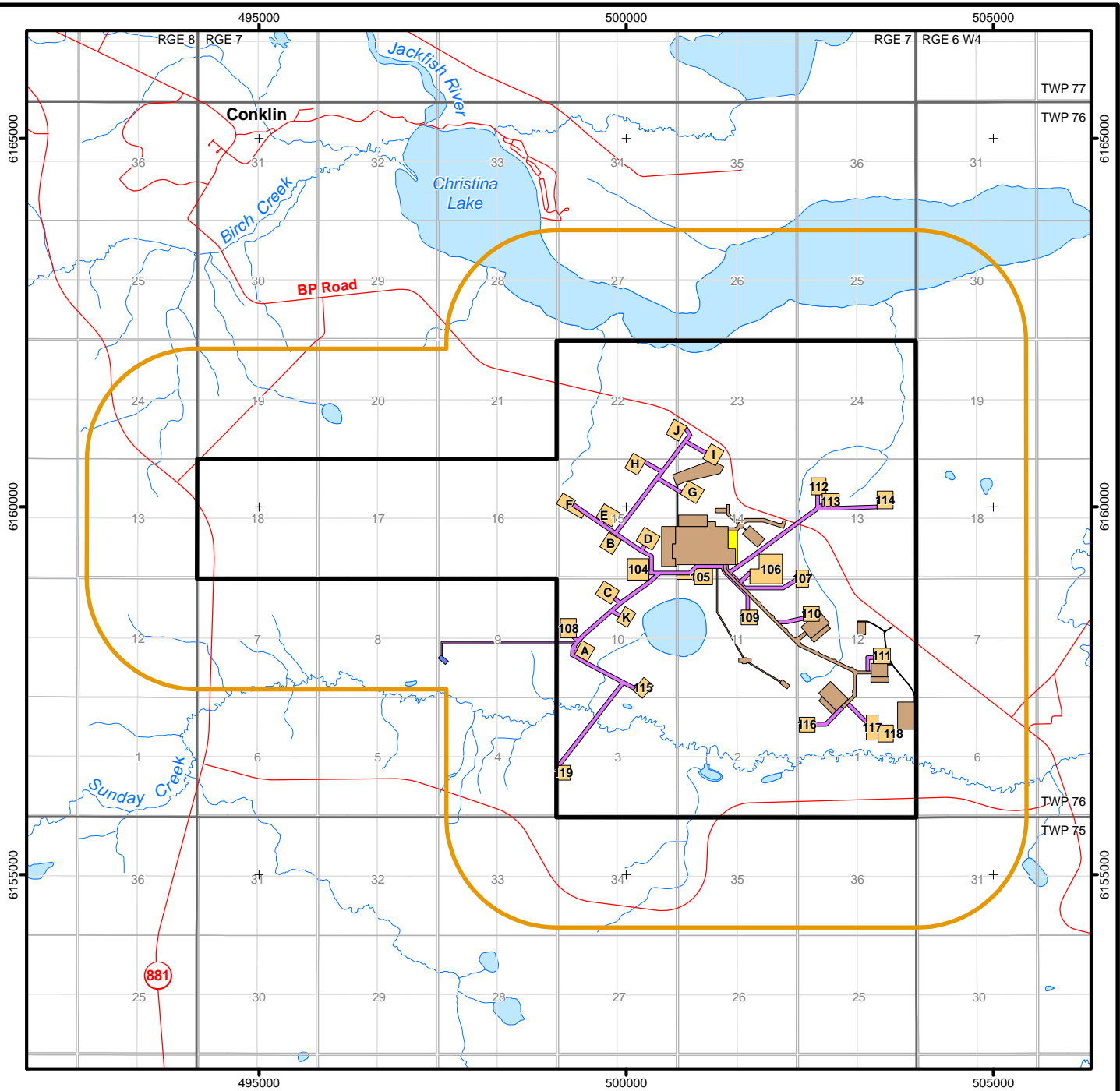
Directive 38 is a receptor-based noise regulation that defines a noise receptor as any permanent or seasonally occupied dwelling. In remote areas, where there are no nearby residents, Directive 38 sets a mandatory limit of 40 dBA on the noise levels at a distance of 1.5 km from the facility fenceline. For the purposes of this assessment, the “facility fenceline” as termed in Directive 38 has been defined as the project lease boundary.

The Local Study Area (LSA) for noise consists of a 1.5 km wide zone around the perimeter of the project lease ([Figure 5.2-1](#)).

The Regional Study Area (RSA) for noise includes an area up to 5 km from the project area boundary, and is designed to ensure that nearby facilities that may impact the predicted noise levels within the LSA are accounted for.

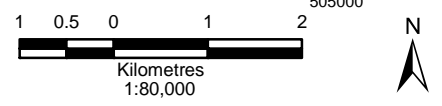
There are no known permanent or seasonally occupied human dwellings (e.g., cabins, cottages, residences, etc.) within the LSA. Conklin is the nearest residential area, which is located approximately 10 km northwest of the proposed Central Processing Facility (CPF) and approximately 6 km northwest from the nearest well pad. Due to the geometrical dissipation of sound levels with respect to distance, the applicable noise criteria at the 1.5 km distance will be more stringent than the applicable criteria at the closest receptor location of Conklin.

Existing or approved energy development projects located within the RSA include EnCana Christina Lake to the east, Devon Jackfish to the southeast and Devon Jackfish 2 to the southwest ([Figure 5.2-2](#)). Due to their proximity, noise generated from these projects has been included in this NIA.



**Legend**

- Noise Local Study Area
- Lease
- Open Water
- Watercourse
- BlackGold Expansion Project Layout**
- Temporary Construction Laydown Area
- Project ROW
- Source Water Well
- Well Pad
- Baseline Disturbance**
- BlackGold Initial Project

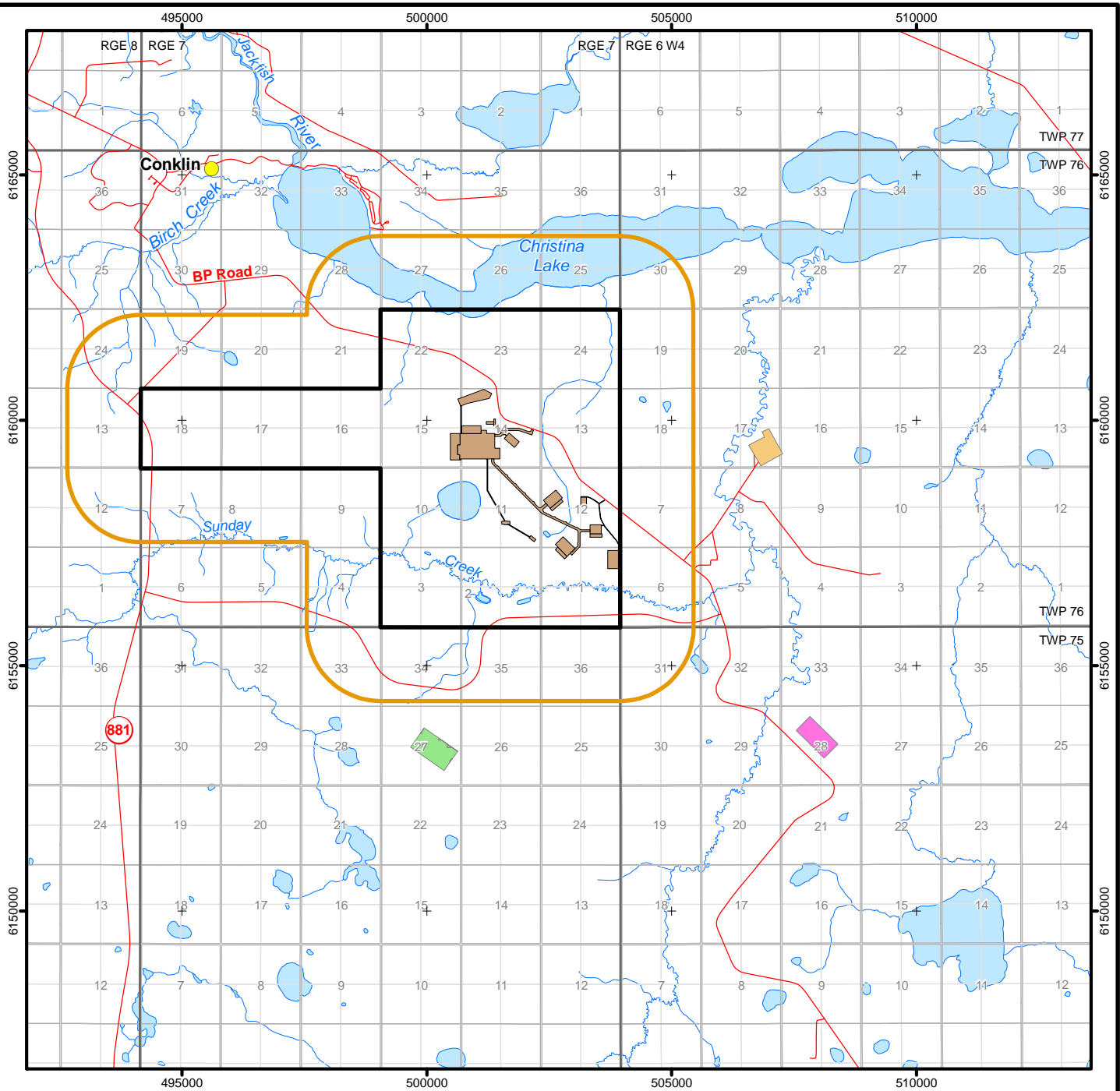


Sources: GeoBase®, KNOC, RWDI, Spatial Data Warehouse Ltd.

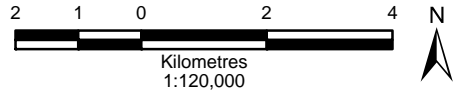
**Korea National Oil Corporation**  
**BlackGold Expansion Project**

**Noise Local Study Area**

DATE: December 2009	<b>Figure 5.2-1</b>
PROJECT: CE03745/100	Fig05.02-01 Noise Study Area 09-12-15
ANALYST: TM	DRAWN BY: AMEC
PROJECTION/DATUM: UTM Zone 12 NAD83	PREPARED BY: AMEC



- Noise Local Study Area
  - Lease
  - Open Water
  - Watercourse
- Existing or Approved Energy Developments**
- KNOC BlackGold Initial Project
  - Devon Jackfish CPF
  - Devon Jackfish 2 CPF
  - EnCana Christina Lake CPF



Sources: GeoBase®, KNOC, RWDI, Spatial Data Warehouse Ltd.

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**Energy Developments**  
**Baseline Case**

DATE: December 2009	<b>Figure 5.2-2</b>
PROJECT: CE03745/100	Fig05.02-02 Baseline Energy Developments 09-12-15
ANALYST: TM	QA/QC: KW CV DR
PROJECTION/DATUM: UTM Zone 12 NAD83	DRAWN BY: AMEC
	PREPARED BY: AMEC

## **5.3 Assessment Approach**

### **5.3.1 Environmental Noise Descriptors**

Environmental noise varies over time. To account for this variance, a single number descriptor known as the Energy Equivalent Sound Level or  $L_{eq}$  is used. The  $L_{eq}$  value, expressed in dBA, is the energy-averaged A-weighted sound level for the given time period. It is defined as the steady, continuous sound level over a specified time period that has the same acoustic energy as the actual varying sound levels occurring over the specified time period. The  $L_{eq}$  values are based on A-weighted sound levels expressed in units of dBA (A-weighted decibels). The A-weightings are assigned to reflect the response of the human ear to different frequencies of sound. The human ear is more sensitive to mid-frequency sounds as reflected in the A-weighting scale.

In order to assess low frequency noise (LFN), Directive 38 also requires that the C-weighted sound levels, expressed in dBC, be determined. The C-weightings represent a nearly flat frequency response and do not reflect the behaviour of human hearing. Directive 38 assesses the potential for LFN complaints based on the difference between the dBA and dBC levels.

The ERCB has different allowable noise levels for day-time, which it defines as 07:00 to 22:00 hrs, and night-time, which it defines as 22:00 to 07:00 hrs. The  $L_{eq}$  during day-time periods is the 15-hour A-weighted energy equivalent sound level and is denoted as the  $L_{eq}$  Day. Similarly, the  $L_{eq}$  during night-time periods is a 9-hour A-weighted energy equivalent sound level and is denoted as the  $L_{eq}$  Night

### **5.3.2 Applicable Noise Guidelines**

Directive 38 defines a fixed limit on the amount of noise measured at a receptor location that may be generated by energy-related facilities. A receptor is defined as a permanent or seasonally-occupied human dwelling. The noise limit for a receptor is set by calculating a permissible sound level according to the procedure in Directive 38. For remote rural areas where no permanent or seasonally-occupied human dwelling exists within a distance of 1.5 km from the facility, Directive 38 requires that operational noise from planned new facilities does not exceed 40 dBA  $L_{eq}$ .

In this assessment, the predicted noise level that is compared to the mandatory sound level is the project noise level with the addition of both the average rural ambient level of 35 dBA, and the noise contribution from existing or approved energy development facilities within the RSA.

Directive 38 states that an LFN complaint condition may exist where the difference between the time weighted average dBA and dBC levels is equal to or greater than 20 dB, and where a clear tonal component exists at a frequency below 250 Hz.

### 5.3.3 Evaluation of Impact

The evaluation methodology used in this NIA also addresses the impact in terms of human perception of sound. The magnitude of the operational noise effects was assessed by comparing the cumulative sound level of both the rural ambient level and the predicted operational sound level at 1.5 km to the recommended noise limit of 40 dBA  $L_{eq}$  at 1.5 km. The ERCB has established that the average night-time Ambient Sound Level (ASL) for remote rural Alberta is approximately 35 dBA  $L_{eq}$  Night.

## 5.4 Methods

The noise emissions modelled in this NIA include both the Initial and Expansion phases of the BlackGold Project. Previously assessed noise sources from the BlackGold Initial Project have been included in the noise model in this NIA (KNOC 2008, 2009).

Noise emissions from the Devon Jackfish, Devon Jackfish 2 and EnCana Christina Lake facilities have also been included in this assessment (Devon 2004, 2006).

### 5.4.1 Computer Modelling

Noise modelling for this NIA was conducted using Cadna/A (Version 3.7.125) noise prediction software. This software uses the noise propagation calculation methodologies prescribed by the International Organization for Standardization (ISO) Standard 9613 (ISO 1993, 1996) and outdoor sound propagation algorithms prescribed. The ISO 9613 sound propagation model predicts noise levels under mildly developed temperature inversion and downwind conditions, which enhances sound propagation to the receptor.

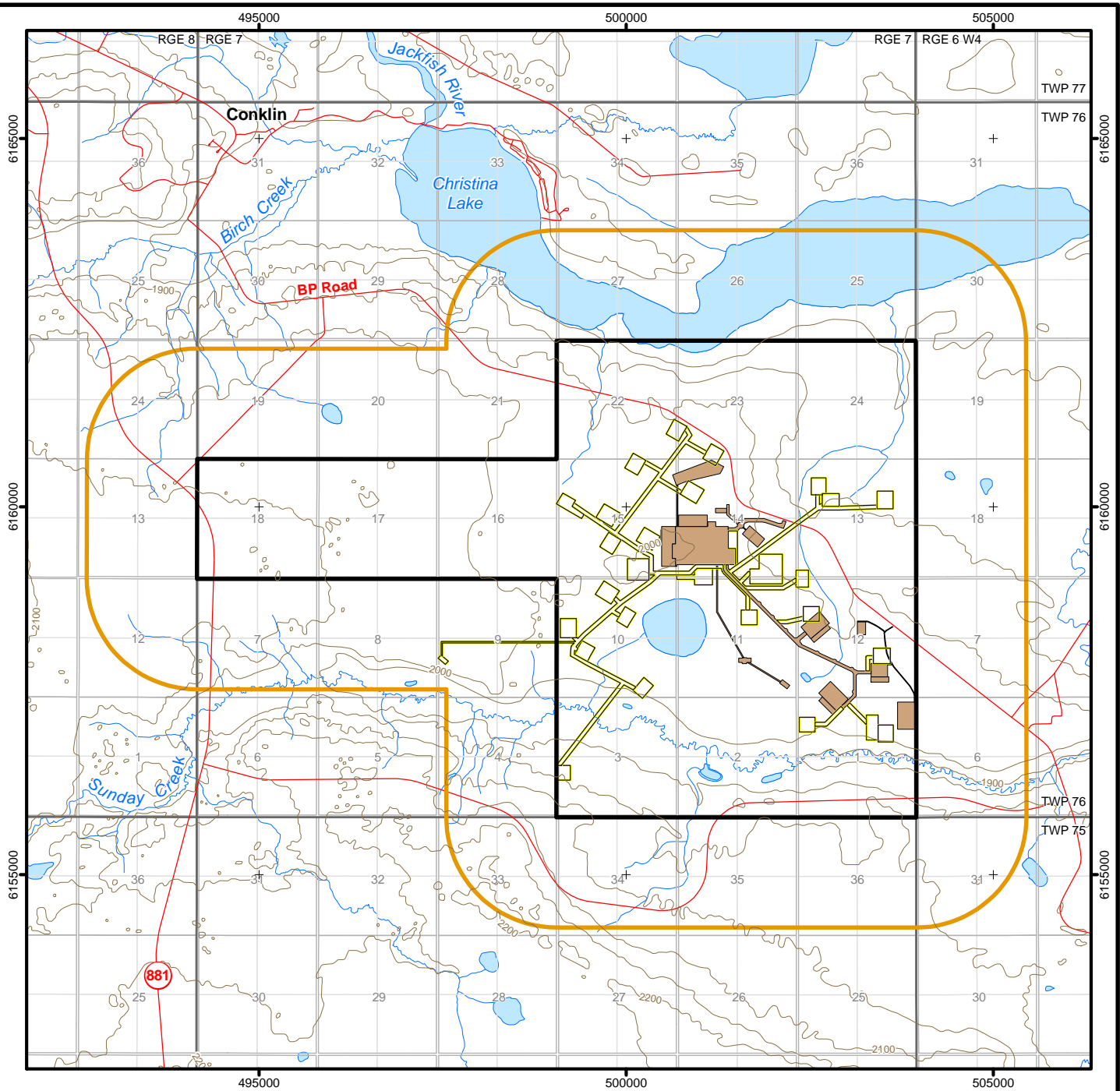
In the absence of existing noise receptors, noise levels were assessed along the borders of the LSA, which is offset a distance of 1.5 km from the boundary of the project lease. To assess LFN in accordance with ERCB Directive 38, noise levels were calculated and assessed in both A-weighted (dBA) and C-weighted (dBC) levels.

### 5.4.2 Terrain

The terrain around the project site can affect sound propagation. As a result, local terrain information in the form of ground contour lines was used in the noise model to create a representative assessment ([Figure 5.4-1](#)). A ground absorption factor of 0.6 was used in accordance with ERCB recommendations.

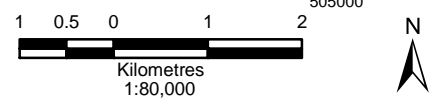
### 5.4.3 Meteorology

Meteorological factors such as temperature, humidity, wind speed and direction affect noise propagation from the sources to the receptor of interest. Wind and temperature inversions can significantly affect outdoor sound propagation, causing considerable variations in project-related sound levels measured at a receptor.




**Legend**

- Noise Local Study Area
- Lease
- BlackGold Expansion Project
- Open Water
- Watercourse
- Contour (Interval - 50 ft)
- Baseline Disturbance**
- KNOG BlackGold Initial Project



Sources: GeoBase®, KNOG, RWDI, Spatial Data Warehouse Ltd.



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**Terrain Contours**

DATE: December 2009	<b>Figure 5.4-1</b>
PROJECT: CE03745/100	Fig05.04-01 Terrain Contours Expansion LSA 09-12-15
ANALYST: CF	QA/QC: KW CV DR
DRAWN BY: AMEC	PREPARED BY: AMEC
PROJECTION/DATUM: UTM Zone 12 NAD83	PREPARED BY: AMEC

If a receptor is located upwind of a facility, the wind will cause greater than normal outdoor sound attenuation. This condition would result in lower sound levels at the receptor than would occur with no wind. However, if the receptor were downwind of a facility, the opposite effect could occur, resulting in higher sound levels than normal at the receptor. Crosswinds do not usually affect outdoor sound propagation and would result in sound levels at the receptor that are similar to those for calm conditions. To be conservative, the ISO 9613 sound propagation model used in this assessment predicts noise levels under mildly developed temperature inversion and downwind conditions to the receptor, both of which enhance sound propagation.

The ISO 9613 algorithms are based on average sound propagation conditions produced by wind speeds in the range of 5.6 to 18.0 km/h. An ambient temperature of 10°C and 70% relative humidity were also applied since these conditions minimize atmospheric attenuation and enhance sound propagation.

#### **5.4.4 Sound Attenuation from Buildings**

The noise-isolating characteristics of a building partition are typically represented by a Sound Transmission Class (STC) rating in dB. The higher the STC rating of a partition, the greater its noise-isolating ability will be. In the application for the Initial Project (KNOG 2008a, 2008b), wall construction providing a noise isolation of STC 29 was applied to all equipment components located inside a building. Directive 38 requires that facilities be modelled under operating conditions and specifically refers to the practice of leaving doors and windows open. In anticipation of the possibility that doors and windows will be open, the applied building noise isolation has been reduced to STC 14 for all applicable noise sources in both the Initial Project and Expansion Project. The value of STC 14 was estimated based on the area of doors and windows that could be open on a building in relation to the wall area of the building.

#### **5.4.5 Noise Sources**

All noise sources included in this assessment were modelled as operating continuously throughout the day-time and night-time hours. As a worst-case noise level scenario, all 29 well pads (two from the Initial Project and 27 from the Expansion Project) were modelled as operating simultaneously. Based on the drilling schedule, it is not expected that more than 10 of the pads would be operating at any one time.

The noise sources used to model the CPF include additional equipment associated with the Expansion Project. Sound power levels are shown in [Table 5.4-1](#). All sound power levels used to model the CPF for the Initial Project have also been included in the current noise model.

The well pads of the Expansion Project were modelled as single point noise sources of equal sound power levels. The sound power level for the well pad noise sources is a summation of the well pad equipment sound power shown in [Table 5.4-2](#). All noise sources used to model the well pads for the Initial Project have also been included in the current noise model.

**Table 5.4-1: Expansion Project CPF Noise Sources and Associated Sound Power Levels**

Name of Source	1/1 Octave Band Sound Power Level (dB)									Overall Levels			Data Source	Enclosure
	31.5	63	125	250	500	1 000	2 000	4 000	8 000	dBA	dBC	dBZ		
HP BFW Pump A	79	83	93	96	96	99	96	92	86	103	104	104	Measurement	Building STC14
HP BFW Pump B	79	83	93	96	96	99	96	92	86	103	104	104	Measurement	Building STC14
LP BFW Pump A	79	83	93	96	96	99	96	92	86	103	104	104	Measurement	Building STC14
LP BFW Pump B	79	83	93	96	96	99	96	92	86	103	104	104	Measurement	Building STC14
Blowdown Pump	77	81	91	94	94	97	94	90	84	101	102	102	RWDI Database	Building STC14
Condensate Pump	77	81	91	94	94	97	94	90	84	101	102	102	RWDI Database	Building STC14
Crystallizer Feed Pump	77	81	91	94	94	97	94	90	84	101	102	102	RWDI Database	Building STC14
Crystallizer Recirculation Pump/Motor	77	81	91	94	94	97	94	90	84	101	102	102	Measurement	Building STC14
Distillate Pump A	77	81	91	94	94	97	94	90	84	101	102	102	Measurement	Building STC14
Distillate Pump B	77	81	91	94	94	97	94	90	84	101	102	102	Measurement	Building STC14
Distillate Pump C	77	81	91	94	94	97	94	90	84	101	102	102	Measurement	Building STC14
Distillate Pump D	77	81	91	94	94	97	94	90	84	101	102	102	Measurement	Building STC14
Fuel Gas Compressor	99	107	107	117	109	103	101	100	93	112	119	119	Vendor Data	None
Fuel Gas Compressor	99	107	107	117	109	103	101	100	93	112	119	119	Vendor Data	None
Glycol Circulation Pump	96	97	98	96	92	87	77	71	65	93	103	103	Measurement	Building STC14
Glycol Heater Exhaust Stack	102	98	94	88	84	80	77	73	69	87	99	100	Vendor Data	None
HP Steam Generator A	81	90	97	93	89	85	82	74	68	91	100	100	Measurement	None
HP Steam Generator B	81	90	97	93	89	85	82	74	68	91	100	100	Measurement	None
Instrument Air Compressor	78	74	79	74	68	63	61	56	49	71	82	83	Vendor Data	Building STC14
MVC Recirculation Pump/Motor A	77	81	91	94	94	97	94	90	84	101	102	102	Measurement	Building STC14
MVC Recirculation Pump/Motor B	77	81	91	94	94	97	94	90	84	101	102	102	Measurement	Building STC14
MVC Recirculation Pump/Motor C	77	81	91	94	94	97	94	90	84	101	102	102	Measurement	Building STC14
MVC Recirculation Pump/Motor D	77	81	91	94	94	97	94	90	84	101	102	102	Measurement	Building STC14
MVC Vapor Compressor	84	87	95	94	94	96	100	99	95	105	105	105	Measurement	Building STC14
MVC Vapor Compressor	84	87	95	94	94	96	100	99	95	105	105	105	Measurement	Building STC14
ORF Charge Pump	73	77	87	90	90	93	90	86	80	97	98	98	Vendor Data	Building STC14
Produced Water Transfer Pump	75	76	77	75	71	66	56	50	44	72	82	82	Measurement	Building STC14
Sales Oil Pump	75	76	77	75	71	66	56	50	44	72	82	82	Measurement	Building STC14
Steam Generator A Exhaust Stack	112	108	104	98	94	90	87	83	79	97	112	114	Measurement	None
Steam Generator B Exhaust Stack	112	108	104	98	94	90	87	83	79	97	112	114	Measurement	None
Utility Glycol Heater	76	82	80	75	71	67	64	56	52	74	85	85	Vendor Data	None

**Table 5.4-2: Expansion Project Well Pad Noise Sources and Associated Power Levels**

Equipment Name	1/1 Octave Band Sound Power Level (dB)									Overall Levels			Data Source	Enclosure
	31.5	63	125	250	500	1 000	2 000	4 000	8 000	dBA	dBC	dBZ		
Downhole Pump	91	92	93	95	95	98	95	91	85	102	104	104	RWDI Database	Building STC14
Downhole Pump	91	92	93	95	95	98	95	91	85	102	104	104	RWDI Database	Building STC14
Downhole Pump	91	92	93	95	95	98	95	91	85	102	104	104	RWDI Database	Building STC14
Downhole Pump	91	92	93	95	95	98	95	91	85	102	104	104	RWDI Database	Building STC14
Downhole Pump	91	92	93	95	95	98	95	91	85	102	104	104	RWDI Database	Building STC14
Pad Demulsifier Injection Pump A	89	90	91	93	93	96	93	89	83	99	101	101	RWDI Database	Building STC14
Pad Demulsifier Injection Pump B	89	90	91	93	93	96	93	89	83	99	101	101	RWDI Database	Building STC14
Start-Up Condensate Pump	88	89	90	92	92	95	92	88	82	99	100	100	RWDI Database	Building STC14
Start-Up Recovered Condensate Pump	87	88	89	91	91	94	91	87	81	97	99	99	RWDI Database	Building STC14
Glycol Recirculation Pump	89	90	91	93	93	96	93	89	83	99	101	101	RWDI Database	Building STC14
Glycol Cooler	112	115	115	112	109	105	102	99	91	111	120	120	RWDI Database	None
Sound Power Levels Used for Expansion Project Well Pads	112	115	115	113	110	109	106	103	96	114	120	121	Summation of Above Equipment Sound Power Levels	

## 5.5 Existing Conditions

Directive 38 requires that, where a project is proposed in an area where there is already an energy industry presence, the applicant must ensure that its facility will not cause the total sound levels to exceed the permissible sound level. The total sound level is the overall sound level from contributing energy facilities in the area, plus the Ambient Sound Level of 35 dBA. In order to assess the overall sound level within the Expansion Project LSA, the contributing noise levels from the approved BlackGold Initial Project, EnCana Christina Lake, and Devon Jackfish 1 and Jackfish 2 facilities were modelled as the existing conditions for noise levels in the area (KNOC 2008a, 2008b; Devon 2004, 2006). The existing condition noise levels at the 1.5 km boundary are presented in [Table 5.5-1](#).

**Table 5.5-1: Existing Conditions Noise Levels at 1.5 km from the Project Lease Boundary**

Location (on a Perimeter Located from the Project Lease Boundary)	Existing or Approved Energy Development Facility Operational Noise Levels (dBA)	Average Rural Alberta Ambient Sound Level (dBA)	Total Sound Level Ambient Plus Existing or Approved Facilities
North	19.8	35	35.1
Northwest	18.3	35	35.1
West	9.6	35	35.0
Southwest	26.1	35	35.5
South	27.9	35	35.8
Southeast	22.2	35	35.2
East	27.6	35	35.7
Northeast	18.1	35	35.1

[Figure 5.5-1](#) presents the noise contours showing the contributions to the existing environment from existing or approved energy development projects in the area.

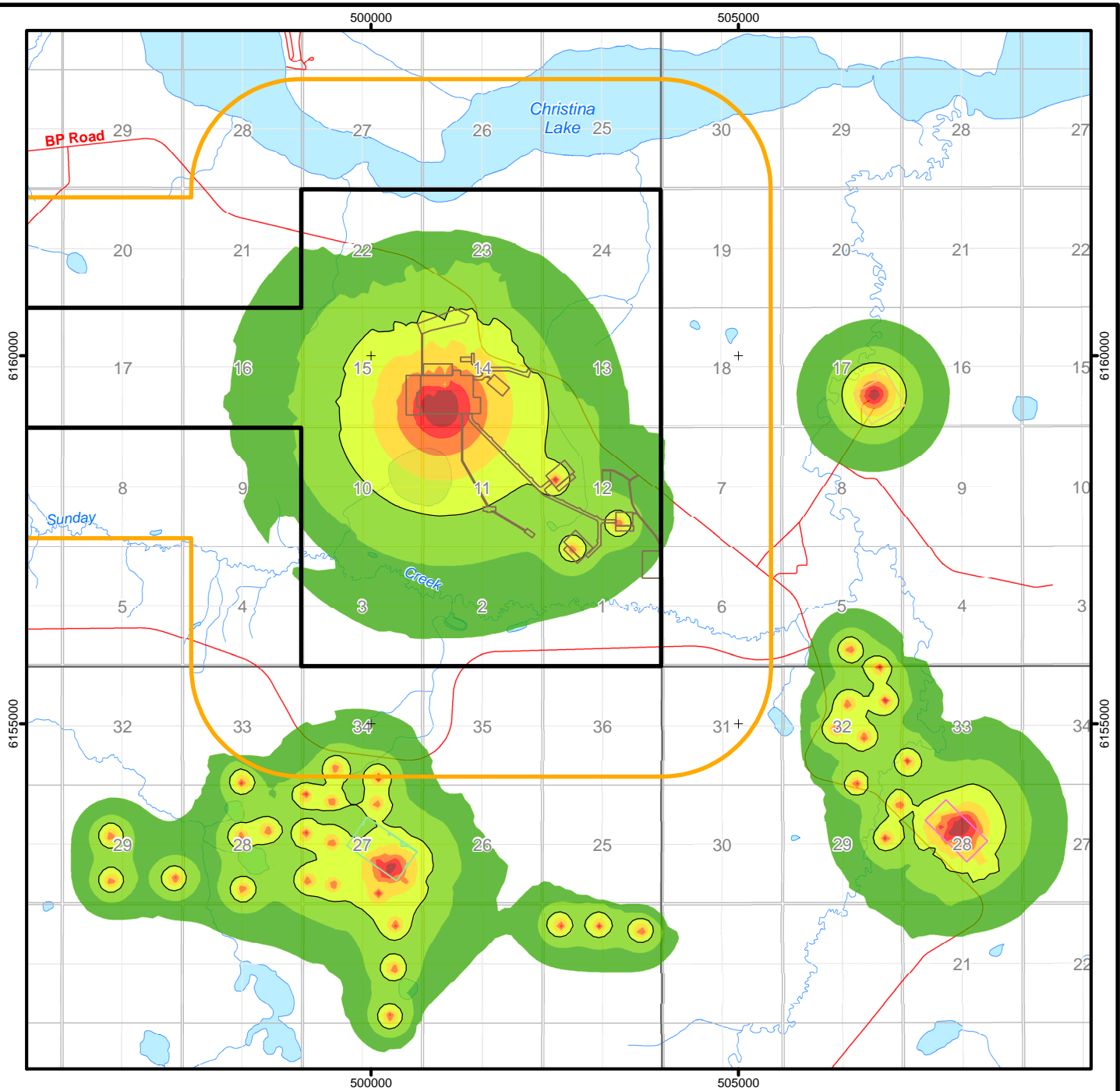
## 5.6 Potential Impacts and Mitigative Measures

[Figure 5.6-1](#) presents the noise contours showing the contribution of the Expansion Project and the existing or approved energy development projects in the area. The overall noise levels, including predicted levels from the Expansion Project, are presented in [Table 5.6-1](#).

**Table 5.6-1: Predicted Noise Levels at 1.5 km from the Project Lease Boundary Including the Expansion Project**

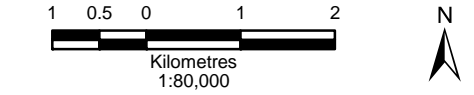
Location	Overall Energy Development Facility Operational Noise Levels (dBA)	Average Rural Alberta Ambient Sound Level (dBA)	Total Sound Level (dBA)	Meets ERCB 40 dBA Requirement?	LFN Indicator dBC-dBA	LFN Likely to be a Concern?
North	30.5	35	36.3	Yes	14.9	No
Northwest	28.8	35	35.9	Yes	14.7	No
West	19.7	35	35.1	Yes	16.7	No
Southwest	31.4	35	36.6	Yes	12.2	No
South	33.2	35	37.2	Yes	16.9	No
Southeast	31.2	35	36.5	Yes	14.2	No
East	33.4	35	37.3	Yes	16.2	No
Northeast	28.1	35	35.8	Yes	18.5	No

S:\GIS\Projects\CE\KNOG\_BlackGold\CE03745\_EIA\ArcGIS\Projects\Application Report Figures\Section 05 - Noise\Fig05.05-01 Noise Contour Existing Conditions.mxd




**Legend**

- Noise Local Study Area
- Lease
- Open Water
- Watercourse
- Existing or Approved Energy Developments**
  - KNOG BlackGold Initial Project
  - Devon Jackfish CPF
  - Devon Jackfish 2 CPF
  - EnCana Christina Lake CPF
- Noise Levels Day dBA**
  - ≥60
  - 55
  - 50
  - 45
  - 40
  - 35
  - 30
- Noise Contour (40 dBA)



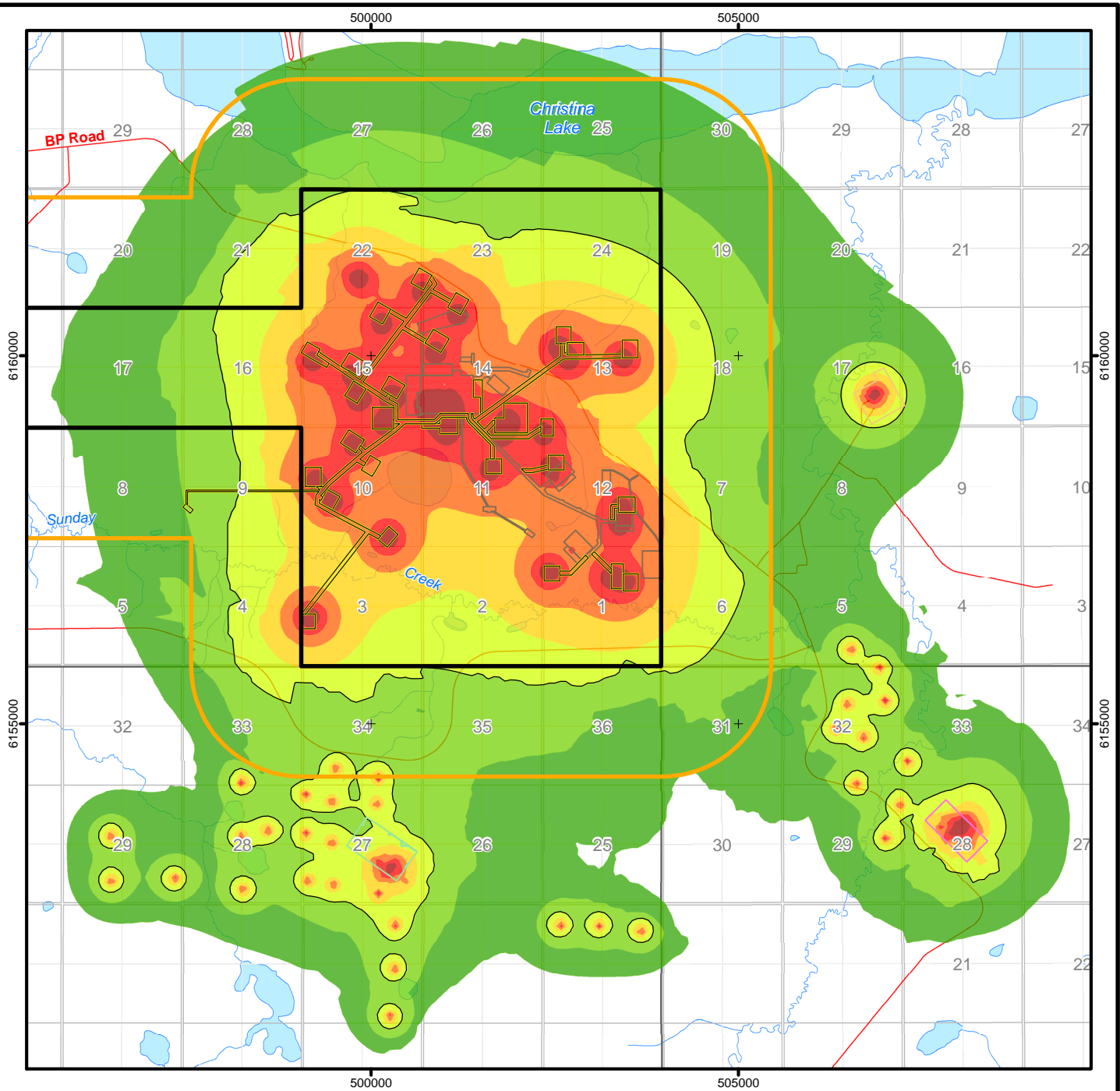
Sources: GeoBase®, KNOG, RWDI, Spatial Data Warehouse Ltd.



**Korea National Oil Corporation**  
**BlackGold Expansion Project**

**Noise Contours**  
**Baseline Case**

DATE: December 2009	<b>Figure 5.5-1</b>
PROJECT: CE03745/100	Fig05.05-01 Noise Contour Existing Conditions 09-12-15
ANALYST: TM	QA/QC: KW CV DR
PROJECTION/DATUM: UTM Zone 12 NAD83	DRAWN BY: AMEC
	PREPARED BY: RWDI



**Legend**

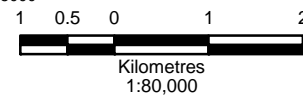
- Noise Local Study Area
- Lease
- BlackGold Expansion Project
- Open Water
- Watercourse

**Existing or Approved Energy Developments**

- BlackGold Initial Project
- Devon Jackfish CPF
- Devon Jackfish 2 CPF
- EnCana Christina Lake CPF

**Noise Levels Day dBA**

- ≥60
- 55
- 50
- 45
- 40
- 35
- 30
- Noise Contour (40 dBA)



Sources: GeoBase®, KNOC, RWDI, Spatial Data Warehouse Ltd.

**Korea National Oil Corporation**  
**BlackGold Expansion Project**

**Noise Contours**  
**Application Case**

DATE: December 2009		<b>Figure 5.6-1</b>	
PROJECT: CE03745/100		Fig05.06-01 Noise Contour Expansion Project 09-12-15	
ANALYST: TM	QA/QC: KW CV DR	DRAWN BY: AMEC	
PROJECTION/DATUM: UTM Zone 12 NAD83		PREPARED BY: RWDI	

The noise model predicts that the change in the facility operational noise levels at a distance of 1.5 km from the facility fence line is negligible and within the ERCB Directive 38 required levels. Since the predicted noise levels meet ERCB guidelines, a cumulative effects assessment was not undertaken.

### **5.6.1 Low Frequency Noise Assessment**

The C-Weighted sound level (dBC) results have been reviewed at the 1.5 km distance from the project lease boundary to determine if there is expected potential for LFN concerns. The maximum difference between C- and A-weighted values is 19.5, at a location where the overall dBA level is 26.1 dBA. This assessment finds that the potential for LFN concerns is minimal.

### **5.7 Summary**

The modelling results from the NIA confirm that the noise level from the project will meet the ERCB's criterion of 40 dBA at a distance of 1.5 km from the project lease boundary and that the potential for LFN concerns is minimal.

### **5.8 Literature Cited**

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