Appendix 4.1-A Noise Modelling Report

TELKWA COAL
LIMITED

Noise Modelling Report

Prepared for:

Telkwa Coal Limited
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Project No. 103260-04

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LIST OF ACRONYMS AND ABBREVIATIONS

Acronym / Abbreviation	Definition
%HA	Percent of high annoyance
Ld	Daytime noise level
Ln	Nighttime noise level
PSL	Permissible sound level
RSA	Regional study area
SPL	Sound pressure level
UTM	Universal Transverse Mercator

LIST OF SYMBOLS AND UNITS OF MEASURE

Symbol / Unit of Measure	Definition
dB	decibel
dBA	A-weighted decibel
hZ	hertz
kg	kilogram
kPa	kilopascal
m	metre
$m/kg^{1/3}$	metre per cube root kilogram

1.0 INTRODUCTION

This appendix provides technical details and assumptions used in the noise assessment for the Project. The noise propagation modelling and blasting methodology is discussed in **Section 2**, and results are detailed in **Section 3**.

2.0 METHODOLOGY

2.1 Noise Modelling

Modelling of Project-related noise was conducted using the DataKustik CadnaA noise prediction software developed based on algorithms from ISO 9613-2. These algorithms are the current international standard for airborne noise propagation and are widely used in environmental noise assessments across BC and Canada. The model accounts for the following factors:

- Sound power levels and directivity of emission sources
- Duration and timing of emission sources
- Distance attenuation
- Source-receptor geometry including heights
- Ground absorption
- Meteorological effects

Potential barrier effects associated with buildings, structures, and surrounding topography were not included in the model. The modelling methodology is further described in the following subsections.

2.1.1 Sound Power Levels

Octave-band sound power levels for all activities and equipment associated with Project operation were estimated based on measurements of similar activities and equipment at other facilities, or obtained from the public literature, as summarized in **Table 2.1**. Measured sound levels were converted to sound power levels using standard formulae for hemispherical spreading.

Table 2.1 Project Sound Power Levels

Location	Source	Quantity	Octave-Band Sound Power Level (dB)							Overall Sound Power Level (dBA)	Data Source [a]	Height Above Grade (m)
			63	125	250	500	1,000	2,000	4,000			
Open Pit	CAT 6015 Shovel/Excavator	3	90	98	98	103	106	104	97	110	NVR	4.6
	Epiroc PV235 Rotary Drill	1	88	94	96	103	106	106	104	111	NVR	3.1
	CAT 988K Front End Loader	2	79	97	107	108	112	108	102	116	NVR	4.5
	CAT 14M Grader	3	81	93	95	100	106	104	97	109	NVR	3.2
	CAT D8T Bulldozer	5	86	95	99	107	103	102	100	110	NVR	3.5
	CAT 390F Excavator	2	114	114	110	107	106	102	97	110	Teck	3.8
	Epiroc T45 Tophammer Drill	1	110	119	116	115	111	110	105	117	Teck	3.0
	CAT 777G Water/Sanding Truck	2	86	100	104	110	113	110	101	116	NVR	4.2
Coal Processing Plant	Crushing/Screening Plant	1	100	103	106	105	102	99	94	107	RMC	3.1
	CAT 988K Front End Loader	1	79	97	107	113	116	113	104	119	NVR	4.5
	Waste Oil Boiler	1	Small boiler located inside building. Assume negligible compared to other sources.									
Rail Loadout	Train	3	111	106	101	103	103	100	100	108	Hemm	0.0
	CAT 988K Front End Loader	1	79	97	107	113	116	113	104	119	NVR	4.5
Borrow Pits	Shovel/Excavator	1	79	97	107	108	112	108	102	116	NVR	2.8
	Rotary Drill	1	81	90	96	99	99	95	89	102	NVR	3.0
	Front End Loader	1	88	94	96	103	106	106	104	111	NVR	3.4
	Haul Truck	3	73	97	102	99	101	101	94	109	NVR	4.0
	Crushing/Screening Plant	1	100	103	106	105	102	99	94	107	RMC	3.1
Minesite Haul Roads	CAT 777G Haul Truck	24.4	86	100	104	110	113	110	101	116	NVR	4.2
	CAT 745 Haul Truck	1.4	86	100	104	110	113	110	101	116	NVR	3.8
	Mine Bus	1	89	97	101	105	107	105	101	112	NVR	0.5

Location	Source	Quantity	Octave-Band Sound Power Level (dB)							Overall Sound Power Level (dBA)	Data Source [a]	Height Above Grade (m)
			63	125	250	500	1,000	2,000	4,000			
Tenas Access Corridor	Super B-Train On-Highway Truck	1.5	89	97	101	105	107	105	101	112	NVR	2.8

[a] Data sources:

Hemm = Hemmera internal database

NVR = Noise and Vibration Resources 2020

RMC = Raw Materials Company 2020

Teck = Teck Coal Ltd. 2014

2.1.2 Source Locations and Characterization

Noise sources along the Minesite haul roads and the Tenas Access Corridor, as well as trains at the Rail Loop were modelled as line sources in CadnaA. All other equipment were modelled as point sources in CadnaA. Equipment at the open pit and borrow pits are not stationary and were conservatively modelled as several point sources around the edges of the main activity area. All noise sources were conservatively modelled to operate simultaneously for 24 hours a day except for equipment at the borrow pits which are expected to operate only 12 hours during the daytime (7:00 am to 7:00 pm).

2.1.3 Receptor Locations

Ambient noise levels in CadnaA are predicted at discrete receptor points. For this assessment, receptor points were defined at private residences, cabins, schools, childcare facilities, and the Backcountry Horsemen of BC's camp (the horsemen camp) located within Telkwa Coal property, just off the Tenas Access Corridor. In addition to these receptor points, ambient noise levels were predicted over a uniform receptor grid with a spacing of 50-m within the noise regional study area (RSA).

2.2 Blasting

Blasting results in a release of energy into the atmosphere in the form of a propagating wave termed air overpressure. The air overpressure or sound wave is perceived as a booming noise that lasts less than a few seconds. The energy released from a blast is typically below a frequency of 250 hertz (Hz) and with discernible intensity is predominantly under 20 Hz.

Blasting results are calculated in this section for reference purposes to support the Wildlife discipline. The method used to assess blasting air overpressure is referenced in the Office of Surface Mining Reclamation and Enforcement (OSMRE) and Unites States Bureau of Mines (USBM) literature by Linehan and Wiss (1980). This approach factors in the depth to the centre of gravity of charge and the constants were chosen to be conservative as they provide the highest predicted blast noise levels. The blast air overpressure formula used is as follows:

$$P = 6.31\, e^{-B}\left(\frac{D}{W^{1/3}}\right)^{-1.16}$$

Where:

P = peak overpressure in kilopascals (kPa)

e = natural logarithm base (2.7183)

B = scaled depth of charge burial ($C/W^{1/3}$) in metres per cube root kilograms ($m/kg^{1/3}$)

C = depth to centre of gravity of charge in metres (m)

W = maximum charge weight per delay in kilograms (kg)

D = distance from the blast to the receiver

The peak overpressure is converted to an unweighted peak sound pressure level (SPL) in decibels from the following formula:

$$SPL = 20\ Log_{10}\ P + 154$$

3.0 RESULTS

3.1 Noise Results

Isopleth figures of CadnaA predicted daytime and nighttime noise levels associated with Project activities and equipment are provided in **Figure 3.1** and **Figure 3.2**, respectively. The highest noise levels are expected to occur in the immediate vicinity of equipment at the open pit.

For comparison with permissible sound levels (PSLs) from the BC Noise Control Best Practices Guideline (BC OGC 2018), baseline noise levels were assigned to each sensitive receptor location based on baseline noise measurements from 1998 and 2017 to 2018 (see **S4-C1-4.2.4 Noise**) and added to Project noise levels from CadnaA modelling.

In addition, the percent of high annoyance (%HA) was calculated for the baseline day-night sound level and for the combined (i.e., Project + baseline) day-night sound level. The difference between the two was then compared to Health Canada's threshold of 6.5%.

Results for all sensitive receptor locations are provided in **Table 3.1**.

Tenas Project

Maximum Predicted Daytime Noise Level (dBA)

615000 620000 625000 630000

6060000 6055000 6050000

TELKWA
Tyhee Lake
LAWSON RD
16
CN
TELKWA COALMINE RD
AVELING COALMINE RD
Telkwa River
TELKWA RIVER FSR
Tenas Creek
Helps Creek
Bulkley River
BYPASS ROAD
RAIL LOADOUT
Goathorn Creek
Four Creek

PRIVATE PROPERTY RECEPTOR 2
PRIVATE PROPERTY RECEPTOR 1

10 dBA
30 dBA
50 dBA
70 dBA

Legend

- Sensitive Receptor
- Project Daytime Noise Level (dBA)
- Rail Line
- Highway
- Road
- Watercourse
- Wetland
- Waterbody
- Municipal Area
- General Private Property
- 138 kV Transmission Line
- 500 kV Transmission Line

Project Features

- Existing 25 kV Power Line
- 25 kV Power Line
- Haul Road
- Rail Loop
- Discharge Path
- Tenas Access Corridor
- Backfill Area
- Control and Plant Sedimentation Pond
- Explosive Infrastructure
- Management Pond
- Mine Infrastructure Complex
- Open Pit
- Pit Lake
- Quarry
- Rail Infrastructure
- Topsoil Stockpile
- Tenas Coal Licenses
- Telkwa Coal Limited Private Property
- Project Area

Notes

1. All mapped features are approximate and should be used for discussion purposes only.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
3. Project line features are for display only.

Sources

- Project Features: Allegiance Coal, April 21, 2021.
- Basedata: Government of British Columbia
- Basemap: World Topo Base

N

1:60,000

0 0.5 1 1.5 2 2.5

Kilometers

NAD 1983 UTM Zone 9N

Page Size: 11" x 17"

103260-04	Production Date: Jul 02, 2021	Figure 3.1

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Tenas Project

Maximum Predicted Nighttime Noise Level (dBA)

615000 620000 625000 630000

6060000 6055000 6050000

Tyhee Lake
TELKWA
LAWSON RD
16
CN
TELKWA COALMINE RD
AVELING COALMINE RD
Telkwa River
TELKWA RIVER FSR
Tenas Creek
Helps Creek
Goathorn Creek
Four Creek
Bulkley River
BYPASS ROAD
RAIL LOADOUT
PRIVATE PROPERTY RECEPTOR 2
PRIVATE PROPERTY RECEPTOR 1
10 dBA
30 dBA
50 dBA
70 dBA

Legend

- Sensitive Receptor
- Project Daytime Noise Level (dBA)
- Rail Line
- Highway
- Road
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1:60,000

0 0.5 1 1.5 2 2.5

Kilometers

NAD 1983 UTM Zone 9N

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103260-04	Production Date: Jul 02, 2021	Figure 3.2

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Table 3.1 Predicted Noise Levels at Sensitive Receptor Locations

Receptor Type	UTM Easting	UTM Northing	Baseline		Project		Project + Baseline		PSL		Change in %HA
			Ld (dBA)	Ln (dBA)	Ld (dBA)	Ln (dBA)	Ld (dBA)	Ln (dBA)	Ld (dBA)	Ln (dBA)	
Telkwa Elementary	625731	6062745	**61.4**	**59.0**	0.0	0.0	**61.4**	**59.0**	58	48	0.0
The Ark Playday Center	625732	6062821	**61.4**	**59.0**	0.0	0.0	**61.4**	**59.0**	58	48	0.0
Tot Spot Family Day Care	624899	6061799	**61.4**	**59.0**	0.0	0.0	**61.4**	**59.0**	58	48	0.0
Residence	621359	6055187	35.7	23.1	42.1	24.1	43.0	26.6	50	40	0.4
Residence	621347	6057296	35.7	23.1	17.4	17.4	35.8	24.1	55	45	0.0
Residence	621148	6057784	45.6	42.1	11.4	11.4	45.6	42.1	58	48	0.0
Residence	621219	6057843	45.6	42.1	10.8	10.8	45.6	42.1	58	48	0.0
Residence	621246	6057883	45.6	42.1	10.3	10.3	45.6	42.1	58	48	0.0
Residence	621260	6058012	45.6	42.1	7.8	7.8	45.6	42.1	58	48	0.0
Residence	621151	6058015	45.6	42.1	7.2	7.2	45.6	42.1	58	48	0.0
Residence	621236	6058089	45.6	42.1	4.2	4.2	45.6	42.1	58	48	0.0
Residence	621248	6058191	45.6	42.1	0.0	0.0	45.6	42.1	58	48	0.0
Residence	621330	6058317	45.6	42.1	0.0	0.0	45.6	42.1	58	48	0.0
Residence	624495	6057858	45.6	**42.1**	30.5	2.2	45.7	**42.1**	50	40	0.0
Residence	624887	6057904	45.6	**42.1**	28.9	0.0	45.7	**42.1**	50	40	0.0
Residence	624310	6058125	45.6	42.1	0.0	0.0	45.6	42.1	53	43	0.0
Residence	624317	6058312	45.6	42.1	0.0	0.0	45.6	42.1	53	43	0.0
Residence	624301	6058433	45.6	42.1	0.0	0.0	45.6	42.1	53	43	0.0
Residence	624413	6058467	45.6	42.1	0.0	0.0	45.6	42.1	53	43	0.0
Residence	624542	6058470	45.6	42.1	0.0	0.0	45.6	42.1	53	43	0.0
Residence	624516	6058298	45.6	42.1	0.0	0.0	45.6	42.1	53	43	0.0
Residence	624666	6058350	45.6	42.1	0.0	0.0	45.6	42.1	53	43	0.0

Receptor Type	UTM Easting	UTM Northing	Baseline		Project		Project + Baseline		PSL		Change in %HA
			Ld (dBA)	Ln (dBA)	Ld (dBA)	Ln (dBA)	Ld (dBA)	Ln (dBA)	Ld (dBA)	Ln (dBA)	
Residence	624709	6058331	45.6	42.1	0.0	0.0	45.6	42.1	53	43	0.0
Residence	624755	6058337	45.6	42.1	0.0	0.0	45.6	42.1	53	43	0.0
Residence	624833	6058269	45.6	42.1	0.0	0.0	45.6	42.1	53	43	0.0
Residence	624946	6058333	45.6	42.1	0.0	0.0	45.6	42.1	53	43	0.0
Residence	625055	6058312	45.6	42.1	0.0	0.0	45.6	42.1	53	43	0.0
Residence	625125	6058347	45.6	42.1	0.0	0.0	45.6	42.1	53	43	0.0
Residence	625140	6058498	45.6	42.1	0.0	0.0	45.6	42.1	53	43	0.0
Residence	625012	6058547	45.6	42.1	0.0	0.0	45.6	42.1	53	43	0.0
Residence	624917	6058542	45.6	42.1	0.0	0.0	45.6	42.1	53	43	0.0
Residence	624848	6058478	45.6	42.1	0.0	0.0	45.6	42.1	53	43	0.0
Residence	624738	6058471	45.6	42.1	0.0	0.0	45.6	42.1	53	43	0.0
Residence	624533	6058522	45.6	42.1	0.0	0.0	45.6	42.1	53	43	0.0
Residence	624511	6059467	35.7	23.1	0.0	0.0	35.7	23.1	50	40	0.0
Residence	624728	6060340	45.6	42.1	0.0	0.0	45.6	42.1	53	43	0.0
Residence	624551	6060520	45.6	42.1	0.0	0.0	45.6	42.1	58	48	0.0
Residence	624633	6060666	45.6	42.1	0.0	0.0	45.6	42.1	58	48	0.0
Residence	624707	6060548	45.6	42.1	0.0	0.0	45.6	42.1	58	48	0.0
Residence	624750	6060645	45.6	42.1	0.0	0.0	45.6	42.1	58	48	0.0
Residence	624811	6060513	45.6	42.1	0.0	0.0	45.6	42.1	53	43	0.0
Residence	624835	6060701	45.6	42.1	0.0	0.0	45.6	42.1	58	48	0.0
Residence	625027	6060650	45.6	42.1	0.0	0.0	45.6	42.1	53	43	0.0
Residence	624985	6060414	45.6	42.1	0.0	0.0	45.6	42.1	53	43	0.0
Residence	625166	6060570	45.6	42.1	0.0	0.0	45.6	42.1	53	43	0.0
Residence	625110	6060346	45.6	42.1	0.0	0.0	45.6	42.1	53	43	0.0
Residence	625293	6060420	45.6	42.1	0.0	0.0	45.6	42.1	53	43	0.0

Receptor Type	UTM Easting	UTM Northing	Baseline		Project		Project + Baseline		PSL		Change in %HA
			Ld (dBA)	Ln (dBA)	Ld (dBA)	Ln (dBA)	Ld (dBA)	Ln (dBA)	Ld (dBA)	Ln (dBA)	
Residence	625211	6060248	45.6	42.1	0.0	0.0	45.6	42.1	53	43	0.0
Residence	625238	6060113	45.6	**42.1**	0.0	0.0	45.6	**42.1**	50	40	0.0
Residence	625493	6060254	45.6	**42.1**	0.0	0.0	45.6	**42.1**	50	40	0.0
Residence	625561	6060138	45.6	**42.1**	0.0	0.0	45.6	**42.1**	50	40	0.0
Residence	625808	6060035	45.6	**42.1**	0.0	0.0	45.6	**42.1**	50	40	0.0
Residence	629422	6059314	41.3	38.0	34.2	34.2	42.1	39.5	55	45	0.2
Residence	629376	6059417	41.3	38.0	32.8	32.8	41.9	39.2	55	45	0.2
Residence	629311	6059475	41.3	38.0	31.9	31.9	41.8	39.0	55	45	0.1
Residence	629162	6059498	41.3	38.0	31.1	31.1	41.7	38.8	55	45	0.1
Residence	628542	6058933	41.3	38.0	31.4	31.4	41.7	38.9	55	45	0.1
Residence	628318	6058826	41.3	38.0	29.9	29.9	41.6	38.6	55	45	0.1
Residence	628475	6058809	41.3	38.0	31.4	31.4	41.7	38.9	55	45	0.1
Residence	628469	6058607	41.3	38.0	32.2	32.2	41.8	39.0	50	40	0.1
Residence	630293	6058896	41.3	38.0	36.6	36.6	42.6	40.4	55	45	0.4
Residence	630568	6058612	41.3	38.0	35.7	35.7	42.4	40.0	55	45	0.3
Residence	630843	6058516	41.3	38.0	32.8	32.8	41.9	39.2	55	45	0.2
Residence	630943	6058355	41.3	38.0	32	32	41.8	39.0	55	45	0.1
Residence	630925	6057608	41.3	38.0	31	31	41.7	38.8	55	45	0.1
Residence	631013	6057550	41.3	38.0	29.9	29.9	41.6	38.6	55	45	0.1
Residence	630907	6057496	41.3	38.0	30.7	30.7	41.7	38.7	55	45	0.1
Residence	630457	6057731	41.3	38.0	36.9	36.9	42.7	40.5	55	45	0.4
Residence	630474	6057528	41.3	38.0	35.1	35.1	42.3	39.8	55	45	0.3
Cabin	626743	6062021	35.7	23.1	0.0	0.0	35.7	23.1	55	45	0.0
Residence	621045	6057791	45.6	42.1	11	11	45.6	42.1	58	48	0.0
Residence	621147	6057863	45.6	42.1	10.3	10.3	45.6	42.1	58	48	0.0

Receptor Type	UTM Easting	UTM Northing	Baseline		Project		Project + Baseline		PSL		Change in %HA
			Ld (dBA)	Ln (dBA)	Ld (dBA)	Ln (dBA)	Ld (dBA)	Ln (dBA)	Ld (dBA)	Ln (dBA)	
Residence	621311	6058287	45.6	42.1	0.0	0.0	45.6	42.1	58	48	0.0
Residence	624652	6058012	45.6	42.1	12.5	0.0	45.6	42.1	53	43	0.0
Residence	624618	6058496	45.6	42.1	0.0	0.0	45.6	42.1	53	43	0.0
Residence	624949	6060663	45.6	42.1	0.0	0.0	45.6	42.1	53	43	0.0
Residence	630914	6058404	41.3	38.0	32.3	32.3	41.8	39.0	55	45	0.1
Residence	630879	6058459	41.3	38.0	32.5	32.5	41.9	39.1	55	45	0.2
Residence	629378	6058797	41.3	38.0	41.8	41.8	44.6	43.3	55	45	1.0
Residence	629404	6059357	41.3	38.0	33.6	33.6	42.0	39.4	55	45	0.2
Horsemen Camp	620359	6055109	35.7	23.1	47.2	30.5	47.5	31.2	50	40	1.0

Note: Values in **bold** font exceed the PSL.

3.2 Blasting Results

The results from the Lineham and Wiss formula include blast design parameters with a maximum charge weight per delay of 495.5 kg and a depth below ground for the centre of charge at 8.875 m for a 12 m bench. The results are provided in **Table 3.2**. The SPL is provided in decibels (dB) and an estimated A-weighted decibel level (dBA) weighted at a 45 dB reduction based on 20 Hz is provided for reference. Extended distances can be extrapolated based on a 7 dB reduction with a doubling of distance.

Table 3.2 Blasting Results

Distance (m)	250	500	1000	1500	2000	4000	6000	8000
SPL (dB)	125	118	112	107	105	98	93	91
SPL (dBA)	80	73	67	62	60	53	48	46

4.0 REFERENCES

British Columbia Oil and Gas Commission (BC OGC). 2018. British Columbia Noise Control Best Practices Guideline. Version 2.1.

Linehan, P and J. Wiss. 1980. Vibration and Air Blast Noise from Surface Coal Mine Blasting. Preprint No. 80-336. Society of Mining Engineers of AIME. Littleton, Colorado.

Noise and Vibration Resources. 2020. Data – SWL. Retrieved from: http://www.noisevibrationresources.com/.

Raw Materials Company. 2016. Commercial Sound Assessment: RMC, Wolford Works, Longford Road, Cannock, WS11 0LF. Prepared by Peak Acoustics Ltd. Report No. LH2403161NR.

Teck Coal Ltd. 2014. Fording River Operations Swift Project Environmental Assessment Certificate Application.