Annex 6-E
Acoustic Assessment Technical Supporting Document
Denison Mines – Wheeler River Project

Prepared for:

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TABLE OF CONTENTS

Page No.

LIST OF TABLES

LIST OF FIGURES

APPENDICES

1.0 INTRODUCTION

This technical report is supplementary to the discussion of the noise impact assessment provided in the main body of the Environmental Impact Statement (EIS) report (Section 6 – Atmospheric and Acoustic Environment). The purpose of this supplemental report is to provide additional technical background details on the assessment methodology, assessment scenarios, source identification and characterization, predictive modelling, and modelling outputs.

2.0 ASSESSMENT SCENARIOS

The Wheeler River Project (the Project) will be completed in four phases: construction, operation, decommissioning, and post-decommissioning. As the nature of operations in each phase differs, the noise assessment scenarios were developed with consideration to each of these phases so as to effectively bound the potential noise effects of the Project over its entire life cycle. Based on the description of associated activities the Construction and Operations scenarios have the greatest potential to influence off-site sound levels. The Decommissioning phase is expected to be similar in nature to the construction phase; however, will not involve as much equipment and truck traffic, there will be no drilling, and the freeze plant will no longer be operating. As such, the Construction stage is expected to bound (i.e., have greater potential for impacts relative to) the Decommissioning stage. The Post-decommissioning phase will involve the least amount of activity of all of the phases, as it primarily involves monitoring conditions at the site over time. As such, the assessment of the Site Construction and Operations phases is expected to fully bound the noise impacts from the Project. These scenarios are discussed in further detail in the following sections.

2.1 CONSTRUCTION SCENARIO

The Construction scenario was based on the activities associated with the first year of construction, which, as planned, involves the most equipment operating on the site during the three-year construction phase. During this first year it is projected that there will be surface facilities construction occurring simultaneously with wellfield drill mobilizations, drilling of freeze holes and ISR wells, and partial operation of the freeze plant. The maximum scenario that was modelled includes the following general activities:

- Surface construction occurring at the ISR Plant location,
- Operation of a concrete batch plant and crusher,
- Freeze plant constructed and operating (partial operation, 2 of 6 units operating),
- Drill rigs operating in the wellfield (ISR wells),
- Deposit of drill waste in the clean waste pile,
- Power supplied by two (2) 1.1 MW generator sets, operating near the Freeze Plant and ISR plant,
- Power supplied by two (2) 450 kW generator sets, operating near the accommodations centre and the operations centre,
- Various vehicle movements (fuel, food, supplies for construction and wellfield development, on-site traffic), and
- Air traffic associated with construction crew changes.

The detailed source inventory for the Construction scenario, and approach to the characterization of each source are discussed in Section 3.0.

2.2 Operations Scenario

The Operations scenario was based on activities being completed in the late stages of the operations phase, with work being completed in Phase 5 of the deposit. Well drilling would continue, and the freeze plant was assumed to be operating at maximum capacity (all 6 skids running). While the site will be powered from the provincial grid at this stage, the power generators were assumed to be operating under emergency conditions as a worst-case scenario. The general activities included in the operations scenario include:

- Full operation of the ISR plant,
- Full operation of the freeze plant (6 out of 6 units operating),
- Drill rigs operating in the wellfield,
- Operation of a concrete batch plant and crusher,
- Deposit of drill waste in the clean waste pile,
- Power supplied by two (2) 1.1 MW generator sets, operating near the Freeze Plant and ISR plant,
- Power supplied by two (2) 450 kW generator sets, operating near the accommodations centre and the operations centre,
- Electrical utilities operating (i.e., transformers),
- Shipping of yellowcake product,
- Various vehicle movements (fuel, food, raw materials, on-site traffic), and
- Air traffic associated with personnel changes.

The detailed source inventory for the Operations scenario, and approach to the characterization of each source are discussed in Section 3.0.

3.0 SOURCE CHARACTERIZATION

The inventory of noise sources for the Construction and Operations scenarios were developed using information provided by Denison. This information included the process flow diagrams, planned construction fleet, initial equipment lists for the ISR process, freeze plant and utilities, as well as information on the process outlined in the Prefeasibility Study [1] and the Project Description [2] reports. The sound power levels (a measure of the sound energy output of a source) were then derived for each identified source based on available information and/or conservative assumptions.

Sound power levels were generally established using manufacturer specifications, historic measurement data from similar sites, or engineering calculation methods referenced from scientific literature. The inputs for the calculations were derived from available manufacturer specifications and the equipment lists provided by Denison. The list of noise sources associated with the Site Construction and Operation scenarios are summarized in Table 1 and Table 2, respectively. These tables provide an indication of the method used to characterize the sound output of the source, as well as a summary of the key parameters used to estimate the sound levels. As a conservative measure, all power ratings for equipment identified in the Denison equipment list for the ISR process were doubled.

Table 1: Noise Source Inventory for Site Construction

Activity	Noise Sources	Method (See Notes)	Key Parameters
Surface construction at ISR Plant	Crane operation	1	260 hp
	Concrete batch plant/crusher	1, 2	750 hp
	Haul truck loading	1	116 hp wheel loader
	Skid steer operation	1	47 hp
Freeze plant (partial operation)	Brine circulation pump (x3)	3	100 hp, 1800 rpm
	Air-cooled condenser (x2)	4	3 hp per fan, 12 fans per unit
	Building radiated noise (x2 chillers)	5, 6	310-ton cooling capacity each
	Haul truck loading	1	116 hp wheel loader
Wellfield activity	Skid steer operation (x2)	1	47 hp (each)
	Bulldozer operation	1	913 hp
	Wheel loader activity	1	116 hp
	Mud rotary drill rig	1	470 hp
	Diamond drill rig	1	525 hp
Clean waste pile activity	Bulldozer operation	1	913 hp
	Wheel loader operation	1	116 hp
Power generation	1.1 MW generators (x2)	7	1.1 MW, 1800 rpm, turbocharged
	450 kW generators (x2)	8	CAT C15
Fuelling	Propane pumps (x2)	3	25 hp, 1800 rpm
Traffic	Fuel/propane deliveries	9	7.5 trucks/day, 35 kph
	Food deliveries	9	2 trucks/day, 35 kph
	Surface construction deliveries	9	7.5 trucks/day, 35 kph
	Wellfield deliveries	9	6 trucks/day, 35 kph
	Wellfield mobilizations	9	30 trucks/day, 35 kph
	Drill waste to clean waste pile	9	14.5 trips/day (wheel loader), 35 kph
	ISR construction – haul truck to clean waste pile	9	24 trucks/day, 35 kph
	Freeze plant const. – haul truck to clean waste pile	9	24 trucks/day, 35 kph
	Crew van between camp and airstrip	9	5 trips/day, 35 kph
	Crew van between camp and Operations Centre	9	20 trips/day, 35 kph
	Crew van between camp and ISR site	9	20 trips/day, 35 kph
	Air traffic to and from site	10	9 flights per week

Notes:
1: Diesel engine [3]; 2: IEC database; 3: Pumps [3]; 4: Air-cooled condensers [4]; 5: Chillers [4]; 6: Building radiated noise (interior to exterior) [5]; 7: Diesel generator [3]; 8: Manufacturer data; 9: FHWA on-road vehicles [4]; 10: Integrated Noise Model (INM) [6].

Table 2: Noise Source Inventory for Operations

Activity	Noise Sources	Method (See Notes)	Key Parameters
ISR plant operations	Building radiated noise: process area	1, 2, 3	Interior SPL calculated at 90.2 dBA
	Building radiated noise: dryer area	1, 2, 3	Interior SPL calculated at 97.6 dBA
Freeze plant (full operation)	Brine circulation pump (x3)	1	100 hp, 1800 rpm
	Air-cooled condenser (x6)	4	3 hp per fan, 12 fans per unit
	Building radiated noise (x6 chillers)	3, 5	310-ton cooling capacity each
Wellfield activity	Wheel loader activity	6	116 hp
	Mud rotary drill rig	6	470 hp
	Diamond drill rig	6	525 hp
	Building radiated noise: pumphouse	3	Interior SPL assumed to be 85 dBA
	Wellfield to ISR booster pumps (x4)	1	100 hp
Concrete production	Concrete batch plant and crusher	6, 7	750 hp
Clean waste pile activity	Wheel loader operation	6	116 hp
Fuelling	Propane pumps (x2)	1	25 hp, 1800 rpm
Power generation	1.1 MW generators (x2)	8	1.1 MW, 1800 rpm, turbocharged
	450 kW generators (x2)	9	CAT C15
Utilities	Main substation transformer (x1)	10	12.5 MVA
	ISR air compressors transformer (x1)	10	3 MVA
	ISR plant transformers (x2)	10	1 MVA
	Freeze plant modules transformer (x1)	10	7.5 MVA
	Freeze plant pumps/controls transformer (x1)	10	1 MVA
	Operations Centre transformer (x1)	10	1 MVA
	Camp transformer (x1)	10	1 MVA
Traffic	Yellowcake shipping	11	2.5 trucks/day, 35 kph
	Reagent deliveries	11	10 trucks/day, 35 kph
	Fuel/propane deliveries	11	7.5 trucks/day, 35 kph
	Food deliveries	11	2 trucks/day, 35 kph
	Material deliveries	11	3 trucks/day, 35 kph
	Wellfield deliveries	11	3 trucks/day, 35 kph
	Wellfield mobilizations	11	30 trucks/day, 35 kph
	Drill waste to clean waste pile	11	9.6 trips/day (wheel loader), 35 kph

Activity	Noise Sources	Method (See Notes)	Key Parameters
	Crew van between camp and airstrip	11	5 trips/day, 35 kph
	Crew van between camp and Ops Ctr.	11	20 trips/day, 35 kph
	Crew van between camp and ISR site	11	20 trips/day, 35 kph
	Air Traffic to and from site	12	4.5 flights per week

Notes: 1: Pumps [3]; 2: Electric motors [3]; 3: Building-radiated noise (interior to exterior) [5]; 4: Air-cooled condensers [4]; 5: Chillers [4]; 6: Diesel engines [3]; 7: IEC Database; 8: Diesel Generator [3]; 9: Manufacturer data; 10 Transformers [3]; 11: FHWA on-road vehicles [4]; 12: Integrated Noise Model [6].

A detailed source summary table is provided in Appendix A, which shows all of the sources included in the predictive modelling and an indication of whether they were active for the Construction scenario, the Operations scenario, or both, the overall sound power level, as well as the octave band data.

4.0 PREDICTIVE MODELLING

The propagation of sound from Project activities associated with the Site Construction and Operations scenarios was predicted using the software package Cadna-A, from DataKustik GmbH [5]. The calculation methodology that is implemented in the Cadna-A model is based directly on ISO Standard 9613-2 *Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation* [7], which is the calculation standard recommended under the Alberta Directive that has been adopted in this assessment [8]. This model can also be used to predict the Ldn metric required under the Health Canada guidance [9]. Air traffic was also assessed within the same Cadna-A model, using a module [6] that implements the Integrated Noise Model (INM) developed by the Federal Aviation Administration (FAA) in the United States.

The premise of the ISO standard, and therefore of the predictive model used in this assessment, is to quantify the various ways in which the sound energy from a noise source (e.g., a drill rig) attenuates as it reaches a receptor (e.g., an off-site cabin). The attenuation parameters include the attenuation due to distance (geometrical divergence), attenuation due to the atmosphere (e.g., relative humidity, temperature), attenuation due to the intervening ground type[1], and attenuation due to obstacles such as natural terrain variations, buildings, or barrier walls. Other parameters that factor into the calculation include source directivity[2], and the effect of other meteorological conditions such as wind. The model calculates the sound attenuation between all sources and all receptors input to the model, and logarithmically sums the individual source contributions at each receptor to provide an overall predicted sound level for each receptor. In a similar manner, a receptor grid can be established in the model space, with the same calculation occurring at each node point. This data can then be used to visually plot the sound propagation from the facility being modelled as a contour map.

[1] Note this may also be a negative attenuation (i.e., a reflection). For example, if the ground between a source and receptor is hard, such as pavement, or otherwise acoustically reflective, such as water.
[2] While many sources are omnidirectional (e.g., a pump would be expected to radiate sound equally in all directions), others are directional (e.g., vertical stacks with airflow that directs the noise upwards).

4.1 MODEL CONFIGURATION

The spatial bounds that have been selected for the assessment, as presented in the EIS, are physically represented in the model space. A scaled 3D representation of the facility and its surroundings are constructed in the model using digital terrain mapping and information on the planned building layouts. This is typically scaled using the UTM coordinate system, for ease of exporting and importing data to and from various mapping software (e.g., GIS, AutoCAD, plotting software). The model space is then further populated with the noise sources that have been identified in the inventorying process described in Section 3.0, and the sound power levels established for these sources are assigned. Similarly, the identified sensitive points of reception that are within the LSA are plotted at the coordinates that have been established.

The temporal bounds that have been discussed in the EIS are represented in two ways:

- Establishing the assessment scenarios (i.e., with regard to the project phase being assessed); and
- Configuring the reference time for the predictions in the model.

The assessment scenarios are configured by inputting all of the identified noise sources to the model, and then identifying those associated with the Construction scenario, the Operations scenario, and which are operational in both scenarios. Controls are then set up in the model to automatically switch sources (and any other related infrastructure, if applicable[3]) on and off, depending on the scenario that is being run.

The temporal boundaries for the predictions are established in the model configuration by establishing the reference times for calculations. Reference times were established in accordance with the guidance documents, which identify that the Ld is the 15-hour period between 07:00 and 22:00, Ln is the 9-hour period between 22:00 and 07:00, and the Ldn is the 24-hour period that combines the Ld and Ln, with a +10 dB penalty for night-time hours [9]. Since the +10 dB penalty is inherent in the Ldn metric (i.e., the Ldn definition includes the +10 dB penalty), the model automatically accounts for it when this parameter is selected for assessment.

There are a number of other configuration parameters that affect the model predictions. These have been set to with the objective of maximizing the conservatism of the calculations, while also reasonably reflecting conditions at the site. These parameters are discussed briefly in Table 3.

[3] For example, the Operations scenario will include the ISR plant as a fully constructed building; however, this building would not yet be constructed in the Site Construction scenario. As such, the controls would be set in the model to turn off not only the ISR Operations sources in the Site Construction run, but also the building itself.

Table 3: Miscellaneous Acoustic Model Configuration Settings

Parameter	Setting	Rationale
Temperature, relative humidity	10°C, 90%	Resulted in maximum predictions
Wind	default	ISO 9613-2 calculations assume a moderate downwind condition for all receptor noise calculations (up to 5 m/s [18 km/h])
Orders of reflection [1]	3	Typical setting for a conservative assessment
Surface absorption [2]	0.37	Buildings set to "Structured Façade", which uses an absorption coefficient of 0.37 (or 2 dB reflection loss).
Ground absorption	Global: 1 Local: 0	The global setting was set to 1 (absorptive) as much of the surrounding area is vegetated. Reflective surfaces such as the Project site and waterbodies were set to 0 (reflective).
Receptor heights	1.5 m above grade	All receptors were assumed to be at an average standing height, which is typically considered to be 1.5 m for such assessments.

Notes:
[1] "Orders of reflection" refers to how many reflections the model will consider when determining possible source-receptor paths.
[2] A measure of the amount of sound energy that is lost (or absorbed) when sound reflects off of a surface such as a building wall.

4.2 Source Configuration

4.2.1 Industrial Sources

There are four main industrial source types available in the model: point sources, line sources, horizontal area sources, and vertical area sources. Each of the sources identified in the development of the source inventories was assigned the source type that most accurately matched its physical characteristics. Examples of point sources include stack tips, pumps, and stationary equipment such as drill rigs. Line sources were used to define the vehicle traffic routes, and the vehicles were then set up as moving points along those lines and assigned the associated number of trips per hour calculated for each. Horizontal area sources have been used to represent the roofs of buildings (radiating noise from sources operating within), and designated areas within which the pieces of mobile equipment were assumed to be operating. Vertical area sources are generally used to represent building walls that are radiating noise from sources operating within (or sides of enclosures, such as those for the generator units).

The sound power levels associated with the sources that represent the building envelopes were calculated by first establishing the interior sound pressure level expected in the building, and then estimating the transmission of sound through the applicable building component (wall or roof). The interior sound pressure level is established using the sound power levels of the sources operating inside of the building, as well as the reflective characteristics of the interior building surfaces. The building is then enveloped with area sources, and the interior sound level is used with the transmission loss of the building component to calculate the sound power level of the exterior surface. The transmission losses were based on 16-gauge steel panel, with the exception of the generator enclosures, which were based on fibreglass reinforced panels (FRP) per the design information provided by Denison. Images of the model set-up, rendered in 3D, are provided in Figure 1 and Figure 2.

4.2.2 Air Traffic Sources

Noise caused by flights arriving and departing the airstrip were assessed using the FLG module in Cadna-A [6], which implements the algorithms from the FAA air traffic noise model INM. INM includes a database of commercial aircraft that are in common use in North America, inclusive of sound power and directivity during both departure and approach. The airstrip was positioned in the model using a reference coordinate, its magnetic headings and proposed length of 1,600 m. It was assumed that flights may arrive and depart either from the north or south, resulting the development of four distinct air routes. The fleets for the various carriers that service northern Saskatchewan mines were reviewed, and a representative aircraft was selected for crew changes. The ATR-42 is a turbo-prop aircraft in common use for regional transport to mine sites and carries up to 52 personnel so is typical for crew changes. The de Havilland DASH 8 is an equivalent aircraft which appears in the INM database and was applied in this assessment. Denison anticipates up to nine flights per week, while the model is configured to predict the maximum 24-hour period. To be conservative, it was assumed that there could be four flights arriving and departing in the same 24-hr period. These were split evenly between among the defined air routes.

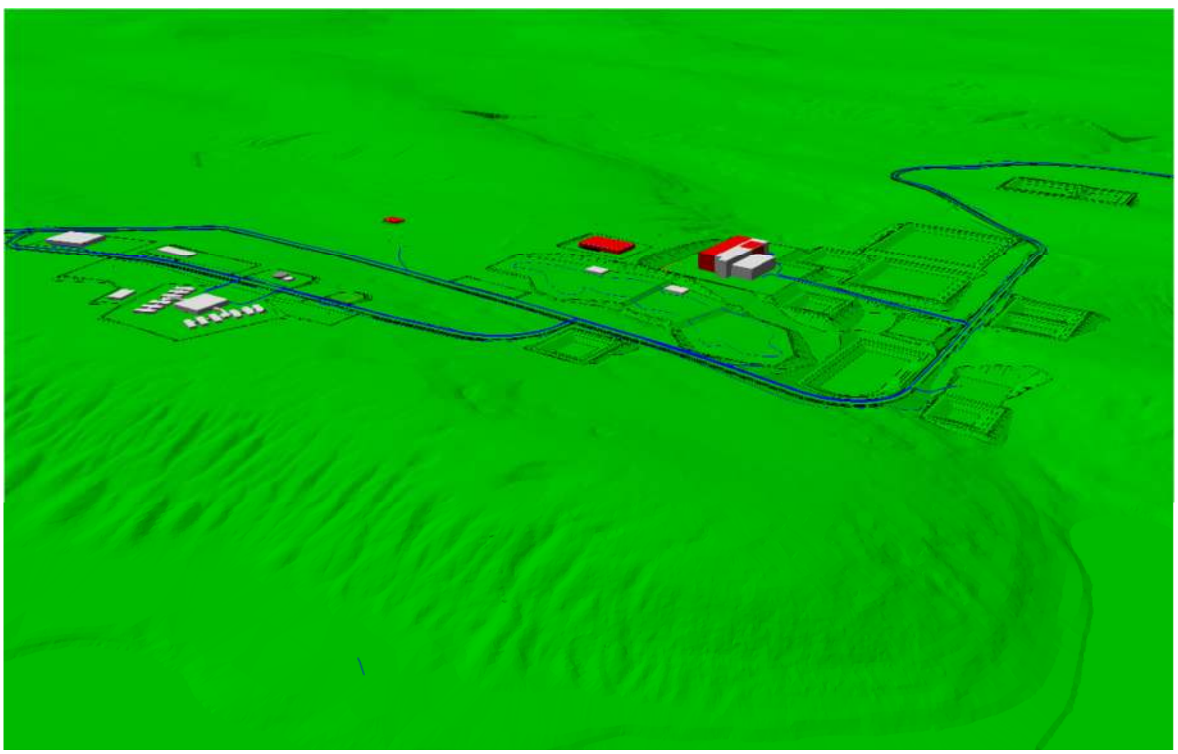


Figure 1: 3D Model View (Looking West)

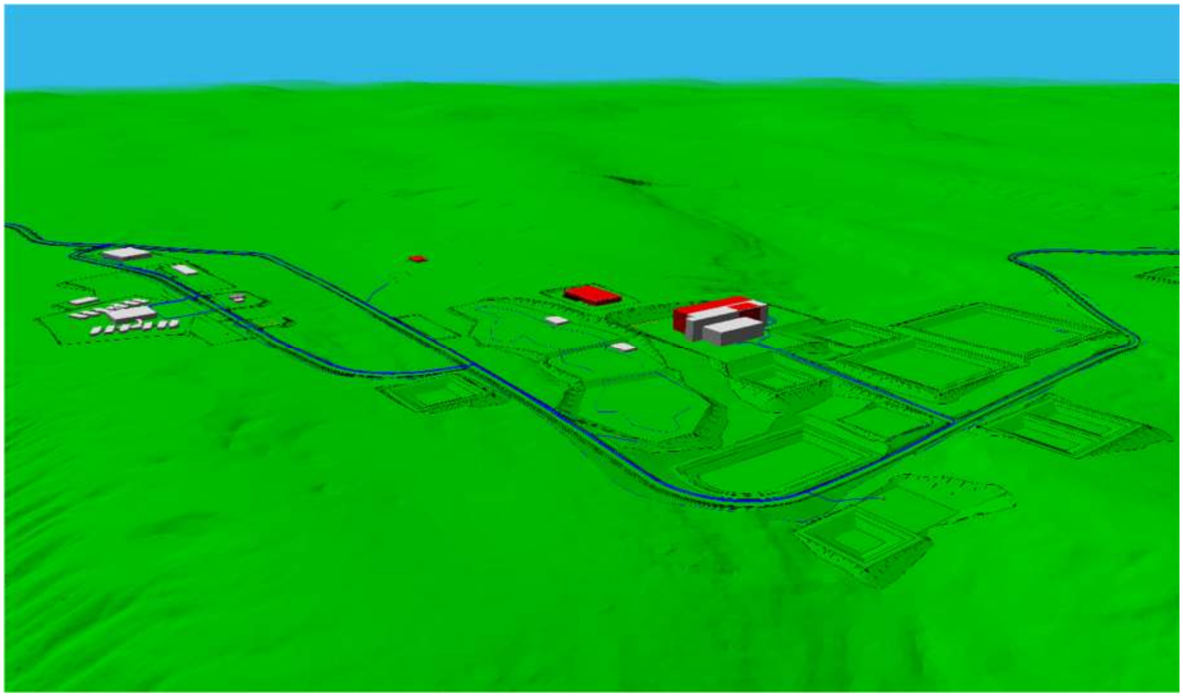
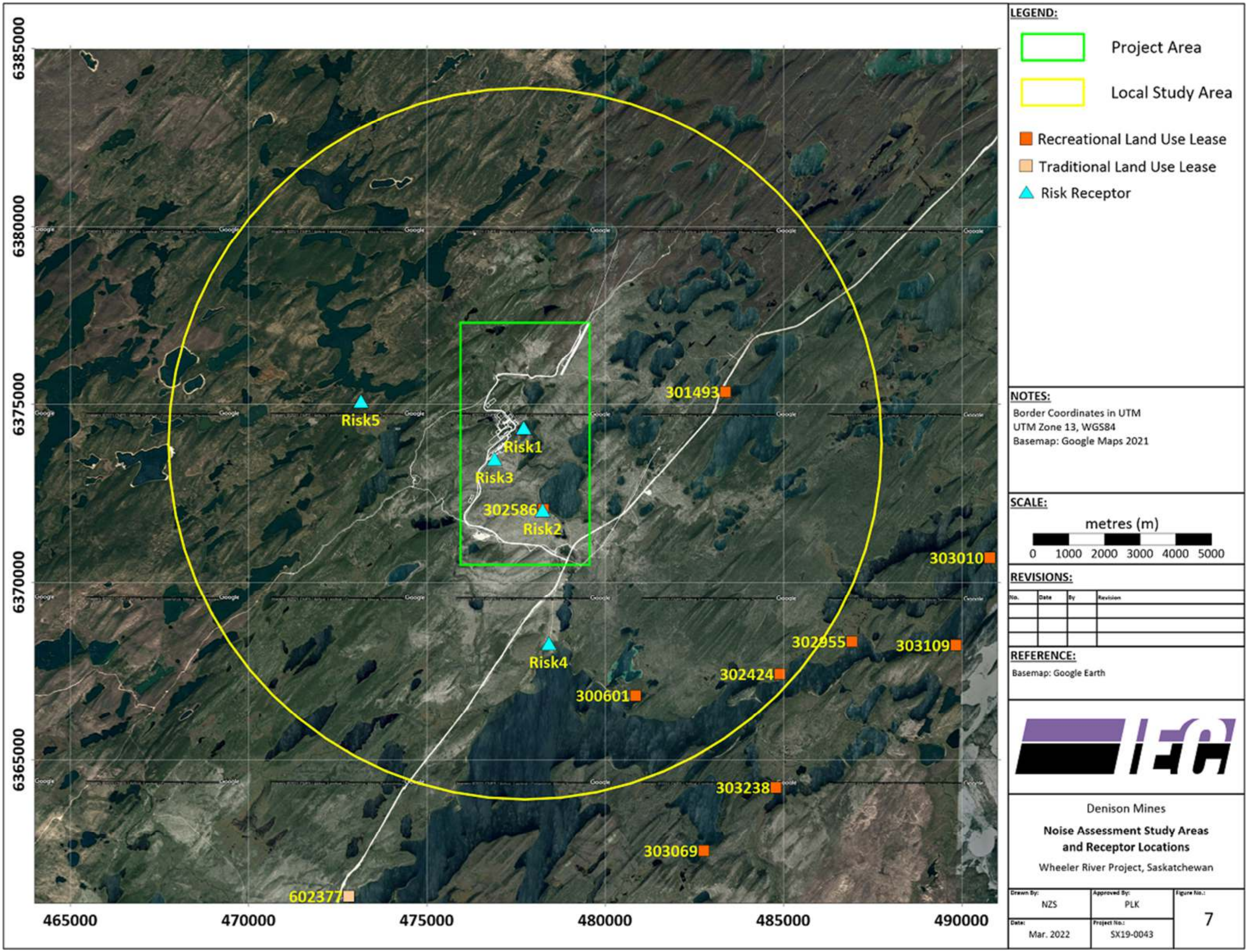


Figure 2: 3D Model View (Looking South-West)

4.3 Points of Reception

Points of reception are discrete locations at which sound levels are predicted in the modelling. These represent the locations at which the sound environment has been identified as a VC, and therefore at which the assessment of noise effects will be evaluated. There are no communities located near to the Project site. The nearest community in terms of straight-line distance is the northern settlement of Wollaston Lake and the neighbouring reserve of Lac La Hache, which are approximately 150 km away. The nearest community in terms of access by road is Pinehouse, which is approximately 260 km away.

There are a number of lease areas in the vicinity of the Project site, and it has been assumed that these contain cabins for purposes of this assessment. As such, these locations have been included as points of reception in the model if they are located within the LSA. In addition, locations of interest to the *Human Health and Ecological Risk Assessment* have been included in the model, which include various types of human locations (nearest seasonal residence, trapping location, and worker camp), and an ecological location. It should be noted that the ecological risk location (Risk1) has not been assessed in against the adopted criteria, which is for human receptors only. In addition, the camp location (Risk3) has not been assessed against the adopted criteria, as it is on-site and associated with the Project, and therefore not representative of a sensitive community. A map depicting the locations of sensitive receptors used in this assessment is included in Figure 3.



LEGEND:
Project Area
Local Study Area
Recreational Land Use Lease
Traditional Land Use Lease
Risk Receptor
NOTES:
Border Coordinates in UTM
UTM Zone 13, WGS84
Basemap: Google Maps 2021
SCALE:
metres (m)
0 1000 2000 3000 4000 5000
REVISIONS:
No. Date By Revision
REFERENCE:
Basemap: Google Earth
Denison Mines
Noise Assessment Study Areas and Receptor Locations
Wheeler River Project, Saskatchewan
Drawn By: NZS
Approved By: PLK
Figure No.: 7
Date: Mar. 2022
Project No.: SX19-0043
6385000
6380000
6375000
6370000
6365000
465000
470000
475000
480000
485000
490000
Risk1
Risk2
Risk3
Risk4
Risk5
301493
302586
303010
302955
303109
302424
300601
303238
303069
602377

5.0 MODELLING RESULTS

5.1 FEDERAL GUIDANCE

The Health Canada criteria for noise assessment include both an absolute limit of 75 dBA (Ldn), and a relative limit of an increase in %HA of no greater than 6.5% [9]. The conservative assessment scenarios defined in Section 3.0 were modelled in accordance with the procedures detailed in Section 4.0, and the results of this assessment are summarized in Table 4.

The predicted future Ldn values at the leased properties were generally predicted to remain equal to or within 0.4 dBA of the baseline levels during both construction and operations, with the exception of one leased location (302586) and one risk location (Risk2), which are located on the same property. Property 302586 is a seasonal cabin located to the south-east of the Wheeler River site, at the edge of McGowan Lake. This location is approximately 1.3 km from the access road connecting to Highway 914. The baseline Ldn of 37.6 dBA applied at the sensitive receptors in this assessment does not include haulage of ore between McArthur River and Key Lake on Highway 914, as this activity has not occurred since 2017 (see Section 6.2.3 of the EIS). If such traffic were to resume, there is potential for the baseline level to increase at this location, which would also increase the baseline %HA and thereby increase the potential for an exceedance of the Health Canada criteria. Based on traffic volumes documented as part of the Millennium Project EA and summarized in a memo prepared by Denison [10], the estimated daily truck traffic on Highway 914 when McArthur River and Key Lake are operating is approximately 58 trucks per day. A model was prepared that estimated the contributing sound levels of this amount of traffic on Highway 914 at each of the sensitive receptors included in the assessment. At location 302586/Risk2 the predicted Ldn due to truck traffic was 18.3 dBA, which would not change the predicted sound levels when added on a logarithmic basis and therefore not change the assessment results based on the Health Canada Guideline.

At Property 302586, the baseline Ldn was predicted to increase by 4.7 dBA during construction, from 37.6 dBA to 42.3 dBA. In terms of %HA, this represents a +0.4% difference. If the baseline and future Ldn values are increased by +10 dB each, per Health Canada recommendation for locations that are expected to be highly sensitive to noise, the increase in %HA at this location changes to +1.3%. The increase is primarily related to the use of heavy equipment in the development of the wellfield and the generators, as well as truck traffic accessing the site from Highway 914. During operations, the increase from baseline at this location was predicted to be 2.8 dBA, from 37.6 dBA to 40.4 dBA. When these are adjusted by +10 dB as above, the resulting change in %HA is +0.7%. During operations, the sound levels at this location are attributable to the heavy equipment operating in the wellfield, use of the emergency generators (included as a worst-case scenario), and traffic along the access road from Highway 914.

The predictive modelling indicates that the Project does not cause an adverse effect with regard to the Health Canada Guideline at any of the identified receptors, as the future conditions remain below 75 dBA and the %HA does not increase by more than 6.5% at any receptor identified.

Contour plots depicting the sound propagation (in Ldn) and increase in %HA from the Construction and Operations phases are provided in Figure 4 to Figure 7. Note that these represent the predicted noise from the site added to the baseline Ldn of 37.6 dBA. These plots show that the sound level contours during construction and operations return to the baseline level within the LSA, with the exception of a small extension to the north-east which is associated with the daytime incoming/outgoing flights at the airstrip. During construction, the Ldn sound levels are predicted to return to background within approximately 6 kilometres of main activity areas, while the Operations Ldn sound levels are predicted to return to background within approximately 4 kilometres of the main activity areas.

5.2 PROVINCIAL GUIDANCE

The PSLs for the Project under the Alberta Directive are 40 dBA (Ld) and 36 dBA (Ln). The conservative assessment scenarios defined in Section 2.0 were modelled in accordance with the procedures detailed in Section 4.0 to predict Ld and Ln sound levels at each identified receptor, and the results of this assessment are summarized in Table 5 and Table 6.

At the leased properties, the sound levels generally remained equal to the baseline sound level, or increased by less than 0.5 dBA, with the exception of the property identified as 302586/Risk2. As noted in the previous section, this receptor is located to the south-east of the Wheeler River site, adjacent to McGowan Lake. During construction, the daytime and night-time sound levels increased over baseline conditions by 5.1 dBA and 4.6 dBA, respectively, and the future levels were found to be less than the established PSLs. The increases in sound level at this location are primarily associated with the construction equipment being used in the development of the wellfield. During operations, the increases are 3.4 dBA and 2.8 dBA during the daytime and night-time, respectively, and are predicted to be below the PSLs.

Contour plots depicting the sound propagation in Ld and Ln for both Construction and Operations are provided in Figure 8 to Figure 11. Note that these depict the future predicted sound levels from the site activities added to the ambient sound levels discussed in Section 6.2.3 of the EIS. The extent of displayed contours represents the return to the established baseline conditions, while the applicable PSL is shown as a blue line. During both construction and operations, the daytime and night-time sound levels are predicted to return to baseline conditions within the LSA, with the exception of some influence of the flight paths associated with use of the airstrip during the daytime hours. The PSLs for daytime and night-time during construction are met within 2 km and 2.5 km of the main activity area at the site, respectively; both of which are well within the LSA spatial boundary. During operations, the PSLs are met within approximately 1 km during the daytime, and 1.5 km during the night-time.

Table 4: Health Canada Guideline Effects Assessment (Construction and Operations)

Name	ID	Baseline Condition [(1)]			Construction					Operations				
		Ldn (dBA)	Ldn-Adj. [(2)] (dBA)	%HA	Ldn (dBA)	Total Ldn [(3)] (dBA)	Ldn-Adj. [(2)] (dBA)	%HA	Δ%HA	Ldn (dBA)	Total Ldn [(3)] (dBA)	Ldn-Adj. [(2)] (dBA)	%HA	Δ%HA
Leased property	300601	37.6	47.6	1.6	21.3	37.7	47.7	1.6	**0.0**	18.9	37.7	47.7	1.6	**0.0**
Leased property	301493	37.6	47.6	1.6	26.4	37.9	47.9	1.7	**0.1**	23.0	37.7	47.7	1.6	**0.0**
Leased property	302424	37.6	47.6	1.6	14.4	37.6	47.6	1.6	**0.0**	14.5	37.6	47.6	1.6	**0.0**
Leased property	302586	37.6	47.6	1.6	40.4	42.3	52.3	2.9	**1.3**	37.3	40.4	50.4	2.3	**0.7**
Leased property	302955	37.6	47.6	1.6	10.9	37.6	47.6	1.6	**0.0**	10.9	37.6	47.6	1.6	**0.0**
Leased property	303010	37.6	47.6	1.6	6.2	37.6	47.6	1.6	**0.0**	6.2	37.6	47.6	1.6	**0.0**
Leased property	303069	37.6	47.6	1.6	14.0	37.6	47.6	1.6	**0.0**	14.0	37.6	47.6	1.6	**0.0**
Leased property	303109	37.6	47.6	1.6	6.4	37.6	47.6	1.6	**0.0**	6.4	37.6	47.6	1.6	**0.0**
Leased property	303238	37.6	47.6	1.6	11.8	37.6	47.6	1.6	**0.0**	11.8	37.6	47.6	1.6	**0.0**
Leased property	602377	37.6	47.6	1.6	16.6	37.6	47.6	1.6	**0.0**	16.6	37.6	47.6	1.6	**0.0**
Risk - ecological on-site [(4)]	Risk1	37.6	N/A	N/A	59.4	59.4	N/A	N/A	**N/A**	45.7	46.3	N/A	N/A	**N/A**
Risk - human: trapper	Risk2	37.6	47.6	1.6	40.4	42.3	52.3	2.9	**1.3**	37.3	40.4	50.4	2.3	**0.7**
Risk - human: camp worker [(4)]	Risk3	37.6	N/A	N/A	51.6	51.8	N/A	N/A	**N/A**	51.7	51.9	N/A	N/A	**N/A**
Risk - human: seasonal resident	Risk4	37.6	47.6	1.6	27.0	38.0	48.0	1.7	**0.1**	24.4	37.8	47.8	1.6	**0.0**
Risk - reference receptor location	Risk5	37.6	47.6	1.6	34.6	39.4	49.4	2.0	**0.4**	32.0	38.7	48.7	1.8	**0.2**

Notes:
(1) The baseline condition (or background condition) was established in the measurement program discussed in Section **Error! Reference source not found.** and summarized in **Error! Reference source not found.**
(2) Per Health Canada guidance, the measured/predicted Ldn should be adjusted by +10 dBA for quiet rural or remote settings [9]
(3) The "Total Ldn" represents the baseline Ldn added logarithmically to the model-predicted Ldn

Name	ID	Baseline Condition (1)			Construction					Operations				
		Ldn (dBA)	Ldn-Adj. (2) (dBA)	%HA	Ldn (dBA)	Total Ldn (3) (dBA)	Ldn-Adj. (2) (dBA)	%HA	Δ%HA	Ldn (dBA)	Total Ldn (3) (dBA)	Ldn-Adj. (2) (dBA)	%HA	Δ%HA
(4) These are not receptors in terms of the Health Canada Guideline, and so only the model results are displayed.														

Table 5: Alberta Directive Effects Assessment (Construction)

Name	ID	Baseline Condition (1)		Construction Only (2)		Total Construction (3)		PSL		Difference (Total – PSL)	
		Day (dBA)	Night (dBA)	Day (dBA)	Night (dBA)	Day (dBA)	Night (dBA)	Day (dBA)	Night (dBA)	Day (dBA)	Night (dBA)
Leased property	300601	30.7	31.3	17.6	14.2	30.9	31.4	40	36	-9.1	-4.6
Leased property	301493	30.7	31.3	21.7	19.7	31.2	31.6	40	36	-8.8	-4.4
Leased property	302424	30.7	31.3	16.3	0	30.9	31.3	40	36	-9.1	-4.7
Leased property	302586	30.7	31.3	34.2	34.0	35.8	35.9	40	36	-4.2	-0.1
Leased property	302955	30.7	31.3	12.8	0	30.8	31.3	40	36	-9.2	-4.7
Leased property	303010	30.7	31.3	8.3	0	30.7	31.3	40	36	-9.3	-4.7
Leased property	303069	30.7	31.3	15.9	0	30.8	31.3	40	36	-9.2	-4.7
Leased property	303109	30.7	31.3	8.5	0	30.7	31.3	40	36	-9.3	-4.7
Leased property	303238	30.7	31.3	13.7	0	30.8	31.3	40	36	-9.2	-4.7
Leased property	602377	30.7	31.3	18.7	0	31.0	31.3	40	36	-9.0	-4.7
Risk - ecological on-site (4)	Risk1	30.7	31.3	53.0	53.0	53.1	53.0	N/A	N/A	N/A	N/A
Risk - human: trapper	Risk2	30.7	31.3	34.2	34.0	35.8	35.9	40	36	-4.2	-0.1
Risk - human: camp worker (4)	Risk3	30.7	31.3	45.3	45.2	45.4	45.4	N/A	N/A	N/A	N/A

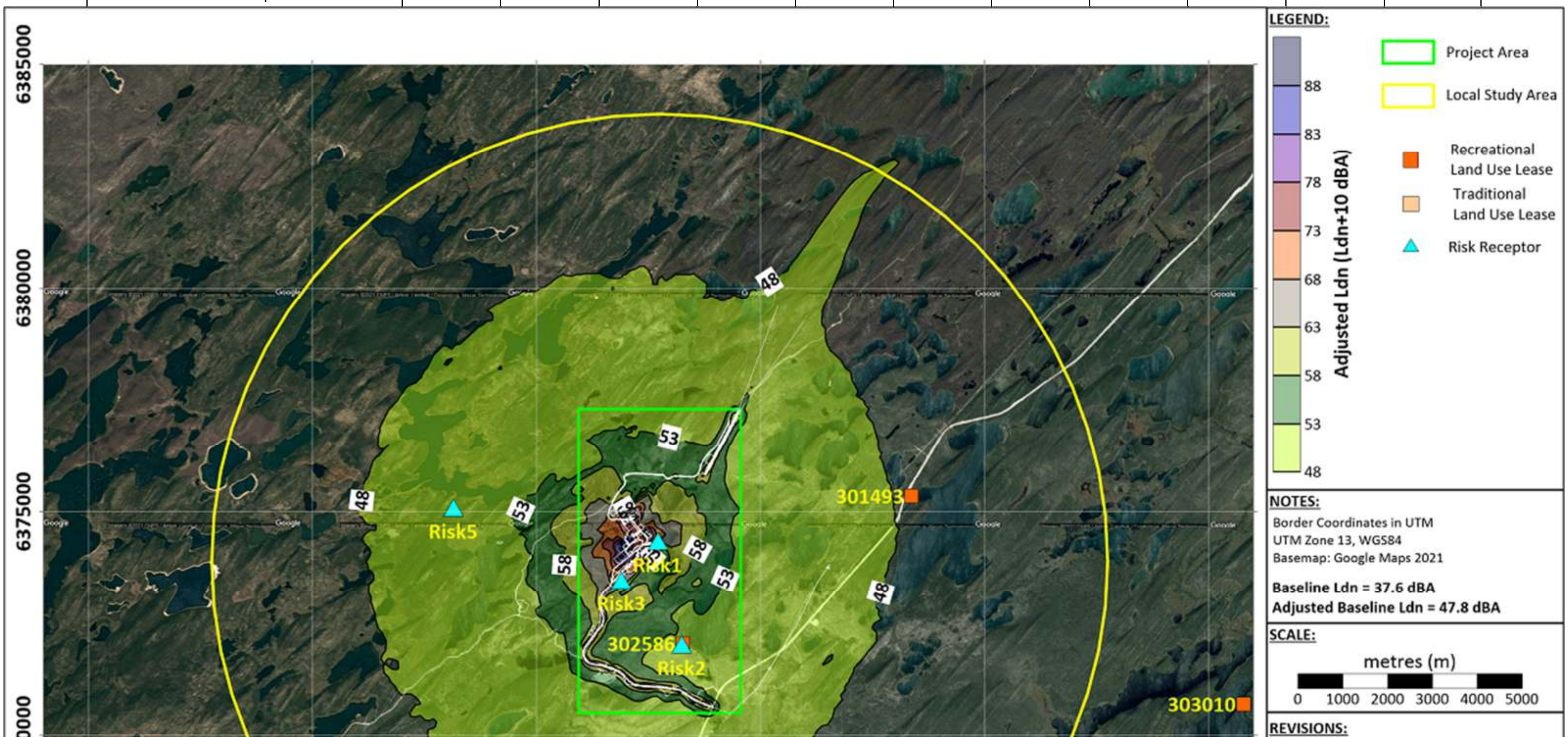
Name	ID	Baseline Condition (1)		Construction Only (2)		Total Construction (3)		PSL		Difference (Total – PSL)	
		Day (dBA)	Night (dBA)	Day (dBA)	Night (dBA)	Day (dBA)	Night (dBA)	Day (dBA)	Night (dBA)	Day (dBA)	Night (dBA)
Risk - human: seasonal resident	Risk4	30.7	31.3	21.6	20.4	31.2	31.6	40	36	-8.8	-4.4
Risk - reference receptor location	Risk5	30.7	31.3	28.3	28.2	32.7	33.0	40	36	-7.3	-3.0

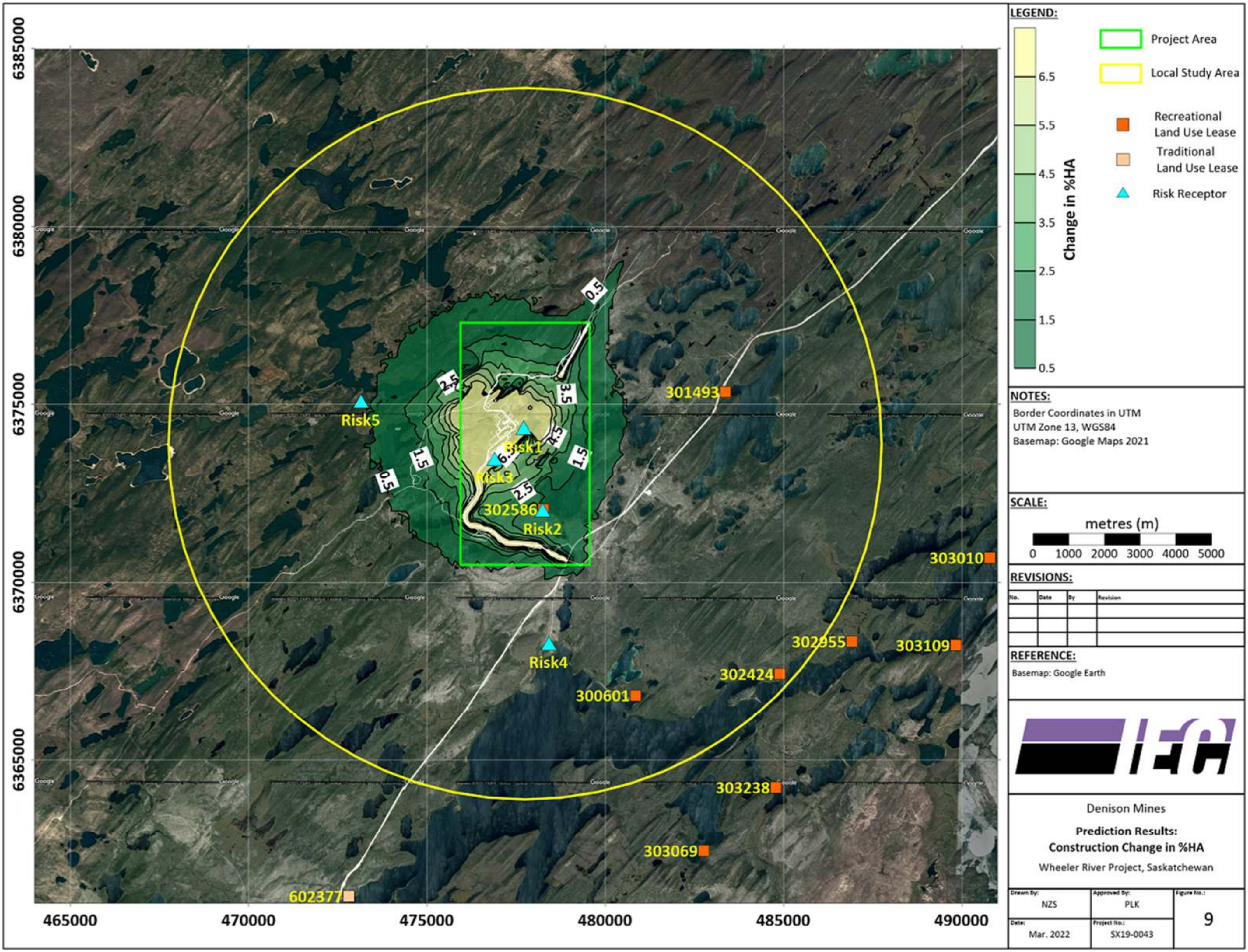
Notes:
(1) The Baseline Condition (or background condition) was established in the measurement program discussed in Section **Error! Reference source not found.** and summarized in **Error! Reference source not found.**.
(2) The Construction Only sound level is the contribution from the Project only, determined via predictive modelling.
(3) The Total Construction sound level is the logarithmic addition of the baseline sound level to the modelled project sound level.
(4) These receptors are not community locations and therefore only the modelling results are displayed.

Table 6: Alberta Directive Effects Assessment (Operations)

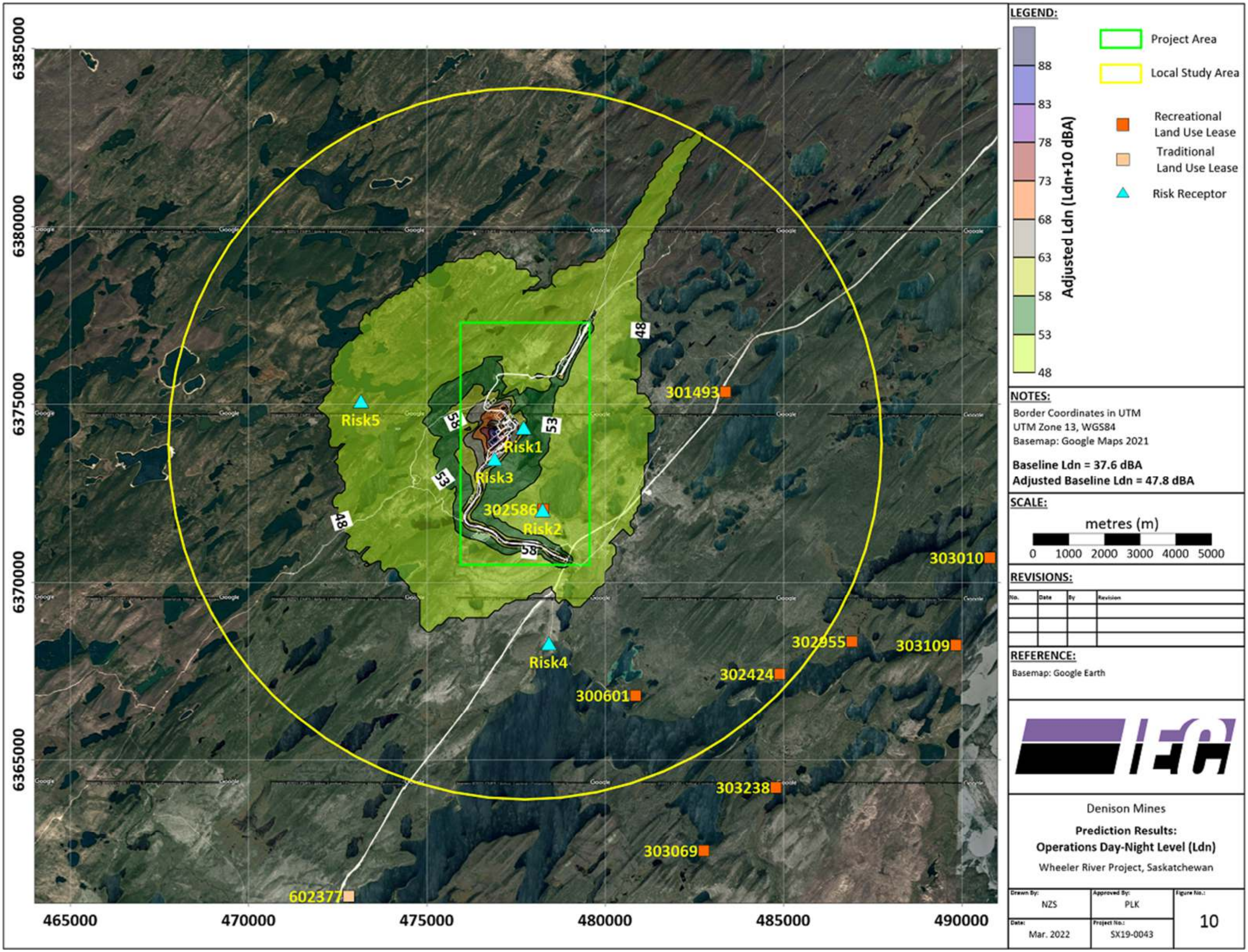
Name	ID	Baseline Condition (1)		Operations Only (2)		Total Operations (3)		PSL		Difference (Total – PSL)	
		Day (dBA)	Night (dBA)	Day (dBA)	Night (dBA)	Day (dBA)	Night (dBA)	Day (dBA)	Night (dBA)	Day (dBA)	Night (dBA)
leased property	300601	30.7	31.3	16.6	11.1	30.9	31.3	40	36	-9.1	-4.7
leased property	301493	30.7	31.3	19.8	15.7	31.0	31.4	40	36	-9.0	-4.6
leased property	302424	30.7	31.3	16.3	0	30.9	31.3	40	36	-9.1	-4.7
leased property	302586	30.7	31.3	31.4	30.7	34.1	34.0	40	36	-5.9	-2.0
leased property	302955	30.7	31.3	12.8	0	30.8	31.3	40	36	-9.2	-4.7
leased property	303010	30.7	31.3	8.3	0	30.7	31.3	40	36	-9.3	-4.7
leased property	303069	30.7	31.3	15.9	0	30.8	31.3	40	36	-9.2	-4.7
leased property	303109	30.7	31.3	8.5	0	30.7	31.3	40	36	-9.3	-4.7
leased property	303238	30.7	31.3	13.7	0	30.8	31.3	40	36	-9.2	-4.7

Name	ID	Baseline Condition (1)		Operations Only (2)		Total Operations (3)		PSL		Difference (Total – PSL)	
		Day (dBA)	Night (dBA)	Day (dBA)	Night (dBA)	Day (dBA)	Night (dBA)	Day (dBA)	Night (dBA)	Day (dBA)	Night (dBA)
leased property	602377	30.7	31.3	18.7	0	31.0	31.3	40	36	-9.0	-4.7
risk - ecological on-site (4)	Risk1	30.7	31.3	41.5	38.7	41.8	39.4	N/A	N/A	N/A	N/A
risk - human: trapper	Risk2	30.7	31.3	31.4	30.8	34.1	34.1	40	36	-5.9	-1.9
risk - human: camp worker (4)	Risk3	30.7	31.3	45.3	45.2	45.4	45.4	N/A	N/A	N/A	N/A
risk - human: seasonal resident	Risk4	30.7	31.3	19.9	17.6	31.0	31.5	40	36	-9.0	-4.5
risk - reference receptor location	Risk5	30.7	31.3	26.0	25.5	32.0	32.3	40	36	-8.0	-3.7





6385000
6380000
6375000
6370000
6365000
465000
470000
475000
480000
485000
490000
0.5
1.5
2.5
3.5
4.5
Risk1
Risk2
Risk3
Risk4
Risk5
301493
302586
303010
302955
303109
302424
300601
303238
303069
602377
LEGEND:
6.5
5.5
4.5
3.5
2.5
1.5
0.5
Change in %HA
Project Area
Local Study Area
Recreational Land Use Lease
Traditional Land Use Lease
Risk Receptor
NOTES:
Border Coordinates in UTM
UTM Zone 13, WGS84
Basemap: Google Maps 2021
SCALE:
metres (m)
0 1000 2000 3000 4000 5000
REVISIONS:
No. Date By Revision
REFERENCE:
Basemap: Google Earth
Denison Mines
Prediction Results:
Construction Change in %HA
Wheeler River Project, Saskatchewan
Drawn By: NZS
Approved By: PLK
Figure No.: 9
Date: Mar. 2022
Project No.: SX19-0043


LEGEND:
Adjusted Ldn (Ldn+10 dBA)
88
83
78
73
68
63
58
53
48
Project Area
Local Study Area
Recreational Land Use Lease
Traditional Land Use Lease
Risk Receptor
NOTES:
Border Coordinates in UTM
UTM Zone 13, WGS84
Basemap: Google Maps 2021
Baseline Ldn = 37.6 dBA
Adjusted Baseline Ldn = 47.8 dBA
SCALE:
metres (m)
0 1000 2000 3000 4000 5000
REVISIONS:
No. Date By Revision
REFERENCE:
Basemap: Google Earth
Denison Mines
Prediction Results:
Operations Day-Night Level (Ldn)
Wheeler River Project, Saskatchewan
Drawn By: NZS
Approved By: PLK
Figure No.: 10
Date: Mar. 2022
Project No.: SX19-0043
6385000
6380000
6375000
6370000
6365000
465000
470000
475000
480000
485000
490000
Risk1
Risk2
Risk3
Risk4
Risk5
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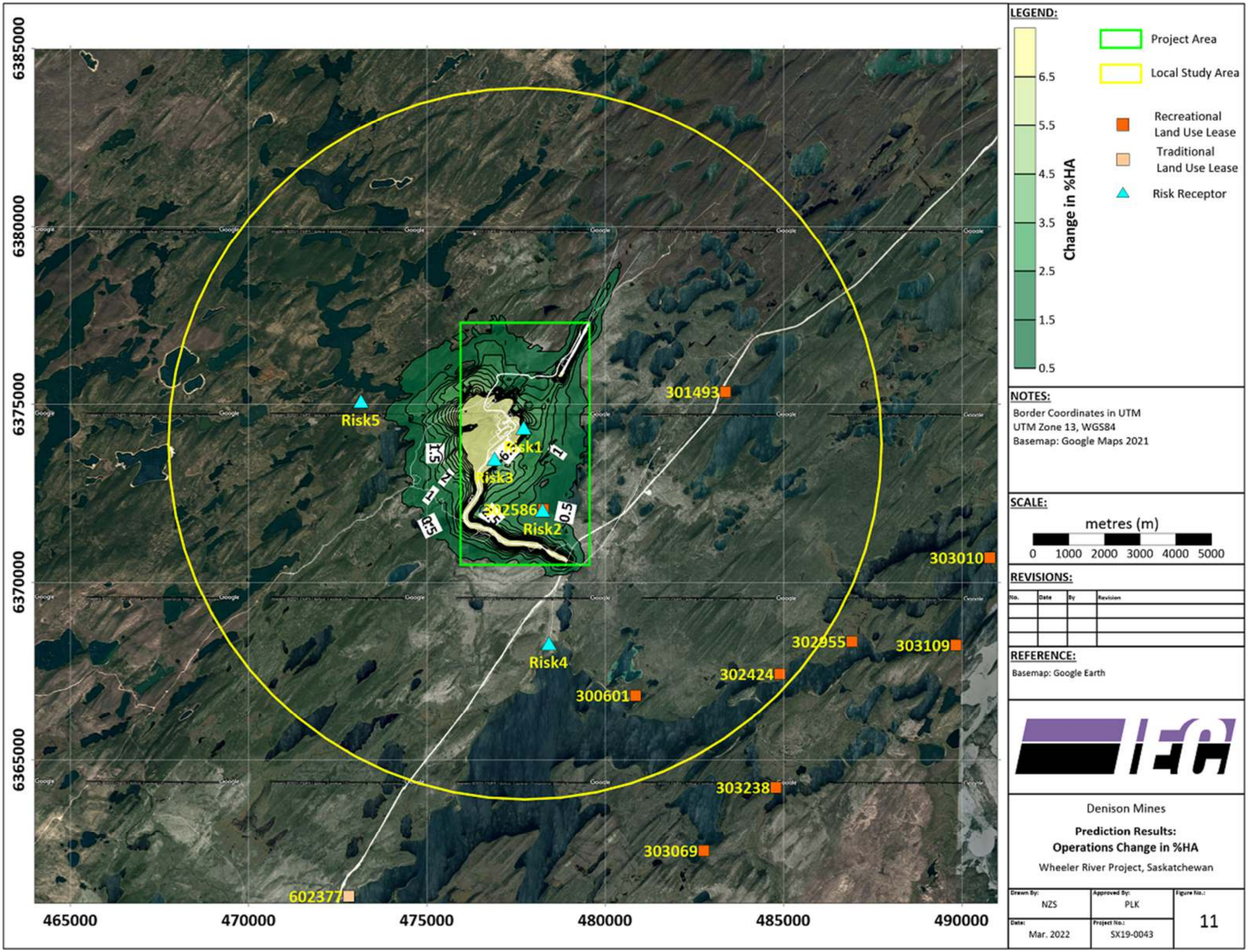
300601
303238
303069
602377
48
53
58



LEGEND:
Project Area
Local Study Area
Recreational Land Use Lease
Traditional Land Use Lease
Risk Receptor
Change in %HA
6.5
5.5
4.5
3.5
2.5
1.5
0.5
NOTES:
Border Coordinates in UTM
UTM Zone 13, WGS84
Basemap: Google Maps 2021
SCALE:
metres (m)
0 1000 2000 3000 4000 5000
REVISIONS:
No. Date By Revision
REFERENCE:
Basemap: Google Earth
Denison Mines
Prediction Results:
Operations Change in %HA
Wheeler River Project, Saskatchewan
Drawn By: NZS
Approved By: PLK
Figure No.: 11
Date: Mar. 2022
Project No.: SX19-0043
Risk1
Risk2
Risk3
Risk4
Risk5
301493
302586
303010
302955
303109
302424
300601
303238
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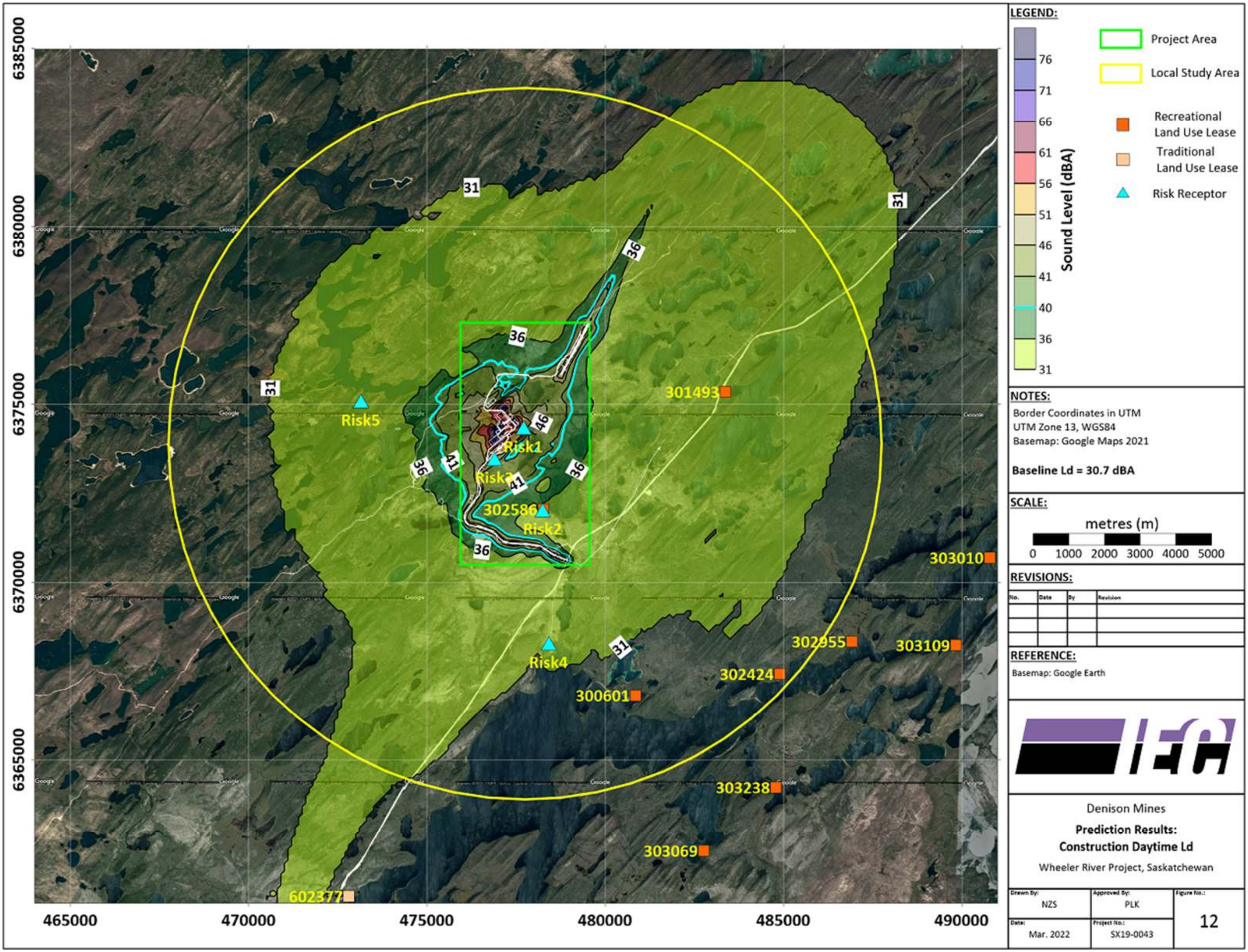
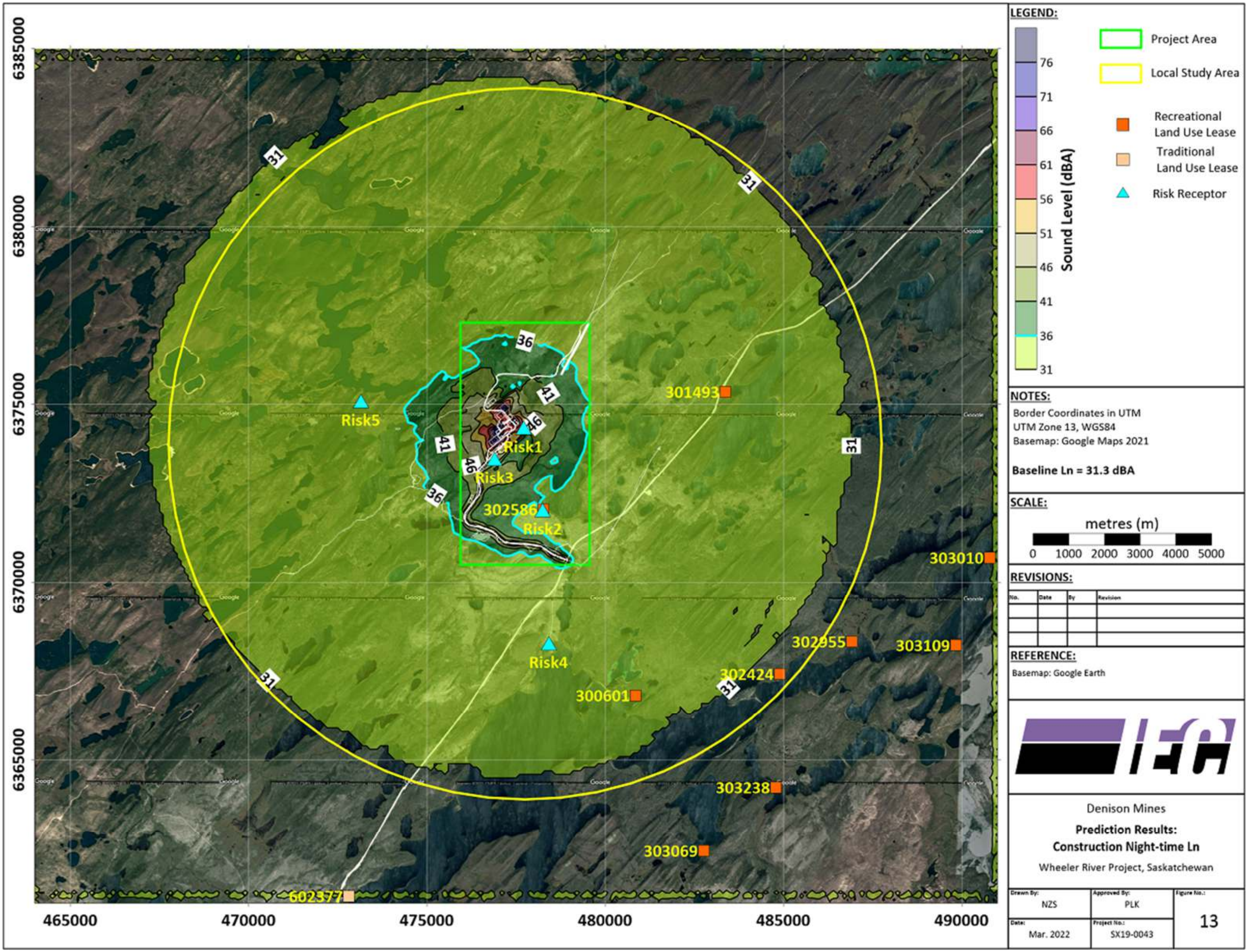
6375000
6370000
6365000



LEGEND:
Sound Level (dBA)
76
71
66
61
56
51
46
41
40
36
31
Project Area
Local Study Area
Recreational Land Use Lease
Traditional Land Use Lease
Risk Receptor
NOTES:
Border Coordinates in UTM
UTM Zone 13, WGS84
Basemap: Google Maps 2021
Baseline Ld = 30.7 dBA
SCALE:
metres (m)
0 1000 2000 3000 4000 5000
REVISIONS:
No.
Date
By
Revision
REFERENCE:
Basemap: Google Earth
Denison Mines
Prediction Results:
Construction Daytime Ld
Wheeler River Project, Saskatchewan
Drawn By: NZS
Approved By: PLK
Figure No.: 12
Date: Mar. 2022
Project No.: SX19-0043
6385000
6380000
6375000
6370000
6365000
465000
470000
475000
480000
485000
490000
Risk1
Risk2
Risk3
Risk4
Risk5
301493
302586
303010
302955
303109
302424
300601
303238
303069
602377



LEGEND:
Project Area
Local Study Area
Recreational Land Use Lease
Traditional Land Use Lease
Risk Receptor
Sound Level (dBA)
76
71
66
61
56
51
46
41
36
31
NOTES:
Border Coordinates in UTM
UTM Zone 13, WGS84
Basemap: Google Maps 2021
Baseline Ln = 31.3 dBA
SCALE:
metres (m)
0 1000 2000 3000 4000 5000
REVISIONS:
No. Date By Revision
REFERENCE:
Basemap: Google Earth
Denison Mines
Prediction Results:
Construction Night-time Ln
Wheeler River Project, Saskatchewan
Drawn By: NZS
Approved By: PLK
Figure No.: 13
Date: Mar. 2022
Project No.: SX19-0043
6385000
6380000
6375000
6370000
6365000
465000
470000
475000
480000
485000
490000
Risk1
Risk2
Risk3
Risk4
Risk5
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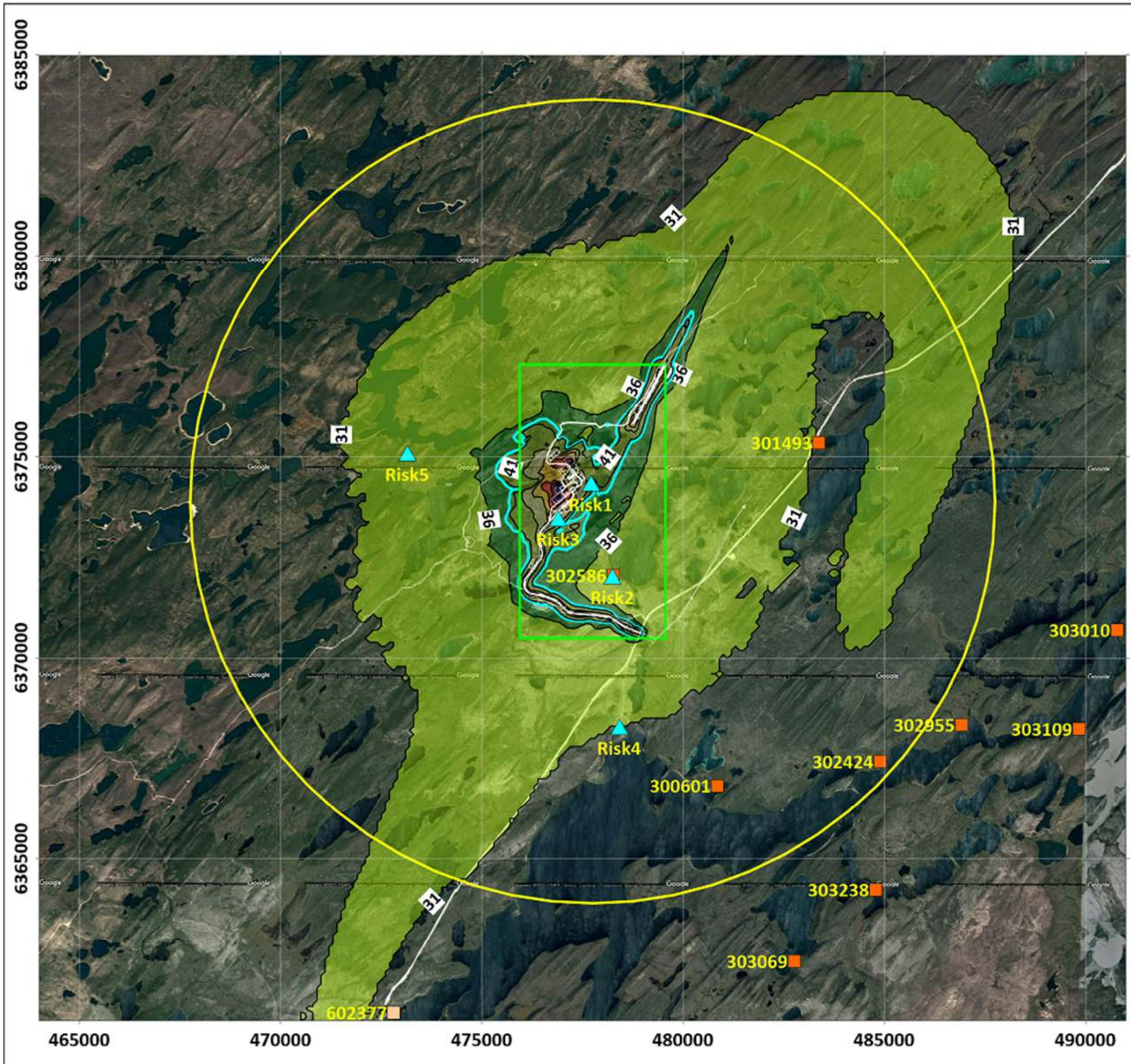
303238
303069
602377



LEGEND:

Sound Level (dBA): 76, 71, 66, 61, 56, 51, 46, 41, 40, 36, 31

- Project Area
- Local Study Area
- Recreational Land Use Lease
- Traditional Land Use Lease
- Risk Receptor

NOTES:

Border Coordinates in UTM
UTM Zone 13, WGS84
Basemap: Google Maps 2021

Baseline Ld = 30.7 dBA

SCALE:

metres (m)
0 1000 2000 3000 4000 5000

REVISIONS:

No.	Date	By	Revision

REFERENCE:

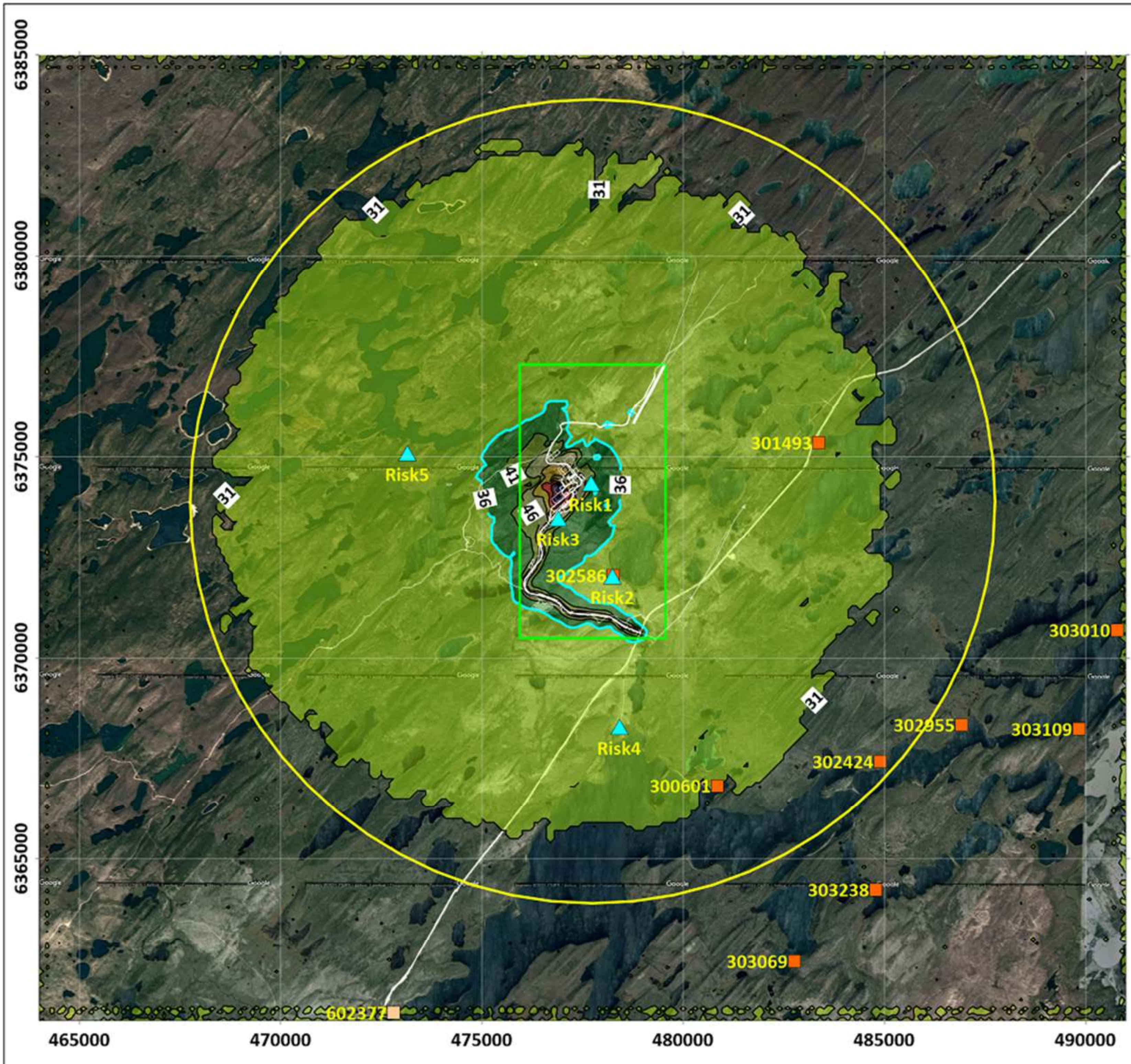
Basemap: Google Earth

Denison Mines

Prediction Results: Operations Daytime Ld

Wheeler River Project, Saskatchewan

Drawn By:	Approved By:	Figure No.:
NZS	PLK	14
Date: Mar. 2022	Project No.: SX19-0043	



LEGEND:

Sound Level (dBA): 76, 71, 66, 61, 56, 51, 46, 41, 36, 31

Project Area

Local Study Area

Recreational Land Use Lease

Traditional Land Use Lease

Risk Receptor

NOTES:

Border Coordinates in UTM
UTM Zone 13, WGS84
Basemap: Google Maps 2021

Baseline Ln = 31.3 dBA

SCALE:

metres (m)

0 1000 2000 3000 4000 5000

REVISIONS:

No.	Date	By	Revision

REFERENCE:

Basemap: Google Earth

Denison Mines

Prediction Results:
Operations Night-time Ln

Wheeler River Project, Saskatchewan

Drawn By:	Approved By:	Figure No.:
NZS	PLK	15
Date: Mar. 2022	Project No.: SX19-0043	

6.0 RECOMMENDED CONSTRUCTION PRACTICES

The following construction practices are recommended based on industry best practices for reducing the likelihood of impacts during construction projects.

Administrative controls

- Planning truck routes to minimize separation distance to the nearest receptors,
- Maximizing the distance between the planned construction staging areas and equipment locations and the sensitive receptors,
- Planning to use the least impactful construction method available,
- Ensuring those potentially impacted by construction noise are aware of how to lodge complaints,
- Complete regular inspections of equipment to ensure it is in good working order, and
- Minimize night-time operations.

Physical controls

- Select mobile construction equipment that is appropriately sized for its task,
- Ensure all exhausts (e.g., mobile equipment, generators) are outfitted with effective muffling devices that are in good working condition,
- Selecting low-noise tools and equipment where available,
- Avoid dropping material from height, and
- Turn off equipment when not being used.

7.0 REFERENCES

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[3] D. H. C. Bies, "Engineering Noise Control: Theory and Practice, 4th Edition," CRC Press, New York, 2009.

[4] L. Miller, "Noise Control for Buildings and Manufacturing Plants," Bolt Beranek and Newman Inc., Cambridge, 1981.

[5] DataKustik GmbH, "Cadna-A Reference Manual (Version 2021 MR1)," DataKustik, Gilching, 2020.

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[7] International Organization for Standardization (ISO), "Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation," ISO, Geneva, 1996.

[8] Alberta Energy Regulator (AER), "Directive 038: Noise Control," AER, Calgary, 2007 (Updated 2013).

[9] Health Canada, "Guidance for Evaluating Human Health Impacts in Environmental Assessment: Noise," Health Canada, Ottawa, 2017.

[10] Denison Mines, "Memorandum re: Traffic Volumes," February 10, 2021.

Appendix A:

Assessment Scenarios and Sound Level Data

Table A-1: Assessment Scenarios and Sound Level Data

Source ID	Source Description	Number of Identical Sources	Sound Power Level (dBA)	Active Status		Octave Band Centre Frequency (Hz); Sound Power Level (dB)									Overall	
				Construction	Operations	31.5	63	125	250	500	1000	2000	4000	8000	dB	dBA
Point Sources																
FP_ACC1Fan(x)	Freeze Plant: ACC Unit 1 Fan	12	94.0	●	●	94.8	97.8	97.8	94.8	91.8	87.8	84.8	81.8	73.8	103.2	94.0
FP_ACC2Fan(x)	Freeze Plant: ACC Unit 2 Fan	12	94.0	●	●	94.8	97.8	97.8	94.8	91.8	87.8	84.8	81.8	73.8	103.2	94.0
FP_ACC3Fan(x)	Freeze Plant: ACC Unit 3 Fan	12	94.0	○	●	94.8	97.8	97.8	94.8	91.8	87.8	84.8	81.8	73.8	103.2	94.0
FP_ACC4Fan(x)	Freeze Plant: ACC Unit 4 Fan	12	94.0	○	●	94.8	97.8	97.8	94.8	91.8	87.8	84.8	81.8	73.8	103.2	94.0
FP_ACC5Fan(x)	Freeze Plant: ACC Unit 5 Fan	12	94.0	○	●	94.8	97.8	97.8	94.8	91.8	87.8	84.8	81.8	73.8	103.2	94.0
FP_ACC6Fan(x)	Freeze Plant: ACC Unit 6 Fan	12	94.0	○	●	94.8	97.8	97.8	94.8	91.8	87.8	84.8	81.8	73.8	103.2	94.0
Gen1_Exh	Generator 1: Exhaust	1	109.4	●	●		118.1	117.1	109.1	105.1	105.1	100.1	90.1	81.1	121.2	109.4
Gen2_Exh	Generator 2: Exhaust	1	109.4	●	●		118.1	117.1	109.1	105.1	105.1	100.1	90.1	81.1	121.2	109.4
FP_BCP(x)	Freeze Plant: Brine Circulation Pump	3	99.3	●	●		89.7	90.7	92.7	92.7	95.7	92.7	88.7	82.7	100.9	99.3
Const_U_PFP1	Utilities (Construction): Propane Fuel Pump (ISR Plant)	1	94.6	●	○		85.0	86.0	88.0	88.0	91.0	88.0	84.0	78.0	96.2	94.6
Const_U_PFP2	Utilities (Construction): Propane Fuel Pump (Camp)	1	94.6	●	○		85.0	86.0	88.0	88.0	91.0	88.0	84.0	78.0	96.2	94.6
U_PFP1	Utilities (Operations): Propane Fuel Pump (ISR Plant)	1	94.6	○	●		85.0	86.0	88.0	88.0	91.0	88.0	84.0	78.0	96.2	94.6
U_PFP2	Utilities (Operations): Propane Fuel Pump (Camp)	1	94.6	○	●		85.0	86.0	88.0	88.0	91.0	88.0	84.0	78.0	96.2	94.6
U_TMS	Utilities: Main Substation Transformer	1	92.1	○	●	88.7	94.7	96.7	91.7	91.7	85.7	80.7	75.7	68.7	100.7	92.1
U_TFPM	Utilities: Freeze Plant Modules Transformer	1	87.9	○	●	84.5	90.5	92.5	87.5	87.5	81.5	76.5	71.5	64.5	96.5	87.9
U_TFPPC	Utilities: Freeze Plant Pumps/Controls Transformer	1	81.0	○	●	77.6	83.6	85.6	80.6	80.6	74.6	69.6	64.6	57.6	89.6	81.0
U_TISRAC	Utilities: ISR Plant Air Compressors Transformer	1	84.6	○	●	81.2	87.2	89.2	84.2	84.2	78.2	73.2	68.2	61.2	93.2	84.6
U_TISRP(x)	Utilities: ISR Plant Process Transformer	2	81.0	○	●	77.6	83.6	85.6	80.6	80.6	74.6	69.6	64.6	57.6	89.6	81.0
U_TOP	Utilities: Operations Centre Transformer	1	81.0	○	●	77.6	83.6	85.6	80.6	80.6	74.6	69.6	64.6	57.6	89.6	81.0
U_TC	Utilities: Camp Transformer	1	81.0	○	●	77.6	83.6	85.6	80.6	80.6	74.6	69.6	64.6	57.6	89.6	81.0
Const_CraneISR	Construction: Crane at ISR Plant	1	109.2	●	○		102.9	107.9	110.9	105.9	103.9	100.9	94.9	88.9	114.5	109.2
Const_CementMix	Construction: Cement Truck/Mixer	1	117.8	●	○		111.5	116.5	119.5	114.5	112.5	109.5	103.5	97.5	123.1	117.8
Const_HTLoad_ISR	Construction: Haul Truck Loading (ISR)	1	109.7	●	○		103.4	108.4	111.4	106.4	104.4	101.4	95.4	89.4	115.0	109.7
Const_HTLoad_FP	Construction: Haul Truck Loading (Freeze Plant)	1	109.7	●	○		103.4	108.4	111.4	106.4	104.4	101.4	95.4	89.4	115.0	109.7
Const_LoaderCWP2	Wellfield (Construction): Loader at Clean Waste Pile (Shaping)	1	109.7	●	○		103.4	108.4	111.4	106.4	104.4	101.4	95.4	89.4	115.0	109.7
Const_WF_LoaderWell	Wellfield (Construction): Loader at Wellfield	1	109.7	●	○		103.4	108.4	111.4	106.4	104.4	101.4	95.4	89.4	115.0	109.7
Const_WF_LoaderCWP	Wellfield (Construction): Loader at Clean Waste Pile	1	109.7	●	○		103.4	108.4	111.4	106.4	104.4	101.4	95.4	89.4	115.0	109.7

Source ID	Source Description	Number of Identical Sources	Sound Power Level (dBA)	Active Status		Octave Band Centre Frequency (Hz); Sound Power Level (dB)									Overall	
				Construction	Operations	31.5	63	125	250	500	1000	2000	4000	8000	dB	dBA
WF_LoaderCWP	Wellfield (Operations): Loader at Clean Waste Pile	1	109.7	○	●		103.4	108.4	111.4	106.4	104.4	101.4	95.4	89.4	115.0	109.7
WF_LoaderWell	Wellfield (Operations): Loader at Wellfield	1	109.7	○	●		103.4	108.4	111.4	106.4	104.4	101.4	95.4	89.4	115.0	109.7
WF_BP(x)	Wellfield: Booster Pump	4	99.3	○	●		89.7	90.7	92.7	92.7	95.7	92.7	88.7	82.7	100.9	99.3
Const_WF_DiamondDrill1	Wellfield (Construction): Diamond Drill Rig	2	113.2	●	○		106.9	111.9	114.9	109.9	107.9	104.9	98.9	92.9	118.5	113.2
Const_WF_MudRotaryDrill1	Wellfield (Construction): Mud Rotary Drill Rig	2	112.8	●	○		106.5	111.5	114.5	109.5	107.5	104.5	98.5	92.5	118.1	112.8
WF_DiamondDrill1	Wellfield: Diamond Drill Rig (Operations)	2	113.2	○	●		106.9	111.9	114.9	109.9	107.9	104.9	98.9	92.9	118.5	113.2
WF_MudRotaryDrill1	Wellfield: Mud Rotary Drill Rig (Operations)	2	112.8	○	●		106.5	111.5	114.5	109.5	107.5	104.5	98.5	92.5	118.1	112.8
Const_Crusher	Wellfield (Construction): Crusher at Borrow Pit	1	120.3	●	○		124	122	122	116	116	115	114	110	128.5	120.3
WF_Crusher	Wellfield (Operations): Crusher at Borrow Pit	1	120.3	○	●		124	122	122	116	116	115	114	110	128.5	120.3
Line Sources [1]																
CTraffic_Fuel	Construction Traffic: Fuel/propane deliveries	1	96.7	●	○		105.2	110.2	113.2	108.2	106.2	103.2	97.2	91.2	116.8	111.5
CTraffic_Food	Construction Traffic: Food deliveries	1	86.5	●	○		105.2	110.2	113.2	108.2	106.2	103.2	97.2	91.2	116.8	111.5
CTraffic_Offsite	Construction Traffic: Off-site trucks from Highway 914 to Gate	1	109.6	●	○		105.2	110.2	113.2	108.2	106.2	103.2	97.2	91.2	116.8	111.5
CTraffic_SurfaceConst	Construction Traffic: Surface construction deliveries	1	96.2	●	○		105.2	110.2	113.2	108.2	106.2	103.2	97.2	91.2	116.8	111.5
CTraffic_Wellfield	Construction Traffic: Wellfield deliveries	1	93.6	●	○		105.2	110.2	113.2	108.2	106.2	103.2	97.2	91.2	116.8	111.5
CTraffic_WellMob	Construction Traffic: Wellfield mobilizations	1	100.6	●	○		105.2	110.2	113.2	108.2	106.2	103.2	97.2	91.2	116.8	111.5
CTraffic_Airstrip	Construction Traffic: Airstrip Traffic	1	87.6	●	○	95.0	98.0	102.0	101.0	98.0	94.0	91.0	84.0	77.0	106.8	99.9
CTraffic_CleanWaste	Construction Traffic: Drill waste to clean pile	1	94.2	●	○		103.4	108.4	111.4	106.4	104.4	101.4	95.4	89.4	115.0	109.7
CTraffic_VantoOps	Construction Traffic: Crew Van to Operations Centre	1	83.2	●	○	95.0	98.0	102.0	101.0	98.0	94.0	91.0	84.0	77.0	106.8	99.9
CTraffic_VantoISR	Construction Traffic: Crew Van to ISR	1	88.1	●	○	95.0	98.0	102.0	101.0	98.0	94.0	91.0	84.0	77.0	106.8	99.9
CTraffic_HT_ISRCWP	Construction Traffic: Haul Truck, ISR to Clean Waste Pile	1	104.5	●	○		110.6	115.6	118.6	113.6	111.6	108.6	102.6	96.6	122.2	116.9
CTraffic_HT_FPCWP	Construction Traffic: Haul Truck, Freeze Plant Clean Waste Pile	1	102.4	●	○		110.6	115.6	118.6	113.6	111.6	108.6	102.6	96.6	122.2	116.9
OpsTraffic_Yellowcake	Operations Traffic: Yellowcake shipping	1	91.7	○	●		105.2	110.2	113.2	108.2	106.2	103.2	97.2	91.2	116.8	111.5
OpsTraffic_Fuel	Operations Traffic: Fuel/propane deliveries	1	96.7	○	●		105.2	110.2	113.2	108.2	106.2	103.2	97.2	91.2	116.8	111.5
OpsTraffic_Food	Operations Traffic: Food deliveries	1	86.5	○	●		105.2	110.2	113.2	108.2	106.2	103.2	97.2	91.2	116.8	111.5
OpsTraffic_Materials	Operations Traffic: Materials	1	93.5	○	●		105.2	110.2	113.2	108.2	106.2	103.2	97.2	91.2	116.8	111.5
OpsTraffic_Offsite	Operations Traffic: Off-site trucks from Highway 914 to Gate	1	110.0	○	●		105.2	110.2	113.2	108.2	106.2	103.2	97.2	91.2	116.8	111.5
OpsTraffic_Reagents	Operations Traffic: Reagents	1	97.7	○	●		105.2	110.2	113.2	108.2	106.2	103.2	97.2	91.2	116.8	111.5
OpsTraffic_Wellfield	Operations Traffic: Wellfield deliveries	1	91.4	○	●		105.2	110.2	113.2	108.2	106.2	103.2	97.2	91.2	116.8	111.5

Source ID	Source Description	Number of Identical Sources	Sound Power Level (dBA)	Active Status		Octave Band Centre Frequency (Hz); Sound Power Level (dB)									Overall	
				Construction	Operations	31.5	63	125	250	500	1000	2000	4000	8000	dB	dBA
OpsTraffic_WellMob	Operations Traffic: Wellfield mobilizations	1	100.6	○	●		105.2	110.2	113.2	108.2	106.2	103.2	97.2	91.2	116.8	111.5
OpsTraffic_CleanWaste	Operations Traffic: Drill waste to clean pile	1	92.4	○	●		103.4	108.4	111.4	106.4	104.4	101.4	95.4	89.4	115.0	109.7
OpsTraffic_Airstrip	Operations Traffic: Airstrip Traffic	1	87.6	○	●	95.0	98.0	102.0	101.0	98.0	94.0	91.0	84.0	77.0	106.8	99.9
OpsTraffic_VantoISR	Operations Traffic: Crew Van to ISR	1	88.1	○	●	95.0	98.0	102.0	101.0	98.0	94.0	91.0	84.0	77.0	106.8	99.9
OpsTraffic_VantoOps	Operations Traffic: Crew Van to Operations Centre	1	83.2	○	●	95.0	98.0	102.0	101.0	98.0	94.0	91.0	84.0	77.0	106.8	99.9
Area Sources																
Const_Dozer_WF	Construction: Bulldozer (Wellfield)	1	118.7	●	○		112.4	117.4	120.4	115.4	113.4	110.4	104.4	98.4	124.0	118.7
Const_SS_ISR	Construction: Skid Steer (ISR Plant)	1	105.8	●	○		99.5	104.5	107.5	102.5	100.5	97.5	91.5	85.5	111.1	105.8
Const_SS_WF1	Construction: Skid Steer (Wellfield 1)	1	105.8	●	○		99.5	104.5	107.5	102.5	100.5	97.5	91.5	85.5	111.1	105.8
Const_SS_WF2	Construction: Skid Steer (Wellfield 2)	1	105.8	●	○		99.5	104.5	107.5	102.5	100.5	97.5	91.5	85.5	111.1	105.8
Const_Dozer_CWP	Construction: Bulldozer (Clean Waste Pile)	1	118.7	●	○		112.4	117.4	120.4	115.4	113.4	110.4	104.4	98.4	124.0	118.7
FP2_Roof	Freeze Plant: Roof (2 Units) [2]	1	86.8	●	○	70.7	74.0	76.6	86.7	82.6	78.6	74.4	71.1	70.1	89.3	84.6
FP6_Roof	Freeze Plant: Roof (6 Units) [2]	1	91.6	○	●	75.5	78.8	81.4	91.5	87.4	83.4	79.2	75.9	74.9	94.1	89.3
Gen1_Top1	Generator 1: Enclosure Top [2]	1	99.0	●	●	105.2	111.0	116.5	116.5	113.8	115.8	113.8	107.0	101.0	123.0	119.9
Gen1_Top2	Generator 1: Enclosure Top [2]	1	94.9	●	●	105.2	111.0	116.5	116.5	113.8	115.8	113.8	107.0	101.0	123.0	119.9
Gen2_Top1	Generator 2: Enclosure Top [2]	1	99.0	●	●	105.2	111.0	116.5	116.5	113.8	115.8	113.8	107.0	101.0	123.0	119.9
Gen2_Top2	Generator 2: Enclosure Top [2]	1	94.9	●	●	105.2	111.0	116.5	116.5	113.8	115.8	113.8	107.0	101.0	123.0	119.9
ISR_Roof	ISR Plant: Process Area Roof [2]	1	86.9	○	●		82.0	82.4	81.8	83.5	84.5	84.1	83.1	76.9	91.8	90.2
ISR_DRoof	ISR Plant: Dryer/Calciner Area Roof [2]	1	88.4	○	●	90.3	87.8	89.2	88.5	91.2	91.2	91.6	90.8	83.8	99.4	97.6
WF_PHR	Wellfield: Pumphouse Roof [2]	1	78.4	○	●										85.0	
CGen_roof	Camp Generator - roof	1	97.5	●	●											
OGen_roof	Operations Centre Generator - roof	1	97.5	●	●											
Vertical Area Sources																
FP2_Walls	Freeze Plant: Walls (2 Units) [2]	1	86.1	●	○	70.7	74.0	76.6	86.7	82.6	78.6	74.4	71.1	70.1	89.3	84.6
FP6_Walls	Freeze Plant: Walls (6 Units) [2]	1	90.9	●	●	75.5	78.8	81.4	91.5	87.4	83.4	79.2	75.9	74.9	94.1	89.3
Gen1_Intake	Generator 1: Air Intake [2]	1	105.4	●	●	105.2	111.0	116.5	116.5	113.8	115.8	113.8	107.0	101.0	123.0	119.9
Gen1_Discharge	Generator 1: Discharge Opening [2]	1	120.5	●	●	105.2	111.0	116.5	116.5	113.8	115.8	113.8	107.0	101.0	123.0	119.9
Gen1_Side1	Generator 1: Enclosure Side [2]	1	97.1	●	●	105.2	111.0	116.5	116.5	113.8	115.8	113.8	107.0	101.0	123.0	119.9
Gen1_Side2	Generator 1: Enclosure Side [2]	1	99.4	●	●	105.2	111.0	116.5	116.5	113.8	115.8	113.8	107.0	101.0	123.0	119.9

Source ID	Source Description	Number of Identical Sources	Sound Power Level (dBA)	Active Status		Octave Band Centre Frequency (Hz); Sound Power Level (dB)									Overall	
				Construction	Operations	31.5	63	125	250	500	1000	2000	4000	8000	dB	dBA
Gen1_Side3	Generator 1: Enclosure Side [2]	1	97.1	●	●	105.2	111.0	116.5	116.5	113.8	115.8	113.8	107.0	101.0	123.0	119.9
Gen1_Side4	Generator 1: Enclosure Side [2]	1	99.5	●	●	105.2	111.0	116.5	116.5	113.8	115.8	113.8	107.0	101.0	123.0	119.9
Gen1_Side5	Generator 1: Enclosure Side [2]	1	96.8	●	●	105.2	111.0	116.5	116.5	113.8	115.8	113.8	107.0	101.0	123.0	119.9
Gen1_Side6	Generator 1: Enclosure Side [2]	1	93.5	●	●	105.2	111.0	116.5	116.5	113.8	115.8	113.8	107.0	101.0	123.0	119.9
Gen2_Intake	Generator 2: Air Intake [2]	1	105.4	●	●	105.2	111.0	116.5	116.5	113.8	115.8	113.8	107.0	101.0	123.0	119.9
Gen2_Discharge	Generator 2: Discharge Opening [2]	1	120.5	●	●	105.2	111.0	116.5	116.5	113.8	115.8	113.8	107.0	101.0	123.0	119.9
Gen2_Side1	Generator 2: Enclosure Side [2]	1	97.1	●	●	105.2	111.0	116.5	116.5	113.8	115.8	113.8	107.0	101.0	123.0	119.9
Gen2_Side2	Generator 2: Enclosure Side [2]	1	99.4	●	●	105.2	111.0	116.5	116.5	113.8	115.8	113.8	107.0	101.0	123.0	119.9
Gen2_Side3	Generator 2: Enclosure Side [2]	1	97.1	●	●	105.2	111.0	116.5	116.5	113.8	115.8	113.8	107.0	101.0	123.0	119.9
Gen2_Side4	Generator 2: Enclosure Side [2]	1	99.5	●	●	105.2	111.0	116.5	116.5	113.8	115.8	113.8	107.0	101.0	123.0	119.9
Gen2_Side5	Generator 2: Enclosure Side [2]	1	96.8	●	●	105.2	111.0	116.5	116.5	113.8	115.8	113.8	107.0	101.0	123.0	119.9
Gen2_Side6	Generator 2: Enclosure Side [2]	1	93.5	●	●	105.2	111.0	116.5	116.5	113.8	115.8	113.8	107.0	101.0	123.0	119.9
ISR_PW	ISR Plant: Process Area Walls [2]	1	88.5	○	●		82.0	82.4	81.8	83.5	84.5	84.1	83.1	76.9	91.8	90.2
ISR_DCW1	ISR Plant: Dryer/Calciner Area Wall [2]	1	87.3	○	●	90.3	87.8	89.2	88.5	91.2	91.2	91.6	90.8	83.8	99.4	97.6
ISR_DCW2	ISR Plant: Dryer/Calciner Area Wall [2]	1	79.0	○	●	90.3	87.8	89.2	88.5	91.2	91.2	91.6	90.8	83.8	99.4	97.6
WF_PHW	Wellfield: Pumphouse Walls [2]	1	76.1	○	●										85.0	
CGen_walls	Camp Generator: Walls	1	102.8	●	●											
OGen_walls	Operations Centre Generator: Walls	1	102.8	●	●											

Notes:

[1] For the line sources, the octave band sound power data is the unadjusted sound power, while the Lw provided is adjusted for the active time based on the route length and speed of travel.

[2] For area and vertical area sources that represent building envelopes, the octave band data is the interior sound pressure level in the room, and the Lw is the calculated sound power based on the transmission loss of the building and size of the building component.